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Digital Radiocommunication Tester CMD80

Precise high-speed measurements on CDMA, TDMA and analog mobiles

For use in

- production
- quality assurance
- service
- development

ROHDE&SCHWARZ

Tektronix

CMD80 – the multitalent

Additional capability continues to be added to the proven CMD80 platform. In addition to CDMA, AMPS (N-AMPS) and TACS (J/N/E-TACS), digital AMPS (IS-136) measurements on mobile stations are now posible with option B84. CMD80 is thus able to support all multiple access methods presently used in mobile communications (FDMA, CDMA, TDMA) on a single hardware platform.

CMD80 with option B84 provides unsurpassed test coverage for the IS-136 standard, offering many capabilities that are not available on some dedicated IS-136 test sets. Among these are half-rate channel support, peak and statistical adjacent-channel power measurements, carrier switching time measurements, etc. This broad IS-136 test coverage will enhance the CMD80´s use in manufacturing tests as well as in engineering applications.



All standards at a glance

Frequency band	Type designation	Airlink standard
US Cellular (800 MHz)	CMDA TDMA AMPS/N-AMPS	IS-95 IS-136 TIA-553, IS-91
Japan Cellular	CDMA N-TACS/J-TACS	T53, IS-95
China Cellular	CDMA E-TACS/TACS	IS-95
US PCS (1900 MHz)	CDMA TDMA	J-STD008, UB-IS-95 IS-136
Korea PCS (1800 MHz)	CDMA	J-STD008, UB-IS-95
Korea2 PCS	CDMA	J-STD008, UB-IS-95

The family members at a glance

CMD80 – CMDA, IS-136, AMPS and more



- CDMA, digital AMPS, AMPS, TACS in one box
- High measurement accuracy and speed
- Remote control via IEEE488/IEC625 bus
- Autotest and remote control via RS232
- Suitable for production, development and service

CMD52 – the leading GSM900 production tester



- All signaling required for GSM900 testing
- Highest measurement accuracy and speed
- Remote control via IEEE488/IEC625 bus
- Autotest and remote control via RS232
- Go/nogo test as well as service mode for exact fault location

CMD55 – the multiband GSM production tester



- GSM900, GSM1800 and GSM1900
- Testing of handover from GSM900 and back
- Other features as CMD52

CMD60 – pure DECT dedication



- Compact, lightweight and extremely fast
- Suitable for service, production and development
- Remote control via IEEE488/IEC625 bus + RS232
- Automated regression and stress testing of DUT
- Automatic go/nogo testing of fixed and portable part

CMD65 – the most versatile production tester



- GSM plus DECT in a single box
- Features equal the combination of CMD55 and CMD60 in almost all respects

development

Manual operation philosophy
Research and development engineers have found the CMD's large clear LC display and user interface with logically structured menus unsurpassed when measuring RF parameters. This is true both in the manual test mode and in the flexible module test with system-specific signal generator and burst analyzer. During call setup the network and system-specific signaling parameters allow the R&D engineers to control the influence of signaling parameters on the mobile´s behavior in the network.

quality assurance

User-definable autotest
The user-friendly display and operation of the CMD is a main requirement when testing manually, but for automated testing the engineer wants a quick and easy way to a ready-made autotest. The CMD family of testers offers different ways of creating such autotests and test scripts, depending on the CMD model and the test requirements.

- Voice loopback and comprehensive testing of mobiles
- Powerful signaling capabilities
- Short measurement time ensuring high throughput
- High measurement accuracy
- Simple interactive operation
- No specialized network knowledge required
- Service mode for exact fault location
- Autotest – complete mobile testing at a keystroke
- Very fast remote control operation
- Compact and lightweight
- Excellent price/performance ratio

In addition to mobile radio networks based on AMPS (Advanced Mobile Phone System) and CDMA (Code Division Multiple Access) standards, more and more networks with underlying TDMA (Time Division Multiple Access) method are gaining importance.

The demand is mostly for dual-mode mobile phones with CDMA/AMPS (IS-95 standard) or D-AMPS/AMPS (IS-136 standard) functionality – frequently also for dual-band mobile phones in the 800 MHz (US Cellular) and 1900 MHz (US PCS) frequency bands. This fact inevitably leads to the need for a mobile radio tester that covers all three standards in both frequency bands.

Many wireless manufacturers are migrating toward "universal" production and test lines for mobile phones, with an eye toward reducing capital, maintenance, and personnel costs. Until now, these economies have been diluted by the cost of equipping test lines with dedicated test sets for every wireless standard.

With the addition of the new option B84, the CMD80 addresses IS-136, CDMA, AMPS, N-AMPS, TACS, E-TACS, J-TACS, and N-TACS test needs. Wireless manufacturers now have an effective way to implement cost-efficient universal manufacturing lines for wireless phones.

