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Multiformat Reference Sync Generator
SPG700 Datasheet

The SPG700 is a multiformat reference sync generator with optional 3G/HD/SD-SDI test signal generator support for traditional SDI-based video infrastructure. It provides multiple video reference signals, such as black burst and HD tri-level sync, and audio reference signals, such as DARS and 48 kHz word clock, and it supports various timecode formats for time reference generator applications.

Key features

- Multiple independent black burst and HD tri-level sync outputs provide all the video reference signals, while DARS and 48 kHz word clock provide all the audio reference signals required in a broadcast or production facility

- Four LTC outputs and VITC on black burst outputs provide time reference signals in a variety of formats

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

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

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

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

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

Applications

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

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

Sync generator and time reference generator

The base configuration includes three sync outputs that can be configured with independent output formats (NTSC/PAL black burst and/or HD tri-level sync) and independently adjustable timing offsets. A high-accuracy, oven-controlled crystal oscillator provides a stable frequency reference for the system, or the pass-through genlock input can be used to lock to an external video reference or 10 MHz continuous wave signal.

The SPG700's Stay GenLock® feature avoids "synchronization shock" if the external reference suffers a temporary disturbance, by maintaining the frequency and phase of each output signal. When the external reference is restored, Stay GenLock® ensures that any accumulated clock drift is removed by slowly adjusting the system clock within standard limits instead of "jamming" back to the correct phase.

Time reference outputs are available in multiple formats. Three independent linear time code (LTC) outputs are available, and a fourth LTC connection can be used as input or output. Each LTC output has independent frame rate selection, time source (time-of-day or program time) and time zone offset. Vertical interval time code (VITC) is available on each NTSC or PAL black output, also with independent time sources and offsets.

SPG700 Multiformat Reference Sync Generator front panel and back panel.

Test signal outputs

The SPG700 can be optionally configured with a variety of test signal outputs.

Option SDI adds two fully independent serial digital video generator channels of two outputs each. Each channel can be configured to any standard 3G/HD/SD-SDI format and frame rate. The selected test pattern can be generated on both outputs per channel, or one output can generate digital black.

A wide variety of standard test patterns are included, such as color bars, convergence grid, step scales, ramps, multiburst, SDI pathological test matrix and a real-time programmable zone plate generator. Bitmap images can be downloaded to the SPG700's flash memory for arbitrary user defined test patterns. ID text, burn-in time code, circle, and color logo overlays can be added to any test pattern, and several ancillary data packet types, including ancillary time code and user-defined packets, can be inserted into the SDI output signal.

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

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

Audio reference signals

Audio reference signals are available on the SPG700. The base configuration includes a 48 kHz word clock output and a Digital Audio Reference Signal (DARS) output.

Audio tone generation is also included with Option SDI as embedded audio on each of the SDI outputs.

Remote access

The SPG700 includes a 10/100/1000BASE-T Ethernet interface for remote access to the instrument. A web-based user interface can be used for all configuration settings and for monitoring system status.

Alarm and key status information is also available via Simple Network Management Protocol (SNMP) messaging, enabling easy integration with network management systems. Remote control and alarm reporting is also available via a general purpose interface (GPI).

The SPG700 has a front-panel USB port that can be used to backup and restore presets and other user data, and to perform system firmware upgrades.

Optional backup power supply

For mission-critical applications, the SPG700 can be configured with a second power supply module. Under normal operation, the designated backup supply is seldom used, ensuring that it has maximum remaining life should the primary supply fail. The backup supply is load-tested once each day to verify that it can serve as the primary supply if necessary.

The usage time of each supply is logged as "temperature-weighted hours", a metric that best estimates the calculated life of the supply. A front-panel LED will indicate when the supply is nearing its end-of-life.

If the primary supply is interrupted for any reason, the system will switch to the backup without any disruption to system operation. Power supply modules are hot-swappable for easy replacement, and feature a locking mechanism to prevent the power cable from accidental disconnection.

Characteristics

All specifications apply to all SPG700 configurations unless noted otherwise.

