R&S®FS-K7
FM Measurement Demodulator for R&S FSx
Software Manual

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Test and Measurement

Software Manual

ROHDE&SCHWARZ

The Software Manual R&S®FS-K7 describes the following Options:

- R&S®FS-K7

The following abbreviations are used throughout this manual:
R&S®FS-K7 is abbreviated as R&S FS-K7.

Table of Contents

1 Introduction

The following chapters describe the new operating functions of the FM demodulator option for Spectrum Analyzer R&S FSP. In the case of functions identical to those of the base unit, reference is made to the relevant chapter in the base unit manual.
The following chapters describe the new operating functions of the FM demodulator option for Spectrum Analyzer R&S FSP and R&S 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.
The digital signal processing in R&S FSP, used in the analyzer mode for digital IF filters, is also ideally suited for demodulating FM or AM signals.
The digital signal processing in R&S FSP and R&S FSU, used in the analyzer mode for digital IF filters, is also ideally suited for demodulating FM or AM signals.
By sampling (digitization) already at the IF and digital downconversion to the baseband (I/Q), the demodulator achieves maximum accuracy and temperature stability. There is no evidence of typical errors of an analog downconversion and demodulation like AM ⇔ FM conversion, deviation error, frequency response or frequency drift at DC coupling. Only the characteristics of the analog IF filter ahead of the A/D converter need to be taken into consideration.

1.1 Circuit Description - Block Diagrams

Fig.1 shows the analyzer's hardware from the IF to the processor. The IF filter is the resolution filter of the spectrum analyzer, with a bandwidth range from 300 kHz to 10 MHz. The A/D converter samples the IF (20.4 MHz) at 32 MHz.
Lowpass filtering and reduction of the sampling rate follow the downconversion to the complex baseband. The decimation depends on the selected demodulation bandwidth. The output sampling rate is set in powers of 2 between 15.625 kHz and 32 MHz. Useless oversampling at narrow bandwidths is avoided, saving computing time and increasing the maximum recording time.
The I/Q data is stored in memories each comprising 128 k words. The hardware triggering (external, IF power) controls the memory.
The I/Q data are stored in memories each comprising 512 k words. The hardware triggering (external, IF power) controls the memory.

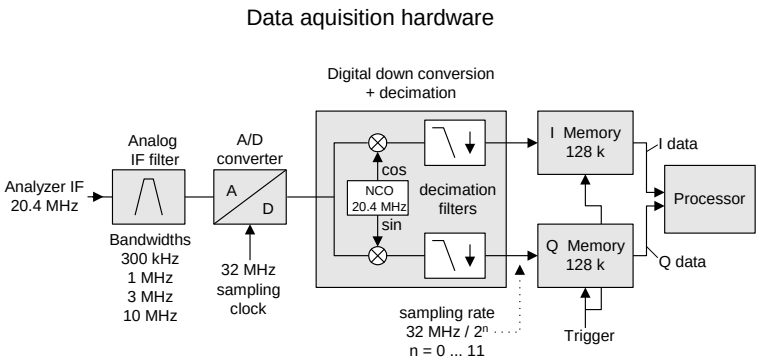


Fig.1 Block diagram of analyzer signal processing

The software demodulator runs on the main processor of the analyzer. The demodulation process is shown in Fig.2. All calculations are performed simultaneously with the same I/Q data set. Magnitude (= amplitude) and phase of the complex I/Q pairs are determined. The frequency result is obtained from the differential phase.

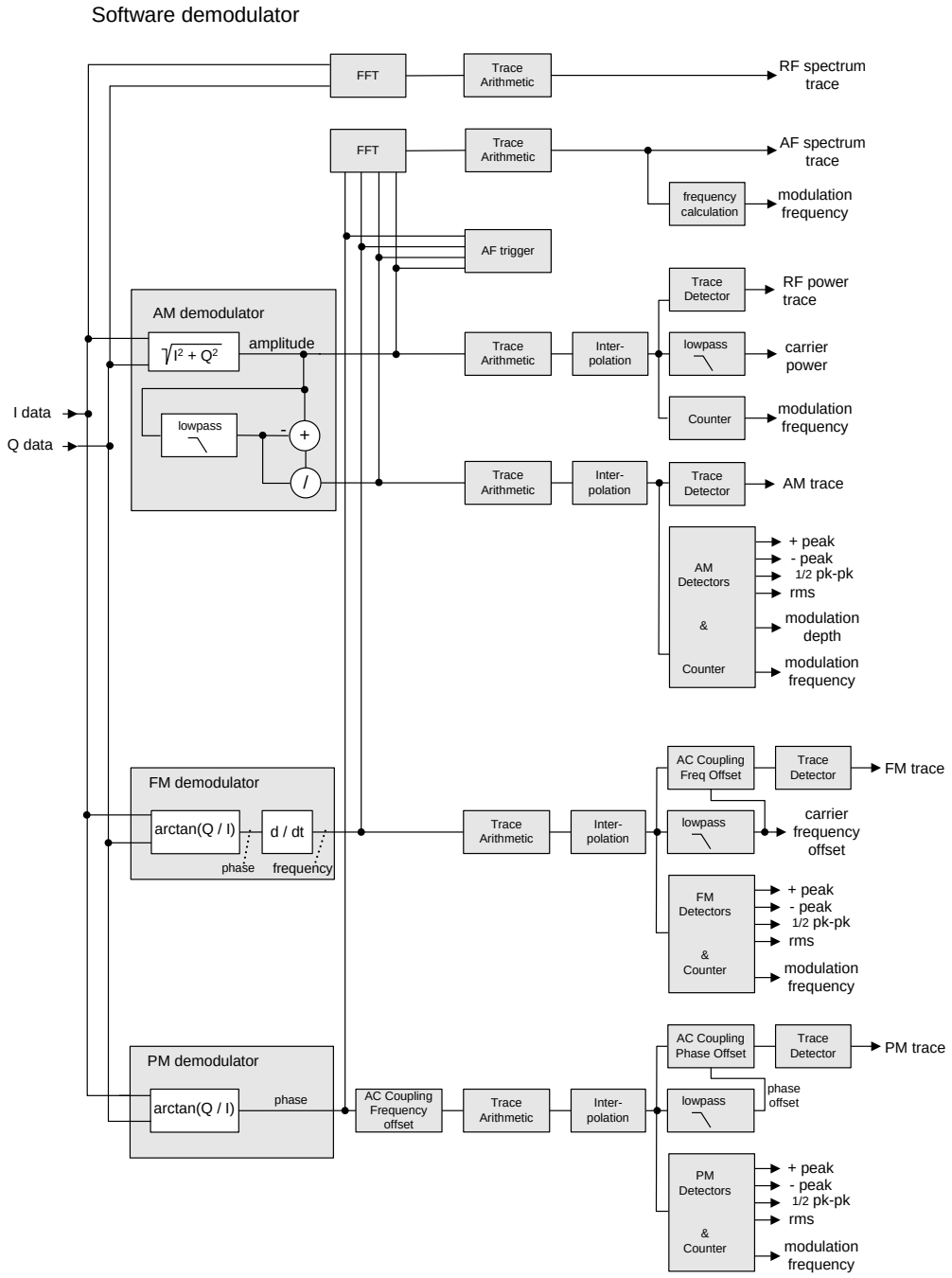


Fig.2 Block diagram of software demodulator

The AM-DC, PM-DC and FM-DC raw data of the demodulators is fed into the **trace arithmetic** block that combines consecutive data sets. Possible functions are: Clear Write, Max Hold, Min Hold and Average. The output data of the trace arithmetic can be read via **GPIB**. The recording length corresponds to the selected sampling rate of 1 to 128 k samples.

The recording length corresponds to the selected sampling rate of 1 to 512 k samples.

501 samples are required for on-screen display. If less data is recorded, the missing intermediate values are calculated by an **interpolation filter**.

If more than 501 samples are recorded, the interpolator becomes ineffective. In this case the **trace detector** reduces the number of samples to 501.

501 samples (R&S FSU: 625 samples) are required for on-screen display. If less data are recorded, the missing intermediate values are calculated by an **interpolation filter**.

If more than 501 (R&S FSU: 625) samples are recorded, the interpolator becomes ineffective. In this case the **trace detector** reduces the number of samples to 501 (R&S FSU: 625).

The trace detector combines several samples according to the functions selectable: Sample, Max Peak, Min Peak, Average, Autopeak, RMS. The **zoom** function does not combine any samples, but selects a sequence of 501 samples from the data set.The trace detector combines several samples according to the functions selectable: Sample, Max Peak, Min Peak, Average, Autopeak, RMS. The **zoom** function does not combine any samples, but selects a sequence of 501 (R&S FSU: 625) samples from the data set.

The data from the trace detector is displayed on the screen and can be read out via GPIB. They display level, phase versus time and/or frequency versus time.

In addition, important parameters are calculated:

- A **counter** determines the **modulation frequency** for AM, PM and FM.
- A **lowpass filter** suppresses the modulation frequency; the result is the average power = **carrier power** with AM and the average frequency = **carrier frequency offset** with FM. The deviation from the selected center frequency is displayed.
- **AC coupling** is possible with FM and PM display. To this end, the carrier frequency offset is subtracted from the FM DC data. In addition, the **frequency deviation** is determined from the trace data. +Peak, -Peak, ½ Peak-Peak and RMS are displayed.

Besides the demodulators, the spectrum of the I/Q data, the FM, the PM or the AM is calculated using **FFT**. The spectrum always comprises 501 samples.

Besides the demodulators, the spectrum of the I/Q data is calculated using FFT. The spectrum always comprises 501 (FSU: 625) samples.

1.2 Further Characteristics

1.2.1 IF Bandwidth

The **analog IF filter** improves the selectivity, but also causes signal distortions. The filter is negligible if:

IF bandwidth ≥ 10 x (modulation frequency + frequency deviation)

IF bandwidths ≤ 3 MHz ensure sufficient image-frequency rejection.

If due to a wide signal bandwidth an IF bandwidth of 10 MHz has to be selected, signals are not allowed to be in the range from 6 MHz to 9 MHz above the receive frequency because they will be convoluted back into the useful band of 10 MHz.

1.2.2 Demodulation Bandwidth

Digital filters determine the demodulation bandwidth. This is not the 3 dB bandwidth but the useful bandwidth which is distortion-free with regard to phase and amplitude.

Therefore the following formulas apply:

- AM: demodulation bandwidth ≥ 2 x modulation frequency
- FM: demodulation bandwidth ≥ 2 x (frequency deviation + modulation frequency)
- PM: demodulation bandwidth ≥ 2 ∗ modulation frequency ∗ (1 + phase deviation)

If the center frequency of the analyzer is not set exactly to the signal frequency, the demodulation bandwidth must be selected larger by the carrier offset, in addition to the requirement described above. This also applies if FM or PM AC coupling has been selected.

In general, the demodulation bandwidth should be as narrow as possible to improve the S/N ratio. The residual FM caused by noise floor and phase noise increases dramatically with the bandwidth, especially with FM (REF _Ref305574188 \h Fig. 3).

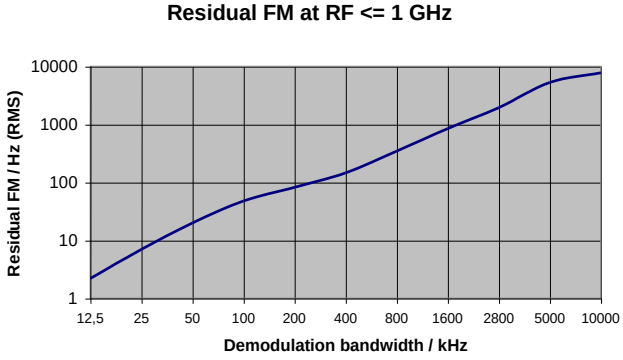


Fig. 3 Residual FM as a function of demodulation bandwidth

1.2.3 AF Trigger

The FM demodulator option allows triggering to the demodulated signal. The display is stable if a minimum of five modulation periods are within the recording time.

In the AM and FM display, triggering is always DC-coupled. In the PM display, triggering is either AC- or DC-coupled, depending on the type of coupling set. Therefore triggering is possible directly to the point where a specific carrier level, phase or frequency is exceeded or not attained. This is particularly helpful when measuring transients if no external trigger signal is available.

1.2.4 Stability of Measurement Results

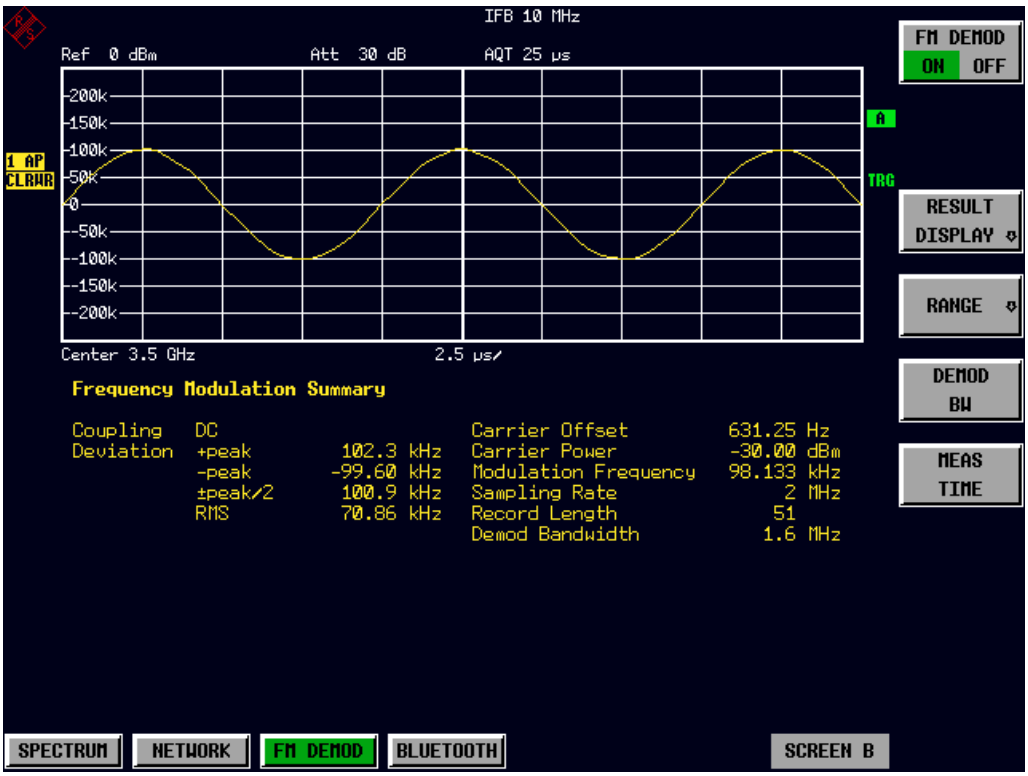
Despite amplitude and frequency modulation, the display of carrier power and carrier frequency offset is stable.

This is achieved by a digital filter which sufficiently suppresses the modulation, provided, however, that the measurement time is ≥ 3 x 1 / modulation frequency, i.e. that at least three periods of the AF signal are recorded.

The mean carrier power for calculating the **AM** is also calculated with a digital filter that returns stable results after a measurement time of ≥ 3 * 1 / modulation frequency, i.e. at least three cycles of the AF signal must be recorded before a stable AM can be show.

2 Settings of the FM Demodulator

The *FM DEMOD* hotkey opens the menu for setting the FM demodulator functions. Simultaneously, the FM demodulator is activated.



2.1 FM Demodulator Main Menu

FM DEMOD ON / OFF
AF FILTER
RESULT DISPLAY
RANGE
DEMOD BW
MEAS TIME
ZOOM

NOTICE

The softkeys visible in the RANGE submenu depend on the selected measurement function (FM / PM / RF SPECTRUM / AF SPECTRUM).

FM DEMOD ON / OFF

The *FM DEMOD ON / OFF* softkey switches the FM demodulator on or off. The FM demodulator default setting is *OFF*; however, when the *FM DEMOD* mode is selected, the demodulator is switched on automatically.

Note:

The resolution bandwidth, video bandwidth and sweep time active before the demodulator is switched on are restored when the demodulator is switched off. Similarly, the trace operating mode and detector are restored (the FM demodulator has separate trace settings).

```
Remote: INST:SEL ADEM
        INST:NSEL 3
```

AF FILTER

The *AF FILTER* softkey opens the submenu for selecting high pass or low pass filters and also a de-emphasis. (see chapter "Selection of Filter – *AF FILTER Menu*").

RESULT DISPLAY

The *RESULT DISPLAY* softkey opens the submenu for selecting the measurement function required (see chapter "Selection of Display Mode - *RESULT DISPLAY Menu*").

RANGE

The *RANGE* softkey opens the submenu for setting the display range of the measurement function selected (see chapter "Scaling of Measurement Results - *RANGE Menu*").

DEMOD BW

The *DEMOD BW* softkey selects the demodulation bandwidth of the FM demodulator. The demodulation bandwidth determines the sampling rate for recording the signal to be analyzed.
The following table shows the relation between demodulation bandwidth and sampling rate:

Demodulation bandwidth	Sampling rate	Comment
120 MHz	256 MHz	with R&S FSQ-B72 only
50/85 MHz (1)	128 MHz	with R&S FSQ-B72 only
30 MHz	64 MHz	with R&S FSQ only
18 MHz	32 MHz	with R&S FSQ only
10 MHz	32 MHz	
8 MHz	16 MHz	This restriction only applies to R&S FSP and R&S FSU without B72: This filter is only flat for about 6 MHz, it has a 3 dB decay at 7 MHz.
5 MHz	8 MHz	

Demodulation bandwidth	Sampling rate	Comment
3 MHz	4 MHz	
1.6 MHz	2 MHz	
800 kHz	1 MHz	
400 kHz	500 kHz	
200 kHz	250 kHz	
100 kHz	125 kHz	
50 kHz	62.5 kHz	
25 kHz	31.25 kHz	
12.5 kHz	15.625 kHz	
6.4 kHz	7.8125 kHz	
3.2 kHz	3.90625 kHz	
1.6 kHz	1.953125 kHz	
800 Hz	976.5625 Hz	
400 Hz	488.28125 Hz	
200 Hz	244.140625 Hz	
100 Hz	122.0703125 Hz	

1) The demodulation bandwidth at a sampling rate of 128 MHz depends on the center frequency that has been set. At a center frequency of ≤3.6 GHz, the demodulation bandwidth is 50 MHz; at higher center frequencies, it is 85 MHz.

```
Remote: SENS:BAND:DEM 10MHz
```

MEAS TIME

The *MEAS TIME* softkey opens an editor for entering the measurement time of the FM demodulator. The permissible value range depends on the demodulation bandwidth selected.

Demodulation bandwidth	Min. measurement time	Max. measurement time with AF trigger	Max. measurement time with other trigger
120 MHz	3.90625 ns	425 µs	510 µs
50 / 85 MHz	7.8125 ns	850 µs	1.0 ms
30 MHz	15.625 ns	1.7 ms	2.0 ms
18 MHz	31.25 ns	3.4 ms	4.1 ms
10 MHz	31.25 ns	3.4 ms	4.1 ms
8 MHz	62.5 ns	6.8 ms	8.2 ms
5 MHz	125 ns	13.6 ms	16.3 ms
3 MHz	250 ns	27.2 ms	32.6 ms
1.6 MHz	500 ns	54.4 ms	65.3 ms

Demodulation bandwidth	Min. measurement time	Max. measurement time with AF trigger	Max. measurement time with other trigger
800 kHz	1 µs	109 ms	131 ms
400 kHz	2 µs	218 ms	261 ms
200 kHz	4 µs	435 ms	522 ms
100 kHz	8 µs	870 ms	1.04 s
50 kHz	16 µs	1.74 s	2.09 s
5 kHz	32 µs	3.48 s	4.18 s
12.5 kHz	64 µs	6.96 s	8.36 s
6.4 kHz	128 µs	13.9 s	16.7 s
3.2 kHz	256 µs	27.8 s	33.4 s
1.6 kHz	512 µs	55.7 s	66.8 s
800 Hz	1.024 ms	111 s	133 s
400 Hz	2.048 ms	222 s	267 s
200 Hz	4.096 ms	445 s	534 s
100 Hz	8.192 ms	891 s	1069 s

```
Remote: SENS:ADEM:MTIM 62.5US
        SENS:SWE:TIME 62.5US
```

ZOOM

In many cases, the number of recorded test points exceeds by far the number of available pixels. Therefore several test points are combined to one pixel if the *ZOOM* function is inactive.
If the *ZOOM* function is activated, a 1-to-1 allocation is selected, i.e. each pixel corresponds to a recorded test point. The start of the zoom window can be determined in the associated field by entering the time.
The zoom function is not available if the number of test points falls below the number of pixels in the diagram (R&S FSP:501,R&S FSU/FSQ: 625).

```
Remote: SENS:ADEM:ZOOM ON  SENS:ADEM:ZOOM:STARt 30US
```

2.1.1 Selection of Filter and Deemphasis – AF FILTER Menu

AF FILTER

The *AF FILTER* softkey opens the submenu for selecting high pass or low pass filters and also a de-emphasis.

HIGH PASS AF FILTER
LOW PASS AF FILTER
DEEMPHASIS
WEIGHTING AF FILTER

HIGH PASS AF FILTER

The *HIGH PASS AF FILTER* softkey opens the submenu for selecting the high pass filter.

The *20 Hz*, *50 HZ* and *300 HZ* softkeys switch on a high pass filter with the given limit to separate the DC component. The filters are indicated by the 3 dB cutoff frequency. The filters are designed as 2nd-order Butterworth filter (12 dB/octave).

The *NONE* softkey deactivates the AF high pass filter. Default is NONE.

The R&S FSP requires the option R&S FSP-B70 for the high pass filter.

The high pass filter are active in the following demodulation bandwidth range:

20 Hz 100 Hz ≤ demodulation bandwidth ≤ 1.6 MHz

50 Hz 200 Hz ≤ demodulation bandwidth ≤ 4 MHz

300 Hz 800 Hz ≤ demodulation bandwidth ≤ 16 MHz

```
Remote: SENS:FILT:HPAS:STAT ON | OFF
        SENS:FILT:HPAS:FREQ 20 Hz | 50 Hz |300 Hz
```

LOW PASS AF FILTER

The *LOW PASS AF FILTER* softkey opens the submenu for selecting the low pass filter.

The *3 KHZ, 15 KHZ; 23 KHZ* and *150 KHZ* softkeys switch on a absolute low pass filter. The filter are indicated by the 3 dB cutoff frequency. The 3 kHz and 15 kHz filters are designed as 5th-order Butterworth filter (30 dB/octave). The 150 kHz filter is designed as 8th-order Butterworth filter (48 dB/octave).

The *5 %, 10%* and *25% HZ* softkeys switch on a relative low pass filter. The filter (3 dB) can be selected in % of the demodulation bandwidth. The filters are designed as 5th-order Butterworth filter (30 dB/octave).

The *NONE* softkey deactivates the AF low pass filter. Default is NONE.

The R&S FSP requires the option R&S FSP-B70 for the absolute low pass filter 3 kHz, 15 kHz and 150 kHz. The relative low pass filters are always available.

The relative low pass filters are active for all demodulation bandwidth's. The absolute low pass filters are active in the following demodulation bandwidth range:

3 kHz	6.4 kHz	≤demodulationbandwidth	≤ 4 MHz
15 kHz	50 kHz	≤demodulationbandwidth	≤ 16 MHz
23 Hz	50 Hz	≤demodulationbandwidth	≤ 8 MHz
150 kHz	400 kHz	≤demodulation bandwidth	≤ 16 MHz

```
Remote: SENS:FILT:LPAS:STAT ON | OFF
        SENS:FILT:LPAS:FREQu:REL 5 | 10 | 25
        SENS:FILT:LPAS:FREQ 3 kHz | 15 kHz | 23kHz | 150 kHz
```

DEEMPHASIS

The *DEEMPHASIS* softkey opens the submenu for selecting the deemphasis.