... meeting the challenges of modern communications

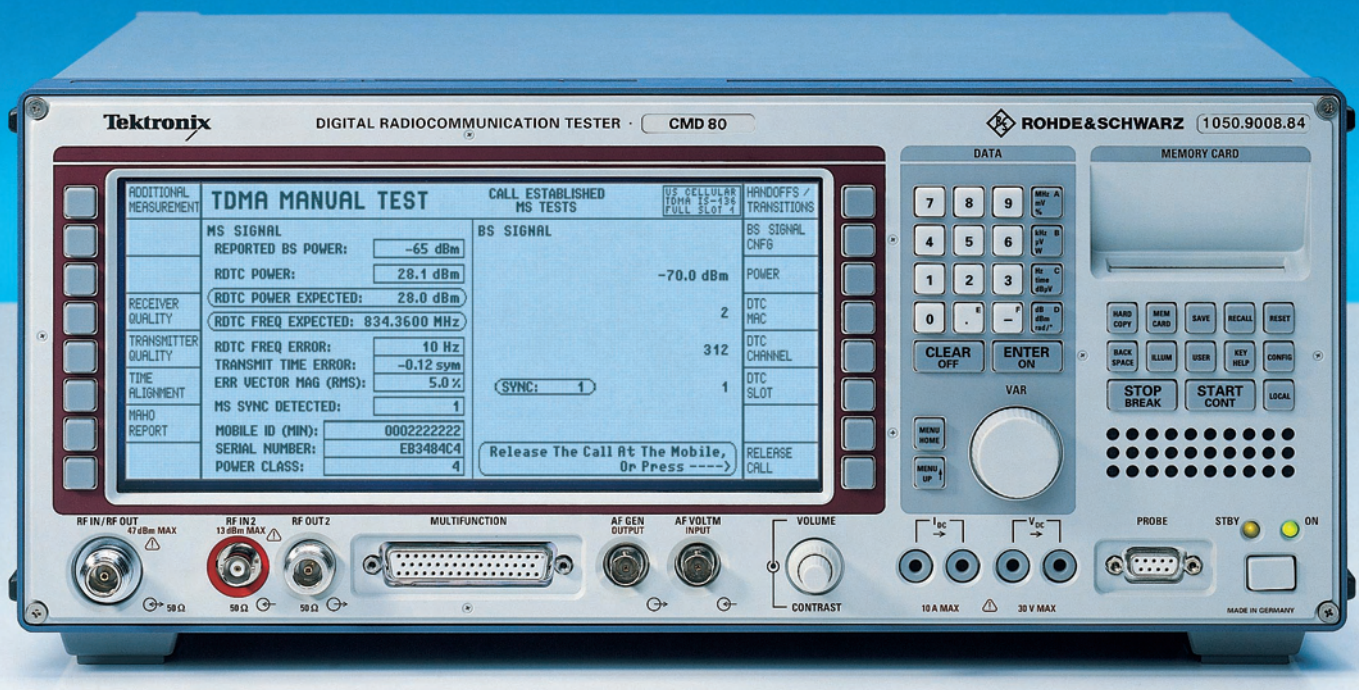
production

service

Fast IEEE bus
In a production line there are two main factors that contribute to high throughput and product quality: IEEE-bus speed and measurement repeatability. The high speed is obtained by parallel measurements and the possibility of issuing multiple commands in a single IEEE string. With combined measurements and measurements like RF peak power which takes only milliseconds, time-consuming power level adjustments where multiple measurements are required are completed in seconds. The high level of measurement repeatability offered ensures the highest possible quality of the end product leaving the factory.

Covering any need for test modes
Service and repair of digital mobiles and cordless phones call for a variety of tests, ranging from simple voice loopback test to complete factory-like production tests. The CMD range of products offers cost-effective solutions for manual testing, stand-alone autotest, as well as remote RS232 operation solutions covering any testing need. Every CMD comes with the same large display and user interface for manual testing of phones and/or modules and RS232 interface for remote operation.

Base-station survey measurements
These are often done on real base stations or by using analog signal generators with power amplifiers. The CMD is able to simulate any CDMA, IS-136, AMPS and TACS base station. This feature enables close-to-life conditions without having to use a real BTS.



(1)
The HOME menu allows simple selection of mobile radio standard (CDMA, TDMA, analog) and frequency band (Cellular, PCS).

(2)
The test menus are divided into two sections; mobile-specific measurement results are displayed on the left, the main settings of the BS signal on the right.

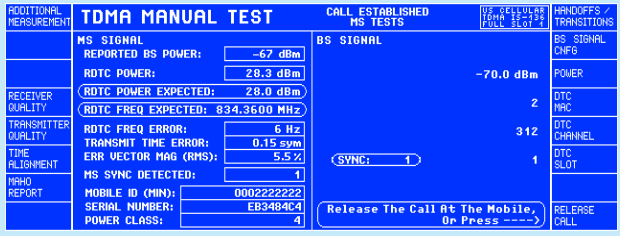
(3)
In the HANDOFFS/TRANSITIONS menu different kinds of handoffs between the mobile radio standards can be performed. After the handoff the user can choose between standard tests and voice loopback test.

(4)
In the IS-136 mode the CMD can send a user-defined short message (SMS) to the mobile.

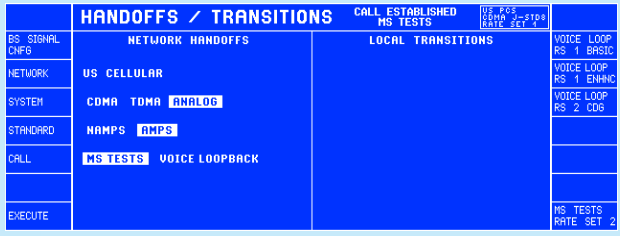
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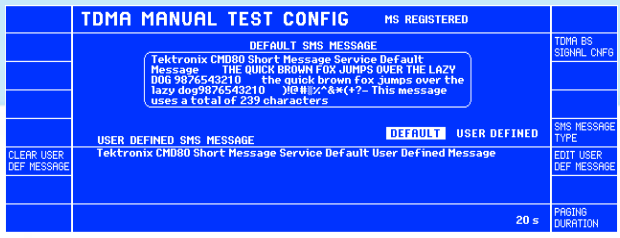
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Measurement technology

Measurements are based on ultramodern digital signal processing. The results are thus available within the shortest possible time, which means an enormous benefit in speed-dictated mass production. DSP technology has two important benefits: measurement functions can be enhanced by software upgrades and new measurement techniques can be added solely by software modifications.

The individual measurements for the various standards are derived directly from the relevant specifications and are preconfigured. Measurements can thus be performed without in-depth knowledge of the relevant network.

Basically, CMD80 provides two different measurement modes for each network. Measurements can be performed either as a module test (ie without call setup to the DUT) or as a manual test with full signaling. In the latter case a call setup for performing the measurement can be made both from the base station (which is simulated by the CMD80) and from the mobile. In this mode it is also possible to set up a call with voice loopback. The audio data picked up by the microphone of the mobile phone are buffered in the CMD80 and reflected to the mobile under test after a delay of about two seconds. In this way speech quality of the DUT can be verified.

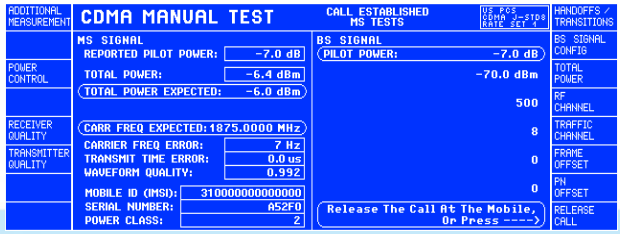
In the signaling mode, implicit handoffs can be made within the same standard (ie a D-AMPS handoff to another digital traffic channel – a new channel number – or changeover to another timeslot at the same TDMA frequency) as well as handoffs to other standards, if defined. This is an important criterion for testing multimode/multiband mobile phones. The measurements themselves are adapted to the relevant transmission standard.

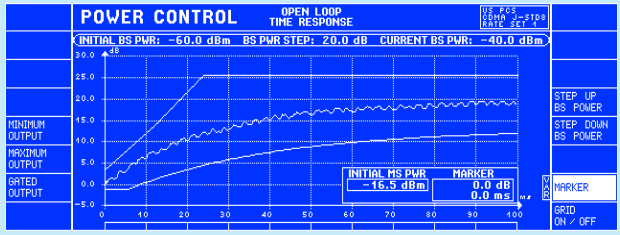
(1)
After registration of the mobile station in the MANUAL TEST mode, the quality of the mobile under test can immediately be examined. In-depth measurements are available in submenus at the push of a button.

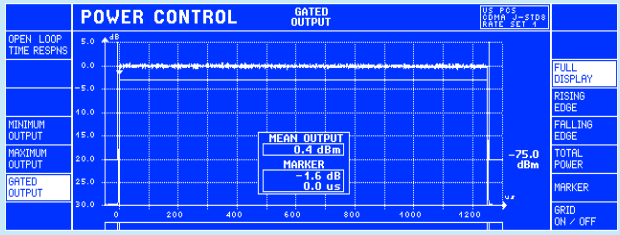
(2)
The open-loop time response test provides a graph of the mobile station output power as a function of time when the mobile station is commanded via open-loop power control to change its output power.

