# Tektronix®

**SPG8000A**
**Master Sync / Clock Reference Generator Technical Reference**

**User Manual**

# Tektronix®

**SPG8000A**
**Master Sync / Clock Reference Generator Technical Reference**

**User Manual**

**Contacting Tektronix**

Tektronix, Inc.
14150 SW Karl Braun Drive
P.O. Box 500
Beaverton, OR 97077
USA

For product information, sales, service, and technical support:
- In North America, call 1-800-833-9200.
- Worldwide, visit www.tek.com to find contacts in your area.

# Table of Contents

# List of Figures

# List of Tables

# Important safety information

This manual contains information and warnings that must be followed by the user for safe operation and to keep the product in a safe condition.

To safely perform service on this product, additional information is provided at the end of this section. (See page xiii, *Service safety summary*.)

## General safety summary

Use the product only as specified. Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. Carefully read all instructions. Retain these instructions for future reference.

Comply with local and national safety codes.

For correct and safe operation of the product, it is essential that you follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

The product is designed to be used by trained personnel only.

Only qualified personnel who are aware of the hazards involved should remove the cover for repair, maintenance, or adjustment.

Before use, always check the product with a known source to be sure it is operating correctly.

This product is not intended for detection of hazardous voltages.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

When incorporating this equipment into a system, the safety of that system is the responsibility of the assembler of the system.

**To avoid fire or personal injury**

**Use proper power cord.** Use only the power cord specified for this product and certified for the country of use.

**Ground the product.** This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, make sure that the product is properly grounded.

**Power disconnect.** The power cord disconnects the product from the power source. See instructions for the location. Do not position the equipment so that it is difficult to operate the power cord; it must remain accessible to the user at all times to allow for quick disconnection if needed.

**Observe all terminal ratings.** To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

**Do not operate without covers.** Do not operate this product with covers or panels removed, or with the case open. Hazardous voltage exposure is possible.

**Avoid exposed circuitry.** Do not touch exposed connections and components when power is present.

**Do not operate with suspected failures.** If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Disable the product if it is damaged. Do not use the product if it is damaged or operates incorrectly. If in doubt about safety of the product, turn it off and disconnect the power cord. Clearly mark the product to prevent its further operation.

Before use, inspect voltage probes, test leads, and accessories for mechanical damage and replace when damaged. Do not use probes or test leads if they are damaged, if there is exposed metal, or if a wear indicator shows.

Examine the exterior of the product before you use it. Look for cracks or missing pieces.

Use only specified replacement parts.

**Do not operate in wet/damp conditions.** Be aware that condensation may occur if a unit is moved from a cold to a warm environment.

**Do not operate in an explosive atmosphere.**

**Keep product surfaces clean and dry.** Remove the input signals before you clean the product.

**Provide proper ventilation.** Refer to the installation instructions in the manual for details on installing the product so it has proper ventilation.

Slots and openings are provided for ventilation and should never be covered or otherwise obstructed. Do not push objects into any of the openings.

**Provide a safe working environment.** Always place the product in a location convenient for viewing the display and indicators.

Be sure your work area meets applicable ergonomic standards. Consult with an ergonomics professional to avoid stress injuries.

Use only the Tektronix rackmount hardware specified for this product.

## Service safety summary

The *Service safety summary* section contains additional information required to safely perform service on the product. Only qualified personnel should perform service procedures. Read this *Service safety summary* and the *General safety summary* before performing any service procedures.

**To avoid electric shock.** Do not touch exposed connections.

**Do not service alone.** Do not perform internal service or adjustments of this product unless another person capable of rendering first aid and resuscitation is present.

**Disconnect power.** To avoid electric shock, switch off the product power and disconnect the power cord from the mains power before removing any covers or panels, or opening the case for servicing.

**Use care when servicing with power on.** Dangerous voltages or currents may exist in this product. Disconnect power, remove battery (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

**Verify safety after repair.** Always recheck ground continuity and mains dielectric strength after performing a repair.

## Terms in this manual

These terms may appear in this manual:

⚠ *WARNING. Warning statements identify conditions or practices that could result in injury or loss of life.*

⚠ *CAUTION. Caution statements identify conditions or practices that could result in damage to this product or other property.*

## Symbols and terms on the product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

When this symbol is marked on the product, be sure to consult the manual to find out the nature of the potential hazards and any actions which have to be taken to avoid them. (This symbol may also be used to refer the user to ratings in the manual.)

The following symbol(s) may appear on the product:

CAUTION
Refer to Manual

Protective Ground
(Earth) Terminal

# Preface

This manual provided detailed operating information about the SPG8000A Multiformat Reference Sync Generator.

Refer to the *SPG8000A Installation and Safety Instructions* manual for information about how to install the instrument, for descriptions of the front and rear panel controls and connectors, and for information about initial configuration.

## Product description

The SPG8000A is a precision multiformat video signal generator, suitable for master synchronization and reference applications. It provides multiple video reference signals, such as black burst, HD tri-level sync and serial digital test patterns, and provides time reference signals such as time code. Audio reference signals such as word clock and DARS are also provided.

The base configuration includes three sync outputs that can be configured with independent output formats (NTSC/PAL black burst and/or HD tri-level sync) and independently adjustable timing offsets. A high-accuracy, oven-controlled crystal oscillator provides a stable frequency reference for the system, or the loop-through genlock input can be used to lock to an external video reference or 10 MHz continuous wave signal. The Stay GenLock® feature avoids "synchronization shock" if the external reference suffers a temporary disturbance, by maintaining the frequency and phase of each output signal. When the external reference is restored, Stay GenLock® ensures that any accumulated clock drift is removed by slowly adjusting the system clock within standard limits instead of "jamming" back to the correct phase.

Time reference outputs are available in multiple formats. Three independent linear time code (LTC) outputs are available, and a fourth LTC connection can be used as input or output. Each LTC output has independent frame rate selection, time source (time of day or program time) and time zone offset. Vertical interval time code (VITC) is available on each NTSC or PAL black output, also with independent time sources and offsets. The SPG8000A can also serve as a Network Time Protocol (NTP) server or as a Precision Time Protocol (PTP) grandmaster clock, providing the time-of-day reference to network-attached devices.



**Figure i: SPG8000A front and rear panels**

**Optional GPS / GLONASS receiver**

Option GPS adds an integrated receiver to the SPG8000A that can receive both GPS and GLONASS signals. When connected to an external antenna that supplies the standard GPS and/or GLONASS RF signal (for example, SPG8000ANT), the SPG8000A can use the GPS/GLONASS system's stable frequency reference.

The GPS/GLONASS signal also includes a precise time-of-day reference that can be used for all time code outputs. Similar to the Stay GenLock® feature, the SPG8000A can maintain the video frequency and phase when the GPS/GLONASS signal is interrupted, and the Holdover Recovery mode will ensure a shock-free realignment of frequency and phase when the GPS/GLONASS signal is restored.

**Optional PTP support**

Option PTP adds two Precision Time Protocol (PTP) engines to the SPG system. The primary PTP engine has the capability to be a master PTP source or lock the SPG to the PTP as a slave. The secondary PTP engine can only be a master. The secondary engine allows implementing two masters when in Internal mode or locked to GPS, and simultaneous Master and Slave operation.

The black outputs support a 1pps mode. This is useful for measuring timing between systems.

**Test signal outputs**  The SPG8000A can be optionally configured with a variety of test signal outputs. Option SDI adds two fully independent serial digital video generator channels of two outputs each. Each channel can be configured to any standard SD/HD/3G-SDI format and frame rate. The selected test pattern can be generated on both outputs per channel, or one output can generate digital black. A wide variety of standard test patterns are included, such as color bars, convergence grid, step scales, ramps, multiburst, SDI pathological test matrix and a real-time programmable zone plate generator.

Bitmap images can be downloaded to the SPG8000A's flash memory for arbitrary user-defined test patterns. ID text, burn-in time code, circle, and color logo overlays can be added to any test pattern, and several ancillary data packet types, including ancillary time code and user-defined packets, can be inserted into the SDI output signal.

The four SDI outputs can be configured to support 4K/UHD full frame, 100% and 75% color bars for quad link square division mode. This allows simple verification of your 4K/UHD workflow within the production studio or mobile truck. Note: VPIDs are compliant only to HD and 3G formats in 4K/UHD formats.

Also included is an audio/video delay test sequence, which in conjunction with a Tektronix waveform monitor, can be used to ensure A/V delay compliance.

**Audio reference signals**  Several audio reference signals are available. The base configuration includes a 48 kHz word clock output and a dedicated Digital Audio Reference Signal (DARS) output. With Option SDI, audio tone generation is included as embedded audio on each of the SDI outputs.

**Remote access**  For remote access to the instrument, a 10/100/1000BASE-T Ethernet interface is included. A web-based user interface can be used for all configuration settings and for monitoring system status. Alarm and key status information is also available with Simple Network Management Protocol (SNMP) messaging, enabling easy integration with network management systems. Remote control and alarm reporting is also available with a general purpose interface (GPI). The front-panel USB port can be used to backup and restore presets and other user data, and to perform system firmware upgrades.

**Optional backup power supply**

For critical applications, the instrument can be configured with a second power supply module. Under normal operation, the designated backup supply is seldom used, ensuring that it has maximum remaining life should the primary supply fail. The backup supply is load-tested once each day to verify that it can serve as the primary supply if necessary. The usage time of each supply is logged as "temperature-weighted hours", a metric that best estimates the calculated life of the supply. A front-panel LED will indicate when the supply is nearing its end-of-life. If the primary supply is interrupted for any reason, the system will switch to the backup without any disruption to system operation. Power supply modules are hot-swappable for easy replacement, and feature a locking mechanism to prevent the power cable from accidental disconnection.

**Key features**

- Multiple independent black burst and HD tri-level sync outputs provide all the video reference signals required in a video broadcast or production facility

- Four LTC outputs, VITC on black burst outputs

- PTP (IEEE 1588) support, including SMPTE ST 2059-2 and AES67 profiles

- GPS/GLONASS-based synchronization gives an accurate time-of-day reference and deterministic video phase reference across multiple independent systems

- Stay GenLock® prevents synchronization shock when the external reference input signal is temporarily lost

- Wide selection of video test patterns in serial digital formats (SD, HD and 3G-SDI)

- 4K/UHD formats support with full frame 100% and 75% color bars (Quad Link Square Division)

- Dual hot-swappable power supplies ensure continuous availability of reference signals

- Easy to manage with Web-based interface for remote configuration and SNMP for status and alert information

**Applications**

- Sync pulse generator and time reference generator for broadcast, studio, mobile, and post-production facilities

- Master or slave (genlock) operation for distributed system architectures

- Video equipment verification, facility link testing, and display calibration

- PTP Grand Master simultaneously serving baseband references to a hybrid facility.

- PTP slave to generate baseband signals.

## Methods of operation

This instrument can be operated using either the front panel or the SPG8000A Web Interface. It is recommended that you use the SPG Web Interface to operate the instrument since it is easier to use and more intuitive. The majority of this manual describes how to operate the instrument using the SPG8000A Web Interface. For your convenience, menu diagrams of the front-panel menus are also provided. (See page 185, *Front panel menu operation*.)

## Product documentation

The following table lists the product documentation that is available for the SPG8000A generator.

**Table i: Product documentation**

| Document | Tektronix Part Number | Description | Availability Print | Web |
|---|---|---|---|---|
| Installation and Safety Instructions | 071-3479-xx (English) | Describes how to install the instrument and provides basic operating information | ✓ | ✓ |
| | 077-1214-xx (Japanese) | | | ✓ |
| | 077-1215-xx (Russian) | | | ✓ |
| User Manual | 077-1216-xx (English) | Provides detailed operating information | | ✓ |
| | 077-1218-xx (Russian) | | | |
| Specifications and Performance Verification | 077-1219-xx | Lists the product specifications and provides procedures for verifying the performance of the instrument | | ✓ |
| Service Manual | 077-1220-xx | Describes how to service the instrument to the module level (such as circuit boards and fuses) | | ✓ |
| Declassification and Security Instructions | 077-1221-xx | Describes how to clear or sanitize the data storage (memory) devices in the product for customers with data security concerns | | ✓ |
| Release Notes | 077-1222-xx | Describes the new features, improvements, and limitations of the instrument firmware | | ✓ |
| SPG800AUP Upgrade Instructions | 075-1092-xx | Provides instructions for upgrading your SPG8000A instrument | | ✓ |

**Table i: Product documentation (cont.)**

| Document | Tektronix Part Number | Description | Availability Print | Availability Web |
|---|---|---|---|---|
| Optional PTP Instructions | 061-4417-xx | Provides instructions to configure the SPG8000A to operate in the PTP network and also provides information about the basics of PTP operation. | | ✓ |
| Video Sync Pulse Generator and Electronic Changeover Unit System Integration Technical Reference | 077-0563-xx (ECO422D)<br>077-0877-xx (ECO8000, ECO8020) | Provides information for system integrators who are designing systems for high-definition (HD) and standard-definition (SD) digital video content where Tektronix electronic changeover units and video sync pulse generators are to be deployed. | | ✓ |

# System timing

## Frame reset signals

The SPG8000A uses the three frame reset signals described below to output different video formats simultaneously.

**FRAME RESET 1**   This frame reset signal runs at 2.997 Hz and supports the 1/1.001 system signal, and is used by the following video formats. These signals are synchronized with each other.

| | | |
|---|---|---|
| NTSC | 1080 23.98sF | 30 fps DF LTC |
| 525-270 | 1080 29.97p | 23.98 fps LTC |
| 1080 23.98p | 1080 59.94i | |
| | 720 59.94p | |

**FRAME RESET 2**   This frame reset signal runs at 6.250 Hz and is used only for PAL, 625, or HD / LTC formats with 50 Hz or 25 Hz frame rates. These signals are synchronized with each other.

| | | |
|---|---|---|
| PAL | 1080 25p | 25 fps LTC |
| 625-270 | 1080 50i | |

**FRAME RESET 3**   This frame reset signal runs at 3.000 Hz and is used for HD / LTC formats with 60 Hz, 30 Hz or 24 Hz frame rates. These signals are synchronized with each other.

| | |
|---|---|
| 1080 24p | 24 fps LTC |
| 1080 24sF | 25 fps LTC |
| 1080 30p | 30 fps LTC [1] |
| 1080 60p | |
| 1080 60i | |
| 720 60p | |

[1]   Not drop frame.

In some modes frame 1 is not aligned with frame 2 and 3. However, when locked to an absolute time source such as GPS, PTP, or when in internal mode, the three frames are all aligned as if they started at the selected Epoch. This enables the frames to have predictable and consistent timing relationships and line up every 4004 seconds.

# GPS and GLONASS signal quality (Option GPS only)

**GPS receiver types**  Earlier versions of the GPS receiver can receive only GPS signals. Later versions of the GPS receiver can receive GPS and/or GLONASS signals. If your module has the GPS/GLONASS receiver, use the REFERENCE menu to configure the module for the type of signal you are using.

**How to determine which GPS receiver is installed in your instrument.**  Firmware version 1.5 or above must be installed in the instrument to view the GPS receiver type readout.

1.  Press the **SYSTEM** button to access the SYSTEM menu.

2.  Use the up (▲) or down (▼) arrow button to select **SYSTEM : VERSION INFO (H/W)**.

3.  Use the left (◄) or right (►) arrow button to select the version display with the **ID** field on the second line of the display as shown below.

The System menu provides readouts containing version information about the instrument hardware. As shown below, one of those readouts now includes the firmware version number installed on the GPS receiver module (1.03 in the image below).

```
SYSTEM : VERSION INFO (H/W)
  V2.8 DO:41  BB:58  ID:3023 1.03
```

3080-068

The ID value in the above readout represents the hardware version of the GPS receiver. The possible values are:

–  3002. This value indicates that the receiver supports GPS signals only. This receiver was replaced by the 3015 receiver.

–  3015. This value indicates that the receiver supports GPS and GLONASS signals. This receiver was replaced by the 3023 receiver. There are some reported limitations with this receiver. See *SPG8000A Release Notes* for more information.

–  3023. This value indicates that the receiver supports GPS and GLONASS signals.

**Figures of Merit (FOM)**  The SPG8000A generator uses Figures of Merit (FOM) to measure and track GPS and/or GLONASS signal quality.

These numbers are a compendium of the GPS and/or GLONASS signal quality and the processes that occur as the instrument progresses through the states needed to lock on to the GPS and/or GLONASS signal. The FOM provides a simple scale to evaluate the state of the GPS and/or GLONASS lock.

The FOM drives the external reference indicator (LED) on the front panel of the mainframe. When in internal mode, the external LED is off. When in external mode, the external LED will be in one of the following states.

- **Green** (Locked). If Genlock signal is locked, or if GPS/PTP is locked with FOM ≥ FOM_THRESHOLD.

- **Yellow** (Unstable). If Genlock signal is near loss of lock, or if GPS/PTP is locked with FOM < FOM_THRESHOLD.

- **Red** (Unlocked). If Genlock signal is loss of lock, or if GPS/PTP is unlocked/missing.

*NOTE. FOM_THRESHOLD is a user adjustable setting.*

*Internal and External LEDs are both on only when REF is Genlock and there is loss of lock. This will cause the Internal LED to be GREEN and the External LED to be RED.*

The FOM provides the scale by which you can set the signal warning threshold.

You can see the current status of GPS and/or GLONASS signal quality using FOM in the STATUS button menu. The following table lists the figures of merit and their descriptions.

**Table 1: Figures of merit for GPS and/or GLONASS signal quality (Option GPS only)**

| Figure of merit (FOM) | Indicator | Description |
|---|---|---|
| 0 | No signal | This means that no usable satellite signals are detected. This is normal for a short time after the signal is applied, but if it lasts more than a minute or so, then it usually means one of the following: that there is a problem in the antenna or cable, the antenna is blocked from direct line of sight to the satellites, or the power is not getting to the antenna. |
| 1 | Low signal | This means that some signal is detected, but that the signal quality is too low for extraction of useful timing or position information. This is a normal situation for a short duration, but if it persists, the causes are likely to be similar to those for FOM state 0. |
| 2 | Acquire satellites | This means that the instrument is receiving data from the satellites and is determining which signals to use. |

**Table 1: Figures of merit for GPS and/or GLONASS signal quality (Option GPS only) (cont.)**

| Figure of merit (FOM) | Indicator | Description |
|---|---|---|
| 3 | Bad position | This means that the instrument detects that the stored position is different from the current position. In this case, the instrument will automatically go to FOM state 4 and reacquire the position. |
| 4 | Acquire position | This means that the instrument is acquiring multiple fixes of the satellite position and averaging this into a new position to store in flash. This state will also be displayed if you manually perform a new position acquisition. This state normally lasts 60 seconds with good GPS and/or GLONASS signal quality. |
| 5 | Adjust phase | This means that the instrument is adjusting the time base or frame timing to correctly line up with the GPS and/or GLONASS signal. |
| 6 | Locked > Signal quality is ≤ 16 | These states indicate that the phase of the frame signals is within 150 ns of the GPS and/or GLONASS signal. The number of arrows indicates the signal quality. It is normal for this to vary with the time of day as the different satellites move through their orbits, and with changes in weather and other conditions. |
| 7 | Locked >> Signal quality is > 16 | |
| 8 | Locked >>> Signal quality is > 26 | |
| 9 | Locked >>>> Signal quality is > 42 | |
| 10 | Locked >>>>> Signal quality is > 68 | |
| 11 | Locked >>>>>> Signal quality is > 110 | |

*NOTE.* *The duration of some states depends on the strength of the received GPS and/or GLONASS signal. If the antenna only has access to part of the sky, or if the cable loss between the antenna and the receiver is too large, then it may take significantly longer to progress up to the higher entries in the FOM table.*

## Time flow block diagram

The following time flow diagram shows time information is used at different points in the system. In particular, it shows how the different user inputs and configuration settings combine with the time base to create the timecode. An asterisk (*) denotes points of possible user input.
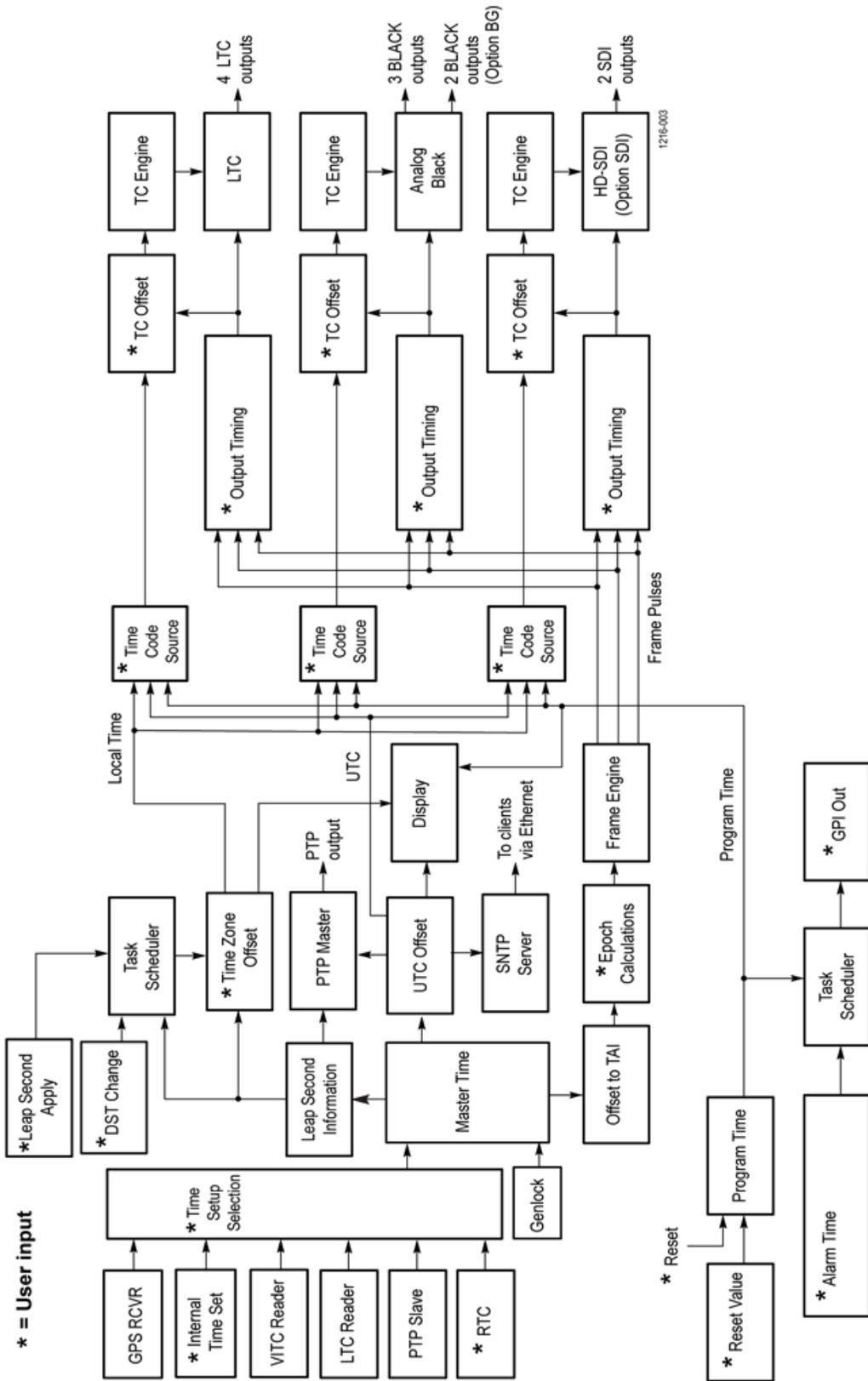
**Figure 1: Time flow block diagram**

SPG8000A User Manual

The following paragraphs describe portions of the Time flow block diagram.

- **Internal Time Set \***. To set Time Setup to internal mode, enter the current date and time and then set the Time Setup to Internal to transfer that time to the Master Time. The time zone offset information is used to convert local time to a master time. Set the local time zone offset before setting the internal time.

- **VITC Reader**. When the instrument is genlocked to NTSC or PAL, the Vertical Interval Timecode on the genlock reference input can be decoded and used as the time source. This time can be viewed on the status bar, and is used as the time source for all the time code outputs. Since the phase of the video signals are set by the genlock, the epoch system does not operate from the VITC input. If SMPTE309 date data is available, the time and date information on the VITC input will be used if enabled in the TIME OF DAY submenu. (See page 160, *Time of Day submenu*.)

- **LTC Reader**. When the reference source is set to INTERNAL, NTSC, PAL or HD SYNC, the LTC signal applied to the LTC 1 input can be used at the time source. This time can be viewed on the status bar and is used as a time source for all the time code outputs. If SMPTE309 date data is available, the time and date information on the LTC input will be used if enabled in the TIME OF DAY submenu. (See page 160, *Time of Day submenu*.)

- **Time Setup Selection**. The possible Time code sources depend on the selected Reference source. If Genlock is the selected reference source, then VITC, LTC, or internal time is available. If Internal is the selected reference source, then internal time is the time code source.

  If VITC or LTC is the time code source, then the time synchronization Mode must be set. There are three choices. Synchronize now sets the time when the user presses the ENTER button (if the incoming time is valid and stable). Synchronize once sets the time once when a valid and stable time code is detected. Follow sets the time every time a new stable and valid time is detected.

- **Genlock**. When NTSC or PAL is selected as the reference and the time source is LTC or VITC with ST309 date, then the timing of the reference sync may be used to improve the accuracy of the master time.

- **Master Time**. The Master Time is the basis for all timecode outputs and for the phase reference of all video outputs.

- **Offset to TAI**. TAI is the International Atomic Time, represented as the number of seconds since the epoch of 0:00:00 January 1, 1958. Proposed standard SMPTE 404M defines the SMPTE Epoch at that same moment. There are exactly 8040 days and 19 leap seconds between the SMPTE Epoch (TAI) and the GPS Epoch.

- **Epoch Calculations \***. The number of seconds since the SMPTE Epoch is used to precisely align video frames with the Master Time clock. For example, an NTSC system operates at 29.97 frames per second (30 fps/1.001),

so there are precisely 30,000 frames every 1001 seconds. By knowing the total number of seconds since the SMPTE Epoch, when all video frames were perfectly aligned, the instrument can determine "where" the pulse-per-second signal is located with respect to video framing. The Epoch adjustment is made in reference to the user-selected Epoch setting: January 1, 1958 or January 1, 1970.

■ **Frame Engine**. The frame engine supplies frame pulse signals based on the SMPTE Epoch to each video output. This ensures that they are properly aligned with respect to the calculated phase for the selected video format of each output.

■ **Output Timing**. Each video output has an independent offset that can be specified to shift that output to align the video and LTC signals in the studio. This time adjustment does not affect the timecode that is applied to that output; the signal and timecode stay together as the timing is changed. The timing offset range and resolution depend on the signal. See the specific output menu for details.

■ **Time Zone Offset \***. The SPG8000A allows users to select an offset between UTC and the local time, usually representing the local time zone. This offset can be specified in hours+minutes+seconds, allowing specification of time zones that do not align with the usual hours-only offset, or for other applications not related to time zones. You can also use this setting to set the internal time to calculate "backward " to the Master Time.

When the input time source is set to VITC or LTC, the instrument works similar to how it works in internal mode, precorrecting the master time of day by the time zone offset. This precorrection assumes that the incoming time code has the correct local time, and causes the outgoing time codes to nominally match the incoming ones, regardless of time-zone offset. However, if the time code synchronization mode is set to "Synchronize now" or "Synchronize once", and the time-zone offset is changed after the time-code sync has occurred, then the time-zone change offsets the incoming and outgoing time codes until the user reasserts the time synchronization.

Additionally, if the time is being set by LTC or VITC with SMPTE309 date data, the system can be configured to use the time zone and DST from the input. (See page 160, *Time of Day submenu*.)

■ **RTC \***. The real time clock (RTC) is used to maintain the date and time while the instrument is off. On start up, the MTOD is initialized from the RTC. If a reference lock is selected, the MTOD shifts to the better clock source when a lock occurs. It the instrument locks to GPS or PTP, then the RTC value is updated to remove any drift from that lower quality timebase.

Additionally, if the internal time is manually set, the RTC is updated.

■ **DST Change \***. Daylight Saving Time (DST) changes twice a year in many time zones, but some locations do not observe daylight savings time. The SPG8000A has a user programmable DST adjustment to the time zone offset

that is made by adding or subtracting a specified amount from the current time setting. The scheduled date and time of the change must be programmed into the instrument. There are two methods for scheduling the DST offset:

- **Once**. In Once mode, the DST offset is applied only once on the date and time you specify. Set the DST offset to either add or subtract an hour from the time zone offset, depending on whether DST is starting or ending in your location.

- **Recurring**. In Recurring mode, the DST offset is applied when the DST START date and time that you specify occurs, and is removed when the DST END date and time that you specify occurs. The recurring DST offset can only be a positive number, such as one hour. The DST START/END dates are formatted as the DST rules are written (for example, DST starts on the First Sunday in March at 02:00). For example, to change to daylight savings time, schedule the system to add one hour to the time zone offset at 02:00:00 (local time) on March 6, 2011. To return to standard time, schedule the system to remove the DST offset at 02:00:00 on November 6, 2011. At the scheduled time and date, the DST change is added to the time zone offset as seen from the instrument display. You can then program the next scheduled DST change.

An incoming VITC or LTC reference may have DST shift already applied. To avoid duplicating DST shifts, disable the DST SCHEDULER if the time of day reference has DST applied.

- **Task Scheduler**. The task scheduler is responsible for triggering scheduled events at the appropriate time. This includes DST changes and triggered alarm outputs.

- **TC Offset \***. Every timecode output has an independent offset (hours, minutes, seconds, frames) that can be added to the value of the selected timecode source.

- **TC Engine**. The timecode engine runs at the rate specified through the user interface and generates the actual timecode bits needed for each output.

- **LTC**. The instrument has four independent linear timecode outputs. Each output can be set independently with regard to timecode format, module timing, and timecode delay.

- **Analog Black**. The instrument provides three analog sync outputs. Each output can be configured as NTSC or PAL Black burst (with optional VITC insertion) or HD trilevel sync.

- **HD-SDI**. Option SDI provides two independent HD-SDI test signal generators, for which ancillary timecode (ATC) can be added.

- **Program Time**. As an alternate to the local time of day, a program time counter can be used as a timecode source for any output. This counter can represent elapsed time, such as the timecode associated with program content during the editing process, for example.

- **Reset Value**. The program time counter will start counting from the specified reset value. Program time can be reset to this value at any time using either the user interface or a general purpose interface (GPI) input.

- **Alarm Time**. An alarm can be set to generate when the program time counter matches a predefined value. For example, you can specify the start timecode of your program content at 01:00:00:00. The program time can be initialized to 00:59:00:00 to start a one minute leader before the program. The alarm time could be set at 00:59:55:00 to signal a five second countdown before the program start, perhaps to signal a change from color bars to Black within the pre-program leader.

- **GPI Out**. The instrument has two General Purpose Interface (GPI) outputs, either of which may be configured to begin when the program time matches a specified alarm time.

# Web user interface

When the Web user interface is enabled in the System menu, you can use a Web browser to remotely control the instrument. Enter the IP address of the instrument in a supported Web browser to open the SPG8000A Web Interface. (See Figure 5.) Click the various tabs to access the instrument settings and controls as you would using the front panel buttons.

*NOTE. The Web user interface must be enabled from the System menu on the instrument front-panel before it can be accessed from a Web browser. (See page 137, System menu.)*

## Operational considerations

It is recommended that a maximum of four simultaneous users be connected to the instrument using the Web interface. If more users are connected, it may result in lower performance and inconsistent behavior.

Some front panel operations may interrupt or reduce the performance of the Web interface. For example, the Web server may experience temporary delays when a large file is being transferred using the USB port or when many buttons are being pressed on the front panel.

**Levels of control**  From the instrument front panel, use the Web User Interface setting in the System menu to control the level of instrument access from a Web browser. Use the left (◄) or right (►) arrow button to select between the following options. Press the **ENTER** button to confirm the selection.

- **Full-Control**. Allows a user to have full control of instrument settings when using the Web User Interface.

- **Disable**. Disables the instrument from being accessed by the Web User Interface.

- **Read-Only**. Allows a user to have read-only access to instrument settings when using the Web User Interface.

*NOTE. Remote port 5000 is not required for the Web UI to function. If the SCPI remote is not required it should be disabled to increase security and prevent disruption by port scanners.*

**Supported web browsers**  For best results, use Google Chrome, Mozilla Firefox, Safari, or Internet Explorer 9.0 or later when you connect to the SPG8000A Web Interface.

*NOTE. The Web user interface requires Javascript to run.*

# Elements of the web user interface

The following figure highlights elements of the Web user interface window. Some display elements are dependent on certain options being installed in the instrument.

*NOTE. A red exclamation mark next to a menu item indicates that an alert exists. Click the item to view the alert details.*

.



**Figure 2: Example SPG8000A web user interface window**

**Table 2: Elements of the web user interface**

| Item number | Description |
|---|---|
| 1 | Menu tabs. Click a tab to access one of the following menus: |

■ **Status menu**. Use this menu to view the status of various instrument functions. You cannot make changes to instrument settings from the Status menu. For more information, see the *Status menu* section. (See page 133.)

■ **Reference menu**. Use this menu to view or change the signal reference or genlock timing settings for the instrument. For more information, see the *Reference menu* section. (See page 77.)

■ **PTP menu**. Use this menu to view or change the primary and secondary PTP settings for the instrument. For more information, see the *PTP menu* section. (See page 170.)

■ **Time menu**. Use this menu to view or change the time settings in the instrument. The settings are divided between the Time of Day, Daylight Savings Time, Program Time, and Jam Sync submenus. Click on the arrow next to the desired submenu to access that menu. For more information, see the *Time menu* section. (See page 159.)

■ **Black menu**. Use this menu to view or change the settings for the Black outputs. You can configure the Black 1–3 tri-level sync signals. Click on the arrow next to the desired Black output to access the menu for that output. For more information, see the *Black menu* section. (See page 47.)

■ **LTC menu**. Use this menu to view or change the settings for the LTC outputs. Click one of the selections for the desired LTC output to access the submenu for that output. For more information, see the *LTC menu* section. (See page 75.)

■ **SDI menu (Option SDI only)**. Use this menu to view or change the settings for the SDI outputs. Click on the arrow next to the desired SDI output to access the menu for that output. For more information, see the *SDI button menu* section. (See page 85.)

■ **Composite menu (Option BG only)**. Use this menu to view or change the settings for the Composite outputs. Click on the arrow next to the desired Composite output to access the menu for that output. For more information, see the *Composite menu* section. (See page 53, *Composite menu (Option BG only)*.)

■ **AES menu**. At the release of this document, a Web interface for the AES menu was not available. For all instruments, use the AES button menu to view or change the settings for the Word Clock (48 kHz) output. For more information, see the *AES menu* section. (See page 43, *AES menu*.)

■ **Embedded menu (Option SDI only)**. Use this menu to view or change the embedded audio settings for the SDI outputs. Click on the arrow next to the desired SDI output to access the menu for that output. For more information, see the *Embedded menu* section. (See page 71.)

■ **Dolby-E Configuration menu (Option DBT only)**. Use this menu to view or change the Dolby-E audio settings. Click on the arrow next to the desired Dolby-E channel to access the menu for that output. For more information, see the *Dolby-E Configuration menu* section. (See page 57.)

■ **System menu**. Use this menu to view or change general instrument settings and to view diagnostic results. The system settings includes Status, Presets, General Settings, SNMP Settings, GPI Settings, Options, and Diagnostics submenus. Click on the arrow next to the desired setting group to access the submenu for that group. For more information, see the *System menu* section. (See page 137.)

**Table 2: Elements of the web user interface (cont.)**

| Item number | Description |
|---|---|
| 2 | Indicators matching the indicators on the front panel of the instrument: |
| | ■ **INT** and **EXT**. Indicates the status of the reference signal used to time signals. Click on INT or EXT to view the reference status on the Status menu tab. |
| | ■ **TIME**. Indicates the status of the selected time input. Click on TIME to view the time status on the Status menu tab. |
| | ■ **PWR1** and **PWR2**. Indicates the status of the Power Supply modules. Click on PWR1 or PWR2 to view the status of the Power Supply modules on the System menu tab. |
| | ■ **FAULT**. Indicates the status of the instrument hardware. Click on FAULT to view the status of any faults on the System menu tab. |
| | For information about the possible states for each indicator, see the *SPG8000A Installation and Safety Instructions*. |
| 3 | Click on Help to open a separate browser window that opens to the Tektronix SPG product Web page. |
| 4 | Click on Refresh to refresh the Web user interface. |
| 5 | Locked / Unlocked. Indicates whether the instrument front panel is locked or unlocked. Click to toggle the setting. |

**System settings available only by using the front panel**

The System menu in the SPG8000A Web Interface does not include all of the menu options that are available using the SYSTEM button on the instrument front panel. (See page 222, *SYSTEM button menu*.)

Information on the following menu items, which are available only from the front panel, is available as described below:

■ Backup and restore Presets to USB (See page 17, *How to backup/restore presets and user data*.)

■ Audio/video Epoch selection

■ Front panel time out period

■ Oven calibration (See the *SPG8000A Installation and Safety Instructions* manual for instructions on how to calibrate the oven oscillator.)

■ Enable / Disable for SCPI remote

# SNMP remote control

When the SPG8000A is connected to an Ethernet network, you can configure the instrument to send SNMP traps to an NMS (Network Management Station) when certain errors are detected. If you intend to use SNMP commands to control the instrument, you must configure SNMP parameters.

## SNMP configuration

The following table shows the SNMP parameters you can set using the System button SNMP submenu or the Web user interface.

**Table 3: SNMP parameters**

| Setting | Description |
|---------|-------------|
| Enable SNMP | Use this setting to turn on or off the remote access using SNMP. |
| Enable Traps | Use this setting to turn on or off the traps that are sent out through SNMP. |
| SNMP Traps | Use this setting to enable or disable the following traps. For more information about each trap, see the *SNMP TRAPS submenu* section. (See page 144.)<br><br>■ Main fan fault<br><br>■ Voltage error<br><br>■ Temperature error<br><br>■ Genlock input missing<br><br>■ Loss of lock<br><br>■ Near loss of lock<br><br>■ VITC/LTC missing<br><br>■ LTC out of SMPTE specifications<br><br>■ Alarm time<br><br>■ PS1 fault<br><br>■ PS2 fault<br><br>■ PS1 TWH (Temperature Weighted Hours)<br><br>■ PS2 TWH (Temperature Weighted Hours) |
| Trap Destinations | Use this setting to set the IP addresses to which SNMP traps are sent through SNMP. Traps can be sent to up to four addresses when error conditions are detected.<br><br>*NOTE. A value of all zeroes for the address will disable that trap output.* |

**Table 3: SNMP parameters (cont.)**

| Public Community | Use this setting to set the Public Community string. This string is effectively a password. Without this string, SNMP commands cannot read values from the instrument. |
|---|---|
| | ***NOTE.*** *The Public String is necessary for SNMP access to read values from the instrument.* |
| Private Community | Use this setting to set the Private Community string. This string is effectively a password. Without this string, SNMP commands cannot change values in the instrument. |
| | ***NOTE.*** *The Private String is necessary for SNMP access to write changes into the instrument.* |

# Download the MIB

You can download the SPG8000 MIB file from the SNMP Settings submenu under the System menu. (See page 143, *SNMP Settings submenu*.) The SPG8000, SPG8000A, and SPG8000A share the same MIB file. Some of the commands in the file will apply to features and functions available only on the SPG8000 and SPG8000A.

# How to backup/restore presets and user data

You can use the backup and restore functions to duplicate settings and signal files between different SPG8000A generators.

You can view the USB drive status under the SYSTEM button menu (not available on the Web interface) and all user data using a USB drive that is connected to the instrument. The following information shows the status of the USB drive:

- **Not Connected** displayed when no USB drive is connected to the instrument.

- **Not Mounted** is displayed when a USB drive is connected to the instrument but is not mounted. Press the **ENTER** button to mount the drive. Normally, a USB drive will automatically mount when connected to the instrument.

- **Mounted** is displayed when a USB drive is connected to the instrument and is mounted. Press the **ENTER** button to safely unmount the drive. The message You May Now Safely Remove USB Drive appears when it is safe to remove the drive.

> ⚠ **CAUTION.** *To prevent the loss of data on the USB drive, be sure to unmount the USB drive before you remove the drive from the instrument.*

## How the backup and restore operations work

During the backup operation, files are copied to a directory named "SpgBackup" in the root directory of the USB drive. The restore operation expects to copy files from this same directory.

All of the copy operations will create new directories/files on either the SPG8000A or the USB drive as needed. If a file with the same name exists in the destination location, it will be overwritten. However, if a file exists in the destination location and not in the source location, the file will be left alone. Therefore, the restore and backup operations act as an overlay, and do not guarantee that there will not be additional files left in the destination location that did not exist in the source location.

**Presets**   When presets are copied, only the MSTATEX.YY files and enough directory structure to hold them in their correct locations (for example, SDI7/PRESET/MSTATE4.P00) will be copied or created.

> **NOTE.** *The preset file names use the format MSTATEX.PYY. In this example, X denotes the slot name, YY denotes the preset number (there are 13 possible presets). Separate presets are stored for each individual mainframe slot.*

Only presets that have content are copied or written by the backup/restore processes. This is because only presets that have been saved have files associated with them and the backup/restore process copies only those files. Any preset that has never been saved will not have an associated file and therefore will not be copied.

**All user data**  When all of the user data is copied, every user file except for the FPGA configuration files will be copied. This function is useful in that all user-created files can be saved, restored, or copied to other SPG8000A instruments.

User files are defined as any file that exists in the /app/F0 directory on the instrument. The files in this directory can include presets, signal files, frame picture files, logo files, sequence files, and for Option SDI, can also include text and font files. The user data files do not include the application software or any Linux files.

## Memory requirements

It is recommended that you use the Flash Memory readout in the System button menu to determine how much memory is available on the instrument before you perform a restore operation. You can also go to the Status submenu of the System menu in the Web interface to see the amount of free and used space. Here is how much memory is required:

- ■ If you are backing up or restoring only presets, you will need up to 1 MB of free space on the USB drive or in the flash memory of the instrument.

- ■ If you are backing up or restoring all of the user data in the instrument, you will need up to 96 MB of free space on the USB drive or in the flash memory of the instrument.

If the backup or restore operation runs out of memory on the USB drive or the flash memory on the instrument before the operation is complete, the operation will copy as much data as it can and will then display an error message stating that the backup or restore operation was incomplete because the drive or device is full.

## Backup/restore procedure

1. Connect a USB drive to the instrument.

2. Press the **System** button to select **System : PRESET**.

**3.** Verify the status of the USB drive:

    **a.** Press the up (▲) or down (▼) arrow button to select **System : USB <status>**.

    **b.** Verify that the USB status is **Mounted**.

    **c.** If the status is Not Mounted, press the **ENTER** button to mount the USB drive.

**4.** Press the up (▲) or down (▼) arrow button to select **System : BACKUP/RESTORE**.

**5.** Press the left (◄) or right (►) arrow button to select one of the following:

    ▬ **Backup Presets to USB**

    ▬ **Backup All User Data to USB**

    ▬ **Restore Presets from USB**

    ▬ **Restore All User Data from USB**

**6.** Press the **ENTER** button to start the selected backup or restore operation.

**7.** A warning message is displayed asking you to verify the operation. Press the **ENTER** button to proceed or press the **BACK** button to cancel the operation.

**8.** Monitor the progress of the file copy operation:

    **a.** During the first stage of the copy process, the display shows the names of the files as they are copied. Depending on the size of the files being copied, this may take a couple of minutes.

    **b.** When all of the files have been copied, the message "Finishing copy..." is displayed while the file system buffers are emptied. This message may appear for a couple of minutes.

    **c.** When the backup or restore operation is complete, the message "Backup completed successfully" or "Restore completed successfully" is displayed before the menu display returns to normal.

*NOTE. If the USB drive or the flash memory on the instrument fills up before the backup or restore operation completes, an error message is displayed. Press the ENTER or BACK button to clear the error message. (See page 18, Memory requirements.)*

9. After the backup or restore operation is complete, press the up (▲) or down (▼) arrow button to select **System : USB (Mounted)**.

10. Press the **ENTER** button to unmount the USB drive. After the message "You may now safely remove the USB drive" is displayed, the menu readout should change to **System : USB (Not mounted)**.

11. Remove the USB drive from the instrument.

# How to transfer or install user files

You can use either an FTP client or a USB drive to transfer user files between instruments or to install user files directly on the instrument.

User files include test signals, logo overlays, and ID text overlay files. To install custom user files, the signal files must be installed in the proper directory on the instrument. (See page 25, *File structure required to install custom user files*.)

**NOTE.** *If you install new test signal files, you must reboot the instrument before you can output the new test signals. You do not need to reboot the instrument before you can use newly installed frame picture files, logo overlay files, or text string overlay files.*

## To transfer or install user files using FTP

Perform the following steps to transfer or install user files using FTP:

1. Connect the instrument to your local Ethernet network or to a standalone Windows PC. See the *SPG8000A Installation and Safety Instructions* for information about installing the instrument on a network.

2. On a computer connected to the same network as the instrument, open an FTP client such as Windows Explorer.

3. In the Windows Explorer command box, enter "ftp://IP address", where IP address is the network address assigned to the instrument.

**NOTE.** *Some FTP clients may ask for login credentials. In this case, login with a user name of "anonymous" and no password.*

4. The Windows Explorer window should immediately connect to the instrument and show the instrument file structure as shown below.
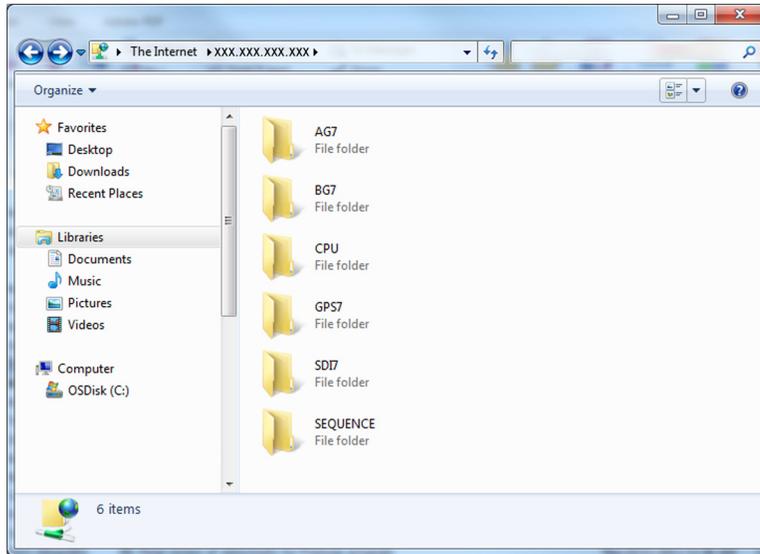
**Figure 3: Example FTP view of the SPG8000A file structure**

5. Use Windows Explorer to drag and drop user files to or from the instrument.

⚠ *CAUTION. If you are installing custom signal files on the instrument such as test signals or logo and ID text overlays, the signal files must be installed in the proper directory. Custom user files installed in the wrong directory location will be ignored by the instrument. (See page 25, File structure required to install custom user files.)*

*NOTE. If the flash memory on the instrument fills up before the copy operation completes, an error message similar to the one below is displayed. Click **OK** to clear the error message. You can use the SYSTEM : FLASH MEMORY menu selection to view the amount of free memory in the instrument.*
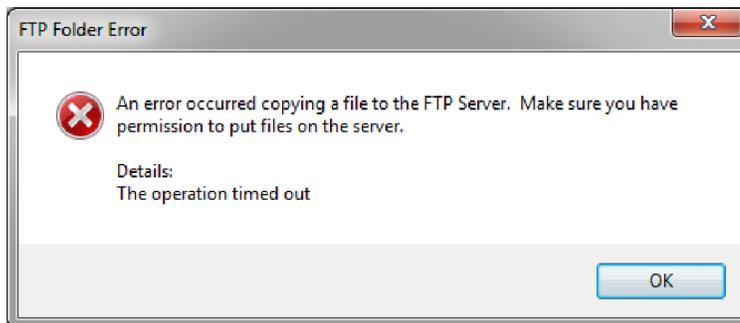


**Figure 4: Example FTP error message when flash memory is full**

6. After you are done transferring files, close the Windows Explorer window.

*SPG8000A User Manual*

# To transfer or install user files using a USB drive

You can use a USB drive connected to the USB port on the front of the instrument to transfer or install user files.

**To transfer user files from an instrument to a USB drive**

Perform the following steps to transfer user files from an SPG8000A generator to a USB drive:

1. Insert a USB memory device into the USB port on the front of the instrument.

2. Verify that the USB device is properly installed:

   a. Press the **SYSTEM** button to access the SYSTEM menu.

   b. Use the up (▲) or down (▼) arrow button to select **SYSTEM : USB (Mounted)**.

   ---

   *NOTE. The display will read "Mounted" if the USB device is properly installed. If the display reads "Unmounted" or "Not Connected", try to reinstall the USB device.*

   *If the instrument still does not recognize the USB device, attempt this procedure again using a different USB device from a well known brand that is 16 GB or less.*

   ---

3. Use the up (▲) or down (▼) arrow button to select **SYSTEM : BACKUP/RESTORE**.

4. Use the left (◄) or right (►) arrow button to select one of the following options, and then press the ENTER button.

   - Select **Backup Presets to USB** to transfer only the stored presets from the instrument.

   - Select **Backup All User Data to USB** to transfer all user data including stored presets and user-created text, logo, picture, and test signal files.

5. In the overwrite confirmation display, press the **ENTER** button to perform the selected backup function.

6. During the backup process, progress messages are displayed. When the message Backup completed successfully is displayed, press any button to return to the SYSTEM menu display.

7. Use the up (▲) or down (▼) arrow button to select **SYSTEM : USB (Mounted)**.

8. Press the **ENTER** button to safely unmount the USB device. You can now use the USB device to transfer the saved files to another SPG8000A generator or to restore user files after a firmware upgrade.

**To install user files from a USB drive to an instrument**

Perform the following steps to install user files from a USB drive to an instrument:

⚠️ *CAUTION. In addition to transferring files from one instrument to another, you can use the Restore All User Data From USB function to directly install user-created text, logo, picture, and signal files on the instrument. To install user files, the files must be organized in specific directories on the USB drive. (See page 25, File structure required to install custom user files.)*

1. Insert a USB memory device containing the user files you want to install on the SPG8000A generator into the USB port on the front of the instrument.

2. Verify that the USB device is properly installed:

   a. Press the **SYSTEM** button to access the SYSTEM menu.

   b. Use the up (▲) or down (▼) arrow button to select **SYSTEM : USB (Mounted)**.

   *NOTE. The display will read "Mounted" if the USB device is properly installed. If the display reads "Unmounted" or "Not Connected", try to reinstall the USB device.*

   *If the instrument still does not recognize the USB device, attempt this procedure again using a different USB device from a well known brand that is 16 GB or less.*

3. Use the up (▲) or down (▼) arrow button to select **SYSTEM : BACKUP/RESTORE**.

4. Use the left (◄) or right (►) arrow button to select one of the following options, and then press the ENTER button.

   - Select **Restore Presets From USB** to install only the stored presets from another instrument.

   - Select **Restore All User Data From USB** to transfer all user data including stored presets and user-created text, logo, picture, and signal files.

5. In the overwrite confirmation display, press the **ENTER** button to perform the selected restore function.

6. During the restore process, progress messages are displayed. When the message Restore completed successfully is displayed, press any button to return to the SYSTEM menu display.

**7.** Use the up (▲) or down (▼) arrow button to select **SYSTEM : USB (Mounted)**.

**8.** Press the **ENTER** button to safely unmount the USB device.

**File structure required to install custom user files**

To install custom user files from a USB drive, the files must be organized in the file structure described below. You can create the proper file structure by performing the Backup All User Data to USB function. You can then copy the directory structure from the USB drive to your computer. (See page 23, *To transfer user files from an instrument to a USB drive*.)

⚠️ *CAUTION. If you are installing custom signal files on the instrument such as test signals or logo and ID text overlays, the signal files must be installed in the associated subdirectory for the file type in the SDI7 directory. Custom user files installed in the wrong directory location will be ignored by the instrument.*

The directory names in the following list are case sensitive.

- A directory named **SpgBackup** is required at the top level of the USB drive.

- In the SpgBackup directory, a subdirectory named **SDI7** is required.

- In the SDI7 directory, subdirectories with the following names are required:

*NOTE. All of the following subdirectories are not required to be in the SDI7 directory to be able to install user files. You only need the subdirectories related to the type of user files you are installing on the instrument. For example, if you are going to install only logo files, you need to have only the LOGO subdirectory exist in the SDI7 directory.*

- LOGO – Use this directory to install only logo overlay files. The logo files must have a .bmp file name extension. (See page 97, *Logo overlay settings*.)

- PICTURE – Use this directory to install only frame picture files for use as test signals. The frame picture files must have a .bmp file name extension. (See page 121, *SDI picture file generation*.)

- SIGNAL – Use this directory to install only test signal files. The test signal files must have an .xml file name extension.

- TEXT – Use this directory to install only ID text overlay files. The ID text files must have a .txt file name extension. (See page 98, *ID Text overlay settings*.)

The following figure shows how the required directory structure for installing custom user files looks using Windows Explorer.
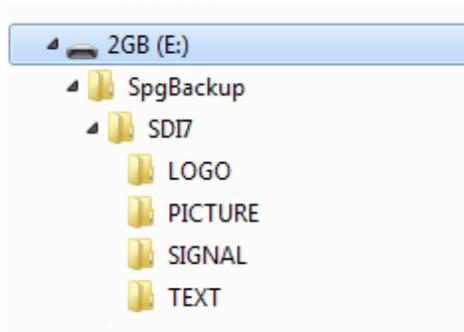


**Figure 5: File structure for installing custom user files**

     *SPG8000A User Manual*

# How to upgrade the instrument firmware

Tektronix releases software and firmware updates for products to add new features and to fix product problems. You can find the latest firmware for your product at the Tektronix Web site (www.tek.com/downloads).

## Determine if a firmware upgrade is needed

Before you begin the upgrade, perform the following steps to determine if the firmware on your instrument should be upgraded and to backup your user files.

⚠ *CAUTION. The firmware upgrade process replaces all installed user files with the factory default files. To prevent the loss of your user files, including custom test signals, logo and ID text overlays, and saved presets, be sure to backup all of your user data before you perform the upgrade. The following procedure includes instructions for backing up your user data.*

1. Verify the current firmware version installed on the instrument:

   a. Press the **SYSTEM** button to access the SYSTEM menu.

   b. Press the up (▲) or down (▼) arrow button to select **SYSTEM : VERSION INFO (F/W)**.

   c. In the second line of the display, note the firmware version number of the instrument.

   | Installed firmware version number | |
   | --- | --- |

2. Verify the latest version of software at the Tektronix Web site:

   a. On a computer, use a Web browser to navigate to the following Tektronix Web site: **www.tek.com/downloads**.

   b. On the Downloads Finder Web page, search by model number (such as SPG8000A) and filter by software and software type to locate the firmware upgrade package for the instrument.

   c. Note the latest version number of the firmware upgrade package(s).

   | Web site firmware version number | |
   | --- | --- |

3. If the latest firmware version at the Web site is the same as the version installed on your instrument, you do not need to upgrade the instrument firmware.

4. If the latest firmware version at the Web site is newer than the version on your instrument, download the latest firmware package to your computer.

**5.** After the firmware package ZIP file is downloaded, extract the following files into the directory of your choice: transfer.exe and firmware.pkg.

---

*NOTE. If a readme.txt file is included in the firmware package, be sure to read the file before you upgrade the firmware.*

---

**6.** If the firmware in your instrument must be upgraded, verify which options are currently installed before you install the software. After you install the upgrade, you will verify that any previously installed options are still enabled.

    **a.** Connect the instrument and computer to your local Ethernet network. See the *SPG8000A Installation and Safety Instructions* for information about installing the instrument on a network.

    **b.** Press the **SYSTEM** button to access the SYSTEM menu.

    **c.** Press the up (▲) or down (▼) arrow button to select **SYSTEM : OPTIONS**. The second line of the display lists the options, if any, that are installed in the instrument. None is displayed if no options are installed, and SDI 3G is displayed if Option SDI is installed.

```
SYSTEM : OPTIONS
  SDI 3G
```

    **d.** Make a note of the installed options.

**7.** If the firmware in your instrument must be upgraded, to prevent the loss of your user files, be sure to backup your user files to a USB drive. (See page 23, *To transfer user files from an instrument to a USB drive*.) You will restore the user files at the end of the upgrade procedure.

---

⚠ *CAUTION. To prevent the loss of your user files, be sure to use the Backup All User Data to USB option in the backup procedure.*

---

## Firmware upgrade overview

There are two methods for upgrading the instrument firmware:

◼ Using a USB memory device (See page 29, *USB firmware upgrade*.)

◼ Using an Ethernet network (requires a Windows PC) (See page 31, *Network firmware upgrade*.)

The time required to complete the firmware upgrade is approximately 10 minutes.

⚠ *CAUTION. The instrument automatically reboots at the end of the upgrade process. Do not perform the upgrade while the instrument is in use as a sync reference.*

*Once the instrument has started to erase internal flash, do not remove power from the instrument. If you do so, the instrument flash may be corrupted and you will have to run the recovery procedure. (See page 34, Firmware upgrade troubleshooting.)*

*NOTE. If power to the instrument is lost before it begins erasing the internal flash, you can restart the firmware upgrade after the instrument reboots. If the instrument displays only a blank screen after power is reapplied, see the troubleshooting section for help. (See page 34, Firmware upgrade troubleshooting.)*

*If you have loaded the instrument memory with a large number of test signals or frame picture files, you may not be able to upgrade the instrument firmware because the memory is too full. If you receive a memory error while attempting to upgrade the firmware, you need to delete some of the test signal or frame picture files and then perform the upgrade.*

## USB firmware upgrade

Use the following steps to upgrade the instrument firmware using a USB memory device.

1. Insert a USB memory device into a USB port of the computer containing the latest instrument firmware.

2. On the computer, navigate to the USB device.

3. On the USB device, create a directory named **SpgUpgrd**.

⚠ *CAUTION. To prevent upgrade failure, be sure to correctly name the upgrade directory. The directory name is case sensitive, with the "S" and the "U" in SpgUpgrd being upper case.*

4. Open the SpgUpgrd directory and copy the firmware.pkg file from the downloaded ZIP file to the USB device. The USB device should have a directory path of **SpgUpgrd\firmware.pkg**.

5. Eject and safely remove the USB device from the computer.

6. If necessary, power on the instrument and wait for the instrument to fully start up before inserting the USB device into the front-panel USB port on the instrument.

**7.** Press the **SYSTEM** button to access the SYSTEM menu.

**8.** Verify that the USB device is properly installed by pressing the up (▲) or down (▼) arrow button to select **SYSTEM : USB (Mounted)**.

---

*NOTE.  The display will read "Mounted" if the USB device is properly installed. If the display reads "Unmounted", try to reinstall the USB device.*

*If the instrument still does not recognize the USB device, attempt this procedure again using a different USB device from a well known brand that is 16 GB or less.*

---

**9.** Press the up (▲) or down (▼) arrow button to select **SYSTEM : FIRMWARE UPGRADE**.

**10.** Press the left (◄) or right (►) arrow button to select **USB Upgrade**, and then press the **ENTER** button.  A confirmation message is displayed as shown below.

