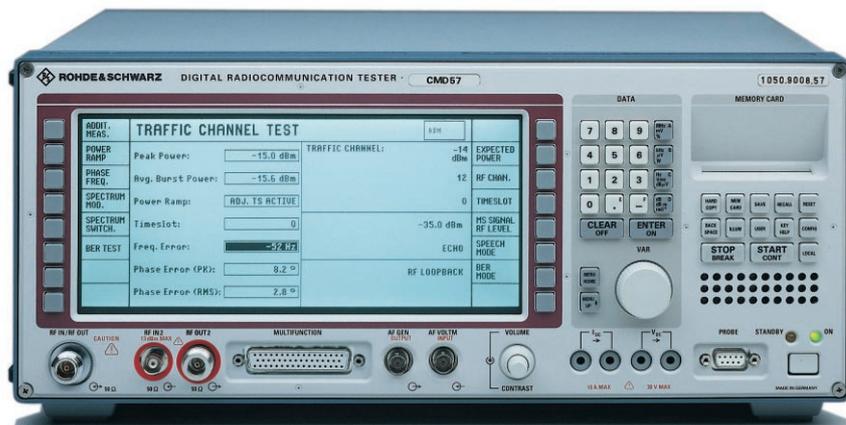


Digital Radiocommunication Testers CMD54, CMD57, CMD59

For production, installation and service of GSM 900/1800/1900 base stations

CMD57



Brief description

Digital Radiocommunication Testers CMD 54/57/59 are advanced top-class instruments for measurements on base stations (BTS) and BTS modules.

CMD 54 is designed for measurements in line with:

- GSM900
- E-GSM
- UIC – European train radiotelephony

CMD 57 additionally covers the following standards:

- GSM1800
- GSM1900 optionally

CMD59 is designed for measurements exclusively in GSM 1900 band.

The main applications are:

- Module testing in production
- Final testing with A_{bis} control
- Installation with A_{bis} control
- Service with test mobile functionality

CMD is the first compact radiocommunication tester worldwide allowing measurements on transmitters and receivers of base stations without affecting telephone calls in progress.

These testers combine compact size with high measurement accuracy and speed. They are suitable both for stationary and mobile use and feature great ease of operation and high reliability.

Operation is extremely easy and requires no detailed GSM knowledge. The high-contrast LCD display with softkeys on both sides allows menu-guided convenient callup of test routines.

The key features at a glance

Characteristic/function	Benefit/application
Transmitter measurements	
Dynamic range >72 dB	Checking the power ramps and output spectrum of the BTS transmitter for compliance with the dynamic range specified by GSM
Measurement of power ramps	Checking the switching characteristics of the BTS transmitter
Phase and frequency error	Testing the modulation characteristics of the BTS transmitter including statistical function
Extremely fast measurement of spectrum due to modulation or switching	Detecting interference to the BTS transmitter at adjacent frequencies, due to modulation or switching
Receiver measurements	
Measurement of bit error rate (BER) via A_{bis} /IEEE bus/RS-232-C interface, BTS loopback or CMD loopback	Testing the BTS receiver characteristics by adaptation to specific implementation in the BTS
Measurement of adjacent timeslot rejection with up to 50 dB higher level	Measuring the automatic gain control (AGC) of the BTS with high level difference between used and adjacent timeslot; simulation of different BTS receive levels

Characteristic/function	Benefit/application
Level error <1dB at -104 dBm	Reproducible and conclusive measurements even at low output levels especially at the sensitivity limits of the receiver
Other measurements	
Echo test	Subjective test of speech quality with call established
Module test	Complete transmitter measurements even without signalling or time synchronization
Multifunction RF generator	Ideal for alignment of receiver modules
DC current and voltage measurement	Optimized for pulsed signals; replaces external measuring instruments
AF measurement facilities and 60-MHz frequency counter (optional)	Replaces external frequency counter; ideal for measuring reference frequencies
RF monitor with bandwidths of 30 kHz, 100 kHz	Replaces external spectrum analyzer
Simulation of fading effects	On request
Flexible use	
Various BTS synchronization facilities as to time and frequency	Easy integration of measuring instrument into operational environment and problem-free adaptation to the specific synchronization signals of a BTS
Remote control via RS-232-C and IEC/IEEE bus	SCPI-compatible for easy generation of user-specific control programs
Low cost of ownership	
Software update via interface	No need to open the instrument; simple download of the latest software version via the RS-232-C interface
3 years of warranty	The optional warranty allows the instruments to be utilized at calculable costs

