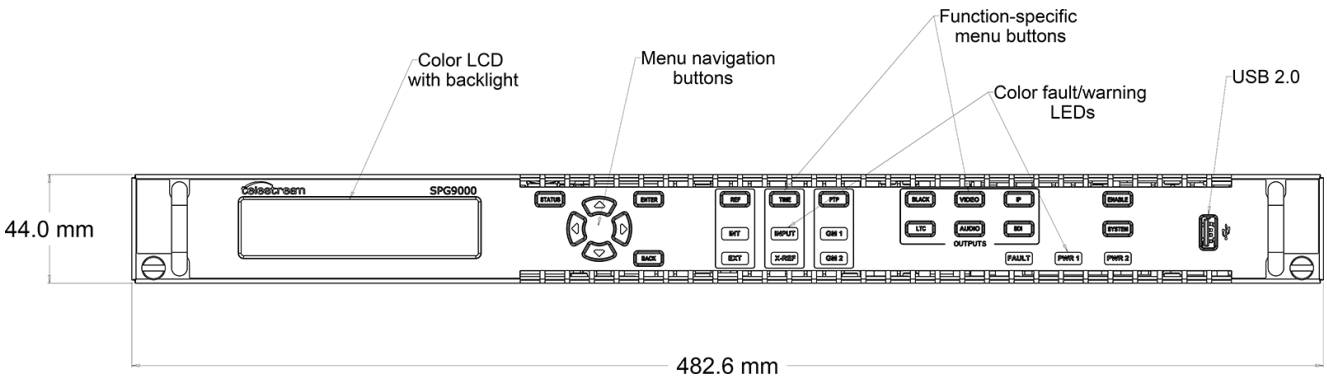
SPG9000

Timing and Reference System
: Tech Specs

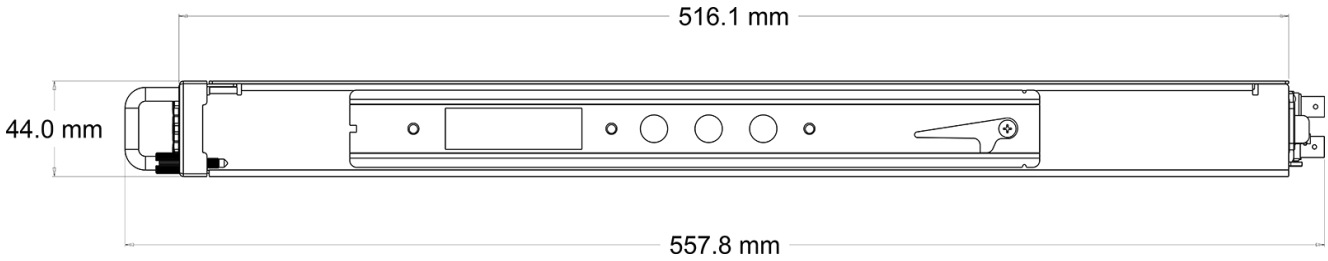
(https://pages.telestream.net/l/693253/2020-09-10/wxll5)

