SPG8000
Master Sync / Clock Reference Generator
Specifications and Performance Verification

Technical Reference

077-0748-00

Tektronix

SPG8000
Master Sync / Clock Reference Generator
Specifications and Performance Verification

Technical Reference

This document applies to firmware version 1.1 and above.

www.tektronix.com

077-0748-00

Tektronix

Contacting Tektronix

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

For product information, sales, service, and technical support:

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

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THE PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

[W2 – 15AUG04]

Table of Contents

List of Figures

List of Tables

General safety summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To avoid fire or personal injury

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

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

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.

Power disconnect. The power cord disconnects the product from the power source. Do not block the power cord; it must remain accessible to the user at all times.

Do not operate without covers. Do not operate this product with covers or panels removed.

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

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

Wear eye protection. Wear eye protection if exposure to high-intensity rays or laser radiation exists.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

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

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.

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

CAUTION
Refer to Manual

Protective Ground
(Earth) Terminal

Preface

This manual describes the specifications and performance verification procedures for the SPG8000 Master Sync / Clock Reference Generator, with or without all of the available options.

This manual is divided into two sections:

- *Specifications* provides physical and electrical characteristics
- *Performance verification* provides procedures to verify the warranted characteristics of the base unit and all options.

Related user documents

The following table contains a list of documents that include user information about the SPG8000 generator.

			Availability		
Document	**Tektronix Part Number**	**Description**	**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 (this document)	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		✓	
Video Sync Pulse Generator and Electronic Changeover Unit System Integration Technical Reference	077-0563-xx	Provides information for system integrators who are designing systems for high-definition (HD) and standard-definition (SD) digital video content where Tektronix electronic changeover units and video sync pulse generators are to be deployed.		✓	✓

Specifications

The information in this section provides electrical, mechanical, and environmental specifications for the SPG8000 generator.

The performance requirements listed in the electrical characteristics portion of these specifications apply over an ambient temperature range of 0 °C to +50 °C. The rated accuracies are valid when the instrument is calibrated at an ambient temperature range of +20 °C to +30 °C, after a warm-up time of 20 minutes.

SPG8000 base unit specifications

The following tables list certification and compliance information, and the electrical, environmental, and mechanical characteristics of the SPG8000 base unit.

Table 1: Timebase characteristics

Characteristic	Performance requirements	Reference information
Frequency accuracy in Internal mode	±135 x 10^{-9} over 1 year calibration interval	After 20 minute instrument warm up. Includes drift and temperature variation. Initial setting after adjustment will typically be within 10 x 10^{-9}.
Frequency accuracy over temperature	±2 x 10^{-9} for ±5 °C variation, ±10 x 10^{-9} for 0 to 50 °C	
Frequency drift, aging	< ±100 x 10^{-9} per year for internal, stay current frequency and stay genlock modes at constant temperature	
Frequency variation from vibration and shock	±25 x 10^{-9} typical from 6 ms half-sine shocks over 20 g	
Genlock range	±7.5 x 10^{-6}	

Table 2: Interface characteristics

Characteristic	Performance requirements	Reference information
Keyboard		17 buttons with green LED backlight, 6 Fault indicators with Red / Green backlight.
Display		LCD with 2 line x 40 characters with backlight, 153 x 15 mm active area.
Ethernet functionality	1000base-T, 100BASE-TX and 10BASE-T Compliant with IEEE 802.3-2000 and ANSI X3.263-1995 standards	
Ethernet connector	8P8C connector supporting 10/100 BaseT	The 8P8C (also known as RJ45) connector has built in LEDs. The Green LED indicates an active connection. The Yellow LED indicates speed. ON = 100, OFF = 10. Wiring follows TIA/EIA-568-B T568A standard Ethernet pin assignments.
GPI		General Purpose Interface for uses such as setting presets or driving alarms. The 15 pin connection has 1 configurable input and 2 configurable outputs. The 9 pin carries the same signal as the 15 pin plus three inputs used to select presets and one more configurable output.
Logical functions		The function of some of the input and outputs may be set from the user interface.
Ground closure		
Input signaling	TTL thresholds of 0.8 V low and 2.0 V high, 5 V max input, –0.5 V min input. Pull low to assert.	Has internal 10 kΩ pull-up to +5 V on each input.
Input timing	Inputs must be asserted and stable for at least 60 ms to be recognized reliably. Inputs that are stable for 40 ms or less will not be recognized.	
Output characteristics	Three open collector outputs	Has internal 10 kΩ pull-up to +5 V. Max current allowed is 100 mA. On resistance is approximately 4 Ohms
Maximum output current	250 mA	On resistance is approximately 4 Ohms
Output duration	Signal alarms asserted as long as the error condition exists. Timer based outputs asserted for the 1 second that the selected time counter matches the user defined time.	
USB		
Type	Host	
Speed	USB 1.0 and 2.0 full-speed (12 Mb/s)	

Table 3: Power characteristics

Characteristic	Performance requirements	Reference information
AC power source		
Rating voltage	100 V to 240 V	***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	50/60 Hz	
Maximum power	130 VA	Actual power varies with type and number of modules installed. Base instrument without modules typically draws 20 watts.
Surge current, typical	20 A peak (25 °C) for ≤ 5 line cycles, after the instrument has been turned off for at least 30 seconds.	
Inrush current, typical	10 A RMS half cycle at initial turn on as per EN55103-1:2009 Annex B.	
Supply connection	Detachable IEC cord set, locking versions available for some geographies.	Locking cords for: USA, Japan, UK, Europe, Switzerland, China, and Australia.
Dual supply hot swap	The instrument can run with either or both supplies. Any plugging or un-plugging supplies or AC input to the supplies will not cause disruption in the system, as long as at least one supply is active. The supplies take 1-2 sec to power up after AC is applied.	
Dual supply operation	When two supplies are present, one will be used to power the instrument and the other will be in an unloaded backup mode.	Keeping the backup supply unloaded minimizes its aging and maximizes the life available if the primary supply fails.
Power supply life tracking	Each supply maintains a usage history, which provides the ability to recommend replacement. Each supply tracks the time in use, the time in standby, and the Temperature Weighted Hours calculation that helps predict the end of life on the supply. The Temperature Weighted Hour calculation uses the temperature at each hour to predict the failure point on the supply.	
Power supply life expectancy, typical	15 years (131,400 hours) at 25 °C outside air, 5 years at 50 °C outside air temperature.	The Temperature Weighed Hours calculation accounts for the aging acceleration at higher temperatures and normalizes it to hours at 25 °C.
Power supply load testing	The backup supply will periodically be tested to insure it can support the instrument load should the primary supply fail. This load is approximately 55 watts and is applied for about 6 sec.	

Table 4: Black and sine outputs

Characteristic	Performance requirements
Number of outputs	Three outputs, all can be black, or Black #3 can be configured as 10 MHz sine wave. Black #2 can be configured to blank during certain errors to trigger an ECO change-over.
Formats	Each output is individually selectable between Bi-level NTSC with or without field ref, NTSC No setup with or without field pulse, PAL with or without field ref, or Tri-level. The base outputs can only generate tri-leval at one clock rate, so all three can be any one of the two sets: Set 1: 1080i59.94, 720p59.94, 1080p23.98, 1080sf23.98. Set 2: 1080p29.97 1080i60, 1080i50, 720p60, 720p50, 1080p24, 1080p30, 1080sf24, 1080p25.
Standards supported	RS170A, SMPTE RP154, SMPTE318M, EBU N14, SMPTE240M, 274M, 296M, and RP211.
Output impedance	75 Ohms
Return loss, typical	40 dB from 300 kHz to 5 MHz, 30 dB to 30 MHz
Amplitude in DC output mode	±1% on difference of 0 and 700 mv DC levels
Amplitude	Standard level for selected format ±2%
Offset	0 ±50 mV
Offset in DC output mode	0 ±40 mV
Bi-Level sync rise and fall time, typical	140 ns for NTSC, 250 ns for PAL
Tri-Level sync rise and fall time, typical	50 ns
SCH	±5 deg for NTSC and PAL
Timing adjust composite	Each output individually adjustable over ± ½ the color frame with 0.5 deg of subcarrier resolution.
Timing Adjust HD rates	Each output individually adjustable over ±½ the frame with <20 ns resolution.
Signal-to-Noise ratio, typical	>60 dB RMS noise relative to 700 mV. DC to 20 MHz.
Sine output amplitude	1.5 V_{p-p} ±10%

Table 5: LTC outputs

Characteristic	Performance requirements
Formats	23.98, 24, 25, 30, 30 drop as per SMPTE 12M
Output level accuracy	5 V ±10% at max level. Differential into 600 Ω
Output level range	Adjustable from 0.5 to 5 V into 600 Ω
Output level adjust resolution, typical	0.5 V steps
Output rise and fall time, typical	40 µs
Output Impedance	30 Ω for each output
Output load	600 nominal, 150 min
Timing adjust range	±1 half a frame for selected format
Timing adjust resolution	10 µs steps
Timecode offset range	24 hours
Timecode offset resolution	1 frame

Table 6: Genlock, VITC and LTC input

Characteristic	Performance requirements
Genlock input type	Two 75 Ω BNC connectors; passive loop through
Genlock input formats	Bi-Level NTSC, NTSC with SMPTE318 10 field flag, PAL; Tri-level HD 1080i59.94, 1080i50, 720p59.94, 720p60, 1080p23.98, 1080p24. 1080p29.97, 1080p30, 1080p25; CW 10 MHz
Genlock input video signal level range, typical	-8 to +6 dB with nominal operation
Genlock input CW signal level range, typical	0.5 to 2 V_{p-p} signal
Genlock input DC tolerance	+5 V max or damage may occur
Genlock hum tolerance	-3 dB of 50 or 60 Hz hum
Genlock white noise tolerance	-33 dB Min SNR of 5 MHz BW noise
Genlock SCH tolerance	+40 deg
Genlock return loss, typical	≥ 30 dB from 300 kHz to 10 MHz
Jitter in NTSC and PAL Burst Lock, typical	<0.5° with ±3 dB amplitude change and >40 dB S/N ratio
Jitter in Tri- level Sync Lock, typical	<1 ns with ±3 dB amplitude change and >40 dB S/N ratio
Jitter in CW Lock, typical	<1 ns with 1 V_{p-p} ±3 dB amplitude change and >40 dB S/N ratio
LTC input	LTC1 output can be configured as an input
LTC input – formats supported	23.98, 24, 25, 29.97 drop frame, and 30 Hz
LTC input – timing to video	To correctly associate the LTC with a given video frame, the LTC start bit should be from 32 µs before to 160 µs after the start of the first broad pulse in vertical blanking of a compatible frame rate being used as the genlock input. This is as specified in SMPTE12M Will accept input timing anywhere in the frame, however near the middle of the video frame the timing may be interpreted as related to the previous or next video frame. A status screen indicates the detected timing in ms
LTC input – signal voltage range	0.5 to 10 V_{p-p} differential, 1 V to 5 V_{p-p} single ended
LTC input – noise tolerance	-30 dB SNR RMS white noise with 10 kHz BW to the p-p signal level, or -10 dB SNR for 5 MHz white noise
LTC input – hum tolerance	0 dB hum to signal ratio
LTC input – error immunity	100 consecutive frames with consistent time code must be detected for time to be considered valid
LTC input impedance, typical	Nominal 600 Ω differential, 300 Ω single-ended
VITC – video formats supported	+VITS can be decoded from NTSC and PAL as per SMPTE 12M-1 2008
VITC – lines on which VITC is detected	+VITC is detected on lines 6 to 22 for all formats (ERI) 12M specified range for NTSC is lines 10 to 20
VITC – timing in line	VITC conforming to the standard timing will be detected. VITC slightly outside the normal timing range may also be detected, but it must not run into burst or sync
VITC – allowed video SNR	VITC will be correctly decoded for signals with more than 30 dB SNR

Table 7: Word clock output specifications

Characteristic	Description
Connector	BNC
Output	48 kHz clock
Output level range and coupling	Selectable as 1 V AC coupled or 2.5 V DC coupled into 75 Ω. Unterminated, this gives 2 V or a 5 V swing
Output rise and fall time, typical	33 ns
Output Impedance	75 Ω
Return loss, typical	46 dB to 10 MHz
Association to video	May be configured to be phased up with any of the three internal frame pulses
Alignment to video, typical	At default timing, a positive going Word Clock transition will align to the appropriate event in the selected video signal within ±1.0 µs

Table 8: SPG8000 environmental characteristics

Characteristic		Description
Temperature	Operating	0 °C to +50 °C, with 15 °C/hour maximum gradient, noncondensing, derated 1 °C per 300 m above 1,500 m altitude.
	Nonoperating	–20 °C to +60 °C, with 15 °C/hour maximum gradient, without disk media installed in disk drives.
Relative Humidity	Operating	20% to 80% at up to +30 °C, maximum wet-bulb temperature of +29 °C (derates relative humidity to 20% relative humidity at +50 °C)
	Nonoperating	5% to 90% (relative humidity) at up to +40 °C, maximum wet-bulb temperature of 40.0 °C (derates relative humidity to 30% relatgive humidity at +60 °C)
Altitude	Operating	To 3.0 km (10,000 feet) Maximum operating temperature decreases 1 °C each 300 m above 1.5 km.
	Nonoperating	To 15 km (50,000 feet)
Vibration	Operating	0.27 G_{RMS}, 5 Hz to 500 Hz, 10 min per axis, three axes
	Nonoperating	2.28 G_{RMS}, 5 Hz to 500 Hz, 10 min 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)
Clearance	Side	5 cm
	Rear	5 cm

Table 9: SPG8000 mechanical characteristics

Characteristic		Description
Dimensions	Height	44 mm (1.7 in)
	Width	483 mm (19 in)
	Depth	567 mm (22.3 in)
Weight [1], net		Approximately 6 kg (base unit only, without rack rail)

Table 9: SPG8000 mechanical characteristics (cont.)

Characteristic	Description
Shipping weight	Typical packaged weight of product: 10.635 kg.
Package dimensions	23 in. W x 30 in. L x 10.5 in. H

1 Weight of the SPG8000 base unit varies depending on the number and type of modules installed.

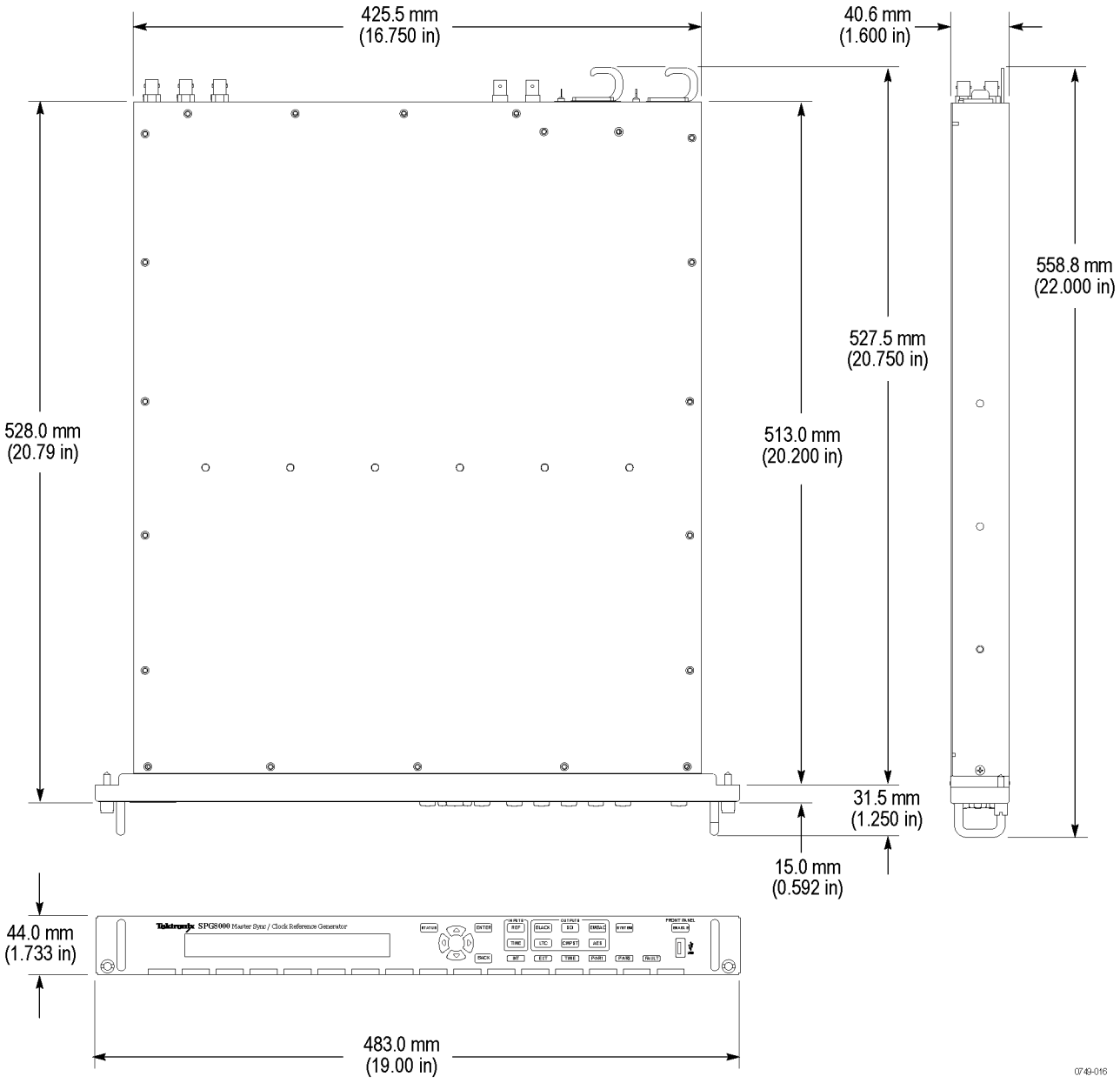


Figure 1: SPG8000 dimensions

Option BG specifications

The following tables list the electrical characteristics and the environmental characteristics of the BG Option.

Table 10: Black and Composite outputs

Characteristic	Performance requirements	Reference information
Connector	BNC	
Number of Black outputs	2	BLACK4 and BLACK5
Formats on Black outputs	Each output is individually selectable between Bi-level NTSC with or without field ref, NTSC No setup with or without field pulse, PAL with or without field ref, or Tri-level. The BG option outputs can only generate tri-leval at one clock rate, so both can be any one of the two sets: Set 1: 1080i59.94, 720p59.94, 1080p23.98, 1080sf23.98. Set 2: 1080p29.97 1080i60, 1080i50, 720p60, 720p50, 1080p24, 1080p30, 1080sf24, 1080p25	
Number of Composite Outputs	2	CPST 1 and CPST 2
Composite formats	NTSC, NTSC No setup, PAL	
Output impedance	75 Ω	
Return loss, typical	≥ 30 dB	To 30 MHz
Sync amplitude accuracy		
NTSC	287 mV ± 2%	
PAL	300 mV ± 2%	
Tri-Level	300 mV ± 2%	
Composite outputs luminance amplitude		
NTSC	714 mV ±1%	
PAL	700 mV ±1%	
Tri-Level	700 mV ±1%	
Sync and Composite amplitude in DC output mode	±1% on the difference between the 0 and 700 mv DC levels	
Chroma Luma gain match	2% on Composite test outputs	
Blanking level	<± 50 mV	
Blanking level in DC output mode	± 10 mV	
Bi-Level Sync rise and fall time for Black and Composite outputs, typical		
NTSC	140 ns	
PAL	250 ns	
Tri-Level Sync rise and fall time for Black outputs, typical	50 ns	
SCH phase accuracy	0° ± 5°	
Timing offset		

Table 10: Black and Composite outputs (cont.)

Characteristic	Performance requirements	Reference information
Range	One full color frame	
Resolution		
Bi-Level	≈18.5 ns	
Tri-Level	≈13.5 ns	

Option AG specifications

The following tables list the electrical and environmental characteristics of the AG Option.

Table 11: AES/EBU Serial Digital Audio outputs and Silence outputs

Characteristic		Performance requirements	Reference information
Connector		4 for Unbalanced AES	BNC
		1 for DARS	BNC
Number of channels		8 for AES	
		2 for DARS	
Audio tone	Frequency	The AES channels may be independently set to any of these 30 discrete settings: 50, 100, 150, 200, 250, 300, 400, 500, 600, 750, 800, 1 k, 1.2 k, 1.5 k, 1.6 k, 2 k, 2.4 k, 3 k, 3.2 k, 4 k, 4.8 k, 5 k, 6 k, 8 k, 9.6 k, 10 k, 12 k, 15 k, 16 k, 20 kHz	
	Level	0 to –60 dBFS in 1 dB steps	
Pre-emphasis		None	
Output level		1 V ± 0.1 V into 75 Ω	Measured across 75 Ω.
Output offset		< 50 mV into 75 Ω	
Required receiver termination		75 Ω ± 10%	
Jitter		<20 ns	
Rise and fall times		37 ps ±7 ps, 10 to 90%	Measured from the 10% to 90% points.
Timing Range		±160 ms relative to the selected video frame	
Timing Resolution		1 µs	

Option SDI specifications

The following tables list the electrical, mechanical, and environmental characteristics of the SDI Dual Channel SD/HD/3G SDI Video Generator option.

Table 12: Option SDI serial video outputs

Characteristic	Performance requirements	Reference information
Video channels	2	The two channels may be independently set for bit rate, format, color space, and others.
Video outputs	4, 2 per channel	
Format	Supports SD, HD, and 3Gb signals. Compatible with SMPTE 25, SMPTE 259, SMPTE 274, SMPTE 292, SMPTE 296, SMPTE 424M, SMPTE 425M, and ITU-R BT601.	The following tables list the supported formats and sample structures: (See Table 15 on page 14.) (See Table 16 on page 14.) (See Table 17 on page 14.) (See Table 18 on page 14.) (See Table 19 on page 14.) (See Table 20 on page 14.) (See Table 21 on page 14.) (See Table 22 on page 15.) (See Table 23 on page 15.) (See Table 24 on page 15.) (See Table 25 on page 15.)
Output type	75 Ω BNC	
Output level	800 mV_{p-p} ±3% on level after ringing has settled 18 to 28 °C range	Measure on 20 Bit square wave in calibration mode
Output level variation with temperature, typical	±1% typical for 0 to 50 °C.	
Rise and fall times for HD and 3Gb	135 ps max. (20% to 80%) measured between runs of at least 3 bits times of constant level.	70 ps typical
Rise and fall times for SD	400 ps min and 1000 ps max (20% to 80%) measured between runs of at least 3 bits times of constant level.	700 ps typical
3Gb alignment jitter, typical	40 ps p-p	0.12 UI
3Gb timing jitter, typical	80 ps p-p	0.24 UI
HD alignment jitter, typical	40 ps p-p	0.06 UI
HD timing jitter, typical	80 ps p-p	0.12 UI
SD alignment jitter, typical	200 ps p-p	0.054 UI
SD timing jitter, typical	200 ps p-p	0.054 UI
Return loss, typical	≥20 dB	5 MHz to 2.0 GHz
	≥12 dB	2.0 GHz to 3 GHz
Overshoot, typical	≤1%	

Table 12: Option SDI serial video outputs (cont.)

