R&S CMU200 (B53, K53, possibly B41), CMUgo, R&S CBT/CBT32 (B55, K55), CBTgo

Measurements on Bluetooth® Products using R&S CMU200/CBT and CMUgo/CBTgo

Application Note

This application note describes how Bluetooth products are tested and measured using the R&S CMU200/CBT by means of the CMUgo/CBTgo remote control program or manual operation.

ROHDE&SCHWARZ

Subject to change – Bernhard Schulz 09.2006 – 1CM50_2E

Contents

1 Overview

The Universal Radio Communication Tester R&S CMU200 can be used to perform fast and accurate measurements of different standards such as GSM, IS-136, AMPS, CDMA, CDMA2000, WCDMA and Bluetooth. The R&S CBT is the “little brother” of the R&S CMU and specially configured to Bluetooth requirements. The R&S CBT comes in two versions: the R&S CBT with display and the R&S CBT32 without display.

This application note describes the use of CMUgo/CBTgo, a Windows application for remote control of the R&S CMU200/CBT and for measuring and testing Bluetooth products. CMUgo/CBTgo also offers different modules for performing tests according to Test Specification RF 2.0 Revision 2.0.E.3“ [1].

The introduction of Enhanced Data Rate (EDR) into the Bluetooth standard has led to a substantial increase of the data rate. EDR has become possible through the use of new modulation modes (π/4-DQPSK and 8DPSK).

IMPORTANT:

The new functions defined in the V2.0 + EDR Bluetooth standard are supported only by the R&S CBT (options R&S K-55, R&S B-55 and R&S U-55) and thus only by CBTgo.

The most important settings and interpretations of the measurement results are also briefly presented within the information regarding manual operation. They are based on CMUgo/CBTgo.

With regard to Bluetooth, the R&S CMU and the R&S CBT/CBT32 are basically equivalent to each other, as are CMUgo and CBTgo. To make this application note easier to read, the term R&S CMU refers to the R&S CMU as well as to the R&S CBT and R&S CBT32, just as CMUgo also refers to CBTgo. If there are explicit differences between them, they will be pointed out separately.

2 Remote Control of R&S CMU200 with CMUgo

Software Features

CMUgo offers a simple user interface for remote control of the R&S CMU200 for all standards available on the R&S CMU200 via a GPIB bus (IEE488.2) and via the RS-232-C interface.

CMUgo includes a feature for outputting test reports. Moreover, a report of remote commands with the times of the individual steps can be output and the remote commands can be copied directly to the Windows clipboard for further processing.

Hardware and Software Requirements

Hardware requirements

- CPU: at least 300 MHz
- RAM: at least 64 Mbyte
- Monitor: SVGA with 800 x 600 pixels or higher
- Hard disk: 50 Mbyte available space
- Peripherals: National Instruments GPIB bus or RS-232-C interface, mouse

Software requirements

- Windows 98/ME/2000/XP
- CMUgo V1.65 with Bluetooth modules V1.65
- CBTgo V1.80 with V1.80 Bluetooth modules

CMUgo Operation

Please refer to the CMUgo manual [2] for information on how to connect the computer and the R&S CMU200, as well as how to install, start and operate CMUgo.

With CMUgo, the remote sequence can be output by using the **Demo** function. Individual sequences can then be created based on this sequence. CMUgo tries to perform the test sequences as quickly as possible. Because the program is structured as a sequencer (information about the previous module is not available), time can be saved through further optimization.

Bluetooth Call Setup Module

The Call Setup module must always be positioned to the beginning of a sequence for Bluetooth (after Basic Initializing). All important parameters for establishing a connection with a Bluetooth product are set here (Fig. 1).

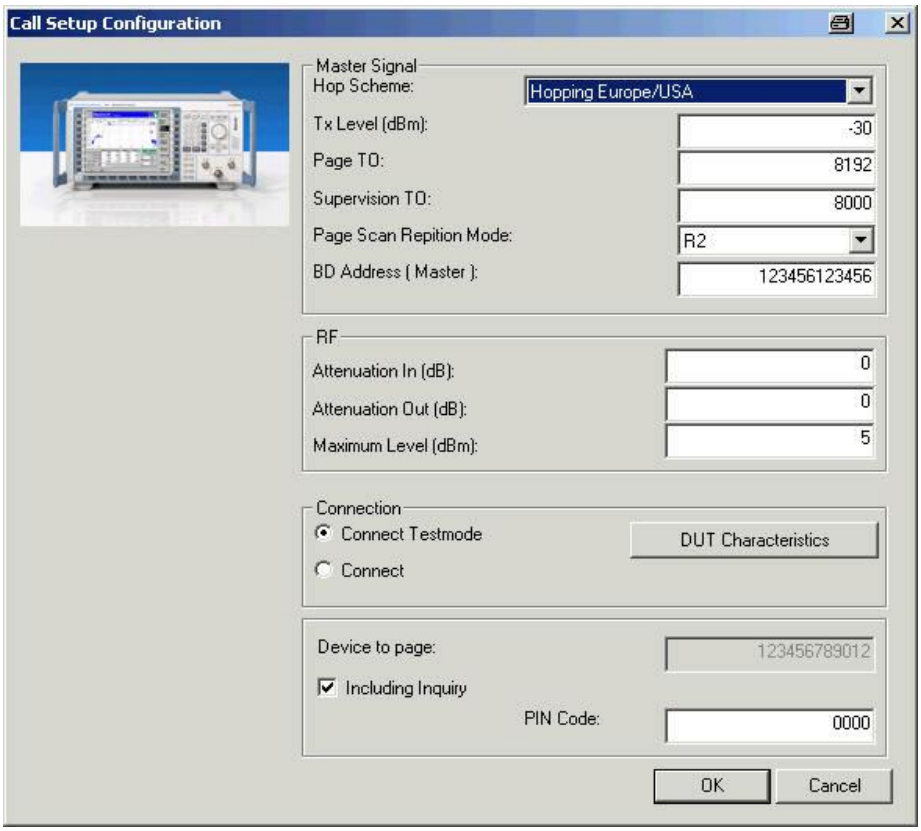

Fig. 1 - Call Setup Configuration

The parameters of the downlink from the R&S CMU200 to the Bluetooth product are set in the **Master signal** section. The TX level of the R&S CMU200, the timeout for call release (supervision TO) and the page scan repetition mode are of primary importance. These parameters *cannot* be modified *after* a connection has been established (exception: TX level).

The CMU connector of the R&S CMU200 (normally RF2, although RF3/4 is better for connections via air) is set under the **RF** section. The settings for attenuation are valid for the complete Bluetooth sequence. They cannot be changed during the test.

Caution: The setting of the 'Maximum level' parameter is important. It should be 5 dB above the expected power of the Bluetooth product. The presetting refers to a class 2 unit with a nominal power of 0 dBm.

The **Connection** section is used to set up a 'normal' Bluetooth connection with the Bluetooth product (**Connect**). The submode can be changed later. **Connect test mode** sets up a connection with the Bluetooth product and then automatically switches to the test mode. Please note that the Bluetooth module may have to be enabled beforehand for the test mode.

In addition, the address to be called can directly be set here or, alternatively, an inquiry can be performed. The inquiry is interrupted when the first Bluetooth product is found. This first address found will then be used for setting up the connection. You can also add a PIN code.

If 'Connect test mode' is selected, further parameters can be set via **Slave signal.** If 'Connect' is set, this button cannot be selected.

The **DUT Characteristics** button opens up the corresponding dialog (see Fig. 2).

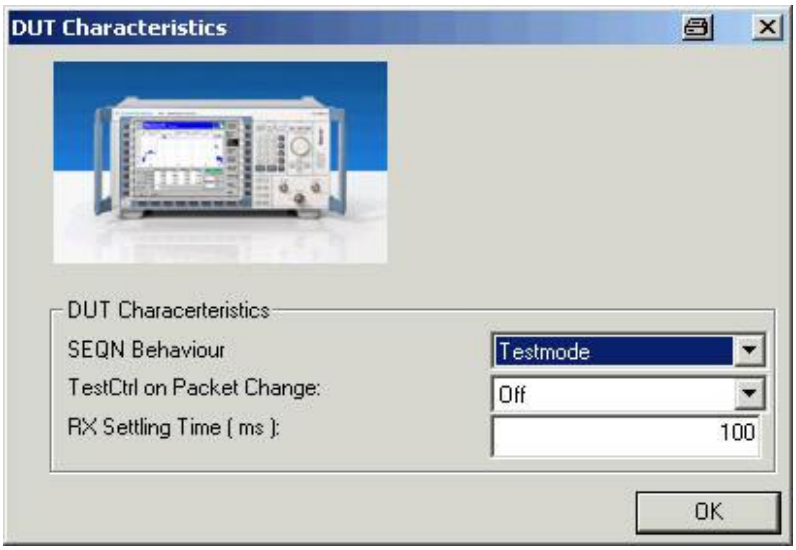

Fig. 2- Call setup DUT characteristics

You can change the applicable parameters in this dialog.

Fig. 3 shows a typical Call Setup entry in the test report.

Test Name and Condition	Lower Limit	Upper Limit	Measured Value	P/F
Country: Hopping Europe/USA, Tx Level: -30.0 dBm, Attenuation (In/Out): 0.0/0.0 dB, Max. Level: 5.0, Page Scan Repition Mode: R2				
Hop Scheme: Hopping Europe/USA, Packet Type: DH1, Length of Testsequence: 27				
Default Device Address: 123456789012, Inquiry: Done				
BD Address (CMU): 123456123456, Test Scenario: Loopback ACL not whit - 1010 Pattern				
Name: Demo, LMP Version: 1.1, Company ID: Ericsson, Version: 123, BD Address: 1234567890				
Connection to Device:			passed	✔

Fig. 3 - Report Call Setup

Bluetooth Call Release Module

In the Bluetooth Call Release module, the existing call to the Bluetooth product is released; the R&S CMU200 enters the standby state (Fig. 4).

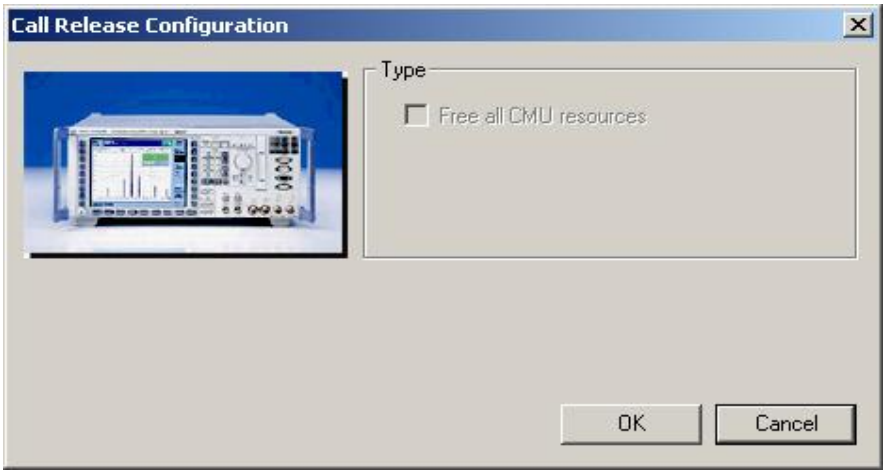

Fig. 4 - Call Release Configuration

If the call is not set up or released, the following window will be displayed (Fig. 5). All other modules (except for Call Setup) will also perform this query.

Fig. 5 – No connection

Fig. 6 shows the entry of Bluetooth Call Release in the test report.

Fig. 6 - Call Release report

Bluetooth Submode Module

The Bluetooth Submode module does not perform any measurements. It is used to switch between the individual submodes (Fig. 7).

The following modes are provided in the **Submode** section:

- Test
- Audio
- Sniff
- Park
- Hold

Some Bluetooth products may not allow each and every transition between submodes.

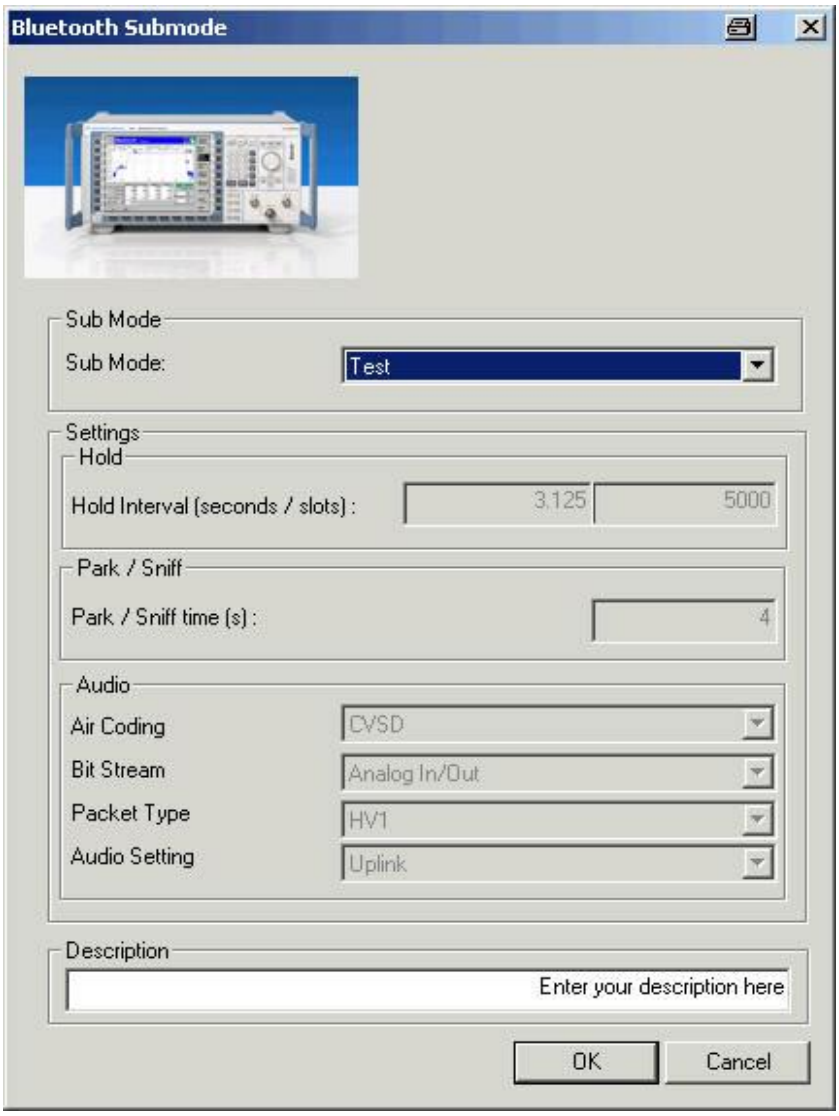

Fig. 7 – Submode

The states and transitions between the individual submodes are shown in Fig. 8.

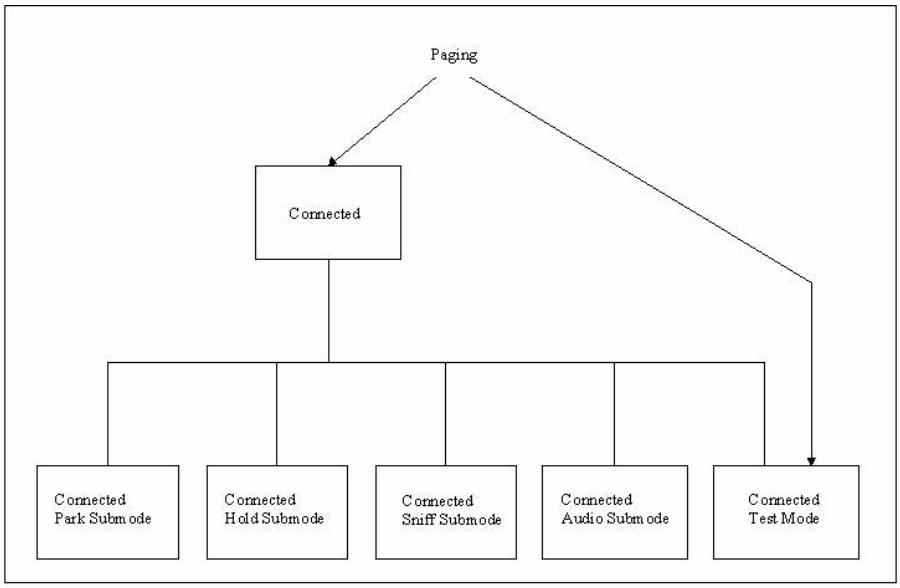

Fig. 8 - States and transitions between the submodes

Test mode

The test mode is a special mode for measuring different parameters. It may be necessary to externally enable the Bluetooth product for the test mode ('Enable Device Under Test'). The CMU200 can be used to change to this state directly via **Connect test mode** (see Call Setup) or via **Connect** followed by 'Enter submode test mode'.

Audio

In the Audio section, the following parameters can be set:

Air coding: CVSD, u-law or A-law

Bit stream: analog in/out or echo

Packet type: HV1, HV2 or HV3

Audio setting: uplink, downlink or crosstalk

The following test scenarios are possible in Audio (Fig. 9 to Fig. 12):

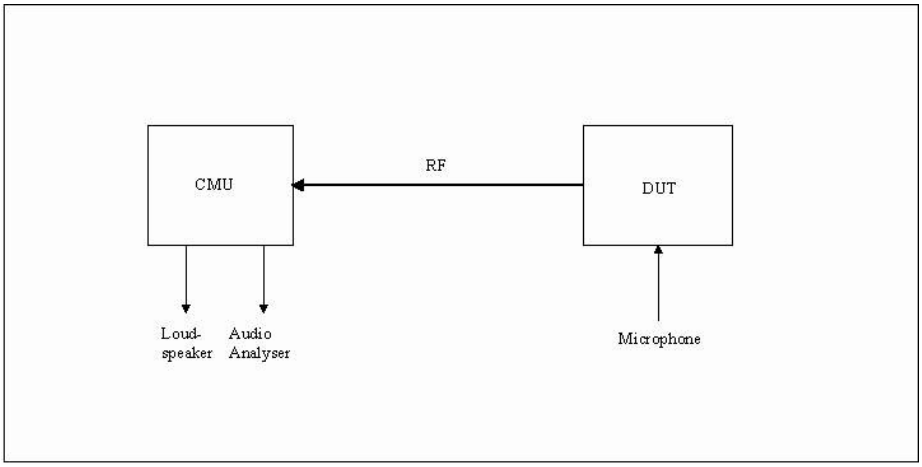

Fig. 9 - Audio uplink

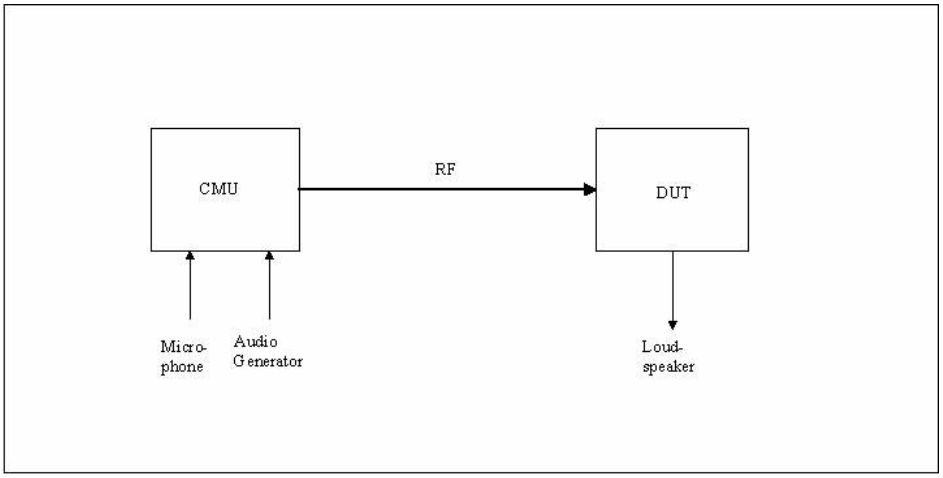

Fig. 10 - Audio downlink

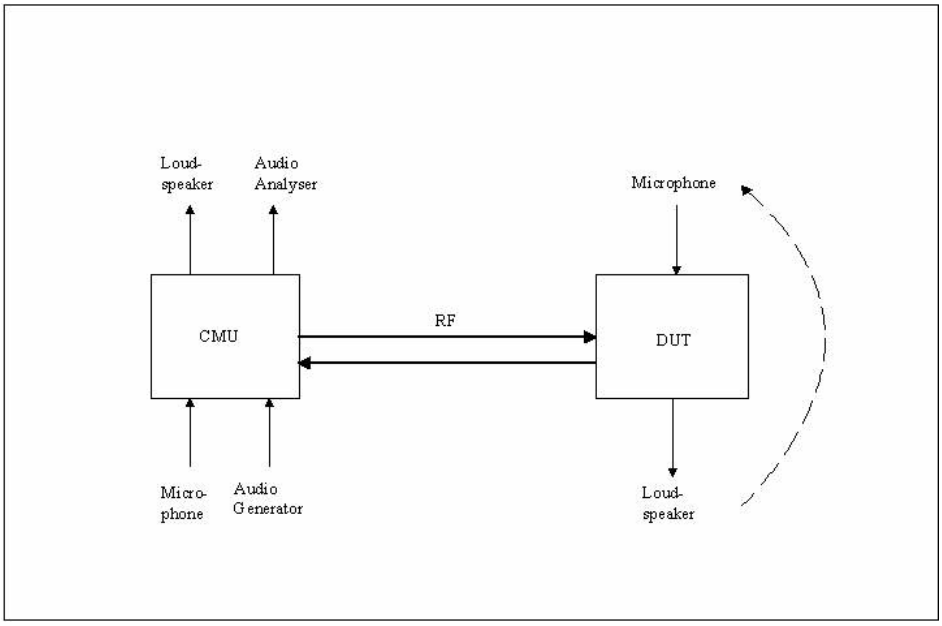

Fig. 11 - Audio crosstalk

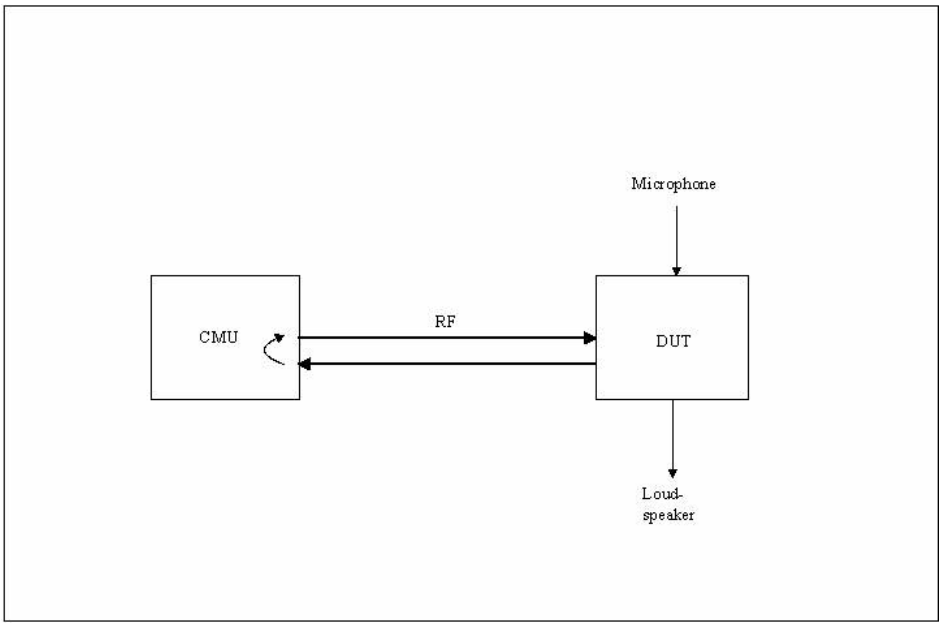

Fig. 12 - Audio echo

Measurements in the 'Analog In/Out' setting can be performed with an external audio analyzer or with option B41 of the R&S CMU200 via the (general) **Audio Test Configuration** (Fig. 13) module in CMUgo.

The R&S CBT does not include an internal audio option.

