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Calian DSA DOCSIS® Signal Analyzer

Best signal quality for maximum data throughput

Only the highest signal quality ensures maximum throughput. The Calian DSA DOCSIS® signal analyzer has been designed to support users by ensuring the highest signal quality. DOCSIS is the standard for transmitting IP data within hybrid fiber coaxial (HFC) cable TV networks. The new DOCSIS 3.1 standard supports unprecedented data rates, meeting the demand for increased data throughput.

At a glance

The Calian DSA allows precise, gapless signal analysis of DOCSIS 3.0, EuroDOCSIS 3.0 and DOCSIS 3.1 signals on the physical layer in real time. A user can detect effects that degrade signal quality, e.g. ingress, reflections and laser clipping. With its dual receivers, the Calian DSA analyzes downstream and upstream signals. The frequency spectrum and key signal characteristics are displayed in compact overviews and diagrams, providing conclusive information about the signal quality.

In addition to DOCSIS signals, the Calian DSA can analyze digital TV signals such as J.83/A/B/C and DVB-C. Although IP data transfer is consuming more and more transmission capacity, digital TV transmission continues to play an important role in cable TV networks. The Calian DSA can analyze digital TV, helping users ensure interference-free coexistence of DOCSIS and digital TV channels.

Convenient operation via the 10.1" touchscreen, intuitive pictograms and logically structured menus allow even less experienced users to operate the instrument after a quick introduction.

Front view

calian.com/advanced-technologies/**cableaccess**
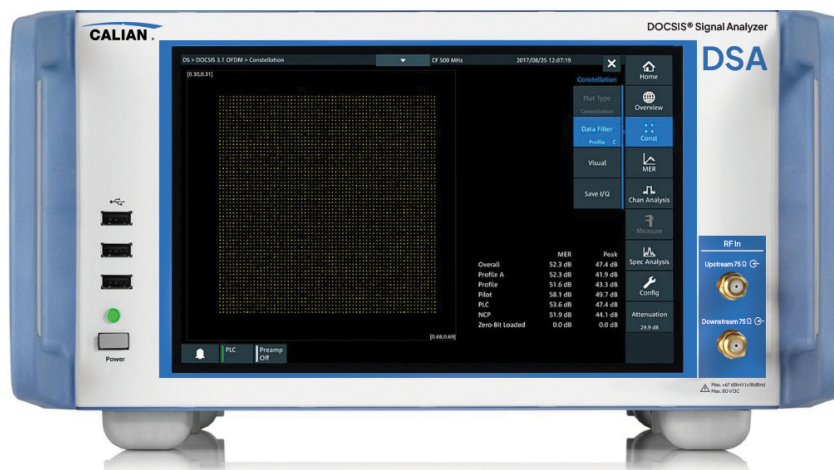
Key facts

- Demodulation and analysis of DOCSIS 3.0/3.1 and EuroDOCSIS 3.0 downstream and upstream signals in real time
- Demodulation and analysis of digital TV signals (J.83/A/B/C, DVB-C) in real time
- Residual modulation error ratio (MER) ≥ 50 dB with DOCSIS 3.1
- Residual MER ≥ 56 dB with SC-QAM
- Dual receivers for
- Downstream (47 MHz to 1794 MHz)
- Upstream (5 MHz to 204 MHz)
- Integrated spectrum analyzer
- 10.1" (25.6 cm) touchscreen
- Remote desktop function
- SCPI/SNMP remote control

Benefits and key features

Powerful, gapless DOCSIS downstream signal analysis

- FPGA based demodulation
- Real-time signal analysis
- Maximum performance
- Integrated spectrum analysis

Detailed analysis of upstream signals

- Additional RF receiver for upstream signals (model DSA-USDS)
- FPGA based real-time demodulation
- Detailed upstream analysis (DSA-K1500)
- DOCSIS timing analysis (DSA-K1505)
- Dynamic upstream signal analysis during live operation
- Upstream signal analysis with Calian SFD
- Cable modem ranging test

