R&S®CMsequencer

One graphical scripting tool for every automated 5G testing need

Product Brochure
Version 01.00

ROHDE&SCHWARZ
Make ideas real

AT A GLANCE

The R&S®CMsequencer is a graphical scripting interface that creates, configures and executes test scripts on the R&S®CMX500 radio communications tester. The R&S®CMsequencer is part of R&S®CMsquares, the powerful R&S®CMX500 user interface and control center.

Background

It is impossible to underestimate the significance of automated testing in the wireless industry. Countless tools, apps and automation frameworks have been developed for such testing because it is so important and the number of applications is so vast. When testing with the 5G R&S®CMX500 radio communication tester, an automated testing tool covers all aspects of 5G testing is mission critical, whether for FR1 RF parameteric tests, FR2 OTA measurements or E2E maximum IP throughput.

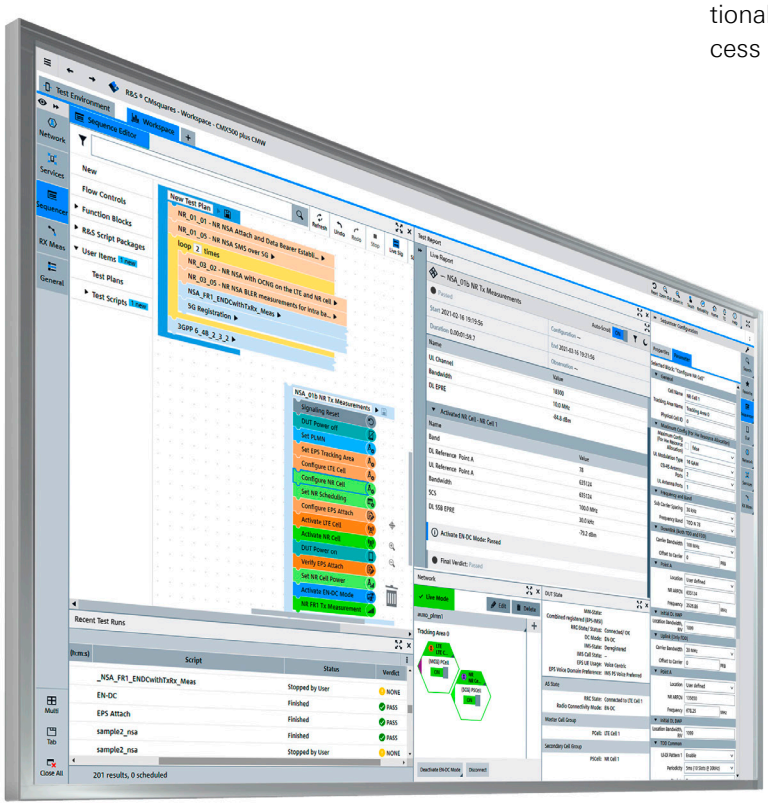
Historically, separate tools/applications with nothing in common and completely disconnected from one another have addressed various testing areas. This means everything may be different, including the user interface and the type of user configuration, the handling of DUT automation and test plans and the way results are generated. Such unparalleled variations often make the user learning curve difficult and steep. Even when using the same network emulator, an enormous amount of time and effort have to be invested in learning the different tools to configure and test hardware functions, reducing efficiency.

New era in graphically creating and executing tests

History need not repeat itself. Rohde&Schwarz offers a single graphical scripting application for automated 5G testing that covers any testing, automation and result management needs. Thanks to the unique, intuitive and flexible graphical user interface, R&S®CMX500 users never have to deal with multiple tools. Handling different testing use cases with a unified user interface flattens the learning curve and opens up opportunities to move beyond the testing limits imposed by fragmented applications.

The future will have a more unified approach, where all necessary functions for any kind of 5G testing are available from a single graphical user interface.

