R&S[®]ZNrun Vector Network Analyzer Automation Suite V2.92 User Manual







Make ideas real



This document applies to the R&S[®]ZNrun application software and related options:

- R&S[®]ZNRUN-K1 "Automated test software for VNAs" (1326.7124.02)
- R&S[®]ZNRUN-K2 "Multi-client capability" (1326.7130.02)
- R&S[®]ZNRUN-K5 "DUT/VNA multiplicity" (1334.4237.02)
- R&S[®]ZNRUN-K6 "Measurement tuning capability" (1334.4250.02)
- R&S[®]ZNRUN-K410 "Compliance test automation for high-speed Ethernet IEEE 802.3bj/by/cd" (1332.6010.02)
- R&S[®]ZNRUN-K411 "Compliance test automation for high-speed Ethernet IEEE 802.3ck" (1332.6026.02)
- R&S[®]ZNRUN-K440 "Compliance test SW automation for PCIe 5.0 and 6.0 cable assemblies" (1332.5965.02)
- R&S[®]ZNPC, license dongle for local licenses (1325.6601.02)
- R&S[®]ZNPC-FL, license dongle for floating licenses (1325.6601.03)

Options R&S[®]ZNRUN-Kxyz are available as **local licenses** (suffix **.02**, as stated above) and **floating licenses** (suffix **.51**).

Except R&S[®]ZNRUN-K2, which does not expire, each of these options includes software maintenance for the first year after purchase. Dedicated maintenance options prolong the maintenance period for additional flexibility:

- R&S[®]ZNRUNSWMK1 "Software maintenance for R&S[®]ZNRUN-K1" (1334.4214.81)
- R&S[®]ZNRUNSWMK5 "Software maintenance for R&S[®]ZNRUN-K5" (1334.4243.81)
- R&S[®]ZNRUNSWMK6 "Software maintenance for R&S[®]ZNRUN-K6" (1334.4220.81)
- R&S[®]ZNRUNMK410 "Software maintenance for R&S[®]ZNRUN-K410" (1332.6061.81)
- R&S[®]ZNRUNMK411 "Software maintenance for R&S[®]ZNRUN-K411" (1332.6078.81)
- R&S[®]ZNRUNMK440 "Software maintenance for R&S[®]ZNRUN-K440" (1332.5994.81)

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The following abbreviation is used throughout this manual: R&S® is abbreviated as R&S.

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1 Introduction

R&S ZNrun is a PC-based software suite for the definition, configuration and execution of automated VNA tests. It controls the involved measurement devices (VNAs, switch matrices, calibration units) and supports many Rohde & Schwarz instruments. A plugin interface is provided to control additional measurement equipment and devices under test via custom remote control connections.

R&S ZNrun stands for modularity, extensibility, compatibility and optimized speed of measurement execution. Therefore it is ideal for use in high volume production of multiport devices requiring control during test, e.g. for testing the RF properties in various operating states.

Setting up R&S ZNrun for testing is as simple as describing the test setup (test equipment, DUTs) and defining the test sequence. Configurations are modular and reusable and therefore minimize your configuration time. Based on the configuration, R&S ZNrun calculates a connection plan, which is optimized for both quality and measurement speed. It also calculates an initialization sequence, calibration plan and a speed-optimized test plan. At execution time, R&S ZNrun verifies that the measurement can be performed with the connected measurement equipment.

Another use case of R&S ZNrun is cable testing. Refer to Chapter 7, "ZNrun Cable Test Client", on page 79.

R&S ZNrun comes with the following applications:

ZNrun Server

The core of the software suite. Runs and manages Measurement Execution Units (MEUs). A plug-in interface enables user-defined extensions, such as custom devices and post processors.

See Chapter 3, "Application overview", on page 11.

ZNrun Workbench

The main graphical user interface (GUI) of R&S ZNrun. Allows you to develop, test and tune a MEU, before it is used in the production field. Can deploy the MEU to a ZNrun Server and communicate with the server during MEU execution. Integrates or gives access to the other R&S ZNrun applications (ZNrun Calibration Client, ZNrun Measurement Client, ZNrun Visualization Client). See Chapter 4, "ZNrun Workbench", on page 15.

ZNrun Calibration Client

The ZNrun Calibration Client guides a technician through all the steps of the calibration process. For laboratory use, it offers a more advanced interface, which allows definition of user-defined calibration tasks. It is available as a stand-alone application and integrated in the ZNrun Workbench.

See Chapter 5, "ZNrun Calibration Client", on page 69.

ZNrun Measurement Client

An application for controlling the execution of a MEU on a ZNrun Server. Provides a graphical and a remote control interface (SCPI commands). A plug-in interface enables user-defined extensions, such as the creation of custom log files and reports.

See Chapter 6, "ZNrun Measurement Client", on page 77.

• ZNrun Visualization Client

The ZNrun Visualization Client allows you to visualize and document measurement results. It is available as a stand-alone application and integrated in the ZNrun Workbench.

See Chapter 4.5.5, "Visualization workspaces", on page 61.

• ZNrun Cable Test Client

The ZNrun Cable Test Client allows even more streamlined measurements with predefined MEUs. This client is particularly useful if the user has to measure a multitude of DUTs (e.g. cables), where standard measurements and appropriate calibrations are requested.

See Chapter 7, "ZNrun Cable Test Client", on page 79.

2 Getting started

2.1 Installation

R&S ZNrun can be installed on a single PC running 64-bit Windows 10. A full installation requires up to 1.5 Gbyte drive space.

The installer must be run with administrative privileges and possibly finishes with a reboot. The following components are automatically installed, if not already present on the target PC:

- .NET Framework 4.7.2
- R&S VISA library (64-bit), the Rohde & Schwarz implementation of the VISA I/O API
- R&S License Server software



During the installation, the target PC has to be online. All ZNrun applications and VNA simulations must be terminated.

The following features are offered for installation:

🗏 R&S ZNrun Setup — 🛛 🗙							
Custom Setup Select the way you want features to be installed.							
Click the icons in t	he tree below to change the v	way	features	s will be i	nstalled.		
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Location:	C: \Program Files\Rohde-Schv	varz	ZNrun (1		Browse	·
Reset	Disk <u>U</u> sage		<u>B</u> ack	<u>!</u>	<u>V</u> ext	Can	cel

- "ZNrun Server", "Cable Test Client", "Calibration Client", "Measurement Client", "Visualization Client", "Workbench": see Chapter 1, "Introduction", on page 5
- "Templates (Examples)": R&S ZNrun also provides a rich application programming interface for the creation of custom plug-ins and clients. To get you started with this API, examples are provided as a Visual Studio 2019 solution. The template examples are installed at

C:\ProgramData\Rohde-Schwarz\ZNrun\2.9x\Resources\Templates.

- "Generic Python Plugin": enables Python scripting of ZNrun Server plug-ins.
- "Generic Report Generator Plugin": allows a plugin developer to create PDF reports from a plugin
- "Default Plug-ins": Currently only comprises a single plug-in for the ZNrun Measurement Client. Its source code is included in the "Templates (Examples)" installer feature.

Note that the provided plugins are not part of the regular software maintenance.

For development of custom .NET plugins, you need Microsoft Visual Studio 2019 or higher. Plugins compiled for x86 don't have to be recompiled to run on ZNrun V2.70 or higher.

2.2 Running your first measurement

Before running your first measurement (using a single VNA), make sure the ZNrun Server machine can access VNA via remote control, using communication interfaces such as LAN, USB, or GPIB. If peripheral devices (calibration units, switch matrices, ...) are also needed, connect them to the VNA.

To run your first measurement on real hardware, perform the following steps:

- Start the ZNrun Server: select "R&S ZNrun 2.9x > ZNrun Server" from the Windows Start menu.
- Run the ZNrun Workbench: select "R&S ZNrun 2.9x" > "ZNrun Workbench" from the Windows start menu. The ZNrun Workbench allows you to create a ZNrun project.

The Zivirun workbench allows you to create a Zivirun project.

- 3. Click the "Start" button in the main toolbar of the ZNrun Workbench to trigger the following actions:
 - a) The workbench sends the project to the server. If the project is valid, the server creates a "Measurement Execution Unit" (MEU) from it.
 - b) The server executes the first measurement cycle.



To run a measurement, a ZNrun Server with a valid license R&S ZNRUN-K1 is required. The license is contained in the Licensing and must be installed on the same machine where the ZNrun Server runs.

2.3 Licensing

Running the ZNrun Server requires a valid core license R&S ZNRUN-K1, and, depending on the desired features, additional licenses for options R&S ZNRUN-K2 etc. Licenses are available as local and floating variants.

- Local licenses must be available on the ZNrun Server.
- **Floating** licenses can also reside on remote license servers that can be reached by the ZNrun Server's license server via LAN.

R&S ZNPC license dongle

R&S ZNRUN licenses "live" on dedicated R&S ZNPC IC chips that are delivered as a smart card and a USB dongle. You can either use the smart card with a smart card reader, or remove the license chip and insert it into the USB dongle.



Figure 2-1: R&S ZNPC license dongle

In any case, the license chip must be properly detected by the license server instance on the PC it is physically connected to. Make sure the RSSmartCardService driver is installed, when the smart card or dongle is connected to this PC for the first time.



- Legacy smart cards with CardOS operating system (shipped before March 2018) are no longer supported and must be replaced.
- If multiple license dongles are connected to one PC, their licenses are pooled.

R&S License Server

The R&S License Server is used for option management on a PC, device or server. It supports:

- Parallel usage of local dongles by multiple applications ("shared access")
- License verification via LAN, using https connections to central license servers with floating licenses

If the ZNrun Server complains about missing licenses, run the R&S License Server Manager browser app from the Windows start menu of the ZNrun Server PC ("Start" > "R&S License Server" > "R&S License Server Manager"). Make sure the required R&S ZNPC licenses are visible in the "Licenses" tab.

Licensing

	R&S License Server 1.25.1 - mu74152	7.rsint	net			() About	⑦ Help
۶١	icenses 🔄 Analytics 🖌 Configur	ation					
Lice	nse providers 😽	<i>P</i> ≞	Categories: C C A A A A	potprint .			•
ZNPC (100019) Device ID: 1325.6601K02-100019-Dk License Server: mu741527.rsint.net (1.25.1)			▼ Designation	To License type	To Count	🍾 Status	
			ZNRUN-K1 - ZNRUN-K1 Automated Test SW VNA	1			
ZNPC (900015) Device ID: 1325.6601K02-900015-eq			ZNRUN-K2 - ZNRUN-K2 Multiclient capability for K1	permanent	1		
License Server: mu741527.rsint.net (1.25.1) ZNRUN-K3 - ZNRUN-K3 Graph Viewer ZNrun permanent			permanent	1	0		
		Sh	wing 3 of 3 licenses.				

If you want to use local licenses but no local licenses are visible, verify that the smart card or license dongle is properly inserted into the smart card reader or USB port of the ZNrun Server PC, respectively. If a license dongle is used, make sure that the IC chip is fully inserted into the dongle (see Figure 2-1).

If you want to use floating licenses, make sure to define one or more remote floating license servers in the license server manager of the ZNrun Server PC and check their connection state.

R&S License Server 1.25.1 - mu741527.rsint	R&S License Server 1.25.1 - mu741527.rsint.net							
P Licenses Analytics / Configuration								
Configuration C + C Refresh Add Remove Last update (UTC): 2021-01-27 14					14:04:43			
 Local license server 	🖽 🍾 Hostname	To Server version	🍾 IP address	T ♦ Port	T ♦ Readonly	▼ ◆ Description	T	state
Floating license servers	amu818.rsint.net	1.26.1	10.0.2.220	9443		Central License Server 01	I	
	amu819.rsint.net	1.26.1	10.0.2.221	9443		Central License Server 02	I	
Product definitions								
	Showing 2 of 2 items.							



- Local licenses are only allowed on a license dongle R&S ZNPC, floating licenses only on a license dongle R&S ZNPC-FL.
- A floating license server must be equipped with the license dongle R&S ZNPC-FL.



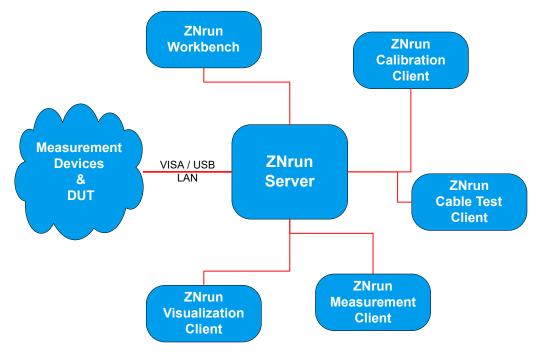
For more information, see the R&S License Server "Managing Floating Licenses" help, which can be opened from the "Help" icon in the top-right corner of the local R&S License Server Manager web interface. A PDF user manual with identical content can be accessed via the R&S License Server folder in the Windows start menu ("Open License Server Manual").

Both help and manual cover the following topics:

- How to manage local licenses
- How to set up a floating license server
- How to connect to and obtain licenses from a floating license server

3 Application overview

The R&S ZNrun software suite consists of a central server component (ZNrun Server) and a set of client applications (ZNrun Workbench, ZNrun Calibration Client, ZNrun Measurement Client, ZNrun Visualization Client). See Chapter 1, "Introduction", on page 5.



3.1 Client-server architecture

The **ZNrun Server** manages the communication with the measurement instruments and the DUT. Rohde & Schwarz instruments are controlled via VISA and/or proprietary USB protocols. Additional test equipment and DUTs can be controlled via VISA or the RFFE/GPIO ports of the R&S ZNA, R&S ZNB or R&S ZNBT. Any type of hardware or software interface can be integrated with R&S ZNrun via the plug-in interface.

The **ZNrun Workbench** allows you to create ZNrun project files, which, when deployed to the ZNrun Server, define one or more server-side Measurement Execution Units (MEUs).

Before starting the actual measurement, the involved vector network analyzers have to be calibrated for full system error correction and/or absolute power level correctness. For this purpose, the R&S ZNrun provides the **ZNrun Calibration Client**, a simple graphical user interface, suitable for guiding a technician through the required calibration steps. For laboratory use, it offers an advanced interface that allows to define custom calibration tasks.

The **ZNrun Measurement Client** allows you to connect to a Measurement Execution Unit that was previously uploaded to the ZNrun Server. It provides a graphical user interface for measurement execution. It shows a stop watch timer that is synchronized with the measurements, which makes it easy to measure the execution time of measurement cycles or single steps. The measurements steps can be performed without interruption – in a so called measurement cycle – or step by step. It is also possible to execute several measurement cycles in succession. Measurement results are written to the hard disk on-the-fly.

Q

It can take some seconds until all parameters have been uploaded to the devices and all communication paths have been tested. However, this upload is done only once: all following measurements require a minimum amount of setup time.

3.2 ZNrun Server

The ZNrun Server can accommodate multiple Measurement Execution Units, but with option R&S ZNrun-K1 alone you can only run one at a time. For parallel execution of multiple Measurement Execution Units, you need option R&S ZNrun-K2.

In addition to VISA, the server can communicate over arbitrary communication interfaces via plug-ins. Plug-ins allow external hardware (such as DUTs and 3rd party measurement equipment) to be synchronized with measurements.

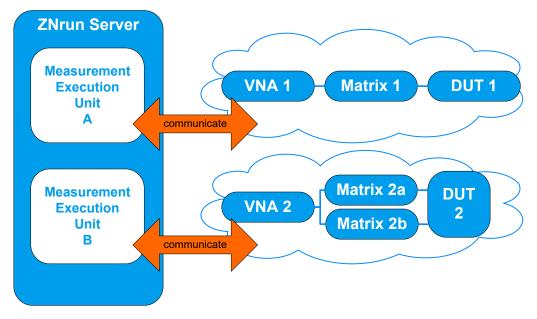


Figure 3-1: ZNrun Server with two Measurement Execution Units

3.3 DUT-centric approach

The DUT and its measurements represent the core of the R&S ZNrun data model ("DUT Measurement Plan").

Typically, DUTs are implemented as "system on a chip" and do not support coaxial connectors. Such a DUT comprises several logical ports that are connected to physical ports using a measurement adapter. The measurement devices can be connected to the physical ports of the measurement adapter.

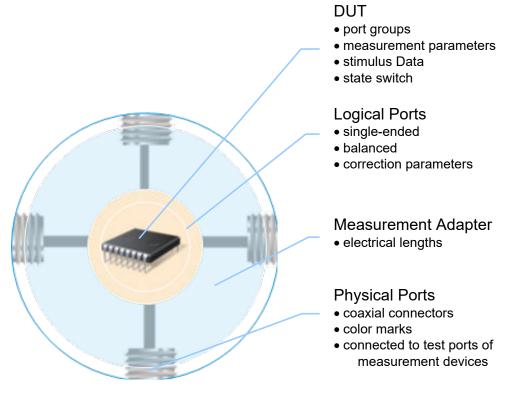


Figure 3-2: DUT model

The DUT Measurement Plan defines the parameters to be measured at or between certain logical ports. It also defines how the measurement is done, e.g. it describes the stimuli the VNA provides during the measurement.

At certain points in time during a measurement sequence, the ZNrun Server possibly needs to interact with the DUT to change its operating state. The DUT Measurement Plan defines those interactions using "DUT State Switches" or plug-ins.

3.4 ZNrun project files

A ZNrun project file is an XML file (with root element Project), containing one or more MeasurementExecutionUnit XML elements.

Each MeasurementExecutionUnit element describes an executable measurement task on the ZNrun Server. It comprises three main child elements:

• a MeasurementDevicesPlan element, describing the measurement equipment configuration

- a DutMeasurementPlan element, describing the DUT, the measurement adapter (test fixture), and the measurement parameters
- an optional ConnectionPlan element describing the physical connections between measurement devices and measurement adapter. Normally, the ConnectionPlan is calculated on the ZNrun server as part of the optimization process, but it can also be specified explicitly



- The structure of the XML files is defined in various XML schema files that can be found at <ZNrun InstallDir>\Server\Schemas.
- The ZNrun Workbench creates ZNrun projects that contain only a single MeasurementExecutionUnit. Its child elements (MeasurementDevicesPlan, DutMeasurementPlan, ConnectionPlan, ...) are distributed to separate files, which makes it easier to reuse them in other ZNrun projects.

4 ZNrun Workbench

The ZNrun Workbench application provides the main graphical user interface (GUI) of R&S ZNrun. It can be used to develop, test and tune a Measurement Execution Unit (MEU) before it is used in the production field.

The ZNrun Workbench supports the two core features of the R&S ZNrun application:

- **Multiplicity** (with option R&S ZNrun-K5)
 - DUT multiplicity

A key feature of the ZNrun Workbench is DUT multiplicity. The ZNrun Workbench natively supports the configuration of measurements on multiple DUTs.

- VNA multiplicity
 The ZNrun Workbench also supports the configuration and execution of a MEU with multiple vector network analyzers.
- **Tuning** (with option R&S ZNrun-K6)

Tuning is a special feature of the R&S ZNrun framework. It can be used to change and optimize the configuration of a MEU during the execution to maximize the use of the measurement. Tuning comes with three tools to enhance the capabilities of the configuration of a MEU with the ZNrun Workbench: "Save Changes", "Create Snapshot", and "Recall Snapshot".

Furthermore, you can search for traces, make a selection and visualize the selected traces easily.

In the ZNrun Workbench, you can also roll out a MEU to multiple test stations.

Workflow

The workflow with the ZNrun Workbench is separated into five phases:



Figure 4-1: ZNrun Workbench workflow

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•	Configuration phase	.28
•	Calibration phase	. 57
•	Execution and visualization phase	. 58
•	Rollout phase	. 64
	•	

4.1 Application overview

The ZNrun Workbench is the central graphical user interface to start and control the components of the R&S ZNrun. The same layout is used for all application phases.

Application overview

CNrun Workbench		_		×
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	View			
2 3		4		
Message Log			~	ļ
Type T Message				•
5				
6				

Figure 4-2: Overview of the ZNrun Workbench layout

- 1 = Main toolbar
- 2 = "DUT Center" panel
- 3 = Workspace
- 4 = "View" panel
- 5 = Log panel 6 = Status bar
- 0 Status bai

4.1.1 Main toolbar

The main toolbar contains the controls to configure and execute a Measurement Execution Unit (MEU). It allows you to start the calibration client, see Chapter 4.4, "Calibration phase", on page 57, and the visualization client, see Chapter 4.5, "Execution and visualization phase", on page 58.

In the configuration phase, the main toolbar has four functional tool groups:

Table 4-1: Main toolbar actions in configuration phase

Group	lcon	Name	Action
Basic commands		New	Creates a MEU configuration with the ZNrun Workbench data structure.
		Open workbench file	Loads an existing MEU configuration from a ZNrun Workbench data structure.
	*	Open ZNrun project	Loads the data structure from an existing R&S ZNrun project, either uncompressed (*.xml) or compressed (*.znrun).

