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## 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.

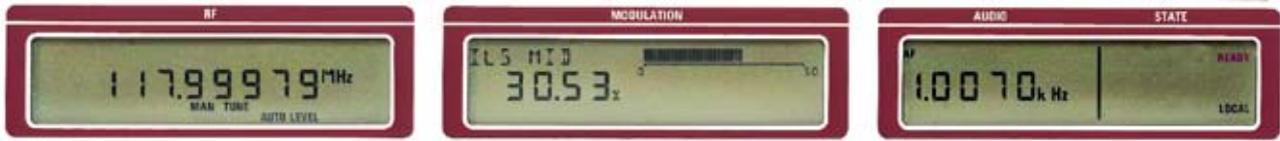
Its comprehensive measurement functions make the R&S®FMAV ideal for all modulation measurements including phase measurements on ILS/VOR systems as well as for use as a calibrator for VOR/ILS signal generators.

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**



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<sup>-9</sup>/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.

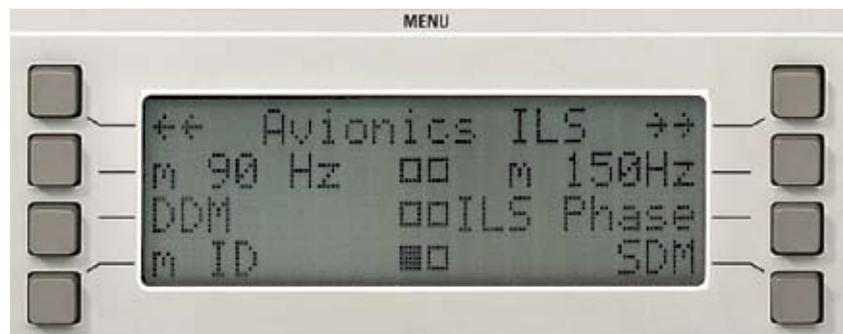
A minimum number of main function keys as well as an alphanumeric menu display with four softkeys down each side make for clear-cut front-panel layout and fast access to the desired measurement functions. Important functions are at the top of the menu hierarchy, the number of submenu levels being limited 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*



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  $\leq 0.0002$  DDM for localizer and  $\leq 0.0005$  DDM for glide path
- ◆ Selective measurement of modulation frequency
- ◆ 90 Hz/150 Hz phase measurement
- ◆ Selective measurement of all ILS distortion products

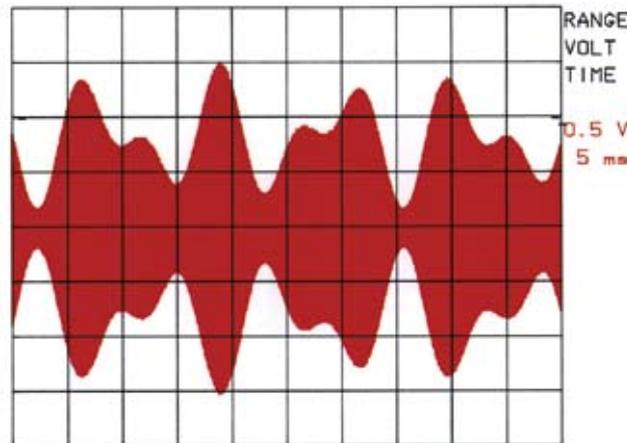
### VOR signals

- ◆ 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  $< 0.02^\circ$ )