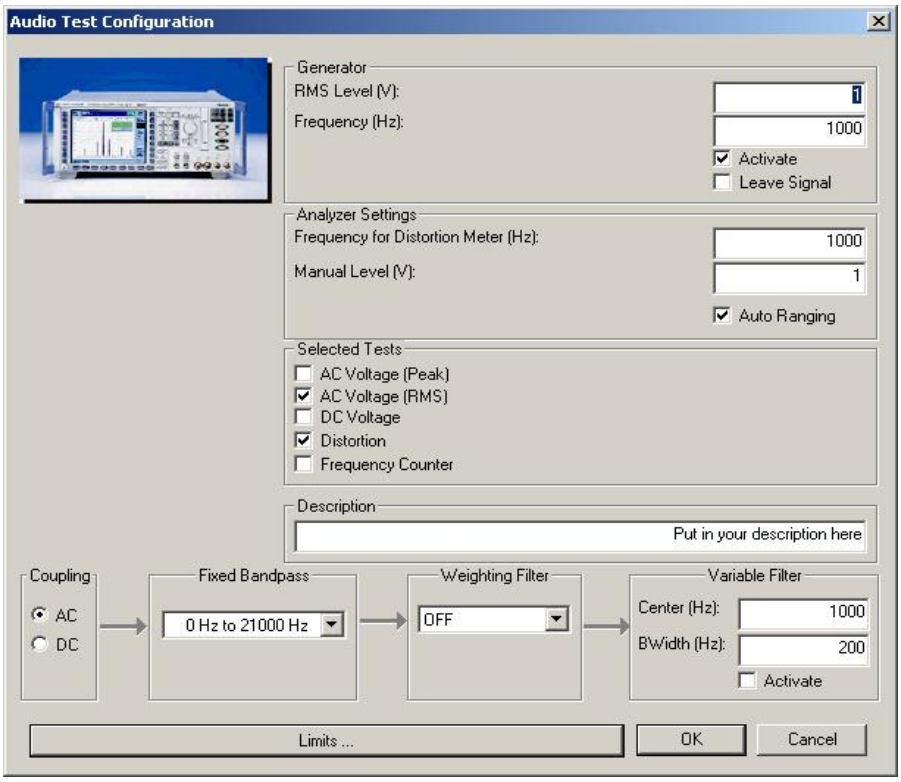

Fig. 13 - Audio Test Configuration

In the Audio Test Configuration module, the audio generator and the audio analyzer of option B41 can be controlled. Moreover, the different limits are set via **Limits** (Fig. 14).

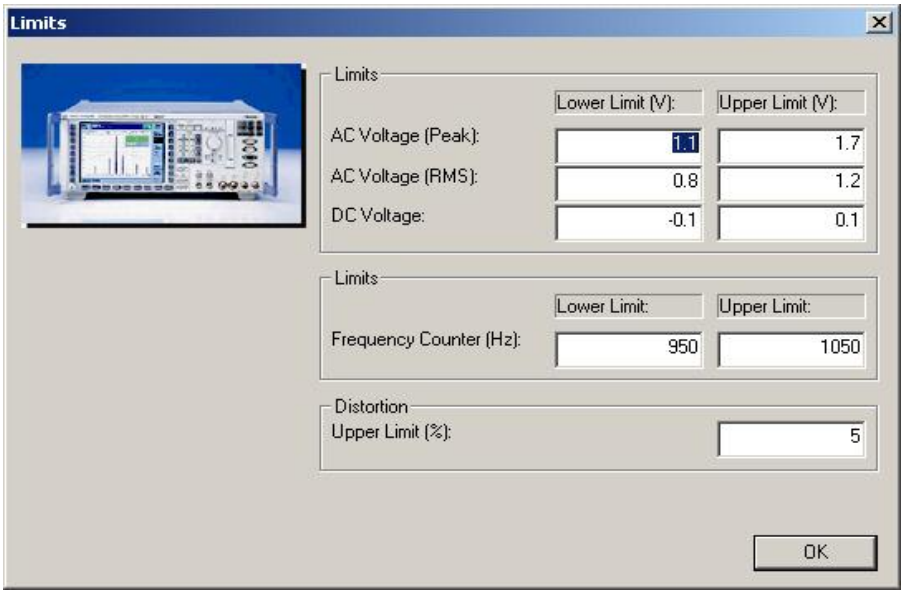

Fig. 14 - Audio limits

Sniff

CMUgo maintains the connection for the specified time (park/sniff time in seconds) in the sniff mode. The normal mode will then be re-activated

automatically. If the set time exceeds that of the 'Supervision timeout' (see Call Setup), the time of the 'Supervision timeout' is used.

Park

CMUgo maintains the connection for the specified time (Park/Sniff time in seconds) in the Park mode. The normal mode will then be re-activated automatically. If the set time exceeds that of 'Supervision timeout' (see Call Setup), the time of the 'Supervision timeout' is used.

Hold

The Bluetooth specification stipulates automatic return from hold to normal mode. This does not require that an extra command be sent. The length of the hold interval can be set by the number of slots.

Fig. 15 shows all possible submode messages in the test report.

Mode: Test
Mode: Audio, Bit Stream: Analog In/Out, Air Coding: CVSD, Packet Type: HV1, Setting: Uplink
Mode: Sniff for 4.0 seconds
Mode: Park for 4.0 seconds
Mode: Hold for 5000 slots
Mode: Normal

Fig. 15 - Submode report

Bluetooth Power Step Module

Power Step offers four different actions for setting the power of the Bluetooth product ('Power Control') (Fig. 16).

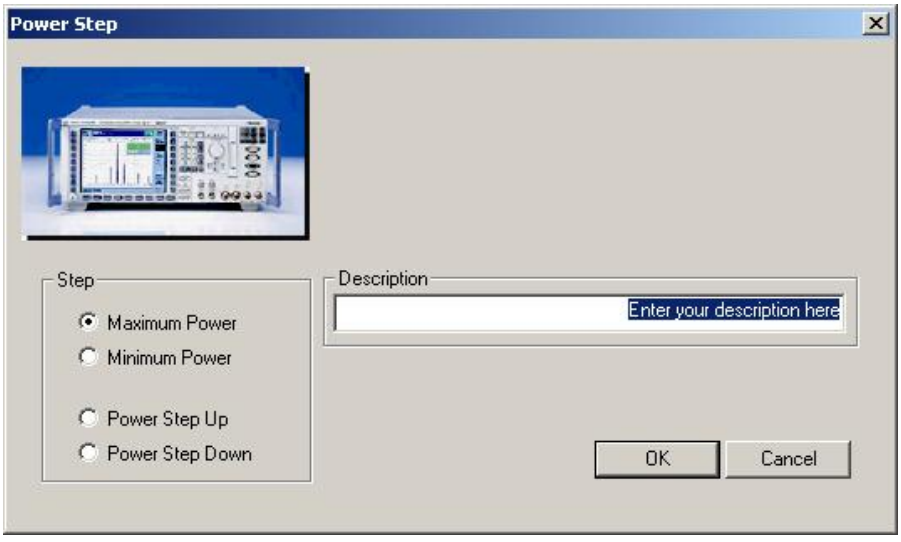

Fig. 16 - Power Step

As a preliminary check, the signaling info queries whether the Bluetooth product actually supports power control. If not, a warning is issued (Fig. 17).

Fig. 17 - Bluetooth product does not support power control

If the Bluetooth product supports power control, various operations can be performed. **Maximum** or **Minimum power** performs one or more power step up(s) or down(s) as long as the Bluetooth product to be tested acknowledges that it is transmitting at a maximum or minimum TX level.

Power step up or **Power step down** performs only one step. If the Bluetooth product acknowledges this step, this acknowledgement is also output in the report.

Fig. 18 shows a typical Power Step entry in the test report.

Power Step: Maximum

Limit reached!

Fig. 18 - Power Step report

Bluetooth Test Set Module

The Test Set Configuration module allows power and modulation to be measured in one operation (Fig. 19).

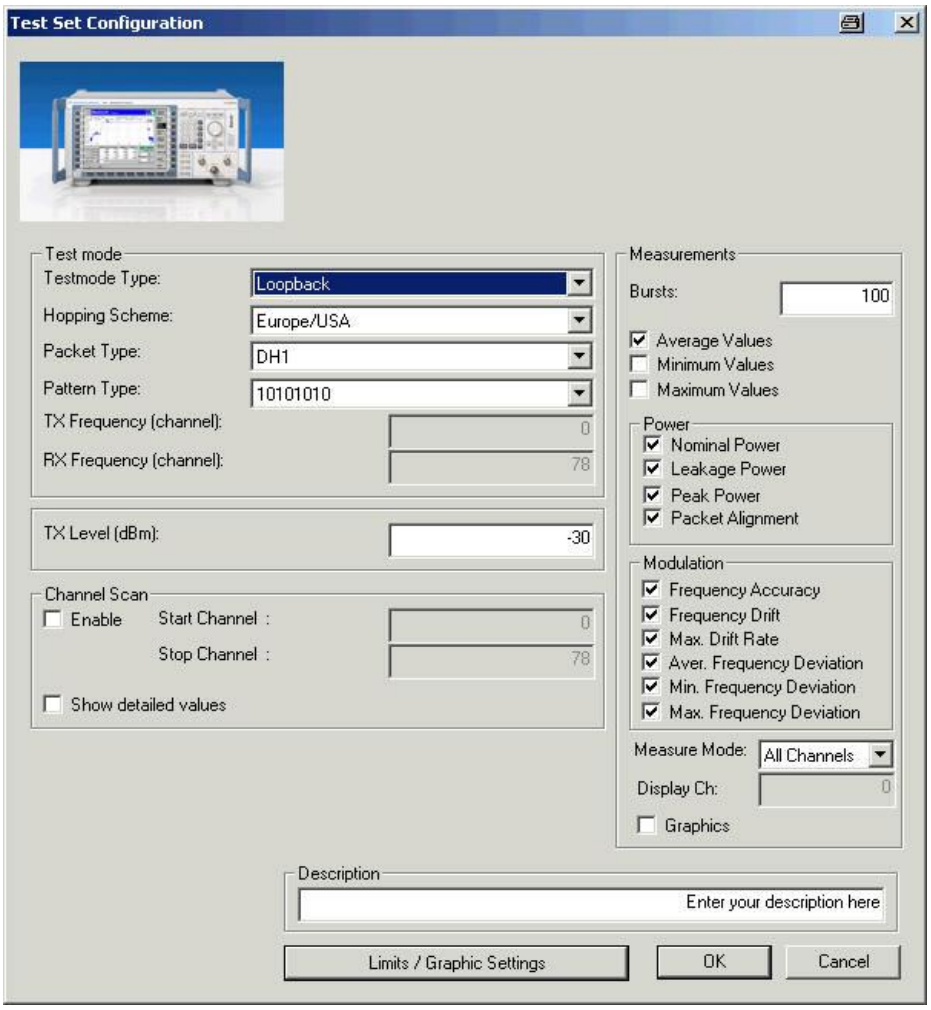

Fig. 19 – Test Set Configuration

The **Test mode** section is used to change the connection parameters. You can set the test mode type, the hopping scheme, the packet type and the pattern type. If ‘RX/TX on single’ has been selected under ‘Hopping Scheme’, you can also set the RX and the TX channel. The TX level of the R&S CMU200 can also be changed.

The **Measurements** section is used to select the specific measurements to be displayed, set the number of bursts and define how results are displayed (average, minimum and/or maximum values). The measurement returns all results irrespective of the selection (and thus always requires the same amount of time), i.e. the selection of results only affects the content of the report itself. If the connection is in the hopping mode, the 'Measure mode' parameter can be used to set whether all channels or only a single channel/display channel is measured. If 'Graphics' is selected, two graphs will be output for the power and modulation characteristic.

Channel scan is used to perform the selected measurements in different (all) channels. The results are automatically displayed in a graph. If ‘Show detailed values’ has been selected, the individual values are also displayed in a table (Fig. 24).

The following window (Fig. 20) opens after the **Limits** button is pressed.

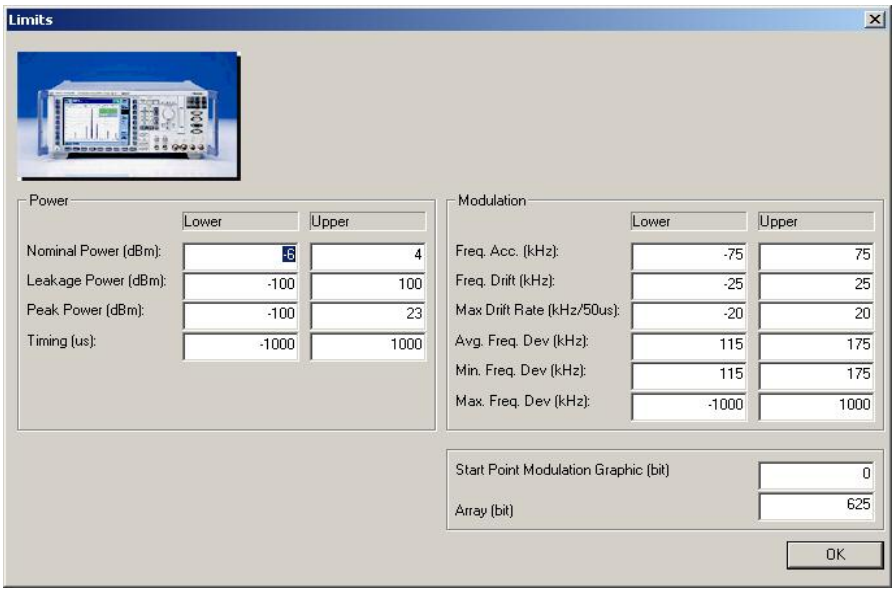

Fig. 20 – Test Set limits

The various limits can be set in the **Power** and **Modulation** sections. The starting point for the modulation graph and the length of the graph can be set. Fig. 21 shows the report for the normal Test Set.

Hop Scheme: Hopping Europe/USA, Packet Type: DH1, Length of Testsequence: 27

Tx Level: -30.0 dBm, 100 Bursts , Mode: All

Test Scenario: Loopback ACL not whit - 1010 Pattern, Filter Bandwidth: Narrow, Freq. Dev: Algorithm: Bit Center

Nominal Power: *Average*	**-6.00 dBm**	**4.00 dBm**	**-5.99 dBm**	✔
Leakage Power: *Average*	**-100.00 dBm**	**100.00 dBm**	**61.75 dBm**	✔
Peak Power *Average*	**-100.00 dBm**	**23.00 dBm**	**-56.91 dBm**	✔
Packet Alignment *Average*	**-1000.00 us**	**1000.00 us**	**493.21 us**	✔
Frequency Accuracy *Average*	**-75.00 kHz**	**75.00 kHz**	**31.58 kHz**	✔
Frequency Drift *Average*	**-25.00 kHz**	**25.00 kHz**	**-24.25 kHz**	✔
Maximum Drift Rate *Average (/ 50 us)*	**-20.00 kHz**	**20.00 kHz**	**-14.11 kHz**	✔
Average Frequency Deviation *Average*	**115.00 kHz**	**175.00 kHz**	**141.74 kHz**	✔
Minimum Frequency Deviation *Average*	**115.00 kHz**	**175.00 kHz**	**115.53 kHz**	✔
Maximum Frequency Deviation *Average*	**-1000.00 kHz**	**1000.00 kHz**	**142.37 kHz**	✔

Fig. 21 - Test Set report

Fig. 22 shows an example of a report for Test Set with channel scan activated. The maximum and minimum and the channel are output for each selected measurement. Fig. 23 again shows the channel scan as a graph in the annex of the report.

Hop Scheme: RX/TX single frequency, Packet Type: DH1, Length of Testsequence: 27, RX Frequency: 78

Tx Level: -30.0 dBm, 100 Packets , Mode: —

Test Scenario: Loopback ACL not whit - 1010 Pattern, Filter Bandwidth: Narrow, Freq. Dev: Algorithm: Bit Center

Nominal Power Maximum: @ *Channel: 70, Average*			-0.54 dBm	✔
Nominal Power Minimum: @ *Channel: 0, Average*			-1.69 dBm	✔
Nominal Power Maximum: @ *Channel: 70, Minimum*			-0.55 dBm	✔
Nominal Power Minimum: @ *Channel: 0, Minimum*			-1.70 dBm	✔
Nominal Power Maximum: @ *Channel: 70, Maximum*			-0.52 dBm	✔
Nominal Power Minimum: @ *Channel: 0, Maximum*			-1.68 dBm	✔
Peak Power Maximum: @ *Channel: 70, Average*			-0.28 dBm	✔
Peak Power Minimum: @ *Channel: 0, Average*			-1.41 dBm	✔
Peak Power Maximum: @ *Channel: 74, Minimum*			-0.30 dBm	✔
Peak Power Minimum: @ *Channel: 0, Minimum*			-1.44 dBm	✔
Peak Power Maximum: @ *Channel: 64, Maximum*			-0.23 dBm	✔
Peak Power Minimum: @ *Channel: 0, Maximum*			-1.38 dBm	✔

Fig. 22 - Test Set report with channel scan

Annex: **Nominal Power:**

Start Channel: 0, Stop Channel: 78, Average: blue, Min: green, Max: red

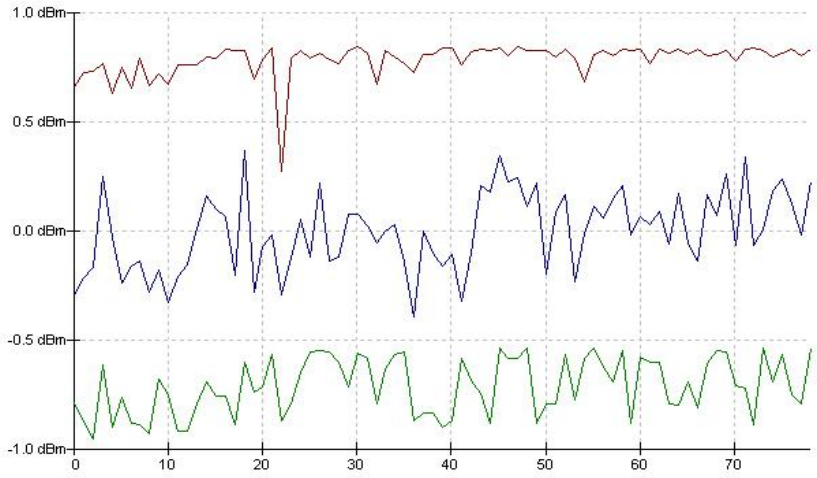

Fig. 23 - Channel scan graph for Test Set report

Hop Scheme: Hopping Europe/USA, Packet Type: DH1

Tx Level: -30.0 dBm, 10 Bursts , Mode: —

Testmode Type: Loopback, Pattern: 10101010, Length of testsequence: 27

Nominal Power: *Average, Channel: 10*			1.81 dBm	
Nominal Power: *Average, Channel: 11*			1.72 dBm	
Nominal Power: *Average, Channel: 12*			1.66 dBm	
Nominal Power: *Average, Channel: 13*			1.63 dBm	
Nominal Power: *Average, Channel: 14*			1.61 dBm	
Nominal Power: *Average, Channel: 15*			1.59 dBm	
Nominal Power: *Average, Channel: 16*			1.63 dBm	
Nominal Power: *Average, Channel: 17*			1.62 dBm	
Nominal Power: *Average, Channel: 18*			1.60 dBm	
Nominal Power: *Average, Channel: 19*			1.59 dBm	
Nominal Power: *Average, Channel: 20*			1.62 dBm	

Fig. 24 - Test Set report with detailed values

Bluetooth BER Test Module

Different receiver tests can be performed with the BERTest (**Fehler! Verweisquelle konnte nicht gefunden werden.**) module. The bit error rate is measured for a specific level.

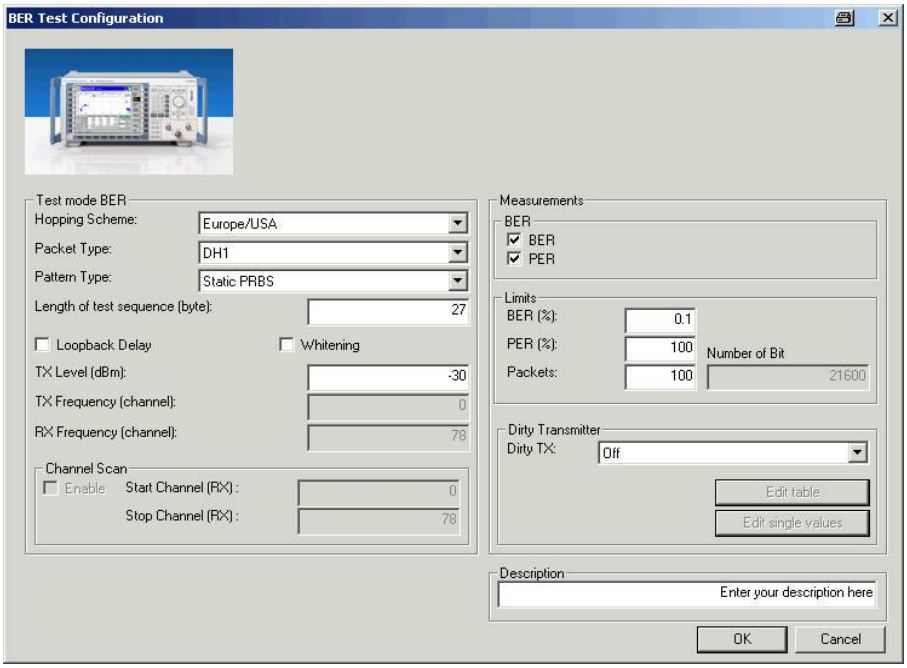

Fig. 25 - BERTest

The various parameters can be changed in the **Test mode BER** section (note that loopback has been preselected). A channel scan can be carried out by several (all) RX channels, automatically displayed in a graph.

You can set the packet type (including EDR packets), the length of the test sequence, whitening and the TX level of the BER measurement. In addition, the 'Loopback delay' parameter has to be adjusted to the corresponding Bluetooth product.

The measurements, the limits and the number of packets can be selected under **Measurements**. CMUgo calculates the number of transmitted bits from the number of packets and the length of the test sequence and outputs this information under ‘Number of bits’.

Fig. 26 shows an example of a BERTest report.

Hop Scheme: Hopping Europe/USA, Packet Type: DH1, Length of Testsequence: 27

Tx Level: -30.0 dBm, 100 Packets, Test Scenario: Loopback ACL not whit - dynamic pseudo random

Loopback Delay: Off, Dirty Transmitter: Off

BER:		**0.10 %**	**0.00 %**	✔
PER:		**0.01 %**	**0.00 %**	✔

Fig. 26 - BERTest report

Dirty transmitter

The R&S CMU and the R&S CBT, and thus also CMUgo and CBTgo, differ with regard to the dirty transmitter. The R&S CBT supports both the static and the dynamic dirty transmitter (Fig. 27).

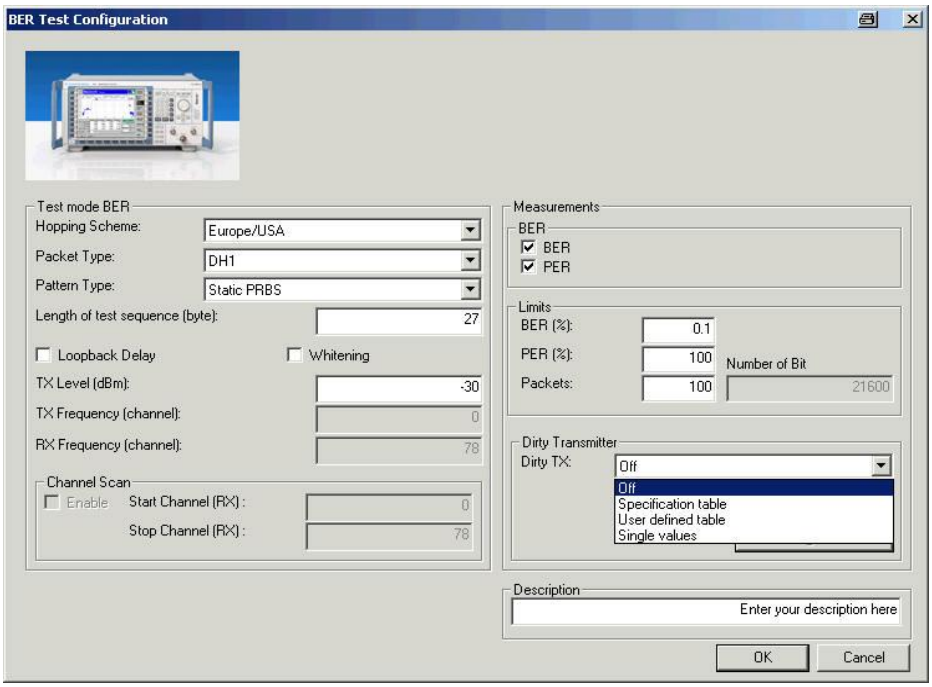

Fig. 27 - CBT BER test with dirty transmitter

Fig. 28 shows the settings for 'DT – User Table'. The presettings comply with the specification ('Specification Table'). Fig. 29 shows the corresponding window for EDR.

