Data sheet

Version 04.00

July 2006

CDMA2000® Base Station Test Application Firmware R&S®FS-K82
1xEV-DO Base Station Test Application Firmware R&S®FS-K84

Transmitter measurements on 3GPP2 signals with Signal Analyzer R&S®FSQ and Spectrum Analyzers R&S®FSU and R&S®FSP

- Adds measurement functions in line with 3GPP2 specifications to the R&S®FSU, R&S®FSQ and R&S®FSP analyzer families
- R&S®FS-K82: provides the functionality needed for CDMA2000® and 1xEV-DV testing
- R&S®FS-K84: provides 1xEV-DO functionality
- Provides the functionality needed for base station testing as well as the related parameters
  - Code domain power (code domain analyzer)
  - Code domain power versus time (R&S®FS-K82)
  - Rho
  - Error vector magnitude (EVM)
  - Peak code domain error
  - Power versus symbol
  - Symbol constellation
  - Channel table
  - Code domain error power
  - Power versus chip (R&S®FS-K84)

Now with 1xEV-DO revision A

ROHDE&SCHWARZ

The R&S®FS-K82 and R&S®FS-K84 application firmware packages can be installed on all models of the Signal Analyzers R&S®FSQ and Spectrum Analyzers R&S®FSU and R&S®FSP. R&S®FS-K82 enhances the range of applications to include code domain power and modulation measurements on CDMA2000® signals for radio configurations 1 to 5 and 10.

cdmaOne base station signals can be analyzed by using radio configuration 1 or 2. R&S®FS-K84 adds the capability to measure code domain power modulation accuracy on all four channel types (pilot, preamble, MAC and DATA) of a 1xEV-DO base station signal.

Featuring wide dynamic range for adjacent channel power, the R&S®FSQ and the R&S®FSU are ideal tools for CDMA2000® base station transmitter measurements in development and production.

The R&S®FSP is the ideal development tool with easy-to-use measurement functions integrated into a cost-effective analyzer – the workhorse for every engineer.

Code domain power measurements

The main application 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 transmitter impairments such as clipping or intermodulation that are not obvious from the spectrum alone.

CDMA2000®

R&S®FS-K82 supports the analysis of orthogonal transmit diversity signals. Not only the signals for the separate antennas can be studied, but also the combined signal as it is seen by a mobile receiver.

The power of the different codes can be shown versus the code number. This is called Hadamard order. The code powers can also be displayed in bit-reversed order which intuitively provides information about how much of the code domain is occupied by each single user.

To investigate power control, the power characteristic in a code channel can be displayed versus a number of power control groups (PCG). The number of PCGs to be analyzed can be changed. For the R&S®FSQ the number of PCGsranges between 2 and 2432, for the R&S®FSU between 2 and 50, and for the R&S®FSP between 2 and 12.

To look even further into the behavior of a single code, the power versus symbol feature is a very useful tool.

1xEV-DO

The code domain analysis in R&S®FS-K84 comprises the analysis of the four different channel types of the signals. The modulation quality of the pilot, preamble, data and MAC parts can be evaluated separately. The modulation formats and the preamble length are automatically detected.

1xEV-DO revision A

With revision A of the standard, a number of parameters in the signal has changed. For code domain analysis, the user merely has to switch between revison 0 and A to make the complete functionality available. Furthermore, any changes to the MAC and preamble are automatically detected.

Measurement overview

Measurement	R&S®FSU/FSP/FSQ	R&S®FSU/FSP/FSQ with R&S®FS-K82	R&S®FSU/FSP/FSQ with R&S®FS-K84
Maximum output power	×	×	×
Frequency error		×	×
Power control dynamic range		×	N/A
Power versus chip		N/A	×
Total power dynamic range		×	×
Occupied bandwidth	×	×	×
Spectrum emission mask		×	×
ACLR	×	×	×
Spurious emissions	×		
Rho		×	N/A
Rho_{MAC}			×
Rho_{DATA}			×
Rho_{pilot}		N/A	×
$Rho_{overall-1}$		N/A	×
$Rho_{overall-2}$		N/A	×
Error vector magnitude		×	×
Peak code domain error		×	×
Power versus time			×

The number of slots that can be analyzed ranges between 2 and 1824 for the R&S®FSQ, between 2 and 32 for the R&S®FSU, and between 2 and 12 for the R&S®FSP.

