

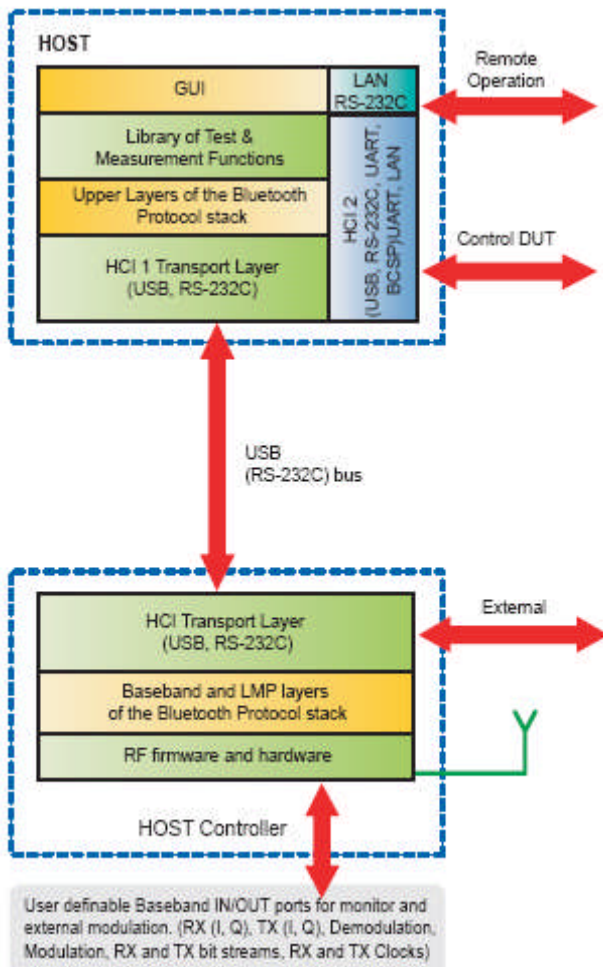


TC-3000C Bluetooth Tester



Product Overview

TC-3000C Bluetooth Tester is able to analyze the data of each packet that is transmitted to the upper application protocol layer using the protocol stack. In addition, the user can examine the transmitting and receiving signal function. Since it has a built-in signal waveform analysis functions such as spectrum analysis, modulation analysis and period power analysis, this enables the user to perform various RF tests simply and conveniently. Moreover, since it is capable of performing various test cases including EDR , it enables the user to verify product compliance to Bluetooth specifications easily.



System Structure

TC-3000C uses the general structure of the Bluetooth system and consists of two parts, which includes the RF/DSP module (Host Controller) that is connected by the internal HCI (Host Control Interface) and host CPU module (Host).

The RF/DSP module consists of the RF Modem and highly functional DSP. The Host CPU (Internal PC) manages the UI (User Interface), screen key input, and I/O control (extra extensions such as RS-232C, USB, LAN, etc.) based on optimized Linux OS. This structure is designed to perform efficiently and safely through its internal PC and high performance of DSP.

Protocol Stack and Analysis function

The built-in Bluetooth protocol stack of TC-3000C was developed using our own technology from the Baseband to the upper profile to improve the performance of the equipment and ability to measure Bluetooth devices. By using the convenient structure, which 'Queue' is located

between each level of the protocol, it enables the user to manage the upgrading of equipment or additions of functions. The user is able to check the status of the DUT protocol by analyzing and transmitting data



