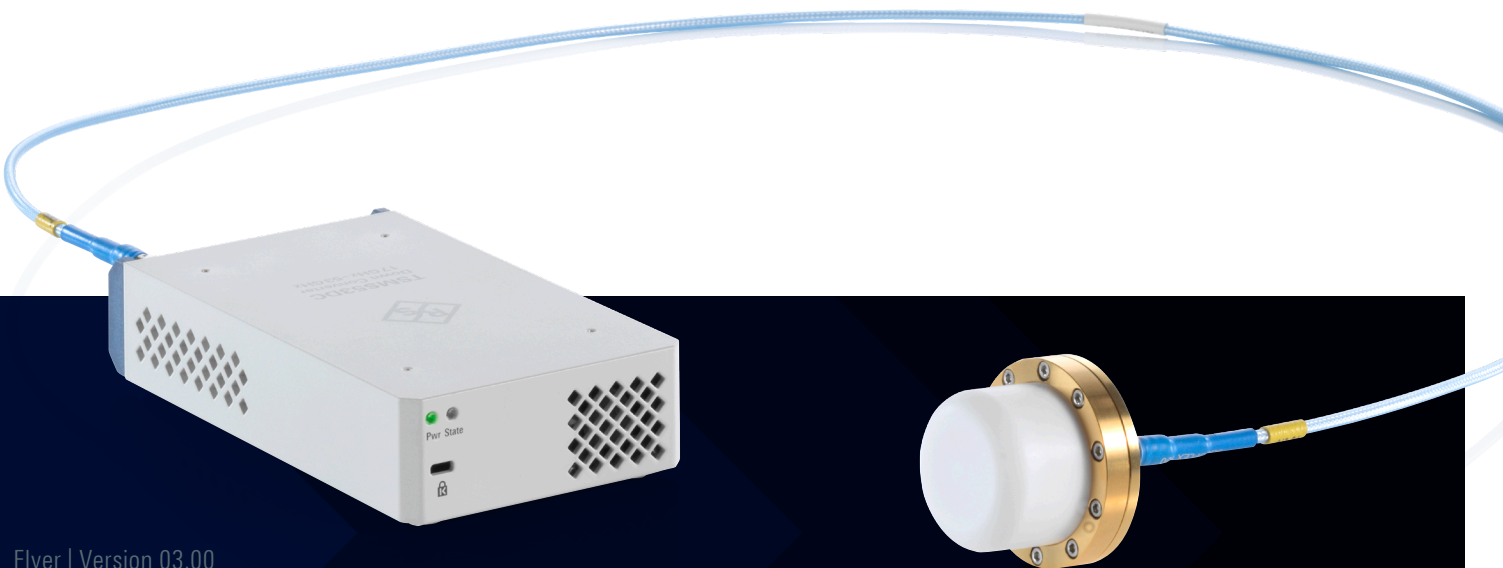


RECEIVE ANTENNAS

Use cases for mobile network testing
and cellular network analysis



Flyer | Version 03.00

ROHDE & SCHWARZ

Make ideas real



AT A GLANCE

Mobile network testing (MNT) and cellular network analysis (CNA) have many use cases that overlap but require different antennas. Together with our R&S®TSMx mobile network scanners, Rohde & Schwarz has several antennas for all types of measurement campaigns. Typical network scanner applications include coverage and signal quality measurements for network verification, optimization, troubleshooting and benchmarking. Network scanners are also used for MIMO, network synchronization, interference and drone based RF measurements.



Typical setup for walk testing with a tablet controlling the R&S®TSMx6B autonomous mobile network scanner with battery pack and antenna

KEY FACTS

- ▶ Rohde & Schwarz offers a complete portfolio of antennas for all mobile network testing and cellular network analysis use cases
- ▶ Ultrawideband directional and omnidirectional antennas provide top system performance
- ▶ Antennas with different mounting options and tailored radiation patterns
- ▶ MIMO, timing and interference measurements can also be performed

USE CASES

Drive testing in frequency range 1 (FR1, below 6 GHz)

▶ page 4

Walk testing in FR1

▶ page 5

Drone based testing in FR1

▶ page 6

LTE MIMO measurements

▶ page 7

Network synchronization and interference measurements in FR1 and FR2

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Drive testing in FR2/mmWave

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Walk testing in FR2/mmWave

▶ page 12



DRIVE TESTING IN FREQUENCY RANGE 1 (FR1, BELOW 6 GHz)

