Digital Radiocommunication Tester CMD80

CDMA, AMPS and IS136 measurements with one unit

The successful Digital Radiocommunication Tester CMD80 has evolved into a multimode mobile radio tester: It now masters D-AMPS according to IS136 along with CDMA and AMPS, making it an indispensable tool in the development, production and service of mobile radio equipment worldwide.

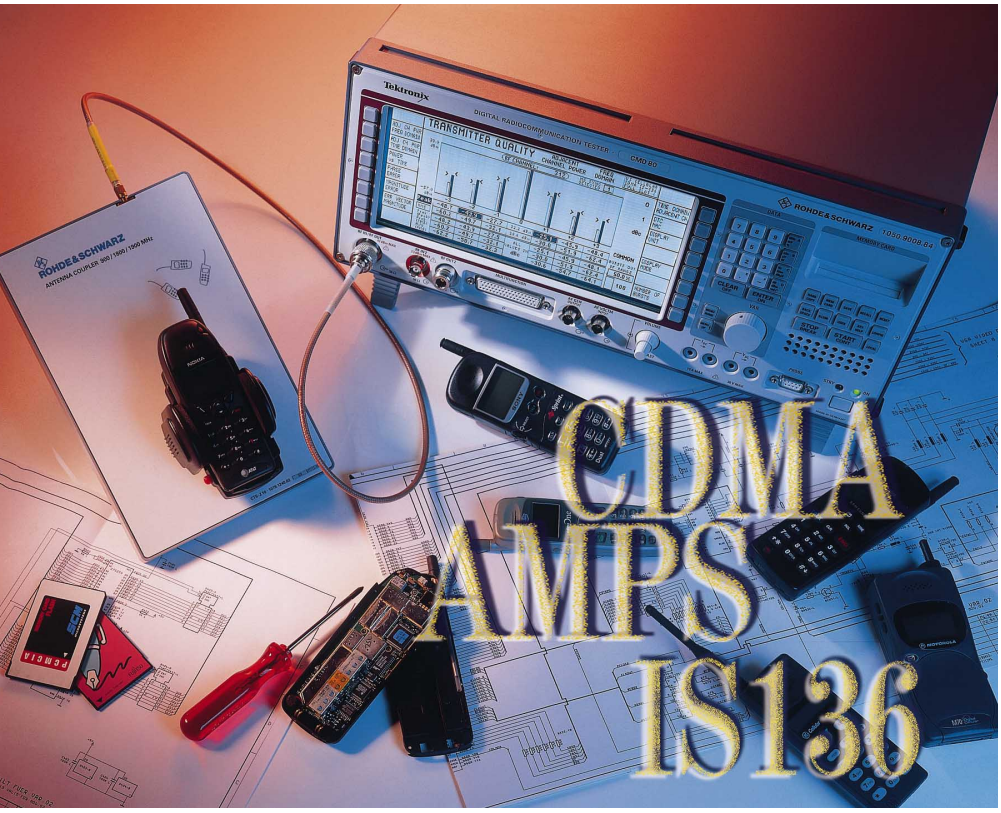

FIG 1 Digital Radiocommunication Tester CMD80, the compact tester for multimode/dual-band mobiles Photo 43 263

In the US, digital networks operating with TDMA (time division multiple access) – D-AMPS – are gaining in importance alongside mobile radio networks based on the analog AMPS (advanced mobile phone system) and the digital CDMA (code division multiple access) standard. In most cases, dual-mode mobile telephones with CDMA/AMPS function (IS95 standard) or D-AMPS/AMPS function (IS136 standard) are offered, often as dual-band phones for the 800 MHz (US cellular) and 1900 MHz (PCS) frequency bands. The consequence of this is that a mobile radio tester is needed that combines all three standards in both frequency bands in a single unit.

Rohde & Schwarz offers such a solution in CMD80 (FIG 1) for full implementation of D-AMPS test technology both with and without signalling. The capability of performing mobile radio measurements according to the three standards with just one instrument is of decisive importance not only in development and service but also, and in particular, in production, where flexible use of mobile radio testers is required. Due to the rapid growth of mobile radio in South America and the Far East, there is huge potential for a multimode/multiband compact tester such as CMD80 in these regions too.

The hardware platform of CMD80 offers a continuous frequency range from 800 to 2200 MHz and the measurements are carried out by means of a digital signal processor. This flexible concept makes it possible to upgrade a CDMA/AMPS dual-mode/dual-band CMD80 [1 to 3] to a multimode/dual-band tester with a minimum of hardware and software, which can be installed straightforward and fast by a service technician.

The various D-AMPS measurements can be performed either as a module test (ie without call setup with the mobile telephone) or with signalling (manual test). Both the US cellular band (800 MHz) and the PCS band (1900 MHz) are covered. The user interface and the IEC/IEEE-bus control comply with the well-proven concept of CDMA and AMPS measurements in CDM80, enabling operation without special knowledge of the different networks.

Measurement standard IS136 defines an external interface to control mobile telephones for testing. This common interface enables checking the different DUT modules without call setup, so the manufacturing process can run at a much faster rate. A bit error rate measurement can even be carried out, ie the receive path of the mobile can also be tested without signalling. The following measurements are possible in the D-AMPS module test with CMD80:

In **transmitter testing** a detailed modulation analysis of the signal received from the mobile station is performed at the power level and frequency defined by the user. The test signal is recorded, synchronized and demodulated. An ideal reference signal, which is compared with the DUT signal, can be generated from these data. The **error vector magnitude** (magnitude of the vectorial error function versus time), the **magnitude error** (amplitude error) and the **phase error** arising during modulation can be derived and represented graphically as a time function versus the emitted burst. These parameters plus **frequency error, origin offset** (carrier crosstalk) and **I/Q imbalance** (measure of unequal gain in the I or Q path of the transmitter modulator) are statistically evaluated and displayed. The **amplitude droop** is also determined to indicate the level difference between the start and the end of a TDMA burst.

