R&S®TSMW Universal Radio Network Analyzer
Scanner for drive tests and I/Q streaming
R&S®TSMW Universal Radio Network Analyzer

At a glance

The R&S®TSMW universal radio network analyzer is a platform for optimizing all conventional wireless communications networks. Two frontends for any input frequency from 30 MHz to 6 GHz, a preselection and a software-defined architecture offer unsurpassed performance while providing maximum flexibility. In addition to functioning as a scanner for wireless communications networks, the R&S®TSMW is also an ideal digital I/Q baseband receiver.

Owing to its hardware platform, the R&S®TSMW universal radio network analyzer offers maximum flexibility. For example, the R&S®TSMW comes in handy as an LTE scanner, and it can be utilized together with the R&S®ROMES4 drive test software to roll out and optimize 3GPP EUTRA networks. In addition to LTE, other wireless communications technologies such as GSM, WCDMA, CDMA2000® 1xEV-DO, TETRA and WiMAX™ are supported simultaneously.

Moreover, the R&S®TSMW can be used as a realtime scanner for I/Q baseband data. The R&S®TSMW-K1 option offers a MATLAB® and a C++ interface via which I/Q measurement data can be captured and evaluated.

Key facts
- User-definable input frequency range from 30 MHz to 6 GHz
- Two independent RF and signal processing paths, each with a bandwidth of up to 20 MHz
- Integrated preselection for high intermodulation suppression while dynamic range is high
- Support of LTE-FDD and TD-LTE
- Parallel measurements in GSM, WCDMA, LTE, CDMA2000® 1xEV-DO, TETRA and WiMAX™ networks with the R&S®ROMES4 drive test software
- Spectrum measurements with the RF power scan option
- I/Q baseband streaming and capturing
- Integrated GPS
R&S®TSMW Universal Radio Network Analyzer

Benefits and key features

LTE and MIMO network rollout and network optimization
- Automatic detection and measurement of all available cells
- MIMO-specific measurements show MIMO gain
- Intersymbol interference analysis with multipath measurements
- Wideband and narrowband measurements
- Support of LTE-FDD and TD-LTE
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Parallel support of multiple wireless communications technologies
- Simultaneous measurements in GSM, LTE, WCDMA, CDMA2000® 1xEV-DO, TETRA and WiMAX™
- Simple scanner setup
- Flexible assignment of the two receivers for maximum measurement speed
- Everything in one instrument
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All-in-one drive test solution with R&S®ROMES4
- Network optimization with scanner and test terminal
- Improvement of QoS
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Maximum flexibility when evaluating I/Q data
- Seamless streaming of I/Q data in realtime
- I/Q recording via LAN to the PC or via Rohde & Schwarz I/Q interface to the R&S®IQR
- Data access via MATLAB® or C++ interface
- Fast integration due to included example application based on MATLAB®
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Unsurpassed hardware platform performance and flexibility
- Broadband with 20 MHz bandwidth and maximum frequency range from 30 MHz to 6 GHz
- Maximum configuration flexibility
- Top dynamic range and measurement accuracy owing to adaptive preselection
- Update of hardware platform via software
- Integrated SuperSense GPS with PPS
- R&S®TSMF special solution
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LTE and MIMO network rollout and network optimization

Using the R&S®TSMW together with the R&S®ROMES4 drive test software opens the door to numerous measurement and analysis capabilities for LTE field tests.

**Automatic detection and measurement of all available cells**
All that the R&S®ROMES4 software needs to “know” is the center frequency of an LTE signal. The R&S®TSMW can find all further information that is required, e.g. the bandwidth used, the physical cell ID, the eNodeB cell ID, the cyclic prefix length, or the synchronization channels (P-SCH and S-SCH) and RSRP/RSRQ/RS-SINR values. This is particularly relevant when a wireless communications network is growing both in size and complexity. The user does not require any detailed knowledge about the LTE network and its structure when carrying out measurements.

Immediately after the measurement is started, the power values of the physical cell IDs are displayed in a Top N chart.

In addition to these values, the RSRP, RSRQ and the narrowband and wideband signal-to-interference-plus-noise ratio (SINR) are output. These values indicate whether interference is present on a signal. The measurement results can be output at a maximum rate of 200 measurements per second.

**Condition number per resource block.**
MIMO-specific measurements show MIMO gain

A special MIMO measurement using the two internal R&S®TSMW receivers measures the true MIMO gain under real-world conditions. Two antennas simultaneously measure the LTE signal, making it possible to determine the degree of correlation of the MIMO channel. This indicates whether MIMO can profitably be used in the measured area and whether investments to expand the infrastructure will pay off.

The MIMO measurement function can be used for 4x2 and 2x2 systems. All measurements are based on the channel matrix H with the complex amplitude and phase values. The matrix is output for each measured cell and resource block. The condition number calculated from the matrices obtained gives a good idea of the degree of correlation of a MIMO channel. A value in the range of 0 dB to 15 dB, for example, indicates good conditions for LTE MIMO.

R&S®ROMES allows the measurement data to be output to a text file for further processing. MIMO-specific measurements are useful for the following applications:

- Determining in what areas MIMO can profitably be used
- Determining whether additional investments for MIMO will pay off
- Optimizing MIMO performance
- Reproducing LTE signal channels in the lab under real-world conditions
Typical configuration of an LTE drive test system consisting of an R&S®TSMW and the R&S®ROMES4 software.

