# R&S®ZNrun
# VECTOR NETWORK ANALYZER TEST AUTOMATION SUITE

## Platform for automated VNA tests


Product Brochure
Version 05.00

ROHDE&SCHWARZ
Make ideas real

# AT A GLANCE

Each stakeholder in the production chain from development to quality control has different requirements when it comes to testing a product. R&S®ZNrun consolidates the tools the individual users need in a single software suite featuring easy-to-use GUIs and automation and optimization intelligence.

For a facility manager, the yardstick for optimization could be maximizing the daily production yield, while for a test engineer it might mean being able to easily define a test configuration and have it loaded on each device in the factory in a few seconds. A tester instead might be interested in seeing only the pass/fail results of the measurements, after having started them by scanning a barcode. Quality managers, in turn, might find it convenient to be able to download documentation and real-time yield statistics while on their way to the factory.

The R&S®ZNrun vector network analyzer test automation suite was designed with optimization in mind and acknowledges the associated requirements by offering each party the possibility to expedite their workflows as much as possible by automating processes. The software leverages all of the Rohde&Schwarz RF measurement experience to make the most complicated measurements with vector network analyzers fast, accurate and most of all easy for everyone.

Testing a frontend module with the R&S®ZNB and an R&S®ZN-Z84 switch matrix.
The R&S®ZNrun vector network analyzer test automation suite increases measurement throughput.

The R&S®ZNrun vector network analyzer test automation suite consists of a powerful tool set. Test developers can configure and control the test setup through a tool called R&S®ZNrun workbench. The R&S®ZNrun measurement client offers test operators a control panel where they can start measurements and verify results with a workflow as easy as clicking just one button.

For an overview of measured data, the software suite offers the R&S®ZNrun visualization client, which not only displays charts and traces in a compact and clear fashion, but also allows exporting them for documentation purposes.


# KEY FACTS

- ▶ All tools for test development
- ▶ DUT-centric graphic user interface
- ▶ Streamlined workflow
- ▶ Flexible and customizable
- ▶ Test tuning

# TOOL SET



# APPLICATIONS

Automated compliance testing and verification of high speed cables

# R&S®ZNrun WORKBENCH

## Universal tool for test development and result analysis

### All you need for test development

The R&S®ZNrun workbench is designed to accommodate the needs of every user with tasks ranging from test development to result analysis.

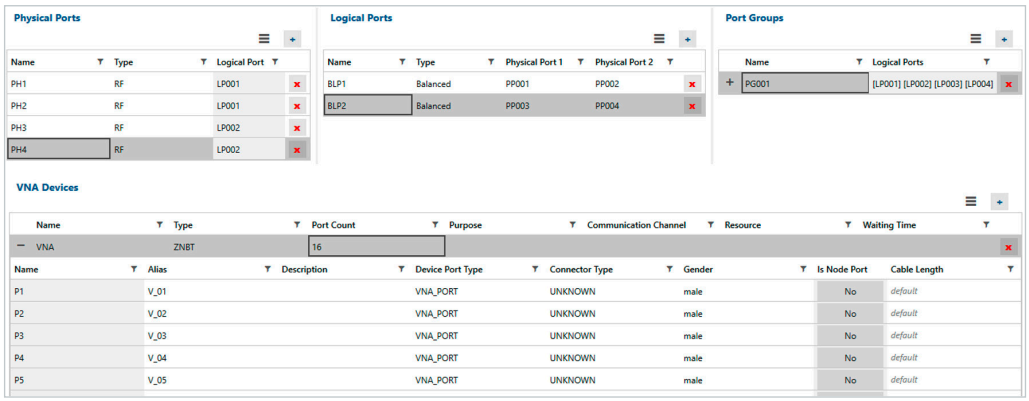
Its brand new framework addresses users with two major use cases: defining complex test scenarios in a straightforward manner and modifying or combining configurations to generate new setups and use them as templates. Furthermore, a tuning tool is available to troubleshoot configurations and adjust them to perfectly fit the needs of a given test scenario. Measurements can be started directly from the R&S®ZNrun workbench and results can be presented in the R&S®ZNrun visualization client.

### DUT-centric measurement configuration

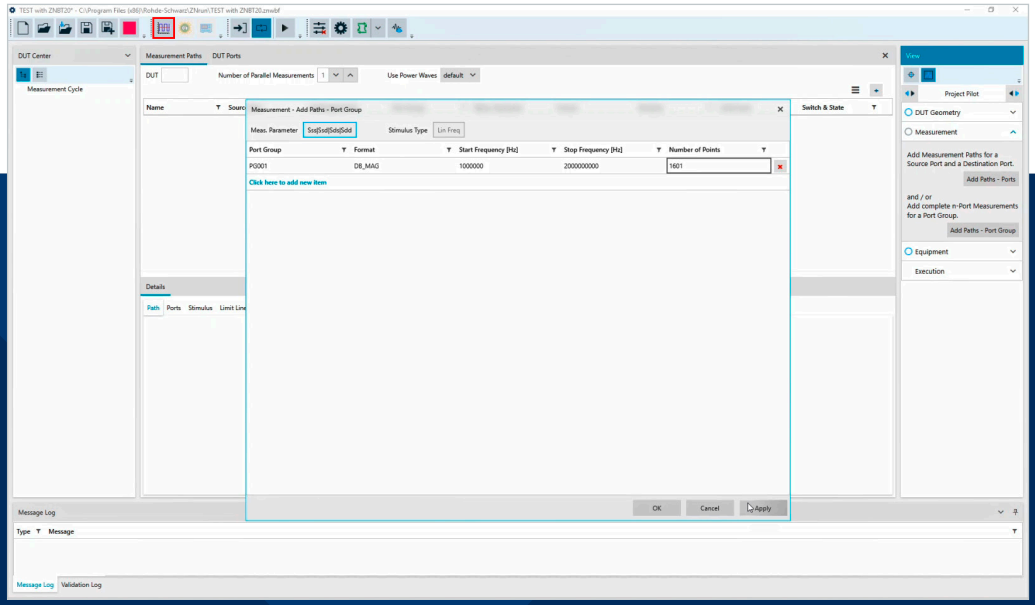
Measurement configuration in the R&S®ZNrun workbench is centered around the device under test (DUT). The first thing the user has to do is define the DUT by specifying its ports and input stimuli.

### Streamlined workflow

In the R&S®ZNrun workbench, the user is guided through the measurement configuration in a streamlined process. Every detail (e.g. parameters to be measured, trigger functions) is added step by step. The user can save and reload configurations, and combine different ones, e.g. by importing items such as a particular stimulus when defining a completely new DUT.




DUT configuration in the R&S®ZNrun workbench




Measurement configuration in the R&S®ZNrun workbench

## Flexible and customizable

The R&S®ZNrun architecture provides a .NET remoting API, a C# plug-in interface and a generic plug-in to support Python code snippets. This ensures the coexistence of existing solutions and R&S®ZNrun. Simply specify the control code to be used in the R&S®ZNrun workbench plug-in section and integrate custom actions into the measurement cycle. Every custom action will be executed as a single step within the measurement cycle.

