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# Digital Radiocommunication Tester CMD 59

## For production, installation and service of PCS base stations

Rohde & Schwarz has an extensive know-how in the field of digital radio measurements. This know-how is fully utilized in the design concept of CMD 59.

Digital Radiocommunication Tester CMD 59 is an advanced top-class instrument for measurements on base stations (BTS) and BTS modules.

It is designed for measurements in line with the PCS1900 standard.

The solution:

CMD

The main applications are:

- Module testing in production
- Final testing with $A_{bis}$ control
- Installation with $A_{bis}$ control
- Service with test mobile functionality

CMD is the first compact radiocommunication tester worldwide allowing measurements on transmitters and receivers of base stations without affecting telephone calls in progress.

ROHDE&SCHWARZ

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# CMD 59 –
# the talent for many applications

## Introduction

With the Digital Radiocommunication Tester CMD 59 Rohde&Schwarz is setting another milestone in PCS1900 radio measurements. This tester combines compact size with high measurement accuracy and speed. It is suitable both for stationary and mobile use and features great ease of operation and high reliability.

Operation is extremely easy and requires no detailed PCS knowledge. The high-contrast LCD display with softkeys on both sides allows menu-guided convenient callup of test routines.

## ...in BTS final test/installation

- BTS measurements by means of signalling
- Call setup for signalling test
- Audio check
- Control of complete BTS system via $A_{bis}$ interface
- Automatic test run
- Generation of user-specific $A_{bis}$ control applications
- Simple modification in case of BTS software updates

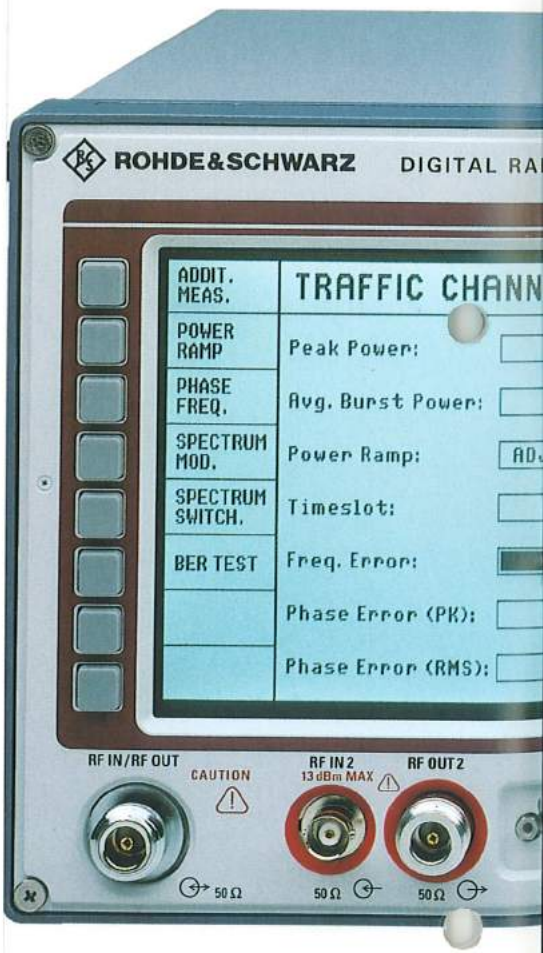
*Details: see*

**CMD – basic model**
**The talent for use in BTS production**

**CMD – with Option CMD-B7 and $A_{bis}$ Control Software**
**The talent for BTS installation/final testing with $A_{bis}$ control**

**CMD – with Option CMD-B8**
**The talent for BTS service with test mobile functionality**

| | |
|---|---|
| • Wide dynamic range | >72 dB |
| • High measurement speed | 60 s for spectrum due to modulation |
| • Signalling software | Call setup by means of RF signalling |
| • $A_{bis}$ card and control software | Control of BTS |
| • Test mobile functionality | Main functions of a mobile phone |
| • Speech coder/decoder | Checking the speech quality |




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# The key features at a glance

| Characteristic/function | Benefit/application |
|---|---|
| **Transmitter measurements** | |
| Dynamic range >72 dB | Checking the power ramps and output spectrum of the BTS transmitter for compliance with the dynamic range specified by PCS1900 |
| Measurement of power ramps | Checking the switching characteristics of the BTS transmitter |
| Phase and frequency error | Testing the modulation characteristics of the BTS transmitter including statistical function |
| Extremely fast measurement of spectrum due to modulation or switching | Detecting interference to the BTS transmitter at adjacent frequencies, due to modulation or switching |
| **Receiver measurements** | |
| Measurement of bit error rate (BER) via $A_{bis}$/IEEE bus/RS-232-C interface, BTS loopback or CMD loopback | Testing the BTS receiver characteristics by adaptation to specific implementation in the BTS |
| Measurement of adjacent timeslot rejection with up to 50 dB higher level | Measuring the automatic gain control (AGC) of the BTS with high level difference between used and adjacent timeslot; simulation of different BTS receive levels |
| Level error <1dB at –104 dBm | Reproducible and conclusive measurements even at low output levels especially at the sensitivity limits of the receiver |
| **Other measurements** | |
| RF monitor with bandwidths of 30 kHz and 100 kHz | Replaces external spectrum analyzers |
| Echo test | Subjective test of speech quality with call established |
| Module test | Complete transmitter measurements even without signalling or time synchronization |
| Multifunction RF generator | Ideal for alignment of receiver modules |
| DC current and voltage measurement | Optimized for pulsed signals; replaces external measuring instruments |
| AF measurement facilities and 60 MHz frequency counter (optional) | Replaces external frequency counter; ideal for measuring reference frequencies |
| Simulation of fading effects | application note on request |
| **Flexible use** | |
| Various BTS synchronization facilities as to time and frequency | Easy integration of measuring instrument into operational environment and problem-free adaptation to the specific synchronization signals of a BTS |
| Remote control via RS-232-C and IEC/IEEE bus interface | SCPI-compatible for easy generation of user-specific control programs |
| **Low cost of ownership** | |
| Software update via interface | No need to open the instrument; simple download of the latest software version via the RS-232-C interface |
| 3 years of warranty | The optional warranty of 3 years allows the instruments to be utilized at calculable costs |

# Main criteria for the decision-maker

The requirements…

The solution:

CMD

## …in production

- Easy integration of measurement facilities into production line
- Testing of BTS receiver and transmitter modules without signalling and via different production-specific interfaces
- High speed in particular on the IEC/IEEE bus to achieve high production throughput
- Easy program generation for the IEC/IEEE bus
- Numerous synchronization and trigger facilities
- Module test allowing measurements even on non-pulsed signals
- Multifunction RF generator for measurements on receiver modules
- CMD replaces a variety of measuring instruments such as ammeter/voltmeter etc
- Extremely fast IEC/IEEE bus
- SCPI-compatible command set for fast program generation

*Details: see page 6*

## …in BTS final test/installation

- BTS measurements by means of signalling
- Call setup for signalling test
- Audio check
- Control of complete BTS system via $A_{bis}$ interface
- Automatic test run
- Generation of user-specific $A_{bis}$ control applications
- Simple modification in case of BTS software updates