Form Factor and Dimensions

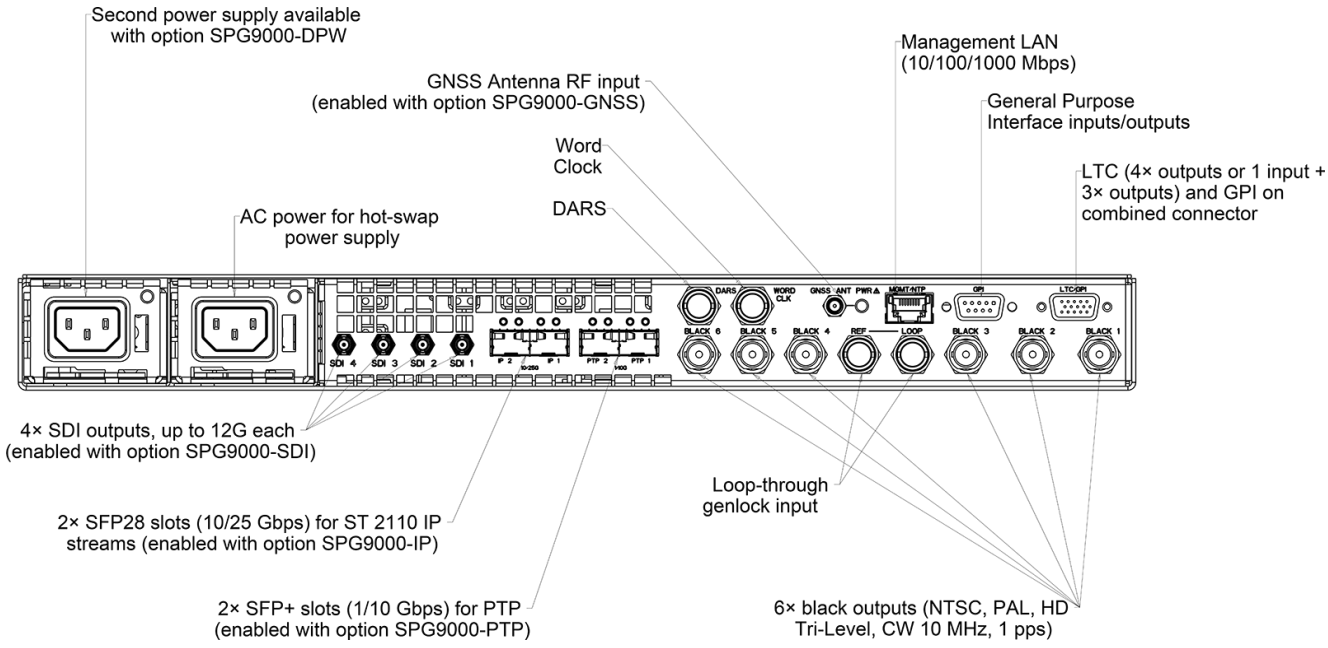


Dimensions

Height	44.0 mm (1.73 in.)
Width	482.6 mm (19 in.)
Depth	516.1 mm (20.32 in.)
Weight	4.85 kg (10.7 lbs)



Connectivity



Baseband Synchronization

Internal Oscillator

Frequency accuracy in internal/holdover modes	±155 × 10^{-9} over 1-year calibration interval; typically ±10 × 10^{-9} just after adjustment.
Frequency drift	<±100 × 10^{-9} per year for internal and holdover modes at constant temperature

Genlock Input

Connector	BNC ×2, passive loop-through

Formats	• NTSC/PAL black burst
	• HD tri-level sync
	  ◦ 1080 60/59.94/50i
	  ◦ 1080 30/29.97/25/24/23.98p
	  ◦ 1080 24/23.98sF
	  ◦ 720 60/59.94/50p
	• CW 10 MHz

Amplitude Range	−8 dB to +6 dB
Lock Stability	
±3 dB amplitude change	<1 ns
Jitter with burst lock	<0.5°
Jitter with tri-level sync lock	<1 ns
Jitter with CW lock	<1 ns (typ. 1°)
Timing Adjustment	
Range	± ½ color frame
Resolution	<0.5° of NTSC/PAL subcarrier, 1 ns for tri-level sync

Black Outputs

Number of Outputs	6

Formats	• Black burst
	  ◦ NTSC-M (7.5 IRE black)
	  ◦ NTSC-J (0 IRE black)
	  ◦ PAL-B
	• HD tri-level sync
	  ◦ 1080 60/59.94/50i
	  ◦ 1080 60/59.94/50/48/47.95/30/29.97/25/24/23.98p
	  ◦ 1080 24/23.98sF
	  ◦ 720 60/59.94/50p
	• CW 10 MHz
	• 1 pps

Amplitude Accuracy	± 2%
Timing Adjustment	± ½ color frame
Range	Clock resolution: 18.5 ns for black burst, 13.5 ns for HD tri-level
Resolution	Fine resolution: 0.1 ns for black burst, 0.2 ns for HD tri-level
Time Code (VITC)	
Line Numbers	User-selectable 1 or 2 lines, default 14/16 for NTSC, 19/21 for PAL
Date and Time	SMPTE ST 309, YYMMDD format
Zone	Time-of-day with adjustable offset, or program (elapsed) time counter
Source	
Ten-Field Sequence	For NTSC formats per SMPTE ST 318 (Black 4-6 outputs only)

