



Fig. 1: The R&S®BTC broadcast test center is the ideal all-in-one solution for end-to-end testing: It generates all audio/video and broadcast signals and provides a comprehensive set of analysis functions for assessing DUTs.

High-end test platform for comprehensive testing of audio and video applications

The R&S®BTC broadcast test center is the perfect platform for almost all tests used in the consumer electronics and automotive sectors as well as professional audio/video applications based on broadcast transmission standards.

Unique end-to-end testing capabilities

The new R&S®BTC broadcast test center (Fig. 1) offers a complete test environment for almost all audio, video and multimedia applications in a single instrument. It generates all necessary signals, simulates transmission and analyzes the audio/video signals from DUTs (typically broadcast receivers) in real-time. The modular and highly scalable test platform supports all global analog and digital TV and audio broadcasting standards and can be optimally adapted to meet different customer requirements. The R&S®BTC can perform complete end-to-end tests over all OSI layers. Thanks to its integrated test application and test sequence control, the R&S®BTC permits users to integrate DUTs in a fully automated test sequence.

Who needs the R&S®BTC broadcast test center?

Thanks to its versatile options and RF characteristics, a very high bandwidth of 160 MHz and a frequency range up to 6 GHz, the R&S®BTC is suitable for a variety of different applications. Typical users are manufacturers of chipsets, tuners and receivers, test houses, QA testers, manufacturers from the automotive and professional satellite equipment sectors, network operators, T&M equipment leasing companies, regulatory authorities and the A&D industry.

Audio and video signals in all major formats

The receivers and decoders used in today's multimedia devices process many different audio and video formats. As the number of formats increases, there is a corresponding increase in possible error sources in the transmission path. Developers of receivers and decoders simulate these errors and analyze the DUT's response. To do this, they need a versatile and powerful test platform such as the R&S®BTC that fulfills all requirements with respect to versatility and flexibility when generating digital audio/video streams and simulating transport stream transmission.

Multimedia generator – the multitalent in the R&S®BTC

The R&S®BTC software-based multimedia generator offers a wide range of applications. It generates audio/video signals based on elementary audio and video streams. The optional recording function plus bitstream and elementary stream player allows users to record and replay both transport streams and bitstreams. In addition, the multimedia generator can modify existing, newly generated or externally fed transport streams via ASI or IP, and then combine these streams into a new multiplex signal. Errors can also be injected as needed.

Error injection and TS multiplexer functionality – stress tests for decoders

The R&S®BTC sequencer can be used to configure dynamic switchover scenarios and to define the timing and

sequencing of these scenarios. Errors can be injected into the MPEG-2 transport streams without interruption at the bit, byte, packet and table level, making it possible to precisely define critical test sequences for decoder stress tests and to reproduce them at any time.

The R&S®BTC remultiplexer uses existing or externally fed transport streams to generate a new multiplex signal and the corresponding new tables (Fig. 2). It supports both ASI and IP input interfaces as well as the internal bitstream and elementary stream players, ensuring optimum flexibility for creating and modifying existing MPEG-2 transport streams.

Gateway functionality – access to all parameters

The multimedia generator has an integrated gateway that offers indispensable functions for generating the required transmission parameters, such as those for DVB-T2. Thanks to the software-based T2-MI gateway, users can generate the T2-MI stream required for the relevant transmission parameters directly in the R&S®BTC and feed the stream to the DVB-T2 realtime coder. All parameters and settings over the entire transmission chain can be modified at any time. The software-based multimedia generator is also prepared for future gateways using different transmission standards.