Characteristic	Performance requirements	Reference information
DC shift during HD and 3Gb mode 32 µs pathological pattern, typical	≤ 25 mV	Amount of shift depends on video format. Many 3Gb formats will be less than ½ of this.
Signal timing, 3Gb, HD, and SD when in Zero H based digital timing mode, typical		Signals are nominally timed, so that the timing reference point on the serial output is aligned within 0.5 µs of the reference edge of an analog reference signal at the same frame rate. Vertically, the first lines with the broad pulses are aligned. Timing adjust of lines is in terms of the raster image, so for Level B signals, this corresponds to ½ of the time for the multiplexed combination of two lines.
Signal timing, HD and SD when in Legacy D to A Analog timing mode, typical		Signals are nominally timed, so that after the SDI signal is passed through a D to A conversion, the sync of the resulting analog signal is aligned within 0.5 µs of the reference edge of an analog reference signal at the same frame rate. Vertically, the first lines with the broad pulses are aligned.

Table 13: SDI7 video signal content

Characteristic	Description
Accuracy of synthesizer generated test signals, typical	0.2%
Signal rise and fall time, 3Gb 1080p 50, 59.95 and 60 signals with 148.5 MHz Luma pixel rate, typical	Y, R, G, B = 16.6 ns Cb/Cr = 33.3 ns except for RP219 which has Y, R, G, B, Cb, Cr = 27.5 ns
Signal rise and fall time, 3Gb and HD signal with 74.25 MHz and 74.176 MHz luma pixel rate, typical	Y, R, G, B = 33.3 ns Cb/Cr = 66.6 ns except for RP219 which has Y, R, G, B, Cb, Cr = 55 ns
Signal rise and fall time, SD, typical	Y = 200 ns Cb/Cr = 400 ns except for RP219 which has Y, Cb, Cr = 300 ns typical
2T pulse HAD	For 148 MHz Luma pixel rate signals, HAD = 16.66 ns. For 74 MHz Luma pixels rate signals, HAD = 33.33 ns. For SD signals at 13.5 MHz Luma pixel rate, HAD is 200 ns (2T5).

Table 14: SDI embedded audio and ancillary data

Characteristic	Description
Generator embedded audio	Embedded Audio may be inserted in the ancillary data space of the SD, HD, and 3Gb video outputs.
Number of audio channels	SD, HD and Level A 3Gb: 16 channels in 4 groups in each link; 8 AES/EBU audio pairs. Level B 3Gb: 32 channels in 4 groups in each link; 16 AES/EBU audio pairs.
Audio tones	10 Hz to 20 kHz in half Hz steps.
Audio levels	-60 to 0 dBFS in 1 dB steps.
Timecode	ATC-LTC and ATC-VITC can be inserted in the signal as a user-defined time or, if a GPS option is present, the timecode can be the time of day of the GPS.
Arbitrary ANC insertion	Arbitrary Type 2 ANC data packet with user selectable DID (8 bits, 01h-7Fh), SDID (8 bits, 01h-FFh), Data Count (DC) (numeric, 0-255 words), User Data Words (UDW) (hex, 0-3FF per word). Number of editable words in string indicated by DC value. User specifiable location (for example, HANC/VANC, line number) for this packet.
Generator ancillary data	SMPTE 352 Embedded Ancillary Data is placed on the video outputs as per SMPTE 425M.

Table 15: SDI7 SD-525 (720 × 486)

Structure			59.94i	50i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:2:2	10b	X															

Table 16: SDI7 SD-625 (720 × 576)

Structure			59.94i	50i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:2:2	10b		X														

Table 17: SDI7 HD-SDI (1920 × 1080)

Structure			59.94i	50i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:2:2	10b	X	X	X	X	X	X	X	X				X	X	X	X	X

Table 18: SDI7 HD-SDI (1280 × 720)

Structure			59.94i	50i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:2:2	10b				X	X	X	X	X	X	X	X					

Table 19: SDI7 3G Level A (1920 × 1080) (option 3G only)

Structure			50i	59.94i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:4:4	12b	X	X	X	X	X	X	X	X				X	X	X	X	X
		10b	X	X	X	X	X	X	X	X				X	X	X	X	X
YCbCr+A		10b	X	X	X	X	X	X	X	X				X	X	X	X	X
YCbCr	4:2:2	12b	X	X	X	X	X	X	X	X				X	X	X	X	X
		10b									X	X	X					
GBR	4:4:4	12b	X	X	X	X	X	X	X	X								
		10b	X	X	X	X	X	X	X	X				X	X	X	X	X
GBR+A		10b	X	X	X	X	X	X	X	X				X	X	X	X	X

Table 20: SDI7 3G Level A (1280 × 720) (option 3G only)

Structure			59.94i	50i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:4:4	10b				X	X	X	X	X	X	X	X					
YCbCr+A	4:4:4	10b				X	X	X	X	X	X	X	X					
GBR	4:4:4	10b				X	X	X	X	X	X	X	X					
GBR+A	4:4:4	10b				X	X	X	X	X	X	X	X					

Table 21: SDI7 3G Level A (2K × 1080) (option 3G only)

Structure			50i	59.94i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
XYZ	4:4:4	12b				X	X	X	X	X				X	X	X	X	X
GBR						X	X	X	X	X								

Table 22: SDI7 3G Level B (1920 × 1080) (option 3G only)

Structure			50i	59.94i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:4:4	12b	X	X	X	X	X	X	X	X				X	X	X	X	X
		10b	X	X	X	X	X	X	X	X				X	X	X	X	X
YCbCr+A		10b	X	X	X	X	X	X	X	X				X	X	X	X	X
YCbCr	4:2:2	12b	X	X	X	X	X	X	X	X				X	X	X	X	X
		10b									X	X	X					
YCbCr+A		12b	X	X	X	X	X	X	X	X				X	X	X	X	X
GBR	4:4:4	12b	X	X	X	X	X	X	X	X				X	X	X	X	X
		10b	X	X	X	X	X	X	X	X				X	X	X	X	X
GBR+A		10b	X	X	X	X	X	X	X	X				X	X	X	X	X

Table 23: SDI7 3G Level B (2K × 1080) (option 3G only)

Structure			50i	59.94i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
XYZ	4:4:4	12b				X	X	X	X	X				X	X	X	X	X
GBR						X	X	X	X	X				X	X	X	X	X

Table 24: SDI7 3G Level B (2×HD 1920 × 1080) (option 3G only)

Structure			50i	59.94i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:2:2	10b	X	X	X	X	X	X	X	X				X	X	X	X	X

Table 25: SDI7 3G Level B (2xHD 1280 × 720) (option 3G only)

Structure			59.94i	50i	60i	23.98p	24p	25p	29.97p	30p	50p	59.94p	60p	23.98psf	24psf	25psf	29.97psf	30psf
YCbCr	4:2:2	10b				X	X	X	X	X	X	X	X					

Option GPS specifications

The following tables list the electrical and environmental characteristics of the GPS Synchronization and Timecode option.

Table 26: GPS7 antenna input

Characteristic	Performance requirements	Reference information
Input type	50 Ω BNC; internally terminated	
Input signal level minimum (typical)	> 18 dB above ambient level	Nominal gain of antenna minus cable loss, so a 35 dB antenna can have 17 dB cable loss at 1.575 GHz.
Return Loss (typical)	8 dB at 1575 MHz	Input has a narrow RF filter so it reflects most energy not near the GPS signal frequency.
DC Antenna power output voltage (typical)	3.3 or 5 V at nominal load	Sourced on Antenna input. May be enabled or disable. Approximately 12 Ω internal resistance so open circuit voltage is greater. Open circuit voltage is typically 3.8 V and 5.4 V.
DC Antenna power output current (typical)	55 mA.	
Antenna fault thresholds (typical)	“OPEN” if <10 mA, “SHORT” if >100 mA. Else “Nominal”	Antenna power state is displayed on UI in GPS status screen. Rear LED shows green flashing if open, green steady if nominal, red if shorted, and off if the power is not enabled.

Table 27: GPS timebase

Characteristic	Performance requirements	Reference information
Reference modes	User may select Internal or External lock to GPS Reference or to Video Reference.	“Internal” sets the frequency to nominal. “External” sets the timebase relative to the GPS input and aligns the frames to extrapolate back to the SMPTE Epoch. Video genlock sets timebase relative to incoming timebase.
Operation when loses lock	User may select Internal or holdover called “Stay Current Frequency”. “Internal” reverts to the nominal frequency as calibrated. “Stay Current Frequency ” holds the last valid frequency from before the input was lost.	
Location modes (GPS mode only)	User may select “Fixed” or “Mobile”.	“Fixed” stores a well-averaged position and then uses that until set to reacquire. “Mobile” recalculates the position continuously and thus has a higher timebase variation.

Table 27: GPS timebase (cont.)

Characteristic	Performance requirements	Reference information
Stability when locked to GPS (typical)	Allan Deviation < 1 x 10^{-10}, measurement interval of 1, 10, or 100 sec in fixed position mode.	Note that this is for fixed mode and is a function of base unit oscillator, satellite signal quality from antenna, and GPS functionality. For mobile mode, the Allan deviation is about 2 x 10^{-10}.
Accuracy when locked to GPS	±1 part in 10^9 averaged over 30 sec. After 20 min warm up and in fixed mode.	Long term stability is set by the GPS, but short term by the base unit.
Accuracy in Holdover mode (typical)	±2 parts in 10^9 from recent valid lock frequency, Temp change of ±5 °C. ±10 parts in 10^9 for 0 to 50 °C.	Translates to 10 ns of drift per 1 sec that is in holdover mode. This is a function of the base unit oscillator.
Clean Recovery Holdover Drift (GPS mode only)	±20 ms	Maximum amount of timebase drift that can be corrected without disruption to video timing.
Clean Recovery Holdover Duration (typical) (GPS mode only)	35 days, must be in stable temperature environment and have warmed up for 20 minutes before holdover.	Length of time that can be in stay current holdover mode and recover without disruption to syncs. Dependant on environment and base unit oven oscillator stability. Translates to 2 ns of drift per sec in holdover mode.
Timing behavior when locked (GPS mode only)	Displays “Locked” if within 150 ns of absolute time as detected by GPS signal.	
Frame Timing Accuracy in fixed position mode (typical) (GPS mode only)	Outputs of any two units are typically timed within 150 ns if both have good signal quality and the same cable delay from antenna to instrument.	Frames Based on SMPTE 404 / TAI Epoch
Frame behavior on Relock (typical) (GPS mode only)	Selectable between Jam Phase, Fast Slew and Stay Legal. In Stay Legal mode, will stay in spec as slew with respect to frequency offset and drift rate spec. If in fast slew or stay legal mode, frames will slew back to the correct alignment via timebase offset without jumping.	Recovery from drift may take a long time if configured for stay legal recovery (approximately 300 sec per line of drift at NTSC or PAL rates).
Timebase offset during Relock (typical) (GPS mode only)	For stay legal mode, limited to less than ±0.2 ppm frequency offset, and limited to change less than 0.02 ppm/sec.	Fast Slew has limits of ±5 ppm offset and 0.5 ppm / sec.

Table 27: GPS timebase (cont.)

Characteristic	Performance requirements	Reference information
Time to acquire satellites and achieve specified stability (typical)	2 Minutes on boot up with warm oven, good satellite signal, and known position.	Frames may jump on initial lock to establish correct relative positions.
Definition of Lock Status Figure of Merit (GPS mode only)	0 No signal 1 Low signal 2 Acquire Satellites 3 Bad Position 4 Acquire Position 5 Adjust Phase 6 Locked > Signal Quality ≤16 7 Locked >> Signal Quality > 16 8 Locked >>> Signal Quality > 26 9 Locked >>>> Signal Quality > 42 10 Locked >>>>> Signal Quality >68 11 Locked >>>>>> Signal Quality > 110	Note that the receiver may take a few minutes to detect and display the signal.

Performance verification

This section provides procedures to verify the performance and functionality of the SPG8000 base unit and units with options installed. Procedures that only apply to specific options will be noted as such.

CAUTION. *To prevent possible damage to a module or the base unit, always disconnect the power from the base unit before installing or removing a module.*

Performance verification preparation

Do the following before starting any of the following performance verification procedures:

Warm up

The SPG8000 base unit and optional modules must have had a warm-up period of at least 20 minutes before you start a performance verification procedure. Refer to the documentation provided with the test equipment for any preparation the test equipment may require.

Save Power On default settings

Before you begin a performance verification procedure, you can save your required instrument settings in the Power On Default preset.

If the instrument settings are saved in the Power On Default preset, you can recall the settings after the performance verification procedure is completed by turning off and on the power (disconnect and connect the power cord).

Set SPG8000 to Factory Mode

Most of the performance verification procedures require that the SPG8000 be restarted or rebooted in Factory Mode. There are two methods to put the SPG8000 into Factory Mode.

Restarting in Factory Mode. Use these steps to restart the SPG8000 in factory mode:

1. Remove power from the SPG8000. (Disconnect the power cord.)
2. Press and hold the **Front Panel ENABLE** button. Continue holding the button while applying power (connecting the power cord). The message **SPG8000 Booting...** will display.
3. Continue to hold the **Front Panel** button until the message **SPG8000 Start up with Factory Mode** displays.
4. Release the **Front Panel** button.

Rebooting in Factory Mode. Use these steps to reboot the SPG8000 in factory mode, without removing power to the instrument:

1. Press and hold the **STATUS**, **ENTER**, and **Front Panel ENABLE** buttons simultaneously.
2. Continue holding the buttons until the message **SPG8000 Booting...** displays.
3. When the message **SPG8000 Booting...** displays, release the **STATUS** and **ENTER** buttons. Continue holding the **Front Panel ENABLE** button.
4. When the message **SPG8000 Start up with Factory Mode** displays, release the **Front Panel ENABLE** button.

Load the factory preset

1. Load the factory preset:
   a. Press the **SYSTEM** button to select **SYSTEM : PRESET**.
   b. Press the **ENTER** button to view the **SYSTEM : PRESET : RECALL** menu.
   c. Press the left (◄) arrow button to select **Factory Default**.
   d. Press the **ENTER** button to load the preset.
2. Press the **BACK** button to exit the Recall menu.

Diagnostics tests

This procedure verifies that the diagnostic tests pass. The diagnostics results should be verified for the base unit and for each option module, if installed.

Required equipment

No equipment is required for this procedure.

Test record

Photocopy this table and use it to record the performance test results.

Table 28: Diagnostics test record

Instrument Serial Number:	Certificate Number:
Temperature:	RH %:
Date of Calibration:	Technician:

Performance test	Result
Power on diagnostics	Pass/Fail
PLL locked	
Main	Pass/Fail
SDI (Option SDI only)	Pass/Fail
SDI DDS (Option SDI only)	Pass/Fail
Temperature	
Main	Pass/Fail
CPU	Pass/Fail
REF (Option GPS only)	Pass/Fail
SDI (Option SDI only)	Pass/Fail
FPGA (Option SDI only)	Pass/Fail
Voltages	Pass/Fail
Fan Speed	
Main	Pass/Fail
PS1	Pass/Fail
PS2 (Option DPW only)	Pass/Fail
Power Supply 1	Pass/Fail
Power Supply 2 (Option PDW only)	Pass/Fail
GPS PHS DET RAMPS (Option GPS only)	Pass/Fail
Module Memory	Pass/Fail
Front panel keys	Pass/Fail
PLL Range	Pass/Fail
Reference infrastructure	Pass/Fail

Diagnostics test procedure

1. Connect the power cord.

NOTE. *Install both power cords if Option DPW is installed.*

2. Check for any power-on error messages as the instrument starts. If present, they be displayed briefly during the power-on process. You can also view them from the instrument Web user interface on the System > Diagnostics page. (*See the SPG8000 Quick Start User Manual for information about the Web user interface.)*
3. Record Pass in the test record if no error messages are displayed, or, to note a failure, record the error message.
4. Set the SPG8000 to Factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)
5. Press the **REF** button.
6. Press the left (◄) arrow button to select **Internal** as the source.
7. Press the **ENTER** button.
8. Press the **SYSTEM** button.
9. Use the up (▲) arrow button to select **DIAGNOSTICS**.
10. Press the **ENTER** button.
11. Use the down (▼) arrow to step through all of the following diagnostic results. Some results are only available if the instrument has a specific option.
    - Tune: Displays 0 with no tuning signal. (Not in test record.)
    - Cal: Displays the most recent calibration data. (Not in test record.)
    - PLL: Verify that each clock frequency shows locked (Lk) by pressing the right (►) arrow button to view each of the following clocks. Record Pass or Fail in the test record.

      Main
      SDI (Option SDI only)
      SDI DDS (Option SDI only)

- TEMPERATURE: Verify that the following board temperature readings are normal (OK) by pressing the right (►) arrow button to view each reading. Record Pass or Fail in the test record.

  Main
  CPU
  REF (Option GPS only)
  SDI (Option SDI only)
  FPGA (Option SDI only)

- VOLTAGE: Verify all voltages are normal (OK) by pressing the right (►) arrow button to view each of the following voltages. Record Pass in the test record if all voltages are normal or list any failed voltages.

NOTE. *If you do not see a specific voltage on your instrument, it is because your instrument does not have the related hardware option installed.*

Main board: +5.0 V
Main board: +3.3 V
Main board: +2.5 V
Main board: +1.8 V
Main board: +1.5 V
Main board: +1.2 V
Main board: –5.0 V
Main board: +3.3 AV

Slot 1: +5.0 V
Slot 2: +5.0 V
Slot 3: +5.0 V
Slot 4: +5.0 V
Slot 1: +3.3 V
Slot 2: +3.3 V
Slot 3: +3.3 V
Slot 4: +3.3 V

Slots 1 & 2: +8.0 AV
Slots 3 & 4: +8.0 AV
Slots 1 & 2: +5.0 AV
Slots 3 & 4: +5.0 AV
Fan +5
RTC Battery

Ref board: +5.0 V
Ref board: +8.0 V
Ref board: –5.0 V relative to +3.3 V
SDI board: +1.2 V
SDI board: +1.2 VA
SDI board: +3.3 V
SDI board: +3.3 VA
SDI board: +1.5 V
SDI board: +3.0 V
SDI board: +1.8 V
SDI board: Dref

- Fan Speed: Verify reported speed is normal (OK) by pressing the left (◄) arrow button to view each of the following fan speeds. Record Pass or Fail in the test record:

  Main
  PS1
  PS2 (Option PDW only)

- Power Supply 1: Verify temperature weighted hours (Tmp Wtd) and voltage (V) is normal (OK). Record Pass or Fail in the test record.
- Power Supply 2: Verify temperature weighted hours (Tmp Wtd) and voltage (V) is normal (OK). Record Pass or Fail in the test record. **(Option PDW only.)**
- GPS PHS DET RAMPS: Press the right (►) arrow button to verify that Up A and B and Down A and B are normal (OK). Record Pass or Fail in the test record. (No test record entry.) **(Option GPS only.)**

12. Run the module memory test as follows:

- **a.** Press the down (▼) arrow to select **DIAGNOSTICS: RUN**, and check that **Module Memory Tests** shows in the menu.
- **b.** Press the **ENTER** button to run the test.
- **c.** Verify that **All Installed Option(s)** memory passes. Record Pass or Fail in the test record.

13. Run the front panel key diagnostic as follows:

- **a.** Press the right (►) arrow button to select **Front Panel Key** from the **DIAGNOSTICS : RUN** menu.
- **b.** Press the **ENTER** button to run the diagnostic.
- **c.** Follow the instructions on the front panel display that will tell you to press specific buttons on the front panel. When the test is over, the display will tell you if the test was passed and then direct you to press the **BACK** button to exit the test.
- **d.** Record resulting pass or fail message in the test record. If a fail occurs, record the error codes.

14. Run the PLL Range check as follows:

- **a.** Press the **ENTER** button to reenter the Diagnostics menu.
- **b.** Press the down arrow until you see the **DIAGNOSTICS: RUN** menu.
- **c.** Press the right (►) arrow button to select **PLL Range Check**.
- **d.** Press the **ENTER** button.
- **e.** After the diagnostics testing is complete, note the PLL Low and High readings. Low should read -90×10^{-6} or lower. High should read $+90 \times 10^{-6}$ or higher. Record Pass or Fail in the test record.

15. Run the reference infrastructure test as follows:

- **a.** Press the down (▼) arrow to select **DIAGNOSTICS: GPS IO TEST**.
- **b.** Press the **ENTER** button to run the test.
- **c.** Verify that the GPS IO test passes. Record Pass or Fail in the test record.

16. Press the **BACK** button to exit the Run menu.

17. Cycle the power to clear the effects of the memory diagnostics.

18. Set the SPG8000 to Factory mode and load the factory presets. (See page 19, *Set SPG8000 to Factory Mode*.) (See page 20, *Load the factory preset*.)

SPG8000 base unit performance verification

The following procedures verify the functionality of the SPG8000 base unit.

Required equipment

The following table lists the required equipment for these procedures.

Table 29: Required equipment for SPG8000 base unit performance verification

Item	No.	Minimum requirement	Recommended equipment
Frequency counter	1	Frequency range: 0.1 Hz to 10 MHz Precision: 10 digits or higher	Tektronix FCA3000 or equivalent
Frequency standard	1	10 MHz Accuracy: 1 x 10^{-9}	Tektronix SPG8000 locked to GPS or equivalent Spectracom/Pendulum 6689
Waveform monitor	1	Composite and SDI input with external reference capability	WFM8300 with Option CPS or equivalent
Oscilloscope	1	Bandwidth: 200 MHz or higher	Tektronix TDS540D or TDS3054
Digital voltmeter	1		Keithley 2700 DMM
GPS receiver with video sync outputs	1	GPS input, 10M CW, NTSC, PAL, Tri-level sync, and SDI outputs	GPS7 and SDI7 module in a TG8000 or equivalent
75 Ω BNC cable	4	Length: 42 inches	Tektronix part number 012-0074-00
75 Ω feed-through terminator [1]	1		Tektronix part number 011-0103-02
75 Ω precision terminator	1		Tektronix part number 011-0102-03
75 Ω coaxial terminator	2		Tektronix part number 011-0163-00
BNC-to-Banana-Plug adapter	1		Pomona model 1269
BNC-to-test-clip adapter	1	Use to measure voltage across 600 Ω load resistor for LTC level procedure	
BNC T connector	1	Used to measure voltage on Black amplitude and offset test (SD)	
9 pin male DSUB connector with wires on pins 6, 7, 8, and 9	1	Used to measure voltage on GPI 3 outputs	
9 pin male header with solder lugs	1	Used to assert GPI 1, 2, 3 inputs to restore presets	

[1] The feed-through terminator is not required if the oscilloscope has an internal 75 Ω terminator.

Test record Photocopy this table and use it to record the performance test results.