To look even further into the behavior of the time division of the signal, the power versus chip is useful.

Measurement of modulation quality: rho, peak code domain error and EVM
Three different measurements are commonly used in CDMA2000® systems for determining the modulation quality:

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

For 1xEV-DO, the rho measurement is subdivided into several new measurements due to the time division structure:

- Rho_{MAC}
- Rho_{DATA}
- Rho_{pilot}
- $Rho_{overall-1}$
- $Rho_{overall-2}$

The composite EVM measurement returns a modulation error value for the total signal, whereas the symbol EVM function yields the individual vector errors of the active channels.

Rho is the correlation between the measured signal and the ideal reference signal and is a measure of the overall modulation quality.

To obtain the peak code domain error (PCDE), the vector error between the measured signal and the ideal reference signal is determined. With CDMA2000®, the base spreading factor is selectable between 64 and 128.

With 1xEV-DO and 1xEV-DV, the spreading factors are fixed for the different channel types of the signal. The transmission rate of the user data is changed by switching the modulation format between QPSK, 8PSK and 16QAM. For the MAC part of the signal in revision A of 1xEV-DO, ON/OFF keying may also be used. These changes are automatically detected by the firmware.

Automatic detection of active channels and their data rate
The data rates of the user channels are automatically detected by R&S®FS-K82 and R&S®FS-K84 and need not be known beforehand. The channel configuration tool enables the user to define the active channels, which improves the capabilities to measure under difficult signal conditions.

Band class settings
The frequency band classes 0 to 12 as specified by the standard are user-selectable, so that the correct limits are set in the ACLR and spectrum emission mask measurements.

Spectrum emission mask
To perform the spectrum emission mask measurement in line with the 3GPP2 specifications, R&S®FS-K82 and R&S®FS-K84 provide an automatic function that produces a pass/fail result. If requested by the band class setting, the limits depend on the channel power.

Spectrum measurements over wide dynamic range
The RMS detector integrated as standard allows accurate transmitter power measurements irrespective of the waveform. Due to their extremely wide dynamic range, the R&S®FSU and R&S®FSQ are the ideal analyzers for out-of-band emissions that have to be detected, for instance, by means of adjacent-channel power measurements.

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

Remote control
All measurements can be remote-controlled. The results and demodulated data bits can be transferred via the IEEE bus. This makes R&S®FS-K82 and R&S®FS-K84 ideal for use in production.

CDMA2000® applications and examples

Code domain power measurement on a signal with 21 active channels (1)
Active and inactive channels are displayed in bit-reversed order. Inactive channels (noise, interference) are displayed with the base spreading factor. The table also shows the main parameters of the total signal at a glance, e.g. total power, pilot power, rho, frequency error and error of chip rate, as well as the parameters of the marked code channel such as code power, modulation format and EVM.

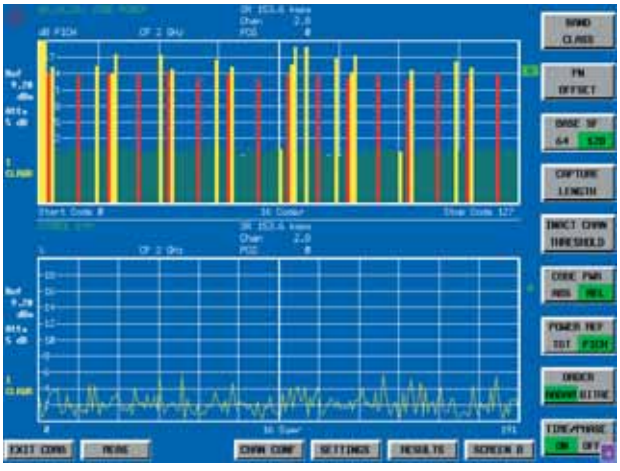
Measurement of error vector magnitude versus symbol (2)
The upper half of the screen displays the code domain overview with the codes sorted in Hadamard order. The EVM for each symbol in a power control group is shown in the lower half of the screen.

