



Digital Direction Finder DDF 190

0.5 MHz to 3 GHz

- Direction finding of signals with any modulation
- Wide-aperture behaviour above 300 MHz
- AC supply or battery operation
- Simultaneous operation of all DF antennas (HF and VHF/UHF) without replacing antennas

Design

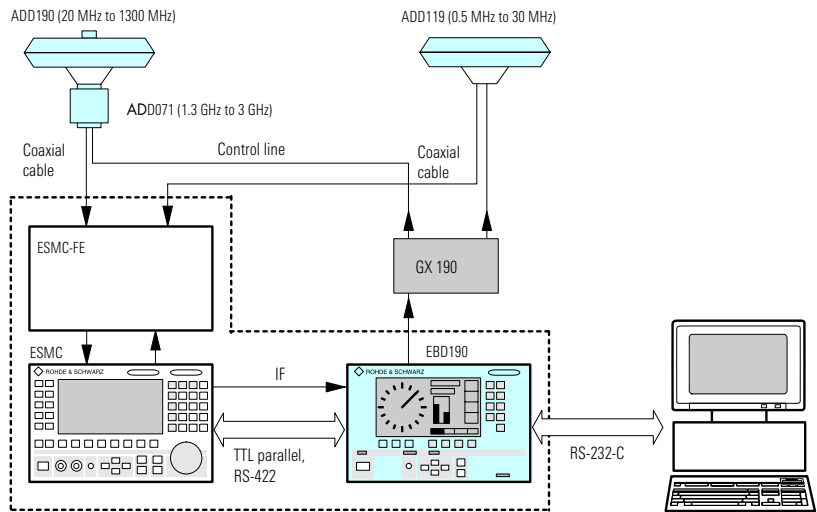
Digital Direction Finder DDF190 may comprise the following elements:

- HF DF Antenna ADD 119 (0.5 MHz to 30 MHz)
- VHF/UHF DF Antenna ADD190 (20 MHz to 1300 MHz)
- UHF DF Antenna ADD071 (1.3 GHz to 3 GHz)
- DF Unit EBD190
- Cable Set DDF190Z

Moreover, a monitoring receiver with unregulated IF output of 10.7 MHz or 21.4 MHz (eg EB200, ESMB, ESMC or ESN) is required.

Characteristics and operation

Digital Direction Finder DDF 190 can be operated in accordance with two DF methods using digital signal processing: the proven Watson-Watt method (HF band) and the advanced correlative interferometer method (VHF/UHF band). In the latter case, the complex antenna voltages of the received signal are compared with stored reference values and then checked for maximum correlation. This DF method



enables implementation of wide-aperture DF antennas comprising only a few antenna elements and covering wide frequency ranges without division into sub-ranges.

The system allows direction finding of signals with any modulation.

Three operating modes can be selected on the DF unit:

NORMAL

In this mode, which is preferably used for monitoring radio networks, the DF process is started and stopped by the squelch of the DF unit. The bearing display follows the various directions of incidence of the signals without any delay.

GATE

This mode is used for direction finding of transmitters whose emissions may be interrupted briefly by modulation (eg keyed transmitters) if the transmitter on-the-air time is too short for NORMAL operating mode.

CONT

In this mode, direction finding is performed continuously so that a bearing may be obtained even for specially modulated or very weak signals for which the DF process is not triggered by the squelch.

In each of these modes, bearings can also be displayed in a histo-





Antenna ADD 119 in mobile use

gram, which is of advantage in the analysis of communication networks.

Histograms display the current bearing in digital form (three-digit number), and all values obtained since the activation of this display mode are shown as radial beams indicating the direction of incidence. The lengths of the beams are a measure of frequency occurrence of the bearings.

The display mode can also be switched to QDM (heading with reference to magnetic north). Results can be output as lists.

In the NORMAL mode, the indication disappears as soon as reception of the DF'd transmitter is over. In the other operating modes, the DF process is terminated by the user. The bearing last determined is stored and can be recalled at a keystroke. It is however overwritten by the next bearing value.

Upon system initialization, the DF antenna system can be electronically oriented to north, so that there are no restrictions to be observed for mechanical setup of the antenna.

The scanning noise caused by the DF process in single-receiver direction finders can be switched off for monitoring purposes by

interrupting the DF process (DF/AF switch-over).

Several test routines are integrated in the direction finder, which can be powered either from the AC supply or battery.

Interfaces

The digital direction finder can be remotely controlled via a serial RS-232-C interface. If the receiver is provided with a serial interface (RS-232, RS-422), it can be connected to a second interface on the DF unit and also remote-controlled via the remote interface of the DF unit. In addition, the direction finder is fitted with a parallel TTL interface for automatic selection of the antenna sub-ranges from the receiver.

