ROHDE&SCHWARZ

Test and Measurement
Division

Software Manual

Application Firmware for Bluetooth Measurements on FSP and FSU

R&S FS-K8

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Tabbed Divider Overview

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1   Introduction

The following chapters describe the new operating functions of the Bluetooth demodulator option for Spectrum Analyzer FSP and FSU. In the case of functions identical to those of the basic unit, reference is made to the relevant chapter in the basic unit manual.

Bluetooth Overview

Bluetooth Technical Parameters

Frequency Bands	USA / Europe 2402 + (0...78) MHz
	France 2454 + (0...22) MHz
Channel Spacing	1 MHz
Modulation	GFSK
Tx filter	Gaussian
BT	0.5
Modulation Index	0.28 – 0.35 nominal 0.32
Frequency Deviation	160 kHz settled
	141 kHz 010101 suite
Bandwidth -3dB	220 kHz
-20dB	1 MHz
Bit Rate	1 Mbps
Bit Length	1 µsec
Slot Length (Frequency Hopping)	625 µsec
Packet Sizes	1, 3, 5 slot packets

Power Classes

Power Class	Maximum (P_{max})	Nominal	Minimum (P_{min})	Power Control
1	100 mW (20 dBm)		1 mW (0 dBm)	from P_{min} (< +4 dBm) to P_{max}
2	2.5 mW (4dBm)	1 mW (0 dBm)	0.25 mW (-6dBm)	optional
3	1 mW (0dBm)			optional

Structure of a Bluetooth Data Packet

Every Bluetooth data packet is divided into 3 basic section: Access Code, Header and Payload. The following figures show the order and bit lengths of the individual sections:

access code 72 bits			54 bits	240 / 1496 / 2744 bits
4 bits	64 bits	4 bits	header	payload*)
preamble	sync word	trailer		

*) During EUT evaluation the payload contains certain bit sequences: PRBS9 (Pseudo Random Bit Sequence) or 11110000 or 10101010

The sync word is transmitted as the major part of the access code. For this purpose the LAP (lower address part) of the BD address will be expanded to 64 bit by adding the BCH code and baker.

sync word 64 bits		
BCH code 34 bits	LAP 24 bits	Barker 6 bits

The LAP (lower adress part) of the BD address serves as a basis for the sync word.

BD – adress 48 bits		
NAP 16 bits	UAP 8 bits	LAP 24 bits

Functional Scope of the Bluetooth Analyzer Option

Supported Tests

The Bluetooth Analyzer Option FS-K8 supports measurements according to the Bluetooth RF Test Specification (Bluetooth SIG) , Revision 0.91, July 2001, on FSP and FSU spectrum analyzers.

The following tests are currently implemented according to this specification:

Test cases taken from the RF Test Specification

5.1.3	Output Power
5.1.8	TX Output Spectrum - Adjacent Channel Power
5.1.9	Modulation Characteristics
5.1.10	Initial Carrier Frequency Tolerance (ICFT)
5.1.11	Carrier Frequency Drift

Overview of Transmitter Tests with settings according to the RF Test Specification

	Hop	Trigger	Synchro-nisation	Packet Type	Payload	Test Mode	Operating Mode	RBW	VBW	Power	Sweep Time	Sweep Count	Trace Mode	Detec-tor	Frequency in MHz	Span	Test cond	Results
Output Power	ON	Extern	Ja (p0), aber auch ohne möglich	Longest supported	PRBS 9	Loop back	FM+RF Power	3MHz	3MHz	Supported maximum	One complete packet	-	Maxh	Peak	Low / middle / high	-	Norm / Ext	Peak and average power 1) P_{AV} < 100 mW (20 dBm) 2) P_{PK} < 200 mW (23 dBm) 3) $P_{max} > P_{AV} > P_{min}$ at maximum power step
TX Output Spectrum – Adjacent Channel Power	OFF	-	Nein	DH1	PRBS 9	Loop back	Analyzer Time Domain	100kHz	300kHz	Supported maximum	79s pro sweep (= 100ms * 10 * 79)	10	Maxh	Aver	2402-2480 – 450kHz ± n * 1MHz mit n = 0..9 bzw. France 2454-2476	-	Norm / Ext	Channel power of all channels 1) P_{TX} (f) $\leq$ – 20 dBm for |M-N| = 2 2) P_{TX} (f) $\leq$ – 40 dBm for |M-N| $\geq$ 3
Modulation Characteristics	OFF	-	Ja (p0)	Longest supported	11110000 10101010	Loop back	FM+RF Power	-	-	Supported maximum	One complete packet	10 (extern)	-	-	Low / middle / high	-	Norm / Ext	All 8 bit peak deviations and average deviations
Initial Carrier Frequency Tolerance	ON / OFF	-	Ja (p0)	DH1	PRBS 9	Loop back	FM+RF Power	-	-	Supported maximum	-	10	-	-	Low / middle / high	-	Norm / Ext	Carrier offset within the 4 preamble bits
Carrier Frequency Drift	ON / OFF	-	Ja (p0)	All supported packets (DH1/3/5)	10101010	Loop back	FM+RF Power	-	-	Not specified	One complete packet	10	-	-	Low / middle / high	-	Norm / Ext	Carrier offsets of the 4 bit preamble, of all 10 bit payload sequences, and the maximum drift rate of all 10 bit payload sequences at 50 µs offset.

Functional Description - Block Diagram

The Adjacent Channel Power Messung is performed in the spectrum analyzer oprating mode of the analyzer. For this test case the complete frequency band is scanned using a sequence of zero span measurements.

All other test cases are based on a digital I/Q demodulator which determines the temporal characteristics of power and frequency. The output data of the demodulator are the basis for calculation of all relevant measurement results like modulation characteristics or output power. The demodulator reaches a maximum in accuracy and temperature stability by sampling the IF signal and converting it digitally down into the base band (I/Q area).

The measurements are performed by passing the following signal processing steps:

▪ LAP (Lower Adress Part) trigger detection

▪ Resampling

▪ Channel filtering

▪ Automated packet and bit pattern detection

▪ Limit check

▪ Parallel display of measurement curves and numeric results on the screen

Figure 1-1 shows the analyzer hardware from the IF to the processor. The analog IF filter is the resolution filter of the spectrum analyzer, which can be selected in a range from 300 kHz to 10 MHz. The A/D converter samples the 20.4 MHz IF signal with a sampling frequency of 32 MHz.

Low pass filtering is performed after the signal has been down-converted into the complex base band and the data rate is reduced in the sequence. The amount of decimation depends on the selected oversampling factor = points / symbol. The default setting is 4, resulting in a 4 MHz sampling rate.

The resulting I/Q data are stored in a memory of 128 k words (FSU 512 k words) for I and Q respectively. The hardware trigger (external or IF power) controls the memory access.
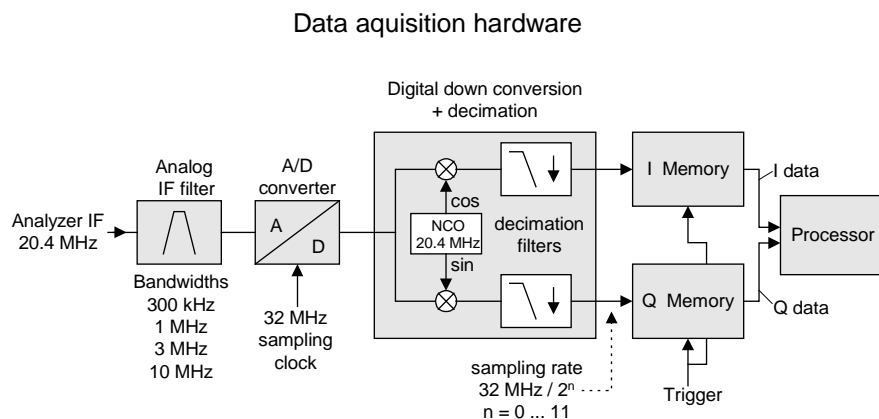
Data aquisition hardware

Fig. 1-1   Block diagram of the signal processing architecture of the analyzer

The software demodulator is implemented on the main processor of the analyzer. All calculations are performed in parallel based on the same I/Q dataset.

Further Characteristics

Bandwidths

The Bluetooth RF Specification defines a minimal bandwidth of 3 MHz. This requirement is related to the standard gaussian filters as normally used by spectrum analyzers. As the amplitude characteristics of these filters is not flat a bandwidth must be selected that is siginificantly higher than the bandwidth of the signal under test. The 3 MHz filter causes an error in frequency deviation of about 4% as soon as a 0101 symbol sequence is used. Therefore an IF bandwidth of 10 MHz is highly recommended for this measurement and set up as the default value. The digital bandwidth is smaller and depends on the selected oversampling factor = points / symbol. With the default setting of 4 the digital bandwidth is 3 MHz. This digital filter has a flat amplitude characteristics and does not affect the frequency deviation of the signal.

Optional Measurement Filter (Meas Filter On)

The RF Specification allows high distortion power in the first adjacent channels. The 3 MHz filter does not suppress this kind of distortion, which leads to a high interference in modulation. Therefore a precise measurement of the frequency deviation is not possible.

In order to obtain correct deviation results the analyzer supplies an optional filter whose passband is only appropriate for the channel to measure. The Bluetooth spectrum has a bandwidth of 1 MHz. The filter is flat within 1.04 MHz (ripple: only 0.02 dB) and has steep edges. This measurement filter is not dependent on the selection of the points / symbol value. As a result the displayed deviation value will increase by 3.2%, but without the filter the displayed deviation value can increase dramatically due to interference from adjacent channels. Generally the result will be more precise, if the displayed deviation is lower with filtering than without filtering. In these cases the inaccuracy caused by the adjacent channel interference is higher than the systematic inaccuracy caused by the filter.
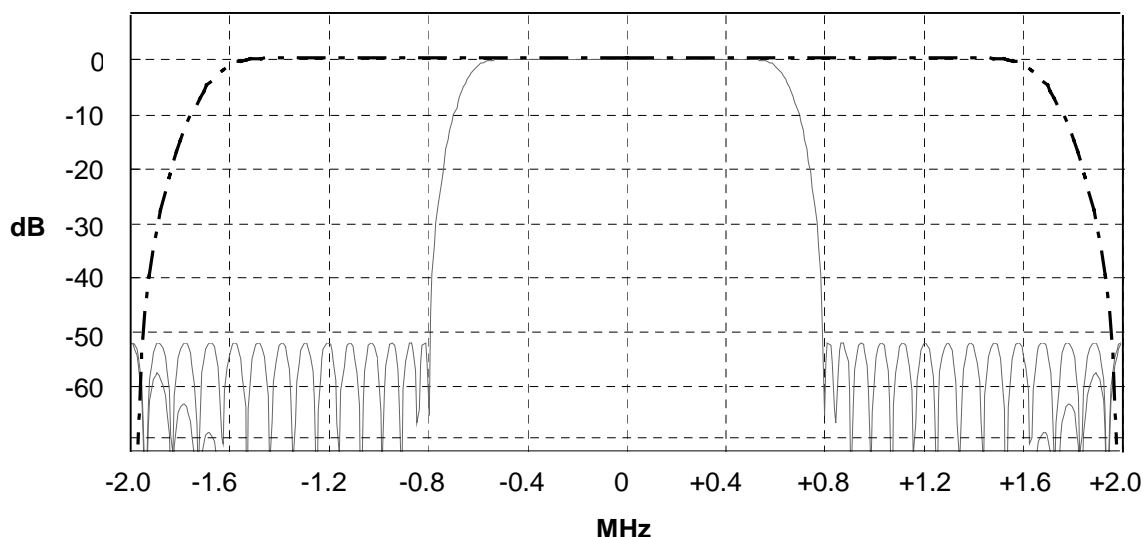

Fig. 1-3   Selection of digital filters
              Dashed-dotted curve: Standard filter with 4 points / symbol
              Solid curve: Optional measurement filter, independent of the points / symbol setting

Oversampling

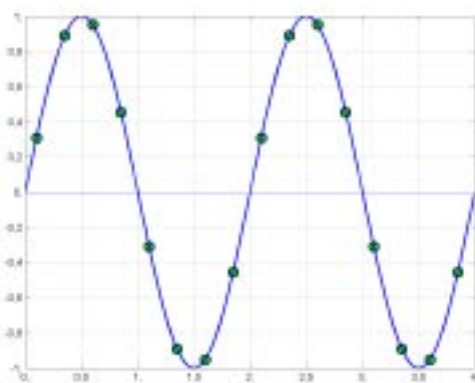The number of samples per symbol is equivalent to the sampling rate in MHz (due to the symbol length of 1 µs).

Digital bandwidth (flat area)	Points per Symbol	Sampling rate
10 MHz	32	32 MHz
8 MHz	16	16 MHz
5 MHz	8	8 MHz
2.8 MHz	4	4 MHz
1.6 MHz	2	2 MHz

According to the RF Test Specification an oversampling factor of 4 is required at minimum. On the analyzer this oversampling factor can be selected as "Points per Symbol" in a range from 2 to 32. The default value is 4.

Although possible a value > 4 is not recommended. It increases the measurement time due to the extended calculation effort. Additionally the resulting bandwidth will be larger than required, which leads to lower measurement accuracy, unless the optional measurement filter (Meas Filter On) is used as described in chapter "Bandwidths".

The analyzer uses a phase shifter in order to move the samples to the zero trespassing points. As a result there is one sample per symbol time, which is especially important for a 0101 symbol sequence in order to obtain the precise value for the peak frequency deviation.

Sampling times before Phase Shifter   Sampling times after Phase Shifter
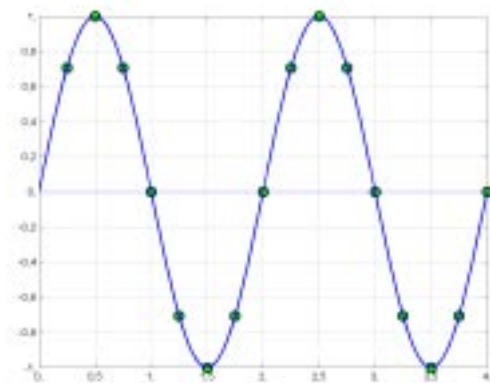

Fig. 1-4   Operation of the Phase Shifter

Advantages of the Phase Shifter:

- No jitter with low sampling rates
- With one sample per zero trespassing point there is always a sample in the middle of the bit length. Therefore the maximum values in the frequency deviation of 0101 bit patterns can be detected precisely also with low sampling rates.
- The immunity to interference when determining the data bits is improved.
- Higher suppression of the distortion during peak detection.

Determining Average or Max/Min Values during several Sweeps (= Bursts)

These functions are very useful in order to obtain more stable results or to find sporadic spurious signals not included in every burst. In many cases the RF Test Specification defines measurements over a 10 burst period.

The number of measurements can be selected using function **Sweep Count** , thus adapting the measurement to the individual requirements.

When using function **Single Sweep** the calculation of average or maximum / minimum values is performed over a well-defined number of sweeps (= Sweep Count).

In contrast to this **Continuous Sweep** yields continuous averaging and calculation of maximum / minimum values over the whole measurement time.

Modulation measurements are performed using trace mode **Clear Write**.

With Continuous Sweep a "live" display is obtained, which allows eg an instant view of changes during alignment of a DUT.

With Single Sweep and Sweep Count 10 the analyzer will evaluate 10 bursts as required by the RF Test Specification. This means that a result is obtained after exactly 10 bursts.

Power measurements are performed using trace mode **Maxhold** in relation with the defined measurement time. The measurement time is selected in a way that makes sure that always one complete burst is acquired. In this case several sweeps are combined to one trace, before this result trace is evaluated.

Impact of the Sweep Counter on the Measurement Results

	Continuous Sweep	**Single Sweep & Sweep Count**
Trace Mode = Clear Write	All measurement results (min., max., average) will be updated with every sweep. The corresponding values will be calculated based on the current curve.	Starts a measurement with n sweeps (n = Sweepcount). All measurement results (min., max., average) will be calculated based on these n sweeps.

Trace Mode = AVG, MaxHold, MinHold	All measurement results (min., max., average) will be updated with every sweep. The corresponding values will be calculated based on the current curve. The trace is the continuous average value (AVG) or the extreme value (MaxHold, MinHold) since the start of the measurement.	Starts a measurement with n sweeps (n = Sweepcount). n defines the number of sweeps that will be taken into account for the trace math functions (AVG, MaxHold, MinHold). The n sweeps will result in one trace and the measurement results (Min, Max, Average) will be calculated based on this summarized trace.

Please note that the above functions may not be mixed up with the detectors of the instrument:

- Detectors combine the measurement data obtained by oversampling to **one pixel** on the screen. The kind of combination (Max Peak, Min Peak, Average, RMS) can be selected.

- The trace functions affect complete measurement curves: A resulting curve is calculated from **several subsequent sweeps**. The method of calculation (Average, Maxhold, Minhold) can be selected here as well.

Thus the detector is the arithmetic rule for how sample data collected with a high data rate are combined to the pixel data of one individual measurement curve, whereas the trace mode is the rule of how samples taken from several measurement curves are to be combined to a new resulting curve.

For the ACP measurement the Average detector is fixed.

Trigger Concepts

As the DUT (Device Under Test) uses frequency hopping, a trigger method is necessary for two reasons:

1. a measurement is only possible during the period of time, when there is a Tx signal (burst) at the frequency under request.

2. In order to determine the modulation characteristics correctly a synchronisation with the preamble of the signal must be supplied.

With selection *Find Sync = On* the synchronisation is supplied towards the 64 bit sync word. For this purpose in a first step a burst is searched automatically within the RF signal, or, if selected, the external trigger or the IF power trigger will be used in order to determine the burst position.

In a second step the sync word position is searched by correlation of the signal with the sync word defined in the initialisation phase. The corellation is performed directly with the FM signal, not with the data bits, which are only available after the phase shifter has been processed. The find burst process will be continued as long as no sync word has been found.

After the position of the sync word has been determined the position of the p0 bit will be calculated from the average value of all zero trespassing points, as defined in the RF test specification. Finally the samples will be moved in a way that each sample matches one zero trespassing point (phase shifting).

The only measurement possible without synchronisation is the Output Power Measurement. The specified measurement time is 20% to 80% of the burst length. Without synchronisation the burst length is defined via the -3dB points of the power curve. With synchronisation the burst starts with the p0 bit. Therefore varying measurement results are possible if the power of the EUT is not constant within the burst.

In order to supply stable synchronisation the EUT must be operated in reduced hopping mode. The EUT is only allowed to toggle between two frequencies, because otherwise the repetition time for the same frequency would become higher than the record length.

If the test environment supplies an external trigger which marks the channel to be measured a synchronisation is also possible with normal hopping operation.

# 2 Getting Started - Introduction to the Bluetooth Operation

Enabling the Bluetooth Option

In order to activate the Bluetooth option on your spectrum analyzer a license key is necessary. This license key is included in the option package.

Note:
*If the option is installed in the factory the license key will be entered before delivery. Entering the lincense key as described below is **not** necessary in this case.*

In order ot open the editor for the license key please use the following frontpanel key sequence:

SETUP ➡ GENERAL SETUP ↓ ➡ OPTIONS ↓
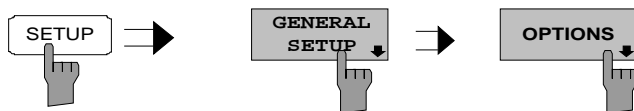
Softkey *OPTIONS* opens a submenu prepared for entering the license key for the Bluetooth option. Any option already installed in the instrument will be displayed in a table opened on entering the submenu.

