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FMB
50 kHz to 5.2 GHz

FMA
50 kHz to 1360 MHz

Version
02.00

December
2003

Modulation Analyzer R&S® FMAB

The specialist for sound broadcast signals from 50 kHz to 1360 MHz

- ◆ Built-in precision stereo decoder both for internal FM stereo decoding and for decoding of an external stereo multiplex signal
- ◆ External stereo decoder input
- ◆ Demodulation of RDS and traffic program signals
- ◆ ITU-R detector and standard weighted/unweighted ITU-R filters
- ◆ Distortion meter from 10 Hz to 100 kHz
- ◆ RF frequency measurement with 10-digit readout, maximum resolution 0.1 Hz
- ◆ High-precision AM, FM and ϕ M measurement over a wide modulation frequency range
- ◆ Complete AF analysis in the L, R, M and S channels including distortion measurement and S/N ratio measurement to ITU-R standard
- ◆ Selective measurement of pilot tone deviation and deviation of 57 kHz traffic program carrier
- ◆ Built-in RDS demodulator with clock and data output for external decoding
- ◆ Measurement of modulation depth of 57 kHz traffic program carrier
- ◆ High-accuracy power measurement (typ. error <0.5 dB)



ROHDE & SCHWARZ

The Modulation Analyzer R&S®FMAB has been especially designed for the analysis of FM stereo broadcast signals. It combines the universal features of the R&S®FMA basic model and the additional measurement capabilities of the built-in stereo decoder.

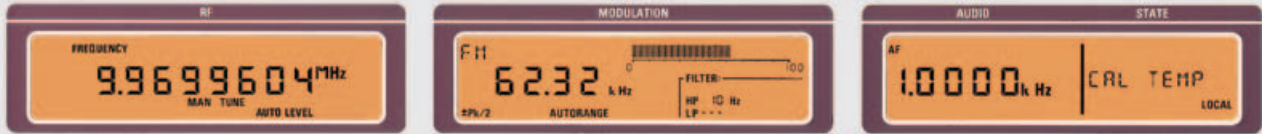
The measurement tasks of the R&S®FMAB mainly cover the field of sound broadcasting and include comprehensive analysis of VHF transmitters, channel transposers and VHF/baseband converters. Since the stereo decoder with all its analysis functions can be

separately used via the rear-panel input, measurements on FM receivers and stereo coders are also possible.

Three large illuminated LCD displays simultaneously read out the measured carrier frequency, modulation and modulation frequency, plus additional information about device status and settings. The clear front-panel layout, with softkeys and a few main function keys, makes for user-friendly operation. Previously complex measurements on FM stereo signals thus become very simple.



Front view of R&S®FMAB



All essential test parameters can be read at a glance on clearly arranged LCD displays

Characteristics

Owing to the clear layout of the R&S® FMAB, all essential test parameters can be read at a glance on the LCD displays. Superimposed additional information, such as the test channel, deemphasis switched on, affords high measurement reliability.

Precision stereo decoder

The precision stereo decoder has been especially designed for wide dynamic range and flat amplitude and phase response that are required in FM stereo measurements. The weighted stereo S/N ratio of ≥ 80 dB and the channel crosstalk attenuation of ≥ 60 dB in the range 30 Hz to 15 kHz are top-class.

The special characteristics of the built-in FM demodulator regarding frequency and phase response as well as low distortion are ideally matched to the stereo decoder. The values achieved meet the relevant specifications of broadcasting corporations and are even better in many cases.

Dynamic range

An extremely low-noise local oscillator (typ. -130 dBc at 1 GHz, 20 kHz carrier offset) ensures a sufficient S/N ratio for FM stereo decoding even far above the VHF band, e.g. for measurements on channel transposers in the UHF range. 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 VHF/baseband converters.