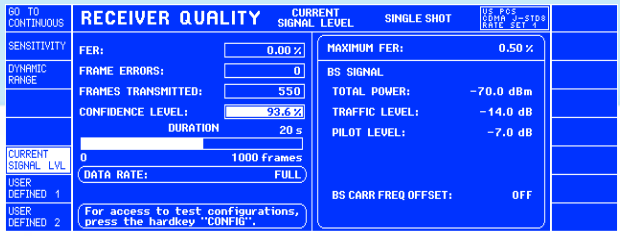
(3)
The gated output of the RF carrier can be displayed in several formats, ie FULL DISPLAY, RISING EDGE or FALLING EDGE.

(4)
In the RECEIVER QUALITY menu the tester performs the receiver quality test and displays the frame error rate over the interval of the most recent number of frames.









CDMA

Code Division Multiple Access (CDMA) is a new concept in wireless communications. It has gained widespread international acceptance by cellular radio system operators as a method that will increase both their system capacity and their service quality.

In addition to transmitter and receiver tests, power control tests play an important role for CDMA. This is more true since power control mechanisms have a decisive influence on the network capacity.

The main CDMA tests include:

- **Power control measurements**
  - Open-loop time response
  - Gated output power
  - Minimum output
  - Maximum output
- **Receiver quality measurements**
  - Frame error rate (FER) measurements
  - Additionally with AWGN generator (option B81) to simulate noise that is caused by other CDMA calls at the same frequency
- **Transmitter quality measurements**
  - Carrier feedthrough and I/Q imbalance
  - Carrier frequency error and transmit time error
  - Waveform quality (ρ factor)
  - Phase error
  - Magnitude error
  - Error vector magnitude

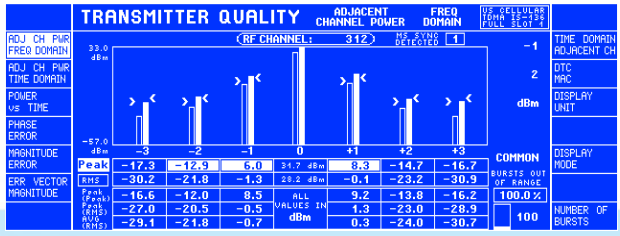
(1)
The adjacent channel power measurement allows the user to measure the adjacent, first, and second alternate channel power and display the results in a frequency domain view.

(2)
The phase error measurement allows the user to measure the difference in phase between the measured signal from the mobile station transmitter and an ideal signal waveform.

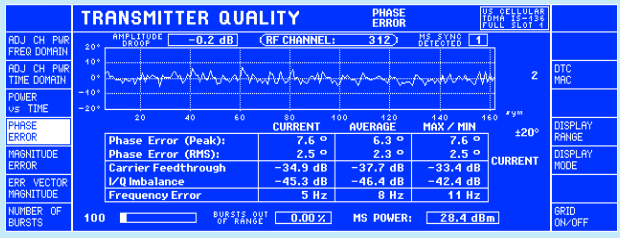
(3)
The time alignment measurement displays the timing alignment (in symbols) between the user-specified delay and the actual measured delay of the burst signal from the mobile station transmitter.

(4)
The mobile assisted handoff (MAHO) report displays the results of the mobile station measurement report, showing the current base station channel in use, its RSSI (received signal strength indication), and the BER range (bit error information estimated by the mobile station).

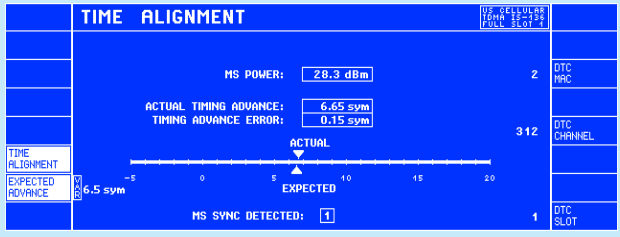
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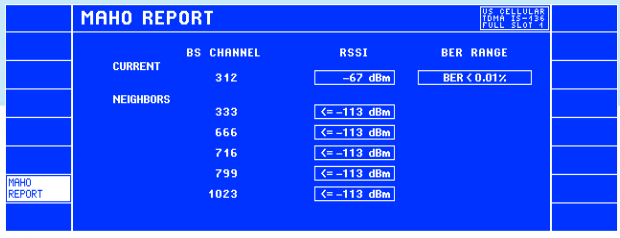
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TDMA

D-AMPS (Digital Advanced Mobile Phone Service) is a digital version of AMPS, the original analog standard for cellular phone service in the United States. Both D-AMPS and AMPS are now used in many countries. D-AMPS adds Time Division Multiple Access (TDMA) to AMPS to get three users for each AMPS channel, tripling the number of calls that can be handled on a channel. D-AMPS is known as IS-136 from the Electronics Industries Assocation/Telecommunication Industries Assocation (EIA/TIA).

As with CDMA, the various measurements for IS-136 are subdivided into groups. The main IS-136 tests include:

- **Transmitter measurements**
  - Adjacent channel power (due to modulation/due to switching), six adjacent/alternate channels
  - Power versus time measurement
  - Origin offset (carrier crosstalk)
  - I/Q imbalance (measure of uneven gain in the I/Q path of the transmitter modulator)
  - Frequency error
  - Amplitude droop (level difference between the start and end of a TDMA burst)
  - Phase error
  - Magnitude error (amplitude error)
  - Error vector magnitude (magnitude of the vectorial error function versus time)
- **Receiver measurements**
  - Bit error rate measurement
- **Time alignment** (in manual test only)
- **SMS transfer** from base to mobile station (in manual test only)
- **Simulation of mobile assisted handoff** (MAHO) – in manual test only

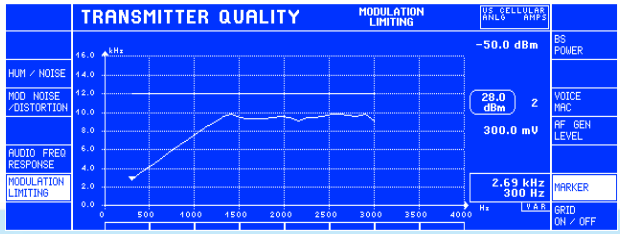
Analog

AMPS (Advanced Mobile Phone Service), N-AMPS
is a standard system for analog signal cellular telephone service in the United States and is also used in other countries. It is based on the initial frequency spectrum allocation for cellular service by the Federal Communica-

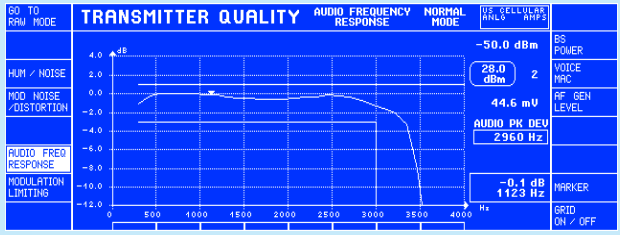
(1)
Within the MODULATION LIMITING menu CMD80 measures the maximum frequency deviation which the mobile transmitter allows.

(2)
When the tester measures the audio frequency response in normal mode, a de-emphasis filter is active and the configuration menu can be used to set limit lines for the measurement.

