

# Cellular Radio Tester

## Radiocommunication Testers

0.1 to 1000 MHz

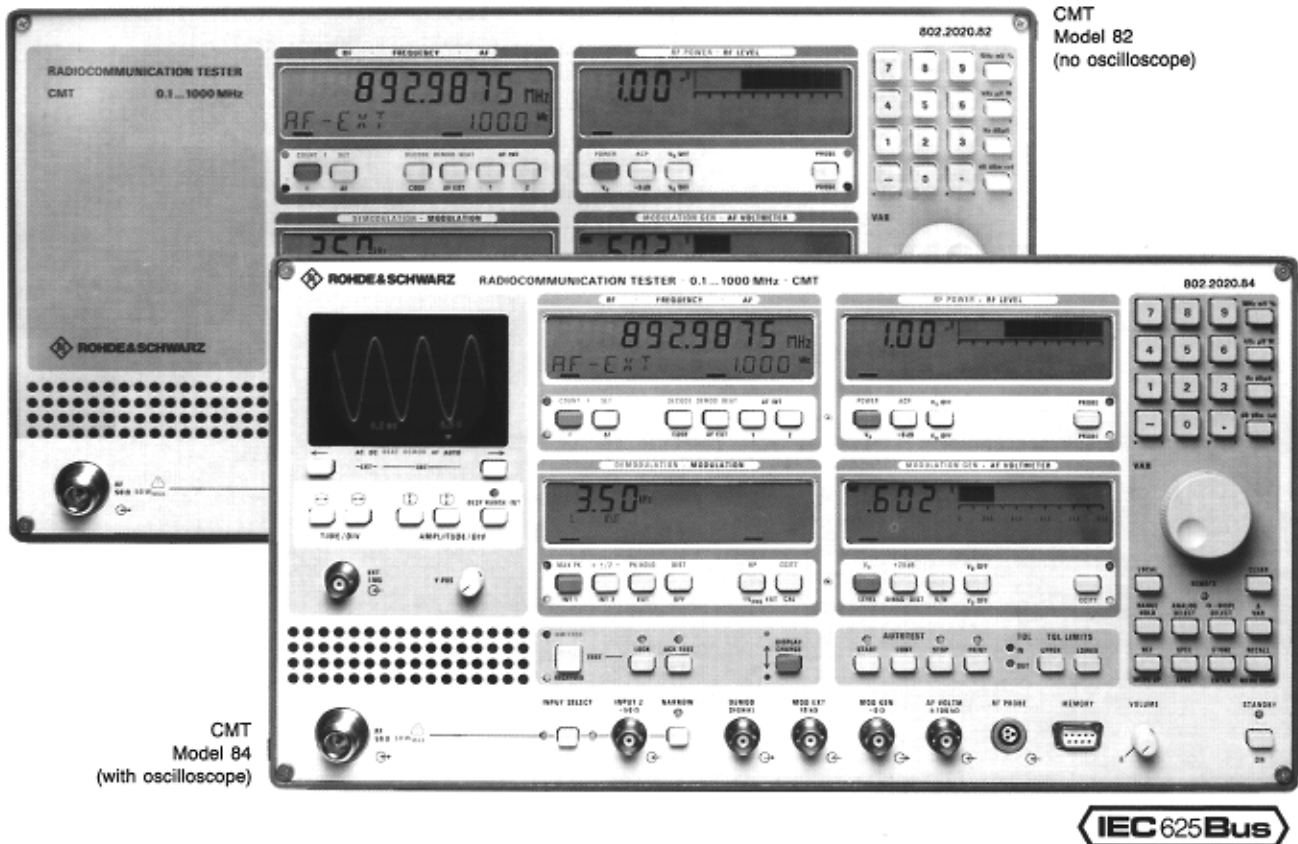
**CMT 82  
CMT 84**

With an AMPS, TACS, NMT 450, NMT 900, Radiocom 2000 and Network C simulator for

- signalling tests
- receiver tests
- transmitter tests



# CELLULAR RADIO TESTER



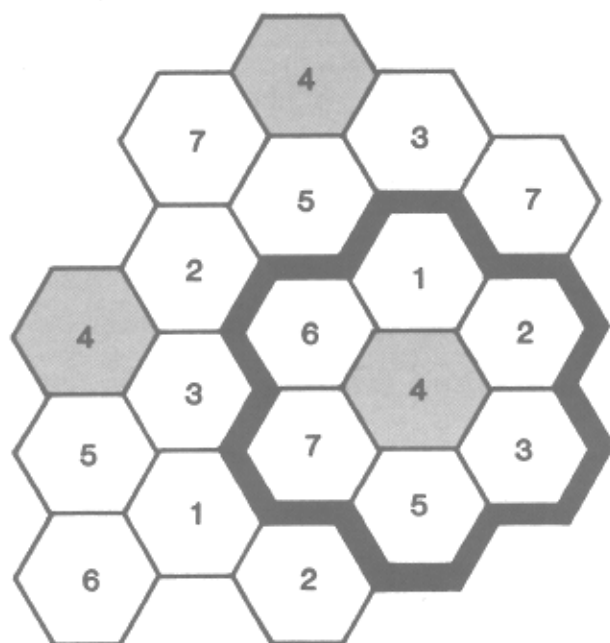
CMT  
Model 82  
(no oscilloscope)

CMT  
Model 84  
(with oscilloscope)

The CMT 82 and the CMT 84 are cost-effective test sets with integral cellular radio simulators and all the facilities for testing mobile telephones

**AMPS** – Advanced Mobile Phone Service  
**TACS** – Total Access Communication System  
**Radiocom 2000** (France)  
**NMT 450** – Nordic Mobile Telephone  
**NMT 900** – Nordic Mobile Telephone  
**Network C** (FRG)

- Cellular radio signalling including supervisory tone generation/evaluation under realistic full-duplex mode conditions
- Various operating levels for easy operation – cellular radio experience and complex tests for in-depth measurements are not necessary
- Comprehensive display of telegram exchange
- Signalling tests to great depth with display of telegram type and contents, telegram blocks, telegram bits and timing
- Special features of each network are taken into account (time compression, subaudio signalling, supervisory tone etc.)
- Isolation of generator, test and control section has been thought through logically so that exhaustive full-duplex measurements can be made
- Printouts on external printer
- Equally suitable for all conventional FM,  $\phi$ M and AM radio equipment
- Can be battery-powered and is light and compact for mobile and stationary use
- Ergonomic manual operation thanks to easy-to-read results which are shown simultaneously on analog and digital displays, on alphanumeric display and on the integral oscilloscope (CMT 84)
- Fully automatic test routines without controller; printout through integral program memory for complete mobile phone tests
- Automatic testing with external controller hooked up via the IEC bus



The principle of modern cellular radio networks. Cells with the same number use the same frequency so that the scarce transmit and receive frequencies can be used several times.

To ensure that the subscriber equipment is compatible with the cellular radio network, signalling must be generated and assessed; the conventional analog test parameters must also meet network specifications.

