



Modulation Analyzers FMA/FMB

Modulation Analysis with High Precision

The Rohde & Schwarz Modulation Analyzers FMA and FMB provide fast and high-precision analysis of all parameters of a modulated signal. Thanks to their versatility they can also be used as RF counters, power meters, voltmeters, psophometers and distortion meters.

The two modulation analyzers only differ in the frequency range they cover. The FMB operates from 50 kHz to

5.2 GHz, the FMA from 50 kHz to 1360 MHz but can be retrofitted to 5.2 GHz. These frequencies are becoming increasingly important for new radio services and special outside-broadcasting links.

Radiotelephony and calibration of signal generators are further applications of these analyzers. Their unrivalled measuring accuracy warrants reliable values.

The low inherent spurious modulation and the psophometer function using the optional CCIR and CCITT filters facilitate measurements and the development of oscillators, transmitters, transposers and receivers.





All important test parameters are indicated simultaneously on clearly arranged LCDs

Characteristics

- Frequency range 50 kHz to 1.36 GHz (5.2 GHz for FMB)
- High measurement speed
- Excellent S/N ratio even at high carrier frequencies
- RF frequency measurement with 10-digit readout
- Extremely accurate AM, FM and ϕ M measurements over a wide modulation frequency range
- AF frequency measurement with 5-digit readout
- Distortion measurement down to 0.005%, continuous in the range 10 Hz to 100 kHz (optional)
- Universal filter capabilities, psophometric weighting filters
- AC/DC measurement of AF voltage
- High-precision power measurement (typ. error <0.5 dB, <0.3 dB guaranteed for FMB)

Measuring accuracy

With a measurement error of 0.5% at modulation frequencies up to 20 kHz and 1% from 20 to 100 kHz, the FMA and FMB offer unprecedented precision in modulation measurements. The accuracy can be enhanced and checked at any time by means of optional AM/FM Calibrator/AF Generator FMA-B4.

Dynamic range

For FM or ϕ M demodulation, an extremely low-noise local oscillator (typ. -130 dBc at 1 GHz, 20 kHz from carrier) is provided, which ensures negligible residual FM and ϕ M up to the highest carrier frequencies. This makes the modulation analyzers ideal for measuring both spurious and wanted modulation.

A weighted FM stereo S/N ratio of typically 78 dB for carrier frequencies up to 170 MHz allows precise S/N ratio measurements on FM broadcast transmitters, channel transposers and sound processing units.

Display

Frequency or level, deviation or modulation depth as well as frequency or distortion are read out separately on three LCDs. All essential device settings, such as mode of operation, type of detector, weighting filter, are displayed too.

A scaled bargraph indicator with a high resolution of one hundred divisions is provided, in particular for adjustments made during modulation or voltage measurements.

If the relative-measurement mode (% or dB) is selected, the bargraph is automatically switched to plus/minus indication when small deviations are measured. This ensures fast and easy adjustment to a defined reference value.

A special min/max hold display simultaneously indicates the current result and the defined minimum and maximum values.

Operation

Modulation Analyzers FMA and FMB are **menu-controlled** to handle the great variety of measurement functions and reduce the number of keys.

The small number of **main function keys** and the alphanumeric display with four softkeys on each side make for clear front-panel layout and fast access to the desired measurement function. Important functions are at the top of the menu hierarchy, the number of submenu levels being limited to a maximum of three.

Parameters, such as reference values for the relative display, are entered via the numeric keypad and terminated with one of the ENTER keys (unit/multiplier keys). The facility for storing up to 20 complete setups largely eliminates operator's errors in complex applications.