---

*NOTE.  If the instrument displays the message **ERROR: SpgUpgrd/firmware.pkg not found**, make sure you have the correct directory path on the USB device and then restart this procedure at step 6.*

---

```
*           Upgrade firmware 1.1 to X.X?         *
*                Yes : ENTER / No : BACK         *
```
3080-007

**11.** A second confirmation is displayed as shown below to remind you that the upgrade will delete all user-created files on the instrument.

---

⚠  *CAUTION.  If you did not backup your user files as part of the upgrade preparation process, it is recommended that you press the BACK button to cancel the upgrade and then backup your user files before performing the upgrade. (See page 23, To transfer user files from an instrument to a USB drive.)  You will restore the user files at the end of the upgrade procedure.*

---

```
* !        User data will be lost. Continue?        ! *
*                Yes : ENTER / No : BACK            *
```
3080-065

**12.** Press the **ENTER** button to proceed with the upgrade or press the **BACK** button to cancel the upgrade.

**13.** When you press ENTER, the upgrade process begins. During the upgrade process, the instrument displays messages indicating the upgrade status.

⚠ **CAUTION.** *Once the instrument has started to erase internal flash, do not remove power from the instrument. If you do so, the instrument flash may be corrupted and you will have to run the recovery procedure. (See page 34, Firmware upgrade troubleshooting.)*

**14.** If the instrument does not reboot at the completion of the firmware upgrade, remove and then reconnect the power cable(s).

**15.** Remove the USB device after the upgrade is complete:

⚠ **CAUTION.** *To prevent a loss of data on the USB device, use the SYSTEM menu to unmount the USB device before removing it from the instrument.*

**a.** Press the **SYSTEM** button.

**b.** Press the up (▲) or down (▼) arrow button to select **SYSTEM : USB (Mounted)**, and then press the **ENTER** button.

**c.** Remove the USB device from the instrument when the message **You may now safely remove the USB drive** appears.

**16.** Proceed to *Verify the firmware upgrade and reinstall user files*. (See page 34.)

## Network firmware upgrade

Use the following steps to upgrade the instrument firmware using a network connection:

**1.** Connect the instrument and a Windows PC to your local Ethernet network or directly connect the instrument to a Windows PC. See the *SPG8000A Installation and Safety Instructions* for information about installing the instrument on a network.

**2.** Prepare the instrument for the firmware upgrade:

**a.** Press the **SYSTEM** front panel button.

**b.** Press the up (▲) or down (▼) arrow button to select **SYSTEM : FIRMWARE UPGRADE**.

**c.** Press the left (◄) or right (►) arrow button to select **Network Upgrade**, and then press the **ENTER** button. A confirmation message is displayed as shown below.

```
*              Begin network firmware upgrade?           *
*                  Yes : ENTER / No : BACK               *
```
3080-008

**d.** A second confirmation is displayed as shown below to remind you that the upgrade will delete all user-created files on the instrument.

⚠ **CAUTION.** *If you did not backup your user files as part of the upgrade preparation process, it is recommended that you press the BACK button to cancel the upgrade and then backup your user files before performing the upgrade. The instructions for backing up user files is described in the section To transfer user files from an instrument to a USB drive. (See page 23.) You will restore the user files at the end of the upgrade procedure.*

```
* !       User data will be lost. Continue?       ! *
*                  Yes : ENTER / No : BACK             *
```
3080-065

**e.** Press the **ENTER** button to proceed with the upgrade or press the **BACK** button to cancel the upgrade.

**f.** When you press ENTER, a **Waiting for network connection** message is displayed with the IP address of the instrument. This indicates the instrument is ready to be upgraded. An example display is shown below.

```
Waiting for network connection . . .
IP Address : XXX.XXX.XXX.XXX (DHCP)
```
3080-009

**3.** Perform the firmware upgrade:

**a.** On the PC, double-click the **transfer.exe** file to launch the transfer program.

**b.** Type the IP address or DNS name of the instrument you are upgrading, and then press **Enter**. This starts the firmware upgrade process. Messages indicating the progress of the upgrade appear in the transfer program window and on the instrument display.

> ⚠ **CAUTION.** *Once the instrument has started to erase internal flash, do not remove power from the instrument. If you do so, the instrument flash may be corrupted and you will have to run the recovery procedure. (See page 34, Firmware upgrade troubleshooting.)*

> **NOTE.** *The upgrade will not proceed until all of the firmware data is transferred to the instrument. Once the upgrade has started, the instrument will attempt to complete the upgrade even if it loses contact with transfer.exe. So that you can monitor the progress of the upgrade, it is suggested that you do not close the transfer.exe window until the transfer utility asks for another IP address.*



**Figure 6: Sample of transfer.exe window after the upgrade is complete**

**4.** If the instrument does not reboot at the completion of the firmware upgrade, remove and then reconnect the power cable.

**5.** Proceed to *Verify the firmware upgrade and reinstall user files*. (See page 34.)

## Verify the firmware upgrade and reinstall user files

1. After the instrument reboots at the end of the upgrade process, press the **SYSTEM** button to access the SYSTEM menu.

2. Press the up (▲) or down (▼) arrow button to select **SYSTEM : OPTIONS**. The second line of the display lists the options, if any, that are installed in the instrument. None is displayed if no options are installed, and SDI 3G is displayed if Option SDI is installed.

```
SYSTEM : OPTIONS
  SDI 3G
```

3. Verify that the options listed match those that you noted before the upgrade.

4. Press the up (▲) or down (▼) arrow button to select **SYSTEM : VERSION INFO (F/W)**. The second line of the display lists the installed firmware version.

5. Verify that the displayed firmware version is the same version as the firmware package you used to perform the upgrade.

6. If you backed up your user files before you upgraded the firmware, reinstall your user files as described in the section *To install user files from a USB drive to an instrument*. (See page 24.)

⚠ **CAUTION.** *To prevent the loss of your user files, be sure to use the **Restore All User Data from USB** option in the restore procedure.*

## Firmware upgrade troubleshooting

If a power failure occurs during the upgrade and the instrument has a blank screen when you reapply power, perform the following procedure.

1. Connect an Ethernet cable between the instrument and your computer or local Ethernet network.

2. Remove the power cable to turn off the instrument.

3. Press and hold the STATUS button and then reconnect the power cable. Continue to hold the STATUS button until the message **Select upgrade network speed:** appears on the top line of the LCD display.

4. Press the left (◄) or right (►) arrow button to select a network speed (10BaseT, 100BaseT, or 1000BaseT), and then press the **ENTER** button. If you do not know your network speed, the 100BaseT selection is recommended.

5. When the message **Select upgrade network mode:** is displayed, press the left (◄) or right (►) arrow button to select from the following modes and then press the **ENTER** button.

   ▬ **DHCP** – Use this selection if the instrument is connected to a network with DHCP support. An IP address will be assigned to the instrument from your network server.

   ▬ **Local IP (192.168.1.1)** – Use this selection if the instrument is connected to a network without DHCP support or is connected to a standalone computer, and you want to use the factory default, static IP address of 192.168.1.1 for the upgrade.

   *NOTE. When you select either the Local IP or the Saved static IP upgrade mode, you cannot edit the displayed IP address. The IP address cannot be edited when the instrument is in recovery mode.*

   ▬ **Saved static IP (IP address)** – Use this selection if the instrument is connected to a network without DHCP support or is connected to a standalone computer, and you want to use the previously saved static IP address assigned to the instrument for the upgrade. The saved IP address is displayed.

   ▬ **Quit and continue booting** – Use this selection to quit the upgrade process and leave the instrument in its current condition.

6. If you did not select Quit and continue booting in the previous step, the top line of the instrument display will show the message **Waiting for network connection** and the second line will list an IP address. Make a note of the displayed IP address.

7. Enter the IP address you noted in the previous step into the upgrade transfer application window on your PC to restart the upgrade process.

⚠ *CAUTION. To prevent upgrade failure, leave the instrument power on during the upgrade process. The upgrade process may take up to 15 minutes to complete.*

8. When the upgrade is complete, the instrument should reboot. If it does not, cycle the power.

If you continue to experience an upgrade problem, contact Tektronix customer support or your local Tektronix representative for assistance.

# How to operate an instrument with two power supplies (Option DPW only)

The standard instrument has one Power Supply module installed. With Option DPW, a second hot-swappable, redundant (backup) Power Supply module is provided. When two Power Supply modules are installed in the instrument, one is configured as the primary supply and the other is configured as the backup supply.

If that the primary supply fails, the backup supply automatically provides power to maintain instrument operation. You can remove and replace a failed supply without having to remove the instrument from operation. (See page 39, *To hot-swap a Power Supply module*.)

## Power supply status

The status of the Power Supply modules can be viewed from the front or rear of the instrument. On the front panel, the PWR1 and PWR2 indicators illuminate using various colors to show the status of the Power Supply modules. The rear panel of each Power Supply module has a STATUS LED that matches the status shown on the PWR1 and PWR2 indicators. See the *SPG8000A Installation and Safety Instructions* for information about the power supply status indicators.

You can use the SYSTEM menu to perform a load test on the backup supply and to view voltage levels in the instrument.

**Temperature weighted hours (TWH)**

The instrument keeps track of the age of a Power Supply module by calculating the temperature weighted hours (TWH). You can view the TWH of each installed supply using the SYSTEM : DIAGNOSTICS menu.

**TWH calculation method.** When the outside air temperature is at 25 °C or cooler, the Power Supply module is expected to last 15 years. As the outside air temperature rises to the maximum operating temperature of 50 °C, the expected life of the supply decreases to 5 years. Every hour, the instrument measures the outside temperature and increments the temperature weighted hours count in response to the measured temperature.

When the TWH value reaches a value of 131,400, then the associated PWR1 or PWR2 indicator will be set to orange to indicate that the supply should be replaced.

*NOTE. When two Power Supply modules are installed, the active supply runs warmer than the backup supply. Therefore, the TWH of the active supply will increase faster than the backup supply.*

## To configure the preferred (active) supply

Perform the following steps to configure which Power Supply module is the preferred (active) supply:

*NOTE. The preferred supply configuration only applies if two Power Supply modules are installed and both of the supplies are connected to a power source. If there are two Power Supply modules installed but one of the supplies has a failure, the good supply will be used to power the instrument regardless of the preferred supply configuration.*

*The recommended usage strategy is to configure one supply as preferred, and use the second supply only in case the first supply has a failure. This usage strategy allows the backup supply to have the maximum remaining life when it is needed.*

*The preferred supply configuration is not saved as part of the preset system. Therefore, the preferred supply configuration will not change when you activate any of the system presets, including the Factory Default preset. (See page 140, Presets submenu.)*

*The following procedure uses the front panel controls on the instrument to configure the preferred (active) supply. You can also use the System > General Settings submenu in SPG8000A Web Interface to configure the preferred supply. (See page 141, General Settings submenu.)*

1. Check the status of the front-panel PWR1 and PWR2 indicators:

   - Bright green indicates the preferred (active) supply.

   - Dim green indicates the inactive (backup) supply.

   *NOTE. If the color of the PWR1 or PWR2 indicators is other than bright or dim green, service the faulty Power Supply module before proceeding.*

2. Check the temperature weighted hours of the installed supplies:

   *NOTE. It is recommended that you configure the supply with the most temperature weighted hours to be used as the primary preferred supply. This allows for the newer supply to be preserved so it can provide the best possible backup should the primary supply fail. (See page 36, Temperature weighted hours (TWH).)*

   a. Press the **SYSTEM** button to access the SYSTEM menu.

   b. Press the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS**, and then press the **ENTER** button to access the DIAGNOSTICS menu.

    **c.** Press the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS : POWER SUPPLY 1**. The second line of the display will list the number of hours the supply has been the active supply and the backup supply.

    **d.** Press the right (►) arrow button to display the number of temperature weighted hours of the first supply as shown below. Note the number of hours of hours shown.

       
```
SYSTEM : DIAGNOSTICS : POWER SUPPLY 1
  Tmp Wtd: 0000677 (OK)(limit:131400)
```
                           3080-063

    **e.** Press the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS : POWER SUPPLY 2**.

    **f.** Press the right (►) arrow button to display the number temperature weighted hours of the second supply. Note the number of hours of hours shown.

**3.** If the Power Supply module with the greatest number of temperature weighted hours is not the currently the preferred supply, then continue this procedure. Otherwise, you do not need to change the preferred supply configuration.

**4.** To change the preferred supply configuration, press the **SYSTEM** button to access the SYSTEM menu.

**5.** Press the up (▲) or down (▼) arrow button to select **SYSTEM : POWER SUPPLY PREFERRED SELECT**.

**6.** Press the left (◄) or right (►) arrow button to display the supply you want to be the primary (active) supply: Power Supply 1 or Power Supply 2. The second line of the display shows the supply status: **Active, Preferred** or **Inactive**.

---

*NOTE. When viewed from the front of the instrument, Power Supply 1 is the left Power Supply module and Power Supply 2 is the right Power Supply module. This matches the orientation of the PWR1 and PWR2 indicators on the front panel.*

---

**7.** If status of the supply is Inactive, press the **ENTER** button to change the status to Active, Preferred. The front-panel indicator for the selected supply should change to bright green.

## To hot-swap a Power Supply module

This procedure describes how to replace a Power Supply module while the instrument is in operation. Perform the following steps to hot-swap a Power Supply module:

⚠ *WARNING. Disconnect the power cord from the Power Supply module before you remove the module from the instrument. Also, do not connect a power cord to the Power Supply module while the module is not installed in the instrument. There are dangerous high voltages inside the module when the power cord is connected.*

⚠ *CAUTION. To prevent an unexpected shutdown of the instrument, be sure to disconnect the correct power cord if you are replacing a faulty Power Supply module. (See Figure 7.)*

*When viewed from the front of the instrument, Power Supply 1 is the left Power Supply module and Power Supply 2 is the right Power Supply module. This matches the orientation of the PWR1 and PWR2 indicators on the front panel. The STATUS LED on the rear panel of each Power Supply module will match the status shown by the front-panel PWR1 and PWR 2 indicators.*

1. Remove the power cable from the Power Supply module that you are removing or replacing.

2. Pull out the handle located at the bottom of the supply. (See Figure 7.)

3. While pushing the retaining latch to the left, use the handle to pull the Power Supply module out of the instrument.

4. Insert the replacement supply into the instrument until it latches into place.

5. If necessary, push the handle of the supply into the storage position.

6. Connect the power cable to the Power Supply module you installed.

7. Check that the status of the Power Supply module you just installed is bright or dim green.

8. If desired, change the preferred supply configuration. (See page 37, *To configure the preferred (active) supply.*)

*NOTE. It is recommended that you configure the supply with the most temperature weighted hours to be used as the primary preferred supply. This allows for the newer supply to be preserved so it can provide the best possible backup should the primary supply fail.*
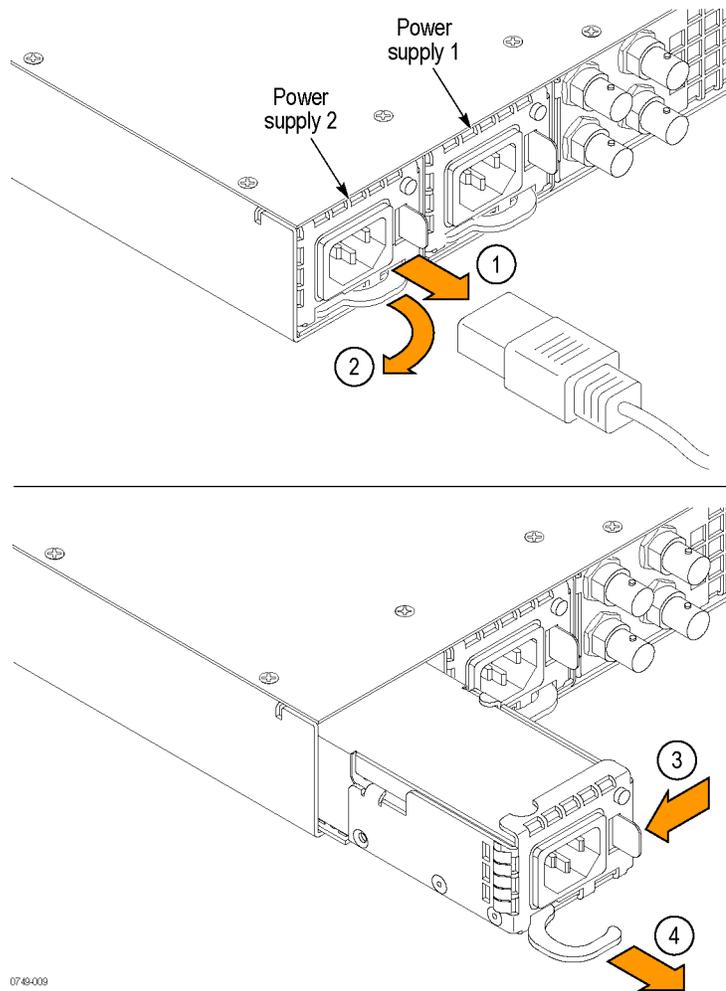
**Figure 7: Removing a Power Supply module**

# How to use Stay Genlock®

## About Stay Genlock®

Stay GenLock® is a digital genlock technology developed by Tektronix to provide additional robustness and stability for genlocked Sync Pulse Generators (SPGs), as in a master/slave configuration.

If the external reference is removed from the genlock input, the instrument must use the internal oscillator as a frequency reference. Although the OXCO is a precision component, small frequency differences are inevitable. However, the Stay GenLock® technology maintains a history of the clock frequency, and therefore attempts to hold the last stable frequency before genlock was lost.

See the *Video Sync Pulse Generator and Electronic Changeover Unit System Integration Technical Reference* manual for more information about the Stay Genlock® function.

## To enable Stay Genlock®

To enable the Stay GenLock® function on the instrument, perform the following steps:

*NOTE. The following procedures use the front panel controls on the instrument to enable Stay GenLock®. You can also use the Reference menu in SPG8000A Web Interface to enable Stay GenLock®. (See page 77, Reference menu.)*

1. Press the front-panel **REFERENCE** button to access the REFERENCE menu.

2. Use the up (▲) or down (▼) arrow button to display **REFERENCE : LOCK LOSS ACTION**.

3. Use the left (◄) or right (►) arrow button to display **Stay at Current Frequency**, and then press the **ENTER** button to confirm the selection.

## How to use Genlock Lock Action mode

In some cases, locking to a reference can cause a disruption or *shock* to the sync signals. To prevent this disruption, Genlock Lock Action mode can be set so you have to allow the system to lock or relock to the reference. This mode is supported when locking to NTSC, PAL, tri-level, and CW signals.

Use the following steps to access Genlock Lock Action mode:

1. Press the **REF** button.

2. Use the up (▲) or down (▼) arrow button to display the **REFERENCE : GL LOCK ACTION MODE** menu.

3. Use the left (◄) or right (►) arrow button to display either **Automatic** or **Wait for user approval**.

In Automatic mode, the system will lock as soon as the conditions allow. In the Wait for user approval mode, the system will not lock until you allow it. While waiting for you to approve a lock, the **EXT** indicator on the front panel will be red, and the lock status readout will indicate **Unlocked - waiting for user approval**.

To approve the system to lock, use the following steps:

1. Press the **REF** button.

2. Use the up (▲) or down (▼) arrow button to display the **REFERENCE: GL MANUAL LOCK APPROVAL** menu.

3. Follow the instructions, then press **ENTER** to approve the lock.

The approval will be active for two seconds to allow the lock to occur. If the system is not able to lock, it will revert to waiting for the lock approval state. The Lock Action Mode feature is supported by the Web UI.

# AES menu

Use the AES button menu to view and configure the timing offset of the Word Clock (48 kHz) and DARS outputs and to set the signal level of the Word Clock.

When Option AG is installed, use this menu to configure the AES audio output settings such as the frequency, amplitude, resolution, timing offset, and audio/video synchronization.

The following figure shows the AES menu including the Global Settings and Channel Parameters.
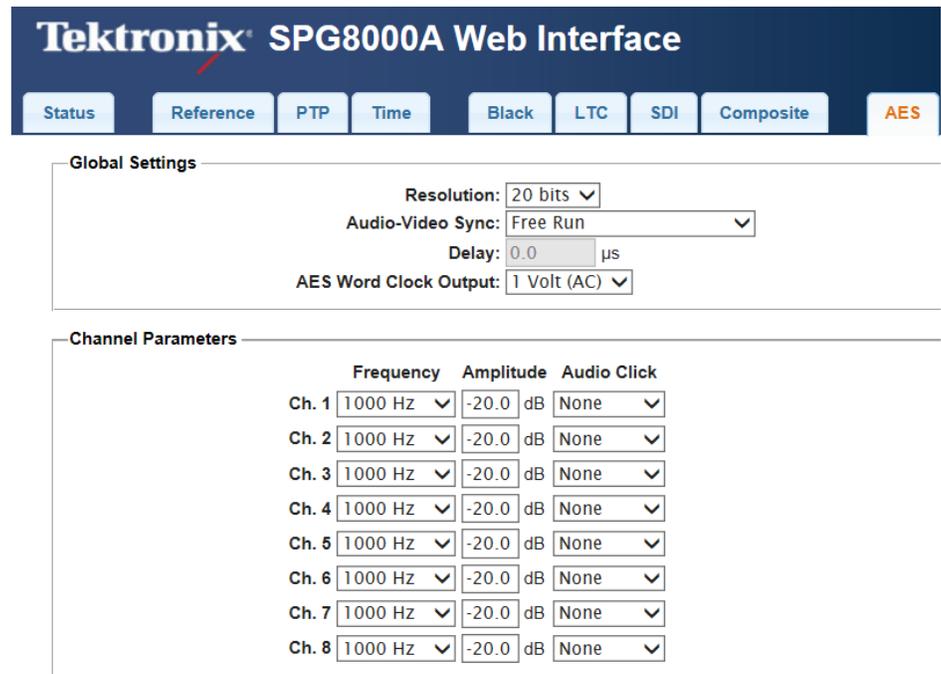


Figure 8: AES menu

## Global settings

**Resolution**  This menu item is available only when Option AG is installed. Sets the resolution of the serial digital audio signal data. Use the drop down menu to select **20 bits** or **24 bits**.

**Audio-Video sync**  This menu item is available only when Option AG is installed. This menu item selects the frame reset signal that is synchronized with the Word Clock and DARS signal outputs.

Use the drop-down list to select the frame reset signal:

- **Free Run**. The Word Clock and DARS signals are not synchronized with any of the frame reset signals.

- **Frame Reset 1 (2.997 Hz)**

- **Frame Reset 2 (6.250 Hz)**

- **Frame Reset 3 (3.000 Hz)**

---

*NOTE. If the frame reset signal used by the Word Clock and DARS signals is reset by a change of the video format, the Word Clock and DARS signal timing is also reset.*

---

**Delay**  Use this to set the timing offset of the Word Clock and DARS outputs relative to the genlock signal or the internal reference signal.

**AES Word Clock output**  Sets the signal level of the Word Clock output. Use the drop-down list to select **1 Volt (AC)** or **5 Volt (DC)**.

## Channel parameters

This menu is available only when Option AG is installed. Select the parameters for audio Channel 1 to Channel 8 from the following drop-down lists.

**Frequency**  Sets the audio signal frequency for the selected audio channel. The choices are:

| | | | |
|---|---|---|---|
| Inactive | 400 Hz | 1600 Hz | 6000 Hz |
| Silence | 500 Hz | 2000 Hz | 8000 Hz |
| 50 Hz | 600 Hz | 2400 Hz | 9600 Hz |
| 100 Hz | 750 Hz | 3000 Hz | 10000 Hz |
| 150 Hz | 800 Hz | 3200 Hz | 12000 Hz |
| 200 Hz | 1000 Hz | 4000 Hz | 15000 Hz |
| 250 Hz | 1200 Hz | 4800 Hz | 16000 Hz |
| 300 Hz | 1500 Hz | 5000 Hz | 20000 Hz |

When **Inactive** is selected, audio data output is disabled.

**Amplitude**  Sets the audio signal amplitude for the selected audio channel. Set the value from -60 dBFS to 0 dBFS.

**Audio click**  Inserts audio clicks in the selected audio channel. The audio tone, if any, is turned off for an interval around the audio click. The choices in the drop-down list are **None**, **1 Second**, **2 Second**, **3 Second**, and **4 Second**.

Audio Click becomes valid when you select **1 Second** to **4 Second** for the Audio Click rate. When Audio Click is valid, Audio Tone is turned off for 0.25 seconds around the click. For example, if you select **3 Second** for the click rate, the audio tone will be output for 2.75 seconds, and silent for 0.25 seconds; the click occurs during this silence. When Audio Click is **None**, the Audio Tone selected with the Frequency setting is output continuously. Audio Click makes it easy to identify any of the four output channels.

# AES menu factory default settings

The following table shows the settings for the AES button menu that are reset when you use the PRESET submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

**Table 4: AES Global Settings factory default settings**

| Menu item name | Settings |
| --- | --- |
| Resolution | 20 bits |
| Audio-Video Sync | Free Run |
| Delay | 0.0 μsec |
| AES Word Clock Output | 1 Volt (AC) |

**Table 5: AES Channel Parameters factory default settings**

| Menu item name | Frequency | Amplitude | Audio Click |
| --- | --- | --- | --- |
| Ch. 1 to Ch. 8 | 1000 Hz | -20.0 dB | None |

# Black menu

Use the Black menu to view and configure the Black outputs. Click one of the bars for the five Black outputs (1, 2, 3, 4, or 5) to open the configuration submenu for that output. Black outputs 1–3 are standard; Black outputs 4–5 are available only with Option BG. The bars for each Black output lists the current signal being output (NTSC Black Burst, for example).

The following figure shows the Black menu with the Black 2 submenu expanded. Most of the entries in all five submenus are the same with the differences noted below.
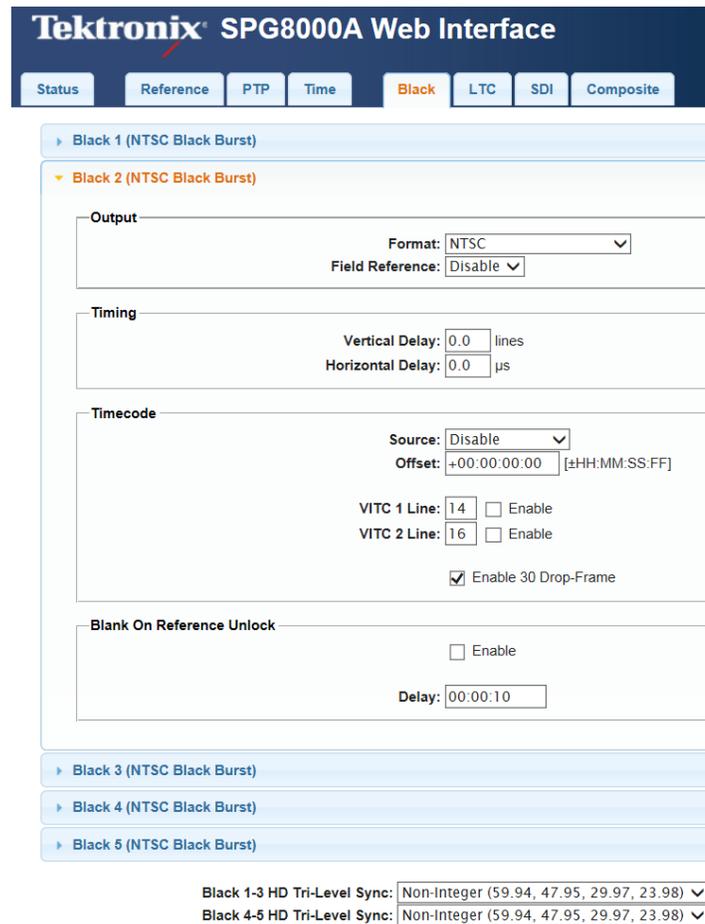


**Figure 9: Black menu with the Black 2 submenu expanded**

*NOTE. Black outputs 1–3 are a group that must use the same HD tri-level sync rate. Likewise, Black outputs 4–5 are a group that must use the same HD tri-level sync rate. Both groups can output the same rate or they can output different rates.*

*When the instrument is in Factory mode, a Calibration menu option is available. See the SPG8000A Service Manual for more information.*

# Black output settings

This submenu contains the Format and Field Reference selections.

**Format**
Use drop-down list to select the signal format for the selected Black output.

Not all of the formats are available for the Black outputs; the available format choices depend on the following:

- The CW 10 MHz format appears only for the Black 3 output. When CW 10 MHz is the selected output format, other Black menu items are unavailable for the Black 3 output.

- The available HD output formats depend on whether the HD tri-level sync rate for the selected Black output is set to integer or non-integer. (See Table 6.)

**Table 6: Black output formats**

| Non-integer formats | Integer formats |
| --- | --- |
| NTSC | NTSC |
| PAL | PAL |
| NTSC-J | NTSC-J |
| CW 10 MHz [1] | CW 10 MHz [1] |
| 1080 59.94i | 1080 60i |
| 1080 23.98sF | 1080 50i |
| 1080 29.97p | 1080 24sF |
| 1080 23.98p | 1080 30p |
| 1080 59.94p | 1080 25p |
| 1080 47.95p | 1080 24p |
| 720 59.94p | 1080 60p |
| 1 PPS | 1080 50p |
| | 1080 48p |
| | 720 60p |
| | 720 50p |
| | 1 PPS |

**1**  The CW 10 MHz format selection appears only for the Black 3 output.

**Field Reference**
This menu item is available only for non-HD formats. Use the drop-down list to select **Enable** or **Disable** for the field reference on the selected Black output.

# Black Timing settings

Use these settings to adjust the timing offset of the selected Black output relative to the internal reference signal. The range of the timing adjustment depends on the format of the selected Black output.

**Vertical Delay**   Enter the Vertical Delay in 1 line increments for the selected Black output.

**Horizontal Delay**   Enter the Horizontal Delay in increments based on the format of the selected Black output.

*NOTE. If you are using the 50, 59.94 or 60 Hz progressive sync as a genlock source and LTC as a time-code source, there are two possible alignments for the resulting system. Alignment can be checked by looking at the LTC timing status screen. If the timing is near zero, then it is aligned. If the timing is near a frame of offset, then it is not aligned.*

*You must unlock and relock the reference to obtain the desired alignment if this is important to the application you are using. Alternatively, you can use a lower frame rate video reference like NTSC, PAL, or 1080i tri-level.*

The following table shows the Vertical Delay line settings and Horizontal Delay adjustment ranges.

**Table 7: Black output timing adjustment ranges**

| Format name | Line settings | Coarse settings (µs) | Fine settings (ns) |
|---|---|---|---|
| NTSC | ± 525 | ± 63.5556 | ± 10.00 |
| PAL | ± 1250 | ± 64.0000 | ± 10.00 |
| 1080 60i | ± 562 | ± 29.6296 | ± 10.00 |
| 1080 59.94i | ± 562 | ± 29.6593 | ± 10.00 |
| 1080 50i | ± 562 | ± 35.5556 | ± 10.00 |
| 1080 24sF | ± 562 | ± 37.0370 | ± 10.00 |
| 1080 23.98sF | ± 562 | ± 37.0741 | ± 10.00 |
| 1080 30p | ± 562 | ± 29.6296 | ± 10.00 |
| 1080 29.97p | ± 562 | ± 29.6593 | ± 10.00 |
| 1080 25p | ± 562 | ± 35.5556 | ± 10.00 |
| 1080 24p | ± 562 | ± 37.0370 | ± 10.00 |
| 1080 23.98p | ± 562 | ± 37.0741 | ± 10.00 |
| 720 60p | ± 375 | ± 22.2222 | ± 10.00 |
| 720 59.94p | ± 375 | ± 22.2444 | ± 10.00 |
| 720 50p | ± 375 | ± 26.6667 | ± 10.00 |

# Black Timecode settings

*NOTE. The Black Timecode settings are available only when a non-HD format is set as the signal format of the selected Black output.*

**Source**    Use the drop-down list to select the timecode source. The default value is Disable.

- **Disable:** Disables the timecode function for the selected Black output.

- **Local (DST):** Uses the local time of day with Daylight Savings Time offset as the timecode.

- **Local (No DST):** Uses the local time of day without Daylight Savings Time offset as the timecode.

- **UTC:** Uses Coordinated Universal Time as the timecode.

- **Program Time:** Uses the program time counter as the timecode.

*NOTE. In addition to enabling the timecode source, at least one line must be specified and enabled to carry a VITC signal.*

**Offset**    Enter an offset for the selected Black output, relative to the selected timecode source in the format ±HH:MM:SS:FF. You can enter a time offset of up to ±23:59:59:29 (maximum frame value depends on the frame rate of the video signal).

*NOTE. The Offset adjustment allows you to enter a time zone correction of up to ±23:59 hours. However, the ST309 standard only implements codes for time zones in the range of -12 to +13 hours. Therefore, when you are using ST309 data as the Time of Day source, it is recommended that the combined programmed offset from time zone and daylight savings time be restricted to the range of -12 to +13 hours.*

**VITC 1 and 2 Line selections**    Use these menu items to insert the same VITC signal on 1 or 2 lines of the vertical interval.

Enter the video line number to insert the selected VITC signal. For NTSC, you can select lines from line 10 to 20 (lines 14 and 16 are recommended). For PAL, you can select lines between 6 and 22 (lines 19 and 21 are recommended).

Select the Enable check box for the selected line to enable or disable the output of a VITC signal.

**Enable 30 Drop-Frame**   Use the check box to enable or disable the 30 Drop Frame mode. Most applications will prefer drop-frame compensation VITC on NTSC, but if needed, it can be disabled by this menu item. This menu item appears only when NTSC or NTSC-J is set as the signal format for the selected Black output.

## Blank on Reference Unlock settings

These settings are available only for the Black 2 output. Use the Enable check box to enable or disable the blanking function when a loss of lock to the reference signal is detected. When enabled, the Black 2 output will be blanked for as long as the loss of lock condition occurs. The purpose of this function is to trigger a downstream change-over unit.

*NOTE. When the Black 2 output is configured to blank on the loss of reference lock, the output should not be used for normal reference applications.*

**Delay**   When the Blank on Reference Unlock function is enabled, you can set the amount of time delay before the Black 2 output will be blanked when a loss of lock to the reference signal is detected. The purpose of the delay is to reduce false alarms by allowing a set amount of time for the loss of lock condition to clear before the Black 2 output is blanked. Enter the delay in HH:MM:SS.

## HD Tri-level Sync Rate

Use this setting to set the HD tri-level sync rate for the 5 Black outputs. The HD tri-level sync rate setting limits which signal formats are available for the Black outputs. Select the desired group of Black outputs (1–3 or 4–5) for which to set the HD tri-level sync rate.

Use the drop-down list to select either **Non-Integer (59.94, 47.95, 29.97, 23.98)** or **Integer (60, 50, 48, 30, 25, 24)**.

*NOTE. The Black outputs 1–3 are a group that must use the same HD tri-level sync rate (integer or non-integer). Likewise, the BLACK outputs 4–5 (Option BG only) are a group that must use the same HD tri-level sync rate. Both groups can output the same rate or they can output different rates.*

*The HD tri-level sync rate setting limits which signal formats are available for the selected group of Black outputs.*

# Black menu factory default settings

The following table shows the settings for the Black menu that are reset when you use the Preset submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

**Table 8: Black menu factory default settings**

| Menu item name | Settings |
|---|---|
| Black 1 to Black 5 [1] | |
| Format | NTSC |
| Field Reference [2] | Disable |
| Timing | Vertical: 0 Line(s) |
| | Horizontal Coarse: 0.0 μsec |
| Timecode [2] | Source: Disable |
| | Offset: +00:00:00:00 |
| | VITC 1 Line |
| | Line Number: |
| | NTSC/NTSC-J: 14 |
| | PAL: 19 |
| | Output: Disable |
| | VITC 2 Line |
| | Line Number: |
| | NTSC/NTSC-J: 16 |
| | PAL: 21 |
| | Output: Disable |
| | Enable 30 Drop Frame: Enabled [3] |
| Blank On Reference Unlock [4] | Disabled |
| Blank On Reference Unlock Delay [4] | 00:00:10 |
| Black 1–3: HD Tri-Level Sync | Non-integer |
| Black 4–5: HD Tri-Level Sync [1] | Non-integer |

[1]  Black outputs 4–5 are available only when Option BG is installed.

[2]  These settings appear only for non-HD formats.

[3]  This setting appears only when the format is set to NTSC.

[4]  These settings appear only for the Black 2 output.

# Composite menu (Option BG only)

When Option BG is installed, use the Composite menu to view and configure the composite video outputs. The following figure shows the Composite menu with the Composite 1 submenu expanded.



**Figure 10: Composite menu**

## Composite output settings

**Format**    Use the drop-down list to select the desired signal formats in the following table.

*NOTE. When you change the signal format, synchronization shock will occur.*

**Test signal**    Use the drop-down list to select the desired test signal. The available signals depend on the selected format (NTSC/NTSC-J or PAL).

**Table 9: Composite output test signals**

| NTSC or NTSC-J format | PAL format |
|---|---|
| Black Burst | Black Burst without field reference |
| Black Burst with field reference | Black Burst |
| Black Burst with 10-field ID | 100% Color Bars |
| 100% Color Bars | 75% Color Bars |
| 75% Color Bars | 100% Color Bar Over Red |
| SMPTE EG1 Color Bar | 75% Color Bar Over Red |
| 40% Flat Field | 40% Flat Field |
| Convergence | Convergence |
| Pluge and Luma Reference | Pluge and Luma Reference |
| Shallow Ramp | CCIR 17 |
| NTC7 Combination | CCIR 18 |
| NTC7 Composite | |

# Composite Timing settings

The following settings allow you to set the timing offset for the selected Composite signal output.

Use this submenu to adjust the timing offset of the selected Composite output relative to the genlock signal or the internal reference signal.

*NOTE. The horizontal timing can be adjusted only in clock cycle increments.*

**Vertical**    Use this menu item to enter the vertical timing by ± ½ a color frame. (See Table 10.)

**Horizontal**    Use this menu item to enter the horizontal offset. You can enter the value from -1 line to +1 line in one clock steps (18.5 ns).

**Table 10: Timing adjustment ranges for composite output signals**

| Format name | Vertical line settings | Horizontal time settings (µs) |
|---|---|---|
| NTSC/NTSC-J | ± 525 | ± 63.5556 |
| PAL | ± 1250 | ± 64.0000 |

# Composite Timecode settings

The following settings allow you to set timecode parameters for the selected Composite output.

Use this submenu to set timecode parameters for the selected output.

**Source**
Use the drop-down list to select the timecode source from the following choices. The default value is Disable.

- **Disable:** Disables the timecode function for the composite outputs.

- **Local (DST):** Uses the local time of day with Daylight Savings Time offset as the timecode.

- **Local (No DST):** Uses the local time of day without Daylight Savings Time offset as the timecode.

- **UTC:** Uses Coordinated Universal Time as the timecode.

- **Program Time:** Uses the program time counter as the timecode.

**Offset**
Use this menu item to set a time offset for the composite outputs from the timecode input. You can enter a time offset of up to ±23:59:59:29 (maximum frame value depends on the frame rate of the video signal) of the selected time of day source in the Time menu (hours : minutes : seconds : video frames).

*NOTE. The Offset adjustment allows you to enter a time zone correction of up to ±23:59 hours. However, the ST309 standard only implements codes for time zones in the range of -12 to +13 hours. Therefore, when you are using ST309 data as the Time of Day source, it is recommended that the combined programmed offset from time zone and DST be restricted to the range of -12 to +13 hours.*

**VITC 1 and 2 Line selections**
Use these menu items to insert the same VITC signal on 1 or 2 lines of the vertical interval.

Enter the video line number to insert the selected VITC signal. For NTSC, you can select lines from line 10 to 20 (lines 14 and 16 are recommended). For PAL, you can select lines between 6 and 22 (lines 19 and 21 are recommended).

Select the Enable check box for the selected line to enable or disable the output of a VITC signal.

**Enable 30 Drop-Frame**
Use the check box to enable or disable the 30 Drop Frame mode. Most applications will prefer drop-frame compensation VITC on NTSC, but if needed, it can be disabled by this menu item. This menu item appears only when NTSC or NTSC-J is set as the signal format for the selected Composite output.

# Composite menu factory default settings

The following table shows the settings for the Composite menu that are reset when you use the Preset submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

**Table 11: Composite menu factory default settings**

| Menu item name | Settings |
| --- | --- |
| Composite 1 or Composite 2 | |
| Format | NTSC |
| Test Signal | NTSC/NTSC-J: Black Burst |
| | PAL: Black Burst No Field Reference |
| TIMING | Vertical: 0.0 Line(s) |
| | Horizontal: 0.0 μsec |
| TIMECODE | SOURCE: Disable |
| | OFFSET: +00:00:00:00 |
| | 30 DROP FRAME: Enable [1] |
| | VITC 1 Line |
| |     Line Number: |
| |         NTSC/NTSC-J: 14 |
| |         PAL: 19 |
| |     Output: Disable |
| | VITC 2 Line |
| |     Line Number: |
| |         NTSC/NTSC-J: 16 |
| |         PAL: 21 |
| |     Output: Disable |
| | Enable 30 Drop Frame: Enabled [3] |

[1] This menu item appears only when the format is set to NTSC or NTSC-J.

# Dolby-E Configuration menu (Option DBT only)

When Option DBT is installed, use the Dolby-E Configuration menu to view and configure settings for Dolby-E channel 1 (CH1) or channel 2 (CH2). The following figure shows the Dolby-E menu with the DOLBY-E-CH1 submenu expanded.
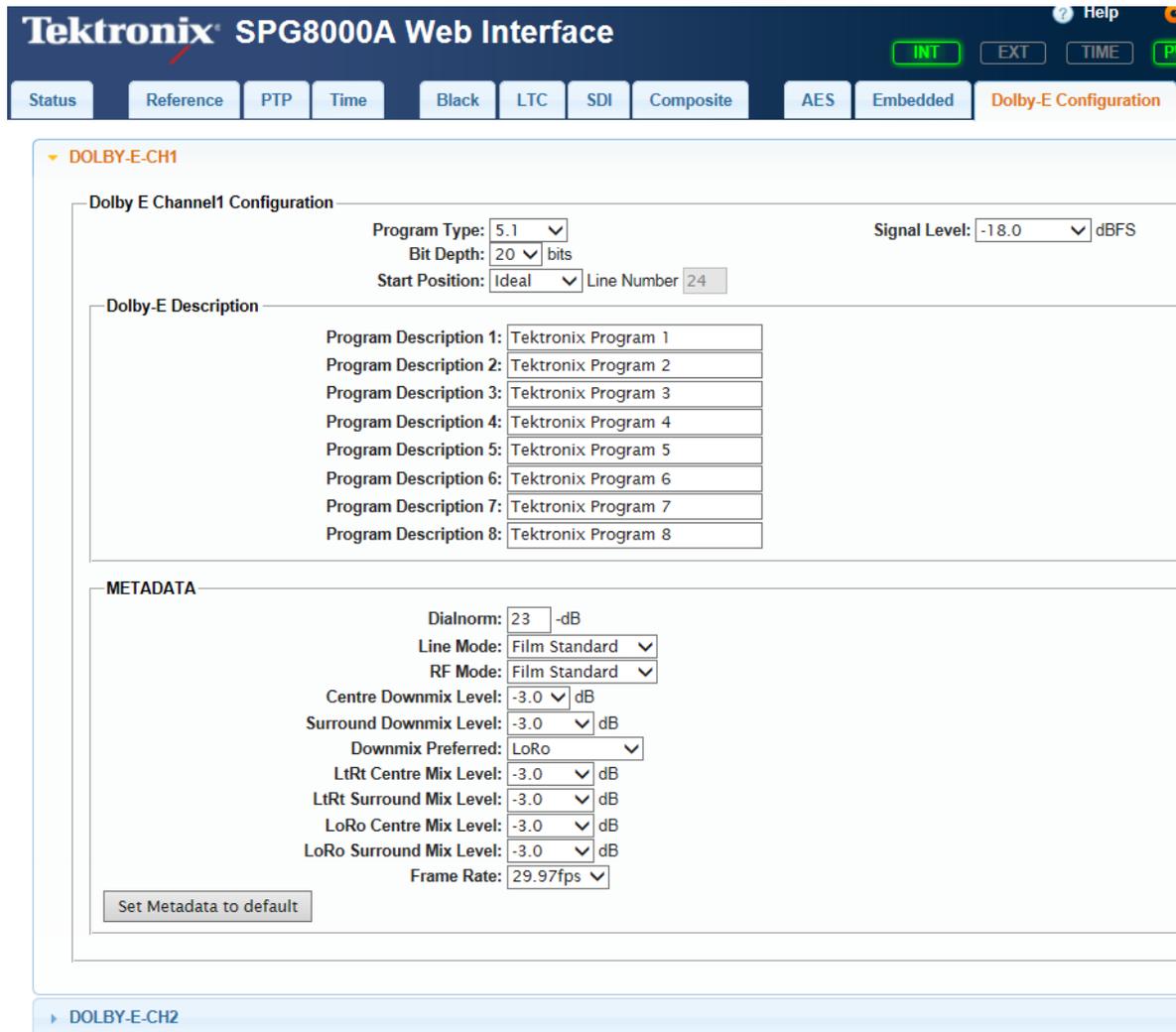


**Figure 11: Dolby-E Configuration menu**

# Dolby-E Channel Configuration

**Program Type**    Use this menu item to specify the program configuration of the Dolby-E signal. This parameter controls both the number of programs in the stream and how the eight audio channels are allocated to the programs.

Use the drop down list to select **5.1**, **5.1+2** (default value), **7.1**, **4x2**, or **8x1**.

**Signal Level**    Use this menu item to set the level of the Dolby-E signal. Use the drop down list to select **–18.0 dBFS**, **–20.0 dBFS**, or **Multi Tone**.

**Bit Depth**    Use this menu item to set the bit depth of the Dolby-E signal when the program type is set to 5.1. Use the drop down list to select **16 bits** or **20 bits**. The bit depth setting is forced to 20 bits for all Dolby E program types except 5.1.

If you set the Dolby-E bit depth to 16 bits, the Dolby-E program setting is changed to 5.1 and the user interface for the program setting shows only 5.1 as being available. (See page 60, *Dolby-E metadata configuration considerations*.)

**Start Position**    Use this menu item to set the starting line position of the Dolby-E signal. Use the drop down list to select **Early**, **Ideal**, **Late**, or **Custom**.

The **Line Number** for the starting position varies depending on the format of the video signal. See the Dolby Web site (**www.dolby.com**) for information about the starting line position for each video format.

When you select Custom, you enter can enter a custom start position ranging from line 7 to line 70.

**Dolby-E Description**    Use this menu item to label each of the available programs (1-8) with a descriptive text identifier. The default program description is Tektronix Program X, where X is the program number (1-8).

# Dolby-E METADATA

**Dialnorm**    Use this menu item to set the dialnorm setting of the Dolby-E signal. This value should represent the long term weighted average level of the dialog within a program. A Dolby Digital decoder will use this parameter to determine what level shift to apply to the audio that will normalize the decoder output. This allows different content to be automatically normalized by the decoder, if the dialnorm value is set correctly.

Enter a value between –1 dB and –31 dB. The default values are:

- –23 dB for –20 dBFS signal levels
- –24 dB for –18 dBFS signal levels

**Line Mode**  Use this menu item to set the line mode compression profile for the Dolby-E signal. Line mode compression is typically used in decoders with either six or two channel line level outputs.

Use the drop down list to select **Film Standard**, **Film Light**, **Music Standard**, **Music Light**, **Speech**, or **Disable**.

**RF Mode**  Use this menu item to set the RF mode compression profile for the Dolby-E signal. RF mode compression is typically used in decoders with two channel RF modulated outputs.

Use the drop down list to select **Film Standard**, **Film Light**, **Music Standard**, **Music Light**, **Speech**, or **Disable**.

**Center Downmix Level**  Use this menu item to set the center downmix level of the Dolby-E signal. This parameter indicates what level shift should be applied to the center channel before adding it to the left and right channels when downmixing to a stereo output. This parameter is used when extended BSI parameters are not active.

Use the drop down list to select **–3.0 dB**, **–4.5 dB**, or **–6.0 dB**.

**Surround Downmix Level**  Use this menu item to set the surround downmix level of the Dolby-E signal. This parameter indicates what level shift should be applied to the surround channels before adding them to the left and right channels when downmixing to a stereo output. This parameter is used when extended BSI parameters are not active.

Use the drop down list to select **–3.0 dB**, **–6.0 dB**, or **Infinite**.

**Downmix Preferred**  Use this menu item to set the preferred downmix of the Dolby-E signal. This parameter is used in consumer decoders that have stereo outputs. This parameter is part of the extended BSI.

Use the drop down list to select **LoRo**, **Not Indicated**, or **LtRt**.

**LtRt Center Mix Level**  Use this menu item to set the LtRt center mix level of the Dolby-E signal. This parameter indicates what level shift should be applied to the center channel before adding it to the left and right channels when downmixing to an LtRt output. This parameter is part of the extended BSI.

Use the drop down list to select **–3.0 dB**, **–4.5 dB**, **–6.0 dB**, **Infinite**, **+3.0 dB**, **+1.5 dB**, **0.0 dB**, or **–1.5 dB**.

**LtRt Surround Mix Level**  Use this menu item to set the LtRt surround mix level of the Dolby-E signal. This parameter indicates what level shift should be applied to the surround channels before adding them to the left and right channels when downmixing to an LtRt output. This parameter is part of the extended BSI.

Use the drop down list to select **–3.0 dB**, **–4.5 dB**, **–6.0 dB**, **Infinite**, **+3.0 dB**, **+1.5 dB**, **0.0 dB**, or **–1.5 dB**.

**LoRo Center Mix Level**  Use this menu item to set the LoRo center mix level of the Dolby-E signal. This parameter indicates what level shift should be applied to the center channel before adding it to the left and right channels when downmixing to an LoRo output. This parameter is part of the extended BSI.

Use the drop down list to select **–3.0 dB**, **–4.5 dB**, **–6.0 dB**, **Infinite**, **+3.0 dB**, **+1.5 dB**, **0.0 dB**, or **–1.5 dB**.

**LoRo Surround Mix Level**  Use this menu item to set the LoRo surround mix level of the Dolby-E signal. This parameter indicates what level shift should be applied to the surround channels before adding them to the left and right channels when downmixing to an LoRo output. This parameter is part of the extended BSI.

Use the drop down list to select **–3.0 dB**, **–4.5 dB**, **–6.0 dB**, **Infinite**, **+3.0 dB**, **+1.5 dB**, **0.0 dB**, or **–1.5 dB**.

**Frame Rate**  Use this menu item to select the video frame rate associated with the Dolby-E signal. Use the drop down list to select **23.98 fps**, **24 fps**, **25 fps**, **29.97 fps**, or **30 fps**.

**Set Metadata to default**  Use this menu item button to reset the Dolby metadata settings back to the factory default settings.

**Dolby-E metadata configuration considerations**

⚠ *CAUTION. Use caution when changing the Dolby-E metadata values. Changing the metadata does not change the encoded audio. Changing the metadata values from default values may cause the signal to not decode correctly.*

When you configure the Dolby E metadata, depending on your selections, other metadata values may change or be limited as follows:

**Program setting.**  The Program setting is the primary metadata control. When you select a program type, the metadata is set according to that program type.

For example, if you set the Dolby E program to 5.1, the Dolby E bit depth setting remains as it is and the user interface for the bit depth control shows both 16-bits and 20-bits as being available.

**Bit depth setting.** If the selected Dolby-E program is 5.1, the bit-depth control allows you to select either 16-bits or 20-bits. For all other supported Dolby-E programs, the bit-depth control shows only the 20-bits selection.

The instrument saves the bit-depth setting for the 5.1 program type. For example, if you select the 5.1 program with 16-bits data and then you change the program to 7.1, the instrument forces the bit-depth setting to 20-bits. If you then switch back to the 5.1 program, the instrument returns the bit-depth setting to 16-bits, since that was the last bit-depth selection made for the 5.1 program configuration.

**Frame rate setting.** If you change the Dolby E frame rate setting, it does not affect the actual audio data being streamed out by the generator, and it does not change the rate at which this data is being streamed or the video frame rate itself.

## Dolby-E generated formats

The tables on the following pages list the Dolby-E generated formats according to frame rate.

**Table 12: Dolby E generated formats – 23.98 Hz frame rate**

| Dolby-E program | Dolby-E level | Signal levels and frequencies | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8x1 | | Program 1 M1 | Program 2 M2 | Program 3 M3 | Program 4 M4 | Program 5 M5 | Program 6 M6 | Program 7 M7 | Program 8 M8 |
| | –20 dBSF | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz |
| | –18 dBSF | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz |
| | Multitone | –18 dBFS 119.9 Hz | –20 dBFS 239.8 Hz | –22 dBFS 359.7 Hz | –24 dBFS 479.5 Hz | –26 dBFS 599.4 Hz | –28 dBFS 1198.8 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |
| 7.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lb | Program 1 Rb |
| | –20 dBSF | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 240 Hz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz |
| | –18 dBSF | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 240 Hz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz |
| | Multitone | –18 dBFS 239.8 Hz | –20 dBFS 359.7 Hz | –22 dBFS 479.5 Hz | –24 dBFS 599.4 Hz | –26 dBFS 1198.8 Hz | –28 dBFS 119.9 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |

**Table 12: Dolby E generated formats – 23.98 Hz frame rate (cont.)**

| Dolby-E program | Dolby-E level | Signal levels and frequencies | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5.1+2 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lt | Program 1 Rt |
| | –20 dBSF | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 240 Hz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz |
| | –18 dBSF | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 240 Hz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz |
| | Multitone | –18 dBFS 239.8 Hz | –20 dBFS 359.7 Hz | –22 dBFS 479.5 Hz | –24 dBFS 599.4 Hz | –26 dBFS 1198.8 Hz | –28 dBFS 119.9 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |
| 5.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | | |
| | –20 dBSF | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 240 Hz | | |
| | –18 dBSF | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 240 Hz | | |
| | Multitone | –18 dBFS 239.8 Hz | –20 dBFS 359.7 Hz | –22 dBFS 479.5 Hz | –24 dBFS 599.4 Hz | –26 dBFS 1198.8 Hz | –28 dBFS 119.9 Hz | | |
| 4x2 | | Program 1 L1 | Program 1 R1 | Program 2 L2 | Program 2 R2 | Program 3 L3 | Program 3 R3 | Program 4 L4 | Program 4 R4 |
| | –20 dBSF | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz | –20 dBFS 2.398 kHz |
| | –18 dBSF | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz | –18 dBFS 2.398 kHz |
| | Multitone | –18 dBFS 119.9 Hz | –20 dBFS 239.8 Hz | –22 dBFS 359.7 Hz | –24 dBFS 479.5 Hz | –26 dBFS 599.4 Hz | –28 dBFS 1198.8 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |

**Table 13: Dolby E generated formats – 24 Hz frame rate**

| Dolby-E program | Dolby-E level | Signal levels and frequencies | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8x1 | | Program 1 M1 | Program 2 M2 | Program 3 M3 | Program 4 M4 | Program 5 M5 | Program 6 M6 | Program 7 M7 | Program 8 M8 |
| | –20 dBSF | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz |
| | –18 dBSF | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz |
| | Multitone | –18 dBFS 120 Hz | –20 dBFS 240 Hz | –22 dBFS 360 Hz | –24 dBFS 480 Hz | –26 dBFS 600 Hz | –28 dBFS 1200 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |

**Table 13: Dolby E generated formats – 24 Hz frame rate (cont.)**

| Dolby-E program | Dolby-E level | Signal levels and frequencies | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 7.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lb | Program 1 Rb |
| | –20 dBSF | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 240 Hz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz |
| | –18 dBSF | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 240 Hz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz |
| | Multitone | –18 dBFS 240 Hz | –20 dBFS 360 Hz | –22 dBFS 480 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 120 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 5.1+2 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lt | Program 1 Rt |
| | –20 dBSF | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 240 Hz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz |
| | –18 dBSF | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 240 Hz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz |
| | Multitone | –18 dBFS 240 Hz | –20 dBFS 360 Hz | –22 dBFS 480 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 120 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 5.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | | |
| | –20 dBSF | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 240 Hz | | |
| | –18 dBSF | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 240 Hz | | |
| | Multitone | –18 dBFS 240 Hz | –20 dBFS 360 Hz | –22 dBFS 480 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 120 Hz | | |
| 4x2 | | Program 1 L1 | Program 1 R1 | Program 2 L2 | Program 2 R2 | Program 3 L3 | Program 3 R3 | Program 4 L4 | Program 4 R4 |
| | –20 dBSF | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz | –20 dBFS 2.400 kHz |
| | –18 dBSF | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz | –18 dBFS 2.400 kHz |
| | Multitone | –18 dBFS 120 Hz | –20 dBFS 240 Hz | –22 dBFS 360 Hz | –24 dBFS 480 Hz | –26 dBFS 600 Hz | –28 dBFS 1200 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |

**Table 14: Dolby E generated formats – 25 Hz frame rate**

| Dolby-E program | Dolby-E level | Signal levels and frequencies | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8x1 | | Program 1 M1 | Program 2 M2 | Program 3 M3 | Program 4 M4 | Program 5 M5 | Program 6 M6 | Program 7 M7 | Program 8 M8 |
| | –20 dBSF | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz |
| | –18 dBSF | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz |
| | Multitone | –18 dBFS 125 Hz | –20 dBFS 250 Hz | –22 dBFS 350 Hz | –24 dBFS 475 Hz | –26 dBFS 600 Hz | –28 dBFS 1200 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 7.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lb | Program 1 Rb |
| | –20 dBSF | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 240 Hz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz |
| | –18 dBSF | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 240 Hz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz |
| | Multitone | –18 dBFS 250 Hz | –20 dBFS 350 Hz | –22 dBFS 475 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 125 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 5.1+2 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lt | Program 1 Rt |
| | –20 dBSF | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 240 Hz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz |
| | –18 dBSF | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 240 Hz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz |
| | Multitone | –18 dBFS 250 Hz | –20 dBFS 350 Hz | –22 dBFS 475 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 125 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 5.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | | |
| | –20 dBSF | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 240 Hz | | |
| | –18 dBSF | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 240 Hz | | |
| | Multitone | –18 dBFS 250 Hz | –20 dBFS 350 Hz | –22 dBFS 475 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 125 Hz | | |
| 4x2 | | Program 1 L1 | Program 1 R1 | Program 2 L2 | Program 2 R2 | Program 3 L3 | Program 3 R3 | Program 4 L4 | Program 4 R4 |
| | –20 dBSF | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz | –20 dBFS 1.0 kHz |
| | –18 dBSF | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz | –18 dBFS 1.0 kHz |
| | Multitone | –18 dBFS 125 Hz | –20 dBFS 250 Hz | –22 dBFS 350 Hz | –24 dBFS 475 Hz | –26 dBFS 600 Hz | –28 dBFS 1200 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |

**Table 15: Dolby E generated formats – 29.97 Hz frame rate**

| Dolby-E program | Dolby-E level | Signal levels and frequencies | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8x1 | | Program 1 M1 | Program 2 M2 | Program 3 M3 | Program 4 M4 | Program 5 M5 | Program 6 M6 | Program 7 M7 | Program 8 M8 |
| | –20 dBSF | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz |
| | –18 dBSF | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz |
| | Multitone | –18 dBFS 119.9 Hz | –20 dBFS 239.8 Hz | –22 dBFS 359.7 Hz | –24 dBFS 479.5 Hz | –26 dBFS 599.4 Hz | –28 dBFS 1198.8 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |
| 7.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lb | Program 1 Rb |
| | –20 dBSF | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 240 Hz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz |
| | –18 dBSF | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 240 Hz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz |
| | Multitone | –18 dBFS 239.8 Hz | –20 dBFS 359.7 Hz | –22 dBFS 479.5 Hz | –24 dBFS 599.4 Hz | –26 dBFS 1198.8 Hz | –28 dBFS 119.9 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |
| 5.1+2 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lt | Program 1 Rt |
| | –20 dBSF | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 240 Hz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz |
| | –18 dBSF | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 240 Hz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz |
| | Multitone | –18 dBFS 239.8 Hz | –20 dBFS 359.7 Hz | –22 dBFS 479.5 Hz | –24 dBFS 599.4 Hz | –26 dBFS 1198.8 Hz | –28 dBFS 119.9 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |
| 5.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | | |
| | –20 dBSF | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 240 Hz | | |
| | –18 dBSF | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 240 Hz | | |
| | Multitone | –18 dBFS 239.8 Hz | –20 dBFS 359.7 Hz | –22 dBFS 479.5 Hz | –24 dBFS 599.4 Hz | –26 dBFS 1198.8 Hz | –28 dBFS 119.9 Hz | | |
| 4x2 | | Program 1 L1 | Program 1 R1 | Program 2 L2 | Program 2 R2 | Program 3 L3 | Program 3 R3 | Program 4 L4 | Program 4 R4 |
| | –20 dBSF | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz | –20 dBFS 2.997 kHz |
| | –18 dBSF | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz | –18 dBFS 2.997 kHz |
| | Multitone | –18 dBFS 119.9 Hz | –20 dBFS 239.8 Hz | –22 dBFS 359.7 Hz | –24 dBFS 479.5 Hz | –26 dBFS 599.4 Hz | –28 dBFS 1198.8 Hz | –30 dBFS 1798.2 Hz | –32 dBFS 2397.6 Hz |

**Table 16: Dolby E generated formats – 30 Hz frame rate**

| Dolby-E program | Dolby-E level | Signal levels and frequencies | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8x1 | | Program 1 M1 | Program 2 M2 | Program 3 M3 | Program 4 M4 | Program 5 M5 | Program 6 M6 | Program 7 M7 | Program 8 M8 |
| | –20 dBSF | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz |
| | –18 dBSF | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz |
| | Multitone | –18 dBFS 120 Hz | –20 dBFS 240 Hz | –22 dBFS 360 Hz | –24 dBFS 480 Hz | –26 dBFS 600 Hz | –28 dBFS 1200 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 7.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lb | Program 1 Rb |
| | –20 dBSF | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 240 Hz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz |
| | –18 dBSF | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 240 Hz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz |
| | Multitone | –18 dBFS 240 Hz | –20 dBFS 360 Hz | –22 dBFS 480 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 120 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 5.1+2 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | Program 1 Lt | Program 1 Rt |
| | –20 dBSF | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 240 Hz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz |
| | –18 dBSF | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 240 Hz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz |
| | Multitone | –18 dBFS 240 Hz | –20 dBFS 360 Hz | –22 dBFS 480 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 120 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |
| 5.1 | | Program 1 L | Program 1 C | Program 1 R | Program 1 Ls | Program 1 Rs | Program 1 LFE | | |
| | –20 dBSF | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 240 Hz | | |
| | –18 dBSF | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 240 Hz | | |
| | Multitone | –18 dBFS 240 Hz | –20 dBFS 360 Hz | –22 dBFS 480 Hz | –24 dBFS 600 Hz | –26 dBFS 1200 Hz | –28 dBFS 120 Hz | | |
| 4x2 | | Program 1 L1 | Program 1 R1 | Program 2 L2 | Program 2 R2 | Program 3 L3 | Program 3 R3 | Program 4 L4 | Program 4 R4 |
| | –20 dBSF | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz | –20 dBFS 3.0 kHz |
| | –18 dBSF | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz | –18 dBFS 3.0 kHz |
| | Multitone | –18 dBFS 120 Hz | –20 dBFS 240 Hz | –22 dBFS 360 Hz | –24 dBFS 480 Hz | –26 dBFS 600 Hz | –28 dBFS 1200 Hz | –30 dBFS 1800 Hz | –32 dBFS 2400 Hz |

The following tables list the Dolby-E loudness measurements for each program. The measurements were made with a Tektronix WFM8000 Series waveform monitor using the ATSC A/85 2013 Loudness preset.