Digital TV signal analysis for interference-free parallel operation with DOCSIS

- FPGA based demodulation
- Real-time signal analysis

Automatic channel measurements with Calian TVSCAN 2.0

- Individual channel tables
- Verification in line with user-specific limits
- 2D and 3D visualization of measurement results

Rear view

Powerful, gapless DOCSIS downstream signal analysis

DOCSIS 3.1 signals can be up to 192 MHz wide and consist of several thousand modulated single carriers. In extreme cases, the single carriers can be modulated with 4096QAM and higher. To take full advantage of DOCSIS 3.1, it is essential to know the quality of an HFC cable network, the components and the signals being transmitted, both at the cable headend and in the field.

This is also true when developing and producing network components such as cable modem termination systems (CMTS), line amplifiers, cable modems, electro-optical converters and modules for remote PHY.

FPGA based demodulation

Demodulation of downstream signals in line with DOCSIS 3.0 (J.83/A/B/C), EuroDOCSIS 3.0 and DOCSIS 3.1 is handled by a powerful field programmable gate array (FPGA).

Changes to standards are incorporated by simply upgrading the firmware, making the Calian DSA a secure investment for the future.

An FPGA based demodulator also eliminates the limitations of measurement performance and precision typically encountered in a modem chipset based field test instrument.

The Calian DSA meets the claim to be the reference for measurements on the physical DOCSIS layer.

Real-time signal analysis

Real time stands for fast and gapless signal processing with short refresh cycles when measuring signal characteristics and displaying traces, which significantly simplifies making adjustments and finding sporadic errors.

Assessing the quality of an HFC network with the Calian DSA and a field strength meter
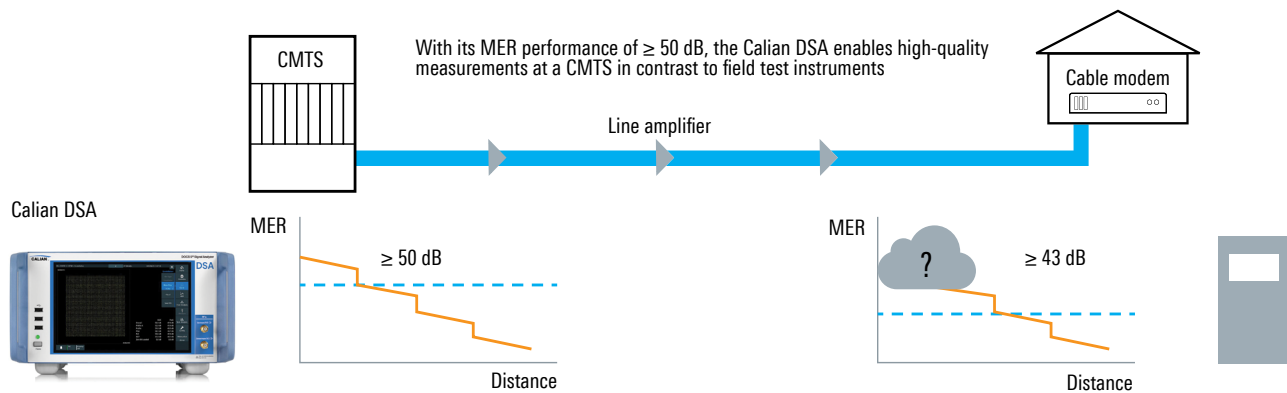
Overview of Calian DSA interfaces and function blocks
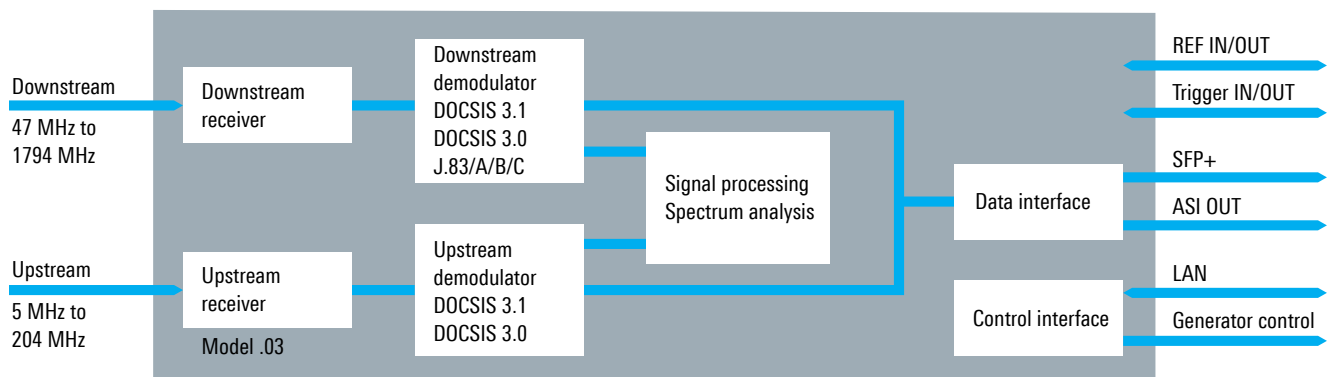
Maximum performance