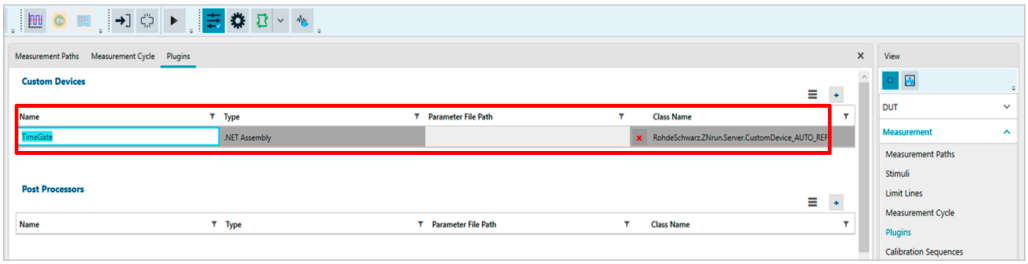
## Automatic detection of connected VNAs

R&S®ZNrun automatically detects the VNAs connected to it provided that the R&S®ZNrun workbench and any number of Rohde&Schwarz VNAs are connected to the same LAN segment. The user can choose the appropriate instrument(s) for the measurements to be performed. If selected instruments are not compatible with the defined setup, an error message is output.

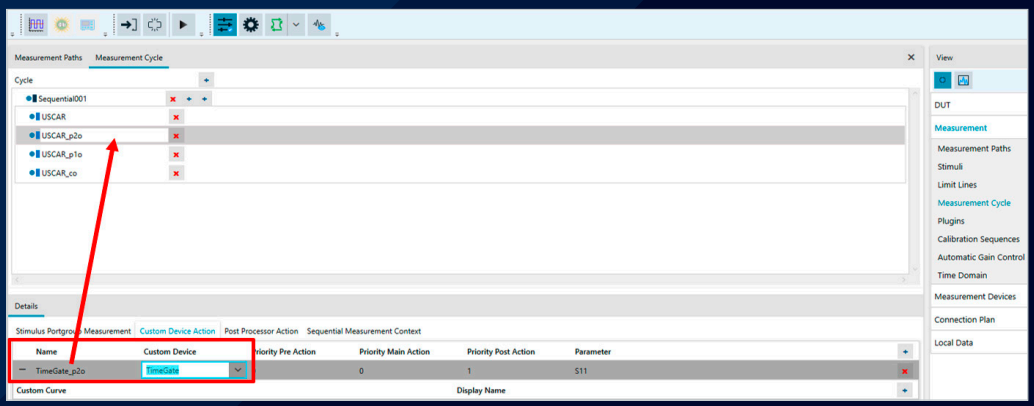
## Free measurement configuration

R&S®ZNrun is a software suite that can be downloaded free of charge from the Rohde&Schwarz website. After starting the R&S®ZNrun workbench, the user can configure measurements, e.g. by defining the port configuration, the stimuli, and the VNA devices to be used. To execute measurements, an R&S®ZNrun server with a valid license (R&S®ZNRUN-K1) is required. The license is contained in the R&S®ZNPC license dongle and must be installed on the same machine on which the R&S®ZNrun server runs. Any additional R&S®ZNrun option purchased is linked to the R&S®ZNRUN-K1 core license, i.e. to the R&S®ZNPC license dongle.

R&S®ZNPC license dongle




Importing a plug-in into the R&S®ZNrun workbench (top) and integrating it into the measurement cycle (bottom)



# R&S®ZNrun CABLE TEST CLIENT

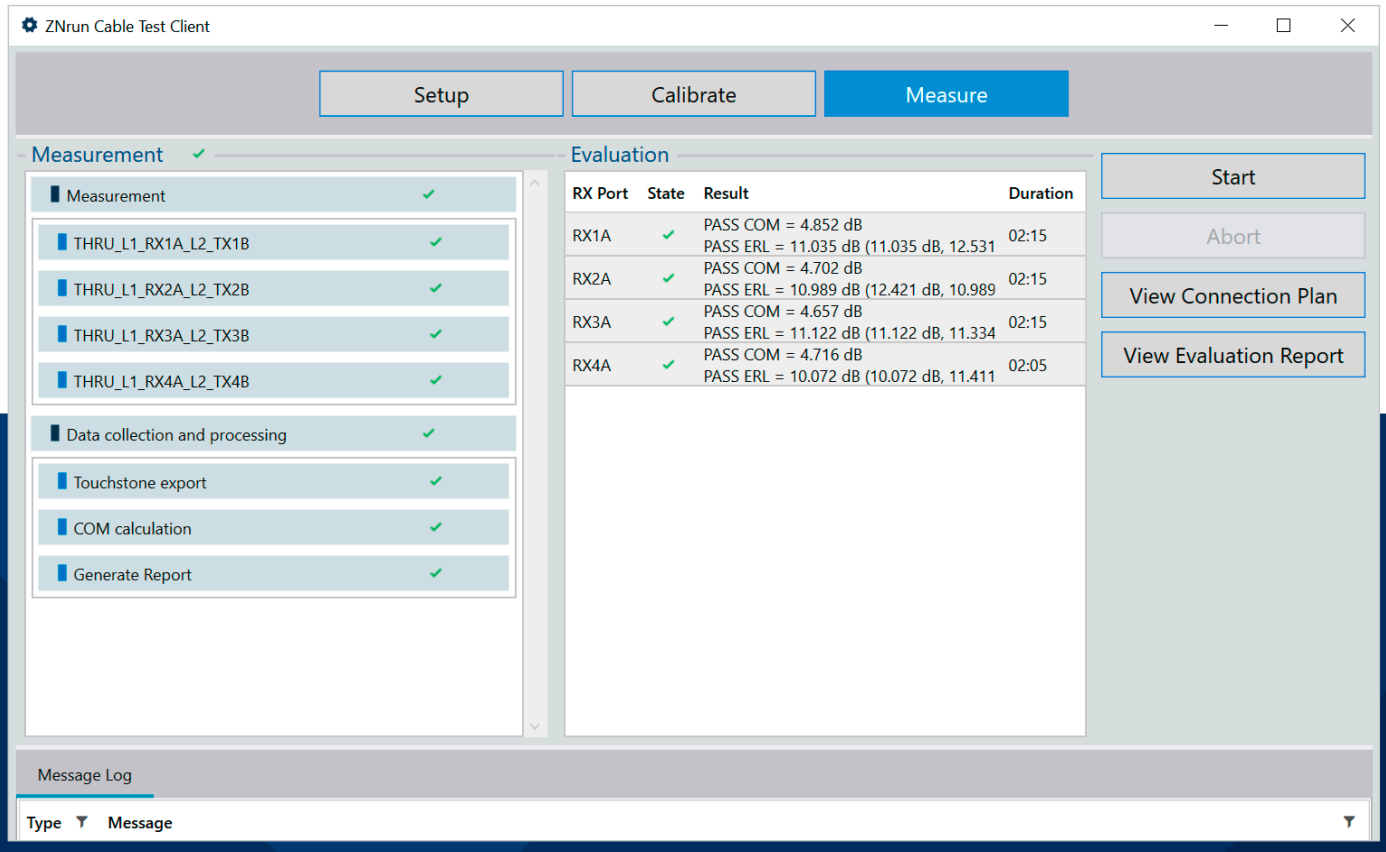
## Simple and efficient S-paramater measurements

### Simplified measurement flow in three steps

R&S®ZNrun cable test client makes S-parameter measurements of DUTs, especially cables, very easy. Measurement requires only three steps.

