R&S®CMWrun
Sequencer Software Tool
Applications

Operators

Chipsets

Internet of Things

Internet of Things

Production

Mobile devices

Automotive

Smart home

PS

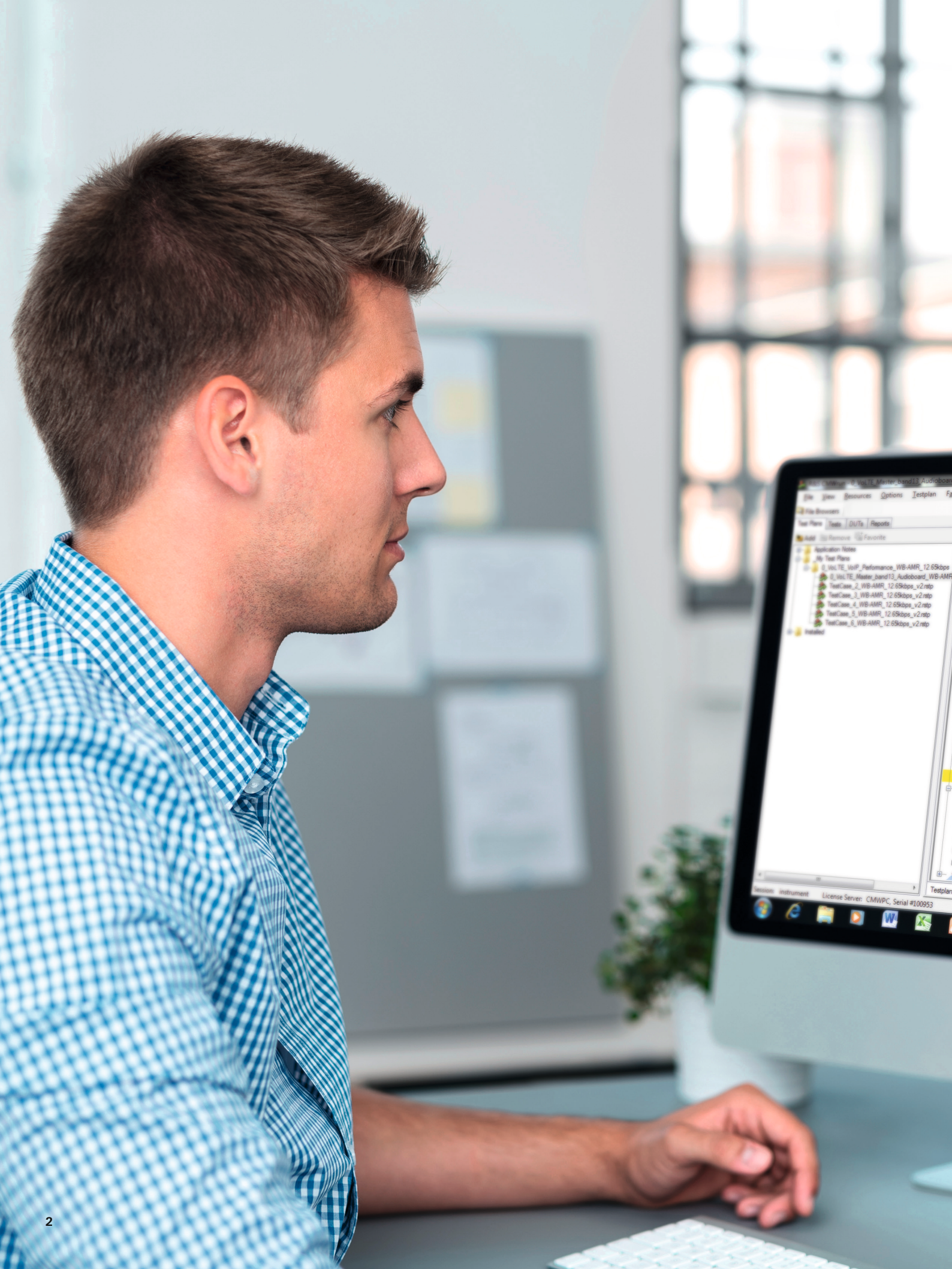
Public safety

Healthcare

Service and repair

ROHDE&SCHWARZ

Application Brochure | Version 06.00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Options
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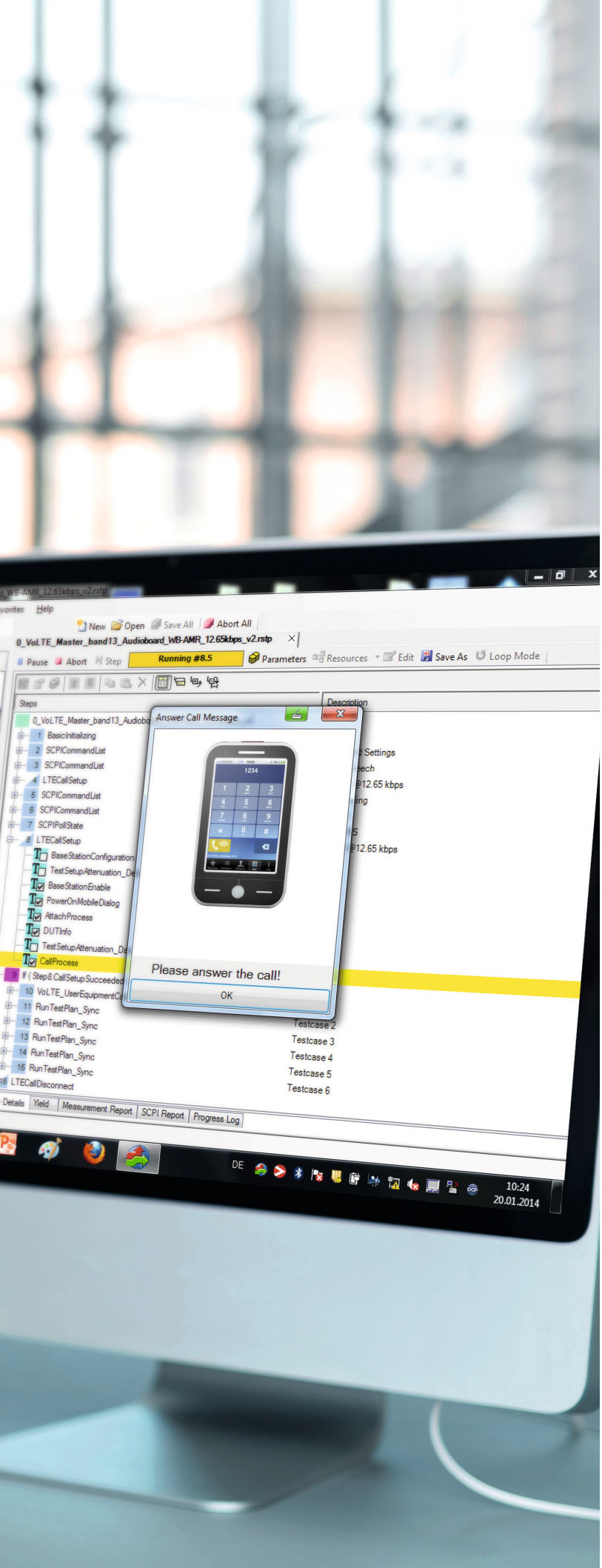
Testplan



Contents

R&S®CMWrun at a glance

The automation tool for the R&S®CMW platform

Today the R&S®CMW is the leading, most popular multi-standard platform for UE testing. It is used by network operators, test houses, handset vendors and chipset manufacturers alike. The R&S®CMWrun automation software meets all requirements for executing remote control test sequences on the R&S®CMW in R&D, quality assurance, production and service for both current and future wireless equipment.

The software engine is based on the execution of test DLLs (plug-in assemblies). This architecture allows easy and straightforward configuration of test sequences without requiring specific programming knowledge of how to remotely control the instrument. It also provides full flexibility when configuring parameters and limits for the test items provided in the standard-specific R&S®CMWrun package options.

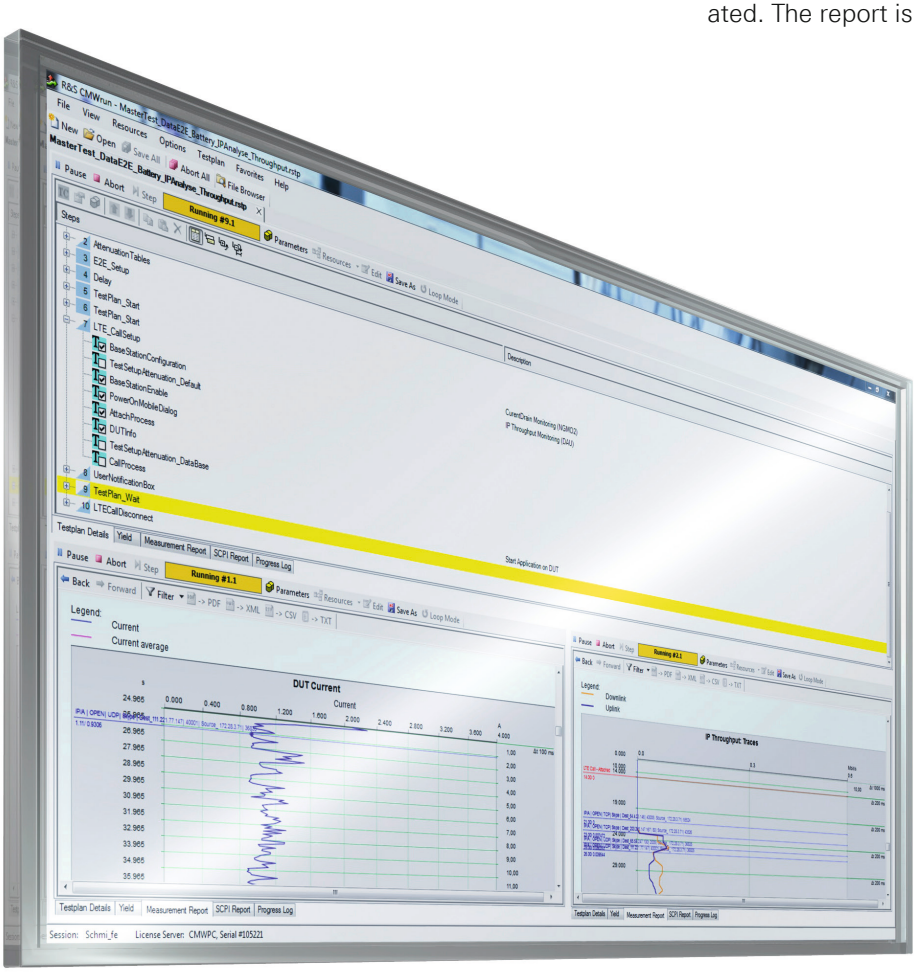
Key facts

- Multitechnology solution for all standards supported by the R&S®CMW family
- Ready-to-use solution for superior user experience test scenarios
- Just GUI, no programming, no code compilation
- Test creation, parameterization, execution and analysis in a single tool
- Full test script and DUT automation (R&S®CMWrun own ADB/Android APP for iPerf/FTP)
- Application for SCPI remote control via LAN, GPIB interface or USB
- Sample test plans included

Intuitive and easy to use

The intuitive graphical user interface makes it simple for users to test wireless devices for compliance with the 3GPP protocols for various technologies.

