



Digital Monitoring Direction Finders R&S DDF0xM

Fast and reliable interception of complex signals from 0.3 MHz to 3000 MHz

- ◆ Maximum accuracy, sensitivity and flexibility
- ◆ Correlative interferometer
- ◆ Monopulse processing (Watson-Watt)
- ◆ Optional direction finding of GSM signals
- ◆ Wide range of antennas for stationary and mobile use
- ◆ User-friendly operation
- ◆ Integration into Rohde&Schwarz radiolocation systems



ROHDE & SCHWARZ



The HF/VHF/UHF Monitoring Direction Finders R&S DDF0xM make intensive use of digital signal processing, in particular in the field of filtering, bearing calculation and signal demodulation.

In this way the high scanning and DF speeds can be achieved that are required for the most common radio transmission methods using bursts and frequency hopping.

The Digital Monitoring Direction Finders R&S DDF0xM come in three models:

- ◆ **HF: R&S DDF01M**
(0.3 MHz to 30 MHz)
- ◆ **VHF/UHF: R&S DDF05M**
(20 MHz to 1300/3000 MHz)
- ◆ **HF/VHF/UHF: R&S DDF06M**
(0.3 MHz to 1300/3000 MHz)

Each direction finder is made up of a DF converter (HF or VHF/UHF) and a digital processing unit. Moreover, one or several DF antennas are required.

The HF DF Converter R&S EH010 is designed for the frequency range 0.3 MHz to 30 MHz, the VHF/UHF DF Converter R&S ET050 for 20 MHz to 1300 MHz. The Converter R&S ET070 (1.3 GHz to 3 GHz), which is connected ahead of the R&S ET050, extends the frequency range up to 3 GHz. The Digital Processing Unit R&S EBD060 has two IF inputs, allowing two DF converters (R&S EH010 and R&S ET050) to be connected simultaneously. The algorithms for the correlative interferometer and for the Watson-Watt DF method are implemented as standard in the software of the digital processing unit.

Digital DF methods

For bearing determination, the complex antenna voltages are measured by a high-grade triple DF receiver that acts like a vector voltmeter. The measured values are digitized. The results are evaluated on the basis of mathematical algorithms. Evaluation can be performed by using the Watson-Watt or interferometer classic DF methods or state-of-the-art correlation methods.

The correlation method provides the following benefits:

- ◆ High accuracy, sensitivity and flexibility
- ◆ High flexibility with respect to antenna geometry
- ◆ Use of wide-aperture antennas with a minimum number of antenna elements (mainly arranged in circular arrays)
- ◆ In mobile use: calibration (option) for effective reduction of DF errors introduced by platform (vehicle, ship, aircraft)

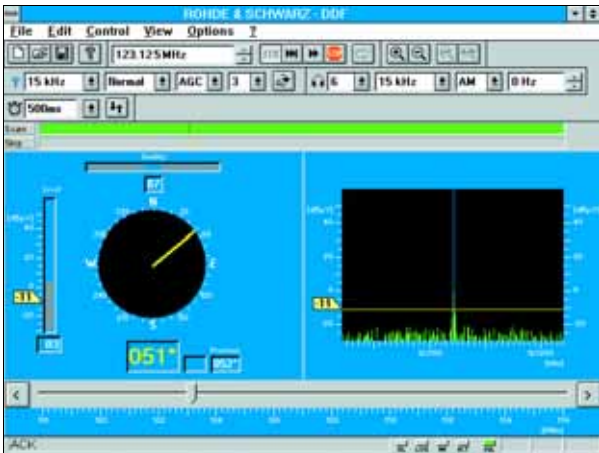
As various algorithms are used for bearing determination, existing DF antennas (e.g. Adcock HF antennas) that are in good operational condition can be connected to the state-of-the-art direction finders.

With the R&S DDFGSM option bearings can be determined for the individual timeslots of a GSM channel.