Table 30: SPG8000 base unit test record

Instrument Serial Number:			Certificate Number:		
Temperature:			RH %:		
Date of Calibration:			Technician:		
Performance test	**–Min**	**+Max**	**Measured**	**Value**	**Value**
Master clock accuracy	9.9999987 MHz	10.0000013 MHz			
NTSC Functional Genlock and timing				Pass	Fail
PAL Functional Genlock and timing				Pass	Fail
1080p24 Functional lock and timing				Pass	Fail
Genlock ADC Bus Stuck				Pass	Fail
Genlock ADC Bus Short				Pass	Fail
Genlock Input					
Minimum level	1550	2550			
Maximum level	2550	3550			
Gain	900	1100			
LTC Positive Input Open Circuit Loop Back					
Minimum level	1250	1500			
Maximum level	2200	2450			
Gain	850	1050			
LTC Negative Input Open Circuit Loop Back					
Minimum level	1250	1500			
Maximum level	2200	2450			
Gain	850	1050			
LTC Positive Input Terminated Loop Back Gain	400	525			
LTC Negative Input Terminated Loop Back Gain	400	525			

Table 30: SPG8000 base unit test record (cont.)

Performance test	–Min	+Max	Measured	Value	Value
Black output functional test and frame pulse test					
Black 1					
PAL				Pass	Fail
1080 59.94i				Pass	Fail
1080 60i				Pass	Fail
Black 2					
PAL				Pass	Fail
1080 59.94i				Pass	Fail
1080 60i				Pass	Fail
Black 3					
PAL				Pass	Fail
1080 59.94i				Pass	Fail
1080 60i				Pass	Fail
Black output bit integrity					
Black 1					
Ramp				Pass	Fail
Calibration setting (AMPL. DAC number)					
Black 2					
Ramp				Pass	Fail
Calibration setting (AMPL. DAC number)					
Black 3					
Ramp				Pass	Fail
Calibration setting (AMPL. DAC number)				Pass	Fail
Black amplitude and offset (SD)					
Black 1					
0 mV (offset)	– 40 mV	+ 40 mV			
700 mV					
Amplitude (difference)	693 mV	707 mV			
Black 2					
0 mV (offset)	– 40 mV	+ 40 mV			
700 mV					
Amplitude (difference)	693 mV	707 mV			

Table 30: SPG8000 base unit test record (cont.)

Performance test	–Min	+Max	Measured Value	Value
Black 3				
0 mV (offset)	– 40 mV	+ 40 mV		
700 mV				
Amplitude (difference)	693 mV	707 mV		
Trilevel Sync Output (HD)				
Black 1				
Blanking level	–50 mV	+50 mV		
Sync amplitude plus	294.0 mV	306.0 mV		
Sync amplitude minus	294.0 mV	306.0 mV		
Black 2				
Blanking level	–50 mV	+50 mV		
Sync amplitude plus	294.0 mV	306.0 mV		
Sync amplitude minus	294.0 mV	306.0 mV		
Black 3				
Blanking level	–50 mV	+50 mV		
Sync amplitude plus	294.0 mV	306.0 mV		
Sync amplitude minus	294.0 mV	306.0 mV		
Black output rise and fall time				
Black 1, NTSC				
fall time of falling sync edge	120 ns	150 ns		
Black 1, 1080 60i				
rising edge in the middle of the tri-level sync	40 ns	60 ns		
Black 2, NTSC				
fall time of falling sync edge	120 ns	150 ns		
Black 2, 1080 60i				
rising edge in the middle of the tri-level sync	40 ns	60 ns		
Black 3, NTSC				
fall time of falling sync edge	120 ns	150 ns		
Black 3, 1080 60i				
rising edge in the middle of the tri-level sync	40 ns	60 ns		
Sine amplitude				
sine amplitude	1.35 V	1.65 V		

Table 30: SPG8000 base unit test record (cont.)

Performance test	–Min	+Max	Measured	Value	Value
LTC level					
LTC 1					
Maximum positive voltage					
Maximum negative voltage					
p–p voltage (difference)	4.5 V	5.5 V			
LTC 2					
Maximum positive voltage					
Maximum negative voltage					
p-p voltage (difference)	4.5 V	5.5 V			
LTC 3					
Maximum positive voltage					
Maximum negative voltage					
p-p voltage (difference)	4.5 V	5.5 V			
LTC 4					
Maximum positive voltage					
Maximum negative voltage					
p-p voltage (difference)	4.5 V	5.5 V			
GPI output functional test					
GPI 1 out	4.5 V	5.5 V			
GPI 2 out	4.5 V	5.5 V			
GPI 3 out	4.5 V	5.5 V			
GPI (antenna disconnected)		< 0.5 V			
GPI input functional test					
Program time				Pass	Fail
GPI input recall test					
GPI recall of bit 1				Pass	Fail
GPI recall of bit 2				Pass	Fail
GPI recall of bit 3				Pass	Fail
48 kHz Clock Output Level (CMOS compatible)					
2.5 V DC coupled into 75 Ω					
High	2.1 V	2.9 V			
Low	–0.2 V	+0.4 V			
1 V AC coupled into 75 Ω	0.9 V	1.1 V			

Master clock accuracy test

Perform this procedure to verify the accuracy of all video and audio related clocks, including black burst subcarriers and SDI rates. The following equipment is required for this test:

- Frequency counter
- Frequency standard
- 75 Ω BNC cable (2 required)
- 75 Ω feed-through terminator

1. Use a 75 Ω BNC cable and the 75 Ω feed-through terminator to connect the **10 MHz / BLACK 3** connector to the INPUT A connector on the frequency counter as shown in the following figure.
2. Use an appropriate cable to connect the frequency standard to the external reference input connector on the frequency counter.

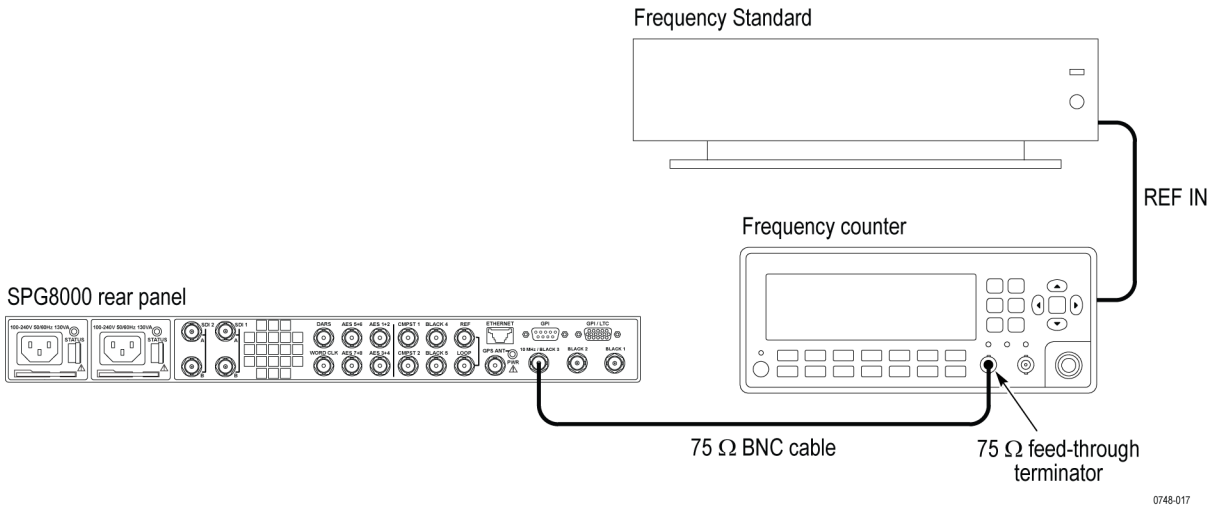


Figure 2: Setup to verify clock accuracy

3. Set the frequency counter to the external reference input.
4. Set the frequency counter to the frequency measurement mode (if necessary), and then set the Gate Time to 1 s.
5. Set the reference source on the SPG8000 to Internal as follows:
   a. Press the **REF** button.
   b. Press the left (◄) arrow button until **Internal** appears in the menu, and then press the **ENTER** button. The **INT** indicator below the Inputs button panel should turn green.

6. Output the CW 10 MHz calibration signal from the BLACK 3 output as follows:
   a. Press the **BLACK** button until you see **BLACK 3** in the menu.
   b. Press the left (◄) arrow button to select **CW 10 MHz**.
   c. Press the **ENTER** button.
7. Set the frequency counter to trigger on the input, and then verify that the displayed frequency is within the range of 9.9999987 MHz to 10.0000013 MHz.
8. Record the frequency in the test record.

Genlock function test

Perform the following procedure to check that the genlock and timing function is operating correctly. This test is divided into three parts: one part checks NTSC, one part checks PAL, and one part checks 1080p24. This test may be performed in normal or factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

NTSC functional genlock and timing.

1. Use a 75 Ω BNC cable to connect the **BLACK 1** connector on the reference unit to the **REF** connector on the SPG8000 under test.
2. Use a second 75 Ω BNC cable to connect the **REF LOOP** connector of the SPG8000 to the **CMPST A** connector on the waveform monitor. Make sure to terminate the loop A input on the waveform monitor.

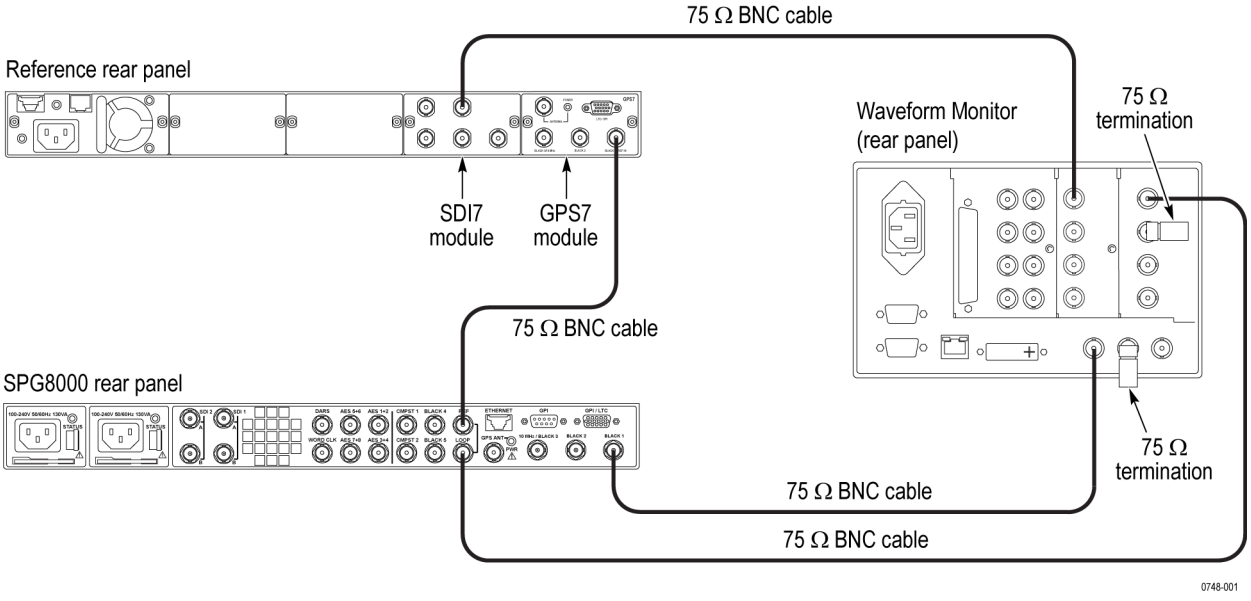


Figure 3: Setup for genlock test

3. Use a third 75 Ω BNC cable to connect the **SDI A** connector on the reference unit to one of the SDI inputs on the waveform monitor.
4. Use a fourth 75 Ω BNC cable to connect the **BLACK 1** connector on the SPG8000 under test to the REF IN connector of the waveform monitor. Make sure to terminate the reference loopthrough on the waveform monitor.
5. Press the composite input and the EXT REF buttons on the front panel of the waveform monitor to display the composite input relative to the reference signal.
6. Set the waveform monitor to 4-tile display mode and select the following displays: WFM, Vector, Timing (press the MEAS button), and Video Session (press the STATUS button).

NOTE. *In the timing display, make sure the "relative to" window indicates "Analog DAC". If it does not, press and hold the MEAS button and correct it.*

7. Load the factory default preset for both the reference unit and the SPG8000 under test. (See page 20, *Load the factory preset*.)
8. Set the reference unit source to Internal as follows:
   a. Press the **MODULE** button until you see GPS7 in the menu.
   b. Press the down (▼) arrow button until **REFERENCE** appears in the menu, and then press the **ENTER** button.
   c. Press the left (◄) arrow button until **Internal** appears in the menu as the source, and then press the **ENTER** button.
   d. Press the **BACK** button to exit the menu.
9. Do the following steps to check that the BLACK 1 output of the reference unit is set to NTSC Black Burst. (This should have been done automatically when the instrument was reset to factory default.)
   a. Press the down (▼) arrow button until **SELECT OUTPUT** appears in the menu.
   b. Press the left (◄) or right (►) arrow until **BLACK 1** appears in the menu, and press the **ENTER** button.
   c. You should see **SELECT FORMAT** in the menu. If you do not, press the down (▼) arrow button until it appears.
   d. You should see **NTSC** on the menu.

      If you do, the output is set correctly. Press the **BACK** button and proceed to step 10.

      If you do not, press the left (◄) or right (►) arrow button until **NTSC** appears, press the **ENTER** button. and then proceed to step e.

e. You should see **Black Burst** on the menu. If you do not, press the left (◄) or right (►) arrow button until **Black Burst** appears, and then press the ENTER button.

f. Press the **BACK** button twice to exit the menu.

10. Set the reference format of the SPG8000 under test to NTSC Burst as follows:

a. Press the **REF** button. You should see **REFERENCE: SOURCE**.

b. Press the right (►) arrow button until you see **NTSC Burst** in the menu, and then press the **ENTER** button.

11. Set the **BLACK 1** output of the SPG8000 under test to NTSC as follows:

a. Press the **BLACK** button. You should see **BLACK 1 : FORMAT** on the menu display.

b. Press the right (►) arrow button until you see **NTSC** in the menu, and then press the **ENTER** button.

12. Check the following and record Pass under *NTSC Functional Genlock and Timing* in the test record if all conditions are met. If any of these conditions are not met, record Fail.

- Check that the EXT light on the front panel of the SPG8000 under test is a steady green.
- Check that the Timing display on the waveform monitor reads 0 lines of offset and less than 0.1 µs of horizontal offset.
- Check that the waveform in the Vector display on the waveform monitor is stable and not spinning.

PAL functional genlock and timing.

13. Set the BLACK 1 output of the reference GPS7 to PAL as follows:

- **a.** Press the down (▼) arrow button until **SELECT OUTPUT** appears in the menu.
- **b.** Press the left (◄) or right (►) arrow until **BLACK 1** appears in the menu, and press the **ENTER** button.
- **c.** You should see **SELECT FORMAT** in the menu. If you do not, press the down (▼) arrow button until it appears.
- **d.** Press the right (►) arrow until **PAL** appears in the menu, and then press the **ENTER** button.
- **e.** Press the right (►) arrow until **Black Burst** appears in the menu, and then press the **ENTER** button.
- **f.** Press the **BACK** button twice to exit the menu.

14. Set the reference format of the SPG8000 under test to PAL Burst as follows:

- **a.** Press the **REF** button. You should see **REFERENCE: SOURCE**.
- **b.** Press the right (►) arrow button until you see **PAL Burst** in the menu, and then press the **ENTER** button.

15. Set the BLACK 1 output of the SPG8000 under test to PAL as follows:

- **a.** Press the **BLACK** button. You should see **BLACK 1 : FORMAT** on the menu display.
- **b.** Press the right (►) arrow button until you see **PAL** in the menu, and then press the **ENTER** button.

16. Check the following and record Pass under *PAL Functional Genlock and Timing* in the test record if all conditions are met. If any of these conditions are not met, record Fail.

- Check that the EXT light on the front panel of the SPG8000 under test is a steady green.
- Check that the Timing display on the waveform monitor reads 0 lines of offset and less than 0.1 µs of horizontal offset.
- Check that the waveform in the Vector display on the waveform monitor is stable and not spinning.

NOTE. *Proceed to the next step if you suspect the waveform monitor has indicated an inaccurate reading on the timing display. Otherwise, this procedure is now complete.*

17. Some waveform monitors may not indicate exactly zero on the timing display for a correctly timed signal. If this is suspected, do the following steps:

a. Remove the termination on the waveform monitor reference input.

b. Connect a cable from that reference input to the CMPST B input on the waveform monitor.

c. Terminate the loopthrough on the CMPST B input.

d. From the waveform monitor front panel, select the CMPST B input. The timing display should show zero because it is the same signal on the input and reference. If it is not shown as zero, do the following to remove any error in the timing measurement:

- Make the timing tile active, then press and hold the MEAS button to bring up the menu.
- Save a timing offset and then change the "relative to" to use the saved offset.

e. Select the first composite input, and compare the timing of the unit under test to see if it is less that 0.1 µs.

1080 24p functional lock and timing.

18. Set the SDI A output format of the reference module to 1080 24p as follows:

- **a.** Press the **MODULE** button until you see SDI output you are using in the menu.
- **b.** Press the **FORMAT** button.
- **c.** Press the left (◄) arrow button until **1080 24p** appears, and then press the **ENTER** button.
- **d.** Press the **BACK** button to exit the menu.

19. Set the reference unit **BLACK 1** to 1080 24p Tri-level Sync as follows:

- **a.** Press the **MODULE** button until you see GPS7.
- **b.** Press the down (▼) arrow button to view **BLACK 1** on the menu, and then press **ENTER**.
- **c.** Press the down (▼) arrow button to view **SELECT FORMAT**.
- **d.** Press the left (◄) or right (►) arrow button to select 1080 24p, and then press the **ENTER** button.

20. Set the reference format of the SPG8000 unit under test to HD Tri-level Sync as follows:

- **a.** Press the **REFERENCE** button.
- **b.** You should see **SOURCE** in the menu. If you do not, press the down (▼) arrow button until it appears.
- **c.** Press the right (►) arrow button until **HD Tri-Level SYNC** appears, and then press the **ENTER** button.

21. Set the **BLACK 1** output of the SPG8000 unit under test to 1080 24p Tri-level Sync as follows:

- **a.** Press the **BLACK** button until you see **BLACK 1-3 : HD TRI-LEVEL SYNC RATE** on the menu.
- **b.** Press the right (►) arrow button to select **Integer**, and then press the **ENTER** button.
- **c.** Press the **BLACK** button until you see **BLACK 1** on the menu
- **d.** Press the left (◄) arrow button until **1080 24p** appears, and then press the **ENTER** button.

22. Select the SDI input on the waveform monitor.

23. Set the timing display for “relative to Serial 0H” on the waveform monitor.

24. Check the following and record Pass under *1080 24p Functional Genlock and Timing* in the test record if all conditions are met. If any of these conditions are not met, record Fail.

    - Check that the EXT light on the front panel of the SPG8000 under test is a steady green.
    - Check that the Timing display on the waveform monitor reads 0 lines of offset and less than 0.1 µs of horizontal offset.

Genlock bit integrity and input gain test

Perform the following procedure to check the genlock bit integrity and input gain. This test is divided into two parts: one part checks bit integrity and one part checks genlock input gain.

This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

Genlock ADC bus stuck and short.

1. If you have just finished the previous procedure, disconnect the reference input of the SPG8000 under test from the waveform monitor composite input. The only connection needed is the one from the reference unit **BLACK 1** to the SPG8000 under test **REF** input.

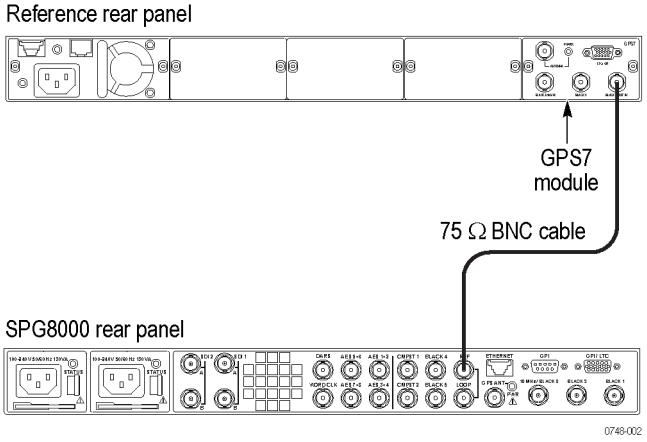


Figure 4: Setup for genlock bit integrity test

2. Set the **BLACK 1 / REF** output of the reference GPS7 to NTSC Black Burst with Field REF as follows:

    a. Press the **MODULE** button until GPS7 appears.

    b. Press the down (▼) arrow button until **SELECT OUTPUT** appears.

    c. You should see **BLACK 1** in the menu. If you do not, press the left (◄) arrow button until it appears, and then press the **ENTER** button.

d. You should see **INPUT-OUTPUT** in the menu. If you do not, press the down (▼) arrow button until it appears.

e. You should see **OUTPUT** (if allowed) in the menu. If you do, press the **ENTER** button. If you do not, press the right (►) arrow button until it appears in the menu, and then press the **ENTER** button.

f. Press the down (▼) arrow button until **SELECT FORMAT** appears in the menu and then press the **ENTER** button.

g. You should see **NTSC** in the menu. If you do, press the **ENTER** button. If you do not, press the right (►) arrow button until it appears, and then press the **ENTER** button.

h. Press the right (►) arrow button until **Black Burst with Field REF** appears, and then press the **ENTER** button.

i. Press the **BACK** button twice to exit the menu.

3. Set the REF source of the SPG8000 under test to NTSC Burst as follows:

a. Press the **REF** button.

b. You should see **SOURCE** in the menu. If you do not, press the down (▼) arrow button until it appears.

c. Press the right (►) arrow button until **NTSC Burst** appears, and then press the **ENTER** button.

4. Run the GPS ADC Bus stuck and short diagnostics on the SPG8000 under test as follows:

a. Press the **SYSTEM** button.

b. Press the up (▲) arrow button until you see **SYSTEM : DIAGNOSTICS**.

c. Press the **ENTER** button to enter the Diagnostics menu.

d. Press the down (▼) arrow button to select **GPS ADC BUS**.

e. View the results for the **Stuck** and **Short** bits.

5. Check the following and record Pass or Fail under *Genlock ADC Bus Stuck* and *Genlock ADC Bus Short* in the test record, depending on the following conditions:

- If all bits in the *Stuck* field show a "-", they all have activity. Record Pass in the test record.
- If any bits in the *Stuck* field show an *H* or an *L*, then the bit is not moving. Record Fail in the test record.
- If all bits in the *Short* field show a "-", then none as shorted together. Record Pass in the test record.
- If any bits in the *Short* field show an *S*, then record Fail in the test record.

Genlock input gain.

6. Press the down (▼) arrow button until you see **GENLOCK INPUT** in the Diagnostics menu.
7. Connect a 75 Ω terminator on the **REF LOOP** input on the SPG8000 under test.
8. Subtract the Min level from the Max level and compare the result to the limits in the test record. Record the Gain, Min, and Max values in the *Genlock input gain* test record.
9. Press the **BACK** button to exit the menu.

