WCDMA/3GPP Application firmware FSIQ-K72

Transmitter measurements on 3GPP base stations and modules with Signal Analyzer FSIQ

Adds further measurement functions according to 3GPP specifications for the FDD mode to the FSIQ analyzer family.

- Code domain power (code domain analyzer)
- Code domain power versus time
- Error vector magnitude (EVM)
- Peak code domain error
- Timing offset
- Occupied bandwidth (OBW)
- Adjacent-channel leakage ratio (ACLR)

Featuring wide dynamic range for adjacent-channel power and high-precision RMS power measurements, FSIQ is an ideal tool for base station transmitter measurements in development and production

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Application Firmware FSIQ-K72 enhances the wide range of applications of Signal Analyzer FSIQ to include code domain power and modulation measurements on 3GPP/FDD base station signals. All transmitter measurements required according to Specification 3G TS 25.141 V3.2.0 can thus be performed by a single instrument.

Measurement	Chapter of Specification 25.141	FSIQ	FSIQ with FSIQ-K72
Base station maximum output power	6.2.1	x	
CPICH power accuracy	6.2.2		x
Frequency error	6.3, 6.7.1	x[2)]	x
Power control dynamic range	6.4.3		x
Total power dynamic range	6.4.4		x
Occupied bandwidth	6.5.1	x	
Spectrum emission mask	6.5.2.1	x[1)]	
ACLR	6.5.2.2	x	
Spurious emissions	6.5.3	x[1)]	
Error vector magnitude	6.7.2	x[2)]	x
Peak code domain error	6.7.3		x

1) These measurements can be performed with basic functions of FSIQ, there are no 3GPP-specific setting functions.
2) These measurements can be performed on a 3.84 MHz QPSK signal (e.g. only P-CCPCH without SCH).Code Domain Power-Messungen

Code domain power measurements

The main application of the FSIQ-K72 is the determination of the power in the individual code channels referred to as code domain power measurement. The power ratios between the individual channels for instance can be checked for compliance with the nominal values. Moreover, this measurement is a very efficient tool for detecting impairments such as clipping or intermodulation effects that are not obvious from the spectrum alone.

The power of the different codes is shown versus the code number. The width of the displayed bargraph intuitively provides information about the occupied code domain and the spreading factor.

To investigate power control, the power characteristic in a code channel can be displayed versus all slots of a frame (10 ms).

Measurement of modulation quality: peak code domain error and EVM

Two different measurements are stipulated in Specification 3G TS 25.141 for determining the modulation quality:

- EVM (error vector magnitude)
- Peak code domain error

For a signal with e.g. only one P-CCPCH without SCH, the EVM can be determined with the normal vector signal analysis function of the FSIQ.

The code domain power measurement offers an in-depth analysis for a WCDMA signal with several active channels. The "modulation accuracy" measurement returns a modulation error value for the total signal, whereas the symbol EVM function yields the individual vector errors of the active channels.

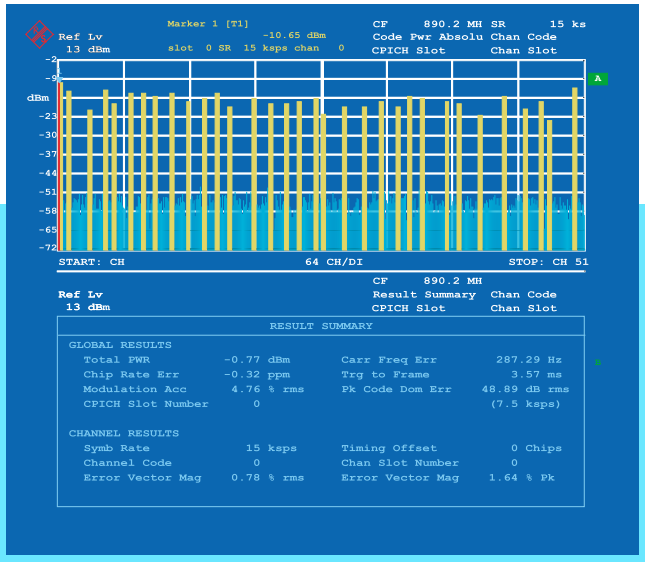
To obtain the peak code domain error (PCDE), the vector error between the measured signal and the ideal reference signal is determined and projected to the codes of a specific spreading factor. With FSIQ-K72, the spreading factor for the PCDE measurement can be selected by the user.