Overview of options and extras

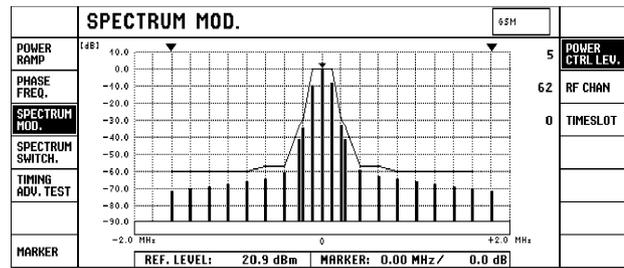
Designation	Brief description, recommendation	Option	Order No.
OEXO Reference Oscillator	For measurements with exacting requirements on frequency stability. Ensures high absolute accuracy, minimum temperature-dependent drift and especially high long-term stability	CMD-B1	1059.6002.02
IQ Modulator Output	For BER measurement on BTS receivers under conditions of fading (application note 1MA04_OE available on request). Generator/fading simulator SMIQ can be connected. Not useable with CMD-B8 and CMD-B2 together, but with CMD-B8 or CMD-B2 (only CMD59)	CMD-B17	1099.3003.02
DCS 1900 Base Station Test	For testing DCS 1900 base stations (only CMD54/57)	CMD-B19	1059.6201.02
OEXO Reference Oscillator	For highly demanding requirements on frequency stability. Oven crystal with highest long-term stability. Aging $3.5 \cdot 10^{-8}$	CMD-B2	1059.8604.02
DC Voltmeter/Ammeter	Specific voltage and current measurements (only for CMD59)	CMD-B20	1059.6401.02
Reference Frequency Inputs/Outputs	For synchronizing DUT and measuring instrument with internal or external frequencies	CMD-B3	1051.6202.02
AF Measurement Unit with Frequency Counter	This option includes an AF generator, a voltmeter, a distortion meter and a frequency counter for measurements on the audio interface or on modules. CMD-B41 permits measurements up to 60 MHz as are required for LO alignment	CMD-B41	1051.6902.02
Realtime Speech Coder/Decoder	This option converts digital speech signals into analog signals (and vice versa) (in conjunction with CMD-K1x, CMD-K30 or CMD-B8)	CMD-B5	1051.8657.02
Adapter for CMD-B6x Options	Required for operating the options CMD-B61 and CMD-B62	CMD-B6	1051.7409.02
IEC/IEEE-Bus Interface	Alternative to standard RS-232-C interface for remote control of CMD	CMD-B61	1051.7609.02
Memory Card Interface	Memory cards are a versatile medium for storing instrument settings	CMD-B62	1051.8205.02
A_{bis} Interface	For sensitivity measurements; required for A _{bis} control. A _{bis} card for BER measurements at this interface	CMD-B7	1051.8357.02