Group	lcon	Name	Action
		Save	Saves all changes to the working ZNrun Work- bench file system.
		Save as	Saves the MEU configuration in the ZNrun Work- bench file system format.
	۵,	Validate	Validates the MEU configuration
Import tools	\∕ <u>↓</u>	Import stimuli	Stimuli can be imported from XML files contain- ing valid DutMeasurementPlan serializations. For details, see Chapter 4.3.3, "Import Stimuli", on page 56.
Execution tools	→]	Go to execution	Switches to the execution phase (see Chap- ter 4.5, "Execution and visualization phase", on page 58 for details).
	¢,þ	Repeat	Activates the continuous loop of the measure- ment cycle.
	•	Start	Switches to the execution phase and starts the measurement cycle.
Rollout tools	*	Go to rollout	Switches to the rollout phase (see Chapter 4.6, "Rollout phase", on page 64 for details)
	5		Note: When working on a protected R&S ZNrun- K4xx project, the rollout functionality is not avail- able, and hence the "Go to Rollout" button is dis- abled.
Settings tools		Activate tuning	Activates the tuning in the execution phase (see Chapter 4.5.1, "Tuning (R&S ZNrun-K6)", on page 58 for details).
	۵	Options	Launches the "Options" dialog (Chapter 4.1.7, "Options", on page 24)
	1 <u>1</u> ~	Go to calibration (using the selected coverage)	Switches to the calibration phase (see Chapter 4.4, "Calibration phase", on page 57)

In the execution phase, the main toolbar also has four functional groups:

Table 4-2: Main toolbar actions in execution phase

Group	Icon	Name	Action
Settings tools	±.	Activate tuning	Activates tuning (see Chapter 4.5.1, "Tuning (R&S ZNrun-K6)", on page 58 for details).
			Once tuning is activated, it cannot be deactiva- ted unless you leave the execution phase.
	*	Options	Launches the "Options" dialog (Chapter 4.1.7, "Options", on page 24)
	1 1 1 1	Go to calibration (using the selected coverage)	Switches to the calibration phase (see Chapter 4.4, "Calibration phase", on page 57)
Execution tools	[→	Leave	Leaves the execution phase and returns to the configuration phase.
	¢,	Repeat	Activates or deactivates the continuous loop of the measurement cycle.
		Start	Starts the execution of the measurement cycle.
		Step	Performs one step in the measurement cycle.
	\bigcirc	Abort	Aborts the running execution of the measure- ment cycle.
		Log cycle execution	Logs the execution of one complete cycle to a log file on the system.
	⋇	Show connections (PDF)	Shows the connection plan of the current MEU in your PDF file viewer.
Tuning tools		Save	Saves the changed configuration to the ZNrun Workbench data structure.
	Ō	Create snapshot	Saves a temporary copy of the current configura- tion. If a changed configuration is saved, the snapshot is deleted.
	$\frac{e^{n+s}e}{e_{n+s}e}$	Recall snapshot	Loads the configuration of the snapshot. If no snapshot exists, the original configuration is loaded.
Visualization tools	5	Add new visualization	Adds a new visualization workspace in the work- space area.

Application overview

Group	lcon	Name	Action
	*	Freeze all traces	Applies to all traces in all visualization workspa- ces. Memorizes the trace data of the previous measurement cycle and displays them as static second trace "Frozen <trace name="">". See Fig- ure 4-50. Requires the tuning option R&S ZNrun-K6.</trace>
	Ŧ	Unfreeze all traces	Removes the "Frozen" traces from all charts in all visualization workspaces. Requires the tuning option R&S ZNrun-K6.
	Ì	Remove	Drag and drop charts from the visualization workspace to the bin to remove charts.
	All ~	DUT selection	Choose a DUT index from the dropdown menu. If a new graph is created in the workspace, only the measurements related to the DUT index are displayed.

Table 4-3: Main toolbar actions in calibration phase

Group		Name	Action
Execution tools	[→	Leave	Leaves the calibration phase and returns to the configuration phase.
	⋇	Show connections (PDF)	Shows the connection plan of the current MEU in your PDF file viewer.
	→]	Go to execution	Switches to the execution phase (see Chap- ter 4.5, "Execution and visualization phase", on page 58 for details).
	~ 11 11 11 11	Calibration coverage selec- tion	 Selects either: DUT-related calibration Full calibration User-defined calibration

Table 4-4: Main toolbar actions in rollout phase

Group	lcon	Name	Action
Settings tools	*	Options	Launches the "Options" dialog (Chapter 4.1.7, "Options", on page 24)
Rollout tools		Leave rollout	Leaves the rollout phase and returns to the con- figuration phase.

Group	Icon	Name	Action
	R	Generate projects	Generates MEUs from the master MEU and the test stations according to your rollout plan.
	\$ 0	Roll out	Rolls out generated MEUs to their dedicated test stations.
	\bigcirc	Abort	Aborts queued packages to be rolled out.
	e °	Log rollout status	Logs the status of the current rollout session to a log file on the file system.
		Overwrite	Determines whether existing generated MEUs are overwritten during "Generate projects".



When working on a protected R&S ZNrun-K4xx project, the rollout functionality is not available.

4.1.2 DUT center

The "DUT Center" displays the measurement cycle with all its measurement paths. You can select between two different representations:

• "Structured Shape": Visualization of the measurement cycle in a tree-like structure. For every element (sequential context, parallel context, or step) a breakpoint for the execution phase of the whole measurement cycle can be set or deleted from the context menu. If a breakpoint is set, a red dot is displayed on the right of the specific element.



In the example above, a breakpoint is set for StimulusPortgroupMeasurement "SPM1_Spara".

"Flattened Shape": Flat outline of all measurements currently available. All measurements used in the measurement cycle are grayed out. Every measurement can be released (i.e. excluded) from the measurement cycle with the right-click context menu.

DUT	Center	~
4	##	
~ N	leasurement Paths	
	MP_PowerOnDummy_0_0	
	MP_IN2_0_1	
	MP_IN2_VSWRA_0_2	
	MP_IN2_VSWRX_0_3	
	MP_IN2_NF_0_4	
	MP_IN2_0_5	
	MP_IN2_VSWRA_0_6	
	MP_IN2_NF_0_8	
	MP_IN2_0_9	
	MP_IN2_NF_0_12	
	MP_IN2_0_13	
	MP_IN2_VSWRA_0_14	
	MP_IN2_NF_0_16	
	MP_IN2_VSWRA_0_18	
	MP_IN2_VSWRX_0_19	

Figure 4-3: Flattened Shape (configuration phase)

In the example above, measurement paths "MP_IN2_0_5" and "MP_IN2_VSWRA_0_6" are released. During the execution phase, the "Flattened" view has a different appearance and serves a different purpose. See"Selection-based visualization workspaces" on page 62. It is only available with Tuning (R&S ZNrun-K6).

Hovering over a measurement path displays additional information. In the configuration phase, the port group, stimulus and switch & state are shown. In the execution phase, a short notation for the measurement parameter, the destination port, and the source port are shown.

Since R&S ZNRUN V2.90, the "DUT Center" views display custom curve nodes with the "Display Name" specified in the related custom device action or post-processor action. Up to V2.80, the custom curve's "Identifier" was used.

4.1.3 Workspace

The main window area is reserved for the configuration of the MEU or for the visualization of measurements. Each configuration group can be displayed in the workspace as a separate tab. In the top half of each tab, a list overview of all configurations is shown. In the bottom half, a more detailed configuration of each list element is displayed. For a detailed explanation of all configuration capabilities, see Chapter 4.3.2, "Expert mode", on page 32.

All tabs in the workspace are floatable and dockable.

ти	Number of Parallel	Measurements 2 🗸	∧ Use Powe	r Waves default 🗸						
									≡	+
Name	Source Port	T Destination Port	▼ Port Group	Meas. Parameter	▼ Format	▼ Stimulus	Limit Lines	AGC Configuration	Switch & State	•
VIP001	LP001	LP001	PG001	Sss	DB_MAG	Stimulus001				
MP002	LP003	LP004	PG001	Sss	DB_MAG	Stimulus002				
/IP003	LP001	LP001	PG001	Sss	SMITH	Stimulus003				
/P004	LP001	LP002	PG001	Sss	DB_MAG	Stimulus003				
letails										
Path Ports St	timulus Limit Lines Switc	h & State								
Name		Mea	. Parameter		Kind			Format		
MP001		Sss			ADVANCED			DB_MAG		

Figure 4-4: Populated workspace

4.1.4 Configuration view

The "Configuration View" is the main tool for selecting configuration settings. It offers two different modes:

 In "Expert" mode, all configuration settings are listed. Selecting a configuration setting opens the corresponding tab in the workspace.

View	
•	
DUT	^
DUT Ports	
Port Map	
State Switches	
Measurement	~
Measurement Devices	~
Connection Plan	~
Local Data	~

See Chapter 4.3.2, "Expert mode", on page 32 for details.

 The "Project Pilot" mode lets you quickly configure MEUs from scratch. A reduced quantity of configuration settings and the automation of most of the configurations simplifies the configuration phase.

View		
۰		÷
٠.	Project Pillot	41
O DUT Ge	ometry	^
	DUT Geometry by defining Logical Ports d that existing DUT Geometry data will b	
Group Log	ical Ports into Port Groups.	
		Add Port Groups
O Measur	ement	~
O Equipm	ent	~
Executio	n	~

The "Project Pilot" can also be used to modify an existing ZNrun Workbench project. See Chapter 4.3.1, "Project Pilot", on page 28 for details.

4.1.5 Log views

By default, the log views are docked at the bottom of the ZNrun Workbench window.

The "Message Log" displays upcoming events during the execution of the ZNrun Workbench.

Message Lo	og	>
Туре 🔻	Message	Ŧ
í	Switching 'DemoProject' to Execution.	
í	ZNrun Server selected automatically to 10.111.0.139	
4	ZNrun Server Version '2.80.1.80' does not match Workbench Version '2.80.1.82'.	
×	Switching to Execution failed. Upload ZNrun Project Data failed.	

The "Validation Log" displays MEU validation results.

Type 🔻	Message	T
×	ZNrun Project File 'DutMeasurementPlan': Schema Validation Error: Line 93, Position 3, http://www.rohde-schwarz.com/ZNrun, EndElement, Name='DutMeasurementPlan', The key sequence 'LP4' in 'http://www.rohde-schwarz.com/ ZNrun:UnigueSingleLogicalPortNames' Keyref fails to refer to some key.	

From its context menu, you can copy the selected message to the clipboard, or clear the related log.

4.1.6 Status bar

💊 Configuration	10.111.0.139	~	UNKNOWN	Cycle #	0	Latest Duration	00:00.000
-----------------	--------------	---	---------	---------	---	-----------------	-----------

The status bar of the ZNrun Workbench window gives access to the following information/settings:

- License information (key symbol with tooltip, for protected R&S ZNRUN-K4xx projects only) and phase indication
- Server connection Select an item from the list of detected ZNrun Servers
- Project (modification) history

The last author is displayed in the status bar. Click the corresponding status bar section to view the full project history.

Project History - test			×
User	Ŧ	Date	Ŧ
STOLTE		9/18/2020 11:33:52 AM	
Restrict number of items 10 V		Clear History OK	

The project (modification) history is tracked in the ProjectHistory.xml file, which is maintained by the ZNrun Workbench together with the Project.xml.

 Measurement execution status, including the number of measurement cycles and the duration of the last measurement cycle (execution phase only) Hovering over the measurement execution status calls up a popup that displays the detailed execution statistics:

Executed 0 Limit Exceeded 0 Passed 0 Aborted 0 Failed 0

Authenticated users (optional)

You can limit the projects that can be run on a particular ZNrun Server to those projects that were last modified by a particular group of users. See "User Authentication Service" on page 102.

4.1.7 Options

The "Options" dialog is accessible via the main toolbar.

 On the "Execution" tab, you can choose to add a time stamp to the created measurement cycle log file names. Furthermore, you can specify the export directory and define the logfile prefix.

Options			×
Execution Visualization Calib	ration Rollout		
Add Date/Time to Log Filename	•		
Export Directory	C:\Users\ \AppData\Local\Temp\	Browse	
Logfile Prefix	MeasTimeLog		
			_
		ОК	

• On the "Visualization" tab, you can set the default workspace layout. Furthermore, you can specify the export directory, and configure the image export from the visualization workspace.

Visualization	
Default Workspace Layout	
Export Directory	C:\Users\stolte\AppData\Local\Temp\
Image Export Height	240
Image Export Width	320
Image Export Scale	1

 On the "Calibration" tab, you can define which tests to perform when entering the calibration phase:

Calibration	
Test cable connections before calibrating	
Test presence of calibration units and power meters at the VNA before calibrating	

• On the "Rollout" tab, you can specify where your device park is located and how many rollouts are allowed in parallel. See Chapter 4.6, "Rollout phase", on page 64 for details. Furthermore, you can specify the report directory and define the report file prefix.

	Rollout	
Device Park Directory		Browse
Number of Rollouts in Parallel	16 🗸 🔨	
Report Directory		Browse
Report File Prefix	Rollout	
Add Date/Time to Filename	•	



These settings are user-specific.

4.2 Getting started

There are three ways to get started with the ZNrun Workbench:

- You can create a Measurement Execution Unit (MEU) configuration with the ZNrun Workbench data structure using the first button in the main toolbar
- You can open an already existing MEU configuration from a ZNrun Workbench file (*.znwbf).

• You can load the MEU configuration from a ZNrun project. If this project was created with a previous R&S ZNrun version, the ZNrun Workbench automatically converts the ZNrun project to a ZNrun Workbench project.

ZNrun_Test_Config - C:\ZNrun_Test_Config	ig.znwbf							-		×
🗋 🖆 🎦 🛱 🂐	↓ <u>↓</u> (1) ↓	¢"> ►	*] 🛱 🌣	1 × 16						
DUT Center	Measurement Paths						×	View		
<u>∎</u> =	DUT XXX Number o	f Parallel Measurem	ents 1 🗸 🔨	Use Power Waves Yes	s ~			• •		÷
Measurement Cycle Sequential001						≡	+	DUT		~
 SPM_PowerOnDummy_0_0 SPM_PowerOnDummy_0_0 	Name T Source Port T		Port Group 🔻 Meas. Par	an 🔻 Format	▼ Stimulus ▼ Limit Lin	es 🔻 Switch & Sta		Measurement		~
MP_PowerOnDummy_0_0	MP_PowerOnDur OUT_Spara	OUT_Spara	1P_OUT_Spara Sss	DB_MAG	PowerOn		×	Measurement Devices		~
V SPM1_Spara MP IN2 0 1	MP_IN2_0_1 IN2	OUT_Spara	2P_IN2_OUT_Spa Sss	DB_MAG	Stimuli_Spara1		×			
V SPM1_VSWR	MP_IN2_VSWRA_ IN2	IN2	2P_IN2_OUT_Spa Sss	SWR	Stimuli_VSWR1		x	Connection Plan		~
SPM1_VSWR MP_IN2_VSWRA_0_2	MP_IN2_VSWRX_ OUT_Spara	OUT_Spara	2P_IN2_OUT_Spa Sss	SWR	Stimuli_VSWR1		×	Local Data		~
MP_IN2_VSWRX_0_3	MP_IN2_NF_0_4 P01	P03	2P_IN2_OUT_NF NF	DB_MAG	Stimuli_NF1		x			
SPM1_NF MP IN2 NF 0 4	MP IN2 0 5 IN2	OUT Snara	2P IN2 OUT Sna Sss	DR MAG	Stimuli Spara?		×			
 SPM2_Spara SPM2 Spara 	Details									
MP_IN2_0_5	Path Ports Stimulus Limit Line	s Switch & State								
V SPM2_VSWR										
MP_IN2_VSWRA_0_6										
Message Log									~	Ŧ
Type ▼ Message										٣
Message Log Validation Log										
configuration Server	Last Author UNKNOWN									

Figure 4-5: Successfully loaded ZNrun Workbench file.



- If loading the MEU configuration from file was unsuccessful, an error message is displayed in the Message Log.
- If a ZNrun Server IP-address is specified in the ZNrun Workbench file, and the server is available, the workbench uses this server for execution of the MEU. Otherwise, a R&S ZNrun server has to be selected from the drop-down menu of the available server connections.

After creating or loading a MEU configuration, the following actions in the main tool bar are enabled:

- Save all changes to the working ZNrun Workbench file system.
- Save your MEU configuration in the ZNrun Workbench file system format.
- Validate the MEU configuration.

Zipped ZNrun projects

Since R&S ZNrun V2.70 the ZNrun Workbench can also work with zipped ZNrun projects (*.znrun), including encrypted R&S ZNrun-K4xx projects.

Open File				×
$\langle \rangle \sim $	ZNrun > test_zipped_project	₹	Search in test_zipped_project	Q,
New folder				~
× 💻	test_zipped_project.znrun			
> 🏪 (C:) OS				
> =				
> 💼				
File name: C:\Users\	\Documents\ZNrun\test_zipped_project	Z	ipped Archive (*.znrun)	^
		z	ipped Archive (*.znrun)	
		P	roject (*.xml)	
		Д	II Files (*.*)	

A *.znrun file contains the ZNrun project file together with all its referenced resources (see Chapter 3.4, "ZNrun project files", on page 13).

test_zipped_project.znrun	×	(+)			
Name					
NonnectionPlan.xml					
DutExtensionsData.xml					
DutMeasurementLocalData.xml					
DutMeasurementPlan.xml					
MeasurementContextParameters.xml					
MeasurementDevicesLoc	alDa	ata.xml			
MeasurementDevicesPlan.xml					
Project.xml					
ProjectHistory.xml					

*.znrun file:

A ZNrun Workbench file can now create and refer to a project XML file or to a

New				×
Name	My zipped project		~	
Location Workbench File	C:\Users\ \Documents\ZNrun\	My zipped project.	~	Browse
Location ZNrun Project	C:\Users\ \Documents\ZNrun\	My zipped project.	~	Browse
Project Format	File Structure			
	File Structure		ОК	Cancel
	Zipped Archive (*.znrun)			



Even after modification, an encrypted R&S ZNrun-K4xx project can only be saved as encrypted *.znrun file.

4.3 Configuration phase

In the configuration phase, you use Configuration view to define or modify the MEU. From this phase, calibration of devices or execution of measurements can be started. Additionally it is possible to switch to Chapter 4.6, "Rollout phase", on page 64.

To change between "Project Pilot" and "Expert" mode, go to the "View" widget and select the appropriate icon.

left icon = Expert mode right icon = Project Pilot

4.3.1 Project Pilot

The "Project Pilot" allows you to configure MEUs from scratch quickly. The "Project Pilot" proceeds in four steps:



Figure 4-6: Workflow in the project pilot mode

4.3.1.1 DUT Geometry

View						
0	N.		÷			
•	Project Pilot		••			
	Geometry		^			
Setup the DUT Geometry by defining Logical Ports and Physical Ports. Mind that existing DUT Geometry data will be replaced.						
		Setup P	orts			
Group	Logical Ports into Port Groups.					
		Add Port Gro	ups			
O Mea	isurement		~			
O Equ	ipment		~			
Exec	cution		~			

Figure 4-7: Project Pilot, step 1: DUT Geometry definition

The "DUT Geometry" definition is subdivided into three steps:

- 1. Set up the logical and physical ports.
- 2. Group logical ports into port groups.
- 3. Configure the DUT ports in detail.

If at least one physical port, one logical port and one port group are defined, the change indicator next to DUT geometry label turns from gray to blue.

1. Set up the logical and physical ports

Use the "Setup Ports" button to open the corresponding dialog.

DUT Geometry - Setup Ports				×
Number of Single Logical Ports		10	~	^
Number of Balanced Logical Ports		0	~	^
Number of Physical Ports		10		
Create One Port Group For All Ports			1	
Create A Port Group For Each Port Pair				
	ОК	c	ance	

Figure 4-8: Setup Ports dialog

Specify the number of single-ended and balanced logical ports. These values determine the number of physical ports, because each single-ended logical port contributes one physical port and each balanced logical port contributes two physical ports.

At this step, you can also apply two simple port grouping mechanisms: group all ports in one group, and/or group each port pair. The next step offers a free configuration of port groups.

2. Group logical ports into port groups

Use the "Add Port Groups" button to open the corresponding dialog.

Name	т Туре	
LP001	Single	
LP002	Single	
LP003	Single	
LP004	Single	
LP005	Single	
LP006	Single	
LP007	Single	
LP008	Single	
LP009	Single	
LP010	Single	
	OK Cancel	Apply

Figure 4-9: Add Port Groups dialog

Select one or more logical ports from the list of available logical ports, then press "Apply" or "OK" to join them in a port group.

3. Configure the DUT ports in detail.

In the last step of the "DUT Geometry" configuration of the "Project Pilot", you can adjust the DUT ports as in expert mode, see "DUT ports" on page 33.

4.3.1.2 Measurement

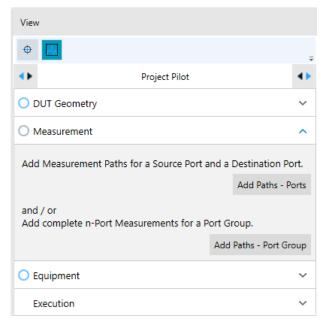


Figure 4-10: Project Pilot, step 2: Measurement definition

The definition of measurements proceeds in three steps:

- 1. Add measurement paths for the source port and a destination port.
- 2. Add complete n-port measurements for a port group.
- 3. Configure the measurements in detail.