OPTIONS ↓ ➡
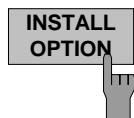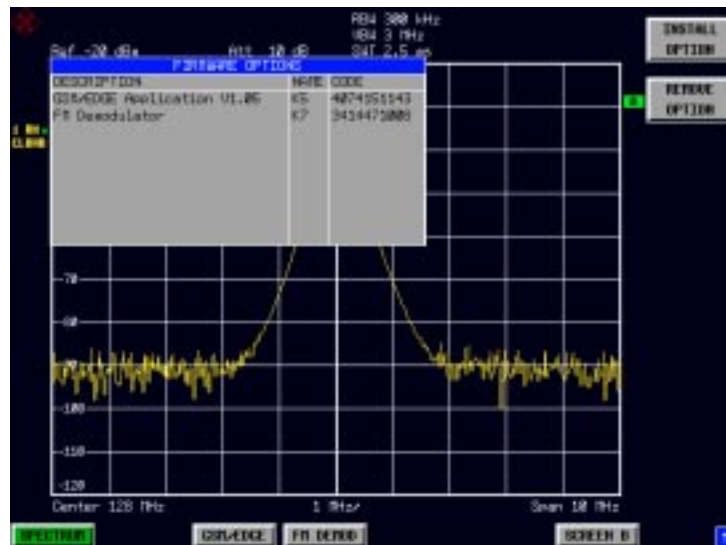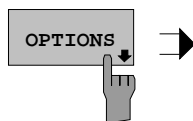
INSTALL OPTION

Softkey *INSTALL OPTION* opens the data entry for the license keycode of a firmware option.

On entry of a valid license key the message *OPTION KEY OK* is displayed in the status line and the firmware option appears in table *FIRMWARE OPTIONS* .

On entry of an invalid license key the message *OPTION KEY INVALID* is displayed in the status line.

IEC-Bus-Befehl: --

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First Operating Steps

Before measurements according to the RF test specification can be started the settings of the analyzer must be adapted to the characteristics of the DUT (device under test). Therefore the following operating sequence is recommended:

1. Set the spectrum analyzer to its default state.

➢ Press *PRESET*.
The analyzer will restore its default settings.

2. Select the Bluetooth operating mode.

➢ Press hotkey *BLUETOOTH*.
The Bluetooth measurement application will be started. The softkey menu *SETTINGS* will be selected.

3. Select a country.

➢ Press softkey *GEOGRAPHY.*
A list containing the available country settings will be opened.

➢ Select the desired country using the *CURSOR* keys and confirm the selection with *ENTER.*
The selection defines the frequency range and the available channel numbers for the transmit channels:
USA, Europe: f = 2402 + k MHz   mit k = 0..78
France: f = 2454 + k MHz   mit k = 0..22

4. Select the transmit channel

➢ Press softkey *CHANNEL* and enter the desired channel number. The available channel numbers are dependent on the available frequency bands, which again depend on the selected country:
USA, Europe: 0 to 78
France: 0 bis 22

5. Select the packet length

➢ Press softkey *PACKET TYPE.*
The list of available packet type opens.

➢ Enter the desired packet length DH1, DH3, DH5 or AUTO (recommended) using the cursor keys. Confirm the selection with *ENTER*.
This selection defines the length of the memory area used for searching the sync information. Shorter packet types speed up the sync search process at the risk of searching an area that does not contain sync information.

6. Select the power class of the DUT

➢ Press softkey *POWER CLASS* and select power class 1 to 3.

7. Configure the sync settings (LAP)

➢ Press hotkey *FIND SYNC*.
The softkey menu for configuration of the sync information will be opened.

➢ Press softkey *LAP* and enter the Lower Address Part of the Bluetooth Device Address of the DUT. The sync word used for the sync search will be calculated.

8. Select a measurement

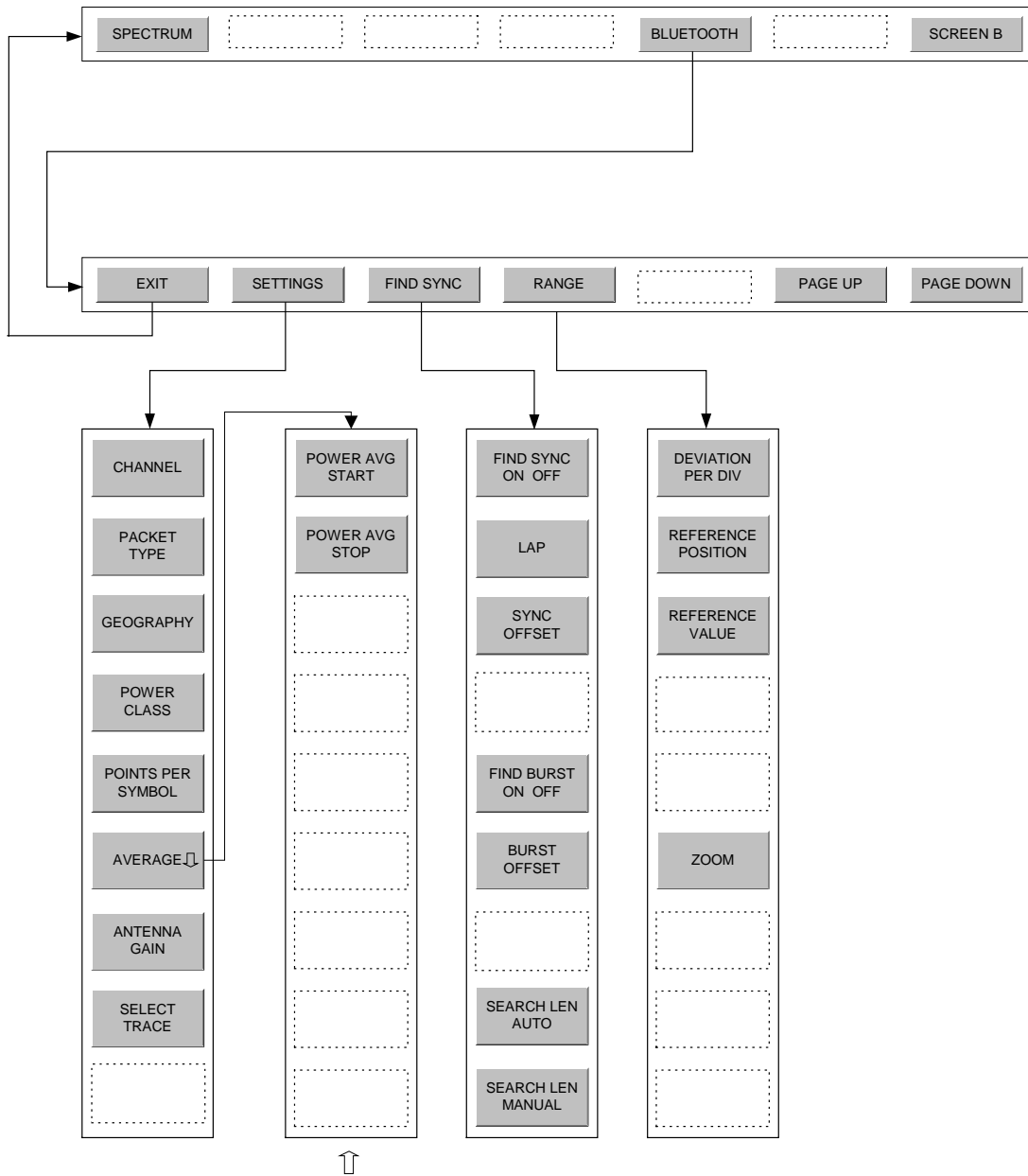➢ Press the *MEAS* key and select the desired measurement in the softkey menu.

➢ Configure measurement time, measurement control (*CONTINUOUS* or *SINGLE*) and the number of measurement cycles (*SWEEP COUNT)* by pressing the corresponding softkeys.

Settings exceeding the functions described in the above setup sequence are included in the reference part of the operating manual in the next chapter.

3   Settings of the Bluetooth Option

Bluetooth Menu Overview

SPECTRUM				BLUETOOTH		SCREEN B

EXIT	SETTINGS	FIND SYNC	RANGE		PAGE UP	PAGE DOWN

CHANNEL	POWER AVG START	FIND SYNC ON OFF	DEVIATION PER DIV
PACKET TYPE	POWER AVG STOP	LAP	REFERENCE POSITION
GEOGRAPHY		SYNC OFFSET	REFERENCE VALUE
POWER CLASS			
POINTS PER SYMBOL			
AVERAGE ⇧		FIND BURST ON OFF	
ANTENNA GAIN		BURST OFFSET	ZOOM
SELECT TRACE			
		SEARCH LEN AUTO	
		SEARCH LEN MANUAL	

⇧

Hotkey *BLUETOOTH*

| BLUETOOTH |

The hotkey *BLUETOOTH* in the menu bar below the LCD screen serves to activate the Bluetooth option and to switch the measurement demodulator on. At the same time the main softkey menu of the Bluetooth option is opened.
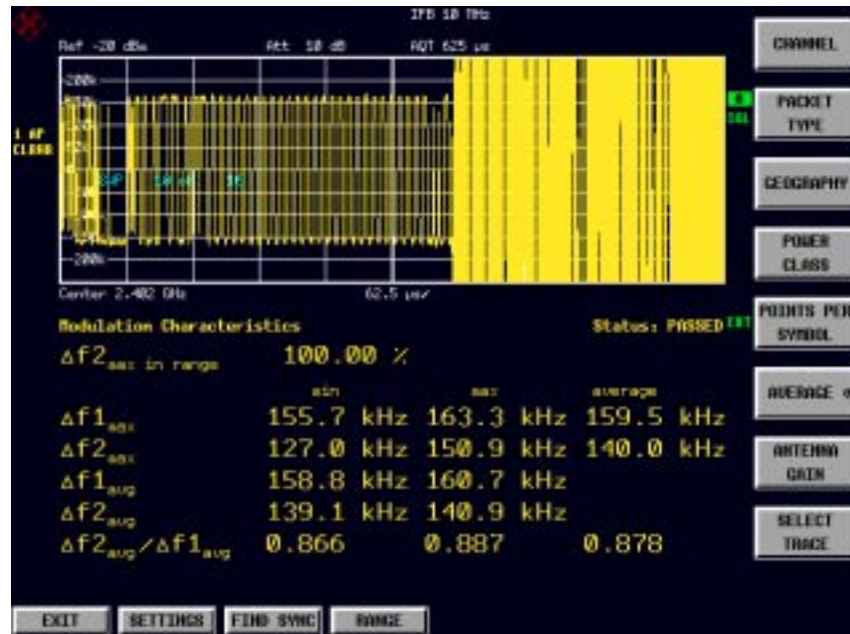

Fig. 3-1   Bluetooth main menu

The Bluetooth main menu contains the entry points for the essential configurations of the Bluetooth demodulator:

- **SETTINGS:**
  This softkey menu contains general settings common to all measurements of the measurement demodulator.

- **FIND SYNC:**
  This softkey menu defines the synchronisation parameters for the Bluetooth signal under request.

- **RANGE:**
  This softkey menu allows the adaption of the scaling of x- and y-axis of the diagram during the measurement of *Modulation Characteristics, Initial Carrier Frequency Tolerance and Carrier Frequency Drift*.

Hotkey *EXIT* is used to leave the Bluetooth Option. The hotkeys *PAGE UP / PAGE DOWN* are used to scroll the result lists of the individual measurements.

IEC/IEEE-bus command: INST:SEL BTOoth
                                 INST:NSEL 12

Bluetooth Main Hotkey Menu

EXIT

Hotkey *EXIT* leaves the Bluetooth option and re-activates the Spectrum mode of the instrument. The Bluetooth demodulator is switched off on leaving the option.

IEC/IEEE-bus command: INST:SEL SAN
                             INST:NSEL 1

SETTINGS

Hotkey *SETTINGS* opens the softkey menu containing the basic settings for the Bluetooth option, which are common to all tests. These settings include:

- Channel number
- Packet type
- Geographical settings
- Power class
- Number of points / symbol
- Averaging
- Antenna gain

IEC/IEEE-bus command: --

FIND SYNC

Hotkey *FIND SYNC* opens the softkey menu containing the settings for searching the sync word and the Bluetooth burst. This includes both the settings of the lower address part (LAP) and the settings of the timing parameters (*SYNC OFFSET, BURST OFFSET*).

IEC/IEEE-bus command: --

RANGE

Hotkey *RANGE* opens the softkey menu containing the settings for the scaling of x- and y-axis for the measurement of the *Modulation Characteristics, Initial Carrier Frequency Tolerance or Carrier Frequency Drift.* This hotkey is not available for other measurement types.

IEC/IEEE-bus command: --

PAGE UP

PAGE DOWN

These hotkeys scroll the list of measurement results. These hotkeys are only visible if the number of measurement results exceeds one screen.

IEC/IEEE-bus command: --

Allgemeine Einstellungen - Menü *SETTINGS*

CHANNEL

The softkey *CHANNEL* opens the editor for the index of the Tx channel. The range of valid values is dependent on the locally available frequency band.

Editing the channel number is in principle equal to changing the center frequency. The major difference is that the center frequency editor does not limit frequency values to the available frequency band, which means that values outside the frequency band and between the discrete channels can be selected.

As soon as the channel number editor is opened after the center frequency has been changed, the center frequency will be rounded to the nearest channel number.

The channel number determines the center frequency for the following measurements:

- Output Power

- Modulation Characteristics

- Initial Carrier Frequency Tolerance

- Carrier Frequency Drift

The center frequencies of the other measurements are independent of the active frequency channel (see menu *FREQ*).

The available value range for the channel number is dependent on the selected country. It is defined as follows:

     USA, Europe (outside France):   0..78
     France: 0..22

The formula for calculating the center frequencies is as follows:

     USA, Europe (outside France): $f = 2402 + k$ MHz   with $k = 0..78$
     France: $f = 2454 + k$ MHz   with $k = 0..22$

The default setting is channel number 0.

IEC/IEEE-bus command: CONF:BTO:CHAN 0

PACKET TYPE

The softkey *PACKET TYPE* opens a list with available packet types, which allows you to chose the one to be measured. The list contains the following packet types:

```
┌──────────────────────────┐
│      PACKET TYPE         │
├──────────────────────────┤
│ ✓DH1 (1 slot packet)    │
│  DH3 (3 slot packet)    │
│  DH5 (5 slot packet)    │
│  AUTO                    │
└──────────────────────────┘
```

The selected packet type will be used for the automatic calculation of the sweep time (*SWEEP TIME AUTO*) and the search length of the sync word (*SEARCH LEN AUTO*). The number of occupied slots is the other decisive factor in both calculations.

The actually transmitted packet type will be determined automatically by the Bluetooth demodulator (which means that the selected packet type need not necessarily correspond to the really transmitted packet type; it will only affect the settings for sweep time and search length as described above).

The default value is packet type DH1.

IEC/IEEE-bus command: CONF:BTO:PTYP DH1 | DH3 | DH5 | AUTO

GEOGRAPHY

The softkey *GEOGRAPHY* opens a list with geographical regions that have different frequency bands:

GEOGRAPHY
✓ Europe
USA
France
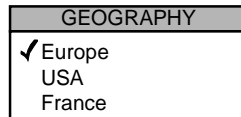
The default setting is *EUROPE*.

IEC/IEEE-bus command: CONF:BTO:GEOG EUR | USA | FRAN

POWER CLASS

The softkey *POWER CLASS* opens the editor for the Bluetooth power classes 1 to 3. The selection of the power class determines the limits for the output power measurement.

The default setting is power class 1.

IEC/IEEE-bus command: CONF:BTO:POW:PCL 1

POINTS PER SYMBOL

The softkey *POINTS PER SYMBOL* allows changing the number of measurement samples per symbol.
The RF Test Specification requests an oversampling factor of at least 4 (default settings). With this oversampling factor a DH5 packet corresponds to 12500 measurement samples (= 2500 samples / slot).

IEC/IEEE-bus command: CONF:BTO:PRAT 2 | 4 | 8 | 16 | 32

AVERAGE

The softkey *AVERAGE* opens the submenu containing the settings for the calculation of the average power. These settings will be used for the measurement of the output power.

IEC/IEEE-bus command: --

ANTENNA GAIN

The softkey *ANTENNA GAIN* allows the input of a level offset in order to take the gain of an antenna into account for displaying power values .

The default setting is 0 dB.

Note:
Offset values <> 0 dB will activate the enhancement label "TDF" at the right diagram border.

IEC/IEEE-bus command: [SENS:]CORR:EGA:INP[:MAGN] 0 DB

SELECT TRACE

The softkey *SELECT TRACE* selects the measurement curve whose numeric results will be displayed in the lower half of the screen.
The default curve selected is trace 1.

IEC/IEEE-bus command: CONF:BTO:TRAC<1...3>:SEL

Configuring the Averaging Method - Submenu *AVERAGE*

In order to determine the average power of a Bluetooth burst the corresponding area of the burst must be selected according to the RF Test Specification. In order to define this averaging area the start position and stop position must be entered in percent of the burst length.

The RF Test Specification allows different methods to determine the position of a Bluetooth burst:

- With *FIND SYNC ON* the burst is defined by the p0 bit and the automatically determined packet length.

- With *FIND SYNC OFF* and *FIND BURST ON* the burst is defined by the two 3dB points. The search of the 3dB points is defined in the RF Test Specification as the alternative method compared with the p0 bit method.
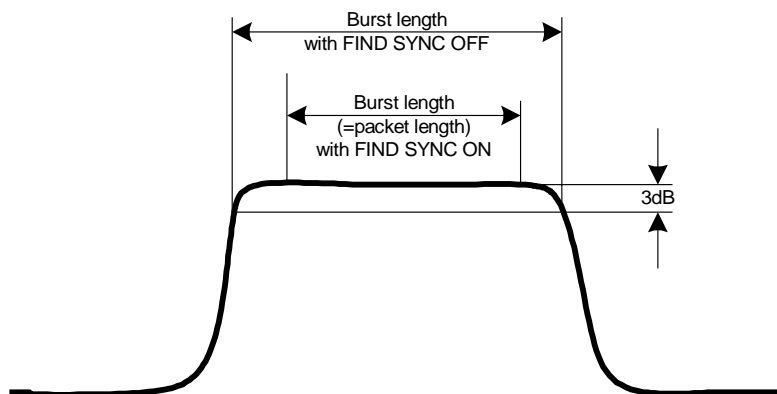
Fig. 3-2   Definition of a Bluetooth burst

With these definitions and dependent on the selected method for determining the burst there are different areas for the calculation of the average power::

AVERAGE START	The softkey *AVERAGE START* aktivates the editor for the start position of the evaluation area for the average burst power. The valid value range is 0 to 100%, the default setting is 20%.

IEC/IEEE-bus command: CONF:BTO:POW:AVER:STAR 20PCT

AVERAGE STOP	The softkey *AVERAGE STOP* aktivates the editor for the stop position of the evaluation area for the average burst power. The valid value range is 0 to 100%, the default setting is 80%.

IEC/IEEE-bus command: CONF:BTO:POW:AVER:STOP 80PCT

Setting of the Synchronisation Parameters - Menu FIND SYNC

With active function *FIND SYNC* the signal processing functions of the analyzer determine the position of the first preamble bit p0 by correlation with the sync word. For this purpose a sufficient record length of the FM demodulated signal is necessary.

