R&S®FSQ-K100/ -K101/-K102 EUTRA/LTE Signal Analysis

Transmitter measurements on LTE signals

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Product Brochure | 02.00

R&S®FSQ-K100/ -K101/-K102 EUTRA/LTE Signal Analysis

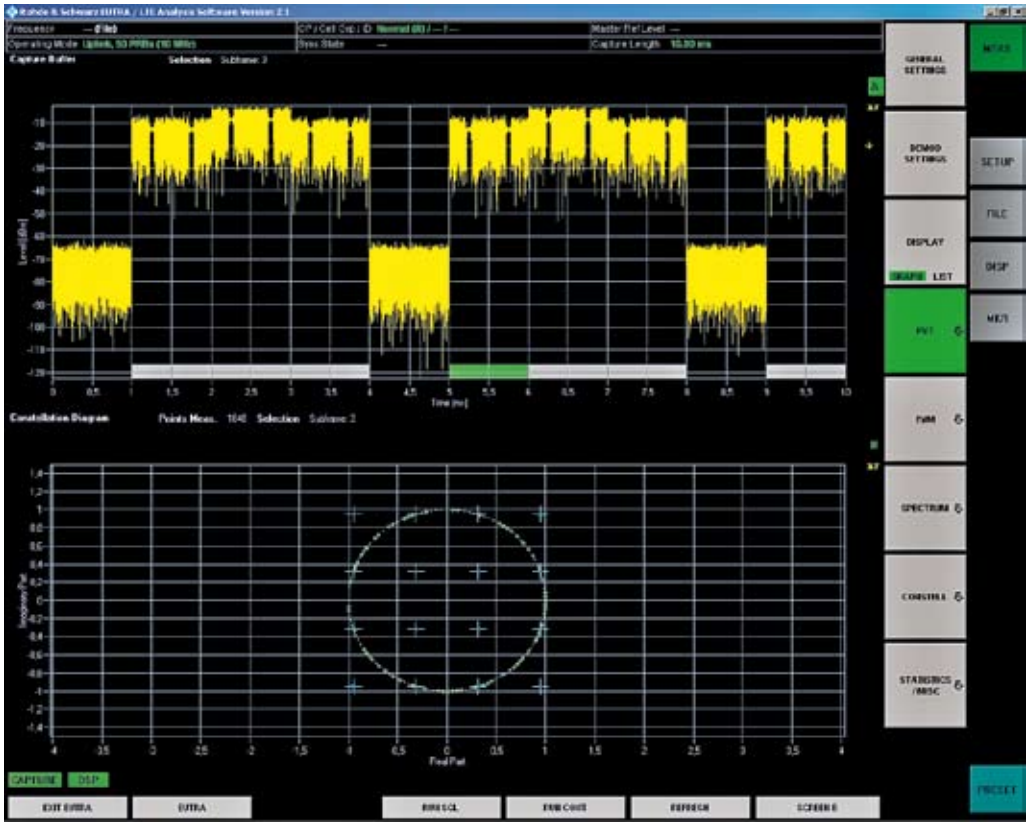
At a glance

The R&S®FSQ-K10x external PC software enhances the R&S®FSQ and R&S®FSG analyzers for transmitter measurements on 3GPP Long Term Evolution (LTE) base stations and user equipment. Analysis of MIMO transmitters provides more insight into the performance of the complete base station.

The software analyzes the modulation quality, e.g. EVM or I/Q imbalance, of 3GPP EUTRA FDD signals in both uplink and downlink. When combining two or up to four signal analyzers, these tasks can even be performed on MIMO transmitters.

R&S®FSQ-K10x analyzes all LTE modulation types: BPSK, QPSK, 16QAM, and 64QAM. The user can define all bandwidths within a range of 1.4 MHz to 20 MHz.

- Quick overview of most important measurement results
- Advanced analysis of radio frame, subframe, resource blocks, and channels
- Autodetection
- EVM <–50 dB



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Benefits and key features

Convenient analysis due to automatic detection of modulation formats

Each subframe of the signal is analyzed and the QPSK, 16QAM or 64QAM modulation formats plus the length of the cyclic prefix are detected and used to automatically configure the demodulator in R&S®FSQ-K100 and R&S®FSQ-K101.

The cell identity can also be automatically detected, which reduces the number of settings required by the user to a minimum.

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Large number of alternatives to determine the performance of the transmitter

A summary of the transmitter performance is displayed in a table, providing a quick overview. As the LTE signals are highly complex (e.g. one frame of a 10 MHz signal may contain over 80000 different error vector magnitude results), graphical displays are more suited to quickly locate performance trouble spots in the transmitter. R&S®FSQ-K100 and R&S®FSQ-K101 provide an abundance of graphical displays.