If at least one measurement path is defined, the change indicator next to measurement label turns from gray to blue.

 Add measurement paths for the source port and a destination port. Use the "Add Paths – Ports" button to open the corresponding dialog. From here, you can create measurement paths with user-defined parameters such as "Source Port", "Destination Port", "Format", "Start Frequency", "Stop Frequency", and "Number of Points".

Measurement - A	Add Paths - Ports					×
Meas. Parameter	Sss Ssd Sds Sdd Stim	ulus Type Lin Freq				
Source Port	T Destination Port	▼ Format	▼ Start Frequency [Hz]	Stop Frequency [Hz]	T Number of Points	T
LP001	LP002	DB_MAG	10000	1000000	1000	×

Figure 4-11: Add Paths – Ports dialog

If a stimulus with the same "Start Frequency", "Stop Frequency", and "Number of Points" exists, the ZNrun Workbench automatically assigns it to the measurement

path. Otherwise the ZNrun Workbench creates a linear frequency stimulus with these parameters and assigns it to the measurement path. By default, the "Add Paths – Ports" dialog selects "Sss" as the measurement parameter.

2. Add complete n-port measurements for a port group.

Use the "Add Paths – Port Group" button to open the corresponding dialog. You can select a whole port group to create measurement paths for each port pair of the port group. Similar to step 1, the parameters are "Format", "Start Frequency", "Stop Frequency", and "Number of Points".

Measurement - Ad	dd Paths - Port Group						×
Meas. Parameter	Sss Ssd Sds Sdd	timulus Type Lin Freq					
Port Group	▼ Format	Start Frequency [Hz]	▼ Stop Frequency [Hz]	Ŧ	Number of Points	T	
PG001	AUTO	10000	1000000		1000		x
Click here to add r	new item						

Figure 4-12: Add Paths – Ports Group dialog

The same logic as in step 1 applies to the reuse or creation of stimulus objects. And also the "Add Paths – Ports Group" dialog selects "Sss" as the default measurement parameter.

3. Configure the measurements in detail.

In the last step of the measurement configuration of the "Project Pilot", you can adjust the measurement parameters as in the expert mode, see Chapter 4.3.2.2, "Measurement configuration", on page 36.

4.3.1.3 Equipment

•		
••	Project Pilot	
O DUT Geor	netry	~
O Measuren	nent	~
O Equipmer	ıt	^
	twork for VNA Devices and select th	nose to use Mind
	VNA Device data will be replaced.	iose to use. minu
		Setup VNA Devices

Figure 4-13: Project Pilot, step 3: Equipment definition

The equipment definition is done in a single step.

Use the "Setup VNA Devices" button to open the corresponding dialog.

R&S [®] ZNrun ZNrun Workbench					h
		Сс	onfigurat	tion phas	e
Equipment - Setup VNA Devices				:	×
DUT Ports Total: 10, Used: 10, Selected VNA Ports: 0	Interface Type	Vxi11	~	Search	
Type T Port Count T Visa Resource					Ŧ

Figure 4-14: Setup VNA Devices dialog

Choose the interface type and search in the network for VNA devices. The list displays the available devices with their type, port count, and the visa resource. During the import of the device information, all existing data is overwritten. Hence, you have to confirm every replacement of an already existing VNA device.

4.3.1.4 Execution

•	Project Pilot	4
O DUT Geome	try	~
O Measureme	nt	~
O Equipment		~
Execution		^
	above are complete, you are read and run the Measurements.	y to check if your Validate
		Start

Figure 4-15: Project Pilot, step 4: Execution

Finally, you can send the MEU to the selected ZNrun Server for validation or execution of the MEU.

4.3.2 Expert mode

In "Expert" mode, you can use the full capabilities of the ZNrun Workbench to configure every aspect of the MEU. To change a specific configuration setting, you can choose an item from the navigation view ("View") which is then displayed in the workspace.

Measurement Pati	hs											×	View	
DUT	Number of	Parallel Measurem	ients 1 🗸 🦯	Use Por	ver Waves defa	ult	~							
												+	DUT	~
	1	Destination 🔻						▼ Limit Line	is T	Switch & S	ta 🔻		Measurement	~
MP001	LP001	LP001	PG001	Sss	DB_MAG		Stimulus001					×	Measurement Devices	~
MP002	LP003	LP004	PG001	Sss	DB_MAG		Stimulus002					×		
MP003	LP001	LP001	PG001	Sss	SMITH		Stimulus003					×	Connection Plan	~
													Local Data	~
Details														
Path Ports Sti	mulus Limit Lines	Switch & State												

Figure 4-16: Expert mode: workspace and navigation view

4.3.2.1 DUT configuration

The purpose of the "DUT" configuration group is to give access to all DUT-related configuration settings.

DUT	^
DUT Ports	
Port Map	
State Switches	
Cable Fixture	

DUT ports

The "DUT Ports" workspace gives access to the DUT port definition, which consists of in three steps:

- 1. Define the physical ports.
- 2. Define the logical ports.
- 3. Define the port groups.

Physical Port	ts			Logical Ports								Port Group	s			
		≡	+						≡	+					≡	+
ame 🏠 🕇	Туре	▼ Logical Port ▼		Name ^	т Туре	ΥP	Physical Port 1	٣	Physical Port 2 T			Name	^ ,	Logical Ports	Ŧ	
P001	DC	LP001	x	LP001	Balanced	P	P001		PP002	×		+ PG001		[LP001] [LP002]	[LP003]	,
P002	RF	LP001	×	LP002	Single	P	P003			×		+ PG002		[LP001] (LP003)	[LP004]	,
P003	RF	LP002	×	LP003	DC	P	P004			×						
P004	RF	LP003	×													
tails																
tails ysical Port Lo	ogical Port Port	Group														
_		Group Description		Delay		One Wa	ny Loss Loss a	nt DC		Lo	s at F	req		Freq for Loss		

Figure 4-17: DUT ports workspace

1. "Physical Ports"

The physical ports of the DUT can be added ("+") or removed ("x") in the "Physical Ports" list of the workspace. There you can declare the type of the physical ports to be either RF or DC.

In the "Details" view, you can add a textual description of the physical port and specify its delay. Furthermore you can toggle "One Way Loss" ON and define the related parameters "Loss at DC", "Loss at Frequency", and "Frequency for Loss".

Details					
Physical Port	ogical Port Port Gro	up			
Name	Description	Delay	One Way Loss Loss at DC	Loss at Freq	Freq for Loss
PP001			OFF		

Figure 4-18: Physical port details

2. "Logical Ports"

A logical port represents the basic element for further definitions of DUT properties and can be added or removed in the "Logical Ports" list of the workspace. There you can declare the type of the logical port to be either single-ended, balanced, or DC. Depending on its type, the logical port comprises one or two physical ports. In the "Details" view, you can provide correction properties for the logical port: its reference impedance (common and differential for balanced ports), and de-/ embedding information. See the user manual of your VNA for more information.

LP3 Balanced OFF Balanced Balanced First Single Port Deembedding Type First Single Port Deembedding Type Second Single Port Embedding Type Second Single Port Embedding Type - Circuit Model None None None	etails															
Name Type Reference Impedance Ref Imp (real) [Ω] Ref Imp (read) [Ω] Reference Impedance Ref Imp (read) [Ω] Ref Imp (imag) [Ω] - LP3 Balanced Balanced OFF OFF OFF OFF OFF Balanced Balanced Balanced First Single Port First Single Port Second Single Port </th <th>hysical Port Logi</th> <th>cal Port</th> <th>Port Group</th> <th></th>	hysical Port Logi	cal Port	Port Group													
Balanced Deembedding Type Balanced Deembedding Type First Single Port Deembedding Type Second Single Port Deembedding Type Second Single Port Second S	Name		Туре			mpedance					Ω]					Differential Ref Imp (imag) [Ω]
Deembedding Type Deembedding Type Embedding Type Mone None None Balanced Logical Port Deembedding Circuit Model Conductance G2 Conductance G3 Capacitance C1 Capacitance C2 Capacitance C1 Gascitance R1 Resistance R2 Conductance G3 Capacitance C1 Capacitance C2 Conductance G3 Capacitance C1 Capacitance C2 Conductance G3 Capacitance C1 Capacitance C2 Conductance G3 <t< th=""><th>LP3</th><th></th><th>Balanced</th><th></th><th>0</th><th>FF</th><th></th><th></th><th></th><th></th><th></th><th>C</th><th>)FF</th><th></th><th></th><th></th></t<>	LP3		Balanced		0	FF						C)FF			
Balanced Logical Port Deembedding Circuit Model Balanced Logical Port Deembedding Circuit Model Circuit Model Resistance R1 Resistance R2 Resistance R3 Conductance G1 Conductance G2 Conductance G3 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C1 Capacitance C2 Capacitance C2 Capacitance C1 Capacitance C2 C		g Type														
Circuit Model Resistance R1 Resistance R2 Resistance R3 Conductance G1 Conductance G2 Conductance G3 Capacitance C1 Capacitance C2 Capacitance C2 STSL default d	- Circuit Model		None	None		None		None		None						
STSL default	Balanced Logi	cal Por	t Deembedo	ding Circuit	Model											
Inductance L1 Inductance L2 Inductance L3 File Name 1 Interchange 1 File Name 2 Interchange 2	Circuit Model	Resis	tance R1	Resistance R2	2 Resis	stance R3	Cor	nductance G1	Cond	luctance G2	Condu	ctance G3	Capacitance	e C1	Capacitance C2	Capacitance C3
	STSL	defau	ılt	default	defa	ult	def	ault	defau	ılt	default		default		default	default
default default None Standard None Standard	Inductance L1	Induc	tance L2	Inductance L	3 File I	Name 1			Inter	change 1	File Na	ime 2			Interchange 2	
	default	defau	ılt	default	None	2			Stand	dard	None				Standard	

Figure 4-19: Logical port details

Since R&S ZNrun version 2.70, Touchstone file-based de-/embedding also supports a more flexible assignment between physical ports and port data:

	Balanced Deembedding	уре	Balanced Embedding Typ	First Single Port Deembedding Type	First Single Port Embedding Type			
-	File	~	None	None	None	None	None	
Ba	lanced Logica	l Po	rt Deembeddii	ng File				
File	Name		h	nterchange				
Em	bedding network	s4p	5	Standard	^			
			5	Standard				
			1	Increasing				
			5	Swapped				
			S	Swapped_Increasing				

See the "Interchange" parameter of related VNA remote control commands.

3. "Port Groups"

In general, a DUT consists of one or more groups of logical ports, which together provide a particular functionality. In the "Port Groups" list of the workspace, you can create and remove such port groups.

In the "Details" view, you can provide ground loop de-/embedding information for the selected port group.

Details									
Physical Port Logical Port Group									
Name	Identifier	Deembedding Type	Embedding Type						
- PG002	fc1bca42-d7ae-4e2e-98a3-866801d390b2	Circuit Model	File						
Ground Loop Deembedding Circuit Model									
Circuit Model Resistance R1 Conductance G1 Capacitance	e C1 Inductance L1								
SL default default default	default								
Ground Loop Embedding File									
File Name									
MyEmbeddingFile.s4p									

Figure 4-20: Details of one port group

Port Map

The "Port Map" workspace consists of a table that lists the port mappings defined during DUT ports definition. The table columns are read-only, however you can delete a port mapping using the "x" icon to the right of the related table row.

				=
Logical Port	Mapping Type	T Physical Port 1	Physical Port 2	٣
LP001	Balanced	PP001	PP002	ж
LP002	Single	PP003		
LP003	DC	PP004		,
LP004	Single	PP004		×

Figure 4-21: Port Map workspace

State Switches

R&S ZNrun focuses on measuring complex DUTs. Besides multiple ports, such a DUT typically provides one or more "control interfaces" that are used to set or request the DUT's state. Depending on the capabilities and applications of the DUT, you have to choose a proper communication path and to define the different states.

itate Switches													
Name		Communicati	ion Channel		▼ Resou	rce			T Waiting	Time		т	
- StateSwitch001		VISA							2000				
State		T Command			• Overw	ritten Logical i	Ports DUT In	dices	r Overwri	tten Port Grou	ps DUT Indices	٣	
StateSwitchState001					[0]				[AI]				
UT Index of Overwritten	ogical Ports			Ŧ	Overwritt	en Logical Por	ts					٣	
					[LP001] [L	P002]							
UT Index of Overwritten	Port Groups			Ŧ	Overwritt	en Port Group	is .					Ŧ	
tate Overwritten Settings			State					Index DL	т				
tate Overwritten Settings witch				-001					т				
tate Overwritten Settings witch tateSwitch001			StateSwitchState			Common		0					
tate Overwritten Settings nitch tateSwitch001 oglcal Port T	• Name		StateSwitchState	Common	e Impedanc	Common Ref Imp (real	Ce			Deembedding	Type Embedd	ding Ty	^r P
ate Overwritten Settings witch ateSwitch001 ogical Port T 1001	× - LP001		StateSwitchState	Common Reference			Ce	0 immon f Imp (in	ag) [Ω]	Deembedding :	Type Embeda Circuit I		(P)
tate Overwritten Settings witch tateSwitch001 ogical Port T P001	× - LP001	Туре	StateSwitchState e gle	Common Reference	e Impedank	Ref Imp (real	Cc () [Ω] Re	0 immon f Imp (in	ag) [Ω]				n p
Intel Overwritten Settings Iwitch IntelSwitch001 oglcal Port T P001	× - LP001	Тури Sing	StateSwitchState e gle	Common Reference	e Impedank	Ref Imp (real	Cc () [Ω] Re	0 immon f Imp (in	ag) [Ω]				P
tate Overwritten Settings witch tateSwitch001 ogical Port T P001	× – LP001 × Single Log	Тури Sing	StateSwitchState e gle	Common Reference	e Impedank	Ref Imp (real	Cc () [Ω] Re	0 immon f Imp (in	ag) [Ω]				P
tate Overwritten Settings witch tateSwitch001 ogical Port T P001	X - LP001 X Single Log File Name None	Тури Sing	StateSwitchState e lle bedding File	Common Reference	e Impedank	Ref Imp (real	Cc () [Ω] Re	0 immon f Imp (in	ag) [Ω]				P
P001	X - LP001 X Single Log File Name Single Log	Type Sing ical Port Deem	StateSwitchState e le bedding File dding Circuit	Common Reference O	e Impedank DN	Ref Imp (real	() [Ω] Re 22	0 immon f Imp (in	ag) [Ω]	File	Circuit I	Aodel	(p)

Figure 4-22: State Switch workspace

4.3.2.2 Measurement configuration

The "Measurement" configuration group allows you to set up the measurement.

Measurement	^
Measurement Paths	
Stimuli	
Limit Lines	
Measurement Cycle	
Plugins	
Calibration Sequences	
Automatic Gain Control	
Time Domain	
 Measurement Paths Stimuli 	S

Measurement Paths	
Stimuli	
Limit Lines	
Measurement cycle	
Plugins	
Calibration sequence	
Automatic Gain Control	
Time domain	

Measurement Paths

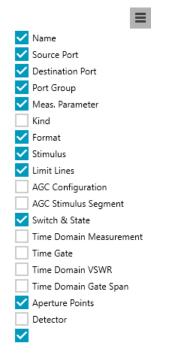
In the "Measurement Paths" workspace, you can define and configure the collection of all measurement paths. In the top section of the workspace, you can set the metaparameters "DUT", "Number of Parallel Measurements", and "Use Power Waves". The number of parallel measurements refers to the DUT multiplicity, i.e. the number of DUTs to be measured.

Configuration phase

Measurement Paths	_											×
DUT	Number of Parall	el Measuremer	nts 1 🗸	^	Jse Power Waves default 💊	/						
Name	▼ Source Port	▼ Destin	ation Port	▼ Port Grou	• T Meas. Paramet	er T Format	▼ Stimulus	▼ Limit Lines	Ŧ	Switch & State	≡ ,	+
MP001	LP001	LP001		PG001	Sss	DB_MAG	Stimulus001					×
MP002	LP003	LP004		PG001	Sss	DB_MAG	Stimulus002					×
MP003	LP001	LP001		PG001	Sss	SMITH	Stimulus003					×
MP004	LP001	LP002		PG001	Sss	DB_MAG	Stimulus003					×
Details Path Ports Stimu	lus LimitLines Swi	tch & State										
Name			Meas. Para	meter		Kind		Format				
MP001			Sss			ADVANCED		DB_MAG				

Figure 4-23: Measurement Paths workspace

The menu that can be opened from the hamburger icon above the configuration table, allows you to toggle the visibility of the configuration possibilities.



Name	Options
"Name"	Set a custom name for the measurement path.
"Source Port"	Select the source port of the measurement from the list of available ports specified in the DUT ports configuration. The source port has to be in the specified port group.
"Destination Port"	Select the destination port of the measurement from the list of available ports speci- fied in the DUT ports configuration. The destination port has to be in the specified port group.
"Port Group"	Assign a port group to the measurement path. The port group is specified in the DUT ports configuration. The source port and the destination port have to be in the specified port group.
"Meas. Parameter"	Select the mixed mode S-parameter to be measured.

Name	Options					
"Kind"	Select the measurement result to be calculated. "ADVANCED" "INSERTION_LOSS" "RETURN_LOSS" "VSWR" "ATTENUATION" "ISOLATION" "BALANCED_AMPLITUDE" "BALANCED_PHASE"					
"Format"	Select how the result is formatted (a.k.a. "Trace Format") "DB_MAG" "LIN_MAG" "IMAG" "REAL" "PHASE" "UNWRAP_PHASE" "SMITH"					
"Stimulus"	Select a stimulus from the list of available stimuli defined in the Stimuli configuration					
"Limit Lines"	Select a limit line from the list of available limit lines specified in the Limit Lines con- figuration.					
"AGC Configura- tion"	Select an AGC configuration table from the list of available AGC configuration tables specified in the Automatic Gain Control configuration.					
"AGC Stimulus Segment"	Select an AGC stimulus segment from the list of available AGC stimulus segments specified in the Automatic Gain Control configuration.					
"Switch & State"	In the "Details" view, add the required State Switches by clicking the "+" icon and selecting the appropriate "State Switch". Then specify the appropriate "State" and "Command".					
"Time Domain Measurement"	Select one of the time domain measurements configured in the Time domain work-space.					
"Time Gate"	Select one of the time gates configured in the Time domain workspace					
"Time Domain VSWR"	Enables or disables time domain voltage standing-wave ratio (TD-VSWR) measure- ment					
"Time Domain Gate Span"	Sets the gate span [ns] for the TD-VSWR measurement					
"Aperture Points"	Sets the number of aperture points for group delay measurements					
"Detector"	Selects the detector for wave quantity-based measurements (waves, ratios)					

Stimuli

In the "Stimuli" workspace, you can define and configure the stimuli you later want to use for different measurement and calibration purposes. New stimuli can be created in the list overview or can be imported with the "Import Stimuli" option, see Chapter 4.3.3, "Import Stimuli", on page 56 for details.

											- 1
											= •
Name				⊤ Pur	pose		т	Туре			т
Stimulus001				USI	E_FOR_MEASUREMENT			Lin Freq			
Stimulus002	timulus002			USE	FOR_USER_CALIBRATION_TAS	к		Log Freq			
Stimulus003			USE	FOR_MEASUREMENT			Segmented				
Details											
Details Stimulus											
Stimulus	Purpose	Туре		Start Frequency [H:	z] Stop Frequency [Hz]	Power [dBm]	Numb	er of Points	Bandwidth [Hz]	Freq. Sweep Mode	
Stimulus Name	Purpose USE_FOR_MEASUREMENT			Start Frequency [H: 10000	z] Stop Frequency [Hz] 100000	Power [dBm] -50	Numb 200	er of Points	Bandwidth [Hz] default	Freq, Sweep Mode	

Figure 4-24: Stimuli workspace

The menu that can be opened from the hamburger icon above the configuration table, allows you to toggle the visibility of the configuration possibilities.



A stimulus is defined by a VNA sweep type ("Type") and the corresponding sweep parameters.

Table 4-6: Supported stimulus parameters

Sweep type	Sweep parameters
"Lin Freq" (linear frequency)	 "Start Frequency" "Stop Frequency" "Power" (optional) "Number of Points" IF "Bandwidth" (optional) "Freq. Sweep Mode"
"Log Freq" (logarithmic frequency)	 "Start Frequency" "Stop Frequency" "Power" (optional) "Number of Points" IF "Bandwidth" (optional)
"Segmented" (segmented frequency)	Each segment represents the frequency range of a linear frequency sweep. You can define it with the same parameters (see first table row).
"Power" (dB-linear power)	 "Start Power" "Stop Power" "CW Frequency" "Number of Points" IF "Bandwidth" (optional)

Sweep type	Sweep parameters
"CW Mode" (continuous wave)	 "CW Frequency" "Power" (optional) "Number of Points" IF "Bandwidth" (optional)
"Time"	 CW Frequency "Power" (optional) "Number of Points" IF "Bandwidth" (optional) "Stop Time"

Limit Lines

In the "Limit Lines" workspace, you can define the limits you want to apply to subsequent measurements.