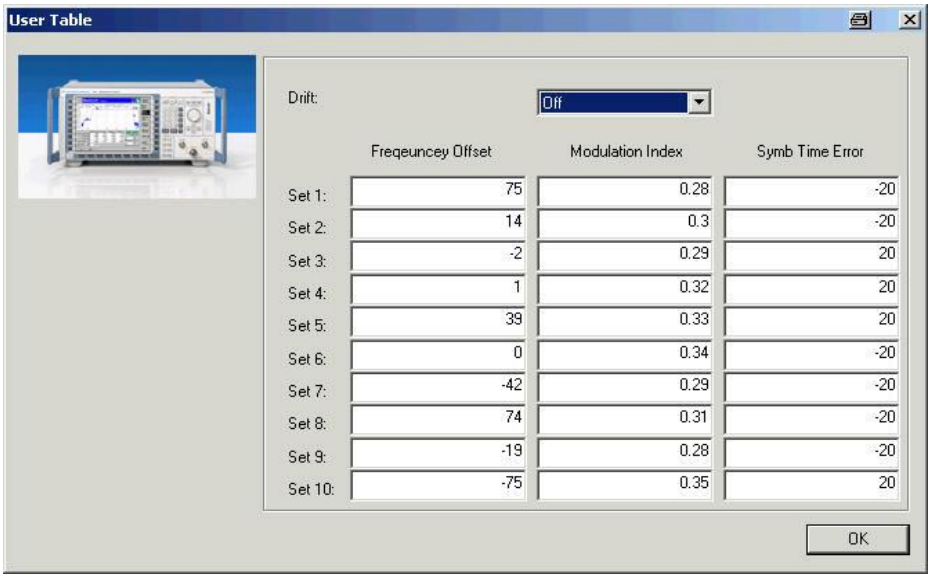

Fig. 28 - CBT DT User Table

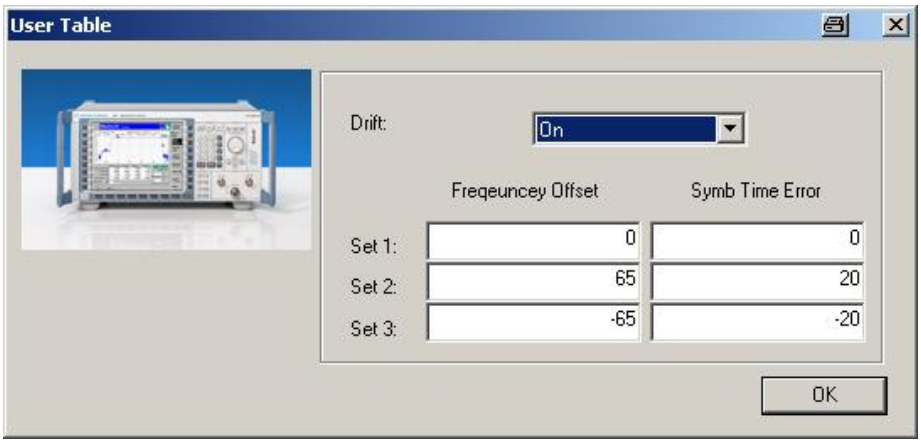

Fig. 29 -CBT DT EDR User Table

Fig. 30 shows the static DT setting ('single values'), which is provided by the R&S CMU as well as the R&S CBT.

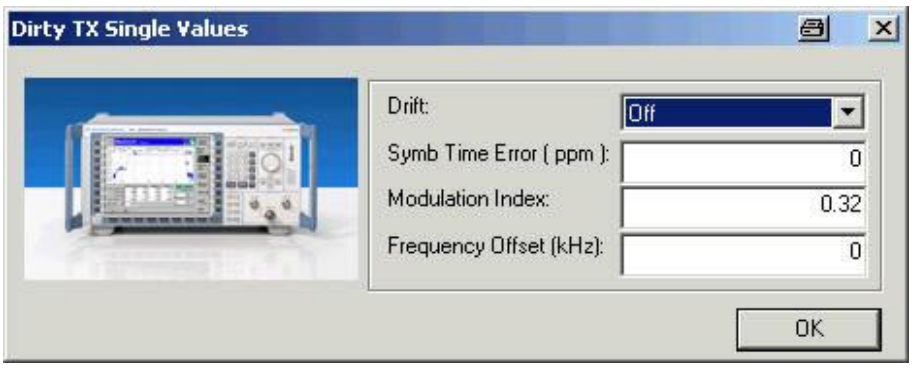

Fig. 30 - CMU and CBT - DT single values

Bluetooth Sensitivity Module

The Sensitivity module conveniently expands the BER test by three channels; the tests can thus be easily processed in accordance with the specification (Fig. 31).

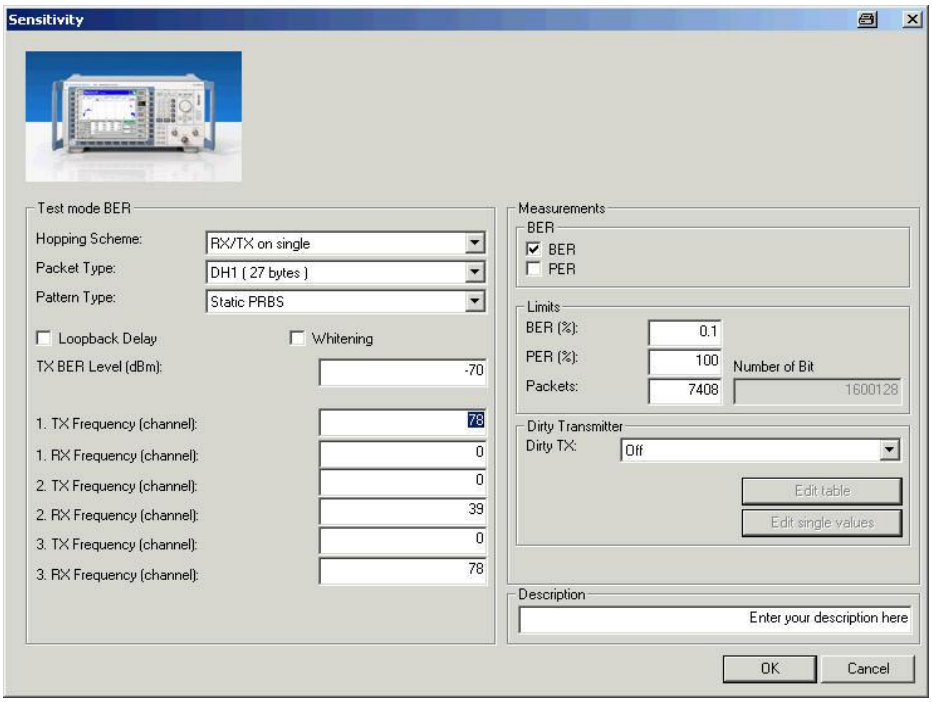

Fig. 31 – Sensitivity

The settings correspond to the BER test settings, but you can now specify three channels.

This module allows you to perform the *Sensitivity – Single Slot Packages* (5.1.13 RCV/CA/01/C) and *Sensitivity – Multi Slot Packages* (5.1.14 RCV/CA/02/C) tests. Make the following settings (obligatory):

- Loopback ACL not whitened – PRBS9 (static pseudo random).
- Hopping off (RX/TX on single).
- TX level –70.0 dBm.
- DH1 for single slot, or DH3 and/or DH5 for multislot.
- Bluetooth product has to transmit at maximum level (it may be necessary to call Power Step beforehand).
- With DH1, 1600000 bit correspond to 7408 packets, with DH3 to 1093 packets and with DH5 to 590 packets.
- All tests must be performed on three frequencies with 0, 39 and 78 usually as the receive channels.

The *Maximum Input Level* (5.1.18 RCV/CA/06/C) test can also be simulated. The same settings as above apply. However, only DH1 packets with a level of –20 dBm are used.

Hop Scheme: RX/TX single frequency, Packet Type: DH1, Pattern: SPRS, Whitening: Off
Tx Level: -70.0 dBm, Packets: 7408, Loopback Delay Off, Dirty Transmitter: Off

BER: *@ Channel: RX: 0, TX: 78*		**0.10 %**	**0.00 %**	
BER: *@ Channel: RX: 39, TX: 0*		**0.10 %**	**0.00 %**	
BER: *@ Channel: RX: 78, TX: 0*		**0.10 %**	**0.00 %**	
Detach device:			**passed**	

Fig. 32 - Report Sensitivity

Bluetooth BER Search Module

The level required to exceed a certain bit error rate is determined here (Fig. 33).

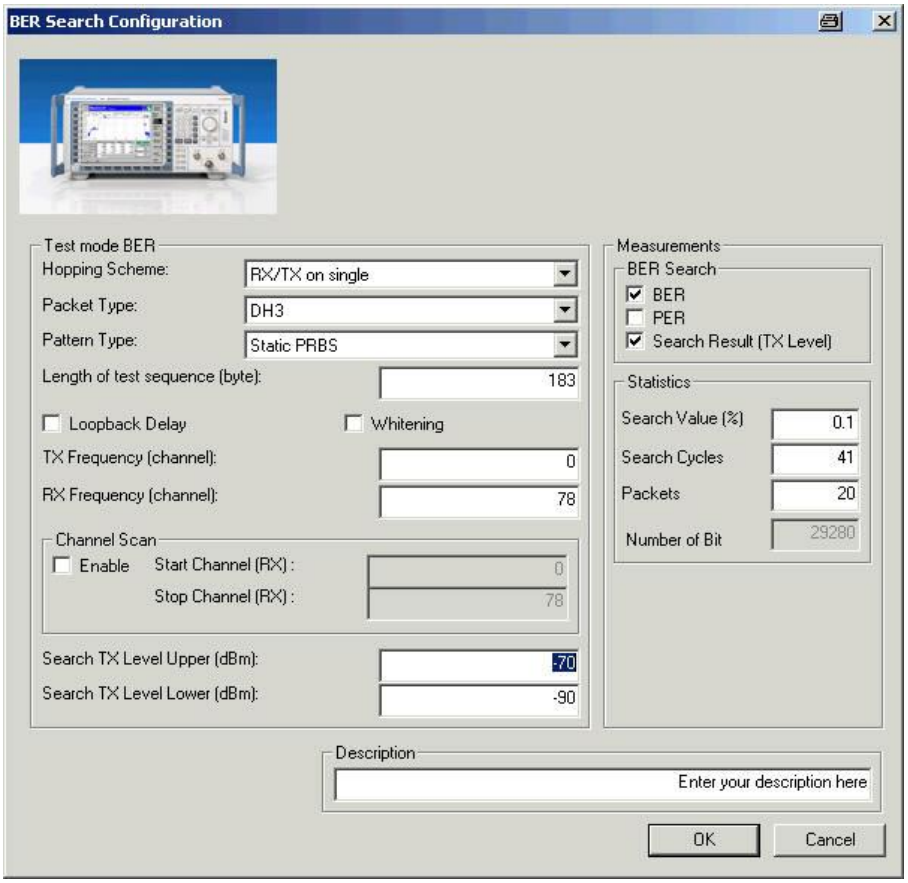

Fig. 33 - BER Search Configuration

BER Search basically offers the same parameters as the BERTest with the exception that a **Search TX level upper** or **lower** and a **Search value** are defined. The R&S CMU200 performs the measurement several times (number in **Search cycles**) until it exceeds the stipulated search value or the minimum level has been reached. If the search value is not reached within the interval, 'not performed' is output for 'Search result'. In this case, the dirty transmitter cannot be set. CMUgo calculates the number of transmitted bits from the number of packets and the length of the test sequence and outputs this information under ‘Number of bits’.

Fig. 34 shows a report for BER Search.

Hop Scheme: Hopping Europe/USA, Packet Type: DH1, Length of Testsequence: 27
Search Tx Level Lower: -80.0 dBm, Search Tx Level Upper: -60.0 dBm, Search Cycles: 20, Search Value: 0.1 %
Test Scenario: Loopback ACL not whit - dynamic pseudo random, 100 Packets
Loopback Delay: Off, Dirty Transmitter: Off

BER:			0.25 %	✔
PER			0.00 %	✔
Search Result (Tx Level):			-78.95 dBm	✔

Fig. 34 - BER Search report

Bluetooth Power Module

The *Output Power* (5.1.3 TRM/CA/01/C) and *Power Control* (5.1.5 TRM/CA/03/C) measurements can be performed with Power (Fig. 35).

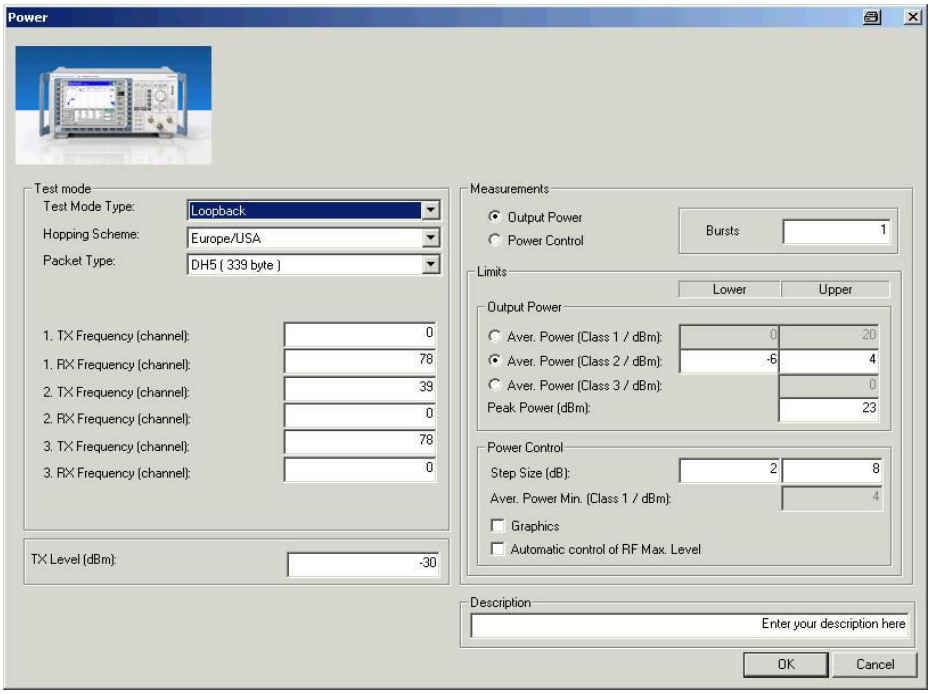

Fig. 35 – Power

The **Test mode** section is used to change the common parameters. The test length is automatically determined by the packet type (DH1: 27 bytes, DH:183 bytes, DH5 339 bytes). The three channels to be measured have been predefined. Moreover, the TX level of the R&S CMU200 can be set.

The **Measurements** section is used to select between output power and power control and to set the number of packets (**Bursts**). The limits for both measurements also have to be set. To obtain the correct limits for output power, the proper power class must be set since it is not transmitted during signaling. An additional graph can be displayed under power control.

Settings for *Output Power* (5.1.3 TRM/CA/01/C):

- Hopping on.
- Loopback.
- Longest possible packet type.
- Permanent setting: PRBS9 (static pseudo random).

- Bluetooth product has to transmit at maximum level (it may be necessary to call Power Step beforehand).
- The peak power and average power are measured.

Fig. 36 shows a report from Power, in this case for output power.

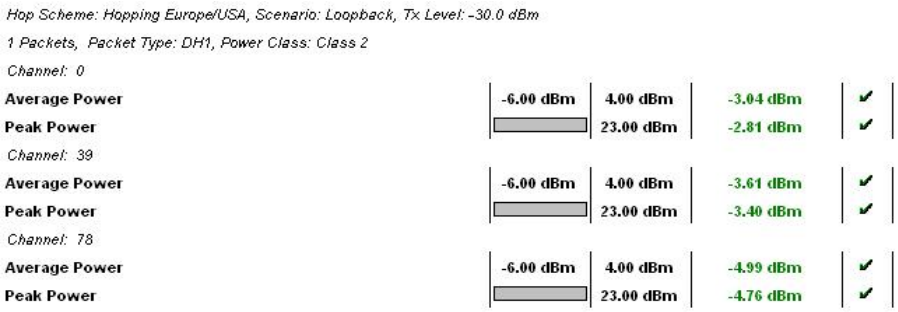

Fig. 36 - Power report for output power

Settings for *Power Control* (5.1.5 TRM/CA/03/C):

- Hopping off (RX/TX on single).
- Loopback.
- DH1.
- Permanent setting: PRBS9 (static pseudo random).
- Bluetooth product must transmit at maximum level (it may be necessary to call Power Step beforehand).
- The individual steps are automatically performed on the three channels and displayed.

Fig. 37 shows part of the Power report, in this case for power control. First, the maximum power is output at the beginning of the sequence. The individual steps are then displayed at the bottom. Once the minimum power is reached, it will be displayed and the steps will then be carried out up to maximum power. The same applies to two other channels.

Fig. 38 shows the graphical representation of power control following the power control report. The individual power steps can be clearly seen. The three selected channels are indicated by 11...22...33... on the x axis.

Hop Scheme: Hopping Europe/USA, Scenario: Loopback, Tx Level: -30.0 dBm

1 Packets, Packet Type: DH1, Power Class: Class 2

Channel: 0

Power at Maximum			-1.71 dBm	✔
Power Step *Down*	2.00 dB	8.00 dB	1.67 dB	▬
Power Step *Down*	2.00 dB	8.00 dB	3.88 dB	✔
Power Step *Down*	2.00 dB	8.00 dB	3.56 dB	✔
Power Step *Down*	2.00 dB	8.00 dB	4.16 dB	✔
Power Step *Down*	2.00 dB	8.00 dB	3.82 dB	✔
Power Step *Down*	2.00 dB	8.00 dB	3.99 dB	✔
Power Step *Down*	2.00 dB	8.00 dB	2.98 dB	✔
Power Step *Down*	2.00 dB	8.00 dB	2.66 dB	✔
Power at Minimum			-28.44 dBm	✔
Power Step *Up*	2.00 dB	8.00 dB	2.65 dB	✔
Power Step *Up*	2.00 dB	8.00 dB	2.99 dB	✔
Power Step *Up*	2.00 dB	8.00 dB	4.01 dB	✔
Power Step *Up*	2.00 dB	8.00 dB	3.80 dB	✔
Power Step *Up*	2.00 dB	8.00 dB	4.14 dB	✔
Power Step *Up*	2.00 dB	8.00 dB	3.58 dB	✔
Power Step *Up*	2.00 dB	8.00 dB	3.88 dB	✔
Power Step *Up*	2.00 dB	8.00 dB	1.67 dB	▬
Power at Maximum			-1.72 dBm	✔

Channel: 39

Fig. 37 - Power report for power control

Annex: **Power Control Steps**

Channel 1: 0, Channel 2: 39, Channel 3: 78

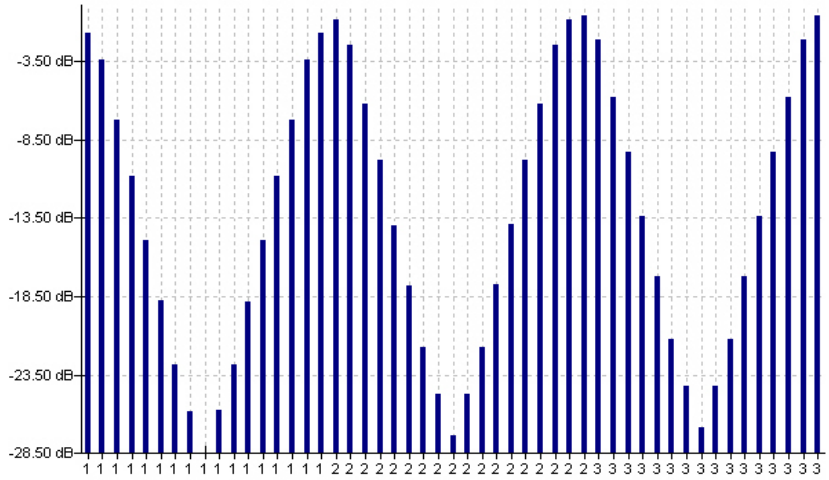

Fig. 38 - Power graph for power control

Bluetooth Modulation Characteristics Module

The *Modulation Characteristics* (5.1.9 TRM/CA/07/C) measurement can be performed with Modulation Characteristics (Fig. 39).

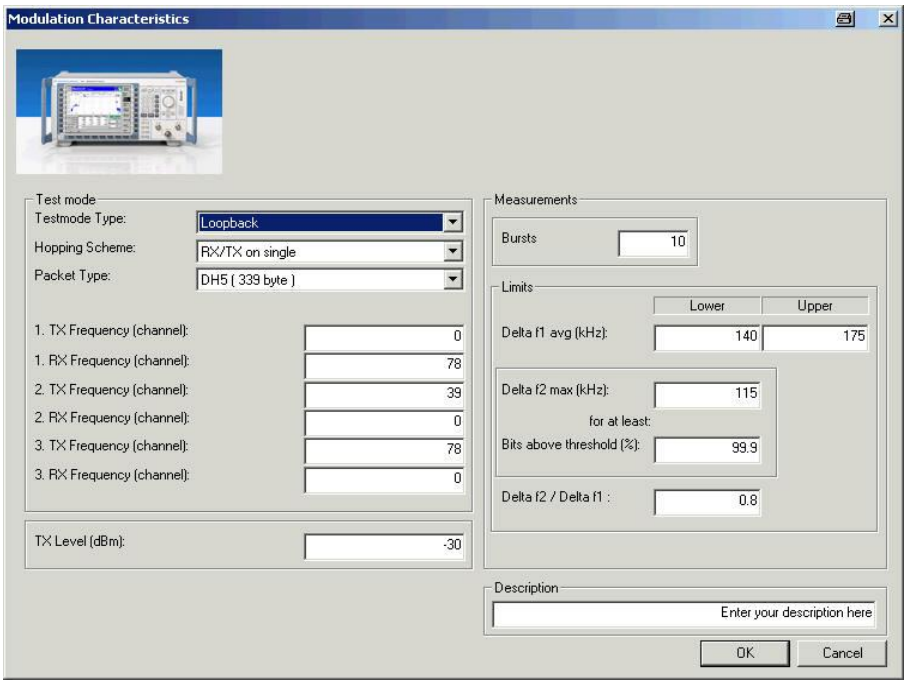

Fig. 39 - Modulation Characteristics

The **Test mode** section is used to change the common parameters. The test length is automatically determined by the packet type (DH1: 27 bytes, DH:183 bytes, DH5 339 bytes). The three channels to be measured have been predefined. Moreover, the TX level of the R&S CMU200 can be set.

The **Measurements** section is used to set the number of packets (bursts) and the various limits.

Settings for *Modulation Characteristics* (5.1.9 TRM/CA/07/C):

- Hopping off (RX/TX on single).
- Loopback.
- Longest possible packet type.
- Bluetooth product must transmit at maximum level (it may be necessary to call Power Step beforehand).
- At least 10 packets.
- The bit patterns and the three channels are changed automatically.

Fig. 40 shows a Modulation Characteristics report.

Hop Scheme: RX/TX single frequency, Packet Type: DH1, Length of Testsequence: 27, Scenario: Loopback, Tx Level: -30.0 dBm
10 Packets, Filter Bandwidth: Narrow, Freq. Dev: Algorithm: Bit Center

Channel: 0				
Delta F1 Avg	**140.00 kHz**	**175.00 kHz**	**156.12 kHz**	✔
Delta F2 Max *Threshold: 115.0 kHz*	**99.90 %**		**100.00 %**	✔
Delta F2 Avg / Delta F1 Avg	**0.80**		**0.95**	✔
Channel: 39				
Delta F1 Avg	**140.00 kHz**	**175.00 kHz**	**161.72 kHz**	✔
Delta F2 Max *Threshold: 115.0 kHz*	**99.90 %**		**100.00 %**	✔
Delta F2 Avg / Delta F1 Avg	**0.80**		**0.95**	✔
Channel: 78				
Delta F1 Avg	**140.00 kHz**	**175.00 kHz**	**165.21 kHz**	✔
Delta F2 Max *Threshold: 115.0 kHz*	**99.90 %**		**100.00 %**	✔
Delta F2 Avg / Delta F1 Avg	**0.80**		**0.95**	✔

Fig. 40 - Modulation Characteristics report

Bluetooth Initial Carrier Frequency Tolerance (ICFT) Module

The *Initial Carrier Frequency Tolerance* (5.1.10 TRM/CA/08/C) measurement can be carried out with ICFT (Fig. 41).

