CALIAN®

Confidence. Engineered.

Document No. 6325-115
Revision 1
August 16, 2024

DOCSIS Cable Load Generator

Specifications

18 Innovation Boulevard, Saskatoon, Saskatchewan, Canada, S7N 3R1
Tel: 306.931.3425, Fax: 306.933.1486
www.calian.com/advanced-technologies

Contents

Contents (cont'd)

Page

Definitions

General

Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 30 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as <, ≤, >, ≥, ±, or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.

Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with <, > or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are designated with the format “parameter: value”.

Typical data as well as nominal and measured values are not warranted by Calian.

RF Characteristics

Frequency

Total frequency range, upstream	CLGD base unit	5 MHz to 204 MHz
Total frequency range, downstream	CLGD base unit	47 MHz to 1218 MHz
	with CLGD-K3018	47 MHz to 1794 MHz
Settable frequency range		depends on selected mode (see Operating modes)
Step size of setting		1 Hz

Level

Downstream output low

Maximum sum level	1 active DOCSIS 3.1 channel	59 dBmV
	1 active J.83/A/B/C channel	62 dBmV
	2 active J.83/A/B/C channels	61 dBmV
	4 active J.83/A/B/C channels	60 dBmV
	158 active J.83/A/B/C channels	57 dBmV
Setting range of sum level		12 dBmV to max. sum level
Level setting range per channel [1]	when more than one channel is active	0 to max. level per channel [2]
Step size of setting		0.1 dB
Level uncertainty	at maximum level, 0 dB tilt and 0 dB attenuation	
	1 active channel	typ. ± 0.25 dB, max. ≤ ± 1.0 dB
	≥ 2 active channels	max. ≤ ± 1.5 dB

Downstream output high

Maximum sum level	1 active DOCSIS 3.1 channel	54 dBmV
	1 active J.83/A/B/C channel	56 dBmV
	2 active J.83/A/B/C channels	55 dBmV
	4 active J.83/A/B/C channels	54 dBmV
	158 active J.83/A/B/C channels	53 dBmV
Setting range of sum level		12 dBmV to max. sum level
Level setting range per channel [1]	when more than one channel is active	0 to max. level per channel [2]
Step size of setting		0.1 dB

[1] When more than one channel is active, the levels of the different channels are set in the digital signal processing unit. In the case of large level differences between the active channels, the signal quality of the channels with low level deteriorates.

[2] The maximum level per channel is determined by the maximum sum level divided by the number of active channels.

Level uncertainty	at maximum level, 0 dB tilt and 0 dB attenuation	
	1 active channel	typ. ± 0.25 dB, max. ≤ ± 1.0 dB
	≥ 2 active channels	max. ≤ ± 1.5 dB

Upstream output

Maximum sum level	1 active DOCSIS 3.1 channel	59 dBmV
	1 active 6.4 MHz DOCSIS 3.0 channel	62 dBmV
	2 active 6.4 MHz DOCSIS 3.0 channels	61 dBmV
	4 active 6.4 MHz DOCSIS 3.0 channels	60 dBmV
Setting range of sum level		12 dBmV to max. sum level
Level setting range per channel [1]	when more than one channel is active	0 to max. level per channel [2]
Step size of setting		0.1 dB
Level uncertainty	at maximum level and 0 dB attenuation	
	1 active channel	typ. ± 0.25 dB, max. ≤ ± 1.0 dB
	≥ 2 active channels	max. ≤ ± 1.5 dB

CSO/CTB output

Maximum sum level	1 active DOCSIS 3.1 channel	27 dBmV
	1 active J.83/A/B/C channel	30 dBmV
	2 active J.83/A/B/C channels	29 dBmV
	4 active J.83/A/B/C channels	28 dBmV
	158 active J.83/A/B/C channels	25 dBmV
Setting range of sum level		12 dBmV to 30 dBmV
Level setting range per channel [1]	when more than one channel is active	0 to max. level per channel [2]
Step size of setting		0.1 dB
Level uncertainty	at maximum level	
	1 active channel	typ. ± 0.25 dB, max. ≤ ± 1.0 dB
	≥ 2 active channels	max. ≤ ± 1.5 dB

