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Version 03.01

December 2007

Modulation Analyzer R&S®FMAV

Modulation analysis for VOR/ILS air navigation

The Modulation Analyzer R&S®FMAV, a member of the R&S®FMA family, features the versatile measurement functions of the R&S®FMA basic model and fulfills the requirements for measurements on ground stations of VOR/ILS air navigation systems.

With its extremely low measurement error achieved by means of digital signal processing, the R&S®FMAV meets the stringent requirements placed on measuring instruments for ILS systems of category III.

Its comprehensive measurement functions make the R&S®FMAV ideal for all modulation measurements including phase measurements on ILS/VOR systems as well as for use as a calibrator for VOR/ILS signal generators.

The R&S®FMAV has been designed especially for air-traffic control authorities, airport operators and manufacturers of air navigation test systems and airborne systems.

Due to its unrivalled measurement accuracy, comprehensive measurement functions and great ease of operation, the R&S®FMAV makes air navigation systems extremely reliable.

ROHDE&SCHWARZ

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

Special R&S®FMAV measurements

- Selective modulation depth measurement on VOR/ILS systems with an error of less than 0.8 % (for ILS: ≤0.5 %)
- DDM measurement with an error of ≤0.0002 DDM for localizer and ≤0.0005 DDM for glide path
- Deviation measurement of VOR subcarrier
- Modulation frequency measurement of VOR/ILS signals
- ILS/VOR phase measurement with extremely high accuracy and resolution down to 0.001 °

General R&S®FMAV measurements

- RF measurement with 10-digit readout and error ≤10 Hz at 100 MHz within calibration interval owing to highly stable reference oscillator (aging $<10^{-9}$/day)
- AM, FM and φM measurements over a wide modulation frequency range
- AF measurement with 5-digit readout
- Selective distortion and intermodulation measurement
- Universal filter capabilities, psophometric weighting filters (optional)
- AF voltage measurement
- RF power measurement with error of typ. <0.5 dB

Characteristics

In addition to the broadband analog demodulators, AF filters and detectors of the R&S®FMA basic model, the R&S®FMAV is equipped with a signal processor. This signal processor module allows the relatively narrowband modulation contents of air navigation signals to be sampled at the IF for subsequent digital demodulation, filtering and evaluation.

The IF is digitized by a 16 bit A/D converter; the digital sampling values are further processed by the signal processor.

In contrast to analog demodulators, filters and detectors, the digital AF filters of the signal processor module are practically error-free and have no drift whatsoever due to aging or temperature.

The digitally demodulated and filtered signals are additionally converted into analog signals by a D/A converter and are available as two channels at two BNC connectors on the rear panel, e.g. for visual checking on an oscilloscope.

Operation

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

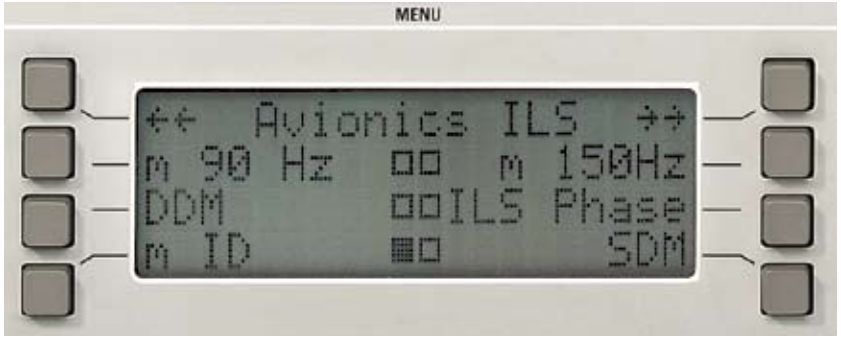
A minimum number of main function keys as well as an alphanumeric menu display with four softkeys down each side make for clear-cut front-panel layout and fast access to the desired measurement functions. Important functions are at the top of the menu hierarchy, the number of submenu levels being limited to a maximum of three so that finding one´s way in the menu is easy.