- A single "Linear" limit line imposes straight-lined upper and/or lower limits on scalar results for a particular stimulus range.
- A "Formula"-defined limit line imposes an upper or lower limit on scalar results for a particular stimulus range.
- A "Circle" imposes a limit on complex (two-dimensional) results.

Limit Lines								×
							= •	•
Name				т Туре			т	
LimitLine001				Linear				x
LimitLine002				Formula				x x x
LimitLine003				Circle				×
Details								
Details								
Limit Lines								
Name	Туре	Start Stimulus	Stop Stimulus	Start Lower Limit	Stop Lower Limit	Start Upper Limit	Stop Upper Limit	
LimitLine001	Linear	0	0	0	0	0	0	

Figure 4-25: Limit Lines workspace

The "Details" section allows you to configure the selected limit line in detail.

Table 4-7: Limit line parameters

Line type	Parameters
"Linear" (straight line)	 "Start Stimulus" "Stop Stimulus" "Start Lower Limit" "Stop Lower Limit" "Start Upper Limit" "Stop Upper Limit"
"Formula" (formula-defined)	 "Start Stimulus" "Stop Stimulus" "Formula". See the user manual of your VNA for supported formulas and their syntax. Limit "Type": upper or lower
Circle (circular)	 "Radius" "Center X" "Center Y"

Measurement cycle

A measurement cycle represents a physical measurement on one or more DUTs. You can specify the order in a tree-like structure as shown in Figure 4-26. If no measurement cycle is defined, the R&S ZNrun server automatically creates a cycle.

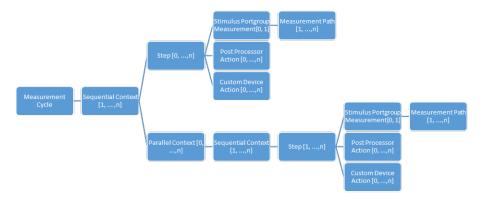


Figure 4-26: Measurement cycle tree structure

The definition of the measurement cycle is done in three steps:

1. Define the structure of the measurement cycle.

As shown in the Figure 4-26, you can add multiple top-level sequential contexts to the measurement cycle.

Measurement Cycle	
Cycle	+
	Add Sequential Context

To every top-level sequential context, you can add multiple steps and parallel contexts.

• Sequential001	x	+ Ad	+ d Ste	ep
Sequential001	x	+	+	
			Ad	ld Parallel Context

To each parallel context, you can add further sequential contexts. During the execution phase, the ZNrun Server runs these sequential contexts in parallel.

• Parallel001	x	+
		Add Sequential Context

To a sequential context inside a parallel context, you can add multiple steps.

Parallel001	х	+		
• Sequential002	ж	+		
		Ad	d Step	

For an example of a complete measurement cycle tree structure, see the following screenshot.

cle	+		
Sequential001	x + +		
Step001	×		
Step002	×		
Parallel001	x +		
Sequential002	x + Sequential003	x +	
Step003	× • Step005	x	
Step004	x Step006	x	

Figure 4-27: Measurement Cycle workspace.

You can assign a custom name to each sequential context, parallel context, or step. For a sequential context, you can also specify a purpose in the "Sequential Measurement Context tab" tab of the "Details" area.

To disable or enable a sequential context, parallel context or step, click the corresponding tree node icon (blue circle).

Sequential contexts, parallel contexts, and steps can function as breakpoints in the execution of the measurement, i.e. to step or pause commands. Click to the left of the corresponding tree node icon to set or remove a breakpoint. A red circle indicates an active breakpoint.

A measurement step is a container for stimulus port groups measurements, custom device actions and postprocessors.

 Define the constituent Stimulus Portgroup Mesurements (SPMs). To add an SPM to a measurement step, select the step in the "Measurement Cycle" workspace and click the "+" icon in the header of the SPM table ("Details" area > "Stimulus Portgroup Measurement" tab).

Stimulus Portgroup Measuremen	t Custom Device Action Po	ost Processor Action	Sequential Me	asurement Contex	t			
Step Name	Name	Prio Pre	Prio Main	Prio Post	Channel Bits	Calibration File	Calibration Hint	Common Parameters Additional Parameters
MeasurementStep2	SPM2	0	0	0	default			OFF Add Stimulus Portgroup Measurement

To add a measurement path to the SPM, select the SPM in the SPM table and click the "+" icon in the header of the "Measurement Paths" table.

Stimulus Portgroup Measuremen	t Custom Device Action P	ost Processor Action	Sequential M	easurement Contex	t					
Step Name	Name	Prio Pre	Prio Main	Prio Post	Channel Bits Calibration File	Calibration Hint	Com	mon Parameters	Additional Parameters	+
MeasurementStep2	SPM2	0	0	0	default			OFF	None	x
Measurement Paths										
Name	Source Port	Destination Port	P	ort Group	Stimulus	AGC Configuration	AGC Stimulus Segm	ent Switc	h & State	+
MP2	LP2	LP3	ц	P1 LP2 LP3	Generator1				Add Measurment	Path

You can also drag a released (unused) measurement path from the flattened view of the "DUT Center" to the "Measurement Cycle" workspace. Drop it on an existing step or on the free space below the last step of a sequential context. The latter automatically adds a step containing this measurement path.

A yellow right-pointing triangle indicates possible drop targets.

DUT Center	Measurement Paths Measurem	nent Cycle Plugins		×
1a 🔠	Cycle			
 Measurement Paths MP001 	Sequential001	x + +		
MP002	Step001	×		
MP003 MP004	Step002	×		
	Parallel001	x +		
	Sequential002	x + Sequential003	x *	
	Step003	× • Step005	×	
	► ■ Step004 → MP003	× Step006	×	

Figure 4-28: Drag & drop of a released measurement path

In the SPM table, you can configure the SPM properties "Name", "Priority Pre Action", "Priority Main Action", "Priority Post Action", "Channel Bits", "Calibration File", "Calibration Hint" and toggle the "Common Parameters" and "Additional Parameters" settings.

If you switch one of the latter two to ON, the "Stimulus Portgroup Measurement" tab displays an additional table that allows you to configure advanced parameters of the related measurement and calibration phases. Common settings such as averaging and power meter deembedding for power cals are available for all measurements.

Details								
Stimulus Portgroup	Measurement Custom Devic	e Action Post Processor Acti	on Sequential Measure	ment Context				
Step Name						Common Parameters	Additional Parameters	+
MeasurementStep2	1					ON	None	ж
Measurement	Paths							
Name	Source Port	Destination Port	Port Group	Stimulus	AGC Configuration	AGC Stimulus Segment Sw	itch & State	+
MP2	LP2	LP3	LP1 LP2 LP3	Generator1				ж
Common Para	meters - Measurement					•		
Average Factor				Average Mode				
1				AUTO				
Common Para	meters - Calibration							
Average Factor		Average Mode		Power Meter De	embedding Filename	Power Meter Deembeddi	ing Trace	
1		AUTO						

Figure 4-29: Stimulus Portgroup measurement detail configuration

Additional parameters are only available for particular measurement types. E.g., in the screenshot below, the parameters of the frequency conversion formula $f_{Destination} =$ Numerator>/<Denominator> * <Channel Base Frequency> + <Offset> are set to measure the second for harmonic:

Details										
Stimulus Portgrou	p Measureme	nt Custom Device	Action Post Proces	sor Action Sequer	ntial Measurement Co	ontext				
Step Name	Name	Prio Pre	Prio Main	Prio Post	Channel Bits	Calibration File	Calibration Hint	Common Parameters	Additional Parameters	+
SPM Harmonics	SPM3	0	0	0	default			OFF	Frequency Conversion	×
Measurement Paths										
Name	Sour	ce Port	Destination Port	Port Group	Stimulus	AG	C Configuration	AGC Stimulus Segmen	Switch & State	+
MP3	LP3		LP4	LP3 LP4	Generator	1				x
Frequency C	onversion P	arameters								
Numerator		Der	nominator		Offset		Fixed Freq	uency Swe Attenuation	Factor	
2		1			0		Ν	lo default		

Figure 4-30: Frequency conversion measurement (available on R&S ZNA/ZNB/ZNBT with option *K*4)

Note that a measurement step executes in a single VNA channel. Hence each measurement path in every SPM of a measurement step must have identical channel settings ("Port Group", "Stimulus", "AGC Configuration", "AGC Stimulus Segment", "Switch & State").

3. Define the custom device actions, post processor actions and the sequential measurement context.

To add a custom device action to a measurement step, select the step in the "Measurement Cycle" workspace, activate the "Custom Device Action" tab in the "Details" area, and click the "+" icon in the table header.

Measurement Cycle				×
Cycle Step001	+ x			^
Details				
Stimulus Portgroup Measurement Name Custom Device Pr	Custom Device Action	Sequential M		+
			Add Custom Device Ac	tion

For each custom device action you can specify a custom "Name" and the parameters "Custom Device", "Priority Pre Action", "Priority Main Action", "Priority Post Action", and "Parameter".

To add a "Custom Curve" to the custom device action, click the "+" icon in the "Custom Curve" table header.

Configuration phase

itimulus Portgroup Measurem	ent Custom Devi	ice Action	Post Processor Ac	tion Sequentia	I Measurement Contex	t	
Name	Custom Device	Priority Pr	re Action Priori	ty Main Action	Priority Post Action	Parameter	4
- CustomDeviceAction001		0	0		0		х

Similarly, to add a custom post processor action to a measurement step, select the step in the "Measurement Cycle" workspace, activate the "Post Processor Action" tab in the "Details" area, and click the "+" icon in the table header.

Measurement Cycle		×
Cycle Step001	+ X	^
<		> ~
Details		
Stimulus Portgroup Measurement Cus	tom Device Action Post Processor Action	Sequential Measurement Context
Name Post Proces	sor Parameter	+
		Add Post Processor Action

Here a custom "Name", the "Post Processor" and a "Parameter" can be specified. To add a "Custom Curve" to the post processor action, click the "+" icon in the "Custom Curve" table header.

Deta	ils				
Stim	ulus Portgroup Measureme	ent Custom Device Action	Post Processor Action	Sequential Measurement Context	
	Name	Post Processor	Parameter		+
-	PostProcessorAction001				x
Cust	om Curve		Display Name		+
					Add Custom Curve

You can define custom devices, post processors and custom curves in the Plugins workspace.

To configure the sequential measurement context, select it in the "Measurement Cycle" workspace, activate the "Sequential Measurement Context" tab in the "Details" area, and turn "Pipelining" ON or OFF.

Measurement Cycle				×
Cycle	+			
Sequential1	х	+ +		^
MeasurementStep1	x			~
Details				
Stimulus Portgroup Measurement	Custom Device Action	Post Processor Action	Sequential Measurement Context	
Name	Purpose	e	Pipelining	
Sequential1			OFF	

Note that pipelining is available for R&S ZNB and R&S ZNBT only, and requires firmware V3.20 or higher. Specifying a purpose for this setting is optional.

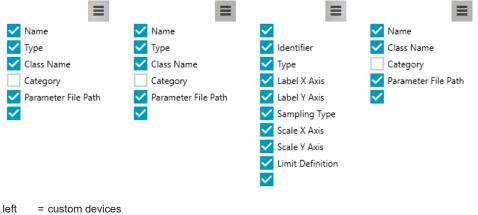
Plugins

In the "Plugins" workspace you can configure custom devices, post processors and custom curves.

Use the "+" icons to add a plugin of the respective plug-in type.

Plugins				×
Custom Devices			=	+
Name	▼ Туре	▼ Class Name	▼ Parameter File Path	T
Post Processors			≡	+
Name	▼ Туре	▼ Class Name	Parameter File Path	T
Custom Curves			=	+
Identifier Type	▼ Label X Axis ▼ Label Y Axi	s 🔻 Sampling Ty; 🍸 Scale X Axis	▼ Scale Y Axis ▼ Limit Definiti	on
Communication Channels				
			≡	+
Name	T Class Name	▼ Parame	ter File Path	T

The menus that can be opened from the hamburger icons above the configuration tables, allow you to toggle the visibility of the plug-in type-specific columns.



middle = post processors

right = custom curves

Table 4-8: Settings for plugins

Plug-in type	Setting	Description
"Custom Devices"	"Name"	A descriptive name of the custom device.
	Туре	The implementation type: • ".NET Assembly" • "Python"
	"Class Name"	The fully qualified name of the custom device class, including its namespace.
	"Category"	Plug-in category (read-only): the fully qualified name of the ICustomDevice interface
	"Parameter File Path"	The path to the corresponding parameter file (read- only).
		The path is a local resource. It can be specified in the Extension Registrations workspace.
"Post Processors"	Name	A descriptive name of the post processor.
	Туре	The implementation type: • ".NET Assembly" • "Python"
	"Class Name"	The full qualified name of the post processor class, including its namespace.
	"Category"	Plug-in category (read-only): the fully qualified name of the IPostProcessor interface
	"Parameter File Path"	The path to the corresponding parameter file (read- only).
		The path is a local resource. It can be specified in the Extension Registrations workspace.
"Custom Curves"	"Identifier"	The string identifier of the custom curve.

Plug-in type	Setting	Description
	"Туре"	The graph type: • "Cartesian" • "Polar" • "Smith" • "Smith Inverted"
	"Label X Axis" / "Label Y Axis"	The label of the x-axis/y-axis.
	"Sampling Type"	 "None" (initial state, must be changed) "Range": "Start" "Stop" "Number of Points" Points (list of points)
	"Scale X Axis" / "Scale Y Axis"	The scale of the x-axis/y-axis. Only editable for "Cartesian" curves. • Linear • Logarithmic
	"Limit Definition"	Switches limit definition for the respective custom curve ON or OFF. If set to ON, a "Limit Definition" table appears beneath the custom curve.
		You can assign a "Name" and "Rank" to this limit. For cartesian curves ("Cartesian"), the limit consists of a set of straight limit lines, each of them defined via: Limit "Type" ("Upper Limit" or "Lower Limit") "Start Value X" "Stop Value X" "Start Value Y" "Stop Value Y"
		For complex curves ("Polar", "Smith", "Smith Inver- ted"), the limit consists of a single circular value range, defined via: • Radius • Center X • Center Y
"Communication Chan- nels"	"Name"	A descriptive name of the (asynchronous) communi- cation channel.
	"Class Name"	The full qualified name of the communication chan- nel class, including its namespace.
	"Category"	Plug-in category (read-only): the fully qualified name of the IClientCommChannel interface
	"Parameter File Path"	The path to the corresponding parameter file (read- only). The path is a local resource. It can be specified in the Extension Registrations workspace.

Configuration phase

Custom Curves					-
Identifier T	Type 🔻 Label X Axis	▼ Label Y Axis ▼ Sampl	ing Type 🔻 Scale X Axis	▼ Scale Y Axis ▼	Limit Definition T
- CustomCurve001	Cartesian	None	LINEAR	LINEAR	ON X
Limit Definition					
Name			Rank		
- My Limit			default		
Туре	Start Value X	Stop Value X	Start Value Y	Stop Valu	e Y +
Upper Limit	100000000	300000000	0	0	x
Lower Limit	100000000	300000000	-10	-10	х

Figure 4-31: Limit definition: cartesian curve

Custom Curves				≡ +
Identifier T Type	🔻 Label X Axis 🔻 Lat	oel Y Axis 🔻 Sampling Type 🔻	Scale X Axis 🔻 Scale Y Axis	▼ Limit Definition ▼
- CustomCurve001 Polar		None		ON X
Custom Curve Sampling				
Points				+
Limit Definition				
Name	Rank	Radius	Center X	Center Y
My Limit	default	1	0	0

Figure 4-32: Limit definition: complex curve

Calibration sequence

In the "Calibration Sequence" workspace, you can specify different calibration sequences for custom device actions. For each calibration step, a custom device with a parameter has to be chosen.

ration Sequences			×
Measurement Reference			+
CalSeq1			×
Custom Device Action	Custom Device	Parameter	•
CustomDeviceAction001	CustomDevice001	4	×
CustomDeviceAction002	CustomDevice002	2	×
CustomDeviceAction003	CustomDevice003	42	x
+ CalSeq2			×
	Massurement Reference Catilong 1 Custom Device Action Custom/DeviceAction001 Custom/DeviceAction002 Custom/DeviceAction003	Measurement Reference Cationg1 Cutom Device Cutom DeviceAction Cutom DeviceAction Cutom DeviceAction001 Cutom DeviceAction Cutom DeviceAction002 Cutom DeviceAction002 Cutom DeviceAction003 Cutom DeviceAction	Massurement Reference Cating1 Cation Device Action Parameter CationDeviceAction/021 CationDevice001 4 CationDeviceAction/022 CationDevice002 2 CationDeviceAction/033 CationDevice003 42

Figure 4-33: Calibration Sequence workspace

Automatic Gain Control

"Automatic Gain Control" (AGC) enables a receiver to sense and adapt its signal input to optimize dynamic range and avoid overload conditions from strong signals or dynamically changing signals across successive scans.

In the "Automatic Gain Control" workspace, you can define and configure AGC tables for the VNA types supporting AGC. Furthermore you can group this AGCs tables to AGC segment maps.

Automatic Gain Control										×
AGC Configurations						AG	iC Segment Maps			
		≡	+				:	=	•	
Identifier	▼ Port Count	т					Identifier	т		
- AgcTable001	2		×			-	AgcStimulusSegmentMap001		×	
VNA Type		т	+			#	AGC Configuration		+ X	
ZVA			×	l		1	AgcTable001		×	
ZVB			×			2	AgcTable002		×	
+ AgcTable002	2		×			+	AgcStimulusSegmentMap002		×	
Details										
AGC Configuration										
Name	Designated VNA	# DrivePort	Pe	cab		Port	1 Receive Port 2			
AgcTable001	ZVA	1 AUTO Y					✓ AUTO ✓			
Agciableool	214	2 LOW_DISTORTION ~					RTION V LOW_DISTORTION V			
		2 LOW_DISTORTION *	u	w_	11:	5101	KICK + LOW_DISTORTION +			

Figure 4-34: Automatic Gain Control workspace

Time domain

Vector network analyzers are able to measure the complex S-parameters of a device under test (DUT) for different frequencies. By applying an inverse Fourier transform, these frequency domain results can be transformed to the time domain, and represented as the impulse response or step response of the DUT. In the time domain, some DUT characteristics can be analyzed easily, for instance faults in cables can be directly localized.

Moreover, special time domain filters, so-called gates, can be used to suppress unwanted signal components such as multireflections. By transforming the gated time domain representation back to the frequency domain, the unwanted signal components are also removed from the S-parameter representation.

In the "Time Domain" workspace, you can configure the two parts of the time domain measurement.

Time Domain	Measurements							=	+
Name	▼ Filter	▼ DC Value Manual	 DC Value Continuous Extrap 	olation 🔻 Impulse Respons	e 🔻 Side Lobe Le	vel [dB] 🔻 Resolution Enh	ancement Factor 🔻 St	tart Time [s] ▼ Stop Time [s]	T
imeDomain001	BANDPASS	0	No	HANN	default	1	de	efault default	
ime Gates									•
	Axis Pair 🔻	Center [s] T Span [s]	▼ Start [s]	▼ Stop [s]	▼ Show Range Li	ne 🔻 Used Filter	▼ Shape	Side Lobe Level [dB]	≡ + ▼

Figure 4-35: Time Domain workspace

Category	Setting	Description
"Time Domain Measurements"	"Name"	The name of the time domain measurement.
	"Filter"	 "BANDPASS" impulse response "LOWPASS" impulse response "LOWPASS_STEP" response
	"DC Value Manual"	Sets the DC value manually, if "DC Value Continuous Extrapola- tion" is disabled.
	"DC Value Continuous Extrapola- tion"	Enables or disables the continu- ous extrapolation of the DC value If enabled ("YES"), "DC Value Manual" is disabled.
	"Impulse Response"	Shape of the filter applied in the frequency domain: • "RECT" (rectangular) • "HANN" • "HAMM" (Hamming) • "BOHM" (Bohman) • "DCH" (Dolph-Chebyshev)
	"Side Lobe Level"	If the impulse response is set to "DCH", the side lobe level can be edited.
	"Resolution Enhancement Factor"	A factor of 1 means that the original sweep range and the measured sweep points are used for the time domain transformation. With higher resolution enhancement factors, the measurement data are extrapolated using a linear prediction method. As a result, the time domain resolution can be improved.
	"Start Time"/"Stop Time"	Defines the display range of the time domain trace
'Time Gate"	"Name"	The name of the time gate.
	"Axis Pair"	CENTER_SPAN START_STOP
	"Center"/"Span"	The center/span of the time gate Only editable if "Axis Pair" is set to "CENTER_SPAN".
	"Start"/"Stop"	Sets the start/stop value of the time gate. Only editable if "Axis Pair" is set to "START_STOP".
	"Show Range Line"	Displays or hides the range line.