- **Setup:** the T&M equipment like the VNA, calibration unit and switch matrix are configured once
- **Calibrate:** guided calibration to achieve meaningful S-parameter measurements especially in a multiport setup, see also R&S®ZNrun calibration client on the next page
- **Measure:** start and monitor all defined measurement steps in a consistent GUI

R&S®ZNrun cable test client with evaluation report



# R&S®ZNrun CALIBRATION CLIENT

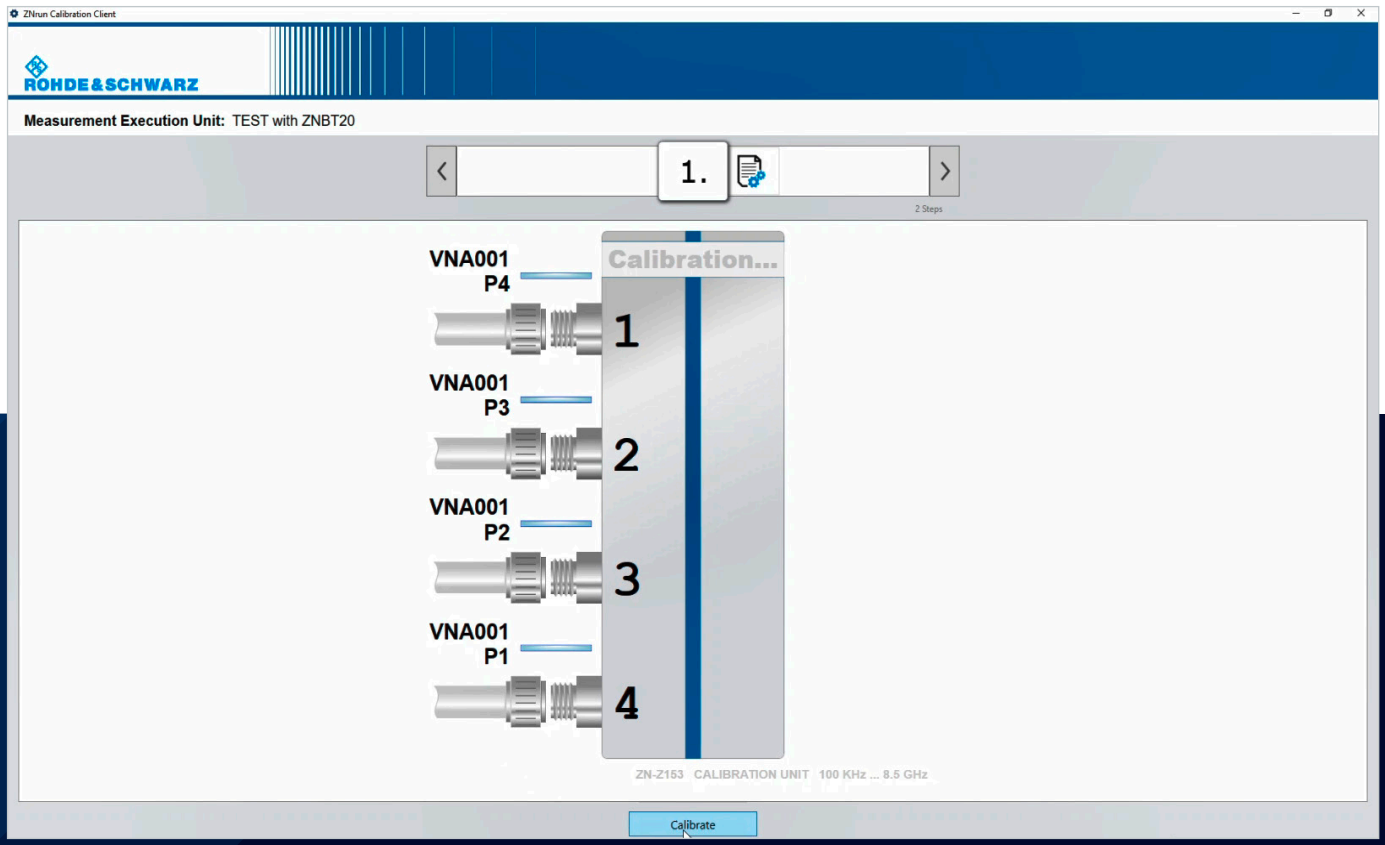
## Easy calibration thanks to intuitive user guidance

### Guidance for calibration with automatic generation of connection plans

Calibrating multiport device setups can be a complex and time-consuming task, especially if T&M equipment is used in a mass production environment. The R&S®ZNrun calibration client guides the user step by step through calibration, allowing optimal accuracy to be achieved with a minimum number of connection steps between the VNA or switch matrix and the calibration unit or kit.

Moreover, R&S®ZNrun can generate the connection plan for a specific measurement scenario for each measurement unit, minimizing errors in connecting VNAs, switch matrices, fixtures and DUTs.

R&S®ZNrun calibration client



# R&S®ZNrun MEASUREMENT CLIENT

## Trouble-free test control

### Easy control of challenging tests

The R&S®ZNrun measurement client provides test operators with a GUI that contains only the functions they really need. If necessary, measurements can simply be started with a click, without any need for additional configurations, and only meaningful results such as pass/fail results or measurement speed can be displayed. The R&S®ZNrun measurement client is a standalone client that can be installed where tests are actually taking place and enables straightforward control of the most challenging measurements.