Three large illuminated LCD displays simultaneously read out the measured values for the following parameters:

- Carrier frequency or power
- Modulation depth, deviation or DDM
- Modulation frequency, distortion or phase

Device status and settings are also displayed.

Softkeys enable fast access to desired measurement functions



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Parameters, such as a reference value for relative display can be entered via the numeric keypad and are terminated with one of the ENTER keys (unit/ multiplier key). Up to 20 complete setups can be stored, which considerably enhances the measurement reliability in complex applications.

The Modulation Analyzer R&S®FMAV features full remote-control capability. The IEC bus interface complies with the IEEE 488.2 standard and enables plain-text programming, which greatly facilitates programming. The query for the ILS DDM value, for instance, is DEMODULATION:AVIONICS:ILS:DDM?

Measurement functions

ILS signals

- Selective measurement of 90 Hz, 150 Hz and sum modulation depth without influence from additional signals (identifiers) with an error of less than 0.5 % of reading
- Measurement of modulation depth of identifier signal in the range from 300 Hz to 4 kHz without influence from ILS signals
- High-precision DDM measurement with an error ≤0.0002 DDM for localizer and ≤0.0005 DDM for glide path
- Selective measurement of modulation frequency
- 90 Hz/150 Hz phase measurement
- Selective measurement of all ILS distortion products

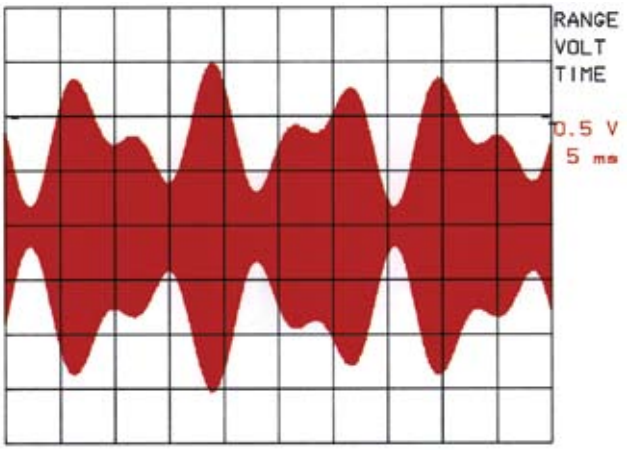
VOR signals

- Selective measurement of 30 Hz and 9.96 kHz modulation depth
- Modulation-depth measurement of identifier signal in the range from 300 Hz to 4 kHz without impairment from VOR signal
- Deviation measurement on 9.96 kHz subcarrier
- Modulation-frequency measurement at 30 Hz, 9.96 kHz and FM-demodulated 30 Hz signal
- High-precision phase measurement on 30 Hz signals (error <0.02 °)

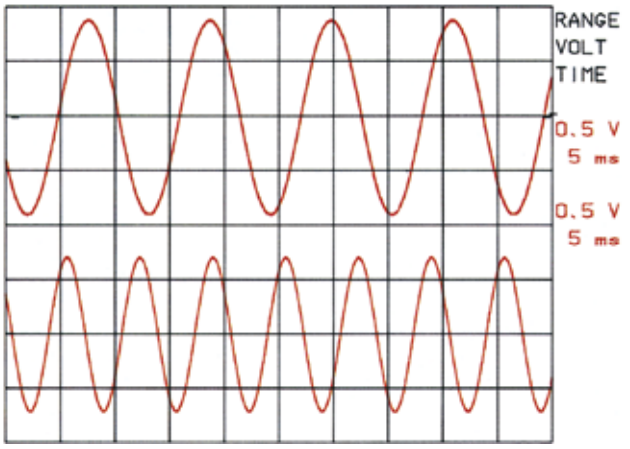


The few main function keys make the R&S®FMAV user-friendly:

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



ILS signal
DDM = 0.1 Δφ = 45 °
90 Hz: m = 45 %,
φ = 0 °
150 Hz: m = 35 %
φ = 45 °



Demodulated ILS signal
top:
90 Hz (φ = 0 °),
filtered;
bottom:
150 Hz: (φ = 45 °),
filtered