Analog signals – still in demand

For analog transmission standards, an audio player is available for replaying WAV and WV files. The multimedia

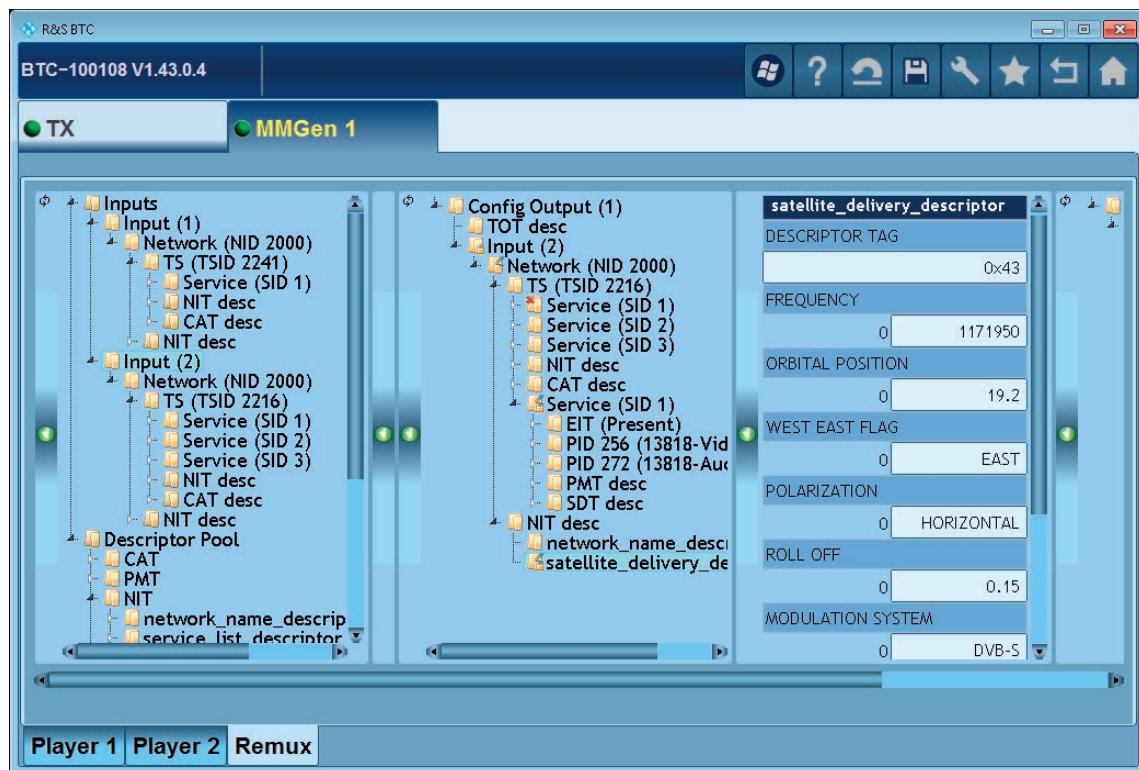


Fig. 2: Using the remultiplexer, transport streams can be modified in realtime without interruption.

Table parameters, e.g. of a network information table (NIT), are easily modified.

generator can also generate analog signals. It generates test patterns for the PAL, NTSC and SECAM standards, supporting all global analog broadcast standards.

Signal generation – with unrivaled RF quality

There has been a steady increase in both the number of integrated transmission standards and the data transmission rates for HD and 4K video resolutions used in the development of tuners, receiver chipsets and terminal equipment. However, more emphasis is also being placed on higher frequencies for broadband and yet relatively untapped frequency ranges. As a result, receivers require excellent RF quality parameters. Thanks to its exceptional RF performance, the R&S®BTC is the first choice for these tests because it generates all global digital and analog cable, satellite and terrestrial TV and audio broadcasting standards.

As a high-end broadcast signal generator, the R&S®BTC provides two independent realtime RF signal paths, each with a modulation bandwidth of 160 MHz for generating internal signals. Externally fed analog I/Q signals have a bandwidth of up to 2 GHz, depending on the set frequency. When defining the internal RF paths, the user can choose between 3 GHz and 6 GHz. Hybrid configurations using both 3 GHz and 6 GHz in

a single instrument are also available. The two either coupled or independent RF paths can also be operated and configured independently of one another. Consequently, the FPGA realtime coders can be loaded with two different or the same two transmission standards.

The R&S®BTC features very low SSB phase noise of up to -135 dBc (1 Hz) and excellent signal filtering. This becomes obvious in the generated RF signals, which exhibit excellent shoulder attenuation and modulation error ratio (MER) values. When using the low phase noise option, even better SSB phase noise values of up to -139 dBc (1 Hz) are available.