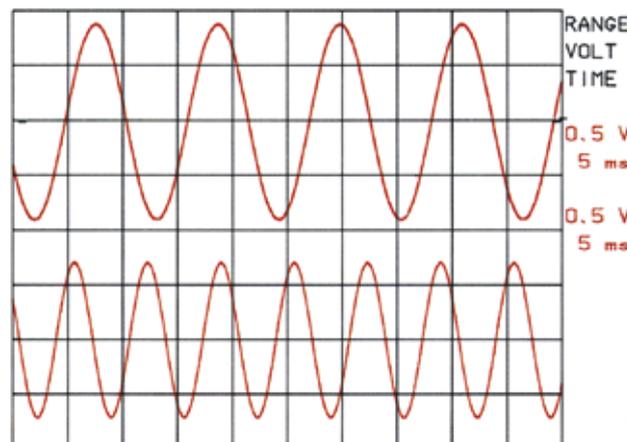


*The few main function keys make the R&S®FMAV user-friendly:*

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



**ILS signal**  
 DDM = 0.1  $\Delta\phi = 45^\circ$   
 90 Hz: m = 45%,  
 $\phi = 0^\circ$   
 150 Hz: m = 35%  
 $\phi = 45^\circ$



**Demodulated ILS signal**  
 top:  
 90 Hz ( $\phi = 0^\circ$ ),  
 filtered;  
 bottom:  
 150 Hz ( $\phi = 45^\circ$ ),  
 filtered

### TACAN signals<sup>1)</sup>

- ◆ 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  $d_2, d_3, \dots, d_n$
- ◆ 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  $n \times 30$  Hz components (ILS signal)
- ◆ Baseband ILS and VOR measurements at voltmeter input

### 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.

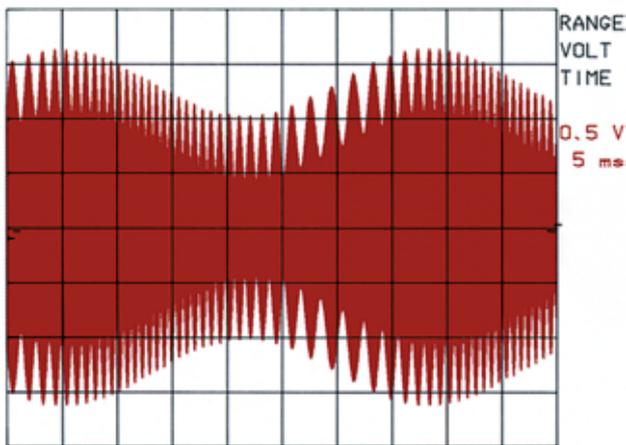
#### Filter R&S®FMA-B1

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

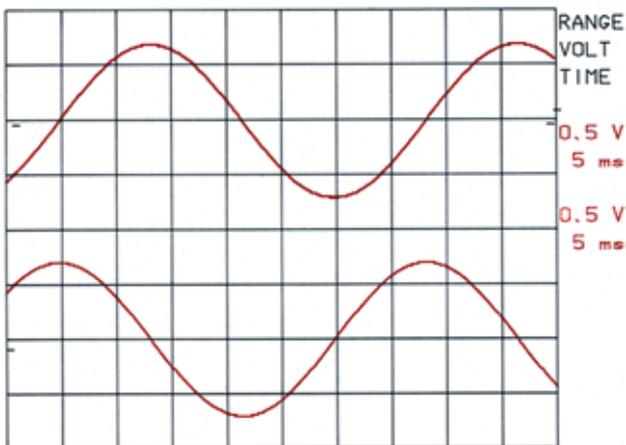
The high-precision internal modulation source (error <0.1%) is used for calibrating the built-in analog demodulators and the AF measurement section. It also enables a simple performance check of the digital VOR/ILS measurement section.

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.



#### VOR signal

30 Hz:  $m = 30\%$ ,  
 $\phi = 90^\circ$   
9.96 kHz<sup>2)</sup>:  $m = 30\%$   
FM:  
deviation 480 Hz  
 $f_{\text{mod}} = 30$  Hz  
phase =  $0^\circ$   
(reference)



#### Demodulated VOR signal

top:  
FM-demodulated  
reference signal  
( $\phi = 0^\circ$ )  
bottom:  
AM-demodulated  
signal,  
30 Hz filtering  
( $\phi = 90^\circ$ )

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

2) Frequency not to scale.