Operation via PC

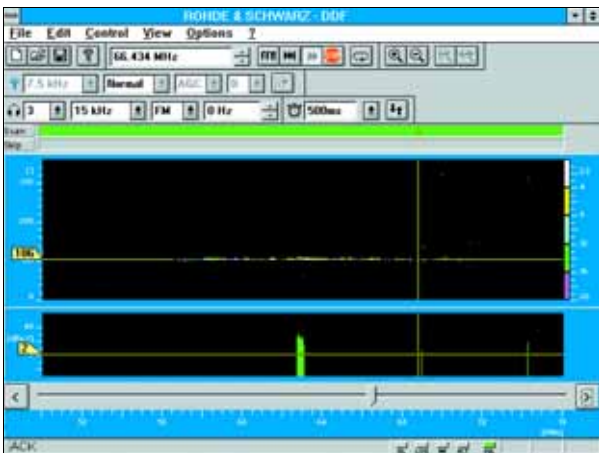
The DF converters and the digital processing unit have as standard no control or display elements so that the direction finder is operated via a PC, which is connected to or integrated in the R&S EBD060.

Each direction finder comes with a software package (R&S DDFMMI) which generates a user interface (MMI) under the WindowsNT operating system.



The interface using windowing technique offers a user-configurable toolbar and object-dependent pop-up menus for maximum operating convenience.

Fixed frequency mode (FFM)



Scan mode

The interface features windowing technique for easy setting of operating parameters by means of a mouse and pop-up menus.

The following display modes are supported:

In fixed frequency mode:

- ◆ Bearing in polar diagram, additionally DF ellipse if Watson-Watt analysis is employed
- ◆ Level (input voltage or field strength), elevation and DF quality as bargraphs with numerical values
- ◆ Level versus frequency in the range ± 100 kHz (HF: ± 12.5 kHz) about the receive frequency (IF spectrum)
- ◆ Bearings versus time (histogram and waterfall display)

In scan mode:

- ◆ Amplitudes and bearings versus frequency
- ◆ Aging of bearings indicated by colours
- ◆ Frequency versus time (waterfall display)

The direction finders are further enhanced by zoom functions, recording and replay functions, the support of libraries with defined scanning ranges, as well as a number of options for remote control of DF units, control of hand-off receivers and Single Station Location Manager.

The Digital Processing Unit R&S EBD060 is optionally available with a built-in PC and colour LCD with 640 x 480 pixels. For EMC, the PC is optimally screened to pre-

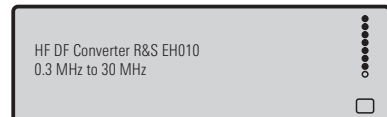
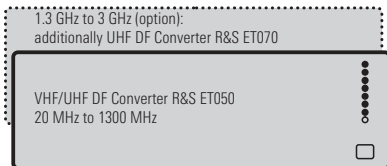
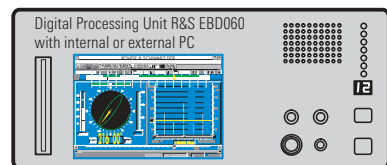
vent radiated electromagnetic interference. This is especially important for direction finders installed in a vehicle or shelter as in this case the DF antennas are usually located close to the DF equipment.

Display Unit R&S EBD060A

The additional Display Unit R&S EBD060A is available for use of the R&S DDF0xM in a vehicle with the DF equipment accommodated in the boot, for example. The R&S EBD060A is of compact design so that it can conveniently be hand-held.

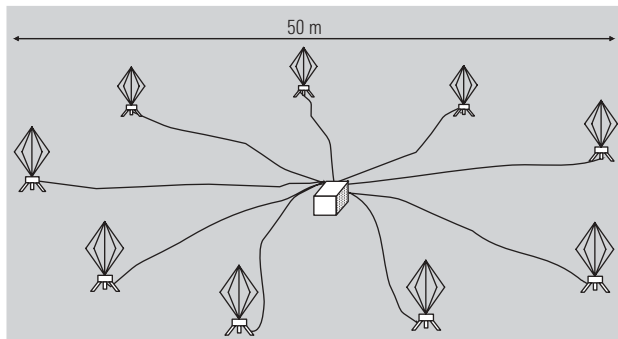
The relevant DF information is shown on an LCD display, and the audio content of the DF'd signal can be monitored via the built-in loudspeaker.

The direction finder comprises up to three units plus the antenna. The integrated PC (option for R&S EBD060) provides great ease of operation.



