Selective Modulation Analyzer FMAS

Stereo receiver and modulation analyzer in one unit

The Selective Modulation Analyzer FMAS from Rohde & Schwarz is the first instrument to combine the characteristics of a universal modulation analyzer with those of an FM stereo/TV dual-sound receiver in the frequency range 5 to 1000 MHz*).

Features

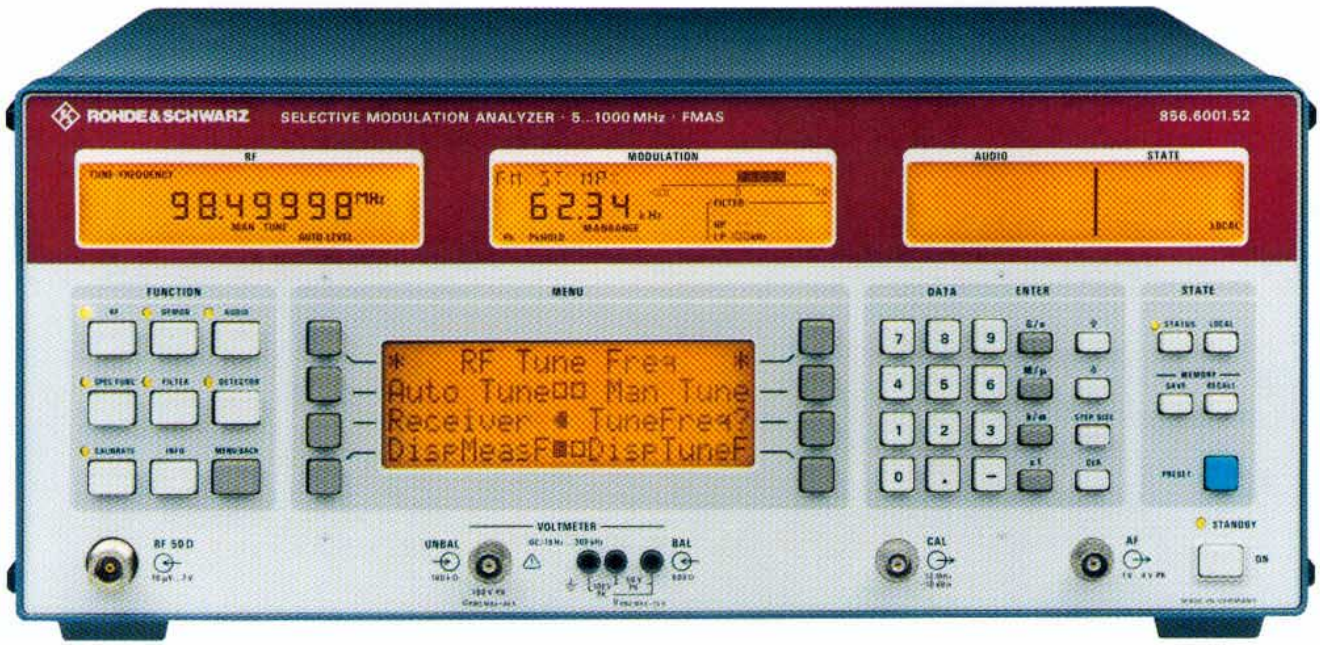
- Excellent static and dynamic selectivity
- Level range 10 µV to 7 V
- Outstanding transfer characteristic
- High overload capability to interfering signals
- Selective RF level measurement

Uses

- Remote measurements on VHF broadcasting and TV dual-sound transmitters such as
  - peak deviation monitoring
  - field-strength and frequency measurements
  - VHF coverage measurements to ARD/DBP Specification 5 R 4/1.3
- Modulation analysis of TV sound signals
- Modulation analysis
  - in cable networks and headends
  - at VHF transmitter combining networks
  - of TV sound subcarriers in the satellite baseband
- FM stereo relay reception

*) This combination can also be obtained by retrofitting FMAB (data sheet PD 756.9551) with options RF/IF Selection FMA-B9 and AF Analyzer/DSP Unit FMA-B8 (data sheet PD 757.0635).

ROHDE & SCHWARZ



Characteristics

FMAS is the first instrument to offer the capabilities of a modulation analyzer together with those of an FM stereo/TV dual-sound receiver. As the receiver can be switched on and off as required, the whole range of applications afforded by a modulation analyzer in the frequency range 50 kHz to 1360 MHz is readily available*). At a high sensitivity of 10 µV, a tunable 4-pole preselection filter (from 87.5 to 108 MHz and >183 MHz) and a high-level input mixer guarantee high overload capability to interfering signals in the receive mode.