*Details: see*

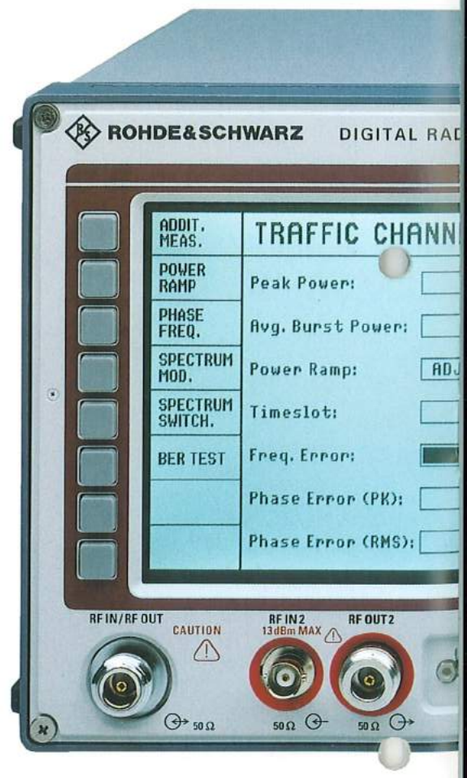
The solution:

CMD

## … and in general

- Great measurement accuracy
- High measurement speed
- Ease of operation
- Easy to transport
- Low purchase and maintenance costs

- CMD 59 is of modular design and thanks to numerous options adaptable to the large variety of base station measurements
- This digital radiocommunication tester features a logical and straightforward measurement concept from production and installation through to service of base stations




Digital Radiocommunication Tester CMD 59 with options



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The solution:

CMD

- Synchronization to RF carrier with signalling information
- Call setup using RF signalling software
- Speech coder for audio tests
- Control of BTS of different manufacturers via $A_{bis}$ interface
- $A_{bis}$ control: software in external notebook or resident in CMD
- Automatic test program for complete functional test

page 8

## ...in BTS service

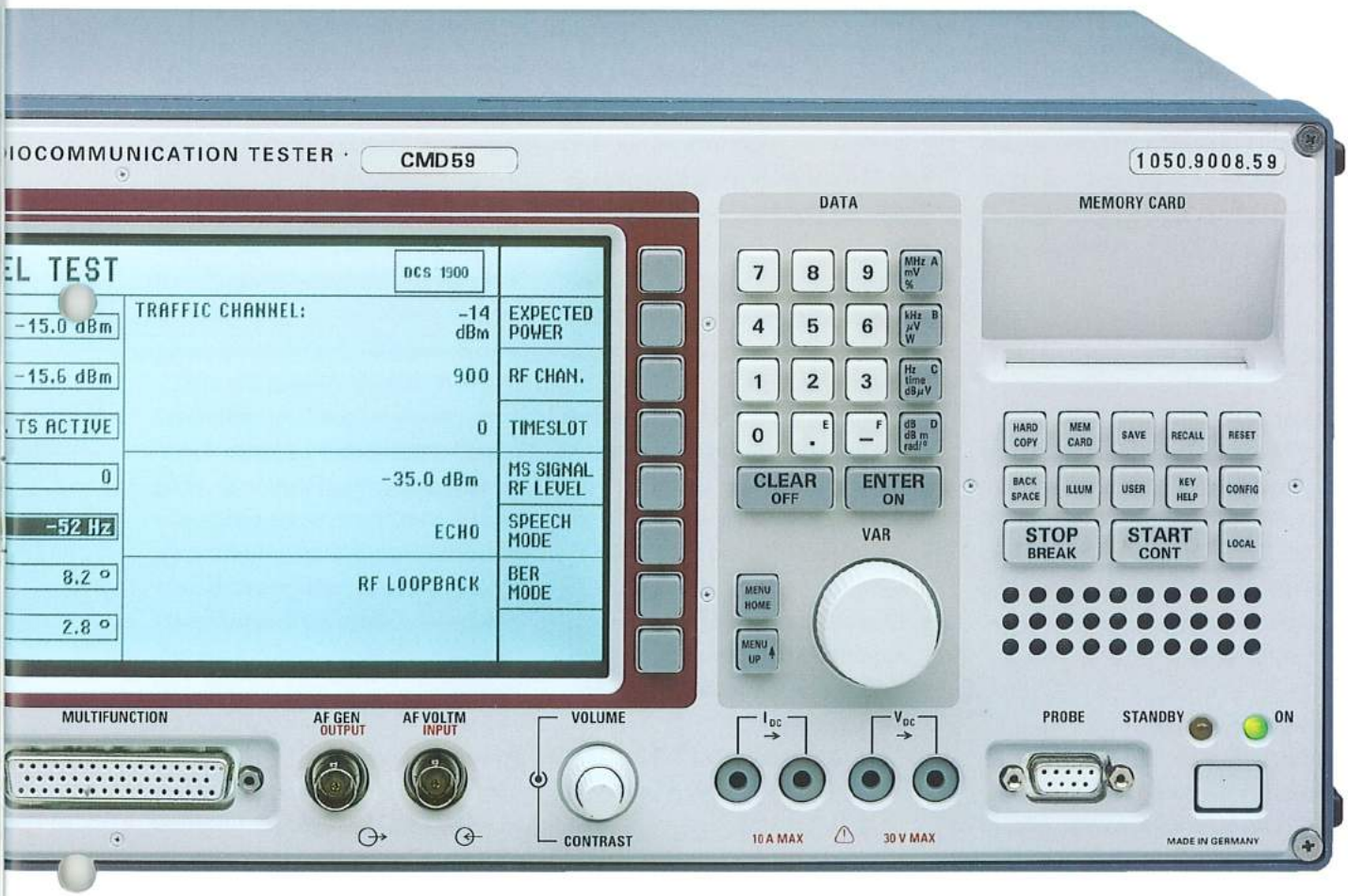
- Measurements on BTS during ongoing operation
- Transmitter and receiver measurements
- Telephone calls in progress are not affected
- Testing of retrofitted transmitter/receiver modules without interruption of operation

The solution:

CMD

- CMD features the main functions of a test mobile and excellent measurement characteristics
- CMD can be fitted with selective filter, signalling software and SIM card reader
- CMD is able to measure receivers during ongoing operation by monitoring the bits received at the $A_{bis}$ interface

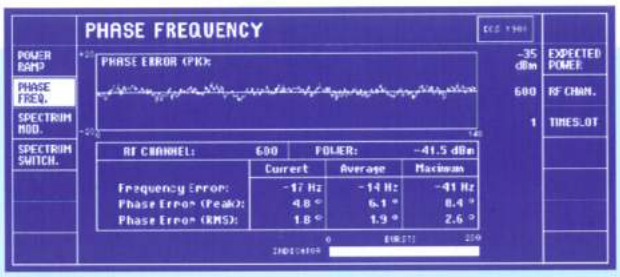
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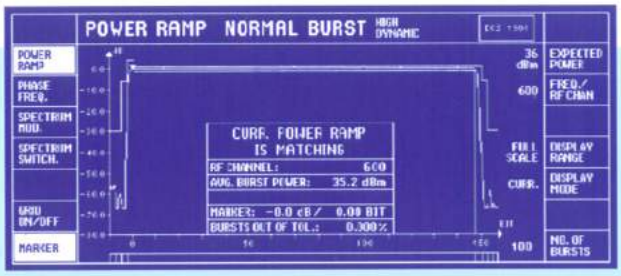



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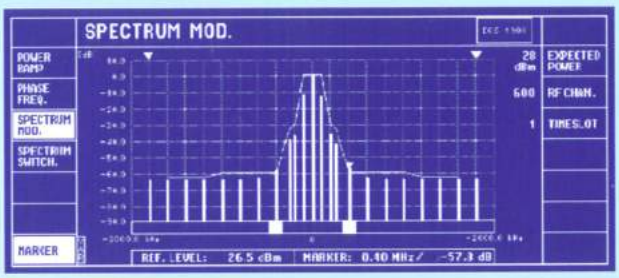
# The technical features in detail




CMD determines phase and frequency errors including maximum and average values




CMD allows the power ramp to be measured with high dynamic range; with graphic display, the zoom function enables application-oriented resolution of parts of the displayed curve




The spectrum due to modulation and switching can be measured in line with PCS specifications within a minimum of time and graphically displayed; the built-in marker function allows the measured value of each individual spectral line to be called up

## The instrument

Digital Radiocommunication Tester CMD 59 is ideal for measurements on complete base station systems as well as on individual transmitter and receiver modules. It covers the frequency range PCS 1900.