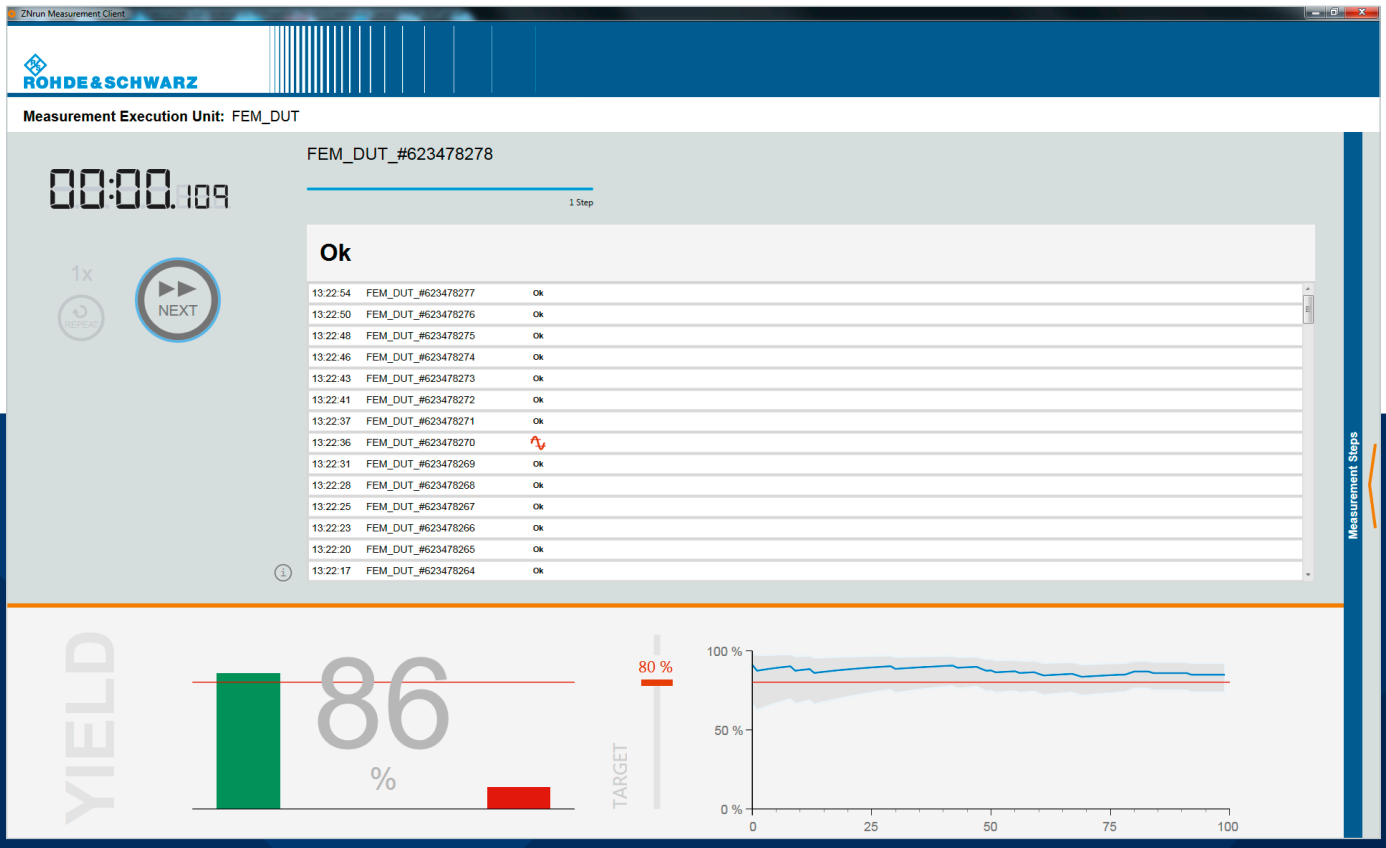
The R&S®ZNrun measurement client is suitable also for experienced users as it allows defining breakpoints, e.g. for debugging purposes.

### Even more customizable

To accommodate individual customer requirements, Rohde & Schwarz engineers can include customized features in the R&S®ZNrun measurement client, providing test operators with a tool that perfectly fits their measurement needs.

Our engineers can reprogram the GUI and adapt it to customer's application needs and to what test operators need to know. Test operators, on the other hand, can benefit from a tailored interface that allows only the operations they need with the least amount of clicks.

R&S®ZNrun measurement client



# R&S®ZNrun VISUALIZATION CLIENT

## Everything in view

### Compact display of all data

Most developers would like to view different measured parameters at a time. The R&S®ZNrun visualization client offers a smart way of displaying data, providing an overview of different measurements. It is also possible to display customized charts.

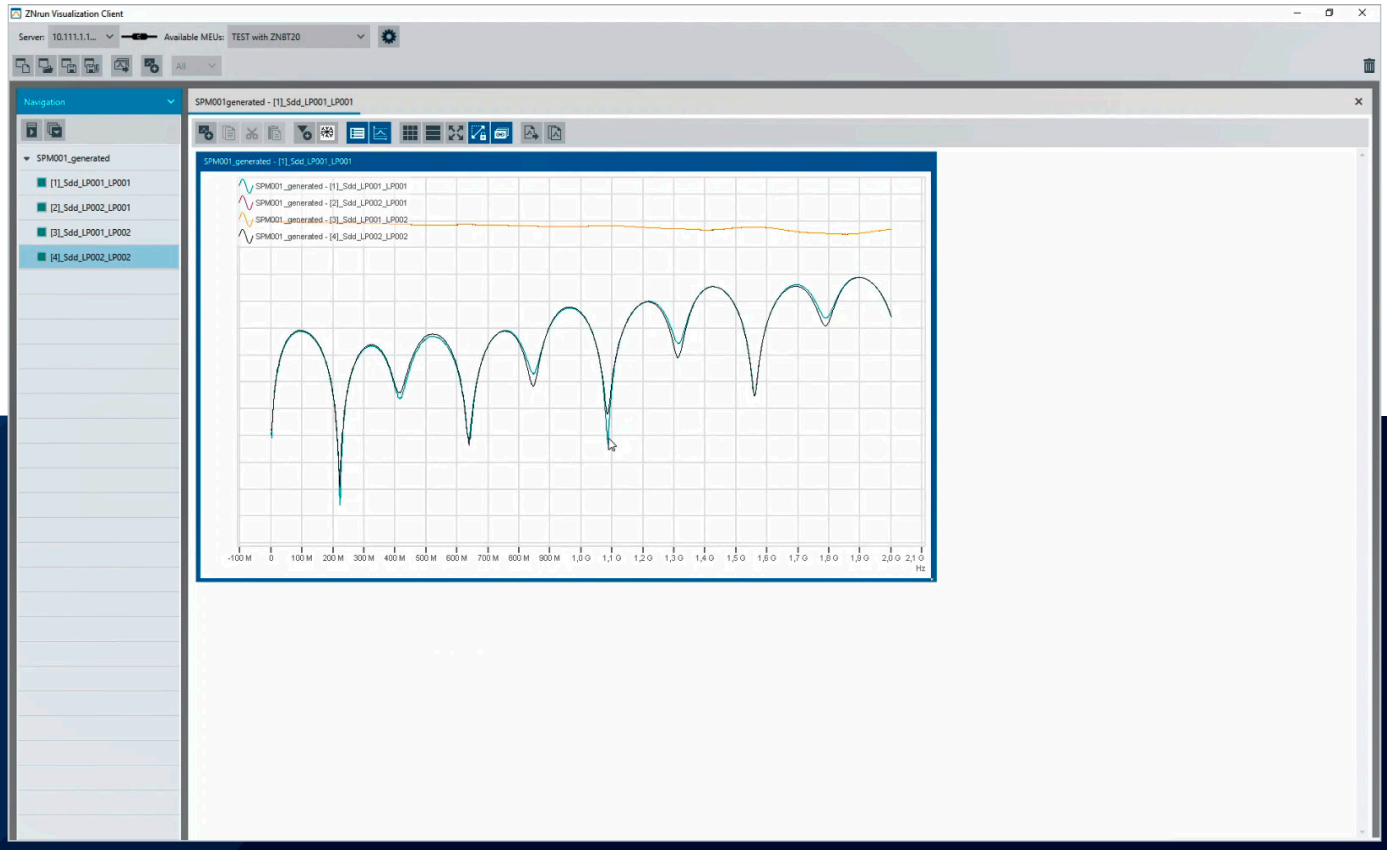
The R&S®ZNrun visualization client also provides a "live" display of every single measurement being executed, enabling a better understanding of results.

