DF antennas for every purpose

From HF to UHF, stationary and mobile

When Rohde & Schwarz launched a new generation of digital direction finders several years ago, a new family of DF antennas appeared at the same time and has been continuously added to. The antennas can be used for both Digital Monitoring Direction Finders DDF0xM and Digital Scanning Direction Finders DDF0xS, which feature three receiver modules. A separate antenna family is provided for the single-channel DDF190.

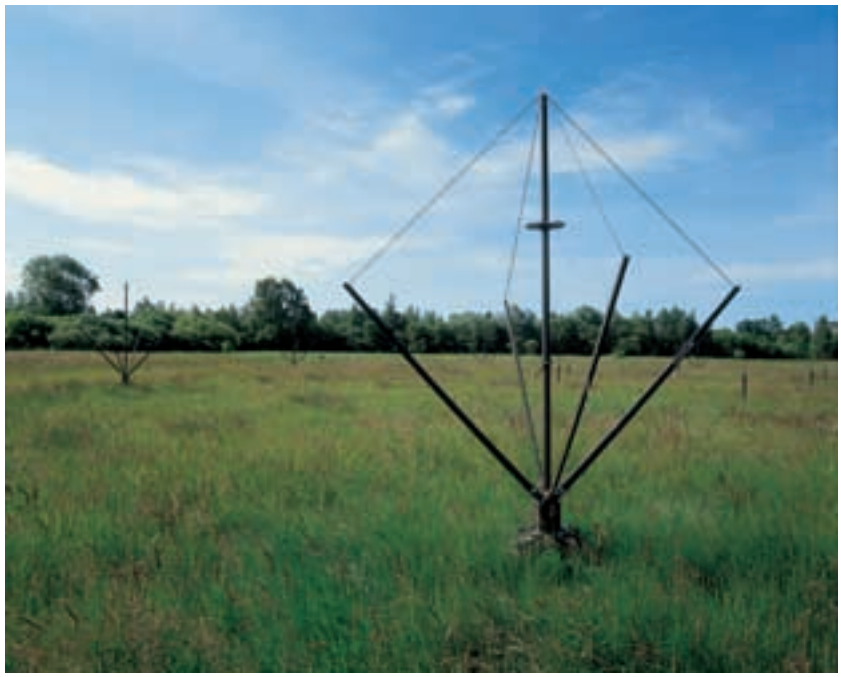

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FIG 1 Interferometer DF Antenna ADD011, combined with Adcock Antenna ADD012 (monopoles in background, right)

The new generation of digital direction finders [1, 2, 3] uses either the classic Watson-Watt method or the advanced correlative interferometer principle. For both, Rohde & Schwarz offers a comprehensive selection of antennas for stationary and mobile use covering the range from HF through UHF (FIG 4).

DF antennas for shortwave

Because of the large wavelengths in the shortwave range from 1000 m to 10 m, DF antennas for this purpose are usually also large. All shortwave antennas from Rohde & Schwarz range from 0.3 MHz to 30 MHz.

Correlative interferometer

The correlative interferometer determines the azimuth of a signal and its elevation. The advantage is that the location of a transmitter can be determined with only one direction finder by considering the ionosphere (SSL: single station location), provided however that the signal is only reflected once by the ionosphere (single-hop propagation).

For the correlative interferometer there are two types of DF antenna: ADD010 and ADD011. The latter consists of nine crossed-loop antenna elements arranged on the circumference of a circle 50 m in diameter (FIG 1). Thanks to their vertical antenna pattern, crossed loops detect signals that arrive as skywaves up to elevation angles of almost 90°.