Table 4-9: Time domain measurement settings

Configuration phase

Category	Setting	Description
	"Used Filter"	 "BANDPASS": only the time domain information inside the time gate is considered "NOTCH": only the time domain information inside the time gate is considered
	"Shape"	Shape of the filter applied in the time domain: • "RECT" (rectangular) • "HANN" • "HAMM" (Hamming) • "BOHM" (Bohman) • "DCH" (Dolph-Chebyshev)
	"Side Lobe Level"	If "Shape" is set to "DCH", the side lobe level can be edited.

4.3.2.3 Measurement Devices configuration

The purpose of the "Measurement Devices" configuration group is the definition of all measurement-related configuration settings.

Measurement Devices	^
Devices	
Device Connections	

•	Devices	52
•	Device Connections	53

Devices

The "Devices" workspace allows you to add and configure VNAs, switch matrices, calibration units, calibration kits, and power meters.

VNA Devices						≡ •
Name	т Туре	T Port Count	Y Purpose	T Communication Channel T Res	ource T Waiting Time	Ŧ
VNA001	ZNB			VISA	2000	×
Matrices						≡ •
Name	т Туре		T Communication Channel	T Resource	Waiting Time	= +
Calibration Unit Devices						
						= +
Name	т Туре		T Communication Channel	T Resource	T Waiting Time	т
Calibration Kit Devices						-
Calibration Kit Devices			У Туре			≡
			¥ Туре			
Name			т Туре			
			т Туре			

Figure 4-36: Devices workspace

For calibration units, calibration kits and power meters, the configuration is straightforward.

For VNAs and switch matrices, you have to configure the RF ports (and DC ports for an R&S ZNB/ZNBT with option B81).

												≡ •
٣	Туре		Port Count	Ŧ	Purpose	٣	Communit	ation Channel 🔻	Resource 7	Waiting Time		7
	ZNB		4				VISA		TCPIP0::ZNrunZNB			×
T Alias		▼ De	scription	T Device	Port Type	▼ Connect	or Type	T Gender	Ŧ	Is Node Port	Cable Length	٣
				VNA_F	ORT	UNKNO	VN	male		No	default	
				VNA_F	ORT	UNKNO	VN	male		No	default	
				VNAJ	ORT	UNKNO	VN	male		No	default	
				VNAJ	ORT	UNKNO	VN	male		No	default	
		T Type ZNB T Alias	ZNB	ZNB 4	2118 4 T Alles T Description T Device 1114 1114 1114 1114 1114 1114 1114 11	ZNB 4	21/8	ZNB 4 VIDA Y Alas Y Description Y Description Y Description Y Convector Type VNLA_DORT UNIXIONN VNLA_DORT UNIXIONN VNLA_DORT UNIXIONN VNLA_DORT UNIXIONN	ZNB VIDA Y Allas Y Description Y Device Fort Type Y Connector Type Y Gender VILA_DORT UNXO/ONN male VILA_DORT UNXO/ONN male VILA_DORT UNXO/ONN male VILA_DORT UNXO/ONN male	ZN3 4 YEA CONSIGNATION Y Alas Y Description Y Description Y Description Y Connectory Type Y Connector	2N8 4 YSA 1C1990-D19uc/2N2 9 Y Alas Y Description Y Device First Type Y Connector Type Y Gender Y Is Node Part VNA_PORT UNXNOVN male No VNA_PORT UNXNOVN male No VNA_PORT UNXNOVN male No	2N8 4 VISA COMPOLIZIVE/DIAL 0 Y Allas Y Description Y Device Port Type Y Gender Y Is Node Fort Cable Length VNA_DORT UNRXOWN male No dpturt VNA_DORT UNRXOWN male No dpturt

Figure 4-37: VNA Devices configuration

Device category	"Device Port Type"	Description
	"GENERIC"	Default value if no specification of the port type is needed for a cer- tain measurement device cate- gory.
"VNA Devices"	"VNA_PORT"	An RF port of a VNA, usually rep- resented by a coaxial connector. This port type provides a receiver and a signal generator at the same time.
	VNA_DC_PORT	A DC port of a VNA. There is no possibility to generate a signal at this type of port.
"Matrices"	MATRIX_VNA_PORT	A matrix port that is typically con- nected to a VNA port.
		In cascaded matrix configurations, a "MATRIX_VNA_PORT" is con- nected to a "MATRIX_TEST_PORT" of another matrix. Currently this is not supported.
	MATRIX_TEST_PORT	A matrix port that is typically used as a test port, i.e. that is connec- ted to the measurement adapter of a DUT.
		In cascaded matrix configurations, a "MATRIX_TEST_PORT" is con- nected to a "MATRIX_VNA_PORT" of another matrix. Currently this is not sup- ported.

Device Connections

The "Device Connections" workspace allows you to define of the connections between VNAs and switch matrices.

Device Connections							×
						≡	+
VNA 1	VNA Port	٣	Matrix	٣	Matrix Port	۲	
VNA001	P1		Matrix001				×

Figure 4-38: Device Connections workspace.

4.3.2.4 Connection Plan configuration

According to the R&S ZNrun API, a ConnectionPlan relates

MeasurementDevices and DUTmeasurementPlans. It has an impact on the execution of the measurement cycle and the required physical (re-) connections. The "Connection Plan" workspace allows you to configure a ConnectionPlan data structure, possibly including DUT multiplicity and VNA multiplicity.

Connection Plan					×
☑ Use Connection Plan Algo	rithm				= +
Device Name	Test Port Name	T Physical Port Name	▼ Dut Index	T Display Name	Ŧ
VNA001	P21	PP001	0		×

Figure 4-39: Connection Plan workspace

If you select "Use Connection Plan Algorithm", the ZNrun Server calculates the connection plan automatically when you switch to the execution phase. It takes the port configurations of the measurement devices and the DUT as input, and preserves manually created connections.

• If the connection plan algorithm yields undesired results, switch back to the configuration phase and add some connections manually.

- For port groups with more than 4 ports, the algorithm doesn't work reliably and should be disabled. Use manual configuration instead.
- If more than one VNA is used, the connection plan algorithm has to be disabled and all connections have to be defined manually.

Click the "+" icon above the "Connection Plan" table to add a new connection. Use the "Device Name" and "Test Port Name" to select a test port on the VNA or matrix. Use the "Physical Port Name" and "DUT Index" to select the connected DUT port. Finally specify a "Display Name" for the connection (optional).



The "DUT Index" refers to a physical DUT. The number of DUTs can be defined via the "DUT" setting in the Measurement Paths workspace.

4.3.2.5 Local Data configuration

In this configuration group, you can specify the local data of the ZNrun project, i.e. the project data that probably have to be modified, when the project is deployed to another ZNrun Server instance.

Local Data	^
Device Communication Properties	
DUT State Switch Communication Proper	ties
Extension Registrations	

Device Communication Properties

The "Device Communication Properties" workspace gathers the communication properties of all measurement devices. All communication properties are editable.

Device Communication Properties				×
				=
Device Name	Communication Channel	▼ Resource	T Waiting Time	Ŧ
VNA001	VISA		2000	x
Matrix001	LOGICAL		2000	×
CalibrationUnit001	VNA_CONTROLLED_VIA_LAN		2000	×

Figure 4-40: Device Communication Properties workspace

If you remove a row from the "Device Communication Properties" table, the corresponding device is **not** removed from the measurement plan. Only its communication properties are reset.

DUT State Switch Communication Properties

This workspace gathers the communication properties of all state switches. All communication properties are editable.

DUT State Switch Communication Propertie	15					>	<
						≡	
Switch T	Туре	٣	Resource	٣	Waiting Time	٣	
StateSwitch001	VISA				0	×	

Figure 4-41: DUT State Switch Communication Properties workspace.

If you remove a row from the "DUT State Switch Communication Properties" table, the corresponding state switch is **not** removed from the measurement plan. Only its communication properties are reset.

Extension Registrations

The "Extension Registrations" workspace gathers information on registered plugins. It displays "Category" and "Class Name" of every custom device and post processor defined in the Plugins workspace. Here you can specify a local path to a parameter file ("Parameter File Path").

Extension Registrations			×
			≡
Category	T Class Name	Y Parameter File Path	т

Figure 4-42: Extension Registrationsworkspace



If you remove a row from the "Extension Registrations" table, the corresponding extension is **not** removed from the list of plug-ins. Only the parameter file path is deleted.

4.3.3 Import Stimuli

You can import stimuli from file. Select the "Import Stimuli" icon from the Chapter 4.1.1, "Main toolbar", on page 16 and pick an *.xml file that contains a valid serialization of a DutMeasurementPlan. For example, you can use the

DutMeasurementPlan.xml that is created by the ZNrun Workbench when the workbench project is saved. The ZNrun Workbench automatically extracts all stimuli from the DUTmeasurementPlan and displays them in a list.

Calibration phase

port Stimul	1										
Name	Ŧ	Туре	т	Full Calibration	т	Start	Ŧ	Stop	т	Segments	
PowerOr	n	Segmented				1000000		10000000		1	
Stimuli_S	Spara1	Segmented				50000000		300000000		3	
Stimuli_\	/SWR1	Segmented				100000000		150000000		1	
Stimuli_1	NF1	Lin Freq				100000000		110000000			
Stimuli_S	Spara2	Segmented				50000000		300000000		3	
Stimuli_\	/SWR2	Segmented				100000000		1500000000		1	
Stimuli_1	NF2	Lin Freq				110000000		120000000			
Stimuli_S	Spara3	Segmented				50000000		300000000		3	
Stimuli_\	/SWR3	Segmented				100000000		150000000		1	
Stimuli_1	NF3	Lin Freq				120000000		130000000			
Stimuli_S	Spara4	Segmented				50000000		300000000		3	
Stimuli_\	/SWR4	Segmented				100000000		150000000		1	
Stimuli_1	NF4	Lin Freq				130000000		140000000			
Stimuli_S	Spara5	Segmented				50000000		300000000		3	
Stimuli_\	/SWR5	Segmented				100000000		150000000		1	
Stimuli_1	NF5	Lin Freq				150000000		160000000			
Stimuli_S	Брагаб	Segmented				50000000		300000000		3	
Stimuli_\	/SWR6	Segmented				100000000		1500000000		1	
Stimuli_1	NF6	Lin Freq				160000000		1700000000			
Stimuli_S	Spara7	Segmented				50000000		300000000		3	
Stimuli_\	/SWR7	Segmented				100000000		150000000		1	
Stimuli_1	NF7	Lin Freq				170000000		180000000			
Stimuli_1	NF7	Lin Freq				170000000		180000000			

Figure 4-43: Import Stimuli dialog

Use the checkboxes to the left to select the stimuli to be imported.

There are three different "Import" modes:

- **Replace:** All new stimuli are imported. Duplicates are replaced with the imported stimuli.
- **Rename:** All new stimuli are imported. The ZNrun Workbench assigns all duplicates a new unique identifier.
- Skip: All new stimuli are imported. Duplicates are not imported.

The default stimuli import mode is "Rename".

4.4 Calibration phase

After the Measurement Execution Unit (MEU) has been configured, you can enter the calibration phase.



Since R&S ZNrun V2.70 the functionality of the ZNrun Calibration Client is integrated in the ZNrun Workbench.

To select the calibration coverage ("DUT Related Calibration", "Full Calibration", "User Defined Calibration"), use the drop-down menu beneath the calibration icon in the Main toolbar.



Figure 4-44: Calibration toolbar icon with calibration coverage selector

For a description of the calibration process, see Chapter 5, "ZNrun Calibration Client", on page 69.

4.5 Execution and visualization phase

After the configuration and calibration of the Measurement Execution Unit (MEU), you can finally proceed with the execution and visualization of the measurement.

4.5.1 Tuning (R&S ZNrun-K6)

Tuning is a special feature of the R&S ZNrun framework. It allows you to change and optimize the configuration of a MEU during the execution phase. It requires option R&S ZNrun-K6.

A parameter change affects all instances of the MEU. Furthermore, tuning comes with three tools to enhance the capabilities of the configuration of a MEU with the ZNrun Workbench:



Figure 4-45: Tuning tools

The leftmost button enables/disables tuning. For a description of the other buttons, see Table 4-2.

4.5.2 Execution View

Access: "View" > "Execution" > "Execution View"

The "Execution View" workspace gathers all information of the MEU execution. In this workspace, the measurement cycle is displayed in a tree-like structure, similar to the Measurement cycle configuration workspace.

Additional information such as the execution status, execution duration or calibration status of a sequential context, parallel context or step is displayed to the right of the corresponding tree node.

Execution View		×
Cycle 00:00.000		
Sequential1	00:00.000	
MeasurementStep1	00:00.000	
• MeasurementStep2	00:00.000	

Figure 4-46: Execution View workspace

In the same way as described for the measurement cycle configuration workspace, you can enable or disable the execution of nodes and set or delete breakpoints.

To start and manipulate the execution, you can use the execution tools in the main toolbar (see Table 4-2).



Figure 4-47: Toolbar icons for the execution phase

Exclusive measurement execution

The ZNrun Server runs the protected R&S ZNrun-K4xx projects as exclusive measurement execution units, i.e.:

- Only the executing client (ZNrun Cable Test Client or ZNrun Workbench) has access to the MEU. Other clients cannot connect to it.
- During execution, the MEU and registered plugins have only limited access to the properties of the ZNrun project.
- The ZNrun Server unloads the MEU when execution stops.

4.5.3 Connections workspace

Access: "View" > "Execution" > "Connections"

In the "Connections" workspace, the connection plan is displayed.

It contains the information of the Connection Plan configuration, plus all automatically generated connections (indicated by a checkmark in "Generated" column).

Execution and visualization phase

								×
Test Port Name 7	Physical Port Name	٣	Dut Index	T Dis	play Name	Ŧ	Generated	٣
P1	P09		0				~	
P3	P01		0				~	
P2	P02		0				~	
P4	P03		0				×	
P8	PP001		0				~	
P7	PP002		0				~	
P6	PP003		0					
P5	PP004		0					
P9	P09		1				~	
	P1 P3 P2 P4 P8 P7 P6 P5	P1 P09 P3 P01 F2 P02 P4 P03 P8 P0001 P7 P002 P6 PP003 P5 P004	P1 P09 P3 P01 P2 P02 P4 P03 P8 PP002 P6 PP003 P5 PP004	P0 0 P3 P01 0 P2 0 0 P4 P03 0 P8 P9001 0 P7 P002 0 P6 P903 0 P5 P904 0	P1 P0 0 P3 P01 0 P2 0 0 P4 P03 0 P8 PP001 0 P7 PP002 0 P6 PP003 0 P5 PP004 0	P1 P0 0 P3 P01 0 P2 P02 0 P4 P03 0 P8 P901 0 P7 P002 0 P6 P903 0 P5 P904 0	P0 0 P3 P01 0 P2 0 0 P4 P03 0 P8 P9002 0 P7 P002 0 P6 P903 0 P5 P904 0	Y Populad Port Name Y Dut Index Y Ditypey Name Y Generated P1 P0 0 ~ P1 P001 0 0 P001 0 P01 P01 P01 P01

Figure 4-48: Connections workspace

4.5.4 Device Communication workspace (Tuning)

Access: "View" > "Execution" > "Device Communication"

Available with Tuning (R&S ZNrun-K6) only, and only if tuning is active. Allows you to send commands to external devices and receive their results asynchronously (i.e. outside the measurement cycle).

Device Communication	×
Asynchronous Device Communication	Command History 1 °IDN?
Transmit VNA-TCPIP::10.111.0.223-Rohde-Schwarz,ZNB26-4Port,1334333065900014,3.70.1.1465-23.09.1.14 ~	
1 Rohde-Schwarz,ZNB26-4Port,1334333065900014,3.70.1.1465-23.09.1.14	
Details	
Device Communication Log	
Type T Command / Response T Commun	nication Channel
→ *IDN? VNA-TCP	PIP::10.111.0.223-Rohde-Schwarz,ZNB26-4Port,
Rohde-Schwarz,ZNB26-4Port,1334333065900014,3.70.1.1465-23.09.1.14 VNA-TCP	PIP::10.111.0.223-Rohde-Schwarz,ZNB26-4Port,

Figure 4-49: Device Communication workspace

The communication interface must be registered as plugin type "Communication Channel" (see "Plugins" on page 46).

- Q
- Commands and responses are interpreted as strings.
- Commands are handled "in the SCPI sense", i.e. line breaks are replaced by semicolons
- By default and without manual registration as "Communication Channel" the VISA channels of connected VNAs are offered for asynchronous "Device Communication" via SCPI.

If the "Communication Channel" is registered and open, you can send commands as follows:

- Enter the command or commands into the "Asynchronous Device Communication" text area.
- Select the (channel to the) target device from the combo-box below the "Asynchronous Device Communication" text area.
- 3. Click "Transmit".

As soon as it is available, the returned text (if any) is displayed in the read-only text area below the "Transmit" button. Transmitted commands and their responses are appended to the "Device Communication Log" – together with the related communication channel.

The transmitted commands are also appended to the (read-only) "Command History" from where you can copy & paste them back to the "Asynchronous Device Communication" text area.

4.5.5 Visualization workspaces

The outcomes of the measurements can be displayed in "Visualization" workspaces. You can either create an empty chart and drag & drop a "Stimulus Portgroup Measurement" from the "DUT Center" onto it. Or you can display a "Stimulus Portgroup Measurement" directly, by dragging & dropping it from the "DUT Center" to the workspace.

To focus on the results of a particular DUT, select the corresponding DUT index from the dropdown menu. Then newly created charts only display the measurements related to this DUT.

All charts are updated during the execution of the measurement cycle. All charts can be edited using the visualization tools:



Table 4-11: Visualization tools (from left to right)

Group	Name	Action
Basic tools	Add empty chart	Adds a new empty chart to the workspace.
Visualization tools	Add marker	Adds a marker to the chart. The position of the marker in the chart can be changed by dragging. A legend entry is created.
	Freeze trace	Memorizes the trace calculated during the previous measure- ment cycle and adds it as a static second trace "Frozen <trace name>" to the related chart. See Figure 4-50.</trace
	Show legends	Shows or hides the legend of a chart.
	Show limits	Shows the limit lines of the measurement path in the chart.
Layout tools	Grid layout	Arranges the charts in a dynamic grid layout. The size of the charts is fixed.
	Stack layout	Arranges the charts stacked over one another. The width of the chart is dynamically adjusted.

Group Name		Action
	Maximize view	Adjusts the size of the chart to the size of the workspace.
Keep aspect ratio		Keeps the aspect ratio of all charts equal. A change of the aspect ratio of one chart affects all charts.
	Couple chart sizes	Keeps the size of all charts equal. A change of the size of one chart affects all charts.
Export tools	Export chart to file	Exports the selected chart as .PNG. The destination folder is chosen by a dialog.
	Copy chart to clip- board	Copies the selected chart to the clipboard.

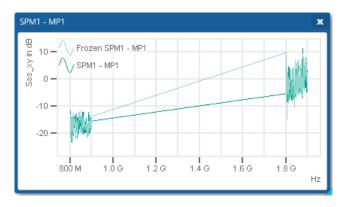


Figure 4-50: Frozen trace

Selection-based visualization workspaces

With activated Tuning (R&S ZNrun-K6), you can access a second "DUT Center" view that offers advanced selection capabilities for visualization.

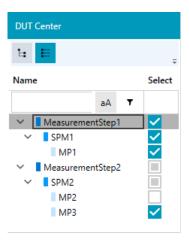


Figure 4-51: Selection view

The selection view displays a subtree of the standard "Structured Shape", limited to nodes that are related to "visualizable objects":

• Measurement paths

- · Custom curves, created by custom device actions and post-processor actions
- Their ancestor nodes (except the "Measurement Cycle" root node)

For large trees, a powerful text filter on the node names can further narrow the displayed subtree:

Name			
search st	ring	аA	۲
	Clear F	Filter	
V SPN	ls equ	al to	
🗸 🛛 Measi	ls not	equal	to
V SPN	Starts	with	
M	Ends v	vith	
	Conta	ins	
	Does 1	not co	ntain

Use the checkboxes in the "Select" column to select or unselect nodes. Selection always applies to a whole subtree: If you select a node, the view automatically selects all its descendants – in particular all related paths and curves.

