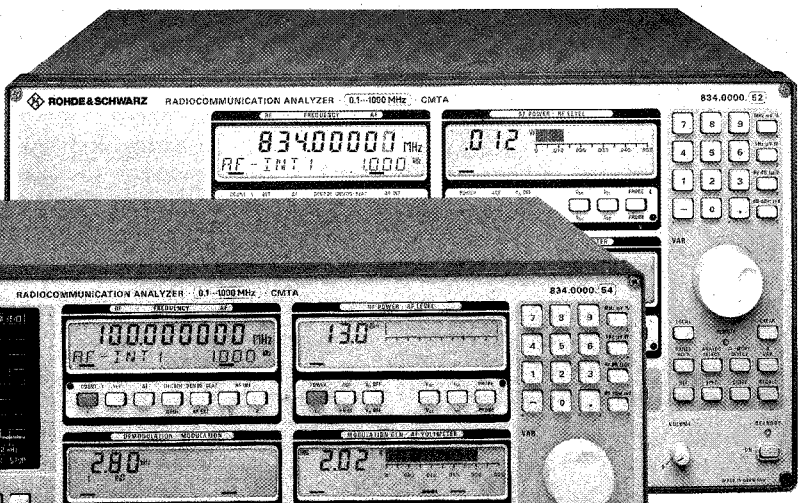
new

CMTA 52/54/84 Radiocommunication Analyzer CMTA ♦ 100 kHz to 1000 MHz

- High-tech radiocommunication tester with novel measurement capabilities
- RF spectrum monitor, AF/SSB spectrum analyzer, storage oscilloscope
- Cellular-radio simulator for Network C, Radiocom 2000, NMT 450/900, AMPS, TACS
- High measurement quality, wide dynamic range



CMTA 52

IEC625Bus

CMTA 54/84

The **Radiocommunication Analyzer CMTA** is a radio measuring system which is fitted with all the signal sources and measuring facilities required for precision measurements on transceivers using **different types of modulation** (AM, FM, φM, SSB). The CMTA features precise and complete measurements, not only in the field of analog radio measurements, but also in the field of cellular-radio testing. The required **system simulator for Network C, Radiocom 2000, NMT 450, NMT 900, AMPS and TACS is already fully integrated in the CMTA** or, depending on the model, can be retrofitted as an option. The range of applications extends from production via quality assurance through to servicing.

Since signal sources and measuring facilities in the CMTA can be used and operated almost independently of one another, they replace a multitude of expensive individual measuring instruments. The most diversified measurement tasks – not only in the field of radio measurements – can be performed easily and reliably.

The independent signal sources and measuring facilities in conjunction with the autorun control (option) or remote control (via IEC/IEEE bus) make the CMTA a **cost-effective automatic test system.** Thanks to its programmability, it features high flexibility for the great variety of RF and AF measurements. With low capital expenditure and a minimum of software, the CMTA meets practically all requirements for automated testing and can be used particularly economically for testing small or multi-product batches.

A custom-tailored CMTA model is available for each application

CMTA 52 **basic model, complete configuration, with novel measuring facilities**

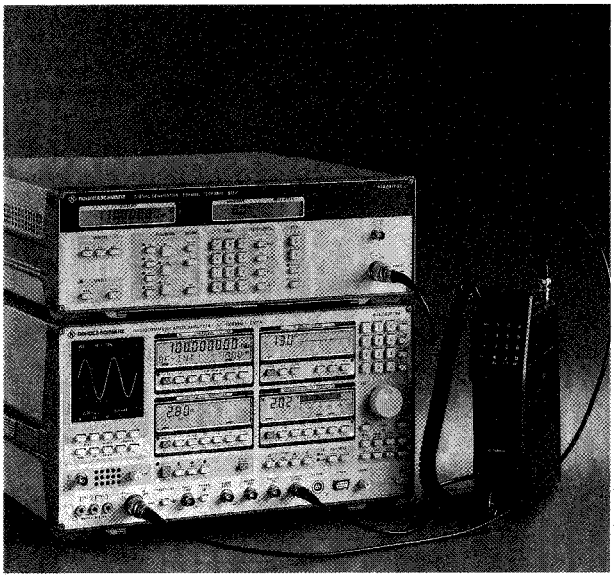
CMTA 54 **same as CMTA 52 + RF spectrum monitor, SSB spectrum analyzer, AF spectrum analyzer, storage oscilloscope**

CMTA 84 **same as CMTA 54 + cellular-radio simulator for Network C, Radiocom 2000, NMT 450, NMT 900, AMPS and TACS, including Duplex Modulation Meter CMTA-B9**

Characteristics

- Universal, top-quality radiocommunication tester
- Fully equipped with all signal sources and measuring facilities for complete testing of all types of transceivers
- Versatile, independent high-precision sources and measuring facilities for general laboratory applications
- High measurement quality thanks to large dynamic range, wide frequency ranges and fast measuring rates
- Numerous additional facilities such as programmable highpass, lowpass, bandpass and notch filter or continuously tunable distortion/SINAD meter

- RF spectrum monitor,
  AF spectrum analyzer,
  storage oscilloscope with universal trigger capabilities
- RF synthesizer featuring high spectral purity, fine frequency resolution and universal modulation capabilities, including AM-DC and FM-DC
- Cellular-radio simulator for Network C, Radiocom 2000, NMT 450, NMT 900, AMPS and TACS
- Refined operating concept
  - ergonomic manual operation
  - fully automatic test sequences provided by integrated autorun control with high memory capacity (option)
  - remote control via IEC/IEEE-bus interface
- Versatile display, output and logging facilities:
  - 5 digital displays, 3 analog displays
  - data logging or program listing on printer
  - graphics display



The high spectral purity and the universal modulation capabilities make the CMTA synthesizer ideal for all highly demanding in-channel receiver measurements. The CMTA also offers optimum conditions for receiver measurements using two signals: the CMTA synthesizer furnishes an "interfering signal" with low phase noise and excellent spurious response suppression; a useful signal (eg from a low-cost signal generator such as the SMX from R&S) can be fed in via the summing input on the rear panel

Signal sources

- RF synthesizer 0.1 to 1000 MHz, 1 Hz resulution, modulation modes: AM (-DC), FM-DC, FM-AC, φM, multiple and multi-tone modulation
- 2 modulation generators, 20 Hz to 30 kHz each
- OCXO reference oscillator
- Tone sequence generator to all standards or user-programmable
- Two-tone generator to DTMF
- Signalling generator for Network C, Radiocom 2000, NMT 450/900, AMPS and TACS with supervisory-tone generators

Measuring facilities

- RF frequency counter 0.4 to 1000 MHz
- RF frequency-offset meter
- RF power meter 5 mW to 50 W
- Adjacent-channel power meter 10 to 85 dB[1])
- Selective RF level meter[1])
- Broadband RF millivoltmeter[1])
- Modulation meter for AM, FM, φM,
  with +PK, −PK, ±PK/2, PK HOLD, RMS rectifiers
- Duplex modulation meter[1])
- AF voltmeter with RMS, +PK, −PK rectifiers
- Highpass filter, programmable (107 Hz to 10 kHz)
- Lowpass filter, programmable (234 Hz to 20 kHz)
- Bandpass filter, programmable (HP + LP)
- Notch filter, programmable (100 Hz to 5 kHz)
- CCITT filter
- SINAD/distortion meter with programmable test frequency
- S/N meter
- AF frequency counter
- DC voltmeter and DC ammeter

Analyzer/oscilloscope unit

- Rf spectrum monitor
- AF spectrum analyzer
- SSB spectrum analyzer
- Storage oscilloscope for AF, DEMOD, EXT signals
  - repetitive mode
  - single-shot mode with high memory capacity
  - various trigger facilities

Signalling facilities

- Selective-call encoder/decoder to all standards, programmable
- DTMF encoder/decoder
- Cellular-radio simulator[1]) for Network C, Radiocom 2000, NMT 450, NMT 900, AMPS and TACS, including
  - time expansion and time compression facility (Network C)
  - subaudio signalling (Radiocom 2000)
  - supervisory tone generation (phi tone, SAT)

Control and storage facilities

- Automatic test routines
- Complete device setups
- Program memory for automatic test sequences without external process controller[1])
- IEC-IEEE-bus interface
- Printer connector for data logging or program listings[1])
- Transfer memory[1]) for transferring automatic test routines
- Relay matrix

[1]) Model, option or accessory.

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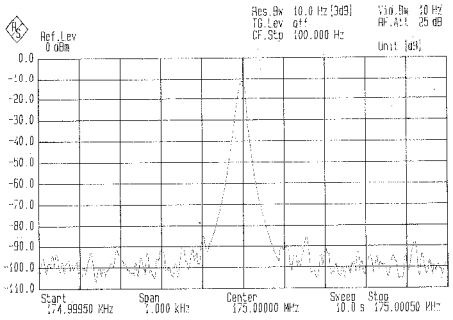
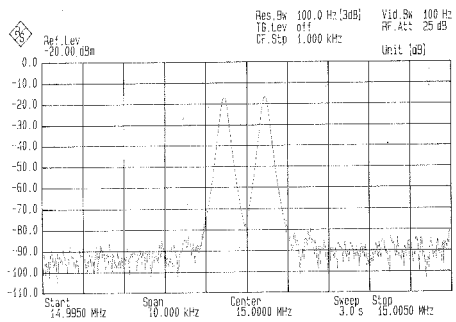
Functional units/characteristics	Performance features/use
RF synthesizer	
Frequency range 0.1 to 1000 MHz, resolution 1 Hz, V_{max} = 16 dBm	Continouos frequency range for all transceiver tests, fine resolution for narrowband DUTs
OCXO reference oscillator with little aging and high frequency accuracy	Features high frequency precision for all generators and counters in the CMTA; can also be used as an external reference frequency for other instruments
High spectral purity	Ensures low spurious FM for all in-channel measurements with high S/N ratio as well as low SSB phase noise and high broadband noise suppression for out-of-channel measurements
AM, FM and φM modulation by one or two internal modulation generators and/or by external modulation (multiple modulation, multi-tone modulation; separate adjustment)	The modulation capabilities exceed by far the bandwidths required in radiotelephone measurements (DC to 100 kHz in FM and AM) and therefore can be used for general-purpose applications, eg for testing broadband communication, navigation and broadcasting receivers
FM-DC coupled modulation up to ±100 kHz deviation	For modulating data streams with DC components and for VCO operation or narrowband sweeping
Very short frequency settling	A must for the rapid channel changes required for testing modern cellular-radio mobile phones
Wide dynamic range with extremely high level resolution	Features high levels for adjacent-channel selectivity and blocking measurements as well as precise low levels for sensitivity measurements
Level adjustment over 20 dB with no discontinuities	For determining the squelch response threshold, squelch hysteresis and AGC measurements