Dialnorm values of –23 dB and –24 dB are used by default within the instrument, depending on the Dolby-E level setting. To use the measured loudness values instead of the default dialnorm values, you can enter them by adjusting the Dolby-E metadata dialnorm setting. To continue using these measured loudness values, use the PRESET menu to create a preset with the specific values you want.

**Table 17: Dolby E loudness measurements – 23.98 and 24 Hz frame rates**

| Dolby-E program | Dolby-E level | Loudness measurement values (LKFS) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Program 1 | Program 2 | Program 3 | Program 4 | Program 5 | Program 6 | Program 7 | Program 8 |
| 8x1 | –20 dBSF | –20.2 | –20.2 | –20.2 | –20.2 | –20.2 | –20.2 | –20.2 | –20.2 |
| | –18 dBSF | –18.2 | –18.2 | –18.2 | –18.2 | –18.2 | –18.2 | –18.2 | –18.2 |
| | Multitone | –22.5 | –23.9 | –25.7 | –27.6 | –29.6 | –30.5 | –31.0 | –32.2 |
| 7.1 | –20 dBSF | –11.3 | | | | | | | |
| | –18 dBSF | –9.3 | | | | | | | |
| | Multitone | –17.2 | | | | | | | |
| 5.1+2 | –20 dBSF | –12.6 | –17.2 | | | | | | |
| | –18 dBSF | –10.6 | –15.2 | | | | | | |
| | Multitone | –17.5 | –28.5 | | | | | | |
| 5.1 | –20 dBSF | –12.6 | | | | | | | |
| | –18 dBSF | –10.6 | | | | | | | |
| | Multitone | –17.5 | | | | | | | |
| 4x2 | –20 dBSF | –17.2 | –17.2 | –17.2 | –17.2 | | | | |
| | –18 dBSF | –15.2 | –15.2 | –15.2 | –15.2 | | | | |
| | Multitone | –20.1 | –23.6 | –27.0 | –28.5 | | | | |

**Table 18: Dolby E loudness measurements – 25 Hz frame rate**

| Dolby-E program | Dolby-E level | Loudness measurement values (LKFS) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Program 1 | Program 2 | Program 3 | Program 4 | Program 5 | Program 6 | Program 7 | Program 8 |
| 8x1 | –20 dBSF | –23.0 | –23.0 | –23.0 | –23.0 | –23.0 | –23.0 | –23.0 | –23.0 |
| | –18 dBSF | –21.0 | –21.0 | –21.0 | –21.0 | –21.0 | –21.0 | –21.0 | –21.0 |
| | Multitone | –22.5 | –23.9 | –25.7 | –27.6 | –29.6 | –30.5 | –31.0 | –32.2 |
| 7.1 | –20 dBSF | –14.1 | | | | | | | |
| | –18 dBSF | –12.1 | | | | | | | |
| | Multitone | –17.2 | | | | | | | |
| 5.1+2 | –20 dBSF | –15.4 | –20.0 | | | | | | |
| | –18 dBSF | –13.4 | –18.0 | | | | | | |
| | Multitone | –17.5 | –28.5 | | | | | | |

**Table 18: Dolby E loudness measurements – 25 Hz frame rate (cont.)**

| 5.1 | –20 dBSF | –15.4 | | | |
| | –18 dBSF | –13.4 | | | |
| | Multitone | –17.5 | | | |
| 4x2 | –20 dBSF | –20.0 | –20.0 | –20.0 | –20.0 |
| | –18 dBSF | –18.0 | –18.0 | –18.0 | –18.0 |
| | Multitone | –20.1 | –23.6 | –27.0 | –28.5 |

**Table 19: Dolby E loudness measurements – 29.97 and 30 Hz frame rates**

| Dolby-E program | Dolby-E level | Loudness measurement values (LKFS) | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | Program 1 | Program 2 | Program 3 | Program 4 | Program 5 | Program 6 | Program 7 | Program 8 |
| 8x1 | –20 dBSF | –19.9 | –19.9 | –19.9 | –19.9 | –19.9 | –19.9 | –19.9 | –19.9 |
| | –18 dBSF | –17.9 | –17.9 | –17.9 | –17.9 | –17.9 | –17.9 | –17.9 | –17.9 |
| | Multitone | –22.5 | –23.9 | –25.7 | –27.6 | –29.6 | –30.5 | –31.0 | –32.2 |
| 7.1 | –20 dBSF | –11.0 | | | | | | | |
| | –18 dBSF | –9.0 | | | | | | | |
| | Multitone | –17.2 | | | | | | | |
| 5.1+2 | –20 dBSF | –12.3 | –16.9 | | | | | | |
| | –18 dBSF | –10.3 | –14.9 | | | | | | |
| | Multitone | –17.5 | –28.5 | | | | | | |
| 5.1 | –20 dBSF | –12.3 | | | | | | | |
| | –18 dBSF | –10.3 | | | | | | | |
| | Multitone | –17.5 | | | | | | | |
| 4x2 | –20 dBSF | –16.9 | –16.9 | –16.9 | –16.9 | | | | |
| | –18 dBSF | –14.9 | –14.9 | –14.9 | –14.9 | | | | |
| | Multitone | –20.1 | –23.6 | –27.0 | –28.5 | | | | |

# Dolby-E Configuration menu factory default settings

The following table shows the settings for the Dolby-E Configuration menu that are reset when you use the Preset submenu to recall the factory default settings.

**Table 20: Dolby-E Configuration menu factory default settings**

| Menu item name | | Settings |
|---|---|---|
| Dolby-E Channel 1 or Dolby-E Channel 2 | | |
| | Dolbly-E Channel Configuration | Program Type: 5.1 |
| | | Signal Level: –18.0 dBFS |
| | | Bit Depth: 20 bits |
| | | Start Position: Ideal |
| | | Line Number: 24 |
| | Dolby-E Description [1] | Program Description 1: Tektronix Program 1 |
| | | Program Description 2: Tektronix Program 2 |
| | | Program Description 3: Tektronix Program 3 |
| | | Program Description 4: Tektronix Program 4 |
| | | Program Description 5: Tektronix Program 5 |
| | | Program Description 6: Tektronix Program 6 |
| | | Program Description 7: Tektronix Program 7 |
| | | Program Description 8: Tektronix Program 8 |
| | METADATA | Dialnorm: –23 dB |
| | | Line Mode: Film Standard |
| | | RF Mode: Film Standard |
| | | Center Downmix Level: –3.0 dB |
| | | Surround Downmix Level: –3.0 dB |
| | | Downmix Preferred: LoRo |
| | | LtRt Center Mix Level: –3.0 dB |
| | | LtRt Surround Mix Level: –3.0 dB |
| | | LoRo Center Mix Level: –3.0 dB |
| | | LoRo Surround Mix Level: –3.0 dB |
| | | Frame Rate: 29.97 fps |

[1] The Dolby-E Stream and Dolby Config settings are available only when Option DBT is installed.

# Embedded menu (Option SDI only)

When Option SDI is installed, use the Embedded menu to view and configure the embedded audio settings on the SDI video outputs. Use this menu to select the audio group for subsequent audio channel configuration, and to configure audio group parameters.

You can select audio group 1, 2, 3, or 4 for all SD, HD, and 3G Level A formats. For 3G Level B formats, you can select audio group 1, 2, 3, or 4 for both Link A and Link B.

In each audio group you can do the following:

■ Enable or disable the embedded audio

■ Select a specific channel

■ Set the sampling mode

■ Set the embedded audio frequency

■ Set the embedded audio amplitude

■ Set the click rate for the selected channel

Click **Embedded 1** to show the selections for the SDI 1 outputs; clicking **Embedded 2** shows the selections for the SDI 2 outputs.

The following figure shows a partial menu diagram for the Embedded 1 menu. You may have to scroll down the window to see the Secondary Output selection.

---

*NOTE. The SPG8000A Web Interface has an issue where the column headings in the Embedded menu do not align with their associated columns. The following figure shows the proper alignment of the column headings.*

---
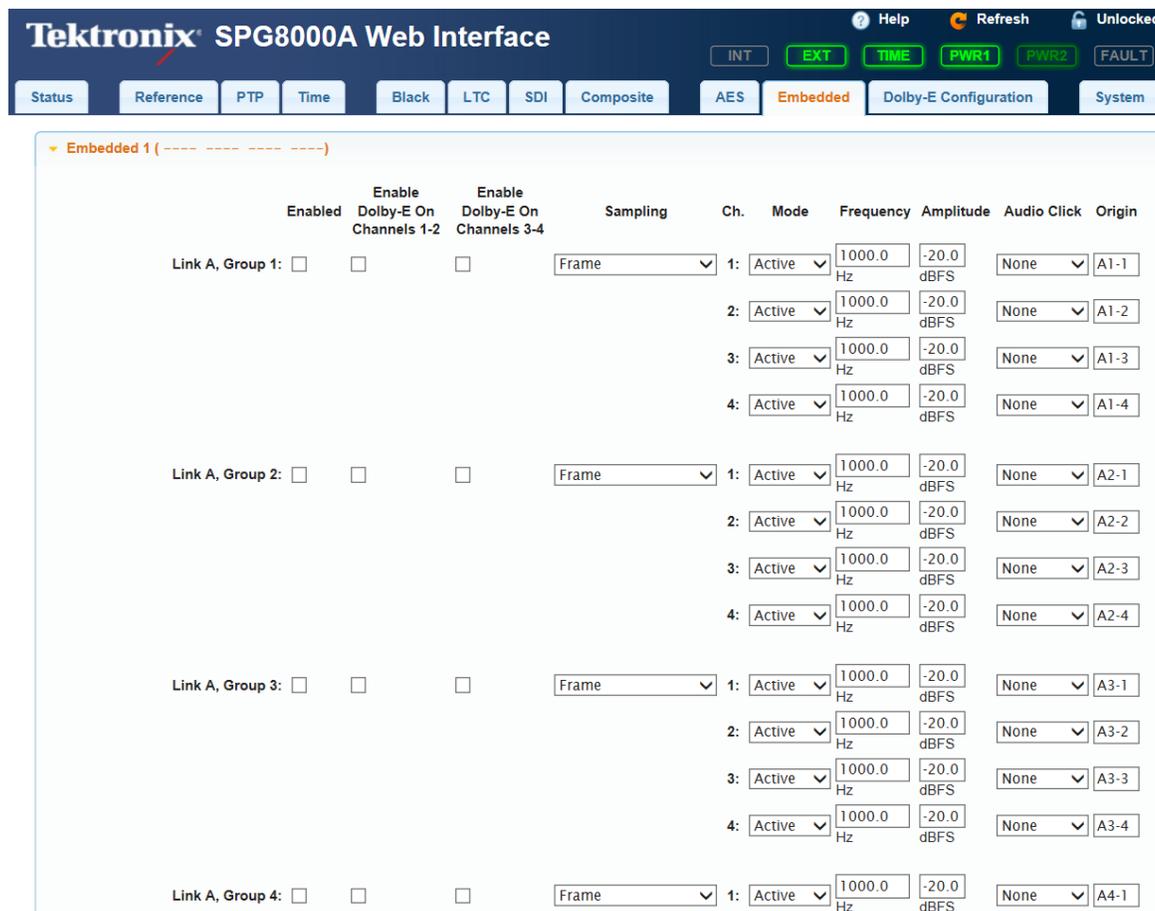
**Figure 12: Partial Embedded menu diagram**

**Group enable**    For most SDI signal formats, select the desired Link A audio group (1–4) by enabling the check box next to the Link A, Group selection. When the SDI signal format is set to 3G Level B, you can select between Link A and Link B for each audio group.

**Sampling**    For each audio group, use the drop-down list to set the sampling alignment status bits for the selected audio group's Audio Control Packet (ACP). Select **Frame**, **Frame w/o Frame #**, or **Asynchronous**. The sampling alignment status bits apply equally to each channel within the selected audio group.

**Channel**    Channels are listed in vertical columns within each audio group. Each channel has its own settings.

**Mode**    Use the drop-down list for each channel to select the mode: **Active**, **Inactive**, and **Mute**.

**Frequency**     For each channel, enter the frequency of the embedded audio signal from 10.0 Hz to 20 kHz, in steps of 0.5 Hz.

**Amplitude**     For each channel, enter the audio amplitude from –60 dBFS to 0 dBFS, in steps of 1 dBFS.

**Audio Click**     For each channel, use the drop-down list to set the audio click rate to one click every one, two, three, or four seconds, or turn the click off.

**Origin**     For each channel, click in the Origin box to enter a channel origin ID of up to four ASCII characters. The default origin values are based on the link, group and channel numbers. For example, an origin value of A1-1 represents Link A, group 1 and channel 1.

**Secondary Output**     Use the drop-down list at the bottom of the Embedded menu to select one of the following signals for the secondary (bottom) BNC connector of the selected SDI output: **Tones**, **No Audio**, or **Mute Audio**.

The SDI 1B audio output is the same format and sample structure as the SDI 1A audio output. The same is true for the SDI 2 connectors.

## Embedded menu factory default settings

The following table shows the settings for the Embedded menu that are reset when you use the Preset submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

**Table 21: Embedded menu factory default settings**

| Menu item name | Settings |
|---|---|
| Embedded 1 or<br>Embedded 2 | |
| Group 1–4 (Link A) | Disable |
| Group 1–4 (Link B) [1] | Disable |
| Sampling | Frame |
| Channel 1–4 | Mode: Active |
| | Frequency: 1000.0 Hz |
| | Amplitude: –20 dBFS |
| | Audio Click: None |
| | Channel Origin: A1-1 through A4-4 |
| Secondary Output | Tones |

[1]     The Link B, Group 1–4 settings are available only when the SDI output mode is set to 3G-Level B. (See page 85, *SDI menu (Option SDI only)*.)

# LTC menu

Use the LTC menu to view and configure the LTC inputs and outputs on the GPI/LTC port. The following figure shows the LTC menu with the LTC 1 submenu expanded to show the menu selections.
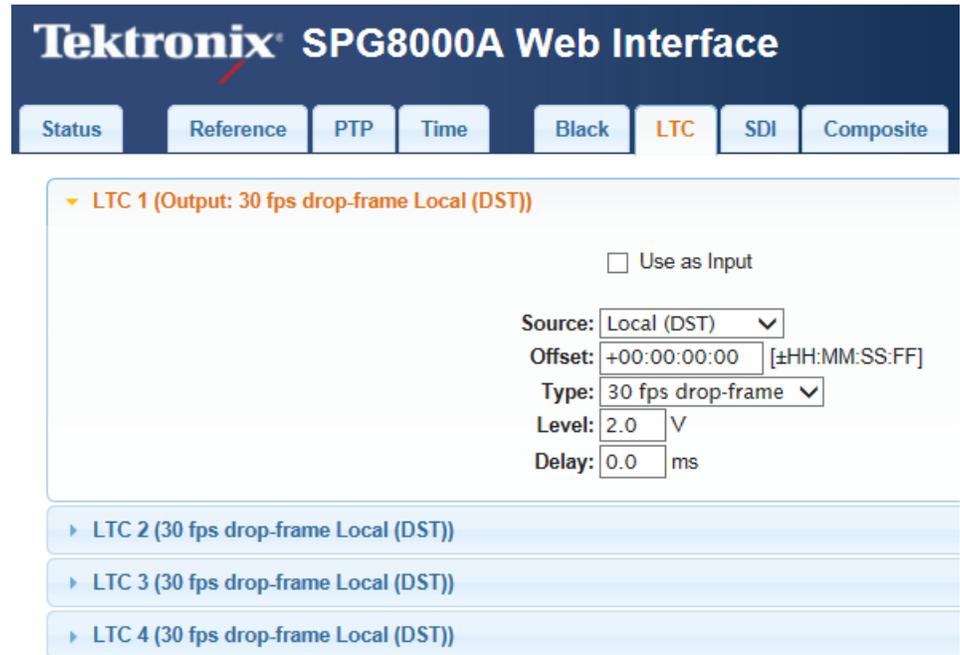


**Figure 13: LTC menu with LTC 1 selected**

**Use as Input**  This menu item is available only with LTC 1. Select this check box to force LTC 1 to be an input.

**Source**  Use drop-down list to select one of the following LTC signal sources. The default value is Local (DST).

- **Disabled:** Disables the LTC outputs.

- **Local (DST):** Uses the local time of day with Daylight Savings Time offset as the timecode.

- **Local (No DST):** Uses the local time of day without Daylight Savings Time offset as the timecode.

- **UTC:** Uses Coordinated Universal Time as the timecode.

- **Program Time:** Uses the Program Time counter as the timecode.

**Offset**   Enter the LTC Offset in the form of ±HH:MM:SS:FF.

---

*NOTE. The Offset adjustment allows you to enter a time zone correction of up to ±23:59 hours. However, the ST309 standard only implements codes for time zones in the range of -12 to +13 hours. Therefore, when you are using ST309 data as the Time of Day source, it is recommended that the combined programmed offset from time zone and the daylight saving time be restricted to the range of -12 to +13 hours.*

---

**Type**   Use the drop-down list to select one of the following LTC output signal formats:

**Table 22: LTC output signal formats**

| Format | Rate | Delay range |
|---|---|---|
| 24fps | 24 fps at 24 Hz | ±20.83 ms |
| 25fps | 25 fps at 25 Hz | ±20.00 ms |
| 30fps | 30 fps at 30 Hz | ±16.67 ms |
| 30fps drop-frame | 30 fps drop frame at 29.97 Hz | ±16.68 ms |
| 24fps @ 23.98 Hz | 24 fps at 23.98 Hz | ±20.85 ms |

**Level**   Enter the signal level of the selected LTC output between 0.5 V and 5.0 V in 0.5 V steps.

**Delay**   Enter the delay in milliseconds that will be used for all the signal formats.

# LTC menu factory default settings

The following table shows the settings for the LTC menu that are reset when you use the Preset submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

**Table 23: LTC button menu factory default settings**

| Menu item name | | Settings |
|---|---|---|
| LTC 1 to LTC 4 | | |
| | Use as Input (LTC 1 only) | Not selected |
| | Source | Local (DST) |
| | Offset | + 00:00:00:00 |
| | Type | 30 fps drop frame |
| | Level | 2.0 V |
| | Delay | 0.00 msec |

# Reference menu

Use the Reference menu to view the current status of instrument settings such as the signal reference source, the signals being output, and information about system faults and alerts. The following figure shows the Reference menu including the Reference information, GPS Information and the Genlock Timing information.
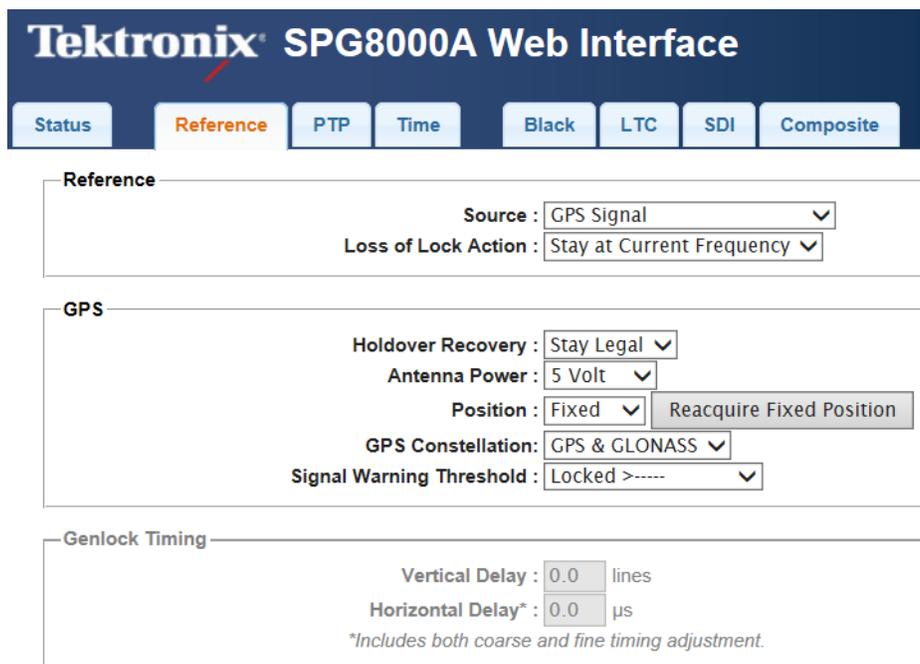


**Figure 14: Reference tab menu**

## Reference settings

**Source**    Use the drop-down menu to select the reference source for the module timing. The following selections are available:

- **Internal**. Uses the internal clock frequency setting as the timing reference.

- **GPS Signal**. This menu item appears only when Option GPS is installed. Uses the GPS and/or GLONASS signal input as the timing reference.

- **NTSC Burst**. Uses the NTSC Black burst signal applied to the REF input connector on the rear panel as the timing reference.

- **NTSC Burst with 10 Field ID**. Uses the NTSC Black burst with 10 Field ID signal applied to the REF input connector as the timing reference.

- **PAL Burst**. Uses the PAL Black burst signal applied to the REF input connector as the timing reference.

■ **HD Tri-Level Sync**. Uses the HDTV trilevel signal applied to the REF input connector as the timing reference.

■ **CW**. Uses the 1, 3.58, 4.43, 5, or 10 MHz continuous wave signal applied to the REF input connector as the timing reference.

■ **PTP**. Primary PTP function is restricted to Slave PTP mode.

## PTP

These menu items appears Option PTP is installed and PTP is the selected reference source.

**Loss of Lock Action**  This menu item is not active when the reference source is set to Internal. Use the drop-down list to select the action that the module will make when a loss of lock condition is detected. Select one of the following actions:

■ **Stay at Current Frequency**. Sets the module timing to keep operating at the current frequency until the reference signal is recovered.

■ **Use Internal Frequency**. Sets the module timing to switch to the internal frequency setting until the reference signal is recovered.

**Holdover Recovery**  Use this setting to select how the module timing responds when the reference signal is recovered after a loss of lock. Select one of the following recovery modes form the drop-down list.

■ **Stay Legal**. Adjusts the module timing to match the recovered PTP while staying within the specified frequency offset and frequency rate of change specifications for NTSC and PAL reference signals.

*NOTE. It can take a long time for the module to recover in this mode since it takes about 300 seconds to correct each 64 ìs line of timing error.*

■ **Jam Phase**. Adjusts the module timing to match the recovered PTP immediately but will typically cause a sync "shock" to the system.

■ **Fast Slew**. Adjusts the module timing to match the recovered PTP at a rate 25 times faster than the legal rate without jumping.

# GPS

This menu item appears only when Option GPS is installed and GPS Signal is the selected reference source.

**Holdover Recovery**    Use this setting to select how the module timing responds when the reference signal is recovered after a loss of lock. Select one of the following recovery modes form the drop-down list.

*NOTE. If the module timing is off by more than 20 ms when the GPS and/or GLONASS signal is recovered, the module forces a jam phase timing recovery. In genlock mode, a jam sync may occur if the timing has drifted more than 20 ns.*

- **Stay Legal**. Adjusts the module timing to match the recovered GPS and/or GLONASS signal while staying within the specified frequency offset and frequency rate of change specifications for NTSC and PAL reference signals.

*NOTE. It can take a long time for the module to recover in this mode since it takes about 300 seconds to correct each 64 ìs line of timing error.*

- **Jam Phase**. Adjusts the module timing to match the recovered GPS and/or GLONASS signal immediately but will typically cause a sync "shock" to the system.

- **Fast Slew**. Adjusts the module timing to match the recovered GPS and/or GLONASS signal at a rate 25 times faster than the legal rate without jumping.

**Antenna Power**    The GPS Antenna connector on the rear panel can supply DC power for a connected GPS and/or GLONASS antenna. Use the drop-down list to select from the following antenna power settings:

- **OFF**. No power is supplied to the GPS and/or GLONASS antenna.

- **3.3 V**. Supplies 3.3 V DC to power the GPS and/or GLONASS antenna.

- **5 V**. Supplies 5 V DC to power the GPS and/or GLONASS antenna.

When the GPS ANT connector is configured to provide power to the antenna, the rear-panel POWER indicator lights as follows:

- Blinks green to indicate an open circuit. This occurs if no antenna is connected or if the current load is less than expected because a splitter or DC block is being used.

- Displays solid red if the connected antenna is shorted. A shorted antenna will not damage the GPS module. If a splitter is used on the antenna, it may

appear as a short at DC but still pass through the RF signal, which would allow the internal GPS system to function.

■ Displays solid green if the current load of the antenna is within the nominal range.

**Position**     Use the drop-down list to select **Fixed** or **Mobile**. The Fixed and Mobile settings define how the GPS/GLONASS receiver calculates the time and position information.

In fixed mode, an averaged position is stored in flash memory, and only the time is calculated each second. This provides greater stability of the time information, and allows operation with fewer satellites. This mode is well suited to broadcast-type installations where the antenna and mainframe do not move.

Mobile mode recalculates both the position and time each second. This allows for compensation of velocity and acceleration, so the frequency and timing information stay correct while moving, at the expense of some stability. This mode is required if the antenna and mainframe are moving.

For applications where the position changes occasionally, but where the antenna and unit are not moving, then either mode may be applicable. Mobile mode may start up faster since it does not need to average 60 fixes to establish a fixed location. However, fixed mode can run with fewer satellites once the position is stored.

**Reacquire Fixed Position**     Click the Reacquire Fixed Position button to erase the saved position, and then reacquire and save a new averaged position. The GPS signal quality might indicate low or no signal during this process.

*NOTE. The module must make 60, 1 second GPS and/or GLONASS readings with at least four satellites to acquire the position. How long this takes depends on various conditions. If there are less than four satellites, a reading cannot be taken.*

**GPS Constellation**     This menu selection appears only for GPS modules with a GPS/GLONASS receiver that are installed in a SPG8000 with firmware version 1.5 or later.

Use the drop-down list to select GPS Only, GLONASS Only, or GPS & GLONASS. If your antenna provides both GPS and GLONASS signals, it is recommended that you use the GPS & GLONASS setting to improve the signal performance and robustness of the system.

*NOTE. After you configure the GPS constellation, it is strongly recommended that you save the module settings to the Power On Default preset. The Power On Default preset saves the configuration parameters in both the TG8000 mainframe and the installed modules, which helps the instrument power on faster in the event of a power outage or interruption.*

Earlier versions of the GPS receiver can receive only GPS signals. Later versions of the GPS receiver can receive GPS and/or GLONASS signals.

**Signal Warning Threshold**

This function provides a warning that the antenna signal has degraded. Set this level below the normal range experienced as a function of time of day, weather, or other variables. To configure the output warning, use the Reference menu. Use the drop-down list to select the FOM (quality of the GPS and/or GLONASS signal) value that will trigger warning indicators.

**Hybrid GPS/CW or PTP/CW operation**

In some locations, the availability of GPS or PTP may not be reliable. Other installations may have a large plant based on a rubidium standard and will want to maintain compatibly with that, but may want to add PTP or other operation based on absolute time. Hybrid operation is a good mechanism for these applications. The CW frame menu is required for this mode to work well.

This mode locks to GPS or PTP to get the correct time and leap second offsets, then switches to 10MHz CW lock to maintain a stable frequency and reject interference on the GPS or PTP. Periodically, the system should be relocked to the GPS or PTP to correct any drift in the system. Depending on the needs of the system, the interval between the relocking may be days or months.

**To enable GPS or PTP and CW reference**

To use this function, access the CW frame menu and set the CW frame to **Keep GPS/PTP Timing**. The CW frame menu operation is displayed in the REF button menu section (See page 203.)

Set the reference to GPS or PTP and allow the system to lock. Connect the CW input and then switch to CW reference. There may be a small shift as this locks, so it should be done at a noncritical time. To relock to the GPS or PTP, change the reference back to that source. Depending on how long the system has been drifting, this will cause more of a disruption, so it should be done at a noncritical time. The SPG8000A should be configured to power on in the GPS or PTP mode so that it recovers the time and phase correctly. A second SPG8000A can be locked to the GPS or PTP, and outputs from the main and extra SPG can be compared in a monitor to help determine how much the system has drifted, and when it is a good time to relock to the GPS or PTP.

# Genlock timing settings

The Genlock Timing settings adjust the timing offset of the input signal relative to the internal reference signal. The selections are unavailable when the reference source is set to Internal or GPS Signal.

The range of the timing adjustment depends on the selected signal format. (See Table 24.)

■ **Vertical Delay**. Enter the delay to adjust the Genlock vertical offset in 1 line increments.

■ **Horizontal Delay**. Enter the Genlock horizontal offset.

*NOTE. If you are using the 50, 59.94 or 60 Hz progressive sync as a genlock source and LTC as a time-code source, there are two possible alignments for the resulting system. Alignment can be checked by looking at the LTC timing status screen. If the timing is near zero, then it is aligned. If the timing is near a frame of offset, then it is not aligned.*

*You must unlock and relock the reference to obtain the desired alignment if this is important to the application you are using. Alternatively, you can use a lower frame rate video reference like NTSC, PAL, or 1080i tri-level.*

Table 24: **Timing adjustment ranges for reference input signals**

| Format name | Line settings | Coarse settings (µs) | Fine settings (ns) |
|---|---|---|---|
| NTSC | ± 525 | ± 63.5556 | ± 10.00 |
| PAL | ± 1250 | ± 64.0000 | ± 10.00 |
| 1080 60i | ± 562 | ± 29.6296 | ± 10.00 |
| 1080 59.94i | ± 562 | ± 29.6593 | ± 10.00 |
| 1080 50i | ± 562 | ± 35.5556 | ± 10.00 |
| 1080 24sF | ± 562 | ± 37.0370 | ± 10.00 |
| 1080 23.98sF | ± 562 | ± 37.0741 | ± 10.00 |
| 1080 30p | ± 562 | ± 29.6296 | ± 10.00 |
| 1080 29.97p | ± 562 | ± 29.6593 | ± 10.00 |
| 1080 25p | ± 562 | ± 35.5556 | ± 10.00 |
| 1080 24p | ± 562 | ± 37.0370 | ± 10.00 |
| 1080 23.98p | ± 562 | ± 37.0741 | ± 10.00 |
| 720 60p | ± 375 | ± 22.2222 | ± 10.00 |
| 720 59.94p | ± 375 | ± 22.2444 | ± 10.00 |

**Table 24: Timing adjustment ranges for reference input signals (cont.)**

| Format name | Line settings | Coarse settings (µs) | Fine settings (ns) |
|---|---|---|---|
| 720 50p | ± 375 | ± 26.6667 | ± 10.00 |
| CW | ± 1125 | ± 64us | N/A |

*NOTE. Genlock timing adjustment in CW reference mode will not provide a consistent timing after a power cycle. The preferred method is to use the hybrid GPS/PTP and CW lock as described in the Hybrid GPS/CW or PTP/CW operation section.*

# Reference menu factory default settings

The following table shows the settings for the Reference menu that are reset when you use the Preset submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

**Table 25: Reference menu factory default settings**

| Menu item name | Settings |
|---|---|
| Reference | |
| Source | Internal |
| Genlock Timing [1] | Vertical: 0 Line(s) |
| | Horizontal Coarse: 0.0 µsec |
| Loss Lock Action [2] | Stay at Current Frequency |
| GL Lock Action Mode [3] | Automatic |
| Holdover Recovery [4] | Stay Legal |
| GPS Antenna Power | Off |
| GPS Position [5] | Fixed |
| GPS Constellation [6] | GPS Only |
| GPS Signal Warning Threshold [5] | Locked > - - - - - |

[1] This menu item appears only when Option GPS is not the reference source; this item does not appear when the reference source is set to Internal.

[2] This menu item does not appear when the reference source is set to Internal.

[3] This menu item appears only when REF Source is NTSC, PAL, Tri-Level, or CW.

[4] This menu item appears only when Options GPS and PTP are installed, and when GPS or PTP is the reference source.

[5] These menu items appear only when Option GPS is installed and GPS is the reference source.

[6] This menu item appears only when Option GPS is installed with a GPS/GLONASS receiver and when the firmware version is 1.5 or later.

SPG8000A User Manual

# SDI menu (Option SDI only)

Option SDI provides two independent HD-SDI test signal generators; use the SDI menu to view and configure the signals on the SDI video outputs. Select either SDI 1 or SDI 2 to expand the selections to show the menus for each generator. The menu selections are similar, but independent for each output. The following figure shows the SDI menu with the SDI 1 submenu expanded.
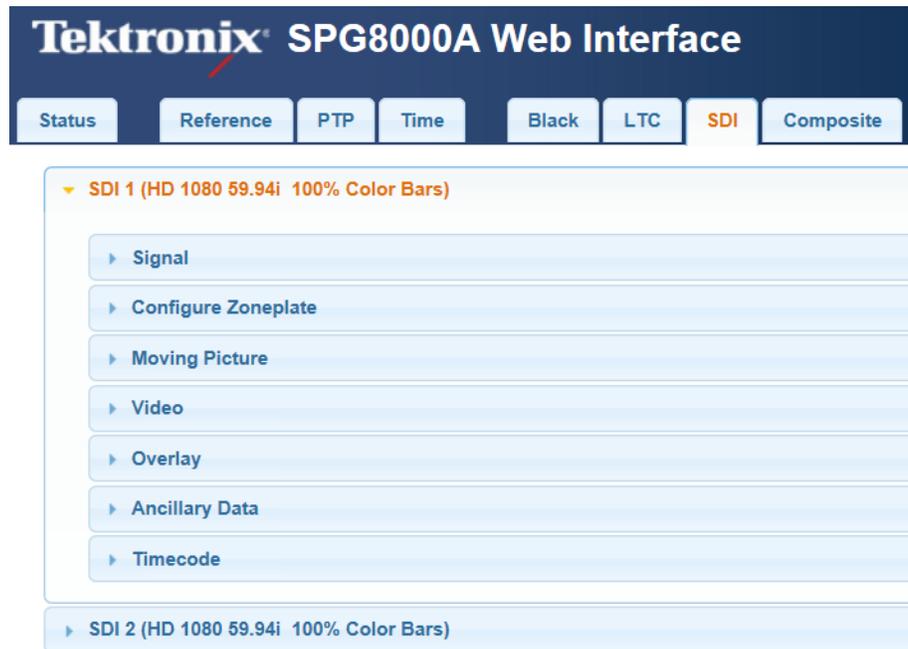


**Figure 15: SDI menu with the SDI 1 submenu expanded**

## SDI Signal submenu

The Signal submenu contains the Standard, Signal Selection, Timing, and other information for defining the SDI signal. The following figure shows an example of the Signal submenu.



**Figure 16: SDI Signal submenu**

**Signal Standard settings**      These settings contains the selections for the Output mode, Format, and Sample Structure/Depth.

■   **Output Mode**. Use the drop-down list to select the Output Mode or to set the 3G-SDI serial link multiplexing method to Level A or Level B.

*NOTE. You can read more about selecting and generating an SDI output signal. (See page 111, How to select an SDI output signal.)*

−   **SD**. Provides a SMPTE 259 compliant signal that runs at 270 Mbps.

−   **HD (1920 × 1080)**. Provides a 1080-line, SMPTE 274M compliant signal.

−   **HD (1280 × 720)**. Provides a 720-line, SMPTE 296M compliant signal.

−   **3G-Level A**. This is one way of constructing the 3 Gb/s serial data stream, as described in SMPTE 425. For the mapping structure 1 signals such as 1080p50, 1080p59.94 and 1080p60, a Level A stream looks similar to HD video (as defined in SMPTE 292), except the data rate is twice as fast. In

Level A, the lines are sent in order, consecutively. For other mapping structures, the video is at a lower frame rate, but has more bits and/or includes more channels. Refer to the SMPTE 425 standard for details on the Level A mapping method.

The following 3G Level A signals are available:

- **(1920 x 1080)**. The output is a 1080-line, SMPTE 425 compliant signal.

- **(1280 x 720)**. The output is a 720-line, SMPTE 425 compliant signal.

- **(2k x 1080)**. This output provides 2048 × 1080 resolution signals, primarily for digital cinema applications.

- **3G Level B**. This is an alternate way of constructing the 3 Gb/s serial data stream, as described in SMPTE 425. A Level B stream looks similar to dual link (as defined in SMPTE 372M). The serial data is constructed by interleaving the two links of the dual link video signal. As a result, some formats will have the serial data take two lines worth of time to propagate. This has implications for the effects of the pathological signals, and can confuse the definition of timing adjustments. Refer to the SMPTE 372M and SMPTE 425 standards for more information.

  The following 3G Level B signals are available:

  - **(1920 x 1080)**. The output is a 1080-line, SMPTE 425 compliant signal.

  - **(2k x 1080)**. This output provides 2048 × 1080 resolution signals, primarily for digital cinema applications.

  - **(2xHD 1080)**. This output provides two standard 1080-line SMPTE 292 HD streams in the same format. Select between Test Signal/Test Signal or Test Signal/Black for the two streams.

  - **(2xHD 720)**. This output provides two standard 720-line SMPTE 292 HD streams in the same format. Select between Test Signal/Test Signal or Test Signal/Black for the two streams.

- **Format**. Use the drop-down list to select the signal format for the selected SDI output. The available format choices depend on the selected Output Mode selection. (See page 111, *Available SDI output signals*.)

- **Sample Structure/Depth**. When the output mode is set to a non-fast-progressive format, the Sample Structure/Depth menu is available. There are several sample structures to choose from. Use the drop-down list to select the desired sample structure.

**3G Level A / Level B formats (720 line)**

    GBR 444 10b                     YCbCr 444 10b

    GBRA 4444 10b                 YCbCrA 4444 10b

**2K line formats**

    XYZ 444 12b                     GBR 444 12b

---

*NOTE. For SD, HD, and 3G fast-progressive formats, the color space / sample structure / depth is always YCbCr 422 10 bit.*

---

**Signal Selection setting**

Use this setting to access test signal sets when the module is in generator mode. The instrument is shipped with a standard set of test signals already installed. (See Table 38 on page 113.) You can also download enhanced test signals. (See Table 39 on page 120.)

**Signal Timing settings**

Use these settings to adjust the timing offset of the serial digital video outputs relative to the internal reference signal (frame reset signal). This allows you to adjust the timing of this module relative to another module or to an external reference (such as Genlock).

- **Vertical**. Enter the vertical timing offset; you can set the value from –½ to +½ frame in 1-line steps.

---

*NOTE. A "line" of timing refers to the timing as if it were a raster scanning a CRT. This may not be the same as the time that a line of data is present on the serial link because of the way that Level B signals are interleaved.*

---

- **Horizontal**. Enter the horizontal timing offset ; you can set the value from –1 to +1 line in 1-clock steps.

- **Relative To**. Sets the Zero Timing D-to-A compensation factor on or off for HD (1.485 Gb/s) and SD (270 Mb/s) formats only. Use the drop-down list to set the timing relative to Serial (0H) or Analog (DAC). In the serial mode (default), the output timing does not include compensation for the delay through a nominal D-to-A converter.

**Other Signal submenu settings**

The following settings appear near the bottom of the SDI Signal submenu:

■ **SMPTE 352 Payload ID Enable**. Select the check box to enable the SMPTE 352M Payload Identifier.

*NOTE. The SMPTE 352M payload identifier is a required element for a compliant 3 Gb/s signal stream. The payload identifier is optional for SD and HD formats.*

■ **Secondary Output**. Use the drop-down list to select a **Test Pattern** or a **Black** signal for the secondary BNC connector.

When set to the Test Pattern selection for channel 1, the SDI 1A and SDI 1B connectors will output the same test signal. The same is true for the channel 2 connectors when Test Pattern is set as the Secondary Output selection for channel 2.

When set to the Black selection for channel 1, the SDI 1B Black signal is the same format and sample structure as the SDI 1A output. The same is true for the channel 2 connectors when Black is set as the Secondary Output selection for channel 2.

■ **Alpha Channel Data**. This setting is active only when the sample structure is set to "+A" for 3G signal formats. Selects the data to be placed on the alpha channel when a sample structure that includes an alpha channel is selected. The channel can contain a duplicate of the Y or G channel data or a flat field signal. Use the drop-down list to Copy of Y/G Channel or select a 0% to 100% Flat Field in 10% increments.

■ **2xHD Stream Content**. This setting is active only when the signal format is set to 2×HD. It selects the content for the first and second HD signals on link A and link B. Use the drop-down list to select **Test Signal/Test Signal**, **Test Signal/Black**, or **Black/Test Signal**.

## SDI Configure Zoneplate submenu

Use this submenu to configure the parameters of zone plate signals. These settings become active when you select a zone plate signal for output from the Signal Selection drop-down list. The information for each signal varies depending on the individual zone plate signal.

The Configure Zoneplate submenu consists of three major sections: Zoneplate Parameters, Video, and information that applies to all zone plate signals. For more information on using zone plate signals, refer to the information later in this document. (See page 121, *SDI Zone plate signals*.)

**Zone plate parameters settings**

The following figure shows an example of the zone plate parameters for a circle zone plate.
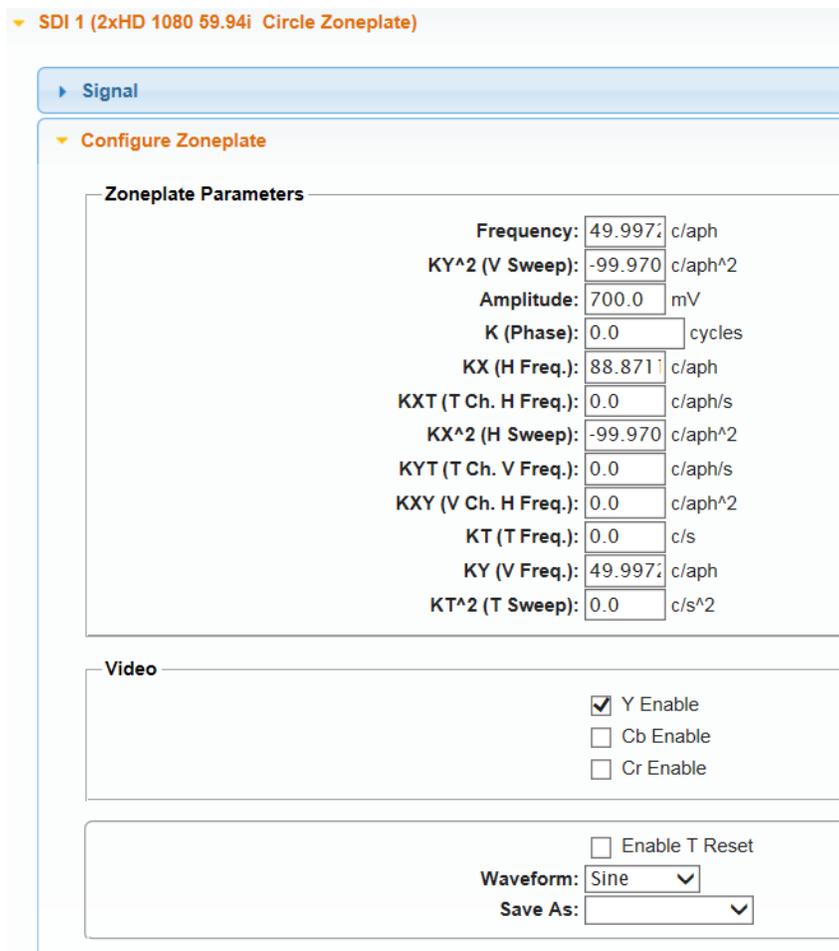


**Figure 17: Circle zone plate configuration parameters**

The information for the zone plate parameters varies with the zone plate signals. The parameters are discussed in more detail later in this document.

■ **Frequency**. This menu item is dependent on the zone plate signal. Detailed information for the different zone plate signals is provided in a separate table. (See Table 40 on page 125.)

■ The remaining parameters are zone plate dependent parameters. These are discussed in detail later in this document. (See page 126, *Zone plate dependent parameters*.)

**Video settings**     The following figure shows the Video menu selections for the Configure Zoneplate submenu.



**Figure 18: Configure Zoneplate video menu selections**

There are three video parameters that can be enabled or disabled by selecting the related check box.

■ **Y/G/X Enable**. Select the check box to display one of the three signal components: the Y component for a YCbCr sample structure, the G component for a GBR sample structure, or the X component for an XYZ sample structure.

■ **Cb/B/Y Enable**. Select the check box to display one of the three signal components: the Cb component for a YCbCr sample structure, the B component for a GBR sample structure, or the Y component for an XYZ sample structure.

■ **Cr/R/Z Enable**. Select the check box to display one of the three signal components: the Cr component for a YCbCr sample structure, the R component for a GBR sample structure, or the Z component for an XYZ sample structure.

*NOTE. When the sampling structure for the current format uses the YCbCr color space, the default settings enable only the Y channel. This results in the familiar Black to white zone plate patterns. When the RGB color space is used the default settings enable all three channels, also resulting in the Black to white zone plate patterns.*

*A colored zone plate pattern can be created by enabling or disabling individual channels. When the XYZ color space is used, the resultant patterns will show some chroma in all combinations of the X/Y/Z channel settings, due to the inherent encoding of this color space.*

**Other parameter settings**     The following figure shows other menu selections for the Configure Zoneplate submenu These menu selections apply to all of the zone plate selections.



**Figure 19: Configure Zoneplate parameters for all zone plate signals**

- **Enable T Reset**. Use the Enable T Reset parameter to reset the time coordinate (t in the zone plate equation) of the pattern to zero. When T Reset is first enabled, the time coordinate is reset to zero and there is no apparent motion in the zone plate, even if any of the time coefficients ($K_{XT}$, $K_{YT}$, $K_T$, or $K_T{}^2$) are non-zero. Enabling the T Reset parameter does not set the other parameters to zero.

  If you then change any of the K parameters, the temporal (t) coordinate will be allowed to change to match. Subsequent changes to K parameters will first reset the time coordinate (t), and then allow it to change with the K parameter.

  When the Enable T Reset check box is cleared, the zone plate time coordinate will increment continuously. Resetting all of the time coefficients ($K_{XT}$, $K_{YT}$, $K_T$, and $K_T{}^2$) to zero will stop the apparent zone plate motion but the temporal coordinate will remain where it is, even if it has moved to an off-screen position.

  You must enable the T Reset parameter to reset the temporal coordinate to zero. To completely disable all motion and reset the pattern, set all of the time related K parameters to zero and enable the T Reset parameter by selecting the check box.

- **Waveform**. Use this parameter to set the waveform shape. Use the drop-down list to set the waveform to a Sine, Triangle, or Square wave.

- **Save As**. Use this parameter to save the setups in one of the custom files. Select the custom file from the drop-down list.

## SDI Moving Picture submenu

Use this submenu to scroll the active picture area of the serial digital video signal up/down or left/right (or randomly), when in generator mode. The following figure shows the Moving Picture submenu.
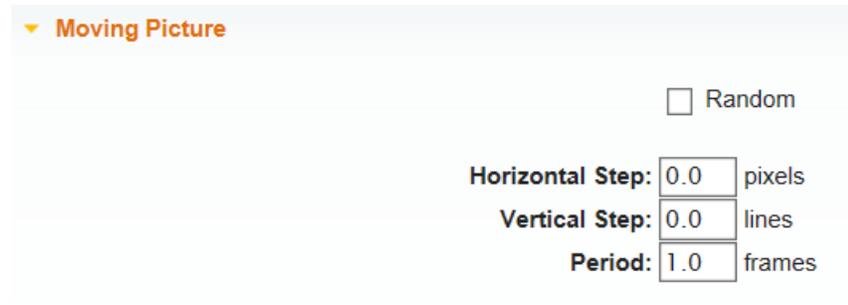


**Figure 20: SDI Moving Picture submenu**

*NOTE. The Moving Picture function is not available with zone plate or multiburst signals. However, zone plate signals can be defined with motion in the zone plate parameters. (See page 123, To modify a zone plate signal.)*

*The Moving Picture function is enabled whenever the H Step or V Step parameter is set to a value other than 0.*

*When Moving Picture is enabled, the circle and text overlays remain static regardless of the signal type (standard test signal or "frame (.BMP) picture"). However, the logo overlay remains static for only standard test signals, but continues to move when used with a "frame (.BMP) picture."*

Use the following menu items to specify the Moving Picture setups:

- **Random**. Select this check box to enable random scrolling. Clear the check box to disable random scrolling.

- **Horizontal Step**. Enter the number of pixels to be scrolled per frame set in the Period menu item below. Set the value from –252 to +252 in 4-sample steps.

- **Vertical Step**. Enter the number of lines to be scrolled per frame set in the Period menu item below. Set the value from –252 to +252 in 1-line steps.

- **Period**. Enter the time interval between occurrences of the scrolling. Set the value from 1 to 16 in 1-frame steps.

## SDI Video submenu

Use this submenu to modify the video output signal. You can enable or disable individual video components, enable or disable edge filtering on each video line, enable or disable Error Detection and Handling (EDH) packet insertion (SD formats only), and enable or display the AV Timing mode.

The following figure shows the SDI Video submenu.

*NOTE. The items in this menu modify the signal output to make it non-standard. To indicate that the signal is non-standard, an asterisk "*" is inserted at the beginning of the signal name displayed in the Status menu.*
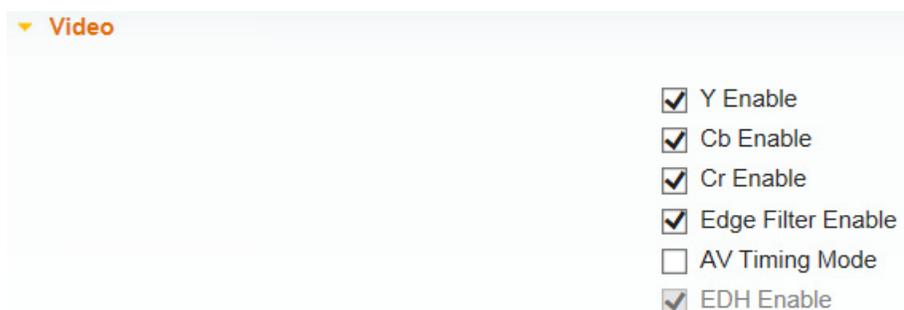


**Figure 21: SDI Video submenu**

Use the following menu items to change the video signal parameters:

■ **Y Enable**. Select this check box to turn on the Y component (YCbCr format), G component (GBR format), or X component (XYZ format) of the serial digital video signal. Clear the check box to disable the Y component.

■ **Cb Enable**. Select this check box to turn on the Cb component (YCbCr format), B component (GBR format), or Y component (XYZ format) of the serial digital video signal. Clear the check box to disable the Cb component.

■ **Cr Enable**. Select this check box to turn on the Cr component (YCbCr format), R component (GBR format), or Z component (XYZ format) of the serial digital video signal. Clear the check box to disable the Cr component.

■ **Edge Filter Enable.** Select this check box to enable the Edge Filter on serial digital video signals that have a filter. This control has no effect on signals without a filter. Clear the check box to disable the Edge Filter.

When the Edge Filter is enabled, certain data transitions between two levels are run through a low-pass filter to set rise times, pulse widths, and to prevent ringing. If the filter is disabled, the edges will not be filtered. The filter should not be disabled in broadcast environments.

Edge filtering is not necessary in certain environments, such as digital cinema applications and several types of picture monitors and projectors. In these cases, disabling the edge filtering will result in instantaneous level changes for adjacent color bars.

■ **AV Timing Mode**. Select this check box to turn on the AV Timing Mode. Clear the check box to disable the AV Timing mode.

In the AV Timing mode, the video and audio are continuously cycled between being on as configured for 1 second then set to Black and muted for 4 seconds. Use this signal to measure the AV delay through a system with the AV Timing mode on an appropriate Tektronix waveform monitor or rasterizer.

■ **EDH Enable**. (SD output mode only.) Select this check box to turn on the insertion of EDH packets. Clear the check box to disable EDH packets.

## SDI Overlay submenu

Use this submenu to select an item (logo, ID text, circle, or burnt-in timecode) to overlay on the output test signal, and to set the blinking mode for the overlay. The following figure shows the Overlay submenu.

*NOTE. You can store overlay functions, including text, in the instrument presets so that the overlay is restored on power up. (See page 140, Presets submenu.)*



**Figure 22: SDI Overlay submenu**

**General overlay settings**   The following menu items appear at the top of the Overlay submenu:

- ■ **Text/Circle Blink Enable**. Select this check box to enable the blinking function of the text and circle overlays. When enabled, use the drop-down list to select a fast or slow blinking mode.

  Select the **Fast** blink mode to set the overlay to blink at approximately 0.5 second intervals. Select the **Slow** blink mode to set the overlay to blink at approximately 1.0 second intervals.

- ■ **Border Enable**. Select this check box to display a black border around the text and circle overlays.

---

*NOTE. Turn on the border to provide cleaner transitions between the overlay and the test signal. This is especially useful for 4:2:2 format signals, which may have some ringing when the border is turned off.*

---

**Logo overlay settings**   Use these settings to select a logo to overlay on the output test signal and to set the display position of the logo. The following figure shows the Overlay Logo settings.



**Figure 23: SDI Overlay Logo settings**

---

*NOTE. To display a logo, you need to create a logo file (.bmp) and use FTP or a USB memory device to copy the file to the SDI7/Logo directory on the instrument. The file must be installed in the Logo folder. Files installed in the wrong location will be ignored by the instrument. (See page 21, How to transfer or install user files.)*

*Logo displays work best with the uncompressed BMP images (24 bits and 32 bits true color). Logo displays do not work with RLE8 or RLE4 BMP compression.*

*BMP files are not scaled for each raster size. For example, a 320×240 size bitmap will be rendered as 320×240 pixels regardless of the current raster area. The bitmap would occupy about 25% of the active video for the SD-525 format, but less than 4% of a 1920×1080 picture. Therefore, you might need to choose a bitmap size appropriate for the target display resolution when using the logo overlay.*

---

The following settings are available for the Logo overlay:

■ **Logo Enable**. Select this check box to enable the Logo overlay and to enable the Logo overlay control settings.

■ **Source**. Use the drop-down list to select a logo file stored in the SDI7/Logo directory.

The default logo is the "first" file in the SDI7/Logo directory, as sorted by the date of the logo file (oldest first). If the factory-provided logo files are installed, the default logo is "Tektronix_logo_500x125.bmp."

If users remove the factory-provided logo files and added their own custom files, then the default logo will be the oldest file installed in the SDI7/Logo directory.

*NOTE. The position of the logo overlay is referenced from the lower right of the active raster area.*

■ **X Position**. Enter the horizontal position of the logo. The position is set as a percentage of active picture width. You can set the value from -100.0% to -1.0% in 0.1% steps.

■ **Y Position**. Enter the vertical position of the logo. The position is set as a percentage of active picture height. You can set the value from -100.0% to -1.0% in 0.1% steps.

