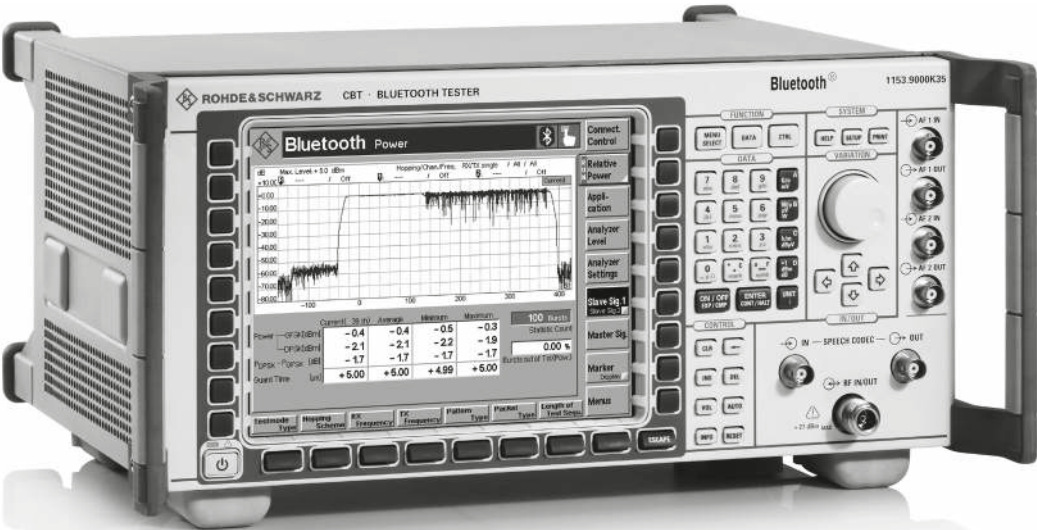


# R&S® CBT/ R&S® CBT32

## Bluetooth® Tester

### Specifications



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Specifications apply under the following conditions: Data without tolerance limits is not binding.

In line with the Bluetooth® Core Specification, bit rates are specified in Mbps (million bits per second).

Mbps is not an SI unit.

The specifications for the R&S®CBT/R&S®CBT32 refer to a fully equipped unit with all applicable options installed.

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## Unit specifications

<b>Standards</b>		Bluetooth® Core Specification Version 4.2: test mode supported Radio Frequency Test Specification V4.2.0 Bluetooth® Low Energy RF PHY Test Specification V4.2.0
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## TCXO time base

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

## Reference frequency input

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

## RF generator

<b>RF channel definition</b>	Bluetooth® menu	2402 MHz + k $\times$ 1 MHz, k = 0 to 93
	Bluetooth® LE menu	2404 + k $\times$ 2 MHz, k = 0 to 10 2406 + k $\times$ 2 MHz, k = 11 to 36 channel 37 = 2402 MHz channel 38 = 2426 MHz channel 39 = 2480 MHz

<b>Frequency range</b>	RF menu	2398 MHz to 2499 MHz
	Bluetooth® menu	2402 MHz to 2495 MHz
	Bluetooth® LE menu	2402 MHz to 2480 MHz

<b>Frequency resolution</b>	channel spacing in line with standard	1 MHz
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<b>Frequency offset range</b>		$\pm 250$ kHz
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<b>Frequency offset resolution</b>		1 kHz
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<b>Frequency uncertainty</b>	RF menu	$\pm 5$ Hz + drift of time base
	Bluetooth® and Bluetooth® LE menu	$\pm 100$ Hz + drift of time base <sup>1</sup>

<b>Hopping scheme</b>	modes in line with Bluetooth® standard	Europe (except France), USA France RX/TX single frequency reduced hopping
	Bluetooth® Low Energy	no hopping and no signaling

<b>Output level range</b>		
RF IN/OUT	for basic rate packets and for Bluetooth® Low Energy packets	-90 dBm to +0 dBm
	for EDR packets (2-DHx, 3-DHx)	-90 dBm to -3 dBm

<sup>1</sup> For Bluetooth® LE signals, the uncertainty is applicable for payload patterns 11110000, 10101010 and PRBS.