Phase-linear IF filters with an amplitude equalizer at the AF together with a low-noise LO yield excellent static and dynamic selectivity and, at the same time, guarantee a high S/N ratio as well as low linear and non-linear distortions.

As there is always a compromise to be made between high selectivity and low distortion and between a high S/N ratio and immunity to overloading, the user may adapt the FMAS to his particular measurement problem:

With the narrow IF filters **FM narrow** and **TV sound**, maximum selectivity can be obtained but distortions are slightly increased. The FM narrow filter makes the FMAS comply with ARD Specification 5/3.5 for stereo relay receivers and is ideally suitable for all kinds of remote measurements such as VHF peak deviation monitoring even under unfavourable receiving conditions.

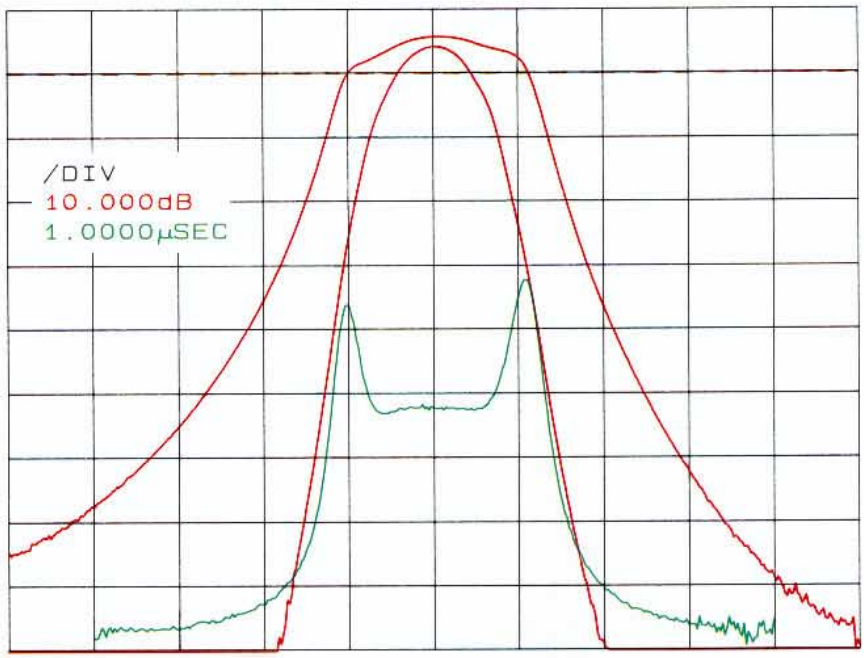
With the IF filter **FM wide,** the FMAS complies with ARD Specification 5/3.4 for FM test demodulators. In addition to the required low distortion, high selectivity (see diagram) is obtained with this filter too. The wide IF filter may be used for example at transmitter combining networks whenever at least two adjacent channels are not occupied.

In the **low-noise** mode, the preamplifier is permanently on and the mixer level is increased so that the maximum S/N ratio is obtained. In the **low-distortion** mode, the mixer level is kept low and the preamplifier is switched off. This mode should be used for measurements on antennas where strong, closely spaced interfering signals within the bandwidth of the preselection filter cause intermodulation in the receive channel. The maximum obtainable S/N ratio is reduced only by about 3 dB but the RF/IF intermodulation suppression improves by 10 dB.

*) See FMAB data sheet PD 756.9551

Factory-stored level calibration data versus frequency guarantee high-precision selective level measurements. With the aid of the AM/FM Calibrator/AF Generator option FMA-B4, level calibration can be updated any time at a fixed RF (10 MHz). Elaborate temperature compensation techniques ensure compliance with specifications over a wide temperature range in the receive mode through

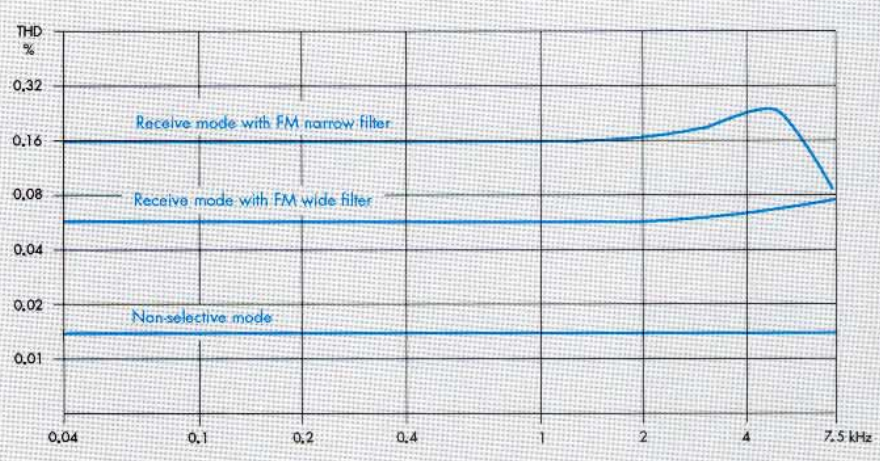
- temperature-responsive tuning of the RF preselector filters by the processor,
- temperature-compensated IF filters,
- computational correction of the selective RF level indication.