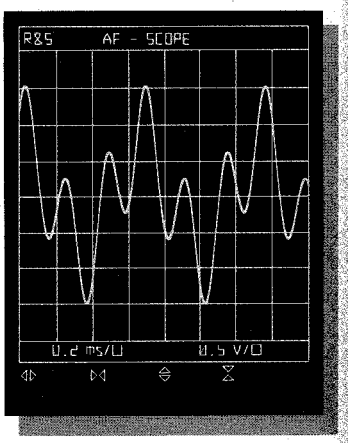


CMTA RF synthesizer spectrum; extremely high spectral purity over the entire frequency range and excellent stability make the RF synthesizer of the CMTA suitable for all – even extremely narrowband – DUTs (picture: hardcopy from R&S Spectrum Analyzer FSA)



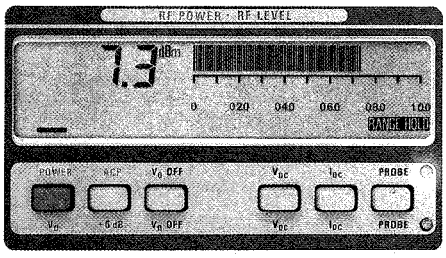
The CMTA synthesizer always supplies the right test signal; even for SSB receiver testing, the RF test signal is available in the form of a tow-tone-modulated RF signal of high spectral purity in a wide range about the receiver bandwidth (picture: hardcopy from R&S Spectrum Analyzer FSA)

AF synthesizer	
Two independent AF synthesizers as modulation sources for the built-in RF synthesizer or for the DUT	For simultaneous generation of test tone and supervisory tone or for testing SSB transmitters with double tones
Frequency range from 20 Hz to 30 kHz, crystal-accurate with high frequency resolution	Test tone can be varied over entire AF range while pilot or supervisory tones can be generated simultaneously and accurately
Dynamic level range from 10 µV to 5 V, with high resolution and excellent S/N ratio (even at low levels)	Provides high levels for driving AF modules or modulators as well as low levels for highly sensitive microphone inputs
Eight presettable fixed frequencies	eg for fast selection of fixed test frequencies
Selective-call sequence and dual-tone sequence generation (eg DTMF) with standard or progammable frequencies	For activating selective-call radiotelephones or for testing the corresponding decoder modules



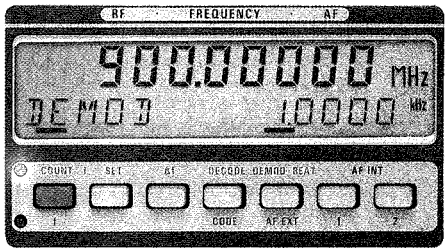
DTMF tone on CMTA screen; the two modulation generators of the CMTA are extremely versatile; they provide pilot and test tones simultaneously, or act as a DTMF tone-sequence generator as in this example

Functional units/characteristics	Performance features/use
Rf power meter	
● Broadband and wide dynamic range	Ensures precise power measurement: from low-power, cordless telephones through to high-power transmitter output stages
● Dynamic measurement range can be extended as desired by using input attenuators	



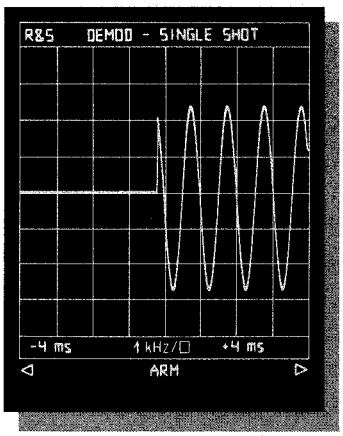
Simultaneous display of measurend power in digital and analog form; while normally the bargraph display is automatically assigned a suitable scale, depending on the measured value, by the AUTO-RANGE function, the full-scale value is held by the RANGE HOLD function for optimum adjustment

RF frequency counter	
● Frequency counter operating independently of RF synthesizer	Also for frequency measurements on relay stations whose transmit and receive frequencies are in different bands or for measurements on frequency-converting modules
● Resolution 1 Hz or 10 Hz	For fast or high-precision measurement
● Two test inputs with a total dynamic level range of 80 dB	For frequency measurements on power transmitters or no-contact frequency measurements on high-impedance signal sources (such as oscillators)



The results (here: RF frequency) including unit are indicated by large and easy-to-read digits in the illuminated display; the lower line is an alphanumeric display, eg for AF results and AF settings (here: frequency of demodulated signal) and may also be used for communication between test set and user

● **AF frequency counter**	Application examples: – Determining externally applied frequencies – even in the IF range (455 kHz) – without loading the source – frequencies demodulated by the CMTA – frequency differences, referred to the RF synthesizer frequency (frequency-offset measurement)
● Wide frequency range	A continuous frequency measurement range is obtained by frequency overlapping with the RF frequency counter
● Two operating modes: period meter and gating-time counter	For fast measurement with high resolution (0.1 Hz) as well as frequency determination of distorted signals
Demodulators	
● For AM, FM or φM	
● Automatically set to the carrier frequency to be demodulated – or presettable	Presetting of the FM deviation meter for eg deviation measurement immediately after carrier modulation or recording of frequency settling (using the CMTA storage oscilloscope)
● Measurement functions: +PK, −PK, ±PK/2, PK HOLD, RMS	For measuring all continuous and transient signals as well as for spurious modulation measurements
● Low spurious modulation	A must for determining high transmitter S/N ratios
● Wide choice of weighting filters (see also next page)	For selectively weighting the signal component of interest or for suppressing unwanted components (selection or suppression of pilot tones)



Extremely fast settling of the FM demodulator allows time-critical analyses, for instance accurate measurement of transmitter settling or, as shown here, squelch response threshold

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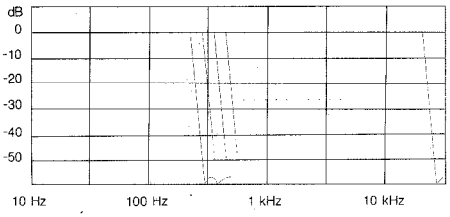
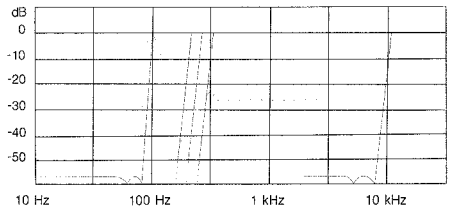
Functional units/characteristics	Performance features/use
Distortion/SINAD meter	
● User-programmable test frequencies in fine steps (100 Hz to 5 kHz)	This means coverage of all test frequencies as well as of all transceiver-specific test frequencies (plus speech-inverted modulation). Moreover, frequencies whose distortion is of particular interest, eg at 1.2 and 1.8 kHz (frequencies used for FFSK) can also be selected
● Wide choice of weighting filters	For determining measured values in deliberately specifically selected AF ranges
AF voltmeter	
● Wide dynamic level range	Therefore equally suitable for measurements on full-output AF transceiver stages as well as for S/N measurements on receivers with a low AF output voltage
● Choise of different weighting filters and time constants	High measuring rates with small time constants for adjustments as well as a large time constant for steady indication in spite of low-frequency signal components
Weighting filters	For AF and demodulation signals
● Programmable lowpass filter ● Programmable highpass filter ● Can be combined to form bandpass filter ● Programmable notch filter ● CCITT filter	The programmable filters and filter combinations ensure precise band limiting: – for reducing the noise bandwidth – for suppressing signal components that are not of interest – for signal weighting to various standards
Decoder functions	
● Single-tone decoding at standard frequencies or programmable	Allows fast checking of the coders for correct code, frequency tolerances being adhered to
● DTMF decoder	
Coder functions	see AF synthesizer (page 190)
Softkey-driven user prompting fo all signals displayed on the screen	Rational guidance in the operating menu ensures fast access to all possible settings and selection of any display modes; the spectrum or time display is the clearest way of displaying the analysis of the CMTA signals from the transceiver

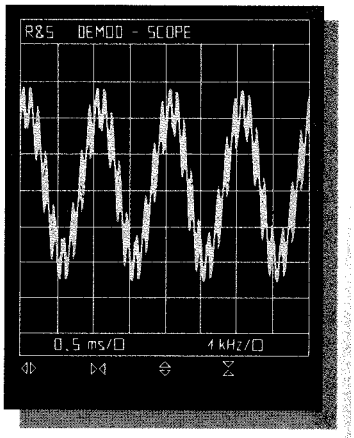


Programmable highpass filter

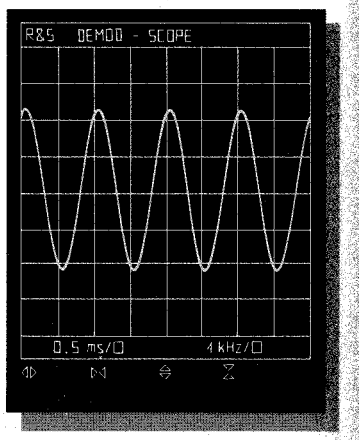


Programmable lowpass filter

Highpass and lowpass filters, each with 60 different programmable cutoff frequencies, with minimum ripple in the pass band and a high stop-band attenuation, allow practically any filter configuration for selective weighting of a test signal; they are also used for suppressing interfering signal components both in the signal demodulated by the CMTA and in the audio signal applied to the AF connector