<b>Output level uncertainty</b>	in temperature range +20 °C to +35 °C	
RF IN/OUT	output level < -10 dBm	< 1.0 dB
	output level ≥ -10 dBm	< 1.5 dB
	in temperature range +5 °C to +45 °C	
	output level < -10 dBm	< 1.5 dB
	output level ≥ -10 dBm	< 2.0 dB

<b>Output level resolution</b>		0.1 dB
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<b>Generator RF output level repeatability</b>	typical values after 1 h warm-up time at constant ambient temperature	< 0.03 dB
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<b>VSWR</b>		
RF IN/OUT		< 1.5

<b>Attenuation of harmonics</b>	$f_0 = 2398 \text{ MHz to } 2499 \text{ MHz, up to } 7 \text{ GHz}$	
RF IN/OUT		> 30 dB

<b>Attenuation of nonharmonics</b>		> 50 dB
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<b>GFSK modulation</b>		
GFSK bit rate	DHx packet types	1 Mbps, $B \times T = 0.5$
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, in temperature range +20 °C to +35 °C	±1 %

<b>DPSK modulation</b>		
$\pi/4$ DQPSK bit rate	2-DHx packet types	2 Mbps
8DPSK bit rate	3-DHx packet types	3 Mbps
Symbol rate		1 Msps
Modulation uncertainty	DEVm	≤ 5 % (RMS)

<b>GFSK modulation Bluetooth® Low Energy</b>		
GFSK bit rate	RF_PHY_Test_Ref, ADV_IND, ADV_NONCONN_IND and DATA packet types	1 Mbps, $B \times T = 0.5$
Modulation index	11110000 pattern frequency deviation 250 kHz	0.50
Modulation index range	frequency deviation 200 kHz to 300 kHz	0.40 to 0.60
Modulation index resolution		0.01
Modulation index uncertainty	11110000 pattern, frequency deviation 250 kHz, in temperature range +20 °C to +35 °C	±1 %

<b>Dirty TX (basic rate)</b>		
Frequency offset range		±250 kHz
Frequency offset resolution		1 kHz
Frequency offset uncertainty		±5 Hz + drift of time base
Modulation index range		0.20 to 0.44
Modulation index resolution		0.01
Modulation index uncertainty	11110000 pattern, in temperature range +20 °C to +35 °C	±1 %
Symbol time error range		±20 ppm
Symbol time error resolution		1 ppm
Symbol time error uncertainty		same as time base

Drift mode	drift is dependent on packet type	on/off
	DH1: frequency modulation with $\pm 25$ kHz deviation and 1600 Hz sinewave modulation frequency	
	DH3: frequency modulation with $\pm 40$ kHz deviation and 500 Hz sinewave modulation frequency	
	DH5: frequency modulation with $\pm 40$ kHz deviation and 300 Hz sinewave modulation frequency	
	successive packets have alternating start phases of $0^\circ/180^\circ$	
Drift resolution		N/A
Drift uncertainty (FM deviation)		$\pm 5$ kHz

<b>Dirty TX (EDR)</b>		
Frequency offset range		$\pm 250$ kHz
Frequency offset resolution		1 kHz
Frequency offset uncertainty		$\pm 5$ Hz + drift of time base
Symbol time error range		$\pm 20$ ppm
Symbol time error resolution		1 ppm
Symbol time error uncertainty		same as time base
Drift mode	frequency modulation with $\pm 10$ kHz deviation and sinewave modulation period of 100 $\mu$ s; successive packets have alternating start phases of $0^\circ/180^\circ$	on/off
Drift resolution		N/A
Drift uncertainty (FM deviation)		$\pm 0.5$ kHz

<b>Dirty TX (Bluetooth® Low Energy)</b>		
Frequency offset range		$\pm 250$ kHz
Frequency offset resolution		1 kHz
Frequency offset uncertainty		$\pm 5$ Hz + drift of time base
Modulation index range		0.40 to 0.60
Modulation index resolution		0.01
Modulation index uncertainty	11110000 pattern, in temperature range +20 °C to +35 °C	$\pm 1$ %
Symbol time error range		$\pm 50$ ppm
Symbol time error resolution		1 ppm
Symbol time error uncertainty		same as time base
Drift mode	frequency modulation with $\pm 50$ kHz deviation and sinewave modulation period of 1600 $\mu$ s (625 Hz); successive packets have alternating start phases of $0^\circ/180^\circ$	on/off
Drift resolution		N/A
Drift uncertainty (FM deviation)		$\pm 5$ kHz

Note: Both the basic rate and EDR dirty transmitter, with the Specification Table setting, are in line with the Bluetooth® Radio Frequency Test Specification V1.2/V2.0+EDR/V2.1+EDR, supporting both single-slot and multi-slot ACL packets.