The applications are diverse. For example, in combined user experience tests, synchronized markers show the IP throughput and current drain at a glance. During analysis, event markers help the user optimize IP throughput and battery life. At the end of the test, an easy-to-read test report containing limits, test results and verdict is generated. The report is available in csv, txt, xml and pdf format.



Intuitive graphical user interface.

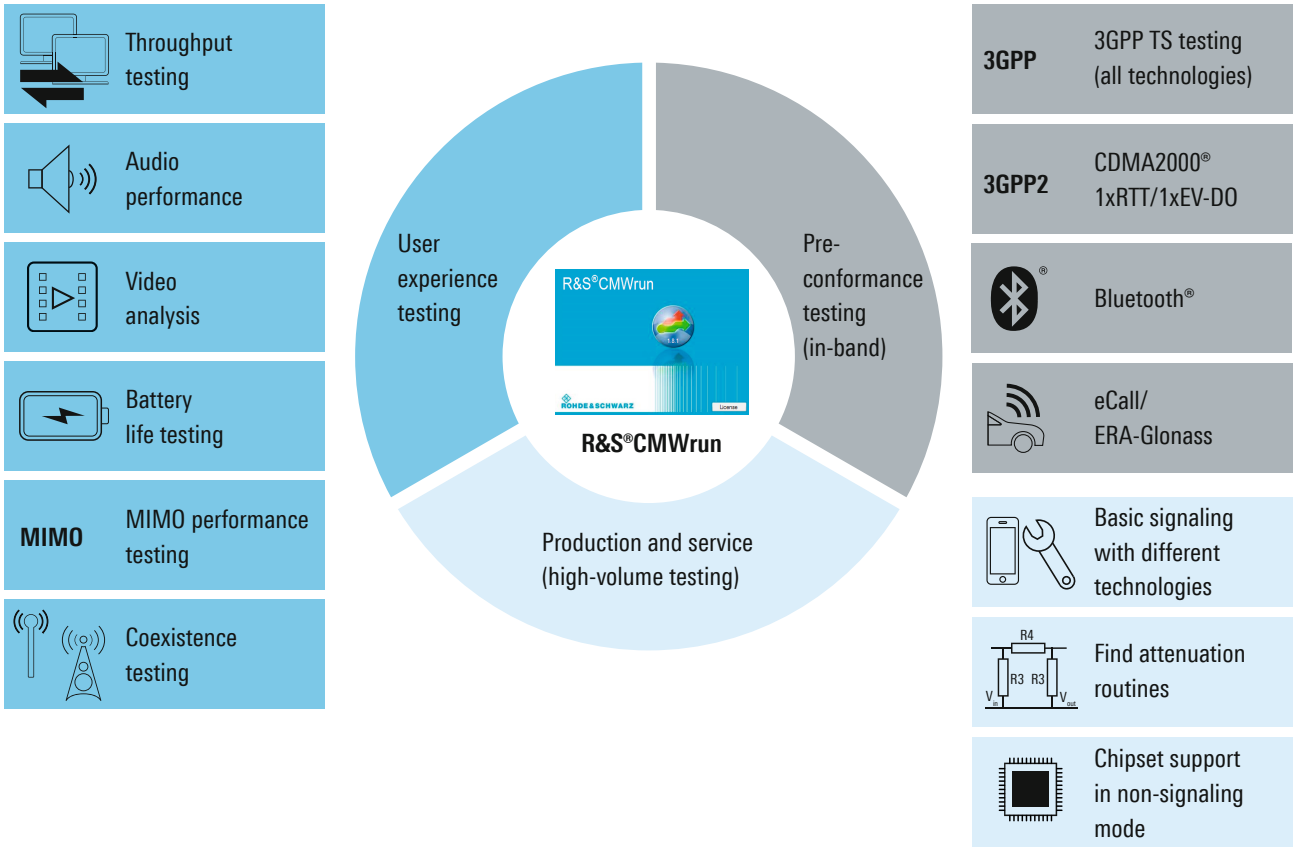
Applications

- RF functional testing, regression testing and RF preconformance testing
- Data throughput and performance measurements
- User experience tests (data, voice, video, battery life, coexistence)
- Operator acceptance tests for audio performance test (PESQ/POLQA)
- High-volume testing (production and service)
- Calibration and verification of chipsets in non-signaling mode

Testing scope

- Basic signaling suite for all technologies (LTE, WCDMA/HSPA, TD-SCDMA, GSM/(E)GRPS, CDMA2000® 1xRTT/CDMA2000® 1xEV-DO, WLAN, Bluetooth®) necessary to service and repair mobile phones
- RF, functional, preconformance and data throughput testing for all standards supported in the R&S®CMW: GSM/GRPS, WCDMA/HSPA, TD-SCDMA, LTE/LTE-A (FDD and TDD), CDMA2000® 1xRTT/CDMA2000® 1xEV-DO, WLAN, Bluetooth®
- LTE/WLAN coexistence testing

R&S®CMWrun use cases



User experience testing

The R&S®CMW test platform can be used to perform, document and evaluate complex user experience tests under simulated, yet realistic conditions. An R&S®CMW tester combined with the R&S®CMWrun automation tool provides an enormous test bandwidth that is unmatched on the market.

User experience testing scenarios

The proliferation of wireless devices has led to enormous growth in global IP traffic. At the same time, users are demanding better audio quality, video streaming and data transmission. Network operators, device manufacturers and app developers need to ensure and optimize a certain quality of experience (QoE) for the wide variety of services based on these functions. A number of different parameters are used for optimization, such as the signaling traffic per app (end-to-end traffic), the number of bytes (IP) consumed per app and the impact on the battery life.

Another challenge is the fact that all current LTE network deployments are optimized for data service, but not for voice. Voice transmission has to be optimized afterwards.

R&S®CMW500/R&S®CMWrun user experience testing for all technologies

	Features/conditions	Metrics
Throughput testing		
 Throughput testing	▪ Upload/download ▪ iPerf/FTP/UDP ▪ Browsing/streaming ▪ IP impairments and fading	▪ Throughput monitoring over time ▪ IP events over time (IP analysis) ▪ Throughput versus modulation coding schemes ▪ BLER versus modulation coding schemes
Audio performance		
 Audio performance	▪ End-to-end voice quality ▪ VoLTE/circuit-switched ▪ Handovers, incl. SRVCC ▪ IP impairments and fading ▪ Real vocoding	▪ Loopback ▪ Voice quality/performance (MOS: POLQA/PESQ) ▪ Audio delay (in ms) ▪ Acoustical measurements
Video analysis		
 Video analysis	▪ Streaming (HTTP streaming server/DASH) ▪ Video call, incl. ViLTE (IR.94) ▪ IP impairments and fading	▪ Conducted (HDMI™/MHL interface) ▪ Over-the-air (embedded barcode) ▪ Missing frames, frame delay, reordered frames ▪ Pixel errors ▪ Subjective quality assessment (SNR/SSIM/MOS)
Battery life testing		
 Battery life testing	▪ By voice, video, data ▪ By defined profile ▪ With signaling and IP event markers	▪ Current, voltage and instantaneous power monitoring over time ▪ Estimated battery life (in h)
Coexistence testing		
 Coexistence testing	▪ WLAN RX desensitization ▪ LTE RX desensitization	▪ Desensitization by distance of aggressor (in dB) ▪ Desensitization by UL power of aggressor (in dB)

The audio quality of VoLTE and legacy standards (GSM, WCDMA, CDMA2000®) depends on several network and DUT factors. Examples include radio conditions, packet loss, packet delay, jitter and jitter distribution.