Spectral purity

CSO/CTB	with CW carriers in 80 channels, at CSO/CTB output, in line with ANSI/SCTE 06 2009 and ANSI/SCTE 161 2009	typ. 70 dB
SNR	with 157 active J.83/A/B/C channels	
	50 MHz to 350 MHz	> 52 dB
	350 MHz to 700 MHz	> 51 dB
	700 MHz to 1000 MHz	> 50 dB
Spurious	50 MHz to 1000 MHz	≤ –63 dBc
	1000 MHz to 1218 MHz	≤ –59 dBc
Single-sideband phase noise	1 kHz to 10 kHz	≤ –56 dBc
	10 kHz to 100 kHz	≤ –60 dBc
	100 kHz to 1 MHz	≤ –68 dBc
	1 MHz to 10 MHz	≤ –70 dBc
	10 MHz to 100 MHz	≤ –61 dBc

Modulation systems

Downstream (CLGD-K200 option)

DOCSIS 3.1

Modulation		COFDM
Bandwidth		24 MHz to 192 MHz
		can be set as the encompassed spectrum in MHz or as the number of guard subcarriers
Frequency		can be set as the frequency of the 0th subcarrier or as the channel center frequency
FFT size		4k (50 kHz offset from carrier)
		8k (25 kHz offset from carrier)
Guard subcarrier	FFT size = 4k (50 kHz offset from carrier)	148 to 2048
	FFT size = 8k (25 kHz offset from carrier)	296 to 4096
MER	f = 500 MHz, bandwidth = 192 MHz	typ. > 53 dB
	2 × 192 MHz OFDM and 24 × J.83/A/B/C	
	f < 600 MHz	≥ 50 dB
	600 MHz ≤ f < 1002 MHz	≥ 47 dB
	1002 MHz ≤ f < 1218 MHz	≥ 45 dB
	1 × 24 MHz OFDM	
	f < 600 MHz	≥ 48 dB
	600 MHz ≤ f < 1002 MHz	≥ 45 dB
	1002 MHz ≤ f < 1218 MHz	≥ 43 dB
PLC location		settable, subcarrier index or frequency of lowest PLC carrier
PLC constellation		16QAM
PLC content	generated internally	dummy data
	external feed	data over IP
NCP constellation		QPSK, 16QAM, 64QAM
Cyclic prefix		0 µs, 0.9375 µs, 1.25 µs, 2.5 µs, 3.75 µs, 5 µs
Windowing		0 µs, 0.3125 µs, 0.625 µs, 0.9375 µs, 1.25 µs
Exclusion band		up to 3 bands, each specified by start subcarrier and number of subcarriers
Continuous pilot parameter		48 to 120

Interleaver depth	FFT size = 4k (50 kHz offset from carrier)	max. 32
	FFT size = 8k (25 kHz offset from carrier)	max. 16
FEC codeword shortening		on/off, can be set for each profile
Number of profiles		1 to 4
Profile constellation		16QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM
	overrange [3]	8192QAM, 16384QAM
Profile content	generated internally	MACLFSR (PRBS)
	external feed	data over IP
Advanced options		import and export of configuration files for complex channel configurations

Digital TV standards and DOCSIS 3.0

1. J.83/A (DVB-C)

Standard		ITU-T J.83 Annex A, EN 300429
Modulation		single-carrier QAM
Bandwidth		8 MHz
Constellation		64QAM, 256QAM
Symbol rate		5 Msymbol/s to 6.952 Msymbol/s
Rolloff		0.15
Interleaver		12, 17
MER		typ. 45 dB
Content	generated internally	PRBS, MPEG-2 transport stream
	external feed	MPEG-2 transport stream over IP

2. J.83/B

Standard		ITU-T J.83 Annex B
Modulation		single-carrier QAM
Bandwidth		6 MHz
Constellation		64QAM, 256QAM
Symbol rate		4 Msymbol/s to 5.37 Msymbol/s
Rolloff		0.12, 0.18
Interleaver		in line with ITU-T J.83 Annex B
MER		typ. 45 dB
Content	generated internally	PRBS, MPEG-2 transport stream
	external feed	MPEG-2 transport stream over IP

[3] The CLGD can generate signals with 8192QAM and 16384QAM. This might, however, violate some specifications of this data sheet.

