Master Sync / Clock Reference Generator and ECO8000 Series Automatic Changeover Unit System Integration

Technical Reference

077-0877-00

Tektronix

Master Sync / Clock Reference Generator and ECO8000 Series Automatic Changeover Unit System Integration

Technical Reference

www.tektronix.com
077-0877-00

Tektronix

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- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

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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, additional information is provided at the end of this section. (See page ix, *Service safety summary*.)

General safety summary

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

Comply with local and national safety codes.

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

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

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

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

This product is not intended for detection of hazardous voltages.

Use personal protective equipment to prevent shock and arc blast injury where hazardous live conductors are exposed.

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.

Do not use the provided power cord for other products.

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

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

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

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

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

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

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

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

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

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

Use only specified replacement parts.

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

Do not operate in an explosive atmosphere.

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

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

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

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

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

Use only the Tektronix rackmount hardware specified for this product.

Service safety summary

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

To avoid electric shock. Do not touch exposed connections.

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

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

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

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

Terms in this manual

These terms may appear in this manual:

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

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

Symbols and terms on the product

These terms may appear on the product:

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

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

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

CAUTION
Refer to Manual

Protective Ground
(Earth) Terminal

Preface

This manual provides information for system integrators who are designing systems for high-definition (HD) and standard-definition (SD) digital video content where Tektronix ECO8000 Series Automatic Changeover Units and video sync pulse and signal generators are to be deployed.

Supported products

This manual describes how to integrate a video system using the following Tektronix products:

- ECO8000 Series Automatic Changeover Unit (includes both the ECO8000 and ECO8020 models)
- SPG8000 Master Sync / Clock Reference Generator
- TG8000 Multiformat Signal Generator

Other products. If you are integrating a system using the Tektronix products listed below, see the system integration manual for the ECO422D (Tektronix part number 077-0563-xx).

- ECO422D SD/HD Changeover Unit
- SPG600/300 Sync Pulse Generators
- TG700 TV Signal Generator

Stay GenLock®

Stay GenLock® is a digital genlock technology developed by Tektronix for the signal generators covered by this manual. It provides additional robustness and stability for genlocked SPGs, as in a master/slave configuration. (See page 125, *Using Stay GenLock®*.)

CAD file drawings

Attached to this PDF document are CAD file illustrations (in .dwg format) of the front and rear panels of various Tektronix video products. You can access the illustrations by opening the PDF and clicking the paperclip icon on the left side of the PDF window.

Product descriptions

The following pages provide descriptions of the Tektronix products supported by this document.

ECO8000 Series Automatic Changeover Unit

The ECO8000 Series Automatic Changeover Unit is a highly versatile automatic sync and signal changeover unit with configurations and capabilities required to address modern master sync application and other advanced sync timing application. The ECO8000 Series offers exceptional reliability, stability, and is designed with optional high-bandwidth input changeover capabilities for HD/SD and/or 3G-SDI signal environments.

Each ECO8000 unit can be used with the following signal generators to form the complete sync generator system, which offers extra redundancy for the critical timing and synchronization system in the facilities.

- A pair of Tektronix Master Sync / Master Clock Reference Generators (SPG8000) for most broadcast facility timing applications.
- A pair of Tektronix Test Signal Generators (TG8000) for more advanced post production facility timing applications.

ECO8000 Series models. The ECO8000 Series consist of the following models:

- **ECO8000:** This model provides up to nine user-configurable BNC channels and four LTC channels. The base configuration has three 50 MHz Electronic Fast Switch (REF/ELSW) channels with options for six more 50 MHz Electronic Fast Switch or 3 GHz Relay Switch (HREF/Relay) channels in groups of three channels each, plus four optional LTC channels. Each channel consisting of primary and backup inputs, and an output.
- **ECO8020:** This model provides up to 20 user-configurable high-density BNC channels and four LTC channels. The base configuration has five 50 MHz Electronic Fast Switch (REF/ELSW) channels with options for 15 more 50 MHz Electronic Fast Switch or 3 GHz Relay Switch (HREF/Relay) channels in groups of five channels each, plus four optional LTC channels. Each channel consisting of primary and backup inputs, and an output.

Web User interface. An easy to navigate Web-based interface allows quick access to most of the instrument settings and views. In most cases, it is easier to access and configure the instrument using the Web Interface.

Channel configuration. Channel configuration can be set either via the front panel or the ECO8000 Web User Interface. Signal amplitude fault detection level follows the setting of the channel configuration. Detection on individual channel may be disabled, giving the option of disabling switching to the backup unit on failure of signals not critical to the facility operation.

Changeover switching. When operated in the switch-on-fault mode, the ECO8000 will automatically select the backup sync source should any of the primary inputs fail. However, in the unlikely event both sync sources are faulty, the ECO8000 will not alternate between the two sources. If necessary, this function may be overridden with the manual sync source selection. Manual source selection also facilitates periodic testing of the changeover function.

50 MHz Electronic Fast Switch channels. The Electronic Fast Switch function, which comes standard with all 50 MHz Electronic Fast Switch channels, significantly improves the changeover switching speed and thus minimizes disturbance of the reference sync signals when switching between primary and backup inputs. The Electronic Fast Switch channels have latching relay backups that engage on loss of power to maintain the selected signal path.

Optional 3 GHz Relay Switch channels. The optional 3 GHz Relay Switch channels are optimized for SD/HD/3GSDI signals, but are also usable for most reference signals. These channels utilize high bandwidth latching relays to preserve the selected signal path upon a loss of power.

Optional LTC channels. The optional LTC channel connections are pin-compatible with the Tektronix SPG8000 and TG8000 generators, so these signals can be connected with standard high-density, 15 pin D-SUB cables. The same cable can be used to carry GPI connections, which allow the SPG8000 to trigger a changeover on certain error conditions such as loss of genlock.

The output connector for the LTC channels can use the optional breakout cable (Option XLR) for simple access to the differential LTC signals.

Front panel controls. In association with the LCD display, front-panel controls are provided for source selection, operating mode, resetting the fault indicators, and for disabling the front-panel controls. LED fault indicators are also provided for each individual channels as well as the status of the power supplies. When the unit is connected to an Ethernet network, these functions are also available from the ECO8000 Web User Interface using a Web browser on a computer connected to the same network.

Optional backup power supply. The optional hot-swappable, redundant (backup) dual power supply system (Option DPW) virtually removes the risk of sync loss due to power supply unit failure, minimizing disruption in operations. Unique to the ECO8000 and ECO8020, the unit periodically tests the backup power supply to verify its performance. If the test fails, a fault will be indicated on the LED fault indicator as well as an error message for backup power supply replacement - providing extra assurance that the backup power supply will be ready when needed.

Alarm and status reporting. Alarm and status information can be reported through SNMP, GPI, email notification, and/or the ECO8000 Web User Interface.

SPG8000 Master Sync / Clock Reference Generator

The SPG8000 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 and NTP (Network 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 independently adjustable timing offsets. Also included is a 48 kHz word clock output. 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 pass-through genlock input can be used to lock to an external video reference or 10 MHz continuous wave signal.

The SPG8000's 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 SPG8000 can also serve as a Network Time Protocol (NTP) server, providing the time-of-day reference to network-attached devices.

Optional GPS receiver. Option GPS adds an internal GPS receiver to the SPG8000. When connected to an external antenna that supplies the standard GPS RF signal, the SPG8000 can utilize the GPS system's stable frequency reference.

The GPS 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 SPG8000 can maintain the video frequency and phase when the GPS signal is interrupted, and the Holdover Recovery mode will ensure a shock-free re-alignment of frequency and phase when the GPS signal is restored.

Optional DARS and AES audio outputs. Option AG adds eight channels (four pairs) of AES audio output and a DARS output (muted audio).

NOTE. *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.*

Optional SDI video outputs. Option SDI adds two channels with two outputs each of SDI video signals. Option 3G adds 3G-SDI video output support.

Optional redundant power supply. Option DPW adds a second Power Supply module to provide a redundant power system.

TG8000 Multiformat Test Signal Generator

The TG8000 is a multiformat, analog and digital, precision signal generation platform. Designed with the changing needs of the video industry in mind, the generator offers sync pulse generation and test signal generation for a wide array of analog, serial digital, and digital high-definition formats.

The instrument has a modular architecture that offers the flexibility to meet the single-format and growing multiformat needs of the video professional. It allows up to four of the following modules to be fitted in the mainframe:

- AG7 Audio Generator module
- AGL7 Analog Genlock module
- ATG7 Analog Test Generator module
- AVG7 Analog Video Generator module
- AWVG7 AnalogWideband Video Generator module
- BG7 Black Generator module
- DVG7 Digital Video Generator module
- GPS7 GPS Synchronization and Timecode module
- HD3G7 HD 3 Gb/s SDI Video Generator module
- HDLG7 HD Dual Link Video Generator module
- HDVG7 HDTV Digital Video Generator module
- SDI7 Dual Channel SD/HD/3G SDI Video Generator module

Related documentation

The following tables list the available user documentation for each of the products supported by this document:

Table i: ECO8000 Series Automatic Changeover Unit documentation

Document	Tektronix Part Number	Description	Availability		
			Print	Web	CD
User Manual	071-3221-xx (English)	Describes how to install, operate, and configure the instrument	✓	✓	
	077-0873-xx (Japanese)			✓	
	077-0874-xx (Russian)			✓	
Specifications and Performance Verification	077-0876-xx	Lists the product specifications and provides procedures for verifying the performance of the instrument		✓	
Release Notes	077-0878-xx	Describes the new features, improvements, and limitations of the instrument firmware		✓	
Declassification and Security Instructions	077-0879-xx	Describes how to clear or sanitize the data storage (memory) devices in the product for customers with data security concerns.		✓	
Service Manual	077-0880-xx	Describes how to service the instrument to the module level (such as circuit boards and fuses), lists the product specifications, and provides a procedure for verifying the performance of the instrument		✓	

Table ii: SPG8000 Master Sync / Clock Reference Generator documentation

Document	Tektronix part number	Description	Availability		
			Print	Web	CD
Quick Start User Manual	071-3080-xx (English)	Describes how to install the instrument and provides basic operating information	✓	✓	✓
	077-0745-xx (Japanese)			✓	✓
	077-0746-xx (Russian)			✓	✓
Technical Reference	077-0747-xx	Provides detailed operating information		✓	✓
Specifications and Performance Verification	077-0748-xx	Lists the product specifications and provides procedures for verifying the performance of the instrument		✓	✓
Service Manual	077-0749-xx	Describes how to service the instrument to the module level (such as circuit boards and fuses)		✓	
Declassification and Security Instructions	077-0750-xx	Describes how to clear or sanitize the data storage (memory) devices in the product for customers with data security concerns.		✓	
Release Notes	077-0751-xx	Describes the new features, improvements, and limitations of the instrument firmware		✓	

Table iii: TG8000 Multiformat Test Signal Generator documentation

Document	Tektronix Part Number	Description	Availability		
			Print	Web	CD
User Manual	071-3036-xx (English)	Describes how to install, operate, and configure the instrument	✓	✓	✓
	071-3037-xx (Japanese)			✓	✓
	071-3038-xx (Russian)			✓	✓
PC Tools Technical Reference	077-0684-xx	Describes how to use the PC tools software that is supplied with the instrument		✓	✓
Specifications and Performance Verification	077-0685-xx	Lists the product specifications and provides procedures for verifying the performance of the instrument		✓	✓
Programmer Manual	077-0686-xx	Provides programming information for the mainframe and related modules		✓	✓
Service Manual	077-0687-xx	Describes how to service the mainframe to the module level (such as circuit boards and fuses) and provides information about servicing generator modules		✓	
Declassification and Security Instructions	077-0688-xx	Describes how to clear or sanitize the data storage (memory) devices in the product for customers with data security concerns.		✓	
Release Notes	077-0689-xx	Describes the new features, improvements, and limitations of the instrument firmware		✓	

Physical, environmental, and power specifications

This section lists the physical, environmental, and power specifications for each of the products covered by this manual.

ECO8000 Series specifications

The following tables list the physical, power, and environmental specifications of the ECO8000 and ECO8020 instruments.

Table 1: ECO8000 Series physical specifications

Characteristic		Description
Dimensions (See Figure 1.) (See Figure 2.)	Height	43.7 mm (1.72 in)
	Width	483 mm (19.0 in)
	Depth	ECO8000: 557 mm (21.9 in) ECO8020: 548 mm (21.6 in)
Weight	Net	4.5 kg (10.0 lbs)
Clearance	Side and rear	5.1 cm (2 in)

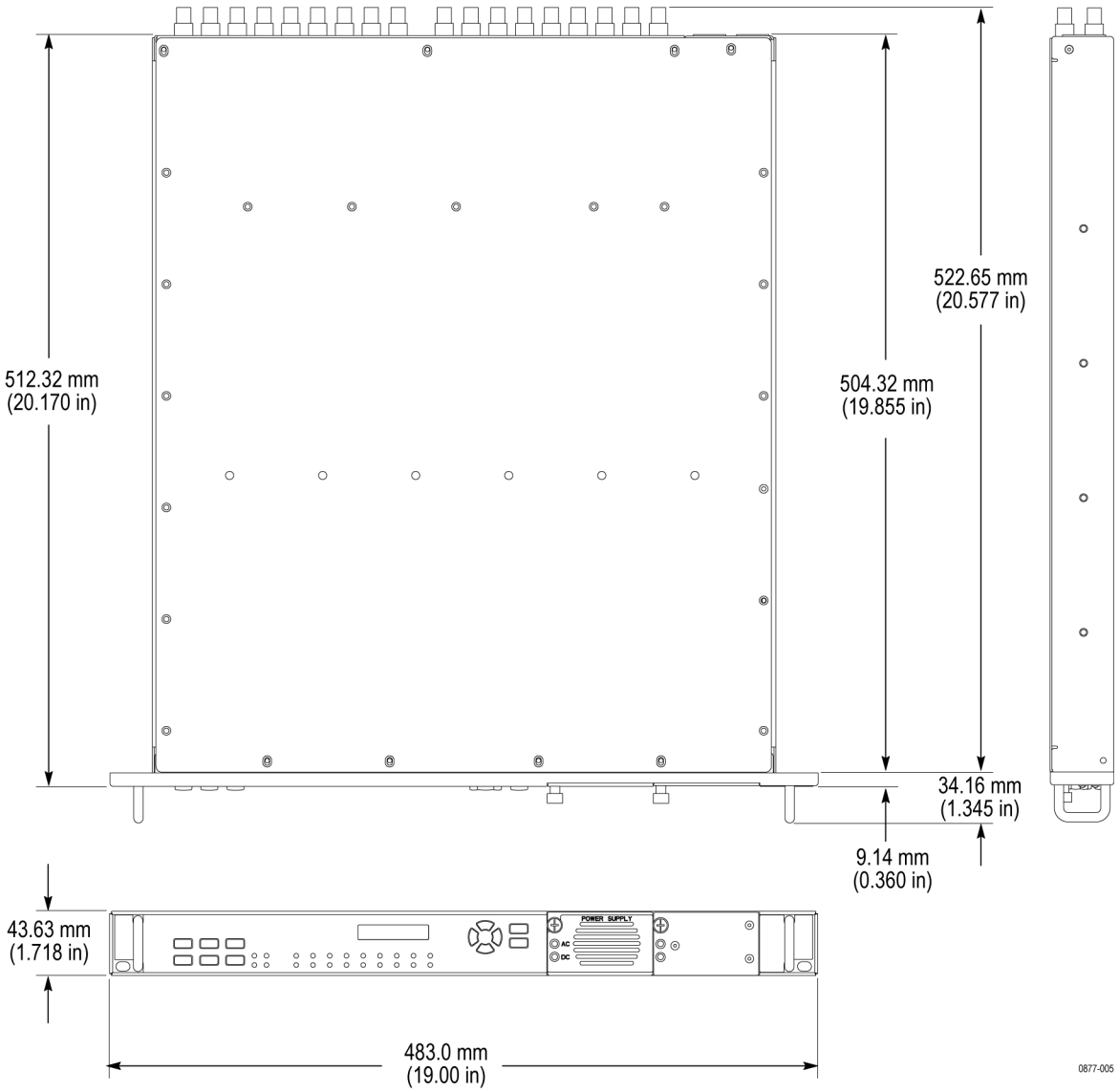


Figure 1: ECO8000 dimensions

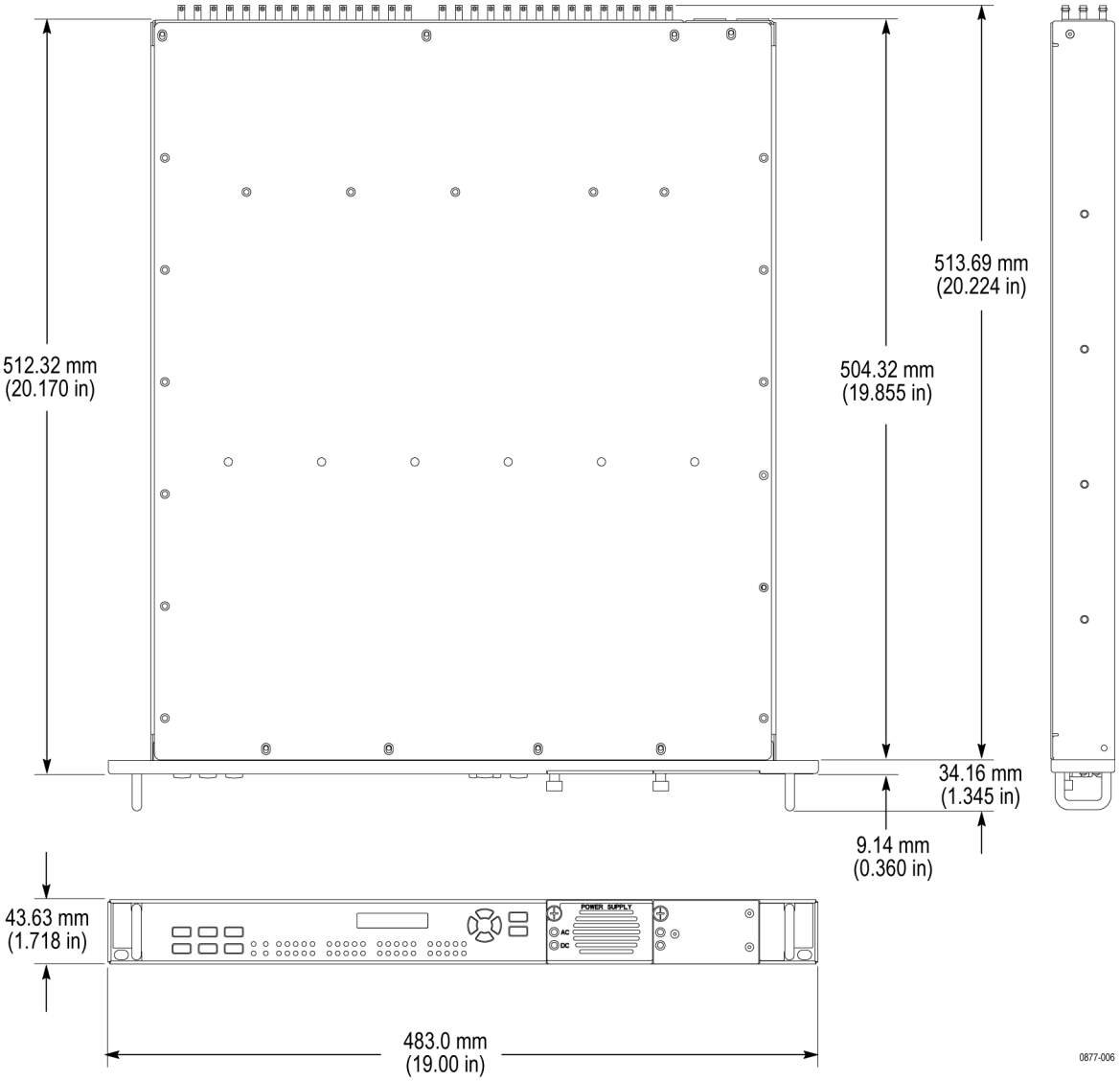


Figure 2: ECO8020 dimensions

Table 2: ECO8000 Series environmental specifications

Characteristic		Description
Temperature	Operating	0 °C to +50 °C (+32 °F to +122 °F), with 15 °C/hour maximum gradient, non-condensing, derated 1 °C per 300 m above 1500 m altitude
	Nonoperating	–20 °C to +60 °C (–4 °F to +140 °F), with 15 °C/hour maximum gradient
Relative humidity	Operating	20% to 80% relative humidity (% RH) at up to +30 °C, maximum Wet-Bulb temperature of +29 °C (derates relative humidity to 20% RH at +50 °C)
	Nonoperating	5% to 80% relative humidity (% RH) at up to +40 °C, maximum Wet-Bulb temperature of +40 °C (derates relative humidity to 30% RH at +60 °C)
Altitude	Operating	To 3,000 m (9,842 feet) Maximum operating temperature decreases 1 °C for each 300 m above 1.5 km
	Nonoperating	To 15,000 m (49,212 feet)
Random vibration	Operating	0.27 G_{RMS} 5 to 500 Hz, 10 minutes per axis, 3 axes (30 minutes total)
	Nonoperating	2.28 G_{RMS} 5 to 500 Hz, 10 minutes per axis, 3 axes (30 minutes total)
Mechanical shock	Operating	0.33 mm pk-pk (0.013 inch pk-pk) constant displacement, 5 to 55 Hz, 3 axes (each axis: 15 minute resonance search, 10 minute dwell at frequency of most significant resonance or, if none, at 33 Hz

Table 3: ECO8000 Series power specifications

Characteristic		Description
AC power source	Voltage range	100 to 240 VAC ***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.*
	Frequency range	50/60 Hz
	Power consumption [1]	50 VA maximum
	Inrush current, average half-cycle RMS (typical)	2 A Per EN55103-1:2009 Annex B

[1] The actual power varies with type and number of modules installed. The base instrument without modules typically draws 10 watts.

SPG8000 specifications

The following tables list the physical, power, and environmental specifications of the SPG8000 instrument.

Table 4: SPG8000 physical specifications

Characteristic		Description
Dimensions (See Figure 2.)	Height	44 mm (1.73 in)
	Width	483 mm (19.0 in)
	Depth	567 mm (22.3 in)
Weight, net		Approximately 6 kg (mainframe only, without with rack rail)
Clearance	Side	5 cm (2 in)
	Rear	7.5 cm (3 in)

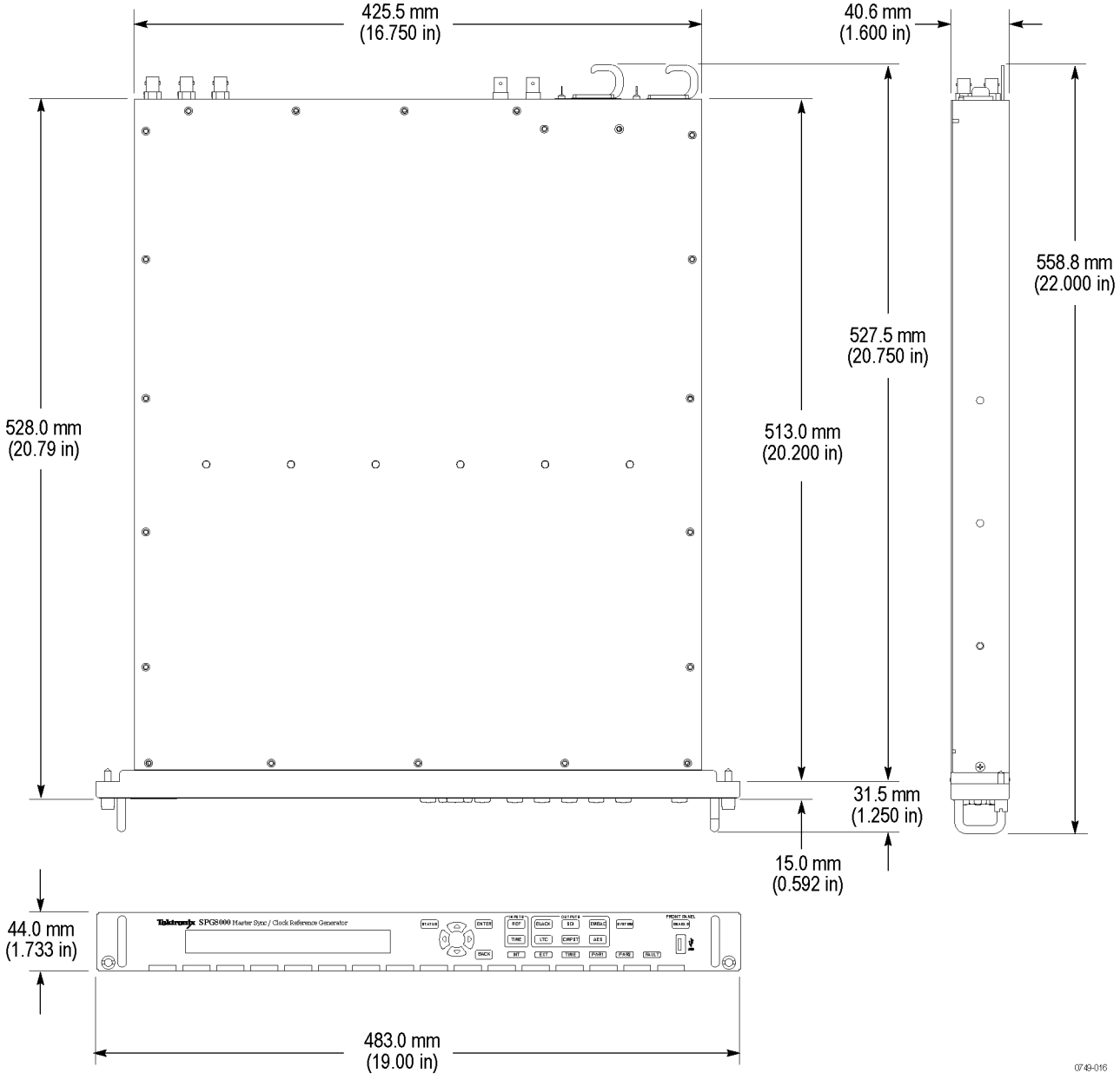


Figure 3: SPG8000 dimensions

Table 5: SPG8000 environmental specifications

Characteristic		Description
Temperature	Operating	0 °C to +50 °C
	Nonoperating	–20 °C to +60 °C
Relative Humidity	Operating	20% to 80% (% RH) at up to +30 °C, noncondensing
	Nonoperating	5% to 90% (% RH) at up to +40 °C, noncondensing
Altitude	Operating	To 3,000 m (10,061 feet)
	Nonoperating	To 15,000 m (50,000 feet)
Vibration	Operating	0.27 G_{rms}, 5 Hz to 500 Hz, 10 minutes per axis, three axes
	Nonoperating	2.28 G_{rms}, 5 Hz to 500 Hz, 10 minutes per axis, three axes
Shock	Operating	Half-sine mechanical shocks, 30 g peak amplitude, 11 ms duration, 3 drops in each direction of each axis (18 total)

Table 6: SPG8000 power specifications

Characteristic		Description
AC power source	Rating voltage	100 V to 240 V
	Frequency range	50/60 Hz
	Power consumption	130 VA (maximum) on active power supply input 130 VA on backup supply input during 5 s daily load test
	Surge current	< 40 A

TG8000 specifications

The following tables list the physical, power, and environmental specifications of the instrument and related modules.