Automatic detection of active channels and their data rate

The scrambling code, which is user-selectable on the FSIQ, must be known for the code domain power measurement. 3GPP/FDD signals may use different spreading factors and data rates in the various channels. The data rates are automatically detected by FSIQ-K72 and need not be known beforehand.

Spectrum measurements over wide dynamic range

FSIQ is a powerful analyzer for WCDMA signals even without Application Firmware FSIQ-K72 and of course retains these functions when fitted with FSIQ-K72. An RMS detector integrated as standard allows precise transmitter power measurements irrespective of the waveform. The reproducibility of the measurement can easily be adapted to the test requirements via the measurement time. Given the settings defined for channel power measurements in line with the 3GPP standard and the associated measurement time of 2 s, a reproducibility of <0.01 dB is obtained for the channel power measurement. With a measurement time of 200 ms the reproducibility (1 σ value) is <0.1 dB. Thanks to its extremely wide dynamic range the FSIQ is the ideal analyzer for out-of-band emissions that have to be detected for instance by means of adjacent-channel power measurements. With a dynamic range of more than 75 dB in the adjacent channel and more than 82 dB in the alternate channel FSIQ exceeds by far the values prescribed by the specification.



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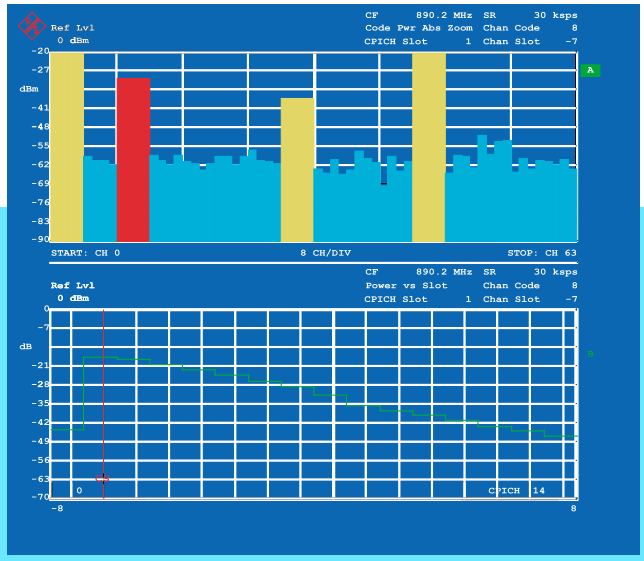

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Measurements cannot only be performed on systems but also on individual components such as amplifiers which have to meet more stringent requirements.

To achieve the maximum dynamic range, the optimum mixer level can be set very precisely using the optional 1 dB Attenuator FSE-B13.

To simplify operation, FSIQ-K72 provides the main spectrum measurements in the main menu:

- Power
- ACLR
- Occupied bandwidth
- Spectrum
- Time domain

Remote control

All measurements can be remote-controlled as well as results and demodulated data be transferred via the IEEE bus. The settings already defined in the application firmware make the handling of the FSIQ extremely easy so that it is ideal for use in production environments.

Other standards

Application Software Packages FSE-K11 (GSM transmitter measurements), FSIQ-K71 (code domain power measurements for IS-95) and the basic vector signal analysis functions of FSIQ itself make FSIQ a universal and multistandard-capable platform for base station transmitter measurements.

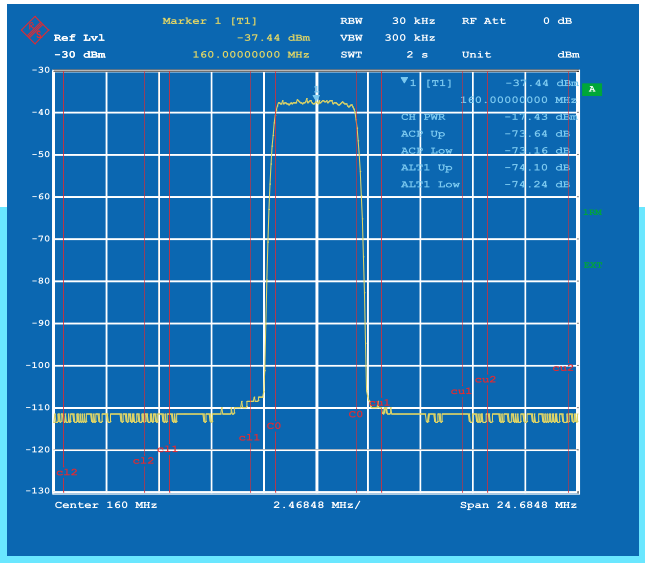
Applications and examples

Code domain power measurement on a signal with 32 active channels (1)