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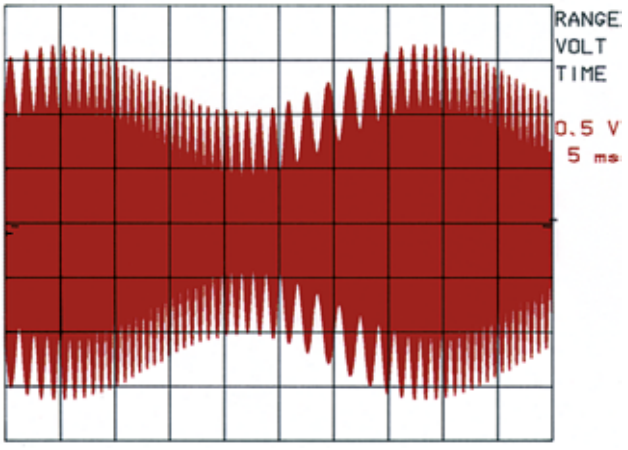
TACAN signals[1)]

- Selective measurement of 15 Hz, 135 Hz and sum modulation depth with an error of less than 0.5 % of reading
- Phase measurement 15 Hz/135 Hz
- Selective measurement of modulation frequency
- Distortion measurement (optional) using the standard analog AM demodulator at all modulation frequencies from 10 Hz to 100 kHz

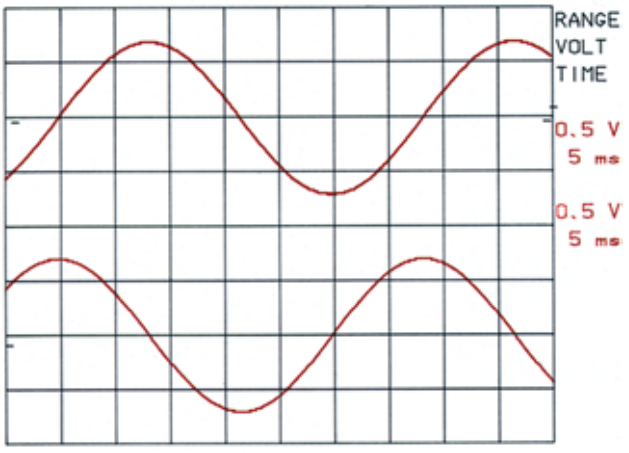
In-depth AF analysis

based on selective harmonic distortion and intermodulation measurement is standard with the R&S®FMAV:

- Selective harmonic distortion measurement of d_2, d_3, ... d_i
- True THD measurement of intermodulation products to IEC 268-3
- Universal measurement of intermodulation products to IEC 268-3
- Scaled display of AF spectrum on an oscilloscope
- Selective distortion measurement on n × 30 Hz components (ILS signal)
- Baseband ILS and VOR measurements at voltmeter input



VOR signal
30 Hz: m = 30 %,
φ = 90 °
9.96 kHz[2)]: m = 30 %
FM:
deviation 480 Hz
f_{mod} = 30 Hz
phase = 0 °
(reference)



Demodulated VOR signal
top:
FM-demodulated reference signal
(φ = 0 °)
bottom:
AM-demodulated signal,
30 Hz filtering
(φ = 90 °)

Options

The options available for the R&S®FMA basic model can also be used for the R&S®FMAV as far as they are appropriate for the R&S®FMAV applications.

Filter R&S®FMA-B1

This filter option contains universal analog AF filters, of which ITU-T filter P53 is of special interest, since it allows weighted noise measurements in radiotelephone systems.

AM/FM Calibrator/AF Generator R&S®FMA-B4

The high-precision internal modulation source (error <0.1 %) is used for calibrating the built-in analog demodulators and the AF measurement section. It also enables a simple performance check of the digital VOR/ILS measurement section.

Since this option is able to produce high-precision VOR/ILS baseband signals (2 rear AF outputs), signal generators can be modulated and hence be used in VOR/ILS systems.

1) Measurements are possible only on non-pulsed signals, not on real-world TACAN signals.
2) Frequency not to scale.