Table 7: TG8000 physical specifications

Characteristic		Description
Dimensions (See Figure 4.)	Height	44 mm
	Width	483 mm
	Depth	559 mm
Weight [1], net		Approximately 5.5 kg (mainframe only, without rack rail)
Clearance	Side	5 cm (2 in)
	Rear	5 cm (2 in)

1 Weight of the instrument will vary depending on the number and type of generator or other modules installed.

Table 8: TG8000 environmental specifications

Characteristic		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 3.0 km (9,842 feet) Maximum operating temperature decreases 1 °C each 300 m above 1.5 km.
	Nonoperating	To 15 km (50,000 feet)
Vibration	Operating	2.65 m/s^2 (0.27 G_{rms}), 5 Hz to 500 Hz, 10 min, three axes
	Nonoperating	22.3 m/s^2 (2.28 G_{rms}), 5 Hz to 500 Hz, 10 min, three axes
Shock, Nonoperating		294 m/s^2 (30 G), half-sine, 11 ms duration

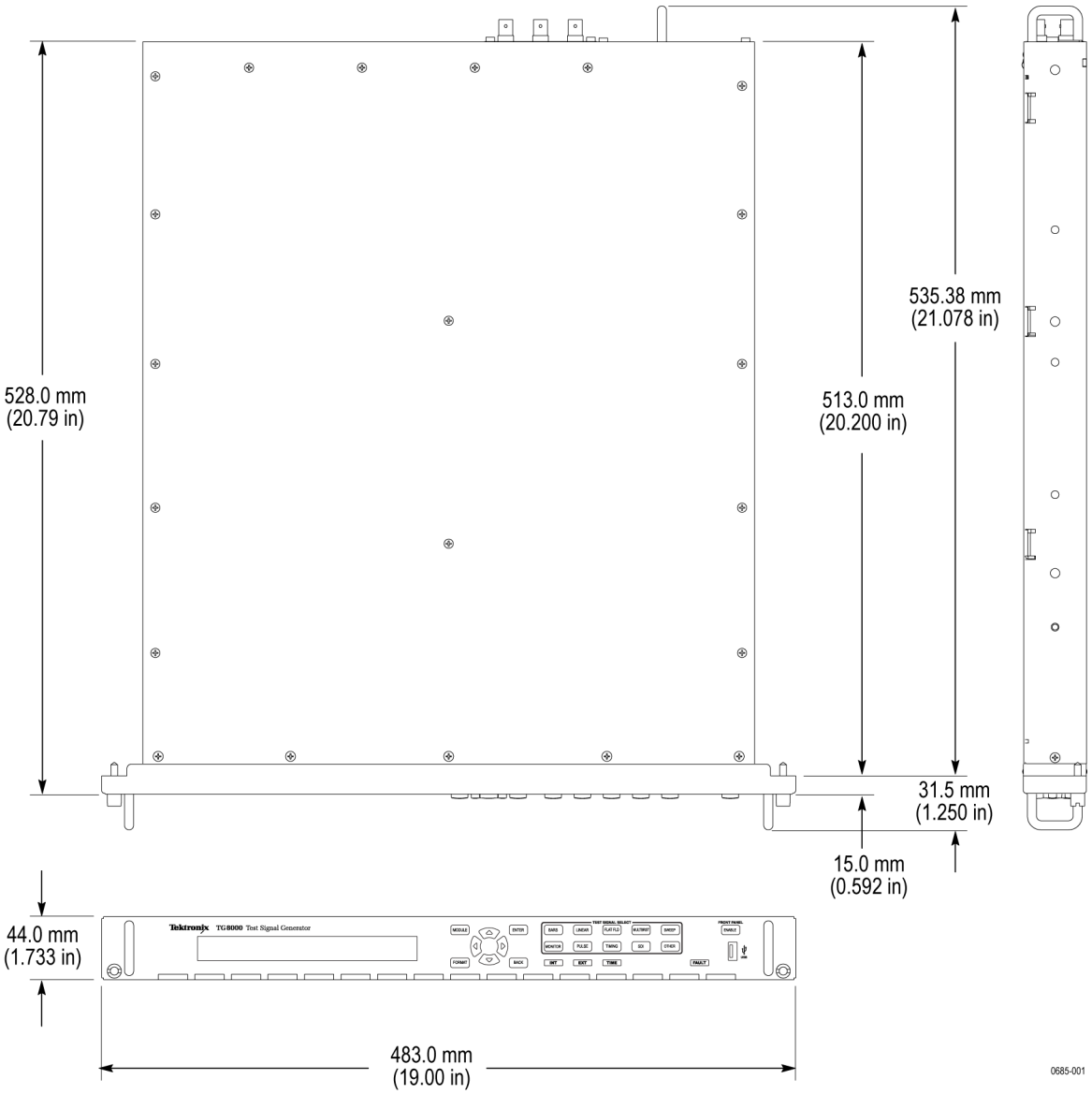


Figure 4: TG8000 dimensions

Table 9: TG8000 power specifications

Characteristic		Description
Number of modules that can be installed		4 maximum. Mainframe limitations: AGL7, GPS7 – Only one of these modules can be installed at a time. When installed, the module must be installed only in slot 1.
Clock, stability		< ±100 parts in 10^{-9} per year
AC power source	Rating voltage	100 V to 240 VAC ***WARNING.*** *To reduce the risk of fire and shock, ensure the mains supply voltage fluctuations do not exceed 10% of the operating voltage range.*
	Frequency range	50/60 Hz
	Maximum power	120 VA
	Maximum current	1.2 A
Heat dissipation, maximum power		120 VA maximum. Maximum line current is 1.2 A_{rms} at 50 Hz
Surge current		≤ 40 A peak for equal or less than 5 line cycles, after the instrument has been turned off for at least 30 seconds

Hardware installation

This section describes how to install each of the products covered by this manual into an equipment rack. Signal wiring diagrams are provided later in this document. (See page 53, *Video system installation*.)

ECO8000 Series installation

Rackmounting

The ECO8000 Series is configured at shipment for use in an equipment rack only if Option RACK was ordered. For information on how to install the instrument into a standard 19-inch equipment rack, refer to the instructions in the *Rackmounting* section. (See page 17.)

SPG8000 installation

Rackmounting

The SPG8000 is configured at shipment for use in an equipment rack. For information on how to install the instrument into a standard 19-inch equipment rack, refer to the instructions in the *Rackmounting* section. (See page 17.)

Option GPS antenna requirements

When Option GPS is installed, an external antenna connection to the instrument is required to receive signals from satellites. (See page 31, *SPG8000 connectors*.) (See page 56, *GPS and GLONASS antenna installation*.)

Stay GenLock®

The SPG8000 generator supports the Tektronix proprietary Stay GenLock function for maintaining a stable genlocked system. (See page 125, *Using Stay GenLock®*.)

TG8000 installation

Rackmounting

For information on how to install the instrument into a standard 19-inch equipment rack, refer to the instructions in the *Rackmounting* section. (See page 17.)

GPS7 module antenna requirements

The GPS7 module requires an external antenna connection to the module to receive signals from satellites. (See page 38, *TG8000 connectors*.) (See page 56, *GPS and GLONASS antenna installation*.)

Stay GenLock®

The AGL7 and GPS7 modules of the TG8000 generator support the Tektronix proprietary Stay GenLock function for maintaining a stable genlocked system. (See page 125, *Using Stay GenLock®*.)

Module installation and removal

The TG8000 is shipped with the optional modules that you ordered already installed and configured. You can add or remove modules as necessary for your application. (See page 12, *Module installation and removal*.)

The following procedures describe how to install and remove modules from the TG8000 mainframe. A screwdriver with a #1 Phillips tip is the only tool you need to install or remove a module.

CAUTION. *To prevent damage to the mainframe and module, always remove the power cord before installing or removing a module.*

NOTE. *The Power Supply module can be removed/installed from the rear panel of the mainframe in a similar manner as the generator modules.*

Preventing component damage.

CAUTION. *Electrostatic discharge (ESD) can damage components on the module and mainframe. To prevent ESD or other component damage, follow the guidelines below when installing, removing or handling a module.*

- Wear a grounded antistatic wrist strap to discharge the static voltage from your body while installing or removing modules from the generator mainframe.
- Transport and store modules in a static-protected bag or container.
- Do not slide the module over any surface.
- Handle modules as little as possible.
- Do not touch module components or connector pins.
- Do not use any devices capable of generating or holding a static charge in the work area where you remove, install, or handle modules.
- Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.
- Do not remove the module circuit board assembly from the shield. The shield is an important stiffener which prevents damage to surface-mount components.

Installing a module. To install a module into an empty slot in the mainframe, perform the following procedure:

1. Unplug the power cord from the power connector on the rear panel of the mainframe.
2. Use the following guidelines to select the slot where you will install the module. The following figure shows a sample module configuration with the associated slot numbers.

   TG8000 mainframe guidelines:

   - For AGL7 and GPS7 modules, only one of these modules can be installed in the TG8000 mainframe at a time, and it must be installed only in slot 1. All other modules may be installed in any slot location.

   NOTE. *When installing a GPS7 module into an existing mainframe, you must perform the mainframe oven calibration. Refer to the Configure the GPS7 Module section in the mainframe user manual for instructions.*

   Although the GPS7 module will operate only in slot 1, in the TG8000 mainframe you can use the GPS7 module to test diagnostics in each of the four mainframe slots. Refer to the TG8000 Specifications and Performance Verification Technical Reference for more information.

   - For the AG7, ATG7, AVG7, AWVG7, BG7, DVG7, HD3G7, HDLG7, HDVG7, and SDI7 modules, up to four of the modules can be installed in the TG8000 mainframe.
   - The TG8000 Power Supply module is user replaceable and must be installed only in the position shown in the following figure.

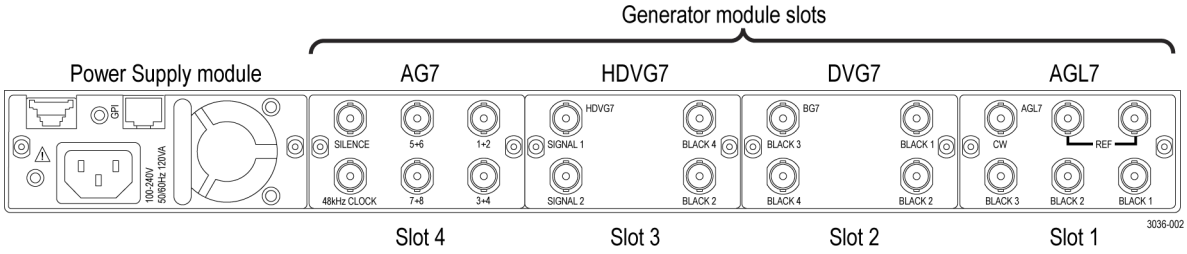


Figure 5: TG8000 slot numbering

3. Use a screwdriver with a #1 Phillips tip to loosen the two screws of the blank panel attached to the slot you want to use, and then pull it away from the instrument. Save the blank panel for future use. (See Figure 6.)

   If you are installing a new module into a slot that already contains a module, remove the existing module. (See page 16, *Removing a module*.)

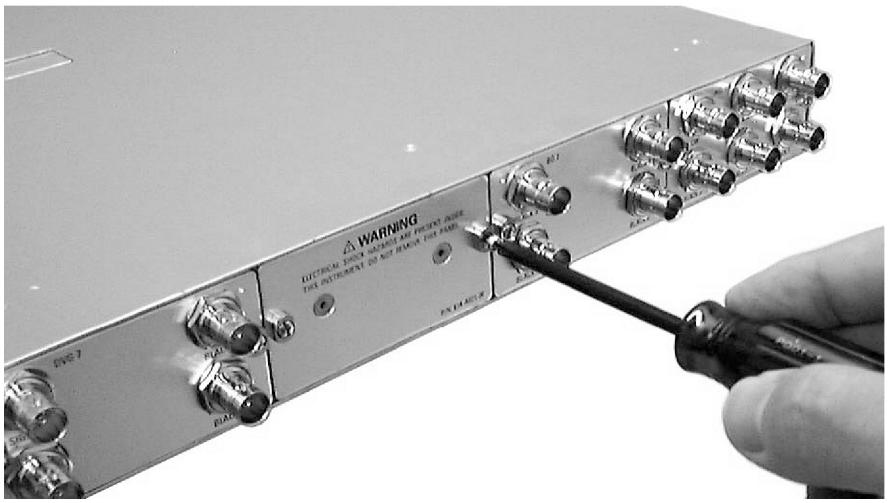


Figure 6: Removing the blank panel

CAUTION. *Be careful not to damage the parts and cables inside of the module when you insert the module into the mainframe.*

4. Insert the module into the slot, paying attention to the module orientation. (See Figure 7.) Push the module into the slot until the connector board of the module is firmly engaged with the Main board of the mainframe.

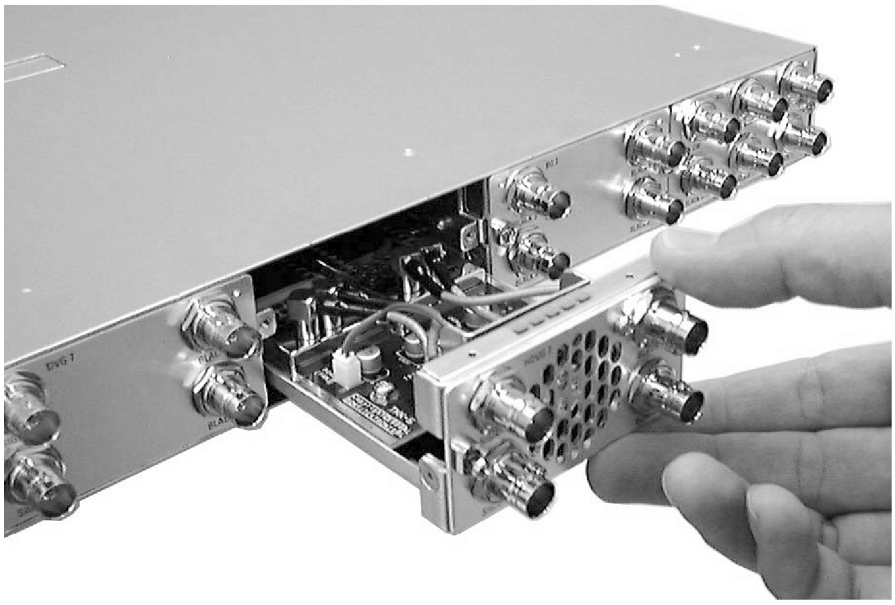


Figure 7: Installing a module

5. Tighten the two screws to secure the module to the mainframe. (See Figure 8.)

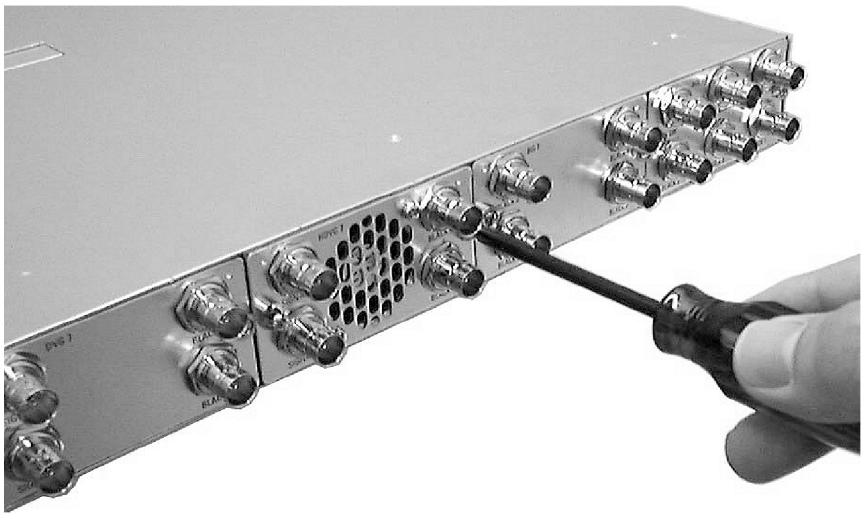


Figure 8: Securing the module

Removing a module. To remove a module from the mainframe, perform the following procedure:

CAUTION. *To facilitate module removal, attach terminations or BNC cables to the module connectors. The connector may be damaged if too much force is applied to it during module removal.*

1. Unplug the power cord from the power connector on the mainframe rear panel.
2. Attach 75 Ω terminations or BNC cables to the BNC connectors on the module to be removed. Module removal becomes easier if the terminations or cables are attached to the connectors at the left and right ends.
3. Use a screwdriver with a #1 Phillips tip to loosen the two screws securing the module to the mainframe.

CAUTION. *Be careful not to damage the parts and cables inside of the module when you remove the module from the mainframe.*

4. Pull the module slowly toward you while supporting the terminations or BNC cables attached to the connectors. (See Figure 9.)

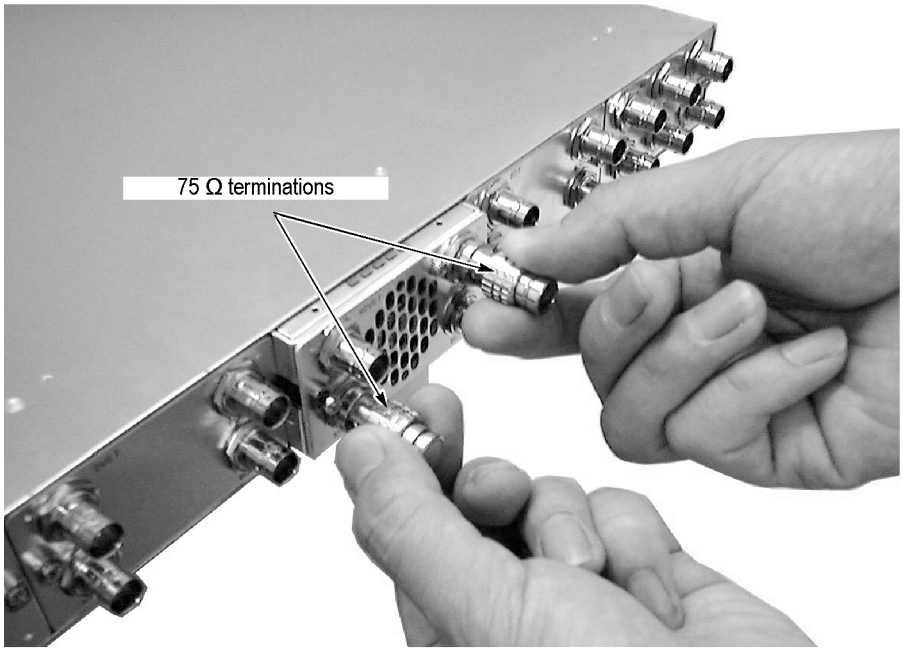


Figure 9: Removing the module

5. If this empty slot will not be used, you must attach a blank panel to the mainframe to control instrument cooling and EMI emissions.

   a. Align the blank panel with the open slot of the mainframe.

   b. Tighten the two screws to secure the blank panel to the mainframe.

   A blank panel is available as an optional accessory for the generator mainframe.

6. If you want to install another module into the slot from which the module is removed, perform the installation procedure starting at step 4. (See page 13, *Installing a module*.)

Rackmounting

This section provides instructions for doing the following:

- Installing the slides onto your product if they are not already installed
- Installing the rails into a standard 19-inch equipment rack
- Installing the instrument into the rails in the rack

WARNING. *To avoid personal injury and instrument damage, do not use slides provided with other instruments from other kits (for example, General Devices, Chassis Trak C-300) with the rails from this kit. The locking feature will not function, resulting in product falling out of the rack when it is removed from the rack.*

Do not mix parts from different rackmount kits. *Mixing the items will result in an instrument that is not secured properly and could fall out of the rack, causing personal injury or instrument damage.*

Required tools

The following tools are required to install the kit hardware:

- #2 Phillips screwdriver
- 3/8 inch wrench

WARNING. *To prevent the rackmounted instrument from tipping forward onto the operator, install the instrument so that the operator will be able to access all of its rear-panel connectors without pushing down on the instrument. Verify that the rack does not become unstable with the instrument fully extended. Do not leave the instrument extended when finished accessing the rear panel.*

Installing the slides

This procedure attaches the slides to the instrument.

NOTE. *The slides may already be installed on your instrument. If they are, skip this procedure and go to Installing the Rails. (See page 21.)*

1. Identify the right rear and left rear of each slide. A warning label will be on the outside side of each slide. (See Figure 10.)
2. Make sure that the rear of the slide is nearest to the rear of the instrument. The front of each slide has a notch in the center edge.
3. Align the mounting holes on the right slide to the mounting holes on the right side of the instrument.

NOTE. *All instruments except for the SPG8000 generator have four mounting holes. The SPG8000 generator has only the first three mounting holes.*

4. Using a screwdriver with a #2 Phillips tip, attach the right slide to the right side of the instrument by doing the following:

NOTE. *Whether your instrument requires the metric screws or the English screws, the screws you need to insert in this step will be the shorter ones (0.375 in or 8 mm). If you do not know which screws your instrument requires, contact a Tektronix Service Center for assistance. (See the back of the title page for contact information.)*

   a. **All instruments except the SPG8000:** Using either the metric or English screws, depending on your instrument, insert three screws into the first three holes. (See Figure 10.)
   b. **SPG8000 only:** Using either the metric or English screws, depending on your instrument, insert two screws into the first two holes. (See Figure 11.)
   c. Place a lever, with the long handle facing the front of the slide and the short hook facing downward, over the third or fourth hole. Use the third hole for the SPG8000 only. Use the fourth hole for all other instruments.
   d. Insert a screw into the bushing.
   e. Insert the bushing and screw into the lever so that the lever is attached to the slide and the slide is secured to the instrument.

5. Rotate the instrument to face the left side and repeat this procedure to install the left slide.

WARNING. *To reduce the risk of injury and equipment damage, make sure that levers are properly installed. An improperly installed lever can prevent the slide from locking or prevent the instrument from being removed from the rack. Make sure that the lever is installed so that the long handle is facing forward and the short hook is facing downward.*

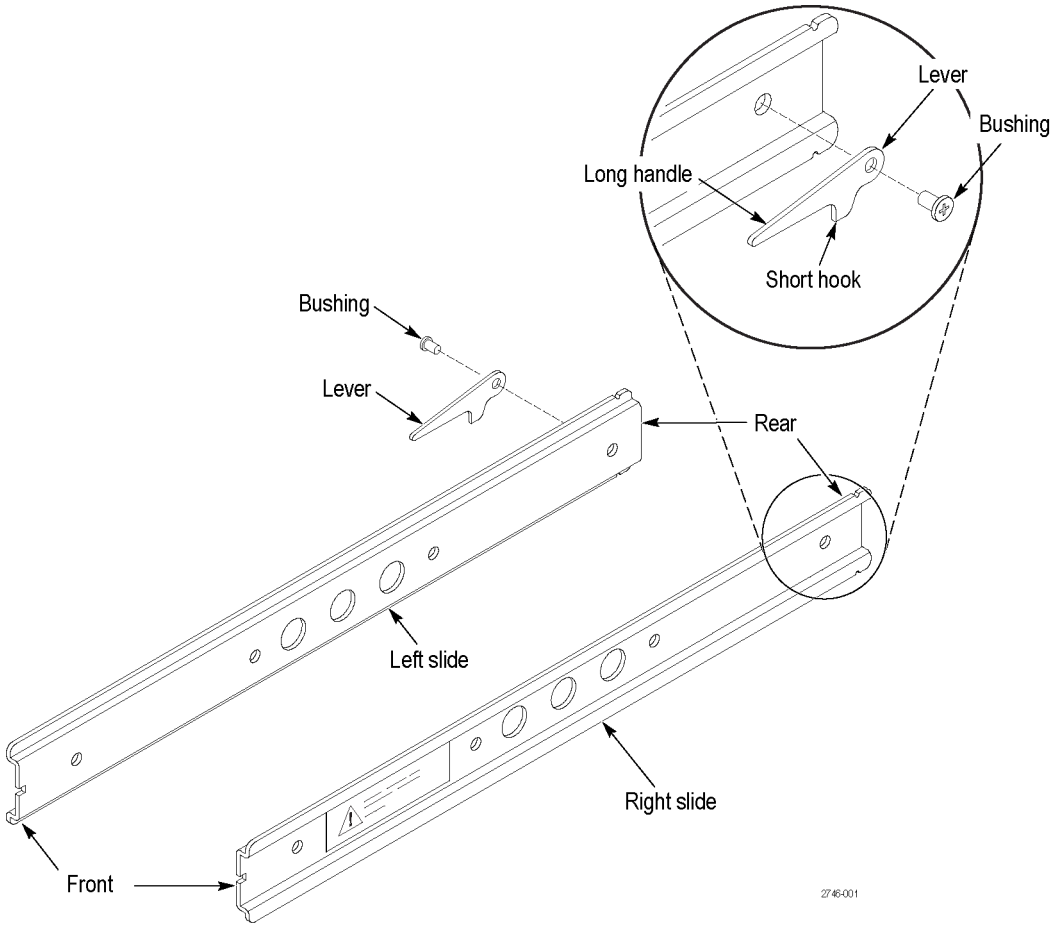


Figure 10: Attaching the slides (all instruments except the SPG8000)

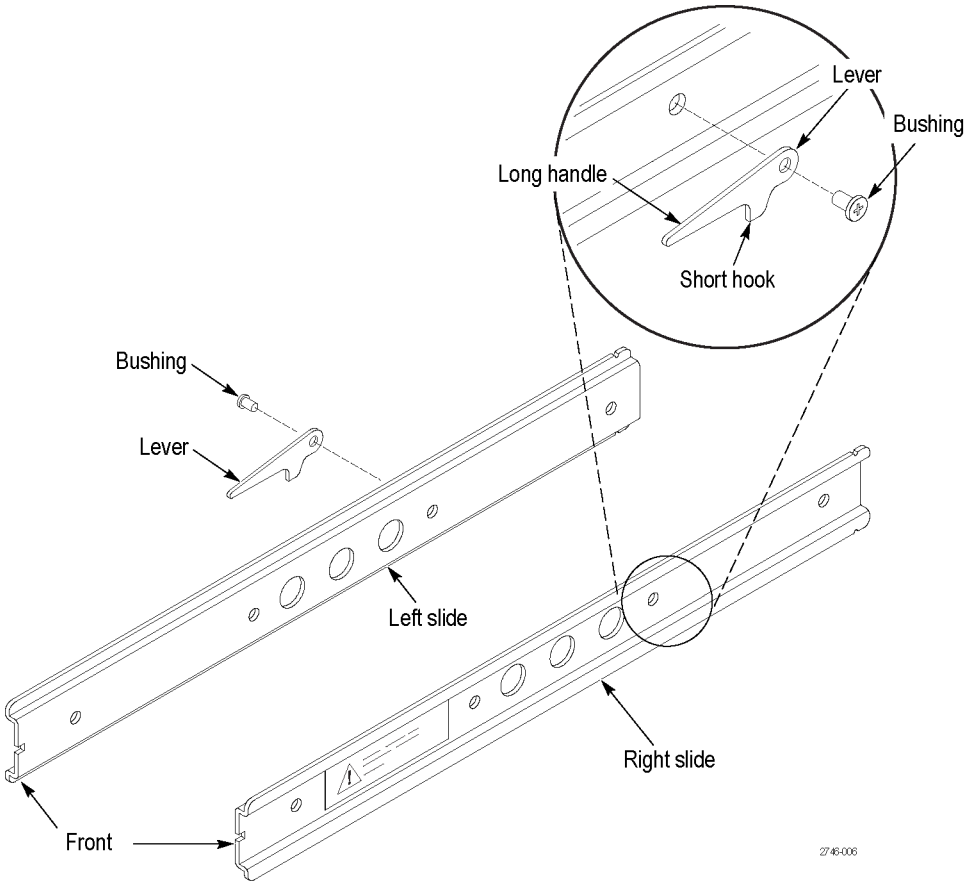


Figure 11: Attaching the slides (SPG8000 only)

Installing the rails

This two part procedure describes how to assemble and install the rails in the equipment rack.