Result display

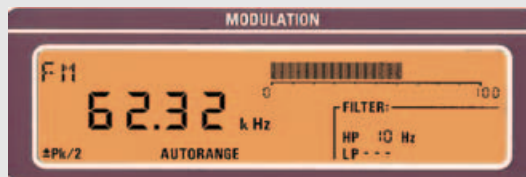
Frequency or level, deviation or modulation depth as well as frequency or distortion are read out independently of one another on three LCD displays. All essential device settings, such as operating

mode, test channel, type of detector, weighting filter, are superimposed on the relevant display.

A scaled bargraph indicator with a high resolution (one hundred divisions) is provided especially for the alignment of DUTs followed by modulation and voltage measurements.

When relative measurement (% or dB) is selected, the bargraph indicator automatically switches to plus/minus indication in the measurement of small deviations. This ensures fast and easy adjustment to a defined reference value.

A special min/max hold mode allows simultaneous analog display of the current result and the defined minimum and maximum values.



The analog bargraph indicator is ideally suited for adjustments, e.g. to a defined reference value

Operation

Due to its versatile measurement functions, the R&S® FMAB is menu-controlled so that there is no need for a great number of individual keys.

The minimal number of main function keys as well as an alphanumeric menu display with four softkeys arranged at both sides make for clear front-panel layout and fast access to the desired measurement functions. Important functions are at a high menu level, the number of submenu levels being limited to a maximum of three so that finding one's way in the menu is easy.

Parameters, like for instance a reference value for relative display, can be entered via the numeric keypad and are terminated with one of the ENTER keys (unit/multiplier keys). The fact that up to 20 complete setups can be stored considerably enhances the measurement reliability in complex applications.

Remote control

The Modulation Analyzer R&S® FMAB features full remote-control capability. The FM stereo measurement facilities are system-compatible. The IEC/IEEE bus interface fully complies with the IEEE 488.2 standard and enables plain-text programming, which greatly facilitates program writing. For setting an FM deemphasis of 50 μ s, for instance, with FM stereo decoding switched on, the following entry is made:

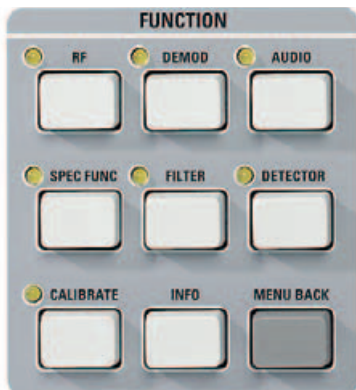
STEREODECODER:DEEMPHASIS 50 US

Measurement functions

The R&S® FMAB features standard measurement functions in modulation analysis and a wide variety of additional capabilities owing to the built-in stereo decoder:

- ◆ Fast, fully automatic ranging to input frequencies from 50 kHz to 1360 MHz at levels from 3 mV to 7 V
- ◆ RF frequency measurement with 10-digit readout and resolution down to 0.1 Hz
- ◆ AM modulation depth, FM and ϕ M deviation with error of less than 0.5%, wide dynamic range and 3 dB bandwidth of >300 kHz; FM and ϕ M deviation measurement range 700 kHz (rad); AM, FM and ϕ M demodulation from 50 kHz carrier frequency upwards
- ◆ Audio frequency measurements with 5-digit readout and resolution down to 1 mHz
- ◆ Distortion and SINAD measurement continuously from 10 Hz to 100 kHz with a dynamic range of >80 dB
- ◆ Psophometric weighting filters
 - Highpass filters 10/20/300 Hz
 - Lowpass filters 3/23/100 kHz
 - ITU-R filters (468-4) weighted and unweighted
 - ITU-T and other special weighting filters

The few main function keys make the R&S® FMAB user-friendly:



- RF** All RF settings such as tuning frequency, input level and RF frequency counter
- DEMOD** Selecting the demodulation modes and access to the FM stereo decoder functions
- AUDIO** Setting the audio frequency counter or the DIST/SINAD meter
- SPEC FUNC** Special functions such as voltmeter mode, IEC/IEEE bus address, bargraph indicator control, etc
- FILTER** Selecting the audio filters
- DETECTOR** Selecting the detector for the modulation display
- CALIBRATE** Calibrating functions
- INFO** Readout of all internal settings on the menu display
- MENU BACK** Going back a level in the menu tree