## The user interface

### Operation

The CMD is extremely easy to operate and requires no detailed PCS knowledge. The high-contrast monochrome LCD display with softkeys on both sides allows menu-guided convenient callup of test routines with various preset specific parameters.

### Simple configuration

All parameters can be individually modified in the configuration menus, thus allowing for instance easy adaptation to stringent user-specific tolerances. If parameters have been modified with respect to the default specifications, this will immediately be shown on the display.

Additional attenuators, cables and amplifiers are often required for connecting the BTS. These are automatically taken into account by the CMD when calculating the measurement results.

### Further advantages

- Protection against incorrect settings
- Extremely easy program generation for computer-controlled operation
- Software update via RS-232-C interface
- Compact size and low weight thanks to LSI technology
- Selftest and automatic alignment for high reliability

## Transmitter measurements

The following PCS-specific measurements are available for transmitter testing:

- Power ramping
- Phase/frequency error
- Spectrum due to modulation
- Spectrum due to switching

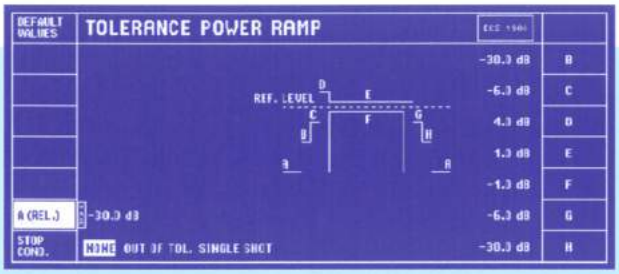
Measurement results on the traffic channel (TCH) of the transmitter are obtained simply by switching to the corresponding menu: depending on the selected function, the power ramp, phase and frequency error or the spectrum measurement will be graphically displayed. Statistical functions such as maximum, minimum and average values are available for some measurements.

### Power ramp

The CMD is able to measure the power ramp with the high dynamic range of >72 dB. With graphic display, the



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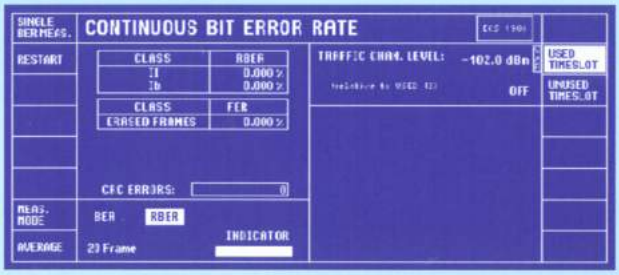



User-defined tolerances, in the example shown for measurement of the power ramp, can easily be entered via configuration menus




The sensitivity of a transceiver module of the base station is verified by means of a bit error rate (BER) test in the RF loopback mode

Bit error rates are shown separately according to bit classes. The level of unused timeslots may be up to +50 dB above that of the timeslot used




zoom function enables application-oriented resolution of parts of the displayed curve.

### Phase and frequency error

The CMD performs these measurements upon recognition of the training sequence in line with the PCS1900 specifications and outputs the results in graphical and numerical form. A bargraph is available for alignments.

### Spectrum

Thanks to digital signal processing (DSP), the spectrum due to modulation or switching can be measured and displayed by the CMD in line with the PCS specifications within an extremely short time. The marker function allows the measured value of each spectral line to be called up. The CMD evaluates for the modulation spectrum for instance 500 bursts on the selected RF channel and each of its 22 offset frequencies within 60 s.

## Receiver measurements

### Bit error rate

The BER measurement is an essential criterion for evaluating the receiver characteristics of a complete BTS system or a receiver module. The CMD provides various possibilities of measuring the bit error rate, either by an internal mode or supported by the device under test.

In the RF loopback mode of the BTS or using the optional $A_{bis}$ *Interface* CMD-B7 the bit sequence received by the BTS can be made available to the CMD for calculating the bit error rate. Continuous measurement as well as preselectable single measurements considerably simplify operation for many applications.

A BER/RBER class II search routine (absolute radio sensitivity) is available.

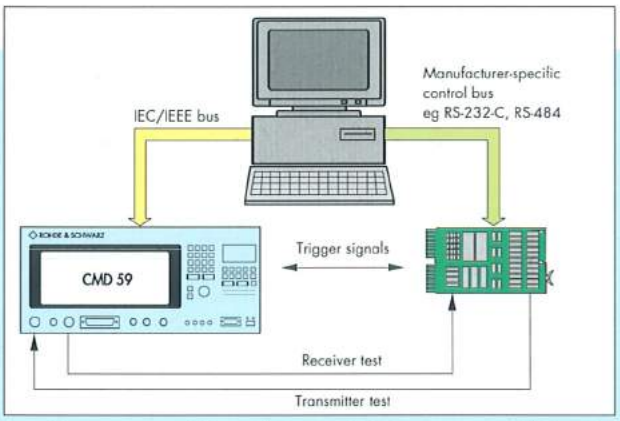
### Adjacent timeslot rejection

An essential criterion is the response of the receiver to fast level variations at the input. The CMD can raise the level of all unused timeslots to up to 50 dB above the level of the used timeslot, thus heavily burdening the receiver during BER measurement.

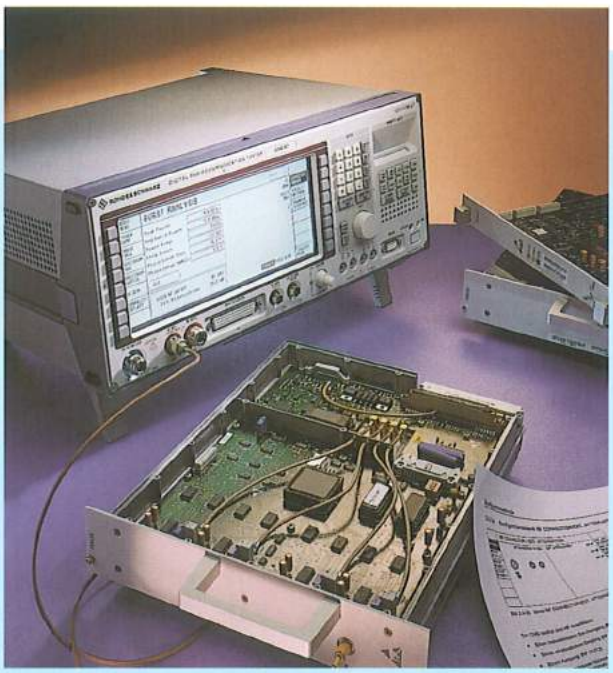


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# Applications in production




Typical test setup in module production: CMD 59 is remote-controlled via the IEC/IEEE bus, while the DUT is controlled via a manufacturer-specific bus



CMD in practical use: testing of transmitter and receiver modules

## The requirements in production

- Easy integration of measurement facilities into production line
- Testing of BTS receiver and transmitter modules without signalling and via different production-specific interfaces
- High speed in particular on the IEC/IEEE bus to achieve high production throughput
- Easy program generation for the IEC/IEEE bus

The solution:

CMD

## Easy to integrate and versatile

The many synchronization and trigger facilities (different bit and frame clocks, C0 carrier and other reference frequencies, reference frequency of $A_{bis}$) as well as additionally built-in analog measurement facilities allow the CMD to be optimally matched to the device under test and to the test environment.

## Transmitter/receiver measurements

The module test allows all essential transmitter measurements to be carried out without signalling. Measurements are possible on pulsed and non-pulsed signals. Modulated or unmodulated RF carriers (with or without power ramping and with or without frequency offset) ensure reliable testing of receiver modules.