CMT models 82 and 84 meet all these requirements as they have been fitted with base station simulators to provide all the

- signalling measurements,
- receiver measurements and
- transmitter measurements

on mobile phones used by all major cellular networks including all the variants found in the FRG and abroad:

<b>Network C</b>	Federal Republic of Germany
<b>NMT 450</b>	Sweden, Finland, Norway, Denmark, Belgium, Luxembourg, The Netherlands, Austria, Spain, Malaysia, Thailand, Indonesia, Turkey
<b>NMT 900</b>	Sweden, Finland, Norway, Denmark, Switzerland
<b>AMPS</b>	USA, Canada
<b>TACS</b>	United Kingdom
<b>Radiocom 2000</b>	France

Test and control facilities, including options, built into the CMT 82 and the CMT 84:

#### Generator section

RF generator	0.1 to 1000 MHz, - 137 to + 13 dBm, fine level tuning over 20 dB
Modulation generator 1	20 Hz to 30 kHz plus 8 extra fixed frequencies
Modulation generator 2	20 Hz to 30 kHz
Dual tone modulation generator	Dual tone generation to DTMF standards, frequency of each tone can be adjusted separately
Selective call encoder	to standard or programmable

#### Cellular radio simulator

NMT 450/900, AMPS, TACS, Network C, Radiocom 2000	Full-duplex signalling; all analog test facilities remain simultaneously available. Each set has all the test facilities (filters, companders, speech inverters etc.) for each network
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#### Control section

IEC bus/control interface	Interface to IEC-625-1 (IEEE 488), 8 relays
Autotest control/printer interface	20 complex/100 simple test programs, 3 relays, Centronics parallel interface

#### Measurement section

RF frequency counter	0.4 to 1000 MHz
RF power meter	5 mW to 50 W
Modulation meter	MAX. PK, - PK, + PK, ± PK/2, PK HOLD, RMS, presettable and has auto- matic tuning
Duplex modulation meter	like modulation meter in basic units
AF voltmeter	0.1 mV to 35 V, true rms, switch-selectable time con- stants
Distortion meter	0.1 to 50%
SINAD meter	1 to 46 dB
S/N meter	1 to 99 dB
AF frequency counter	20 Hz to 500 kHz
Frequency offset meter	20 Hz to 20 kHz
Oscilloscope (CMT 84)	ext.: AC, DC; int.: AF volt- age, demod. signal, beat frequency, distortion factor to standard or programmable
Selective call decoder	
Adjacent-channel power meter	20 to 80 dB
RF millivoltmeter	10 kHz to 1 GHz, 1 mV to 100 V
Selective RF millivoltmeter	to approx. 1 µV
Dual tone decoder	uses DTMF procedure
AF filter	CCITT filter, 150 Hz highpass, 300 Hz highpass
Off-air measurements	from about 5 µV
Monitoring facility	AF signal, demod. signal, frequency offset

# CELLULAR RADIO TESTER

## Characteristics, uses

The Radiocommunication Testers CMT 84 (with integral oscilloscope) and CMT 82 (without oscilloscope) have the same basic functions as the standard CMT models, the CMT 54 and the CMT 52. The CMT 84 and the CMT 82 are, therefore, fully equipped to test AM, FM and  $\phi$ M radiotelephones. Their manual and automatic modes, their suitability for mobile and stationary use, and the universal test facilities coupled with high measurement precision make the testers ideal for a wide variety of cellular radio test applications. Their small, compact construction, low weight and the fact that they can be battery-powered, make them ideal for field work.

With the base station simulators built into the CMT 82 and 84, the testers can perform all signalling measurements on the

- NMT 450, NMT 900, Network C, Radiocom 2000, AMPS and TACS networks

as stipulated in PTT regulations as well as all AF and RF measurements. The testers are designed to handle the parameters of each network.

The operator himself can enter the frequency range, channel and duplex offset on the testers. This is a simple way of dealing with non-standard systems in other countries – Turkey, for example, uses NMT 900 signalling in the 450 MHz range.

All standard routines are available so that the system conformity of cellular radio subscriber equipment can be reliably checked and the performance characteristics ascertained in the shortest possible time with a minimum of entries.

Integrating all the essential test facilities in just one set has advantages for all areas of application:

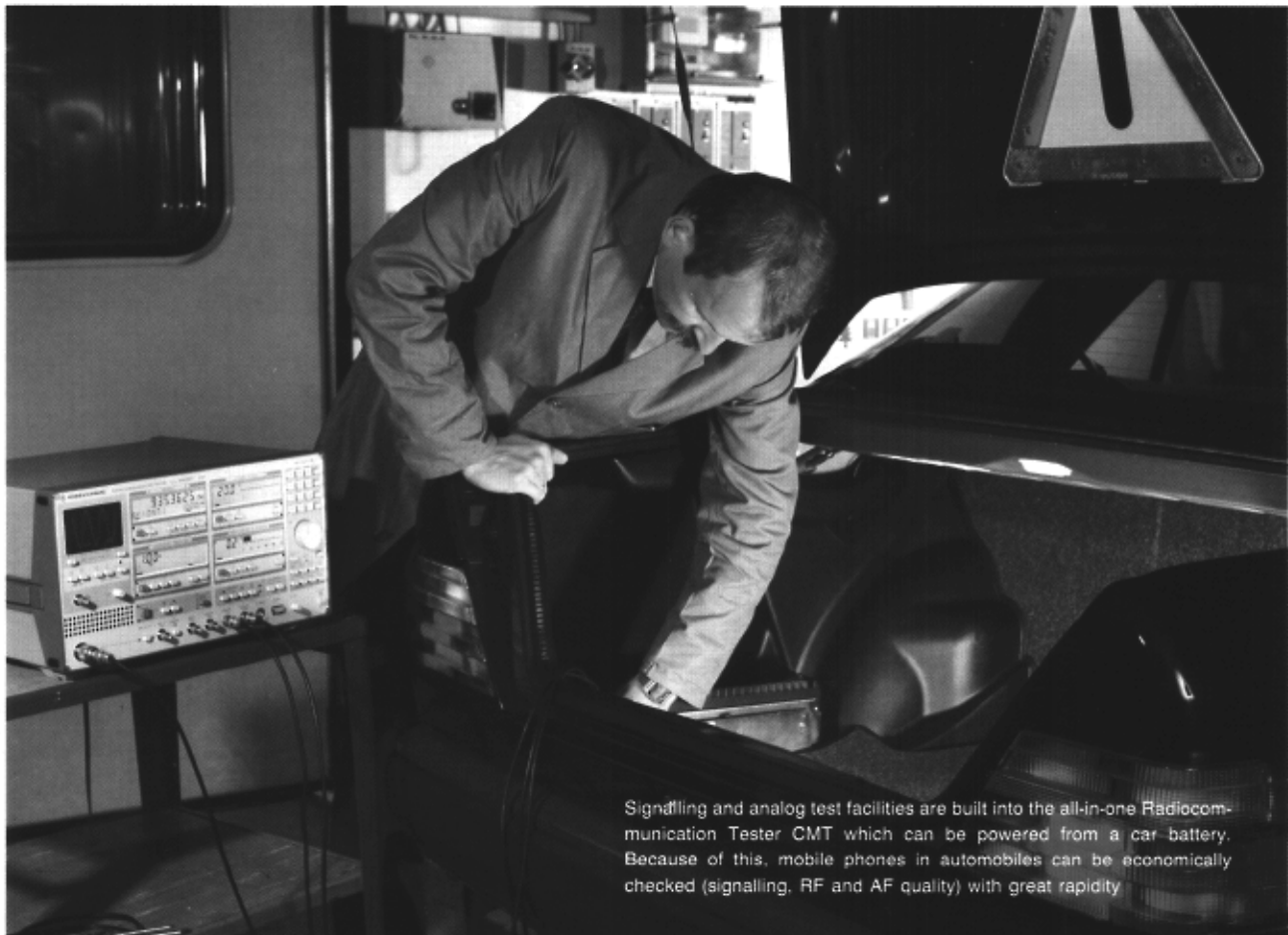
- no test setup cabling
- minimal space requirements for easy integration into ATE, test department work areas and test vehicles
- mobile use

Built-in intelligence for:

- a complete test set with the fastest, system compatible reaction
- real-time base station simulation to provide realistic radio traffic area conditions
- accessing the analog test facilities at any time (even during signalling)

also:

- optimal test runs
- no operator errors with menu-driven user prompts
- no in-depth cellular radio experience necessary