What is particularly important for TDMA systems is measurement of **power versus time,** compared to a user-configurable template. Finally, an **adjacent-channel power** measurement (ACP) can be performed. This examines spectral effects due to switching the burst on and off and effects due to modulation, which may disturb transmission in adjacent channels. All six adjacent/alternate channels are evaluated at the same time and represented in a bar diagram (FIG 2). As an alternative, the power curve within an adjacent channel can be examined in the time domain.

For **receiver testing** the mobile station is set to a loopback mode via an external controller by means of a command defined in the D-AMPS standard. CMD80 then sends a test signal at a level that can be set in a wide range, and which contains a suitable, known bit sequence. The mobile telephone can synchronize to this sequence and return it to CMD80 after demodulation. This reflected signal (errorfree transmission on the uplink from the mobile to the base station can be assumed) is demodulated to bit level in CMD80, compared with the known bits of the original signal and the **bit error rate** then calculated. The sensitivity of the mobile station can be determined in this way (FIG 3).

The **manual test mode** with call setup to the mobile telephone is used to perform menu-guided operational checks as required in particular in final production testing and in service. In this test mode the mobile first registers in the base station, which is simulated by CMD80. After that a call with **voice loopback** can be set up by CMD80 or the telephone to be tested. The audio data recorded by the mobile's microphone are buffered in CMD80 and reflected to the tested mobile station after a 2 s delay. In this way the speech quality of the DUT can be checked.

A call is set up by CMD80 or the mobile to perform the measurements. In addition to the parameters that can already be examined in the module test, a **time-alignment measurement** is offered in this mode. CMD80 signals to the mobile telephone the time delay, if any, of the mobile's burst signal with respect to the reference clock in the network and measures this time offset. This function is important with TDMA systems for propagation delay compensation in distant base stations. CMD80 can also check **SMS** (short message service) **transfer** to D-AMPS mobile telephones (base station to mobile station). This verifies the capability of a mobile to receive and display user-definable text messages up to a length of 256 bytes.

Another feature of CMD80 is simulation of **mobile assisted handoff** as defined by IS136. When instructed by CMD80, the mobile telephone examines signal quality in different RF channels and reports the results to the base station to support the handoff procedure. **Implicit handoffs** within the standard, ie handoff to another digital traffic channel (a new channel number) or changeover to another timeslot on the same TDMA frequency, can be performed as well as handoffs from and to AMPS. This is decisive for testing multimode mobile telephones.

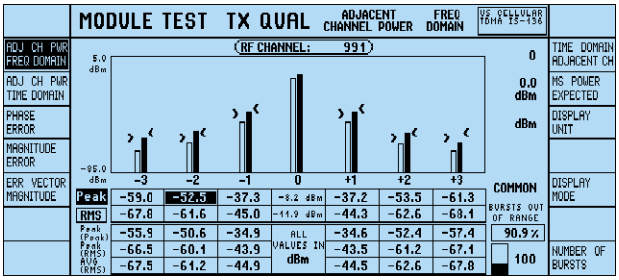

FIG 2
ACP measurement with Digital Radiocommunication Tester CMD80 in D-AMPS module test

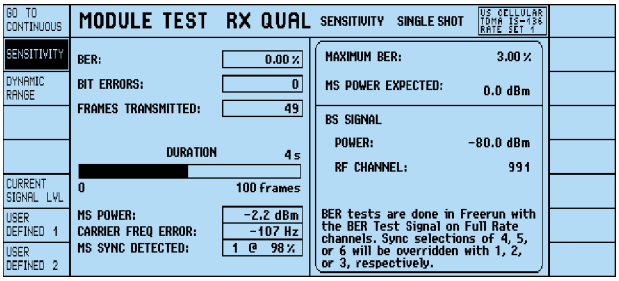

FIG 3
Bit error rate measurement on receive section of mobile with CMD80

Based on its new TDMA measurement capability, CMD80 with its high-speed IEC/IEEE-bus operation, clear and uniform operating concept for AMPS, CDMA and D-AMPS and compact design offers a future-oriented approach and thus optimum prerequisites for use in development, service and production.

Thomas Rösner

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[3] Maucksch, T.: From dual-mode to multimode radiocommunication tester – IS136 standard now implemented in CMD80. News from Rohde & Schwarz (1997) No. 156, p 33

Key features of Digital Radiocommunication Tester CMD80

Multimode/dual-band mobile radio tester for production, development, service

High measurement speed, high flexibility, simple operation

Networks and frequency bands

US cellular (800 MHz)	CDMA(IS95), AMPS/N-AMPS (IS95) D-AMPS/NADC (IS136, IS54)
US PCS (1900 MHz)	CDMA (UB-IS95, J-STD008) D-AMPS/NADC (IS136, IS54)
Japan cellular	CDMA (T53, IS95), N-TACS/J-TACS
China cellular	CDMA (IS95), E-TACS/TACS
Korea PCS (1800 MHz)	CDMA (J-STD008, UB-IS95)

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