R&S®DDF007
Locating radio transmitters
Application brochure

ROHDE&SCHWARZ

Radiomonitoring & Radiolocation
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R&S®DDF007 Locating radio transmitters

Contents

The compact DF system based on the R&S®DDF007 portable direction finder offers functional diversity and performance previously not found in a system of this size. It can be used as a fixed or mobile DF station, or as a portable manual direction finder for indoor applications, and can be reconfigured within minutes to meet the requirements of a given task. The R&S®DDF007 comes with a wide range of powerful software options and add-ons, making it an excellent choice for all applications that call for a compact and flexible yet powerful DF system.

Locating radio interference sources

Your requirements

Faulty, poorly shielded or incorrectly set electronic devices can unintentionally emit electromagnetic waves and degrade or even disrupt radiocommunications. Consequently, it is necessary to quickly locate the building, or the specific room within a building, from which the radio interference originates. Unfortunately, the buildings of interest are often to be found in densely built-up areas.

Monitoring solution

If radio interference occurs continuously or frequently, using a mobile direction finder is the quickest way to locate the interference source. Within minutes, the compact DF system based on the R&S®DDF007 portable direction finder can turn a normal vehicle into a DF vehicle covering the frequency range from 20 MHz to 6 GHz. This vehicle makes it possible to find the right building in a timely manner. In addition, during the drive, the R&S®Mobile Locator software (included in R&S®RA-LOC) automatically locates the source of interference with a high degree of accuracy.

To identify individual rooms within the building, the portable R&S®HE300 active directional antenna is connected to the R&S®DDF007 instead of the DF antenna.

The integrated wideband receiver in the R&S®DDF007 makes it possible to scan the spectrum at high speed and identify, analyze and record any signal of interest.

The DF system's above-average DF accuracy (compared with conventional solutions available on the market) provides good DF results – especially in the UHF/SHF range, and even in densely built-up areas.

Application

Depending on the RFI frequency, either the R&S®ADD107 or R&S®ADD207 compact DF antenna is equipped with an R&S®ADD17XZ3 vehicle adapter with magnetic mount. Then the R&S®ADD17XZ5 cable set is connected, and the DF antenna is mounted centrally on the vehicle roof. Thanks to its large magnetic surface and ability to adapt to slightly curved vehicle roofs, the adapter has been approved for speeds of up to 130 km/h.

When mounting the DF antenna, the arrow on the top of the antenna radome has to point toward the vehicle's heading. This ensures that the direction finder points to the front when the transmitter of interest is located in front, because the bearings are always referenced to the direction of this arrow.

For added safety, the DF antenna is also secured with a steel wire, which can be attached, for example, to a handle inside the vehicle. The DF antenna cable set is routed into the vehicle through a slightly opened window and is connected to the R&S®DDF007 (see photo at bottom of page 3). If necessary, the direction finder can be supplied with power from the cigarette lighter via the R&S®HA-Z202 vehicle adapter.

Since the vehicle body has a strong influence on DF accuracy, especially in the VHF range, it is necessary to select the appropriate correction set in the R&S®DDF007 graphical user interface (see recommended settings). The different correction sets that can be selected include the environment-dependent omniphase values for the Watson-Watt DF method.

Recommended settings for the R&S®DDF007

- Frequency: center frequency of interfering signal
- Step mode: manual
- Step (similar to DF bandwidth): similar to bandwidth of interfering signal
  - A step of 25 kHz usually leads to good results
  - Not recommended: using a step < 8.33 kHz
- Selectivity: default
- DF squelch (averaging mode): NORM
  - The “off” setting is recommended for weak signals near the noise floor (regardless of the level threshold)
- DF squelch level: depends on signal environment
- DF quality squelch: 0%
- DF measurement time (integration time): 1 s
  - Recommended time when close to the transmitter: 500 ms
  - Recommended time when using the R&S®Mobile Locator software (page 6): 100 ms
- DF antenna reference (compass): GPS direction
- Magnetic declination: automatic via GPS
- Correction set: car roof

Homing in on a transmitter

As soon as the direction finder has been set and points in the direction of the radio interference, homing in on the transmitter can begin. The driver steers the vehicle in the direction of the bearing, keeping an eye on the receive level. For safety reasons, Rohde & Schwarz recommends that a passenger monitor the DF results and inform the driver about the route to take.

In the vicinity of the transmitter, the receive level rises significantly and varies considerably. If the mobile direction finder moves past the transmitter, the DF beam follows the transmitter and changes its direction very quickly. This clearly indicates that the transmitter location has been found.

To identify individual rooms within the building, the portable R&S®HE300 active directional antenna is connected to the R&S®DDF007 instead of the DF antenna.

As a rule, the DF quality indicates how reliable the DF results are. In densely built-up areas, however, the direction finder receives so many reflections that – due to the compact DF antennas used here – the DF quality no longer necessarily correlates with the DF accuracy. Consequently, bearings of low quality might be more accurate than bearings of high quality. For this reason, the DF quality threshold should be set to 0 % when using the R&S®DDF007 in urban environments.

When taking bearings in densely built-up areas, the mobile direction finder must constantly be in motion, because tall buildings both reflect and shadow signals. If the mobile direction finder comes to a standstill in an environment of this kind, or if the vehicle is parked, the bearings generally become unreliable. Only measurements taken from multiple positions will yield good DF results.

Map display

Homing in on a transmitter becomes easier when the DF vehicle's current position is displayed continuously on a map using a DF beam. The R&S®DDF007-GPS option makes it possible to display DF and location results on OpenStreetMap (OSM) maps on the R&S®DDF007. These maps can be downloaded from the Internet free of charge using the R&S®OpenStreetMapWizard (OSMWizard) software (included with the R&S®DDF007). The maps can be stored on the SD card of the R&S®DDF007 to make them available for field use. The R&S®DDF007 compares its current GPS position with the available map data and automatically selects the appropriate map.