**ID Text overlay settings**    Use these settings to create text or to select a text file that will be overlaid on the output test signal, and to set the display position of the text.

*NOTE. You can store overlay functions, including text, in the instrument presets so that the overlay is restored on power up.*

To display a text overlay, you need to either enter a text string or create a text file (.txt) and use FTP or a USB memory device to copy the file to the SDI7/TEXT directory on the instrument. The file must be installed in the TEXT folder. Files installed in the wrong directory location will be ignored by the instrument. (See page 21, *How to transfer or install user files*.)

When a text file is used, any Unicode character supported by the default font can be displayed. The text file can be encoded as plain 7-bit ASCII text, or UTF-8 encoding when extended Unicode characters are used. The text file can also include embedded newline characters to create text overlays spanning multiple lines.

When the string is entered from the front panel, it is limited to 30 characters in length, and can contain only standard ASCII characters.

The instrument uses a TrueType font to render text overlays; the default typeface is Deja Vu Sans. The font file is named "default.ttf" and is stored in the SDI7 directory of the instrument memory.

The instrument supports Latin, Cryillic, Greek, and symbol character sets for use with the text overlay. Using FTP, you can download an alternate TrueType font file. Make sure that the font file is renamed to "default.ttf" and that the instrument is rebooted for the new font to take effect.

The following figure shows the SDI Overlay ID Text settings.



**Figure 24: SDI Overlay ID Text settings**

The following settings are available for the ID Text overlay:

- **Text Enable**. Select this check box to enable the ID Text overlay and to enable the ID Text overlay control settings.

- **X Position**. Enter the horizontal position of the text. The position is set as a percentage of active picture width. You can set the value from 0.0% to 99.0% in 0.1% steps.

---

*NOTE. The position of the text overlay is referenced from the top left of the active picture.*

---

- **Y Position**. Enter the vertical position of the text. The position is set as a percentage of active picture height. You can set the value from 0.0% to 99.0% in 0.1% steps.

■ **Height**. Enter the font size of the text. The size is set as a percentage of active picture height. You can set the value from 1.0% to 100.0% in 0.1% steps.

■ **Source Selection**. Use these menu items to display a user-entered text string or a selected text file.

  ▬ **File Selection**. Select this check box to enable the File drop-down list to select a text file stored in the SDI7/TEXT directory. If this check box is not selected, the instrument will use the text in the String field.

  ▬ **String**. Enter the for the logo text; you can use up to 30 characters.

  ▬ **File**. Select the text file containing the logo text from the drop-down list.

**Circle overlay settings**     Use these settings to overlay a circle on the output test signal and set the display position of the circle. The following figure shows the SDI Overlay Circle settings.



**Figure 25: SDI Overlay Circle settings**

*NOTE. The position of the circle overlay is referenced from the center of the active picture.*

The following settings are available for the Circle overlay:

■ **Circle Enable**. Select this check box to enable the Circle overlay and to enable the Circle overlay control settings.

■ **X Position**. Enter the horizontal position of the circle. The position is set as a percentage of active picture width. You can set the value from -50.0% to 50.0% in 0.1% steps.

■ **Y Position**. Enter the vertical position of the circle. The position is set as a percentage of active picture height. You can set the value from -50.0% to 50.0% in 0.1% steps.

■ **Diameter**. Enter the diameter of the circle. The diameter is set as a percentage of active picture height. You can set the value from 0.0% to 100.0% in 0.1% steps.

**Burnt-In Timecode overlay settings**

Use these settings to overlay a timecode readout (HH:MM:SS;frames) on the output test signal and set the size and position of the timecode readout. The following figure shows the SDI Overlay Burnt-In Timecode submenu.



**Figure 26: SDI Overlay Burnt-In Timecode settings**

The following settings are available for the Burnt-In Timecode overlay:

■ **BITC Mode**. Use the drop-down list to disable the burnt-In Timecode or select a Large or Small timecode.

■ **X Position**. Enter the horizontal position of the timecode. The position is set as a percentage of active picture width. You can set the value from -50.0% to 50.0% in 0.1% steps.

■ **Y Position**. Enter the vertical position of the timecode. The position is set as a percentage of active picture height. You can set the value from -50.0% to 50.0% in 0.1% steps.

■ **Second Line Enable.** Select the check box to enable a second line of timecode readout (YY/MM/DD) on the output signal.

## SDI Ancillary Data submenu

The ancillary data payload can carry non-video information, such as an Active Format Description (AFD), Closed Caption information, or other metadata.

*NOTE. The ancillary inserter can place the data packet anywhere in the field and can overwrite any of the ancillary or video data with a few exceptions; the inserter will not overwrite embedded audio or CRC. Use care to not overwrite important information.*

Use this submenu to set the ancillary data payload structure. The ancillary data payload can include information to supplement the video stream, including the Data Identifier (DID), Secondary Data Identifier (SDID), Data Count (DC), User Data Words (UDW), and a Checksum (CS).

The Data Identifier (DID) and Secondary Data Identifier (SDID) indicate the type of data contained in the packet.

The Data Count indicates the number of User Data Words to follow, and the User Data Words (UDW) comprise the actual payload carried in the ancillary data. The instrument addresses User Data Words 000 through 254.

**Ancillary Data Payload settings**

The following figure shows the SDI Ancillary Data Payload settings.



Figure 27: SDI Ancillary Data Payload settings

The following settings are available for the Ancillary Data Payload:

- **Manually Set Parity**. Select the check box to manually set the parity. If the check box is not selected, the parity is set automatically. Automatic parity is an 8-bit mode, while Manual parity allows 10-bits. If a 10-bit word is entered while in manual parity and the module is later set to automatic parity, the correct 8 bits will be sent. The entire 10-bit word is in system memory, though, so if the module is then reset to manual parity the entire 10-bit word entered by the user will be transmitted.

- **DID**. Use this field to edit the hex value of the Data ID word. You can set the Data ID from 0x00 to 0xFF (in 8-bit mode), or from 0x000 to 0x3FF (in 10-bit mode).

- **SDID/DBN**. Use this field to edit hex value of the Secondary ID word. You can set the Secondary ID from 0x00 to 0xFF (in 8-bit mode), or from 0x000 to 0x3FF (in 10-bit mode).

- **DC**. Use this field to edit the Data Count word to show the number of User Data Words to follow. You can set the Data Count from 0x00 to 0xFF (in 8-bit mode), or from 0x000 to 0x3FF (in 10-bit mode).

■ **UDW**. Use this area to enter a User Data Word from word 000 through word 254. You can set the User Data Word from 0x00 to 0xFF (in 8-bit mode), or from 0x000 to 0x3FF (in 10-bit mode). Click **Set UDW** to set the User Data Word. Click **Clear UDW** to clear the entire User Data Word.

*NOTE. To make this process easier, you can use the PC-based TG Setup application. This application also allows you to import and export User Data Words as CSV files.*

■ **Checksum**. Use this menu item to set the hex value of the Checksum. You can set the Checksum from 0x00 to 0xFF (in 8-bit mode), or from 0x000 to 0x3FF (in 10-bit mode). If the **Auto-Calculate** check box is selected, the checksum is calculated automatically.

**Ancillary Data Output settings**

The Ancillary Data Output settings define the ancillary data payload output. The menu selections differ depending on the output mode defined in the SDI Signal submenu. (See page 86, *Signal Standard settings*.) A Line selection is available in progressive formats where you can specify the line to carry the ancillary data.

*NOTE. Different video modes and formats have different ranges of lines and pixels in their active and ANC spaces. Users should be careful to change the line, field and sample offset parameters of the ANC insertion feature after changing video modes or formats to be sure the ANC data is programmed as desired.*

*If the line number or sample offset are left at values outside the allowed range for a given format, the packet will not be inserted in the stream. Alternatively if these parameters are left at values near the end of active or ANC space, the packet may overwrite other elements of the stream such as EAV and SAV.*

The following figure shows the SDI Ancillary Data Output settings.



**Figure 28: SDI Ancillary Data Output settings**

The following settings are available for the Ancillary Data Output:

■ **Field**. Use the drop-down list to set the Field to carry the ancillary data payload. Select between **Field 1 Only**, **Field 2 Only**, and **Field 1 & 2**. This menu setting is available only in interlaced formats.

■ **Field1 Line**. Enter a line number in Field 1 to carry the ancillary data payload. This menu setting is available only in interlaced formats.

■ **Field2 Line**. Enter a line number in Field 2 to carry the ancillary data payload. This menu setting is available only in interlaced formats.

■ **Sample Offset**. Enter the sample number where the ancillary data header will be. This is the first word of the ancillary data packet.

*NOTE. Be sure to change the sample offset when you change the raster size. Otherwise, the ANC insertion may occur in an unexpected place or even be outside the raster structure. The sample offset is set relative to SAV to use standard sample numbering. However, this means that the most normal location at the start of HANC varies as a function of raster size.*

■ **Video Channel**. Use the drop-down list to set the video channel to **Luma** or **Chroma**.

■ **Link Location**. Use the drop-down list to set the link location to **Link A** or **Link B**. This menu setting is available only in 3G Level B formats.

■ **Stream Location**. Use the drop-down list to select **HD Stream1** or **HD Stream2**. This menu setting is available only in 2×HD formats.

■ **Output Continuously**. Select this check box to continuously output an ancillary data payload into the SDI video signal. When the check box is cleared, the ancillary data payload output is disabled.

■ **Insert Single Packet**. When the Output Continuously check box is cleared, click **Insert Single Packet** to insert one packet on one field into the SDI video signal.

**SDI ancillary data payload example**

As an example, one of the ancillary data payloads that can be easily generated by the instrument is the Active Format Description (AFD). AFD is a method of identifying the active area of the video picture to be displayed. Using AFD the aspect ratio of the picture can be automatically optimized for the display being used. AFD is defined in SMPTE 2016-1, and mapping AFD and bar data is defined in SMPTE 2016-3. The packet format appears as shown here:

*NOTE. This is an example only. Inserting an AFD packet will not affect the SDI video produced.*

DID: 0x41
SDID: 0x05
DC: 8

| UDW[000] | 0 | AFD Code | | | AR | 0 | 0 |
|---|---|---|---|---|---|---|---|
| UDW[001] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| UDW[002] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| UDW[003] | T | B | L | R | 0 | 0 | 0 | 0 |
| UDW[004] | First bar data (b8 – b15) | | | | | | |
| UDW[005] | First bar data (b0 – b7) | | | | | | |
| UDW[006] | Second bar data (b8 – b15) | | | | | | |
| UDW[007] | Second bar data (b0 – b7) | | | | | | |

CS: automatic calculation

Where AR = aspect ratio (1=16:9, 0=4:3), T = top bar data flag, B= bottom bar data flag, L = left bar data flag, and R = right bar data flag.

---

*NOTE. These are all eight-bit values for the respective User Data Word. The instrument will automatically calculate the parity bits when Parity is set to Automatic, which is the default.*

---

Most AFD codes do not require bar data information; only the first user data word must be defined. For example, one common AFD code for a 16:9 coded frame is "1001" (9), which indicates a 4:3 image, horizontally centered, with pillarboxes, as shown in the following figure:
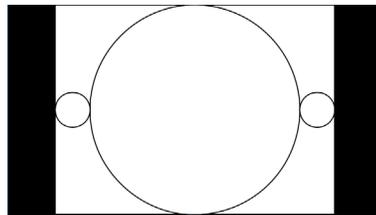


**Figure 29: AFD code "1001" for a 16:9 coded frame**

Therefore, for this AFD code set the data words as follows:

UDW [000]:  0x4C
UDW [001]:  0x00
UDW [002]:  0x00
UDW [003]:  0x00
UDW [004]:  0x00
UDW [005]:  0x00
UDW [006]:  0x00
UDW [007]:  0x00

The AFD ancillary data packet should be located in the active line portion of the vertical ancillary space (VANC), but no earlier than the second line after the RP 168 switch point. Line 9 with a sample offset of 0 (first word of active video, immediately after SAV) is a suitable location. The selected video channel should be **Luma** for most ancillary packets, including AFD. Finally, set the **ANC PAYLOAD Output** mode to **Continuous** to start AFD insertion of the active test signal. For this example, the SMPTE RP 219 color bars are an effective test pattern, because the center section of the 16:9 test signal contains the original 4:3 aspect ratio SMPTE pattern.

## SDI Timecode submenu

Use this submenu to set ancillary timecode (ATC) parameters for the selected output. The following figure shows the SDI Timecode submenu.



**Figure 30: SDI Timecode submenu**

**Source**
Use the drop-down list to select the timecode source from the following choices. The default value is Local (DST).

- **Local (DST):** Uses the local time of day with Daylight Savings Time offset as the timecode.

- **Local (No DST):** Uses the local time of day without Daylight Savings Time offset as the timecode.

- **UTC:** Uses Coordinated Universal Time as the timecode.

- **Program Time:** Uses the program time counter as the timecode.

*NOTE. The Local (DST), Local (No DST) and UTC menu items are available only when Option GPS is installed in the instrument.*

**Offset**   Use this menu item to set a Timecode Offset for the SDI outputs. This is an offset from the selected timecode source.

*NOTE. The Offset adjustment allows you to enter a time zone correction of up to ±23:59 hours. However, the ST309 standard only implements codes for time zones in the range of -12 to +13 hours. Therefore, when you are using ST309 data as the Time of Day source, it is recommended that the combined programmed offset from time zone and DST be restricted to the range of -12 to +13 hours.*

**ATC-LTC Enable**   Select this check box to enable or disable the Ancillary Linear time code type of ANC packets.

**ATC-VITC Enable**   Select this check box to enable or disable the Ancillary Vertical Interval time code type of ANC packets.

**30 DROP Frame Enable**   Select this check box to enable or disable the Drop Frame mode for the 30 frame per second timecode format. This menu item is available only when the frame or field rate for the current format is 29.97 or 59.94.

## SDI menu factory default settings

The following table shows the settings for the SDI menu that are reset when you use the Preset submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

The default settings are identical for the SDI 1 and SDI 2 outputs.

**Table 26: SDI menu factory default settings**

| Menu item name | Settings |
| --- | --- |
| Output Mode | HD (1920 × 1080) |
| Format | 1080 59.94i |
| Sample Structure/Depth [1] | YCbCr 4:2:2 10b |
| Alpha Channel Data [2] | Use Y/G Channel |
| 2xHD Stream Content [3] | Test Signal / Test Signal |
| Signal Selections | |

**Table 26: SDI menu factory default settings (cont.)**

| Menu item name | Settings |
|---|---|
| Color Bar | 100% Color Bars |
| Linearity | Limit Ramp |
| Flat Field | 100% Blue Field |
| Multiburst | Y Multiburst 15–30 MHz |
| Zoneplate | Circle Zoneplate |
| Monitor | Black-Dark Gray Step Scale |
| Pulse Bar | Color Pulses |
| Timing | Co-siting Pulse |
| SDI | SDI Matrix |
| Frame Picture [4] | No BMP files found in /SDI7/PICTURE/ |
| Moving Picture | |
| Horizontal Step | 0 Sample(s) |
| Vertical Step | 0 Line(s) |
| Period | 1 Frame(s) |
| Random | Disable |

**Table 26: SDI menu factory default settings (cont.)**

| Menu item name | Settings |
|---|---|
| Overlay : Logo | |
| Status | Disable |
| Source | Tektronix_logo_500x125.bmp |
| | *NOTE. The default logo is the "first" file in the SDI7/Logo directory, as sorted by the date of the logo file (oldest first). If the factory-provided logo files are installed, the default logo is "Tektronix_logo_500x125.bmp."* |
| | *However, if the user has removed the factory-provided logo files and added their own custom files, then the default logo will be the oldest file installed in the SDI7/Logo directory.* |
| X Position | –5 % APW |
| Y Position | –5 % APH |
| Overlay : ID Text | |
| Status | Disable |
| Source | User-entered string |
| X Position | 5.0 % APW |
| Y Position | 5.0 % APH |
| Font Size | 8.0 % APH |
| Overlay : Circle | |
| Status | Disable |
| X Position | 0.0 % APW |
| Y Position | 0.0 % APH |
| Diameter | 90.0 % APH |
| Overlay : Burnt-In Timecode | |
| Mode | Disable |
| X Position | 5.0 % APW |
| Y Position | 5.0 % APH |
| Second Line | Disable |
| Overlay : Blink | |
| Text/Circle Blink | Off |
| Overlay : Border | |
| Text/Circle Border | Enable |

**Table 26: SDI menu factory default settings (cont.)**

| Menu item name | | Settings |
|---|---|---|
| Timing | | |
| | Vertical | 0 Line(s) |
| | Horizontal | 0.0000 µs |
| | Relative To [5] | Serial (0H) |
| Timecode | | |
| | Source [6] | Without Option GPS: Program Time |
| | | With Option GPS: Local (DST) |
| | Offset [7] | +00:00:00:00 |
| | 30 Drop [8] | Enable 30 Drop Frame |
| | ATC-LTC | Disable |
| | ATC-VITC | Disable |
| Video | | |
| | Y | Enable |
| | Cb | Enable |
| | Cr | Enable |
| | Edge Filter | Enable |
| | AV Timing Mode | Disable |
| | EDH [9] | Enable |
| Ancillary Data | | |
| | Output | Disable |
| | Parity | Automatic |
| | DID | 0x01 |
| | SDID | 0x00 |
| | DC | 0x01 (1) |
| | UDW | 0x00 |
| | CS | 0x00 (Auto: 0x202) |
| | Auto-Calculate CS | Enable |
| | Field | 1 Only |
| | Field 1 Line | 9 |
| | Field 2 Line | 9 |
| | Sample Offset | 1928 (VANC) |
| | Video Channel | Luma |
| | Link Location [10] | Link A |
| | Stream Location [3] | HD Stream 1 |

**Table 26: SDI menu factory default settings (cont.)**

| Menu item name | Settings |
|---|---|
| SMPTE 352 Payload ID | Enable |
| Secondary Output | Test Pattern |

[1] This menu item is available only when a 3G-SDI 2K format is selected.

[2] This menu item is available only when a 3G-SDI format is selected with YCbCrA or GBRA sample structure.

[3] This menu item is available only when a 3G-SDI 2xHD format is selected.

[4] You must load frame picture files into the /SDI7/PICTURE/ directory to select a frame picture signal for output.

[5] This menu item is available only for HD (1.485 Gb/s) formats.

[6] The default timecode source depends on whether Option GPS is installed.

[7] This menu item is available only when Option GPS is installed.

[8] This menu item is available only for non-integer frame rates.

[9] This menu item is available only when the output mode is set to SD.

[10] This menu item is available only when a 3G-Level B format is selected.

# How to select an SDI output signal

To select an output signal, perform the following procedure to generate either 3 Gb/s SDI, 1.5 Gb/s HD-SDI, or 270 Mb/s SD video test signals:

1. Select the output mode in the SDI Signal submenu. (See page 86, *Signal Standard settings*.)

2. Select the signal format in the SDI Signal submenu. (See page 86, *Signal Standard settings*.)

3. Select the sample structure and depth in the SDI Signal submenu. (See page 86, *Signal Standard settings*.)

4. Select the test signal that you want to generate in the SDI Signal submenu. (See page 88, *Signal Selection setting*.)

**Available SDI output signals**    The following tables list the available SDI output signals and their associated structure.

**Table 27: SDI – 3G Level A (1920 × 1080)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:4:4 | 12b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| YCbCr+A | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| YCbCr | 4:2:2 | 12b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| | | 10b | | | | | | | | | X | X | X | | | | | |
| GBR | 4:4:4 | 12b | X | X | X | X | X | X | X | X | | | | | | | | |
| | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| GBR+A | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |

**Table 28: SDI – 3G Level A (1280 × 720)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:4:4 | 10b | | | | X | X | X | X | X | X | X | X | | | | | |
| YCbCr+A | 4:4:4 | 10b | | | | X | X | X | X | X | X | X | X | | | | | |
| GBR | 4:4:4 | 10b | | | | X | X | X | X | X | X | X | X | | | | | |
| GBR+A | 4:4:4 | 10b | | | | X | X | X | X | X | X | X | X | | | | | |

**Table 29: SDI – 3G Level A (2K × 1080)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XYZ | 4:4:4 | 12b | | | | X | X | X | X | X | | | | X | X | X | X | X |
| GBR | | | | | | X | X | X | X | X | | | | X | X | X | X | X |

**Table 30: SDI – 3G Level B (1920 × 1080)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:4:4 | 12b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| YCbCr+A | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| YCbCr | 4:2:2 | 12b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| | | 10b | | | | | | | | | X | X | X | | | | | |
| YCbCr+A | | 12b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| GBR | 4:4:4 | 12b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |
| GBR+A | | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |

**Table 31: SDI – 3G Level B (2K × 1080)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| XYZ | 4:4:4 | 12b | | | | X | X | X | X | X | | | | X | X | X | X | X |
| GBR | | | | | | X | X | X | X | X | | | | X | X | X | X | X |

**Table 32: SDI – 3G Level B (2×HD 1080)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:2:2 | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |

**Table 33: SDI – 3G Level B (2×HD 720)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:2:2 | 10b | | | | X | X | X | X | X | X | X | X | | | | | |

*SPG8000A User Manual*

**Table 34: SDI – HD-SDI (1920 × 1080)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:2:2 | 10b | X | X | X | X | X | X | X | X | | | | X | X | X | X | X |

**Table 35: SDI – HD-SDI (1280 × 720)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:2:2 | 10b | | | | X | X | X | X | X | X | X | X | | | | | |

**Table 36: SDI – SD-525 (720 × 486)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:2:2 | 10b | X | | | | | | | | | | | | | | | |

**Table 37: SDI – SD-625 (720 × 576)**

| Structure | | | 59.94i | 50i | 60i | 23.98p | 24p | 25p | 29.97p | 30p | 50p | 59.94p | 60p | 23.98psf | 24psf | 25psf | 29.97psf | 30psf |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YCbCr | 4:2:2 | 10b | | X | | | | | | | | | | | | | | |

# Test signal sets

The following tables list the signals assigned to each test signal set and the signals that can be selected in the signal set when the module is in generator mode. For example, when you select the COLOR BAR signal set, a signal in the Color Bars signal set is output.

*NOTE. Picture displays operate best with uncompressed BMP images (24 bits and 32 bits true color). Picture displays do not work with RLE8 or RLE4 BMP compression.*

**Table 38: Standard SDI test signal sets**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| Color Bar | 100% Color Bars<br>75% Color Bars (100% White)<br>75% Color Bars (75% White) | Eight full-height bars of white, yellow, cyan, green, magenta, red, blue, and Black. This pattern is available with three variations, at 100% value for all bars, at 75% value for colors and 100% for white, and at 75% value for all bars. |
| | 100% Color Bars Over Red<br>75% Color Bars Over Red | These variations on color bars are available only in the 625 50i format of the SD output mode. They consist of the 75% or 100% color bars signal on the top half of the raster, and a matching 75% or 100% red field on the lower half. |

**Table 38: Standard SDI test signal sets (cont.)**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| | SMPTE EG1 Color Bars | Color bars per SMPTE EG 1-1990. This pattern includes 75% color bars, reverse blue bars, −I and +Q sections, Black, white, and pluge sections. This pattern is only available for YCbCr formats, since the −I and +Q sections contain color components outside the legal RGB gamut. For the SD output mode, this pattern is available only for the 525-line 59.94i format. |
| | SMPTE RP219 Color Bars | Color bars per SMPTE RP 219-2002. This pattern is intended for 16×9 aspect ratio displays, with additional elements as compared to EG1 bars. The SDI implementation includes −I and +Q sections, but unlike the similar sections in EG1 bars, they have additional luminance to stay within RGB gamut. The −2% patch of the pluge section is clipped to 0% Black for XYZ formats. For SD, the color bars are the 4:3 aspect ratio version, as if converted from the 16:9 image with a center cut. |
| | SMPTE EG432-1 Color Accuracy | Split-screen color bars using values from SMPTE RP 431-2-2007. The upper half of the pattern is essentially the same as 100% color bars, corresponding to the "–1" set of colors defined in Table A.4 of the RP. The lower half is a set of desaturated color bars, corresponding to the "–2" color patch values. |
| | 4K Q1/3 100% Color Bars<br>4K Q2/4 100% Color Bars<br>4K Q1/3 75% Color Bars (100% White)<br>4K Q2/4 75% Color Bars (100% White)<br>4K Q1/3 75% Color Bars (75% White)<br>4K Q2/4 75% Color Bars (75% White) | These color bars are for Quad-Link 4K. They provide the four independent 3Gb/s signals, which together, define a full 4K image. |
| | BT2111-0 HLG Narrow<br>BT2111-0 PQ Narrow | These provide High-Dynamic-Range (HDR) signals that combine color bars and other signal types according to the BT2111-0 standard. The Color Bars sections include both a 2020 and 709 gamut section. |
| Linearity | 5 Step Staircase<br>10 Step Staircase | Series of vertical bars of equal steps on all three channels. These patterns are color-independent so they will appear differently in YCbCr, RGB, or XYZ color spaces. Since the range of valid levels is not evenly divisible by 5 or 10 steps, the first and last bars slightly exceed the valid range, but are still well within legal limits. For example, the valid range for 10-bit YCbCr formats is from 64–940 for the Y channel (876 steps) and from 64–960 for the Cb/Cr channels (896 steps). Therefore, the level of the first bar is 62 and the level of the last bar is 942/962, which results in equal step sizes across the pattern. |

**Table 38: Standard SDI test signal sets (cont.)**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| | Valid Ramp<br>Y Valid Ramp<br>B-Y Valid Ramp<br>R-Y Valid Ramp | The Valid Ramp is a matrix of three different ramps, designed to test the video component channels for YCbCr, and for gamut range testing in all color spaces. These three ramps are also available as individual patterns that span the picture width. First, the Y Valid Ramp spans from Black to white, across the valid range of the luminance (Y) channel. Next, the B−Y Valid Ramp spans from yellow to cyan, across the valid range of the Cb color difference channel. Last, the R−Y Valid Ramp spans from cyan to red, across the valid range of the Cr color difference channel. |
| | 3 Channel Ramp | Wide ramp from the lower valid value to the upper valid value for all three channels. This pattern is color-independent, so it will appear differently in YCbCr, RGB, or XYZ color spaces. On each side of the ramp there are small plateaus at the blanking level (Black) and at the valid level. |
| | Limit Ramp | Wide ramp that spans the legal limit range (4–1019 for 10-bit formats and 16–4079 for 12-bit formats) for all three channels. On each side of the ramp there are small plateaus at the blanking level, the valid level, and the limit level. |
| | Shallow Ramp Matrix | Vertical matrix of shallow ramps that together span the range between legal limits (4–1019 for 10-bit formats and 16–4079 for 12-bit formats). Each bit value is held for 16 pixels for 10-bit formats and for 4 pixels for 12-bit formats. There is overlap between the end of one ramp and the start of the next ramp. |
| | Color Ramp Matrix | Vertical matrix of ramps across the colors available in the valid RGB gamut. Each set of ramps transitions between adjacent hues: red–yellow–green–cyan–magenta–blue–red. From the top of the pattern, the first three rows of ramps are at 25%, 50%, and 75% saturation. The fourth row of ramps includes fully saturated colors at 100% value. The next three rows of ramps are at 75%, 50%, and 25% value. The bottom row of ramps is monochrome. |

**Table 38: Standard SDI test signal sets (cont.)**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| Flat Field | 0% Flat Field (Black)<br>50% Flat Field<br>100% Flat Field (White) | Full-frame monochrome flat fields. The factory installed patterns include 0% (Black), 50%, and 100% (white).<br><br>You can install extended signal sets, which include additional patterns for the remaining 10% increments. (See Table 39 on page 120.) |
| | 100% Red Field, 100% Green Field, 100% Blue Field, 100% Cyan Field, 100% Magenta Field, 100% Yellow Field | Full-frame color flat fields. The factory installed patterns include each of six colors (red, green, blue, cyan, magenta, and yellow) at 100% value.<br><br>You can install enhanced signal sets, which include additional patterns for these six colors at 75% value. (See Table 39 on page 120.) |
| | 10% Flat Field, 20% Flat Field, 30% Flat Field, 40% Flat Field, 60% Flat Field, 70% Flat Field, 80% Flat Field, 90% Flat Field | Full-frame monochrome flat fields available in individual patterns from 10% to 90% in 10% increments.<br><br>These signals are not part of the factory installed signal sets. You must install the enhanced signal sets to access these signals. (See Table 39 on page 120.) |
| | 75% Red Field, 75% Green Field, 75% Blue Field, 75% Cyan Field, 75% Magenta Field, 75% Yellow Field | Full-frame color flat fields available in individual patterns of 75% value for each of six colors (red, green, blue, cyan, magenta, and yellow).<br><br>These signals are not part of the factory installed signal sets. You must install the enhanced signal sets to access these signals. (See Table 39 on page 120.) |
| | Black to White-1, Black to White-2, Black to White-3, Black to White-4, Black to White-5, Black to White-6, Black to White-7, Black to White-8, Black to White-9, Black to White-10, Black to Gray-1, Black to Gray-2, Black to Gray-3, Black to Gray-4, Black to Gray-5, Black to Gray-6, Black to Gray-7, Black to Gray-8, Black to Gray-9, Black to Gray-10 | Full-frame monochrome flat fields representing the individual steps in the SMPTE EG 432–1 step-scale patterns available under the MONITOR button.<br><br>These signals are not part of the factory installed signal sets. You must install the enhanced signal sets to access these signals. (See Table 39 on page 120.) |
| | Red-1 Field, Red-2 Field, Green-1 Field, Green-2 Field, Blue-1 Field, Blue-2 Field, Cyan-1 Field, Cyan-2 Field, Magenta-1 Field, Magenta-2 Field, Yellow-1 Field, Yellow-2 Field | Full-frame color flat fields representing the individual colors in the SMPTE EG 432–1 color-accuracy patterns available under the COLOR BAR button.<br><br>These signals are not part of the factory installed signal sets. You must install the enhanced signal sets to access these signals. |

**Table 38: Standard SDI test signal sets (cont.)**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| Multiburst | | Multiburst pattern consisting of five or six sine wave packets, each of fixed frequency. This pattern is typically used for frequency response testing for one or three video channels. The packets have a 60% amplitude range upon a 50% level, therefore range between 20% and 80% levels. |
| | | For comparison to these peak limits, flat pedestals at 80% and 20% levels are present on the left side of the pattern. The set of packet frequencies used in each pattern is determined by the maximum bandwidth of the output format. |
| | | For 4:2:2 YCbCr formats, one multiburst pattern consists only of a Y channel signal, up to the maximum frequency limit, and the second multiburst pattern is identical for all three channels, up to half of the Y channel frequency limit. |
| | | For 4:4:4 formats, each multiburst pattern is identical for all three channels. |
| | Multiburst 0.5–2.75 MHz | (SD formats only) Three channel pattern with packet frequencies of 0.5, 1.0, 1.5, 2.0, and 2.75 MHz. |
| | Y Multiburst 0.5–5.75 MHz | (SD formats only) Y channel pattern with packet frequencies of 0.5, 1.0, 2.0, 3.0, 4.0 and 5.75 MHz. |
| | Multiburst 1–15 MHz | (HD and 3G formats only) Three channel pattern with packet frequencies of 1, 3, 6, 9, 12, and 15 MHz. |
| | Y Multiburst 15–30 MHz | (HD formats only) Y channel pattern with packet frequencies of 15, 18, 21, 24, 27, and 30 MHz. |
| | Multiburst 15–30 MHz | (4:4:4 and fast-progressive 3G formats only) Three channel pattern with packet frequencies of 15, 18, 21, 24, 27, and 30 MHz. |
| | Y Multiburst 35–60 MHz | (Fast-progressive 3G formats only) Y channel pattern with packet frequencies of 35, 40, 45, 50, 55, and 60 MHz. |
| Zone plate | Circle, Diagonal Sine, H Sine, H Sweep, V Sine, V Sweep, Custom-1, Custom-2 | Zone plate test signal with real-time parametric controls. These test signals are listed in the Configure Zoneplate submenu. (See page 89, *SDI Configure Zoneplate submenu*.) |
| Monitor | ChromaDuMonde | Color reference chart, used with permission of DSC Laboratories. The pattern consists of a series of DSC standard color patches representing the six primary colors, 18 evenly spaced intermediate colors, and four skin tone reference patches. The 24 primary and intermediate colors will show as a hexagonal shape on a vectorscope display, providing a reference for comparison with a camera-generated image of a physical DSC ChromaDuMonde chart. The pattern also includes an 11-step crossed grayscale section and a center section with 0% Black and 100% white patches. |

**Table 38: Standard SDI test signal sets (cont.)**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| | SMPTE 303M Color Reference | Color reference chart per SMPTE 303M, also known as the GretagMacbeth ColorChecker® chart. Cyan patch #18 cannot be reproduced properly in the RGB and XYZ color spaces because the red component lies at approximately −14%, which exceeds legal limits for RGB formats. This patch will appear as a cyan and Black checkerboard pattern, where the cyan patches are of a different hue than the full cyan patch as seen in YCbCr formats because the red component is clipped at 0%. The color values used from SMPTE 303M are those with respect to the $D_{65}$ illuminant. |
| | Black-White Step Scale<br>Black-Dark Gray Step Scale | Gray scale patterns per §6.9 of SMPTE EG 432-1-2007. A series of ten different monochrome patches at increasing luminance values is centered on a gray background, to verify gray scale tracking. The ten steps of the Black to white scale are normalized gamma-corrected values of 1/10 to 1 and the ten steps of the Black to dark gray scale are 1/31 to 10/31. |
| | Pluge and Luma Reference | Includes two elements to help in Black and white balance. The left side of the pattern contains a pluge pattern, with three vertical bars of −2%, 0%, and +2% Black. The right side of the pattern contains four gray boxes corresponding to luminance levels of 110 mV, 200 mV, 450 mV, and 700 mV (100% white) in the analog domain. The −2% patch of the pluge section is clipped to 0% Black for XYZ formats. |
| | Checkerboard | 4×4 grid of alternating Black and white patches, used to measure intra-frame contrast per §6.8 of SMPTE SMPTE EG 432-1-2007. |
| | Window | White square centered on a Black background. This pattern can be used as an alternative to a full-field white pattern when it is desirable for the average picture level (APL) to approximate normal program content. |
| | Production Aperture | Includes single-pixel wide lines at the extreme edges of the active video area, marking the complete production aperture. Vertical lines are implemented as single-sample pulses with no edge filtering, so this pattern is not legal as a broadcast signal. |
| | Clean Aperture | Grid pattern per SMPTE RP 187-1995. The clean aperture is marked by the outer markers, with overscan markers at approximate 2.5% increments. The center 4:3 section of a 16:9 image has an additional set of aperture and overscan markers. Each line on the grid is implemented with two horizontal lines or a double-width pulse centered on two samples, because the actual aperture boundary and the center of the image each lie midway between lines and samples. |
| | Convergence | Grid pattern of equal size squares, with a dot at the center of each square. Each line and dot is implemented as a single horizontal line or single-sample pulse. This pattern is used to verify convergence of RGB channels, and no color fringing should be visible on the white lines and dots when the channels are aligned. |

**Table 38: Standard SDI test signal sets (cont.)**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| Pulse Bar | 2T Pulse and Bar | Two pulses of 2T half-amplitude width and full-scale amplitude. A positive pulse is added to a base level at the minimum valid value, and a negative pulse is added to a bar level at the maximum valid value. The 2T pulse is used for Short Time response testing and the bar is used for Line Time response testing. |
| | | The type of 2T pulse depends on the signal format: |
| | | ■ For SD-525 format, this is a 2T4 pulse |
| | | ■ For SD-625 format, this is a 2T5 pulse |
| | | ■ For HD and slow-progressive 3G formats, this is a 2T30 pulse |
| | | ■ For 3G fast progressive formats, this is a 2T60 pulse |
| | | ■ For 4:2:2 formats, chroma pulses are at half the bandwidth |
| | Color Pulses | Eight color pulses of 2T half-amplitude width upon Black and white backgrounds. The upper half of the pattern has positive pulses on a Black background, testing each combination of the three color channels. The lower half of the pattern has a white background, so negative pulses are used to result in the same line colors. For example, the yellow pulse in the upper half is 100% red plus 100% green, resulting in yellow on a Black background. At the same horizontal location in the lower half, a pulse of −100% blue added to the white background also results in a yellow line. |
| Timing | Co-siting Pulse | One single-sample wide pulse in the center of the image, used to show the timing relationship and alignment between chroma and luma channels. Different amplitudes are used to distinguish the three channels. |

**Table 38: Standard SDI test signal sets (cont.)**

| Signal set | Signals in the signal set | Description |
|---|---|---|
| SDI | Equalizer Test | Full-field equalizer test pattern per SMPTE RP 198-1998. This pattern consists of alternate 10-bit words, 300h and 198h, regardless of the current sampling structure and format. For 10-bit 4:2:2 YCbCr HD-SDI formats, the Y samples carry the 198h words and the Cb/Cr samples carry the 300h words, resulting in a magenta-shaded field for this pattern. For other formats, these same 10-bit word values will result in different color representations. This pattern also includes the polarity control word, such that the first sample in the active picture in every other frame is 190h instead of 198h. |
| | PLL Test | Full-field phase-locked loop test pattern per SMPTE RP 198-1998. This pattern consists of alternate 10-bit words, 200h and 110h, regardless of the current sampling structure and format. It appears as a 24% gray field in 10-bit 4:2:2 YCbCr formats, but as different colors in other formats. |
| | SDI Matrix | Matrix pattern, with the equalizer test pattern (300h 198h) in the upper half of the field and the PLL test pattern (200h 110h) in the lower half of the field. |
| Frame Picture | Frame Picture | Picture rendered from user-supplied BMP files stored in the PICTURE directory of the mainframe memory. Use the left or right arrow button to select a test signal from the list. (See page 121, *SDI picture file generation*.) |

**Table 39: Enhanced SDI test signal sets**

| Enhanced signal set | Description |
|---|---|
| Monochrome fields | Includes all monochrome flat fields from 0% to 100% in 10% increments |
| Color fields | Includes color fields for six primary and secondary colors at both 100% and 75% values |
| SMPTE RP431-2 color patches | Includes full field patterns for each of the Black-White and Black-Dark Gray steps, plus the "–1" and "–2" color patches |

## SDI picture file generation

Frame pictures are .bmp files that are used to generate pictures. When generating signals from frame pictures, the instrument does not filter the video signal except at the left and right borders of the raster. The unfiltered signal allows users to control exactly what is generated and to create stressful patterns.

The instrument allows picture files to be used at resolutions larger and smaller than the native size of the picture file. If the picture image is larger than needed, it will be truncated and only the upper left corner of the image will be displayed. If the picture file resolution is smaller than the output raster, then the image will be displayed in the upper left corner of the output, and Black will be shown in the rest of the image.

The combination of not filtering and the use of nonnative image sizes has the potential to cause problems in several areas:

■ If the video in the frame picture file has fast transitions that exceed the normal video limits, then the final output may ring excessively and therefore not be appropriate for transmission. In most cases, the picture file should be processed to limit the edge speed before it is downloaded to the instrument.

■ If the video in the frame picture file is not shaped at the edges of the raster, then there may be ringing if the signal is put in motion. If this is a concern, then the picture file should be processed to have gradual transitions at the edges before it is downloaded.

■ If the frame picture file is used at a raster that is smaller than the native size of the file, then it will be truncated at the output raster size which may create unshaped edges. These will be masked for normal operation, but will be exposed if the signal is set in motion. If this is a problem, then the user should create a second version of the picture file that has the desired native raster size and has shaped edges.

■ If a frame picture file is used at a raster size greater than the native size of the file, then the two edges will inherently end up somewhere inside the output raster image. If the file has unshaped edges, then the output may have excessive ringing even when not in motion. If this is a concern, then the picture file should be processed to have gradual transitions at the edges before it is downloaded.

## SDI Zone plate signals

Zone plate video test patterns, or simply "zone plates", are important tools for the evaluation of video processing systems and techniques.

They are called zone plates because the classical circular pattern looks like an optical zone plate (which uses the principles of Fresnel diffraction to focus and intensify light). Today, however, the name has been applied to a wide variety of stationary and "moving" test patterns.

The following figure shows two enlarged optical zone plates. The white areas are transparent and the black areas are opaque. The precise spacing of the rings focuses and intensifies light that passes through the plate.
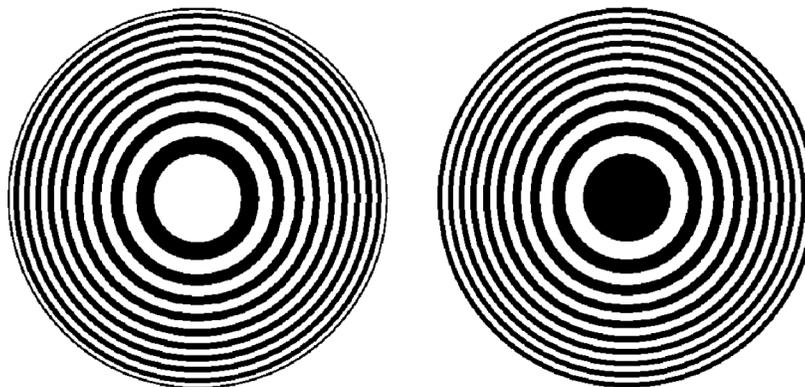


**Figure 31: Optical zone plates (enlarged)**

When Option SDI is installed, the instrument generates electronic zone plate signals, and can be configured to provide a near infinite number of test patterns. Six basic patterns are predefined (Circle, Diagonal, Horizontal Sine, Horizontal Sweep, Vertical Sine, and Vertical Sweep) for convenience. These patterns all have an overall, or pattern control, parameter.

Pattern control parameters are unique to the specific predefined signals, and are only found as the first item of the specific signal menu. User-created zone plate signals saved as Custom-1 or Custom-2 do not have pattern control parameters. The dependent parameters are common to all of the zone plate signals, and are found below the pattern control parameter in the menu for each zone plate signal.

Altering the pattern control parameter will make changes to the test signal while maintaining the basic pattern. For example, the pattern control parameter for the Circle zone plate signal is the Circle Frequency parameter. The Circle Frequency parameter controls the maximum frequency of the circle. You may change the Circle Frequency at will, and the system will adjust four other dependent parameters to maintain the pattern as a circle. However, if you change the underlying dependent parameters individually the pattern may change to be something other than a circle.

After changes have been made you can save the new signal as a custom zone plate signal.

**To use a zone plate signal**

Zone plate signals can be accessed from the Signal Selection setting in the SDI Signal submenu. (See page 86, *SDI Signal submenu*.) Here is an example of how you can use zone plate signals to simplify a common task.

One common task is measuring the horizontal frequency response of a system. With a typical swept-frequency generator you would apply a signal such as a 1 MHz to 30 MHz sweep with markers every 5 MHz. Then you try to estimate the frequency of the 3 dB roll-off point by interpolating the position of the 3 dB point between the markers.

The instrument's adjustable zone plate signal provides a better way:

■ The H Sweep Zoneplate pattern control parameter is the H Sweep Frequency, which controls the upper frequency limit of the sweep (the swept-to frequency).

  ‒ Simply adjust the H Sweep Frequency until the system roll-off is at –3 dB.

  ‒ Read the frequency directly from the instrument display.

■ The H Sine Zoneplate, which provides a constant frequency horizontal sine signal instead of a swept signal, can be used to reduce error in measuring attenuation at a given frequency.

  ‒ Set the Horz. Frequency parameter to a low value and measure the amplitude of the entire line.

  ‒ Next, calculate the –3 dB point ($0.707 \times$ the low frequency amplitude).

  ‒ Finally, increase the Horz. Frequency parameter until the system response for the whole line is at the calculated –3 dB level, and read the –3 dB frequency directly from the instrument display.

■ Since the ZP Amplitude parameter is adjustable for each of these signals, you can measure the response at 100%, 60%, or any other level as needed.

These same techniques can be used to measure vertical or diagonal response, by selecting the appropriate zoneplate signal.

**To modify a zone plate signal**
There are times when a specific test case requires a modified zone plate signal. By making and saving changes to the zone plate parameters you can create a new signal that is based on the selected signal, and then save that new signal. Changes you make affect only the new signal; the standard zone plate signal used as a basis for the new signal is not changed.

Before making changes, make sure you are familiar with both the zone plate pattern control parameters and zone plate pattern dependent parameters. (See page 124, *Zone plate pattern control parameters*.) (See page 126, *Zone plate dependent parameters*.)

Perform the following steps to change a zone plate signal parameters:

1. In the SDI menu, open the Signal submenu to access the Signal Selection drop-down list.

2. Use the drop-down list to view the Zoneplate Signals subgroup and select a zone plate signal from the provided six standard zone plate signals (Circle,

Diagonal, H Sine, H Sweep, V Sine, and V Sweep), or two user-defined signals (Custom-1 Zoneplate or Custom-2 Zoneplate). Each of the standard zone plate signals have a pattern control parameter that is unique to that signal as shown in the following table:

| Zone plate signal | Pattern control parameter |
| --- | --- |
| Circle | Circle frequency: [x] c/aph [1] |
| Diagonal | Diag. Frequency: [x] c/aph [1] |
| H Sine | Horiz. Frequency: [x] MHz |
| H Sweep | H Sweep Frequency: [x] MHz |
| V Sine | Vert. Frequency: [x] c/aph [1] |
| V Sweep | V Sweep Frequency: [x] c/aph [1] |

[1] c/aph = cycles per active picture height

3. When the desired zone plate signal is displayed, such as **Circle Zoneplate**, click Configure Zoneplate to open the Circle Zoneplate submenu.

4. While the pattern control parameter is displayed, you can edit the menu parameters to modify the signal while maintaining the basic pattern.

5. When you are done changing parameters, go to the **Save As:** menu item at the bottom of the menu and select either **Custom 1** or **Custom 2** to save the signal modifications.

**Zone plate pattern control parameters**

*NOTE. Zone plate variations can be sinusoidal, square, or triangular. These discussions of zone plated parameters will refer to sinusoidal variations for convenience.*

Zone plate patterns are made up of sinusoidal variations in luminance, with the "peaks" of the sine waves resulting in white areas on the video screen and the wave "troughs" shown as gray or black. The cycles can occur in all three of the video dimensions: horizontally, or along each line of the picture; vertically, or "down" the video frame; and temporally (with time). The three dimensions are often referred to by the shorthand designations of X, Y, and T.

The luminance of any point in the picture, physically on the screen and in time, is determined by the value of sine at that particular point; the value of sine follows from the phase of the cycle at that point; and (by the definition of a zone plate) the phase of any point is determined by the equation:

$$\phi_{xyt} = k_\phi + k_X\left(x\right) + k_Y\left(y\right) + k_T\left(t\right) + k_{XT}\left(xt\right) + k_{YT}\left(yt\right) + k_{XY}\left(xy\right)$$
$$+\frac{1}{2}k_{X^2}\left(x^2\right) + \frac{1}{2}k_{Y^2}\left(y^2\right) + \frac{1}{2}k_{T^2}\left(t^2\right)$$

where x, y, and t are the coordinates of the point in question and $k_\Phi$, $k_X$, $k_Y$, $k_T$, $k_{XT}$, $k_{YT}$, $k_{XY}$, $k_X{}^2$, $k_Y{}^2$, and $k_T{}^2$ are constants.

All instrument zone plate patterns are defined with coefficients of ten parameters that correspond to the constants in the above equation. While the possibilities are virtually endless, most common zone plates are defined with only one or two parameters, while the coefficients of the remaining parameters are kept at zero.

The instrument generates six standard zone plate signals: circle frequency, diagonal frequency, horizontal sine frequency, horizontal sweep frequency, vertical sine frequency, and vertical sweep frequency. Each standard zone plate signal has a pattern control parameter. (See Table 40.) This pattern control parameter is unique to the zone plate signal it is associated with.

When you first enter the zone plate parameters menu for a signal, the pattern control parameter for that signal is displayed. The pattern control parameter controls the basic pattern frequency by adjusting the dependent parameters. For example, if you change the Circle Frequency, the generator adjusts four of the dependent parameters to keep the circle round.

**Table 40: Zone plate pattern control parameters**

| Zone plate signal | Pattern control parameter | Parameter definition |
|---|---|---|
| Circle | Circle Frequency (maximum c/aph) | The circle frequency is actually the equivalent of the maximum vertical sinusoid frequency at the very top and bottom of the screen (see the discussion of the $K_Y{}^2$ parameter). Adjusting the circle frequency has the simple effect of increasing or decreasing the maximum frequency at the outer edges of the pattern. However, this adjustment actually changes the coefficients of four of the zone plate parameters to keep the pattern round and centered on the screen. |
| Diagonal | Diagonal Frequency (equivalent c/aph) | The diagonal frequency is $\sqrt{2}$ times the vertical and horizontal frequencies (c/aph). Adjusting the diagonal sine frequency changes both the KX and KY coefficients. |
| H Sine | Horizontal Frequency (MHz) | The horizontal frequency reported on the display is the real time frequency of the sine wave that causes the vertical bar pattern. The maximum frequency is half of the clock frequency used by the generator for the active video standard (for example, 74.25 MHz/2 = 37.125 MHz). |
| H Sweep | H Sweep Frequency (maximum MHz, or multiple) | For horizontal sweep frequencies up to half of the video standard's sampling frequency, $f_s$, the displayed value is the maximum (or swept to) frequency of the sine wave. For numbers greater than $f_s/2$, dividing the displayed value by the sampling frequency will give the number of complete DC–($f_s/2$)–DC cycles per line. For example, in a standard with sampling frequency of 74.25 MHz, a horizontal sweep frequency of 148.5 MHz will result in approximately two complete frequency sweeps across the picture. |

**Table 40: Zone plate pattern control parameters (cont.)**

| Zone plate signal | Pattern control parameter | Parameter definition |
|---|---|---|
| V Sine | Vertical Frequency (c/aph) | The vertical frequency is actually the $K_Y$ coefficient. The maximum frequency (c/aph) corresponds to the number of active video lines in a field of the active video standard. For example, when an 1125-line system is output (which has 1080 active lines), $K_Y$ can be any value between −540 and 540. |
| V Sweep | V Sweep Frequency (maximum c/aph, or multiple) | The vertical sweep frequency is actually the $K_Y{}^2$ coefficient. For numbers greater than maximum, dividing the displayed value by that maximum will give twice the number of complete DC-max-DC sweeps per field (sweeps = $(K_Y{}^2/K_Y)/2$). For example, in a standard with 1080 lines per field, a vertical sweep frequency of 2160 c/aph$^2$ would result in one complete frequency sweep down the picture. |

# Zone plate dependent parameters

The zone plate dependent parameters are listed below the Frequency pattern control parameter in each of the zone plate patterns; they are the same for all zone plate patterns.

**Frequency (pattern control) parameter**

Display name: Frequency

Units: c/aph per active picture height (c/aph$^2$)

The instrument generates six standard zone plate signals: circle frequency, diagonal frequency, horizontal sine frequency, horizontal sweep frequency, vertical sine frequency, and vertical sweep frequency. Each standard zone plate signal has a pattern control parameter. (See Table 40 on page 125.)

**$K_Y{}^2$ parameter**

Display name: KY^2 (V Sweep)

Units: c/aph per active picture height (c/aph$^2$)

The $K_Y{}^2$ (V Sweep) parameter sets the increase (or decrease) in vertical frequency down the frame. ($K_Y{}^2$ compares to $K_X{}^2$ as $K_Y$ compares to $K_X$.) Again, a good way to see the effect of $K_Y{}^2$ is to view the field on a waveform monitor. With KY set to 0.0, a $K_Y{}^2$ coefficient of 10 will result in the apparent vertical sine wave changing from DC to 10 c/aph from the top of the picture to the bottom.

To center the "DC point" at mid-screen, set $K_Y{}^2$ to −2 times $K_Y$.

The Vertical Sweep zone plate is a "$K_Y{}^2$-only" zone plate. (See Figure 35.)

**Figure 32: A "K$_Y$2-only" zone plate**

**Amplitude parameter**

Display name: Amplitude

Units: mV

Use this parameter to adjust the zone plate signal amplitude from 0.0 mV to 798.0 mV, in 0.5 mV increments. The default value is 700 mV.

**K parameter**

Display name: K (Phase)

Units: cycles

The K$_\varnothing$ parameter is the initial phase of the pattern; it cannot create a pattern by itself. To see the effects of this adjustment, first set the K$_X$ coefficient to approximately 0.75 and set a waveform monitor to view the line waveform. Then adjust K$_\varnothing$. The sine wave will begin on each line at the selected point in the cycle. Note that 0.25 cycle corresponds to a phase of 90 degrees (or $\pi/2$ radians); recall that the sine of 90° is 1.0 and the sine of –90° is –1.0. When K$_\varnothing$ = 0.25, the pattern will begin in the upper left corner of the screen as white; when K$_\varnothing$ = –0.25, the beginning will be Black.

**K$_X$ parameter**

Display name: KX (H Freq.)

Units: cycles/active picture height (c/aph)

K$_X$ denotes the initial constant horizontal frequency of the pattern. To see the effects of changing this coefficient, set a waveform monitor to view the video lines. Note that the units are cycles per active picture height. The number of cycles in a line will depend on the width-to-height aspect ratio of the active format. For example, K$_X$ = 9.0 will result in approximately 12 cycles per line in a format with a 4:3 aspect ratio; the same setting will yield about 16 cycles per line when the ratio is 16:9.

To estimate the equivalent absolute frequency of the sine wave (i.e., to convert from c/aph to c/s, or Hz), use the formula

$$f_{eq} \approx K_X \times R_{l:av} \times R_{aspect} \times N_{lines} \times f_{frame}$$

where

$R_{aspect}$ = the aspect ratio (width ÷ height)
$N_{lines}$ = the number of lines per frame
$f_{frame}$ = the frame rate
$R_{l:av}$ = the ratio of line length to the length of the active video

The maximum frequency is (±) half of the active format's sampling frequency. In formats that use a 74.25 MHz clock, for example, the maximum value of KX will correspond to a sine frequency of 37.1 MHz.

The Horizontal Sine zone plate, for example, is a "$K_X$-only" zone plate. (See Figure 35.)
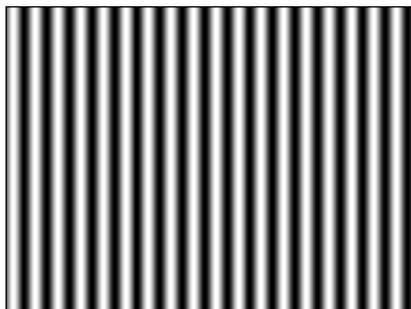


**Figure 33: A "$K_X$-only" zone plate**

**$K_{XT}$ parameter**    Display name: KXT (T Ch. H Freq.)

Units: c/aph per second (c/aph/s)

The $K_{XT}$ (T Ch. H Freq.) parameter controls the change in horizontal sine frequency over time. Setting $K_{XT}$ to 1.0, for example, causes the horizontal frequency to increase by one c/aph each second. If $K_X$ is 0.0, then the frequency will be 10 c/aph after ten seconds, 20 c/aph after twenty seconds, and so forth. The frequency will increase until it reaches the maximum for the active format, then the phase of the signal will "flip" by 180° (the sine wave will become "negative") and the frequency will continue to "increase" through DC, when the cycle will begin again.

**$K_X{}^2$ parameter**    Display name: KX^2 (H Sweep.)

Units: c/aph per active picture height (c/aph²)

The $K_X2$ (H Sweep) parameter sets the increase (or decrease) in the horizontal frequency as a function of position along the video line. When $K_X2$ alone is applied, the result resembles a common sweep test signal. Again, use a waveform monitor to look at (all) the video lines to see the effects of $K_X2$. When $K_X$ is 0.0, setting $K_X2$ to 9 will result in the line waveform changing from DC to 9 c/aph in the width equal to one "active picture height." As with $K_X$, the ending frequency will depend on the aspect ratio of the active video format. For example, in a 16:9 format with a $K_X$ of –9.0, a $K_X2$ coefficient of 9.0 will cause the waveform to increase to DC in one "aph." The frequency will continue to increase to approximately 7.0 c/aph by the end of the line.

Use this formula to calculate $K_X$ and $K_X2$ terms for a sweep with the DC point at mid-screen:

$$K_X = \left(-\tfrac{1}{2}R_{aspect}\right) \times K_{X2}$$

where $R_{aspect}$ is the aspect ratio (width ÷ height) of the active format.

The Horizontal Sweep zone plate (H Sweep) is a "$K_X2$-only" zone plate. (See Figure 35.)
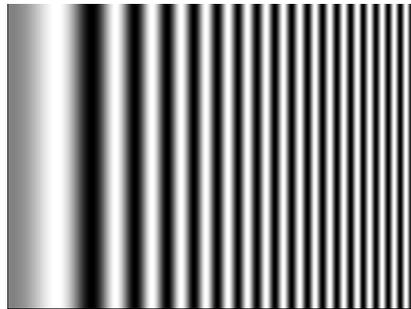


**Figure 34: A "$K_X2$-only" zone plate**

**$K_{YT}$ parameter**

Display name: KYT (V Ch. V Freq.)

Units: c/aph per second (c/aph/s)

The $K_{YT}$ (V Ch. V Freq.) parameter controls the change in vertical sine frequency over time. Setting $K_{YT}$ to 1.0, for example, causes the vertical frequency to increase by one c/aph each second. If KY is initially 0.0, then the frequency will be 10 c/aph after ten seconds, 20 c/aph after twenty seconds, and so forth. The frequency will increase until it reaches the maximum for the active format, then the phase of the signal will "flip" by 180° (the frequency will become "negative") and the frequency will continue to increase through DC in a repetitive cycle.

**$K_{XY}$ parameter**

Display name: KXY (V Ch. H Freq.)

Units: c/aph per active picture height (c/aph²)

The $K_{XY}$ (V Ch. H Freq.) parameter sets the change in horizontal frequency as a function of the vertical position in the video frame. To see the effects of this parameter, set the waveform monitor to view one selected line only. Then, with $K_{XY}$ set to approximately 25 (all other coefficients left at 0.0), look at line waveforms from top to bottom of the frame. The horizontal frequency increases slightly on each succeeding line, reaching 25 c/aph on the last line of active video. The result can be thought of as a vertically arranged "sweep" signal.

**$K_T$ parameter**

Display name: KT (T Freq.)

Units: cycles per second (c/s)

The $K_T$ (T Freq.) parameter, if used alone, does not create a "pattern." Rather, the entire screen will cycle (sinusoidally) between white and Black. The effect will be similar on either line or field display of a waveform monitor.

Typically, a small $K_T$ coefficient is set to add apparent motion to a standard circle, sine wave, or sweep pattern. To see the picture effects of this parameter, select any of the standard zone plates and vary $K_T$. Note that the $K_T$ coefficient may be positive or negative; the sign will determine the direction of the pattern's motion.

**$K_Y$ parameter**

Display name: KY (V Freq.)

Units: cycles per active picture height (c/aph)

The $K_Y$ (V Freq.) parameter sets the initial *vertical* frequency of the pattern (it is analogous to $K_X$ rotated 90° clockwise). To see the effects of this parameter, set it to a low number and adjust a waveform monitor to view one or two fields of the instrument SDI output. The variation in the (dc) voltage level from line to line will give the field waveform the appearance of a sampled sine wave, especially at a $K_Y$ of around 5 to 10 c/aph (the sinusoid can become difficult to discern at higher frequencies). Note that in the Y (vertical) parameters, the c/aph units translate directly into visible cycles down the frame.