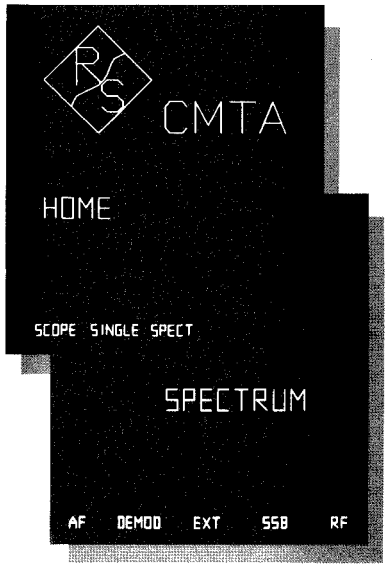


The pilot tone interferes with the distortion weighting of the test tone



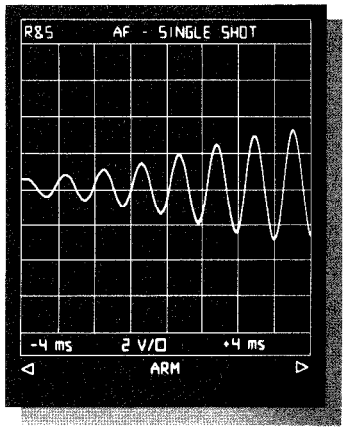
For selective distortion weighting of the test tone, the lowpass filter is adjusted so that the signal harmonics are weighted while the interfering pilot tone is suppressed; in this way, a subaudio pilot tone can also be suppressed by the programmable highpass filter

Functional units/characteristics	Performance features/use
Digital storage oscilloscope	For displaying external signals or signals derived from the CMTA, such as demodulated signals, AF, beat or distortion signals
• Wide dynamic range	For covering a wide external measurement range and for detecting all internally generated or demodulated signals over a wide dynamic range
• Frequency range: DC to 20 kHz with high sampling rate	Aliasing-free display, even signals at the upper cutoff frequency
• Repetitive mode or single shot • Various trigger modes, eg pre-trigger and trigger delay • Total storage capacity eight times greater than that of display memory	The single-shot mode is provided for investigating transmitter settling, selective-calls, data bursts or current drain for transmitter keying, for example



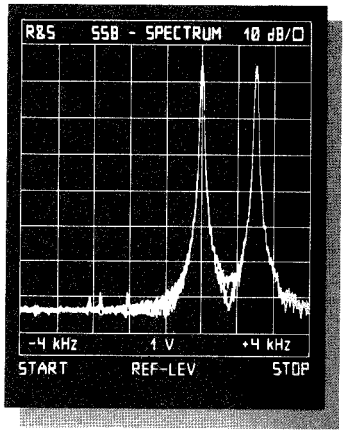
Starting from the home menu, the various display modes can be selected via further menu branches such as SPECTRUM, which in turn provides a choice of numerous signal sources

AF spectrum analyzer with synthesizer accuracy	For displaying external signals or signals derived from the CMTA, such as demodulated signals, AF or beat signals
• Wide dynamic range	Provides a wide reference-level range for external signals and covers the entire dynamic range for all internal signals
• Frequency up to 20 kHz	Wide frequency range for all AF spectra relevant to radio measurements – both before demodulation (modulation spectrum) and after demodulation (AF or demodulated signals)
• Display has large dynamic range (70 dB) • Three test-filter bandwidths • Span, start and stop frequency are user-selectable	For measuring very small spectral components, even when very close to the fundamental; also for identifying minute spurious voltages that may be found on VCO tuning voltage
• Crystal-accurate at any point on the frequency axis	Crystal-accurate frequency measurement on even weak signals, eg by displaying the spectrum of the beat signal produced by adding RF signals (received via antenna)



The storage oscilloscope's easy-to-use trigger facilities make single-shot signals visible, even under adverse conditions; the above example shows an audio signal with AGC

SSB analyzer with synthesizer accuracy	
• SSB transmitter test with test signal generation (eg AF dual tone) and display of measured signal)	For determining transmitter intermodulation, the vestigial sideband and the suppressed carrier component
• SSB receiver test with test signal generation and measured signal display	AF spectrum display with conventional SSB indication, hence: spectrum display has correct frequency sense, even if the transmitter is sending an inverted sideband
• RF narrowband analysis	Detection of smallest signal (down to µV range) with frequency determination and display of modulation spectra



The narrowband filters and the conversion oscillators of the SSB spectrum analyzer featuring an extremely high spectral purity resolve the SSB transmitter spectrum shown above even when small spectral components are close to large spectral components

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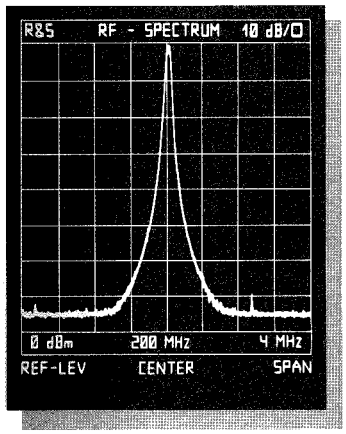
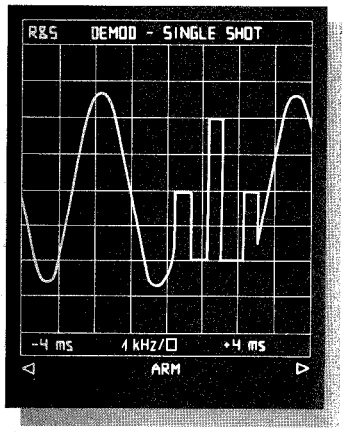
Functional units/characteristics	Performance features/use
RF spectrum monitor ● Full CMTA frequency range ● Two inputs with a total dynamic range of more than 80 dB and an additional dynamic range of 60 dB for the display ● Span from 30 kHz to 10 MHz ● Four test filters ● Each point on the frequency axis has synthesizer accuracy	In addition to the narrowband SSB analyzer, the RF spectrum monitor allows broadband applications such as determination of far-off spurious responses or radiomonitoring with the aid of an antenna at the second input of the CMTA Exact knowledge of the frequency and the frequency relationship of several spectral lines is absolutely necessary for determining the origin of spurious responses
Cellular radio simulator ● Network C ● Radiocom 2000 ● NMT 450 and NMT 900 ● AMPS ● TACS	For all major cellular radio networks tests and analyses such as: – fast signalling tests for checking system compliance – in-depth analyses of signalling data – determination of analog transceiver characteristics
DC current/DC voltage measurement ● Wide dynamic range for measurements	For checking the transceiver power supply and determining the current drain; can also be used for general applications
IEC/IEEE bus with relay matrix	Allows fully automated measurements through remote control of the tester and through DUT control by means of the relays integrated in the CMTA
RF millivoltmeter (option)	For measurements on modules and open transceivers in wide level and frequency ranges
Adjacent-channel power meter (option) ● Filters to CEPT-FTZ ● Standard and free channel spacing ● Wide dynamic range for measurements (up to 85 dB) ● Selective voltmeter	Ensures precision measurement at all frequencies thanks to the RF synthesizer and allows measurements in full-duplex mode with the duplex modulation meter under operational conditions
Duplex modulation meter (option)	If the duplex modulation meter is used for the transmitter test, the RF synthesizer is free to drive the radio receiver; there are, thus, no restrictions on fullduplex operation while adjacent-channel power measurements are being performed
Autorun control/printer interface (option) with relay matrix ● About 2000 program steps, for up to 100 programs ● User prompts on alphanumeric display ● Stops can be set for checks and adjustments ● Program transferability	Ensures reproducible test runs, including DUT control by relays for – comprehensive transceiver testing – fast go/nogo tests – combination of time-critical operating steps



The RF spectrum monitor with a dynamic range for the display of more than 70 dB, excellent image-frequency rejection and synthesizer accuracy from 1 to 1000 MHz permits all kinds of interference to be determined

Trigger, level and time parameters for complex signals (eg in Network C) are easy to select in the setting menu



The large memory depth of the digital oscilloscope makes it possible to analyse the signal precisely over a wide time range. By using a time window, one effectively extends the time axis by a factor of 8. A section of a time-compressed signal (Network C) where data have been inserted into the analog signal is shown

Models

Model CMTA 52

Basic model comprising

- OCXO reference oscillator
- Two AF generators (dual-tone generator)
- Selective-call decoder and DTMF coder/decoder
- DC-coupled frequency modulation
- Programmable weighting filters (HP, LP, BP, notch)
- Continuously tunable distortion and SINAD meter
- Interface to IEC 625-1/IEEE 488 with relay matrix
- DC voltage and current measurements

Model CMTA 54

- OCXO reference oscillator
- Two AF generators (dual-tone generator)
- Selective-call decoder and DTMF coder/decoder
- DC-coupled frequency modulation
- Programmable weighting filters (HP, LP, BP, notch)
- Continuously tunable distortion and SINAD meter
- Interface to IEC 625-1/IEEE 488 with relay matrix
- DC voltage and current measurements
- RF spectrum monitor
- AF spectrum analyzer
- SSB spectrum analyzer
- Digital storage oscilloscope

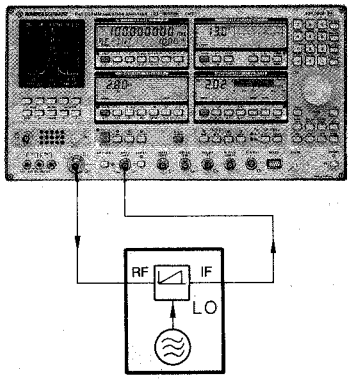
Model CMTA 84

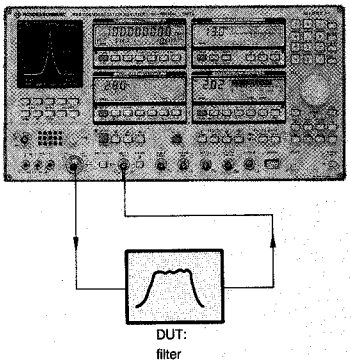
- OCXO reference oscillator
- Two AF generators (dual-tone generator)
- Selective-call decoder and DTMF coder/decoder
- DC-coupled frequency modulation
- Programmable weighting filters (HP, LP, BP, notch)
- Continuously tunable distortion and SINAD meter
- Interface to IEC 625-1/IEEE 488 with relay matrix
- DC voltage and current measurements
- RF spectrum monitor
- AF spectrum analyzer
- SSB spectrum analyer
- Digital storage oscilloscope
- Cellular-radio simulator for Network C, Radiocom 2000, NMT 450, NMT 900, AMPS, TACS
- Duplex Modulation Meter CMTA-B9

Module test

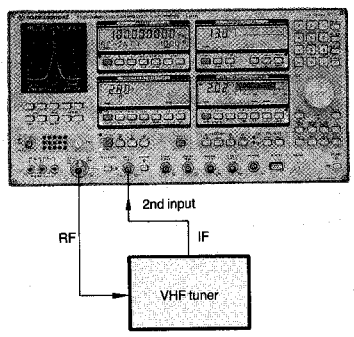
Due to the logical separation into generator and measurement section, the RF frequency counter and – if the duplex synthesizer (Duplex Modulation Meter CMTA-B9) is fitted – also the modulation meter, selective RF level meter, adjacent-channel power meter and frequency-offset meter operate fully independently of the built-in RF synthesizer. These stand-alone measuring facilities are ideal for module testing. Inside the CMTA, the RF input and the RF output and be isolated by means of a switch; this ensures that each measuring facility is completely isolated from the others and also makes the CMTA suitable for new applications, such as universal measurements on frequency-converting modules and devices, for applying stimuli to electronic circuits and simultaneously measuring even the weakest signals.