Designation	Brief description, recommendation	Option	Order No.
Test Mobile Functionality	Adds signalling software, SIM card reader and selective filter to the basic model (CMD-B6 required, not usable with CMD-B2 and CMD-B17)	CMD-B8	1059.8204.02
A_{bis} Control Software	Comprises the A _{bis} control software for a certain base station including application program for manual and automatic testing (CMD-B7 required)	ERICSSON RBS200, RBS2000	CMD-K10 1082.2050.02
		NOKIA DE21, DE34, DE45, PRIME SITE	CMD-K11 1082.2150.02
		ITALTEL BS902	CMD-K12 1082.2250.02
		NMC S2000, S4000, S8000	CMD-K13 1082.2350.02
		SIEMENS SBS20, SBS60	CMD-K14 1082.2450.02
		ALCATEL uBTS G2, M1C/M1M, G1 MKII, G2	CMD-K16 1082.2750.02
		LUCENT TECH. BTS2000/2, Cube	CMD-K17 1082.2850.02
Software Upgrade Contract	1 year software upgrade for A _{bis} Control Software	CMD-K10	CMDSK10 1082.2950.02
		CMD-K11	CMDSK11 1082.3040.02
		CMD-K12	CMDSK12 1082.3740.02
		CMD-K13	CMDSK13 1082.3140.02
		CMD-K14	CMDSK14 1082.3240.02
		CMD-K16	CMDSK16 1082.3340.02
		CMD-K17	CMDSK17 1082.3440.02
Signalling Software	For signalling purposes eg in test network or in production. Adds call setup functionality to the basic model (functionality is also contained in CMD-B8)	CMD-K30	1082.4530.02
Ciphering Software	Allows encryption according to ETSI Rec. (A5-1/A5-2) (in conjunction with CMD-B8)	CMD-K51 CMD-K52	1082.3540.02 1082.3640.02
UIC European Train Radio	Allows measurements in the UIC frequency range – European train radiotelephony based on GSM-identical signalling (for CMD54/57 only)	CMD-K80	1082.4930.02
Modification Kit High-Level 2nd RF Output (13 dBm)	For off-air measurements. The standard output level range of the second output is approx. –33 dBm to –120 dBm; the level range +9 dBm to –60 dBm is offered alternatively (for CMD54 only)	CMD-U2	1059.6301.02
Modification Kit High-Level 2nd RF Output (9 dBm or 11 dBm)	For off-air measurements. The standard output level range of the second output is approx. –35 dBm to –120 dBm; the level range +9 dBm/+11 dBm to –60 dBm is offered alternatively (for CMD57/59 only, not usable with CMD-U13)	CMD-U3	1059.6501.02
Trigger Inputs/Outputs	The time synchronization signals can additionally be applied to BNC connectors on the rear panel. For monitoring purposes the demodulated I/Q signals are brought out at BNC sockets (rear panel)	CMD-U5	1059.6901.02
Power Meas. Calibration	Power measurement error GSM 1800/1900 <0.5 dB (38 dBm to 44 dBm); output level accuracy for BER <1 dB (–95 dBm to –102 dBm)	CMD-U9	1059.7408.02
Modification of RF IN/OUT	Test of micro BTS. Peak power meter measurement range –10 dBm to 37 dBm alternatively to standard range 0 dBm to 47 dBm (not usable with CMD-U3)	CMD-U13	1059.4009.02
Memory Card	Formatted PCMCIA-compatible memory card for storing instrument settings (CMD-B62 required)	CMD-Z1	1059.4809.02
Cable Sets	Cable sets comprise A _{bis} control and monitor cables 75 Ω and 120 Ω, RF connections for A _{bis} control and in-service tests	NMC BTS (US models)	CMD-Z20 1099.3403.02
		ERICSON RBS2000	CMD-Z21 1099.3503.02
		ERICSON RBS200	CMD-Z22 1099.3655.02
		SIEMENS SBS20/60	CMD-Z23 1099.3803.02
		NOKIA DE21/34	CMD-Z24 1099.3955.02
		NOKIA DE45	CMD-Z25 1099.4100.02
Rucksack	Multifunction carrying bag for the instrument	CMD-Z40	1059.7808.02
Handset	Together with CMD-B8 + CMD-B5 allows to talk using CMD in the same way as a mobile	CMD-Z50	1059.4250.02
Message Editor	For analysis of signalling logs on an external PC. Message editor for layer 3 message log	CRPCPH2	1081.6552.02
Transit Case	Robust case for transport CMD with Rucksack CMD-Z40	ZZK-014	1013.9595.00

