Testing OFDM-based transmission methods using Rohde & Schwarz signal analyzers

The new R&S®FSQ-K96 OFDM vector signal analysis PC software for the R&S®FSQ and R&S®FSG signal analyzers is the world's leading solution for demodulating general OFDM signals. The software performs standard-independent analysis and can be user-configured. Thus, it can be optimally adapted to the individual signal.

OFDM vector signal analysis at a glance

Many radiocommunications systems today make use of orthogonal frequency division multiplex (OFDM) multicarrier modulation. In the case of OFDM, information is distributed to multiple carriers. As a result, signals are less sensitive to interference and echoes than in other modulation methods. If you want to analyze the modulation quality of OFDM signals, specialized measuring equipment is required. The solutions currently available on the market can only be applied to specific OFDM standards such as WLAN or WiMAX.

In contrast, the new R&S®FSQ-K96 OFDM vector signal analysis PC software for the high-end R&S®FSQ and R&S®FSG signal analyzers from Rohde & Schwarz is an all-purpose tool – it can determine the modulation quality of almost all OFDM signals (FIG 1). Plus, owing to their low phase noise and excellent demodulation characteristics, these two signal analyzers meet the most stringent of requirements. Depending on their configuration, the signal analyzers can measure OFDM signals with a bandwidth of up to 120 MHz. The R&S®FSQ with a frequency range of up to 40 GHz also covers microwave applications. The R&S®FSQ-B71 analog baseband inputs allow you to perform measurements directly in the baseband. If the R&S®FSQ-B17 digital I/Q interface is applied, digital subassemblies can be analyzed without having to make use of analog components (FIG 2).

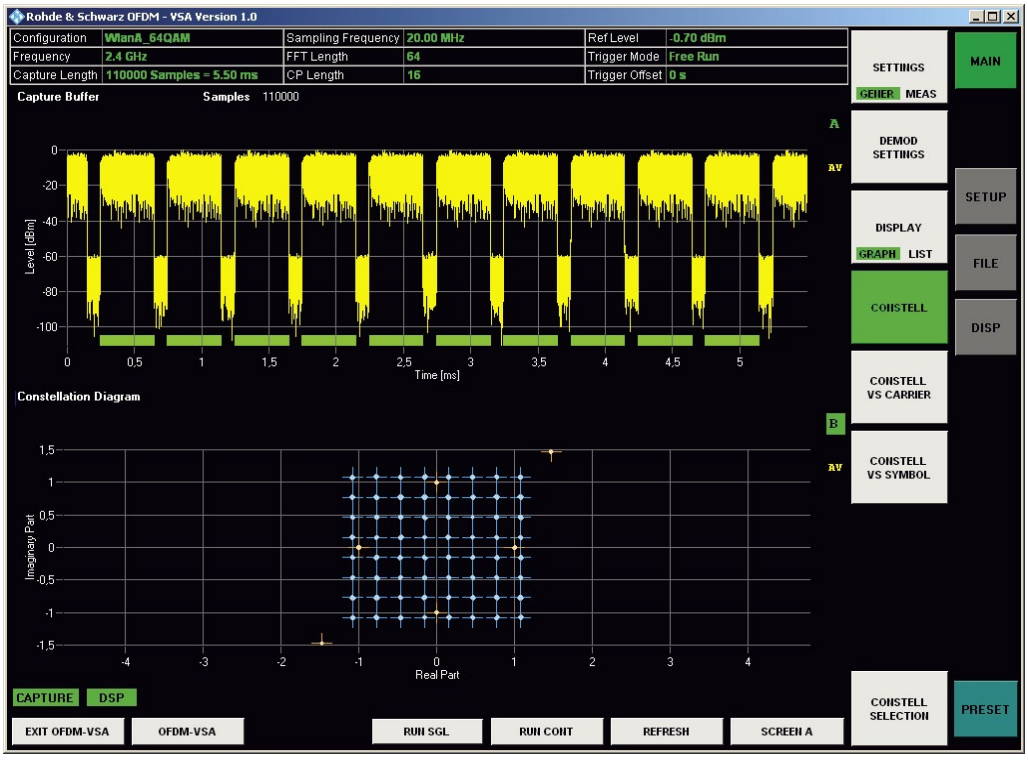

FIG 1 The upper part of the display shows the recorded signal in the time domain. The lower part shows the constellation diagram with the in-phase and quadrature components over the entire range of the measured input data. It can be displayed either for all carriers or for selected carriers. Color coding makes identification of the different modulation formats easy.

	R&S®FSG	R&S®FSQ
Frequency range	50 MHz to 8 GHz 50 MHz to 13.6 GHz	50 MHz to 3.6 GHz 50 MHz to 8 GHz 50 MHz to 26.5 GHz 50 MHz to 40 GHz
EVM (WiMAX)	<–46 dB	<–48 dB
Demodulation bandwidth	28 MHz	28 MHz, 120 MHz optional
Analog baseband inputs	–	optional
Digital I/Q interface	optional	optional

FIG 2 The R&S®FSQ-K96 OFDM vector signal analysis PC software can be used in conjunction with the R&S®FSQ or R&S®FSG signal analyzers. The instruments have to run on firmware version 4.35 or later.