All FMA and FMB functions can be **remote-controlled**. The IEC-bus interface complying with IEEE 488.2 enables plain-text programming so facilitating program writing. To set an FM deemphasis of 50 μ s for example, the following entry is made:

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DEMODULATION:FM:DEEMPHASIS
50 US
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The few main function keys afford great ease of operation:

RF	All RF settings such as tuning frequency input level RF frequency counter
DEMODO	Selecting the demodulation mode
AUDIO	Setting the AF counter and DIST/SINAD meter
SPEC FUNC	Special functions such as volt- meter mode, IEC-bus address, bargraph indicator control, etc.
FILTER	Selecting the audio filters
DETECTOR	Selecting the detector for modulation display
CALIBRATE	Calibration functions
INFO	Information on all options connected and on the special settings not displayed
MENU BACK	Going from a lower to a higher menu

Measurement functions

The FMA and FMB provide comprehensive measurement functions for conventional modulation analysis:

- Fast, fully automatic adjustment to input frequencies from 50 kHz to 1360 MHz (5.2 GHz)
- RF frequency measurement with 10-digit readout and resolution up to 0.1 Hz
- Measurement of AM modulation depth, FM and ϕ M deviation with maximum error of 0.5%, wide dynamic range and 3-dB bandwidth of >300 kHz
- FM and ϕ M deviation measurement range 700 kHz (700 rad)
- AM, FM and ϕ M demodulation from a carrier frequency of 50 kHz onwards
- AF frequency measurement with 5-digit readout and resolution down to 1 mHz
- THD and SINAD measurements from 10 Hz to 100 kHz with a dynamic range of >80 dB (optional)
- Weighted measurements with high-pass filters 10/20/300 Hz, lowpass filters 3/23/100 kHz as well as optional CCIR, CCITT and other special weighting filters
- Precise detectors: separate +PK and -PK detectors with extremely short response time, true rms detector, quasi-peak detector to CCIR 468-4 with filter option
- DC and AC voltage measurements



Softkeys enable fast access to measurement functions

The FMA measures powers to an accuracy of typically 0.5 dB over the total frequency range. Thanks to its high-precision attenuator and special calibration facility the FMB guarantees a value of ± 0.3 dB. External attenuators are taken into account in the readout. An overload protection for input powers up to 5 W is provided in all units as standard.

Application

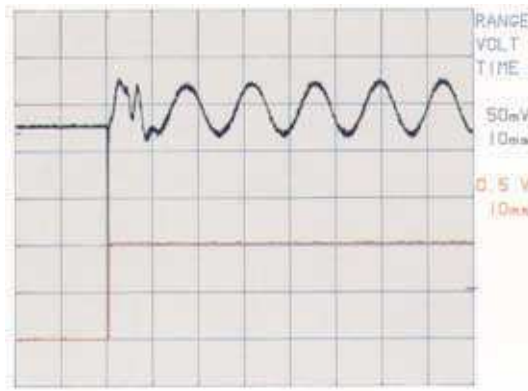
A phase-compensated noise-suppression filter is provided at the FM-MPX output, mainly for use with the internal or any external stereo decoder.

Separate +PK and -PK detectors featuring fast response time and high accuracy are ideal for simultaneously detecting positive and negative peak deviation of FM stereo program signals. With the use of the PK hold function these values can be measured continuously over extremely short to very long periods.

DC-coupled AM and FM demodulator outputs, high DC stability, short settling time of the FM demodulator ($< 100 \mu\text{s}$ for a frequency error of < 500 Hz) and a storage oscilloscope connected to the AM and FM outputs make it possible to measure on/off transients of radio equipment to FTZ 17R2028. The AM output signal whose DC voltage component is proportional to the RF input level is used as a trigger signal.

The FM demodulator has a 3-dB bandwidth of 330 kHz and measures deviations up to 700 kHz. It can be used to analyze modulators such as the GMSK*) modulators in digital mobile-radio networks.