The antenna elements can be folded up, mounted on tripods and are thus suitable for stationary and transportable use. ▶

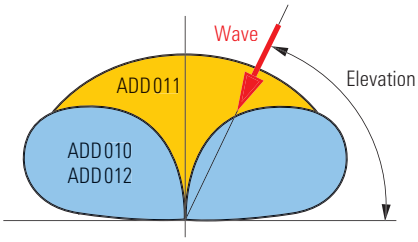

FIG 2 Vertical patterns of ADD011, consisting of crossed-loop elements, and ADD010 and ADD012, both designed with rod antennas

DF Antenna ADD010 is intended for mobile applications in the same frequency range. It consists of nine monopole elements, also arranged in a circle 50 m in diameter. They can be set up and dismantled faster, and take up less space during transport. In this case the vertical pattern only allows detection of signals up to elevation angles of about 60° (FIG 2). In particular when determining elevation, major errors can be produced by signals with steep angles of incidence. With nine elements and a triple receiver arrangement, sequential sampling is necessary, requiring extended signal duration. On the other hand, the correlative interferometer stands out for its high accuracy and stability.

Adcock/Watson-Watt direction finder

DF Antenna ADD012 is intended for stationary applications using the Watson-Watt method. It is in the nature of Adcock antennas that they do not cover as wide a frequency range as DF antennas for a correlative interferometer. ADD012 may consist of one or two circular arrays, each with eight monopoles, and one central antenna, the circles being 7 m and/or 22 m in diameter. Since the Watson-Watt method only gives you the azimuth and no elevation, the vertical pattern of the monopole plays a minor role (FIG 2). The signals of the Adcock antenna are processed simultaneously during the Watson-Watt evaluation, i.e. without any switching steps, so signals of shorter duration are detected and higher search speed is possible.

If the available space is limited, on ships or vehicles for instance, there is no alternative to compact DF antennas, but these can only be implemented for Watson-Watt. For vehicular use or temporary installation on a tripod, HF DF Antenna ADD119 is the best choice. It can be used in single- and three-channel systems.

ADD015 was specially designed for shipboard use and so that an extra VHF-UHF DF Antenna ADD150 can be mounted on its tip [4].

Modernization of older systems

Users in the shortwave range in particular will modernize their Adcock/Watson-Watt direction finder from time to time, but wish to continue using the generally rather elaborate Adcock component. With Direction Finder DDF01M or DDF01S, this is quite straightforward by connecting Antenna Interface GX060 between DF antenna and DF instrumentation.

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FIG 3 Together, correlative interferometer antennas ADD051 (= ADD050 with ADD150) and ADD070 (cylinder below) cover the frequency range 20 MHz to 3000 MHz

DF antennas for VHF-UHF

Apart from elevation, the same fundamentals apply to DF methods in the VHF-UHF range. Here too, there are DF antennas for evaluation by the correlative interferometer or Watson-Watt principle, for both stationary and mobile use.

Correlative interferometer

A wide range of antennas is available for the correlative interferometer. Compact VHF-UHF DF Antenna ADD150 covers 20 MHz through 1300 MHz in a stationary or mobile role. Due to its compact size, performance is slightly limited at the bottom end of the frequency range (sensitivity, response to multipath propagation). This deficiency can be reduced in mobile use by approaching the transmitter. In stationary mode, VHF Antenna ADD050, which is optimized for the 20 MHz to 200 MHz range, can be added (together they form DF Antenna ADD051, FIG 3). UHF DF Antenna ADD070 (FIG 3), both mobile and stationary, covers the range between 1.3 GHz and 3 GHz.

GSM frequencies 900 MHz/1800 MHz and 1900 MHz are gaining in importance. Organizations responsible for correct use of the frequency spectrum are very much interested in locating sources of interference in these bands – especially in built-up areas. DF Antenna ADD170, which is especially immune to reflection, was developed for this purpose.

