



SPG8000A
Master Sync / Clock Reference Generator
Installation and Safety Instructions



071-3479-00



**SPG8000A
Master Sync / Clock Reference Generator
Installation and Safety Instructions**

Warning

The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to all safety summaries prior to performing service.

This document supports SPG8000A firmware V2.1 and above.

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- In North America, call 1-800-833-9200.
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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, see the *Service safety summary* that follows the *General 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, ensure that the product is properly grounded. Do not disable the power cord grounding connection.

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 rating 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 manual's installation instructions 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 the 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.

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.

Symbols on 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 symbols may appear on the product:



CAUTION
Refer to Manual



Protective Ground
(Earth) Terminal

Preface

This manual describes how to install the SPG8000A Master Sync / Clock Reference Generator and provides basic operating information.

Product description



Figure 1: SPG8000A Master Sync / Clock Reference Generator front and back panels

The SPG8000A is a precision multi-format 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 and composite analog test patterns, and it provides time reference signals such as time code, NTP (Network Time Protocol), and IEEE 1588 PTP (Precision Time Protocol).

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 1 pps) and independently adjustable timing offsets. The 1 pps output is only available on these three sync outputs. With Option BG, four more analog outputs can be added. 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, providing the time-of-day reference to network-attached devices.

Optional GPS receiver

The GPS option adds an internal GPS/GLONASS receiver to the SPG8000A. When connected to an external antenna that supplies the standard GPS and/or GLONASS RF signal, the SPG8000A can utilize the GPS/GLONASS system’s stable frequency reference. The GPS and/or 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 and/or GLONASS signal is interrupted, and the Holdover Recovery mode will ensure a shock-free re-alignment of frequency and phase when the GPS and/or GLONASS signal is restored.

Optional PTP (IEEE 1588) support

Option PTP provides timing reference capability that is compliant with IEEE 1588 Precision Time Protocol (PTP) and supports SMPTE ST2059 and AES67 profiles.

The SPG8000A can supply PTP outputs as a master and can reference to PTP inputs as a slave, or it can do both simultaneously.

Test signal outputs

The SPG8000A can be optionally configured with a variety of test signal outputs. Option BG adds two additional black outputs and adds two composite analog outputs (NTSC or PAL) that can be used to generate test patterns such as color bars, or serve as additional black burst 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, or 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.

Audio reference signals

Several audio reference signals are available. The base configuration includes a 48 kHz word clock output, and Option AG adds five AES/EBU output pairs. One pair is dedicated to a Digital Audio Reference Signal (DARS) output, and the other four pairs are used for test tone generation, with independent tone frequency and amplitude settings for each of the 8 channels. 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 via Simple Network Management Protocol (SNMP) messaging, enabling easy integration with network management systems. Remote control and alarm reporting is also available via 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, and NTP server provide time reference signals in a variety of formats; the NTP server requires Option GPS
- GPS and GLONASS-based synchronization gives an accurate time-of-day reference and deterministic video phase reference, and locks remote SPG8000A systems to each other
- Option PTP provides timing reference capability that is compliant with IEEE 1588 Precision Time Protocol (PTP)
- Stay GenLock[®] and GPS Holdover Recovery prevent synchronization shock when the external reference input or GPS/GLONASS signal is temporarily lost

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

Product documentation

Table 1: Product documentation

Document	Tektronix Part Number	Description	Availability	
			Print	Web
Installation and Safety Instructions	071-3479-xx (English) 077-1214-xx (Japanese) 077-1215-xx (Russian)	Describes how to install the instrument and provides basic operating information	✓	✓ ✓ ✓
User Manual	077-1216-xx 077-1217-xx (Japanese) 077-1218-xx (Russian)	Provides detailed operating information		✓
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		✓
Video Sync Pulse Generator and Electronic Changeover Unit System Integration Technical Reference	077-0563-xx (ECO422D) 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.		✓

Conventions used in this manual

The term "instrument" is used throughout this manual to generically refer to the SPG8000A generator.

If installed, the optional GPS receiver in the instrument can receive both GPS and GLONASS signals. The term "GPS" is used throughout this manual to generically refer to GPS and GLONASS signal functionality.

Operating requirements

This section provides the environmental and power operating requirements for the instrument.

Environmental operating requirements

Check that the location of your installation has the proper operating environment as listed in the following table.



CAUTION. Damage to the instrument can occur if this instrument is powered on at temperatures outside the specified temperature range.

Table 2: Environmental requirements

Parameter		Description
Temperature	Operating	0 °C to +50 °C
	Nonoperating	–20 °C to +60 °C
Relative Humidity	Operating	20% to 80% (No condensation); Maximum wet-bulb temperature 29.4 °C
	Nonoperating	5% to 90% (No condensation); Maximum wet-bulb temperature 40.0 °C
Altitude	Operating	To 3,000 m (9,842 feet) Maximum operating temperature decreases 1 °C each 300 m above 1.5 km.
	Nonoperating	To 15,000 m (49,212 feet)


Leave space for cooling by ensuring standard side clearance for rack mounting or 2 inches (5.1 cm) of side clearance for benchtop use. Also, ensure sufficient rear clearance (approximately 2 inches) so that cables are not damaged by sharp bends.

For complete specifications for the instrument, refer to the *Specifications and Performance Verification Technical Reference* manual.

AC power requirements

Check that your location provides the proper electrical power requirements as listed in the following table.

Table 3: AC line power requirements

Parameter	Description
Line Voltage Range	100 - 240 VAC ±10%
	 WARNING. To reduce the risk of fire and shock, ensure that the mains supply voltage fluctuations do not exceed 10% of the operating voltage range.
Line frequency	50/60 Hz
Maximum power	130 VA

Installation

Initial product inspection

Perform the following product inspection procedure when you receive your instrument:

1. Inspect the shipping carton for external damage, which may indicate damage to the instrument.
2. Remove the SPG8000A generator from the shipping carton, and then check that the instrument has not been damaged in transit. Prior to shipment the instrument is thoroughly inspected for mechanical defects. The exterior should not have any scratches or impact marks.

NOTE. Save the shipping carton and packaging materials for instrument repackaging in case shipment becomes necessary.

3. Verify that the shipping carton contains the instrument, the standard accessories, and any optional accessories that you ordered. See [Table 4: Standard and optional accessories](#) on page 5.
4. Verify that all of the product options that you ordered are installed:
 - Before installation, you can verify the hardware options by viewing the rear panel. See [Figure 4: SPG8000A rear panel](#) on page 20. After installation, use the **SYSTEM : OPTIONS** menu selection to view which product options are installed.
 - If you ordered Option PTP when you purchased the instrument, this software option should already be enabled and you should have received a document showing the option key. After the instrument is installed, use the **SYSTEM : OPTIONS** menu selection to verify that the option is enabled. If you need to enter the option key, see [How to enter the option key \(Option PTP only\)](#) on page 4.

The following example display shows all of the available hardware options (GPS, AG, BG, SDI) and software options (3G, DBT, PTP) that may be installed. Software options 3G (3G-SDI signals) and DBT (Dolby E audio generation) are included with Option SDI.

SYSTEM : OPTIONS GPS AG BG SDI 3G DBT PTP
--

Contact your local Tektronix Field Office or representative if there is a problem with your instrument or if your shipment is incomplete.

Exterior cleaning

The instrument exterior was inspected for debris when it was shipped. If necessary, you can clean the exterior of the instrument as follows.



WARNING. To prevent injury or death, power off the instrument and disconnect it from line voltage before cleaning.

Clean the exterior surfaces of the chassis with a dry lint-free cloth or a soft-bristle brush. If any dirt remains, use a cloth or swab dipped in a 75% isopropyl alcohol solution. Use a swab to clean narrow spaces around controls and connectors. Do not use abrasive compounds on any part of the instrument that may be damaged by it.



CAUTION.

Avoid the use of chemical cleaning agents that might damage the plastics used in the instrument. Use only deionized water when cleaning the front-panel buttons. Use a glass cleaner to clean the LCD. For the rest of the instrument, use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

How to enter the option key (Option PTP only)

In order for Option PTP to be enabled in your instrument, the option key associated with Option PTP must be entered into the instrument. Each option key applies to only one instrument. Locate the option key document for your instrument, and then perform the following steps to enter the option key:

NOTE. *This procedure uses the instrument front panel to enter the option key. You can also use the SPG8000A Web interface to remotely enter the option key. Refer to the SPG8000A User Manual for information about using the SPG8000A Web interface to enter the option key.*

1. Press the front-panel **SYSTEM** button to access the SYSTEM menu.
2. Press the up (▲) or down (▼) arrow button until **SYSTEM : OPTIONS** is displayed.
3. The second line of the display lists the options installed in the instrument.

