Operator: noname Donnerstag, 22. September 2005 16 48 43 CMU Ident: RobeeSs.Inward, CMU 200-1100.0008.02,102562,V3.611 TDMA Options: 0,817,821Var14,853Var14,854Var14,856Var14,856,COPROC, FULL,853,855,858,859,FCMC/A TDMA DMD0cr60,098,70,829,821,822,423,828,456,727,828,827,458,456,456,477,833,651,462,468,454 WCDMA UE Fading WCDMA UE Fading Sequence: Total Hame and Condition Insert Intel Under Linit	LIST36 Call Release LIST36 Call Setup LIST36 Call Setup LIST36 Call Setset LIST36 Echotest	<u>5</u> 5	VCDMA UE Fading Test End
Test Name and Condition Lower Limit Upper Limit Measured V. Operating Band J, Channel DUUL 106629613, RF Level-624 dBm, Attenuation (IV/OW) 0.71.07. dB ACPICH: -10.00 dB, SSCH: -15.00 dB, S-CCPCH: -15.00 dB, S-CCPCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, S-CCPCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, S-CCPCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, S-CCPCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, S-CCPCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, S-CCPCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, S-CCPCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, SSCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB, SSCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB COPICH: -15.00 dB COPICH: -15.00 dB COPICH: -10.00 dB, SSCH: -15.00 dB COPICH: -15.00 dB COP			
MCC 1, MAC 1, LAC 1 CellType RMC 12.2 kbps DLUL, Test Loop Mode 2 MSS 001010235605, Serial Number: NAN Call to Mobile: Call Release Test: MS Serial Number: NAN Result:	ber 7.3 Multi-path 2a (Case 1) User Def 9.6 dB O dBm Att O dBm Att Control of 13.8 dB Ss t t 10 % - Sh	CH Parameters RF Channel Band Select Dp. Band ttenuations Cable Loss DL Cable Loss DL MU Baseband Input Calibration	10562 1 dB 1 dB 1 dB 2 operties sate Test Item v of selected Test Item

Products: RS[®]CMU200 (B17),RS[®]SMU (B14, B15), RS[®]CMU-Z11, RS[®]NRP-Z21, RS[®] NRP-Z22, RS[®] NRP-Z23, RS[®] NRP-Z24, RS[®]NRP, RS[®]NRVD, RS[®]NRVS

3GPP User Equipment Tests Under Fading Conditions with CMUGo! and R&S[®]CMU200 / R&S[®]SMU / R&S[®]AMU

Application Note

This application note describes how to perform 3GPP (UTRA-FDD) user equipment (UE) performance tests under fading conditions according to TS 34.121 with the automated R&S testsoftware CMUGo!. The test setup requires a Universal Radio Communication Tester R&S[®]CMU200 with IQ-IF interface option R&S[®]CMU-B17 and a Vector Signal Generator R&S[®]SMU or Fading Simulator R&S[®]AMU.



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Rohde & Schwarz

1 Overview

The signal strength and quality of signals received by 3GPP User Equipment (UE) is influenced by effects resulting from the movement of the UE, and the overlay of numerous delayed signals caused by reflections. The phenomenon is called fading and is classified in profiles such as Fine Delay, Moving Propagation and Birth-Death Propagation Fading. This applica-tion note describes how to connect an R&S[®]CMU200 Radio Communication Tester with IQ-IF interface option R&S[®]CMU-B17 to an R&S[®]SMU Signal Generator for generating 3GPP signals suitable for tests under fading conditions according to the test specification TS 34.121 for performance tests. It also describes the according CMUGo! function WCDMA_Fading_SMU for automatic baseband calibration and BLER measurement.

CMUGo! can be downloaded free of charge from the <u>R&S website</u>.

The following abbreviations are used in the text for R&S[®] test equipment:

CMU200	R&S [®] CMU200 Universal Radio Communication Tester
SMU	R&S [®] SMU200A Vector Signal Generator
AMU	R&S [®] AMU200A Fading Simulator
NRP-Z11, NRP-Z21, etc.	R&S [®] NRP-Z11, R&S [®] NRP-Z21, etc. Power Sensors
NRP	R&S [®] NRP Power Meter
NRVD	R&S [®] NRVD Power Meter
NRVS	R&S [®] NRVS Power Meter
R&S	Rohde & Schwarz GmbH und Co. KG

2 Introduction to 3GPP Fading

There are basicly two factors that affect the quality of a received 3GPP signal. A signal from the base station (Node B) usually makes its way to the UE via multiple paths. For test purposes, a variety of profiles simulate realworld fading:

- Pure Doppler which simulates direct transmission paths for which Doppler shift is occuring due to movement of the UE.
- Rayleigh Fading simulates a radio hop which arises as a result of scatter caused by obstacles in the signal path (buildings, etc.).

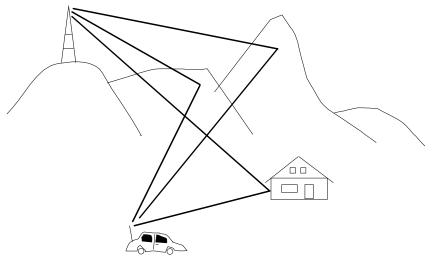
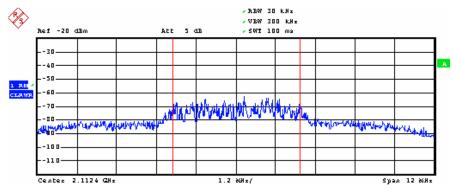


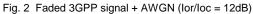
Fig. 1 Multi-path Fading

Delay variations (whether sudden or slow) become important with fast modulation standards such as 3GPP. Therefore two further propagation conditions were introduced in order to simulate the full range of influences affecting the receiver.

- Moving Propagation
- Birth Death Propagation

Since a UE only can decode the signal on one specific RF frequency at a time, the modulated signals on other frequencies simply appear as noise. The quality of the received signal is affected by the ratio of the signal power to the surrounding traffic noise level (Signal/Noise Ratio). This effect is simulated by including some Additive White Gaussian Noise (AWGN) to the signal.