LTC Input/Outputs

Number of Outputs	4 outputs or 3 outputs and 1 input
Connector	Available through D-sub 15-pin connector; Optional break-out cable to XLR connectors
Formats	24 fps (24 Hz or 23.98 Hz), 25 fps, 30 fps, 30 fps drop-frame (29.97 Hz) per SMPTE ST 12-1
Source	Time-of-day with adjustable offset, or program (elapsed) time counter
Output Amplitude	5V ±10%, adjustable from 0.5 V to 5 V in 0.5 V steps

Word Clock

Connector	BNC ×1
Frequency	48 kHz
Output Level	0-5 V DC (CMOS compatible) or ±1 V into 75 Ω (AES level)

DARS

Outputs	Outputs 2 channels (1 AES/EBU pair)
Connector	BNC ×1
Amplitude	1 V ± 0.2 V
Sampling Frequency	48 kHz (lock on video signal)
Quantization	Linear PCM, 20 or 24 bits

Network Time Protocol (NTP)

Network Interface	Combined MGMT/NTP interface for management functions and NTP server/client RJ45 connector, 10/100/1000 Mbps line speed
Server	
Stratum Level	Stratum 1 when the reference time source is GNSS or PTP Follower
Client Query Rate	Optional Stratum 12 operation for internal time or LTC/VITC time source Optional Rate limiting is enabled to prevent DoS attacks
Number of Clients	Maximum 1 query per 8 seconds for each individual client, unless disabled 5000 or more at maximum query rate
Client	
Operation	Available when using internal time source
Remote Time Servers	Update internal time from NTP manually, upon system startup, from API, or from GPI One or two remote servers from local network or Internet

Precision Time Protocol (PTP)

Port Connectors	2× SFP+ sockets. Available transceiver modules for 1G or 10G line speeds.
Operating Modes	Leader only, Follower only, Ordinary Clock (adaptive).
PTP Instances	2 independent, as dual Leader, dual Follower or Follower + Leader
Profiles	SMPTE ST 2059-2, AES67 Media Profile, IEEE 1588-2019 Default
Communication Model	Multicast, Unicast, Mixed Multicast/Unicast
Follower Lock Time	Typically 30 seconds for initial lock
Follower Lock Range	± 7.5 ppm
Measurements	For follower, shown on user interface or available via API • Offset from Master • Path Delay • Leader-Follower Delay • Follower-Leader Delay
Status Reporting	Current GM Clock Identity, Clock Class, Clock Accuracy, Time Source Message rates for Announce, Sync, Delay_Req, and Delay_Resp messages
SMPTE Synchronization Metadata	For ST 2059-2 profile, automatically inserted in TLV data of Management messages for leader instances, and automatically decoded for follower instances

Global Navigation Satellite System (GNSS)

GNSS Receiver

Constellations	GPS, GLONASS, Galileo, BeiDou, QZSS

Frequency Bands	L1 1575.42 MHz and 1602 MHz (GPS, GLONASS, Galileo) L1 1561.098 MHz (Beidou) L5 1176.45 MHz (GPS, QZSS, Galileo, BeiDou)
Time Accuracy	Within 150 ns to UTC
Acquisition Time	2 minutes on boot up with warm oven, good satellite signal, and known position
Status Reporting	Available via user interface and API • Satellites in view and in fix • Per-satellite signal information • Position

GNSS Antenna Input

Connector	SMA female
Input Impedance	50 Ω, internally terminated
DC antenna power output voltage	3.3 V or 5 V at 55 mA
Fault Protection	Short-circuit/open detection and protection
Return loss	15 dB for L1 band at 1575 MHz 7 dB for L5 band at 1176 MHz
Signal Strength	Recommended 18 dB above ambient level after cable loss and signal amplifiers

Test Signal Generation

Video Formats

All listed formats are available for SDI outputs. ST 2110-20 video streams support 10-bit YCbCr 4:2:2 progressive and interlaced formats and 12-bit RGB and YCbCr 4:4:4 formats for all listed image sizes and frame rates.

