R&S®RTP-K98
Modulated Load Pull
User Manual

1706717402
Version 03

ROHDE&SCHWARZ
Make ideas real

This document describes the Modulated Load Pull measurement functions procedures of the following option:

- R&S®RTP-K98 (1803.6990.02)

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1706.7174.02 | Version 03 | R&S®RTP-K98

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol.

Contents

1 R&S ScopeSuite overview

The R&S ScopeSuite software is used with R&S RTP oscilloscopes. It can be installed on a test computer or directly on the oscilloscope. For system requirements, refer to the Release Notes.

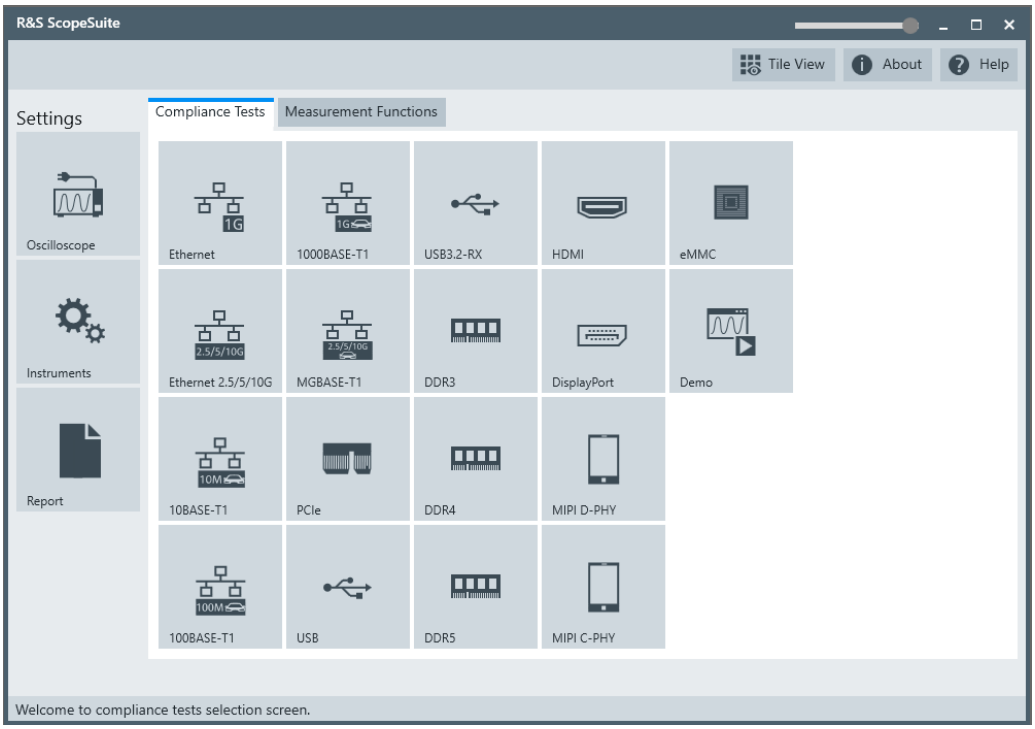


Figure 1-1: Compliance Tests

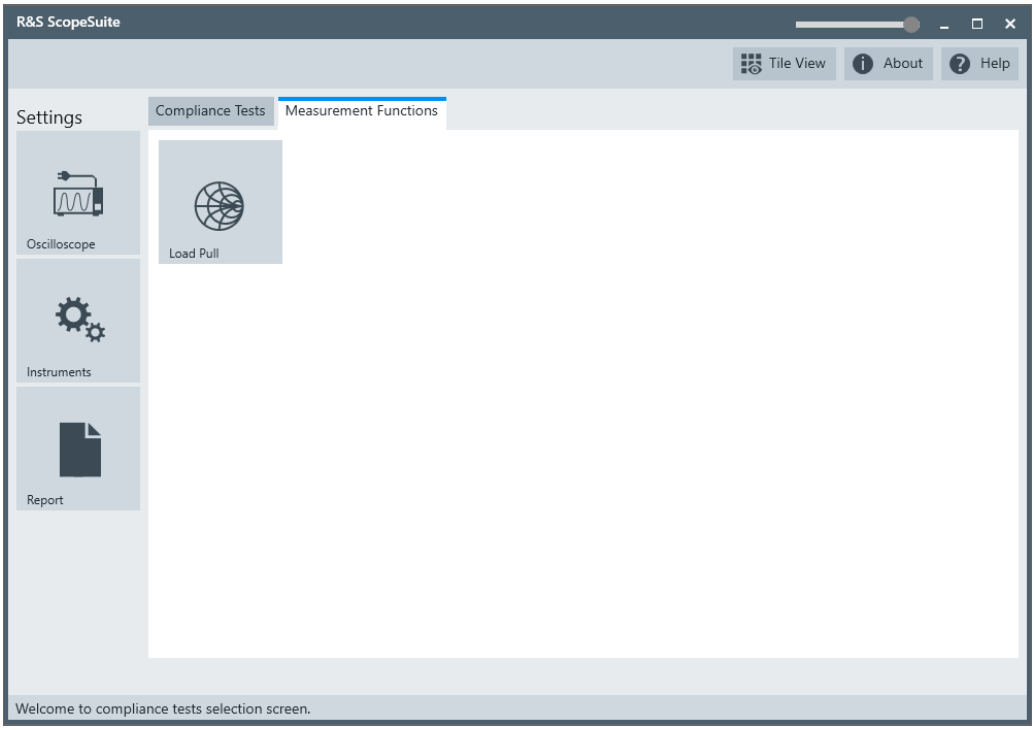


Figure 1-2: Measurement Functions

The R&S ScopeSuite main panel has several areas:

- "Settings": connection settings to oscilloscope and other instruments also default report settings
- "Compliance Tests": selection of the compliance test
- "Measurement Functions": selection of the measurement functions
- "Demo": accesses demo test cases that can be used for trying out the software without having a connection to an oscilloscope
- : shift sideways to change the transparency of the dialog box
- "Help": opens the help file, containing information about the R&S ScopeSuite configuration
- "About": gives information about the R&S ScopeSuite software
- "Tile View": allows a personalization of the compliance test selection
  You can configure which tests are visible in the compliance test section and which are hidden, so that only the ones you use are displayed.

► To hide a test from the "Compliance Tests" view, do one of the following:

a) Right-click on the compliance test that you want to hide.
The icon of the test changes, see Figure 1-3. Now with a left click you can hide the test.

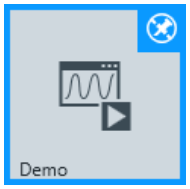


Figure 1-3: Unpin icon