### Intelligent data management and documentation

The R&S®ZNrun visualization client has the ability to manage result data from the user's measurements. It automatically recognizes any changes made, e.g. to data range, or to stimulus signals during the tuning phase, and rescales and updates result charts accordingly.

Results can be documented in numerical and graphical form in the R&S®ZNrun visualization client via a plug-in. They can also be easily exported using the most common portable data format.

R&S®ZNrun visualization client within the R&S®ZNrun workbench



# APPLICATIONS

## AUTOMATED COMPLIANCE TESTING AND VERIFICATION OF HIGH SPEED CABLES

### Fully automated compliance test and verfication solution

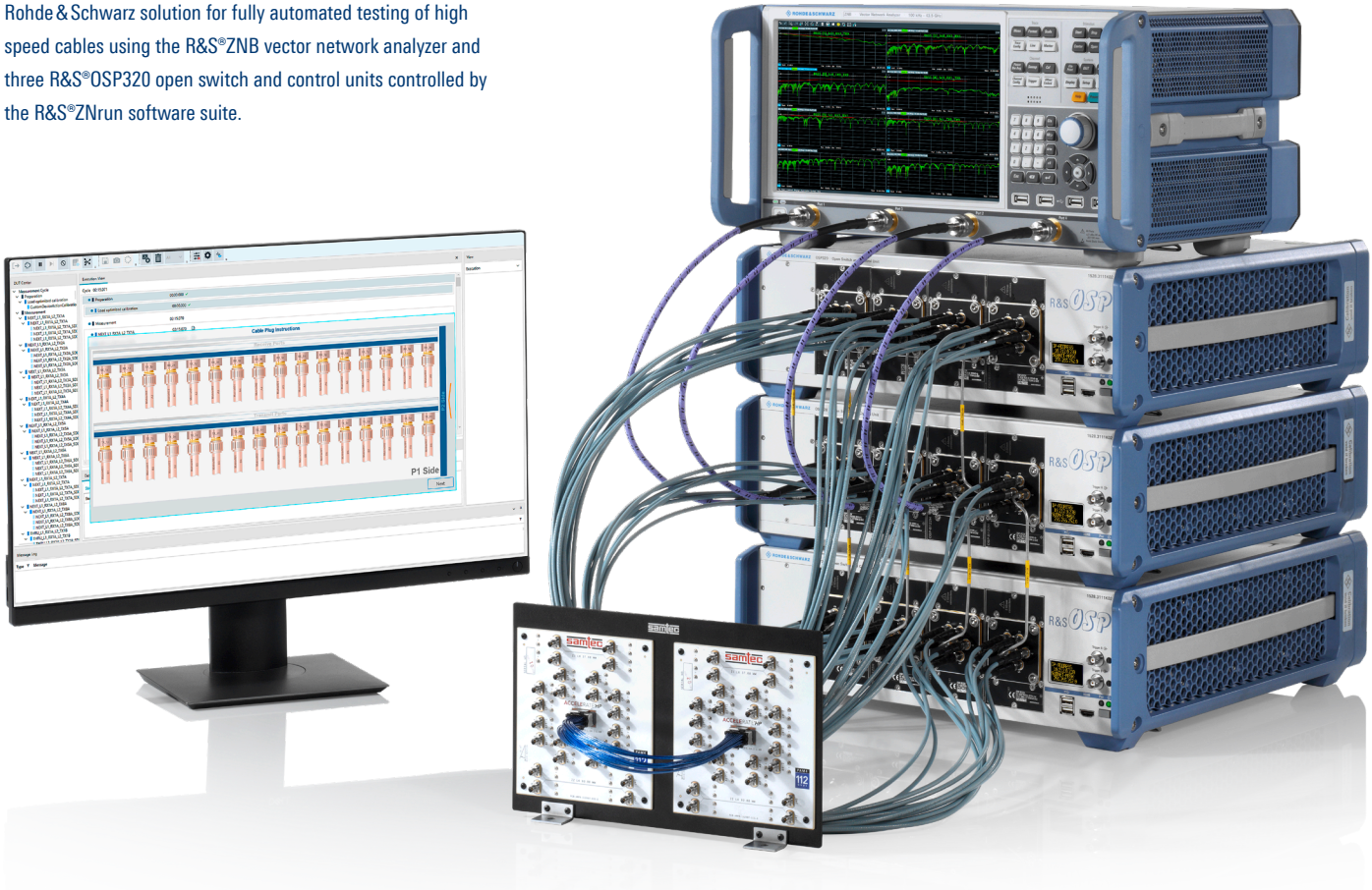
Testing high speed cable assemblies for data centers or consumer electronics is a highly complex task that requires support of higher frequencies and a multiport setup. Conventional manual testing with a 4-port vector network analyzer is time-consuming and error-prone, requiring the cables to be reconnected many times and different tests to be executed repetitively for every lane in a cable assembly.

Rohde&Schwarz introduces its first fully automated compliance test solution, based on the R&S®ZNrun vector network analyzer test automation suite. It allows easy, precise and time-saving compliance testing and verification of high speed cable assemblies and conforms to the latest technology standards like high speed Ethernet up to IEEE 802.3ck and PCI Express (PCIe) generation 5.0 and 6.0.

### Fast multiport measurements without reconnecting cables

The R&S®ZNRUN-K4xx compliance test automation options include three simple steps for the test procedure: setup, calibrate and measure. Each automated step is optimized for minimum measurement time and delivers reproducible results – two key benefits of this fully automated solution from Rohde&Schwarz. For example, a 48-port setup with an R&S®ZNB vector network analyzer and an R&S®OSP open switch and control unit makes it possible to switch up to 256 ports without reconnecting any port. This drastically reduces the typical test time. For example, the test time for an IEEE 802.3cd high speed Ethernet cable with 8 lanes takes just one hour compared to one day with manual testing.

Rohde&Schwarz solution for fully automated testing of high speed cables using the R&S®ZNB vector network analyzer and three R&S®OSP320 open switch and control units controlled by the R&S®ZNrun software suite.



## Unique time-optimized calibration

The calibration algorithms in R&S®ZNrun are optimized for maximum speed and a minimum number of cable reconnections, saving effort and time. For example, calibrating a 48-port setup for testing IEEE 802.3cd 8-lane cables requires no more than 45 minutes instead of several hours.

## Straightforward testing in three steps

With the R&S®ZNrun compliance test automation options, testing is organized in three steps: setup, calibrate and measure. The R&S®ZNrun compliance test automation options guide the user through port connection for calibration, minimizing the risk of erroneous connections and increasing confidence in measurement results. The software GUI provides comprehensive user guidance, making it easy to connect a multiport R&S®OSP setup to the test fixture and cable assembly under test.

## Automated generation of comprehensive reports

Test results are automatically stored and can be postprocessed in line with the recommendations defined in the relevant standards. Result tables, S-parameter diagrams and overall pass/fail results are consolidated into a printable test report, allowing the user to save time and focus on result analysis.

