Data sheet

Version 02.00

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AM/FM/φM Measurement Demodulator R&S®FS-K7

for the Analyzers R&S®FSQ/FSU/FSP and the Test Receivers R&S®ESCI/ESPI

AM/FM/φM demodulator for measuring analog modulation parameters

Displays

- Frequency modulation (FM)
- Amplitude modulation (AM)
- Phase modulation (φM)
- Table with numeric results: peak and RMS deviation, modulation frequency
- Carrier offset, carrier power
- Carrier power versus time
- RF spectrum (FFT spectrum analysis)
- AF spectrum with SINAD and THD values

Features

- Digital measurement demodulator with large bandwidth range from 100 Hz to 10 MHz
- Up to 120 MHz demodulation bandwidth with the R&S®FSQ fitted with option R&S®FSQ-B72
- AF filters (highpass, lowpass, deemphasis)
- Large memory depth for long measurement sequences (2 × 128 ksample I/Q memory)

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R&S®FSQ/FSU/FSP/ESCI/ESPI as AM/FM/φM measurement demodulators

Characteristics

The universal characteristics of the digital measurement demodulator option open up a wide range of applications, for example measuring frequency deviation or the frequency settling of synthesizers. The FM measurement capability of this option enables the analyzers and test receivers to carry out specific modulation measurements such as needed in the development and production of Bluetooth® or DECT modules.

The Measurement Demodulator R&S®FS-K7 also performs FFT analysis of the demodulated signal, allowing received signal quality to be determined from the SINAD and THD values. Various filters (highpass, lowpass, deemphasis) are available that can be used to simulate real receive-signal structures, thus enabling accurate characterization of analog transmit and receive systems.

The capability to perform Fourier analysis of the RF signal combines the advantages of a high-end spectrum analyzer with those of an FFT analyzer in a single unit. This expands the comprehensive functionality of the Rohde & Schwarz analyzers and test receivers by the capability to carry out spectrum analysis by first recording the complete signal, thus capturing full signal information, and then representing the signal in the frequency domain.

Measurement results can be displayed as:

- Frequency (FM), amplitude (AM) or phase (φM) versus time
- Carrier power versus time
- RF spectrum (FFT)
- FFT of demodulated signal (AF spectrum)

In addition, the main modulation parameters are numerically displayed in a table. These parameters include frequency, amplitude and phase deviation (peak, RMS), modulation frequency and carrier power.

Fourier analysis of the AF signal additionally delivers the SINAD (signal-to-noise-and-distortion ratio) and THD (total harmonic distortion) values of the measured signal; the instrument is automatically tuned to the modulation frequency.

The large I/Q memory of the analyzers and test receivers can store sequences with a length of up to 1070 s (demodulation bandwidth 100 Hz) or 65 ms (demodulation bandwidth 1.6 MHz).

This enables full analysis of long bit sequences such as occur in DECT signals, for example. Moreover, you can read out the measured values, the recorded demodulated signal, the RF spectrum (FFT) and the AF spectrum (FFT) in ASCII or binary format via GPIB, RS-232-C or LAN and process the data on an external PC.

The R&S®FS-K7 also provides special trigger capabilities, featuring an AM, FM and φM trigger as well as an RF level trigger with a wide dynamic range. You can thus measure signals for which no external trigger is available.