Once you have made your choice, you can visualize all selected measurement paths and custom curves with a single context menu action:

Name			Select	
	аA	۲		
Measure SPM1	Sele	ct all Fi		ths and Curves
MP1				Paths and Curves
V SPM2	Disp	lay Sel	ected Iter	ms in extra Workspaces
MP2 MP3			 ✓ 	

"Display Selected Items in Extra Workspaces" creates:

 A visualization workspace "<measurement step name>" for each affected measurement step

(i.e. for each measurement step with at least one path or curve selected)

• Within these workspaces, a chart for every selected path or curve of the related measurement step

In the example above, it creates visualization workspaces for "MeasurementStep1" and "MeasurementStep2", each comprising a single chart:

Rollout phase

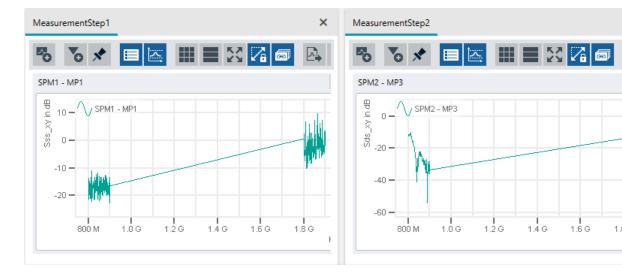
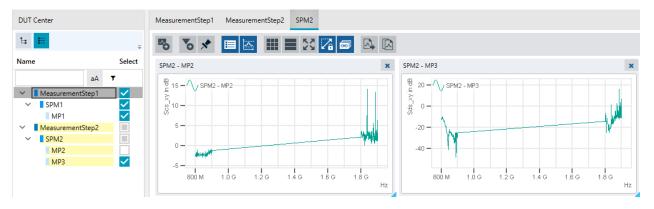


Figure 4-52: Selection-based visualization workspaces

- When executed again, "Display Selected Items in Extra Workspaces" deletes all selection-based visualization workspaces and creates them anew, based on the current selection. All modifications of existing selection-based visualization workspaces are lost.
 - For your convenience, actions "Close"/"Close All Workspaces"/"Close All Workspaces But This" were added to the context menu of the visualization workspace tabs. The "Close All" actions affect docked visualization workspaces only.

If a visualization workspace has focus, the selection view highlights the workspace's (implicit) selection with light-yellow node backgrounds.



4.6 Rollout phase

You can use ZNrun Workbench to roll out a valid Measurement Execution Unit (MEU) to multiple test stations, controlled by one or multiple ZNrun Server(s). The MEU loaded in ZNrun Workbench serves as master MEU. The test stations must be described as your "Device Park".

Q

A test station is a set of devices comprising, for example:

- One or more VNAs
- One or more DUT adapters
- Matrix devices (optional)
- Calibration devices (optional)

To control rollout, use the rollout tools in the main toolbar (see Table 4-4).

$\textcircled{\Rightarrow}$	R	0	\odot	E.	
-----------------------------	---	---	---------	----	--



When working on a protected R&S ZNrun-K4xx project, the rollout functionality is not available.

4.6.1 Device Park

The "Device Park" describes your available test stations (VNAs, matrices). It is located in an arbitrary root directory on your file system.

Each test station in the device park is represented by a subdirectory. The name of the directory is used as name of the test station. Each test station subdirectory needs to contain a MeasurementDevicesPlan.xml and a MeasurementDevicesLocalData.xml file:

```
<Root>

|-- <TestStationName>

|-- <MeasurementDevicesPlan>.xml

|-- <MeasurementDevicesLocalData>.xml

|-- <TestStationName>

|-- <MeasurementDevicesPlan>.xml

|-- <MeasurementDevicesLocalData>
```

Additional files in the subdirectory are ignored for rollout.



Set up the root directory of your device park in the "Rollout" tab of the options dialog (see Chapter 4.1.7, "Options", on page 24).

4.6.2 Rollout Plan view

Device Park		Sel	ect / Deselect All	Rollout Plan					
Test Station 🔻	Devices	T Nr Test Ports	▼ Use ▼	Test Station	▼ S	Server IP	▼ G	ienerated 🔻	
VNA24	[VNA,TCPIP::ZNrunZNBT3]	24		VNA2_Matrix24	1	27.0.0.1		2	ж
VNA2_Matrix24	[VNA,TCPIP::ZNrunZNB1] [Matrix001,127.0.0.1]	24	~	VNA4	1	27.0.0.1	F	2	x
VNA4	[VNA001,TCPIP::ZNrunZNBT1::hislip0]	4	~	VNA8	U	inknown	E C	2	х
VNA4_Matrix10	[VNA,TCPIP::ZNrunZNB1] [Matrix001,localhost]	10							
VNA8	[VNA,TCPIP::ZNrunZNBT1]	8	✓						
VNA8_Matrix16_16	[VNA,TCPIP::ZNrunZNBT1] [Matrix_1,localhost] [Matrix_2,localhost]	32							
ZNB4	[VNA,TCPIP::ZNrunZNB1]	4							
ZNBT24	[VNA001,TCPIP::ZNrunZNBT2]	24							
ZNBT24_ZNB4_VNA4	[VNA001,TCPIP::ZNrunZNBT1] [VNA002,TCPIP::ZNrunZNB1] [VNA003,TCPIP::ZNrunZNB2]	32							
Details									
/NA Devices Matrix E	Devices Calibration Unit Devices Calibr	ation Kit Devices Power N	leter Devices						
Name	т Туре т Р	Port Count T	Purpose	T Communication	Chanı 🔻	Resource	▼ Waitir	ng Time	
+ VNA	UNKNOWN 2			VISA		TCPIP::ZNrunZNB1	0		

Device Park section

The upper left part of the "Rollout Plan" presents the device park in tabular form, each test station identified by its configured "Test Station" name.

Device Park			Sel	ect / D	eselec	t A
Test Station 🔻	Devices	T	Nr Test Ports	T	Use	Ţ
VNA24	[VNA,TCPIP::ZNrunZNBT3]		24			
VNA2_Matrix24	[VNA,TCPIP::ZNrunZNB1] [Matrix001,127.0.0.1]		24		~	
VNA4	[VNA001,TCPIP::ZNrunZNBT1::hislip0]		4		\checkmark	
VNA4_Matrix10	[VNA,TCPIP::ZNrunZNB1] [Matrix001,localhost]		10			
VNA8	[VNA,TCPIP::ZNrunZNBT1]		8		\checkmark	
VNA8_Matrix16_16	[VNA,TCPIP::ZNrunZNBT1] [Matrix_1,localhost] [Matrix_2,localhost]		32			
ZNB4	[VNA,TCPIP::ZNrunZNB1]		4			
ZNBT24	[VNA001,TCPIP::ZNrunZNBT2]		24			
ZNBT24_ZNB4_VNA4	[VNA001,TCPIP::ZNrunZNBT1] [VNA002,TCPIP::ZNrunZNB1] [VNA003,TCPIP::ZNrunZNB2]		32			

For each test station, the corresponding table row displays:

- The constituent "Devices" (resource strings)
- The overall "Nr. of Test Ports" available for DUT connections

Tick the "Use" checkbox for those test stations, to which you want to roll out the master MEU.



A test station that does not offer sufficient test ports for the master MEU is grayed out and cannot be used for rollout.

When you select a test station, the "Details" view provides more details:

Deta											
VNA	Devices	Matrix Devices	Calibration Unit Devices	Calibration Kit Devices	Power Meter Devices						
	Name		🛚 Туре	▼ Port Count	▼ Purpose	•	Communication Chani	Resource	T	Waiting Time	T
+	VNA		UNKNOWN	2			VISA	TCPIP::ZNrunZNB1		0	

Rollout Plan section

The test stations selected for "Use" in the Device Park section are transferred to the "Rollout Plan" section in upper right part of the "Rollout Plan" view.

Rollout Plan					
Test Station	٣	Server IP	T	Generated '	T
VNA2_Matrix24		127.0.0.1			x
VNA4		127.0.0.1			x
VNA8		unknown		1	ж

For each test station, enter the IP address of the ZNrun Server to be used for rollout ("Server IP"). Then click the "Generate projects" button in the main tool bar (see Table 4-4).

A generated MEU comprises all components of the master MEU, except for any measurement devices and their local data, which are read from the used test station.

Manual changes to generated MEUs

At that point, you can apply manual changes to the generated MEUs. Manual changes can be necessary to adjust individual test stations (e. g. to set up de-/embedding) or the connection plan.

Edit the project files manually or in the ZNrun Workbench, or run a script to perform the necessary changes.

Repeated MEU generation

If you have modified your master MEU or the test stations in your device park, you have to regenerate the MEUs. Toggle the "Overwrite" button in the main tool bar to allow formerly generated MEUs to be overwritten (see Table 4-4).

Note that MEU regeneration also overwrites any manual changes applied to the formerly generated MEUs.

4.6.3 Rollout Status view

When your generated measurement execution units are ready for rollout, open the "Rollout Status" view.

Rollout Status						×
Select / D	Deselect All					
Roll Out 🔻	Generated MEU	▼ Server IP	▼ State	T	Message Lines 🔻	Primary Message T
	ZNrun_Test_Config_VNA2_Matrix24	127.0.0.1				
	ZNrun_Test_Config_VNA4	127.0.0.1	×	\times	81	MeasurementDevices: At least one matrix state must be available. Perform calibration to fix it!
\checkmark	ZNrun_Test_Config_VNA8	unknown	×		2	SocketException: Der angegebene Host ist unbekannt
Details Messages	ted MEU					
	Test_Config_VNA4					
Stimu	ings: urementDevices: At least one matrix state IlusPortGroupMeasurement (SPM_PowerC IlusPortGroupMeasurement (SPM1 Spara)	OnDummy_0_0) requires a	new matrix state			

For each "Generated MEU" that you want to roll out right now, tick the "Roll Out" checkbox in the respective column. Then click the "Roll out" button in the main tool bar (see Table 4-4).

The rollout process starts and for each selected "Generated MEU" the "State" column indicates the rollout progress. A connection plan generated by the respective ZNrun Server can be downloaded using the "Connections" icon.

The ZNrun Workbench collects the messages received from the related ZNrun Servers. The "Rollout Status" view displays the number of "Message Lines" collected, and a "Primary Message". When you select a generated MEU, the "Details" view presents all messages.

You can repeat rollout for the same or a different selection of generated MEUs. The "Rollout Status" view reflects the status for all the rollouts performed during the current rollout session.

Rollout status log

You can log the rollout status of the current session to a file, according to your options (see Chapter 4.1.7, "Options", on page 24). Click the "Log rollout status" button in the main tool bar (see Table 4-4).

5 ZNrun Calibration Client

R&S ZNrun comes with a graphical calibration client that can be accessed via the Windows Start menu item "R&S ZNrun [version]" > "ZNrun Calibration Client".

The calibration client has a simple user interface suitable for guiding a technician through all the steps of the calibration process. For laboratory use, it offers a more advanced interface which allows the definition of user-defined calibration tasks.

(i)

Protected R&S ZNrun-K4xx projects can only be calibrated from the ZNrun Cable Test Client or ZNrun Workbench.

5.1 Calibration modes

The ZNrun Calibration Client offers 4 different calibration modes:

DUT-related calibration

The required calibration tasks are derived from an existing DUTMeasurementPlan, i.e. the calibration fits exactly to the measurement requirements of a particular DUT (stimuli, test ports, states of matrix and switches). Every measurement parameter in the DUTMeasurementPlan is calibrated exactly without interpolation, which is the preferred option if a fast and accurate calibration is desired.

Depending on the individual measurement steps, this option can lead to individual calibrations for every measurement step.

• Generic calibration

Creates a multi-purpose calibration for a set of test ports, based on user-defined calibration stimuli settings. The intention is to use a common calibration for multiple DUTs and test ports without the need to recalibrate. Make sure to define a sufficient frequency range to prevent uncalibrated traces.

In contrast to DUT-related calibration, a generic calibration usually results in interpolated calibrations for a given DUTMeasurementPlan.

If switch matrices are involved, only a subset of the possible matrix routes is calibrated, compromising between calibration effort/time and application benefit.

• Full calibration

Similar to generic calibration, but with every possible switch matrix route being calibrated. This calibration mode enables full flexibility of test port usage.

• User-defined calibration

Allows the creation of any calibration or recalibration. The three calibration modes described above can serve as starting points, but you can even define custom calibrations based on a single calibration standard (Open, Short, Match, Through ...).

Depending on how matrix devices are controlled, there are restrictions while combining test ports into groups simultaneously used by measurement or calibration.

Partial port group calibration (default) – matrix directly controlled by ZNrun Server

The test ports are divided into groups whose size is equal to the number of used matrix VNA ports, and for whom routes between the related matrix test ports and matrix VNA ports exist. All such port combinations are calibrated. Transmission measurements between two ports are then restricted to the combinations covered in the partial port group calibration. This mechanism can be used with all supported VNAs.

Full port group calibration – matrix directly controlled by VNA

All possible groups of test ports, whose size is equal to the number of used matrix VNA ports and for whom routes between the related matrix test ports and matrix VNA ports exist, are fully calibrated. You can then measure transmission parameters between each pair of test ports without restriction. The downside is an increased calibration time, because the number of calibration procedures can be large. This mechanism can be used for VNAs whose firmware supports matrix control.

5.2 Deployment

The ZNrun Calibration Client offers two different modes of operation:

- Calibration step mode: execution of the actual calibration process in a step-bystep manner
- **Calibration task mode**: configuration of user-defined calibration tasks which can be executed in the calibration step mode afterwards

The operation mode of the calibration client can be controlled via command-line arguments.

By default the ZNrun Calibration Client connects to a ZNrun Server running on the same machine and conducts a generic calibration (see Chapter 5.1, "Calibration modes", on page 69) in calibration step mode.

5.3 Command line interface

The ZNrun Calibration Client can be parameterized using a shortcut link or directly via the Windows command prompt.

Command line interface

ZNrun Calibration Client	
ROHDE&SCHWARZ	
Commandline Usage:	
-i IP_ADDRESS,ip=IP_ADDRESS	(Default: localhost) IP address of the ZNrun server.
-c COVERAGE,coverage=COVERAGE	(Default: GENERIC_CALIBRATION) DUT_RELATED_CALIBRATION GENERIC_CALIBRATION USER_DEFINED_CALIBRATION FULL_CALIBRATION
-1 NAME,load=NAME	Load Measurement Execution Unit 'NAME'. Already existing units will be re-loaded.
check=VERSION	Check that the loaded Measurement Execution Unit has correct 'VERSION'.
-u NAME,use=NAME	Use existing Measurement Execution Unit 'NAME'.
-e,edit	Start in edit mode for user defined calibration.
noautoconnect	Do not connect to single Measurement Execution Units automatically.
noconnectiontest	Do not test cable connections before calibrating.
help	Display this help screen.
Cle	ose Application

Figure 5-1: Help screen of the ZNrun Calibration Client

The help screen is displayed on erroneous command-line arguments or if the '--help' parameter is used. It offers text selection and copy to clipboard [CTRL]+[C] functionality.

Command-line examples

ZNrunCalibrationClient.exe --ip=192.168.1.42 --load="DUT3425" -c DUT RELATED CALIBRATION

- Connect to the ZNrun Server running at IP address 192.168.1.42
- Create, load and use a MEU named DUT3425
- Conduct a DUT-related calibration in step-by-step mode

ZNrunCalibrationClient.exe --ip=192.168.1.42 --noautoconnect
--edit

- Connect to the ZNrun Server running at IP address 192.168.1.42.
- Do not connect to a MEU that is already loaded. Instead, the ZNrun Calibration Client presents a dialog that lets you choose the MEU to load or connect to.
- Start in calibration task mode.

```
ZNrunCalibrationClient.exe --load="DUT3425" --check="v 2.0"
--edit
```

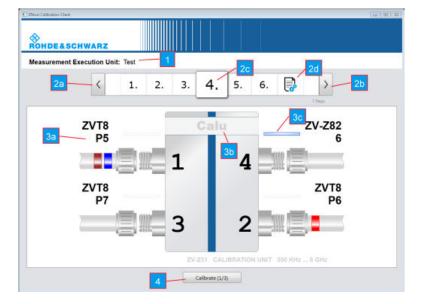
- Connect to ZNrun Server running on the same machine
- Create, load and use a MEU named DUT3425
- Make sure that the loaded version was saved under version v 2.0 and that its content was not modified.
- Start in calibration task mode.

Note that you have to use quotation signs if a command line argument contains white-space characters (e.g. "v 2.0").

5.4 Execution of calibration steps

The GUI in calibration step mode is separated into two major parts:

- List of calibration steps
- Connection scheme of the current calibration step



- 1 = Name of the MEU
- 2 = List of calibration steps
- 2a = Step backward
- 2b = Step forward
- 2c = Current calibration step
- 3 = Connection scheme of the current calibration step

- 3a = Graphical representation of connecting instruction
- 3b = Unique name of the calibration device
- 3c = Changed indicator modified connection related to the previous step
- 4 = Perform calibration step

Keyboard shortcuts can be used to navigate through the list of calibration steps and to trigger calibration step procedures.

Table 5-1: ZNrun Calibration Client: Keyboard shortcuts

Keyboard shortcut	Related user control	Description
$\leftarrow or \downarrow$	2a	Step forward through the list of calibration steps
\rightarrow or \uparrow	2b	Step backward through the list of calibration steps
Pos1	-	Go to the beginning of the list
End	-	Go to the end of the list
Enter	3b	Perform calibration of current step

5.5 Representation of the calibration devices

The connection scheme shows a graphical representation of the calibration unit/kit and how cables have to be connected to the measurement devices.

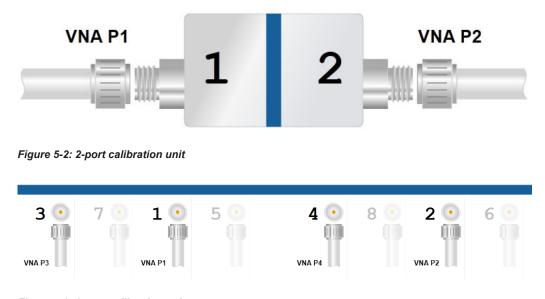


Figure 5-3: 8-port calibration unit

Cables can be marked with user-defined names and up to three colors. Once you have connected all cables, press the calibration button. A symbol in the upper right corner of each calibration step represents the result of the calibration procedure. If successful, a green check mark is displayed. An exclamation mark in a yellow triangle represents an error. In addition, a tooltip provides further information about the result.

If a calibration step was successfully executed, the dialog automatically proceeds to the next calibration step. Cable connections that have to be changed are marked with a blue "change indicator". For example, in Calibration using a calibration unit: step 1 successfully executed four of eight connections have to be changed before the step can be executed.

Before performing the calibration step, the application runs an automatic connection test. If an invalid or missing connection is detected, this connection is marked with a blinking red color mark and the calibration is canceled. For example, in Calibration using a calibration unit: wrong connection in step 2 the connection between calibration unit port 6 and measurement test port "ZV-Z82 4" is invalid.



Figure 5-4: Calibration using a calibration unit: before step 1

Clean Client	
ZNrun Calibration - EpcosDemo	DhneSP2T
<	1. 2. 3. A stops
Calu	ZV-Z58 CALIBRATION UNIT 300 kHz 8 GHz
3 • 7 • ZVTB P5 ZVTB P5 ZVTB P5 ZVTB P5	1 5 6 4 8 2 6 6 TB P7 ZVTE P8 ZV-282 9 ZV-282 3 ZV-282 4
	Calibrate

Figure 5-5: Calibration using a calibration unit: step 1 successfully executed

Calibration summary



Figure 5-6: Calibration using a calibration unit: wrong connection in step 2

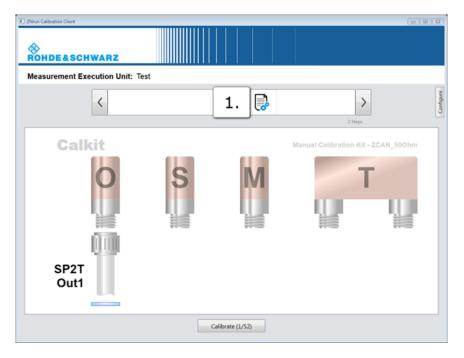


Figure 5-7: Calibration using a calibration kit

5.6 Calibration summary

The final "step" of the calibration procedure is an auto-generated "Calibration Summary". It lists the preceding calibration steps, together with their result (pass/fail) and an "Error Hint" for failed steps.

<		1. ⁴ Calibration Summary	2 Step
	Result	Error Hint	



The previously existing calibration report functionality was removed in R&S ZNrun version 2.90.

6 ZNrun Measurement Client

The R&S ZNrun installer comes with a measurement execution client implementation that can be accessed via the Windows Start menu item "R&S ZNrun [version] > ZNrun Measurement Client".

The ZNrun Measurement Client provides a clean and simple graphical user interface which allows to control the execution of a pre-configured

MeasurementExecutionUnit. In addition it provides a remote control interface that allows to control the measurement execution via SCPI commands. A plug-in interface enables user-defined extensions such as the creation of custom log files and reports.

ZNuu Massurement Client		
Measurement Execution Unit: FEM_D	UT	
88:88.809	FEM_DUT_#623478278	
	D224 FEM_DUT_#023/10271 0 1222.0 FEM_DUT_#023/10276 0 1222.40 FEM_DUT_#023/10276 0 1222.40 FEM_DUT_#023/10276 0 1222.41 FEM_DUT_#023/10276 0 1222.41 FEM_DUT_#023/10276 0 1222.41 FEM_DUT_#023/10276 0 1222.41 FEM_DUT_#023/10276 0 1222.31 FEM_DUT_#023/10276 0 1222.21 FEM_DUT_#023/10276 0 1222.21 FEM_DUT_#023/10276 0 1222.22 FEM_DUT_#023/10276 0 1222.21 FEM_DUT_#023/10276 0 1222.22 FEM_DUT_#023/10276 0 1222.22 FEM_DUT_#023/10276 0 1222.22 FEM_DUT_#023/10276 0 1222.22 FEM_DUT_#023/10276 0 1222.20 FEM_DUT_#023/10276 0 1222.20 FEM_DUT_#023/10276 0 1222.20 FEM_DUT_#023/10276 0	Messurement Steps
XELD	80 % 100 % 1	

Figure 6-1: ZNrun Measurement Client

6.1 Basic functions

The "Load Measurement Execution Unit Setup" allows to re-/load a Measurement Execution Unit. Re-/loading a Measurement Execution Unit re-/initializes the related measurement devices.