The record length can be defined using the softkeys *SEARCH LEN AUTO* and *SEARCH LEN MANUAL*. If the sync word cannot be found in the signal, the message "SYNC NOT FOUND" will be displayed on the screen, and the corresponding bit in the STATus:QUEStionable:SYNC register will be set during remote operation.

The function *FIND SYNC* is active only during the following measurements:

- Output Power
- Modulation Characteristics
- Initial Carrier Frequency Tolerance
- Carrier Frequency Drift

The softkey *SYNC OFFSET* defines the number of bits to be displayed in front of the access code (p0 bit).
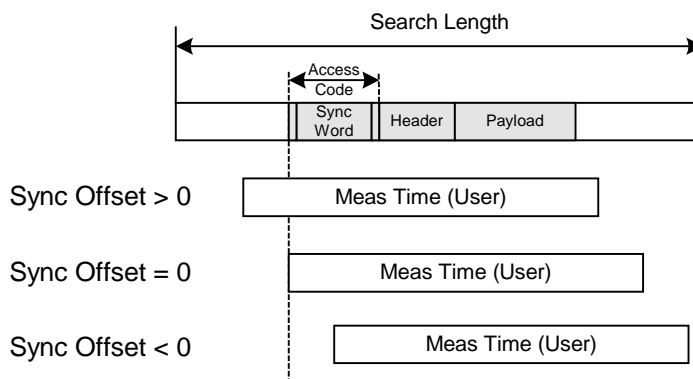
If both functions *FIND SYNC* and *FIND BURST* are active, the sync word will be determined in an identified burst. If function *FIND BURST* is not active or no burst is identified, the total record length (*Search Length*) will be investigated.

Function *FIND BURST* can be activated without active sync search. If no burst is identified in this case, the message "BURST NOT FOUND" will be displayed on the screen, and the corresponding bit in the STATus:QUEStionable:SYNC register will be set during remote operation.

The softkey *BURST OFFSET* defines the time to be displayed in front of the identified burst.

The results of the modulation measurements

- Modulation Characteristics

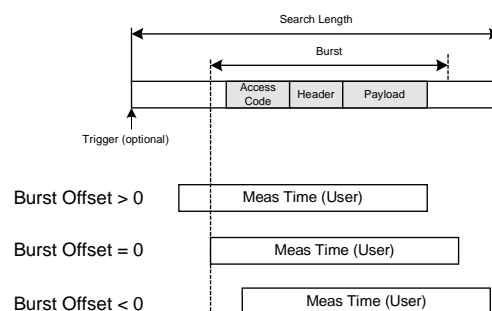- Initial Carrier Frequency Tolerance

- Carrier Frequency Drift

can only be calculated with active function *FIND SYNC*.

The measurement of output power can be performed with either of the functions *FIND SYNC* or *FIND BURST* active.

FIND SYNC ON OFF	The softkey *FIND SYNC ON/OFF* toggles the search of the sync word. The default setting is *FIND SYNC ON*.

IEC/IEEE-bus command: [SENS:]DDEM:SEAR:SYNC:STAT ON

LAP	The softkey *LAP* allows the input of the lower 24 bit (Lower Address Part, LAP)of the 'Bluetooth Device Address' (BD_ADDR) of the equipment under test (EUT).

The LAP is used to calculate the 64-bit 'sync word'. The 'sync word' in return is used to determine the start of a packet by correlation and to determine the position of the first preamble bit p0 using the method described in the RF Test Specification.

The valid value range for the lower address part is 000000h - FFFFFFh, its default setting is 0000000h.

IEC/IEEE-bus command: [SENS:]DDEM:SEAR:SYNC:LAP <hex>

SYNC OFFSET	The softkey *SYNC OFFSET* activates the input of the number of bits to be displayed in front of the first preamble bit p0. If the sync word is identified, but the selected measurement time cannot be displayed due to the selected sync offset, the message "SYNC OFFSET INVALID" will be displayed on the screen.

The valid value range comprises of -10000 bits to + 100000 bits, with negative values moving the preamble to the left, positive values to the right. The default setting for the sync offset is = 0.

IEC/IEEE-bus command: [SENS:]DDEM:SEAR:SYNC:OFFS 0

FIND BURST ON OFF	The softkey *FIND BURST ON/OFF* toggles the search for a burst for the output power measurement between on and off. If both functions *FIND BURST and FIND SYNC* are active the search area for the sync word will be limited to the area of the detected burst.

The default setting is *FIND BURST ON*.

IEC/IEEE-bus command: [SENS:]DDEM:SEAR:PULS:STAT ON | OFF

BURST OFFSET	The softkey *BURST OFFSET* opens the editor for the time to be displayed in front of the identified burst. If the burst is identified, but the selected measurement time cannot be displayed due to the selected burst offset, the message "BURST OFFSET INVALID" will be displayed on the screen.

The valid value range comprises of -10 ms to + 10 ms, with negative values moving the burst to the left, positive values to the right. The default setting for the burst offset is = 0.

IEC/IEEE-bus command: [SENS:]DDEM:SEAR:PULS:OFFS 0

SEARCH LEN AUTO	The softkey *SEARCH LEN AUTO* activates the automatic selection of the search length for the search of the sync word or the burst, depending on the selected packet type.

The automatic search length is determined as follows:

Trigger free run
         search length = 3 * packet length + | sync offset or burst offset |
all other trigger modes:
         search length = 1 * packet length + 1 Slot + | sync offset or burst offset |

If the selected measurement time is higher than the packet length, the difference
         measurement time - packet length
is added to the search length.

The default setting for the automatic calculation of the search length is ON.

IEC/IEEE-bus command: [SENS:]DDEM:SEAR:TIME:AUTO   ON | OFF

SEARCH LEN MANUAL	The softkey *SEARCH LEN MANUAL* switches the automatic selection of the search length off and opens the editor for the search length used for determining the sync word or the burst.

The input of the search length is done in seconds; the valid value range is 100µs to (130560µs / points per symbol).

There is a relation between the selected # of points / symbol and the maximum search length (in # of slots):

points per symbol	max search length
2	104,4 slots
4	52,2 slots
8	26,1 slots
16	13,1 slots
32	6,5 slots

Note:
Measurements without trigger require at least 3 times the record length as a value for the search length in loop back operation (see SEARCH LEN AUTO). With this condition the packet types that can be identified with an oversampling factor of 16 are restricted to DH1 and DH3. With an oversampling factor of 32 only DH1 packets can be identified reliably.

The default setting is 1875µs. This is the value used by *SEARCH LEN AUTO* (= 3 * DH1 packet length = 3 * 625µs.

IEC/IEEE-bus command: [SENS:]DDEM:SEAR:TIME 1875US

Modifying the Diagram Scales - Menu *RANGE*

The hotkey *RANGE* is only available, if a test with display of the FM modulated signal is selected. This menu allows adaption of both the scaling of the y-axis and activation of the zoom function for the x-axis.

<table>
<tr>
<td>

DEVIATION PER DIV

</td>
<td>

The softkey *DEVIATION PER DIV* allows the selection of the FM deviation to be displayed. The valid value range is 1 Hz / Div to 1 MHz / Div; the default setting is kHz.

IEC/IEEE-bus command: DISP:WIND:TRAC:Y:PDIV 50kHz

</td>
</tr>
<tr>
<td>

REFERENCE POSITION

</td>
<td>

The softkey *REFERENCE POSITION* defines the position of the reference line for the frequency deviation on the y-axis of the diagram. In the default setting of the analyzer this line corresponds to a frequency deviation of 0 Hz.

The input is performed in % of the diagram height, with 100% corresponding to the upper diagram border. The default setting is 50% (vertical middle of the diagram).

IEC/IEEE-bus command: DISP:WIND:TRAC:Y:RPOS 50PCT

</td>
</tr>
<tr>
<td>

REFERENCE VALUE

</td>
<td>

The softkey *REFERENCE VALUE* defines the FM deviation at the reference line on the y-axis. This allows individual frequency offsets to be taken into account for the display of the measurement curves.
The valid value range is 0 to $\pm$ 10 MHz; the default setting is 0 Hz.

IEC/IEEE-bus command: DISP:WIND:TRAC:Y:RVAL 0HZ

</td>
</tr>
<tr>
<td>

ZOOM

</td>
<td>

The softkey *ZOOM* activates the zoom function and opens the editor for the zoom start position. With active zoom function an area of only 501 samples is displayed.

The valid value range for the zoom start position is 0 to (meas time - 500 / sampling rate).
The default setting for the zoom function is *OFF.*

IEC/IEEE-bus command: SENS:ADEM:ZOOM ON
                                SENS:ADEM:ZOOM:STARt 30US

</td>
</tr>
</table>

Selection of Measurements - Hardkey *MEAS*

The hardkey *MEAS* selects the menu containing the Bluetooth measurements:

MEAS

OUTPUT POWER ⇩
TX SPEC ACP ⇩
MODULATION CHAR ⇩
INIT CARR FREQ TOL⇩
CARR FREQ DRIFT ⇩

CONTINUOUS SWEEP
SINGLE SWEEP
MEAS TIME MANUAL
MEAS TIME AUTO
SWEEP COUNT

CONTINUOUS SWEEP
SINGLE SWEEP
MEAS TIME MANUAL
MEAS TIME AUTO
SWEEP COUNT

START TEST
CONTINUE TEST
CONTINUOUS SWEEP
SINGLE SWEEP
MEAS TIME MANUAL
MEAS TIME AUTO
SWEEP COUNT

CONTINUOUS SWEEP
SINGLE SWEEP
SWEEPTIME MANUAL
SWEEPTIME AUTO
SWEEP COUNT
NO. OF ADJ CHAN

CONTINUOUS SWEEP
SINGLE SWEEP
MEASTIME MANUAL
MEASTIME AUTO
SWEEP COUNT
AVERAGE⇩

The following settings can be configured individually for each of the measurements:
- RBW   (the IF bandwidth set up for modulation measurements is valid for all measurements)
- VBW
- RBW auto mode
- VBW auto mode
- Trace mode
- Detector
- Sweep count
- Sweep time auto mode
- Sweep time

The settings which are specific for each measurement become active as soon as the corresponding measurement is selected. Changes to the above settings performed using the menus for the hardkeys BW, TRACE and SWEEP are always related to the selected measurement.

The settings defined in the RF Test Specification can thus be modified individually for development or production.

By using the function *STARTUP RECALL* the individual configuration of the various tests can be preserved over a preset.

IEC/IEEE-bus command: CONF:BTO:MEAS <measurement>

with <measurement> =

OPOW	Output Power
ACLR	TX Output Spectrum - Adjacent Channel Power
MCH	Modulation Characteristics
IFCT	Initial Carrier Frequency Tolerance
CFDR	Carrier Frequency Drift

Measuring the Output Power - Softkey *OUTPUT POWER*

The output power measurement determines the maximum and average output power during a burst of the equipment under test (EUT). For this purpose a complete packet is recorded in the time domain.
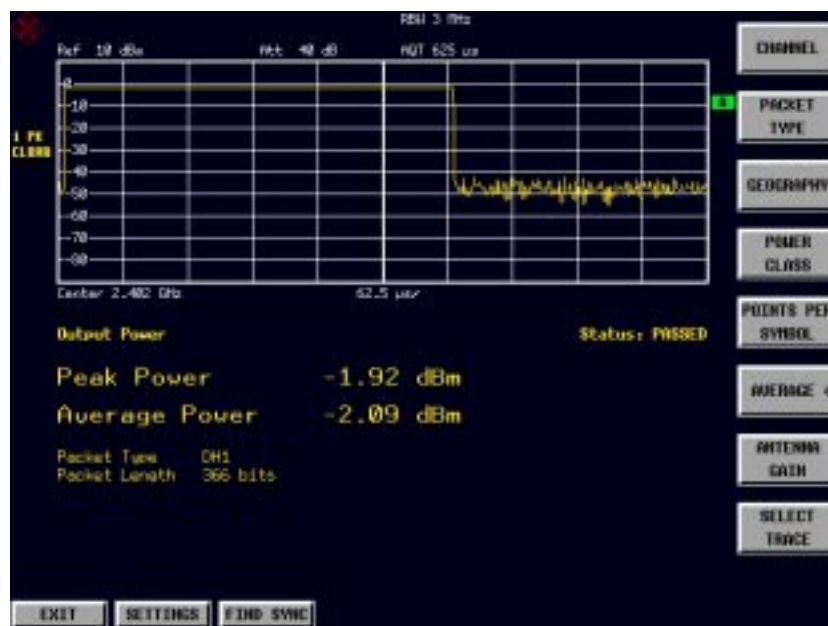
Fig. 3-3   Output power measurement

The peak value is determined from the complete contents of the measurement curve, whereas the average power is calculated from an area of at least 20% to 80% of the burst.

During the output power measurement the Bluetooth demodulator is active in order to determine the sync word within the signal, which is later-on used as the trigger basis. The Bluetooth demodulator is placed in a signal path without video filter. This is why the video filter cannot be activated with the output power measurement.

The EUT must keep the following limits according to the RF Test Specification:

1. P_{AV} < 100 mW (20 dBm) EIRP
2. P_{PK} < 200 mW (23 dBm) EIRP
3. If the EUT is conforming to power class 1: P_{AV} > 1 mW (0 dBm)
4. If the EUT is conforming to power class 2:   0.25 mW (-6 dBm) < P_{AV} < 2.5 mW (4 dBm)
5. If the EUT is conforming to power class 3: P_{AV} < 1 mW (0 dBm)

A violation of these limits is marked on the screen in red letters.
'

CONTINUOUS SWEEP	The softkey *CONTINUOUS SWEEP* selects continuous measurement operation. This is the default setting of the instrument. IEC/IEEE-bus command: INIT:CONT ON

SINGLE SWEEP	The softkey *SINGLE SWEEP* selects single measurement operation and starts a measurement cycle. IEC/IEEE-bus command: INIT:CONT OFF INIT,*WAI

MEASTIME MANUAL	The softkey *MEASTIME MANUAL* opens the editor for the sweep time of the output power measurement. The valid value range is 1 µs to (130560 µs / points per pymbol). The default setting is 625 µs. IEC/IEEE-bus command: CONF:BTO:SWE:TIME 625us

MEASTIME AUTO	The softkey *MEASTIME AUTO* activates the automatic calculation of the sweep time for the output power measurement. For the output power measurement the automatically calculated sweep time corresponds to the length of a packet.

Examples: DH1   625us
                 DH3   1875us
                 DH5   3125us

As a default setting the automatic sweeptime calculation is switched on.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME:AUTO ON

SWEEP COUNT	The softkey *SWEEP COUNT* opens the editor for the number of sweeps to be initiated by softkey *SINGLE SWEEP*. The valid value range is 0 to 32767, the default setting is 0.

Note:
The maximum and minimum value calculated from the individual sweeps for the P_{AV} - value will be displayed only for sweep count values <> 0.

With sweep count = 0 only the P_{AV} - value of the current measurement will be displayed.

IEC/IEEE-bus command: CONF:BTO:SWE:COUN 0
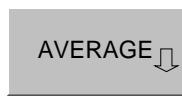
AVERAGE ⇩

The softkey *AVERAGE* opens the submenu for the settings required for calculation of the average power with output power measurement (see menu *SETTINGS*).

IEC/IEEE-bus command: --

Adjacent Channel Power Measurement - Softkey *TX SPEC ACP*

The measurement of the TX Output Spectrum - Adjacent Channel Power measurement measures the power of all adjacent channels.
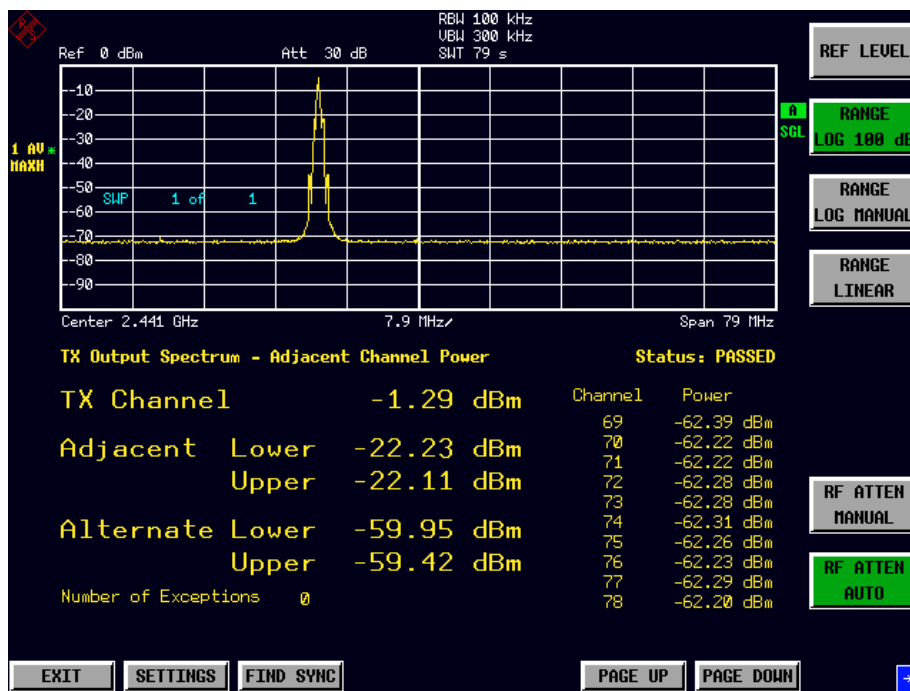
Fig. 3-4   TX Spectrum ACP measurement

The following limits are given by the RF Test Specification:

1) P_{TX} (f) ≤ -20 dBm for |M-N| = 2

2) P_{TX} (f) ≤ -40 dBm for |M-N| ≥ 3

with

M = Transmit channel of the equipment under test

N = adjacent channel to be measured

A violation of these limits will be marked by red color and an asterisk (*).

CONTINUOUS
SWEEP

The softkey *CONTINUOUS SWEEP* selects continuous measurement operation. This is the default setting of the instrument.

IEC/IEEE-bus command: INIT:CONT ON

SINGLE SWEEP	The softkey *SINGLE SWEEP* selects single measurement operation and starts a measurement cycle.

IEC/IEEE-bus command: INIT:CONT OFF
                                                   INIT,*WAI

SWEEPTIME MANUAL	The softkey *SWEEPTIME MANUAL* opens the editor for the sweep time of the output power measurement.

The valid value range is 10 μs (minimum meas time for one channel) to 16000 s. The default setting is 79 s.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME 79s

SWEEPTIME AUTO	The softkey *SWEEPTIME AUTO* activates the automatic calculation of the sweeptime for the TX Output Spectrum - Adjacent Channel Power measurement. The automatic sweeptime corresponds to the settings defined in the RF Test Specification.

The default state of this function is ON.
IEC/IEEE-bus command: CONF:BTO:SWE:TIME:AUTO ON

|	
SWEEP COUNT	The softkey *SWEEP COUNT* opens the editor for the number of sweeps to be initiated by softkey *SINGLE SWEEP* for the TX Output Spectrum - Adjacent Channel Power measurement.

The valid value range is 0 to 32767, the default setting is 10.

IEC/IEEE-bus command: CONF:BTO:SWE:COUN 10

NO. OF ACP CHAN	The softkey *NO. OF ACP CHAN* opens the editor for the number of adjacent channels, whose power is to be measured.