Signalling and analog test facilities are built into the all-in-one Radiocommunication Tester CMT which can be powered from a car battery. Because of this, mobile phones in automobiles can be economically checked (signalling, RF and AF quality) with great rapidity

Example showing a printout of a fully automatic test routine for which autorun control was used instead of an external controller:

The user can not only set up the complete test run with all its settings, measurements and signalling sequences himself but also determine the printout format (explanatory texts, rems, result lists with and without test parameters etc.). If a tolerance is specified, any out-of-tolerance results are marked (righthand column)

The test report can also be varied to suit the application: simple listing of all the conventional radiotelephone characteristics (top) and/or an in-depth signalling analysis (bottom)

LINE	COMMAND	PARAMETER	RESULT	TOL
000	PROGRAM	11		
001	***** NMT 900 *****			
004	***** DEMO - PROGRAM WITH AF ADAPTER *****			
005	***** R+S CMT 64/66 NMT TEST SET *****			
006	TESTED BY : STEINMUELLER IVCA			
007	DATE : 20.01.1988			
008	RADIO SET : NMT 900 S NO.100617			
043	***** CONNECT.MS->BS *****			
044	***** DIAL NO.+PR.HF *****			
045	***** LIFT HANDSET *****			
058	***** CALL CONNECTED TO 1 *****			
063	***** POWER LEVELS - 0.1..2 *****			
064	***** CHANNEL SPACING 12.5KHZ *****			
069	POWER		0.094 W	
073	POWER		0.879 W	
077	POWER		5.09 W	
078	RF COUNT		890.012590 MHz	
080	ACP	1 CH. dB	-57.4 dB	
081	ACP	2 CH. dB	-79.1 dB	
085	SINAD	20 dB	20.9 dB	
087	RF LEVEL		0.652 uV	
087	***** CHANGE TO TC 1999 *****			
096	POWER		0.095 W	
100	POWER		0.918 W	
104	POWER		5.41 W	
105	RF COUNT		914.376550 MHz	
107	ACP	1 CH. dB	-40.9 dB	
108	ACP	-1 CH. dB	-62.2 dB	
109	ACP	2 CH. dB	-78.1 dB	
110	ACP	-2 CH. dB	-77.4 dB	
112	SINAD	20 dB	20.6 dB	
114	RF LEVEL		0.610 uV	
114	***** CHANGE TO TC 500 *****			
119	***** TX - MEASUREMENTS *****			
124	POWER		0.102 W	
128	POWER		0.982 W	
132	POWER		5.73 W	
133	RF COUNT		902.488760 MHz	
135	ACP	1 CH. dB	-43.1 dB	
136	ACP	-1 CH. dB	-61.7 dB	
137	ACP	2 CH. dB	-78.0 dB	
138	ACP	-2 CH. dB	-73.7 dB	
141	MAX PK	3 KHz	2.98 kHz	-PK
142	AF OUTPUT		0.174 V	
142	TX DIST		1.78 X	

255	***** ANALYSIS SIGNALLING "POWER CHANGE" *****			
260	SPEC C12960			
261	→		TOTAL RECS= 8	
261	SPEC C12321	1	1 000	
262	→		3A C→M OOH	
262	SPEC C12321	2	2 139	
263	→		3A C→M OOH	
263	SPEC C12321	3	3 176	
264	→		10B C←M OOH	
264	SPEC C12321	4	4 277	
265	→		3A C→M OOH	
265	SPEC C12321	5	5 311	
266	→		10B C←M OOH	
266	SPEC C12321	6	6 416	
267	→		3A C→M OOH	
267	SPEC C12321	7	7 449	
268	→		10B C←M OOH	
268	SPEC C12321	8	8 566	
269	→		10B C←M OOH	
269	***** FRAME 10B ANALYSIS *****			
270	SPEC C12340		-SEL-	
271	→		10B FRAME n.9	
271	SPEC C12341	1	1	
272	→		10B POWER CODE	
272	SPEC C12341	2	500	
273	→		10B CHANNEL NO	
273	SPEC C12341	3	1	
274	→		10B PREFIX	
274	SPEC C12341	4	6	
275	→		10B MS COUNTRY	
275	SPEC C12341	5	784116	
276	→		10B MS IDENT.	
276	SPEC C12341	6	1	
277	→		10B CMT AREA	
277	SPEC C12341	7	2	
278	→		10B CMT CNTRY	
278	SPEC C12341	8	2	
279	→		10B TRAFF. AREA	
279	SPEC C12341	9	566	
280	→		10B PASSWORD	

The wide range of options for increasing the number of uses for the testers can also be used to great advantage for checking cellular radio subscriber equipment. The remote control interface (IEC Bus/Control Interface CM-B4 option) and the program autorun (Autorun Control/Printer Interface CM-B5 option) in particular make it possible to include cellular radio measurements in a single program. This gives a complete, automatic mobile phone test which can handle signalling and analog parameters and print out a test report on a printer. These features make the cellular radio tester ideal for the following stationary and mobile applications:

- fast go/nogo tests for incoming and final inspections
- extremely fast in situ check on mobile telephones
- repair acceptance, fault analysis and repair documentation
- final testing, quality assurance and development
- routine maintenance

#### Options for the CMT 82 and CMT 84

IEC Bus/Control Interface	CM-B4
Autorun Control/Printer Interface	CM-B5
Adjacent-channel Power Meter	CMT-B6
2nd AF Synthesizer	CMT-B7
RF Millivoltmeter	CM-B8
DTMF Decoder	CM-B11

Beginning of a test report (starting with extra rems) showing call setup on channel 1, changing to channel 1999 and channel 500 measuring the three power levels, and the adjacent channel power and the sensitivity for 20 dB SINAD on channel 500. Detailed transmitter/receiver measurements (in this case, starting with the modulation sensitivity for a deviation of 3 kHz and the associated modulation distortion) are also made on channel 500.

◀ In-depth analysis of signalling and frame contents illustrated with power change: Using only one special function each time, the analysis is called up and each frame listed. All the frames (in this case 8) are listed in order, the frame type (here 3A, 10B), transmission direction (C→M: CMT→mobile station, M→C: mobile station→CMT) and timing in ms (0 ms, 139 ms, 176 ms, ...) being output in each case. Any signalling errors are listed according to type (here 00H [ex] meaning no error).

For frame analysis (in this case frame 10B), all the frame contents are displayed in plain text with the word contents in the correct order. Power code (power level, here 1), channel no. (500), prefix (frame identification), MS country (home country of mobile station, here 6 for Sweden), MS identification (subscriber number, here 784116), CMT area (base station area, here 1), CMT country (country of base station, here 2 for Sweden), traffic area (cell number), password (566).



# CELLULAR RADIO TESTER

## Features, test capabilities

The cellular radio testers are based on basic models 52 and 54 of the Radio Communication Tester CMT. It has the following extensions as standard

- Duplex Modulation Meter (CM-B9),
- OCXO Reference Oscillator (CMT-B1) and
- cellular radio simulator.

The cellular radio simulator has a 3-microprocessor control unit which performs all the network signalling on both the coder and decoder side in full-duplex. When fitted with the simulator, the testers can handle parameters from different networks and perform all the main signalling procedures listed below as well as carry out all RF and AF measurements to PTT guidelines.

- registration
- call setup
- holding speech connection for each network type
- channel changeover
- power change
- call clear down

Because of the large signalling test depth, the following can also be displayed:

- data telegram timing
- telegram contents
- telegram parameters
- telegram bits
- type of error

This gives a comprehensive overview of signalling. Error injection to check the error correction facilities of the subscriber telephone is also possible.