## Specifications

<b>Frequency range</b>	50 kHz to 1360 MHz	
Frequency tuning	automatic <sup>1)</sup> 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 <sup>-7</sup> /year	
After 30 days of operation	1 × 10 <sup>-9</sup> /day	
Temperature effect	2 × 10 <sup>-9</sup> /°C	
Warm-up time	15 min	
External reference input/output	manual or remote-controlled switchover	
<b>RF input</b>	Z <sub>in</sub> = 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)	
<b>RF power measurement</b>		
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)	
<b>Amplitude modulation measurement</b>		
Modulation frequency range	10 Hz to 200 kHz	
Resolution	0.1 % of reading; max. 0.001 % AM	
Measurement error <sup>2)</sup> with peak detection (% of reading, plus peak residual AM)		
f <sub>in</sub> = 50 kHz to 300 kHz	f <sub>mod</sub>	error
m ≤ 80 %	30 Hz to 3 kHz	≤ 0.8 %
m ≤ 95 %	10 Hz to 8 kHz	≤ 2 %
f <sub>in</sub> = 300 kHz to 10 MHz	f <sub>mod</sub>	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 <sub>in</sub> ≥ 10 MHz	f <sub>mod</sub>	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 <sup>3)</sup>		
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 <sub>mod</sub> = 1 kHz, meas. bandwidth 20 Hz to 3 kHz)		
f <sub>in</sub> = 50 kHz to 10 MHz, deviation = 5 kHz	≤ 0.2 %	
f <sub>in</sub> ≥ 10 MHz, deviation = 50 kHz	≤ 0.1 %	
AF distortion <sup>4)</sup> for		
f <sub>mod</sub> = 10 Hz to 20 kHz	≤ 0.2 %	
m = 40 %	≤ 0.4 %	
40 % < m ≤ 80 %	≤ 0.4 %	

<b>Frequency modulation measurement</b>		
Modulation frequency range	10 Hz to 200 kHz	
Maximum measurable deviation for		
f <sub>in</sub> = 50 kHz to 300 kHz	f <sub>in</sub> /10	
f <sub>in</sub> = 300 kHz to 10 MHz	150 kHz	
f <sub>in</sub> ≥ 10 MHz	700 kHz	
Measurement error <sup>2)</sup> with peak detection (plus peak residual FM)	f <sub>mod</sub>	error
f <sub>in</sub> = 50 kHz to 300 kHz	30 Hz to 5 kHz	≤ 0.5 %
	10 Hz to 8 kHz	≤ 2 %
f <sub>in</sub> = 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 <sub>in</sub> ≥ 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 <sup>3)</sup> for f <sub>in</sub>	≤ 340 MHz	≤ 680 MHz
In line with ITU-T, RMS	≤ 0.5 Hz	≤ 0.7 Hz
20 Hz to 23 kHz, RMS	≤ 2 Hz	≤ 3 Hz
ITU-R, quasipeak + 50 μs deemph.	≤ 3 Hz	≤ 4 Hz
≤ 1360 MHz	≤ 1 Hz	≤ 5 Hz
≤ 5 Hz	≤ 3 Hz	≤ 6 Hz
AF distortion for deviation	75 kHz	500 kHz
f <sub>in</sub> ≥ 10 MHz		
f <sub>mod</sub> = 30 Hz to 20 kHz <sup>5)</sup>	≤ 0.05 %	≤ 0.2 %
f <sub>mod</sub> = 20 kHz to 100 kHz	≤ 0.15 %	≤ 0.5 %
f <sub>in</sub> > 500 kHz		
f <sub>mod</sub> = 30 Hz to 20 kHz	≤ 0.1 %	
Incidental FM (m = 50 %, f <sub>mod</sub> = 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	
<b>Phase modulation measurement</b>		
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 <sub>in</sub> = 50 kHz to 300 kHz	1/10 × f <sub>in</sub> /kHz × 1 rad	
f <sub>in</sub> = 300 kHz to 10 MHz	150 rad	
f <sub>in</sub> ≥ 10 MHz	700 rad	
Error <sup>2)</sup> of peak detection (plus peak residual φM)		
f <sub>mod</sub> = 300 Hz to 5 kHz	≤ 2 %	
f <sub>mod</sub> = 300 Hz to 10 kHz	≤ 2 %	
f <sub>mod</sub> = 300 Hz to 100 kHz	≤ 2 %	
Resolution	≤ 0.1 % (minimum 0.0001 rad)	
Residual φM <sup>3)</sup> for f <sub>in</sub>	≤ 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 <sub>mod</sub> = 200 Hz to 20 kHz, Δφ = 4 rad, f <sub>in</sub> ≥ 500 kHz	≤ 0.1 %	
<b>AF voltmeter</b>		
DC voltage measurement		
Range	± 10 μV to 20 V	
Offset voltage <sup>6)</sup>		
Unbalanced input	≤ 1 mV	} can be corrected to ≤ 30 μV using offset function
Balanced input	≤ 3 mV	
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	