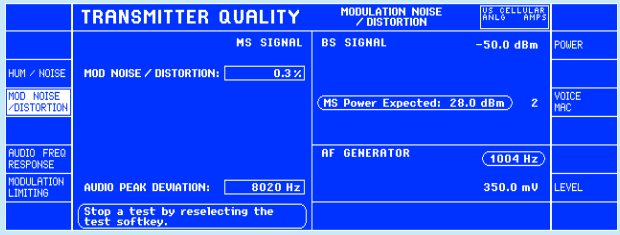
(3)
The modulation noise and distortion result is highlighted if the percentage of modulation noise and distortion exceeds the limit specified in the configuration menu.



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tions Commission (FCC) in 1970. Introduced by AT&T in 1983, AMPS became the most widely deployed cellular system in the United States.

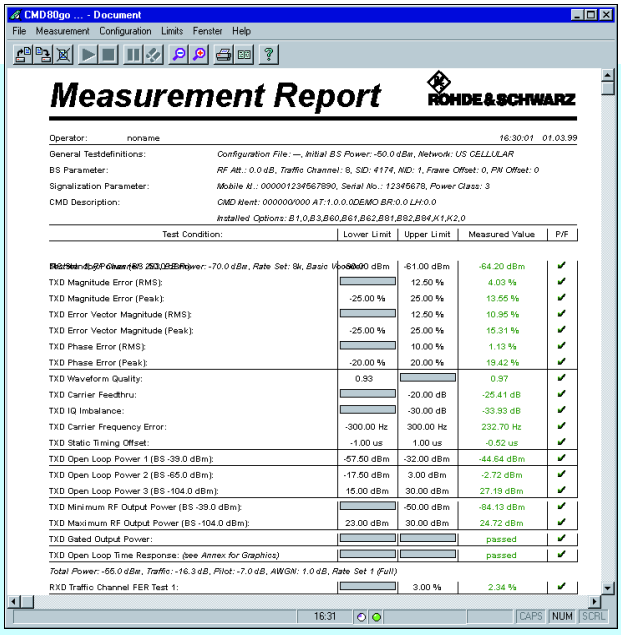
TACS (Total Access Communications System), J/N/E-TACS
Signaling and measurements for the TACS implementations are very similar to those for the AMPS standard, with only a few minor changes. The channel ranges and their associated frequency assignments are different from the AMPS standard, and the default values for many parameters are adjusted to appropriate values for the TACS standards.

Within the various AMPS/TACS measurements both the RF parameters and the audio signal of the mobile phone are investigated.

The main AMPS/TACS tests include:

- **Carrier power**
- **Carrier frequency error**
- **SAT frequency error/peak deviation**
- **ST frequency error/peak deviation**
- **Carrier power measurement**
- **Receiver measurements**
  - Sensitivity
  - Hum/noise
  - Harmonic distortion
  - Audio frequency response
- **Transmitter measurements**
  - Hum/noise
  - Modulation noise/distortion
  - Audio frequency response
  - Modulation limiting

Applications


CMD80go ... - Document

File Measurement Configuration Limits Fenster Help

Measurement Report ROHDE&SCHWARZ

Operator: noname 16:30:01 01.03.99

General Testdefinitions: *Configuration File: —, Initial BS Power: -50.0 dBm, Network: US CELLULAR*

BS Parameter: *RF Att.: 0.0 dB, Traffic Channel: 8, SID: 4174, NID: 1, Frame Offset: 0, PN Offset: 0*

Signalization Parameter: *Mobile Id.: 000001234567890, Serial No.: 12345678, Power Class: 3*

CMD Description: *CMD Ident: 000000/000 AT:1.0.0.0DEMO BR:0.0 LH:0.0*

Installed Options: B1,0,B3,B60,B61,B62,B81,B82,B84,K1,K2,0

Test Condition:	Lower Limit	Upper Limit	Measured Value	P/F
[illegible]		-61.00 dBm	-64.20 dBm	✔
TXD Magnitude Error (RMS):		12.50 %	4.03 %	✔
TXD Magnitude Error (Peak):	-25.00 %	25.00 %	13.55 %	✔
TXD Error Vector Magnitude (RMS):		12.50 %	10.95 %	✔
TXD Error Vector Magnitude (Peak):	-25.00 %	25.00 %	15.31 %	✔
TXD Phase Error (RMS):		10.00 %	1.13 %	✔
TXD Phase Error (Peak):	-20.00 %	20.00 %	19.42 %	✔
TXD Waveform Quality:	0.93		0.97	✔
TXD Carrier Feedthru:		-20.00 dB	-25.41 dB	✔
TXD IQ Imbalance:		-30.00 dB	-33.93 dB	✔
TXD Carrier Frequency Error:	-300.00 Hz	300.00 Hz	232.70 Hz	✔
TXD Static Timing Offset:	-1.00 us	1.00 us	-0.62 us	✔
TXD Open Loop Power 1 (BS -39.0 dBm):	-57.50 dBm	-32.00 dBm	-44.64 dBm	✔
TXD Open Loop Power 2 (BS -65.0 dBm):	-17.50 dBm	3.00 dBm	-2.72 dBm	✔
TXD Open Loop Power 3 (BS -104.0 dBm):	15.00 dBm	30.00 dBm	27.19 dBm	✔
TXD Minimum RF Output Power (BS -39.0 dBm):		-50.00 dBm	-84.13 dBm	✔
TXD Maximum RF Output Power (BS -104.0 dBm):	23.00 dBm	30.00 dBm	24.72 dBm	✔
TXD Gated Output Power:			passed	✔
TXD Open Loop Time Response: *(see Annex for Graphics)*			passed	✔
Total Power: -65.0 dBm, Traffic: -16.3 dB, Pilot: -7.0 dB, AWGN: 1.0 dB, Rate Set 1 (Full)				
RXD Traffic Channel FER Test 1:		3.00 %	2.34 %	✔

16:31 CAPS NUM SCRL

Above: The CMD80go measurement report provides a clear overview of results and mobile-specific information



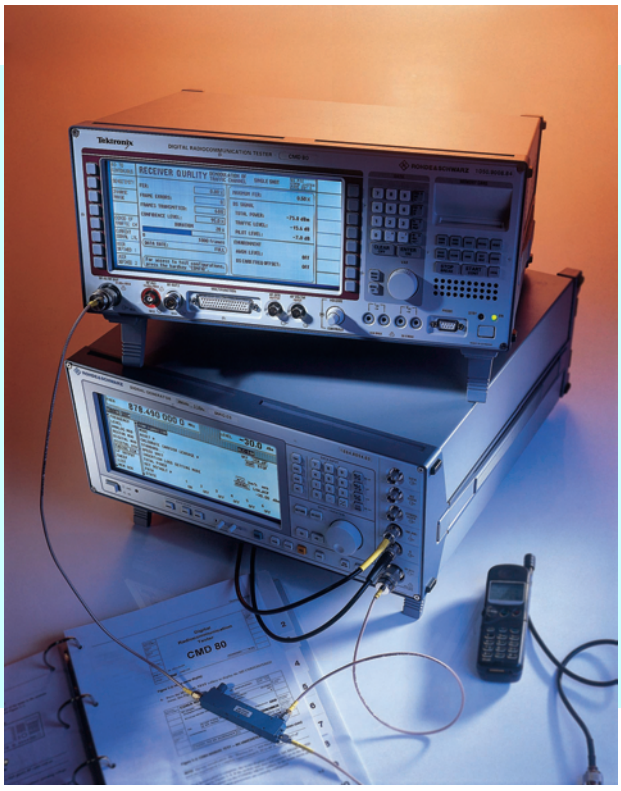
Right: The CMD80go software runs on all commercial PC platforms. Remote control is effected via a simple serial connection