**Intersymbol interference analysis with multipath measurements**

By means of the channel impulse response measurement, the R&S®TSMW can measure multipath propagation and reflections and then display the results by using the R&S®ROMES4 software. Reflections can be measured in a time frame of –6 µs to +34 µs. This means that the eight-fold length of a normal cyclic prefix can be measured. As a result, the user can detect violations of the guard interval (intersymbol interference, ISI).

A further interference factor may be excessively high base station phase noise. The R&S®TSMW’s low inherent phase noise allows users to also detect problems in the base station.

**Wideband and narrowband measurements**

The R&S®TSMW automatically recognizes the bandwidth of the LTE signal. Based on this information, fast narrowband measurements and slower wideband measurements are output simultaneously. Wideband measurements are especially important to detect any interference caused by external sources such as TV transmitters, repeaters, jammers and narrowband interferers.

**Equipment required for LTE drive tests**

- R&S®TSMW universal radio network analyzer
- R&S®TSMW-K29 LTE scanner option
- R&S®TSMW-K30 LTE MIMO scanner option
- R&S®TSMW-Z1 power supply
- R&S®ROMES4 drive test software
- R&S®ROMES4T1W R&S®TSMW all-technology driver for R&S®ROMES
- R&S®ROMES4LT8 LTE Samsung driver
- R&S®ROMES4LTQ LTE Qualcomm driver

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Narrowband</th>
<th>Wideband</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received power</td>
<td>Power</td>
<td>RSRP</td>
</tr>
<tr>
<td>Quality</td>
<td>RSRQ</td>
<td>Based on full RS bandwidth</td>
</tr>
<tr>
<td>SNR</td>
<td>SINR</td>
<td>RS-SINR</td>
</tr>
<tr>
<td>Total power</td>
<td>$P_{total}$</td>
<td>RSSI</td>
</tr>
</tbody>
</table>

1) SC: synchronization channel.
2) RS: reference signal.
Of particular interest is the SINR of the reference signal (RS-SINR), which is measured for each resource block, cell and antenna. This measurement shows interference and its spectral position, making it possible to quickly trace the causes of interference. The figure to the left shows the paths of a 2x2 or 4x2 LTE system as a waterfall diagram, making changes over time visible. A marker allows the user to quickly find the resource block and frequency from which interference originates, as well as the associated RS-SINR and time stamp.

**Support of LTE-FDD and TD-LTE**

The R&S®TSMW can also perform FDD and TDD measurements. Measurements can be carried out in parallel in the TDD frequency bands 33 to 43 and the FDD frequency bands 1 to 25.

There are no additional costs for TD-LTE and other frequency bands, making the R&S®TSMW an investment for the future – with maximum flexibility.

![Wideband RS-SINR per resource block and per antenna.](image)

**TopN with narrowband, wideband and MIMO values.**
<table>
<thead>
<tr>
<th>Bands and technologies supported by the R&amp;S® TSMW</th>
<th>E-UTRA operating band</th>
<th>Uplink (UL) operating band BS: receive</th>
<th>Downlink (DL) operating band BS: transmit</th>
<th>Duplex mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>● 1</td>
<td>1920 MHz to 1980 MHz</td>
<td>2110 MHz to 2170 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 2</td>
<td>1850 MHz to 1910 MHz</td>
<td>1930 MHz to 1990 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 3</td>
<td>1710 MHz to 1785 MHz</td>
<td>1805 MHz to 1880 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 4</td>
<td>1710 MHz to 1755 MHz</td>
<td>2110 MHz to 2155 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 5</td>
<td>824 MHz to 849 MHz</td>
<td>669 MHz to 894MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 6</td>
<td>830 MHz to 840 MHz</td>
<td>875 MHz to 885 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 7</td>
<td>2500 MHz to 2570 MHz</td>
<td>2620 MHz to 2690 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 8</td>
<td>880 MHz to 915 MHz</td>
<td>925 MHz to 960 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 9</td>
<td>1749.9 MHz to 1784.9 MHz</td>
<td>1844.9 MHz to 1879.9 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 10</td>
<td>1710 MHz to 1770 MHz</td>
<td>2110 MHz to 2170 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 11</td>
<td>1427.9 MHz to 1447.9 MHz</td>
<td>1475.9 MHz to 1495.9 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 12</td>
<td>699 MHz to 716 MHz</td>
<td>729 MHz to 746 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 13</td>
<td>777 MHz to 787 MHz</td>
<td>746 MHz to 756 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 14</td>
<td>788 MHz to 798 MHz</td>
<td>756 MHz to 768 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 15</td>
<td>Reserved</td>
<td>Reserved</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 16</td>
<td>Reserved</td>
<td>Reserved</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 17</td>
<td>704 MHz to 716 MHz</td>
<td>734 MHz to 746 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 18</td>
<td>815 MHz to 830 MHz</td>
<td>860 MHz to 875 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 19</td>
<td>830 MHz to 845 MHz</td>
<td>875 MHz to 890 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 20</td>
<td>832 MHz to 862 MHz</td>
<td>791 MHz to 821 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 21</td>
<td>1447.9 MHz to 1462.9 MHz</td>
<td>1495.9 MHz to 1510.9 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 23</td>
<td>2000 MHz to 2020 MHz</td>
<td>2180 MHz to 2200 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 24</td>
<td>1626.5 MHz to 1660.5 MHz</td>
<td>1525 MHz to 1559 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 25</td>
<td>1850 MHz to 1915 MHz</td>
<td>1930 MHz to 1995 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 26</td>
<td>2115 MHz to 2170 MHz</td>
<td>2220 MHz to 2255 MHz</td>
<td>FDD</td>
<td></td>
</tr>
<tr>
<td>● 27</td>
<td>1920 MHz to 1980 MHz</td>
<td>2110 MHz to 2170 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 28</td>
<td>2020 MHz to 2075 MHz</td>
<td>2120 MHz to 2190 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 29</td>
<td>1910 MHz to 1970 MHz</td>
<td>1920 MHz to 1980 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 30</td>
<td>1860 MHz to 1920 MHz</td>
<td>1870 MHz to 1930 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 31</td>
<td>1930 MHz to 1990 MHz</td>
<td>1940 MHz to 2000 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 32</td>
<td>1910 MHz to 1970 MHz</td>
<td>1920 MHz to 1980 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 33</td>
<td>1900 MHz to 1960 MHz</td>
<td>1910 MHz to 1970 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 34</td>
<td>2010 MHz to 2075 MHz</td>
<td>2120 MHz to 2190 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 35</td>
<td>1850 MHz to 1910 MHz</td>
<td>1860 MHz to 1910 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 36</td>
<td>1930 MHz to 1990 MHz</td>
<td>1940 MHz to 2000 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 37</td>
<td>1910 MHz to 1970 MHz</td>
<td>1920 MHz to 1980 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 38</td>
<td>2570 MHz to 2630 MHz</td>
<td>2620 MHz to 2680 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 39</td>
<td>1880 MHz to 1940 MHz</td>
<td>1890 MHz to 1950 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 40</td>
<td>2300 MHz to 2360 MHz</td>
<td>2310 MHz to 2370 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 41</td>
<td>2496 MHz to 2556 MHz</td>
<td>2506 MHz to 2566 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 42</td>
<td>3400 MHz to 3600 MHz</td>
<td>3410 MHz to 3600 MHz</td>
<td>TDD</td>
<td></td>
</tr>
<tr>
<td>● 43</td>
<td>3600 MHz to 3800 MHz</td>
<td>3610 MHz to 3800 MHz</td>
<td>TDD</td>
<td></td>
</tr>
</tbody>
</table>
Parallel support of multiple wireless communications technologies