The test specification for 3GPP User Equipment (TS 34.121) contains numerous test cases in order to guarantee wide ranging functionality. The fading or propagation conditions are classified as:

- STATIC PROPAGATION For a UE located at a fixed point the received signal is merely overlayed by surrounding traffic noise (AWGN).
- MULTI-PATH FADING PROPAGATION (Fine Delay) This simulates the effect that occurs when a UE is moving with a certain speed. The test specification 3GPP TS 34.121 defines 6 different cases that cover typical situations, e.g. pedestrian (3 km/h), cars (50 km/h) and trains (250 km/h). The signal is additionally overlayed by surrounding traffic noise.
- MOVING PROPAGATION (Moving Delay) Simulates the gradual change of one moving path to a reference path which occurs while driving on a flat countryside with no other dramatic landscape changes such as entering a forest. The signal is additionally overlayed by surrounding traffic noise.
- BIRTH-DEATH PROPAGATION Is the sudden cancellation of the direct path leaving only one reflected path left. This situation may occur when turning around a corner and leaving the basestation's line of sight. The signal is additionally overlayed by surrounding traffic noise.

The SMU requires both fading options SMU-B14 and SMU-B15 to simulate these effects according to the test specification 3GPP TS 34.121.

3 3GPP Fading with CMU200 and SMU

Test Setup

The specification TS 34.121 prescribes the following test setup variations for performance tests under fading conditions. For the static propagation test AWGN is added to the signal.

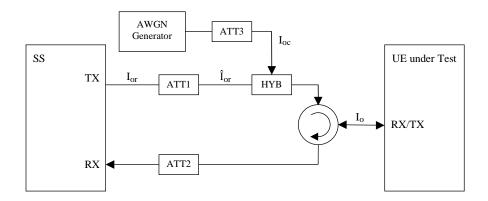


Fig. 3 Connection for Static Propagation Test

In the multi-path fading propagation test the signal is faded first, then AWGN is added to the faded signal.

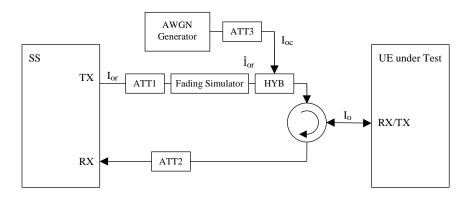


Fig. 4 Connection for Multi-path Fading Propagation Test

The same effect is achieved by simulating fading and AWGN in the baseband layer inside the SMU.

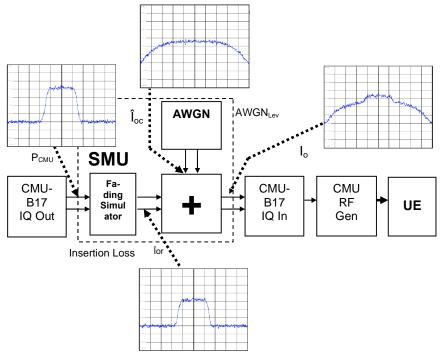


Fig. 5 Baseband Fading

The 3GPP baseband signal generated by the CMU200 is fed to the SMU IQ baseband input via the CMU-B17 IQ/IF option. The manipulated BB signal is returned to the CMU which modulates it to RF.

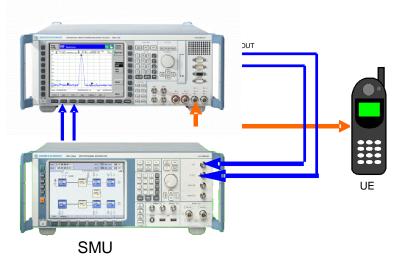


Fig. 6 Test setup

The CMU IQ out signal exceeds the SMU 0 dBfs (= 0.5Vp) limit und must therefore be attenuated accordingly with the I/Q-IF-Levelrms control. This control allows an attenuation range of 0...20 dB.

	^d Receive	er Quality	CM OFF HSDPA	1	Connect Control
WCDMA FDD Connection Contro	l 🖬 🛛 P	' <mark>S:</mark> Ic	lle	CS: Si	gnal On
Digital unit TX path TX path T	I/Q-IF RX Pa TX Pa I/Q-IF Ref. L Ref. L	iterface It Settings ath	☑ RX/ Byr - 6.: - 5.:	Q-IF Level rms /TX Bypas: pass pass 8 dB 0 dBm dBm dB	
Trigger I/Q-IF Analyzer				Misc.	1 2

Fig. 7 I/Q-IF Level rms

The SMU can determine the level of the baseband input and automatically adjust it to Up = 0.5V which corresponds to AWGN level. This enables a very precise $\hat{l}or/loc$ setting. The attenuation caused by the external 3 dB attenuators, the SMU baseband insertion loss and the RF cable loss must be compensated with the CMU RF level. The following section explains the steps necessary to perform this manually.

BLER Measurement Preparation

In order to obtain precise BLER results two calibration steps must be performed prior to the actual measurement.

- Manual measurement of the RF cable loss between the CMU RF2 output and the UE at various relevant frequencies.
- Manual or automatic calibration of the SMU Baseband Insertion Loss which is necessary to adjust the signal level (lor) to the AWGN level (loc). The automatic calibration is performed in the the CMUGo! function WCDMA_Fading_SMU.

When the cable and insertion losses are known it is possible to calculate the CMU output level compensation (EXTernal ATTenuation OUTPut) in order to obtain the prescribed UE input power.

RF Cable Loss

The loss of the RF cable between the CMU to the UE can be determined with an R&S power meter NRP, NRP-zx, NRVS or NRVD.

1. Connect the power meter (e.g. NRP-Z11) instead of the UE to the cable.

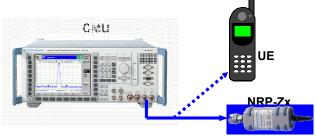


Fig. 8 Measure Cable Loss

- 2. Reset CMU with **RESET** \rightarrow **ALL**.
- 3. Press Menu Select → Basic Functions → RF → Analyzer / Generator on CMU. [BILD]
- 4. Press **CONNECT. CONTROL** on CMU.

