Product brochure

Version 02.00

April 2004

Bluetooth® Testers R&S®CBT/CBT 32

Fast and versatile for development, production and verification

- *Bluetooth* RF tests on all channels
- Full dirty transmitter for BER tests
- Speech codec integrated
- Cost-effective rack version R&S®CBT 32 for production applications
- Very short cycle time for high production throughput

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General

The *Bluetooth* Testers R&S®CBT offer a large number of statistical monitoring and measurement functions. It is possible, for instance, to define individual tolerances for each measured value and to stop a measurement sequence after a certain number of measurements or when a tolerance has been exceeded. Besides the common traces for power and modulation versus time, averaged minimum or maximum traces can also be displayed over a user-defined number of packets.

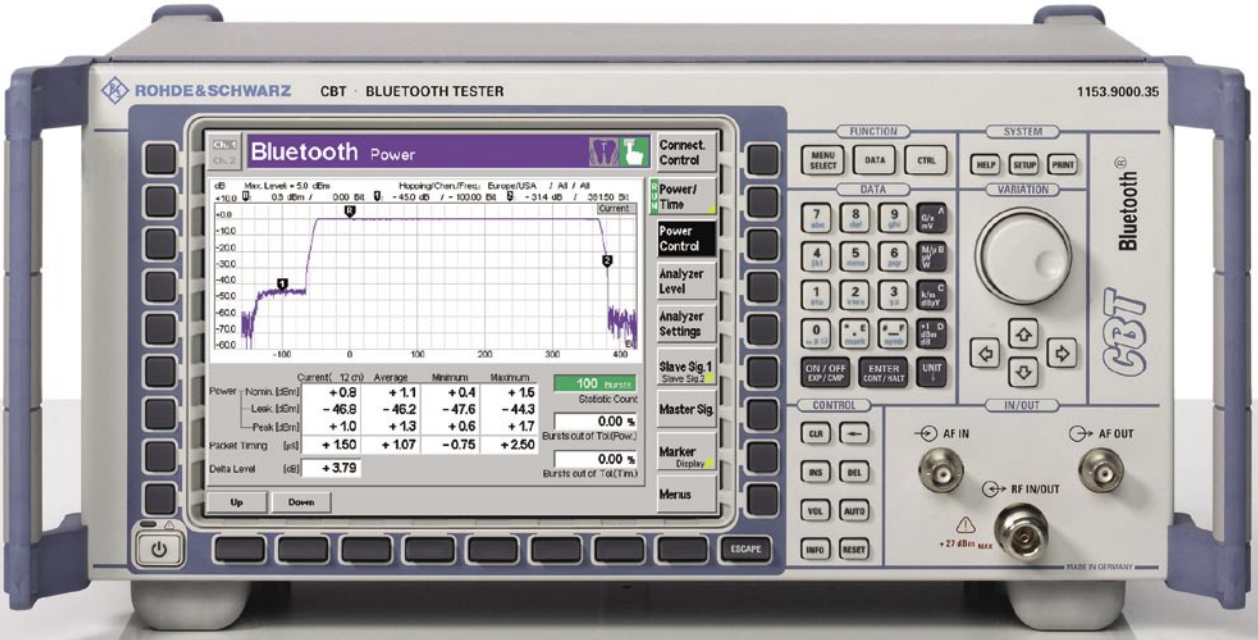
Signalling

Setting up a *Bluetooth* connection
The R&S®CBT acts as the master of a *Bluetooth* piconet, the DUT as a slave. The R&S®CBT is able to perform the inquiry procedure for the identification of all *Bluetooth* devices within range of the R&S®CBT. All devices found are listed on the display and one of them can be selected for the paging procedure. The R&S®CBT then establishes the connection to the DUT and switches it to test mode operation. The inquiry procedure can be skipped, if the *Bluetooth* device address of the DUT is already known. In this case, a shorter setup time for the connection can be achieved. This is important for production tests of *Bluetooth* devices to increase the maximum throughput of a production line. According to the *Bluetooth* test mode specification, the DUT has to be locally enabled for test mode operation. After a *Bluetooth* link is established, the R&S®CBT sends commands to the