All signalling and analog test facilities operate in full duplex mode. The generator section and the measurement section are therefore isolated from each other and so can be used for realistic tests even when signalling is taking place. This applies in particular to:

- test and data modulation which can be selected separately and independently of each other
- high-quality duplex modulation meters for measuring modulation without test compromises – even during signalling

- adjacent-channel power measurements can even be carried out during signalling (worst-case modulation to PTT guidelines)
- transmission power measurements – even on the control channel (Network C time slot).

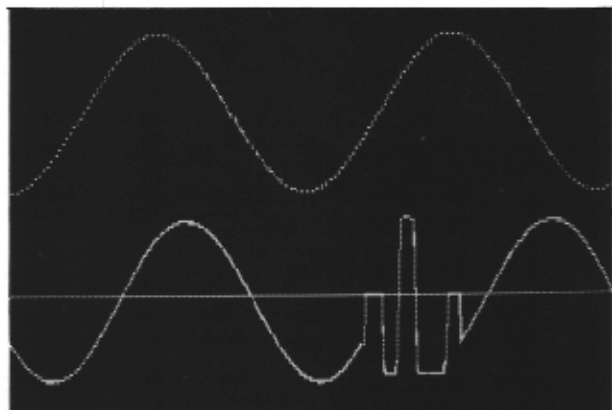
The CMT can handle all the special features of every network so that no extra equipment is necessary for high-quality testing:

- realistic traffic area simulation with up to 32 programmable (level, range, code) base station (Network C)
- integral time compression and expansion with high test quality based on digital signal processing (Network C)
- all conventional radio telephone measurements – also adjacent-channel power, transmission power in the control channel and SINAD – during speech inversion, burst signalling and concentrated signalling (Network C)
- frequency and modulation mode of 4-kHz supervisory tone (NMT) and SAT tones (AMPS/TACS) are user selectable
- can be set for public, private and combined networks (Radiocom 2000)
- integral low-speed modem for automatic subaudio signalling (Radiocom 2000)
- switchable filters for rejecting subaudio signalling (Radiocom 2000), 4-kHz supervisory tone (NMT), SAT tones (AMPS/TACS)
- test frequency conversion appropriate for speech inversion (Network C)

In addition to conventional tests, the data and the test modulation and/or the variation of the RF level can be specified separately for in-depth investigations on:

- bit error rate,
- signalling sensitivity,
- call probability and
- error correction features

The monitor mode (Network C) which has a continuous telegram display immediately shows the reaction of the subscriber equipment. It is equally easy to determine the effects of co-channel or adjacent-channel interference. The CMT already has a suitable input to add the signal from the 2nd generator which is required for this test.



The CMT 82 and the CMT 84 can handle all special network features; the example on the left illustrates time expansion/compression for Network C (FRG):

The compressed signal with data on it (from mobile telephone) is buffered, expanded and output again without introducing any phase jumps. The data that has been separated is processed further while the expanded signal is measured (e.g. deviation, distortion, S/N ratio). For transmission to the mobile telephone, the AF signal is time compressed/expanded, and the data is inserted in the time slots with the required data.

The CMT's switchable time expansion/compression is implemented using high-accuracy digital processing making it possible to measure all parameters of interest precisely.

All the test facilities in the CMT 82 and CMT 84 can be used for all measurements on conventional AM, FM and  $\phi$ M radio equipment, but are particularly suitable for all cellular radio applications:

#### RF synthesizer

- Low residual FM for S/N to over 60 dB (referred to a 4 kHz deviation, CCITT weighting, 70-cm band)
- Electronic, interruption-free level variation over 20 dB to check mobile phones' reactions to drop-outs

#### RF modulators

- Data and test modulation can be set independently for signalling decoder tests
- Dual-tone modulation for intermodulation measurements (effects on the supervisory tones)
- DC coupled AM for fast level jumps to simulate the radio traffic area

#### AF synthesizer

- High spectral purity for precise S/N ratio measurements on sensitive microphone inputs even when small output voltages are used
- Low output impedance for connection to low-impedance microphone inputs

#### Supervisory tone generators

- Variable, with high frequency resolution (0.1 Hz) for measuring decoding tolerances

#### RF power meter

- High sensitivity (can be used from 1 mW) for precise measurements at low power levels
- RF level measurements from about 1  $\mu$ V using a sensitive input with calibration facility for more precision
- Automatic, internal time slot trigger for power measurements in the control channel (Network C)
- Trigger output (RF power indicator) for controlling external devices (transient recorder etc.)

#### RF frequency counter

- Completely separate from the RF synthesizer (direct frequency counting) for all frequency measurements (also IF)

#### AF frequency counter, frequency offset counter

- There are two operating modes: the first is for rapid period measurements or interference-proof gate time measurements on shallow-modulated supervisory tones (NMT). The second is for frequency offset measurements during signalling (Network C)

#### RF demodulators

- Completely separate from RF synthesizer
- Switch-selectable MAX PK, - PK, + PK,  $\pm$ PK/2 display
- PK HOLD function is also provided to handle transient data modulation
- Switch-selectable RMS weighting for interference-free investigation of shallow modulation (supervisory tones)
- Automatically set to shortest settling time when channels are changed

- FM DC-coupled demodulator output for investigating transmitter settling behaviour (e.g. when channels are changed)
- Low residual FM (< 12 Hz at 1 GHz, CCITT weighting) for all transmitter S/N measurements

#### Universal filters

- CCITT filter, 300-Hz highpass filter, various bandpass filters for separate data modulation, useful modulation and supervisory tone measurements

#### Distortion meter, SINAD meter, AF voltmeter

- High sensitivity; large dynamic range even when small signals are measured

#### S/N meter

- For measuring the S/N ratio when receivers and transmitters are being tested. Supervisory tones are taken into account even when signalling is going on

#### Adjacent-channel power meter (option CMT-B6)

- Completely separate from the RF synthesizer so that measurements can even be made when signalling is taking place
- High sensitivity for measurements on mobile phones operating at the lowest power level
- Can also be used down to a few microvolts as a selective RF level meter for module tests

#### RF millivoltmeter (option CM-B8)

- Completely separate from the RF synthesizer for measurements with probes or insertion units from 10 kHz to 1 GHz, the level range being 1 mV to 100 V

#### OCXO crystal oscillator

- Minimal variations due to temperature and aging for all generators, counters and the cellular radio simulator

#### 2nd AF synthesizer/DTMF dual-tone generator (option CMT-B7)

- For checking how multitone modulation affects supervisory tones (intermodulation)
- DTMF dual-tone generator for checking pushbutton dialling decoders

#### Oscilloscope (CMT 84)

- Displays AF signals, demodulated signals and frequency offsets
- AC/DC coupling can be used to display external signals
- Displays the demodulated signal with or without time compression/expansion (Network C)

#### Autorun control/printer interface (option CM-B5)

- For writing and storing fully automatic test routines
- Any combination of signalling and conventional measurements
- Printouts (on external printer) giving three different levels of analysis

The data sheet (data sheet 802202) on the CMT 52 and 54, the basic models, describes all the test facilities incorporated in the CMT 82 and the CMT 84, and also the recommended add-ons and accessories; see page 3 of this data sheet for a brief description.

# CELLULAR RADIO TESTER CMT 84

## Display:

Transmitter modulation

Distortion (with or without  
300 Hz highpass or CCITT  
filter)

Modulation setting  
(int. 1, int. 2, ext.)