NOTE. *Options GPS, AG, BG, and SDI are hardware options. Options 3G and DBT are software options that are included with Option SDI. Software Option PTP is the only option that requires an option key in order to operate.*

4. Press the **ENTER** button to enter the OPTIONS submenu.
5. Press the up (▲) or down (▼) arrow button until **SYSTEM : OPTIONS : UNIQUE ID** is displayed.
6. Verify that the displayed ID matches the module ID listed on the option key document. This indicates that you are attempting to update the correct instrument.
7. Enter the option key:
 - a. Press the up (▲) or down (▼) arrow button to select **SYSTEM : OPTIONS : KEY**. The existing option key string is displayed.
 - b. Press the **ENTER** button to enter the option key edit mode. The underscore character () appears under the first character of the option key.
 - c. Use the up (▲) or down (▼) arrow button to select the first character of the option key.
 - d. Use the left (◀) or right (▶) arrow button to move the underscore character to the next character in the option key.
 - e. Enter all of the option key characters, and then press the **ENTER** button to confirm the selection.
 - f. Press the **BACK** button to exit the OPTIONS submenu and return to the SYSTEM menu.

8. Cycle power on the instrument to ensure that Option PTP is fully operational.
9. Check that Option PTP is enabled:
 - a. From the SYSTEM button menu, press the up (▲) or down (▼) arrow button until **SYSTEM : OPTIONS** is displayed.
 - b. Check that PTP is displayed in the second line of the display. This verifies that Option PTP has been enabled.

SYSTEM : OPTIONS
GPS AG BG SDI 3G DBT PTP

- c. If Option PTP is not enabled, use the **SYSTEM : OPTIONS : UNIQUE ID** display and the **SYSTEM: OPTIONS : KEY** display to verify that you are updating the correct instrument and that you entered the option key correctly.

Accessories

The following table lists the standard and optional accessories provided with the SPG8000A generator.

Table 4: Standard and optional accessories

Accessory	Std.	Opt.	Tektronix part number
SPG8000A Installation and Safety Instructions (English) Note: Japanese and Russian language versions of this document are available in PDF format on the Tektronix Web site (www.tek.com/downloads).	●		071-3479-xx
Power cord See International power cord options on page 6.	●		Varies by option
Rackmounting hardware (Option RACK only)		●	351-1137-00
Rackmount installation instructions (Option RACK only)		●	071-2746-xx
D-sub to XLR/BNC adapter cable (Option XLR only) ¹		●	NA ²
Gigabit Ethernet optical SFP module, 1310 nm, single-mode, LC connector (Option LX only)		●	NA ³
Gigabit Ethernet optical SFP module, 850 nm, multimode, LC connector (Option SX only)		●	NA ⁴
GPS/GLONASS rooftop antenna (5.0 VDC, 1588 MHz range signals, F connector) for GPS and GLONASS satellites ⁵		●	SPG8000ANT

¹ This 6 foot adapter cable connects from the 15-pin D-sub GPI/LTC connector on the SPG8000A to four XLR male connectors (for LTC input/outputs) and three BNC male connectors (for General Purpose Interface (GPI) input/outputs).

² For a replacement cable, order SPG800AUP Option XLR.

³ For a replacement module, order SPG800AUP Option LX.

⁴ For a replacement module, order SPG800AUP Option SX.

⁵ The antenna works with the integrated internal GPS/GLONASS receiver of a SPG8000A with Option GPS.

International power cord options

All of the available power cord options listed below include a lock mechanism except as noted to keep the power cord attached to the instrument.

- Opt. A0 – North America power (standard)
- Opt. A1 – Universal EURO power
- Opt. A2 – United Kingdom power
- Opt. A3 – Australia power
- Opt. A5 – Switzerland power
- Opt. A6 – Japan power
- Opt. A10 – China power
- Opt. A11 – India power (no locking power cord)
- Opt. A12 – Brazil power (no locking power cord)
- Opt. A99 – No power cord

Product installation

Rackmount installation (Option RACK only)



WARNING. *Personal injury or damage to the instrument can occur if the instrument is not properly secured in the equipment rack.*

When you order Option RACK, the instrument is configured at shipment for use in an equipment rack. Refer to the *Rackmount Slides and Rails Kit Instructions*, Tektronix part number 071-2746-XX, that was supplied with the instrument for instructions on how to install the rackmounting hardware.

To install the instrument into an equipment rack. After you have installed the rackmounting hardware, perform the following steps to install the instrument into an equipment rack:



WARNING. *To prevent injury during product installation, use care not to pinch hands or fingers in the rails and slides.*

1. Insert the instrument left and right slides into the ends of the rack rails while tilting the long handle part of each lever upward. See [Figure 2: Installing or removing the instrument into or from the rack \(Option RACK only\)](#) on page 7.

NOTE. *Make sure to insert the instrument slides inside the inner rack rails. You may also need to tilt the rear of the instrument up or down at a slight angle to fit the slides into the rails.*

2. Push the instrument into the rack until it stops.



CAUTION. *To prevent damage to the instrument and rackmount, do not force the instrument into the rack if it does not slide smoothly. The rails assembly may need to be adjusted to resolve the problem.*

3. Retighten any loose screws and push the instrument all the way into the rack. If the tracks do not slide smoothly, readjust the rail assemblies.
4. When adjusting is completed, tighten all rail assembly 10-32 screws using 28 inch-lbs of torque.

5. If the instrument has knob screws on the front corners, tighten them so that they are secured in the rack.
6. To remove the instrument from the rack, loosen the knob screws.

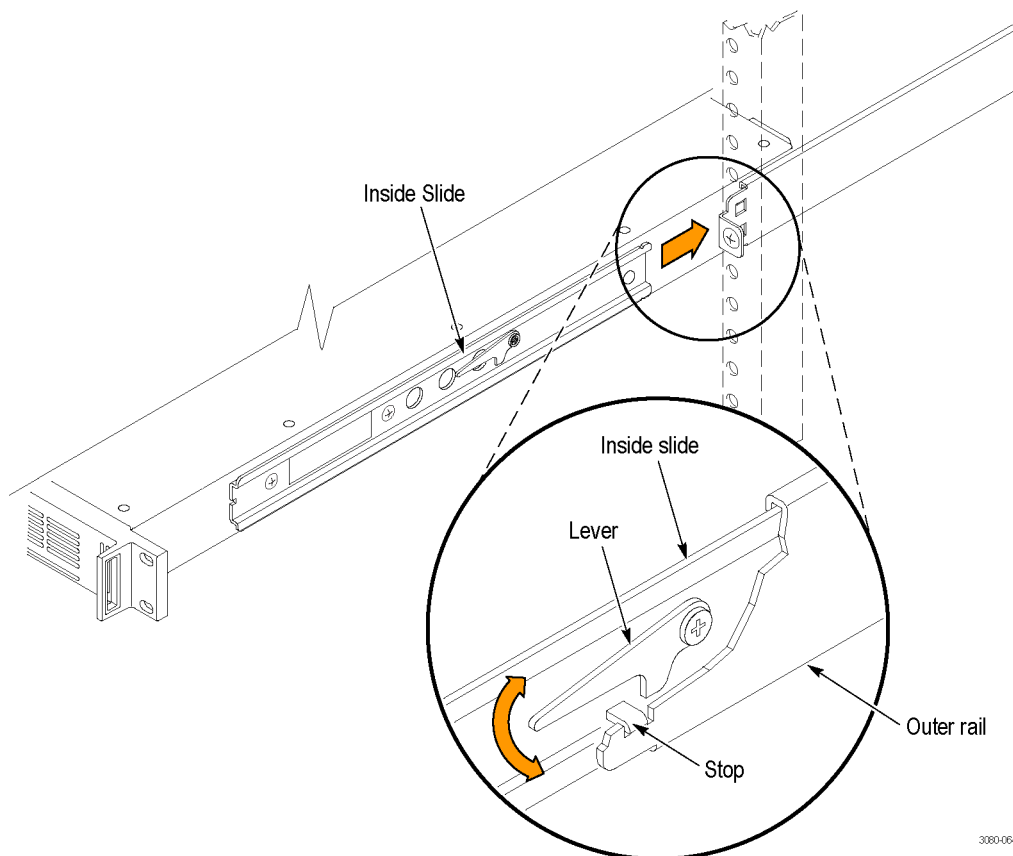


Figure 2: Installing or removing the instrument into or from the rack (Option RACK only)

To remove the instrument from an equipment rack. Perform the following steps to remove an instrument that is installed in an equipment rack:



WARNING. To prevent injury when removing the product from the rack, do not forcefully and abruptly pull the product from the rack. Pull with the minimum force required to move the instrument with a consistent, even motion.

1. Loosen the knob screws, if present, that attach the front of the instrument to the rack.
2. Gently pull the instrument toward you until you can reach the levers at the rear of the instrument.

3. Tilt both lever handles upward simultaneously to allow them to clear the stops. See [Figure 2: Installing or removing the instrument into or from the rack \(Option RACK only\)](#) on page 7.
4. Pull the instrument past the stops and out of the rack.

Power connection

The instrument operates from a single-phase power source with the neutral conductor at or near earth ground. The line conductor is fused for over-current protection. A protective ground connection through the grounding conductor in the locking power cord is essential for safe operation.

The standard instrument has one Power Supply module installed. With Option DPW, a second hot-swappable redundant (backup) Power Supply module is installed. When two Power Supply modules are installed in the instrument, one is configured to be the primary supply and the other is configured to be the backup supply. In the event that the primary supply fails, the backup supply will automatically provide power to maintain instrument operation. See the *SPG8000A User Manual* for detailed information about how to operate the instrument with two power supplies.