Image Size	Scan Type	Frame Rate	Sampling	Color Space	Bit Depth
720×486	Interlaced	29.97	4:2:2	YCbCr	10

720×576	Interlaced	25	4:2:2	YCbCr	10
1280×720	Progressive	60/59.94/50	4:2:2	YCbCr	10
		30/29.97/25/24/23.98	4:4:4	YCbCr	10
			4:4:4	RGB	10
1920×1080	Progressive	60/59.94/50	4:2:2	YCbCr	10
		30/29.97/25/24/23.98	4:4:4	YCbCr	10
			4:4:4	RGB	10
			4:4:4	YCbCr	12
			4:4:4	RGB	12
			4:2:2	YCbCr	12
	Interlaced	30/29.97/25	4:2:2	YCbCr	10
			4:4:4	YCbCr	10
			4:4:4	RGB	10
			4:4:4	YCbCr	12
			4:4:4	RGB	12
			4:2:2	YCbCr	12
	Segmented	30/29.97/25/24/23.98	4:2:2	YCbCr	10
			4:4:4	YCbCr	10
			4:4:4	RGB	10
			4:2:2	YCbCr	12
2048×1080	Progressive	60/59.94/50/48/47.95	4:2:2	YCbCr	10
		30/29.97/25/24/23.98	4:4:4	YCbCr	10
			4:4:4	RGB	10
			4:4:4	YCbCr	12
			4:4:4	RGB	12
			4:2:2	YCbCr	12
		30/29.97/25/24/23.98	4:4:4	XYZ	12
	Segmented	30/29.97/25/24/23.98	4:2:2	YCbCr	10
			4:4:4	YCbCr	10
			4:4:4	RGB	10
			4:4:4	YCbCr	12
			4:4:4	RGB	12
			4:2:2	YCbCr	12
			4:4:4	XYZ	12
3840×2160	Progressive	60/59/94/50	4:2:2	YCbCr	10
		30/29.97/25/24/23.98	4:2:2	YCbCr	10
			4:4:4	YCbCr	10
			4:4:4	RGB	10
			4:4:4	YCbCr	12
			4:4:4	RGB	12
			4:2:2	YCbCr	12

4096×2160	Progressive	60/59/94/50/48/47.95	4:2:2	YCbCr	10
		30/29.97/25/24/23.98	4:2:2	YCbCr	10
			4:4:4	YCbCr	10
			4:4:4	RGB	10
			4:4:4	YCbCr	12
			4:4:4	RGB	12
			4:2:2	YCbCr	12

Video Encoding

Colorimetry	BT.601, BT.709, or BT.2020 per source format
Transfer Characteristics	SDR, HDR HLG, HDR PQ
Range	Narrow or Full, as permitted by source format

Video Test Patterns

Color Bars	100%, 75%, Bars Over Red, SMPTE EG1, SMPTE RP219-1 and RP219-2, BT.2111 (HLG Narrow, PQ Narrow, PQ Full), EBU 3373, NBCU HLG, Sony S-Log3, ARIB B28, ARIB B66
Monitor	BT.814 SD/SDR/HDR Pluge, Pluge and Luma Reference, Convergence, Production Aperture, Clean Aperture, Checkerboard, Window, EBU 3374 EOTF Validation, Black-White Step Scale, Black-Dark Gray Step Scale, SMPTE 303M Color Reference, SMPTE EG432-1 Color Accuracy, ChromaDuMonde
Linearity	Valid Ramps (Y, B-Y, R-Y), Limit Ramp, 3 Channel Ramp, Shallow Ramp Matrix, Color Ramp Matrix, 5/10 Step Staircases
Flat Field	0% Black, 50% Gray, 100% White, 100% Red/Green/Blue/Cyan/Magenta/Yellow, Interlaced Field Test
SDI Pathological	Equalizer Test, PLL Test, Checkfield per SMPTE RP198, Full-Length and Half-Length variants, Bandwidth Test, Matrix, Matrix with Color Bars
Frequency Response	Multiburst, various packet frequencies
Pulses	2T Pulse and Bar, Color Pulses, Co-siting Pulse
Image File	Any user-supplied image file, TIFF 16-bit or 8-bit RGB format. Automatic colorimetry conversion if necessary for YCbCr output.