DF antennas

A variety of DF antennas is available to match different applications. The antennas offered include Adcock, crossed-loop and circular arrays (see tables on page 5). All the antennas offered feature a coding function to inform the DF system of the algorithm (correlation or Watson-Watt) to which the direction finder is to be set.



HF DF Antenna R&S ADD011

Optionally, the antennas for mobile use can be equipped with an electronic compass by which the bearings are automatically referred to magnetic north. Adapters are available for installing the mobile DF antennas on vehicles or masts, e.g. on ships. In many cases, non-R&S antennas (Adcock) already installed can be used with the direction finders. For this, the Antenna Interface R&S GX060 (0.3 MHz to 650 MHz) is required.

Multicoupler R&S VE010

The Multicoupler R&S VE010 makes it possible to operate up to six Direction Finders R&S DDF01M or R&S DDF01S (data sheet PD 0757.2173) from one HF DF Antenna R&S ADD010 or R&S ADD011. With the R&S VE010, the Direction Finders R&S DDF0xM/R&S DDF0xS can be connected to the HF DF antenna in

any combination and operated completely independently of one another.



VHF/UHF DF antenna system

For cable lengths exceeding 10 m for the VHF/UHF range, the Power Supply R&S IN061 is supplied with the cable.

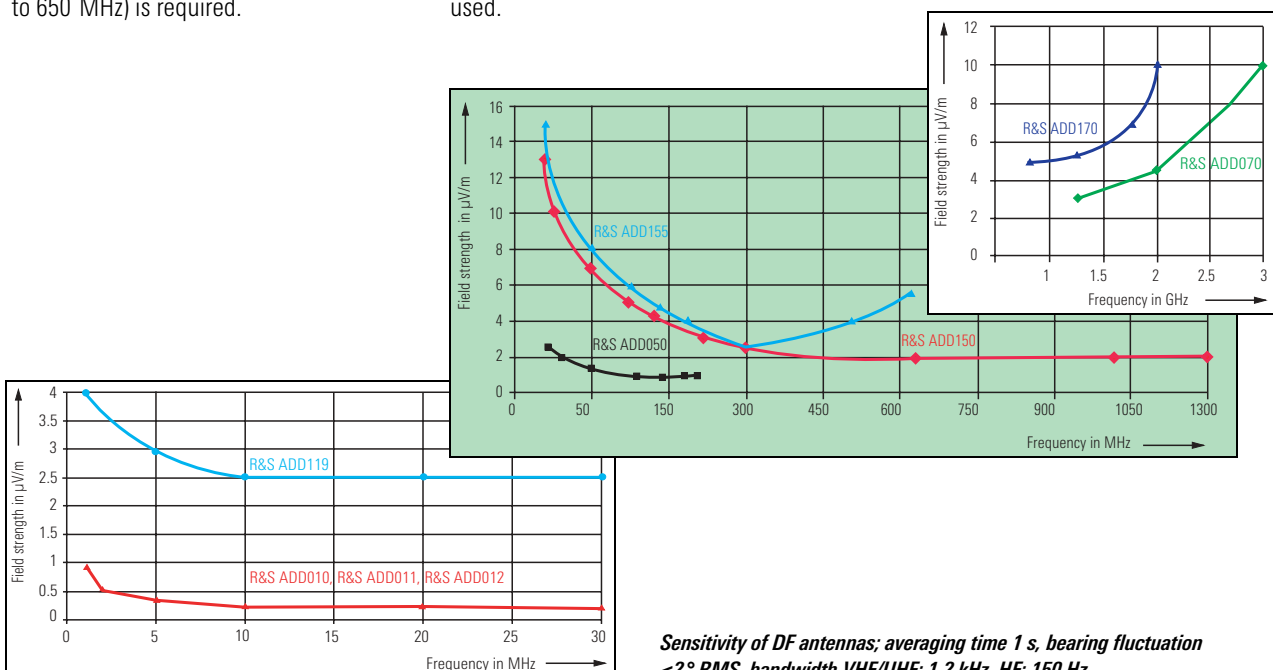
Antenna cables

The Antenna Cable R&S ADD01xZ is required for connecting the HF DF antenna to the DF equipment. The cable is available in various lengths to suit the application.