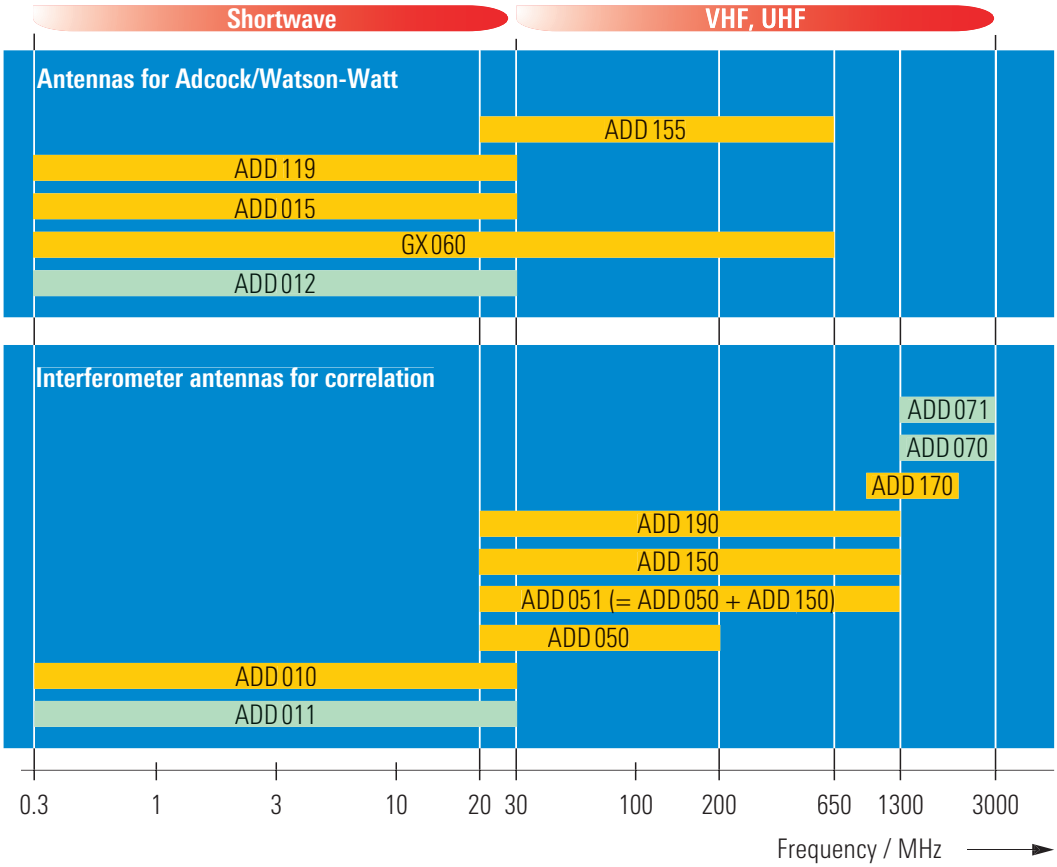
Adcock/Watson-Watt direction finder

The Watson-Watt method can also be utilized with compact DF Antenna ADD155 covering 20 MHz to 650 MHz.

Antennas for DDF190

In the shortwave range, DDF190 operates in Watson-Watt mode. HF DF Antenna ADD119 is designed for both the two three-channel DDF0xM and DDF0xS direction finders and single-

FIG 4
Antenna selection for Digital Direction Finders DDF0xM, DDF0xS and DDF190 (yellow: mobile and stationary, green: stationary)



channel DDF 190. DF Antenna ADD 190 for the VHF-UHF range (30 MHz to 1300 MHz) is almost identical to ADD 150 but operates with a single channel.

UHF DF Antenna ADD 071 (1.3 GHz to 3 GHz) is very similar to ADD 070. The antenna voltages of ADD 190 and ADD 071 are evaluated by the correlative interferometer method. Because of the single-channel evaluation, a multiplex method patented by Rohde & Schwarz is additionally implemented in DDF 190 and its antennas.

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REFERENCES

[1] Digital Monitoring Direction Finders DDF0xM – State-of-the-art monitoring direction finding from HF to UHF. News from Rohde & Schwarz (1996) No. 150, pp 22–25

[2] Digital Scanning Direction Finders DDF0xS – Fast direction finding of broadband and shortterm signals. News from Rohde & Schwarz (1998) No. 158, pp 21–23

[3] VHF-UHF Direction Finder DDF 190 – Digital direction finding from 20 to 3000 MHz to ITU guidelines. News from Rohde & Schwarz (1996), No. 152, pp 30–32

[4] Shortwave direction finding on ships. News from Rohde & Schwarz (1999) No. 162, pp 29–30

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