To ensure that the bearings displayed on a map are referenced to north, it is necessary to continuously measure the vehicle's current orientation relative to north and take it into account in the bearings. The directional information from the GPS data is used for this purpose. It is calculated from the information on the locations that have been passed through and is very precise. These calculations can only be performed if the DF vehicle is moving.

The electronic (magnetic) compass integrated into the DF antenna is not used, because the vehicle adapter's magnetic mount greatly falsifies the compass results.

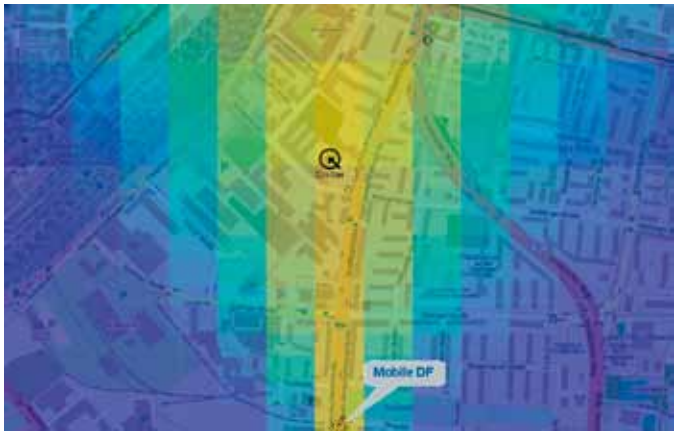
OpenStreetMap (OSM)

OpenStreetMap (OSM) is a user-editable world map that is available at the following Internet address:
http://www.openstreetmap.org/

OSM is a wiki project in which users can participate by uploading and editing geographical information such as GPS tracking data or the course of a road or river. This world map is growing daily.

OpenStreetMap data can be used freely under the terms of the Creative Commons Attribution-ShareAlike 2.0 license.

R&S®Mobile Locator, first result.



R&S®Mobile Locator, second result.

R&S®Mobile Locator, third result.

R&S®Mobile Locator, radiolocation result.

Automatic location using the R&S®Mobile Locator software

In urban environments, reflections are unavoidable. As a result, the direction finder does not always point steadily in the direction of the transmitter, but often in other directions. Extending the averaging time brings no advantage, because incorporating incorrect bearings into the averaging would significantly deteriorate the overall results. Instead, Rohde&Schwarz recommends observing the bearings to determine the direction finder's primary direction. Bearings that erratically indicate completely different directions should be ignored.

Algorithms that separate the correct bearings from the wrong ones can solve this problem. For example: A bearing can be considered to be 100-percent wrong if it indicates a completely different direction than multiple bearings that were taken earlier. The location of the transmitter cannot abruptly change to such an extent. Simple averaging of the bearings is also insufficient (see above). The new R&S®Mobile Locator software, which is part of the R&S®RA-LOC radiolocation software module, uses intelligent averaging to continuously calculate the primary DF direction. It merges multiple results from different positions to provide a single location result (running fix). R&S®Mobile Locator makes it possible for the first time to automatically locate a transmitter by moving the DF vehicle. This does not require special skills or experience on the part of the operator.

The screenshots show how the R&S®Mobile Locator software uses a multitude of bearings to calculate a radiolocation result step by step and displays this result on a map using the R&S®MapView geographic information software. For every location within a definable area, the software continuously calculates the probability of the transmitter being at that location. This probability is then indicated in different colors. If a sufficiently high number of individual results is available, R&S®Mobile Locator calculates the transmitter's location (red circle in bottom screenshot).

In the example, the transmitter's location (black circle) is determined in just a few minutes to an accuracy of 30 m after driving past it just once. The yellow circle indicates the DF vehicle.

When R&S®Mobile Locator is used for radiolocation, the integration time must be set to 100 ms. The more bearings are taken per integration period, the faster the radiolocation result becomes available.

To run the R&S®Mobile Locator software, Rohde&Schwarz recommends using a PC with the following performance data (minimum requirements):

- Windows 7, 64 bit
- Powerful multicore processor (e.g. Intel Core i5)
- 4 Gbyte DDR3 SDRAM
- OpenGL graphics card (e.g. NVIDIA Quadro NVS or FX series)
- Ethernet interface

Notes on using the R&S®Mobile Locator software

- Set the DF measurement time (integration time) to the lowest possible value; 100 ms for the R&S®DDF007
- Drive around the area of interest (in contrast to manual homing); in built-up areas, select multilane main roads whenever possible; if necessary, use a bypass if the transmitter is located in a small city or town
- Set the DF squelch (level threshold) so that bearings are only taken for signals that are above the threshold (bearings on weak signals reduce radiolocation accuracy)
- In areas with particularly strong reflections: close the R&S®Mobile Locator software and then reopen it (deletes previous bearings and results that could influence the radiolocation result)
- Settings on the R&S®DDF007: The signal level is indicated by the pitch of an adjustable beep to inform operators that they are approaching the target; the signal is output via headphones (using an appropriately equipped car radio and commercially available cables)

Locating a transmitter at close range

To identify individual rooms within buildings, the portable R&S®HE300 active directional antenna is connected to the R&S®DDF007 (instead of the DF antenna). The operator switches the R&S®DDF007 to receive mode and observes the signal level. The operator rotates the antenna around its axis in order to manually locate the signal source. Due to its radiation pattern, the R&S®HE300 receives a significantly stronger signal when it is pointed in the transmitter's direction.