CAUTION. *The instrument does not have a power switch. When you connect the power cable to the AC line connector, the instrument powers on.*

Do not install or remove a Power Supply module when a power cord is attached to that module.

How to connect the power cable(s)

Connect the power cable to the instrument first, and then connect it to the AC power source. Connecting the power cable causes the instrument to power on.

After the instrument boots up and initializes, make sure that the FAULT indicator is not illuminated and that no faults are reported on the instrument display. If the FAULT indicator is illuminated, perform the appropriate user action. See [Table 8: States of the FAULT indicator](#) on page 19.

Backup supply (Option DPW). . If the instrument has two Power Supply modules installed (Option DPW), connect a power cable to each of the supplies. After the instrument powers on, configure the instrument for the preferred (active) supply. See the *SPG8000A User Manual* for detailed information about how to operate the instrument with two power supplies.

Network installation

The instrument has a 10/100/1000 BASE-T Ethernet port on the rear panel that allows you to use a PC to remotely control the instrument and to upload and download user files such as signal or logo files.

This section provides instructions for connecting the instrument to a single PC or to a network and for setting the network parameters on the Ethernet port.

See *How to transfer user files* for instructions on how to upload and download user files using the Ethernet port.

Connecting the instrument to your PC(s)

You can use one of the following two methods to connect the instrument to your PC(s):

- If you are connecting the instrument directly to a single PC, use an Ethernet cable to connect between the Ethernet port on the instrument and the Ethernet port on the PC.
- If you are connecting the instrument to your local Ethernet network, use an Ethernet cable to connect between the Ethernet port on the instrument and the Ethernet hub port of your local network. By connecting to an Ethernet network, you can access the instrument using any PC on the network.

To configure the network parameters

The following two procedures describe how to configure the network parameters on the instrument. Use the first procedure if your network supports DHCP; use the second procedure if your network does not support DHCP.

To configure parameters for a network with a DHCP server. If your network has a DHCP server, perform the following steps to configure the instrument to function as a DHCP client. When the instrument is connected to the network and DHCP service is enabled, the instrument obtains the necessary network addresses automatically from the DHCP server.

NOTE. Under some network environments, the instrument may not be able to get the IP address automatically from a DHCP server. In this case, you need to enter the appropriate address value in each submenu item.

Refer to your network administrator or to the user documentation supplied with your network server operating system (OS) for detailed information about DHCP server functions.

1. Press the front-panel **SYSTEM** button to access the SYSTEM menu.
2. Press the up (▲) or down (▼) arrow button to select **SYSTEM : NETWORK**.
3. Press the left (◀) or right (▶) arrow button to select **Setup**, and then press the **ENTER** button. This accesses the NETWORK SETUP submenu. The top line of the display should read **SYSTEM : NET SETUP : DHCP**.
4. Press the left (◀) or right (▶) arrow button to select **Enable**, and then press the **ENTER** button.
5. Press the **BACK** button to exit the NETWORK SETUP submenu.

To configure parameters for a network without a DHCP server. If your network does not have a DHCP server, perform the following procedure to set the network parameters:

1. Press the front-panel **SYSTEM** button to access the SYSTEM menu.
2. Press the up (▲) or down (▼) arrow button to select **SYSTEM : NETWORK**.
3. Press the left (◀) or right (▶) arrow button to select **Setup**, and then press the **ENTER** button. This accesses the NETWORK SETUP submenu. The top line of the display should read **SYSTEM : NET SETUP : DHCP**.
4. Press the left (◀) or right (▶) arrow button to select **Disable**, and then press the **ENTER** button.
5. If you connected the instrument directly to a single PC:
 - a. Press the up (▲) or down (▼) arrow button to select **SYSTEM : NET SETUP : IP ADDRESS**, and then press the **ENTER** button to enter the edit mode.
 - b. Use the arrow buttons to set the IP address to be the same IP address as the PC's address except for the last number, and then press the **ENTER** button. The last number in the address must be different than the last number in the PC's IP address.
 - c. Press the up (▲) or down (▼) arrow button to select **SYSTEM : NET SETUP : SUBNET MASK**, and then press the **ENTER** button to enter the edit mode.
 - d. Use the arrow buttons to set the subnet mask to be the same net mask (subnet mask) used by the PC, and then press the **ENTER** button. Do not enter a number if the PC does not have a net mask.

- e. You do not need to enter a **GATEWAY** address if you are directly connected to a single PC.
 - f. Press the BACK button to exit the NETWORK SETUP submenu.
6. If you connect the instrument to your local Ethernet network, see the *Caution* note below.



CAUTION. To prevent communication conflicts on your Ethernet network, ask your local network administrator for the correct numbers to enter in the NETWORK PARAMETERS submenu if you connect the instrument to your local Ethernet network.

7. Verify the Ethernet connection by using a ping command from the PC.

GPS and/or GLONASS antenna installation (Option GPS only)

If your instrument has Option GPS installed, you need to connect a GPS and/or GLONASS antenna and check the main oscillator calibration before you put the instrument into service.

If you ordered SPG8000AANT, you received a GPS/GLONASS rooftop antenna (5.0 VDC, 1588 MHz range signals, F connector) for GPS and/or GLONASS signals that works with the integrated internal GPS/GLONASS receiver of an instrument with Option GPS installed.

Antenna requirements

The instrument requires an external antenna to receive GPS and/or GLONASS signals from satellites. You must set up an antenna system to provide the GPS and/or GLONASS signal as an input to the instrument. You can configure the instrument to provide 3.3 V or 5 V DC power for the antenna.



WARNING. Prevent risk of shock or fire by ensuring that the GPS and/or GLONASS antenna is protected from lightning strikes when it is mounted outside a building or facility. The instrument does not have isolation protection from lightning, so the facility installation must provide suitable protection for the GPS and/or GLONASS antenna external to the instrument. Failure to use appropriate precautions can result in injury or death.



CAUTION. To avoid antenna damage, do not turn on the DC antenna power until you know that the antenna is designed to handle the selected voltage. Antenna damage can occur if the antenna is not designed to handle the voltage you select.

The frequencies for GPS and GLONASS signals are slightly different. Be sure to choose an antenna that supports all of the satellite constellations you intend to use. It is recommended that you use an antenna that can receive both GPS and GLONASS signals. This allows the instrument timing to be more stable since a GPS/GLONASS antenna can communicate with more satellites.

When a GPS and/or GLONASS feed is first connected to the antenna input on the instrument, it can take several minutes for the signal quality to reach its nominal potential. How long that takes depends on such things as antenna site, cable plant design, and available satellites. Excluding those variables, the typical time to acquire satellites and achieve specified stability with a good satellite signal, known position, and a warmed up instrument, is two minutes.

Antenna system

Antenna systems vary depending on the operating environment and on safety and regulatory requirements. A simplified typical system is shown in the following figure to help you with planning and understanding the trade-offs of one set up versus another.

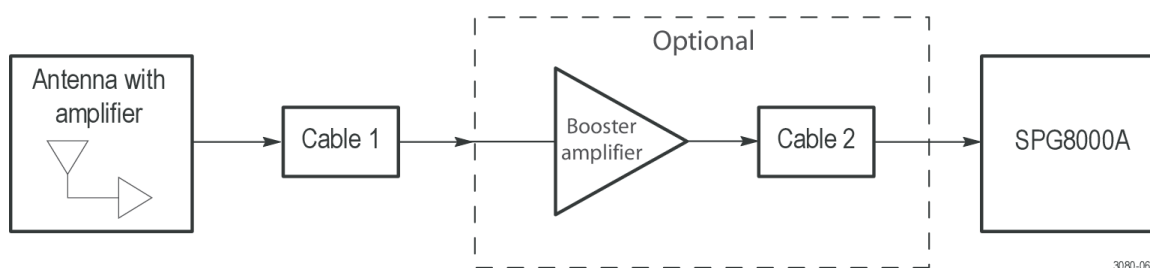


Figure 3: Simplified GPS/GLONASS antenna system

A GPS and/or GLONASS specific antenna with amplifier provides sufficient gain to drive a reasonable length of cable, and provides filtering to reject signals at other frequencies. A typical example of this for GPS signals is the Trimble Bullet III, 35 dB, 5 V, antenna.

In a simple system without the optional booster, Cable 1 connects the antenna to the instrument. The length of this cable is limited by its attenuation at the carrier frequency (GPS: 1575 MHz, GLONASS: 1602 MHz). The instrument should have a signal that is 18 dB or greater above the ambient level. For example, for a 35 dB antenna, the allowed cable loss is $35 - 18 = 17$ dB. See [Figure 3: Simplified GPS/GLONASS antenna system](#) on page 11.

Cables. Attenuation varies significantly depending on cable type. Cable loss is about 13 dB/100 ft for a miniature coaxial cable like the Belden 1855, while for a RG11 style like the Belden 7731, the loss is only 5.5 dB/100 ft. This correlates to an allowable length of 130 ft for the small cable, to over 300 ft for the larger cable.