## CMD replaces expensive additional instruments

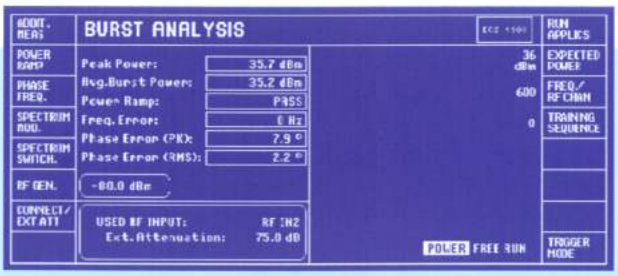
Additional instruments are not required when using the CMD, since they are already or can be integrated:

- ammeter/voltmeter
- RF and AF signal generators
- frequency counter
- power meter

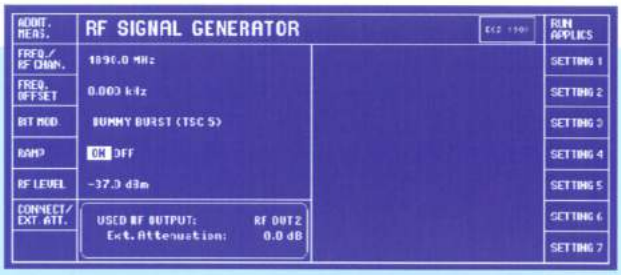
The CMD voltmeter/ammeter is designed for pulsed signals with specific time constant; AF voltmeter, AF generator and frequency counter enable measurements to be performed on the audio interface as well as measurement of reference frequencies.



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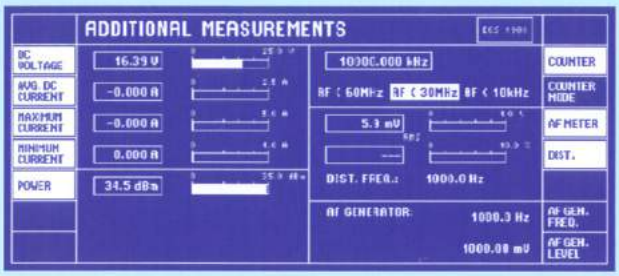



The module test allows measurements on pulsed and non-pulsed signals at discrete frequencies




A versatile RF generator is available for alignments. Softkeys can be allocated to frequently used settings

The CMD voltmeter/ammeter is designed for pulsed signals with specific time constant; AF voltmeter, AF generator and frequency counter enable measurements to be performed on the audio interface




## High speed

High measurement speed is no problem with remote control via the SCPI-compatible IEC/IEEE bus. Remote control is alternatively possible via the RS-232-C interface using the same command set (use of notebook).

## Ease of programming

The SCPI-compatible command set allows convenient programming of the IEC/IEEE bus. During program generation all commands for troubleshooting can be shown on the CMD display. To enhance speed, they can be blanked after successful testing.

## Recommended system configuration

The basic configuration in conjunction with Option CMD-B3 is sufficient for many applications.

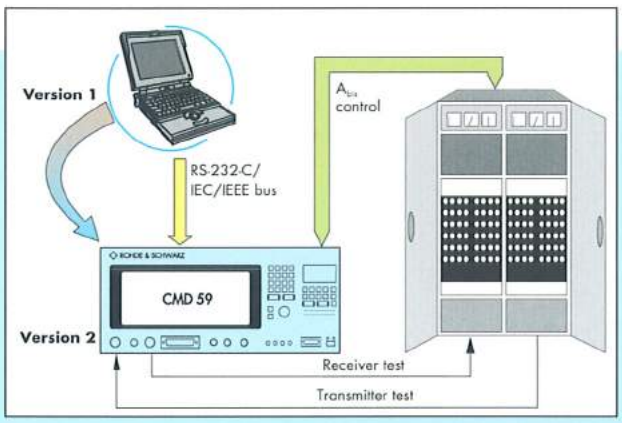
Options CMD-B6 and -B61 are required for remote control via the IEC/IEEE bus.

The optional *AF Measurement Unit with Frequency Counter* CMD-B41 is recommended for further analog measurements.

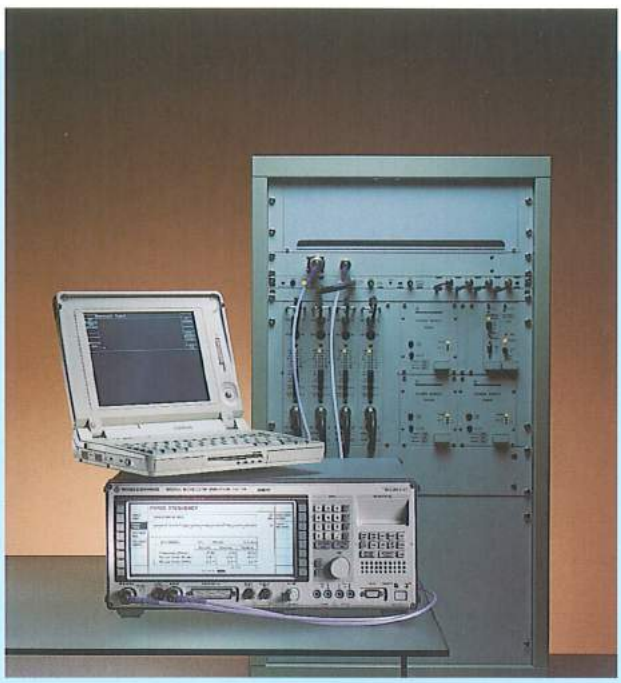


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# Applications in BTS final testing/installation




Typical test setup for BTS final testing or installation. The CMD controls the base station via the $A_{bis}$ interface. The control software is either run on an external notebook (version 1) or directly in the CMD (version 2)



CMD in practical use: a base station is controlled via the $A_{bis}$ interface

## The requirements in BTS final testing/installation

- Measurements on BTS by means of signalling
- Call setup for signalling test
- Audio check
- Control of complete BTS system via $A_{bis}$ interface
- Automatic test run

The solution:

CMD

## Measurements on active base stations

For BTS final testing, measurements have to be performed on active base stations which, controlled by external devices, send RF carriers with signalling information (eg C0 carrier and TCH). The basic CMD model is an efficient tool for both transmitter and receiver measurements.

With synchronization to the C0 carrier, the transmitted power as well as the phase and frequency error are shown on the LCD. This allows a rapid conclusion to be made on the functioning of the BTS.

## Call setup/ signalling

The CMD is provided with signalling characteristics when using the optional *Signalling Software* CMD-K30. After synchronization to the base station, a complete call can be set up by means of signalling at the RF interface. Immediately after setting up a traffic channel, all relevant RF data are measured and displayed.
The following functions are supported:

- mobile originated calls
- base station originated calls
- location update
- call release

Since the signalling information sent by the BTS is evaluated by the CMD in realtime, the following functions are also supported:

- frequency hopping
- channel change
- change of timeslot



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## Recommended system configuration

For signalling tests it is recommended to use the optional *Signalling Software* CMD-K30 with the basic model fitted with Option CMD-B3.

For the control of a base station the *$A_{bis}$ Interface* CMD-B7 plus the appropriate control software are required. The latter is offered in manufacturer-specific software packages.

Options CMD-B6 and -B61 are required for remote control via IEC/IEEE bus.

Since an appropriate reference frequency is usually not available for field installation, it is recommended to use Option CMD-B2.




Menu example of the application software for $A_{bis}$ control on CMD 59

## Speech coder for audio tests

If the optional software *Realtime Speech Coder/Decoder* CMD-B5 is additionally installed, the audio quality can also be checked and the BTS tested under realistic conditions.