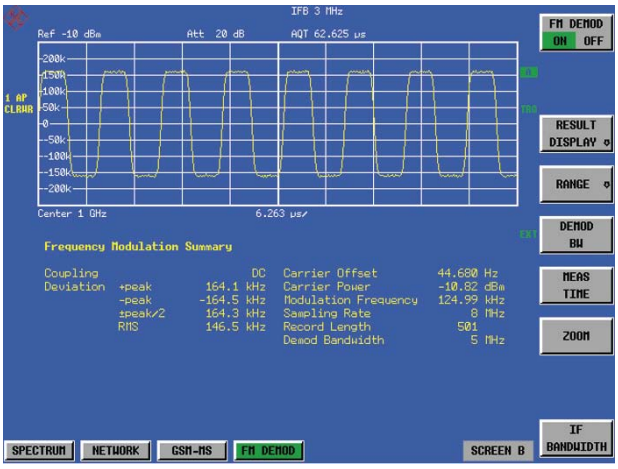


Fig. 1: Modulation characteristic of a Bluetooth signal

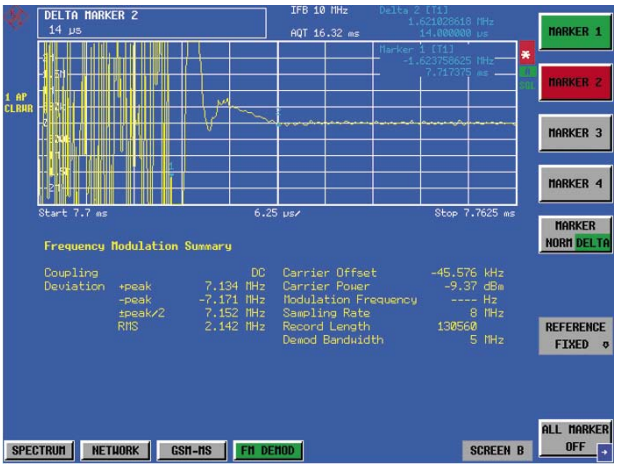


Fig. 2: Frequency settling of a synthesizer

Measurement examples

Bluetooth modulation characteristic (Fig. 1)
The frequency deviation of the signal is determined for a defined bit sequence (…11110000… or …10101010…) and displayed as a trace as well as numerically.

Frequency settling of a synthesizer (Fig. 2)
The FM demodulator function can be used to measure synthesizer frequency settling in digital communications systems such as GSM or Bluetooth® transmitters.

VHF radio signal (Fig. 3)
The AF spectrum of the demodulated 99.3 MHz radio signal in the example below clearly shows the pilot signal at 19 kHz, the sum signal of the stereo channels below 15 kHz, and the difference signal from 23 kHz to 53 kHz. The radio data system (RDS) components above 53 kHz are also clearly discernible.

FM signal (Fig. 4)
If an FM signal has a fixed frequency, the SINAD and THD values for example can be accurately determined, which is important in the development and production of analog transmit and receive systems.

Fig. 3: AF spectrum of a VHF stereo radio signal

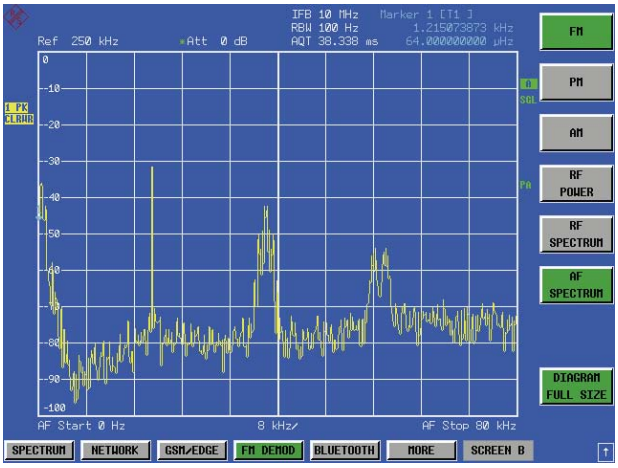
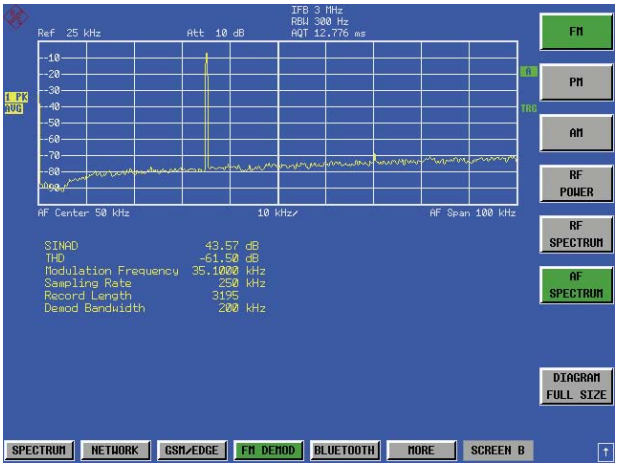