To provide the highest possible data rates in the downstream, the DOCSIS 3.1 standard defines a MER value of ≥ 50 dB at the signal output of a CMTS. With its extremely high-quality RF receiver, the Calian DSA can precisely measure signals at this level of quality, allowing users to assess the limits and margins at every point in the cable TV network.

Integrated spectrum analysis

An integrated spectrum analyzer supplements the versatile signal analysis functionality. Five markers, five traces and five user-defined masks are provided for detailed spectrum analysis. Other features include measurement of the phase noise and ACP, alternatively in the 6 MHz, 7 MHz or 8 MHz grid. The convenient zoom function on the touchscreen makes it easy to navigate within the spectrum.

Detailed analysis of upstream signals

Up to now, the quality of internet connections has primarily been judged by the maximum download speed, but the upload speed is receiving more and more attention as an additional criterion, driven by cloud services and video uploading to social media platforms.

For higher data throughput in the upstream channel, the DOCSIS 3.1 standard offers an extended frequency range, greater channel bandwidths and modulation formats up to 4096QAM. However, performance may be impaired by cumulative interference originating from the connected cable modems and associated cabling.

Detailed knowledge of the physical conditions on the upstream channel is required in order to optimize data throughput and minimize interference during operation.

## Additional RF receiver for upstream signals (model DSA-USDS)

For analysis of upstream signals, the Calian DSA model DSA-USDS has an additional RF receiver covering the frequency range from 5 MHz to 204 MHz. This receiver enables measurements in cable networks, during production
or in the lab, where e.g. simultaneous analysis and monitoring of upstream and downstream signals is required.

FPGA based real-time demodulation

Just as for downstream signals, an FPGA in the Calian DSA handles demodulation and analysis of upstream signals. Particularly for reliable acquisition and precise analysis of upstream burst signals and the interference that