5. Generate a CW signal on the CMU with **RF** LEVEL = -10.0 dBm (Pnom) and **FREQUENCY** \rightarrow e.g. 2112.4 MHz.

Ch. 1 Ch. 2	Analy	zer / Gen	erator			≈ 1	Connect. Control
😑 RF Conne	ection Con	trol 滚				RF	Generator On
Modulation		Off		2112	– 10.0 de 2.4000000 m	Hz	Generator Tx Frequency
					- 72 de 350.0 м	Bm RF Level	Frequency
		Analyzer	Generator		RF ⊕+	Sync.	1 2

Fig. 9 CMU Configuration for Cable Loss Measurement

6. Zero the power meter.

Power Viev File View Re	ver solution Options H	Help			8	>
	E&SCHWARZ	POWER VIEWER				
	Zer	coin	g		100315	
						J

Fig. 10 Zero power sensor

7. Enter NRP-Zx correction frequency (e.g. 2.11e9 Hz).

8. Perform measurement (Pmeas).

	lution Options						8	×
ROHDE	&SCHWARZ	POWER VI	ewer					
_		_	11	. 00	0	dBr	n 100058	
	×	dBm		Frequency / Hz	Offset	Averaging Manual Length		
Exit		(<u>A%</u>)	(M2 <u>R</u> ef	2.11e9	0.000	64		D

Fig. 11 Power Measurement

9. The resulting cable loss is the difference between the measured power (Pmeas = -11.0 dBm) and the CMU nominal level (Pnom = -10.0 dBm).

Cable Loss = $P_{nom} - P_{meas} = -10.0 \, dBm + 11.0 \, dBm = 1.0 \, dB$

The Cable Loss must be memorized for later use.

SMU Baseband Insertion Loss

This section shows how to calibrate the SMU baseband input (BB Input) manually. The same steps are performed automatically in the CMUGo! function **WCDMA_FADING_SMU** described in chapter 4.

1. Select the 3GPP signalling mode on the CMU with MENU SELECT \rightarrow 3G UMTS USER EQUIPMENT \rightarrow WCDMA FDD \rightarrow SIGNALLING \rightarrow RECEIVER QUALITY \rightarrow BER.

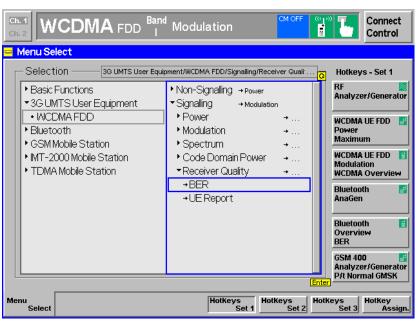


Fig. 12 Select 3G BER Mode

- 2. Set the RF parameters to realistic values, e.g.
 - RF Chn. Downlink → 10562 (= 2112.4 MHz)
 - Downlink Power \rightarrow -60.0 dBm
 - Dedicated Channel → RMC
 - Band Select → Operating Band I

Ch. 1 WCDMA FDD Band Modulation	Connect Control
😑 WCDMA FDD Connection Control 🛔 PS: Signal Off CS:	Signal On
RF Chn. Downlink 2112.4 MHz 10562 Waiting for	Signal Off
RF Chn. Uplink 1922.4 MHz 9612 UE registration or call from the UE.	
Downlink Power Output Ch. Power	Connect UE (CS)
UE Power Control 33.0 dBm - 20.0 dBm For Packet Switched - HSDPA Test Mic Max. allow. UE-Pow. UL Target Power the PS Domain (Netw. Ta	te
Openioop Power Signature	Dedicated Chan. (CS)
- 8.0 dBm Operating Band	Band Select
Connection Handover UE Signal BS Signal Network AF/RF () Syn	1c. <u>1</u> 2

Fig. 13 CMU RF Parameters

3. Route the CMU I/Q signal to the baseband output with CONNECT CON-TROL $\rightarrow 2 \rightarrow I/Q$ -IF INTERFACE $\rightarrow I/Q$ -IF \rightarrow FADING.

Ch. 1 WCDMA FDD I	Modulation	CM OFF
WCDMAFDD Connection Control		
Trigger I/Q-IF Analyzer		Misc. 1 2

Fig. 14 I/Q-IF Setting

4. Turn SMU **BB INPUT** \rightarrow **ON**.

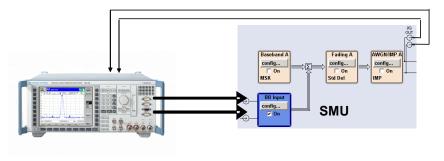


Fig. 15 Correction configuration

5. Perform **BB INPUT** → **CONFIG...** → **BASEBAND INPUT SETTINGS** → **AUTO LEVEL SET** in SMU to determine CMU IQ output level.

🧱 Baseband Input Setti	ngs 🔤 🗆 🔯
State	On
Mode	Analog Input 💽
I/Q Swap	🗆 On
l/Q Skew (Q Delay)	0.000 ns 💌
Baseban	d Input Level
Auto Level Set	
Crest Factor	11.05 dB 💌
Peak Level	0.76 dBfs -
Signal	Monitoring
NO OVERLOAD	۵

Fig. 16 BB Auto Level Set

The BB input level is calculated as

BBrms = PeakLevel - CrestFacto r = 0.76 dBfs - 11.05 dB = -10.29 dBfs

This value must be stored for later use. This procedure can also be performed automatically in the CMUGo! function **WCDMA_Fading_SMU** by checking the **BB INPUT CALIBRATION** button (see section 4 - 3G Fading Test with CMUGo!).

<u>Note:</u> The OVERLOAD LED (red) may eventually appear but does not affect the measurement results.

- 6. Enter the FADING A → CONFIG... Fading Settings menu and select:
 - STATE \rightarrow ON
 - STANDARD \rightarrow 3GPP Case 1 (UE/BS)
 - Signal dedicated to → BASEBAND OUTPUT
 - VIRTUAL RF \rightarrow 2.1124 GHz

🔜 Fading A							= = ×
					State	1	On
Set To Default	Save/Rec	all	Standard		3GPP	Case 1 (U	ie/BS) 💌
		Gener	al Settings				
Configuration	Fine Delay 50MHz	-					
Signal dedicated to	Baseband Output	•	Virtual RF		2.	112 400 00	00 00 GHz 💌
Common Speed for all Pa	ths	2	Speed Unit		km/h		-
Restart Event	Auto	•			Restart		
Ignore RF changes < 5%		🗆 On	Frequency	Hop. Mode	Off		•
		Path	Settings				
Path Table	Path Delay Wiz	ard	Coupled Para	meters	Insertion	Loss Con	figuration
면 ⁰⁻							static Path
0 10- 20-						ř	pure Doppler
S 30-							Rayleigh
<u>u</u> 40-							Rice const Phase
bath loss							delay
0.00 0.10	0.20 0.30 0	0.40 0.50	0.60 0	1.70 0.80	0.90	1.00	/µs

Fig. 17 Fading Menu

7. Enter the AWGN/IMP A \rightarrow conFig... \rightarrow I/Q IMPAIRMENTS (DIGITAL BASE-BAND)... menu and determine the Signal Level (RMS).

