R&S®DSA
DOCSIS Signal Analyzer
Best signal quality for maximum data throughput
Only the highest signal quality ensures maximum throughput. The R&S®DSA DOCSIS signal analyzer has been designed for supporting 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.

The R&S®DSA allows precise, gapless signal analysis of DOCSIS 3.0, EuroDOCSIS 3.0 and DOCSIS 3.1 signals on the physical layer in realtime. A user can detect effects that degrade signal quality, e.g. ingress, reflections and laser clipping. With its dual receivers, the R&S®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 R&S®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 R&S®DSA can analyze digital TV, helping users to 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.

**Key facts**
- Demodulation and analysis of DOCSIS 3.0/3.1 and EuroDOCSIS 3.0 downstream and upstream signals in realtime
- Demodulation and analysis of digital TV signals (J.83/A/B/C, DVB-C) in realtime
- Residual 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
R&S® DSA
DOCSIS Signal Analyzer
Benefits and key features

Powerful, gapless DOCSIS downstream signal analysis
- FPGA-based demodulation
- Realtime signal analysis
- Maximum performance
- Integrated spectrum analysis
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Detailed analysis of upstream signals
- Additional RF receiver for upstream signals (model 03)
- FPGA-based realtime demodulation
- Detailed upstream analysis R&S® DSA-K1500
- Cable modem ranging test
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Digital TV signal analysis for interference-free parallel operation with DOCSIS
- FPGA-based demodulation
- Realtime signal analysis
  ➤ page 9

Rear view of R&S® DSA
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 R&S®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 R&S®DSA meets the claim to be the reference for measurements on the physical DOCSIS layer.

**Realtime signal analysis**

Realtime stands for fast and gapless signal processing with short refresh cycles when measuring signal characteristics and displaying traces, so that it is significantly easier to make adjustments and find sporadic errors.

**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 R&S®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. 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 overall interference originating from the connected cable modems and associated cabling.

Optimization of data throughput, as well as operation with the least possible interference, are only possible with detailed knowledge of the physical conditions on the upstream channel.

Additional RF receiver for upstream signals (model 03)

For analysis of upstream signals, the R&S®DSA model 03 has an additional RF receiver covering the frequency range from 5 MHz to 204 MHz. This additional 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 realtime demodulation
Just as for downstream signals, an FPGA in the R&S®DSA handles demodulation and analysis of upstream signals. Particularly for reliable acquisition and precise analysis of burst upstream signals and the interference that affects them in the upstream channel, high-performance signal processing is essential.

Detailed upstream analysis R&S®DSA-K1500
The R&S®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, MER vs. Time, Amplitude, Group Delay and Phase, are available for further analysis of the transmission channel. This enables users to precisely characterize the physical quality of an upstream channel and its components.

For defined transmission of upstream signals, the necessary signal parameters are communicated in an upstream channel descriptor (UCD) from a CMTS. If a CMTS with this information is not available, the signal parameters for analysis of an upstream signal can also be manually entered in the R&S®DSA. Particularly in combination with the R&S®SFD and R&S®CLGD DOCSIS signal generator, this enables users to perform upstream channel analyses even if they do not have a CMTS or a cable modem.

Upstream DOCSIS 3.1 IQ density with 256QAM.

Upstream DOCSIS 3.0 signal configuration.
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. In order to measure upstream signals transmitted by a cable modem, the R&S®DSA DOCSIS signal analyzer can be combined with the R&S®SFD DOCSIS signal generator to form a compact test system. Here the R&S®SFD takes over some of the tasks of a CMTS in order to trigger ranging by the modem. The quality of the upstream signals transmitted by the modem is analyzed and displayed by the R&S®DSA. This allows fast and easy testing and comparison of cable modems from different manufacturers or production batches.
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 R&S®DSA-K1501 option the R&S®DSA is able to analyze both digital TV and DOCSIS signals.