3. J.83/C (ISDB-C)

Standard		ITU-T J.83 Annex C
Modulation		single-carrier QAM
Bandwidth		6 MHz
Constellation		64QAM, 256QAM
Symbol rate		4 Msymbol/s to 5.325 Msymbol/s
Rolloff		0.13
Interleaver		12, 17
MER		typ. 45 dB
Content	generated internally	PRBS, MPEG-2 transport stream
	external feed	MPEG-2 transport stream over IP

Analog TV standards

Standards		PAL, NTSC
Bandwidth	NTSC	6 MHz
	PAL	7 MHz, 8 MHz
Content		color bar test pattern with 1 kHz sinusoidal tone

Arbitrary waveform generator

Number of samples per ARB waveform file		≤ 67.1 Msample (2^{26} samples)
Value range		≤ ±32767
File size		≤ 256 Mbyte
Included ARB waveform files	for analog TV	NTSC, PAL with 7 MHz bandwidth, PAL with 8 MHz bandwidth
	for digital TV and DOCSIS 3.0	DVB-C with 64QAM, DVB-C with 256QAM, J.83/B with 64QAM, J.83/B with 256QAM, J.83/C with 64QAM, J.83/C with 256QAM, ISDB-T
	for DOCSIS 3.1	DOCSIS 3.1 with 192 MHz bandwidth
Narrowband ARB generator in fundamental frequency range (not available in Fullband AWGN mode)		
Frequency range		47 MHz to 1218 MHz
ARB bandwidth		≤ 10 MHz
Number of simultaneously played ARB waveform files		max. 4
Number of RF channels per waveform file [4]		max. 160

[4] An ARB waveform file with a bandwidth of up to 10 MHz can be played on multiple RF channels at the same time. ARB waveform files with bandwidths > 10 MHz can be played only on one RF channel.

Sample rate per waveform file	when 4 files are played simultaneously	≤ 18 Msample/s
Broadband ARB generator in fundamental frequency range (not available in Fullband AWGN mode)		
Frequency range		47 MHz to 1218 MHz
ARB bandwidth		≤ 200 MHz
Number of simultaneously played ARB waveform files	bandwidth ≤ 100 MHz	max. 2
	100 MHz < bandwidth ≤ 200 MHz	1
Number of RF channels per waveform file		1
Sample rate per waveform file	when 2 files are played simultaneously	≤ 170 Msample/s
	when 1 file is played	≤ 340 Msample/s
Broadband ARB generator in expanded frequency range (CLGD-K3018 required) (not available in Fullband AWGN mode)		
Frequency range		1218 MHz to 1794 MHz
ARB bandwidth		≤ 200 MHz
Number of simultaneously played ARB waveform files	bandwidth ≤ 100 MHz	1 or 2 (in addition to those specified under Broadband ARB generator in fundamental frequency range)
	100 MHz < bandwidth ≤ 200 MHz	1 (in addition to those specified under Broadband ARB generator in fundamental frequency range)
Number of RF channels per waveform file		1
Sample rate per waveform file	when 2 files are played simultaneously	≤ 170 Msample/s
	when 1 file is played	≤ 340 Msample/s

Basic waveform library (CLGD-K2 option)

CLGD-K2 is unlocked on all CLGD base units.

Waveform files	FM	random noise, 22 carriers
	ATV, PAL B	color bars, AF 1 kHz, 2-tone, no pilot
	ATV, PAL DK, CHINA	color bars, AF 1 kHz, 1-tone
	ATV, PAL G	color bars, AF 1 kHz, 2-tone, no pilot
	ATV, PAL I	color bars, AF 1 kHz, 1-tone
	rectangle for CMX tests	15.675 kHz
	ATV, SECAM L	color bars, AF 1 kHz, 2-tone, no pilot

Transport stream generator

The CLGD comes with a built-in transport stream generator that can play back MPEG-2 transport stream files. The generated transport stream can be used as the content for a J.83/A/B/C channel.

