Bluetooth™ measurements in CMU200

General

The CMU200 with the *Bluetooth* option can set up a *Bluetooth* connection to a Device Under Test (DUT) via the RF interface. The CMU200 switches the DUT into test mode and performs a number of basic RF measurements (TX and RX). According to the *Bluetooth* Test Mode Specification the DUT has to be locally enabled for the test mode operation. All measurements can be performed in hopping-, reduced hopping- or non-hopping-mode. The CMU200 supports measurements using DH1, DH3 and DH5 packets.

The coupling between the CMU200 and the DUT can be either via a cable or a coupler, depending on the implementation of the DUT.

Applications

The Universal Radio Communication Tester CMU200 with the *Bluetooth* option is the ideal instrument for production, development and maintenance of any kind of devices with integrated *Bluetooth* wireless technology.

The CMU200 can also be equipped with additional options for cellular standards like GSM, AMPS, TDMA or CDMA. Therefore the CMU200 is an ideal tester for mobile phone production, as it offers measurements in line with *Bluetooth* wireless technology and cellular standards in one instrument. With a further extension, which is already in development, the CMU200 will be able to run *Bluetooth* measurements and cellular measurements simultaneously. This means the total test time for a mobile phone will not be increased by the *Bluetooth* tests because the two types of tests can take place at the same time.

Compliance with existing Bluetooth standards

The CMU200 is compliant with the *Bluetooth* core specification Ver. 1.0 B (Core specification Ver 1.1 in preparation). The *Bluetooth* Test Mode (Core Spec. Part I:1) is implemented with all commands needed to perform the TX/RX measurements.

The *Bluetooth* RF Test Specification Ver. 0.9 describes RF test cases for the *Bluetooth* qualification process. Rohde&Schwarz offers the Test System TS8960 for *Bluetooth* qualification tests, which is fully compliant with the RF Test Specification. Although the CMU200 was not designed for qualification tests, the RF test specification was taken as a guideline for the implementation of the CMU200´s *Bluetooth* measurements.

Signalling

Setting up a *Bluetooth* connection

The CMU200 acts as the master of a *Bluetooth* piconet, the DUT as a slave. The CMU200 is able to perform the inquiry procedure for the identification of all *Bluetooth* devices within range of the CMU200. All devices found are listed on the display and one of them can be selected for the paging procedure. The CMU200 then establishes the connection to the DUT and switches it into 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.

Signalling information from the DUT

The CMU200 is able to display a variety of information which is received from the DUT (eg device name, version numbers, service class, supported features).

TX measurements

The current measurement values for each parameter are displayed on the CMU200 screen. Additionally average, maximum and minimum values are displayed as a result of a statistical evaluation of a settable number of *Bluetooth* packets (bursts).

Power measurements

Measurement parameters:

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- Nominal power (measured as the part of the burst starting at the detected 1st bit of the preamble (bit 0) to the last bit of the burst)
- Leakage power (measured within defined areas before and after the burst) Peak power (shows the highest powerlevel within a burst)

