R&S[®]CLG Cable Load Generator Simulation of analog and digital cable TV networks with full channel loading



Product Brochure | 03.00

R&S®CLG Cable Load Generator At a glance

The R&S[®]CLG cable load generator is a multichannel signal generator for cable TV signals. It is the world's first instrument to simulate cable TV networks with full channel loading. The R&S[®]CLG generates both digital and analog TV signals. These signals can be freely combined, allowing users to simulate any conceivable channel loading scenario in the lab. The R&S[®]CLG has a frequency range from 47 MHz to 1002 MHz, covering all cable TV frequency bands used worldwide. Within this frequency range, the R&S[®]CLG can generate up to 158 analog and digital channels using the American 6 MHz channel spacing or up to 119 channels using the European 8 MHz spacing. Users can define the signal levels and frequencies separately for each channel. Each digital channel can transmit one transport stream or pseudo random bit sequence (PRBS). The analog channels carry a test pattern with test tones. To simulate the conditions in a real-world cable TV network, the R&S[®]CLG can superimpose 50 Hz or 60 Hz AC hum on all channels.

The R&S[®]CLG is primarily intended for testing cable TV receivers and cable tuners. It can also be used to test CATV amplifiers. If linearity demands on the device under test (DUT) are very high, an external bandstop filter may have to be used to improve the signal-to-noise ratio. The R&S[®]CLG can be fully remote controlled, making it ideal for integration into automatic test systems. All this functionality has been packed into a compact instrument that is only 19" wide and one HU high. To generate as many TV signals as those delivered by the R&S[®]CLG previously required a rack full of generators.

Key facts

- I Frequency range from 47 MHz to 1002 MHz
- I Up to 158 channels for US cable TV
- I Up to 119 channels for European cable TV
- I More than 53 dBc CNR and 60 dBc CSO/CTB¹⁾
- High MER of 40 dB (typ.)²⁾

¹⁾ CNR: carrier-to-noise ratio;

- CSO/CTB: composite second order/composite triple beat.
- ²⁾ MER: modulation error ratio.



R&S[®]CLG Cable Load Generator Benefits and key features

Full simulation of cable TV networks

- Any combination of digital and analog modulations
- American and European channel spacing
- Simulation of AC hum as superimposed amplitude modulation
- I Adjustable tilt and AWGN
- External transport stream feeding and internal test pattern generation
- Internal test pattern generation
- I Generation of CW signals for CSO/CTB measurements
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Easy configuration of complex test scenarios

- Separate level and frequency settings for each channel
- I Setting of tilt across all channels
- I Easy operation on a PC via a web GUI
- I Remote control using SCPI or SNMP
- Memory space for over 100 user-defined instrument setups
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Full simulation of cable TV networks

Typical loading of cable TV networks in Germany with analog and digital channels.



Typical CNR of the R&S[®]CLG.



Output signal spectrum with a 15 dB tilt.



Any combination of digital and analog modulations

The digitization of TV, including cable TV, continues to advance. Despite this fact, many cable TV networks still carry a number of analog channels. While operators in the US usually maintain a clear separation of analog channels in the lower and digital channels in the upper frequency range, channels are often randomly combined in European networks. The R&S°CLG can generate digital signals in line with the DVB-C, J.83/B, ISDB-C and ISDB-T standards as well as analog PAL, SECAM, NTSC and FM radio signals. Each of these signals can be modulated onto any RF channel, making it possible to simulate any conceivable channel loading scenario.

American and European channel spacing

The US and many other countries use 6 MHz channel spacing in their cable TV networks. In Europe, a channel spacing of 8 MHz is used. The R&S[®]CLG generates up to 160 channels so that the range of available frequencies from 47 MHz to 1002 MHz can be completely filled with signals – these are 158 channels with US spacing and 119 channels with European spacing.