Assembling the rails.

1. Measure the distance between the front and rear rail of the equipment rack.
2. Align the rear bracket to the right rail. Notice that the rear bracket has multiple pairs of mount-through holes. When aligning the bracket and rail, be sure to select a pair of holes that mount the rear bracket so that the flange-to-flange distance matches the front rail to rear rail spacing of the rackmount rack just measured in step 2. (See Figure 12.)
3. Using a screwdriver with a #2 Phillips tip, attach the rear bracket to the right rail using two 10-32 screws and a bar nut. Leave the screws loose so that you can adjust the overall length of the rail assembly in the rack.
4. Repeat this procedure to assemble the left rail assembly.

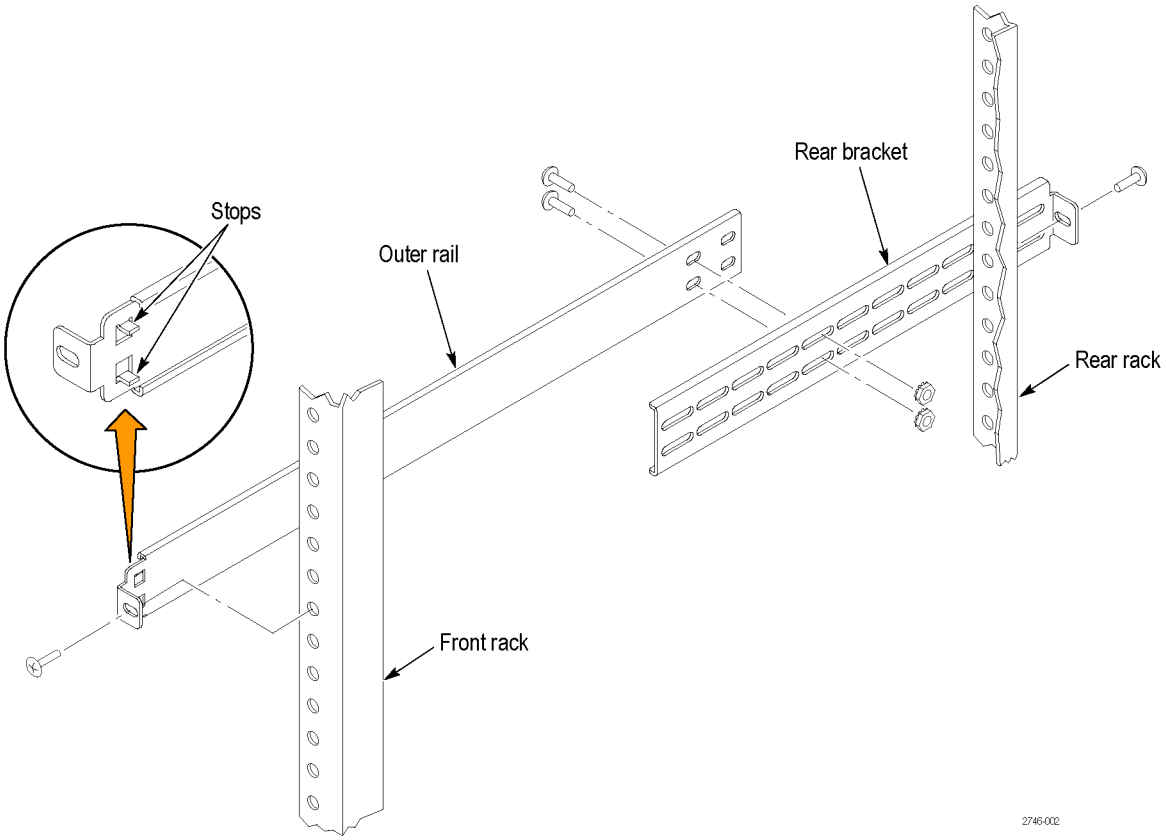


Figure 12: Assembly and mounting of rails

Mounting the rails.

1. Select a 1/2 inch spaced hole in the front rack.
2. Select the mounting method according to your rack type:
   - Mount the rails with their front and rear flanges outside the front and rear racks and add a bar nut to the installation only if the rails have untapped holes.
   - Mount the rails with their front and rear flanges inside the front and rear racks and add a bar nut. This mounting method assumes untapped holes.
3. Using the method and hardware determined from step 2, attach the right rail assembly to the equipment rack front and rear rails. The screws should be fully, but lightly, seated so that you can adjust the rack later.
4. Tighten the screws left loose when you assembled the rails, applying 28 inch-lbs of torque, to fix the front to rear flange spacing of the rail assembly.
5. Repeat this procedure to mount the left rail assembly.

Installing the instrument into the rack

This procedure describes how to install the instrument into the 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 13.)

NOTE. *Make sure to insert the instrument slides inside the inner rack rails. You may also need to tilt 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.

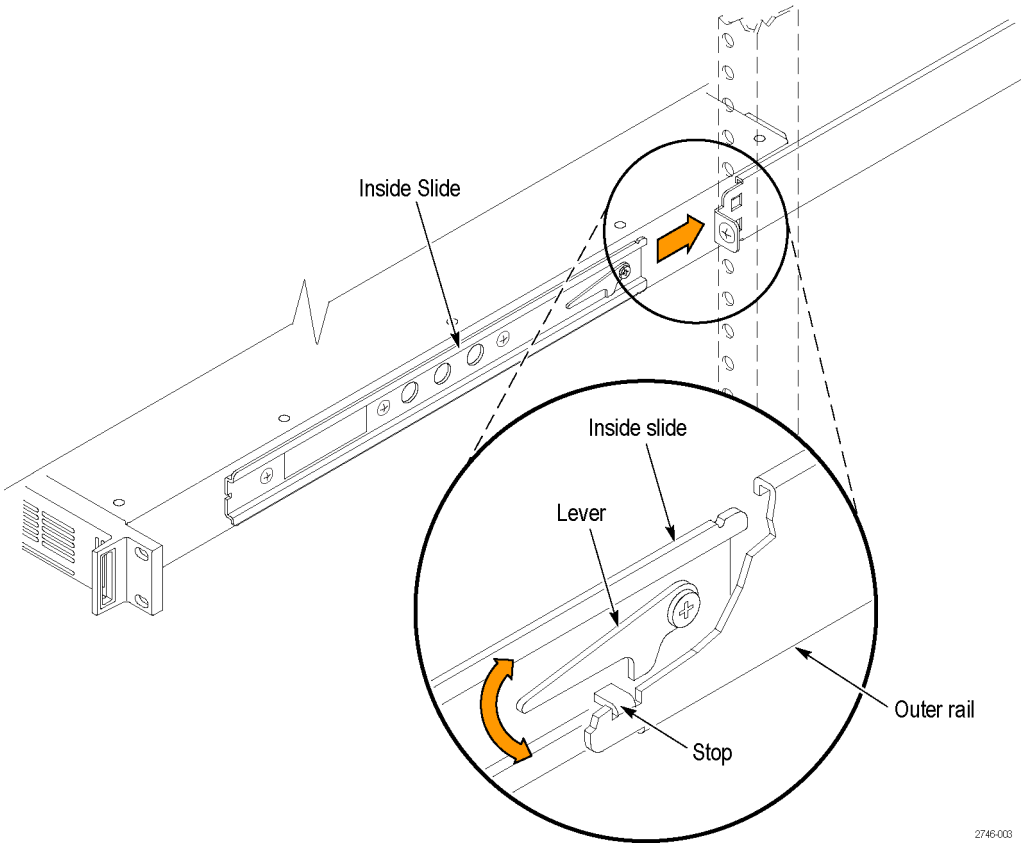


Figure 13: Installing or removing the instrument into or from the rack

Removing the instrument from the rack

This procedure describes how to remove the instrument from the 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 13.)
4. Pull the instrument past the stops and out of the rack.

Power and signal connectors

The following pages describe the power and signal connectors for each of the instruments supported by this document.

ECO8000 Series connectors

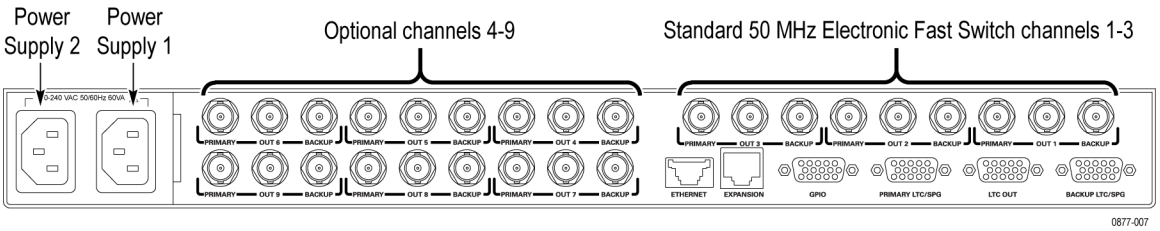


Figure 14: ECO8000 rear panel

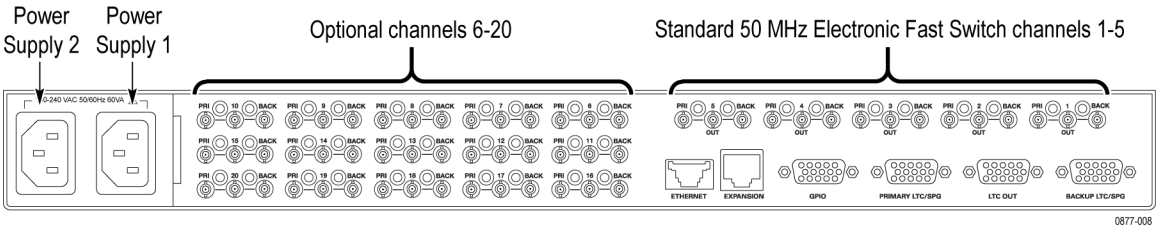


Figure 15: ECO8020 rear panel

Power connector(s)

Standard instruments are shipped with one Power Supply module installed in slot 1. If you ordered Option DPW, your instrument was shipped with two Power Supply modules installed.

The ECO8000 Series 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 ECO8000 Series operates from an AC line frequency of 50/60 Hz, over the range of 100 - 240 VAC (±10%), without the need for configuration.

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.

Procedures for powering the instrument on and off and for configuring one of the supplies to be the preferred (active) supply are provided later in this document.
(See page 79, *ECO8000 Series power on / power off*.)
(See page 99, *Configure the preferred (active) power supply (Option DPW only)*.)

Standard channel connectors

The standard channels are always 50 MHz Electronic Fast Switch channels. (See Figure 14.) (See Figure 15.) For the ECO8000 there are three standard channels; for the ECO8020 there are five standard channels.

Table 10: ECO8000 Series channel input ratings

Characteristic	Reference information
Maximum switched voltage	
Standard and Option REF 50 MHz Electronic Fast Switch channels	–3 V to +5 V
Option HREF 3 GHz Relay Switch channels	±2.5 V peak, 1.5 V RMS
Option LTC channels	±5 V
Maximum switched current (Option HREF only)	100 mA

Signal connectors. The signal connectors on the rear panel are arranged into a Primary input, a Backup input, and an Output for each installed channel. A general overview of the connectors for each channel is provided below.

- **Primary:** Signal input from the primary sync generator. The Primary signal should be the same signal type that is connected to the Backup input on the same channel.
- **Output:** Signal output, which is either from the Primary or Backup signal input.
- **Backup:** Signal input from the backup sync generator. The Backup signal should be the same signal type that is connected to the Primary input on the same channel.

Signal types. Various kinds of signals are best suited to certain channel types. Before you connect signals to the channel connectors, review the information in the *Signal connections* section of this document. (See page 54.)

Optional channel connectors

Each row of optional channels can be either of the following types. Use the CHANNEL menu to determine the type of channel installed in each optional channel row.

- Option REF 50 MHz Electronic Fast Switch channels
- Option HREF 3 GHz Relay Switch channels

The input ratings for the optional channels are listed on the previous page. (See Table 10.)

The ECO8000 can have up to two rows of optional channels. Each row provides three additional channels, allowing the ECO8000 to have a maximum of nine channels. (See Figure 14.)

The ECO8020 can have up to three rows of optional channels. Each row provides five additional channels, allowing the ECO8020 to have a maximum of 20 channels. (See Figure 15.)

Signal types. Various kinds of signals are best suited to certain channel types. Before you connect signals to the channel connectors, review the information in the *Signal connections* section of this document. (See page 54.)

Ethernet port

Standard 10/100 BASE-T Ethernet connector used for connecting the instrument to an Ethernet network. When connected to a network, you can use the Web User Interface to operate the instrument. (See page 117, *ECO8000 Series networking*.)

Expansion port

Standard Ethernet connector (with nonstandard signals) used for connecting multiple ECO8000 Series instrument together so that they function as one larger changeover unit. (See page 98, *Configure the Expansion port*.)

GPIO port

15-pin DSUB connector used to connect GPI signals to the ECO8000 Series units. The following table lists the signals and their function for each pin on the GPIO connector.

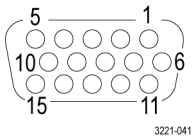


Table 11: GPIO port signal pinouts

Pin	Signal	Function
1	State – Primary Backup	Output – high if Primary is selected, low if Backup is selected
2	Primary fault	Output – goes low if a Primary fault is present
3	Backup fault	Output – goes low if a Backup fault is present
4	State – Manual Auto	Output – high if Manual mode is selected, low if Auto mode is selected
5	GND	Ground
6	Power fault	Output – goes low if a fault is present in the power subsystem as indicated by the AC or DC LEDs on the supplies
7	Manual mode	Input – drive this pin low to assert Manual mode (10 KΩ pull-up resistor)
8	Auto mode	Input – drive this pin low to assert Auto mode (10 KΩ pull-up resistor)
9	Fault reset	Input – drive this pin low to assert a fault reset (10 KΩ pull-up resistor)
10	Configurable fault	Output – goes low if any fault selected in the GPI EVENTS menu are present; also goes low during any watchdog reboot
11	GND	Ground
12		Not used
13	Primary select	Input – drive this pin low to select the Primary source (10 KΩ pull-up resistor)
14	Backup select	Input – drive this pin low to select the Backup source (10 KΩ pull-up resistor)
15		Not used

Primary and backup LTC/SPG ports

15-pin DSUB connectors used to connect LTC and GPI signals from Tektronix SPG8000 or TG8000 generators to the ECO8000 Series units.

NOTE. *The SPG Trigger signal on these connectors (pin 1) will operate even when Option LTC is not installed. The rest of the connector pin functions require Option LTC.*

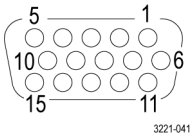


Table 12: LTC/SPG connector signal pinouts

Pin	Signal	Function
1	SPG trigger	Input – Used to receive a fault-condition trigger signal from the sync generator
2		Not used
3		Not used
4		Not used
5	LTC4–	Input – LTC4– signal
6	GND	Ground
7	LTC3–	Input – LTC3– signal
8	LTC2–	Input – LTC2– signal
9	GND	Ground
10	LTC1–	Input or output – LTC1– signal [1]
11		Not used
12	LTC3+	Input – LTC3+ signal
13	LTC2+	Input – LTC2+ signal
14	LTC1+	Input or output – LTC1+ signal [1]
15	LTC4+	Input – LTC4+ signal

[1] The LTC 1 channel can be configured as an input or output in the CHANNEL menu.

LTC OUT port

15-pin DSUB connector for connecting LTC signals. The LTC1 signal can be be configured as an input using the CHANNEL menu.

NOTE. *The SPG Trigger signals on this connector (pins 1 and 2) will operate even when Option LTC is not installed. The rest of the connector pin functions require Option LTC.*

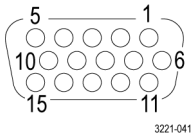


Table 13: LTC OUT connector signal pinouts

Pin	Signal	Function
1	Primary SPG trigger	Output – SPG trigger signal from the primary input
2	Backup SPG trigger	Output – SPG trigger signal from the backup input
3		Not used
4		Not used
5	LTC4–	Output – LTC4– signal
6	GND	Ground
7	LTC3–	Output – LTC3– signal
8	LTC2–	Output – LTC2– signal
9	GND	Ground
10	LTC1–	Output or input – LTC1– signal [1]
11		Not used
12	LTC3+	Output – LTC3+ signal
13	LTC2+	Output – LTC2+ signal
14	LTC1+	Output or input – LTC1+ signal [1]
15	LTC4+	Output – LTC4+ signal

[1] The LTC 1 channel can be configured as an input or output in the CHANNEL menu.

LTC1 input mode. If LTC1 is configured as an input, then an LTC signal applied the LTC output connector is connected to both the LTC Primary and Backup. This allows an LTC input to drive both the Primary and Backup SPG LTC inputs.

SPG trigger function. The SPG trigger function allows errors detected in the SPG to trigger a source switch in the ECO8000 Series. (See page 93, *Configure the SPG trigger input*.)

SPG8000 connectors

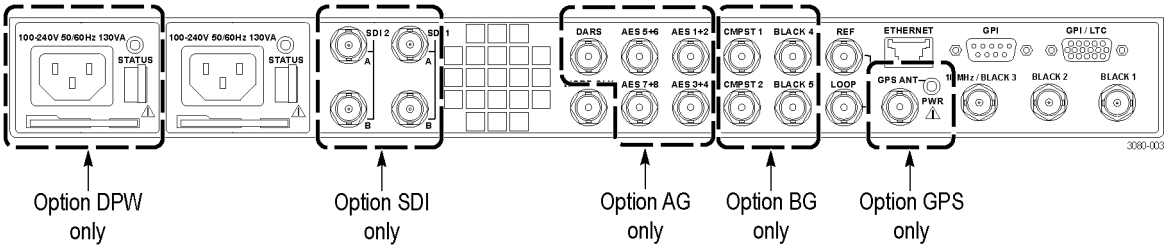


Figure 16: SPG8000 rear panel

Power connector

The standard instrument includes one Power Supply module. With Option DPW, a second hot-swappable redundant (backup) Power Supply module is installed.

The SPG8000 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 SPG8000 operates from an AC line frequency of 50/60 Hz, over the range of 100 - 240 VAC (±10%), without the need for configuration.

⚠ ***WARNING.*** *Injury or death can occur as the result of electrical shock. To avoid electrical shock, do not connect power to the SPG8000 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.

SDI 1/2 output connectors (Option SDI only)

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

NOTE. *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. See *SDI button menu diagram (Option SDI only)* in the SPG8000 *Quick Start User Manual*.
- **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. See *SDI button menu diagram (Option SDI only)* in the SPG8000 *Quick Start User Manual*.

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 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.

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.

NOTE. *You can use the menus to independently set the format and timing of the three black outputs and to enable VITC to be applied to the output signal.*

GPS/GLONASS antenna connector (Option GPS only)

Option GPS requires an external antenna to receive signals from satellites. You must set up an antenna system to provide the GPS and/or GLONASS signal as an input to the module. (See page 56, *GPS and GLONASS antenna installation*.)

Earlier versions of the GPS module in the SPG8000 include a receiver that can receive only GPS signals. Later versions of the GPS module include a receiver that can receive both GPS and GLONASS signals. If your module has the GPS/GLONASS receiver, use the REFERENCE menu to configure the module for the type of signal you are using. (See page 56, *How to determine which GPS receiver is installed in your SPG8000*.)

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 GPS7 module. 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 GPS to function.
- Displays solid green if the current load of the antenna is within the nominal range.

Ethernet Port

Use this port to connect to your local Ethernet network. You can control the SPG8000 mainframe and all installed modules remotely through the port. Also, you can upload and download various files such as signal files, logo files, and preset files through the port.

GPI port

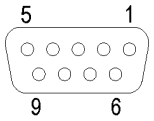
You can use the dedicated General Purpose Interface (GPI) port to perform the following tasks. See the *SPG8000 Quick Start User Manual* for details on the configuration and use of the GPI port.

- Recall preset 1 through 7 of the available 13 user-defined presets
- Output up to three alarm signals
- Trigger the instrument to reset the program time, reacquire the GPS postion (Option GPS only), or to force a jam sync

The GPI port is a 9 pin, D-sub connector that includes one ground closure input, three ground closure outputs, and three preset selection inputs. You can use the SYSTEM : GPI menu to configure the function of the ground closure input and outputs. The GPI alarm configuration applies to both the GPI port and the GPI/LTC port.

Table 14: GPI port – connector pin assignments

Pin #	Function
1	Ground
2	GPI out 1
3	GPI out 2
4	GPI input
5	+5 V (1 k source resistance, so very limited current)
6	GPI out 3
7	GPI preset select 3
8	GPI preset select 2
9	GPI preset select 1



GPI/LTC port

You can use the General Purpose Interface (GPI/LTC) port to perform the following tasks. See the *SPG8000 Quick Start User Manual* for details on the configuration and use of the GPI/LTC port.

- 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 postion (Option GPS only), or to force a jam sync

This is a 15 pin, D-sub connector that carries four differential LTC signals, one ground closure input, and two ground closure outputs. 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. The GPI alarm configuration applies to both the GPI port and the GPI/LTC port.

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

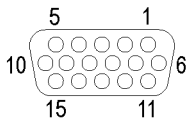
The GPI/LTC connector provides full functionality when you use the LTC DSUB-to-XLR breakout cable that is available as an optional accessory. The GPI/LTC connector provides partial functionality when you use a standard RGBHV (VGA-to-BNC) breakout cable. (See Table 15.)

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.

Table 15: 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	Blue BNC
4	No connection	
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	+5 V (1 k source resistance, so very limited current)	
12	LTC 3 positive	
13	LTC 2 positive	H BNC
14	LTC 1 positive	V BNC
15	LTC 4 positive	



TG8000 connectors

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

CAUTION. *If power is applied to the mainframe, be sure to terminate any unused outputs on any of the modules using 75 Ω terminators.*

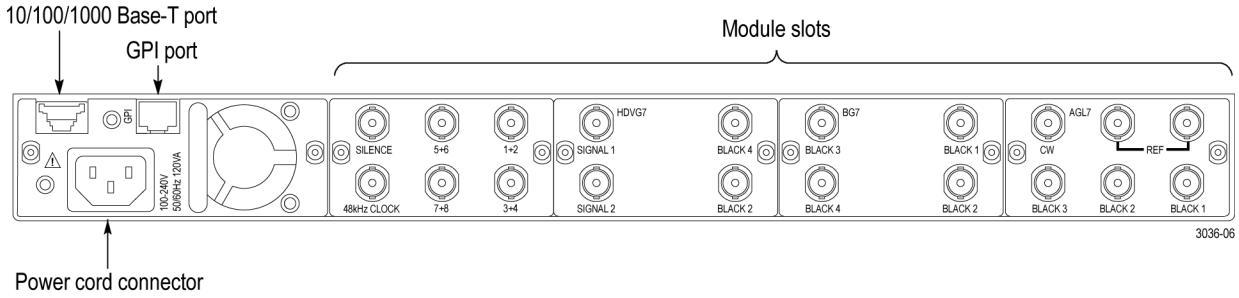


Figure 17: TG8000 rear panel

Power connector

The generator 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.

WARNING. *Injury or death can occur as the result of electrical shock. To avoid electrical shock, do not connect power to the generator when the top cover is off. Dangerous potentials are present on the Power circuit board.*

The generator operates from an AC line frequency, over the range of 100 - 240 VAC (±10%), without the need for configuration.

Power cords. Locking power cords are supplied with the TG8000 mainframe to prevent the cords from being easily disconnected.