Automatic detection of channels and decoding of information (3)
Information about the active channels is presented in a list. In addition, the user data transmitted on each physical channel can be analyzed.

Measurement of code domain power versus time (4)
The code domain power can additionally be displayed versus the selected 10 PCGs to determine the accuracy of power control.

1

2



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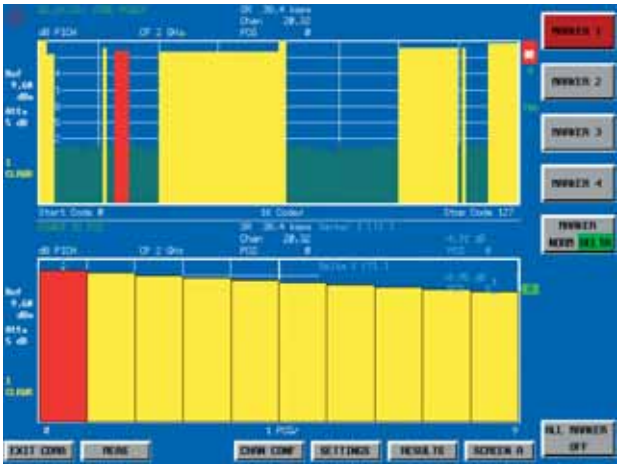
4



1xEV-DO applications and examples

Code domain overview display of MAC (5)
The upper part of the screen shows the active codes for the MAC transmission. In the lower part, a summary of the results, symbol rate, power and symbol EVM are displayed for the in-phase part of the signal.

Channel table and composite constellation diagram of MAC (6)
The upper part of the screen shows an overview of the detected channels and a number of parameters, such as power, modulation format and timing offset. The lower part shows the composite constellation diagram of the MAC part of the signal.

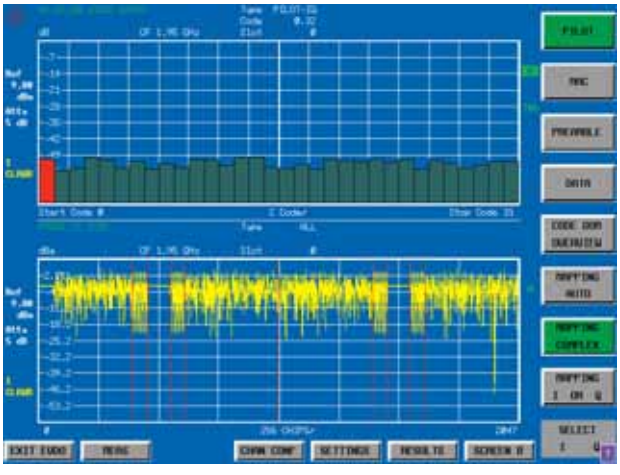
Error power and power versus chip (7)
The distribution of the error power for the pilot part of the signal is displayed in the upper part of the display. The power versus chip is shown in the lower part. The pilot, MAC, data and pilot parts of the signal are marked with red bars.

Code domain overview of a revision A signal (8)
The code domain shows the MAC part of the signal. The base spreading factor is 128, as compared to 64 in the revision 0 signal (5). The lower part of the screen shows the results for the MAC part. The selected red code uses ON/OFF keying.

