FIG 1 **WLAN measurements on the Signal Analyzer R&S® FSQ.**

Signal Analyzer R&S® FSQ/Spectrum Analyzer R&S® FSP

WLAN measurements with analyzers from Rohde & Schwarz

New options expand the scope of applications of the R&S® FSQ [1] and R&S® FSP [2] analyzers by spectrum and modulation measurements on OFDM signals in accordance with the WLAN standards IEEE 802.11a/g. Numerous measurements as specified by the standards are thus available at a keystroke.

WLAN requires efficient analyzers

Compared to single-carrier modulation methods, the multicarrier method that is used with the wireless LAN standards IEEE 802.11a and IEEE 802.11g places new requirements on transmitters and receivers, and thus also on T&M technology. For example, the high crest factor of these signals calls for an amplifier design that is matched to the signal. Then there is the additional challenge that a complete 802.11g module requires the implementation of both a single-carrier and a multicarrier modulation method in a single instrument.

Rohde & Schwarz therefore offers WLAN options tailored to development and production that complement the high-end Signal Analyzer R&S® FSQ (FIG 1) and the favourably priced Spectrum Analyzer R&S® FSP.

Standards 802.11a and g

WLAN signals in accordance with the standard 802.11a are defined for gross transmission rates from 6 Mbit/s to 54 Mbit/s; transmission is via OFDM. A total of 52 single carriers spaced at 312.5 kHz are used; four carriers in their function as pilots are BPSK-modulated. Each of the remaining 48 carriers is either BPSK-, QPSK-, 16QAM- or 64QAM-modulated. The signal itself occupies approx. 16 MHz, the channel bandwidth has been specified at 20 MHz, and the channel center frequency is an integer multiple of 5 MHz. With 802.11a, the signal is transmitted at 5.6 GHz, with 802.11g OFDM at 2.4 GHz.

The standard 802.11a specifies a series of transmitter measurements. However, in development and production, requirements go beyond these measurements. Both Rohde & Schwarz analyzers therefore support a multitude of other measurements – in addition to those defined in the standard. Moreover, both instruments also provide all the functions of a spectrum analyzer.

R&S®FSQ high-end tester

The R&S®FSQ with WLAN option is a high-end tester for development and production. The 802.11a signal occupies a bandwidth of nearly 20 MHz which cannot be processed by conventional RF spectrum analyzers. This is where the R&S®FSQ with an RF bandwidth of up to 28 MHz that can be vector-analyzed shows off its advantages. Signal analyses in the 5 GHz band (802.11a), in the 2.4 GHz band (802.11g, OFDM), on any IF between 10 MHz and 3.6/8/26.5 GHz (FIGs 2 and 3) and in the baseband (with optional analog baseband inputs) are thus feasible.

WLAN options for the R&S®FSQ and the R&S®FSP

- Complex WLAN OFDM measurements at a keystroke
- For laboratory and production
- Measurements at RF, IF or in the baseband
- EVM and spectral measurements
- Fully configurable in only two windows
- Remote-controllable and fast
- Spectrum and signal analyzer in a single instrument

Extremely low inherent and phase noise, unrivalled low residual error vector magnitude (EVM), high dynamic range as well as outstanding accuracy make the R&S®FSQ the ideal high-end tester for the development of baseband ICs, amplifiers and modules where tolerances and limit values often have to be narrower than specified in the standard.

Convenient to operate

Two simple tables (FIG 4) provide an overview of all settings of the WLAN option, making it possible to change them at a keystroke. Once the application has been started, only the frequency/channel number needs to be entered before the measurement can start. The analyzer follows level changes by means of the optional auto-level function which makes manual entries superfluous.

It is therefore very easy to perform single measurements, measurements with a definable number of bursts, coherent measurements within a settable period of time or continuous measurements. The results are output in a table (incl. limit values) or as a graphical display (incl. limit value lines and pass/fail information) in one or two windows simultaneously (FIG 5).