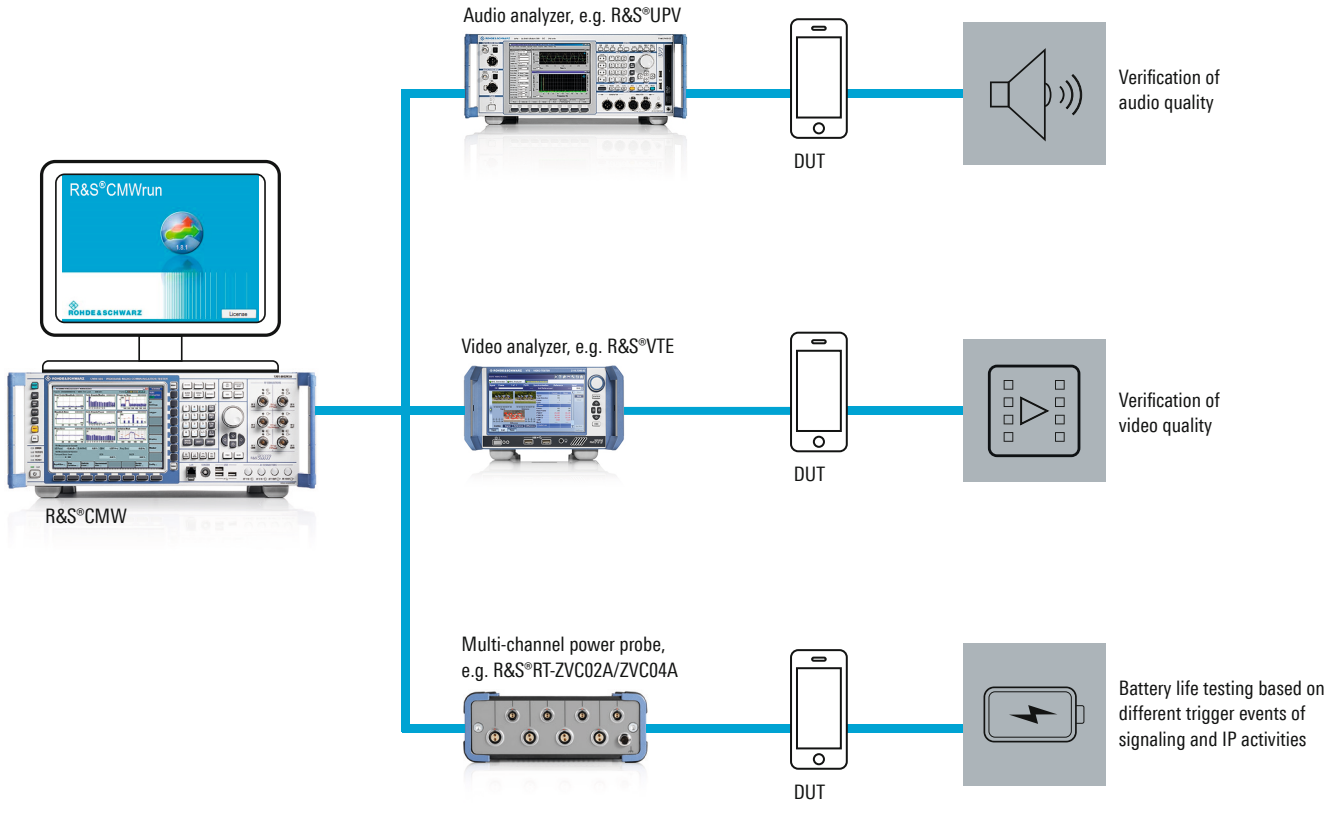
User experience testing with the R&S®CMW platform

In real networks, it is not possible to reliably reproduce and test user experience requirements. The R&S®CMW is an automated, fully integrated solution for testing under controlled, realistic conditions. User quality expectations can be efficiently achieved. The R&S®CMW simultaneously emulates, parameterizes and analyzes two different wireless systems and their IP data throughput. The solution includes the integrated data application unit (DAU) as the basis for the IMS server, the audio board and the emulation of all cellular and non-cellular technologies.

The table shows the measurements that can be performed with the R&S®CMW500 and additional instruments, fully controlled by the R&S®CMWrun software.

The R&S®CMWrun sequencer software tool is an all-encompassing automation tool for audio/video performance and battery life testing. Any deviations from the expected audio and video output can be automatically and precisely detected.

User experience testing scenarios



Video testing

R&S®CMWrun – conducted (HDMI™/MHL interface) video analysis test solution based on R&S®VTE.

Since mobile video streaming is still new, many test personnel will be familiar with video or with mobile communications, but not with both. R&S®CMWrun provides automated test sequences, reducing the amount of special knowledge required for video testing. It controls the R&S®CMW500 wideband radio communication tester, which simulates a mobile network including the data application unit (DAU) integrated HTTP streaming server (DASH). In addition, the channel can be modified via IP impairments or through fading scenarios. This allows real test conditions in a fully controlled environment

The R&S®CMWrun solution is radio bearer agnostic, which means that video testing analysis can be done with any radio access technology that supports E2E video streaming – LTE(FDD/TDD), WCDMA/HSPA, GSM/(E) GPRS and WLAN. Based on the R&S®CMW500 data application unit (DAU), R&S®CMWrun is tailored to customers who want to test the application layer, either for benchmarking purposes or simply to test the DUT performance under real user experience scenarios to obtain a conclusive overview of the key performance parameters for video analysis.

Two methods of testing are available:

- Conducted over an HDMI™/MHL interface with the evaluations based on the R&S®VTE video tester
- Over-the-air based on embedded barcodes in prepared videos, based on the R&S®Z17 barcode scanner kit for video analysis

Conducted (HDMI™/MHL interface)

The R&S®VTE video tester performs difference picture analyses for detecting and objectively analyzing degradations in a mobile device's decoded video signal. It provides subjective quality assessment (SNR/SSIM/MOS). The video content is output to the R&S®VTE over the mobile device's MHL, HDMI™ or Miracast interface. The R&S®CMWrun CMW-KT105 solution provides full automation (for R&S®CMW500 and R&S®VTE).

Over-the-air (embedded barcode)

The R&S®CMW-Z17 barcode scanner in conjunction with the R&S®CMWrun sequencer tool (R&S®CMW-KT104) offers an easy way to evaluate basic and key parameters of video performance based on video frame evaluation: missing frames, frame delay and reordered frames. A high-speed barcode scanner evaluates the reception and decoding of barcodes that have been previously integrated into the streamed video. A set of reference videos is part of the delivery package or users can upload their own videos. In these videos, each frame contains a barcode with the sequence number in all video frames. The application also allows testing of DASH bitrate switching when changing the channel conditions.

The video testing solution is available in the following standard-specific R&S®CMWrun packages:

- R&S®CMW-KT053: for WCDMA/HSPA and GSM/(E) GPRS
- R&S®CMW-KT055: for LTE/LTE-A (FDD/TDD)
- R&S®CMW-KT057: for WLAN
- R&S®CMW-KT058: for CDMA2000®

The following options are mandatory:

- R&S®CMW-KT051: to remotely control E2E applications, e.g. video streaming in the R&S®CMW500 data application unit (DAU)
- R&S®CMW-KT104: for over-the-air (embedded barcode) video analysis with the R&S®CMW-Z17 barcode scanner
- R&S®CMW-KT105: for conducted (HDMI™/MHL interface) video analysis with the R&S®VTE video analyzer

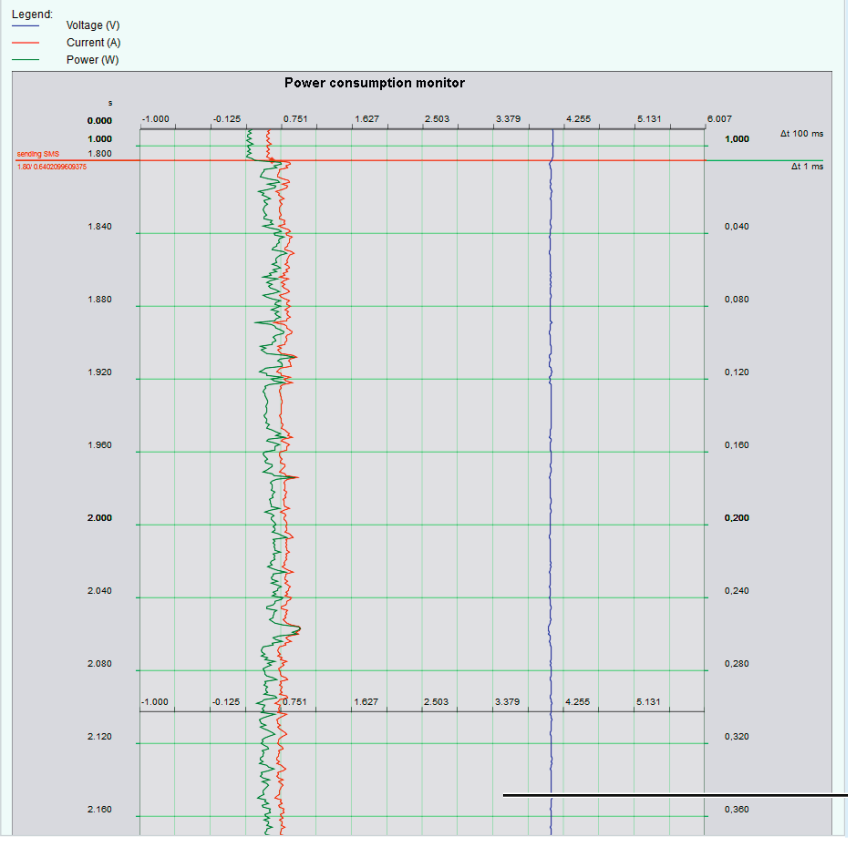
R&S®CMWrun – over-the-air (embedded barcode) video analysis based on R&S®CMW-Z17/R&S®CMW-KT104.

Battery life measurements

With the Internet of Things (IoT) world and its diverse applications that require a battery charge to last at least ten years, battery life testing becomes more important than ever. And for smartphones where more and more apps are running, it is crucial to test the latest features for reducing power consumption. Driven by the new IoT requirements for ultra-low power, in its latest releases (12 and 13) the 3GPP standardization recently defined features such as power save mode (PSM) and enhanced DRX (eDRX) in the diverse IoT UE categories as well as cDRX to reduce power consumption as much as possible.

The performance of these features to reduce power consumption can only be tested and analyzed in a controlled emulated network environment. R&S®CMWrun offers the right solution for such tests under real, yet controlled conditions based on the well-known R&S®CMW500. The R&S®CMWrun CMW-KT051 collects samples from the R&S®RT-ZVC02A/R&S®RT-ZVC04A multi-channel power probe with autoranging at a high sample rate and displays the current and voltage or even the calculated instantaneous power (in Watt) over time. Specific signaling trigger events (e.g. LTE attach, connected, idle signaling state or

Battery life testing with IP analysis, fully automated with R&S®CMWrun



Power consumption monitoring over time

IMS registration) have been implemented, providing more details (i.e. more samples). These are displayed and time-correlated on the power consumption diagram. The power consumption diagram is also correlated to events at the IP level by using IP traffic analysis (R&S®CMW-KM051), which indicates which app or IP flow affects the battery lifetime of smartphones or other wireless devices.

The R&S®RT-ZVC02A/R&S®RT-ZVC04A multi-channel power probe with autoranging with R&S®CMWrun allows you to monitor (in real scenarios) the power (current and voltage) consumed by IoT or M2M devices being powered by their own batteries, an A/C power adapter or even a USB connection. Smartphones use their own batteries and not simply a dummy battery. It is possible to monitor multiple channels and compare the power that parts on a board consume. For instance comparing how much the application processor, the RF power stage, or even individual components contribute to the total consumed power – always under a real signaling scenario. The R&S®CMWrun setup controlling the R&S®CMW500 and the R&S®RT-ZVC02A/R&S®RT-ZVC04A multi-channel power probe with autoranging covers all power testing requirements of IoT devices, M2M applications, wireless modules used in the automotive industry, RF components under any signaling or non-signaling scenario for R&D, performance, regression or acceptance testing.