For the VHF/UHF range, the Antenna Cable R&S ADD05xZ or R&S ADD07xZ is used.

Effective lightning protection

The cable inputs and outputs of the DF antennas are overvoltage-protected as standard. For the VHF/UHF DF Antennas R&S ADD150, R&S ADD050 and R&S ADD051, a lightning rod is supplied to protect the equipment against direct strikes.



Sensitivity of DF antennas; averaging time 1 s, bearing fluctuation $\leq 2^\circ$ RMS, bandwidth VHF/UHF: 1.2 kHz, HF: 150 Hz

Specifications – HF Antennas

Type (Order No.)	R&S ADD 119 (4053.6509.02)	R&S ADD010 (4045.0105.03)	R&S ADD011 (4045.0005.02)	R&S ADD012 (4051.1400.02)	R&S ADD012 (4051.1400.12)
Application	mobile, fast scanning for ground waves and sky waves with low elevation angle	semi-mobile and stationary, for signals with elevation angle $\leq 50^\circ$, SSL possible to a limited extent	stationary, for signals with elevation angle $\leq 85^\circ$, SSL possible	semi-mobile and stationary, maximum scanning speed	
Frequency range	(0.3) 1 MHz to 30 MHz, below 1 MHz with limited sensitivity and accuracy				
Antenna type	1 crossed loop and 1 active dipole	active 9-element circular array of rod antennas	active 9-element circular array of crossed loops	U-Adcock, 1 x 8 elements + center antenna	U-Adcock, 2 x 8 elements + center antenna, switchover at 12 MHz
DF method	Watson-Watt	correlation		Watson-Watt	
Polarization	vertical		vertical, horizontal, circular	vertical	
DF accuracy (in reflection-free environment)	2° RMS	1° RMS		1° RMS (1 MHz to 25 MHz)/2° RMS (25 MHz to 30 MHz) with operation in subranges 1 MHz to 12 MHz/12 MHz to 30 MHz	
Sensitivity	4 $\mu\text{V/m}$ to 2.5 $\mu\text{V/m}$ typ. (2° bearing fluctuation, 1 s averaging time)	1 $\mu\text{V/m}$ to 0.2 $\mu\text{V/m}$ typ. (2° bearing fluctuation, 1 s averaging time)		1 $\mu\text{V/m}$ to 0.2 $\mu\text{V/m}$ typ. with operation in subranges 1 MHz to 12 MHz and 12 MHz to 30 MHz (2° bearing fluctuation, 1 s averaging time)	1 $\mu\text{V/m}$ to 0.2 $\mu\text{V/m}$ typ. (2° bearing fluctuation, 1 s averaging time)
Dimensions	1100 mm dia x 238 mm	antenna circle: 50 m dia, height of rod antenna: approx. 2 m	antenna circle: 50 m dia, height of crossed loop: 3.4 m incl. tripod	antenna circle: 7 m dia (for 1 MHz to 30 MHz) or alternatively: 20 m dia (for 1 MHz to 12 MHz), height of element: 2 m	antenna circle: 20 m dia, height of element: 2 m
Weight	25 kg	single element: 14 kg, network: 22 kg	single element: 33 kg, network: 22 kg	single element: 14 kg, network: 22 kg	
Maximum wind speed	200 km/h without ice, 173 km/h with 30 mm radial ice deposit	160 km/h without ice			
Operating temperature range	-40°C to +65°C				
Power supply	from DF equipment for antenna cables <10 m, otherwise Power Supply R&S IN061	from power supply integrated as standard			