As with the ACP measurement of the basic instrument firmware this value refers to the number of adjacent channels on one side of the Tx channel. This means that with a selected value of 10 the analyzer will measure in total 21 channels (10 lower channels + TX channel + 10 upper channels).

The frequency range required for the measurement is set up automatically. The center frequency will also be adapted automatically dependent on the selected TX channel.

The measurement of the adjacent channels is limited to the available Bluetooth frequency band, which means that at maximum 79 channels (23 channels in France) will be measured.

Value range: 0 to 78 (Europe/USA), 0 to 22 (France).

The default setting is 78.
IEC/IEEE-bus command: CONF:BTO:ACLR:ACP 78

Measuring the Modulation Characteristics - Softkey *MODULATION CHAR*

The measurement of the modulation characteristics determines the maximum frequency deviation of all 8 bit sequences of the payload.

Additionally the average value of the maximum frequency deviation of a packet will be calculated. For this purpose the equipment under test is configured in a way that packets with bit pattern "11110000" and "10101010" are transmitted alternately. According to the RF Test Specification this sequence has to be repeated 10 times.
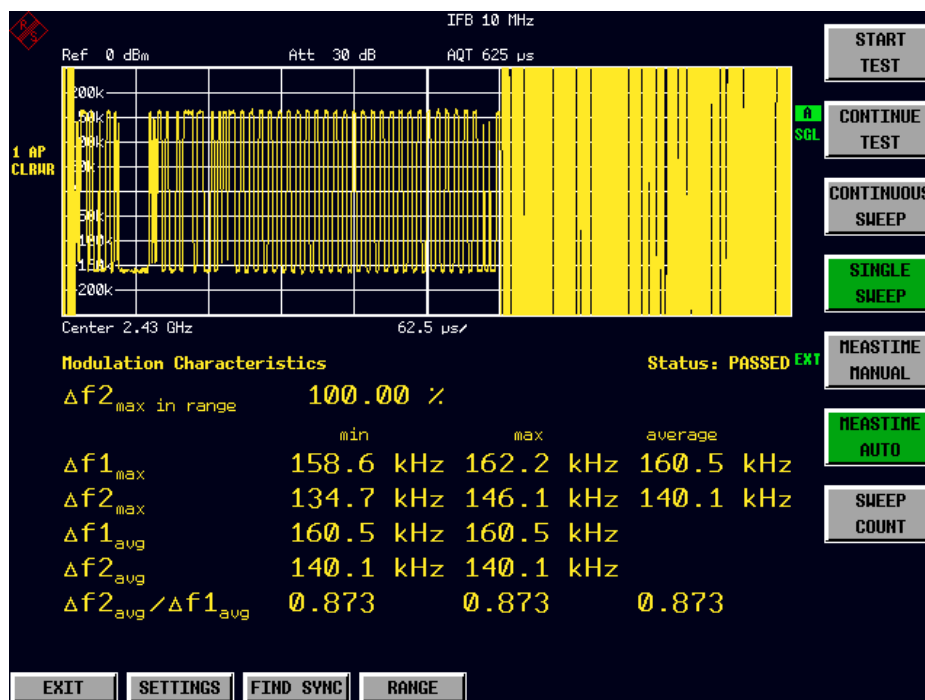
Fig. 3-5   Modulation Characteristics measurement

START TEST	The softkey *START TEST* initiates a new measurement. All frequency deviation values obtained earlier are discarded.

The bit pattern in the payload will be detected automatically. The frequency deviation of a packet is determined according to the procedure defined in the RF Test Specification.

IEC/IEEE-bus command: INIT;*WAI

CONTINUE TEST	After the bit pattern has been toggled at the EUT the softkey Softkey *CONTINUE TEST* measures the frequency deviation of further packets, just like softkey *START TEST* did for the first bit pattern type. The results of the preceeding measurement are preserved and will be taken into account during the new measurements.

IEC/IEEE-bus command: INIT:CONM

CONTINUOUS SWEEP	The softkey *CONTINUOUS SWEEP* selects continuous measurement operation. This is the default setting of the instrument. The number of displayed measurement results depends on the detected bit pattern.

IEC/IEEE-bus command: INIT:CONT ON

SINGLE SWEEP	The softkey *SINGLE SWEEP* selects single measurement operation and starts a measurement cycle. The number of displayed measurement results depends on the detected bit pattern.

IEC/IEEE-bus command: INIT:CONT OFF
                                             INIT;*WAI

MEAS TIME MANUAL	The softkey *MEASTIME MANUAL* opens the editor for the sweep time of the modulation characteristics measurement.

The valid value range is 1 µs to (130560 µs / points per pymbol). The default setting is 625 µs.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME 625us

MEAS TIME AUTO	The softkey *MEASTIME AUTO* activates the automatic calculation of the measurement time for the modulation characteristics measurement. The automatic sweeptime corresponds to the settings defined in the RF Test Specification.

The default state of this function is ON.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME:AUTO ON

SWEEP COUNT	The softkey *SWEEP COUNT* opens the editor for the number of sweeps to be initiated by softkey *SINGLE SWEEP* for the modulation characteristics measurement.

The valid value range is 0 to 32767, the default setting is 0.

IEC/IEEE-bus command: CONF:BTO:SWE:COUN 0

Measuring the Initial Carrier Frequency Tolerance - Softkey *INIT CARR FREQ TOL*

The measurement of the Initial Carrier Frequency Tolerance determines the carrier offset of the four preamble bits. According to the RF Test Specification the calculation of the carrier offset is performed from the middle of the first preamble bit to the middle of the bit following the preamble.

Fig. 3-6   Initial Carrier Frequency Tolerance measurement

CONTINUOUS SWEEP	The softkey *CONTINUOUS SWEEP* selects continuous measurement operation. This is the default setting of the instrument.

IEC/IEEE-bus command: INIT:CONT ON

SINGLE SWEEP	The softkey *SINGLE SWEEP* selects single measurement operation and starts a measurement cycle.

IEC/IEEE-bus command: INIT:CONT OFF
                             INIT;*WAI

MEASTIME MANUAL	The softkey *MEASTIME MANUAL* opens the editor for the sweep time of the initial carrier frequency tolerance measurement.

The valid value range is 1 µs to (130560 µs / points per pymbol). The default setting is 10 µs.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME 625us

MEAS TIME
AUTO

The softkey *MEASTIME AUTO* activates the automatic calculation of the measurement time for the modulation characteristics measurement. The automatic sweeptime corresponds to the settings defined in the RF Test Specification.

The default state of this function is ON.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME:AUTO ON

SWEEP
COUNT

The softkey *SWEEP COUNT* opens the editor for the number of sweeps to be initiated by softkey *SINGLE SWEEP* for the initial carrier frequency tolerance measurement.

The valid value range is 0 to 32767, the default setting is 10.

Note:
With trace mode CLEAR/WRITE and single sweep operation the selected number of sweeps will be processed and according to the RF Test Specification the results of all sweeps will be compared with the defined tolerance.

If a different trace mode is selected, the analyzer can alternatively combine several traces and determine the measurement results from the resulting trace.

IEC/IEEE-bus command: CONF:BTO:SWE:COUN 10

Measuring the Carrier Frequency Drift - Softkey *CARRIER FREQ DRIFT*

The measurement of the Carrier Frequency Drift determines the maximum frequency drift between the average value of the preamble bits and any 10 bit group of the payload. Additionally the maximum drift rate between all 10 bit groups in the payload is determined every 50µs.
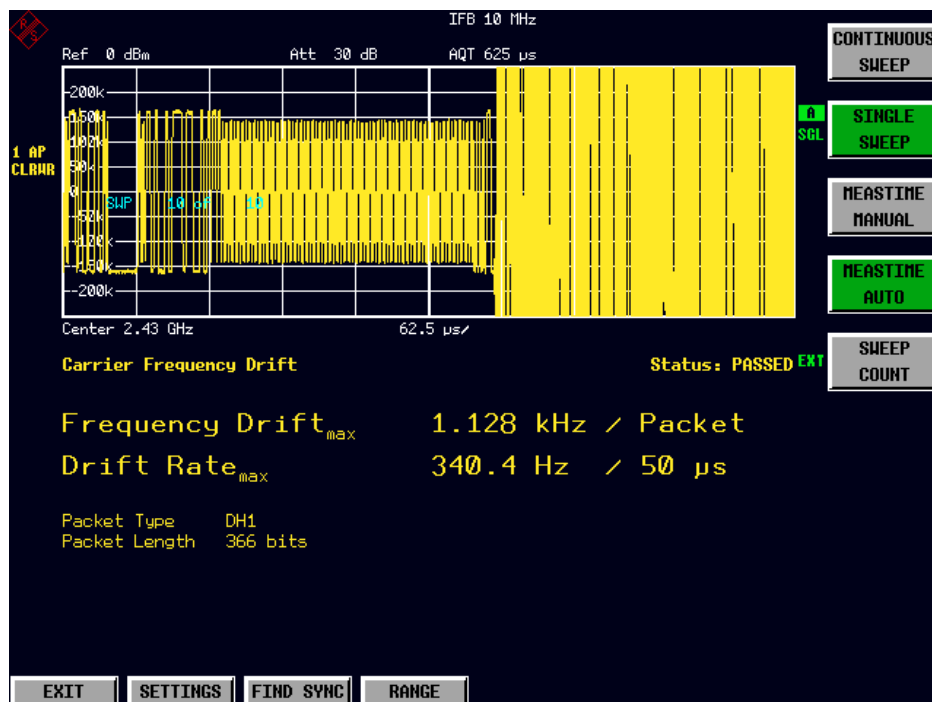

Fig. 3-7   Carrier Frequency Drift measurement

CONTINUOUS SWEEP

The softkey *CONTINUOUS SWEEP* selects continuous measurement operation. This is the default setting of the instrument.

IEC/IEEE-bus command: INIT:CONT ON

SINGLE SWEEP

The softkey *SINGLE SWEEP* selects single measurement operation and starts a measurement cycle.

IEC/IEEE-bus command: INIT:CONT OFF
                               INIT;*WAI

MEASTIME AUTO

The softkey *MEASTIME AUTO* activates the automatic calculation of the sweep time. The automatically calculated sweep time corresponds to the length of a packet.

Examples: DH1   625us
           DH3   1875us
           DH5   3125us

As a default setting the automatic sweeptime calculation is switched on.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME:AUTO ON

MEAS TIME MANUAL

The softkey *MEASTIME MANUAL* opens the editor for the sweep time of the Carrier Frequency Drift measurement.

The valid value range is 1 μs to (130560 μs / points per pymbol). The default setting is 625 μs.

IEC/IEEE-bus command: CONF:BTO:SWE:TIME 625us

SWEEP COUNT

The softkey *SWEEP COUNT* opens the editor for the number of sweeps to be initiated by softkey *SINGLE SWEEP* for the initial carrier frequency tolerance measurement.

The valid value range is 0 to 32767, the default setting is 10.

Note:
With trace mode CLEAR/WRITE and single sweep operation the selected number of sweeps will be processed and according to the RF Test Specification the results of all sweeps will be compared with the defined tolerance.

If a different trace mode is selected, the analyzer can alternatively combine several traces and determine the measurement results from the resulting trace.

IEC/IEEE-bus command: CONF:BTO:SWE:COUN 10

Setting the Center Frequency - Hardkey FREQ

```
 ┌─────────┐
 │  FREQ   │
 └────┬────┘
      │
 ┌─────────┐
 │ CENTER  │
 ├─────────┤
 │  CF-    │
 │STEPSIZE │
 ├─────────┤
 │         │
 ├─────────┤
 │         │
 ├─────────┤
 │         │
 ├─────────┤
 │         │
 ├─────────┤
 │         │
 ├─────────┤
 │         │
 ├─────────┤
 │         │
 └─────────┘
```
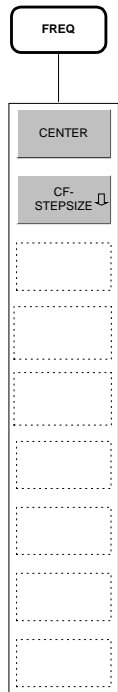
For the measurements

- Output Power
- TX Spectrum ACP
- Modulation Characteristics
- Initial Carrier Frequency Tolerance
- Carrier Frequency Drift

the selection of a frequency channel via softkey *CHANNEL* in menu *SETTINGS* is necessary in order to provide correct function according to the RF Test Specification. A change of the center frequency via menu *FREQ* is possible for these measurements, but the relation to the frequency channel will be lost, which means that the vlaue range for the center frequency is not limited to frequencies within valid frequency channels.

The return to the fixed relation between center frequency and Bluetooth frequency channels is performed at the moment when softkey *CHANNEL* is pressed or another measurement is selected. The center frequency will be rounded to the nearest frequency channel.

Setting the Frequency Range - Hardkey *SPAN*

The hardkey *SPAN* is not available in the *BLUETOOTH* operating mode.

Power Settings - Hardkey *AMPT*

AMPT	→		
		REF LEVEL	REF LEVEL POSITION
		RANGE LOG 100dB	REF LEVEL OFFSET
		RANGE LOG MANUAL	
		RANGE LINEAR	
			EL ATTEN AUTO — Option FSP-B25
		RF ATTEN MANUAL	EL ATTEN MANUAL — Option FSP-B25
		RF ATTEN AUTO	EL ATTEN OFF — Option FSP-B25
			RF INPUT 50Ω 75Ω
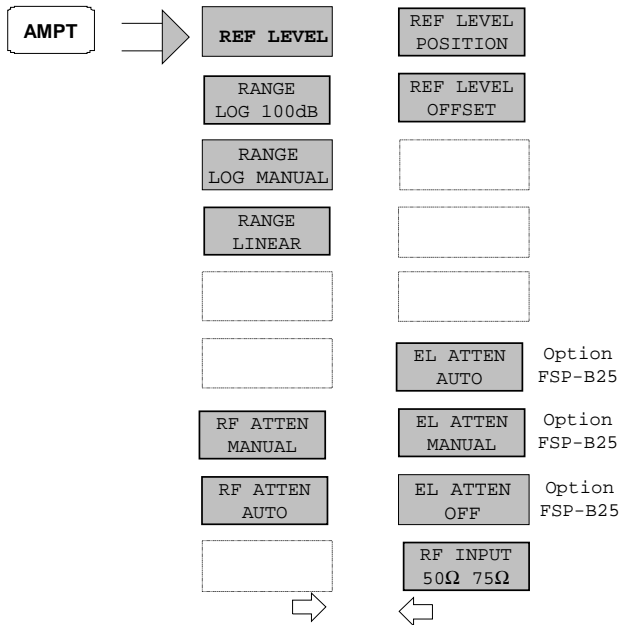
The functions of menu *AMPT* are identical to those of the basic instrument.

The functions

RANGE LOG 100 dB,
RANGE LOG MANUAL und
RANGE LINEAR

are only available with measurements *OUTPUT POWER and TX SPECTRUM ACP .*

Note:
The REF LEVEL value defines the maximum input power of the A/D converter. It must therefore be equal or higher than the maximum power of the signal under test.

Bandwidth Settings - Hardkey *BW*

The configuration of the bandwidths is distinguished between 3 groups of measurements:

1. Output Power
   Here only the setting of the resolution bandwidth *(RES BW)* and measurement time *(MEAS TIME)* is possible.

2. Modulation Characteristics, Initial Carrier Frequency Tolerance, Carrier Frequency Drift:
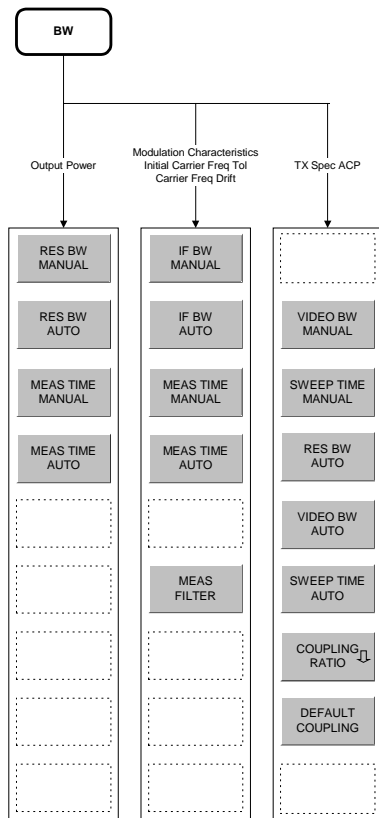   In addition to the IF bandwidth *(IF BW, is equal to the resolution bandwidth of the analyzer)* and measurement time a measurement filter *(MEAS FILTER)* can be switched on or off.
   Please note that the settings selected here affect all of the above measurements.

3. TX Spectrum ACP:
   The video bandwidth *(VIDEO BW)* and the corresponding couplings can be selected. Resolution bandwidth and filter type cannot be modified with this measurement function.

The following statement is equally valid for all groups of measurement functions:

The softkeys *RES BW AUTO* or *IF BW AUTO* select the bandwidths according to the values defined in the RF Test Specification.

Value range and default settings of measurement time / sweep time are described in chapter "Hardkey: MEAS" together with the corresponding softkeys *MEAS TIME / SWEEP TIME*.

The function of the softkeys *VIDEO BW MANUAL / AUTO, COUPLING RATIO* and *DEFAULT COUPLING* is identical to the basic instrument. Please refer to the corresponding chapters of the basic instrument operating manual.

Please note that the corresponding GPIB commands are placed in the CONF:BTO subsystem.

MEAS FILTER

The softkey *MEAS FILTER* activates a filter that limits the bandwidth for the modulation measurements.

The filter is flat within 1.04 MHz (ripple: only 0.02 dB) and has steep slopes outside this area. The filter has the following characteristics:

- Passband Ripple up to ±550 kHz < 0.5 dB (peak to peak)

- Minimum attenuation in the transition band
  ± 650 kHz: ≥ 3 dB
  ± 1 MHz: ≥ 14 dB
  ± 2 MHz: ≥ 44 dB

The default filter setting is OFF.

IEC/IEEE-bus command: [SENS:]DDEM:FILT:MEAS OFF | BTO

Starting Measurements - Hardkey *SWEEP*

In the *BLUETOOTH* operating mode the hardkey *SWEEP* is used for direct entry into the measurement menu of the currently selected measurement.. The "deviation" via the key sequence *MEAS* + *submenu selection* is not necessary in this case.

The functions of the individual softkeys are descreibed in the corresponding chapter of the submenu of hardkey *MEAS*.

Please note that the corresponding GPIB commands are placed in the CONF:BTO subsystem.

Trigger Settings - Hardkey *TRIG*
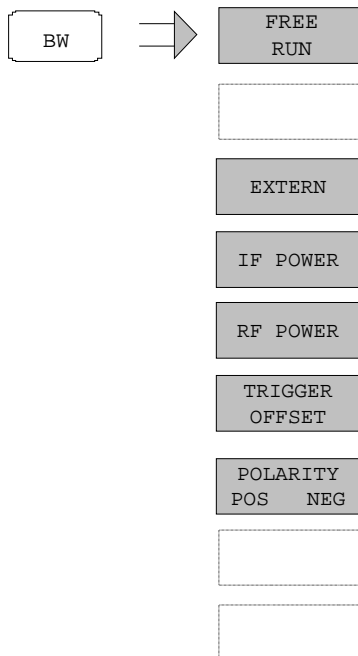
The hardkey *TRIG* opens a menu to set up the various trigger sources and to select the polarity of the trigger signal. The active trigger mode is signalled by colouring the corresponding softkey.