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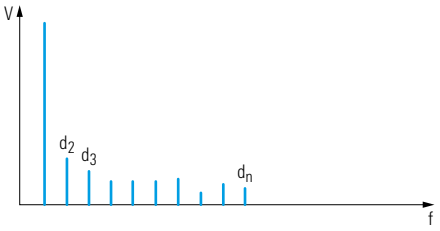
Specifications

Frequency range	50 kHz to 1360 MHz
Frequency tuning	automatic[1] or manual
Display	10-digit readout
Resolution	0.1 Hz/1 Hz/10 Hz/100 Hz selectable
Frequency error	±1 digit + error of reference frequency
Reference oscillator	
Aging	1×10^{-7}/year
After 30 days of operation	1×10^{-9}/day
Temperature effect	2×10^{-9}/°C
Warm-up time	15 min
External reference input/output	manual or remote-controlled switchover
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 kHz to 300 kHz	f_{mod} / error
m ≤ 80 %	30 Hz to 3 kHz / ≤0.8 %
m ≤ 95 %	10 Hz to 8 kHz / ≤2 %
f_{in} = 300 kHz to 10 MHz	f_{mod} / error
m ≤ 80 %	30 Hz to 10 kHz / ≤0.8 %
m ≤ 95 %	30 Hz to 20 kHz / ≤1 %
	10 Hz to 20 kHz / ≤2 %
	10 Hz to 50 kHz / ≤5 %
f_{in} ≥ 10 MHz	f_{mod} / error
m ≤ 80 %	30 Hz to 20 kHz / ≤0.8 %
m ≤ 95 %	30 Hz to 100 kHz / ≤1 %
	10 Hz to 100 kHz / ≤2 %
	10 Hz to 200 kHz / ≤2 %
Residual AM[3]	
In line with ITU-T	≤0.01 %
20 Hz to 23 kHz, RMS	≤0.03 %
In line with 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[4] for f_{mod} = 10 Hz to 20 kHz	
m = 40 %	≤0.2 %
40 % < m ≤ 80 %	≤0.4 %

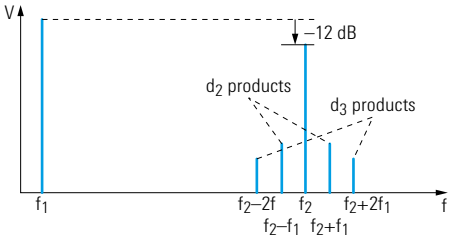
Frequency modulation measurement			
Modulation frequency range	10 Hz to 200 kHz		
Maximum measurable deviation for			
f_{in} = 50 kHz to 300 kHz	f_{in}/10		
f_{in} = 300 kHz to 10 MHz	150 kHz		
f_{in} ≥ 10 MHz	700 kHz		
Measurement error[2] with peak detection (plus peak residual FM)	f_{mod}		error
f_{in} = 50 kHz to 300 kHz	30 Hz to 5 kHz		≤0.5 %
	10 Hz to 8 kHz		≤2 %
f_{in} = 300 kHz to 10 MHz	30 Hz to 10 kHz		≤0.5 %
	30 Hz to 20 kHz		≤1 %
	10 Hz to 50 kHz		≤2 %
f_{in} ≥ 10 MHz	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	≤1360 MHz
In line with ITU-T, RMS	≤0.5 Hz	≤0.7 Hz	≤1 Hz
20 Hz to 23 kHz, RMS	≤2 Hz	≤3 Hz	≤5 Hz
ITU-R, quasipeak + 50 µs deemph.	≤3 Hz	≤4 Hz	≤6 Hz
AF distortion for deviation	75 kHz	500 kHz	
f_{in} ≥ 10 MHz			
f_{mod} = 30 Hz to 20 kHz[5]	≤0.05 %	≤0.2 %	
f_{mod} = 20 kHz to 100 kHz	≤0.15 %	≤0.5 %	
f_{in} > 500 kHz			
f_{mod} = 30 Hz to 20 kHz	≤0.1 %		
Incidental FM (m = 50 %, f_{mod} = 1 kHz, BW = 20 Hz to 3 kHz, plus peak residual FM)	≤10 Hz		
Deemphasis	50 µs/75 µs/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		
Maximum measurable deviation (up to max. 1 kHz AF, –6 dB/octave for f > 1 kHz)			
f_{in} = 50 kHz to 300 kHz	1/10 × f_{in}/kHz × 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	≤2 %		
f_{mod} = 300 Hz to 10 kHz	≤2 %		
f_{mod} = 300 Hz to 100 kHz	≤2 %		
Resolution	≤0.1 % (minimum 0.0001 rad)		
Residual φM[3] for f_{in}	≤680 MHz	>680 MHz	
ITU-T weighting	≤0.002 rad	≤0.004 rad	
300 Hz to 23 kHz	≤0.005 rad	≤0.01 rad	
AF distortion (at AF output), f_{mod} = 200 Hz to 20 kHz, Δφ= 4 rad, f_{in} ≥ 500 kHz	≤0.1 %		
AF voltmeter			
DC voltage measurement			
Range	±10 µV to 20 V		
Offset voltage[6]			
Unbalanced input	≤1 mV	}	can be corrected to
Balanced input	≤3 mV	}	≤30 µV using offset function
Resolution	≤0.1 %		
Error			
3 kHz lowpass filter	±0.5 % ±100 µV ±offset voltage		
5 Hz lowpass filter (with filter option)	±0.5 % ±10 µV ±offset voltage		