Upstream signal analysis in HFC CATV networks
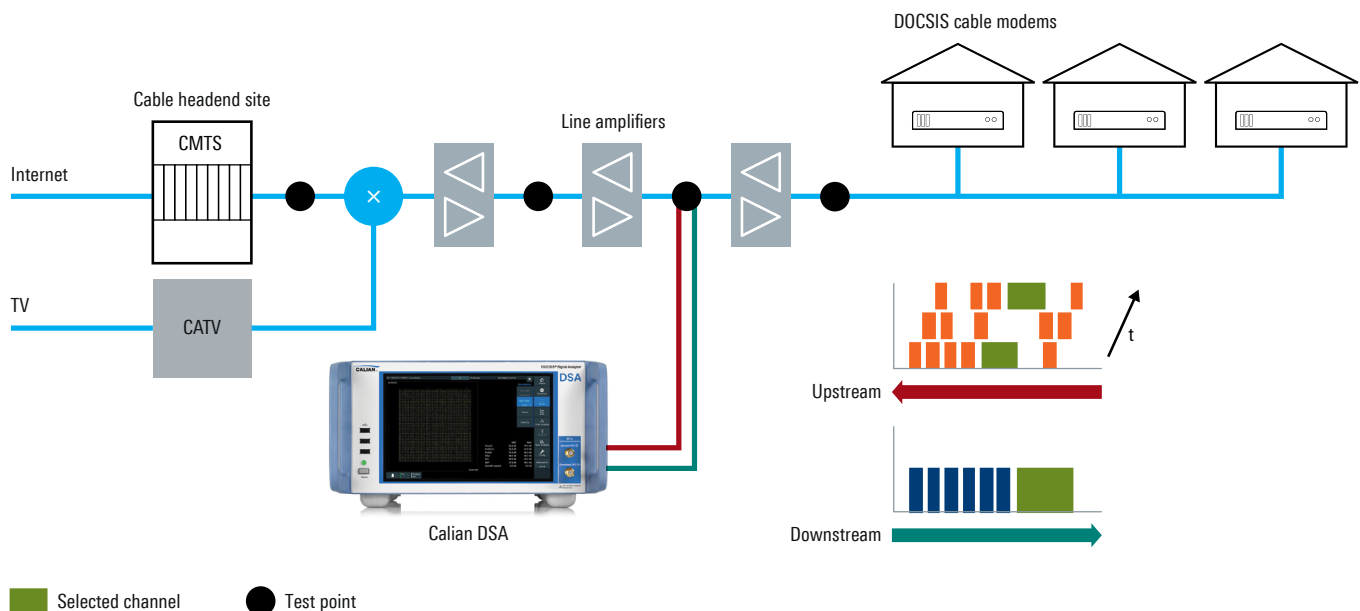
affects them in the upstream channel, high-performance signal processing is essential.

Detailed upstream analysis (DSA–K1500)

The DSA-K1500 upstream analysis option enables detailed analysis of A-TDMA (DOCSIS 3.0/EuroDOCSIS) and OFDMA (DOCSIS 3.1) signals. The overview screen, which displays the key signal states and measured values for the specific standard, is the core element of signal analysis. Additional views, including constellation, amplitude, group delay and phase, are available for further analysis of the transmission channel. Especially for long-term measurements, the MER, bit error ratio (BER) and signal power versus time measurements will be of interest for clearly detecting sporadic events or changes by trend. This enables users to precisely characterize the physical quality of an upstream channel and its components.

For defined transmission of upstream signals, a CMTS communicates the necessary signal parameters in an upstream channel descriptor (UCD). If a CMTS with this information is not available, the signal parameters for analysis of an upstream signal can be manually entered in the Calian DSA. Particularly in combination with the Calian SFD DOCSIS® signal generator and Calian CLGD DOCSIS® cable load generator, this enables users

to perform upstream channel analyses even if they do not have a CMTS or a cable modem.

DOCSIS timing analysis (DSA–K1505)

Another factor crucial to the reliable operation of a DOCSIS network is its overall timing. The DSA-K1505 option extends the comprehensive set of measurements by:

- Upstream burst offset jitter measurement
- Upstream I/Q data synchronous streaming
- Downstream DOCSIS timestamp jitter measurement
- Downstream timestamp measurement with respect to 1 pulse per second (1PPS) input

Dynamic upstream signal analysis during live operation

The unique dynamic upstream analysis function requires model DSA-USDS with its two separate RF receivers for the upstream and downstream.