The Measurement Steps of the Measurement Cycle defined by the Measurement Execution Unit are displayed as table rows. The table columns represent the Measurement Step name, "Next" and "Disabled?" switches (see Advanced features), and the path to the "File" where the results of the Measurement Step shall be stored.

A spinner control allows to specify the number *n* of Measurement Cycles to be executed.

The "Start / Continue", "Pause" and "Stop" buttons allow a basic control of the Measurement Cycle execution. When the "Start" button is pressed, the client executes the Measurement Cycle *n* times or until the "Pause" or "Stop" button is pressed. "Continue" resumes a paused execution.

The stop watch allows to measure the execution time.

Errors that occur during the loading or execution phase are shown in status row on the bottom of the dialog. If an error occurs during the execution of a particular MeasurementStep, this step is marked in red. In addition, a tooltip shows the error text.

6.2 Advanced features

In addition to the Basic functions described above, the ZNrun Measurement Client offers advanced functionality to control the execution of MeasurementCycles. These functions are:

- Stepwise Execution
- Breakpoints at Measurement Steps
- Disabled Measurement Steps

Measurement Steps can be executed step by step. To initiate this mode, press "Step" button or set a breakpoint at that Measurement Step and press "Start" button. If a Measurement Cycle is paused at a breakpoint, the execution can be resumed by using "Step" or "Continue" button. Breakpoints are set by a mouse click on "Next" column of a MeasurementStep in the list view. A red dot in "Next" column represents an active breakpoint. A blue arrow shows the Measurement Step to be executed next when the "Step" button is pressed.

Measurement Steps can be disabled by activating the checkbox in the "Disabled?" column.

7 ZNrun Cable Test Client

As an alternative to the general purpose ZNrun Workbench or ZNrun Measurement Client, you can use the ZNrun Cable Test Client to perform cable tests. To get them running, you need the following:

- A workstation (a PC or a VNA)
- A full ZNrun installation on that workstation, including the ZNrun Server and the ZNrun Cable Test Client
- A license to run the ZNrun Server on that workstation
- Previously created (compressed) *.znrun projects for cable tests
- Test devices, such as a VNA (and switch matrices, where appropriate)
- A calibration device, such as a calibration unit or a calibration kit

7.1 ZNrun projects for cable tests

The ZNrun Workbench can generate compressed *.znrun projects for subsequent execution in the ZNrun Cable Test Client.

The purpose of such a project is to **test a particular cable type on a defined set of test devices** (VNA, switch matrix). It defines the type of VNA to be used and the number of test ports it has to provide. It also defines whether switch matrices are required, together with their type and equipping.

The intention is to define a so-called MOI (method of implementation) for cable testing:

- 1. The measurement steps the ZNrun Server performs.
- The measurement data the ZNrun Server collects and evaluates.
- 3. The cable test results the ZNrun Server reports.

With options R&S ZNrun-K4xx, Rohde & Schwarz provides predefined projects for cable tests according to various communication standards. See Chapter 7.3, "Compliance test automation", on page 91. Since R&S ZNRUN V2.90 these projects are automatically installed with the ZNrun Cable Test Client.



Since R&S ZNRUN V2.90, the predefined MOI projects are read-only.

To modify such a project, open it in the ZNrun Workbench, make your changes, and save it to a different location. Or copy the project to a different location and remove the read-only flag before opening it in the ZNrun Workbench.

7.2 Graphical user interface

If selected during R&S ZNrun installation, the ZNrun Cable Test Client can be accessed via the Windows "Start" menu item "R&S ZNrun <version>" > "ZNrun Cable Test Client".

First start-up

When you start the ZNrun Cable Test Client for the first time, it appears as follows:

Setup Calibrate Measure 1 - Master Project Cable Tes Cable Tes V Browse Project Description		\times
V Browse		
Logical Por		
Test Case Postprocess		
2 Measurement F	Parar	ms
3		
Message Log		
Type 🔻 Message		٣
4		

- 1 = navigation panel
- 2 = work area (phase dependent)
- 3 = setting selection ("Setup" phase)
- 4 = log panel

The navigation panel indicates the current test phase: "Setup" (initial), "Calibrate" or "Measure". Use the corresponding buttons to switch from one phase to another.

Once you have selected a ZNrun cable test project and have set up your test station, you can switch from "Setup" to "Calibrate" or "Measure". From that point on, you can arbitrarily switch between the three phases.



When you switch to "Calibrate" or "Measure", the ZNrun Cable Test Client attempts to run the ZNrun Server on the same machine. Make sure that the ZNrun license is available.

Subsequent start-ups

The next time you start up the ZNrun Cable Test Client, it will restore the previous Cable Test > Master Project and test station configuration from the user-specific cable client settings. You can immediately proceed to Calibrate or Measure, as you like.

User-specific client settings

User-specific ZNrun Cable Test Client settings are stored in subdirectories Rohde-Schwarz\ZNrunCableTestClient.exe_Url_<URL>\ of your %LOCALAPPDATA% directory (typically C:\Users\<username>\AppData\Local\).

Quit

If no calibration or measurement is running, you can quit the ZNrun Cable Test Client by closing its application window.

7.2.1 Setup

When the ZNrun Cable Test Client starts up for the first time, there are no preconfigured folders to search for *.znrun files. Click the "Browse..." button to browse to a folder containing ZNrun cable test projects on your workstation.

Cable Test > Master Project

After you have selected a folder, the upper combo box displays its path, and the lower combo box is populated with the ZNrun projects in this folder. From the latter, select the cable test project you want to work with (the "Master Project").

Master Project		
C:\ProgramData\Rohde-Schwarz\ZNrun\2.9x\Resources\MOI\ieee-802-3\IEEE8023ck\800GBASE-CR8	~	Browse
ZNA50-OSP320-48port		^
ZNA50-OSP320-48port		
ZNB43-OSP320-48port		

Cable Test > Supported Communication Standard + Test Station

After selecting the master project, and "Cable Test" on the right, the work area displays:

- The communication standard the selected project covers (encrypted R&S ZNrun-K4xx projects)
- The devices that are specified in this project (the "Test Station")

Graphical user interface

						Cable Te
C:\ProgramData\Roho	de-Schwarz\ZNrun\2.9x.8	Beta\Resources\MOI\i	eee-802-3\IEEE8023ck\8	00GBAS 🗸	Browse	
ZNA50-OSP320-48po	rt				~	
Supported Comn	nunication Standar	rd				
Specification	Link Speed [Gb/s]	Symbol Rate [Gbaud/s]	Medium Type	TX Lanes		
IEEE 802.3ck-2022 Clause 162	800	53.125	Cable	8		
teres Charles						
Test Station ——						
Device	Туре	Test Ports	Communication Cha	nnel I	Resource	
	Type ZNA	Test Ports 4	Communication Cha		Resource CPIP::172.16.0.1	
Device VNA				1		
Device	ZNA	4	VISA	/IA_LAN	CPIP::172.16.0.1	

Verify that your test equipment matches the specification:

- For the VNA, the *recommended* type is preselected. You can use a different instrument than the recommended one ("Type": "Other"), e.g. you can use a R&S ZNA or R&S ZNBT instead of a R&S ZNB. Make sure, however, that the "Other" VNA covers the frequency range required for the selected cable test, and that it has at least as many test ports as the default the listed number of test ports.
- The switch matrices must have exactly the specified types.

Refer to the R&S ZNrun-K4xx documentation, for the R&S OSP320 based matrix types and their setup.

Now personalize the test station:

- 1. For the VNA, enter the VISA resource string (or at least the IP address).
- 2. For the switch matrix (if used), select the communication channel and enter:
 - a) The VISA resource string (or at least the IP address) if VISA communication is used
 - b) The USB resource string if the switch matrix is connected via USB
- Select whether you use a calibration unit or a calibration kit.

CalibrationUnit	^
CalibrationUnit	
CalibrationKit	

- a) For a calibration unit, select "Any" if only one is connected to your VNA or if it does not matter which one is used. Otherwise select its type and enter its USB resource string.
- b) For a calibration kit, select its type.

To check that everything is set up correctly, try to switch to "Calibrate" and then to "Measure".

Setup	Calibrate	Measure
Setup	Calibrate	Measure
Setup	Calibrate	Measure



Connections between VNA and switch matrix

If the loaded cable test project uses switch matrices, make sure that IP connections between ZNrun Server, VNA and switch matrices can be established.

Switch to the Measure phase to view the master project's Connection plan in your workstation's PDF file viewer. Establish the RF connections between the VNA and the switch matrices as displayed in the connection plan.

Watch out for messages displayed in the "Message Log".

Logical Ports

In the "Logical Ports" panel, you can de-embed the test fixtures and specify the balanced reference impedances of the links (cable + test fixtures).

For R&S ZNrun-K41x projects, you can specify:

- Deembedding settings for the RX and for the TX side, which apply to all balanced RX and TX ports, respectively
- Reference impedances for the common and the differential mode, which apply to *all* balanced ports

ogical Port De	faults			
	DE-/EMBEDDIN	G		
Port	Usage	Touchstone File	Interchange Mode	Logical Ports
Fixture RX side	Deembedding	🗋 Select a file	$ \begin{array}{c} $	
Fixture TX side	Deembedding		1 2 3 4 Standard	
COMMON REFERENCE IMP	PEDANCE	DIFFERENTIA REFERENCE I		
real [Ω]	imag [Ω]	real [Ω]	imag [Ω]	
25	0	100	0	

Figure 7-1: Logical Ports configuration R&S ZNRUN-K41x

For R&S ZNrun-K440 projects, you can specify *default* deembedding and reference impedance settings. Whenever you modify such a default setting, it is applied to *all*

related balanced logical ports. However, it is also possible to overwrite these settings for individual TX and RX ports.

Logical Port Defaults —				
	DE-/EMBEDDING			
Port	Usage	Touchstone File		Interchange Mode
Fixture left	Deembedding			1 2 3 4 Standard
Fixture right	Deembedding			1 2 3 4 Standard
COMMON			DIFFERENTIAL	
REFERENCE IMPEDANCE			REFERENCE IMPEDANCE	
real [Ω]	imag [Ω]	r	real [Ω]	imag [Ω]
21.25	0	8	85	0

Logical Ports Configuration

		DE-/EMBED	DIN	G			COMMON		IPEDANCE				IPEDANCE	
Port	٣	Usage	T	Touchstone File	٣	Interchange Mode	real [Ω]	٣	imag [Ω]	۲	real [Ω]	۲	imag [Ω]	۲
TX0_L		Deembedding				$\begin{array}{c} 1 \\ 1 \\ 3 \\ 3 \end{array}$	21.25		0		85		0	
TX0_R		Deembedding				$\begin{array}{c} 1 \\ 2 \\ 3 \\ 3 \end{array}$	21.25		0		85		0	
TX1_L		Deembedding				$\begin{array}{c} \bullet \\ \bullet \\ \bullet \\ 3 \end{array} \begin{array}{c} 1 \\ \bullet \\ 3 \end{array} \begin{array}{c} 2 \\ \bullet \\ \bullet \\ \end{array} \begin{array}{c} \bullet \\ \bullet $	21.25		0		85		0	
TV4 D		N 1 10				⊷ 1 2 → ,	21.25		^		05		^	

Figure 7-2: Logical ports configuration R&S ZNRUN-K440

• At this point, only s4p Touchstone files can be used for dembedding. Circuit models are not supported.

To create these deembedding files, we recommend using the deembedding assistant of the VNA firmware.

- The overwritten settings are persisted in the user-specific cable client settings.
- For R&S ZNrun-K41x tests, deembedding is not required, but for R&S ZNrun-K440 tests it is recommended.
- For PCIe 5.0 and 6.0 cables (R&S ZNRUN-K440), the limits defined in the specification are based on a differential reference impedance of 85 Ω.

Test Case Selection

In the "Test Cases" panel, you can define:

- The test cases that you want to run during the measurement phase.
- For each test case, the aggressor (TX) lanes to be driven for the measured victim (RX) lane
- The evaluations and exports to be performed
- Whether a report shall be generated

Graphical user interface

RX Lane	٣	Test Case	٣	Execute	T	TX Lanes	T	
		THRU / SKEW / TDR				1		
1		NEXT				1,2,3,4		
		FEXT				2,3,4		Test Cases
						2		
•••••	••••	•••••	•••	• • • • • • • • •	• • • • •	•••••	•••••	
•••••	••••	THROT SKEWT TOK	•••		••••	•••••	•••••	
4		NEXT	•••	$\overline{}$	••••	- 1,2,3,4	•••••	
4	•••••		•••		••••		•••••	
4	••••	NEXT	•••		••••	1,2,3,4		
4	••••	NEXT FEXT	•••			1,2,3,4		

Figure 7-3: Test case selection for R&S ZNrun-K41x projects (IEEE 802.3)

Deselecting THRU/SKEW/TDR, NEXT and FEXT test cases reduces the number of setups to be generated and the number of measurements to be performed on the VNA. Hence, it can significantly reduce the preparation and measurement time of the cable test.

The evaluation/calculation and export parts can consist of multiple items, which can be de-/selected individually:

Test Case	T	Execute	T
Calculate psNEXT (L)			
Calculate psNEXT (R)			
Calculate psFEXT (L)			
Calculate psFEXT (R)			
Calculate psXT (L)			
Calculate psXT (R)			
Calculate ccICNNEXT (L)			
Calculate ccICNNEXT (R)			
Calculate ccICNFEXT (L)			
Calculate ccICNFEXT (R)			
Calculate iRL (L)			
Calculate iRL (R)			
Calculate EIPS (L)			
Calculate EIPS (R)			
Calculate EPPS (L)			
Calculate EPPS (R)			
Touchstone Export THRU / NEXT / FEX	т		
Trace Export THRU / NEXT / FEXT			
Trace Export psNEXT / psFEXT / psXT			
Results Export iRL / ccICN / EIPS / EPP	s		

Figure 7-4: Evaluation and export selection for R&S ZNrun-K440 projects (PCle)

Your selection is persisted in the user-specific cable client settings.

Q

At the end of each measurement, the selected results (exports, report) are saved to a subdirectory <code>ZNrun\<MOI name>\<Timestamp></code> of your user documents directory (typically <code>C:\Users\<username>\Documents\)</code>.

Postprocessing

Some of the encrypted R&S ZNrun-K4xx projects allow you to specify the tools and their parameters that are used to postprocess the measured data:

 COM Configuration		
COM Executable	Configuration File	Postprocessing
com_ieee8023_93a.exe	100GBASE-CR4.xlsx	Postprocessing

Figure 7-5: Postprocessing for R&S ZNrun-K41x projects (IEEE 802.3)

E.g., for the IEEE 802.3 standard compliance tests of R&S ZNrun-K41x, you can select the IEEE COM executable and its configuration file. See the R&S ZNrun-K4xx manual.

Ç

Modified postprocessing settings are persisted in the selected master project.

Measurement Params

The "Measurement Params" panel allows you to adjust the stimuli and limit lines of the encrypted R&S ZNrun-K4xx projects according to your preferences.

Measurement Parameters -		
Measurement Parameters	Edit	
Stimuli		Measurement Params
Limit Lines		Measurement Parants
Edit In ZNrunWorkbench		

After selecting "Stimuli" or "Limit Lines", you can click the "Edit in ZNrun Workbench" button to run the workbench app and open the corresponding workspaces.

DUT Center	Measurement P	aths Stimuli	Limit Lines				×
₩ E							+
Measurement Cycle Measurement	Name		۲	7 Туре		T	
	SDD21_limit			Segment			×
THRU_L1_RX1A_L2_TX1B_SDD21_path	SDD11_limit			Segment			x
THRU_L1_RX1A_L2_TX1B_SDD11_path THRU_L1_RX1A_L2_TX1B_SDD22_path	SDD22_limit			Segment			x
THRU_L1_RX1A_L2_TX1B_SCD11_path THRU_L1_RX1A_L2_TX1B_SCD22_path	SCD11_limit			Segment			×
THRU_L1_RX1A_L2_TX1B_SCD21_path THRU_L1_RX1A_L2_TX1B_SCC11_path THRU_L1_RX1A_L2_TX1B_SCC22_path	SCD22_limit			Segment			x
NEXT_L1_RX1A_L2_TX1A NEXT_L1_RX1A_L2_TX1A	Details						
NEXT_L1_RX1A_L2_TX1A_SDD21_path NEXT_L1_RX1A_L2_TX1A_SDD11_path	Limit Lines						
NEXT_L1_RX1A_L2_TX1A_SDD22_path	Name	Туре	Segment	Is Enabled	Start Stimulus	Stop Stimulus	Star
NEXT_L1_RX1A_L2_TX2A NEXT_L1_RX1A_L2_TX2A SDD21_path	SDD21_limit	Segment	Formula	Yes	5000000	1900000000	defa
NEXT_L1_RX1A_L2_TX2A_SDD11_path NEXT_L1_RX1A_L2_TX2A_SDD11_path NEXT_L1_RX1A_L2_TX2A_SDD22_path			Linear	Yes	12890000000	12890000000	-22,4



Modified measurement parameters are persisted in the selected master project.

- Since V2.90, the predefined R&S ZNRUN-K4xx MOI projects are **read-only**. Hence you cannot edit the "Measurement Params" of such a project.
- To modify such a project, open it in the ZNrun Workbench, make your changes and save the project to a different location.
 Or copy the original project to a different location and remove the read-only flag before opening it in the ZNrun Cable Test Client or ZNrun Workbench.
 Then select the new project as the "Master Project" (instead of the original one).

7.2.2 Calibrate

During this phase, the ZNrun Cable Test Client sets up a DUT-related calibration for the current cable test project. For more information, refer to Chapter 5.1, "Calibration modes", on page 69. The setup uses the calibration device that you specified in the Setup phase.

	Setup	Calibrate	Measure
Calibrate —	<	1. 2.	3. 4. >
	Matrix001 1 	CalUnit 1 2	Matrix001 2
		Calibrate (1/3)	

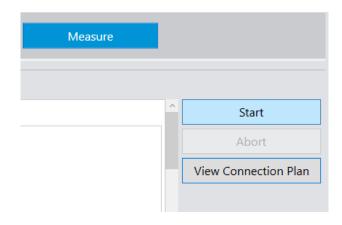
Follow the instructions and execute the calibration steps, as described in Chapter 5.4, "Execution of calibration steps", on page 72. When calibration has finished, you are ready to "Measure".



If you are using a different calibration device, the graphical representation possibly looks different than in the screenshot above. Refer to Chapter 5.5, "Representation of the calibration devices", on page 73.

7.2.3 Measure

In "Measure" phase, the ZNrun Cable Test Client displays all measurement steps of the current ZNrun cable test project. Put the cable under test into the cable fixture. Then click the "Start" button to run the test for that cable.

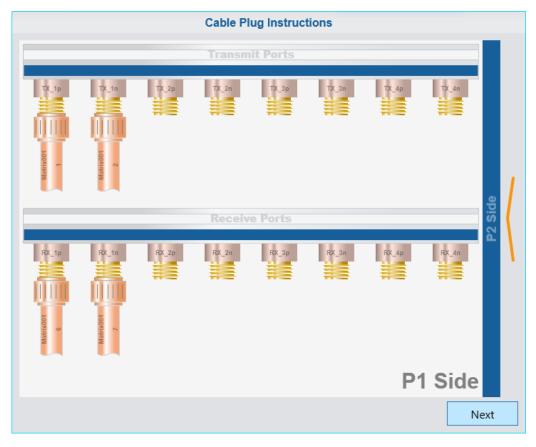


Plug instructions

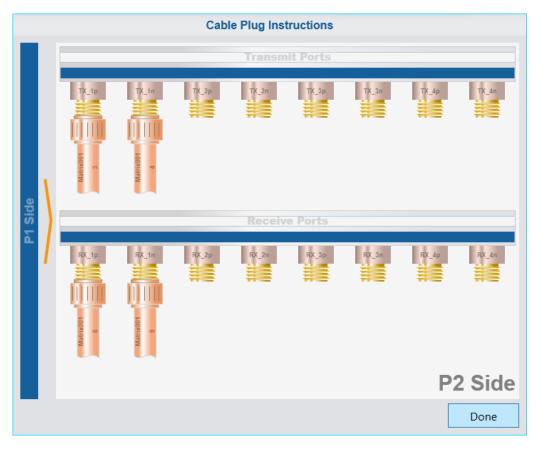
The ZNrun Cable Test Client displays cable plug instructions before running the first measurement step.

A ZNrun cable test project can run on measurement devices which have fewer test ports than the cable fixture. For example, it is possible to test a 32-port cable with a switch matrix with only 8 test ports. In that case, plug instructions are displayed even if only one cable is measured.

