

# CMD80: measurements for CDMA and AMPS mobiles



FIG 1  
Digital Radio-communication Tester CMD80 – specialist for CDMA (code-division multiple access) and AMPS (advanced mobile phone service)  
Photo 42 816/1

Rohde & Schwarz, a world market leader in mobile-radio measurements, and its US partner company Tektronix have jointly developed a mobile-phone tester for the US mobile-radio system CDMA to IS95 standard: Digital Radio-communication Tester CMD80 (FIG 1). It also incorporates the technology needed for measurements in the predecessor analog AMPS network, which is still in use. CMD80 measures the RF and AF parameters of mobile stations supporting both standards or dual-mode equipment in development, production and service with the aid of network-specific signalling. It covers the 800-MHz band (cellular radio mobiles for CDMA and analog AMPS), the 1900-MHz band (PCS mobiles for CDMA, PCS = personal communication system) and the 1700-MHz band for the Korean variant of CDMA.

GSM was the first fully digital mobile-radio network. It has been well established in Europe and is now spreading

worldwide. The American response to the successful European standard was CDMA, set down in standard IS95. This mobile-radio system is competing worldwide with GSM. In contrast to mobile-radio network operators, it is not for Rohde & Schwarz to opt in favour of one or the other of these two competing standards. Rohde & Schwarz offers T&M technology for all major digital mobile-radio networks. T&M experience gathered through working with one network may be used beneficially with another. Special features of the individual networks are taken into consideration. The **CDMA system** has a number of such **special features** with implications for the measurements themselves:

- A single subscriber occupies 100% of the radio channel resources (time and bandwidth). Every further subscriber will require the same. This means that each subscriber is a potential source of interference for all

the others. For a subscriber at a certain distance from a base station not to be blocked by another subscriber close by, the signals of all mobiles are required to have approximately the same level at the base station. So it is necessary to ensure through measurements that the mobile transmitter has sufficient dynamic range and that it is able to adjust its output power fast and exactly (range of open-loop power control, time response of open-loop power control, FIG 2, range of closed-loop power control). Essential for network operation is the reliable power adjustment of each and every mobile station.

- CDMA signalling is as complex as in any other network. Some aspects are particularly critical, requiring special care on the part of the tester for the system to work smoothly. Before a mobile is linked to the network, it is not subjected to power control from the base station. The mobile therefore has to probe into the network at very low power (random access, access probe output power). Accessing the network with high power could lead to all active subscribers being blocked. This signalling procedure and others of similar complexity are offered by CMD80 to guarantee smooth network operation. The remaining signalling serves for setting the mobile phone into a state in which RF and AF measurements can be carried out.
- Another consequence of the above is that the receiver of a mobile station is confronted with a large number of simultaneous signals. The base station emits not only the signal to be received by the mobile, but at the same time and at the same frequency also the signals for the

## CDMA measurements by CMD80 to IS98

### Signalling

Broadcast system information  
Random access  
Registration  
Call setup mobile to base  
Call setup base to mobile  
Power change  
Frequency change  
Mobile-initiated call release  
Base-initiated call release

### Receiver test

Receiver sensitivity and dynamic range

### Transmitter test

Frequency accuracy  
Waveform quality  
Range of open-loop output power  
Time response of open-loop power control  
Access probe output power  
Range of closed-loop power control  
Maximum RF output power  
Minimum controlled output power  
Standby output power and gated output power

remaining mobiles plus a synchronization aid for all mobiles. On top of all that, interference from other cells is also present. For this reason, numerous variants of receiver testing have been worked out. Besides the useful signal, CMD80 simultaneously provides a large variety of useful and interfering signals for receiver testing.

- With all subscribers communicating on the same frequency, anyone can disturb anyone. The positive side of the coin is that while an active subscriber is not speaking and therefore not transmitting (which, according to statistics, is the case in more than 50% of the time on average for bi-directional speech), his mobile does

not produce any interference, thereby releasing system capacity for additional subscribers without any organizational efforts. The variable rate speech coder, which reduces transmission activity in three steps for reduced speech activity, produces some special characteristics relevant for measurements which have no equivalent in GSM networks. Transmission activity is reduced by transmitting only at irregular intervals, but with nominal power during those periods. There is a special power ramping measurement function dedicated to this characteristic (gated output power).

Bearing these facts in mind, Rohde & Schwarz made a careful selection of measurements to be performed by Digital Radiocommunication Tester CMD80. A considerable number of the measurements and signalling operations implemented in CMD80 are similar to those in other networks. These are supplemented by CDMA-specific features (compiled in blue box top left).

CMD80 also offers transmitter measurements revealing more than what is stipulated in the standard specifications. Measurements to standard only have to differentiate between good and bad units, while the additional measurements performed by CMD80 also provide detailed information on the possible origins of faults. These measurements include error vector magnitude, phase error and magnitude error (each with peak value, rms value and parameter versus time), carrier feedthrough, IQ imbalance as well as an audio test (acoustic echo)

and checking operating voltage and current.

In the US, cellular phones were first operated in the **analog network AMPS**. Succeeding systems with higher spectral efficiency were used in the same 800-MHz band to supplement and provide additional capacity to the AMPS network. Each of these succeeding networks is required to be able to work with the original network in dual mode, and this is likely to remain so in the foreseeable future. Therefore CDMA mobiles must also be able to work with AMPS in the dual mode. Consequently, measurements have to cover both modes as well. This is no problem for CMD80: the blue box below shows an overview of the available AMPS measurements. In addition, a handover function allows linking the two systems CDMA and AMPS.

## AMPS measurements by CMD80 to IS55

### Signalling

Broadcast system information  
Registration  
Call setup mobile to base  
Call setup base to mobile  
Power change  
Frequency change  
Mobile-initiated call release  
Base-initiated call release

### Transmitter test

Carrier frequency  
Power/standby power/access power  
Modulation deviation limiting  
Transmitter audio response  
Hum and noise  
Modulation distortion and noise  
Overall peak deviation  
Frequency error (supervisory audio tone)  
Peak deviation (SAT)  
Frequency error (signalling tone)  
Peak deviation (ST)  
Peak deviation (audio)

### Receiver test

Receiver sensitivity (SINAD)  
Hum and noise  
Harmonic distortion  
Receiver audio frequency response

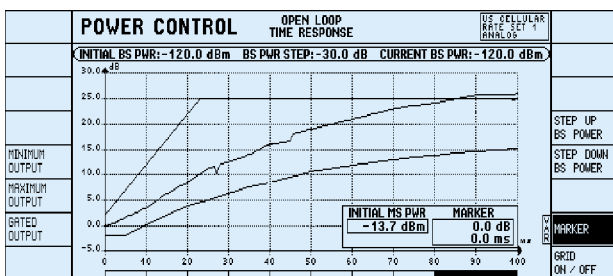


FIG 2  
Parameter versus  
time of mobile  
station power with  
tolerance limits

Thomas Maucksch

Reader service card 154/09