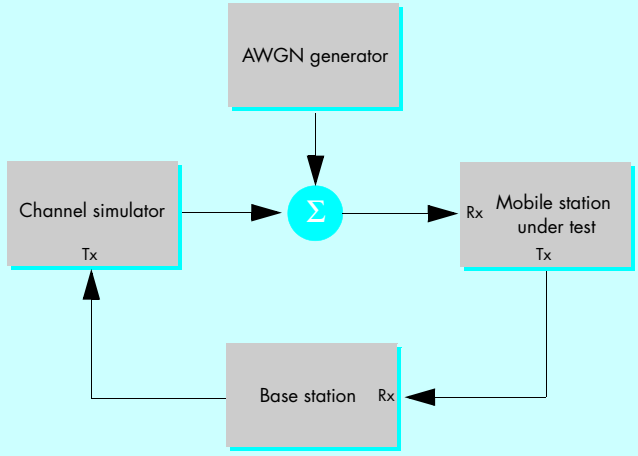
Autorun

The various autorun applications allow the full testing of mobile phones without need for an additional process controller and without specialized knowledge of the different networks. Such applications are ideal for final testing in production and in the service. The measurement applications are based on the specifications of the various standards and can be configured via a functional user interface. Upon completion of the test sequence the results are clearly displayed in a test report.

CMD80go

The CMD80go program offers comprehensive remote control capabilities for the Digital Radiocommunication Tester via a convenient Windows software package (versions are available for Windows 95 and Windows NT). This application software features an autotest that can be configured according to the different standards for testing mobile phones. The results are summarized in a comprehensive test report which can be printed or stored for further processing with other programs (eg Microsoft Excel).





Above: Schematic representation of fading measurement

Left: The test setup for fading measurements is very simple and merely requires CMD80 and SMIQ to be interconnected

Fading application

The receiver quality of a CDMA mobile phone in line with the IS-95 standard is determined by measuring the frame error rate in the presence of an AWGN noise signal.

The combination of Vector Signal Generator SMIQ with the options

- Noise Generator and Distortion Simulator (SMIQB17)
- Fading Simulator (SMIQB14)

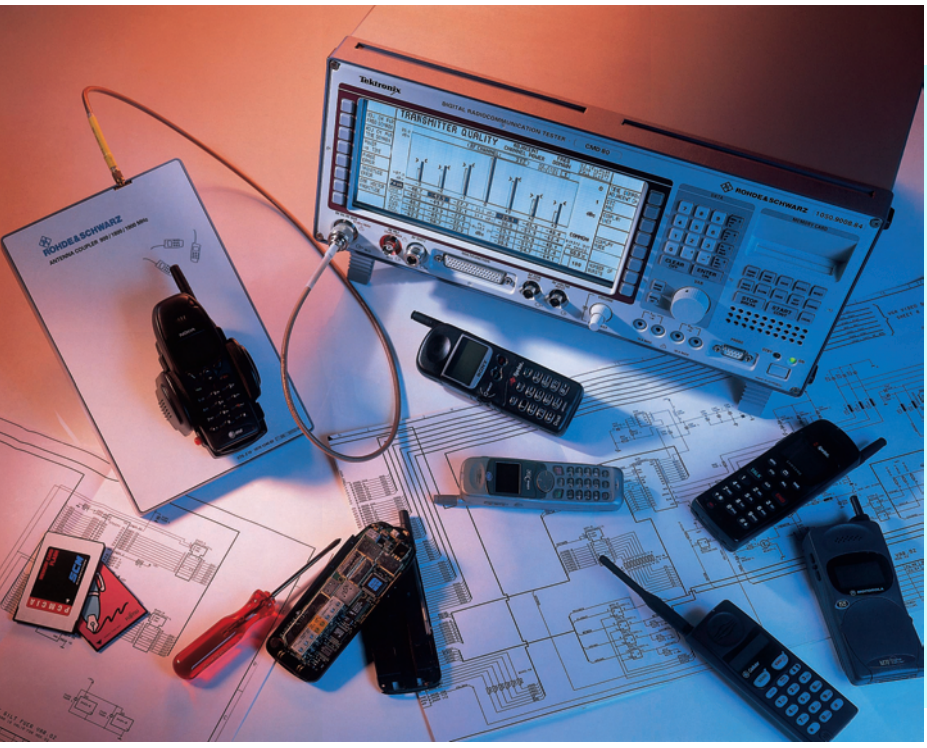
and Digital Radiocommunication Tester CMD80 with the optional I/Q Modulator Outputs (B17) allows simple performance of the receiver quality tests.

In this application, CMD80 assumes the function of the base station. SMIQ then generates both the required multipath signal and the AWGN signal and combines these two signals at its output. The fading profiles specified by the IS-98 standard can be called on SMIQ from a list of preprogrammed standards at a keystroke. Moreover, the user can edit further multipath profiles.

For these tests the mobile phone is set to the loopback mode. At the same time, the base station is measuring the frame error rate. Measurements are carried out at different bit rates.

There is a similar application for testing D-AMPS mobile phones.

Options in detail



Memory Card Interface*)

The memory card option makes software updates extremely easy. Simply plug in the card with the new firmware release, switch on and that's all. There is just no easier way. Moreover, instrument settings can be stored on a memory card and transported to another instrument. Screenshots can also be stored on the memory card in the form of PCX files.

*) R&S option B62, fitted as standard in basic model for North America

Message Monitor *)

The Message Monitor allows to display and record the communication between the base station (CMD80) and the CDMA mobile station. The messages from the forward and reverse link thus become transparent and visible.

The option uses the service port of CMD80 to display the data on an external PC via a special cable. The program runs on all PC-compatible computers under Windows 95 or Windows NT.

*) Option B83 for R&S, MM18 for Tektronix

Access Channel Registration Message

```
[ 8] ACCESS CHAN: Registration Message - (Type 1)
[ 3]    Ack Seq: 3
[ 3]    Msg Seq: 5
[ 1]    Ack Req: 1
[ 1]    Valid Ack: 0
[ 3]    Ack Type: 2
[ 3]    Mobile Station Identifier (MSID) Type 3
[ 4]    Length=10
[32]       ESN: D314AD06h
[ 1]       IMSI_Class: 0
[ 2]          IMSI Type:  2
[ 1]             Reserved[1] 0
[10]             MCC:        310
[34]             IMSI_S:     0000007590
[ 2]    Authentication Mode: 0    None
[ 4]    Registration Type: Timer Based
[ 3]    Slot Cycle Index: 2
[ 8]    Mobile Protocol Rev: 1
[ 8]    Station Class Mark: A0h
[ 1]    Mobile Terminated Calls Accepted: True
[ 6]    Reserved 0
[30]    CRC: 1E1ECA1Fh
```