Simulation of AC hum as superimposed amplitude modulation

AC hum superimposed on useful signals is a frequent problem in cable TV networks. There are many sources of AC hum, ranging from inadequate or damaged shielding to a dried-out capacitor in a power supply unit. It is impossible to prevent AC hum completely in practice. Receivers must therefore be able to cope with this type of interference. Relevant standards require verification that receivers still work correctly when receiving signals superimposed with AC hum. The R&S[®]CLG allows users to modulate its entire output signal, i.e. all of its channels, with defined AC hum. The AC hum frequency can be set in the range from 47 Hz and 200 Hz.

External transport stream feeding and internal test pattern generation

Up to 128 of the R&S[®]CLG's digital TV channels can transmit live transport streams. The R&S[®]CLG receives transport streams via its 10GigE port and assigns them to the different channels. Alternatively, the R&S[®]CLG can internally generate PRBS as content for the digital channels. This alternative simplifies test setups, as no external signal source is required. The PRBS are provided with error protection in accordance with the selected transmission standard so that the bit error ratio (BER) can be measured on the receiving end. All analog TV signals delivered by the R&S[®]CLG contain a color bar test pattern and test tones. The CSO/CTB parameter is often used in cable TV measurements to characterize DUT nonlinearity. The R&S[®]CLG can generate an unmodulated carrier for each of its channels for measuring this parameter.

Easy configuration of complex test scenarios

Configuring the R&S[®]CLG via the web GUI.

SCHWAR	z		Cable Lo	bad	1	Gen	erat	tor				
ode B B Mode	Blo	k Setting ick # of Channels	Channels Allocated	AW	G B	AWG File	Symbol Rate (MS/s)	Constellation	n Roll-Off	Interleave Mode	Useful Data Rate (Mbps)	
В	1.1	16	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 1-	ON		A256Q 💌					Constant of	
	1 2	16	17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 2	ON	-	A256Q -						
Control	1	16	33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 4	ON	•	A256Q 💌						
	4	16	49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 5	ON	-	A256Q -						
tions 🗖	1.5	16	65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 7	ON	•	A256Q 💌						
	e	16	81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 9	ON	-	A256Q -						
- C	1 7	16	97, 98, 99, 100, 101, 102, 103, 104, 10	ON	-	A256Q -						
	8	7	113, 114, 115, 116, 117, 118, 119	ON	•	A256Q 💌						
	5	, O		OFF	•	A256Q -						
105 C	1	0 0		OFF	-	A256Q *						

Separate level and frequency settings for each channel

When simulating a cable TV network with full channel loading, it is very important to set different levels for the individual channels across a broad range. The R&S®CLG allows levels to be set between 0 and a maximum value¹⁾ in steps of 0.1 dB. This makes it possible, for example, to compensate for the frequency response of external components such as cables or couplers to ensure that an exact, defined level is always present at the DUT input. This is important for CSO/CTB measurements, for example. The R&S[®]CLG's ability to set levels individually also makes it possible to simulate the frequency response of a real cable TV network. It is not even necessary to set the amplitude of each channel individually. The R&S®CLG allows the user to define a tilt across the entire spectrum. The generator then sets the individual channels to the corresponding levels.

Easy operation on a PC via a web GUI

To configure the numerous user-definable signals the R&S°CLG can deliver, a large number of parameters have to be set. The R&S°CLG's intuitive graphical user interface (GUI) makes configuration of the output spectrum easy. Implemented as a web GUI, it can be displayed using any conventional browser. Once defined, instrument set-ups can be stored in the R&S°CLG's internal memory and called up at any time.

Remote control using SCPI or SNMP

Conformance testing of a receiver in line with a given test specification is a complex, repetitive task. Automated measurements save time and prevent errors. The R&S°CLG is controlled via its LAN interface and is therefore easily integrated into automatic test systems. All R&S°CLG functions can be remote controlled using SCPI commands or SNMP.

 $^{\scriptscriptstyle 1\!\!\!)}$ The maximum value depends on the number of active channels.



