R&S®ADDx
Multichannel DF Antennas
Product overview

ROHDE&SCHWARZ

Product Brochure | Version 10.00

R&S®ADD070, R&S®ADD050SR, R&S®ADD153SR and R&S®ADD-LP.

R&S®ADDx Multichannel DF Antennas

At a glance

The R&S®ADDx DF antennas are decisive for the high efficiency of the Rohde&Schwarz multichannel direction finders because they offer unique technical innovations. The wide product range covers stationary, transportable and mobile applications. In development, the focus was on the lightning protection concept of the antennas and their immunity to harsh ambient conditions.

Due to the large number of antenna elements, the R&S®ADDx DF antennas offer high direction-finding accuracy and sensitivity, as well as outstanding immunity to reflections. The active/passive switchover allows them to flexibly adapt to the signal environment and considerably increases their immunity to strong signals (see below).

The R&S®ADDxxxSR DF antennas are ready for the super-resolution DF method, with which bearings can be taken on multiple co-channel signals and the signals can be separated.

Key facts

- High DF accuracy and sensitivity, as well as high immunity to reflections due to the large number of antenna elements
- Ready for the super-resolution DF method for taking bearings on co-channel transmitters (R&S®ADDxxxSR)
- Active/passive switchover by mouse click for adapting the antenna to the signal environment (R&S®ADD011SR/050SR/011P/253/153SR/157)
- Antenna elements with variable electrical length for automatic adaptation to the current receive frequency (R&S®ADD157/253/153SR)
- Effective, integrated lightning protection with optional extension for applications with high likelihood of lightning strikes (R&S®ADD157/253/153SR)

Benefits and key features

Twelve efficient DF antenna models for any application

▷ page 4

Superior immunity to reflections

- Stable bearings even with a 50 percent share of reflections
- Above-average antenna base (aperture) due to the exceptionally large number of antenna elements

▷ page 12

Ready for the super-resolution DF method

- Taking bearings of up to seven signals simultaneously on the same frequency
- Additional information such as receive level and DF quality for all signals whose bearings are taken
- Taking bearings of all users of a TDMA network on a specific frequency (e.g. TETRA)

▷ page 14

Exceptionally high DF sensitivity and dynamic range

- Use of antenna elements with electrically configurable structure
- Optimal adaptation to the individual receive frequency ranges
- Higher sensitivity and bandwidth than with elements without frequency-dependent adaptation of the antenna element structure – with same dimensions

▷ page 15

Active/passive switchover by mouse click

- Adaptation of the R&S®ADD011SR, R&S®ADD050SR, R&S®ADD011P, R&S®ADD253, R&S®ADD153SR and R&S®ADD157 DF antennas to the signal environment
- Switchover from active to passive mode
- Active mode for maximum DF sensitivity; passive mode for maximum intermodulation suppression

▷ page 16

Integrated, extendible lightning protection

- Utmost protection against lightning strikes
- No impairment of DF accuracy
- No time-consuming calibration after installation of the DF antenna

▷ page 17

Easy replacement of DF antennas

- No individual calibration due to detailed development and precise production
  - Replacement of a DF antenna model without renewed administration/input of calibration data

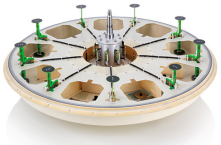
▷ page 18

Model overview

R&S®ADDx multichannel DF antennas

	**R&S®ADD078SR** **UHF/SHF SR DF antenna** mobile and stationary	Frequency range from 1.3 GHz to 6 GHz ▷ page 6
	**R&S®ADD119** **HF DF antenna** mobile	Frequency range from 300 kHz to 30 MHz ▷ page 6
	**R&S®ADD011SR** **super-resolution HF DF antenna** stationary and transportable	Frequency range from 300 kHz to 30 MHz ▷ page 7
	**R&S®ADD011SRX** **super-resolution N-channel HF DF antenna** stationary and transportable	Frequency range from 300 kHz to 30 MHz ▷ page 7
	**R&S®ADD050SR** **super-resolution VHF DF antenna** stationary and transportable	Frequency range from 20 MHz to 450 MHz ▷ page 7
	**R&S®ADD153SR** **super-resolution VHF/UHF DF antenna** mobile and stationary	Frequency range from 20 MHz to 1.3 GHz ▷ page 8

R&S®ADDx multichannel DF antennas

	**R&S®ADD157** **dual polarized VHF/UHF DF antenna** mobile and stationary	Frequency range from 20 MHz to 1.3 GHz (vertical)/ frequency range from 40 MHz to 1.3 GHz (horizontal) ▷ page 9
 R&S®ADD070 mounted below an R&S®ADD153SR	**R&S®ADD070** **UHF DF antenna** stationary and transportable	Frequency range from 1.3 GHz to 3 GHz ▷ page 8
	R&S®ADD011P **HF DF antenna** portable	Frequency range from 300 kHz to 30 MHz ▷ page 9
	**R&S®ADD253** **VHF/UHF broadband DF antenna** mobile	Frequency range from 20 MHz to 3 GHz ▷ page 9
	**R&S®ADD216** **compact LF UHF DF antenna** mobile	Frequency range from 300 kHz to 3 GHz ▷ page 10
	R&S®ADD015 **centric mast HF DF antenna** mobile and stationary	Frequency range from 1 MHz to 30 MHz ▷ page 10

R&S®ADD078SR

- Mobile and stationary DF antenna for the frequency range from 1.3 GHz to 6 GHz
- Multi-element DF antenna with two circular antenna arrays arranged on top of each other; each array contains eight elements
- DF measurements up to ITU class A DF accuracy
- Ready for the super-resolution DF method
- Ready for installation of an additional DF antenna on top
- For installation on a mast by means of an R&S®ADD07XZB mast adapter or for use on an R&S®ADD1XTP tripod

R&S®ADD078SR.

R&S®ADD119

- Mobile DF antenna for the frequency range from 300 kHz to 30 MHz
- Suitable for ground waves and low-angle sky waves
- DF measurements up to ITU class A DF accuracy
- For installation on a vehicle roof by means of an R&S®AP502Z1 vehicle adapter or for use on an R&S®ADD1XTP tripod

R&S®ADD119.

R&S®ADD011SR

- Stationary and transportable DF antenna for the frequency range from 300 kHz to 30 MHz
- Suitable for ground waves and sky waves
- Multi-element DF antenna with 9/18 antenna elements
- DF measurements up to ITU class A DF accuracy
- Available in different diameters (50 m, 100 m and 150 m)
- Model with 18 antenna elements in two concentric DF circles for especially high DF sensitivity and accuracy
- Measurement of elevation enabling single station location (SSL) (optional)
- Ready for the super-resolution DF method
- Antenna elements with active/passive switchover for adaptation to the signal environment

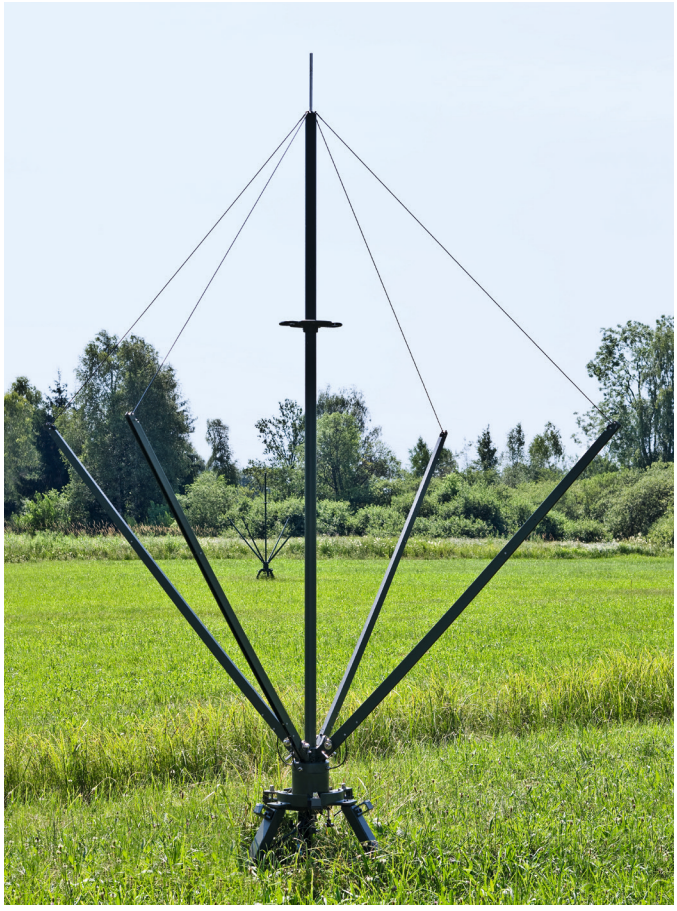
R&S®ADD050SR

- Stationary and transportable DF antenna for the frequency range from 20 MHz to 450 MHz
- Multi-element DF antenna with nine antenna elements
- DF measurements up to ITU class A DF accuracy
- Ready for the super-resolution DF method
- Antenna elements with active/passive switchover for adaptation to the signal environment
- Integrated, extendible lightning protection concept with lightning rod (option); no impact on DF accuracy
- R&S®ADD-LP extended lightning protection (option)
- Installation of an additional DF antenna above the R&S®ADD050SR possible (using the R&S®KM051 intermediate mast and the R&S®ADD150A mast adapter)

R&S®ADD011SRX

- N-channel HF DF antenna for the R&S®DDF1GTX
- Superior DF sensitivity
- Other features: same as R&S®ADD011SR, see above

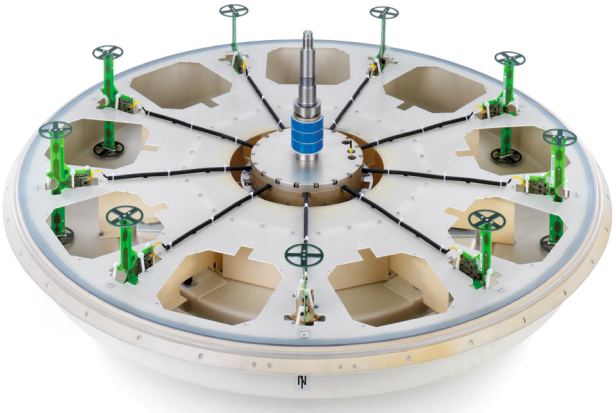
R&S®ADD011SR and R&S®ADD011SRX.