A trigger mode different from *FREE RUN* is indicated on the screen by the enhancement label **TRG**.

The softkey *RF POWER* is only available with the R&S FSP with Option R&S FSP-B6 (TV- and RF-Trigger).

FREE RUN

The softkey *FREE RUN* activates a continuous measurement sequence, which means that there is no explicit trigger of the measurement start. At the end of one measurement the next one is started immediately.

FREE RUN isthe default setting.

IEC/IEEE-bus command: TRIG:SOUR IMM

EXTERN

The *EXTERN* softkey activates triggering via a TTL signal at the input connector *EXT TRIGGER/GATE* on the rear panel.

IEC/IEEE-bus command: TRIG:SOUR EXT

IF POWER

The *IF POWER* softkey activates triggering of the measurement via signals which are outside the measurement channel.

For this purpose, the R&S FSP uses a level detector at the second intermediate frequency. The trigger level can be selected in a range between –30 dBm and -10 dBm at the input mixer.

The R&S FSU also uses a level detector at the second intermediate frequency. The trigger level in this case can be selected in a range between –50 dBm and -10 dBm at the input mixer.

The resulting trigger level at the RF input is calculated via the following formula:

$$Mixerlevel_{\min} + RFAtt - \Pr eampGain \; \leq \; Input\ Signal \; \leq \; Mixerlevel_{\max} + RFAtt - \Pr eampGain$$

The bandwidth at the intermediate frequency is 10 MHz for the FSP and 50 MHz for the FSU. The analyzer is triggered as soon as the trigger threshold is exceeded within a 5 MHz range (FSU: 25 MHz range) around the selected frequency (= start frequency in the frequency sweep).. Thus, the measurement of spurious emissions, eg for pulsed carriers, is possible even when the carrier lies outside the selected frequency span.

IEC/IEEE-bus command: TRIG:SOUR IFP

RF POWER

The *RF POWER* softkey activates triggering of the measurement via signals which are outside the measurement channel.

For this purpose, the analyzer uses a level detector at the second intermediate frequency. The trigger level can be selected in a range between –50 dBm and -10 dBm at the input mixer.

The resulting trigger level at the RF input is calculated via the following formula:

$$Mixerlevel_{min} + RFAtt - \Pr eampGain \; \leq \; Input\ Signal \; \leq \; Mixerlevel_{max} + RFAtt - \Pr eampGain$$

The bandwidth at the intermediate frequency is 80 MHz. The analyzer is triggered as soon as the trigger threshold is exceeded within a 40 MHz range around the selected frequency (= start frequency in the frequency sweep).. Thus, the measurement of spurious emissions, eg for pulsed carriers, is possible even when the carrier lies outside the selected frequency span.

Note:
This function is only available with the R&S FSP and only with option TV- und RF-Trigger R&S FSP-B6.

IEC/IEEE-bus command: TRIG:SOUR RFP

TRIGGER OFFSET

The *TRIGGER OFFSET* softkey activates the window for entering the time offset between the trigger signal and the start of the sweep.

Triggering is delayed by the entered time with respect to the trigger signal (time entered > 0) or is started earlier (time entered < 0).

The default setting is 0 s.

IEC-Bus-Befehl   TRIG:HOLD 10US

POLARITY POS NEG

The *POLARITY POS/NEG* softkey selects the polarity of the trigger source.

The sweep starts after a positive or negative edge of the trigger signal. The selected setting is highlighted.

The selection is valid for all trigger modes with the exception of *FREE RUN*; in the gate mode, it also applies to the gate polarity.

The default setting is *POLARITY POS*.

Note: *This function is only available with detector boards with model index $\geq$ 3. With older boards the setting will be ignored.*

IEC/IEEE-bus command: TRIG:SLOP POS

Measurement Display - Hardkey *MKR*

MKR	⟹	MARKER 1

MARKER 2

MARKER 3

MARKER 4

MARKER NORM DELTA

ALL MARKER OFF
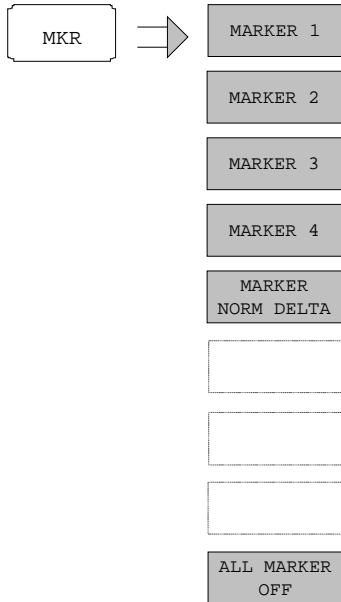
The functions of menu *MKR* are identical to the basic instrument.

The only difference is that the display of the measurement result is coupled to the active result display.

For the measurements

- Output Power
- TX Spectrum ACP

the result is displayed in dBm or dB.

For the measurements

- Modulation Characteristics
- Initial Carrier Frequency Tolerance
- Carrier Frequency Drift

the result is displayed in Hz.

Marker Search Functions - Hardkey *MKR* ⟹

MKR▶ ⟹

SELECT MARKER

PEAK

CENTER = MKR FREQ

REF LEVEL = MKR LVL

NEXT PEAK

NEXT MODE

PEAK EXCURSION

MKR->TRACE

MKR -> CF STEPSIZE

MIN

NEXT MIN

NEXT MODE

ABSOLUTE PEAK / MIN

SEARCH NEXT LEFT

SEARCH NEXT RIGHT
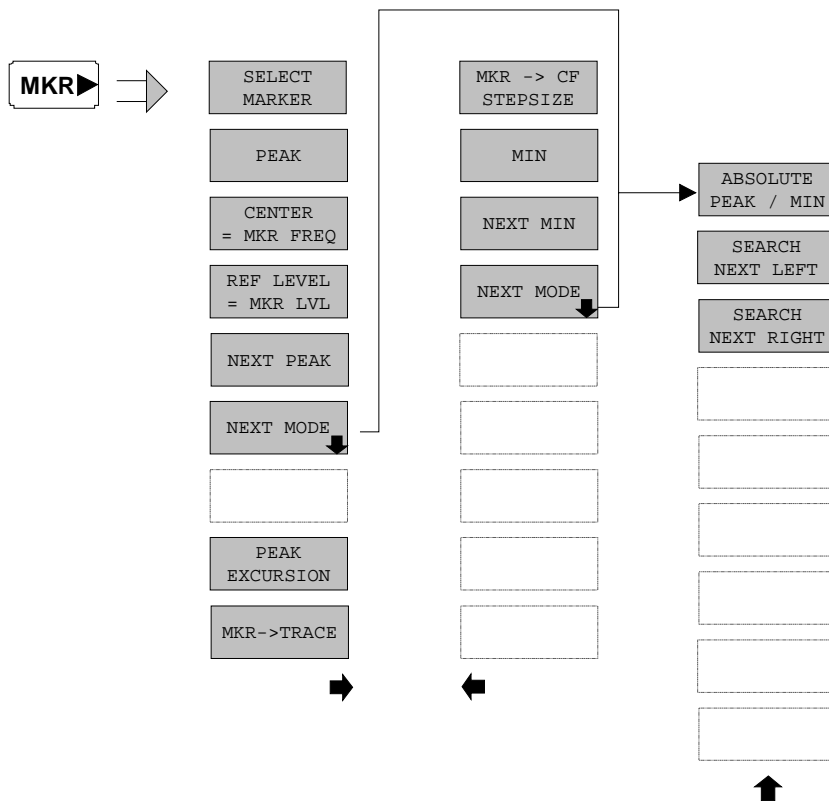
The functions of menu *MKR* ⇒ are identical to those of the basic instrument.

The functions

➢ *CENTER = MKR FREQ*

➢ *REF LEVEL = MKR LVL*

are only available with measurements *OUTPUT POWER* and *TX SPECTRUM ACP*.

Marker Functions - Hardkey *MKR FCTN*

| MKR FCTN | ⇒ | SELECT MARKER | | The available functions of menu *MKR FCTN* are identical to those of the basic instrument. |

| PEAK |

| |

| |

| |

| |

| |

| |

| MKR->TRACE |

Other Hardkeys

The functions of the other hardkeys are identical to those of the basic instrument. Please refer to the corresponding chapters of the basic instrument operating manual.

Please note that some of the corresponding GPIB commands are placed in the CONF:BTO subsystem.

4   Remote Control - Description of commands

The following sections are to complete and update Chapters 5 and 6 of the FSP / FSU manual.
The "Description of commands" section includes the new commands valid especially for the R&S FS-K8 application, as well as modified commands of the basic instrument, as far as they are used by the R&S FS-K8 option. commands which are used equally in basic instrument and option K8 are marked accordingly in the operating manual of the basic instrument.

In the description of measurements in Chapter 3, the corresponding IEC/IEEE-bus commands are stated for each softkey.

Note: *Measurements for operating mode BLUETOOTH are always performed in screen A. Therefore all commands which use the numeric suffix for selection of the screen must be supplied with either the numeric suffix 1 (eg* `CALCulate1`*) or without numeric suffix (eg* `CALCulate`*).*

Overview of the Status Registers

Fig. 4-1 Overview of the status registers

STATus-QUEStionable:SYNC Register

This register contains information about sync and bursts not found, and about premeasurement results exceeding or falling short of expected values.
The bits can be queried with commands "`STATus:QUEStionable:SYNC:CONDition?`" and "`STATus:QUEStionable:SYNC[:EVENt]?`".

Bit No.	Meaning
0	**BURSt not found (screen A)** This bit is set if no burst is found in the measurements/premeasurements. If a burst is found in these measurements/premeasurements, the bit is reset.
1	**SYNC not found (screen A)** This bit is set if the synchronization sequence (training sequence) is not found in the measurements/premeasurements. If the synchronization sequence (training sequence) is found in these measurements/premeasurements, the bit is reset.
2 to 15	see basic instrument operating manual

Common commands

COMMAND	PARAMETERS	COMMENT
*OPT?		Option Identification Query; query only

*OPT?
   OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the options installed. The options are separated from each other by comma. The signature for option R&S FS-K8 is placed at position 33 in the response string:

Example:
0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,K8,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0

Calculate – Subsystem

CALCulate:BTOoth – Subsystem

The following commands are used to configure the operating mode BLUETOOTH analyzer (Option R&S FS-K8).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate			
:BTOoth			Option FS-K8
:OPOWer			
[:PEAK]?			query only
:AVERage?	MINimum | MAXimum		query only
:ACLR			
[:LIST]?			query only
:EXCeptions?			query only
:MCHar			
:DF<1|2>			
:AVERage?	MINimum | MAXimum		query only
:MAXimum?	MINimum | MAXimum | AVERage		query only
:PERCent?			query only
:RATio?	MINimum | MAXimum | AVERage		query only
:ICFTolerance?	MINimum | MAXimum | AVERage		query only
:CFDRift			
[:MAXimum]?			query only
:RATE?			query only
:PLENgth?			query only
:PTYPe?			query only
:STATus?			query only

CALCulate:BTOoth:OPOWer[:PEAK]?

This command reads the peak value of the Output Power Measurement according to the BLUETOOTH standard.

Note: *This command is only available with active Output Power Measurement (command CONF:BTO:MEAS OPOW). With all other measurements it will lead to a query error.*

Example:

`"INST:SEL BTO"`	'activates the Bluetooth option
`"INIT:CONT OFF"`	'select single sweep operation
`"CONF:BTO:CHAN 10"`	'select channel 10
`"CONF:BTO:GEOG EUR"`	'select geographical region Europe
`"CONF:BTO:PCL 1"`	'select power class 1
`"CONF:BTO:BTO:PRAT 4"`	'select 4 points per symbol
`"CONF:BTO:PTYP DH1"`	'select 1 slot packet
`"DDEM:SEAR:PULS ON"`	'activate the FIND BURST function
`"DDEM:SEAR:PULS:OFFS 0s"`	'set burst offset = 0
`"DDEM:SEAR:SYNC ON"`	'activate the FIND SYNC function
`"DDEM:SEAR:SYNC:OFFS 0s"`	'set the sync offset = 0
`"DDEM:SEAR:SYNC:LAP 0"`	'set the lower address part = 0
`"DDEM:SEAR:TIME:AUTO ON"`	'select automatic search length
`"CONF:BTO:MEAS OPOW"`	'activate the Output Power Measurement
`"INIT;*WAI"`	'start the measurement with synchronisation
`"CALC:BTO:OPOW?"`	'query the output power result

Characteristics:	*RST value:	-
	SCPI:	device specific
Mode:	BT	

CALCulate:BTOoth:OPOWer:AVERage? MINimum | MAXimum

This command reads the average value of the Output Power measurement according to the Bluetooth standard.

With a sweep count value of ≥ 1 (*CONF:BTO:SWE:COUN*) and trace mode clear/write (*DISP:WIND:TRAC:MODE WRIT*) the selected number of measurements is performed when a single sweep is started (*INIT:IMM*). During these measurements the minimum and maximum values are determined.
If only a single measurement is performed, the minimum and maximum value will be identical.

Note: *This command is only available with active Output Power measurement (command CONF:BTO:MEAS OPOW). With all other measurements this command will lead to a query error.*

Example:	`"INST:SEL BTO"`	'activate the Bluetooth option
	`"INIT:CONT OFF"`	'select single sweep operation
	`"CONF:BTO:CHAN 10"`	'select channel 10
	`"CONF:BTO:GEOG EUR"`	'select geographical region Europe
	`"CONF:BTO:PCL 1"`	'select power class 1
	`"CONF:BTO:BTO:PRAT 4"`	'select 4 points per symbol
	`"CONF:BTO:PTYP DH1"`	'select 1 slot packet
	`"DDEM:SEAR:PULS ON"`	'activate the FIND BURST function
	`"DDEM:SEAR:PULS:OFFS 0s"`	'set burst offset = 0
	`"DDEM:SEAR:SYNC ON"`	'activate the FIND SYNC function
	`"DDEM:SEAR:SYNC:OFFS 0s"`	'set the sync offset = 0
	`"DDEM:SEAR:SYNC:LAP 0"`	'set the lower address part = 0
	`"DDEM:SEAR:TIME:AUTO ON"`	'select automatic search length
	`"CONF:BTO:MEAS OPOW"`	'activate the Output Power Measurement
	`"CONF:BTO:SWE:COUN 20"`	'activate measurement over 20 sweeps
	`"INIT;*WAI"`	'start the measurement with synchronisation
	`"CALC:BTO:OPOW:AVER? MAX"`	'query the maximum average value of the 'Output Power measurement

Characteristics:	*RST value:	-
	SCPI:	device specific
Mode:	BT	

CALCulate:BTOoth:ACLR[:LIST]?

This command determines the power of the selected adjacent channels. The number of adjacent channel pairs is defined with command CONF:BTO:ACLR:ACP.

The results are returned as a list of power values. The structure of the list is as follows:

<TX channel – n>...<TX channel – 1> <TX channel> <TX channel + 1>...<TX channel + n>

The number of adjacent channels is limited at the Bluetooth band limits.

Note: *This command is only available with active Adjacent Channel Power measurement (command CONF:BTO:MEAS ACLR). With all other measurements this command will lead to a query error.*

Example:	`"INST:SEL BTO"`	'activate the Bluetooth option
	`"INIT:CONT OFF"`	'select single sweep operation
	`"CONF:BTO:MEAS ACLR"`	'activate the Adjacent Channel Power
		'measurement
	`"INIT;*WAI"`	'start the measurement with synchronisation
	`"CALC:BTO:ACLR?"`	'query the power list

Characteristics:	*RST value:	-
	SCPI:	device specific
Mode:	BT	

CALCulate:BTOoth:ACLR:EXCeptions?

This command determines the number of exceptions which occured during the adjacent channel power measurement according to the Bluetooth specification.

Note: *This command is only available with active Adjacent Channel Power measurement (command CONF:BTO:MEAS ACLR). With all other measurements this command will lead to a query error.*

Example:	`"INST:SEL BTO"`	'activate the Bluetooth option
	`"INIT:CONT OFF"`	'select single sweep operation
	`"CONF:BTO:MEAS ACLR"`	'activate the Adjacent Channel Power
		'measurement
	`"INIT;*WAI"`	'start the measurement with synchronisation
	`"CALC:BTO:ACLR?"`	'Pegelliste abfragen
	`"CALC:BTO:ACLR:EXC?"`	'query the number of exceptions

Characteristics:	*RST value:	-
	SCPI:	device specific
Mode:	BT	

CALCulate:BTOoth:MCHar:DF2:PERCent?

This command determines the percentage of measurements of the frequency deviation, for which the value of $\Delta f2_{max}$ is within the allowed range.

Notes: *The numeric suffix 1 (...:DF1:Percent?) is not allowed for this command.*

The command is only available with active Modulation Characteristics measurement (command CONF:BTO:MEAS MCH). With all other measurements this command will lead to a query error.

Example:	`"INST:SEL BTO"`	'activate the Bluetooth option
	`"INIT:CONT OFF"`	'select single sweep operation
	`"CONF:BTO:CHAN 10"`	'select channel 10
	`"CONF:BTO:GEOG EUR"`	'select geographical region Europe
	`"CONF:BTO:PCL 1"`	'select power class 1
	`"CONF:BTO:BTO:PRAT 4"`	'select 4 points per symbol
	`"CONF:BTO:PTYP DH1"`	'select 1 slot packet
	`"DDEM:SEAR:PULS ON"`	'activate the FIND BURST function
	`"DDEM:SEAR:SYNC ON"`	'activate the FIND SYNC function
	`"DDEM:SEAR:SYNC:OFFS 0s"`	'set the sync offset = 0
	`"DDEM:SEAR:SYNC:LAP 0"`	'set the lower address part = 0
	`"DDEM:SEAR:TIME:AUTO ON"`	'select automatic search length
	`"CONF:BTO:MEAS MCH"`	'activate the Modulation Characteristics
		'measurement
	`"CONF:BTO:SWE:COUN 20"`	'init the sweep counter with 20

```
                      '... EUT emits bit pattern 10101010
                      "INIT;*WAI"                 'start the measurement with synchronisation
                      "CALC:BTO:MCH:DF2:PERC?"    'query the percentage of "in range"
                                                  'measurements
```

Characteristics: *RST value: -
                       SCPI: device specific

Mode: BT

CALCulate:BTOoth:MCHar:DF<1|2>:AVERage? MINimum | MAXimum

This command determines the average frequency deviation for varying bit patterns of the payload.
The assignment of command to frequency deviation and bit pattern is as follows:

Frequency deviation	$\Delta f1_{avg}$	$\Delta f2_{avg}$
Bit pattern	"11110000"	"10101010"
Minimum value	CALC:BTO:MCH:DF1:AVER? MIN	CALC:BTO:MCH:DF2:AVER? MIN
Maximum value	CALC:BTO:MCH:DF1:AVER? MAX	CALC:BTO:MCH:DF2:AVER? MAX

The command INIT:IMM starts a new measurement and erases the previous results. Further
measurements can be performed using the command INIT:CONM, which allows calculation of
minimum and maximum values over several measurements. Minimum and maximum value will be
equal if only one measurement was executed.
With a sweep count value of ≥ 1 (*CONF:BTO:SWE:COUN*) and trace mode clear/write
(*DISP:WIND:TRAC:MODE WRIT*) several measurements will be performed with one single
command (*INIT:IMM* oder *INIT:CONM*). In this case all the measurements will be taken into account
for calculation of the minimum / maximum value.