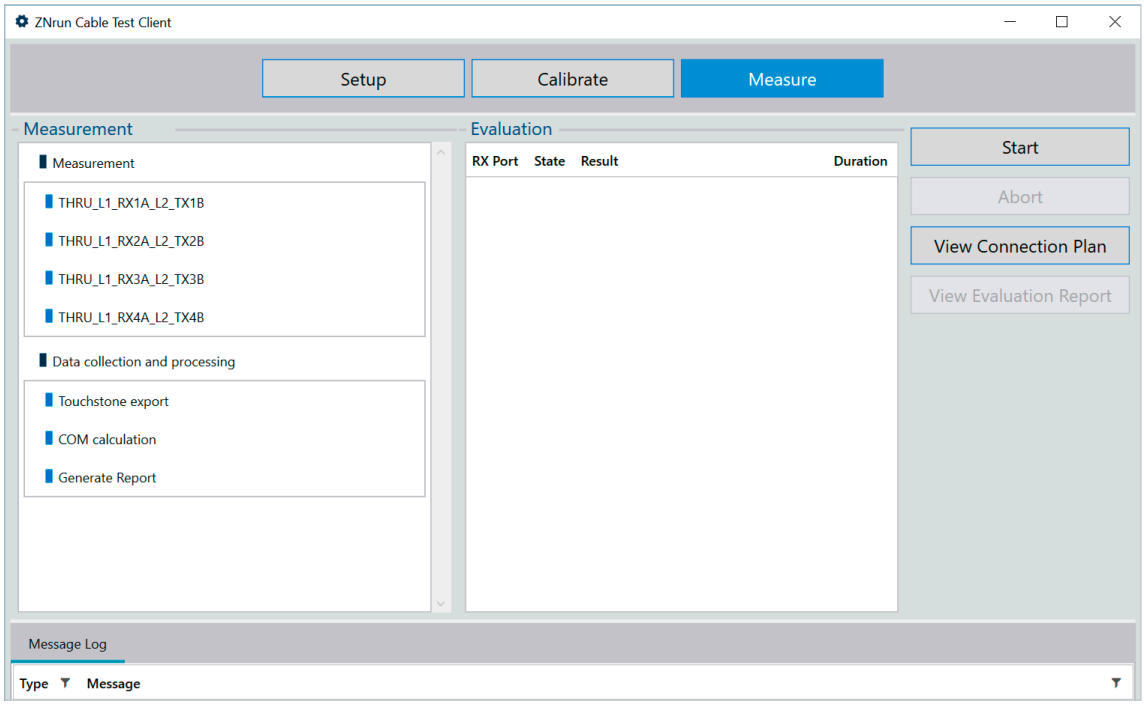
## Beyond compliance

R&S®ZNrun adapts flexibly to a range of testing needs. Designers and test engineers can use R&S®ZNrun workbench to debug setups and cables. Users can set key parameters such as frequency range or sweep time to customer-specific values in order to perform initial plausibility measurements before starting a full compliance test.

## Automation interface

Via the R&S®ZNrun automation interface for production testing, the measurement workflow can be extended with other applications or integrated into existing automated testing environments.

Compliance measurements on high speed cables made easy with R&S®ZNrun in only three steps: setup – calibrate – measure.
R&S®ZNrun also controls execution of the test steps and lists the actions to be taken for each step.



## Flexibility in parameter selection for efficient measurements and evaluation

R&S®ZNRUN-K4xx compliance test automation options allow the user to select the lanes in the cable under test with just a click. Once the lanes under test are chosen, the type of measurement to be performed can be selected individually on each lane. Typical test cases are: through (THRU), near end crosstalk (NEXT), far end crosstalk (FEXT) and time domain analysis.

Regarding the post-processing, the user has the flexibility to select the preferred metrics to be calculated for the evaluation. E.g. differential insertion loss, differential return loss, power sum NEXT (PSNEXT) and power sum FEXT (PSFEXT), as specified in the peripheral component interconnect express (PCIe) standard. The flexible GUI of R&S®ZNrun enables the user to test and evaluate cables in a fast and easy way, according to his design and preference.

## Precise test fixture deembedding

The R&S®ZNRUN-K4xx compliance test automation options achieve accurate measurement results over the whole frequency range when combined with the enhanced deembedding options accessible through the software menu. The available options are EaZy deembedding (EZD, R&S®ZNB-K210), in-situ deembedding (ISD, R&S®ZNB-K220) and smart fixture deembedding (SFD, R&S®ZNB-K230) in the R&S®ZNB for example.

## Required licenses

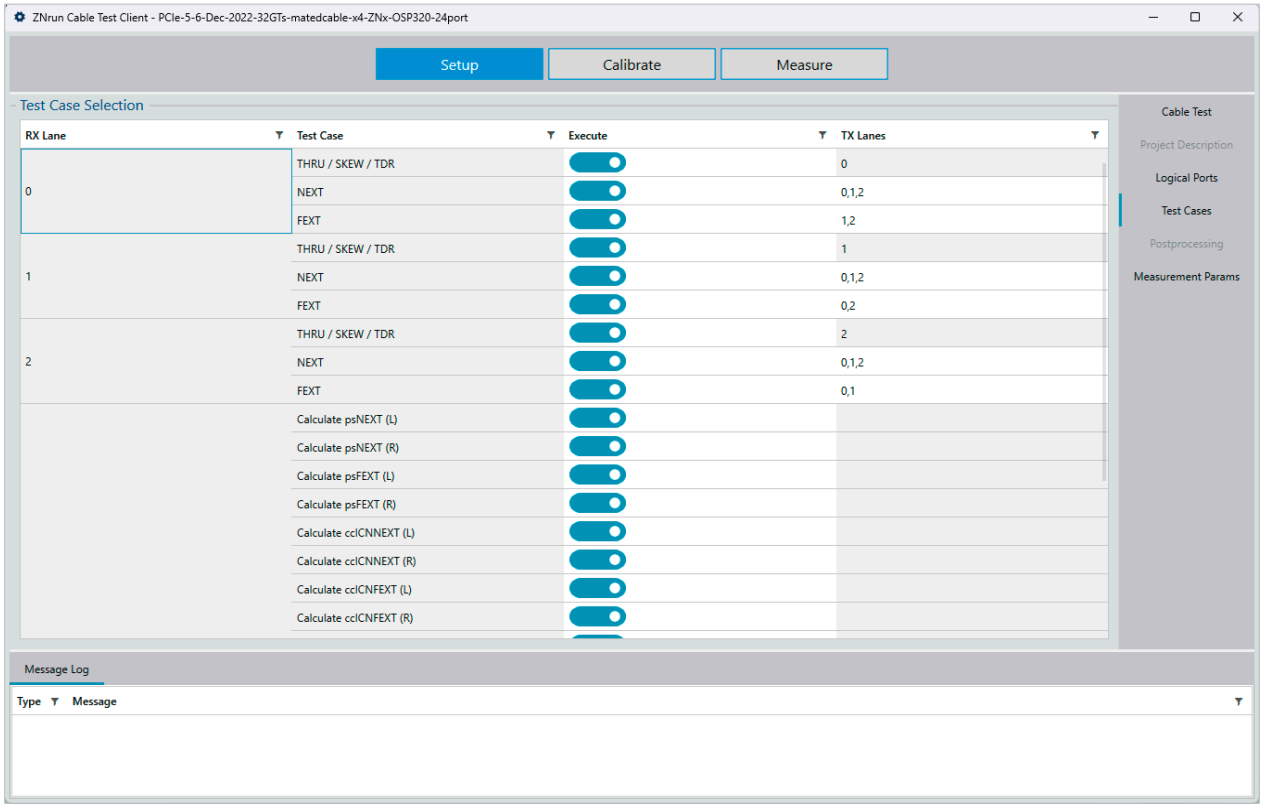
The Rohde&Schwarz solutions for fully automated compliance testing of high speed cable assemblies include support for hardware, software and accessories.