The Vertical Sine zone plate is a "$K_Y$-only" zone plate. (See Figure 35.)



**Figure 35: A "$K_Y$-only" zone plate**

**K$_T$2 parameter**

Display name: KT^2 (T Sweep)

Units: cycles per second per second (c/s^2)

The K$_T$2 (T Sweep) parameter sets the change in temporal frequency over time. If K$_T$ is initially 0.0, setting K$_T$ 2 to 1.0 will result in an apparent K$_T$ of 10.0 after ten seconds, 20.0 after twenty seconds, and so forth. The temporal frequency will increase to maximum, return to 0.0, and repeat the cycle as long as the value of K$_T$ 2 remains greater than zero.

# Status menu

Click the Status tab to view the current status of instrument settings such as the signal reference source, the signals being output, and information about system faults and alerts. This menu is for viewing status only and no changes to the instrument settings can be made from this menu. The following figure shows the menu diagram on the left side of the Status menu.



**Figure 36: Status display**

In addition to the LTC status display on the top right of the display, there are indicators to provide a quick view of the instrument status. More information on these indicators is available under the System tab. (See page 137, *System menu*.)

**How to make configuration changes from the Status menu**

Each of the status items listed in the Status menu have links highlighted in blue that allow you to quickly move to the configuration menu for that parameter. For example, click Black 1 to go to the configuration menu for the Black 1 output.

**Reference**

This section of the Status display lists the currently selected reference source. Click the Reference tab to change the reference source.

**GPS**

This section shows the GPS and/or GLONASS signal quality, the number of satellites used, and the status of the GPS and/or GLONASS antenna.

**Genlock**

This section of the Status display shows the status and signal amplitude of the timing offset. If the Reference Source is set to Internal, these menu items will not contain any data. If a fault occurs, the Status field lists possible reasons for the fault. Click the System tab for more information on a fault or a reason for an alert.

**Time**

This section of the Status display shows the currently selected timing source on the top line and displays additional timing status messages. The information depends on the selected time source (such as, LTC, VITC, Internal). The submenu also provides an overview of the LTC input, format, and timing information for LTC outputs. and information on the current time settings.

**Video**

This section of the Status display shows the current format for each of the Black outputs (1–3). The submenu item appears only when Option SDI is installed; it shows the format and test signal on the selected SDI output (1 or 2).

**Audio**

This section of the Status display appears only when Option SDI is installed; it shows the status of the audio on each of the embedded audio groups and channels for the selected SDI output.

**LTC**    This section appears on the right side of the Status display. This section of the Status display shows the current source for each of the LTC outputs (1–4) and the Type fields show the format of each signal. If LTC 1 is configured to be an input, the display shows "Input" as the status for that signal. Click on the heading of each column to quickly go to the related item under the LTC tab.

┌─ **LTC** ────────────────────────────────────────────────────┐

| | **LTC 1 ( Output)** | **LTC 2** | **LTC 3** | **LTC 4** |
|---|---|---|---|---|
| **Source:** | Time of Day | Time of Day | Time of Day | Time of Day |
| **Type:** | 30 fps drop-frame | 30 fps drop-frame | 30 fps drop-frame | 30 fps drop-frame |

**Figure 37: LTC status display**

**PTP Status**    This section appears on the right side of the Status display. This section shows the status for the PTP master (primary and secondary) and PTP slave. The master status reports the clock quality and some of the ST2059-2 metadata parameters it is sending. The slave status reports the clock quality and some of the ST2059-2 metadata parameters it is receiving.

# System menu

Use the System menu to view and configure instrument settings such as network parameters, SNMP traps, GPI alarms, installed options, display brightness, beeper control, and hardware/firmware versions.

You can also use this menu to perform firmware upgrades, save and recall presets, and view diagnostic results.

The following figure shows the top-level System menu.



**Figure 38: System menu**

**Status indicators**
The INT, EXT, TIME, PWR1, PWR2, and FAULT indicators on the top right side of the SPG8000A Web Interface display provide a quick overview of the system status. If there are any problems, the color of the indicators change (such as red). You can click on an indicator to quickly go to the related menu to get more information. More information on the front panel indicators is provided in the *SPG8000A Installation and Safety Instructions*.

**Status submenus**
Click the individual selections to open submenus for the System menu.

- **Status**. This submenu provides a quick overview of the current system status. (See page 142, *PTP Network Settings submenu*.)

- **Presets**. Use this submenu to save or recall instrument settings saved as a preset. (See page 140, *Presets submenu*.)

- **General Settings**. Use this submenu to provide information on the general instrument settings and to upgrade the firmware through the Network. (See page 141, *General Settings submenu*.)

- **PTP Network Settings**. Use this submenu to set the Network parameters on the PTP connection. (See page 142, *PTP Network Settings submenu*.)

■ **SNMP Settings**. Use this submenu to enable or disable SNMP (Simple Network Management Protocol), and to configure up to four IP addresses to receive SNMP traps. (See page 143, *SNMP Settings submenu*.)

■ **GPI Settings**. Use this submenu to configure the General Purpose Interface (GPI) inputs and outputs. (See page 146, *GPI Settings submenu*.)

■ **Options**. Use this submenu to view which options are installed in the instrument. (See page 149, *Options submenu*.)

■ **Diagnostics**. Use this submenu to view the results of diagnostic tests for various components of the instrument. (See page 149, *Diagnostics submenu*.)

## Status submenu

Use this submenu to provide an overview of the status of the instrument. The menu items are read-only and cannot be modified directly. The following figure shows an example of the Status submenu; in this example no faults or alerts were detected by the instrument.

**▾ Status (No Fault, No Alert)**

**Faults**

• **No Fault**

**Alerts**

• **No Alert**

**Frame Resets**

|  | Frequency | Blk 1,2,3 LTC | Blk 4,5 Cmpst | AES | SDI |
|---|---|---|---|---|---|
| Frame Reset 1 | 2.997 Hz | ✔ | ✔ | – | ✔ |
| Frame Reset 2 | 6.25 Hz | – | ✔ | – | – |
| Frame Reset 3 | 3.0 Hz | – | – | – | – |

**Versions**

**Firmware Version:** 2.2 Dec 05 16:29 2016
**PTP Firmware Version:** R2.3.0
**Hardware:**
Main: v0.14 Fr:v1.5 FP:v1.1 PS:v2.7;  Reference: v3.9 DO:40 BB:57 ID:3015 v1.06;  BG: v1.2 BG1:33 BG3:36;  AES: v1.1 AUD:08;  SDI: v2.5 G: v2.3 2014-10-9 13:18

**Memory**

**Used:** 16.58 MiB (17383424 bytes)
**Free:** 79.42 MiB (83279872 bytes)

**Figure 39: System Status submenu**

**SPG8000A User Manual**

The Status submenu contains the following sections:

- **Faults**. If there are any instrument faults, this section contains a brief description of the fault. If no faults are detected, **No Fault** is displayed. Refer to the *SPG8000A Installation and Safety Instructions* for more information on the alert and fault error messages.

- **Alerts**. If there are any instrument alerts, this section contains a brief description of the alert. If no alerts are detected, **No Alert** is displayed. Refer to the *SPG8000A Installation and Safety Instructions* for more information on the alert and fault error messages.

- **Frame Resets**. This section displays the three frame reset signals in the instrument and shows, if any, which instrument outputs are currently using each frame reset signal. Refer to *Frame reset signals* for detailed information about how the frame reset signals are used. (See page 1.)

  The following figure shows the Frame Reset 1 signal being applied to the Black 1, 2, 3, 4 and 5 and SDI outputs. In this example, no outputs are using the Frame Reset 3 signals.

| Frame Resets | Frequency | Blk 1,2,3 LTC | Blk 4,5 Cmpst | AES | SDI |
|---|---|---|---|---|---|
| Frame Reset 1 | 2.997 Hz | ✔ | ✔ | – | ✔ |
| Frame Reset 2 | 6.25 Hz | – | ✔ | – | – |
| Frame Reset 3 | 3.0 Hz | – | – | – | – |

**Figure 40: Frame Resets example**

- **Versions**. This section displays the versions of the various software and hardware components in the instrument. The firmware version includes the date and time of the firmware build; the date and time are in the format <month, date, time, year>.

  The hardware versions include the following:

  - Main. Lists the versions for the CPU, main FPGA (Fr), Front Panel board (FP), and Power Supply Combiner board (PS).

  - Reference. Lists the versions for the Black board PLD, both of the Black board FPGA versions (DO and BB), and an ID value. The ID value will always be "0000 v0.0".

  - BG. Lists the versions for the Option BG PLD, and both of the Option BG FPGA versions (BG1 and BG3).

- AES. The AES version will always be v0.0.

- SDI. When Option SDI is installed, lists the versions for the SDI PLD, the SDI FPGA version (G), and the build date (year, month, day, time).

■ **Memory**. This section displays the total amount of flash memory that is installed in the instrument and displays the amount of memory that is being used and the amount that remains free (available). The graphical bar provides a quick view of the amount of memory being used.

The flash memory is used by the custom test signal, frame picture, logo, font, and text overlay files that you install in the instrument. When the amount of available memory is low, you might need to delete some of these custom files from memory before you can install new files.

# Presets submenu

Use this submenu to recall instrument settings saved as a preset or save the current instrument settings to a preset. You can also delete or rename presets. The following figure shows the Presets submenu.
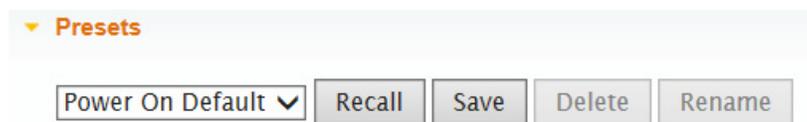


**Figure 41: System Presets submenu**

Use the drop down list to select the desired preset. There are 13 selectable presets. The first seven numbered presets can be recalled using the mainframe GPI (General Purpose Interface).

The following three presets are named at the factory and have special functions:

■ **Power On Default**. Use this preset to save instrument settings that you want automatically loaded when the instrument powers on. You cannot assign this preset name to another preset.

■ **User Default**. Use this preset to save user-specified default settings. If you save new instrument settings in this preset, a confirmation message appears to prevent overwriting.

■ **Factory Default**. Use this preset to reset the mainframe and all of the installed modules to the factory default settings. Some System button menu settings are not affected when the factory default settings are recalled. (See page 158, *System menu factory default settings*.)

Use the following buttons to recall, save, delete, or rename existing presets:

- **Recall**. Click the button to recall the instrument settings saved in the selected preset.

- **Save**. Click the button to save the current instrument settings to one of the 13 available presets, shown in the drop-down list.

- **Delete**. Click the button to delete the contents of the specified preset in the drop-down list. You cannot delete the following presets: Power on Default, User Default, and Factory Default.

- **Rename**. Click the button to rename the selected preset from the drop-down list. When you click the Rename button, another dialog box appears where you can enter the new name. You can enter a text string of up to 32 characters. Click **OK** after entering the new name.

## General Settings submenu

Use this submenu to enable or disable the alarm beeper, adjust the front panel LCD contrast, select the active power supply, and to update the firmware through the Network.

- **Enable Alarm Beeper**. Select the check box to enable the beeper function in the instrument. When enabled, the beeper alerts the user when a fan fault condition has been detected. Clear the check box to disable the alarm beeper.

- **Front Panel LCD Contrast**. Enter a number between 0 and 40 to adjust the contrast of the LCD display. The default value is 8.

- **Active Power Supply**. When two power supply modules are installed in the instrument (Option DPW) and both are connected to power, use this menu item to select which of the two supplies is the primary (active) supply.

*NOTE. It is recommended that you configure the supply with the most temperature weighted hours to be used as the primary supply. This allows for the newer supply to be preserved so it can provide the best possible backup should the primary supply fail. For more information about how to operate an instrument with two power supplies, see the SPG8000A Installation and Safety Instructions.*

- **SPG A/V output EPOCH Selection**. Use this setting to change the timing on the Black outputs.

*NOTE. For PTP systems, set this to the 1970 epoch.*

- **Upgrade Firmware (via Network)**. Click this button to upgrade the instrument firmware using the Network. To upgrade the firmware using a

USB drive, you must use the instrument front panel to perform the upgrade. (See page 27, *How to upgrade the instrument firmware*.)

When you click the Upgrade Firmware button, a dialog box displays a warning that the firmware upgrade procedure will disrupt instrument operation and will overwrite all user data. Click OK to proceed or Cancel to cancel the procedure.

When you click OK, the instrument will connect to the Network to download the latest firmware. Follow the on-screen instructions to download the firmware.

## PTP Network Settings submenu

Use this submenu allows the user to set the Network parameters on the PTP connection. The following figure shows an example of the PTP Network Settings submenu.



**Figure 42: PTP Network Settings submenu**

This menu also allows setting the DSCP level on the PTP messages. For most situations, the default value of 0 for noncritical General messages and 46 for the Event messages is appropriate. If you are using the AES67 profile, it may help to set both message types to the maximum value of 56. Changing these values resets all of the PTP systems and will disrupt the PTP operation for about 35 seconds.

This menu also allows control of the internal switch. The RJ45 and SFP ports can be configured as fully cross-linked, isolated or to mirror the RJ45 to the SFP. For most applications the Isolated setting is appropriate. This setting allows the two ports to both access PTP functions and not allow cross traffic. If you want the ports to work like a normal switch, use the Cross-linked setting. In this setting, all traffic into either port will echo out the other port. In Mirror mode, all the traffic in and out of the RJ45 port will be echoed to the SFP port. This is useful if you need to use Wireshark on a Unicast system. In this case, hook the Wireshark PC to the SFP port and use the internal switch to mirror the traffic.

The PTP Network Settings submenu contains the following sections:

- **PTP MAC Address**.

- **Switch Mode**.

- **DSCP Event Message Priority**.

- **DSCP General Message Priority**.

**IPv4 Setttings**

- **Enable DHCP**.

- **IP Address**.

- **Subnet Mask**.

- **Gateway**.

## SNMP Settings submenu

Use this submenu to enable or disable SNMP (Simple Network Management Protocol) remote control of the instrument and to configure up to four IP addresses to receive SNMP traps. The following figure shows the SNMP Settings submenu.



**Figure 43: SNMP Settings submenu**

This submenu has the following menu items:

- **Enable SNMP**. Select this check box to enable SNMP communication with the instrument; clear the check box to disable the communication.

- **Enable Traps**. Select this check box to enable the instrument to send SNMP traps; clear the check box to disable the instrument from sending SNMP traps.

- **SNMP Traps**. This section of the submenu lists the individual SNMP traps. Select individual traps for which instrument conditions will trigger an SNMP

trap to be sent. For more information on each trap refer to the discussion of the SNMP Traps. (See page 144, *SNMP Traps*.)

■ **Trap Destinations**. Use these entry boxes to set the destination IP addresses of the SNMP traps. You can configure up to four IP addresses to which SNMP traps will be sent when error conditions are detected.

*NOTE. The default value for the SNMP trap addresses is all zeroes, which disables the trap outputs.*

■ **Public Community**. Use this area to set the Public Community string, which is effectively a password and is required before SNMP commands can read values from the instrument. The default string value is **public**. You can enter a string of up to 16 characters.

■ **Private Community**. Use this area to set the Private Community string, which is effectively a password and is required before SNMP commands can read or write changes into the instrument. The default string value is **private**. You can enter a string of up to 16 characters.

■ **Download SPG8000 MIB File**. Click this link to download and open the SPG8000 MIB file. The SPG8000, SPG8000A, and SPG8000A share the same MIB file. Some of the commands in the file will apply to features and functions available only on the SPG8000 and SPG8000A.

**SNMP Traps**  Select the individual traps to be sent by the instrument to trigger an SNMP trap. Select the check boxes to enable the traps; clear the check boxes to disable them.

■ **Main Fan Fault**. When enabled, the instrument sends an SNMP trap when a fault with the main fan is detected.

■ **Voltage Error**. When enabled, the instrument sends an SNMP trap when a voltage error is detected. You can use the Diagnostics submenu to view the current instrument voltages. (See page 149, *Diagnostics submenu*.)

■ **Temperature Error**. When enabled, the instrument sends an SNMP trap when a temperature error is detected. You can use the Diagnostics submenu to view the current instrument temperatures. (See page 149, *Diagnostics submenu*.)

■ **GPS Signal Missing**. When enabled, sends an SNMP trap when a loss of the GPS and/or GLONASS input signal to the instrument is detected.

■ **Genlock Input Missing**. When enabled, the instrument sends an SNMP trap when a loss of the genlock reference input signal is detected.

■ **Loss of Lock**. When enabled, the instrument sends an SNMP trap when a loss of lock to the genlock reference input signal is detected.

- **Near Loss of Lock**. When enabled, the instrument sends an SNMP trap when a near loss of lock to the genlock reference input signal is detected. The threshold for near loss of lock is approximately $2 \times 10\text{-}6$ from the ends of the tune range.

- **VITC/LTC Missing**. When enabled, the instrument sends an SNMP trap when a loss of the VITC or LTC output signal is detected.

- **LTC Out of SMPTE Spec**. When enabled, the instrument sends an SNMP trap when the LTC input signal is detected to be noncompliant with the SMPTE standard.

- **GPS FOM**. When enabled, sends an SNMP trap when the quality of the GPS and/or GLONASS input signal to the instrument is detected to be below the quality level limit configured in the Reference menu. (See page 79, *GPS*.)

- **Alarm Time**. When enabled, the instrument sends an SNMP trap when the program time counter matches the Alarm Time value configured in the TIME menu.

- **PS1 Fault**. When enabled, the instrument sends an SNMP trap when a fault with Power Supply 1 is detected.

- **PS2 Fault**. When enabled, the instrument sends an SNMP trap when a fault with Power Supply 2 is detected.

- **PS1 TWH**. When enabled, the instrument sends an SNMP trap when Power Supply 1 is detected to have exceeded the temperature weighted hours limit.

- **PS2 TWH**. When enabled, the instrument sends an SNMP trap when Power Supply 2 is detected to have exceeded the temperature weighted hours limit.

# GPI Settings submenu

The GPI Settings submenu configures the General Purpose Interface (GPI) inputs and outputs. See the *SPG8000A Installation and Safety Instructions* for information about the GPI interface.

The following figure shows the GPI submenu.



**Figure 44: GPI Settings submenu**

This submenu contains the following menu items:

- **Input Trigger Select**. Use the drop-down list to configure pin 4 of the GPI port connector to trigger the instrument to perform one of the functions listed below.

  - **None**. This selection disables the GPI Input Trigger function.

  - **Reset Program Time**. This selection resets the program time of the instrument.

  - **Reacquire GPS Position**. When Option GPS is installed, forces the instrument to reacquire the GPS and/or GLONASS position from the antenna input.

  - **Jam Sync**. This selection immediately synchronizes the instrument timecode to the selected time source for each output.

  *NOTE. A daily Jam Sync should be performed on systems running at non-integer frame rates. This can be scheduled using the Jam Sync submenu in the Time menu. (See page 168, Jam Sync submenu.)*

- **GPI Output Alarms**. Use these menu items to configure which instrument faults will trigger an output signal on the selected GPI output. Each Output

Alarm Section has a series of faults that can be selected to trigger an output signal. These faults are described in more detail under GPI Output Alarm Selections. (See page 148, *GPI Output Alarm Selections*.)

Each GPI output corresponds to specific pins on the GPI and GPI/LTC port connector on the rear panel of the instrument.

- **Output 1 Alarm Select**. This output corresponds to pin 2 on the GPI port connector and pin 1 on the GPI/LTC port connector.

- **Output 2 Alarm Select**. This output corresponds to pin 3 on the GPI port connector and pin 2 on the GPI/LTC port connector.

- **Output 3 Alarm Select**. This output corresponds to pin 6 on the GPI port connector. The GPI output 3 signal does not appear on the GPI/LTC port connector.

- **Alarm Delays**. Use these menu items to configure the delay for each of the GPO Lock and GPO Time error and warning conditions. The purpose of the delay settings is to reduce the number of false alarms by allowing time for the fault condition to clear before an alarm signal is sent. The delays for each of the error and warning conditions are in the HH:MM:SS format. The default delay is 10 seconds for each of the error and warning conditions. The delay is applied to all three GPI output signals.

  - **GPO Lock Error**. Sets the delay time before a GPI alarm signal is sent when a loss of lock to the genlock reference input signal is detected.

  - **GPO Lock Warning**. Sets the delay time before a GPI alarm signal is sent when a near loss of lock to the genlock reference input signal is detected. The threshold for near loss of lock is approximately $2 \times 10e\text{-}6$ from the ends of the tune range.

  - **GPO Time Error**. Sets the delay time before a GPI alarm signal is sent when the instrument detects that the selected time input is invalid. For example, if LTC is the selected time input and the signal is missing or discontinuous.

  - **GPO Time Warning**. Sets the delay time before a GPI alarm signal is sent when the instrument detects that the selected time input is present and valid, but not meeting all expectations. For example, if LTC is the selected time input but the timing between LTC and the genlock input does not meet the SMPTE 12M specification.

**GPI Output Alarm Selections**

The GPI Output Alarm Selections configure which instrument faults will trigger an output signal on the selected GPI output (1, 2 or 3). Each GPI output is separately configured.

■ **Hardware Fault**. When enabled, sends an alarm signal to the selected GPI output when a hardware fault in the instrument is detected. Use the Diagnostics submenu in the System menu to view information for all conditions that can trigger this fault. (See page 149, *Diagnostics submenu*.)

■ **PS Fault**. When enabled, sends an alarm signal to the selected GPI output when a fault with either Power Supply module is detected.

■ **Lock Error**. When enabled, sends an alarm signal to the selected GPI output when a loss of lock to the genlock reference input signal is detected.

■ **Lock Warning**. When enabled, sends an alarm signal to the selected GPI output when a near loss of lock to the genlock reference input signal is detected. The threshold for near loss of lock is approximately $2 \times 10e\text{-}6$ from the ends of the tune range.

■ **Time Error**. When enabled, sends an alarm signal to the selected GPI output when the selected time input is invalid. For example, if LTC is the selected time input and the signal is missing or discontinuous.

■ **Time Warning**. When enabled, sends an alarm signal to the selected GPI output when the selected time input is present and valid, but not meeting all expectations. For example, if LTC is the selected time input but the timing between LTC and the genlock input does not meet the SMPTE 12M specification.

■ **Alarm Time**. When enabled, sends an alarm signal to the selected GPI output for the one second when the program time counter matches the Alarm Time value configured in the TIME menu. (See page 166, *Scheduled Time*.)

# Options submenu

The Options submenu displays which options are installed in the instrument and allows you to enter the option key for Options 3G and/or DBT.

The following figure shows the Options submenu.



**Figure 45: Options submenu**

This submenu contains the following menu items:

- **Unique ID**. This is the unique ID number assigned to the instrument. You must provide this ID number when you order Option SDI.

- **Option Key**. This area displays the option key assigned to the instrument. If you order an upgrade to the instrument, you may be supplied a new option key that you must enter using this menu item to enable the option. Enter the option key and then click **Apply** to enable the option.

- **Options Enabled**. This is a list of hardware and software options installed in the instrument. If your instrument has Option SDI installed, **SDI 3G** will be listed. If no options are installed, **None** is displayed.

- **Option**. This area displays a list and description of the installed options.

# Diagnostics submenu

The Diagnostics submenu displays the results of diagnostic tests for various components of the instrument. It contains information on the following components of the SPG8000A:

- Mainframe, including power supply and main board voltages information

- Reference module

■ SDI module.

■ PTP module.

---

*NOTE.* *The Diagnostics submenu provides information on all of the conditions that drive the FAULT light on the front panel, and the Hardware fault selection on the GPI.*

*When the instrument is in Factory mode, you can view additional diagnostic results and initiate specific diagnostic tests for servicing the instrument. See the SPG8000A Service Manual for more information about the Factory mode diagnostics.*

---

**Mainframe diagnostic readouts**

The following figure shows the diagnostic readouts for the Mainframe. The readouts are grouped into sections for general diagnostics, power supply diagnostics, and Main board voltages.
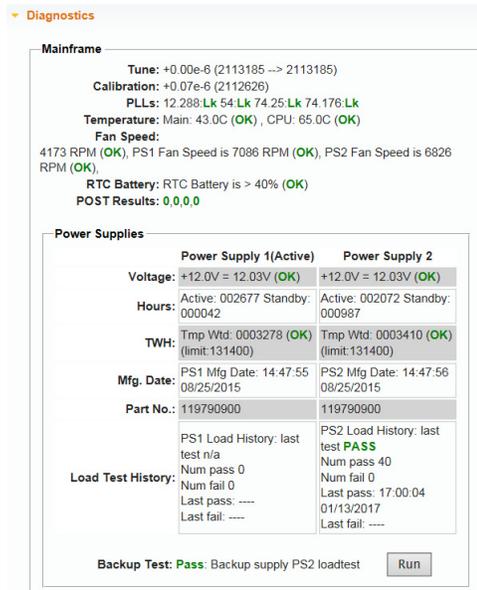


**Figure 46: Mainframe diagnostic readouts**

**General mainframe diagnostic readouts.** The following general diagnostic readout information is provided for the Mainframe:

- **Tune**. This readout displays how far the instrument is deviating from the calibrated internal frequency of the internal oscillator to lock to an external reference input. One value of this readout is to determine if the instrument oscillator needs to be calibrated. If the instrument is locked to a traceable reference, then any tune value indicates error in the instrument calibration.

  The first part of the readout indicates the fractional amount of deviation from the calibrated frequency. For example, if you use a reference signal to lock to a video source that is 5 parts per million high, then the readout will say "+5.00e-6". This allows you to measure the frequency of the reference input and to see if the input is near the end of the available tuning range. If the instrument is in internal reference mode, the tune value should be 0.00 e-6 and the integer values will equal the Calibration value readout.

---

*NOTE. The display will show non-zero deviation values only when the signal reference source is not configured as Internal in the Reference menu. (See page 77.)*

---

  The integer values indicate the actual tuning control word. The allowed range of the tuning control word is 0 to 4,194,304. The first number is the current value of the word and the second number is the target value for the tuning control loop. In most cases, these two values are the same. However, in the case where the instrument needs to make a large frequency change to achieve signal lock, then depending on the instrument mode, the value may slew slowly to the target value to stay inside the allowed slew rate for reference systems. In this case, the first number will slew over seconds or minutes until it equals the value of the second number. If the instrument is taking a long time to lock to an external reference signal, the Tune readout may provide valuable information about what is happening.

- **Calibration**. This readout displays the tuning control word for the calibrated frequency of the mainframe oscillator and how far the instrument is deviating from the calibrated frequency to achieve a lock to the internal reference.

  The first part of the readout indicates the fractional amount of deviation from the calibrated frequency. For example, a readout of "0.59e-6" indicates a fractional correction of 0.59 parts per million. When a calibration of the instrument oscillator is performed, the readout values will typically change.

  Over the life of the oscillator oven, the expected frequency drift is ±2.5 e-6, so this number should always be in this range. If the fractional number is not within this range, then the instrument may have been miscalibrated, or the oscillator oven may have drifted out of specification since the last calibration. In this case, you should consider calibrating the internal frequency of the

instrument using the Oven oscillator calibration procedure as described in the *SPG8000A Installation and Safety Instructions*.

After calibration, if the value is still greater than ±2.5 e-6, then you may need to get the oven oscillator serviced.

- **PLLs**. These readouts display the frequency for each of the internal clocks used to drive the video outputs. All of the clocks should show a status of locked (**Lk**) during normal instrument operation.

- **Temperature**. These readouts display the temperature of the Main and CPU hardware components in degrees C followed by the status. The status shows **OK** when a temperature is within the operating range or **WARN** when a temperature is out-of-range.

- **Fan Speed**. This readout displays the current speed of the main fan in RPM followed by the status. **OK** displays when the fan operation is within range; **WARN** displays when the fan operation is out of range.

- **RTC Battery**. This readout displays the status of the RTC (Real Time Controller) battery power level. The following status messages can appear:

  - **> 40% (OK)**. This indicates the battery power is good.

  - **20% to 40% (WARN)**. This indicates the battery power is getting low and should be replaced soon.

  - **< 20% (LOW)**. This indicates that the battery should be replaced immediately.

- **POST Results**. This readout displays error codes for four internal modules. The error code numbers should all be "0" (zero). Non-zero numbers indicate a hardware problem with the instrument and that the instrument should be returned to Tektronix for service. This readout is not available from the instrument front panel.

**Power Supplies diagnostic readouts.** The following figure shows the diagnostic information for the power supplies, a subset of the Mainframe diagnostic information.



**Figure 47: Power Supplies diagnostic readouts (load test in progress)**

The following diagnostic information is shown for each installed Power Supply module:

- **Voltage**. These readouts display the status of the +12 V supply on each installed power supply module. If the voltage is within the operating range **OK** is displayed; if the voltage is out-of-range, **WARN** is displayed. If a power supply module is not installed, **PS<1 or 2> 12V: not installed** is displayed.

- **Hours**. These readouts display the number of hours that each installed power supply module has been in the preferred (Active) and backup (Standby) states. If a power supply module is not installed, **PS<1 or 2> not installed** is displayed for that module.

- **TWH**. These readouts display the number of temperature weighted hours that each installed power supply module has been in operation versus a limit of 131,400 hours. **OK** displays if the number of hours is within the operating limit; **WARN** displays when the number of hours exceeds the limit. For critical applications, you may want to replace the power supply periodically to prevent down time.

  The instrument uses a log to track the number of hours that a power supply module has been powering the instrument. The expected life of a power supply module varies with the temperature and load. For a fully-loaded instrument in

a 25 °C room, the power supply is specified to last at least 15 years (131,400 hours). For a lightly loaded instrument with only one or two modules running a 25 °C, the power supply should last 20 years (175,000 hours).

At the maximum room temperature, the expected life of the power supply is significantly less. For example, for a fully loaded instrument operating at 50 °C room temperature, the expected life of the power supply is 5 years (43,800 hours). The temperature-weighted hours (TWH) accounts for variations in the operating environment and displays a number normalized to 25 °C operation. Therefore, if the TWH is near the 131,400 recommended limit, then you should consider replacing the supply.

If a power supply module is not installed, **PS<1 or 2> not installed** is displayed for that power supply.

- **Mfg. Date**. These readouts display the manufacturing date of each installed power supply module. The readouts include the time (HH:MM:SS) and the date (day, month, year). If a power supply module is not installed, **PS<1 or 2> not installed** is displayed for that module.

- **Part No**. These readouts display the Tektronix part number of each installed power supply module. If a power supply module is not installed, this readout displays **0** for that power supply. This readout is not available from the instrument front panel.

- **Load Test History**. These readouts display a brief history of the load test for each installed power supply module. The readouts include the status of the previous load test for each installed power supply module (when the module was configured to be the backup (standby) supply), the number of times the module has passed or failed the test, and the date (year, month, day) and time (HH:MM:SS) of the last test. If a power supply module is not installed, **PS<1 or 2> not installed** is displayed for that power supply.

- **Backup Test.** The instrument must have two power supply modules installed (Option DPW) and connected to power to run this load test. The load test checks that the power supply module that is configured as the backup supply is operational and ready to be configured as the primary (preferred) supply.

  You can manually perform the backup test by clicking the **Run** button. While the instrument is in operation, this test is automatically performed once every

24 hours. The example diagnostic display above shows the readout with a load test in progress.

---

*NOTE. If you have only one power supply installed that is connected to power, an error message will appear if you attempt to run this test.*

*If you attempt to run the load test immediately after changing the preferred supply configuration or if you rerun the test immediately after running the test a first time, an error message may appear stating that the load must cool down before the test can be run. The error message includes an estimate of the time needed for the load to cool down before you can run the test. An example message in this situation is "Error: cooldown, 1 min 40 sec left."*

---

**Main Board Voltages diagnostic readouts.** These readouts display the status of the Main board voltages. **OK** displays when the voltages are within the operating range; **WARN** displays when a voltage is out-of-range.

The following figure shows the diagnostic information for the main board voltages, a subset of the Mainframe diagnostic information.



**Figure 48: Main Board Voltages diagnostic readouts**

**Reference Module
diagnostic readouts**

The following figure shows the diagnostic information for the Reference Module.


```
┌─Reference Module ──────────────────────────────────────┐
│     ADC Stuck Bits: LLLLLLHH----                        │
│     ADC Short Bits: SSSSSSSS----                        │
│     Genlock Input: Min: 1989 Max: 1994                  │
│          LTC+ Input: Min (Raw): 1043 Max (Raw): 1278    │
│          LTC- Input: Min (Raw): 1019 Max (Raw): 1268    │
│          REF Board: NA                                  │
│              Tune: Phase: 0x8000001A DDS: 2113109 Fine  │
│     Phase Detect: Up: A=0x0699 (OK) B=0x0693 (OK)       │
│     Phase Detect: Down: A=0x8CE7 (OK) B=0x9092 (OK)     │
│                                                         │
│  ┌─Reference Module Voltages ──────────────────┐        │
│  │           +5V: 4.9V (OK)                     │        │
│  │     −5V wrt 3.3V: 0x0386 (OK)                │        │
│  │           +8V: 7.9V (OK)                     │        │
│  └─────────────────────────────────────────────┘        │
└─────────────────────────────────────────────────────────┘
```
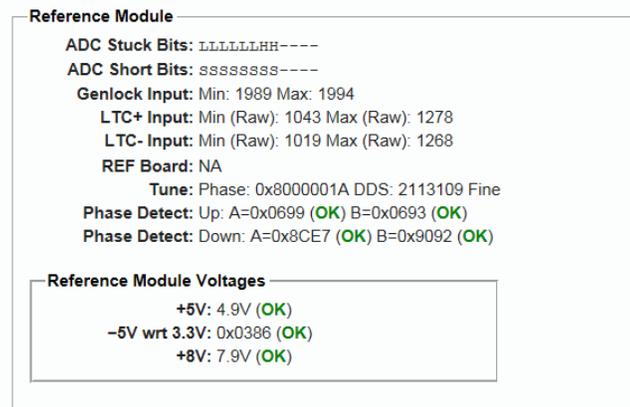
**Figure 49: Reference Module diagnostic readouts**

The following diagnostic readouts are shown for the Reference Module.

*NOTE. If no input is applied to the Genlock circuit, then the ADC bits will be moving and so may appear stuck. This is not an indication of a problem.*

■ **ADC Stuck Bits**. This readout is a 12-bit display showing the bits stuck high (H), low (L), or OK (-).

■ **ADC Short Bits**. This readout is a 12-bit display showing any shorted adjacent lines (SS) (-).

■ **Genlock Input**. This readout displays the minimum and maximum value from the genlock ADC for the present input signal.

■ **LTC+ input**. This readout displays the minimum and maximum raw ADC values of the positive LTC input.

■ **LTC- input**. This readout displays the minimum and maximum raw ADC values of the negative LTC input.

■ **REF Board**. Placeholder

■ **Tune**. This readout should be ignored.

■ **Phase Detect**. Placeholder.

■ **Reference Module voltages**. These readouts display the voltages of the Reference module. The status for each voltage displays **OK** when the voltages are within the operating range; the status displays **WARN** when a voltage is out-of-range.

**SDI Module diagnostic readouts**

The following figure shows the diagnostic information for the SDI Module.
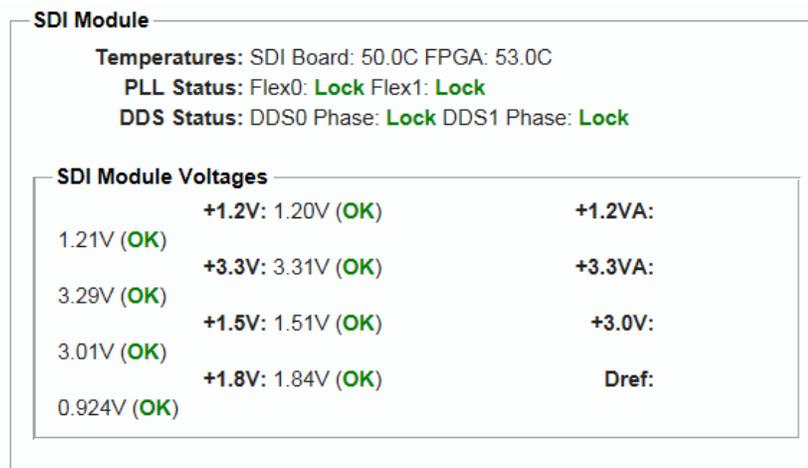


**Figure 50: SDI Module diagnostic readouts**

The following diagnostic readouts are shown for the SDI module:

■ **Temperatures**. This readout displays the temperatures of the SDI board and the FPGA in degrees C.

■ **PLL Status**. This area displays information about the clocks used to generate SDI signals (Option SDI only):

 – **Flex0**. This readout indicates the state of the flexible clock generator for output channel 1 (SDI 1A and SDI 1B connectors). This readout should show **Lock** (locked). An **Unlk** (unlocked) reading might indicate a problem with the Option SDI board or with the instrument.

 – **Flex1**. This readout indicates the state of the flexible clock generator for output channel 2 (SDI 2A and SDI 2B connectors). This readout should show Lock (locked). An **Unlk** (unlocked) reading might indicate a problem with the Option SDI board or with the instrument.

■ **DDS Status**. This readout displays information about the clocks used to generate SDI signals (Option SDI only):

 – **DDS0 Phase**. This readout indicates that the flex clock circuit is correctly aligned with the internal frame pulse for output channel 1 (SDI 1A and SDI 1B connectors). This readout should show **Lock** (locked). An **Unlk** (unlocked) reading might indicate a problem with the Option SDI board or with the instrument.

 – **DDS1 Phase**. This readout indicates that the flex clock circuit is correctly aligned with the internal frame pulse for output channel 1 (SDI 2A and SDI 2B connectors). This readout should show **Lock** (locked). An **Unlk**

(unlocked) reading might indicate a problem with the Option SDI board or with the instrument.

■ **SDI Module voltages**. These readouts display the voltages on the SDI module. The status for each voltage displays **OK** when the voltages are within the operating range; the status displays **WARN** when a voltage is out-of-range.

# System menu factory default settings

The following table shows the settings for the System menu that are reset when you use the Preset submenu to recall the factory default settings. (See page 140, *Presets submenu*.)

The following System button menu settings are not restored when you recall the factory default settings:

■ Front panel time-out period

■ Network parameters

■ SNMP parameters

■ Web user interface control setting

■ Beeper control setting

■ Power supply preference selection (Option DPW only)

**Table 41: System menu factory default settings**

| Menu item name | Settings |
|---|---|
| GPI | |
| Input Trigger | None |
| Output <1–3> | |
| Hardware Fault | Disable |
| Power Supply Fault | Disable |
| Lock Error | Disable |
| Lock Warning | Disable |
| Time Error | Disable |
| Time Warning | Disable |
| Alarm Time | Disable |
| Alarm Delays | |
| GPO Lock Error | 00:00:10 |
| GPO Lock Warning | 00:00:10 |
| GPO Time Error | 00:00:10 |
| GPO Time Warning | 00:00:10 |

# Time menu

Use the Time menu to set instrument time parameters in submenus, such as the time of day source, the time zone offset, the daylight savings time schedule, the program time, and the jam sync settings.

The following figure shows the Time menu.



**Figure 51: Time menu**

The following submenus are available in the Time menu:

■ **Time of Day.** Sets the time of day reference that will be used by the instrument. (See page 160, *Time of Day submenu.*)

The possible reference choices change depending on the selected reference source. (See page 77, *Reference menu.*)

■ **Daylight Savings Time.** Configures how the instrument handles Daylight Saving Time. (See page 163, *Daylight Savings Time submenu.*)

■ **Leap Second.** Schedules when the instrument applies leap seconds (Option GPS only). When Option GPS is installed and GPS is selected as the reference source in the Reference menu. (See page 166, *Leap Second submenu (Option GPS only).*)

■ **Program Time.** Configures the program time parameters for the instrument. The Program Time is used to create a time code that is not locked to time of day. This is useful if the time code is intended to start at a uniform time for multiple takes of a production. (See page 167, *Program Time submenu.*)

■ **Jam Sync.** Configures the parameters for the Jam Sync function. Use the function to immediately synchronize the instrument timecode with the selected time source for each output or to regularly schedule a synchronization. (See page 168, *Jam Sync submenu.*)

# Time of Day submenu

This submenu sets the time of day reference that will be used by the instrument when the reference source is set to Internal in the Reference menu. The following figure shows the Time of Day submenu with the Source set to GPS Signal.



**Figure 52: Time of Day submenu**

**Source**    Use this setting to select a Time of Day source from the drop-down list:

■ **GPS Signal**. If GPS Signal is selected, the time from the GPS/GLONASS receiver is used to derive the time of day. This menu item is only available if GPS Signal is the selected reference source in the Reference menu.

⚠ *CAUTION. When you select GPS signal as the timecode reference source, then depending on the GPS and/or GLONASS signal availability, it can take a while for the instrument to lock to the GPS and/or GLONASS signal. During the time before the instrument locks to the GPS and/or GLONASS signal, the instrument uses time based on the internal real time clock.*

■ **Internal**. In Internal Time of Day mode, the user can manually input the time. On versions 2.5.1 and earlier, setting the time manually did not affect the Real Time Clock (RTC). On later versions of the software, setting the time manually also sets the RTC.

■ **LTC Input**. Selects the LTC time code input as the timecode reference. The function of the LTC connector must be set to Input to use LTC as a time code input.

■ **VITC Input**. Selects the vertical interval time code as the timecode reference. The VITC input is only available when the Reference Source is set to a video Genlock signal.

*NOTE. When the VITC or LTC inputs are used as time-of-day sources, the hh:mm:ss:ff settings will be synchronized to the VITC or LTC source (if present). When the SMPTE309 Data mode is set to Use as Input or to Use as Input/Output, the date is set using the VITC or LTC source. When the SMPTE309 Data mode is set to Ignore, the date is set from the internal RTC. (See page 161, SMPTE309 Data.)*

**Mode**
When LTC Input or VITC Input is selected as the Time of Day source, use the Mode drop-down list to select one of the following synchronization modes:

■ **Follow**. The time of day follows the VITC or LTC on the input signal if the signal is stable for at least 100 consecutive frames.

■ **Synchronize Once**. The VITC or LTC on the input signal is continuously monitored until a stable signal is received (at least 100 consecutive frames). At that time, the time of day synchronizes (once) to this reference.

■ **Synchronize Now**. The time of day attempts to synchronize with the VITC or LTC on the input signal when you click the **Synchronize Now** button. A total of ten attempts to synchronize are made. After ten attempts, no further attempts are made to synchronize regardless if synchronization occurred or failed. A stable signal of at least 100 consecutive frames is needed.

**SMPTE309 Data**
When LTC Input or VITC Input is selected as the Time of Day source, use the SMPTE309 Data drop-down list to select how the instrument will respond to ST309 data in the timing source:

*NOTE. The Time Zone Offset adjustment allows you to enter a time zone correction of up to ±23:59 hours. However, the ST309 standard only implements codes for time zones in the range of -12 to +13 hours. Therefore, when you are using ST309 data as the Time of Day source, it is recommended that the combined programmed offset from time zone and Daylight Savings Time be restricted to the range of -12 to +13 hours.*

■ **Ignore**. If available, the HH:MM:DD;FF data on the incoming LTC/VITC signal is used, but any YYYY-MM-DD, TZ-Offset and Daylight Savings Time enabled/disabled data is completely ignored in the Time of Day system. In this mode, the Time Zone and Daylight Savings Time settings in the instrument menu are used to set the time of day from the input time code and the date is set from the internal RTC. This is the mode that should be used if there is no ST309 date data on the input time code. In this case, the STATUS button display will still show the YYYY-MM-DD, TZ-Offset and DST settings from the instrument menu.

■ **Use as Input**. The ST309 data in the timing source is used and applied to the master Time system in the instrument. For example, if the data indicates that the time zone offset is +8:00 hours, then the master Time is set to the YYYY-MM-DD HH:MM:SS;FF from the LTC/VITC input, minus the 8 hour offset. This makes the master Time set to UTC. However, the timecode data on all outputs is then recalculated based on the time zone offset and DST

offset settings on the instrument. This mode is useful if the incoming time code data is from a different time zone than the outputs you intend to create.

■ **Use as Input/Output**. The ST309 data in the timing source is used and applied to the master Time as when "Use as Input" is selected. But in this case, the time zone offset and Daylight Savings Time enabled/disabled data from the LTC/VITC timing source is used to drive the output timecode including the ST309 data. This means that any time zone offset and Daylight Savings Time adjustment settings in the instrument are ignored and that whatever timecode data is coming in from the LTC/VITC timing source will match the data on the timecode for the signal outputs.

**Notes about SMPTE309 data usage.**

■ If ST309 data is not present on the selected time reference, then the default SMPTE309 Data mode setting of "Ignore" is the correct selection. For most applications in which the input time reference does have the ST309 data, then the setting of "Input" is usually the best choice. While in "Input" mode, the time zone and DST programming on the input and output are independent, with the input set by the ST309 data on the input and the outputs being set by the menu in the instrument. This is the best mode of operation even if all units are set to the same time zone and DST values.

■ When the SMPTE309 Data mode is set to "Ignore," you cannot use the Time Zone Offset or DST offset controls on the slave unit to adjust the time code outputs. The reason for this is that the slave unit assumes that the VITC/LTC inputs are local time and already have such corrections applied. However, you can offset the time code on individual outputs using the offset controls for each output. The local time zone and DST settings do affect the master time-of-day since the offsets are subtracted from the input and added to the output, but the net effect is that the outputs match the inputs unless individually offset.

■ SMPTE309 time zone offset data on individual outputs is not affected by adjusting time code offsets on individual outputs. The time code offset controls on the individual outputs does not affect the time zone offset fields in the output time code data. For example, if the slave unit is configured with a time zone offset of –08:00 and then you also adjust the time code offset on the SDI Channel 1 output by another +03:00 hours, the SMPTE309 data on that output will still read –08:00 in the time zone offset field even though the actual output is UTC –05:00 hours.

■ The applied DST offset display is incorrect when the SMPTE309 Data mode is set to "Use as Input/Output." When "Use as Input/Output" is selected, the Applied DST Offset indicator on the slave unit does not report the actual DST offset being applied by the system. Instead, the indicator reports the DST offset that would be applied if the slave unit was using its own DST offset configuration (as it would in VITC/LTC "Ignore" or "Use as Input" modes).

**Internal Date/Time**     Use this setting to manually enter the date and time in the form YYYY-MM-DD HH:MM:SS to activate the time-of-day change.

> ⚠ *CAUTION.* *When you apply the start time and date offset, this typically causes a disruption to the syncs, so care should be taken to verify the date and time are correct before activating the time-of-day setting for Internal mode.*

> *NOTE.* *The manual time of day setting is not automatically reapplied when the instrument power is cycled. If the instrument powers on in Internal mode, the time of day will be acquired from the real time clock in the instrument.*
>
> *The time zone offset must be set to maintain the correct relationship between UTC and local time.*

**Time Zone Offset**     Use this setting to set the time zone offset for your location in reference to UTC in the form ±HH:MM.

This setting allows you to enter a time zone correction of up to ±23:59 hours. However, the ST309 standard only implements codes for time zones in the range of -12 to +13 hours. Therefore, when you are using ST309 data as the Time of Day source, it is recommended that the combined programmed offset from time zone and Daylight Savings Time be restricted to the range of -12 to +13 hours.

> *NOTE.* *When the Daylight Savings Time schedule is set to Once and the daylight savings event occurs, the scheduled offset will be added to the time zone offset and the Daylight Savings Time schedule will be cleared. This allows for a new schedule to be set up for any time in the future. (See page 191, Daylight Savings Time submenu.)*

## Daylight Savings Time submenu

This submenu configures how the instrument handles Daylight Saving Time. The following figure shows the Daylight Savings Time submenu.



**Figure 53: Daylight Savings Time submenu**

**Selection Mode**   Use this drop-down list to set the DST schedule function to one of the following:

- **Disable**. Use this setting to disable the Daylight Savings Time schedule function.

- **Once**. Use this setting to schedule a specific calendar date and time to apply or remove the daylight savings time offset. For example, "2016-03-06 02:00:00."

- **Recurring**. Use this setting to set up relative dates and times to apply and remove the daylight savings time offset. For example, "1st Sun of Oct 02:00:00."

⚠ *CAUTION. When you change the selection mode, any daylight savings time offset that is currently being applied will be removed and any new daylight savings time offset that is configured for the new mode will be applied immediately.*

**Offset**   Use this setting to set the daylight savings time offset that will be applied when either the Once Date/Time event or the Recurring Start event occurs at the user-scheduled time.

The date and time digits take the following form: HH:MM. When the Recurring Start function is set, this offset can only be a positive number.

*NOTE. The Offset adjustment allows you to enter a time zone correction of up to ±23:59 hours. However, the ST309 standard only implements codes for time zones in the range of -12 to +13 hours. Therefore, when you are using ST309 data as the Time of Day source, it is recommended that the combined programmed offset from time zone and DST be restricted to the range of -12 to +13 hours.*

**Once Date/Time**    Use this setting to enter the date and time in the form YYYY-MM-DD HH:MM:SS for when you want to apply daylight savings time a single time. The Selection Mode must be set to Once for this setting to be active.

*NOTE. In Once Date/Time mode, the pending offset can be positive or negative, which allows you to add or subtract from the currently applied daylight savings time offset.*

⚠ *CAUTION. An incoming VITC or LTC reference may have a daylight savings time shift already applied. To avoid duplicating shifts, disable the daylight savings time if the time of day reference has daylight savings time applied.*

*In Once Date/Time mode, daylight savings time offsets can be compounded. This means that if an offset is currently being applied, and the scheduled time is then changed to a future date, the newly configured offset will be added to the already applied offset. For example, if an offset of +1 hour is applied on March 9 and the scheduled date is then changed to March 16, the resulting offset after March 16 will be +2 hours.*

**Recurring Start**    The Recurring Start time is the time when the daylight savings time offset will be added to the time zone offset. Use the drop-down lists to enter the information and then the time in the following format: HH:MM:SS. For example, if you enter Second Sunday in March 02:00:00 for the Recurring Start time, the daylight savings time offset would be added to the time zone offset on the second Sunday in March at 2 AM.

*NOTE. If you enable the Recurring function at a time between the Start and End settings, the daylight savings time offset is immediately applied.*

**Recurring End**    The Recurring End time is the time when the daylight savings time offset will be removed. Enter the information similar to the Recurring Start time described above.

# Leap Second submenu (Option GPS only)

When Option GPS is installed and GPS is selected as the reference source in the Reference menu, you can use this submenu to schedule when leap seconds are implemented.

For many applications, it might be fine to apply the leap second at midnight UTC. However, for some time zones this might cause a disruption during a critical programming time slot. The Leap Second submenu allows the leap second to be deferred up to 24 hours.

*NOTE. The Leap Second submenu is only available when GPS is configured as the reference source in the REF button menu.*

The following figure shows the Leap Second submenu.
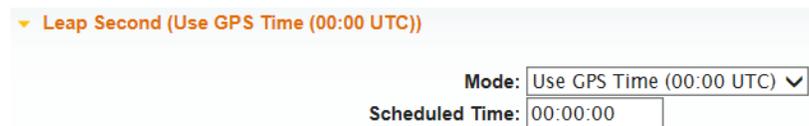


**Figure 54: Leap Second submenu**

**Mode**
Use this setting to select when the leap second will be applied.

Use this drop-down list to set the Mode to one of the following:

- **Use GPS Time (00:00 UTC)**. Applies the leap second adjustment immediately when signalled by the internal GPS system at 23:59:60 UTC on June 30 or December 31 (as appropriate), regardless of the local time.

- **Defer to Scheduled Time**. Applies the leap second at the deferred time configured using the Scheduled Time menu item below.

**Scheduled Time**
Use this setting to schedule a deferred time to apply the leap second adjustment.

Enter the Scheduled Time schedule setting in the form HH:MM:SS.

# Program Time submenu

This submenu configures the program time parameters for the instrument. Program time is used to create time code that is not locked to time of day. This is useful if the time code is intended to start at a uniform time for multiple takes of a production.

The following figure shows the Program Time submenu.



**Figure 55: Program Time submenu**

*NOTE. You can use the Input Trigger setting in the System GPI submenu to configure pin 4 of the GPI port connector to trigger the instrument to reset the program time. (See page 146, GPI Settings submenu.)*

**Initial Time**  Use this setting to enter the initial program time. The digits take the following form: HH:MM:SS. Click the **Apply Initial Time Now** button to apply the initial time.

**Alarm Time**  Select the Enable Alarm box to enable the alarm time function.

Enter the Alarm Time schedule setting in the form HH:MM:SS. Using the GPI connector, the Alarm Time function can be used to drive a light or similar indicator of alarm occurrences at a specific time in a program.

*NOTE. You can use the System GPI Output submenu to configure the GPI port connector to output a signal when the Alarm Time setting is reached. (See page 148, GPI Output Alarm Selections.)*

# Jam Sync submenu

This submenu configures the parameters for the Jam Sync function. Use the function to immediately synchronize the instrument timecode with the selected time source for each output or to regularly schedule a synchronization.

*NOTE. A daily Jam Sync should be performed on systems running at non-integer frame rates.*

The following figure shows the Jam Sync submenu diagram.



**Figure 56: Jam Sync submenu**

**Scheduled/Disable**     Select the check box to enable the Jam Sync function. When enabled, the Jam Sync function will be applied at the time configured using the Scheduled Time selection below.

**Scheduled Time**     Enter the scheduled time for the daily Jam Sync function. The digits take the following form: HH:MM. Click the **Synchronize Now** button to immediately perform a jam sync to remove the residual error in the drop-frame time code counting.

*NOTE. You can use the Input Trigger setting in the System GPI submenu to configure pin 4 of the GPI port connector to trigger the instrument to force a Jam Sync. (See page 146, GPI Settings submenu.)*

# Time menu factory default settings

The following table shows the settings for the Time menu that are reset when you use the Preset submenu to recall the factory default settings.

**Table 42: Time menu factory default settings**

| Menu item name | Settings |
| --- | --- |
| Time of Day | |
| Source [1] | Without Option GPS or when the Reference source is not GPS: VITC Input |
| | With Option GPS: GPS Signal |
| Mode | Follow |
| SMPTE309 Data | Ignore |
| Internal Time of Day | 2008–01–01 00:00:00 |
| Time Zone Offset | +00:00 |
| Daylight Savings Time | |
| Mode | Disable |
| Offset | +01:00 |
| ONCE Scheduled Time | 2008–01–01 00:00:00 |
| RECUR Start | Second Sunday in March 02:00:00 |
| RECUR End | First Sunday in November 02:00:00 |
| Leap Second [2] | |
| Mode | Use GPS Time (00:00 UTC) |
| Scheduled Time | 00:00:00 |
| Program Time | |
| Initial Time | 00:00:00 |
| Alarm | Disabled |
| Alarm Time | 00:00:00 |
| Jam Sync | |
| Mode | Scheduled |
| Scheduled Time | 00:00:00 |

[1] The default Time of Day source depends on whether Option GPS is installed and whether the Reference source is set to GPS.

[2] This menu item is only available when Option GPS is installed and when the Reference source is set to GPS Signal.

# PTP menu

There are two PTP engines: Primary and Secondary.

■ The Primary PTP engine will be either Master or Slave depending on the Reference selection. Adaptive mode between master and slave is not supported.

■ The Secondary PTP engine is only a master. The primary and secondary PTP engine cannot be on the same domain. The SPG8000A will display an error message if an attempt is made to set them to the same domain.

The following figure shows the PTP menu with the Primary Configuration submenu expanded.



**Figure 57: PTP Primary Master Configuration**

The following figure shows the PTP menu with the Primary Configuration submenu expanded and the Reference Source set to PTP.
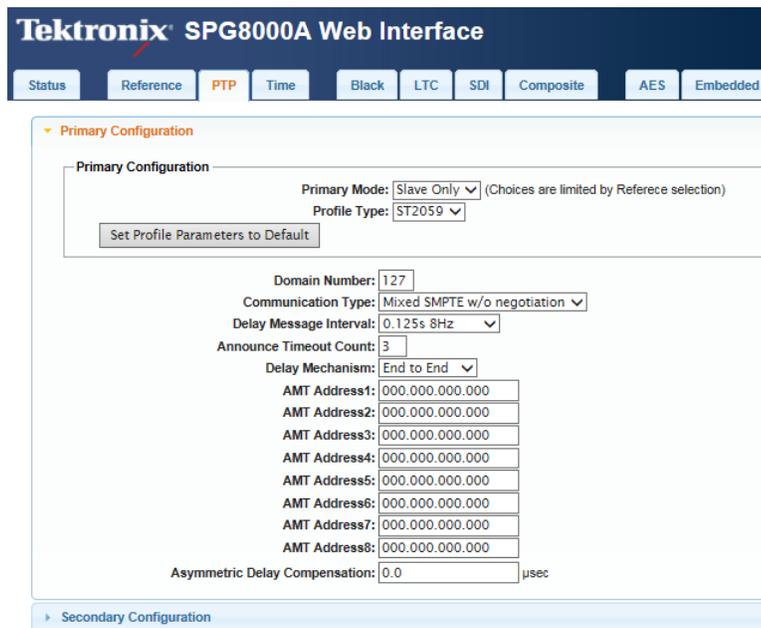


**Figure 58: PTP Primary Slave Configuration**

---

*NOTE. The entries in the PTP menu vary depending on modes of the instrument. Master and Slave modes need different settings. Multicast, Unicast and Mixed modes have different settings. Different profiles allow different ranges for some parameters.*

---

**Primary and Secondary Mode**

Master can be enabled or disabled. Slave is only active if the Reference is set to PTP mode.

**Profile Type**

Use this drop-down list to set the Profile Type to one of the following: **General**, **ST2059**, **AVB**, or **AES67**

**Set Profile Parameters to Default**

The defaults will set a nominal value given the selected profile.

**Domain**

Defaults to a reasonable setting for each profile. Users are not allowed to set both PTP engines to the same domain.

**Communication Type**
All of the master and slave devices on a given domain must use compatible communication modes. For most profiles, this means the master and slave communication modes need to match exactly. On the SMPTE profile, the Multicast and Mixed modes are compatible, so a master in any of these modes will work with a slave in any of those modes.

Unicast is separate and the master and slave must match.

*NOTE.* *The Unicast and Mixed without negotiation modes require that the IP address of all the masters be entered into the Acceptable Master Table (AMT) of the slave.*

**Announce Interval**
Announce interval allows setting the rate at which the master will send announce messages. For Unicast mode there are two settings: Desired and Required. The slave will start by requesting the Desired rate. If the master refuses that rate, the slave will request a slower rate. This continues down to the Required setting. If the master cannot support the Required setting, the communication will not start. The default for the Required setting is the minimum rate / maximum interval allowed in the profile.

**Sync Interval**
Sync interval allows setting the rate at which the master will send sync messages. For Unicast mode there are two settings: Desired and Required. The slave will start by requesting the Desired rate. If the master refuses that rate, the slave will request a slower rate. This continues down to the Required setting. If the master cannot support the Required setting, the communication will not start. The default for the Required setting is the minimum rate / maximum interval allowed in the profile.