Measuring the transmission characteristics of a frequency-converting module; the selective level meter and the synthesizer operate at different frequencies; the CMTA RF counter determines the DUT oscillator frequency





Measuring the frequency response of a filter; synthesizer and selective level meter operate at the same frequency



Test setup for measuring the sensitivity of a VHF tuner; the signal source furnishes the RF frequency, level and modulation; the sensitivity is determined from the S/N ratio measured after demodulation of the tuner IF signal

CMTA

Autorun control

In addition to the automatic test routines and the IEC/IEEE bus, the Autorun Control/Printer Interface Option CMTA-B5 is available for further automation. In the learn mode, sequences for complete transceiver testing can be generated simply without an external process controller, stored in a nonvolatile memory and recalled at any time. The memory has capacity for storing 100 simple test routines or about 20 comprehensive transceiver tests.

A test sequence is defined by simply entering the test parameters or by calling up a particular measurement (as in manual mode) and then pressing the STORE key. It is also possible to enter upper and lower tolerance limits for all measurements. The control relays contained in the CMTA can be integrated into the test sequence, so that eg transceiver functions that cannot be remotely controlled (such as squelch on/off) will be performed automatically.

The insertion of **stop functions** is particularly useful. **Continuous stops and wait loops** are possible. With continuous stops, the CMTA interrupts the automatic test sequence and enables the user to carry out manual settings (eg starting selective call). Wait loops are required to allow for transceiver transients after the channel change in the fast automatic mode.

When a test routine is written, various **user prompts** can be included. These prompts are output on the alphanumeric display and request the operator to take the appropriate action (such as switching from transmitter to receiver test). They may be combined with the stop function.

A **printer** with Centronics interface can be **directly connected to the CMTA** to log the complete test sequence. The printout contains explanatory text and complete results evaluated using the tolerances which have been entered.

For **portability of test routines** to other test sets, a small, battery-buffered memory module (CM-Z1) is available as an accessory which can be plugged into the front panel.

An additional application of the autorun control is, for instance, the fast execution of **time-critical test sequences under realtime conditions** (eg the output of different tone sequences in rapid succession).

The great variety of test programs and the measurement evalution (by means of preset tolerances) is a particular advantage for a **fast go/nogo transceiver test.**

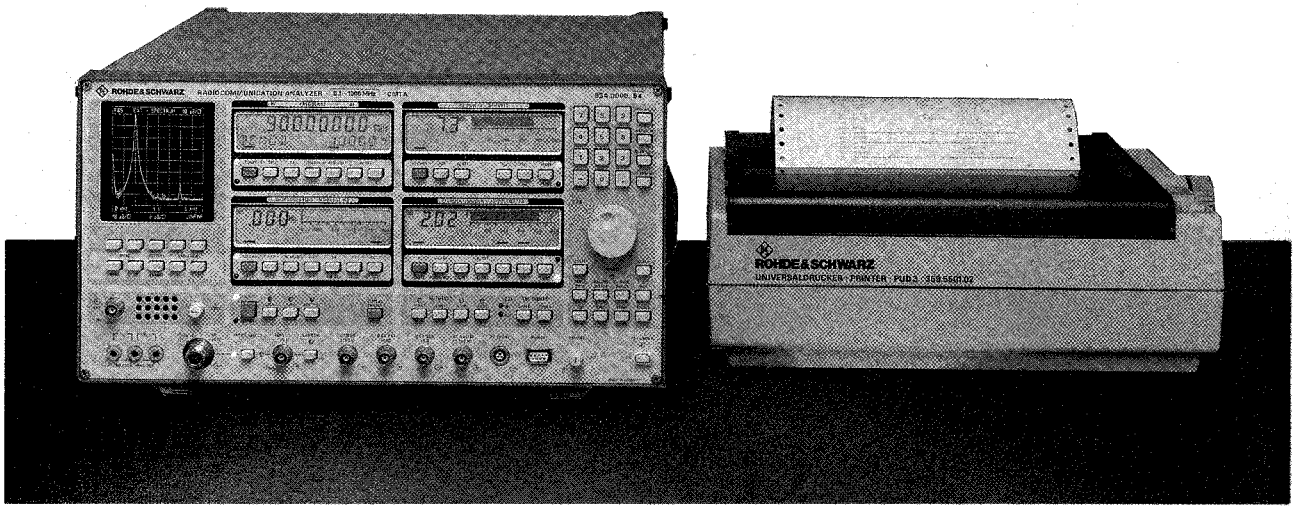
For **transceiver servicing,** the printer log provides fault information before repairs are carried out and serves as a repair document after the repair. The portability of the test routines to other test sets ensures uniform testing methods at all service centres.

The use of the autorun control as well as the highly informative printouts, which are produced by the CMTA within a very short time, greatly facilitate complete **final transceiver testing in batch production.** Since program parts, measurement routines and parameter settings can easily be modified, the use of the autorun control is not only advantageous for recuring measurement sequences, but also for program runs which are very similar.

The comprehensive module test capabilities of the CMTA in conjunction with the great variety of programs make the CMTA an automatic stand-alone module test system. It features versatility, flexibility and – compared with conventional automatic testers – also a favourable price.

The option CMTA-B5 is practically identical with option CMT-B5; details see page 173.

In addition to the IEC/IEEE bus, the Autorun Control/Printer Interface Option CMTA-B5 can also be used for automated testing; without an external controller, it allows complete transceiver tests to be generated, stored in a non-volatile memory and transferred to other testers using a transfer memory; the CMTA outputs the test logs directly on a printer



Options

RF Millivoltmeter CM-B8

The RF millivoltmeter option allows high-impedance probes to be connected to measure RF voltages in amplifiers, demodulators, mixer oscillators, etc. without affecting the circuit. Furthermore, insertion units can be connected for match-terminated output-level measurement of modules or subassemblies in development, production and servicing for troubleshooting, calibration and maintenance. A wide choice of measuring heads and insertion units is available for frequencies from 10 kHz to 1 GHz and voltages from 1 mV to 100 V.

Duplex Modulation Meter CMTA-B9

The duplex modulation meter (duplex synthesizer) option – already fitted in model 84 – can be used at a keystroke for the demodulators of the CMTA, for the adjacent-channel power meter, the selective RF level meter and for the frequency offset meter. Transmitter measurements can thus be performed independently of the basic unit synthesizer. This characteristic is a must for transceivers of modern cellular radio networks, since these can only be held in transmit mode by the presence of a receive signal. The duplex synthesizer covers the entire RF range and is therefore also suitable for transceivers and repeater stations whose transmit and receive frequencies are in different bands.

Adjacent-channel Power Meter and Selective RF level Meter CMT-B6

The adjacent-channel power meter features a wide dynamic range for measurements at all frequencies. Even in full-duplex mode under operational conditions, the measurement limit of the adjacent-channel power measurement is distinctly better than the specified limit value, while the synthesizer is offering a test or data signal to the transceiver.

The adjacent-channel power meter measures the power transmitted in the upper or lower, first or second adjacent channel (selectable) in dB (referred to the useful-channel power) or absolute. Like all measuring facilities for transmitter testing, the adjacent-channel power meter can be connected to the high-sensitivity input, which features the same dynamic range for measurements in a level range which is 40 dB more sensitive.

The hig selectivity and excellent dynamic range of the adjacent-channel power meter make it also ideal for selective measurement of the absolute level at any frequency in a wide level range.

Autorun Control/Printer Interface CMTA-B5

This option allows complete test programs to be generated, executed and stored in a non-volatile memory – including error logging on a printer – without the use of an external process controller (detailed description see paye 195).

Cellular-radio Simulator CMTA-B13

This option (which is already fitted in the CMTA 84) enables, in conjunction with the Duplex Modulation Meter CMTA-B9, measurements on mobile stations of cellular radio networks (detailed description see pages 200 and 201).

Recommended extras

RF Probe URV-Z7, RF Insertion Units URV-Z2 and URV-Z4 in conjunction with RF Millivoltmeter CM-B8 for measuring RF voltages and RF levels in the wide frequency range from 10 kHz to 1 GHz and with a large dynamic range from 1 mV to 100 V (depending on model).

Oscilloscope Probe SMFS-Z1 with selectable attenuation 1:1/10:1/ground for displaying external AC and DC signals on the storage oscilloscope or AF analyzer of the CMTA models 54 or 84.

Detector Probe SMFS-Z2 for measuring RF levels from 100 kHz to 500 MHz and displaying frequency response curves during sweep measurements on duplexers, IF filters, resonant circuits and demodulators on the storage oscilloscope of the CMTA models 54 or 84.

Front-panel Grips ZZG-95 as additional carrying handles on the left and right of the instrument, also for protecting the controls during field operation.

19" Adapter ZZA-95 for easy integration of the CMTA into 19" systems without modifying the equipment configuration (Front-panel Grips ZZG-95 are included).

Transfer Memory CM-Z1 for transferring test programs of the Autorun Control CMTA-B5 from one CMTA to another and for program filing.

Service Kit CMTA-Z2 with RF cables and extender cable for maintaining and servicing the CMTA.

Highpass Filters CM-Z11, CM-Z12 and CM-Z13 as plug-in filter unit of extremely compact design with BNC connectors for suppressing unwanted frequency bands (eg for off-air measurements) or for suppressing the transmitter signal fundamental for harmonic measurements to above 80 dB.