HF extension

To cover the HF range, two new features have to be implemented:

- Connection of HF DF Antenna ADD 119 to receiver and to DF unit
- Installation of current firmware (version 2.0 or higher)¹⁾ with evaluation algorithm for Watson-Watt method in DF unit

¹⁾ The new firmware is available on the Internet (Rohde&Schwarz homepage) for updating.

If DDF 190 is operated only in the HF range, the connections between DF Antenna ADD 119 and the DF unit are straightforward (Cable Set DDF 190Z consisting of one RF cable, one control cable and, if necessary, Power Supply IN061). Where DF Antenna ADD 190 and/or DF Antenna ADD071 are to be used in addition, Connection Board GX190 is needed, since EBD 190 has only one control output and each receiver only one RF input. The connection board performs frequency-dependent, automatic switch-over to the required DF antenna and allows up to three communication receiving antennas to be connected to the receiver input. Switchover is made via the DF/AF keys on EBD 190.

Where it is not possible to mount all DF antennas at the top of the mast, DF Antenna ADD 119 is to be fitted on a bracket on the side of the mast. This asymmetrical installation leads to bearing errors, which can however be kept low by fitting a second ADD 119 on the opposite side of the mast. The signals from the two antennas are taken to Combiner GX 119 and then to the DF equipment.



DF antennas

For DDF 190 there are three DF antennas for mobile and stationary applications covering the frequency ranges 0.5 MHz to 30 MHz (ADD 119), 20 MHz to 1300 MHz (ADD190) and 1.3 GHz to 3 GHz (ADD071). The add-on Electronic Compass GH 150 can be fixed to the antennas for automatic direction finding referred to north.



Display Unit EBD 190A for detached use

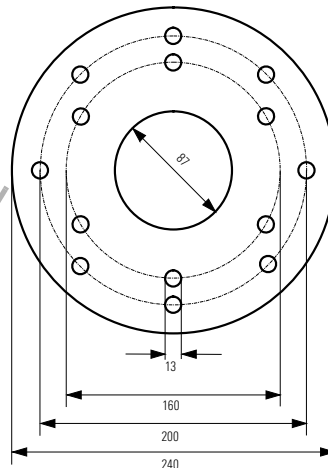
Extras

For operation of DDF 190 with ESMC in the VHF/UHF range in a vehicle with the DF unit accommodated in the boot of the car for instance, the additional Display Unit EBD 190A is available. It shows the relevant DF information on an LCD display and can be handheld conveniently thanks to its compact size. The audio content of the DF'd signal can be monitored via the built-in loudspeaker.

Various adapters are available for the DF antennas allowing stationary installation on a mast or mobile installation on a vehicle/shelter.



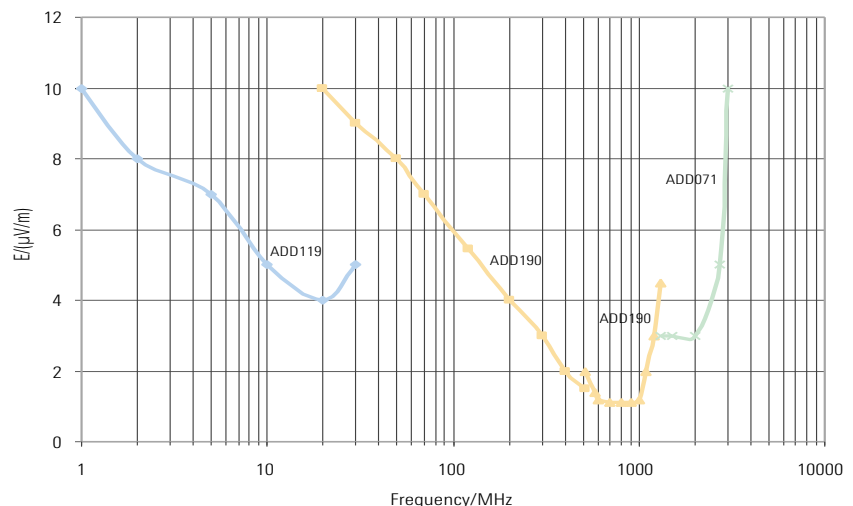
Antennas ADD 190 (top) and ADD071



Flange dimensions

Certified Environmental System
ISO 14001
REG. NO 1954

The antenna cables come in various lengths, and in various types to match the frequency range up to 30 MHz, 1300 MHz or 3 GHz. Cables of more than 40 m in length require Power Supply IN061, which is automatically supplied with the cable set when cables of this length are ordered.