Fig. 4: AF spectrum of a frequency-modulated signal



Specifications

	R&S®FSP/R&S®ESCI/ R&S®ESPI	R&S®FSU	R&S®FSQ (R&S®FSQ with R&S®FSQ-B72)
Measurement of analog modulation signals			
Demodulation bandwidth	100 Hz to 10 MHz	100 Hz to 10 MHz	100 Hz to 28 MHz (100 Hz to 120 MHz)
Max. recording length	130560 samples		
Demodulation bandwidth	sampling rate/max. recording time		
100 Hz	122.07 Hz/891.2896 s		
Binary sequence			
6.4 kHz	7.8125 kHz/13.926 s		
12.5 kHz	15.625 kHz/6.9632 s		
Binary sequence			
1.6 MHz	2 MHz/0.0544 s		
3 MHz	4 MHz/0.0272 s		
5 MHz	8 MHz/0.0136 s		
8 MHz	16 MHz/0.0068 s		
10 MHz	32 MHz/0.0034 s		
18 MHz	–		32 MHz/0.0034 s
30 MHz	–		64 MHz/0.0017 s
50 MHz (with R&S®FSQ-B72)	–		128 MHz/0.00085 s
120 MHz (with R&S®FSQ-B72)	–		256 MHz/0.000425 s
Display	frequency versus time (FM), amplitude versus time (AM), phase versus time (φM), RF power versus time, RF spectrum (FFT), AF spectrum (FFT), table with numeric values for: modulation deviation (peak, RMS), modulation frequency, carrier offset, carrier power (power of unmodulated carrier), SINAD, THD		
AF (modulation frequency)			
Range	≤5 MHz (max. 0.5 × demodulation bandwidth)		
Resolution	5 digits		
Measurement uncertainty	0.1 %		
AF filters			
Lowpass	3 kHz, 15 kHz, 150 kHz, 5 %, 10 %, 25 % of demodulation bandwidth		
Highpass	50 Hz, 300 Hz		
Deemphasis	25 µs, 50 µs, 75 µs, 750 µs		
AM demodulation			
Measurement range	0 % to 100 % modulation depth		
Modulation depth uncertainty (AF ≤ 0.1 × IF bandwidth), AF ≤ 1 MHz	<3 % of measured value + residual AM		
Residual AM[1] Demodulation bandwidth ≤ 200 kHz, RMS			
RF ≤ 6 GHz	0.06 %		
RF > 6 GHz	$0.06\,\% \times \frac{f}{6\ \mathrm{GHz}}$		
Distortion (AF 10 Hz to 100 kHz)	0.3 %		
FM rejection AF + deviation ≤ 0.5 × demodulation bandwidth and AF ≤ 0.1 × IF bandwidth	typ. 1 % + residual AM		
FM demodulation			
Frequency deviation measurement range	0 Hz to 5 MHz		0 Hz to 14 MHz (0 Hz to 60 MHz)
Deviation uncertainty (AF + deviation ≤ 0.5 × demodulation bandwidth and AF ≤ 0.1 × IF bandwidth), AF ≤ 1 MHz[2]	<3 % of measured value + residual FM		
Residual FM[1] Demodulation bandwidth ≤ 200 kHz, RMS			
RF ≤ 1 GHz	80 Hz	15 Hz	
RF = 3 GHz	130 Hz	65 Hz	
Distortion (AF 10 Hz to 100 kHz, deviation < 400 kHz)	0.3 %		
AM rejection AF 100 Hz to 1 kHz, 50 % modulation	30 Hz		

	R&S®FSP/R&S®ESCI/ R&S®ESPI	R&S®FSU	R&S®FSQ (R&S®FSQ with R&S®FSQ-B72)
φM demodulation			
AF (max. 0.5 × demodulation bandwidth)	0 Hz to 5 MHz		0 Hz to 14 MHz (0 Hz to 60 MHz)
φM measurement range	<1000 rad		
Residual φM[1)] RF = 1 GHz (highpass filter 300 Hz)	5 mrad	1 mrad	
Carrier power versus time			
Display range Max. dynamic range Demodulation bandwidth 200 kHz Display linearity S/N > 16 dB	noise floor to +30 dBm typ. 75 dB typ. 0.2 dB		
Power of unmodulated carrier Measurement uncertainty S/N > 16 dB (RF = 50 kHz to 3 GHz)	typ. 1 dB		
Trigger functions	RF level; AM, FM, φM demodulation		
AF spectrum			
Span	≤5 MHz		≤14 MHz (≤60 MHz)
Resolution bandwidth	1 Hz to 10 MHz		
RF spectrum			
Span	≤10 MHz		≤28 MHz (≤120 MHz)
Resolution bandwidth (FFT filters)	1 Hz to 10 MHz		
Shape factor	2.5:1, nominal		
Modulation distortion			
Frequency range	10 Hz to 5 MHz		10 Hz to 14 MHz (10 Hz to 60 MHz)
Measurement functions Measurement range Resolution Measurement uncertainty	THD, SINAD –100 dB to 0 dB 0.01 dB typ. 0.5 dB		

Ordering information

Order designation	Type	Order No.
AM/FM/φM Measurement Demodulator	R&S®FS-K7	1141.1796.02

[1)] RF input level ≥ (reference level/dBm – 10) dBm and RF input level ≥ (RF attenuation/dB – 30) dBm.
[2)] AF ≤ 500 kHz with the R&S®ESCI.

More information at
www.rohde-schwarz.com
(search term: FSQ/FSU/FSP)

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