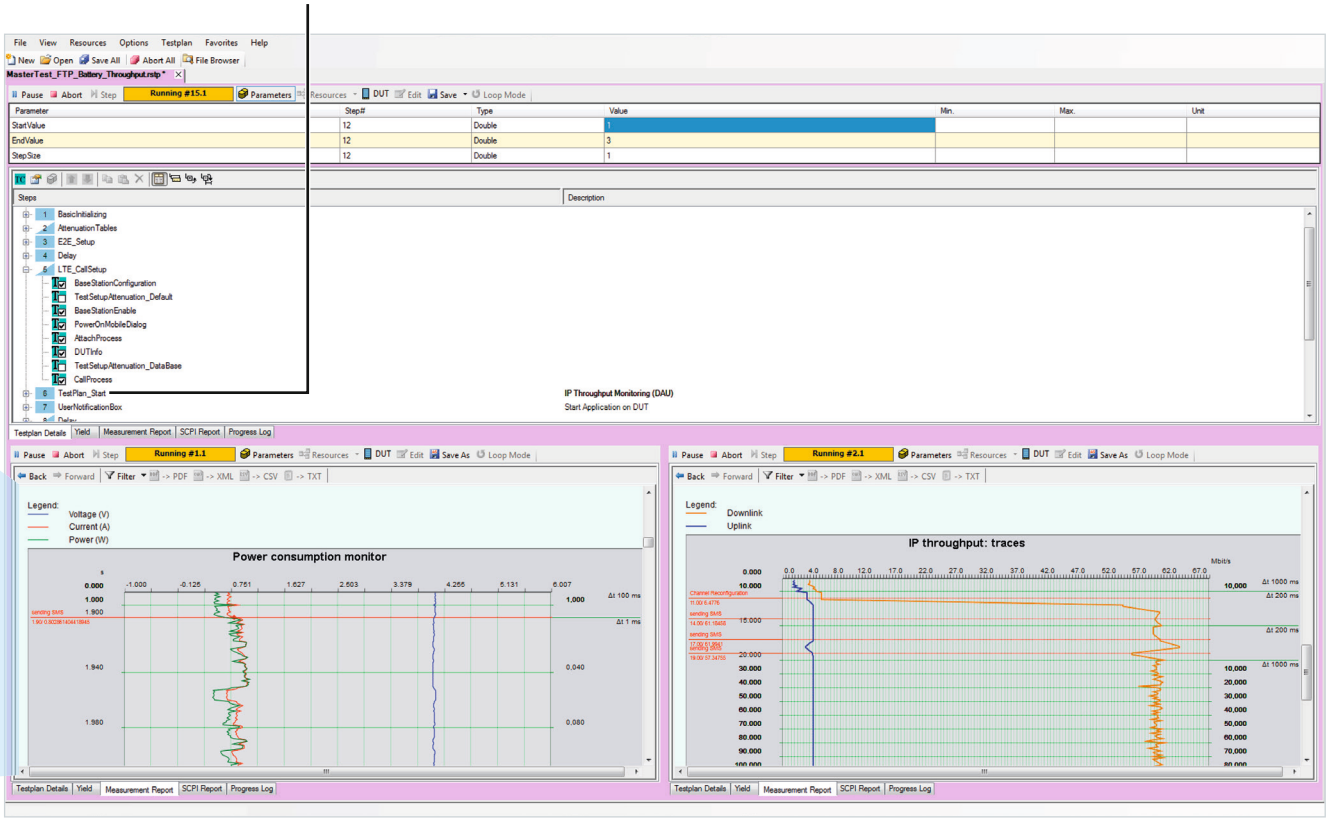
Battery life measurements and IP throughput testing are available in the following standard-specific R&S®CMWrun packages:

- R&S®CMW-KT053: for WCDMA/HSPA and GSM/(E) GPRS
- R&S®CMW-KT054: for TD-SCDMA
- R&S®CMW-KT055: for LTE/LTE-A (FDD/TDD)
- R&S®CMW-KT057: for WLAN/Bluetooth®
- R&S®CMW-KT058: for CDMA2000®, 1xRTT/1xEV-DO

The following option is mandatory:

- R&S®CMW-KT051: adds E2E services and FTP/iPerf, controls the R&S®CMW500 data application unit (DAU) and remotely controls the R&S®RT-ZVC02A/R&S®RT-ZVC04A multi-channel power probe with autoranging

Typical test plan for E2E call



Battery life testing with the R&S®RT-ZVC02A/ R&S®RT-ZVC04A multi-channel power probe with autoranging

The latest specifications for battery life measurement require not only monitoring of the current over time but also the voltage, including calculation of the instantaneous power at high sampling rates. For such testing requirements, it must be possible to measure the power a device consumes based on a real use case, i.e. powered by a real battery or from the USB interface or even from an AC adapter.

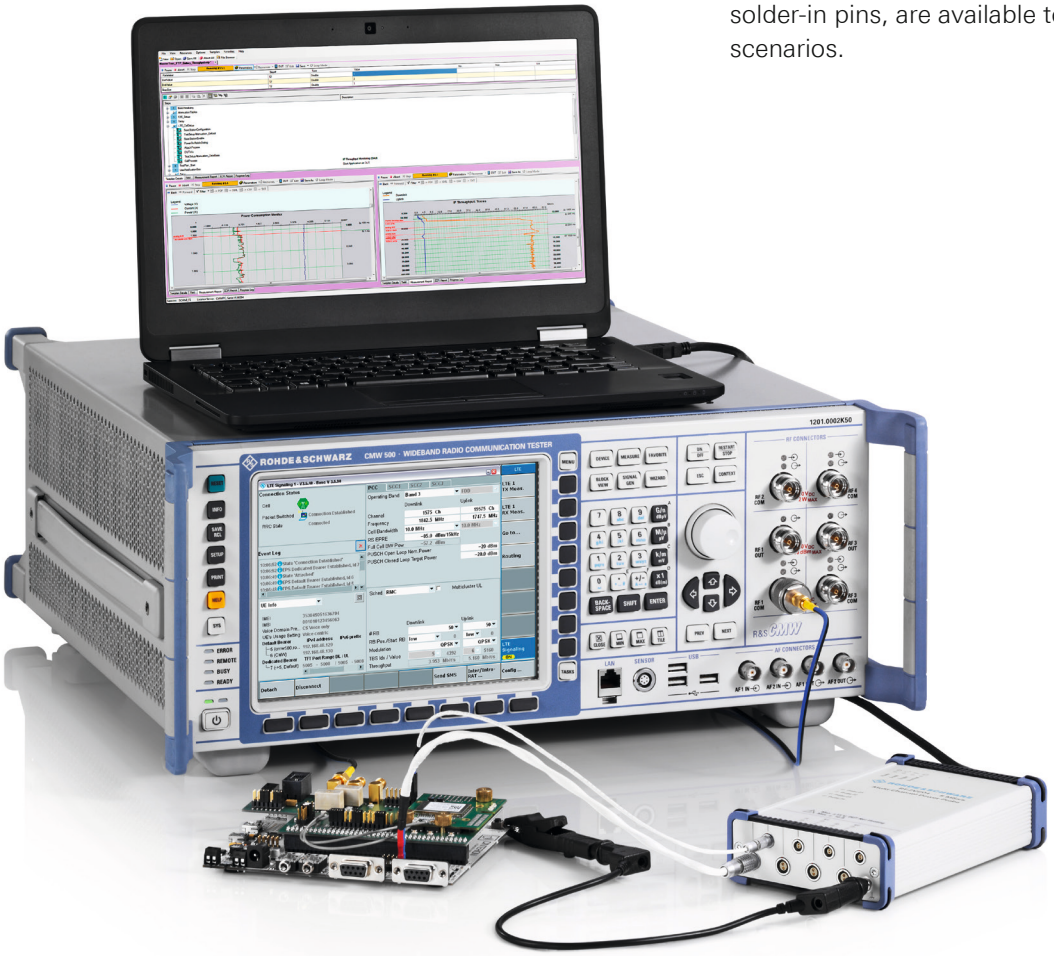
The R&S®RT-ZVC02A/R&S®RT-ZVC04A multi-channel power probe with autoranging is designed to cover precisely such uses cases, and even offers up to two (with R&S®RT-ZVC02A) or four (with R&S®RT-ZVC04A) voltage and current channels.

Each power measurement group consists of a voltmeter and ammeter with 18-bit A/D resolution and 5 Msample/s sampling rate. The built-in multiplier function, available for each group, ensures synchronous, sample-by-sample multiplication of current and voltage samples at a rate of 5 Msample/s. An internal decimation unit accumulates the consumed power by averaging over 100, 1000 or 10 000 samples. This ensures that even very short power consumption peaks are captured, while reducing the data transfer rate to a level a PC can handle. Based on this data, R&S®CMWrun estimates the battery life and displays all power group measurements such as current, voltage and instantaneous power on the event graph.

The R&S®RT-ZVC02A/R&S®RT-ZVC04A multi-channel power probe's ammeter is equipped with internal shunts that can be selected for one of the different measurement ranges of interest. The current can also be measured based on an external shunt that is configured and fitted directly to the device under test. In this case, the current is calculated based on the voltage drop across this external reference shunt – the internal ammeter becomes a high impedance voltmeter, effectively avoiding connection cable losses caused by high currents.

An autoranging mode for current measurements using either internal or external shunts is also available. It ensures highest current measurement precision by automatically changing the scale based on the current reading. The autoranging feature allows seamless current, voltage and power measurements up to a data rate of 50 ksample/s.

For the connection to the DUT, various connectivity options, such as 4 mm plugs, pin connectors and solder-in pins, are available to cover all kinds of application scenarios.



Power consumption monitoring solution with R&S®CMWrun based on the R&S®CMW500 and the R&S®RT-ZVC04A multi-channel power probe.