Note: *The commands are only available with active Modulation Characteristics measurement
              (command CONF:BTO:MEAS MCH). With all other measurements this command will
              lead to a query error.*

Example:
```
            "INST:SEL BTO"               'activate the Bluetooth option
            "INIT:CONT OFF"             'select single sweep operation
            "CONF:BTO:CHAN 10"          'select channel 10
            "CONF:BTO:GEOG EUR"         'select geographical region Europe
            "CONF:BTO:PCL 1"            'select power class 1
            "CONF:BTO:BTO:PRAT 4"       'select 4 points per symbol
            "CONF:BTO:PTYP DH1"         'select 1 slot packet
            "DDEM:SEAR:PULS ON"         'activate the FIND BURST function
            "DDEM:SEAR:SYNC ON"         'activate the FIND SYNC function
            "DDEM:SEAR:SYNC:OFFS 0s"    'set the sync offset = 0
            "DDEM:SEAR:SYNC:LAP 0"      'set the lower address part = 0
            "DDEM:SEAR:TIME:AUTO ON"    'select automatic search length
            "CONF:BTO:MEAS MCH"         'activate the Modulation Characteristics
                                        'measurement
            "CONF:BTO:SWE:COUN 20"      'init the sweep counter with 20
            '... EUT emits bit pattern 1111000
            "INIT:IMM;*WAI"             'start the measurement with
                                        'synchronisation and erase previous
                                        'measurement results
            "CALC:BTO:MCH:DF1:AVER? MIN"    'query minimum value "11110000"
            "CALC:BTO:MCH:DF1:AVER? MAX"    'query maximum value "11110000"
            '... EUT emits bit pattern 10101010
            "INIT:CONM;*WAI"            'start additional measurement with
                                        'synchronisation
            "CALC:BTO:MCH:DF2:AVER? MIN"    'query minimum value "10101010"
            "CALC:BTO:MCH:DF2:AVER? MAX"    'query maximum value "10101010"
```

Characteristics: *RST value: -
                        SCPI: device specific

Mode: BT

CALCulate:BTOoth:MCHar:DF<1|2>:MAXimum? MINimum | MAXimum | AVERage

This command determines the maximum frequency deviation for different bit patterns of the payload.Diese commande ermitteln den maximalen Frequenzhub für unterschiedliche Bitmuster der Nutzlast. The assignment of command to frequency deviation and bit pattern is as follows:

Frequency deviation	$\Delta f1_{max}$	$\Delta f2_{max}$
Bit pattern	"11110000"	"10101010"
Minimum value	CALC:BTO:MCH:DF1:MAX? MIN	CALC:BTO:MCH:DF2:MAX? MIN
Maximum value	CALC:BTO:MCH:DF1:MAX? MAX	CALC:BTO:MCH:DF2:MAX? MAX
Average value	CALC:BTO:MCH:DF1:MAX? AVER	CALC:BTO:MCH:DF2:MAX? AVER

The command INIT:IMM starts a new measurement and erases the previous results. Further measurements can be performed using the command INIT:CONM, which allows calculation of minimum and maximum values over several measurements. Minimum, maximum and average value will be equal if only one measurement was executed.
With a sweep count value of ≥ 1 (*CONF:BTO:SWE:COUN*) and trace mode clear/write (*DISP:WIND:TRAC:MODE WRIT*) several measurements will be performed with one single command (*INIT:IMM* oder *INIT:CONM*). In this case all the measurements will be taken into account for calculation of the minimum / maximum / average value.

Note: *The commands are only available with active Modulation Characteristics measurement (command CONF:BTO:MEAS MCH). With all other measurements this command will lead to a query error.*

Example:
```
"INST:SEL BTO"                'activate the Bluetooth option
"INIT:CONT OFF"              'select single sweep operation
"CONF:BTO:CHAN 10"          'select channel 10
"CONF:BTO:GEOG EUR"         'select geographical region Europe
"CONF:BTO:PCL 1"            'select power class 1
"CONF:BTO:BTO:PRAT 4"       'select 4 points per symbol
"CONF:BTO:PTYP DH1"         'select 1 slot packet
"DDEM:SEAR:PULS ON"         'activate the FIND BURST function
"DDEM:SEAR:SYNC ON"         'activate the FIND SYNC function
"DDEM:SEAR:SYNC:OFFS 0s"    'set the sync offset = 0
"DDEM:SEAR:SYNC:LAP 0"      'set the lower address part = 0
"DDEM:SEAR:TIME:AUTO ON"    'select automatic search length
"CONF:BTO:MEAS MCH"         'activate the Modulation Characteristics
                            'measurement
"CONF:BTO:SWE:COUN 20"      'init the sweep counter with 20
'... EUT emits bit pattern 1111000
"INIT:IMM;*WAI"             'start the measurement with
                            synchronisation and erase previous
                            'measurement results
"CALC:BTO:MCH:DF1:MAX? MIN"    'query minimum value "11110000"
"CALC:BTO:MCH:DF1:MAX? MAX"    'query maximum value "11110000"
"CALC:BTO:MCH:DF1:MAX? AVER"   'query average value "11110000"
'... EUT emits bit pattern 10101010
"INIT:CONM;*WAI"            'start additional measurement with
                           'synchronisation
"CALC:BTO:MCH:DF2:MAX? MIN"    query minimum value "10101010"
"CALC:BTO:MCH:DF2:MAX? MAX"    query maximum value "10101010"
"CALC:BTO:MCH:DF2:MAX? AVER"   query average value "10101010"
```

Characteristics:	*RST value:	-
	SCPI:	device specific
Mode:	BT	

CALCulate:BTOoth:MCHar:RATio? MINimum | MAXimum | AVERage

This command determines the ratio of the average frequency deviations for varying bit patterns of the payload. The assignment of command to frequency deviation and bit pattern is as follows:

Frequency deviation $\Delta f2_{avg}/\Delta f1_{avg}$
Minimum value   CALC:BTO:MCH:RAT? MIN
Maximum value   CALC:BTO:MCH:RAT? MAX
Average value   CALC:BTO:MCH:RAT? AVER

The command INIT:IMM starts a new measurement and erases the previous results. Further measurements can be performed using the command INIT:CONM, which allows calculation of minimum and maximum values over several measurements. Minimum, maximum and average value will be equal if only one measurement was executed.
With a sweep count value of ≥ 1 (*CONF:BTO:SWE:COUN*) and trace mode clear/write (*DISP:WIND:TRAC:MODE WRIT*) several measurements will be performed with one single command (*INIT:IMM* oder *INIT:CONM*). In this case all the measurements will be taken into account for calculation of the minimum / maximum / average value.

Note: *The commands are only available with active Modulation Characteristics measurement (command CONF:BTO:MEAS MCH). With all other measurements this command will lead to a query error.*

Example:	`"INST:SEL BTO"`	'activate the Bluetooth option
	`"INIT:CONT OFF"`	'select single sweep operation
	`"CONF:BTO:CHAN 10"`	'select channel 10
	`"CONF:BTO:GEOG EUR"`	'select geographical region Europe
	`"CONF:BTO:PCL 1"`	'select power class 1
	`"CONF:BTO:BTO:PRAT 4"`	'select 4 points per symbol
	`"CONF:BTO:PTYP DH1"`	'select 1 slot packet
	`"DDEM:SEAR:PULS ON"`	'activate the FIND BURST function
	`"DDEM:SEAR:SYNC ON"`	'activate the FIND SYNC function
	`"DDEM:SEAR:SYNC:OFFS 0s"`	'set the sync offset = 0
	`"DDEM:SEAR:SYNC:LAP 0"`	'set the lower address part = 0
	`"DDEM:SEAR:TIME:AUTO ON"`	'select automatic search length
	`"CONF:BTO:MEAS MCH"`	'activate the Modulation Characteristics 'measurement
	`"CONF:BTO:SWE:COUN 20"`	'init the sweep counter with 20
	'... EUT emits bit pattern 1111000	
	`"INIT:IMM;*WAI"`	'start the measurement with synchronisation and erase previous 'measurement results
	'... EUT emits bit pattern 10101010	
	`"INIT:CONM;*WAI"`	'start additional measurement with 'synchronisation
	`"CALC:BTO:MCH:RAT? MIN"`	'query the minimum value
	`"CALC:BTO:MCH:RAT? MAX"`	'query the maximum value
	`"CALC:BTO:MCH:RAT? AVER"`	'query the average value

Characteristics:	*RST value:	-
	SCPI:	device specific
Mode:	BT	

CALCulate:BTOoth:ICFTolerance? MINimum | MAXimum | AVERage

This command determines the Initial Carrier Frequency Tolerance.

With a sweep count value of ≥ 1 (*CONF:BTO:SWE:COUN*) and trace mode clear/write (*DISP:WIND:TRAC:MODE WRIT*) several measurements will be performed with one single command (*INIT:IMM* oder *INIT:CONM*). In this case all the measurements will be taken into account for calculation of the minimum / maximum / average value.
Minimum, maximum and average value will be equal if only one measurement was executed.

Note: *The commands are only available with active Modulation Characteristics measurement (command CONF:BTO:MEAS MCH). With all other measurements this command will lead to a query error.*

Example: `"INST:SEL BTO"`   'activate the Bluetooth option
                  `"INIT:CONT OFF"`   'select single sweep operation
                  `"CONF:BTO:CHAN 10"`   'select channel 10
                  `"CONF:BTO:GEOG EUR"`   'select geographical region Europe
                  `"CONF:BTO:PCL 1"`   'select power class 1
                  `"CONF:BTO:BTO:PRAT 4"`   'select 4 points per symbol
                  `"CONF:BTO:PTYP DH1"`   'select 1 slot packet
                  `"DDEM:SEAR:PULS ON"`   'activate the FIND BURST function
                  `"DDEM:SEAR:SYNC ON"`   'activate the FIND SYNC function
                  `"DDEM:SEAR:SYNC:OFFS 0s"`   'set the sync offset = 0
                  `"DDEM:SEAR:SYNC:LAP 0"`   'set the lower address part = 0
                  `"DDEM:SEAR:TIME:AUTO ON"`   'select automatic search length
                  `"CONF:BTO:MEAS ICFT"`   'activate the ICFT Measurement
                  `"CONF:BTO:SWE:COUN 20"`   'init the sweep counter with 20
                  `"INIT;*WAI"`   'start the measurement with synchronisation
                  `"CALC:BTO:ICFT? MIN"`   'query the minimum value
                  `"CALC:BTO:ICFT? MAX"`   'query the maximum value
                  `"CALC:BTO:ICFT? AVER"`   'query the average value

Characteristics: *RST value: -
                      SCPI: device specific

Mode: BT

CALCulate:BTOoth:CFDRift[:MAXimum]?

This command determines the maximum Carrier Frequency Drift.

Note: *This command is only available with active Carrier Frequency Drift measurement (command CONF:BTO:MEAS CFDR). With all other measurements this command will lead to a query error.*

Example: `"INST:SEL BTO"`   'activate the Bluetooth option
                  `"INIT:CONT OFF"`   'select single sweep operation
                  `"CONF:BTO:CHAN 10"`   'select channel 10
                  `"CONF:BTO:GEOG EUR"`   'select geographical region Europe
                  `"CONF:BTO:PCL 1"`   'select power class 1
                  `"CONF:BTO:BTO:PRAT 4"`   'select 4 points per symbol
                  `"CONF:BTO:PTYP DH1"`   'select 1 slot packet
                  `"DDEM:SEAR:PULS ON"`   'activate the FIND BURST function
                  `"DDEM:SEAR:SYNC ON"`   'activate the FIND SYNC function
                  `"DDEM:SEAR:SYNC:OFFS 0s"`   'set the sync offset = 0
                  `"DDEM:SEAR:SYNC:LAP 0"`   'set the lower address part = 0
                  `"DDEM:SEAR:TIME:AUTO ON"`   'select automatic search length
                  `"CONF:BTO:MEAS CFDR"`   'activate the CFDR measurement

	`"INIT;*WAI"`	'start the measurement with synchronisation
	`"CALC:BTO:CFDR?"`	'query the result

Characteristics: *RST value: -
                        SCPI: device specific

Mode: BT

CALCulate:BTOoth:CFDRift:RATE?

This command determines the maximum Carrier Frequency Drift per 50 µs.

Note: *This command is only available with active Carrier Frequency Drift measurement
           (command CONF:BTO:MEAS CFDR). With all other measurements this command will
           lead to a query error.*

Example: `"INST:SEL BTO"`   'activate the Bluetooth option
                `"INIT:CONT OFF"`   'select single sweep operation
                `"CONF:BTO:CHAN 10"`   'select channel 10
                `"CONF:BTO:GEOG EUR"`   'select geographical region Europe
                `"CONF:BTO:PCL 1"`   'select power class 1
                `"CONF:BTO:BTO:PRAT 4"`   'select 4 points per symbol
                `"CONF:BTO:PTYP DH1"`   'select 1 slot packet
                `"DDEM:SEAR:PULS ON"`   'activate the FIND BURST function
                `"DDEM:SEAR:SYNC ON"`   'activate the FIND SYNC function
                `"DDEM:SEAR:SYNC:OFFS 0s"` 'set the sync offset = 0
                `"DDEM:SEAR:SYNC:LAP 0"`   'set the lower address part = 0
                `"DDEM:SEAR:TIME:AUTO ON"` 'select automatic search length
                `"CONF:BTO:MEAS CFDR"`   'activate the CFDR measurement
                `"INIT;*WAI"`   'start the measurement with synchronisation
                `"CALC:BTO:CFDR:RATE?"`   'query the result

Characteristics: *RST value: -
                        SCPI: device specific

Mode: BT

CALCulate:BTOoth:PLENgth?

This command reads the length of the packet analyzed by the preceeding measurement.

Note: *This command ist nur only available, if a measurement was started via INIT:IMMediate
           before and if this measurement is completed. With a missing or incomplete
           measurement the command will cause a query error.*

           *This command is only available with measurement of Output Power
           ((CONF:BTO:MEAS OPOW), Power Control (CONF:BTO:MEAS PCON), Modulation
           Characteristics (CONF:BTO:MEAS MCH), Initial Carrier Frequency Tolerance
           (CONF:BTO:MEAS ICFT) and Carrier Frequency Drift (CONF:BTO:MEAS CFDR).*

Example: `"INST:SEL BTO"`   'activate the Bluetooth option
                `"INIT:CONT OFF"`   'select single sweep operation
                `"CONF:BTO:MEAS OPOW"`   'activate the Output Power Measurement
                `"INIT;*WAI"`   'start the measurement with synchronisation
                `"CALC:BTO:PLEN?"`   'query the packet length

Characteristics: *RST value: -
                        SCPI: device specific

Mode: BT

CALCulate:BTOoth:PTYPe?

This command determines the type of the packet analyzed by a preceeding measurement.

Note: *This command ist nur only available, if a measurement was started via INIT:IMMediate before and if this measurement is completed. With a missing or incomplete measurement the command will cause a query error.*

               This command is only available with measurement of Output Power ((CONF:BTO:MEAS OPOW), Power Control (CONF:BTO:MEAS PCON), Modulation Characteristics (CONF:BTO:MEAS MCH), Initial Carrier Frequency Tolerance (CONF:BTO:MEAS ICFT) and Carrier Frequency Drift (CONF:BTO:MEAS CFDR).

Response: Folgende Pakettypen werden erkannt und als Character Data zurückgegeben: AUX1, DH1, DH3, DH5, DM1, DM3, DM5, FHS, HV1, HV2, HV3, DV, NULL, POLL, UNDEF

Example: `"INST:SEL BTO"`   'activate the Bluetooth option
                      `"INIT:CONT OFF"`   'select single sweep operation
                      `"CONF:BTO:MEAS OPOW"`   'activate the Output Power Measurement
                      `"INIT;*WAI"`   'start the measurement with synchronisation
                      `"CALC:BTO:PTYP?"`   'query the packet type

Characteristics: *RST value: -
                      SCPI: device specific

Mode: BT

CALCulate:BTOoth:STATus?

This command queries the status of a preceeding measurement.

Results:
               0:      PASS
               1:      FAIL.

Note: *This command ist nur only available, if a measurement was started via INIT:IMMediate before and if this measurement is completed. With a missing or incomplete measurement the command will cause a query error.*

Example: `"INST:SEL BTO"`   'activate the Bluetooth option
                      `"INIT:CONT OFF"`   'select single sweep operation
                      `"CONF:BTO:MEAS OBW"`   'OBW Measurement aktivieren
                      `"INIT;*WAI"`   'start the measurement with synchronisation
                      `"CALC:BTO:STAT?"`   'query the status

Characteristics: *RST value: -
                      SCPI: device specific

Mode: BT

CALCulate:DELTamarker - Subsystem

The CALCulate:DELTamarker subsystem controls the delta-marker functions in the instrument. The measurement windows are selected via CALCulate1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT

CALCulate<1|2>
  :DELTamarker<1...4>
    :Y?
	
	--
		
		--
			
			query only

CALCulate<1|2>:DELTamarker<1...4>:Y?

This command queries the measured value of the selected delta marker in the indicated measurement window. The corresponding delta marker will be activated, if necessary. The output is always a relative value referred to marker 1 or to the reference position (reference fixed active).

To obtain a valid query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the delta marker and the query of the y-value. This is only possible in single sweep mode.

Depending on the unit defined with CALC:UNIT or on the activated measuring functions, the query result is output in the units below:

- DBM | DBPW | DBUV | DBMV | DBUA: Output unit DB
- WATT | VOLT | AMPere: Output unit W | V | A
- Statistics function (APD or CCDF) on: Dimensionless output
  Result Displays:
- FM (FS-K7):   Hz
- RF POWER (FS-K7):   dB
- SPECTRUM (FS-K7):   dB
- OUTPUT POWER (FS-K8):   dB
- TX SPECTRUM ACP (FS-K8):   dB
- MODULATION CHARACTERISTICS (FS-K8):   Hz
- INITIAL CARR FREQ TOL (FS-K8):   Hz
- CARRIER FREQ DRIFT (FS-K8):   Hz

Example:
    "INIT:CONT OFF"   'Switches to single-sweep mode.
    "CALC:DELT2 ON"   'Switches on delta marker 2 in screen A.
    "INIT;*WAI"   'Starts a sweep and waits for its end.
    "CALC:DELT2:Y?"   'Outputs measurement value of delta marker 2 in
        'screen A.

Characteristics: *RST value: -
                SCPI: device-specific

Mode: A, GSM/EDGE, FM, BT

CALCulate:MARKer - Subsystem

The CALCulate:MARKer subsystem checks the marker functions in the instrument. The measurement windows are assigned to CALCulate 1 (screen A) or 2 (screen B).

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2>			
:MARKer<1...4>			
:Y?	--	--	query only
:PEXCursion	<numeric_value>	DB | HZ	

CALCulate<1|2>:MARKer<1...4>:Y?

This command queries the measured value of the selected marker in the selected measurement window. The corresponding marker is activated before or switched to marker mode, if necessary.

To obtain a valid query result, a complete sweep with synchronization to the sweep end must be performed between the activation of the marker and the query of the y value. This is only possible in single sweep mode.

The query result is output in the unit determined with `CALCulate:UNIT`.

In the default setting, the output is made depending on the unit determined with `CALC:UNIT`; only with linear level scaling is the output in %.