DUT to switch it to the desired test mode. The R&S®CBT is then able to perform a number of transmitter and receiver measurements. The R&S®CBT is also capable of setting up a normal *Bluetooth* asynchronous connectionless (ACL) link without activating the test mode. Via this normal link, the power and frequency accuracy of every DUT can be measured, regardless of whether the DUT has been locally enabled for the test mode. If a normal (ACL) link is used, the R&S®CBT can switch the DUT to the audio, hold, park and sniff modes.

Control commands to the DUT
The R&S®CBT can send user-specific control commands in the form of any type of bytes to the DUT via the normal ACL link. This application, which is very useful in production, allows the control of specific DUT functions via the RF interface, e.g. switching a headset LED on and off.

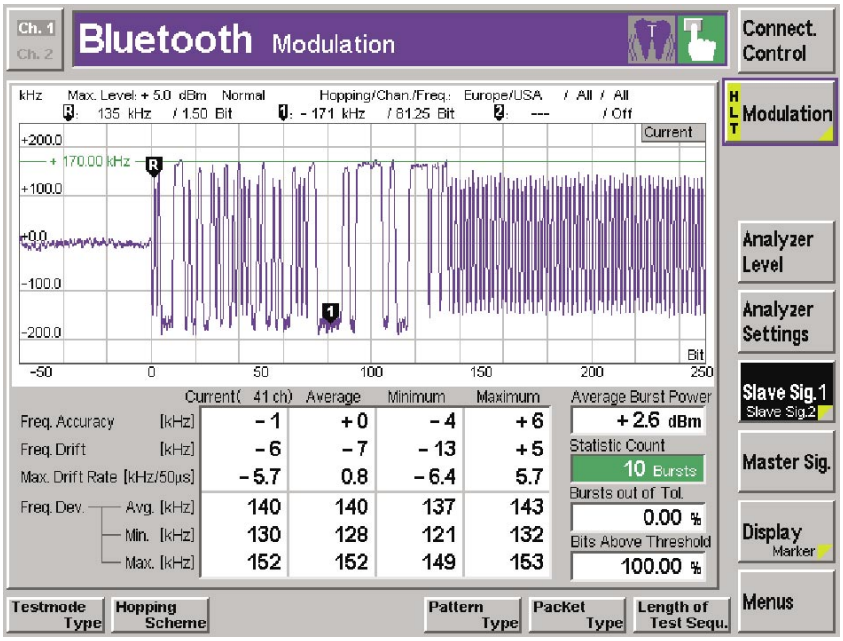
Audio mode
In the audio mode, the R&S®CBT establishes a synchronous connection-oriented (SCO) link to the DUT in addition to the ACL link. The R&S®CBT's built-in *Bluetooth* audio codec supports CVSD as well as A-law and µ-law coding. External audio generators and analyzers can be connected by means of one analog input and output each on the R&S®CBT front panel.

R&S®CBT Bluetooth Tester with large display for R&D and production



Park, hold and sniff modes
The power consumption of a *Bluetooth* chip set is considerably reduced in these three modes, making them particularly important in all battery-powered *Bluetooth* devices. The R&S®CBT can switch the DUT to the park, hold or sniff mode, making it possible to check the reduced power consumption by means of external test equipment.

Signalling information from the DUT
The R&S®CBT is able to display a variety of information that is received from the DUT (e.g. device name, version numbers, service class, supported features).