Transport stream format	MPEG-2, SPTS with 1 PAT and 1 PMT
Packet size	188 byte
Transport stream file size	max. 188 Mbyte
File format	.trp, .ts, .mpg
Seamless loop playback	can be switched on and off for continuity counter, PCR, DTS/PTS, TDT/TOT
Bit rate	≤ bit rate of channel

Enhanced functions for downstream (CLGD-K201 option)

DOCSIS 3.1

Insertion of DOCSIS timestamp in downstream PLC	on/off
Flow rate indicator	display of transmission data rate for each profile of a DOCSIS 3.1 channel or each DOCSIS 3.0 carrier in bps
DOCSIS 3.1 PLC mode	standard/FSW compatibility, extended DOCSIS 3.1 PLC contents (Rohde and Schwarz FSW compatibility mode) additional transmission of DPD messages for profiles B, C and D on the PLC)

Upstream (CLGD-K300 option)

DOCSIS 3.1

Modulation		burst OFDMA
Burst timing		controlled via trigger input
FFT size	50 kHz offset from carrier	2k
	25 kHz offset from carrier	4k
Bandwidth	FFT size = 2k (50 kHz offset from carrier)	10 MHz to 96 MHz
	FFT size = 4k (25 kHz offset from carrier)	6.4 MHz to 96 MHz
		can be set as the encompassed spectrum in MHz or as the number of guard subcarriers
Constellation		QPSK, 8QAM, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM, 512QAM, 1024QAM, 2048QAM, 4096QAM

Cyclic prefix		0.9375 µs, 1.25 µs, 1.525 µs, 1.875 µs, 2.1875 µs, 2.5 µs, 2.8125 µs, 3.125 µs, 3.75 µs, 5 µs, 6.25 µs
Windowing		0 µs, 0.3125 µs, 0.625 µs, 0.9375 µs, 1.25 µs, 1.5625 µs, 1.875 µs, 2.1875 µs
Pilot structure	FFT size 2k (50 kHz offset from carrier)	1 to 7
	FFT size 4k (25 kHz offset from carrier)	8 to 14
	with pilot boosting	5 to 7 and 12 to 14
Burst types		data
		initial ranging
		fine ranging
		bandwidth request
		wideband probe
Settable parameters	data	pilot pattern, constellation, scrambler, scrambler seed, number of frames, user starting minislot, user ending minislot, content
	initial ranging	number of subcarriers, number of minislots, starting minislot, preamble pattern, preamble value offset, preamble length, MAC address, downstream channel ID
	fine ranging	number of subcarriers, number of minislots, starting minislot, preamble pattern, preamble value offset, data
	bandwidth request	number of minislots, symbols, subslot, requested number of bytes, SID
	wideband probe	start subcarrier, subcarrier skipping, symbols in frame
Content		PRBS or user-defined file

DOCSIS 3.0 A-TDMA

Modulation		burst A-TDMA
Burst timing		controlled via trigger input
Bandwidth		0.8 MHz, 1.6 MHz, 3.2 MHz, 6.4 MHz
Constellation		QPSK, DQPSK, 8QAM, 16QAM, D16QAM, 32QAM, 64QAM
Preamble pattern		user-defined hex string
Preamble length	integer number of QPSK symbols	up to 1536 bit
Preamble value offset		multiple of symbol size
Preamble type		QPSK0, QPSK1
FEC error correction parameter T	no FEC	T = 0
	FEC with 2 × T parity bytes	T = 1 to 16
FEC codeword information bytes	parameter k	16 to 253
Last codeword length		fixed, shortened
Reed-Solomon interleaver mode		disabled, fixed, dynamic
Reed-Solomon interleaver depth	interleaver mode = fixed	2 to (2048 / (k + 2T))
Reed-Solomon interleaver block size	interleaver mode = dynamic	2 × (k + 2T) to 2048
Scrambler		on, off
Scrambler seed		15 bit from user-defined hex string
Content		PRBS or user-defined file

DOCSIS 3.0 S-CDMA

Modulation		burst S-CDMA
Burst timing		controlled via trigger input
Bandwidth		1.6 MHz, 3.2 MHz, 6.4 MHz
Constellation		QPSK, 8QAM, 16QAM, 32QAM, 64QAM, TCM-QPSK, TCM-8QAM, TCM-16QAM, TCM-32QAM, TCM-64QAM, TCM-128QAM
Preamble pattern		user-defined hex string
Preamble length	integer number of QPSK symbols	up to 1536 bit
Preamble value offset		multiple of symbol size
Preamble type		QPSK0, QPSK1
FEC error correction parameter T	no FEC	T = 0
	FEC with 2 × T parity bytes	T = 1 to 16
FEC codeword information bytes	parameter k	16 to 253
Last codeword length		fixed, shortened
Scrambler		on, off
Scrambler seed		15 bit from user-defined hex string