## $A_{bis}$ control

Both for final testing in production and for installation the network configuration has to be simulated in the measuring instrument and tailored to the specific needs of the individual BTS type.

The CMD features an interesting concept for testing base stations. Via the *$A_{bis}$ Interface* CMD-B7 and the appropriate BTS-specific CMD software the base station can be controlled and measurements carried out at the RF interface.

**Version 1:**
**Control by external PC**

Being remote-controlled via an external notebook, the CMD can execute BTS-specific $A_{bis}$ control programs. These application programs are used for manual control of the BTS. The notebook sends O&M messages via the CMD to the BTS. The following functions are supported:

- BTS reset
- BTS configuration
- software download
- BTS reconfiguration
- TRX activation (TCH, BCCH)
- TRX deactivation

As soon as the BTS has reached the desired status to be tested (eg carrier with maximum power on channel x activated), the typical RF characteristics of transmitter and receiver can be measured. One of the outstanding features of this concept is that the application program can be tailored to the user-specific needs.

**Version 2:**
**Direct control by CMD**

As soon as the application program run on the external PC satisfies the requirements of the user, it can be downloaded into the CMD so that for performing the measurements only the CMD is required. The menus of the application program are now displayed on the CMD. Softkeys are provided for selecting $A_{bis}$ control mode or RF measurement.

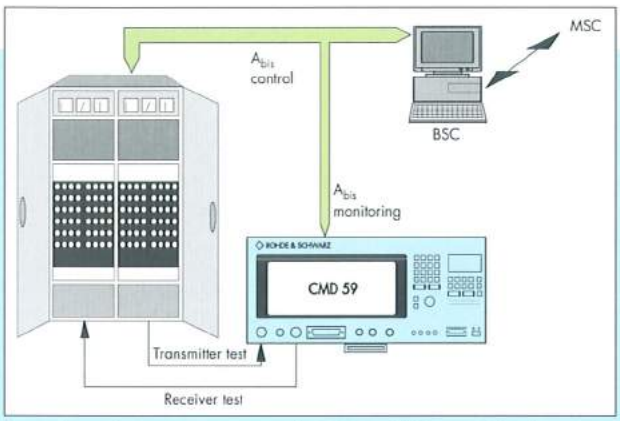
## Automatic testing

The software comes with an application program for each of the two versions allowing fully automatic testing of the BTS.



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# Applications in BTS service




Typical setup for in-service testing. The CMD establishes a call and monitors the bits received at the $A_{bis}$ interface for receiver measurements



The BTS remains in operation while the CMD performs measurements

## The requirements in BTS service

- Measurements on BTS without interruption of operation
- Transmitter and receiver measurements
- Telephone calls in progress are not affected
- Testing of retrofitted transmitter/receiver modules without interruption of operation

The solution:

CMD

## Test mobile functionality

The optional *Test Mobile Functionality* CMD-B8 adds an essential feature to the CMD: it operates like a mobile phone and features excellent measurement capabilities. In conjunction with the monitoring function of the optional *$A_{bis}$ Interface* CMD-B7, timeslot-accurate and channel-selective RF measurements can be performed on receivers and transmitters.

Thanks to this concept, CMD is the first compact radiocommunication tester worldwide allowing measurements on transmitters **and** receivers of base stations during ongoing operation. A very important factor is that transmitter and receiver modules can be retrofitted without interruption of operation. Telephone calls in progress are not affected either.

The optional *Test Mobile Functionality* CMD-B8 comprises the following modules:

- Signalling software for call setup, call holding and call clearing
- SIM card reader for successful identification
- $A_{bis}$ monitoring for BER measurements to test receiver sensitivity (CMD-B7 required)
- Selective filter for adjacent-channel suppression

## Signalling software

The signalling protocols in line with the OSI layer model are implemented in the CMD – to the extent required for the measurements. The CMD behaves like



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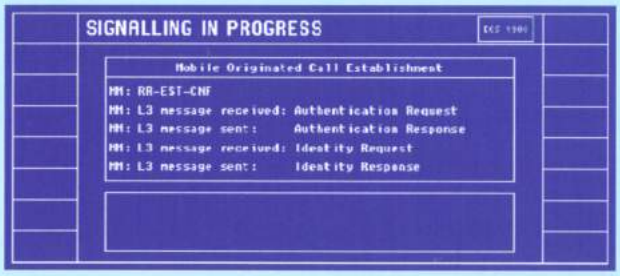
## Recommended system configuration

Options CMD-B8 and CMD-B6 providing all the necessary extensions for a call setup in the network plus a selective filter are required in addition to the basic model fitted with Option CMD-B3. Option CMD-B7 is required for receiver measurements with the aid of $A_{bis}$ monitoring.

Remote control is possible via the RS-232-C interface fitted as standard. Since an appropriate reference frequency is usually not available for field installation, it is recommended to use Option CMD-B2.

The optional *Realtime Speech Coder/Decoder* CMD-B5 is available for audio tests.

Where both $A_{bis}$ control and test mobile functionality with $A_{bis}$ monitoring are required, the following configuration is recommended: Basic model with CMD-B3 + CMD-B6 + CMD-B7 + CMD-K1x + CMD-B8 + CMD-K51.




Typical signalling in progress (layer 3) during call setup

a mobile phone in the network. The following functions are supported:

- mobile originated calls
- base station originated call
- location update
- authentication
- call release

It is possible to make a layer 3 message log on the CMD. The log can be analyzed on an external PC by means of the message editor CRPCPH2.

Immediately after setting up a traffic channel, all relevant RF data are measured and displayed. Since the signalling information sent by the BTS is evaluated by the CMD in realtime, the following functions are also supported:

- frequency hopping
- change of timeslot
- channel change

## SIM card reader

Like a PCS mobile phone the CMD also requires a SIM card reader for proper call setups, since only registered SIM cards provide access to the network. The card reader included in the optional *Test Mobile Functionality* CMD-B8 accepts SIM cards of credit card size and is fitted to the bottom of the instrument so that the size of the instrument is not affected.

## Ciphering software

To be used for signalling in encrypted networks – according to the A5-1 or A5-2 algorithm.

## $A_{bis}$ monitoring

After a call setup the CMD applies RF signals modulated with CCITT bit pattern to the BTS receiver. Typical levels are in the range <–100 dBm. The level error of the CMD is <1 dB at –104 dBm.

The optional *$A_{bis}$ Interface* is connected to the BTS – BSC link with high impedance and samples the bits received by the BTS (260-bit speech frames) in the relevant timeslot. The detected bit errors are displayed in the BER measurement menu.

## Selective filter

The contradictory requirements for broadband measurement and high selectivity are satisfied with the aid of a special filter which provides reliable suppression of interfering carriers close to the channel selected (typ. ≥±3 channels). The measurement accuracy is not significantly affected. The filter features a typical attenuation of 30 dB at 600 kHz from the carrier frequency.