Name	Description	Notes
K1 IS-95 CDMA 800 MHz Test Capabilities	CDMA cellular extension. Allows measurements on CDMA mobile phones which are operating in cellular band (800 MHz)	Option is also required for AMPS (B82) and D-AMPS (B84) measurements in the cellular band (standard for US market)
K2 PCS1900/1700 MHz Test Capabilities	CDMA PCS extension. Allows measurements on CDMA mobile phones which are operating in PCS band (1900/1700 MHz)	Option is also required for D-AMPS (option B84) measurements in the PCS band
B1 OCXO Reference Oscillator	OCXO reference oscillator, aging $\pm 1 \times 10^{-7}$. Ensures high absolute accuracy, minimum temperature-dependent drift and especially high long-term stability. Used for measurements with exacting requirements on frequency stability	
B3 Reference Frequency Inputs/Outputs	Multifrequency reference input/output. For synchronizing DUT and measuring instruments with internal or external frequencies. Allows synchronization of CMD to an internal or external frequency of 2.048, 10, 13, 26, 39, 52 MHz	
B14 Rate Set 2 (13k vocoder support)	Rate set 2 extension for CDMA mobile phones. Allows testing of CDMA mobiles which support 13 kbit/s data rate	
B17/B17IQ I/Q Modulator Outputs	I/Q signals from the CMD modulator and burst trigger signals are provided for Rohde & Schwarz Signal Generator SMIQ for conformity tests under fading conditions	
B60 Carrier Board for B61/B62	Adapters for B6x options	Option is required for options B61/62 (standard for US market)
B61 IEEE/IEC-Bus Interface	IEC625/IEEE488-bus interface. Remote control alternative to the RS232C interface fitted as standard. Used for fast remote control of CMD	Requires option B60
B62 Memory Card Interface	Memory card interface. Allows storage of instrument setups as well as fast and easy upgrades to new software features. Highly recommended	Requires option B60 (standard for US market)
B81 AWGN Generator	The AWGN extension allows to add additional white Gaussian noise to the base station signal. This option is used to simulate the noise floor of additional CDMA traffic channels.	
B82 Analog Option	Analog extension. Allows measurements on AMPS, N-AMPS, J/N/E-TACS mobile stations	Requires option K1 and B60
B83, MM18 Message Monitor	The message monitor operates with the CMD80 to interpret and display CDMA forward/reverse link messages on an IBM PC-compatible computer running Windows 95/NT	
B84 IS-136 (D-AMPS) Test Capabilities	IS-136 extension. Allows testing of D-AMPS (IS-136) mobile phones	Requires option B82 For cellular band, option K1 is required For PCS band, option K2 is required
U22 Controller Board Upgrade	The controller board upgrade option is equipped with current CPU and RAM.	Required for option B84 (not available for US market) *)
U82 Analog Board Upgrade	The analog board upgrade is part of option B82 (mod.12/14). It replaces the old analog board of option B82 (mod. 02/04)	Required for option B84 (not available for US market) *)
U84 Link Handler Upgrade	Link handler upgrade replaces link handler of CMD80 (mod. 80/81)	Required for option B84 (not available for US market) *)
CTS-Z10 Mobile Coupling Device	The mobile coupling device is suitable for development and service purposes	
CTS-Z12 Shielding Box	The shielding box together with the coupling device (CTS-Z10) protects the mobile from external electromagnetic influence	CTS-Z10 is highly recommended
ZZA-94/1R Rackmount Adapter	Adapter for mounting the CMD into a 19'' rack	
ZZK-943 CMD Transportation Box	The transportation box protects the CMD against mechanical shock	(not available for US market)

*) The upgrade options U22/U82/U84 are necessary only if a CMD80, model 80/81, has to be upgraded to IS-136 test capabilities.

Specifications

CDMA

Signal generator

Frequency

Range	US Cellular	869 MHz to 894 MHz
	Japan Cellular	832 MHz to 870 MHz
	China Cellular	934 MHz to 969 MHz
	PCS (US)	1930 MHz to 1990 MHz
	PCS (Korea)	1805 MHz to 1870 MHz
Resolution		1 Hz
Error		same as timebase

Output level

RF IN/OUT	–124 dBm to –20 dBm
RF OUT 2	–105 dBm to 0 dBm
Resolution	0.1 dB
Error (RF IN/OUT)	<1.5 dB

Modulation	QPSK
Carrier suppression	30 dB

Analyzer

Frequency

Range	US Cellular	824 MHz to 849 MHz
	Japan Cellular	887 MHz to 925 MHz
	China Cellular	889 MHz to 924 MHz
	PCS (US)	1850 MHz to 1910 MHz
	PCS (Korea)	1715 MHz to 1780 MHz
Resolution		1 Hz
Error		same as timebase

Power measurement

Reference level range	
RF IN/OUT (full scale)	–28 dBm to +41 dBm
RF IN 2 (full scale)	–69 dBm to 0 dBm
Measurement error, absolute	<1.5 dB
Measurement error, relative	<0.3 dB (reference level –30 dB)
Dynamic range within the following range	50 dB below reference level
RF IN/OUT (full scale)	–65 dBm to +41 dBm
RF IN 2 (full scale)	–75 dBm to 0 dBm

Demodulation	O-QPSK
Modulation analyzer error of ρ factor (25 ±10) °C	<0.003 (for ρ: 0.9 to 1)
Frequency measurement range	–3 kHz to +3 kHz
Frequency measurement error	<reference ±30 Hz
Timing measurement error	<60 ns

Rate set support	
Rate set 1 (8 k)	standard
Rate set 2 (13 k)	**option B14**
AWGN generator	**option B81**
Equivalent noise bandwidth	1.8 MHz typ.
Gain adjustment range	–20 dB to +6 dB of forward channel power
Signaling	
Digital modes	IS-95, UB-IS-95, J-STD008, T53

TDMA – option B84

Signal generator

Frequency

Range	US Cellular	869 MHz to 894 MHz
	PCS (US)	1930 MHz to 1990 MHz
Resolution		1 Hz
Error		same as timebase

Output level

RF IN/OUT	–120 dBm to –20 dBm
RF OUT 2	–100 dBm to 0 dBm
Resolution	0.1 dB
Error (RF IN/OUT)	<1.5 dB

Modulation	π/4 DQPSK or unmodulated
Error	<4 % (EVM rms)
Mod. distortion 3rd order	<–45 dBc
Carrier feedthrough	<–25 dB

Spectral purity	
SSB phase noise	–94 dBc (1 Hz at 50 kHz offset)
	–106 dBc (1 Hz at 100 kHz offset)

Analyzer

Frequency

Range	US Cellular	824 MHz to 849 MHz
	PCS (US)	1850 MHz to 1910 MHz
Resolution		1 Hz
Error		same as timebase

Power measurement

Reference level range	
RF IN/OUT (full scale)	0 dBm to 39 dBm
RF IN 2 (full scale)	–40 dBm to 0 dBm
Residual level	<–65 dBm (RF IN/OUT)

Spectral purity	
Phase noise	–94 dBc at 50 kHz offset
	–106 dBc at 100 kHz offset