R&S®ADD050SR.

R&S®ADD153SR

- Mobile and stationary DF antenna for the frequency range from 20 MHz to 1.3 GHz
- Multi-element DF antenna with nine antenna elements
- DF measurements up to ITU class A DF accuracy
- Antenna elements with variable electrical length for optimal adaptation to the receive frequency
- Ready for the super-resolution DF method
- Antenna elements with active/passive switchover for adaptation to the signal environment
- Integrated, extendible lightning protection concept with lightning rod; no impact on DF accuracy
- R&S®ADD-LP extended lightning protection (option)
- For installation on a mast by means of an R&S®ADD150A mast adapter, on a vehicle roof by means of an R&S®AP502Z1 vehicle adapter or for use on an R&S®ADD1XTP tripod



R&S®ADD153SR open.

R&S®ADD070

- Stationary and mobile DF antenna for the frequency range from 1.3 GHz to 3 GHz
- Multi-element DF antenna with eight antenna elements
- DF measurements up to ITU class A DF accuracy
- Ready for installation below another DF antenna (model .12, see picture below)
- Protected against overvoltage caused by nearby lightning strikes
- Especially stable version (model .02) available for installing the R&S®ADD050SR and another DF antenna (see picture on page 2)
- For installation on a mast by means of an R&S®ADD071Z mast adapter or for use on an R&S®ADD1XTP tripod

R&S®ADD070 mounted below an R&S®ADD153SR.

R&S®ADD157

- Mobile and stationary DF antenna for the frequency range from 20 MHz to 1.3 GHz (vertical polarization) or from 40 MHz to 1.3 GHz (horizontal polarization)
- Switchable between horizontal and vertical polarization
- Multi-element DF antenna with nine antenna elements each for vertical and horizontal polarization
- DF measurements up to ITU class A DF accuracy
- Antenna elements with variable electrical length for optimal adaptation to the receive frequency (vertical polarization)
- Antenna elements with active/passive switchover for adaptation (vertical and horizontal polarization) to the signal environment
- Integrated, extendable lightning protection concept with lightning rod; no impact on DF accuracy
- R&S®ADD-LP extended lightning protection (option)
- For installation on a mast by means of an R&S®ADD150A mast adapter, on a vehicle roof by means of an R&S®AP502Z1 vehicle adapter or for use on an R&S®ADD1XTP tripod

R&S®ADD157.

R&S®ADD011P

- Portable DF antenna for the frequency range from 300 kHz to 30 MHz
- Lightweight design for easy transportation and installation
- Suitable for ground waves and sky waves
- Multi-element DF antenna with nine antenna elements
- DF measurements up to ITU class A DF accuracy
- Measurement of elevation enabling single station location (SSL) (optional)
- Ready for the super-resolution DF method
- Antenna elements with active/passive switchover for adaption to the signal environment
- R&S®ADD011P-HC handling case set (optional)

R&S®ADD253

- Mobile broadband DF antenna for the frequency range from 20 MHz to 3 GHz
- Multi-element DF antenna with nine antenna elements for the VHF/UHF range and eight antenna elements for the UHF range
- Antenna elements with active/passive switchover for adaptation to the signal environment
- Antenna elements with variable electrical length for optimal adaptation to the receive frequency (20 MHz to 1.3 GHz)
- Integrated, extendible lightning protection concept with lightning rod; no impact on DF accuracy
- R&S®ADD-LP extended lightning protection (option)
- For installation on a mast by means of an R&S®ADD150A mast adapter, on a vehicle roof by means of an R&S®AP502Z1 vehicle adapter or for use on an R&S®ADD1XTP tripod

R&S®ADD253 open.

R&S®ADD216

- Mobile broadband DF antenna for the frequency range from 300 kHz to 3 GHz
- Highly integrated antenna system with unique DF sensitivity and accuracy
- Especially suitable for use on board ships
- Multi-element DF antenna for VHF/UHF (with eight antenna elements each) and additional reference antennas
- Two independent omnidirectional reception antennas for the HF and VHF/UHF ranges already integrated for connecting separate receivers
- Protected against overvoltage caused by nearby lightning strikes

R&S®ADD015

- Mobile and stationary DF antenna for the frequency range from 1 MHz to 30 MHz
- Suitable for ground waves and low-angle sky waves
- Circular array with four dipole antenna elements with integrated ferrite loops
- DF measurements up to ITU class A DF accuracy
- For installation around the mast (centric mast design)
- Variable DF antenna diameter for easy adaption to the mast

R&S®ADD216.

R&S®ADD253 VHF/UHF broadband DF antenna.

Superior immunity to reflections

Due to multipath propagation (especially in metropolitan areas), not only the direct wave but also reflections arrive at the DF antenna. The R&S®ADDx multichannel DF antennas offer (due to their design) a higher immunity to such reflections than most other commercially available antennas, since they feature an exceptionally large number of antenna elements. Virtually all R&S®ADDx DF antennas comprise nine antenna elements for the HF/VHF/UHF range, and eight for the UHF range. Commercially available DF antennas typically have only five. The R&S®ADDx (except the R&S®ADD119) enable stable bearings even with a 50 percent share of reflections. If only five antenna elements are used, however, such conditions may result in substantial DF errors in certain frequency ranges (see shaded area in diagram).

The aperture of a DF antenna (diameter/wavelength) can be considerably enlarged by increasing the number of antenna elements. The distance between two adjacent antenna elements of a DF antenna is defined such that for all wave angles of incidence, at least one pair of elements has a distance that – at the maximum operating frequency – is less than half the wavelength. In wide frequency ranges, commercially available five-element DF antennas therefore have a much smaller aperture than DF antennas with nine elements.

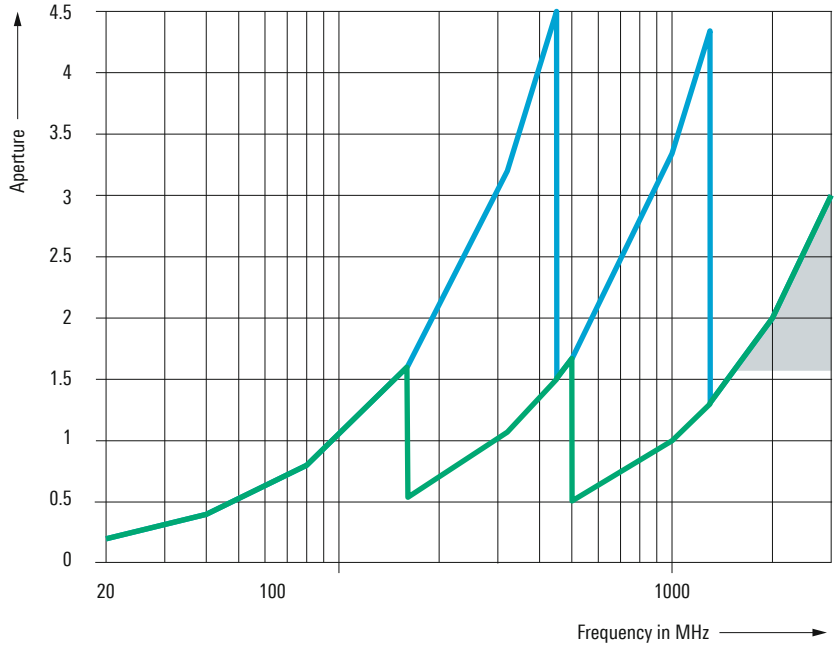
The aperture of a DF antenna largely determines the efficiency of a direction finder. The wider the DF antenna's aperture, the higher the DF accuracy and sensitivity as well as the immunity to reflections (see ITU SMH 2002 chapter 4.7.1.1.3).

This advantage is not apparent from the specifications, since data sheets always specify the instrument and system accuracy for ideal, reflection-free DF antenna environments and strong signals to allow comparisons.

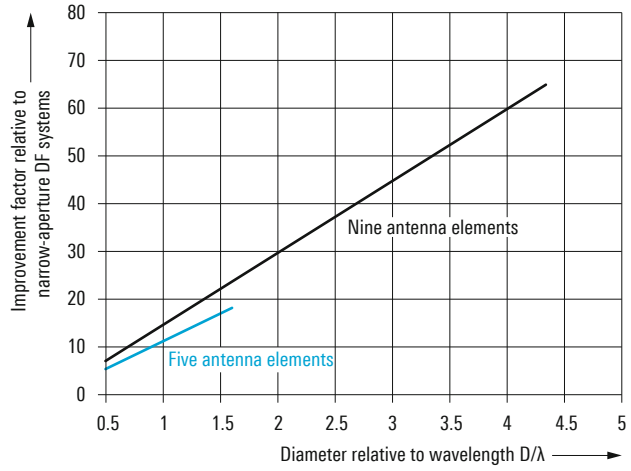
DF antennas featuring nine elements and the correlative interferometer DF method offer by far the widest aperture and therefore higher accuracy and sensitivity (see figure at top of next page). As a result, they have a considerably greater improvement factor (relative to small-base DF antennas) than DF antennas with only five elements (see figure at center of next page).