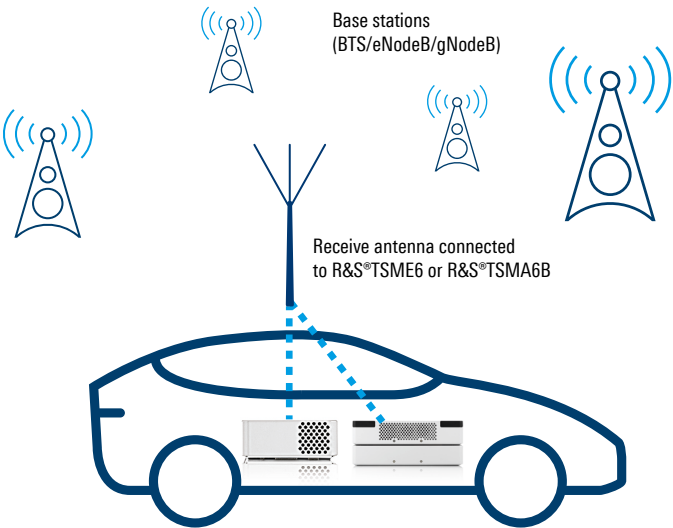
Mobile network operators typically deploy ultra-dense networks and use the entire available frequency range to provide customers with the best quality of service. Most measurement campaigns focus on creating an unbiased picture of power levels and signal quality in the entire RF environment. Signals from transmitters are received from all directions over a wide frequency range.

Rohde&Schwarz has wideband omnidirectional antennas with magnetic or fixed mounts for drive testing in frequency range 1 (FR1). The antenna models cover a frequency range from 350 MHz to 470 MHz for public safety and critical communications and a frequency range from 600 MHz to 6000 MHz for mobile networks.



Drive testing with an R&S®TSMA6B, controlled by a tablet.

Typical setup



Recommended products

| Designation | Type | Order No. |
|--|---------------|--------------|
| Antenna mount, magnetic | R&S®TSME-ZA1 | 1506.9817.02 |
| Antenna mount, fixed | R&S®TSME-ZA2 | 1506.9823.02 |
| Antenna mount, magnetic, with integrated GPS antenna | R&S®TSME-ZA3 | 1506.9830.02 |
| Antenna mount, fixed, with integrated GPS antenna | R&S®TSME-ZA4 | 1506.9846.02 |
| Antenna emitter, 380 MHz to 430 MHz ¹⁾ | R&S®TSMW-ZE7 | 1519.5709.02 |
| Antenna emitter, 698 MHz to 2700 MHz ¹⁾ | R&S®TSMW-ZE8 | 1506.9852.02 |
| Antenna emitter, 430 MHz to 470 MHz ¹⁾ | R&S®TSMW-ZE9 | 1519.5709.03 |
| Antenna emitter, 600 MHz to 6000 MHz ¹⁾ | R&S®TSME-ZE17 | 3666.1574.02 |
| Ultrawideband antenna, 350 MHz to 6000 MHz | R&S®TSME-Z9 | 3590.8039.02 |

¹⁾ Requires an R&S®TSME-ZAx antenna mount.

WALK TESTING IN FR1

Walk testing measurement campaigns are best for ultra-dense urban or indoor areas. The campaigns need small and lightweight antennas attached to portable solutions such as the R&S®FR4 Freerider 4 backpack system and the R&S®TSMA6-ZCB2 carrying bag. Walk testing campaigns serve the same purpose as drive testing ones: creating an unbiased picture of the all power levels and the signal quality in an RF environment. These campaigns need wideband and omnidirectional antennas.



Indoor walk testing with an R&S®TSMA6B in the carrying bag, controlled by a tablet.

Typical setup



Recommended products

| Designation | Type | Order No. |
|--|--------------|--------------|
| Single-port ultrawideband antenna, 698 MHz to 6000 MHz | R&S®TSME-Z10 | 4900.1917.02 |
| Ultrawideband antenna, 615 MHz to 6000 MHz, for walk testing | R&S®TSME-Z17 | 4900.1969.02 |
| TETRA panel antenna, 380 MHz to 500 MHz, for walk testing, compatible with R&S®MNT Core 2 backpack and R&S®TSMA6-ZCB2 carrying bag | R&S®TSME-Z19 | 4900.1998.02 |