The *25 us, 50 us, 75 us* and *750 us* softkeys switch on a de-emphasis with the given time constant.

The *NONE* softkey deactivates the de-emphasis. Default is NONE.

The R&S FSP requires the option R&S FSP-B70 for the de-emphasis.

The de-emphasis is active in the following demodulation bandwidth range:

25 µs 25 kHz ≤ demodulation bandwidth ≤ 30 MHz

50 µs 6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz

75 µs 6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz

750µs 800 Hz ≤ demodulation bandwidth ≤ 4 MHz

The following table shows the required demodulation bandwidth for an error less than 0.5 dB up to a maximum AF frequency.

Deemphasis	25 µs	50 µs	75 µs
Maximum AF Frequency	25 kHz	12 kHz	8 kHz
Required demodulation bandwidth	≥ 200 kHz	≥ 100 kHz	≥ 50 kHz

For higher AF frequencies the demodulation bandwidth must be increased.

```
Remote: SENS:FILT:DEMP:STAT ON | OFF
        SENS:FILT:DEMP:TCON 25 us | 50 us | 75 us | 750 us
```

WEIGHTING AF FILTER

The *WEIGHTING AF FILTER softkey* opens the submenu for selecting the weighting filter.

NONE
CCITT
CCIR UNWEIGHTED
CCIR WEIGHTED
A WEIGHTED

NONE

The *NONE* softkey deactivates the weighting filter. This is the default setting.

```
Remote:  ---
```

CCITT

The *CCITT* softkey switches on a CCIT P.53 weighting filter. The weighting filter is active in the following demodulation bandwidth range:

20 kHz ≤ demodulation bandwidth ≤ 3 MHz

```
Remote: SENS:FILT:CCIT:STAT ON | OFF
```

CCIR UNWEIGHTED

The CCIR UNWEIGHTED softkey switches on the CCIR unweighted filter, which is the combination of the 20 Hz highpass and 23 kHz low pass filter. The weighting filter is active in the following demodulation bandwidth range:

50 kHz ≤ demodulation bandwidth ≤ 1.6 MHz

```
Remote: SENS:FILT:CCIR:UNW:STAT ON | OFF
```

CCIR WEIGHTED

The *CCIR WEIGHTED* softkey switches on the CCIR weighted The weighting filter is active in the following demodulation bandwidth range:

100 kHz ≤ demodulation bandwidth ≤ 3 MHz

```
Remote: SENS:FILT:CCIR:WEIG:STAT ON | OFF
```

A WEIGHTED

The *A WEIGHTED* softkey switches on the A weighted filter. The weighting filter is active in the following demodulation bandwidth range:

100 kHz ≤ demodulation bandwidth ≤ 800 kHz

```
Remote: SENS:FILT:AWE:STAT ON | OFF
```

2.1.2 Selection of Display Mode – RESULT DISPLAY Menu

In order to display the measurement results the screen is divided in two halves:
In the upper half, the measurement results are displayed as a trace, in the lower half the results of additional evaluation functions are shown. The *RESULT DISPLAY* softkey allows the user to select the measurement results to be displayed.

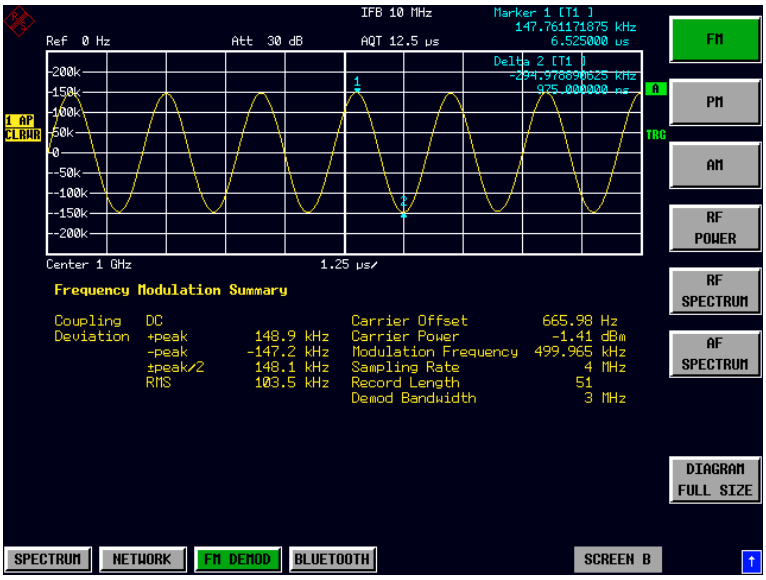
RESULT DISPLAY

The *RESULT DISPLAY* softkey opens a submenu for selecting the measurement result to be displayed.
The demodulated FM, PM or AM signal, the RF signal in the time domain or the RF or AF frequency spectrum determined via FFT can be selected for display.
All displays are determined from the I/Q data set recorded for the measurement. In *SINGLE SWEEP* mode, the single data set recorded can be evaluated in all displays simply by switching the result display.

FM
PM
AM
RF POWER
RF SPECTRUM
AF SPECTRUM
SELECT TRACE
FULL SIZE DIAGRAM

FM

The *FM* softkey selects the demodulated FM signal for display. Depending on the *AF COUPLING AC/DC* selection in the *RANGE* menu, the average value of the demodulated signal is mapped onto the vertical center of the diagram (*AC* selected) or deviates from the center of the diagram by a signal-dependent frequency offset (*DC* selected).

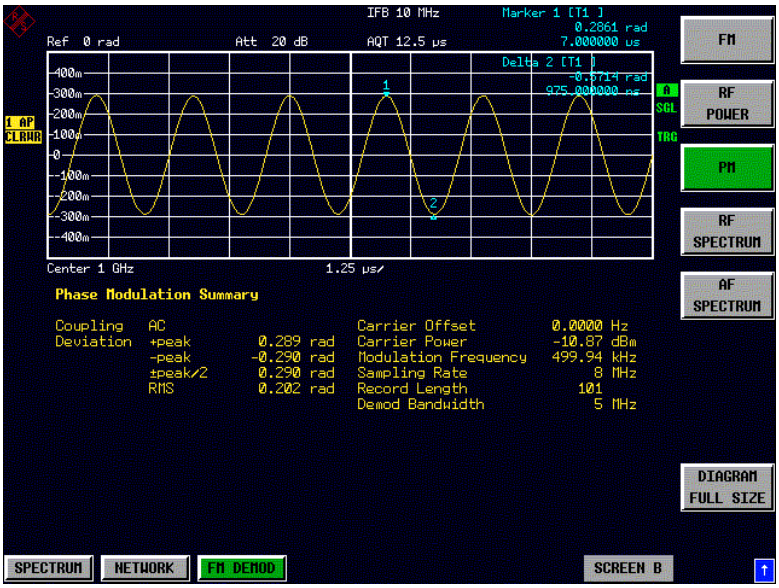


In *SINGLE SWEEP* mode, the data is determined from the current I/Q data set, i.e. a change to FM does not trigger a new measurement.

```
Remote: CALC:FEED 'XTIM:FM'
```

PM

The *PM* softkey selects the display of the demodulated PM signal.

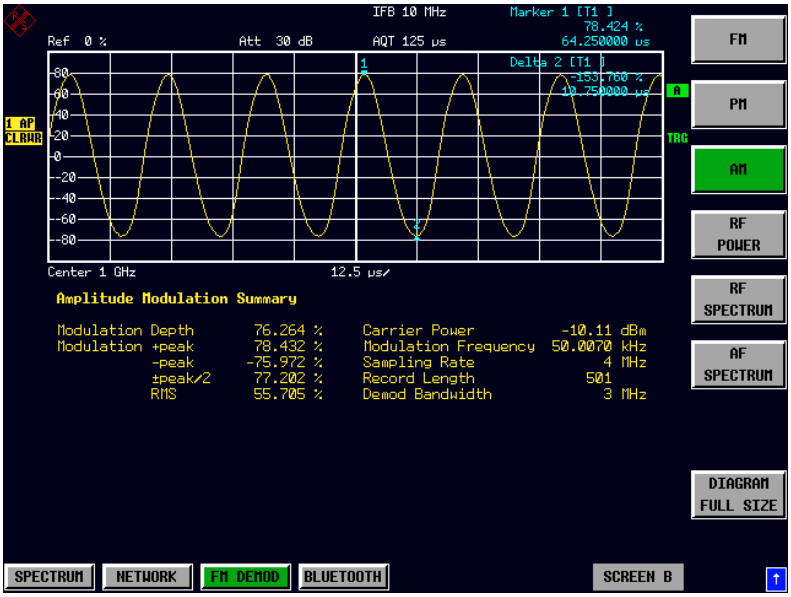


In *SINGLE SWEEP* mode, the data is determined from the current I/Q data set, i.e. a change to *PM* does not trigger a new measurement.

```
Remote: CALC:FEED 'XTIM:PM'
```

AM

The *AM* softkey selects the display of the demodulated AM signal.

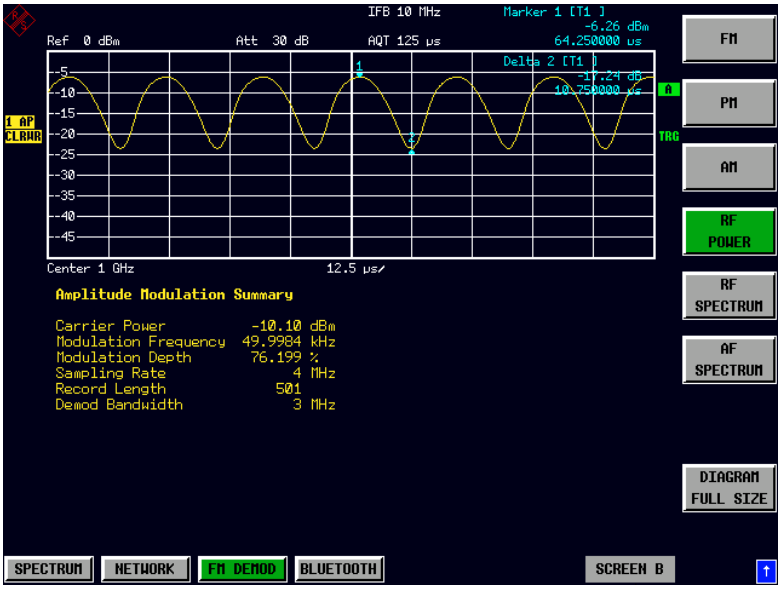


In *SINGLE SWEEP* mode, the data is determined from the current I/Q data set, i.e. a change to *AM* does not trigger a new measurement.

```
Remote: CALC:FEED 'XTIM:AM:REL'
```

RF POWER

The RF POWER softkey selects the display of the RF signal in the time domain. In contrast to normal analyzer operation, the level values are determined from the recorded I/Q data set by means of summation.

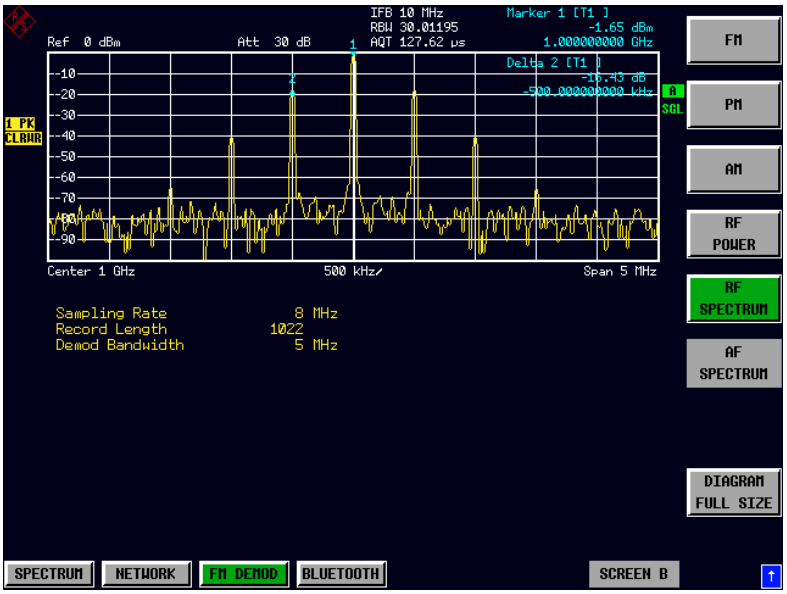


In *SINGLE SWEEP* mode, the data is determined from the current I/Q data set, i.e. a change to *RF POWER* does not trigger a new measurement.

```
Remote: CALC:FEED 'XTIM:RFP'
```

RF SPECTRUM

The *RF SPECTRUM* softkey selects the RF signal in the frequency domain for display. In contrast to normal spectrum analyzer operation, the measured values are determined using FFT from the recorded I/Q data set.



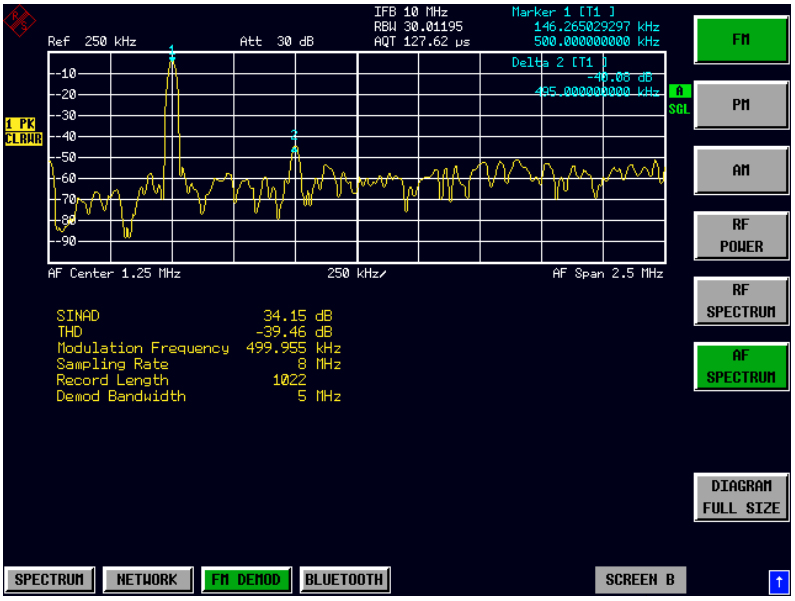
In *SINGLE SWEEP* mode, the data is determined from the current I/Q data set, i.e. a change to *SPECTRUM* does not trigger a new measurement.

```
Remote: CALC:FEED 'XTIM:SPECTRUM'
```

AF SPECTRUM

The *AF SPECTRUM* softkey selects the display of the AF spectrum. The AF spectrum can be calculated from the FM signal, PM signal or the RF signal in the time domain.

The softkey is not available if the RF spectrum display is selected.



In *SINGLE SWEEP* mode, the data is determined from the current I/Q data set, i.e. a change to *AF SPECTRUM* does not trigger a new measurement.

```
Remote: CALC:FEED 'XTIM:FM:AFSP'
        CALC:FEED 'XTIM:PM:AFSP'
        CALC:FEED 'XTIM:AM:AFSP'
        CALC:FEED 'XTIM:RFP:AFSP'
```

SELECT TRACE

The *SELECT TRACE* softkey selects the trace, the data of which is to be displayed in the lower half of the screen.

```
Remote: --
```

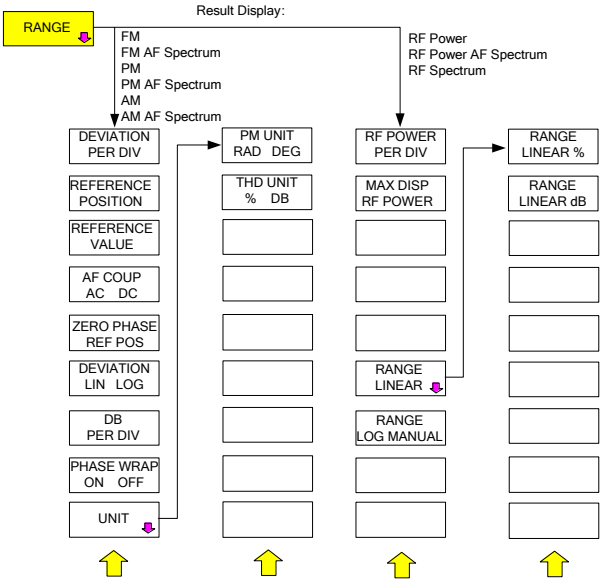
FULL SIZE DIAGRAM

The *FULL SIZE DIAGRAM* switches the diagram to full screen size.

```
Remote: DISP:SIZE LARG
```

2.1.3 Scaling of Measurement Results – *RANGE* Menu

RANGE



The *RANGE* softkey opens a submenu for determining the diagram scaling for the selected measurement.

The softkeys visible depend on the selected measurement function (FM / RF POWER /PM / RF SPECTRUM):

2.1.4 Scaling Functions for *FM, PM* and *AM* Result Display

DEVIATION PER DIV

The *DEVIATION PER DIV* softkey allows the phase or frequency deviation to be displayed in the range 1 Hz/div to 1 MHz/div with the FM display and in the range 0.0001 rad/div to 1000 rad/div with the PM display.

To prevent corruption of the measurement results, the IF bandwidth of the analyzer must be larger than the maximum frequency deviation plus modulation frequency (*IF BANDWIDTH* softkey in the *FM DEMOD* menu).

The softkey is not available in the AF spectrum display of the FM or PM signal, as scaling in this case is performed via the *DB PER DIV* and *REFERENCE VALUE* softkeys.

```
Remote: DISP:WIND:TRAC:Y:PDIV 50kHz
```

REFERENCE POSITION

The *REFERENCE POSITION* softkey determines the position of the reference line for the phase or 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 for the display of the FM signal or to a phase deviation of 0 rad for the display of the PM signal.

The position is entered as a percentage of the diagram height with 100 % corresponding to the upper diagram border. The default setting is 50 % (diagram center) for the display of the PM or FM signal and 100% (upper diagram border) for the AF spectrum display of the PM or FM signal.

```
Remote: DISP:WIND:TRAC:Y:RPOS 50PCT
```

REFERENCE VALUE

The *REFERENCE VALUE* softkey determines the frequency or phase deviation at the reference line of the y axis. The reference value is set separately for each display of the PM and FM signal and the AF spectrum of the PM and FM signal.

FM signal display:

The reference value makes it possible to take individual frequency offsets into account in the trace display (in contrast, the *AF COUP AC/DC* softkey permits automatic correction by the average frequency offset of the signal).
Values between 0 and ± 10 MHz can be selected. The softkey is not available if the *AF COUP AC* function has been activated.

AF spectrum display of the FM signal:

In the default setting, the reference value defines the FM deviation at the upper diagram border.
Values between 0 and 10 MHz can be selected.

PM signal display:

The reference value makes it possible to take individual phase offsets into account in the trace display (in contrast, the *AF COUP AC/DC* softkey permits automatic correction by the average phase offset of the signal).
Values between 0 and ± 10000 rad can be selected. The softkey is not available if the *AF COUP AC* function has been activated.

AF spectrum display of the PM signal:

In the default setting, the reference value defines the PM deviation at the upper diagram border.
Values between 0 and 10000 rad can be selected.

```
Remote: DISP:WIND:TRAC:Y:RVAL 0 HZ
```

AF COUP AC/DC

The *AF COUP AC/DC* softkey controls the automatic correction of the frequency offset and phase offset of the input signal:

FM signal display:

- If DC is selected, the absolute frequency is displayed, i.e. an input signal with an offset relative to the center frequency is not displayed symmetrically with respect to the zero line.

- If AC is selected, the frequency offset is automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

PM signal display:

- If DC is selected, the phase runs according to the existing frequency offset. In addition, the DC signal contains a phase offset of ±π.
- If AC is selected, the frequency offset and phase offset are automatically corrected, i.e. the trace is always symmetric with respect to the zero line.

The softkey is not available with the AF spectrum display of the FM or PM signal.

```
Remote: SENS:ADEM:AF:COUP DC
```

ZERO PHASE REF POS

The *ZERO PHASE REF POS* softkey defines the position at which the phase of the PM-demodulated signal is set to 0 rad. The entry is made with respect to time. In the default setting, the first measured value is set to 0 rad.
This softkey is available only in the PM display with DC coupling.

```
Remote: SENS:ADEM:PM:RPO:X 10us
```

DEVIATION LIN/LOG

The *DEVIATION LIN/LOG* softkey switches between logarithmic and linear display of the frequency deviation or phase deviation or modulation depth (AM).
The softkey is only available in the AF spectrum deviation of the FM or PM or AM signal.

```
Remote: DISP:WIND:TRAC:Y:SPAC LOG
```

DB PER DIV

The *DB PER DIV* softkey makes it possible to select the FM or PM deviation or modulation depth to be displayed in the range 0.1 dB/div to 20 dB/div.
The softkey is not available if linear display is set.

```
Remote: DISP:WIND:TRAC:Y:PDIV 5DB
```

PHASE WRAP ON/OFF

The *PHASE WRAP ON/OFF* softkey activates/deactivates phase wrap.

ON The phase will be displayed in the range ±180° (±π). For example, if the phase exceeds +180°, 360° is subtracted from the phase value, with the display thus showing >-180°.

OFF The phase will not be wrapped.

This softkey in available in the PM signal displays.

```
Remote: CALC:FORM PHAS | UPH
```

UNIT

The *UNIT* softkey opens the submenu for selecting units.

PM UNIT RAD/DEG

The *PM UNIT RAD/DEG* softkey is used to select the unit for displaying PM signals.

```
Remote: UNIT:ANGL RAD
```

THD UNIT %/DB

The THD UNIT %/DB softkey selects between % and dB for displaying the THD measurement result.

```
Remote: UNIT:THD PCT | DB
```

FUND FREQ MANUAL / FUND FREQ AUTO

The *FUND FREQ MANUAL / FUND FREQ AUTO* softkeys switches between automatic or manual selection of the fundamental frequency used for the SINAD and THD calculations. With automatic selection the peak in the AF spectrum is used as the fundamental frequency.

When switching from AUTO to MANUAL the current modulation frequency result is used as a default if the measurement result is available at this time.

These softkeys are available, if result *AF SPECTRUM* is switched on.

```
Remote: CALC:ADEM:THD:FREQ:FUND:AUTO ON | OFF
        CALC:ADEM:THD:FREQ:FUND:VALue <numeric value>
```

2.1.5 Scaling Functions for Result Displays with Level Display

MAX DISP RF POWER

The *MAX DISP RF POWER* determines the maximum RF power to be displayed. The selected value affects only the display. The reference level determines the dynamic range limit of the analyzer's A/D converter. If the input signal exceeds the selected reference level, the measurement results are impaired by A/D converter overloading. If a value higher than the reference level is selected for MAX DISP RF POWER, the dynamic range limit (= reference level) is highlighted by a red line on the screen:

———— POS x dBm ————

```
Remote: DISP:WIND:TRAC:Y:RVAL 10 DBM
```

RF POWER LOG/LIN

The *RF POWER LOG/LIN*
softkey allows the user to select logarithmic or linear level display.

```
Remote: DISP:WIND:TRAC:Y:SPAC LOG
```

RF POWER PER DIV

The *RF POWER PER DIV* softkey determines the RELATIVE power between two divisions on the y axis of the diagram.

```
Remote: DISP:WIND:TRAC:Y:PDIV 10 DB
```

RANGE LINEAR

The *RANGE LINEAR* softkey is identical to the softkey of the base unit.

RANGE LINEAR

The *RANGE LINEAR* softkey is identical to the softkey of the base unit.