Measurements in the lab or in the field can be performed anywhere on the path between the cable modems and a CMTS or a remote PHY component. All that is needed are suitable test outputs to allow simultaneous access to the upstream and downstream signals. Synchronizing to pulsed upstream signals is a technical challenge for a conventional signal analyzer, especially when there are

Testing of network components and network segments in the upstream with the Calian DSA and Calian SFD

Calian DSA

Calian SFD

Upstream

Pilot

Network component or network segment
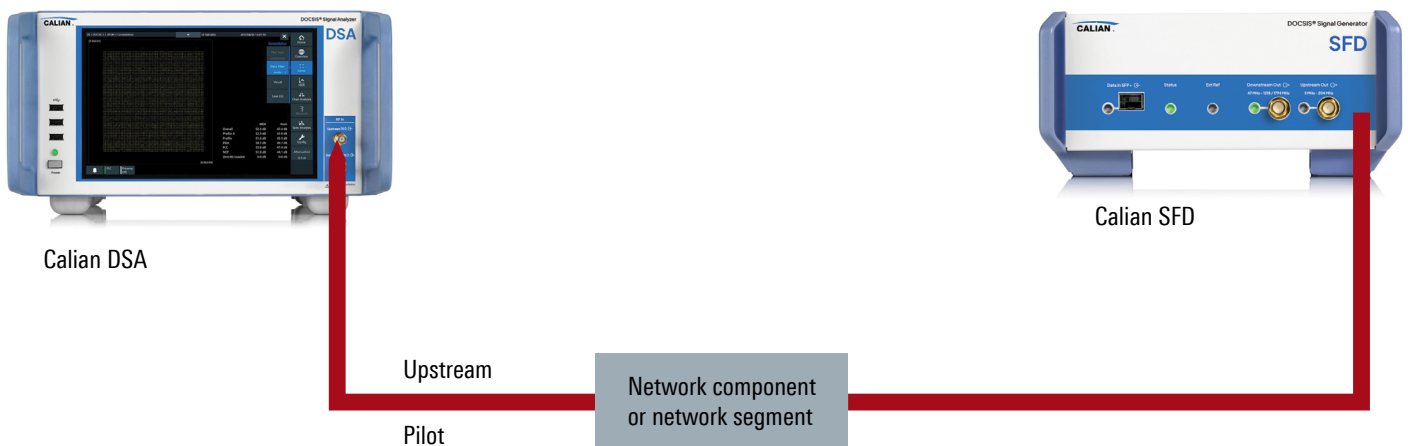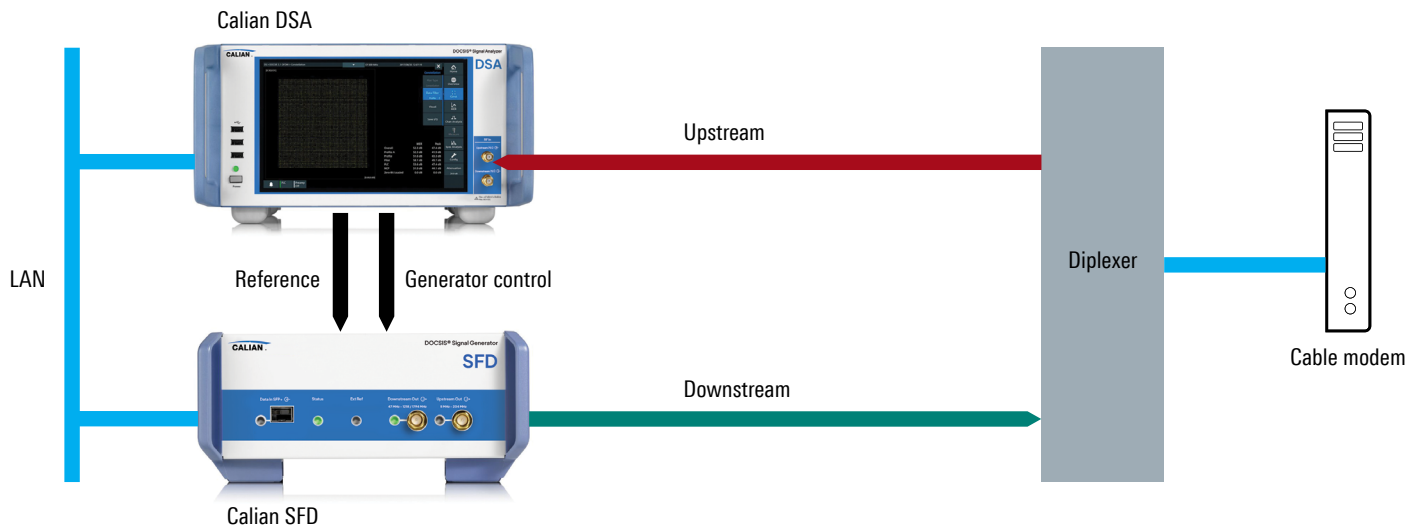
a large number of signals in the upstream channel. This is no problem for the Calian DSA.

