

Automatic precompliance testing of D-Book-conformant TV receivers

The D-Book, a technical specification from the UK's Digital TV Group (DTG), provides a detailed description of the technical hurdles that a DVB-T / DVB-T2 receiver must overcome in order to be sold in the United Kingdom. However, manufacturers are known to use the same test specifications for equipment destined for other regional markets. A new, fully automated solution from Rohde & Schwarz provides an elegant way to perform these tests using a single measuring instrument.

“Logo tests” for verifying product quality

Since manufacturers are allowed to self-certify the compatibility of their products with the DVB-T/DVB-T2 standard, it is clearly in their interest to ensure that their receivers will work properly in real-world TV networks. However, the

DVB-T/DVB-T2 standard does not contain any T&M specifications for receivers that could serve as a foundation for satisfactory product quality testing. In certain countries, this gap has been filled by standardization organizations that are typically initiated by local network operators who come together

to issue detailed technical recommendations for equipment manufacturers in their region of influence. Examples of these requirement catalogs include the Scandinavian NorDig standard and the Digital TV Group's D-Book for the United Kingdom. Manufacturers wishing to market their TV sets or set-top



DTG Testing

DTG Testing, the test house of the Digital TV Group (DTG), has approved the R&S®BTC broadcast test center together with the R&S®AVBrun D-Book test suite for precompliance testing to D-Book 7.3.

Fig. 1: The setup for D-Book-conformant precompliance tests is limited to an R&S®BTC broadcast test center, a remote control device, a remotely switchable power supply, and a Windows PC for configuring and controlling the tests.

boxes with the UK's familiar Freeview logo must have their products certified by an accredited test house such as DTG Testing. Due to time and cost constraints, manufacturers are unlikely to accept such a procedure unless they are relatively certain to pass the test – especially since products generally require further approvals such as for the HDMI™ and MHL™ interfaces. In the past, achieving such certainty required manufacturers to perform their own tests using custom test systems

with numerous components. The disadvantages of such systems are obvious and include the high cost of purchasing, calibrating and servicing the system and the need for control software. In contrast, the turnkey D-Book test solution from Rohde&Schwarz, which has been tested and approved by DTG, offers a very compact approach with an all-in-one measuring instrument – the R&S®BTC broadcast test center and the D-Book test suite based on the R&S®AVBrun test sequence software.



Automated picture quality analysis beats conventional test and measurement

In order to ensure that TV receivers can handle a wide range of receiving conditions, chapters 9 and 10 of the D-Book define a number of RF tests for different signal scenarios (channel allocations, interferers). Remarkably, however, the D-Book does not specify whether the quality verification is done using objective T&M procedures (BER

measurements, transport stream analysis) or just by visual picture inspection. The ideal solution, of course, would be a mixture of both – an automated picture quality analysis by a measuring instrument using assessment methods adequate to a human viewer. That’s exactly what the R&S®BTC offers (see box) and what the Rohde&Schwarz test solution is based on. Automated picture quality analysis has also the major benefit that no contact with internal

interfaces (typically hard to reach) is required in order to tap the signals. Instead, consumer electronics equipment can be tested in what is basically its delivery state. Access is required only to the RF (or antenna) input and a standard device output, preferably an HDMI™ interface. With receivers that do not have a digital output, measurements can be made on an analog interface such as Scart or RGB.

Picture quality analysis with the R&S®BTC

The picture quality is automatically assessed by the R&S®BTC A/V distortion analysis function. The deviation from an assumed ideal reference, and not the absolute A/V quality, is assessed. Consequently, the reference recording must originate from the same video processing chain and the same A/V material. Suitable transport streams with short A/V sequences (e.g. 20 s) are an integral part of the R&S®AVBrun test suite software.

The D-Book recommends that picture assessment should have three observation periods of 10 s each (this applies to each defined signal scenario). The criterion for good signal quality is that no visible errors occur during two out of three observation periods. When an instrument such as the R&S®BTC is used to perform this assessment, the challenge is to translate the concept of a “visible error” into a measurable quantity. Various methods are commonly used. One method involves the peak signal-to-noise ratio (PSNR) – a quality parameter that takes into account the mean square deviation of the color intensity and brightness for each pixel in the test picture with respect to the corresponding reference pixel. Although the