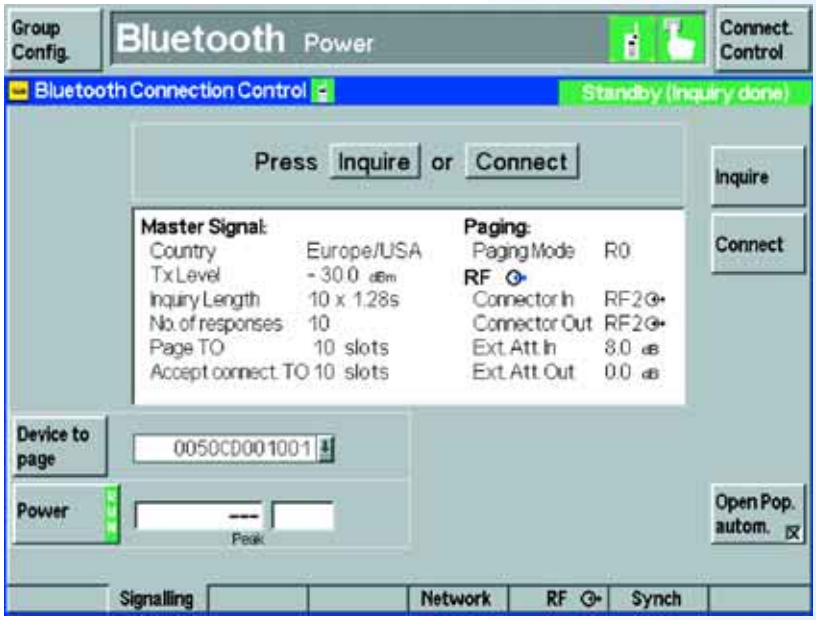
Timing measurements

Measurement parameter:

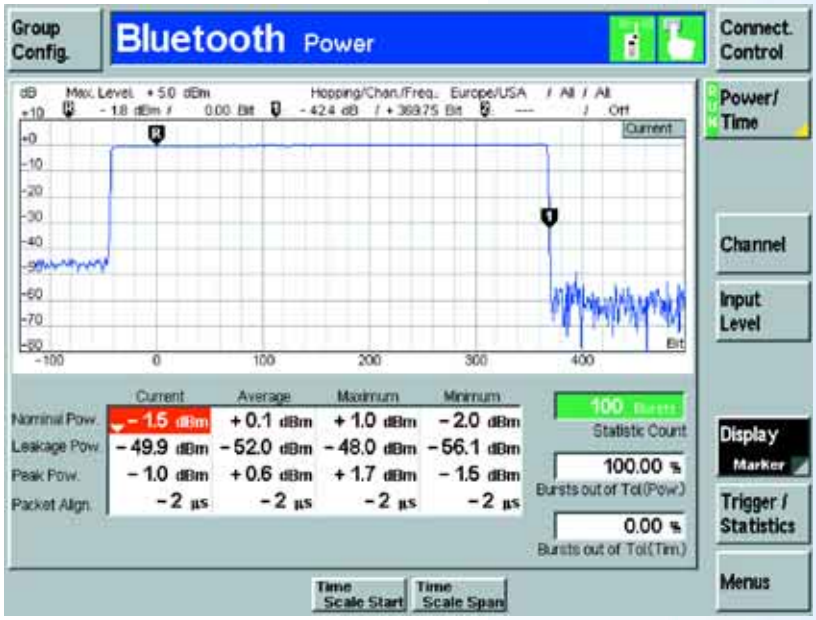
- Packet alignment (distance between ideal master receiver slot and detected bit 0 of the received burst)

This measurement is displayed on the "Power" screen.

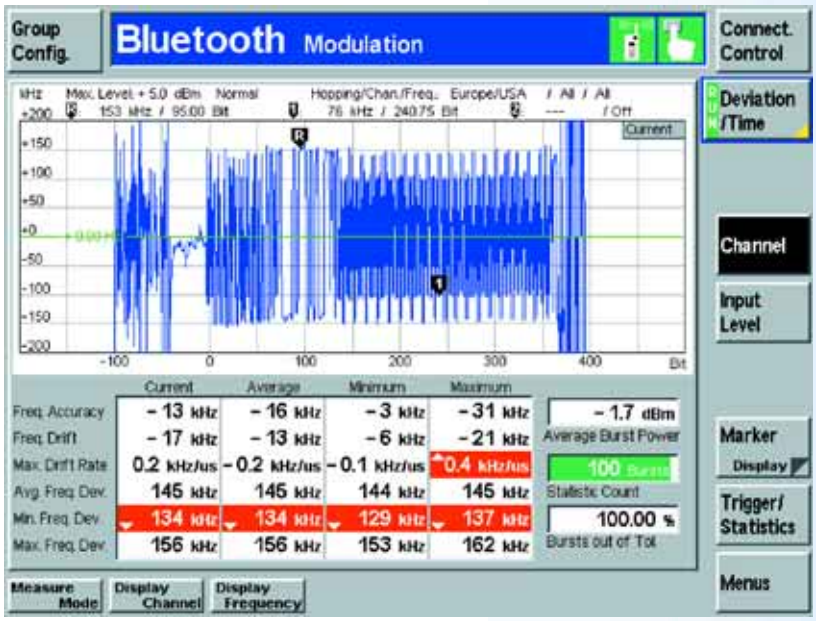
The connection control menu allows to inquire addresses of all Bluetooth devices in range. The "Device to page" softkey then selects the DUT for the measurements tests. Alternatively the input of a known address is possible