📰 I/Q Impairments A (Digital Baseband) 📃 🗔 🔯							
I/Q Impairments							
State		Off					
I Offset	0.00	%	•				
Q Offset	0.00	%	•				
Gain Imbalance	0.000	dB	┚				
Quadrature Offset	0.00	deg	┚				
Optimize Internal I/Q Impairments For RF Output							
Baseband Signal Level							
Crest Factor		27.35	dB				
Peak Level		0.01 dB	lfs				
Signal Level (RMS)		-27.34 dB	lfs				

Fig. 18 I/Q Impairments Menu

The difference between **BBRMS** (see formula on page 13) and the **SIGNAL LEVEL (RMS)** is the baseband insertion loss of the SMU. The

sum of the **RF CABLE LOSS**, **SMU BASEBAND INSERTION LOSS** and 3 dB external input attenuators must be compensated with the CMU **Ext**ernal **ATT**enuation **OUTPUT** control.

Ext.Outp.Att = BbRms - SignalLevelRms + 3 dB + CableLoss= -10,29 dBfs + 27.34 dBfs + 3 dB + 1,0 dB= 21,05 dB

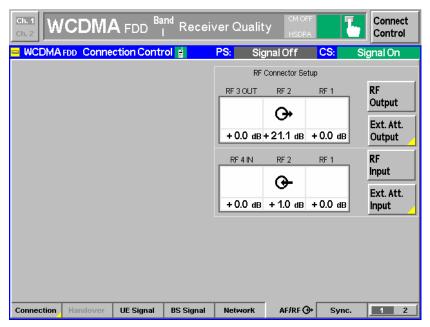


Fig. 19 CMU External Attenuation Output

Enter the AWGN/IMP A → CONFIG... → AWGN... menu and select (differing from default):

🔜 AWGN Settings A				
Mode	Additive Noise		•	
System Bandwidth	3.840 0	MHz	•	
Minimum Noise/System Bandwidth Ratio			1.5	
Noise Bandwidth	6.2	200 0	MHz	
Noise Level Configu	ration			1
Set Noise Level Via	C/N		•	
Reference Mode	Noise		•	
Bit Rate	100.000 000	kbps	-	
Carrier/Noise Ratio	0.00	dB	•	
Eb/N0	15.84	dB	-	
Carrier Level	-60.00	dBm	Ŧ	
Noise Level (System Bandwidth)	-60.00	dBm	•	
Noise Level (Total Bandwidth)	-54.66	dBm	-	
Carrier+Noise Level	-56.99	dBm	-	
Carrier+Noise PEP	-35.59	dBm	-	•

Fig. 20 AWGN Menu

- STATE \rightarrow ON
- MINIMUM NOISE/SYSTEM BANDWIDTH RATIO \rightarrow 1.5
- **REFERENCE MODE** → **NOISE** (as defined in TS 34.121)
- **CARRIER/NOISE RATIO** \rightarrow **0.00 dB**. This allows easy comparison since lor = loc = lor + loc 3.01 dB.
- NOISE LEVEL (SYSTEM BANDWIDTH) \rightarrow -60 dBm

When entering a realistic value for loc (e.g. NOISE LEVEL \rightarrow -60.00 dBm) the total output power lo (CARRIER + NOISE LEVEL) will display the correct value. Io is calculated with following formula:

$$lo = 10^* \log(10^{\frac{\hat{l}or/dB}{10}} + 10^{\frac{loc/dB}{10}})$$

After all compensation measures have been taken lo is the expected power fed to the UE.

9. The resulting CMU RF channel power may optionally be checked with a spectrum analyser, e.g. FSQ8 in Fast ACP mode.

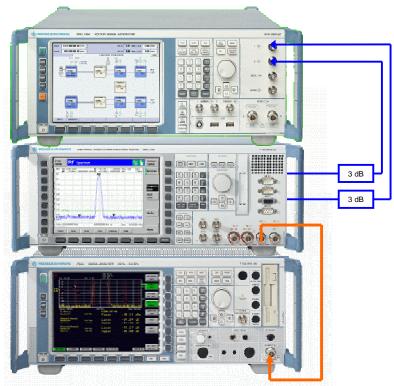


Fig. 21 Io Measurement with FSQ

Note:

For a steady FSQ power readout the **SPEED** parameter in the SMU Fading Path Table may be set to the maximum value (817.5 km/h). Be sure to reset it for BLER measurements.

	Fading A: Path Table Standa	ard/Fine Delay							
		1	1	2		2		3	3
		1	2	1		2		1	2
	State	Off	Off	0	n	Off		On	Off
	Profile	Rayleigh	Rayleigh	Ra	ayleigh	Rayleigh		Rayleigh	Rayleigh
	Path Loss /dB	0.00	0.00	0.1	00	0.00		10.00	0.00
	Basic Delay /us	0.00	0.00	0.1	00	0.00		0.00	0.00
	Additional Delay/us	0.000 00	0.000 00	0.	000 00	0.000 00		0.976 00	0.000 00
	Resulting Delay /us	0.000 00	0.000 00	0.1	000 00	0.000 00		0.976 00	0.000 00
F	Power Ratio /dB						ľ		
AS	const Phase /deg	0.0	0.0	0.	0	0.0		0.0	0.0
T	Speed /km/h	817.5	817.5	81	17.5	817.5		817.5	817.5
	Freq. Ratio	0.00	0.00	0.1	00	0.00		0.00	0.00

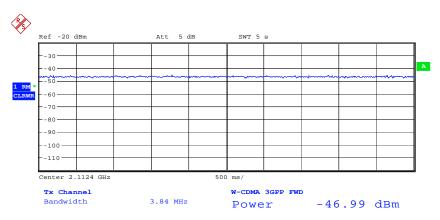
Fig. 22 Fading Path Table

The noise level loc may be easily measured by disconnecting the baseband input cables from the SMU.