## RF analyzer

<b>VSWR</b>		
RF IN/OUT	2398 MHz to 2499 MHz	< 1.5
<b>RF channel definition</b>		
	Bluetooth® menu	2402 MHz + k × 1 MHz, k = 0 to 93
	Bluetooth® LE menu	2404 + k × 2 MHz, k = 0 to 10 2406 + k × 2 MHz, k = 11 to 36 channel 37 = 2402 MHz channel 38 = 2426 MHz channel 39 = 2480 MHz
<b>Frequency range</b>		
	RF menu	2398 MHz to 2499 MHz
	Bluetooth® menu	2402 MHz to 2495 MHz
	Bluetooth® LE menu	2402 MHz to 2480 MHz
<b>Frequency resolution</b>		
	channel spacing in line with standard	1 MHz
<b>Frequency uncertainty</b>		
		±5 Hz + drift of time base
<b>Hopping scheme</b>		
	modes in line with Bluetooth® standard	Europe (except France), USA France RX/TX single frequency reduced hopping
	Bluetooth® Low Energy	no hopping and no signaling

## Power meter (frequency-selective) and power versus time

<b>Measurement bandwidth</b>		
	filter definition: passband	
	Bluetooth® and Bluetooth® LE menu	
	filter bandwidth → wide	2.0 MHz
	filter bandwidth → narrow	1.3 MHz
	RF menu	10 Hz to 1 MHz in 1/2/3/5 steps
<b>Level range</b>		
RF IN/OUT	continuous power	-40 dBm to +22 dBm
	peak envelope power <sup>2</sup> (PEP)	+26 dBm (400 mW)
<b>Level uncertainty</b>		
	in temperature range +20 °C to +35 °C	
RF IN/OUT	Bluetooth® and Bluetooth® LE menu	
	from full scale down to -25 dB	< 1.0 dB
	RF menu	
	input level -40 dBm to +22 dBm	< 1.0 dB
<b>Level uncertainty</b>		
	in temperature range +5 °C to +45 °C	
RF IN/OUT	Bluetooth® and Bluetooth® LE menu	
	from full scale down to -25 dB	< 1.5 dB
	RF menu	
	input level -40 dBm to +22 dBm	< 1.5 dB
<b>Level resolution</b>		
	in manual mode	0.1 dB
	in remote control mode	0.01 dB
<b>Reference level for full dynamic range</b>		
RF IN/OUT	GFSK signal	
	continuous power	-25 dBm to +22 dBm
	peak envelope power <sup>2</sup> (PEP)	+26 dBm (400 mW)

<sup>2</sup> Mean value of power versus time must be equal to or less than permissible continuous power.

<b>Dynamic range</b>	filter bandwidth → wide	> 55 dB (RMS)
<b>RF level measurement repeatability</b>	typical values after 1 h warm-up time at constant ambient temperature	< 0.03 dB

## Modulation analyzer

<b>Measurement bandwidth</b>	filter definition: passband	
	filter bandwidth → wide	2.0 MHz
	filter bandwidth → narrow	1.3 MHz

<b>Level range</b>		
RF IN/OUT	GFSK signal	from full-scale setting down to -25 dB

<b>Level range</b>		
RF IN/OUT	DPSK signal	from full-scale setting down to -25 dB

<b>Total measurement range for frequency offset and frequency deviation (GFSK)</b>	Bluetooth® menu frequency offset < maximum deviation	-250 kHz to +250 kHz
	Bluetooth® LE menu frequency offset < maximum deviation	-350 kHz to +350 kHz

<b>Nominal measurement range for DPSK signals</b>	filter bandwidth → wide	-75 kHz to +75 kHz
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<b>Frequency offset uncertainty in preamble (GFSK)</b>	Bluetooth® menu for deviation ≤ 160 kHz	≤ 2 kHz
	Bluetooth® LE menu for deviation ≤ 250 kHz	≤ 2 kHz

<b>Frequency stability uncertainty (DPSK)</b>	for $\omega_i \leq 75$ kHz, for deviation ≤ 160 kHz	≤ 2 kHz
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<b>Frequency deviation uncertainty in payload (GFSK)</b>	for modulation index 0.22 to 0.42 filter bandwidth → narrow	≤ 1.3 %
	Bluetooth® LE menu for extended modulation index 0.42 to 0.60 filter bandwidth → narrow	≤ 1.3 %

<b>Frequency deviation uncertainty in payload (DPSK)</b>	PRBS pattern in temperature range +20 °C to +35 °C	
	DEVm	≤ 3 % (RMS)
	DEVm	≤ 8 % (peak)

<b>Uncertainty of frequency drift measurement (GFSK)</b>	measured in burst related to frequency offset in preamble	
	10101010 pattern	≤ 2 kHz