Reference input

Connector	BNC ×2, passive loop-through
Input impedance	75 Ω
Input signal	
NTSC/PAL black burst	
HD tri-level sync	1080/60/59.94/50I
	1080/30/29.97/25/24/23.98P
	1080/24/23.98PsF
	720/60/59.94/50P
10 MHz continuous wave	
Amplitude range	−8 dB to +6 dB
S/N ratio	>40 dB
SCH phase	0 ±40°
Return loss	≥30 dB at 300 kHz to 10 MHz
Lock stability	
±3 dB amplitude change	<1 ns
Jitter with burst lock	<0.5°
Jitter with sync lock	<1 ns
Jitter with CW lock	<1 ns (typ. 1°)

Genlock input

Timing adjustment range	Anywhere in the color frame
Timing adjustment resolution	<0.5° of NTSC/PAL subcarrier, 1 ns with tri-level sync input
Color framing	Keeps accuracy even with ±45° SCH error of input reference signal
Genlock tune range	$\pm 7.5 \times 10^{-6}$

Time reference input

Source	LTC input or VITC read from NTSC/PAL genlock input
Time zone offset	−23:59 to +23:59
Daylight saving adjustment	Start/end from recurring calendar or manually scheduled, with adjustable offset
Leap second adjustment	Inserted at 00:00 UTC on the scheduled date, or deferred up to 24 hours

LTC input

Connector	Available through D-sub 15-pin connector; Optional break-out cable to XLR connector available
Formats	24 fps (24 Hz or 23.98 Hz), 25 fps, 30 fps, 30 fps drop-frame (29.97 Hz) per SMPTE 12M
Timing to video	Compliant with SMPTE 12M and continues to operate over at least 90% of possible timing range
Signal voltage range	0.5 to 10 V_{p-p} differential, 1 to 5 V_{p-p} single ended
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
Hum tolerance	0 dB hum-to-signal ratio
Error immunity	100 consecutive frames with consistent time code must be detected for time to be considered valid
Input impedance	Nominal 600 Ω differential, 300 Ω single ended

Reference outputs

Number of outputs	3 analog sync outputs
Connector	BNC ×3
Formats	NTSC/PAL black burst, HD tri-level sync, 10 MHz continuous wave, or 1 PPS
Format combinations	
NTSC/PAL black burst	Available on all outputs (BLACK 1-3)
HD tri-level sync	Black outputs 1-3 can independently produce any of the formats from the integer rate group (24,25,30,50,60 Hz) or the non-integer rate group (23.98, 29.97, 59.94 Hz).
10 MHz CW	BLACK 3 output only
Output impedance	75 Ω
Return loss	≥40 dB from 300 kHz to 5 MHz
	≥25 dB from 5 MHz to 30 MHz

Black burst outputs

Standards	SMPTE 170M, ITU-R BT.1700-1, EBU N14, SMPTE RP154, RP318M-B
Formats	NTSC-M (7.5 IRE black), NTSC-J (0 IRE black), PAL-B
Time Code	Optional VITC insertion
Line	One or two lines, user selectable
Source	Time-of-day with adjustable offset, or program (elapsed) time counter
Amplitude accuracy	±2%
SCH phase	< ±5°
Timing adjustment	Independent per output
Range	Anywhere in the color frame
Resolution	Clock resolution 18.5 ns (1/54 MHz)
	Fine resolution 0.1 ns on BLACK 1-3

HD tri-level sync outputs

Standards	SMPTE 240M, 274M, 296M, RP211
Formats	1080/60/59.94/50I
	Black 1-3 outputs: 1080/60/59.94/50/48/47.95/30/29.97/25/24/23.98P
	Black 4-5 outputs: 1080/30/29.97/25/24/23.98P
	1080/24/23.98PsF
	720/60/59.94/50P
Amplitude accuracy	±2%
Timing adjustment	Independent per output
Range	Anywhere in the color frame
Resolution	Clock resolution 13.5 ns (1/74.25 MHz)
	Fine resolution 0.2 ns for BLACK 1-3

LTC outputs

Number of outputs	3 or 4 (LTC1 is selectable as input or output)
Connector	Available through D-sub 15-pin connector; Optional break-out cable to XLR connectors available
Formats	24 fps (24 Hz or 23.98 Hz), 25 fps, 30 fps, 30 fps drop-frame (29.97 Hz) per SMPTE 12M
Source	Time-of-day with adjustable offset, or program (elapsed) time counter
Output amplitude	5 V ±10%, adjustable from 0.5 V to 5 V in 0.5 V steps