Video Overlays

ID Text

Text Length	Multiple lines, up to 1000 characters total

Available Scripts	Latin, Cyrillic, Chinese (both Simplified and Traditional), Japanese, Korean, Devanagari, Arabic
Appearance	Near-white (90%) with or without near-black (10%) border rectangle
Text Size	Adjustable from 1% to 25% of active picture height
Position	Adjustable anywhere within the active picture

Burnt-In Time Code

Value	Same format and source as ancillary time code, updated every frame
Displayed Digits	HH:MM:SS:FF (hours, minutes, seconds, frames) “.0” or “.1” suffix for frame-pair when the video frame rate is greater than 30 fps Optional YYYY-MM-DD (year, month, day) on second line of text
Text Size	10% or 20% of active picture height, including black border rectangle
Position	Adjustable anywhere within the active picture

Logo

File format	PNG, 8-bit RGBA, full color with transparency
Maximum size	1920×1080 pixels
Position	Adjustable anywhere within the active picture

Audio Tones

Number of Tones	32 independent tone generators. Each tone generator can be used for any individual SDI embedded audio channel and any individual ST 2110-30 audio channel.
Sampling	48 kHz
Resolution	24 bits (HD and UHD), 20 bits (SD)
Frequency	10.0 Hz to 20000.0 Hz, 0.5 Hz resolution
Amplitude	−60 to 0 dBFS, 1dB steps or mute
Channel Identification	Audible click, AES channel origin

Serial Digital Interface (SDI)

SDI Outputs

Number of Outputs	4
Connector	HD-BNC
Output Impedance	75 Ω
Output Amplitude	800 mV_{p-p} ±3%
Rise/Fall Time	
SD	≤ 700 ps (20-80%), 550 ps typ.
1.5G/3G	≤ 100 ps (20-80%), 60 ps typ.
6G/12G	≤ 42 ps (20-80%), 30 ps typ.
Jitter	
SD	210 ps typ. (alignment), 300 ps typ. (timing)
1.5G	40 ps typ. (alignment), 70 ps typ. (timing)
3G	30 ps typ. (alignment), 60 ps typ. (timing)
6G/12G	15 ps typ. (alignment), 45 ps typ. (timing)
Return Loss	≥ 25 dB typ. from 5 MHz to 2 GHz ≥ 15 dB typ. from 2 GHz to 3 GHz ≥ 10 dB typ. from 3 GHz to 6 GHz ≥ 10 dB typ. from 6 GHz to 12 GHz

SDI Formats

Standard Definition (SD-SDI)	
Interface Bit Rate	270 Mbps
Standards	SMPTE ST 259 Level C, ST 272,
Formats	720×486 (525-line) and 720×576 (625-line)
High Definition (HD-SDI)	
Interface Bit Rate	1.485 Gbps and 1.485/1.001 Gbps
Standards	SMPTE ST 274, ST 292-1, ST 296
Formats	1920×1080, 2048×1080, 1280×720 4:2:2 10-bit
3G-SDI	
Interface Bit Rate	2.97 Gbps and 2.97/1.001 Gbps
Standards	SMPTE ST 424, ST 425-1
Formats	1920×1080, 2048×1080, 1280×720 Level A, Mapping Structures 1, 2, 3, and 4 Level B, per ST 372 Mapping Structures I, II, III, and IV

6G-SDI	
Interface Bit Rate	5.94 Gbps and 5.94/1.001 Gbps
Standards	SMPTE ST 2081-10, ST 425-3
Formats	1920×1080, 2048×1080, 3840×2160, 4096×2160 ST 2081-10 Mode 1 and Mode 2
12G-SDI	
Interface Bit Rate	11.88 Gbps and 11.88/1.001 Gbps
Standards	SMPTE ST 2082-10, ST 425-5
Formats	3840×2160, 4096×2160 ST 2082-10 Mode 1