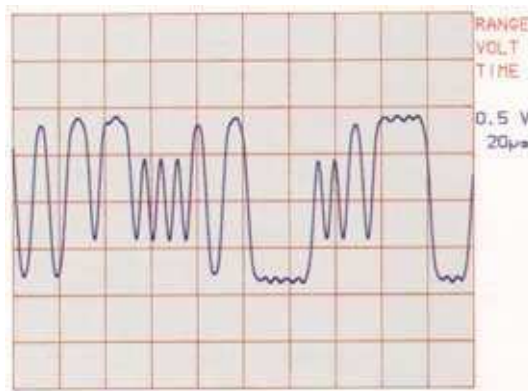
*) Gaussian minimum shift keying



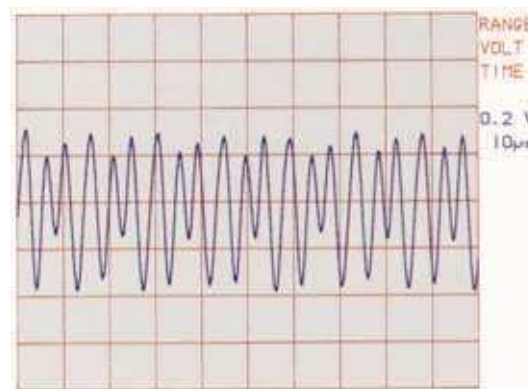
Transient measurement on radio sets

Upper curve: FM output signal

Lower curve: trigger signal at AM output (DC-coupled)



GMSK signal (such as used in digital mobile-radio system) frequency-demodulated by FMA ($B \times T = 0.3$, $f_{\text{bit}} = 270,833$ baud (pseudo-random bit sequence); the high demodulation bandwidth of 330 kHz ensures an undistorted signal at the FM or AM output; the frequency deviation can be measured accurately



GMSK signal as shown above, but modulated with all 1's; the 2.9-kHz deviation generated by the non-ideal GMSK modulator can be measured with the required bandwidth

Peak deviation monitoring

When used together with a process controller, eg PSA from Rohde & Schwarz, the FMA and FMB are particularly suitable for monitoring the peak deviation of VHF broadcast transmitters. In the PK hold mode, all modulation peaks, even the narrowest, are measured to a high accuracy by the +PK and -PK detectors which operate in parallel and have a very short response time. The monitoring intervals can be from ≈ 100 ms to any duration. For each interval, all parameters measured by the detectors such as +PK, -PK, rms and quasi-peak are read out.

Modulation Analyzers FMA and FMB afford a high measurement speed thanks to the following features:

- Fast automatic frequency adjustment by direct frequency measurement up to 1.36 GHz, even if the AM depth is high.
- Two independent frequency counters for simultaneous RF and AF counting.
- All measurement times can be adapted to the specific measurement problem, eg lowest test frequency or required counter resolution.

Measurement functions that are not required can be switched off, for example to allow extremely fast modulation measurements with preset RF level and frequency. A maximum of 10 modulation values can thus be measured per second.

Fitted with a low-noise synthesizer of 0.1-Hz resolution, broadband IF connectors and free slots, the modulation analyzers are **designed to meet future applications**. The FMA frequency range can be extended to 5.2 GHz (option FMA-B12).

Options

DIST/SINAD Meter FMA-B2

The DIST/SINAD meter can be continuously tuned from 10 Hz to 100 kHz either automatically or manually. It is able to measure distortion (THD + N) down to typically $<0.005\%$ and thus meets the requirements of pure audio measurements using a voltmeter. The result can also be read out as a SINAD value in dB.

Filter FMA-B1

This option contains the following universal weighting filters:

- Psophometric filter to CCIR 468-4 with quasi-peak detector
- Filter P53 to CCITT; 30-kHz and 120-kHz Bessel lowpass filters; highpass filters can be switched in for correct peak measurements on squarewave modulation signals
- 5-Hz lowpass filter for hum suppression in DC voltmeter mode
- Special ϕM filter which allows correct demodulation with modulation frequencies of 10 Hz and above
- 4.2-kHz lowpass filter with steep skirts, particularly for spurious modulation measurements on AM broadcast transmitters (German ARD Standard Specifications No. 5/4.1)

10-MHz Reference Oscillator FMA-B10

Highly stable 10-MHz reference oscillator with aging of $<1 \times 10^{-9}/\text{day}$

AM/FM Calibrator/AF Generator FMA-B4

This option is an extremely precise AM/FM calibration source with an error of $<0.1\%$ and at the same time a universal baseband generator fitted with two switch-selected outputs for AF, single-tone, two-tone and stereo multiplex signals (data sheet PD 756.9951).

5.2-GHz Frequency-range Extension FMA-B12 (for FMA only)

This unit extends the FMA frequency range to 5.2 GHz, eg for new radio services or special outside-broadcasting links.