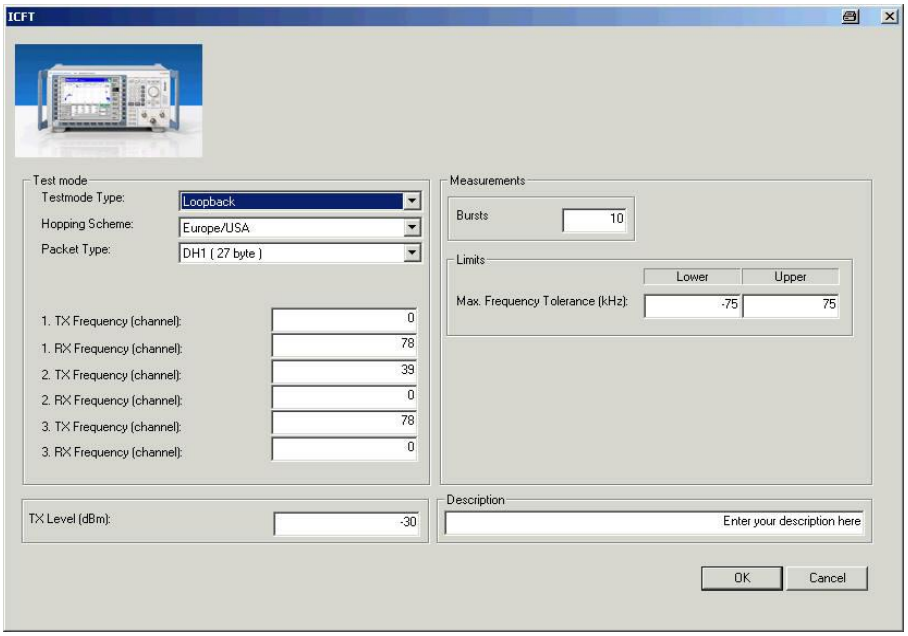

Fig. 41 – ICFT

The **Test mode** section is used to change the common parameters. The test length is automatically determined by the packet type (DH1: 27 bytes, DH:183 bytes, DH5 339 bytes). The three channels to be measured have been predefined. Moreover, the TX level of the R&S CMU200 can be set.

The **Measurements** section is used to set the number of packets (bursts) and the various limits.

Settings for *Initial Carrier Frequency Tolerance* (5.1.10 TRM/CA/08/C):

- Hopping off (RX/TX on single) and hopping on.
- Loopback.
- DH1.
- Permanent setting: Bit pattern PRBS9 (static pseudo random).
- The Bluetooth product must transmit at maximum level (it may be necessary to call Power Step beforehand)
- At least 10 packets.
- The three channels are changed automatically.

Fig. 42 shows an example of an ICFT report.

Hop Scheme: RX/TX single frequency, Scenario: Loopback, Tx Level: -30.0 dBm
10 Packets, Filter Bandwidth: Narrow, Packet Type: DH1, Freq. Dev. Algorithm: Bit Center

Channel: 0				
Max. Frequency Tolerance	**-75.00 kHz**	**75.00 kHz**	**13.24 kHz**	✔
Channel: 39				
Max. Frequency Tolerance	**-75.00 kHz**	**75.00 kHz**	**6.16 kHz**	✔
Channel: 78				
Max. Frequency Tolerance	**-75.00 kHz**	**75.00 kHz**	**10.25 kHz**	✔

Fig. 42 - Initial Carrier Frequency Tolerance report

Bluetooth Carrier Frequency Drift Module

The *Carrier Frequency Drift* measurement (5.1.10 TRM/CA/09/C) is carried out with Carrier Frequency Drift (Fig. 43).

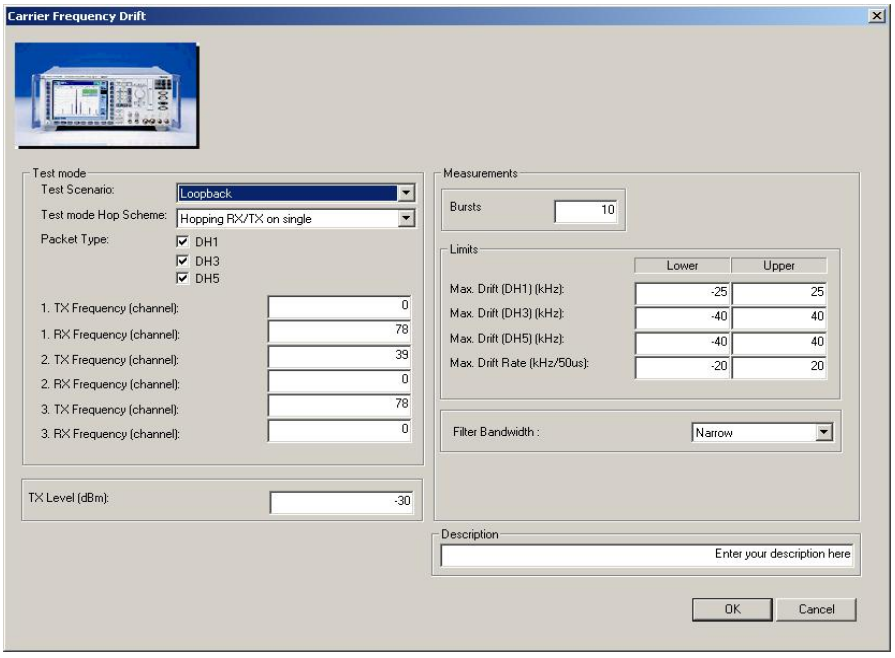

Fig. 43 - Carrier Frequency Drift

The **Test mode** section is used to change the common parameters. The test length is automatically determined by the packet type (DH1: 27 bytes, DH:183 bytes, DH5 339 bytes). The three channels to be measured have

been predefined. Moreover, the TX level of the R&S CMU200 can be set. It is not necessary to select just one packet type here, i.e. one or more packet types can be selected.

The **Measurements** section is used to set the number of packets (bursts) and the various limits.

Settings for *Carrier Frequency Drift* (5.1.10 TRM/CA/09/C):

- Hopping off (RX/TX on single) and hopping on.
- Loopback.
- DH1, DH3 and DH5.
- Permanent setting: Correct bit pattern 1010.
- At least 10 packets.
- The three channels are automatically changed.

Fig. 44 shows a Carrier Frequency Drift report.

Hop Scheme: RX/TX single frequency, Scenario: Loopback, Tx Level: -30.0 dBm
10 Bursts, Filter Bandwidth: Narrow

Channel: 0				
Max. Drift (DH1)	-25.00 kHz	25.00 kHz	14.17 kHz	✔
Max. Drift (DH3)	-40.00 kHz	40.00 kHz	1.59 kHz	✔
Max. Drift (DH5)	-40.00 kHz	40.00 kHz	30.08 kHz	✔
Max. Drift Rate (DH1) *(/ 50 us)*	-20.00 kHz	20.00 kHz	12.10 kHz	✔
Max. Drift Rate (DH3) *(/ 50 us)*	-20.00 kHz	20.00 kHz	-7.92 kHz	✔
Max. Drift Rate (DH5) *(/ 50 us)*	-20.00 kHz	20.00 kHz	9.07 kHz	✔
Channel: 39				
Max. Drift (DH1)	-25.00 kHz	25.00 kHz	22.80 kHz	✔
Max. Drift (DH3)	-40.00 kHz	40.00 kHz	3.15 kHz	✔
Max. Drift (DH5)	-40.00 kHz	40.00 kHz	-3.03 kHz	✔
Max. Drift Rate (DH1) *(/ 50 us)*	-20.00 kHz	20.00 kHz	-14.31 kHz	✔
Max. Drift Rate (DH3) *(/ 50 us)*	-20.00 kHz	20.00 kHz	0.00 kHz	✔
Max. Drift Rate (DH5) *(/ 50 us)*	-20.00 kHz	20.00 kHz	-10.59 kHz	✔
Channel: 78				
Max. Drift (DH1)	-25.00 kHz	25.00 kHz	18.11 kHz	✔
Max. Drift (DH3)	-40.00 kHz	40.00 kHz	22.37 kHz	✔
Max. Drift (DH5)	-40.00 kHz	40.00 kHz	39.74 kHz	✔
Max. Drift Rate (DH1) *(/ 50 us)*	-20.00 kHz	20.00 kHz	-11.62 kHz	✔
Max. Drift Rate (DH3) *(/ 50 us)*	-20.00 kHz	20.00 kHz	13.75 kHz	✔
Max. Drift Rate (DH5) *(/ 50 us)*	-20.00 kHz	20.00 kHz	19.99 kHz	✔

Fig. 44 - Carrier Frequency Drift report

Bluetooth Spectrum 20 dB Module

The Spectrum 20 dB module provides a spectrum measurement for measuring the bandwidth of the 20 dB signal below the carrier (Fig. 45). This measurement corresponds to the TX output spectrum 20 dB bandwidth measurement (5.1.7 TRM/CA/05/C).

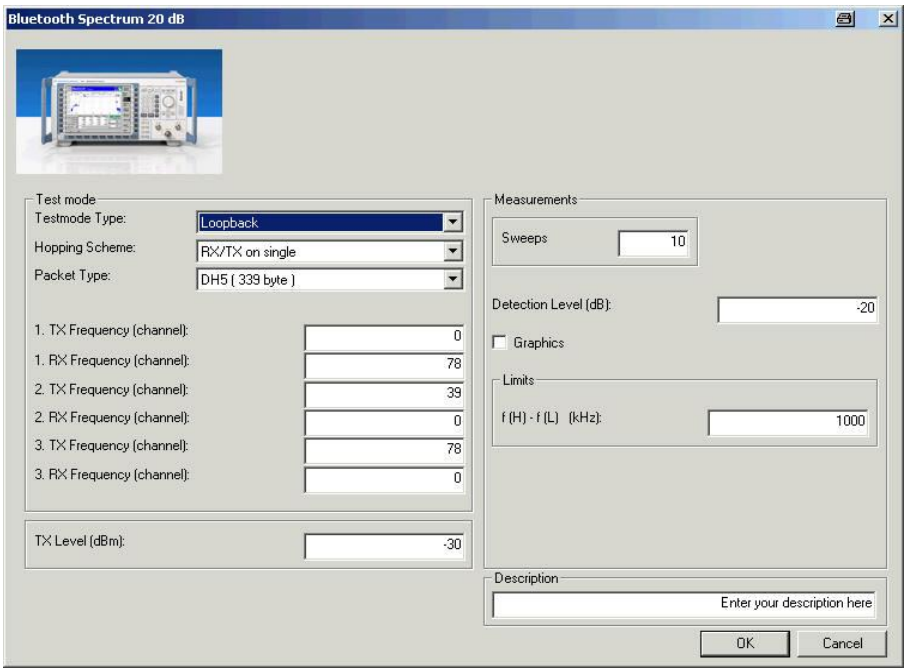

Fig. 45 - Spectrum 20 dB

The usual parameters ‘Test Mode Type’, ‘Hopping Scheme’, ‘Packet Type’ and three channels can be set under **Test mode**. Moreover, you can specify the TX level.

On the right-hand side under Measurements, you can set the number of sweeps, the detection level and the limit; plus, you can select a graphic output.

Settings for TX output spectrum 20 dB bandwidth (5.1.7 TRM/CA/05/C):

- Hopping off (RX/TX on single).
- Loopback or TX mode.
- Longest possible packet type.
- Bluetooth product has to transmit at maximum level (it may be necessary to call Power Step beforehand).
- Permanent setting: bit pattern PRBS9 (static pseudo random).
- At least 10 sweeps.
- The three channels are automatically changed.

Fig. 46 shows the report entry, Fig. 47 shows the graph.

Hopping Scheme: RX/TX single frequency, Packet Type: DH5, Length of Testsequence: 339, Testmode: Loopback
10 Bursts, Detection Level: -20.0 dB, Pattern: Static PRBS, Tx Level: -30.0 dBm

Channel: 0		
f (L) :		**-443.78 kHz**
f (H) :		**394.98 kHz**
f (H) - f (L) :	**1000.00 kHz**	**838.76 kHz**
Channel: 39		
f (L) :		**-390.91 kHz**
f (H) :		**394.28 kHz**
f (H) - f (L) :	**1000.00 kHz**	**785.19 kHz**
Channel: 78		
f (L) :		**-390.80 kHz**
f (H) :		**394.21 kHz**
f (H) - f (L) :	**1000.00 kHz**	**785.01 kHz**

Fig. 46 - Report spectrum 20 dB

Annex: **Spectrum 20 dB Graphic**

Blue: Ch: 0: P Emission: -1.3 dBm, Green: Ch: 39: P Emission: -1.3 dBm , Red: Ch: 78: P Emission: -1.3 dBm

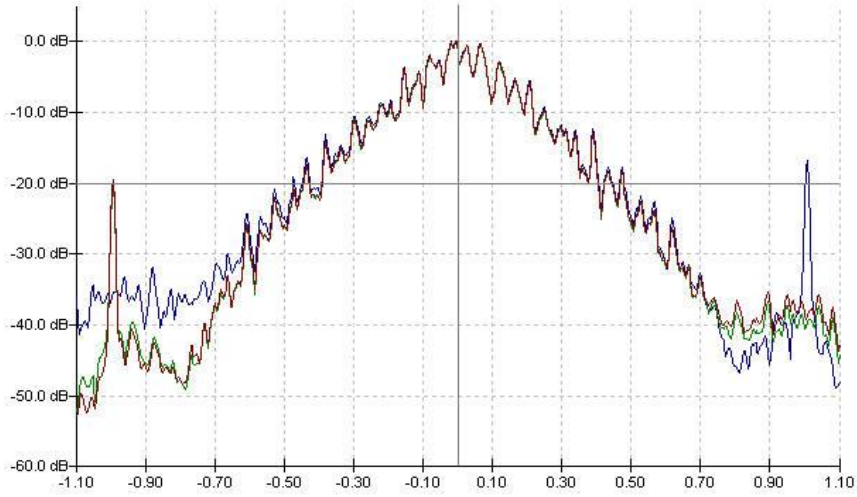

Fig. 47 - Report: Spectrum 20 dB graph

Bluetooth Spectrum ACP Module

The Spectrum ACP module provides the adjacent channel power measurement (Fig. 48). This measurement corresponds to the TX output spectrum ACP measurement (5.1.8 TRM/CA/06/C).

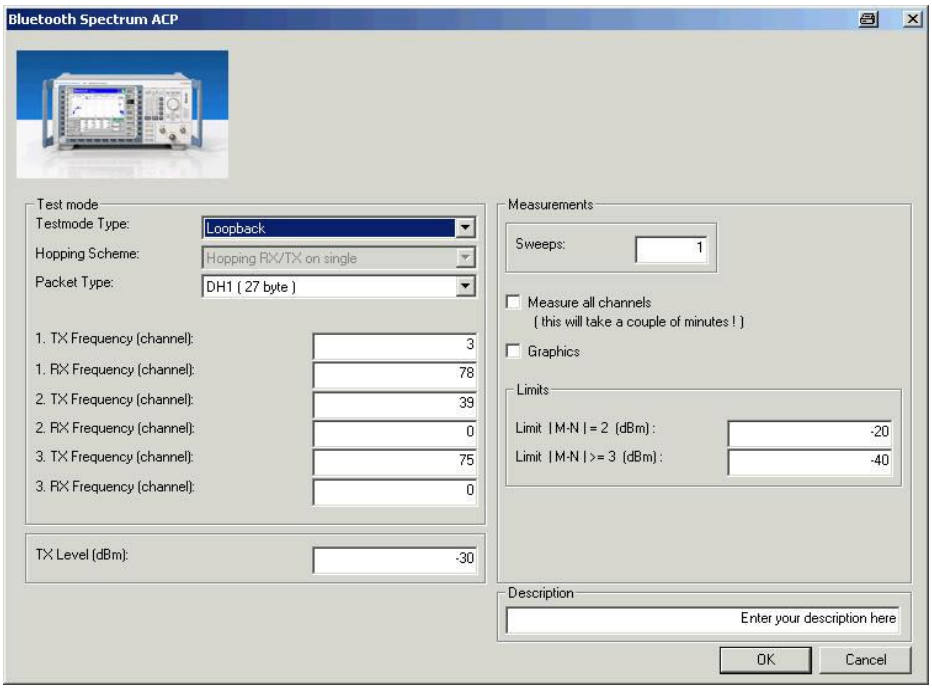

Fig. 48 - Spectrum ACP

Again, the test mode type, packet type, three channels as well as the TX level are set under Test mode. This measurement is always performed in non-hopping mode (RX/TX on single).

Settings for TX output spectrum ACP (5.1.8 TRM/CA/06/C):

- Hopping off (RX/TX on single).
- Loopback or TX mode.
- DH1.
- Bluetooth product has to transmit at maximum level (it may be necessary to call Power Step beforehand).
- Permanent setting: bit pattern PRBS9 (static pseudo random).
- At least 10 sweeps.
- The three channels are changed automatically.

You can set the number of sweeps, enter the limits and select the graphical output under Measurements. If ‘Measure all channels’ has been selected, all 78 adjacent channels per channel are measured.

Fig. 49 shows the report entry; Fig. 50 shows the graph.

Hopping Scheme: RX/TX single frequency, Packet Type: DH1, Length of Testsequence: 27, Testmode: Loopback

1 Sweeps, Pattern: Static PRBS, Tx Level: -30.0 dBm

Channel: 3	
ACPower: -3	-47.05 dBm
ACPower: -2	-41.15 dBm
ACPower: -1	-24.83 dBm
ACPower: *Center*	1.77 dBm
ACPower: +1	-24.92 dBm
ACPower: +2	-42.84 dBm
ACPower: +3	-47.38 dBm
Channel: 39	
ACPower: -3	-47.69 dBm
ACPower: -2	-44.44 dBm
ACPower: -1	-24.68 dBm
ACPower: *Center*	1.74 dBm
ACPower: +1	-24.84 dBm
ACPower: +2	-45.29 dBm
ACPower: +3	-48.68 dBm
Channel: 75	
ACPower: -3	-47.28 dBm
ACPower: -2	-40.80 dBm
ACPower: -1	-24.30 dBm
ACPower: *Center*	1.90 dBm
ACPower: +1	-24.50 dBm
ACPower: +2	-42.93 dBm
ACPower: +3	-47.46 dBm

Fig. 49 – Report Spectrum ACP (normal)

Annex: **Spectrum ACP Graphic**

Channel: 3

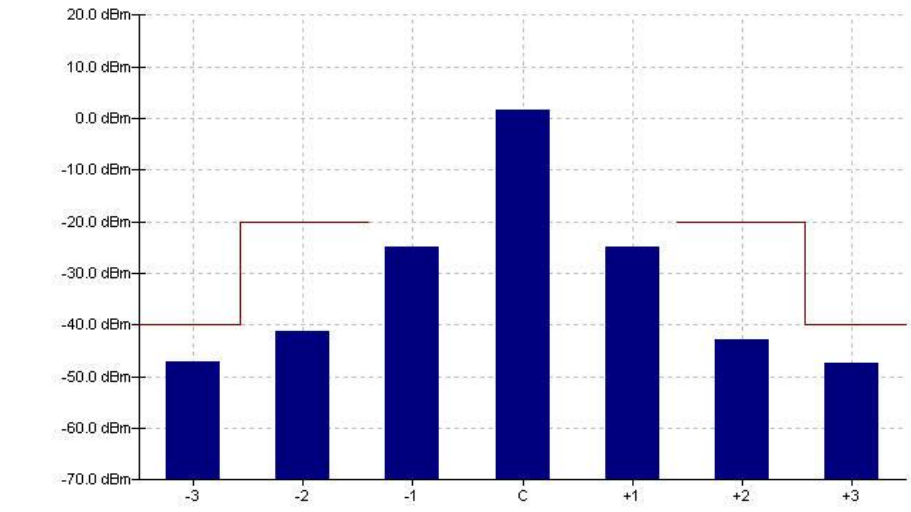

Fig. 50 - Report: Spectrum ACP graph (normal)

Fig. 51 shows a report section; Fig. 52 shows a channel of the graph.

Hopping Scheme: RX/TX single frequency, Packet Type: DH1, Length of Testsequence: 27, Testmode: Loopback

1 Sweeps, Pattern: Static PRBS, Tx Level: -30.0 dBm

Channel: 3

ACPower: *0*	**-47.00 dBm**
ACPower: *1*	**-41.49 dBm**
ACPower: *2*	**-24.78 dBm**
ACPower: *3*	**1.80 dBm**
ACPower: *4*	**-24.94 dBm**
ACPower: *5*	**-42.81 dBm**
ACPower: *6*	**-47.37 dBm**
ACPower: *7*	**-50.70 dBm**
ACPower: *8*	**-49.89 dBm**
ACPower: *9*	**-60.50 dBm**
ACPower: *10*	**-60.71 dBm**
ACPower: *11*	**-62.42 dBm**
ACPower: *12*	**-62.97 dBm**
ACPower: *13*	**-63.18 dBm**
ACPower: *14*	**-63.48 dBm**
ACPower: *15*	**-63.40 dBm**
ACPower: *16*	**-62.63 dBm**
ACPower: *17*	**-63.23 dBm**
ACPower: *18*	**-63.69 dBm**
ACPower: *19*	**-63.52 dBm**
ACPower: *20*	**-63.97 dBm**
ACPower: *21*	**-64.03 dBm**

Fig. 51 - Report Spectrum ACP section (all channels)

Annex: **Spectrum ACP Graphic**

Channel: 3

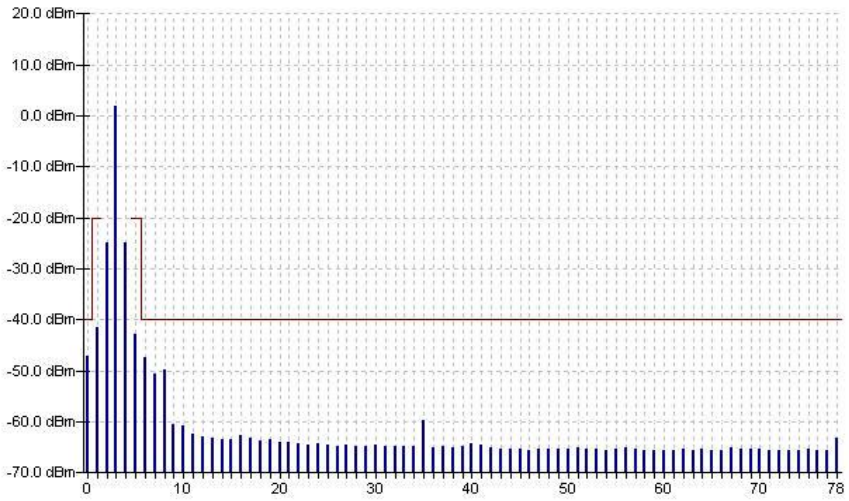

Fig. 52 - Report: Spectrum ACP graph (all channels)

Bluetooth EDR CFS & MA Module

The Module EDR CFS & MA provides the *EDR Carrier Frequency Stability and Modulation Accuracy* measurement in accordance with TRM/CA/11/C (Fig. 53).

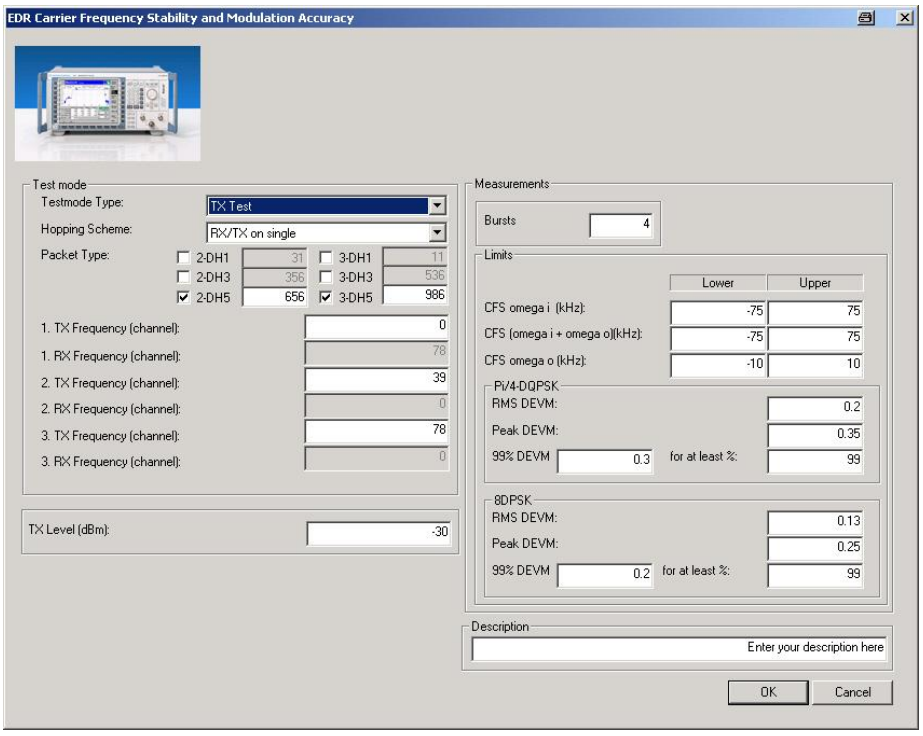

Fig. 53 - EDR CFS & MA

The test type, the packet type, three channels and the TX level are set under **Test mode**.

Under **Measurements**, you can set the number of bursts as well as the limits, in part separately for the different modulation modes.