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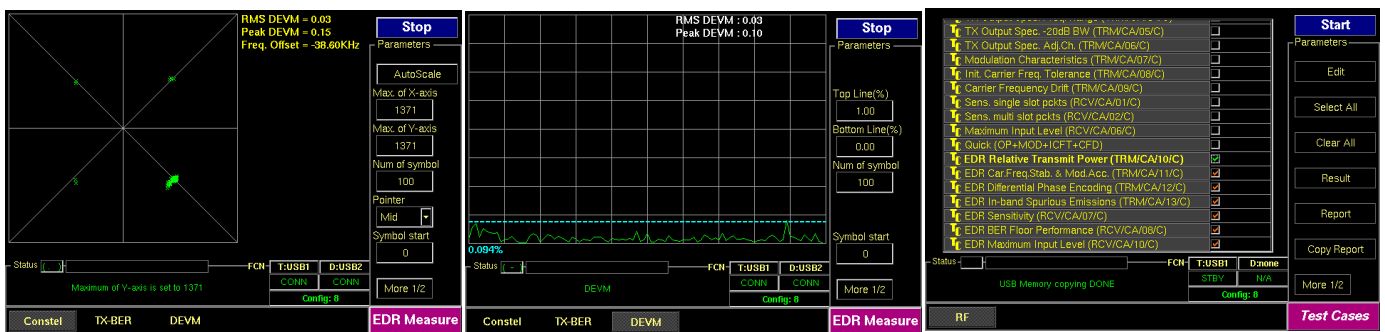
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related to Baseband, LMP, HCI Command, L2CAP, RFCOMM, SDP, AVDTP, and Profile, and it can be analyzed through the Link Analyzer and Host Analyzer function.

EDR

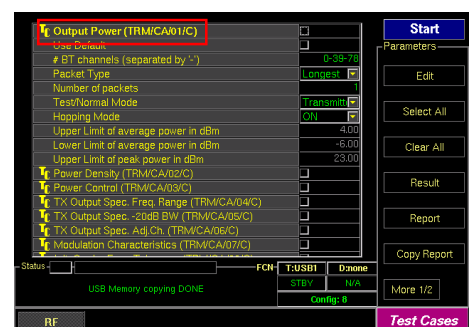
Bluetooth is wireless telecommunication technology to exchange data and voice by connecting devices that are within a specified range. However, the speed of data transmission is quite low, 1Mbps, and its application range is limited. Therefore, EDR was added to Bluetooth to the specification as a migration to 2.0 to overcome this problem. Now, it is able to support 2Mbps and 3Mbps data transmission rates.

TC-3000C supports both 2Mbps and 3Mbps EDR functions and provides EDR Measurement for measuring the performance of RF and Baseband. Users analyze the PSK modulation of DUT by using the I-Q Constellation function of EDR Measurement. They are able to check the eligibility of EDR performance for the test through 7 EDR related RF test cases (EDR Relative Transmit Power, EDR Carrier Frequency Stability and Modulation Accuracy, EDR Differential Phase Encoding, EDR In-band Spurious Emissions, EDR Sensitivity, EDR BER Floor Performance, EDR Maximum Input Level).



Overall Automatic Measurement

TC-3000C has built-in test cases such as RF, EDR and Baseband, which are included in the Bluetooth test standards. The user is able to conduct overall measurements automatically to determine the product compliance to the test criteria using only one operation. The user is able to change the measurement criteria and conditions of 13 Baseband test cases, 12 RF test cases, and 7 EDR related RF test cases. Various test cases can be performed