The considerably higher immunity to reflections of DF antennas with nine elements (compared with five-element DF antennas) can be mathematically proven by simulating the DF antennas in a two-wave field (direct wave and reflection). First, the DF values that a DF antenna in a two-

Comparison of aperture of commercially available five-element DF antennas (green) with that of Rohde&Schwarz DF antennas (blue)



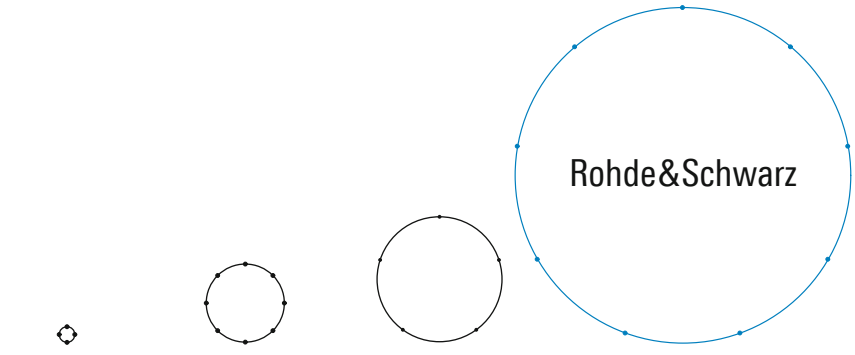
Improvement factor for correlative interferometer



wave field would produce are calculated one after the other, the field strength of the direct wave being twice as high as that of the reflection. Since the DF error depends on the frequency, the angle of incidence and the phase angle of the reflection, all combinations are simulated. Then the RMS value is determined based on the detected individual errors.

As the table below shows, DF antennas with nine elements provide a considerably higher DF accuracy than commercially available five-element DF antennas. It is assumed that the five-element DF antennas exhibit a system DF accuracy of 1° RMS in a reflection-free environment. Since the Rohde&Schwarz DF antennas take bearings in the frequency range above 1.3 GHz using eight elements, an eight-element DF antenna is simulated in this frequency range.

Improvement of DF accuracy as a function of DF antenna aperture



Four elements
Adcock/Watson-Watt
D/λ = 0.2

Eight elements
Adcock/Watson-Watt
D/λ = 1.0

Five elements
Correlative interferometer
D/λ = 1.6

Nine elements
Correlative interferometer
D/λ = 4.3

Maximum permissible diameter of the DF antenna relative to the wavelength for unambiguous DF results for up to 50 % environmental reflections

Average DF error of different DF antennas in two-wave field

	Frequency ranges	DF antenna diameter	DF accuracy in two-wave field (approx.)
Stationary applications			
Rohde&Schwarz DF antennas	20 MHz to 450 MHz	3 m	1.6° RMS
	450 MHz to 1.3 GHz	1 m	1.1° RMS
	1.3 GHz to 3 GHz	0.3 m	2.2° RMS
Commercially available five-element DF antennas	20 MHz to 160 MHz	3 m	4.6° RMS
	160 MHz to 500 MHz	1 m	5.8° RMS
	500 MHz to 3 GHz	0.3 m	10° RMS
Mobile applications			
Rohde&Schwarz DF antennas	20 MHz to 1.3 GHz	1 m	1.7° RMS
	1.3 GHz to 3 GHz	0.3 m	2.2° RMS
Commercially available five-element DF antennas	20 MHz to 500 MHz	1 m	6.1° RMS
	500 MHz to 3 GHz	0.3 m	10° RMS

Ready for the super-resolution DF method

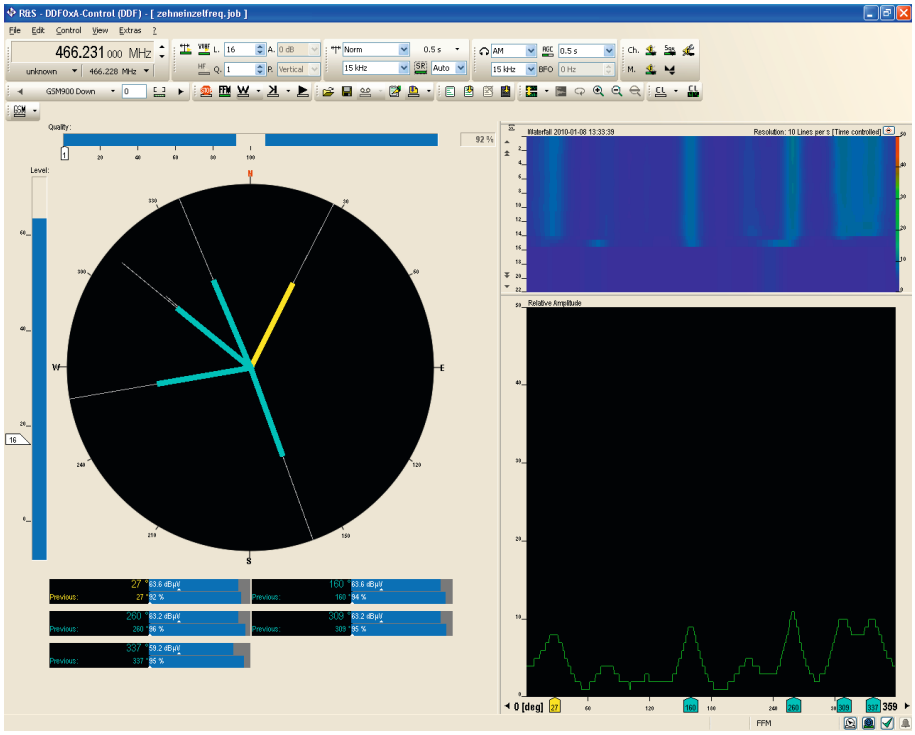
Most radio DF methods are based on the assumption that a specific frequency is occupied exclusively by the transmitter of interest. However, if other transmitters simultaneously occupy the same frequency, direction finding may be impaired. This is referred to as co-channel interference, where the DF result depends on the level ratio of the transmitters. Two variants are possible:

- One of the transmitters is clearly stronger than the others; its direction is displayed with slight DF errors
- The transmitters have similar levels; the DF result is usually incorrect

These results apply equally to all classic DF principles including correlative interferometer, Doppler and Watson-Watt methods.

To allow the bearings of co-channel signals to be taken, Rohde&Schwarz now provides a super-resolution DF method for its R&S®DDF5GTS and R&S®DDF1GTX direction finders. This method is offered as the R&S®DDFx-SR option and supplements the DF methods already available. This new DF method is able to resolve a wave field with multiple signals on the same frequency. The number and angle of incidence of the waves in the field are first calculated precisely and then displayed. This option makes it possible to take separate bearings of up to seven different signals on the same frequency. The number of signals depends on the angle of incidence and the S/N ratio.

An excellent price/performance ratio is attained through optimal use of the multiple receive channels of the R&S®DDF5GTS and R&S®DDF1GTX direction finders. To make this possible, DF antennas whose antenna elements can be combined into various subgroups must be utilized. The new R&S®ADDxxxSR DF antennas meet these requirements.



Exceptionally high DF sensitivity and dynamic range

In order for the DF antenna elements to exhibit good receive characteristics, adaptation to the following stage must be optimized and coupling to the adjacent elements minimized. These requirements can best be met over a wide frequency range by using configurable antenna structures:

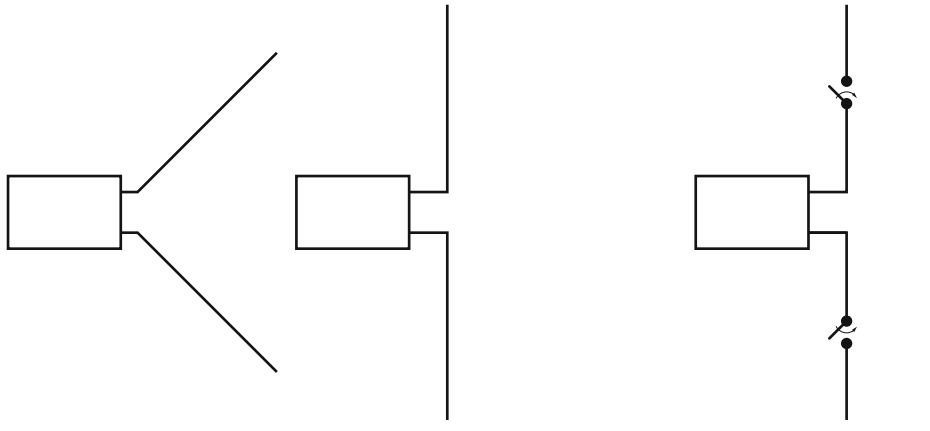
- At low frequencies, configuration of the element for maximum electrical length
- At high frequencies, selection of the most effective antenna length to achieve the best possible compromise between decoupled receive power and impact on the directional pattern due to mutual coupling

Optimal results are achieved using electric switches that connect or disconnect parts of the antenna element (see figure, right).