Word clock output

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

Serial digital test signal outputs (Option SDI)

Number of outputs	2 independent test pattern generators with 2 outputs each
Video signal	Test pattern on both outputs or test pattern on one output and digital black on the second output
Connector	BNC ×4
Output impedance	75 Ω
Output amplitude	800 mV$_{p-p}$ ±3%
Overshoot	≤1% (typical)
Rise/Fall time	
HD, 3G	≤70 ps (typical) (20-80%)
SD	≤700 ps (typical) (20-80%)
Jitter	
HD, 3G	≤40 ps (typical) (alignment)
	≤80 ps (typical) (timing)
SD	≤200 ps (typical) (alignment)
	≤200 ps (typical) (timing)
Timing adjustment	Independent per generator channel
Range	Anywhere in the frame
Resolution	One clock cycle at the Y, G, or X pixel rate
Return loss	≥15 dB from 5 MHz to 2.5 GHz (typical)
	≥10 dB from 2.5 GHz to 3 GHz (typical)

Standard Definition (SD) output formats (Option SDI)

Standards	SMPTE 259M, 272M, 291M
Bit rate	270 Mb/s
Formats	720×486/59.94/I (525 lines)
	720×576/50/I (625 lines)

High Definition (HD) output formats (Option SDI)

Standards	SMPTE 274M, 291M, 292M, 296M
Bit rate	1.485 Gb/s and 1.485/1.001 Gb/s
Formats	1280×720/60/59.94/50/30/29.97/25/24/23.98P
	1920×1080/60/59.94/50I
	1920×1080/30/29.97/25/24/23.98P
	1920×1080/30/29.97/25/24/23.98PsF

3 Gb/s output formats (Option SDI)

Standards	SMPTE 291M, 424M, 425-1
Bit rate	2.97 Gb/s and 2.97/1.001 Gb/s
Alpha channel	Same as Y/G channel or flat field (0% to 100% in 10% steps)

Formats

Format		Sample structure	Frame/Field rates
Level A			
	1280×720	4:4:4 Y'C'$_B$C'$_R$(+A)/10-bit 4:4:4 R'G'B'(+A)/10-bit	60/59.94/50/30/29.97/25/24/23.98P
	1920×1080	4:2:2 Y'C'$_B$C'$_R$/10-bit	60/59.94/50P
		4:4:4 Y'C'$_B$C'$_R$(+A)/10-bit 4:4:4 R'G'B'(+A)/10-bit	60/59.94/50I 30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
		4:4:4 Y'C'$_B$C'$_R$/12-bit 4:4:4 R'G'B'/12-bit	60/59.94/50I 30/29.97/25/24/23.98P
		4:2:2 Y'C'$_B$C'$_R$/12-bit	60/59.94/50I 30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
	2048×1080	4:4:4 R'G'B'/12-bit 4:4:4 X'Y'Z'/12-bit	30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
Level B Dual-Link			
	1920×1080	4:2:2 Y'C'$_B$C'$_R$/10-bit	60/59.94/50P
		4:4:4 Y'C'$_B$C'$_R$(+A)/10-bit 4:4:4 R'G'B'(+A)/10-bit	60/59.94/50I 30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
		4:4:4 Y'C'$_B$C'$_R$/12-bit 4:4:4 R'G'B'/12-bit	60/59.94/50I 30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
		4:2:2 Y'C'$_B$C'$_R$(+A)/12-bit	60/59.94/50I 30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
	2048×1080	4:4:4 R'G'B'/12-bit 4:4:4 X'Y'Z'/12-bit	30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
Level B Dual-Stream			
	2× 1920×1080	4:2:2 Y'C'$_B$C'$_R$(+A)/10-bit	60/59.94/50I 30/29.97/25/24/23.98P 30/29.97/25/24/23.98PsF
	2× 1280×720	4:2:2 Y'C'$_B$C'$_R$(+A)/10-bit	60/59.94/50/30/29.97/25/24/23.98P

4K/UHD outputs (Option SDI)