A booster amplifier can be added if more length is needed, as shown in the optional block in the signal path system. See [Figure 3: Simplified GPS/GLONASS antenna system](#) on page 11.

If a 20 dB amplifier is added, then 20 dB more cable loss can be accommodated. This equates to another 150 ft of small coax, or 360 ft of large coax.

Although the GPS/GLONASS input and most of the other components are 50 Ω , either 50 Ω or 75 Ω cables can be used in most installations. The reflections from the impedance mismatch will not cause significant changes in the system because the signal is narrow band and the cable loss is usually many dBs. However, you should not mix short cable lengths of different impedances, as this might create reflections with the potential to cause signal degradation.

Amplification. The instrument provides either 3.3 V or 5 V DC power to drive the amplified antenna and booster amplifier. The power is carried on the same coax as the GPS and/or GLONASS signal, and can be turned off if the antenna is powered by a separate supply. When you are designing the antenna system, check the voltage and current requirements of the components to insure compatibility.

The location of the booster amplifier is important. It needs to be before the second length of cable shown in the simplified antenna system diagram. If the booster amplifier is placed just *before* the instrument, then the signal will have been attenuated too far and the output may be noisy. If you cannot put the optional booster amplifier in the middle of a long run of cable, then put it near the antenna rather than near the instrument end.

For more complex systems, a variety of booster amplifiers, powered and passive splitters, DC blocks, and filters are available from a number of vendors.

Antenna location. It is important that the GPS and/or GLONASS antenna location has a clear view of a large part of the sky. Since GPS and GLONASS satellites are constantly orbiting the earth, they may be in any direction at a given time. If part of the sky is blocked by buildings, trees, mountains, etc., then fewer satellites will be visible. It is also possible to get reflected signals that will have come by a longer path than expected and thus may degrade timing accuracy and stability. When evaluating a site, it is important to monitor it over several days and with a variety of weather conditions present.

This antenna information is not intended to cover all aspects of the antenna system design. Important topics that were not covered include items like lightning protection and drip loops. For information about the cable plant design in your system, contact the appropriate person or group in your organization, or contract with a qualified installer.

Check the oven oscillator calibration

Since the oscillator frequency was adjusted accurately at the factory, you should not need to adjust the oven oscillator frequency immediately after the initial installation. However, you can adjust the oscillator frequency at any time to improve the accuracy of the internal frequency. When Option GPS is installed, you may be able to improve the accuracy slightly after installation since the instrument will be at the normal temperature for your specific installation site. To determine if the oven oscillator needs to be calibrated, perform the following steps while the instrument is locked to a GPS/GLONASS reference signal:

1. Press the **SYSTEM** button to access the SYSTEM menu.
2. Press the up (▲) arrow button to select **SYSTEM : DIAGNOSTICS**.
3. Press the **ENTER** button to access the DIAGNOSTICS menu.
4. Check that **Fine** is showing on the right side of the TUNE readout on the LCD display.
5. Check the Tune readout value. If the value is greater than $\pm 0.10e-6$, then you need to calibrate the oven oscillator. If the value is less than $\pm 0.10e-6$, then no calibration is required.

NOTE. *Even if the value is less than $\pm 0.10e-6$ and no calibration is required, you may want to calibrate the oven oscillator anyway to ensure maximum accuracy and to postpone the need for a calibration in the future.*

6. Press the **BACK** button to exit the DIAGNOSTICS menu.

If an oscillator calibration is needed, perform the calibration procedure located in the *SPG8000A User Manual*.

GPS constellation configuration

You can use the REFERENCE menu to configure the instrument for the type of satellite constellations you want the instrument to use. If your antenna can receive both GPS and GLONASS signals, it is recommended that you configure the instrument to use both GPS and GLONASS signals. This allows the instrument timing to be more stable since a GPS/GLONASS antenna can communicate with more satellites.

Controls and connections

Front panel controls



LCD display

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.

You can adjust the contrast of the LCD display using the SYSTEM menu.

STATUS button

Use the STATUS button to view the status of instrument settings such as the GPS parameters, the format of the black outputs, the format of the composite outputs, the format of the SDI outputs, and the status of the LTC signals. You can also view messages explaining the cause of any red or orange fault LEDs on the front panel.

The STATUS button menu allows you to only view information about the settings and state of the instrument. Since no changes to the instrument operation can be made from this menu, it is always safe to navigate this menu while the instrument is in operation.

Menu control buttons

Use these buttons to control the menu display.

Arrow (▲), (▼), (◀), and (▶) Buttons. Use these arrow buttons to scroll 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.

INPUTS

Use these buttons to access menus for controlling the Reference and Time settings in the instrument.

REF button. Use the REF button to access the Reference menu where you can configure the reference source and genlock timing settings.

TIME button. Use the TIME button to access the Time menu where you can configure timing settings such as the time of day, time zone offset, DST schedule, and alarm time and delay.

OUTPUTS

Use these buttons to access menus for configuring the signal outputs.

BLACK button. Use the BLACK button to configure the format, timing, timecode, and tri-level sync rate of the Black outputs. Three Black outputs are standard; there are five Black outputs when Option BG is installed.

SDI button. Option SDI is required for this button to operate. Use the SDI button to configure the output mode and format of the selected test signal on the optional SDI outputs. You can also enable the moving picture mode, enable and configure an overlay on the test signal outputs.

CMPST button. Option BG is required for this button to operate. Use the CMPST button to configure the format and test signal on the optional Composite outputs.

EMBED button. Option SDI is required for this button to operate. Use the EMBED button to configure the embedded audio on the optional SDI outputs.

LTC button. Use the LTC button to configure the LTC input and outputs on the GPI / LTC connector.

AES button. Use the AES button to configure the audio outputs.

SYSTEM button

Use the SYSTEM button to access the System menu where you configure and view various system settings. You can save and recall presets, configure the network settings, enable the Web user interface and the SNMP interface, backup and restore instrument settings, view alarms, configure the GPI interface, run and view instrument diagnostics, and upgrade the instrument firmware.

PTP button

Use the PTP button to configure the PTP (Precision Time Protocol) parameters for the Primary and Secondary engines such as the profile type, domain value, time-stamp mode (one-step or two-step), communication mode (multicast, unicast, or mixed), intervals (announce, sync, delay), and the delay mechanism.

FRONT PANEL ENABLE button

Use this button to enable or disable the front-panel buttons. When pressing this button for about one second while the front-panel buttons are enabled, all of the front-panel buttons are disabled. If you have selected a timeout period in the FRONT PANEL DISABLE item in the UTILITY submenu, and that period passes without a button push, all of the front-panel buttons are also disabled.

Press and hold this button for about three second to enable the front-panel buttons. The timeout counter is restarted (if the timeout period is already set) and the indicator next to the button lights to show that the front-panel is enabled.

Refer to *SYSTEM menu* for more information about the settings the period until the front panel times out.

USB port

Use the USB port to upgrade the instrument firmware and to copy files such as presets and test signal files between instruments.

Front panel indicators

INT and EXT reference indicators. The INT (internal) and EXT (external) LEDs indicate the status of the reference signal used to time signals. The states of the INT and EXT indicators depend on whether Option GPS is installed in the instrument. The following table shows the states of the LEDs for the different reference signal configurations.

Table 5: States of the INT and EXT reference indicators

Reference source	Operational status	EXT LED state	INT LED state
Internal	Good	Off	Solid green
Internal	Warming up	Off	Blink green
GPS and/or GLONASS (Option GPS only)	Good	Solid green	Off
GPS and/or GLONASS (Option GPS only)	FOM is less than the GPS signal warning threshold ¹	Solid amber	Off
GPS and/or GLONASS (Option GPS only)	“GPS not locked”	Solid red	Solid green
PTP (Option PTP only)	Good	Solid green	Off
PTP (Option PTP only)	“Near Loss of PTP lock”	Solid amber	Off
PTP (Option PTP only)	“PTP not locked”	Solid red	Solid green
Genlock	Good	Solid green	Off
Genlock	“Near Loss of Genlock”	Solid amber	Off
Genlock	“Genlock not locked”	Solid red	Solid green

TIME indicator. The TIME indicator shows the status of the selected time input. The following table shows the states of the TIME indicator for the different time source configurations.

¹ The FOM warning level is set using the REFERENCE : GPS SIGNAL WARNING selection in the REF button menu. This status occurs when the GPS system is locked but the FOM falls below the configured warning threshold level.

Table 6: States of the TIME indicator

Selected time source	Time status	TIME LED state
Internal	Time is based on the internal master time of day register. This may have been set by an external source, the RTC, or manually.	Off
External (GPS/GLONASS, PTP, VITC, or LTC)	OK. The selected time input is present and being used to control the time in the instrument.	Solid green
External (LTC only)	OK. The timing of LTC and genlock video are the same frame rate and the relative timing is inside the SMPTE 12M specification, or LTC is a different rate than the genlock input.	Solid green
External (LTC only)	Warning. The timing of LTC and genlock video are the same frame rate but the relative timing is outside the SMPTE 12M specification.	Solid yellow
External (GPS/GLONASS, PTP, VITC, or LTC)	Error. Missing, discontinuous, or for LTC only, badly timed relative to the genlock input.	Solid red

PWR1 and PWR2 indicators. The PWR1 and PWR2 indicators illuminate using various colors to show the status of the Power Supply modules. The following table describes the different states of the indicators.