The R&S®TSMW can be adapted to the customer’s application by using various options. Together with the R&S®ROMES4 software, up to seven different technologies can be measured and displayed at the same time, while the hardware resources can be scaled as needed.

Simultaneous measurements in GSM, LTE, WCDMA, CDMA2000® 1xEV-DO, TETRA and WiMAX™

Multiple wireless communications technologies are often used simultaneously. Particularly during the rollout of new technologies such as 3GPP LTE or WiMAX™ IEEE802.16e, wireless communications networks such as GSM/WCDMA, CDMA2000® 1xEV-DO or TETRA are already present. To keep the T&M effort and the related costs low, an all-in-one solution should be used. Rohde & Schwarz offers the perfect solution with its R&S®TSMW and the R&S®ROMES4 software.

Simple scanner setup

The user generally does not require expert knowledge about the wireless communications network to be tested. The R&S®TSMW detects all important information automatically. For example, the user only has to enter the following parameters: the UARFCN number in a WCDMA network, the band in a GSM network, the center frequency in a WiMAX™ or LTE network, and the channel number in a CDMA2000® 1xEV-DO network. The R&S®TSMW then automatically detects and measures all detectable scrambling codes, channels, preamble indices and physical cell IDs. The measurement speed is not affected by the quantity of measured signals. Similarly for TETRA, all active channels in a 15 MHz downlink band are detected and decoded automatically.

Flexible assignment of the two receivers for maximum measurement speed

Technologies to be measured can flexibly be distributed to two RF and signal paths. Measuring two technologies in parallel does not cause any reduction in measurement speed. If further technologies are added, they are time-distributed to the hardware resources. This feature enables the R&S®TSMW to offer maximum performance in multiple-technology measurements. Up to seven wireless communications technologies can be measured at the same time.
Everything in one instrument

Wireless communications scanners such as the R&S®TSMW are primarily used when measurements must be performed independently of a test terminal. The R&S®ROMES4 software offers a Top N evaluation of all available signals for each technology. The user receives an overview of the strongest signals and can sort them by provider. Especially in CDMA2000® and WCDMA networks, this evaluation plays a crucial role in reducing pilot pollution.

Furthermore, neighbor cells that may not be found by a test terminal can be detected. Missing neighbor cells can be detected independently of the technology. This enables the user to identify coverage gaps or interference. The capability to demodulate the broadcast information of the broadcast channel (BCH) offers insight into the network configuration. Applications such as automatic neighborhood analysis or automatic interference detection can easily be carried out by applying this functionality.

The RF spectrum scan running in parallel additionally supports finding external interferences. Moreover, the function is very useful in spectrum clearing, in refarming and in using the digital dividend.

The R&S®TSMW can also be used for benchmark purposes. Multiple technologies and multiple providers can be scanned simultaneously. Even when a new technology is being rolled out, already present networks can be monitored as well.