Digital Radiocommunication Testers CMD54, CMD57, CMD59

ADDITIONAL MEASUREMENTS	TRAFFIC CHANNEL TEST		DCS 1800	
POWER RAMP	Peak Power:	44.8 dBm	TRAFFIC CHANNEL:	45 dBm EXPECTED POWER
PHASE FREQ.	Avg. Burst Power:	44.4 dBm	RF Channel:	740
SPECTRUM MOD.	Power Ramp:	PASS	Timeslot:	0
SPECTRUM SWITCH.	Timeslot:	0		-35.0 dBm MS SIGNAL RF LEVEL
BER TEST	Freq. Error:	15 Hz		HANDSET SPEECH MODE
	Phase Error (PK):	7.2 °		RF LOOPBACK BER MODE
	Phase Error (RMS):	2.1 °		CALL RELEASE

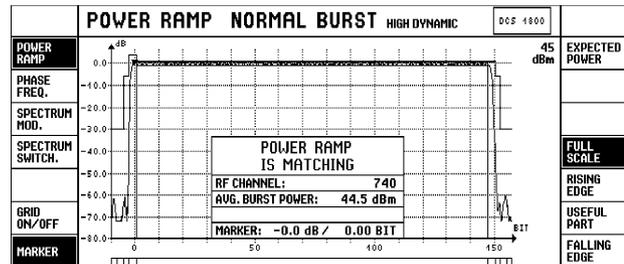
After synchronization to the base station and setting up of a traffic channel, all relevant RF parameters are immediately measured and displayed; this menu also allows a quick change of channel, power and timeslot as well as setting of CMD transmission parameters



The spectrum due to modulation and switching can be measured in line with GSM specifications within a minimum of time and graphically displayed; the built-in marker function allows the digital value of each individual spectral line to be called up

SINGLE BER MEAS.	CONTINUOUS BIT ERROR RATE		DCS 1800	
RESTART	CLASS	RBER	TRAFFIC CHAN. LEVEL:	-103.0 dBm USED TIMESLOT
	II	0.321 %	(relative to USED TS)	0.0 dB UNUSED TIMESLOT
	Ib	0.000 %		
	CLASS	FER		
	ERASED FRAMES	0.000 %		
	MS RECEIVER REPORTS			
	RxLev	9 (-102 to -101 dBm)		
	RxBqual	1 (0.2 to 0.4 %)		
	CRC ERRORS:			
	0			
MEAS. MODE	BER	RBER		
AVERAGE	20 Frame	INDICATOR		

Sensitivity of a transceiver module of the base station is verified by means of a bit error rate (BER) test in RF loopback mode



CMD 54 allows the power ramp to be measured with high dynamic range; with graphic display, the zoom function enables application-oriented resolution of parts of the displayed curve

Specifications in brief

Common data of CMD 54/57

Timebase TCXO	standard
Nominal frequency	10 MHz
Frequency drift (0 to 35°C)	≤1.5 × 10 ⁻⁶
Aging	≤0.5 × 10 ⁻⁶ /year (at 35°C)
Timebase OCXO	Option CMD-B1
Nominal frequency	10 MHz
Frequency drift (0 to 50°C)	≤1 × 10 ⁻⁷
Aging	≤2 × 10 ⁻⁷ /year
	≤5 × 10 ⁻⁹ /day after 30 days of operation
Timebase OCXO	Option CMD-B2
Nominal frequency	10 MHz
Frequency drift (0 to 50°C) (referred to 25°C)	≤5 × 10 ⁻⁹
Aging after 30 days of operation and under constant operat. conditions	≤3.5 × 10 ⁻⁸ /year
	≤5 × 10 ⁻¹⁰ /day
Warmup time (at 25°C)	approx. 10 min
DC voltmeter	(CMD59: option CMD-B20)
Measurement range	0 V to ±30 V
DC ammeter	(CMD59: option CMD-B20)
Operating modes	current averaging with GSM-adapted time constant, current peak measurement (maximum and minimum)