DRONE BASED TESTING IN FR1

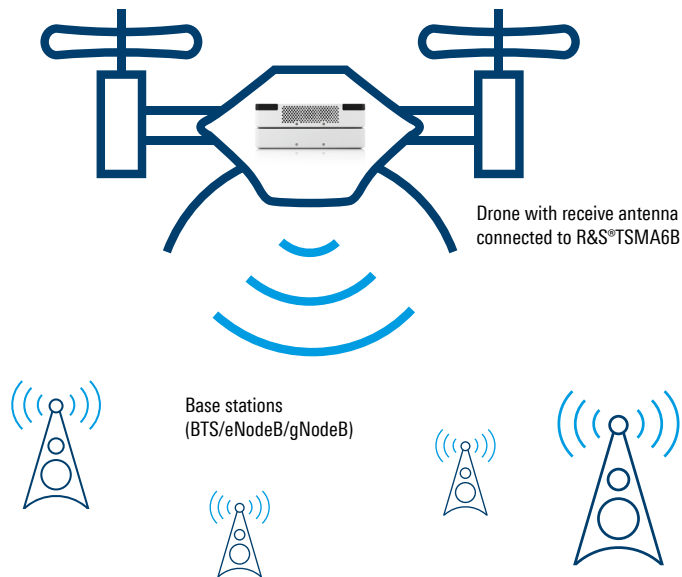
Network scanners can be mounted on drones to verify base station sites or perform measurements in unique locations. During the tests, the drones fly around a site at different elevations. Weight is crucial to drone based measurement campaigns. The drone payload directly affects flight times and the drone model. In general, walk testing antennas are wideband, omnidirectional and lightweight antennas but drone installations require tailored solutions and may use specific antenna types and demand special approvals or certifications.

Special directional antennas are required when a scanner is used at high altitudes, for example when estimating airborne base station positions.



Drone based testing with an R&S®TSM 6B.

Typical setup



Note

Drone setups are typically individually tailored setups, therefore we do not offer specific antennas for that use case.

LTE MIMO MEASUREMENTS

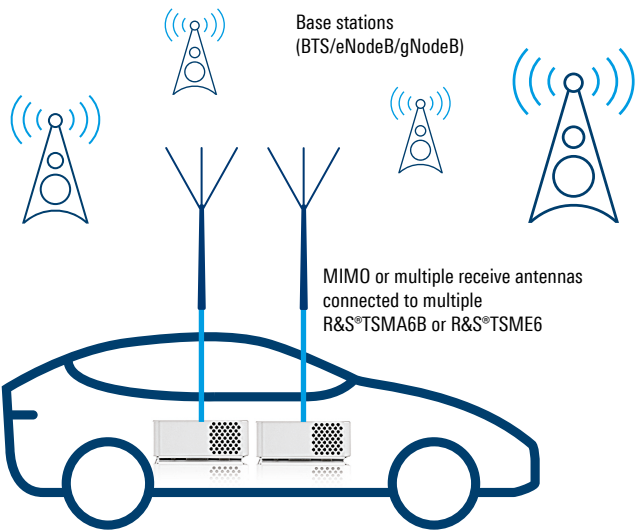
LTE MIMO measurements are a special discipline in mobile network testing measurement campaigns. The results should reflect achievable network performance in the field. Base station antennas are typically cross polarized to transmit and receive two or four (preferably uncorrelated) RF paths and get the most out of LTE MIMO deployments. The correlation mainly depends on the structural details of base station antennas and are highly dependent on the sector location. The best possible RF paths are uncorrelated and are usually possible in the main direction, while the performance at the cell edge is critical. LTE MIMO measurements reveal the number of uncorrelated RF paths and the quality of decorrelation.

LTE MIMO measurements can be carried out in drive and walk tests. Rohde&Schwarz has magnetic and fixed mount MIMO antennas for drive testing. Small, omnidirectional antennas for walk tests can be attached to the R&S®FR4 Freerider 4 backpack system.