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# The options in detail

| Option | | Characteristics | Uses/ recommendation |
|---|---|---|---|
| **OCXO Reference Oscillator** | **CMD-B1** | Ensures high absolute accuracy, minimum temperature-dependent drift and especially high long-term stability | For measurements with exacting requirements on frequency stability |
| **IQ Modulator Output** | **CMD-B17** | Via this output a SMIQ generator/fading simulator can be connected | BER measurement on BTS receivers under conditions of fading (application note 1MA04_0E available on request) |
| **OCXO Reference Oscillator** | **CMD-B2** | Oven crystal with highest long-term stability. Ensures compliance with tolerances specified by PCS1900 | For highly demanding requirements on frequency stability |
| **DC Voltmeter/Ammeter** | **CMD-B20** | Specific voltage and current measurements | |
| **Multi-Reference Frequency Inputs/Outputs** | **CMD-B3** | For synchronizing DUT and measuring instrument with internal or external frequencies | For all applications |
| **AF Measurement Unit with Frequency Counter** | **CMD-B41** | This option comprises an AF generator, an AF voltmeter, a distortion meter and a frequency counter for measurements on the audio interface or on modules. CMD-B41 allows measurements up to 60 MHz | For all applications to replace external devices |
| **Realtime Speech Coder/ Decoder** | **CMD-B5** | This option converts digital speech signals into analog signals (and vice versa) | In conjunction with CMD-K1x, CMD-K30 or CMD-B8 |
| **Adapter for CMD-B6x Options** | **CMD-B6** | CMD-B6 is required for the use of Options CMD-B61 and -B62 | |
| **IEC/IEEE Bus Interface** | **CMD-B61** | Remote control alternative to the RS-232-C interface fitted as standard | For fast remote control of the CMD |
| **Memory Card Interface** | **CMD-B62** | Memory cards are a versatile medium for storing instrument settings | For users needing identical equipment configurations and for $A_{bis}$ control |
| **$A_{bis}$ Interface** | **CMD-B7** | $A_{bis}$ card for BER measurements at this interface | For sensitivity measurments; required for $A_{bis}$ control |
| **Test Mobile Functionality** | **CMD-B8** | Adds signalling software, SIM card reader and selective filter to the basic model (CMD-B6 required) | |
| **$A_{bis}$ Control Software** | **CMD-K10, -K11, -K12, -K13, -K14, -K16, -K17** | Comprises the $A_{bis}$ control software for a certain base station including application program for manual and automatic testing (CMD-B7 required) | Available on request |
| **Signalling Software** | **CMD-K30** | Adds call setup functionality to the basic model (this functionality is also contained in CMD-B8) | For signalling purposes eg in test network or in production |
| **Ciphering Software** | **CMD-K51, CMD-K52** | Allows encryption according to ETSI Rec. | In conjunction with CMD-B8 |
| **Software Upgrade Contract** | **CMDSK10/ 11/12/13/ 14/16/17** | 1 year software upgrade for $A_{bis}$ Control Software CMD-Kxx | |
| **Modification Kit High-Level 2nd RF Output (9 dBm)** | **CMD-U3** | The standard output level range of the second output is approx. –35 dBm to –120 dBm; the level range +9 dBm to –60 dBm is offered alternatively | Off-air measurements |
| **Trigger Inputs/Outputs** | **CMD-U5** | The time synchronization signals can additionally be applied to BNC connectors on the rear panel. For monitoring purposes the demodulated I/Q signals are brought out at BNC sockets (rear panel) | |



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| Option | | Characteristics | Uses/ recommendation |
|---|---|---|---|
| **Power Measurement Calibration** | **CMD-U9** | Power measurement error GSM1900 <0.5 dB | |
| **Modification of RF IN/OUT** | **CMD-U13** | Peak power meter measurement range –10 dBm to 37 dBm alternatively to standard range 0 dBm to 47 dBm | Test of micro BTS |
| **Memory Card** | **CMD-Z1** | Formatted PCMCIA-compatible memory card for storing instrument settings | CMD-B62 required |
| **Cable Sets** | **CMD-Z20, -Z21, -Z22, -Z23, -Z24, -Z25** | Cable sets comprise $A_{bis}$ control and monitor cables 75 Ω and 120 Ω, RF connections for $A_{bis}$ control and in-service tests | |
| **Rucksack** | **CMD-Z40** | Multifunction carrying bag for the instrument, suitable to be carried in hand, over the shoulder or on the back | See photo on foldout page at the back |
| **Handset** | **CMD-Z50** | Together with CMD-B8 + CMD-B5 allows to talk using CMD 59 in the same way as a mobile | In conjunction with CMD-B5 |
| **Message Editor** | **CRPCPH2** | Message editor for layer 3 message log | For analysis of signalling logs on an external PC |
| **Transit Case** | **ZZK-014** | Robust case for transport the CMD with the Rucksack CMD-Z40 (rucksack to be ordered in addition) | |

# Specifications

## Common data of CMD

| | |
|---|---|
| **Timebase TCXO** | standard |
| Nominal frequency | 10 MHz |
| Frequency drift in temperature range 0 to 35°C | ≤1.5 x $10^{-6}$ |
| Aging | ≤0.5 x $10^{-6}$/year (at 35°C) |
| **Timebase OCXO** | Option CMD-B1 |
| Nominal frequency | 10 MHz |
| Frequency drift in temperature range 0°C to 50°C | ≤1 x $10^{-7}$ |
| Aging | ≤2 x $10^{-7}$/year |
| | ≤5 x $10^{-9}$/day after 30 days of operation |
| Warmup time (at 25°C) | approx. 5 min |
| **Timebase OCXO** | Option CMD-B2 |
| Nominal frequency | 10 MHz |
| Frequency drift | |
| in temperature range 0°C to 50°C (referred to 25°C) | ≤5 x $10^{-9}$ |
| with instrument turned by 90° (at 25°C) | ≤1 x $10^{-8}$ |
| after 2 h warmup time (at 25°C, after 24 h out of operation) | ≤5 x $10^{-9}$ |
| Aging after 30 days of operation and under constant operat. conditions | ≤3.5 x $10^{-8}$/year |
| | ≤5 x $10^{-10}$/day |
| Warmup time (at 25°C) | approx. 10 min |
| **DC voltmeter** | Option CMD-B20 |
| Measurement range | 0 V to ±30 V |
| Resolution | 10 mV |
| Error | ≤2% + resolution |
| **DC ammeter** | Option CMD-B20 |
| Operating modes | current averaging with adapted time constant, current peak measurement (maximum and minimum) |
| Measurement range | 0 A to ±10 A |
| Common-mode rejection | ±30 V |
| Resistance | 50 mΩ |
| Resolution for current averaging | 1 mA/10 mA |
| Resolution for peak measurement | 10 mA |
| Residual indication (no current at input) | ≤10 mA (at room temperature) |
| Error | ≤2% + residual indication + resolution |
| **AF Measurement Unit** | Option CMD-B41 |
| **AF generator** | |
| Frequency range | 50 Hz to 10 kHz |
| Frequency resolution | 0.1 Hz |
| Frequency error | same as timebase + half resolution |
| Level range | 10 µV to 5 V |
| Level resolution | 10 µV at a voltage <1 mV |
| | ≤1% at a voltage ≥1 mV |
| Level error | ≤5% at a voltage ≥1 mV |
| Distortion | ≤0.5% |
| Max. output current | 20 mA |
| Output impedance | <5 Ω |
| **AF voltmeter** | |
| Frequency range | 50 Hz to 10 kHz |
| Measurement range | 0.1 mV to 30 V |
| Resolution | 100 µV at a voltage <10 mV |
| | 1% at a voltage ≥10 mV |
| Error | ≤5% + resolution |
| Input impedance | 1 MΩ |
| **Distortion meter** | |
| Frequency range | 300 Hz to 3 kHz |
| Input level range | 100 mV to 30 V |
| Resolution | 0.1% of THD |
| Inherent distortion | ≤0.5% |
| Error | ≤5% + inherent distortion |
| Measurement bandwidth | 10 kHz |
| **AF counter** | |
| Frequency range | 20 Hz to 10 kHz |
| Input level range | 10 mV to 30 V |
| Resolution | ≤1 Hz |
| Error | same as reference + resolution |
| Input impedance | 1 MΩ |
| **IF counter** | |
| Frequency range | 10 kHz to 60 MHz |
| Input level range | 100 $mV_{rms}$ to TTL |
| Resolution | 1 Hz |
| Error | same as reference + resolution |
| Input impedance | approx. 1 MΩ \|\|100 pF |