b) Click on "Title View" to show a list of the available test cases. By clicking a test case in the show list, you can pin/unpin it from the main panel.

2 Preparing the measurements

2.1 Test equipment

For load pull compliance tests, the following test equipment is mandatory:

- **R&S RTP** with 4 channels and minimum 8 GHz bandwidth equipped with the following options:

Equipment	Option	Quantity
Either one of the following R&S RTP:	• R&S RTP084B • R&S RTP134B • R&S RTP164B	1
R&S RTP I/Q software interface	R&S RTP-K11	1
R&S ScopeSuite	-	1
Modulated load pull compliance test option, installed on the R&S ScopeSuite	R&S RTP-K98	1
Precision BNC to SMA adapter	R&S RT-ZA16	2

- **R&S SMW200A** vector signal generator equipped with the following options:

Equipment	Option	Quantity
Frequency range for RF path A: 100 kHz and 20 GHz	R&S SMW-B1020	1
Frequency range for RF path B: 100 kHz and 20 GHz	R&S SMW-B2020	1
I/Q paths to RF: Wideband baseband main module	R&S SMW-B13XT	2
Wideband baseband high signal dynamics	R&S SMW-B9F	2
Baseband extension to 1 GHz RF bandwidth	R&S SMW-K525	2
Baseband extension to 2 GHz RF bandwidth	R&S SMW-K527	2
Phase coherence	R&S SMW-B90	1
(Optional) User-defined frequency response correction	R&S SMW-K544	2

- **Additional equipment**

Equipment	Option	Quantity
VNA calibration kit, 2.9 mm female connector	R&S ZN-Z129	1
Power Meter with LAN interface	R&S NRP40SN or similar	1
Directional Coupler	Depending on the DUT's frequency range	2
SMA cables (4 for R&S RTP to the directional coupler and 2 for R&S SMW to the directional coupler)	-	6

Equipment	Option	Quantity
(Only for envelope tracking) Secondary vector signal generator	R&S SMW200A	1
Circulators	Depending on the DUT's frequency range and power range	≥ 2

Test setup

Before using R&S ScopeSuite, set up the equipment according to your needs. Figure 2-1 shows an example of a reference setup.