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Quick analysis of transmitter performance by controlling the demodulator

After a performance problem has been identified, it is helpful in fault finding to change the settings of the demodulator. The captured data can be analyzed again, which ensures that any sporadic problem will be analyzed in detail as soon as it has been captured by the R&S®FSQ-K100/-K101/-K102 software.

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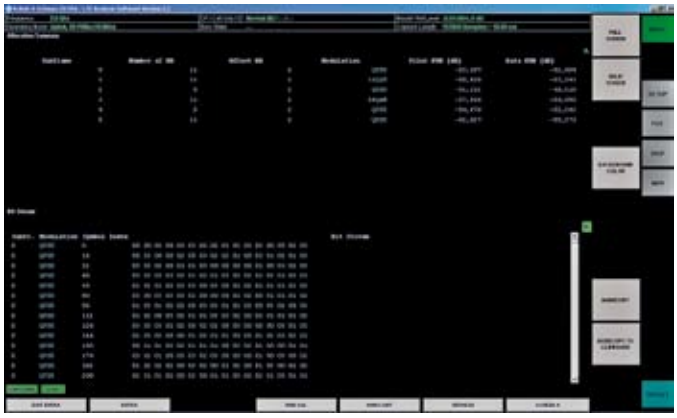
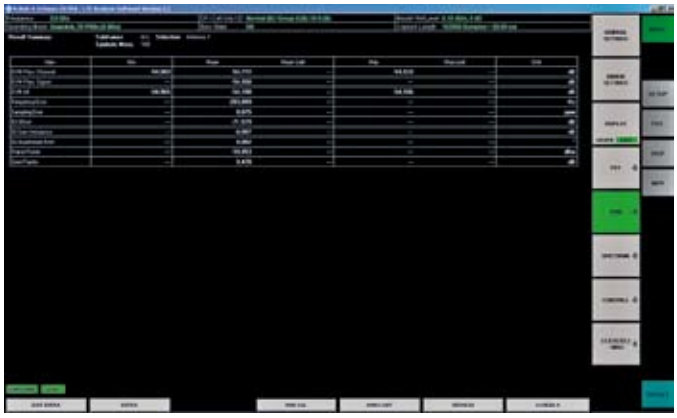
Convenient analysis due to automatic detection of modulation formats

Summary of the resource allocations automatically detected in the UL together with the demodulated raw bits for each allocation in the complete subframe.



Numeric display of the most important modulation parameters.



Graphical indication of the synchronization.
The S-SYNC in the analyzed signal contains an error, which is indicated in the rightmost box.

The upper display shows the power versus time of the captured downlink signal, plus the positions of the reference signals, P-SYNC and S-SYNC. The display below shows the error vector magnitude per subframe for the ten subframes in the frame.

Large number of alternatives to determine the performance of the transmitter

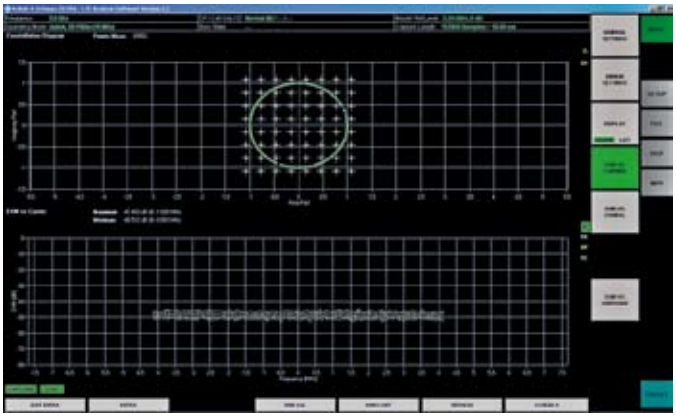
The most important measurement results are listed in a table to provide a quick overview of the performance of the transmitter:

- Error vector magnitude (EVM) of all carriers
- EVM physical channel
- EVM physical signal
- Frequency error
- Sampling error
- Modulation parameters: I/Q error, gain imbalance, and quadrature error
- Power
- Crest factor

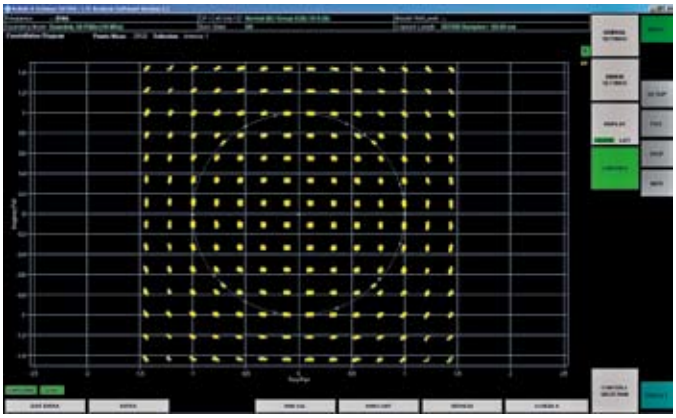
For advanced analysis, a number of graphical displays is available:

- Frame power with color indication of important parts in the signals, such as P-SYNC, S-SYNC, and reference symbols
- EVM versus carrier, symbol or subframe
- Frequency error versus symbol
- Channel flatness and flatness difference
- Group delay
- Power spectrum (DL only)
- Constellation diagram with selection of modulation formats, allocation, carrier and for MIMO signals before (at the antenna) and after the MIMO decoder
- Allocation summary
- CCDF
- Bit stream
- Signal flow

Constellation diagram of an uplink signal together with the EVM versus carrier.



Constellation diagram at antenna 1 for a MIMO signal.



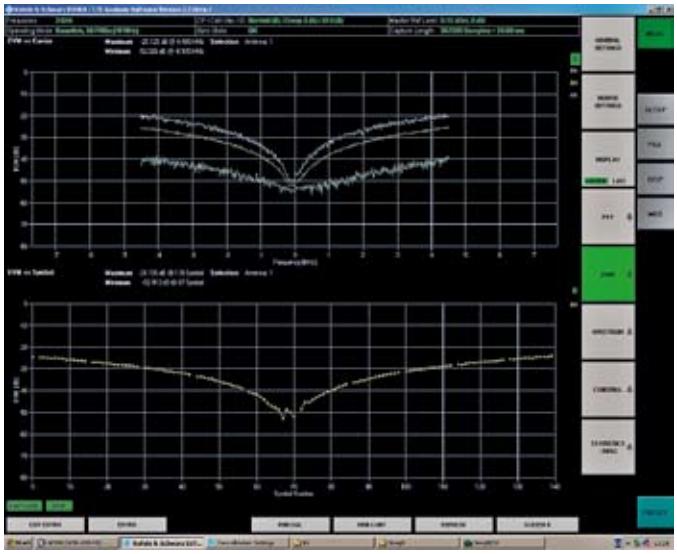
Constellation diagram of the same signal displayed after the MIMO decoder.

Quick analysis of transmitter performance by controlling the demodulator

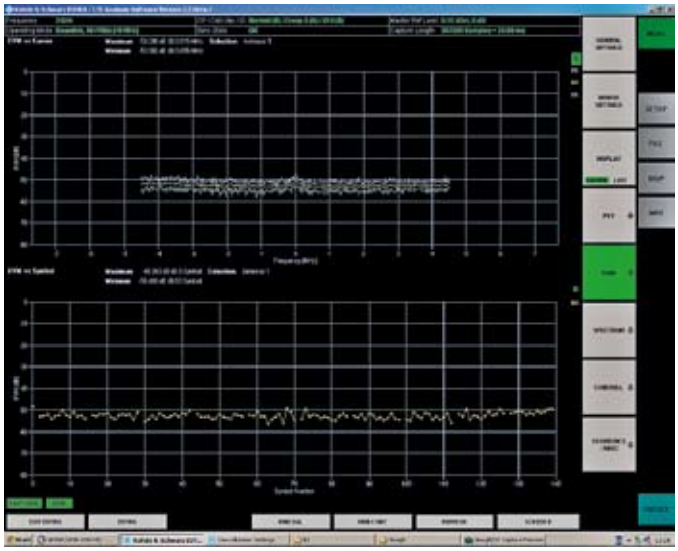
In the SISO case, each subframe is analyzed separately for the number of resource blocks used and the modulation formats used in the signal. The results make it possible to configure the demodulator for best performance and ease of use.

For verification purposes, the allocations can also be entered in the R&S®FSQ-K100/-K101/-K102 software, and the measured signal can be analyzed using these settings to validate the allocations made by the transmitter.

Downlink signal with poor EVM.



The activated tracking parameters for the demodulator reveal that the signal has a timing problem.



Technologies

UMTS Long Term Evolution (LTE)

UMTS LTE is to ensure the competitiveness of UMTS for the next ten years and beyond and to provide a low-latency and packet-optimized system with high data rate. LTE is also known as EUTRA (Evolved UMTS Terrestrial Radio Access) and EUTRAN (Evolved UMTS Terrestrial Radio Access Network). Besides peak data rates of 100 Mbps in the downlink and 50 Mbps in the uplink, a significant increase in spectrum efficiency and capacity as well as a significant latency reduction are planned.