Licenses for the following items are required to run the R&S®ZNrun compliance test automation options:

- R&S®ZNRUN-K1 VNA test automation software
- R&S®ZNRUN-K4xx compliance test automation option for the respective standard(s) (see ordering information)

A dedicated maintenance option is available for each R&S®ZNRUN-K4xx option.

Flexible GUI: the user can select the lanes to be tested, measurements to be performed and post-processing metric to be calculated with R&S®ZNrun.



## Recommended configurations for high speed Ethernet cables

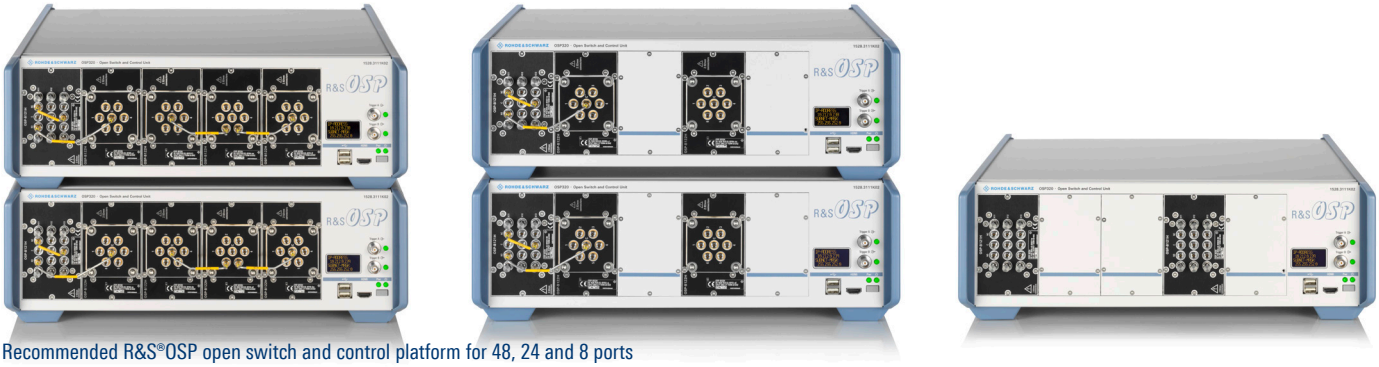
| | Compliance test for IEEE 802.3bj/by/cd | Compliance test for IEEE 802.3ck |
|---|---|---|
| **Software** | | |
| R&S®ZNrun option | R&S®ZNRUN-K410 | R&S®ZNRUN-K411 |
| R&S®ZNrun core software | R&S®ZNRUN-K1 | R&S®ZNRUN-K1 |
| License dongle | R&S®ZNPC | R&S®ZNPC |
| **Hardware** | | |
| Vector network analyzer | R&S®ZNB26 | R&S®ZNA50 |
| Calibration unit | R&S®ZN-Z53 or R&S®ZN-Z54 | R&S®ZN-Z55 or R&S®ZN-Z156 (model .03) |
| R&S®OSP open switch and control platform | | |
| 48 ports | 2 × R&S®OSP320,<br>2 × R&S®OSP-B121H and 8 × R&S®OSP-B122H,<br>1 × R&S®ZV-Z40CR8 [1] | 2 × R&S®OSP320,<br>2 × R&S®OSP-B121U and 8 × R&S®OSP-B122U,<br>1 × R&S®ZV-Z50CR8 [1] |
| 24 ports | 2 × R&S®OSP320,<br>2 × R&S®OSP-B121H and 4 × R&S®OSP-B122H,<br>1 × R&S®ZV-Z40CR4 [1] | 2 × R&S®OSP320,<br>2 × R&S®OSP-B121U and 4 × R&S®OSP-B122U,<br>1 × R&S®ZV-Z50CR4 [1] |
| 8 ports | 1 × R&S®OSP320,<br>2 × R&S®OSP-B121H | 1 × R&S®OSP320,<br>2 × R&S®OSP-B121U |

## Recommended configurations for PCIe 5.0/6.0 cables

| | Compliance test for PCIe 5.0/6.0 |
|---|---|
| **Software** | |
| R&S®ZNrun option | R&S®ZNRUN-K440 |
| R&S®ZNrun core software | R&S®ZNRUN-K1 |
| License dongle | R&S®ZNPC |
| **Hardware** | |
| Vector network analyzer | R&S®ZNB43 |
| Calibration unit | R&S®ZN-Z54 |
| R&S®OSP open switch and control platform | |
| 64 ports | 3 × R&S®OSP320,<br>12 × R&S®OSP-B122H,<br>1 × R&S®ZV-Z40X8 [1] |
| 32 ports | 2 × R&S®OSP320,<br>8 × R&S®OSP-B122H,<br>1 × R&S®ZV-Z40X4 [1] |

R&S®ZV-Z40CR8 semirigid cable set for interconnection between R&S®OSP RF switch modules. Recommended for R&S®ZNRUN-K410 compliance test for IEEE 802.3bj/by/cd with 48 ports.

[1] Cable set used for interconnection between R&S®OSP RF switch modules.



Recommended R&S®OSP open switch and control platform for 48, 24 and 8 ports

# R&S®ZNrun ADVANCED CAPABILITIES

## Optional features

### Multiclient control

In a mass production environment, it is important that multiple measurements can be run at the same time. The R&S®ZNRUN-K2 multiclient capability option allows more than one measurement execution unit to run on the R&S®ZNrun server, requiring only a single license for the R&S®ZNRUN-K2 option.

### Synchronized measurements on multiple DUTs or with multiple VNAs

There is a growing need for parallel characterization of multiple RF paths in different RF bands, especially in the production of frontend modules for mobile communications, for characterizing MIMO antennas, or even for cavity filters. The R&S®ZNRUN-K5 DUT/VNA multiplicity option allows parallel measurements. This unique feature makes it possible to connect one vector network analyzer from Rohde&Schwarz to multiple DUTs or controllers of the same type (e.g. two handlers) and measure in parallel. The R&S®ZNRUN-K5 option also enables measuring a complex DUT using multiple vector network analyzers from Rohde&Schwarz (provided no crossbar measurements are needed between VNAs) and collecting results as if for a single measurement.