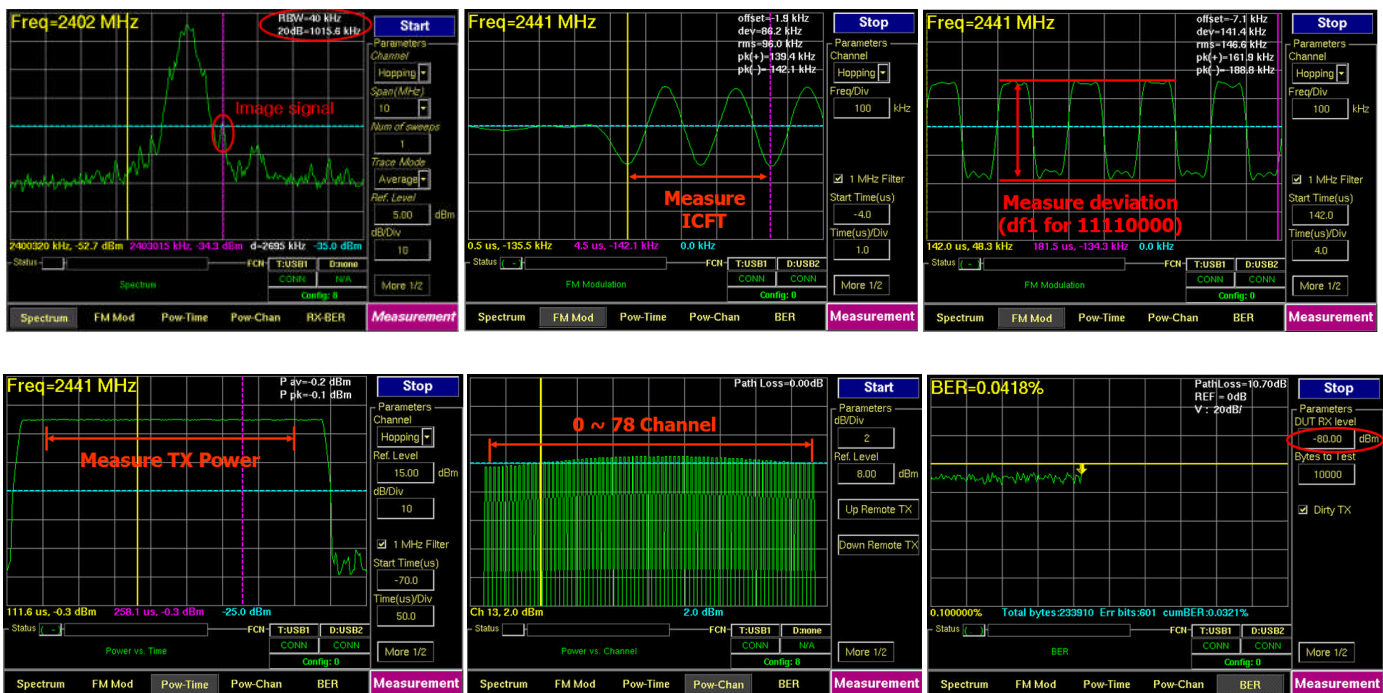
simultaneously. A test results report can then be checked through the GUI. The report can be saved and copied.

Speed Test Mode

TC-3000C provides a Quick Test Case function which enables the user to select only those test cases that suit the user's manufacturing testing requirements with the combination of the four most used RF test cases (Output Power, Modulation Characteristic, Initial Carrier Frequency Tolerance, Carrier Frequency Drift). Thus, through this function, it increases the manufacturing efficiency by reducing unnecessary measurement times.

Measurement Function

The TC-3000C provides specialized functions for performing Bluetooth test measurement. It can monitor the Spectrum, Modulation, Channel Power and RX-BER. From EDR measurement function, the user is able to check IQ Constellation, TX-BER, and DEVM. There are various powerful waveform analysis functions available for checking and solving the RF functions of the device.



Audio Analyzer

Different from common audio analyzers that only check simple audio functions by applying Headset, Handsfree, Audio gateway, A2DP(stereo headset) profile of Bluetooth, the audio analyzing function of TC-3000C transmits the tone signal through the Bluetooth link and analyzes the signal received from the reception. Therefore, the user is able to examine not only audio but also the RF function simultaneously. The audio analyzer function of the TC-3000C provides a wide range of choices through various analyzing



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functions, which provide more than the standard analyzing functions offered by most devices (i.e., distortion of audio signal, SINAD, RMS, etc.). Additional functions of TC-3000C include Audio Spectrum, SCO loopback, Audio Sweep, etc.