CM-Z11 150-MHz highpass filter for harmonic measurements on transceivers in the 4-m band
CM-Z12 300-MHz highpass filter for harmonic measurements on transceivers in the 2-m band
CM-Z13 700-MHz highpass filter for harmonic measurements on transceivers in the 70-cm band

The transmitter signal is derived from the additional 30-dB RF output (the fundamental being largely eliminated by the corresponding HP filter) and applied to the second RF input for measuring the harmonic. Since the cabling need not be changed during the complete transceiver test, fully automatic testing can also be easily implemented.

VSWR Insertion Unit CM-Z20 for measuring forward and reflected power and VSWR in the frequency range from 1 MHz to 1 GHz. It has three built-in, independent directional couplers covering the main frequency ranges 1 to 30 MHz, 30 to 200 MHz and 200 to 1000 MHz with overlapping and ensures high accuracy over a wide dynamic range. The 5-m connecting cable makes it possible to connect the meter between transmitter and antenna even at difficult-to-access points.

CMTA

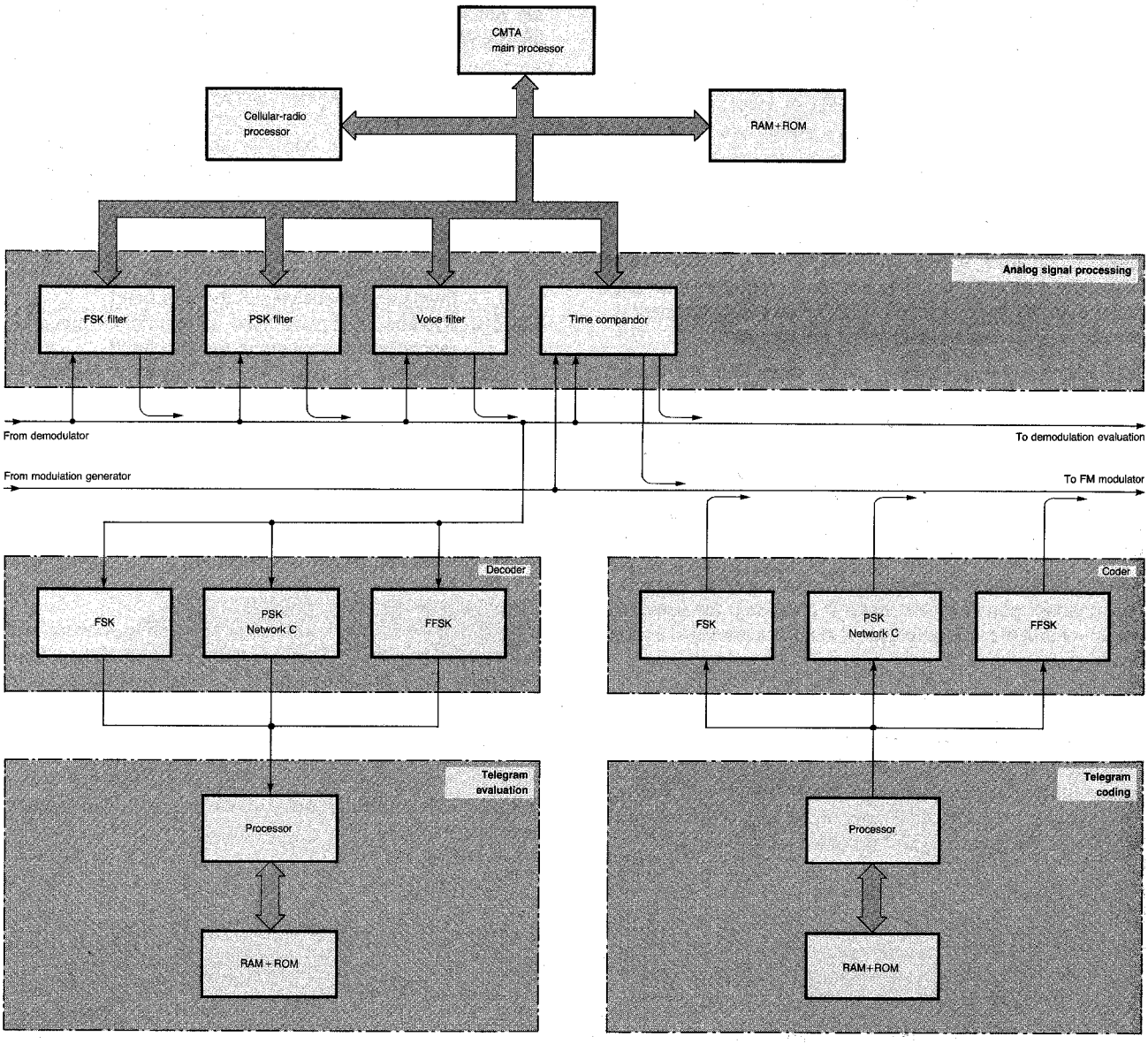
Cellular-radio Simulators

The cellular-radio simulator is already fully integrated in the CMTA 84. For the CMTA 52 and CMTA 54, the optional cellular-radio simulator (CMTA-B13) is available for cellular-radio measurements.

The CR simulator contains simulators for all major cellular radio networks. With these simulators, the network-specific call setup can be performed, the speech connection held, the channel and power changed, and also the call cleared down.

Thanks to the cellular-radio simulator, the CMTA is able to influence the signalling parameters and to analyze data telegrams in detail (down to bit level), thus providing comprehensive information on the signalling procedures between transceiver and CMTA (CMTA being the base station). If further detailed information on the signalling generated is required, the storage oscilloscope is available for diagnostic analysis and data telegram recording. The signalling test depth is extremely high. All parameters, including timing, are displayed or output on a printer.

The cellular-radio functional unit is designed as a three-processor system (coder, decoder, coordination processor); it has all functions required for the cellular radio networks, Network C, Radiocom 2000, NMT, AMPS and TACS, such as signalling data generation (coder/decoder) and analog signal processing (AF signals)



The integration of all the necessary measuring facilities in only one instrument brings advantages in all fields of application:

- no cabling required
- minimum space requirement for easy integration into automated test systems and testshop workstations
- radiotelephones of all cellular radio networks can be tested by one tester

The high intelligence of the CMTA provides

- fast, system-compatible response from the complete tester
- access to the analog test facilities at any time (even during signalling)

The following advantages result for the user:

- optimized test routines
- no operating errors thanks to menue-controlled user prompting
- no detailed system knowledge is required

Design and measurements

A three-microprocessor control unit generates, evaluates and coordinates the date streams. Different modems convert the data stream into modulated signals. A signal processing unit with filters and a time expansion/time compression facility allows a network-specific separation of test tones and data signals for the transmitter test and separate processing. The deviation of data and test tone for the receiver test can therefore be adjusted separately.

Precise analog measurements can be performed on radiotelephones of all cellular radio networks under operational conditions and without using the service mode.

Receiver tests

- AF voltage and AF frequency response
- AF distortion and SINAD or S/N
- receiver sensitivity

Transmitter tests

- power
- frequency
- data modulation
- test tone modulation and modulation frequency response
- spurious modulation
- modulation distortion or S/N
- adjacent-channel power (in full duplex mode)

The signalling capabilities of the CMTA enable detailed investigation of

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

Operation

The operating functions of the cellular-radio simulator have the same structure for all cellular radio networks. They have been designed so that a cellular-radio mobile phone can be reliably checked for system conformity and all performance data measured. No parameters whatsoever need be entered for standard routines, since they are already in the basic setting. For detailled investigations, all base or mobile station parameters may however be varied in their values and contents.

The alphanumeric display is the main means of communication for all inputs and outputs. All available routines can be simply selected using the spinwheel and started by just pressing a key, the required information being displayed in plain text. The large volume of network-specific information is cut down to the absolute minimum at the highest user level to make for convenient operation; only system-compatible test routines are offered to ensure error-free and fast operation.

As with practical system operation, it is possible to select any one of the main two modes "registered" and "call set up". The advantage here is that standard routines can be executed several times in their various versions without having to reregister. The CMTA expects completely correct telegrams from the mobile phone without using redundancy for error correction. This ensures detection of any systematic bit errors, which would restrict the error correction capability under real operating conditions.

If errors occur, the evaluation protocol is automatically called up, in which the preceding telegrams can be displayed in plain text or at bit level. Troubleshooting is facilitated by the possibility of defining an abort telegram during the evaluation. An additional error-tolerant mode detects any secondary errors and provides fast and comprehensive error diagnosis without having to eliminate the primary error.

CMTA

CELLULAR RADIO – network signalling

NMT 450/900

Main mode selection
NMT 450
NMT 900

Adaptation possible 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 (CMTA)
MTX (CMTA) → mobile phone
Call setup with error check according to guidelines including response time measurement

Signalling during traffic
Change in channel
Change in power

Signalling protocol with output of
Time scale (timing)
Telegram parameters
Telegram bits
Type of error (if any)

Call cleardown by
Mobile phone
MTX (CMTA)

Others
Store, recall und reset functions for specific data sets of mobile phone and MTX

Specifications
(extra data for NMT)

Data deviation setting (1200 baud)

Frequency deviation	0 to 6 kHz
Resolution	2% of full scale value(1.5, 3 or 6 kHz)
Error	like CMTA 52 + resolution

Supervisore tone (accompanying voice or test tone)

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	like CMTA 52 + resolution

Supervisory tone for test purposes
Continuous adjustment of frequency and deviation ... refer to AF synthesizer of CMTA 52

Deviation measurement
1200 baud (without accompanying test tones) ... refer to frequency deviation meter of CMTA 52
Supervisory tone (with or without accompanying test tones) ... refer to frequency deviation meter of CMTA 52

AMPS, TACS

Network selection
AMPS
TACS

Parameter selection
Paging/access channel
Voice channel
Power level
Busy/idle bit spezification
Other system-relevant special parameters

Autonomous registration

Call setup (origination)
Mobile phone → base station (CMTA)
Base station (CMTA) → 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
- type of error (if any)

Call cleardown by
mobile station
base station (CMTA)

Others
Store, recall and reset function for specific data sets

Specifications
(extra data for AMPS and TACS)

Data deviation setting	0 to 12 kHz	
Resolution f <5 kHz	100 Hz	
f ≥5 kHz	2%	
Error	same as CMTA 52 + resolution	
SAT (accompanying voice or test tone)	5970/6000/6030 Hz or adjustable: 5000 ≤f ≤7000 Hz	
Frequency resolution	1 Hz	
Frequency error	same as reference frequency + ½ resolution	
Deviation	0 to 6 kHz	
Resolution	<50 Hz (with deviation <6 kHz) <100 Hz (with test deviation <12 kHz)	
Error	same as CMTA 52 + resolution	
Deviation measurement		
Data deviation or SAT with test deviation	same as CMTA 52	
Separate weighting of SAT and test tone	by switchable filters	
Error	same as CMTA 52 + filter effect	
	Passband/ ripple	Stopband/ attenuation
Highpass filter (SAT meas.)	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