The antenna elements of the R&S®ADD153SR, R&S®ADD253, R&S®ADD157 and R&S®ADD216 DF antennas are subdivided in the VHF/UHF range by means of PIN diodes and allow the electrically effective structure to change very quickly. As a result, they are always optimally adapted to the receive frequency and offer especially high sensitivity.

Commercially available DF antennas that cover a very wide frequency range with antenna elements of constant length (see figure, left) are usually optimized for the UHF range and are considerably less sensitive in the VHF range than the Rohde&Schwarz models with variable electrical length.

Antenna structures



Antenna elements of constant length

Antenna element of variable electrical length

Active/passive switchover by mouse click

The number of radio services and transmitters is continuously growing, which results in an increasing cumulative load on the antenna input and the receiver input. Especially digital broadcasting services such as DVB-T and DAB with their high bandwidths represent a growing challenge to the linearity of antennas and receivers. The problem may intensify if the DF antenna is in the vicinity of a strong transmitter – which, particularly in metropolitan areas, can hardly be avoided.

If the number of strong signals becomes too high, intermodulation products may become visible in the spectrum. In the worst case, they would mask signals of interest and make it impossible to take bearings.

Most Rohde&Schwarz DF antennas are equipped with active antenna elements, which provide significantly higher sensitivity than passive elements – and also have compact dimensions. Although an extremely linear, active antenna circuitry with top-quality components is used, very strong signals may cause intermodulation.

Passive antennas provide a much higher linearity and therefore generate virtually no intermodulation products; however, they are either less sensitive or considerably larger than active antennas. In applications where only compact antennas can be used, passive DF antennas are substantially less sensitive in the VHF and the lower UHF range than active models.

Up until now, users have had to decide what is more important to them: the higher sensitivity offered by active DF antennas or the immunity to strong signals provided by passive DF antennas.

The R&S®ADD011SR, R&S®ADD011P, R&S®ADD050SR, R&S®ADD253, R&S®ADD153SR and R&S®ADD157 DF antennas for the first time make it possible to bypass the active circuitry of the antenna elements. The user can switch the active elements to passive mode by a simple mouse click. These DF antennas unite the advantages of both methods without their disadvantages.

Integrated, extendible lightning protection

DF antennas for the VHF/UHF range are usually positioned as high as possible in order to achieve wide coverage. The higher a DF antenna is located, the more likely it will be struck by lightning. This applies especially to areas with frequent thunderstorms.

Most installed Rohde&Schwarz DF antennas that are at risk of being struck by lightning after installation feature built-in, efficient lightning protection up to an installation height of 20 m:

- Lightning rod that prevents the lightning from striking the DF antenna from the side
- Massive metal core inside the DF antenna to divert the lightning current to the mast so that the current flows off safely via the ground
- Gas arresters at all critical spots prevent voltage peaks (caused by lightning bolts) from destroying the DF antenna circuitry

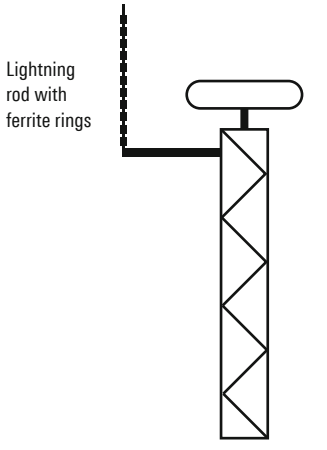
This lightning protection concept was taken into account in development right from the start and does not impair DF accuracy. As a result, the DF accuracy specified in the data sheets is attained even with the lightning rod.

Commercially available DF antennas without integrated lightning protection have a lightning rod that is erected next to the DF antenna, which leads to considerable DF errors (especially in the VHF range). Even if this type of lightning rod is lined with ferrite rings and is positioned two meters away from the DF antenna, the DF accuracy is considerably poorer than specified in the data sheet for a reflection-free environment (see table on page 18). At certain frequencies where the lightning rod is in resonance, considerable DF errors of more than 20° can occur. It is not possible to predict precisely how high the DF errors will be.

If the spacing between the DF antenna and the lightning rod next to it is less than two meters, or if the rod is not thoroughly ferritized, the DF errors to be expected are even significantly higher.

The additional DF errors due to the separate lightning rod can be slightly reduced by calibration. This calibration, however, is very complicated and can correct only some of the DF errors. But even after calibration, additional DF errors in the VHF range can occur at any time.

Lightning protection for antennas



DF antenna without integrated lightning protection

R&S®ADD157 with integrated lightning protection

R&S®ADD157 with R&S®ADD-LP.

For the R&S®ADD050SR, R&S®ADD153SR, R&S®ADD253 and R&S®ADD157 DF antennas, the R&S®ADD-LP extended lightning protection is optionally available. It is recommended for installation heights of more than 20 m above ground (e.g. masts > 20 m, tall buildings, mountaintops). The picture shows the R&S®ADD-LP extended lightning protection, which consists of two crossed lightning rods that protrude laterally beyond the DF antenna and therefore provide an especially high level of protection against lightning striking from the side.

Comparison of specifications of DF antennas with and without lightning protection

	DF antenna without integrated lightning protection [1]	**Rohde&Schwarz DF antennas with integrated lightning protection** [2]
Average DF accuracy according to data sheet (reflection-free environment)	1° RMS	1° RMS
Average DF accuracy with lightning protection, 20 MHz to 200 MHz	5° RMS	1° RMS
Average DF accuracy with lightning protection, > 200 MHz	2° RMS	1° RMS
Additional DF error due to lightning protection	depending on frequency, up to 20°	no additional DF error

[1] Measurement with separate lightning rod, lined with ferrite rings, two meters away from antenna.
[2] Example data for R&S®ADD050SR.

Easy replacement of DF antennas

Unlike commercially available antennas, Rohde&Schwarz DF antennas do not need to be individually calibrated. Owing to precise production, the R&S®ADDx DF antennas behave exactly as foreseen in theory. They provide the high DF accuracy specified in the data sheet without subsequent correction by means of individual calibration.

When developing antennas, Rohde&Schwarz strives to avoid individual calibration. This is ensured by the following:

- High decoupling of obstacles (e.g. cables)
- High common-mode rejection
- Minimal mutual coupling between antenna elements

If, for example, a Rohde&Schwarz DF antenna is irreparably damaged after being struck by lightning, it can be replaced with the same model without having to manage new calibration data and store it in the direction finder.

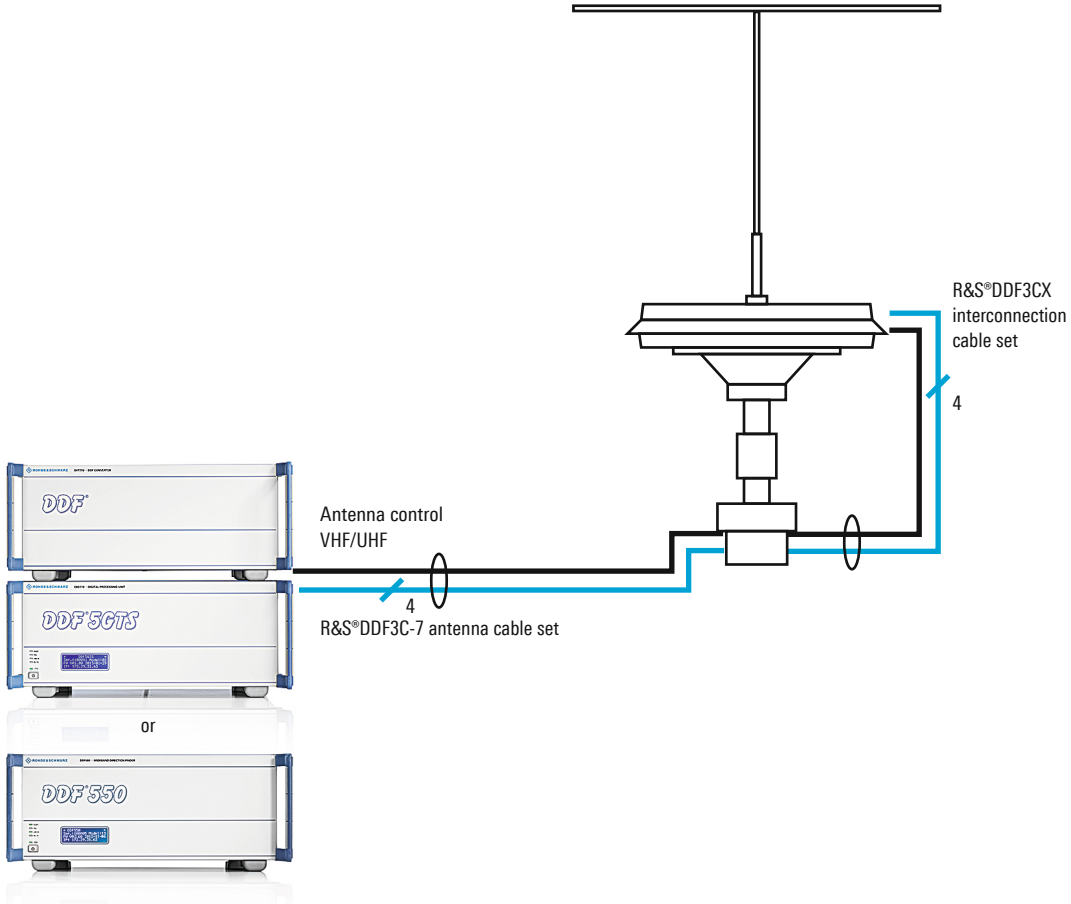
System configuration

Stationary DF from 20 MHz to 6 GHz

R&S®DDF550/DDF5GTS with R&S®ADD078SR and R&S®ADD153SR/157

Description	Type	Order No.
Super-Resolution VHF/UHF DF Antenna or Dual Polarized VHF/UHF DF Antenna	R&S®ADD153SR or R&S®ADD157 (select one only)	4071.6007.12 4069.4800.22
Super-Resolution UHF/SHF DF Antenna	R&S®ADD078SR	4098.4005.02
Accessories		
Mast Adapter for compact DF antennas; color: light ivory	R&S®ADD150A	4041.2655.02
Antenna Mast Adapter for R&S®ADD078SR, top	R&S®ADD07XZT	4069.7200.02
Antenna Mast Adapter for R&S®ADD078SR, bottom	R&S®ADD07XZB	4069.7300.02
Power Supply	R&S®IN061	4041.9508.02
Extended Lightning Protection	R&S®ADD-LP	4069.6010.02
Interconnection Cable Set	R&S®DDF3CX	4098.4763.10
Antenna Cable Set	R&S®DDF3C-7	4098.4757.xx (length: 5/10/20/30 m)