RANGE LINEAR %

The *RANGE LINEAR %* softkey is identical to the softkey of the base unit.

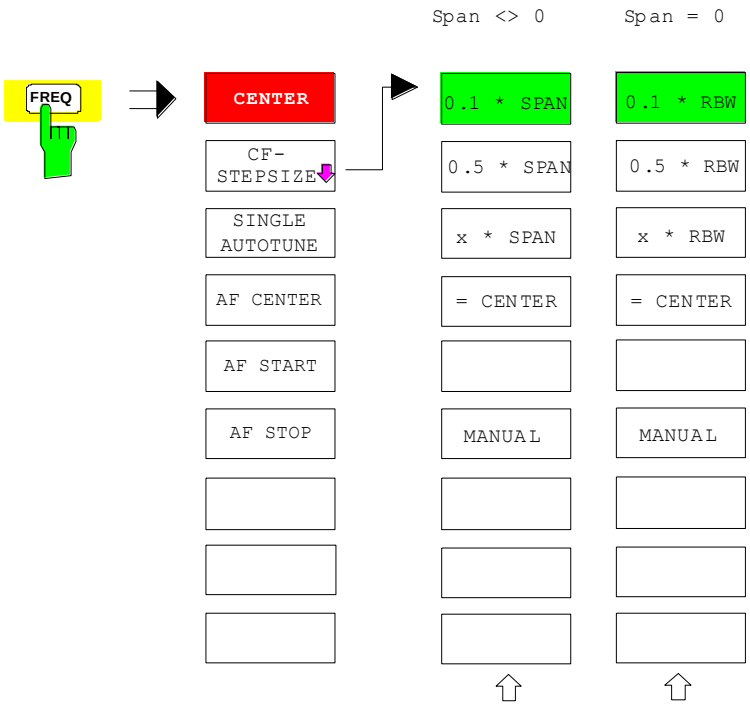
RANGE LINEAR dB

The *RANGE LINEAR dB* softkey is identical to the softkey of the base unit.

RANGE LOG MANUAL

The *RANGE LOG MANUAL* softkey is identical to the softkey of the base unit.

2.2 FREQ Key



The *FREQ* menu functions are identical to those of the base unit.

If the AF spectrum display is active, the *AF CENTER*, *AF START* and *AF STOP* softkeys, with which the displayed frequency range is defined within the demodulation - bandwidth, are also available.

SINGLE AUTOTUNE

This softkey activates an automatic signal search.

```
Remote: SENS:FREQ:CW:AFC ONC
```

AF CENTER

The *AF CENTER* softkey allows the user to select the center frequency within the AF spectrum.

```
Remote: SENS:ADEM:AF:CENT 1MHZ
```

AF START

The *AF START* softkey allows the user to select the start frequency within the AF spectrum.

```
Remote: SENS:ADEM:AF:STAR 0HZ
```

AF STOP

The *AF STOP* softkey allows the user to select the stop frequency within the AF spectrum.
The maximum AF stop frequency corresponds to half the demodulation bandwidth.

```
Remote: SENS:ADEM:AF:STOP 2MHZ
```

2.3 SPAN Key

The *SPAN* menu allows the user to select the frequency range to be displayed if the spectrum displays of the FM demodulator are active.

AF Spectrum	RF Spectrum
AF SPAN	FREQUENCY SPAN
AF FULL SPAN	FULL SPAN
DEMOD BW	DEMOD BW

AF SPAN

The *AF SPAN* softkey allows the user to select the frequency range if the AF spectrum displays are active.
Values between the sampling rate/200 and the demodulation bandwidth/2 can be selected.

```
Remote: SENS:ADEM:AF:SPAN 2.5 MHz
```

FREQUENCY SPAN

The *FREQUENCY SPAN* softkey allows the user to select the frequency range if the *RF SPECTRUM* display is active.
Values between the sampling rate/200 and the demodulation bandwidth/2 can be selected.

```
Remote: SENS:ADEM:SPEC:SPAN:ZOOM 5 MHz
```

AF FULL SPAN

The *AF FULL SPAN* softkey sets the maximum frequency range if the AF spectrum displays are active.
The maximum frequency range corresponds to half the demodulation bandwidth.

```
Remote: SENS:ADEM:AF:SPAN:FULL
```

FULL SPAN

The *FULL SPAN* softkey sets the maximum frequency range if the RF spectrum display is active.

The maximum frequency range corresponds to the demodulation bandwidth.

```
Remote: ADEM:SPEC:SPAN:ZOOM MAX
```

DEMOD BW

The demodulation bandwidth of the FM demodulator is selected with the *DEMOD BW* softkey.

Note:

The function is identical to the function of the DEMOD BW softkey in the FM DEMOD main menu.

```
Remote: SENS:BAND:DEM 10MHz
```

MEAS TIME

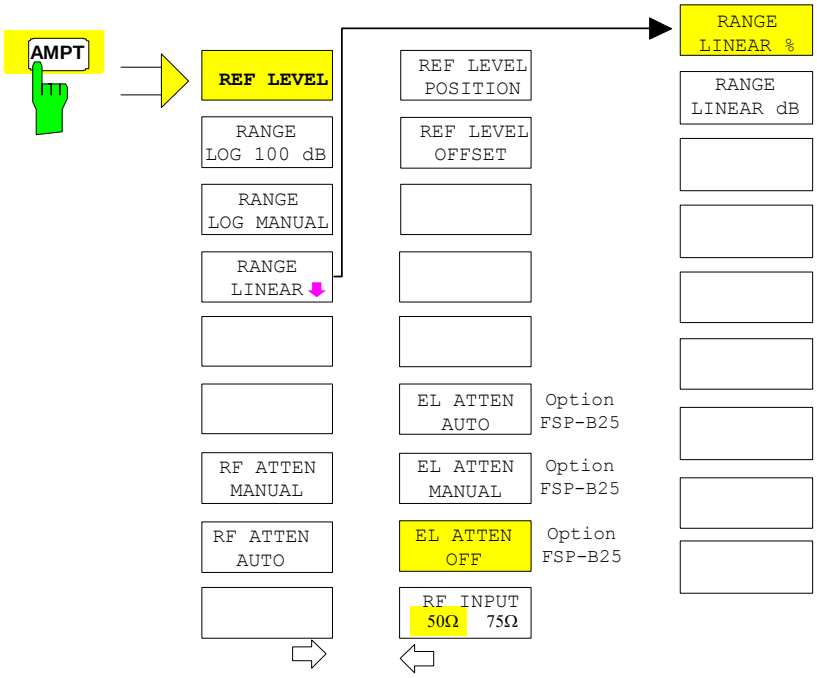
The *MEAS TIME* softkey opens the input field for the measurement time of the FM demodulator.

Note:

The function is identical to the function of the MEAS TIME softkey in the FM DEMOD main menu.

```
Remote: SENS:ADEM:MTIM 62.5US
        SENS:SWE:TIME 62.5US
```

2.4 AMPT Key



The *AMPT* menu functions are identical to those of the base unit.

The following functions are only available with level displays:

- RANGE LOG 100 dB
- RANGE LOG MANUAL
- RANGE LINEAR

The REF LEVEL value defines the clipping level of the A/D converter and must therefore be set greater than or equal to the maximum power of the signal to be analyzed.

2.5 *BW* Key

The *BW* menu comprises all functions relating to the band limiting of the analyzed signal.

RES BW
IF BW AUTO
IF BW MANUAL
DEMOD BW
MEAS TIME

RES BW

If the Spectrum result display is active, the *RES BW* softkey selects the resolution bandwidth for the signal displayed. Note that these resolution bandwidths are obtained by means of FFT filters from 1 Hz to 10 MHz.

Note:
The softkey is available only if the RF SPECTRUM or AF SPECTRUM result display is active.
The IF bandwidth is limited by analog LC filters using the IF BW MANUAL and IF BW AUTO softkeys.

```
Remote: SENS:ADEM:SPEC:BAND:RES 10 kHz
```

IF BW AUTO

The *IF BW AUTO* softkey couples the IF bandwidth of the analyzer (i.e. the bandwidth of the analog LC filters) to the selected demodulation bandwidth.

```
Remote: SENS:BAND:RES:AUTO ON
```

IF BW MANUAL

The *IF BW MANUAL* softkey allows the IF bandwidth of the analyzer to be entered (i.e. the bandwidth of the analog filters). Bandwidths from 300 kHz to 10 MHz can be selected.

```
Remote:SENS:BAND:RES 1 MHz
```

Note:
Manual setting of the IF bandwidth is usually not required. If an IF bandwidth is set that is narrower than the value defined by AUTO coupling,

- the RF frequency response is identical to that of the IF filter if the spectrum display is active,
- an AF frequency response corresponding to a lowpass filter equivalent to the IF filter occurs in the case of FM demodulation.

DEMOD BW

The demodulation bandwidth of the FM demodulator is selected via the DEMOD BW softkey.

Note:
The function is identical to that of the DEMOD BW softkey in the FM DEMOD main menu.

```
Remote: SENS:BAND:DEM 10MHz
```

MEAS TIME

The *MEAS TIM**E*** softkey opens the editor for entering the data-recording time of the FM demodulator.

Note:
The function is identical to that of the MEAS TIME softkey in the FM DEMOD main menu.

```
Remote: SENS:ADEM:MTIM 62.5US
        SENS:SWE:TIME 62.5US
```

2.6 TRIG Key

The *TRIG* key opens a menu for setting the different trigger sources and for selecting the trigger polarity. The active trigger mode is indicated by highlighting the associated softkeys.

To indicate that a trigger mode other than FREE RUN has been set, the **TRG** enhancement label is displayed on the screen. If two measurement windows are displayed, TRG is indicated next to the window in question.

FREE RUN
DEMOD SIGNAL
FM SIGNAL
PM SIGNAL
AM SIGNAL
RF POWER SIGNAL
EXTERN
IF POWER
TRIGGER OFFSET
POLARITY POS/NEG

FREE RUN

The *FREE RUN* softkey activates the free-running sweep, i.e. the measurement start is not triggered explicitly. When a measurement is completed, the next one starts immediately. *FREE RUN* is the default setting.

```
Remote: TRIG:SOUR  IMM
```

DEMOD SIGNAL

The *DEMOD SIGNAL* softkey opens the menu for selecting the various trigger sources.

FM SIGNAL

With a modulated signal, the trigger source that is selected with the FM SIGNAL softkey is the point at which a specific absolute phase is reached by the input signal. The associated trigger threshold can be entered simultaneously.
Measurement is triggered if the selected threshold is exceeded. A periodic signal modulated onto the carrier frequency can be displayed in this way.

Note:

For triggering with the FM SIGNAL trigger source to be successful, the measurement time must cover at least five periods of the audio signal.
The triggering responds to the absolute frequency, i.e. it is always DC-coupled.

```
Remote: TRIG:SOUR FM
        TRIG:LEV:FM 10 kHz
```

PM SIGNAL

With a modulated signal, the trigger source that is selected with the *PM SIGNAL* softkey is the point at which a specific absolute frequency is reached. The associated trigger threshold can be entered simultaneously.
Measurement is triggered if the selected threshold is exceeded. A periodic signal modulated onto the carrier frequency can be displayed in this way.

Note:

For triggering with the PM SIGNAL trigger source to be successful, the measurement time must cover at least five periods of the audio signal.
Triggering is either AC- or DC-coupled, depending on the AF COUPLING AC/DC setting in the RANGE menu.

```
Remote: TRIG:SOUR PM
        TRIG:LEV:PM 0.2 rad
```

AM SIGNAL

With a modulated signal, the trigger source that is selected with the *AM SIGNAL* softkey is the point at which a specific modulation depth is reached. The associated trigger threshold can be entered simultaneously.
Measurement is triggered if the selected threshold is exceeded. A periodic signal modulated onto the carrier frequency can be displayed in this way.

Note:

For triggering with the AM SIGNAL trigger source to be successful, the measurement time must cover at least five periods of the audio signal.

```
Remote: TRIG:SOUR AMR
        TRIG:LEV:AM:REL 0.2 rad
```

RF POWER SIGNAL

With a modulated signal (AF signal), the trigger source that is selected with the *RF POWER SIGNAL* softkey is the point at which a specific signal level is reached. The associated trigger threshold can be entered simultaneously.
Measurement is triggered if the selected threshold is exceeded. A periodic signal modulated onto the carrier frequency can be displayed in this way.

Note:

The RF POWER SIGNAL trigger differs from the RF POWER trigger in that the AF signal is taken into account rather than the RF signal.
For triggering with the AM trigger source to be successful, the measurement time must cover at least five periods of the audio signal.

```
Remote: TRIG:SOUR AM
        TRIG:LEV:AM -30 dBm
```

EXTERN

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

```
Remote: TRIG:SOUR  EXT
        SWE:EGAT:SOUR  EXT
```

IF POWER

The *IF POWER* softkey activates triggering of measurement by means of signals outside the measurement channel.
To this end, the R&S FSP uses a level detector on the second intermediate frequency. The threshold of the level detector can be selected between -30 dBm and -10 dBm at the input mixer.
The R&S FSU also uses a level detector on the second intermediate frequency. The threshold of the level detector can be selected between –50 dBm and
–10 dBm at the input mixer for R&S FSU.
This means that the input signal range within which the trigger responds can be calculated as follows:

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

The bandwidth on the intermediate frequency is 10 MHz. The measurement is triggered if the trigger threshold is exceeded by a signal in a range of 5 MHz around the center frequency.
For R&S FSU the bandwidth on the intermediate frequency is 80 MHz, which means that the measurement is triggered if the trigger threshold is exceeded in a range of 40 MHz around the center frequency.
This allows spurious signals to be measured, such as pulsed carriers, even if the carrier itself is not within the display frequency range.

```
Remote: TRIG:SOUR IFP
        SWE:EGAT:SOUR IF
```

RF POWER

The *RF POWER* softkey activates triggering of measurement by means of signals outside the measurement channel.
To this end, the analyzer uses a level detector on the first intermediate frequency. The threshold of the level detector can be selected between -50 dBm and -10 dBm at the input mixer. This means that the input signal range within which the trigger responds can be calculated as follows:

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

The bandwidth on the intermediate frequency is 80 MHz. The measurement is triggered if the trigger threshold is exceeded by the set frequency in a 40 MHz range. This allows spurious to be measured, such as pulsed carriers, even if the carrier itself is not within the display frequency range.

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

```
Remote: TRIG:SOUR  RFP
        SWE:EGAT:SOUR  RFP
```

TRIGGER OFFSET

The *TRIGGER OFFSET* softkey allows the user to enter a time offset between the trigger signal and the beginning of the measurement.
Triggering is delayed (entry value >0) or advanced (entry value <0) by the time entered.
The permissible setting range depends on the demodulation bandwidth and is given in the following table:

Demodulation bandwidth	Min. trigger offset	Max. trigger offset
120 MHz	-126 ns	31.7ms
50 / 85 MHz	-253 ns	63.5 ms
30 MHz	-507 ns	126.9 ms
18 MHz	-1 ms	253.9 ms
10 MHz	-2 ms	507.9 ms
8 MHz	-4.1 ms	1015.8 ms
5 MHz	-8.1 ms	2031.6 ms
3 MHz	-16.3 ms	4064.1 ms
1.6 MHz	-32.5 ms	8126.2 ms
800 kHz	-65 ms	16.2524 s
400 kHz	-130 ms	32.5048 s
200 kHz	-260.1 ms	65.0097 s
100 kHz	-520.2 ms	130.0193 s
50 kHz	-1040.4 ms	260.0386 s
25 kHz	-2080.7 ms	520.0773 s
12.5 kHz	-4151.5 ms	1040.1546 s
6.4 kHz	-8.322 s	2080.3 s
3.2 kHz	-16.64 s	4160.6 s
1:6 kHz	-33.29 s	8321.2 s
800 Hz	-66.58 s	16642 s
400 Hz	-133.1s	33284 s
200 Hz	-266.3 s	66569 s
100 Hz	-532.6 s	133139 s

```
Remote: TRIG:HOLD  10US
```

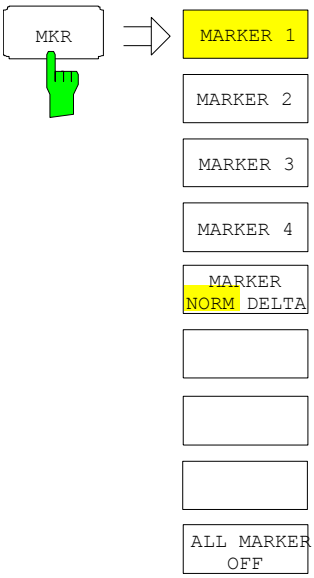
POLARITY POS/NEG

The *POLARITY POS/NEG* softkey determines the trigger slope polarity.
The measurement sequence starts upon a positive or negative slope of the trigger signal. The valid setting is highlighted.
The setting is valid for all trigger modes except *FREE RUN*.
The default setting is *POLARITY POS*.

Note:
The function is available only for detector boards with model index ≥ 3. Previous boards ignore the setting.

```
Remote: TRIG:SLOP POS
```

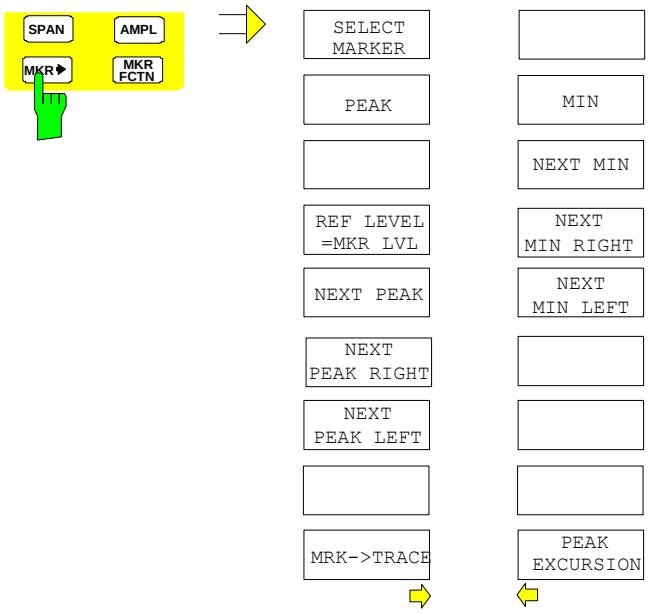
2.7 MKR Key



The *MKR* menu functions are identical to those of the base unit.

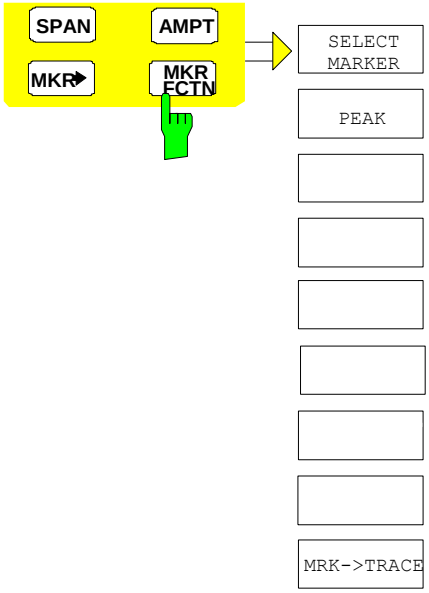
Only the measurement result display is coupled to the active result display and is in Hz if FM and FM AF spectrum are selected, in rad if PM and PM AF spectrum are selected, or in dBm or dB if RF POWER, RF POWER AF spectrum and RF SPECTRUM are selected.

2.8 *MKR* ⇒ Key



The *MKR* ⇒ menu functions are identical to those of the base unit.
The function *REF LEVEL = MKR LVL* is not available if the FM result display is active.

2.9 MKR FCTN Key



The available *MKR FCTN* menu functions are identical to those of the base unit.

2.10 *MEAS* Key

The *MEAS* menu functions are not available in the FM DEMOD mode.

2.11 Other Keys

The functions of the other keys are identical to those of the base unit. Please refer to the relevant chapters in the operating manual of the base unit.

3 Multicarrier Phase Measurement

NOTICE

Multicarrier phase measurement is only supported by R&S FSQ and R&S FSG.

The Multicarrier Phase Measurement returns spectral magnitude and phase values of an input signal consisting of several unmodulated carriers. These results can further be used to calculate frequency response and group delay characteristics of radio channels.

Two different measurement methods are implemented to calculate the level and phase values versus frequency. The orthogonal method returns the result at the carrier frequencies only and offers superior performance and accuracy. The flattop method returns a more convenient spectrum plot showing also the transitions between the carriers and should be selected to get a spectral overview.

3.1 Orthogonal Method

The sample frequency and the FFT length are internally chosen such that their ratio equals the carrier spacing Δf .

$$\Delta f = \frac{\text{Sample Frequency}}{\text{FFT Length}}$$

Thus all carriers are orthogonal to each other within an observation interval of one FFT length and the FFT returns phase and level results exactly at the carrier frequencies. Several FFT results are averaged according to the selected measurement time. The FFT is preceded by a frequency correction to avoid intercarrier interference by matching the carrier frequencies to the FFT grid.

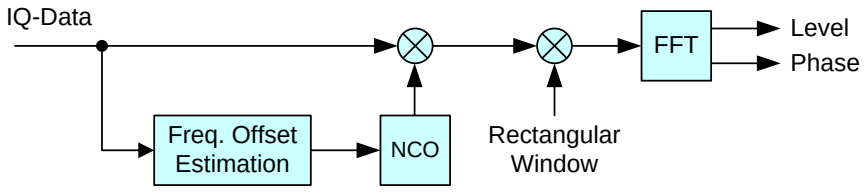


Fig. 4 Block diagram of the orthogonal measurement method

It is recommended to set the span according to the following equation:

$$\text{Span} = (\text{NumberOfCarriers} - 1) \cdot \Delta f \ .$$

3.2 Flattop Method

The IQ data signal is multiplied by a flattop window before performing the FFT. The flattop window guarantees correct level and phase values even if the carrier frequencies do not match the FFT grid, so this method is applicable if the carrier spacing is not uniform. The measurement time determines the FFT length and must be chosen high enough to avoid overlapping of the window responses of adjacent carriers. The resulting trace data contains also the transitions between the carriers.