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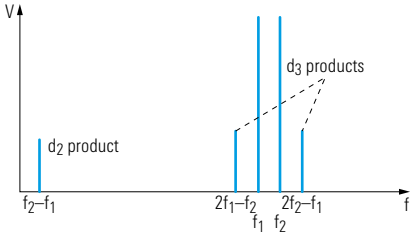
AC voltage measurement	
Frequency range	10 Hz to 300 kHz
Measurement range	30 µV to 20 V
Resolution	0.1 % of reading
Error (RMS detector)	
30 Hz to 20 kHz	≤1 % ±30 µV (100 kHz lowpass filter)
10 Hz to 100 kHz	≤2 % ±100 µV (without lowpass filter)
10 Hz to 200 kHz	≤3 % ±100 µV (without lowpass filter)
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 kΩ ‖50 pF, BNC connector
Balanced	input impedance 600 Ω, three-contact connectors to DIN 41628
AF detector	
Peak detector	positive or negative peak of AF or arithmetic mean of the two
RMS detector	true RMS-responding rectifiers, readout as RMS value or converted to peak for sinewave
Quasipeak 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, combined with 20 Hz highpass filter to ITU-R 468-4, unweighted) 100 kHz (4th order)
Filter option	ITU-R 468-4 (weighted) ITU-T 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 modulation for modulation frequency ≤10 Hz) external filters possible
AF frequency display	5 digits
Frequency range	10 Hz to 300 kHz
Resolution	1 mHz to 10 Hz
Error	±0.005 % ±3 mHz ±1 digit
Selective distortion measurement	
Readout	in % or dB
Display range	0.001 % to 20 % –100 dB to –14 dB
Measurement of individual distortion	d_i (i = 2, 3, to 10)
Measurement error 10 Hz ≤ f_1 ≤ 14 kHz, f_{di} ≤ 42 kHz	≤5 % of reading ±0.02 % absolute
THD measurement	
Measurement of harmonic	i = n (n = 2 to 10 selectable)
Measurement error 10 Hz ≤ f_1 ≤ 14 kHz, f_{dn} ≤ 42 kHz	≤5 % of reading ±0.03 % absolute



Intermodulation measurement	
Intermodulation distortion d_2, d_3 to DIN 45403 and IEC 268-3	
Readout	in % or dB
Display range	0.001 % to 20 % –100 dB to –14 dB
Measurement error $f_2+2 \times f_1 \leq 42$ kHz, $f_1 \geq 10$ Hz	≤5 % of reading ±0.1 % absolute



