R&S®TSME6 ULTRACOMPACT DRIVE TEST SCANNER

All bands and technologies simultaneously, future-proof upgradeability

Product Brochure
Version 17.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®TSME6 provides a maximum degree of freedom and upgradeability for efficient drive and walk tests. With its ultracompact design as well as multiband and multitechnology support for simultaneous measurements, the scanner fulfills all the requirements for a state-of-the-art measurement tool.

With its ultrabroadband frontend, the scanner measures all supported technologies from 350 MHz to 6 GHz simultaneously. The future-proof architecture and in-field upgradeability for both hardware and software enable up to 4x4 MIMO measurements and pave the way for 5G.

A compact, lightweight and sophisticated design with a low maximum power consumption of 13 W rounds off the features of this flexible, high-performance measurement tool for both drive and walk tests.

R&S®TSME6 ultracompact drive test scanner.

KEY FACTS

- No limitations in 3GPP frequency bands up to 6 GHz
- Measure more than ten technologies simultaneously in one scanner
- Supports R&S®TSME44DC and R&S®TSMS53DC downconverters for mmWave measurements
- Compact and lightweight with customized mechanical concept for cascading
- Low power consumption

BENEFITS

High-performance multifunctional platform

- Simultaneous measurements with no limitations in 3GPP frequency bands and technologies with SIB/L3 decoding support (up to 3GPP Release 17)
- Cascading and upward/downward compatibility for maximum freedom
- Easy software and hardware upgrades for new features
- Proof of upgradeability: mmWave and sub6 GHz 5G NR measurements on the R&S®TSME6, including FRMCS and 5G RedCap support
- Advanced 5G NR measurements
- 5G RedCap (5G NR-Light) support
- Cellular V2X support
- Mission-critical voice and data (MCX) network support (P25 and TETRA measurements)
- NB-IoT/Cat NB1 measurements
- LTE-M measurements
- RF power spectrum measurements up to 6 GHz for spectrum clearance
- Advanced measurements for deep network insights

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Versatile design and functionality

- Ultracompact design
- Minimal noise thanks to advanced cooling concept and low power consumption
- Integrated multi-GNSS with improved sensitivity and untethered dead reckoning
- Reduced setup time to increase efficiency of drive and walk tests

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Supported by a wide variety of software products

- Universal software platform for parallel measurements with scanners and test UE for QoS and user experience analysis
- Advanced measurements in LTE for troubleshooting and optimization
- Scanner application in benchmarking and optimization solutions
- Open interface and use as OEM

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Backpack system

- Maximum independence and configuration freedom
- Rugged and lightweight for all types of measurement campaigns

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HIGH-PERFORMANCE MULTIFUNCTIONAL PLATFORM

Simultaneous measurements with no limitations in 3GPP frequency bands and technologies with SIB/L3 decoding support (up to 3GPP Release 17)

The core of the R&S®TSME6 consists of very fast signal processing and a receiver frontend that seamlessly supports the frequency range from 350 MHz to 6 GHz. Decades of Rohde & Schwarz RF experience allows both to be combined in an extremely compact scanner. The R&S®TSME6 is fully user-configurable and enables simultaneous measurements. It covers all major wireless communications standards and offers deep RF and network insights with SIB/layer 3 (SIB/L3) decoding support and advanced LTE measurements.

With well-established LTE-Advanced network features such as carrier aggregation, the scanner is designed for high measurement speeds – even in multicarrier, multitechnology configurations.

Multitechnology measurements are mandatory for 5G NR non-standalone networks. Since information necessary to access the 5G NR carrier is transmitted on LTE, the R&S®TSME6 can decode the latest Release 15/16/17 SIB messages for LTE-5G NR dual connectivity and LTE sidelink information to perform these measurements simultaneously at high speed.

Examples of simultaneous use of multiple frequencies in different bands for each technology

	North America					Europe		
GSM	850 MHz	1900 MHz	–	–	–	900 MHz	1800 MHz	–
WCDMA	850 MHz	1900 MHz	2100 MHz/ AWS	–	–	900 MHz	2100 MHz	–
LTE-FDD, LTE-M	600 MHz/ 700 MHz	850 MHz	1900 MHz	2100 MHz/ AWS	LTE-LAA: 5300 MHz	700 MHz/ 800 MHz	1800 MHz	2100 MHz/ 2600 MHz
LTE-TDD	2500 MHz	3400 MHz	–	–	–	2500 MHz	3400 MHz	–
NB-IoT/Cat NB1	700/800/900/1800/1900/2100 MHz					700/800/900/1800/1900/2100 MHz		
Spectrum	UL and DL frequencies					UL and DL frequencies		
5G NR	sub6 GHz/FR1 (native), mmWave/FR2 (24 GHz to 44 GHz with R&S®TSME44DC, 17 GHz to 53 GHz with R&S®TSMS53DC), FDD/TDD up to Release 17, non-standalone/EN-DC, standalone							

Technology support at a glance

	Technologies supported	MIB, SIB decoding
GSM	●	●
WCDMA	●	●
CDMA2000®	●	●
1xEV-DO (Rel. 0/Rev. A/Rev. B)	●	●
WiMAX™ IEEE 802.16e	●	●
TD-LTE	●	● (Release 17, up to SIB32)
LTE-FDD	●	● (Release 17, up to SIB32)
LTE-M	●	●
NB-IoT/Cat NB1	●	●
C-V2X LTE	●	●
TETRA, TETRA DMO	●	●
Project 25 (P25)	● (phase 1, phase 2)	not yet
RF power scan	●	–
CW channel power RSSI scan	●	–
5G NR (FR1, FR2 with downconverter, FDD/TDD up to Release 17)	●	operation mode detection (NSA, SA) [1], MIB, SIB1 [1], OSI (SIB2 to SIB21, posSIBs) [1]; if broadcast

[1] CPU with AVX2 instruction set required.

Additionally, the 5G NR demodulator is upgraded continuously and currently supports up to SIB21. This enables the detection of special network configurations such as operation mode, RAN slicing and bandwidth part configurations.

The R&S®TSME6 not only supports measurements based on specific channels and signals, but also decodes MIB-SIB/L3 broadcast information from base stations. This feature makes it possible to determine the configuration of the wireless communications network in detail and to easily detect errors. MIB-SIB/L3 broadcast information is supported for all major 3GPP technologies.

Cascading and upward/downward compatibility for maximum freedom

Each investment in measurement tools should be long-term, ensuring maximum investment protection. The R&S®TSME6 achieves this by offering upward and downward compatibility. The synchronization interface can interact with a predecessor R&S®TSME or another R&S®TSME6 for MIMO measurements and can also control the R&S®TSME44DC/R&S®TSMS53DC downconverter when measuring above 6 GHz for 5G NR applications. The result is a future-proof product that offers users maximum freedom. See the R&S®TSME44DC/R&S®TSMS53DC product brochure (PD 3607.9608.12) for more details.