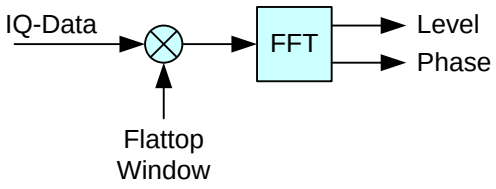


Fig. 5 Block diagram of the flattop measurement method

3.3 Group Delay Measurements

The group delay of a DUT is defined as the negative derivative of the phase response with respect to the angular frequency

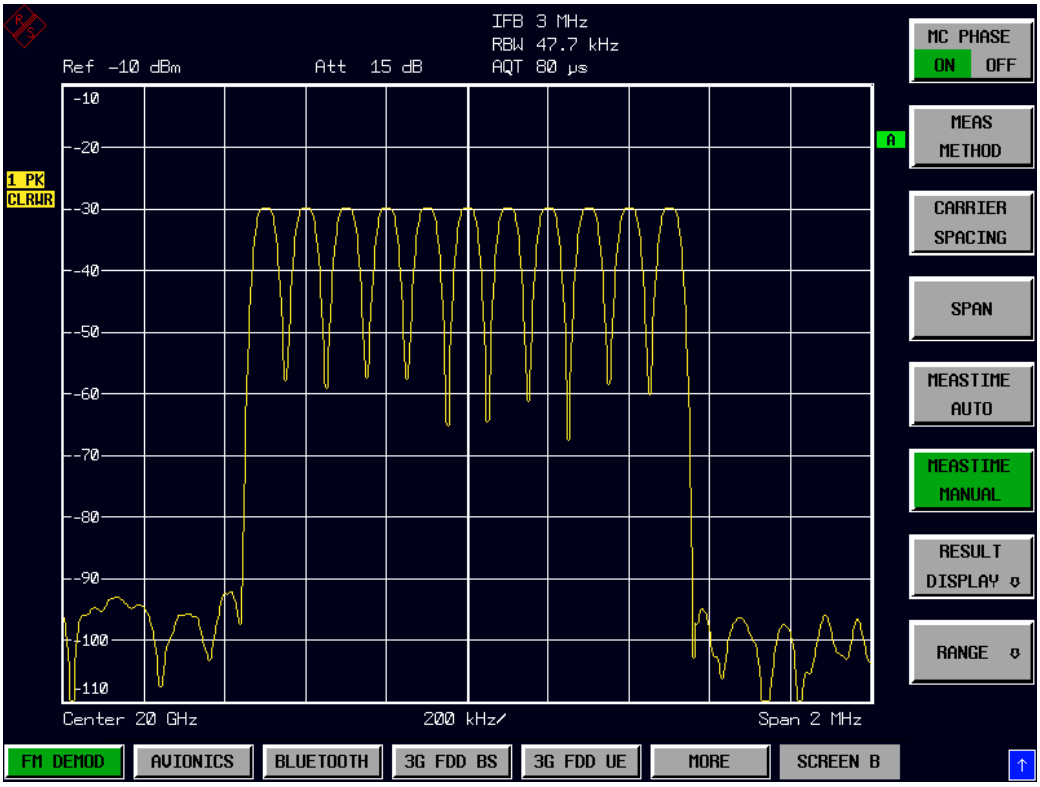
$$\tau = -\frac{d\phi(\omega)}{d\omega}.$$

It is recommended to use an input signal with low crest factor and the orthogonal measurement method to get the phase response of the DUT. A calibration measurement should be performed to account for the internal frequency responses of the transmitter and the analyzer. A common reference frequency is mandatory. An external trigger must be used for absolute group delay measurements. The following list summarizes the necessary measurement and calculation steps:

1. Calibration Measurement without DUT → $\phi_{cal}(k)$
2. Measurement with DUT → $\phi_{meas}(k)$
3. Calculate DUT Phase Response $\phi(k) = \phi_{meas}(k) - \phi_{cal}(k)$
4. Unwrap Phase Response
5. Calculate Group Delay $\tau(k) = -\frac{\phi(k) - \phi(k-1)}{2\pi \cdot \Delta f}$

3.4 Settings –MC PHASE RESPONSE Menu

The *MC PHASE RESPONSE* softkey in the main menu of the FM demodulator opens the menu to perform multicarrier phase measurements.



MC PHASE ON / OFF
MEAS METHOD
CARRIER SPACING
SPAN
MEASTIME AUTO
MEASTIME MANUAL
RESULT DISPLAY

NOTICE

The arrangement of the softkeys in the RANGE submenu depends on the set diagrams (Magnitude vs Freq / Phase vs Freq / Phase Polar)..

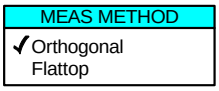
MC PHASE ON / OFF

The *MC PHASE ON / OFF* softkey switches the multicarrier phase measurement on or off.

```
Remote: SENS1:ADEM ON
        SENS1:ADEM:MCPH:STAT ON
```

MEAS METHOD

The softkey opens a list box to select between the method based on orthogonal and flattop-window measurement.



Remote: SENS1:ADEM:MCPH:METH ORTH

CARRIER SPACING

The *CARRIER SPACING* softkey defines the spacing between two carriers.

Note:

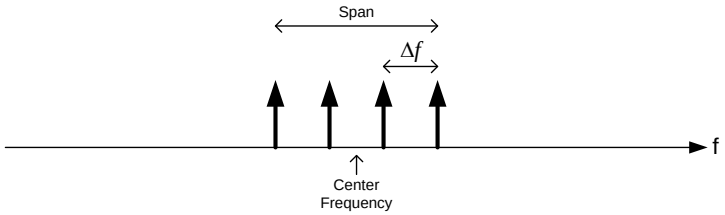
For the method based on flattop-window measurement, the carrier spacing is only required to calculate the automatic measurement time.

Remote: SENS1:ADEM:MCPH:SPAC 100KHZ

SPAN

The *SPAN* softkey defines the number of carriers to be measured.

Example:
A span ≥ 3 * carrier spacing (Δf) is required to measure a signal with four carriers.



Remote: SENS1:ADEM:SPEC:SPAN:MAX 3MHZ

MEASTIME AUTO

The *MEASTIME AUTO* softkey activates the automatic calculation of the recording length.

Remote: SENS1:ADEM:MTIM:AUTO ON

MEASTIME MANUAL

The *MEASTIME MANUAL* softkey opens a data entry field to manually enter the recording length.

Remote: SENS1:ADEM:MTIM 1ms

RESULT DISPLAY

The *RESULT DISPLAY* softkey opens the submenu to select the required measurement function (s. section "Selection of Result Display – *RESULT DISPLAY* " Menu).

3.4.2 Selection of Result Display – *RESULT DISPLAY* Menu

The *RESULT DISPLAY* softkey opens a submenu to select the measurement result to be displayed.

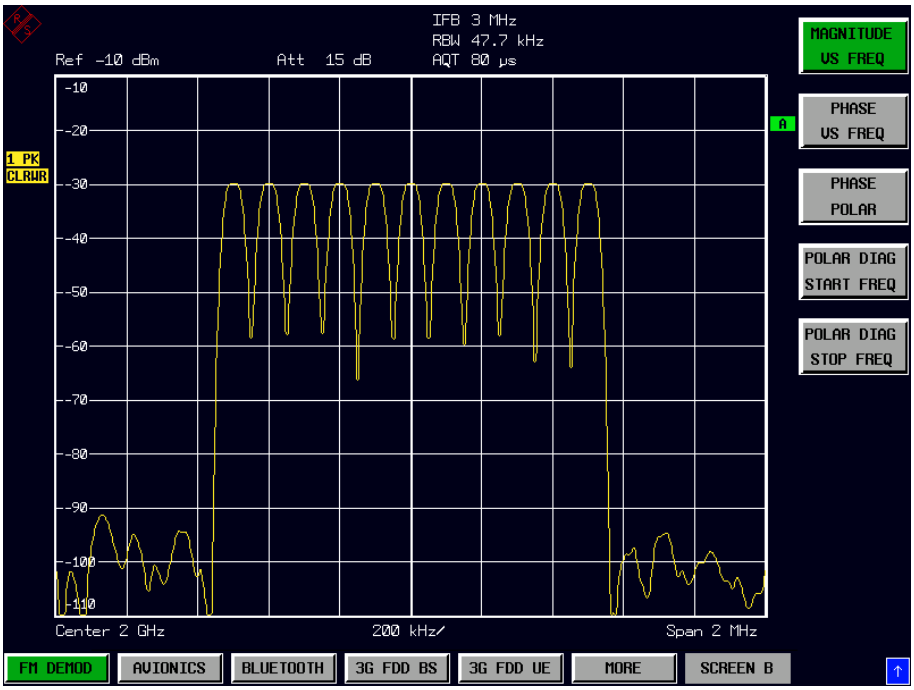
The magnitude or phase of the signal in the frequency domain or the phase in a polar diagram can be selected.

All results are determined by the I/Q data set recorded for the measurement. In the *SINGLE SWEEP* mode, the data set recorded once can be evaluated in all diagrams by simply switching over the result display.

MAGNITUDE VS FREQ
PHASE VS FREQ
PHASE POLAR
POLAR DIAG START FREQ
POLAR DIAG STOP FREQ

MAGNITUDE VS FREQ

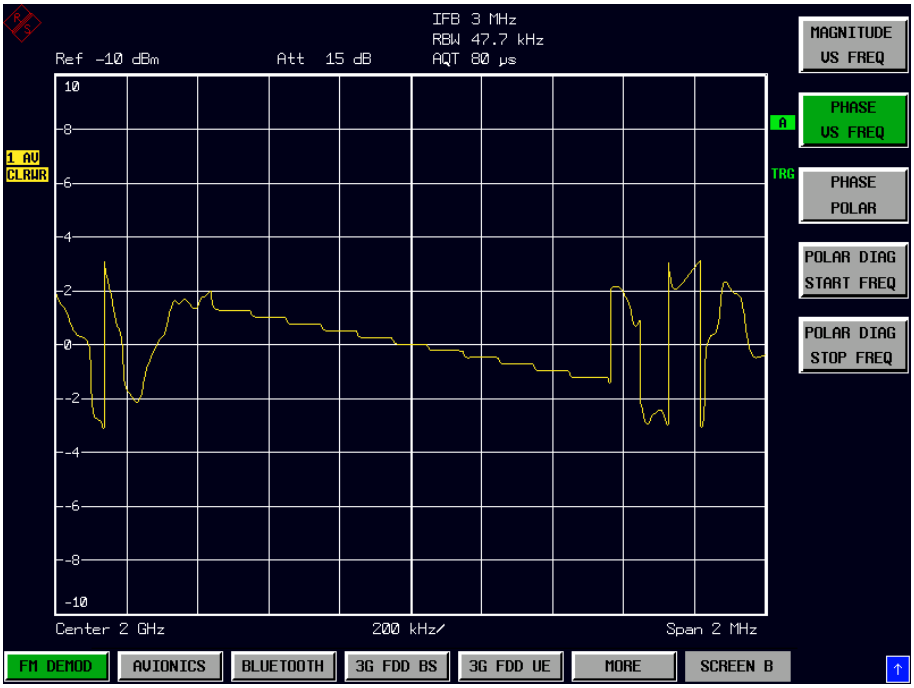
The *MAGNITUDE VS FREQ* softkey selects the level diagram of the signal in the frequency domain.



Remote: CALC:FEED 'XFR:SPEC:MAGN'

PHASE VS FREQ

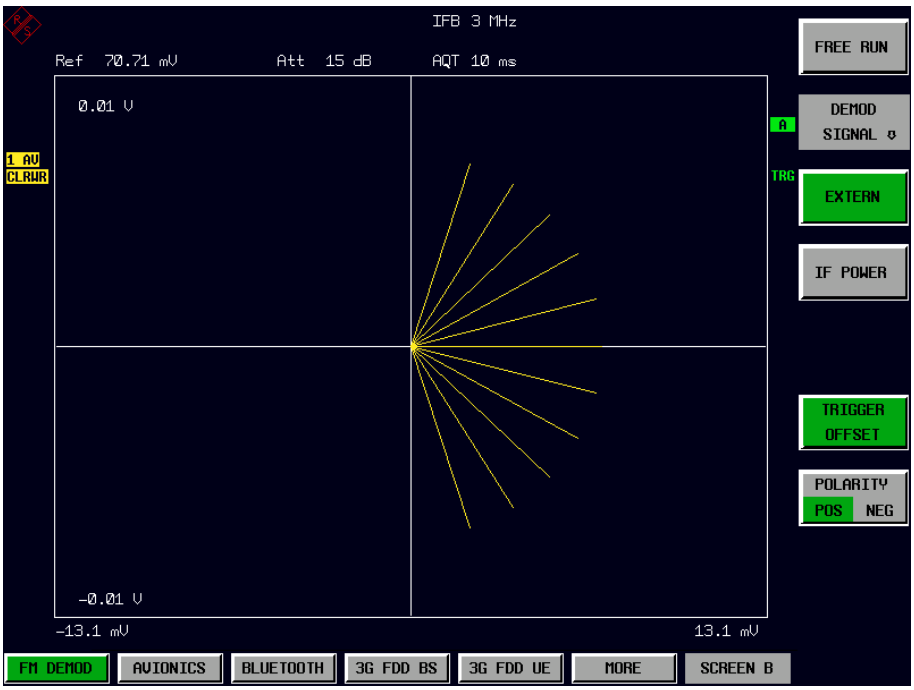
The *PHASE VS FREQ* softkey selects the phase diagram of the signal in the frequency domain.



Remote: CALC:FEED 'XFR:SPEC:PHAS'

PHASE POLAR

The *PHASE POLAR* softkey selects the phase diagram in a polar diagram. The displayed frequency domain is determined with the two softkeys *POLAR DIAG START FREQ* and *POLAR DIAG STOP FREQ*.



Remote: CALC:FEED 'SPEC:POL'

POLAR DIAG START FREQ

The *POLAR DIAG START FREQ* softkey determines the start frequency starting from which the phases are displayed in the polar diagram. In the *MAGNITUDE VS FREQ* and *PHASE VS FREQ* diagrams, the start frequency is characterized by a display line.

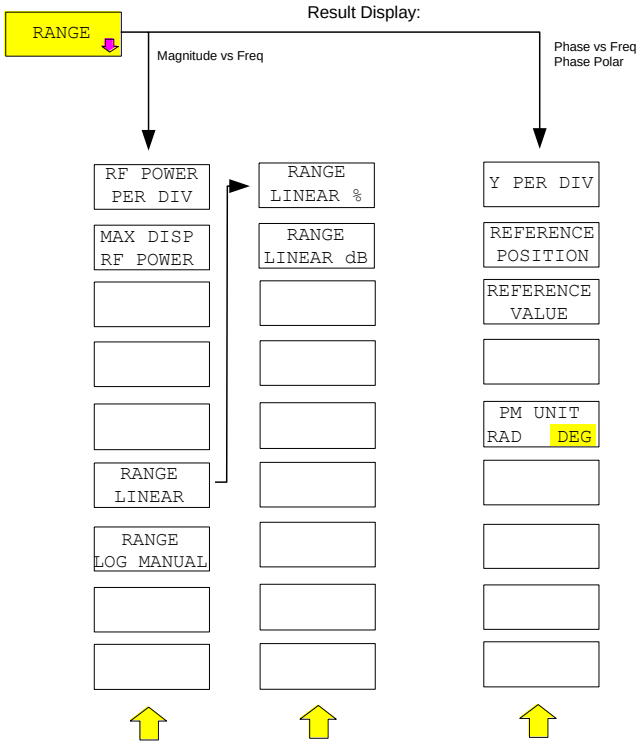
```
Remote: CALC:ADEM:MCPH:POL:FREQ:STAR 100MHz'
```

POLAR DIAG STOP FREQ

The *POLAR DIAG STOP FREQ* softkey determines the stop frequency up to which the phases are displayed in the polar diagram. In the *MAGNITUDE VS FREQ* and *PHASE VS FREQ* diagrams, the stop frequency is characterized by a display line.

```
Remote: CALC:ADEM:MCPH:POL:FREQ:STOP 120MHz'
```

3.4.3 Scaling of Measurement Results –*RANGE* Menu



The *RANGE* softkey opens a submenu to determine the diagram scaling for the selected display.

The visible selection of the softkeys depends on the selected diagram (Magnitude vs Freq / Phase vs Freq / Phase Polar).

The scaling of the level diagram (Magnitude vs Freq) is identical to the level diagrams of analog demodulation (RF Power und RF Spectrum).

3.4.4 Scaling Functions for Result Displays with Phase Diagrams

Y PER DIV

The *Y PER DIV* softkey determines the scaling of the Y axis for the two phase diagrams (Phase vs Freq / Phase Polar).

To display the phase in the frequency domain, make the entry using the unit selected by means of the *PM UNIT RAD/DEG* softkey.

In the polar diagram, the entry is made in Volt. The scaling of the X axis is coupled to the Y axis in the polar diagram.

Remote: DISP:WIND:TRAC:Y:PDIV 0.5RAD

REFERENCE POSITION

The *REFERENCE POSITION* softkey determines the position of the reference line for the phase diagram in the frequency domain. The default setting is 50 % (diagram center).

```
Remote: DISP:WIND:TRAC:Y:RPOS 50PCT
```

REFERENCE VALUE

The *REFERENCE VALUE* softkey determines the value of the reference line for phase diagram in the frequency domain. The basic setting is 0 rad.

```
Remote: DISP:WIND:TRAC:Y:RVAL 0RAD
```

PM UNIT RAD/DEG

The *PM UNIT RAD/DEG* softkey allows you to select the unit for displaying phase values.

```
Remote: UNIT:ANGL RAD
```

4 Remote Control - Description of Commands

The information in this chapter supplements and updates chapters 5 and 6 of the R&S FSP manual. This chapter contains the new commands that apply specifically to option R&S FS-K7 as well as the modified commands of the basic instrument provided they are used by R&S FS-K7.

Every attempt was made to ensure the highest possible compatibility of the R&S FS-K7 commands with those of analog demodulation of the FSE family. A few commands were included in the command set for this reason only.

In the description of menu operation in chapter 2, each softkey is indicated with the associated IEC/IEEE bus commands.

The measurements of the FM Demodulator mode are always carried out in screen A. Therefore, the commands where the numeric suffix selects the screen must either start with numeric suffix 1 (i.e. `CALCulate1)` or without a numeric suffix (i.e. `CALCulate)`.

4.1 Common Commands

***OPT?**

OPTION IDENTIFICATION QUERY queries the options included in the instrument and returns a list of the installed options. The options are separated by commas. In the response string, the identification of option R&S FS-K7 is indicated at position 32:

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
,K7,0,0,0,0,0,0,0,0
```

4.2 CALCulate Subsystem

4.2.1 CALCulate:ADEMod Subsystem

CALCulate1:ADEMod:MCPHase:POLar:FREQuency:STARt <numeric_value>

Multicarrier measurement: start frequency for range selection in polar diagram.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement.
```

```
SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

CALC1:ADEM:MCPH:POL:FREQ:STAR:STAT ON
'Switch on start frequency.

CALC1:ADEM:MCPH:POL:FREQ:STAR 20GHZ
'Set start frequency.
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate1:ADEMod:MCPHase:POLar:FREQuency:STARt:STAT ON|OFF

Multicarrier measurement: activates start frequency for range selection in polar diagram and activates display line in the frequency diagram

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement.

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

CALC1:ADEM:MCPH:POL:FREQ:STAR:STAT ON"
'Start frequency to default, activate display line.
```

Characteristics

*RST value: OFF
SCPI: device-specific

CALCulate1:ADEMod:MCPHase:POLar:FREQuency:STOP <numeric_value>

Multicarrier measurement: stop frequency for range selection in polar diagram.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement.

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

CALC1:ADEM:MCPH:POL:FREQ:STOP:STAT ON
'Switch on stop frequency

CALC1:ADEM:MCPH:POL:FREQ:STOP 20.001GHZ
'Set stop frequency.
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate1:ADEMod:MCPHase:POLar:FREQuency:STOP:STATe ON|OFF

Multicarrier measurement: activates stop frequency for range selection in polar diagram and activates display line in the frequency diagram.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement.

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

CALC1:ADEM:MCPH:POL:FREQ:STOP:STAT ON
'Stop frequency to default, activate display line.
```

Characteristics

*RST value: OFF
SCPI: device-specific

CALCulate<1|2>:ADEMod:THD:FREQuency:FUNDamental:AUTO[:STATe] ON | OFF

This command switches between automatic or manual selection of the fundamental frequency used for the SINAD and THD calculations. With automatic selection the peak in the AF spectrum is used as the fundamental frequency.
When switching the auto state off, the current modulation frequency result is used as a default for CALC:ADEM:THD:FREQ if the measurement result is available at this time.
This command is available, if Result *AF SPECTRUM* is switched on.

Example

```
CALC:ADEM:THD:FREQ:FUND:AUTO OFF
'deactivates the auto selection and uses the current
'Modulation Freq. as fundamental frequency
CALC:ADEM:THD:FREQ:FUND:VAL 1kHz
'set the fundamental frequency
```

Characteristics

*RST value: ON
SCPI: device-specific

CALCulate<1|2>:ADEMod:THD:FREQuency:FUNDamental:VALue ON | OFF

This command sets the fundamental frequency used for the SINAD and THD calculations.
The query command is available only with "CALC:ADEM:THD:FREQ:FUND:AUTO OFF".

Example

```
CALC:ADEM:THD:FREQ:FUND:AUTO OFF
'deactivates the auto selection and uses th current
```

```
'Modulation Freq.as fundamental frequency
```

Characteristics

*RST value: ON
SCPI: device-specific

4.2.2 CALCulate:DELTamarker Subsystem

The CALCulate:DELTamarker subsystem controls the delta marker functions in the instrument.

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.
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 on the activated measuring functions, the query result is output in the units below:

Result display FM:	Hz	
Result display PM:	rad | deg	
Result display AM:	%	
Result display RF POWER:	dB	(logarithmic display)
	%	(linear display)
Result display RF SPECTRUM:	dB	(logarithmic display)
	%	linear display)
Result display AF SPECTRUM:	dB	(logarithmic display)
	Hz | % | rad | deg	(linear display)

Example

```
INIT:CONT OFF
'Switch to single-sweep mode
CALC:DELT2 ON
'Switch on delta marker 2
INIT;*WA
'Start a sweep and wait for its end
CALC:DELT2:Y?
'Output measured value of delta marker 2.
```

Characteristics

*RST value: -
SCPI: device-specific

4.2.3 CALCulate:FEED Subsystem

The CALCulate:FEED subsystem selects the type of evaluation of the measured data. This corresponds to the selection of the Result Display in manual mode.
If the FM demodulator is active, the selection of the type of evaluation is independent of the measurement window. Therefore, the numeric suffix <1|2> is irrelevant and ignored.

CALCulate<1|2>:FEED <string>

This command selects the trace data to be displayed.

Parameters:

<string>::=

'SPECtrum:POLar'	Multicarrier measurement: display of phase in polar diagram.
'XFRequency:SPECtrum[:MAGNitude]'	Multicarrier measurement: magnitude diagram of RF spectrum.
'XFRequency:SPECtrum:PHASe'	Multicarrier measurement: phase diagram of RF spectrum.
'XTIM:AM:RELative[:TDOMain]'	Demodulated AM signal in standardized display.
'XTIM:AM:RELative:AFSPectrum<1...3>'	AF spectrum of the demodulated AM signal in standardized display, results referenced to traces 1 to 3.
'XTIM:AM[:ABSolute][:TDOMain]'	Demodulated AM signal in level display. Same as 'XTIM:RFPower'.
'XTIM:AM[:ABSolute]:AFSPectrum<1...3>'	AF spectrum of the demodulated AM signal in level display, results referenced to traces 1 to 3. Same as 'XTIM:RFPower:AFSPectrum'.
'XTIM:RFPower[:TDOMain]'	Demodulated AM signal in level display.
'XTIM:RFPower:AFSPectrum<1...3>'	AF spectrum of the demodulated AM signal in level display, results referenced to traces 1 to 3.
'XTIM:FM[:TDOMain]'	Demodulated FM signal.
'XTIM:FM:AFSPectrum<1...3>'	AF spectrum of the demodulated FM signal, results referenced to traces 1 to 3.
'XTIM:PM[:TDOMain]'	Demodulated PM signal
'XTIM:PM:AFSPectrum<1...3>'	AF spectrum of the demodulated PM signal
'XTIM:AMSummary<1...3>[:ABSolute]'	AM results in level display, referenced to traces 1 to 3.
'XTIM:AMSummary<1...3>:RELative'	AM results in standardized display, referenced to traces 1 to 3.
'XTIM:FMSummary<1...3>'	FM results, referenced to traces 1 to 3
'XTIM:PMSummary<1...3>'	PM results, referenced to traces 1 to 3.
'XTIM:SPECtrum'	RF spectrum of the signal determined from the measured data via FFT.

Example

```
CALC:FEED 'XTIM:FM'
'Select the display of the FM signal
```

Characteristics

*RST value: XTIM:FM'
SCPI: conforming

4.2.4 CALCulate:FORMat Subsystem

The CALCulate:FORMat subsystem defines the conversion of measured data.

CALCulate<1|2>:FORMat PHASe | UPHase

This command activates the limitation to ±180°.

Parameter:

PHASe: Limitation to ±180°
UPHase: Unwrapped

Example

```
CALC:FORM PHAS
'Activated the limitation to ±180°.
```

Characteristics

*RST value: UPAS
SCPI: conforming

4.2.5 CALCulate:MARKer Subsystem

The CALCulate:MARKer subsystem controls the marker functions in the instrument.

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

This command defines the peak excursion, i.e. the spacing below the trace maximum which must be attained before a new maximum is recognized, or the spacing above the 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 of the numerical value depends on the active display.

Example

```
CALC:MARK:PEXC 10dB
'SPECTRUM display
CALC:MARK:PEXC 100 Hz
'FM DEMOD display
```

Characteristics

*RST value: 50 kHz (for FM displays)
0.5 RAD (for PM displays)
5 PCT (for standardized AM displays)
6 dB (for level displays)
SCPI: device-specific

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

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.

Example

```
INIT:CONT OFF
'Switch to single-sweep mode

CALC:MARK2 ON
'Switch on marker 2

INIT;*WAI
'Start a sweep and waits for its end

CALC:MARK2:Y?
'Output the measured value of marker 2.
```

Characteristics

*RST value: -
SCPI: device-specific

4.2.6 CALCulate:MARKer:FUNCtion:ADEMod Subsystem

The CALCulate:MARKer:FUNCtion:ADEMod subsystem contains the marker functions for the option FM Demodulator R&S FS-K7.

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:AFRequency[:RESult<1...3>]?

This command queries the audio frequency with analog demodulation. The numeric suffix indicates whether trace 1, 2 or 3 is selected.

If several demodulation modes are activated simultaneously with command SENS:ADEM:FM:TYPE, SENS:ADEM:PM:TYPE, SENS:ADEM:AM:TYPE, SENS:ADEM:RFP:TYPE, SENS:ADEM:FM:AFSP:TYPE, SENS:ADEM:PM:AFSP:TYPE, SENS:ADEM:AM:AFSP:TYPE or SENS:ADEM:RFP:AFSP, the audio frequency of the display mode selected with CALC:FEED is returned.

Example

```
ADEM ON
'Switch on FM demodulator

CALC:FEED 'XTIM:AM:TDOM
'Switch on AM result display         or
```

```
CALC:FEED 'XTIM:FM:TDOM
'Switch on FM result display          or

CALC:FEED 'XTIM:RFP:AFSP
'Switch on AF spectrum result

DISP:TRAC ON
'display of the FM and trace           or

CALC:FEED 'XTIM:RFP:AFSP
'Switch on AF spectrum result display

DISP:TRAC ON
'of the RF power signal and trace

CALC:MARK:FUNC:ADEM:AFR?
Query audio frequency
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:AM[:RESult<1...3>]? PPEak| MPEak| MIDDle| RMS

This command queries the results of the AM modulation measurement. The numeric suffix (:RESult<1...3>) indicates whether trace 1, 2 or 3 is selected.