**Announce Timeout Count**
Announce timeout count sets the number of announce messages which can be missed before the device will assume the master is no longer present. After that time, all the devices on the domain will start the process of selecting a new master.

**Priority 1 and Priority 2**
Priority 1 and 2 are used in the BMCA to select the active master. Typically, all the masters should have the Priority 1 parameter set to the same value, and then use the Priority 2 parameter to select the primary master if all have the same clock quality. A lower value is preferred. For example, if you set the Priority 2 parameter of the primary master to 127, then set the Priority 2 parameter of all other masters to 128.

**One-step and two-step**  One-step and two-step communication mode controls whether the timestamp for the sync message is sent in the sync (one-step mode) or sent in a follow-up message (two-step mode). Some devices, such as transparent clocks, only work on two-step messages. All slaves are required to work in both one-step and two-step modes.

**Delay Mechanism**  Use the drop-down list to select between the two delay modes are available:

■ **Peer-to-Peer**. In this mode the Pdelay request and Pdelay response messages are local to each link in the network. Each device determines the local link and device delays. The sync message from the master then collects the corrections as it propagates from the master to slave. Peer-to-Peer mode is useful in PTP networks where the routing configuration changes. For Peer-to-Peer mode to work well, all of the devices need to be PTP aware.

■ **End-to-End**. In this mode the sync, follow up, delay request and delay response messages go through the network all the way between the master and slave. End-to-End mode is useful in PTP networks where some or all devices are not PTP aware.

*NOTE. End-to-End mode is the default and a common mode for video networks.*

**Delay Message Interval**  Delay Message Interval allows setting the rate at which the master will send delay request messages. For Unicast mode there are two settings: Desired and Required. The slave will start by requesting the Desired rate. If the master refuses that rate, the slave will request a slower rate. This continues down to the Required setting. If the master cannot support the Required setting, the communication will not start. The default for the Required setting is the minimum rate / maximum interval allowed in the profile.

**AMT Address**  Acceptable Master Table (AMT) is required in Unicast and Mixed without Negotiation modes. Enter the IP address of all masters into the AMT of the slaves. The AMT can support up to eight IP addresses.

**Asymmetric Delay Compensation**  Asymmetric Delay Compensation allows correcting the slave timing for any asymmetric delay in the network. Use the 1 pps or other timing signal to determine the required delay. This should not be necessary if the network is PTP aware.

## ST2059 profile menu selections

When ST2059 is the selected profile and the SPG8000A is configured as a PTP master, these additional menu selections appear. These settings only drive the Synchronization Metadata message content and have no effect on the operation of the master. Each of these menu selections can be set to "Auto" to ensure that the metadata bits are sent in a valid state.

**ST2059 SM Default Frame** Use this setting to set the metadata message fields to indicate the selected frame rate: 23.98, 24, 25, 29.97, 30, 47.95, 48, 50, 59.94, 60, 71.92, 72, 100, 119.9, or 120.

**ST2059 SM Drop Frame Flag** Use this setting to set the metadata message bit for the Drop Frame Flag to enabled or disabled.

**ST2059 SM CFID** Use this setting to set the metadata message bit for the Color Frame ID to enabled or disabled.

## How to configure Option PTP on the SPG8000A

**General information** The operation of the instrument is intended to be primarily an SPG with the addition of PTP functionality, and the menu structure reflects this orientation.

**Reference mode.** The Reference mode selection restricts the possible PTP functions as follows:

- If the Reference mode is set to GPS, Genlock or Internal, the primary PTP engine is a master.

- If the Reference mode is set to PTP, then the primary PTP engine is restricted to Slave PTP mode.

- Automatically adapting between master and slave functions with the BMCA is not supported.

**Secondary PTP engine.** A secondary PTP engine is also available. This allows implementing two masters when in Internal mode or locked to GPS, and simultaneous Master and Slave operation.

The primary and secondary PTP systems must be on different domains.

**Presets.** Most of the PTP functions are saved in the presets. After configuring the instrument, a user can save the Power-on preset so that the desired instrument state is restored when the instrument is powered on.

**Black outputs.** The black outputs support a 1pps mode. This is useful for measuring timing between systems.

**Firmware update.** After a firmware update, the presets are often not valid and will usually be erased. Therefore, after an update please use the REF button menu to reselect either GPS or PTP as the Reference mode, and then use the PTP button menu to reselect all of the parameters. Next, use the SYSTEM button menu to resave the Power-on preset with your preferred settings.

**Basic setup recommendations**

1. Use the SYSTEM button menu to set the PTP network IP address using DHCP or Manual mode. (Press the SYSTEM button, and then press the down arrow twice to access the menu.)

*NOTE. Both PTP ports share the same network address. See the PTP network settings section below for information about how to configure the two PTP ports.*

2. Use the REF button menu to set the Reference mode depending on whether the SPG8000A will be a PTP master, slave or both. (Press the REF button, and then press the left or right arrow to select. Press ENTER to confirm the selection.)

   - If the SPG8000A is to be the PTP master, select either GPS, Genlock or Internal mode.

   - If the SPG8000A is to be a PTP slave, select PTP mode.

   - If the SPG8000A is to be both a PTP master and slave, select PTP mode and then configure the secondary master.

3. If Genlock mode is selected as the Reference mode, then also set the time to VITC, LTC, or Internal. In addition, select to use the ST309 data as "input" if ST309 date information is available in the input timecode.

4. Use the PTP button menu to configure the Primary master or slave PTP profile, message rates, etc. (Press the PTP button once, and then use the arrow keys and the ENTER / BACK keys as necessary to make selections.)

5. If desired, press the PTP button a second time to access the secondary PTP engine. Select parameters as needed.

# PTP operational overview

**PTP introduction**  Option PTP for the SPG8000A adds two Precision Time Protocol (PTP) engines to the SPG system. The primary PTP engine has the capability to be a master PTP source or lock the SPG to the PTP as a slave. The secondary PTP engine can only be a master.

**PTP operating modes.**  The basic operating mode of the SPG is set in the Reference Select menu. The reference selection drives the allowed function of the primary PTP engine as follows:

- If the SPG reference selection is set to internal, or to lock to an external GPS, NTSC, PAL, Tri-level or CW signal, then the primary PTP engine can only be a master.

- If the SPG reference selection is set to lock to an external PTP signal, then the primary PTP engine can only be a slave.

**PTP master selection.**  In a PTP network, all the masters on the network are evaluated by the Best Master Clock Algorithm (BMCA). The BMCA runs on all devices, and chooses a master based on several parameters. Some of the parameters relate to clock quality; conversely the Priority 1 and Priority 2 parameters are set by the user to influence the choice of a master:

- Priority 1. This parameter defines which clocks are allowed to be considered as masters. To be considered as a master, the value should be set to 128 or less. Priority 1 is the first criteria in the BMCA, so if Priority 1 is set to a lower value than other devices on the system, then it will be chosen even if the clock quality is poor. Typically, all the masters in a domain should have the same value for the Priority 1 parameter.

- Priority 2. This parameter is used to break the tie between masters that have the same clock quality. Several values may be used to define a hierarchy of devices. Most profiles use 128 as a default, so a value of 127 or lower would indicate a preferred master.

- The final tie-breaker in the BMCA is the clock ID. This is usually the MAC address so it provides a unique value by which the BMCA can choose.

**Network topology.**  In a typical IEEE1588 PTP network, many devices may be either masters or slaves. If the current master stops working, all the devices that are capably of being a master broadcast their clock quality and a new master is selected.

For video networks it may make sense to depart from the telecom-style PTP topology and dedicate devices to be only masters or slaves. This is the approach supported by the SPG8000A, which allows for a more traditional primary and backup master structure controlling a range of slave devices. The BMCA is still used to select the active master and the network still takes the place of the ECO in the legacy Black-burst/Tri-level network.

**The five basic PTP timing messages**

There are five basic timing messages in a PTP system: Announce, Sync, Follow-up, Delay request, and Delay response. Other messages are present in some instances. For example, grant requests and responses appear in unicast systems, and Type Length Value (TLV) management messages appear in SMPTE ST2059 profile systems.

**Announce message.** The Announce message is sent by the master to advertise its capability. This message contains the clock quality and priority settings needed for the BMCA to evaluate which device is the best master.

**Sync message.** The Sync message is sent by the master and is used to measure the propagation delay from the master to slave. The sync message may contain the timestamp indicating when it was sent, or that time may be in the Follow-up message. The receiver must timestamp the sync message upon receipt. These two timestamps are usually called "t1" and "t2" and provide the first delay measurement.

**Follow-up message.** The Follow-up message is sent only in cases where the PTP network hardware is not capable of inserting the timestamp into the Sync message. (See page 179, *One-step and two-step operation*.)

**Delay request message.** The Delay request is sent by the slave. The time at which it is sent is noted by the slave, but is not included in the message. This time is usually called "t3." When the delay request is received by the master, the master timestamps the receive time. This timestamp is usually called "t4."

**Delay response message.** The delay response is sent from the master to the slave. The response contains the t4 time stamp from when the master received the delay request. Once the slave receives the delay response, it has the second pair of timestamps needed to calculate the second delay measurement of the slave to master delay.

**Message timing.** The following figure show the relationships between the five PTP timing messages.
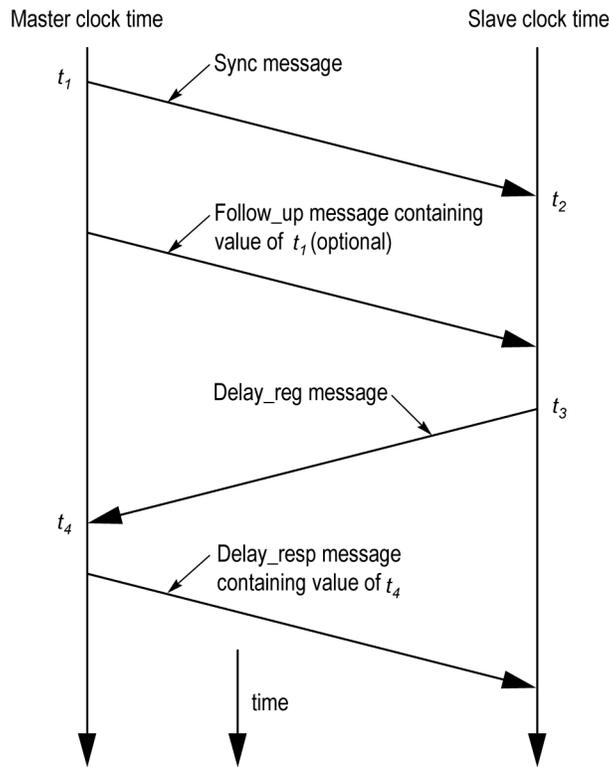


**Profiles** The IEEE1588 standard defines multiple parameters, such as the rates for Sync and Announce messages, and optional functions such as grandmaster clusters. Specific industries wanting to use PTP are encouraged to define their own "profile," which allows the PTP standard to be tuned for specific applications. The profile defines the default and range of each parameter, and defines with options are required, allowed or prohibited.

In the SPG8000A, the profile can be initialized to the default value for a given profile and mode. After setting the reference mode, the user should go to the PTP menu and select the profile. The user then has the options to initialize the profile parameters to the default value for both the selected profile and operating mode (Master, Slave or Adaptive). After initialization, the user can modify the profile parameters and save as part of an instrument preset. The allowed range of the parameters is restricted to that which is allowed for the given profile type.

**Domains**
The IEEE1588 standard defines "domains," which allow multiple PTP services to coexist simultaneously on one physical Ethernet connection. For example, on a given network one master and several slaves can be using domain 0 while a second master and other slaves are using domain 1. These two PTP services are independent. One use for this is to have masters on different domains provide PTP on different profiles. For example, domain 0 might be an AES67 profile, domain 1 could be a master using the AVB (802.1AS) profile, and domain 127 could be a master on the SMPTE ST2059 profile.

Since the SPG8000A has two PTP engines, the instrument can provide PTP mastering on two domains and two profiles simultaneously. With multiple SPGs, more domains and profiles can coexist on the same network.

**One-step and two-step operation**
Some PTP messages have a time stamp associated with them. This time stamp indicates the time of the local clock when the message was sent or received. In some cases, the hardware can embed the time stamp in the message as it is sent. This is known as "one-step" mode since the message and its associated time are sent together.

In other cases, the hardware is not capable of inserting the time into the message, so instead it is sent in a second follow-up message. This is called "two-step" mode since there are two messages.

It is interesting to note that in End-to-End mode, only the Sync message is effected by the one-step and two-step setting since it is the only message that needs the transmit time stamp inserted. This means that other than masters, all devices should be able to process either one-step or two-step message types. In a similar fashion, Peer-to-Peer mode has some messages that may require follow-up support.

**Multicast, Unicast, and Mixed Communication modes**
There are three basic message modes for PTP: Multicast, Unicast, and mixed Multicast and Unicast. For full Multicast or Unicast modes, all of the PTP messages are sent in the selected mode type.

For some profiles, such as some telecom profiles and the SMPTE ST2059 profile, a mixture of Multicast and Unicast are allowed. On the SMPTE profile unique mixed mode, the Announce and Sync messages are sent as multicast. However, the Delay request and Delay Response messages are sent as Unicast.

Some points to understand about communication modes:

■ Whatever mode is chosen, the master and slave must match or be compatible

■ Multicast and Mixed mode may need IGMP joins and leaves

■ Full Unicast must have the master address in all slave AMTs

■ Unicast without negotiation does not allow master to regulate load

- Two masters can be used on different domains to serve slaves on different communication modes

- For systems with a large number of end points, multicast mode will create a significant message processing burden on the slaves and switch. Mixed mode is intended to reduce this overhead and is recommended on large systems.

**Multicast system messages.** Multicast messages are broadcast and so they can be received without knowing the address of the sender. This allows a slave to hook up to the network, receive the announce messages and discover the identity of the master. Multicast in some networks requires the devices to use IGMP to join and leave the multicast group.

In Multicast PTP systems, the master sets the rate of the announce and sync messages. The master also sends the maximum allowed delay request rate in the delay response message. Ideally, the slave will use that value to set the delay request rate although some slave set this rate independently. The delay request rate is typically the same as the sync rate, but may be higher or lower.

**Unicast system messages.** Unicast messages require the address of the master be entered into the Acceptable Master Table (AMT) in each slave. If there are multiple masters, the IP address for each master must be entered in the AMTs of all the slaves.

In Unicast PTP systems, the slave starts the messaging process. The slave sends several grant requests to the master requesting specific rates for each message type. If the master accepts the grant requests, it will send grant acknowledges. If the master denies the grant, the slave may send a new grant request at a lower rate. This process may continue for several iterations until the master and slave agree on a rate. The master and slave will then start exchanging the PTP messages. If the master cannot support any of the rates requested by the slave, then the slave will not be able to lock to the master.

**Mixed mode system messages.** In Mixed Mode systems, some messages are Multicast and some are Unicast. For the SMPTE ST2059 profile, the Announce and Sync messages are sent as Multicast. This allows devices to discover the active master. The Delay Request rate is configured for Unicast, so the slave and master must exchange grant messages before the system will start the full range of messages.

In Mixed mode without negotiation, the delay request rate set by the slave must be equal to or less than the Sync rate set by the master. Otherwise, the slave will not be able to connect to the master.

**SMPTE profile system messages.** For SMPTE profile systems, a given domain must use one type of message for all Announce, Sync and Follow up messages. Therefore, all masters and slaves on that domain must be configured for either Multicast or they all must be configured for Unicast.

For SMPTE mixed mode, the Announce, Sync, and Follow up messages are configured as Multicast so that the delay requests can be Multicast, Unicast, or Unicast without negotiation. To use this combination, set the master and slave to any of the modes: Multicast, Mixed, or Mixed without negotiation. The masters will support all of the slave modes simultaneously.

**BMCA**  The Best Master Clock Algorithm (BMCA) is used to choose the active master on the domain. This is partially explained in the introduction to this document. The BMCA operation varies somewhat as function of communication mode.

**Multicast mode.**  In Multicast mode, the active master sends announce messages that all other masters and slaves can receive. So all devices can evaluate the BMCA and decide on the best master. If any device detects that its BMCA rating is better than the current master, it will send an announce and take over as the active master.

**Unicast mode.**  In Unicast mode, slaves only get Announce messages if they establish a grant from the master. Therefore, each slave must set up a grant with every device in its AMT. Since the masters do not set up grants from other masters, they do not have the information to evaluate the BMCA and know if they are the active master. It is up to the slaves to evaluate the BMCA based on the announce message they get from each master in their AMT. Each slave then decides which master is the best and then set up grants for the other message types. If slaves on a given network have a different list of masters in their AMT, then they may choose a different master.

**Mixed mode.**  In a SMPTE ST2059 mixed environment, the announce message is Multicast. Therefore, the BMCA can follow the Multicast conventions.

**Compensating for causes of asymmetric delay**  Several factors can cause the PTP message delay to be different for the messages sent from the master to slave as opposed to the messages the other direction from the slave to master. Unless corrected, this propagation delay asymmetry will cause an offset in the clock phase equal to ½ the difference in the two path delays. There are 4 main causes of asymmetric delay: Rate mismatch in the ports on a switch, Traffic mismatch on the two paths, message type mismatch, and cable delay variation. The paragraphs below contain hints on how to design the system to minimize the delay asymmetry. Alternatively, the SPG8000A provides a way to manually enter a correction value to cancel the delay error.

**Rate mismatch.**  Rate mismatch in a switch causes a delay asymmetry because the switch does a "store and forward" on messages. This means the entire message must be stored in the buffer before it starts to be "forwarded" or sent out. For example, for a 100 Mb input and 1 Gb output, the switch must wait for the entire message to clock in at the slow rate before it can start outputting the message at the high rate. Conversely for a 1 Gb/s input and 100 Mb/s output, the entire packet is quickly read in at the faster rate, so then the output can start sooner, albeit at a lower rate.

While the total time is the same for both directions, the delay on the fast-in, slow-out direction is shorter on the packets which contain the PTP timestamps. This effect is significant on a 100 Mb/1 Gb rate mismatch, but much less significant on a 1 G/10 G switch since the message time at 1 Gb/s is quite short. If the switch supports Transparent Clock (TC) mode, then this rate mismatch delay effect is corrected by the TC delay correction.

**Traffic mismatch.** Another cause of asymmetric delay is traffic mismatch on the two paths. If there is a high percentage of traffic utilization on the master to slave path, then most of the PTP messages may be delayed significantly. If the traffic on the other direction is significantly different, then the messages on the path may not suffer the same delay.

This effect can be quite large depending on the traffic, the quality of the switch, and the number of switches in the network. To reduce this effect, a user should avoid large loading on the PTP network, use high-quality switches that avoid this delay variance, or use PTP Transparent mode switches which will insert residence time information to allow the slave to correct for this delay.

Setting the DSCP on the PTP messages and enabling QoS on the switch will give the PTP messages priority over the other traffic. This will help control the effects of traffic delay and asymmetry.

**Message type mismatch.** Another cause of delay asymmetry is message type mismatch. For example, if the sync message is Multicast and the delay request is Unicast, then some switches may process the messages differently and cause a differential delay. Since the SMPTE profile allows a mixed mode operation, switches should be evaluated to ensure they do not have this effect. If transparent mode switches are used, then this effect should be corrected by the slave.

**Cable delay variation.** The actual propagation delay through Cat 5 cable can be significantly different in one direction versus the other direction. This can be due to the twist rate on the pairs, routing inside the sheath, material differences, etc. The PTP system is incapable of removing this effect, so the best way to prevent this is to use high-quality cable with a minimum variation in the physical propagation delay.

# PTP menu factory default settings

The following table shows the settings for the PTP menu that are reset when you use the Preset submenu to recall the factory default settings.

**Table 43: PTP menu factory default settings**

| Menu item name | Settings |
| --- | --- |
| Primary Configuration | |
| Primary Mode | Disable Master |
| Profile Type | ST2059 |
| Domain Number | 127 |
| Communication Type | Mixed SMPTE w/o negotiation |
| Announce Interval | 0.25s 4Hz |
| Sync Interval | 0.125s 8Hz |
| Announce Timeout Count | 3 |
| Priority 1 | 128 |
| Priority 2 | 128 |
| Primary Step | One Step |
| ST2059 SM Default Frame [1] | 29.97 |
| ST2059 SM Drop Frame Flag [1] | Enable |
| ST2059 SM CFID [1] | Enable |
| Delay Mechanism | End to End |
| Secondary Master Configurations | |

**Table 43: PTP menu factory default settings (cont.)**

| Menu item name | Settings |
|---|---|
| Secondary Master Mode | Disable Master |
| Profile Type | ST2059 |
| Domain Number | 126 |
| Communication Type | Mixed SMPTE w/o negotiation |
| Announce Interval | 0.25s 4Hz |
| Sync Interval | 0.125s 8Hz |
| Announce Timeout Count | 3 |
| Priority 1 | 128 |
| Priority 2 | 128 |
| Secondary Step | One Step |
| ST2059 SM Default Frame [1] | 29.97 |
| ST2059 SM Drop Frame Flag [1] | Enable |
| ST2059 SM CFID [1] | Enable |
| Delay Mechanism | End to End |

[1] When ST2059 is the selected profile and the SPG8000A is configured as a PTP master, these additional menu selections appear.

# Front panel menu operation

This section provides information about operating the instrument using the front-panel buttons and display. These menus and selections are similar to those on the Web interface.

The descriptions for the menu selections shared between the SPG8000A Web Interface and the front-panel menus are located the associated AES, Black, Embedded, LTC, Reference, SDI, Status, and System menu sections of this manual.

**Submenu and menu selection names**

The names of submenus and menu selections on the front panel do not always directly correlate with the names that appear on the SPG8000A Web Interface. The SPG8000A Web interface display reduces the need for some submenus and there is more room for selection names.

**Menu access buttons**

Use the following buttons to access the desired menu display:

- **AES**. Use this button menu to view and configure the timing offset and voltage of the Word Clock (48 kHz) output.

- **BLACK**. Use this menu to view or change the settings for the Black outputs. Option BG must be installed to access the settings for the Black 4 and Black 5 outputs. You can also configure the Black 1–3 and Black 4–5 tri-level sync signals. Click on the arrow next to the desired Black output to access the menu for that output.

- **CMPST**. (Option BG only) Use this menu to view or change the settings for the Composite outputs. Click on the arrow next to the desired Composite output to access the menu for that output.

- **EMBED**. (Option SDI only) Use this button menu to view and configure the embedded audio settings on the SDI video outputs. Use this menu to select the audio group for subsequent audio channel configuration, and to configure audio group parameters.

- **LTC**. Use this button menu to view and configure the LTC inputs and outputs on the GPI/LTC port.

- **REF**. Use this button menu to view and configure instrument settings such as the signal reference source, the signals being output, and information about system faults and alerts.

- **SDI**. (Option SDI only) Use this button menu to view and configure the signals on the SDI video outputs. Press the SDI button repeatedly to select the desired SDI output (SDI 1 or SDI 2) to configure. The menu selections for the SDI 1 and SDI 2 outputs are similar, but are independent for each output.

- **STATUS**. Use this button menu to view the current status of instrument settings such as the signal reference source, the signals being output, and

information about system faults and alerts. This menu is for viewing status only and no changes to the instrument settings can be made from this menu.

■ **SYSTEM**. Use this button menu to view and configure instrument settings such as network parameters, SNMP traps, GPI alarms, installed options, display brightness, beeper control, and hardware/firmware versions. You can also use this menu to perform firmware upgrades, save and recall presets, and view diagnostic results.

■ **TIME**. Use this button menu to set instrument time parameters in submenus, such as the time of day source, the time zone offset, the daylight savings time schedule, the program time, and the jam sync settings.

■ **PTP**. Use this menu to view or change the primary and secondary PTP settings for the instrument.

**Menu control buttons**      Use the following buttons to control the menu display:

■ **Arrow buttons** (▲, ▼, ◄, and ►). Use these arrow buttons to navigate through the available menu items.

■ **ENTER button**. Use the ENTER button to enable the selected menu item or to enter a submenu.

■ **BACK button**. Use the BACK button to return to the previous menu item.

**LCD display readouts**      The LCD display is a two-line, 40-character-per-line display. Almost all menus have two lines of text, where the first line shows the current position in the current menu, and the second line shows the current selection (if there is not a submenu). If nothing is on the second line, press the ENTER button to access the corresponding submenu.

The readouts on the LCD display vary depending on the instrument setting and which menu is being accessed. The following figure shows some example display readouts.

Example 1

```
SYSTEM : NET SETUP : DHCP
   ■ Enable                                    ↵
```

Example 2

```
SDI 1 : TIMING
   Press ENTER for menu                        ↵
```

Example 3

```
STATUS : ALERT
   Loss of lock on REF input              1/3
```

3080-040
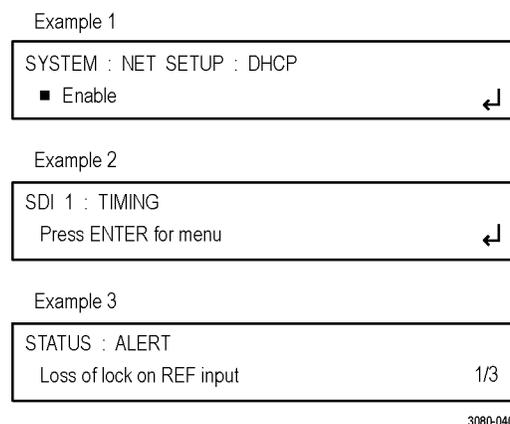
**Figure 59: Example display readouts**

The format of the readouts usually follow these guidelines:

■ The top line of the display lists the current menu selection. The first word is usually the name of the selected button menu, followed by the name of a parameter or category.

■ The second line of the display shows the setting of the selected menu setting. As shown in example 1 above, a bullet in front of a setting indicates that setting is the currently selected setting.

■ As shown in examples 1 and 2 above, if a carriage return character is displayed at the far right of the second line, this indicates one of both of the following two situations:

  ‒ There are additional settings that can be accessed by pressing the left (◄) or right (►) arrow button. When the desired setting is displayed, press the ENTER button to select that setting.

  ‒ There is a submenu available for the menu selection that can be accessed by pressing the ENTER button. When you enter a submenu, press the BACK button to return to the top menu.

■ As shown in example 2 above, if the second line of the display reads "Press ENTER for menu," this indicates that you need to press the ENTER button to access the submenu for that menu selection.

■ As shown in example 3 above, if there are multiple alerts or faults reported in the STATUS menu, the far right of the second line will display the currently viewed alert or fault number followed by the total number of alerts or faults. In example 3, the display shows "1/3," indicating that the currently displayed alert is number one of three reported alerts. In this situation, press the left (◄) or right (►) arrow button to view the other alerts or faults.

# AES button menu

Use the AES button menu to view and configure the timing offset and voltage of the Word Clock (48 kHz) output. The following figure shows the top level diagram for the AES button menu.



Press the (AES) button

| | |
| --- | --- |
| AES AUDIO : CHANNEL PARAMETERS | Channel 1 Channel 2 Channel 3 Channel 4 Channel 5 Channel 6 Channel 7 Channel 8 |

*1

ENTER → To AES AUDIO CHANNEL submenu for the selected audio channel
BACK ←

AES AUDIO : RESOLUTION
■ 20 bits
◁ ▷  24 bits / 20 bits
*1

AES AUDIO : AUDIO - VIDEO SYNC
■ Free Run
◁ ▷  Free Run / Frame Reset 1 (2.997 Hz) / Frame Reset 2 (6.250 Hz) / Frame Reset 3 (3.000 Hz)
*1

AES AUDIO : TIMING OFFSET
Press ENTER for menu
ENTER → To AES AUDIO TIMING OFFSET submenu
BACK ←

AES AUDIO : AES WORD CLOCK OUTPUT
■ 1 Volt (AC)
◁ ▷  1 Volt (AC) / 5 Volt (DC)

1216-004

*1 These menu items appear only when Option AG is installed.

**Figure 60: AES button menu diagram**

**AES AUDIO CHANNEL submenu (Option AG only)**

The following menu opens for the selected AES audio channel when you press ENTER in the AES button menu with CHANNEL PARAMETERS selected.



Press ENTER
in the (AES) button menu
with CHANNEL PARAMETERS selected

| | | | |
|---|---|---|---|
| Inactive | 400 Hz | 1600 Hz | 6000 Hz |
| Silence | 500 Hz | 2000 Hz | 8000 Hz |
| 50 Hz | 600 Hz | 2400 Hz | 9600 Hz |
| 100 Hz | 750 Hz | 3000 Hz | 10000 Hz |
| 150 Hz | 800 Hz | 3200 Hz | 12000 Hz |
| 200 Hz | 1000 Hz | 4000 Hz | 15000 Hz |
| 250 Hz | 1200 Hz | 4800 Hz | 16000 Hz |
| 300 Hz | 1500 Hz | 5000 Hz | 20000 Hz |

AES AUDIO : CHANNEL 1
■ Frequency : 1000 Hz ↵

AES AUDIO : CHANNEL 1
Amplitude : -20.0 dB    ◁ ▷  Adjust the amplitude

AES AUDIO : CHANNEL 1
■ Audio Click : Off ↵

OFF
1 Sec.
2 Sec.
3 Sec.
4 Sec.

1216-005
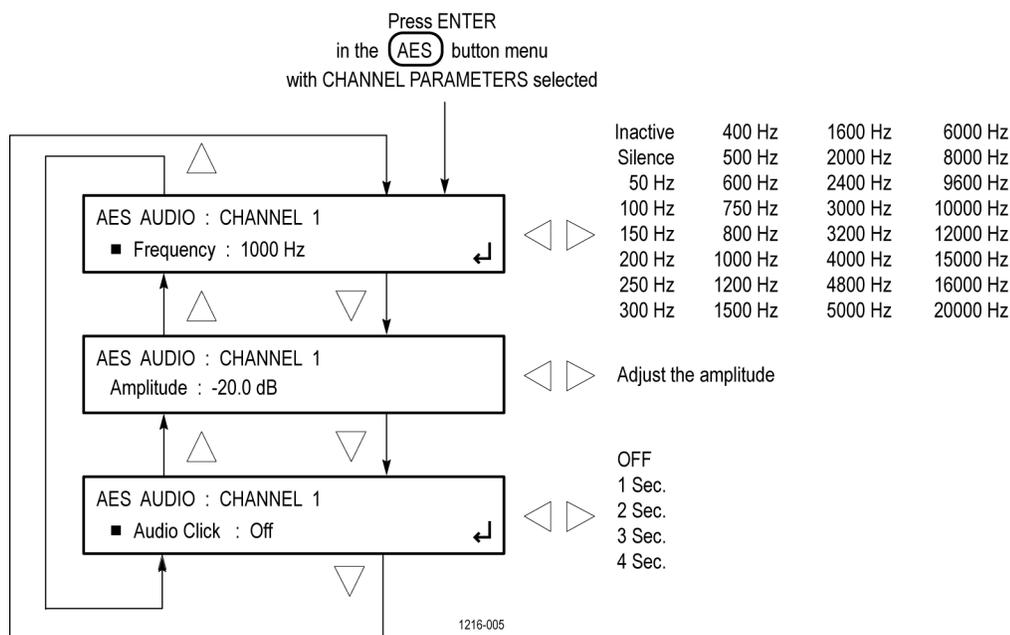
**Figure 61: AES AUDIO CHANNEL submenu diagram (Option AG only)**

**AES TIMING OFFSET submenu**

The following menu opens for the selected AES audio channel when you press ENTER in the AES button menu with TIMING OFFSET selected.



Press ENTER
in the (AES) button menu
with TIMING OFFSET selected

*1

AES : TIMING OFFSET
Delay : 0.0 μsec    ↵    ◁ ▷  Edit the delay
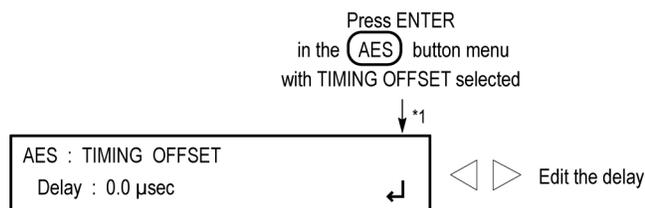
*1 To adjust the offset, the AUDIO-VIDEO SYNC setting must
be set to one of the frame reset signals.          1216-006

**Figure 62: AES TIMING OFFSET submenu diagram (Option AG only)**

*NOTE. You can reset the timing offset to zero by pressing the left (◀) and right (▶) arrow buttons simultaneously.*

*You cannot adjust the timing offset when Free Run is selected as the AUDIO-VIDEO SYNC mode.*

# BLACK button menu

Use the BLACK button menu to view and configure the BLACK outputs. Press the **BLACK** button repeatedly to select the desired BLACK output (1–5) or to select the desired group of BLACK outputs (1–3 or 4–5) for which to set the HD tri-level sync rate. The following figures shows the top level diagrams for the BLACK button menu.
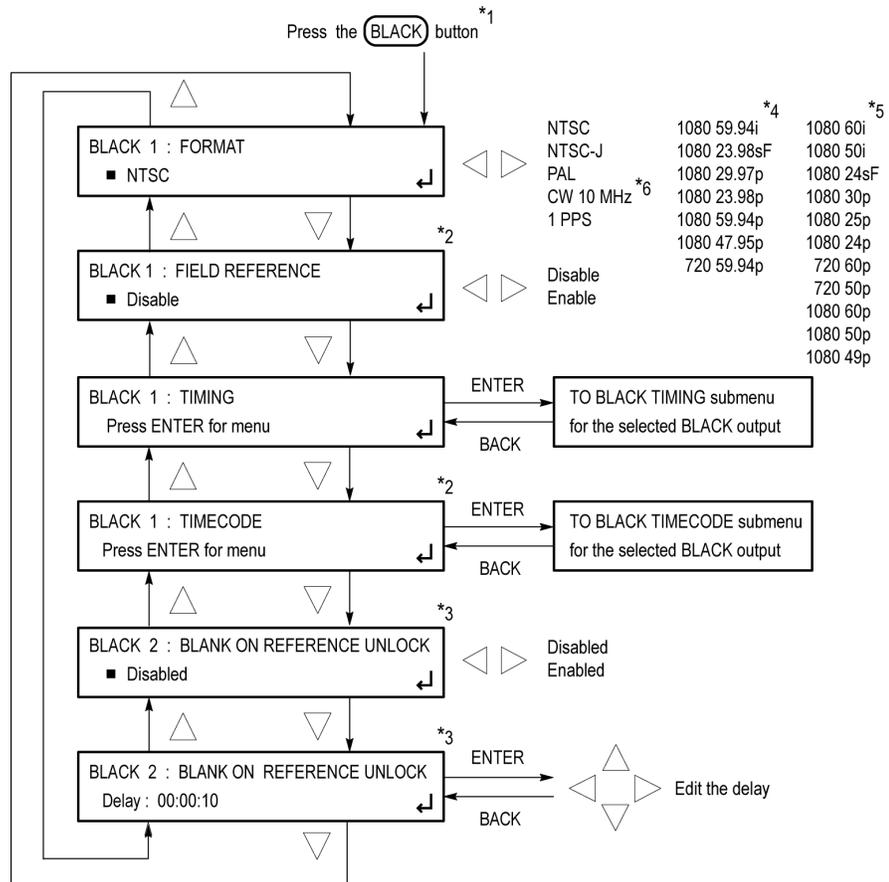
Press the (BLACK) button *1

BLACK 1 : FORMAT
 ■ NTSC ↵

◁ ▷

NTSC       1080 59.94i   1080 60i *5
NTSC-J     1080 23.98sF  1080 50i
PAL        1080 29.97p   1080 24sF
CW 10 MHz *6  1080 23.98p   1080 30p
1 PPS      1080 59.94p   1080 25p
           1080 47.95p   1080 24p
            720 59.94p    720 60p
                          720 50p
                         1080 60p
                         1080 50p
                         1080 49p
*4

BLACK 1 : FIELD REFERENCE
 ■ Disable ↵    *2

◁ ▷  Disable
     Enable

BLACK 1 : TIMING
 Press ENTER for menu ↵

ENTER → TO BLACK TIMING submenu for the selected BLACK output
BACK

BLACK 1 : TIMECODE
 Press ENTER for menu ↵    *2

ENTER → TO BLACK TIMECODE submenu for the selected BLACK output
BACK

BLACK 2 : BLANK ON REFERENCE UNLOCK
 ■ Disabled ↵    *3

◁ ▷  Disabled
     Enabled

BLACK 2 : BLANK ON REFERENCE UNLOCK
 Delay : 00:00:10 ↵    *3

ENTER →  Edit the delay
BACK

*1 Press the (BLACK) button repeatedly to select the desired BLACK output (1-5) or to select the desired group of Black outputs (1-3 or 4-5). BLACK outputs 1-3 are standard; BLACK outputs 4-5 are available with Option BG only. When you select a group of BLACK outputs, you can set whether a non-integer or an integer clock will be used for the HD tri-level sync rate for those outputs.
*2 These menu items are available only for non-HD formats.
*3 These menu items are available only for the BLACK 2 output.
*4 These menu items appear only when the HD tri-level sync for the selected BLACK output is set to non-integer.
*5 These menu items appear only when the HD tri-level sync for the selected BLACK output is set to integer.
*6 The CW 10 MHz format selection appears only when the BLACK 3 output is selected. When CW 10 MHz is the selected output format, the other menu selections are not available.

1216-007

**Figure 63: BLACK button menu diagram – part 1**
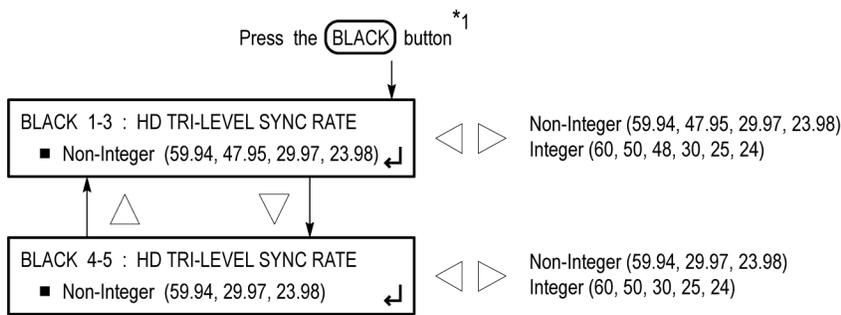
Continued from previous page

Press the (BLACK) button *1

BLACK 1-3 : HD TRI-LEVEL SYNC RATE
■ Non-Integer (59.94, 47.95, 29.97, 23.98) ↵

◁ ▷   Non-Integer (59.94, 47.95, 29.97, 23.98)
      Integer (60, 50, 48, 30, 25, 24)

△        ▽

BLACK 4-5 : HD TRI-LEVEL SYNC RATE
■ Non-Integer (59.94, 29.97, 23.98) ↵

◁ ▷   Non-Integer (59.94, 29.97, 23.98)
      Integer (60, 50, 30, 25, 24)

*1 Press the (BLACK) button repeatedly to select the desired BLACK output (1-5) or to select the desired group of Black outputs (1-3 or 4-5). BLACK outputs 1-3 are standard; BLACK outputs 4-5 are available with Option BG only. When you select a group of BLACK outputs, you can set whether a non-integer or an integer clock will be used for the HD tri-level sync rate for those outputs.
                                        1216-008

**Figure 64: BLACK button menu diagram – part 2**

**BLACK TIMING submenu**     The following menu opens for the selected BLACK output when you press ENTER in the BLACK button menu with TIMING selected.

Press ENTER
in the (BLACK) button menu
with TIMING selected

*1

BLACK 1 : TIMING : NTSC
  Vertical : 0 Line(s)

◁ ▷   Edit the number of lines

△        ▽

BLACK 1 : TIMING : NTSC
  Horizontal Coarse : 0.0000 µsec

◁ ▷   Edit the number of microseconds

△        ▽

BLACK 1 : TIMING : NTSC
  Horizontal Fine : 0.00 nsec

◁ ▷   Edit the number of nanoseconds
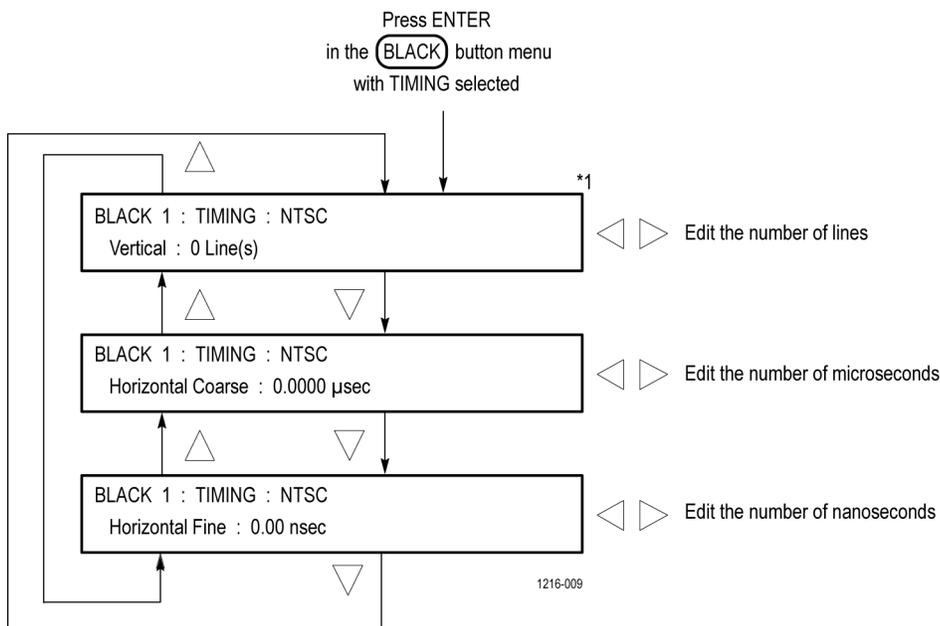
▽          1216-009

*1 The displayed timing format depends on which format is selected in the BLACK button main menu.

**Figure 65: BLACK TIMING submenu diagram**

**BLACK TIMECODE submenu**

The following menu opens for the selected BLACK output when you press ENTER in the BLACK button menu with TIMECODE selected.
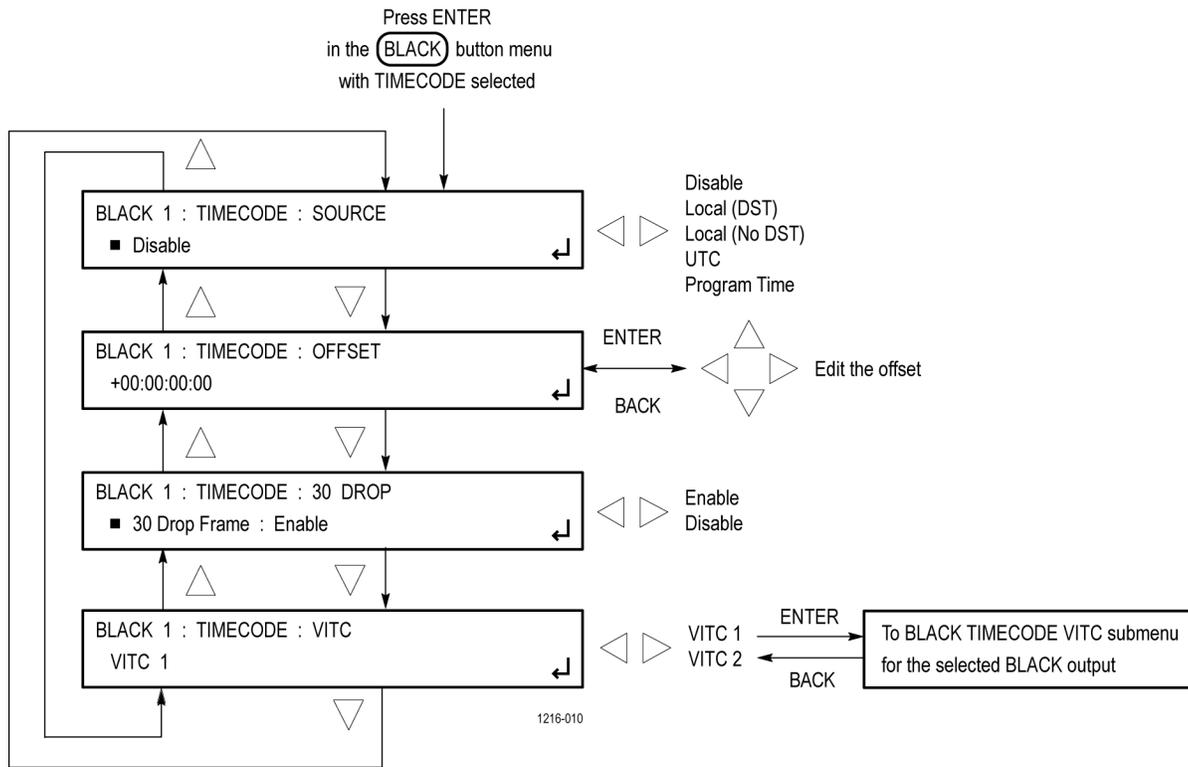


Figure 66: BLACK TIMECODE submenu diagram

**BLACK TIMECODE VITC submenu**

The following menu opens for the selected VITC signal when you press ENTER in the BLACK TIMECODE submenu with VITC selected.
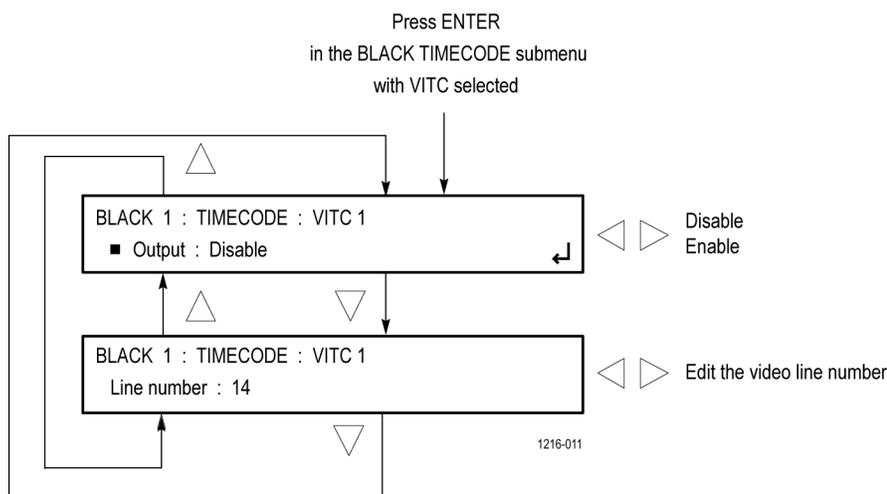


Figure 67: BLACK TIMECODE VITC submenu diagram

# CMPST button menu (Option BG only)

When Option BG is installed, press the CMPST button to view and configure the composite video outputs. Press the **CMPST** button repeatedly to select the desired composite output: **CMPST 1** or **CMPST 2**. The following figures show the menu diagrams for the CMPST button.



**Figure 68: CMPST button menu diagram**

**COMPOSITE TIMING submenu**

The following menu opens for the selected Composite output when you press ENTER in the CMPST button menu with TIMING selected.



**Figure 69: COMPOSITE TIMING submenu diagram**

*NOTE. You can reset the timing offset to zero by pressing the left (◄) or right (►) arrow buttons simultaneously. The horizontal timing can be adjusted only in clock cycle increments.*

**COMPOSITE TIMECODE submenu**

The following menu opens for the selected composite output when you press ENTER in the CMPST button menu with TIMECODE selected.
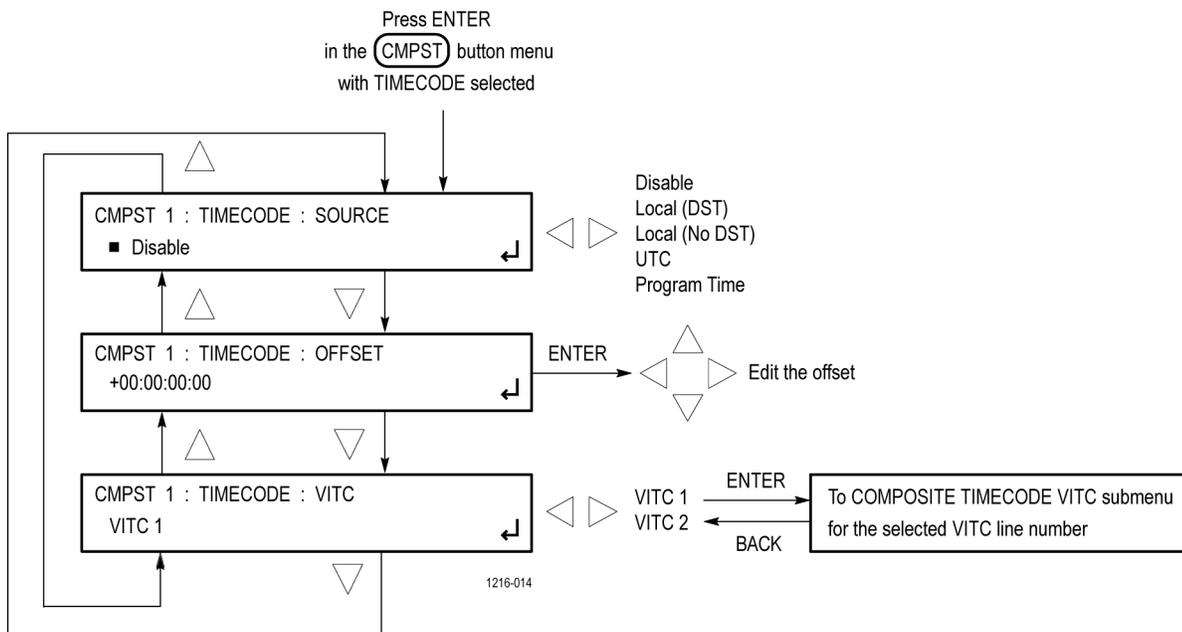


**Figure 70: COMPOSITE TIMECODE submenu diagram**

**COMPOSITE TIMECODE VITC submenu**

The following menu opens for the selected Composite output when you press ENTER in the CMPST TIMECODE submenu with VITC selected.
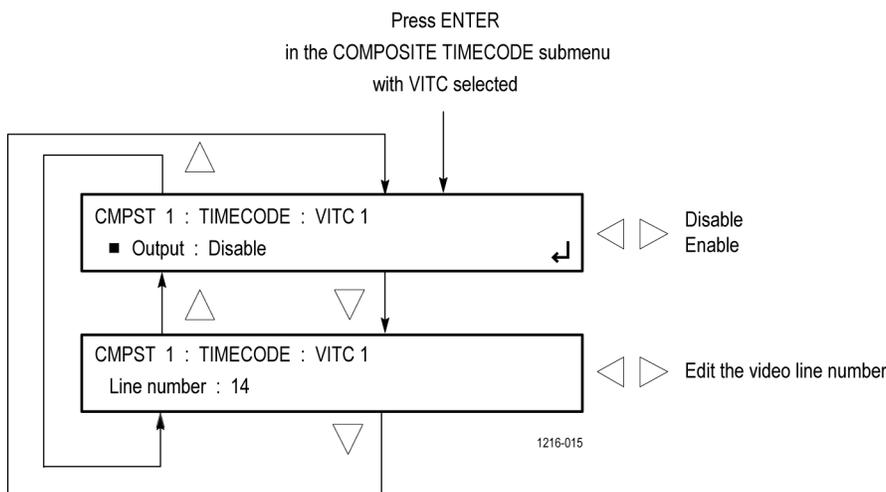


**Figure 71: COMPOSITE TIMECODE VITC submenu diagram**

# EMBED button menu (Option SDI only)

When Option SDI is installed, press the EMBED button to view and configure the embedded audio settings on the SDI video outputs. Use this menu to select the audio group for subsequent audio channel configuration, and to configure audio group parameters. Press the **EMBED** button repeatedly to select the embedded audio on the desired SDI outputs.

The following figure shows the menu diagram for the EMBED button.
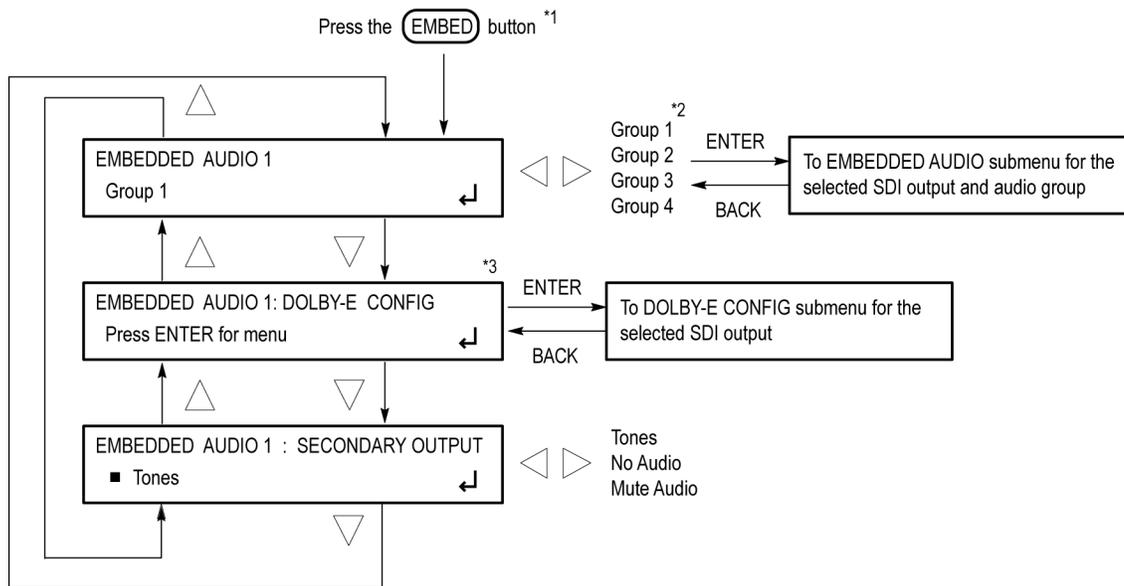


*1 Press the EMBED button repeatedly to select the embedded audio for the desired SDI output (1 or 2).

*2 Option 3G only: When the SDI signal format is set to 3G Level B, you can select groups 1-4 for link A or select groups 1-4 for link B.

*3 This menu item appears only when Option DBT is installed (Option SDI is required).

1216-016

**Figure 72: EMBED button menu diagram**

*SPG8000A User Manual*

**EMBEDDED AUDIO GROUP submenu**

The following menu opens for the selected SDI output and audio group when you press ENTER in the EMBED button menu with EMBEDDED AUDIO Group selected.



Press ENTER in the EMBED menu with EMBEDDED AUDIO selected

EMBEDDED 1 : AUDIO : GRP-1
■ Status : Disable
Disable
Enable

EMBEDDED 1 : AUDIO : GRP-1
■ Dolby-E Stream Ch1-2: Disabled
Disable
Enable
*1

EMBEDDED 1 : AUDIO : GRP-1
■ Dolby-E Stream Ch3-4: Disabled
Disable
Enable
*1

EMBEDDED 1 : AUDIO : GRP-1
Channel : 1
1
2
3
4
ENTER
BACK
To EMBEDDED CHANNEL submenu for the selected audio channel

EMBEDDED 1 : AUDIO : GRP-1
■ Sampling : Frame
Frame
Frame without Frame Number
Asynchronous
1216-017

*1 This menu item appears only when Option DBT is installed (Option SDI is required).

**Figure 73: EMBEDDED AUDIO GROUP submenu diagram**

**EMBEDDED AUDIO CHANNEL submenu**

The following menu opens for the selected SDI output, audio group and channel when you press ENTER in the EMBEDDED AUDIO submenu with Channel selected.
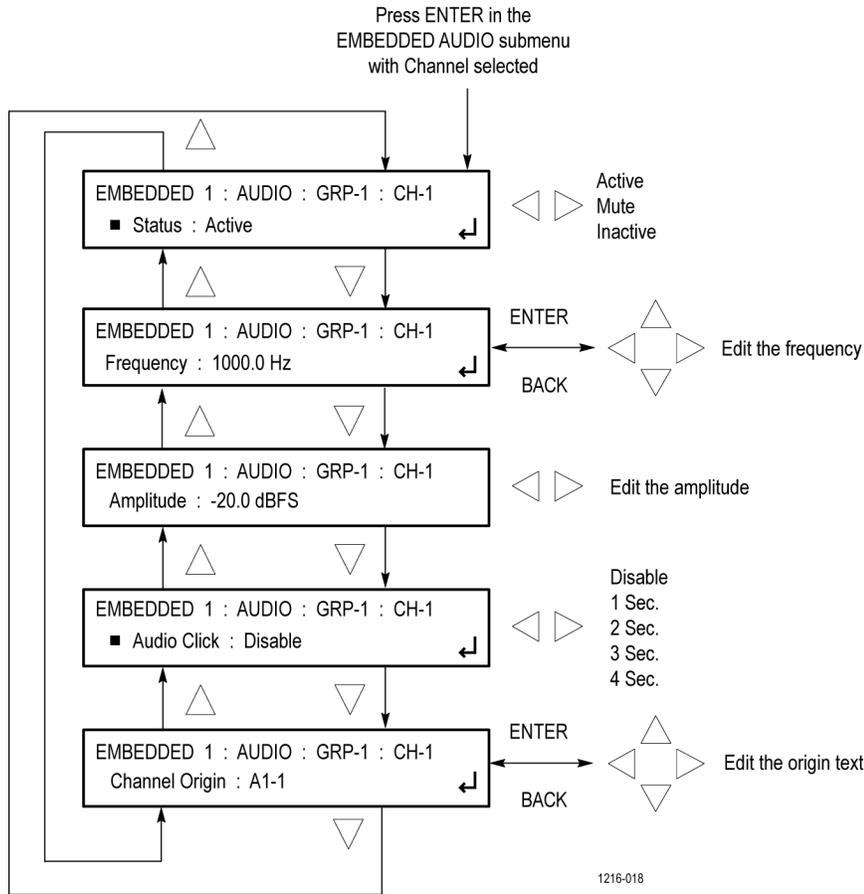


**Figure 74: EMBEDDED CHANNEL submenu diagram**

**DOLBY-E CONFIG submenu (Option DBT only)**

The DOLBY-E CONFIG submenu is available only when Option DBT is installed.