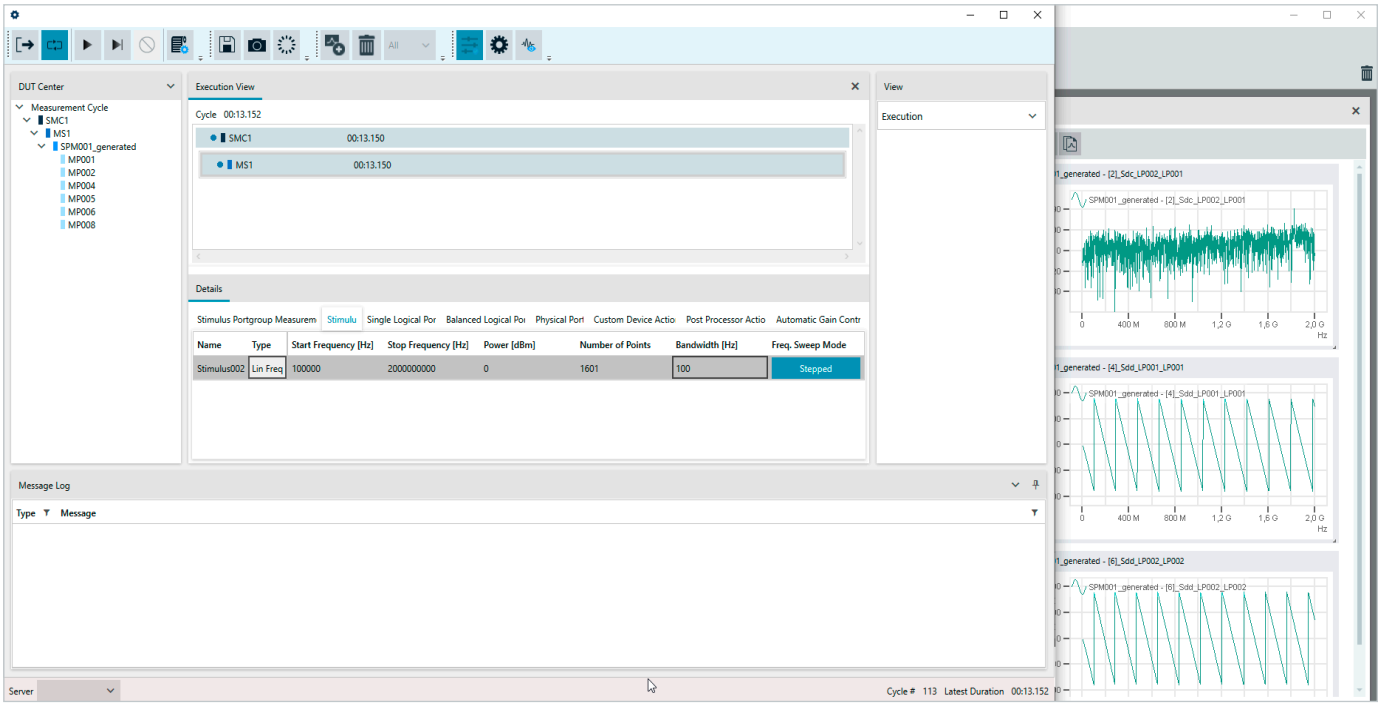
### Measurement tuning

When a new product is introduced, test engineers usually do not know exactly how to measure that product with the perfect balance between speed and accuracy with the equipment they have.

By performing a full calibration across the whole frequency range supported by the DUT and configuring the measurement with the smallest IF bandwidth and maximum number of points, the user has a basic configuration to start with. Together with the R&S®ZNRUN-K6 measurement tuning capability option the R&S®ZNrun workbench is the perfect tool for a test engineer to troubleshoot and optimize a specific configuration and immediately observe the effect of each modification.

The measurement can be further optimized e.g. by using a segmented sweep perfectly matching the DUT characteristics or by introducing a delay at a particular frequency or a loss for a particular DC value. The tuned measurement can be finally saved, and also temporarily stored as a snapshot with the possibility of rolling back to the previous one.

Measurement tuning with the R&S®ZNrun visualization client and the R&S®ZNRUN-K6 option.



# SYSTEM REQUIREMENTS

| Requirements | |
|---|---|
| **System** | |
| PC processor | 64 bit (x64), 1 GHz or faster |
| Memory | |
| RAM | 1.5 Gbyte |
| Disk space | 1.5 Gbyte |
| USB port | for R&S®ZNPC license dongle |
| Operating system | Windows 10 |
| Microsoft .NET Framework 4.7.2 or higher | can be installed during installation of R&S®ZNrun |
| Virtual instrument software architecture (VISA) library | can be installed during installation of R&S®ZNrun, possible from version 1.5 |
| **Plug-in development** | |
| Microsoft Visual Studio 2019 or higher | installed, in line with system requirements |

# ORDERING INFORMATION

| Designation | Type | Order No. |
|---|---|---|
| **R&S®ZNrun core software and license dongle** | | |
| VNA test automation software (core software) | R&S®ZNRUN-K1 | 1326.7124.02 |
| License dongle | R&S®ZNPC | 1325.6601.02 |
| **Enhanced capability options** | | |
| Multiclient capability | R&S®ZNRUN-K2 | 1326.7130.02 |
| DUT/VNA multiplicity | R&S®ZNRUN-K5 | 1334.4237.02 |
| Measurement tuning capability | R&S®ZNRUN-K6 | 1334.4250.02 |
| **Compliance test automation options** | | |
| Compliance test automation for high speed Ethernet IEEE 802.3bj/by/cd | R&S®ZNRUN-K410 | 1332.6010.02 |
| Compliance test automation for high speed Ethernet IEEE 802.3ck | R&S®ZNRUN-K411 | 1332.6026.02 |
| Compliance test automation for PCIe 5.0/6.0 | R&S®ZNRUN-K440 | 1332.5965.02 |
| **Maintenance options** [1] | | |
| Software maintenance for R&S®ZNRUN-K1 | R&S®ZNRUNSWMK1 | 1334.4214.81 |
| Software maintenance for R&S®ZNRUN-K5 | R&S®ZNRUNSWMK5 | 1334.4243.81 |
| Software maintenance for R&S®ZNRUN-K6 | R&S®ZNRUNSWMK6 | 1334.4220.81 |
| Software maintenance for R&S®ZNRUN-K410 | R&S®ZNRUNMK410 | 1332.6061.81 |
| Software maintenance for R&S®ZNRUN-K411 | R&S®ZNRUNMK411 | 1332.6078.81 |
| Software maintenance for R&S®ZNRUN-K440 | R&S®ZNRUNMK440 | 1332.5994.81 |

[1] Dedicated maintenance options are included for the first year after purchase. This period can be optionally prolonged.

## More information

- Rohde&Schwarz VNAs: www.rohde-schwarz.com/products/test-and-measurement/network-analyzers_64043.html
- R&S®OSP open switch and control platform: www.rohde-schwarz.com/product/osp-n

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

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

**Rohde&Schwarz**

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

www.rohde-schwarz.com

**Sustainable product design**

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

Certified Quality Management
ISO 9001

Certified Environmental Management
ISO 14001

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PD 3607.1836.12 | Version 05.00 | December 2023 (jr)
R&S®ZNrun Vector Network Analyzer Test Automation Suite
Data without tolerance limits is not binding | Subject to change


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