PPEak	Result of measurement with detector +PK
MPEak	Result of measurement with detector -PK
MIDDle	Result of averaging ±PK/2
RMS	Result of measurement with detector RMS

Example

```
ADEM ON
'Switch on FM demodulator

CALC:FEED 'XTIM:AM:REL:TDOM
'Switch on AM result display

DISP:TRAC ON
'Switch on trace

CALC:MARK:FUNC:ADEM:AM? PPE
'Query the peak value
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:CARRier[:RESult<1...3>]?

This command queries the carrier power.

With the RF power result display, the carrier power is determined from trace 1 to 3 as specified in the numeric suffix. With all other result displays, the carrier power is determined from the current trace data (CLR/WRITE trace).

Example

```
ADEM ON
'Switch on FM demodulator

CALC:FEED 'XTIM:RFP
'Switch on RF power result display

CALC:MARK:FUNC:ADEM:CARR?
'Query carrier power
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:FERRor[:RESult<1...3>]?

This command queries the frequency error with FM and PM demodulation. With FM demodulation, trace 1 to 3 is selected with the numeric suffix (:RESult<1...3>). With PM demodulation, the frequency error is determined from the current measurement data (CLR/WRITE trace).

The mean offset thus determined differs from that calculated in the `[SENSe:]ADEMod:FM:OFFSet?` query, since, for determining the frequency deviation, the modulation is removed by means of lowpass filtering, producing results that are different from those obtained by averaging with the SENSe:... command.

This command is available only for traces in the FM and PM result displays. If any other result display is selected, this command is disabled.

Example

```
ADEM ON
'Switch on FM demodulator

CALC:FEED 'XTIM:FM:TDO
'Switch on FM result display

CALC:MARK:FUNC:ADEM:FERR?
'Query frequency error of trace 1
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:FM[:RESult<1...3>]? PPEak|MPEak|MIDDle|RMS

This command queries the results of FM modulation measurement. The numeric suffix indicates whether trace 1, 2 or 3 is selected.

PPEak Result of measurement with detector +PK
MPEak Result of measurement with detector -PK
MIDDle Result of averaging ±PK/2
RMS Result of measurement with detector RMS

Example

```
ADEM ON
'Switch on FM demodulator
CALC:FEED 'XTIM:AM:REL:TDOM
'Switch on AM result display
DISP:TRAC ON
'Switch on trace
CALC:MARK:FUNC:ADEM:AM? PPE
'Query the peak value
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:PM[:RESult<1...3>]? PPEak|MPEak|MIDDle|RMS

This command queries the results of the PM modulation measurement of analog demodulation. The numeric suffix (:RESult<1...3>) indicates whether trace 1, 2 or 3 is selected.

PPEak Result of measurement with detector +PK

MPEak Result of measurement with detector -PK

MIDDle Result of averaging ±PK/2

RMS Result of measurement with detector RMS

Example

```
ADEM ON
'Switch on FM demodulator
 CALC:FEED 'XTIM:PM:TDOM
'Switch on PM result display
 DISP:TRAC ON
'Switch on trace
 CALC:MARK:FUNC:ADEM:PM? PPE
'Query the peak value
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:SINad:RESult<1...3>?

This command queries the result of the SINAD measurement. The numeric suffix (:RESult<1...3>) indicates whether trace 1, 2 or 3 is selected.

Example

```
ADEM ON"
'Switch on FM demodulator
 CALC:FEED 'XTIM:RFP:AFSP
'Switch on AF spectrum of FM
 DISP:TRAC ON
'Switch on trace
 CALC:MARK:FUNC:ADEM:SIN:RES?
'Query SINAD result
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1...4>:FUNCtion:ADEMod:THD:RESult<1...3>?

This command queries the result of the THD measurement. The numeric suffix (:RESult<1...3>) indicates whether trace 1, 2 or 3 is selected.

Example

```
ADEM ON
'Switch on FM demodulator
CALC:FEED 'XTIM:RFP:AFSP
'Switch on AF spectrum of FM
DISP:TRAC ON
'Switch on trace
CALC:MARK:FUNC:ADEM:THD:RES?
'Query THD result
```

Characteristics

*RST value: -
SCPI: device-specific

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth:RESult?

This command queries the AM modulation depth in the indicated measurement window. A complete sweep with synchronization to sweep end must be performed between switching on the function and querying the measured value to obtain a valid query result. This is only possible in single sweep mode.
The numeric suffix <1 to 4> of :MARKer is irrelevant for this command.

Example

```
INIT:CONT OFF
'Switches to single-sweep mode.

CALC:MARK:X 10MHZ
'Sets the reference marker (marker 1) to 'the carrier signal
at 10 MHz.

CALC:MARK:FUNC:MDEP ON
'Switches on the modulation depth 'measurement in screen A.

INIT;*WAI
'Starts a sweep and waits for the end.

CALC:MARK:FUNC:MDEP:RES?
'Outputs the measured value of screen A.
```

Characteristics

*RST value: -
SCPI: device-specific

This command is only a query and therefore has no *RST value.

CALCulate<1|2>:MARKer<1 to 4>:FUNCtion:MDEPth:[:STATe]

This command switches on the measurement of the AM modulation depth. An AM-modulated carrier is required on the screen for correct operation. If necessary, marker 1 is previously activated and set to the largest signal available.

The level value of marker 1 is regarded as the carrier level. On activating the function, marker 2 and marker 3 are automatically set as delta markers symmetrically to the carrier to the adjacent maxima of the trace.

If the position of delta marker 2 is changed, delta marker 3 is moved symmetrically with respect to the reference marker (marker 1). If the position of delta marker 3 is changed, fine adjustment can be performed independently of delta marker 2.

The analyzer calculates the power at the marker positions from the measured levels.

The AM modulation depth is calculated from the ratio of power values at the reference marker and the delta markers. If the two AM sidebands differ in power, the average value of the two power values is used for calculating the AM modulation depth.

The numeric suffix <1 to 4> of :MARKer is irrelevant with this command.

Example

```
CALC:MARK:X 10MHZ
'Sets the reference marker (marker 1) to 'the carrier signal
at 10 MHz

CALC:MARK:FUNC:MDEP ON
'Switches on the modulation depth 'measurement in screen A.

CALC:DELT2:X 10KHZ
'Sets delta markers 2 and 3 to the signals 'at 10 kHz from
the carrier signal

CALC:DELT3:X 9.999KHZ
'Corrects the position of delta marker 3 'relative to delta
marker 2.
```

Characteristics

*RST value: OFF
SCPI: device-specific

4.2.7 CALCulate:UNIT Subsystem

The CALCulate:Unit subsystem defines the units for the parameters that can be set and the measurement results.

CALCulate<1|2>: UNIT:ANGLe DEG | RAD

This command selects the unit for angles.

Example

CALC:UNIT:ANGL DEG"

Characteristics

*RST value: RAD
SCPI: device-specific

4.3 DISPlay Subsystem

The DISPLay subsystem controls the selection and presentation of textual and graphic information as well as of trace data on the display.

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

This command defines the scaling of the Y-axis in the current unit.
Separate scalings are maintained for the following displays:

- FM display
- PM display
- AM display
- Logarithmic AF spectrum display

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

Example

```
DISP:WIND1:TRAC:Y:PDIV 10KHz
'Set Y scale to '10 kHz/div.
```

Characteristics

*RST value: 50 kHz (FM display)
2 rad (PM display)
20 PCT (AM display)
10 dB (AF spectrum display)
SCPI: conforming

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 in TRACe<1...3> is irrelevant.
Separate reference positions are maintained for the following displays:

- RF power, RF spectrum and AF spectrum of the RF power
- FM, PM and AM
- AF spectrum of the FM, PM and A

Example

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

Characteristics

*RST value: 100 PCT (level display)
50 PCT (FM, PM or AM display)
100 PCT (AF spectrum display of the FM, PM or AM)
SCPI: conforming

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

This command defines the reference value assigned to the reference position, thus corresponding to the REFERENCE VALUE parameter in manual control. Separate reference values are maintained for the various displays.
The numeric suffix in TRACe<1...3> is irrelevant.

Example

```
DISP:WIND1:TRAC:Y:RVAL 0
'Defines the display value of the reference position at 0 dB
```

Characteristics

*RST value: 0 Hz
0 rad (PM display)
0 PCT (AM display)
250 kHz (FM AF spectrum display)
10 rad (PM AF spectrum display)
100 PCT (AM AF spectrum display)
SCPI: device-specific

DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LINear | LOGarithmic | LDB

This command switches between linear and logarithmic display in the selected window. In the case of linear display, it is also possible to switch between unit % (command `DISP:WIND:TRAC:Y:SPAC LIN`) and unit dB (command `DISP:WIND:TRAC:Y:SPAC LDB`). .
In the case of AF spectrum displays, only the parameters LINear and LOGarithmic are permitted.
The numeric suffix for TRACe<1...3> is irrelevant.

Example

```
DISP:WIND1:TRAC:Y:SPAC LIN
```

Characteristics

*RST value: LOGarithmic
SCPI: conforming

4.4 INSTrument Subsystem

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

INSTrument:NSELect 1| 3

This command switches between the operating modes by means of numbers.

Parameter:

1: Spectrum analysis mode
3: FM demodulator mode

Example

```
INST:NSEL 1
'Switch to SPECTRUM mode
```

Characteristics

*RST value: 1
SCPI: conforming

INSTrument[:SELect] SANalyzer | ADEMod

This command switches between the operating modes by means of text parameters.

Parameter:

ADEMod: FM demodulator mode
SANalyzer: Spectrum analysis mode

Example

```
INST SAN
'Switch to SPECTRUM mode
```

Characteristics

*RST value: SANalyzer
SCPI: conforming

4.5 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, i.e. it is not necessary to include the SENSe node in command sequences.

4.5.1 [SENSe:]ADEMod Subsystem

The purpose of the commands defined below is to set up the R&S FSP spectrum analyzer for the measurement of FM, PM and AM modulated signals in a way that allows to obtain as many measurement results as possible with a single shot measurement.

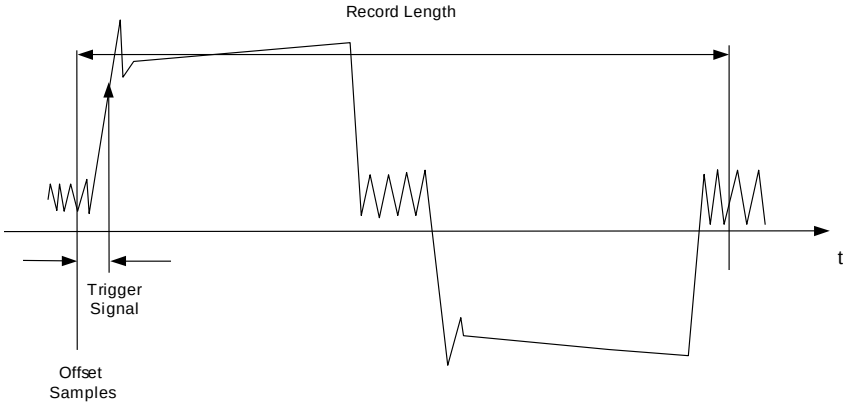
For this purpose, the R&S FSP has been equipped with a demodulator that is capable of performing both FM and AM demodulation at a time. Additionally maximum, minimum and average or current values can be obtained in parallel over a selected number of measurements. In order to make it suitable for bursted signals the demodulator can be configured in terms of pretrigger time, sample rate and record length.

Demodulation will be performed offline, i.e. on signals previously stored into memory. The I/Q memory available for this purpose is 2 x 128 k samples. The sampling rate can be selected in the range from 15.625 to 32 MHz.

The R&S FS-K supports measurement data rates up to 64 MHz, and the option R&S FS-K-B72 supports rates up to 256 MHz.

Example In the case of a *Bluetooth* signal, the signal in question is described in the following diagram:

Frequency versus time:



Measurement results of interest are:

- FM offset
- FM deviation (maximum and minimum) for signal modulated with ‘1‘ values only.
- FM deviation (maximum and minimum) for signal modulated with ‘0‘ values only.
- AM modulation depth for positive and negative burst ramp.

These values can be obtained by external computations from the frequency or amplitude versus time data. For this purpose, the R&S FSP will deliver the following results:

- Demodulated FM signal (current values, averaged, maxhold or minhold selectable)

- Demodulated AM signal (current values, averaged, maxhold or minhold selectable)
- FM offset (current value or averaged selectable)

The following settings are required on the R&S FSx:

- Types of demodulation to be performed simultaneously (AM/FM)
- Sampling rate
- Record length
- Trigger source (free run/external)
- Pretrigger samples
- Number of measurements for average/maxhold/minhold

In addition, the required measurement results need to be configured for each type of demodulation. The R&S FSx can simultaneously determine multiple types of demodulation with a maximum of 3 different result types. The following result types can be selected:

WRITe	The current measurement results are determined.
AVERage	The measurement results are averaged over a specified number of measurements
MAXHold	The maximum result values are determined over a specified number of measurements
MINHold	The minimum result values are determined over a specified number of measurements

In practice, the commands defined below are used as follows:

The instrument is set first. Then a measurement is started and the result list read in after synchronization to the end of the measurement. This method permits the control computer to be used for other tasks while the R&S FSP is performing the measurement.

Analog demodulation is only available for screen A. Therefore, it is not permissible to enter "SENSe2..." for the commands of the SENSe:ADEMod subsystem.

[SENSe:]ADEMod:AF:CENTer <numeric_value>

This command sets the center frequency for the display of the AF spectrum.

Example

```
ADEM ON
'Switch on FM demodulator
CALC:FEED 'XTIM:RFP:AFSP
'Switch on "FM AF spectrum" display

or
CALC:FEED 'XTIM:RFP:AFSP
'Switch on "AF spectrum of the RF power signal" display
```

```
ADEM:BAND 5 MHz
'Set meas. bandwidth to 5 MHz

ADEM:AF:CENT 500kHz
'Set AF center frequency to 500 kHz

ADEM:AF:SPAN 200kHz
'Set AF span to 200 kHz
```

Characteristics

*RST value: 1.25 MHz
SCPI: device-specific

[SENSe:]ADEMod:AF:COUPling AC | DC

This command selects the coupling of the AF path.

Example

```
ADEM:AF:COUP DC
'Switch on DC coupling.
```

Characteristics

*RST value: AC
SCPI: device-specific

[SENSe:]ADEMod:AF:SPAN <numeric_value>

This command sets the span for the display of the AF spectrum.
The span is limited to half the measurement bandwidth of analog demodulation (SENS:ADEM:BAND).

Example

```
ADEM ON
'Switch on FM demodulator

CALC:FEED 'XTIM:RFP:AFSP'
'Set "FM AF spectrum" display

or

CALC:FEED 'XTIM:RFP:AFSP'
'Switch on "AF spectrum of the RF power signal" display

ADEM:BAND 5 MHz
'Set meas. bandwidth to 5 MHz

ADEM:AF:CENT 500kHz
'Set AF center frequency to 500 kHz

ADEM:AF:SPAN 200kHz
'Set AF span to 200 kHz
```

Characteristics

*RST value: 2.5 MHz
SCPI: device-specific

[SENSe:]ADEMod:AF:SPAN:FULL

This command sets the maximum span for the display of the AF spectrum. The maximum span corresponds to half the measurement bandwidth of analog demodulation (SENS:ADEM:BAND).

Example

```
ADEM ON
'Switch on FM demodulator

CALC:FEED'XTIM:RFP:AFSP'
'Switch on "FM AF spectrum" display

or

CALC:FEED'XTIM:RFP:AFSP'
'Switch on "AF spectrum of the RF power signal" display

ADEM:BAND 5 MHz
'Set meas. bandwidth to 5 MHz

ADEM:AF:SPAN:FULL
'Set AF span to 2.5 MHz
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:AF:STARt <numeric_value>

This command sets the start frequency for the display of the AF spectrum.

Example

```
ADEM ON
'Switch on FM demodulator

CALC:FEED 'XTIM:RFP:AFSP'
'Switch on "FM AF spectrum" display

or

CALC:FEED 'XTIM:RFP:AFSP'
'Switch on "AF spectrum of the RF power signal" display

ADEM:BAND 5 MHz
'Set meas. bandwidth to 5 MHz

ADEM:AF:STAR 0kHz
'Set AF start frequency to 0 kHz
```

```
ADEM:AF:STOP 500kHz
'Set AF stop frequency to 500 kHz
```

Characteristics

*RST value: 0 MHz
SCPI: device-specific

[SENSe:]ADEMod:AF:STOP <numeric_value>

This command sets the stop frequency for the display of the AF spectrum. The stop frequency is limited to half the measurement bandwidth of analog demodulation (SENS:ADEM:BAND).

Example

```
ADEM ON
'Switch on FM demodulator
CALC:FEED 'XTIM:RFP:AFSP'
'Switch on "FM AF spectrum" display
or
CALC:FEED 'XTIM:RFP:AFSP'
'Switch on "AF spectrum of the RF power signal" display
ADEM:BAND 5 MHz
'Set meas. bandwidth to 5 MHz
ADEM:AF:STAR 0kHz
'Set AF start frequency to 0 kHz
ADEM:AF:STOP 500kHz
'Set AF stop frequency to 500 kHz
```

Characteristics

*RST value: 2.5 MHz
SCPI: device-specific

[SENSe:]ADEMod:BANDwidth | BWIDth:DEModulation <numeric_value>

This command defines the demodulation bandwidth for analog demodulation. Depending on the selected demodulation bandwidth, the instrument selects the required sampling rate. The available values of the demodulation bandwidths are defined by the sampling rates.

Demodulation bandwidth	Sampling rate	Comment
120 MHz	256 MHz	with R&S FSQ-B72 only
50 MHz/85 MHz (1)	128 MHz	with R&S FSQ-B72 only
30 MHz	64 MHz	with R&S FSQ only
18 MHz	32 MHz	with R&S FSQ only
10 MHz	32 MHz	
8 MHz	16 MHz	This restriction only applies to R&S FSP and R&S FSU without B72: This filter is only flat for about 6 MHz, it has a 3dB decay at 7 MHz.
5 MHz	8 MHz	
3 MHz	4 MHz	
1,6 MHz	2 MHz	
800 kHz	1 MHz	
400 kHz	500 kHz	
200 kHz	250 kHz	
100 kHz	125 kHz	
50 kHz	62.5 kHz	
25 kHz	31.25 kHz	
12.5 kHz	15.625 kHz	
6.4 kHz	7.8125 kHz	
3.2 kHz	3.90625 kHz	
1.6 kHz	1.953125 kHz	
800 Hz	976.5625 Hz	
400 Hz	488.28125 Hz	
200 Hz	244.140625 Hz	
100 Hz	122.0703125 Hz	

(1) The demodulation bandwidth at a sampling rate of 128 MHz depends on the center frequency that has been set. At a center frequency of =3.6 GHz, the demodulation bandwidth is 50 MHz; at higher center frequencies, it is 85 MHz.

Example

```
ADEM:BAND:DEM 1MHz
'Set test bandwidth to 1 MHz.
```

Characteristics

*RST value: 5 MHz
SCPI: device-specific

[SENSe:]ADEMod:MTIMe <numeric_value>

This command sets the measuring time for the analog demodulation.

Example

```
ADEM:MTIM 62. 5us
'Set measurement time to 62.5 µs.
```

Characteristics

*RST value: 62. 5us
SCPI: device-specific

[SENSe1]:ADEMod:MTIMe:AUTO ON|OFF

This command activates/deactivates the automatic measurement time of the multicarrier measurement.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement.
SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.
SENS1:ADEM: MTIM:AUTO OFF
'Set measurement time to manual setzen.
```

Characteristics

*RST value: OFF
SCPI: device-specific

[SENSe:]ADEMod:RLENgth?

This command returns the currently set record length for the analog demodulation.

Example

```
ADEM:RLEN?
'Return the current record length.
```

Characteristic:

*RST value: -
SCPI:device-specific

[SENSe:]ADEMod:SET <sample rate>,<record length>,<trigger source>,<trigger slope>,<offset samples>,<# of meas>

This command configures the FM demodulator of the R&S FSP.

Parameter:

<sample rate>: Frequency at which measured values are taken from the A/D converter and stored in I/Q memory.

Value range: 122.0703125 Hz, 244.140625 Hz, 488.28125 Hz, 976.5625 Hz, 1.953125 kHz, 3.90625 kHz, 7.8125 kHz, 15.625 kHz, 31.25 kHz, 62.5 kHz, 125 kHz, 250 kHz, 500 kHz, 1 MHz, 2 MHz, 4 MHz, 8 MHz, 16 MHz, 32 MHz

<record length>: Number of samples to be stored in I/Q memory.

Value range: 1 to 130560 (128 * 1024 - 512)

<trigger source>: Selection of the trigger source for the demodulator.

Valid values: IMMediate | EXTernal IFPower | FM | AM | AMRelative | PM

<trigger slope>: Trigger slope selected.

Valid values: POSitive | NEGative

The value indicated here will be ignored for <trigger source> = IMMediate.