10/100/1000 BASE-T port

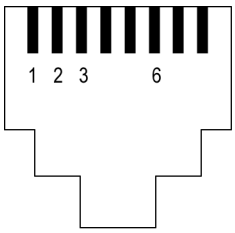
Use this port to connect to your local Ethernet network. You can control the generator mainframe and all installed modules remotely through the port. Also, you can upload and download various files such as signal files, logo files, and preset files through the port.

NOTE. *On the TG8000 mainframe the Ethernet port is 10/100/1000 BASE-T and there is a separate GPI port.*

General Purpose Interface (GPI) port

You can use the GPI port to recall one of the seven available instrument presets, output an alarm signal, and display an alarm status on the LCD.

The following figure shows the pin assignments of th. GPI connector. Use pins 1, 2, and 3 to input signals for recalling a preset. Use pin 4 to output 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.



GPI port

3036-075

Table 16: Pin assignments of the mainframe GPI connector

Pin number	Function	Level
1, 2, and 3	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
6	Output	Low < 0.4 V or ground (when sinking 100 ma; maximum on-resistance 4 Ω)

AG7 module connectors

The AG7 Audio Generator module is equipped with six BNC connectors as described below. (See Figure 18.)

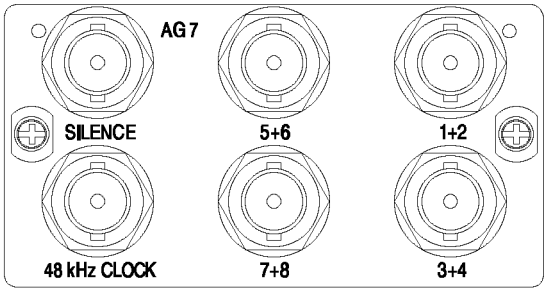


Figure 18: AG7 module connectors

- **1+2:** Outputs channels 1 and 2 of the selected AES/EBU serial digital audio signal.
- **3+4:** Outputs channels 3 and 4 of the selected AES/EBU serial digital audio signal.
- **5+6:** Outputs channels 5 and 6 of the selected AES/EBU serial digital audio signal.
- **7+8:** Outputs channels 7 and 8 of the selected AES/EBU serial digital audio signal.
- **SILENCE:** Outputs a silence signal (DAR signal).
- **48 kHz CLOCK:** Outputs a 48 kHz clock signal. The clock output level can be set as described below.

Setting the clock output level. Use jumper **J452** on the AG7 module to set the output level of the 48 kHz clock signal. (See Figure 19.)

Install the jumper on pins 3+4 of J452 (factory-default position) to set the clock output level to CMOS compatible. Install the jumper on pins 1+2 of J452 to set the clock output level to 1V.

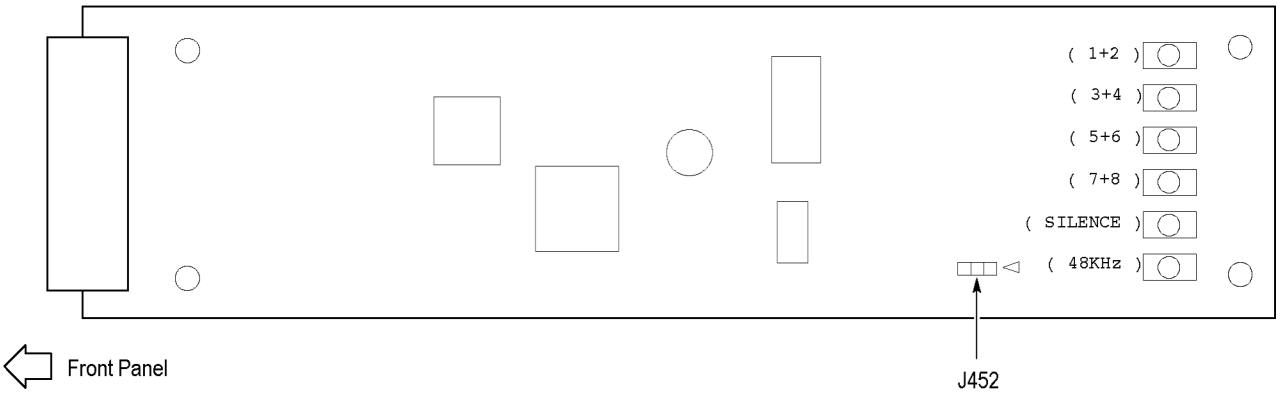


Figure 19: Location of J452 on the AG7 module

AGL7 module connectors

The AGL7 Analog Genlock module is equipped with six BNC connectors as described below. (See Figure 20.)

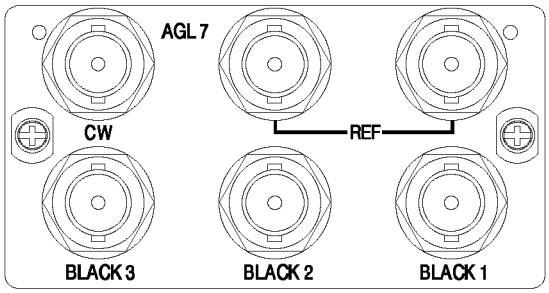


Figure 20: AGL7 module connectors

- **REF**: Input loopthrough connectors for an external reference signal, which can be NTSC/PAL black burst or HDTV trilevel sync signals. The signal input requires proper external termination.
- **CW**: Internally terminated input connector for CW (Continuous Wave) signals: 1, 3.58, 4.43, 5, and 10 MHz.

  You can configure the CW connector to output a 48 kHz word clock signal: (See page 42, *Changing the input/output configuration*.)
- **BLACK 1:** Outputs the selected black burst signal.

NOTE. *You cannot output HDTV trilevel sync signals from the BLACK 1 connector.*

- **BLACK 2:** Outputs the selected black burst or HDTV trilevel sync signal.
- **BLACK 3:** Outputs the selected black burst signal or HDTV trilevel sync signal.

Alarm output. When the mainframe GPI interface is enabled, you can configure the BLACK 1, BLACK 2, or BLACK 3 connector to output an alarm. When an alarm condition is detected, the output signal from the selected connector turns off for about 60 ms.

The AGL7 module alarm output is available only when the mainframe GPI is enabled and the GPI ALARM OUTPUT menu item is set to Enable.

Changing the input/output configuration. The CW connector is configured at the factory to be an input for CW signals. You can reconfigure the connector to output a 48 kHz word clock signal by changing the position of an internal cable.

CAUTION. *To prevent damage to the mainframe and the module, be sure to disconnect the power cord before removing the module.*

To output a 48 kHz word clock signal from the CW connector:

1. Disconnect the coaxial cable from the connector labeled **J040** on the AGL7 module. (See Figure 21.)
2. Reconnect the cable to the connector labeled **J960** on the AGL7 module.
3. Place the **48 kHz CLOCK** label provided with the module on the rear panel below the CW connector.

NOTE. *The word clock signal automatically follows the format of the Black 1 signal.*

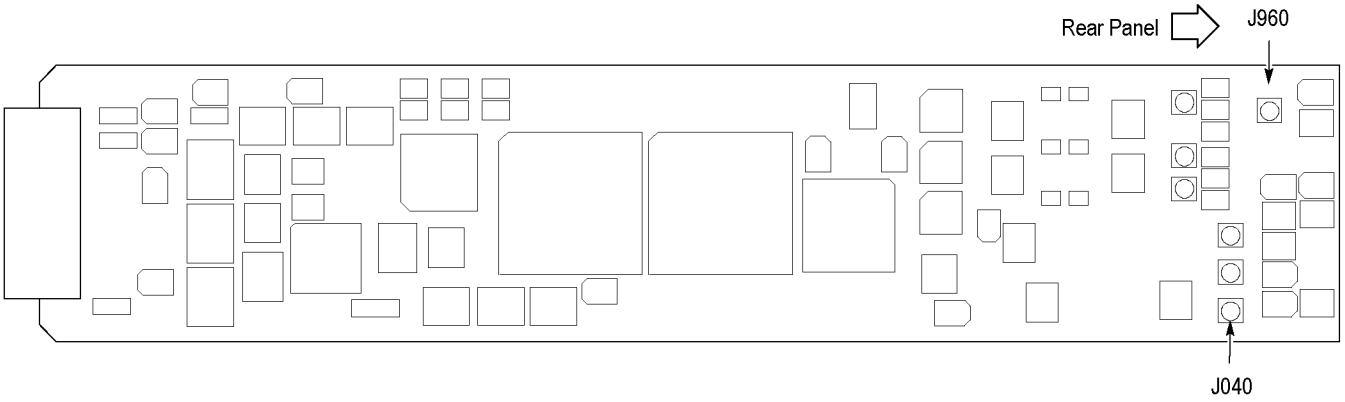


Figure 21: Location of J040 and J960 on the AGL7 module

ATG7 module connectors

The ATG7 Analog Test Generator module is equipped with four BNC connectors as described below. (See Figure 22.)

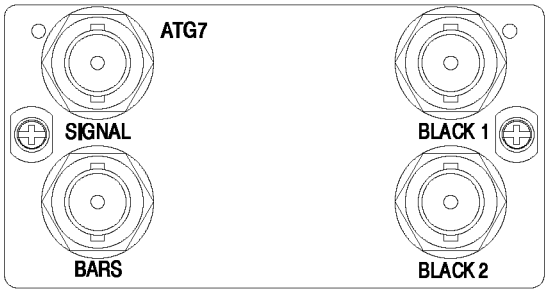


Figure 22: ATG7 module connectors

- **BLACK 1:** Outputs the selected black burst, timing pulse, or subcarrier signal.
- **BLACK 2:** Outputs the selected black burst, timing pulse, or subcarrier signal.
- **SIGNAL:** Outputs the signal selected using the front-panel test signal buttons.
- **BARS:** Outputs the selected black burst or color bars signal.

AVG7 module connectors

The AVG7 Analog Video Generator module is equipped with three pairs of BNC connectors as described below. (See Figure 23.)

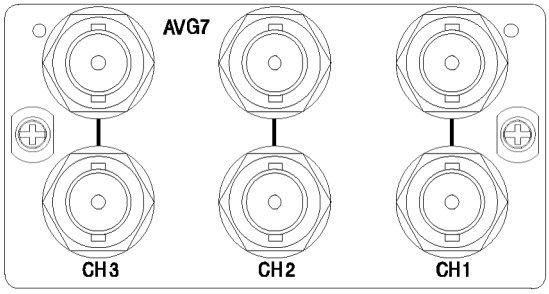


Figure 23: AVG7 module connectors

NOTE. *Each pair of connectors (CH 1, CH 2, and CH 3) output the same signal.*

- **CH 1:** Outputs the selected analog component or composite video signal.
- **CH 2:** Outputs the selected analog component or composite video signal.
- **CH 3:** Outputs the selected analog component or composite video signal.

AWVG7 module connectors

The AWVG7 Analog Wideband Video Generator module is equipped with three pairs of BNC connectors as described below. (See Figure 24.)

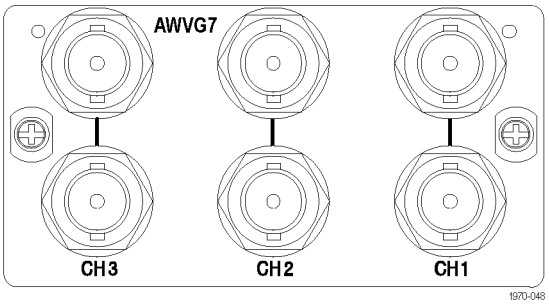


Figure 24: AWVG7 module connectors

NOTE. *Each pair of connectors (CH 1, CH 2, and CH 3) output the same signal.*

- **CH 1:** Outputs the selected analog component video signal.
- **CH 2:** Outputs the selected analog component video signal.
- **CH 3:** Outputs the selected analog component video signal.

BG7 module connectors

The BG7 Black Generator module is equipped with four BNC connectors as described below. (See Figure 25.)

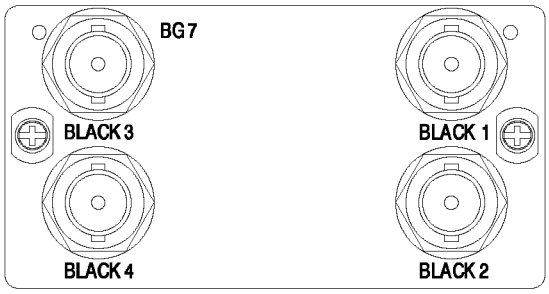


Figure 25: BG7 module connectors

- **BLACK 1:** Outputs the selected black burst or HDTV trilevel sync signal.
- **BLACK 2:** Outputs the selected black burst or HDTV trilevel sync signal.
- **BLACK 3:** Outputs the selected black burst or HDTV trilevel sync signal. Option CB enables this connector to also output a 10 field ID or color bars signal.
- **BLACK 4:** Outputs the selected black burst or HDTV trilevel sync signal output. Option CB enables this connector to also output a 10 field ID or color bars signal.

DVG7 module connectors

The standard DVG7 Digital Video Generator module is equipped with two BNC connectors to output serial digital video signals. Option BK adds two additional BNC connectors to output serial digital black signals. (See Figure 26.)

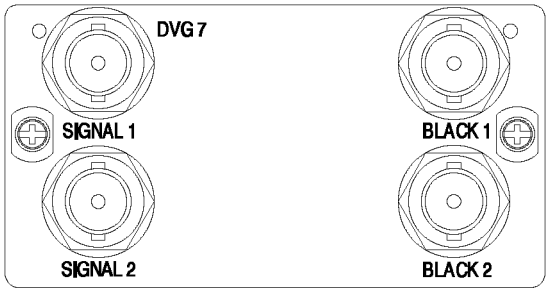


Figure 26: DVG7 module connectors (Option BK)

- **SIGNAL 1:** Outputs the selected serial digital video signal.
- **SIGNAL 2:** Outputs the selected serial digital video signal.
- **BLACK 1:** Outputs the selected serial digital black signal (Option BK only).
- **BLACK 2:** Outputs the selected serial digital black signal (Option BK only).

NOTE. *The SIGNAL 1 and SIGNAL 2 connectors output the same test signal, and the BLACK 1 and BLACK 2 connectors output the same black signal.*

GPS7 module connectors

The GPS7 GPS Synchronization and Timecode module is equipped with four BNC connectors and one 15-pin, D-sub connector as described below. (See Figure 27.)

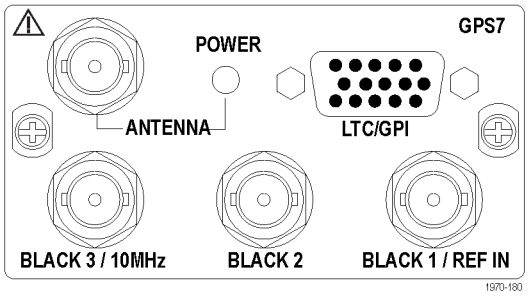


Figure 27: GPS7 module connectors

- **ANTENNA:** Input connector for a GPS antenna. The GPS7 module requires an external antenna to receive signals from satellites. You must set up an antenna system to provide the GPS signal as an input to the module. (See page 56, *GPS and GLONASS antenna installation*.)

  You can use the GPS7 module 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 POWER indicator lights as follows:

  - Blinks green to indicate an open circuit. This occurs if no antenna is connected or if the current load is less than expected because a splitter or DC block is being used.
  - Displays solid red if the connected antenna is shorted. A shorted antenna will not damage the GPS7 module. 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 GPS to function.
  - Displays solid green if the current load of the antenna is within the nominal range.

- **LTC/GPI:** 15 pin, D-sub connector that carries four differential LTC signals, one ground closure input, and two ground closure outputs. You can use the menus to independently set the format and timing of the four LTC signals and to select the function of the ground closure input and outputs.

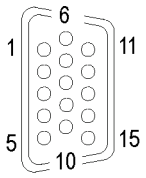
  The LTC/GPI connector provides full functionality when you use the LTC DSUB-to-XLR breakout cable that is available as an optional accessory with the GPS7 module. The LTC/GPI connector provides partial functionality when you use a standard RGBHV (VGA-to-BNC) breakout cable. (See Table 17.)

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.

Table 17: GPS7 module LTC/GPI connector pin assignments

Pin #	Function	VGA cable
1	GP01	Red BNC
2	GP02	Green BNC
3	GPI	Blue BNC
4	No connection	
5	LTC4N	
6	Ground	Ground
7	LTC3N	Ground
8	LTC2N	Ground
9	No connection	
10	LTC1N	Ground
11	No connection	
12	LTC3P	
13	LTC2P	H BNC
14	LTC1P	V BNC
15	LTC4P	



- **BLACK 1 / REF IN:** Outputs the selected black burst or HDTV trilevel sync signal. You can also configure this connector to receive analog video signals for use as a Genlock reference. (Earlier GPS7 modules do not have the reference input capability. On these modules, the connector is labeled BLACK 1.)
- **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.
- **BLACK 3 / 10 MHz:** Outputs the selected black burst or HDTV trilevel sync signal. You can also configure this connector to output a 10 MHz sine wave. (This connector is labeled 10 MHz / BLACK 3 on earlier GPS7 modules.)

NOTE. *You can use the menus to independently set the format and timing of the three black outputs and to enable VITC to be applied to the output signal.*

HD3G7 module connectors

The HD3G7 3 Gb/s SDI Video Generator module provides four BNC connectors as described below. (See Figure 28.)

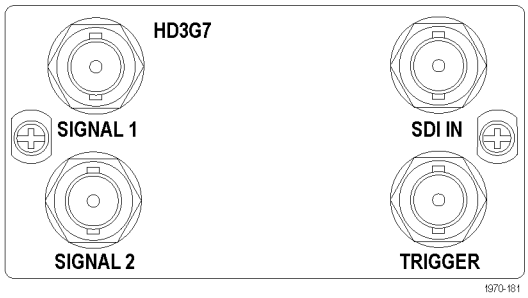


Figure 28: HD3G7 module connectors

- **SIGNAL 1:** Outputs the selected HD-SDI serial digital video test signal or an upconverted version of the input signal on the SDI IN connector.
- **SIGNAL 2:** The Signal 2 output can be configured to output a test pattern, where it produces the same output as the Signal 1 output, or to output a Black signal in the same format as the Signal 1 output.
- **SDI IN:** Input connector for an HD-SDI (4:2:2) video signal that you want to be upconverted.
- **TRIGGER:** Outputs a selected signal. The available choices for output are: system clock (148.5 MHz), frame/field pulse (once per video frame or field), or a line pulse (once per video line).

  When an interlaced format is selected, the frame/field pulse selection produces a frame-rate square wave trigger output which is low during field one and high during field two. The frame pulse selection produces the once per field pulse for all other formats.

NOTE. *When the SECONDARY OUTPUT selection is set to Test Pattern the SIGNAL 1 and SIGNAL 2 connectors output the same test signal.*

HDLG7 module connectors

The HDLG7 HD Dual Link Video Generator is equipped with five BNC connectors as described below. (See Figure 29.)

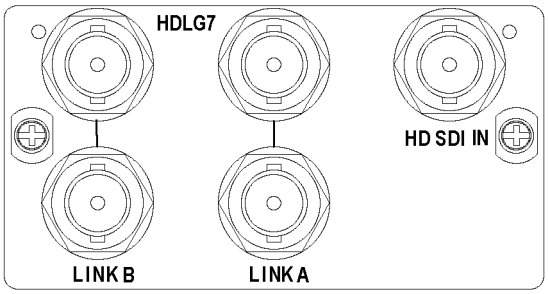


Figure 29: HDLG7 module connectors

- **HD SDI IN:** Input connector for an HD-SDI (4:2:2) video signal that you want to be upconverted.

NOTE. *Each pair of connectors (LINK A and LINK B) output the same signal.*

- **LINK A:** Outputs the selected HD-SDI dual-link video test signal or an upconverted version of the signal on the HD SDI IN connector.
- **LINK B:** Outputs the selected HD-SDI dual-link video test signal or an upconverted version of the signal on the HD SDI IN connector.

HDVG7 module connectors

The standard HDVG7 Digital Video Generator module is equipped with two BNC connectors to output serial digital video signals. Option BK adds two additional BNC connectors to output serial digital black signals. (See Figure 30.)

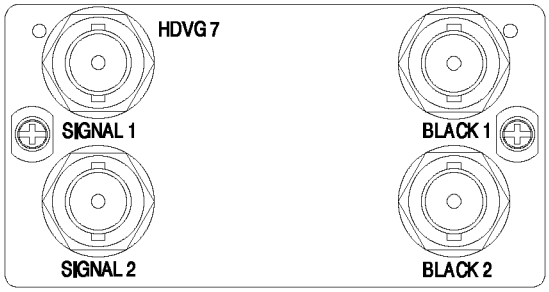


Figure 30: HDVG7 module connectors (Option BK)

NOTE. *The SIGNAL 1 and SIGNAL 2 connectors output the same test signal, and the BLACK 1 and BLACK 2 connectors output the same black signal.*

- **SIGNAL 1:** Outputs the selected serial digital video signal.
- **SIGNAL 2:** Outputs the selected serial digital video signal.
- **BLACK 1:** Outputs the selected serial digital black signal (Option BK only).
- **BLACK 2:** Outputs the selected serial digital black signal (Option BK only).

SDI7 module connectors

The SDI7 2 Channel SD/HD 3 Gb/s SDI Video Generator module provides five BNC connectors as described below. (See Figure 31.)

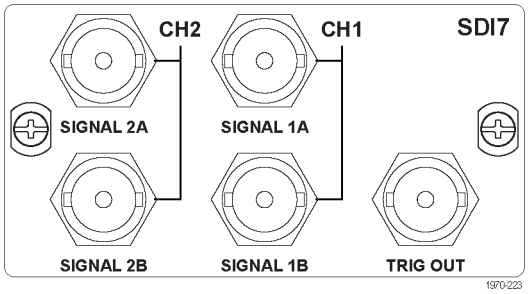


Figure 31: SDI7 module connectors

NOTE. *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.
- **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.

- **TRIG OUT:** This output can be configured to output one of the following signals: system clock (148.5 MHz), frame/field pulse (once per video frame or field), line pulse (once per video line), or pixel clock.

  When an interlaced format is selected, the frame/field pulse selection produces a frame-rate square wave trigger output which is low during field one and high during field two. The frame pulse selection produces the once per field pulse for all other formats.

  The rate of the pixel clock depends on the signal format of the selected trigger source (channel 1 or channel 2):

  - 27 MHz for SD formats
  - 74.25 or 74.18 MHz for HD formats and most 3G formats (where 74.25 MHz is for integer frame rates and 74.18 MHz is for non-integer frame rates such as 59.94, 29.97, and 23.98 fps)
  - (Option 3G only) 148.5 MHz for signal formats such as 50p and 60p; 148.35 MHz for signal formats such as 59.94p.

Video system installation

This section provides illustrations showing examples or how to connect signals from the signal generators to the ECO8000 Series Automatic Changeover Unit.

System considerations

Using identical sync sources

It is recommended that the primary and backup sync sources be identically configured. If the two sync source generators have significantly different configurations, it may cause a source switch when both of the sync sources lose power.

To understand this, consider the following scenario. If power is cut to both of the sync sources, the sync signals will fail as the power supples on the generators turn off. If the signal output from one of the sync generators is maintained longer, then the ECO8000 Series may detect one input as good and the other as bad and switch to the “good” sync source.

This might happen if the backup sync generator has only a few black outputs, but the primary sync generator has many blacks, audio and SDI signal outputs. The difference in the number of outputs loading the power supplies will make the primary sync generator turn off faster. This causes the ECO8000 Series to detect the primary source as failed while the backup is still working, resulting in a source switch.

The ECO8000 Series detects the loss of AC power and inhibits source switching to mitigate this issue. However, it can still occur in extreme cases. If it is necessary to have differently configured sync generators on the primary and backup inputs, it is recommended that you thoroughly test the loss of power condition during the system qualification testing.

Using the Expansion port to gang two ECOs

The ECO8000 Series has the ability to connect two instruments so that they function as a single larger switch. This function is useful in situations where more channels are needed than can be supported using only one instrument. One instrument operates as a master unit and the other as a slave unit.

A slave unit may change state if the master unit is changed from master to disabled or if the interconnection cable is removed. It is recommended that you configure the master and slave units during system setup and that you not change the configuration while the instrument is in operation. To help enforce this recommendation, the ECO8000 Series must be in Manual mode before you can change the state of the expansion port. (See page 98, *Configure the Expansion port*.)

Testing the backup source

Tektronix recommends that you test the backup sync source every 6 months. The ECO8000 Series keeps track of the last time the source was changed from primary to backup and visa-versa. If it has been more that 6 months since a source switch, then an event will be entered in the Event Log. You can also configure any of the reporting methods (SNMP trap, e-mail, GPI signal, instrument beeper) to generate an output when the backup test is due.

Signal connections

Before you connect signals to the ECO8000 Series, create a table similar to the one shown below so that you can plan which signals need to connect to which channels on the instrument.

Table 18: Example plan for connecting signals to an ECO8000

Channel	Channel type	Signal source	Destination	Signal format	Notes
1	REF (ELSW)	Black 1	Studio 1	NTSC	
2	REF (ELSW)	Black 2	Studio 2	PAL	
3	REF (ELSW)	Black 3	Basement	1080i59	
4	REF (ELSW)	Black 4	MC Tri	1080i50	
5	REF (ELSW)	Black 5	Truck 1	1080i60	
6	REF (ELSW)	Word Clock	MC WC	5 V	
7	HREF (Relay)	Silence	Sound room	AES	2.5, 2.3 dB
8	HREF (Relay)	SDI 1	MC SD BARS	SD 525	
9	HREF (Relay)	SDI 2	MC HD BARS	HD 1080i59	
LTC1	LTC	0.5 V	MC LTC	30 DF	
LTC2	LTC	1 V	Studio 1 LTC	30 DF	4 dB
LTC3	LTC	2 V	Studio 2 LTC	25 FPS	
LTC4	LTC	5 V	Basement LTC	30 DF	
SPG trigger		Loss of lock, hardware error			

Signal types

Depending on the channel type, the standard input signal can be PAL black burst, NTSC black burst, analog trilevel sync, SDI video, serial digital audio or word clock. The preset source-switching threshold settings support these types of input signals.

However, almost any type of signal can pass through the unit (within the bandwidth and voltage/current limitations). When connecting nonstandard signals, you can set custom source-switching threshold settings to support the desired level of source switching.