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# Specifications (continued)

**PCS-specific measurement of spectrum**

**Spectrum due to modulation**

| | |
|---|---|
| Test method | relative measurement, averaging |
| Resolution filter bandwidth | 30 kHz |
| Measurement at an offset of | 100/200/250/400/600/800/1000 /1200/1400/1600 and 1800 kHz |
| Dynamic range for offset >400 kHz | better than specified by PCS 1900 max. 80 dB |
| Error | <±1.5 dB |

**Spectrum due to switching**

| | |
|---|---|
| Test method | relative measurement, Max Hold over several measurements |
| Resolution filter bandwidth | 30 kHz |
| Measurement at an offset of | 400/600/1200 and 1800 kHz |
| Dynamic range for offset >400 kHz | better than specified by PCS 1900 max. 80 dB, with SW correction max. 76 dB, without SW correction |
| Error | ≤1.5 dB (dynamic range <50 dBc) ≤2.5 dB (dynamic range 50 to 80 dBc) |

| | |
|---|---|
| **Multi-Reference Frequency Inputs/Outputs** | Option CMD-B3 |
| Synchronization input: Frequency (selectable) | bit clock (270.8 kHz), 2/4/16 times PCS bit clock, 1 to 13 MHz in 1 MHz steps, 2.048/16.384/26/39/52 MHz |
| Impedance | approx. 100 Ω |
| Level | 0 dBm to TTL |
| Synchronization output 1: Frequency | 10 MHz with internal reference or frequency at synchronization input with external reference |
| Level | TTL, $R_{out}$ = 50 Ω |
| Synchronization output 2: Frequency (selectable) | bit clock, 2/4/16 times PCS bit clock, 1/2/4 or 13 MHz |
| Level | TTL, $R_{out}$ = 50 Ω |
| **$A_{bis}$ Interface** | Option CMD-B7 |
| Receive channel (traffic/speech) | 75 Ω/high-impedance, unbalanced; 120 Ω/high-impedance, balanced; 16 kbit/s, timeslot selectable; E1/T1 protocol |
| **Interfaces** | RS-232-C (9-pin), Centronics (25-pin) |

## General data

| | |
|---|---|
| Rated temperature range | 0°C to +45°C to DIN IEC 68-2-1/2 |
| Storage temperature range | –40°C to +60°C |
| Electromagnetic compatibility | complies with requirements of European EMC directive (89/336/EEC) |
| Mechanical resistance | |
| Sine vibration | to DIN IEC 68-2-6, 5 Hz to 55 Hz, 0.15 mm amplitude, 2 cycles |
| Random vibration | to DIN 40046 part 24, 10 Hz to 300 Hz, 10 $m/s^2$ rms, 5 min/axis |
| Shock | to MIL-STD-810D, 400 $m/s^2$, shock spectrum in 6 main axes |
| Power supply | 100 V to 120 V AC ±10% 20 Hz to 400 Hz ±5% |
| Power consumption (without options) | approx. 85 W |
| Electrical safety | VDE 0411, class I |
| Dimensions (W x H x D) | 435 mm x 192 mm x 363 mm |
| Weight (without options) | approx. 15 kg |

## Specific data of CMD 59

| | |
|---|---|
| **RF generator** | |
| Frequency range | PCS1900: 1850.2 to 1909.8 MHz |
| Frequency accuracy | same as timebase |
| Resolution | PCS channel spacing 200 kHz |
| Settling time | <3 ms for phase error <2° |
| Output level (RF IN/OUT)/(OUTPUT 2) | –37 dBm to –120 dBm |
| Resolution | 0.1 dB |
| Level error (RF IN/OUT)/(OUTPUT 2) | ≤1.5 dB (≤1 dB at –104 dBm) |
| Harmonics (RF IN/OUT) | <–30 dBc |
| Modulation | GMSK, B x T = 0.3 |
| Phase error | <4° rms, <10° peak |

| | |
|---|---|
| **Peak power meter** (RF IN/OUT) | |
| Frequency range | 1700 MHz to 1900 MHz |
| Measurement range | 0 dBm to 47 dBm |
| Maximum RF power | 47 dBm pulsed 45 dBm CW 47 dBm CW at room temperature |
| Resolution | 0.1 dB |
| Error in PCS1900 band 1930.2 MHz to 1989.8 MHz | ≤0.8 dB + resolution (P >4 dBm) |
| VSWR | ≤1.3 |

| | |
|---|---|
| **Phase and frequency error measurement** | |
| Frequency range | PCS1900: 1930.2 to 1989.8 MHz |
| Level range | |
| RF IN/OUT | 0 dBm to 47 dBm |
| RF IN 2 | –51 dBm to 0 dBm |
| Inherent phase error | ≤1.5° rms, ≤5° peak |
| Frequency measurement error | ≤5 Hz + timebase |

| | |
|---|---|
| **Burst power measurement** | |
| Frequency range | PCS1900: 1930.2 to 1989.8 MHz |
| Reference level for full dynamic range | |
| RF IN/OUT | PCS1900: 0 dBm to 47 dBm |
| RF IN 2 | –31 dBm to 0 dBm |
| Absolute measurement error of peak power | |
| RF IN/OUT, unsynchronized | same as peak power meter |
| RF IN/OUT, synchronized to C0 carrier | ≤1.5 dB |
| RF IN 2 | ≤1.5 dB |
| Resolution in active part of timeslot | ≤0.1 dB |

| | |
|---|---|
| **High-dynamic burst analysis** | |
| Relative error of individual test samples | ≤1.5 dB to 72 dB below peak power |
| Dynamic range | >72 dB |
| Measurement limit RF IN/OUT | <–42 dBm |
| Measurement limit RF IN 2 | <–79 dBm |

## CMD 59 in multicarrier mode (Option CMD-B8)

The specifications apply to all cases, in which interfering carriers (up to 30 dB above useful level) are more than 30 channels away. If there are interfering signals close to the useful carrier, an additional IF filter is switched in (multicarrier mode).

**Typical filter characteristics in multicarrier mode**

| Offset from useful channel (kHz) | Filter suppression (dB) |
|---|---|
| 0 | 0 (reference) |
| 200 | <3 |
| 400 | >20 |
| 600 | >33 |
| 800 | >41 |
| 1000 | >48 |

This filter increases the measurement error for phase and power measurements.

| | |
|---|---|
| **Phase and frequency error measurement** | |
| Inherent phase error | ≤2° (rms), ≤7.5° (peak) |
| **Measurement of peak power/burst power** | |
| Level error | ≤1.5 dB |