Current range using internal shunts

R&S®CMW-KT051 power consumption, shunt: 50 mΩ

Range	Measurement accuracy	● = Seamless range change
6 A	±(0.2% + 9 mA)	
4.5 A	±(0.2% + 0.9 mA)	Activity
450 mA	±(0.2% + 135 µA)	Idle
45 mA	±(0.2% + 72 µA)	Sleep

Seamless range changes [1]

Autoranging ensures a less than 2% reading error between the ranges. For the 50 mΩ shunt ranges, the lowest current value with 2% error is 4 mA, with 5% error is 1.6 mA, and with 10% error is 750 µA.

R&S®CMW-KT051 power consumption, shunt: 200 mΩ

Range	Measurement accuracy	● = Seamless range change
3 A	±(0.2% + 2.4 mA)	
1.125 A	±(0.2% + 225 µA)	Activity
112.5 mA	±(0.2% + 33.8 µA)	Idle
11.25 mA	±(0.2% + 18 µA)	Sleep

Seamless range changes [1]

Autoranging ensures a less than 2% reading error between the ranges. For the 200 mΩ shunt ranges, the lowest current value with 2% error is 1 mA, with 5% error is 400 µA, and with 10% error is 200 µA.

R&S®CMW-KT051 power consumption, shunt: 1 Ω

Range	Measurement accuracy	● = Seamless range change
900 mA	±(0.2% + 450 µA)	
225 mA	±(0.2% + 45 µA)	Activity
22.5 mA	±(0.2% + 6.8 µA)	Idle
2.25 mA	±(0.2% + 3.6 µA)	Sleep

Seamless range changes [1]

Autoranging ensures a less than 2% reading error between the ranges. For the 1 Ω shunt ranges, the lowest current value with 2% error is 200 µA, with 5% error is 80 µA, and with 10% error is 40 µA.

[1] With 50 ksample/s.

Specifications in brief

R&S®RT-ZVC02A/R&S®RT-ZVC04A multi-channel power probe with autoranging For the voltmeter and ammeter ranges, the least significant bit (LSB) or minimum measurable current or voltage depends on the measurement setup, noise level and decimation mode		
Voltmeter		18-bit at 5 Msample/s A/D conversion
Voltage range	LSB: 14 µV	1.88 V
	LSB: 28 µV	3.75 V
	LSB: 57 µV	7.5 V
	LSB: 114 µV	15 V
Ammeter		18-bit at 5 Msample/s A/D conversion
Current range using internal shunts		see figures on previous page
Power meter		seamless and synchronous multiplication of current and voltage samples at 5 Msample/s (sample by sample)
USB interface to PC	controlled by R&S®CMWrun	USB 3.0 micro B
R&S®CMWrun graphical interface for displaying results For use with the R&S®CMW-KT051 software option plus dedicated signaling extension for control and evaluation of power consumption monitoring and battery life measurements		
Number of supported power measurement groups in parallel	each power measurement group consists of a voltmeter and ammeter with internal multiplier for instantaneous power calculation	up to 4 for the R&S®RT-ZVC04A, up to 2 for the R&S®RT-ZVC02A
Displayed measurements in the R&S®CMWrun report/power consumption monitor		parallel monitoring of voltage and current samples with calculation and display of the instantaneous power in R&S®CMWrun software
Sample rate displayed in the R&S®CMWrun report/power consumption monitor	available sample rate per measured channel (voltage, current and instantaneous power)	10/50/100/500/1000/5000/50000 samples/s
Trigger events		signaling events in red lines, IP analysis triggers in blue lines

Ordering information

Designation	Type	Order No.
Multi-Channel Power Probe with Autoranging, 2 × 4 voltage/current channels, for R&S®CMWrun	R&S®RT-ZVC04A	1326.0259.34
Multi-Channel Power Probe with Autoranging, 2 × 2 voltage/current channels, for R&S®CMWrun	R&S®RT-ZVC02A	1326.0259.32
Accessories		
Extended Cable Set, PCB, length: 32 cm	R&S®RT-ZA30	1333.1686.02
Extended Cable Set, 4 mm, length: 32 cm	R&S®RT-ZA31	1333.1692.02
Extended Cable Set, 4 mm, length: 100 cm	R&S®RT-ZA34	1333.1892.02
Extended Cable Set, PCB, length: 100 cm	R&S®RT-ZA35	1333.1905.02
Solder-In Cable Set	R&S®RT-ZA36	1333.1911.02
Graphical interface based on R&S®CMWrun (USB connection to the PC with R&S®CMWrun environment)		
R&S®CMWrun general-purpose (adds battery life, graphical user interface and other features such as audio, E2E applications)	R&S®CMW-KT051	1203.4157.02

Audio performance testing solution

The R&S®CMWrun software is the right overall automation tool for audio/speech performance testing of VoLTE and legacy standards. In this setup, the R&S®CMW500 callbox tester acts as a 2G/3G and LTE network emulator. It provides integrated IMS service support plus an audio board with the standard specific speech codecs for voice calls. The R&S®UPV audio analyzer supports PESQ/POLQA algorithms for objective audio analysis.

Research and development testing

With just a few mouse clicks, the user can define a testing campaign that includes the key signaling parameters and conditions in an LTE network with their possible impact on the audio quality and user experience. Signaling parameters that are integrated into the R&S®CMW500 and can be configured via R&S®CMWrun include: integrated IMS server to establish a voice or video call, RoHC, SPS, TTI bundling, dedicated bearer and QoS, IP environment (IPv4 and IPv6), delay, jitter, packet losses and fading profiles.

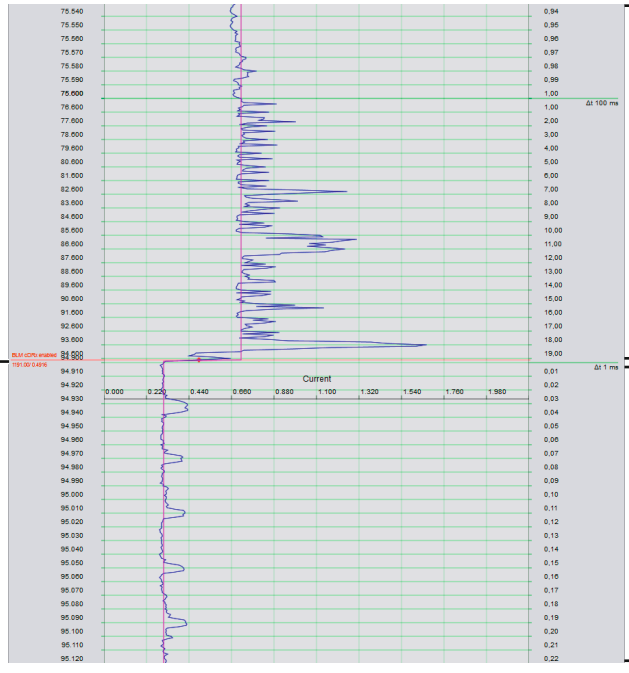
The audio testing solution is available in the following standard-specific R&S®CMWrun packages:

- R&S®CMW-KT053: for WCDMA and GSM
- R&S®CMW-KT055: for LTE/VoLTE
- R&S®CMW-KT058: for CDMA2000®

The following option is mandatory:

- R&S®CMW-KT051:
  to remotely control the R&S®UPV audio analyzer

Audio quality testing



Event marker indicating LTE/ cDRX active

UPV_SpeechQualityMeasurement: POLQA Measurement

Start Measurement: POLQA - Uplink, Super-Wide, Single-Mode
1 / 5 . . .
<-- MOS=4.3380
2 / 5 . . .
<-- MOS=4.4141
3 / 5 . . .
<-- MOS=4.3305
4 / 5 . . .
<-- MOS=4.3871
5 / 5 . . .
<-- MOS=4.2495

Verification of audio quality and power consumption compared to a standard LTE/VoLTE call with the cDRX power save mode enabled; POLQA values before and after, including power consumption monitoring

UPV_SpeechQualityMeasurement: POLQA Measurement

Start Measurement: POLQA - Uplink, Super-Wide, Single-Mode
1 / 5 . . .
<-- MOS=4.4302
2 / 5 . . .
<-- MOS=4.3532
3 / 5 . . .
<-- MOS=4.4029
4 / 5 . . .
<-- MOS=4.4368
5 / 5 . . .
<-- MOS=4.3533

Carrier acceptance testing

R&S®CMWrun also covers carrier acceptance testing, extending the R&D test coverage beyond the industry standards' test plans.

The following R&S®CMWrun packages are available as turnkey solutions for audio performance acceptance testing:

- VZW, requires R&S®CMW-KTF11
- AT&T, requires R&S®CMW-KTF12
- CMCC, requires R&S®CMW-KTF13
- CHU, requires R&S®CMW-KTF15
- CHT, requires R&S®CMW-KTF16

For all other providers, Rohde&Schwarz offers the R&S®CMW-KT140 option which is based on 3GPP.

Application example: IMS, DRX plus power consumption and audio quality

Power consumption of smart phones has been a hot topic on the market for years. With the introduction of VoLTE, there is a risk that voice calls could totally drain the batteries of 4G phone. Features such as DRX should greatly improve power consumption, but ultimately the application behavior and delivered audio quality need to be tested and analyzed in an emulated network environment.

The Rohde&Schwarz VoLTE power consumption test solution consists of a network emulator (R&S®CMW500), audio analyzer (R&S®UPV), power probe with autoranging (R&S®RT-ZVC02A/RT-ZVC04A) and R&S®CMWrun test sequencer software.