Measurement range	0 V to ±10 A
Common-mode rejection	±30 V
Resistance	50 mΩ
AF Measurement Unit	Option CMD-B41
AF generator	
Frequency range	50 Hz to 10 kHz
Level range	10 μV to 5 V
Output impedance	<5 Ω
AF voltmeter	
Frequency range	50 Hz to 10 kHz
Measurement range	0.1 mV to 30 V
Input impedance	1 MΩ
Distortion meter	
Frequency range	300 Hz to 3 kHz
Input level range	100 mV to 30 V
AF counter	
Frequency range	20 Hz to 10 kHz
Input level range	10 mV to 30 V
Resolution	≤1 Hz
IF counter	
Frequency range	10 kHz to 60 MHz
Input level range	100 mV rms to TTL
Resolution	1 Hz

Digital Radiocommunication Testers CMD54, CMD57, CMD59

GSM-specific measurement of spectrum

Spectrum due to modulation

Test method relative measurement, averaging
 Resolution filter bandwidth 30 kHz
 Measurement at an offset of 100/200/250/400/600/800/
 1000/1200/1400/1600 and
 1800 kHz
 Dynamic range better than specified by GSM
 for offset >400 kHz max. 80 dB
 Error $\leq \pm 1.5$ dB

Spectrum due to switching

Test method relative measurement, Max Hold over
 several measurements
 Resolution filter bandwidth 30 kHz
 Measurement at an offset of 400/600/1200 and 1800 kHz
 Dynamic range better than specified by GSM
 for offset >400 kHz max. 80 dB, with SW correction
 max. 76 dB, without SW correction
 Error ≤ 1.5 dB (dynamic range <50 dBc)
 ≤ 2.5 dB (dynamic range 50 to 80 dBc)

Multi-Reference Frequency Inputs/Outputs Option CMD-B3

Synchronization input:
 Frequency (selectable) GSM bit clock (270.8 kHz),
 2/4/16 times GSM bit clock, 1 to
 13 MHz in 1 MHz steps, 2.048/
 16.384/26/39/52 MHz
 Impedance approx. 100 Ω
 Level 0 dBm to TTL
 Synchronization output 1:
 Frequency 10 MHz with internal reference
 or frequency at synchronization input
 with external reference
 Level TTL, $R_{out} = 50 \Omega$
 Synchronization output 2:
 Frequency (selectable) GSM bit clock, 2/4/16 times GSM
 bit clock, 1/2/4 or 13 MHz
 Level TTL, $R_{out} = 50 \Omega$

A_{bis} Interface

Receive channel (traffic/speech) Option CMD-B7
 75 Ω /high-impedance, unbalanced;
 120 Ω /high-impedance, balanced;
 16 kbit/s, timeslot selectable

Interfaces

RS-232-C (9-pin), Centronics (25-pin)

Specific data of CMD54 (GSM900)

RF generator

Frequency range GSM900: 890.2 to 914.8 MHz
 E-GSM900: 880.2 to 890.0 MHz
 Frequency accuracy same as timebase
 Resolution GSM channel spacing 200 kHz
 Settling time <3 ms for phase error <2°
 Output level (RF IN/OUT)/
 (OUTPUT 2) -33 to -120 dBm
 Modulation GMSK, B x T = 0.3
 Phase error $\leq 4^\circ$ rms, $\leq 10^\circ$ peak

Peak power meter (RF IN/OUT)

Frequency range 800 to 1000 MHz
 Measurement range 10 to 47 dBm
 VSWR ≤ 1.3

Phase and frequency error measurement

Frequency range GSM900: 935.2 to 959.8 MHz
 E-GSM900: 925.2 to 935.0 MHz

Level range
 RF IN/OUT 10 to 47 dBm
 RF IN 2 -60 to 0 dBm

Burst power measurement

Frequency range GSM900: 935.2 to 959.8 MHz
 E-GSM900: 925.2 to 935.0 MHz
 Reference level for full
 dynamic range
 RF IN/OUT 10 to 47 dBm
 RF IN 2 -37 to 0 dBm