<table>
<thead>
<tr>
<th>Technologies supported by the R&amp;S®TSMW</th>
<th>SIB decoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSM</td>
<td>●</td>
</tr>
<tr>
<td>WCDMA</td>
<td>●</td>
</tr>
<tr>
<td>CDMA2000®</td>
<td>● ●</td>
</tr>
<tr>
<td>1xEV-DO (Rel.0/Rev.A/Rev.B)</td>
<td>● ●</td>
</tr>
<tr>
<td>WiMAX™ IEEE802.16e</td>
<td>● ●</td>
</tr>
<tr>
<td>TD-LTE</td>
<td>● Available as of H1/2012</td>
</tr>
<tr>
<td>LTE FDD</td>
<td>● ●</td>
</tr>
<tr>
<td>TETRA</td>
<td>● ●</td>
</tr>
</tbody>
</table>
All-in-one drive test solution with R&S®ROMES4

When used together with the R&S®TSMW, the R&S®ROMES4 drive test software also supports test terminals. The R&S®TSMW can be used to detect and eliminate mobile radio network errors indicated by a terminal.

When combined with R&S®ROMES4, the R&S®TSMW can be used with the technologies listed in the following table.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>3GPP LTE MIMO</td>
<td>R&amp;S®TSMW-K30</td>
</tr>
<tr>
<td>3GPP LTE</td>
<td>R&amp;S®TSMW-K29</td>
</tr>
<tr>
<td>WiMAX™ IEEE802.16e</td>
<td>R&amp;S®TSMW-K28</td>
</tr>
<tr>
<td>GSM/WCDMA</td>
<td>R&amp;S®TSMW-K21</td>
</tr>
<tr>
<td>CDMA2000® 1xEV-DO Rev. B</td>
<td>R&amp;S®TSMW-K22</td>
</tr>
<tr>
<td>TETRA</td>
<td>R&amp;S®TSMW-K26</td>
</tr>
<tr>
<td>RF power scan</td>
<td>R&amp;S®TSMW-K27</td>
</tr>
</tbody>
</table>

Network optimization with scanner and test terminal

The R&S®ROMES4 drive test software not only evaluates measurement data from Rohde & Schwarz scanners. It also covers test terminals. These terminals establish either a voice or a data link. For example, a voice connection enables the user to measure speech quality or to generate a statistical evaluation about dropped calls. In the case of data links, the maximum possible transmission rate must be achieved. This is verified by means of data services such as an FTP download.

Improvement of QoS

Example: LTE

During an FTP download, a test terminal displays the maximum current data transmission rate. If this rate is too low with regard to the wireless communications technology being used, the channel quality indicator (CQI) measured by the test terminal can be used to trace the cause of the problem.

If the CQI is too low, either the received signal may be too weak or the measured SINR may be very low. In this case, the test terminal will not be able to use any higher-order modulation types such as 64QAM. The R&S®TSMW can detect and identify such trouble spots independently of the terminal. If the received signals are too weak, this may indicate that the test terminal did not find a neighbor cell. The R&S®TSMW is network-independent because it does not rely on neighbor lists. Unknown neighbor cells can therefore be detected without any problem. Even automatic neighbor relation (ANR) algorithms that are used by self-organizing networks (SON) can be verified.
Maximum flexibility when evaluating I/Q data

The R&S®TSMW offers a truly mobile solution for recording all types of RF signals. The R&S®TSMW-K1 digital I/Q data interface allows users of this option to perform technology-independent channel measurements. These measurements can be used to simulate realistic fading scenarios in a lab environment. The recorded I/Q data can either be replayed in the lab using a Rohde & Schwarz signal generator or analyzed using the MATLAB®/C++ interface. I/Q data can be recorded in two ways. The R&S®TSMW can be connected with a PC via a LAN interface, or the data can be recorded with the R&S®IQR via the Rohde & Schwarz I/Q interface. The higher data rate of the Rohde & Schwarz I/Q interface makes it possible to record both frontends of the R&S®TSMW with up to 2 × 20 MHz instead of using a 20 MHz I/Q measurement bandwidth.

To facilitate I/Q data analysis, the GPS data are saved together with the I/Q data. The R&S®TSMW offers a truly mobile solution for recording all types of RF signals.

I/Q streaming via LAN (1)

For this application, the R&S®TSMW and a high-performance PC are connected via Gigabit Ethernet. This interface allows a maximum stream bandwidth of 20 MHz. The measured data is stored on a fast hard disk. It can be replayed as a waveform on a Rohde & Schwarz signal generator or analyzed via MATLAB®. In addition to offering a MATLAB®-based GUI for controlling the recording, the R&S®TSMW-K1 option also includes a MATLAB® and a C++ interface. These interfaces permit simple access to the I/Q data after the measurement or in realtime. The recording time is limited only by the size of the hard disk. A hard disk with a write speed of at least 80 Mbyte/s is recommended to avoid any problems.

I/Q streaming via Rohde & Schwarz I/Q interface (2)

Due to its higher transmission bandwidth, the Rohde & Schwarz I/Q interface enables I/Q streaming with 1 × 20 MHz bandwidth (2 × 20 MHz in future release). The R&S®TSMW is directly connected with the R&S®IQR and is operated via the R&S®IQR touchscreen. The I/Q data stored on the removable hard disks of the R&S®IQR can be output to a host PC via Gigabit Ethernet for offline analysis. All Rohde & Schwarz instruments with a Rohde & Schwarz I/Q interface, e.g. a signal generator, can be connected via the digital I/Q interface.

The R&S®IQR enables a recording time of one to three hours depending on the digital word length (8, 12, 16 or 20 bit).
Two ways to record I/Q data: I/Q data can be analyzed on a PC or replayed on a signal generator.