LTC input gain and impedance test

Perform the following procedure to check that the LTC input gain and impedance are functioning properly. This test is divided into three parts: the first part checks the LTC positive input open circuit loop back; the second part checks the LTC negative input open circuit loop back; the third part checks the LTC positive and negative terminated inputs loop back gain. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

LTC positive input open circuit loop back.

1. If you have just finished the previous procedure, press the **LTC** button until **LTC 1** appears in the menu.
2. Press the up (▲) arrow button until **OUTPUT LEVEL** appears in the menu.
3. Press the right (►) arrow button until the level shows **5.0 Volt**, and then press the **ENTER** button.
4. Press the down (▼) arrow button until **LTC1 LOOPBACK** appears in the menu.
5. Press the right arrow button (►) until **Enable** appears in the menu, and then press the **ENTER** button.
6. View the diagnostics as follows:
   a. Press the **SYSTEM** button.
   b. Press the up (▲) arrow button until **DIAGNOSTICS** appears in the menu, and then press the **ENTER** button.
   c. Press the up (▲) or down (▼) arrow buttons until **LTC POS INPUT** appears.
7. Record the Min and Max levels in *LTC Positive input open circuit loop back* in the test record.
8. Subtract the Min level from the Max level and record the result in *LTC positive open circuit loop back gain* in the test record.

LTC negative input open circuit loop back.

9. Press the right (►) arrow button until **LTC NEG INPUT** appears in the Diagnostics menu

10. Record the Min and Max levels in *LTC Negative input open circuit loop back* in the test record.

11. Subtract the Min level from the Max level and record the result in *LTC negative open circuit loop back gain* in the test record.

LTC positive and negative terminated inputs loop back gain.

12. Connect a breakout cable to the LTC / GPI input of the SPG8000 under test.

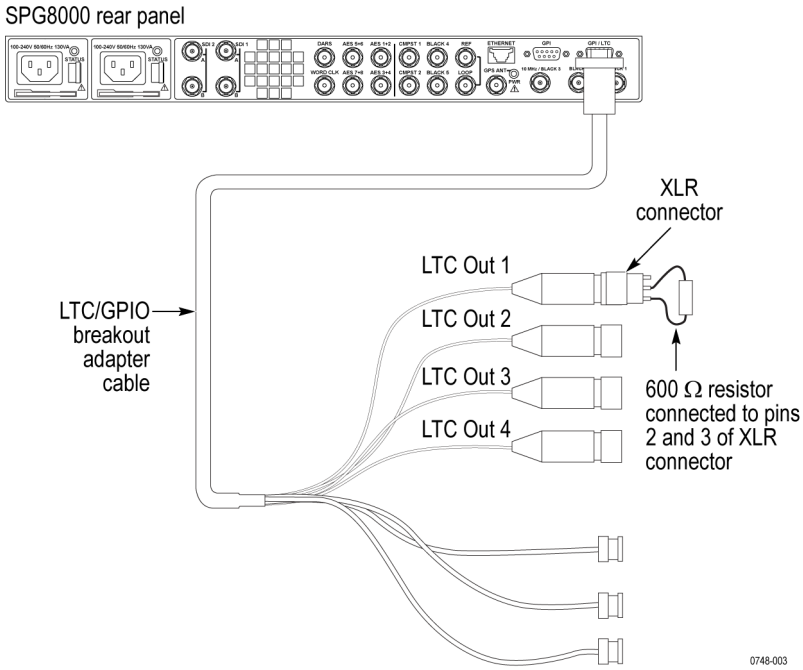


Figure 5: Setup for LTC input gain and impedance test

13. Connect a 600 Ω XLR load with meter access to LTC1 end of the breakout cable.

14. Press the left (◄) arrow button to view the **LTC POS INPUT** diagnostic display again.

15. Note the Min level and Max level and then subtract the Min level from the Max level and record the result in *LTC Positive input terminated loop back Gain* in the test record.

16. Press the right (►) arrow button until **LTC NEG INPUT** appears in the Diagnostics menu.

17. Note the Min level and Max level and then subtract the Min level from the Max level and record the result in *LTC Negative input terminated loop back Gain* in the test record.

Black output functional test and frame pulse test

Perform the following procedure to check that the Black signal output and internal frame pulse signals are functioning properly.

If you have just finished the previous test, disconnect all the cables from the unit under test before beginning this procedure.

1. Connect an SDI signal from the reference unit, like one from an SDI7 module, to the SDI input of a video monitor, and select that input as the active input on the waveform monitor.

NOTE. *You can use any HD signal. For example, HD 1080i59, 1080i50, or 1080p24.*

2. Connect a cable from the BLACK 1 output on the SPG8000 under test to the external reference input of the video monitor, and terminate the loop through on the monitor with a 75 Ω terminator.

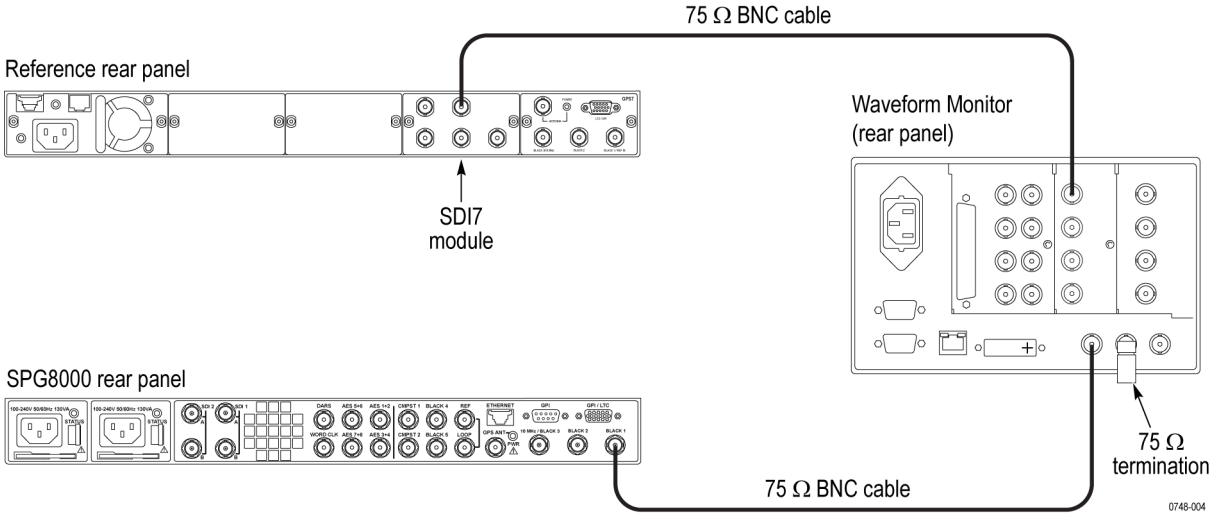


Figure 6: Setup for black output and frame pulse test

3. Press the **EXT REF** button on the video monitor.

4. Set the reference source on the SPG8000 to internal:
   a. Press the **REF** button. You should see **REFERENCE : SOURCE** on the menu.
   b. Use the left (◄) or right (►) arrow button to select **Internal**.
   c. Press the **ENTER** button.
5. Set **BLACK 1** to PAL on the SPG8000 as follows:
   a. Press the **BLACK** button. You should see **BLACK 1 : FORMAT** on the menu.
   b. Use the left (◄) or right (►) arrow button to select **PAL**.
   c. Press the **ENTER** button.
6. Check that the video monitor shows PAL as the reference input.
7. Record the result in the test record.
8. Set the **BLACK 1** output of the SPG8000 under test to 1080 59.94i as follows:
   a. Press the **BLACK** button until you see **BLACK 1-3 : HD TRI-LEVEL SYNC RATE** on the menu.
   b. Press the right (►) arrow button to select **Non-Integer**, and then press the **ENTER** button.
   c. Press the **BLACK** button until you see **BLACK 1** on the menu
   d. Press the left (◄) arrow button until **1080 59.94i** appears, and then press the **ENTER** button.
9. Check that the video monitor shows a 1080 59.94i signal on the reference input.
10. Record the result in the test record.
11. Set the **BLACK 1** output of the SPG8000 under test to 1080 60i as follows:
    a. Press the **BLACK** button until you see **BLACK 1-3 : HD TRI-LEVEL SYNC RATE** on the menu.
    b. Press the right (►) arrow button to select **Integer**, and then press the **ENTER** button.
    c. Press the **BLACK** button until you see **BLACK 1** on the menu
    d. Press the left (◄) arrow button until **1080 60i** appears, and then press the **ENTER** button.
12. Check that the video monitor shows a 1080 60i signal on the reference input.
13. Record the result in the test record.

14. Disconnect the cable from the **BLACK 1** connector of the SPG8000 under test and connect it to the **BLACK 2** connector of the SPG8000 under test.
15. Repeat steps 5 through 13 for the BLACK 2 output.
16. Disconnect the cable from the **BLACK 2** connector of the SPG8000 under test and connect it to the **BLACK 3** connector of the SPG8000 under test.
17. Repeat steps 5 through 13 for the BLACK 3 output.

Black output bit integrity test

Perform the following test to insure that all the bits in the black generators are working correctly. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

1. Connect a cable from the **BLACK 1** output of the SPG8000 under test to the CMPST A input on the video monitor, and terminate the loopthrough with a 75 Ω terminator.

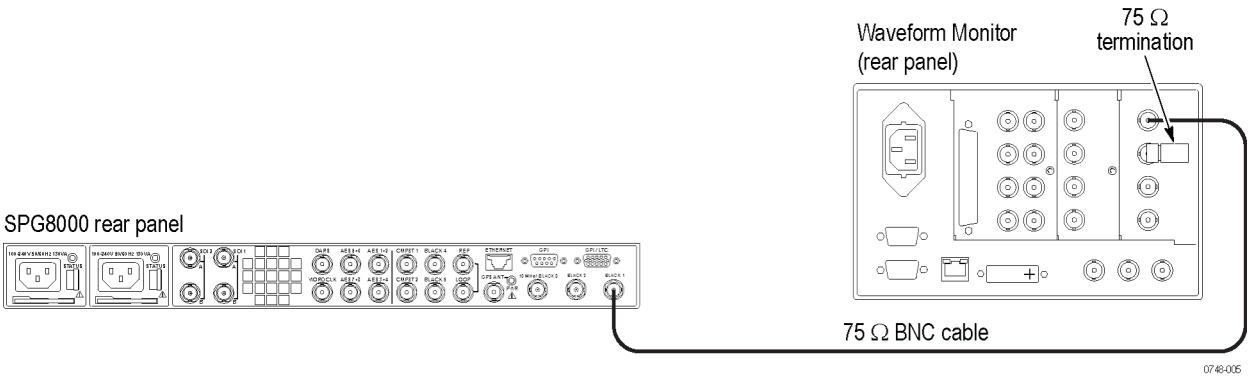


Figure 7: Setup for black output bit integrity test

2. Activate the waveform monitor composite input.
3. Press the **BLACK** button on the SPG8000 until you see **BLACK 1 : FORMAT**.
4. Use the left (◄) or right (►) arrow button to select **NTSC**.
5. Press the **ENTER** button.
6. Use the up (▲) arrow button to select **CALIBRATION**.
7. Press the **ENTER** button to select **Amplitude Calibration**.

NOTE. *Write down the calibration setting (AMPL. DAC number) in case you need to restore it later.*

8. Press the right (►) arrow until you see the **Ramp HPF** ramp signal.

9. Look at the three ramps on the waveform monitor display. The larger of the two ramps should each have 16 equal steps.

NOTE. *View the waveform display in full screen mode for easiest viewing.*

10. Use the Gain function on the waveform monitor to expand the signal to 10X.
11. Now check that the shallowest ramp has 16 equal steps.
12. Record Pass or Fail in the test record.
13. Check that the RAMP HPF calibration setting has not changed. If it has, then restore the original value.
14. Press the **BACK** button to exit the Calibration menu.
15. Repeat this procedure for the Black 2 and Black 3 outputs of the SPG8000.

Black amplitude and offset test (SD)

Perform this procedure to check that Black signal output amplitude and offset for SD signals are adjusted to within specification. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

1. Connect the BNC-to-Banana-plug adapter to the voltmeter.
2. Connect the BNC T to the adapter.
3. Connect a 75 Ω precision terminator to one end of the BNC T connector.
4. Connect a 75 Ω BNC cable to the other end of the BNC T connector.
5. Connect the other end of the cable to the **BLACK 1** output on the SPG8000.

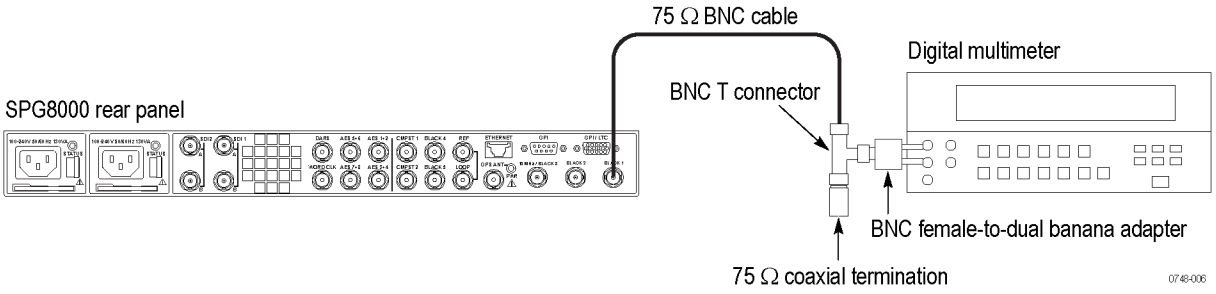


Figure 8: Setup for Black amplitude and offset test (SD)

6. Set the Black 1, Black 2, and Black 3 signals to NTSC as follows:
   a. Press the **BLACK** button on the SPG8000 until you see **BLACK 1: FORMAT** on the menu.
   b. Use the left (◄) or right (►) arrow button to select **NTSC**.
   c. Press the **ENTER** button.
   d. Repeat the previous substeps for the **BLACK 2** and **BLACK 3** outputs.
7. Press the **BLACK** button until you see **BLACK 1** on the menu.
8. Use the up (▲) arrow button to select **CALIBRATION**.
9. Press the **ENTER** button to select **Amplitude Calibration**.

NOTE. *Write down the calibration setting (AMPL. DAC number) in case you need to restore it later.*

10. Check that the calibration mode signal is 0 V on the SPG8000 display. This value is displayed in parentheses after the AMPL. DAC number.
11. Record the voltmeter reading in the test record. This is the offset value.
12. Use the right (►) arrow to select the 700 mV level.
13. Record the value in the test record.
14. Calculate the difference between the 700 mV and 0 mV signal levels and record this in the test record.
15. Check that the calibration setting has not changed. If it has, then restore the original value.
16. Press the **BACK** button to exit the calibration menu for the Black 1 signal.
17. Repeat step 7 through 16 for Black 2 and Black 3.

Trilevel Sync output test (HD)

Perform this procedure to check that Black 1 through 3 output amplitude and offset for HD Trilevel sync signals are adjusted to within specification. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

1. Connect the **BLACK 1** output of the SPG8000 to the oscilloscope and terminate the input with a 75 Ω feedthrough terminator.

NOTE. *Make sure that the oscilloscope input is set to 1 MΩ mode if you are using the feedthrough terminator.*

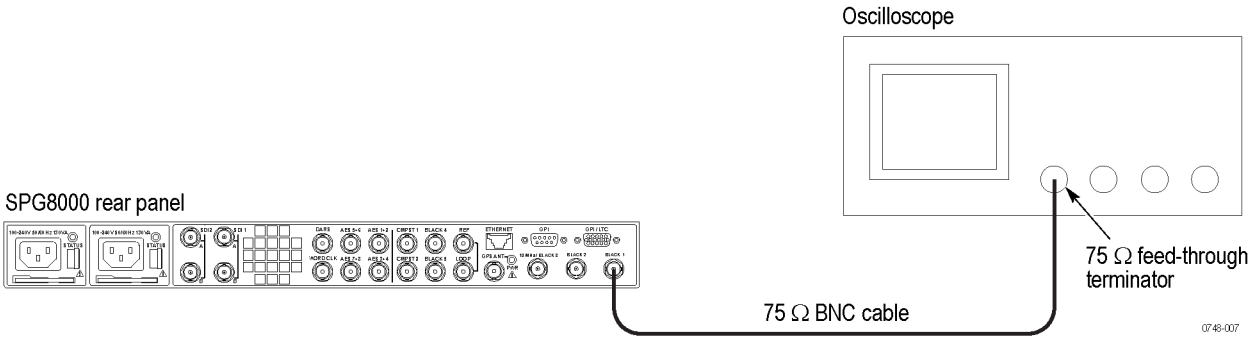


Figure 9: Setup for trilevel sync output test and black output rise and fall time test

2. Select the **1080 59.94i** HD sync signal for Black 1, Black 2, and Black 3 outputs on the SPG8000 as follows:
   a. Press the **BLACK** button until you see **BLACK 1-3 : HD TRI-LEVEL SYNC RATE** in the menu.
   b. Press the left (◄) arrow button to select **Non-Integer**, and press the **ENTER** button.
   c. Press the **BLACK** button until you see **BLACK 1 : FORMAT**.
   d. Press the left (◄) or right (►) arrow button to select **1080 59.94i**, and then press **ENTER**.
   e. Repeat the previous substeps for the **BLACK 2** and **BLACK 3** outputs.

3. Set the oscilloscope settings as follows:

Control	Setting
Vertical	100 mV/div
Vertical offset	0 V
Horizontal	500 ns/div
Horizontal position	Center
Input	CH1
Trigger	CH1
Trigger level	–150 mV
Trig position	50%
Trig slope	Rising Edge
Acquire mode	Sample

4. Verify that the blanking level is within the range of +50 mV to –50 mV.
5. Record the measured value in the test record for *Blanking Level*.
6. Change the oscilloscope vertical scale to 10 mV/div.
7. Align the blanking level with the center graticule line on the oscilloscope.
8. Change the oscilloscope vertical offset to 300 mV.
9. Verify that the high level of the signal (sync amplitude plus) is within the range of +0.6 div to –0.6 div to the center graticule (except for ringing of the rising edge).
10. Record the measured value in the test record for *Sync amplitude plus*.
11. Change the oscilloscope vertical offset to –300 mV.
12. Verify that the low level of the signal (sync amplitude minus) is within the range of +0.6 div to –0.6 div to the center graticule (except for ringing of the falling edge).
13. Record the measured value in the test record for *Sync amplitude minus*.
14. Set the vertical offset to 0 V and change the vertical gain to 100 mV/div.
15. Repeat steps 4 through 13 for the Black 2 and Black 3 outputs, making sure to move the cable to the connector of the output you are testing.

Black output rise and fall time test

Perform this procedure to check that the Black output rise and fall time meet specifications.

Use the same setup as the previous test. (See Figure 9.)

1. Connect the **BLACK 1** output of the SPG8000 to the oscilloscope and terminate the input with a 75 Ω feedthrough terminator.

NOTE. *Make sure that the oscilloscope input is set to 1 MΩ mode if you are using the feedthrough terminator.*

2. Press the **BLACK** button until you see the **BLACK 1 : FORMAT** menu.
3. Use the left (◄) or right (►) arrow button to select **NTSC**.
4. Press the **ENTER** button.
5. Press the **BLACK** button until you see **BLACK 1-3 : HD TRI-LEVEL SYNC RATE** in the menu.
6. Press the left (◄) arrow button to select **Integer**, and press the **ENTER** button.
7. On the oscilloscope, set the trigger slope to negative and then measure the 10 % to 90 % fall time of the falling sync edge.
8. Record the result in the test record.
9. Press the **BLACK** button until you can see the **BLACK 1 : FORMAT** menu.
10. Use the right (►) arrow to select a **1080 60i** signal format.
11. Press the **ENTER** button.
12. On the oscilloscope, set the trigger slope to positive and then measure the 10% to 90% rise time of the rising edge in the middle of the Tri-level Sync.
13. Record the result in the test record.
14. Repeat the above steps for the Black 2 and Black 3 outputs, skipping steps 5 and 6.

Sine amplitude test

Perform this procedure to check the sine amplitude.

1. Connect the **BLACK 3** output on the SPG8000 to the oscilloscope, and terminate the input with a 75 Ω feed-through terminator.

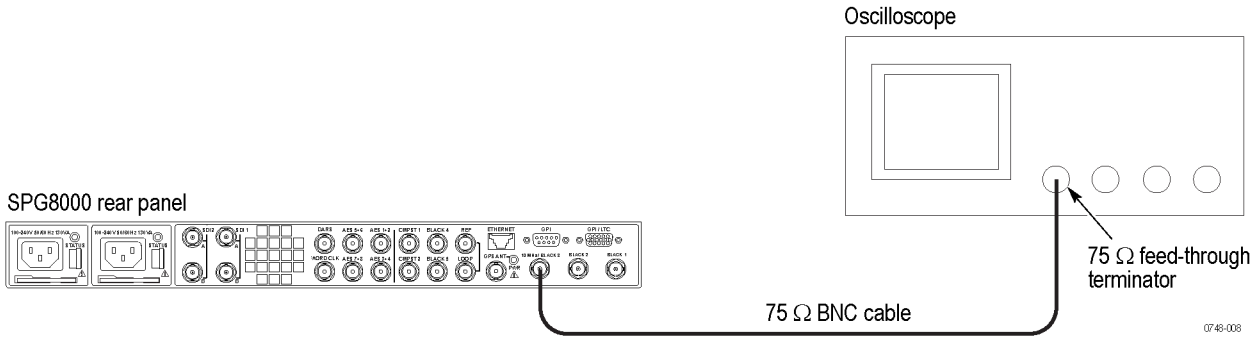


Figure 10: Setup for sine amplitude test

2. Press the **BLACK** button until **BLACK 3 : FORMAT** appears.
3. Use the left (◄) arrow button to select **CW 10 MHz**.
4. Press the **ENTER** button.
5. Measure the amplitude of the sine wave on the oscilloscope.
6. Record the result in the test record.

LTC level test

Perform this test to check the LTC levels are within limits. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

1. Create an LTC load with voltmeter access by soldering a 600 Ω resistor to pins 2 and 3 of the female XLR connector.
2. Connect the LTC load with voltmeter access to the LTC 1 connector on the LTC/GPIO breakout adapter cable.
3. Connect the LTC/GPIO adapter cable to the DSUB connector on the rear of the module.
4. Connect a BNC-to-test clip adapter to the voltmeter using a BNC-to-Banana adapter and BNC cable.
5. Attach the clips to either side of the 600 Ω resistor.