Embedded Audio

Number of Channels	16 (4 groups of 4 channels each)
Channel Control	Enable/Disable per group Active/Inactive per channel
Standard	SMPTE ST 299-1

Ancillary Data

Ancillary Time Code	ATC_LTC and/or ATC_VITC per SMPTE ST 12-2
Source	Local time-of-day with adjustable offset, UTC, or program (elapsed) time counter
Format	24 fps, 25 fps, 30 dps drop-frame, 30 fps non-drop per video format
Payload Identifier	Per SMPTE ST 352, automatic or manual override
Error Detection and Handling	EDH packet inserted in SD-SDI per SMPTE RP 165

Internet Protocol (IP)

IP Ports

Port Connectors	2 SFP28 sockets
Line Speed	10 Gbps or 25 Gbps per installed SFP type

Error Correction	RS-FEC per Clause 108 of IEEE 802.3by-2016 Enable/disable for 25G SFPs, not applicable for 10G SFPs

ST 2110 Generation

Operating Modes	Stream generation on both ports per SMPTE ST 2022-7 or on either individual port
Number of Streams	6× ST 2110-20 video streams 6× ST 2110-30 audio streams 6× ST 2110-40 data streams
Sender Type	Type N – Gapped PRS
RTP Payload Type	Independent value (96–127) per stream
UDP Size Limit (MAXUDP)	1460 octets
UDP Port Numbers	Independent source and destination port numbers for both paths of each stream
Destination Address	Multicast, 224.0.2.0 to 239.255.255.255 Independently configured for both paths of each stream
Session Description Protocol (SDP)	Available via web interface and API for each enabled stream
ST 2110-20 Video	
Packing Mode	General Packing Mode (GPM) or Block Packing Mode (BPM)
TR_{OFFSET}	Automatically calculated or Manual override
ST 2110-30 Audio	
Number of Channels	Each stream is independently configured for 1, 2, 4, 6, 8, or 16 channels
Channel Order	Manual configuration, signaled via SDP
Packet Time	1 ms or 125 µs
ST 2110-40 Data	
Payload Formats	Ancillary Time Code (ATC_LTC or ATC_VITC) per SMPTE ST 12-2 Time code format of 24 fps, 25 fps, 30 fps, or 30 fps drop-frame Associated video format of 525, 625, 750, 1125 or 2250 lines

Networked Media Open Specifications (NMOS)

Specifications	IS-04 NMOS Discovery and Registration IS-05 NMOS Device Connection Management

Registry Discovery	Automatic using DNS-SD (unicast or multicast) or Manual
API Versions	
Node	v1.0, v1.1, v1.2, v1.3
Connection	v1.0, v1.1
Registration	v1.0, v1.1, v1.2, v1.3
Data Model	The SPG9000 is represented as one Node, consisting of one Device, consisting of 18 Senders (6 video, 6 audio, 6 data)

Power Consumption

Typical	130 VA
Maximum	180 VA
Voltage Range	100 to 240 VAC ±10%, 50/60 Hz

Packaging Dimensions

Height	29.2 cm (11.5 in.)
Width	64.1 cm (25.2 in.)
Depth	73.7 cm (29.0 in.)
Weight	9.6 kg (21.2 lbs.) with no options 12.0 kg (28.7 lbs.) with all options

Ordering Information

Base Model

Product Code	Description
SPG9000	SPG9000 timing and reference generator; includes loop-through genlock input, 6 analog black/tri-level outputs, 4 LTC outputs, word clock output, DARS output, general-purpose interface, and management LAN interface

Licensed Feature Options

Option Code	Description
SPG9000-GNSS	License; SPG9000, Enable internal GNSS receiver and time synchronization features
SPG9000-PTP	License; SPG9000, Enable PTP (IEEE 1588) support on two ports
SPG9000-SDI	License; SPG9000, Enable SD/HD/UHD test signal generation on four SDI outputs
SPG9000-IP	License; SPG9000, Enable ST 2110 test signal generation on two IP ports
SPG9000-TSG	License; SPG9000, Includes both SDI and IP licenses for test signal generation