Specifications – VHF/UHF Antennas

Type (Order No.)	R&S ADD 150 (4041.1007.02)	R&S ADD 155 (4040.9004.02)	R&S ADD050 (4041.4006.02)	R&S ADD051 (4041.7005.02)	R&S ADD070 (4043.4003.02/.12) ¹⁾	R&S ADD 170 (4055.7502.02)
Application	VHF/UHF, mobile and stationary	VHF/UHF, mobile and stationary, maximum search speed	VHF, stationary, enhanced accuracy especially with multipath propagation	VHF/UHF, stationary, combination of R&S ADD 150 and R&S ADD050 (see photo on page 4)	UHF, stationary, can be mounted below VHF/UHF antennas on same mast	mobile direction finding in GSM bands
Frequency range	20 MHz to 1300 MHz	20 MHz to 500 (650) MHz, above 500 MHz with limited accuracy	20 MHz to 200 MHz	20 MHz to 1300 MHz	1300 MHz to 3000 MHz	800 MHz to 2000 MHz
Antenna type	9 active antenna elements in radome	Adcock, 2 x active 8-element circular arrays in radome	active 9-element circular array	2 x active 9-element circular array	8-element circular array	8-element circular array with center antenna
DF method	correlation	Watson-Watt	correlation			
Polarization	vertical					
DF accuracy (in reflection-free environment)	2° RMS (20 MHz to 200 MHz) 1° RMS (200 MHz to 1300 MHz)	3° RMS (20 MHz to 50 MHz) 2° RMS (50 MHz to 500 MHz)	1° RMS		2° RMS	
Sensitivity	13 $\mu\text{V/m}$ to 2 $\mu\text{V/m}$ typ. (2° bearing fluctuation, 1 s averaging time)	15 $\mu\text{V/m}$ to 5 $\mu\text{V/m}$ typ. (2° bearing fluctuation, 1 s averaging time)	2.5 $\mu\text{V/m}$ to 1 $\mu\text{V/m}$ typ. (2° bearing fluctuation, 1 s averaging time)	wind load on flange: 2078 Nm at 188 km/h without ice, 2495 Nm at 162 km/h with 30 mm ice deposit	3 $\mu\text{V/m}$ to 10 $\mu\text{V/m}$ typ. (2° bearing fluctuation, 1 s averaging time)	5 $\mu\text{V/m}$ typ. (0.8 GHz) 10 $\mu\text{V/m}$ typ. (2 GHz) (2° bearing fluctuation, 1 s averaging time)
Dimensions	1100 mm dia x 238 mm	1100 mm dia x 238 mm	antenna circle: 3 m dia, height: 1 m, with lightning rod: 3.1 m		340 mm dia x 1200 mm (.02) 340 mm dia x 492 mm (.12)	455 mm dia, height: 365 mm
Weight	30 kg		66 kg	110 kg	90 kg (.02), 12 kg (.12)	9 kg
Maximum wind speed	200 km/h without ice, 162 km/h with 30 mm radial ice deposit					
Operating temperature range	-40°C to +65°C					
Power supply	from DF equipment for antenna cables <10 m, otherwise from Power Supply R&S IN061		Power Supply R&S IN061 required		from DF equipment for antenna cables <10 m, otherwise from Power Supply R&S IN061 ²⁾	

¹⁾ Model 12: lightweight model for mobile use.

²⁾ R&S IN061 required for combination of R&S ADD 150 and R&S ADD070.

Specifications

R&S DDF01M and R&S DDF06M (HF section)