**Application examples**
- Navigation: Recording of GPS/GLONASS/Galileo signals in different regions. Recorded signals can be replayed under controlled conditions in the lab. This results in faster time-to-market for GPS receivers and mobile phones.
- Broadcasting: Recording of TV/FM signals during a drive test. Recorded signals can be replayed under lab conditions to test TV/FM receivers.
- LTE MIMO and LTE-Advanced: Channel measurements for 4x2 MIMO scenarios and subsequent analysis, e.g. using MATLAB®.

**Equipment required for I/Q recording (1)**
- R&S®TSMW universal radio network analyzer
- R&S®TSMW-K1 digital I/Q software option
- R&S®TSMW-Z1 AC power supply
- PC with Gigabit LAN interface and support of jumbo frames
- Hard disk with SATA interface and min. data write rate of 80 Mbyte/s

**Equipment required for I/Q recording (2)**
- R&S®TSMW universal radio network analyzer
- R&S®TSMW-K1 digital I/Q software option
- R&S®TSMW-B1 Rohde & Schwarz I/Q interface
- R&S®TSMW-Z1 AC power supply
- R&S®IQR100 I/Q data recorder
- R&S®IQR-B110 memory pack

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**Recording of I/Q data**

1. Record I/Q data with max. 20 MHz bandwidth

   ![Diagram 1](image1)

   - **R&S®TSMW**
   - I/Q data
   - Gbit LAN I/Q interface
   - **PC**

2. Record and replay I/Q data with 1 × 20 MHz bandwidth (2 × 20 MHz in future release)

   ![Diagram 2](image2)

   - **R&S®TSMW**
   - I/Q data
   - via Rohde & Schwarz interface
   - **DUT**
   - **R&S®IQR**
   - **Signal generator**
   - RF signal
Unsurpassed hardware platform performance and flexibility

Broadband with 20 MHz bandwidth and maximum frequency range from 30 MHz to 6 GHz

The R&S®TSMW universal radio network analyzer offers a hardware platform with maximum flexibility. The two integrated broadband receivers (30 MHz to 6 GHz) with a bandwidth of 20 MHz each and a separate preselection open the door to a variety of applications.

These features allow the R&S®TSMW to cover all existing and future frequency bands without any additional upgrade costs.

Maximum configuration flexibility

The R&S®TSMW contains two independent receivers with a bandwidth of 20 MHz each. The two receivers can be used for different technologies or they can share the measurement tasks for a single technology, such as scanning and demodulating system information blocks (SIBs). This case is particularly interesting when the maximum scan rate needs to be achieved. For LTE MIMO-specific measurements, the two receivers are controlled simultaneously.

In some cases, only one receiver is required, which is why the R&S®TSMW is also available as a single-channel model. A software option allows the second receiver to be quickly and easily activated at a later point in time. Although it consumes 30% less power, the single-channel R&S®TSMW provides the full range of functions.
Top dynamic range and measurement accuracy owing to adaptive preselection
To achieve top measurement accuracy and dynamic range, the R&S®TSMW has an integrated preselection. Thus, multiple adjustable filters reduce intermodulation in advance. The analyzer can therefore detect signals with a sensitivity that is considerably below the noise level (noise figure 7 dB at 3.5 GHz).

Update of hardware platform via software
The hardware platform can be updated and its functionality enhanced by means of software. This allows the R&S®TSMW to be expanded in the field to handle additional technologies without having to be sent in for an upgrade. Only the specific options required are added, for example when the user wants to add LTE or LTE MIMO to the existing GSM/WCDMA function.

Integrated SuperSense GPS with PPS
An integrated SuperSense GPS receiver with 16 channels and a refresh rate of 4 Hz allows the analyzer to be used also in areas with weak GPS signals. The R&S®TSMW does not need a GPS signal to perform indoor measurements. GPS can improve synchronization, but it is not absolutely necessary.

R&S®TSMF special solution
The R&S®TSMF is a special model of the R&S®TSMW that does not permit any I/Q measurements with the R&S®TSMW-K1 option. All other functions are fully available.
# Specifications