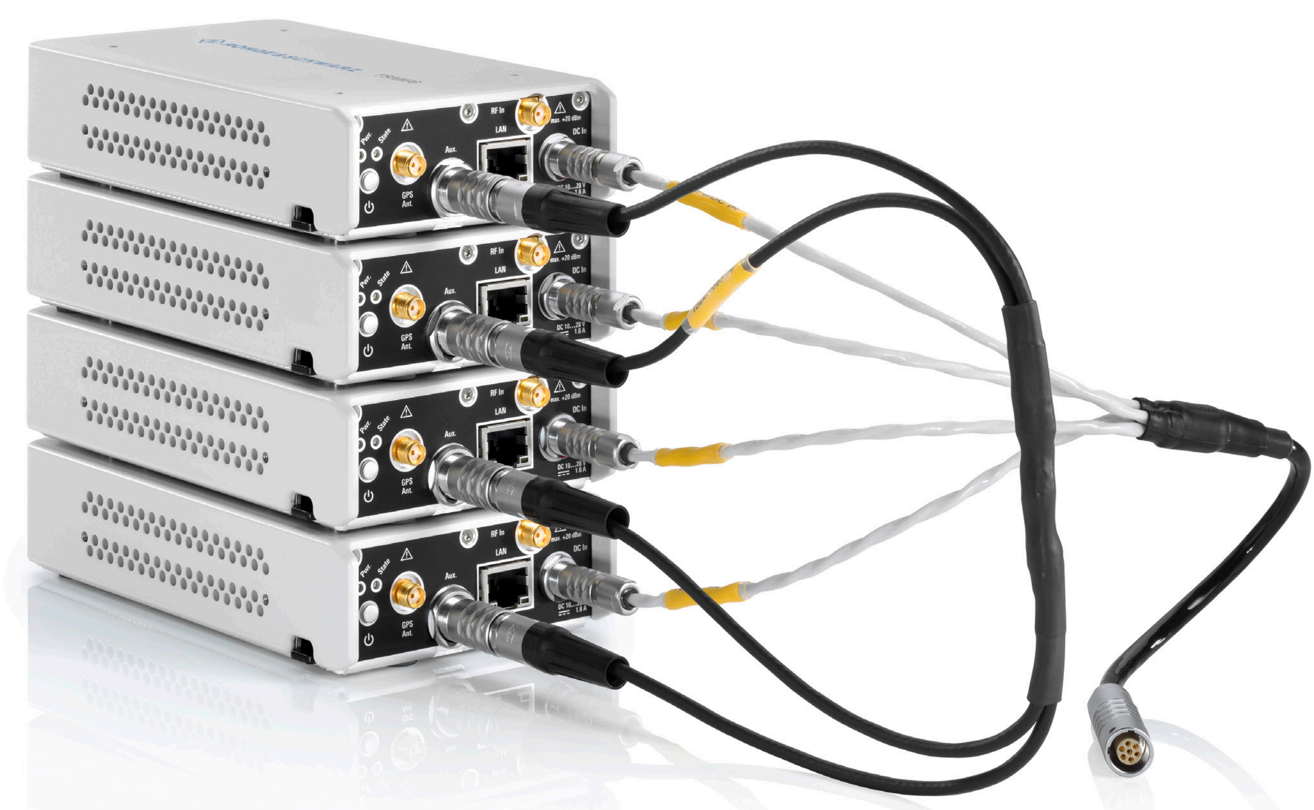
Multiple units can be conveniently cascaded thanks to a customized mechanical concept. A click-in mechanism creates a vibration-proof stack of seamlessly and mechanically connected R&S®TSME6 scanners and R&S®TSME44DC and R&S®TSMS53DC downconverters.

Easy software and hardware upgrades for new features

Additional support for new technologies and currently supported features can be easily managed via software updates on a straightforward graphical user interface.

With an extended hardware synchronization interface for controlling additional future and current hardware such as the R&S®TSME and the R&S®TSME6 for MIMO measurements, the R&S®TSME6 removes the limits of hardware compatibility.

Cascading multiple R&S®TSME6 network scanners using the R&S®TSME6-ZC4 synchronization cable for up to four units and the R&S®TSME6-ZYC4 4 × DC Y-cable for the power supply.



Proof of upgradeability: mmWave and sub6 GHz 5G NR measurements on the R&S®TSME6, including FRMCS and 5G RedCap support

5G NR has become the leading radio access technology in mobile networks. New use cases such as ultra-high-speed internet access, massive numbers of connected devices and low latency connections require a completely different radio interface to LTE. This leads to a very flexible physical layer that can be adapted to different use cases to enhance network availability and maximize quality of service – from low latency to ultra high data rate applications. One example of flexibility is the position of synchronization signal blocks (SSB). SSBs do not necessarily have to be at the center of the 5G NR carrier. It is almost impossible to detect them manually without having detailed information about the network configuration. The automatic channel detection (ACD) feature finds the frequency and transmission case of 5G NR SSBs without any user input except the frequency range where the algorithm should search for 5G NR SSBs.

A special network configuration in the frequency domain is dynamic spectrum sharing between 5G NR and LTE. The configuration helps operators rapidly deploy 5G NR and use their spectrum even more efficiently. This puts additional requirements on receivers. The R&S®TSME6 can identify and accurately measure such carriers. Additionally, the Future Railway Mobile Communication System (FRMCS) is on the horizon. FRMCS is a communications standard based on 5G NR that is optimized for railway voice and data communications operating on narrowband carriers. The R&S®TSME6 can perform RF measurements on such carriers and decode SIB/layer 3 information.

Another essential building block of the 5G NR physical layer is the use of beamforming technology. It is key to overcoming the issue of higher path loss due to operation at higher frequencies. Beamforming is even used for synchronization signals that UE traditionally uses to synchronize with the network. 5G NR synchronization signals are also used for channel quality estimations, which are the basis for establishing effective data transmissions.

The R&S®TSME6-K50 5G NR scanning option enables the R&S®TSME6 to measure 5G NR synchronization signal blocks on both sub6 GHz and mmWave spectra with an R&S®TSME44DC (24 GHz to 44 GHz) or R&S®TSMS53DC (17 GHz to 53 GHz) downconverter. 5G NR SSB measurements help verify 5G NR coverage and the effect of beamforming, which is a very complex technology involving several components. Each SSB can be transmitted on different beams (depending on the network configuration), which can be measured by the scanner. The scanner can also read the MIB content of each SSB and SIB1 to SIB21 if broadcast by the network. Using different SSBs and beams makes the scanner results three dimensional – power and signal-to-noise and interference measurements for each PCI and SSB/beam index deliver a complete set of

ROMES provides new views and signals for a clear overview of different PCIs and SSBs.

data to verify the transmission of each SSB/beam. 5G NR SSB measurements are supported for all SSB subcarrier spacings and transmission cases defined for sub6 GHz bands. ROMES drive test software provides new views and signals, giving a clear overview of different PCIs and SSBs for all evaluation tasks during measurement and replay.

Advanced 5G NR measurements

Network synchronization in the time domain becomes even more important with the introduction of 5G NR in TDD mode. Perfectly synchronized networks in the time domain offer better performance because they do not suffer from overlapping uplink and downlink timeslots. The R&S®TSME6 measures the time of arrival offset between the PPS pulse (or the internal receiver clock) and the received 5G NR and LTE synchronization signal blocks (SSB) to determine the quality of network synchronization.