Accessory Options

Option Code	Description
SPG9000-RACK	Rackmount slides and rails kit for SPG9000 (1 RU height, standard full depth)
SPG9000-XLR	Adapter cable (6 feet long) from 15-pin D-sub GPI/LTC connector on the SPG9000 to 4 XLR male connectors (for LTC input/outputs) and 3 BNC male connectors (for General Purpose Interface input/outputs)

SFP Modules

Option Code	Description
SPG9000-SFP-1GESR	Gigabit Ethernet short reach 850 nm SFP transceiver module
SPG9000-SFP-10GESR	10G Ethernet short reach 850 nm SFP+ transceiver module
SPG9000-SFP-10GELR	10G Ethernet long reach 1310 nm SFP+ transceiver module
SPG9000-SFP-25GESR	25G Ethernet short reach 850 nm SFP28 transceiver module
SPG9000-SFP-25GELR	25G Ethernet long reach 1310 nm SFP28 transceiver module

Power Options

Option Code	Description
SPG9000-SPW	Includes a single hot-swappable power supply
SPG9000-DPW	Includes two hot-swappable power supply modules for a redundant (primary + backup) pair

Power Cords

Option Code	Description
PWR-CORD-NA-S15	North America Power Cord, Straight 15A
PWR-CORD-EURO	Universal EURO Power Cord
PWR-CORD-CHN	China Power Cord
PWR-CORD-IND	India Power Cord
PWR-CORD-AUS	Australia Power Cord
PWR-CORD-UK	United Kingdom Power Cord
PWR-CORD-BRZ	Brazil Power Cord
PWR-CORD-CHE	Switzerland Power Cord
PWR-CORD-JPN	Japan Power Cord
PWR-CORD-NONE	No Power Cord or AC Adapter

Service Options

Option Code	Description
SPG9000 R3	Standard Warranty Extended to 3 Years. Covers parts, labor and 2-day shipping within country. Guarantees faster repair time than without coverage. All repairs include performance verification and updates. Hassle free - a single call starts the process
SPG9000 R5	Standard Warranty Extended to 5 Years. Covers parts, labor and 2-day shipping within country. Guarantees faster repair time than without coverage. All repairs include performance verification and updates. Hassle free - a single call starts the process

Standalone Accessories

The DPW, RACK and XLR accessories can be ordered at the same time as the base SPG9000 product (see “Accessory Options” above) and shipped together in the same packaging, or they can be ordered separately and shipped in individual packaging. The ANT accessory is only shipped in separate packaging.

Product Code	Description
SPG9000-ACC-ANT	Multi-GNSS (GPS, GLONASS, Galileo, BeiDou) dual-band (L1 & L5) rooftop antenna that works with the integrated GNSS receiver of the SPG9000 with option SPG9000-GNSS. Includes mounting bracket. Coaxial cable with type-N connector required.
SPG9000-ACC-DPW	Hot-swappable, redundant (backup) power supply for the SPG9000
SPG9000-ACC-RACK	Rackmount slides and rails kit for SPG9000 (1 RU height, standard full depth)
SPG9000-ACC-XLR	Adapter cable (6 feet long) from 15-pin D-sub GPI/LTC connector on the SPG9000 to 4 XLR male connectors (for LTC input/outputs) and 3 BNC male connectors (for General Purpose Interface input/outputs)

Post-Purchase License Upgrades

The licensed feature options for the SPG9000 can be ordered at any time after the initial base unit purchase. No hardware upgrades are necessary to enable these features.

Product Code	Description
SPG9000-LICENSE	Upgrade license(s) to enable features for the SPG9000

Option Code	Description
SPG9000-LIC-GNSS	License; SPG9000, Enable internal GNSS receiver and time synchronization features
SPG9000-LIC-PTP	License; SPG9000, Enable PTP (IEEE 1588) support on two ports
SPG9000-LIC-SDI	License; SPG9000, Enable SD/HD/UHD test signal generation on four SDI outputs
SPG9000-LIC-IP	License; SPG9000, Enable ST 2110 test signal generation on two IP ports
SPG9000-LIC-TSG	License; SPG9000, Includes both SDI and IP licenses for test signal generation