The WLAN option can be remote-controlled via the IEC/IEEE bus and LAN, which is a prerequisite for use in production.

FIG 2 **Standard-conformant spectrum measurement with mask and pass/fail information.**

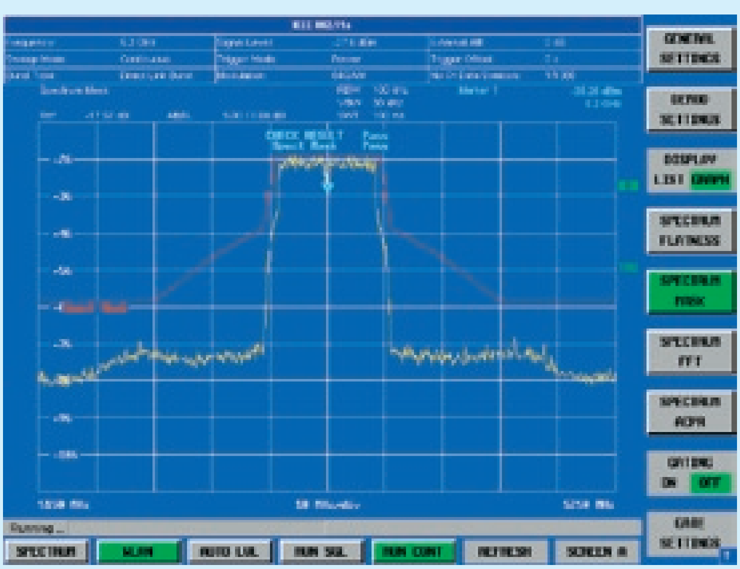
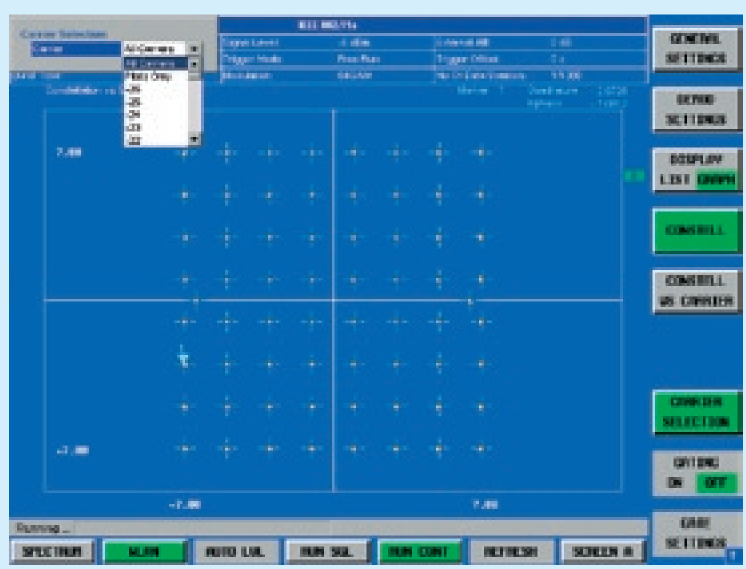