All default settings comply with the test specification.

Settings for *EDR Carrier Frequency Stability and Modulation Accuracy* (TRM/CA/11/C):

- Hopping off (RX/TX on single)
- Loopback or TX mode
- 2-DH5 **and** 3-DH5
- Permanent setting: bit pattern PRBS9 (static pseudo random)
- 10000 symbols per frequency are to be measured. Four packets with the preset length for each packet type yield approx. 10000 symbols.
- The three channels are changed automatically.

Fig. 54 shows a typical entry in the report.

Hopping Scheme: RX/TX single frequency, Testmode: TX Test, Tx Level: -30.0 dBm

4 Bursts

Channel: 0

omega i *2-DH5*	-75.00 kHz	75.00 kHz	-62.13 kHz	✔
omega o + omega i *2-DH5*	-75.00 kHz	75.00 kHz	-74.60 kHz	✔
omega o *2-DH5*	-10.00 kHz	10.00 kHz	1.48 kHz	✔
DEVM RMS *2-DH5*		0.20 %	0.03 %	✔
DEVM Peak *2-DH5*		0.35 %	0.26 %	✔
DEVM 99% *2-DH5, Threshold: 0.30*	99.00 %		0.28 %	✔
omega i *3-DH5*	-75.00 kHz	75.00 kHz	1.84 kHz	✔
omega o + omega i *3-DH5*	-75.00 kHz	75.00 kHz	-8.64 kHz	✔
omega o *3-DH5*	-10.00 kHz	10.00 kHz	-9.69 kHz	✔
DEVM RMS *3-DH5*		0.13 %	0.08 %	✔
DEVM Peak *3-DH5*		0.25 %	0.04 %	✔
DEVM 99% *3-DH5, Threshold: 0.20*	99.00 %		0.18 %	✔

Fig. 54 - Report of EDR CFS & MA

Bluetooth EDR Phase Encoding Module

Using the EDR Phase Encoding module, you can verify whether the DUT is correctly encoding in accordance with TRM/CA/12/C (Fig. 55).

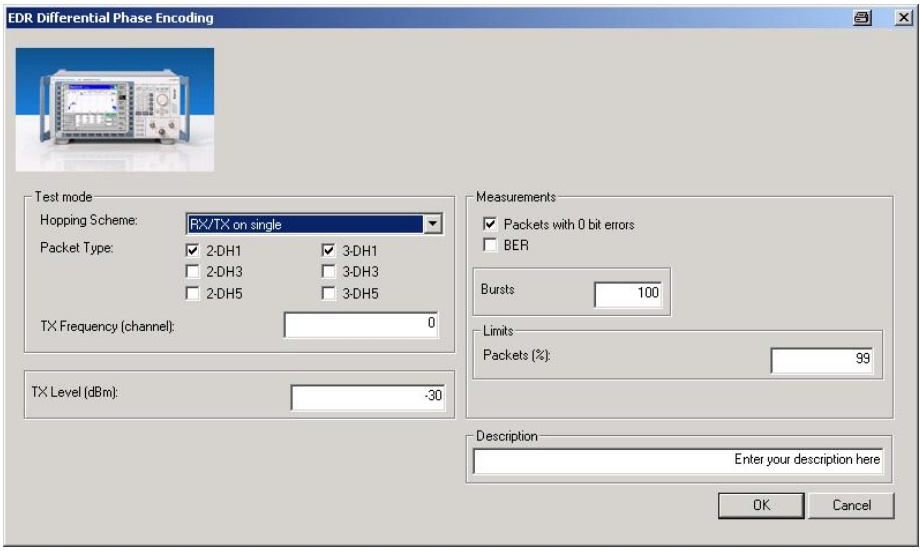

Fig. 55 - EDR Phase Encoding

The hopping scheme, the packet type and the TX frequency (channel) are set under **Test mode**. This measurement can be performed in the TX mode only. The TX level is also entered here. Under **Measurements**, the number of bursts and the limit are specified.

Settings for *EDR Phase Encoding* (TRM/CA/12/C):

- Hopping off (RX/TX on single)
- TX mode
- 2-DH1 **and** 3-DH1
- Permanent setting: bit pattern PRBS9 (static pseudo random)
- 100 bursts
- Lowest channel

Fig. 56 shows a typical entry in the report.

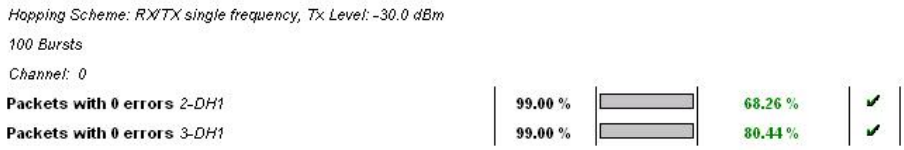

Fig. 56 - Report of EDR Phase Encoding

Bluetooth EDR Relative Transmit Power Module

Using the EDR Relative Transmit Power module, you can measure the difference in power between the DPSK-modulated and the GFSK-modulated part of the burst in accordance with TRM/CA/10/C (Fig. 57).

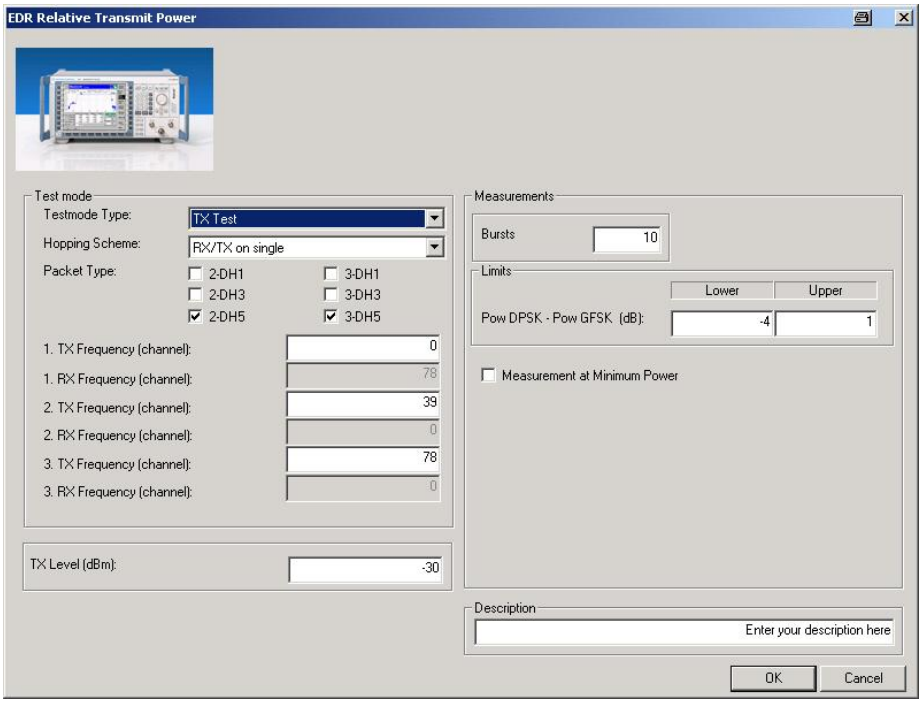

Fig. 57 - EDR Relative Transmit Power

The test type, the hopping scheme, the packet type, three channels and the TX level are set under **Test mode**. Under **Measurements**, you can enter the number of packets (bursts) and the limits.

If **Measurement at Minimum Power** is activated, the measurement is carried out with the DUT transmitting at maximum and at minimum power on all three channels. To this effect, CBTgo sends a *Power Step Up/Down* command for each channel until the DUT signals back that it is transmitting at maximum or minimum power.

Settings for *EDR Relative Transmit Power* (TRM/CA/10/C):

- Hopping off (RX/TX on single)
- Loopback or TX mode

- 2-DH5 **and** 3-DH5
- Permanent setting: bit pattern PRBS9 (static pseudo random)
- 10 bursts on each of the three channels
- Measurement at maximum and at minimum power

Fig. 58 shows a typical entry in the report.

Hopping Scheme: RX/TX single frequency, Testmode: TX Test, Tx Level: -30.0 dBm
10 Bursts
Channel: 0

Power DPSK - Power GFSK *2-DH5*	**-4.00 dB**	**1.00 dB**	**-3.00 dB**	✔
Power GFSK *2-DH5*			**-2.00 dB**	✔
Power DPSK *2-DH5*			**1.00 dB**	✔
Power DPSK - Power GFSK *3-DH5*	**-4.00 dB**	**1.00 dB**	**-2.00 dB**	✔
Power GFSK *3-DH5*			**-2.00 dB**	✔
Power DPSK *3-DH5*			**0.00 dB**	✔

Fig. 58 - Report of EDR Relative Transmit Power

Bluetooth EDR Sensitivity Module

The EDR Sensitivity module is used to measure the bit error rate (BER) (Fig. 59).

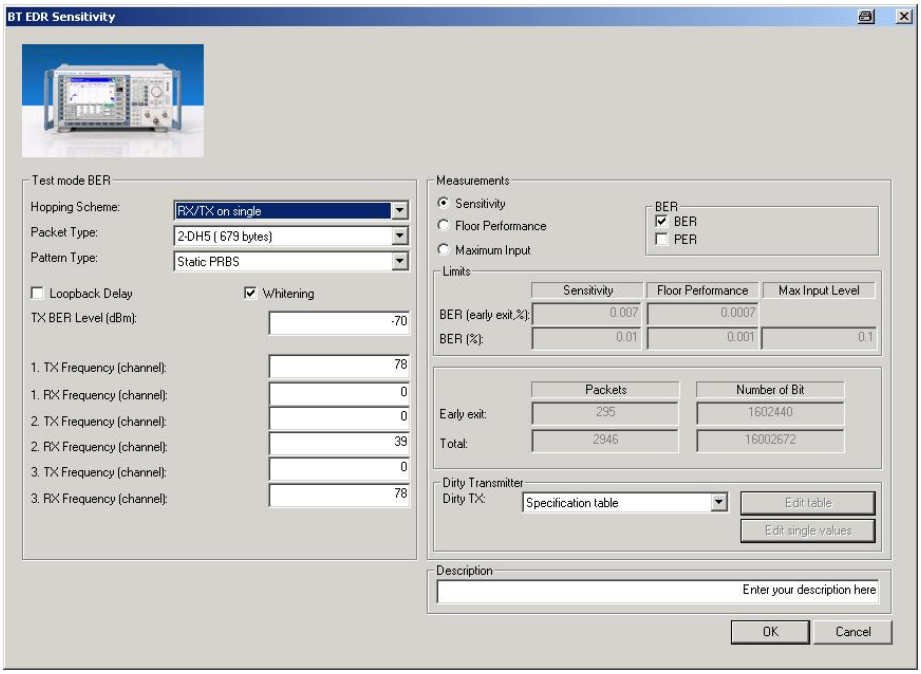

Fig. 59 - EDR Sensitivity

The test specification calls for three different measurements to be performed:

a) Settings for *EDR Sensitivity* (TRM/CA/07/C):

- Hopping off (RX/TX on single)
- Loopback mode

- 2-DH5 **and** 3-DH5
- Permanent setting: bit pattern PRBS9 (static pseudo random)
- 100 bursts
- Three channels
- Whitening on
- TX level –70 dBm
- Dirty transmitter on

b) Settings for *EDR Floor Performance* (TRM/CA/08/C):

- Hopping off (RX/TX on single)
- Loopback mode
- 2-DH5 **and** 3-DH5
- Permanent setting: bit pattern PRBS9 (static pseudo random)
- 100 bursts
- Three channels
- Whitening on
- TX level –60 dBm

c) Settings for *EDR Maximum Input Level* (TRM/CA/10/C):

- Hopping off (RX/TX on single)
- Loopback mode
- 2-DH5 **and** 3-DH5
- Permanent setting: bit pattern PRBS9 (static pseudo random)
- 100 bursts
- Three channels
- Whitening on
- TX level –20 dBm

Under **Measurements**, you can select one of the three types of BER measurements. The settings made before for the individual measurements are activated automatically. The permanently set limits, the number of packets and thus the number of bits transmitted are also displayed here. The test specification enables early exit for the *Sensitivity* and *Floor Performance* BER measurements. For the *Sensitivity* measurement, this means that the measurement can be exited if a BER lower than 0.007 % is obtained for the initial 1,600,000 bits. If this is not the case, a BER lower than 0.01 % must be obtained after a total of 16,000,000 bits. For *Floor Performance*, the BER must be lower than 0.0007 % for the initial 8,000,000 bits and lower than 0.001 % after a total of 160,000,000 bits.

Under **Test mode BER**, you can set the hopping scheme, the packet type (each with fixed length) and the pattern type. *Loopback Delay* and *Whitening* have to be activated. The indicated TX BER level is a default value and can be modified. The three channels can also be user-defined.

Fig. 60 shows an entry for a *Sensitivity* measurement where no early exit was made. The BER and the limit for each channel are stated as absolute values multiplied by $1*10^{-6}$ rather than as percentage values. Fig. 61 shows a measurement where early exit was made (*early pass*).

Hop Scheme: RX/TX single frequency, Packet Type: 2-DH5, Pattern: SPRS, Whitening: On

Tx Level: -70.0 dBm, Packets: 2946, Packets (early exit): 295, Loopback Delay Off, Dirty Transmitter: Specification Table

Test: Sensitivity, Bit 16002672, Bit (early exit): 1602440

BER: @ *Channel: RX: 0, TX: 78,* * 1E-6		100.00	62.99	✔
BER: @ *Channel: RX: 39, TX: 0,* * 1E-6		100.00	36.98	✔
BER: @ *Channel: RX: 78, TX: 0,* * 1E-6		100.00	57.17	✔

Fig. 60 - Report of EDR Sensitivity,

Hop Scheme: RX/TX single frequency, Packet Type: 2-DH5, Pattern: SPRS, Whitening: On

Tx Level: -70.0 dBm, Packets: 2946, Packets (early exit): 295, Loopback Delay Off, Dirty Transmitter: Specification Table

Test: Sensitivity, Bit 16002672, Bit (early exit): 1602440

BER: @ *Channel: RX: 0, TX: 78, Early exit,* * 1E-6		70.00	0.00	✔
PER: @ *Channel: RX: 0, TX: 78, Early exit,*			0.00 %	✔

Fig. 61 - Report of EDR Sensitivity,

Bluetooth EDR Test Set Module

The EDR Test Set Configuration Module allows you to perform the power and modulation measurement for EDR packets in a single operation (Fig. 62).

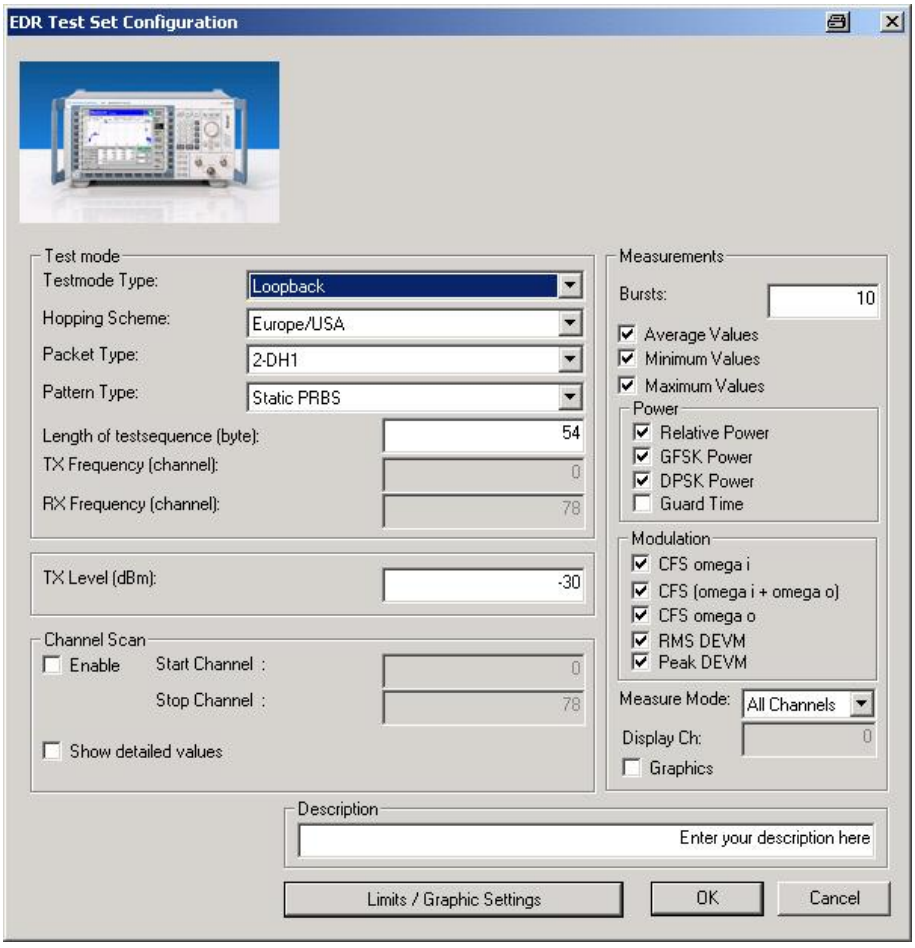

Fig. 62 - EDR Test Set Configuration

The link parameters can be edited under **Test mode**. The test type, the hopping scheme, the packet type and the pattern type can be entered here. If *RX/TX on single* is selected under *Hopping Scheme*, the RX and the TX channel can be set in addition. The TX level of the R&S CBT can also be edited.

Under **Measurements**, you can select the specific measurements to be displayed, set the number of bursts and define whether results should be displayed as average, minimum and/or maximum values. The measurement returns all results irrespective of the display mode(s) selected (and thus always requires the same amount of time). This means that the selection only affects the results displayed in the report. If the link is in the hopping mode, you can use *Measure Mode* to define whether all channels (*All Channels*) or only a single channel (*Single Channel/Display Channel*) are to be measured. If *Graphics* is activated, two graphs will be output for the power and the modulation characteristic.

Channel Scan can be used to perform measurements on selected (or all) channels. Results are automatically displayed in a graph (Fig. 65). If *Show detailed values* is activated, the results for the selected channels are also displayed in a table (Fig. 66).

The **Limits / Graphics Settings** button opens another window (Fig. 63).

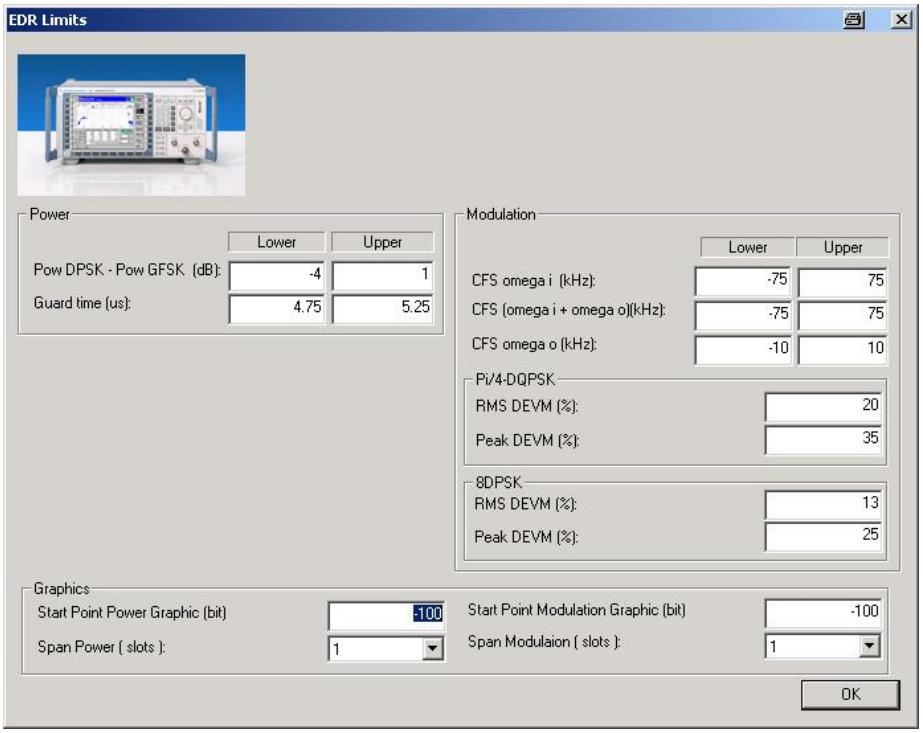

Fig. 63 - EDR Test Set limits

Limits can be set under **Power** and **Modulation**. In addition, the starting points for the power and modulation graphs and the lengths of the graphs can be set. Fig. 64 shows the report for a standard EDR Test Set measurement.

Hop Scheme: Hopping Europe/USA, Packet Type: 2-DH1

Tx Level: -30.0 dBm, 10 Bursts , Mode: All

Testmode Type: Loopback, Pattern: SPRS, Length of testsequence: 54

Relative Power: *Average*	-4.00 dB	1.00 dB	-1.37 dB	✔
Relative Power: *Minimum*	-4.00 dB	1.00 dB	-1.17 dB	✔
Relative Power: *Maximum*	-4.00 dB	1.00 dB	-1.30 dB	✔
GFSK Power: *Average*			0.91 dBm	✔
GFSK Power: *Minimum*			0.40 dBm	✔
GFSK Power: *Maximum*			0.98 dBm	✔
DPSK Power: *Average*			-0.46 dBm	✔
DPSK Power: *Minimum*			-0.77 dBm	✔
DPSK Power: *Maximum*			-0.32 dBm	✔
Guard time: *Average*			4.90 us	✔
Guard time: *Minimum*			5.17 us	✔
Guard time: *Maximum*			4.95 us	✔
CFS Omega i: *Average*	-75.00 kHz	75.00 kHz	73.06 kHz	✔
CFS Omega i: *Minimum*	-75.00 kHz	75.00 kHz	7.96 kHz	✔
CFS Omega i: *Maximum*	-75.00 kHz	75.00 kHz	-28.42 kHz	✔
CFS Omega i + Omega o: *Average*	-75.00 kHz	75.00 kHz	30.65 kHz	✔
CFS Omega i + Omega o: *Minimum*	-75.00 kHz	75.00 kHz	-34.17 kHz	✔
CFS Omega i + Omega o: *Maximum*	-75.00 kHz	75.00 kHz	52.23 kHz	✔
CFS Omega o: *Average*	-10.00 kHz	10.00 kHz	-0.10 kHz	✔
CFS Omega o: *Minimum*	-10.00 kHz	10.00 kHz	-9.96 kHz	✔
CFS Omega o: *Maximum*	-10.00 kHz	10.00 kHz	2.22 kHz	✔
DEVM RMS: *Average*		20.00 %	1.85 %	✔
DEVM RMS: *Minimum*		20.00 %	10.85 %	✔
DEVM RMS: *Maximum*		20.00 %	4.60 %	✔
DEVM Peak: *Average*		35.00 %	21.60 %	✔

Fig. 64 - Report of standard EDR Test Set measurement

Annex: **Relative Power:**

Start Channel: 0, Stop Channel: 78, Average: blue, Min: green, Max: red

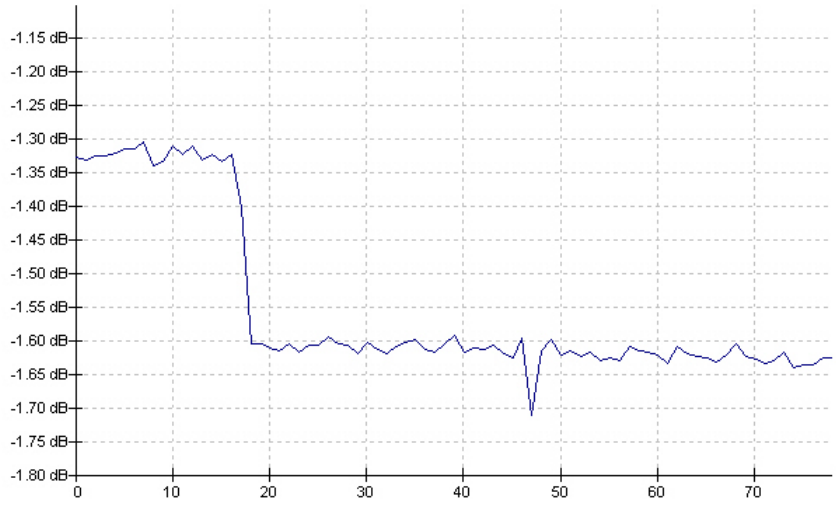

Fig. 65 - Report of EDR Test Set measurement with channel scan, graphic display

Hop Scheme: Hopping Europe/USA, Packet Type: 2-DH1

Tx Level: -30.0 dBm, 10 Bursts , Mode: —

Testmode Type: Loopback, Pattern: SPRS, Length of testsequence: 54

Relative Power: *Average, Channel: 10*			-1.30 dB	
Relative Power: *Average, Channel: 11*			-1.32 dB	
Relative Power: *Average, Channel: 12*			-1.31 dB	
Relative Power: *Average, Channel: 13*			-1.33 dB	
Relative Power: *Average, Channel: 14*			-1.31 dB	
Relative Power: *Average, Channel: 15*			-1.32 dB	
Relative Power: *Average, Channel: 16*			-1.34 dB	
Relative Power: *Average, Channel: 17*			-1.32 dB	
Relative Power: *Average, Channel: 18*			-1.31 dB	
Relative Power: *Average, Channel: 19*			-1.32 dB	
Relative Power: *Average, Channel: 20*			-1.31 dB	

Fig. 66 - Report of EDR Test Set measurement with detailed values

3 Manual Operation of R&S CMU200

This section **cannot** replace **nor is intended** to replace the Bluetooth manual in the R&S CMU200 [3] [4]. Only a handful of important settings and measurement results are to be interpreted in this section. The structure mainly corresponds to that of CMUgo in section 2.