Suitable for a wide range of applications

No matter whether you need a solution in development or in production, R&S®FSQ-K96 from Rohde & Schwarz is the ideal tool for numerous fields of application:

Wireless communications
Usually, no specialized measuring solutions for new OFDM standards are available in the initial phases of development. But things are quite different with the R&S®FSQ-K96 OFDM vector signal analysis PC software – Rohde & Schwarz supports the dynamic development of forthcoming wireless communications standards right from the start. Component manufacturers profit from the application software: They can now apply user-defined OFDM signals to test modules such as amplifiers and are no longer dependent on standard-conforming test signals.

Broadcasting
In broadcasting, too, transmission signals need to be measured or receivers need to be tested and analyzed in detail. New TV standards such as DVB-T or DVB-H are based on OFDM and can now for the first time also be analyzed with the R&S®FSQ and R&S®FSG signal analyzers.

Proprietary systems
Especially in military applications, OFDM systems deviate from digital standards and are often proprietary systems. Even the slightest deviations from standard make signal analysis using conventional software impossible. R&S®FSQ-K96 offers a high degree of freedom in the selection of test parameters and can also demodulate OFDM signals that have not been standardized.

Universities and research institutes also profit from the versatile OFDM demodulation software.

Comprehensive configuration options

R&S®FSQ-K96 offers comprehensive setting capabilities for optimally adapting the measurements to the signals to be analyzed. In addition to frequency or level, the user can set general OFDM parameters such as offset from carrier, number of carriers, sampling rate or guard interval length via the user interface. A configuration file defines further parameters in detail so that the software can synchronize and demodulate almost any OFDM signal. The file contains user-definable information about the structure of the preamble, the position and value of the pilot carriers as well as the position and modulation format of the data carriers. R&S®FSQ-K96 supports any PSK and QAM modulation mode of the individual carriers and can also demodulate OFDMA signals. Rohde & Schwarz provides predefined configuration files for the WLAN 802.11a, 802.11g OFDM, WiMAX 802.16 OFDM, DVB-T and DVB-H standards.

In addition to the parameters in the configuration file, parameters such as synchronization and tracking can also be set manually. This facilitates error analysis – you can find power drops within a burst by means of level tracking, for example. Or you can compensate for frequency variations in measurement results by means of phase tracking.

Numerous evaluation functions

After the OFDM demodulator has been configured, the analyzer measures all relevant parameters that characterize OFDM signals and displays the results in a table. One important parameter is error vector magnitude (EVM), which allows the assessment of modulation quality. Owing to its low phase noise, the R&S®FSQ signal analyzer provides accurate EVM measurement results, even if the number of carriers is high. In addition to a numeric table, numerous graphical displays facilitate signal analysis – for example, the signal flow chart (FIG 3) or the power display of each carrier and symbol (FIG 4).

Perfect match: the vector signal generators from Rohde & Schwarz

To characterize modules/instruments that are based on OFDM transmission standards, you need both signal analyzers and signal generators. The vector signal generators from Rohde & Schwarz, which include an arbitrary waveform generator (ARB), can generate general OFDM signals and OFDMA test signals. For example, you can generate signals using mathematical tools and then load these signals into the ARB. As the generators have a large memory capacity, high resolution and sampling rates up to 300 MHz, they can generate accurate OFDM signals over the entire bandwidth supported by the R&S®FSQ-K96 software.

Summary

Rohde & Schwarz offers an all-in-one measurement solution for generating and analyzing OFDM signals. The R&S®FSQ-K96 OFDM vector signal analysis PC software expands the R&S®FSQ and R&S®FSG signal analyzers' scope of applications for analyzing general OFDM signals. R&S®FSQ-K96 from Rohde & Schwarz is truly unique: It is the only solution worldwide that is able to demodulate standard-conforming signals as well as proprietary OFDM and OFDMA signals.