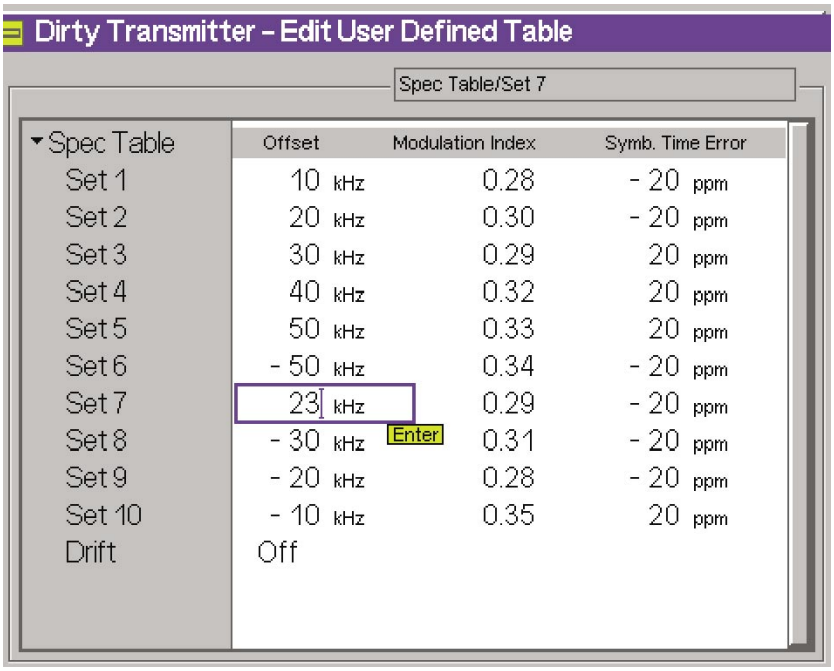


Compliance with existing Bluetooth® standards

The R&S®CBT is compliant with the *Bluetooth* Core Specifications Version 1.1. The *Bluetooth* test mode (Core Spec. Part I:1) is implemented with all commands needed to perform the TX/RX measurements. In addition, the R&S®CBT is capable of testing all DUTs that support the new *Bluetooth* Core Specifications Version 1.2, since the test mode specified in the new version does not include any changes relevant to the R&S®CBT.

TX measurements

The current measurement values for each parameter are displayed on the R&S®CBT screen. Additionally, average, maximum and minimum values are displayed as a result of a statistical evaluation of a definable number of *Bluetooth* packets (bursts).



Power measurements (output power)
Measurement parameters:

- Nominal power (measured as the part of the burst starting at the detected first bit of the preamble (bit 0) to the last bit of the burst)
- Peak power (shows the highest power level within a burst)
- Leakage power (measured within defined areas before and after the burst)

Power control
The Power menu enables the power control function of a *Bluetooth* DUT to be checked. In this mode, the R&S®CBT can send the "Power up" and "Power down" commands to the DUT. The user has two keys for manual power control. After each keystroke, the R&S®CBT displays in a measurement window the difference level as compared to each

previous power level. In compliance with the *Bluetooth* specifications, all difference values must be in the 2 dB to 8 dB range. When the maximum or minimum power level is reached, the DUT sends a message which is displayed on the R&S®CBT.

Timing measurements (packet timing error)
Measurement parameter:

- Packet alignment (distance between ideal master receiver slot and detected bit 0 of the received burst)

This measurement is displayed on the Power screen

Modulation measurements (modulation characteristics/quality)
Measurement parameters:

- Frequency accuracy/initial carrier frequency tolerance (ICFT, difference between measured frequency and intended transmitted frequency, measured in the preamble at the beginning of a packet)
- Carrier frequency drift (difference between the frequency at the start of the packet and the frequency in the payload)
- Maximum drift rate (maximum drift rate anywhere within the packet payload)
- Average, maximum and minimum frequency deviation (calculated over the packet payload)

In compliance with the *Bluetooth* RF test specifications, a minimum of 99.9 % of all measured bits must have a frequency deviation of at least 115 kHz. The R&S®CBT shows the measurement results in an additional window in the modulation display.

Channel display in frequency-hopping mode
The R&S®CBT enables the convenient determination of all RF channels in which the DUT exceeds specified tolerances. If "on limit failure" is set as a stop condition in frequency-hopping measurements, the R&S®CBT automatically stops the measurement when a measured value exceeds the defineable limit values. The R&S®CBT in addition displays the number of the channel in which the out-of-tolerance condition occurred – a very helpful function for laboratory measurements.