The output signal level is set using the integrated electronic step attenuator, which provides a broad interruption-free range. The output power for each RF path is a maximum of +18 dBm, providing a sufficient level range for all broadcast signals and interferer signal scenarios.

Simulation of the entire physical transmission channel

Portable and mobile terminal equipment experience continually changing receive conditions. These situations must be simulated under realistic realtime conditions during

development so that the receivers can be optimized. The R&S®BTC offers a variety of noise sources, predistortion at the transmitting and receiving ends, a powerful fading simulator suitable for MIMO scenarios and multiple ARB generators. The two RF paths can also be used to simulate single-frequency networks (SFN) and diversity scenarios.

Signals from a variety of noise sources, including broadband or bandwidth-limited Gaussian noise, impulsive noise and signals generated by a 10 MHz phase noise option, can be combined and added to the wanted signal. Users can enter defined phase noise traces directly via touchscreen, and the R&S®BTC calculates the new coefficients and phase noise trace internally.

The integrated predistortion function simulates linear and nonlinear predistortions at the transmitting and receiving ends. It can also be used to change the signal's phase and group delays. As a result, the R&S®BTC output signal can be optimally adjusted to match amplifier characteristics. Simulation of satellite transmission scenarios using IMUX and OMUX traces is also possible (Fig. 3). Even tuner input characteristics can be simulated using this function.

The FPGA-based fading hardware offers up to 40 paths per RF channel and covers all DAB SFN and DVB-T2 MISO tests. The 40 fading paths provided by two fading modules can be internally split over four transmission paths for simulating 2x2 MIMO scenarios. The R&S®BTC is already today the ideal reference signal source for evaluating DVB-T2 MIMO applications.

The two independent RF channels and their transmission simulations are also ideal for complex multidiversity scenarios. The oscillators for the two modulators can be phase-locked as needed.

Multiple ARB generator – easy generation of complex interferer signal scenarios

The main challenges faced by manufacturers of receiver chips and receivers, certifiers and test houses lie in testing the receive characteristics for broadband and multistandard terminal equipment. They encounter interferer signals as well as the new transmission standards that are intended to minimize the effects of these interferences.



Fig. 3: Transmission simulation based on the input and output multiplexer (IMUX and OMUX) in a satellite transponder.

As an alternative to signal generation using realtime coders, the flexible multiple ARB generators in the R&S®BTC can also be used to replay synthetic signals with a length of up to 1 Gsample. Each RF path is equipped with an ARB generator that can generate up to eight independent interferer signals, making it possible to generate complex and realistic interferer scenarios (Fig. 4). The large memory depth allows broadband satellite or whitespace signals to be generated and then added internally to a wanted signal generated by the realtime coder. The user can position each individual interferer signal within a 160 MHz bandwidth and set the level to a C/I ratio of up to 60 dB.

The R&S®WinIQSIM2™ software is available for simulating digital dividend or whitespace scenarios. The software generates the I/Q signals and supports numerous wireless communications standards. Together with the R&S®BTC ARB generator, suitable interferer signals are generated and added to the wanted signal.

The R&S®CLG cable load signal generator is an excellent addition to the R&S®BTC when working with full channel load scenarios in cable applications that require a high-quality RF wanted signal and many adjacent channel signals. The R&S®SLG satellite load generator complements the R&S®BTC for satellite applications (see page 38).

A/V analysis and signal generation modules – digital and analog

Testers of modern audio/video components are confronted with a variety of interfaces and formats. Designed as an extensible platform, the R&S®BTC broadcast test center can be expanded with modules from the comprehensive R&S®VTC video tester portfolio to meet all T&M requirements with respect to signal generation and analysis both now and in the future (Fig. 5). The R&S®VTC portfolio includes analog and digital modules with electrical and optical interfaces that are plugged into the R&S®BTC.

As a result, DUTs can simply be connected to the R&S®BTC via their interfaces, including CCVS, YP_BP_R, HDMI and SPDIF. This is the basis for additional software-based audio/video testing options that are based on the installed modules.