Network C

Radio traffic area definition
2 standard base stations with different levels and at different distances
Up to 32 base stations with programmable level, distance and signalling
or up to 16 control channel frequencies

Registration with definition of control channel and power rating
Registration by level
Registration by distance
Registration by definition (32 base station or 16 control channels)

Relocation

Call setup with definition of channel, power rating and authentification
Incoming call setup without queue
Incoming call setup with queue
Outgoing call setup without queue
Outgoing call setup with queue
Outgoing call setup with neighbouring base station assistance

Power control
Power increase/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 (see specifications)

Checking error-correction facility
Bit error implantation

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

Others
Transmission of clock pulses for charge meter
Setting of any charge count
Direction of speech scrambling

Specifications
(extra data for Network C)

Simulation of base station	up to 32 base stations with programmable level and phase (distance)
Data clock	
Error	same as for reference frequency
Dynamic phase range	0 to 50 µs
Resolution	0.8 µs
RF level	
Dynamic level range	0 to 40 dB (0 dB fine level setting)
Resolution	0.1 dB
Error (up to 20 dB attenuation)	0.1 dB per dB or attenuation

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

Frequency deviation of data	0 to 6 kHz
Resolution	100 Hz
Error	same as CMTA 52 + resolution
and independently adjustable	
Test modulation (fs values)	250 Hz/1.5 kHz/3 kHz/6 kHz
Resolution	same as for CMTA 52
Error (f_{AF} <4 kHz)	same as for CMTA 52 + 1% of fs

Measurement of test frequenyc deviation in burst signalling mode with deviation weighted after expansion

Deviation measurement ranges (fs values)	250 Hz/1.5 kHz/3 kHz/6 kHz
Resolution	same as for CMTA 52
Frequency range	20 Hz to 6 kHz (−3 dB)
Error (f_{AF} <4 kHz)	same as CMTA 52 + 1% of fs
Distortion (f_{AF} = 1 kHz)	<1% ($\Delta f > \frac{1}{2}$ fs)

Measurement of test frequency deviation

without data frequency deviation (service mode of mobile station)	same as for CMTA 52

Measurement of data frequency deviation

in burst and concentrated signalling mode (without test frequency deviation)	same as for CMTA 52

Radiocom 2000

Mode selection
Private
Public
Combined (private/public)

Automatic registration
Number of mobile phone
Home base station of mobile phone

Mobile phone and network parameters
Number of mobile phone
Number of home base station
Number of traffic channel

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

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

Call cleardown by
mobile station
base station (CMT)

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

Specifications
(extra data for Radiocom 2000)

Data deviation setting

1200 baud	
Phase deviation	full scale: 1.5/3/6 rad
Resolution	1% of fs
Error	same as CMTA 52 + resolution
50 baud (speech-accompanying signalling)	
Frequency deviation	0 to 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 CMTA 52 + resolution

Deviation measurement

1200 baud (without accompanying test tones)	see phase deviation meter of CMTA 52
50 baud (with or without accompanying test tones)	see frequency deviation meter of CMTA 52

CMTA

Specifications

Reference ..... OCXO reference oscillator
Aging ..... $<2 \times 10^{-9}$/day
(after 30 days operation)
typ. $<2 \times 10^{-7}$/year
Temperature effect ..... $<2 \times 10^{-9}$/°C
Warmup time ..... none, because of standby-mode heating; otherwise <15 min

Combined input/output connector
Input
Frequency ..... 10 MHz ±50 Hz
Level ..... >100 mV_{rms} into 50 Ω
Output
Frequency ..... 10 MHz
Level ..... TTL (Z_{out} approx. 50 Ω)
Extra output connector ..... 10 MHz, 0 dBm

Receiver measurements

Signal generator

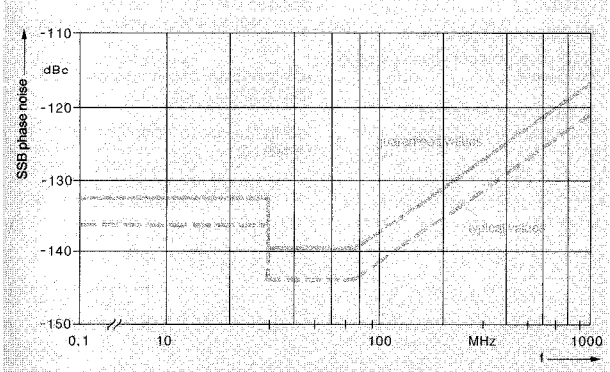
Frequency
Range ..... 100 kHz to 1000 MHz
Resolution ..... 1 Hz
Frequency error ..... <½ resolution + reference error
Level CW, FM, φM ..... −137 to +13 dBm
(0.032 µV to 1 V into 50 Ω)
AM ..... −137 to +7 dBm
Overrange
without specification ..... adjustable to +16 dBm
Resolution ..... 0.1 dB
Level error (P ≥−127 dBm) ..... <±1.5 dB[1])
Fine level adjustment ..... 0 to −19.9 dB, non-interrupting
Spectral purity
Spurious signals
Harmonics ..... <−30 dBc
Residual AM (rms)
at 0.03 to 20 kHz ..... <0.02%

Frequency	0.1 to 31.25	31.25 to 62.50	62.5 to 125	125 to 250	250 to 500	500 to 1000	MHz
Nonharmonic signals more than >5 kHz from the carrier ...	<−70	<−80	<−80	<−80	<−76	<−70	dBc
Residual FM 0.03 to 3 kHz (CCITT)	<2	<1	<1	<1	<2	<3	Hz
0.03 to 20 kHz	<6	<4	<4	<4	<6	<12	Hz
Wideband noise for CW (>2 MHz from carrier, 1 Hz bandwidth)[1])	−140	−145	−145	−145	−145	−145	dBc

Modulation modes
Internal/external, AC or DC ..... AM, FM, φM
Multiple modulation ..... AM int. with FM/φM ext.
FM/φM int. with AM ext.
Multitone modulation ..... 2 × int.
int. with ext.
2 × int. with ext.

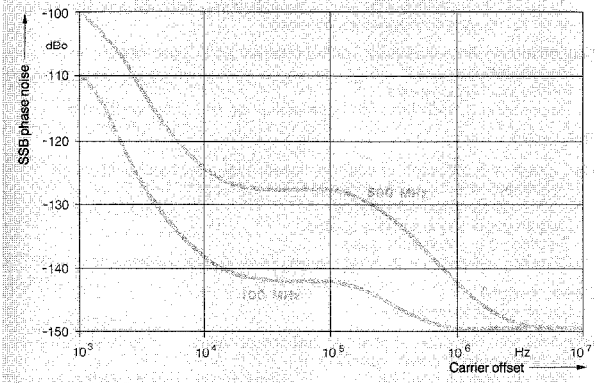
Amplitude modulation

Modulation depth ..... 0 to 99%
Resolution 0.5%
Modulation frequency ..... DC to 50 kHz



Single-sideband phase noise 20 kHz from carrier, 1 Hz bandwidth

Modulation distortion[1])
f_{mod} ≤10 kHz ..... <1% for 30% AM,
<1.5% for 80% AM
Error (m <0.8, no EXT CAL,
AF <30 kHz)[1]) ..... <5% of setting + spur. AM



Single-sideband phase noise at 100 and 500 MHz, 1 Hz bandwidth

Frequency modulation

Frequency	0.1 to 31.25	31.25 to 62.50	62.5 to 125	125 to 250	250 to 500	500 to 1000	MHz
Max. deviation	200	50	100	200	400	800	kHz

Resolution at Δf <1 kHz ..... 10 Hz
at Δf ≥1 kHz ..... ≤1%
Modulation frequency range
FM AC ..... 10 Hz to 100 kHz
FM DC ..... DC to 100 kHz
Modulation distortion
(f_{mod} <10 kHz, ½ max. deviation) ... <1% (via MOD EXT, typ. 0.1%)
Error (without EXT CAL,
20 Hz to 100 kHz) ..... <5% of setting + residual FM
Frequency error for FM DC
Carrier frequency offset when
FM DC is switched on
f_c >31.25 MHz ..... <1% of deviation + $1 \times 10^{-6} f_c$
f_c ≤31.25 MHz ..... <1% of deviation + 200 Hz

Phase modulation

Phase deviation ..... 0 to 5 to 80 rad
(see FM modulation)
Modulation frequency ..... 300 Hz to 6 kHz
Resolution Δφ <0.1 rad ..... 1 mrad
Δφ ≥0.1 rad ..... ≤1%
Error ..... same as FM + 2% frequency response

AF voltmeter

Weighting ..... rms, peak +, peak −
Frequency ..... 50 Hz to 20 kHz
Weighting filter ..... see transmitter and receiver measurements
Measurement range ..... 35 V
Resolution V <10 mV ..... 100 µV
V ≥10 mV 1%
Error[2]) ..... <±3% of reading + resolution
Input impedance ..... ≥100 kΩ

AF frequency counter

Frequency range ..... 20 Hz to 500 kHz
Input voltage <30 kHz ..... 3 mV to 30 V
≥30 kHz ..... 30 mV to 30 V
Resolution ..... 0.1 Hz, 1 Hz, selectable
Error ..... see time base + resolution

The S/N meter determines the S/N ratio for the AF voltmeter input signal by switching the modulation on and off
Dynamic range ..... see AF voltmeter
Resolution ..... 0.1 dB
Error ..... <0.5 dB + error due to residual AM/FM of the RF synthesizer

Transmitter measurements

Power meter

Frequency ..... 1.5 to 1000 MHz
Range ..... 5 mW to 50 W (75 W usable max)
Error (0% AM)
P >20 dBm ..... 0.4 dB + resolution
7 dBm <P <20 dBm ..... 0.5 dB typ.
Resolution
Display in dBm ..... 0.1 dBm
Display in watts P <10 mW ..... 0.1 mW
P ≥10 mW 1%

Footnotes on page 205.

