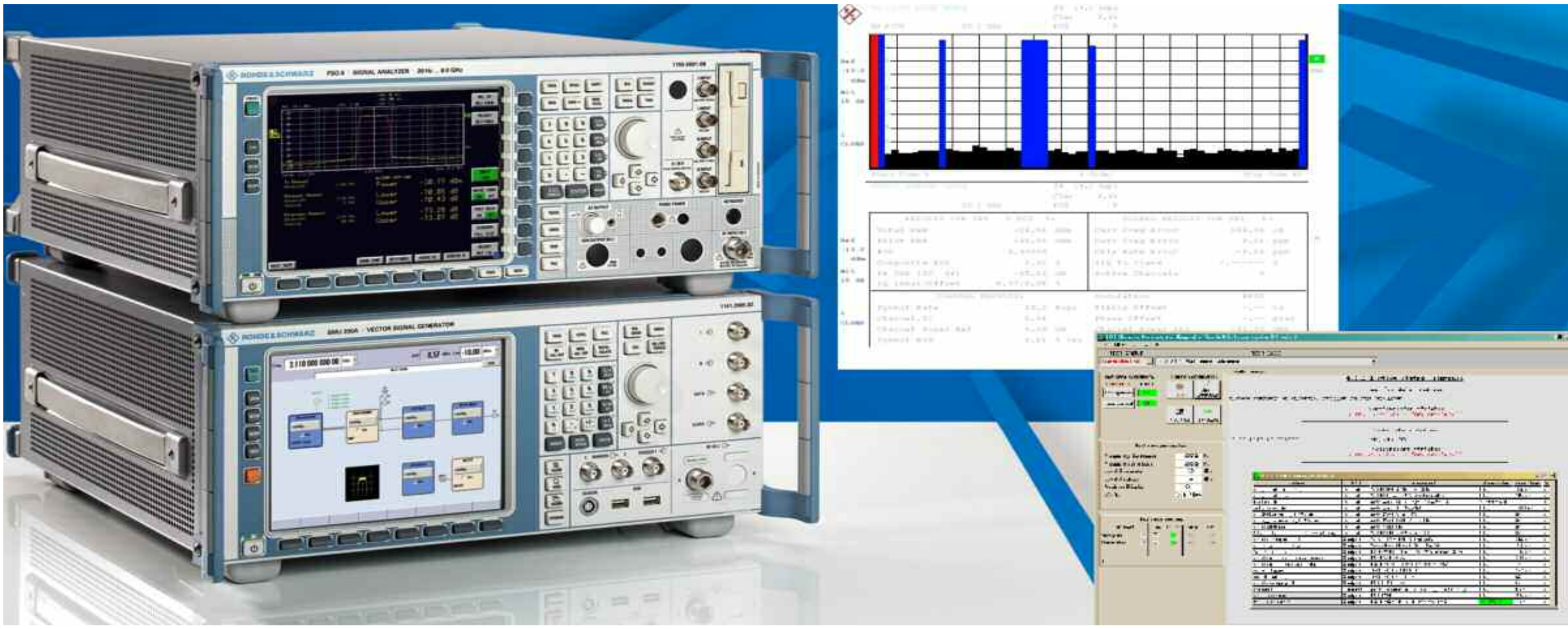


Products: R&S® Vector Signal generator SMU200A, R&S® Signal Analyzer FSP, R&S® FSU, R&S® FSQ

CDMA2000® Base Station Tests With the R&S®SMU200A Vector Signal Generator and Rohde & Schwarz Spectrum Analyzers

Application Note 1MA109

This Application Note describes measurements compliant with the CDMA2000® base station standard described in 3GPP2 C.S0010-C v2.0 / TIA/EIA-97-F-1.

The primary focus is on solutions for generating and analyzing CDMA2000 signals. The special characteristics that make the selected signal generators and signal analyzers highly suitable for this purpose are detailed, and remote control programming is demonstrated by means of a free-of-charge program.

ROHDE&SCHWARZ

Contents

The following abbreviations are used in this Application Note for Rohde & Schwarz test equipment:

- The R&S SMU vector signal generator is referred to as SMU.
- The R&S FSP spectrum analyzer is referred to as FSP.
- The R&S FSU spectrum analyzer is referred to as FSU.
- The R&S FSQ signal analyzer is referred to as FSQ.
- The FSP, FSU, and FSQ in general are referred to as FSx.

1 Overview

CDMA2000 as described by the Third Generation Partnership Project 2 (3GPP2) is an access method for use in the IMT-2000 proposal for third-generation (3G) cellular phone systems. The system is based on spread-spectrum codes and provides high and variable data rates.

This Application Note describes solutions for generating and analyzing CDMA2000 signals using equipment from Rohde & Schwarz. The features that make the SMU vector signal generator and the FSP and FSU spectrum analyzers and the FSQ signal analyzer highly suitable for this purpose are detailed.

This Application Note describes the solution with an SMU200A. Furthermore, various changes made to the standard are covered here.

Each measurement as described in the standard is shown, special implementation tips are provided, and typical measurement results are presented as instrument screenshots.

This Application Note covers receiver and transmitter tests in line with the following standards:

- 3GPP2 C.S0010-C v2.0
- TIA/EIA-97-F-1

Additionally, a small, free-of-charge test sequencer software program named "GDE" (=Generic Demonstration Engine) is included to show the necessary IEEE bus commands and to run all CDMA2000 tests for demonstration and evaluation.

2 General

Special Comments

The specification mentions the spreading rates (SR) 1 ("1x") and 3 ("3x"). The SMU-K46 software option supports SR1, and only SR1 is described here. The SMU can generate SR3 via ARB files. See [xxx].

Very high power occurs on base stations! Be sure to use suitable attenuators in order to prevent damage to the test equipment.

All Rohde & Schwarz test equipment shall be operated using an external reference frequency.

Instruments as required in the standard

The following section describes the necessary functional blocks according to the standard ([1], Section 6.4 - Standard Test Equipment) and the corresponding Rohde & Schwarz instruments and options:

Channel simulator (Section 6.4.1)

The channel simulator applies different fading profiles to the signal in order to test the receiver part of the base station.

The **SMU-B14** hardware option (fading simulator) for the **SMU** can generate all the required fading profiles quickly and easily.

Waveform quality measurement (Section 6.4.2)

This calculates the difference between the ideal and the measured signal in a vector-oriented manner (I and Q components) and calculates parameters such as the rho factor or the phase error. The calculation is done in the I/Q or code domain.

The **FSQ** / **FSU** / **FSP** with the **FS-K82** software option (CDMA2000 base station) is the ideal instrument for this kind of measurement task. It provides automatic channel detection, fast measurement in the code domain, and many different functions to evaluate CDMA2000 signals.

Mobile station simulator (Section 6.4.3)

The simulator provides a CDMA2000 signal to the RX port of the base station under test for different measurements.

An **SMU** signal generator and the **SMU-K12** software option (CDMA2000 signal generation) can generate all types of CDMA2000 signals for the 1x mode. It provides flexible signal setup for all parameters.

Please note that an SMU is NOT capable of performing an FER (frame error rate) or BER (bit error rate) measurement of a CDMA2000 signal.
For FER and BER measurements, the base station must provide a "service mode" for performing the FER and BER measurement in the base station.

AWGN generator (Section 6.4.4)

The AWGN generator simulates additive noise which is in reality generated by different sources like other mobile stations.

The **SMU-K62** software option (additive white Gaussian noise) for the SMU can generate all the required types of noise with fast setup time and very good settability and gain flatness.

CW generator (Section 6.4.5)

The CW generator is used to generate CW interference signals.

The **SMU-K61** software option (multicarrier CW signals) for the SMU can generate all the CW interferer signals.

You may use a high performance CW generator from Rohde & Schwarz such as a second **SMU/SMJ** or **SMV** or **SMR** (with full frequency range needed) to generate the CW signal.

Spectrum analyzer (Section 6.4.6)

The spectrum analyzer is used to perform power and spurious signal measurements.

You may use any Rohde & Schwarz spectrum analyzer such as the **FSP**, **FSU** or **FSQ**. In combination with the **FS-K82** CDMA2000 software option, this is the ideal choice for performing CDMA2000 transmitter measurements and evaluating receiver spurious signals.

Average power meter (Section 6.4.7)

The average power meter is used to measure the exact input power at the BS RX port or TX port.

The **NRP** power meter used in conjunction with the **NRP-Z11** power sensor is ideal for this purpose. It offers innovative multipath sensor technology, 90 dB dynamic range, high measurement speed, and accurate measurement results.

You can use the NRP-Z11 in combination with the NRP base unit or directly connect it to your PC via USB bus (using the **NRP-Z3** or **NRP-Z4** option).

Complete test setup

The following overview shows a recommended complete test setup for CDMA2000 BS tests.

For each individual test, only a part of the components is used. Please refer to the corresponding section in order to check which instruments are necessary.

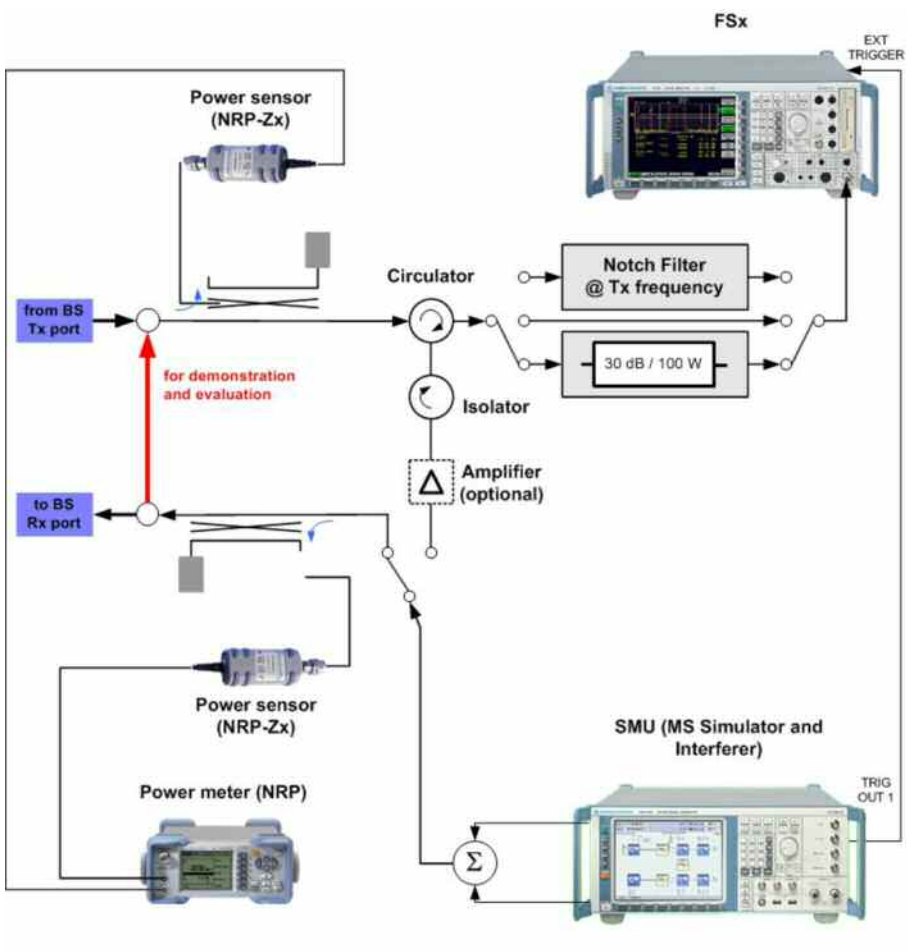


Figure 1 - Complete test setup

Test modes

The standard stipulates ten different test modes (Table 1).

Test Mode	Forward Traffic Channel Radio Configuration			Reverse Traffic Channel Radio Configuration		
	Fundamental	Supplemental	Dedicated Control	Fundamental	Supplemental	Dedicated Control
1	SO 2 / 54 / 55	SO 30		SO 2 / 54 / 55	SO 30	
	RC1			RC1		
2	SO 9 / 54 / 55	SO 31		SO 9 / 54 / 55	SO 31	
	RC2			RC2		
3	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC3			RC3		
4	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC4			RC3		
5	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC5			RC4		
6	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC6			RC5		
7	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC7			RC5		
8	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC8			RC6		
9	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC9			RC6		
10(a)	SO 32 / 54 / 55	SO32	SO32	SO 32 / 54 / 55	SO32	SO32
	RC10			RC3		

Table 1 - Test modes

GDE

This Application Note comes with a small demo program called "GDE" (=Generic Demonstration Engine) which is free of charge.

Each test described in this Application Note can be executed quickly and easily using the demo program. Results and test times can be evaluated with a single mouse click.

The program offers a straightforward user interface, benchmarking, and IEEE command sequence export functions for integrating the programming code into any user-specific test environment.

NOTE - Demonstration:

To demonstrate or evaluate the functions of the instruments, please connect the SMU vector signal generator directly to the FSx signal analyzer via the RF port.

PC requirements

Recommended system configuration:

- ***Operating system:***
  Windows 98 / 2000 / Me / XP
  Microsoft Internet Explorer 5.0 or later
- ***General PC requirements:***
  - Pentium II 450 MHz or later
  - 128 Mbyte
  - 50 Mbyte free hard disk space (to store WV files and test cases)
  - XGA monitor (1024x768)

- ***IEC/IEEE bus interface:***
  National Instruments GPIB card, driver software version 1.7 or later

Installation

The file 1MAxx_<version number>.EXE is required in order to install the sequencer GDE and the CDMA2000 test cases on the controlling PC.

Execute the installation program and select the installation directory. During installation, program files are copied to a directory of your choice. A new menu item “R&S CDMA2000 tests” is created in the START menu of your windows system.

Getting started

When the program is started the first time, you are requested to register.

We kindly ask you to register GDE. Registration is free of charge and does not obligate you or your company. The unregistered version has full functionality and no expiration date.

Please follow the instructions on the screen in order to register GDE. After clicking "Continue" or entering Name and Key, the user interface will come up:

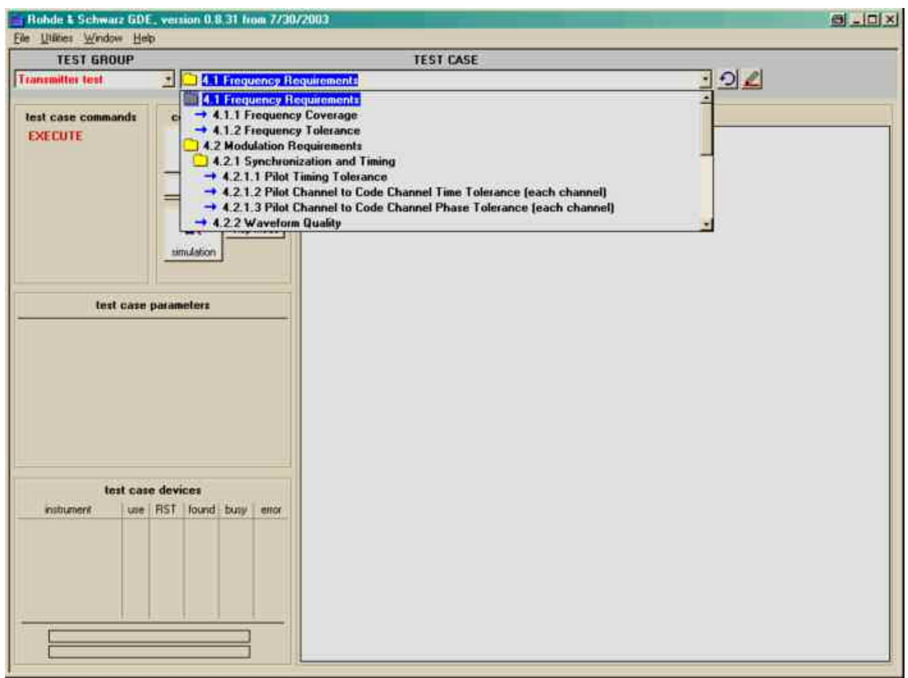


Figure 2 - GDE overview

- Under TEST GROUP, you can select between transmitter and receiver tests.
- Each test described in this Application Note is listed in the list box TEST CASE.
- Once a test case is selected, you can set up additional parameters (TEST CASE PARAMETERS).

- Test runs are always divided into configuration and measurement. Use the buttons in the TEST CASE COMMANDS frame to start the individual test steps.
- Results and messages are displayed in the RESULT SUMMARY frame.

For details about information and installation, please refer to the manual on GDE or use the online manual by pressing the <F1> key in GDE.

3 CDMA Receiver Minimum Standards

Note: If RX diversity measurements need to be carried out, a two-path SMU can generate two uncorrelated CDMA signals.

Note: The SMU can provide several different signals for triggering the BUT (frame trigger, P2S trigger, etc).

Prior considerations

The tests are listed individually here based on their structure in the specification. Every test sequence of the demonstration can be run by itself. To save time, several tests can also be combined.

Demonstration

For all RX measurements, the SMU generates the signal. For demonstrations the analyzer shows the test signal generated by the SMU.

Level

The signal level to be set (S) is described indirectly in the specification via the noise level N and the ratio of the received energy per bit (E_b) to the received noise power and interference power (N_0). Calculating the logarithm as follows

$$\frac{S}{N} = \frac{E_b}{N_0} \bullet \frac{Bit\ rate}{Bandwidth}$$

yields

$$S = N + \frac{E_b}{N_0} + 10\log\frac{Bit\ rate}{Bandwidth} \qquad \text{(Formula 1)}$$

Example: With the parameters mentioned in the specification (Access Channel Probe (3.2.2.1))

- N = - 90 dBm
- E_b/N_0 = 6.5 dB
- Bit rate = 4.8 kbps
- Bandwidth = 1.23 MHz

the level S = -107.59 dBm is to be set.

For the demonstration the levels have been adapted to make it easy to display them on a spectrum analyzer.

RX test models

For the RX test, specific channels for each case must be generated individually:

- R-ACH only
- R-EACH only

- R-CCCH only

With the R-traffic channels, all combinations supported by the base station must be tested. These differ depending on the radio configuration, frame duration, and data rate. Two default scenarios have been created for the demonstration in GDE:

- RC1: R-FCH on, R-SCCH0 to R-SCCH6 off, data rate 1.2 kbit/s
- RC3: R-FCH on, R-SCH1 and R-SCH2 off, data rate 1.5 kbit/s, frame duration 20 ms

By using the examples, you can simply make changes and incorporate them into your own program. Table 2 shows an overview of the instruments and options used for the RX test. Table 3 shows the individual test signals.