Softkeys enable fast access to desired measurement functions

- ◆ Precision detectors: separate +PK and –PK detector with extremely short response time, MAX PEAK function; true RMS detector; quasi-peak detector to ITU-R 468-4
- ◆ AC and DC voltage measurements
- ◆ Power measurement (error typ. ≤ 0.5 dB, overload protection circuit for up to 5 W input power)

Options

The R&S®FMAB can be expanded by the optional highly stable 10 MHz Reference Oscillator R&S®FMA-B10 with aging of $<1 \times 10^{-9}$ /day. The frequency measurement error at 100 MHz of maximally 200 Hz is thus reduced down to 10 Hz within a calibration interval of one year.

The AM/FM Calibrator R&S®FMA-B4 including an AF generator from 10 Hz to 100 kHz with two external, separately switchable outputs is also available as an option. The error of the calibration source is less than 0.1%.

The 5.2 GHz Frequency Extension R&S®FMA-B12 is provided for special applications at higher frequencies, e.g. outside-broadcast links in the GHz range.

Applications

A phase-compensated noise suppression filter with a bandwidth of 95 kHz (-3 dB) can be switched into circuit between FM demodulator and stereo decoder especially for internal stereo decoding. High-frequency spurious components can thus be efficiently kept away from the stereo decoder, with negligible effect on the phase linearity and channel crosstalk from L to R and R to L. In conjunction with the option R&S®FMA-B4 (calibrator and audio generator), the R&S®FMAB can be expanded to form a complete test set especially for FM broadcast transmitters. All quality-relevant parameters of VHF sound broadcast transmitters can thus be measured without the need for any additional measuring instruments.

Separate +PK and –PK detectors featuring very short response time and high precision are ideally suited for simultaneous detection of positive and negative peak deviation of FM stereo program signals. In conjunction with the PK HOLD function, peak deviations can be monitored for periods ranging from very short to a duration of any length. If the MAX PEAK function is selected on the R&S®FMAB, the maximum deviation will be indicated on the display.

Peak deviation monitoring

In conjunction with a process controller, e.g. the R&S®PSA, the R&S®FMAB is ideal for monitoring the peak deviation of VHF broadcast transmitters. In the PK HOLD mode, +PK and –PK detectors operating in parallel and featuring a very short response time ensure precise measurement of all, even the narrowest of modulation peaks. The monitoring intervals can be from ≤ 100 ms up to any duration. The values measured by all detectors such as +PK, –PK, RMS and quasi-peak can be read out per unit time.



Rear view of the R&S®FMAB

The R&S®FMAB is designed for high measurement speed:

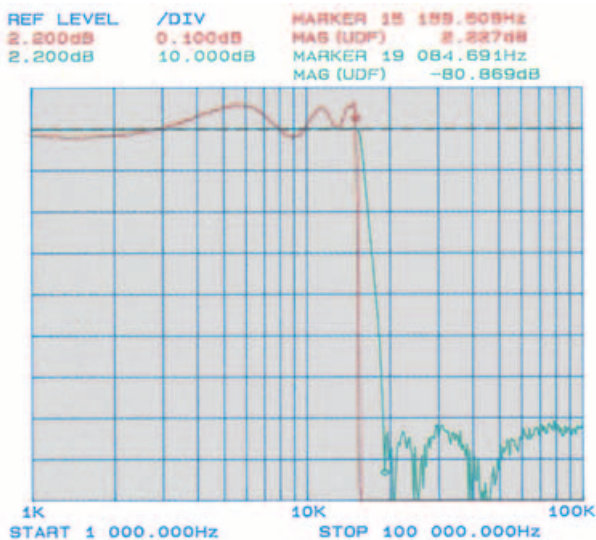
- ◆ Fast, automatic frequency adjustment by direct frequency measurement up to 1.36 GHz
- ◆ Correct frequency measurement even at large AM depth due to state-of-the-art technologies
- ◆ Two independent frequency counters for simultaneous RF and AF measurement