Block diagram of the R&S[®]CLG

ANSI/SCTE 40 compliance testing of receivers

The cable TV signals that arrive at viewers' living room outlets are far from ideal: Noise, reflections and adjacentchannel interferers degrade signal quality. Set-top boxes and other cable TV receivers must be able to handle such signals and supply viewers with high-quality images and sound. To ensure this, the American Society of Cable Television Engineers (SCTE) established the ANSI/SCTE 40 Digital Cable Network Interface Standard. The standard specifies that receivers must continue to function properly when the following types of interference are present simultaneously:

- I Broadband white noise
- I Phase noise in the useful signal
- I Micro-reflections
- I Superimposed amplitude modulation caused by AC hum
- Analog or digital adjacent-channel interferers
- I Discrete CW interference signal in the useful channel
- I Full channel loading of cable TV network

The above scenario, including all types of interference, can be implemented using an R&S°SFU broadcast test system and an R&S°CLG cable load generator. The R&S°SFU delivers the useful signal as well as white noise, phase noise and micro-reflections. The R&S°CLG simulates the cable network with full channel loading. It also generates the adjacent channels and the discrete CW interference signal and superimposes AC hum. The R&S°CLG is the only instrument on the market to superimpose AC hum on all channels as stipulated by ANSI/SCTE 40. Previous solutions have only been able to simulate AC hum in the useful channel. The R&S°SFU and the R&S°CLG can be remote controlled, making it possible to automate the entire test routine.



Specifications in brief

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RF parameters		
Frequency	setting range	47 MHz to 1002 MHz
	step size	1 Hz
Output power	sum power of all active channels	25 dBmV to 60 dBmV
	accuracy (at maximum output level and with attenuator set to 0 dB)	$\leq \pm 1 \text{ dB}$
	step size per channel	0.1 dB
	frequency response in 6 MHz channel	≤ 0.25 dB
CSO/CTB (in line with ANSI/SCTE 06 2009)	with CW signals in 157 channels	> 60 dB
Signal-to-noise ratio	$f \le 600 \text{ MHz}$	> 53 dBc
	f > 600 MHz	> 51 dBc
Modulation		
QAM	standards	J.83/A (DVB-C), J.83/B, J.83/C (ISDB-C)
	constellations	64QAM, 256QAM
	MER	40 dB (typ.)
	content	transport stream or PRBS
Analog TV	standards	PAL, SECAM, NTSC
	bandwidths	6 MHz, 7 MHz, 8 MHz
	content	color bar test pattern and 1 kHz tone
OFDM	standards	ISDB-T
	bandwidths	6 MHz
	content	PRBS
Arbitrary waveform generator	sample rate	max. 4 waveform files with 20 Msample/s each
Other		CW, FM radio
Simulation of signal impairments		
Tilt	linear across entire frequency range	0 dB to ±18 dB
AC hum	AM modulation depth	0% to 6%
	hum frequency	47 Hz to 200 Hz, step size 0.1 Hz
AWGN	C/N	-60 dB to 0 dB in up to 16 channels
	noise bandwidth	automatically coupled with symbolrate or user defined to 10 MHz
Interfaces		
RF output		F connector, 75 Ω
Transport stream input	10GigE	10GBase-CX4
Control interface	Ethernet	10/100BaseT
10 MHz reference input		BNC, 50 Ω
General data		
Operating temperature range		0°C to +40°C
Dimensions	$W \times H \times D$	482.6 mm × 44.5 mm × 279.4 mm (19.0 in × 1.75 in × 11.0 in)
Weight		3.2 kg (7.05 lb)

Ordering information

Designation	Туре	Order No.
Cable Load Generator (including power cable and manual)	R&S°CLG	2116.9170.02
Options		
Basic Waveform Library	R&S [®] CLG-K2	2116.9264.02
Extended Waveform Library (user-defined)	R&S [®] CLG-K3	on request

Service that adds value

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About Rohde & Schwarz

The Rohde & Schwarz electronics group is a leading supplier of solutions in the fields of test and measurement, broadcasting, secure communications, and radiomonitoring and radiolocation. Founded more than 80 years ago, this independent global company has an extensive sales network and is present in more than 70 countries. The company is headquartered in Munich, Germany.

Sustainable product design

- I Environmental compatibility and eco-footprint
- I Energy efficiency and low emissions
- Longevity and optimized total cost of ownership

Certified Quality Management

Certified Environmental Management

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