Class	Number	Measurement	Conf	Instruments needed												
				RF generator			cdma2000 SW	CW source		Spectrum analyzer					cdma2000 SW	
				SMU	SMU-K62 (AWGN)	SMU-B14 (fading)	SMU-K12	SMU 2nd RF path	SMU 2nd RF path Multi CW	FSQ	FSU	FSP	FSIQ	R&S SA	FS K82	FSIQ K71
Receiver test	3.1	Frequency Coverage Requirements	---	---			---	---		---					---	
	3.2	Access Probe Acquisition	1	☑	☑		☑	---		---					---	
	3.3	*R-CCCH Demodulation Performance*														
	3.3.1	Performance in Additive White Gaussian Noise	1	☑	☑		☑	---		👓	👓	👓	👓	👓		
	3.3.2	Performance in Multipath Fading with Closed Loop Power Control	2	☑	☑	☑	☑	---		👓	👓	👓	👓	👓		
	3.6	*R-Traffic Channel Demodulation Performance*														
	3.6.1	Performance in Additive White Gaussian Noise	1	☑	☑		☑	---		👓	👓	👓	👓	👓		
	3.6.2	Performance in Multipath Fading without Closed Loop Power Control	2	☑	☑	☑	☑	---		👓	👓	👓	👓	👓		
	3.6.3	Performance in Multipath Fading with Closed Loop Power Control	2	☑	☑	☑	☑	---		👓	👓	👓	👓	👓		
	3.7	*Receiver Performance*														
	3.7.1	Receiver Sensitivity	1	☑			☑	---		👓	👓	👓	👓	👓		
	3.7.2	Receiver Dynamic Range	1	☑			☑	---		👓	👓	👓	👓	👓		
	3.7.3	Single Tone Desensitization	3	☑			☑	☑		👓	👓	👓	👓	👓		
	3.7.4	Intermodulation Spurious Response Attenuation	4	☑			☑	☑	☑	👓	👓	👓	👓	👓		
	3.7.5	Adjacent Channel Selectivity	8	☑			☑	☑		👓	👓	👓	👓	👓		
	3.8	*Limitations on Emissions*														
	3.8.1	Conducted Spurious Emissions	any	---			---	---		☺	☺	☺	☺	☺	---	
	3.8.2	Radiated Spurious Emissions	any	---			---	---		☺	☺	☺	☺	☺	---	
	3.9	Receiver Signal Quality Indicator (RSQI)	1	☑	☑		☑	---								

☑ needed for the measurement (exact this one)
☺ can do the measurement (one of them)
👓 needed for demonstration
--- not used

Conf Functional Setup according to Standard Chapter 6.5.1

Table 2 - Instruments for RX tests

Class	Number	Measurement	R-ACH	SR1 R-EACH	SR3 R-EACH	SR1 R-CCCH	SR3 R-CCCH	all Fundamental CTM	all Dedicated Control CTM	all Supplemental CTM	all Supplemental Code CTM	Fundamental Traffic CTM 1	Fundamental Traffic CTM 2	Fundamental Traffic CTM 3	Fundamental Traffic CTM 5	Fundamental Traffic CTM 7	Fundamental Traffic CTM 9	Dedicated Control CTM 3	Dedicated Control CTM 5	Dedicated Control CTM 7	Dedicated Control CTM 9
Receiver test	3.1	Frequency Coverage Requirements	--	--	--	--	--	--	--	--		--	--	--	--	--	--	--	--	--	--
	3.2	Access Probe Acquisition	X	X	X																
	3.3	R-CCCH Demodulation Performance																			
	3.3.1	in Additive White Gaussian Noise				X	X														
	3.3.2	in Multipath Fading with Closed Loop Power Control				X	X														
	3.6	R-Traffic Channel Demodulation Performance																			
	3.6.1	in Additive White Gaussian Noise						X	X	X	X										
	3.6.2	in Multipath Fading without Closed Loop Power Control						X													
	3.6.3	in Multipath Fading with Closed Loop Power Control						X	X	X	X										
	3.7	Receiver Performance																			
	3.7.1	Receiver Sensitivity										X		X		X		X		X	
	3.7.2	Receiver Dynamic Range										X		X		X		X		X	
	3.7.3	Single Tone Desensitization										X		X		X		X		X	
	3.7.4	Intermodulation Spurious Response Attenuation										X		X		X		X		X	
	3.7.5	Adjacent Channel Selectivity										X		X		X		X		X	
	3.8	Limitations on Emissions																			
	3.8.1	Conducted Spurious Emissions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3.8.2	Radiated Spurious Emissions	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	3.9	Receiver Signal Quality Indicator (RSQI)										X	X	X	X	X	X	X	X	X	X

CTM: Channel Test Mode

Table 3 - Test signals for RX tests

Frequency coverage requirements (3.1)

No measurements are necessary here, because the frequency assignment is a setting of the software in the base station.

Access probe acquisition (3.2)

This test checks the receive characteristics of the base station for access probes with additive white Gaussian noise (AWGN).

The mobile station simulator generates an access probe signal (R-ACH and R-EACH) onto which AWGN is also superimposed. The base station counts the number of the successfully interpreted access probes. The ratio of interpreted access probes to transmitted access probes can be calculated using this figure.

Test setup

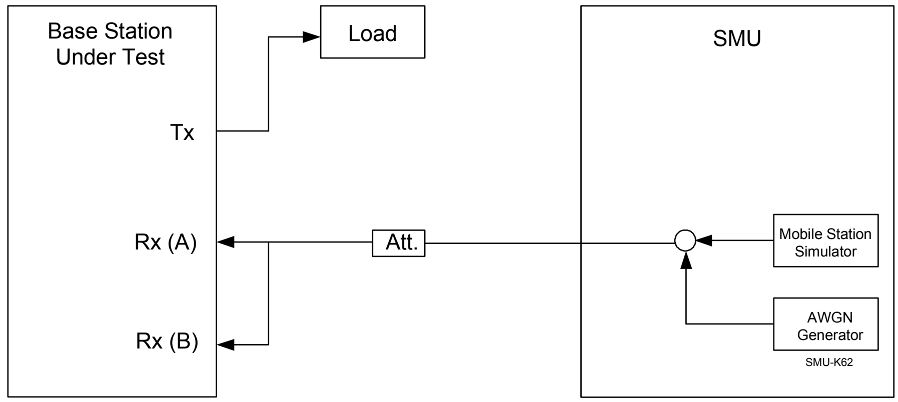


Figure 3 - Test setup for access probe acquisition

Access channel probe acquisition (3.2.2.1)

Settings

Table A1.1 of the specification defines the range of the E_b/N_0 to be used – together with the corresponding error rate. Applying formula 1, the generator levels can be determined using the predefined noise power N of -90 dBm (SR1). The test must be carried out for all band classes.

Remote control example

The example in GDE does the following:

- Generates an R-ACH with a frame duration of 20 ms and a data rate of 4.8 kbit/s with the SMU
- Uses the generator level that has been set
- Adds AWGN with an E_b/N_0 of 6.5 dB
- For demonstrations the analyzer shows the spectrum of the test signal both with and without AWGN.

Figure 4 shows the spectrum of the demonstration signal of the R-ACH.

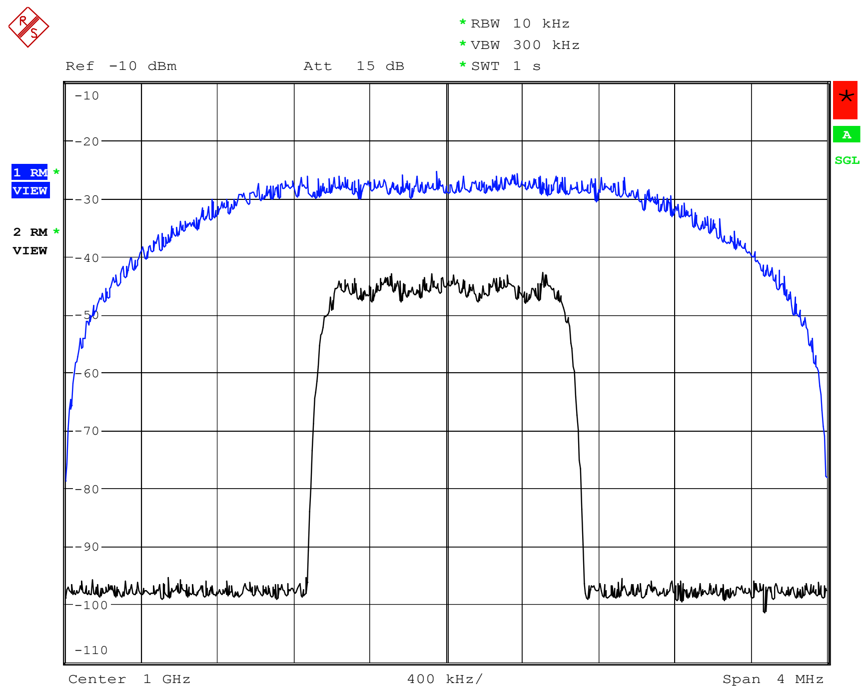


Figure 4 - Demonstration: spectrum access probe acquisition

Enhanced access probe acquisition (3.2.2.2)

Settings

Table A1.2 of the specification defines the range of the E_b/N_0 to be used – together with the corresponding maximum error rate. Applying formula 1, the generator levels can be determined using the predefined noise power N of -90 dBm (SR1). The test must be carried out for all band classes.

Remote control example

The example in GDE does the following:

- Generates an R-EACH with a frame duration of 20 ms and a data rate of 9.6 kbit/s with the SMU
- Uses the generator level that has been set
- Adds AWGN with an E_b/N_0 of 5.7 dB
- For demonstrations the analyzer shows the spectrum of the test signal both with and without AWGN.

R-CCCH demodulation performance (3.3)

The tests in this area check the receive characteristics of the base station for the reverse common control channel (R-CCCH).

Performance in additive white Gaussian noise (3.3.1)

This test checks the receive characteristics of the base station for the R-CCCH with additive white Gaussian noise (AWGN) by measuring the frame error rate (FER).

The mobile station simulator generates an R-CCCH plus AWGN. The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

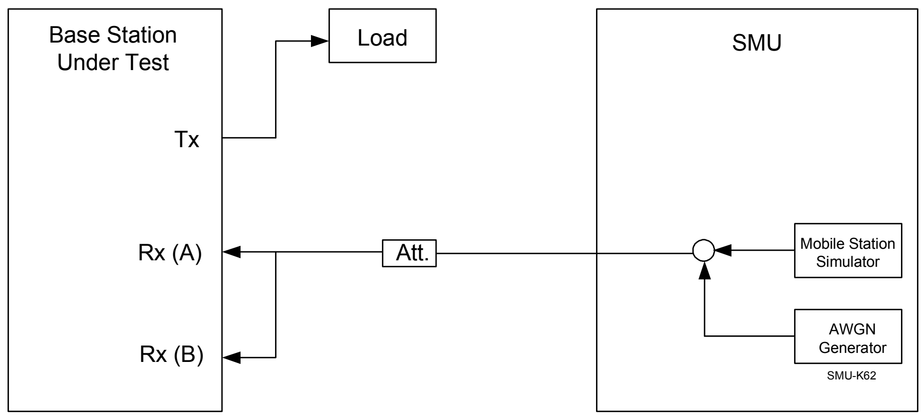


Figure 5 - Test setup: R-CCCH demodulation, AWGN

Settings

Table A2.1.1 of the specification defines the range of the E_b/N_0 to be used – together with the corresponding error rates – in six scenarios that differ with respect to data rate, frame duration, and AWGN. Applying formula 1, the generator levels are determined with the predefined noise power N of -84 dBm (SR1). The test must be carried out for all band classes.

Remote control example

The example in GDE does the following:

- Generates an R-CCCH with a frame duration of 20 ms and a data rate of 9.6 kbit/s with the SMU.
- Uses the generator level that has been set
- Adds AWGN with an E_b/N_0 of 4.0 dB and 4.6 dB
- for demonstrations the analyzer shows the spectrum of the test signal both twice with and without AWGN.

Figure 6 shows the spectrum of the demonstration signal of the R-CCCH.

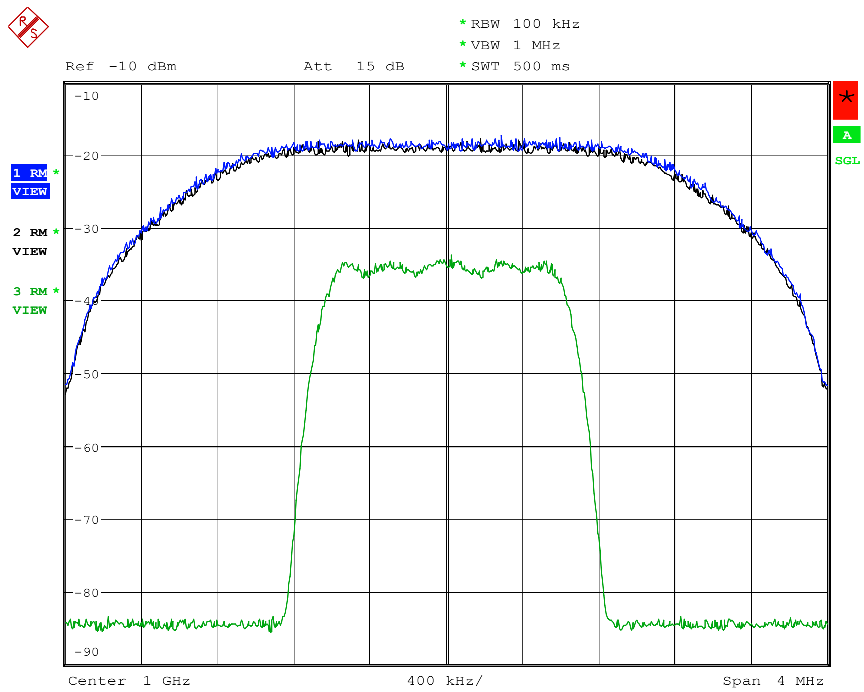


Figure 6 - Demonstration: spectrum, R-CCCH demodulation

Performance in multipath fading with closed loop power control (3.3.2)

This test checks the receive characteristics of the base station for the R-CCCH with additive white Gaussian noise (AWGN) and fading by measuring the frame error rate (FER).

The mobile station simulator generates an R-CCCH, simulates fading, and adds AWGN. The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

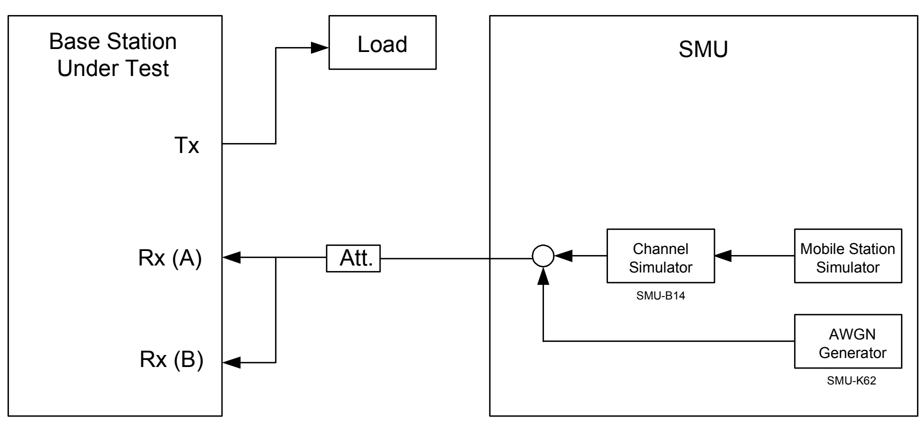


Figure 7 - Test setup: R-CCCH demodulation, fading

Settings

The specification describes four (standard) fading profiles.

Case	Channel simulator configuration	SMU setting
A	1 (3 km/h, 1 path)	CDMA 6
B	2 (8 km/h, 2 paths)	CDMA 1
C	3 (30 km/h, 1 path)	CDMA 3
D	4 (100 km/h, 3 paths)	CDMA 4

Table 4 – Fading profile, R-CCCH

In addition, the band classes are combined into three groups. The six different scenarios from Section 3.3.1, which differ in data rate, frame duration, and AWGN level, are again defined for each fading profile and each group. In addition, the corresponding maximum error rates are defined. (Specification: Table A 2.2.1) Applying formula 1, the generator levels can be determined using the predefined noise power N of -84 dBm (SR1). The test must be carried out for all band classes.

Remote control example

The example in GDE does the following:

- Generates an R-CCCH with a frame duration of 20 ms and a data rate of 9.6 kbit/s with the SMU
- Uses the generator level that has been set
- Runs the four fading profiles
- Adds AWGN for each
- For demonstrations the analyzer shows the four tests.
- The analyzer level should be set to 0 dBm for the demonstration in order to be able to display the measurement results.

R-traffic channel demodulation performance (3.6)

The tests in this area check the receive characteristics of the base station for the reverse traffic channel (R-TCH).

Performance in additive white Gaussian noise (3.6.1)

This test checks the receive characteristics of the base station for the R-TCH with additive white Gaussian noise (AWGN) by measuring the frame error rate (FER).

The mobile station simulator generates an R-TCH plus AWGN. The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

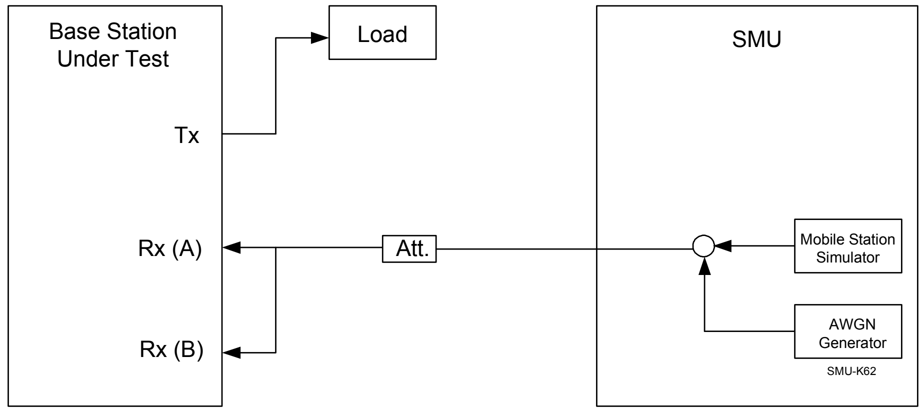


Figure 8 - Test setup: R-TCH, AWGN

Settings

Tables A5.1.1 to A5.1.8 of the specification define the range of the E_b/N_0 to be used – together with the corresponding maximum error rates – depending on the radio configuration, supported channels (R-FCH, R-DCCH, R-SCCH, and R-SCH), data rate, coding and frame duration. Applying formula 1, the generator levels can be determined using the predefined noise power N of -84 dBm (SR1). The test must be carried out for all band classes.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set
- Adds AWGN with an E_b/N_0 of 4.1 dB and 4.7 dB for RC1 and 7.0 dB and 7.6 dB for RC3
- For demonstrations the analyzer shows two tests both with and without AWGN
- Settings such as channels, data rate, and frame duration can easily be changed

Performance in multipath fading without closed loop power control (3.6.2)

This test checks the receive characteristics of the base station for the R-TCH with additive white Gaussian noise (AWGN) and fading by measuring the frame error rate (FER).