High-dynamic burst analysis

Relative error of individual
 test samples ≤ 1.5 dB to 72 dB below peak power
 Dynamic range >72 dB
 Measurement limit RF IN/OUT < -36 dBm
 Measurement limit RF IN 2 < -83 dBm

Specific data of CMD57/59 (GSM900/1800/1900)

RF generator

Frequency range GSM900: 890.2 to 914.8 MHz
 E-GSM900: 880.2 to 890.0 MHz
 GSM1800: 1710.2 to 1784.8 MHz
 GSM1900¹⁾:
 1850.2 to 1909.8 MHz
 Frequency accuracy same as timebase
 Resolution GSM channel spacing 200 kHz
 Settling time <3 ms for phase error <2°
 Output level (RF IN/OUT)/(OUTPUT 2)
 Modulation -35(-37¹⁾) to -120 dBm
 Phase error GMSK, B x T = 0.3
 $< 4^\circ$ rms, $< 10^\circ$ peak

Peak power meter (RF IN/OUT)

Frequency range 800 to 1000/1700 to 1900 MHz
 Measurement range 0 to 47 dBm
 Maximum RF power 47 dBm pulsed
 45 dBm CW
 47 dBm CW at room temperature
 VSWR ≤ 1.3

Phase and frequency error measurement

Frequency range GSM900: 935.2 to 959.8 MHz
 E-GSM900: 925.2 to 935.0 MHz
 GSM1800: 1805.2 to 1879.8 MHz
 GSM1900¹⁾:
 1930.2 to 1989.8 MHz
 Level range
 RF IN/OUT 0 to 47 dBm
 RF IN 2 -57(-51¹⁾) to 0 dBm

Burst power measurement

Frequency range GSM900: 935.2 to 959.8 MHz
 E-GSM900: 925.2 to 935.0 MHz
 GSM1800: 1805.2 to 1879.8 MHz
 GSM1900¹⁾:
 1930.2 to 1989.8 MHz
 Reference level for full
 dynamic range
 RF IN/OUT GSM900: 10 to 47 dBm
 GSM1800/1900: 0 to 47 dBm
 RF IN 2 -37(-31¹⁾) to 0 dBm

High-dynamic burst analysis

Relative error of individual
 test samples ≤ 1.5 dB to 72 dB below peak power
 Dynamic range >72 dB
 Measurement limit RF IN/OUT GSM900: < -36 dBm
 GSM1800: < -48 dBm
 GSM1900: < -42 dBm
 GSM: < -83 dBm
 Measurement limit RF IN 2 GSM1800: < -85 dBm
 GSM1900: < -79 dBm

Digital Radiocommunication Testers CMD54, CMD57, CMD59

CMD 54/57/59 in multicarrier mode (Option CMD-B8)

The specifications apply to all cases, in which interfering carriers (up to 30 dB above useful level) are more than 30 GSM channels away. If there are interfering signals close to the useful carrier, an additional IF filter is switched in (multicarrier mode).

Typical filter characteristics in multicarrier mode

Offset from useful channel (kHz)	Filter suppression (dB)
0	0 (reference)
200	<3
400	>20
600	>33
800	>41
1000	>48

This filter increases the measurement error for phase and power measurements.

Phase and frequency error measurement

Inherent phase error $\leq 2^\circ$ (rms), $\leq 7.5^\circ$ (peak)

Measurement of peak power/burst power

Level error ≤ 1.5 dB

GSM-specific spectrum measurements

The dynamic range specified for the basic model refers to the sum of all input voltage components. The additional GSM carriers appear as strong spurious emissions in the spectrum measurement and have to be taken into account accordingly when evaluating the tolerances.