Stereo Decoder FMA-B3

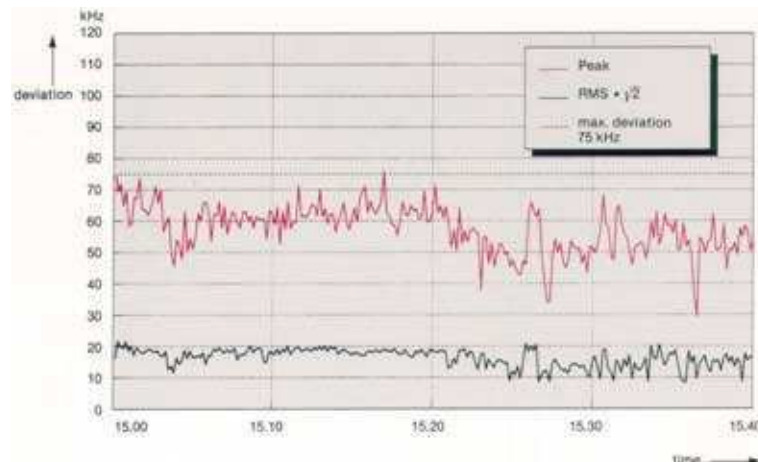
The FMA-B3 decodes the internal or any external FM stereo signal (see data sheet PD 756.9551).

AF Analyzer FMA-B8

Enables FMA and FMB for in-depth AF analysis such as

- selective modulation depth and AF level measurements from 10 to 150 kHz
- selective harmonic distortion and true THD measurements
- universal intermodulation measurements

When used with an external PC, FMA and FMB are able to monitor peak deviation measured at intervals of <100 ms



Specifications

(The specifications apply to both FMA and FMB unless specified otherwise)

Frequency range	50 kHz to 1360 MHz (FMA) 50 kHz to 5.2 GHz (FMB or FMA with option FMA-B12) automatic ¹⁾ or manual	
Frequency tuning	10-digit readout	
Display	0.1/1/10/100 Hz, selectable	
Resolution	±1 digit + error of reference frequency	
Frequency error	standard option FMA-B10	
Reference oscillator	1x10 ⁻⁶ /year	1x10 ⁻⁷ /year
Aging after 30 days of operation	–	1x10 ⁻⁹ /day
Temperature effect	2.5x10 ⁻⁶ (0 to 55 °C)	2x10 ⁻⁹ /°C
Warmup time	15 min	15 min
External reference input/output	manual or remote-controlled switchover	

RF input	Z _{in} = 50 Ω, N connector	
SWR	<1.4 (with 10 dB attenuation)	
FMA	f _{in} : 50 kHz to 1.36 to >2.72 GHz	
FMB or FMA with FMA-B12	1.36 GHz	2.72 GHz
attenuation $\hat{S} \geq 10$ dB in power-meter mode (attenuation $\hat{S} \geq 20$ dB)	≤1.4	≤2 δ≤2
Level ranges	≤1.2	≤1.5 ≤2
Overload protection	up to 5 W (15 V RMS)	
Maximum peak voltage	25 V (including DC)	

RF power measurement	FMA	
Frequency range	50 kHz to 1.36 GHz	
Power measurement range	0.18 μW to 1 W (-37.5 to +30 dBm)	
Measurement error	δ±1.5 dB ±0.05 μW (-37.5 to -10 dBm) δ≤1 dB, typ. 0.5 dB (-10 to +30 dBm)	

FMB or FMA with FMB-B12	Power measurement range	
	0.18 μW to 1 W (-37.5 to +30 dBm)	
Error limits ²⁾ with input level:	-37.5 to -10 dBm	+5 to +30 dBm
f _{in} = 50 kHz to 1.36 GHz:	±1 dB	±0.3 dB ±0.5 dB
f _{in} = 1.36 GHz to 5.2 GHz	±1.5 dB	±0.5 dB ±1 dB
	(±0.05 μW)	(±0.05 μW)