The mobile station simulator generates an R-TCH, simulates fading, and adds AWGN. The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

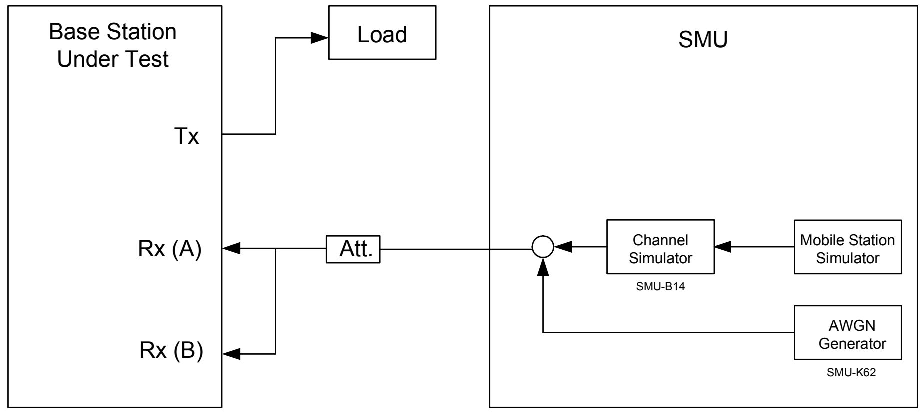


Figure 9 - Test setup: R-TCH, fading, without closed loop

Settings

The specification describes four (standard) fading profiles.

Case	Channel simulator configuration	SMU setting
B	2 (8 km/h, 2 paths)	CDMA 1
C	3 (30 km/h, 1 path)	CDMA 3
D	4 (100 km/h, 3 paths)	CDMA 4
D2	4 (100 km/h, 3 paths)	CDMA 4

Table 5 - Fading profile, R-TCH

In addition, the band classes are combined into three groups. The six different scenarios from Section 3.6.1, which differ in data rate, frame duration, channels (R-FCH and R-SCCH), and AWGN level, are defined for each fading profile and each group. In addition, the corresponding maximum error rates are defined. (Specification: Tables A5.2.1 to A5.2.3) Applying formula 1, the generator levels can be determined using the predefined noise power N of -84 dBm (SR1). The test must be carried out for all band classes, but only for RC1 and RC2.

Remote control example

The example in GDE does the following:

- Generates an RC1 R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Uses the generator level that has been set
- Runs the four fading profiles
- Adds AWGN with an E_b/N_0 of 4.1 dB and 4.7 dB

- For demonstrations the analyzer shows two tests both with and without AWGN

Performance in multipath fading with closed loop power control (3.6.3)

This test checks the receive characteristics of the base station for the R-TCH with additive white Gaussian noise (AWGN) and fading by measuring the frame error rate (FER).

The mobile station simulator generates an R-TCH, simulates fading, and adds AWGN. The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

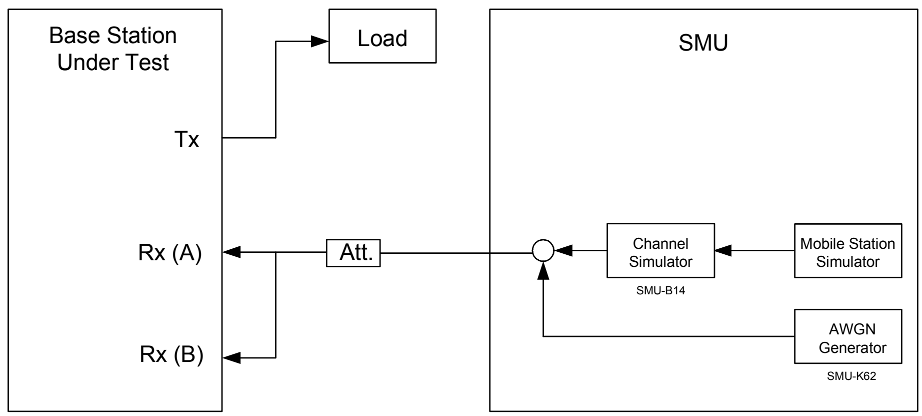


Figure 10 - Test setup: R-TCH, fading, with closed loop

Settings

The specification describes four (standard) fading profiles.

Case	Channel simulator configuration	SMU setting
A	1 (3 km/h, 1 path)	CDMA 6
B	2 (8 km/h, 2 paths)	CDMA 1
C	3 (30 km/h, 1 path)	CDMA 3
D	4 (100 km/h, 3 paths)	CDMA 4

Table 6 - standard fading profiles

In addition, the band classes are combined into three groups. The six different scenarios from Section 3.6.1, which differ in data rate, frame duration, channels (R-FCH, R-DCCH, R-SCCH, and R-SCH), and AWGN level, are defined for each fading profile and each group. In addition, the corresponding maximum error rates are defined. (specification: Table A 5.3.1 to A 5.3.7) Applying formula 1, the generator levels can be determined using the predefined noise power N of -84 dBm (SR1). The test must be carried out for all band classes and for all RCs.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set
- Runs the four fading profiles
- Adds AWGN
- Settings such as channels, data rate, and frame duration can easily be changed
- For demonstrations the analyzer shows two tests both with and without AWGN

Receiver performance (3.7)

Receiver sensitivity (3.7.1)

This test checks the sensitivity of the receiver of the base station for the reverse traffic channel by measuring the frame error rate (FER). Receiver sensitivity is the minimum level at which the FER does not exceed 1 %.

The mobile station simulator generates an R-TCH. The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

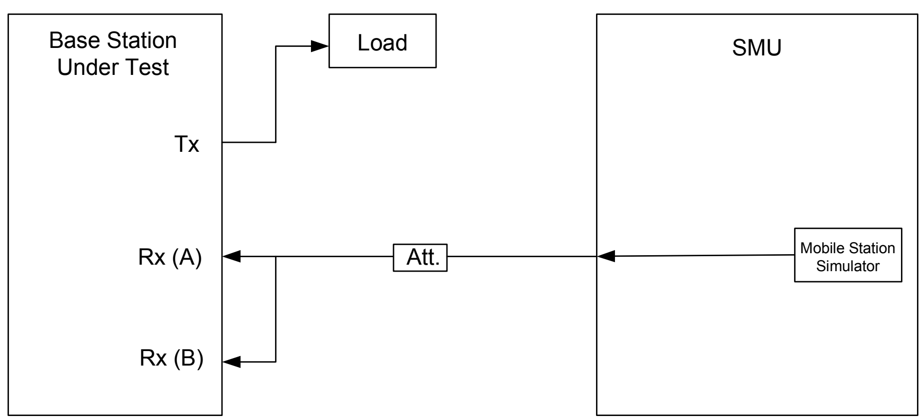


Figure 11 - Test setup: receiver sensitivity

Settings

Depending on the RC, the test can be carried out either on R-FCH or R-DCCH. The test must be carried out for all band classes and all RCs. The sensitivity point should be -117 dBm for bands 450 and 800, and -119 dBm for other bands.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set
- Settings such as channels, data rate, and frame duration can easily be changed
- For demonstrations the analyzer shows the spectrum of the test signal

Figure 12 shows the spectrum of the demonstration signal for the R-TCH.

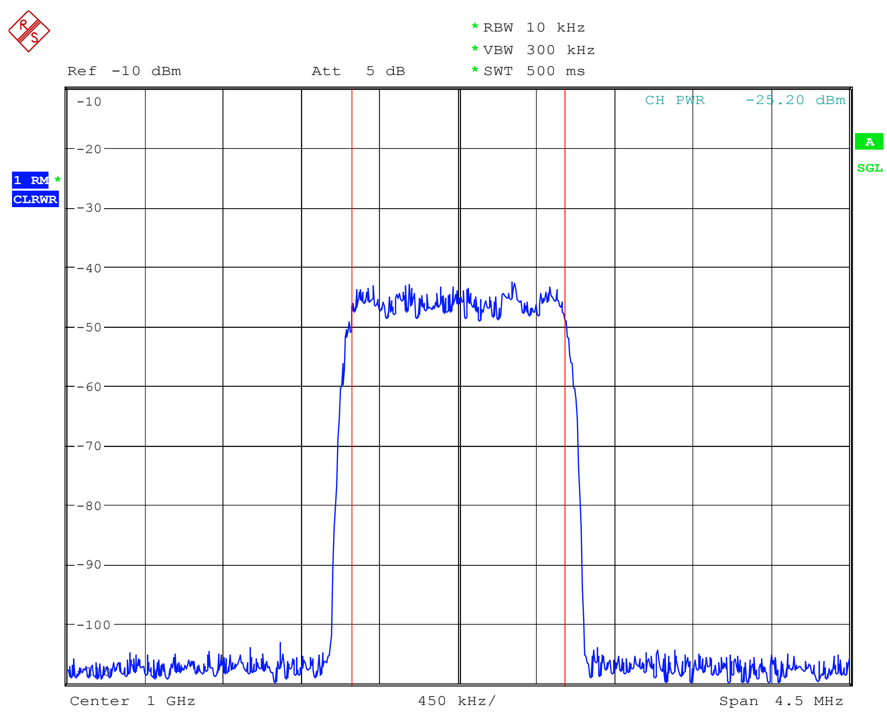


Figure 12 - Demonstration: spectrum, receiver sensitivity

Receiver dynamic range (3.7.2)

This test shows the range of the receiver of the base station for the reverse traffic channel at which the frame error rate (FER) does not exceed 1 %. The value from test 3.7.1 is used as the lower limit.

The mobile station simulator generates an R-TCH. The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

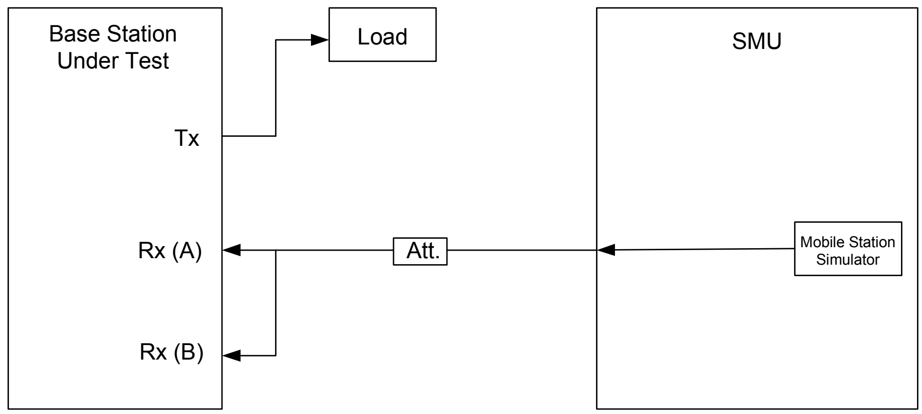


Figure 13 - Test setup: receiver dynamic range

Settings

Depending on the RC, the test can be carried out either on R-FCH or R-DCCH. The test must be carried out for all band classes and all RCs.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set and carries out two level steps below
- Settings such as channels, data rate, and frame duration can easily be changed
- For demonstrations the analyzer shows three spectrum of the test signal with different power levels

Figure 14 shows the spectrum of the demonstration signal for the R-TCH at three different levels.

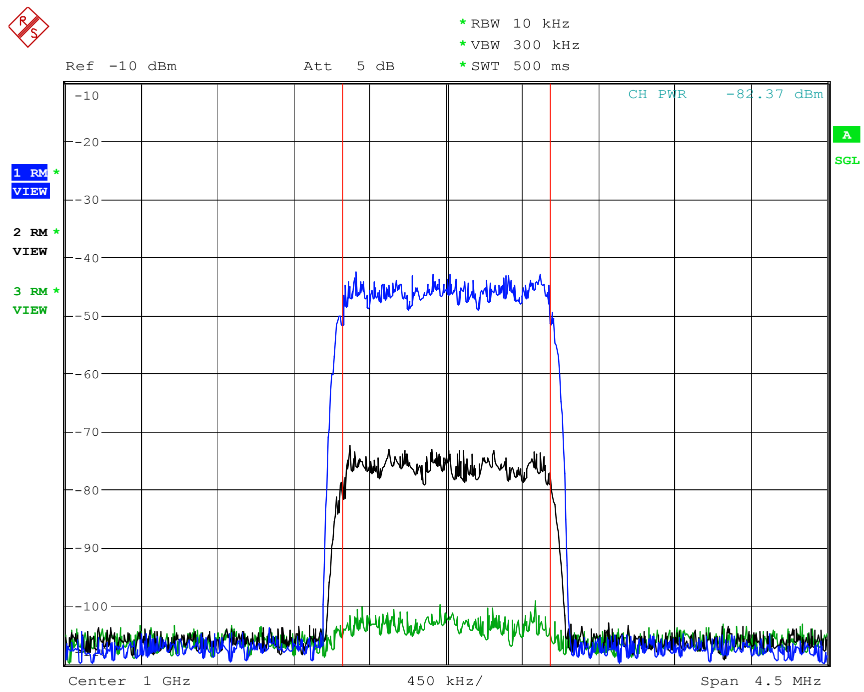


Figure 14 - Demonstration: spectrum, receiver dynamic range

Single tone desensitization (3.7.3)

This test checks the receiver of the base station by means of a reverse traffic channel with the additional presence of a CW interferer.

The mobile station simulator generates an R-TCH and, with the second channel, a CW interferer (frequency offset and level see table).

Band class (subclass)	CW power above in dB	CW frequencies
0	50	f_1 - 750 kHz and f_2 + 750 kHz
	87	f_1 - 900 kHz and f_2 + 900 kHz
0 (subclass 0 for China)	50	f_1 - 750 kHz and f_2 + 750 kHz
	87	f_1 – 1.11 MHz and f_2 + 1.11 MHz
1,4,6,7,8,10,14,15	80	f_1 – 1.25 MHz and f_2 + 1.25 MHz
2,3,5,9,11,12	87	f_1 - 900 kHz and f_2 + 900 kHz

Table 7 - Single tone desensitization, CW levels, and CW frequencies

The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode. The FER must not exceed 1.5 %.

Test setup

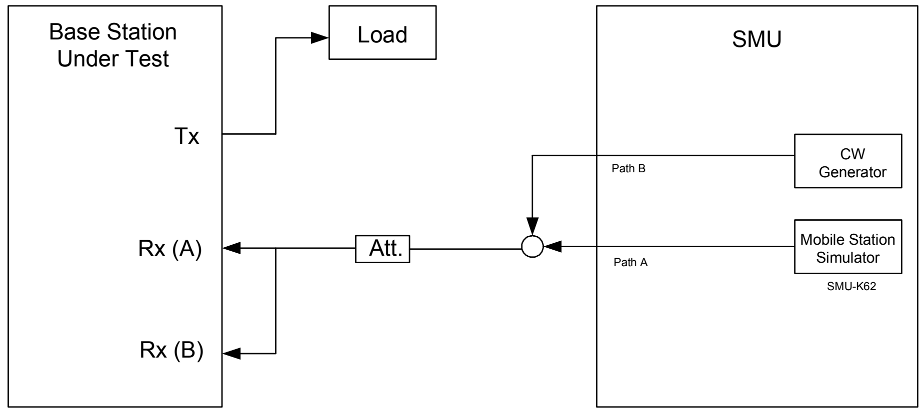


Figure 15 - Test setup: single tone desensitization

Settings

Depending on the RC, the test can be carried out either on R-FCH or R-DCCH. The test must be carried out for all band classes and all RCs.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set (should be -60 dBm for the demonstration)
- Generates a CW interferer with the second channel of the SMU first with an offset of ±750 kHz and then ±900 kHz. Here, both levels are raised only 50 dB above the wanted generator level.
- For demonstrations the analyzer shows the spectrum of the test signal for three CW interferers

Figure 16 shows the spectrum of the demonstration signal for single tone desensitization.

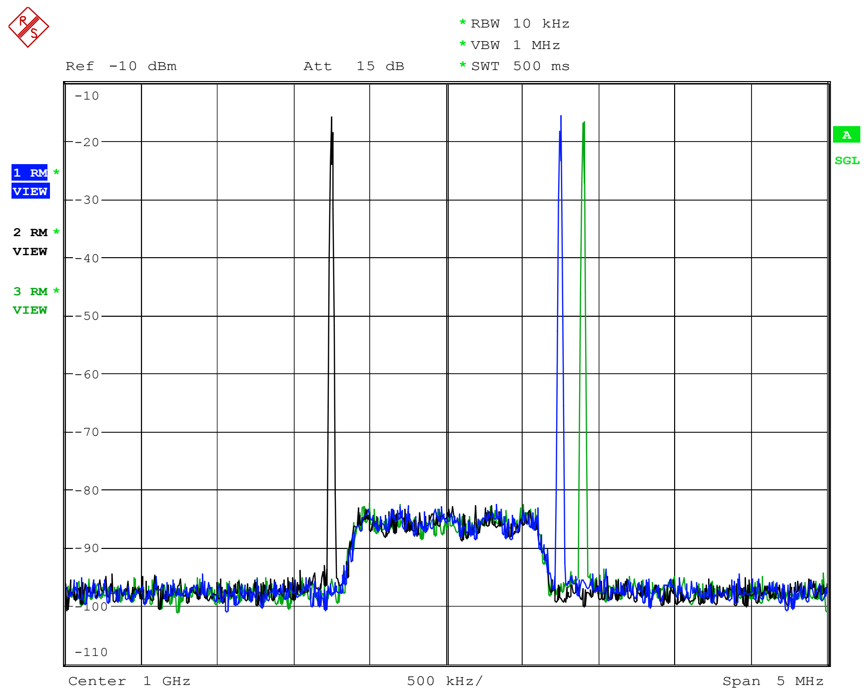


Figure 16 - Demonstration: single tone desensitization

Intermodulation spurious response attenuation (3.7.4)

This test checks the receiver of the base station by means of a reverse traffic channel with the additional presence of two CW interferers that can generate intermodulation products on the receiver frequency.