Follow these plug instructions for the 1st cable side, and connect the test ports on VNA or switch matrix to the cable fixture ports.



Click "Next" to display the plug instructions for the 2nd cable side and follow the plug instructions for the 2nd cable side.



Finally, click "Done" and start or continue to measure.

- Measure Cycle	
Measure	
Step_11	×
Step_15	×
Step_51	×
Step_55	×
Step_12	+
Step_16	
Step_52	
Char 66	

Execution state indicators

The measurement steps get one of the following marks:

~	Executed successfully
+	In progress
×	Error (see "Message Log")
~	Limit line violation

No calibration file indicator

This icon (and tooltip) indicates that no matching calibration file was found for this measurement step.

G	No Matching Calibration	File

Result files

The generated result files (exports, report, see Test Case Selection) are saved to a subdirectory ZNrun\<MOI name>\<Timestamp> of your user documents directory (typically C:\Users\<username>\Documents\).

7.3 Compliance test automation

Options R&S ZNrun-K4xx

Testing high-speed cable assemblies for data centers or consumer electronics, requires high frequencies and a multi-port setup. Characterizing the cable under test with a 4-port vector network analyzers is a time-consuming process: Executing different characterization tests for every lane (or combination of lanes) in a cable assembly, requires many cable reconnections, with many chances for human errors.

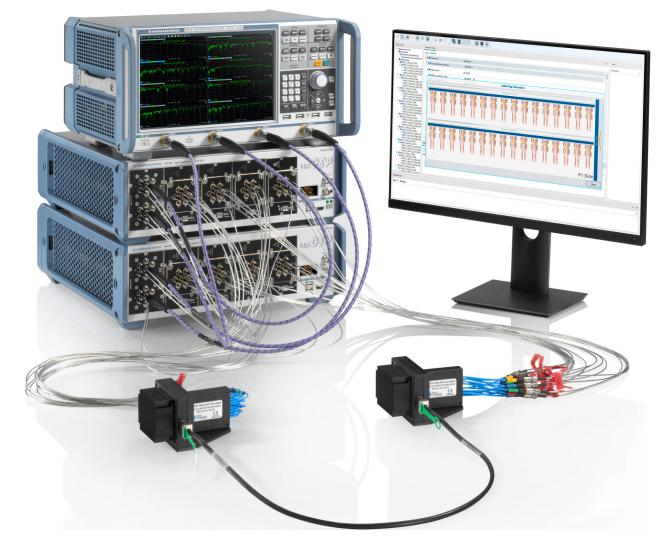
Options R&S ZNrun-K4xx enable precise and time-saving compliance tests of highspeed cable assemblies (and connectors), in line with the relevant standards. Each compliance test defines three simple steps for the test procedure: Setup, calibrate and measure. The automated measurement step is time-optimized and ensures reproducibility of results.

The multi-port setup, based on the R&S OSP open switch and control platform, enables up to 256 ports switching without manual port reconnection. This setup reduces the typical test time drastically. For example, the test time for a high-speed Ethernet cable with 8 lanes in line with IEEE 802.3cd, is reduced to one hour compared to one day with manual testing.



Starting with version 2.80, the ZNrun Server automatically configures the required R&S OSP paths when executing one of the predefined compliance test projects.

Compliance test automation



The implemented calibration algorithms are optimized for maximum speed and minimum number of reconnections. This optimization reduces user's effort and allows time saving. For example, the calibration of the 48-port setup for IEEE 802.3cd cables with 8 lanes, takes maximally 45 minutes instead of several hours. User guidance during calibration and measurement minimizes the risk of human error and increases the confidence in the test results.

For advanced users, the ZNrun Workbench offers an easy way to debug and verify the setup and DUT.

The full compliance test automatically executes all required measurement steps and post-processes the measured data according to the standard. It exports both raw and processed measurement data and generates a comprehensive test report, including the measurement results and the overall pass/fail verdict. The exported measurement data allow you to do further analysis and custom postprocessing.

For detailed information, refer to the R&S ZNrun-K4xx documentation.

Development and precompliance testing

Since R&S ZNrun V2.90 it is possible to select and configure the test cases to be executed. You can now customize the tests according to your needs for development purposes and precompliance testing.

7.4 Command-line interface

The main purpose of the ZNrun Cable Test Client command-line interface (CLI) is to test multiple cables in a production environment – with optimized speed and without unnecessary user interactions.

With GUI and CLI, when testing the first cable, the ZNrun Server and test station must be prepared. Depending on the complexity of the cable test project, the preparation takes a noticeable amount of time, so it should be executed only once. At the GUI, this is exactly what happens if you remain in the measurement stage and click the "Start" button multiple times.

Since R&S ZNrun V2.90, the ZNrun Cable Test Client CLI now also implements this logic.

For CLI operation, a console application CableTestConsole.exe is available in the ZNrun Calibration Client installation directory (typically

C:\Program Files\Rohde-Schwarz\ZNrun\<version>\CableTestClient). It provides:

- Error handling and feedback via error messages displayed in stdout/stderr
- Application logging
- A return code to report success or error

General syntax:

```
CableTestConsole.exe
<phase>
--file=<zipped ZNrun project archive>
[--setup=<setup parameters (XML)>]
[--testStation=<test station parameters (XML)>]
[--plugSpan=<timeout for cable reversion>]
```

Table 7-1: CableTestConsole.exe command-line parameters

<phase></phase>	prepareMeas measurement leaveMeas
file	Path to a zipped R&S ZNRUN project archive (*.znrun).
	Corresponds to the master project at the GUI.*
setup	Path to an XML file modifying the test setup defined in thefile project.
	Corresponds to the logical ports configuration and test case selection at the GUI.*
	The related XML schema CableTestSetupData.xsd can be found in the subdirectory CableTestClient\Schemas of the R&S ZNrun installation directory.

testStation	Path to an XML file modifying the test station defined in thefile project.
	Corresponds to the test station settings at the GUI.*
	The related XML schema CableTestStation.xsd can be found in the subdirectory CableTestClient\Schemas of the R&S ZNrun installation directory.
plugSpan	Defines the timeout of interactive cable flip requests (see "Plug instructions" on page 89). Positive integer, interpreted as seconds. The default is 10.
	Only relevant for the measurement phase, and only if cable flips are required.
* The CableTestConsole.exe d	oes not reuse the corresponding settings of the GUI client.

7.4.1 Measurement preparation

With CableTestConsole.exe prepareMeas ..., the CLI starts the ZNrun Server (if necessary), creates the MEU, and prepares the test station for performing a particular cable test. The MEU remains loaded.

Command-line call:

```
CableTestConsole.exe

prepareMeas

--file=<zipped ZNrun project archive>

[--setup=<setup parameters (XML)>]

[--testStation=<test station parameters (XML)>]
```

For a description of the parameters, see Table 7-1.



There is no need to run CableTestConsole.exe prepareMeas ... again, unless:

- Recalibration is required
- A different cable test shall be performed
- The ZNrun Server MEU was unloaded
- The test station was changed or must be reinitialized for some other reason

7.4.2 Measurements

With <code>CableTestConsole.exe</code> measurement \ldots , the CLI attaches to the loaded ZNrun Server MEU and executes it once. The MEU remains loaded.

Command-line call:

```
CableTestConsole.exe
measurement
--file=<zipped ZNrun project archive>
[--plugSpan=<timeout for cable reversion>]
```

For a description of the parameters, see Table 7-1.

 (\mathbf{i})

The ZNrun Server checks the referenced project against the running MEUs. If there is no match, execution results in an error.

7.4.3 Termination

CableTestConsole.exe leaveMeas ... unloads the related MEU, shuts down the ZNrun Server, and leaves the measurement phase.

```
CableTestConsole.exe
measurement
--file=<zipped ZNrun project archive>
```

For a description of the --file parameter, see Table 7-1.



The ZNrun Server checks the referenced project against the running MEUs. If there is no match, execution results in an error.

7.4.4 Calibration

Because calibration is an interactive process, it is not provided by the console application, but by the GUI client CableTest.exe, which is also located in the ZNrun Cable Test Client installation directory (typically

C:\Program Files\Rohde-Schwarz\ZNrun\<version>\CableTestClient).

To run the GUI client in calibration mode, execute the following command:

```
CableTest.exe
  calibrate
  --file=<zipped ZNrun project archive>
  [--setup=<setup parameters (XML)>]
  [--testStation=<test station parameters (XML)>]
```

For a description of the parameters, see Table 7-1.



CableTest.exe calibrate ... immediately enters the calibration mode. "Setup" and "Measurement" mode are not available.

Perform the calibration steps as described in Chapter 7.2.2, "Calibrate", on page 88. Then quit the application. Error reports and other feedback are provided via the "Message Log".

Requirements for this kind of calibration:

- Must be performed with the same stimuli as used during the related measurements
- Should be performed with the same --setup as later measurements
- Must be performed with the same --testStation as later measurements

Command-line interface

8 ZNrun Settings app

The ZNrun Settings app allows you to modify the settings of the ZNrun Server and certain client interactions.



Exit the server and all its connected clients before launching the ZNrun Settings app.

Access: Windows Start menu > "R&S ZNrun 2.9x" > "ZNrun Settings"

8.1 ZNrun Server configuration

ZNrun Server	ZNrun Server Configuration	
Measurement Client	Calibration Settings	
	Calibration timeout extension factor	1
	Disable measurement cycle controller events	
	Fetch Limit Lines (requires 'Limit Checks Only' unchecked)	✓
	Fetch whole S-Parameter matrix additionally to measurement parameters	
	Limit Checks Only	
	Max. allowed number of jammed Post Processing Cycles	10
	Max. depth of API Post Processing Queue	100
	Max. length of internal data history	1
	Network Settings	
	Retrieve Sweep-Time from VNA	~
	Touchstone Output Settings	
	Use VNA channels instead of setups	
	User Authentication Service	
	VISA timeout	60000

8.1.1 Calibration settings

When entering the measurement phase, the ZNrun Server automatically selects "suitable" calibrations of the related VNAs. To this end, the metadata of all calibration files created using this server instance are registered in the server-side *calibration results database*.

```
%PROGRAMDATA%\Rohde-Schwarz\ZNrun\<version>\
ZNrunCalibrationResults.xml.
```

Calibration selection is a two-step process.

- The ZNrun Server determines the applicable calibrations, i.e. those calibrations of the respective VNA that can be used for the related SPM.
 For example, such a calibration must cover a port group that contains the port groups of the SPM's measurement paths.
- The ZNrun Server applies the user-defined filtering and sorting (see "Filter & Sort Results by: / Then by:" on page 98).

 Calibration Settings 	
1. Filter & Sort Results by:	DATE_LATEST_FIRST ~
2. Then by:	STIMULUS_FULL_MATCH Y
3. Then by:	EXTENDED_ATTRIBUTES_MATCH *
4. Then by:	NONE Y
Enable maintenance of results database	\checkmark
Include Bandwidth in stimulus check	
Include Power in stimulus check	
PowerMeter Correction File Upload timeout	300000

The calibration results database only contains the *metadata* of the calibrations, not the calibration data themselves. A calibration can only be selected, if the corresponding calibration file is still available in the calibration pool of the related VNA. If not, an error message is generated.

Activate Enable maintenance of results database to keep the calibration results database in sync with the cal pools.

Filter & Sort Results by: / Then by:

Determines how the ZNrun Server selects a calibration from the calibration results database, when it runs a MEU.

1. Filter & Sort Results by:	FULL_MATCH	~
2. Then by:	STIMULUS_FULL_MATCH	~
3. Then by:	INTERPOLATED_FREQUENCY_GRID_MATCH	~
4. Then by:	DATE_LATEST_FIRST	*
	NONE	
	DATE_LATEST_FIRST	
	FULL_MATCH	
	STIMULUS_FULL_MATCH	
	INTERPOLATED_FREQUENCY_GRID_MATCH	
	EXTENDED_ATTRIBUTES_MATCH	

As filter & sort criteria 1, ..., 4 you can specify one of the following values:

FULL_ MATCH (filter criterion)	 A calibration gets the FULL_MATCH flag, if: It uses same stimulus settings as the designated measurement It was created with the same calibration-related "Common Parameters" (such as averaging and power meter deembedding) and "Additional Parameters" as the designated SPM. See Figure 4-29.
	To create such a calibration, perform a "DUT related calibration" with the ZNrun Calibration Client.
STIMULUS_ FULL_MATCH (filter criterion)	A calibration gets the STIMULUS_FULL_MATCH flag, if it uses the same stimu- lus settings as the designated measurement.
INTERPOLATED_ FREQUENCY_GRID_ MATCH (filter + sort criterion)	 A calibration gets the INTERPOLATED_FREQUENCY_GRID_MATCH flag, if: It does not get the FULL_MATCH or STIMULUS_FULL_MATCH flag It is based on a frequency sweep (linear, logarithmic, segmented) whose sweep range covers the sweep range of the designated SPM. It uses the same additional stimulus settings (power, bandwidth, selectivity, frequency sweep mode, settings as the designated SPM Among the matching calibrations, the ones with the highest point density are preferred. To create a multi-purpose calibration, which can be reused with interpolation, create a stimulus with "Purpose" USE_FOR_FULL_CALIBRATION, with a large frequency and a high number of sweep points. Then perform a "Full Calibration" with the ZNrun Calibration Client.
EXTENDED_ ATTRIBUTES_ MATCH (filter criterion)	A calibration gets the EXTENDED_ATTRIBUTES_MATCH flag, if it was created using the same calibration-related common and additional parameters as the designated SPM. This criterion is typically used to narrow a selection defined using the other MATCH criteria.
DATE_LATEST_FIRST (sort criterion)	Among the matching calibrations selected using the prioritized MATCHes above, prefer the latest one(s).
NONE	No (additional) filtering or sorting; ignored

Among the specified **filters**, the first MATCH in the list takes precedence, while subsequent ones are used for ranking. If no MATCH is found, the SPM is uncalibrated.

Example:

1. Filter & Sort Results by:	FULL_MATCH	~
2. Then by:	DATE_LATEST_FIRST	~
3. Then by:	NONE	~
4. Then by:	NONE	~

The selection logic only considers (applicable) calibrations with FULL_MATCH flag. Among those calibrations, the latest one is selected.

This configuration is the ZNrun Server default.

Example:

1. Filter & Sort Results by:	STIMULUS_FULL_MATCH	~
2. Then by:	INTERPOLATED_FREQUENCY_GRID_MATCH	~
3. Then by:	EXTENDED_ATTRIBUTES_MATCH	~
4. Then by:	DATE_LATEST_FIRST	¥

The selection logic only considers (applicable) calibrations with STIMU-LUS_FULL_MATCH, or INTERPOLATED_FREQUENCY_GRID_MATCH, or EXTEN-DED_ATTRIBUTES_MATCH, with descending preference.

If calibrations with INTERPOLATED_FREQUENCY_GRID_MATCH were found, only the ones with the highest point density are considered.

If calibrations with STIMULUS_FULL_MATCH or INTERPOLATED_FRE-QUENCY_GRID_MATCH were found, from the remaining calibrations, the ones with EXTENDED_ATTRIBUTES_MATCH are preferred, and the ZNrun Server uses the latest one.

Example:

1. Filter & Sort Results by:	DATE_LATEST_FIRST	~
2. Then by:	STIMULUS_FULL_MATCH	~
3. Then by:	INTERPOLATED_FREQUENCY_GRID_MATCH	~
4. Then by:	EXTENDED_ATTRIBUTES_MATCH	~

Among all applicable calibrations, the ZNrun Server selects the latest one. The other criteria only take effect, if there are several latest ones.

Using DATE_LATEST_FIRST as priority 1 is probably not what you want. Typically, it is used as the last criterion, below the MATCH criteria.

Example:

1. Filter & Sort Results by:	INTERPOLATED_FREQUENCY_GRID_MATCH	~
2. Then by:	DATE_LATEST_FIRST	~
3. Then by:	NONE	~
4. Then by:	NONE	~

The selection logic only considers INTERPOLATED_FREQUENCY_GRID_MATCH calibrations. Among the ones with highest point density, the latest one is selected.

This setting is convenient for lab work, where a general-purpose S-parameter calibration with large frequency span and a high number of points provides sufficient precision for most of your measurements.

Note that for an SPM with the same stimulus settings as the general-purpose calibration, the latter is a STIMULUS_FULL_MATCH, but not an INTERPOLATED_FRE-QUENCY_GRID_MATCH. Hence, with the above configuration, the ZNrun Server does not select the general-purpose calibration in this case. To catch this border case, give STIMULUS_FULL_MATCH priority 2:

1. Filter & Sort Results by:	INTERPOLATED_FREQUENCY_GRID_MATCH	~
2. Then by:	STIMULUS_FULL_MATCH	۷
3. Then by:	DATE_LATEST_FIRST	~
4. Then by:	NONE	~

Enable maintenance of results database

If "Enable maintenance of results database" is selected (default), the ZNrun Server keeps the *calibration results database* up to date. Before running a measurement on a VNA, the ZNrun Server checks whether the VNA's calibration pool still contains the calibration files registered for this VNA, and removes orphan calibration file registrations.

Tip: Deactivate this feature if the cleanup operations cause inadvertent side-effects on the VNA.

Include Bandwidth/Power in Stimulus Check

Up to version 2.80, the ZNrun Server did not check whether power and bandwidth settings used during calibration match the settings of the current stimuli.

With "Include Bandwidth in Stimulus Check"" and "Include Power in Stimulus Check" you can activate this additional power/bandwidth check. The selected checks apply to all filter stages and filter values.

Note: Including bandwidth and/or power, makes the selection logic of R&S ZNrun more restrictive than the one of the VNAs which does not consider bandwidth and power settings.

PowerMeter Correction File Upload timeout

Timeout value in milliseconds, default 300,000 (5 minutes).

Depending on the network speed, the transfer of a power meter correction file from the ZNrun Server to the VNA can take several minutes. Increase this value if you are experiencing timeout errors.

8.1.2 Other settings

Calibration Timeout Extension Factor

Default is 1.

If you are experiencing timeout errors during calibration, you can increase the extension factor to a value > 1 (default: 1). Usually it is not necessary to modify this value.

Fetch whole S-parameter matrix ...

If checked, then for each SPM the ZNrun Server reads the full S-parameter matrix of the involved DUT ports, in addition to the measured parameters. Plugins can access it via API.

Note: For this to work, either all S-parameters must be measured, or the SPMs must be calibrated (full n-port system error correction). Otherwise the ZNrun Server generates an error when entering the execution phase.

Use VNA channels instead of setups

If checked, SPMs are configured as channels rather than setups.

Speeds up the measurement if pipelining is used (R&S ZNB and R&S ZNBT with firmware \geq V3.20 only).

User Authentication Service

Limits the projects that can be run on the ZNrun Server to those projects that were last modified by a particular group of users.

You can maintain a newline-separated list of authenticated users in

C:\ProgramData\Rohde-Schwarz\ZNrun\<version>\ AuthenticatedUsers.txt

on the ZNrun Server.

Glossary: Frequently used terms

С

Configuration phase: State of a Measurement execution unit in which you can set, change or remove configuration data. It is not possible to calibrate devices or execute measurements in this state.

Connection plan: A connection plan describes the HF connections between the test ports of the Measurement devices and the measurement adapter carrying the DUT (DUT measurement plan). Formally, the ConnectionPlan data structure links a MeasurementDevices to a DUTMeasurementPlan.

D

DUT measurement plan: The DUTMeasurementPlan data structure describes the device under test (including the measurement adapter) and the parameters to be measured. It corresponds to a particular type of DUT and does **not** contain any information about the Measurement devices to be used.

Ε

Execution phase: State of a Measurement execution unit in which the measurements – described by the configuration data – can be run. In this state, the configuration data cannot be modified and is the basis for calculating the Measurement cycle. The measurement cycle can be steered using the IMeasurementControl interface.

Μ

Measurement cycle: Represents the measurement process which is calculated from the configuration data of the Measurement execution unit. The cycle consists of a sequence of Measurement steps. It is possible to label the cycle with a unique identifier which allows distinguishing successive cycles.

Measurement devices: The MeasurementDevices data structure describes a set of measurement devices that can be used to measure a DUT (vector network analyzers, switch matrices, calibration units). It includes information about the connections between VNAs and switch matrices, but does **not** contain any information about potential measurement objects and the parameters to be measured (see DUT measurement plan).

Measurement execution unit: A measurement execution unit represents a measuring task for a DUT with all measurement equipment and properties. Technically, it is an instance of IMeasurementExecutionUnit on the ZNrun Server, holding the three database components MeasurementDevices, DUTMeasurementPlan and ConnectionPlan (see Measurement devices, DUT measurement plan and Connection plan, respectively). The database is managed by the MEU and is the basis for all measurement executions.

Measurement step: Container for Stimulus port group measurements. A measurement step is non-interruptible but can function as a breakpoint in a Measurement cycle. All stimulus port group measurements within a measurement step are executed in parallel.

```
S
```

Stimulus port group measurement: A specific measurement, defined by a set of measurement parameters, a group of DUT ports and a stimulus description. User-specific actions (provided by plug-ins) can be hooked onto stimulus port group measurements.