Channel type connection guidelines

When connecting signals to the instrument, use the following guidelines:

- Use REF (ELSW) channels to connect non-SDI signals
- Use HREF (Relay) channels to connect SDI signals

You can connect non-SDI signals to HREF (Relay) channels. However, there will be a sync interruption when primary/backup source switches occur.

Recommended tools

The ECO8000 uses standard BNC connectors; the ECO8020 uses HD BNC connectors. Due to the tight spacing between connectors, it is recommended that you use a BNC installation/removal tool to connect or disconnect cables on these connectors. Listed below are sources where you can obtain these tools.

Instrument	Manufacturer	Part number
ECO8000	Trompeter	RT-1L
ECO8020	Amphenol® RF (www.amphenolrf.com)	227–T2000

GPS and GLONASS antenna installation

The following pages describe the requirements of the antenna system for SPG8000 generators with Option GPS and for TG8000 generators with a GPS7 module installed.

The TG8000 GPS7 module requires a signal from a GPS antenna. Depending on the type of GPS receiver in the SPG8000, a GPS and/or GLONASS signal is required. (See page 56, *How to determine which GPS receiver is installed in your SPG8000*.)

NOTE. *SPG8000 generators with Option GPS and TG8000 generators with a GPS7 module installed require an RF signal from the antenna. If your installation optically isolates the antenna feed, you will need to obtain a GPS RF-to-Optical and a Optical-to-GPS RF converter in order to apply a RF signal to the antenna input on the generators.*

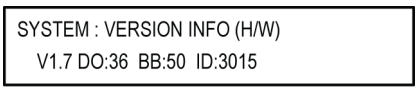
SPG8000 GPS receiver types

Earlier versions of the GPS module in the SPG8000 include a receiver that can receive only GPS signals. Later versions of the GPS module include a receiver that can receive both GPS and GLONASS signals. If your module has the GPS/GLONASS receiver, use the REFERENCE menu to configure the module for the type of signal you are using.

How to determine which GPS receiver is installed in your SPG8000.

NOTE. *Firmware version 1.5 or above must be installed in the instrument in order to view the GPS receiver type readout.*

1. Press the **SYSTEM** button to access the SYSTEM menu.
2. Use the up (▲) or down (▼) arrow button to select **SYSTEM : VERSION INFO (H/W)**.
3. Use the left (◄) or right (►) arrow button to select the version display with the **ID** field on the second line of the display as shown below.



3080-066

- If the ID value is **3015**, then the later GPS receiver is installed that can receive GPS and GLONASS signals.
- If the ID value is **3002**, then the earlier GPS receiver is installed that can receive only GPS signals.

SPG8000ANT GPS antenna

If you ordered SPG8000ANT from Tektronix, you received a GPS rooftop antenna (5.0 VDC, 1575 MHz range signals, F connector) for GPS signals that works with the integrated internal GPS receiver of a SPG8000 with Option GPS installed or with a TG8000 GPS7 module.

Antenna requirements

The SPG8000 and the TG8000 GPS7 module require an external antenna to receive signals from satellites. You must set up an antenna system to provide the GPS or GLONASS signal as an input to the module. You can configure the instrument to provide 3.3 V or 5 V DC power for the antenna.

The SPG8000 and the TG8000 GPS7 module require an RF signal from the antenna. If your facility uses an optical GPS signal, you will need to use an optical-to-RF converter to provide an RF signal to the SPG8000 and the TG8000 GPS7 module.

WARNING. *Prevent risk of shock or fire by ensuring that the GPS or GLONASS antenna is protected from lightning strikes when it is mounted outside a building or facility. The SPG8000 generator and the GPS7 module and the generator mainframe do not have isolation protection from lightning, so the facility installation must provide suitable protection for the antenna external to the generator mainframe. 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.

When a GPS or GLONASS feed is first connected to the antenna input on the module, it can take several minutes for the signal quality to reach its nominal potential. How long that takes depends on variables such 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. (See Figure 32.)

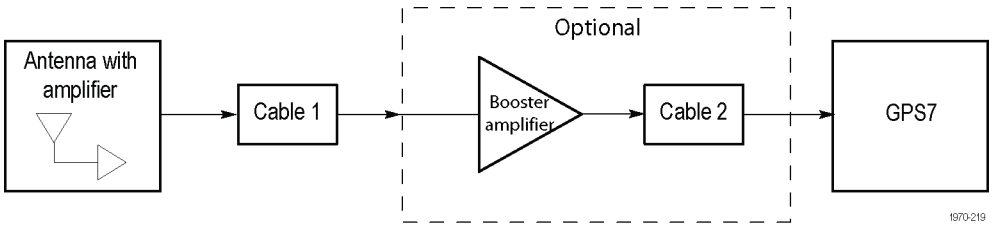


Figure 32: Simplified GPS or GLONASS antenna system

A GPS 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 SPG8000 generator. 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 32.)

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 32.)

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 antenna 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 SPG8000 and the TG8000 GPS7 module provide 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 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 GPS7, 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 GPS7 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 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 lightening 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.

SPG8000 SD/HD/3G system installation

The following pages describe example system connections for the following installations:

- ECO8000 and SPG8000 with Option GPS
- ECO8000 and SPG8000 without Option GPS
- ECO8020 and SPG8000 with Option GPS
- ECO8020 and SPG8000 without Option GPS

ECO8000 and SPG8000 with Option GPS system installation

The following illustration shows how to connect an ECO8000 and two SPG8000's with Option GPS for an SD/HD/3G video system. This system will occupy 3RU in an equipment rack.

SPG8000 inputs. The following SPG8000 inputs are available. The example signal connections illustration uses a GPS signal reference input.

- A reference signal from a GPS or GLONASS antenna (See page 56, *How to determine which GPS receiver is installed in your SPG8000*.)
- An LTC signal can be connected to the GPI/LTC connector
- A reference signal from the system Master Clock (NTSC, PAL, or tri-level sysnc) can be connected to the REF loopthrough connector
- A 10 MHz CW signal can be connected to the REF loopthrough connector

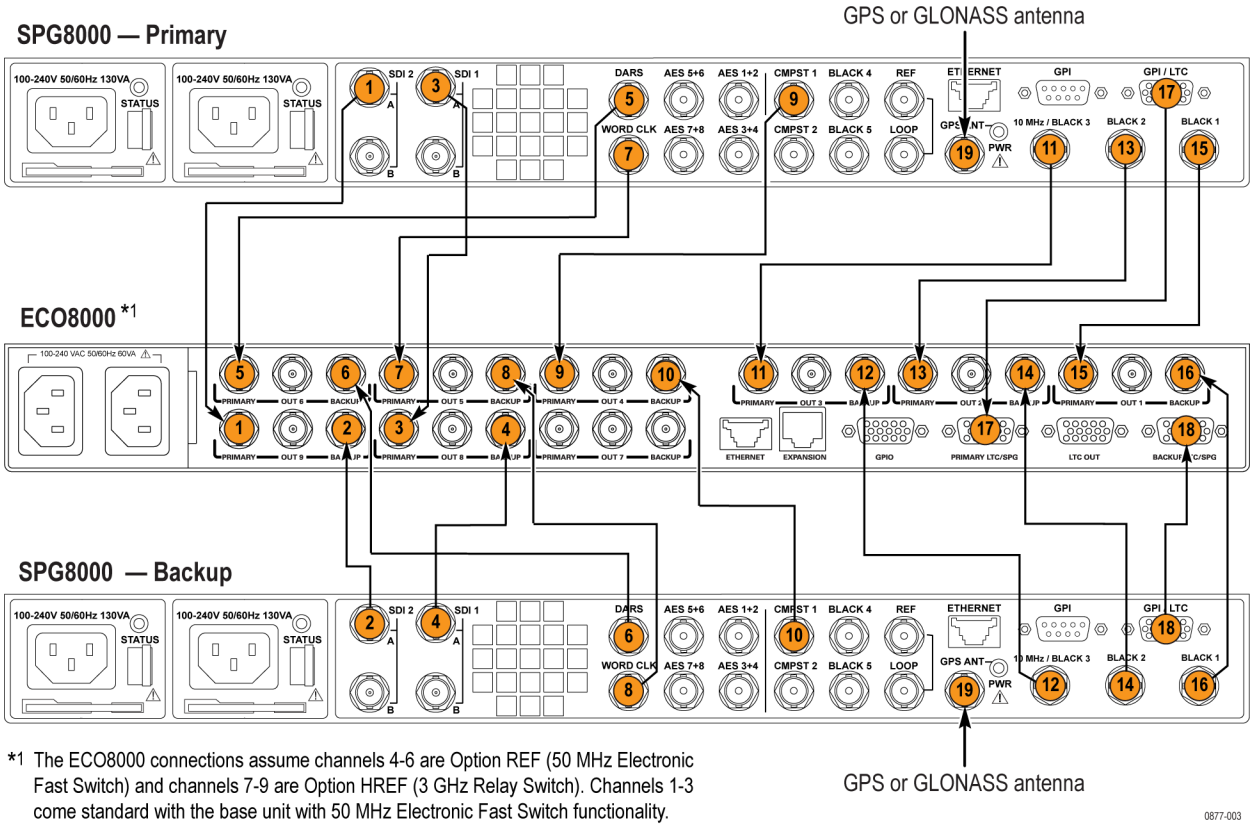
SPG8000 outputs. The following SPG8000 outputs are available (depending on installed options):

- Five bi-level or tri-level black syncs
- Two composite or Black syncs
- Four LTC
- One Word Clock
- Four SDI test signals supporting SD, HD, and 3 Gb/s formats
- Four AES/EBU audio pairs on BNC
- One DARS audio reference on BNC

ECO8000 channel types. This example system assumes that channels 4-6 are Option REF (50 MHz ELSW) and channels 7-9 are Option HREF (3 GHz Relay). Channels 1-3 come standard as Option REF (50 MHz ELSW).

ECO8000 outputs. The output connections from the ECO8000 are not shown. The ECO8000 outputs need to connect to the appropriate place in your video system.

Example system diagram. The following diagram and table show an example of how to connect two SPG8000's with Option GPS and an ECO8000 Series for an SD/HD/3G video system.



*1 The ECO8000 connections assume channels 4-6 are Option REF (50 MHz Electronic Fast Switch) and channels 7-9 are Option HREF (3 GHz Relay Switch). Channels 1-3 come standard with the base unit with 50 MHz Electronic Fast Switch functionality.

Figure 33: System connections example for ECO8000 and SPG8000 with Option GPS

Table 19: System connections example for ECO8000 and SPG8000 with Option GPS

Connection number (See Figure 33.)	External signal	SPG8000 primary connector	SPG8000 backup connector	ECO8000 connector	ECO8000 channel type
1		SDI 2		PRIMARY 9	HREF (Relay)
2			SDI 2	BACKUP 9	HREF (Relay)
3		SDI 1		PRIMARY 8	HREF (Relay)
4			SDI 1	BACKUP 8	HREF (Relay)
5		DARS		PRIMARY 6	REF (ELSW)
6			DARS	BACKUP 6	REF (ELSW)
7		WORD CLK		PRIMARY 5	REF (ELSW)
8			WORD CLK	BACKUP 5	REF (ELSW)
9		CMPST 1		PRIMARY 4	REF (ELSW)
10			CMPST 1	BACKUP 4	REF (ELSW)
11		10 MHz/ BLACK 3		PRIMARY 3	REF (ELSW)
12			10 MHz/ BLACK 3	BACKUP 3	REF (ELSW)
13		BLACK 2		PRIMARY 2	REF (ELSW)
14			BLACK 2	BACKUP 2	REF (ELSW)
15		BLACK 1		PRIMARY 1	REF (ELSW)
16			BLACK 1	BACKUP 1	REF (ELSW)
17		GPI/LTC		PRIMARY LTC/SPG	LTC
18			GPI/LTC	BACKUP LTC/SPG	LTC
19	GPS and/or GLONASS [1]	GPS ANT	GPS ANT		

[1] Earlier versions of the Option GPS module in the SPG8000 include a receiver that can receive only GPS signals. Later versions of the GPS module include a receiver that can receive both GPS and GLONASS signals. (See page 56, *How to determine which GPS receiver is installed in your SPG8000*.)

ECO8000 and SPG8000 without Option GPS system installation

The following illustration shows how to connect an ECO8000 and two SPG8000's without Option GPS for an SD/HD/3G video system. This system will occupy 3RU in an equipment rack.

SPG8000 inputs. The following SPG8000 inputs are available. The example signal connections illustration uses a Master Clock reference input.

- An LTC signal can be connected to the GPI/LTC connector
- A reference signal from the system Master Clock (NTSC, PAL, or tri-level sysnc) can be connected to the REF loopthrough connector
- A 10 MHz CW signal can be connected to the REF loopthrough connector

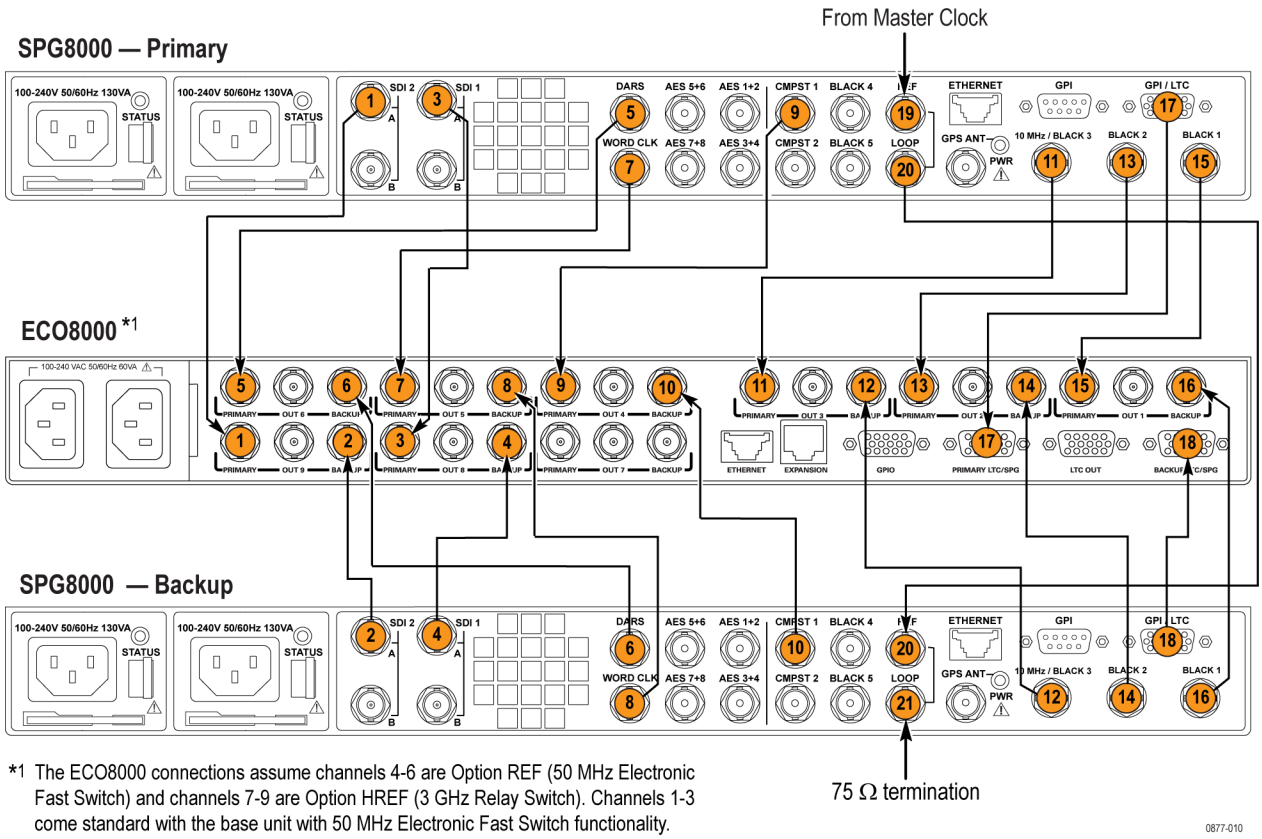
SPG8000 outputs. The following SPG8000 outputs are available (depending on installed options):

- Five bi-level or tri-level black syncs
- Two composite or Black syncs
- Four LTC
- One Word Clock
- Four SDI test signals supporting SD, HD, and 3 Gb/s formats
- Four AES/EBU audio pairs on BNC
- One DARS audio reference on BNC

ECO8000 channel types. This example system assumes that channels 4-6 are Option REF (50 MHz ELSW) and channels 7-9 are Option HREF (3 GHz Relay). Channels 1-3 come standard as Option REF (50 MHz ELSW).

ECO8000 outputs. The output connections from the ECO8000 are not shown. The ECO8000 outputs need to connect to the appropriate place in your video system.

Example system diagram. The following diagram and table show an example of how to connect two SPG8000's without Option GPS and an ECO8000 Series for an SD/HD/3G video system.



*1 The ECO8000 connections assume channels 4-6 are Option REF (50 MHz Electronic Fast Switch) and channels 7-9 are Option HREF (3 GHz Relay Switch). Channels 1-3 come standard with the base unit with 50 MHz Electronic Fast Switch functionality.

Figure 34: System connections example for ECO8000 and SPG8000 without Option GPS

Table 20: System connections example for ECO8000 and SPG8000 without Option GPS

Connection number (See Figure 34.)	External signal	SPG8000 primary connector	SPG8000 backup connector	ECO8000 connector	ECO8000 channel type
1		SDI 2		PRIMARY 9	HREF (Relay)
2			SDI 2	BACKUP 9	HREF (Relay)
3		SDI 1		PRIMARY 8	HREF (Relay)
4			SDI 1	BACKUP 8	HREF (Relay)
5		DARS		PRIMARY 6	REF (ELSW)
6			DARS	BACKUP 6	REF (ELSW)
7		WORD CLK		PRIMARY 5	REF (ELSW)
8			WORD CLK	BACKUP 5	REF (ELSW)
9		CMPST 1		PRIMARY 4	REF (ELSW)
10			CMPST 1	BACKUP 4	REF (ELSW)
11		10 MHz/ BLACK 3		PRIMARY 3	REF (ELSW)
12			10 MHz/ BLACK 3	BACKUP 3	REF (ELSW)
13		BLACK 2		PRIMARY 2	REF (ELSW)
14			BLACK 2	BACKUP 2	REF (ELSW)
15		BLACK 1		PRIMARY 1	REF (ELSW)
16			BLACK 1	BACKUP 1	REF (ELSW)
17		GPI/LTC		PRIMARY LTC/SPG	LTC
18			GPI/LTC	BACKUP LTC/SPG	LTC
19	Master Clock	REF			
20		LOOP	REF		
21	75 Ω termination		LOOP		

ECO8020 and SPG8000 with Option GPS system installation

The following illustration shows how to connect an ECO8020 and two SPG8000's with Option GPS for an SD/HD/3G video system. This system will occupy 3RU in an equipment rack.

SPG8000 inputs. The following SPG8000 inputs are available. The example signal connections illustration uses a GPS signal reference input.

- A reference signal from a GPS antenna
- An LTC signal can be connected to the GPI/LTC connector
- A reference signal from the system Master Clock (NTSC, PAL, or tri-level sysnc) can be connected to the REF loopthrough connector
- A 10 MHz CW signal can be connected to the REF loopthrough connector

SPG8000 outputs. The following SPG8000 outputs are available (depending on installed options):

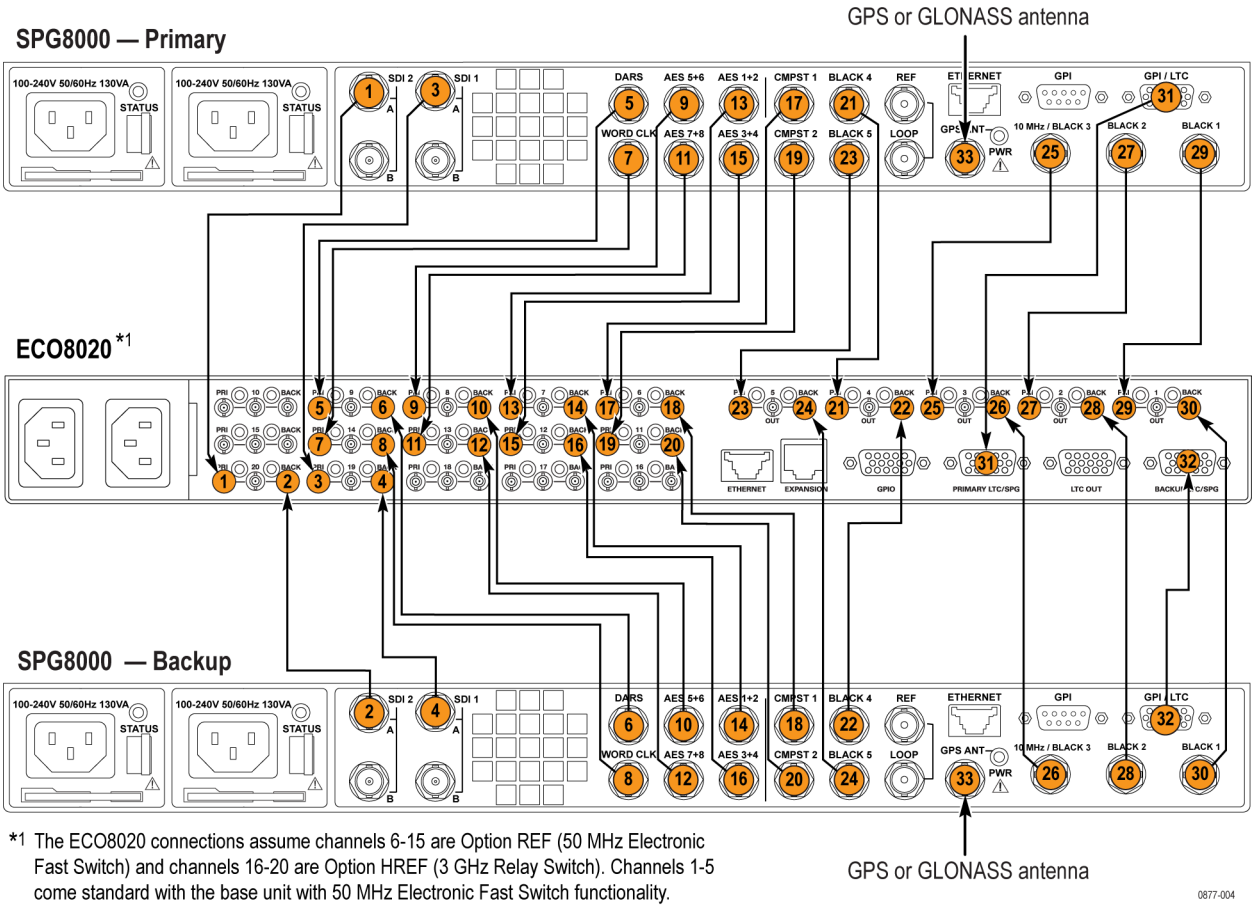
- Five bi-level or tri-level black syncs
- Two composite or Black syncs
- Four LTC
- One Word Clock
- Four SDI test signals supporting SD, HD, and 3 Gb/s formats
- Four AES/EBU audio pairs on BNC
- One DARS audio reference on BNC

ECO8020 channel types. This example system assumes that channels 6-15 are Option REF (50 MHz ELSW) and channels 16-20 are Option HREF (3 GHz Relay). Channels 1-5 come standard as Option REF (50 MHz ELSW).

ECO8020 outputs. The output connections from the ECO8020 are not shown. The ECO8020 outputs need to connect to the appropriate place in your video system.

Example system diagram. The following diagram and table show an example of how to connect two SPG8000's with Option GPS and an ECO8020 Series for an SD/HD/3G video system.

NOTE. *For simplicity, only two SDI channels are connected in this example. However, you could use the unused ECO8020 HREF channels (16-18) to connect the other two SDI outputs from the SPG8000 generators.*



*1 The ECO8020 connections assume channels 6-15 are Option REF (50 MHz Electronic Fast Switch) and channels 16-20 are Option HREF (3 GHz Relay Switch). Channels 1-5 come standard with the base unit with 50 MHz Electronic Fast Switch functionality.

Figure 35: System connections example for ECO8020 and SPG8000 with Option GPS

Table 21: System connections example for ECO8020 and SPG8000 with Option GPS

Connection number (See Figure 35.)	External signal	SPG8000 primary connector	SPG8000 backup connector	ECO8020 connector	ECO8020 channel type
1		SDI 2		PRI 20	HREF (Relay)
2			SDI 2	BACK 20	HREF (Relay)
3		SDI 1		PRI 19	HREF (Relay)
4			SDI 1	BACK 19	HREF (Relay)
5		DARS		PRI 9	REF (ELSW)
6			DARS	BACK 9	REF (ELSW)
7		WORD CLK		PRI 14	REF (ELSW)
8			WORD CLK	BACK 14	REF (ELSW)
9		AES 5+6		PRI 8	REF (ELSW)
10			AES 5+6	BACK 8	REF (ELSW)
11		AES 7+8		PRI 13	REF (ELSW)
12			AES 7+8	BACK 13	REF (ELSW)
13		AES 1+2		PRI 7	REF (ELSW)
14			AES 1+2	BACK 7	REF (ELSW)
15		AES 3+4		PRI 12	REF (ELSW)
16			AES 3+4	BACK 12	REF (ELSW)
17		CMPST 1		PRI 6	REF (ELSW)
18			CMPST 1	BACK 6	REF (ELSW)
19		CMPST 2		PRI 11	REF (ELSW)
20			CMPST 2	BACK 11	REF (ELSW)
21		BLACK 4		PRI 4	REF (ELSW)
22			BLACK 4	BACK 4	REF (ELSW)
23		BLACK 5		PRI 5	REF (ELSW)
24			BLACK 5	BACK 5	REF (ELSW)
25		10 MHz/ BLACK 3		PRI 3	REF (ELSW)
26			10 MHz/ BLACK 3	BACK 3	REF (ELSW)
27		BLACK 2		PRI 2	REF (ELSW)
28			BLACK 2	BACK 2	REF (ELSW)
29		BLACK 1		PRI 1	REF (ELSW)
30			BLACK 1	BACK 1	REF (ELSW)
31		GPI/LTC		PRIMARY LTC/SPG	LTC

Table 21: System connections example for ECO8020 and SPG8000 with Option GPS (cont.)