Deployment

EUTRAN can be deployed as a standalone network, but integration with existing UMTS and GSM/GPRS/EDGE networks is a major deployment scenario as well.

OFDMA

Orthogonal frequency division multiple access is a multi-user version of the orthogonal frequency division multiplexing (OFDM) digital modulation scheme. OFDMA systems use a large number of closely spaced carriers to transmit data. Each carrier transmits at a much lower data rate than the complete system, and is therefore less susceptible to the distortions that may occur in the RF channel. The OFDMA modulation scheme is used in the downlink of LTE.

SC-FDMA

Single-carrier frequency division multiple access is the modulation format used in the uplink. It is closely related to OFDMA but has a lower peak-to-average ratio and has been chosen by the standardization committee because this feature will lead to better efficiency in the user equipment.

MIMO

MIMO is the use of multiple antennas at both the transmitter and receiver to improve communications performance. It offers significant increases in data throughput and link range without additional bandwidth or transmit power. MIMO can be subdivided into three main categories, i.e. precoding, spatial multiplexing, and diversity coding.

System configuration

Baseband measurements

The R&S®FSQ-B71 option makes it possible to analyze signals in the analog baseband. The signals can be single-ended or balanced.
Digital baseband signals can be analyzed by adding the R&S®FSQ-B17.

MIMO measurements

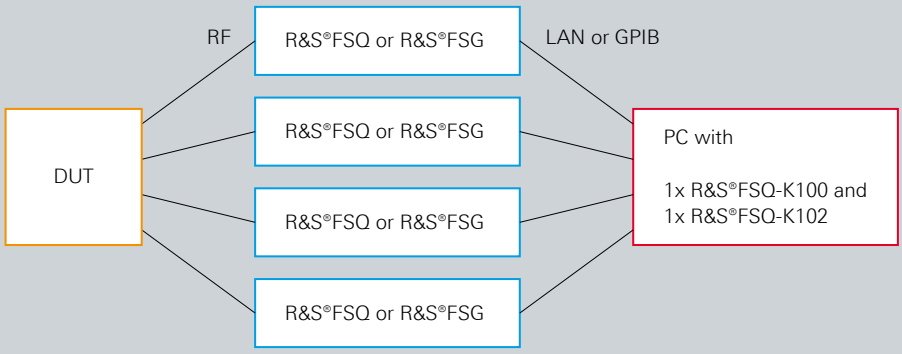
For measurements on multiple antenna systems in the downlink, several R&S®FSQ or R&S®FSG analyzers can be combined. For a complete signal analysis, the same numbers of analyzers and transmitters are required. Two analyzers are required for a two-transmitter system and four analyzers for a four-transmitter system.

To perform MIMO measurements, only one of the R&S®FSQ or R&S®FSG analyzers must be equipped with the R&S®FSQ-K100 and R&S®FSQ-K102 option keys.

Minimum system requirements

WindowsXP Pro + Service Pack II, 512 Mbyte RAM,
1 Gbyte free disk space, graphics resolution 800 × 600 pixel.
GPIB or LAN interface, VISA driver.

Configuration for a four-transmitter MIMO system



Ordering information

Designation	Type	Order No.
EUTRA/LTE Downlink PC Software	R&S®FSQ-K100	1308.5244.02
EUTRA/LTE Uplink PC Software	R&S®FSQ-K101	1308.9058.02
EUTRA/LTE Downlink MIMO PC Software (requires R&S®FSQ-K100)	R&S®FSQ-K102	1309.9000.02
Hardware options required for the R&S®FSQ/FSG analyzers		
Signal Analyzer 20 Hz to 3.6 GHz	R&S®FSQ3	1155.5001.03
Signal Analyzer 20 Hz to 8 GHz	R&S®FSQ8	1155.5001.08
Signal Analyzer 20 Hz to 26.5 GHz	R&S®FSQ26	1155.5001.026
Signal Analyzer 20 Hz to 40 GHz	R&S®FSQ40	1155.5001.40
Spectrum Analyzer 9 kHz to 8 GHz	R&S®FSG8	1309.0002.08
Spectrum Analyzer 9 kHz to 13 GHz	R&S®FSG13	1309.0002.13
I/Q Baseband Inputs (R&S®FSQ only)	R&S®FSQ-B71	1157.0113.02
I/Q Digital Baseband Interface	R&S®FSQ-B17	1163.0063.02
Extras		
Digital Signal Interface Module including power supply, USB and LVDS cable, three breakout boards, one Tyco Z-Dok 168-pin connector, operating and service manual	R&S®EX-IQ-Box	1409.5505.02

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For data sheets, see
PD 5213.8521.22
PD 5213.9186.22
and www.rohde-schwarz.com
(search terms: FSQ-K100/-K102,
FSQ-K101)

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