## Display:

Transmit frequency, nominal  
frequency

RF frequency setting

## Display:

Cellular radio menu items  
Signalling  
Base station parameters  
Telegram, frame, bit and  
timing analysis

AF oscilloscope

RF input  
RF output

Red: transmitter test  
Blue: receiver test  
Black: transmitter and receiver test

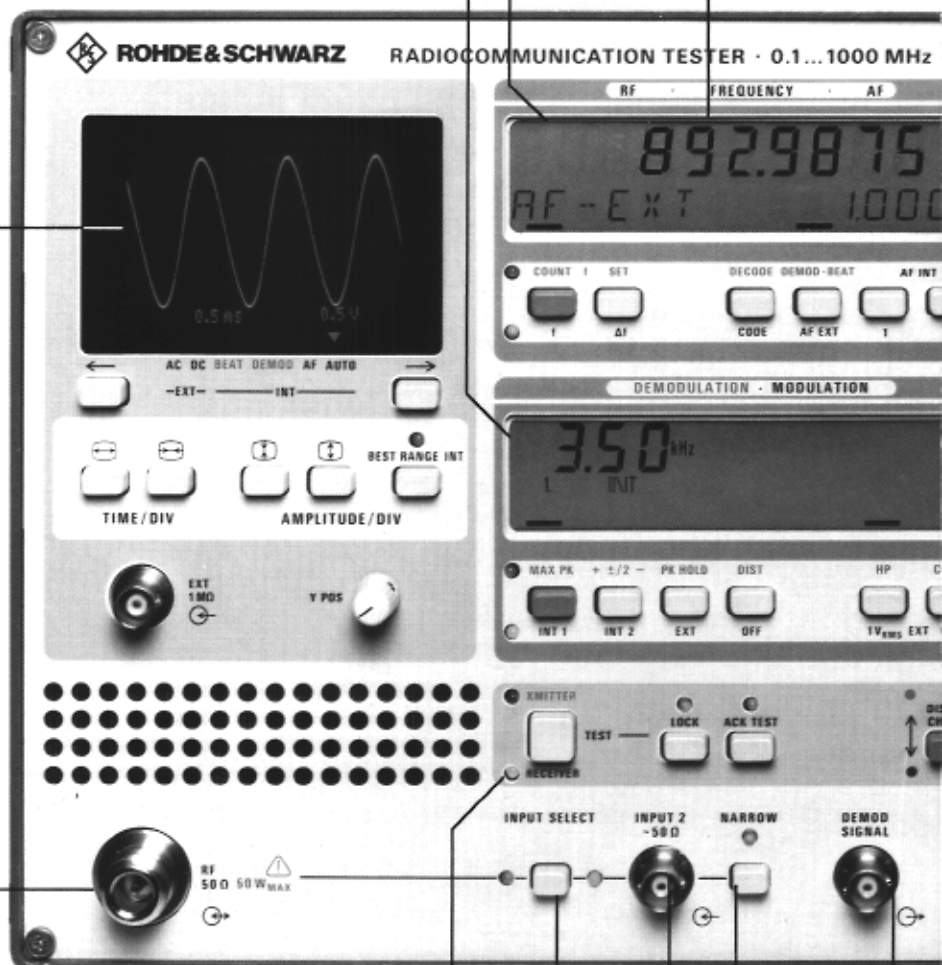
Transmitter test/receiver test selector  
Acknowledgement call test  
Display switchover

RF input  
selector

Sensitive RF input  
(off-air  
measurements)

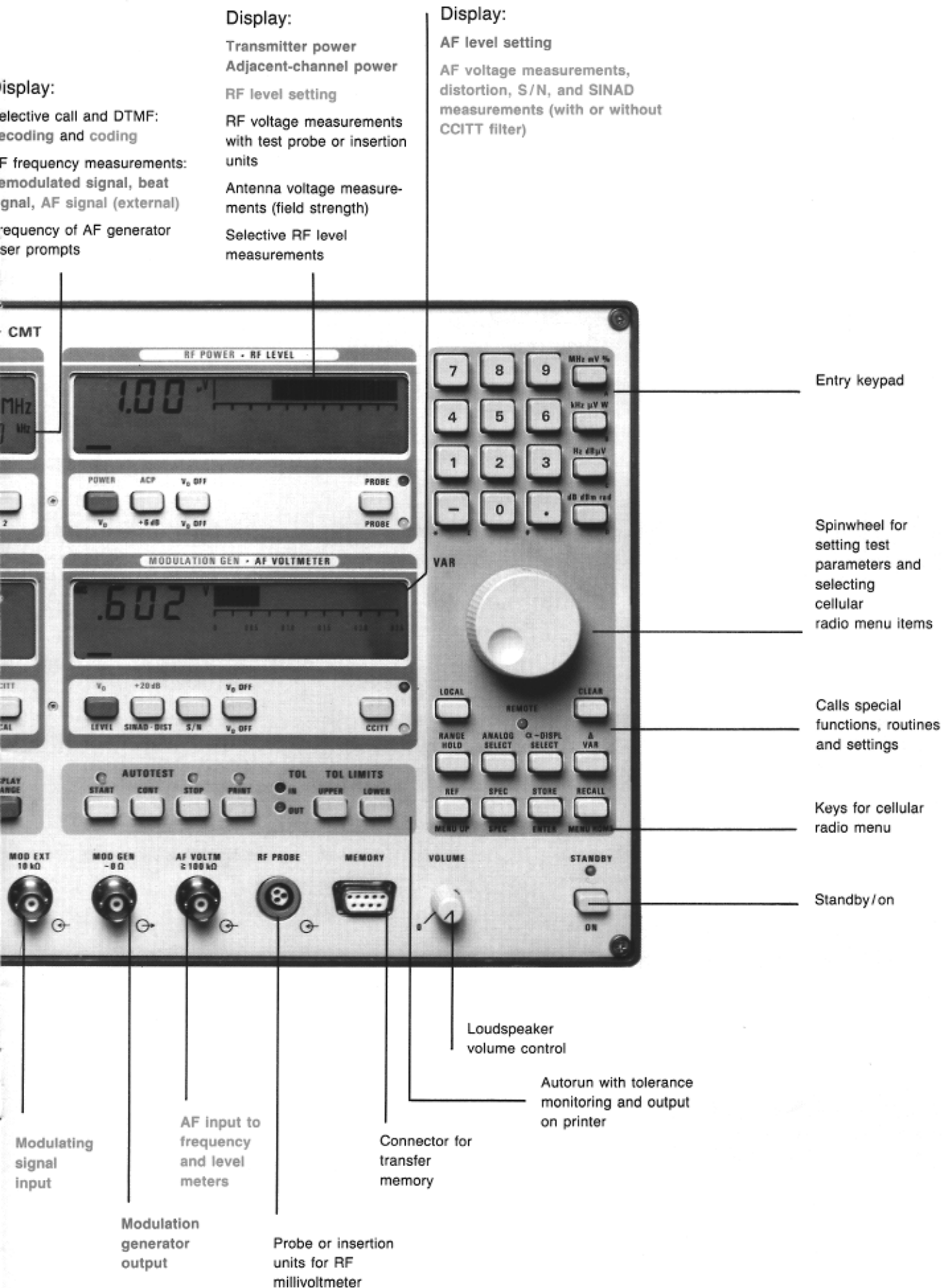
IF bandwidth

Demodulated  
signal output





# FRONT-PANEL DETAILS



# CELLULAR RADIO TESTER

As far as signalling is concerned, the cellular radio tester has all the settings and test routines for realistic testing. The most important information is listed below:

## Network C

### Radio traffic area definition

- 2 standard base stations with different levels and at different distances
- 32 base stations with programmable level, distance and signalling

### Registration with definition of control channel and power rating

- Registration by level
- Registration by distance
- Registration by definition (32 base stations)

### Relocation

- Relocation by level
- Relocation by distance
- Relocation by definition (32 base stations)

### Call setup with definition of channel and power rating

- Incoming call setup without queue
- Incoming call setup with queue
- Outgoing call setup without queue
- Outgoing call setup with queue