With R&S®CMsquares sequencer or just R&S®CMsequencer, Rohde&Schwarz provides unique and intuitive ways to create test sequences for a wide range of test use cases, including 5G RF parametric testing, 3GPP RF testing, protocol verification and E2E IP testing. Working seamlessy with R&S®CMsquares interactive mode, R&S®CMsequencer makes it simple to create and execute test scripts and test plans in an automated environment. Users build tests by arranging color coded functional blocks one after the other, making the whole process child's play. 5G testing has never been easier.



R&S®CMsequencer, well nested in web based R&S®CMsquares, brings the right balance of simplicity and flexibility to graphical scripting.

BENEFITS

R&S®CMsequencer is ideal for many testing activities with the R&S®CMX500. Chipset manufacturers, module makers, OEMs, network operators, regulatory organizations, service and repair companies – R&S®CMsequencer can support almost any use case. R&S®CMsequencer simplifies workflows and helps create and execute test scripts and test plans and clearly displays the execution results.

STATE OF THE ART, FUTURE PROOF SOFTWARE

The world of software is trending towards web applications. R&S®CMsequencer and R&S®CMsquares interactive mode are web-based applications and can work on any operating system.

COMPLETE TEST COVERAGE IN ONE GRAPHICAL APPLICATION

In RF parameteric tests, 3GPP RF tests, throughput tests, mobility tests, failure scenarios or any combination of them – R&S®CMsequencer provides a single location for creating and executing tests.

BUILT-IN AUTOMATED CAMPAIGN MANAGEMENT

R&S®CMsequencer has sophisticated features to create test campaigns, automate DUT handling during remote execution and result collection, incl. 3D measurements charts for FR2.

SIMPLIFIED WAY TO CONTROL EXTERNAL EQUIPMENT

OTA chambers for FR2 testing, power supplies for battery life testing or other external equipment – R&S®CMsequencer makes controlling and handling external equipment easy.

AUTOMATIC DUT-SUPPORTED BAND COMBINATION TESTS

Effortless scanning through all DUT-supported band combinations and verifying KPIs (RF, Tput, etc.) in each band combination.

R&S®CMsequencer HIGHLIGHTS

R&S®CMsequencer is embedded in the R&S®CMsquares web-interface concept from Rohde&Schwarz, where it introduces users to seamless and uniform testing in both interactive and graphical scripting modes.

Unblock tests with blocks

In R&S®CMsequencer blocks form both the biggest and smallest units. From test campaigns to changing scheduling configurations, from controlling positioners in OTA chambers to adding user prompts, blocks are available for any operation. Having a single unit streamlines the creation of both simple and more complicated test sequences.

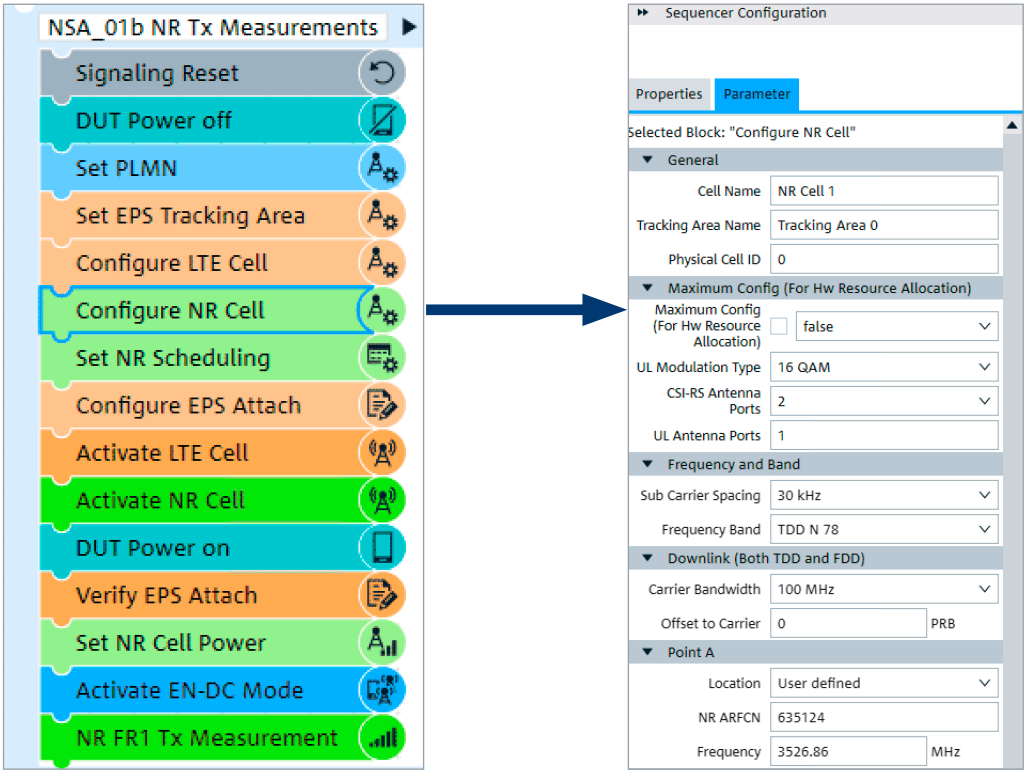
Blocks are placed in categories and rules are applied to the blocks in a particular category. Test script blocks can contain signaling or RF measuring blocks, but a test script block cannot contain another test script block. A block with multiple test script blocks is a test plan block.