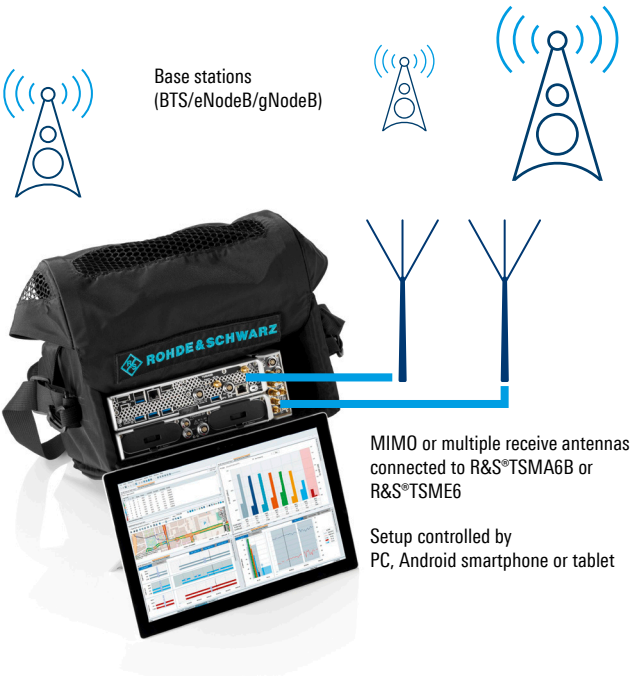
A MIMO antenna setup consists either of multi-port antennas with multiple antenna elements in a single housing or a combination of multiple omnidirectional single port antennas. When the setup has multiple antennas, use the ones recommended in the chapters on drive testing and walk testing in frequency range 1 (see pages 4 and 5).

Typical setup for LTE MIMO measurements

Drive testing



Walk testing



Recommended products

| Designation | Type | Order No. |
|---|----------------|--------------|
| 4-port MIMO antenna, 698 MHz to 3500 MHz (2x2 MIMO) and 5150 MHz to 5850 MHz (2x2 MIMO) for drive testing | R&S®TSME-Z14 | 4900.1952.02 |
| 2-port antenna, 698 MHz to 3800 MHz, with magnetic mount | R&S®TSME-Z15P2 | 3657.5770.02 |



 **ROHDE & SCHWARZ**

NETWORK SYNCHRONIZATION AND INTERFERENCE MEASUREMENTS IN FR1 AND FR2

Rohde&Schwarz mobile network scanners support multiple features for timing and interference measurements. Interference has an enormous impact on network QoS and the scanner has features that can detect and measure arrival times for signals to verify network synchronization or can simply focus on uplink signals.

High precision timing and interference measurements are usually site-specific. Accurate timing measurements require good RF conditions (power levels, signal-to-noise ratios and interference), since these conditions have a direct impact on measurement accuracy. Unwanted signals and contributions from multipath propagation must be suppressed. Directional antennas, such as the R&S®HE400LP for FR1 and the R&S®HE800-PA for FR2, are ideal here.

The R&S®HE400LP and the R&S®HE800-PA can also help with interference hunting. Finding an interference source is essential, so a directional antenna is normally used for interference hunting. The antenna can help locate points or directions to determine the angle of arrival for an interference source.

Omnidirectional antennas can be used but might not have the best measurement performance and accuracy.



R&S®HE400LP handheld directional antenna with log-periodic antenna module for FR1



R&S®HE800-PA handheld directional antenna with preamplifier for FR2

Recommended products

| Designation | Type | Order No. |
|---|---------------|--------------|
| Basic handheld directional antenna (antenna handle) | R&S®HE400BC | 4104.6000.04 |
| Log-periodic antenna module, 450 MHz to 8 GHz | R&S®HE400LP | 4104.8402.02 |
| Handheld directional antenna with preamplifier (power supply via USB required) | R&S®HE800-PA | 4115.6006.02 |
| With restrictions in performance and/or accuracy (omnidirectional antennas) | | |
| Antenna holder including R&S®TSMS-OMN70 omnidirectional mmWave antenna (17 GHz to 53 GHz) and RF cable (1.85 mm), compatible with R&S®FR4 Freerider 4 backpack system and R&S®TSMA6-ZCB2 carrying bag | R&S®FR4-5G-A3 | 1900.6403.42 |
| Antenna emitter, 600 MHz to 6000 MHz | R&S®TSME-ZE17 | 3666.1574.02 |
| Ultrawideband antenna, 615 MHz to 6000 MHz, for walk testing | R&S®TSME-Z17 | 4900.1969.02 |