Measurements without link setup
Many *Bluetooth* DUTs can be locally switched to the transmitter test mode via the HCI interface. The R&S®CBT can carry out power, frequency and modulation measurements on such DUTs without previously establishing a *Bluetooth* link.

RX measurements

For RX measurements, the built-in signal generator generates a selectable bit sequence, which is looped back in the DUT and demodulated and processed by the R&S®CBT again. The TX level

R&S®CBT 32 Bluetooth Tester: Cost-effective rack version of the R&S®CBT with identical features but without display

of the R&S®CBT can be adjusted for this measurement. The BER application allows up to five test programs to be defined. Each program can independently set settings such as control parameters, limits, repetition or statistical cycles.

Sensitivity (single slot packets/ multislot packets)
Measurement parameters:
- BER (percentage of bit errors that have occurred within the current statistical cycle)
- BER search function (sensitivity level for a predefined BER level)
- PER (percentage of packet errors that have occurred within the current statistical cycle)

Dirty transmitter
For BER tests, the *Bluetooth* RF test specification stipulates a dirty transmitter as a signal source in the tester. Every 20 ms, the dirty transmitter (dirty TX) changes the frequency offset, modulation index and symbol timing error. A table in the specification describes ten different value combinations of these three parameters, which are used one after the other. The dirty TX additionally superimposes a defined frequency drift on its output signal; the frequency drift phase varies by 180° from packet to packet.

The dirty TX in the R&S®CBT and R&S®CBT 32 provides the following operating modes:
- Dynamic dirty TX using the value table from the specification; drift superimposition switched on
- Dynamic dirty TX using a user-defined value table; drift superimposition either switched on or off (see figure on page 3)
- Static dirty TX; the values for frequency offset, modulation index and symbol timing error can be set in any combination with respect to each other; drift superimposition either switched on or off

Bluetooth® RF test cases

The R&S®CBT and R&S®CBT 32 can be used for the evaluation of the following *Bluetooth* test purposes as described in the *Bluetooth* RF test specification 0.92:
- TRM/CA/01/C (output power)
- TRM/CA/03/C (power control)
- TRM/CA/07/C (modulation characteristics)
- TRM/CA/08/C (initial carrier frequency tolerance)
- TRM/CA/09/C (carrier frequency drift)
- RCV/CA/01/C (sensitivity – single-slot packets)
- RCV/CA/02/C (sensitivity – multislot packets)
- RCV/CA/06/C (maximum input level)

Remote compatibility between the R&S®CMU 200 and the R&S®CBT/CBT 32

All remote scripts generated for the *Bluetooth*/signalling functional group of the R&S®CMU 200 can also be used for the R&S®CBT and R&S®CBT 32 without any modifications. The only prerequisite for compatibility is that in the R&S®CMU remote script one of the shared inputs/ outputs RF1 or RF2 of the R&S®CMU is used for the measurement.

Ordering information

Bluetooth® Tester with display, 4HU	R&S®CBT	1153.9000.35
Bluetooth® Tester without display, 19", 2HU, for remote control	R&S®CBT 32	1153.9000.32

Certified Quality System ISO 9001 DQS REG. NO 1954 QM

Certified Environmental System ISO 14001 DQS REG. NO 1954 UM

For specifications, see PD 0758.1287.22
and www.rohde-schwarz.com
(search term: CBT)