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<td>Level measurement uncertainty</td>
<td>S/N &gt; 16 dB, 30 MHz to 2.5 GHz</td>
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<tr>
<td></td>
<td>S/N &gt; 16 dB, 2.5 GHz to 6 GHz</td>
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<tr>
<td>Maximum permissible input level</td>
<td>5 dBm/0 V DC</td>
</tr>
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<td>Noise figure</td>
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</tr>
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<td></td>
<td>3.5 GHz, preamplifier off typ. 19 dB</td>
</tr>
<tr>
<td>Intermodulation-free dynamic range</td>
<td>level 2x –45 dBm, 3.5 GHz, preamplifier on typ. –65 dBc (–12.5 dBm TOI)</td>
</tr>
<tr>
<td></td>
<td>level 2x –35 dBm, 3.5 GHz, preamplifier off typ. 70 dBc (0 dBm TOI)</td>
</tr>
<tr>
<td>RF receive paths</td>
<td>independent 2</td>
</tr>
<tr>
<td>VSWR</td>
<td>30 MHz ≤ f ≤ 2.5 GHz typ. 1.5</td>
</tr>
<tr>
<td></td>
<td>2.5 GHz ≤ f ≤ 6 GHz typ. 1.7</td>
</tr>
<tr>
<td>Preselection channels</td>
<td>5 per RF path, 3 used as tracking filters</td>
</tr>
<tr>
<td><strong>LTE characteristics</strong></td>
<td></td>
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<td>Frequency bands supported</td>
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<td>Measurement modes</td>
<td>LTE-FDD and TD-LTE</td>
</tr>
<tr>
<td>Measurement speed</td>
<td>automatic detection of all 504 physical cell IDs max. 200 measurements/s</td>
</tr>
<tr>
<td>Physical decoding accuracy</td>
<td></td>
</tr>
<tr>
<td>Sensitivity for initial physical cell ID decoding (S-SCH)</td>
<td>–123 dBm</td>
</tr>
<tr>
<td>Sensitivity after successful physical cell ID decoding (S-SCH)</td>
<td>–127 dBm</td>
</tr>
<tr>
<td>SINR dynamic range</td>
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</tr>
<tr>
<td><strong>WiMAX™ characteristics</strong></td>
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<td>Frequency bands supported</td>
<td>no restrictions</td>
</tr>
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<td>Measurement speed</td>
<td>automatic detection of all 114 preamble indices 5 measurements/s</td>
</tr>
<tr>
<td>Preamble decoding accuracy</td>
<td>frame duration 5 ms; FFT size 1024; bandwidth 10 MHz; 2.5 GHz ± 1 dB (–30 dBm to –109 dBm)</td>
</tr>
<tr>
<td>Sensitivity for initial preamble decoding RSSI</td>
<td>&lt; –97 dBm</td>
</tr>
<tr>
<td>Sensitivity after successful preamble decoding RSSI</td>
<td>&lt; –112 dBm</td>
</tr>
<tr>
<td>SINR dynamic range</td>
<td>–20 dB to +40 dB</td>
</tr>
<tr>
<td><strong>GSM characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency bands supported</td>
<td>no restrictions</td>
</tr>
<tr>
<td>Measurement modes</td>
<td>SCH code power, TCH total in-band power, timeslot power, BCH demodulation for all system information types</td>
</tr>
<tr>
<td>Measurement speed</td>
<td>500 channels/s</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>–118 dBm</td>
</tr>
<tr>
<td>Measurement accuracy</td>
<td>typ. ±1 dB</td>
</tr>
<tr>
<td>BSIC decoding accuracy</td>
<td>98% for C/I &gt; +2 dB</td>
</tr>
<tr>
<td>BSIC decoding dynamic range</td>
<td></td>
</tr>
<tr>
<td>Sensitivity for initial BSIC detection</td>
<td>C/I &gt; –18 dB</td>
</tr>
<tr>
<td>Sensitivity after successful BSIC detection</td>
<td>C/I &gt; –29 dB</td>
</tr>
<tr>
<td>BCCH decoding dynamic range</td>
<td>C/I &gt; 0 dB</td>
</tr>
<tr>
<td><strong>WCDMA characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency bands supported</td>
<td>no restrictions</td>
</tr>
<tr>
<td>Number of RF carrier frequencies</td>
<td>max. 12</td>
</tr>
<tr>
<td>Measurement speed</td>
<td>high speed/high dynamic range 100 Hz/12 Hz, with BCH demodulation</td>
</tr>
<tr>
<td>Scrambling code detection sensitivity</td>
<td></td>
</tr>
<tr>
<td>Sensitivity for initial SC detection high speed/high dynamic range</td>
<td>–112 dBm/–121 dBm</td>
</tr>
<tr>
<td>Sensitivity after successful SC detection high speed/high dynamic range</td>
<td>–118 dBm/–123 dBm</td>
</tr>
</tbody>
</table>
### Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrambling code detection accuracy RSCP</td>
<td>typ. &lt; 1 dB</td>
</tr>
<tr>
<td>Scrambling code false detection (ghost code)</td>
<td>E/I_0 &gt; -12 dB typ. &lt; 1.5 dB</td>
</tr>
<tr>
<td>Dynamic range E/I_0</td>
<td>&lt; 10^{-4}</td>
</tr>
<tr>
<td>Min. BCH demodulation threshold E/I_0</td>
<td>&gt; -17 dB</td>
</tr>
</tbody>
</table>

#### CDMA2000® characteristics

| Frequency bands supported                     | no restrictions                            |
| Number of RF carrier frequencies              | max. 18                                    |
| Measurement speed                             | automatic detection of all 512 PN codes     |
| PN detection sensitivity                      | 10 Hz                                      |
| Dynamic range                                 | E/I_0                                      |

#### 1xEV-DO characteristics (Rel.0/Rev.A/Rev.B)

| Frequency bands supported                     | no restrictions                            |
| Number of RF carrier frequencies              | max. 18                                    |
| Measurement speed                             | 10 Hz                                      |
| PN detection sensitivity                      | -120 dBn                                   |
| Dynamic range                                 | E/I_0                                      |

#### TETRA characteristics

| TETRA bands supported                         | no restrictions                            |
| Number of RF carrier frequencies              | within a 10 MHz downlink band              |
| Channel resolution                            | 25 kHz (QPSK)                              |
| Measurement speed                             | max. 8000 channels/s, 20/s for a 10 MHz block |
| Sensitivity                                   | RSSI measurements                          |
| Resampling rate                               | 1 Msample/s to 21.94 Msample/s             |
| Demodulation bandwidth                        | 20 MHz                                     |
| I/Q buffer size                               | 200 Mbyte                                  |

#### I/Q characteristics (requires R&S®TSMW-K1)

| Digital filter bandwidth, burst               | 800 kHz to 20 MHz                          |
| Digital filter bandwidth, streaming          | hardware requirements: Gbit LAN link, jumbo frames, hard disk transfer rate 80 Mbyte/s |
| Resampling rate                               | max. 22 Msample/s                          |
| Demodulation bandwidth                        | 20 MHz                                     |
| I/Q buffer size                               | 200 Mbyte                                  |