Active and inactive channels are marked in different colours. Inactive channels (noise, interference) are displayed with the highest spreading factor. The table shows in addition the main parameters of the total signal at a glance, e.g. total power, frequency error and error of chip rate, as well as the parameters of the marked code channel, such as timing offset and code power.

Measurement of code domain power versus time (2)

The code power can additionally be displayed versus the 15 slots of a frame to determine the accuracy of power control.



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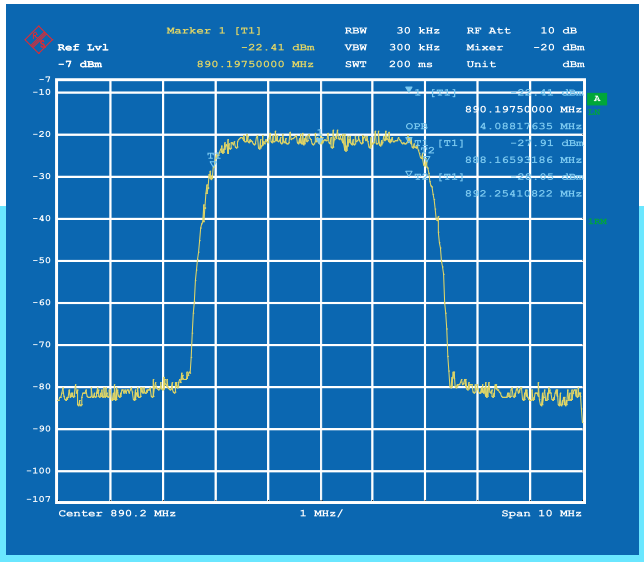

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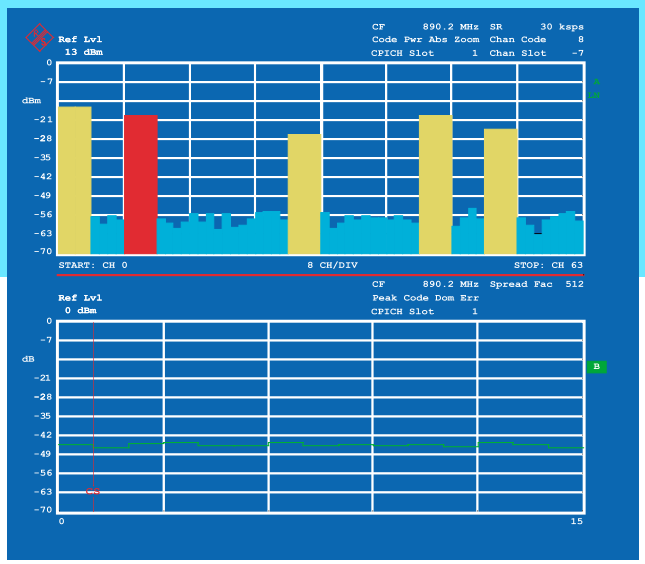

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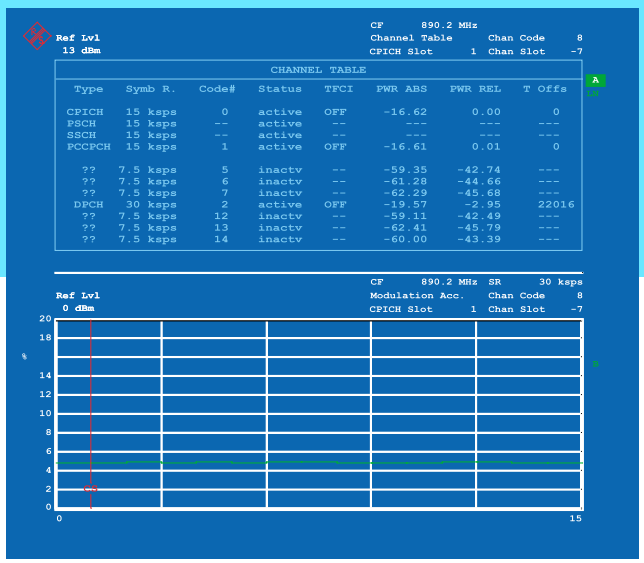

ACLR measurement with maximum dynamic range and highly reproducible RMS power measurement (3)

The requirements for measurements on components are usually more stringent than the limit values prescribed by the specification. With its low noise figure of 18 dB and third-order intercept point of 20 dBm (FSIQ7), the FSIQ features an adjacent-channel leakage ratio of 75 dB.