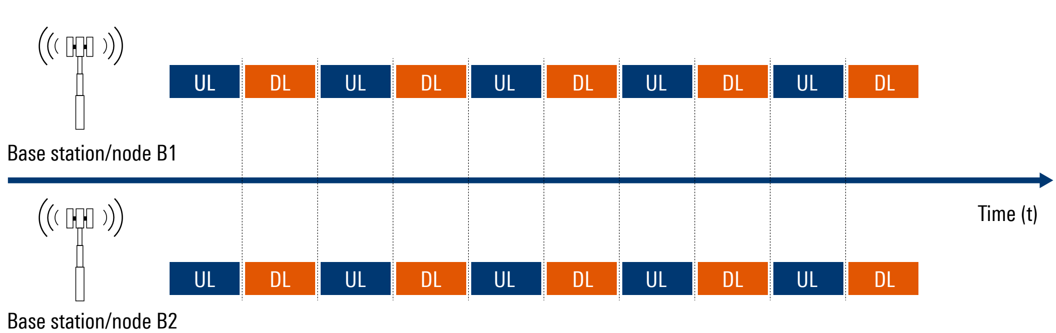
While the time of arrival offset between the PPS pulse and the SSB is a relative value, some measurements require the absolute time of arrival of the 5G NR SSB. Absolute times of arrival are mandatory to measure the time alignment error of a specific site. The entire signal chain, including the baseband, signal processing, cables and antenna elements with phase shifters and filters, can add significant time delays until the signal is transmitted over the air. The receiver can provide absolute and calibrated time of arrival values (UTC time), allowing these delays to be detected and optimized. Time alignment error measurements require an extremely precise timebase and stationary measurements to avoid multipath propagation and Doppler shift. Any deviation of a network's timebase will lead to a frequency drift. The precise SSB center frequency is therefore measured to detect drifting cells in the frequency domain.

A lack of network synchronization can cause interference in uplink and downlink slots. Internal interference comes from the network itself. But multiple external factors can also cause interference. The impact on network performance is the same: a reduced signal-to-noise ratio and a sharp decline in network performance. The uplink is the weak path and, if affected, it can completely prevent connections between the network and the phone. OSS data tells network operators which cells are experiencing interference, so they can focus on finding the source and powering it down. The R&S®TSME6 can measure the uplink and downlink spectrum by applying a time gate. The time gate can be automatically configured if the uplink/downlink configuration is broadcast in the system information messages. Otherwise, users can manually configure the uplink and downlink slots of interest. The result is a realtime spectrum of the configured time gate with a panoramic view of the entire spectrum or focused on interference to quickly locate the sources.

5G RedCap (5G NR-Light) support

5G Reduced Capability (RedCap), also known as 5G NR-Light, is a 5G standard for the vast and growing internet of things (IoT) landscape based on 5G technology. 5G RedCap aims to meet the requirements of IoT devices that need smaller, less complex RF solutions with better battery life than existing 5G offerings and lower costs. The R&S®TSMx mobile network scanners enable the user to easily detect 5G RedCap carriers with the automatic channel detection (ACD) feature, verify their network coverage and decode related SIB/layer 3 information.

Perfectly synchronized network



Cellular V2X support

For several years, vehicle manufacturers and government agencies have sought ways to increase road safety, manage traffic efficiently and, in the future, make driving more comfortable. Vehicle-to-everything (V2X) is a new generation of information and communications technology that connects vehicles to everything and can support these goals. V2X offers low latency vehicle-to-vehicle (V2V), vehicle-to-roadside infrastructure (V2I) and vehicle-to-pedestrian (V2P) communications to add a new dimension to future driver assistance systems.

In 3GPP Release 14, there is a specification for V2X communications referred to as cellular V2X (C-V2X), which uses LTE technology as the physical interface for communications.

The standard describes two modes. The vehicle-to-network (V2N) mode, with communications over the Uu interface, uses traditional cellular links to enable cloud services to be integrated into end-to-end solutions, e.g. to allow road and traffic information for a given area to be distributed to vehicles. The R&S®TSME6 ultracompact drive test scanner with the R&S®TSME6-K29 LTE scanning option is frequently used to validate and optimize the Uu interface in LTE networks.

The second mode is referred to as direct or sidelink mode (V2V, V2I, V2P), where communications take place over the PC5 interface. In this mode, C-V2X does not necessarily require a network infrastructure. It can operate without a subscriber identity module (SIM), without network assistance and uses GNSS as its primary source for time synchronization.

With the R&S®TSME6-K36 C-V2X LTE scanning option, the R&S®TSME6 measures the coverage and quality of the C-V2X direct communications between vehicles, infrastructure and vehicles, and vehicles and pedestrians. The scanner provides a neutral reference RF measurement that is independent of the suppliers of the commercial V2X transmitters and receivers, which serves as a baseline for the assessment of the system.

In addition, the scanner can decode ITS stack messages, which enables validation of a correct ITS implementation as well as verification of ITS applications in the field. By parsing the ITS messages and taking into account the location of the scanner and the arrival time of the signal, the distance and elevation difference between the C-V2X source and the scanner is calculated. If the C-V2X source broadcasts message generation time, the delay between when the message is generated and when it is received (one-way latency) can also be measured. This is particularly important for emergency braking events.

Visualization of C-V2X scanner measurements with ROMES.

The network scanner contributes to road safety and efficient traffic management, as illustrated in the following three use cases:

Roadside infrastructure deployment

As part of a C-V2X ecosystem, roadside units (RSU) will be deployed to inform vehicles about traffic conditions, road infrastructure and safety-relevant conditions. Vehicles can receive the layout of crossroads and traffic light conditions, speed limit information and warnings about construction sites. RSUs can be deployed permanently or temporarily and the information provided can be changed dynamically. To ensure that vehicles receive the information correctly, the RSU locations and coverage area must be planned as part of the rollout, similar to network planning in cellular networks. In dense urban environments with street canyon effects, challenges close to 6 GHz include radio transmission and reception and, in particular, reflections. A reference RF measurement with the scanner validates the planning result and helps improving the planning process for future sites. Following successful validation, owners and operators of critical RSU infrastructure can be sure that the system performs properly and contributes to road safety as expected.

Roadside infrastructure maintenance

Cities and road infrastructure are constantly changing, as is the RF environment in which the C-V2X system operates. The RSU hardware and connected antennas are also subject to wear in adverse environmental conditions, which is why RSUs need to be checked regularly.

The R&S®TSME6 ultracompact drive test scanner can validate the coverage and function of the transmitted signal during a drive test and can rule out the presence of any interference that could affect the operation of V2X communications.

Validation of V2V scenarios

The vehicle-to-vehicle application undergoes rigorous testing in the development and deployment phase.

During development, tests are conducted in proving grounds using real and simulated vehicles to validate functions such as emergency electronic brake light, left turn assist and intersection movement assist. The RF signals of all present real or virtual vehicles can be analyzed with the C-V2X scanner to validate the test setup.

Very dense traffic situations can occur in the field, leading to high spectrum occupancy and possible interference. The C-V2X scanner can analyze the RF environment in such situations and detect possible issues.

Software solutions

With the R&S®TSMx-API for R&S®TSMx mobile network scanners, the R&S®TSME6 can be used with any software in the fields of roadside infrastructure and traffic management testing, planning, deployment and maintenance.

The ROMES software supports C-V2X scanning for engineering use cases and as a reference implementation.

Mission-critical voice and data (MCX) network support (P25 and TETRA measurements)

Another safety-relevant use case of the R&S®TSME6 is coverage and interference measurement in mission-critical voice and data networks. Such networks are used by fire departments, police and other emergency services and are designed for maximum coverage and reliability in emergency situations. Sufficient RF coverage and quality affects everyone's safety. Depending on the region, TETRA/TETRA DMO and/or P25 networks are deployed. The R&S®TSME6 supports TETRA/TETRA DMO and P25 phase 1 and 2. Demodulation of system information is supported in TETRA/TETRA DMO.