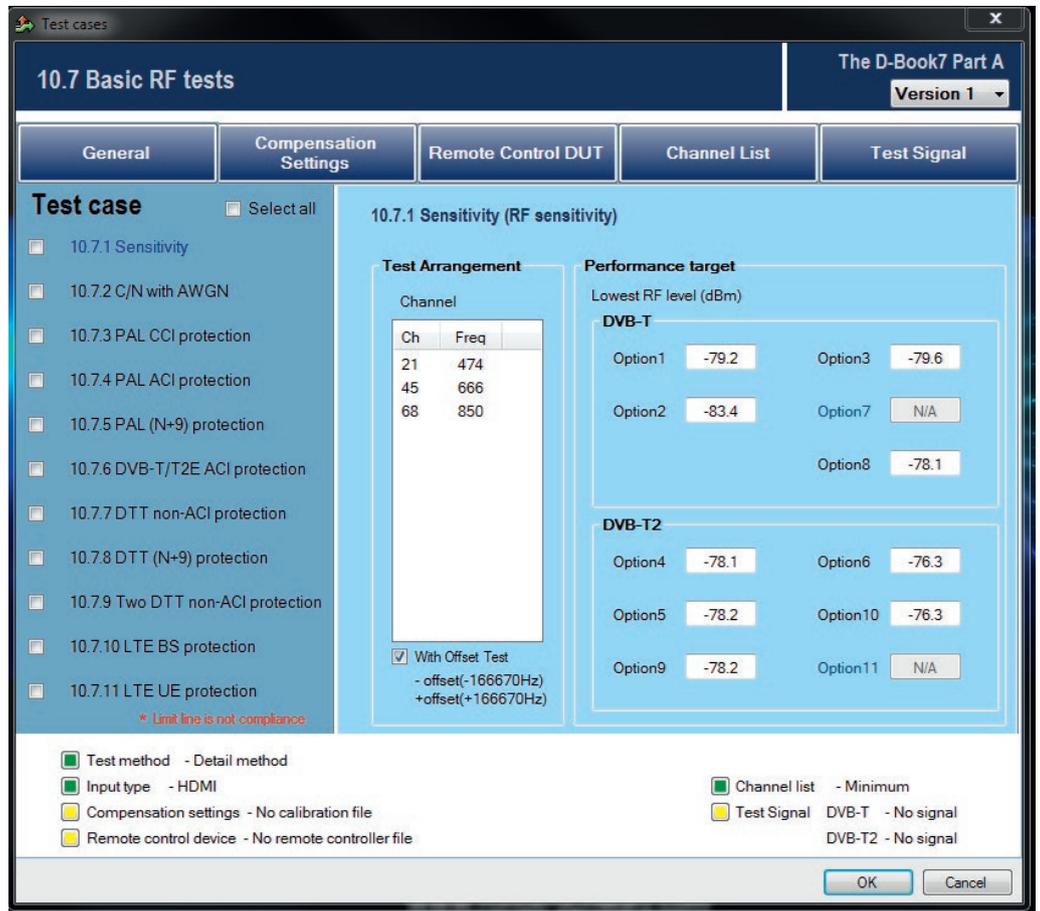
PSNR method is well established, it ignores certain idiosyncrasies of human image perception which mean that a poor PSNR value does not necessarily imply that a human viewer would also find the picture to have low quality. The structural similarity (SSIM) measurement method provides a better model of human visual perception. Based on the insight that people perceive images in terms of structures, the method analyzes the extent to which these

structures are retained in comparison to the reference picture. The result is an index value between 0 and 1, where 1 implies full agreement with the reference picture. The R&S®BTC determines the PSNR and the SSIM value (along with other quality indicators; see Fig. 2). The tolerance limits for pass/fail decisions in line with the D-Book are stored as a parameter set, but they can also be user-specified for other measurements.

Fig. 2: The distortion analyzer of the R&S®BTC combines various picture quality parameters in a clear analysis screen.



Fig. 3: The user interface for the R&S®AVBrun test sequence control software with the R&S®BTC-KT3310 D-Book test suite closely parallels the structure of the D-Book specifications and is largely self-explanatory.



A compact all-in-one solution to replace expensive rack systems

Fig. 1 shows the simplicity of the test setup. The R&S®BTC handles all of the functions needed to generate the necessary signal scenarios and analyze the output signal. Only the following components are needed to perform fully automated tests (even unattended): an adaptive remote control device (RedRat3-II), a remotely switchable power supply (NET8212), and a PC for configuring and controlling the tests. The remote control device is used to control the channel switching as required by the test software; the switchable power supply allows a DUT to be restarted in case it crashes or fails to respond (which is detected by the system) so the test can resume from the point of interruption. R&S®AVBrun is the Windows software used for test automation with the R&S®BTC. It is

extended with the R&S®BTC-KT3310 test suite for D-Book-conformant tests. The terminology and chapter numbers used in the menus correspond to the D-Book layout to make the configuration process fast and easy (Fig. 3). The default settings can be used to perform all of the tests exactly as described in the D-Book. However, users can deviate from the recommendations if necessary in order to analyze errors or perform more in-depth studies that go beyond the specified parameters. Test passed or failed (and if it failed): Where are improvements necessary? Hints on that can be found in the clear test report generated by the software according to the test plan each time it runs. The report can be saved in PDF or XML format. The entire test procedure involves only a bare minimum of manual intervention, thereby boosting the efficiency while eliminating possible error sources.

Another benefit is that the single calibration procedure required for the test setup (including the RF cable and adapter / attenuator) can be performed very quickly from the menus with an R&S®NRP power sensor connected to the R&S®BTC.

Test modules for additional standards in preparation

The R&S®AVBrun software is suitable for automating all types of tests with the R&S®BTC. The D-Book test suite will be followed by additional test suites for the latest NorDig standard (version 2.4) as well as the E-Book standard (IEC 62216). The R&S®BTC is advancing in the direction of a universal tester for automatic precompliance measurements on broadcast receivers in all markets.

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