Bluetooth™ measurements in CMU200

General

The CMU200 was the first *Bluetooth* test set on the market and is the only tester which performs all measurements in full hopping, reduced hopping or non-hopping-mode. Measurements using DH1, DH3 and DH5 packets are supported. According to the *Bluetooth* Test Mode Specification the DUT has to be locally enabled for test mode operation. The CMU200 switches the DUT to test mode and performs a number of basic RF measurements (TX and RX).

Applications

The CMU200 with the *Bluetooth* option is the ideal instrument for production, development and maintenance of any kind of devices with integrated *Bluetooth* interface.

Due to its modular platform concept the CMU200 is the ideal solution for all cellular standard mobile phones production lines.

Parallel operation for high measurement speed

Due to the high measurement speed and large memory capacity of the CMU200, transmitter and receiver measurements can be carried out simultaneously. When measurements are performed in frequency hopping mode, a great test depth is rapidly attained. Only a few seconds are required between call setup, transmitter and receiver measurements and call detach. Fast test cycles guarantee a fast return of investment.

Many convenient measurement functions

The CMU200 offers a great 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 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 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.

Signalling information from the DUT

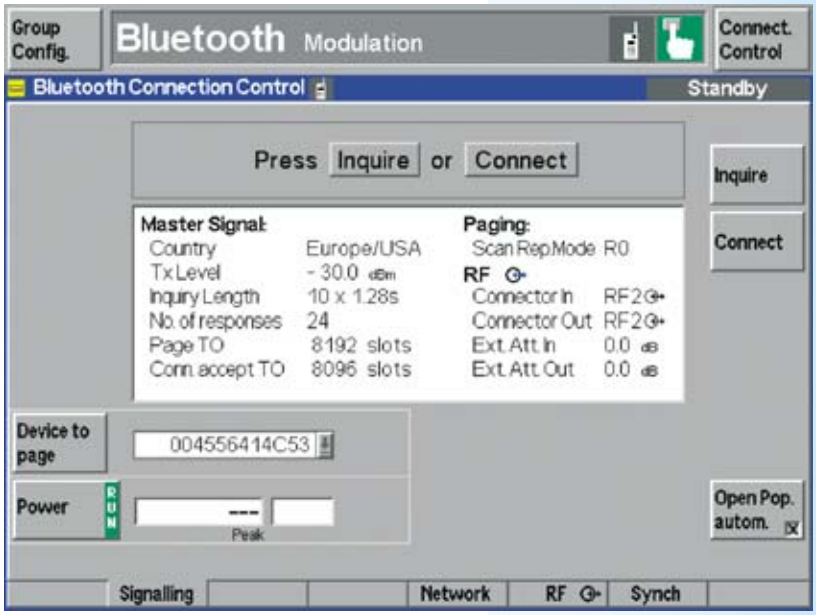
The CMU200 is able to display a variety of information which is received from the DUT (e.g. device name, version numbers, service class, supported features).

Compliance with existing Bluetooth standards

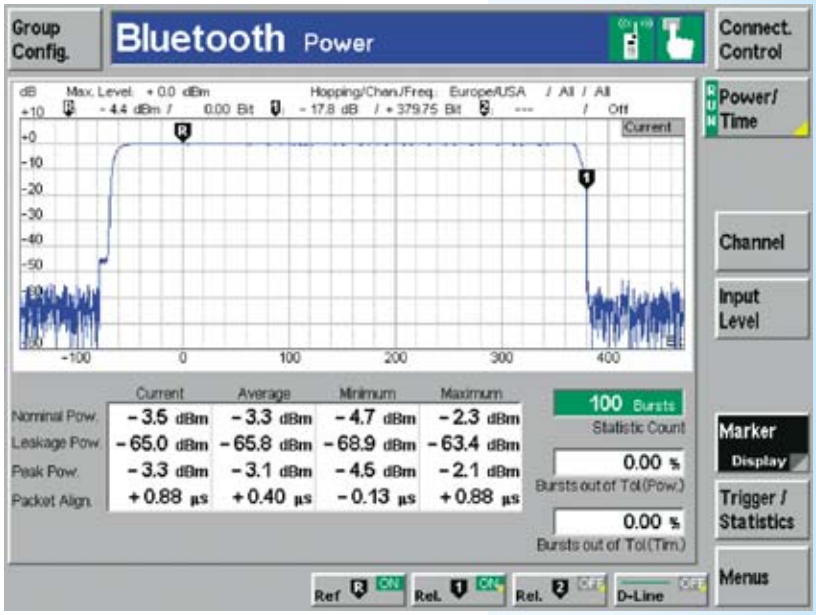
The CMU200 is compliant with the *Bluetooth* Core Specifications Ver. 1.0 B and 1.1. The *Bluetooth* Test Mode (Core Spec. Part I:1) is implemented with all commands needed to perform the TX/RX measurements.

The *Bluetooth* RF Test Specification Ver. 0.91 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. All implemented TX measurements are according to the test specification 0.91.