<b>Relative frequency drift uncertainty (GFSK)</b>	referenced to frequency offset value in preamble	
	10101010 pattern	≤ 1 kHz

<b>Frequency drift uncertainty (DPSK)</b>	for $\omega_o \leq 10$ kHz	≤ 1 kHz
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<b>Frequency resolution (GFSK)</b>	in manual mode	1 kHz
	in remote control mode	1 Hz

<b>Frequency resolution (DPSK)</b>	in manual mode	100 Hz
	in remote control mode	1 Hz

## Packet timing measurement

<b>Range</b>		$\pm 20 \mu\text{s}$
<b>Resolution</b>		$0.25 \mu\text{s}$
<b>Uncertainty</b>		$\leq 0.25 \mu\text{s} + \text{resolution}$

## Guard time measurement

<b>Resolution</b>		$0.01 \mu\text{s}$
<b>Uncertainty</b>		$\leq 0.05 \mu\text{s}$

## Speech codec

<b>Speech decoder output</b>	SPEECH CODEC OUT	BNC connector
Output impedance		$< 10 \Omega$
Maximum output current		20 mA (peak)
Full range output level		1 V (peak)

<b>Speech coder input</b>	SPEECH CODEC IN	BNC connector
Input impedance		100 k $\Omega$
Full range input level	high voltage range	1.4 V (peak)
	low voltage range	0.1 V (peak)

## R&S®CBT-B41 audio generator/analyzer option

### AF generator

<b>Output impedance</b>		$< 4 \Omega$
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<b>Maximum output current</b>		20 mA (peak)
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<b>AF sinewave generator</b>	AF 1 OUT, AF 2 OUT	BNC connector
Frequency range		20 Hz to 20 kHz
Frequency uncertainty		same as time base + half resolution, see base unit specifications
Frequency resolution		0.1 Hz
Output level range		10 $\mu\text{V}$ to 5 V
Output level resolution	at level $< 10 \text{ mV}$	10 $\mu\text{V}$
	at level $\geq 10 \text{ mV}$	0.1 %
Output level uncertainty	at level $\geq 1 \text{ mV}$ and frequency $\leq 10 \text{ kHz}$	$\leq 1.5 \% + \text{resolution}$
THD+N <sup>3</sup>	at level $\geq 100 \text{ mV}$ into load $\geq 600 \Omega$	$\leq 0.05 \%$

### AF analyzer

<b>Input impedance</b>		1 M $\Omega$    100 pF
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<b>AF voltmeter</b>	AF 1 IN, AF 2 IN	BNC connector
Frequency range		50 Hz to 20 kHz
Level range		50 $\mu\text{V}$ to 30 V
Level resolution	at level $< 1 \text{ mV}$	1 $\mu\text{V}$
	at level $\geq 1 \text{ mV}$	0.1 %
Level uncertainty	at $1 \text{ mV} \leq \text{level} \leq 2 \text{ V}$	$< 1.5 \% + \text{resolution}$
	at $2 \text{ V} < \text{level} \leq 20 \text{ V}$	$< 2.0 \% + \text{resolution}$

<sup>3</sup> Measurement bandwidth 21.9 kHz.

<b>THD+N meter</b>		
Measurement bandwidth		21 kHz
Frequency range		100 Hz to 10 kHz
Level range		10 mV to 30 V
Resolution		0.01 % THD+N
Inherent distortion	at $100 \text{ mV} \leq \text{level} \leq 20 \text{ V}$	< 0.05 % THD+N
Uncertainty	at $100 \text{ mV} \leq \text{level} \leq 2 \text{ V}$	< 1 % + inherent resolution
	at $2 \text{ V} < \text{level} \leq 20 \text{ V}$	< 2 % + inherent resolution

## R&S®CBT-B42 digital audio interface option

<b>S/P-DIF</b>	S/P-DIF IN, S/P-DIF OUT	in line with IEC 60958-3
<b>Sampling rate</b>		48 kHz

## Inputs and outputs (rear panel)

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

<b>Printer interface LPT</b>	parallel (Centronics compatible)	25-pin D-Sub connector
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<b>Keyboard</b>		USB connector
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<b>Analog monitor (VGA)</b>		15-pin D-Sub connector
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<b>Trigger output</b>	RF menu	
	test trigger	BNC connector TRIG OUT
	Bluetooth® menu	
	burst trigger	BNC connector TRIG OUT

<b>External reference REF IN</b>	10 MHz	BNC connector
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## General data