Use following settings on the analyzer:

- FREQUENCY \rightarrow 2112.4 MHz
- Press Meas \rightarrow Chan Pwr Acp \rightarrow Cp / Acp Standard \rightarrow WCDMa 3GPP Fwd
- Enter SweeP → SweeP Time → 5s
- Press Meas \rightarrow Chan Pwr Acp \rightarrow Cp / Acp Config \rightarrow No. of Adj. Chan \rightarrow 0
- Press Meas \rightarrow Chan Pwr Acp \rightarrow Cp / Acp Config \rightarrow Fast Acp \rightarrow ON

With the CMU **OUTPUT CHANNEL POWER** set to -60 dBm the expected total output power **Io** is **-56,99 dBm** (see figure below).





4 CMUGo! Multi-path Fading Propagation Example Test 2a, Case 1

CMUGo! is a software platform for easily creating automated test routines with a CMU and various R&S test equipment required for GSM, CDMA200 or 3GPP tests. This section shows the steps necessary to perform a BLER measurement according to **7.3 MULTI-PATH FADING PROPAGATION TEST 2A, CASE1**.

A detailed description of the WCDMA CALL SETUP and WCDMA FADING SMU functions is given in chapter 5. The demo sequence **3GUEFADTST.SEQ** included in CMUGo! note contains <u>all</u> performance tests listed in the test specification TS 34.121.

Defining SMU GPIB Address

In order to use the SMU in CMUGo! click on the menu item **CONFIGURATION** → **AUXILIARY GPIB PORT 1:**. Set the **DEVICE NAME** to SMU, make sure you have the correct **PRIMARY ADDRESS** and check **ENABLE PORT**.

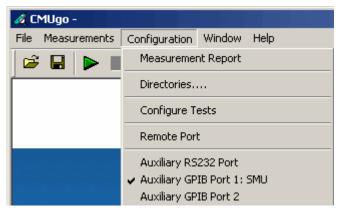


Fig. 24 AUX GPIB Port 1

Auxiliary GPI	B Port 1		a x
- Device Name			
	SMU		
- Primary Addre	ss	- Secondary Add	ress
	28		0
EOT Mode		-EOS Character	
	1		0
- Timeout			
	60		ОК
			Cancel
Enable Port 🖡	~		

Fig. 25 SMU GPIB Address

Configuring a BLER Test Sequence

A test sequence can be generated in CMUGo! by using a mouse to drag and drop a function from the **AvaiLable** to the **Selected** list. A BLER measurement (e.g. 7.3 Multi-path Test 2a, Case 1) requires at least following steps.

Item	Selected	Description
1 2 3 4 5 6	Basic Initializing SMU 3G Baseband Calibration WCDMA Call Setup WCDMA UE Fading WCDMA Call Release Test End	7.3 Multi-path Test 2a, Case 1

Fig. 26 BLER Test Sequence

• **BASIC INITIALIZING** – Selects the required function group, e.g. **WCDMA 1900 FDD** and initializes the CMU accordingly. The **RF** function group must also be switched ON.

Basic Initializing		8	×
	Active function groups ✓ RF GSM 400 GSM 850 GSM 1800 GSM 1800 GSM 1900 IS-136 800 IS-136 1900 IS-CDMA Cellular IS-CDMA PCS Band IS-CDMA 2000 450 MHz IS-CDMA 2000 VCS Band IS-CDMA 2000 INT2K Band VCDMA 1900 FDD Bluetooth AMPS Audio Ix-EvD0	Cancel]
	External 10 MHz Reference Show CMU Report Screen Skip the Reset (Be aware of possible malfunction)		

Fig. 27 Basic Initializing

 WCDMA CALL SETUP – Performs the call. The yellow marked CHANNEL CONFIGURATION parameters P-CPICH, P-SCH, S-SCH, P-CCPCH, PICH and Data Information Rate are configured in this menu (see Chapter 5). The other test specific parameters are set in the succeeding WCDMA UE FADING functions.

Call Setup Configuration			a ×
	Band Operating Band I RF Downlink Channet: 10562 Frequency (MHz): 2112.4 RF Uplink Channet: 9613 Frequency (MHz): 1922.6 Duplex Space (MHz): 190 RF Level (dBm): -50.6	Channel Configuration Code Level (dB) P-CPICH: .10 P-SCH: .15 S-SCH: .15 P-CCPCH: .12 S-CCPCH: .12 S-CCPCH: .12 S-CCPCH: .12 P-CPICH: .12 S-CCPCH: .12 P-CH: .12	OK Cancel
	Call Setup RMC 12.2 kbps DL/UL C Call from Mobile C Call from CMU Wait Before Calling (Sec.) Maximum Time (Sec.) 30	AICH: DPDCH: AICH: A	
	Attenuations Input Attenuation (dB): Output Attenuation (dB): OUtput Attenuation (dB): CMU Connector: C RF1 © RF2	Additional Settings Analyzer Settings Manual Level (dBm): Manual Level follows Channel Configuration Autoranging	

Fig. 28 WCDMA Call Setup

WCDMA FADING SMU – This function allows to enter a test case as specified in TS 34.121 (performance tests 7.2 static propagation, 7.3 multi-path fading propagation, 7.4 moving propagation and 7.5 birth-death propagation). By selecting a TEST NUMBER the parameters IOR/IOC, IOC, DPCH_EC/IOR and BLER LIMIT are preset with the appropriate value. When the SMU BASEBAND INPUT CALIBRATION checkbox is ON the SMU determines the baseband input RMS level. This function needs to be turned ON only in the first test after the WCDMA CALL SETUP. Select RF Channel and enter the cable loss.

DCH Parameters TCH Parameters Test Number 7.3 Multi-path 2a (Case 1) Ior / Ioc User Def 9.6 dB Ioc -60 dBm Information Data Rate -64 kbps DPCH_Ec/lor -13.8 dB BLER Settings -00 dBm
BLER Limit 10 % SMU Baseband Input Number of Transport Blocks 2000 Calibration Description 7.3 Multi-path Test 2a, Case 1

Fig. 29 WCDMA Fading SMU

• WCDMA CALL RELEASE – This command releases the call.