- ◆ All measurement times can be adapted to the specific measurement problem, e.g. lowest measurement frequency or required counter resolution

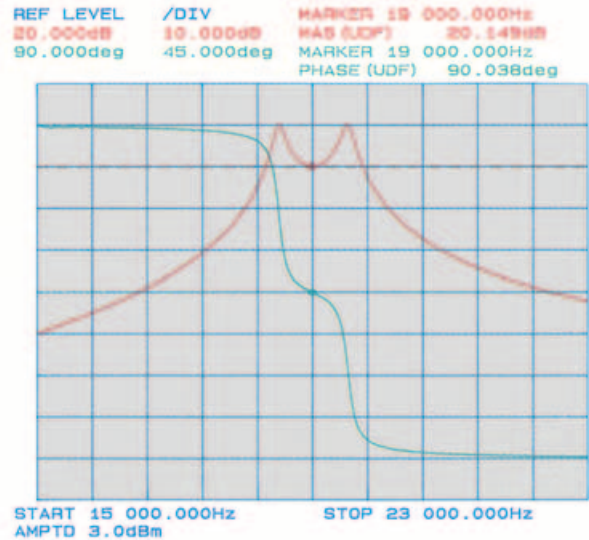
Measurement functions that are not required can be switched off, e.g. for extremely fast modulation measurement with preset RF level and preset RF frequency. In this way, 10 modulation values can be measured per second.

Future-oriented design

The frequency range can be extended up to 5.2 GHz, thus allowing measurements on special broadcasting and program distribution systems. The built-in firmware can easily be updated via a serial interface using a PC compatible with the industry standard.



Frequency response in L channel;
Selected components ensure minimum frequency response and high spurious suppression in the L, R, M, S channels



Frequency response of pilot filter;
A high-selectivity pilot tone filter allows unimpaired measurement of the pilot tone deviation; the phase error of the pilot tone filter can be automatically eliminated with the aid of a method specially developed by Rohde & Schwarz; new standards are thus set in the measurement of stereo channel crosstalk

Specifications

Frequency	
Frequency range	50 kHz to 1360 MHz
Frequency tuning	automatic ¹⁾ or manual
Display	10-digit readout
Resolution	0.1/1/10/100 Hz selectable
Frequency error and drift	±1 digit + error of reference frequency
Reference oscillator	standard option R&S® FMA-B10
Aging	2 x 10 ⁻⁶ /year 1 x 10 ⁻⁷ /year
After 30 days of operation	— 1 x 10 ⁻⁹ /day
Temperature effect	2.5 x 10 ⁻⁶ 2 x 10 ⁻⁹ /°C (0°C to 55°C)
Warmup time	15 min 15 min
External reference input/output	manual or remote-controlled switch-over
Output level	12 dBm ±2 dB
Input level range	-10 dBm to +15 dBm
RF input	Z _{in} = 50 Ω, N connector, VSWR <1.4 with 10 dB attenuation
Overload protection	up to 5 W (15 V RMS)
Maximum peak voltage	25 V (including DC)
RF power measurement	
Frequency range	50 kHz to 1360 MHz
Power measurement range	0.18 μW to 1 W (-37.5 dBm to +30 dBm)
Measurement error	
0.18 μW ≤ P < 0.1 mW	≤±1.5 dB ±0.05 μW
P ≥ 0.1 mW	≤1 dB (typ. 0.5 dB)
Amplitude modulation measurement	
Modulation frequency range	10 Hz to 200 kHz
Resolution	0.1% of reading; max. 0.001% AM
Measurement error ²⁾ with peak detection (% of reading, plus peak residual AM)	
f _{in} 50 to 300 kHz >300 kHz to 10 MHz ≥10 MHz measurement error	
m ≤80% 30 Hz to 3 kHz 30 Hz to 10 kHz 30 Hz to 20 kHz ≤0.8%	
m ≤95% — 30 Hz to 20 kHz 30 Hz to 100 kHz ≤1%	
10 Hz to 8 kHz 10 Hz to 20 kHz 10 Hz to 100 kHz ≤2%	
— 10 Hz to 50 kHz 10 Hz to 200 kHz ≤5%	
Residual AM ³⁾	
To ITU-T	≤0.01%
20 Hz to 23 kHz, RMS	≤0.03%
To ITU-R	≤0.05%
Incidental AM in FM mode (f _{mod} = 1 kHz, meas. bandwidth 20 Hz to 3 kHz)	
f _{in} = 50 kHz to 10 MHz, deviation = 5 kHz	≤0.2%
f _{in} ≥10 MHz, deviation = 50 kHz	≤0.1%
AF distortion for f _{mod} = 10 Hz to 20 kHz (for f _{in} <300 kHz: f _{mod} = 10 Hz to 5 kHz)	
m = 40%	≤0.2%
40% ≤ m ≤ 80%	≤0.4%