Connector ..... N
Impedance ..... 50 Ω
VSWR ..... ≤1.3

Time limiting Ambient temperature	25 °C	50 °C
50 W	none	5 min on 5 min off
75 W	2 min on 5 min off	1 min on 5 min off

RF frequency counter

Frequency ..... 1 MHz to 1 GHz
(can be used from 400 kHz)

Input level
RF input/output ..... 5 mW to 50 W
2nd input ..... 5 to 500 mV
Resolution ..... 10 Hz, 1 Hz, selectable
Error ..... see time base + resolution,
±2 Hz at f >100 MHz

Modulation meter

(Specification for duplex off mode)
Operating modes ..... AM, FM, φM,
+PK, −PK, ±PK/2, PK Hold,
MAX PK or RMS

Frequency deviation meter

Frequency ..... 4 to 1000 MHz
Deviation range ..... 100 kHz
Peak weighting or
RMS weighting or
automatic switchover at ..... deviation of 100 Hz
Demodulation frequency
Display ..... 20 Hz to 20 kHz
Resolution Δf <1 kHz ..... 1 Hz
Δf ≥1 kHz ..... 1% of reading
Output for demod. signal ..... DC to 20 kHz
Residual FM[3]) f_c <500 MHz ..... 3 Hz to CCITT
f_c ≥500 MHz ..... 5 Hz to CCITT
Error[2]) ..... 3% + error due to residual FM + resolution

Input level for specified
test error ..... P >20 mW, V >10 mV
Weighting filters ..... 750 µs deemphasis,
see transmitter and receiver measurements for more weighting filters

Usable input level	IF wide	IF wide + CCITT filter	IF narrow[4])	IF narrow[4]) + CCITT filter
RF input/ output	20 µW to 50 W	0.5 µW to 50 W	0.5 µW to 50 W	5 nW to 50 W
2nd input	300 µV to 1 V	50 µV to 1 V	50 µV to 1 V	5 µV to 1 V

Phase deviation meter

Phase deviation ..... 25 rad
Peak weighting or
RMS weighting or
automatic switchover at ..... 0.1 rad
Demodulation frequency ..... 300 Hz to 10 kHz
Resolution <0.1 rad ..... 0.001 rad
≥0.1 rad 1%
Error ..... see FM deviation meter
+ 2% frequency response
Weighting filters, switchable ..... see transmitter and receiver measurements

AM meter

Frequency ..... 1.5 MHz to 1000 MHz
Range 99%
Resolution m <10% ..... 0.01% AM
m ≥10% ..... 0.1% AM
Demodulation frequency ..... 50 Hz to 20 kHz
Residual AM[5]) ..... <0.03% to CCITT
Error (m <0.8)[2])[6]) ..... <5% of reading + residual AM
Input level for specified
error ..... P >5 mW, V >5 mV
Weighting filters ..... see transmitter and receiver measurements

Usable input level	IF wide	IF wide + CCITT filter	IF narrow[4])	IF narrow[4]) + CCITT filter
RF input/ output	2 µW to 50 W	50 nW to 50 W	50 nW to 50 W	5 nW to 50 W
2nd input	100 µV to 50 mV	15 µV to 50 mV	15 µV to 50 mV	5 µV to 50 mV

300-Hz highpass filter (can be switched into demodulation path)

Error in passband ..... <0.5 dB (300 Hz to 20 kHz)
Attenuation at 240 Hz ..... >20 dB
Attenuation at 190 Hz ..... >40 dB

Transmitter and receiver measurements

CCITT filter ..... to CCITT specifications

Programmable notch filter

Progr. notch frequencies ..... 100 Hz ≤f_{notch} ≤5 kHz
Weighting bandwidth
100 Hz ≤f_{notch} <500 Hz ..... 4 kHz
500 Hz ≤f_{notch} ≤5 kHz ..... 20 kHz
Error in passband ..... ≤0.5 dB
Maximum attenuation
(for input voltages >100 mV) ..... ≥60 dB
Relative notch bandwidth (60 dB) ... ±1%
Relative notch bandwidth (50 dB) ... ±2%
Relative centre frequency spacing
100 Hz to 500 Hz ..... <0.3%
500 Hz to 1 kHz ..... <0.6%
1 kHz to 2 kHz ..... <1.2%
2 kHz to 5 kHz ..... <3%

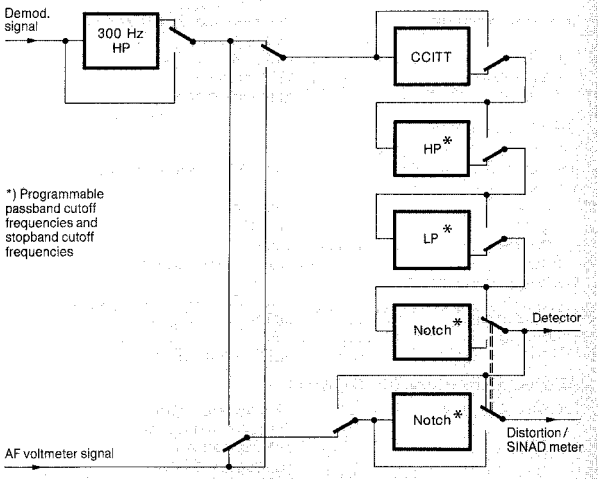
Programmable highpass filter

Progr. passband cutoff
frequencies (0.5 dB) ..... 107 Hz to 10.6 kHz, in 60 steps
Upper cutoff frequency ..... 21 kHz or
approx. 10 times the passband cutoff frequency
Error in passband ..... ≤0.5 dB
Maximum attenuation
(for input voltages >100 mV) ..... ≥50 dB
Stopband cutoff frequency/
passband cutoff frequency 0.75
Intrinsic distortion ..... <0.3%
Passband cutoff frequency spacing approx. 100 Hz up to 3 kHz

Programmable lowpass filter

Progr. passband cutoff
frequencies (0.5 dB) ..... 235 Hz to 21 kHz, in 60 steps
Error in passband ..... ≤0.5 dB
Maximum attenuation
(for input voltages >100 mV) ..... ≥50 dB
Stopband cutoff frequency/
passband cutoff frequency 1.33
Inherent distortion ..... <0.3%
Passband cutoff frequency spacing approx. 100 Hz up to 4 kHz

Programmable bandpass filter ... combination of high and lowpasses



Possible weighting filter configurations

Distortion measurements on the AF or demodulated signals, weighted or unweighted (see filter configuration)

Test frequency ..... 100 Hz to 5 kHz
Range ..... to 50%
Resolution 0.1%
Minimum input voltage ..... 30 mV
Intrinsic distortion ..... ≤0.3%
Error ..... <5% of reading + intrinsic distortion

SINAD measurements on AF or demodulated signals, weighted or unweighted (see filter configurations)

Test frequency ..... 1 kHz or 100 Hz to 5 kHz
Range ..... to 50 dB
Resolution ..... 0.1 dB
Minimum input voltage ..... 30 mV
Test limits due to
stopband filter attenuation ..... >50 dB
inherent noise ..... <0.1 mV
Error ..... <0.5 dB + effect of test limit

CMTA – Specifications (continued)

Modulation generators

Operating modes	single-tone modulation, dual-tone modulation with separately adjustable parameters, dual tone having the same level at the modulation generator output
Frequency	20 Hz to 25 kHz (can be used to 30 kHz)
Frequency resolution	
f <1/3/6/10/20 kHz	0.1/0.2/1/2.5/10 Hz
f ≥20 kHz	20 Hz
Frequency error	<½ resolution
Fixed frequencies	8, presettable
Output voltage	10 µV to 5 V
Resolution V_0 <1 mV	10 µV
V_0 ≥1 mV	1%
Error (V_0 >1 mV)	<3%
Output impedance	<3 Ω
Max. output current	20 mA
Distortion f <10 kHz	<0.5%
f ≥10 kHz	<1%

Selective call encoder/decoder

Standard tone sequences	ZVEI1/ZVEI2/CCIR/EIA/EEA/EURO/VDEW/CCITT, NATEL and customer-specific sequences, preselectable
Digits	0 to 9, A to F
Call length	1 to 25 tones
Automatik repeat	selectable
Encoder	
Frequency offset	can be set to ±10%
Tone duration	to standard or preselectable
Duration 1st tone	adjustable
Pause duration	adjustable
Decoder	tolerances to standard or programmable with out-of-tolerance display

DTMF decoder

Standard	DTMF
Display	tones 0 to 9, A to D, *, #
Call length	25 digits
Minimum S/N ratio of signal to be decoded	3 dB, typ.

Dual-tone encoder to DTMF and customer-specific sequences

Digits	0 to 9, A to D, *, #
Call length	25 dual tones
Tone/pause duration	to standard or programmable

DC measurements

Range (including test range and common mode drive)	|V| ≤30 V, referred to chassis ground
Voltage measurement	
Range	0 to ±30 V
Input impedance	10 MΩ
Test limit	1 mV
Error	<3% + test resolution
Current measurements	
Ranges	0 to ±10 A, for a short time 15 A
Impedance	50 mΩ
Limit	1 mA
Error	<3% + resolution

AF spectrum analyzer (CMTA 54/84)

Displayable signals	AF voltmeter input demodulated signals, beat signals external signals (Z_{in} approx. 1 MΩ)
Frequency	to 20 kHz (crystal accurate)
Level (reference level)	
AF	1.6 mV to 35 V (rms)
Demodulated FM	50 Hz to 100 kHz (peak)
Demodulated AM	0.1 to 100% (peak)
Demodulated φM	0.1 to 25 rad (peak)
External signals	5 mV to 14 V (rms)
Dynamic range (for ext. signals >10 mV)	66 dB, referred to the reference level plus 6 dB overdrive reserve
Scale	log. 10 dB/div, log, 2 dB/div or linear
Level error (f >50 Hz)	±2 dB to 60 dB below reference level

Automatic test filter selection as a function of span

3 test filters	Bandwith at 3 dB	Bandwith at 60 dB
	16 Hz	160 Hz
	40 Hz	400 Hz
	100 Hz	1000 Hz

SSB spectrum analyzer (CMTA 54/84)

SSB receiver test	AF analysis via AF input
SSB transmitter test	AF analysis after internal RF-IF conversion
RF frequency	400 kHz to 1000 MHz
Level (reference level	−24 to +47 dBm (RF input/output) −64 to +17 dBm (2nd input)
Span	0 to 16 kHz (±8 kHz)
Dynamic range	typ. 66 dB
Level error	typ. 3 dB