<b>Operating temperature range</b>		+5 °C to +45 °C, in line with EN 60068-2-1 and -2
<b>Storage temperature range</b>		-25 °C to +60 °C, in line with EN 60068-2-1 and -2
<b>Humidity</b>	+40 °C, noncondensing	80 % relative humidity, in line with EN 60068-2-78

<b>Electromagnetic compatibility</b>		in line with EMC Directive 89/336/EEC, applied standard: EN 61326 (immunity for industrial environment; class A emissions)
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**Note:**

The instrument complies with the emission requirements stipulated by EN 55011 class A. This means that the instrument is suitable for use in industrial environments. In line with EN 61000-6-4, operation in residential, commercial and business areas or in small-size companies is not covered.

Thus, the instrument may not be operated in residential, commercial and business areas or in small-size companies, unless additional measures are taken to ensure that EN 61000-6-3 is complied with.

<b>Electrical safety</b>		IEC 61010-1, EN 61010-1, UL 3111-1, CAN/CSA-C22.2 No. 1010.1
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<b>Mechanical resistance</b>	nonoperating mode	
Vibration	sinusoidal	in line with EN 60068-2-6, EN 61010-1, MIL-T-28800D class 5, 5 Hz to 150 Hz, max. 2 g at 55 Hz, 55 Hz to 150 Hz, 0.5 g const.
	random	in line with EN 60068-2-64, 10 Hz to 300 Hz, acceleration 1.2 g RMS
Shock		in line with EN 60068-2-27, MIL-STD-810D, 40 g shock spectrum

<b>Power supply</b>		power factor correction, in line with EN 61000-3-2
Input		100 V to 240 V $\pm$ 10 % (AC), max. 220 VA, 47 Hz to 63 Hz
Power consumption	R&S®CBT R&S®CBT32	approx. 60 W approx. 50 W

<b>Display</b>	not included in the R&S®CBT32	21 cm TFT color display (8.4")
Resolution		640 $\times$ 480 pixel (VGA resolution)
Pixel failure rate		$< 2 \times 10^{-5}$

<b>Dimensions (W <math>\times</math> H <math>\times</math> D)</b>	R&S®CBT	411 mm $\times$ 193 mm $\times$ 317 mm (16.2 in $\times$ 7.6 in $\times$ 12.5 in) (7/8 $\times$ 19"; 4 HU)
	R&S®CBT32	465 mm $\times$ 93 mm $\times$ 417 mm (18.3 in $\times$ 3.7 in $\times$ 16.4 in) (19"; 2 HU)

<b>Weight</b>	R&S®CBT	approx. 7 kg (15.4 lb)
	R&S®CBT32	approx. 6 kg (13.2 lb)

## Ordering information

Designation	Type	Order No.
<b>Base units</b>		
Bluetooth® Tester with display, 4 HU	R&S®CBT	1153.9000.35
Bluetooth® Tester without display, 19", 2 HU, for remote control	R&S®CBT32	1153.9000.32
<b>Hardware options</b>		
Dual-Channel Audio Generator and Analyzer, for R&S®CBT only	R&S®CBT-B41	1170.3406.05
Dual-Channel Audio Generator and Analyzer, for R&S®CBT32 only	R&S®CBT-B41	1170.3406.02
Digital Audio Interface (S/P-DIF; R&S®CBT-B41 required)	R&S®CBT-B42	1170.3706.03
<b>Software options</b>		
A2DP Stereo Profile and SBC Codec (R&S®CBT-B41 required)	R&S®CBT-K52	1170.4002.02
Handsfree and Headset Profiles	R&S®CBT-K54	1170.3806.02
Enhanced Data Rate (EDR)	R&S®CBT-K55	1170.3206.02
Bluetooth® Low Energy Option (Low Energy Non-Signaling Measurements)	R&S®CBT-K57	1170.4102.02
<b>Accessories</b>		
19" Adapter, 2 HU, for R&S®CBT32	R&S®ZZA-211	1096.3260.00
19" Adapter, 4 HU, for R&S®CBT	R&S®ZZA-S03	1105.6756.00
Documentation of Calibration Values	R&S®DCV-1	0240.2187.08
Antenna Coupler for mobile phones	R&S®CMU-Z10	1150.0801.10
RF Shielded Cover, extension for R&S®CMU-Z10	R&S®CMU-Z11	1150.1008.02
Bluetooth® Antenna, extension for R&S®CMU-Z10	R&S®CMU-Z12	1150.1043.02

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R&S®CBT/ R&S®CBT32 Bluetooth® Tester

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