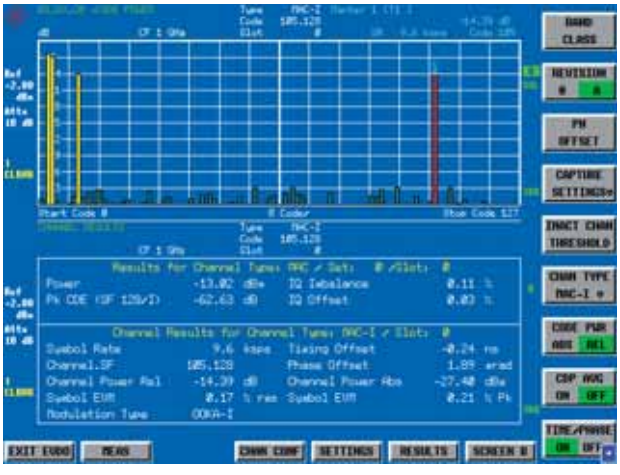
5

6

7



8



Specifications

The specifications below apply to the R&S®FSUx (R&S®FSU3/8/26/46/50), R&S®FSQx (R&S®FSQ3/8/26/40) and R&S®FSPx (R&S®FSP3/7/13/30/40). They are based on the data sheet specifications of the Analyzers R&S®FSQ, R&S®FSU and R&S®FSP and have not been checked separately. Specifications apply 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%. The specified level measurement errors do not take into account systematic errors due to reduced S/N ratio.

Common parameters

Measurement	R&S®FSP	R&S®FSU/R&S®FSQ
Code domain power (applies to code domain power and code domain power versus slot)		
Total signal power, measurement uncertainty	<0.5 dB	<0.3 dB
Pilot power, measurement uncertainty	<0.6 dB	<0.4 dB
Code power, measurement uncertainty Absolute Relative	 <0.6 dB <0.1 dB	 <0.4 dB <0.1 dB
Composite EVM		
Measurement range	1.5% to 25%	1% to 25%
Inherent EVM	<1.5%	<1%
Measurement uncertainty	<0.5% of reading	<0.25% of reading
Output power		
Measurement uncertainty Absolute Relative	 <0.5 dB <0.2 dB	 <0.3 dB <0.1 dB
Occupied bandwidth (99%)		
Measurement uncertainty	<85 kHz	<85 kHz
Spurious emissions		
Level uncertainty <3.6 GHz 3.6 GHz to 13 GHz	 <0.5 dB <2.5 dB	 <0.5 dB <2.5 dB
Trig to Frame		
Accuracy	<210 ns	<210 ns

R&S®FS-K82 only

Measurement	R&S®FSP	R&S®FSU/R&S®FSQ
Peak code domain error (PCDE)		
Measurement range	0 dB to 55 dB	0 dB to 60 dB
Inherent PCDE	55 dB	60 dB
Frequency error		
Measurement range Measurement uncertainty (S/N >40 dB)	<1 kHz <1.5 Hz + error of reference frequency	<1 kHz <1.5 Hz + error of reference frequency

R&S®FS-K84 only

Measurement	R&S®FSP	R&S®FSU/R&S®FSQ
Peak code domain error (PCDE)		
Measurement range	0 dB to –53 dB	0 dB to –58 dB
Inherent PCDE Pilot MAC Data Preamble	 –50 dB –53 dB –47 dB –50 dB	 –55 dB –58 dB –52 dB –55 dB
Measurement uncertainty	<1 dB (0 dB to –40 dB)	<1 dB (0 dB to –40 dB)
Frequency error		
Measurement range Measurement uncertainty (S/N >40 dB)	<8 kHz <1.5 Hz + error of reference frequency	<8 kHz <1.5 Hz + error of reference frequency

Ordering information

Application Firmware R&S®FS-K82 and R&S®FS-K84 can be integrated into any member of the R&S®FSU, R&S®FSQ or R&S®FSP families.

Designation	Type	Order No.
CDMA2000® Base Station Test Application Firmware	R&S®FS-K82	1157.2316.02
1xEV-DO Base Station Test Application Firmware	R&S®FS-K84	1157.2851.02

Recommended extras

Designation	Type	Order No.
High-Power Attenuator 20 dB, 50 W, 0 GHz to 6 GHz	R&S®RDL50	1035.1770.52

More information at
www.rohde-schwarz.com
(search terms: FS-K82, FS-K84)

ROHDE&SCHWARZ

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