FIG 3 **Constellation diagram of all or (selectable) individual carriers.**



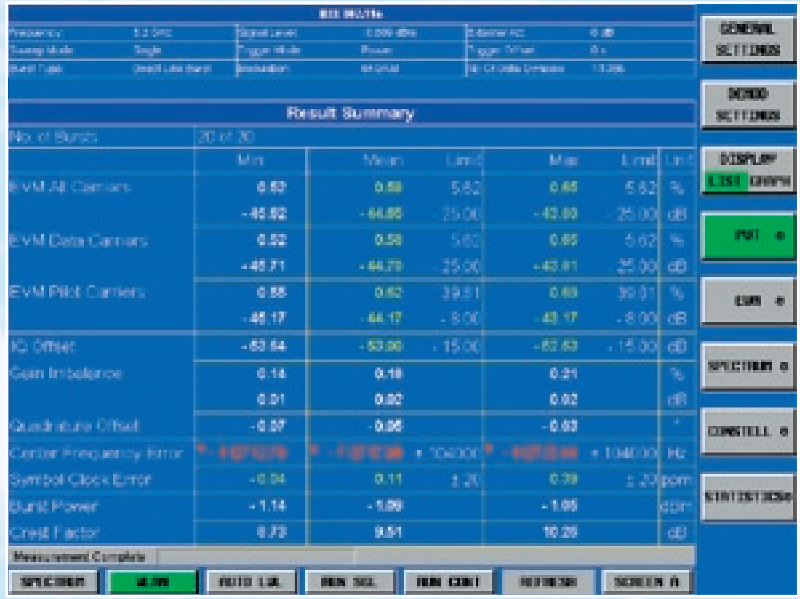


FIG 5 Display of the main parameters at a glance: The measurement covering 20 bursts shows an EVM of –45.62 dB for the "best" burst (min) and –43.8 dB for the worst burst (max) as well as an average EVM of 44.65 dB for all bursts. The red figures indicate that the measured frequency error value exceeds the limit value specified by the standard.

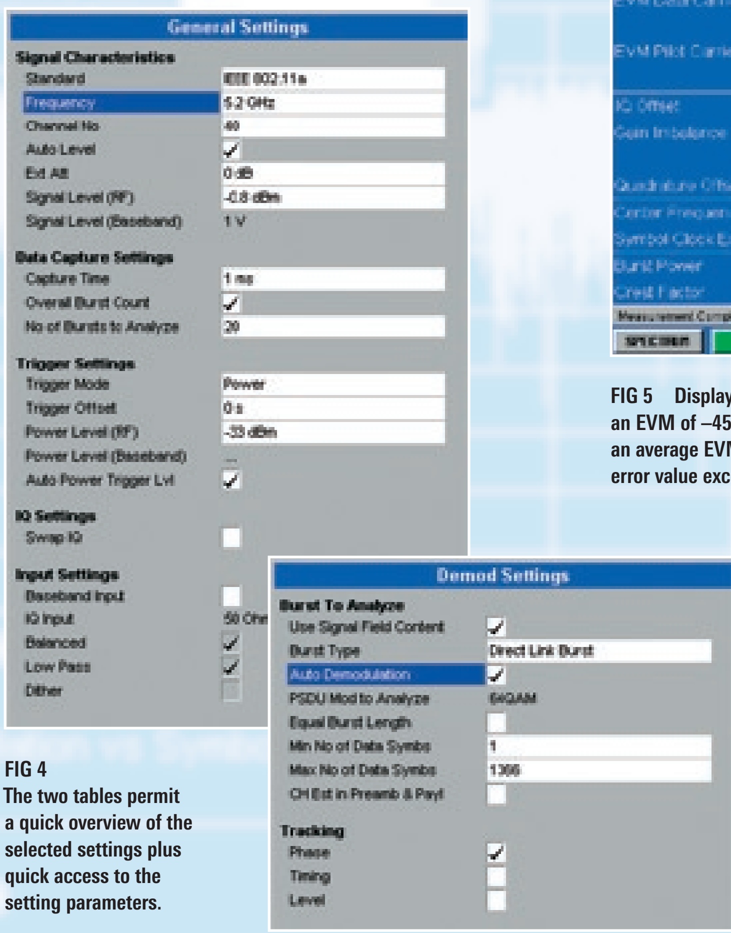


FIG 4
The two tables permit a quick overview of the selected settings plus quick access to the setting parameters.

FIG 6 Burst configuration.