Using its powerful signal processing and a complex algorithm, the Calian DSA optimizes its internal timing based on the distances to the CMTS and the cable modems. Next, the upstream receiver performs a self-configuration based on the upstream channel descriptors (UCD) received via the downstream.

Afterwards, the Calian DSA starts continuously scanning the selected downstream channel for relevant upstream bandwidth allocation map (MAP) messages for the designated upstream channel in order to detect the appropriate pulsed upstream signals and creates a list of associated service identifiers (SID). To perform measurements on a specific cable modem, this list can be filtered by media access control address (MAC) or SID.

Upstream signal analysis with the Calian SFD

The Calian DSA DOCSIS® signal analyzer's SFD upstream analysis function – with signals delivered by the Calian SFD DOCSIS® signal generator – offers a convenient way to test and measure network components and network segments using upstream signals.

The Calian SFD serves as a signal source for standard-

compliant upstream signals in line with DOCSIS 3.0 and DOCSIS 3.1.

Using a modulated auxiliary carrier, the signal parameters set on the Calian SFD are transferred to the Calian DSA and automatically set. This eliminates the time-consuming and error-prone process of matching the instrument settings to each other.

Cable modem ranging test

High-performance operation depends not only on the quality of the network components in the upstream channel, but also on the quality of the upstream signal transmitted by the cable modem. To measure upstream signals transmitted by a cable modem, the Calian DSA DOCSIS® signal analyzer can be combined with the Calian SFD DOCSIS® signal generator to form a compact test system.

Here the Calian SFD takes over some of the tasks of a CMTS in order to trigger ranging by the modem. The Calian DSA analyzes and displays the quality of the upstream signals transmitted by the modem. This allows fast and easy testing and comparison of cable modems from different manufacturers or production batches.

Digital TV signal analysis for interference-free parallel operation with DOCSIS

Digital TV will be transmitted over TV cable networks for many years before it is completely replaced by IP TV over DOCSIS. Until then, HFC cable network operators must ensure that DOCSIS and TV channels operate in parallel without negatively affecting one another. Equipped with the DSA-K1501 option, the Calian DSA is able to analyze both digital TV and DOCSIS signals.

FPGA based demodulation

The Calian DSA uses FPGAs to demodulate digital TV signals in line with the J.83/A/B/C and DVB-C standards. For further processing, the demodulated MPEG-2 transport streams are available at the ASI output located on the rear of the Calian DSA.

Real-time signal analysis

Real-time signal analysis not only offers a speed advantage, it also facilitates measurements such as BER, MER and signal power versus time, as well as constellation measurements for displaying sporadic errors.