Characteristics of various IF filters in the FMAS (frequency axis 200 kHz/div)

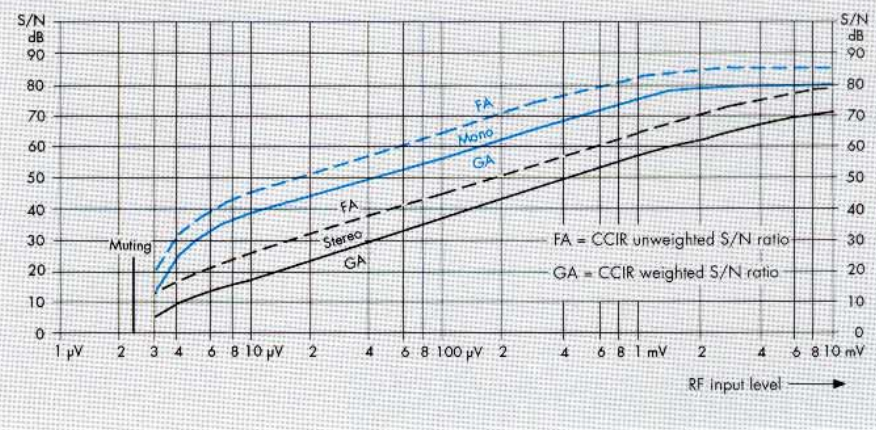
red: Maximum selectivity is obtained with the **FM narrow** filter. With a wider bandwidth the **FM wide** filter still offers good selectivity.

green: The particularly low distortion of the FM wide filter is obtained thanks to a very flat group-delay response in the range ±100 kHz around the centre frequency.



Stereo THD at 75 kHz dev. Thanks to high phase linearity, distortion remains low even with the narrow IF filter.

Considerably lower distortion is obtained with the FM wide filter which is particularly suitable for modulation analysis in cable networks and transmitter combining networks.



S/N ratio of input voltage (referred to 40 kHz dev). The high sensitivity and selectivity make the FMAS particularly suitable for measurements directly at the antenna.

Uses

Measurements which up to now were time-consuming and laborious become simple with the FMAS:

The IF filter FM narrow meets all requirements of relay receivers. Remote measurements on VHF transmitters are easier and much more accurate. It is no longer necessary to use a separate receiver with IF filters that are not optimal for FM mono or stereo signals. In addition, the receiver's S/N ratio is often inadequate because of poor phase noise.

Other fields of application for the FM narrow filter are accurate peak deviation monitoring, remote measurements of field strength and frequency with high precision as well as coverage measurements. In many cases it is not the field strength but multi-path reception that puts limits on the coverage area of a VHF transmitter. The degree of multi-path reception can be determined by parallel evaluation of AM and FM components of a received FM mono or stereo signal.

In the FMAS this is possible with the built-in AF analyzer and the quotient measurement function. Measured results are indicated in "% modulation depth/kHz deviation". Thus FMAS complies with the specifications of ARD and DBP Telekom. In addition, the built-in stereo decoder allows aural monitoring via headphones.

The special IF filter TV sound makes the FMAS suitable for modulation analysis of dual-sound carriers in TV transmitters and in cable networks, uninfluenced by vision modulation or adjacent channels. Further applications are remote deviation monitoring as well as level and frequency monitoring of TV sound carriers. The TV-sound filter permits also TV sound subcarriers in the satellite baseband to be analyzed.

The IF filter FM wide is particularly suitable for **modulation analysis** of the relatively wideband FM stereo signals for all applications where adjacent channels are not occupied. AF frequency response, modulation distortion and stereo crosstalk of this filter are considerably lower than those of the FM narrow filter. All transmitters of a particular site can be measured at the transmitter combining network so that the analyzer need not be carried from one transmitter to another. Such measurements save time, simplify automatic monitoring and make sure that the signal quality is not impaired by transmitter combining filters.