Frequency modulation measurement		
Modulation frequency range	10 Hz to 200 kHz	
Max. measurable deviation for	f _{in} /10	
f _{in} : 50 kHz to 300 kHz	150 kHz	
f _{in} : 300 kHz to 10 MHz	700 kHz	
f _{in} : ≥10 MHz		
Meas. error ²⁾ with peak detection (plus peak residual FM)		
f _{in} : 50 kHz to 300 kHz	f _{mod}	error
	30 Hz to 5 kHz	≤0.5%
	10 Hz to 8 kHz	≤2%
f _{in} : 300 kHz to 10 MHz	f _{mod}	error
	30 Hz to 10 kHz	≤0.5%
	30 Hz to 20 kHz	≤1%
	10 Hz to 50 kHz	≤2%
f _{in} : ≤10 MHz	f _{mod}	error
	30 Hz to 20 kHz	≤0.5%
	30 Hz to 100 kHz	≤1%
	10 Hz to 200 kHz	≤2%
Resolution	better than 0.1% of reading (min. 0.1 Hz)	
Residual FM ³⁾ for f _{in}	≤340 MHz	≤680 MHz
To ITU-T, RMS	≤0.5 Hz	≤0.7 Hz
20 Hz to 23 kHz, RMS	≤2 Hz	≤3 Hz
ITU-R, quasi-peak +50 μs deemphasis	≤3 Hz	≤4 Hz
≤1360 MHz	≤1 Hz	≤5 Hz
20 Hz to 23 kHz, RMS	≤2 Hz	≤3 Hz
ITU-R, quasi-peak +50 μs deemphasis	≤3 Hz	≤4 Hz
≤1360 MHz	≤1 Hz	≤5 Hz
Stereo S/N ratio ³⁾ weighted to ITU-R, 40 kHz deviation, at FM output (with noise filter)		
f _{in} : 10 MHz to ≤170 MHz	≥76 dB	
f _{in} : 170 MHz to ≤340 MHz	≥73 dB	
f _{in} : 340 MHz to 680 MHz	≥68 dB	
Stereo crosstalk (f _{in} ≥10 MHz, without noise filter)		
f _{mod} = 1 kHz	≥56 dB down	
30 Hz ≤ f _{mod} ≤15 kHz	≥50 dB down	
AF distortion for deviation of f _{in} ≥10 MHz	75 kHz	500 kHz
f _{mod} = 30 Hz to 20 kHz ⁴⁾	≤0.05%	≤0.2%
f _{mod} = 20 kHz to 100 kHz	≤0.15%	≤0.5%
f _{in} > 500 kHz	≤0.1%	—
f _{mod} = 30 Hz to 20 kHz	≤0.1%	—
Incidental FM (m = 50%, f _{mod} = 1 kHz, B = 20 Hz to 3 kHz, plus peak residual FM)	≤10 Hz	
Deemphasis	50/75/750 μs selectable, effective at AF output and, if selected, for readout of results	
Phase modulation measurement		
Modulation frequency range	200 Hz to 200 kHz	
With special φM filter	10 Hz to 20 kHz	
Max. measurable deviation (up to max. 1 kHz AF, -6 dB/octave for f >1 kHz)		
f _{in} : 50 kHz to 300 kHz	1/10 x f _{in} /kHz x 1 rad	
f _{in} : 300 kHz to 10 MHz	150 rad	
f _{in} : ≥10 MHz	700 rad	