Band class (subclass)	CW power above in dB	CW frequencies
0,2,3,5,9,11	72	f_2 + 900 kHz and f_2 + 1700 kHz + i * 1250 kHz
		f_1 - 900 kHz and f_1 - 1700 kHz - i * 1250 kHz
0 (subclass 0 for China)	72	f_2 + 1110 kHz and f_2 + 1910 kHz + i * 1250 kHz
		f_1 - 1110 kHz and f_1 - 1910 kHz - i * 1250 kHz
1,4,6,8,14,15	70	f_2 + 1.25 MHz and f_2 + 2.05 MHz + i * 1.25 MHz
		f_1 - 1.25 MHz and f_1 – 2.05 MHz – i * 1.25 MHz
7,10,12	72	f_2 + 1.25 MHz and f_2 + 2.05 MHz + i * 1.25 MHz
		f_1 - 1.25 MHz and f_1 – 2.05 MHz – i * 1.25 MHz

Table 8 - Intermodulation spurious response, CW levels, and CW frequencies

The mobile station simulator generates an R-TCH and, with the second channel, two CW interferers (for frequency offset and level, see Table 8).

The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode. The FER must not exceed 1.5 %.

Test setup

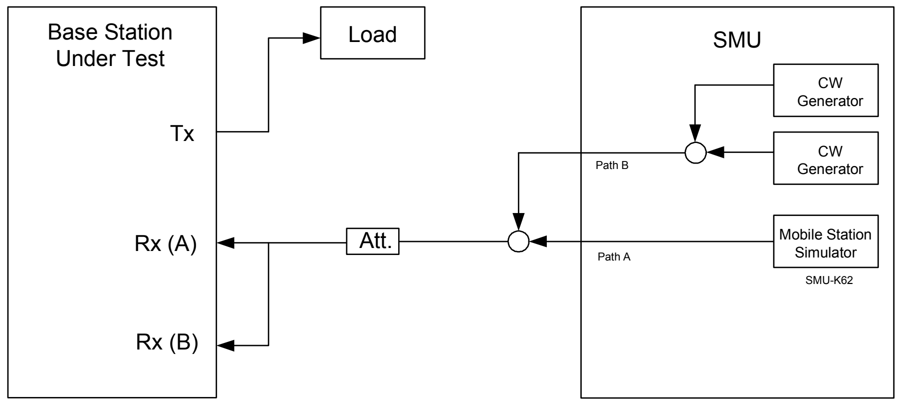


Figure 17 - Test setup: intermodulation spurious response attenuation

Settings

Depending on the RC, the test can be carried out either on R-FCH or R-DCCH. The test must be carried out for all band classes and all RCs.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set (should be -60 dBm for the demonstration)
- Generates two CW interferers with offsets of ±900 kHz and ±1700 kHz with the second channel of the SMU. Here, both levels are only raised 50 dB above the wanted generator level.
- For demonstrations the analyzer shows the spectrum of the test signals twice

Figure 18 shows the spectrum of the demonstration signal for intermodulation spurious response attenuation.

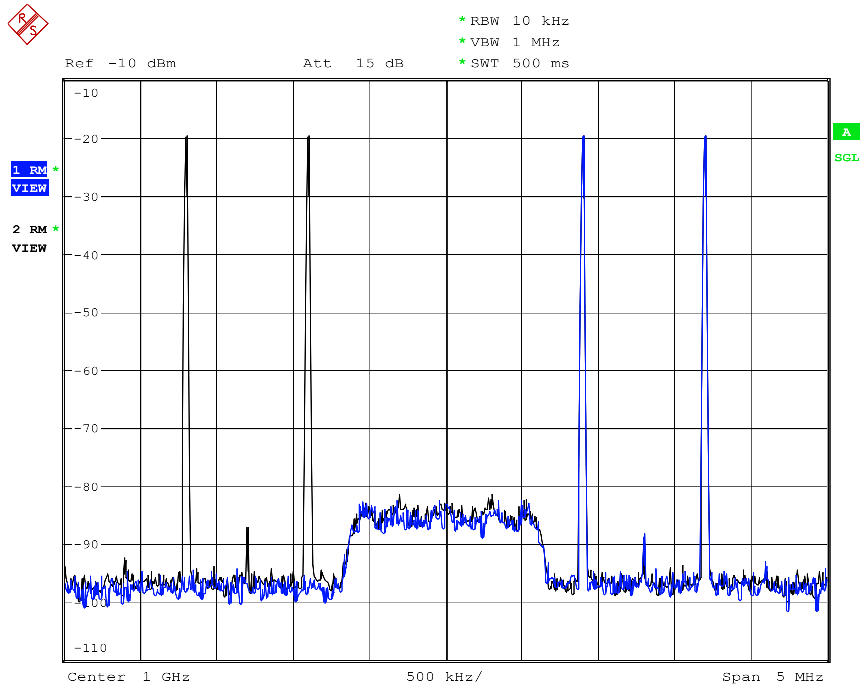


Figure 18 - Demonstration: intermodulation spurious response attenuation

Adjacent channel selectivity (3.7.5)

This test checks the receiver of the base station by means of a reverse traffic channel with the additional presence of a second CDMA channel.

The mobile station simulator generates an R-TCH and, with the second channel, an additional CDMA channel (RC3) at an offset of ±2.5 MHz with a level of -53 dBm.

The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode. The FER must not exceed 1.5 %.

Test setup

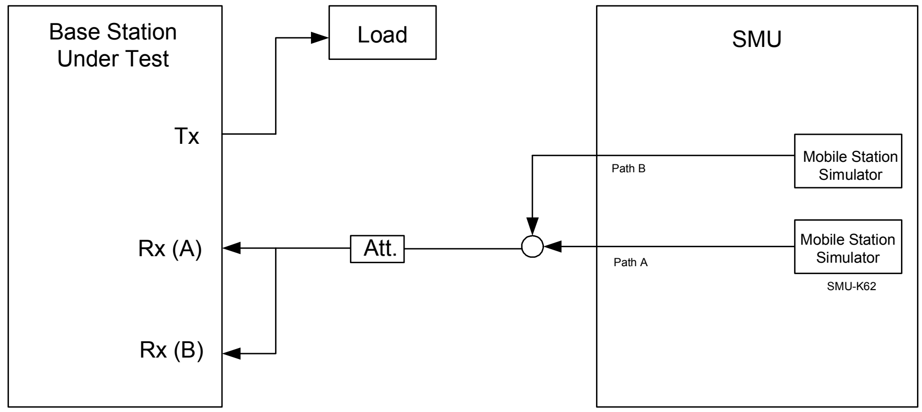


Figure 19 - Test setup: adjacent channel selectivity

Settings

Depending on the RC, the test can be carried out either on R-FCH or R-DCCH. The test must be carried out for all RCs but only for band class 6.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set
- Using the second channel of the SMU, generates the additional CDMA channel (RC3) with offsets of ±2.5 MHz and a level of -53 dBm.
- For demonstrations the analyzer shows twice the spectrum of the test signal

Figure 20 shows the spectrum of the demonstration signal for adjacent channel selectivity.

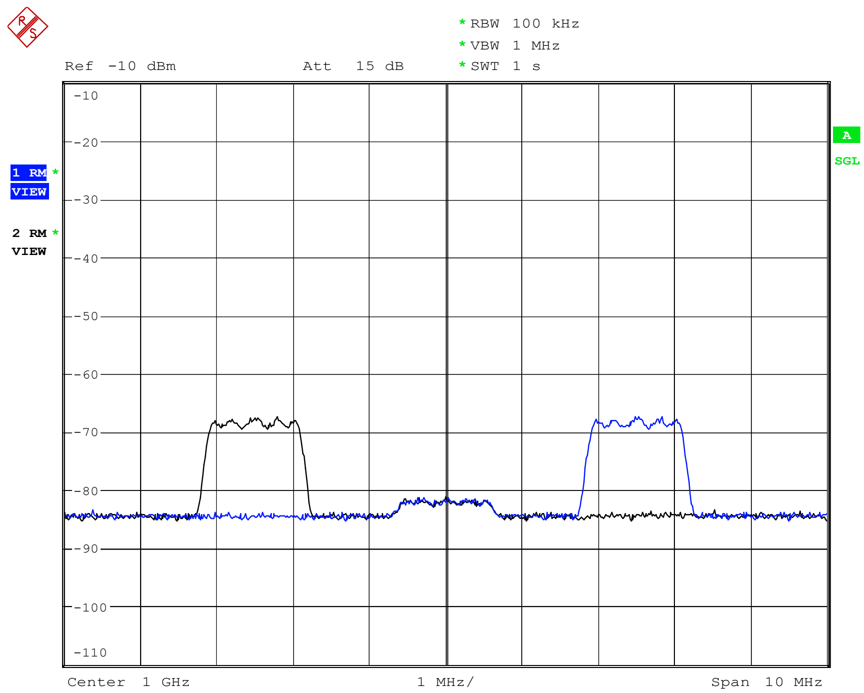


Figure 20 - Demonstration: spectrum, adjacent channel selectivity

Receiver blocking (3.7.6)

This test checks the receiver of the base station by means of a reverse traffic channel with the additional presence of a CW interferer at various frequencies.

The mobile station simulator generates an R-TCH and, with the second channel, a CW interferer with 1 MHz steps in the frequency ranges and level as follows:

Frequency range	Level above wanted signal in dB
1 MHz to 1899 MHz	100
1900 MHz to 2000 MHz (skip range +-2.5 MHz around carrier)	75
2001 MHz to 12.75 GHz	100

Table 9 - Receiver blocking, CW level, and frequency ranges

The SMU can generate frequencies of up to a maximum of 6 GHz. If the entire frequency range is used, an instrument such as the SMR must be implemented.

The base station receives the signal and must determine the frame error rate (FER). Since it is not possible to set up a call to the base station with the SMU, the base station must be changed to a suitable mode.

Test setup

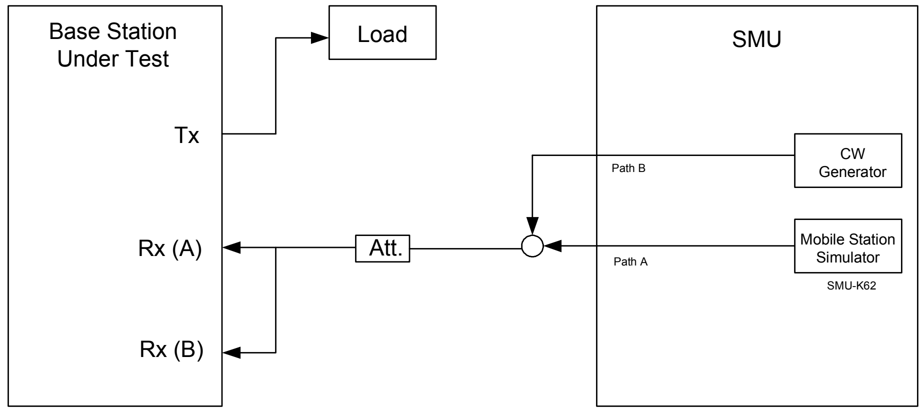


Figure 21 - Test setup: receiver blocking

Settings

Depending on the RC, the test can be carried out either on R-FCH or R-DCCH. The test must be carried out for all RCs but only for band class 6.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Uses the generator level that has been set (should be -60 dBm for the demonstration)
- Generates first a CW interferer at the generator frequency that has been set and then 1 MHz further with a level of 50 dB above the wanted channel with the second channel of the SMU.
- For demonstrations the analyzer shows the spectrum of the test signal

Limitations on emissions (3.8)

Conducted spurious emissions (3.8.1)

Conducted spurious emissions are defined as signals at the receiver input that are generated or amplified by the base station.

Different limits are applied for the various frequency ranges (see specification)

A spectrum analyzer is connected to the input of the base station and measures the emissions with the output switched off.

Test setup

Figure 22 - Test setup: conducted spurious emissions

Settings

Measures in various bands (see specification)

Remote control example

Two example in GDE do the following:

- Example 1 measures in a continuous sweep
- Example 2 measures in multiple individual sweeps

Figure 23 shows an excerpt from the GDE report.

3.8.1 Conducted Spurious Emissions (using high resolution sweep and search limit)

- Configuration started -

please switch off BS Tx outputs or SMU RF output

- Configuration done -
Execution Time: 0,694 s
Analyzer: 0,694 s

- Measurement started -

```
BC 0 Rx....................-97,564 dBm
BC 1 Rx....................-97,505 dBm
BC 2 Rx....................-97,651 dBm
BC 3 Rx....................-97,265 dBm
BC 4 Rx....................-96,948 dBm
BC 5 Rx....................-97,724 dBm
BC 6 Rx....................-97,448 dBm
BC 7 Rx....................-97,494 dBm
BC 8 Rx....................-96,948 dBm
BC 9 Rx....................-97,651 dBm
BC 0 Tx....................-97,265 dBm
BC 1 Tx....................-97,448 dBm
BC 2 Tx....................-98,373 dBm
BC 3 Tx....................-98,113 dBm
BC 4 Tx....................-97,557 dBm
BC 5 Tx....................-97,724 dBm
BC 6 Tx....................-96,129 dBm
BC 7 Tx....................-98,277 dBm
BC 8 Tx....................-97,465 dBm
BC 9 Tx....................-98,373 dBm
non-Tx and Rx - 1. gap.....-88,472 dBm
non-Tx and Rx - 2. gap.....-96,491 dBm
non-Tx and Rx - 3. gap.....-98,484 dBm
non-Tx and Rx - 4. gap.....-46,342 dBm
PHS special................-85,370 dBm
non-Tx and Rx - high range.-93,514 dBm
```

Figure 23 - Demo: conducted spurious emissions

Radiated spurious emissions (3.8.2)

The specification does not explicitly cover any measurements. Country-specific requirements are applied.

Receiver signal quality indicator (RSQI) (3.9)

In this test, the calculation of the RSQI is checked by the base station. The base station must measure the E_b/N_0. The mobile station simulator generates a noise with a specific level and a signal with an E_b/N_0 of -6 dB. Then the power of the signal is increased in steps of 1 dB, and E_b/N_0 is measured after each step until 14 dB is reached or exceeded.

Test setup

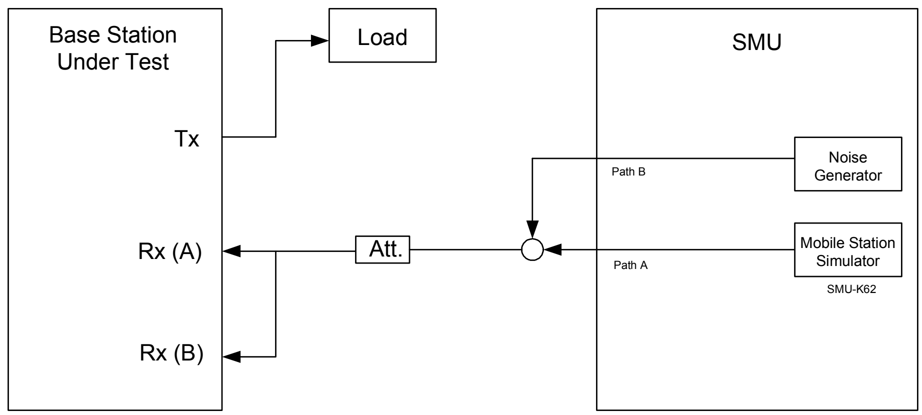


Figure 24 - Test setup: receiver signal quality indicator (RSQI)

Settings

This test applies for all band classes. Depending on the RC, the test can be carried out either on R-FCH or R-DCCH. The test must be carried out for all RCs.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Generates noise by means of the second channel of the SMU with the adjustable level.
- The level is initially determined by the E_b/N_0 of 8 dB. It is then incremented in steps of 1 dB.
- Calculates the measured E_b/N_0 for the demonstration with the analyzer at each level step.

4 CDMA Transmitter Minimum Standards

Prior considerations

The tests are listed individually here based on their structure in the specification. Every test sequence of the demonstration can be run by itself. To save time, several tests can also be combined. In particular, individual measurements (e.g. CDP measurements) can be carried out together.

Demonstration

For all TX measurements, the FSx measures the TX signal of the base station. For the demonstration with GDE, the signal is generated by the SMU and measured by a spectrum analyzer.

TX test models

For the TX tests, the specification (Section 6.5.2) lists several test models. The model for the "normal" traffic channel consists of the following channels (Table 10):

Channel	No.	Fraction of power		Comments
		linear	log	
Pilot (F-PICH)	1	20 %	-7.0 dB	W_0^{128}
Paging (F-PCH)	1	4.71 %	-13.3 dB	W_1^{64}
Sync (F-SYNC)	1	18.82 %	-7.3 dB	W_{32}^{64}
Traffic (F-FCH + F-SCH)	6*	9.412 % each	-10.3 dB each	Full rate, equal power

Table 10 - Test model: F-TCH

A test model for the transmit diversity path has also been created (Table 11):

Channel	No.	Fraction of power		Comment
		linear	log	
Transmit diversity pilot (F-TDPICH)	1	20 %	-7.0 dB	W_{16}^{128}
Traffic (F-FCH + F-SCH)	6*	9.412 % each	-10.3 dB each	Full rate, equal power

Table 11 - Test model: F-TCH, transmit diversity

*Note: For some tests, the max. possible number of traffic channels supported by the BS needs to be used. Six channels were always selected for the demonstration.

Furthermore, a model for packet data tests is available (Table 12):

Channel	No.	Fraction of power		Comments
		linear	log	
Pilot (F-PICH)	1	10 %	-10 dB	W_0^{64}
Paging (F-PCH)	1	10 %	-10 dB	W_1^{64}
Sync (F-SYNC)	1	5 %	-13 dB	W_{32}^{64}
Packet data control (F-PDCCH)	1	10 %	-10 dB	W_{33}^{64}
Traffic (F-FCH)	1	10 %	-10 dB	variable
Packet data (F-PDCH)	1	55 %	-2.6 dB	highest data rate of BS

Table 12 - Test model: F-TCH, packet data (1xEV-DV)

Three subchannels with the following settings are used for the demonstration. These can be changed in the SMU as necessary. Be sure to pay attention to any code conflicts that occur.

- Walsh codes 31, 15, and 23
- Packet interval: 20 ms
- Number of bits per packet: 408
- Data rate: 81.6 kbit/s
- Number of timeslots per packet: 4
- Modulation: QPSK
- Timeslot offset: 4, 8, and 12

Excluding the complex test models, some tests require only the pilot channel (F-PICH).