### Gbit LAN I/Q interface

| Data format                                   | 8/12/16 or 20 bit                          |

#### R&S®Digital I/Q interface (additionally requires R&S®TSMW-B1)

| Interface                                     | clock rate level                          |
|                                               | LVDS                                      |
|                                               | 26-pin MDR                                 |
| Data format                                   | channel link protocol: clock rate max. 22.1 MHz |
| Source                                        | interface mode 1 (enable mode)            |
|                                               | frontend 1 and 2                          |

#### RF power scan

| Frequency range                               | 30 MHz to 6 GHz                           |
| Resolution bandwidths                         | 140 Hz to 1.438 MHz                       |
| Sensitivity                                   | 22.4 kHz RBW, RMS, at 900 MHz             |
|                                               | preamplifier off                          |
|                                               | -107 dBm                                  |
|                                               | preamplifier on                           |
|                                               | -116 dBm                                  |
| 140 Hz RBW, RMS, at 900 MHz                   | preamplifier off                          |
|                                               | -129 dBm                                  |
|                                               | preamplifier on                           |
|                                               | -138 dBm                                  |
| Scan speed                                    | 180 kHz resolution, 100 MHz span, 20 MHz bandwidth |
|                                               | 130 Hz                                    |
|                                               | 11.23 kHz resolution, 10 MHz span, 10 MHz bandwidth |
|                                               | 690 Hz                                    |
|                                               | 140 Hz resolution, 1 MHz span, 1 MHz bandwidth |
|                                               | 64 Hz                                     |
### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. number of frequency ranges</td>
<td>20</td>
</tr>
<tr>
<td>Detectors</td>
<td>Max, RMS, Auto, Min</td>
</tr>
</tbody>
</table>

### Physical characteristics

<table>
<thead>
<tr>
<th>RF inputs</th>
<th>SNAP N connector 50 Ω</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data interface</td>
<td>RJ-45 10/100/1000BaseT Ethernet[^3]</td>
</tr>
<tr>
<td>External reference input</td>
<td>BNC female 50 Ω</td>
</tr>
<tr>
<td>External trigger input/output</td>
<td>BNC female 5 V, TTL</td>
</tr>
<tr>
<td>GPS antenna connector</td>
<td>SMA female/active GPS antenna 50 Ω/3 V, max. 100 mA</td>
</tr>
<tr>
<td>GPS USB interface (standalone)</td>
<td>type B USB connector</td>
</tr>
</tbody>
</table>

### GPS receiver

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition</td>
<td>–148 dBm</td>
</tr>
<tr>
<td>Tracking</td>
<td>–158 dBm</td>
</tr>
<tr>
<td>Channels</td>
<td>16</td>
</tr>
<tr>
<td>Time to first fix (TTFF)</td>
<td></td>
</tr>
<tr>
<td>Cold/warm/hot start</td>
<td>–125 dBm 41 s/33 s/ &lt; 3.5 s</td>
</tr>
</tbody>
</table>

### System requirements

<table>
<thead>
<tr>
<th>R&amp;S®ROMES4 drive test software[^4]</th>
<th>controller (Pentium IV, 2 Gbyte RAM, Gigabit Ethernet, USB 1.0, USB required only if GPS is used as standalone application)</th>
</tr>
</thead>
</table>

[^1]: Suitable cable included in R&S®IQR I/Q data recorder.
[^2]: Reference for RF power scan: 2.66 GHz Intel Dual Core, 4 Gbyte RAM; settings: 2000 ms buffer, RMS time detector, 1000 ms buffer, RMS frequency detector, 1000 values, 1000 updates/s, flat-top window, auto attenuation ON, filter flat-top.
[^3]: Jumbo frames are recommended for measurements with R&S®TSMW-K1. All measurement speed specifications can vary depending on the speed of the PC used.
[^4]: If the R&S®TSMW-K1 Gigabit digital I/Q interface is used, the R&S®ROMES4 drive test software is not required. Instead, MATLAB® or customer-specific software must be installed.

### General data

#### Environmental conditions

<table>
<thead>
<tr>
<th>Temperature</th>
<th>operating temperature range +5°C to +40°C</th>
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<tbody>
<tr>
<td></td>
<td>permissible temperature range 0°C to +50°C</td>
</tr>
<tr>
<td></td>
<td>storage temperature range –25°C to +85°C</td>
</tr>
<tr>
<td>Damp heat</td>
<td>+40°C, 95%, relative humidity, cyclic in line with EN 60068-2-30</td>
</tr>
</tbody>
</table>

#### Mechanical resistance

| Vibration                            | sinusoidal 5 Hz to 150 Hz, 0.15 mm constant amplitude, 55 Hz to 150 Hz, 0.5 g constant in line with EN 60068-2-6 |
| Shock                                | random 10 Hz to 500 Hz, acceleration 1.9 g RMS in line with EN 60068-2-64 method no. 516.4, procedure I, 40 g shock spectrum in line with EN 60068-2-27, MIL-STD-810E |

#### Power supply

| Nominal voltage                      | 9 V to 18 V DC                                                        |
| Nominal current                      | max. 10 A                                                            |

| Dimensions                           | W x H x D 180 mm x 130 mm x 270 mm (7.1 in x 5.12 in x 10.63 in)       |
| Weight                               | approx. 5.1 kg (11.26 lb)                                             |