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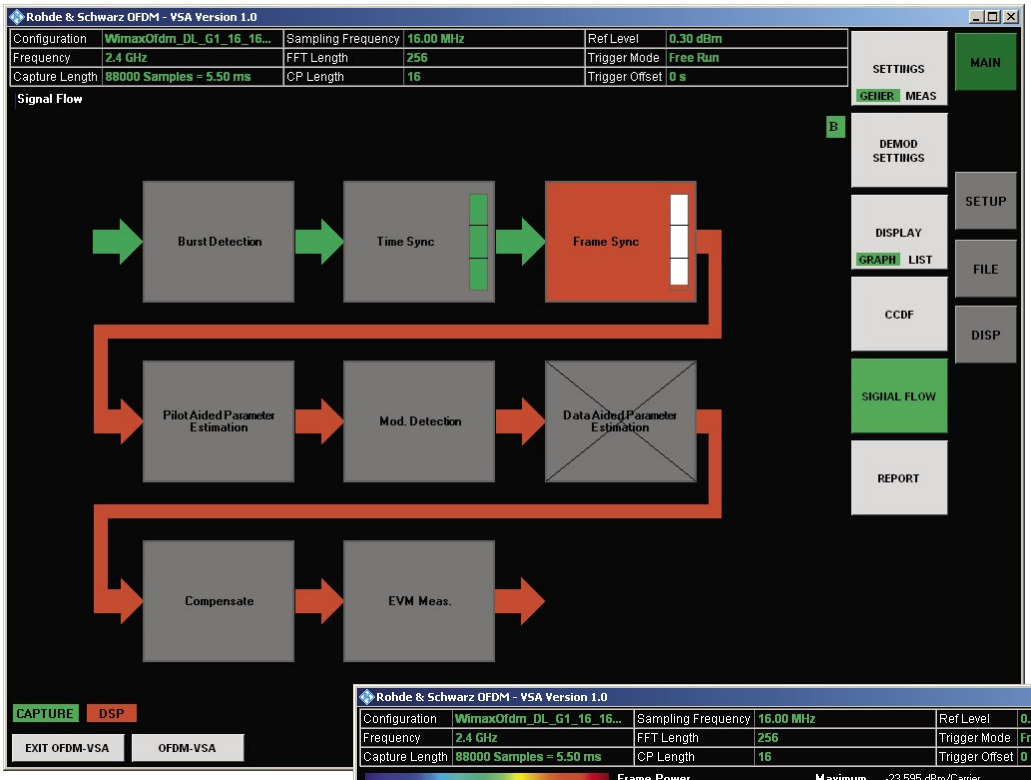

FIG 3 The signal flow chart describes the current measurement status in detail. It also offers information about the area in which the signal to be analyzed is faulty or deviates from the settings. The signal flow chart is a powerful tool for troubleshooting problems in the modulation of the signal. In this example, the pilot cells of the signal do not match the configurations. Unused blocks are crossed out.

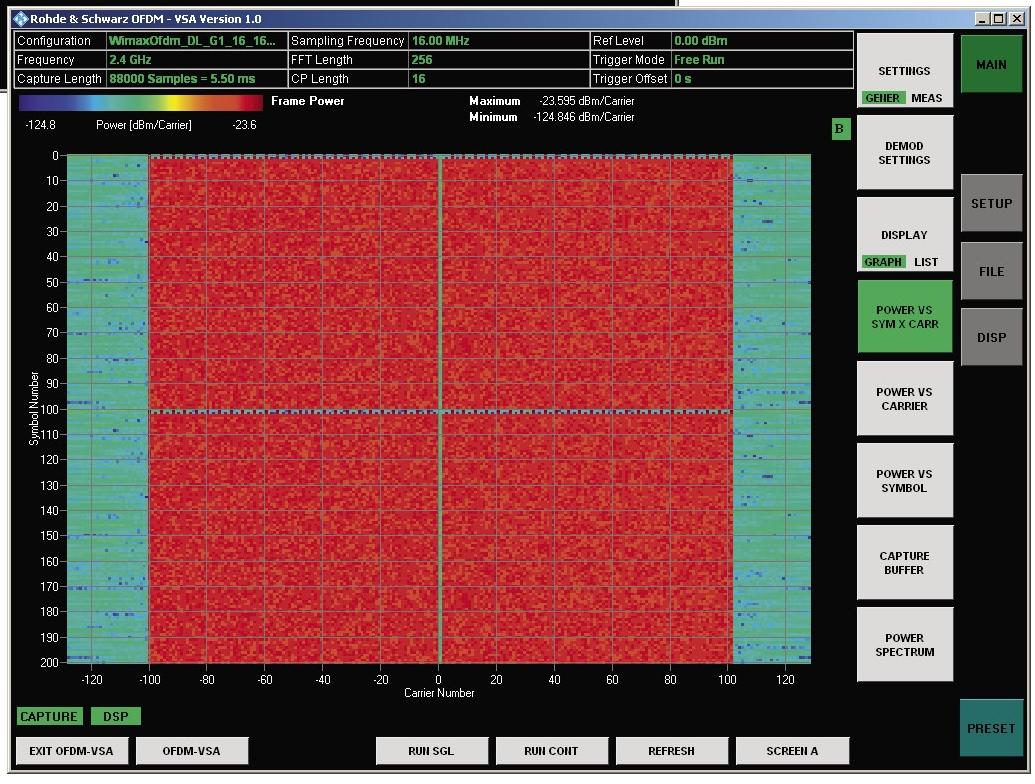

FIG 4 The diagram shows the power of each carrier and symbol of the received frames in dBm for each carrier. The values are color-coded in accordance with a table of colors that is displayed in the upper area of the measurement window.