Ordering information

Designation	Type	Order No.
Portable Direction Finder	R&S®DDF007	4090.5019.02
R&S®DF7-CTL control software included (requires R&S®DDF007-RC remote control option)		
GPS Software Interface/Map Display	R&S®DDF007-GPS	4090.5083.02
Remote Control	R&S®DDF007-RC	4090.5048.02
Vehicle Adapter for Power Supply	R&S®HA-Z202	1309.6117.00
Compact VHF/UHF DF Antenna	R&S®ADD107	4090.7005.02
Compact UHF/SHF DF Antenna	R&S®ADD207	4096.0002.02
Vehicle Adapter with Magnetic Mount	R&S®ADD17XZ3	4090.8801.02
Cable Set with Converter, 5 m	R&S®ADD17XZ5	4090.8660.02
Active Directional Antenna, including mechanical compass	R&S®HE300	4067.5900.02
Active Directional Antenna, including electronic compass	R&S®HE300	4067.5900.03
Basic R&S®RAMON Module, depending on license	R&S®RA-BASIC	3020.9490.02
Radiolocation Module with R&S®Mobile Locator Software	R&S®RA-LOC	3020.8941.02
Geographic Information Software, maps not included, depending on license	R&S®MapView	4046.1205.02

Locating short-duration radio interference

R&S®DDF007 with an R&S®ADD107 DF antenna on a wooden tripod, mounted on a roof.

Your requirements

Short-duration radio interference can disturb other radio services. When that happens, the building (or room within the building) containing the radio interference source must be located quickly. Unfortunately, these buildings are often in densely built-up areas. It is not possible to use a DF vehicle to locate short-duration radio interference, because the transmissions are not long enough for homing.

Monitoring solution

Short-duration radio interference can be located using two, preferably three, compact DF stations based on the R&S®DDF007. The compact DF antennas are mounted on lightweight wooden tripods and installed temporarily at exposed sites, for example on the roofs of tall buildings. The direction finder uses automatic or manual triangulation to locate a signal source.

To identify individual rooms within the building, the portable R&S®HE300 active directional antenna is connected to the R&S®DDF007 instead of the DF antenna.

The integrated wideband receiver in the R&S®DDF007 makes it possible to scan the spectrum and identify, analyze and record the signal of interest.

The DF system's above-average DF accuracy (compared with conventional solutions available on the market) provides good DF results – especially in the UHF/SHF range, and even in densely built-up areas.

Application

Since the propagation of radio waves in the VHF/UHF/SHF range between buildings is worse than in areas without buildings or in open terrain, the DF antennas should be installed at a level that is higher than the surrounding buildings, e.g. on hills or the roofs of tall buildings. Locating the interference source requires at least two DF stations at different sites.

A DF station based on the R&S®DDF007 can be carried and set up by a single person:

- Set up the R&S®ADD17XZ6 wooden tripod
- Connect the R&S®ADD17XZ5 cable set to the selected DF antenna [1)]
- Fasten the R&S®ADD107 or R&S®ADD207 compact DF antenna to the tripod with four bolts (antenna selection depends on frequency range of interest)
- Connect the cable set to the R&S®DDF007

[1)] Note: When using the R&S®ADD107 on the wooden tripod, the three supplied split ferrites must be attached at the spots marked white on the DF antenna cable set.

Due to the lithium-ion battery pack built into the R&S®DDF007, the DF station does not require an external power supply. If the operating time in DF mode exceeds two hours, it can be extended using additional battery packs.

The electronic (magnetic) compass integrated into the DF antenna makes it possible to measure bearings referenced to north without having to align the DF antenna. The declination – which depends on the DF antenna's position – is either taken into account automatically via the GPS module or entered manually. The integrated GPS compass is not used, because the DF antenna is stationary.

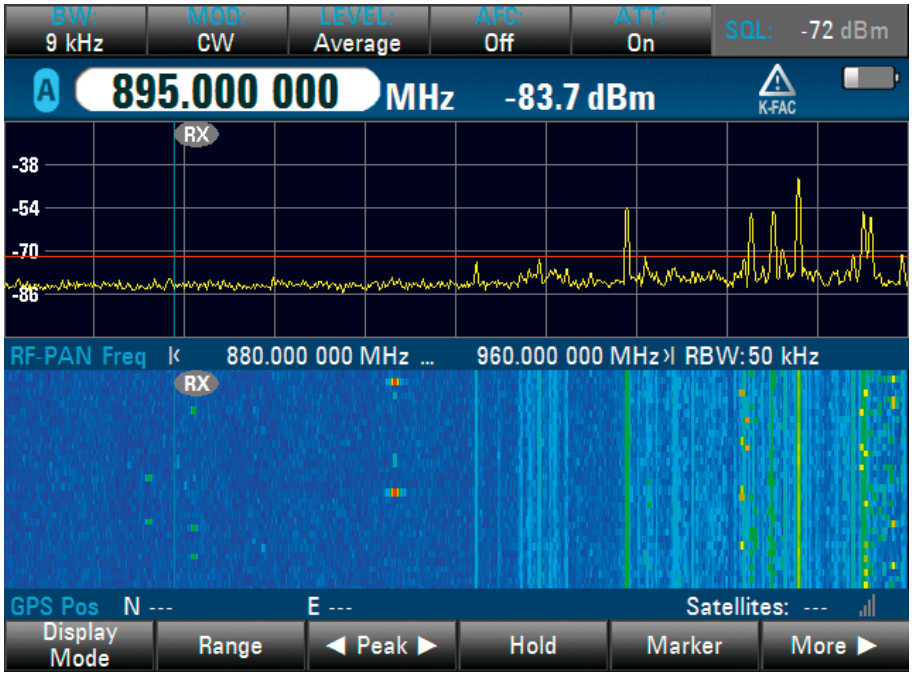
Especially in the VHF range, the environment surrounding the DF antenna has a strong influence on DF accuracy. For this reason, it is important to select the appropriate correction set (tripod) in the R&S®DDF007 user interface.