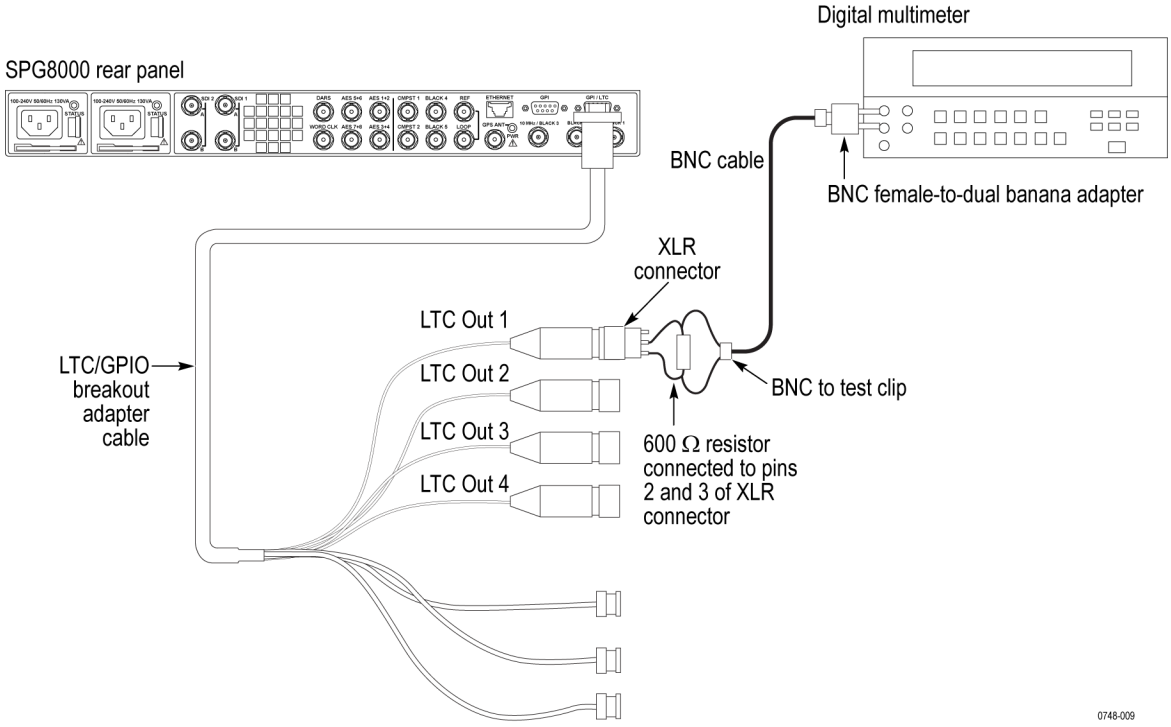


Figure 11: Setup for LTC level test

6. Press the **LTC** button to select **LTC 1**.
7. Press the right (►) or left (◄) arrow button to view **Output (if allowed)** on the menu.
8. Press the **ENTER** button.
9. Press the down arrow button to select **LTC 1 : SOURCE**.
10. Press the right (►) arrow button to select **Program Time**, and then press the **ENTER** button.

11. Use the up (▲) arrow button to select **CALIBRATION**.
12. Use the left (◄) arrow button to select **Set maximum positive voltage**.
13. Press the **ENTER** button.
14. Record the voltage result in the test record.
15. Use the left (◄) arrow button to select **Set maximum negative voltage**.
16. Press the **ENTER** button.
17. Record the voltage result in the test record.
18. Solve for the difference between the two voltages you recorded to get the p-p voltage.
19. Record the result in the test record.
20. Repeat this procedure for LTC 2, LTC 3, and LTC 4, skipping steps 7 and 8.

GPI output functional test

This procedure checks that the GPI output is functioning properly.

1. Use a 75 Ω cable to connect the **BLACK 1** output of the reference unit to the **REF** input connector of the SPG8000 under test, and terminate the reference **LOOP** connector.
2. Set the **BLACK 1** output of the reference unit to NTSC as follows:
   a. Press the **MODULE** button to select the GPS7 module.
   b. Press the down (▼) arrow button until **SELECT OUTPUT** appears in the menu.
   c. Use the left (◄) or right (►) arrow button until **BLACK 1** appears in the menu, and then press the **ENTER** button.
   d. You should see **SELECT FORMAT** in the menu. If you do not, press the down (▼) arrow button until it appears.
   e. You should see **NTSC** on the menu. If you do not, press the left (◄) or right (►) arrow button until **NTSC** appears, and then press the **ENTER** button.
   f. You should see **Black Burst** on the menu. If you do not, press the left (◄) or right (►) arrow button until **Black Burst** appears, and then press the **ENTER** button.
3. Set the **REF** input of the SPG8000 under test to NTSC as follows:
   a. Press the **REF** button on the SPG8000.
   b. Press the up (▲) arrow button until you see **SOURCE**.
   c. Use the left (◄) or right (►) arrow button to select **NTSC Burst**.

d. Press the **ENTER** button.

e. Check that the **EXT** indicator light on the front panel is green and stable.

4. Connect the **GPI/LTC** connector of the SPG8000 to the voltmeter as follows:

a. Connect the BNC-to-Banana-plug adapter to the voltmeter.

b. Connect the LTC/GPIO breakout adapter cable to the **GPI/LTC** DSUB on the back of the SPG8000.

c. Connect the GPI 1 connector on the breakout cable to the BNC-to-Banana-plug adapter.

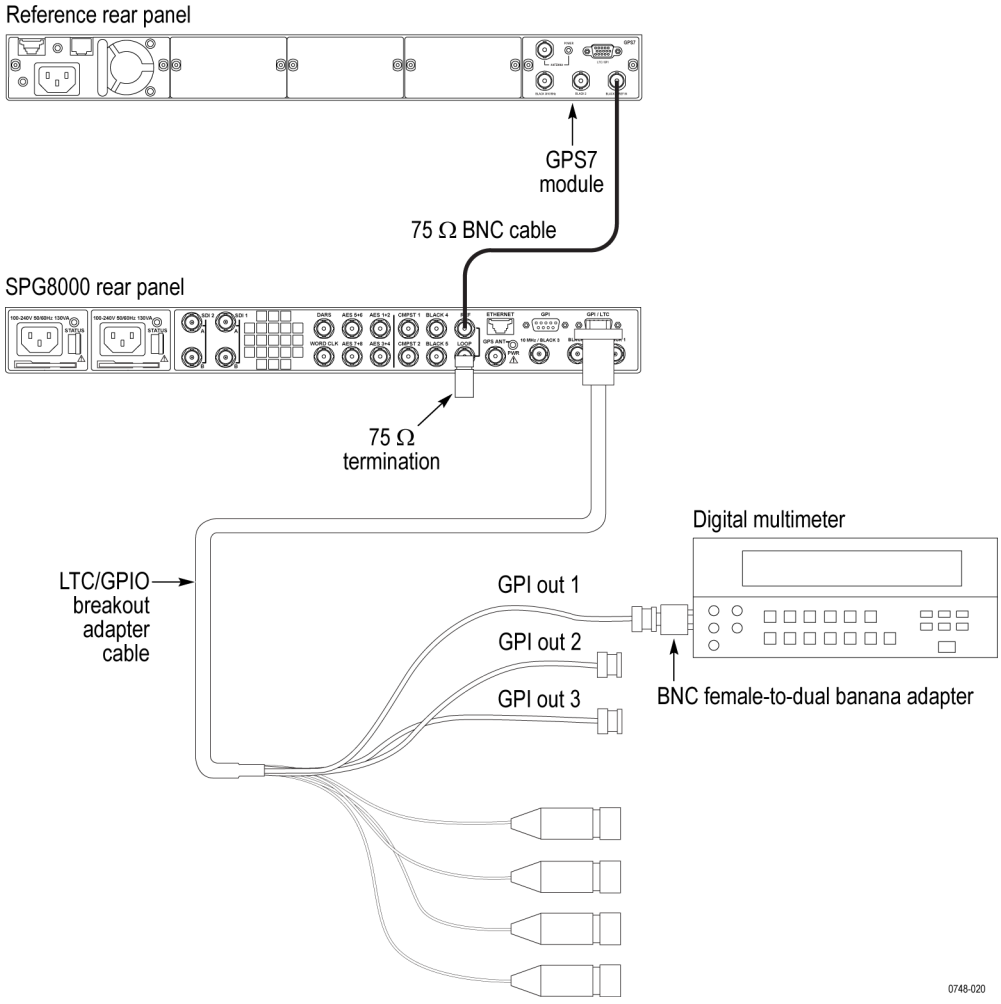


Figure 12: Setup for GPI output test

5. Configure the GPI 1 output to be asserted on unlock as follows:
   a. Press the **SYSTEM** button on the SPG8000 under test.
   b. Use the down (▼) arrow button to select **GPI**, and then press the **ENTER** button.
   c. Use the down (▼) arrow button to select **GPI : OUTPUT 1**, and then press the **ENTER** button.
   d. Use the down (▼) arrow button to select **LOCK ERROR**.
   e. Press the right (►) arrow button to select **Enable**, and then press the **ENTER** button.
6. Check that the voltage on the GPI 1 output measures between 4.5 V and 5.5 V.
7. Record the result in the test record.
8. Disconnect the reference input to the SPG8000 under test. After 15 seconds, check that the GPI 1 output is below 0.5 V.
9. Record the result in the test record.
10. Reconnect the cable from the reference unit to the reference input on the SPG8000 under test.
11. Repeat steps 5 through 10 for the GPI 2 output.
12. Solder a wire to pin 6 of the male 9-pin DSUB connector.
13. Use test leads to attach the voltmeter to the pin-6 wire from the DSUB connector and to chassis ground.
14. Repeat steps 5 through 10 for the GPI 3 output.
15. Disconnect the GPI 3 output from the voltmeter.

GPI input functional test

This procedure checks that the GPI input is functioning correctly. If you have just completed the previous test, do the following:

1. Configure the GPI input of the SPG8000 to reset the program time:
   a. Press the **SYSTEM** button.
   b. Use the down (▼) arrow button to select **GPI**, and then press the **ENTER** button.
   c. Use the down (▼) arrow button until you see **INPUT TRIGGER**.
   d. Press the right (►) arrow button until you see **Reset Program Time**, and then press the **ENTER** button.
2. Check that the reference source is set to Internal as follows:
   a. Press the **REF** button.
   b. Use the right (►) or left (◄) arrow button to view **Internal**.
   c. Press the **ENTER** button.
3. Press the **STATUS** button.
4. Press the down (▼) arrow button to select **TIME : Internal**.
5. Press the right (►) arrow button to view the Program Time, and then record the value.
6. Attach a 75 Ω terminator to the GPI input for 2 seconds, and then remove it.
7. Look at the program time now and compare it to the program time you wrote down before. The time on the display should have reset to the default start time of 00:00:00:00 and now be counting again.
8. Record Pass or Fail in the test record.

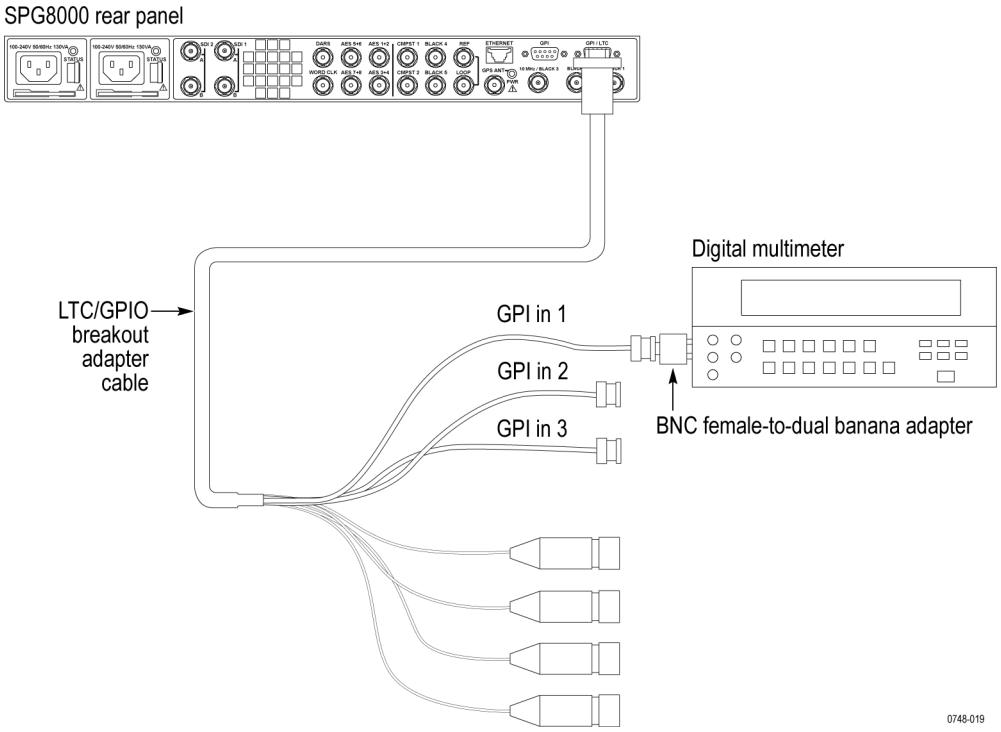


Figure 13: Setup for GPI input test

GPI input recall test

Perform this procedure to insure that the GPI inputs can trigger a preset restore on presets 1 to 7. If you have just completed the previous test, do the following. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

1. Solder one three inch wire to each of the following pins: 6, 7, 8, and 9.
2. Connect the 9-pin header to the **GPI** connector on the rear of the SGP8000.
3. Press the **SYSTEM** button.
4. Touch the wire from pin 9 to the chassis of the SPG8000.
5. Check that the display on the SPG8000 shows + **Factory Check: Preset-1** +.
6. Record Pass or Fail for *GPI recall of bit 1* in the test record.
7. Touch the wire from pin 8 to the chassis of the SPG8000.
8. Check that the display on the SPG8000 shows + **Factory Check: Preset-2** +.
9. Record Pass or Fail for *GPI recall of bit 2* in the test record.
10. Touch the wire from pin 7 to the chassis of the SPG8000.
11. Check that the display on the SPG8000 shows + **Factory Check: Preset-4** +.
12. Record Pass or Fail for *GPI recall of bit 3* in the test record.

48 kHz clock output level test

Perform the following procedure to verify that 48 kHz clock signal is output correctly from the 48 kHz **WORD CLK** connector: This test is divided into two sections: the first section tests the output at 2.5 V, and the second section tests the output at 1 V AC. The following equipment is required for this test:

- Oscilloscope
- 75 Ω BNC cable
- 75 Ω feed-through terminator

2.5 V DC coupled into 75 Ω.

1. On the SPG8000, set the Word Clock output to 5 V (DC):
   a. Press the **AES** button.
   b. Press the up (▲) arrow button until you see **AES WORD CLOCK OUTPUT**.
   c. Press the right (►) arrow button until you see **5 Volt (DC)**, and then press the **ENTER** button.
2. Use the 75 Ω BNC cable and the 75 Ω feed-through terminator to connect the 48 kHz **WORD CLK** connector to the oscilloscope CH1 input as shown in the following figure.

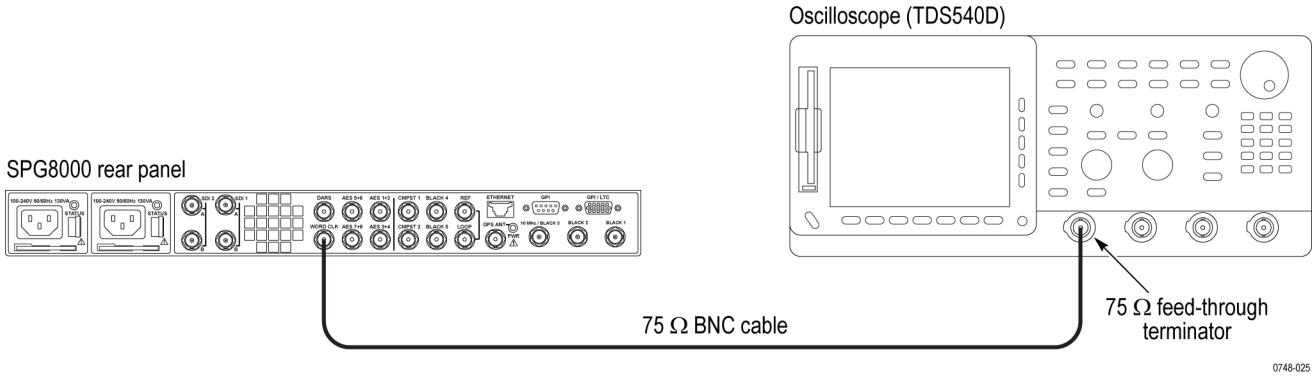


Figure 14: Setup for 48 kHz clock output test

3. Set the oscilloscope settings as follows:

Control	Setting
Vertical	500 mV/div
Horizontal	10 µs/div
Record Length	1000
Acquire menu	Sample
Trigger position	50%
Trigger slope	Rising Edge
Trigger level	+0.5 V
Input impedance	1 MΩ
Measure	Amplitude

4. Measure the low and high levels and record the results in the test record.

1 V AC coupled into 75 Ω.

5. On the SPG8000, set the Word Clock output to 1 V (AC):
   a. Press the **AES** button.
   b. Press the up (▲) arrow button until you see **AES WORD CLOCK OUTPUT**.
   c. Press the right (►) arrow button until you see **1 Volt (AC)**, and then press the **ENTER** button.
6. Set the oscilloscope settings as follows:

Control	Setting
Vertical	500 mV/div
Horizontal	200 µs/div
Record Length	1000
Acquire menu	Sample
Trigger position	50%
Trigger slope	Rising Edge
Trigger level	+0.0 V
Input impedance	1 MΩ
Measure	Amplitude

7. Measure the level and record the result in the test record.

Option AG performance verification

The following procedure verifies the functionality of the Option AG serial digital audio and silence outputs.

NOTE. *The procedure in this section only applies to SPG8000 instruments with Option AG installed.*

Required equipment

The following table lists the required equipment for the following procedure.

Table 31: Required equipment for Option AG performance verification

Item	Qty.	Minimum requirements	Recommended equipment
Digital Audio Monitor	1		Tektronix AMM768 or WFM8300 with Option AUD or equivalent
Oscilloscope	1	Bandwidth: 200 MHz or higher	Tektronix TDS540D or TDS3054
75 Ω BNC cable	1	Length: 42 inches	Tektronix part number 012-0074-00 or Belden 1694 or MarkerTek 1694-B-B-3
75 Ω feed-through terminator	1		Tektronix part number 011-0103-02

Test record Photocopy this table and use it to record the performance test results.

Table 32: Option AG test record

Instrument Serial Number:			Certificate Number:		
Temperature:			RH %:		
Date of Calibration:			Technician:		
Performance test	**Minimum**	**Measured**	**Maximum**	**Value**	**Value**
AES/EBU Serial Digital Audio Output Signal Amplitude					
1+2	900 mV		1100 mV		
3+4	900 mV		1100 mV		
5+6	900 mV		1100 mV		
7+8	900 mV		1100 mV		
DARS Output Level	900 mV		1100 mV		
AES/EBU Bar Graph Levels					
1+2	–20 dBfs				
3+4	–20 dBfs				
5+6	–20 dBfs				
7+8	–20 dBfs				
DARS Bar Graph Level				Pass	Fail

Procedures

Be sure you have performed the performance verification preparation before proceeding. (See page 19, *Performance verification*.)

You can perform performance verification procedures individually, if desired.

AES/EBU serial digital audio output level test

Perform the following procedure to verify that serial digital audio signals are output correctly from the 1+2, 3+4, 5+6, 7+8, and DARS connectors. The procedure is divided into two sections: the first checks the AES output signal amplitude levels using an oscilloscope, and the second checks the AES bar level outputs using a digital audio monitor.

AES/EBU output signal amplitude level.

1. Use the 75 Ω BNC cable and the 75 Ω feed-through terminator to connect the AES 1+2 connector on the SPG8000 to the oscilloscope CH1 input as shown in the following figure.

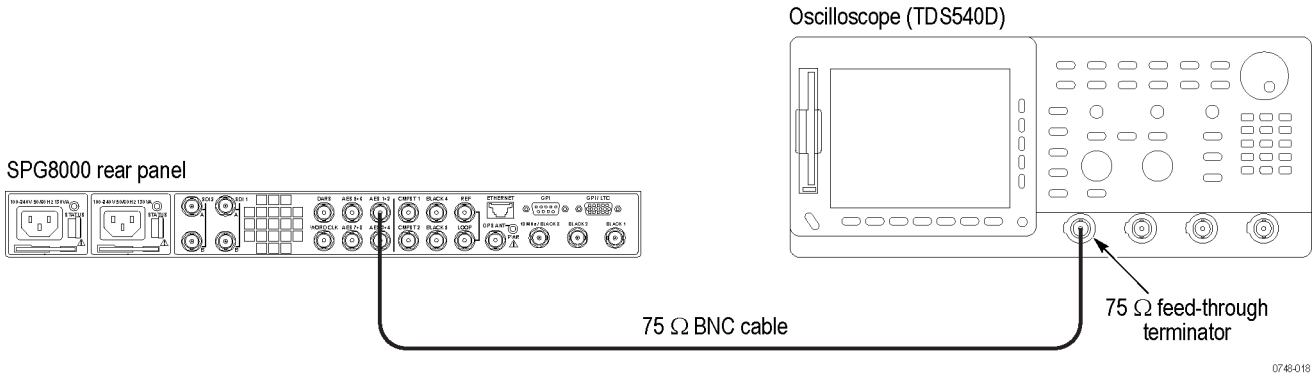


Figure 15: Oscilloscope setup for serial digital audio outputs test

2. Set the oscilloscope settings as follows:

Control	Setting
Vertical	200 mV/div
Horizontal	100 ns/div
Acquire	Sample
Trigger position	50%
Trigger slope	Rising Edge
Input impedance	1 MΩ
Measure	Amplitude

3. Load the factory default preset. (See page 20, *Load the factory preset*.)

4. Use the oscilloscope to measure that the signal amplitude is within the range of 900 mV to 1100 mV for the AES 1+2 channel.

5. Record the measured value for AES 1+2 in the test record.

6. Use the oscilloscope to measure that the signal amplitude is within the range of 900 mV to 1100 mV for the remaining AES channels as follows:

   - Change the BNC cable connection from the AES 1+2 connector to the AES 3+4 connector and record the measured value for AES 3+4 in the test record.
   - Change the BNC cable connection from the AES 3+4 connector to the AES 5+6 connector and record the measured value for AES 5+6 in the test record.
   - Change the BNC cable connection from the AES 5+6 connector to the AES 7+8 connector and record the measured value for AES 7+8 in the test record.
   - Change the BNC cable connection from the AES 7+8 connector to the DARS connector and record the measured value for DARS in the test record.

7. Change the BNC cable connection from the DARS connector to the AES 1+2 connector.

AES/EBU bar graph levels.

8. Disconnect the BNC cable and the 75 Ω terminator from the oscilloscope CH1 input connector, and then connect the BNC cable to the A IN 1,2 BNC connector on the digital audio monitor rear panel as shown in the following figure.