DRIVE TESTING IN FR2/mmWAVE

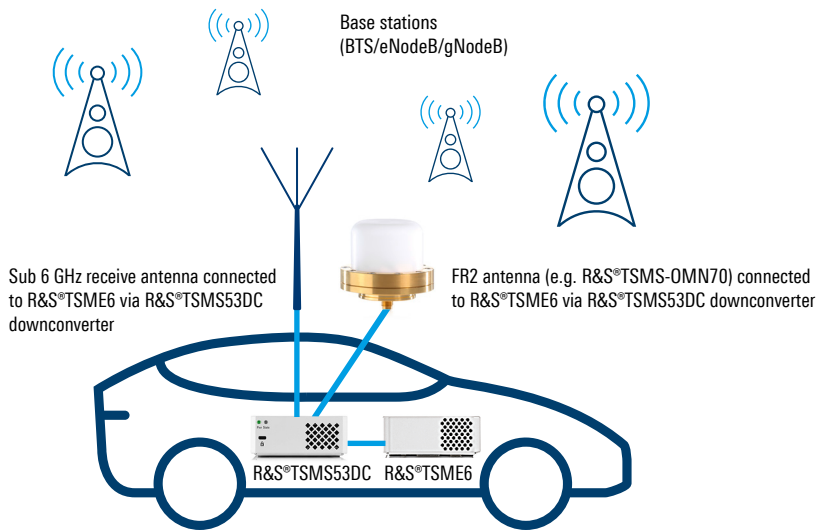
Drive testing in FR2 (currently 17 GHz to 53 GHz) requires detecting and measuring signals with high path loss. Cell sizes are typically between 100 m and 400 m depending on the environment. Equipment sensitivity is a key factor when measuring FR2 signals. Our R&S®TSMS53DC down-converter and the R&S®TSMS-OMN70 omnidirectional mmWave antenna are part of our high-performance component portfolio for measuring in the entire mmWave frequency range.

Our magnetic mount (R&S®TSMS-OMAGM) for the R&S®TSMS-OMN70 can be used to attach the antenna to a vehicle roof.

Rohde&Schwarz has developed and manufactures the R&S®TSMS-OMN70 and its accessories.

The R&S®TSMS-OMN70 antenna radiation pattern is optimized for its use case with higher gain for signals transmitted from positions elevated relative to the horizon, which is the typical location for base station antennas. This optimization increases sensitivity for the entire system and emulates FR2 beamforming capabilities in user equipment, increasing the signal-to-noise ratio and interference ratio and compensates for some path loss.

Typical setup

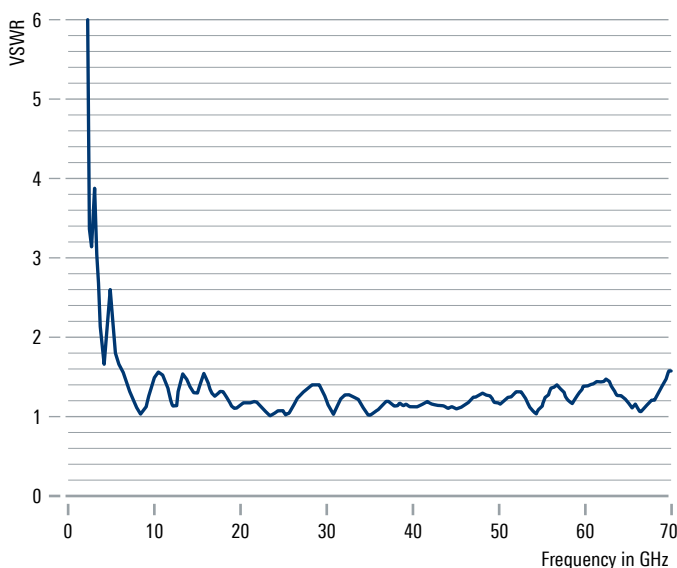


R&S®TSMa6B autonomous mobile network scanner with battery pack and R&S®TSMS53DC downconverter in a carrying bag connected to an R&S®TSMS-OMN70 omnidirectional mmWave antenna; controlled by a tablet.

R&S®TSMS-OMN70 omnidirectional mmWave antenna (17 GHz to 53 GHz)