Output mode	Quad Link Square Division
Standards	All supported 3G/HD-SDI standards
Formats	All supported 2048×1080 and 1920×1080 3G/HD-SDI formats
Test signals	Full Frame 75% & 100% color bars only

Test pattern output

Color bars	100%, 75%, SMPTE EG1, SMPTE RP219, SMPTE EG432-1
Flat field	Full field 0% (Black), 50%, 100% (White), Red, Green, Blue, Cyan, Magenta, Yellow
Linearity test	Ramp, Limit Ramp, Valid Ramp, Shallow Ramp Matrix, 5/10 Step Staircase
Monitor	Checkerboard, Clean Aperture, Convergence, Black-White Step Scale, Black-Dark Gray Step Scale, Pluge and Luma Reference, Production Aperture, Window, SMPTE 303M Color Reference, ChromaDuMonde
SDI pathological	Equalizer Test, PLL Test, SDI Matrix per SMPTE RP178/RP198
Frequency response	Multiburst, Real-time parametric moving zone plate
Pulses	2T Pulse and Bar, Color Pulses, Co-siting Pulse
Full-frame picture	User-defined bitmap files (BMP format) can be downloaded to flash memory and displayed in any format

Video overlay output

Logo	24-bit color bitmap file (BMP format) or 32-bit with transparency, up to 1920×1080 pixel size. Adjustable on-screen position.
ID text	Programmable string from front-panel entry (printable ASCII characters) or downloaded text file (UTF-8 encoding) for any Unicode characters. A preinstalled TrueType font is provided for Latin, Greek, and Cyrillic characters; an alternate TrueType font file may be downloaded to support other character sets. Character size is adjustable (%APH, 0.1% resolution).
Burnt-in time code	On-screen display of the current time code value (HH:MM:SS:FF) for the output, updated every field. Character size is 10% APH.
Circle	Adjustable diameter (%APH).
Border	Text and circle overlays are rendered as near-white objects, with a selectable enclosing near-black bounding area.
Blink	Text and circle overlays can blink on and off for dynamic on-screen activity.
Position	All overlay objects have adjustable on-screen position.

Embedded audio output

Standards	SMPTE 272M (SD), 299 (HD/3G)
Active channels	16 channels (SD, HD, 3G-A), 32 channels (3G-B)
Sample frequency	48 kHz
Digital coding	24 bits (HD, 3G), 20 bits (SD)
Signal alignment	Async. and Sync. (no frame #), Synchronous (frame #)
Tone frequency	10.0 Hz to 20000.0 Hz, 0.5 Hz resolution
Level	–60 to 0 dBFS, 1 dB steps
Channel identification	Audible click, AES channel origin bytes

Ancillary data output

Error detection and handling	EDH packet inserted in SD-SDI signals per SMPTE RP165
Video payload identifier	Optional VPID insertion per SMPTE 352M
Ancillary time code	Optional ATC insertion per SMPTE 12M-2
Format	ATC-LTC and/or ATC-VITC
Source	Time-of-day with adjustable offset, or program (elapsed) time counter
User-programmable ANC packet	
Content	DID, SDID, DC, UDW (255), CS; Automatically calculate checksum and/or parity, or manual override
Location	Line number, sample offset, luma/chroma channel, virtual link (3G)
Mode	Continuous insertion or single packet

DARS output

Outputs	2 channels (1 AES/EBU pair)
Output impedance	75 Ω, unbalanced
Connector	BNC ×1
Output amplitude	1 ±0.2 V
Frequency, level	No signal
Sampling frequency	48 kHz (lock on video signal)
Quantization	Linear PCM, 20 or 24 s (2's complement)
Transfer coding	Bi-phase mark

Internal oscillator

Frequency accuracy in Internal mode	$\pm135 \times 10^{-9}$ over 1-year calibration interval. Typically $\pm10 \times 10^{-9}$ just after adjustment.
Frequency accuracy over temperature	$\pm2 \times 10^{-9}$ for ±5 °C variation $\pm10 \times 10^{-9}$ for 0 to 50 °C
Frequency variation from vibration and shock	$\pm25 \times 10^{-9}$ from 6 ms half-sine shocks over 20g
Frequency drift	$< \pm100 \times 10^{-9}$ per year for internal and Stay GenLock® modes at constant temperature