R&S®DDF550/DDF5GTS with R&S®ADD078SR and R&S®ADD153SR/157



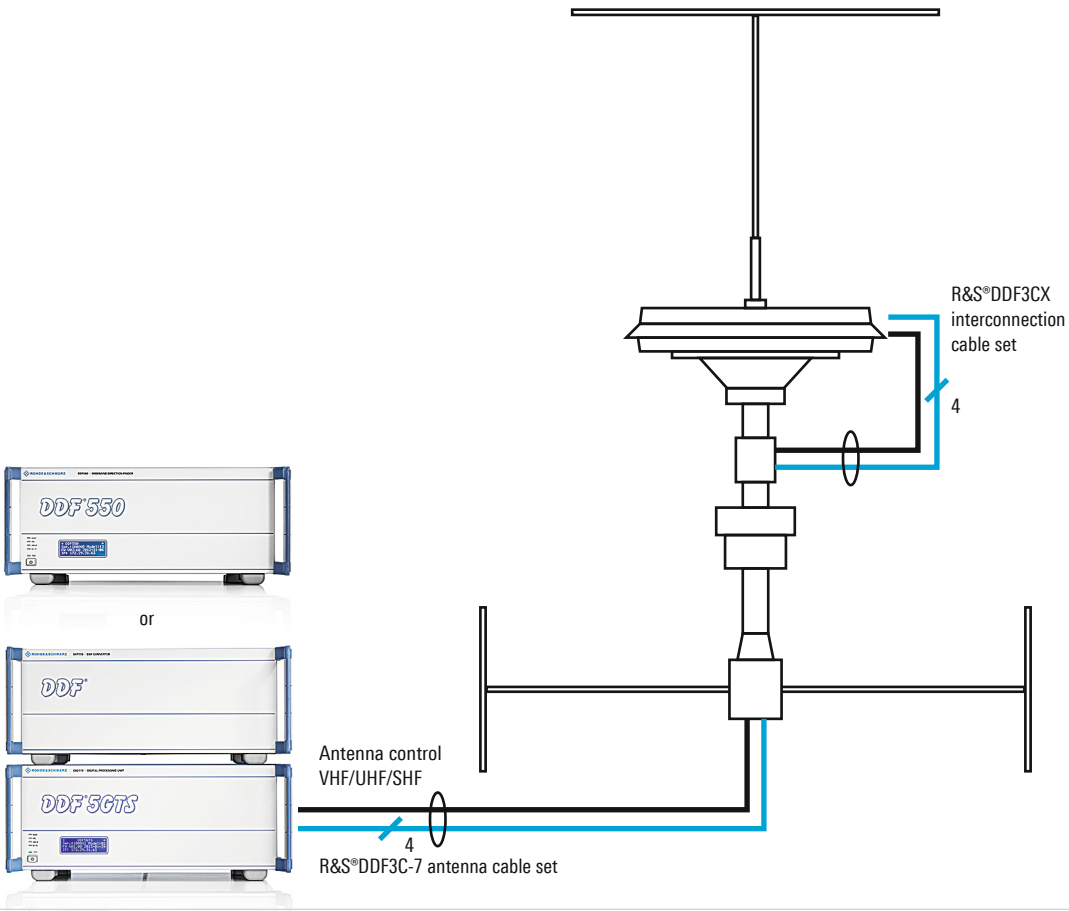
Note: Depending on the cable length, the R&S®IN061 power supply is required (included in the DF antenna cable set). The R&S®IN061 includes a 10 m control cable.
A power cable is required for the R&S®IN061 (not part of the delivery).

Stationary DF from 20 MHz to 6 GHz

R&S®DDF550/DDF5GTS with R&S®ADD050SR, R&S®ADD078SR and R&S®ADD153SR/157

Description	Type	Order No.
Super-Resolution VHF/UHF DF Antenna or Dual Polarized VHF/UHF DF Antenna	R&S®ADD153SR or R&S®ADD157 (select one only)	4071.6007.12 4069.4800.22
Super-Resolution UHF/SHF DF Antenna	R&S®ADD078SR	4098.4005.02
Super-Resolution VHF DF Antenna	R&S®ADD050SR	4071.7003.12
Accessories		
Mast Adapter for compact DF antennas; color: light ivory	R&S®ADD150A	4041.2655.02
Intermediate Mast	R&S®KM051	4041.9008.02
Antenna Mast Adapter for R&S®ADD078SR, top	R&S®ADD07XZT	4069.7200.02
Antenna Mast Adapter for R&S®ADD078SR, bottom	R&S®ADD07XZB	4069.7300.02
Power Supply	R&S®IN061	4041.9508.02
Extended Lightning Protection	R&S®ADD-LP	4069.6010.02
Interconnection Cable Set	R&S®DDF3CX	4098.4763.10
Antenna Cable Set	R&S®DDF3C-7	4098.4757.xx (length: 5/10/20/30 m)

R&S®DDF550/DDF5GTS with R&S®ADD050SR, R&S®ADD078SR and R&S®ADD153SR/157



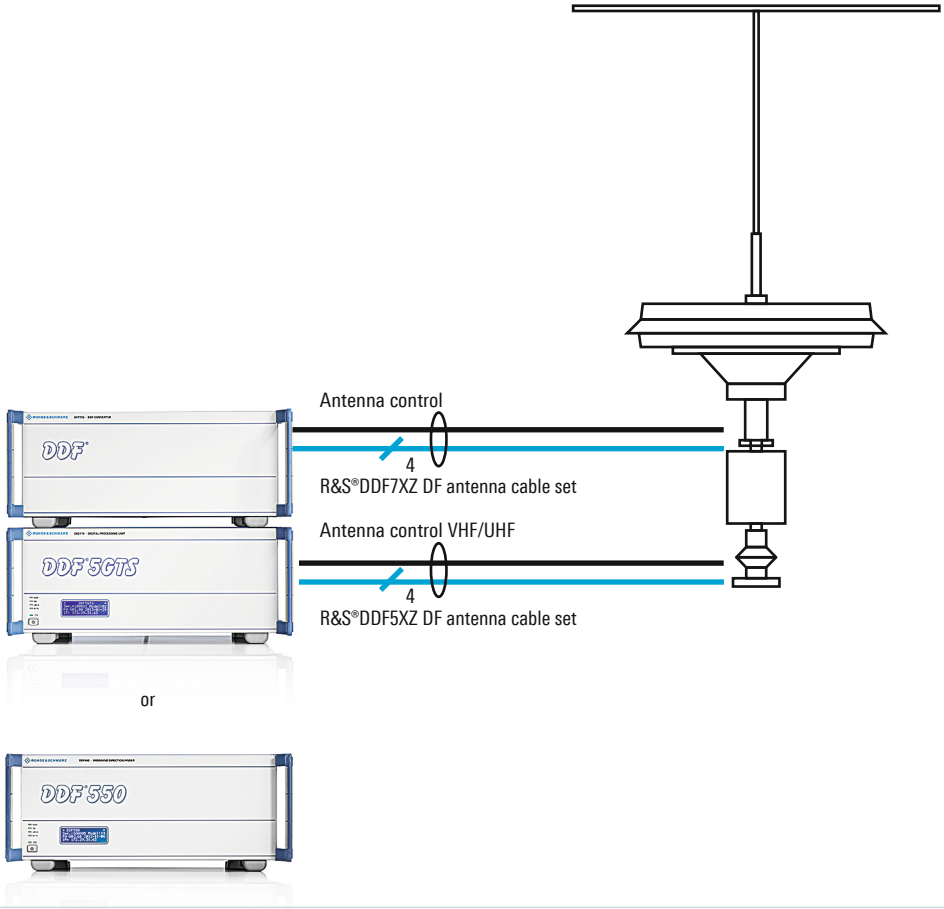
Note: The R&S®IN061 includes a 10 m control cable. A power cable is required for the R&S®IN061 (not part of the delivery).