Integrating a DUT in the test environment with simultaneous audio/video signal generation and analysis makes it possible to perform fast and objective picture failure point (PFP) analysis, ensuring an automated, convenient and reproducible assessment of picture quality.

Additional functions and options of the R&S®VTx modules and the new generator module are described on page 50 of this issue.

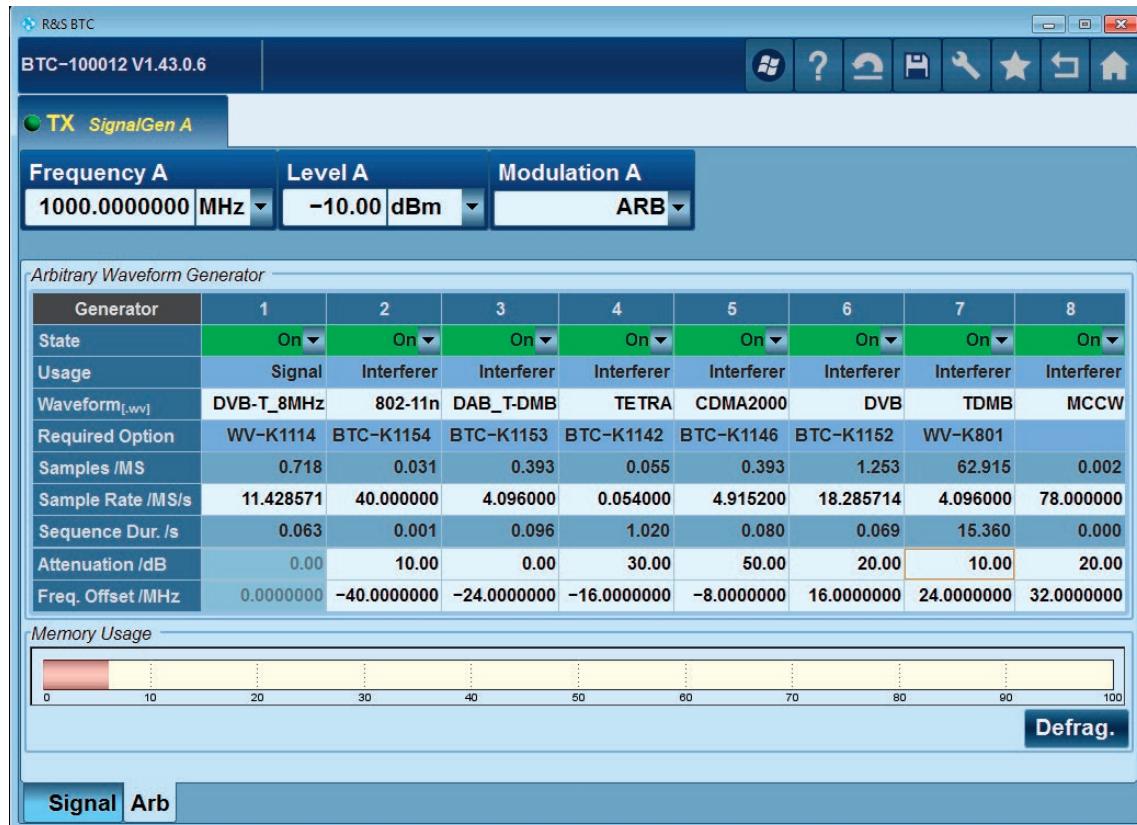


Fig. 4: The multiple ARB generator can generate up to eight different signal spectra for simulating a variety of channel assignments.



Fig. 5: With its wide range of plug-in modules, the R&S®BTC can be perfectly adapted to any application.

Versatile interfaces – for every need

In addition to the widely used ASI and ETI interfaces, the real-time coders in the R&S®BTC also provide an IP interface for broadcast applications as specified for DVB-T2, DVB-C2 and DVB-S2. This interface can be used to feed in external audio, video and data.

Developers of chips and tuners need I/Q data to be highly flexible in terms of data rates and data formats. The R&S®BTC is therefore equipped with multiple digital I/Q interfaces and flexible data input and output for ideal test and design capabilities (Fig. 6).