If the FM Demodulator (R&S FS-K7) is activated, the query result is output in the following units:
- Result display FM: Hz
- Result display RF POWER LOG: dBm
- Result display RF POWER LIN: %
- Result display SPECTRUM LOG: dBm
- Result display SPECTRUM LIN: %

If the BLUETOOTH Demodulator (R&S FS-K8) is activated, the query result is output in the following units:
- OUTPUT POWER (FS-K8):   dBm
- TX SPECTRUM ACP (FS-K8):   dBm
- MODULATION CHARACTERISTICS (FS-K8):   Hz
- INITIAL CARR FREQ TOL (FS-K8):   Hz
- CARRIER FREQ DRIFT (FS-K8):   Hz

Example: `"INIT:CONT OFF"`   'Switches to single-sweep mode.
                   `"CALC:MARK2 ON"`   'Switches marker 2 in screen A.
                   `"INIT;*WAI"`   'Starts a sweep and waits for the end.
                   `"CALC:MARK2:Y?"`   'Outputs the measured value of marker 2 in screen A.

Characteristics: *RST value: -
                      SCPI: device specific

Mode: A, GSM/EDGE, FM, BT

CALCulate<1|2>:MARKer<1...4>:PEXCursion <numeric_value>

This command defines the peak excursion., ie the spacing below a trace maximum which must be attained before a new maximum is recognized, or the spacing above a trace minimum which must be attained before a new minimum is recognized. The set value is valid for all markers and delta markers. The unit depends on the selected operating mode.

| **Example:** | `"CALC:MARK:PEXC 10dB"` | 'Defines peak excursion 10 dB in 'SPECTRUM mode |
| | `"CALC:MARK:PEXC 100 HZ"` | Defines peak excursion 100 Hz in 'FM DEMOD + BLUETOOTH mode |

Characteristics: *RST value: 6dB
                       SCPI: device specific

The numeric suffix in MARKer<1 to 4> is irrelevant.

Mode: A, GSM/EDGE, FM, BT

CONFigure – Subsystem

CONFigure:BTOoth – Subsystem

The following commands are used for configuration of the BLUETOOTH analyzer operating mode (option R&S FS-K8).

COMMAND	PARAMETERS	UNIT	COMMENT
CONFigure			
:BTOoth			Option FS-K8
:CHANnel	\<numeric_value>	--	
:GEOGraphy	EURope | USA | FRANce		
:PCLass	\<numeric_value>	--	
:POWer	\<numeric_value>	--	
:AVERage			
:STARt	\<numeric_value>	PCT	
:STOP	\<numeric_value>	PCT	
:PRATe	\<numeric_value>	--	
:PTYPe	DH1 | DH3 | DH5 | AUTO		
:ACLR			
:ACPairs	\<numeric_value>		
:MEASurement	OPOWer | ACLR | MCHar | ICFTolerance | CFDRift		
:BANDwidth			
[:RESolution]	\<numeric_value>	HZ	
:AUTO	\<Boolean>		
:VIDeo	\<numeric_value>	HZ	
:AUTO	\<Boolean>		
:BWIDth			
[:RESolution]	\<numeric_value>	HZ	
:AUTO	\<Boolean>		
:VIDeo	\<numeric_value>	HZ	
:AUTO	\<Boolean>		
:DETector\<1...3>			
[:FUNCtion]	APEak | NEGative | POSitive | SAMPle | RMS | AVERage		
:SWEep			
:COUNt	\<numeric_value>	--	
:TIME	\<numeric_value>	S	
:AUTO	\<Boolean>		
:TRACe\<1...3>			
:MODE	WRITe|VIEW|AVERage| MAXHold|MINHold|BLANk		
:SELect	--		

CONFigure:BTOoth:CHANnel 0...78

This command selects the frequency channel for the measurements according to the Bluetooth standard.

Note: *The value range depends on the selected geographical regiaon ([SENSe:]BTOoth:GEOGraphy):*
EURope, USA: 0...78
FRANce: 0...22

Example: `"CONF:BTO:CHAN 20"`   'select channel 20

Characteristics: *RST value: 0
                       SCPI: device specific

Mode: BT

CONFigure:BTOoth:GEOGraphy EURope | USA | FRANce

This command selects the geographical region for the measurements:

          EURope: Europe outside France
          USA: USA
          FRANce: France

The region determines the number of available frequency channels (command: [SENSe:]BTOoth:CHANnel). Additionally the standard for the measurement of spurious emissions will be selected: ETS 300 328 (Europe incl. Frankreich) or FCC Part 15.247,c (USA).

Example: `"CONF:BTO:GEOG USA"`   'selects region "USA"

Characteristics: *RST value: EURope
                       SCPI: device specific

Mode: BT

CONFigure:BTOoth:PCLass 1...3

This command selects the power class for the Output Power measurement. The power class defines the limits for the Output Poer measurement.

Example: `"CONF:BTO:PCL 3"`   'selects power class 3

Characteristics: *RST value: 1
                       SCPI: device specific

Mode: BT

CONFigure:BTOoth:POWer:AVERage:STARt 0...100PCT

This command defines the start position for the calculation of the average power of a burst.

Note: *Depending on the setting FIND SYNC ON or OFF (command SENS:DDEM:SEAR:*
          SYNC:STAT ON/ OFF) the burst is either defined by the p0 bit and the packet length or
          the 3 dB points according to the RF Test Specification. As a result there are different
          areas within the burst for calculating the average power:
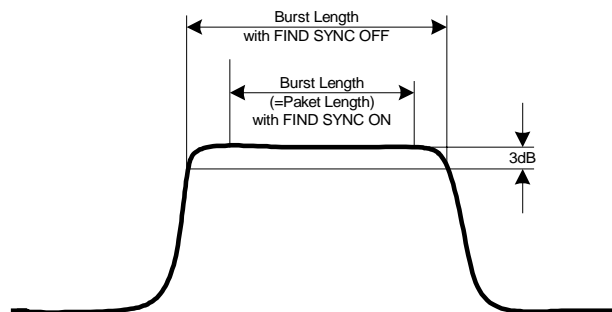
Example: `"CONF:BTO:POW:AVER:STAR 10PCT"`   'sets the starting point for the
                                                          'calculation to 10% of the
                                                          'burst length

Characteristics: *RST value: 20%
                      SCPI: device specific

Mode: BT

CONFigure:BTOoth:POWer:AVERage:STOP 0...100PCT

This command defines the end position for the calculation of the average power of a burst.

Note: *Depending on the setting FIND SYNC ON or OFF (command SENS:DDEM:SEAR:*
          SYNC:STAT ON/ OFF) the burst is either defined by the p0 bit and the packet length or
          the 3 dB points according to the RF Test Specification. As a result there are different
          areas within the burst for calculating the average power (see command
          SENS:BTO:POW:AVER:STARt).

Example: `"CONF:BTO:POW:AVER:STAR 90PCT"`   'sets the end point for the
                                                          'calculation to 90% of the
                                                          'burst length

Characteristics: *RST value: 80%
                      SCPI: device specific

Mode: BT

CONFigure:BTOoth:PRATe 2 | 4 | 8 | 16 | 32

This command selects the number of measurement samples (points) per symbol for the measurement.

Note: *The RF Test Specification specifies an oversampling factor of at least 4.*

Example: `"CONF:BTO:PRAT 16"`   'selects 16 points/symbol

Characteristics: *RST value: 4
                      SCPI: device specific

Mode: BT

CONFigure:BTOoth:PTYPe DH1 | DH3 | DH5 | AUTO

This command selects the packet type to be measured:

DH1:	1 slot packet
DH3:	3 slot packet
DH5:	5 slot packet
AUTO:	automatic detection of the packet type

Example: `"CONF:BTO:PTYP DH5"`   'selects type "5 slot packet"

Characteristics: *RST value: DH1
                       SCPI: device specific

Mode: BT

CONFigure:BTOoth:ACLR:ACPairs <numeric value>

This command selects the number of adjacent channel pairs during the measurement of the adjacent channel power. The number of adjacent channels will be limited as soon as the border of the Bluetooth frequency band is reached.

Notes: *This command is only available with active Adjacent Channel Power Measurement (command: CONF:BTO:MEAS ACLR).*

Example: `"CONF:BTO:ACLR:ACP 10"`   'selects 10 adjacent channel pairs

Characteristics: *RST value: 78
                       SCPI: device specific

Mode: BT

CONFigure:BTOoth:MEASurement OPOWer | ACLR | MCHar | ICFTolerance | CFDRift

This command selects the current measurement according to the Bluetooth standard.

Parameter:	OPOWer	Measurement der Ausgangsleistung
	ACLR	Measurement der Nachbarkanalleistung
	MCHar	Measurement der Modulationseigenschaften
	ICFTolerance	Measurement der 'Initial Carrier Frequency Tolerance'
	CFDRift	Measurement der Frequenzdrift

Example: `"CONF:BTO:MEAS ACLR"`   'selects the measurement of the adjacent
                                                   'channel power.

Characteristics: *RST value: OPOWer
                       SCPI: device specific

Mode: BT

CONFigure:BTOoth:BANDwidth|BWIDth[:RESolution] <numeric_value>

This command sets the resolution bandwidth of the analyzer for the currently selected Bluetooth measurement (see command *[SENSe:]BAND:RES*).

For the measurements of Modulation Characteristics (*CONF:BTO:MEAS MCH*), Initial Carrier Frequency Tolerance (*CONF:BTO:MEAS ICFT*) and Carrier Frequency Drift (*CONF:BTO:MEAS CFDR*) the resolution bandiwdth corresponds to the IF bandwidth of the signal.

Einstellbereich:	300kHz..10MHz	Output Power; Power Control, Modulation Characteristics, Initial Carrier Frequency Tolerance, Carrier Frequency Drift
	100kHz	TX Output Spectrum Adjacent Channel Power

A change to the resolution bandwidth will stop its link to the settings of the RF Test Specification.

Note: *The settings for the measurements of Modulation Characteristics (*CONF:BTO:MEAS MCH*), Initial Carrier Frequency Tolerance (*CONF:BTO:MEAS ICFT*) and Carrier Frequency Drift (*CONF:BTO:MEAS CFDR*) is common to all three measurements. For all other Bluetooth measurements the setting is only valid for the currently active measurement (see command* CONF:BTO:MEAS*).*
This command is not available with active adjacent channel power measurement (command: CONF:BTO:MEAS ACLR).

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the TX Output Spectrum '20dB Bandwidth measurement
	`"CONF:BTO:BAND 1KHZ"`	'sets the resolution bandwidth to 1kHz

Characteristics:	*RST value:	- (AUTO is set to ON)
	SCPI:	device specific
Mode:	BT	

CONFigure:BTOoth:BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF

This command links the resolution bandwidth to the settings according to the RF Test Specification.

Note: *The settings for the measurements of Modulation Characteristics (*CONF:BTO:MEAS MCH*), Initial Carrier Frequency Tolerance (*CONF:BTO:MEAS ICFT*) and Carrier Frequency Drift (*CONF:BTO:MEAS CFDR*) is common to all three measurements. For all other Bluetooth measurements the setting is only valid for the currently active measurement (see command* CONF:BTO:MEAS*).*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the measurement of the 'TX Output Spectrum 20dB Bandwidth
	`"CONF:BTO:BAND:AUTO ON"`	'activates the RBW coupling

Characteristics:	*RST value:	ON
	SCPI:	device specific
Mode:	BT	

CONFigure:BTOoth:BANDwidth|BWIDth:VIDeo 1 Hz ... 10 MHz

This command sets the video bandwidth for the currently selected Bluetooth measurement. It is only available for the measurements of Power Density *(CONF:BTO:MEAS PDEN)*, TX Output Spectrum Frequency Range *(CONF:BTO:MEAS FRAN)*, TX Output Spectrum 20 dB Bandwidth *(CONF:BTO:MEAS OBW)* and TX Output Spectrum Adjacent Channel Power *(CONF:BTO:MEAS ACLR)*.

The available filters have a bandwidth range of 1 Hz to 10 MHz. On a change in video bandwidth its link according to the RF Test Specification is switched off.

Note: *This setting is valid only for the currently active measurement (see command* CONF:BTO:MEAS*) and it is independent of other Bluetooth measurements.*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the TX Output
		'Spectrum 20dB Bandwidth
		'measurement
	`"CONF:BTO:BAND:VID 100HZ"`	'sets the video bandwidth to 100 Hz

Characteristics:	*RST value:	- (AUTO is set to ON)
	SCPI:	device specific
Mode:	BT	

CONFigure:BTOoth:BANDwidth|BWIDth:VIDeo:AUTO ON | OFF

This command links the video bandwidth to the settings according to the RF Test Specification. It is only available for the measurements of Power Density *(CONF:BTO:MEAS PDEN)*, TX Output Spectrum Frequency Range *(CONF:BTO:MEAS FRAN)*, TX Output Spectrum 20 dB Bandwidth *(CONF:BTO:MEAS OBW)* and TX Output Spectrum Adjacent Channel Power *(CONF:BTO:MEAS ACLR)*.

Note: *This setting is only valid for the currently active measurement (see command* CONF:BTO:MEAS*) and it is independent fo the other Bluetooth measurements.*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the TX Output
		'Spectrum 20dB Bandwidth
		'measurement
	`"CONF:BTO:BAND:VID:AUTO ON"`	'switches the VBW coupling on

Characteristics:	*RST value:	ON
	SCPI:	device specific
Mode:	BT	

CONFigure:BTOoth:DETector<1...3>   APEak | NEGative | POSitive | SAMPle | RMS | AVERage

This command selects the detector for the currently selected Bluetooth measurement. The numeric suffix assigns the detector to a trace (1 to 3).

Note: *The RMS detector is not available for the measurements Modulation Characteristics (*CONF:BTO:MEAS MCH*), Initial Carrier Frequency Tolerance (*CONF:BTO:MEAS ICFT*) and Carrier Frequency Drift (*CONF:BTO:MEAS CFDR*).*

The setting is valid for the currently selected measurement (see command CONF:BTO:MEAS*) and independent of other Bluetooth measurements.*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the TX Output
		'Spectrum 20dB Bandwidth
		'measurement
	`"CONF:BTO:DET2 RMS"`	'sets the detector for trace 2 to RMS

Characteristics:	*RST value:	PEAK	Output Power; Power Density, Power Control,
			TX Output Spectrum Frequency Range,
			TX Output Spectrum 20 dB Bandwidth,
		AVER	TX Output Spectrum Adjacent Channel Power,
		APEAK	Modulation Characteristics,
			Initial Carrier Frequency Tolerance,
			Carrier Frequency Drift
	SCPI:		device specific

Mode: BT

CONFigure:BTOoth:SWEep:COUNt 0...32767

This command defines the number of sweeps for the currently selected Bluetooth measurement. This number will be started as a "single sweep". With trace mode setting clear/write (CONF:BTO:TRAC:MODE WRIT) the measurement results will be calculated for each sweep and taken into account for the calculation of minimum, maximum and average values. For the remaining trace settings (AVER, MAXH, MINH) the measurement results will be calculated from the resulting trace. In average mode the value 0 defines the sliding average of the measurement data over 10 sweeps. werden die Meßergebnisse aus dem resultierenden Trace berechnet.

Note: *The setting is valid only for the currently active measurement (see command* CONF:BTO:MEAS*) and independent of the other Bluetooth measurements.*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the measurement of TX Output
		'Spectrum 20dB Bandwidth
	`"INIT:CONT OFF"`	'selects single sweep operation
	`"CONF:BTO:SWE:COUN 20"`	'sets the number of sweeps to 20
	`"INIT;*OPC"`	'start a sweep with synchronisation

Characteristics:	*RST value:	0	Output Power; Power Density, Power Control,
		50	TX Output Spectrum Frequency Range,
		10	TX Output Spectrum 20 dB Bandwidth,
			TX Output Spectrum Adjacent Channel Power,
			Modulation Characteristics,
			Initial Carrier Frequency Tolerance,
			Carrier Frequency Drift

Mode: BT

CONFigure:BTOoth:SWEep:TIME <numeric_value>

This command defies the duration of a sweep sequence for the active Bluetooth measurement.

Value range:	(1us to 130560us) / (points per symbol)	
		Output Power; Power Control, Modulation Characteristics, Initial Carrier Frequency Tolerance, Carrier Frequency Drift
	2,5ms...16000s	TX Output Spectrum Frequency Range, TX Output Spectrum 20 dB Bandwidth
	1µs... 16000s	Power Density
	10µs... 16000s	TX Output Spectrum Adjacent Channel Power

With direct programming using command `SWEep:TIME` will stop its link to the settings according to the RF Test Specification.

Note: *This setting is valid for the currently active measurement (see command* CONF:BTO:MEAS*) and is independent of other Bluetooth measurements.*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the TX Output Spectrum '20dB Bandwidth measurement
	`"CONF:BTO:SWE:TIME 10MS"`	'sets a sweeptime of 10 ms

Characteristics:	*RST value:	- (AUTO is set to ON)
	SCPI:	device specific

Mode:	BT

CONFigure:BTOoth:SWEep:TIME]:AUTO ON | OFF

This command links the sweep time to the settings according to the RF Test Specification.

Note: *This setting is valid for the currently active measurement (see command* CONF:BTO:MEAS*) and is independent of other Bluetooth measurements.*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the TX Output Spectrum '20dB Bandwidth measurement
	`"CONF:BTO:SWE:TIME:AUTO ON"`	'switches the sweeptime coupling on

Characteristics:	*RST value:	ON
	SCPI:	device specific

Mode:	BT

CONFigure:BTOoth:TRACe<1...3>:MODE WRITe | VIEW | AVERage | MAXHold | MINHold | BLANk

This command defines the way of displaying and evaluating the measurement curves for the selected Bluetooth measurement. WRITe corresponds to manual operating mode Clr/Write.

The numeric suffix selects the trace related to this setting.

The number of measurement to be executed for AVERage, MAXHold und MINHold is defined with command `CONF:BTO:SWEep:COUNt`. Please note that a synchronisation to the end of the indicated number of measurements is only possible during single sweep operation.

Note: *This setting is valid for the currently active measurement (see command* CONF:BTO:MEAS*) and is independent of other Bluetooth measurements.*

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the measurement of TX Output
		'Spectrum 20dB Bandwidth
	`"INIT:CONT OFF"`	'selects single sweep operation
	`"CONF:BTO:SWE:COUN 10"`	'sets the sweep count to 10
	`"CONF:BTO:TRAC2:MODE AVER"`	'switches averaging for trace 2 on
	`"INIT;*OPC"`	'starts a measurement with synchronisation

Characteristics:	*RST value:	WRITe
	SCPI:	device specific
Mode:	BT	

CONFigure:BTOoth:TRACe<1...3>:SELect

This command selects the measurement curve for evaluation of the modulation characteristics.

Example:	`"INST:SEL BTO"`	'activates the Bluetooth option
	`"CONF:BTO:MEAS OBW"`	'activates the measurement of TX Output
		'Spectrum 20dB Bandwidth
	`"INIT:CONT OFF"`	'selects single sweep operation
	`"CONF:BTO:TRAC2:SEL"`	'selects trace 2 for measurement result
		'queries

Characteristics:	*RST value:	--
	SCPI:	device specific
Mode:	BT	

DISPlay - Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of measurement data on the display.
The measurement windows are selected by WINDow1 (screen A) or WINDow2 (screen B) .