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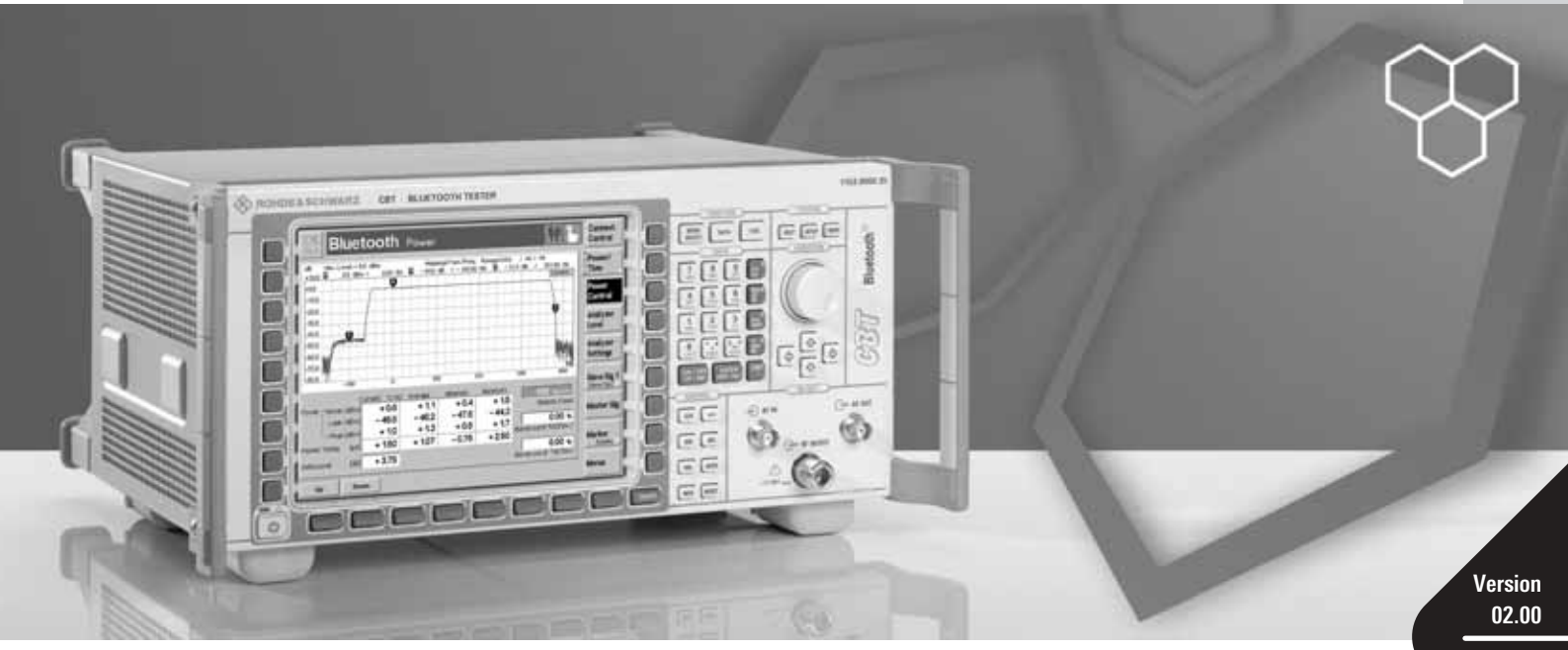
PD 0758.1287.12 · R&S® CBT/CBT 32 · Version 02.00 · April 2004 · Data without tolerance limits is not binding · Subject to change

Specifications



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Bluetooth® Tester R&S®CBT

Specifications

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CONTENTS

Unit specifications

Standards		Bluetooth Core Specifications Version 1.1

Timebase TCXO

Max. frequency drift	in temperature range +5 °C to +45 °C	$\pm 1 \times 10^{-6}$
Max. aging		$\pm 1 \times 10^{-6}$/year

Reference frequency input

Synchronization input		BNC connector REF IN
Frequency	sinewave squarewave (TTL level)	10 MHz 10 MHz
Max. frequency variation		$\pm 5 \times 10^{-6}$
Input voltage range		0.5 V to 2 V, rms
Impedance		50 Ω

RF generator

RF channel definition	Bluetooth menu	2402 MHz + k x 1 MHz, k = 0 to 93

Frequency range		
	RF menu	2398 MHz to 2499 MHz
	Bluetooth menu	2402 MHz to 2495 MHz