AC voltage measurement	
Frequency range	10 Hz to 300 kHz
Measurement range	30 $\mu$ V to 20 V
Resolution	0.1 % of reading
Error (RMS detector)	
30 Hz to 20 kHz	$\leq 1\% \pm 30 \mu\text{V}$ (100 kHz lowpass filter)
10 Hz to 100 kHz	$\leq 2\% \pm 100 \mu\text{V}$ (without lowpass filter)
10 Hz to 200 kHz	$\leq 3\% \pm 100 \mu\text{V}$ (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 $\Omega$   50 pF, BNC connector
Balanced	input impedance 600 $\Omega$ , three-contact connectors to DIN 41628

<b>AF detector</b>	
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 sine wave
Quasipeak detector	detector to ITU-R Rec. 468-4

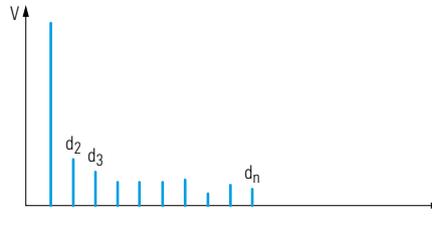
<b>Weighting filters</b>	
Highpass filters	10 Hz (2nd order) 20 Hz (3rd order) 300 Hz (2nd order)
Lowpass filters	3 kHz (4th order) 23 kHz (4th order, combined with 20 Hz highpass filter to ITU-R 468-4, unweighted) 100 kHz (4th order)
Filter option	ITU-R 468-4 (weighted) ITU-T P53 5 Hz lowpass (for DC measurement) 30 kHz Bessel lowpass, 4th order 120 kHz Bessel lowpass, 4th order 4.2 kHz Cauer lowpass special $\phi$ M filter (phase modulation for modulation frequency $\leq 10$ Hz) external filters possible

<b>AF frequency display</b>	
Frequency range	5 digits
Resolution	10 Hz to 300 kHz
Error	1 mHz to 10 Hz
	$\pm 0.005\% \pm 3 \text{ mHz} \pm 1 \text{ digit}$

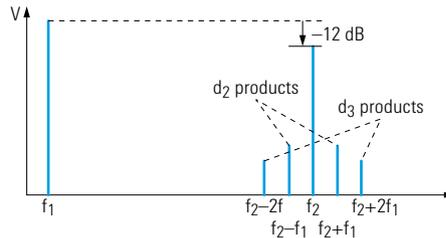
<b>Selective distortion measurement</b>	
Readout	in % or dB
Display range	0.001 % to 20 % -100 dB to -14 dB