VERSATILE DESIGN AND FUNCTIONALITY

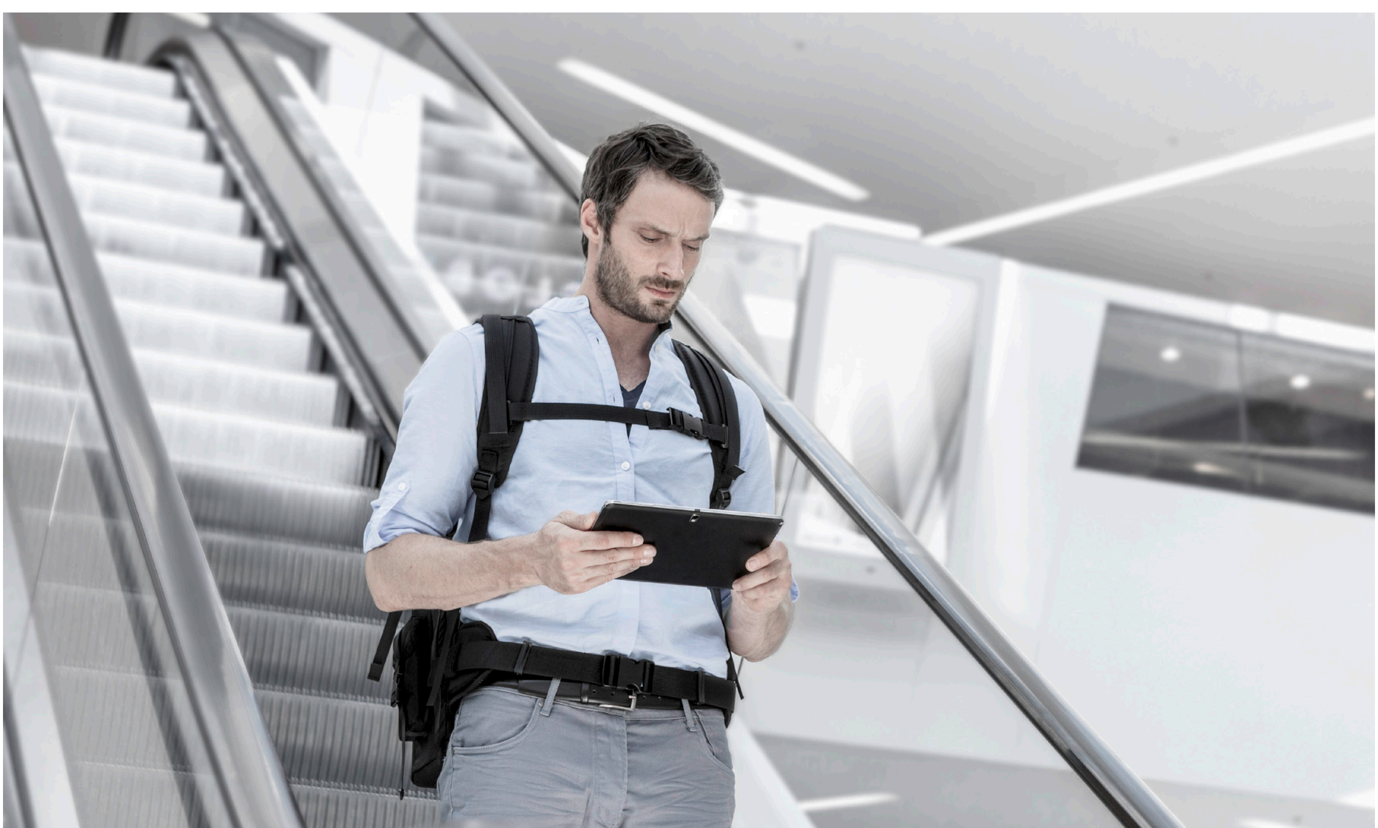
Ultracompact design
Measuring 35 mm × 85 mm × 154 mm and weighing only 490 g, the R&S®TSME6 is the lightest and most compact scanner in its class.

Minimal noise thanks to advanced cooling concept and low power consumption
Walk tests using a backpack require an unobtrusive measurement procedure, i.e. minimal noise and operation in a wide ambient temperature range. The R&S®TSME6 has a precise temperature-controlled fan and an advanced cooling concept for perfect interaction between active and passive cooling mechanisms. This ensures continuous operation in vehicles and in a convenient backpack system.

Integrated multi-GNSS with improved sensitivity and untethered dead reckoning
For precise and uninterrupted location tracking even in critical dense urban and in-vehicle environments, the R&S®TSME6 includes a multi-GNSS receiver with exceptionally high sensitivity for position fixing and position tracking that supports all major satellite navigation systems. The receiver can be addressed via the LAN interface and does not require an additional data link to the PC. Using up to three satellite systems in parallel for precise location tracking, the multi-GNSS chip uses the results from the integrated gyro/acceleration sensor to bridge gaps in satellite based data. This is useful for example when driving through road tunnels in a vehicle (requires a specific mounting solution).

Reduced setup time to increase efficiency of drive and walk tests
Setting up the measurement campaign is the most time-consuming process before valuable field data can be captured during drive and walk tests. To reduce costs and setup time, the R&S®TSME6 provides a helpful channel configuration feature for major 3GPP standards such as 5G NR, NB-IoT, LTE, LTE-M, WCDMA, GSM and CDMA2000®/1xEV-DO. In combination with the R&S®ROMES4ACD or R&S®TSME6-K40 automatic channel detection option, the R&S®TSME6 automatically detects active channels in a specified 3GPP band or frequency range. The results obtained during automatic channel detection can be added directly to the workspace, even during the measurement campaign. Technologies, frequency bands and carrier bandwidths are no longer static in shared spectrum networks. LTE can be deployed in a spectrum traditionally used for GSM or WCDMA, for

Walk test with the R&S®TSME6 and backpack system.



example. During drive and walk tests in such networks, frequent bandwidth and channel changes can regularly occur in all environments depending on the rollout strategy. To speed up the detection process and release signal processing capacity for other parallel measurement tasks, users can enhance the automatic channel detection feature with an optional spectrum scan.

NB-IoT/Cat NB1 measurements

The R&S®TSME6-K34 option enables the R&S®TSME6 to measure in NB-IoT/Cat NB1 networks. NB-IoT/Cat NB1 is a 3GPP standard for connecting a huge number of devices, such as smart meters, to the internet of things (IoT). While traditional LTE standards mainly enhance throughput and network capacity, NB-IoT/Cat NB1 focuses on low power consumption for IoT devices and maximum availability of the connection, especially indoors.

Indoor measurements require lightweight and ultracompact scanners with low power consumption. For coverage validation, troubleshooting and optimization, the R&S®TSME6 measures signal power and quality and the signal to interference and noise ratio (SINR) on each available physical cell ID based on synchronization and reference signals.

To efficiently integrate the NB-IoT carrier into the available spectrum, the standard provides three operating modes. The R&S®TSME6 supports all three modes. The most spectrum-efficient mode is the LTE in-band operating mode, where the NB-IoT carrier uses the spectrum of one LTE physical resource block (PRB). The guard band and standalone operating modes allow NB-IoT deployments independent of the LTE spectrum.

With the appropriate R&S®TSME6 options, NB-IoT measurements can be run simultaneously with measurements on other technologies such as GSM, LTE and (W)CDMA. For optimization or when troubleshooting, the impact of the NB-IoT spectrum on adjacent GSM/LTE/(W)CDMA spectra and vice versa can be validated.

