DVB-C2 receiver tests in a simulated cable TV network with full channel load

The R&S®SFU broadcast test system generates DVB-C2 signals for receiver tests with a variety of simulated interference types. The selection tests stipulated by the DVB Project require a cable TV network with full channel load. Combining the R&S®SFU and the R&S®CLG makes it quick and easy to create a flexible cable TV network with full channel load and to simulate all types of realistic interference, permitting testing in accordance with DVB.

Your task
A TV receiver in a typical cable TV network must be capable of handling various types of interference, such as phase noise, amplifier noise, microreflections, AC hum, narrowband interference and impulsive noise. These types of interference originate primarily in the cable TV network or in the headend’s cable modem termination system (CMTS). At the same time, adjacent channels make channel selection difficult and the sheer number of channels causes intermodulation in the receiver. The DVB Project (www.dvb.org) is therefore requiring DVB-C2 receiver tests in a cable TV network operating at full channel load, such as for the Kabel Deutschland GmbH (KDG) network in Berlin. One option for implementing these tests is to participate in a KDG Plug Fest. However, this requires extensive planning and is time consuming and expensive.

Test setup for DVB-C2 receiver tests with the R&S®SFU and R&S®CLG

![Diagram of test setup for DVB-C2 receiver tests with the R&S®SFU and R&S®CLG](image)
Performing DVB-C2 receiver tests on a cable TV network with full channel load directly in the development lab would both lower costs and increase flexibility. Users must be able to configure the various influences as needed in order to isolate problems and simulate extreme scenarios.

**T & M solution**

The R&S®SFU broadcast test system works together with the R&S®CLG cable load generator to simulate a cable TV network with full channel load, including a DVB-C2 signal and all realistic types of interference. The R&S®SFU uses its DVB-C2 realtime coder to generate DVB-C2 compliant signals with an 8 MHz or 16 MHz RF bandwidth and to simulate reproducible amplifier noise, phase noise, impulsive noise, microreflections and AC hum.

**Amplifier noise:** In a typical cable TV network, amplifiers are cascaded along the transmission path. In addition to their inherent noise, amplifiers also amplify the noisy input signal (consisting of thermal noise, intermodulation products, etc.). These influences on the wanted signal are essentially white noise that can be simulated by using an additive white Gaussian noise (AWGN) generator. On the R&S®SFU, this is done by configuring the carrier to noise (C/N) ratio.

**Phase noise:** When the headend generates the signal, the oscillators are generating phase noise. This influence on the wanted signal can be configured using the R&S®SFU.

**Impulsive noise:** The noise resulting from switching on electrical devices is simulated with single or repeated pulses of random strength, duration and frequency. The R&S®SFU can also simulate these types of interference.

**Microreflections:** Impedance mismatches, especially over the final miles of the transmission path and in the residential wiring, can lead to reflections. The R&S®SFU fading generator simulates this effect.

**AC hum:** The amplifiers’ power supplies generate AC hum along the transmission path. The integrated fading generator simulates the AC hum for the measurement channels generated by the R&S®SFU. The AC hum frequency and AC hum depth for the R&S®CLG generated channel load can be configured on the R&S®CLG.

**Narrowband interference:** To simulate narrowband interference caused by mobile phones, the R&S®CLG generates a narrow carrier wave (CW) signal in the channel coming into the TV receiver. The R&S®SFU can simulate AC hum and narrowband interference in the channel, though the R&S®CLG requires less configuration effort to generate these types of interference.

The R&S®CLG simulates channel load for up to 160 channels. The user can select any frequency and level (in 0.1 dB steps). Channels can be assigned anywhere within the frequency range from 47 MHz to 1002 MHz. The R&S®CLG generates a signal mix, for example consisting of DVB-C, ATV, FM and narrowband signals. A web-based GUI is used to configure the R&S®CLG – either manually or, more conveniently, using the free configuration file provided by Rohde & Schwarz for the KDG’s channel load.

The configuration file can be downloaded at www.rohde-schwarz.com, search term: “7BM88”.

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**Typical cable TV network impairments**

<table>
<thead>
<tr>
<th>Headend</th>
<th>Broadcasting</th>
<th>End user</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMTS</td>
<td>Modulator</td>
<td>Set-top box</td>
</tr>
<tr>
<td>Phase noise</td>
<td>Interference from adjacent channels</td>
<td>AC</td>
</tr>
<tr>
<td>Cable TV network with full channel load</td>
<td>AWGN</td>
<td>Impulsive noise</td>
</tr>
<tr>
<td>Microreflections</td>
<td>AC hum</td>
<td>Narrowband interference</td>
</tr>
</tbody>
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Configuration
A DVB-C2 receiver is easily tested with a simulated cable signal by performing these steps on the R&S®CLG:
- Run the configuration file
- Enable network AC hum (e.g. 3% at 50 Hz)
- Switch the channel in question (e.g. D562) from modulated to CW and lower the noise level

And performing the following steps on the R&S®SFU:
- Configure the DVB-C2 signal for the channel in question (including frequency, level, QAM)
- Configure the various noise effects independently of one another (amplifier noise, phase noise, impulsive noise)
- Configure and enable fading to simulate microreflections and AC hum (for more information, go to www.rohde-schwarz.com, Application Note 7BM68)

The signals from the two instruments are combined and applied to the receiver that is set to the DVB-C2 channel. This simulation of a flexible and realistic cable TV network, with all types of interference, can be used at any time in the development lab. The dimensions of the test setup are just 483 mm × 222 mm × 483 mm (19 in × 8.75 in × 19 in), requiring no more space than two standard desktop PCs.

Application
The DVB-C2 receiver is subjected to full channel load in order to check its functionality (Go/NoGo test). A bit error ratio (BER) test determines whether the DVB-C2 receiver can adequately process and output a noisy signal with as few errors as possible. However, this test does not provide any indication as to whether errors are visible to the end user.

In cases where an evaluation from the end-user perspective is needed, or when the test point required for the BER measurement is not accessible in the receiver, the R&S®VTC or R&S®VTE audio/video tester is used. Both instruments can analyze the output audio/video signal at the available audio/video ports (analog, HDMI™) on the DVB-C2 receiver. A delta analysis between the audio/video signal under test and the previously recorded, interference-free reference signal shows errors that are visible and audible to the end user (visible errors, audio dropouts). The result is an objective, reproducible and automated assessment of the signal being processed by the receiver that makes it possible to detect the effect of the various types of interference.

Product overview

<table>
<thead>
<tr>
<th>Designation</th>
<th>Type</th>
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<tbody>
<tr>
<td>Cable load generator (including power cable and manual)</td>
<td>R&amp;S®CLG</td>
</tr>
<tr>
<td>Broadcast test system</td>
<td>R&amp;S®SFU</td>
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<tr>
<td>DVB-C2 coder</td>
<td>R&amp;S®SFU-B15, R&amp;S®SFU-K17</td>
</tr>
<tr>
<td>AWGN noise</td>
<td>R&amp;S®SFU-K40</td>
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<tr>
<td>Phase noise</td>
<td>R&amp;S®SFU-K41</td>
</tr>
<tr>
<td>Impulsive noise</td>
<td>R&amp;S®SFU-K42</td>
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<tr>
<td>Multinoise use</td>
<td>R&amp;S®SFU-K43</td>
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<tr>
<td>Fading simulator</td>
<td>R&amp;S®SFU-B30 or R&amp;S®SFU-B31</td>
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Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

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