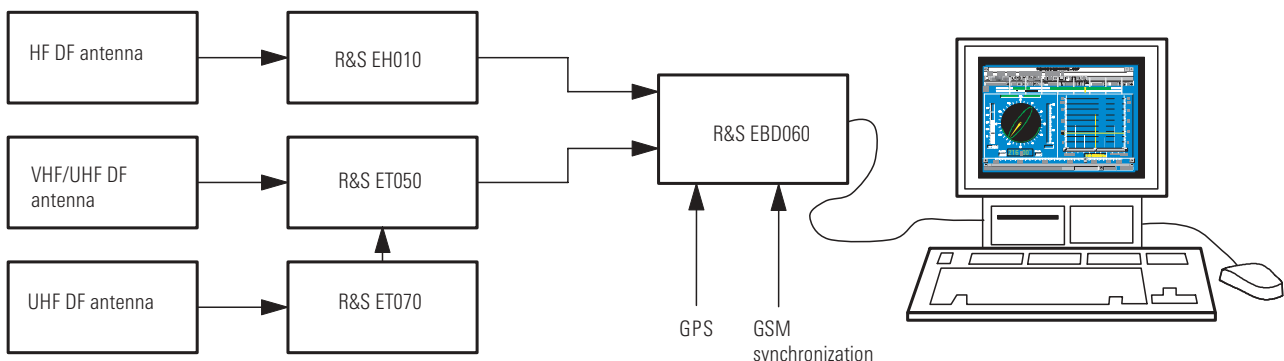
Frequency range	0.3 MHz to 30 MHz
Polarization HF	depending on antenna (see page 5)
DF method	correlative interferometer and Watson-Watt method
Operation	via integrated (option) or external PC
Inherent DF error	0.5° RMS
DF accuracy (in reflection-free environment)	1° RMS with Antenna R&S ADD 011
Sensitivity (2° RMS bearing fluctuation)	depending on antenna system (see diagram on page 4)
Operating modes	Fixed Frequency Mode (FFM), Scan Mode, Search Mode
DF modes (FFM)	Normal, Gate, Continuous
Display	azimuth/frequency spectrum, polar diagram, histogram, waterfall, realtime IF panoramic display (25 kHz bandwidth)
Resolution of display	1° or 0.1°
Bearing information	numerical and graphical display of azimuth and elevation, bearing quality and signal level
FFT realtime bandwidth	25 kHz
Minimum signal duration for DF	5 ms (down to 0.5 ms with Watson-Watt method)
Scanning speed	0.5 MHz/s for 1 kHz resolution
Channel spacing	0.125/0.25/0.5/1/2.5/5/25 kHz
Selectivity for DF (1 dB bandwidth)	0.075/0.15/0.3/0.6/1.5/3/15/25 kHz
Selectivity for audio monitoring (1 dB bandwidth)	0.15/0.3/0.6/1.5/3/15/25 kHz
Reception modes	CW, AM, FM, SSB
Linearity	
SOI	50 dBm typ.
TOI (inband)	8 dBm typ.
TOI (signal spacing >0.1 MHz)	25 dBm typ.
Dynamic range	120 dB typ.
Impedance	50 Ω
Frequency stability	2×10^{-6} at -10°C to +55°C
Image frequency rejection	>90 dB, 110 dB typ.
IF rejection	>90 dB, 110 dB typ.
Power supply	
AC	115/230 V AC + 10%/-12%, 47 Hz to 440 Hz, max. 300 VA
Battery	20 V to 32 V DC, max. 250 W
Built-in test	module monitoring, fault signalling
Remote control	RS-232-C; ISDN or Ethernet with suitable PC configuration

R&S DDF05M and R&S DDF06M (VHF/UHF section)

Frequency range	20 MHz to 1300 MHz (up to 3000 MHz with Converter R&S ET070)
Polarization VHF/UHF	vertical
DF method	correlative interferometer and Watson-Watt method
Operation	via integrated (option) or external PC
Inherent DF error	0.5° RMS
DF accuracy ¹⁾ (in reflection-free environment)	1° RMS with Antenna R&S ADD051 (stationary) 2° RMS (20 MHz to 200 MHz with R&S ADD 150) 1° RMS (200 MHz to 1300 MHz with R&S ADD 150)
Sensitivity (2° RMS bearing fluctuation)	depending on antenna system (see diagram on page 4)
Operating modes	Fixed Frequency Mode (FFM), Scan Mode, Search Mode
DF modes (FFM)	Normal, Gate, Continuous
Display	azimuth/frequency spectrum, polar diagram, histogram, waterfall, realtime IF panoramic display (200 kHz bandwidth)
Resolution of display	1° or 0.1°
Bearing information	numerical and graphical display of azimuth, bearing quality and signal level
FFT realtime bandwidth	200 kHz
Minimum signal duration for DF	500 μs (down to 10 μs with Watson-Watt method)
Scanning speed	1800 channels/s, 45 MHz/s for 25 kHz resolution
Channel spacing	1/2/4/8/10/12.5/20/25/50/100/200 kHz
Selectivity for DF (1 dB bandwidth)	0.6/1.2/2.4/4.8/6/7.5/12/15/30/120/200 kHz
Selectivity for audio monitoring (1 dB bandwidth)	0.6/1.2/2.4/4.8/6/7.5/12/15/30/200 kHz
Reception modes	CW, AM, FM, SSB
Linearity	
SOI	50 dBm typ.
TOI (inband)	12 dBm typ.
Dynamic range	120 dB typ.
Impedance	50 Ω
Frequency stability	2×10^{-6} at -10°C to +55°C
Image frequency rejection	>90 dB, 110 dB typ.
IF rejection	>90 dB, 110 dB typ.
Power supply	
AC	115/230 V AC + 10%/-12%, 47 Hz to 440 Hz, max. 300 VA
Battery	20 V to 32 V DC, max. 250 W
Built-in test	module monitoring, fault signalling
Remote control	RS-232-C, ISDN (see HF)