Stationary DF from 20 MHz to 3 GHz

R&S®DDF550/DDF5GTS with R&S®ADD070 and R&S®ADD153SR/157

Description	Type	Order No.
Super-Resolution VHF/UHF DF Antenna or Dual Polarized VHF/UHF DF Antenna	R&S®ADD153SR or R&S®ADD157 (select one only)	4071.6007.12 4069.4800.22
UHF DF Antenna	R&S®ADD070	4043.4003.12
Accessories		
Mast Adapter for compact DF antennas; color: light ivory	R&S®ADD150A	4041.2655.02
Antenna Adapter for R&S®ADD070, without cable inlet/ flange, top	R&S®ADD071Z	4043.7002.03
Antenna Adapter for R&S®ADD070, with cable outlet, bottom	R&S®ADD071Z	4043.7002.02
Power Supply	R&S®IN061	4041.9508.02
Extended Lightning Protection	R&S®ADD-LP	4069.6010.02
DF Antenna Cable Set	R&S®DDF5XZ	4064.6728.xx (length: 5/10/20/50/80/100 m)
DF Antenna Cable Set	R&S®DDF7XZ	4064.8043.xx (length: 5/10/20/50/80/100 m)

R&S®DDF550/DDF5GTS with R&S®ADD070 and R&S®ADD153SR/157



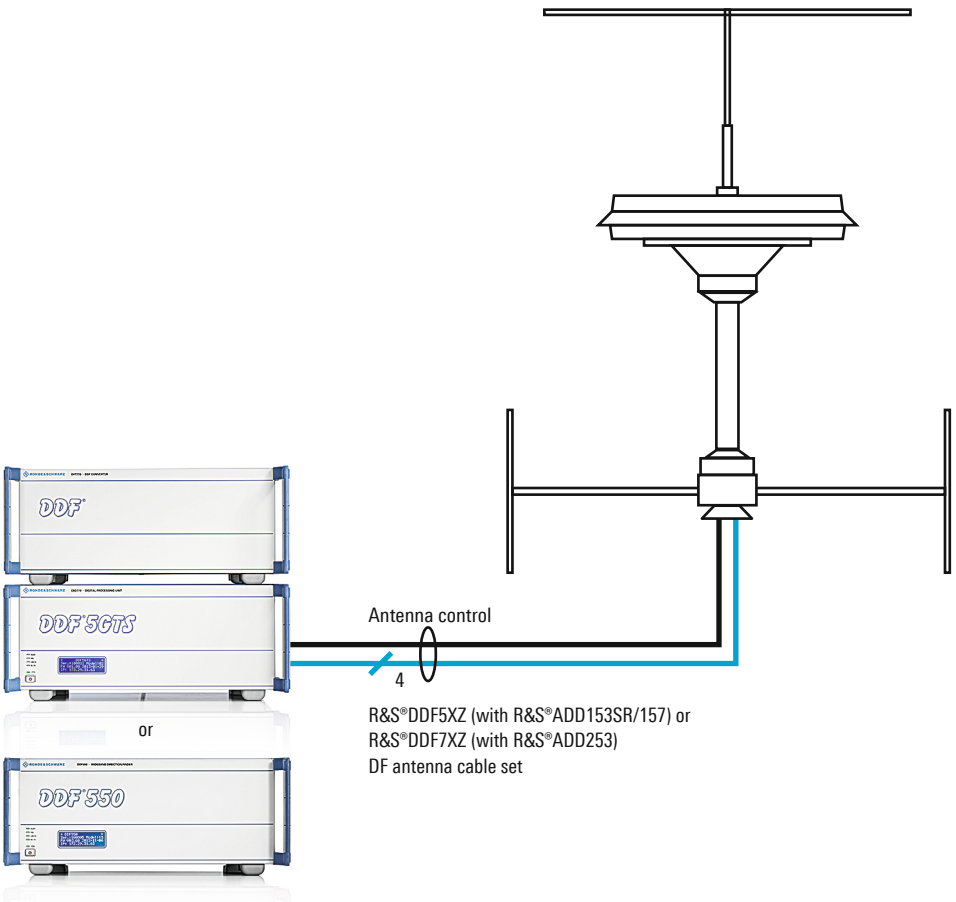
Note: Depending on the cable length, the R&S®IN061 power supply is required (included in the DF antenna cable set). The R&S®IN061 includes a 10 m control cable.
A power cable is required for the R&S®IN061 (not part of the delivery).

Stationary DF from 20 MHz to 1.3 GHz (with R&S®ADD15x) or 3 GHz (with R&S®ADD253)

R&S®DDF550/DDF5GTS with R&S®ADD050SR and R&S®ADD153SR/157/253

Description	Type	Order No.
Super-Resolution VHF/UHF DF Antenna or Dual Polarized VHF/UHF DF Antenna or VHF/UHF Broadband DF Antenna	R&S®ADD153SR or R&S®ADD157 or R&S®ADD253 (select one only)	4071.6007.12 4069.4800.22 4071.4004.02
Super-Resolution VHF DF Antenna	R&S®ADD050SR	4071.7003.12
Accessories		
Mast Adapter for compact DF antennas; color: light ivory	R&S®ADD150A	4041.2655.02
Intermediate Mast	R&S®KM051	4041.9008.02
Power Supply	R&S®IN061	4041.9508.02
Extended Lightning Protection	R&S®ADD-LP	4069.6010.02
DF Antenna Cable Set	R&S®DDF5XZ	4064.6728.xx (length: 5/10/20/50/80/100 m)
DF Antenna Cable Set	R&S®DDF7XZ	4064.8043.xx (length: 5/10/20/50/80/100 m)

R&S®DDF550/DDF5GTS with R&S®ADD050SR and R&S®ADD153SR/157/253



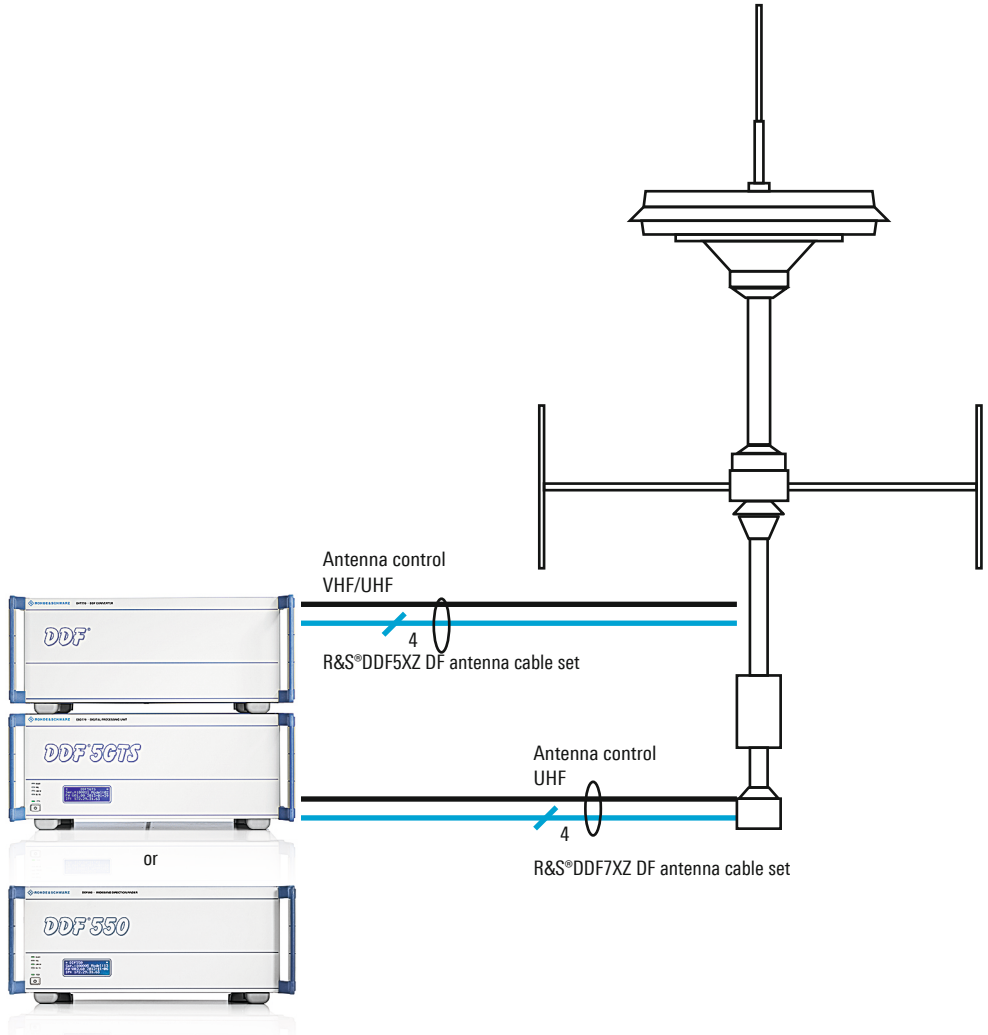
Note: Depending on the cable length, the R&S®IN061 power supply is required (included in the DF antenna cable set). The R&S®IN061 includes a 10 m control cable. A power cable is required for the R&S®IN061 (not part of the delivery).

Stationary DF from 20 MHz to 3 GHz

R&S®DDF550/DDF5GTS with R&S®ADD070, R&S®ADD050SR and R&S®ADD15x

Description	Type	Order No.
Super-Resolution VHF/UHF DF Antenna or Dual Polarized VHF/UHF DF Antenna	R&S®ADD153SR or R&S®ADD157 (select one only)	4071.6007.12 4069.4800.22
UHF DF Antenna	R&S®ADD070	4043.4003.02
Super-Resolution VHF DF Antenna	R&S®ADD050SR	4071.7003.12
Accessories		
Mast Adapter for compact DF antennas; color: light ivory	R&S®ADD150A	4041.2655.02
Intermediate Mast	R&S®KM051	4041.9008.02
Power Supply	R&S®IN061	4041.9508.02
Extended Lightning Protection	R&S®ADD-LP	4069.6010.02
DF Antenna Cable Set	R&S®DDF7XZ	4064.8043.xx (length: 5/10/20/50/80/100 m)
DF Antenna Cable Set	R&S®DDF5XZ	4064.6728.xx (length: 5/10/20/50/80/100 m)

R&S®DDF550/DDF5GTS with R&S®ADD070, R&S®ADD050SR and R&S®ADD15x



Note: Depending on the cable length, the R&S®IN061 power supply is required (included in the DF antenna cable set). The R&S®IN061 includes a 10 m control cable.
A power cable is required for the R&S®IN061 (not part of the delivery).