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.

In addition to the PWR1 and PWR2 indicators, the rear panel of each Power Supply module has a STATUS LED that matches the status shown on the PWR1 and PWR2 indicators.

Table 7: States of the PWR1 and PWR2 indicators

PWR1 / PWR2 indicator state	Power Supply module condition	Example(s)	User actions
Off	Not installed	When only one Power Supply module is installed, the PWR indicator for the uninstalled supply is turned off.	None; this state indicates normal operation.
Dim green	No faults; backup supply	When two Power Supply modules are installed and connected to a power source, the indicator for the backup supply is dim green.	None; this state indicates normal operation.
Bright green	No faults; active supply	When a single Power Supply module is installed and connected to a power source, the indicator for that supply is bright green. When two Power Supply modules are installed and connected to a power source, the indicator for the active (primary) supply is bright green.	None; this state indicates normal operation.
Dim orange ²	Warning; backup supply	When two Power Supply modules are installed and connected to a power source, the indicator for the backup supply is dim orange when a marginally low or high power supply voltage is detected, or when the supply has exceeded the specified temperature weighted hours. See the <i>SPG8000A User Manual</i> for detailed information about how to operate the instrument with two power supplies.	Use the STATUS button menu to view information about the warning. Remove the associated Power Supply module for repair.

² The dim and bright orange warning states clear immediately if the marginal voltage condition is corrected.

PWR1 / PWR2 indicator state	Power Supply module condition	Example(s)	User actions
Bright orange ³	Warning or fault; active supply	<p>When two Power Supply modules are installed and connected to a power source, the indicator for the active (primary) supply is bright orange when a marginally low or high power supply voltage is detected, or when the supply has exceeded the specified temperature weighted hours.</p> <p>When the power supply fan has failed (active supply).</p>	<ol style="list-style-type: none"> 1. If two Power Supply modules are installed and the status of the inactive supply is also faulted (red), replace the inactive supply or install the power cable. The system will automatically switch to use the good supply, which will turn the indicator to red from bright orange. Proceed to step 4. 2. If only one Power Supply module is installed, install a second supply so that you can repair the first supply. 3. If two Power Supply modules are installed and the status of the inactive supply is no faults (dim green), use the System menu to configure the other Power Supply module to be the active (primary) supply. See the <i>SPG8000A User Manual</i> for detailed information about how to operate the instrument with two power supplies. 4. Remove the associated Power Supply module for repair.
Red ⁴	Fault (including being installed but unplugged)	<p>When the 12 V power from a supply is too high or too low (includes if the supply has failed).</p> <p>When two Power Supply modules are installed and one of the supplies has no AC power applied.</p> <p>When the power supply fan has failed (inactive supply).</p> <hr/> <p>NOTE. <i>In the case of a failed fan on both supplies, the instrument will keep running as long as the voltage is adequate.</i></p>	<ol style="list-style-type: none"> 1. Verify that the power cable is connected to the Power Supply module and that the power cable is connected to the power source. 2. Remove the associated Power Supply module for repair.

FAULT indicator. The FAULT illuminates when there is a problem with the instrument hardware. The following table shows the states of the FAULT indicator for hardware failures.

NOTE. You can view descriptions of the active alerts and faults using the STATUS menu. See [Alert and fault error messages](#) on page 24.

³ The dim and bright orange warning states clear immediately if the marginal voltage condition is corrected.

⁴ The red fault state is maintained for approximately 30 seconds after the fault is cleared to allow you more time to observe the fault condition.

Table 8: States of the FAULT indicator

Instrument condition	Example(s)	FAULT LED state	User actions
A fault condition exists that has the potential to damage the instrument hardware	<ul style="list-style-type: none"> ▪ The main fan has stopped turning ▪ The internal temperature of the instrument is too high 	Blinking red	<ol style="list-style-type: none"> 1. Press the STATUS button to view a message describing the fault. 2. Navigate to the SYSTEM > DIAGNOSTICS menu. 3. Scroll through the diagnostic readouts and look for fan or voltage “Warn” messages. 4. The FAULT indicator will continue to blink red unless the fan restarts or the internal temperature falls to normal levels. 5. If the fault does not clear, unplug the instrument from the power source and contact Tektronix customer support.
A fault condition exists that renders the instrument unusable	<ul style="list-style-type: none"> ▪ The fan speed is out of range ▪ An internal power supply voltage is out of range 	Solid red	<ol style="list-style-type: none"> 1. If the instrument is still on, navigate to the STATUS > FAULT menu to view the fault message. 2. If the fault message is for voltage issues, navigate to the SYSTEM > DIAGNOSTICS menu. 3. Scroll through the diagnostic readouts and look for voltage “Warn” messages. 4. Unplug the instrument from the power source and contact Tektronix customer support.
A fault condition exists, but the instrument is still usable	<ul style="list-style-type: none"> ▪ The main or SDI PLL is unlocked ▪ There is an SDI DDS phase error ▪ A Power Supply module has reached the temperature weighted hour limit 	Solid amber	<ol style="list-style-type: none"> 1. Navigate to the STATUS > FAULT menu to view the fault message. 2. Navigate to the SYSTEM > DIAGNOSTICS menu. 3. Scroll through the diagnostic readouts and look for a “PLL UL” (unlocked) message. 4. When you are ready to have the instrument serviced, unplug the instrument from the power source and contact Tektronix customer support.

Instrument condition	Example(s)	FAULT LED state	User actions
Normal	<ul style="list-style-type: none"> The instrument is operating properly The instrument is turned off 	Off	None

Rear panel connectors

The following figure shows the locations of the SPG8000A connectors on the rear panel. A brief discussion of each connector follows the illustration.

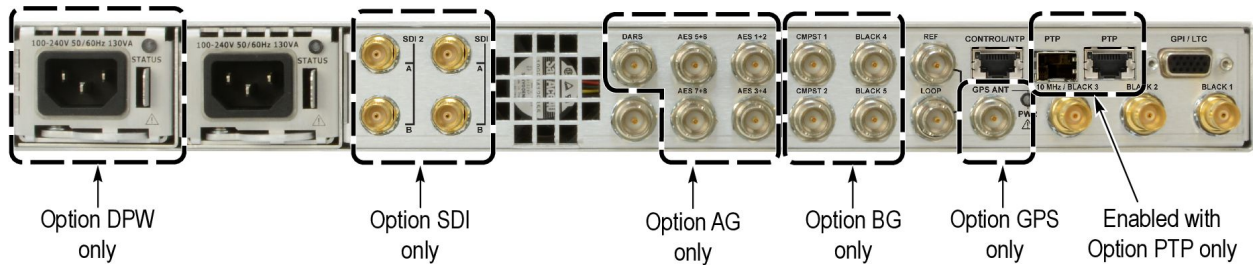


Figure 4: SPG8000A rear panel

Power connector(s)

This instrument is designed to operate from a single-phase power source with the neutral conductor at or near earth ground. Only the line conductor is fused for over-current protection. A protective ground connection through the grounding conductor in the power cord is essential for safe operation.

The instrument operates from an AC line frequency of 50/60 Hz, over the range of 100 - 240 VAC ($\pm 10\%$), without the need for configuration. See [AC power requirements](#) on page 1.



WARNING. Injury or death can occur as the result of electrical shock. To avoid electrical shock, do not connect power to the instrument when the top cover is off. There are dangerous potentials present on the Power Supply circuit boards when the power cord is connected.

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

Backup power supply (Option DPW only). The standard instrument includes one Power Supply module. With Option DPW, a second hot-swappable redundant (backup) Power Supply module is installed. See the *SPG8000A User Manual* for detailed information about how to operate the instrument with two power supplies.

SDI 1-2 output connectors (Option SDI only)

With Option SDI, the following SDI signal BNC connectors are installed.

- When the SECONDARY OUTPUT selection is set to Test Pattern for channel 1, the SIGNAL 1A and SIGNAL 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.
- **SIGNAL 1A:** Outputs the selected SDI serial digital video test signal for channel 1.
- **SIGNAL 1B:** This output can be configured to output a test pattern, where it produces the same output as the Signal 1A output, or to output a Black signal in the same format as the Signal 1A output. Use the SDI button menu to configure the secondary output. You can also configure the audio to be the same as Signal 1A, or to have no audio or muted audio. Use the EMBED button menu to configure the audio on the secondary output.
- **SIGNAL 2A:** Outputs the selected SDI serial digital video test signal for channel 2.
- **SIGNAL 2B:** This output can be configured to output a test pattern, where it produces the same output as the Signal 2A output, or to output a Black signal in the same format as the Signal 2A output. Use the SDI button menu to configure the secondary output. You can also configure the audio to be the same as Signal 2A, or to have no audio or muted audio. Use the EMBED button menu to configure the audio on the secondary output.

Word clock output connector

Outputs a 48 kHz word clock signal. You can set the output amplitude to 1 V (AC) or 5 V (DC). The word clock output and the optional AES audio outputs can be synchronized to any of the three frame pulses, and the phase can be adjusted relative to the frame pulse. Use the AES button menu to configure the word clock output.