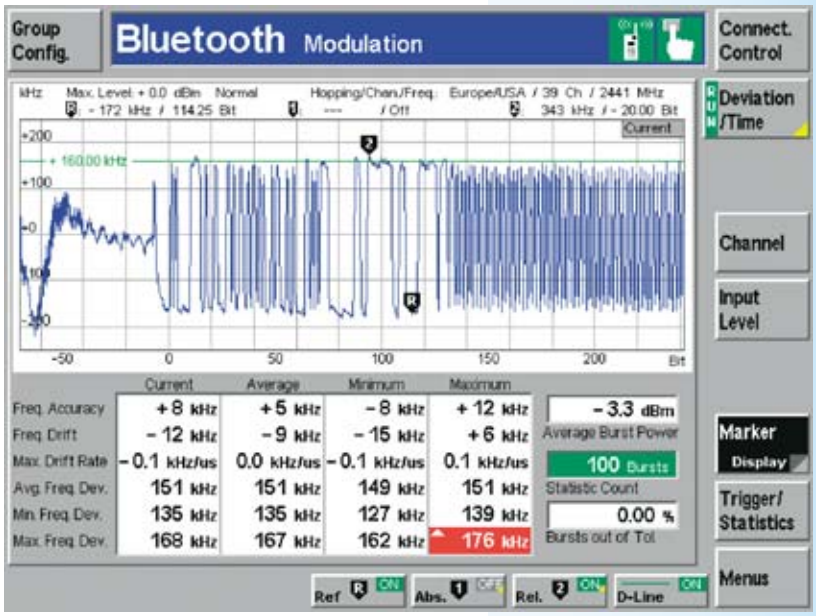
The connection control menu allows the addresses of all Bluetooth devices in range to be inquired. The "Device to page" softkey then selects the DUT for the measurements. Alternatively, the input of a known address is possible



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



The graphical display of the modulation results may be spread between 1/1 and 1/16 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

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 (Output power)

Measurement parameters:

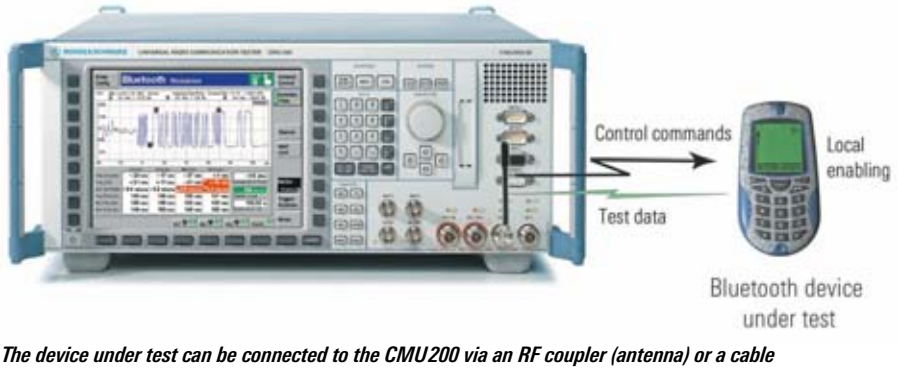
- Nominal power (measured as the part of the burst starting at the detected 1st bit of the preamble (bit 0) to the last bit of the burst)
- Peak power (shows the highest power level within a burst)
- Leakage power (measured within defined areas before and after the burst)

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.



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

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)

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 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/multi-slot packets)

Measurement parameters

- BER (percentage of bit errors that have occurred within the current statistical cycle)

Bluetooth specifications

Standards Bluetooth Core Specifications Version 1.0 B and 1.1

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

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

Modulation

GFSK (AC coupling cut-off frequency 100 Hz)	1 Mbps, BxT=0.5
Modulation index (11110000 pattern in temperature range +23°C to +35°C)	0.304 to 0.336 plus residual FM (see base unit)

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
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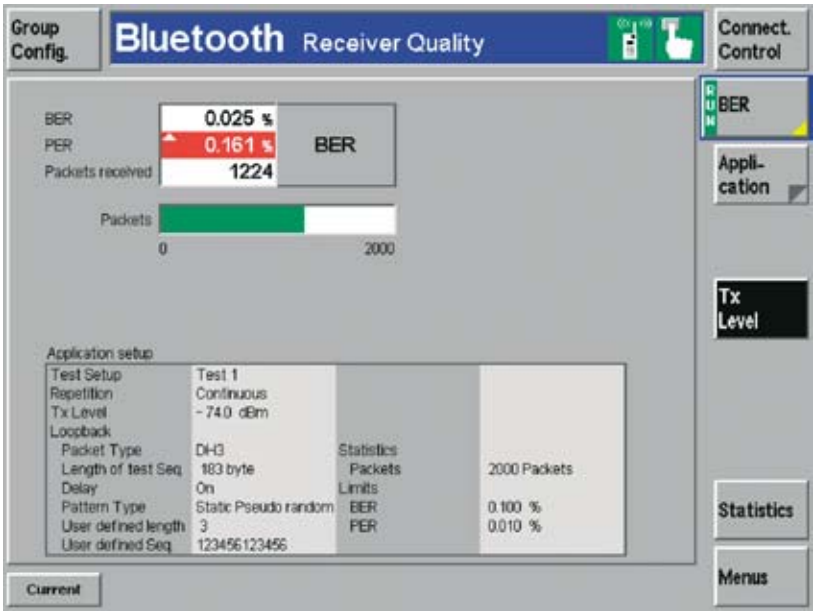
Frequency resolution channel spacing 1 MHz according to standard

Frequency hopping all modes according to standard



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

- BER search function (sensitivity level for a predefined BER level)
- 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)

Bluetooth wireless technology highlights of CMU200

- *Bluetooth* test mode signalling
- Full hopping mode measurements
- All packet types (DH 1, 3, 5)
- 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* Core Specifications Version 1.0 B and 1.1
- RF Test Specification Version 0.91

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

	+23°C to +35°C	+5°C to +45°C
RF1, RF2	<0.7 dB	<1.0 dB
RF4IN	<0.9 dB	<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	≤2 kHz
Frequency deviation error in payload (for deviation ≤200 kHz)	
for 11110000 pattern	≤2 %
for 10101010 pattern	≤4 %
Total measurement range for frequency offset and frequency deviation	–250 kHz to +250 kHz

Timing measurement

Range	±20 µs
Uncertainty	≤0.25 µs