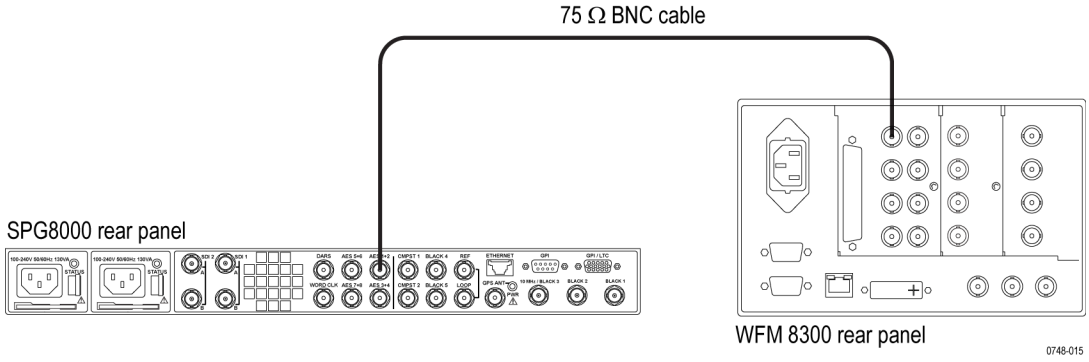


Figure 16: Audio monitor setup for serial digital audio outputs test

9. Check that no CRC errors are displayed on Channel 1 and Channel 2 of the digital audio monitor.
10. Verify that the digital audio monitor bar graphs show both Channel 1 and Channel 2 at –20 dBfs.
11. Record the measured value for 1+2 in the *AES/EBU bar graph levels* section of the test record.
12. Use the digital audio monitor to verify that the bar graphs show each channel at –20 dBfs for the remaining AES channels as follows:
    - On the SPG8000, change the BNC cable connection from the AES 1+2 connector to the AES 3+4 connector and record the measured value for AES 3+4 in the test record.
    - On the SPG8000, change the BNC cable connection from the AES 3+4 connector to the AES 5+6 connector and record the measured value for AES 5+6 in the test record.
    - On the SPG8000, change the BNC cable connection from the AES 5+6 connector to the AES 7+8 connector and record the measured value for AES 7+8 in the test record.
13. Change the BNC cable connection from the AES 7+8 connector to the DARS connector and verify that MUTE is displayed and that the bar levels are at the bottom of the bar graph.
14. Record Pass or Fail in the *DARS bar graph level* section of the test record.

Option BG performance verification

The following procedures verify the functionality of the Option BG black generator outputs.

NOTE. *All of the procedures in this section only apply to SPG8000 instruments with Option BG installed.*

Required equipment

The following table lists the required equipment for the following procedures.

Table 33: Required equipment for Option BG performance verification

Item	Qty.	Minimum requirement	Recommended equipment
Oscilloscope	1	Bandwidth: 200 MHz or higher	Tektronix TDS540D or TDS3054
Digital voltmeter	1	??	??
75 Ω BNC cable	1	Length: 42 inches	Tektronix part number 012-0074-00 or MarkerTek 1694-B-B-3
BNC T connector	1	Used to measure voltage on Black amplitude and offset test (SD)	
BNC female-to-dual-banana-plug adapter	1		Pomona model 1269
75 Ω feed-through terminator	1		Tektronix part number 011-0055-02
75 Ω precision terminator	1		Tektronix part number 011-0102-03

Test record Photocopy this table and use it to record the performance test results.

Table 34: Option BG test record

Instrument Serial Number: Certificate Number:

Temperature: RH %:

Date of Calibration: Technician:

Performance test				Minimum	Measured	Maximum
Tri-Level Sync Output						
	Blanking Level					
		BLACK 4		–50 mV		+50 mV
		BLACK 5		–50 mV		+50 mV
	Sync Amplitude plus					
		BLACK 4		294.0 mV		306.0 mV
		BLACK 5		294.0 mV		306.0 mV
	Sync Amplitude minus					
		BLACK 4		294.0 mV		306.0 mV
		BLACK 5		294.0 mV		306.0 mV
Black Output and Offset (SD)						
	Sync Amplitude					
		BLACK 4				
			0 mV (offset)	–40 mV		+40 mV
			700 mV			
			Amplitude (difference)	693.0 mV		707.0 mV
		BLACK 5				
			0 mV (offset)	–40 mV		+40 mV
			700 mV			
			Amplitude (difference)	693.0 mV		707.0 mV

Table 34: Option BG test record (cont.)

Performance test			Minimum	Measured	Maximum
Composite Output					
	Luminance Offset and Gain (Measured on DC signals)				
		CMPST 1			
		0 mV (offset)	–40 mV		+40 mV
		700 mV			
		Amplitude (difference)	693.0 mV		707.0 mV
		Blanking level			
		CMPST 2			
		0 mV (offset)	–40 mV		+40 mV
		700 mV			
		Amplitude (difference)	693.0 mV		707.0 mV
		Blanking level			
	Composite Luma to Chroma Gain Match (Measured on PAL 75% Color Bars with 100% White)				
		CMPST 1 Luma to Cyan bar match	–6.7 mV		+6.7 mV
		CMPST 2 Luma to Cyan bar match	–6.7 mV		+6.7 mV

Procedures

The following procedure checks that the Option BG outputs are operating correctly. Be sure you have performed the performance verification preparation before proceeding. (See page 19, *Performance verification*.)

Trilevel sync outputs test

Perform the following procedure to verify the blanking level and sync amplitude of trilevel sync signals. The following equipment is required for the test:

- Oscilloscope
- 75 Ω BNC cable
- 75 Ω feed-through terminator

1. Use the 75 Ω BNC cable and the 75 Ω feed-through terminator to connect the **BLACK 4** connector on the SPG8000 to the oscilloscope CH1 input as shown in the following figure.

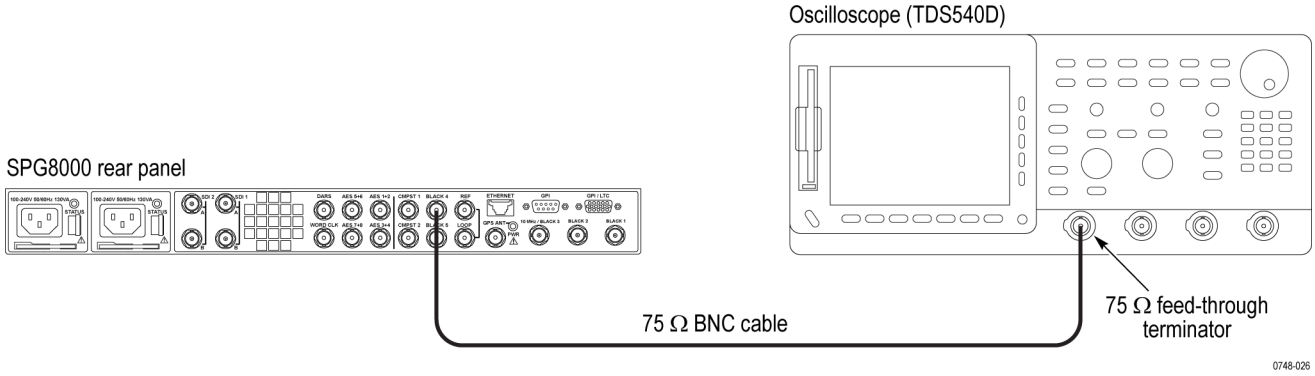


Figure 17: Setup for tri-level sync and black (PAL) output tests

2. Load the factory default preset. (See page 20, *Load the factory preset*.)
3. Select the **1080 59.94i** HD sync signal for BLACK 4 output on the SPG8000 as follows:
   a. Press the **BLACK** button until you see **BLACK 4 : FORMAT**.
   b. Press the left (◄) or right (►) arrow button to select **1080 59.94i**, and then press **ENTER**.
   c. Repeat this step for the **BLACK 5** output.

4. Set the oscilloscope settings as follows:

Control	Setting
Vertical	50 mV/div
Vertical offset	0 V
Horizontal	500 ns/div
Horizontal position	Center
Trig position	50%
Trig level	–150 mV
Trig slope	Rising Edge
Acquire menu	Sample

5. Verify that the blanking level is within the range of +50 mV to –50 mV.
6. Record the measured value in the test record for *Tri-level Sync Output Blanking Level*.
7. Change the oscilloscope vertical scale to 10 mV/div.
8. Align the blanking level with the center graticule line on the oscilloscope.
9. Change the oscilloscope vertical offset to 300 mV.
10. Verify that the high level of the signal (sync amplitude plus) is within the range of +0.6 div to –0.6 div to the center graticule (except for ringing of the rising edge).
11. Record the measured value in the test record for *Sync Amplitude plus*.
12. Change the oscilloscope vertical offset to –300 mV.
13. Verify that the low level of the signal (sync amplitude minus) is within the range of +0.6 div to –0.6 div to the center graticule (except for ringing of the falling edge).
14. Record the measured value in the test record for *Sync Amplitude minus*.
15. Set the vertical offset to 0 V and change the vertical gain to 50 mv/div.
16. Change the BNC cable connection from the **BLACK 5** connector to the **BLACK 4** connector on the SPG8000 and repeat steps 5 through 14.

Black output and offset test (SD)

Perform this procedure to check that Black signal output amplitude and offset for SD signals are adjusted to within specification. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

1. Connect the BNC-to-Banana-plug adapter to the voltmeter.
2. Connect the BNC T to the adapter.
3. Connect a 75 Ω precision terminator to one end of the BNC T connector.
4. Connect a 75 Ω BNC cable to the other end of the BNC T connector.
5. Connect the other end of the cable to the **BLACK 4** output on the SPG8000.

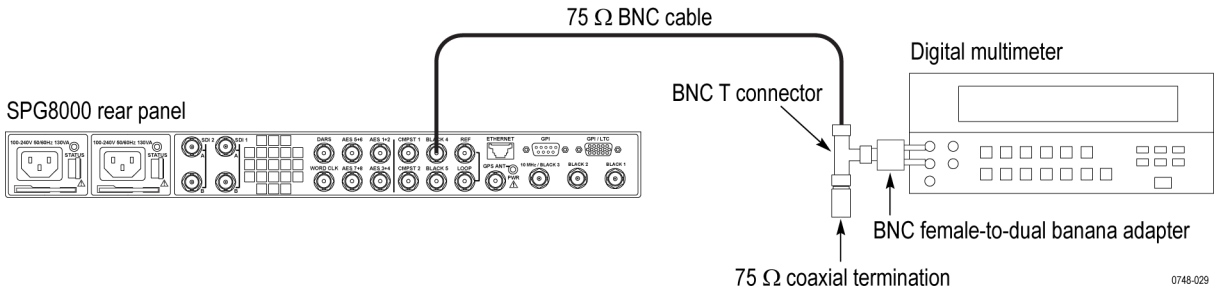


Figure 18: Setup for Black amplitude and offset test (SD) – Option BG

6. Set the Black 4 and Black 5 signals to NTSC as follows:
   a. Press the **BLACK** button on the SPG8000 until you see **BLACK 4 : FORMAT** on the menu.
   b. Use the left (◄) or right (►) arrow button to select **NTSC**.
   c. Press the **ENTER** button.
   d. Repeat the previous substeps for the **BLACK 5** output.
7. Press the **BLACK** button until you see **BLACK 4** on the menu.
8. Use the up (▲) arrow button to select **CALIBRATION**.
9. Use the right (►) arrow button to select **DAC Offset (0 V DC)**.
10. Press the **ENTER** button.
11. Record the voltmeter reading in the test record. This is the offset value.
12. Use the right (►) arrow to select **DAC Gain (700 mV DC)**.
13. Press the **ENTER** button.
14. Record the value in the test record.
15. Calculate the difference between the 700 mV and 0 mV signal levels and record this in the test record.
16. Repeat steps 7 through 15 for Black 5.

Composite offset and gain test

Perform this procedure to check that Composite signal output offset and gain for SD signals are adjusted to within specification. This test should be performed in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

1. Connect the BNC-to-Banana-plug adapter to the voltmeter.
2. Connect the BNC T to the adapter.
3. Connect a 75 Ω precision terminator to one end of the BNC T connector.
4. Connect a 75 Ω BNC cable to the other end of the BNC T connector.
5. Connect the other end of the cable to the **CMPST 1** output on the SPG8000.

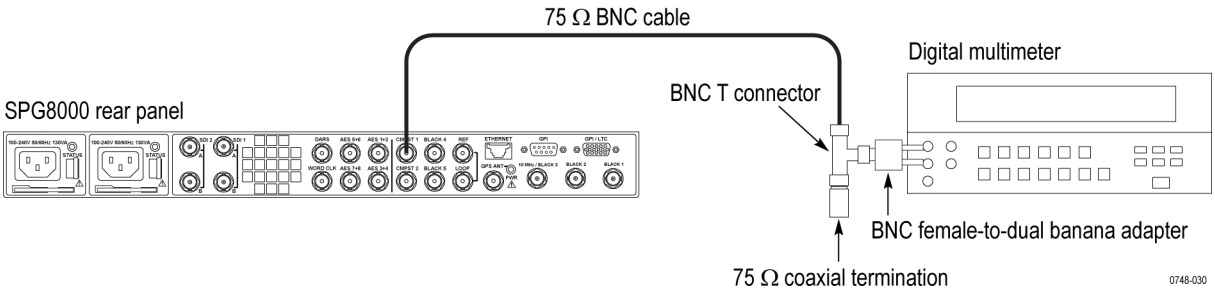


Figure 19: Setup for Composite offset and gain test

6. Set the CMPST 1 and CMPST 2 signals to NTSC as follows:
   a. Press the **CMPST** button on the SPG8000 until you see **CMPST 1 : FORMAT** on the menu.
   b. Use the left (◄) or right (►) arrow button to select **NTSC**.
   c. Press the **ENTER** button.
   d. Repeat the previous substeps for the **CMPST 2** output.
7. Press the **CMPST** button until you see **CMPST 1** on the menu.
8. Use the up (▲) arrow button to select **CALIBRATION**.
9. Use the right (►) arrow button to select **DAC Offset (0 V DC)**.
10. Press the **ENTER** button.
11. Record the voltmeter reading in the test record. This is the offset value.
12. Use the right (►) arrow to select **DAC Gain (700 mV DC)**.
13. Press the **ENTER** button.
14. Record the value in the test record.
15. Calculate the difference between the 700 mV and 0 mV signal levels and record this in the test record.
16. Repeat steps 7 through 15 for CMPST 2.

Composite luminance / chrominance gain match test

This test verifies the luminance and chrominance gain match of the color bars signal. The following equipment is required for this test:

- Oscilloscope
- 75 Ω BNC cable
- 75 Ω feed-through terminator

1. Use the 75 Ω BNC cable to connect the **CMPST 1** connector on the SPG8000 to the **CH 1** of the oscilloscope, as shown.
2. Connect the 75 Ω feed-through terminator to the loopthrough on the oscilloscope.

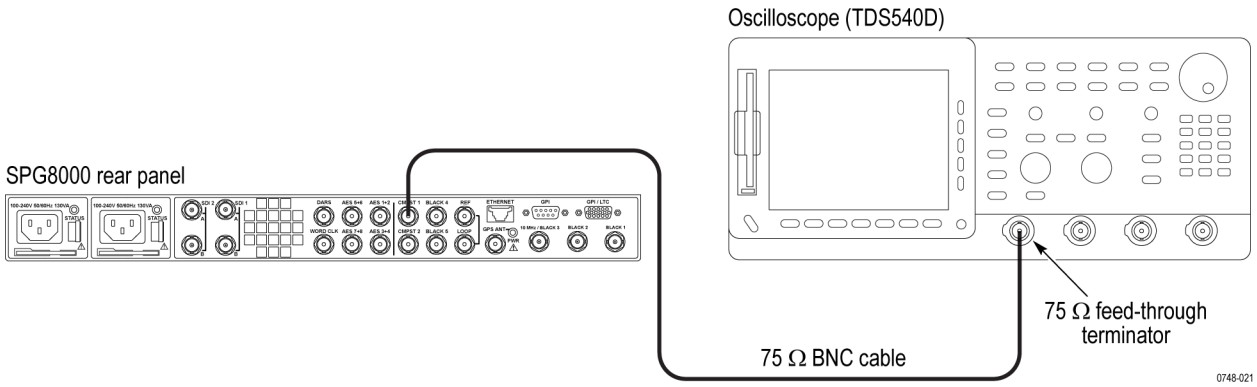


Figure 20: Setup for luminance and chrominance test

3. Select **PAL 75% Bars 100% white** signal for **CMPST 1** and **CMPST 2** as follows:
   a. Press the **CMPST** button until you see **CMPST 1 : FORMAT** in the menu.
   b. Press the right (►) arrow button to select **PAL**, and then press the **ENTER** button.
   c. Press the down (▼) arrow button to view the **CMPST 1 : TEST SIGNAL** menu.
   d. Press the right (►) arrow button to select **75% Color Bar 100% White**, and then press **ENTER** button.
   e. Press the **CMPST** button until you see **CMPST 2 : FORMAT** in the menu.
   f. Press the right (►) arrow button to select **PAL**, and then press the **ENTER** button.

g. Press the down (▼) arrow button to view the **CMPST 2 : TEST SIGNAL** menu.

h. Press the right (►) arrow button to select **75% Color Bar 100% White**, and then press **ENTER** button.

4. To compare the tops of the white bar and the second (cyan) chroma packet to verify luma to chroma match, start by setting the oscilloscope settings as follows:

Control	Setting
Vertical	10 mV/div
Vertical offset	0.7 V
Trig position	10%
Trig type	Edge rising
Trig level	0.6 V
Record length	50,000
Time per div	2.5 µs
Trig hold-off	50 µs

5. Turn on voltage cursors and measure the difference between the top of the white bar and the Cyan bar.

6. Record the difference in the test record for *Luma to Cyan bar match*.

7. Change the BNC cable connection from the **CMPST 1** connector on the SPG8000 to the **CMPST 2** connector on the SPG8000 and repeat steps 5 through 6.

Option GPS performance verification

The following procedures verify the functionality of the Option GPS Synchronization connectors.

NOTE. *All of the procedures in this section only apply to SPG8000 instruments with Option GPS installed.*

Required equipment

The following table lists the required equipment for the following procedure.

Table 35: Required equipment for Option GPS performance verification

Item	Qty.	Minimum requirements	Recommended equipment
GPS antenna feed with good signal level	1	Less than 5 dB attenuation since last amplifier	If a GPS antenna feed is not available, use the following equipment (or equivalent) to create a GPS signal source. ■ Trimble Bullet III: 5 V, 35 dB gain, antenna with F-connector ■ Cable: up to 200 ft Belden 1694A, with F connector on one end and a BNC on the other
SDI video signal and GPS signal source	1	HD, SDI, GPS	SDI7 and GPS7 modules in a TG8000 or equivalent
6, 10, and 20 dB antenna pads	variable If antenna has no additional amps, one 6 dB and one 10 dB should be adequate. For a fully buffered system, 30 or 40 dB total is probably needed.	Use several pads that allow similar ranges	6 dB, Mini-circuits HAT-6-75 10 dB, Mini-circuits HAT-10-75 20 dB, Mini-circuits HAT-20-75
Waveform monitor	1		Tektronix WFM8300 or WFM7120 with Option CPS
Voltmeter	1		Fluke
LTC/GPIO breakout adapter cable	1		Tektronix part number 012-1717-00
600 Ω LTC load with meter access	1		Create this item by soldering a 600 Ω resistor to pins 2 and 3 of a female XLR

Table 35: Required equipment for Option GPS performance verification (cont.)

Item	Qty.	Minimum requirements	Recommended equipment
Antenna splitter	1	Use to drive one signal into two GPS7 inputs	Any 2:1 splitter with appropriate connector adapters or GPS Source S12S with (3) SMA to BNC adapters, Tyco part number 1058083-1 or ZFDC-10-5-S with 3 SMA to BNC adapters, Tyco part number 1058083-1
75 Ω, precision terminator	1		Tektronix part number 011-0102-03
75 Ω coaxial terminator	2		Tektronix part number 011-0163-00
BNC T	2		Tektronix part number 103-0030-00
BNC to Banana Plug adapter	1		Pomona model 1269
75 Ω BNC cable	4	3 ft long	Tektronix part number 012-0074-00 or MarkerTek 1894-B-B-3

Test record Photocopy this table and use it to record the performance test results.

Table 36: Option GPS test record

Instrument Serial Number:			Certificate Number:		
Temperature:			RH %:		
Date of Calibration:			Technician:		
Performance test	**–Min**	**+Max**	**Measured**	**Value**	**Value**
DC antenna output power voltage					
0 V					
3.3 V	3.3 V	4 V			
5 V	5 V	6 V			
Antenna current and fault thresholds					
Flashing green (open circuit)				Pass	Fail
Steady green (nominal load)				Pass	Fail
Voltage with nominal load	4.5 V	5 V			
Steady red (short circuit)				Pass	Fail
Lock to GPS signal from antenna					
Signal quality (reference unit)	40	80			
Difference in signal quality between reference unit and unit under test	≤ 20 units from reference unit value	≥ 20 units from reference unit value			
Frequency accuracy when locked to GPS					
Vector phase change	– 38 °	+ 38 °			
Frame timing accuracy					
Timing	– 0.185 µs	+ 0.185 µs			
Internal frequency	– 2.5 e^{-6}	+2.5 e^{-6}			

Procedures

Be sure to perform the Common Diagnostics Tests before proceeding. (See page 21, *Diagnostics tests*.)

You can perform performance verification procedures individually, if needed.

Set to factory mode and load factory preset

1. Change the instrument to factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

NOTE. *Although not all of the following tests need to be performed in factory mode, they can be. If you are going to perform all of the procedures, or a particular set of procedures, start up the instrument in factory mode at the start of the first procedure.*

Leave the instrument in factory mode until you are finished or the instructions say otherwise.

2. Load the factory default preset. (See page 20, *Load the factory preset*.)

DC antenna output power voltage test

Perform the following procedure to check that the DC antenna power output is in the proper voltage range.

1. Connect the BNC-to-Banana-plug adapter to the voltmeter.
2. Connect the BNC T to the adapter.
3. Connect a 75 Ω BNC cable to the other end of the BNC T connector.
4. Connect the other end of the cable to the **GPS ANT** input on the rear of the SPG8000.

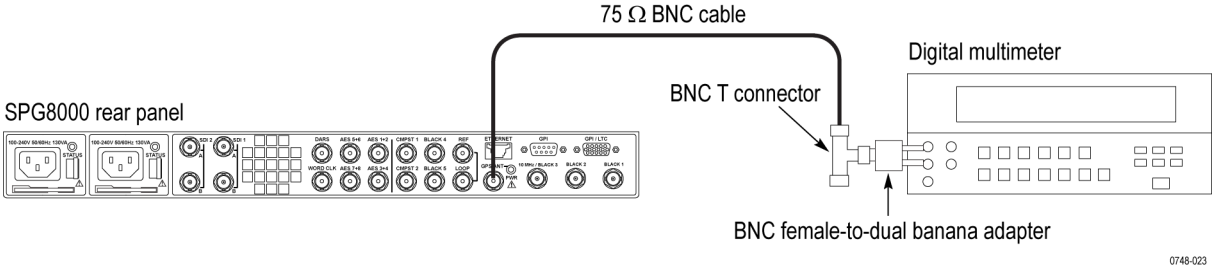


Figure 21: Setup for DC antenna output power voltage test

5. Measure the voltage and record the value in the test record.

6. Set the antenna voltage to 0 V as follows:
   a. Press the **REF** button.
   b. Use the up (▲) or down (▼) arrow button to select **GPS ANTENNA POWER**.
   c. Use the right (►) arrow button to select **Off**.
   d. Press the **ENTER** button.
7. Check that the voltmeter shows 0 V.
8. Record the result in the test record for the 0 V entry.
9. Set the antenna voltage to 3.3 V as follows:
   a. Use the right (►) arrow button to select **3.3 Volt**.
   b. Press the **ENTER** button.
10. Check that the voltmeter shows between 3.3 V and 4 V.
11. Record the result in the test record for the 3.3 V entry.
12. Now set the antenna voltage to 5 V as follows:
   a. Use the right (►) arrow button to select **5 Volt**.
   b. Press the **ENTER** button.
13. Check that the voltmeter shows between 5 V and 6 V.
14. Record the result in the test record for the 5 V entry.