Modulation analyzer

CR band: 824 MHz to 849 MHz	
EVM RMS (residual)	1%
EVM Pk (residual)	3%
CR band: 1850 MHz to 1950 MHz	
EVM RMS (residual)	1.5%
EVM Pk (residual)	5%
I/Q offset (residual)	50 dB (0.3%)
I/Q imbalance (residual)	50 dB (0.3 %)
Frequency measurement range	–1 kHz to +1 kHz
Frequency measurement error	<5 Hz + reference

Power versus time

Level error	<1.5 dB down to 20 dB below reference level, 3 dB else, dynamic limit 66 dB (IS-136 BW)
Leakage power	–65 dBm

Adjacent channel power

Dynamic range	
1st adjacent channel	36 dB
2nd and 3rd adjacent channel	55 dB

Signaling	
Digital modes	IS-136A

Analog – option B82

RF signal generator

Frequency

Range	AMPS	869 MHz to 894 MHz
	N-AMPS	869 MHz to 894 MHz
	TACS	935 MHz to 960 MHz
	J-TACS	860 MHz to 870 MHz
	E-TACS	917 MHz to 950 MHz
	N-TACS	843 MHz to 846 MHz
		863.5 MHz to 867 MHz
Resolution		1 Hz
Error		same as timebase + resolution

Output level

RF IN/OUT	–124 dBm to -20 dBm
RF OUT 2	–105 dBm to 0 dBm
Resolution	0.1 dB
Error (RF IN/OUT)	<1.5 dB

Modulation

FM deviation	0 Hz to 12 kHz
FM resolution	1 Hz
FM rate	50 Hz to 15 kHz
FM distortion (THD + noise)	≤0.5% (dev. 8 kHz, rate 1 kHz, BW 0.3 Hz to 3 kHz, (25 ±5) °C)
Residual FM	<10 Hz (rms, CCITT)
Deviation error	≤2 % of setting + residual FM + FM resolution + timebase error (0.3 kHz ≤FM rate ≤3 kHz, measurement bandwidth 30 Hz to 20 kHz)

RF analyzer

Frequency

Range	AMPS	824 MHz to 849 MHz
	N-AMPS	824 MHz to 849 MHz
	TACS	890 MHz to 915 MHz
	J-TACS	915 MHz to 925 MHz
	E-TACS	872 MHz to 905 MHz
	N-TACS	898 MHz to 901 MHz
		918.5 MHz to 922 MHz
Resolution		1 Hz

Reference level range	
RF IN/OUT (full scale)	–28 dBm to +41 dBm
RF IN 2 (full scale)	–69 dBm to 0 dBm

RF frequency measurement

Dynamic range (from ref. level)	>40 dB
Resolution	1 Hz
Error	<resolution + timebase error

RF power measurement

Narrowband (RF IN/OUT, DSP):	
Reference level range	0 dBm to +41 dBm
Range	0 dB to 50 dB below reference level
Error	<1.5 dB
Wideband:	
Range	
RF IN/OUT	0 dBm to +41 dBm
RF IN 2	–16 dBm to 0 dBm
Error	<1.5 dB

FM measurement

RF bandwidth	
((2 x deviation) + (4 x rate))	≤60 kHz
Deviation range	0 kHz to 30 kHz
Resolution	1 Hz
FM rate range	0 kHz to 12 kHz
Sensitivity (BW 0.3 to 3 kHz, SINAD 12 dB, dev. 2.9 kHz, FM rate 1 kHz)	
RF IN/OUT connector (ref. level = –28 dBm)	typ. 13 µV (–85 dBm)
RF IN 2 connector (ref. level = –69 dBm)	typ. 1.3 µV (–105 dBm)
Residual FM	
RF IN/OUT	typ. ≤7 Hz (BW 0.3 to 3 kHz, rms)
RF IN 2	typ. ≤9 Hz (BW 0.3 to 3 kHz, rms)
Error	<4% of reading + 30 Hz + residual FM (FM rate ≤12 kHz, deviation ≤30 kHz)

Signaling

Analog mode	AMPS, N-AMPS TACS, J/E/N-TACS

Audio source

Frequency

Range	50 Hz to 4 kHz (single tone)
Resolution	1 Hz
Error	half resolution

Output voltage

Range	0.1 mV to 5 V, rms
Resolution	0.1 mV
Maximum output current	20 mA peak
Output impedance	<5 Ω
Level error	<5% (output voltage >1 mV)
Distortion (THD + noise)	≤0.1% (BW 100 kHz, output voltage ≥200 mV)

AF analyzer

Frequency measurement

Range	50 Hz to 15 kHz
Resolution	1 Hz
Error	<1 Hz + timebase
Input voltage range	10 mV to 30 V

AC voltage measurement

Input range	0.1 mV to 30 V, rms
Error	< 5% + resolution
Nominal input impedance	1 MΩ ll 100 pF

Distortion measurement

Bandwidth	limited by C-message filter
Frequency	1004 Hz
Input voltage range	100 mV to 30 V, rms
Inherent distortion	<0.2 %
Resolution	0.1% distortion
Error	<5% + inherent distortion

SINAD measurement

Bandwidth	limited by C-message filter
Frequency	1004 Hz
Input voltage range	100 mV to 30 V, rms
Inherent distortion	<0.2%
Resolution	0.1 dB
Error	<5% + inherent distortion

Audio filters, notch filters automatically selected based on the specific measurement configuration

Timebase

Standard timebase

Nominal frequency	10 MHz
Frequency drift in temperature range 5 °C to 35 °C	≤1.5 x 10^{-6}
Frequency aging	≤0.5 x 10^{-6} / year (at 35 °C)

OCXO reference oscillator	**option B1**
Nominal frequency	10 MHz
Frequency drift in temperature range 5 °C to 45 °C	≤1 x 10^{-7}
Frequency aging	≤2 x 10^{-7} / year, ≤0.5 x 10^{-9} /day after 30 days of operation
Warmup time (at 25 °C)	approx. 5 min

Reference frequency inputs/outputs	**option B3**
Synchronization input	1, 2, 5 or 10 MHz, selectable
Impedance	approx. 100 Ω
Input voltage range	632 mV (pp) to 5 V (pp)
Synchronization output	
Frequency	10 MHz or frequency at sync input
Voltage	5 V (pp), R_{out} = 50 Ω
Additional synchronization signals	see Carrier Board option B60

Carrier board	**option B60**
Synchronization output	selectable between: 2 s (even second pulse) 80 ms super frame 20 ms paging frame 26.67 ms sync frame 1.25 ms power control frame 19.6608 MHz system clock for D-AMPS: 80 ms super frame

Option B60 is required for options B61, B62 and B82

VSWR

RF IN/OUT (N connector)	typ. 1.3
RF IN 2 (BNC connector)	typ. 1.8
RF OUT 2 (N connector)	typ. 1.8

DC measurements

DC voltage measurement

Range	± (0 to 30) V
Resolution	10 mV
Error	<2% + resolution

DC current measurement

Mode	averaging, +peak, –peak
Range	±(0 to 10) A
Common-mode rejection	± 30 V
Shunt resistance	50 mΩ
Resolution for averaging	1 mA / 10 mA
Resolution for peak	10 mA
Residual indication	<10 mA at 25°C and common mode rejection ± voltage 10 V
Error	<2% + resolution + residual indication

Interfaces

IEEE/IEC-bus interface	**option B61** interface to IEC625-1
Other interfaces	RS232C (9-contact) Centronics (25-contact)