The following menu opens for the selected SDI output when you press ENTER in the EMBED button menu with DOLBY-E CONFIG selected.
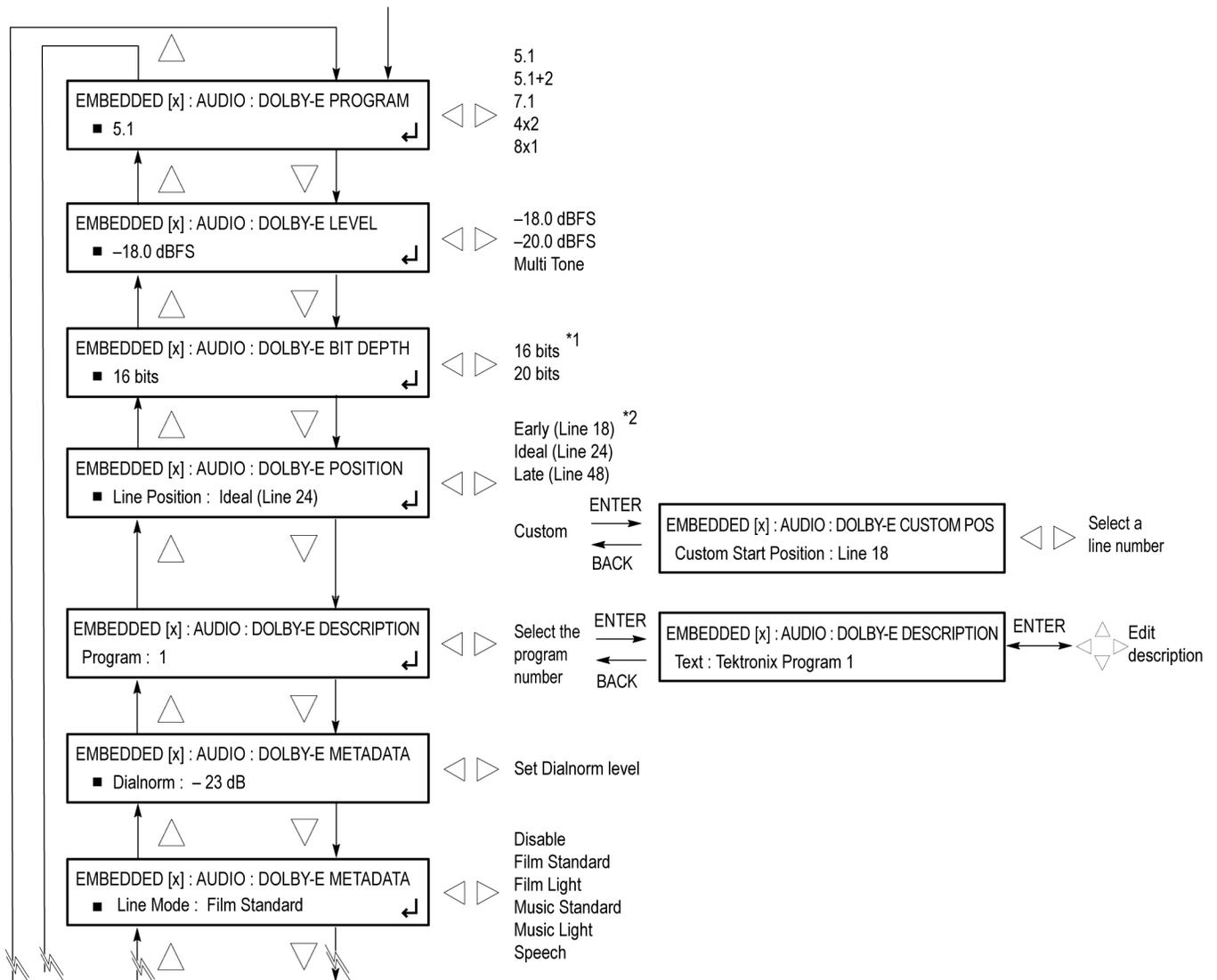


*1 The 16 bits setting is available only when the Dolby-E program type is set to 5.1.
*2 The line numbers vary depending on the video format.

**Figure 75: DOLBY-E CONFIG submenu diagram – part 1**

Continued from previous page

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ RF Mode : Music Light

Disable
Film Standard
Film Light
Music Standard
Music Light
Speech

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ Center Downmix Level : –3.0db

–3.0db
–4.5db
–6.0db

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ Surround Downmix Level : –3.0db

–3.0db
–6.0db
Infinite

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ Downmix Preferred : LoRo

Not Indicated
LtRt
LoRo

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ LtRt Center Mix Level : –3.0db

| +3.0db | –3.0db |
| +1.5db | –4.5db |
| 0.0db | –6.0db |
| –1.5db | Infinite |

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ LtRt Surround Mix Level : –3.0db

| +3.0db | –3.0db |
| +1.5db | –4.5db |
| 0.0db | –6.0db |
| –1.5db | Infinite |

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ LoRo Center Mix Level : –3.0db

| +3.0db | –3.0db |
| +1.5db | –4.5db |
| 0.0db | –6.0db |
| –1.5db | Infinite |

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ LoRo Surround Mix Level : –3.0db

| +3.0db | –3.0db |
| +1.5db | –4.5db |
| 0.0db | –6.0db |
| –1.5db | Infinite |

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
■ Frame Rate : 23.98 fps

23.98 fps
24. fps
25. fps
29.97 fps
30. fps

EMBEDDED [x] : AUDIO : DOLBY-E METADATA
Set Metadata to default <Press ENTER>

ENTER

Reset Dolby-E metadata

1216-020

**Figure 76: DOLBY-E CONFIG submenu diagram – part 2**

# LTC button menu

Press the LTC button to view and configure the LTC inputs and outputs on the GPI/LTC port. The following figure shows the menu diagram for the LTC button.
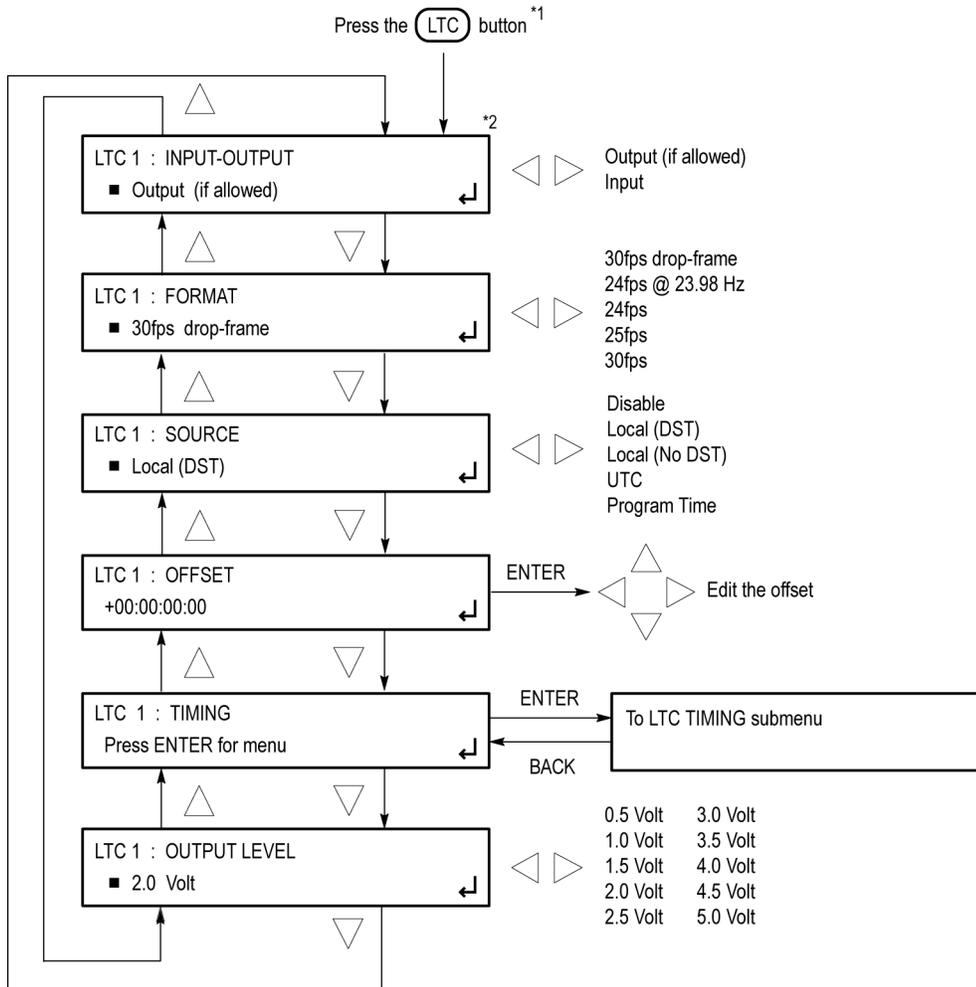


**Figure 77: LTC button menu diagram**

**LTC TIMING submenu**

The following menu opens for the selected LTC signal when you press ENTER in the LTC button menu with TIMING selected.
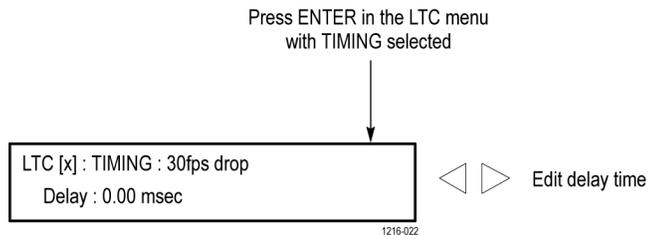


**Figure 78: LTC TIMING submenu diagram**

# REF button menu

Press the REF button to view the current status of instrument settings such as the signal reference source, the GPS and/or GLONASS time and antenna quality, the signals being output, and information about system faults and alerts. The following figure shows the menu diagram for the REF button.

Press the (REF) button

REFERENCE : SOURCE
■ NTSC Burst

GPS Signal *1
NTSC Burst
NTSC Burst with 10 field ID
PAL Burst
HD Tri-Level Sync
CW
PTP *2
Internal

*3

REFERENCE : GENLOCK TIMING
Press ENTER for menu

ENTER

To GENLOCK TIMING submenu

BACK

*4

REFERENCE : LOCK LOSS ACTION
■ Stay at Current Frequency

Stay at Current Frequency
Use Internal Frequency

*5

REFERENCE : FRAME RESET (CW)
■ Keep GPS/PTP Timing

2.997 Hz : NTSC, 59.94, 23.98 Hz Group
6.250 Hz : PAL and 50 Hz Group
3.000 Hz : 60 and 24 Hz Group
Keep GPS/PTP Timing

*6

REFERENCE : GL LOCK ACTION MODE
■ Automatic

Automatic
Wait for User Approval

*6

REFERENCE : GL MANUAL LOCK APPROVAL
Press ENTER to lock now

*1 This menu item appears only when Option GPS is installed.
*2 This menu item appears only when Option PTP is installed.
*3 This menu item appears only when Options GPS and PTP are not reference sources; this item does not appear when the reference source is set to Internal.
*4 This menu item does not appear when the reference source is set to Internal.
*5 These menu items appear only when the reference source is set to CW mode.
*6 These menu items appear only when the reference is set to NTSC, PAL, Tri-Level and CW.

1216-076

**Figure 79: REF button menu diagram — part 1**

Continued from previous page



REFERENCE : HOLDOVER RECOVERY
■ Stay Legal

*7
Stay Legal
Jam Phase
Fast Slew

REFERENCE : GPS ANTENNA POWER
■ Off

*1
Off
3.3 Volt
5 Volt

REFERENCE : GPS POSITION
■ Fixed

*8
Fixed
Mobile

REFERENCE : ACQUIRE GPS POSITION
Press ENTER to reacquire fixed pos.

*8
ENTER
→ Reacquire GPS fixed position

REFERENCE : GPS CONSTELLATION
GPS & GLONASS

*9
GPS & GLONASS
GPS Only
GLONASS Only

REFERENCE : GPS SIGNAL WARNING
■ 6 - Locked ▶ --------

*8
Edit warning level

*1  This menu item appears only when Option GPS is installed.
*7  These menu items appear only when Option GPS or PTP is installed and GPS or PTP is the reference source.
*8  These menu items appear only when Option GPS is installed and GPS is the reference source.
*9  This menu item appears only when Option GPS is installed and when the instrument has a
    GPS/GLONASS receiver, and when firmware version 1.5 or higher is installed.

1216-077

**Figure 80: REF button menu diagram — part 2**

**GENLOCK TIMING submenu**

The GENLOCK TIMING submenu is available only when the selected reference source is not GPS Signal, PTP or Internal.

Press ENTER in the
REFERENCE : GENLOCK TIMING menu

REFERENCE : GENLOCK TIMING : < Genlock Source >
    Vertical : 0 Line(s)

◁ ▷  Edit number of lines

REFERENCE : GENLOCK TIMING : < Genlock Source >
    Horizontal Coarse : 0.0000  μ sec

◁ ▷  Edit number of microseconds

REFERENCE : GENLOCK TIMING : < Genlock Source >
    Horizontal Fine : 0.00  nsec

◁ ▷  Edit number of nanoseconds

1216-024
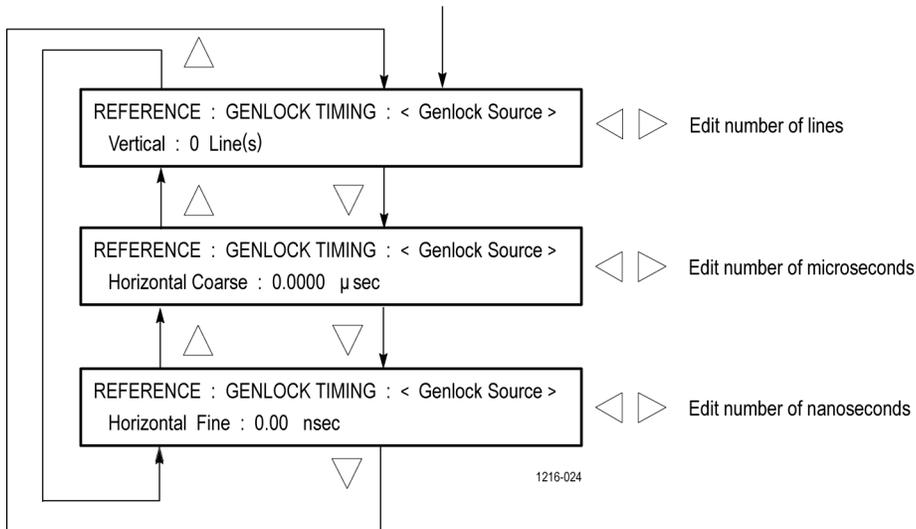
**Figure 81: GENLOCK TIMING submenu diagram**

# SDI button menu (Option SDI only)

When Option SDI is installed, press the SDI button to view and configure the signals on the SDI video outputs. The following figures show the menu diagrams for the SDI button.



Press the (SDI) button *1

SDI 1 : OUTPUT MODE (1080 59.94i)
■ HD (1920 x 1080)

HD (1920 × 1080)            3G-Level B (1920 × 1080)
HD (1280 × 720)             3G-Level B (2K × 1080)
3G-Level A (1920 × 1080)    3G-Level B (2xHD 1080)
3G-Level A (1280 × 720)     3G-Level B (2xHD 720)
3G-Level A (2K × 1080)      SD

*2
SDI 1 : FORMAT (HD 1080)
■ 1080 59.94i

Select the format

*3
SDI 1 : SAMPLE STRUCTURE / DEPTH
■ YCbCr 422 12b

YCbCr 422 12b        GBRA 4444 10b
YCbCrA 4224 12b      YCbCr 444 12b
GBR 444 12b          YCbCr 444 10b
GBR 444 10b          YCbCrA 4444 10b

ENTER
SDI 1 : TEST SIGNAL
Press ENTER for menu

To SDI TEST SIGNAL submenu for the selected SDI output

BACK

*4
SDI 1 : ALPHA CHANNEL DATA
■ Use Y/G Channel

Use Y/G Channel
0% Flat Field
   -- up to --    (in 10% increments)
100% Flat Field

*5
SDI 1 : 2xHD STREAM CONTENT
■ Test Signal / Test Signal

Test Signal / Test Signal
Test Signal / Black
Black / Test Signal

ENTER
SDI 1 : MOVING PICTURE
Press ENTER for menu

To SDI MOVING PICTURE submenu for the selected SDI output

BACK

1216-025

*1 Press the (SDI) button repeatedly to select the desired SDI output (1 or 2).
*2 The available formats depend on the OUTPUT MODE setting.
*3 This selection is available only for 3G formats (2K formats limited to GBR 444 and XYZ 444 color spaces).
*4 This selection is available only for 3G formats with YCbCrA or GBRA sample structures.
*5 This selection is available only for 2xHD output mode.

Continued on next page

**Figure 82: SDI button menu diagram – part 1**

Continued from previous page



| | |
|---|---|
| SDI 1 : OVERLAY<br>Press ENTER for menu ↵ | ENTER → To SDI OVERLAY submenu<br>for the selected SDI output<br>← BACK |
| SDI 1 : TIMING<br>Press ENTER for menu ↵ | ENTER → To SDI TIMING submenu<br>for the selected SDI output<br>← BACK |
| SDI 1 : TIMECODE<br>Press ENTER for menu ↵ | ENTER → To SDI TIMECODE submenu<br>for the selected SDI output<br>← BACK |
| SDI 1 : VIDEO<br>Press ENTER for menu ↵ | ENTER → To SDI VIDEO submenu<br>for the selected SDI output<br>← BACK |
| SDI 1 : ANCILLARY DATA<br>Press ENTER for menu ↵ | ENTER → To SDI ANC PAYLOAD submenu<br>for the selected SDI output<br>← BACK |
| SDI 1 : SMPTE 352 PAYLOAD ID<br>■ Enable ↵ | ◁ ▷ Enable<br>Disable |
| SDI 1 : SECONDARY OUTPUT<br>■ Test Pattern ↵ | ◁ ▷ Test Pattern<br>Black |

1216-026

**Figure 83: SDI button menu diagram – part 2**

**SDI TEST SIGNAL submenu**

The instrument comes with a standard set of test signals already installed. The following figure shows the SDI TEST SIGNAL submenu.
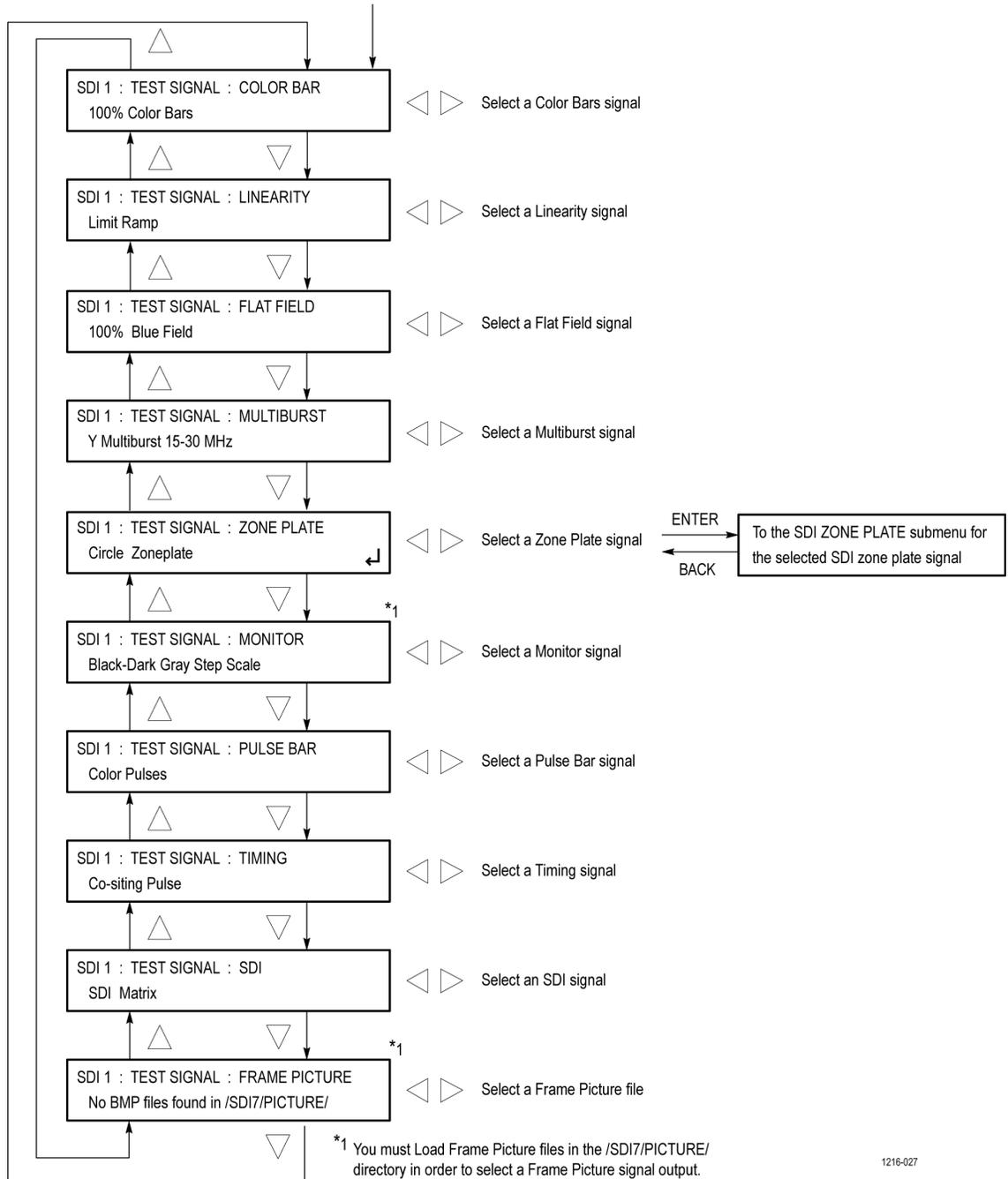


Figure 84: SDI TEST SIGNAL submenu diagram

SPG8000A User Manual

**SDI MOVING PICTURE submenu**

The following figure shows the diagram for the SDI MOVING PICTURE submenu.
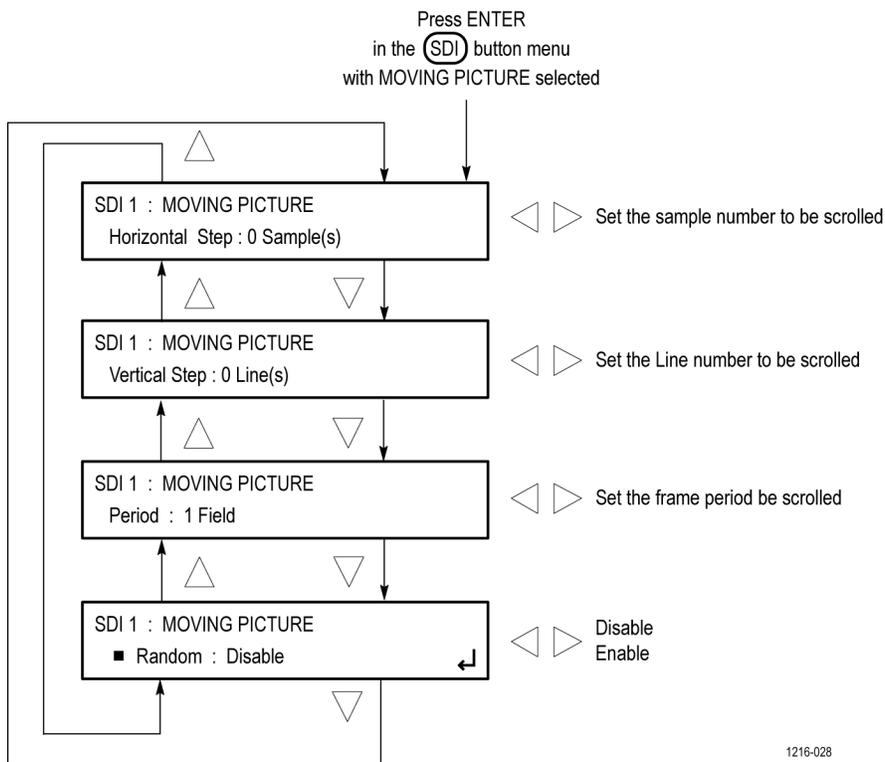


**Figure 85: SDI MOVING PICTURE submenu diagram**

**SDI OVERLAY submenu**     The following figure shows the diagram for the SDI OVERLAY submenu.
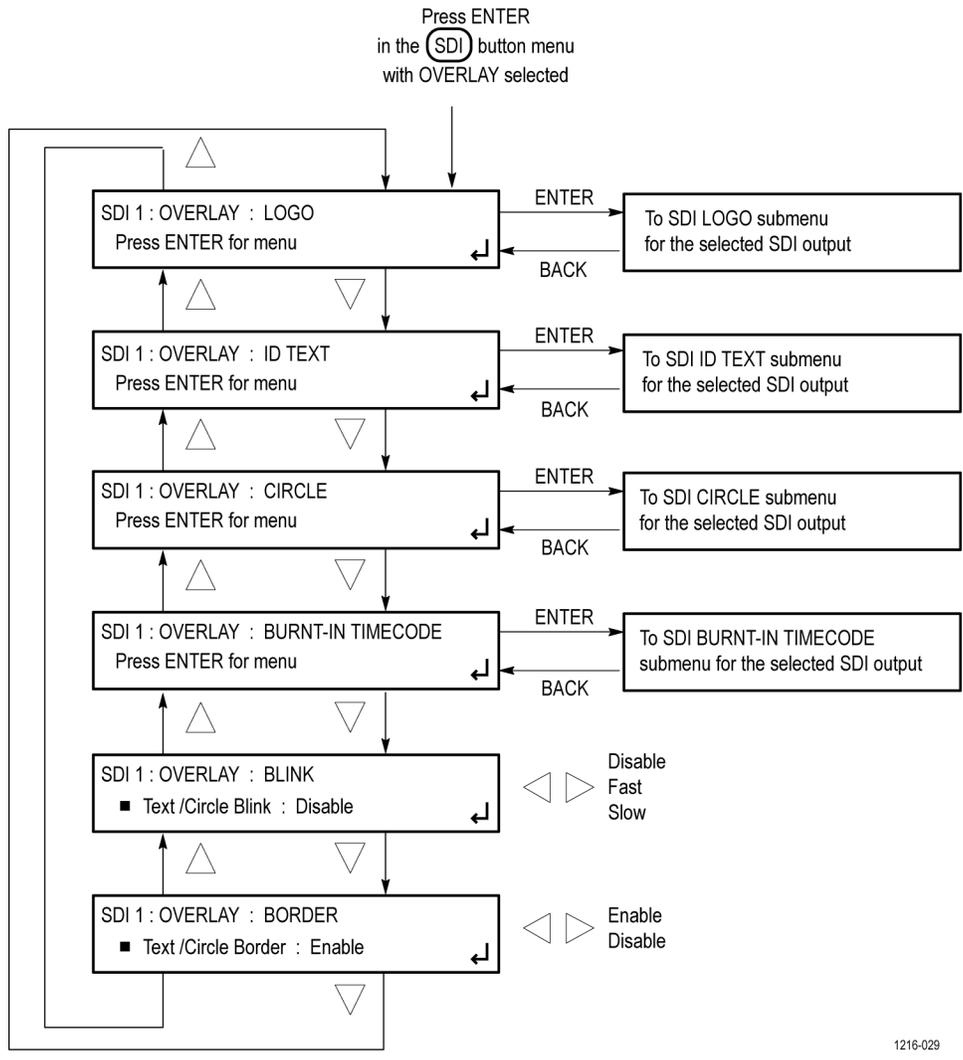


**Figure 86: SDI OVERLAY submenu diagram**

**SDI OVERLAY LOGO submenu**    The following figure shows the diagram for the SDI OVERLAY LOGO submenu.
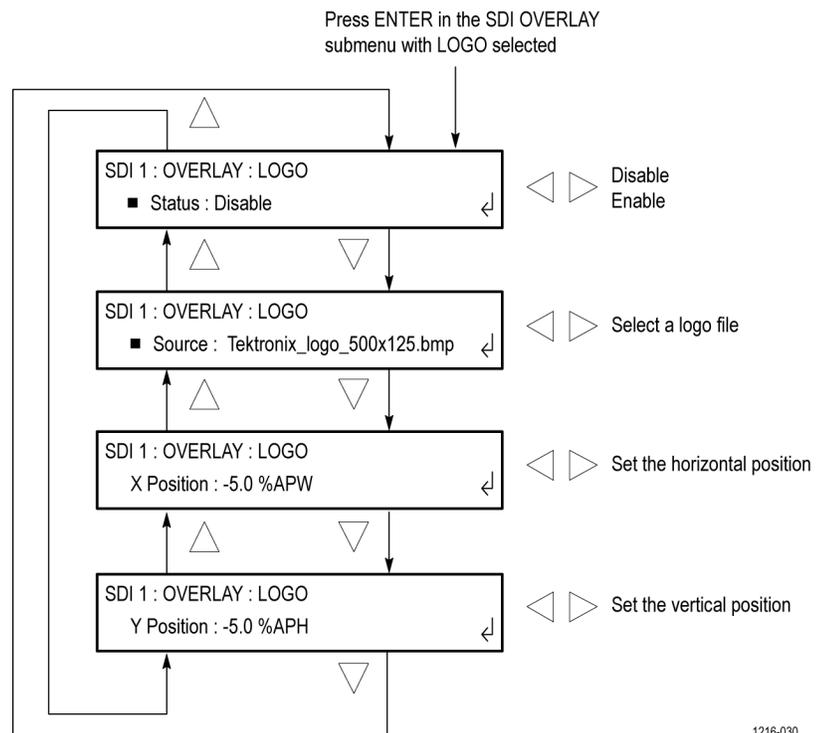


**Figure 87: SDI OVERLAY LOGO submenu**

**SDI OVERLAY ID TEXT submenu**    The following figure shows the diagram for the SDI OVERLAY ID TEXT submenu.
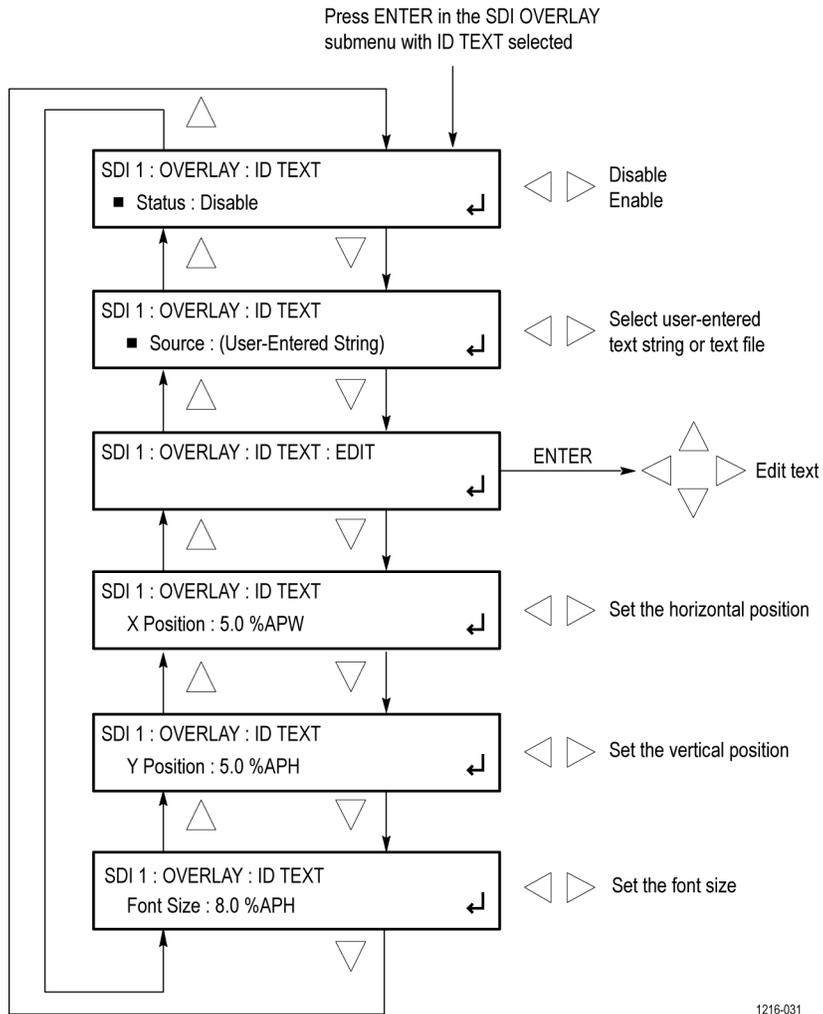


**Figure 88: SDI OVERLAY ID TEXT submenu**

**SDI OVERLAY CIRCLE submenu**

The following figure shows the diagram for the SDI OVERLAY CIRCLE submenu.

Press ENTER in the SDI OVERLAY
submenu with CIRCLE selected

SDI 1 : OVERLAY : CIRCLE
■ Status : Disable

Disable
Enable

SDI 1 : OVERLAY : CIRCLE
X Position : 0.0 % APW

Set the horizontal position

SDI 1 : OVERLAY : CIRCLE
Y Position : 0.0 % APH

Set the vertical position

SDI 1 : OVERLAY : CIRCLE
Diameter : 90.0 % APH

Set the diameter of the circle

1216-032
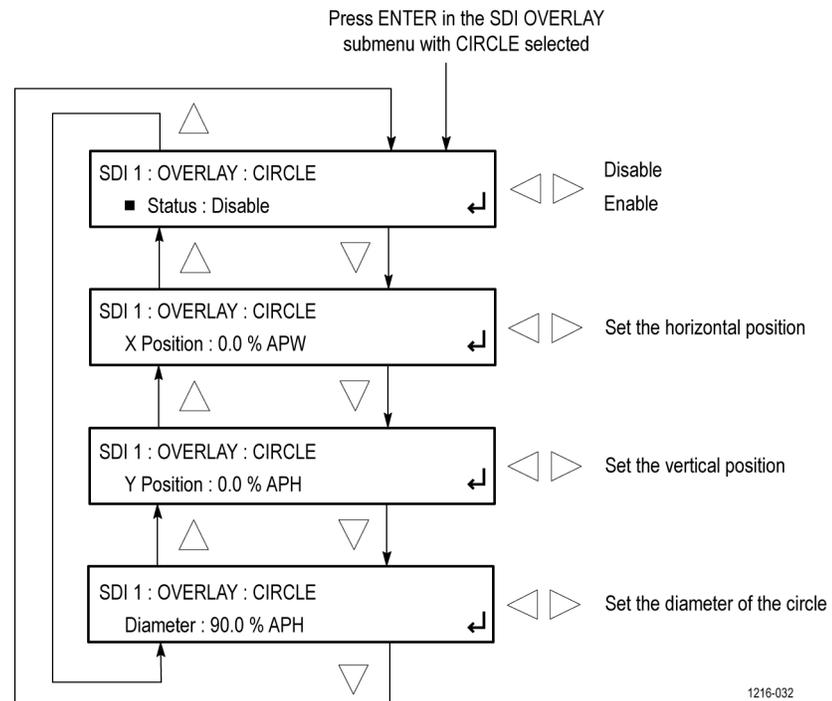
**Figure 89: SDI OVERLAY CIRCLE submenu**

**SDI OVERLAY BURNT-IN TIMECODE submenu**

The following figure shows the diagram for the SDI OVERLAY BURNT-IN TIMECODE submenu.
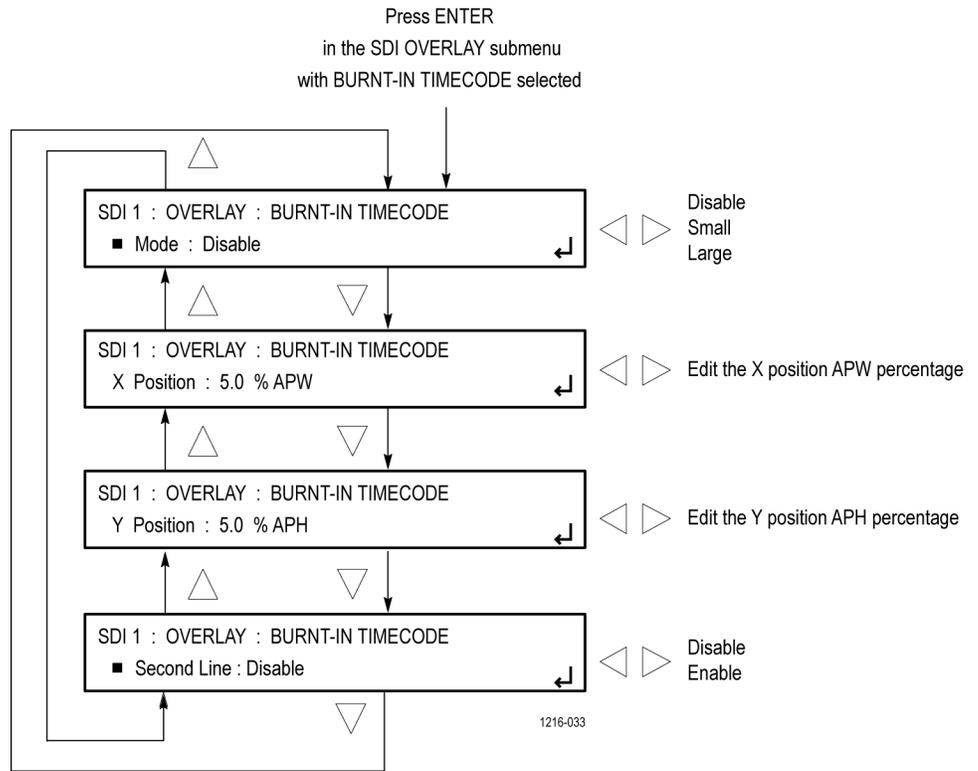


**Figure 90: SDI OVERLAY BURNT-IN TIMECODE submenu**

**SDI TIMING submenu**    The following figure shows the diagram for the SDI TIMING submenu.
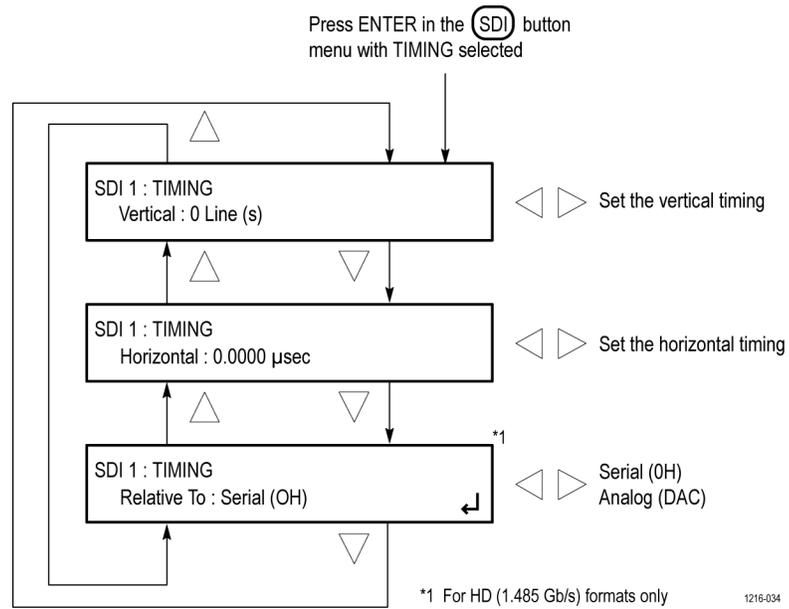


**Figure 91: SDI TIMING submenu diagram**

**SDI TIMECODE submenu**   The following figure shows the diagram for the SDI TIMECODE submenu.
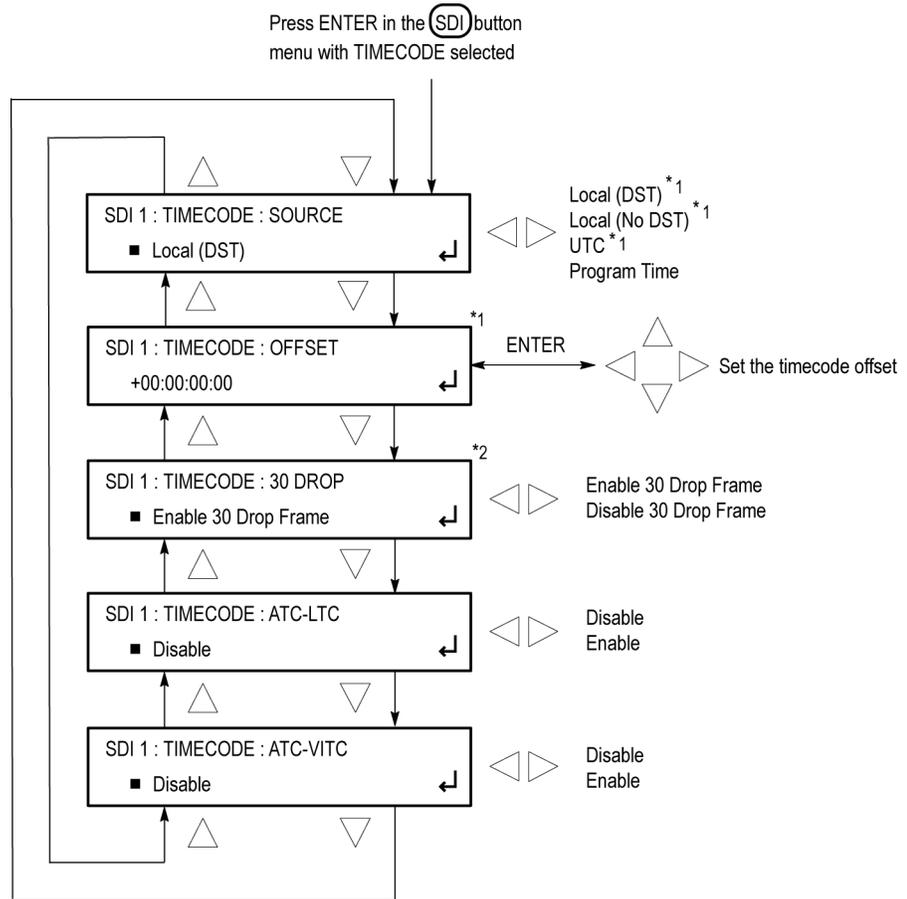


**Figure 92: SDI TIMECODE submenu diagram**

**SDI VIDEO submenu**  The following figure shows the diagram for the SDI VIDEO submenu.
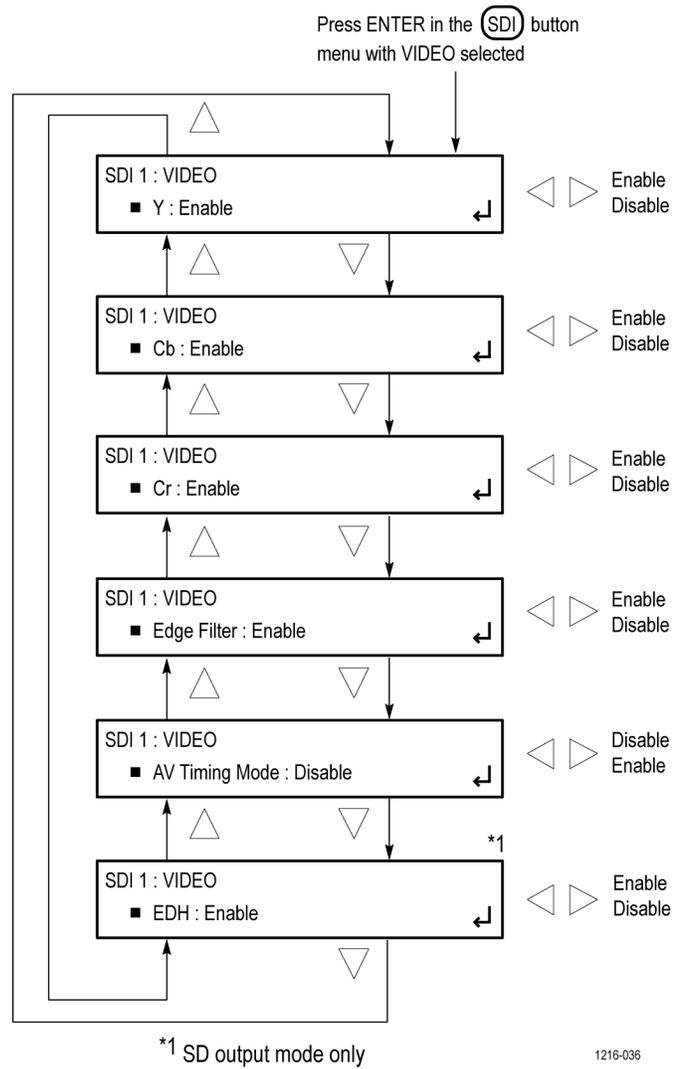


Figure 93: SDI VIDEO submenu diagram

**SDI ANC PAYLOAD submenu**

The following figures show the diagrams for the SDI ANC PAYLOAD submenu.
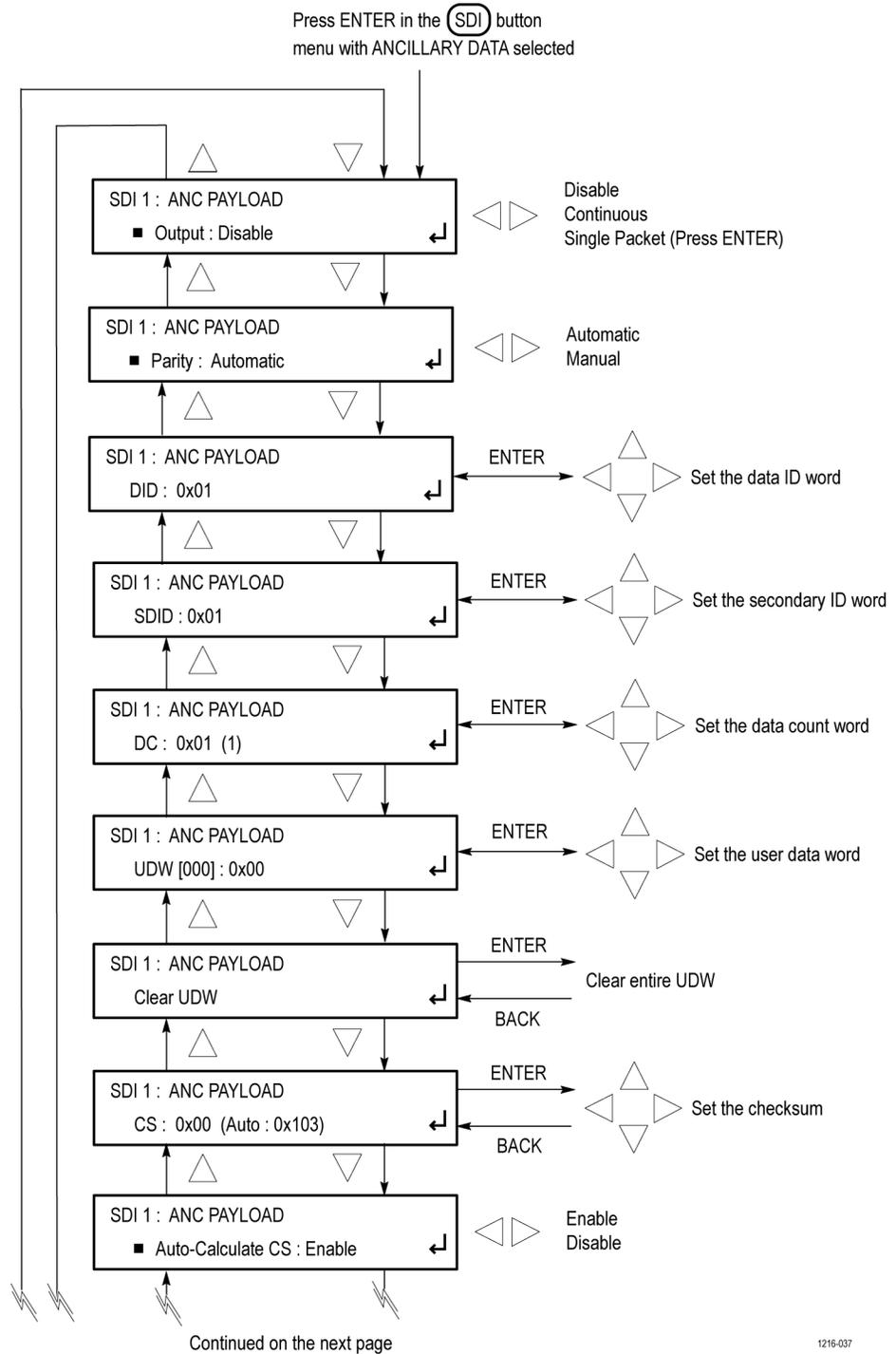


**Figure 94: SDI ANC PAYLOAD submenu diagram – part 1**

From previous page



SDI 1 :  ANC PAYLOAD
Line:  9                                    *1

Select line for ANC payload

SDI 1 :  ANC PAYLOAD
■ Field:  1 Only                            *2

1 Only
2 Only
1 and 2

SDI 1 :  ANC PAYLOAD
Field 1 Line: 9                             *2

Select field structure

SDI 1 :  ANC PAYLOAD
Field 2 Line: 9                             *2

Select field structure

SDI 1 :  ANC PAYLOAD
Sample Offset :  1928 (HANC)

Set sample offset

SDI 1 :  ANC PAYLOAD
■ Video Channel : Luma

Luma
Chroma

SDI 1 :  ANC PAYLOAD
■ Link Location:  Link A                    *3

Link A
Link B

SDI 1 :  ANC PAYLOAD
■ Stream Location:  HD Stream 1             *4

HD Stream 1
HD Stream 2

*1 Progressive formats only

*2 Interlaced formats only

*3 3G-B and DL formats only

*4 2xHD formats only                        1216-038

**Figure 95: SDI ANC PAYLOAD submenu diagram – part 2**

**CLEAR UDW.**  Use this menu item to clear the entire User Data Word.  Press the **ENTER** button to enter the CLEAR UDW mode, which will present the following dialog:

```
*          Clear entire UDW?          *
*        Yes : ENTER / No : BACK      *
```
0747-032

## STATUS button menu

Press the STATUS button to view the current status of instrument settings such as the signal reference source, GPS and/or GLONASS signal quality, the signals being output, and information about system faults and alerts.  This menu is for viewing status only and no changes to the instrument settings can be made from this menu.  The following figures show the menu diagram for the STATUS button.

Power on the SPG8000 or press
the (STATUS) button

*1

STATUS : FAULT
  PS2  fault error                    1/2
◁ ▷   View more faults

*2

STATUS : ALERT
  No GPS signal detected              1/3
◁ ▷   View more alerts

*3

STATUS : REFERENCE : GPS
  No Signal
◁ ▷   View more reference  status

*4

STATUS : TIME : GPS
  INT : 2012-10-23 20:10:24:30 (Local)
◁ ▷   View more time status

STATUS : PTP : PRIMARY : MASTER
  Disabled
◁ ▷   View more PTP primary master status

STATUS : PTP : PRIMARY : SLAVE
  Disabled
◁ ▷   View more PTP primary slave status

STATUS : PTP : SECONDARY : MASTER
  Disabled
◁ ▷   View more PTP secondary master status

*5

STATUS : GPS
  GPS  Signal  Quality : 10.0  Sats : 8/8
◁ ▷   View more GPS status

STATUS : BLACK 1-3
  B1: NTSC  B2: 720p59  B3: 1080i59
◁ ▷   View the status of the BLACK 4-5 outputs
        (option BG only)

*1 This menu item appears only when an instrument hardware issue has caused a status indicator to turn Orange or Red on the front panel status or web interface.
*2 This menu item appears only when a problem with the reference or time inputs that has caused a status indicator to turn Orange or Red on the front panel status or web interface.
*3 The readout for this menu item depends on the selected reference source (i.e. GPS, Internal, NTSC Burst, etc.).
*4 The readout for this menu item depends on the selected time source (i.e. GPS, LTC, VITC, Internal, etc.).
*5 This menu item appears only when Option GPS is installed.

Continued on next page                             1216-039

**Figure 96: STATUS button menu diagram – part 1**

Continued from previous page

STATUS : LTC
L1: 30DF   L2: 24   L3: 30   L4: 30DF

*6
STATUS : CMPST 1 : NTSC
100%  Color Bars
◁ ▷  View the status for the CMPST 2 output status

*7
STATUS : AES  AUDIO
PP  PP  PP  PP

*8
STATUS : SDI 1 : 100%  Color Bars
HD  1080  59.94i
◁ ▷  View the status for the SDI 2

*8
STATUS : EMBEDDED AUDIO 1
PPPP  PPPP - - - - - - - -
◁ ▷  View the embedded audio status for the SDI 2 output

*6  This menu item appears only when Option BG is installed.
*7  This menu item appears only when Option AG is installed.
*8  These menu items appear only when Option SDI is installed.

1216-040

**Figure 97: STATUS button menu diagram – part 2**

# SYSTEM button menu

Press the SYSTEM button to view and configure instrument settings such as network parameters, SNMP traps, Web interface access, GPI alarms, installed options, display brightness, beeper control, front panel disable, and hardware/firmware versions.

You can also use this menu to perform firmware upgrades, calibrate the oven oscillator, mount or unmount a USB device, save and recall presets, view diagnostic results, and perform a load test on the power supply.

The following figures show the menu diagram for the SYSTEM button.

Press the (SYSTEM) button

SYSTEM : PRESET
　Press ENTER for menu

ENTER → To PRESET submenu
BACK

SYSTEM : NETWORK
　Press ENTER for menu

ENTER → To NETWORK SETUP submenu
BACK

SYSTEM : PTP NETWORK
　Press ENTER for menu

ENTER → To PTP NETWORK submenu
BACK

SYSTEM : SPG A/V OUTPUT EPOCH SELECTION
　■ 1970　Jan 1st 00:00:00　GMT

◁ ▷　1970　Jan 1st　00:00:00　GMT
　　　1958　Jan 1st　00:00:00　GMT

SYSTEM : SNMP
　Press ENTER for menu

ENTER → To SNMP submenu
BACK

*1

SYSTEM : SCPI　-　PORT　5000
　■ Enable

◁ ▷　Enable
　　　Disable

SYSTEM : WEB　USER INTERFACE
　■ Full-Control

◁ ▷　Full-Control
　　　Disable
　　　Read-Only

*2

SYSTEM : USB　(Not Connected)
　No USB Drive Detected

SYSTEM : BACKUP / RESTORE
　Backup　Presets to USB

◁ ▷　Backup Presets to USB
　　　Backup All User Data to USB
　　　Restore Presets from USB
　　　Restore All User Data from USB

SYSTEM : GPI
　Press ENTER for menu

ENTER → To GPI submenu
BACK

SYSTEM : LCD　CONTRAST
　LOW << 8 >> HIGH

◁ ▷　Adjust the LCD display contrast

*1　Disable SCPI when it is not in use

1216-041

*2　The USB selection shows the USB status (mounted or unmounted) and allows for manual mounting or unmounting.

Continued on next page

**Figure 98:  SYSTEM button menu diagram – part 1**
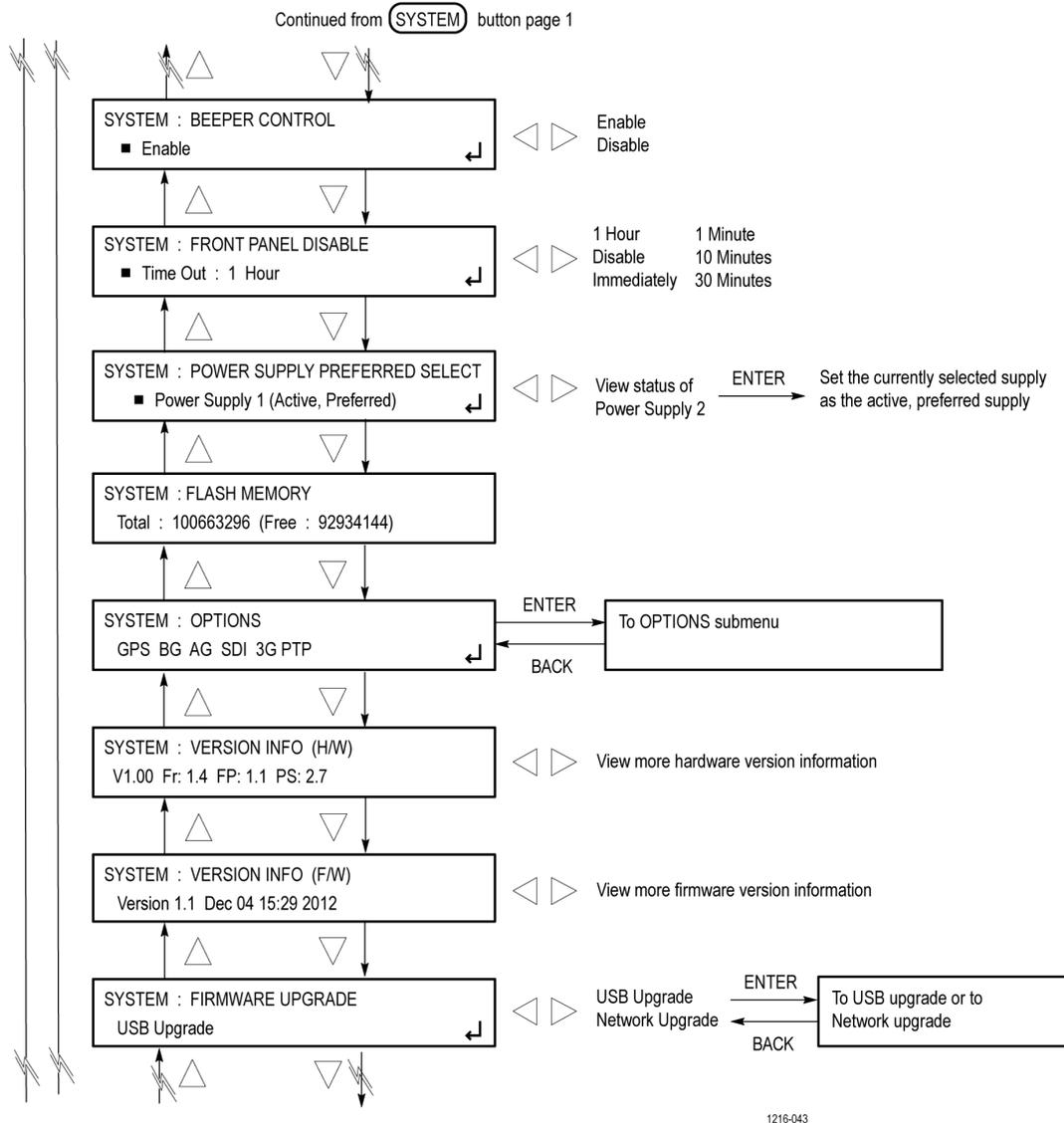
Figure 99: SYSTEM button menu diagram – part 2

SPG8000A User Manual

Continued from (SYSTEM) button page 2

| | ENTER | |
|---|---|---|
| SYSTEM : CALIBRATE OVEN<br>Internal Frequency Calibration ↵ | → ← BACK | To CALIBRATE OVEN submenu |
| SYSTEM : FRAME RESET STATUS<br>Press ENTER for menu ↵ | ENTER → ← BACK | To FRAME RESET STATUS submenu |
| SYSTEM : EVENT LOG<br>Press ENTER for menu ↵ | ENTER → ← BACK | To EVENT LOG submenu |
| SYSTEM : DIAGNOSTICS<br>Press ENTER for menu ↵ | ENTER → ← BACK | To DIAGNOSTICS submenu |
| SYSTEM : POWER SUPPLY LOAD TEST<br>Press ENTER for menu ↵ | ENTER → ← BACK | To POWER SUPPLY LOAD TEST submenu |

1216-042

**Figure 100: SYSTEM button menu diagram – part 3**

**WEB USER INTERFACE.** Disables or sets the control limits for the SPG8000A Web User Interface (See page 11, *Web user interface*.). Use the left (◄) or right (►) arrow button to select between the following options. Press the **ENTER** button to confirm the selection.

■ **Full-Control**. Allows a user to have full control of instrument settings when using the Web User Interface.

■ **Disable**. Disables the instrument from being accessed by the Web User Interface.

■ **Read-Only**. Allows a user to have read-only access to instrument settings when using the Web User Interface.