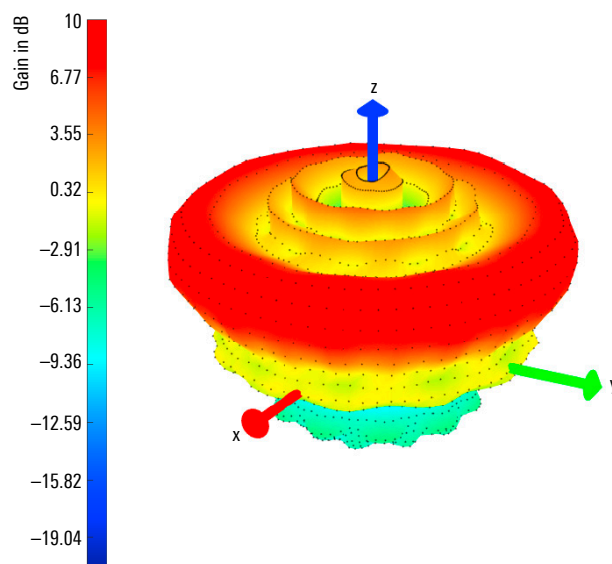
| Specifications in brief | | |
|-----------------------------|------------------------------------|------------------------------------|
| Frequency range | in-band | 17 GHz to 53 GHz |
| | out-of-band | 4.5 GHz to 70 GHz |
| Polarization | | vertical |
| Input impedance | | 50 Ω |
| VSWR, return loss | in-band | < 2.0, better than 10 dB |
| | out-of-band | < 2.6, better than 7 dB |
| Gain | average gain | 3 dBi to 5 dBi, in-band |
| | maximum gain | 7.4 dBi, in-band |
| Connector | | 1.85 mm or 2.4 mm, female |
| Maximum input power | CW | 33 dBm |
| Radiation pattern | azimuth plane | max. gain 30° to 40° above horizon |
| | horizontal plane | omnidirectional |
| Operating temperature range | | -10°C to +55°C |
| Ingress protection | | IP65 |
| Conformity | | CE, RoHS |
| Maximum driving speed | with R&S®TSMS-OMAGM magnetic mount | 130 km/h (68 mph) |
| Dimensions | H x \varnothing | 50 mm x 50 mm (1.97 in x 1.97 in) |
| Weight | | 120 g (0.26 lb) |

VSWR of R&S®TSMS-OMN70 (meas.)



Measured 3D antenna radiation pattern

The 3D antenna radiation pattern of the R&S®TSMS-OMN70 shows the elevated gain maximum above the horizon.

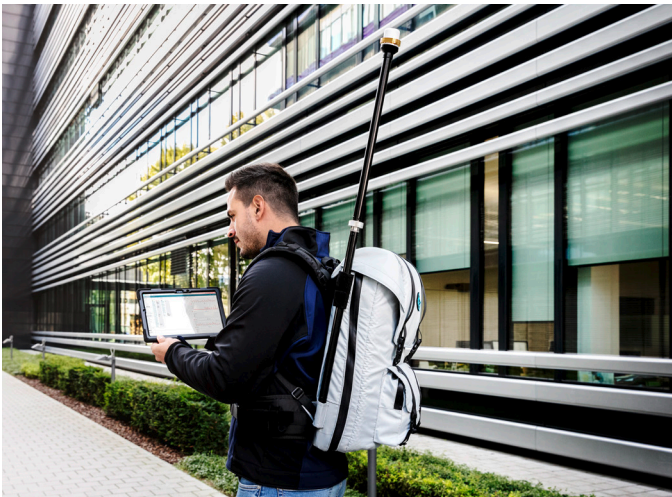


Recommended products

| Designation | Type | Order No. |
|--|----------------|--------------|
| Omnidirectional mmWave antenna, 17 GHz to 53 GHz | R&S®TSMS-OMN70 | 4902.6000.02 |
| Magnetic mount for R&S®TSMS-OMN70 | R&S®TSMS-OMAGM | 4902.6100.02 |