Measurement of occupied bandwidth (4)

The occupied bandwidth is measured to determine the bandwidth in which 99% of the signal power is transmitted. The limit value according to 3GPP is 5 MHz.

Peak code domain error measurement (5)

The peak code domain error is projected to the codes of the highest spreading factors. The maximum value of all codes per slot is displayed.

Error vector measurement (6)

A signal comprising a large number of active channels can no longer be analyzed with the usual vector signal analyzer functions. FSIQ-K72 therefore provides the modulation accuracy measurement function that allows the EVM of a total signal to be measured for multichannel signals too. This measurement is closer to reality than the EVM measurement with one active channel only (P-CCPCH).

Specifications

The specifications below apply to FSIQ3, FSIQ7, FSIQ26 and FSIQ40 fitted with options FSIQ-B70 and FSIQ-K72. They are based on the data sheet specifications of Signal Analyzer FSIQ and have not been checked separately. Specifications are guaranteed under the following conditions: 15 minutes warmup time at ambient temperature, specified environmental conditions met, calibration cycle adhered to and internal calibration performed. Data with tolerances are measurement uncertainties with a confidence level of 95%. Data without tolerances are typical values. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.

Measurement		Test specifications and permissible measurement uncertainty to 3G TS 25.141 V3.2.0
Code domain power (applies to code domain power and code domain power vs slot)		
Total signal power, measurement uncertainty	<0.6 dB	6.2.1
CPICH power, measurement uncertainty	<0.7 dB	6.2.2
Code power; measurement uncertainty Absolute Relative	 <0.7 dB <0.1 dB	
Frequency error Measurement range Uncertainty (S/N > 40 dB)	 <1 kHz <1.5 Hz + error of reference frequency	6.3, 6.7.1 <0.05 ppm
Modulation accuracy (composite EVM)		
Measurement range	1.5% to 25%	
Inherent EVM	<1.5%	
Measurement uncertainty	<0.5%	
Peak Code Domain Error		6.7.3
Measurement range Inherent PCDE Measurement uncertainty	0 dB to – 60 dB –60 dB <1 dB (0 dB to – 40 dB)	–33 dB
Output power		6.2.1
Measurement uncertainty, absolute	<0.6 dB	1 dB
Measurement uncertainty, relative	<0.2 dB	0.7 dB
Occupied bandwidth (99%)		6.5.1
Measurement uncertainty	<85 kHz	
ACLR (adjacent channel leakage ratio) (3.84 MHz BW)		6.5.2.2
5 MHz offset Dynamic range Measurement uncertainty	 75 dB <0.5 dB (ACLR <60 dB)	45 dB
10 MHz Offset Dynamic range Measurement uncertainty	 82 dB <0.5 dB (ACLR <60 dB)	50 dB
Spurious emissions		
Level uncertainty <2.2 GHz 2.2 GHz to 4 GHz >4 GHz	 <1dB <1.5 dB <2.5 dB	

Ordering information

Application Firmware FSIQ-K72 can be integrated into any member of the FSIQ family. Option FSIQ-B70, memory extension and DSP, is a prerequisite for operating the application firmware. Additional modifications may become necessary if option FSIQ-B70 is retrofitted.

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Designation	Type	Order No.
Application Firmware 3GPP BTS Code Domain Power Measurements for FSIQ	FSIQ-K72	1126.4746.02
DSP and IQ Memory Extension 2 x 512 k	FSIQ-B70	1119.6747.02

Recommended extras

Designation	Type	Order No.
1 dB Attenuator for FSE/FSIQ	FSE-B13	1126.4746.02
High-Power Attenuator 20 dB, 50 W, 0 GHz to 6 GHz	RDL50	1035.1700.52

Certified Quality System ISO 9001 DQS REG. NO 1954

Certified Environmental System ISO 14001 REG. NO 1954-03

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