Amplitude modulation measurement	Modulation frequency range	
	10 Hz to 200 kHz	
Resolution	0.1% of rdg; max. 0.001% AM	
Measurement error ³⁾ with peak detection (% of rdg, plus peak residual AM)	f _{in} : 50 to 300 kHz 300 kHz to 10 MHz ≥10 MHz	
m	δ≤80%	meas. error δ≤0.8%/typ. 0.5%
mδ ≤95%	30 Hz to 3 kHz	30 Hz to 10 kHz
	30 Hz to 20 kHz	30 Hz to 100 kHz
	10 Hz to 8 kHz	10 Hz to 100 kHz
	10 Hz to 50 kHz	10 Hz to 200 kHz
Residual AM ⁴⁾	f < 1.36 GHz	f $\hat{S} \geq 1.36$ GHz
to CCITT	≤0.01%	≤0.02%
20 Hz to 23 kHz, RMS	≤0.03%	≤0.06%
to CCIR	δ	≤0.05% ≤0.1%
Incidental AM in FM (f _{mod} = 1 kHz, meas. bandwidth 20 Hz to 3 kHz)	f _{in} = 50 kHz to 10 MHz, deviation = 5 kHz δ≤0.2%	
	f _{in} $\hat{S} \geq 10$ MHz, deviation = 50 kHz ≤0.1%	
AF distortion ⁵⁾ for f _{mod} = 10 Hz to 20 kHz	m = 40% δ≤0.2%	
	40% ≤ m ≤ 80% δ≤0.4%	

Frequency modulation measurement	Modulation frequency range	
	10 Hz to 200 kHz	
Max. measurable deviation for f _{in} :	50 to 300 kHz	300 kHz to 10 MHz
	f _{in} /10	150 kHz
Meas. error ³⁾ with peak detection (plus peak residual FM)	f _{in} : 50 to 300 kHz	300 kHz to 10 MHz
	f _{mod} error	f _{mod} error
	30 Hz to 5 kHz ≤0.5%	30 Hz to 10 kHz ≤0.5%
	10 Hz to 8 kHz ≤2%	30 Hz to 20 kHz ≤1%
		10 Hz to 50 kHz ≤2%
		10 Hz to 200 kHz ≤2%
Resolution better than 0.1% of rdg (min. 0.1 Hz)	δ≤340 ≤680 δ≤1360 MHz	
Residual FM ⁴⁾ for f _{in} (in MHz)	CCITT, RMS	
	20 Hz to 23 kHz, RMS	δ≤2 Hz ≤3 Hz ≤5 Hz
	CCIR, quasipeak + 50 μs deemph. with f _{in} (in GHz)	δ≤3 Hz ≤4 Hz ≤6 Hz
	CCITT, RMS	δ≤2.72 δ ≤5.2
	20 Hz to 23 kHz, RMS	δ≤2 Hz δ ≤4 Hz
	CCIR, quasipeak + 50 μs deemph.	δ≤10 Hz ≤20 Hz ≤24 Hz

Stereo S/N ratio ⁴⁾ weighted to CCIR, 40 kHz deviation, at FM output (with noise filter)	f _{in} : 10 to δ≤170 MHz	
	170 to ≤340 MHz	
	340 to 680 MHz	
	≥76 dB, typ. 78 dB	≥73 dB
	≥68 dB	
Stereo crosstalk (f _{in} ≥ 10 MHz, without noise filter)	f _{mod} = 1 kHz	
	30 Hz δ≤ f _{mod} ≤ 15 kHz	
AF distortion for deviation of f _{in} ≥ 10 MHz	75 kHz	500 kHz
f _{mod} = 30 Hz to 20 kHz ⁵⁾	δ≤0.05%	δ≤0.2%
= 20 kHz to 100 kHz	δ≤0.15%	δ≤0.5%
f _{in} > 500 kHz	δ≤0.1%	–
f _{mod} = 30 Hz to 20 kHz	Incidental FM (m = 50%, f _{mod} = 1 kHz, B = 20 Hz to 3 kHz, plus peak residual FM)	
	Deemphasis	
	≤10 Hz	
	50/75/750 μs selectable, effective at AF output and, if selected, for result display	