Special calibration (Modcal)

Service option Z8, special calibration for TX path
valid for CDMA output signals (all values at room temperature (25 ± 5) °C)

Absolute level error	
RF IN/OUT (–108 to –20 dBm)	typ. <1 dB
RF OUT 2 (–103.5 to 0 dBm)	typ. <1 dB
Relative level error (linearity at one frequency)	
RF IN/OUT (–108 to –38 dBm)	all values are in a range of ±0.5 dB
RF OUT 2 (–103.5 to –18 dBm)	all values are in a range of ±0.5 dB

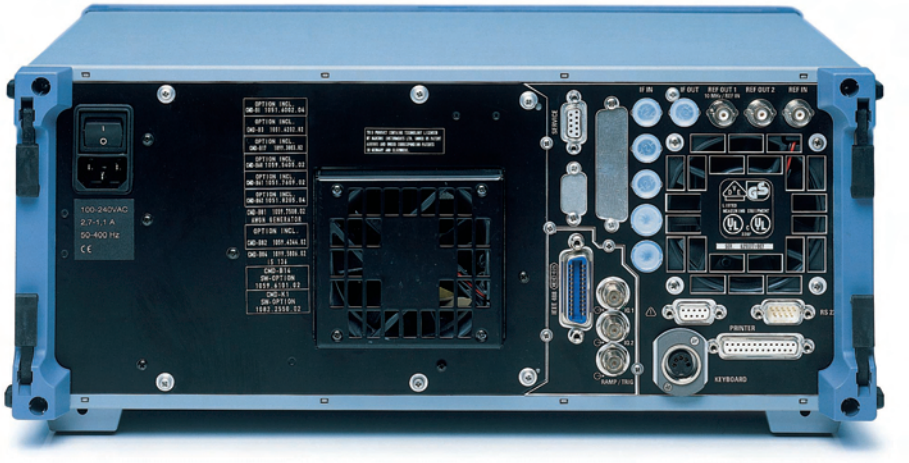
Important note:
The range of 1 dB has to be determined over all measured values inclusive (it is not determined ±0.5 dB with respect to any one particular value).

Valid network handoffs

Network	Handoff from standard	Valid handoff to standards
US Cellular		
	CDMA (IS-95)	AMPS or N-AMPS
	AMPS	N-AMPS
	N-AMPS	AMPS
	AMPS	TDMA (IS-136A)
	TDMA (IS-136A)	AMPS
	TDMA (IS-136A)	US PCS TDMA (IS-136A)
Japanese Cellular		
	CDMA (IS-95)	J-TACS or N-TACS
	J-CDMA (T53)	J-TACS or N-TACS
	J-TACS	N-TACS
	N-TACS	J-TACS
Chinese Cellular		
	CDMA (IS-95)	E-TACS or TACS
US PCS		
	CDMA (J-STD008)	AMPS or N-AMPS
	TDMA (IS-136A)	AMPS
	TDMA (IS-136A)	US Cellular TDMA (IS-136A)

General data

Rated temperature range	5 °C to 45 °C to DIN IEC 68-2-1 /2
Storage temperature range	–40 °C to +60 °C
Electromagnetic compatibility	complies with requirements of EMC directive 89/336/EEC (EN50081-1 and EN50082-2)
Mechanical resistance	
Vibration, sinusoidal	meets IEC68-2-6, IEC1010-1, EN61010-1, MIL-T-28800 D class 5, 5 Hz to 55 Hz, max. 2 g, 55 Hz to 150 Hz, 0.5 g const.
Vibration, random	meets DIN IEC 68-2-36, DIN 40046 T24, 10 Hz to 300 Hz, 1.2 g rms
Shock	meets DIN IEC 68-2-27, 40 g shock spectrum
Power supply	90 V to 265 V, 45 Hz to 440 Hz
Power consumption (without options)	approx. 80 W
Electrical safety	meets EN61010-1, EN60950, IEC 1010-1, VDE 0411, class1
Dimensions (W x H x D)	435 mm x 192 mm x 363 mm
Weight (without options)	approx. 15 kg



Ordering information

ROHDE&SCHWARZ

Designation	Type	Order No.
Digital Radiocommunication Tester (basic unit, CMD-K1 and/or CMD–K2 required)	CMD80	1050.9008.84
Options		
IS-95 CDMA 800 MHz Test Capabilities	CMD-K1	1082.2550.02
PCS1900/1700 MHz Test Capabilities	CMD-K2	1082.2650.02
OCXO Reference Oscillator	CMD-B1	1051.6002.04
Reference Frequency Inputs/Outputs	CMD-B3	1051.6202.02
Rate Set 2 (13k vocoder support)	CMD-B14	1059.6101.02
I/Q Modulator Outputs	CMD-B17	1099.3003.02
Carrier Board for -B61/B62	CMD-B60	1059.5405.02
IEEE/IEC-Bus Interface	CMD-B61 *)	1051.7609.02
Memory Card Interface	CMD-B62 *)	1051.8205.04
AWGN Generator	CMD-B81	1059.7508.02
Analog Option (AMPS, TACS)	CMD-B82 ***)	1059.4344.12
Message Monitor	CMD-B83	1099.5706.02
IS-136 (D-AMPS) Test Capabilities	CMD-B84 **)	1099.5806.02
Controller Board Upgrade	CMD-U22	1099.5906.02
Analog Board Upgrade	CMD-U82	1129.0506.02
Link Handler Upgrade	CMD-U84	1129.0606.02
Mobile Coupling Device	CTS-Z10	1079.1240.02
Universal RF Shielding Box	CTS-Z12	1079.1470.02
Rackmount Adapter	ZZA-94	0396.4905.00
CMD Transportation Box	ZZK-943	1013.9350.00

Ordering information

Tektronix

Designation	Type
Digital Radiocommunication Tester for 800 MHz (US Cellular) and 1900 MHz (PCS)	CMD80
Options	
IS-95 CDMA 800 MHz Test Capabilities	Standard
PCS1900/1700 MHz Test Capabilities	CMD80 K2
OCXO Reference Oscillator	CMD80 B1
Reference Frequency Inputs/Outputs	CMD80 B3
Rate Set 2 (13k vocoder support)	CMD80 B14
I/Q Modulator Outputs	CMD80 B17IQ
Carrier Board for -B61/B62	Standard
IEEE/IEC-Bus Interface	CMD80 B61 *)
Memory Card Interface	Standard
AWGN Generator	CMD80 B81
Analog Option (AMPS, TACS)	CMD80 B82
Message Monitor	MM18
IS-136 (D-AMPS) Test Capabilities	CMD80 B84 **)
Rackmount Adapter	CMD80 1R

*) Option B60 required **) Option B82 required ***) Option K1 and B60 required

Fax Reply (Digital Radiocommunication Tester CMD80)

❑ **Please send me an offer**

❑ **I would like a demo**

❑ **Please call me**

❑ **I would like to receive your free-of-charge CD-ROM catalog**
(including Test&Measurement Products)

Others: _____

_____

_____

Name: _____

Company/Department: _____

Position: _____

Address: _____

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_____

Country: _____

Telephone: _____

Fax: _____

E-mail: _____

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