Functional blocks are color coded for better understanding. For example, LTE blocks are orange, whereas NR blocks are green. Every block covers certain parameters. Users can configure them to control the actions of the block as well as R&S®CMX500 configuration and DUT signaling interactions. For example, NR cell properties (band, bandwidth, SCS, etc.) can be configured in a configure NR cell block.

View events and measurements live and offline

Having test sequences that merely provide a pass/fail verdict is usually not enough. Reports often need to outline the important events that occurred during execution. When performing RF or E2E measurements, measurement reports presenting measurement values as tables or graphical charts can also be valuable.

When executing individual test scripts, these reports are important during runtime. Live reporting helps feed results immediately back to the user rather than waiting until the end of the test script execution. But for regression tests or running test plans in an automated environment, offline test reports are essential to post analysis and the generation of end results.



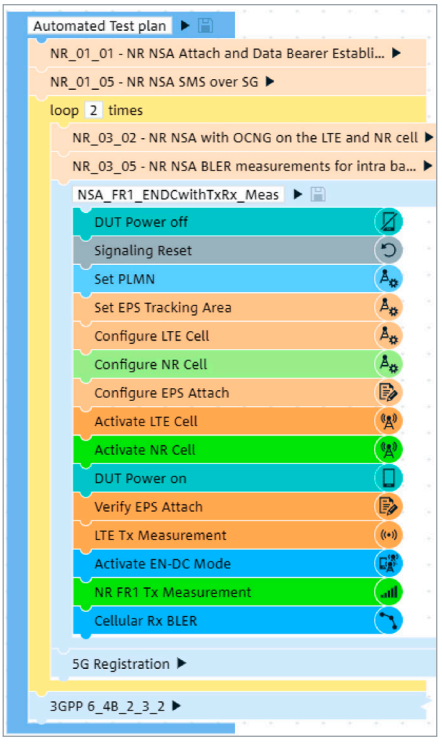
Sequential arrangement of blocks with detailed parameterization, scripting of tests cannot get easier than this.

R&S®CMsequencer can do both. When executed from the graphical user interface, the live reporting square shows the important events and measurement results both in tables and graphs. 3D measurement graphs are also included in FR2 reports. At the end of every test, an offline report is created in various formats (.pdf, .csv, .html).

Manage automated test campaigns

Using the same graphical interface that was used to create the tests to add them into automated regression campaigns saves a lot of time. In an environment with a familiar look and feel, test sequences can be added to a test plan and executed with a single click. Both scripts created in R&S®CMsequencer and those created using the XLAPI Python interface can be executed. R&S®CMsequencer is the default campaign management tool in the R&S®CMsquares software toolchain.

Robust features for managing test campaigns on the R&S®CMX500, regardless of the interface used to create test scripts.