Frequency resolution	channel spacing according to standard	1 MHz

Frequency offset range		±250 kHz

Frequency offset resolution		1 kHz

Frequency uncertainty		
	RF menu	±5 Hz + drift of timebase
	Bluetooth menu	±100 Hz + drift of timebase

Hopping scheme	modes according to standard	Europe (except France), USA France RX/TX single frequency Reduced hopping

Output level range		
RF IN/OUT		–90 dBm to +0 dBm

Output level uncertainty	in temperature range +20 °C to 35 °C	
RF IN/OUT	output level < –10 dBm output level ≥ –10 dBm	<1.0 dB <1.5 dB

Output level uncertainty	in temperature range +5 °C to +45 °C	
RF IN/OUT	output level < –10 dBm output level ≥ –10 dBm	<1.5 dB <2.0 dB

Output level resolution		0.1 dB

Generator RF output level repeatability	typical values after 1 h warmup time at constant ambient temperature	<0.03

VSWR		
RF IN/OUT		<1.5

Attenuation of harmonics	f_0 = 2398 MHz to 2499 MHz, up to 7 GHz	
RF IN/OUT		>30 dB

Attenuation of nonharmonics		>50 dB

Modulation		
GFSK		1 Mbps, B x T = 0.5
Modulation index	11110000 pattern, frequency deviation 160 kHz	0.32
Modulation index range	frequency deviation 100 kHz to 220 kHz	0.20 to 0.44
Modulation index resolution		0.01
Modulation index uncertainty	11110000 pattern, frequency deviation 160 kHz	±5 %

Dirty TX	according to Bluetooth RF test specifications V0.92, supporting both single and multislot	
Frequency offset range		±250 kHz
Frequency offset resolution		1 kHz
Frequency offset uncertainty		±5 Hz + drift of timebase
Modulation index range		0.20 to 0.44
Modulation index resolution		0.01
Modulation index uncertainty		±5 %
Symbol time error range		±20 ppm
Symbol time error resolution		1 ppm
Symbol time error uncertainty		same as timebase
Drift mode		On/Off
Drift uncertainty		±5 kHz

RF analyzer

VSWR		
RF IN/OUT	2398 MHz to 2499 MHz	<1.5

RF channel definition	Bluetooth menu	2402 MHz + k x 1 MHz, k = 0 to 93

Frequency range		
	RF menu	2398 MHz to 2499 MHz
	Bluetooth menu	2402 MHz to 2495 MHz

Frequency resolution	channel spacing according to standard	1 MHz

Frequency uncertainty		±5 Hz + drift of timebase

Hopping scheme	modes according to standard	Europe (except France), USA France RX/TX single frequency Reduced hopping

Power meter (frequency-selective) and power versus time

Measurement bandwidth	filter definition: passband	
	Bluetooth menu *Filter Bandwidth → wide* *Filter Bandwidth → narrow*	 2.0 MHz 1.3 MHz
	RF menu	10 Hz to 1 MHz in 1/2/3/5 steps

Level range		
RF IN/OUT	continuous power peak envelope power[1] (PEP)	–40 dBm to +22 dBm +26 dBm (300 mW)

Level uncertainty	in temperature range +20 °C to +35 °C	
RF IN/OUT	Bluetooth menu from full scale down to –25 dB RF menu input level –40 dBm to +22 dBm	 <1.0 dB <1.0 dB

Level uncertainty	in temperature range +5 °C to +45 °C	
RF IN/OUT	Bluetooth menu from full scale down to –25 dB RF menu input level –40 dBm to +22 dBm	 <1.5 dB <1.5 dB

Level resolution	in manual mode in remote control mode	0.1 dB 0.01 dB

Reference level for full dynamic range	GFSK signal	
RF IN/OUT	continuous power peak envelope power[1] (PEP)	–25 dBm to +22 dBm +26 dBm (300 mW)

Dynamic range	*Filter Bandwidth → wide*	>55 dB, rms

RF level measurement repeatability	typical values after 1 h warmup time at constant ambient temperature	<0.03 dB