### Power control

- Power increase
- Power reduction

### Hand-off with definition of channel and power rating

- Hand-off, concentrated signalling
- Intracell/intercell hand-off

### Release by subscriber

- On-hook
- Release initiation

### Release by base station

- With announcement
- All trunks busy
- Subscriber busy
- Subsystem

### Telegram evaluation individually or automatically if there is an error condition

- Display of last 255 telegrams (abort telegram selectable)
- Parameters
- Telegram bits\*)

### Checking error-correction facility

- Bit error injection

### Monitoring mode with continuous display of all telegrams sent by mobile station

### Others

- Transmission of clock pulses for charge meter
- Detection of speech scrambling

\*) Bit level can only be examined with Manufacturer Software CMT-B12 (PPT approval is necessary in some countries)

## AMPS/TACS

### Parameter selection

- Paging/access channel
- Voice channel
- Power channel
- Busy/idle bit specification
- Other system-relevant special parameters

### Call setup (origination)

- Mobile phone → base station (CMT)
- Base station (CMT) → mobile phone

### Signalling during conversation

- Power change
- Voice channel change
- Flash request
- Error check in identity request

### Evaluation of results

- Dialled number
- Flash request number
- Signalling protocol with output of
  - telegram blocks
  - data bits
  - timing
  - response time
  - type of error (if any)

### Call clear-down by

- mobile station
- base station (CMT)

### Others

- Store, recall and reset function for specific data sets

**NMT 450/900****Adaptation to various**

- Country codes
- Radio bands (with radio band limits, channel spacing, interleaved channel spacing, duplex frequency spacing)

**Parameter input**

- Mobile phone priority
- Power level
- Calling channel
- Traffic channel

**Automatic roaming provides**

- Mobile phone number

**Call setup**

- Mobile phone → MTX (CMT)
- MTX (CMT) → mobile phone
- Call setup with error check according to guidelines

**Signalling during traffic**

- Change in channel
- Change in power

**Signalling protocol with output of**

- Response time
- Time scale (timing)
- Telegram parameters
- Telegram bits
- Type of error (if any)

**Call clear-down by**

- Mobile phone
- MTX (CMT)

**Others**

- Store, recall and reset functions for specific mobile phone and MTX data sets

**Radiocom 2000****Mode selection**

- Private
- Public
- Combined (private/public)

**Automatic registration**

- Mobile phone number
- Home base station of mobile phone

**Mobile phone and network parameters**

- Mobile phone number
- Home base station number
- Traffic channel number

**Call setup**

- Mobile phone → base station (CMT)
- Base station (CMT) → mobile phone with definition of
  - type of connection (simplex/duplex)
  - various call priorities or restrictions (time restriction)
  - error check

**Result evaluation**

- Indication of dialled number
- Signalling protocol with
  - telegram blocks
  - telegram bits
  - timing
  - response time
  - type of error (if any)

**Call clear-down by**

- Mobile station
- Base station (CMT)

**Others**

- Store, recall and reset function for specific data sets of mobile phone and base station (CMT)

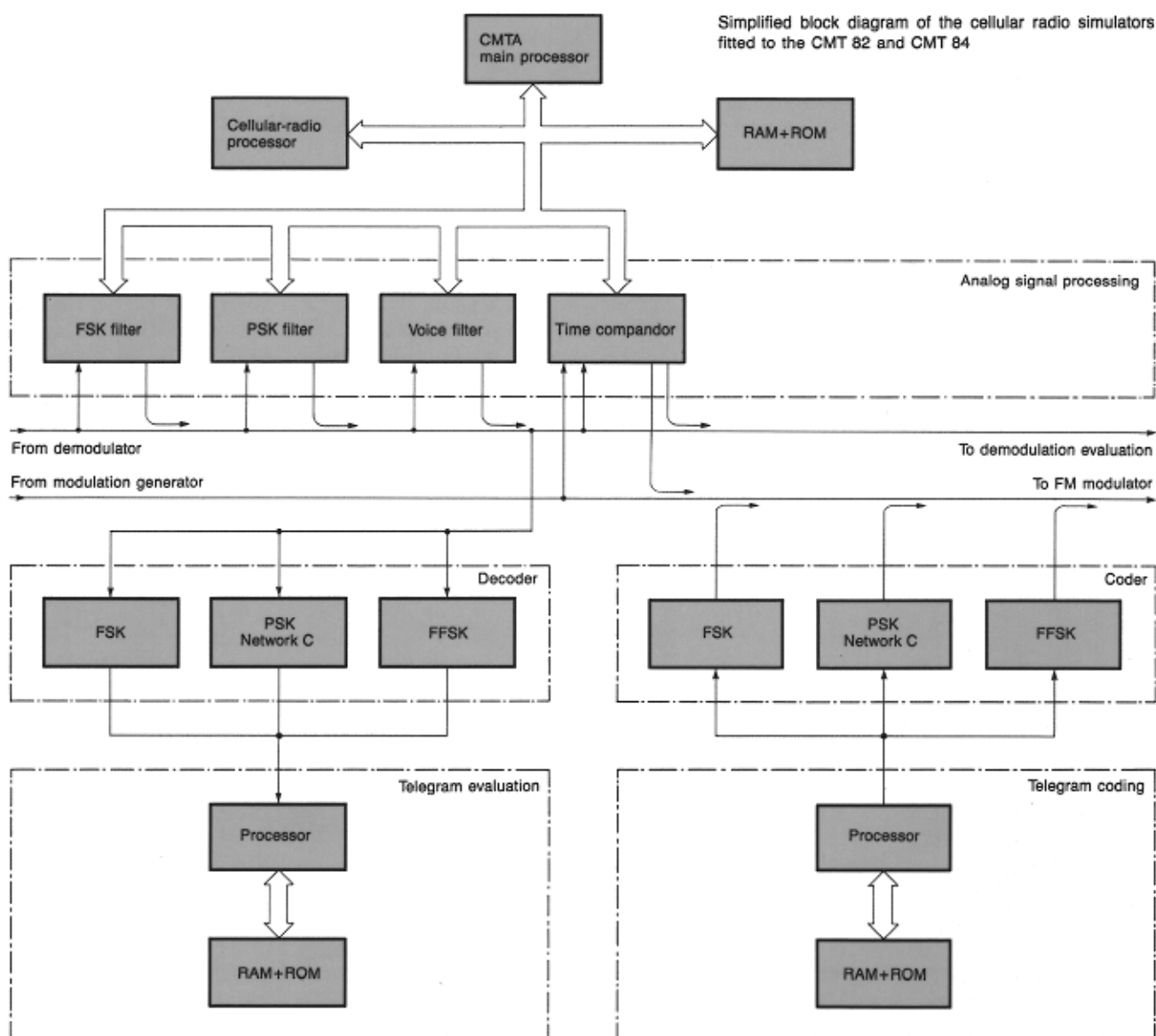
# CELLULAR RADIO TESTER

The CMT 82 and CMT 84 have a wide range of accessories and add-ons:

- **Basic Software CMT-K1** and **Basic Software CMT-K2** for controlling the CMT with a process controller from the PCA controller family (CMT-K1), the Process Controller PUC or the Radiocode Test Set SCUD (CMT-K2)
- **Oscilloscope Probe SMFS-Z1** and **Detector Probe SMFS-Z2**
- **RF Probe URV-Z7** and **10-V Insertion Unit URV-Z2**, the **URV-Z4** is also available for the RF Millivoltmeter CM-B8
- **Transfer Memory CM-Z1** for transferring the test programs that run on the Autorun Control/Printer Interface (CM-B5) from one CMT to another and for setting up a program library
- **Carrying Bag CMT-Z3**
- **Service Kit CMT-Z2**
- **Front-panel Grips ZZG-95** and **19" Adapter ZZA-95**

The CMT 82 and CMT 84 have been fitted with cellular radio simulators which means they can handle all types of network; there are, however, CMTs that can only be used for one type of network:

Network	CMT model without oscilloscope	CMT model with oscilloscope
Network C	CMT 56	CMT 58
Radiocom 2000	CMT 60	CMT 62
NMT 450/900	CMT 64	CMT 66
AMPS/TACS	CMT 70	CMT 72



## Operation

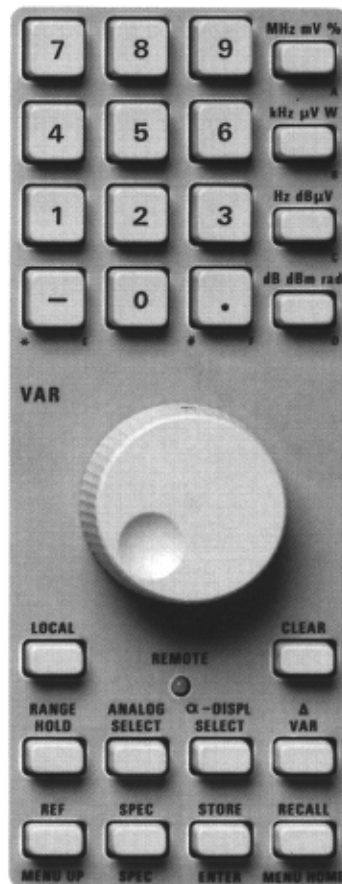
The operating procedures of the cellular radio testers have been designed to check the system conformity of cellular radio mobile stations and to determine all performance features with a minimum of effort. For standard routines, there is no need to enter any parameters as they are already included in the basic setting. However, all base station parameters can be modified for in-depth analysis.

The alphanumeric display indicates all inputs and outputs and so is the operator's main means of communication with the set. All routines are simply selected with the spinwheel and started by pressing a button. All relevant information is displayed in plain text, and the large amount of network information is reduced to a manageable minimum. As the CMT 82 and 84 "know" which network type they are testing, the operator cannot select routines for other networks; this prevents operator errors and makes operation easier.

Like a real system, the operator can switch between the main operating modes "registered" and "call set up" as often as he likes. This is very useful because standard routines and their various variations can be run several times without having to continually re-register. The CMT expects that the telegrams from the mobile phone are always correct, i.e. redundancy does not have to be used for error control. This makes it possible to detect any systematic bit errors which would, in practice, restrict the error control facilities.

If any errors occur, the decode menu is called automatically. This menu shows the previous telegrams in plain text or at the bit level (the Network C bit level can only be examined with Manufacturer Software CMT-B12; PTT approval is necessary in the FRG). The possibility of defining an abort telegram for the decoding procedure helps rationalize troubleshooting. An extra error tolerant mode detects any secondary errors and without having to eliminate the primary error carries out fast, comprehensive error diagnosis.

To check the error correction facilities of the mobile equipment, bit errors can be injected in signalling or an error check routine that complies to the relevant standard can be called.



Menu control makes operating the CMTs exceptionally easy: function selection (horizontally in the operator menu) with spinwheel and execution (vertically in the operator menu) by pressing the ENTER button. The MENU UP button is for going backwards in the menu (advantage: the phone stays registered), new start with the MENU HOME key.

Example showing parameters relevant to signalling on the CMT 82's and the CMT 84's alphanumeric display (Radiocom 2000 above, Network C below)



Registration status display: mobile phone number, combined (private/public) radiotelephone, 121st registration

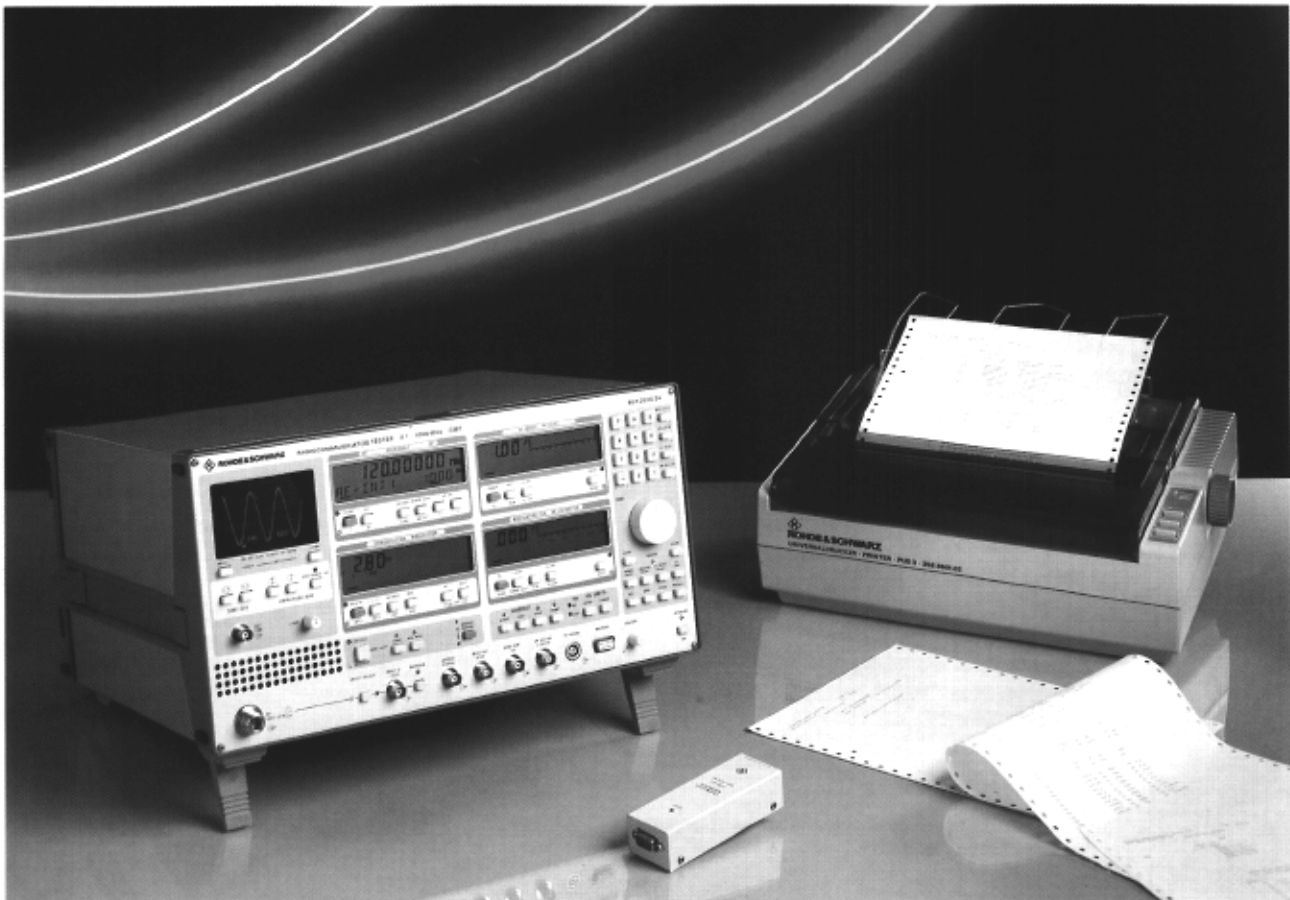


When registration is over, the CMT shows the subscriber number which it has extracted from signalling



# CELLULAR RADIO TESTER

As well as the IEC bus (option), the Autorun Control/Printer Interface Option CM-B5 can be used for automatic testing. In learn mode, programs for complete mobile phone tests including signalling can be created. The procedure is extremely simple, and no external controller is required. The programs are stored in memory with battery backup and can be transferred to other CMTs with the Transfer Memory option. Test reports are printed out on a printer (e.g. PUD 2 or PUD 3 from Rohde & Schwarz) directly connected to the CMT