The screenshot shows the 'Audio Analyzer' interface. On the left, three red arrows point to the 'Audio Analyzer', 'Output power', and 'ICFT Modulation' sections. The 'Audio Analyzer' section displays: Frequency 1000.0 Hz, P. Power -27.5 dBm, SINAD 28.9 dB, RMS -25.8 dBm, and Distortion 3.6%. The 'Output power' section shows a table of power levels for channels 0, 39, 78, and 79. The 'ICFT Modulation' section shows a table of modulation parameters for channels 0, 39, and 78. The 'Parameters' section on the right includes Tone Freq (Hz) set to 1000, Tone level (dBm) set to -26, Audio In (Hz) set to 1000, and DUT RX level set to 0.00 dBm. A red arrow points from the 'DUT RX level' label to the 0.00 dBm value.

The screenshot shows the 'Audio Spectrum' interface. A red oval highlights a peak in the spectrum labeled '1 kHz Test signal'. The interface includes a 'Parameters' section on the right with settings for Tone Freq (Hz) at 1000, Tone level (dBm) at -31, dBm/Div at 10, Ref. Level (dBm) at -10, Num of Avg at 1, and DUT RX level at 0.00 dBm. A red arrow points from the 'DUT RX level' label to the 0.00 dBm value. The status bar at the bottom indicates 'Marker Step is set to 1'.



Key Feature

- Supports Bluetooth 1.1/1.2/2.0(+ EDR)/2.1
- Integrated measurement (RF, Audio, Protocol)
- Measures the suitability of Bluetooth specifications, overall auto measurement function according to test case
 - Supports 12 RF test cases
 - Supports 13 basic Baseband test cases
 - Supports Dirty Transmitter
- Audio performance (SCO Link) Measurement function (Option 3000-10)
 - Audio test function using Headset, Handsfree, A2DP profile(stereo headset)
 - Audio quality verification (SINAD, Distortion), Audio spectrum, SCO loopback function
- RF signal analyzer function (Option 3000-20)
 - Spectrum Analyzer, Analyze Modulation wave form, power vs. time, power vs. channel, RX-BER
- Protocol analyzer function (Option 3000-30)
 - Supports Master/Slave mode
 - Baseband, LMP, HCI, L2CAP, RFCOMM, SDP, AVDTP, Profile packet analysis
 - Execute function of HCI command
- EDR Function (Option 3000-40)
 - I-Q Constellation
 - DEVM (Differential Error Vector Magnitude)
 - TX Bit Error Rate (TX-BER)
 - Supports 7 EDR RF test cases
- Digital signal generator for 2.4GHz/Spectrum Analyzer
- User definable Baseband IN/OUT ports for real-time signal monitoring, external modulation, audio source and audio analyzer
- HCI interface for DUT connection: USB, RS-232C (UART, BCSP)
- Remote control: TCP/IP (LAN), RS-232C
- Simple upgrade through the Internet or USB.

Bluetooth Measurement Structure

Normally for Bluetooth measurement, a test JIG that holds the DUT (Device under test) and TEM Cell, or Shield Box are needed in addition to the Bluetooth tester. In a shield box, the connection method would be based dependent on the configuration of DUT. Due to variations in their sizes, most Bluetooth products do not have a connector for measurements. Therefore in most cases it requires over the air coupling through to the Bluetooth antenna with the use of an antenna coupler or through conductive testing by making physical



contact through the use of probes in the case of test Bluetooth Module or PCBs. An efficient RF shielding environment is important for accurate and correct measurements under in any circumstances. Measurement error could occur by a simple shield box that has irregular RF coupling or resonance problems. All our test cells remove these problems and provide a reliable RF coupling environment with efficient shielding. In addition, we provide a perfect Bluetooth measurement system with TC-3000C.