Stationary DF from 20 MHz to 450 MHz

R&S®DDF550/DDF5GTS with R&S®ADD050SR and R&S®ADD-LR

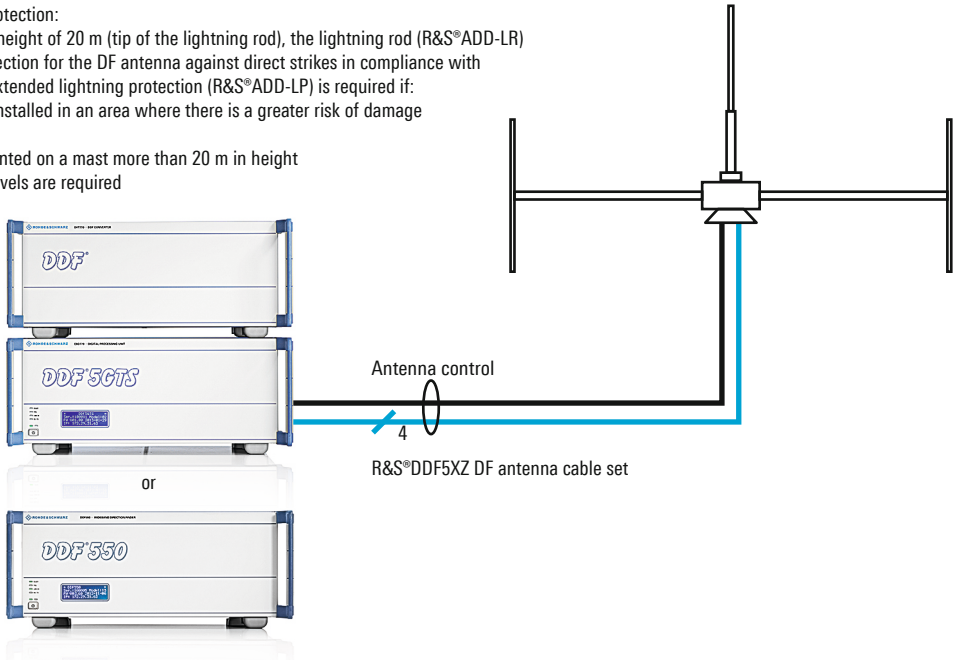
Description	Type	Order No.
Super-Resolution VHF DF Antenna	R&S®ADD050SR	4071.7003.12
Accessories		
Power Supply	R&S®IN061	4041.9508.02
Lightning Protection Lightning Rod or Extended Lightning Protection	 R&S®ADD-LR R&S®ADD-LP	 4109.0800.02 4069.6010.02
DF Antenna Cable Set	R&S®DDF5XZ	4064.6728.xx (length: 5/10/20/50/80/100 m)

R&S®DDF550/DDF5GTS with R&S®ADD050SR and R&S®ADD-LR

Note regarding lightning protection:

Up to an installation height of 20 m (tip of the lightning rod), the lightning rod (R&S®ADD-LR) provides normal protection for the DF antenna against direct strikes in compliance with German standards. Extended lightning protection (R&S®ADD-LP) is required if:

- the DF antenna is installed in an area where there is a greater risk of damage due to lightning
- the antenna is mounted on a mast more than 20 m in height
- higher protection levels are required



Note: As of 25 cm cable length, the R&S®IN061 power supply is required (included in the 80 m and 100 m DF antenna cable sets). The R&S®IN061 includes a 10 m control cable. A power cable is required for the R&S®IN061 (not part of the delivery).

Stationary/shipboard DF from 300 kHz to 3 GHz

R&S®DDF550/DDF5GTS with R&S®ADD216

Description	Type	Order No.
Compact LF UHF DF Antenna	R&S®ADD216	4068.3000.02
Accessories		
DF Antenna Cable Set	R&S®DDF7XZ	4064.6728.xx (length: 5/10/20/30/40/50 m)
Power Supply	R&S®IN061	4041.9508.02
HF Dipole	R&S®HP016	4068.3500.xx (model .0x: active; model .1x: passive)

For cable length ≥ 30 m, the R&S®IN061 power supply is required. For shipboard applications, the R&S®HP016 may be required in addition.

Mobile/stationary DF from 20 MHz to 3 GHz

R&S®DDF550/DDF5GTS with R&S®ADD253 on mast, vehicle roof or tripod

Description	Type	Order No.
VHF/UHF Broadband DF Antenna	R&S®ADD253	4071.4004.12
Accessories		
DF Antenna Cable Set	R&S®DDF7XZ	4064.8043.xx (length: 5/10/20/50/80/100 m)
Power Supply (required for cable length ≥ 40 m)	R&S®IN061	4041.9508.02
Mast Adapter for compact DF antennas; color: light ivory	R&S®ADD150A	4041.2655.02
Extended Lightning Protection	R&S®ADD-LP	4069.6010.02
Vehicle Adapter	R&S®AP502Z1	0515.1419.02
Tripod with Adapter	R&S®ADD1XTP	4063.4409.02
Electronic Compass	R&S®GH150	4041.8501.02

Mobile/stationary DF from 20 MHz to 1.3 GHz

R&S®DDF550/DDF5GTS with R&S®ADD153SR/157 on mast, vehicle roof or tripod

Description	Type	Order No.
Super-Resolution VHF/UHF DF Antenna	R&S®ADD153SR	4071.6007.12
Dual Polarized VHF/UHF DF Antenna	R&S®ADD157	4069.4800.22
Accessories		
DF Antenna Cable Set	R&S®DDF5XZ	4064.6728.xx (length: 5/10/20/50/80/100 m)
Power Supply (required for cable length ≥ 50 m)	R&S®IN061	4041.9508.02
Mast Adapter for compact DF antennas; color: light ivory	R&S®ADD150A	4041.2655.02
Extended Lightning Protection	R&S®ADD-LP	4069.6010.02
Vehicle Adapter	R&S®AP502Z1	0515.1419.02
Tripod with Adapter	R&S®ADD1XTP	4063.4409.02
Electronic Compass	R&S®GH150	4041.8501.02

Mobile/stationary DF from 300 kHz to 30 MHz

R&S®DDF550/DDF5GTS with R&S®ADD119 on vehicle roof or tripod

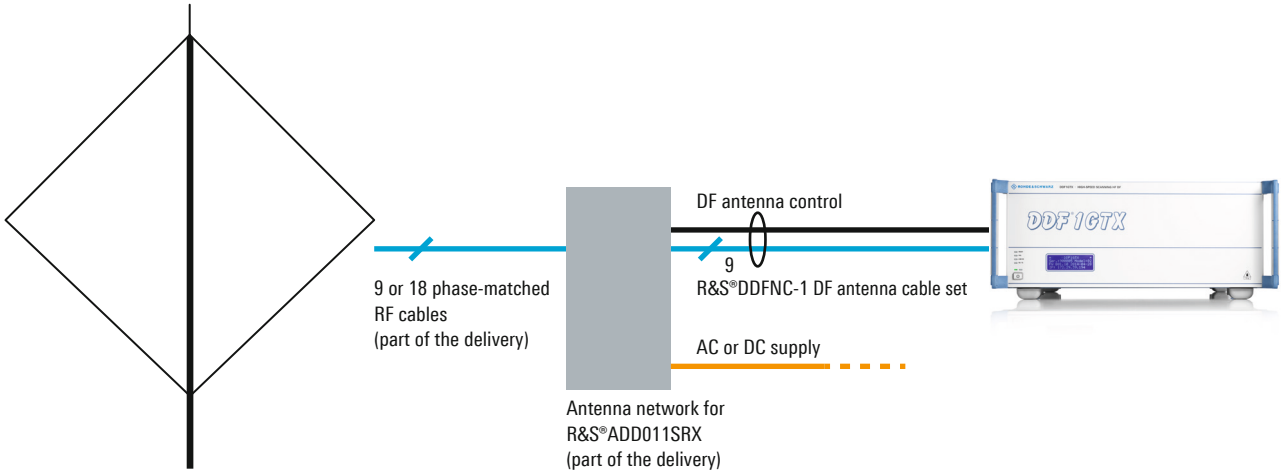
Description	Type	Order No.
HF DF Antenna, mobile	R&S®ADD119	4053.6509.02
Accessories		
DF Antenna Cable Set	R&S®DDF1XZ	4064.6286.xx (length: 5/30/100/150 m)
Power Supply (required for cable length ≥ 80 m)	R&S®IN061	4041.9508.02
Vehicle Adapter	R&S®AP502Z1	0515.1419.02
Tripod with Adapter	R&S®ADD1XTP	4063.4409.02
Electronic Compass	R&S®GH150	4041.8501.02

The installation height of the R&S®ADD119 must not exceed 2 m above ground.