Error ²⁾ of peak detection (plus peak residual ϕM) f_{mod} : 300 Hz to 5 kHz f_{mod} : 300 Hz to 10 kHz f_{mod} : 300 Hz to 100 kHz With special ϕM filter: f_{mod} : 10 Hz to 5 kHz f_{mod} : 10 Hz to 10 kHz	$\leq 2\%$ $\leq 2\%$ $\leq 2\%$ $\leq 2\%$ $\leq 2\%$
Resolution	$< 0.1\%$ (minimum 0.0001 rad)
Residual ϕM ³⁾ for f_{in} ITU-T weighting 300 Hz to 23 kHz	≤ 680 MHz 680 MHz ≤ 0.002 rad ≤ 0.004 rad ≤ 0.005 rad ≤ 0.01 rad
AF distortion (at AF output) (f_{mod} 200 Hz to 20 kHz, $\Delta\phi = 4$ rad, $f_{in} \geq 500$ kHz)	$\leq 0.1\%$
AF voltmeter	
DC voltage measurement Range	$\pm 10 \mu V$ to 20 V
Offset voltage ⁵⁾ Unbalanced input Balanced input	≤ 1 mV } can be corrected to $\leq 30 \mu V$ ≤ 3 mV } using offset calibration
Resolution	$< 0.1\%$
Error	$\pm 0.5\% \pm 10 \mu V \pm \text{offset voltage}$
AC voltage measurement Frequency range Measurement range Resolution	10 Hz to 300 kHz 30 μV to 20 V 0.1% of reading
Error (RMS detector) 30 Hz to 20 kHz 10 Hz to 100 kHz 10 Hz to 200 kHz	$\leq 1\% \pm 30 \mu V$ (100 kHz lowpass filter) $\leq 2\% \pm 100 \mu V$ (without lowpass filter) $\leq 3\% \pm 100 \mu V$ (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 Balanced	input impedance 100 k Ω < 50 pF, BNC connector input impedance 600 Ω , 3-contact connectors to DIN 41628
AF detector	
Peak detector	positive or negative peak of AF or their arithmetic mean
RMS detector	true RMS-responding rectifier, read-out as RMS value or converted to peak for sinewave
Quasi-peak detector	detector to ITU-R 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) 100 kHz (4th order) 5 Hz lowpass (for DC measurement) 30 kHz Bessel lowpass (4th order) 120 kHz Bessel lowpass (4th order) 4.2 kHz Caer lowpass

Standard filters	ITU-R 468-4 weighted ITU-R 468-4 unweighted ITU-T P53; plus external filters
AF frequency display	
Frequency range	10 Hz to 300 kHz
Resolution	1 mHz to 10 Hz
Error	$\pm 0.005\% \pm 3$ mHz ± 1 digit
Distortion measurement	
Readout either in % or SINAD in dB, automatic adjustment for S/N ≥ 20 dB	
Measurement range	10 Hz to 100 kHz
Display range THD SINAD	0.005% to 50% 6 dB to 86 dB
Maximum error 10 Hz to 100 kHz (harmonics up to 300 kHz) 20 Hz to 20 kHz (with 100 kHz lowpass filter)	± 2 dB $\pm 0.15\%$ THD ± 1 dB $\pm 0.03\%$ THD