Remote access

Network interface	10/100/1000 BASE-T
Configuration	Web-based user interface, HTML with JavaScript
Management	SNMPv2

General Purpose Interface (GPI)

Connector	Two outputs and one input also available on the same 15-pin D-sub connector as the LTC signals. Optional breakout cable makes these available on BNC connectors.
Outputs	Three, user-selectable to assert on specific events
1, 2	Assert on one of: loss of lock, near loss of lock, loss of input signal, or timer expiry
3	Assert on logical OR of any of: fan fault, loss of lock, near loss of lock, loss of genlock input
Output level	0.5-5 V
Inputs	Two (using 4 pins on connector)
1	User-selectable to jam sync or restart timer
2	Three pins on connector to recall preset 1-7
Input level	0.8-2.4 V

Physical characteristics

Dimensions	
Height	44 mm (1.7 in.)
Width	483 mm (19 in.)
Depth	559 mm (21.5 in.)
Weight (net)	4.85 kg (10.7 lb.)

Environmental

Power consumption	130 VA (max) on active power supply input
	130 VA on backup supply input during 5 s daily load test
Temperature	0 to +50 °C
Altitude	3,000 m (9,842 ft.)
Source voltage	100 to 240 VAC ±10%, 50/60 Hz

Ordering information

Models

SPG700 Multiformat Reference Sync Generator base unit Includes: Genlock input with loop-through output, three analog composite black or HD tri-level sync outputs, LTC input/outputs (4 out or 1 in/3 out), 48 kHz word clock and DARS outputs; general purpose interface, 10/100/1000 Ethernet interface with Web UI support, SNMP support – 3G/HD/SD-SDI support optional

Instrument options

Product option

Opt. SDI Add two independent sets of 3G/HD/SD-SDI test and test/black signal generation outputs

Accessory options

Opt. DPW Add a second hot-swappable redundant (backup) power supply

Opt. RACK Add rackmount slides and rails kit for SPG700 (1 RU height, standard full depth)

Opt. XLR Add an adapter cable (six feet long) from 15-pin D-sub GPI/LTC connector on the SPG700 to four XLR male connectors (for LTC input/outputs) and three BNC male connectors (for GPI input/outputs)

Power plug options

Opt. A0 North America power plug (115 V, 60 Hz)

Opt. A1 Universal Euro power plug (220 V, 50 Hz)

Opt. A2 United Kingdom power plug (240 V, 50 Hz)

Opt. A3 Australia power plug (240 V, 50 Hz)

Opt. A5 Switzerland power plug (220 V, 50 Hz)

Opt. A6 Japan power plug (100 V, 50/60 Hz)

Opt. A10 China power plug (50 Hz)

Opt. A11 India power plug (50 Hz)

Opt. A12 Brazil power plug (60 Hz)

Opt. A99 No power cord

Service options

Opt. C3 Calibration Service 3 Years

Opt. C5 Calibration Service 5 Years

Opt. D1 Calibration Data Report

Opt. D3 Calibration Data Report 3 Years (with Opt. C3)

Opt. D5 Calibration Data Report 5 Years (with Opt. C5)

Opt. G3 Complete Care 3 Years (includes loaner, scheduled calibration, and more)

Opt. G5 Complete Care 5 Years (includes loaner, scheduled calibration, and more)

Opt. R3 Repair Service 3 Years (including warranty)

Opt. R3DW   Repair Service Coverage 3 Years (includes product warranty period). 3-year period starts at time of instrumentpurchase

Opt. R5   Repair Service 5 Years (including warranty)

Opt. R5DW   Repair Service Coverage 5 Years (includes product warranty period). 5-year period starts at time of instrumentpurchase

SPG70UP field upgrades

Opt. DPW   Add a replacement or second hot-swappable redundant (backup) power supply. A power cord option must also be specified. (See Power plug options.)

Opt. RACK   Add rackmount slides and rails kit for SPG700 (1 RU height, standard full depth)

Opt. XLR   Add an adapter cable (six feet long) from 15-pin D-sub GPI/LTC connector on the SPG700 to four XLR male connectors (for LTC input/outputs) and three BNC male connectors (for GPI input/outputs)

Option XLR adapter cable

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