Difference-frequency distortion d_2, d_3 to DIN 45403 and IEC 268-3	
Readout	in % or dB
Display range	0.001 % to 20 % –100 dB to –14 dB
Measurement error (f_2–f_1 ≥ 30 Hz) $2 \times f_2$–$f_1 \leq 42$ kHz	≤5 % of reading ±0.05 % absolute



Measurement of distortion and intermodulation products on ILS signals (AM with 90 Hz, 150 Hz (DDM = 0) and identifier signal 1020 Hz)	
Selectable single or total harmonic distortion (THD) measurement on 90 Hz, 150 Hz and 1020 Hz components Accuracy	≤5 % of reading ±0.1 % absolute
Selective distortion measurement of n × 30 Hz components from 30 Hz to 1200 Hz relative to 90 Hz component (= 100 %) Accuracy	≤5 % of reading ±0.1 % absolute
Total harmonic distortion (THD) measurement of speech channel from 300 Hz to 3 kHz (90 Hz, 150 Hz components on, 1020 Hz comp. off) Accuracy	≤5 % of reading ±0.1 % absolute
Measuring time	
Automatic tuning; RF, modulation and modulation frequency measurement with 10 Hz RF resolution (highpass filter and PK detector switched on)	typ. 1 s

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Fast modulation measurement (RF, modulation range and level programmed)	≤120 ms
DIST measurement	
f_{mod} ≥ 30 Hz	typ. 2.5 s
f_{mod} ≥300 Hz	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	6 dBm (1.545 V) into 600 Ω 40 kHz deviation (DC-coupled)
For φM	1.545 V into 600 Ω, 40 rad
Distortion output (with optional DIST/SINAD meter)	max. 1 V into 600 Ω
AF output	1 V to 4 V into 600 Ω (peak voltage)
10 MHz reference frequency	input/output selectable
Output	+12 dBm, 50 Ω
Input	–10 dBm to +12 dBm
Deflection for external oscilloscope	
DSP1	Y deflection, 0 V to 4 V, BNC female
DSP2	X deflection, 0 V to 4 V, BNC female
Scale markers	
Vertical	13 markers, 10 dB/div
Horizontal	10 markers
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	SH1, AH1, L4, T5, SR1, RL1, DC1, DT1, PP1, C0
VOR/ILS-specific data	
This data is guaranteed within the frequency ranges specified (f_{in}). Typical values for all frequencies ≥10 MHz.	
VOR	
f_{in}: 10 MHz; 108 MHz to 120 MHz	
Amplitude modulation measurement	
m: 10 % to 90 %	
f_{mod}	measurement error[7] (% of reading)
30 Hz ±1 %	≤0.8 %
9.96 kHz ±1 %	≤0.8 %
300 Hz to 4 kHz	≤1.2 % (typ. ≤0.8 %)
Frequency modulation measurement at 9.96 kHz carrier	
Max. measurable deviation	700 Hz
f_{mod}	measurement error[7] (% of reading)
30 Hz ±1 %	≤0.5 % ±0.1 Hz
Phase difference measurement at 30 Hz	
Measurement range	0 ° to 360 °
Measurement error	≤±0.03 ° (typ. ≤±0.02 °)
Resolution	≤0.01 °
ILS	
f_{in}: 10 MHz; 108 MHz to 120 MHz; 328 MHz to 336 MHz	
Amplitude modulation measurement	
m: 10 % to 90 %	
f_{mod}	measurement error[7] (% of reading)
90 Hz ±2 %	≤0.5 %
150 Hz ±2 %	≤0.5 %
300 Hz to 4 kHz (identifier)	≤1.5 % (typ. ≤0.8 %)
DDM measurement	
Measurement range	0 DDM to ±0.2 DDM
f_{mod}: 90 Hz ±1 % and 150 Hz ±1 %	
m	measurement error[7]
18 % to 22 %	≤±0.0002 DDM ±0.1 % of reading
32 % to 48 %	≤±0.0005 DDM ±0.1 % of reading
Resolution	≤0.0001 DDM
Measurement of phase angle between 90 Hz and 150 Hz signals	
Measurement range	±60 °
Measurement error	≤±0.2 °
Resolution	≤0.01 °
TACAN[8]	
f_{in}: 10 MHz; 950 MHz to 1250 MHz	
Amplitude modulation measurement	
m: 10 % to 90 %	
f_{mod}	measurement error[7] (% of reading)
15 Hz ±2 %	≤0.5 %
135 Hz ±2 %	≤0.5 %
Measurement of phase angle between 15 Hz and 135 Hz signals	
Measurement range	±180 ° (135 Hz)
Measurement error	≤±0.5 °
Resolution	≤0.01 °
AF outputs DSP1, DSP2	max. 4 V into 600 Ω
DC offset	≤±3 mV
Additional error	
Scaling for AM	4 V/100 % ±1 % ±2 mV
Scaling for FM	4 V/1 kHz ±1 % ±2 mV
Gain difference for ILS (90 Hz to 150 Hz)	0.2 %
Phase difference for VOR (30 Hz)	0.05 °
TACAN (15 Hz to 135 Hz)	0.2 °
ILS (90 Hz to 150 Hz)	0.3 °
VOR/ILS baseband at voltmeter UNBAL input	
AM sensitivity	100 mV to 10 V peak, 100 % AM
VOR	
Amplitude modulation measurement	
f_{mod}	measurement error[7] (% of reading)
30 Hz ±1 %, 9.96 kHz ±1 %	≤0.8 %
300 Hz to 4 kHz (identifier)	≤1.2 %
Frequency modulation measurement at 9.96 kHz carrier	
Maximum measurable deviation	700 Hz
f_{mod}	measurement error[7]
30 Hz ±1 %	≤0.5 % ±0.1 Hz
Phase difference measurement at 30 Hz	
Measurement range	0 ° to 360 °
Measurement error	≤±0.02 °
Resolution	≤0.01 °
ILS	
Amplitude modulation measurement	
f_{mod}	measurement error[7] (% of reading)
90 Hz ±2 %, 150 Hz ±2 %	≤0.5 %
300 Hz to 4 kHz (identifier)	≤1.5 %
DDM measurement	
Measurement range	0 DDM to ±0.2 DDM
f_{mod}	90 Hz ±1 %, 150 Hz ±1 %
m	measurement error[7]
18 % to 22 %	≤±0.0002 DDM ±0.1 % of reading
32 % to 48 %	≤±0.0005 DDM ±0.1 % of reading