<offset samples>: Number of samples to be used as an offset to the trigger signal.

Value range: -65024 to 130560 (= -64 * 1024 + 512 to 128 * 1024 - 512)

The indicated value is ignored for <trigger source> = IMMediate

<# of meas>: Number of measurements. The value indicated here is particularly necessary for the AVERage/MAXHold/MINHold function.

Value range: 0 to 32767

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Will perform a measurement with the following settings:
sample rate    = 8 MHz
record length  = 32000
trigger source = EXTernal
trigger slope  = POSitive
offset samples = -500 (= 500 samples before trigger occurs )
# of meas      = 30
```

Characteristics

*RST values:	sample rate	= 8 MHz
	record length	= 501
	trigger source	= IMMediate
	trigger slope	= POSitive
	offset samples	= 0
	# of meas	= 0

SCPI: device-specific

[SENSe:]ADEMod:SRATe?

This command returns the currently set sampling rate for the analog demodulation.

Example

```
ADEM:SRAT?
'Return the current sampling rate.
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod[:STATe] ON | OFF

This command switches on the FM demodulator of the instrument. The instrument will be set to time-domain measurement (span = 0) at the current center frequency.

Note:
The measurement is always performed in screen A. Split-screen operation will be switched off as soon as the demodulator is activated.

Example

```
ADEM ON
'Switch on the FM demodulator
```

Characteristics

*RST value: OFF
SCPI: device-specific

[SENSe:]ADEMod:ZOOM:STARt 0 s to measurement time

This command selects the start time for displaying the individual measurement values of the FM demodulator. The maximum value depends on the measurement time set in the instrument; this value can be queried with ADEM:ZOOM:START? MAX.
If the zoom function has been switched on, 501 (R&S FSP) or 625 (R&S FSU and R&S FSQ) measurement points will be displayed starting at the time that has been set.

Example

```
ADEM:ZOOM ON
'Switch on zoom function
ADEM:ZOOM:STAR 500us
'Set display starting point to 500 µs
```

Characteristics

*RST value: 0 s
SCPI: device-specific

[SENSe:]ADEMod:ZOOM[:STATe>] ON | OFF

This command switches the zoom function for the measurement data of the FM demodulator on or off. Depending on the selected measurement time and demodulation bandwidth, more measurement points are captured than can be shown on the display.
If the zoom function has been switched on, exactly 501 (R&S FSP) or 625 (R&S FSU and R&S FSQ) measurement points from the measured value memory will be shown starting at the time defined with [SENS:]ADEM:ZOOM:STARt.
If the zoom function has been switched off, all measurement points will be compressed down to the number of points available on the display by means of data reduction.

Example

```
ADEM:ZOOM ON
'Switch on the zoom function.
```

Characteristics

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

4.5.2 [SENSe:]ADEMod:AM Subsystem

[SENSe:]ADEMod:AM[:ABSolute]:AFSPectrum:RESult? <result type>

This command reads out the result data of the AF spectrum of the RF signal in the time domain for the specified result type. The format of the output data is defined using the FORMat command.

Note:
Traces cannot be queried when VIEW is active.

Parameters

<result type>:

WRITe	The current measured values are returned.
AVERage	The measurement results averaged over the specified number of measurements are returned.
MAXHold	The maximum result over the specified number of measurements is returned.
MINHold	The minimum result over the specified number of measurements is returned.

Note:
The specified result type must be one that was configured with the command [SENSe:] ADEMod:AM[:ABSolute]:AFSPectrum[:TYPE]. Otherwise, a query error will be generated.

Return values:

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit is dBm (logarithmic display) or V (linear display).

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>
where

#4	Number of digits in the following number of data bytes (= 4 in the Example)
1024	Number of following data bytes *(# of DataBytes* = 1024 in the Example)
<value x>	4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator
ADEM:FM AVER,MAXH,MINH
'Select FM results to be measured
ADEM:AM WRIT,OFF,OFF
'Select results of the RF signal to be 'measured in the time
domain
ADEM:AM:AFSP FSP WRIT,OFF,OFF
'Select the AF spectrum results of the 'RF signal to be
measured in the time 'domain
ADEM ON
'Switch on demodulator
INIT;*WAI
'Start measurement and wait for end
FORM ASC
'Select output format
ADEM:FM:RES? AVER
'Read FM average value result data
ADEM:FM:RES? MAXH
'Read FM MAXHold result data
```

```
ADEM:FM:RES? MINH
'Read FM MINHold result data
ADEM:AM:RES? WRIT
'Read current AM result data
ADEM:AM:AFSP:RES? WRIT
'Read current AF spectrum resul 'data of the RF signal in the
time domain
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:AM[:ABSolute]:AFSPectrum[:TYPE] <result type 1>,<result type 2>,<result type 3>

This command selects the AF spectrum result types of the RF signal in the time domain to be measured simultaneously.

Parameters

<result type 1/2/3>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results are averaged over the specified number of measurements.
	MAXHold	The maximum result over the specified number of measurements is determined.
	MINHold	The minimum result over the specified number of measurements is determined.
	VIEW	The measurement result is frozen on the display, i.e. it is not recalculated in further measurements.
	OFF	The result type is not used.

Settings different from OFF can be assigned to only one result type at a time.
Together with other signals, a maximum of six traces can be activated simultaneously.
For example, three FM and three PM result types can be activated simultaneously.
If all result types are set to OFF, no AF spectrum of the RF signal in the time domain will be calculated.
The result type AF spectrum of the RF signal in the time domain cannot be activated simultaneously with other AF spectra.

Examples:

```
ADEM:AM:AFSP FSP AVER,MAXH,MINH
'Determine average, maximum and minimum simultaneously
ADEM:AM:AFSP FSP WRIT,OFF,OFF
'Determine only the current measurement results
ADEM:AM:AFSP OFF,OFF,OFF
'Switch off calculation of the AF spectrum
```

Characteristics

*RST values: OFF,OFF,OFF
SCPI: device-specific

[SENSe:]ADEMod:AM[:ABSolute][:TDOMain]:RESult? <result type>

This command reads the result data obtained by AM demodulation depending on the type indicated as a parameter. The data format of the output data is defined by the FORMat command.

Note:
Traces cannot be queried when VIEW is active.

Parameters:

<result type>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results averaged over the specified number of measurements are obtained.
	MAXHold	The maximum result is determined over the specified number of measurements.
	MINHold	The minimum result is determined over the specified number of measurements.

Note:
The result type indicated must be one that was configured with the command [SENSe:]ADEMod:AM[:ABSolute][:TDOMain] [:TYPE]. Otherwise, a query error will be generated.

Return values:

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit is dBm (logarithmic display) or V (linear display).

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>

with

#4	Number of digits in the following number of data bytes (= 4 in the Example)
1024	Number of following data bytes (*# of DataBytes*, = 1024 in the Example)
<value x>	4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set up demodulator parameters

ADEM:FAM AVER,MAXH,MINH
'Select results to measure

ADEM ON
'Switch on demodulator

INIT;*WAI
'Start measurement and wait for end

FORM ASC
'Select output format

ADEM:FM:RES? AVER
'Read average results

ADEM:FM:RES? MAXH
'Read MAXHold results

ADEM:FM:RES? MINH
'Read MINHold results
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:AM:RELative:AFSPectrum:RESult? <result type>

This command reads out the result data of the AF spectrum of the AM-demodulated signal for the specified result type. The format of the output data is defined using the FORMat command.

Note:

Traces cannot be queried when VIEW is active.

Parameter:

<result type>:	WRITe	The current measured values are returned.
	AVERage	The measurement results averaged over the specified number of measurements are returned.
	MAXHold	The maximum result over the specified number of measurements is returned.
	MINHold	The minimum result over the specified number of measurements is returned.

Note:

The specified result type must be one that was configured with the command [SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE]. Otherwise, a query error will be generated.

Return values:

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit is dBm (logarithmic display) or % (linear display).

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>

Where

#4	Number of digits in the following number of data bytes (= 4 in the Example)
1024	Number of following data bytes *(# of DataBytes* = 1024 in the Example)
<value x>	4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator
ADEM:FM AVER,MAXH,MINH
'Select the FM results to be measured
ADEM:AM:REL WRIT,OFF,OFF
'Select the AM results to be
'measured
ADEM:AM:REL:AFSP WRIT,OFF,OFF
'Select the AF spectrum results of the 'demodulated AM signal
to be measured
ADEM ON
'Switch on demodulator
INIT;*WAI
'Start measurement and wait for end
FORM ASC
'Select output format
ADEM:FM:RES? AVER
'Read FM average value result data
ADEM:FM:RES? MAXH
'Read FM MAXHold result data
ADEM:FM:RES? MINH
'Read FM MINHold result data
ADEM:AM:REL:RES? WRIT
'Read current AM result data
ADEM:AM:REL:AFSP:RES? WRIT
'Read current AF spectrum result data of the demodulated AM
```

signal

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:AM:RELative:AFSPectrum[:TYPE] <result type 1>,<result type 2>,<result type 3>

This command selects the AF spectrum result types of the AM-demodulated signal to be measured simultaneously.

Parameter:

<result type 1/2/3>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results are averaged over the specified number of measurements.
	MAXHold	The maximum result over the specified number of measurements is determined.
	MINHold	The minimum result over the specified number of measurements is determined.
	VIEW	The measurement result is frozen on the display, i.e. it is not recalculated in further measurements.
	OFF	The result type is not used.

Settings different from OFF can be assigned to only one result type at a time. Together with other signals, a maximum of six traces can be activated simultaneously. For example, three FM and three PM result types can be activated simultaneously. If all result types are set to OFF, no AF spectrum of the AM-demodulated signal will be calculated.
The result type AF spectrum of the AM-demodulated signal cannot be activated simultaneously with other AF spectra.

Examples:

```
ADEM:AM:REL:AFSP AVER,MAXH,MINH
'Determine average, maximum and minimum value simultaneously

ADEM:AM:REL:AFSP WRIT,OFF,OFF
'Determine only the current measured values

ADEM:AM:REL:AFSP OFF,OFF,OFF
'Switch off calculation of the AF spectrum
```

Characteristics

*RST values: OFF,OFF,OFF
SCPI: device-specific

[SENSe:]ADEMod:AM:RELative[:TDOMain]:RESult? <result type>

This command reads out the result data of the AM demodulation for the specified result type. The format of the output data is defined using the FORMat command.

Note:
Traces cannot be queried when VIEW is active.

<result type>:	WRITe	The current measured values are returned.
	AVERage	The measurement results averaged over the specified number of measurements are returned.
	MAXHold	The maximum result over the specified number of measurements is returned.
	MINHold	The minimum result over the specified number of measurements is returned.

Note:
The specified result type must be one that was configured with the command [SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE]. Otherwise, a query error will be generated.

Return values:

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit is %.

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>

where

#4	Number of digits in the following number of data bytes (= 4 in the Example)
1024	Number of following data bytes *(# of DataBytes* = 1024 in the Example)
<value x>	4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator

ADEM:FM AVER,MAXH,MINH
'Select FM results to be measured

ADEM:AM:REL WRIT,OFF,OFF
'Select AM results to be measured

ADEM ON
'Switch on demodulator
```

```
INIT;*WAI
'Start measurement and wait for end

FORM ASC
'Select output format

ADEM:FM:RES? AVER
'Read FM average result data

ADEM:FM:RES? MAXH
'Read FM MAXHold result data

ADEM:FM:RES? MINH
'Read FM MINHold result data

ADEM:AM:REL:RES? WRIT
'Read current AM result data
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:AM:RELative[:TDOMain][:TYPE] <result type 1>,<result type 2>,<result type 3>

This command selects the result types to be measured simultaneously in the case of AM demodulation.

Parameter:

<result type 1/2/3>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results are averaged over the specified number of measurements.
	MAXHold	The maximum result over the specified number of measurements is determined.
	MINHold	The minimum result over the specified number of measurements is determined.
	VIEW	The measurement result is frozen on the display, i.e. it is not recalculated in further measurements.
	OFF	The result type is not used.

Settings different from OFF can be assigned to only one result type at a time.
Together with other signals, a maximum of six traces can be activated simultaneously. For example, three FM and three PM result types can be activated simultaneously
If all result types are set to OFF, the AM demodulator will be switched off.

Examples:

```
ADEM:AM:REL AVER,MAXH,MIN
'Determine average, maximum and minimum value simultaneously
```

```
ADEM:AM:REL WRIT,OFF,OFF
'Determine only the current measured values
ADEM:AM:REL OFF,OFF,OFF
'Switch off the AM demodulator
```

Characteristics

*RST values: WRITe,OFF,OFF

SCPI: device-specific

4.5.3 [SENSe:]ADEMod:FM Subsystem

[SENSe:]ADEMod:FM:AFSPectrum:RESult? <result type>

This command reads out the result data of the AF spectrum of the FM-demodulated signal for the specified result type. The format of the output data is defined using the FORMat command.

Note:
Traces cannot be queried when VIEW is active.

Parameter:

<result type>:	WRITe	The current measured values are returned.
	AVERage	The measurement results averaged over the specified number of measurements are returned.
	MAXHold	The maximum result over the specified number of measurements is returned.
	MINHold	The minimum result over the specified number of measurements is returned.

Note:
The specified result type must be one that was configured with the command [SENSe:]ADEMod:FM:AFSPectrum[:TYPE]. Otherwise, a query error will be generated.

Return values:

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit is dBm (logarithmic display) or V (linear display).

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>

where

#4 Number of digits in the following number of data bytes (= 4 in the

Example)
1024 Number of following data bytes *(# of DataBytes* = 1024 in the Example)
<value x> 4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator
ADEM:FM AVER,MAXH,MINH
'Select FM results to be measured
ADEM:AM:REL WRIT,OFF,OFF
'Select AM results to be measured
ADEM:FM:AFSP WRIT,OFF,OFF
'Select AF spectrum results of the 'demodulated FM signal to
be 'measured
ADEM ON
'Switch on demodulator
INIT;*WAI
'Start measurement and wait for end
FORM ASC
'Select output format
ADEM:FM:RES? AVER
'Read FM average result data
ADEM:FM:RES? MAXH
'Read FM MAXHold result data
ADEM:FM:RES? MINH
'Read FM MINHold result data
ADEM:AM:RES? WRIT
'Read current AM result data
ADEM:FM:AFSP:RES? WRIT
'Read current AF spectrum result data 'of the demodulated FM
signal
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:FM:AFSPectrum[:TYPE] <result type 1>,<result type 2>,<result type 3>

This command selects the AF spectrum result types of the FM-demodulated signal to be measured simultaneously.

Parameter:

<result type 1/2/3>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results are averaged

	over the specified number of measurements.
MAXHold	The maximum result over the specified number of measurements is determined.
MINHold	The minimum result over the specified number of measurements is determined.
VIEW	The measurement result is frozen on the display, i.e. it is not recalculated in further measurements.
OFF	The result type is not used.

Settings different from OFF can be assigned to only one result type at a time.

Together with other signals, a maximum of six traces can be activated simultaneously. For example, three FM and three PM result types can be activated simultaneously.
If all result types are set to OFF, no AF spectrum of the FM-demodulated signal will be calculated.
The result type AF spectrum of the FM-demodulated signal cannot be activated simultaneously with other AF spectra.

Examples:

```
ADEM:FM:AFSP AVER,MAXH,MINH
'Determine average, maximum and minimum value simultaneously

ADEM:FM:AFSP WRIT,OFF,OFF
'Determine only the current measured values

ADEM:FM:AFSP OFF,OFF,OFF
'Switch off calculation of the AF spectrum
```

Characteristics

*RST values: OFF,OFF,OFF
SCPI: device-specific

[SENSe:]ADEMod:FM:OFFSet? <result type>

This command calculates the FM offset of the current measured data set.

If averaging has been activated prior to data acquisition (using the command [SENSe:]ADEMod:FM [:TYPE]), the average FM offset can also be obtained by setting <result type> = AVERage. The average FM offset obtained in this way differs from the one calculated by CALC:MARK:FUNC:ADEM:FERR?, since, for determination of the frequency deviation, the modulation is removed by means of lowpass filtering, producing results that are different from those obtained by averaging.

Parameters:

<result type>:	IMMediate	The current measurement results are used for calculating the FM offset.
	AVERage	The measurement results averaged over the

specified number of measurements are used for calculation of the FM offset.

Note:
If no average measurement has been active during the last measurement sequence, only the command [SENSe:]ADEMod:FM:OFFSet? IMMediate will return a valid result (data to calculate the FM offset are taken from the last measured data set).
[SENSe:]ADEMod:FM:OFFSet? AVERage will cause a query error in this case.

Example

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator to perform '30 measurements

ADEM:FM AVER,OFF,OFF
'Set FM results to perform
'averaging

ADEM:AM OFF,OFF,OFF
'Switch off AM demodulation

ADEM ON
'Switch on FM demodulator

INIT;*WAI
'Start measurement and wait 'for end

ADEM:FM:OFFS? IMM
'Read FM offset of last measurement of the sequence 'of 30

ADEM:FM:OFFS? AVER
'Read FM offset averaged over 30 measurements
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:FM[:TDOMain]:RESult? <result type>

This command reads the result data obtained by FM demodulation depending on the type indicated as a parameter. The data format of the output data is defined by the FORMat command.

Note:
Traces cannot be queried when VIEW is active.

Parameter:

<result type>:

WRITe	The current trace data is recorded.
AVERage	The measurement results averaged over the specified number of measurements are obtained.
MAXHold	The maximum result is determined over the specified number of measurements.
MINHold	The minimum result is determined over the specified number of measurements.

Note:
The specified result type must be one that was configured with the command [SENSe:]ADEMod:FM[:TYPE]. Otherwise, a query error will be generated.

Return values:

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit is Hz.

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>

with

#4	Number of digits (= 4 in the Example) of the following number of data bytes
1024	Number of following data bytes *(# of DataBytes* = 1024 in the Example)
<value x>	4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator 'parameters

ADEM:FM AVER,MAXH,MINH
'Select FM results to measure

ADEM:AM WRIT,OFF,OFF
'Select AM results to measure

ADEM ON
'Switch on demodulator

INIT;*WAI
'Start measurement and wait 'for end

FORM ASC
'Select output format

ADEM:FM:RES? AVER
'Read FM average results

ADEM:FM:RES? MAXH
'Read FM MAXHold results

ADEM:FM:RES? MINH
'Read FM MINHold result data

ADEM:AM:RES? WRIT
'Read current AM results
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:FM[:TDOMain][:TYPE] <result type 1>,<result type 2>,<result type 3>

This command selects the result types to be created in parallel by FM demodulation.

Parameters:

<result type 1/2/3>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results are averaged over the specified number of measurements.
	MAXHold	The maximum result is determined over the specified number of measurements.
	MINHold	The minimum result is determined over the specified number of measurements.
	VIEW	The measurement result is frozen on the display, i.e. it is not recalculated in further measurements.
	OFF	The result type is not used.

Note:
Settings different from OFF can be assigned to only one result type at a time. Together with other signals, a maximum of six traces can be activated simultaneously. For example, three FM and three PM result types can be activated simultaneously.

The FM demodulator is deactivated by setting all result types to OFF.

Examples:

```
ADEM:FM AVER,MAXH,MINH
'Determine average, maximum and minimum value simultaneously

ADEM:FM WRIT,OFF,OFF
'Determine only the current measurement result

ADEM:FM OFF,OFF,OFF
'Switch off the FM demodulator
```

Characteristics

*RST values: WRITe,OFF,OFF
SCPI: device-specific

4.5.4 [SENSe:]ADEMod:MCPHase Subsystem

[SENSe1]:ADEMod:MCPHase:METHod ORTHogonal|FLATtop

The command selects the method for the multicarrier measurement.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurementSENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

SENS1:ADEM:MCPH:METH  ORTHl
'Select method.
```

Characteristics

*RST value: ORTH
SCPI: device-specific

[SENSe1]:ADEMod:MCPHase:POLar:RESult?

Multicarrier measurement: query of polar trace irrespective of selected diagram, Returns list with magnitude/phase pairs.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on..

SENS1:ADEM:MCPH:POL:RESult?
'Trace query
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe1]:ADEMod:MCPHase:SPACing <numeric_value>

The command enters the carrier spacing of the multicarrier measurement.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

SENS1:ADEM:MCPH: SPAC 100KHZ
'Enter spacing.
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe1]:ADEMod:MCPHase:STATe ON|OFF

The command activates/deactivates the multicarrier phase measurement.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on
```

Characteristics

*RST value: OFF
SCPI: device-specific

4.5.5 [SENSe:]ADEMod:PM Subsystem

[SENSe:]ADEMod:PM:AFSPectrum:RESult? <result type>

This command reads out the result data of the AF spectrum of the PM-demodulated signal for the specified result type. The format of the output data is defined using the FORMat command.

Note:
Traces cannot be queried when VIEW is active.

Parameter:

<result type>:

WRITe	The current measured values are returned.
AVERage	The measurement results averaged over the specified number of measurements are returned.
MAXHold	The maximum result over the specified number of measurements is returned.
MINHold	The minimum result over the specified number of measurements is returned.

Note:
The specified result type must be one that was configured with the command [SENSe:]ADEMod:PM:AFSPectrum[:TYPE]. Otherwise, a query error will be generated.

R**eturn values:**

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit is dB (logarithmic display) or depends on the unit selected - either RAD or DEG (linear display).

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>
where

#4	Number of digits in the following number of data bytes (= 4 in the Example)
1024	Number of following data bytes *(# of DataBytes* = 1024 in the Example)
<value x>	4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator

ADEM:PM AVER,MAXH,MINH
'Select PM results to be measured

ADEM:AM:REL WRIT,OFF,OFF
'Select AM results to be measured

ADEM:PM:AFSP WRIT,OFF,OFF
'Select AF spectrum results of the 'demodulated PM signal to
be 'measured

ADEM ON
'Switch on demodulator

INIT;*WAI
'Start measurement and wait for end

FORM ASC
'Select output format

ADEM:PM:RES? AVER
'Read PM average result data

ADEM:PM:RES? MAXH
'Read PM MAXHold result data

ADEM:PM:RES? MINH
'Read PM MINHold result data

ADEM:AM:RES? WRIT
'Read current AM result data

ADEM:PM:AFSP:RES? WRIT
'Read current AF spectrum result data 'of the demodulated PM
signal
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:PM:AFSPectrum[:TYPE] <result type 1>,<result type 2>, <result type 3>

This command selects the AF spectrum result types of the PM-demodulated signal to be measured simultaneously.

Parameter:

<result type 1/2/3>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results are averaged over the specified number of measurements.
	MAXHold	The maximum result over the specified number of measurements is determined.
	MINHold	The minimum result over the specified number of measurements is determined.
	VIEW	The measurement result is frozen on the display, i.e. it is not recalculated in further measurements.
	OFF	The result type is not used.

Settings different from OFF can be assigned to only one result type at a time. Together with other signals, a maximum of six traces can be activated simultaneously. For example, three PM and three PM result types can be activated simultaneously. If all result types are set to OFF, no AF spectrum of the PM-demodulated signal will be calculated.
The result type AF spectrum of the PM-demodulated signal cannot be activated simultaneously with other AF spectra.

Examples:

```
ADEM:PM:AFSP AVER,MAXH,MINH
'Determine average, maximum and minimum value simultaneously

ADEM:PM:AFSP WRIT,OFF,OFF
'Determine only the current measured values

ADEM:PM:AFSP OFF,OFF,OFF'
Switch off calculation of the AF spectrum
```

Characteristics

*RST values: OFF,OFF,OFF
SCPI: device-specific

[SENSe:]ADEMod:PM:RPOint[:X] 0s to measurement time

This command determines the position where the phase of the PM-demodulated signal is set to 0 rad. The maximum possible value depends on the measurement time selected in the instrument; this value is output in response to the query ADEM:PM:RPO:X? MAX.

Example