Specifications

The specifications apply to the FMAS in the receive mode. For the non-selective mode refer to FMAB data sheet PD 756.9551. (Instead of the distortion meter FMAS includes AF Analyzer/DSP Unit FMA-B8, data sheet 757.0635).

Frequency

Frequency range	5 to 1000 MHz	
1st IF	158.5 MHz at f_{in} = 87.5 to 108 MHz and 183 to 273 MHz, otherwise 208.5 MHz	
Image frequencies	f_{in} + 317 MHz at 158.5 MHz IF f_{in} + 417 MHz at 208.5 MHz IF f_{in} + 17 MHz, f_{in} – 3 MHz	
IF bandwidths (–3 dB)	FM wide 350 kHz	FM narrow/TV sound 150 kHz
Shape factor (–3/–60 dB)	3.4	3.7

RF level

RF input level range	–87 to +30 dBm (10 µV to 7 V)
Overload protection	up to 5 W (15 V_{rms}), max. peak voltage 25 V
VSWR	≤2.7 (without attenuation) ≤1.4 (with ≥10 dB attenuation)
Selective level measurement (peak measurement) Measurement error [1])	
5 to 500 MHz	≤±2 dB ±3 µV
500 to 1000 MHz	≤±3 dB ±3 µV
LO feed through at f_{in} + IF	
87.5 to 108 MHz	≤20 µV
otherwise	≤60 µV

FM stereo

Selectivity
Ratio of wanted to unwanted signal for a weighted S/N ratio of ≥54 dB referred to a wanted signal of Δf 40 kHz, f_{mod} 500 Hz. Stereo measurements with a 50 µs deemphasis in the stereo decoder.
Specifications apply to input levels ≥200 µV (–61 dBm) for mono and ≥2 mV (–41 dBm) for stereo.

	Stereo		Mono	
Common-channel suppression				
Frequency difference				
0 to 10 kHz				
Unwanted signal, unmodulated	≤49 dB		≤49 dB	
Unwanted signal, modulated				
f_{mod} 500 Hz				
dev. ±40 kHz	≤63 dB		≤44 dB	
Nearby selectivity				
Unwanted signal, modulated				
f_{mod} 500 Hz, Δf 75 kHz	FM wide	FM narrow	FM wide	FM narrow
Frequency difference				
±100 kHz	≤64 dB	≤61 dB	≤7 dB	≤4 dB
±200 kHz	≤25 dB	≤11 dB	≤7 dB	≤0 dB
±300 kHz	≤5 dB	≤–15 dB	≤4 dB	≤–16 dB
±600 kHz	–	–	≤–26 dB	≤–46 dB
Far-off selectivity				
Unwanted signal, modulated				
f_{mod} 500 Hz, Δf 75 kHz, frequency difference ≥1.2 MHz (except for image frequency and 1st IF)				
87.5 to 108 MHz	–	–	≤–54 dB	≤–54 dB
otherwise	–	–	≤–40 dB	≤–40 dB

Image-frequency rejection
Unwanted signal, modulated
f_{mod} 500 Hz, FM: Δf 75 kHz,
AM: m=90% at image frequency ±6 kHz

	Stereo	Mono
87.5 to 108 MHz	≤–10 dB	≤–30 dB
otherwise	≤+10 dB	≤–10 dB

IF rejection
Unwanted signal, modulated
f_{mod} 500 Hz, FM: Δf 75 kHz,
AM: 90% at IF ±6 kHz

87.5 to 108 MHz	≤–20 dB	≤–40 dB
5 to <87.5/ >108 to 350 MHz	≤+15 dB	≤–5 dB
otherwise	≤–10 dB	≤–30 dB

Linear distortions
Amplitude frequency response
measured at MPX signal output,
Δf 40 kHz,
ref. frequency 500 Hz

	FM wide	FM narrow
40 Hz to 43 kHz	≤±0.1 dB	≤±0.1 dB
43 to 53 kHz	≤±0.1 dB	≤±0.3 dB
53 to 61 kHz	≤±0.2 dB	≤±1 dB
61 to 70 kHz	≤±0.5 dB	≤±3 dB
70 to 75 kHz	≤±1.5 dB	≤±5 dB

Stereo crosstalk between L and R channel
measured via stereodecoder,
without deemphasis

40 Hz to 5 kHz	≥–50 dB	≥–37 dB
5 to 15 kHz	≥–44 dB	≥–31 dB

Nonlinear distortions
THD measured at MPX signal output (mono)

	Δf 75 kHz		Δf 100 kHz	
	FM wide	FM narrow	FM wide	FM narrow
40 Hz to 5 kHz	–	≤0.5%	–	≤1%
40 Hz to 15 kHz	≤0.25%	–	≤0.5%	–