LTE-M measurements

LTE-M is another 3GPP standard for connecting things to the internet. LTE-M addresses use cases other than NB-IoT, for instance voice (VoLTE) and mobility. It also provides higher data rates than NB-IoT. LTE-M is based on legacy LTE and reuses some of the cell-specific signals. Like NB-IoT, LTE-M uses smart mechanisms to enlarge the link budget. One of these mechanisms is frequency hopping to overcome fading and areas of bad SINR (resulting from LTE traffic and other interference) across the LTE spectrum. This is achieved by dividing the LTE carrier into several LTE-M narrowbands that can handle LTE-M traffic in a manner that suits the RF environment. The R&S®TSME6 supports LTE-M measurements that deliver RF parameters (SINR, RSRP, RSRQ and RSSI) on each of these LTE-M narrowbands via a PCI interface to identify, for example, the best narrowband for LTE-M data transmission.

In the ROMES drive test software, all narrowbands can be compared at a glance to evaluate the RF environment in the surrounding narrowbands. Fading and interference from LTE traffic and other pilot signals can cause the RF parameter differences between the narrowbands to be quite remarkable. Scanner based and module based results can also be compared to verify whether the LTE-M module is using the best narrowband for data transmission.

RF power spectrum measurements up to 6 GHz for spectrum clearance

To overcome capacity problems in mobile networks, additional spectra will be acquired. In the latest frequency plans, the spectrum from 3.2 GHz to 6 GHz will be used for additional LTE carriers as well as for the fifth generation of mobile networks, which is ready to become the main technology and is expected to grow significantly over the next few years. To provide the best quality of service following a commercial network rollout, spectrum measurements during the early engineering phase must ensure that the new spectrum is free of interference. Especially when it comes to spectra that overlap with Wi-Fi® and are heavily occupied by Wi-Fi® access points, a general picture of the spectrum occupancy is needed to detect the noise floor and identify areas with a critical SINR before network rollout.

Advanced measurements for deep network insights

Passive scanner measurements are no longer limited to measuring specific signals and channels and decoding SIB/L3 information. The R&S®TSME6 uses intelligent and optimized signal processing algorithms to provide deep network insights that go beyond purely RF parameters.

Dedicated measurements on reference signals of each LTE resource block deliver a complete picture of broadband carriers. They also provide insights into fading effects, wideband and narrowband interference and inband operation of advanced IoT technologies. These technologies occupy LTE resource blocks such as LTE-M and Cat NB1/NB-IoT and might affect adjacent subbands.

During a drive test, ROMES uses measurement and location data provided by the R&S®TSME6 to quickly and accurately estimate the geographic position and sector orientation of the base stations. 5G NR, GSM, WCDMA, LTE, NB-IoT, CDMA2000®/1xEV-DO and TETRA networks are supported in parallel. This unique feature enables users to quickly generate a base station list for export or graphical display.

SUPPORTED BY A WIDE VARIETY OF SOFTWARE PRODUCTS

Universal software platform for parallel measurements with scanners and test UE for QoS and user experience analysis

The ROMES drive test software collects, visualizes and stores data from Rohde & Schwarz scanners and special mobile devices. The scanners and mobile devices can be controlled and configured via ROMES, which runs through various user-configurable measurement routines and supports all major 3GPP technologies. Examples of QoS measurements include FTP download/upload and voice quality testing. In combination with special QualiPoc devices, ROMES supports even more test routines, enabling analysis of real-world user experiences such as uploading a file to a cloud or watching a live video stream.

The package of available test routines, supported technologies and devices is continually being expanded. For example, ROMES supports scanner and device based measurements in 5G NR, NB-IoT/Cat NB1 and LTE-M networks – the latest network technologies for connecting devices ("things") to the internet. Both measurements can be performed in parallel, enabling troubleshooting and optimization. As an example, NB-IoT devices are limited to one specific network and impaired by various behaviors that are also influenced by the test script. Drive tests conducted with NB-IoT user equipment that is actively transferring data miss a certain amount of data during the segments in connected mode. Scanner based measurements are able to supply uninterrupted measurement data independent of the user equipment. The measurements provide the purely RF view needed for verification, troubleshooting, competitor analysis and network optimization.

Advanced measurements in LTE for troubleshooting and optimization

In the case of unexpected results that indicate poor network performance, the parallel scanner measurement can be used for troubleshooting. If the data throughput is lower than expected, the channel quality indicator (CQI) can help determine the reason for the reduced data throughput. A low CQI might indicate areas of high interference. High interference reduces the signal to interference and noise ratio (SINR), resulting in a lower modulation and coding scheme value. This significantly reduces the data rate. The R&S®TSME6 measures and analyzes interference and insufficient coverage in parallel for various LTE channels. It detects channel-specific top N pools containing strong and weak cells, and also covers the carrier aggregation case in LTE. To estimate the upper limit of data throughput based on the current RF conditions, the scanner delivers an estimated throughput value, which is visualized by ROMES for each data layer in MIMO measurement setups.

Scanner application in benchmarking and optimization solutions

SmartBenchmarker systems are modular and rugged drive test systems with up to 8 individual PC modules that support e.g. 2 scanners for MIMO measurements and 24 mobile devices for a comprehensive benchmarking approach. This high-productivity measurement system meets all the requirements for efficient and error-free operation in large-scale deployments. To evaluate benchmarking results, Rohde & Schwarz offers various data management tools that provide scalable data analysis, flexible interfaces and reporting for the data captured during benchmarking campaigns.

Open interface and use as OEM

Many manufacturers have integrated Rohde & Schwarz scanners permanently into their drive test toolchain. The application programming interface R&S®TSMx-API for R&S®TSMx mobile network scanners makes it easy to integrate the R&S®TSME6 and create individual solutions for mobile network testing and cellular network analysis.

The native Windows based ViCom API supports all technologies provided by the network scanner. The new R&S®ViComWeb runs an API server under Windows that is queried via the web, which makes integration simpler than with the native Windows API.

For details about R&S®ViComWeb, see the R&S®TSMx-API for R&S®TSMx mobile network scanners product brochure (PD 3684.1366.12).

BACKPACK SYSTEM

Maximum independence and configuration freedom

To ensure efficient measurement campaigns even in multi-scanner measurement scenarios such as 4x4 MIMO, a backpack system is available. It can hold up to four scanners and six mobile phones, including all accessories, allowing the user to work independently in the field. To reduce valuable hardware setup time, the batteries are charged inside the backpack. The system is based on the well-established Rohde & Schwarz mobile network testing backpack platform, with all accessories provided from a single source.

The backpack system can be optionally equipped with an ultracompact PC system that runs ROMES or SmartBenchmarker. It can be accessed via Windows Remote Desktop and be used by any suitable device over LAN, Wi-Fi® or Bluetooth®.

Rugged and lightweight for all types of measurement campaigns

The backpack includes a Gigabit Ethernet switch for multi-scanner operation and a USB hub for mobile device based measurements. An integrated cooling system ensures reliable operation even during long measurement campaigns. Measurement antennas can be connected internally and externally to support various antenna models with different mounting locations for walk tests and drive tests.

Featuring ergonomic straps, soft padding, a rugged hard shell that protects the electronics inside from external impacts and long-lasting battery-powered operation, the backpack meets all the requirements for everyday use.