Activated LTE Cell - LTE Cell 1

Activated NR Cell - NR Cell 1

Name	Value
Band	78
DL Reference Point A	620046
UL Reference Point A	620046
Bandwidth	10.0 MHz
SCS	30.0 kHz
DL SSB EPRE	-69.3 dBm

DUT Information

IMEI	353585110017012

Activate EN-DC Mode: Passed

NR FR1 - 6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1 @ DC_1A_n78/15kHz|30kHz/5MHz|10MHz

Test Item	Test Condition	Lower Limit	Upper Limit	Measured	Unit	Verdict
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM QPSK;Inner_Full(12@6);Pumax;pc3;ID:23	19.50	25.00	26.07	dBm	Failed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM QPSK;Edge_1RB_Left(1@0);Pumax;pc3;ID:24	17.50	25.00	24.30	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM QPSK;Edge_1RB_Right(1@23);Pumax;pc3;ID:25	17.50	25.00	23.85	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM QPSK;Outer_Full(24@0);Pumax;pc3;ID:26	17.50	25.00	24.61	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 16 QAM;Inner_Full(12@6);Pumax;pc3;ID:27	19.00	25.00	25.62	dBm	Failed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 16 QAM;Edge_1RB_Left(1@0);Pumax;pc3;ID:28	17.50	25.00	24.48	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 16 QAM;Edge_1RB_Right(1@23);Pumax;pc3;ID:29	17.50	25.00	24.00	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 16 QAM;Outer_Full(24@0);Pumax;pc3;ID:30	17.50	25.00	24.63	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 64 QAM;Edge_1RB_Left(1@0);Pumax;pc3;ID:31	16.00	25.00	24.22	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 64 QAM;Edge_1RB_Right(1@23);Pumax;pc3;ID:32	16.00	25.00	23.73	dBm	Passed
6.2B.2.3 UE Maximum Output Power reduction for Inter-Band EN-DC within FR1	n78;620334;10MHz;30kHz;CP-OFDM 64 QAM;Outer_Full(24@0);Pumax;pc3;ID:33	16.00	25.00	24.04	dBm	Passed

Live updates on executing scripts with optional downloads of reports in various file formats.

TESTING USE CASES

3GPP RF automated tests

Verifying 3GPP RF test cases in line with TS 38.521 (pre-conformance) is one of the most basic and important use cases for 5G testing. Verifying sections 6 and 7, TX and RX tests provide the basic sanity tests for device RF characteristics.

R&S®CMsequencer offers these tests simply and automatically for a one-click test execution solution. Special 3GPP blocks that comply with the configuration and test points in 3GPP TS 38.521 offer a readymade way to test device RF functions. R&S®CMsequencer 3GPP blocks also allow modification of default configurations and the flexibility to test non-compliant configurations.

Even though easy 3GPP testing configuration and execution are important, comprehensive measurement reports for these tests are also vital. R&S®CMsequencer measurement reports come in various formats providing a tabular summary of all 3GPP measurements with verdicts for each measurement added to the right. Results and verdicts are immediately available along with summary verdicts for all 3GPP tests.

Multi-Eval, BLER and sensitivity tests

R&S®CMsequencer offers blocks to thoroughly verify RF parameteric DUT tests for more R&D focused RF applications. Transmission and receiver characteristic tests, such as EVM, spurious emissions, RX sensitivity are just a block away with R&S®CMsequencer. Sweeping channels, bands, bandwidth and TX/RX testing for every iteration is greatly simplified with R&S®CMsequencer. Fast frequency change allows time-optimized performance of such sweep tests.

As with 3GPP tests, comprehensive test reports are generated in .csv format for post processing. Executing these tests (incl. 3GPP tests) can be automated both with R&S®CMsequencer and your custom automation framework. Faceless R&S®CMsequencer enables the integration of execution R&S®CMsequencer test scripts and test plans and collection of test results in any custom automation framework.

Note: R&S®CMsequencer offers complete flexibility when mixing 3GPP test blocks with R&D RF measurement blocks. Having ONE single test creation and automation tool for all 5G testing use cases, gives users the freedom to fulfill their testing needs with complete flexibility and confidence.