DARS and AES audio output connectors (Option AG only)

With Option AG, the following audio connectors are installed.

- **AES 1+2:** Outputs channels 1 and 2 of the selected AES/EBU serial digital audio signal.
- **AES 3+4:** Outputs channels 3 and 4 of the selected AES/EBU serial digital audio signal.
- **AES 5+6:** Outputs channels 5 and 6 of the selected AES/EBU serial digital audio signal.
- **AES 7+8:** Outputs channels 7 and 8 of the selected AES/EBU serial digital audio signal.
- **DARS:** Outputs a DARS (muted audio) signal.

The word clock output and the AES audio outputs can be synchronized to any of the three internal frame pulses, and the phase can be adjusted relative to the frame pulse. Use the AES button menu to configure the word clock output.

Composite outputs and black 4-5 output connectors (Option BG only)

With Option BG, the following composite and additional Black outputs are installed.

- **CMPST 1:** Outputs the selected composite video signal.
- **CMPST 2:** Outputs the selected composite video signal.
- **BLACK 4:** Outputs the selected black burst or HDTV trilevel sync signal.
- **BLACK 5:** Outputs the selected black burst or HDTV trilevel sync signal.

REF loopthrough input connectors

Use the REF input loopthrough connectors for an external reference signal, which can be NTSC/PAL black burst or HDTV trilevel sync signals. The reference input requires proper external termination. The signal may connect on to other devices via the loop connection. However, the signal must be terminated eventually, either on the instrument or at the other device.

10 MHz and BLACK 1-2-3 output connectors

- **BLACK 1:** Outputs the selected black burst or HDTV trilevel sync signal.
- **BLACK 2:** Outputs the selected black burst or HDTV trilevel sync signal. You can configure this output connector to turn off if certain errors are detected. The output will remain off as long as the error occurs. Use this function to trigger a downstream ECO to switch to backup.
- **10 MHz / BLACK 3** Outputs the selected black burst or HDTV trilevel sync signal. You can also configure this connector to output a 10 MHz sine wave.

You can use the BLACK button menu to independently set the format and timing of the three black outputs and to enable VITC to be applied to the output signal. For tri-level signals, the BLACK 1, 2, and 3 outputs are a group that must all output either integer or non-integer rates. See [Management of tri-level sync output rates](#) on page 32.

GPS and-or GLONASS antenna connector (Option GPS only)

With Option GPS, you can reference the instrument timing to the GPS and/or GLONASS satellite system. You must connect a GPS and/or GLONASS antenna to the instrument in order to use this functionality. The GPS and/or GLONASS antenna input must meet specific requirements. See [Antenna requirements](#) on page 10.

You can use the Reference menu to enable this connector to provide 3.3 V or 5 V DC power to the antenna. When the connector is configured to provide power to the antenna, the rear-panel GPS ANT 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 SPG8000A generator. If a splitter is used on the antenna, it may appear as a short at DC but will still pass through the RF signal, which will allow the internal GPS system to function.
- Displays solid green if the current load of the antenna is within the nominal range.

Control/NTP port

Use this port to connect to your local Ethernet network. You can control the instrument remotely through the port and you can use the port to upload and download various files such as signal files, logo files, and preset files.

When Options GPS and/or PTP are installed, you can use this port to output an NTP (Network Time Protocol) reference signal.

PTP ports

With Option PTP, the operation of the two PTP ports is enabled. You can use these ports to reference the instrument timing to PTP (Precision Time Protocol). Two types of PTP ports are provided:

- PTP interface 1: RJ45 copper 10/100/1000 BaseT Ethernet connection
- PTP interface 2: SFP cage that supports 1 Gigabit SFP modules

GPI/LTC port

You can use the General Purpose Interface (GPI/LTC) port to perform the following tasks. See [General purpose interface \(GPI/LTC\) port](#) on page 26.

- Input (LTC 1 only) an LTC signal or output up to four LTC differential signals
- Output up to two alarm signals
- Trigger the instrument to reset the program time, reacquire the GPS and/or GLONASS position (Option GPS only), or to force a jam sync
- Recall presets 1 through 7 of the available 13 user-defined presets

This is a 15 pin, D-sub connector that carries four differential LTC signals, two ground closure outputs, and three inputs. The inputs can be configured as three preset inputs, or as two preset inputs and one general input. You can use the LTC button menu to independently set the format and timing of the four LTC signals. You can use the SYSTEM : GPI menu to configure the function of the ground closure input and outputs.

You can configure LTC1 to be an LTC input instead of an output. The supported LTC signal formats include 23.98, 24, 25, 29.97 drop frame, and 30 Hz, as per SMPTE 12M.

The Option XLR breakout cable provides access to most of the signals on the GPI/LTC connector, with the only exceptions being the preset inputs on pins 4 and 11. When using a standard RGBHV VGA-to-BNC breakout cable, the available signals are as shown below. See [Table 9: GPI/LTC port – connector pin assignments](#) on page 23.

NOTE. You do not need the optional LTC and GPI breakout cable if you are using only VITC and/or ATC as a timecode signal.

For correct operation if you use a VGA-to-BNC breakout cable, pins 6, 7, 8 and 10 must be internally grounded together in the cable and to the connector shell.

Do not use VGA cables which ground unused pins because that may disrupt operation of the GPI/LTC port.

Table 9: GPI/LTC port – connector pin assignments

Pin #	Function	VGA cable	
1	GPI out 1	Red BNC	
2	GPI out 2	Green BNC	
3	GPI input / Preset select 3	Blue BNC	
4	Preset select 1		
5	LTC 4 negative		
6	Ground	Ground	
7	LTC 3 negative	Ground	
8	LTC 2 negative	Ground	
9	Ground		
10	LTC 1 negative	Ground	
11	Preset select 2		
12	LTC 3 positive		
13	LTC 2 positive	H BNC	
14	LTC 1 positive	V BNC	
15	LTC 4 positive		

LCD display readouts

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.

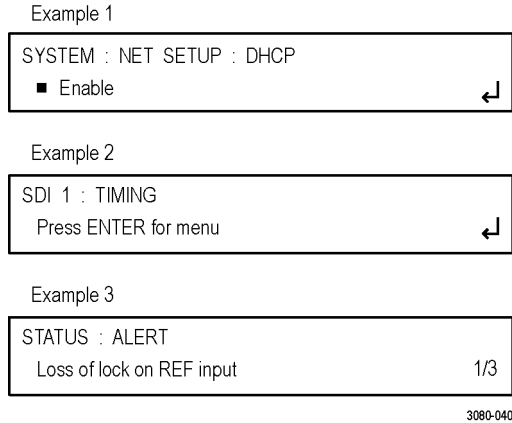


Figure 5: Example display readouts

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.

Alert and fault error messages

When error conditions occur, you can view descriptions of the alert and fault messages using the STATUS menu as described below.

1. Press the **STATUS** button to access the STATUS menu.
2. Press the up (▲) or down (▼) arrow button to select **STATUS : FAULT** or **STATUS : ALERT**.
3. Press the left (◀) or right (▶) arrow button to view all of the reported faults or alerts. The possible messages are listed in the following table.

Table 10: Possible alert and fault error messages

Alert messages	Fault messages
Near loss of lock on REF input	No fault
Loss of lock on reference input	Main cooling fan fault
No GPS signal detected	Temperature out of range
VITC or LTC input missing	Internal diagnostic test failed
LTC out of SMPTE spec	PS1 fault error
No REF input signal detected	PS2 fault error
GPS Figure of Merit (FOM)	PS1 temp. wtd. hours exceed limit
Alarm time	PS2 temp. wtd. hours exceed limit

Remote control

Web user interface

When the Web user interface is enabled in the SYSTEM menu, you can use a Web browser to remotely access the instrument. When you enter the IP address of the instrument in a supported Web browser, the Web Interface opens as shown in the following figure. Click the various tabs to access the instrument settings and controls as you would using the front panel buttons.

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. Use the SYSTEM menu to control the level of instrument access from a Web browser. You can allow full control or read-only access. When the Web user interface is disabled, no instrument access is allowed using a Web browser.