Table 13 shows an overview of the instruments and options used for the RX test. Table 14 lists the individual test signals.

Class	Number	Measurement	Conf	Instruments needed: RF generator			cdma2000 SW	CW source		Spectrum analyzer					cdma2000 SW	
				SMU	SMU K62	SMU B14	SMU-K12	SMU 2nd RF path	SMU 2nd RF path Multi CW	FSQ	FSU	FSP	FSIQ	R&S SA	FS K82	FSIQ K71
Transmitter test	*4.1*	*Frequency Requirements*														
	4.1.1	Frequency Coverage	---	---			---	---		---					---	
	4.1.2	Frequency Tolerance	any	👓			👓			☑	☑	☑	☑ 1)		✱	☑
	4.2	*Modulation Requirements*														
	4.2.1	*Synchronization and Timing*														
	4.2.1.1	Pilot Timing Tolerance	5	👓			👓			☑	☑	☑	☑		✱	
	4.2.1.2	Pilot Channel to Code Channel Time Tolerance	6	👓			👓			☑	☑	☑	☑ 1)		✱ 1)	
	4.2.1.3	Pilot Channel to Code Channel Phase Tolerance	6	👓			👓			☑	☑	☑	☑ 1)		✱ 1)	
	4.2.2	Waveform Quality	5	👓			👓			☑	☑	☑	☑ 2)		✱	☑
	4.2.3	Forward Power Control Subchannel	1	👓			👓			☑	☑	☑	☑			
	4.3	*RF Output Power Requirements*														
	4.3.1	Total Power	any	👓			👓			☑	☑	☑	☑	☑		
	4.3.2	Pilot Power	any	👓			👓			☑	☑	☑	☑ 1)		✱ 1)	
	4.3.3	Code Domain Power	6 / 7	👓			👓			☑	☑	☑	☑ 1)		✱ 1)	
	4.4	*Limitations on Emissions*														
	4.4.1	Conducted Spurious Emissions	any	---			---	---		☑	☑	☑	☑ 3)		✱	---
	4.4.2	Radiated Spurious Emissions	any	---			---	---		☑	☑	☑	☑	☑	---	
	4.4.3	Inter-Base Station Transmitter Intermodulation	9	👓			☑	☑								
	4.4.4	Occupied Bandwidth	any	👓			👓	---		☑	☑	☑	☑	☑	☑	☑

✱	needed for the measurement	1)	with FSIQK71 only RC1-2, max. 9 active channels
☑	can do the measurement	2)	possible with FSIQ-B7 and FSIQK71
👓	needed for demonstration	3)	power dependant mask adjust only with FS-K83
---	not used	Conf	Functional Setup according to Standard Chapter 6.5.1

Table 13 - Instruments for TX tests

Class	Number	Measurement	F-PICH	F-TDPICH	F-Pilot(s)	BS Test Model	Fundamental Traffic CTM 1	Fundamental Traffic CTM 2	Fundamental Traffic CTM 3	Fundamental Traffic CTM 7	Dedicated Control CTM 3	Dedicated Control CTM 7
Transmitter test	***4.1***	***Frequency Requirements***										
	4.1.1	Frequency Coverage	--	--	--	--	--	--	--	--	--	--
	4.1.2	Frequency Tolerance	X									
	4.2	***Modulation Requirements***										
	4.2.1	*Synchronization and Timing*										
	4.2.1.1	Pilot Timing Tolerance			X							
	4.2.1.2	Pilot Channel to Code Channel Time Tolerance				X						
	4.2.1.3	Pilot Channel to Code Channel Phase Tolerance				X						
	4.2.2	Waveform Quality	X	X								
	4.2.3	Forward Power Control Subchannel					X	X	X	X	X	X
	4.3	***RF Output Power Requirements***										
	4.3.1	Total Power				X						
	4.3.2	Pilot Power				X						
	4.3.3	Code Domain Power					X	X	X	X	X	X
	4.4	***Limitations on Emissions***										
	4.4.1	Conducted Spurious Emissions				X						
	4.4.2	Radiated Spurious Emissions	--	--	--	--	--	--	--	--	--	--
	4.4.3	Inter-Base Station Transmitter Intermodulation				X						
	4.4.4	Occupied Bandwidth				X						

CTM: Channel Test Mode

Table 14 - Signals for TX tests

Frequency requirements (4.1)

Frequency coverage (4.1.1)

No measurements are necessary here, because the frequency assignment is a setting of the software in the base station.

Frequency tolerance (4.1.2)

In this test, the frequency error is measured relative to the frequency that has been set. The spectrum analyzer equipped with the CDMA2000 software option (K-46) measures the frequency error by using the F-PICH. The maximum permissible tolerance is ±5 ppm.

Test setup

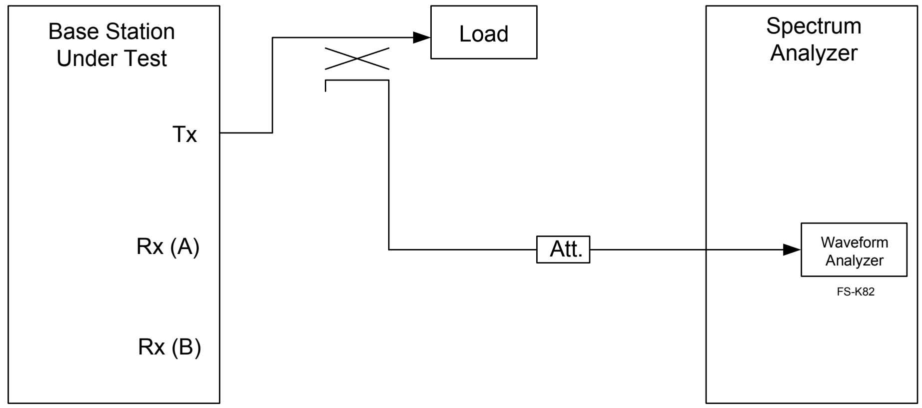


Figure 25 - Test setup: frequency tolerance

Settings

This test needs to be carried out under 4.2.2 and for all band classes.

Remote control example

The example in GDE

- Generates an F-PICH for the demonstration with the SMU
- Sets the analyzer to a frequency error measurement and outputs the values for the frequency error in Hz and in ppm

Figure 26 shows the measurement for frequency tolerance on the spectrum analyzer.

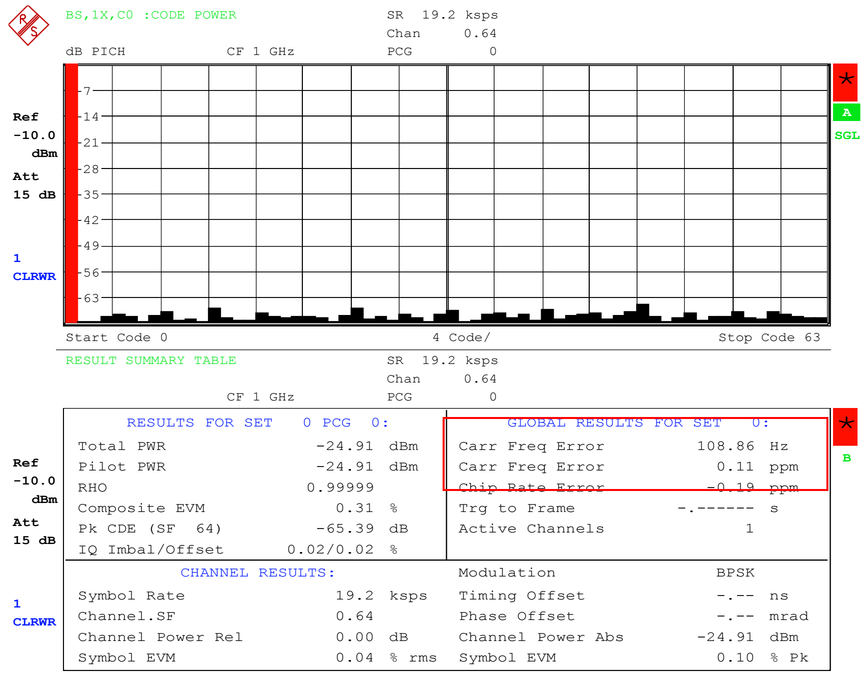


Figure 26 - Demonstration: frequency tolerance

Modulation requirements (4.2)

Synchronization and timing (4.2.1)

Pilot timing tolerance (4.2.1.1)

Every CDMA base station must adjust its time reference to the CDMA system time. If the external reference source is not present, the timing must not vary by more than 10 µs for 8 hours and should not vary by more than 3 µs.

For the test, the timing of the pilot channel is measured relative to the reference time (P2S signal, every two seconds). This requires triggering of the measuring instrument in response to the P2S signal.

The spectrum analyzer carries out a measurement in the code domain and determines the time difference of the pilot relative to the trigger.

Test setup

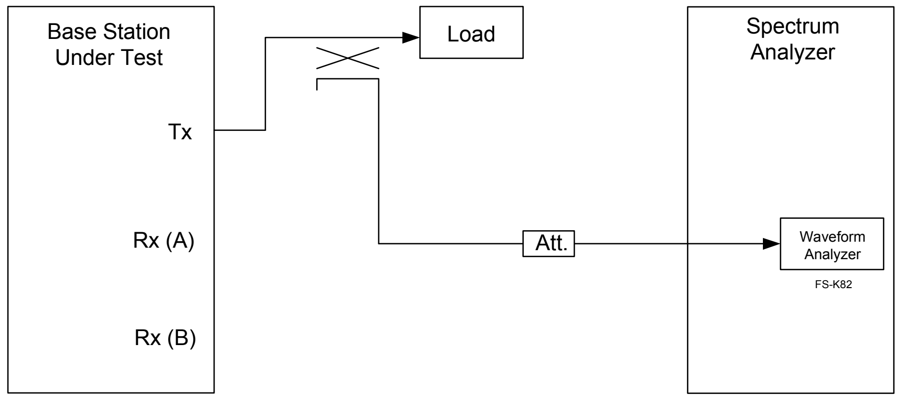


Figure 27 – Test setup: pilot timing tolerance

Settings

The base station must generate only an F-PICH. The test needs to be carried out for all CDMA channels (sectors and frequencies).

Remote control example

The example in GDE

- Generates an F-PICH for the demonstration with the SMU. The SMU provides a superframe trigger at the Marker 1 socket of the front panel. The Ext Trigger socket of the FSx must be connected with the Marker 1 socket via a BNC cable.
- Sets the analyzer to a timing measurement and outputs the values for the timing.

Figure 28 shows the measurement for pilot timing on the spectrum analyzer.

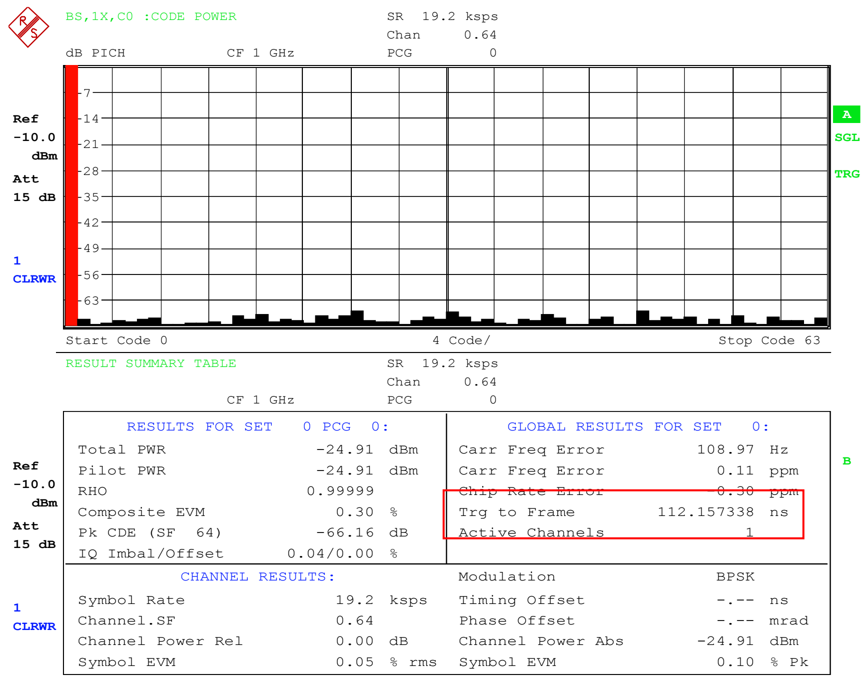


Figure 28 - Demonstration: pilot timing tolerance

Pilot channel to code channel time tolerance (4.2.1.2)

In this test, the timing between the pilot channel and the other code channels of a forward channel is checked. The difference must not be more than ±50 ns. For the transmit diversity path, the difference must not be more than ±100 ns and should be less than ±50 ns.

The spectrum analyzer carries out a measurement in the code domain and determines the time difference of the individual code channels relative to the pilot.

Test setup

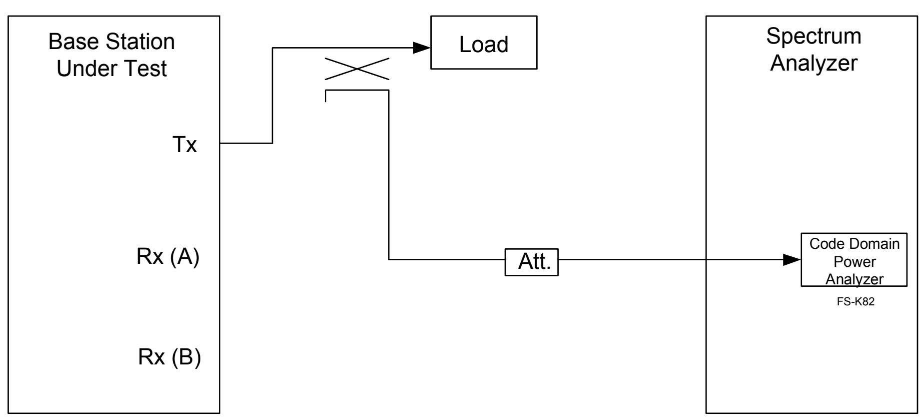


Figure 29 - Test setup: pilot channel to code channel time tolerance

Settings

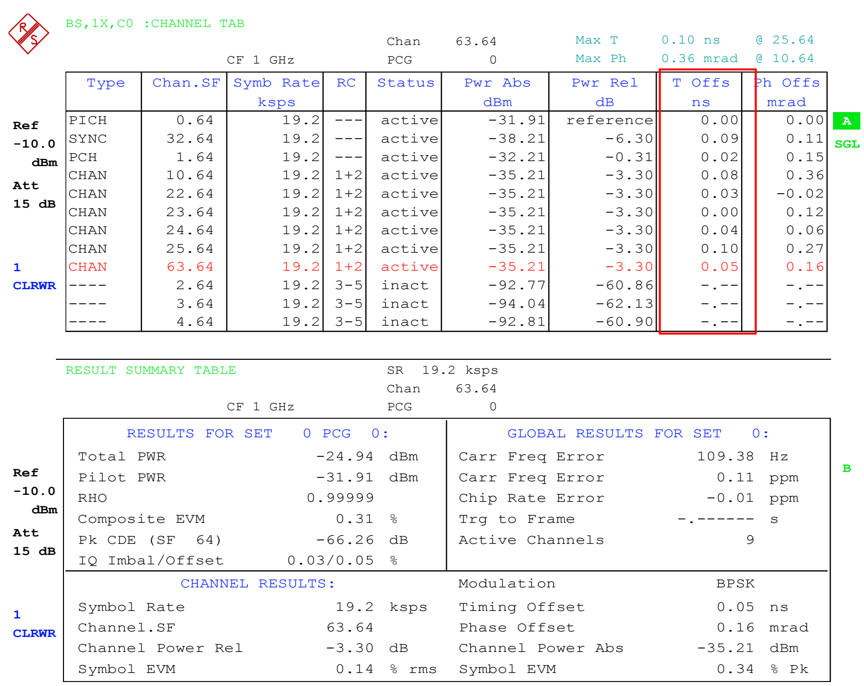
The base station must generate an F-PICH and additional code channels. The test needs to be carried out for all band classes.

Remote control example

The example in GDE do the following:

- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the SMU.
- Sets the analyzer to a timing measurement and outputs the values for the timing of the various code channels.
- Second example generates an F-FCH and an additional five F-SCHs for the second antenna with the SMU (transmit diversity).
- Third example generates an F-PICH, F-SYNC, F-PDCCH, F-PDCH, as well as three subchannels for packet data (1xEV-DV). Plus, an additional F-FCH is set up.

Figure 30 shows the measurement for the timing pilot channel to code channel on the spectrum analyzer.



Type	Chan.SF	Symb Rate ksps	RC	Status	Pwr Abs dBm	Pwr Rel dB	T Offs ns	Ph Offs mrad
PICH	0.64	19.2	---	active	-31.91	reference	0.00	0.00
SYNC	32.64	19.2	---	active	-38.21	-6.30	0.09	0.11
PCH	1.64	19.2	---	active	-32.21	-0.31	0.02	0.15
CHAN	10.64	19.2	1+2	active	-35.21	-3.30	0.08	0.36
CHAN	22.64	19.2	1+2	active	-35.21	-3.30	0.03	-0.02
CHAN	23.64	19.2	1+2	active	-35.21	-3.30	0.00	0.12
CHAN	24.64	19.2	1+2	active	-35.21	-3.30	0.04	0.06
CHAN	25.64	19.2	1+2	active	-35.21	-3.30	0.10	0.27
CHAN	63.64	19.2	1+2	active	-35.21	-3.30	0.05	0.16
----	2.64	19.2	3-5	inact	-92.77	-60.86	-.--	-.--
----	3.64	19.2	3-5	inact	-94.04	-62.13	-.--	-.--
----	4.64	19.2	3-5	inact	-92.81	-60.90	-.--	-.--

RESULTS FOR SET 0 PCG 0:			GLOBAL RESULTS FOR SET 0:		
Total PWR	-24.94	dBm	Carr Freq Error	109.38	Hz
Pilot PWR	-31.91	dBm	Carr Freq Error	0.11	ppm
RHO	0.99999		Chip Rate Error	-0.01	ppm
Composite EVM	0.31	%	Trg to Frame	-.------	s
Pk CDE (SF 64)	-66.26	dB	Active Channels	9	
IQ Imbal/Offset	0.03/0.05	%			
CHANNEL RESULTS:			Modulation	BPSK	
Symbol Rate	19.2	ksps	Timing Offset	0.05	ns
Channel.SF	63.64		Phase Offset	0.16	mrad
Channel Power Rel	-3.30	dB	Channel Power Abs	-35.21	dBm
Symbol EVM	0.14	% rms	Symbol EVM	0.34	% Pk

Figure 30 - Demonstration: pilot channel to code channel time tolerance

Pilot channel to code channel phase tolerance (4.2.1.3)

Here, the phase errors between the pilot channel and the other code channels of a forward channel are measured. The phase error must not exceed 0.15 rad and should be less than 0.05 rad.