**BACKUP/RESTORE.** Backs up or restores the instrument presets or all user data using a USB drive. Use the left (◄) or right (►) arrow button to select the type of backup or restore operation, and then press the **ENTER** button to perform the operation. (See page 17, *How to backup/restore presets and user data*.)

**FRONT PANEL DISABLE.** Sets the time-out period until the front-panel buttons are disabled. Use the left (◄) or right (►) arrow button to select from the following choices: Off, Immediately, 1 Minute, 10 Minutes, 30 Minutes, and 1 Hour. Press the **ENTER** button to enable the selection.

When you select any of these time-out periods (except Off), the front-panel buttons are disabled when that time passes without a button push. If this happens, press and hold the FRONT PANEL ENABLE button for a few seconds to restart the time-out counter and enable the front-panel buttons.

**VERSION INFO (H/W).** Displays the hardware versions of the various components in the instrument. The available displays depend on the hardware options installed in the instrument. Use the left (◄) or right (►) arrow button to view all of the hardware version readouts.

The display below lists the following hardware versions: CPU, main FPGA (Frame), Front Panel Board (FP), and Power Supply Combiner Board (PS).

```
SYSTEM : VERSION INFO (H/W)
  V0.13  Fr:1.4  FP:1.1  PS:2.7
```
1216-044
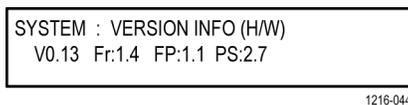
The display below depends on which firmware version is installed in the instrument. For instruments with firmware version 1.4 and below, the display lists the following hardware versions for the base instrument: Black/GPS board PLD, and both of the Black/GPS board FPGA versions (DO and BB).

```
SYSTEM : VERSION INFO (H/W)
  V1.7  DO:34  BB:46
```
1216-045
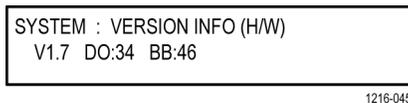
As shown below, for instruments with firmware version 1.5 and above, the display also includes a GPS receiver module ID field. For instruments with firmware version 2.5 and above, the display also includes the firmware version number installed on the GPS receiver module (1.20 in the image below).

The ID value in the readout below represents the hardware version of the GPS receiver. The possible values are:

- 3002. This value indicates that the receiver supports GPS signals only. This receiver was replaced by the 3015 receiver.

- 3015. This value indicates that the receiver supports GPS and GLONASS signals. This receiver was replaced by the 3023 receiver. There are some reported limitations with this receiver. See *SPG8000A Release Notes* for more information.

- 3023. This value indicates that the receiver supports GPS and GLONASS signals.

```
SYSTEM : VERSION INFO (H/W)
  V2.8  DO:41 BB:57  ID:3002  1.20
```
1216-046

The display below lists the following hardware versions: Option BG PLD, and both of the Option BG FPGA versions (BG1 and BG3).

```
SYSTEM : VERSION INFO (H/W)
  V1.2  BG1:33  BG3:36
```
1216-047

The display below lists the following hardware versions: Option AG PLD, and the Option AG FPGA version (AUD).

```
SYSTEM : VERSION INFO (H/W)
  V1.1  AUD:08
```
1216-048

The display below lists the following hardware versions: Option SDI PLD, and the Option SDI FPGA version (G) and build date (year, month, day, time).

```
SYSTEM : VERSION INFO (H/W)
  V2.5  G: 1.7  2012-11-8  14:30
```
1216-049

**VERSION INFO (F/W).** Displays the firmware version number installed in the instrument and the date and time of the firmware build. The date and time are in the format <month, date, time, year>.

**CALIBRATE OVEN.** Calibrates the frequency of the internal oven oscillator of the instrument. You can calibrate the oscillator using one of the following two methods:

- **GPS signal.** If Option GPS is installed in the instrument, you can use a GPS and/or GLONASS signal to calibrate the oscillator without removing the instrument from service.

- **PTP.** If Option PTP is installed in the instrument, you can lock the instrument to PTP and calibrate the oscillator without removing the instrument from service.

- **Frequency reference signal.** If Option GPS is not installed in the instrument or if you do not have access to a GPS and/or GLONASS signal, you can use a frequency reference signal such as NTSC Burst or CW to calibrate the oscillator. In this case, you must remove the instrument from service to calibrate the oscillator.

**Settings available only in the front-panel SYSTEM button menu**

The following SYSTEM button menu settings are available only using the front panel and are not available on the SPG8000A Web Interface:

- **SPG A/V OUTPUT EPOCH SELECTION.** Sets which SMPTE Epoch reference will be used for system timing. Use the left (◄) or right (►) arrow button to select from the following choices: 1970 Jan 1st 00:00:00 GMT or 1958 Jan 1st 00:00:00 GMT. Press the **ENTER** button to enable the selection.

- **FRONT PANEL DISABLE.** Sets the time-out period until the front-panel buttons are disabled. Use the left (◄) or right (►) arrow button to select from the following choices: Disable, Immediately, 1 Minute, 10 Minutes, 30 Minutes, and 1 Hour. Press the **ENTER** button to enable the selection.

- **SCPI – PORT 5000.** Enables or disables the access to the SCPI remote control port. This is independent from the Web interface access.

*NOTE. If the remote port is not needed this setting should be disabled to provide better security and resistance to port scanning.*

When you select any of these time-out periods (except Disable), the front-panel buttons are disabled and the display dims when that time passes without a button push. To enable front-panel operation, press and hold the FRONT PANEL ENABLE button for a few seconds to restart the time-out counter and enable the front-panel buttons.

**PRESET submenu**    The following figure shows the diagram for the PRESET submenu.
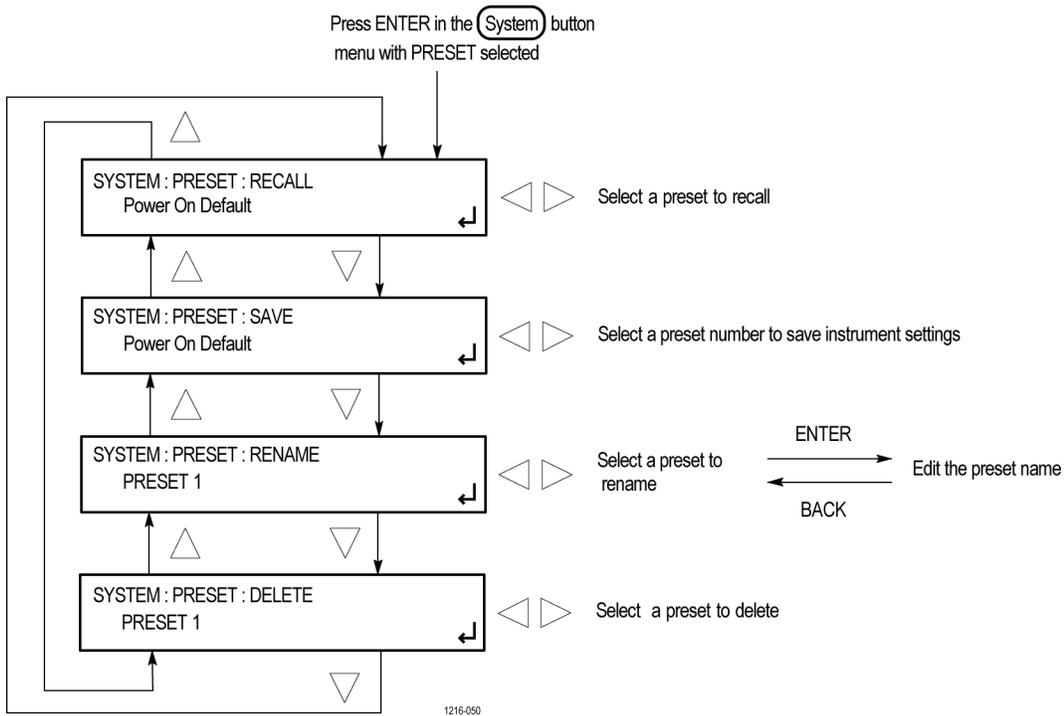


**Figure 101: PRESET submenu**

**NET SETUP submenu** The following figure shows the diagram for the NETWORK SETUP submenu.
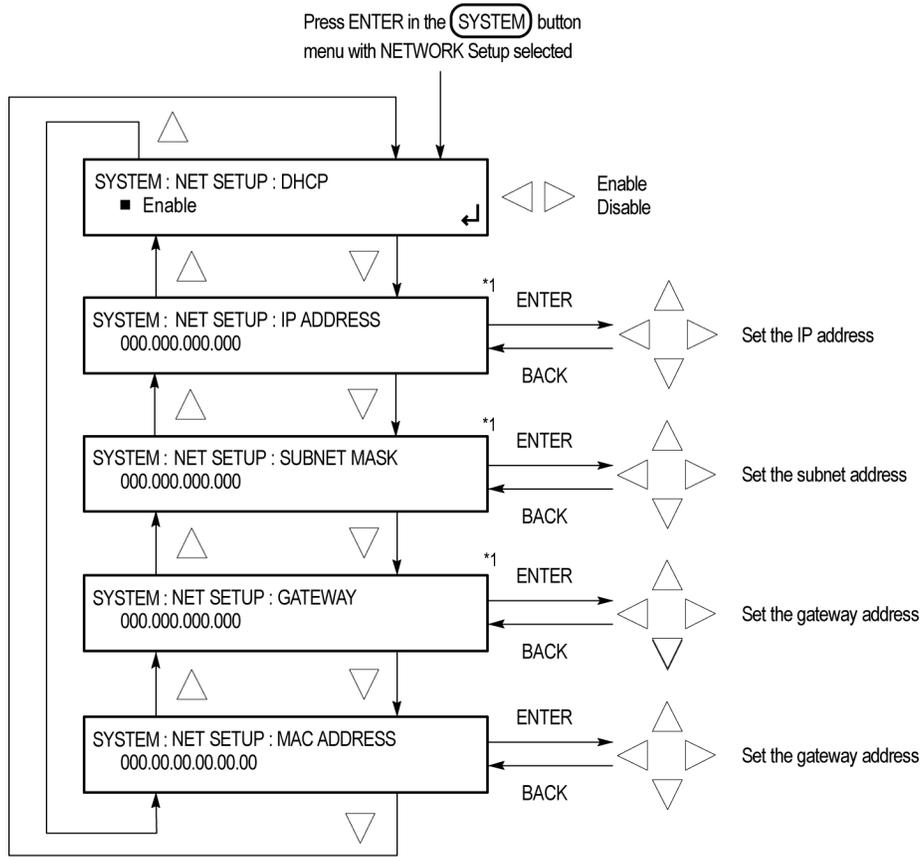


**Figure 102: NET SETUP submenu**

**PTP submenu**     The following figure shows the diagram for the PTP submenu.
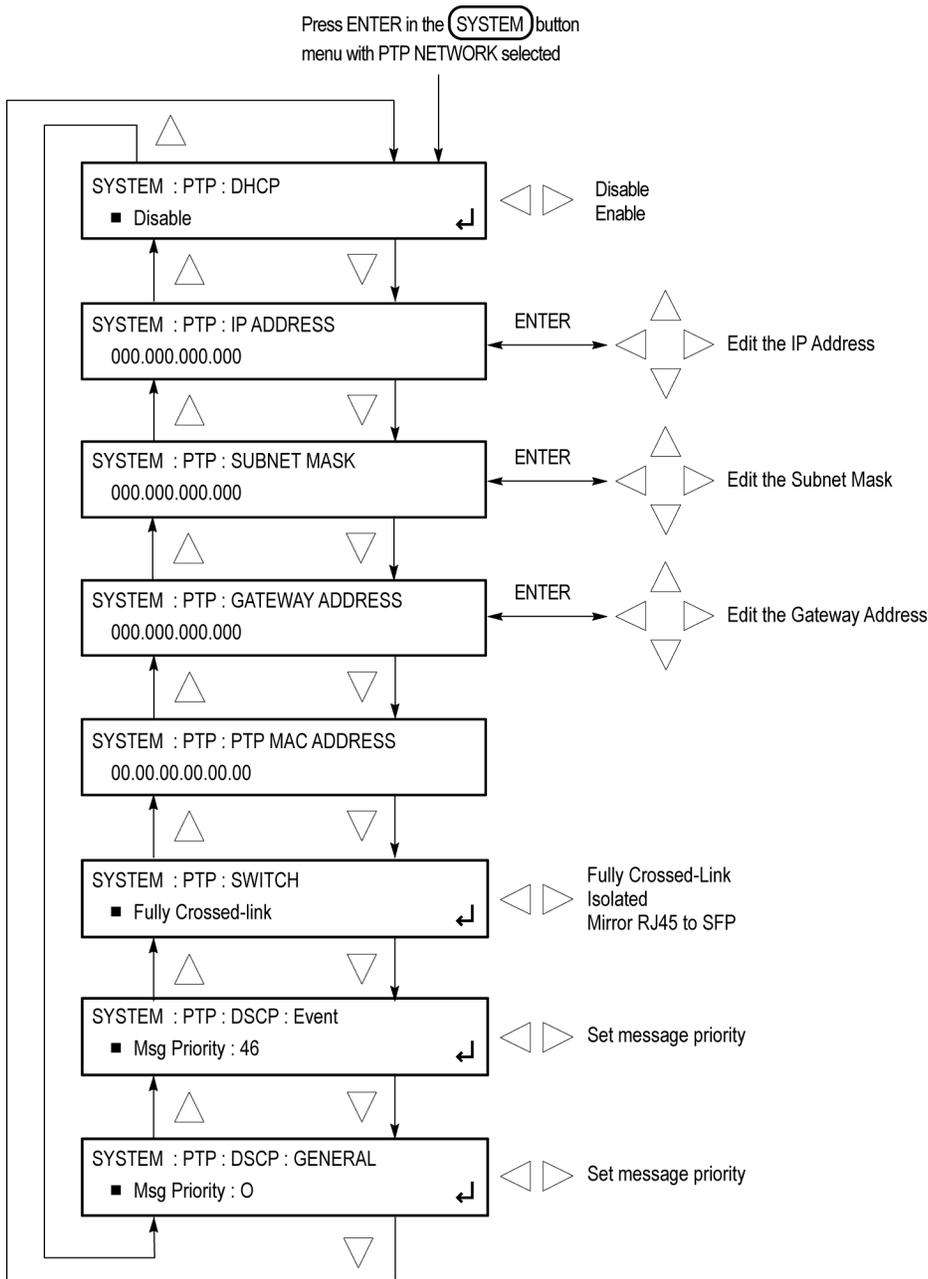


SYSTEM button - PTP NETWORK submenu diagram          1216-052

**Figure 103: PTP submenu**

**SNMP submenu**   The following figure shows the diagram for the SNMP submenu.
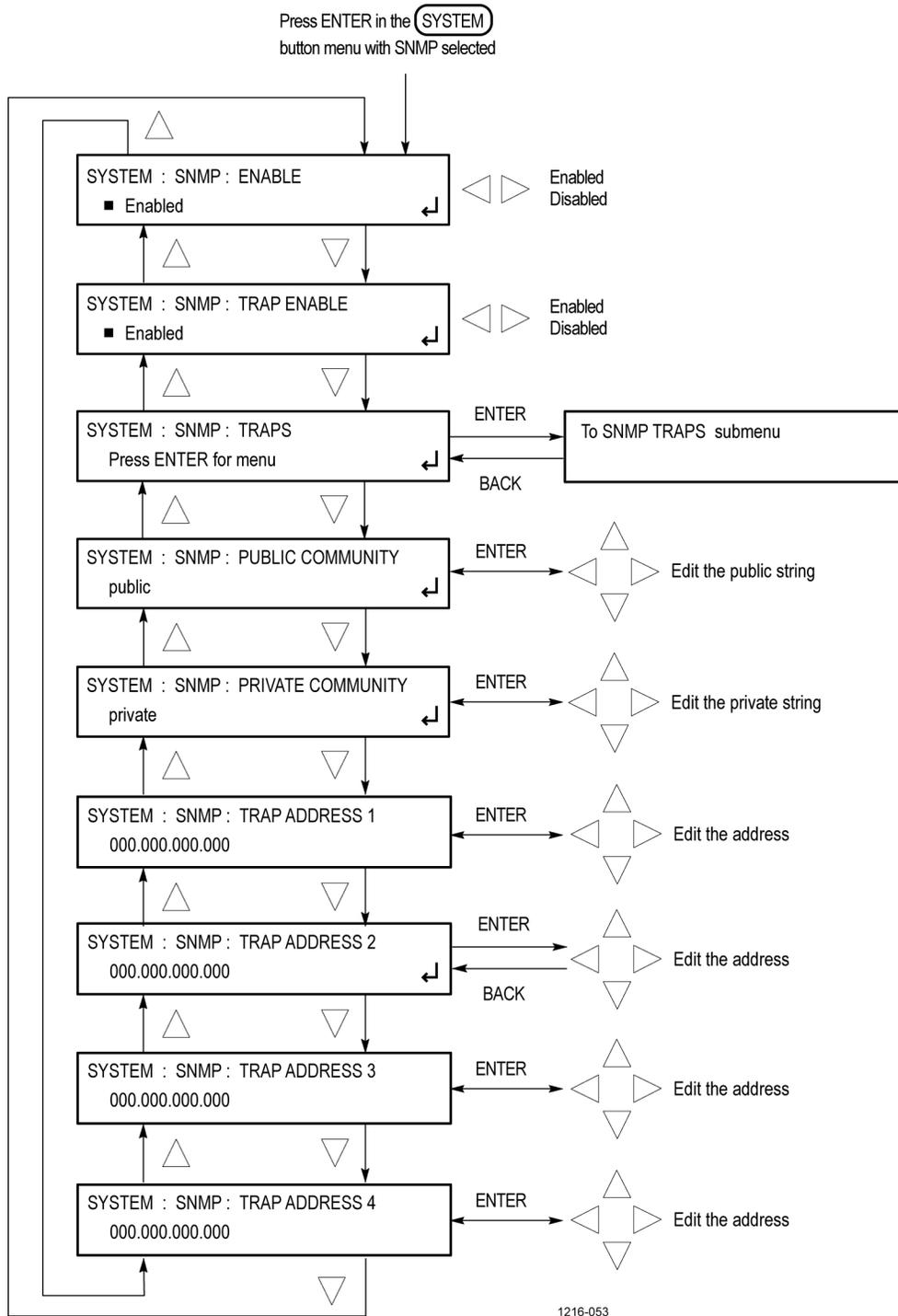


**Figure 104: SNMP submenu diagram**

*SPG8000A User Manual*

**SNMP TRAPS submenu**    The following figures show the diagrams for the SNMP TRAPS submenu.
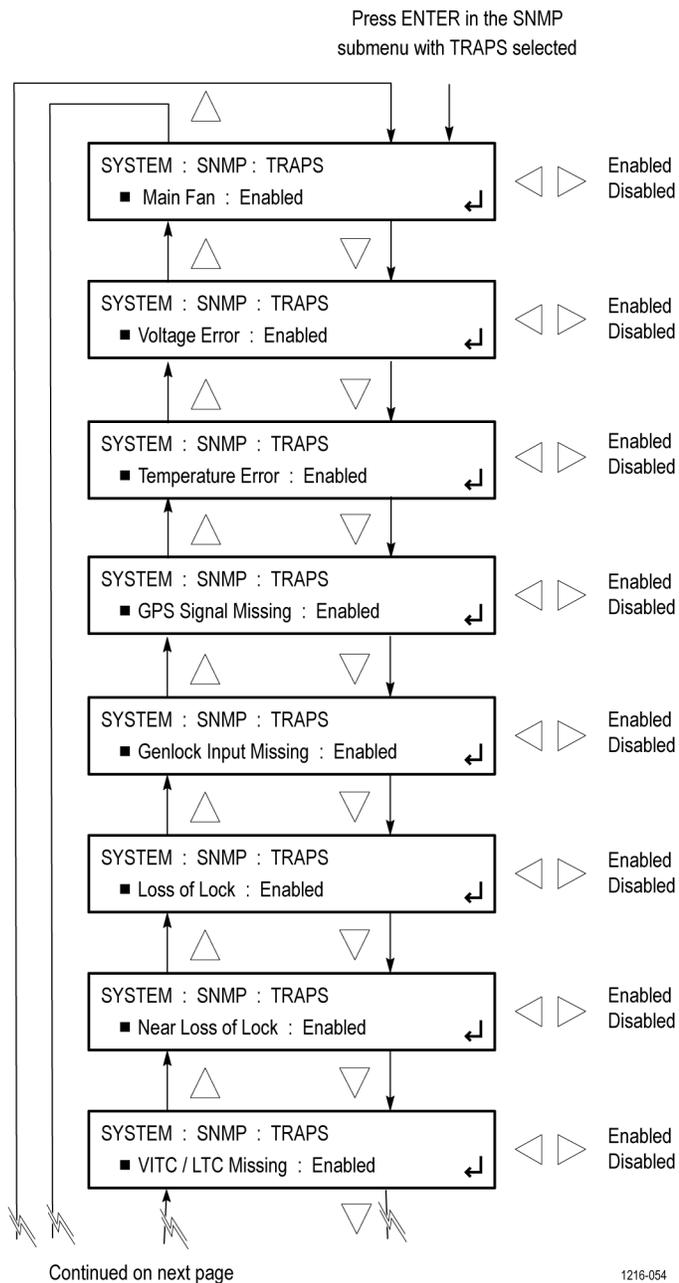


**Figure 105: SNMP TRAPS submenu diagram – part 1**

Continued from previous page
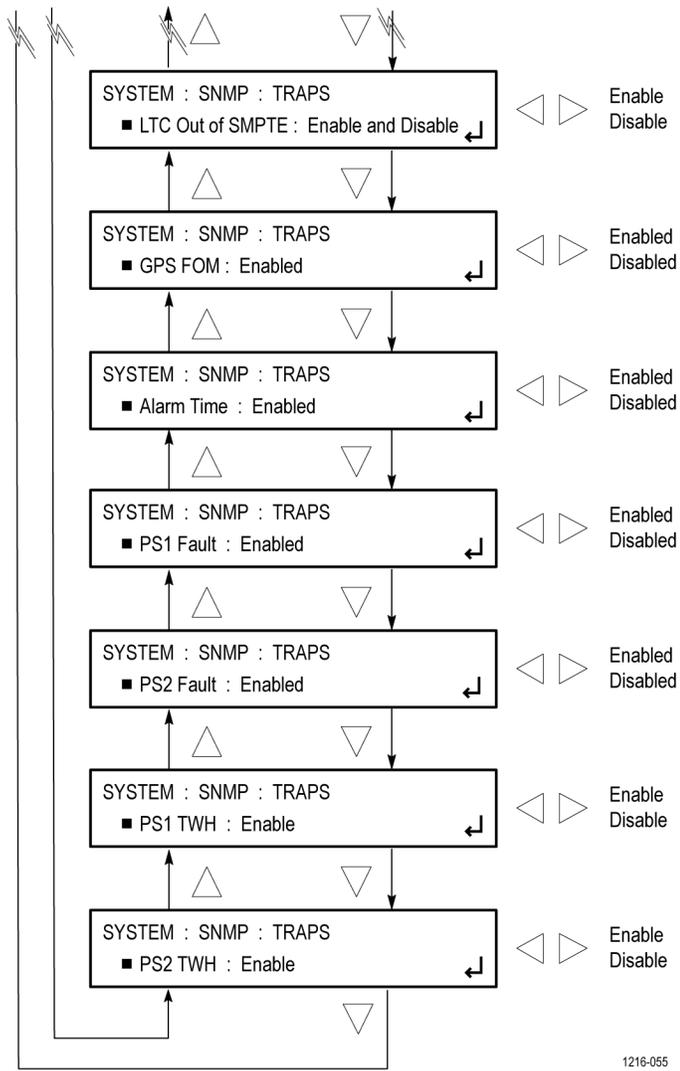


**Figure 106: SNMP TRAPS submenu diagram – part 2**

**GPI submenu**   The following figure shows the diagram for the GPI submenu.
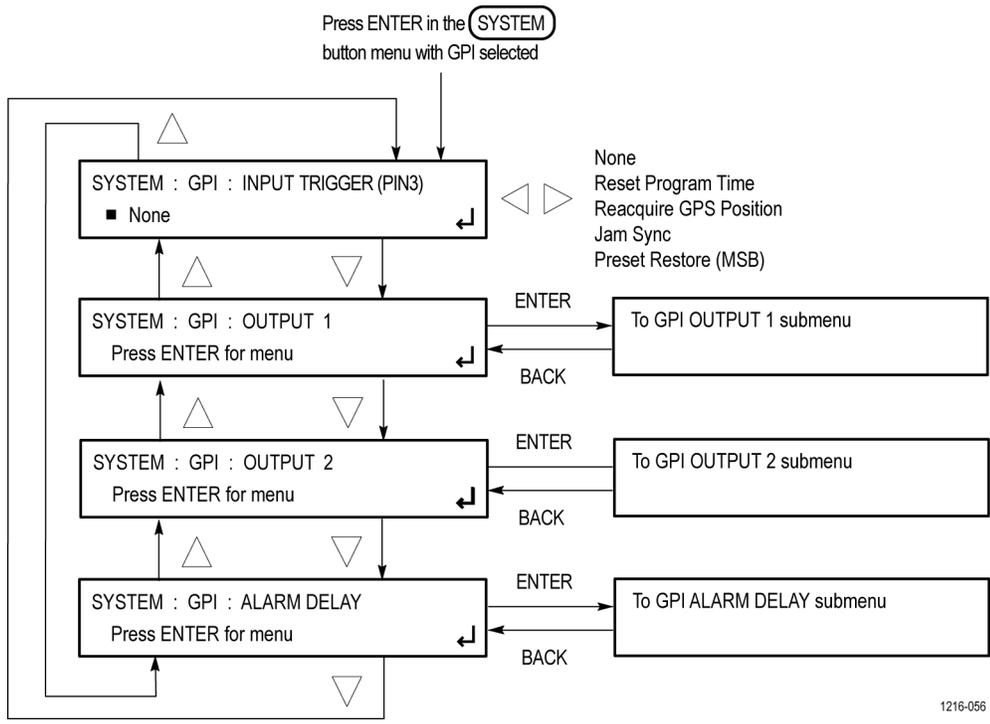


**Figure 107: GPI submenu diagram**

**GPI OUTPUT <1, 2, or 3> submenu**

The following figure shows the diagram for the selected GPI OUTPUT submenu (1, 2, or 3).
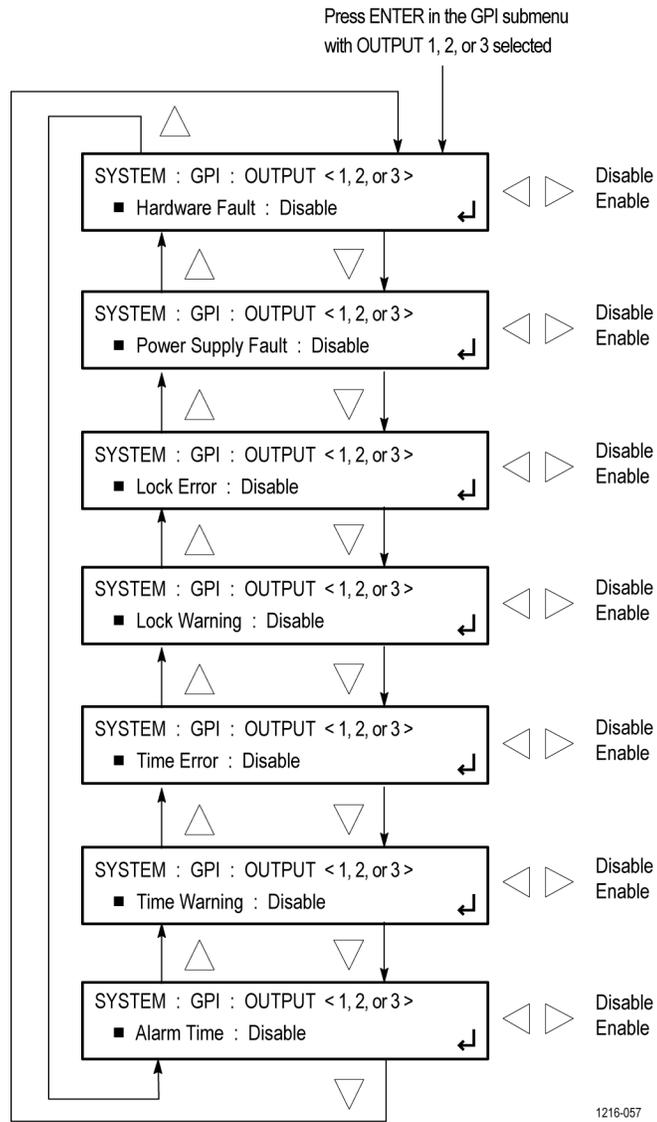


**Figure 108:  GPI OUTPUT <1, 2, or 3> submenu diagram**

**GPI ALARM DELAY submenu**

The following figure shows the diagram for the GPI ALARM DELAY submenu.
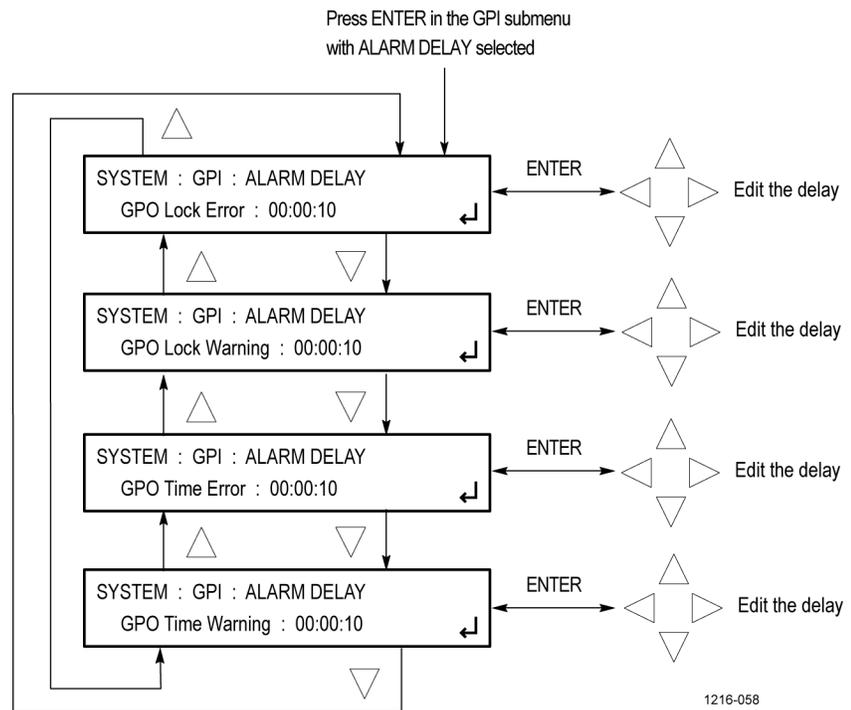


**Figure 109: GPI ALARM DELAY submenu diagram**

**OPTIONS submenu**

The following figure shows the diagram for the OPTIONS submenu.
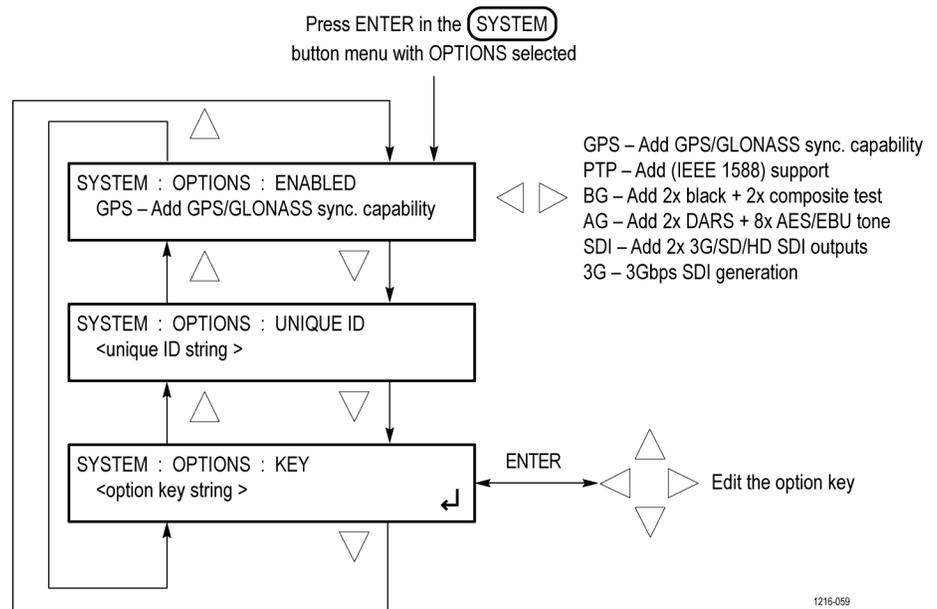


**Figure 110: OPTIONS submenu diagram**

**FRAME RESET STATUS submenu**

The following figure shows the diagram for the FRAME RESET STATUS submenu.
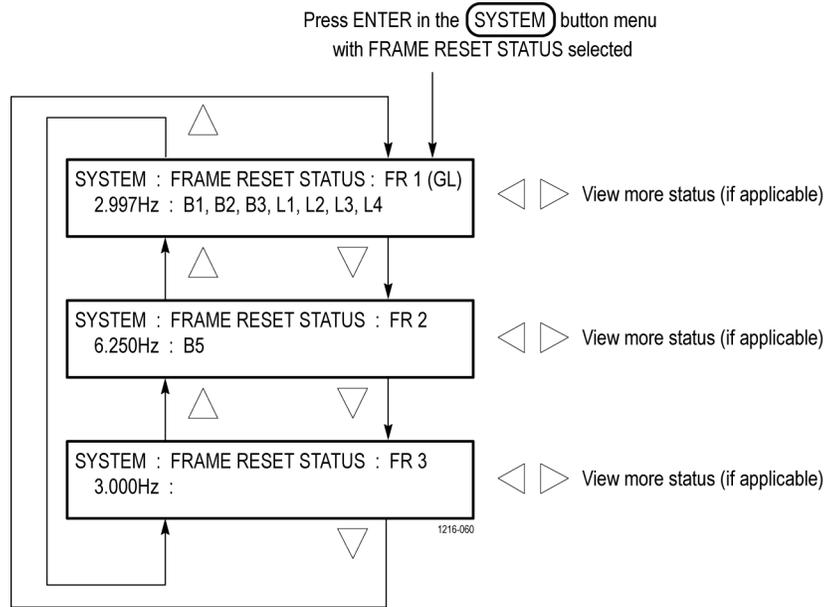


**Figure 111: FRAME RESET STATUS submenu diagram**

**EVENT LOG submenu** The following figure shows the diagram for the EVENT LOG submenu.

Press ENTER in the (SYSTEM) button
menu with EVENT LOG Setup selected

*1
ENTER

SYSTEM : EVENT LOG : EVENT LOG BY TYPE
Press ENTER for menu

BACK

View all events by type

*1
ENTER

SYSTEM : EVENT LOG : EVENT LOG BY TIME
Press ENTER for menu

BACK

View log entries in the
order by time

*1
ENTER

SYSTEM : EVENT LOG : LAST EVENT BY TYPE
Press ENTER for menu

BACK

View the last entry of
each type of event

*2
ENTER

SYSTEM : EVENT LOG : CLEAR EVENT LOG
Press ENTER

Clear the event log

*3
ENTER

SYSTEM : EVENT LOG : SAVE LOG TO USB
Press ENTER

Export the event log to a USB device

*1 Each event that is logged is described below this figure.
*2 This is a true clear and there is no recovery.
*3 Log entries will be saved by event type.

1216-074

**Figure 112: EVENT LOG submenu diagram**

With Event Log selected there are three ways to view the log entries:

■ **EVENT LOG BY TYPE.** Allows you to see all the log entries by the type of event. In each type, the log entries are listed by time. Use the up (▲) and down (▼) arrow buttons to view the different types of events. If the event has additional information, use the left (◄) and right (►) arrow buttons to view the later entries.

■ **EVENT LOG BY TIME.** Lists all the log entries in the order they occurred. The list starts with the oldest entry. Push the right arrow to get to

later entries. Use the left (◄) arrow button to see the recent entries and the right (►) arrow button to view the later entries.

■ **LAST EVENT BY TYPE.** Displays the last entry of each type of event. Use the up (▲) and down (▼) arrow buttons to view the different types of events.

---

*NOTE. If the log is filled with one type of entry, this submenu will keep the last entry of each type and prevent one type from filling the entire log.*

---

The different types of logged events are listed below in the order in which they appear in the log:

■ **Reference near loss of lock.** Indicates if the lock system was near the pull range limit (typically about ±8 ppm).

■ **Reference loss of lock.** Indicates that the instrument was unable to lock to the selected reference. For PTP and GPS references, the log will display the value of the FOM that was present at the time of the event.

■ **GPS missing.** Indicates that GPS was enabled and no GPS satellites were detected.

■ **Fan fault.** Shows if any of the fans stalled or were running slow.

■ **Temperature fault.** Indicates that the temperature sensors were detecting a temperature that was above or below the allowed limits.

■ **Diagnostic error.** Shows if any of the diagnostics failed. This includes monitors on the power supplies, fans, temperature, and various phase locked loops. This log entry corresponds to the fault light on the front panel.

■ **LTC/VITC missing.** Indicates that the selected time input of LTC or VITC was not present.

■ **LTC not SMPTE.** Indicates that LTC was not timed to the reference within the limits defined by SMPTE ST 12.

■ **Genlock input missing.** Indicates if Analog sync reference loop through input was selected and not present.

■ **GPS/PTP FOM.** Indicates that the Figure of Merit dropped below the user configured threshold.

■ **Alarm time.** Logs the time that the user configured alarm clock was triggered .

■ **Power supply 1 fault.** Indicates that power supply 1 was not working or did not have AC power applied.

■ **Power Supply 2 fault.** Indicates that power supply 2 was not working or did not have AC power applied.

■ **Power supply 1 TWH.** Shows if the supply has logged more than 131,000 temperature-weighted hours of use. This indicates the supply is near the end of its design life and should be replaced.

■ **Power supply 2 TWH.** Shows if the supply has logged more than 131,000 temperature-weighted hours of use. This indicates the supply is near the end of its design life and should be replaced.

■ **PS switch.** Indicates if the instrument switched from one power supply to another.

■ **Instrument reboot.** Records the time of each start up.

■ **MTOD change.** Logs the time of any change to the master time of the instrument.

■ **DST change.** Logs the time of any Daylight Saving Time change.

■ **Frame 1,2,3 change.** Indicates that the internal frame pulse phase was adjusted. These adjustments may cause disruptions in the output signals. Adjustments are normal when initially locking to a reference or aligning outputs to an epoch. The additional value on the log entry indicates the number of clock cycles by which the frame pulse was adjusted.

■ **Leap second change.** Indicates that a leap second has been detected and applied. The value indicates the leap second offset received from the GPS or PTP input.

■ **Reference source change.** Indicates the new selected reference any time the reference source is changed. the values are: 0 is Internal, 1 is GPS, 2 is NTSC Burst, 3 is NTSC Burst with 10 Field ID, 4 is PAL Burst, 5 is Tri-Level Sync, 6 is CW, and 7 is PTP.

■ **Reference locked.** Indicates the time at which the reference is locked. This is useful when used with the **Reference loss of lock** events to determine how long a system was unlocked.

■ **Wait for user approval.** Indicates the time at which the system started waiting for a user to allow the system to lock.

**DIAGNOSTICS submenu**     The following figure shows the diagram for the DIAGNOSTICS submenu.

Press ENTER in the (SYSTEM) button
menu with DIAGNOSTICS selected

SYSTEM : DIAGNOSTICS : TUNE
Tune : +0.00e-6  (2071383 -- >  2071383)

◁ ▷    View more tuning status

SYSTEM : DIAGNOSTICS : CALIBRATION
Cal :  -0.12e-6  (2071383)

SYSTEM : DIAGNOSTICS : PLL  STATUS MAIN
12.288:Lk  54:Lk  74.25:Lk  74.176:Lk

◁ ▷    View more clock status

SYSTEM : DIAGNOSTICS : TEMPERATURE
Main : 42.0C  (OK)  ,  CPU: 54.0C  (OK)

◁ ▷    View more temperatures

SYSTEM : DIAGNOSTICS : VOLTAGE
Main board  +5.0V  =  4.98V  (OK)

◁ ▷    View more voltages

SYSTEM : DIAGNOSTICS : FAN SPEED
Main : 3927  RPM  (OK)

◁ ▷    View more fan speeds

Continued on next page

1216-061

**Figure 113: DIAGNOSTICS submenu diagram – part 1**

Press ENTER in the (SYSTEM) button
menu with DIAGNOSTICS selected

Continued from previous page

SYSTEM : DIAGNOSTICS : POWER SUPPLY 1
Active : 000780   Standby : 000120

View more Power Supply 1 status

SYSTEM : DIAGNOSTICS : POWER SUPPLY 2
Active : 000120   Standby : 000780

View more Power Supply 2 status

SYSTEM : DIAGNOSTICS : GPS PHS DET RAMPS
Up:  A=0x067B  (OK)   B=0x0688  (OK)

View more GPS phase detector status

SYSTEM : DIAGNOSTICS : GPS  ADC  BUS
Stuck  LLLLLLHH - - - -   Short   SSSSSSSS - - - -

SYSTEM : DIAGNOSTICS : GENLOCK INPUT
Min :   1990    Max :   1994

SYSTEM : DIAGNOSTICS : LTC POS INPUT
Min (Raw):   1036    Max (Raw):   1280

View more LTC input status

1216-062

**Figure 114: DIAGNOSTICS submenu diagram – part 2**

**POWER SUPPLY LOAD TEST submenu**

The following figure shows the diagram for the POWER SUPPLY LOAD TEST submenu.
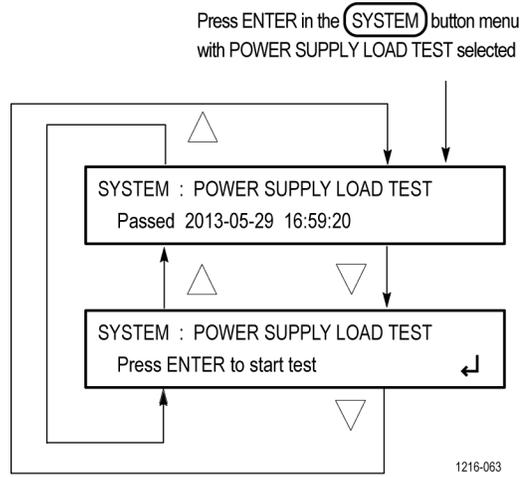


**Figure 115: POWER SUPPLY LOAD TEST submenu diagram**

# TIME button menu

Press the TIME button to set instrument time parameters such as the time of day source, the time zone offset, the DST schedule, the leap second schedule, the program time, and the jam sync settings. The following figure shows the TIME button menu diagram.

Press the (TIME) button

TIME : TIME OF DAY
  Press ENTER for menu  ↵

ENTER →  To TIME OF DAY submenu
← BACK

TIME : TIME ZONE OFFSET
  +00:00  ↵

← ENTER →  Edit the offset

TIME : DST SCHEDULE
  Press ENTER for menu  ↵

ENTER →  To DST SCHEDULE submenu
← BACK

TIME : PROGRAM TIME
  Press ENTER for menu  ↵

ENTER →  To PROGRAM TIME submenu
← BACK

TIME : JAM SYNC
  Press ENTER for menu  ↵

ENTER →  To JAM SYNC submenu
← BACK

TIME : LEAP SECOND
  Press ENTER for menu  ↵

*1
ENTER →  To LEAP SECOND submenu
← BACK

*1 This menu item is available only when Option GPS is installed and GPS is set as the reference source in the REF button menu.

1216-064

**Figure 116: TIME button menu diagram**

**TIME OF DAY submenu**     The following figure shows the diagram for the TIME OF DAY submenu.
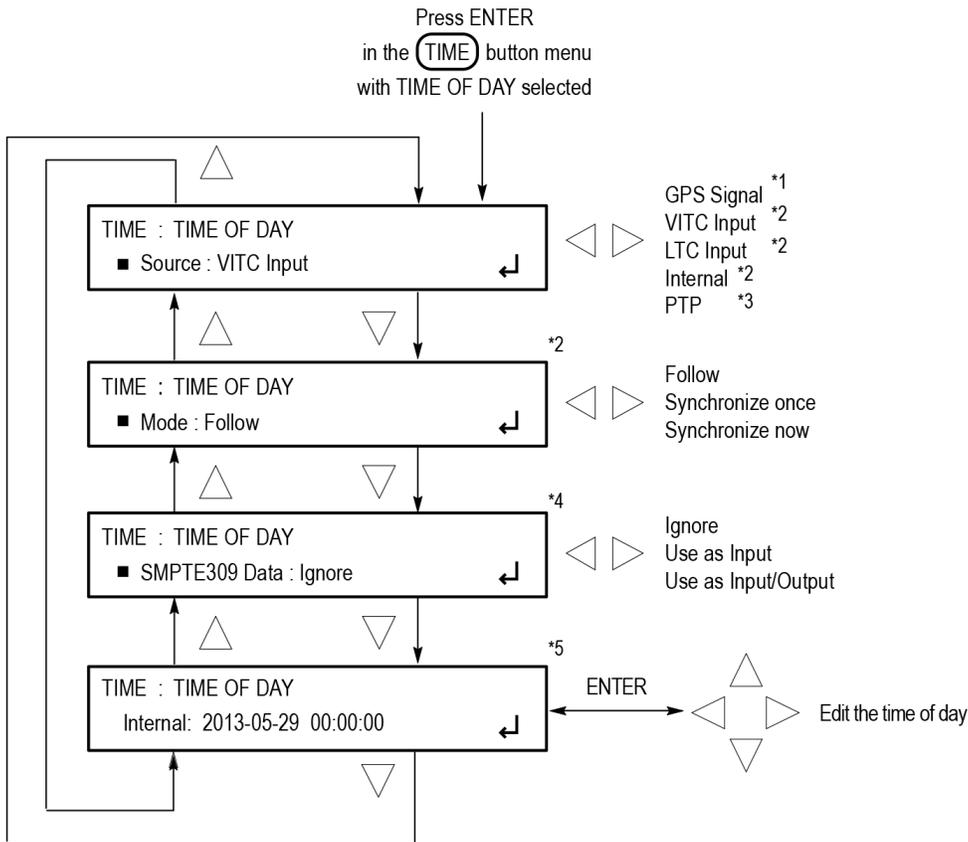


*1  This selection appears only when GPS is set as the reference source.

*2  These selections appear only when GPS or PTP is not set as the reference source.

*3  This selection appears only when PTP is set as the reference source.

*4  This selection appears only when LTC or VITC is set as theTime of Day source.

*5  This selection appears only when the TIME OF DAY source is set to Internal.

**Figure 117: TIME OF DAY submenu diagram**

*SPG8000A User Manual*

**DST SCHEDULE submenu**   The following figure shows the diagram for the DST SCHEDULE submenu.
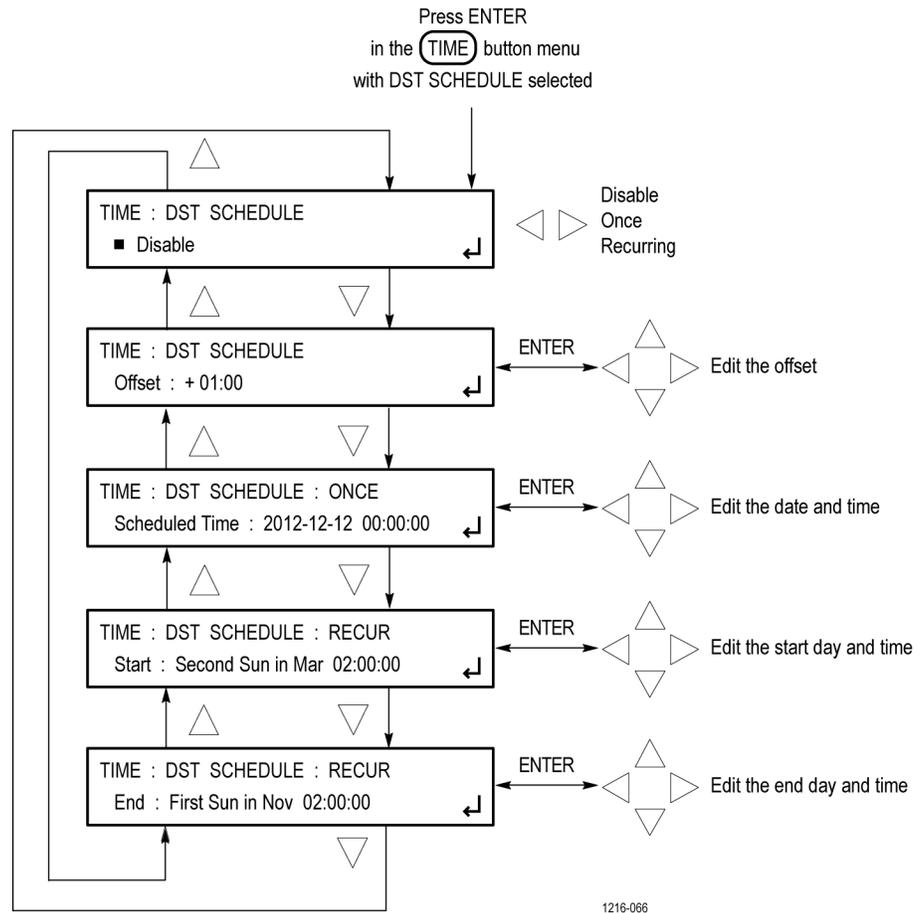


**Figure 118: DST SCHEDULE submenu diagram**

**PROGRAM TIME submenu**    The following figure shows the diagram for the PROGRAM TIME submenu.
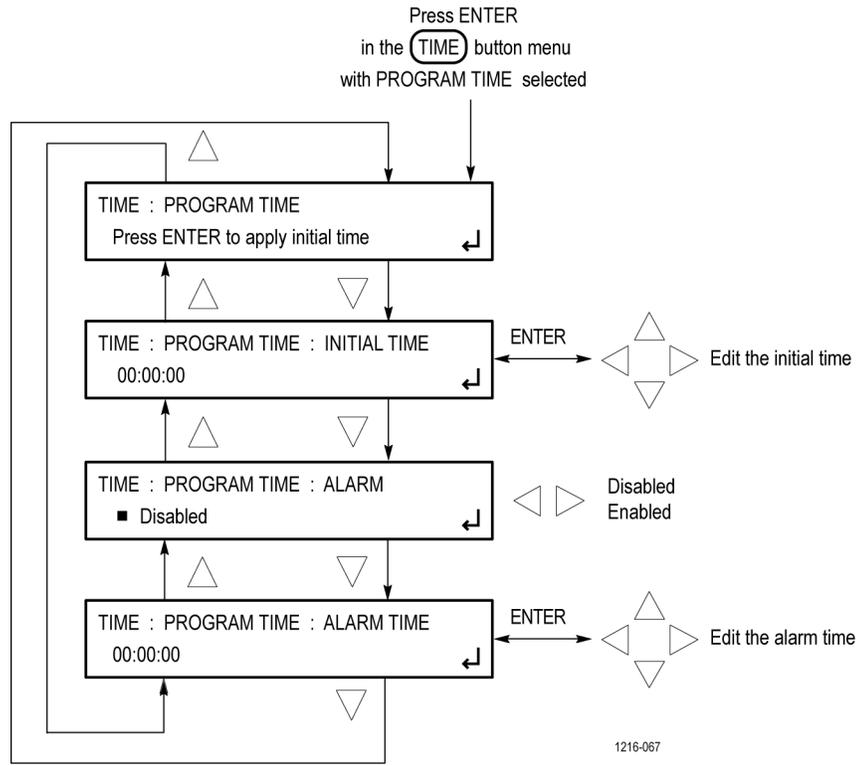


**Figure 119: PROGRAM TIME submenu diagram**

**JAM SYNC submenu**    The following figure shows the diagram for the JAM SYNC submenu.
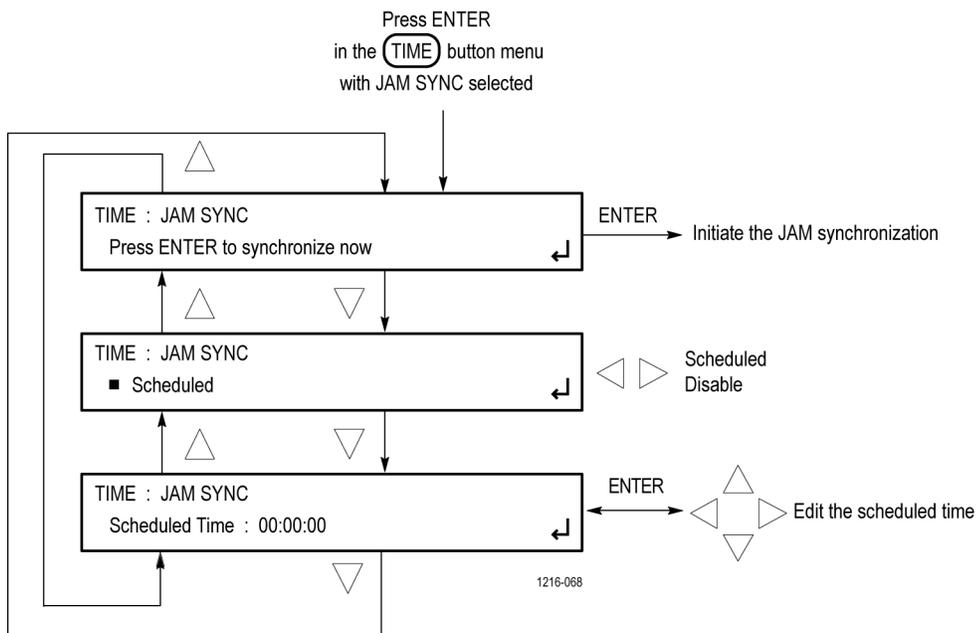


**Figure 120: JAM SYNC submenu diagram**

**LEAP SECOND submenu (Option PTP or GPS only)**    The following figure shows the diagram for the LEAP SECOND submenu.
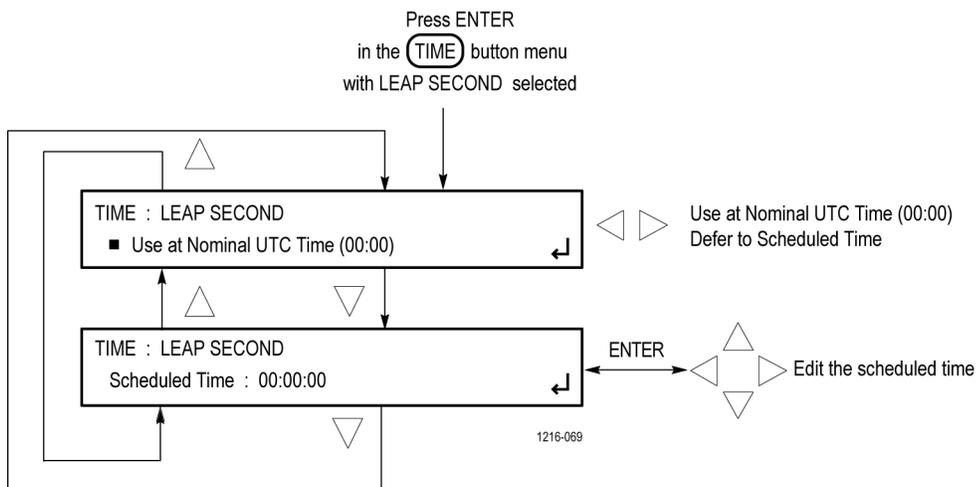


**Figure 121: LEAP SECOND submenu diagram**

## PTP button menu

Use this menu to view or change the primary and secondary PTP settings for the instrument.

**PTP master settings**

The following figures show the primary master settings, press the PTP button again to access the identical secondary master settings.



**Figure 122: PTP primary master menu diagram – part 1**

Continued from previous page



PTP : PRIMARY MASTER : ST2059 PROFILE
   Priority 1 : 128                          ↵

Set priority 1

PTP : PRIMARY MASTER : ST2059 PROFILE
   Priority 2 : 128                          ↵

Set priority 2

PTP : PRIMARY MASTER : STEP
   ■ One Step                                ↵

One Step
Two Step

*1

PTP : PRIMARY MASTER : ST2059 PROFILE
   ■ ST2059 SM Default Frame : 29.97         ↵

Set default frame

*1

PTP : PRIMARY MASTER : ST2059 PROFILE
   ■ ST2059 SM Drop Frame Flag :  Enabled    ↵

Enabled
Disabled
Auto

*1

PTP : PRIMARY MASTER : ST2059 PROFILE
   ■ ST2059 SM CFID :  Enabled               ↵

Enabled
Disabled
Auto

PTP : PRIMARY MASTER : ST2059 PROFILE
   ■ Delay Mechanism : End To End            ↵

End to End
Peer to Peer

*1 These selections appear only when the profile is set to ST2059.          1216-078

**Figure 123: PTP primary master menu diagram – part 2**

**PTP slave settings**   The following figures show the primary slave settings.



Press the (PTP) button

PTP : PRIMARY SLAVE : MODE
■ Slave
◁ ▷ Choices limited by reference selection

PTP : PRIMARY SLAVE : PROFILE TYPE
■ ST2059
◁ ▷ ST2059
AES67
AVB
General

PTP : PRIMARY SLAVE : PROFILE PARAMS
Press ENTER to set to Default
ENTER → Set profile parameters to default

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Domain : 127
◁ ▷ Set the profile domain

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Comm : Unicast
◁ ▷ Mixed SMPTE w/o Negotiation
Unicast
Multicast
Mixed SMPTE

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Announce Desired Interval: 0.25s 4Hz
*1
◁ ▷ 0.125s 8Hz   1s 1Hz
0.25s 4Hz   2s 0.5Hz
0.5s 2Hz

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Announce Reqd. Interval : 2s 0.5Hz
*1
◁ ▷ 0.125s 8Hz   1s 1Hz
0.25s 4Hz   2s 0.5Hz
0.5s 2Hz

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Sync Desired Interval : 0.125s 8Hz
*1
◁ ▷ 0.125s 8Hz   0.008s 128Hz
0.25s 4Hz   0.015s 64Hz
0.5s 2Hz   0.031s 32Hz
0.0625s 16Hz

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Sync Required Interval : 0.5s 2Hz
*1
◁ ▷ 0.125s 8Hz   0.008s 128Hz
0.25s 4Hz   0.015s 64Hz
0.5s 2Hz   0.031s 32Hz
0.0625s 16Hz

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Delay Msg Desired Intvl : 0.125s 8Hz
*1
◁ ▷ 0.125s 8Hz   0.008s 128Hz
0.25s 4Hz   0.015s 64Hz
0.5s 2Hz   0.031s 32Hz
0.0625s 16Hz

PTP : PRIMARY SLAVE : ST2059 PROFILE
■ Delay Msg Reqd. Intvl : 0.5s 2Hz
*1
◁ ▷ 0.125s 8Hz   0.008s 128Hz
0.25s 4Hz   0.015s 64Hz
0.5s 2Hz   0.031s 32Hz
0.0625s 16Hz

Continued on the next page

*1 These selections appear only in Unicast mode.   1216-073

**Figure 124: PTP primary slave menu diagram – part 1**

Figure 125: PTP primary slave menu diagram – part 2

# Index

*SPG8000A User Manual*