Connection number (See Figure 35.)	External signal	SPG8000 primary connector	SPG8000 backup connector	ECO8020 connector	ECO8020 channel type
32			GPI/LTC	BACKUP LTC/SPG	LTC
33	GPS and/or GLONASS [1]	GPS ANT	GPS ANT	NA	

[1] Earlier versions of the Option GPS module in the SPG8000 include a receiver that can receive only GPS signals. Later versions of the GPS module include a receiver that can receive both GPS and GLONASS signals. (See page 56, *How to determine which GPS receiver is installed in your SPG8000*.)

ECO8020 and SPG8000 without Option GPS system installation

The following illustration shows how to connect an ECO8020 and two SPG8000's without Option GPS for an SD/HD/3G video system. This system will occupy 3RU in an equipment rack.

SPG8000 inputs. The following SPG8000 inputs are available. The example signal connections illustration uses a GPS signal reference input.

- A reference signal from a GPS antenna
- An LTC signal can be connected to the GPI/LTC connector
- A reference signal from the system Master Clock (NTSC, PAL, or tri-level sysnc) can be connected to the REF loopthrough connector
- A 10 MHz CW signal can be connected to the REF loopthrough connector

SPG8000 outputs. The following SPG8000 outputs are available (depending on installed options):

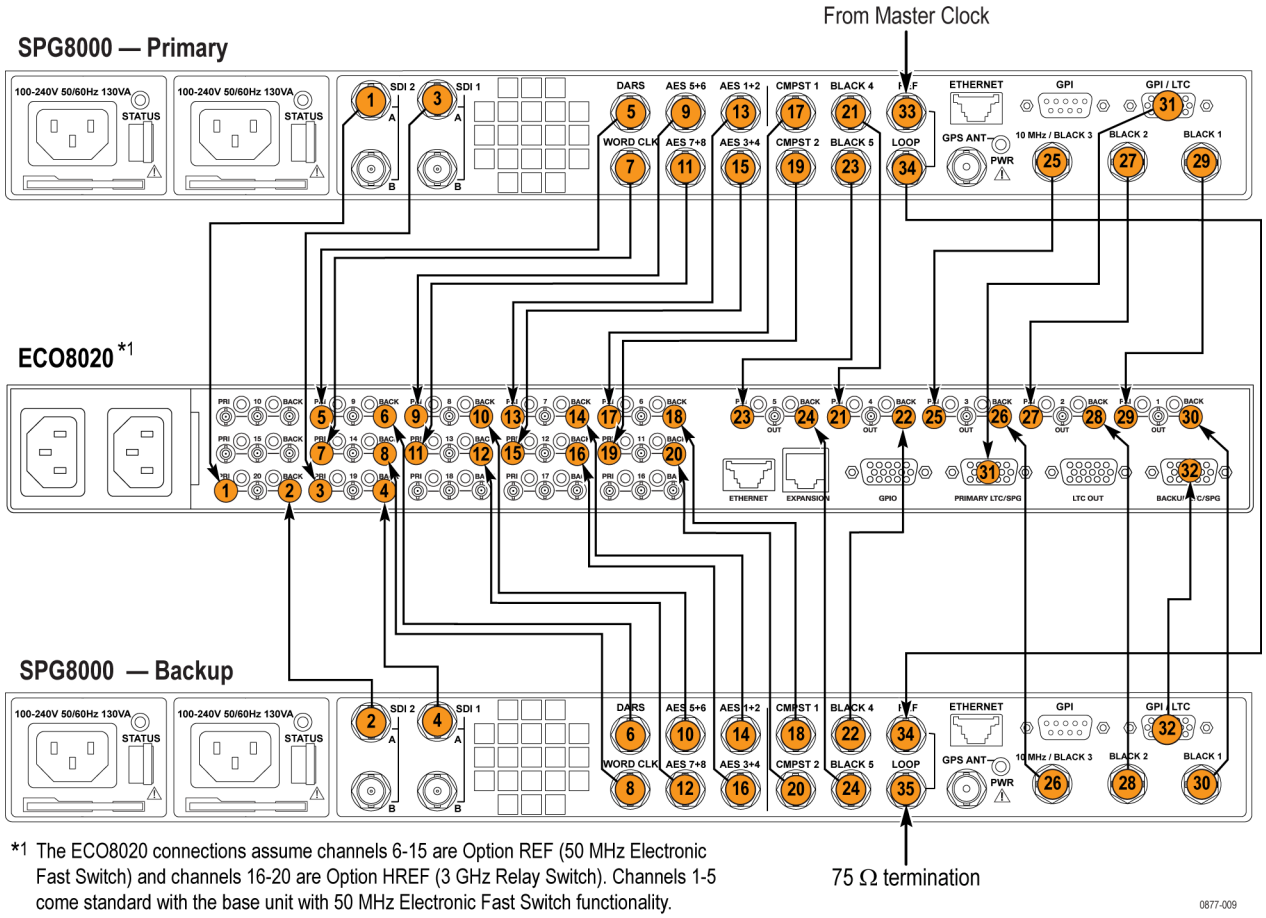
- Five bi-level or tri-level black syncs
- Two composite or Black syncs
- Four LTC
- One Word Clock
- Four SDI test signals supporting SD, HD, and 3 Gb/s formats
- Four AES/EBU audio pairs on BNC
- One DARS audio reference on BNC

ECO8020 channel types. This example system assumes that channels 6-15 are Option REF (50 MHz ELSW) and channels 16-20 are Option HREF (3 GHz Relay). Channels 1-5 come standard as Option REF (50 MHz ELSW).

ECO8020 outputs. The output connections from the ECO8020 are not shown. The ECO8020 outputs need to connect to the appropriate place in your video system.

Example system diagram. The following diagram and table show an example of how to connect two SPG8000's without Option GPS and an ECO8020 Series for an SD/HD/3G video system.

NOTE. *For simplicity, only two SDI channels are connected in this example. However, you could use the unused ECO8020 HREF channels (16-18) to connect the other two SDI outputs from the SPG8000 generators.*



*1 The ECO8020 connections assume channels 6-15 are Option REF (50 MHz Electronic Fast Switch) and channels 16-20 are Option HREF (3 GHz Relay Switch). Channels 1-5 come standard with the base unit with 50 MHz Electronic Fast Switch functionality.

Figure 36: System connections example for ECO8020 and SPG8000 without Option GPS

Table 22: System connections example for ECO8020 and SPG8000 without Option GPS

Connection number (See Figure 36.)	External signal	SPG8000 primary connector	SPG8000 backup connector	ECO8020 connector	ECO8020 channel type
1		SDI 2		PRI 20	HREF (Relay)
2			SDI 2	BACK 20	HREF (Relay)
3		SDI 1		PRI 19	HREF (Relay)
4			SDI 1	BACK 19	HREF (Relay)
5		DARS		PRI 9	REF (ELSW)
6			DARS	BACK 9	REF (ELSW)
7		WORD CLK		PRI 14	REF (ELSW)
8			WORD CLK	BACK 14	REF (ELSW)
9		AES 5+6		PRI 8	REF (ELSW)
10			AES 5+6	BACK 8	REF (ELSW)
11		AES 7+8		PRI 13	REF (ELSW)
12			AES 7+8	BACK 13	REF (ELSW)
13		AES 1+2		PRI 7	REF (ELSW)
14			AES 1+2	BACK 7	REF (ELSW)
15		AES 3+4		PRI 12	REF (ELSW)
16			AES 3+4	BACK 12	REF (ELSW)
17		CMPST 1		PRI 6	REF (ELSW)
18			CMPST 1	BACK 6	REF (ELSW)
19		CMPST 2		PRI 11	REF (ELSW)
20			CMPST 2	BACK 11	REF (ELSW)
21		BLACK 4		PRI 4	REF (ELSW)
22			BLACK 4	BACK 4	REF (ELSW)
23		BLACK 5		PRI 5	REF (ELSW)
24			BLACK 5	BACK 5	REF (ELSW)
25		10 MHz/ BLACK 3		PRI 3	REF (ELSW)
26			10 MHz/ BLACK 3	BACK 3	REF (ELSW)
27		BLACK 2		PRI 2	REF (ELSW)
28			BLACK 2	BACK 2	REF (ELSW)
29		BLACK 1		PRI 1	REF (ELSW)
30			BLACK 1	BACK 1	REF (ELSW)
31		GPI/LTC		PRIMARY LTC/SPG	LTC
32			GPI/LTC	BACKUP LTC/SPG	LTC

Table 22: System connections example for ECO8020 and SPG8000 without Option GPS (cont.)

Connection number (See Figure 36.)	External signal	SPG8000 primary connector	SPG8000 backup connector	ECO8020 connector	ECO8020 channel type
33	Master Clock	REF			
34		LOOP	REF		
35	75 Ω termination		LOOP		

TG8000 SD/HD/3G system installation

The following pages describe example system connections for the following installations:

- ECO8000 and TG8000 SD/HD/3G system with GPS (TG8000 modules installed: AG7, BG7, GPS7, and SDI7)
- ECO8000 and TG8000 SD/HD system without GPS (TG8000 modules installed: AG7, AGL7, DVG7, and HDVG7)

TG8000 SD/HD/3G system with GPS

The following illustration shows how to connect two TG8000's and an ECO8000 for an SD/HD/3G video system that uses GPS. This system will occupy 3RU in an equipment rack.

TG8000 modules. For this system, each TG8000 has the following modules installed: AG7, BG7, GPS7, and SDI7.

TG8000 inputs. The following inputs are available:

- A GPS antenna is required to connect to the GPS7 module
- An LTC signal can be connected to the GPS7 module
- A reference signal from the system Master Clock (NTSC, PAL, or tri-level sysnc) can be connected to the GPS7 module.
- A 10 MHz CW signal can be connected to the GPS7 module.

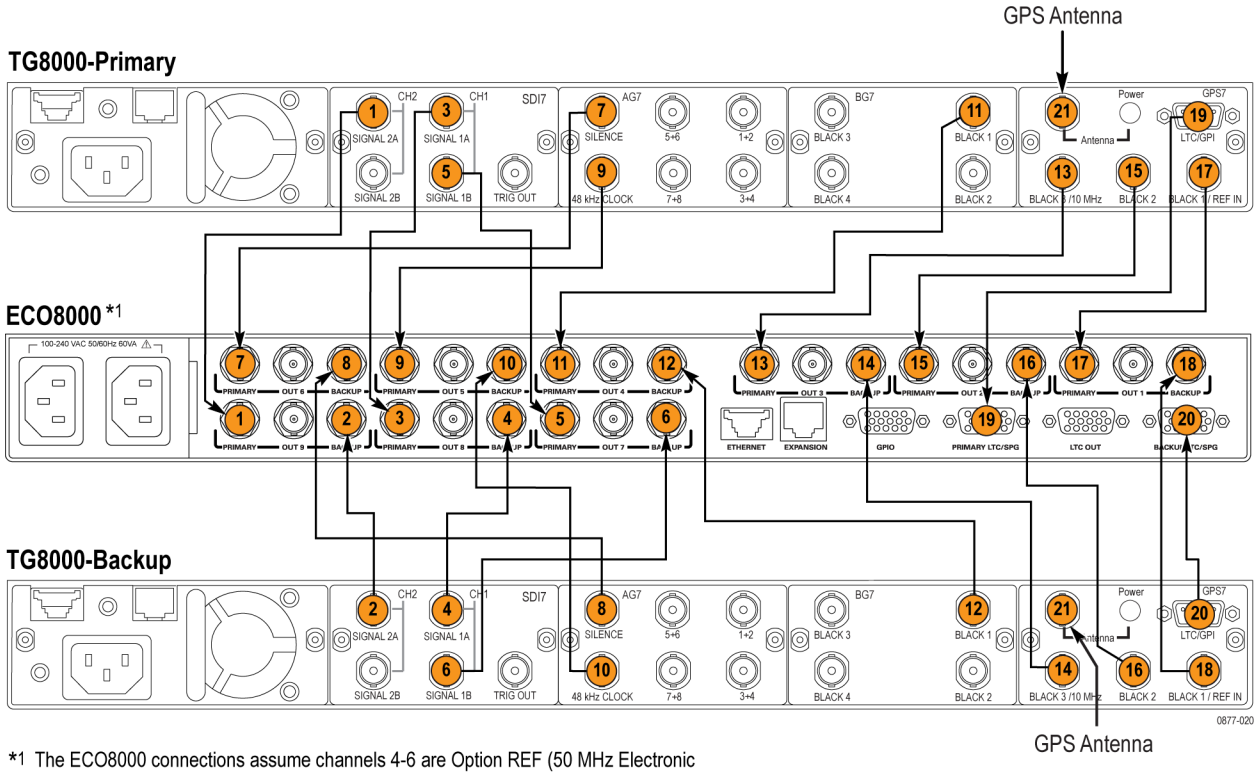
TG8000 outputs. The following outputs are available:

- Four LTC
- Seven channels of Black syncs
- Two SD/HD/3G-SDI video signals
- Two SD/HD/3G-SDI Black syncs
- Four AES/EBU audio pairs on BNC
- One 48 kHz clock
- One audio Silence

ECO8000 channel types. This example system assumes that channels 4-6 are Option REF (50 MHz ELSW) and channels 7-9 are Option HREF (3 GHz Relay). Channels 1-3 come standard as Option REF (50 MHz ELSW).

ECO8000 outputs. The output connections from the ECO8000 are not shown. The ECO8000 outputs need to connect to the appropriate place in your video system.

Example system diagram. The following diagram and table show an example of how to connect two TG8000's (with AG7, BG7, GPS7, and SDI7 modules) and an ECO8000 for an SD/HD/3G video system with GPS.



*1 The ECO8000 connections assume channels 4-6 are Option REF (50 MHz Electronic Fast Switch) and channels 7-9 are Option HREF (3 GHz Relay Switch). Channels 1-3 come standard with the base unit with 50 MHz Electronic Fast Switch functionality.

Figure 37: Connections for an SD/HD/3G system with GPS using two TG8000's and an ECO8000

Table 23: Connections for an SD/HD/3G system with GPS using two TG8000's and an ECO8000

Connection number (See Figure 37.)	External signal	TG8000 primary connector	TG8000 backup connector	ECO8000 connector	ECO8000 channel type
1		SDI7 – SIGNAL 2A		PRIMARY 9	HREF (Relay)
2			SDI7 – SIGNAL 2A	BACKUP 9	HREF (Relay)
3		SDI7 – SIGNAL 1A		PRIMARY 8	HREF (Relay)
4			SDI7 – SIGNAL 1A	BACKUP 8	HREF (Relay)
5		SDI7 – SIGNAL 1B		PRIMARY 7	HREF (Relay)
6			SDI7 – SIGNAL 1B	BACKUP 7	HREF (Relay)
7		AG7 – SILENCE		PRIMARY 6	REF (ELSW)
8			AG7 – SILENCE	BACKUP 6	REF (ELSW)
9		AG7 – 48 KHZ CLOCK		PRIMARY 5	REF (ELSW)
10			AG7 – 48 KHZ CLOCK	BACKUP 5	REF (ELSW)
11		BG7 – BLACK 1		PRIMARY 4	REF (ELSW)
12			BG7 – BLACK 1	BACKUP 4	REF (ELSW)
13		GPS7 – BLACK 3		PRIMARY 3	REF (ELSW)
14			GPS7 – BLACK 3	BACKUP 3	REF (ELSW)
15		GPS7 – BLACK 2		PRIMARY 2	REF (ELSW)
16			GPS7 – BLACK 2	BACKUP 2	REF (ELSW)
17		GPS7 – BLACK 1		PRIMARY 1	REF (ELSW)
18			GPS7 – BLACK 1	BACKUP 1	REF (ELSW)
19		GPS7 – LTC/GPI		PRIMARY LTC/SPG	LTC
20			GPS7 – LTC/GPI	PRIMARY LTC/SPG	LTC
21	GPS antenna	GPS7 – Antenna	GPS7 – Antenna		

TG8000 SD/HD system without GPS

The following illustration shows how to connect two TG8000's and an ECO8000 for an SD/HD video system without GPS. This system will occupy 3RU in an equipment rack.

TG8000 modules. For this system, each TG8000 has the following modules installed: AG7, AGL7, DVG7, and HDVG7.

TG8000 inputs. The following inputs are available:

- A reference signal from the system Master Clock (NTSC, PAL, or tri-level sysnc) is required. Loop-through connectors are provided for the reference input signal. You can use one of the loop-through connectors to attach a 75 Ω termination for the input signal.
- A 10 MHz CW signal can be connected to the AGL7 module.

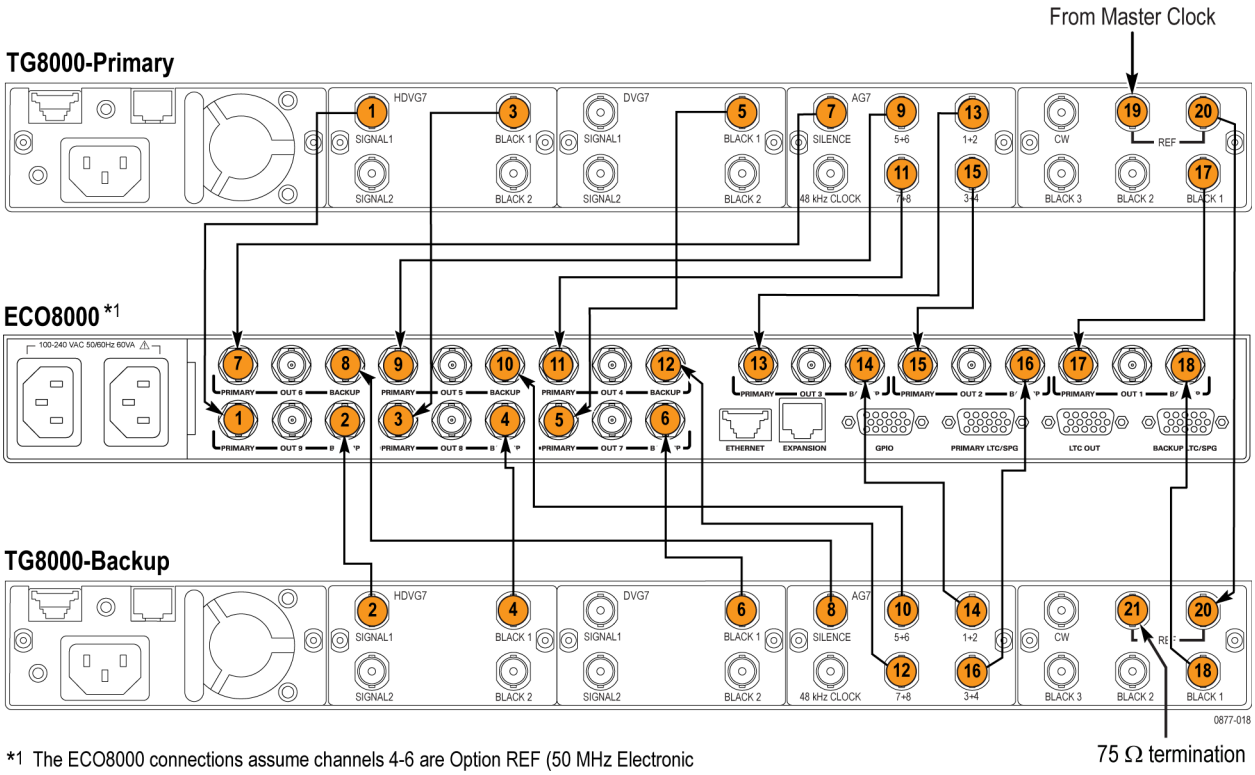
TG8000 outputs. The following outputs are available:

- Three channels of Black syncs
- Four SD-SDI video outputs (two standard, two additional with Option BK)
- Four HD-SDI video outputs (two standard, two additional with Option BK)
- Four AES/EBU audio pairs on BNC
- One 48 kHz clock
- One audio Silence

ECO8000 channel types. This example system assumes that channels 4-6 are Option REF (50 MHz ELSW) and channels 7-9 are Option HREF (3 GHz Relay). Channels 1-3 come standard as Option REF (50 MHz ELSW).

ECO8000 outputs. The output connections from the ECO8000 are not shown. The ECO8000 outputs need to connect to the appropriate place in your video system.

Example system diagram. The following diagram and table show an example of how to connect two TG8000's (with AG7, AGL7, DVG7, and HDVG7 modules) and an ECO8000 for an SD/HD video system without GPS.



*1 The ECO8000 connections assume channels 4-6 are Option REF (50 MHz Electronic Fast Switch) and channels 7-9 are Option HREF (3 GHz Relay Switch). Channels 1-3 come standard with the base unit with 50 MHz Electronic Fast Switch functionality.

Figure 38: Connections for an SD/HD system without GPS using two TG8000's and an ECO8000

Table 24: Connections for an SD/HD system without GPS using two TG8000's and an ECO8000

Connection number (See Figure 38.)	External signal	TG8000 primary connector	TG8000 backup connector	ECO8000 connector	ECO8000 channel type
1		HDVG7 – SIGNAL 1		PRIMARY 9	HREF (Relay)
2			HDVG7 – SIGNAL 1	BACKUP 9	HREF (Relay)
3		HDVG7 – BLACK 1		PRIMARY 8	HREF (Relay)
4			HDVG7 – BLACK 1	BACKUP 8	HREF (Relay)
5		DVG7 – BLACK 1		PRIMARY 7	HREF (Relay)
6			DVG7 – BLACK 1	BACKUP 7	HREF (Relay)
7		AG7 – SILENCE		PRIMARY 6	REF (ELSW)
8			AG7 – SILENCE	BACKUP 6	REF (ELSW)
9		AG7 – 5+6		PRIMARY 5	REF (ELSW)
10			AG7 – 5+6	BACKUP 5	REF (ELSW)
11		AG7 – 7+8		PRIMARY 4	REF (ELSW)
12			AG7 – 7+8	BACKUP 4	REF (ELSW)
13		AG7 – 1+2		PRIMARY 3	REF (ELSW)
14			AG7 – 1+2	BACKUP 3	REF (ELSW)
15		AG7 – 3+4		PRIMARY 2	REF (ELSW)
16			AG7 – 3+4	BACKUP 2	REF (ELSW)
17		AGL7 – BLACK 1		PRIMARY 1	REF (ELSW)
18			AGL7 – BLACK 1	BACKUP 1	REF (ELSW)
19	Master Clock	AGL7 – REF			
20		AGL7 – REF	AGL7 – REF		
21	75 Ω termination		AGL7 – REF		

Power on / power off procedures

ECO8000 Series power on / power off

This 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 power cord is essential for safe operation.

CAUTION. *The instrument does not have a power switch. When you connect the power plug to one of the AC line connectors, and the Power Supply module for that slot is installed, the instrument powers on. If you have only one power supply installed, be sure to connect the power plug to the correct rear-panel power connector.*

ECO8000 Series power-on

1. Connect the supplied power cord(s) to the rear-panel power connector.

NOTE. *If Option DPW is installed, your instrument will have two power cords.*

2. Connect the other end of the power cord(s) to your local AC power source.
3. After connecting the power, verify the status of the power supply LEDs. When the instrument is running, the power supply LEDs indicate the status of the supplies, including the internal fans and which of the supplies is currently powering the instrument. (See page 81, *ECO8000 Series Power Supply module LED states*.)

CAUTION. *If the LEDs indicate that the fan on a power supply is not working, disconnect the power cord on the failed supply from the AC power source and contact your local Tektronix Field Office or representative.*

When the instrument powers on, the power-on self test runs automatically. (See page 80, *ECO8000 Series power-on self test*.)

ECO8000 Series power-off

Remove power completely from the instrument by disconnecting the power cord(s) from the rear-panel of the instrument.

ECO8000 Series power-on self test

The power-on self test is run when the Configuration and Monitoring system first boots up. The test is run regardless of whether the reboot is caused by cycling power or by other means, such as a watchdog timeout or by pressing and holding the ENABLE and RESET keys.

If any failure occurs, it will be reported in the following ways:

- An error message is written on the LCD display and is visible for 2 seconds.
- The STATUS menu FAULT display will indicate that the self-test has failed and display the event code. This display will not be erased until instrument power is cycled.
- A similar message, which includes the event code, is entered in the Event Log.
- If the user-configurable event reporting methods (SNMP trap, e-mail, GPI signal, instrument beeper) are enabled to notify in the event of a voltage error, then a message is sent using the enabled method(s).

ECO8000 Series event codes. The self-test event code is a bit-wise value with each fault type assigned a bit. The following table lists the possible error codes.

Table 25: Self test error codes

Test type	Code
Front panel communications	0 (LSB)
Main board communications	1
Module 1 communications	2
Module 2 communications (if installed)	3
Module 3 communications (if installed)	4
Module 4 communications (if installed)	5
Power Supply combiner communications	6
MRAM communications	7
RTC communications	8 (MSB)

ECO8000 Series Power Supply module LED states

When the instrument is running, the power supply LEDs indicate the status of the supplies, including the internal fans and which of the supplies is currently powering the instrument.

If the instrument loses power from both supplies, the LEDs continue to provide status to help troubleshoot the root of the problem. In this mode, the LEDs flash to conserve the power in the storage capacitor. Typically the LED flashing should last for 10 minutes after the loss of power.

If both of the supplies are good, the system will use the supply that is configured to be the preferred (active) supply. If one power supply has a problem, the system will switch to the other supply. If either supply can support the instrument load, even if it has a non-fatal problem, the system will choose the best supply and attempt to continue to operate.

CAUTION. *If the instrument is in operational use and both of the installed supplies have a problem and you are going to replace one of the supplies, be sure to remove the supply that has the red LED. The orange LED indicates the supply is active, so it is capable of running the instrument. The supply with the red LED may or may not be able to power the instrument while the other supply is being swapped.*

The following table shows the states of the AC and DC LEDs on a Power Supply module when the power is on.

Table 26: Power on LED states for an ECO8000 Series Power Supply module

Power Supply state	AC LED state	DC LED state
Normal, Active	Green	Green
Normal, Backup	Green	Dim Green
AC < 75 V, DC supply running	Red	Green
AC < 75 V, DC supply failed	Red	Red
AC OK, DC supply failed	Green	Red
Marginal Low or High DC, Active		Orange
Marginal Low or High DC, Backup		Yellow
Load Test Fail - Backup		Red
Load Test Fail – Active		Orange
Fan Fail - Active		Orange
Fan Fail - Backup		Red
Supply not installed, AC present	Green	Off
Supply not installed, AC absent	Off	Off

The following table shows the states of the AC and DC LEDs on a Power Supply module when the power is off. The LEDs will blink for several minutes after power is removed from the instrument to help troubleshoot power problems.