<b>Measurement of individual distortion</b>	
Readout	$d_i$ ( $i = 2, 3, \text{ to } 10$ )
Measurement error	
$10 \text{ Hz} \leq f_1 \leq 14 \text{ kHz}, f_{in} \leq 42 \text{ kHz}$	$\leq 5\%$ of reading $\pm 0.02\%$ absolute

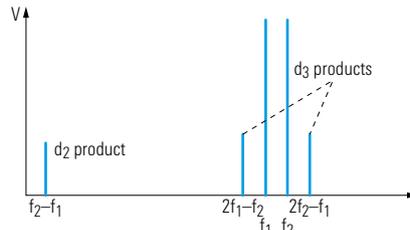
<b>THD measurement</b>	
Measurement of harmonic	$i = n$ ( $n = 2$ to $10$ selectable)
Measurement error	
$10 \text{ Hz} \leq f_1 \leq 14 \text{ kHz}, f_{in} \leq 42 \text{ kHz}$	$\leq 5\%$ of reading $\pm 0.03\%$ absolute



<b>Intermodulation measurement</b>	
<b>Intermodulation distortion <math>d_2, d_3</math> to DIN 45403 and IEC 268-3</b>	
Readout	in % or dB
Display range	0.001 % to 20 % -100 dB to -14 dB
Measurement error	
$f_2 + 2 \times f_1 \leq 42 \text{ kHz}, f_1 \geq 10 \text{ Hz}$	$\leq 5\%$ of reading $\pm 0.1\%$ absolute



<b>Difference-frequency distortion <math>d_2, d_3</math> to DIN 45403 and IEC 268-3</b>	
Readout	in % or dB
Display range	0.001 % to 20 % -100 dB to -14 dB
Measurement error ( $f_2 - f_1 \geq 30 \text{ Hz}$ )	
$2 \times f_2 - f_1 \leq 42 \text{ kHz}$	$\leq 5\%$ of reading $\pm 0.05\%$ absolute



<b>Measurement of distortion and intermodulation products on ILS signals (AM with 90 Hz, 150 Hz (DDM = 0) and identifier signal 1020 Hz)</b>	
Selectable single or total harmonic distortion (THD) measurement on 90 Hz, 150 Hz and 1020 Hz components	
Accuracy	$\leq 5\%$ of reading $\pm 0.1\%$ absolute
Selective distortion measurement of $n \times 30 \text{ Hz}$ components from 30 Hz to 1200 Hz relative to 90 Hz component (= 100%)	
Accuracy	$\leq 5\%$ of reading $\pm 0.1\%$ 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	$\leq 5\%$ of reading $\pm 0.1\%$ absolute

<b>Measuring time</b>	
Automatic tuning; RF, modulation and modulation frequency measurement with 10 Hz RF resolution (highpass filter and PK detector switched on)	typ. 1 s

Fast modulation measurement (RF, modulation range and level programmed)	≤120 ms
DIST measurement $f_{mod} \geq 30$ Hz $f_{mod} \geq 300$ Hz	typ. 2.5 s typ. 1 s
<b>Outputs</b>	
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 Output Input	input/output selectable +12 dBm, 50 Ω -10 dBm to +12 dBm
Deflection for external oscilloscope DSP1 DSP2	Y deflection, 0 V to 4 V, BNC female X deflection, 0 V to 4 V, BNC female
Scale markers Vertical Horizontal	13 markers, 10 dB/div 10 markers
<b>Remote control</b>	
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
<b>VOR/ILS-specific data</b>	
This data is guaranteed within the frequency ranges specified ( $f_{in}$ ). Typical values for all frequencies ≥10 MHz.	
<b>VOR</b>	
$f_{in}$ : 10 MHz; 108 MHz to 120 MHz	
Amplitude modulation measurement m: 10% to 90% $f_{mod}$ 30 Hz ±1% 9.96 kHz ±1% 300 Hz to 4 kHz	measurement error <sup>(7)</sup> (% of reading) ≤0.8% ≤0.8% ≤1.2% (typ. ≤0.8%)
Frequency modulation measurement at 9.96 kHz carrier Max. measurable deviation $f_{mod}$ 30 Hz ±1%	700 Hz measurement error <sup>(7)</sup> (% of reading) ≤0.5% ±0.1 Hz
Phase difference measurement at 30 Hz Measurement range Measurement error Resolution	0° to 360° ≤±0.03° (typ. ≤±0.02°) ≤0.01°
<b>ILS</b>	
$f_{in}$ : 10 MHz; 108 MHz to 120 MHz; 328 MHz to 336 MHz	
Amplitude modulation measurement m: 10% to 90% $f_{mod}$ 90 Hz ±2% 150 Hz ±2% 300 Hz to 4 kHz (identifier)	measurement error <sup>(7)</sup> (% of reading) ≤0.5% ≤0.5% ≤1.5% (typ. ≤0.8%)