Analyzing the interfering signal

The radio interference's exact frequency is often not known and must first be identified. The R&S®DDF007 is set to receive mode and the frequency range is scanned using the R&S®DDF007-PS panorama scan option. The high scan speed makes it possible to reliably detect even short-duration radio interference and to store and display it in the spectrum using the max. hold function.

For more precise analysis, the operator marks the interfering signal in the spectrum and switches the R&S®DDF007 to fixed frequency mode (FFM). The center frequency can be measured precisely after the displayed bandwidth has

R&S®DDF007 in panorama scan mode.



been reduced and the resolution increased. The waterfall display shows the interfering signal's behavior versus time and makes it possible to measure the transmit duration.

Recommended settings for the R&S®DDF007

- Frequency: center frequency of interfering signal
- Step mode: manual
- Step (similar to DF bandwidth): similar to bandwidth of interfering signal
  - A step of 25 kHz usually leads to good results
  - Not recommended: using a step < 8.33 kHz
- Selectivity: default
- DF squelch (averaging mode): NORM
  - The "off" setting is recommended for weak signals near the noise floor (regardless of the level threshold)
- DF squelch level: depends on signal environment
- DF quality squelch: 70 %
- DF measurement time (integration time): 1 s
- DF antenna reference (compass): compass heading
- Magnetic declination: automatic via GPS
- Correction set: tripod

Manual location

A bearing is calculated and displayed as soon as an interfering signal occurs. However, it is not possible to locate the interfering transmitter until two or more bearings from different DF sites are available. For this reason, the bearings from all DF sites involved are collected (via mobile phone, for example) at one DF site, where they are stored in the R&S®DDF007 together with the GPS coordinates. The R&S®DDF007-GPS option makes it possible to display all DF and site data in OpenStreetMap (OSM) maps. The triangulation function allows location of the interfering transmitter.

Automatic location using a DF network

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Locating the building of interest

Triangulation makes it possible to locate the interfering transmitter to an accuracy of a few hundred meters. In densely built-up areas, however, it is difficult to precisely find the building where the interfering transmitter is. To unambiguously identify the building of interest at close range, any vehicle can be turned into a mobile direction finder in just a few steps (page 3).

Locating a transmitter at close range

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OpenStreetMap (OSM)

OpenStreetMap (OSM) is a user-editable world map that is available at the following Internet address:
http://www.openstreetmap.org/

OSM is a wiki project in which users can participate by uploading and editing geographical information such as GPS tracking data or the course of a road or river. This world map is growing daily.

OpenStreetMap data can be used freely under the terms of the Creative Commons Attribution-ShareAlike 2.0 license.

R&S®DDF007 with map display and triangulation.

Ordering information

Designation	Type	Order No.
Portable Direction Finder	R&S®DDF007	4090.5019.02
GPS Software Interface/Map Display	R&S®DDF007-GPS	4090.5083.02
Panorama Scan	R&S®DDF007-PS	4090.5025.02
Compact VHF/UHF DF Antenna	R&S®ADD107	4090.7005.02
Compact UHF/SHF DF Antenna	R&S®ADD207	4096.0002.02
Cable Set with Converter, 5 m	R&S®ADD17XZ5	4090.8660.02
Wooden Tripod	R&S®ADD17XZ6	4090.8860.02
Active Directional Antenna, including mechanical compass	R&S®HE300	4067.5900.02
Active Directional Antenna, including electronic compass	R&S®HE300	4067.5900.03

Locating public mobile radios

Your requirements

Public mobile radios, which are hardly any larger than mobile phones, are widely used today since they are readily available and can be operated without a license. They are frequently used for mobile applications; their emissions typically last only a few seconds. The frequency channel on which the public mobile radios are communicating is often not known. Location results can be significantly affected by DF errors, depending on the distance between the direction finder and the transmitter. High DF accuracy is therefore mandatory. This makes it difficult to reliably locate a signal source, especially in built-up areas.

Monitoring solution

Public mobile radios are located using two or (ideally) three DF stations based on the R&S®DDF007 portable direction finder. The compact DF antennas are mounted on lightweight tripods and installed temporarily at exposed sites (for example on the roof of tall buildings). All DF stations are interconnected via PCs and radio links (e.g. GSM or UMTS) to form a DF network. One PC locates the target radio, using automatic triangulation, and displays the result on a map. The DF network can also be remotely controlled.

For close-range identification, the portable R&S®HE300 active directional antenna is connected to the R&S®DDF007 instead of the DF antenna.

The integrated wideband receiver in the R&S®DDF007 makes it possible to scan the spectrum and identify, analyze and record the signal of interest.

The DF system's above-average DF accuracy (compared with conventional solutions available on the market) provides good DF results and high location accuracy – especially in the UHF/SHF range.

Application

In the public mobile radios' frequency range (usually around 450 MHz), the propagation of radio waves between buildings is worse than in areas without buildings or in open terrain. Therefore, the DF antennas should be installed at a level that is higher than the surrounding buildings, e.g. on hills or the roofs of tall buildings. Locating the public mobile radio requires at least two DF stations at different sites.