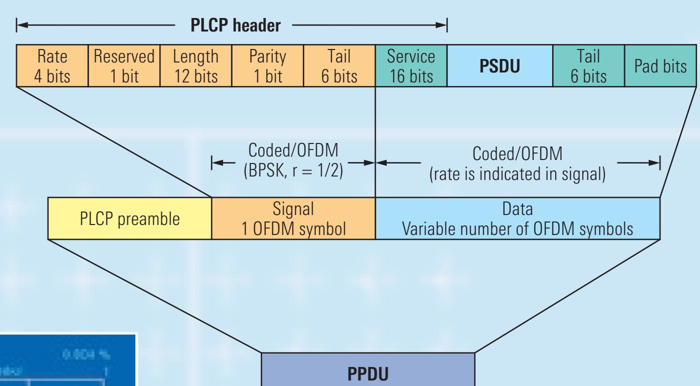


FIG 7
EMV versus symbols (top) or versus carriers (bottom).

Useful in development

Signals in accordance with WLAN 802.11a/g may contain bursts that vary in modulation modes and lengths. The developer is often faced with the task of filtering the bursts according to a specific modulation mode and specific length from this mixture, demodulating them and comparing them to limit values.

The WLAN option also frees the developer from having to perform this task. Both the modulation mode to be analyzed and the burst length (number of payload symbols) can be set in such a way that only those bursts are analyzed that correspond to these criteria. Together with the settable number of bursts to be measured, it is for example possible to automatically detect and measure 64QAM-modulated bursts and bursts with a length of 67 payload symbols in such a mixture.

The duration of the intervals between the transmitted bursts can vary as well. If long intervals are expected, measurement speed can be further augmented by selecting an appropriate trigger (free run, external or power trigger) and a signal-specific data-recording time. The trigger threshold is selected either manually or automatically.

The evaluation of the signal field – an information field in each burst in which, for example, the modulation mode and number of payload symbols are coded (FIG 6) – permits automatic modulation detection and a test to check whether the content of the signal field is correct. In the bit stream display, the transmitted raw bits can be checked for each burst and carrier.

Various in-depth analysis and evaluation capabilities for the development and verification phase are available, e.g. EVM versus all carriers or versus symbols (FIG 7).

R&S®FSP – economical for production

When WLAN components are produced, reduced and very simple measurements are usually performed to maximize throughput. With its fast and highly accurate power and spectrum measurements, the R&S®FSP is the ideal spectrum analyzer for this purpose; complemented with the R&S®FSP-K90 option, it is also able to measure the modulation parameters of the WLAN signal on a reduced number of OFDM carriers. In accordance with a patent-pending method, it uses only the 28 inner carriers for modulation analysis which are completely sufficient for adjusting the EVM or the I/Q offset, for example.

Summary

Thus, the R&S®FSQ and the R&S®FSQ-K90 cover all requirements in development while the R&S®FSP and the R&S®FSP-K90 provide an economical solution for production.

In addition to spectrum analysis, the analyzers of course handle the full range of modern communication methods. In times of rapid change, measurement applications for GSM/EDGE, WCDMA, HSDPA, cdma2000 and TD-SCDMA ensure a flexible response to shifting market priorities. The Signal Analyzer R&S®FSQ is also ideal for handling bandwidth requirements exceeding 30 MHz.

The R&S®FSQ-K70 vector signal analysis option expands the R&S®FSQ by universal demodulation and analysis functions for digitally modulated signals up to a symbol rate of 25 Msymb/s.

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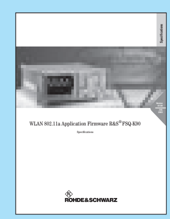
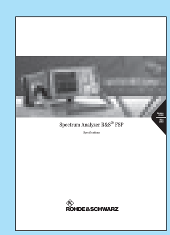
More information and data sheets at www.rohde-schwarz.com (search term: FSQ and FSP)

R&S®FSQ-K90 data sheet



R&S®FSQ brochure/ specifications

R&S®FSP brochure



R&S®FSP specifications

REFERENCES

[1] Signal Analyzers R&S®FSQ – Bandwidth and dynamic range for future systems and technologies. News from Rohde & Schwarz (2002) No. 174, pp 17–21

[2] Spectrum Analyzer R&S®FSP – Medium class aspiring to high end. News from Rohde & Schwarz (1999) No. 166, pp 4–7

– IEEE standards 802.11a/b/g.