SPECIFICATIONS

Base unit		
System requirements	minimum	PC, 2 Gbyte RAM, Gigabit Ethernet, 9k jumbo frames
	recommended	quad core CPU [1], 8 Gbyte RAM, Gigabit Ethernet, 9k jumbo frames
RF characteristics		
Frequency range		350 MHz to 6 GHz
Level measurement uncertainty	350 MHz to 3 GHz	< 1 dB
	3 GHz to 6 GHz	< 1.5 dB
Maximum operating measurement range input level		–10 dBm (nom.)
Maximum extended measurement range input level	in extended range mode: not 100 % compliant with measured values	+10 dBm (nom.)
Maximum safe permissible input level		+20 dBm/10 V DC
Noise figure	900 MHz	5 dB (meas.)
	2100 MHz	5 dB (meas.)
	3500 MHz	6 dB (meas.)
	5100 MHz	7 dB (meas.)
Intermodulation-free dynamic range	900 MHz	–2 dBm (meas.)
	2100 MHz	–2 dBm (meas.)
	3500 MHz	–9 dBm (meas.)
	5100 MHz	–14 dBm (meas.)
RF receive paths		1
VSWR (preselection on/off)	350 MHz ≤ f ≤ 1.6 GHz	< 2.7/2.0 (meas.)
	1.6 GHz ≤ f ≤ 2.45 GHz	< 2.6/1.7 (meas.)
	2.45 GHz ≤ f ≤ 3.6 GHz	< 3.0/2.3 (meas.)
	3.6 GHz ≤ f ≤ 6.0 GHz	< 3.4/2.6 (meas.)
Frequency accuracy	GPS locked	0.03 ppm
	GPS unlocked	< 1 ppm
LTE/LTE-M characteristics		
Frequency bands supported		no restrictions
Measurement modes	automatic detection of carrier bandwidth: 1.4/3/5/10/15/20 MHz	LTE-FDD, LTE-TDD, LTE-M
Measurement speed (LTE/LTE-M)	automatic detection of all 504 physical cell IDs with SIB decoding active/two adjacent channels	max. 399 Hz/25 Hz (meas.)
Physical decoding accuracy		
Sensitivity for initial physical cell ID decoding	sync signal power (LTE)	–128 dBm (meas.)
	RSRP (LTE/LTE-M)	–147 dBm/–132 dBm (meas.)
Sensitivity after successful physical cell ID decoding	sync signal power (LTE)	–130 dBm (meas.)
	RSRP (LTE/LTE-M)	–149 dBm/–132 dBm (meas.)
WB RS SINR dynamic range		–20 dB to +42 dB (meas.)
Sync SINR dynamic range		–20 dB to +42 dB (meas.)
PCI false detection (ghost code)		$< 10^{-8}$
LTE C-V2X characteristics		
Measurements supported	PSCCH and PSSCH	RS-RSRP, RS-CINR, RSSI
Regions supported		EU, NA, CN
Transmission mode supported		TM4 (GNSS reception required)
Sensitivity		–110 dBm
Measurement speed		2 Hz to 4 Hz
CINR dynamic range		–5 dB to +30 dB

[1] AVX2 instruction set required for 5G NR SIB demodulation.

Base unit		
NB-IoT/Cat NB1 characteristics		
Frequency bands supported		no restrictions
NB-IoT/Cat NB1 measurement modes		▶ standalone ▶ guard band ▶ in-band
Sensitivity for physical cell ID decoding (initial decoding)	sync signal power (NSSS power)	–132 dBm (meas.)
	reference signal power (NRSRP)	–143 dBm (meas.)
Sensitivity for physical cell ID decoding (after successful decoding)	sync signal power (NSSS power)	–135 dBm (meas.)
	reference signal power (NRSRP)	–146 dBm (meas.)
Sync CINR dynamic range	sync signals (NSSS CINR)	–18 dB to +30 dB (meas.)
	reference signals (NRS CINR)	–17 dB to +30 dB (meas.)
Measurement speed		5 Hz (single channel) (meas.)
Demodulation threshold	sync signal power (NSSS power)	–120 dBm (meas.)
PCI false detection (ghost code)		$< 10^{-8}$
5G NR characteristics		
Frequency bands supported		FR1 (sub6 GHz), FR2 (24 GHz to 44 GHz), FDD/TDD up to Release 16/17
SSB subcarrier spacings supported		15 kHz, 30 kHz, 120 kHz, 240 kHz
SSB periodicities supported		5 ms, 10 ms, 20 ms, 40 ms, 80 ms, 160 ms
SSB index detection threshold (single PCI)	SS-RSRP (10 ms periodicity, 30 kHz subcarrier spacing)	–145 dBm (meas.)
	SS-RSRP (40 ms periodicity, 30 kHz subcarrier spacing)	–140 dBm (meas.)
	SS-RSRP (5 ms periodicity, 15 kHz subcarrier spacing)	–153 dBm (meas.)
	SS-RSRP (20 ms periodicity, 15 kHz subcarrier spacing)	–146 dBm (meas.)
	SS-RSRP (20 ms periodicity, 120 kHz subcarrier spacing)	–136 dBm (meas.)
	SS-RSRP (20 ms periodicity, 240 kHz subcarrier spacing)	–135 dBm (meas.)
SINR dynamic range	against AWGN	
	20 ms periodicity, 30 kHz subcarrier spacing	–21 dB to +40 dB (meas.)
	20 ms periodicity, 240 kHz subcarrier spacing	–18 dB to +33 dB (meas.)
	against interfering cell	
	20 ms periodicity, 30 kHz subcarrier spacing	–40 dB to +40 dB (meas.)
	20 ms periodicity, 240 kHz subcarrier spacing	–40 dB to +33 dB (meas.)
Measurement speed (single PCI)	20 ms periodicity, 30 kHz subcarrier spacing	49 Hz (meas.)
	40 ms periodicity, 30 kHz subcarrier spacing	26 Hz (meas.)
	20 ms periodicity, 120 kHz subcarrier spacing	49 Hz (meas.)
	80 ms periodicity, 120 kHz subcarrier spacing	14 Hz (meas.)
Minimum MIB demodulation threshold	SS-RSRP (30 kHz subcarrier spacing)	–144 dBm (meas.)
	SS-SINR (30 kHz subcarrier spacing)	–21 dB (meas.)
Minimum SIB demodulation threshold	SS-RSRP (30 kHz subcarrier spacing)	–123 dBm (meas.)
	SS-SINR (30 kHz subcarrier spacing)	–5 dB (meas.)
Timebase accuracy (for time alignment measurements)	depending on quality of GNSS signal	5 ns to 30 ns (meas.)
WCDMA characteristics		
Frequency bands supported		no restrictions
Number of RF carrier frequencies		max. 32
Measurement speed	high speed/high dynamic mode, automatic detection of all 512 scrambling codes	300 Hz/80 Hz with BCH demodulation
Scrambling code detection sensitivity (RSCP)		
Sensitivity for initial SC detection	high speed/high dynamic mode	–116 dBm/–127 dBm (meas.)
Sensitivity after successful SC detection	high speed/high dynamic mode	–122 dBm/–132 dBm (meas.)