The network emulator must be capable of emulating an LTE network according to the latest standards and specifications. The emulator also needs to provide IMS functionality so that a VoLTE-capable device can register, and it must be possible to establish either a mobile-originated or mobile-terminated voice call based on IMS. Third, the base station emulator needs to provide the required audio functionality, including audio codecs,

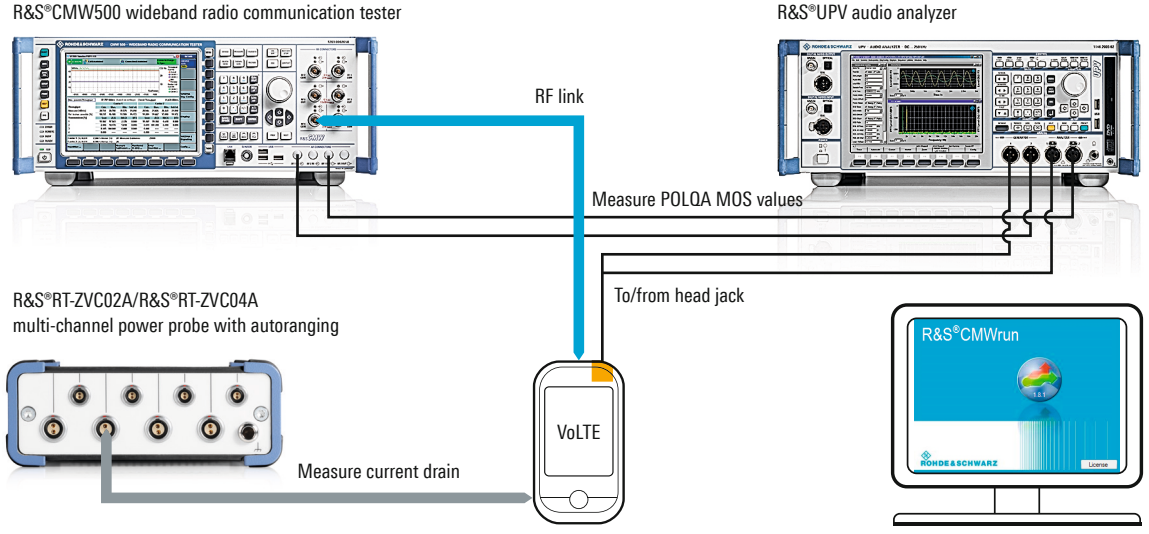
such as the adaptive multirate (AMR) codec for wideband and narrowband (AMR-WB, AMR-NB) with their respective codec rates. In addition, the test set needs to support cDRX functionality according to latest standards. All this is available with the R&S®CMW500 wideband radio communication tester.

To test audio quality during a VoLTE call, an audio generator and analyzer is required that is able to generate and analyze audio waveforms using the latest methodologies according to PESQ or POLQA, whereby the latter is used for audio quality measurements during VoLTE calls. The R&S®UPV audio analyzer is the instrument of choice for testing audio quality independently of the underlying methodology because it supports both PESQ and POLQA.

The device's current drain during an active call, especially when DRX is activated, can be monitored with the R&S®RT-ZVC02A/RT-ZVC04A multi-channel power probe with autoranging.

The entire test setup for testing VoLTE calls, including audio quality and power consumption for different audio codecs and codec rates, and separately for downlink and uplink, is shown in the figure below.

Automated IMS, DRX plus power consumption and audio quality measurements with R&S®CMWrun



In-device coexistence testing

Modern communications devices support a large number of standards in a very small space, which can lead to interference due to occupying the same or adjacent frequency bands or due to harmonics. Ensuring standard-compliant operation and minimal mutual interference is crucial.

Multiple standards in one instrument

Modern communications devices can contain multiple RF systems, e.g. cellular multiband antennas for LTE-A, 3G, CDMA2000®, 2G and non-cellular technologies such as WLAN, Bluetooth® and various GNSS systems. Measurements of in-device coexistence determine the desensitization, i.e. reduction of the RX sensitivity with and without a strong interferer signal. For standard sensitivity tests, measuring the receiver error rate has been adopted as the evaluation criterion. The packet error rate (PER) is measured for WLAN, for example.

The coexistence testing solution is available in the following standard-specific R&S®CMWrun packages:
- R&S®CMW-KT055: for LTE/LTE-A (FDD/TDD)
- R&S®CMW-KT057: for WLAN/Bluetooth®

The following option is mandatory:
- R&S®CMW-KT115: for coexistence automation and report generation

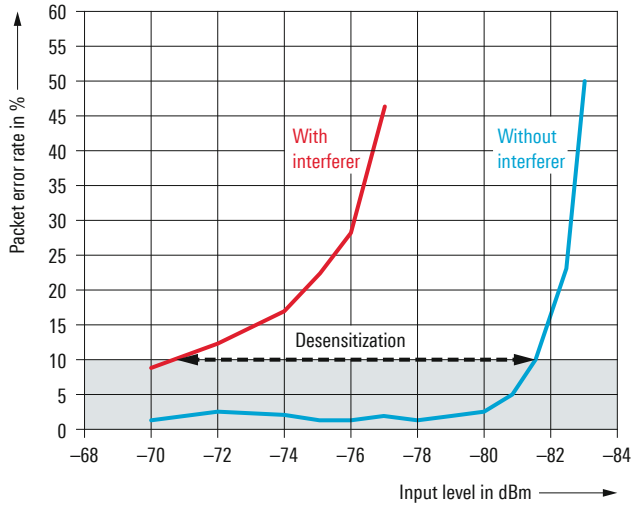
Modern communications devices contain multiple RF systems.

Coexistence measurements with the R&S®CMW500

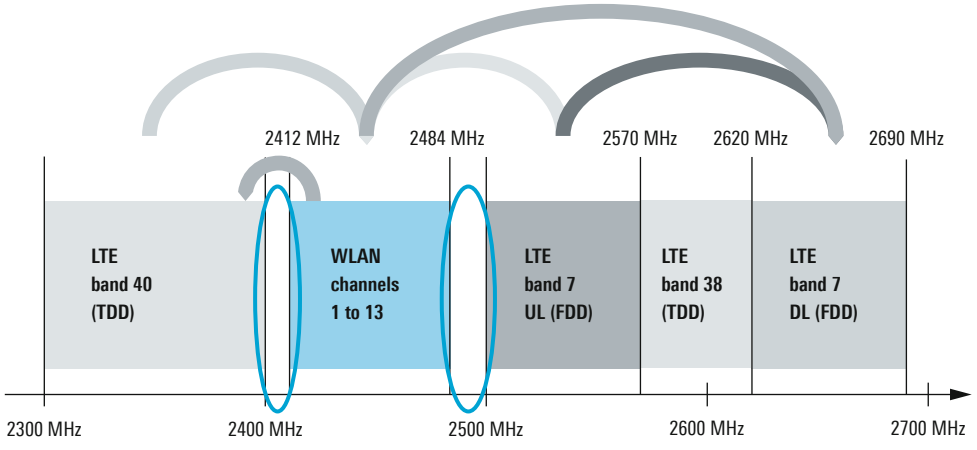
The R&S®CMW500 is ideal for coexistence measurements. It provides signaling for both cellular and non-cellular technologies. It can operate two different wireless systems in parallel and can define the relative RX sensitivity measurements. In combination with a shielded chamber (e.g. R&S®TS7124 RF shielded box, R&S®CMW-Z10 RF shield box or R&S®DST200 RF diagnostic chamber), measurements can be performed in the lab with a high degree of reproducibility. The R&S®CMWrun sequencer software tool can be used to automate measurements and test reports.

The test results can be used to determine specific, effective measures for optimizing development and integration. Specific examples include improving the decoupling of the antenna system, effectively reducing the signal-to-noise ratio of the interferer and optimizing the operating mode.

In-device coexistence testing



Possible interference between WLAN and LTE



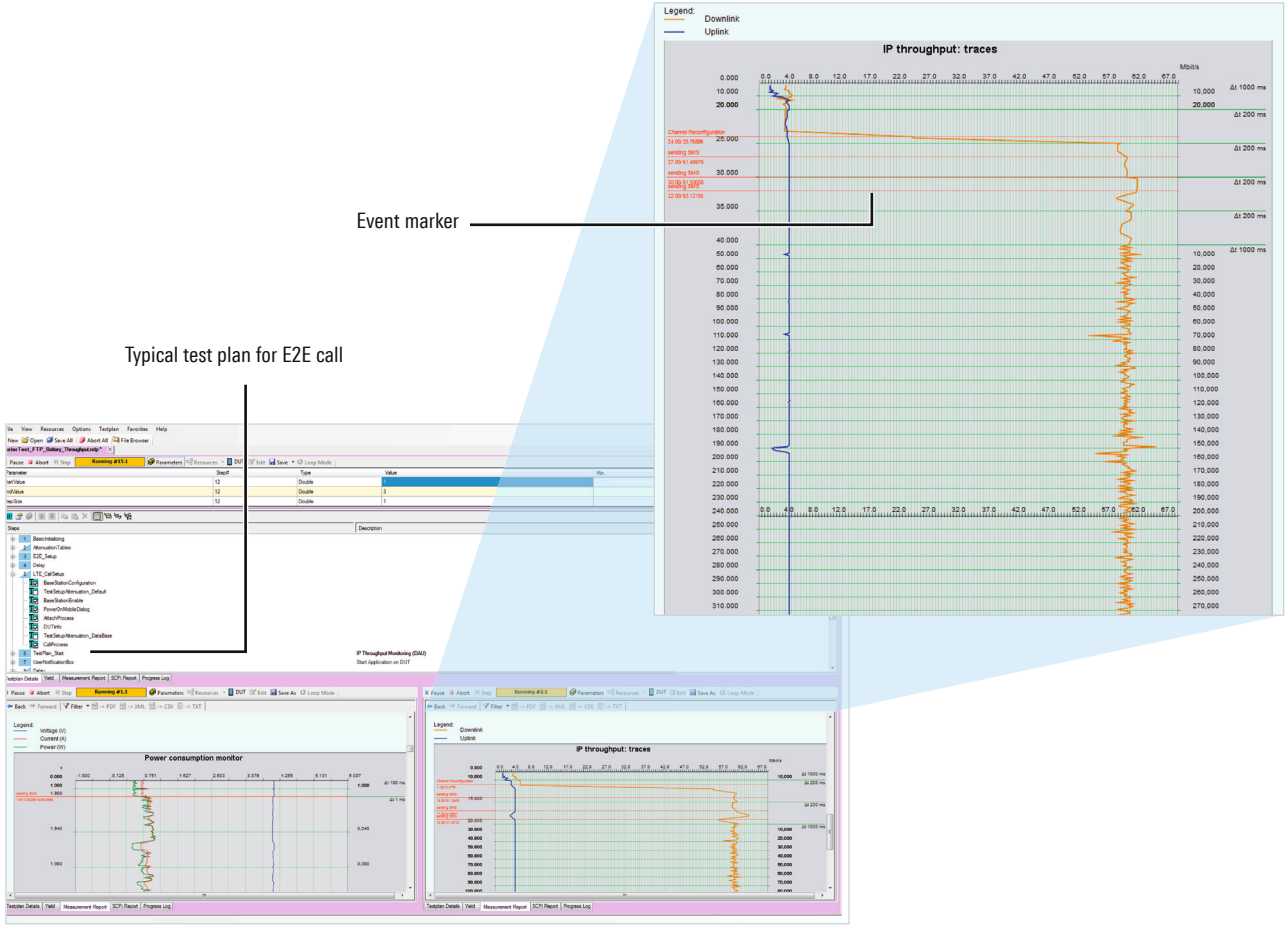
IP throughput testing

When it is necessary to test wireless devices under realistic conditions, examine physical RF parameters and E2E behavior or verify standard-compliant behavior of a DUT, the R&S®CMW callbox is the right solution – with full automation via R&S®CMWrun software.