The spectrum analyzer carries out a measurement in the code domain and determines the phase difference between individual code channels and the pilot.

Test setup

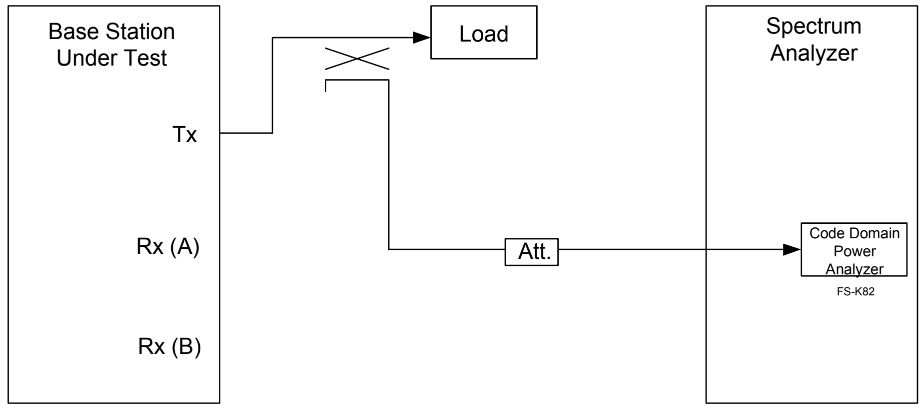


Figure 31 - Test setup: pilot channel to code channel phase tolerance

Settings

The base station must generate an F-PICH and additional code channels. The test needs to be carried out for all band classes.

Remote control example

The example in GDE do the following:

- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the SMU.
- Sets the analyzer to a phase measurement and outputs the values for the phases of the various code channels.
- Second example generates an F-FCH and an additional five F-SCHs for the second antenna with the SMU (transmit diversity).
- Third example generates an F-PICH, F-SYNC, F-PDCCH, F-PDCH, as well as three subchannels for packet data (1xEV-DV). Plus, an additional F-FCH is set up.

Figure 32 shows the measurement for the phase tolerance pilot channel to code channel on the spectrum analyzer.

BS,1X,C0 :CHANNEL TAB

Chan 63.64 Max T 0.10 ns @ 25.64
CF 1 GHz PCG 0 Max Ph 0.36 mrad @ 10.64

Ref -10.0 dBm
Att 15 dB
1 CLRWR

Type	Chan.SF	Symb Rate ksps	RC	Status	Pwr Abs dBm	Pwr Rel dB	T Offs ns	Ph Offs mrad
PICH	0.64	19.2	---	active	-31.91	reference	0.00	0.00
SYNC	32.64	19.2	---	active	-38.21	-6.30	0.09	0.11
PCH	1.64	19.2	---	active	-32.21	-0.31	0.02	0.15
CHAN	10.64	19.2	1+2	active	-35.21	-3.30	0.03	0.36
CHAN	22.64	19.2	1+2	active	-35.21	-3.30	0.03	-0.02
CHAN	23.64	19.2	1+2	active	-35.21	-3.30	0.00	0.12
CHAN	24.64	19.2	1+2	active	-35.21	-3.30	0.04	0.06
CHAN	25.64	19.2	1+2	active	-35.21	-3.30	0.10	0.27
CHAN	63.64	19.2	1+2	active	-35.21	-3.30	0.05	0.16
----	2.64	19.2	3-5	inact	-92.77	-60.86	-.--	-.--
----	3.64	19.2	3-5	inact	-94.04	-62.13	-.--	-.--
----	4.64	19.2	3-5	inact	-92.81	-60.90	-.--	-.--

A SGL

RESULT SUMMARY TABLE

SR 19.2 ksps
Chan 63.64
CF 1 GHz PCG 0

Ref -10.0 dBm
Att 15 dB
1 CLRWR

RESULTS FOR SET 0 PCG 0:			GLOBAL RESULTS FOR SET 0:		
Total PWR	-24.94	dBm	Carr Freq Error	109.38	Hz
Pilot PWR	-31.91	dBm	Carr Freq Error	0.11	ppm
RHO	0.99999		Chip Rate Error	-0.01	ppm
Composite EVM	0.31	%	Trg to Frame	-.------	s
Pk CDE (SF 64)	-66.26	dB	Active Channels	9	
IQ Imbal/Offset	0.03/0.05	%			
CHANNEL RESULTS:			Modulation	BPSK	
Symbol Rate	19.2	ksps	Timing Offset	0.05	ns
Channel.SF	63.64		Phase Offset	0.16	mrad
Channel Power Rel	-3.30	dB	Channel Power Abs	-35.21	dBm
Symbol EVM	0.14	% rms	Symbol EVM	0.34	% Pk

B

Figure 32 - Demonstration: pilot channel to code channel phase tolerance

Waveform quality (4.2.2)

In this test, the waveform quality factor (rho) of the pilot channel is checked. This factor represents the ratio of the measured signal to an ideal signal. All base stations must be better than 0.912. In addition, the requirement is higher for RC10 (see specification).

The spectrum analyzer carries out a measurement in the code domain and determines the rho factor.

Test setup

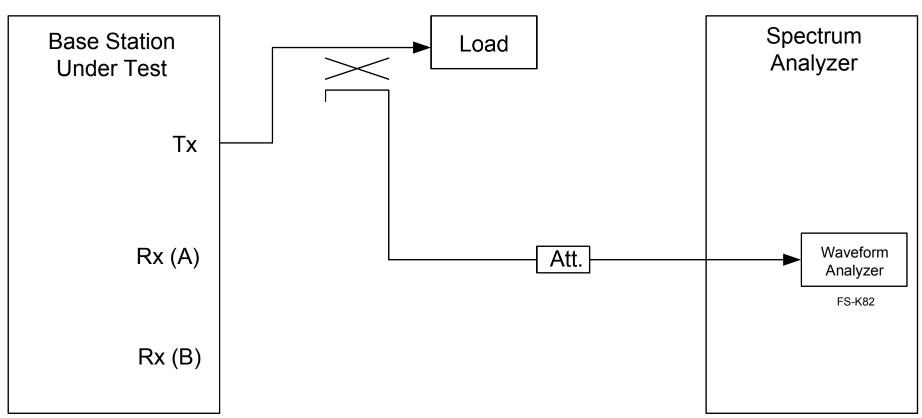


Figure 33 - Test setup: waveform quality

Settings

The base station must generate only an F-PICH. The test needs to be carried out for all band classes.

Remote control example

The example in GDE does the following:

- Generates an F-PICH for the demonstration with the SMU.
- Sets the analyzer to a rho measurement and outputs the values for rho.
- Note: GDE rounds rho off to 1.0 here.

Figure 34 shows the measurement for waveform quality on the spectrum analyzer.

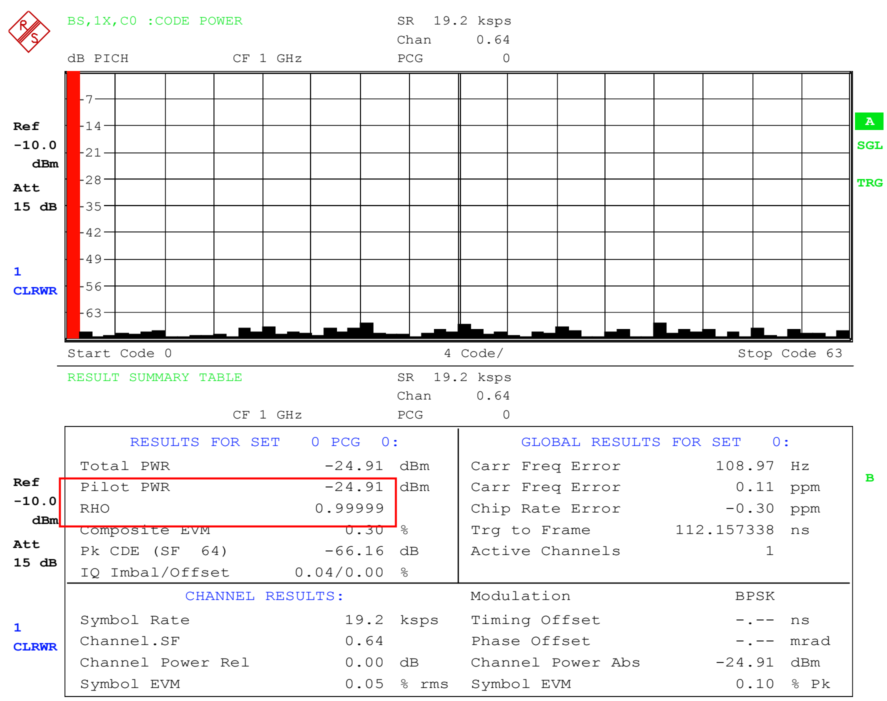


Figure 34 - Demonstration: waveform quality

Forward power control subchannel (4.2.3)

Here, the power control bits need to be checked. The mobile station simulator (SMU) generates a signal that varies by 10 dB. The base station must respond with specific power control bits.

Test setup

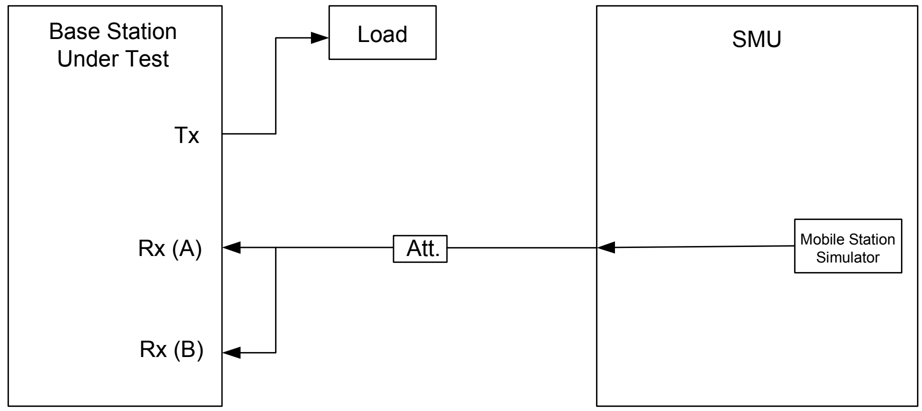


Figure 35 - Test setup: forward power control subchannel

Settings

The mobile station simulator generates an R-FCH. The test needs to be carried out for all band classes. The power initially remains at the same level (alternating 10), then transmits 0 ten times in order to reduce 10 dB, and then sends alternating 10 again. The signal repeats every 80 ms.

Remote control example

Two example in GDE do the following:

- Example for RC1 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.2 kbit/s with the SMU; R-SCCHs are switched off
- Example for RC3 generates an R-FCH with a frame duration of 20 ms and a data rate of 1.5 kbit/s with the SMU; R-SCHs are switched off
- Measures the time characteristic of the signal in the zero span for the demonstration with a spectrum analyzer

Figure 36 shows the time characteristic of the SMU signal in the demonstration.

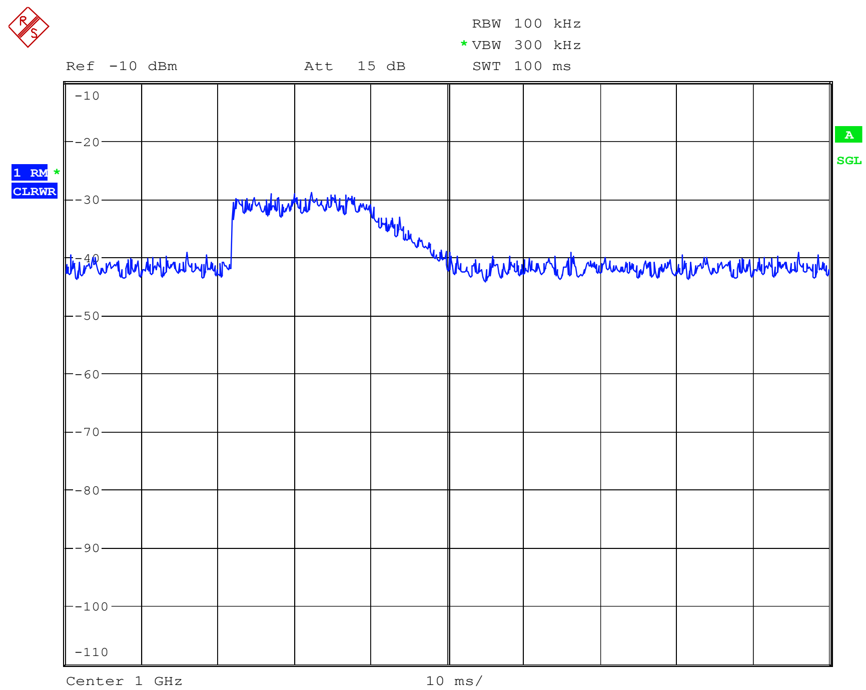


Figure 36 - Demonstration: forward power control subchannel

RF output power requirements (4.3)

Total power (4.3.1)

In this test, the (total) output power of the base station is checked. The power must not vary more than +2 dB and – 4 dB from the specified power.

The spectrum analyzer carries out a measurement of the (total) power.

Test setup

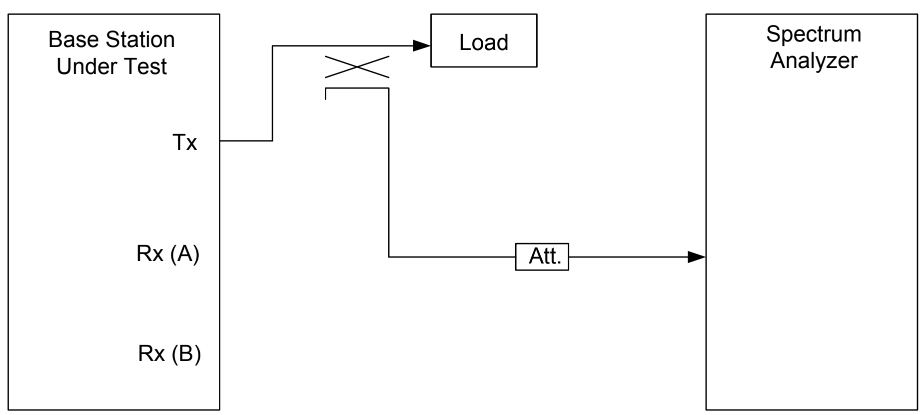


Figure 37 - Test setup: total power

Settings

The base station generates a complete forward channel. The test needs to be carried out for all band classes.

Remote control example

The example in GDE does the following:

- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the SMU.
- Measures the channel power once with FS-K82 or via the standard channel measurement

Figure 38 shows the spectrum of the demonstration signal for total power.

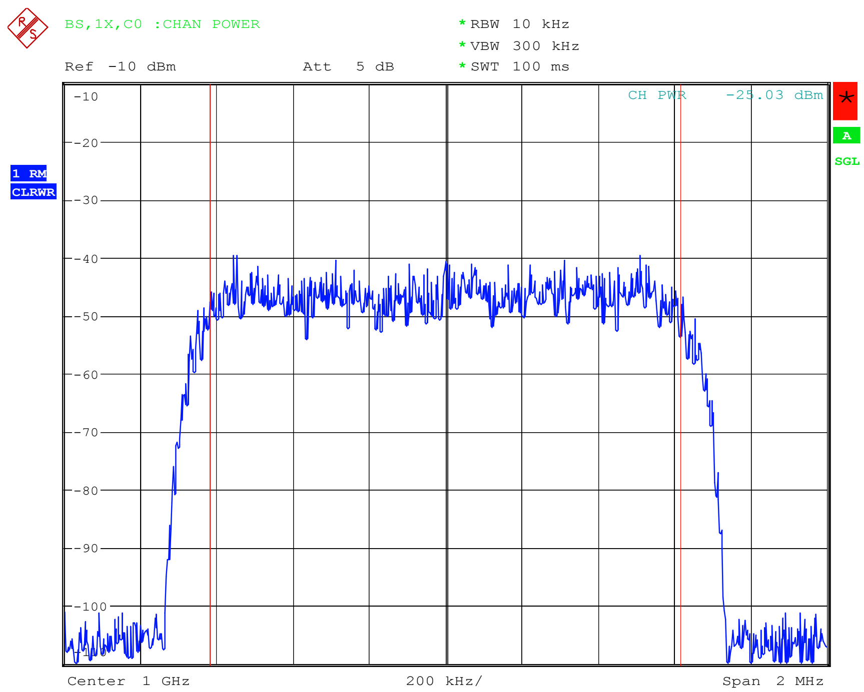


Figure 38 - Demonstration: total power

Pilot power (4.3.2)

The power of the pilot channel and the total power of a forward channel are measured here. The (pilot) power must not vary more than ±0.5 dB from the specified power.

The spectrum analyzer carries out a measurement in the code domain of the pilot power and of the total power.

Test setup

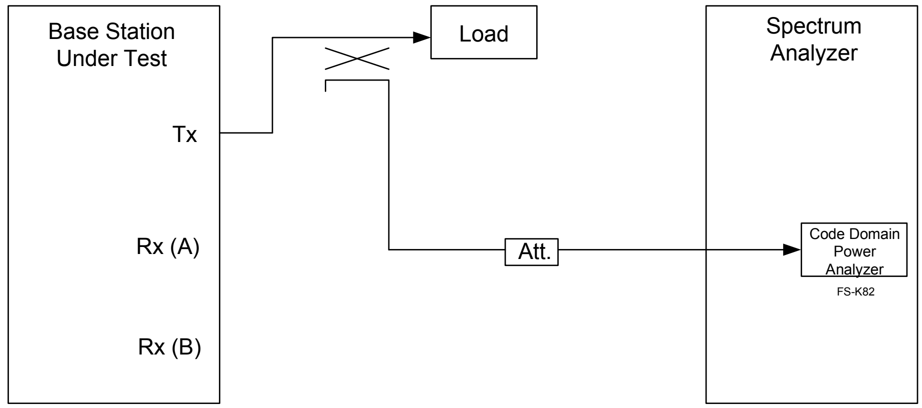


Figure 39 - Test setup: pilot power

Settings

The base station generates a complete forward channel. The test needs to be carried out for all band classes.