Phase modulation measurement	Modulation frequency range	
	200 Hz to 200 kHz	
Max. measurable deviation (up to max. 1 kHz AF, -6 dB/octave for f > 1 kHz)	f _{in} : 50 to 300 kHz	
	300 kHz to 10 MHz	≥10 MHz
	1/10 f _{in} /kHz x 1 rad	150 rad
700 rad	Error ³⁾ of peak detection (plus peak residual φM)	
f _{mod} 300 Hz to 5 kHz	300 Hz to 10 kHz	300 Hz to 100 kHz
with special φM filter (FMA-B1):	10 Hz to 5 kHz	10 Hz to 10 kHz
	10 Hz to 10 kHz	10 Hz to 10 kHz
δ	≤2%	≤2%
δ	≤2%	≤2%
Resolution < 0.1% (minimum 0.0001 rad)		

Residual φM ⁴⁾ for f _{in}	δ≤680 MHz	≤1.36 GHz
CCITT weighting	δ≤0.002 rad	≤0.004 rad
300 Hz to 23 kHz	δ≤0.005 rad	≤0.01 rad
at f _{in}	≤2.72 GHz	≤5.2 GHz
CCITT weighting	δ≤0.008 rad	≤0.016 rad
300 Hz to 23 kHz	δ≤0.02 rad	≤0.04 rad
AF distortion (at AF output) (f _{mod} 200 Hz to 20 kHz, Δφ = 4 rad, f _{in} $\hat{S} \geq 500$ kHz)	δ≤0.1%	

AF voltmeter	DC voltage measurement:	
Range	±10 μV to 20 V	
Offset voltage ⁶⁾	unbalanced input	
	δ≤1 mV	} can be corrected to δ≤30 μV using offset
	balanced input	
function	δ≤3 mV	
Resolution	<0.1%	

Error	
3-kHz lowpass filter	$\pm 0.5\% \pm 100 \mu\text{V} \pm \text{offset voltage}$
5-kHz lowpass filter (with filter option)	$\pm 0.5\% \pm 10 \mu\text{V} \pm \text{offset voltage}$
AC voltage measurement:	
Frequency range	10 Hz to 300 kHz
Measurement range	30 μV to 20 V
Resolution	0.1 % of rdg
Error (RMS detector)	
30 Hz to 20 kHz	$\leq 1\% \pm 30 \mu\text{V}$ (100-kHz lowpass filter)
10 Hz to 100 kHz	$\delta \leq 2\% \pm 100 \mu\text{V}$ (without lowpass filter)
10 Hz to 200 kHz	$\delta \leq 3\% \pm 100 \mu\text{V}$ (without lowpass filter)
Weighting facilities	all AF measuring facilities, such as detector, filter, frequency counter and distortion meter, can also be used in voltage measurements
Inputs	
unbalanced	input impedance 100 k Ω 50 pF, BNC connector
balanced	input impedance 600 Ω , 3-contact connectors to DIN 41 628
AF detector	
Peak detector	positive or negative peak of AF or arithmetic mean of both
RMS detector	true RMS-responding rectifier, readout as RMS value or converted to peak for sinewave
Quasi-peak detector	to CCIR Rec. 468-4
Weighting filters	
Highpass filters	10 Hz (2nd order) 20 Hz (3rd order) 300 Hz (2nd order)
Lowpass filters	3 kHz (4th order) 23 kHz (4th order; meets CCIR 468-4, unweighted, if combined with 20-Hz highpass) 100 kHz (4th order) CCIR 468-4 (weighted) CCITT P53 5-Hz lowpass (for DC measurement) 30-kHz Bessel lowpass, 4th order 120-kHz Bessel lowpass, 4th order 4.2-kHz Cauer lowpass special ϕM filter (phase demodulation for modulation frequencies ≥ 10 Hz) external filters possible
Filter option	
AF frequency display	
Frequency range	5 digits 10 Hz to 300 kHz
Resolution	1 mHz to 10 Hz
Error	$\pm 0.005\% \pm 3$ mHz ± 1 digit
Distortion meter (option FMA-B2)	
Readout either in % or SINAD in dB, automatic adjustment for S/N ≥ 20 dB	
Measurement range	10 Hz to 100 kHz
Display range	
THD	0.005 to 50%
SINAD	6 to 86 dB
Maximum error	
10 Hz to 100 kHz (harmonics up to 300 kHz)	± 2 dB $\pm 0.15\%$ THD
20 Hz to 20 kHz (with 100-kHz lowpass)	± 1 dB $\pm 0.03\%$ THD
Measuring time	
Automatic tuning; RF, modulation and modulation-frequency measurement with 10 Hz RF resolution (HP filter and PK detector switched on)	typ. 1 s
Fast modulation measurement (RF, modulation range and level programmed)	≤ 120 ms
DIST measurement f_{mod}	typ. 2.5 s
≤ 30 Hz	typ. 1 s
≥ 300 Hz	
Outputs	
IF output	max. 200 mV into 50 Ω
AM output	max. 1 V into 600 Ω (can be DC-coupled)