Typical effects of an interferer on power and modulation measurement results (see diagrams on the right). The characteristics of an interferer close to the carrier have the following effect on the measurement error:

- Power: the lower the power of the interferer, the smaller the measurement error.
- Frequency offset: the larger the frequency offset of the interferer, the smaller the measurement error. In the diagrams on the right an interferer with an offset of $m=3$ or $m=6$ GSM channels has been assumed.
- Spectral purity: the narrower the modulation spectrum of the interferer, the smaller the measurement error. In the diagrams on the right the modulation spectrum to GSM 05.05 with linear interpolation (in the dB/Hz coordinates) has been used (worst case spectrum).
- Number of carriers: the fewer the carriers, the smaller the measurement error. In the example, 1 interferer has been assumed.

The curves shown in the diagrams have been **calculated** assuming the worst case spectrum as interferer, the guaranteed CMD-B8 specifications for phase and power measurement and a typical IF filter characteristic.

The **measured values** are based on a real GSM spectrum, typical CMD-B8 specifications and typical filter characteristic.

General data

Rated temperature range	0 to +45°C to DIN IEC 68-2-1/2
Storage temperature range	-40 to +60°C
Power supply	100 to 120 V AC $\pm 10\%$ 200 to 240 V AC $\pm 10\%$ 50 to 400 Hz $\pm 5\%$
Power consumption (without options)	approx. 85 W
Dimensions (W x H x D)	435 mm x 192 mm x 363 mm
Weight (without options)	approx. 14 kg

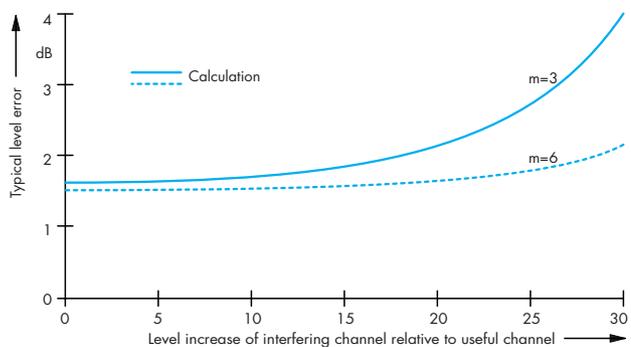
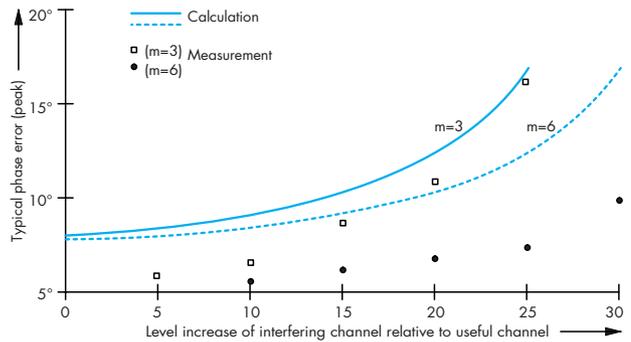
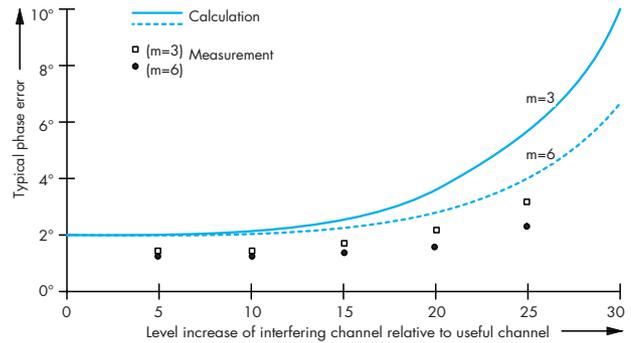
Ordering information

Digital Radiocommunication Tester

for GSM 900	CMD54	1050.9008.54
for GSM 1800	CMD57	1050.9008.57
for GSM 1900n	CMD-B19	1050.9008.59

Accessories supplied power cable, operating manual, fuses

Options see overview of options on page 31



Phase and level error as a function of adjacent-channel power and adjacent-channel frequency offset

1) In GSM 1900 mode with option CMD-B19 fitted.