Remote control example

The example in GDE does the following:

- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the SMU.
- Measures the total channel power as well as the pilot channel power

Figure 40 shows the demonstration measurement in the code domain.

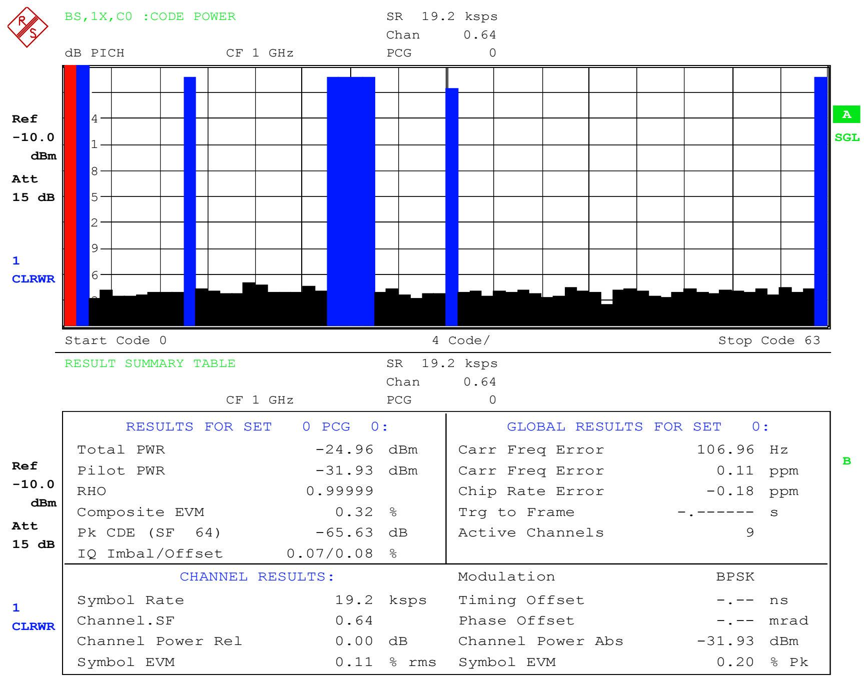


Figure 40 - Demonstration: pilot power

Code domain power (4.3.3)

The power of the individual code channels is measured here. The orthogonality of the individual codes is checked by doing this. Inactive channels must not exceed a specific level relative to the total power (see specification, Section 4.3.3.3).

The spectrum analyzer carries out a measurement of the individual code channels in the code domain.

Test setup

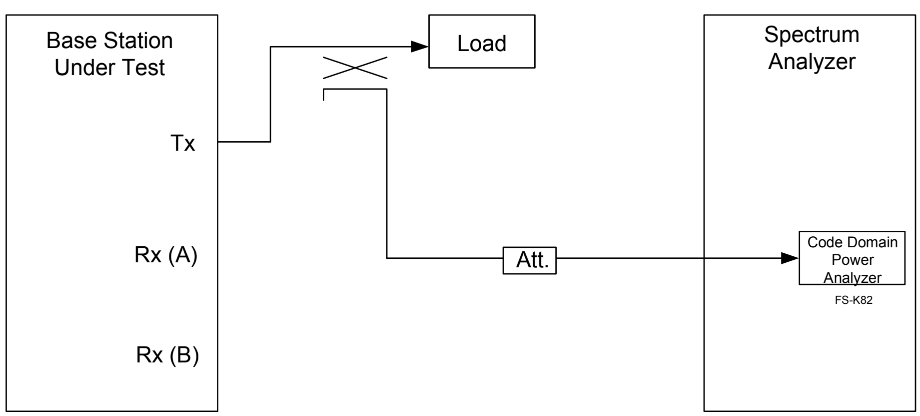


Figure 41 - Test setup: code domain power

Settings

The base station generates a complete forward channel. The test needs to be carried out for all band classes.

Remote control example

The example in GDE do the following:

- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the SMU.
- Second example generates an F-FCH and an additional five F-SCHs with the SMU (transmit diversity) for the second antenna.
- Third example generates an F-PICH, F-SYNC, F-PDCCH, F-PDCH, as well as three subchannels for packet data (1xEV-DV). Plus, an additional F-FCH is set up.
- Measures the power of the individual (active) code channels.

Figure 42 shows the demonstration measurement in the code domain.

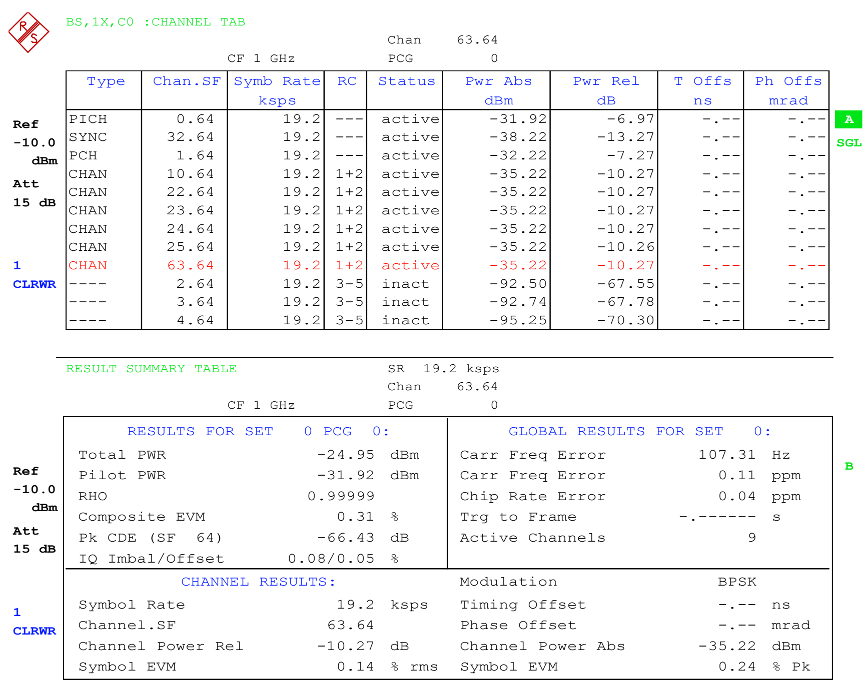


Figure 42 - Demonstration: code domain power

Limitations on emissions (4.4)

Conducted spurious emissions (4.4.1)

The objective here is to prevent unwanted signals from occurring outside the CDMA channel.

The spectrum analyzer measures the power that occurs outside the band. Various limits apply (see specification).

Test setup

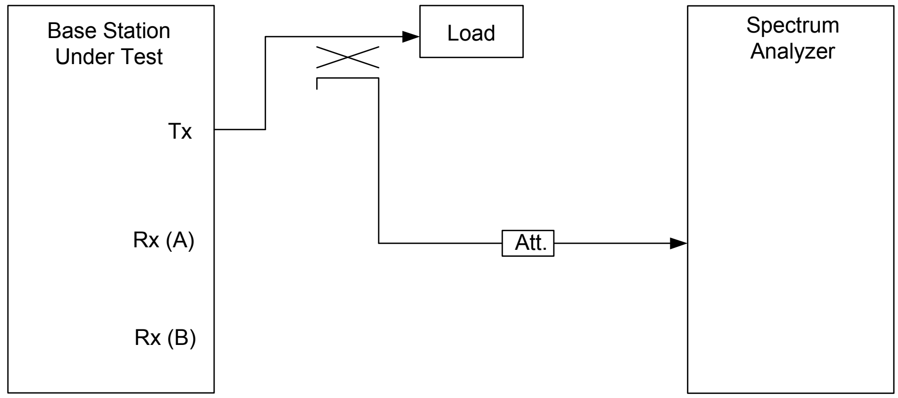


Figure 43 - Test setup: conducted spurious emissions

Settings

The base station generates a complete forward channel. The test needs to be carried out for all band classes. (See Tables 4.4.1.3-1 to 4.4.1.3.-6 in the specification.)

Remote control example

The example in GDE does the following:

- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the SMU.
- Measures the power values in the individual frequency ranges; the example covers various BCs.

Figure 44 shows a demonstration in GDE.

```
channel power.......................................-20,944 dBm
BC 0,2,7,9,10, +750 kHz...+1.98 MHz.................-60,783 dB
BC 0,2,7,9,10 ,-750 kHz...-1.98 MHz.................-62,386 dB
BC 0,2,7,9,10, +1.98 MHz...+4 MHz...................-62,970 dB
BC 0,2,7,9,10, +1.98 MHz...+4 MHz...................-83,914 dBm
BC 0,2,7,9,10, -1.98 MHz...-4 MHz...................-62,577 dB
BC 0,2,7,9,10, -1.98 MHz...-4 MHz...................-83,521 dBm
BC 7, + 3.25 MHz...4.0 MHz..........................-91,692 dBm
BC 7, -3.25 MHz...-4.0 MHz..........................-92,942 dBm
BC 0,2,7,9,10, 9 kHz...150 kHz......................-81,324 dBm
BC 0,2,7,9,10, 150 kHz...30 MHz.....................-76,121 dBm
BC 0,2,7,9,10, > 4 MHz: 30 MHz...1 GHz left.........-74,600 dBm
BC 0,2,7,9,10, > 4 MHz:  30 MHz...1 GHz right.......-25,982 dBm
BC 0,2,7,9,10, 1 GHz...5 GHz........................-23,638 dBm
BC 1,4,6,8,14,15 - +885 kHz...1.25 MHz..............-63,334 dB
BC 1,4,6,8,14,15 - -885 kHz...-1.25 MHz.............-64,039 dB
BC 1,4,6,8,14,15 - +1.25 MHz...1.98 MHz.............-63,034 dB
BC 1,4,6,8,14,15 - +1.25 MHz...1.98 MHz.............-83,978 dBm
BC 1,4,6,8,14,15 - -1.25 MHz...-1.98 MHz............-65,426 dB
BC 1,4,6,8,14,15 - -1.25 MHz...-1.98 MHz............-86,370 dBm
BC 1,4,6,8,14,15 - 1.98 MHz...2.25 MHz..............-62,059 dBc
BC 1,4,6,8,14,15 - 1.98 MHz...2.25 MHz..............-83,004 dBm
BC 1,4,6,8,14,15 - -1.98 MHz...-2.25 MHz............-64,506 dBc
BC 1,4,6,8,14,15 - -1.98 MHz...-2.25 MHz............-85,450 dBm
BC 1,4,6,8,14,15 - 2.25 MHz...4.00 MHz..............-42,618 dBm
BC 1,4,6,8,14,15 - -2.25 MHz...-4.00 MHz............-67,571 dBm
BC 1,4,6,8,14,15 - > 4 MHz: 9 kHz .. 150 kHz........-82,030 dBm
BC 1,4,6,8,14,15 - > 4 MHz: 150 kHz .. 30 MHz.......-75,256 dBm
BC 1,4,6,8,14,15 - > 4 MHz: 30 MHz .. 1 GHz.........-31,919 dBm
BC 1,4,6,8,14,15 - > 4 MHz: 1 GHz .. 5 GHz, left....-65,439 dBm
BC 1,4,6,8,14,15 - > 4 MHz: 1 GHz .. 5 GHz, right.-61,489 dBm
BC 11,12 - 750 kHz...885 kHz........................-63,382 dB
BC 11,12 - -750 kHz...-885 kHz......................-62,577 dB
BC 11,12 - 885 kHz...1.125 MHz......................-64,772 dB
BC 11,12 - -885 kHz...-1.125 MHz....................-64,660 dB
BC 11,12 - 1.125 MHz...1.98 MHz.....................-62,446 dB
BC 11,12 - -1.125 MHz...-1.98 MHz...................-63,016 dB
BC 11,12 - 1.98 MHz...4.00 MHz......................-61,776 dB
BC 11,12 - -1.98 MHz...-4.00 MHz....................-63,498 dB
BC 11,12 - 4.00 MHz...6 MHz.........................-76,390 dBm
BC 11,12 - -4.00 MHz...-6 MHz.......................-74,040 dBm
BC 11,12 - > 6 MHz: 9 kHz .. 150 kHz................-80,991 dBm
BC 11,12 - > 6 MHz: 150 kHz .. 30 MHz...............-74,777 dBm
BC 11,12 - > 6 MHz: 30 MHz .. 1 GHz.................-27,494 dBm
BC 11,12 - > 6 MHz: 1 GHz .. 12.75 GHz, left........-66,657 dBm
BC 11,12 - > 6 MHz: 1 GHz .. 12.75 GHz, right.......-63,418 dBm
BC 3 - 10 MHz .. 810 MHz............................-68,145 dBm
BC 3 - 810 MHz .. 832 MHz, RBW 100 kHz..............-75,047 dBm
BC 3 - 832 MHz .. 834 MHz, RBW 100 kHz..............-75,534 dBm
BC 3 - 834 MHz .. 838 MHz, RBW 100 kHz..............-73,834 dBm
BC 3 - 838 MHz .. 846 MHz, RBW 100 kHz..............-74,951 dBm
BC 3 - 846 MHz .. 860 MHz, RBW 100 kHz..............-75,080 dBm
BC 3 - 860 MHz .. 895 MHz, RBW 100 kHz..............-75,749 dBm
BC 3 - 895 MHz .. 3 GHz, RBW 1 MHz..................-26,250 dBm
BC 6 - PHS..........................................-70,646 dBm
BC 6 - GSM900.......................................-74,929 dBm
BC 6 - GSM900.......................................-73,622 dBm
BC 6 - DCS 1800.....................................-74,360 dBm
BC 6 - DCS 1800.....................................-74,569 dBm
BC 6 - UTRA-TDD.....................................-66,238 dBm
BC 6 - UTRA-TDD.....................................-67,079 dBm
BC 6 - Always.......................................-66,693 dBm
BC 10 - 1...........................................-82,824 dBm
BC 10 - 2...........................................-83,348 dBm
```

Figure 44 - Demonstration: conducted spurious emissions

Radiated spurious emissions (4.4.2)

The specification does not explicitly cover any measurements. Regional requirements are applied.

Inter-base station transmitter intermodulation (4.4.3)

The objective here is to prevent unwanted signals from occurring outside the CDMA channel due to interference from another base station.

The SMU simulates a second (interfering) base station. The spectrum analyzer measures the power at specific frequencies.

Test setup

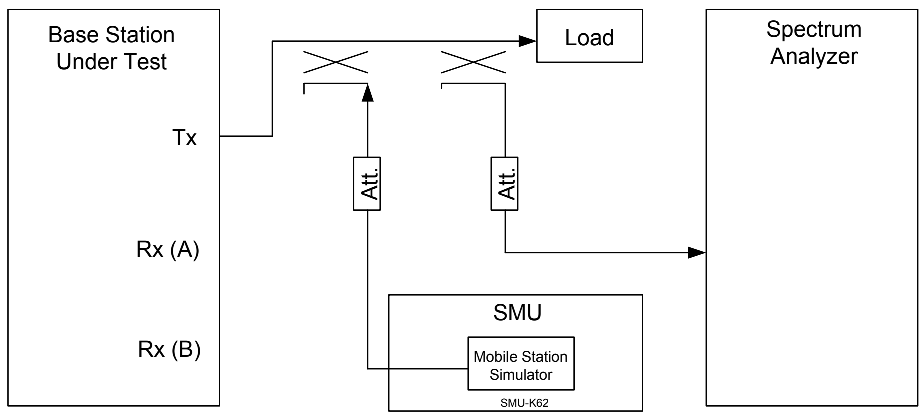


Figure 45 - Test setup: inter-base station transmitter intermodulation

Settings

The base station generates a complete forward channel. The test needs to be carried out for all band classes. The SMU simulates an external base station with a level 30 dB under the BUT at an offset frequency of 1.25 MHz. The spectrum analyzer performs a measurement on the imaged frequency in each case.

Remote control example

The example in GDE does the following:

- Simulates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the second channel of the SMU.
- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, plus five F-SCHs with the first channel of the SMU.
- Measures the channel power in the imaged frequency range in each case

Figure 46 shows the two spectrum measurements of the demonstration signal.

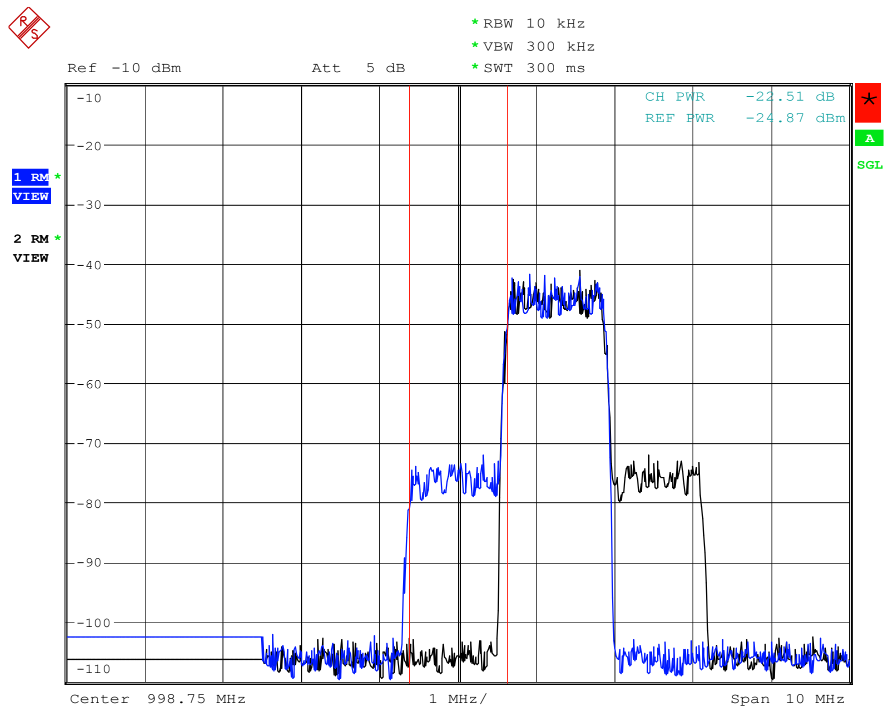


Figure 46 - Demonstration: inter-base station transmitter intermodulation

Occupied bandwidth (4.4.4)

The objective here is to ensure that the transmitted signal has the correct bandwidth.

The spectrum analyzer measures the occupied bandwidth.