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

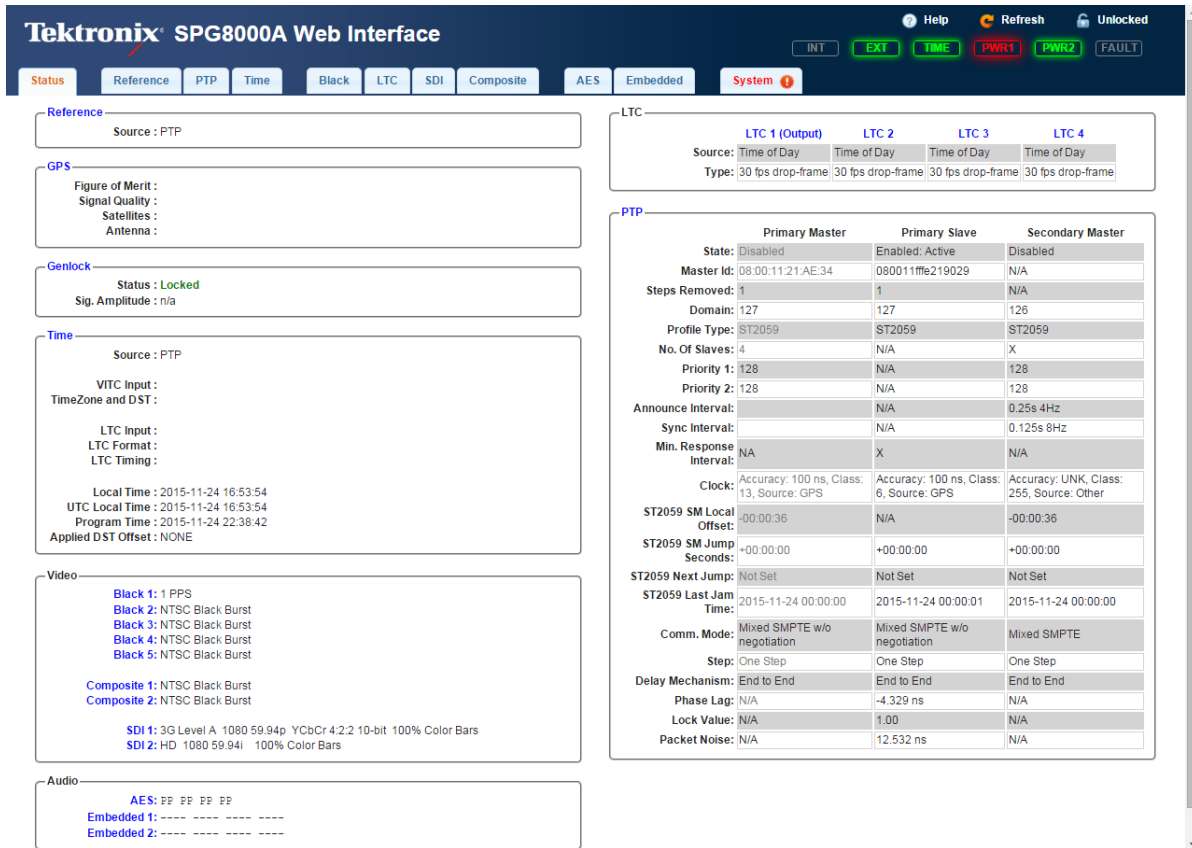


Figure 6: Example Web Interface window

General purpose interface (GPI/LTC) port

This section describes how to configure and use the GPI/LTC port. The instrument provides one port on the rear panel to serve as a General Purpose Interface (GPI). With the GPI, you can recall any of the first seven available presets and output up to three alarm signals. See *GPI/LTC port* on page 22 for the pin assignments of the port.

Signal requirements for the GPI/LTC connector. The following figure shows the signal requirements for the GPI/LTC connector. Use the input signals to recall a preset and use the output signals as an alarm signal. Frame ground is used for the ground return. When using a shielded LAN cable (shielded twisted pair cable), you can use the shield of the cable as ground.

Table 11: Signal requirements for the GPI/LTC connector

Function	Level
Input	High > 2.4 V or open (connected to an internal 10 kΩ pull-up resistor) Low < 0.8 V or ground (input impedance: 10 kΩ) Timing: Ignores pulses < 40 ms and always detects pulses > 60 ms
Output	Low < 0.4 V or ground (when sinking 250 mA; maximum on-resistance 2 Ω)

To recall a preset. When pin 3 of the GPI/LTC connector is configured for preset selection (SYSTEM > GPI > INPUT TRIGGER > Preset Restore), you can recall any of the first seven instrument presets by combinations of signal levels on pins 3, 4, and 11 of the GPI/LTC connector. When pin 3 is configured to any other function (reset program time, jam sync, or none), only presets 1, 2 and 3 can be recalled. The following table lists the combinations of signal levels for the pins and the preset number to be recalled.

Table 12: Signal level combinations and the corresponding preset for the GPI/LTC port

Pin 3 (dual purpose)	Pin 11	Pin 4	Preset number
High	High	Low	1
High	Low	High	2
High	Low	Low	3
Low	High	High	4
Low	High	Low	5
Low	Low	High	6
Low	Low	Low	7

All of the input signals are active low. When the signal level(s) for the specified pin(s) goes from High to Low, the corresponding preset is recalled. For example, when the signal level for pin 4 goes from High to Low, preset 1 is recalled.

NOTE. *The time required to change the instrument settings depends on the contents of the selected preset.*

GPI input signal configuration. You can use the SYSTEM : GPI : INPUT TRIGGER menu to configure pin 3 of the GPI/LTC port connector to trigger the instrument to perform one of the following functions:

- Reset the program time
- Reacquire the GPS and/or GLONASS position (Option GPS only)
- Force a jam sync

To output an alarm signal. The instrument can output three alarm signals from the GPI/LTC connector when internal errors occur. Alarms can be generated from pins 1 and 2 of the GPI/LTC port connector. Since the output signal is an active low; the signal level goes from High to Low when any errors occur.

In addition to the alarm signals on the GPI/LTC port, you can configure the BLACK 2 output to send an alarm signal when the signal reference lock is lost. When the reference lock is lost, the output signal from the BLACK 2 connector turns off for as long as the error condition exists.

NOTE. *Many of the error conditions can be configured for a delay to reduce false alarms. If an error condition occurs and then clears before the delay time has counted down, then no alarm signal will be sent.*

You can use the SYSTEM : GPI menu to enable an alarm signal output when one of the following internal conditions occurs:

- Hardware fault (such as the fan stops working)
- Power supply fault
- Genlock lock error or warning (for example, the instrument cannot lock to a genlock signal or the frequency of the genlock signal and the internal reference have shifted considerably, and the SPG8000A is near loss of lock. The threshold for near loss of lock is approximately 2×10^{-6} from the ends of the tune range.
- Genlock timing error or warning

SNMP traps

When the instrument 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. Use the SYSTEM : SNMP menu to configure the IP addresses of the traps destinations and to select which errors will generate traps. See the *User Manual* for instructions on how to enable and configure the instrument to send SNMP traps.

Initial configuration

This section provides a high-level overview of the instrument settings that are typically set after you have physically installed the instrument. See the *SPG8000A User Manual* for more detailed information.

Firmware upgrades

Tektronix releases product updates to add new features and to fix problems with the product firmware. During installation, it is recommended that you verify your instrument has the latest firmware version installed. You can find the latest firmware for your product at the Tektronix Web site (www.tek.com/downloads).

Select the timing reference

Use the REF button menu to select the type of reference signal that your video installation uses:

- NTSC burst
- NTSC burst with 10 field ID
- PAL burst
- HD tri-level sync
- CW
- Internal
- GPS (requires Option GPS)
- PTP (requires Option PTP)

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.

To enable this function, use the REF button menu to set the Lock Loss Action setting to "Stay at Current Frequency."

Lock recovery

Use the REF button menu to select how the instrument timing responds when the reference signal is recovered after a loss of lock (stay legal, jam phase, or fast slew).

Configure the GPS reference settings (Option GPS only)

Use the REF button menu to set the GPS reference settings:

- GPS holdover recovery (stay legal, jam phase or fast slew)
- GPS antenna power (off, 3,3 V or 5 V)
- GPS position (fixed or mobile)
- GPS constellation (GPS only, GLONASS only or GPS and GLONASS)
- GPS signal warning level

Configure the PTP reference settings (Option PTP only)

Use the SYSTEM button menu to set the PTP network IP address (DHCP or Manual mode).

NOTE. Both PTP ports share the same network address.

Use the REF button menu to set the Reference mode:

- 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.
- If Genlock 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.

Use the PTP button menu to configure the PTP reference settings:

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. The possible PTP menu entries are listed below:

- Profile type (general, ST2059, AVB or AES67)
- Domain (each PTP engine must be on a different domain)
- Communication mode
- Announce interval
- Sync interval
- Delay message rate
- Announce timeout count
- Priority 1 and 2 values
- One-step or two-step communication mode
- Delay mechanism (peer-to-peer or end-to-end)
- For Unicast and Mixed without Negotiation modes, set the AMT (Acceptable Master Table) addresses
- Asymmetric delay

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.

- ST2059 SM Default Frame Rate
- ST2059 SM Drop Frame Flag (enable, disable, auto)
- ST2059 SM CFID (enable, disable, auto)

If desired, press the PTP button again to configure the secondary master parameters.

Configure the NTP server (Options GPS and PTP only)

Options GPS and PTP enable an implementation of the Network Time Protocol (NTP), using the network interface of the instrument. The NTP server operation and configuration is automatic.

See [Network installation](#) on page 8 for information about how to configure the IP address of the Control/NTP port.

NTP server with Option GPS

When the Master time is set to GPS and the instrument acquires a valid time, the server will respond with valid NTP packets to time requests from NTP clients. When the Master time is set to GPS, the server always responds with UTC time only. It is the responsibility of the NTP client (PC workstation, file server, etc.) to be configured with the correct time zone offset. The NTP server will work only while the system is locked to a GPS and/or GLONASS reference signal.