Call Release Configuration		8	×
	Type ○ Release from Mobile ④ Release from Testset CMU ✓ Free all CMU resources Call Release Maximum Time (sec.)	20	
	ОК	Cancel	

Fig. 30 WCDMA Call Release

• **TEST END** – Is necessary for all test sequences and closes unused handles and frees unused memory.

Configure Test End	
	Start Autosave Procedures Dialog closes automatically after (Sec): 3
	OK Cancel

Fig. 31 Test End

Running the Test Sequence

- Load the example Test 2a, Case 1 with CONFIGURATION → CONFIGURE TESTS → LOAD SEQUENCE... → T2AC1.SEQ.
- Start the sequence by selecting **MEASUREMENTS** → **START** from the menu, pressing **CTRL-F5** or clicking on the green arrow.

🄏 Cl	MUgo -		🔏 CMUgo -
File	Measurements	Configuration	File Measurements Configuration
6	Start	Ctrl+F5	🖻 🖬 🕨 🔳 📣
⊢	Stop	Ctrl+F6	
	Pause	Ctrl+F7	
	Step	Ctrl+F8	
	Demo Mode		

Fig. 32 Start Test Sequence

• After approx. 30s you will be prompted to switch ON the mobile for registration.

Message		8
	Please switch your mobile on !	
	ОК	

Fig. 33 Switch Mobile On

After turning the mobile ON the message will disappear as soon as the mobile has been registered.

• After approx. 80 seconds the test is completed and a measurement report window appears.

Operator:	noname			Dienstag,	20. Dezember 2005	13:43:22
CMU Ident:	Rohde&Schwarz,CMU 200-1100.	0008.02,102652,	,1/3.80/			
Options:	0,B17,B21Var14,B52Var14,B53V	ar14,854Var14,8	856 <i>Var14,B</i> 66,C(DPROC_FULL,E	383, B85, B88, B95, PCA	IICIA
	WDDC400,U99,K0,K20,K21,K22,	K23,K2 4 ,K26,K2	7,K28,K29,K42,K	43,K44,K45,K4	7,K48,K53,K61,K62,K6	53
	K64,K65,K66,K67,K68,K69,K80,K	81,K82,K83,K84	,K85,K86,K87,K8	8,K92,K96,FMF	?6,Intel Celeran(TM)	
	256 MB					
	nxtx1					
Sequence:						
	Test Name and Condition		Lower Limit	Upper Limit	Measured Value	P/F
Operating Band	1, Channel DL/UL 10562/9613, RF L	evel-50.6 dBm, .	Attenuation (In/C	ut) 0.0 / 0.0 dB		
P-CPICH: -10.0	0 dB, P-SCH: -15.00 dB, S-SCH: -15	.00 dB, P-CCPC	H: -12.00 dB, S-0	ССРСН: -5.30 d	В	
PICH: -15.00 dl	3, AICH -8.30 dB, DPDCH (Code 6): -	-10.30 dB, DPCC	CH/DPDCH Offse	et 0.00 dB		
MCC 1, MNC 1,	LAC 1 CallType RMC 64 kbps DL/U	iL, Test Loop Ma	ode 2			
/MSI: 00101012	3456063,Serial Number: 351547000	581600				
Call to Mobile:					passed	
BLER Measure	ement 7.3 Multi-path Test 2a, Case	1		10.00 %	3.10 %	
Call Release T	eet:				passed	

Fig. 34 Measurement Report

CMUGo! considers the **CALL TO MOBILE**, **BLER MEASUREMENT** and **CALL RELEASE** as tests and includes them accordingly in the result line.

BLER vs. Îor/loc Characteristic

An easy method for comparing different UEs with each other is a BLER characteristic with variable $\hat{l}or/loc$. The following test sequence **T2AC1 CHAR.SEQ** based on 7.3 Multi-path fading, Test 2a, Case 1, was performed with decreasing $\hat{l}or/loc$ (12 dB to 0 dB) and constant loc = -60dBm.

Operator:					
	noname		Montag,	14. November 2005	11:13:55
CMU Ident:	Rohde&Schwarz, CMU 200-1100.0008.02, 102	· ·	00000 000		1 2/10
Options:	0,B17,B21Var14,B52Var14,B53Var14,B54Var WDDC400,U99,K0,K20,K21,K22,K23,K24,K26				
	K64, K65, K66, K67, K68, K69, K80, K81, K82, K83,				,3
	256 MB	no 1 ,no3,no0,no7,no	JO, N JE, N JO, / MII	io,micr ocicion (mi)	
	rxtx1				
Sequence:					
•	Test Name and Condition	Lower Limit	Upper Limit	Measured Value	P/F
Operating Ban	i I, Channel DL/UL 10562/9613, RF Level -50.4 dE	Bm, Attenuation (In/C	Dut) 0.0 / 0.0 dB	1	
P-CPICH: -10.0	0 dB, P-SCH: -15.00 dB, S-SCH: -15.00 dB, P-CC		ССРСН: -5.30 а	В	
PICH: -15.00 d	3, AICH-8.30 dB, DPDCH (Code 6): -10.30 dB, D	PCCH/DPDCH Offs	et 0.00 dB		
MCC 1, MNC 1	. LAC 1 CallType RMC 64 kbps DL/UL, Test Loop	Mode 2			
IMSI: 00101012	3456063,Serial Number: 351547000581600				
Call to Mobile				passed	
BLER Measur	ement 7.3 Test 2a, Case 1 lon/loc = 12.0dB		10.00 %	0.70 %	
BLER Measur	ement 7.3 Test 2a, Case 1 lon/loc = 11.0dB		10.00 %	1.15 %	
BLER Measur	ement 7.3 Test 2a, Case 1 Ion/Ioc = 10.0dB		10.00 %	1.60 %	
BLER Measur	ement 7.3 Test 2a, Case 1 lon/loc = 9.0dB		10.00 %	2.55 %	
BLER Measur	ement 7.3 Test 2a, Case 1 lon/loc = 8.0dB		10.00 %	3.10 %	
BLER Measur	ement 7.3 Test 2a, Case 1 Ion/Ioc = 7.0dB		10.00 %	4.60 %	
BLER Measur	ement 7.3 Test 2a, Case 1 lor/loc = 6.0dB		10.00 %	6.65 %	
BLER Measur	ement 7.3 Test 2a, Case 1 Ion/Ioc = 5.0dB		10.00 %	9.50 %	
BLER Measur	ement 7.3 Test 2a, Case 1 lor/loc = 4.0dB		10.00 %	12.85 %	
BLER Measur	ement 7.3 Test 2a, Case 1 Ion/Ioc = 3.0dB		10.00 %	17.85 %	
BLER Measur	ement 7.3 Test 2a, Case 1 Ion/Ioc = 2.0dB		10.00 %	23.60 %	
BLER Measur	ement 7.3 Test 2a, Case 1 lor/loc = 1.0dB		10.00 %	29.25 %	
	ment 7.3 Test 2a, Case 1 lor/loc = 0.0dB		10.00 %	36.40 %	
BLER Measur			10.00.00	NAN	
	ement 7.3 Test 2a, Case 1 lor/loc = -1.0dB		10.00 %	nen	
BLER Measur	ement 7.3 Test 2a, Case 1 lor/loc = -1.0dB ement 7.3 Test 2a, Case 1 lor/loc = -2.0dB		10.00 % 10.00 %	not performed	