**FPGA-based demodulation**
The R&S®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 at the rear of the R&S®DSA.

**Realtime signal analysis**
Realtime signal analysis not only offers a speed advantage, it also facilitates measurements such as bit error ratio (BER), MER versus time and constellation diagram for displaying sporadic errors.
# Specifications in brief

## RF parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Downstream with J.83 QAM</th>
<th>Upstream (model 03 only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range</td>
<td>47 MHz to 1794 MHz</td>
<td>5 MHz to 204 MHz</td>
</tr>
<tr>
<td>Level</td>
<td>downstream per 24 MHz up to 67 dBmV (+18 dBm)</td>
<td>upstream (model 03 only) up to 67 dBmV (+18 dBm)</td>
</tr>
<tr>
<td>MER (downstream)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47 MHz to 600 MHz</td>
<td>≥ 50 dB</td>
<td></td>
</tr>
<tr>
<td>600 MHz to 1000 MHz</td>
<td>≥ 48 dB</td>
<td></td>
</tr>
<tr>
<td>1000 MHz to 1794 MHz</td>
<td>≥ 47 dB</td>
<td></td>
</tr>
<tr>
<td>with SC-QAM, 100 MHz to 1200 MHz</td>
<td>≥ 56 dB</td>
<td></td>
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</table>

## Spectrum analyzer

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
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<tr>
<td>Level accuracy</td>
<td>±0.5 dB at 25°C</td>
</tr>
<tr>
<td>Resolution bandwidth</td>
<td>10 Hz to 3 MHz, 0 Hz</td>
</tr>
</tbody>
</table>

## 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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
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<tbody>
<tr>
<td>Screen</td>
<td>10.1&quot; touchscreen</td>
</tr>
<tr>
<td>Resolution</td>
<td>1280 × 800 pixel</td>
</tr>
<tr>
<td>Dimensions</td>
<td>W × H × D</td>
</tr>
<tr>
<td>Weight</td>
<td>≤ 7.5 kg (16.5 lb)</td>
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## Ordering information

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<tr>
<th>Designation</th>
<th>Type</th>
<th>Order No.</th>
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<tbody>
<tr>
<td><strong>Base unit</strong></td>
<td></td>
<td></td>
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<tr>
<td>Signal Analyzer for DOCSIS and digital cable TV, DOCSIS 3.1 downstream demodulator included</td>
<td>R&amp;S®DSA</td>
<td>2118.7800.02</td>
</tr>
<tr>
<td>Signal Analyzer for DOCSIS and digital cable TV, DOCSIS 3.1 downstream demodulator included, with upstream receiver</td>
<td>R&amp;S®DSA</td>
<td>2118.7800.03</td>
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<tr>
<td><strong>Accessories supplied:</strong> Power cable, quick start guide</td>
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<td></td>
</tr>
<tr>
<td><strong>Software options (firmware)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upstream Demodulation/Analysis</td>
<td>R&amp;S®DSA-K1500</td>
<td>2118.7723.02</td>
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<td>J.83, D3.0 DS Demodulation/Analysis</td>
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<td>2118.7730.02</td>
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<td><strong>Extras</strong></td>
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<td>19&quot; Adapter 4E 3/4 T350</td>
<td>R&amp;S®ZZA-KN11</td>
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### Warranty

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<tr>
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<tbody>
<tr>
<td>Base unit</td>
<td>3 years</td>
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<tr>
<td>All other items</td>
<td>1 year</td>
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</table>

**Options**

<table>
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<tr>
<th>Type</th>
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<tbody>
<tr>
<td>Extended Warranty, one year</td>
<td>R&amp;S®WE1</td>
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<tr>
<td>Extended Warranty, two years</td>
<td>R&amp;S®WE2</td>
</tr>
<tr>
<td>Extended Warranty with Calibration Coverage, one year</td>
<td>R&amp;S®CW1</td>
</tr>
<tr>
<td>Extended Warranty with Calibration Coverage, two years</td>
<td>R&amp;S®CW2</td>
</tr>
</tbody>
</table>

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Rohde & Schwarz
The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

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