NTP server with Option PTP

When the Master time is set to PTP and the instrument acquires a valid time, the server will respond with valid NTP packets to time requests from NTP clients. When the Master time is set to PTP, the server always responds with UTC time only. It is the responsibility of the NTP client (PC workstation, file server, etc.) to be configured with the correct time zone offset. The NTP server will work only while the system is locked to a PTP reference signal.

Configure the Black 1-3 signal outputs

Use the BLACK button menu to configure the Black 1-3 outputs as follows:

- Select the signal format
- Enable or disable the field reference
- Set the vertical and/or horizontal timing offset
- For non-HD formats, set the timecode parameters
- For HD formats, set the HD tri-level sync rate (see [Management of tri-level sync output rates](#) on page 32)

Configure the Black 4-5 and Composite outputs (Option BG only)

Use the BLACK button menu to configure the Black 4-5 outputs as follows:

- Select the signal format
- Enable or disable the field reference
- Set the vertical and/or horizontal timing offset
- For non-HD formats, set the timecode parameters
- For HD formats, set the HD tri-level sync rate (see [Management of tri-level sync output rates](#) on page 32)

Use the CMPST button menu to configure each Composite outputs as follows:

- Select the signal format
- Select the test signal
- Set the timing offset
- Set the timecode parameters

Management of tri-level sync output rates

For tri-level sync signals, the BLACK 1, 2, and 3 outputs comprise a group that must all output either integer or non-integer rate signals. When Option BG is installed, the BLACK 4 and 5 outputs comprise a separate group, which also must output either integer or non-integer rates. That means that Option BG must be installed in order for the instrument to simultaneously generate tri-level sync signals in both integer and non-integer rates.

Perform the following steps to set the rate for tri-level sync signals for each of the BLACK output groups:

1. Press the BLACK button repeatedly to select **BLACK 1–3 : HD TRI-LEVEL SYNC RATE**.
2. Press the left (◀) or right (▶) arrow button to select the desired HD tri-level sync rate for the BLACK 1, 2, and 3 outputs: **INTEGER (60, 50, 30, 25, 24)** or **NON-INTEGER (59.94, 29.97, 23.98)**.
3. Press the **ENTER** button to select the displayed rate. A bullet will appear in front of the selected rate to indicate the current selection.
4. **Option BG only:** Press the BLACK button repeatedly to select **BLACK 4–5 : HD TRI-LEVEL SYNC RATE**.
5. Repeat steps and to set the desired HD tri-level sync rate for the BLACK 4 and 5 outputs.

Configure the AES outputs (Option AG only)

Use the AES button menu to configure the AES audio outputs as follows:

- Set the channel parameters (frequency, amplitude and audio click rate)
- Set the audio resolution (24 bits or 20 bits)
- Select the frame reset signal to be synchronized with the digital audio signal
- Set the timing offset of the audio outputs relative to the genlock or internal reference signal

Configure the SDI outputs (Option SDI only)

Use the SDI button menu to configure the SDI signal outputs as follows:

- Select the output mode
- Select the signal format
- For 3G signal formats, select the sample structure/depth
- For 3G signal formats with +A sample structure, select the data to be placed on the alpha channel
- For 2×HD output modes, select the content for the first and second HD signals on links A and B
- Select the test signal
- Enable and configure the moving picture mode
- Enable and configure a signal overlay (logo, text or circle)
- Set the timing offset
- Set the timecode parameters
- Enable or disable individual components of the output serial stream
- Define and control user-defined ancillary data payload insertion
- Enable or disable the SMPTE 352 Payload ID
- Configure the second SDI connector to output a test pattern (same signal as the first SDI output) or black signal (same format and sample structure as first SDI output)

Use the EMBED button menu to configure the embedded audio on the SDI signal outputs as follows:

- Enable embedded audio on desired audio groups (for 3G Level B signal formats, you can select between Link A and Link B for each audio group)
- Configure the sampling alignment status bits for the selected audio group's Audio Control Packet (ACP)
- Enable embedded audio on desired audio channels
- Configure the frequency and amplitude of each audio channel
- Enter a channel origin ID for each audio channel
- Enable an audio click and set the click rate
- Enable Dolby-E audio stream generation on desired audio groups
- Configure the Dolby-E audio program type, level, bit depth, position and description
- Configure the various Dolby-E metadata parameters
- Configure the secondary (bottom) BNC connector of the selected SDI output for an audio output of tones, no audio or muted audio

Configure the primary power supply (Option DPW only)

Option DPW provides a second hot-swappable, redundant (backup) Power Supply module. Use the SYSTEM button menu to configure which of the two power supplies is the primary supply.

Configure presets

Presets allow you to save multiple instrument configuration settings so that you can quickly recall the settings when needed. You can save up to 15 different instrument configurations, including a power-up default setting and a user default setting.

For example, you can configure three different presets so that the instrument can easily switch between generating different video formats such as NTSC, PAL, or HD. Use the SYSTEM : PRESET menu to save, recall, rename, or delete instrument presets.

The following instrument settings are stored in non-volatile memory and are not saved as part of the preset system:

- The preferred supply configuration setting
- Network configuration settings such as the IP address, gateway address and subnet mask
- SNMP trap addresses

Compliance Information

This section lists the EMC (electromagnetic compliance), safety, and environmental standards with which the instrument complies.

EMC compliance

EC Declaration of Conformity – EMC

Meets intent of Directive 2004/108/EC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

EN 55103. Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use.^{1,2}

- Environment E2 – commercial and light industrial
- Part 1 Emission
 - EN 55022. Class B radiated and conducted emissions
 - EN 55103-1 Annex A. Radiated magnetic field emissions
- Part 2 Immunity
 - IEC 61000-4-2. Electrostatic discharge immunity
 - IEC 61000-4-3. RF electromagnetic field immunity
 - IEC 61000-4-4. Electrical fast transient / burst immunity
 - IEC 61000-4-5. Power line surge immunity
 - IEC 61000-4-6. Conducted RF immunity
 - IEC 61000-4-11. Voltage dips and interruptions immunity
 - EN 55103-2 Annex A. Radiated magnetic field immunity

EN 61000-3-2. AC power line harmonic emissions

EN 61000-3-3. Voltage changes, fluctuations, and flicker

Mfr. Compliance Contact.

Tektronix, Inc. PO Box 500, MS 19-045
Beaverton, OR 97077, USA
www.tek.com

Australia / New Zealand Declaration of Conformity – EMC

Complies with the EMC provision of the Radiocommunications Act per the following standard, in accordance with ACMA:

- EN 55022. Radiated and conducted emissions, Class B, in accordance with EN 55103-1.

¹ For compliance with the EMC standards listed here, high quality shielded interface cables should be used.

² Average half-cycle r.m.s. inrush current at initial switch-on: 1.8 A. Average half-cycle r.m.s. after 5 second power interruption: 1.6 A.

Safety compliance

This section lists the safety standards with which the product complies and other safety compliance information.

EU declaration of conformity – low voltage

Compliance was demonstrated to the following specification as listed in the Official Journal of the European Union:

Low Voltage Directive 2006/95/EC.

- EN 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

U.S. nationally recognized testing laboratory listing

- UL 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Canadian certification

- CAN/CSA-C22.2 No. 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Additional compliances

- IEC 61010-1. Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements.

Equipment type

Test and measuring equipment.

Safety class

Class 1 – grounded product.

Pollution degree description

A measure of the contaminants that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.

- Pollution Degree 1. No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
- Pollution Degree 2. Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
- Pollution Degree 3. Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
- Pollution Degree 4. Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Pollution degree

Pollution Degree 2 (as defined in IEC 61010-1). Note: Rated for indoor, dry location use only.

IP rating

IP20 (as defined in IEC 60529).

Measurement and overvoltage category descriptions

Measurement terminals on this product may be rated for measuring mains voltages from one or more of the following categories (see specific ratings marked on the product and in the manual).

- Measurement Category II. For measurements performed on circuits directly connected to the low-voltage installation.
- Measurement Category III. For measurements performed in the building installation.
- Measurement Category IV. For measurements performed at the source of low-voltage installation.

NOTE. Only mains power supply circuits have an overvoltage category rating. Only measurement circuits have a measurement category rating. Other circuits within the product do not have either rating.

Mains overvoltage category rating

Overvoltage Category II (as defined in IEC 61010-1)

Environmental compliance

This section provides information about the environmental impact of the product.

Product end-of-life handling

Observe the following guidelines when recycling an instrument or component:

Equipment recycling. Production of this equipment required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the product's end of life. To avoid release of such substances into the environment and to reduce the use of natural resources, we encourage you to recycle this product in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.



This symbol indicates that this product complies with the applicable European Union requirements according to Directives 2012/19/EU and 2006/66/EC on waste electrical and electronic equipment (WEEE) and batteries. For information about recycling options, check the Tektronix Web site (www.tek.com/productrecycling).

Perchlorate materials. This product contains one or more type CR lithium batteries. According to the state of California, CR lithium batteries are classified as perchlorate materials and require special handling. See www.dtsc.ca.gov/hazardouswaste/perchlorate for additional information.

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