The R&S®CMW callbox is a base station emulator. It generates the signaling messaging and connects directly to the DUT. Depending on the IP data throughput (E2E performance), additional IP analyses across different layers are possible. These analyses reveal who generates how much and what E2E traffic, and how the traffic can be optimized for the various applications. The stability of the IP application can also be tested with specific IP impairments. In parallel with the E2E performance measurements, the R&S®CMW can analyze the PHY and MAC layer throughput and measure RF parameters such as EVM and UL power.

R&S®CMWrun controls the R&S®CMW data application unit's (DAU) built-in IP services such as iPerf and FTP. All E2E setups are supported: with the DUT in a modem role, connected to client PC or as standalone DUT running the R&S®CMWrun APP for Android DUT automation with iPerf and FTP services. This allows full automation when running E2E throughput tests. In the R&S®CMWrun graphical monitor, the same signaling and IP event markers described in the solution for battery life are also available for IP throughput testing and are time synchronized if both monitors, for current drain and IP throughput, are enabled in the test plan.

IP throughput testing with IP analysis, fully automated with R&S®CMWrun



RF preconformance testing solution

When the test focus is on preconformance RF testing in line with the specification rather than validation testing, the right choice is the R&S®CMW500 RF tester, remotely controlled by R&S®CMWrun.

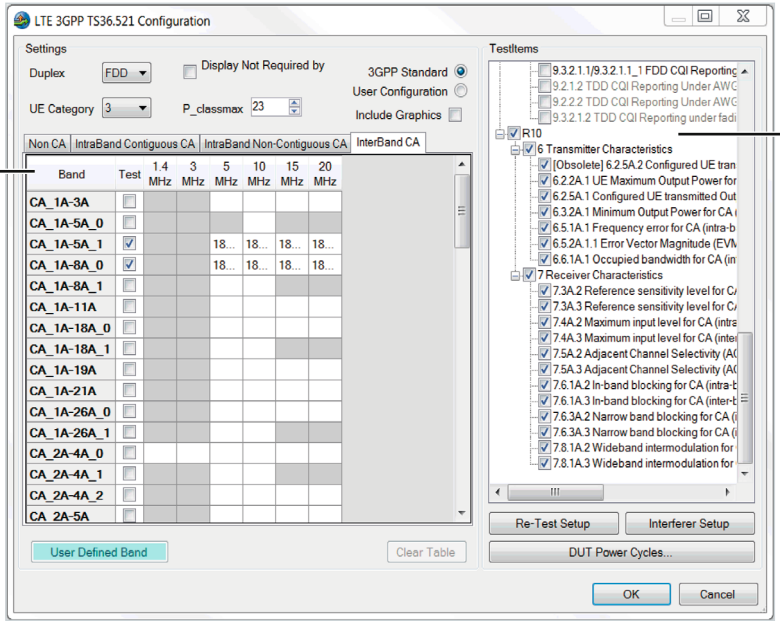
Using a standalone R&S®CMW500, and with just a few configuration clicks for bands, channels and bandwidth, the tool provides a comprehensive result report that gives the user a first impression of in-band compliance. This provides beneficial knowledge in the very early stage of verification, before doing more complex system tests or validation.

The preconformance testing solution is available in the following standard-specific R&S®CMWrun options:

- R&S®CMW-KT053: WCDMA/HSPA in line with 3GPP TS 34.121 and GSM/(E)GPRS in line with 3GPP TS 51.010 specifications
- R&S®CMW-KT054: TD-SCDMA in line with 3GPP TS 34.122 specification
- R&S®CMW-KT055: LTE/LTE-A in line with 3GPP TS 36.521 Rel.8 and Rel.10, FDD and TDD, including tests cases for high-power UEs
- R&S®CMW-KT057: Bluetooth® and Bluetooth® low energy in line with TS 4.2.2 RF specifications
- R&S®CMW-KT058: CDMA2000® 1xRTT/1xEV-DO in line with 3GPP2 specification

LTE 3GPP RF preconformance testing with R&S®CMWrun

Flexible configuration of
- Band
- Bandwidth
- Channels to be tested



Selection of test cases

Conformance testing solution for eCall/ERA-Glonass

The European Union and the Russian Federation aim to have intelligent telematics-based vehicle safety systems in place by 2015 to speed up emergency response times in order to save human lives. eCall (emergency call) and ERA-Glonass (automated emergency response) are electronic safety systems for cars. The systems automatically call the emergency number for local emergency medical services in the event of a serious road accident.

Rohde&Schwarz offers a compact solution for automated, reliable and reproducible end-to-end conformance tests on eCall/ERA-Glonass modules independent of the real-world mobile network. The R&S®CMW-KA094 eCall and R&S®CMW-KA095 ERA-Glonass application software simulate a PSAP and remotely control the R&S®CMW500 wideband radio communication tester to emulate a cellular network in the lab.

To simplify extensive conformance tests, the R&S®CMWrun CMW-KT110 sequencer software tool is added. It provides ready-to-use test sequences for eCall and ERA-Glonass modules in line with CEN/TS 16454 and GOST 55530 respectively. Required test sequences are conveniently selected and combined on the straightforward user interface. R&S®CMWrun automatically configures the R&S®CMW-KA094/-KA095 PSAP application software via remote control to execute the selected tests.

It creates a complete test report with pass/fail indication for each IVS module. The ability to verify compliance with standards at an early design stage makes it possible to take corrective action and optimize an IVS module in a timely manner.

The R&S®CMW-KA094/-KA095 PSAPs with the R&S®CMW500 and R&S®SMBV100A test instruments and the R&S®CMWrun CMW-KT110 application are a compact solution for testing the functionality and standard-compliant conformance of your IVS modules in the lab. The test instruments are a future-ready investment and can be upgraded to meet upcoming test requirements.

R&S®CMWrun conformance testing solution for eCall/ERA-Glonass.

Turnkey solutions for production

Today's production lines for wireless devices require an optimal combination of flexibility, performance and capacity utilization. As the leading supplier of T&M equipment for the production of wireless devices, Rohde&Schwarz meets these stringent requirements with the R&S®CMW platform. The R&S®CMW500 wideband radio communication tester and the R&S®CMW100 communication manufacturing test set are ideal for use in production.

The R&S®CMW100 and the R&S®CMW500 are compatible in terms of remote control and measurement as well as test time optimization and capacity utilization. Test time optimization using DL broadcast and interleaving significantly shortens the time required for calibration and verification as compared to single-DUT testing. Customers can draw on existing implementation experience and considerably reduce development time.

R&S®CMWrun offers a turnkey production solution for calibration and verification of different chipset suppliers. These packages can be used as a reference implementation that customers can integrate into their own automation tool or as ready-to-go tool in the production environment.

Please contact the Rohde&Schwarz sales representative for a list of available chipsets for turnkey production solutions.

The R&S®CMW100 being remote controlled by R&S®CMWrun together with the R&S®TS7124 RF shielded box for device testing.

Simple and intuitive solution for service and repair testing

Running tests on mobile phones in the service and repair market segment could not be easier.

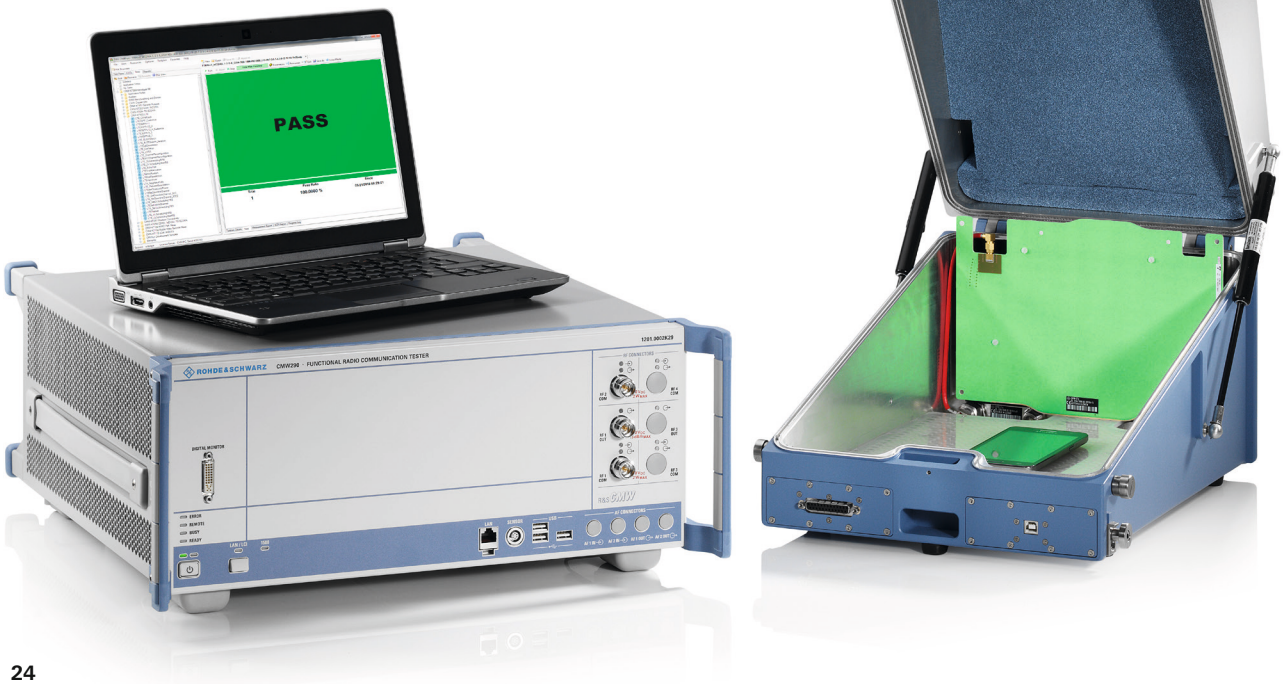
The R&S®CMW500 in combination with the R&S®CMWrun CMW-KT050 package offers the following highlights:

- Select test plan by photo: the picture of the selected phone is displayed to help the operators confirm the correct model to be tested
- Easy to operate: just follow the instructions on the screen; all test plans are predefined; there is no need to change parameters
- Test results and yield updated on the fly: once the tests are complete, the pass/fail results for the tests are displayed in a complete test report

For the service and repair personnel running the tests, it's really that simple – there are no settings to change, just a sequence of tests to be selected for the identified phone. The user simply follows the R&S®CMWrun instructions/ prompts.