The Calian DSA can analyze digital TV signals in the frequency range from 47 MHz to 1794 MHz. The DSA-K1502 option enables the analysis of these digital TV signals via the upstream RF input of the Calian DSA (model DSA-USDS) to perform amplifiers measurements in line with the IEC 60728-3 standard.
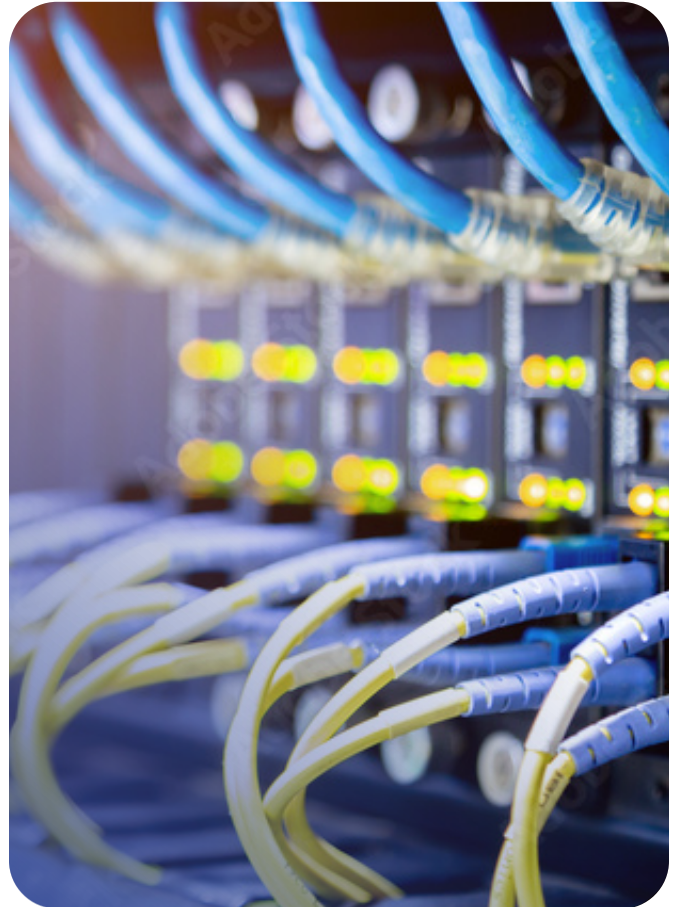
Specifications in brief

Specifications in brief		
RF parameters		
Frequency range	Downstream with J.83 QAM	47 MHz to 1794 MHz
	Upstream (model DSA-USDS only)	5 MHz to 204 MHz
Level	Downstream per 24 MHz	Up to 67 dBmV (+18 dBm)
	Upstream (model DSA-USDS only)	Up to 67 dBmV (+18 dBm)
MER (downstream)	47 MHz to 600 MHz	≥ 50 dB
	600 MHz to 1000 MHz	≥ 48 dB
	1000 MHz to 1794 MHz	≥ 47 dB
	With SC-QAM, 100 MHz to 1200 MHz	≥ 56 dB
Spectrum analyzer		
Level accuracy		±0.5 dB at +25 °C
Resolution bandwidth		10 Hz to 3 MHz, zero span
Downstream demodulation		
DOCSIS 3.0 (SC-QAM), J.83/A/B/C	In line with CM-SP-PHYv3.0, CM-SP-DRFI and ITU-T J.83	
Symbol rate		0.4 Msymbol/s to 7.2 Msymbol/s
Constellation		4QAM to 256QAM (J.83A/C up to 1024QAM)
DOCSIS 3.1 (OFDM)	In line with CM-SP-PHYv3.1	
Bandwidth		Up to 192 MHz
FFT modes		4k, 8k
Constellation		16QAM to 16384QAM
Upstream demodulation		
DOCSIS 3.0 (A-TDMA)	In line with CM-SP-PHYv3.0	
Symbol rate		1.28 Msymbol/s to 5.12 Msymbol/s
Constellation		QPSK to 256QAM, DQPSK, DQAM16
DOCSIS 3.1 (OFDMA)	In line with CM-SP-PHYv3.1	
Bandwidth		Up to 96 MHz
FFT modes		2k, 4k
Constellation		QPSK to 2048QAM
General data		
Screen		10.1" touchscreen
Resolution		1280 × 800 pixel
Dimensions	W × H × D	358 mm × 196 mm × 411 mm (14.1 in × 7.7 in × 16.2 in)
Weight		≤ 7.5 kg (16.5 lb)
Narrowband interference		AWGN up to 20 MHz bandwidth

For more information and to place your order email at.cablesolutions@calian.com

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We are a growing company headquartered in Ottawa with offices and projects spanning North American, European and international markets with a focus on innovative healthcare, communications, learning and cybersecurity solutions.

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