FM/ ϕM output for FM	6 dBm (1.545 V) into 600 Ω , 40 kHz deviation (DC-coupled) 1.545 V into 600 Ω , 40 rad
for ϕM	
Distortion output (with optional DIST/SINAD meter)	max. 1 V into 600 Ω
AF output	1 to 4 V into 600 Ω (peak voltage)
10-MHz reference frequency output	switch-selected output/input +12 dBm, 50 Ω , sinewave -10 to +12 dBm
input	
Interface for firmware update	7-contact Cannon connector
Remote control	
Interface	IEC 625-1/625-2 (IEEE 488.1/488.2), connector: 24-contact Amphenol; controls all device functions including Serial Poll and Parallel Poll
Interface functions	SH1, AH1, L4, T5, SR1, RL1, DC1, DT1, PP1, CO
General Data	
Environmental conditions	to IEC 359, class I
Rated temperature range	0 to +55 $^{\circ}\text{C}$
Storage temperature range	-40 to +70 $^{\circ}\text{C}$
RFI suppression	to VDE 0871, limit B and German PTT regulations 527/1979
Power supply	100/120/220/240 V $\pm 10\%$, 47 to 440 Hz (170 VA)
Dimensions, weight	435 mm x 192 mm x 460 mm, 25 kg

Ordering information

Order designation	
Modulation Analyzer FMA	852.8500.52
Modulation Analyzer FMB	856.5005.52

Accessories supplied	special cable for firmware update, manual, power cable, spare fuses
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Options		
Filter	FMA-B1	855.2002.52
DIST/SINAD Meter	FMA-B2	855.0000.52
FM Stereo Decoder		
(see data sheet PD 756.9551)	FMA-B3	856.0003.52
AM/FM Calibrator/AF Generator (data sheet PD 756.9951)	FMA-B4	855.6008.52
AF Analyzer/DSP Unit (data sheet PD 757.0635)	FMA-B8	855.9007.55
RF/IF Selection (data sheet PD 757.0912; only for FMA without FMA-B12)	FMA-B9	856.6501.52
Reference Oscillator	FMA-B10	856.3502.52
5.2-GHz Frequency Range Extension for FMA	FMA-B12	855.8500.52

Recommended extras		
Service Kit	FMA-Z1	856.4009.52
19" Adapter	ZZA-94	396.4905.00
Transport Case	ZZK-944	1013.9366.00
High-power Attenuator 20 dB, 50 W	RDL50	1035.1700.52

- ¹) In specified input-level range; for amplitude-modulated signals with $m \leq 80\%$: specified minimum input level +10 dB.
- ²) Frequency-response correction switched on, ambient temperature 20 to 25 $^{\circ}\text{C}$, additional error per 10 $^{\circ}\text{C}$ deviation: 0.1 dB for levels ≥ -10 dBm, 0.2 dB for levels < -10 dBm.
- ³) In temperature range 20 to 30 $^{\circ}\text{C}$, additional error of $\pm 0.5\%$ over total temperature range; error of RMS detection may be up to twice as high as that of peak detection.
- ⁴) For input level ≥ 20 dB above specified minimum input level.
- ⁵) 100-kHz lowpass filter switched on.
- ⁶) With input attenuator switched on: value x 10.



ROHDE&SCHWARZ

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