Measured via stereodecoder	Stereo		Mono	
	FM wide	FM narrow	FM wide	FM narrow
40 Hz to 5 kHz				
Δf 75 kHz	≤0.3%	≤0.8%	≤0.25%	≤0.5%
Δf 100 kHz	≤0.6%	≤1.6%	≤0.5%	≤1%

Difference-frequency distortion
to IEC 268-3
measured at MPX signal
output (mono),
difference frequency 1 kHz,
Δf 75 kHz

	FM wide	FM narrow
5 to 15 kHz		
d_2	≤0.1%	≤0.25%
d_3	≤0.15%	≤0.37%
15 to 53 kHz		
d_2	≤0.2%	≤0.5%
d_3	≤0.3%	≤0.75%
Difference frequency 1 kHz, Δf 100 kHz		
5 to 15 kHz		
d_2	≤0.2%	≤0.5%
d_3	≤0.3%	≤0.75%
15 to 53 kHz		
d_2	≤0.4%	≤1%
d_3	≤0.6%	≤1.5%

S/N ratio
to CCIR 468-4, deemphasis 50 µs,
ref. to Δf 40 kHz
Unweighted S/N ratio,
low-noise mode[2])

	Stereo			Mono		
f_{in}/MHz:	5 to 130	130 to 470	470 to 1000	5 to 130	130 to 470	470 to 1000
Input level						
≥200 µV	–	–	–	≥63 dB	≥63 dB	≥63 dB
≥2 mV	≥63 dB	≥63 dB	≥61 dB	≥80 dB	≥80 dB	≥78 dB
≥20 mV	≥75 dB	≥68 dB	≥65 dB	≥80 dB	≥80 dB	≥78 dB

Weighted S/N ratio,
low-noise mode[2])

	Stereo			Mono		
f_{in}/MHz:	5 to 130	130 to 470	470 to 1000	5 to 130	130 to 470	470 to 1000
Input level						
≥200 µV	–	–	–	≥58 dB	≥58 dB	≥58 dB
≥2 mV	≥58 dB	≥58 dB	≥56 dB	≥76 dB	≥76 dB	≥74 dB
≥20 mV	≥70 dB	≥63 dB	≥60 dB	≥76 dB	≥76 dB	≥74 dB

TV dual sound

Input signal	TV dual-sound signal, standard B/G, at IF or in bands I, II and IV, V, with and without modulated vision carrier
Deviation measurement error 30 Hz to 15 kHz, Δf ≤70 kHz	≤±1% + residual FM
Difference error with successive deviation measurement, sound channel 1/sound channel 2, 30 Hz to 15 kHz	≤±0.3% + residual FM

Non-linear distortions THD	Δf 50 kHz	Δf 70 kHz
f_{mod} 30 Hz to 5 kHz	≤0.3%	≤0.5%
f_{mod} 5 to 15 kHz	≤0.5%	≤1%

Difference-frequency distortion (30 Hz to 15 kHz)		
d_2	≤0.2%	≤0.3%
d_3	≤0.3%	≤0.5%

S/N ratio
Quasi-peak measurement to CCIR 468-4, weighted and unweighted. Deemphasis 50 µs referred to Δf 30 kHz.

Input level (selective)	Unweighted	Weighted
≥200 µV	≥53 dB	≥53 dB
≥2 mV	≥73 dB	≥73 dB

Channel crosstalk, ref. to Δf 30 kHz, selective measurement, deemphasis 50 µs, other sound subcarrier modulated with frequencies from 30 Hz to 15 kHz, Δf 55 kHz, level (selective) ≥5 mV	≥80 dB

Ordering information

Order designation	Selective Modulation Analyzer FMAS	856.6001.52
Accessories supplied	special cable for firmware update, manual, power cable, spare fuses	
Options		
AM/FM Calibrator/AF Generator	FMA-B4	855.6008.52
Reference Oscillator ($\Delta f/f\ 10^{-7}$/year)	FMA-B10	856.3502.52
Other options	see FMA/FMB data sheet PD 756.9300	
Recommended extras		
Log-periodic Antenna	HL023 A1	577.8017.02
High-power Attenuator (20 dB, 50 W)	RDL50	1035.1700.52
To be fitted into FMA or FMAB		
AF Analyzer/DSP Unit	FMA-B8	855.9007.55
RF/IF Selection	FMA-B9	856.6501.52

[1]) In the range 15 to 35 °C, over the full temperature range the error doubles.

[2]) In the low-distortion mode, the S/N value may be lower by up to typ. 3 dB

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