The power menu shows the results in graphical and scalar form. Statistical functions as well as convenient markers aid further evaluation. The timing measurement complements the numerical power results



The graphical display of the modulation results may be spread between 1/1 and 1/8 of a burst for in-depth analysis. The "Max. Freq. Dev." and "Min Freq. Dev." results allow the highest and lowest values for 10 bit long fractions of a payload to be evaluated individually

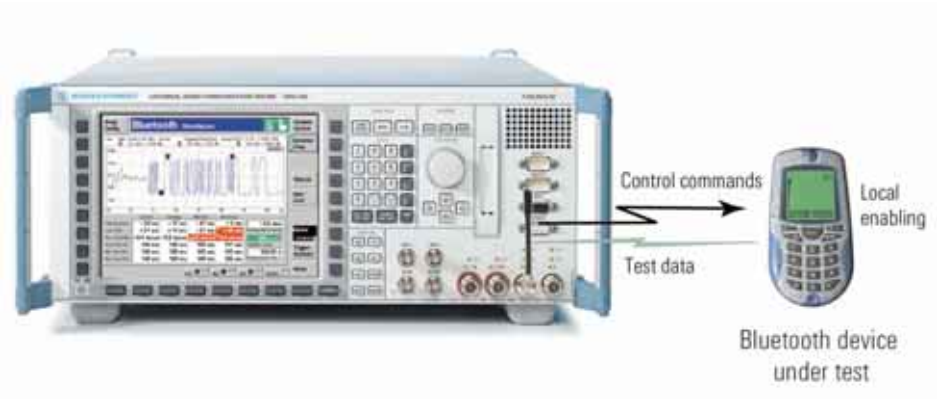


Bluetooth wireless technology in CMU200

Modulation measurements

Measurement parameters:

- Frequency accuracy (difference between measured frequency and intended transmitted frequency, measured in the preamble at the beginning of a packet)
- 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)



The device under test can be connected to the CMU200 via a RF coupler (antenna) or a cable

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 CMU200 again. The TX level of the CMU200 can be adjusted for this measurement. The BER application supports defining up to five test programs. Each program can independently set settings such as control parameters, limits, repetition or statistical cycles.

Bluetooth specifications

Standards Bluetooth Specification Version 1.0 b

RF generator

Frequency range

Europe (except Spain and France), USA and Japan	2.4000 GHz to 2.4835 GHz
France	2.4465 GHz to 2.4835 GHz
Spain	2.4450 GHz to 2.475 GHz

Frequency resolution channel spacing 1 MHz according to standard

Frequency hopping all modes according to standard

Output level range (modulated signal)

RF1	–106 dBm to –33 dBm
RF2	–106 dBm to –12 dBm
RF3OUT	–90 dBm to +5 dBm

Output level resolution 0.1 dB

Output level uncertainty

RF1	
in temperature range +23°C to +35°C	<0.9 dB
in temperature range +5°C to +45°C	<1.6 dB
RF2	
in temperature range +23°C to +35°C	<0.9 dB
in temperature range +5°C to +45°C	<1.6 dB
RF3OUT	
in temperature range +23°C to +35°C	<1.1 dB
in temperature range +5°C to +45°C	<1.6 dB