## Specifications

The specifications of the appropriate CMT basic units (see data sheet 802 202) are valid for the Cellular Radio Testers models 82 and 84

Extra data for models 82 and 84:

<b>Time base</b>	
Aging .....	$< 1 \times 10^{-9}$ / day (after 30 days operation)
Temperature effect .....	$< 2 \times 10^{-9}$ / °C
Warmup time .....	15 min

## Network C

**Simulation of base station** ..... up to 32 base stations with programmable level and phase (distance)

<b>Data clock</b>	
Error .....	same as for reference frequency
Dynamic range .....	0 to 50 $\mu$ s
Resolution .....	0.6 $\mu$ s

<b>RF level</b>	
Dynamic range .....	0 to -40 dB (0 dB fine level setting)
Resolution .....	0.1 dB per dB of attenuation
Error (up to 20 dB attenuation) .....	0.1 dB per dB of attenuation

**Data and test modulation** using compression facility in burst or concentrated signalling mode

<b>Frequency deviation of data</b> .....	0 to 6 kHz
Resolution .....	100 Hz
Error .....	same as basic models CMT 52 and CMT 54 + resolution

and independently adjustable

<b>Test modulation (fs values)</b> .....	250 Hz / 1.5 kHz / 3 kHz / 6 kHz
Resolution .....	same as basic models CMT 52 and CMT 54
Error ( $f_{AF} < 4$ kHz) .....	same as basic models CMT 52 and 54 + 1% of fs

**Test frequency deviation** measurements in burst signalling mode with deviation weighted after expansion

<b>Deviation measurement ranges (fs values)</b> .....	250 Hz / 1.5 kHz / 3 kHz / 6 kHz
Resolution .....	same as basic models CMT 52 and CMT 54
Frequency range .....	20 Hz to 6 kHz (-3 dB)
Error ( $f_{AF} < 4$ kHz) .....	same as basic models CMT 52 and CMT 54 + 1% of fs
Distortion ( $f_{AF} = 1$ kHz) .....	$< 1\%$ ( $\Delta f > 1/2$ fs)

**Test frequency deviation** measurements without data frequency deviation (service mode of mobile station)..... same as basic models CMT 52 and CMT 54

**Data frequency deviation** measurements in burst and concentrated signalling mode (without test frequency deviation) ..... same as basic models CMT 52 and CMT 54

## AMPS/TACS

<b>Data deviation setting</b> .....	0 to 12 kHz
Resolution 1 < 5 kHz .....	100 Hz
Resolution 5 < 12 kHz .....	2%
Error .....	same as basic models CMT 52 and 54 + resolution

<b>SAT (accompanying voice or test tone)</b> .....	5970 / 6000 / 6030 Hz or adjustable: $5000 \leq f \leq 7000$ Hz
Frequency resolution .....	1 Hz
Frequency error .....	same as reference frequency + 1/2 resolution
Deviation .....	0 to 6 kHz
Resolution .....	$< 50$ Hz (with test deviation $< 6$ kHz), $< 100$ Hz (with test deviation $< 12$ kHz)
Error .....	same as basic models CMT 52 and 54 + resolution

<b>Deviation measurement</b>	
Data deviation or SAT with test deviation .....	same as basic models CMT 52 and 54
Separate weighting of SAT and test tone .....	by switchable filters
Error .....	same as basic models CMT 52 and 54 + filter effect

	Passband / ripple	Stopband / attenuation
Highpass filter (SAT measurement) .....	$f > 5$ kHz / $< 0.5$ dB	$f < 3.5$ kHz / $> 40$ dB
Lowpass filter (test tone meas.) .....	$f < 3.5$ kHz / $< 0.5$ dB	$f > 5$ kHz / $> 40$ dB

## Radiocom 2000

<b>Data deviation setting</b>	
1200 baud	
Phase deviation .....	full scale: 1.5/3/6 rad
Resolution .....	1% of fs
Error .....	same as basic models CMT 52 and 54 + resolution

<b>50 baud (voice-accompanying signalling)</b>	
Frequency deviation .....	0 to $\geq 1$ kHz
Resolution .....	$< 50$ Hz (with test deviation $< 1.5$ kHz), $< 100$ Hz (with test deviation $< 3$ kHz), $< 200$ Hz (with test deviation $< 6$ kHz)
Error .....	same as basic models CMT 52 and 54 + resolution

<b>Deviation measurement</b>	
1200 baud (without accompanying test tones) .....	see phase deviation meter of basic models CMT 52 and 54
50 baud (with or without accompanying test tones) .....	see frequency deviation meter of basic models CMT 52 and 54

## NMT 450/900

<b>Data deviation setting (1200 baud)</b>	
Frequency deviation .....	0 to 6 kHz
Resolution .....	2% of full-scale value (1.5, 3 or 6 kHz)
Error .....	same as basic models CMT 52 and 54 + 3% + resolution

<b>Supervisory tone (accompanying voice or test tone)</b>	
Frequency .....	3955 / 3985 / 4015 / 4045 Hz
Error .....	$< 0.1$ Hz
Deviation .....	0 to 1 kHz
Resolution .....	2% of full-scale value of test tone (1.5, 3 or 6 kHz)
Error .....	same as basic models CMT 52 and 54 + resolution

**Supervisory tone for test purposes** continuous adjustment of frequency and deviation ..... see AF synthesizer for basic models CMT 52 and 54

<b>Deviation measurement</b>	
1200 baud (without accompanying test tones) .....	see frequency deviation meter for basic models CMT 52 and 54
Supervisory tone (with or without accompanying test tones) .....	see frequency deviation meter for basic models CMT 52 and 54

## General data

<b>Weight</b>	
CMT 82 .....	approx. 22 kg
CMT 84 .....	approx. 24 kg
Other general data .....	same as basic models CMT 52 and 54

## Ordering information

<b>Order designation</b> .....	► Radiocommunication Tester
	0.1 to 1000 MHz
CMT 82 (without oscilloscope) .....	802.2020.82
CMT 84 (with oscilloscope) .....	802.2020.84

**Supplied accessories** ..... operating manual, power cable, service manual

<b>Options</b>	
IEC Bus/Control Interface .....	CM-B4 ..... 803.3914.02
Autorun Control/Printer Interface .....	CM-B5 ..... 803.3314.02
Adjacent-channel Power Meter .....	CM-B6 ..... 803.7810.02
2nd AF Synthesizer .....	CM-B7 ..... 803.2618.02
RF Millivoltmeter .....	CM-B8 ..... 803.6813.02
DTMF Decoder .....	CM-B11 ..... 803.4610.02
Low Rate FM .....	SCM-U1') ..... 804.1615.02
Network C software for manufacturers .....	CMT-B12') ..... 835.7915.02

<b>Recommended extras</b>	
Transfer Memory .....	CM-Z1 ..... 803.7510.02
Service Kit .....	CMT-Z2 ..... 803.9212.02
Carrying Bag .....	CMT-Z3 ..... 803.9506.02
Process Controller .....	PCA 5 ..... 375.2010.04
Process Controller .....	PUC ..... 344.8900.10
IEC-bus Cable .....	PCB ..... 292.2013.10
Universal Impact Printer .....	PUD 2 ..... 359.5018.02
Universal Ink-jet Printer .....	PUD 3 ..... 359.5501.02
Radiocode Test Set .....	SCUD03 ..... 393.7110.03
19" Adapter .....	ZZA-95 ..... 396.4911.00
Front-panel Grips SU .....	ZZG-95 ..... 396.5176.00

See the data sheet for the basic models CMT 52 and 54 for more information on accessories

1) Factory-fitted only

2) For investigating the bit level of Network C (PTT approval is necessary in some countries)



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Printed in the Federal Republic of Germany  
Subject to change - Data without tolerances: order of magnitude only  
886 (Ro so)