Stereo decoder

Crosstalk 30 Hz to 15 kHz, RMS or ITU-R detector L to R, R to L M to S, S to M	≥ 60 dB down ≥ 50 dB down
Frequency response L, R, M, S 30 Hz to 15 kHz	max. ± 0.1 dB
Level difference between L and R	≤ 0.1 dB
Measurement errors L, R, M, S 19 kHz pilot tone Level, deviation 57 kHz carrier (level) AM of 57 kHz carrier ($f_{mod} = 10$ Hz to 125 Hz)	$\leq 2\%$ $\leq 5\%$ $\leq 2\%$ of reading +0.1% AM
Nonlinear distortion (with input level 6 dBm and 12.5 dBm, L, R, M, S outputs) THD (30 Hz to 15 kHz) Intermodulation distortion to DIN 45403	$\leq 0.1\%$ $d_2 \leq 0.05\%$, $d_3 \leq 0.1\%$
S/N ratio, referred to +6 dBm at 500 Hz, deemphasis 50 μs ITU-R unweighted ITU-R weighted	≥ 80 dB ≥ 80 dB
Auxiliary carrier suppression, referred to +6 dBm Pilot tone (19 kHz) RDS/ARI (57 kHz)	≥ 90 dB ≥ 80 dB
Deemphasis	50 μs or 75 μs , switch-selectable
External decoder input	
Common-mode rejection $f \leq 1$ kHz 1 kHz $< f \leq 15$ kHz 15 kHz $< f \leq 100$ kHz	≥ 60 dB ≥ 50 dB ≥ 36 dB
Input impedance	≥ 40 k Ω

Input level range	-12 dBm to +12.5 dBm (600 Ω) (nominal +6 dBm/40 kHz)
Resolution of level setting	≤0.2 dB
Stereo decoder outputs	
L, R, M	balanced, 3-contact connectors on rear panel, to DIN 41628, +6 dBm, $Z_{out} \leq 30 \Omega$, $Z_i \geq 300 \Omega$
S (L-R/2)	unbalanced, BNC connector, $Z_i \geq 600 \Omega$
RDS demodulator outputs	
Signals available	9-contact Cannon connector on rear panel data, clock, quality signal, TP information, 57 kHz carrier (TTL)
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 already programmed)	≤120 ms
DIST measurement $f_{mod} \geq 30$ Hz $f_{mod} \geq 300$ Hz	typ. 2.5 s typ. 1 s
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 For φM	6 dBm (1.545 V) into 600 Ω, 40 kHz deviation (DC-coupled) 1.545 V into 600 Ω, 40 rad

Distortion output	max. 1 V into 600 Ω
AF output	1 V to 4 V peak into 600 Ω with autoranging
Remote control	
Interface	IEC 625-1/625-2 (IEEE 488.1/488.2), connector: 24-contact Amphenol; controlling all device functions including Serial Poll and Parallel Poll
Interface functions	SHI, AH1, L4, T5, SR1, RL1, DC1, DT1, PP1, CO
General data	
Temperature Operating temperature range Permissible temperature range Storage temperature range	0 °C to +55 °C 0 °C to +55 °C -40 °C to +70 °C
Humidity	+40 °C, non-condensing, 80% relative humidity, meets EN 60068-2-3
RFI suppression	meets EN 55011 class B and EN 61326 (EMC Directive 89/336/EEC)
Safety	meets EN 61010-1 : 1991
Power supply	100/120/220/240 V ±10%, 47 Hz to 440 Hz (170 VA)
Dimensions, weight	435 mm x 192 mm x 460 mm, 25 kg

¹⁾ For amplitude-modulated signals: $P_{in} \geq -27$ dBm, $m \leq 80\%$.

²⁾ In temperature range 20 °C to 30 °C, additional error of ±0,5% over entire temperature range; error of RMS detection may be up to twice as high as of peak detection.

³⁾ For input level ≥20 dB above specified minimum input level.

⁴⁾ 100 kHz lowpass filter switched in.

⁵⁾ Input attenuator switched on: value x 10.

Ordering information

Modulation Analyzer	R&S®FMAB	856.4750.52
Accessories supplied		
Special cable for firmware updating, manual, power cable, spare fuses		
Options		
Reference Oscillator	R&S®FMA-B10	856.3502.52
AM/FM Calibrator	R&S®FMA-B4	855.6008.52
5.2 GHz Frequency Extension	R&S®FMA-B12	855.8500.52
Recommended extras		
High-Power Attenuator 20 dB, 50 W	R&S®RDL	1035.1716.00
Service Kit	R&S®FMA-Z1	856.4009.52
19" Adapter	R&S®ZZA-94	396.4905.00



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