<b>DDM measurement</b>	
Measurement range $f_{mod}$ : 90 Hz ±1% and 150 Hz ±1% m	0 DDM to ±0.2 DDM measurement error <sup>(7)</sup> ≤±0.0002 DDM ±0.1% of reading ≤±0.0005 DDM ±0.1% of reading ≤0.0001 DDM
18% to 22% 32% to 48% Resolution	
Measurement of phase angle between 90 Hz and 150 Hz signals Measurement range Measurement error Resolution	±60° ≤±0.2° ≤0.01°
<b>TACAN<sup>(9)</sup></b>	
$f_{in}$ : 10 MHz; 950 MHz to 1250 MHz	
Amplitude modulation measurement m: 10% to 90% $f_{mod}$ 15 Hz ±2% 135 Hz ±2%	measurement error <sup>(7)</sup> (% of reading) ≤0.5% ≤0.5%
Measurement of phase angle between 15 Hz and 135 Hz signals Measurement range Measurement error Resolution	±180° (135 Hz) ≤±0.5° ≤0.01°
<b>AF outputs DSP1, DSP2</b>	
DC offset Additional error Scaling for AM Scaling for FM Gain difference for ILS (90 Hz to 150 Hz) Phase difference for VOR (30 Hz) TACAN (15 Hz to 135 Hz) ILS (90 Hz to 150 Hz)	max. 4 V into 600 Ω ≤±3 mV 4 V/100% ±1% ±2 mV 4 V/1 kHz ±1% ±2 mV 0.2% 0.05° 0.2° 0.3°
<b>VOR/ILS baseband at voltmeter UNBAL input</b>	
AM sensitivity	100 mV to 10 V peak, 100% AM
<b>VOR</b>	
Amplitude modulation measurement $f_{mod}$ 30 Hz ±1%, 9.96 kHz ±1% 300 Hz to 4 kHz (identifier)	measurement error <sup>(7)</sup> (% of reading) ≤0.8% ≤1.2%
Frequency modulation measurement at 9.96 kHz carrier Maximum measurable deviation $f_{mod}$ 30 Hz ±1%	700 Hz measurement error <sup>(7)</sup> ≤0.5% ±0.1 Hz
Phase difference measurement at 30 Hz Measurement range Measurement error Resolution	0° to 360° ≤±0.02° ≤0.01°
<b>ILS</b>	
Amplitude modulation measurement $f_{mod}$ 90 Hz ±2%, 150 Hz ±2% 300 Hz to 4 kHz (identifier)	measurement error <sup>(7)</sup> (% of reading) ≤0.5% ≤1.5%
<b>DDM measurement</b>	
Measurement range $f_{mod}$ m	0 DDM to ±0.2 DDM 90 Hz ±1%, 150 Hz ±1% measurement error <sup>(7)</sup> ≤±0.0002 DDM ±0.1% of reading ≤±0.0005 DDM ±0.1% of reading
18% to 22% 32% to 48%	