Test setup

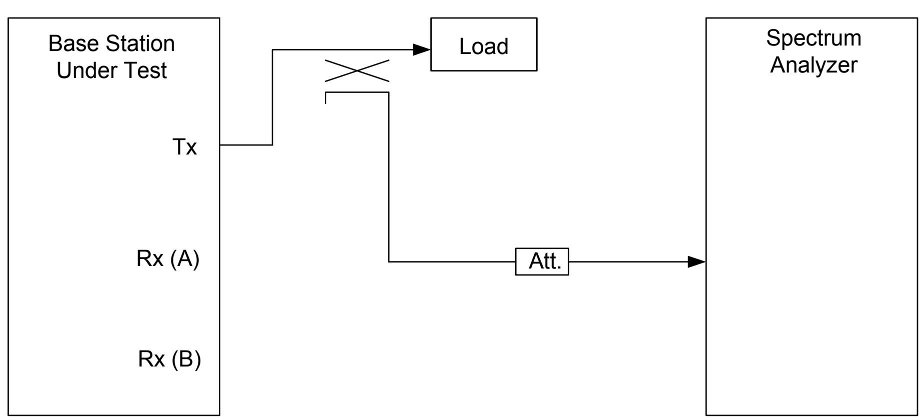


Figure 47 - Test setup: occupied bandwidth

Settings

The base station generates a complete forward channel. The test only needs to be carried out for BC3 and BC6.

Remote control example

The example in GDE does the following:

- Generates an F-PICH, F-SYNC, F-PCH, an F-FCH, and an additional five F-SCHs for the demonstration with the SMU.
- Measures the bandwidth of the signal

Figure 48 shows the demonstration measurement.

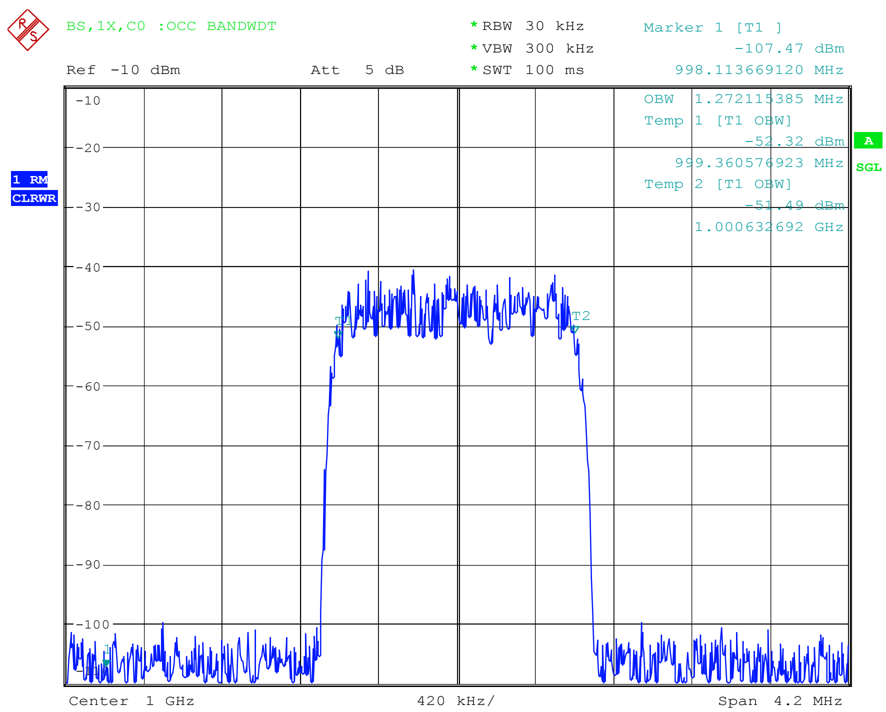


Figure 48 - Demonstration: occupied bandwidth

5 Appendix

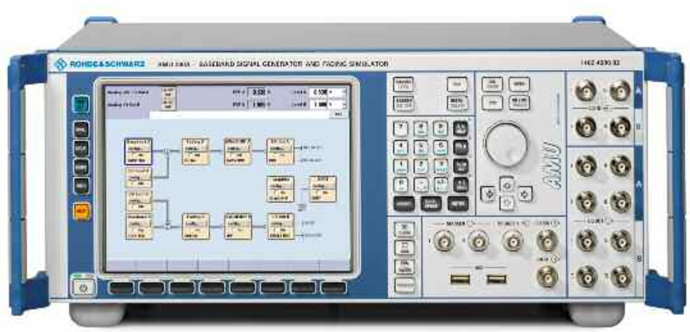
Rohde & Schwarz solutions for CDMA2000 base station tests

Signal generators

The **SMJ** vector signal generators are particularly suitable for generating CDMA2000 signals. As an SMJ is equipped with high-performance modulators, the baseband signal input to an SMJ is modulated with minimum distortion into the RF band.

The SMJ can also be used for channel simulation as a result of the wide range of options such as a fading simulator and an additive white Gaussian noise (AWGN) generator. Channel simulation is required, for example, for receiver sensitivity measurements and is often needed for customer-specific measurements.

The **AMU** Baseband signal generator and Fading simulator provides realtime IQ generation according to different digital standards, a flexible ARB generator and a channel simulator in one instrument (one or two pathes).



The **AFQ** I/Q modulation generator is a flexible baseband source. With its high-end technical specifications (variable clock rate up to 300 MHz, Maximum IQ Bandwitdh of up to 100 MHz, 256 Msample or 1Gsample memory depth), the AFQ provides enhanced performance for the receiver test, baseband test, and out-of-standard applications.

Signal analyzers

Three different instruments are available for signal analysis:

- For high-performance CDMA2000 code domain analysis, either the **FSQ** signal analyzer or the **FSU** spectrum analyzer is an ideal choice. Each offers excellent dynamic range and comprehensive modulation-analysis capability including **code domain power (CDP)** using the FS-K82 option and **CCDF measurement** capability.

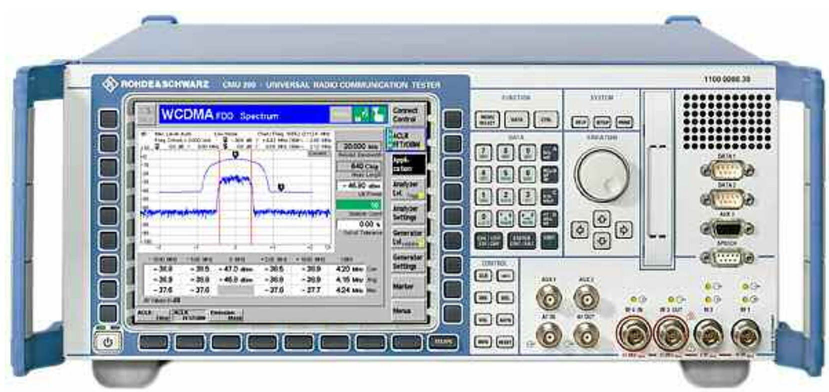
- When the highest level of performance is not required, the **FSP** spectrum analyzer is an ideal choice. Its many features including **fast ACP measurement** and **CCDF measurement** enable the FSP to cover a wide range of RF measurements.
  With the FS-K82 option, the FSP also provides code domain power analysis and has nearly the same software capabilities as an FSU or FSQ (number of slots and EVM performance is slightly different).

- The **FSIQ** signal analyzer can complete all the spectrum measurements plus **modulation analysis** and **code domain power (CDP)** measurement for IS95 signals, which are a subset of CDMA2000.
  cdmaOne measurements with the FSIQ are not discussed in this Application Note. Please refer to 1MA34 ([1]) for a detailed description of CDMA2000 measurements with the FSIQ.

Other instruments

- To set up the exact power at the BS RX port, the **NRP** power meter in combination with the **NRP-Z11** power sensor is ideal for this purpose.

- For measurements on the CDMA2000 mobile stations (MS), you can use the **CMU200** universal radiocommunication tester in combination with **CMU-B83** (CDMA2000 signaling unit) and **CMU-K83 .. 87** (software options for different CDMA2000 band classes).



Remote sequences

The most important remote settings are briefly explained here in order to make any possible modifications easier. In the examples for GDE, comments are provided for the fully executable sequences.

TX part (FSx)

General settings:

```
SENS:FREQ:CENT <frequency> Hz // frequency
DISP:WIND:TRAC:Y:RLEV <level> dBm    // level
SENS:ROSC:SOUR <source>              // external or internal
reference
INST:SEL BC2K                        // select CDMA2000 BS
measurement
INIT:CONT OFF                        // continuous sweep off
```

Measurements:

```
CALC:FEED 'XTIM:CDP:ERR:SUMM'        // select measurement screen
       or:
CALC:FEED 'XTIM:CDP:ERR:CTAB'        // screen: select channel table

INIT:IMM                             // start an individual sweep
```

Fetch results:

Summary screen

```
CALC:MARK:FUNC:CDP:RES? xxx          // xxx is desired measurement
result
```

CTAB screen

```
SENS:CDP:CODE 10                     // select Walsh code
CALC:MARK:FUNC:CDP:RES? xxx          // fetch xxx measurement result
for code 10
```

RX part (SMU)

General settings:

```
SOUR:FREQ <frequency> Hz             // frequency
SOUR:POW:LEV <level> dBm             // level
SOUR:BB:C2K:LINK REV                 // reverse link
SOUR:BB:C2K:MST1:PRES                // mobile station 1: preset
SOUR:BB:C2K:MST1:MODE xxx            // select type (traffic,
dedicated control, access, enhanced access)
SOUR:BB:C2K:MST1:CHAN<x>:STAT ON     // activate channel no. x
SOUR:BB:C2K:MST1:STAT ON             // activate mobile station 1
SOUR:BB:C2K:STAT ON                  // activate CDMA2000
OUTP ON                              // activate RF
```

AWGN:

```
SOUR:AWGN:BWID 1.23MHZ              // system bandwidth (CDMA2000
1.23 MHz)
SOUR:AWGN:POW:MODE EN               // Eb/N0 mode
SOUR:AWGN:BRAT 9.6kbps              // bit rate (here 9.6 kbit/s)
SOUR:AWGN:ENR 5.7DB                 // Eb/N0 values (here 5.7 dB)
SOUR:AWGN:STAT ON                   // AWGN on
```

Access probe:

```
SOUR:BB:C2K:MST1:MODE ACC           // access mode
SOUR:BB:C2K:MST1:CHAN1:STAT ON      // channel 1:R-ACH on
```

Enhanced access probe:

```
SOUR:BB:C2K:MST1:MODE EACC          // enhanced access mode
SOUR:BB:C2K:MST1:CHAN2:STAT ON      // channel 2: R-EACH on
SOUR:BB:C2K:MST1:CHAN2:DATA:RATE DR9K6 // R-EACH data rate 9.6 kbps
SOUR:BB:C2K:MST1:CHAN2:FLEN 20ms    // R-EACH frame length 20 ms
```

Common control:

```
SOUR:BB:C2K:MST1:MODE CCON          // common control mode
SOUR:BB:C2K:MST1:CHAN2:STAT ON      // channel 2: R-CCCH on
SOUR:BB:C2K:MST1:CHAN2:DATA:RATE DR9K6 // R-CCCH data rate 9.6 kbps
SOUR:BB:C2K:MST1:CHAN2:FLEN 20ms    // R-CCCH frame length 20 ms
```

Traffic RC1:

```
SOUR:BB:C2K:MST1:MODE TRAF          // traffic channel mode
SOUR:BB:C2K:MST1:RCON 1             // RC1
SOUR:BB:C2K:MST1:CHAN1:STAT ON      // R-FCH on
SOUR:BB:C2K:MST1:CHAN1:DATA:RATE DR1K2      // R-FCH rate 1.2 kbps
SOUR:BB:C2K:MST1:CHAN2:STAT OFF     // R-SCCH0 off
SOUR:BB:C2K:MST1:CHAN2:DATA:RATE DR1K2      // R-SCCH0 rate 1.2 kbps
SOUR:BB:C2K:MST1:CHAN3:STAT OFF     // R-SCCH1 off
SOUR:BB:C2K:MST1:CHAN3:DATA:RATE DR1K2      // R-SCCH1 rate 1.2 kbps
SOUR:BB:C2K:MST1:CHAN4:STAT OFF     // R-SCCH2 off
SOUR:BB:C2K:MST1:CHAN4:DATA:RATE DR1K2      // R-SCCH2 rate 1.2 kbps
SOUR:BB:C2K:MST1:CHAN5:STAT OFF     // R-SCCH3 off
SOUR:BB:C2K:MST1:CHAN5:DATA:RATE DR1K2      // R-SCCH3 rate 1.2 kbps
SOUR:BB:C2K:MST1:CHAN6:STAT OFF     // R-SCCH4 off
SOUR:BB:C2K:MST1:CHAN6:DATA:RATE DR1K2      // R-SCCH4 rate 1.2 kbps
SOUR:BB:C2K:MST1:CHAN7:STAT OFF     // R-SCCH5 off
SOUR:BB:C2K:MST1:CHAN7:DATA:RATE DR1K2      // R-SCCH5 rate 1.2 kbps
SOUR:BB:C2K:MST1:CHAN8:STAT OFF     // R-SCCH6 off
SOUR:BB:C2K:MST1:CHAN8:DATA:RATE DR1K2      // R-SCCH6 rate 1.2 kbps
```

Traffic RC3:

```
SOUR:BB:C2K:MST1:MODE TRAF          // traffic channel mode
```

```
SOUR:BB:C2K:MST1:RCON 3              // RC3
SOUR:BB:C2K:MST1:CHAN1:STAT OFF      // R-PICH off
SOUR:BB:C2K:MST1:CHAN2:STAT OFF      // R-DCCH off
SOUR:BB:C2K:MST1:CHAN2:FLEN 20ms     // R-DCCH frame length 20 ms
SOUR:BB:C2K:MST1:CHAN3:STAT ON       // R-FCH on
SOUR:BB:C2K:MST1:CHAN3:DATA:RATE DR1K5      //R-FCH data rate 1.5
kbps
SOUR:BB:C2K:MST1:CHAN3:FLEN 20ms     // R-FCH frame length 20 ms
SOUR:BB:C2K:MST1:CHAN4:STAT OFF      // R-SCH1 off
SOUR:BB:C2K:MST1:CHAN4:DATA:RATE DR1K5      // R-SCH1 data rate 1.5
kbps
SOUR:BB:C2K:MST1:CHAN4:FLEN 20ms     // R-FCH frame length 20 ms
SOUR:BB:C2K:MST1:CHAN5:STAT OFF      // R-SCH2 off
SOUR:BB:C2K:MST1:CHAN5:DATA:RATE DR1K5      // R-SCH2 data rate 1.5
kbps
SOUR:BB:C2K:MST1:CHAN5:FLEN 20ms     // R-FCH frame length 20 ms
```

Fading:

```
SOUR:FSIM:PRES               // fading preset
SOUR:FSIM ON                 // fading on
SOUR:FSIM:STAN CDMA3         // fading profile selection (CDMA 3)
```

Abbreviations

Abbrev.	***Meaning***
ACH	access channel
ACP	adjacent channel power
ACPR	adjacent channel power ratio
AWGN	additive white Gaussian noise
BC	band class (set of uplink and downlink frequencies)
BER	bit error rate
BS	base station
CCH	common control channel
CDMA	code division multiple access
CDP	code domain power
CW	continuous wave (unmodulated signal)
DS	direct sequence (mode for accessing the air interface)
F-…	forward …
FCH	fundamental channel
FER	frame error rate
FL	forward link (from BS to MS)
LSO	loopback service option
MAC	medium access control
MC	multicarrier (mode for accessing the air interface)
MS	mobile station
MSO	Markov service option
PCH	paging channel
PEP	peak average power
PICH	pilot channel
PRBS	pseudo random noise sequence
R-…	reverse …
RBW	resolution bandwidth
RC	radio configuration
RL	reverse link (from MS to BS)
RSQI	received signal quality indicator
RX	receive
SCCH	supplemental code channel
SCH	supplemental channel
SO	service option
SR	spreading rate
SYNC	sync channel
TD	transmit diversity
TDPICH	transmit diversity pilot channel
TDSO	test data service option
TX	transmit

List of Figures

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References

[1][2] 3GPP2: **Recommended Minimum Performance Standards for CDMA2000 Spread Spectrum Base Stations, Release C (Version 2.0)**, C.S0010-C v2.0, TIA/EIA-97-F-1, 02/2006

[3] Rohde & Schwarz: **Manual vector signal generator SMU200A**, 1007.9845.32-09-I

[4] Rohde & Schwarz: **Software Manual CDMA2000/1xEV–DV Base Station Test (Application Firmware R&S® FS–K82)**, 1007.9797.44-04

Additional information

Please send comments and suggestions regarding this Application Note to **TM-Applications@rohde-schwarz.com**

6 Ordering Information

SMU200A Vector Signal Generator		
R&S® SMU200A		1141.2005.02
R&S® SMU-B102	RF Path A: 100 kHz to 2.2 GHz	1141.8503.02
R&S® SMU-B103	RF Path A: 100 kHz to 3 GHz	1141.8603.02
R&S® SMU-B104	RF Path A: 100 kHz to 4 GHz	1141.8703.02
R&S® SMU-B106	RF Path A: 100 kHz to 6 GHz	1141.8803.02
R&S® SMU-B202	RF Path B: 100 kHz to 2.2 GHz	1141.9400.02
R&S® SMU-B203	RF Path B: 100 kHz to 3 GHz	1141.9500.02
R&S® SMU-B10	Baseband with ARB (64 Msamples)	1141.7007.02
R&S® SMU-B13	Baseband Main Module	1141.8003.02
R&S® SMU-B14	Fading Simulator	1160.1800.02
R&S® SMU-K46	Software: CDMA2000 BS	1160.9876.02
Signal analyzer, spectrum analyzer, and options		
R&S® FSP3	9 kHz to 3 GHz	1093.4495.03
R&S® FSP7	9 kHz to 7 GHz	1093.4495.07
R&S® FSP13	9 kHz to 13 GHz	1093.4495.13
R&S® FSP30	9 kHz to 30 GHz	1093.4495.30
R&S® FSP40	9 kHz to 40 GHz	1093.4495.40
R&S®FS-K82	Software: CDMA2000 BS	1157.2316.02
R&S® FSU3	20 Hz to 3.6 GHz	1129.9003.03
R&S® FSU8	20 Hz to 8 GHz	1129.9003.08
R&S® FSU26	20 Hz to 26.5 GHz	1129.9003.26
R&S®FS-K82	Software: CDMA2000 BS	1157.2316.02
R&S® FSQ3	20 Hz to 3.6 GHz	1155.5001.03
R&S® FSQ8	20 Hz to 8 GHz	1155.5001.08
R&S® FSQ26	20 Hz to 26.5 GHz	1155.5001.26
R&S®FS-K82	Software: CDMA2000 BS	1157.2316.02

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