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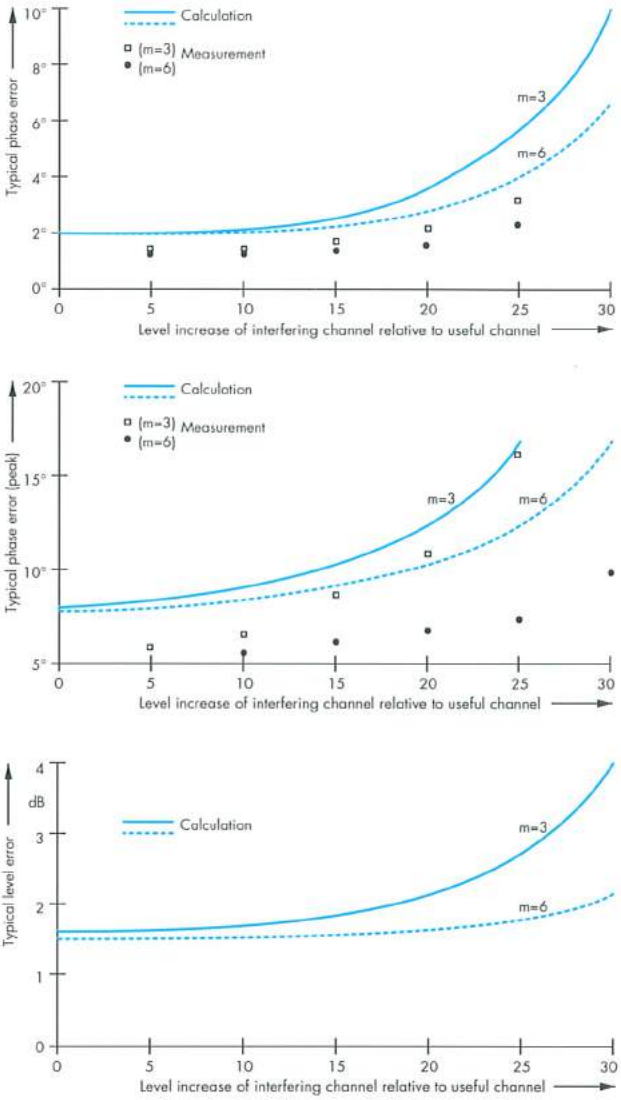
**PCS 1900-specific spectrum measurements**
The dynamic range specified for the basic model refers to the sum of all input voltage components. The additional carriers appear as strong spurious emissions in the spectrum measurement and have to be taken into account accordingly when evaluating the tolerances.

**Typical effects of an interferer on power and modulation measurement results** (see diagrams on the right). The characteristics of an interferer close to the carrier have the following effect on the measurement error:
- Power: the lower the power of the interferer, the smaller the measurement error.
- Frequency offset: the larger the frequency offset of the interferer, the smaller the measurement error. In the diagrams on the right an interferer with an offset of m=3 or m=6 PCS channels has been assumed.
- Spectral purity: the narrower the modulation spectrum of the interferer, the smaller the measurement error. In the diagrams on the right the modulation spectrum with linear interpolation (in the dB/Hz coordinates) has been used (worst case spectrum).
- Number of carriers: the fewer the carriers, the smaller the measurement error. In the example, 1 interferer has been assumed.

The curves shown in the diagrams have been **calculated** assuming the worst case spectrum as interferer, the guaranteed CMD-B8 specifications for phase and power measurement and a typical IF filter characteristic.

The **measured values** are based on a real PCS spectrum, typical CMD-B8 specifications and typical filter characteristic.






Phase and level error as a function of adjacent-channel power and adjacent-channel frequency offset

Rear panel of CMD






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# Ordering information

| Designation | Type | Order No. |
|---|---|---|
| **Digital Radiocommunication Tester*** for PCS1900 | CMD 59 | 1050.9008.59 |
| **Accessories supplied** Power cord, operating manual, spare fuses | | |
| **Options** (for all models, unless stated otherwise) | | |
| OCXO Reference Oscillator | CMD-B1 | 1051.6002.02 |
| OCXO Reference Oscillator | CMD-B2 | 1059.8604.02 |
| DC Voltmeter/Ammeter | CMD-B20 | 1059.6401.02 |
| Multi-Reference Frequency Inputs/Outputs | CMD-B3 | 1051.6202.02 |
| AF Measurement Unit with Frequency Counter | CMD-B41 | 1051.6902.02 |
| Realtime Speech Coder/Decoder | CMD-B5 | 1051.8657.02 |
| Adapter for CMD-B6x Options | CMD-B6 | 1051.7409.02 |
| IEC/IEEE Bus Interface**) | CMD-B61 | 1051.7609.02 |
| Memory Card Interface**) | CMD-B62 | 1051.8205.02 |
| $A_{bis}$ Interface | CMD-B7 | 1051.8357.04 |
| Test Mobile Functionality | CMD-B8 | 1059.8204.02 |
| IQ Modulator Output | CMD-B17 | 1099.3003.02 |
| Certified Calibration | CMD-CAL | 1032.4043.07 |
| $A_{bis}$ Control Software for ERICSSON BTS RBS200/2000 | CMD-K10 | 1082.2050.02 |
| $A_{bis}$ Control Software for NOKIA BTS DE21/34/45, PRIME SITE | CMD-K11 | 1082.2150.02 |
| $A_{bis}$ Control Software for ITALTEL BTS BR 902 | CMD-K12 | 1082.2250.02 |
| $A_{bis}$ Control Software for NMC BTS S2000/S4000/S8000 | CMD-K13 | 1082.2350.02 |
| $A_{bis}$ Control Software for SIEMENS BTS SBS20/60 | CMD-K14 | 1082.2450.02 |
| $A_{bis}$ Control Software for ALCATEL BTS uBTS G2, M1C/M1M/M2M, G1 MKII, G2 | CMD-K16 | 1082.2750.02 |
| $A_{bis}$ Control Software for LUCENT BTS BTS 2000/2, Cube | CMD-K17 | 1082.2850.02 |
| Signalling Software | CMD-K30 | 1082.4530.02 |
| Ciphering Software to A5-1 standard | CMD-K51 | 1082.3540.02 |
| Ciphering Software to A5-2 standard | CMD-K52 | 1082.3640.02 |
| 1 year software upgrade for CMD-K10 | CMDSK10 | 1082.2950.02 |
| 1 year software upgrade for CMD-K11 | CMDSK11 | 1082.3040.02 |
| 1 year software upgrade for CMD-K12 | CMDSK12 | 1082.3740.02 |
| 1 year software upgrade for CMD-K13 | CMDSK13 | 1082.3140.02 |
| 1 year software upgrade for CMD-K14 | CMDSK14 | 1082.3240.02 |
| 1 year software upgrade for CMD-K16 | CMDSK16 | 1082.3340.02 |
| 1 year software upgrade for CMD-K17 | CMDSK17 | 1082.3440.02 |
| Modification Kit High-Level 2nd RF Output (9 dBm) | CMD-U3 | 1059.6501.02 |
| I/Q Demodulator Outputs and Trigger Input (BNC connectors on rear panel, factory installation only) | CMD-U5 | 1059.6901.02 |
| Power Measurement Calibration (error <0.5 dB) | CMD-U9 | 1059.7408.02 |
| Modification of Peak Power Meter Measurement Range to –10 dBm to 37 dBm | CMD-U13 | 1059.4009.02 |
| Formatted Memory Cards | CMD-Z1 | 1059.4809.02 |

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**PCS 1900-specific spectrum measurements**
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phase and power measurement and a typical IF

The **measured values** are based on a real PCS sy
specifications and typical filter characteristic.






# Ordering information (continued)

| Designation | Type | Order No. |
|---|---|---|
| Cable Set for NMC BTS | CMD-Z20 | 1099.3403.02 |
| Cable Set for ERICSON RBS2000 | CMD-Z21 | 1099.3503.02 |
| Cable Set for ERICSON RBS200 | CMD-Z22 | 1099.3655.02 |
| Cable Set for SIEMENS SBS B520 | CMD-Z23 | 1099.3803.02 |
| Cable Set for NOKIA DE 21/34 | CMD-Z24 | 1099.3955.02 |
| Cable Set for NOKIA DE 45 | CMD-Z25 | 1099.4100.02 |
| Rucksack | CMD-Z40 | 1059.7808.02 |
| Handset (requires CMD-B5) | CMD-Z50 | 1059.4250.02 |
| Message Editor for Layer 3 Message Log | CRPCPH2 | 1081.6552.02 |
| Transit Case for CMD with rucksack (rucksack not included) | ZZK-014 | 1013.9595.00 |

* The original colours of the LCD display can be seen on the large photo on page 2/3.

** CMD-B6 also required.



The CMD can easily be carried in the rucksack available as an option. For on-site measurements the CMD can be used inside the rucksack.

Certified Quality System
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CE

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