```
ADEM:PM:RPO:X 500us
'Set the position where the phase to 0 rad setting to 500 µs.
```

Characteristics

***RST** value 0 s
SCPI: conforming

[SENSe:]ADEMod:PM[:TDOMain]:RESult? <result type>

This command reads the result data obtained by PM demodulation depending on the type indicated as a parameter. The data format of the output data is defined by the FORMat command.

Note:
Traces cannot be queried when VIEW is active.

Parameter:

<result type>:	WRITe	The current trace data is recorded.
	AVERage	The measurement results averaged over the specified number of measurements are obtained.
	MAXHold	The maximum result is determined over the specified number of measurements.
	MINHold	The minimum result is determined over the specified number of measurements.

Note:
The specified result type must be one that was configured with the command [SENSe:]ADEMod:PM[:TYPE]. Otherwise, a query error will be generated.

Return values:

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma-separated values (CSV) of the measured values in floating point format. The output unit depends on the unit selected - either RAD or DEG.

Binary format (FORMat REAL,32):

In this case, the command will return binary data (Definite Length Block Data according to IEEE 488.2), with each measured value formatted in 32-bit IEEE 754 floating point format. The response string will have the following structure:

#41024<value1><value2>...<value n>

with

#4	Number of digits (= 4 in the Example) of the following number of data bytes
1024	Number of following data bytes *(# of DataBytes* = 1024 in the Example)
<value x>	4-byte floating point value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Set demodulator 'parameters

ADEM:PM AVER,MAXH,MINH
'Select PM results to measure

ADEM:AM WRIT,OFF,OFF
'Select AM results to measure

ADEM ON
'Switch on demodulator

INIT;*WAI
'Start measurement and wait 'for end

FORM ASC
'Select output format

ADEM:PM:RES? AVER
'Read PM average results

ADEM:PM:RES? MAXH
'Read PM MAXHold results

ADEM:PM:RES? MINH
'Read PM MINHold result data

ADEM:AM:RES? WRIT
'Read current AM results
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:PM[:TDOMain] [:TYPE] <result type 1>,<result type 2>,<result type 3>

This command selects the result types to be created in parallel by PM demodulation.

Parameter:

<result type 1/2/3>:	WRITe	The current measured values are recorded.
	AVERage	The measurement results are averaged over the specified number of measurements.
	MAXHold	The maximum result is determined over the specified number of measurements.
	MINHold	The minimum result is determined over the specified number of measurements.
	VIEW	The measurement result is frozen on the display, i.e. it is not recalculated in further measurements.
	OFF	The result type is not used.

Settings different from OFF can be assigned to only one result type at a time.

Together with other signals, a maximum of six traces can be activated simultaneously. For example, three PM and three PM result types can be activated simultaneously.

The PM demodulator is deactivated by setting all result types to OFF.

Examples:

```
ADEM:PM AVER,MAXH,MINH
'Determine average, maximum and minimum value simultaneously

ADEM:PM WRIT,OFF,OFF
'Determine only the current measurement result

ADEM:PM OFF,OFF,OFF'
Switch off the PM demodulator
```

Characteristics

*RST values: WRITe,OFF,OFF
SCPI: device-specific

4.5.6 [SENSe:]ADEMod:SPECtrum Subsystem

[SENSe:]ADEMod:SPECtrum:BANDwidth|BWIDth[:RESolution] 1 Hz to 10 MHz

This command sets the resolution bandwidth for spectrum represetation that was determined from the analog demodulation data.
The recording time required is calculated from the and the sampling rate indirectly set via ADEM:SPEC:SPAN:MAX or ADEM:BAND. If the available recording time is not sufficient for the given bandwidth, the recording time is set to ist maximum and the resolution bandwidth is enlarged to the resulting bandwidth.

Example

```
ADEM ON
'Switches on the FM demodulator
CALC:FEED 'XTIM:SPEC'
'Switches on the result display RF spectrum
or
 CALC:FEED 'XTIM:FM:AFSP'
'Switches on the result display AF spectrum of FM
or
CALC:FEED 'XTIM:RFP:AFSP'
'Switches on the result display AF spectrum  of RF power signal
ADEM:BAND:RES 61.2kHz
'Sets the resolution bandwidth to 61.2 kHz.
```

Characteristics

*RST value: 61.2 kHz
SCPI: device-specific

[SENSe1]:ADEMod:SPECtrum[:MAGNitude]:RESult? WRITe | AVERage| MAXHold | MINHold

This command queries the magnitude trace irrespective of the diagram in the multicarrier measurement.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement.
SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

CALC1:FEED 'XFR:SPEC'
'Magnitude diagram.
SENS1:ADEM:SPEC:TYPE WRIT, OFF, OFF
'Trace mode
SENS1:ADEM:SPEC: RESult? WRIT
'Trace query
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe1]:ADEMod:SPECtrum[:MAGNitude]:TYPE WRITe | AVERage | MAXHold | MINHold | VIEW | OFF, WRITe | AVERage | MAXHold | MINHold | VIEW | OFF, WRITe | AVERage | MAXHold | MINHold | VIEW | OFF

This command sets the trace mode for magnitude in the multicarrier measurement.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.
CALC1:FEED 'XFR:SPEC'
'Magnitude diagram.

SENS1:ADEM:SPEC:TYPE WRIT, OFF, OFF
'Trace mode
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe1]:ADEMod:SPECtrum:PHASe:RESult? WRITe | AVERage| MAXHold | MINHold

This command queries the phase trace irrespective of the diagram in the multicarrier measurement.

Example

```
SENS1:ADEM ON
'Switch on Ademod measurement

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

CALC1:FEED 'XFR:PHAS'
'Phase diagram.
SENS1:ADEM:SPEC:PHAS:TYPE WRIT, OFF, OFF
'Trace mode
SENS1:ADEM:SPEC:PHAS: RES? WRIT
'Trace query
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe1]:ADEMod:SPECtrum:PHASe:TYPE WRITe | AVERage | MAXHold | MINHold | VIEW | OFF, WRITe | AVERage | MAXHold | MINHold | VIEW | OFF, WRITe | AVERage | MAXHold | MINHold | VIEW | OFF

This command sets the trace mode for phase in the multicarrier measurement.

Example

```
SENS1:ADEMod ON
'Switch on Ademod measurement.

SENS1:ADEM:MCPH:STAT ON
'Multicarrier measurement on.

CALC1:FEED 'XFR:PHAS'
'Phase diagram.

SENS1:ADEM:SPECtrum:PHASe:TYPE WRIT, OFF, OFF
'Trace mode
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe:]ADEMod:SPECtrum:RESult? <result type>

This command reads the result data obtained by RF SPECtrum measurement depending on the type indicated as a parameter. The data format of the output data block is defined by the FORMat command.

Note:

It is not possible to read out trace data when result type VIEW is selected.

Parameters:

<result type>:	WRITe	The current measurement results will be obtained
	AVERage	The measurement results will be averaged over the given # of measurements
	MAXHold	The maximum result values will be obtained over the given # of measurements
	MINHold	The minimum result values will be obtained over the given # of measurements

Note:

The result type indicated must be one of those configured by [SENSe:]ADEMod:SPEC[:TYPE]. Otherwise a query error will be generated.

Return Values:

ASCII Format (FORMat ASCII):

In this case the command will yield a list of comma separated values (CSV) of the measured values in floating point format. The output unit is dBm.

Binary Format (FORMat REAL,32):

In this case the command will yield binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32 Bit IEEE 754 Floating-Point-Format. The schematics of the result string will be as follows:

#41024<value1><value2>...<value n>
with

#4	number of digits (= 4 in the Example) of the following number of data bytes
1024	number of following data bytes (= 1024 in the Example)
<value x>	4-Byte-Floating Point Value

Examples:

```
ADEM:SET 8MHz,32000,EXT,POS,-500,30
'Sets up demodulator parameters

ADEM:SPEC AVER,MAXH,MINH
'Sets up RF spectrum results to measure

ADEM:SPEC WRIT,OFF,OFF
'Sets up AM results to measure

ADEM ON
'Switches on demodulator
```

```
INIT;*WAI
'Starts measurement and waits for sync

FORM ASC
'Selects output format

ADEM:SPEC:RES? AVER
'Reads RF spectrum average results

ADEM:SPEC:RES? MAXH
'Reads RF spectrum max hold results

ADEM:SPEC:RES? MINH
'Reads RF spectrum min hold results

ADEM:SPEC:RES? WRIT
'Reads spectrum current results
```

Characteristics

*RST values: -
SCPI: device-specific

[SENSe:]ADEMod:SPECtrum:SPAN[:MAXimum] <numeric_value>

This command sets the maximum frequency range for displaying the RF spectrum that was determined from the FM demodulation data. The maximum span corresponds to the measurement bandwidth of analog demodulation (SENS:ADEM:BAND).

Span	Sampling rate	Comment
120 MHz	256 MHz	with R&S FSQ-B72 only
50 MHz/85 MHz (1)	128 MHz	with R&S FSQ-B72 only
30 MHz	64 MHz	with R&S FSQ only
18 MHz	32 MHz	with R&S FSQ only
10 MHz	32 MHz	
8 MHz	16 MHz	This restriction only applies to R&S FSP and R&S FSU without B72: This filter is only flat for approx. 6 MHz; it has a 3 dB decay at 7 MHz.
5 MHz	8 MHz	
3 MHz	4 MHz	
1,6 MHz	2 MHz	
800 kHz	1 MHz	
400 kHz	500 kHz	
200 kHz	250 kHz	
100 kHz	125 kHz	
50 kHz	62.5 kHz	
25 kHz	31.25 kHz	
12.5 kHz	15.625 kHz	
6.4 kHz	7.8125 kHz	
3.2 kHz	3.90625 kHz	
1.6 kHz	1.953125 kHz	
800 Hz	976.5625 Hz	
400 Hz	488.28125 Hz	
200 Hz	244.140625 Hz	
100 Hz	122.0703125 Hz	

(1) The demodulation bandwidth at a sampling rate of 128 MHz depends on the center frequency that has been set. At a center frequency of =3.6 GHz, the demodulation bandwidth is 50 MHz; at higher center frequencies, it is 85 MHz.

Example

```
ADEM ON"
'Switches on the FM demodulator

CALC:FEED 'XTIM:SPEC'
'Switches on result display RF spectrum

ADEM:SPEC:SPAN:MAX 5 MHz
'Sets the max. span to 5 MHz

ADEM:SPEC:SPAN:ZOOM 1 MHz
'Sets the displayed span to 1 MHz
```

Characteristics

*RST value: 5 MHz
SCPI: device-specific

[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM <numeric_value>

This command sets the frequency range for result display of RF spectrum determined from FM demodulation data. The frequency range for result display is limited to the maximum span (SENS:ADEM:SPEC:SPAN:MAX) or to the measurement bandwidth of analog demodulation (SENS:ADEM:BAND).

Example

```
ADEM ON
'Switches on the FM demodulator

CALC:FEED 'XTIM:SPEC'
'Switches on result display RF spectrum"
ADEM:SPEC:SPAN:MAX 5 MHz
'Sets the maximum span to 5 MHz

ADEM:SPEC:SPAN:ZOOM 1 MHz
'Sets displayed span to 1 MHz
```

Characteristics

*RST value: 5 MHz
SCPI: device-specific

[SENSe:]ADEMod:SPECtrum[:TYPE] <result type 1>,<result type 2>,<result type 3>

This command selects the result types to be created in parallel by the RF SPECtrum measurement with active analog demodulation.

Parameters:

<result type 1/2/3>.	WRITe	The current measurement results will be obtained
	AVERage	The measurement results will be averaged over the given # of measurements
	MAXHold	The maximum result values will be obtained over the given # of measurements
	MINHold	The minimum result values will be obtained over the given # of measurements
	VIEW	The measurement results are frozen and displayed, i.e. they are not calculated for subsequent measurements.
	OFF	The result type will not be used.

Each value besides OFF can only be assigned to one result type at a time.

Together with other signals, a maximum of six traces can be activated simultaneously. For example, three FM and three PM result types can be activated simultaneously.

If all result types are set to OFF, switch off calculation of the AF spectrum.

Examples

```
ADEM:SPEC AVER,MAXH,MINH
'Creates average, max hold and min hold values at a time
ADEM:SPEC WRIT,OFF,OFF
'Only creates the current measurement values
ADEM:SPEC OFF,OFF,OFF
'Switches FM demodulation off
```

Characteristics

*RST values: OFF,OFF,OFF
SCPI: device-specific

4.5.7 [SENSe:]BANDwidth Subsystem

This subsystem controls the setting of the analyzer's filter bandwidths. Both groups of commands (BANDwidth and BWIDth) perform the same functions.

[SENSe<1|2>:]BANDwidth|BWIDth:DEMod <numeric_value>

This command sets the bandwidth for analog demodulation. Depending on the selected demodulation bandwidth, the instrument selects the required sampling rate. The available values of the demodulation bandwidths are determined by the sampling rates.

Rounded off demodulation bandwidth	Sampling rate	Comment
120 MHz	256 MHz	with R&S FSQ-B72 only
50/85 MHz (1)	128 MHz	with R&S FSQ-B72 only
30 MHz	64 MHz	with R&S FSQ only
18 MHz	32 MHz	with R&S FSQ only
10 MHz	32 MHz	
8 MHz	16 MHz	This restriction only applies to R&S FSP and R&S FSU without B72: This filter is only flat for approx. 6 MHz; it has a 3 dB decay at 7 MHz.
5 MHz	8 MHz	
3 MHz	4 MHz	
1.6 MHz	2 MHz	
800 kHz	1 MHz	
400 kHz	500 kHz	
200 kHz	250 kHz	
100 kHz	125 kHz	
50 kHz	62.5 kHz	
25 kHz	31.25 kHz	
12.5 kHz	15.625 kHz	
6.4 kHz	7.8125 kHz	
3.2 kHz	3.90625 kHz	
1.6 kHz	1.953125 kHz	
800 Hz	976.5625 Hz	
400 Hz	488.28125 Hz	
200 Hz	244.140625 Hz	
100 Hz	122.0703125 Hz	

(1) The demodulation bandwidth at a sampling rate of 128 MHz depends on the center frequency that has been set. At a center frequency of =3.6 GHz, the demodulation bandwidth is 50 MHz; at higher center frequencies, it is 85 MHz

Example

```
ADEM:BAND:DEM 1MHz
'Set test bandwidth to 1 MHz
```

Characteristics

*RST value: 5 MHz
SCPI: device-specific

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution] <numeric_value>

This command sets the IF bandwidth of the demodulator.
Analog resolution filters are available that are implemented as LC filters with four circuits (R&S FSP) or 5 circuits (R&S FSU/R&S FSQ).

Instrument	IF bandwidth	Steps
R&S FSP	300 kHz to 10 MHz	1,3,10
R&S FSU	200 kHz to 10 MHz	1,2,3,5,10
R&S FSQ	200 kHz to 50 MHz	1,2,3,5,10

If the resolution bandwidth is modified, coupling to the demodulation bandwidth is automatically switched off.

Example

```
BAND 1MHz
'Set IF bandwidth to 1 MHz
```

Characteristics

*RST value: - (AUTO is set to ON)
SCPI: conforming

[SENSe<1|2>:]BANDwidth|BWIDth[:RESolution]:AUTO ON | OFF

This command automatically couples the IF bandwidth to the demodulation bandwidth
(BW_{RBW} = 10 * BW_{Demod}).

Example

```
BAND:AUTO OFF
'Switch off coupling of the IF bandwidth to the demodulation
bandwidth
```

Characteristics

*RST value: ON
SCPI: conforming

4.5.8 [SENSe:]FILTer Subsystem

This subsystem controls the setting of the high pass and low pass filters and the deemphasis .

[SENSe<1|2>:]FILTer:AWeighted[:STATe] ON | OFF

This command activates/deactivates the A weighted filter. The weighting filter is active in the following demodulation bandwidth range:

100 kHz ≤ demodulation bandwidth ≤ 800 kHz

Example

```
SENS:FILT:AW ON
'activates the A weighted filter
```

Characteristics

*RST value: OFF
SCPI:: device-specific

The numeric suffix <1|2> is irrelevant with this command.

[SENSe:]FILTer:CCIR[:STATe] ON | OFF

This command activates the CCIR weighting filter .
The weighting filter is active in the following demodulation bandwidth range:

50 kHz ≤ demodulation bandwidth ≤ 1.6 MHz

The CCIR unweighted filter is the combination of the 20 Hz highpass and 23 kHz lowpass filter.

Example

```
SENS:FILT:CCIR:STAT ON
```

Characteristics

*RST value: -NONE
SCPI: device-specific

[SENSe<1|2>:]FILTer:CCIR[:UNWeighted][:STATe] ON | OFF

This command activates/deactivates the CCIR unweighted filter which is the combination of the 20 Hz highpass and 23 kHz low pass filter. The filter is active in the following demodulation bandwidth range:

50 kHz ≤ demodulation bandwidth ≤ 1.6 MHz

Example

```
SENS:FILT:CCIR ON
'activates the unweighted CCIR filter
```

Characteristics

*RST value: OFF
SCPI: device-specific

The numeric suffix <1|2> is irrelevant with this command.

[SENSe<1|2>:]FILTer:CCIR:WEIGhted[:STATe] ON | OFF

This command activates/deactivates the CCIR weighted filter. The filter is active in the following demodulation bandwidth range:

100 kHz ≤ demodulation bandwidth ≤ 3 MHz

Example

```
SENS:FILT:CCIR:WEIG ON
'activates the weighted CCIR filter
```

Characteristics

*RST value: OFF
SCPI: device-specific

The numeric suffix <1|2> is irrelevant with this command.

[SENSe:]FILTer:CCITt[:STATe] ON | OFF

This command activates den Bewertungsfilter CCITT (CCITT P.53).
The weighting filter is active in the following demodulation bandwidth range:

25 kHz ≤ demodulation bandwidth ≤ 3 MHz

Example

```
SENS:FILT:CCIT:STAT ON
```

Characteristics

*RST value: NONE
SCPI: device-specific

[SENSe<1|2>:]FILTer:DEMPhasis[:STATe] ON | OFF

This command activates the selected deemphasis.

Example

```
FILT:DEMP ON
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe<1|2>:]FILTer:DEMPhasis:TCONstant 25 us | 50 us | 75 us | 750 us

This command selects the de-emphasis with the given time constant
The R&S FSP requires the option R&S FSP-B70 for the de-emphasis.
The de-emphasis is active in the following demodulation bandwidth range:

25 µs 25 kHz ≤ demodulation bandwidth ≤ 30 MHz
50 µs 6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz
75 µs 6.4 kHz ≤ demodulation bandwidth ≤ 18 MHz
750µs 800 Hz ≤ demodulation bandwidth ≤ 4 MHz

The following table shows the required demodulation bandwidth for an error less than 0.5 dB up to a maximum AF frequency.

Deemphasis	25 µs	50 µs	75 µs	750 µs
Maximum AF Frequency	25 kHz	12 kHz	8 kHz	800 Hz
Required demodulation bandwidth	>= 200 kHz	>= 100 kHz	>= 50 kHz	>= 6.4 kHz

For higher AF frequencies the demodulation bandwidth must be increased.

Example

```
FILT:DEMPTCON 75us
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe<1|2>:]FILTer:HPASs:FREQuency 20 Hz | 50 Hz | 300 Hz

This command selects the high pass filter. The filters are indicated by the 3 dB cutoff frequency. The filters are designed as 2nd-order Butterworth filter (12 dB/octave).
The R&S FSP requires the option R&S FSP-B70 for the high pass filter.
The high pass filter are active in the following demodulation bandwidth range:

20 Hz 100 Hz ≤ demodulation bandwidth ≤ 1.6 MHz
50 Hz 200 Hz ≤ demodulation bandwidth ≤ 4 MHz
300 Hz 800 Hz ≤ demodulation bandwidth ≤ 16 MHz

Example

```
FILT:HPAS:FREQ 300
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe<1|2>:]FILTer:HPASs[:STATe] ON | OFF

This command activates the selected high pass filter.

Example

```
FILT:HPAS ON
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe<1|2>:]FILTer:LPASs:FREQuency[:ABSolute] 3kHz | 15 kHz | 23 kHz | 150 kHz

This command selects the absolute low pass filter. The filter are indicated by the 3 dB cutoff frequency. The 3 kHz, 15 kHz and 23 kHz filters are designed as 5th-order Butterworth filter (30 dB/octave). The 150 kHz filter is designed as 8th-order Butterworth filter (48 dB/octave).

The R&S FSP requires the option R&S FSP-B70 for the absolute low pass filter. The relative low pass filters are active for all demodulation bandwidth's.

The high pass filter are active in the following demodulation bandwidth range:

3 kHz	6.4 kHz ≤ demodulation bandwidth ≤ 4 MHz
15 kHz	50 kHz ≤ demodulation bandwidth ≤ 16 MHz
23 kHz	50 kHz ≤ demodulation bandwidth ≤ 16 MHz
150 kHz	400 kHz ≤ demodulation bandwidth ≤ 16 MHz

Example

```
FILT:LPAS:FREQ 3KHz
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe<1|2>:]FILTer:LPASs:FREQuency:RELative 5 | 10 | 25 PCT

This command selects the relative low pass filter. The filter (3 dB) can be selected in % of the demodulation bandwidth. The filters are designed as 5th-order Butterworth filter (30 dB/octave).

The relative low pass filters are active for all demodulation bandwidth's. They are always available.

Example

```
FILT:LPAS:REL 10PCT
```

Characteristics

*RST value: -
SCPI: device-specific

[SENSe<1|2>:]FILTer:LPASs[:STATe] ON | OFF

This command activates the selected low pass filter.

Example

```
FILT:LPAS ON
```

Characteristics

*RST value: -
SCPI: device-specific

4.5.9 [SENSe:]FREQuency Subsystem

The SENSe:FREQuency subsystem defines the frequency axis of the active display. The frequency axis can either be defined via the start/stop frequency or via the center frequency and span.

The measurement windows are selected by SENSe1 (screen A) and SENSe2 (screen B).

[SENSe<1|2>:]FREQuency:CW:AFC ONCE

This command executes an automatic signal search.

Example

```
FREQ:CW:AFC ONCE"
```

Characteristics

*RST value: -
SCPI: conforming

This command is an event and therefore has no *RST value and no query.

4.6 TRACe Subsystem

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

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.

With active FM Demodulator (option R&S FS-K7), only the trace data that are displayed are read out and reloaded. Part of the measured data that can be queried with the marker, however, is derived from the raw data. These measurement results are no longer available after reloading a trace, the query commands cause a query error.

Example

TRAC TRACE1,"+A$ (A$: Data list in current format)
TRAC2? TRACE1"

Return values:

Scaling of the data is in the currently set level unit.

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma separated values (CSV) of the measured values.

The number of test points is 501 (R&S FSP) or 625 (R&S FSU/R&S FSQ).

Binary format (FORMat REAL,32):

In this case, the command returns binary data (Definite Length Block Data according to IEEE 488.2), with the measured values arranged in subsequent lists of I and Q data in 32-bit IEEE 754 floating point format. The response string will have the following structure:

R&S FSP:	#42004<meas value 1><meas value value2>...<meas value 501>
R&S FSU/ R&S FSQ:	#42500<meas value 1><meas value value2>...<meas value 625>

with

#4	Number of digits in the following number of data bytes (= 4 in the example)
2004/2005	Number of the following data bytes *(# of DataBytes*, = 2004/2005 in the example)
<meas value x>	4-byte floating point value

Characteristics

*RST value: -
SCPI: conforming

The trace data is 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, this data consists of values separated by commas. If the transfer takes place using the REAL format (REAL,32), the data is 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 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 is selected with "`MMEMory:SELect[:ITEM]:ALL`" or "`"MMEMory:SELect[:ITEM]:TRACe`". Trace data in ASCII format (ASCCII FILE

EXPORT) is exported with the command "MMEM:STORe:TRACe".