Ready for the future – modular and scalable

New and constantly changing development requirements, new and enhanced standards, time-limited projects, preproduction and small batch production – all of these present huge challenges to all parties involved, not only financially, but also in terms of the T&M equipment logistics. These challenges are an ideal task for the flexible, intelligent R&S®BTC. Its modular and highly scalable platform design is excellently suited for a variety of broadcast applications. It eliminates time-consuming and costly test setups that require a large number of individual test instruments. The future-ready modular design ensures expandability, also for future modules (Fig. 7).

I/Q data processing with different sample rates

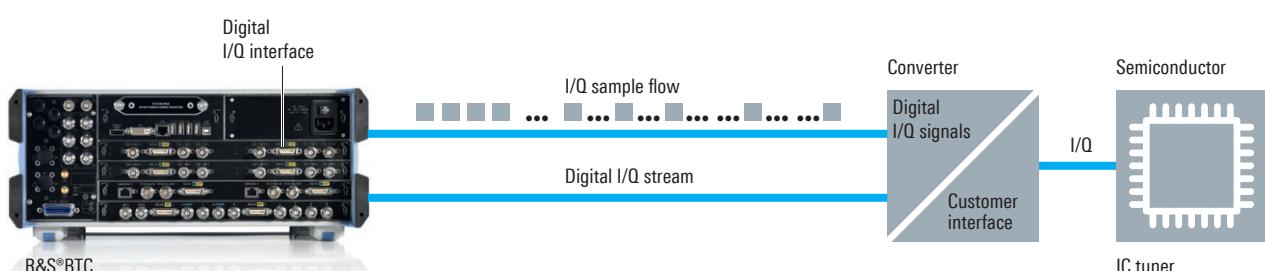


Fig. 6: The digital I/Q interfaces for the R&S®BTC enable I/Q data processing with different sample rates.

The R&S®BTC also scores top marks for its serviceability. Hardware modules can be installed or replaced directly on site. Even the hard disk and processor modules can be swapped out to keep the platform up to date.

The new, flexible software licensing concept opens a wide range of options for users and T&M equipment leasing companies. The following licenses are available:

- **Floating licenses** for two-path instruments can be intelligently activated on the path that is currently being used
- **Permanent licenses** can be activated for each path
- **Portable licenses** can be transferred from one R&S®BTC to another via the Rohde & Schwarz license server
- A **time-limited licensing model** is available for projects lasting only one or three months

Easy operation – touchscreen, remote or automated

The R&S®BTC is easy to use thanks to its capacitive 8.4" touchscreen and specially designed GUI. A hierarchical design featuring individual function blocks simplifies navigation and provides users with an overview of the entire test setup at any time, even when complex test setups are used.

Since the R&S®BTC is compatible with the remote control commands used by the R&S®SFx family of TV test transmitters, it can be easily integrated into existing test environments.