Antenna current and fault thresholds test

Perform the following procedure to check that the antenna current and fault thresholds are within limits.

1. Use the equipment connection from the previous test. (See Figure 21 on page 75.)
2. Set the antenna voltage to 5 V, if it is not already, as follows:
   a. Press the **REF** button.
   b. Use the up (▲) or down (▼) arrow button to select **GPS ANTENNA POWER**.
   c. Use the right (►) arrow button to select **5 Volt**.
   d. Press the **ENTER** button.
3. Check that the antenna power LED on the rear panel of the SPG8000 is flashing green. This indicates an open circuit.
4. Record Pass or Fail in the test record.
5. Apply a 75 Ω precision terminator to the BNC T connector.
6. Check that the voltage is between 4.5 V and 5 V.
7. Record the result in the test record.
8. Check that the antenna power LED on the SPG8000 rear panel is a steady green. This indicates a nominal load.
9. Record the Pass or Fail in the test record.
10. Remove the BNC-to-Banana adapter from the BNC T, and install a second BNC T and a precision terminator on the end of the cable to the antenna input. This will exceed the allowed current on the antenna.
11. Check that the antenna power LED on the SPG8000 rear panel is a steady red. This indicates a short circuit.
12. Record the result in the test record.

Lock to GPS signal from antenna test

Perform the following procedure to check that the GPS locks onto the minimum allowable signal. This test requires a reference GPS7 unit.

1. Set the antenna power as needed by the antenna in the test system.
2. Connect an antenna splitter to the GPS input signal feed.
3. Connect one output of the splitter to the GPS antenna input of the reference unit and then power on the unit.
4. Connect the other output of the splitter to the **GPS ANT** input of the SPG8000 under test.

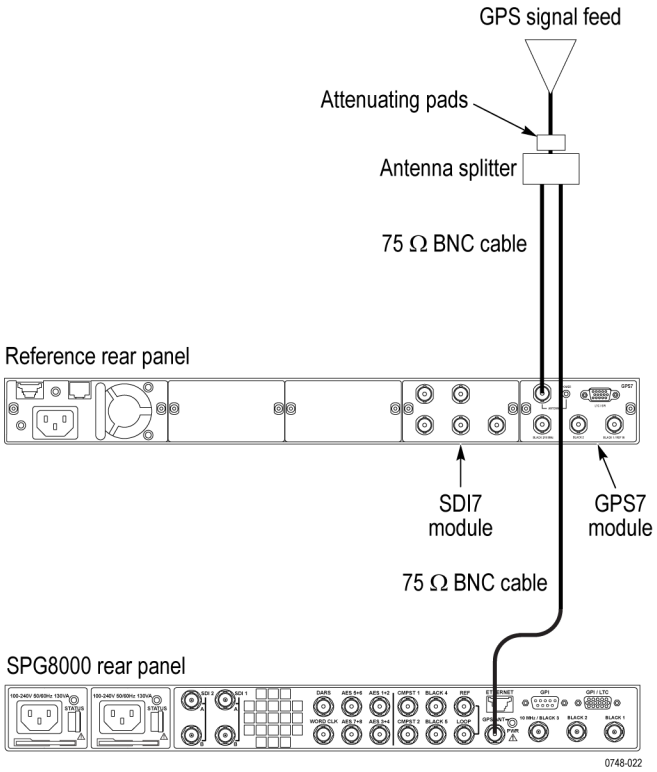


Figure 22: Setup for the GPS signal lock from antenna test

5. Check the signal quality on the reference unit as follows:

   a. Use the up (▲) or down (▼) arrow button to select **STATUS** from the GPS7 module menu.

   b. Use the left (◄) or right (►) arrow button to select **Signal Quality**.

   c. If the signal quality does not already show "Locked", check that the signal quality changes from *No Signal* to *Low Signal* to *Acquiring satellites* to *Adjusting phase* to *Locked*.

NOTE. *It is okay if some steps are skipped. Depending on the signal level, it may take from a few seconds to several minutes to leave the "No Signal" state.*

6. Check the signal quality on the SPG8000 under test as follows:

   a. Press the **STATUS** button.

   b. Press the down (▼) arrow button until you see **STATUS : GPS**.

   c. Use the left (◄) or right (►) arrow button to view the **GPS SIGNAL QUALITY: 30.0 Sats: 4/4** readout. Check that the signal quality value is greater than 30 and that the number of satellites is above 4/4.

7. Add attenuating pads between the antenna and the splitter until the signal quality on the reference unit is in the 40 to 80 range.

8. Record the signal quality of the reference unit in the test record.

9. Check that the signal quality on the SPG8000 under test is within 20 counts of the reference unit.

10. Record the difference between the reference unit and the SPG8000 under test in the test record.

11. Remove the attenuators from the input to the splitter and reconnect the signal from the antenna. If possible, leave the antenna on the SPG8000 under test connected during subsequent tests to allow the system to stabilize.

Frequency and frame timing accuracy test

This procedure checks that the frequency and frame timing are accurate when locked to GPS.

Frequency accuracy when locked to GPS.

1. Check that the antenna is connected to both a GPS7 reference module (or other reference instrument) and the **GPS ANT** connector of the SPG8000 under test.

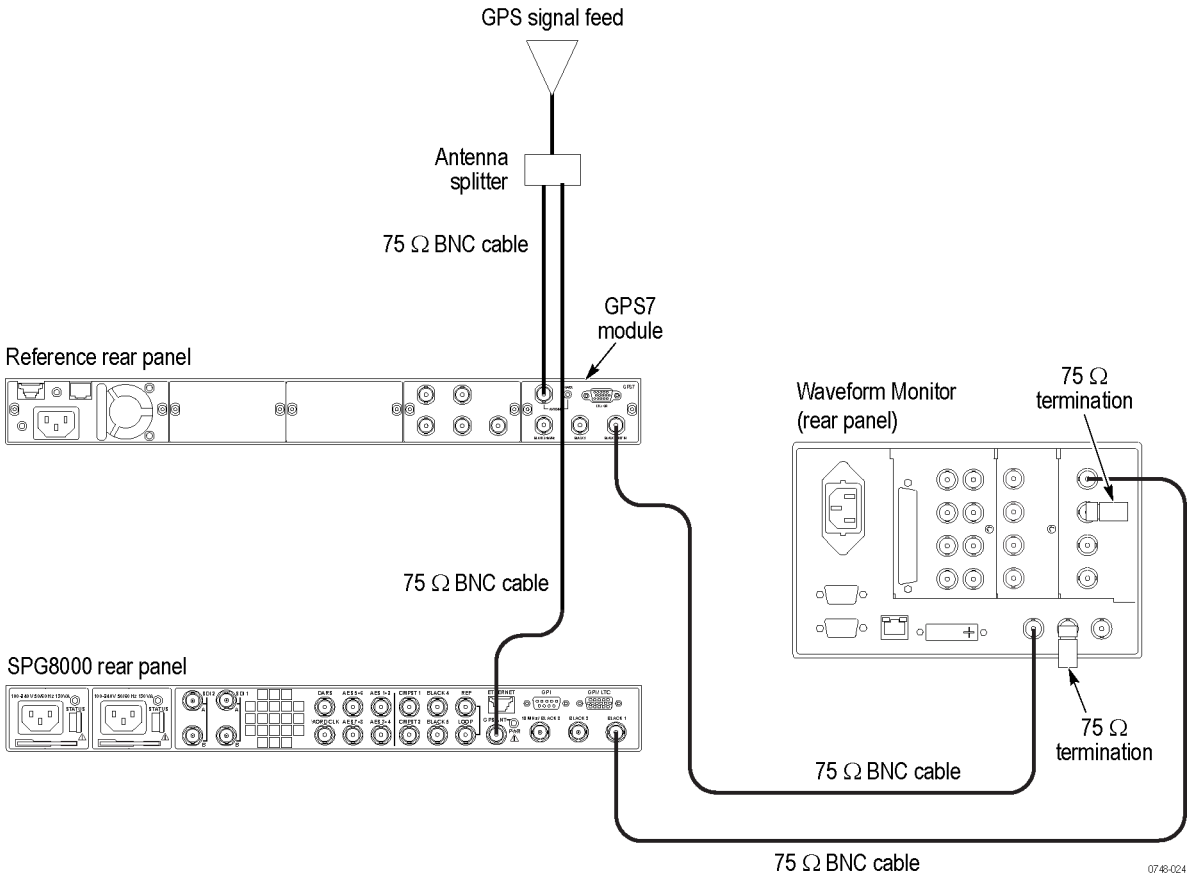


Figure 23: Setup for frequency accuracy and frame timing accuracy tests

2. Check that both the reference module and the SPG8000 under test have been on for 20 minutes to allow the ovens to warm up.
3. Check the signal quality on the reference module as follows:
   a. Press the **MODULE** button until **GPS7** appears.
   b. Use the up (▲) or down (▼) arrow button, if needed, to select **STATUS**.
   c. Check that the top line of the status display shows **Locked**.
   d. Use the left (◄) or right (►) arrow button to select **Signal Quality**.
4. Check the value on the reference unit. A value of 30 or above is adequate.

5. Check the signal quality on the SPG8000 under test as follows:
   a. Press the **STATUS** button.
   b. Press the down (▼) arrow button until you see **STATUS : GPS**.
   c. Use the left (◄) or right (►) arrow button to view the **GPS SIGNAL QUALITY: 30.0 Sats: 4/4** readout. Check that the signal quality value is greater than 30 and that the number of satellites is above 4/4.
6. Check the value on the SPG8000 under test. A value of 30 or above is adequate.
7. Go to the diagnostics page on the reference unit and check that the system is in **Fine** mode as follows. If it is not, then allow it to warm up and stabilize.
   a. Use the up (▲) arrow button to select **DIAGNOSTICS**.
   b. Press the **ENTER** button.
   c. Press the right (►) arrow to display **TUNE**.
   d. Check that **Fine** shows on the right side of the display.
   e. Press **BACK** to exit Diagnostics menu.
8. Go to the diagnostics page on the SPG8000 under test and check that the system is in **Fine** mode as follows. If it is not, then allow it to warm up and stabilize.
   a. Press the **SYSTEM** button.
   b. Use the up (▲) arrow button to select **DIAGNOSTICS**.
   c. Press the **ENTER** button.
   d. Check that you can see **SYSTEM : DIAGNOSTICS : TUNE** in the menu.
   e. Press the right (►) arrow to display the **Phase** and **DDS** values.
   f. Check that **Fine** shows to the right of the readings. If it does not, allow more time for the system to stabilize.
   g. Press **BACK** to exit the Diagnostics menu.
9. Set the **BLACK 1** output on the reference unit to NTSC as follows:
   a. Use the up (▲) or down (▼) arrow button to select **SELECT OUTPUT**.
   b. Use the left (◄) or right (►) arrow button to select **Black 1**.
   c. Press **ENTER** to display **INPUT-OUTPUT**.
   d. Use the down (▼) arrow button to display **SELECT FORMAT**.
   e. Press **ENTER** twice to select **NTSC** and **Black Burst**.

10. Set the **BLACK 1** output on the SPG8000 unit under test to NTSC as follows:

    a. Press the **BLACK** button until you see **BLACK 1: FORMAT** on the menu.

    b. If you see **NTSC** on the display, press the **ENTER** button. If you do not see NTSC, press the right (►) arrow button until you do, and then press the **ENTER** button.

11. Connect **BLACK 1** of the reference unit to the reference input on the waveform monitor, and terminate the loop through with a 75 Ω terminator.

12. Connect **BLACK 1** of the SPG8000 under test to the **CMPST A** input of the waveform monitor, and terminate the loop through with a 75 Ω terminator.

13. Display the composite input on the waveform monitor and select external reference.

14. View the Vector Display in full screen mode.

15. Use the variable gain function to expand the burst to overlap the compass rose graticule.

16. Write down the minimum and maximum vector phase you observe over a 30 second period.

17. Calculate the difference and record the result in the test record.

18. View the Timing Display in full screen mode.

19. Record the timing value in the test record.

Frame timing accuracy when locked to GPS.

20. View the Timing Display in full screen mode.

21. Record the timing value in the test record.

Internal frequency calibration test

Perform the following procedure to set the internal frequency of the base unit internal oscillator. This adjustment stores the current correction to the oven oscillator frequency while is it locked to a GPS or a reference signal, to be used when in **Internal** mode. It can be done without any disruption to operation and is best done in the operating environment of the instrument.

1. Connect the power cord to the SPG8000.
2. Check for error messages as the instrument starts.
3. Connect a GPS signal to the GPS ANT connector.

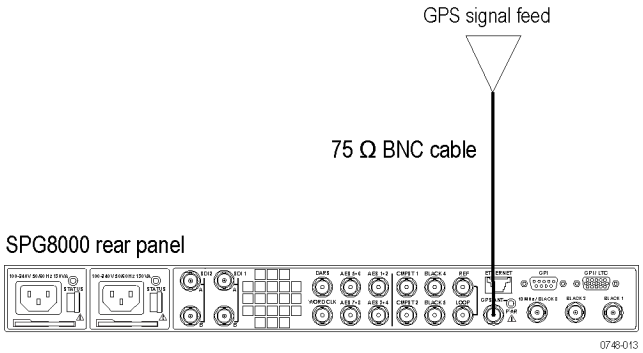


Figure 24: Setup for internal frequency calibration

4. Allow the instrument to warm up for at least 20 minutes.
5. Check that the signal on the SPG8000 under test is locked as follows:
   a. Press the **STATUS** button.
   b. Press the down (▼) arrow button until you see **STATUS : REFERENCE : GPS**.
   c. Check that **Locked >>>>** shows on the display.
6. Go to the diagnostics page on the SPG8000 under test and check that the system is in **Fine** mode as follows. If it is not, then allow it to warm up and stabilize.
   a. Press the **SYSTEM** button.
   b. Use the up (▲) arrow button to select **DIAGNOSTICS**.
   c. Press the **ENTER** button.
   d. Check that you can see **SYSTEM : DIAGNOSTICS : TUNE** in the menu.
   e. Press the right (►) arrow to display the **Phase** and **DDS** values.
   f. Check that **Fine** shows to the right of the readings. If it does not, allow more time for the system to stabilize.

7. Check the Tune values. This is the amount that the SPG8000 is tuning to lock to the GPS signal. If this is more than ±0.1 e^{-6}, then oven calibration is recommended and you should proceed to step 8. Otherwise exit the procedure.

8. Calibrate the oven correction as follows:

   a. Press the **SYSTEM** button.

   b. Press the up (▲) arrow button several times until you see **CALIBRATE OVEN**.

   c. Press the up (▲) arrow button until you see **DIAGNOSTICS**, and then press the **ENTER** button.

   d. Press the down arrow button until you see **SYSTEM : DIAGNOSTICS : CALIBRATION** and a value such as **Cal: –0.13 e^{-6} (2069204)**.

9. Record the value you see in the test record. This is the correction that is being applied to the internal oven in over to achieve calibration.

NOTE. *If the value is outside the test limits, then the Oven has drifted more than expected and might need to be replaced.*

Option SDI and Option 3G performance verification

The following procedures verify the functionality of the Option SDI connectors.

NOTE. *All of the procedures in this section only apply to SPG8000 instruments with Option SDI installed. Some steps have setups that depend on whether Option 3G is also installed.*

Required equipment

The following table lists the required equipment for the following procedure.

Table 37: Required equipment for Option SDI performance verification

Item	No.	Minimum requirement	Recommended equipment
Waveform monitor	1	HD-SDI waveform monitor with 3 Gb/s capabilities	Tektronix WFM8300 with Option 3G and Option PHY
Digital signal analyzer	1	Digital signal analyzer with a 20 GHz electrical sampling module and a probe interface module	Tektronix DSA8200 with an 80E04 electrical sampling module and an 80A03 Tek Connect Probe Interface module with semirigid cable
Tekconnect 75 Ω to 50 Ω adapter with BNC input connector	1		Tektronix part number TCA75
Tekconnect adapter with BNC input connector	1		Tektronix part number TCA-BNC
1 m (3 ft) BNC to BNC high-bandwidth cable	3	Used to hook DUT to scope for Amplitude and rise time tests	Belden 1694, MarkerTek 1694-B-B-3
Stable 10 kHz sine generator	1	CW sine wave, with 800 mV p-p ± 5% into 75 Ω, THD < 60 dBc, 10 kHz, and less than 50 mV DC offset	A Tek AFG3101
Precision RMS voltmeter	1		Keithley 2700 DMM
6 dB SMA attenuator	1		Tektronix part number 015-1001-01
SMA (male) to BNC (female) adapter	1		Tektronix part number 015-0554-00
75 Ω Precision terminator	1		75 Ω Precision terminator (Tektronix part number 011-0102-03)
BNC to Banana Plug adapter	1		Pomona model 1269
BNC T	1		Tektronix part number 103-0030-00
BNC (female) to BNC (female) 75 Ω barrel	1		Amphenol part number 31-70019

Test record Photocopy this table and use it to record the performance test results.

Table 38: Option SDI test record

Instrument Serial Number: Certificate Number:

Temperature: RH %:

Date of Calibration: Technician:

Performance test		Minimum	Maximum	Value	Value
SDI diagnostics	PLL status				
	Flex0			Pass	Fail
	Flex1			Pass	Fail
	DDS status				
	DDS0			Pass	Fail
	DDS1			Pass	Fail
	Voltages				
	+1.2 V			Pass	Fail
	+1.2 VA			Pass	Fail
	+3.3 V			Pass	Fail
	+3.3 VA			Pass	Fail
	+1.5 V			Pass	Fail
	+3.0 V			Pass	Fail
	+1.8 V			Pass	Fail
	Dref			Pass	Fail
	SRAM Memory				
	Addr Bus			Pass	Fail
	Data Bus			Pass	Fail
	Memory Test			Pass	Fail
	DDR2 Memory				
	Addr Bus			Pass	Fail
	Data Bus			Pass	Fail
	Memory Test			Pass	Fail

Table 38: Option SDI test record (cont.)

Performance test		Minimum	Maximum	Value	Value
Output function and jitter (channel 1 and channel 2)	Signal 1A 1080 50p/ 1080 50i			Pass	Fail
	Jitter 1080 50p/ 1080 50i	0 ns	50 ps p-p		
	Signal 1B 1080 59.94p/ 1080 59.94i			Pass	Fail
	Jitter 1080 59.94p/ 1080 59.94i	0 ns	50 ps p-p		
	Signal 1B 1080 24p			Pass	Fail
	Jitter 1080 24p	0 ns	50 ps p-p		
	Signal 2A 1080 50p/ 1080 50i			Pass	Fail
	Jitter 1080 50p/ 1080 50i	0 ns	50 ps p-p		
	Signal 2B 1080 59.94p/ 1080 59.94i			Pass	Fail
	Jitter 1080 59.94p/ 1080 59.94i	0 ns	50 ps p-p		
	Signal 2B 1080 24p			Pass	Fail
	Jitter 1080 24p	0 ns	50 ps p-p		

Table 38: Option SDI test record (cont.)

Performance test		Minimum	Maximum	Value	Value
Amplitude characterization	DMM measurement (Typically, 0.2880 V)				
	Cycle RMS (Typically, 116 mV)				
	Cycle mean (Typically, 1 mV)				
	RMS amplitude of sine wave (Typically, 116 mV)	SQRT((cycle RMS)^2 - (cycle mean)^2)			
	Attenuation factor	2.35	2.55		
SDI Output Amplitude (channel 1 and channel 2)	Signal 1A amplitude calculated	776 mV	824 mV		
	Signal 1B amplitude calculated	776 mV	824 mV		
	Signal 2A amplitude calculated	776 mV	824 mV		
	Signal 2B amplitude calculated	776 mV	824 mV		
SDI Rise and Fall Time (HD and 3G) Signal 1A	Rise time	0 ps	135 ps		
	Fall time	0 ps	135 ps		
	Difference	-50 ps	+50 ps		
SDI Rise and Fall Time (SD) Signal 1A	Rise time	400 ps	1000 ps		
	Fall time	400 ps	1000 ps		
	Difference	-500 ps	+500 ps		
SDI Rise and Fall Time (HD and 3G) Signal 1B	Rise time	0 ps	135 ps		
	Fall time	0 ps	135 ps		
	Difference	-50 ps	+50 ps		
SDI Rise and Fall Time (SD) Signal 1B	Rise time	400 ps	1000 ps		
	Fall time	400 ps	1000 ps		
	Difference	-500 ps	+500 ps		

Table 38: Option SDI test record (cont.)

Performance test		Minimum	Maximum	Value	Value
SDI Rise and Fall Time (HD and 3G) Signal 2A	Rise time	0 ps	135 ps		
	Fall time	0 ps	135 ps		
	Difference	-50 ps	+50 ps		
SDI Rise and Fall Time (SD) Signal 2A	Rise time	400 ps	1000 ps		
	Fall time	400 ps	1000 ps		
	Difference	-500 ps	+500 ps		
SDI Rise and Fall Time (HD and 3G) Signal 2B	Rise time	0 ps	135 ps		
	Fall time	0 ps	135 ps		
	Difference	-50 ps	+50 ps		
SDI Rise and Fall Time (SD) Signal 2B	Rise time	400 ps	1000 ps		
	Fall time	400 ps	1000 ps		
	Difference	-500 ps	+500 ps		

Preparation

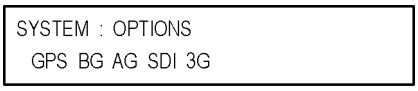
Be sure you have performed the performance verification preparation before proceeding. (See page 19, *Performance verification preparation*.)

Performance verification procedures can be performed individually, if needed.

Check for Option 3G

Check whether Option 3G is installed on your instrument. If Option 3G is installed, then you should use the setups in the following procedures that are called out for Option 3G.

1. Press the **SYSTEM** button to access the SYSTEM menu.
2. Press the up (▲) or down (▼) arrow button to select **SYSTEM : OPTIONS**. The second line of the display lists the installed options. The readout will show **3G** if Option 3G is installed.



3080-061

SDI diagnostics

Check the SDI diagnostics before performing the performance verification tests. Some of the SDI diagnostics are available only when the instrument is in factory mode.