¹⁾ For slim masts with a height between 4 m and 8 m, the specified values may be exceeded in the frequency range between 20 MHz and 40 MHz (by 1° to 2°, depending on the mast symmetry and the ground connections at the mast base) because of the self-resonance of the mast that can occur.

Digital HF/VHF/UHF direction finder from 0.3 MHz to 3000 MHz with external PC



General specifications

	R&S EBD060	R&S EH010/R&S ET050/R&S ET070
Dimensions (W x H x D)	436 mm x 192 mm x 460 mm	436 mm x 148 mm x 460 mm
Weight	24 kg	22 kg
Operating temperature range	without PC: 0°C to +50°C with PC: +5°C to +45°C	-10°C to +55°C
Rated temperature range	+5°C to +40°C	0°C to +50°C
Storage temperature range	without PC: -40°C to +70°C with PC: -20°C to +60°C	-40°C to +70°C
Humidity	meets DIN EN 60068-2-30, +40°C at 95% rel. humidity	meets DIN EN 60068-2-30, max. 95%, cyclic test at 25/55°C
Shock	meets DIN EN 60068-2-27 (MIL-STD-810E), 40 g shock spectrum	
Vibration, sinusoidal	meets DIN EN 60068-2-6, 5 Hz to 50 Hz, 0.15 mm amplitude	
Vibration, random	meets DIN EN 60068-2-64, 10 Hz to 300 Hz, 1.2 g (rms)	
EMC	MIL-STD-461 CE03, RE02; R&S EBD060 with integrated PC: EN55022, EN61000-4-3	

Integrated PC (option)

Type	Pentium/166 MHz
Display	colour TFT display, 640 x 480 pixels
RAM	32 Mbyte
Hard disk	3.5", 3.2 Gbyte
Floppy disk drive	3.5", 1.44 Mbyte
Serial interfaces	COM 1, COM 2, LAN
Parallel interface	LPT 1
CD-ROM drive	external

Power Supply R&S IN061

	115/230 V AC \pm 15%, 47 Hz to 63 Hz; 20 V to 32 V DC, max. 4.5 A (terminal strip)
Dimensions, weight	345 mm x 255 mm x 155 mm, 10 kg
Operating temperature range	-40°C to +65°C

Electronic Compass R&S GH150

for integration into the Antennas R&S
ADD119, R&S ADD150, R&S ADD155
and R&S ADD170

Ordering information

Digital Monitoring Direction Finders

0.3 MHz to 30 MHz	R&S DDF01M	4044.8002.02
20 MHz to 1300 MHz	R&S DDF05M	4044.8254.02
20 MHz to 3000 MHz	R&S DDF05M	4044.8254.03
0.3 MHz to 1300 MHz	R&S DDF06M	4044.8502.02
0.3 MHz to 3000 MHz	R&S DDF06M	4044.8502.03
Models with integrated PC		xxxxxxxx.1x

Accessories supplied transputer board (ISA-16, Order No.
4039.5950.02), cables between DF
converter and digital processing unit,
standard software (R&S DDFMMI)

Antennas see tables on page 5

Accessories

Antenna cable	on request	
Electronic Compass		
(for R&S ADD119/150/155/170)	R&S GH150	4041.8501.02
GSM DF Unit	R&S DDFGSM	4050.4257.03
Remote-Control Software	R&S DDFREM	4050.4105.02
Various adapters for mast and vehicle installation	on request	

Certified Environmental System
ISO 14001
REG. NO 1954

Certified Quality System
ISO 9001
DQS REG. NO 1954



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