Spreading intervals per frame		1 to 32
Codes per minislot		2 to 32
Active codes	mode 1	64 to 128
Symbol interleaver step size		1 to 31
Codes per subframe		2 to number of active codes
Code hopping seed		settable
Content		PRBS or user-defined file

Arbitrary waveform generator

Bandwidth		≤ 100 MHz
Burst timing		controlled via trigger input
Number of simultaneously played ARB waveform files	bandwidth ≤ 10 MHz	max. 4
	bandwidth ≤ 100 MHz	max. 2
Number of RF channels per waveform file [5]	bandwidth ≤ 10 MHz	max. 32
	bandwidth > 10 MHz	1
ARB waveform files included	for DOCSIS 3.0	A-TDMA with 1.6 MHz bandwidth
		A-TDMA with 3.2 MHz bandwidth
		A-TDMA with 6.4 MHz bandwidth
		S-CDMA with 1.6 MHz bandwidth
		S-CDMA with 3.2 MHz bandwidth
		S-CDMA with 6.4 MHz bandwidth
	for DOCSIS 3.1	OFDMA initial ranging
		OFDMA fine ranging
		OFDMA wideband probe
		OFDMA bandwidth request
		OFDMA data packet

Full duplex DOCSIS generator (CLGD-K400 option)

Simultaneous transmission capabilities		up to 6 OFDM channels 6 OFDMA channels (or CW sounding across 6 OFDMA channels or 3 user ARB channels) 3 AWGN generators 16 SC-QAM channels, with features and limitations as defined below
Frequency range	uses downstream low port	47 MHz to 1218 MHz

[5] An ARB waveform file with a bandwidth of up to 10 MHz can be played on multiple RF channels at the same time. ARB waveform files with bandwidths > 10 MHz can be played only on one RF channel.

Operating modes

Since only one operating mode at a time can be active, the CLGD cannot generate downstream and upstream signals simultaneously.

Downstream signal generation

Downstream signal generation requires the CLGD-K200 option. The CLGD-K3018 frequency range extension is required for the enhanced downstream signal generation functionality.

DOCSIS 3.1 mode

Basic functionality (Fullband AWGN mode not active)		
Settable frequency range	downstream output, low	108 MHz to 1218 MHz
Number of DOCSIS 3.1 channels		max. 5
Number of single-carrier QAM channels		0
Enhanced functionality (CLGD-K3018 required) (Fullband AWGN mode not active)		
Settable frequency range	downstream output, high	252 MHz to 1794 MHz
Number of DOCSIS 3.1 channels		max. 8
Number of single-carrier QAM channels		0
Functionality with Fullband AWGN mode active (CLGD-K1051 required)		
Number of DOCSIS 3.1 channels		up to 6 within 108 to 1218 MHz up to 3 within 1218 MHz to 1794 MHz with CLGD-K3018 option maximum 8 channels total across both bands with CLGD-K3018 option
Number of single-carrier QAM channels		0

Mixed mode

Basic functionality (Fullband AWGN mode not active)		
Settable frequency range	for DOCSIS 3.1 at downstream output, low	108 MHz to 1218 MHz
	for single-carrier QAM channels at downstream output, low	47 MHz to 1218 MHz
	simultaneously usable [6]	max. 1146 MHz
Number of DOCSIS 3.1 channels		max. 2
Number of single-carrier QAM channels	J.83/B, J.83/C (ISDB-C)	max. 160
	J.83/A (DVB-C)	max. 128
Enhanced functionality (CLGD-K3018 required) (Fullband AWGN mode not active)		

[6] All simultaneously generated single-carrier QAM channels must lie within an 1146 MHz frequency band, i.e. between 47 MHz and 1193 MHz or between 72 MHz und 1218 MHz or in a maximally 1146 MHz wide frequency band in between these two. This limitation does not apply to the “Downstream High” output since the settable frequency band of 252 MHz to 1218 MHz for single-carrier QAM channels is less than 1146 MHz.