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General data	
Environmental conditions	to IEC 359, class I
Operating temperature range	0 °C to +55 °C
Storage temperature range	–40 °C to +70 °C
RFI suppression	in line with VDE 0871, limit B and German PTT regulations 527/1979
Power supply	100 V/120 V/220 V/240 V ±10 %, 47 Hz to 440 Hz (170 VA)
Dimensions, weight	435 mm × 192 mm × 460 mm, 19 kg

1) For amplitude-modulated signals: P_{in} ≥–27 dBm, m ≤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) For f_{in} <300 kHz: f_{mod} = 10 Hz to 8 kHz.
5) 100 kHz lowpass filter switched on.
6) Input attenuator switched on: value × 10.
7) In temperature range 20 °C to 30 °C, additional error ±0.3 % over entire temperature range.
8) Measurements are possible only on non-pulsed signals (not on real-world TACAN signals).

Ordering information

Order designation	Type	Order No.
VOR/ILS Modulation Analyzer	R&S®FMAV	856.4509.52
Accessories supplied	special cable for firmware update, manual, power cable, spare fuses	
Options		
Filter	R&S®FMA-B1	855.2002.52
AM/FM Calibrator/AF Generator	R&S®FMA-B4	855.6008.52
Recommended extras		
High-Power Attenuator, 20 dB, 50 W	R&S®RDL 50	1035.1700.52
19" Adapter	R&S®ZZA-94	396.4905.00
Service Kit	R&S®FMA-Z1	856.4009.52

Certified Quality System ISO 9001 DQS REG. NO 1954 QM

Certified Environmental System ISO 14001 DQS REG. NO 1954 UM

Rear view of the R&S® FMAV



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