#### Product conformity

| Electromagnetic compatibility        | EU EMC directive 2004/108/EC and 72/245/EEC in line with |
|                                      | ■ EN 61326-1 (industrial environment) |
|                                      | ■ EN 61326-2-1 |
|                                      | ■ EN 55011 (class B) |
|                                      | ■ EN 61000-3-2 |
|                                      | ■ EN 61000-3-3 |
|                                      | ■ 72/245/EEC chapter 3.2.9 applied |
| Product safety                       | EU, in line with EN 61010-1                                          |
| Third party certifications           | VDE-GS mark, certificate no. 40023750                                |
|                                      | CSA-ccCSAUL mark, certificate no. 1986837                           |
# Ordering information

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<tr>
<th>Designation</th>
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<th>Order No.</th>
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<tr>
<td><strong>Base unit</strong></td>
<td></td>
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</tr>
<tr>
<td>Universal Radio Network Analyzer</td>
<td>R&amp;S®TSMW</td>
<td>1503.3001.03</td>
</tr>
<tr>
<td>(Scope of delivery: R&amp;S®TSMW, LAN cable, 2 x antennas (820 MHz to 960 MHz, 1700 MHz to 2170 MHz), GPS antenna, 12 V DC power cable (cigarette lighter connector), CD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universal Radio Network Analyzer, without I/Q streaming capabilities</td>
<td>R&amp;S®TSMF</td>
<td>1503.3001.04</td>
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<tr>
<td><strong>R&amp;S®TSMW options</strong></td>
<td></td>
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</tr>
<tr>
<td>GSM/WCDMA Scanner Option (for R&amp;S®ROMES4)</td>
<td>R&amp;S®TSMW-K21</td>
<td>1503.4514.02</td>
</tr>
<tr>
<td>CDMA2000® 1xEV-DO Rev. A</td>
<td>R&amp;S®TSMW-K22</td>
<td>1503.4520.02</td>
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<td>TETRA</td>
<td>R&amp;S®TSMW-K26</td>
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<td>WiMAX™ Scanner Option (for R&amp;S®ROMES4)</td>
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<td><strong>Additional software</strong></td>
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<td>Power Supply</td>
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<td>1503.4608.02</td>
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<td>Rack Adapter</td>
<td>R&amp;S®TSMW-Z2</td>
<td>1503.3901.02</td>
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<tr>
<td>Backpack System</td>
<td>R&amp;S®TSMW-Z3</td>
<td>1514.4010.02</td>
</tr>
<tr>
<td>Transit Case with Rollers</td>
<td>R&amp;S®TSMW-Z5</td>
<td>1117.9955.02</td>
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<tr>
<td>Soft Carrying Bag</td>
<td>R&amp;S®FSH-Z25</td>
<td>1145.5896.02</td>
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<tr>
<td>Magnetic Antenna Mount without GPS</td>
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<td>1145.6705.00</td>
</tr>
<tr>
<td>Magnetic Antenna Mount with GPS</td>
<td>R&amp;S®TSMW-ZA3</td>
<td>1145.6728.00</td>
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<tr>
<td>Antenna, 400 MHz to 440 MHz (requires antenna mount)</td>
<td>R&amp;S®TSMW-ZE2</td>
<td>1117.8165.00</td>
</tr>
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<td>Antenna, 360 MHz to 410 MHz (requires antenna mount)</td>
<td>R&amp;S®TSMW-ZE3</td>
<td>1117.8159.00</td>
</tr>
<tr>
<td>Antenna, 1700 MHz to 2700 MHz (requires antenna mount)</td>
<td>R&amp;S®TSMW-ZE4</td>
<td>1514.5281.00</td>
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<tr>
<td>Antenna, 700 MHz to 960 MHz and 1700 to 2500 MHz (requires antenna mount)</td>
<td>R&amp;S®TSMW-ZE6</td>
<td>1516.2515.00</td>
</tr>
<tr>
<td>GPS RF Recording Kit for the R&amp;S®TSMW</td>
<td>R&amp;S®TSMW-ZZ0</td>
<td>1506.9775.02</td>
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<tr>
<td><strong>Service options</strong></td>
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<td></td>
</tr>
<tr>
<td>Extended Warranty, one year</td>
<td>R&amp;S®WE1TSMW</td>
<td>Please contact your local Rohde &amp; Schwarz sales office.</td>
</tr>
<tr>
<td>Extended Warranty, two years</td>
<td>R&amp;S®WE2TSMW</td>
<td></td>
</tr>
<tr>
<td>Extended Warranty, three years</td>
<td>R&amp;S®WE3TSMW</td>
<td></td>
</tr>
<tr>
<td>Extended Warranty, four years</td>
<td>R&amp;S®WE4TSMW</td>
<td></td>
</tr>
<tr>
<td>Extended Warranty with Calibration Coverage, one year</td>
<td>R&amp;S®CW1TSMW</td>
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<tr>
<td>Extended Warranty with Calibration Coverage, two years</td>
<td>R&amp;S®CW2TSMW</td>
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<tr>
<td>Extended Warranty with Calibration Coverage, three years</td>
<td>R&amp;S®CW3TSMW</td>
<td></td>
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<tr>
<td>Extended Warranty with Calibration Coverage, four years</td>
<td>R&amp;S®CW4TSMW</td>
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Your local Rohde & Schwarz expert will help you determine the optimum solution for your requirements and will be glad to provide you with a customized quotation.
To find your nearest Rohde & Schwarz representative, visit [www.sales.rohde-schwarz.com](http://www.sales.rohde-schwarz.com)
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Environmental commitment
- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

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