Settable frequency range	for DOCSIS 3.1 at downstream output, high	252 MHz to 1794 MHz
	for single-carrier QAM channels at downstream output, high	252 MHz to 1218 MHz
Number of DOCSIS 3.1 channels		max. 4
Number of single-carrier QAM channels	J.83/B, J.83/C (ISDB-C)	max. 160
	J.83/A (DVB-C)	max. 120
Functionality with Fullband AWGN mode active (CLGD-K1051 required)		
Number of DOCSIS 3.1 channels		Up to 2 within 108 MHz to 1218 MHz Up to 3 within 1218 MHz to 1794 MHz with CLGD-K3018 option Maximum 4 channels total across both bands with CLGD-K3018 option
Number of single-carrier QAM channels		Up to 160 J.83B or 120 DVB-C, within 47 MHz to 1218 MHz

Upstream signal generation

Upstream signal generation requires the CLGD-K200 option.

Cable modem emulation mode

Upstream CM emulation mode		
Settable frequency range		5 MHz to 204 MHz
Number of DOCSIS 3.1 channels		max. 2
Number of DOCSIS 3.0 channels	with different parameters in each channel	max. 4
	with identical parameters in each channel	max. 32

Upstream burst timing control

Signal timing	continuous, burst, single-shot
Trigger delay	0 µs to 9999 µs
Burst spacing	0 µs to 9999 µs
Trigger output	0 µs to 9999 µs after trigger input
Resolution of timing settings	4 ns

Signal interference simulation

The CLGD base unit enables the user to add a tilt to the output spectrum. All other signal interference simulations require the CLGD-K1050 option.

Tilt

Total setting range [7]	–15 dB (1 GHz) to +15 dB (1 GHz)
Step size of setting	0.1 dB
Tilt caused by analog filters [8]	–15 dB (1 GHz), –9 dB (1 GHz), 0, +9 dB (1 GHz), +15 dB (1 GHz)

AWGN (CLGD-K1050 option)

1 dB bandwidth	800 kHz to 200 MHz
Step size of setting	1 kHz
Center frequency	can be set in the active frequency range
Noise level	0 dBmV to 51 dBmV
Step size of setting	0.1 dB
Reference quantity of C/N	absolute noise level
	signal power in symbol rate of channel
	signal power in user-defined receiver bandwidth

Fullband AWGN (CLGD-K1051 option)

1 dB bandwidth	1.5 MHz to 1171 MHz (without CLGD-K3018 option) 1.5 MHz to 1794 MHz (with CLGD-K3018 option)
Step size of setting	1.5 MHz
Center frequency	can be set in the active frequency range
Noise level	0 dBmV to 51 dBmV
Step size of setting	0.1 dB
Reference quantity of C/N	absolute noise level
Interaction with other signal impairment simulation	microreflections, narrowband interferer, AM hum, phase noise impairments can be applied to DOCSIS signals when CLGD-K1050 license is installed, but are not applied to the Fullband AWGN signal. If configured, tilt is applied to both DOCSIS and Fullband AWGN signals.

Microreflections (CLGD-K1050 option)

The simulation of microreflections affects all active channels.

[7] The overall tilt is the sum of the frequency response of an analog filter and the level settings of the individual channels. For every desired tilt, the CLGD automatically finds the most favorable combination of analog filter and level setting.

[8] The fact that the tilt is set by an analog filter does not deteriorate signal-to-noise ratio versus frequency.

Number of reflections	0 to 5
Duration	0 µs to 5 µs
Step size of setting	0.1 µs
Attenuation	0 dB to 40 dB
Step size of setting	0.1 dB

AC hum (CLGD-K1050 option)

The CLGD simulates AC hum by superimposing amplitude modulation on all active channels.

Mains frequency	47 Hz to 200 Hz
Step size of setting	0.1 Hz
AM modulation depth	0 % to 6 %
Step size of setting	0.1 %

Narrowband interference signal and impulsive noise (CLGD-K1050 option)

The narrowband interference signal can be placed on any frequency in the frequency range of the selected mode and can overlap an active channel. To simulate impulsive noise, the narrowband interference signal can be periodically pulsed.