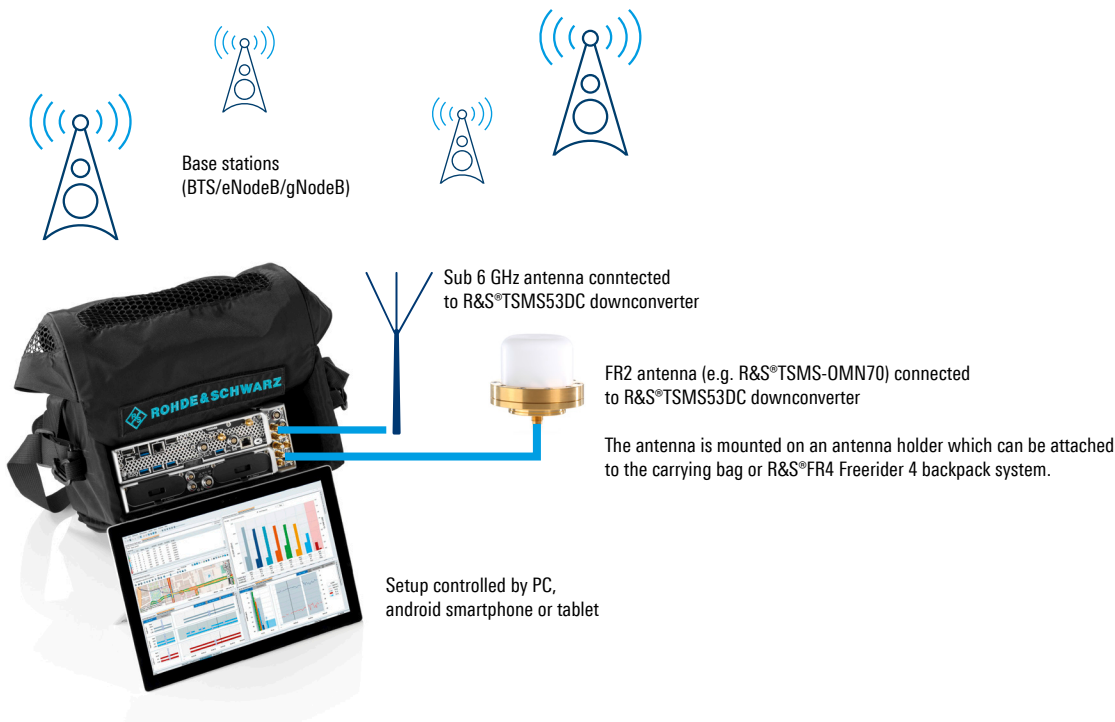
WALK TESTING IN FR2/mmWAVE

The R&S®TSMS-OMN70 omnidirectional mmWave antennas can also be used for walk testing. The R&S®FR4-5G-A3 antenna holder attaches the R&S®TSMS-OMN70 antenna to our R&S®FR4 Freerider 4 backpack system and the R&S®TSMA6-ZCB2 carrying bag. The antenna holder elevates the R&S®TSMS-OMN70 to minimize the impact of the human body on the RF conditions.



Walk testing with the R&S®FR4 Freerider 4 backpack system using the R&S®TSMS-OMN70 antenna mounted on the R&S®FR4-5G-A3 antenna holder.

Typical setup



Recommended products

| Designation | Type | Order No. |
|---|---------------|--------------|
| Antenna holder including R&S®TSMS-OMN70 omnidirectional mmWave antenna (17 GHz to 53 GHz) and RF cable (1.85 mm), compatible with R&S®FR4 Freerider 4 backpack system and R&S®TSMA6-ZCB2 carrying bag | R&S®FR4-5G-A3 | 1900.6403.42 |

ORDERING INFORMATION

| Designation | Type | Order No. |
|--|----------------|--------------|
| Antenna mount, magnetic | R&S®TSME-ZA1 | 1506.9817.02 |
| Antenna mount, fixed | R&S®TSME-ZA2 | 1506.9823.02 |
| Antenna mount, magnetic, with integrated GPS antenna | R&S®TSME-ZA3 | 1506.9830.02 |
| Antenna mount, fixed, with integrated GPS antenna | R&S®TSME-ZA4 | 1506.9846.02 |
| Antenna emitter, 380 MHz to 430 MHz ¹⁾ | R&S®TSMW-ZE7 | 1519.5709.02 |
| Antenna emitter, 698 MHz to 2700 MHz ¹⁾ | R&S®TSMW-ZE8 | 1506.9852.02 |
| Antenna emitter, 430 MHz to 470 MHz ¹⁾ | R&S®TSMW-ZE9 | 1519.5709.03 |
| Antenna emitter, 600 MHz to 6000 MHz ¹⁾ | R&S®TSME-ZE17 | 3666.1574.02 |
| Multiband dipole paddle antenna for backpack, 698 MHz to 2700 MHz | R&S®TSME-Z7 | 3591.2870.02 |
| Ultrawideband antenna, 350 MHz to 6000 MHz | R&S®TSME-Z9 | 3590.8039.02 |
| Single-port ultrawideband antenna, 698 MHz to 6000 MHz | R&S®TSME-Z10 | 4900.1917.02 |
| 3-port antenna, 698 MHz to 2690 MHz (MIMO) and GPS | R&S®TSME-Z11 | 4900.1923.02 |
| 2-port MIMO reference antenna, 698 MHz to 2700 MHz | R&S®TSME-Z12 | 4900.1930.02 |
| 4-port MIMO antenna, 698 MHz to 3500 MHz (2x2 MIMO) and 5150 MHz to 5850 MHz (2x2 MIMO), for drive testing | R&S®TSME-Z14 | 4900.1952.02 |
| 2-port antenna, 698 MHz to 3800 MHz, with magnetic mount | R&S®TSME-Z15P2 | 3657.5770.02 |
| Ultrawideband antenna, 615 MHz to 6000 MHz, for walk testing | R&S®TSME-Z17 | 4900.1969.02 |
| TETRA panel antenna, 380 MHz to 500 MHz, for walk testing, compatible with R&S®MNT Core 2 backpack and R&S®TSM-A6-ZCB2 carrying bag | R&S®TSME-Z19 | 4900.1998.02 |
| Omnidirectional mmWave antenna, 17 GHz to 53 GHz | R&S®TSMS-OMN70 | 4902.6000.02 |
| Magnetic mount for R&S®TSMS-OMN70 | R&S®TSMS-OMAGM | 4902.6100.02 |
| Basic handheld directional antenna (antenna handle) | R&S®HE400BC | 4104.6000.04 |
| Log-periodic antenna module, 450 MHz to 8 GHz | R&S®HE400LP | 4104.8402.02 |
| Handheld directional antenna with preamplifier (power supply via USB required) | R&S®HE800-PA | 4115.6006.02 |
| Antenna holder including R&S®TSMS-OMN70 omnidirectional mmWave antenna (17 GHz to 53 GHz) and RF cable (1.85 mm), compatible with R&S®FR4 Freerider 4 backpack system and R&S®TSM-A6-ZCB2 carrying bag | R&S®FR4-5G-A3 | 1900.6403.42 |