Call Setup and Release

Before measurements can be performed on a Bluetooth module, a connection has to be set up between the R&S CMU200 (master) and the Bluetooth product.

Fig. 67 shows the Connection Control window. The address of the module to be called must be queried via **Inquire** or entered under 'Master signal'. A connection in the test mode can then be directly established via **Connect test mode** or a connection in the normal Bluetooth mode can be established via **Connect**. For information about the individual submodes see section 2. Once a connection has been established, it can be released using **Detach** (no figure).

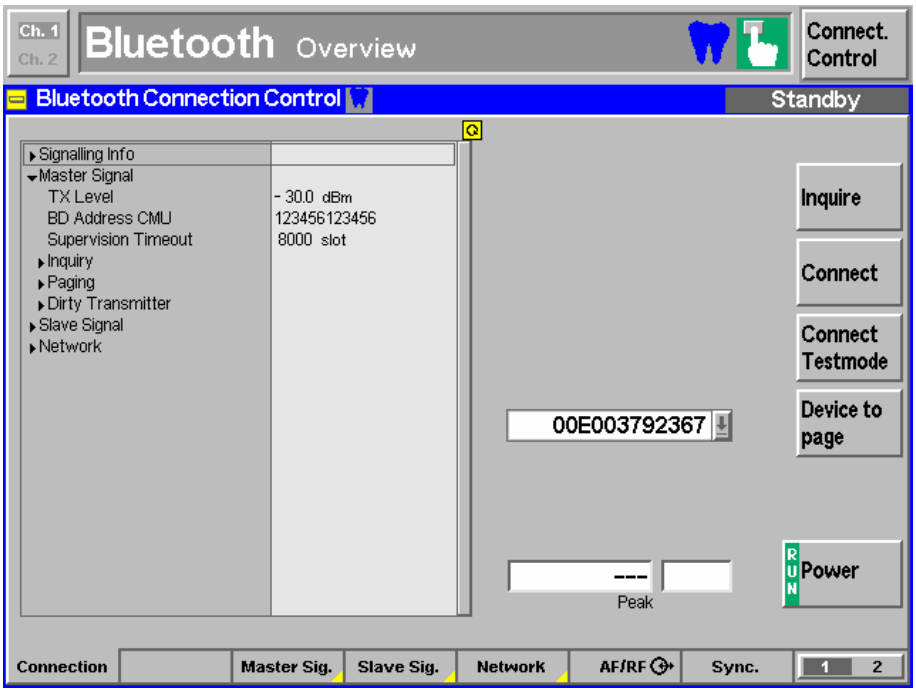

Fig. 67 - Call setup and release

To establish this connection, the R&S CMU200 uses the settings in the **Master signal**, **Slave signal** and **Network** tabs. Parts of these settings can be changed later during an existing connection.

Fig. 68 shows essential settings for master signal.

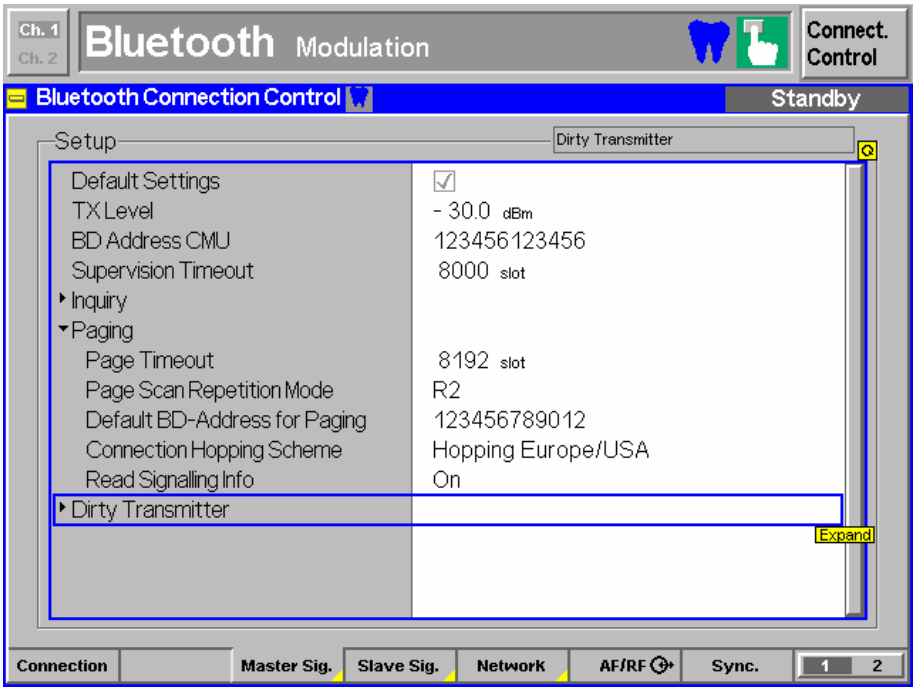

Fig. 68 - Master signal

Fig. 69 shows the most important slave signal parameters that can also be changed in a connection.

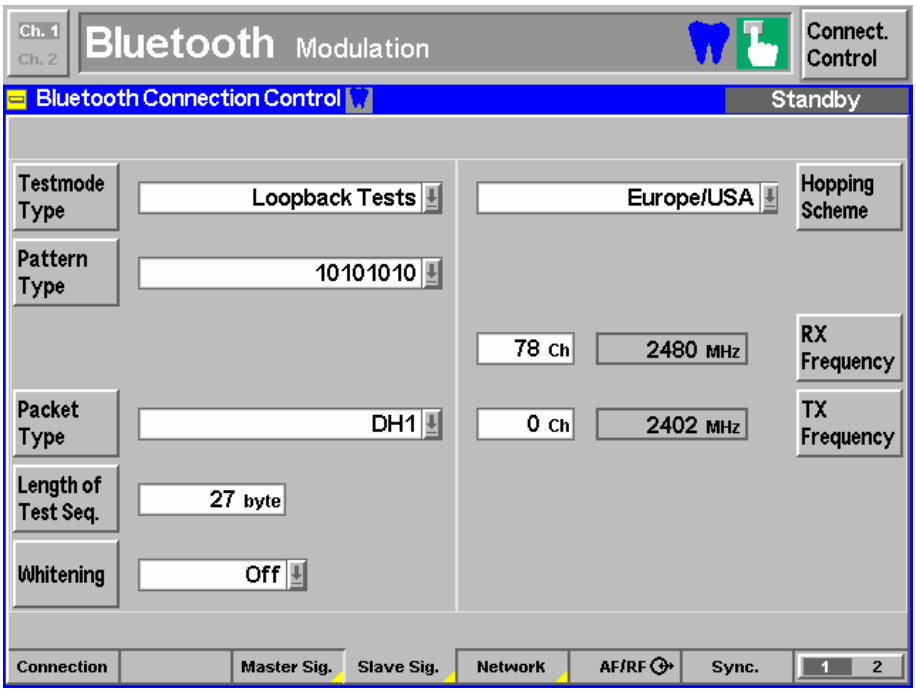

Fig. 69 -Slave signal

The individual submode parameters can be set under 'Network' (Fig. 70):

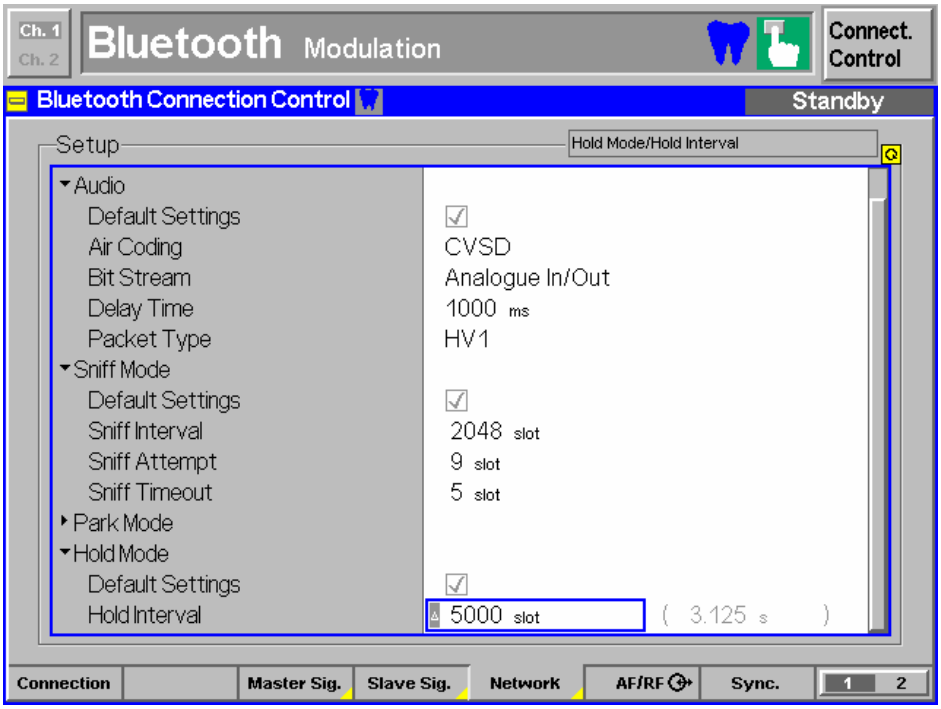

Fig. 70 - Network showing submodes

Once a connection has been established, individual submodes can be activated (Fig. 71). The submode can be activated with 'Enter Submode', and 'Exit...' can be used to return to the normal mode.

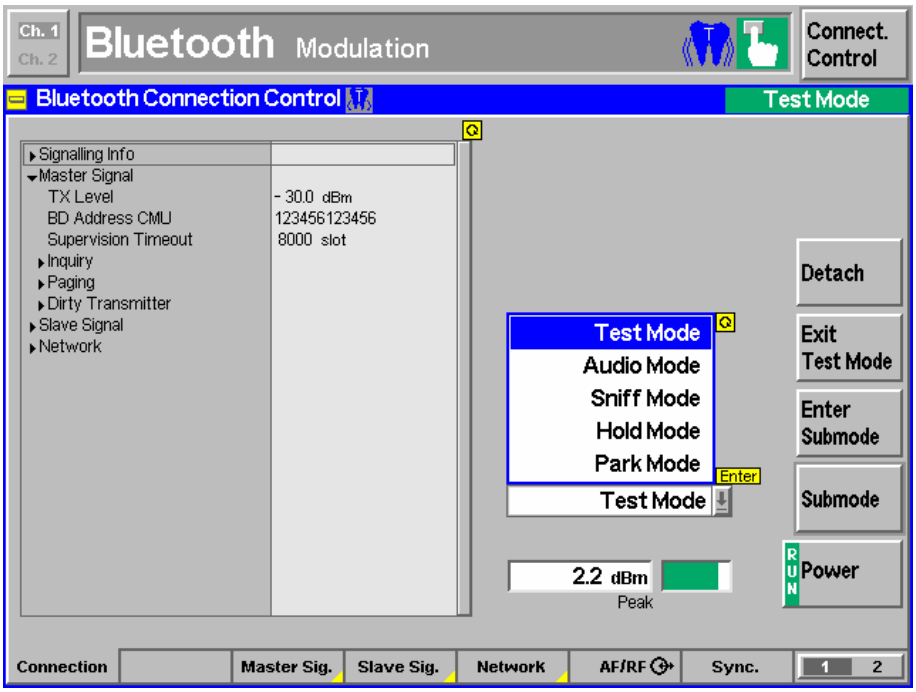

Fig. 71 - Submodes in a connection

Fig. 8 in section 2 shows the various states and transitions between the individual submodes.

Power (Power Control, Output Power)

The **Power** button under Menus is used to access the power measurement display (Fig. 72). The average, minimum and maximum values are shown for the nominal, leakage and peak power.

***Power Control* (5.1.5 TRM/CA/03/C)**

Pressing **Power control** (right bar) will display two additional buttons (**Step up** or **Step down**) in the second bottom row; they are used to test the power control function. If 'Step up' or 'Step down' is pressed, the corresponding action is performed, followed by another power measurement. The before-and-after difference will be displayed as the **Delta level** at the bottom left.

***Output Power* (5.1.3 TRM/CA/01/C)**

The module must initially transmit at full power, i.e. it may be necessary to increase the power with 'Step up' until the message 'Maximum power reached' is displayed. The power measurement will then be performed.

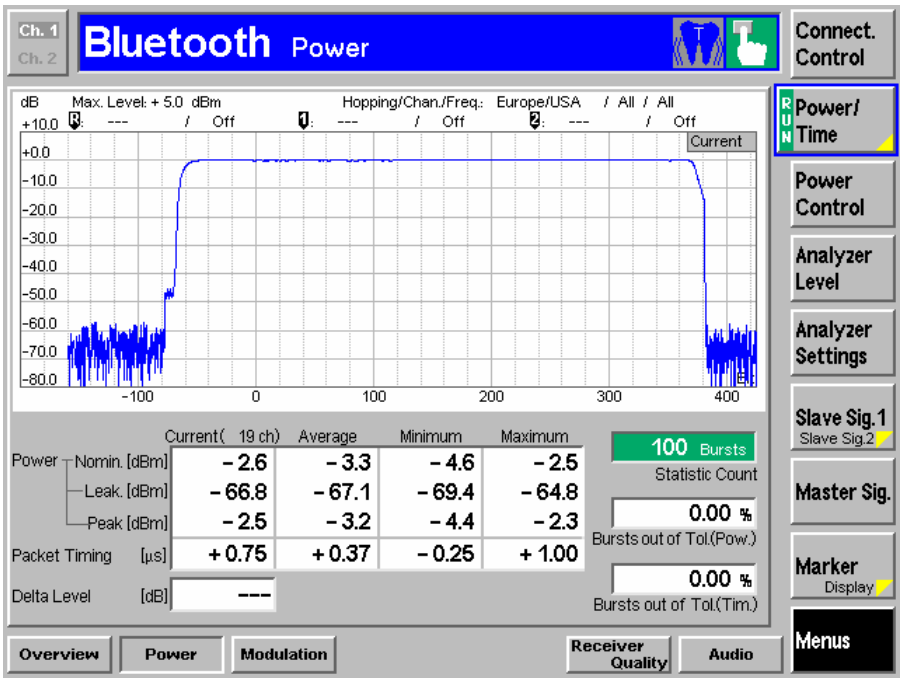

Fig. 72 – Power

Modulation (Mod. Char., ICFT, Carrier Freq. Drift)

The **Modulation** button under Menus is used to access the modulation measurement display (Fig. 73). The average, minimum and maximum values for frequency accuracy, frequency drift, maximum drift rate and frequency deviation are displayed.

The settings for the filter bandwidth and the algorithm for calculating the frequency deviation (Fig. 74) will be displayed after pressing the **Modulation** button in the right bar twice.

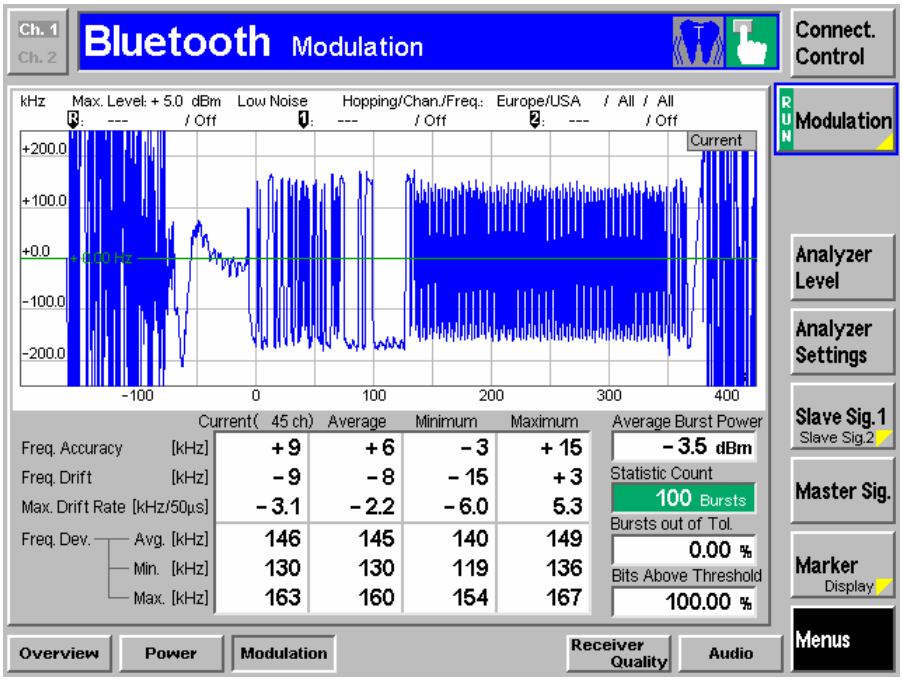

Fig. 73 – Modulation

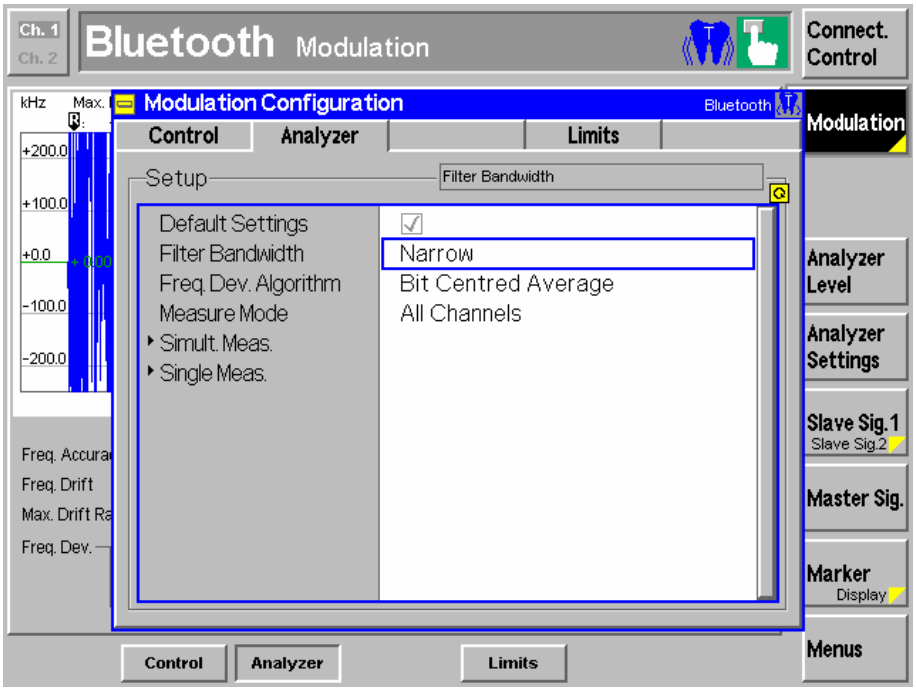

Fig. 74 - Modulation settings

***Modulation Characteristics* (5.1.9 TRM/CA/07/C)**

The results for Δf1avg (with bit pattern 11110000) and Δf2avg (with bit pattern 10101010) are displayed in the **Freq. dev. avg.** row under the **Average** column, and the percentage for Δf2max is displayed in the **Bits above threshold** field. The user must manually switch between the bit patterns.

***Initial Carrier Frequency Tolerance* (5.1.10 TRM/CA/08/C)**

The most important results are shown in the **Freq. accuracy** row under the **Maximum** and **Minimum** columns.

***Carrier Frequency Drift* (5.1.10 TRM/CA/09/C)**

The results in the **Freq. drift** and **Max. drift rate** rows under the **Minimum** and **Maximum** columns have to be taken into consideration.

Spectrum

You can access the Spectrum display via the **Spectrum** button.

Two different test applications can be selected by pressing the **Application** button in the right bar.

20 dB spectrum

The 20 dB spectrum measurement shows the spectrum around the active channel. The occupied 20 dB frequency range is measured below the power of the active channel.

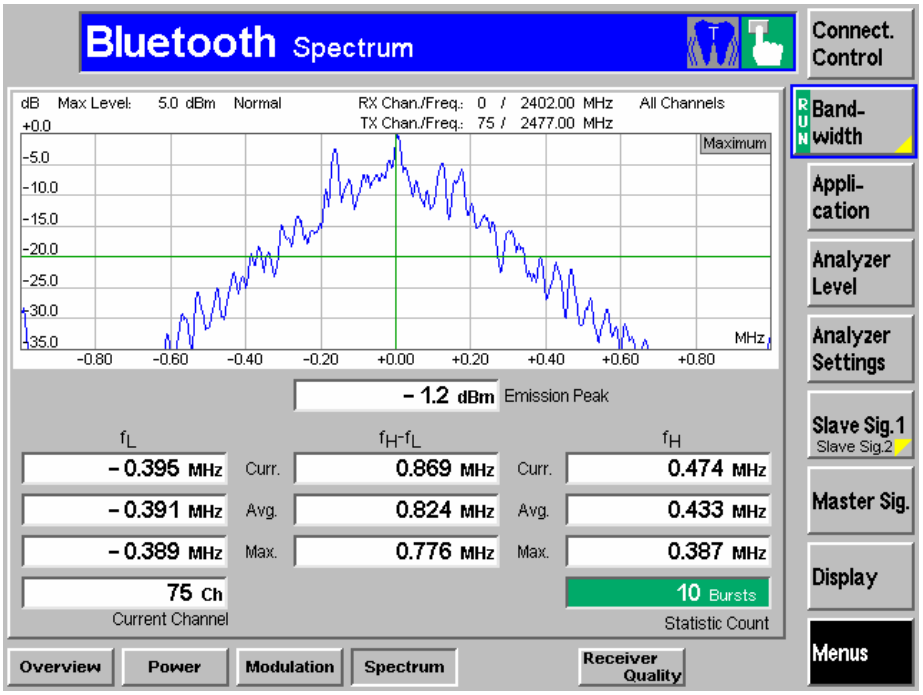

Fig. 75 - 20 dB spectrum

The R&S CMU displays three different graphs and the associated measurement values. In other words, the three ‘Curr.’ measurement values refer to the current trace, and so on. This also explains why the maximum value may be lower than the current value.

***TX output spectrum 20 dB* bandwidth (5.1.7 TRM/CA/05/C)**

The results in the Maximum line and the Maximum trace have to be taken into account. The bit pattern to be used is PRBS9 (static pseudo random).

ACP spectrum

The adjacent channel power spectrum measurement shows the power in the active channel as well as the power in the three adjacent channels. These channels are user-selectable. The bit pattern to be used is PRBS9 (static pseudo random). Hopping is not permissible (RX/TX on single).

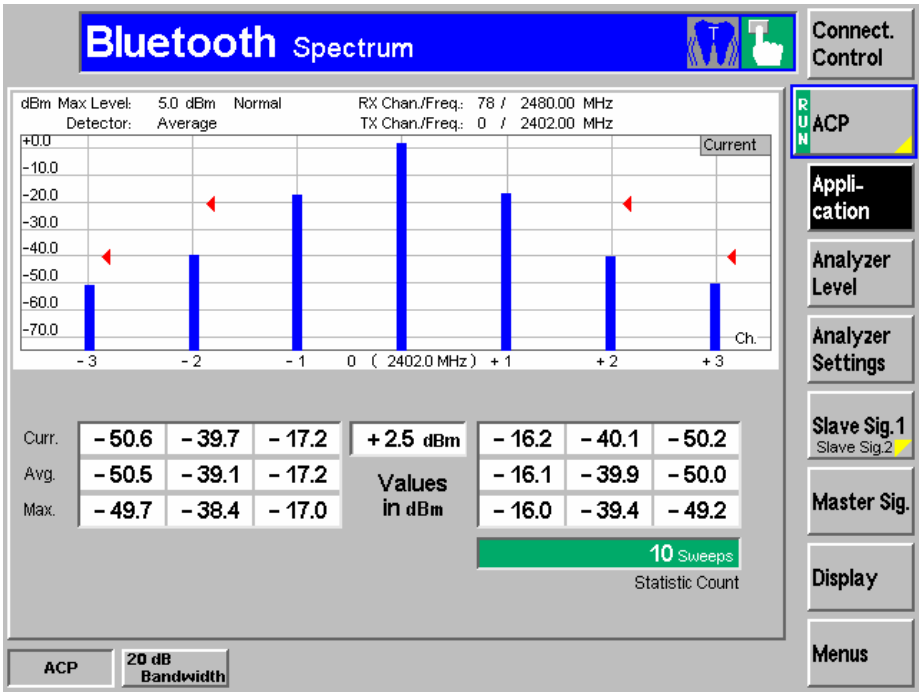

Fig. 76 – ACP spectrum

Receiver Quality

The **Receiver Quality** button under Menus is used to access the Receiver Quality measurement display.