Typical sensitivity of DDF 190 with Rohde&Schwarz receiver: <math><5^\circ</math> RMS bearing fluctuation, 1 kHz bandwidth, 5 s averaging time

Specifications

DF method	Watson-Watt or correlative interferometer
Frequency range (depending on receiver/ DF antenna)	
HF	0.5 MHz to 30 MHz
VHF/UHF	20 MHz to 1300 MHz
UHF	1.3 GHz to 3 GHz
DF accuracy in reflection-free environment*)	2° RMS (0.5 MHz to 30 MHz) 2° RMS (20 MHz to 80 MHz) 1° RMS (80 MHz to 1300 MHz) 2° RMS (1.3 GHz to 3 GHz)
Resolution of A/D converter	16 bit
Minimum signal duration	50 ms
DF sensitivity (≤5° RMS fluctuation, 5 s averaging time, 8 kHz bandwidth Rohde & Schwarz receiver)	typ. 15 µV/m to 4 µV/m (frequency- dependent, see diagram on page 4)
HF	typ. 1 µV/m to 10 µV/m (frequency- dependent, see diagram on page 4)
VHF/UHF	typ. 3 µV/m to 10 µV/m
UHF	1 kHz, 2.5 kHz, 8 kHz, 25 kHz, 100 kHz
Bandwidths (internal)	100 ms to 5 s
Averaging time	internal or external
Squelch	10.7 MHz or 21.4 MHz, 50 Ω, level <0 dBm unregulated (ie without AGC), broadband or narrowband
IF input	

DF display	graphic LCD on front panel; three-digit display with additional indication of direction on compass rose
Data interface	RS-232-C for remote control of system, 2nd serial interface and parallel inter- face for receiver control

Ordering information

Digital Direction Finder 20 MHz to 1300 MHz 20 MHz to 3000 MHz	DDF 190	4046.4004.02 4046.4004.03
HF DF Antenna	ADD 119	4053.6509.02
Antenna Cable Set 0.5 MHz to 1300 MHz 20 MHz to 3000 MHz	DDF 190Z	4046.4104.xx 4045.1301.xx
Connection Board	GX 190	4032.1508.02
Combiner	GX 119	4032.1008.02
Display Unit	EBD 190A	4041.6009.02
Electronic Compass	GH 150	4041.8501.02
Remote-control software		on request

*) 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 may occur.

General data	DF Unit EBD 190	Antenna ADD 119	Antenna ADD 190	Antenna ADD 071
Operating temperature range	-10°C to +55°C	-40°C to +65°C to MIL-STD-810E Meth. 501.3 and 502.3		
Storage temperature range	-40°C to +70°C	-40°C to +85°C to MIL-STD-810E Meth. 501.3 and 502.3		
Permissible humidity	to DIN IEC 68-2-30, max. 95% cyclic, 25°C/55°C			
Mechanical resistance				
Vibration, sinusoidal	to DIN IEC 68-2-6 (MIL-T-28800D), 5 Hz to 55 Hz, 0.15 mm amplitude			
Vibration, random	to DIN IEC 68-2-36, 10 Hz to 500 Hz, 1.9 g (rms)			
Shock	to DIN IEC 68-2-27 (MIL-STD-810D, MIL-T-28800 D), 40 g shock spectrum			
Class of protection	-	IP 55 to DIN 40050		
Immunity to salt fog to sand and dust	to MIL-STD-810E Method 509.3 to MIL-STD-810E Method 510.3			
Lightning protection	-	against nearby lightning strokes	against direct lightning strokes to IEC 1024-1 class of protec- tion IV (I = 100 kA, di/dt = 100 kA/ms)	
Electromagnetic compatibility	EN 50081-1, EN 50082-2, EN 55022 class B			
Power supply	AC: 100/120/230/240 V, -12/+10%, 47 Hz to 440 Hz, over- voltage-protected to VDE 160, ≤40 VA; DC: 10 V to 32 V, ≤20 W	15 V to 18 V DC, max. 2 A from DF Unit EBD 190 for cable lengths <40 m. For cable lengths >40 m, power supply is via IN 061 (supplied with cable set).		
Dimensions (W x H x D)	219 mm x 147 mm x 460 mm	1.1 m dia., height 0.22 m	1.1 m dia., height 0.26 m (with lightning rod 1.26 m)	0.3 m dia., height 0.5 m
Weight	approx. 10 kg	approx. 25 kg	approx. 30 kg (incl. lightning rod)	approx. 12 kg
Max. wind speed	-	200 km/h (without ice deposit) 162 km/h (with 3 cm radial ice deposit) (to DIN 4131 zone IV)		



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