Base unit		
Scrambling code false detection (ghost code)		< 10^{-9}
Dynamic range E_c/I_0 for initial detection	high speed/high dynamic mode	–19 dB/–28 dB (meas.)
Dynamic range E_c/I_0 after successful detection	high speed/high dynamic mode	–23 dB/–30 dB (meas.)
Minimum BCH demodulation threshold E_c/I_0	high speed/high dynamic mode	> –15 dB/–19 dB (meas.)
GSM characteristics		
Frequency bands supported		no restrictions
Measurement modes	in parallel	DB/TCH/SCH code power, TCH total in-band power, TCH timeslot power, GSM spectrum, BCH demodulation for all system information types
Measurement speed	with SI decoding active	800 channels/s (meas.)
Sensitivity	detection/BSIC decoding/BCH decoding	–122 dBm/–120 dBm/–119 dBm (meas.)
BSIC decoding dynamic range		
Sensitivity for initial BSIC detection		C/I > –1 dB (meas.)
Sensitivity after successful BSIC detection		C/I > –24 dB (meas.)
BCCH decoding dynamic range		C/I > 0 dB (meas.)
CDMA2000® characteristics		
Frequency bands supported		no restrictions
Number of RF carrier frequencies		max. 32
Measurement speed	automatic detection of all 512 PN codes	80 Hz (meas.), with BCH demodulation
PN detection sensitivity (initial decoding)	RSCP without/with demodulation	–130 dBm/–125 dBm (meas.)
1xEV-DO characteristics (Rel. 0/Rev. A/Rev. B)		
Frequency bands supported		no restrictions
Number of RF carrier frequencies		max. 32
Measurement speed		30 Hz (meas.), with BCH demodulation
PN detection sensitivity (initial decoding)	RSCP without/with demodulation	–130 dBm/–125 dBm (meas.)
TETRA characteristics		
Measurement type		RF parameters, constellation diagram/EVM measurements
TETRA bands supported		no restrictions
Number of RF carrier frequencies	within a 10 MHz downlink band	max. 400
Channel resolution		25 kHz (QPSK)
Measurement speed		max. 8000 channels/s, 20/s for a 10 MHz block
Sensitivity (RSSI)	RSSI measurements	–128 dBm (meas.)
	TETRA BSCH decoding (BSCH decoding for channels with SNR > 8 dB)	–121 dBm (meas.)
	BER measurements	–121 dBm (meas.)
Project 25 (P25) characteristics		
Sensitivity (RSSI)		–130 dBm to –25 dBm (meas.)
Dynamic range (SNR)		3 dB to 50 dB (meas.)
Measurement rate		max. 5 Hz (meas.)
WiMAX™ characteristics		
Frequency bands supported		no restrictions
Measurement speed	automatic detection of all 114 preamble indices	9 channels/s (meas.)
Preamble decoding accuracy	frame duration: 5 ms; FFT size: 1024, bandwidth: 10 MHz/2.657 GHz	±1 dB (–20 dBm to –110 dBm) (meas.)
Sensitivity for initial preamble decoding	RSSI, bandwidth: 10 MHz	–105 dBm (meas.)
Sensitivity after successful preamble decoding	RSSI, bandwidth: 10 MHz	–129 dBm (meas.)
SINR dynamic range		–22 dB to +26 dB (meas.)
RF power scan		
Frequency range		350 MHz to 6 GHz
Frequency resolution		140 Hz to 1.438 MHz
Sensitivity	22.46 kHz (RMS) frequency resolution, at 900 MHz	–126 dBm (meas.)
	140 Hz resolution bandwidth, RMS, at 900 MHz	–147 dBm (meas.)

Base unit		
Scan speed	180 kHz resolution, 100 MHz span, 20 MHz bandwidth, FFT size: 128	315 Hz (meas.)
	11.23 kHz resolution, 10 MHz span, 10 MHz bandwidth, FFT size: 1024	950 Hz (meas.)
	140 Hz resolution, 1 MHz span, 1 MHz bandwidth, FFT size: 8192	130 Hz (meas.)
RSSI scan speed	20 MHz span, 20 MHz bandwidth, FFT size: 1024	99 GSM channels: max. 995 Hz (98505 channels/s) (meas.)
	20 MHz span, 20 MHz bandwidth, FFT size: 256	4 WCDMA channels: max. 995 Hz (3980 channels/s) (meas.)
	20 MHz span, 20 MHz bandwidth, FFT size: 256	1 LTE channel (20 MHz): max. 995 Hz (995 channels/s) (meas.)
Maximum number of frequency ranges		20
Detectors		max., min., RMS, auto
CW scanning		
Sensitivity channel power RSSI scan	200 kHz channel (GSM)	–117.5 dBm (meas.)
	5 MHz channel (UMTS)	–103 dBm (meas.)
	20 MHz channel (LTE)	–97.5 dBm (meas.)
Scan rate	200 kHz channel (GSM)	1900 Hz (190000 channels/s) (meas.)
	5 MHz channel (UMTS)	12995 Hz (51980 channels/s) (meas.)
	20 MHz channel (LTE)	13000 Hz (13000 channels/s) (meas.)
Interfaces		
	LAN	Gigabit Ethernet
	GPS_{Ant}	SMA female
	RF_{In}	SMA female
	AUX	6-pin connector, synchronization and control interface for additional hardware
	DC_{In}	input for DC power supply (10 V to 28 V/1.8 A)
Multi-GNSS receiver		
Supported navigation systems	max. three in parallel, combinations depend on software implementation	multi-GNSS: GPS, GLONASS, BeiDou, Galileo
Sensitivity (GPS, Galileo, GLONASS)	cold start	–148 dBm
	tracking/reacquisition	–160 dBm
Acquisition (GPS, Galileo, GLONASS)	cold start	26 s
	hot start	1 s
Channels		50
General data		
Environmental conditions		
Temperature range	operating	0 °C to +50 °C
	storage	–40 °C to +70 °C
Damp heat		+25 °C/+55 °C, 95 % relative humidity, noncondensing cyclic, in line with EN 60068-2-30
Mechanical resistance		
Vibration	sinusoidal	5 Hz to 55 Hz, 0.15 mm amplitude constant, 55 Hz to 150 Hz, 0.5 g constant, in line with EN 60068-2-6
	random	10 Hz to 300 Hz, acceleration 1.9 g (RMS), 300 Hz to 500 Hz, acceleration 1.2 g (RMS), in line with EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810E, method 516.4, procedure I
Power rating		
Supply voltage	DC	10 V to 28 V/1.8 A
Power consumption during operation		typ. 10.5 W, max. 13 W
Maximum inrush current		2 A at 10 V

Base unit		
Product conformity		
Electromagnetic compatibility	EU	in line with EMC directive 2004/108/EC, applied harmonized standards: EN 61326-1 (industrial environment), EN 61326-2-1, EN 55011 (class B), EN 61000-3-2, EN 61000-3-3, EN 50498
	Korea	KC mark
Electrical safety	EU	in line with directive 2014/35/EU: EN 61010-1
	USA	UL 61010-1
	Canada	CAN/CSA-C22.2 no. 61010-1
International safety approvals	Association for Electrical, Electronic and Information Technologies (VDE)	VDE mark, certificate no. 40039189
	Canadian Standards Association (CSA)	$_{C}$CSA$_{US}$ mark, certificate no. 70002782
Calibration interval		24 months
Dimensions	W × H × D	154 mm × 35 mm × 85 mm (6.06 in × 1.38 in × 3.35 in)
Weight		490 g (1.08 lb)

R&S®TSME-Z1 AC power supply		
Power rating		
Input voltage		100 V to 240 V AC ± 10 %
Input frequency		47 Hz to 63 Hz
Input current	230 V to 100 V AC	0.4 A to 0.8 A
Efficiency		CEC V
Output voltage		12 V DC
Output current		2.5 A
Standard output cable length		180 cm (5.9 ft)
Temperature range	operating	0 °C to +60 °C
	derating	derated linearly from 40 °C at 100 % load to 60 °C at 60 % load
Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EU	applied harmonized standards: EN 61204-3 (class A), EN 61000-3-2, EN 61000-3-3
	international	CISPR/FCC (class A)
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EU	applied harmonized standard: EN 60950-1
	international	UL 60950-1, PSE J60950-1
Restriction of the use of hazardous substances	EU: in line with 2011/65/EU (RoHS)	applied harmonized standard: EN 50581
Dimensions and weight		
Dimensions	W × H × D	57.6 mm × 33.5 mm × 107.7 mm (2.27 in × 1.32 in × 4.24 in)
Weight		400 g (0.88 lb)