Two different test applications can be selected by pressing the **Application** button in the right bar. 'BER' returns the bit error rate for a fixed level, while 'BER Search' returns the level for a specific bit error rate. A static dirty transmitter can be added via **Master signal** in the right bar. The settings will then be entered via **Modulation index** and **Frequency offset** in the bottom line (Fig. 77).

Dirty Transmitter

With regard to the dirty transmitter, the R&S CMU and R&S CBT differ. While the R&S CMU provides only a static DT, the R&S CBT additionally offers the full dynamic DT.

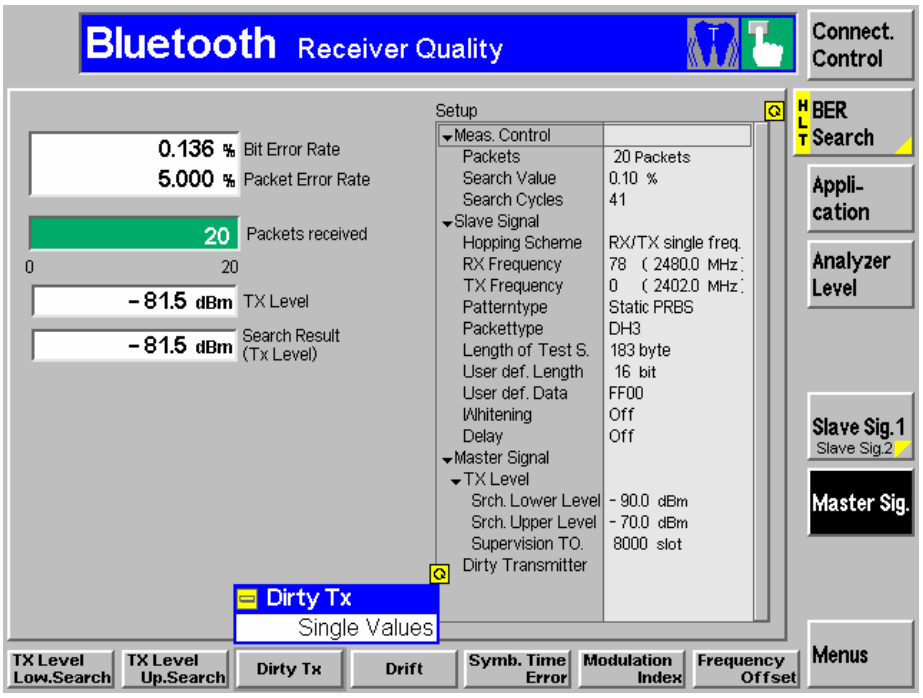

Fig. 77 - DT single values (R&S CMU and R&S CBT)

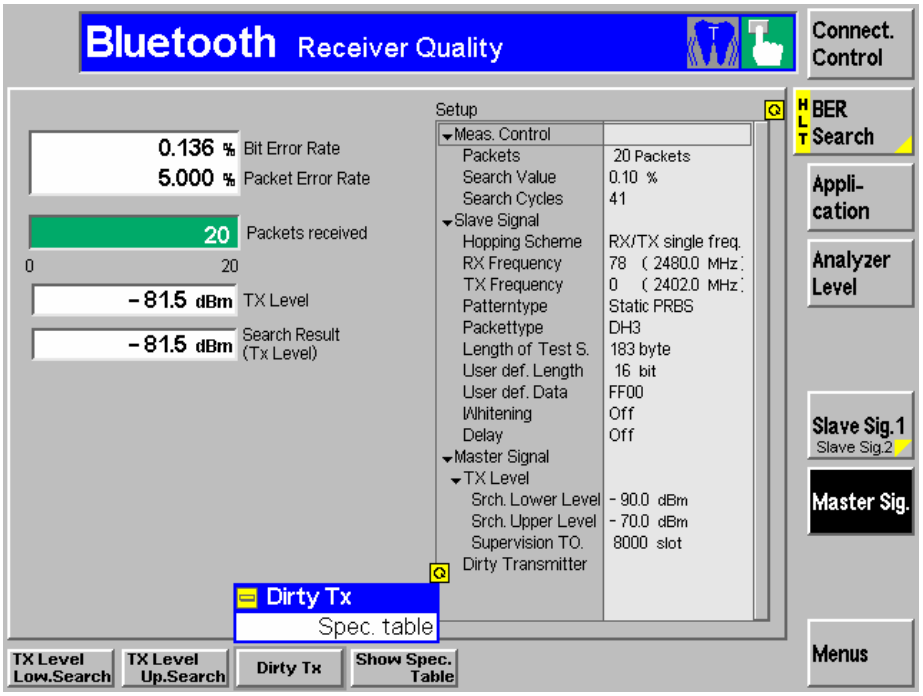

Fig. 78 - DT specification table (R&S CBT only)

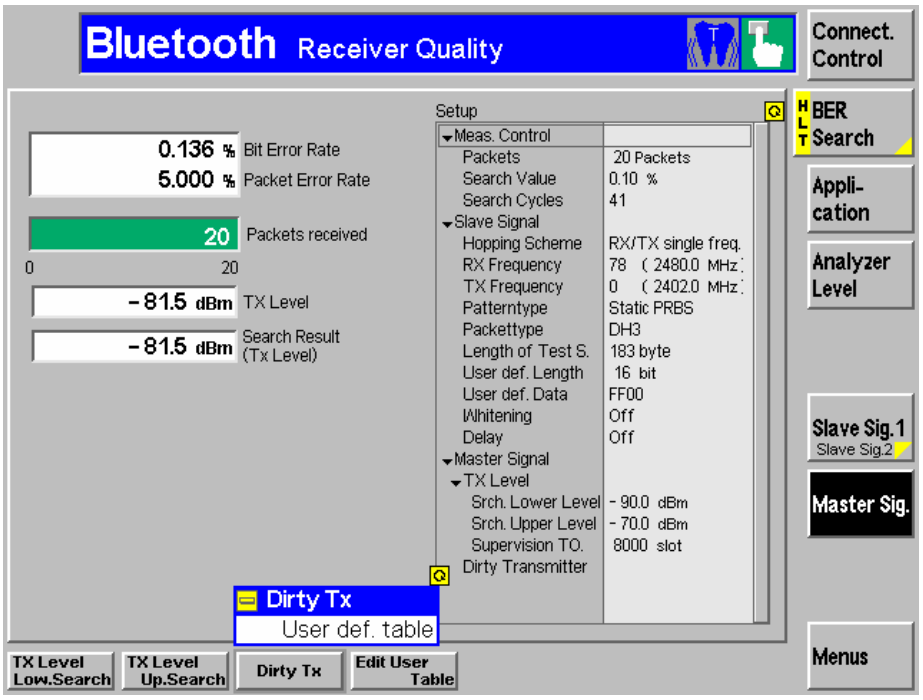

Fig. 79 - DT user-defined table (R&S CBT only)

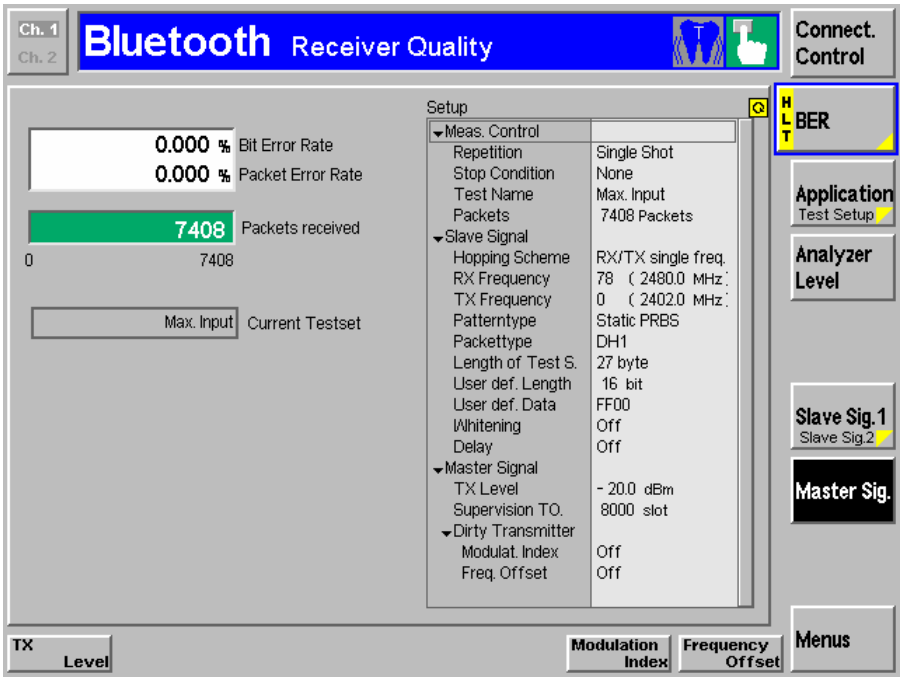

Fig. 80 - Dirty transmitter in Receiver Quality

BER

The bit error rate, packet error rate and the number of packets received are displayed here (Fig. 81).

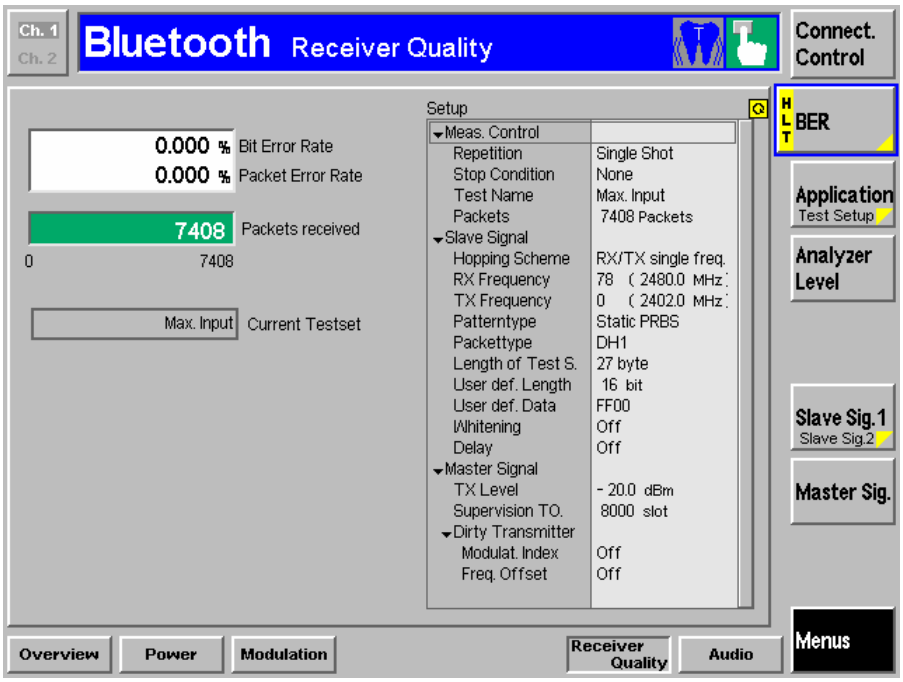

Fig. 81 – BER

BER Search

The bit error rate, packet error rate and the search result are displayed. If no result is displayed, the search interval has to be modified (Fig. 82).

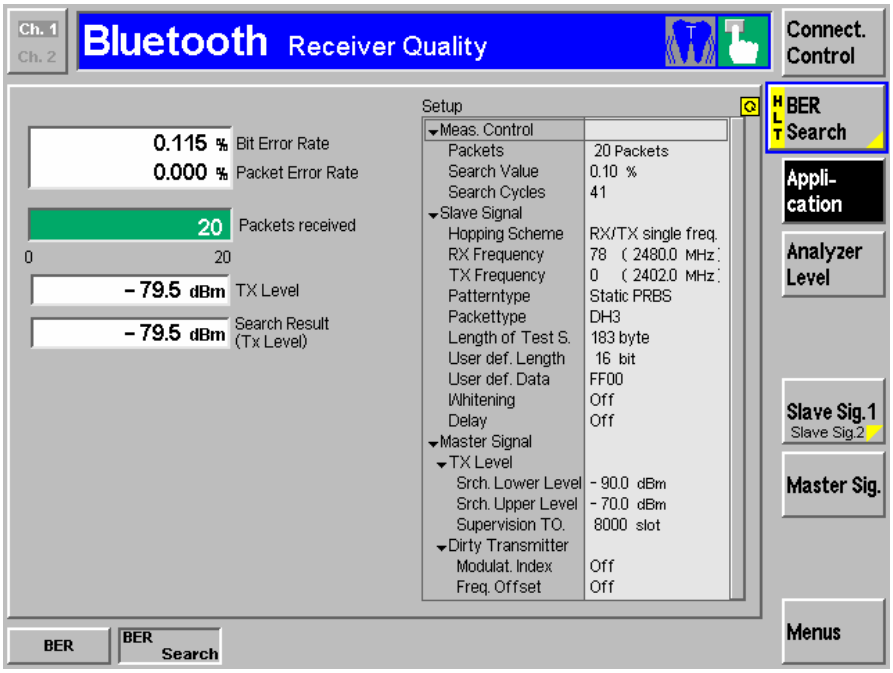

Fig. 82 - BER Search

EDR Measurements

To perform EDR measurements, the appropriate packet type for the Bluetooth connection has first to be selected. Fig. 83 shows the available selection.

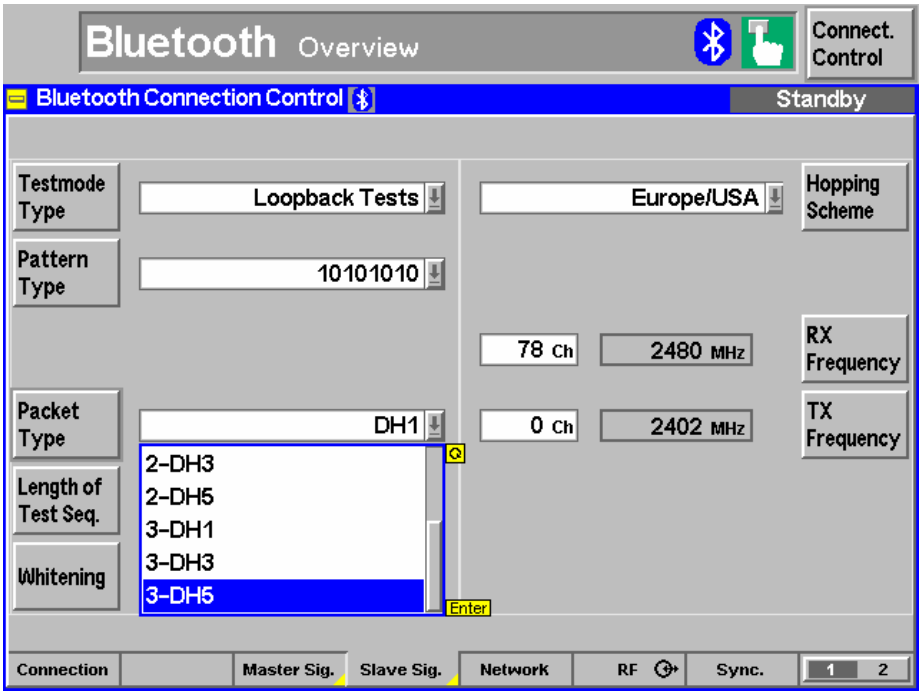

Fig. 83 - Packet types in Connection Control window

Packet types 2-DH1, 2-DH3 and 2-DH5 types are π/4-DQPSK-modulated (two bits per symbol); types 3-DH1, 3-DH3 and 3-DH5 are 8DPSK-modulated (three bits per symbol).

Various measurements can now be performed.

EDR Relative Power

This measurement determines the difference in power between the GFSK-modulated and the DPSK-modulated part of the burst.

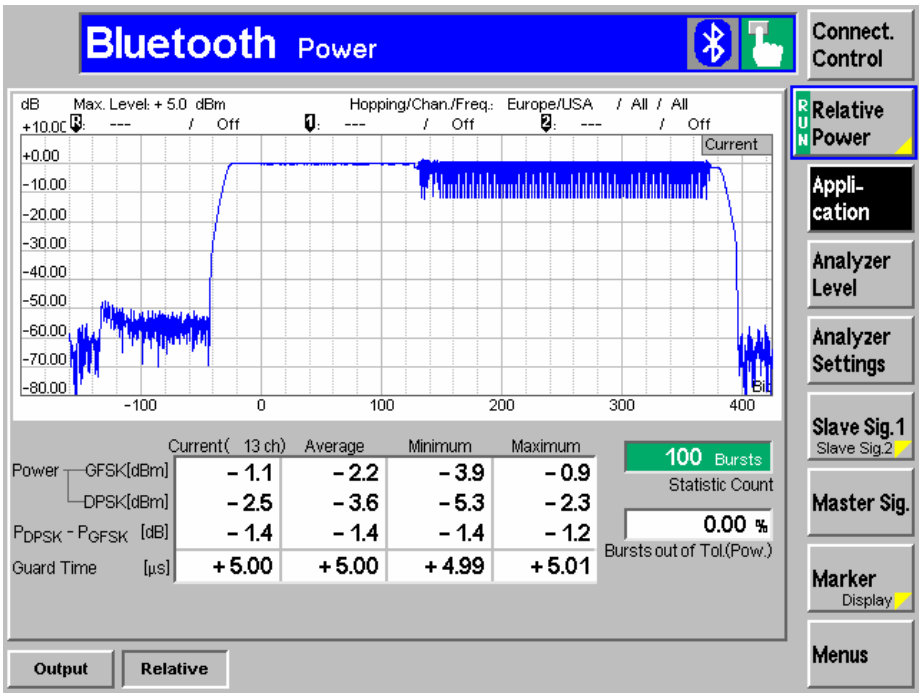

Fig. 84 - EDR Relative Power

EDR Modulation DPSK

This measurement determines both the *initial carrier frequency error* ω_i (within the packet header) and the *frequency error* ω_0 for all 50 µs blocks. In addition, $\omega_0+\omega_i$ is displayed (Fig. 85), and the differential error vector magnitude (DEVM) calculated and displayed.

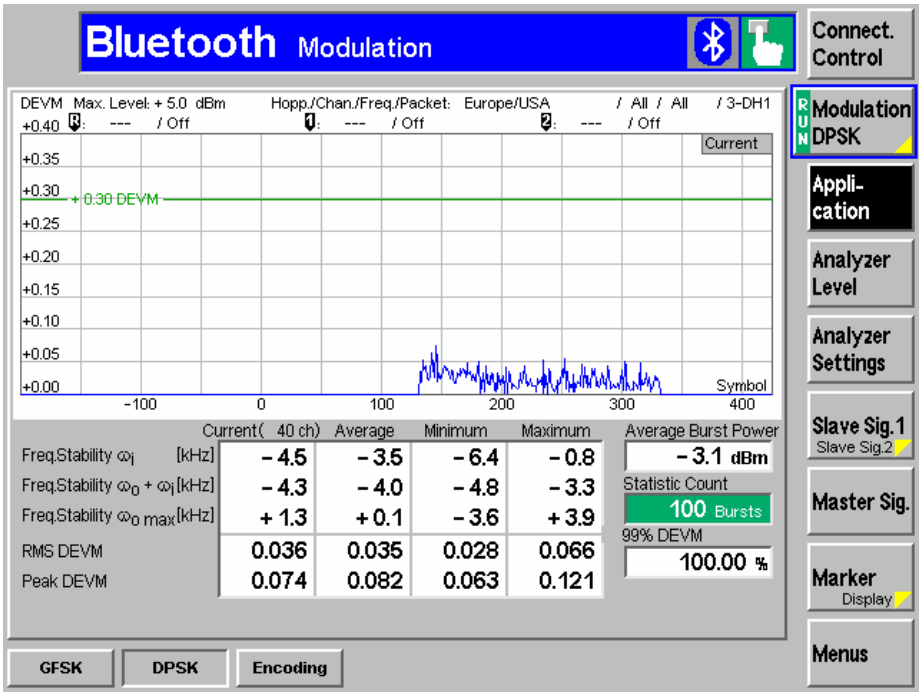

Fig. 85 - EDR Modulation DPSK

EDR Modulation Encoding

This measurement determines bit errors generated during encoding in the DUT (Fig. 86) (Phase encoding).

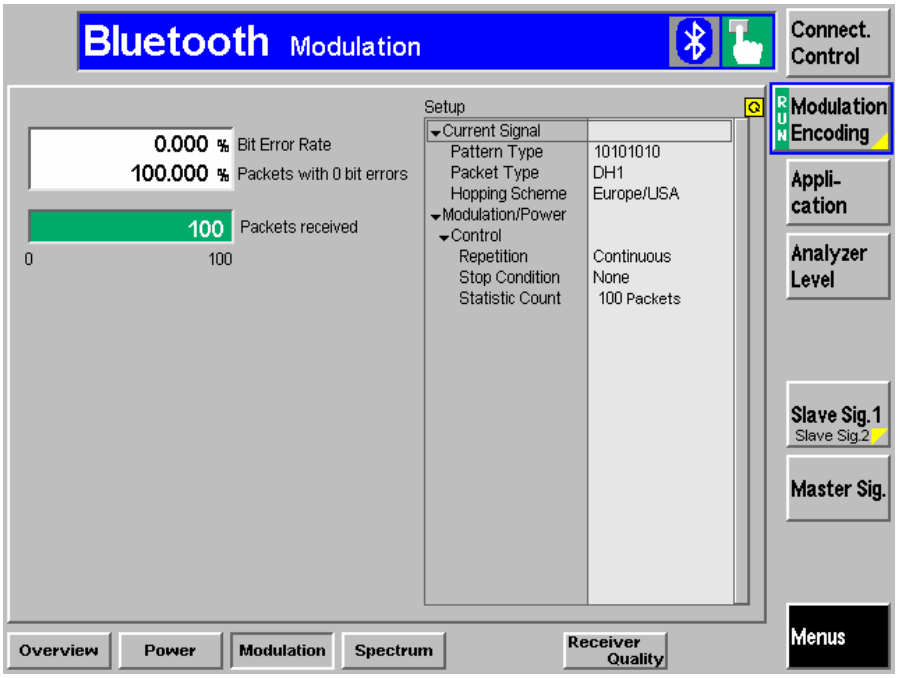

Fig. 86 - EDR Modulation Encoding

EDR Receiver Quality

The BER of EDR packets is determined with the standard Receiver Quality measurement (see above). Only the desired EDR packets have to be selected.

4 Annex

Table of Figures

Remote sequences

Bluetooth Call Setup

```
CONF:MISC:CCD ON
LEV:MAX 5.0
SENS:CORR:LOSS 15.0
SOUR:CORR:LOSS 15.0
CONF:MSIG:PAG:HSCH EUSA
CONF:MSIG:PAG:PSRM R2
CONF:MSIG:TXL -30.0
CONF:MSIG:PAG:TOUT 8192
CONF:MSIG:SVT 400
CONF:MSIG:INQ:NOR 1
CONF:MSIG:BDAD '123456123456'
```

```
CONF:MSIG:PAG:TARG '123456789012'
CONF:NETW:TEST:RLS 100
CONF:NETW:TEST:TCPC OFF
CONF:NETW:TEST:SNB TEST
CONF:DUT:PINC '0000'
PROC:SIGN:ACT INQ
SIGN:XST?
SIGN:XST?
CONF:SIGN:PTAR BD01
PROC:SIGN:ACT TEST
SIGN:XST?
SINF:NAME?
SINF:VERS?
SINFo:BDAD?
```

Bluetooth Call Release

```
PROC:SIGN:ACT DET
SIGN:STAT?
```

Bluetooth Power Step

Power control supported by the DUT?

```
SINF:FEAT:PCON?
SIGN:STAT?
```

One step up

```
PROC:PCON:STEP UP
PCON:STAT?
```

Bluetooth Testset

TX level -30 dBm, DH1, hopping EUSA, loopback 10101010

```
CONF:MSIG:TXL -30.0
PROC:SSIG:TMOD:LBT:PTYP DH1
PROC:SIGN:HSCH EUSA;*OPC?
PROC:SSIG:TMOD:LBT:PATT P11
PROC:SSIG:TMOD:TMTY LBT;*OPC?
```

100 Bursts Power:MPR measurement

```
CONF:POW:MPR:CONT:REP SING,NONE,NONE
CONF:POW:MPR:CONT:STAT 100
PROC:SIGN:FREQ:UNIT CH
CONF:POW:MPR:MMOD ALL
INIT:POW:MPR
FETC:POW:MPR?
ABOR:POW:MPR
```

Bluetooth BER test

Status, BER: –30 dBm, DH1, 27 bytes, EUSA, delay off, whitening off

SIGN:STAT?