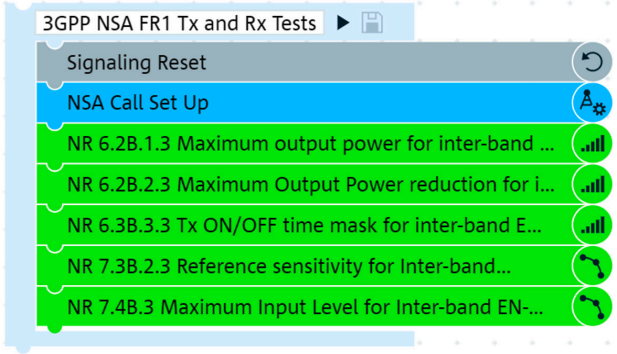
End-to-end application tests

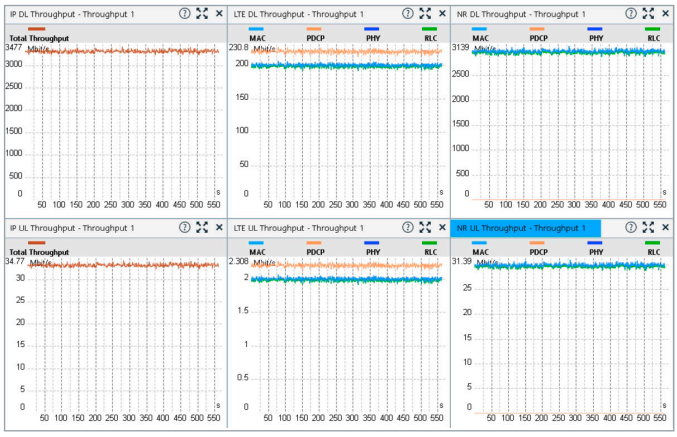
Verification of high level KPIs such as E2E throughput, audio tests or battery-life tests are extremely important for 5G DUTs. To fulfill these testing needs, R&S®CMsequencer offers blocks and functions to automatically verify such high level KPIs.

Features such as carrier aggregation (CA) with E2E IP level throughput (TCP/UDP), VoNR, EPS fallback to LTE, battery consumption monitoring and audio codec tests can be easily created and tested with R&S®CMsequencer. Additional equipment for testing these functions can be handled directly by R&S®CMsequencer. This can all be done from the comfort of R&S®CMsequencer for external

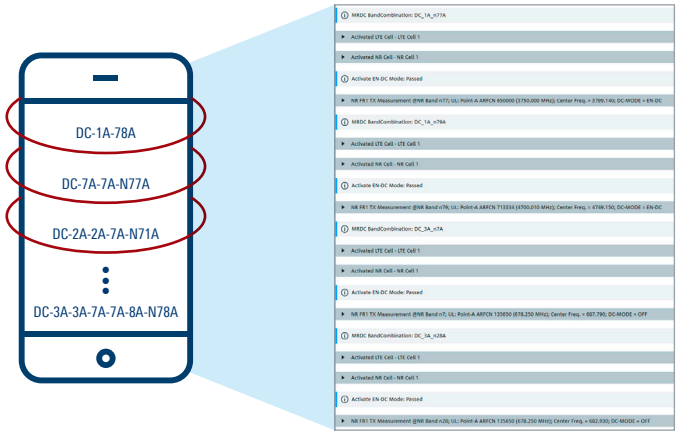
All RF related TX/RX measurements are just a block away.

3GPP RF automated tests are a smart way to test 3GPP conformant RF test cases and allow test point configuration modification.





End-to-end application tests: R&S®CMsequencer offers exhaustive end-to-end IP level testing possibilities into maximum throughput.



The R&S®CMsequencer Shuffler iterates through device MRDC band combinations. This provides a fully automated way of checking the health of the DUT.

equipment configuration and control. Test reports can log all the data generated during the tests, as tables and charts or graphs.

Note: When an E2E application is configured with R&S®CMsequencer, the measurements are automatically reflected in R&S®CMsquares interactive mode. Users can seamlessly switch to interactive mode to continue interactive testing.