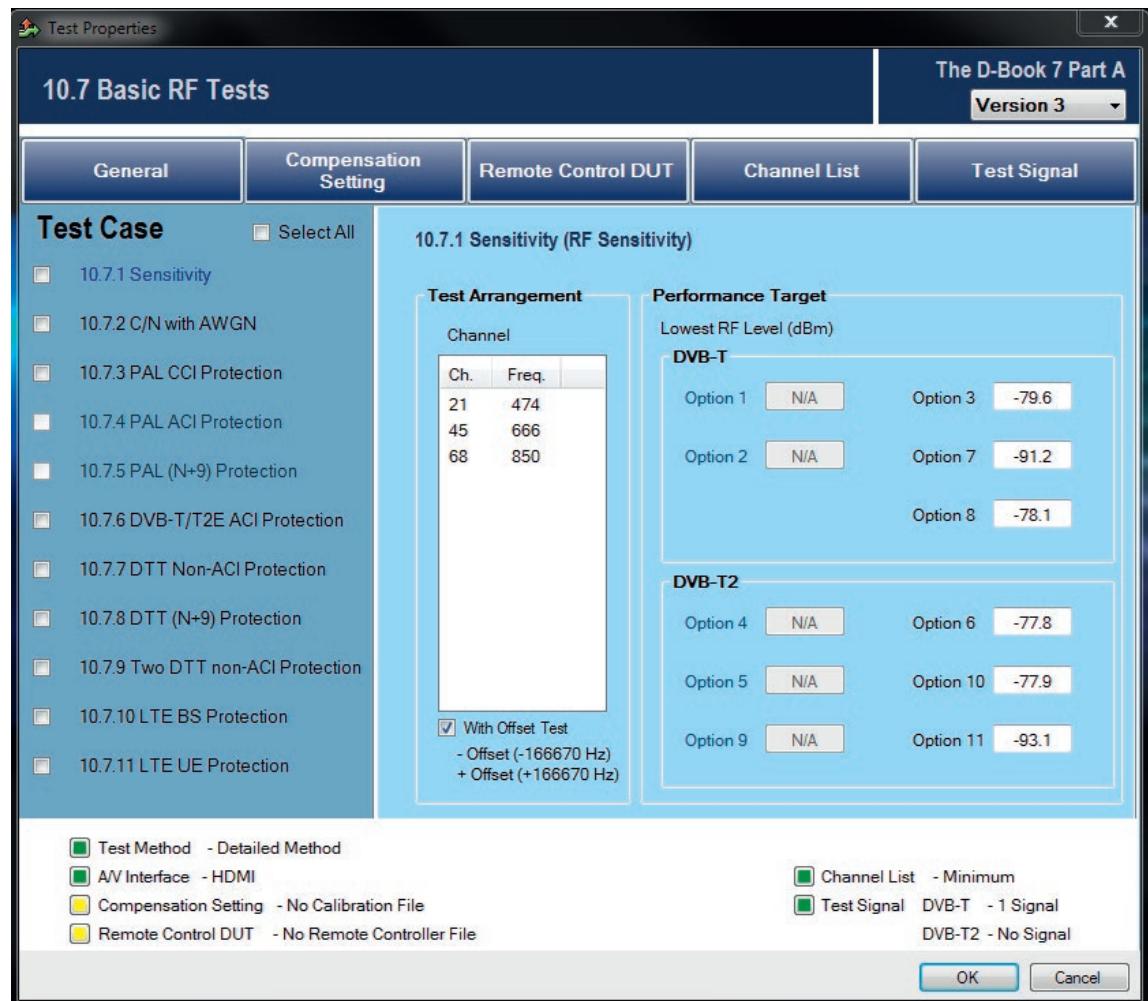
Fully automated internal test sequences – fast and reproducible

Ever shorter development, test and product introduction cycles are now the norm. At the same time, the effort



Fig. 7: The future-ready modular design ensures expandability, also for future modules.

Fig. 8: Automation reduces test times and delivers reproducible results. This example shows the D-Book Minimum Requirement Specifications test case.



required for maintaining test depth and generating test reports is increasing. This makes automated, reproducible test cases essential. The R&S®AVBrun sequencer tool is available for automating test sequences. This tool can be used to configure proprietary test plans by selecting the tests to be completed and defining their sequence. Once the test sequences are defined for individual test tasks, they run automatically.

In combination with optional test suites, the R&S®AVBrun supports full test automation. A test suite based on the Digital TV Group (DTG) D-Book contains all predefined test cases required for each test (Fig. 8). The test cases control the defined functions in the R&S®BTC, enable the required signal and set the generator to the specified frequency, level and transmission standard. They also launch the required transmission simulations with the corresponding C/N in the AWGN generator and the required fading profile, add interferer signals as needed and assess the results using the integrated audio/video analysis options.

The user chooses which test cases are to be enabled and disabled in the sequence. It is even possible to define test loops consisting of individual test cases or specific sequences. Turn-around times are reduced, and completed tests can be reproduced and the reports displayed at any time. The test reports are available in various formats, making time-consuming certification and logo tests both fast and dependable. The currently available D-Book test suite will be supplemented in the near future with E-Book and NorDig suites.

Summary

The R&S®BTC broadcast test center is an all-in-one solution that can be used to perform current and future tests in almost all audio and video transmission modes, and to subject receivers to tests extending far beyond what is normally required by the standards. The test platform can be quickly and flexibly adapted to new and changing test requirements at any time.

Ralph Kirchhoff