A DF station based on the R&S®DDF007 can be carried and set up by a single person (see photo on page 9):

- Set up the R&S®ADD17XZ6 wooden tripod
- Connect the R&S®ADD17XZ5 cable set to the selected DF antenna [1)]
- Fasten the R&S®ADD107 or R&S®ADD207 compact DF antenna to the tripod with four bolts (antenna selection depends on frequency range of interest)
- Connect the cable set to the R&S®DDF007

[1)] Note: When using the R&S®ADD107 on the wooden tripod, the three supplied split ferrites must be attached at the spots marked white on the DF antenna cable set

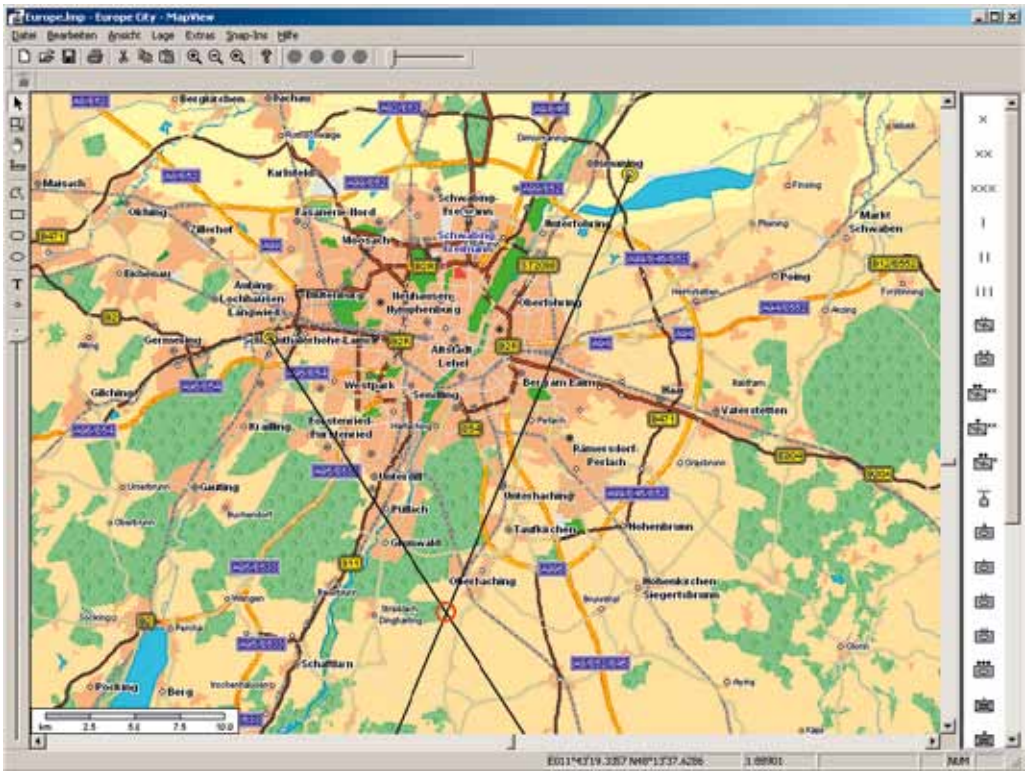
Due to the lithium-ion battery pack built into the R&S®DDF007, the DF station does not require an external power supply. If the operating time in DF mode exceeds two hours, it can be extended using additional battery packs.

The electronic (magnetic) compass integrated into the DF antenna makes it possible to measure bearings referenced to north without having to align the DF antenna. The declination – which depends on the DF antenna's position – is either taken into account automatically via the GPS module or entered manually. The integrated GPS compass is not used, because the DF antenna is stationary.

Automatic location using a DF network

Users of public mobile radios change their positions frequently and quickly, which makes radiolocation difficult. Manual location is possible, but is often too slow. The solution to this problem is to use a DF network with at least two DF stations interconnected via a data link. One of these DF stations is the master station, where the radiolocation result is calculated and displayed. This makes it possible to obtain a radiolocation result within just a few seconds (depending on the data link).

R&S®MapView display of location result obtained using two DF stations.



The required system software can be configured from components of the R&S®ARGUS or R&S®RAMON software family to take special customer requirements into consideration. An R&S®RAMON based system solution requires installation of at least the following R&S®RAMON software modules on the DF station's PC:

- R&S®RA-BASIC
- R&S®DF7-CTL for controlling the R&S®DDF007
- R&S®RA-RC for remote control of the DF stations
- R&S®RA-LOC for calculating the radiolocation results and for connecting detached DF stations via data links with low transmission bandwidth (< 19 kbit/s)
- R&S®MapView for displaying maps [2)]
- Electronic maps, if needed [2)]

Depending on the system requirements and the type of data link, additional hardware components and R&S®RAMON modules as well as a routed IP-based data link (e.g. GSM or UMTS) may be needed.

[2)] Only required at the master station.

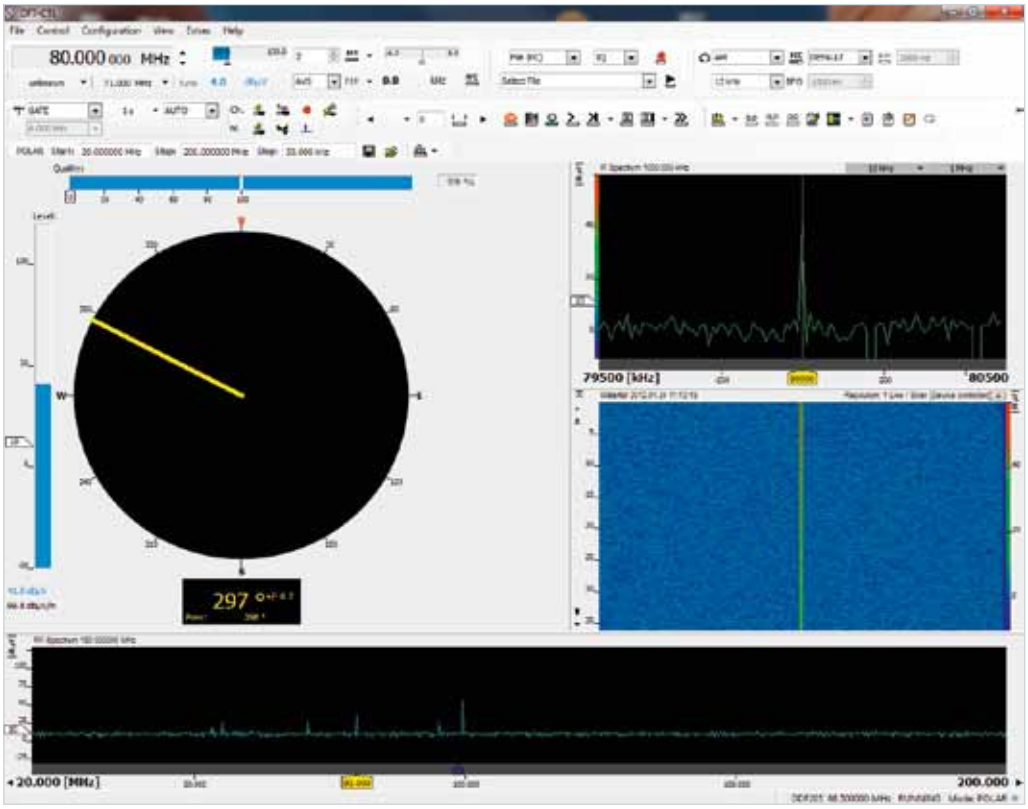
The entire DF network can also be remotely controlled. An additional PC/laptop on which at least the following R&S®RAMON software modules are installed becomes the master PC:

- R&S®RA-BASIC
- R&S®RA-RC for remote control of the DF stations
- R&S®RA-LOC for calculating the radiolocation results and for connecting detached DF stations via data links with low transmission bandwidth (< 19 kbit/s)
- R&S®MapView for displaying maps
- Electronic maps, if needed

For the application described here, Rohde & Schwarz recommends PCs with at least the following performance data:

- Windows 7, 64 bit
- Powerful multicore processor (e.g. Intel Core i5)
- 4 Gbyte DDR3 SDRAM
- OpenGL graphics card (e.g. NVIDIA Quadro NVS or FX series)
- Ethernet interface

R&S®DF7-CTL control software.



Selecting sites for the DF stations
The radiolocation accuracy achieved by two DF stations depends largely on the sites of the DF stations relative to the transmitter: The flatter the angle at which the two DF beams intersect, the poorer the radiolocation accuracy at that site. The transmitter of interest can best be located in the blue areas; the radiolocation accuracy is lower in the red areas (see figure below).

Settings in the R&S®DF7-CTL GUI for controlling the R&S®DDF007
- Frequency: center frequency of voice channel
- Resolution (similar to DF bandwidth): similar to voice channel bandwidth
- Selectivity: default
- DF mode (averaging mode): NORM
  - The "CONT" setting is recommended for weak signals near the noise floor (regardless of the level threshold)
- Level threshold: depends on signal environment
- Quality (DF quality threshold): 70 %
- Averaging time (integration time): 1 s
- DF antenna configuration (compass): antenna compass
  - Configuration, DF antenna configuration
- Declination mode: GPS
  - Configuration, compass configuration
- Correction set: tripod

Manual location
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Locating a transmitter at close range
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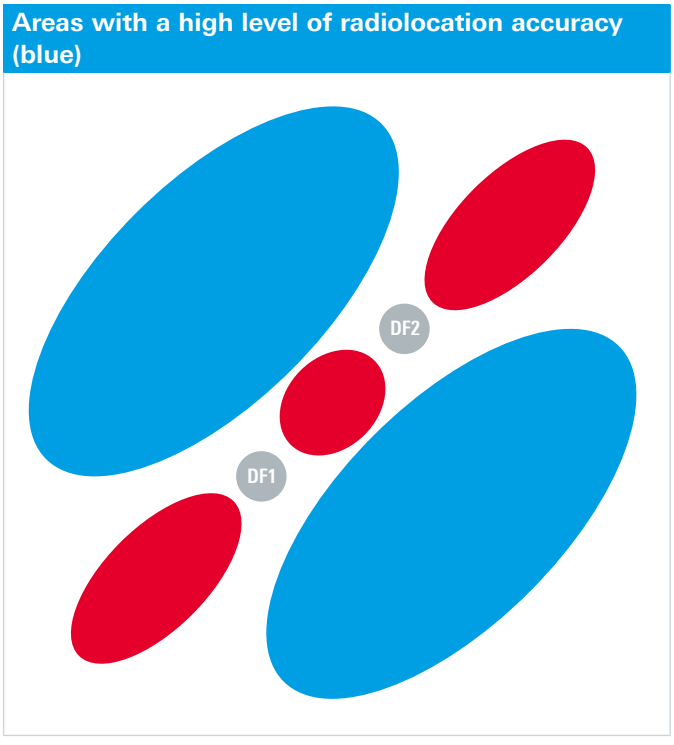
Areas with a high level of radiolocation accuracy (blue)



Ordering information

Designation	Type	Order No.
Portable Direction Finder	R&S®DDF007	4090.5019.02
R&S®DF7-CTL control software included (requires R&S®DDF007-RC remote control option)		
Remote Control	R&S®DDF007-RC	4090.5048.02
Compact VHF/UHF DF Antenna	R&S®ADD107	4090.7005.02
Compact UHF/SHF DF Antenna	R&S®ADD207	4096.0002.02
Wooden Tripod	R&S®ADD17XZ6	4090.8860.02
Cable Set with Converter, 5 m	R&S®ADD17XZ5	4090.8660.02
Active Directional Antenna, including mechanical compass	R&S®HE300	4067.5900.02
Active Directional Antenna, including electronic compass	R&S®HE300	4067.5900.03
Basic R&S®RAMON Module, depending on license	R&S®RA-BASIC	3020.9490.02
Radiolocation Module with R&S®Mobile Locator Software	R&S®RA-LOC	3020.8941.02
Workstation License for access to detached device controllers connected via LAN/WAN	R&S®RA-RC	3020.9602.02
Geographic Information Software, maps not included, depending on license	R&S®MapView	4046.1205.02
Depending on the system requirements and the type of data connection, additional hardware components and R&S®RAMON modules may be required.		