Table 27: Power off LED states for an ECO8000 Series Power Supply module

Power Supply state	AC LED state	DC LED state
AC present, DC bad	Flash green	Flash red
AC missing, DC missing	Flash red	Off
AC present, supply not installed	Flash green	Off
AC missing, supply not installed	Off	Off
AC present, DC present, on-board converter failure	Flash green	Flash green

Troubleshooting ECO8000 Series power supply problems. For troubleshooting power supply problems, take these steps:

- If the AC LED is red, verify the power source connecting to the instrument.
- If the DC LED is red, replace the supply module.
- Examine the STATUS menu display and the Event Log readouts to locate details on the nature of the faults.

SPG8000 power on / power off

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 power cord is essential for safe operation.

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

SPG8000 power-on

1. Connect the supplied power cord(s) to the rear-panel power connector(s).

NOTE. *If Option DPW is installed, your instrument will have two power cords.*

2. Connect the other end of the power cord(s) to your local AC power source.
3. After connecting the power, make sure that the fan on the rear panel is working. If the fan is not working, turn off the power by disconnecting the power cord(s) from the AC power source, and then contact your local Tektronix Field Office or representative.

SPG8000 power-off

Remove power completely from the instrument by disconnecting the power cord(s) from the rear-panel of the instrument.

SPG8000 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 28: States of the SPG8000 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 [1]	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.	Use the STATUS button menu to view information about the warning. Remove the associated Power Supply module for repair.

Table 28: States of the SPG8000 PWR1 and PWR2 indicators (cont.)

PWR1 / PWR2 indicator state	Power Supply module condition	Example(s)	User actions
Bright orange [1]	Warning or fault; active supply	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. When the power supply fan has failed (active supply).	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 page 102, *Configure the preferred (active) power supply (Option DPW only)*.) 4. Remove the associated Power Supply module for repair.
Red [2]	Fault (including being installed but unplugged)	When the 12 V power from a supply is too high or too low (includes if the supply has failed). When two Power Supply modules are installed and one of the supplies has no AC power applied. When the power supply fan has failed (inactive supply). ***NOTE.*** *In the case of a failed fan on both supplies, the instrument will keep running as long as the voltage is adequate.*	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.

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

[2] 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.

SPG8000 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 page 86, Alert and fault error messages.)*

Table 29: States of the SPG8000 FAULT indicator

Instrument condition	Example(s)	FAULT LED state	User actions
A fault condition exists that has the potential to damage the instrument hardware	▪ The main fan has stopped turning ▪ The internal temperature of the instrument is too high	Blinking red	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	▪ The fan speed is out of range ▪ An internal power supply voltage is out of range	Solid red	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.

Table 29: States of the SPG8000 FAULT indicator (cont.)

Instrument condition	Example(s)	FAULT LED state	User actions
A fault condition exists, but the instrument is still usable	▪ 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	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.
Normal	▪ The instrument is operating properly ▪ The instrument is turned off	Off	None

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 30: 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

TG8000 power on / power off

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 power cord is essential for safe operation.

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

TG8000 power-on

1. Connect the supplied power cord to the rear-panel power connector.
2. Connect the other end of the power cord to your local AC power source.
3. After connecting the power, make sure that the fan on the rear panel is working. If the fan is not working, turn off the power by disconnecting the power cable from the AC power source, and then contact your local Tektronix Field Office or representative.

TG8000 power-off

Remove power completely from the instrument by disconnecting the power cord from the rear-panel of the instrument.

ECO8000 Series configuration

Initial product setup overview

Perform the following steps after you have installed the instrument and have connected the input and output signals as described earlier in this manual:

1. Press and hold the PANEL ENABLE button to enable the front-panel control buttons. The instrument beeps when the panel buttons are enabled.
2. Press the MANUAL MODE button to put the ECO8000 Series in Manual mode.
3. Use the CHANNEL menu to configure each of the installed channels as follows:
   a. Disable all unused channels.
   b. Enter identification labels for each channel that will be in use.
   c. Choose to enable or disable the changeover trigger function for each channel that will be in use. (See page 91, *Configure the channel inputs and threshold levels*.)
   d. Set the correct threshold level (based on the signal type) for each channel that will be in use. (See page 91, *Configure the channel inputs and threshold levels*.)
   e. For HREF channels, enable/disable the Relay Check function for each channel that will be in use.
4. Configure the primary and backup sync generators which are providing inputs to the ECO8000 Series as follows:
   a. Set the signal outputs to the desired format.
   b. If you want the sync generators to detect faults and trigger a source switch on the ECO8000 Series, then set the GPI outputs to assert on the desired fault conditions. (See page 93, *Configure the SPG trigger input*.) You will also need to enable the SPG Input Trigger function on the ECO8000 Series.
   c. Save the configured signal and GPI settings as the power-on preset.
5. Configure the startup delay. (See page 92, *Configure the startup delay*.)

6. Verify the channel threshold settings:

   a. Press the front-panel FAULT RESET button. If the signal thresholds are properly set, the LED indicators for the active channels should all turn green.

   b. Use the DIAGNOSTICS submenu readouts to verify the threshold settings. The levels should be around +3 dB for BNC channels and around +4 dB for LTC channels.

7. Press the front-panel AUTO MODE button to put the ECO8000 Series in Auto mode.

8. Verify the installation as follows:

   a. Disconnect signal inputs to the ECO8000 Series to simulate errors. Verify a proper source switch.

   b. Cycle power on the primary sync pulse generator to verify a switch to the backup source. Repeat on the backup sync pulse generator.

   c. If the SPG Input Trigger function is enabled, cause an error in the primary sync pulse generator and verify a source change. For example, remove the genlock input on sync pulse generator if that is one of the faults enabled to be monitored. The genlock error on the sync pulse generator is typically configured for a delay of 10 seconds, so you may have to wait to see the source change. Repeat on the backup sync pulse generator.

   d. Remove power input to the ECO8000 Series to verify correct operation.

   e. Cycle power to the entire system to verify correct operation after power is restored.

9. Configure event reporting. (See page 96, *Configure event reporting*.)

Configure the channel inputs and threshold levels

Once you have connected the signals, you need to configure each channel you have connected and disable any unused channels. Use the Main menu to select a channel and then press the ENTER button to enter the CHANNEL menu for that channel.

Use the CHANNEL menu to enable/disable the channel, to enable/disable the channel from triggering a changeover if the signal crossed the threshold level, to set the threshold level, and to assign a label to the channel as an aid in identifying the signal connected to that channel.

Verify the signal margin

Once you have configured the channels, use the PRI VS THRES and the BACK VS THRS readouts in the DIAGNOSTICS submenu to verify that you have set the thresholds to the proper levels. The levels should be around +3 dB for REF (ELSW) and HREF (Relay) channels, and around +4 dB for LTC channels.

Terminate the HREF outputs

If the HREF/Relay board outputs are not terminated, it will change the level readings in the DIAGNOSTICS submenu on the selected channel (primary or backup). The unselected primary or backup channel is terminated in the ECO8000 Series, but the selected primary or backup channel drives through to the output. Be sure to connect the channel output to the actual load during setup to insure proper configuration.

Configure the startup delay

The Startup Delay function defines the time period after the ECO8000 Series unit powers up, during which the instrument will not make AUTO mode source switches. The Channel Control system (left-hand buttons) and the basic ECO functions are fully operational a second or two after power is applied. However, on loss of power the sync sources may not be ready for a period of time depending on the type of sync pulse generator. While the sync pulse generator is starting up, the ECO may make undesirable source switches as the sync pulse generator signals turn on at different times.

To prevent this, the ECO8000 Series has the ability to delay AUTO mode switching for the period of time set in the Startup Delay function. Additionally, at the end of the start up delay, any yellow LED states are cleared (this is effectively like asserting the Fault Reset button at the end of the timeout period).

Set the startup delay

Perform the following steps to set the startup delay:

1. Cycle the power on the sync pulse generators connected to the ECO8000 Series and measure the amount time until the sync generators are fully booted and the LEDS on the ECO have all turned to yellow.

CAUTION. *If the sync generators are configured to use GPS as the timing source and if you have the SPG trigger function configured to monitor the GPS lock, you need to include the time necessary for the sync generators to lock to the GPS signal.*

2. Add a few seconds to the measured startup time of the sync pulse generators to provide some margin. For example, if the startup time of the sync pulse generators is 30 seconds, then a good value for the ECO startup delay would be 35 seconds.
3. On the ECO8000 Series, access the SYSTEM CONFIG menu.
4. Press the up (▲) and down (▼) arrow buttons to select STARTUP DELAY.
5. Press the left (◄) or right (►) arrow button to set the startup delay time period.

NOTE. *You can also use the System tab in the Web Interface to set the startup delay.*

Configure the SPG trigger input

The SPG trigger input function allows for a condition that is sensed in the Tektronix SPG8000 and TG8000 generators to trigger a source changeover on the ECO8000 Series unit. For example, if the genlock on the primary SPG8000 generator loses lock, then that SPG8000 can signal the ECO8000 Series unit to switch to the backup source. Since the SPG8000 and TG8000 generators have comprehensive internal monitoring capability, this allows the overall system to react to more subtle sync conditions, sometimes even before they start to cause problems.

To use this function, the SPG Input Trigger function must be enabled on the ECO8000 Series and the GPI outputs from the primary and backup sync generators must be connected to the LTC/SPG conectors on the ECO8000 Series. If the sync generator is a Tektronix SPG8000, or a TG8000 with a GPS7 installed, the connections can be done using a 15-pin HD DSUB cable. For other sync generators, a custom wiring harness may be required. See *SPG trigger cable connections* below.

The primary and backup SPG8000 or TG8000 generators need to have the GPI1 output programmed to assert on the combination of events which are intended to cause a changeover trigger. A common set of conditions to enable are “Hardware Fault,” “Near Loss of Lock,” and “Lock Error”. With these settings, the SPG will detect these conditions, assert GPI1, and then the ECO will detect that SPG Trigger input and trigger a changeover.

Configure the SPG alarm delay

To prevent unnecessary signal source changeovers, the SPG8000 and TG8000 generators allow you to configure a time delay before an error condition triggers a changeover. Setting a delay allows time for short errors and warnings to clear before an error signal is sent to trigger a changeover.

With the holdover capability in the SPG8000 and TG8000 generators, a short GPS unlock will not cause any disruption in the syncs, so there is no reason to immediately register an error and trigger an ECO to changeover.

To minimize unnecessary changeovers when using the SPG8000 and TG8000 generators as your signal sources, it is recommended that you configure the alarm delay on the generators for a time period between one and five minutes.

CAUTION. *If the primary and backup SPG8000 generators use a common reference, such as the same genlock source or the same GPS antenna, then the primary SPG8000 generator should be set for a longer delay on loss on lock. In case of a failure on the common reference, this allows the primary SPG8000 generator to assert the fault later, which avoids an unnecessary source switch by the ECO8000 Series.*

Additionally, the ECO8000 Series may switch sources when the two SPG8000 generators relock if the backup generator locks before the primary generator.

SPG trigger cable connections and GPI configuration

The following table lists the types of connections that can be made from a SPG8000 or TG8000 generator to the LTC/SPG connector on the ECO8000 Series. (See page 29, *Primary and backup LTC/SPG ports*.)

Table 31: SPG trigger cable connections and GPI configuration

Connection type	Cable requirements	Configuration requirements
From the SPG8000 LTC/GPIO connector to the ECO8000 Series LTC/SPG connector	Use a 15-pin DSUB cable with male connectors	On the SPG8000, configure GPO1 to assert on the desired fault conditions
From the SPG8000 GPI connector to the ECO8000 Series LTC/SPG connector	You will need to build a custom cable. One end will have a 9-pin male DSUB connector and the other end will have a 15-pin male DSUB connector. Connect one of the three GPO signals on the SPG8000 GPI connector to pin 1 on the ECO8000 Series LTC/SPG connector. Ground the cable: connect pin 1 of the SPG8000 GPI connector to pin 6 or 9 on the ECO8000 Series LTC/SPG connector.	On the SPG8000, configure the GPI output that you connected to pin 1 on the ECO8000 Series LTC/SPG connector to assert on the desired fault conditions
From the TG8000 GPS7 module LTC/GPI connector to the ECO8000 Series LTC/SPG connector	Use a 15-pin DSUB cable with male connectors	On the TG8000 GPS7 module, configure GPO1 to assert on the desired fault conditions
From the TG8000 GPI port to the ECO8000 Series LTC/SPG connector [1]	You will need to build a custom cable. One end will have a RJ-45 connector and the other end will have a 15-pin male DSUB connector. Connect pin 6 of the TG8000 GPI port to pin 1 on the ECO8000 Series LTC/SPG connector. Ground the cable: connect pin 8 of the TG8000 GPI port to pin 6 or 9 on the ECO8000 Series LTC/SPG connector.	On the TG8000, configure the GPI output that you connected to pin 1 on the ECO8000 Series LTC/SPG connector to assert on the desired fault conditions

[1] This connection type is for TG8000 generators that do not have a GPS7 module installed.

The signal pinouts for each of the SPG8000 and TG8000 connectors are shown in the following tables.

Table 32: Signal pinouts for the SPG8000 GPI/LTC connector and the TG8000 GPS7 module LTC/GPI connector

Pin	Signal
1	GPO1
2	GPO2
3	GPI
4	

Table 32: Signal pinouts for the SPG8000 GPI/LTC connector and the TG8000 GPS7 module LTC/GPI connector (cont.)

5	LTC4–
6	GND
7	LTC3–
8	LTC2–
9	GND
10	LTC1–
11	
12	LTC3+
13	LTC2+
14	LTC1+
15	LTC4+

Table 33: Signal pinouts for the SPG8000 GPI connector

Pin	Signal
1	GND
2	GPO1
3	GPO2
4	GPI
5	5 V
6	GPO3
7	Preset1
8	Preset2
9	Preset3

Table 34: Signal pinouts for the TG8000 GPI port

Pin	Signal
1	GPI1
2	GPI2
3	GPI3
4	
5	
6	GPO
7	
8	GND

Configure event reporting

The ECO8000 Series monitors several operational parameters and records events when faults occur (See page 97, *Fault and event descriptions*.).

The instrument provides four methods for the reporting of fault events: SNMP trap, e-mail, GPI signal, and instrument beeper. You can configure which events are reported using one or a combination of these methods.

SNMP trap reporting

The instrument can send SNMP traps to up to four IP addresses when enabled events occur. Use the SNMP CONFIG submenu to the SNMP settings and use the TRAP EVENTS submenu to select which events will be reported using SNMP traps.

E-mail reporting

The instrument can send e-mail notifications to one e-mail address when enabled events occur. Use the EMAIL REPORTING submenu to configure the e-mail settings and use the EMAIL EVENTS submenu to select which events will be reported using e-mail.

NOTE. *The e-mail client used by the ECO8000 Series does not support the TLS (Transport Layer Security) protocol. This protocol is used by most ISPs and free e-mail services like gmail, yahoo, live.com, etc.*

Some e-mail servers do not require a login name and password. Before you configure the e-mail reporting parameters, it is recommended that you contact your local network administrator to determine the e-mail server address and to determine whether an e-mail login name and password are required.

GPI signal reporting

The instrument can send a GPI signal using the GPIO connector when enabled events occur (See page 28, *GPIO port*.). Use the GPI EVENTS submenu to select which events will be reported using the GPIO connector.

Instrument beeper reporting

The instrument can emit a beep when enabled events occur. Some events, such as a primary/backup source switch, emit a single beep. Other events, such as a primary fault, emit one beep per second for as long as the event is active. Use the BEEPER EVENTS submenu to select which events will be reported using the instrument beeper.

Fault and event descriptions

The following table describes the faults and events that may be reported by the instrument.

Table 35: Fault and event descriptions

Fault or event	Description
Primary fault	One or more of the active primary input channels is being driven by a signal that is below the configured level threshold for that channel
Backup fault	One or more of the active backup input channels is being driven by a signal that is below the configured level threshold for that channel
Pri/Backup switch	The instrument has switched sources from primary to backup (or vice-versa), either manually or automatically
PS<1 or 2> LD test fail	The indicated Power Supply module has failed the last manual or automatic load test (load tests are run every 24 hours during normal operation if two power supplies are installed)
PS<1 or 2> AC fault	The AC input to the indicated power supply has failed
PS<1 or 2> DC fault	The 12 V DC output of the indicated power supply has failed (reported only on supplies which have a power input)
PS<1 or 2> fan fault	The fan in the indicated power supply has failed
PS<1 or 2> warning	The 12 V DC output level on the indicated supply is above or below the nominal range
PS<1 or 2> temp fault	The indicated power supply is over temperature
PS<1 or 2> TWH warning	The TWH (Temperature Weighted Hours) limit has been exceeded on the indicated power supply
PS switchover	On instruments with two Power Supply modules, the instrument has switched from using one supply to using the other supply
Board supply	A power supply has failed on the indicated circuit board
Temperature fault	The instrument is being operated at too high a temperature
Back test due	The recommended test interval for checking the backup channels has been exceeded
Post failed	A failure was detected during the power on self test (See page 80, *ECO8000 Series power-on self test*.)
HREF relay fail	A relay failure was detected on one of the HREF channels
Reboot normal	The instrument was rebooted manually
Reboot watchdog	The CPU (Configuration and Monitoring system) was rebooted automatically when its watchdog signal was not detected

Configure the Expansion port

The ECO8000 Series has the ability to connect two instruments so that they function as a single larger switch. This function is useful in situations where more channels are needed than can be supported using only one instrument.

To enable the Expansion port function, you need to configure one ECO as the master unit and the other ECO as the slave unit using the SYSTEM CONFIG menu. Both instruments must be connected together via the rear-panel EXPANSION port connectors using a standard Ethernet RJ-45 cable.

Once the two instruments are configured as Master and Slave and are connected together, the left-hand buttons (Channel Control system) on the Master unit will control both instruments and the left-hand buttons on the Slave unit will be disabled. The right-hand buttons (Configuration and Monitoring system) on both units will operate normally. This allows the configuration for each ECO to be set independently either via the front panel or the Web Interface.

If the Expansion port connection between two instruments is disconnected, the Slave unit will revert to Master mode so that it will operate independently.

CAUTION. *A slave unit may change state if the master unit is changed from master to disabled or if the interconnection cable is removed.*

It is recommended that you configure the master and slave units during system setup and that you not change the configuration while the instrument is in operation. To help enforce this recommendation, the ECO8000 Series must be in Manual mode before you can change the state of the expansion port.

Independent GPI outputs

When you use the Expansion port to connect two instruments, the GPI outputs are still independent. For example, if a fault occurs on a master unit signal, only the GPI output on the master unit will be activated. Likewise, if a fault occurs on a slave unit signal, only the GPI output on the slave unit will be activated.

If you want to have a common GPI output for the connected instruments, the two GPI signals can be connected together. The GPI outputs are open with a weak pull-up resistor to 5 V when they are not asserted, and are connected to ground when they are asserted. Therefore, the GPI outputs can be connected in a "wire-OR" so that either unit can drive the GPI output low.

For the GPI inputs, only the master unit needs to driven. The slave unit will follow any changes which are made to the master unit.

Configure the preferred (active) power supply (Option DPW only)

When two Power Supply modules are installed in the instrument, one is configured as the primary supply and the other is configured as the backup supply. In the event that the primary supply fails, the backup supply automatically provides power to maintain instrument operation.

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

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

The preferred supply configuration is not set as part of the Hardware Initialization function. Therefore, the preferred supply configuration will not change when you reset the instrument using the Hardware Initialization function.

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

1. Check the status of the front-panel DC LED indicators on both supplies:
   - Bright green indicates the current preferred (active) supply
   - Dim green indicates the current inactive (backup) supply

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

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

NOTE. *It is recommended that you configure the supply with the most temperature weighted hours to be used as the primary preferred supply. This allows for the newer supply to be preserved so it can provide the best possible backup should the primary supply fail. For more information about temperature weighted hours, see the ECO8000 Series Quick Start User Manual.*

   a. From the top-level Main menu, press the up (▲) or down (▼) arrow button to select **SYSTEM CONFIG**, and then press the **ENTER** button to access the SYSTEM CONFIGURATION menu.

b. Press the up (▲) arrow button to select **DIAGNOSTICS**, and then press the **ENTER** button to access the DIAGNOSTICS submenu.

c. Press the up (▲) or down (▼) arrow button to select **PS1 HOURS**. The second line of the display lists the number of hours the supply has been the active supply.

d. Press the right (►) arrow button to select **PS1 TW HOURS**. The second line of the display lists the number of temperature weighted hours of the first supply. Note the number of hours of hours shown.

e. Press the down (▼) arrow button to select **PS2 HOURS**.

f. Press the right (►) arrow button to select **PS2 TW HOURS**. The second line of the display lists the number of temperature weighted hours of the second supply. Note the number of hours of hours shown.

g. Press the **BACK** button to exit the DIAGNOSTICS submenu and return to the SYSTEM CONFIGURATION menu.

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

4. If you want to change the preferred supply configuration, press the up (▲) or down (▼) arrow button to select **PREFERRED SUPPLY**.

5. Press the left (◄) or right (►) arrow button to display the supply you want to be the primary (active) supply: PS1 or PS2. The second line of the display shows the selected supply and its status: **Active, Preferred** or **Inactive**.

NOTE. *When viewed from the front of the instrument, PS1 is the left Power Supply module and PS2 is the right Power Supply module.*

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

SPG8000 configuration

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.

NOTE. *Any of the BLACK outputs can generate either NTSC or PAL regardless of the tri-level rate selection.*

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 preferred (active) power supply (Option DPW only)

The standard SPG8000 has one Power Supply module installed. With Option DPW, a second hot-swappable, redundant (backup) Power Supply module is provided. When two Power Supply modules are installed in the instrument, one is configured as the primary supply and the other is configured as the backup supply.

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

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

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

The preferred supply configuration is not saved as part of the preset system. Therefore, the preferred supply configuration will not change when you activate any of the system presets, including the Factory Default preset.

1. Check the status of the front-panel PWR1 and PWR2 indicators:
   - Bright green indicates the preferred (active) supply.
   - Dim green indicates the inactive (backup) supply.

   NOTE. *If the color of the PWR1 or PWR2 indicators is other than bright or dim green, service the faulty Power Supply module before proceeding. (See page 83, SPG8000 PWR1 and PWR2 indicators.)*

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

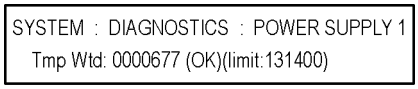
   NOTE. *It is recommended that you configure the supply with the most temperature weighted hours to be used as the primary preferred supply. This allows for the newer supply to be preserved so it can provide the best possible backup should the primary supply fail.*

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

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

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

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



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

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

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

4. If you want to change the preferred supply configuration, press the **SYSTEM** button to access the SYSTEM menu.

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

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

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

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

Oven oscillator calibration

This adjustment stores the current frequency of the master clock oscillator for use when the instrument is set to **Internal** mode. You can calibrate the internal oscillator frequency at any time after you install the instrument in its operating environment and allow it to reach a stable operating condition.

NOTE. *It is recommended that you perform the internal oscillator frequency calibration at least once a year to compensate for oscillator drift.*

Check if calibration is needed

Perform the following steps to determine if the oven oscillator needs to be calibrated.

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 ±0.10e–6, then you need to calibrate the oven oscillator. If the value is less than ±0.10e–6, then no calibration is required.

NOTE. *Even if the value is less than ±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.

Adjustment methods

You can calibrate the oscillator using GPS, GLONASS or reference signals such as NTSC Burst or CW. If you are not using a GPS or GLONASS reference signal, the reference signal from a frequency signal generator must be at the correct frequency. Procedures for using either method are provided.

If your SPG8000 generator has Option GPS installed, you should use a GPS or GLONASS signal to adjust the master clock frequency. When you use a GPS or GLONASS signal to adjust the master clock, the calibration can be performed while the instrument is in service, which avoids any system downtime or any warm-up period.

If you do not have Option GPS installed or if you do not have access to a GPS or GLONASS signal, you will need to take the instrument out of service to adjust the master clock using an input from a frequency generator.

How to adjust the oven oscillator using GPS and/or GLONASS

If your SPG8000 has Option GPS installed, perform the following procedure to use GPS and/or GLONASS to set the internal frequency of the instrument internal oscillator. This procedure can be done without any disruption to operation and is best performed in the operating environment of the instrument.

CAUTION. *For instruments in service: To prevent inaccurate calibration, be sure the instrument is warmed up and locked to a GPS and/or GLONASS signal for at least 20 minutes before you perform this procedure. The instrument requires a 20 minute warm-up time in a +20 °C to +30 °C environment before it is adjusted. Adjustments done before the operating temperature has stabilized may cause errors in performance.*

1. Press the **STATUS** button to access the STATUS menu.
2. Use the up (▲) or down (▼) arrow button to check that there are no faults or alerts reported.
3. If you are adjusting the oven oscillator with the instrument in service, proceed to step 12. Otherwise, perform the next step.

CAUTION. *To prevent problems with the output signals, do not perform steps 4-9 while your instrument is in service.*

4. Press the **REF** button to access the REFERENCE menu.
5. Press the left (◄) or right (►) arrow button to select **GPS Signal** as the reference source.
6. Press the **ENTER** button to confirm the selection. A bullet appears in front of the readout to indicate the current selection.
7. Press the up (▲) arrow button to select **REFERENCE : GPS CONSTELLATION**.
8. Press the left (◄) or right (►) arrow button to select **GPS & GLONASS**.
9. Press the **ENTER** button to confirm the selection. A bullet appears in front of the readout to indicate the current selection.
10. Let the instrument warm up for 20 minutes with the GPS signal connected before proceeding.
11. Press the **STATUS** button to access the STATUS menu.
12. Press the up (▲) arrow button to select **STATUS : REFERENCE : GPS**.
13. Check that the status readout shows **Locked**.