Mode		continuous, or periodically pulsed
Period length		0 s to 11.18 s
Step size of setting		1 µs
Pulse length		0 s to 5.59 s
Step size of setting		1 µs
Center frequency		any frequency in the frequency range of the selected mode
Interference signal level	referred to the wanted signal	–40 dB to +5 dB
Step size of setting		0.1 dB
Modulation		AWGN
Bandwidth		0 Hz to 20 MHz
Step size of setting		1 Hz

Phase noise (CLGD-K1050 option)

The phase noise affects all active channels.

Format [9]		double-sideband noise, integrated via a frequency decade, referenced to the level of the carrier, in dBc

[9] The DOCSIS 3.1 standard specifies the phase noise in this relatively unusual format. The CLGD also uses this format, making it easy to set the specifications found in the DOCSIS 3.1 standard. The user manual describes how to convert the phase noise to the more common single sideband format with a normalized bandwidth of 1 Hz.

Offset from carrier		1 kHz to 100 MHz
Characteristic		user-defined in frequency decades
Setting range	1 kHz to 10 kHz offset from carrier	–65 dBc to –30 dBc
	10 kHz to 100 kHz offset from carrier	–65 dBc to –44 dBc
	100 kHz to 1 MHz offset from carrier	–65 dBc to –50 dBc
	1 MHz to 10 MHz offset from carrier	–65 dBc to –51 dBc
	10 MHz to 100 MHz offset from carrier	–65 dBc to –57 dBc
Step size of setting		0.1 dBc

Interfaces

RF outputs

The CLGD comes with four coaxial adapters from type F male to type F female connectors. Calian recommends always leaving these adapters on the RF outputs of the CLGD to prevent wear on these outputs.

Downstream fundamental frequency range (Downstream Low connector)

Type		F female, 75 Ω
Frequency range		47 MHz to 1218 MHz
Return loss	47 MHz to 750 MHz	≥ 14 dB
	750 MHz to 870 MHz	≥ 13 dB
	870 MHz to 1218 MHz	≥ 12 dB

Downstream expanded frequency range (Downstream High connector)

Type		F female, 75 Ω
Frequency range		252 MHz to 1794 MHz
Return loss	258 MHz to 750 MHz	≥ 14 dB
	750 MHz to 870 MHz	≥ 13 dB
	870 MHz to 1218 MHz	≥ 12 dB
	1218 MHz to 1794 MHz	≥ 10 dB

Upstream

Type		F female, 75 Ω
Frequency range		5 MHz to 204 MHz
Return loss		≥ 10 dB

CSO/CTB

Type		F female, 75 Ω
Frequency range		47 MHz to 1002 MHz
Return loss	47 MHz to 750 MHz	≥ 14 dB
	750 MHz to 870 MHz	≥ 13 dB
	870 MHz to 1002 MHz	≥ 12 dB

Data and transport stream inputs

IP data inputs	2 × SFP+

Control inputs and output

Reference input	BNC, 50 Ω
Reference frequency	10 MHz, 10.24 MHz
Trigger input	BNC, 50 Ω
Trigger output	BNC, 50 Ω
LAN control interface	RJ-45
Control via Wi-Fi	with USB Wi-Fi adapter [10]

Enhancements

USB interfaces	2 × USB type A

[10] Basically, control should be possible with every commercially available USB Wi-Fi adapter. The function was tested with the TL-WN722N adapter from TP-LINK.

General data

Environmental conditions		
Temperature	operating temperature range	0 °C to +45 °C
Damp heat		0 % to 50 %, noncondensing, max. 80 % for temperature up to +31 °C, decreases linearly to 50 % at +45 °C
Mechanical resistance		
Vibration	operational	NEBS
	transport	NEBS transport 2B
Power rating		
Rated voltage		120 V to 240 V AC
Rated frequency		50 Hz to 60 Hz
Rated power		200 VA
Product conformity		
Electromagnetic compatibility		EN 55011, EN 61326-1, EN 61326-2-2 ICES-003 part 15 of FCC rules radio interference class A und basic immunity requirements
Electrical safety	in line with EU low voltage directive 2006/95/EC	applied harmonized standard: EN 61010-1
	USA	UL 61010-1
	Canada	CAN/CSA-C22.2 No. 61010-1
Calibration interval		after 12 months, then every 36 months
Dimensions	W × H × D	462 mm × 105 mm × 406 mm (19", 2 HU) (18.19 in × 4.13 × 15.98 in)
Weight		5.2 kg (11.46 lb)