Locating interference in security-critical areas

Your requirements

Special means are required for analyzing and locating radio interference and other transmitters for the following scenarios:

- In areas where authorities or companies cannot eliminate radio interference or monitor compliance with radiocommunications regulations
- In security-critical areas, such as airports, seaports and military bases
- In areas where certain radio services are not allowed and compliance with this rule must be monitored
- At major events, such as sporting events

These applications call for the temporary installation of a DF system for detecting and locating transmitters and radio interference.

Monitoring solution

In such environments, the DF system based on the R&S®DDF007 comes into its own: It can be deployed and expanded flexibly. Radio interference and other signals are detected, analyzed and located in a timely manner. The compact DF antennas are mounted on a tripod and installed temporarily on the roof of a building for monitoring and taking bearings. The integrated wideband receiver in the R&S®DDF007 makes it possible to scan the spectrum and identify, analyze and record the signal of interest. If necessary, the DF antenna can be mounted on a vehicle roof in just a few easy steps and used to locate transmitters. DF stations can be networked and radiolocation results displayed on a map within seconds (depending on the data link).

For close-range identification, the portable R&S®HE300 active directional antenna is connected to the R&S®DDF007 instead of the DF antenna.

Application

For an overview of the spectrum, either the R&S®ADD107 or the R&S®ADD207 is mounted on an R&S®ADD17XZ6 tripod, installed at an exposed site and connected to the R&S®DDF007 using the R&S®ADD17XZ5 cable set. The panorama scan option allows the spectrum to be scanned at up to 2 GHz/s. The signal of interest is displayed with high resolution and a bandwidth of up to 10 MHz. It is analyzed in the time domain using a waterfall display.

Analyzing signals with R&S®GX430

For in-depth signal analysis, classification and demodulation/decoding in realtime, the R&S®DDF007 is connected to a PC running the R&S®GX430 signal analysis and processing software. In receive mode, the R&S®DDF007 (equipped with the R&S®DDF007-RC remote control option) transfers the I/Q data with a bandwidth of up to 500 kHz to the external PC via its Ethernet interface. The R&S®GX430 software offers numerous tools for signal analysis in realtime.

Recording signals on the R&S®DDF007

The R&S®DDF007-IR internal recording option makes it possible to record various signal characteristics in receive mode and to store them on the SD card in the R&S®DDF007:

- Recording of I/Q data with a bandwidth of up to 500 kHz
- Recording of audio information
- Recording of spectra

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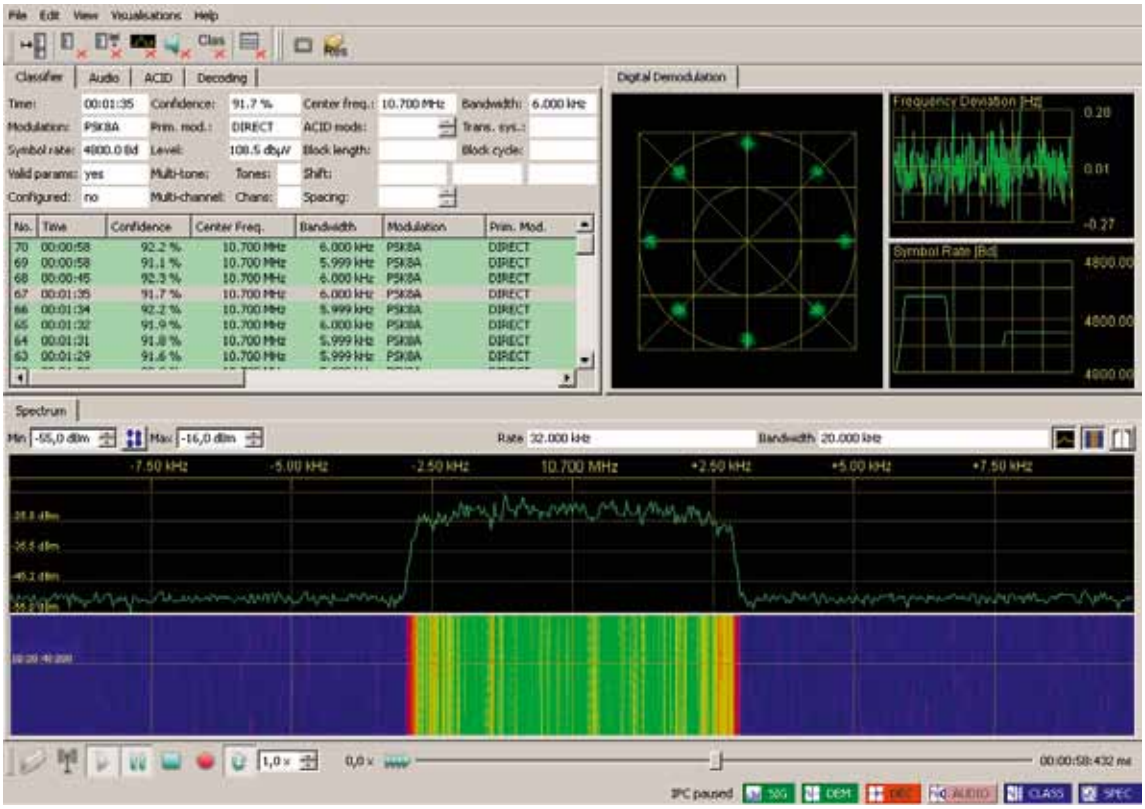
R&S®GX430 PC-based signal analysis software: spectrum, demodulation and classification results.