Fig. 35 BLER vs. lor/loc

The curve has a non-linear chararacteristic and becomes rather steep with increasing lor / loc. This region suites best for curve comparison.

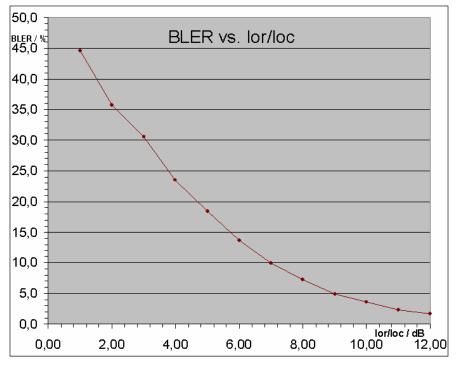


Fig. 36 BLER vs. Îor/loc

5 Using TS 34.121 Parameters in CMUGo!

The receiver characteristics of the Dedicated Channel (DCH) in different multi-path fading environments are determined by the **BL**ock **E**rror **R**atio (BLER) values. This section is also based on **7.3 MULTI-PATH TEST 2A, CASE 1** and shows which parameters from the test specification TS 34.121 are relevant and how they are used in the CMUGo! functions **WCDMA CALL SETUP** and **WCDMA FADING SMU**.

WCDMA Call Setup

The **DOWNLINK PHYSICAL CHANNEL** levels and the test dependant **INFORMATION DATA RATE** are configured in the CMUGO! function **WCDMA CALL SETUP** and marked yellow. The non-marked parameters may be left in default state since they are test dependant and will be overriden in the succeeding **WCDMA UE FADING** command(s).

 Band	Channel Configuration						
Operating Band I	-		CMU Default	Code	Level (dB)	OK	
RF Downlink Channel:	10562	P-CPICH:		1	-10	Canc	el :
Frequency (MHz):	2112.4	P-SCH:			-15		
 RF Uplink Channel:	9613	S-SCH:			-15		
 Frequency (MHz):	1922.6	P-CCPCH:			-12		
Duplex Space (MHz):	190	S-CCPCH:			2 -5.3		
RF Level (dBm):	-50.6	PICH:	N		2 .15.0		
I.		AICH:	M		3 -8.3		
		DPDCH:	•		6 -10.3		
Call Setup				1	1		
RMC 12.2 kbps DL/UL	<u> </u>						
 Call from Mobile Call from CMU 		DPCCH7 D	PDCH Offset:		0		
Wait Before Calling (Sec.):	0			Additiona	al Call Setup 🔲		
Maximum Time (Sec.)	30				C Connection		
AMB			Addition	al Setting:	\$		
Attenuations		Analyzer Se	ettings				
Input Attenuation (dB):	0	Manual Lev	/el (dBm):		0		
Output Attenuation (dB):	0	Manual	Level follows	Channel I	Configuration		
CMU Connector: C RF1	• RF2	Autorar	nging				

Fig. 37 WCDMA Call Setup

In the following list taken from TS 34.121 the according levels are marked and apply for performance tests 7.1 Static Propagation, 7.2 Multi-path Fading Propagation, 7.3 Moving Propagation and 7.4 Birth-Death propagation.

Physical Channel	Power	Note
P-CPICH	P-CPICH_Ec/lor = <mark>-10 dB</mark>	Use of P-CPICH or S-CPICH as phase reference is specified for each requirement and is also set by higher layer signalling.
S-CPICH	S-CPICH_Ec/lor = -10 dB	When S-CPICH is the phase refer- ence in a test condition, the phase of S-CPICH shall be 180 degrees offset from the phase of P-CPICH. When S- CPICH is not the phase reference, it is not transmitted.
P-CCPCH	P-CCPCH_Ec/lor = <mark>-12 dB</mark>	
SCH	SCH_Ec/lor = <mark>-12 dB</mark>	This power shall be divided equally between Primary and Secondary Synchronous channels
PICH	PICH_Ec/lor = <mark>-15 dB</mark>	
DPCH	Test dependent power	When S-CPICH is the phase refer- ence in a test condition, the phase of DPCH shall be 180 degrees offset from the phase of P-CPICH.
OCNS	Necessary power so that total transmit power spectral density of Node B (lor) adds to one	OCNS interference consists of 16 dedicated data channels as specified in table E.3.6.
		ompensate for the presence of transient the DPCH channels may be used.

Table E.3.3: Downlink Physical Channels transmitted during a connection

Table 7.3.1.11: DCH parameters in multi-path fading propagation conditions (Case 1)

Parameter	Test 1	Test 2	Test 3	Test 4	Unit
Phase reference	P-CPICH				
\hat{I}_{or}/I_{oc}	9,6				dB
I _{oc}		dBm / 3,84 MHz			
Information Data Rate	12,2	<mark>64</mark>	144	384	kbps

INFORMATION DATA RATE is the data rate of the signal (e.g. 64 kbps for Test 2a, Case 1). It is test dependedant, but must be configured before establishing a call. This means that a call must be released and re-established before performing a test case with a different Information Data Rate.

WCDMA Fading SMU

The test dependant DCH parameters for the test **7.3 DEMODULATION OF DCH IN MULTI-PATH FADING PROPAGATION CONDITIONS TEST 2A**, CASE 1 are configured in the function WCDMA FADING SMU.