R&S®TSMA6-Z1 AC power supply (with R&S®TSMA6-Z174 adapter cable)		
Power rating		
Input voltage	at +25 °C (1.6 A charge/1.6 A discharge)	100 V to 240 V AC ± 10 %
Input frequency		50/60 Hz ± 5 %
Input current	230 V to 115 V AC	0.7 A to 1.4 A
Efficiency		CEC VI
Output voltage		15 V DC
Output current		7.0 A
Standard output cable length		120 cm (3.9 ft)
Temperature range	operating	–10 °C to +70 °C
	derating 230 V AC	derated linearly from +45 °C at 100 % load to +70 °C at 50 % load
	derating 110 V AC	derated linearly from +40 °C at 100 % load to +60 °C at 50 % load
Product conformity		
Electromagnetic compatibility	EU: in line with EMC Directive 2014/30/EU	applied harmonized standards: EN 55032 (class B), EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-8, EN 61000-4-11
	international	CISPR 32
Electrical safety	EU: in line with Low Voltage Directive 2014/53/EU	applied harmonized standard: EN 60950
	international	CCC GB4943.1, PSE J60950-1, KC K60950-1
Restriction of the use of hazardous substances	EU: in line with 2011/65/EU (RoHS)	applied harmonized standard: EN 50581
Dimensions and weight		
Dimensions	W × H × D	67 mm × 35 mm × 167 mm (2.64 in × 1.38 in × 6.57 in)
Weight		583 g (1.29 lb)

Measured values (meas.)
Characterize expected product performance by means of measurement results gained from individual samples.

Nominal values (nom.)
Characterize product performance by means of a representative value for the given parameter, e.g. nominal impedance. In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

ORDERING INFORMATION

Designation	Type	Order No.
Base unit (includes accessories such as power cable, manual)		
Ultracompact drive test scanner	R&S®TSME6	4900.0004.02
Scope of delivery: R&S®TSME6, LAN cable, GPS antenna, 12 V DC power supply cable (cigarette lighter cable), 4 mounting pins, getting started manual (printed version)		
Software options (firmware)		
P25 scanning	R&S®TSME6-K19	4900.2720.02
WCDMA scanning	R&S®TSME6-K21	4900.2188.02
CDMA2000® scanning	R&S®TSME6-K22	4900.2165.02
GSM scanning	R&S®TSME6-K23	4900.2194.02
1xEV-DO Rev. A scanning	R&S®TSME6-K24	4900.2159.02
CW scanning	R&S®TSME6-K25	4900.2242.02
TETRA scanning	R&S®TSME6-K26	4900.2142.02
RF power scan	R&S®TSME6-K27	4900.2120.02
WiMAX™ scanning	R&S®TSME6-K28	4900.2136.02
LTE scanning	R&S®TSME6-K29	4900.2171.02
LTE 2x2, 4x2, 4x4 MIMO	R&S®TSME6-K30	4900.2113.02
LTE eMBMS scanning	R&S®TSME6-K32	4900.2288.02
NB-IoT/Cat NB1 scanning	R&S®TSME6-K34	4900.2207.02
LTE-M scanning	R&S®TSME6-K35	4900.2465.02
C-V2X LTE scanning	R&S®TSME6-K36	4900.2707.02
5G NR scanning	R&S®TSME6-K50	4900.2436.02
5G NR scanning add-ons	R&S®TSME6-K51	4900.2488.02
5G RedCap scanning	R&S®TSME6-K52	4900.2736.02
Automatic channel detection	R&S®TSME6-K40	4900.2259.02
Block I/Q data	R&S®TSME6-K10	Contact your local Rohde & Schwarz sales office
Simultaneous measurement in 1 band	R&S®TSME6-K1B	4900.2094.02
Simultaneous measurement in 2 bands	R&S®TSME6-K2B	4900.2088.02
Simultaneous measurement in 3 bands	R&S®TSME6-K3B	4900.2071.02
Simultaneous measurement in 4 bands	R&S®TSME6-K4B	4900.2065.02
Simultaneous measurement in 5 bands	R&S®TSME6-K5B	4900.2059.02
Simultaneous measurement in all bands	R&S®TSME6-KAB	4900.2107.02
Upgrade with one additional band (in-field)	R&S®TSME6-KUB	4900.2307.02
Additional software		
ROMES drive test software	ROMES	1117.6885.04
R&S®TSME6 driver, for ROMES drive test software	R&S®ROMES4T1E	1117.6885.82
ROMES option, base station position estimation	R&S®ROMES4LOC	1117.6885.32
ROMES option, automatic channel detection	R&S®ROMES4ACD	1506.9869.02
Extras		
Downconverter (24 GHz to 44 GHz)	R&S®TSME44DC	4901.2600.02
Downconverter (17 GHz to 53 GHz)	R&S®TSMS53DC	4902.0001.02
AC power supply	R&S®TSME-Z1	1514.7310.00
Cigarette lighter cable	R&S®TSME6-ZCC	4900.1900.02
19" rack adapter for four R&S®TSME6 scanners	R&S®TSME6-Z2	4900.1030.02
Mounting kit	R&S®TSME6-Z4	4900.1100.02
Carrying box	R&S®TSME6-Z5	4900.1875.02
R&S®TSME DC Y-cable	R&S®TSME-ZYC	1514.7290.02
R&S®TSME6 4 × DC Y-cable	R&S®TSME6-ZYC4	4900.1846.02
R&S®TSMA6 AC power supply	R&S®TSMA6-Z1	4901.0550.02

Designation	Type	Order No.
Synchronization cable for two R&S®TSME6 scanners	R&S®TSME6-ZC2	4900.1800.02
Synchronization cable for up to four R&S®TSME6 scanners	R&S®TSME6-ZC4	4900.1817.02
Synchronization port to BNC port cable	R&S®TSME6-ZCS	4901.1540.02
Synchronization port to BNC and SMA cable	R&S®TSME6-ZCS2	4901.1704.02
Antennas		
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, 406 MHz to 440 MHz	R&S®TSMW-ZE2	1117.8165.00
Antenna emitter, 380 MHz to 430 MHz	R&S®TSMW-ZE7	1519.5709.02
Antenna emitter, 698 MHz to 2700 MHz	R&S®TSMW-ZE8	1506.9852.02
Antenna emitter, 430 MHz to 470 MHz	R&S®TSMW-ZE9	1519.5709.03
Antenna emitter, 600 MHz to 6000 MHz	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) + 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) + 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
PC accessories		
USB 3.0 to Gbit LAN adapter	R&S®TSPC-U2L	3593.8430.02
USB-C to 4 × Gbit LAN adapter (2 ports usable)	R&S®TSPC-U2L4	3718.2423.02
5-port USB or AC-powered LAN switch	R&S®TSPC-LS	3624.8364.02
Backpack system		
Backpack system	Contact your local Rohde & Schwarz sales office	

Warranty		
Base unit		3 years
All other items [1]		1 year
Service options		
Extended warranty, one year	R&S®WE1	Contact your local Rohde & Schwarz sales office
Extended warranty, two years	R&S®WE2	
Extended warranty with calibration coverage, one year	R&S®CW1	
Extended warranty with calibration coverage, two years	R&S®CW2	
Extended warranty with accredited calibration coverage, one year	R&S®AW1	
Extended warranty with accredited calibration coverage, two years	R&S®AW2	

[1] For options that are installed, the remaining base unit warranty applies if longer than one year. Exception: all batteries have a one-year warranty.

Your local Rohde & Schwarz expert will help find the best solution for you.
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