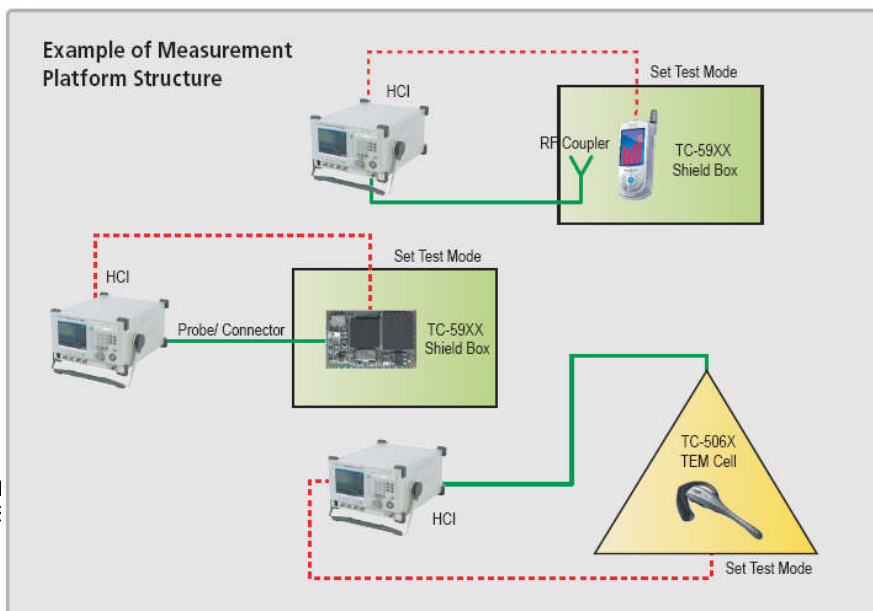
RF Performance Test and Test Mode

The RF function measurement of the Bluetooth device refers to the measurement test standard specified in the Bluetooth RF test specifications. Since the TC-3000C has 12 built-in RF test cases and 7 built-in EDR related test cases, the user is able to measure automatically using only one operation.

According to the Bluetooth RF test specifications, the DUT must be measured in a loopback or Transmitter test mode, and this would be the most important consideration for Bluetooth measurement. The test mode is activated by TC-3000C control through the HCI port of DUT. When there is no HCI port, use the user's DUT control program in PCB status or activate the test mode through operating the Bluetooth chip manufacturer's specified keying sequence of the completed product. If the method of test mode activation is not available, the user must use a verification method that can check the performance of the product in Normal mode such as the audio measurement method.

Measurement of Audio Performance

Bluetooth products such as mobile phones and headsets are audio products that have speakers and a microphone. Therefore, not only the RF measurement but also inspection of audio performance is important. Since the TC-3000C has a built-in Audio Analyzer that is specially designed for the measurement of Bluetooth devices, the user is able to measure the performance of devices that include the audio feature accurately and easily without using any additional test equipment. In addition, since it has built-in low level of protocol stack and a profile that is related to audio, even if the device has no HCI port for activation of the test mode, the user is able to examine the device in Normal mode status. Through the audio measurement solution, it supports RF special measurement of the test case and inspects faulty audio. Therefore, the user is able to perform a perfect measurement of the system range from development to the whole manufacturing process.





Product Specification

RF SOURCE

Output Frequency

Range: 2.4GHz ~ 2.5GHz

Accuracy: $\pm 46\text{Hz}$ + Frequency Reference Drift

Resolution: 1KHz

Switching Time: $<160\mu\text{s}$, $\pm 75\text{kHz}$ of the final frequency

Output Level

Range: 0 ~ -80dBm

Accuracy: $\pm 1\text{dB}$

Resolution: $\pm 0.1\text{dB}$

Modulation

Type: GFSK BT=0.5

Deviation Range: 0.00 ~ 1MHz

Resolution: 600KHz

Modulation Rate: 0 ~ 1Mbps

RF ANALYZER

Input Frequency

Range: 2.4GHz ~ 2.483GHz

Accuracy: $\pm 46\text{Hz}$ + Frequency Reference Drift

Resolution: 1KHz

LO Switching Time: $<160\mu\text{s}$, $\pm 75\text{kHz}$ of the final frequency

Input Level

Range: -10 ~ -80dBm (+20dBm ~ -50dBm with 30dB attenuator ON)

Absolute Max: +25dBm

Accuracy: $\pm 1\text{dB}$, 0.1dB resolution

Intermediate Frequency

IF Frequency: 70MHz

Filter BW: 10MHz Max.