Stationary HF DF from 300 kHz to 30 MHz

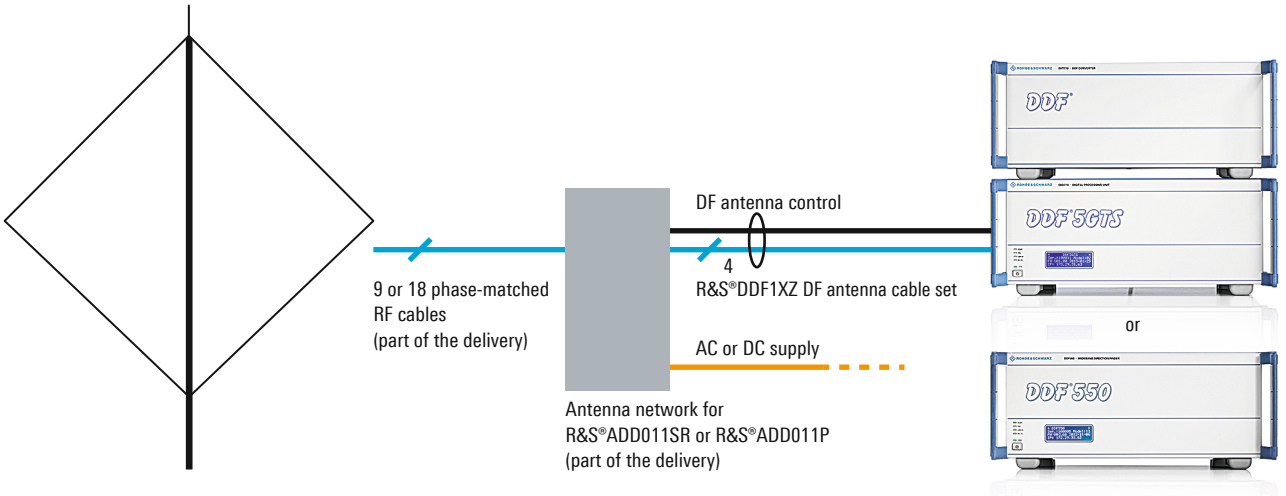
R&S®DDF1GTX with R&S®ADD011SRX		
Description	**Type**	**Order No.**
N-channel HF DF Antenna, Ø 50 m	R&S®ADD011SRX	4200.5000.2x
N-channel HF DF Antenna, Ø 100 m	R&S®ADD011SRX	4200.5000.0x
N-channel HF DF Antenna, Ø 50 m and 150 m	R&S®ADD011SRX	4200.5000.1x
Accessories		
N-channel DF antenna cable set	R&S®DDFNC-1	4101.4006.xx (length: 2/5/30/250 m)
R&S®DDF550/DDF5GTS with R&S®ADD011SR		
Description	**Type**	**Order No.**
Super-Resolution HF DF Antenna, Ø 50 m (1 antenna array)	R&S®ADD011SR	4078.0004.2x
Super-Resolution HF DF Antenna, Ø 100 m (1 antenna array)	R&S®ADD011SR	4078.0004.0x
Super-Resolution HF DF Antenna, Ø 50 m and 150 m (2 antenna arrays)	R&S®ADD011SR	4078.0004.1x
Accessories		
DF Antenna Cable Set	R&S®DDF1XZ	4064.6286.xx (length: 5/30/100/150/250 m)
R&S®DDF550/DDF5GTS with R&S®ADD011P		
Description	**Type**	**Order No.**
Portable HF DF Antenna	R&S®ADD011P	4099.2006.05
Accessories		
DF Antenna Cable Set	R&S®DDF1XZ	4064.6286.xx (length: 5/30/100/150/250 m)
Handling Case for R&S®ADD011P	R&S®ADD011P-HC	4099.2870.02

R&S®DDF1GTX with R&S®ADD011SRX



Note: A power cable is required to supply the antenna network. The R&S®IN061 power supply is not required.

R&S®DDF550/DDF5GTS with R&S®ADD011SR or R&S®ADD011P



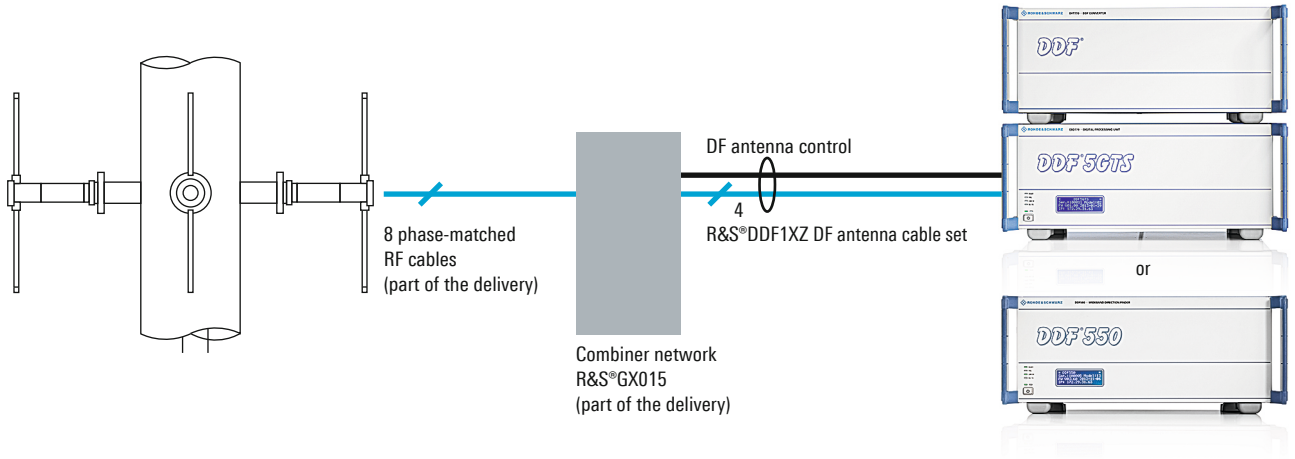
Note: A power cable is required to supply the antenna network. The R&S®IN061 power supply is not required.

Mobile HF DF from 1 MHz to 30 MHz

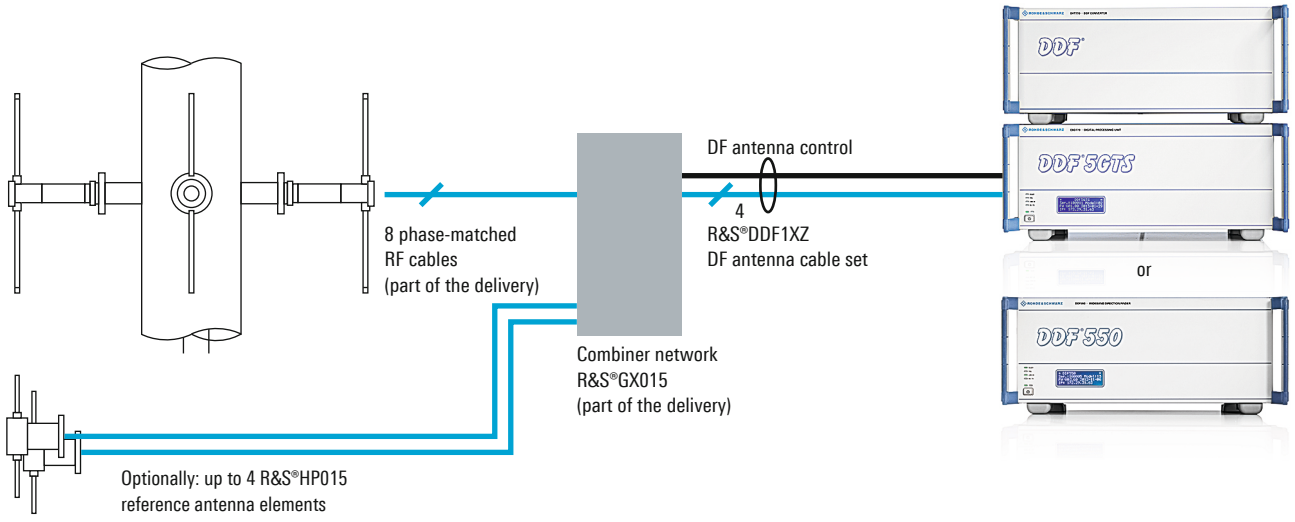
R&S®DDF550/DDF5GTS with R&S®ADD015

Description	Type	Order No.
Centric Mast HF DF Antenna, cable length: 8 m (EF400)	R&S®ADD015	4200.7002.04
Centric Mast HF DF Antenna, cable length: 5 m (RG214)	R&S®ADD015	4200.7002.54
Centric Mast HF DF Antenna, cable length: 8 m (RG214)	R&S®ADD015	4200.7002.84
Reference Antenna Element (optional)	R&S®HP015	4200.7902.02
Accessories		
DF Antenna Cable Set	R&S®DDF1XZ	4064.6286.xx (length: 5/30/100/150/250 m)

R&S®DDF550/DDF5GTS with R&S®ADD015



R&S®DDF550/DDF5GTS with R&S®ADD015 (optionally with R&S®HP015)



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Rohde&Schwarz GmbH&Co. KG
www.rohde-schwarz.com

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Regional contact

- Europe, Africa, Middle East | +49 89 4129 12345
  customersupport@rohde-schwarz.com
- North America | 1 888 TEST RSA (1 888 837 87 72)
  customer.support@rsa.rohde-schwarz.com
- Latin America | +1 410 910 79 88
  customersupport.la@rohde-schwarz.com
- Asia Pacific | +65 65 13 04 88
  customersupport.asia@rohde-schwarz.com
- China | +86 800 810 82 28 | +86 400 650 58 96
  customersupport.china@rohde-schwarz.com

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R&S®ADDx Multichannel DF Antennas

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