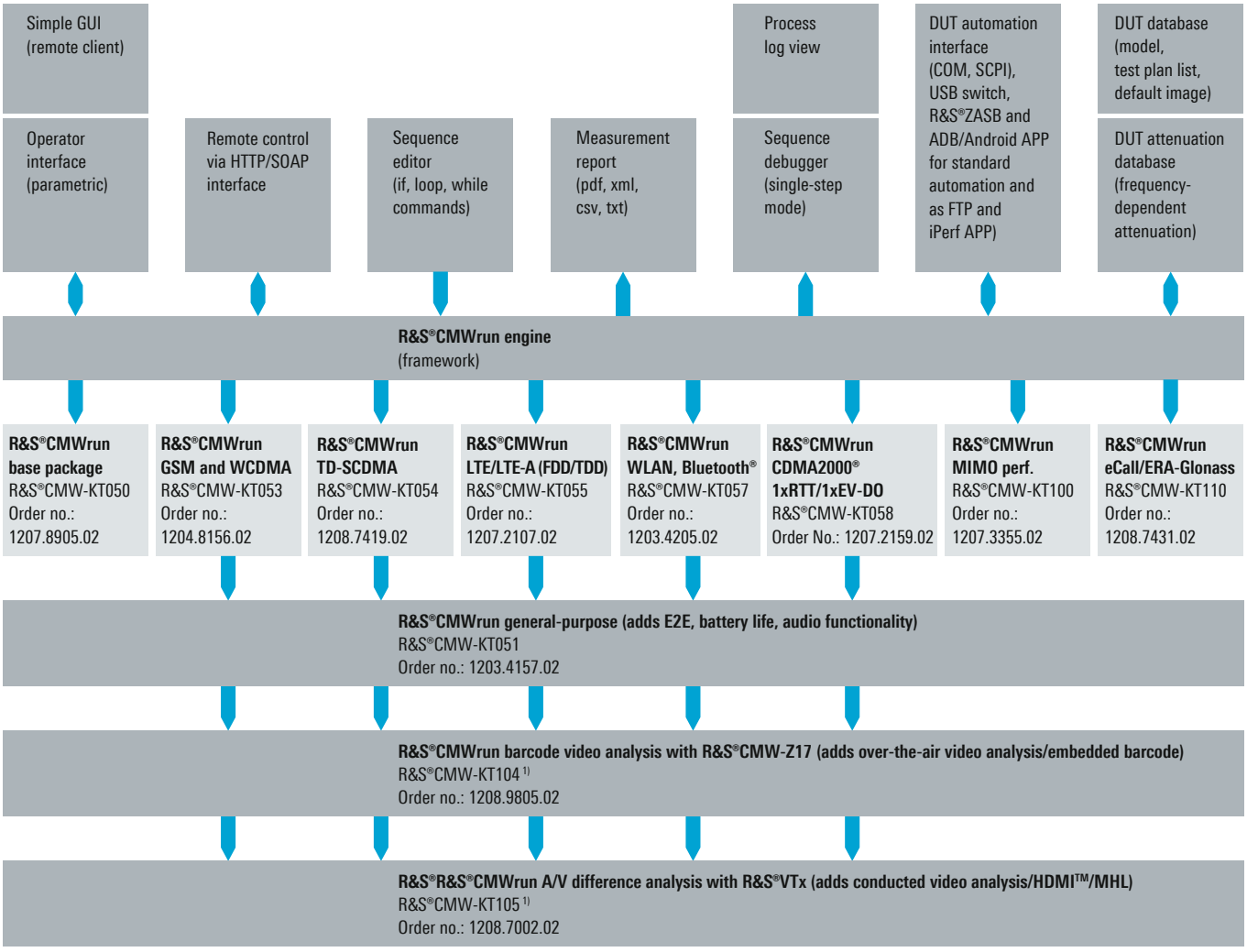
The R&S®CMWrun CMW-KT050 controls all installed basic signaling tests required for service applications for any technology installed on the R&S®CMW500 (LTE, WCDMA/ HSPA, TD-SCDMA, GSM/(E)GPRS, CDMA2000® 1xRTT/ CDMA2000® 1xEV-DO, WLAN and Bluetooth®).

The perfect equipment setup for service applications: the R&S®CMW290 functional radio communication tester with the R&S®CMW-Z10 RF shield box and the R&S®CMWrun sequencer software tool for automated measurements.



Option overview

R&S®CMWrun concept, features, interfaces and applications



1) For video testing, either R&S®CMW-KT104 or R&S®CMW-KT105 or both.

Glossary

Term	Explanation
2G, 3G, 4G, 5G	second, third, fourth, fifth generation of mobile telecommunications technology
3GPP 3GPP TS 3GPP2	3rd Generation Partnership Project 3GPP technical specification 3rd Generation Partnership Project 2
ACL	adjacent channel leakage
AMR AMR-WB AMR-NB	adaptive multi-rate ... codec for wideband ... codec for narrowband
Android ADB	Android debug bridge, used to control android devices
API	application programming interface
APP	mobile application software
ARB	arbitrary waveform generator
A/V difference	audio/video lip difference
BLER	block error ratio
BLM	battery life management
Bluetooth® Bluetooth® SIG Bluetooth® BR Bluetooth® EDR Bluetooth® LE	wireless technology standard for exchanging data over short distances ... special interest group ... basic rate ... enhanced data rate ... low energy
CA	carrier aggregation
CC 2CC/3CC/4CC	component carrier two/three/four component carrier aggregation
CDMA	code division multiple access
CDMA2000® CDMA2000® 1xRTT CDMA2000® 1xEV-DO	family of 3G mobile technology standards ... one times radio transmission technology ... one times evolution-data optimized
CEN	European Committee for Standardization specifications
COM	component object model, serial port interface
CTIA	The Wireless Association (formerly: Cellular Telephone Industries Association)
DAU	data application unit
DASH	dynamic adaptive streaming over HTTP
DL	downlink
DLL	dynamic link library
DPI	deep packet inspection
DRX cDRX eDRX	discontinuous reception, the power saving mode in LTE connected mode discontinuous reception enhanced DRX
DUT	device under test
E2E	end to end
eCall	European emergency call system
EVM	error vector magnitude
FDD	frequency division duplexing
FTP	file transfer protocol
GCF	Global Certification Forum
Glonass, ERA-Glonass	Russian system for satellite-based navigation, Russian automated emergency call system
GNSS, A-GNSS	global navigation satellite system, assisted GNSS
GOST	Russian standard, mentioned here for ERA-Glonass norms

Term	Explanation
GPRS EGPRS	general packet radio service enhanced GPRS
GPIB	general purpose instrumentation bus
GPS	global positioning system
GSM	global system for mobile communications
GSMA	GSM Association
GUI	graphical user interface
HDMI™	high definition multimedia interface
HSPA HSPA+	high-speed packet access evolved HSPA
HTTP	hypertext transfer protocol
IEEE	Institute of Electrical and Electronics Engineers
IMEI	international mobile equipment identity
IMS	IP multimedia subsystem
In-device coexistence	requirement to simultaneously operate multiple collocated radio systems with their antennas in a single communications device
IOT	interoperability test
IoT	Internet of Things
IP IPv4 IPv6	Internet protocol Internet protocol version 4 Internet protocol version 6
iPerf	freeware for measuring the throughput of a network
IVS	in-vehicle system
LAN	local area network
LTE LTE-A LTE-FDD LTE-LAA LTE-MTC LTE-TDD LTE-U PS-LTE ViLTE VoLTE	long-term evolution LTE-Advanced LTE frequency division duplex LTE license assisted access LTE machine-type communication LTE time division duplex LTE-Unlicensed public safety LTE video over LTE voice over LTE
M2M	machine to machine
MAC	medium access control (L2 in the OSI model)
MBMS eMBMS	multimedia broadcast multicast services evolved MBMS
MHL	mobile high-definition link
MIMO	multiple input multiple output
MOS	mean opinion score
Miracast	certification program of the Wi-Fi Alliance, defines peer-to-peer, wireless protocol
MS	mobile station
MSD	minimum set of data (vehicle data)
NAS	network attached storage
OSI model L1, L2, L3, ... L7	open systems interconnection model different layers of the OSI model
OTA	over the air
PS	public safety
PSAP	public-safety answering point
PSM	power save mode
PESQ	perceptual evaluation of speech quality
PHY	physical layer (L1 in the OSI model)

Term	Explanation
POLQA	perceptual objective listening quality assessment
PSNR	peak signal-to-noise ratio
QoE	quality of experience
QoS	quality of service
RAN	random access network
R&D	research and development
RAT inter-RAT or IRAT multi-RAT	radio access technology inter-radio access technology multi-radio access technology
RF	radio frequency
RLC	radio link control
RoHC	robust header compression; a standardized method to compress the IP, UDP, UDP-Lite, RTP and TCP headers of Internet packets
RX	receiver
SCPI	standard commands for programmable instruments
SISO	single input single output
SNR	signal-to-noise ratio

Term	Explanation
SPS	semi-persistent scheduling; a feature used in LTE
SRVCC	single radio voice call continuity
SSIM	structural similarity
T&M	test and measurement
TDD	time division duplexing
TD-SCDMA	time division synchronous code division multiple access
TRX	transceiver
TTI	transmission time interval; used in LTE and WCDMA
TX	transmitter
UDP	user datagram protocol
UE	user equipment
UL	uplink
USB	universal serial bus
WCDMA	wideband CDMA
WLAN	wireless local area network

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The Rohde&Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

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