14. Check the signal lock indicator and check the tune setting:
    a. Press the **SYSTEM** button to access the SYSTEM menu.
    b. Press the up (▲) arrow button to select **SYSTEM : DIAGNOSTICS**.
    c. Press the **ENTER** button to access the DIAGNOSTICS menu.
    d. Check that **Fine** is showing on the right side of the TUNE readout on the LCD display.
    e. Check the Tune readout value. If the value is greater than ±0.10e–6, then you need to calibrate the oven oscillator. If the value is less than ±0.10e–6, then no calibration is required.
    f. Press the **BACK** button to exit the DIAGNOSTICS menu.
15. If you need to calibrate the oscillator, press the up (▲) arrow button to select **SYSTEM : CALIBRATE OVEN**.
16. Press the **ENTER** button to access the **Internal Frequency Calibration** submenu.
17. In the **Execute Calibration?** confirmation display, press the **ENTER** button to start the calibration. The instrument will display the stored calibration value.
18. Press the **ENTER** button.
19. Press the **BACK** button to exit the calibration menu when the calibration is complete.
20. Verify the calibration:
    a. Press the **SYSTEM** button to display the SYSTEM menu.
    b. Press the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS**, and then press the **ENTER** button to access the DIAGNOSTICS submenu.
    c. Press the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS : CALIBRATION**.
    d. Check that the CAL value is less than **2.5 e^{-6}**.

NOTE. *If the CAL value is greater than 2.6 e^{-6}, then the oscillator oven may need to be serviced.*

How to adjust the oven oscillator without GPS

If your SPG8000 does not have Option GPS installed, perform the following procedure to use a signal generator to set the internal frequency of the instrument internal oscillator. This procedure requires that you take the instrument out of service in order to adjust the master clock.

CAUTION. *To prevent inaccurate calibration, be sure the instrument is warmed up for at least 20 minutes before you perform this procedure. The instrument requires a 20 minute warm-up time in a +20 °C to +30 °C environment before it is adjusted. Adjustments done before the operating temperature has stabilized may cause errors in performance.*

In addition, be sure the signal generator is allowed an appropriate warm-up time to meet the frequency accuracy.

Required equipment. The following table lists the equipment required to adjust the master clock frequency using a frequency signal generator.

Table 36: Equipment required to adjust the SPG8000 master clock using a signal generator

Item	No.	Minimum requirement	Recommended equipment
Frequency standard	1	Frequency: 10 MHz ±1×10^{-9} Amplitude: 8 dBm	Tektronix GPS7 locked to GPS, GLONASS or equivalent Spectracom/Pendulum 6689
75 Ω BNC cable	1	Length: 42 inches	Tektronix part number 012-0074-00
75 Ω termination	1		Tektronix part number 011-0163-00

Procedure. Perform the following steps to use a signal generator to set the frequency of the SPG8000 internal oscillator.

1. Set the output of the frequency generator as follows:

   Frequency: 10.000000 MHz
   Output level: 8 dBm

2. Use the 75 Ω BNC cable to connect the REF connector on the SPG8000 generator to the output of the frequency generator as shown in the following figure.

NOTE. *You can use a Tektronix TG700 or TG8000 signal generator with a GPS7 module installed to produce the 10 MHz frequency standard.*

In this case, ensure that the GPS7 module is locked to a GPS or GLONASS signal in fine mode. Configure the Black 3 output of the GPS7 module to output a 10 MHz sine wave. Connect the GPS7 module Black 3 output to the REF input on the SPG8000 you are testing.

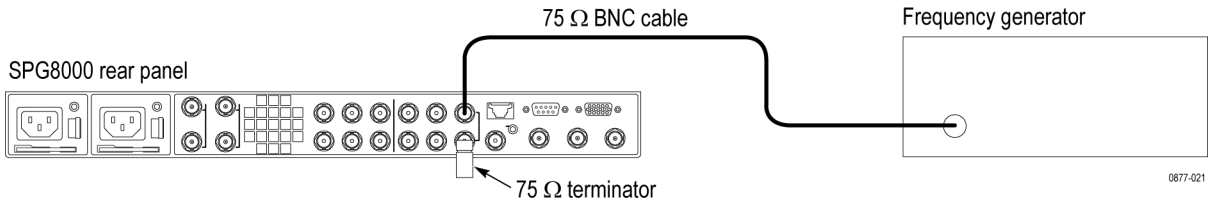


Figure 39: Connection for adjusting the SPG8000 master clock using a frequency generator

3. Connect a 75 Ω termination to the other REF connector on the SPG8000 generator.
4. Restart the instrument in Factory mode:
   a. Press and hold the **STATUS**, **ENTER**, and **Front Panel ENABLE** buttons simultaneously.
   b. Continue holding the buttons until the message **SPG8000 Booting...** displays.
   c. When the message **SPG8000 Booting...** displays, release the **STATUS** and **ENTER** buttons. Continue holding the **Front Panel ENABLE** button.
   d. When the message **SPG8000 Start up with Factory Mode** displays, release the **Front Panel ENABLE** button.
5. Let the instrument warm up for 20 minutes before proceeding.

6. Set the reference source to CW as follows:
   a. Press the **REF** button to display the REFERENCE menu.
   b. Press the left (◄) or right (►) arrow button to select **CW**, and then press the **ENTER** button.
   c. Check that the front-panel EXT LED is solid green, indicating that the instrument is locked to the signal.
7. Press the **SYSTEM** button to display the SYSTEM menu.
8. Press the up (▲) or down (▼) arrow button to select **SYSTEM : CALIBRATE OVEN**, and then press the **ENTER** button.
9. A message will be displayed asking you to verify that you want to execute the calibration. Press the **ENTER** button to proceed with the calibration.
10. Verify that the message **CALIBRATION result = xxxxxxx** is displayed. The result should be seven characters near the value of **2,097,152**. Press the **ENTER** button to exit the calibration mode.
11. Verify the calibration:
    a. Press the **SYSTEM** button to display the SYSTEM menu.
    b. Press the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS**, and then press the **ENTER** button to access the DIAGNOSTICS submenu.
    c. Press the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS : CALIBRATION**.
    d. Check that the CAL value is less than **2.5 e^{-6}**.

NOTE. *If the CAL value is greater than 2.6 e^{-6}, then the oscillator oven may need to be serviced.*

TG8000 configuration

There are two methods for calibrating the oven oscillator in the TG8000:

- Using a GPS7 module and a GPS signal
- Using an AGL7 or GPS7 module and a frequency signal generator

Oven oscillator calibration – GPS signal

NOTE. *This procedure requires that you have a GPS7 module installed in the TG8000 mainframe.*

When you install a GPS7 module into a TG8000 mainframe, it is suggested that you calibrate the mainframe oscillator oven as part of the installation and qualification process to optimize the system under the actual operating conditions. This calibration is optional for the TG8000 mainframe.

The oven calibration is performed using the CAL OVEN submenu, which is located in the UTILITY submenu of the generator main menu. The CAL OVEN submenu can be accessed in regular or factory mode.

NOTE. *Perform the mainframe internal frequency calibration at least once a year to compensate for oscillator drift. With a GPS7 module installed, this calibration can be done while the instrument is in service.*

Internal frequency calibration

Use this menu to set the internal frequency of the mainframe internal oscillator. This may be done without removing the instrument from service, allowing you to compensate for oven drift while the instrument is in its operating environment.

The mainframe oscillator is calibrated by storing the current frequency of the oscillator while it is locked to a GPS or a reference video signal. This stored frequency value is used when the instrument boots up and when there is a loss of signal lock and the instrument is configured to switch to internal timing.

The following figure shows the CAL OVEN submenu. You can find the complete internal frequency calibration procedure in the User Manual that was shipped with your product.

CAUTION. *To prevent an incorrect oscillator frequency from being stored as the calibrated value, be sure that the instrument is locked to one of the following signal sources before you run the internal frequency calibration routine: Rubidium clock, GPS antenna (GPS7 module only), or the master sync signal of your video installation.*

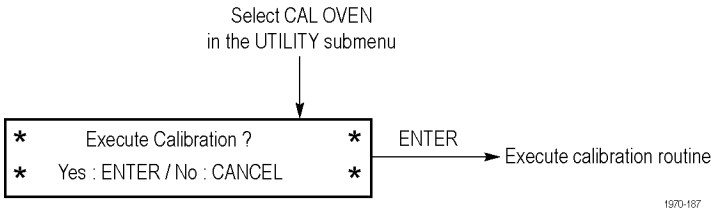


Figure 40: Mainframe internal frequency calibration menu

Press the **ENTER** button to execute the oscillator frequency calibration routine or press the **CANCEL** button to exit the menu.

To calibrate the internal frequency

Perform the following procedure to set the internal frequency of the mainframe internal oscillator. This adjustment stores the current frequency of the oscillator while it is locked to a GPS signal. It is stored for used when the instrument is set to **Internal** mode. This procedure can be done without any disruption to operation and is best performed in the operating environment of the instrument.

1. If your instrument is in servce, proceed to step 6.
2. Connect the power cord to the TG8000 mainframe.
3. Check for error messages as the instrument starts.
4. Connect a GPS signal to the rear of the module.
5. Allow the instrument to warm up for a minimum of 20 minutes.
6. Press the **MODULE** button until **GPS7 : STATUS** appears.
7. Check that the signal status shows **Locked**.
8. Check that signal lock indicator displays **Fine**:
   a. Press the up (▲) arrow button to select **DIAGNOSTICS**.
   b. Press the **ENTER** button.
   c. Press the right (►) arrow button to select **TUNE**.
   d. Check that **Fine** is showing on the right side of the LCD display.
9. Press the **MODULE** button until **TG8000** appears.
10. Press the up (▲) arrow button to select **UTILITY**.
11. Press the **ENTER** button.
12. Press the up (▲) arrow button to select **CAL OVEN : SELECT**.
13. Press the **ENTER** button to access the **Internal Frequency Calibration** submenu.
14. Press the **ENTER** button to start the calibration. The instrument will display the stored calibration value.

15. Press the **ENTER** button.
16. Press the **BACK** button to exit the calibration menu when the calibration is complete.
17. Verify the calibration:
    a. Press the **MODULE** button until **TG8000 : PRESET** is displayed.
    b. Press the up (▲) or down (▼) arrow button to select **UTILITY**, and then press the **ENTER** button to access the UTILITY submenu.
    c. Press the up (▲) or down (▼) arrow button to select **DIAGNOSTICS**, and then press the **ENTER** button to access the DIAGNOSTICS submenu.
    d. Press the left (◄) or right (►) arrow button to select **DIAGNOSTICS : CAL**.
    e. Check that the CAL value is less than **2.5 e^{-6}**.

NOTE. *If the CAL value is greater than 2.6 e^{-6}, then the oscillator oven may need to be serviced.*

Oven oscillator calibration – frequency signal generator

NOTE. *This procedure requires that you have a AGL7 or GPS7 module installed in the TG8000 mainframe.*

Use this procedure to adjust the frequency of the mainframe master clock if you do not have a GPS7 module or if you do not have access to a GPS signal.

Required equipment

The following table lists the equipment required to adjust the master clock frequency using a frequency signal generator.

Table 37: Equipment required to adjust the TG8000 master clock using a signal generator

Item	No.	Minimum requirement	Recommended equipment
Analog genlock module or GPS synchronization module	1		Tektronix AGL7 module or Tektronix GPS7 module
Frequency standard	1	Frequency: 10 MHz ±1×10–9 Amplitude: 8 dBm	Tektronix GPS7 locked to GPS or equivalent Spectracom/Pendulum 6689
75 Ω BNC cable	1	Length: 42 inches	Tektronix part number 012-0074-00

Procedure Perform the following procedure to adjust the master clock frequency using a frequency standard.

1. Set the output of the frequency standard as follows:

   Frequency: 10.000000 MHz
   Output level: 8 dBm

2. Use a 75 Ω BNC cable to connect the output of the frequency standard to one of these connectors:

   - CW connector on the AGL7 module
   - BLACK 1 / REF IN connector on the GPS7 module

NOTE. *You can use a Tektronix TG700 or TG8000 signal generator with a GPS7 module installed to produce the 10 MHz frequency standard.*

In this case, ensure that the GPS7 module is locked to a GPS signal in fine mode. Configure the Black 3 output of the GPS7 module to output a 10 MHz sine wave. Connect the GPS7 module Black 3 output to the CW input on the AGL7 module of the TG8000 you are testing.

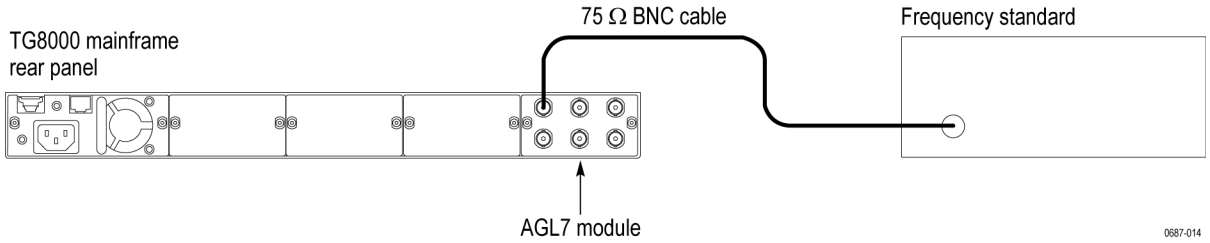


Figure 41: Connection for adjusting the TG8000 master clock using a frequency standard (AGL7 module shown)

3. Restart the instrument in Factory mode:

   a. Press and hold the **MODULE**, **ENTER**, and **Front Panel ENABLE** buttons simultaneously.

   b. Continue holding the buttons until the message **TG8000 Booting...** displays.

   c. When the message **TG8000 Booting...** displays, release the **MODULE** and **ENTER** buttons. Continue holding the **Front Panel ENABLE** button.

   d. When the message **TG8000 Start up with Factory Mode** displays, release the **Front Panel ENABLE** button.

4. Let the instrument warm up for 20 minutes before proceeding.

5. Set the genlock source to CW of the AGL7 Genlock module as follows:
   a. Press the **MODULE** button to display the AGL7 main menu.
   b. Press the up (▲) or down (▼) arrow button to select **GENLOCK**, and then press the **ENTER** button to access the GENLOCK submenu.
   c. Press the left (◄) or right (►) arrow button to select **CW**, and then press the **ENTER** button.
   d. Press the **BACK** button to return to the AGL7 main menu.
6. Press the **MODULE** button until **TG8000 : PRESET** is displayed.
7. Press the up (▲) or down (▼) arrow button to select **UTILITY**, and then press the **ENTER** button to access the UTILITY submenu.
8. Press the up (▲) or down (▼) arrow button to select **CAL OVEN : SELECT**, and then press the **ENTER** button.
9. A message will be displayed asking you to verify that you want to execute the calibration. Press the **ENTER** button to proceed with the calibration.
10. Verify that the message **CALIBRATION result = xxxxxxx** is displayed. The result should be seven characters near the value of **2,097,152**. Press the **ENTER** button to exit the calibration mode.
11. Verify the calibration:
    a. Press the **MODULE** button until **TG8000 : PRESET** is displayed.
    b. Press the up (▲) or down (▼) arrow button to select **UTILITY**, and then press the **ENTER** button to access the UTILITY submenu.
    c. Press the up (▲) or down (▼) arrow button to select **DIAGNOSTICS**, and then press the **ENTER** button to access the DIAGNOSTICS submenu.
    d. Press the left (◄) or right (►) arrow button to select **DIAGNOSTICS : CAL**.
    e. Check that the CAL value is less than **2.5 e^{-6}**.

NOTE. *If the CAL value is greater than 2.6 e^{-6}, then the oscillator oven may need to be serviced.*

Network operation

ECO8000 Series networking

The ECO8000 Series has a 10/100 BASE-T Ethernet port on the rear panel that allows you to use a PC to remotely control the instrument.

This section provides instructions for connecting the ECO8000 Series to a single PC or to a network and for setting the network parameters on 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 ECO8000 Series network parameters. 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 manually enter the appropriate network parameter values.*

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.

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1. Press the front-panel **BACK** button as necessary to access the top-level Main menu.
2. Press the up (▲) or down (▼) arrow button to select **SYSTEM CONFIG**, and then press the **ENTER** button to access the SYSTEM CONFIG menu.

3. Press the up (▲) or down (▼) arrow button to select **NETWORK CONFIG**, and then press the **ENTER** button to access the NETWORK CONFIG submenu. The display shows whether DHCP is enabled or not.
4. If necessary, press the left (◄) or right (►) arrow button to select **Enable**, and then press the **ENTER** button to implement the selection.
5. Press the down (▼) arrow button to select **IP ADDRESS**.
6. The second line of the display will show an IP address after the instrument receives an address from the DHCP server. The message "Waiting for DHCP" will appear until the instrument receives the address.
7. After the display shows an IP address, press the **BACK** button to exit the NETWORK CONFIG 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 **BACK** button as necessary to access the top-level Main menu.
2. Press the up (▲) or down (▼) arrow button to select **SYSTEM CONFIG**, and then press the **ENTER** button to access the SYSTEM CONFIG menu.
3. Press the up (▲) or down (▼) arrow button to select **NETWORK CONFIG**, and then press the **ENTER** button to access the NETWORK CONFIG submenu. The display shows whether DHCP is enabled or not.
4. If necessary, press the left (◄) or right (►) arrow button to select **Disable**, and then press the **ENTER** button to implement the selection.
5. If you connected the instrument directly to a single PC:
   a. Press the up (▲) or down (▼) arrow button to select **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 **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 CONFIG submenu.

6. If you connected the instrument to your local Ethernet network:

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

   a. Press the up (▲) or down (▼) arrow button to select **IP ADDRESS**, and then press the **ENTER** button to enter the edit mode.

   b. Use the arrow buttons to set the IP address to the address supplied by your network administrator, and then press the **ENTER** button.

   c. Press the up (▲) or down (▼) arrow button to select **SUBNET MASK**, and then press the **ENTER** button to enter the edit mode.

   d. Use the arrow buttons to set the subnet mask to the address supplied by your network administrator, and then press the **ENTER** button.

   e. Press the up (▲) or down (▼) arrow button to select **GATEWAY ADDRESS**, and then press the **ENTER** button to enter the edit mode.

   f. Use the arrow buttons to set the gateway address to the address supplied by your network administrator, and then press the **ENTER** button.

   g. Press the **BACK** button to exit the NETWORK CONFIG submenu.

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

Web user interface

After you have configured the network settings and have enabled the Web user interface in the SYSTEM CONFIG menu, you can use a Web browser to remotely access the instrument. To open the Web user interface, enter the IP address of the instrument in a supported Web browser. In the Web user interface you can click various tabs to access the instrument settings and controls as you would using the front panel buttons.

Supported Web browsers. For best results, use Google Chrome, Mozilla Firefox, Safari, or Internet Explorer 9.0 or later.

SPG8000 networking

The SPG8000 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 SPG8000 to a single PC or to a network and for setting the network parameters on the Ethernet port.

See *How to transfer user files* in the *SPG8000 Quick Start User Manual* for instructions on how to upload and download user files using the Ethernet port.

Connecting the SPG8000 to your PC(s)

The SPG8000 uses the rear-panel Ethernet port to communicate with a PC or network. You can use one of the following two methods to connect the SPG8000 to your PC(s):

- If you are connecting the SPG8000 directly to a single PC, use an Ethernet cable to connect between the Ethernet port on the SPG8000 and the Ethernet port on the PC.
- If you are connecting the SPG8000 to your local Ethernet network, use an Ethernet cable to connect between the Ethernet port on the SPG8000 and the Ethernet hub port of your local network. By connecting to an Ethernet network, you can access the SPG8000 using any PC on the network.

To configure the network parameters

The following two procedures describe how to configure the SPG8000 network parameters. 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 SPG8000 is connected to the network and DHCP service is enabled, the SPG8000 obtains the necessary network addresses automatically from the DHCP server.

NOTE. *Under some network environments, the SPG8000 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.

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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 SPG8000 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 SPG8000 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 SPG8000 to your local Ethernet network.*

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

Web user interface

After you have configured the network settings and have enabled the Web user interface in the SYSTEM menu, you can use a Web browser to remotely access the instrument. To open the Web user interface, enter the IP address of the instrument in a supported Web browser. In the Web user interface you can click various tabs to access the instrument settings and controls as you would using the front panel buttons.

Supported Web browsers. For best results, use Google Chrome, Mozilla Firefox, Safari, or Internet Explorer 9.0 or later.

TG8000 networking

Connecting to a network

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

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

Refer to the *PC Tools Technical Reference* for detailed information about how to upload and download files using the Ethernet port.

Connecting the generator to your PC(s)

The generator uses the rear-panel Ethernet port to communicate with a PC or network. You can use one of the following two methods to connect the generator to your PC(s):

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

Setting Ethernet network parameters

Use the NETWORK SETUP submenu to set the network parameters for the generator.

Accessing the NETWORK SETUP submenu.

Perform the following procedure to access the NETWORK SETUP submenu:

1. Press the front-panel **MODULE** button repeatedly to display the mainframe main menu.
2. Use the up (▲) or down (▼) arrow button to select **UTILITY**, and then press the **ENTER** button. This accesses the UTILITY submenu.
3. Use the up (▲) or down (▼) arrow button to select **Network**.
4. Use the left (◄) or right (►) arrow button to select **Setup**. This accesses the NETWORK SETUP submenu.

Setting the parameters on a network with a DHCP server. If your network has a DHCP server, use the NETWORK SETUP submenu to enable the generator to function as a DHCP client. When the generator is connected to the network and DHCP service is enabled, the generator obtains the necessary network addresses automatically from the DHCP server.

NOTE. *Under some network environments, the generator 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.

Setting the parameters on 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. If you connect the generator directly to a single PC:
   a. Set the **IP ADDRESS** parameter to be the same IP address as the PC's address except for the last number. The last number must be different than the last number in the PC's IP address.
   b. Set the **SUBNET MASK** parameter to be the same net mask (subnet mask) used by the PC. Do not enter a number if the PC does not have a net mask.
   c. You do not need to enter a **GATEWAY ADDR** if you are directly connected to a single PC.
2. If you connect the generator 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 generator to your local Ethernet network.*

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

TGSetup utility

After you have configured the network settings, you can use the TG Setup utility to set parameters on the TG8000 and the installed modules. When you open the TG Setup utility on your PC and enter the IP address of your TG8000, the TG Setup window opens and the front-panel buttons of the TG8000 are disabled.

In the TG Setup window you can click various tabs to access the instrument or module settings and controls as you would using the front-panel buttons. For more information about the TG Setup utility, see the *TG8000 PC Tools Technical Reference* (Tektronix part number 077-0684-xx).

Appendix A: Using Stay GenLock®

Digital video systems require synchronization and test signal sources with low jitter and high stability. The AGL7 and GPS7 modules of the Tektronix TG8000 generator and the SPG8000 Master Sync / Master Clock Reference Generators include the Stay GenLock technology, which provides a robust reference signal solution for broadcast and post-production facilities.

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

For more information about the Stay GenLock function, refer to the *Using Stay GenLock* application note (part number 20W-23500-0), which can be located on the Tektronix Web site (www.tektronix.com).

Enabling Stay Genlock® on the SPG8000

To enable the Stay GenLock function on the SPG8000 generator, perform the following steps:

1. Press the front-panel **REFERENCE** button to access the REFERENCE menu.
2. Use the up (▲) or down (▼) arrow button to display **REFERENCE : LOCK LOSS ACTION**.
3. Use the left (◄) or right (►) arrow button to display **Stay at Current Frequency**, and then press the **ENTER** button to confirm the selection.

Lock recovery. The SPG8000 generator includes settings for selecting how the instrument timing responds when the reference signal is recovered after a loss of lock. Perform the following steps to select the recovery mode.

1. Press the front-panel **REFERENCE** button to access the REFERENCE menu.
2. Use the up (▲) or down (▼) arrow button to display **REFERENCE : GPS HOLDOVER RECOVERY**.
3. Use the left (◄) or right (►) arrow button to select one of the following modes, and then press the **ENTER** button to confirm the selection.

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

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

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

- Jam Phase: Adjusts the instrument timing to match the recovered GPS signal immediately but will typically cause a sync "shock" to the system.
- Fast Slew: Adjusts the instrument timing to match the recovered GPS signal at a rate 25 times faster than the legal rate without jumping.

Enabling Stay GenLock® on the TG8000

The TG8000 has two modules that support the Stay GenLock function: AGL7 and GPS7.

AGL7 module

To enable the Stay GenLock function on a AGL7 module installed in a TG8000, perform the following steps:

1. Press the front-panel **MODULE** button until the **AGL7** main menu appears.
2. Use the up (▲) or down (▼) arrow button to display **GENLOCK**, and then press the **ENTER** button to enter the Genlock submenu.
3. Use the up (▲) or down (▼) arrow button to display **GENLOCK: LOCK LOSS ACTION**.
4. Use the left (◄) or right (►) arrow button to display **Stay Current Frequency**, and then press the **ENTER** button to confirm the selection.

GPS7 module

To enable the Stay GenLock function on a GPS7 module installed in a TG8000, perform the following steps:

1. Press the front-panel **MODULE** button until the **GPS7** main menu appears.
2. Use the up (▲) or down (▼) arrow button to display **REFERENCE**, and then press the **ENTER** button to enter the Reference submenu.
3. Use the up (▲) or down (▼) arrow button to display **REFERENCE: LOCK LOSS ACTION**.
4. Use the left (◄) or right (►) arrow button to display **Stay Current Frequency**, and then press the **ENTER** button to confirm the selection.

Lock recovery. The GPS module includes settings for selecting how the module timing responds when the reference signal is recovered after a loss of lock. Perform the following steps to select the recovery mode.

1. Press the front-panel **MODULE** button until the **GPS7** main menu appears.
2. Use the up (▲) or down (▼) arrow button to display **REFERENCE**, and then press the **ENTER** button to enter the Reference submenu.

3. Use the up (▲) or down (▼) arrow button to display **REFERENCE: GPS HOLDOVER RCVRY**.
4. Use the left (◄) or right (►) arrow button to select one of the following modes, and then press the **ENTER** button to confirm the selection.

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

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

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

- Jam Phase: Adjusts the module timing to match the recovered GPS signal immediately but will typically cause a sync "shock" to the system.
- Fast Slew: Adjusts the module timing to match the recovered GPS signal at a rate 25 times faster than the legal rate without jumping.

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