Modulation analyzer

Measurement bandwidth	filter definition: passband	
	Filter Bandwidth → wide *Filter Bandwidth → narrow*	2.0 MHz 1.3 MHz

Level range	GFSK signal	
RF IN/OUT		from full scale down to –25 dB

Total measurement range for frequency offset and frequency deviation		–250 kHz to +250 kHz

Frequency offset uncertainty in preamble	for deviation ≤160 kHz	≤2 kHz

Frequency deviation uncertainty in payload	for deviation ≤200 kHz	
	11110000 pattern	≤2 %
	10101010 pattern	≤4 %

[1] Mean value of power vs time must be equal to or less than allowed continuous power.

Frequency drift uncertainty	measured in burst related to frequency offset value in preamble	
	10101010 pattern maximum typically	 ≤2 kHz ≤1 kHz

Frequency resolution	in manual mode in remote control mode	1 kHz 1 Hz

Timing measurement

Range		±20 µs
Resolution		0.25 µs
Uncertainty		≤0.25 µs + resolution

Speech codec

Speech decoder output	AF OUT	BNC connector
Output impedance		<10 Ω
Maximum output current		20 mA, peak
Full range output level		1 V, peak

Speech coder input	AF IN	BNC connector
Input impedance		100 kΩ
Full range input level	low sensitivity high sensitivity	1.4 V, peak 0.1 V, peak

Inputs and outputs (rear panel)

Remote control interfaces		
IEC/IEEE bus	IEC 60625-2 (IEEE 488.2)	24-pin Amphenol connector
Serial interface COM 1	RS-232-C (COM)	9-pin sub-D connector

Printer interface LPT	parallel (Centronics compatible)	25-pin sub-D connector

Keyboard		USB connector

Analog monitor (VGA)		15-pin sub-D connector

Trigger output	RF menu test trigger Bluetooth menu burst trigger	 BNC connector TRIG. OUT BNC connector TRIG. OUT

General specifications

Operating temperature range		+5 °C to +45 °C, meets EN60068-2-1 and -2
Storage temperature range		–25 °C to +60 °C, meets EN60068-2-1 and -2
Humidity	+40 °C, non-condensing	80 % relative humidity, meets EN 60068-2-3

Electromagnetic compatibility		meets EMC Directive 89/336/EEC, applied standard: EN 61326 (immunity for industrial environment; class B emissions)

Electrical safety		IEC 61010-1, EN 61010-1, UL3111-1, CAN/CSA-C22.2 No. 1010.1

Mechanical resistance	non-operating mode	
Vibration	sinusoidal	meets EN 60068-2-6, EN 61010-1, MIL-T-28800 D class 5, 5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const
Vibration	random	meets EN 60068-2-64, 10 Hz to 300 Hz, acceleration 1.2 g rms
Shock		meets EN 60068-2-27, MIL-STD-810D, 40 g shock spectrum

Power supply		power factor correction, meets EN61000-3-2
Input		100 V to 240 V ±10 % (AC), max. 220 VA, 50 Hz to 60 Hz –5 % to +10 %
Power consumption	CBT CBT32	approx. 60 W approx. 50 W

Display	not included in model CBT32	21 cm TFT colour display (8.4”)
Resolution		640 x 480 pixels (VGA resolution)
Pixel failure rate		$<2 \times 10^{-5}$

Dimensions	W x H x D	
	CBT	411 mm x 193 mm x 317 mm (7/8 x 19”; 4 height units)
	CBT32	465 mm x 93 mm x 417 mm (19”; 2 height units)

Weight	CBT CBT32	approx. 7 kg approx. 6 kg

Specifications are valid under the following conditions:

Data without tolerance limits is not binding.

In compliance with the Bluetooth core specification, bit rates are specified in Mbps (million bits per second).

Mbps is not an SI unit.

For product brochure, see PD 0758.1287.12
and www.rohde-schwarz.com
(search term: CBT)

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