COMMAND	PARAMETERS	UNIT	COMMENT
DISPlay			
[:WINDow<1|2>]			
:TRACe<1...3>			
:Y			
[:SCALe]			
:RVALue	<numeric_value>	DB | HZ	
:RPOSition	<numeric_value>	PCT	
:PDIVision	<numeric_value>	DB | HZ	Option FM-Demodulator

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RVALue <numeric_value>

This command ist available with

- option Tracking Generator / Ext. Generator Control (R&S FSP-B9/B10) and function *NORMALIZE* switched on

- option FM demodulator (R&S FS-K7) and result display FM switched on

- option Bluetooth analyzer (R&S FS-K8) and measurement Modulation Characteristics, Initial Carrier Frequency Drift or Carrier Frequency Tolerance switched on.

It defines the result value assigned to the reference position on the graticule. In manual operation this corresponds to function REFERENCE VALUE.

The numeric suffix with TRACe<1...3> is irrelevant.

Example:	`"DISP:WIND1:TRAC:Y:RVAL 0"`	sets the result value at the reference position to 0 dB (option Tracking Generator/Ext. Generator Control) or to 0 Hz (options FM demodulator and Bluetooth)

Characteristics:	*RST value:	0 dB (operating mode NETWORK)
		0 Hz (operating mode FM-Demodulator and Bluetooth)
	SCPI:	device specific

Mode: A, GSM/EDGE, FM, BT

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RPOSition 0...100PCT

This command defines the position of the reference value in the selected measurement window. The numeric suffix with TRACe<1...3> is irrelevant.

With function *NORMALIZE* switched on in operating mode NETWORK (option Tracking Generator / Ext. Generator Control R&S FSP-B9/B10) the reference position marks the reference point for the normalized measurement data in the diagram.

With active FM demodulator the reference position for result displays RF POWER and SPECTRUM will be kept apart from the one for result display FM.

In operating mode BLUETOOTH the selected reference position is valid for all measurements.

Example:	`"DISP:WIND1:TRAC:Y:RPOS 50PCT"`

Characteristics:	*RST value:	100 PCT (mode SPECTRUM)
		50 PCT (mode NETWORK, FM DEMOD and BLUETOOTH)
	SCPI:	conforming
Mode:	A, GSM/EDGE, FM, BT	

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:PDIVision <numeric_value>

This command defines the scaling of the y-axis in the currently selected unit.

Das numerische Suffix bei TRACe<1...3> ist ohne Bedeutung.

Example:	`"DISP:WIND1:TRAC:Y:PDIV 10KHz"`	'sets the y-scale to '10 kHz/div.

Characteristics:	*RST value:	-
	SCPI:	conforming
Mode:	FM, BT	

This command is only available with option R&S FS-K7 (FM-Demodulator) or R&S FS-K8 (Bluetooth).

INSTrument - Subsystem

The INSTrument subsystem selects the operating mode of the unit either via text parameters or fixed numbers.

COMMAND	PARAMETERS	UNIT	COMMENT
INSTrument			
[:SELect]	SANalyzer| ADEMod | MGSM WCDPower | BWCDpower | MWCDpower | BTOoth		
:NSELect	<numeric_value>		

INSTrument[:SELect]   SANalyzer | ADEMod | MGSM | WCDPower|BWCDpower | MWCDpower | BTOoth

This command selects the operating mode by input of the corresponding name.

Parameter:

ADEMod:	mode FM-Demodulator
SANalyzer:	mode SPECTRUM
MGSM:	mode GSM/EDGE Analyzer
WCDPower:	mode 3G FDD BTS
BWCDpower	mode 3G FDD BTS (alias for WCDPower)
MWCDpower	mode 3G FDD MS
BTOoth	mode BLUETOOTH

Example:	`"INST SAN"`	'selects mode *SPECTRUM* .

Characteristics:	*RST value:	SANalyzer
	SCPI:	conforming
Mode:	alle	

Parameter ADEMod is only available with option R&S FS-K7.

Parameter MGSM is only available with option R&S FS-K5.

Parameters WCDPower and BWCDpower require option R&S FS-K72.

Parameter MWCDpower requires option R&S FS-K73.

Parameter BTOoth requires option R&S FS-K8.

INSTrument:NSELect <numeric value>

This command schaltet zwischen den Betriebsarten über Zahlen um.

Parameter:	1:	mode Spektrumanalyse
	3:	mode FM-Demodulator
	5:	Betriebsart GSM/EDGE Analyzer
	8:	mode 3G FDD BTS
	9:	mode 3G FDD UE
	12:	mode BLUETOOTH

Example: `"INST:NSEL 1"` 'selects mode *SPECTRUM*.

Characteristics: *RST value: 1
                    SCPI: conforming

Mode: all

Parameter 3 is only available with option R&S FS-K7.

Parameter 5 is only available with option R&S FS-K5.

Parameter 8 requires option R&S FS-K72.

Parameter 9 requires option R&S FS-K73.

Parameter 12 requires option R&S FS-K8.

SENSe - Subsystem

The SENSe subsystem is organized in several subsystems. The commands of these subsystems directly control device-specific settings, they do not refer to the signal characteristics of the measurement signal.
The SENSe subsystem controls the essential parameters of the analyzer. In accordance with the SCPI standard, the keyword "SENSe" is optional for this reason, which means that it is not necessary to include the SENSe node in command sequences.
The measurement windows are selected by SENSe1 and SENSe2:

SENSe1 = Modification of screen A settings
SENSe2 = Modification of screen B settings.

Screen A is automatically selected if 1 or 2 is missing.

SENSe:DDEMod - Subsystem

This subsystem controls the parameters for digital demodulators.

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:DDEMod			
:FILTer			Option FS-K8
:MEASurement	OFF	BTOoth		
:SEARch			Option FS-K8
:PULSe		S	
:OFFSet	<numeric_value>		
[:STATe]	<Boolean>		
:SYNC		--	Option FS-K8
:LAP	<hex>		
:OFFSet	<numeric_value>		
[:STATe]	<Boolean>	S	
:TIME	<numeric value>		Option FS-K8
:AUTO	<Boolean>		

[SENSe<1|2>:]DDEMod:FILTer:MEASurement OFF | BTOoth

This command selects the receive filter for the signal to measure.

Example: `"DDEM:FILT:MEAS BTOoth"` 'Bluetooth measurement filter ON

Characteristics: *RST value: OFF
SCPI: device specific

Mode: BT

SENSe<1|2>:]DDEMod:SEARch:PULSe:OFFSet <numeric_value>

This command defines the time to be recorded before a signal burst is recognized.
The valid value range is 0 to ± 10 ms.

Example: `"DDEM:SEAR:PULSe:OFFS 1MS"` 'Burst offset = 1ms before start of the burst

Characteristics: *RST value: 0
SCPI: device specific

Mode: BT

[SENSe<1|2>:]DDEMod:SEARch:PULSe[:STATe] ON | OFF

This command switches the search for a signal burst on or off.

Example: `"DDEM:SEAR:PULS OFF"`

Characteristics: *RST value: ON
SCPI: device specific

Mode: BT

[SENSe<1|2>:]DDEMod:SEARch:SYNC:OFFSet <numeric_value>

This command defines the number of bits to be recorded before the first preamble bit is detected. The valid value range is 0 to ± 10000.

Example: `"DDEM:SEAR:SYNC:OFFS 10"`   'Sync offset = 10 bits before the preamble bits

Characteristics: *RST value: 0
SCPI: device specific

Mode: BT

[SENSe<1|2>:]DDEMod:SEARch:SYNC:LAP <hex>

Mit diesem command werden die niederwertigen 24 Bit (LAP) der 'Bluetooth Device Address' des untersuchten Messobjekts festgelegt. Aus diesen 24 Bit wird das Synchronisierungsmuster zur Bestimmung des Beginns eines Pakets ermittelt. Der Wertebereich ist damit 0 ... FFFFFF Hex.

Example: `"DDEM:SEAR:SYNC:LAP #HA3F45B`   'stellt LAP A3F45B Hex ein

Characteristics: *RST value: 0
SCPI: device specific

Mode: BT

[SENSe<1|2>:]DDEMod:SEARch:SYNC[:STATe] ON | OFF

This command switches the search for a sync pattern on or off.

Example: `"DDEM:SEAR:SYNC ON"`   'switches the sync pattern search on.

Characteristics: *RST value: OFF
SCPI: device specific

Mode: BT

[SENSe<1|2>:]DDEMod:SEARch:TIME 100µs ... 130560µs/(Points per Symbol)

This command selects manual setting of the record length and defines the record length to be used for the search of sync word and burst. The input of the record length is expected in seconds.

Value range: 100us to 130560µs / (points per symbol)

Points per Symbol	maximum record length
2	104.4 slots
4	52.2 slots
8	26.1 slots
16	13.1 slots
32	6.5 slots

Note: *For measurements without trigger at least 3 times the packet length is required during loop back operation. That means that with an oversampling factor of 16 only packet types DH1 and DH3 can be detected reliably; with an oversampling factor of 32 only DH1 packets can be detected.*

Example: `"DDEM:SEAR:TIME 100US"`   'Sets the record length for sync word and burst search to 100µs.

Characteristics: *RST value: 1875µs
                       SCPI: device specific

Mode: BT

[SENSe<1|2>:]DDEMod:SEARch:TIME:AUTO ON | OFF

This command activates the automatic setting of the record length for the sync word and burst search, depending on the selected packet type.

The automatic record length is determined a follows:

Free Run Trigger:
    search length = 3 * packet length + abs(sync offset) or
    search length = 3 * packet length + abs(burst offset)

alle anderen Triggerarten:
    search length = 1 * packet length + 1 slot + abs(sync offset) or
    search length = 1 * packet length + 1 slot + abs(Burst Offset)

If the selected MEAS TIME is longer than the packet length, the difference MEAS TIME - packet length is added to the record length.

Example: `"DDEM:SEAR:TIME:AUTO OFF"` 'selects manual input for the record length

Characteristics: *RST value: ON
                       SCPI: device specific

Mode: BT

SENSe:EGAin - Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
[SENSe<1|2>]			
:EGAin			Option FS-K8
:INPut			
[:MAGnitude]	<numeric_value>	DB	

[SENSe<1|2>:]CORRection:EGAin:INPut[:MAGNitude] -200...200dB

This command makes an external gain known to the analyzer, which will take it into account during the display of measurement results. With this function the gain of an antenna or of an external preamplifier can be taken into account for the measurement values.

Example: `"CORR:EGA:INP 10DB "`   'takes 10 dB external gain into account

Characteristics: *RST value: 0dB
                       SCPI: device specific

Mode: BT

TRACe - Subsystem

The TRACe subsystem controls access to the instrument's internal trace memory.

COMMAND	PARAMETERS	UNIT	COMMENT
TRACe<1|2>			
[:DATA]	TRACE1|TRACE2|TRACE3|TRACE4, <block>|<numeric_value>...	-	

TRACe<1|2>[:DATA]   TRACE1| TRACE2| TRACE3, <block> | <numeric_value>

This command transfers trace data from the control computer to the instrument, the query reads trace data out of the instrument. The associated measurement window is selected with the numeric suffix of TRACe<1|2>.

Note:
If the FM demodulator (option FS-K7) is active, only the displayed trace data is read out and recalled. A portion of the measurement data that can be called by means of a marker, however, is calculated from the raw measurement data. These results are no longer available after recalling a trace; the associated queries generate a query error.

Example: `"TRAC TRACE1,"+A$`   (A$: data list in the current format)
                       `"TRAC? TRACE1"`

Characteristics: *RST value: -
                       SCPI: conforming

Mode: all

Return values:

The returned values are scaled in the current level unit. Returned FM-modulated measurement values (activated option R&S FS-K7 or FS-K8) are scaled in Hz.

ASCII format (FORMat ASCII):

In this case a list of values separated by commas is returned (Comma Separated Values = CSV).

The number of measurement points is 501 for the R&S FSP, 625 for the R&S FSU.

Binary format (FORMat REAL,32):

In this case the command returns binary format (REAL,32). The data are transferred in block format (Definite Length Block Data according to IEEE 488.2). They are arranged in succeeding lists of I and Q data of 32 Bit IEEE 754 floating point numbers. General structure of the return string:

R&S FSP: #42004<meas value 1><meas value value2>...<meas value 501>

R&S FSU: #42500<meas value 1><meas value value2>...<meas value 625>

with

#4	digits of the subsequent number of data bytes (4 in the example)
2004	Number of the subsequent data bytes (2004 in the example)
2500	Number of subsequent data bytes (2500 in the example))
<meas value x>	4 byte floating point measurement values

Transfer format:

The trace data are transferred in the current format (corresponding to the command FORMat ASCii|REAL). The device-internal trace memory is addressed using the trace names 'TRACE1' to 'TRACE3'.

The transfer of trace data from the control computer to the instrument takes place by indicating the trace name and then the data to be transferred. In ASCII format, these data are values separated by commas. If the transfer takes place using the format real (REAL,32), the data are transferred in block format.

The parameter of the query is the trace name TRACE1 to TRACE3, it indicates which trace memory will be read out.

Saving and recalling:

Saving and recalling trace data together with the device settings to/from the device-internal hard disk or to/from a floppy is controlled via the commands "MMEMory:STORe:STATe" and "MMEMory:LOAD:STATe" respectively. Trace data are selected with "MMEMory:SELect[:ITEM]:ALL" or "MMEMory:SELect[:ITEM]:TRACe".

Trace data in ASCII format (ASCII FILE EXPORT) are exported with the command "MMEM:STORe:TRACe".

Das Übergabeformat der Trace-Daten richtet sich nach der Geräteeinstellung:

The transfer format for the trace data depends on the instrument setting:

The transfer format for the trace data depends on the instrument setting:

SPECTRUM mode (span > 0 and zero span):

   R&S FSP: 501 results are output in the unit selected for display.

   R&S FSU: 625 results are output in the unit selected for display.

   Note: *With AUTO PEAK detector, only positive peak values can be read out.*
       Trace data can be written into the instrument with logarithmic display only in dBm, with linear display only in volts.

   FORMAT REAL,32 is to be used as format for binary transmission.

Alphabetical List of Commands

The following list contains all new commands for option BLUETOOTH analyzer, R&S FS-K8

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Assignment Softkey/Hotkey to the Remote Commands

This chapter contains the assignment of the remote commands to the softkey menus for the menus, where the Bluetooth analyzer option differs from the basic instrument. For unchanged menus the assignment is included in the operating manual of the basic instrument.

Bluetooth Main Menu

| BLUETOOTH | INST:SEL BTOoth
INST:NSEL 12 |

| EXIT | INST:SEL SAN
INST:NSEL 1 |

| SETTINGS | -- |

| FIND SYNC | -- |

| RANGE | -- |

| PAGE UP |
| PAGE DOWN | -- |

Hotkey SETTINGS

| CHANNEL | CONF:BTO:CHAN 0 |

| PACKET TYPE | CONF:BTO:PTYP DH1 | DH3 | DH5 | AUTO |

| GEOGRAPHY | CONF:BTO:GEOG EUR | USA | FRAN |

| POWER CLASS | CONF:BTO:POW:PCL 1 |

| POINTS PER SYMBOL | CONF:BTO:PRAT 2 | 4 | 8 | 16 | 32 |

| AVERAGE ⇩ | -- |

| ANTENNA GAIN | [SENS:]CORR:EGA:INP[:MAGN] 0 DB |

| SELECT TRACE | CONF:BTO:TRACe<1...3>:SELect |

Softkey *AVERAGE*

| AVERAGE START | CONF:BTO:POW:AVER:STAR <numeric_value> |

| AVERAGE STOP | CONF:BTO:POW:AVER:STOP <numeric_value> |

Hotkey *FIND SYNC*

FIND SYNC ON OFF	[SENS:]DDEM:SEAR:SYNC:STAT ON
LAP	[SENS:]DDEM:SEAR:SYNC:LAP <hex>
SYNC OFFSET	[SENS:]DDEM:SEAR:SYNC:OFFS 0
FIND BURST ON OFF	[SENS:]DDEM:SEAR:PULS:STAT ON	OFF
BURST OFFSET	[SENS:]DDEM:SEAR:PULS:OFFS 0
SEARCH LEN AUTO	[SENS:]DDEM:SEAR:TIME:AUTO ON	OFF
SEARCH LEN MANUAL	[SENS:]DDEM:SEAR:TIME 1875US

Hotkey *RANGE*

DEVIATION PER DIV	DISP:WIND:TRAC:Y:PDIV 50kHz
REFERENCE POSITION	DISP:WIND:TRAC:Y:RPOS 50PCT
REFERENCE VALUE	DISP:WIND:TRAC:Y:RVAL 0HZ
ZOOM	SENS:ADEM:ZOOM ON SENS:ADEM:ZOOM:STARt 30US

Hardkey *MEAS*

MEAS	CONF:BTO:MEAS \<measurement\> mit \<measurement\> =

              OPOW   Output Power
              ACLR   TX Output Spectrum-Adjacent Channel Power
              MCH   Modulation Characteristics
              IFCT   Initial Carrier Frequency Tolerance
              CFDR   Carrier Frequency Drift

Softkey *OUTPUT POWER*

CONTINUOUS SWEEP	INIT:CONT ON

SINGLE SWEEP	INIT:CONT OFF

MEASTIME MANUAL	CONF:BTO:SWE:TIME 625us

MEASTIME AUTO	CONF:BTO:SWE:TIME:AUTO ON

SWEEP COUNT	CONF:BTO:SWE:COUN 0

AVERAGE ⇩	--

Softkey *TX SPEC ACP*

CONTINUOUS SWEEP	INIT:CONT ON
SINGLE SWEEP	INIT:CONT OFF
SWEEPTIME MANUAL	CONF:BTO:SWE:TIME <numeric_value>
SWEEPTIME AUTO	CONF:BTO:SWE:TIME:AUTO ON
SWEEP COUNT	CONF:BTO:SWE:COUN <numeric_value>
NO. OF ACP CHAN	CONF:BTO:ACLR:ACPairs <numeric_value>

Softkey *MODULATION CHARACTERISTICS*

START TEST	INIT:IMMediate
CONTINUE TEST	INIT:CONMeas
CONTINUOUS SWEEP	INIT:CONT ON
SINGLE SWEEP	INIT:CONT OFF INIT;*WAI
MEAS TIME MANUAL	CONF:BTO:SWE:TIME <numeric_value>

MEAS TIME AUTO	CONF:BTO:SWE:TIME:AUTO ON

SWEEP COUNT	CONF:BTO:SWE:COUN <numeric_value>

Softkey _INIT CARR FREQ TOL_

CONTINUOUS SWEEP	INIT:CONT ON

SINGLE SWEEP	INIT:CONT OFF INIT;*WAI

MEASTIME MANUAL	CONF:BTO:SWE:TIME <numeric_value>

MEASTIME AUTO	CONF:BTO:SWE:TIME:AUTO ON

SWEEP COUNT	CONF:BTO:SWE:COUN <numeric_value>

Softkey _CARRIER FREQ DRIFT_

CONTINUOUS SWEEP	INIT:CONT ON

SINGLE SWEEP	INIT:CONT OFF INIT;*WAI

MEASTIME AUTO	CONF:BTO:SWE:TIME:AUTO ON

MEASTIME MANUAL	CONF:BTO:SWE:TIME <numeric_value>

| SWEEP COUNT | CONF:BTO:SWE:COUN <numeric_value> |

Hardkey *BW*

| MEAS FILTER | [SENS:]DDEM:FILT:MEAS OFF \| BTO |

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5   Contents, Figures, Index

Contents

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