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

501 (R&S FSP) or 625 (R&S FSU and R&S FSQ) results are output in the unit selected for display.

With AUTO PEAK detector, only positive peak values can be read out.

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

4.7 TRIGger Subsystem

The trigger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep. An external trigger signal can be applied to the connector at the rear panel of the instrument.

TRIGger<1|2>[:SEQuence]:HOLDoff -100...+100s

This command defines the length of the trigger delay.

Example

```
TRIG:HOLD 500us
```

Characteristics

*RST value: 0s
SCPI: conforming

TRIGger<1|2>[:SEQuence]:LEVel:AM[:ABSolute] -100...+30dBm

This command sets the level when AM modulated signals are used as trigger source.

Note:

For triggering with the AF, AM and FM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Example

```
TRIG:LEV:AM -30 dBm
'Set the AM trigger threshold to -30 dBm
```

Characteristics

*RST value: -20 dBm
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:AM:Relative -100...+30dBm

This command sets the den modulation depth when AM modulated signals are used as trigger source.

Note:
For triggering with the AF, AM and FM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Example

```
TRIG:LEV:AM:REL -10 PCT
'Set the AM trigger threshold to -10 PCT
```

Characteristics

*RST value: 0 PCT
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:FM -10...+10MHz

This command sets the level when FM modulated signals are used as trigger source.

Example

```
TRIG:LEV:AM 10 kHz
'Set the FM trigger threshold to 10 kHz
```

Characteristics

*RST value: 0 Hz
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:IFPower -30...-10DBM

This command sets the level for the IF power trigger source.

Example

```
TRIG:LEV:IFP -20DBM
```

Characteristics

*RST value: -20 DBM
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:PM -1000...+1000RAD

This command sets the phase when PM-modulated signals are used as a trigger source.

Note:
For triggering with the AF, AM, AMR, PM and FM trigger sources to be successful, the measurement time must cover at least five periods of the audio signal

Example

```
TRIG:LEV:PM 1.2 RAD
'Set the PM trigger threshold to 1.2 rad
```

Characteristics

*RST value: 0 RAD
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:RFPower -50...-10DBM

This command sets the level for the RF power trigger source.

Example

```
TRIG:LEV:RFP –20DBM
```

Characteristics

*RST value: -20 DBM
SCPI: device-specific

This command is only available in conjunction with option TV and RF-Trigger R&S FSP-B6.

TRIGger<1|2>[:SEQuence]:SLOPe POSitive|NEGative

This command selects the slope of the trigger signal. The selection of the trigger slope is valid for all trigger signal sources.

Example

```
TRIG:SLOP NEG"
```

Characteristics

*RST value: POSitive
SCPI: conforming

TRIGger<1|2>[:SEQuence]:SOURce IMMediate | EXTernal | VIDeo | IFPower | RFPower | TV | AF | AM | AMR | FM | PM

This command selects the trigger source for the start of a sweep

Note:
The selection of RFPower and TV is only possible with option R&S FSP-B6 (TV and RF-Trigger).

Parameters:

IMMediate = Automatic triggering of the next measurement at the end of the previous one. The parameter corresponds to the FREE RUN setting.
EXTernal = The next measurement is triggered by the signal at the external trigger input
VIDeo = The next measurement is triggered by the detection of a signal at

the video filter output. VIDeo cannot be selected if the FM demodulator s active.

IFPower = The next measurement is triggered by the detection of a signal at the instrument IF (10 MHz bandwidth). I

RFPower = The next measurement is triggered by the detection of a signal at the instrument RF (80 MHz bandwidth). (only R&S FSP/ESCI/ESPI)

TV = The next measurement is triggered by the detection of a TV signal according to the settings of the TRIGger:SEQuence:VIDeo-subsystem. TV cannot be selected if the FM demodulator is active.

FM = The next measurement is triggered on detection of an FM modulated signal (equivalent to 'FM')

AMR = The next measurement is triggered on detection of an audio signal after AM demodulation

AM = The next measurement is triggered on detection of an RF signal in the time domain.

PM = The next measurement is triggered on detection of an audio signal after PM demodulation

Note:
For triggering with the AF, AM and FM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Example

```
TRIG:SOUR EXT
'Select the external trigger input as source for the trigger signal
```

Characteristics

*RST value: IMMediate
SCPI: conforming

4.8 UNIT Subsystem

The UNIT subsystem defines the units of the parameters to be set and measurement results.

UNIT:ANGLe DEG | RAD

This command selects the unit for angles.

Example

```
UNIT:ANGL DEG"
```

Characteristics

*RST value: RAD
SCPI: conforming

UNIT:THD DB | PCT

Selects the unit for THD measurements

Example

```
UNIT:THD PCT"
```

Characteristics

*RST value: DBM
SCPI: device-specific

Example

TRAC TRACE1,"+A$ (A$: Data list in current format)
TRAC2? TRACE1"

Return values:

Scaling of the data is in the currently set level unit.

ASCII format (FORMat ASCII):

In this case, the command will return a list of comma separated values (CSV) of the measured values.

The number of test points is 501 (R&S FSP) or 625 (R&S FSU/R&S FSQ).

Binary format (FORMat REAL,32):

In this case, the command returns binary data (Definite Length Block Data according to IEEE 488.2), with the measured values arranged in subsequent lists of I and Q data in 32-bit IEEE 754 floating point format. The response string will have the following structure:

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

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

with

#4 Number of digits in the following number of data bytes (= 4 in the example)

2004/2005 Number of the following data bytes *(# of DataBytes*, = 2004/2005 in the example)

<meas value x> 4-byte floating point value

Characteristics

*RST value: -
SCPI: conforming

The trace data is 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, this data consists of values separated by commas. If the transfer takes place using the REAL format (REAL,32), the data is 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 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 is selected with "`MMEMory:SELect[:ITEM]:ALL`" or ""`MMEMory:SELect[:ITEM]:TRACe`". Trace data in ASCII format (ASCCII FILE

EXPORT) is exported with the command "MMEM:STORe:TRACe".

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

501 (R&S FSP) or 625 (R&S FSU and R&S FSQ) results are output in the unit selected for display.

With AUTO PEAK detector, only positive peak values can be read out.
FORMAT REAL,32 is to be used as format for binary transmission.

4.7 TRIGger Subsystem

The trigger subsystem is used to synchronize instrument actions with events. It is thus possible to control and synchronize the start of a sweep. An external trigger signal can be applied to the connector at the rear panel of the instrument.

TRIGger<1|2>[:SEQuence]:HOLDoff -100...+100s

This command defines the length of the trigger delay.

Example

```
TRIG:HOLD 500us
```

Characteristics

*RST value: 0s
SCPI: conforming

TRIGger<1|2>[:SEQuence]:LEVel:AM[:ABSolute] -100...+30dBm

This command sets the level when AM modulated signals are used as trigger source.

Note:

For triggering with the AF, AM and FM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Example

```
TRIG:LEV:AM -30 dBm
'Set the AM trigger threshold to -30 dBm
```

Characteristics

*RST value: -20 dBm
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:AM:Relative -100...+30dBm

This command sets the den modulation depth when AM modulated signals are used as trigger source.

Note:
For triggering with the AF, AM and FM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Example

```
TRIG:LEV:AM:REL -10 PCT
'Set the AM trigger threshold to -10 PCT
```

Characteristics

*RST value: 0 PCT
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:FM -10...+10MHz

This command sets the level when FM modulated signals are used as trigger source.

Example

```
TRIG:LEV:AM 10 kHz
'Set the FM trigger threshold to 10 kHz
```

Characteristics

*RST value: 0 Hz
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:IFPower -30...-10DBM

This command sets the level for the IF power trigger source.

Example

```
TRIG:LEV:IFP -20DBM
```

Characteristics

*RST value: -20 DBM
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:PM -1000...+1000RAD

This command sets the phase when PM-modulated signals are used as a trigger source.

Note:
For triggering with the AF, AM, AMR, PM and FM trigger sources to be successful, the measurement time must cover at least five periods of the audio signal

Example

```
TRIG:LEV:PM 1.2 RAD
'Set the PM trigger threshold to 1.2 rad
```

Characteristics

*RST value: 0 RAD
SCPI: device-specific

TRIGger<1|2>[:SEQuence]:LEVel:RFPower -50...-10DBM

This command sets the level for the RF power trigger source.

Example

```
TRIG:LEV:RFP -20DBM
```

Characteristics

*RST value: -20 DBM
SCPI: device-specific

This command is only available in conjunction with option TV and RF-Trigger R&S FSP-B6.

TRIGger<1|2>[:SEQuence]:SLOPe POSitive|NEGative

This command selects the slope of the trigger signal. The selection of the trigger slope is valid for all trigger signal sources.

Example

```
TRIG:SLOP NEG"
```

Characteristics

*RST value: POSitive
SCPI: conforming

TRIGger<1|2>[:SEQuence]:SOURce IMMediate | EXTernal | VIDeo | IFPower | RFPower | TV | AF | AM | AMR | FM | PM

This command selects the trigger source for the start of a sweep

Note:
The selection of RFPower and TV is only possible with option R&S FSP-B6 (TV and RF-Trigger).

Parameters:

IMMediate = Automatic triggering of the next measurement at the end of the previous one. The parameter corresponds to the FREE RUN setting.
EXTernal = The next measurement is triggered by the signal at the external trigger input
VIDeo = The next measurement is triggered by the detection of a signal at

the video filter output. VIDeo cannot be selected if the FM demodulator s active.

IFPower = The next measurement is triggered by the detection of a signal at the instrument IF (10 MHz bandwidth). I

RFPower = The next measurement is triggered by the detection of a signal at the instrument RF (80 MHz bandwidth). (only R&S FSP/ESCI/ESPI)

TV = The next measurement is triggered by the detection of a TV signal according to the settings of the TRIGger:SEQuence:VIDeo-subsystem. TV cannot be selected if the FM demodulator is active.

FM = The next measurement is triggered on detection of an FM modulated signal (equivalent to 'FM')

AMR = The next measurement is triggered on detection of an audio signal after AM demodulation

AM = The next measurement is triggered on detection of an RF signal in the time domain.

PM = The next measurement is triggered on detection of an audio signal after PM demodulation

Note:
For triggering with the AF, AM and FM trigger sources to be successful, the measurement time must cover at least 5 periods of the audio signal.

Example

```
TRIG:SOUR EXT
'Select the external trigger input as source for the trigger signal
```

Characteristics

*RST value: IMMediate
SCPI: conforming

4.8 UNIT Subsystem

The UNIT subsystem defines the units of the parameters to be set and measurement results.

UNIT:ANGLe DEG | RAD

This command selects the unit for angles.

Example

```
UNIT:ANGL DEG"
```

Characteristics

*RST value: RAD
SCPI: conforming

UNIT:THD DB | PCT

Selects the unit for THD measurements

Example

```
UNIT:THD PCT"
```

Characteristics

*RST value: DBM
SCPI: device-specific

4.9 Table of Softkeys and Hotkeys including Assignment of Remote-Control Commands

This chapter contains the assignment of the remote-control commands to those softkey menus that differ from the base unit with regard to the FM demodulator option. The operating manual of the base unit covers the assignment of the unchanged menus.

4.9.1 FM Demodulator Main Menu

FM DEMOD	
FM DEMOD ON OFF	INSTrument:SELect ADEMod INSTrument:NSELect 3
AF FILTER	---
HIGH PASS AF FILTER	---
NONE	[SENSe:]FILTer:HPASs OFF
20 Hz	[SENSe:]FILTer:HPASs ON [SENSe:]FILTer:HPASs:FREQ 20
50 Hz	[SENSe:]FILTer:HPASs ON .....[SENSe:]FILTer:HPASs:FREQuency 50
300 Hz	[SENSe:]FILTer:HPASs ON .....[SENSe:]FILTer:HPASs:FREQuency 300
LOW PASS AF FILTER	---
NONE	[SENSe:]FILTer:LPASs OFF
5% DEMOD BW	[SENSe:]FILTer:LPASs ON ..[SENSe:]FILTer:LPASs:FREQuency:RELative 5PCT
10% DEMOD BW	[SENSe:]FILTer:LPASs ON .[SENSe:]FILTer:LPASs:FREQuency:RELative 10PCT
25% DEMOD BW	[SENSe:]FILTer:LPASs ON .[SENSe:]FILTer:LPASs:FREQuency:RELative 25PCT
3 kHz	[SENSe:]FILTer:LPASs ON .....[SENSe:]FILTer:LPASs:FREQuency 3kHz
15 kHz	[SENSe:]FILTer:LPASs ON .....[SENSe:]FILTer:LPASs:FREQuency 15kHz
23 kHz	[SENSe:]FILTer:LPASs ON [SENSe:]FILTer:LPASs:FREQuency 23kHz
150 kHz	[SENSe:]FILTer:LPASs ON .....[SENSe:]FILTer:LPASs:FREQuency 150kHz


DEEMPHASIS

NONE
[SENSe:]FILTer:DEMPhasis OFF
25 us
[SENSe:]FILTer:DEMPhasis ON
[SENSe:]FILTer:DEMPhasis:TCON 25us
50 us
[SENSe:]FILTer:DEMPhasis ON
[SENSe:]FILTer:DEMPhasis:TCON 50us
75 us
[SENSe:]FILTer:DEMPhasis ON
[SENSe:]FILTer:DEMPhasis:TCON 75us
750 us
[SENSe:]FILTer:DEMPhasis ON
[SENSe:]FILTer:DEMPhasis:TCONstant 750us
WEIGING FILTER

CCITT
[SENSe:]FILTer:CCITt:STAT ON | OFF
[SENSe:]FILTer:CCIR:STAT ON | OFF
CCIR
[SENSe:]FILTer:DEMPhasis ON
[SENSe:]FILTer:DEMPhasis:TCONstant 25us
RESULT DISPLAY

FM
CALCulate<1|2>:FEED 'XTIMe:FM[:TDOMain]'
PM
CALCulate<1|2>:FEED 'XTIMe:PM[:TDOMain]'
AM
CALCulate<1|2>:FEED 'XTIMe:AM:RELative'
RF POWER
CALCulate<1|2>:FEED 'XTIMe:RFPower'
RF SPECTRUM
CALCulate<1|2>:FEED 'XTIMe:SPECTRUM'
AF SPECTRUM
CALCulate<1|2>:FEED 'XTIMe:FM:AFSPectrum'
CALCulate<1|2>:FEED 'XTIMe:PM:AFSPectrum'
CALCulate<1|2>:FEED 'XTIMe:AMSummary:RELative:AFSPectrum'
CALCulate<1|2>:FEED 'XTIMe:RFPower:AFSectrum <1...3>'
SELECT TRACE

DIAGRAM FULL SIZE
DISPlay[:WINDow<1|2>]:SIZE LARGe|SMALl
RANGE

DEVIATION PER DIV
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:PDIVision <numeric_value>
REFERENCE POSITION
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:RPOSition <numeric_value>


REFERENCE VALUE
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:RVALue <numeric_value>
AF COUP AC DC
[SENSe:]ADEMode:AF:COUPling AC | DC
ZERO PHASE REF POS
[SENSe:]ADEMode:PM:RPOint:X <numeric_value>
DEVIATION LIN LOG
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LINear|LOGarithmic
DB PER DIV
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:PDIVision <numeric_value>
PHASE WRAP ON OFF
CALCulate<1|2>:FORMat PHASe
UNIT

PM UNIT RAD DEG
UNIT:ANGLe RAD | DEG
THD UNIT % DB
UNIT:THD PCT | DB
MAX DISP RF POWER
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:RVALue <numeric_value>
RANGE LINEAR
RANGE LINEAR %
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LINear
RANGE LINEAR DB
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LDB
RANGE LOG MANUAL
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing LOG
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SCALe <num_value>
RF POWER PER DIV
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:PDIVision <numeric_value>
DEMOD BW
[SENSe:]BANDwidth:DEM 10MHz
MEAS TIME
[SENSe:]ADEMod:MTIMe 62.5US
[SENSe:]SWEep:TIME 62.5US
ZOOM
[SENSe:]ADEMod:ZOOM ON
[SENSe:]ADEMod:ZOOM:STARt 30US

4.9.2 *FREQ* Key

CENTER
```
[SENSe:]FREQuency:CENTer <num_value>
```

CF-SREPSIZE

0.1 * SPAN
```
[SENSe:]FREQuency:CENTer:STEP:LINK SPAN;
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
```

0.5 * SPAN
```
[SENSe:]FREQuency:CENTer:STEP:LINK SPAN;
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
```

X * SPAN
```
[SENSe:]FREQuency:CENTer:STEP:LINK SPAN;
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <num_value>
```

0.1 * RBW
```
[SENSe:]FREQuency:CENTer:STEP:LINK RBW;
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 10PCT
```

0.5 * RBW
```
[SENSe:]FREQuency:CENTer:STEP:LINK RBW;
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor 50PCT
```

X * RBW
```
[SENSe:]FREQuency:CENTer:STEP:LINK RBW;
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <num_value>
```

= CENTER

without function in IEC/IEEE-bus mode

MANUAL
```
[SENSe:]FREQuency:CENTer:STEP <num_value>
```

SINGLE AUTOTUNE
```
[SENSe:]FREQuency:CW:AFC ONCe
```

AF CENTER
```
[SENSe:]ADEMod:AF:CENTer <num_value>
```

AF START
```
[SENSe:]ADEMod:AF:STARt <num_value>
```

AF STOP
```
[SENSe:]ADEMod:AF:STOP <num_value>
```

4.9.3 SPAN Key

AF SPAN
```
[SENSe:]ADEMod:AF:SPAN <num_value>
```

FREQUENCY SPAN
```
[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM
```

AF FULL SPAN
```
[SENSe:]ADEMod:AF:SPAN FULL
```

FULL SPAN

```
[SENSe:]ADEMod:SPECtrum:SPAN:ZOOM MAX
```

DEMOD BW

```
[SENSe:]BAND:DEM 10MHz
```

MEAS TIME

```
[SENSe:]ADEM:MTIM 62.5US
[SENSe:]SWE:TIME 62.5US
```

4.9.4 *AMPT* Key

REF LEVEL

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel <num_value>
```

RANGE LINEAR

RANGE LINEAR %

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing  LINear
```

RANGE LINEAR DB

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing  LDB
```

RANGE LOG 100 dB

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing  LOGarithmic;
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]  100 dB
```

RANGE LOG MANUAL

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y:SPACing  LOGarithmic;
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]  <num_value>
```

RF ATTEN MANUAL

```
INPut:ATTenuation <num_value>
```

RF ATTEN AUTO

```
INPut:ATTenuation:AUTO ON
```

REF LEVEL POSITION

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RPOSition <num_value>
```

REF LEVEL OFFSET

```
DISPlay[:WINDow<1|2>]:TRACe<1...3>:Y[:SCALe]:RLEVel:OFFSet <num_value>
```

EL ATTEN AUTO

```
INPut:EATT:AUTO ON (only with option R&S FSP-B25)
```

EL ATTEN MANUAL

```
INPut:EATT <num_value> (only with option R&S FSP-B25)
```

EL ATTEN OFF

```
INPut:EATT:STATe OFF (only with option R&S FSP-B25)
```

RF INPUT 50Ω 75Ω

```
INPut:IMPedance 50 | 75
```

4.9.5 *BW* Key

RES BW
```
[SENSe:]ADEM:SPEC:BAND:RES 10 kHz
```

IF BW AUTO
```
[SENSe:]BAND:RES:AUTO ON
```

IF BW MANUAL
```
[SENSe:]BAND:RES 1 MHz
```

DEMOD BW
```
[SENSe:]BAND:DEM 10MHz
```

MEAS TIME
```
[SENSe:]ADEMod:MTIMe 62.5US
[SENSe:]SWEep:TIME 62.5US
```

4.9.6 *TRIG* Key

FREE RUN
```
TRIGger:SOURce  IMMediate
```

DEMOD SIGNAL
```
---
```

FM SIGNAL
```
TRIGger:SOURce FM
TRIGger:LEVel:FM <numeric_value>
```

PM SIGNAL
```
TRIGger:SOURce PM
TRIGger:LEVel:PM  <numeric_value>
```

AM SIGNAL
```
TRIGger:SOURce AMRelative
TRIGger:LEV:AM:REL  <numeric_value>
```

RF POWER SIGNAL
```
TRIGger:SOURce AM
TRIGger:LEVel:AM:[:ABSolute]  <numeric_value>
```

EXTERN
```
TRIGger:SOURce  EXTernal
```

IF POWER
```
TRIGger:SOURce IFPower
```

TRIGGER OFFSET
```
TRIGger:HOLDoff   <numeric_value>
```

POLARITY POS NEG
```
TRIGger:SLOPe  POS
```

4.9.7 MKR Key

MARKER 1..4
```
CALCulate<1|2>:MARKer<1...4>[:STATe]   ON | OFF;
CALCulate<1|2>:MARKer<1...4>:X <numeric value>;
CALCulate<1|2>:MARKer<1...4>:Y?
CALCulate<1|2>:DELTamarker1[:STATe]   ON | OFF;
CALCulate<1|2>:DELTamarker<1...4>:X <numeric value>;
CALCulate<1|2>:DELTamarker<1...4>:Y?
```

MARKER NORM DELTA	CALCulate<1|2>:DELTamarker<1...4>[:STATe] ON | OFF;
ALL MARKER OFF	CALCulate<1|2>:MARKer<1...4>:AOFF CALCulate<1|2>:DELTamarker<1...4>:AOFF

4.9.8 *MKR* ⇒ Key

SELECT MARKER	without function in IEC/IEEE-bus mode
PEAK	CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK] CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]
REF LEVEL = MKR LVL	CALCulate<1|2>:MARKer<1...4>:FUNCtion:REFerence
NEXT PEAK	CALCulate<1|2>:MARKer<1...4>:MAXimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MAXimum:NEXT
NEXT PEAK RIGHT	CALCulate<1|2>:MARKer<1...4>:MAXimum:RIGHt CALCulate<1|2>:DELTamarker<1...4>:MAXimum:RIGHt
NEXT PEAK LEFT	CALCulate<1|2>:MARKer<1...4>:MAXimum:LEFT CALCulate<1|2>:DELTamarker<1...4>:MAXimum:LEFT
MKR-> TRACE	CALCulate<1|2>:MARKer<1...4>:TRACe <numeric value> CALCulate<1|2>:DELTamarker<1...4>:TRACe <numeric value>
MIN	CALCulate<1|2>:MARKer<1...4>:MINimum[:PEAK] CALCulate<1|2>:DELTamarker<1...4>:MINimum[:PEAK]
MIN NEXT	CALCulate<1|2>:MARKer<1...4>:MINimum:NEXT CALCulate<1|2>:DELTamarker<1...4>:MINimum:NEXT
NEXT MIN RIGHT	CALCulate<1|2>:MARKer<1...4>:MINimum:RIGHt CALCulate<1|2>:DELTamarker<1...4>:MINimum:RIGHt
PEAK EXCURSION	CALCulate<1|2>:MARKer<1...4>:PEXCursion <num_value>

4.9.9 MKR FCTN Key

SELECT MARKER	*w*ithout function in IEC/IEEE-bus mode
PEAK	CALCulate<1|2>:MARKer<1...4>:MAXimum[:PEAK] CALCulate<1|2>:DELTamarker<1...4>:MAXimum[:PEAK]
MKR-> TRACE	CALCulate<1|2>:MARKer<1...4>:TRACe <numeric value> CALCulate<1|2>:DELTamarker<1...4>:TRACe <numeric value>

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