Iterate through device MRDC band combinations

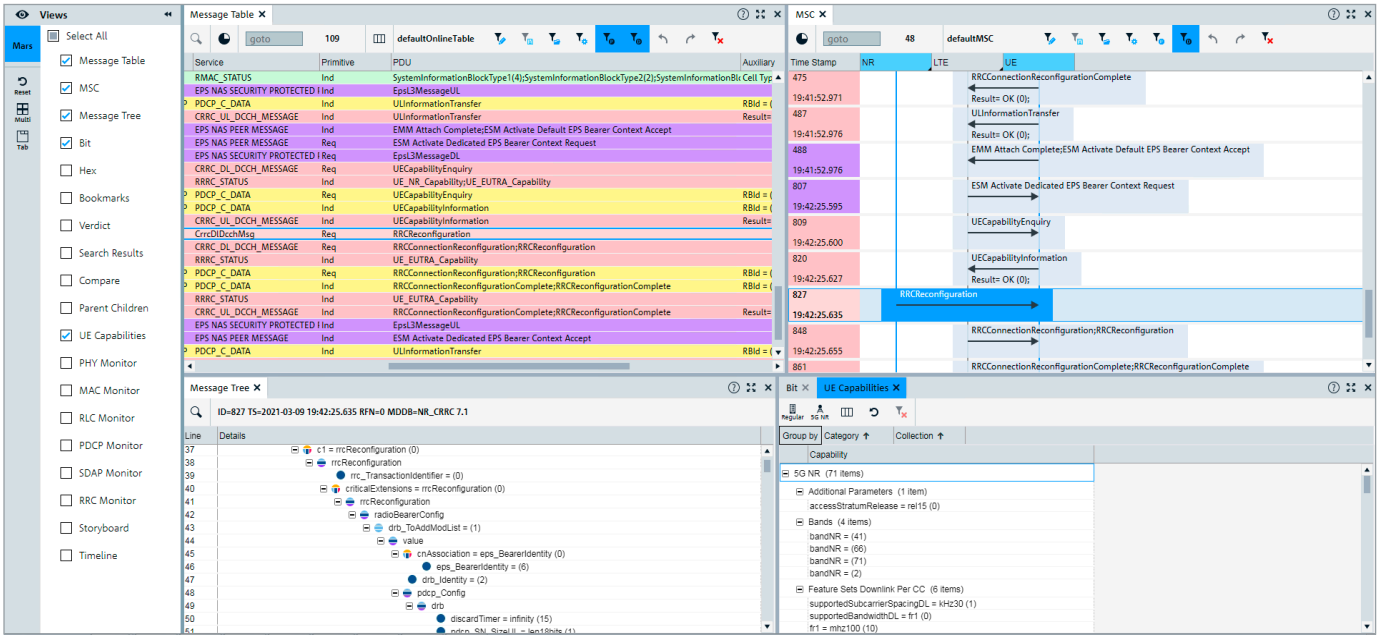
The growing number of DUT-supported bands and band combinations make it essential to not just test functions on isolated bands or band combinations but on all of such bands or band combinations. This can easily result in hundreds and thousands of test scripts and be hard to maintain. Above all, every DUT reports different combinations and tests should be chosen based on the report bands and band combinations.

The R&S®CMsequencer shuffler function can help with automatic iteration across the bands and band combinations reported by the DUT. This drastically reduces user time and effort and the number of test scripts needed to test RF and protocol functions for all supported combinations.

Online and offline log analysis

Test script execution can be tracked in R&S®CMXmars. Simplified views of the message sequencer chart, user equipment capability views and detailed views of message content trees help make sense of the test execution in real time. Of course, the same message log is available offline and can be downloaded along with the measurement report.

Log analysis online and offline: R&S®CMXmars covers all the needed feature set for analysis and debugging.



Service that adds value

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

Rohde&Schwarz

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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Sustainable product design

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

Certified Quality Management
ISO 9001

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ISO 14001

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