¹⁾ Requires an R&S®TSME-ZAx antenna mount.

Your local Rohde&Schwarz expert can help find the best solution for you.
To find your nearest Rohde&Schwarz representative, visit www.rohde-schwarz.com

USE CASES AND COMPATIBILITY MATRIX

| Antenna type | R&S®TSME-Z10, R&S®TSME-Z19 for TETRA applications | R&S®FR4-5G-A3 incl. R&S®TSMS-OMN70 | R&S®TSME-Z17 ¹⁾ | R&S®TSME-Z17 | R&S®TSMS-OMN70 (antenna only) | R&S®HE400LP | R&S®HE800-PA | |
|---|---|---------------------------------------|----------------------------|-----------------|----------------------------------|-------------|--------------|--|
| Use cases | | | | | | | | |
| Drive testing in FR1 | | | ● | | | | | |
| Walk testing in FR1 | ● | | | ● | | | | |
| Drone based testing in FR1 | | | | ○ | | | | |
| Drive testing with LTE MIMO measurements | | | ○ ²⁾ | | | | | |
| Walk testing with LTE MIMO measurements | | | | ○ ²⁾ | | | | |
| Network synchronization and interference measurements in FR1 | | | ○ | ○ | | ● | | |
| Network synchronization and interference measurements in FR2 | | ○ | ○ | ○ | ○ | | ● | |
| Drive testing in FR2 | | | | | ● ³⁾ | | | |
| Walk testing in FR2 | | ● | | | | | | |

- Recommended antenna.
- Applicable with restrictions.

¹⁾ Requires an R&S®TSME-ZAx antenna mount.
²⁾ Multiple antennas required.
³⁾ Magnetic mount required.
⁴⁾ Fixed mount.
⁵⁾ For network synchronization and interference measurements.

| | R&S® TSMW-ZE7/-ZE8/ -ZE9 ¹⁾ | R&S® TSME-Z9 | R&S® TSME-Z11 | R&S® TSME-Z12 | R&S® TSME-Z14 | R&S® TSME-Z15P2 |
|--|---|--------------|---------------|---------------|-----------------|-----------------|
| | • | • | | | | |
| | | | | | | |
| | | | | | ○ ⁴⁾ | • |
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Service at Rohde & Schwarz
You're in great hands

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

Rohde & Schwarz

The Rohde & Schwarz technology group is among the trailblazers when it comes to paving the way for a safer and connected world with its leading solutions in test & measurement, technology systems and networks & cybersecurity. Founded 90 years ago, the group is a reliable partner for industry and government customers around the globe. The independent company is headquartered in Munich, Germany and has an extensive sales and service network with locations in more than 70 countries.

www.rohde-schwarz.com

Mobile network testing

The company's broad and diverse product portfolio for mobile network testing addresses every test scenario in the network lifecycle – from base station installation to network acceptance and network benchmarking, from optimization and troubleshooting to interference hunting and spectrum analysis, from IP application awareness to QoS and QoE of voice, data, video and app-based services.

Sustainable product design

- ▶ Environmental compatibility and eco-footprint
- ▶ Energy efficiency and low emissions
- ▶ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

Rohde & Schwarz customer support

www.rohde-schwarz.com/support



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PD 3684.0176.32 | Version 03.00 | September 2024 (jr)

Receive antennas | Use cases for mobile network testing and cellular network analysis

Data without tolerance limits is not binding | Subject to change

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