RF spectrum monitor (CMTA 54/84)

Frequency	400 kHz to 1000 MHz
Level (reference level)	−24 to +47 dBm (RF input/output), −64 to +17 dBm (2nd input)
Dynamic range for input level >13 dBm (RF input/output) or >−27 dBm (2nd input)	>60 dB (for the frequencies >0.5 × f_c or <2 × f_c), referred to the reference level
Scale	log. 10 dB/div, log, 2 dB/div or linear
Level error	<3 dB

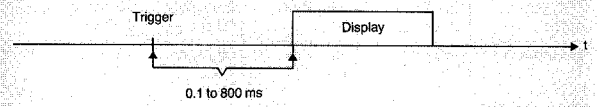
Automatic test filter selection as a function of span

4 test filters	Bandwidth at 3 dB	Bandwidth at 60 dB
	2.5 kHz	35 kHz
	8 kHz	120 kHz
	25 kHz	350 kHz
	80 kHz	1200 kHz

Oscilloscope (CMTA 54/84) digital storage oscilloscope

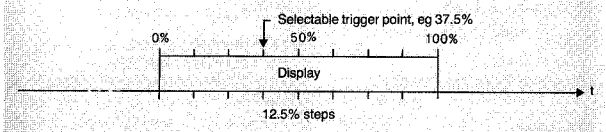
Displayable signals	external signal (Z_{in} approx. 1 MΩ, AC/DC coupling) AF, demodulated signals (AM, FM, φM), beats (AC coupling)
Amplitude (1/2/5 steps)	
External	2 mV/div to 5 V/div
AF voltmeter	1 mV/div to 20 V/div
Demod AM	0.1%/div to 40%/div
Demod FM	20 Hz/div to 40 kHz/div
Demod φM	0.01 rad/div to 10 rad/div
Time base	crystal accurate
Divisions	1/2/5 from 0.05 ms/div to 50 ms/div
Bandwidth	DC to 20 kHz (usable to 100 kHz)
Trigger	
Trigger slope	+ or −
Trigger level	full screen height, in 160 steps

Trigger delay



Main operating modes	scope or single-shot
Scope mode	repeat mode with automatic free-running

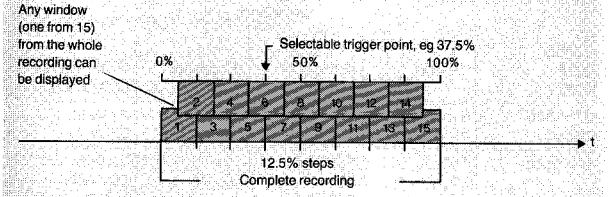
Pre-trigger



Single-shot mode

Recording time	3.2 to 3200 ms
Screen display	⅛ the recording (15 overlapping ranges)
Trigger source, generally	signal itself
Specially for AF and demodulated signals	signal or "EXT" connector

Pre-trigger



IEC bus/control interface

Interface	IEC 625-1 (IEEE 488)
Control interface	8 relays
Contact loading	V <28 V, I <0.25 A, P <3 VA

Options

Autorun Control/Printer Interface CMTA-B5

Memory	about 100 simple test programs or about 20 complex test routines (battery backup)
DUT control	3 relays
Contact loading	V <28 V, I <0.25 A, P <3 VA
Printer connector	Centronics parallel interface

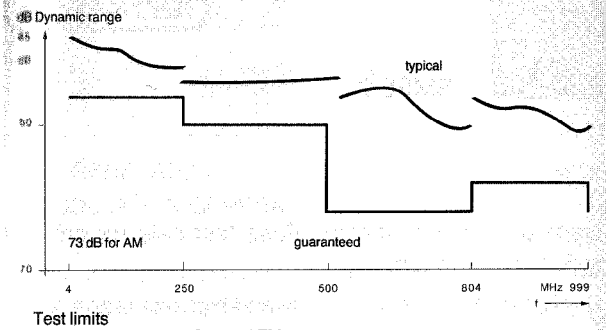
RF Millivoltmeter CM-B8[7])

Frequency	10 kHz to 1000 MHz (depends on probe)
Range	1 mV to 10 V/10 mV to 100 V (depends on probe)
Display	in mV, V, W, dBm or dBµV
Resolution for V >100 mV	1% or 0.1 dBm
Error	basic error + frequency response error
Basic error (V >10 mV)	
+20 to +25° C	<5%
+15 to +30° C	<6%
+5 to +40° C	<8%
Frequency response error	depends on probe
Probes	see recommended extras

Adjacent-channel Power Meter CMT-B6

Frequency	4 to 1000 MHz
Channel spacing	10/12.5/20/25 kHz
Dynamik range	10 to 85 dB

Test limits
(P >20 mW; CW and FM, display in dB)



Test limits (5 mW <P <20 mW; CW and FM display in W)	<0.5 nW
Error (display in dB)	to CEPT/FTZ filter specifications
(display in W)	same as display in dB + power meter error

Test limits for full duplex mode (P >20 mW) in conjunction with the Duplex Modulation Meter CMTA-B9

f <200 MHz and 70-cm band	>78 dB, typ. 82 dB (for AM >73 dB)
900-MHz-band	>76 dB, typ. 79 dB (for AM >73 dB)

Selektive level measurements

Models 84, 54, 52	selective level measurements using RF amplifier with AGC (relative measurements)
Models 84, 54	selective level measurements using attenuators (absolute level measurements)

Duplex Modulation Meter CMTA-B9

Stand-alone modulation meter independent of the basic unit for AM, FM and φM; for measurements on relay stations and full-duplex radio equipment
Data that differs from that of the basic unit:

Frequency deviation meter	
Residual modulation	f_c <500 MHz <6 Hz to CCITT f_c ≥500 MHz <12 Hz to CCITT

CR Simulator CMTA-B13 or

Model 84	simulation the base Network C, Radiocom 2000, NMT 450/900, AMPS and TACS (see from page 180)

General data

Operating temperature	0 to +50° C
Storage temperature	−40 to +70° C
Shock/vibration testing	shock-tested to DIN 40046, part 7 (30 g, 11 ms); vibration-tested to DIN 40046, part 8 (11 to 55 Hz, 2 g); corresponds to IEC publications 68-2-27 and 68-2-6
EMC/RFI	to VDE 0871/0875 and Bundespost regulation 1046/84
Power supply	88 to 132 V/194 to 264 V, 47 to 420 Hz, 200 VA, safety class 1
Dimensions (W×H×D)	420 mm×220 mm×460 mm
Weight	approx 26 kg (depends on model)

Accessories and extras

for RF Millivoltmeter CM-B8	
RF Probe URV-Z7 10-V Insertion Unit URV-Z2 100-V Insertion Unit URV-Z4	see URV3, pagee 439
for oscilloscope	
Oscilloscope Probe SMFS-Z1	
Division ratio/bandwidth	10:1/approx 100 MHz 1:1/approx. 10 MHz ground
Maximum voltage	400 V
C compensation	to 60 pF
Connector	BNC
Detector Probe SMFS-Z2	
Frequency range	100 kHz to 500 MHz
Input capacitance	approx. 4 pF
Maximum voltage	50 V
Polarity	positive
Connector	BNC
For Autorun Control/ Printer Interface CMA-B5	
Transfer Memory CM-Z1	handy semiconductor memory module for storing test routines so that they can be run on different test setups
Service Kit CMTA-Z2	extender/adapter cable set

Ordering information

Order designation	▶ Radiocommunication Analyzer
CMTA 52	834.0000.52
CMTA 54 with spectrum analyzer, and storage oscilloscope	834.0000.54
CMTA 84 with spectrum analyzer, storage oscilloscope and CR simulator[8])	834.0000.84
Supplied accessories	power cable

Options

Autorun Control/Printer Interface	CMTA-B5	835.3661.02
Adjacent-channel Power Meter	CMT-B6	803.7810.02
RF Millivoltmeter	CM-B8	803.6813.02
Duplex-Synthesizer/ Modulation Meter[9])	CMTA-B9	835.3510.02
Cellular-Radio-Simulator[9])[10]) for Network C[9]), Radiocom 2000, NMT 450, NMT 900, AMPS, TACS	CMTA-B13	835.3810.02
Network C software for manufactures[8])	CMT-B12	835.7915.02

Recommended extras

Transfer Memory	CM-Z1	803.7510.02
Printer Cable	CM-Z5	835.6919.02
Highpass Filter 150 MHz	CM-Z11	835.5012.02
Highpass Filter 300 MHz	CM-Z12	835.5064.02
Highpass Filter 700 MHz	CM-Z13	835.5112.02
VSWR Insertion Unit	CM-Z20	1002.3003.52
Service Kit	CMTA-Z2	835.6819.02
Process Controller	PCA5	375.2010.04
Process Controller	PUC	344.8900.10
IEC-bus Cable	PCK	292.2013.10
Universal Impact Printer	PUD2	359.5018.02
Universal Ink-jet Printer	PUD3	359.5501.02
Radiocode Test Set	SCUD03	393.7110.03
Oszilloskope Probe	SMFS-Z1	358.0312.02
Detector Probe	SMFS-Z2	358.0412.02
Demodulator Probe	SWOB3-Z	241.2116.00
BNC Adapter	URV-Z	241.1110.02
Termination (50 Ω)	RMF	100.2927.50
19″ Adapter	ZZA-95	396.4911.00
Front-panel Grips 5U	ZZG-95	396.5176.00

Recommended extras for RF Millivoltmeter CM-B8

RF Probe	URV-Z7	292.5312.02
10-V Insertion Unit 50 Ω/N connector	URV-Z2	288.8010.55
100-V Insertion Unit 50 Ω/N connector	URV-Z4	283.7716.55

For more accessories see URV3
For terminations and attenuator pads, see section 13

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1) For fine level variations to 0 dB.
2) Without weighting filter.
3) P >20 mW, V >10 V.
4) IF narrow: bandwith approx. 25 kHz.
5) P >5 mW, V >5 mV.
6) For f <4 MHz with P >15 W or V >30 mV; typ. error.
7) No Probe; see recommended extras.
8) For examining the Network C bit level, only with CMT-B12 (in some countries, the permission of the PTT is required).
9) Fitted as standard in CMTA 84.
10) CMTA-B9 is also required.