1. Change the instrument to factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)
2. Load the factory default preset. (See page 20, *Load the factory preset*.)
3. Press the **SYSTEM** button to access the SYSTEM menu.
4. Use the up (▲) or down (▼) arrow button to select **SYSTEM : DIAGNOSTICS**, and then press the **ENTER** button.
5. Use the down (▼) arrow button to view the **PLL STATUS MAIN** display.
6. Use the right (►) arrow button to view the **PLL STATUS SDI** display.
7. Check that **Flex0** and **Flex1** both show **Lock**, and then record Pass or Fail in the test record.
8. Use the right (►) arrow button to view the **DDS STATUS SDI** display.
9. Check that **DDS0 Phase** and **DDS1 Phase** both show **Lock**, and then record Pass or Fail in the test record.
10. Use the down (▼) arrow button to view the **VOLTAGE** display.
11. Use the left (◄) arrow button to view the **VOLTAGE SDI BRD** displays 1 through 4.
12. Check that all voltages show **OK** for each VOLTAGE SDI BRD display, and then record Pass or Fail in the test record.

13. Use the down (▼) arrow button to select **SRAM ADDR BUS 1**.
14. Use the right (►) arrow button to view the **SRAM ADDR BUS** displays 1 through 3.
15. Check that all buses show **(OK)** for each SRAM ADDR BUS display, and then record Pass or Fail in the test record.
16. Use the down (▼) arrow button to select **SRAM DATA BUS 1**.
17. Use the right (►) arrow button to view the **SRAM DATA BUS** displays 1 through 3.
18. Check that all buses show **(OK)** for each SRAM DATA BUS display, and then record Pass or Fail in the test record.
19. Use the down (▼) arrow button to select **SRAM MEM TEST**, and then press the **ENTER** button to start the test. The SRAM memory test takes approximately 60 seconds to complete.
20. Check that the display reads **SRAM: 0 bad sectors detected**, and then record Pass or Fail in the test record.
21. Use the down (▼) arrow button to select **DDR2 ADDR BUS 1**.
22. Use the right (►) arrow button to view the **DDR2 ADDR BUS** displays 1 and 2.
23. Check that all buses show **(OK)** for each DDR2 ADDR BUS display, and then record Pass or Fail in the test record.
24. Use the down (▼) arrow button to select **DDR2 DATA BUS 1**.
25. Use the right (►) arrow button to view the **DDR2 DATA BUS** displays 1 and 2.
26. Check that all buses show **(OK)** for each DDR2 DATA BUS display, and then record Pass or Fail in the test record.
27. Use the down (▼) arrow button to select **DDR2 MEM TEST**, and then press the **ENTER** button to start the test. The DDR2 memory test takes approximately 7 seconds to complete.
28. Check that the display reads **DDR2: 0 errors detected**, and then record Pass or Fail in the test record.
29. Press the **BACK** button to exit the **DIAGNOSTICS** submenu.

Exit factory mode. Exit the factory mode to recover from the memory tests before continuing with the next verification steps:

30. Remove and then reattach the power cord to restart the SPG8000.

Output functional and jitter test

1. Connect a 1 m cable from the **SDI 1A** output on the SPG8000 under test to the SDI A input of a WFM8300 with Options 3G and PHY.

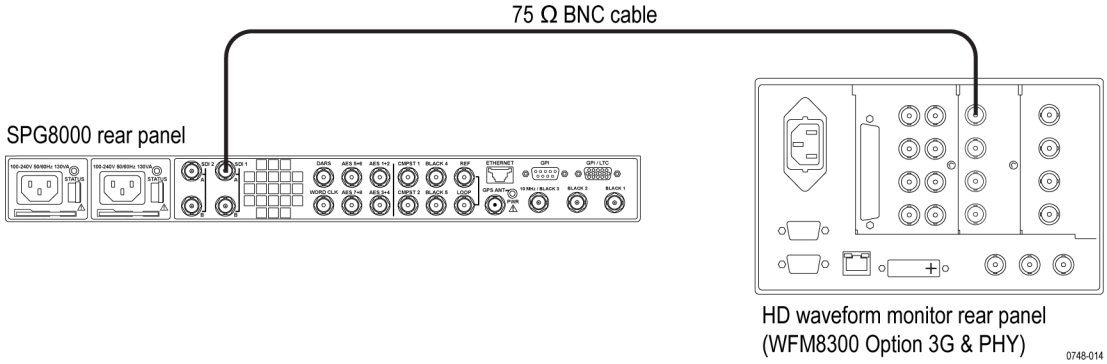


Figure 25: Setup for output and jitter test

2. Press the **SDI** button on the SPG8000. You should see **SDI 1: OUTPUT MODE** in the menu.
3. Press the left (◄) or right (►) arrow button to select the appropriate output mode as listed below. When the desired output mode is displayed, press the **ENTER** button to confirm the selection.
   - Option 3G installed: select **3G-Level A (1920 × 1080)**
   - Option 3G not installed: select **HD (1920 × 1080)**
4. Press the down (▼) arrow button until you see **FORMAT** in the menu.
5. Press the left (◄) or right (►) arrow button to select the appropriate output mode as listed below. When the desired output mode is displayed, press the **ENTER** button to confirm the selection.
   - Option 3G installed: select **1080 50p**
   - Option 3G not installed: select **1080 50i**
6. Check that the WFM8300 displays the selected format in the status bar:
   - Option 3G installed: **1080 50p** is displayed
   - Option 3G not installed: **1080 50i** is displayed
7. Record Pass or Fail in the test record.
8. Select a tile on the WFM8300 and press the **FULL** button to view the display full screen.
9. Press the **EYE** button on the WFM8300. If necessary, press and hold the **EYE** button to access the menu and set the jitter HP filter to 100 kHz.

`

10. Set the test signal on the SPG8000 to 75% Color Bars (75% White) as follows:
    a. Press the down (▼) arrow button until you see **TEST SIGNAL** in the menu, and then press the **ENTER** button.
    b. Press the right (►) arrow button until you see **75% Color Bars (75% White)**.
    c. Press the **ENTER** button.
11. Measure the jitter on the WFM8300 as follows:
    a. Set the WFM8300 vertical gain to 5x.
    b. Set the WFM8300 horizontal magnification to 10x.
    c. Center an eye crossing on the WFM8300 screen.
    d. Press the WFM8300 Display button, and then turn on Infinite Persistence and set the waveform intensity to 50%.
    e. Turn on the WFM8300 time cursors.
    f. Shift the WFM8300 trace position to restart the persistence. Wait 30 seconds, and then use the time cursors to measure the width of the eye at the narrowest point on the WFM8300 display.
12. Record the jitter reading in the test record.
13. Move the cable from the SDI 1A connector to the **SDI 1B** connector.
14. Repeat steps 4 through 12 for the **SDI 1B** output using the following format:
    - Option 3G installed: select **1080 59.94p**
    - Option 3G not installed: select **1080 59.94i**
15. Repeat steps 2 through 12 for the **SDI 1B** output, but change the Output Mode to **HD (1920 x 1080)** and the format to **1080 24p**.
16. Move the cable from the SDI 1B connector to the **SDI 2A** connector.
17. Press the **SDI** button on the SPG8000 until you see **SDI 2: OUTPUT MODE**.
18. Repeat steps 2 - 12 for the **SDI 2A** output.
19. Move the cable from the SDI 2A connector to the **SDI 2B** connector.
20. Repeat steps 14 - 15 for the **SDI 2B** output.

Amplitude characterization

There are two parts to this test: Part A and Part B. Part A sets up a reference to the DMM. Part B characterizes the test system.

Part A: Reference against the DMM.

1. Connect the equipment as follows:
   - **a.** One end of a 1 m high bandwidth cable to the AFG3101 output.
   - **b.** The other end of the 1 m cable to the BNC T.
   - **c.** The BNC T to a BNC to banana adapter.
   - **d.** The other end of the BNC T to a precision terminator.
   - **e.** The end of the banana adapter to the input of the DMM.

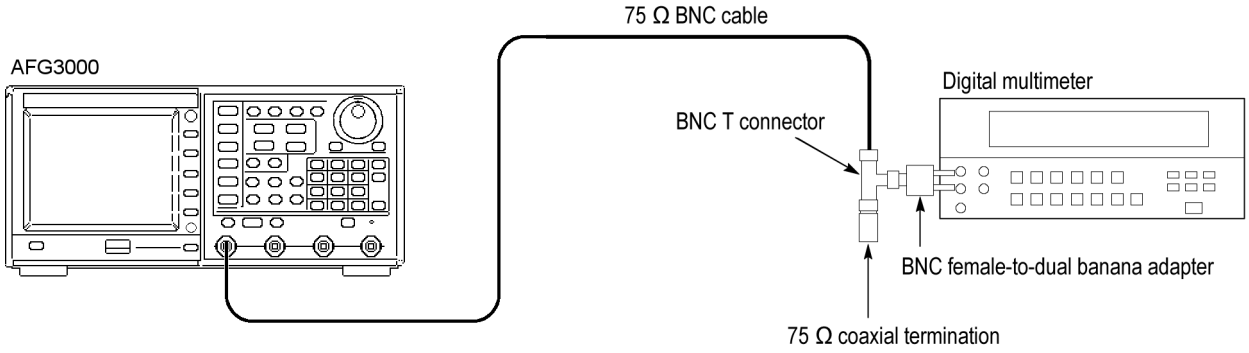


Figure 26: Setup for reference against the DMM

2. Set the AFG3101 to output a sine wave into a load impedance of 75 Ω.
3. Set the AFG3101 to a 10 kHz output into a load impedance of 75 Ω.
4. Set the AFG3101 to an 800 mV_{p-p} output into a load impedance of 75 Ω.
5. Check that the output of the AFG3101 is On.
6. Set the DMM to measure AC voltage using a medium filter setting. Set the range to allow for four digits of RMS amplitude.
7. Record the DMM measurement in the test record.

Set up the digital signal analyzer.

CAUTION. *Electrostatic discharge can damage the oscilloscope modules. To prevent damage, always work in a static free environment and discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules.*

1. Install the 80A03 output cable into the Channel 1/2 slot of the oscilloscope.
2. Install the 80E04 sampling head into the 80A03 adapter and connect the two using the SMA cables.
3. Install the TCA-75 into the left port of the 80A03.
4. Install the TCA-BNC into the right port of the 80A03.

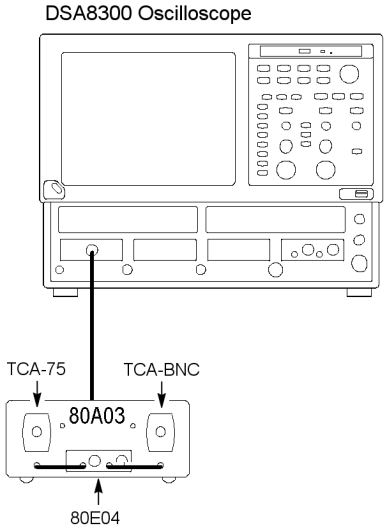


Figure 27: Set up the digital signal analyzer

5. If needed, press the Default Settings button on the oscilloscope.
6. Press the Channel 1 button on the 80E04 sampling head to activate Channel 1.

Part B: Characterization of the test system.

7. Connect the equipment as follows:
   - **a.** AFG3101 output to 1 m high bandwidth cable.
   - **b.** The other end of the cable to a TCA-75.
   - **c.** The TCA-75 to the 80A03 in the oscilloscope and plug-in.
   - **d.** A 50 Ω cable from the AFG3101 trigger output.
   - **e.** The other end of the 50 Ω cable to the BNC to SMA adapter.
   - **f.** The SMA adapter to the 6 dB pad.
   - **g.** The 6 dB pad to the trigger direct input on the oscilloscope.

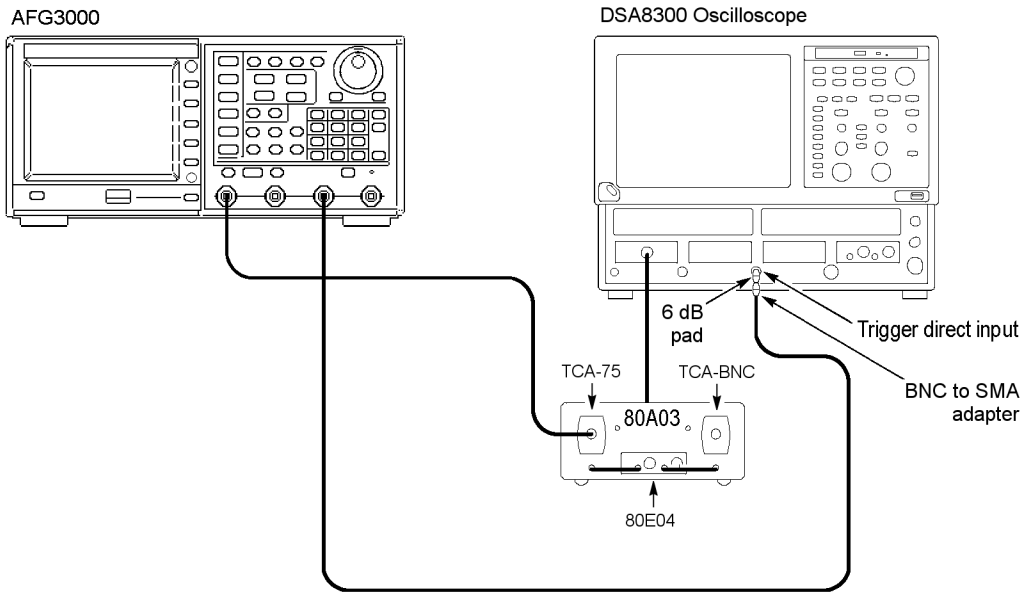


Figure 28: Setup for characterization of the test system

8. Keep the AFG3101 at the same output as in Part A of this test.
9. Set the oscilloscope to a horizontal scale of 20 µs.
10. Set the oscilloscope to a vertical scale of 50 mV.
11. Set the oscilloscope to averaging 16 and set the record length to 4000 points.
12. On the oscilloscope, select measurement 1 and then pulse amplitude and select it to measure Cycle RMS.
13. On the oscilloscope, select measurement 2 and then pulse amplitude and select it to measure Cycle Mean.
14. Record the Cycle RMS and Cycle Mean values in the test record.

15. Calculate the corrected RMS amplitude of the sine wave:

    SQRT((cycle RMS)^2 - (cycle mean)^2)

16. Record the result in the test record.

17. Calculate the total attenuation factor for the system. This is the DMM measurement divided by the corrected RMS sine wave amplitude. This attenuation factor will be used after measuring the signal outputs in the next test.

18. Record the attenuation factor value in the test record.

19. Enter the attenuation factor value into the oscilloscope:

    a. On the oscilloscope, press the SETUP DIALOG button.

    b. Select the “Vert” tab from the top of the setup page.

    c. Select the “External Attenuation” box, and then enter the attenuation factor calculated in step 17 above.

SDI output amplitude

Perform this test with the instrument in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

Perform this test after you have performed the *Amplitude characterization procedure*. (See page 94.)

CAUTION. *The serial output level can be adjusted when the instrument is in factory mode. Be careful not to accidentally adjust this level, as this will invalidate the factory calibration. If you need to perform a serial output level adjustment, see the SPG8000 service manual for the procedure.*

1. Connect a 75 Ω cable from the **SDI 1B** output on the SPG8000 through the BNC to SMA adapter (with or without the 6 dB pad) to the trigger direct input on a sampling oscilloscope.
2. Connect a 1 m high-bandwidth cable from the **SDI 1A** output of the SPG8000 to the TCA75 BNC on the oscilloscope adapter.

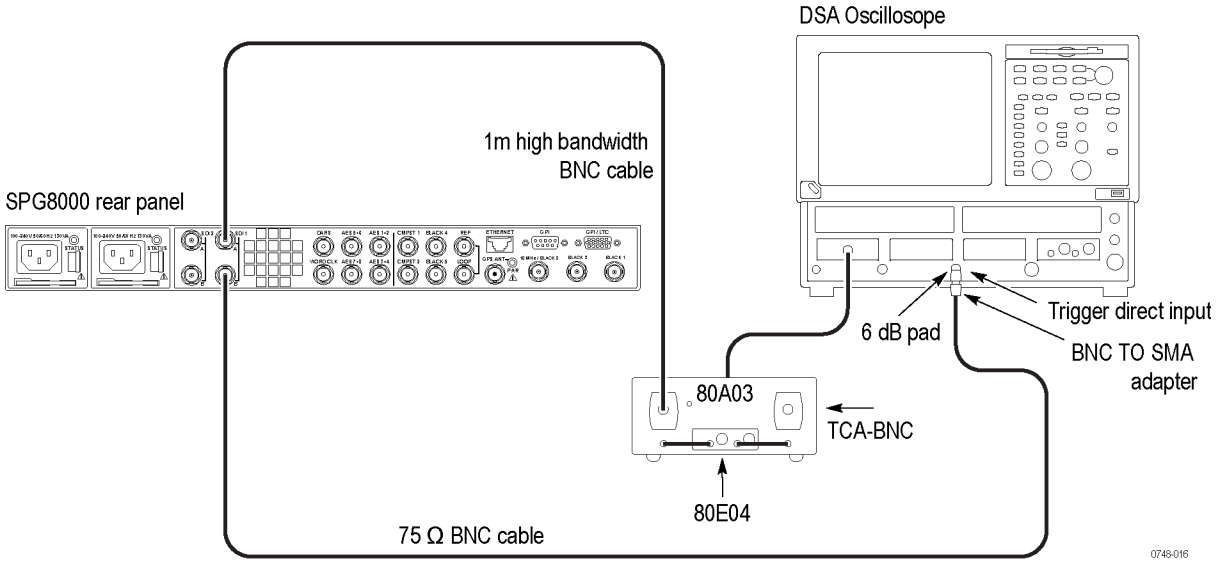


Figure 29: Setup for SDI output amplitude test

3. Set the SDI calibration signal for **SDI 1A** to 20 bits square on the SPG8000 as follows:
   a. Press the **SDI** button on the SPG8000.
   b. Use the up (▲) arrow button to select **CALIBRATION**. You should see **Channel 1 : Top** in the menu.
   c. Press the **ENTER** button.
   d. Press the right (►) arrow button to select **20 bits Square**.

4. Set the scope to averaging 16 and set the record length to 4000 points, the time/div to 2 ns, and the amplitude per division to 100 mV.
5. On the scope, select Measurement 3, Pulse-Amplitude, and then Amplitude to measure the amplitude on the flat part of the long pulse.
6. Right click on the measurement readout, and select **Show Statistics** and **Show Annotations** from the pop-up menu.
7. Press the **Clear Data** button on the oscilloscope and wait about 5 seconds before proceeding to the next step.
8. Record the average value, which is indicated by the letter μ. Multiply μ by the attenuation factor you obtained in step 17 of the previous test.

NOTE. *If you entered the attenuation factor into the scope at the end of the amplitude characterization test (See page 94, Amplitude characterization.), then the scope will display the multiplication result.*

9. Record the result in the test record.
10. Swap the signal cables between the SDI 1A and SDI 1B connectors so that **SDI 1A** connects to the trigger input and **SDI 1B** connects to the adapter.
11. Repeat steps 7 through 9 for the SDI 1B output.
12. Move the signal cable from the **SDI 1A** connector to the **SDI 2B** connector, and move the signal cable from the **SDI 1B** to the **SDI 2A** connector.
13. Repeat steps 7 through 12 for the SDI 2A and SDI 2B outputs.
14. Press the **BACK** button to exit the SDI calibration mode.
15. If you are performing the verification procedures in order, you can skip forward to step 1 of the *SDI rise and fall time* test. Otherwise, proceed to the next step.
16. Exit factory mode by removing and then reattaching the power cord to restart the SPG8000.

SDI rise and fall time

Perform this test with the instrument in factory mode. (See page 19, *Set SPG8000 to Factory Mode*.)

This procedure uses the same equipment setup as the previous procedure. (See Figure 29 on page 98.)

CAUTION. *The serial output level can be adjusted when the instrument is in factory mode. Be careful not to accidentally adjust this level, as this will invalidate the factory calibration. If you need to perform a serial output level adjustment, see the SPG8000 service manual for the procedure.*

1. Connect a 75 Ω cable from the **SDI 1B** connector in the SPG8000 through the SMA to BNC adapter (with or without the 6 dB pad) to the trigger direct input on a sampling oscilloscope.
2. Connect a cable from the **SDI 1A** output of SPG8000 to the TCA75 BNC on the oscilloscope adapter.
3. Set the SDI calibration signal for SDI 1A to 20 bits square on the SPG8000 as follows:
   a. Press the **SDI** button on the SPG8000.
   b. Use the up (▲) arrow button to select **SDI 1 : CALIBRATION**. You should see **Channel 1 : Top** in the menu.
   c. Press the **ENTER** button.
   d. Press the right (►) arrow button to select **20 bits Square**.
4. On the oscilloscope, set the horizontal scale to 200 ps.
5. Set the oscilloscope to averaging 16 and set the record length to 4000 points.
6. On the oscilloscope, select Measurement 4 and then Pulse-Timing for the Rise Time.
7. Select the Reference Level tab from Measure and set the reference high to 80% and the low to 20%.
8. Select Measurement 5 and then Pulse-Timing for the Fall Time.
9. Select the Reference Level tab from Measure and set the reference high to 80% and the low to 20%.
10. Set the horizontal position to put the rising edge of the waveform about 2.5 divisions to the left of center.
11. Measure the rise time and record the result in the test record.
12. Use the horizontal position knob to put the falling edge about 2.5 divisions left of center.
13. Measure the fall time and record the result in the test record.

14. Check that the difference between the rise and fall times is within the specified limits and record the result in the test record.
15. Swap the signal cables between the SDI 1A and SDI 1B connectors so that **SDI 1A** connects to the trigger input and **SDI 1B** connects to the adapter.
16. Repeat steps 10 through 14 for the SDI 1B output.
17. Move the signal cable from the **SDI 1A** connector to the **SDI 2B** connector, and move the signal cable from the **SDI 1B** connector to the **SDI 2A** connector.
18. Repeat steps 10 through 16 for the SDI 2A and SDI 2B outputs.
19. Press the **BACK** button to exit the SDI calibration mode.
20. Disconnect all signal cables from the SPG8000.
21. Set the SDI output mode to SD:
    a. Press the **SDI** button. **SDI 1 : OUTPUT MODE** should be displayed.
    b. Use the left (◄) or right (►) arrow button to select the **SD** output mode. Press the **ENTER** button to confirm the selection.
    c. Press the down (▼) arrow button to select **SDI 1 : FORMAT**.
    d. Use the left (◄) or right (►) arrow button to select the **525 59.94i** format. Press the **ENTER** button to confirm the selection.
22. Connect a 1 m cable from the SDI 1A output to the 3G SDI A input of a WFM8300 with Options 3G and PHY. (See Figure 25 on page 92.)
23. Set up the WFM8300 to display an eye diagram and eye measurements full screen.
24. Record the rise time, fall time, and difference in the test record.
25. Move the cable from the SDI 1A connector to the SDI 1B connector.
26. Repeat step 24 for the SDI 1B connector.
27. Repeat steps 21 - 26 for the SDI 2A and SDI 2B connectors.

Exit factory mode. Exit the factory mode.

28. Remove and then reattach the power cord to restart the SPG8000.