WCDMA UE Fading				8	×
Instruments: SMU, CMU200	DCH Parameters Test Number 7.3 Multi-path Ior / Ioc User Def Ioc Information Data Rate DPCH_Ec/Ior BLER Settings BLER Limit Number of Transport Blocks - Description 7.3 Multi-path T	2a (Case 1) 💌 9.6 dB -60 dBm 64 kbps -13.8 dB 10 % 2000 est 2a, Case 1	- Attenuations	10562 . Band 1 💌 1	JB JB

Fig. 38 WCDMA Fading SMU (Test 2a, Case 1)

The DCH parameters are taken from following TS 34.121 table.

Table 7.3.1.11: DCH parameters in multi-path	n fading propagation conditions (Case 1)
--	--

Parameter	Test 1	Test 2	Test 3	Test 4	Unit
Phase reference	P-CPICH				
\hat{I}_{or}/I_{oc}	<mark>9,6</mark>				dB
I _{oc}		dBm / 3,84 MHz			
Information Data Rate	12,2	64	144	384	kbps

PHASE REFERENCE – The CMU200 currently supports only P-CPICH and therefore cannot perform tests involving S-CPICH (e.g. 7.3.1.17 / 7.3.1.18).

ÎOR/IOC is the Signal to Noise Ratio (SNR) between the WCDMA Output Channel Power **ÎOR** and the AWGN signal level **IOC**. (e.g. 9.6 dB for Test 2a, Case 1). The CMU Output Channel Power is equivalent to Îor and is calculated as:

$$\hat{I}_{or} = I_{oc} + \frac{\hat{I}_{or}}{I_{oc}} = -60,0 \,\mathrm{dBm} + 9,6 \,\mathrm{dB} = -50,4 \,\mathrm{dBm}$$

loc is the absolute level of the AWGN interferer (e.g. -60dBm for Test 2a, Case 1) at 3.84 MHz system bandwidth.

Test Number	$\frac{DPCH_E_c}{I_{or}}$	BLER
1	–14,9 dB	10 ⁻²
2	<mark>–13,8 dB</mark>	10 ⁻¹
2	–9,9 dB	10 ⁻²
3	–10,5 dB	10 ⁻¹
5	−6,7 dB	10 ⁻²
Λ	−6,2 dB	10 ⁻¹
4	–2,1 dB	10 ⁻²

Table 7.3.1.12: DCH requirements in multi-path fading propagation conditions (Case 1)

DPCH_Ec/lor – is the ratio of the **D**edicated **P**hysical **Ch**annel to the signal level **Îor** (e.g. -13.8dB for Test 2a, Case 1).

BLER LIMIT – is the specified maximum measured Block Error Rate (e.g $10^{-1} = 10\%$ for Test 2a, Case 1).

TEST NUMBER – Selects the test according to TS 34.121, e.g. 7.3 Multi-path Test 5, Case 2 and sets the parameters **Ior/Ioc** (S/N ratio), **Ioc** (AWGN level), **DPCH_Ec/Ior** and also the **BLER LIMIT**. The fading path parameters are also automatically configured according to the table below.

	se 1, 3km/h		se 2, 3 km/h		e 3, 20 km/h
Relative Delay [ns]	Average Power [dB]	Relative Delay [ns]	Average Power [dB]	Relative Delay [ns]	Average Power [dB]
0	<mark>0</mark>	0	0	0	0
<mark>976</mark>	<mark>-10</mark>	976	0	260	-3
		20000	0	521	-6
				781	-9

Table D.2.2.1: Propagation conditions for multi-path fading environments

USER DEF – Indicator that becomes checked as soon as one of the parameters **IOR/IOC**, **IOC**, **DPCH_EC/IOR** or **BLER LIMIT** is changed. This indicates that the test is no longer specified by TS34.121 but user defined.

INFORMATION DATA RATE – Indicator that shows the INFORMATION DATA RATE of the selected Test Number e.g. 64 kbps. It must match the Information Data Rate of the preceeding **WCDMA CALL SETUP**. And cannot be changed during an established call.

NUMBER OF TRANSPORT BLOCKS – Number of blocks that are taken into account for BLER measurement. A higher number results in better averaging. Range 1...50000.

CABLE LOSS DL – Cable loss of the **D**ownLink channel. It is calculated as CABLE LOSS DL = Pnom - Pmeas = -10,0 Bm + 11,0 dBm = 1,0 dBm

6 Additional Information

Please contact <u>TM-Applications@rsd.rohde-schwarz.com</u> for comments and further suggestions.

7 Ordering information

Communication Tester CMU 200 CMU-B17 CMU-U65 CMU-B68 CMU-B56 CMU-B21 CMU-PK60 CMU-Z10 CMU-Z11	IQ-IF Interface Measurement DSP for WCDMA / CDMA200 - upgrade kit Layer-1 Board (3GPP/FDD,DL+UL) 3GPP Signalling Unit Univ.Signalling Unit (3GPP Hardw.) Softw.Package–3GPP/FDD/UE,TX- Test Gen. Band 1+2+3+4+5+6 Antenna Coupler Shielded Chamber for Mobile Sta-	1149.9809.02 1150.1850.14 1100.5200.14 1159.3355.02 1150.0801.02
Vector Signal Generator SMU200A SMU-B14 SMU-B15 SMU-B17 SMU-K62	tions (300 kHz to 2.2 GHz) Fading simulator 6 path, mandatory 2nd Fading simulator, mandatory Baseband Inputs AWGN	1125.5555.02 1085.4002.02 1085.4402.02 1142.2880.02 1159.8511.02
Power Meter NRP NRP-Z11 NRP-Z21 NRP-Z22 NRP-Z23 NRP-Z24	Power Meter Power Sensor Power Sensor Power Sensor Power Sensor Power Sensor	1143.8500.02 1138.3004.02 1137.6000.02 1137.7506.02 1137.8002.02 1137.8502.02
Signal Analyzer FSQ3	(20 Hz to 3.6 GHz)	1155.5001.03



ROHDE & SCHWARZ GmbH & Co. KG · Mühldorfstraße 15 · D-81671 München · P.O.B 80 14 69 · D-81614 München · Telephone +49 89 4129 -0 · Fax +49 89 4129 - 13777 · Internet: <u>http://www.rohde-schwarz.com</u>

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