Ordering information

Designation	Type	Order No.
Portable Direction Finder	R&S®DDF007	4090.5019.02
Panorama Scan	R&S®DDF007-PS	4090.5025.02
Internal Recording	R&S®DDF007-IR	4090.5031.02
Remote Control	R&S®DDF007-RC	4090.5048.02
Compact VHF/UHF DF Antenna	R&S®ADD107	4090.7005.02
Compact UHF/SHF DF Antenna	R&S®ADD207	4096.0002.02
Vehicle Adapter with Magnetic Mount	R&S®ADD17XZ3	4090.8801.02
Cable Set with Converter, 5 m	R&S®ADD17XZ5	4090.8660.02
Wooden Tripod	R&S®ADD17XZ6	4090.8860.02
Active Directional Antenna, including mechanical compass	R&S®HE300	4067.5900.02
Active Directional Antenna, including electronic compass	R&S®HE300	4067.5900.03
PC-Based Signal Analysis and Signal Processing [1)]	R&S®GX430	4071.5500.02

[1)] For more information and options, see the R&S®GX430 product brochure (PD 5213.8321.12) and data sheet (PD 5213.8321.22).

Locating GSM and UMTS mobile phones

Your requirements

It frequently becomes necessary to locate GSM and UMTS mobile phones, for example when people can no longer place a call after becoming victims of an accident or crime. In such cases, the mobile phones must be located within a very short period of time.

Monitoring solution

In cases when the area of interest can be reached by road, the quickest way to locate the mobile phone is to deploy a mobile direction finder. Within minutes, the compact DF system based on the R&S®DDF007 portable direction finder can turn a normal vehicle into a DF vehicle with which the mobile phone of interest can be found in a short period of time. When equipped with the R&S®ADD207 compact UHF/SHF DF antenna, the R&S®DDF007 covers all GSM and UMTS frequency bands. During the drive, the R&S®Mobile Locator software (included in R&S®RA-LOC) automatically locates the mobile phone of interest with a high degree of accuracy.

To identify individual rooms within the building, the portable R&S®HE300 active directional antenna is connected to the R&S®DDF007 instead of the DF antenna.

The DF system's above-average DF accuracy (compared with conventional solutions available on the market) provides good DF results – especially in the UHF/SHF range, and even in densely built-up areas.

Application

To locate the device, the mobile phone of interest is first set to an idle traffic channel that no other mobile phone is using. Then the phone is switched to continuous transmission mode. These two steps are prerequisites for successful radiolocation.

First, the R&S®ADD207 DF antenna is equipped with an R&S®ADD17XZ3 vehicle adapter with magnetic mount. Then, the R&S®ADD17XZ5 cable set is connected, and the DF antenna is mounted centrally on the vehicle roof. Thanks to its large magnetic surface and ability to adapt to slightly curved vehicle roofs, the adapter has been approved for speeds of up to 130 km/h.

When mounting the DF antenna, the arrow on the top of the antenna radome has to point toward the vehicle's heading. This ensures that the direction finder points to the front when the transmitter of interest is located in front, because the bearings are always referenced to the direction of this arrow.

For added safety, the DF antenna is also secured with a steel wire, which can be attached, for example, to a handle inside the vehicle. The DF antenna cable set is routed into the vehicle through a slightly opened window and is connected to the R&S®DDF007 (see photo at bottom of page 3). If necessary, the direction finder can be supplied with power from the cigarette lighter via the R&S®HA-Z202 vehicle adapter.

The burst signals (577 µs) transmitted by the GSM mobile phone of interest can best be located in the GATE mode, which was specially developed for short-duration signals. In this mode, the antenna signals are stored and combined intelligently so that even short-duration signals can be located reliably if they are recurrent.

Recommended settings for the R&S®DDF007

- Frequency: frequency of traffic channel for mobile phone of interest
- Step mode: manual
- Step (similar to DF bandwidth):
  - GSM: 200 kHz
  - UMTS: 1 MHz
- Selectivity: default
- DF squelch (averaging mode):
  - GSM: GATE
  - UMTS: off
- DF squelch level: depends on signal environment
- DF quality squelch: 0%
- DF measurement time (integration time): 1 s to 2 s
  - Recommended time when close to the transmitter: 500 ms
- DF antenna reference (compass): GPS direction
- Magnetic declination: automatic via GPS
- Correction set: car roof

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Ordering information

Designation	Type	Order No.
Portable Direction Finder	R&S®DDF007	4090.5019.02
R&S®DF7-CTL control software included (requires R&S®DDF007-RC remote control option)		
GPS Software Interface/Map Display	R&S®DDF007-GPS	4090.5083.02
Remote Control	R&S®DDF007-RC	4090.5048.02
Vehicle Adapter for Power Supply	R&S® HA-Z202	1309.6117.00
Compact VHF/UHF DF Antenna	R&S®ADD107	4090.7005.02
Compact UHF/SHF DF Antenna	R&S®ADD207	4096.0002.02
Vehicle Adapter with Magnetic Mount	R&S®ADD17XZ3	4090.8801.02
Cable Set with Converter, 5 m	R&S®ADD17XZ5	4090.8660.02
Active Directional Antenna, including mechanical compass	R&S®HE300	4067.5900.02
Active Directional Antenna, including electronic compass	R&S®HE300	4067.5900.03
Basic R&S®RAMON Module, depending on license	R&S®RA-BASIC	3020.9490.02
Radiolocation Module with R&S®Mobile Locator Software	R&S®RA-LOC	3020.8941.02
Geographic Information Software, maps not included, depending on license	R&S®MapView	4046.1205.02

Service you can rely on

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

About Rohde&Schwarz

Rohde&Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established more than 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability

Certified Quality System
ISO 9001

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

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 8228/+86 400 650 5896
  customersupport.china@rohde-schwarz.com

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