Modulation

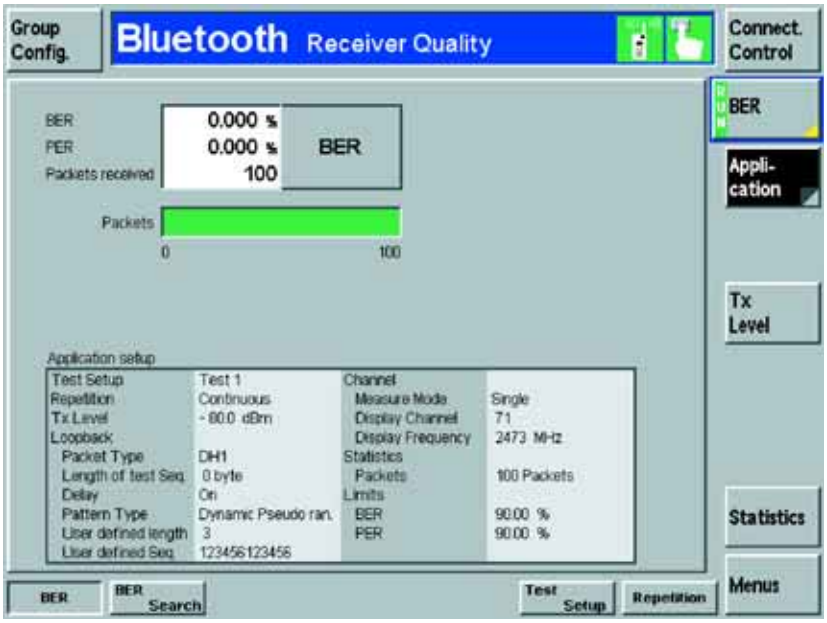
GFSK	
(AC coupling cut off frequency 100Hz)	1 Mbps, B*T=0.5
Modulation index (1111000 pattern	
in temperature range +23°C to +35°C)	0.304 to 0.336 plus residual FM (see base unit)

Bluetooth wireless technology highlights of CMU200

- *Bluetooth* test mode signalling
- High measurement accuracy and speed
- Parallel TX and RX measurement of the RF interface in loopback mode
- Output of *Bluetooth* specific clock signal
- IF signal output
- Graphical and scalar result output

Supported Standards

- *Bluetooth* Specification Version 1.0 b (prepared for Version 1.1)



The receiver quality measurement includes output of BER and PER values. Supports three modes, single shot, continuous and search of a target BER value by automatic variation of CMU200 output level. Up to 5 different best scenarios can be configured.

Sensitivity

Measurement parameters

- BER (percentage of bit errors that have occurred within the current statistical cycle)
- PER (percentage of packet errors that have occurred within the current statistical cycle, where an errored packet is a packet with a header which cannot be corrected)

RF analyzer

Frequency range	
Europe (except Spain and France), USA and Japan	2.4000 GHz to 2.4835 GHz
France	2.4465 GHz to 2.4835 GHz
Spain	2.4450 GHz to 2.475 GHz
Frequency resolution	channel spacing 1 MHz according to standard
Frequency hopping	all modes according to standard

Power meter (frequency selective) and power versus time

Level Resolution	0.1 dB
Reference level for full dynamic range (GFSK signal)	
RF1	0 dBm to +41 dBm
RF2	–14 dBm to +33 dBm
RF4IN	–32 dBm to 0 dBm
Level uncertainty from full scale down to –25 dB	
RF1, RF2	
in temperature range +23°C to +35°C	<0.7 dB
in temperature range +5°C to +45°C	<1.0 dB
RF4IN	
in temperature range +23°C to +35°C	<0.9 dB
in temperature range +5°C to +45°C	<1.1 dB
Dynamic range	>55 dB (BW= 3 MHz, rms)

Modulation analyzer (BW= 3 MHz)

Level range (GFSK signal)	
RF1, RF2, RF4IN	from full–scale setting down to –25 dB
Frequency offset error in preamble	≤4 kHz
Frequency deviation error in payload (for deviation ≤200 kHz)	≤5.5%
Total measurement range for frequency offset and frequency deviation	–250 kHz to +250 kHz

Timing measurement

Range	±20 µs
Uncertainty	≤0.25 µs