Sampling Rate: 40MHz

1MHz Digital Filter ON/OFF

SPECTRUM ANALYZER

Frequency Range: 2.4~2.483GHz

Max Span: 10MHz

Resolution BW: ~40KHz at 10MHz Span.



Averaging: 1~50

FM MODULATION ANALYZER

Modulation: FM, GFSK

Frequency Response: 1MHz with channel filter selected

Deviation Range: 0~4MHz

Resolution: 0.1KHz

Frequency Accuracy: 1KHz

POWER-TIME

Level Accuracy: ± 1 dB, 0.1dB resolution

Trigger Method: Access Code (BT), Power Level

POWER-CHANNEL (BT Mode)

Level Accuracy: ± 1 dB, 0.1dB resolution

DUT Mode: Null Packet or Test Mode

RX BER TEST (BT Mode)

DUT Mode: Requires loopback Test Mode

Graph: Log Scale BER-Time

Reading: %, Instantaneous, Cumulative

Parameters: RX Power, Measurement Data Length, Packet Length/Type

I-Q CONSTELLATION (EDR BT Mode)

DUT Mode: Requires EDR Test Mode

Graph: Display I-Q symbol of DPSK

Parameters: Symbol start point, Number of symbol

TX BER TEST (BT Mode)

DUT Mode: Requires EDR Transmitter Test Mode

Graph: Log Scale TX BER-Time and PER (Packet Error Rate)

Reading: %, Instantaneous, Cumulative

Parameters: Number of packets

DEVM (Differential Error Vector Magnitude)

DUT Mode: Requires EDR Test Mode

Graph: Displays DEVM on time axis

Useful test for measuring DEVM variance in a packet

FREQUENCY REFERENCE

Internal Reference Stability: ± 1 ppm vs. at $-20 \sim 70^\circ\text{C}$, ± 1 ppm/first year

External Reference: 10MHz



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FRONT PANEL

RF In/Out Port: N-type, 50 ohm, VSWR <1.6

Baseband In/Out ports: 4BNC

- IN: input impedance 50ohms, Max input level is $\pm 1V_{pp}$
- OUT: output impedance 50ohms, normal output level is $\pm 1V_{pp}$, DC coupled
- RX (I, Q), TX (I, Q), Demodulation, Modulation, RX and TX bit streams, RX and TX Clocks

REAR PANEL

HCI Interface for DUT: RS-232C, USB

Remote Programming Interface: TCP/IP (LAN), RS-232C

MISCELLANEOUS

Operating temperature: 5 ~ 40°C

Line Voltage: 100 to 240VAC, 50/60Hz

Dimensions: 375(w) x 432(d) x 220(h) mm

Weight: 10Kg

Ordering Information

TC-3000C, Bluetooth Tester, Signal Generator that includes 12 RF Test Cases

Option

3000-10: Audio Analyzer, Includes SCO Link, Audio Test, and Audio Spectrum

3000-20: Measurement Function, Includes Spectrum, FM Modulation, Power vs. Channel, Power vs. Time, RX- BER

3000-30: Protocol Analyzer, Includes Link Analyzer (Link, Packet Information, LMP, HCI, Baseband Information) and Host Analyzer (Link, L2CAP, RFCOMM, SDP, AVDTP Profile)

3000-40: EDR(Enhanced Data Rate) Function, Includes 7 EDR RF Test Cases, *EDR Measurement (Constellation, DEVM, TX-BER)

*In order to utilize the EDR functions, Option 3000-20 must also be purchased along with 3000-40.