CONF:RXQ:BER:TSET1:LEV -30.0

CONF:RXQ:BER:TSET1:PTYP DH1

CONF:RXQ:BER:TSET1:LOTS:DH1P 27

CONF:RXQ:BER:TSET1:HSCH EUSA;*OPC?

CONF:RXQ:BER:TSET1:DEL OFF

CONF:RXQ:BER:TSET1:WHIT OFF

Static PRBS, dirty transmitter off

CONF:RXQ:BER:TSET1:PATT SPRS

CONF:MSIG:DTX:SCOP RXQ

CONF:MSIG:DTX OFF

BER packets 100 measurements

CONF:RXQ:BER:TSET1:CONT:REP SING,NONE,NONE

CONF:RXQ:BER:TSET1:CONT:STAT 100

CONF:RXQ:BER:TSET T1

READ:RXQ:BER?

ABOR:RXQ:BER

Bluetooth BER search

Status, interval, DH3, 183 bytes, no hopping

SIGN:STAT?

CONF:RXQ:SBER:LEV -90.0,-70.0

CONF:RXQ:SBER:LBAC:PTYP DH3

CONF:RXQ:SBER:LOTS:DH3P 183

CONF:RXQ:SBER:HSCH RXTX;*OPC?

Delay off, whitening off, static PRBS

CONF:RXQ:SBER:DEL OFF

CONF:RXQ:SBER:WHIT OFF

CONF:RXQ:SBER:PATT SPRS

PROC:SIGN:FREQ:UNIT CH

CONF:RXQ:SBER:FREQ 0CH,78CH;*OPC?

Measurement

INIT:RXQ:SBER

FETC:RXQ:SBER:STAT?

FETC:RXQ:SBER?

ABOR:RXQ:SBER

Bluetooth power

Status, -30 dBm, DH5, 339 bytes, EUSA, loopback, static PRBS, whit off

```
SIGN:STAT?
CONF:MSIG:TXL -30.0
PROC:SSIG:TMOD:LBT:PTYP DH5
PROC:SSIG:TMOD:LBT:LOTS:DH5P 339
LEV:MAX?
PROC:SIGN:HSCH EUSA;*OPC?
PROC:SSIG:TMOD:TMTY LBT
PROC:SSIG:TMOD:LBT:PATT SPRS
PROC:SSIG:TMOD:LBT:WHIT OFF;*OPC?
```

Bursts 1, 1 channel

```
CONF:POW:TIME:CONT:REP SING,NONE,NONE
CONF:POW:TIME:CONT:RMOD SCAL
CONF:POW:TIME:CONT:STAT 1
CONF:POW:TIME:MMOD SING
CONF:POW:TIME:MFR:UNIT CH
PROC:SIGN:FREQ:UNIT CH
```

Channel 0 measurement

```
CONF:POW:TIME:MFR 0
PROC:SSIG:LBT:FREQ 0,78;*OPC?
INIT:POW:TIME
FETC:POW:TIME?
```

Channel 39 measurement

```
CONF:POW:TIME:MFR 39
PROC:SSIG:LBT:FREQ 39,0;*OPC?
INIT:POW:TIME
FETC:POW:TIME?
```

Channel 78 measurement

```
CONF:POW:TIME:MFR 78
PROC:SSIG:LBT:FREQ 78,0;*OPC?
INIT:POW:TIME
FETC:POW:TIME?
ABOR:POW:TIME
```

Bluetooth modulation characteristics

Status, -30 dBm, DH5, 339 bytes, no hopping, loopback, pattern 11110000, whitening off

```
SIGN:STAT?
CONF:MSIG:TXL -30.0
PROC:SSIG:TMOD:LBT:PTYP DH5
PROC:SSIG:TMOD:LBT:LOTS:DH5P 339
PROC:SIGN:HSCH RXTX;*OPC?
PROC:SSIG:TMOD:TMTY LBT
PROC:SSIG:TMOD:LBT:PATT P44
```

```
PROC:SSIG:TMOD:LBT:WHIT OFF;*OPC?
PROC:SIGN:FREQ:UNIT CH
```

Channel 0 measurement, 10 bursts, pattern 11110000 and 10101010

```
PROC:SSIG:LBT:FREQ 0,78;*OPC?
CONF:MOD:DEV:CONT:REP SING,NONE,NONE
CONF:MOD:DEV:CONT:STAT 10
CONF:MOD:DEV:CONT:RMOD SCAL
CONF:MOD:DEV:MMOD SING
CONF:MOD:DEV:MFR:UNIT CH
CONF:MOD:DEV:MFR 0
CONF:MOD:DEV:BATH:THR 115.0
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PATT P11
INIT:MOD:DEV
FETC:MOD:DEV:EXT?
```

Channel 39 measurement, 10 bursts, pattern 11110000 and 10101010

```
PROC:SSIG:TMOD:LBT:PATT P44
PROC:SSIG:LBT:FREQ 39,0
CONF:MOD:DEV:MFR 39
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PATT P11
INIT:MOD:DEV
FETC:MOD:DEV:EXT?
```

Channel 78 measurement, 10 bursts, pattern 11110000 and 10101010

```
PROC:SSIG:TMOD:LBT:PATT P44
PROC:SSIG:LBT:FREQ 78,0
CONF:MOD:DEV:MFR 78
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PATT P11
INIT:MOD:DEV
FETC:MOD:DEV:EXT?
ABOR:MOD:DEV
```

Bluetooth ICFT

-30 dBm, DH1, 27 bytes, EUSA, loopback, static PRS, whitening off

```
CONF:MSIG:TXL -30.0
CONF:MOD:DEV:CONT:REP SING,NONE,NONE
CONF:MOD:DEV:CONT:RMOD SCAL
CONF:MOD:DEV:CONT:STAT 10
CONF:MOD:DEV:MMOD SING
```

```
CONF:MOD:DEV:MFR:UNIT CH
PROC:SIGN:HSCH EUSA;*OPC?
PROC:SSIG:TMOD:LBT:PTYP DH1
PROC:SSIG:TMOD:LBT:LOTS:DH1P 27
PROC:SSIG:TMOD:TMTY LBT
PROC:SSIG:TMOD:LBT:PATT SPRS
PROC:SSIG:TMOD:LBT:WHIT OFF;*OPC?
PROC:SIGN:FREQ:UNIT CH
```

Channel 0 measurement

```
CONF:MOD:DEV:MFR 0
PROC:SSIG:LBT:FREQ 0,78;*OPC?
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SIGN:FREQ:UNIT CH
```

Channel 39 measurement

```
CONF:MOD:DEV:MFR 39
PROC:SSIG:LBT:FREQ 39,0;*OPC?
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SIGN:FREQ:UNIT CH
```

Channel 78 measurement

```
CONF:MOD:DEV:MFR 78
PROC:SSIG:LBT:FREQ 78,0;*OPC?
INIT:MOD:DEV
FETC:MOD:DEV?
ABOR:MOD:DEV
```

Bluetooth carrier frequency drift

-30 dBm, DH1, EUSA, loopback, pattern 10101010, whitening off

```
CONF:MSIG:TXL -30.0
CONF:MOD:DEV:CONT:REP SING,NONE,NONE
CONF:MOD:DEV:CONT:RMOD SCAL
CONF:MOD:DEV:CONT:STAT 10
CONF:MOD:DEV:MMOD SING
CONF:MOD:DEV:MFR:UNIT CH
CONF:MOD:DEV:MFR 0
PROC:SIGN:HSCH EUSA;*OPC?
PROC:SSIG:TMOD:TMTY LBT
PROC:SSIG:TMOD:LBT:PATT P11
PROC:SSIG:TMOD:LBT:WHIT OFF;*OPC?
PROC:SIGN:FREQ:UNIT CH
```

Channel 0 measurement, DH1, DH3 and DH5

```
PROC:SSIG:LBT:FREQ 0,78;*OPC?
```

```
PROC:SSIG:TMOD:LBT:PTYP DH1
PROC:SSIG:TMOD:LBT:LOTS:DH1P 27
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PTYP DH3
PROC:SSIG:TMOD:LBT:LOTS:DH3P 183
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PTYP DH5
PROC:SSIG:TMOD:LBT:LOTS:DH5P 339
INIT:MOD:DEV
FETC:MOD:DEV?
```

Channel 39 measurement, DH1, DH3 and DH5

```
CONF:MOD:DEV:MFR 39
PROC:SSIG:LBT:FREQ 39,0;*OPC?
PROC:SSIG:TMOD:LBT:PTYP DH1
PROC:SSIG:TMOD:LBT:LOTS:DH1P 27
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PTYP DH3
PROC:SSIG:TMOD:LBT:LOTS:DH3P 183
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PTYP DH5
PROC:SSIG:TMOD:LBT:LOTS:DH5P 339
INIT:MOD:DEV
FETC:MOD:DEV?
```

Channel 78 measurement, DH1, DH3 and DH5

```
CONF:MOD:DEV:MFR 78
PROC:SSIG:LBT:FREQ 78,0;*OPC?
PROC:SSIG:TMOD:LBT:PTYP DH1
PROC:SSIG:TMOD:LBT:LOTS:DH1P 27
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PTYP DH3
PROC:SSIG:TMOD:LBT:LOTS:DH3P 183
INIT:MOD:DEV
FETC:MOD:DEV?
PROC:SSIG:TMOD:LBT:PTYP DH5
PROC:SSIG:TMOD:LBT:LOTS:DH5P 339
INIT:MOD:DEV
FETC:MOD:DEV?
ABOR:MOD:DEV
```

Bluetooth spectrum 20 dB

Status, -30 dBm, DH5, 339 bytes, no hopping, loopback, static PRS, whitening off

SIGN:STAT?

CONF:MSIG:TXL -30.0

PROC:SSIG:TMOD:LBT:PTYP DH5

PROC:SSIG:TMOD:LBT:LOTS:DH5P 339

PROC:SIGN:HSCH RXTX;*OPC?

PROC:SSIG:TMOD:TMTY LBT

PROC:SSIG:TMOD:LBT:PATT SPRS

PROC:SSIG:TMOD:LBT:WHIT OFF;*OPC?

PROC:SIGN:FREQ:UNIT CH

Channel 0 measurement

PROC:SSIG:LBT:FREQ 0,78

CONF:SPEC:BWID:CONT:REP SING,NONE,NONE

CONF:SPEC:BWID:CONT:STAT 10

CONF:SPEC:BWID:CONT:RMOD ARR

CONF:SPEC:BWID:MMOD SING

CONF:SPEC:BWID:MCH 0

CONF:SPEC:BWID:DLEV -20.0

INIT:SPEC:BWID

FETC:SPEC:BWID?

Channel 39 measurement

PROC:SSIG:LBT:FREQ 39,0

CONF:SPEC:BWID:MCH 39

INIT:SPEC:BWID

FETC:SPEC:BWID?

Channel 78 measurement

PROC:SSIG:LBT:FREQ 78,0

CONF:SPEC:BWID:MCH 78

INIT:SPEC:BWID

FETC:SPEC:BWID?

ABOR:SPEC:BWID

Bluetooth spectrum ACP

Status, -30 dBm, DH1, 27 bytes, no hopping, loopback, static PRS, whitening off

SIGN:STAT?

CONF:MSIG:TXL -30.0

PROC:SSIG:TMOD:LBT:PTYP DH1

PROC:SSIG:TMOD:LBT:LOTS:DH1P 27

PROC:SIGN:HSCH RXTX;*OPC?

PROC:SSIG:TMOD:TMTY LBT

```
PROC:SSIG:TMOD:LBT:PATT SPRS
PROC:SSIG:TMOD:LBT:WHIT OFF;*OPC?
PROC:SIGN:FREQ:UNIT CH
```

Channel 3 measurement

```
PROC:SSIG:LBT:FREQ 3,78
CONF:SPEC:ACP:CONT:REP SING,NONE,NONE
CONF:SPEC:ACP:CONT:STAT 1
CONF:SPEC:ACP:DMOD AVG
CONF:SPEC:ACP:LUN ABS
CONF:SPEC:ACP:MCH:REL -3,-2,-1,1,2,3
CONF:SPEC:ACP:CCH 3
INIT:SPEC:ACP
FETC:SPEC:ACP:STAT?
FETC:SPEC:ACP?
PROC:SIGN:FREQ:UNIT CH
```

Channel 39 measurement

```
PROC:SSIG:LBT:FREQ 39,0
CONF:SPEC:ACP:CCH 39
INIT:SPEC:ACP
FETC:SPEC:ACP:STAT?
FETC:SPEC:ACP?
PROC:SIGN:FREQ:UNIT CH
```

Channel 75 measurement

```
PROC:SSIG:LBT:FREQ 75,0
CONF:SPEC:ACP:MCH:REL -3,-2,-1,1,2,3
CONF:SPEC:ACP:CCH 75
INIT:SPEC:ACP
FETC:SPEC:ACP:STAT?
FETC:SPEC:ACP?
ABOR:SPEC:ACP
```

Bluetooth EDR CFS & MA

Status, -30 dBm, configuration

```
SIGN:STAT?
CONF:MSIG:TXL -30.0
CONF:MOD:DPSK:CONT:REP SING,NONE,NONE
CONF:MOD:DPSK:CONT:RMOD SCAL
CONF:MOD:DPSK:CONT:STAT 4
CONF:MOD:DPSK:MMOD SING
CONF:MOD:DPSK:MFR:UNIT CH
CONF:MOD:DPSK:DEVM:THR 0.30,0.20
```

No hopping, TX mode, static PRS

```
PROC:SIGN:HSCH RXTX;*OPC?
```

```
PROC:SSIG:TMOD:TMTY TXT
PROC:SSIG:TMOD:TXT:PATT SPRS;*OPC?
PROC:SIGN:FREQ:UNIT CH
```

Channel 0 measurement, 2-DH5, 656 bytes length

```
CONF:MOD:DPSK:MFR 0
PROC:SSIG:TXT:FREQ 0;*OPC?
PROC:SSIG:TMOD:TXT:PTYP E25P
PROC:SSIG:TMOD:TXT:LOTS:E25P 656;*OPC?
INIT:MOD:DPSK
FETC:MOD:DPSK?
```

Channel 0 measurement, 3-DH5, 986 bytes length

```
PROC:SSIG:TMOD:TXT:PTYP E35P
PROC:SSIG:TMOD:TXT:LOTS:E35P 986;*OPC?
INIT:MOD:DPSK
FETC:MOD:DPSK?
```

Channel 39 measurement, 2-DH5, 656 bytes length

```
CONF:MOD:DPSK:MFR 39
PROC:SSIG:TXT:FREQ 39;*OPC?
PROC:SSIG:TMOD:TXT:PTYP E25P
PROC:SSIG:TMOD:TXT:LOTS:E25P 656;*OPC?
INIT:MOD:DPSK
FETC:MOD:DPSK?
```

Channel 39 measurement, 3-DH5, 986 bytes length

```
PROC:SSIG:TMOD:TXT:PTYP E35P
PROC:SSIG:TMOD:TXT:LOTS:E35P 986;*OPC?
INIT:MOD:DPSK
FETC:MOD:DPSK?
```

Channel 78 measurement, 2-DH5, 656 bytes length

```
CONF:MOD:DPSK:MFR 78
PROC:SSIG:TXT:FREQ 78;*OPC?
PROC:SSIG:TMOD:TXT:PTYP E25P
PROC:SSIG:TMOD:TXT:LOTS:E25P 656;*OPC?
INIT:MOD:DPSK
FETC:MOD:DPSK?
```

Channel 78 measurement, 3-DH5, 986 bytes length

```
PROC:SSIG:TMOD:TXT:PTYP E35P
PROC:SSIG:TMOD:TXT:LOTS:E35P 986;*OPC?
INIT:MOD:DPSK
FETC:MOD:DPSK?
```

Bluetooth EDR Phase Encoding

Status, -30 dBm, configuration, no hopping, TX mode, static PRS

```
SIGN:STAT?
CONF:MSIG:TXL -30.0
CONF:MOD:ENC:CONT:REP SING,NONE,NONE
CONF:MOD:ENC:CONT:STAT 100
PROC:SSIG:TMOD:TMTY TXT
PROC:SSIG:TMOD:TXT:PATT SPRS
PROC:SIGN:FREQ:UNIT CH
```

Channel 0 measurement, 2-DH1, 54 bytes length

```
PROC:SSIG:TXT:FREQ 0;*OPC?
PROC:SIGN:HSCH RXTX;*OPC?
PROC:SSIG:TMOD:TXT:PTYP E21P
PROC:SSIG:TMOD:TXT:LOTS:E21P 54;*OPC?
INIT:MOD:ENC
FETC:MOD:ENC?
```

Channel 0 measurement, 3-DH1, 83 bytes length

```
PROC:SSIG:TMOD:TXT:PTYP E31P
PROC:SSIG:TMOD:TXT:LOTS:E31P 83;*OPC?
INIT:MOD:ENC
FETC:MOD:ENC?
```

Bluetooth EDR Relative Transmit Power

Status, -30 dBm, configuration, no hopping, TX mode, static PRS

```
SIGN:STAT?
CONF:MSIG:TXL -30.0
CONF:POW:REL:CONT:REP SING,NONE,NONE
CONF:POW:REL:CONT:RMOD SCAL
CONF:POW:REL:MMOD SING
CONF:POW:REL:MFR:UNIT CH
CONF:POW:TIME:CONT:STAT 1
LEV:MAX?
PROC:SIGN:HSCH RXTX;*OPC?
PROC:SSIG:TMOD:TMTY TXT
PROC:SSIG:TMOD:TXT:PATT SPRS;*OPC?
PROC:SIGN:FREQ:UNIT CH
```

Channel 0 measurement, 2-DH5, 679 bytes length

```
CONF:POW:REL:MFR 0
PROC:SSIG:TXT:FREQ 0;*OPC?
PROC:SSIG:TMOD:TXT:PTYP E25P
PROC:SSIG:TMOD:TXT:LOTS:E25P 679;*OPC?
INIT:POW:REL
```

```
FETC:POW:REL?
```

Channel 0 measurement, 3-DH5, 1021 bytes length

```
PROC:SSIG:TMOD:TXT:PTYP E35P
PROC:SSIG:TMOD:TXT:LOTS:E35P 1021;*OPC?
INIT:POW:REL
FETC:POW:REL?
```

Channel 39 measurement, 2-DH5, 679 bytes length

```
CONF:POW:REL:MFR 39
PROC:SSIG:TXT:FREQ 39;*OPC?
CONF:POW:REL:CONT:STAT 10
PROC:SSIG:TMOD:TXT:PTYP E25P
PROC:SSIG:TMOD:TXT:LOTS:E25P 679;*OPC?
INIT:POW:REL
FETC:POW:REL?
```

Channel 39 measurement, 3-DH5, 1021 bytes length

```
PROC:SSIG:TMOD:TXT:PTYP E35P
PROC:SSIG:TMOD:TXT:LOTS:E35P 1021;*OPC?
INIT:POW:REL
FETC:POW:REL?
```

Channel 78 measurement, 2-DH5, 679 bytes length

```
CONF:POW:REL:MFR 78
PROC:SSIG:TXT:FREQ 78;*OPC?
CONF:POW:REL:CONT:STAT 10
PROC:SSIG:TMOD:TXT:PTYP E25P
PROC:SSIG:TMOD:TXT:LOTS:E25P 679;*OPC?
INIT:POW:REL
FETC:POW:REL?
```

Channel 78 measurement, 3-DH5, 1021 bytes length

```
PROC:SSIG:TMOD:TXT:PTYP E35P
PROC:SSIG:TMOD:TXT:LOTS:E35P 1021;*OPC?
INIT:POW:REL
FETC:POW:REL?
```

Bluetooth EDR Sensitivity

Status, -70 dBm, configuration, no hopping, TX mode, static PRS, whitening off

```
SIGN:STAT?
CONF:RXQ:BER:TSET1:HSCH RXTX;*OPC?
CONF:RXQ:BER:TSET1:DEL OFF
CONF:RXQ:BER:TSET1:PATT SPRS
CONF:RXQ:BER:TSET1:WHIT OFF;*OPC?
CONF:RXQ:BER:TSET1:LEV -70.0
```

2-DH5, 679 bytes, DT specification table

CONF:RXQ:BER:TSET1:PTYP E25P

CONF:RXQ:BER:TSET1:LOTS:E25P 679

CONF:MSIG:DTX:SCOP RXQ

CONF:MSIG:DTX STAB

CONF:RXQ:BER:TSET1:CONT:REP SING,NONE,NONE

3704 packets

CONF:RXQ:BER:TSET1:CONT:STAT 3704

CONF:RXQ:BER:TSET T1

PROC:SIGN:FREQ:UNIT CH

Channel 0

CONF:RXQ:BER:TSET1:FREQ 78CH,0CH;*OPC?

INIT:RXQ:BER

FETC:RXQ:BER:STAT?

FETC:RXQ:BER?

33334 packets

CONF:RXQ:BER:TSET1:CONT:STAT 33334

INIT:RXQ:BER

FETC:RXQ:BER:STAT?

FETC:RXQ:BER?

Channel 39, 3704 packets

CONF:RXQ:BER:TSET1:CONT:STAT 3704

CONF:RXQ:BER:TSET1:FREQ 0CH,39CH;*OPC?

INIT:RXQ:BER

FETC:RXQ:BER:STAT?

FETC:RXQ:BER?

33334 packets

CONF:RXQ:BER:TSET1:CONT:STAT 33334

INIT:RXQ:BER

FETC:RXQ:BER:STAT?

FETC:RXQ:BER?

Channel 78, 3704 packets

CONF:RXQ:BER:TSET1:CONT:STAT 3704

CONF:RXQ:BER:TSET1:FREQ 0CH,78CH;*OPC?

INIT:RXQ:BER

FETC:RXQ:BER:STAT?

FETC:RXQ:BER?

33334 packets

CONF:RXQ:BER:TSET1:CONT:STAT 33334

INIT:RXQ:BER

FETC:RXQ:BER:STAT?

FETC:RXQ:BER?

ABOR:RXQ:BER

Bluetooth EDR Sensitivity

Status, -30 dBm, configuration, Europe/USA hopping, TX mode, static PRS, 2-DH1, 27 bytes, loopback

SIGN:STAT?

CONF:MSIG:TXL -30.0

PROC:SSIG:TMOD:LBT:PTYP E21P

PROC:SSIG:TMOD:TXT:LOTS:E21P 27

PROC:SSIG:TMOD:LBT:LOTS:E21P 27

*OPC?

PROC:SIGN:HSCH EUSA;*OPC?

PROC:SSIG:TMOD:LBT:PATT SPRS

PROC:SSIG:TMOD:TMTY LBT;*OPC?

CONF:POW:MPE:CONT:REP SING,NONE,NONE

CONF:POW:MPE:CONT:STAT 10

PROC:SIGN:FREQ:UNIT CH

CONF:POW:MPE:MMOD ALL

Measurement

INIT:POW:MPE

FETC:POW:MPE?

ABOR:POW:MPE

References

[1] Bluetooth Test & Interoperability Working Group: RF **Test Suite Structure and Test Purposes System Specification 2.0 + EDR Revision 2.0.E.3,** 03/2005, Bluetooth SIG, Inc.

[2] Rohde & Schwarz: **Manual for Windows Application CMUgo (V1.00**), 12/2002, 1136.3971.00

[3] Rohde & Schwarz: **Operating Manual for Software Option K53** (1115.5000.02 Revision 1115.5081.12-06-)

[4] Rohde & Schwarz: **Operating Manual for Bluetooth Tester CBT** (1153.9000.35 Revision 1154.3470.12-01-)

Additional Information

Please send any comments and information regarding this application note to CMUApplication@rsd.rohde-schwarz.com

A file with a Bluetooth example is provided on the Internet.

Ordering Information

Universal Radio Communication Tester		
R&S CMU200		1100.0008.02
Option B53	Bluetooth Extension	1100.5700.02
Option K53	Bluetooth test software	1115.5000.02
Option B41 (optional)	Audio generator and analyzer	1100.5300.02
Bluetooth Tester		
R&S CBT with display, 4 HU	R&S CBT	1153.9000.35
R&S CBT without display, 19", 2 HU	R&S CBT32	1153.9000.32
Option B55	Hardware option: EDR Extension	1170.3006.02
Option U55	Hardware upgrade kit for EDR Extension	1170.3106.02
Option K55	EDR software option	1170.3206.02

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