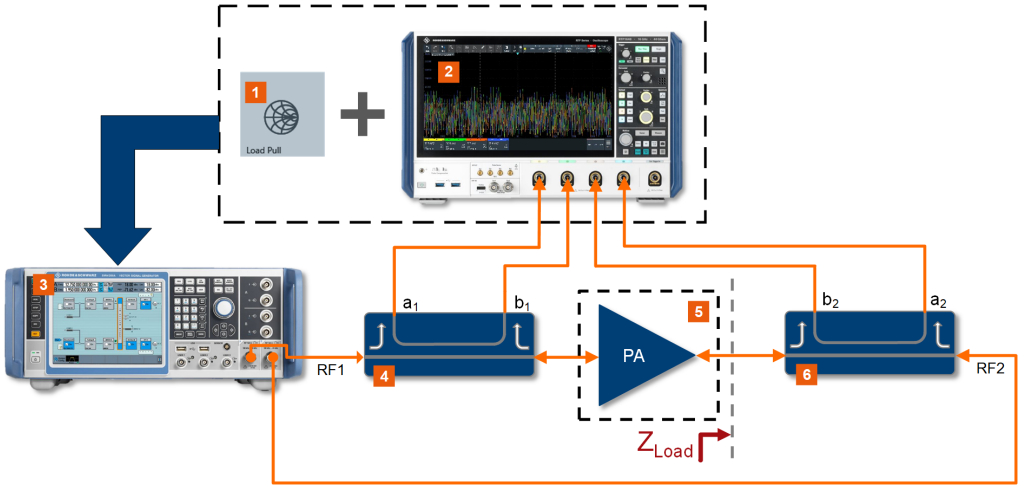


Figure 2-1: An example of a test setup with a DUT for load pull measurement

Z_{Load} = Load impedance
1 = "Load Pull" option in R&S ScopeSuite
2 = R&S RTP
3 = R&S SMW200A
4 and 6 = Directional coupler
5 = DUT

2.2 Installing software and license

The preparation steps are performed only once for each computer and instrument that are used for testing.

Uninstall older versions of the R&S ScopeSuite

If an older version of the R&S ScopeSuite is installed, make sure to uninstall the old version before you install the new one. You can find the version number of the current installation in "Help" menu > "About". To uninstall the R&S ScopeSuite, use the Windows "Control Panel" > "Programs".

For best operation results, we recommend that the installed firmware versions of the R&S ScopeSuite and the oscilloscope are the same.

To install the R&S ScopeSuite

1. Download the latest R&S ScopeSuite software from the "Software" section on the Rohde & Schwarz R&S RTP website:
   www.rohde-schwarz.com/product/rtp.html
2. Install the R&S ScopeSuite software:
   - On the computer that is used for testing, or
   - On the R&S RTP.

   For system requirements, refer to the Release Notes.

To install the license key on the R&S RTP

► When you got the license key of the compliance test option, enable it on the oscilloscope using [Setup] > "SW Options".
For a detailed description, refer to the R&S RTP user manual, section "Installing Options", or to the online help on the instrument.

2.3 Setting up the network

If the R&S ScopeSuite software runs on a test computer, the computer and the testing oscilloscope require a LAN connection.

There are two ways of connection:

- LAN (local area network): It is recommended that you connect to a LAN with DHCP server. This server uses the Dynamic Host Configuration Protocol (DHCP) to assign all address information automatically.
- Direct connection of the instruments and the computer or connection to a switch using LAN cables: Assign fixed IP addresses to the computer and the instruments and reboot all devices.

To set up and test the LAN connection

1. Connect the computer and the instruments to the same LAN.
2. Start all devices.
3. If no DHCP server is available, assign fixed IP addresses to all devices.
4. Ping the instruments to make sure that the connection is established.
5. If VISA is installed, check if VISA can access the instruments.
   a) Start VISA on the test computer.
   b) Validate the VISA address string of each device.

See also:

- Section 2.5, "Connecting the R&S RTP", on page 11

2.4 Starting the R&S ScopeSuite

To start the R&S ScopeSuite on the test computer or on the oscilloscope:

► Double-click the R&S ScopeSuite program icon.

To start the R&S ScopeSuite on the instrument, in the R&S RTP firmware:

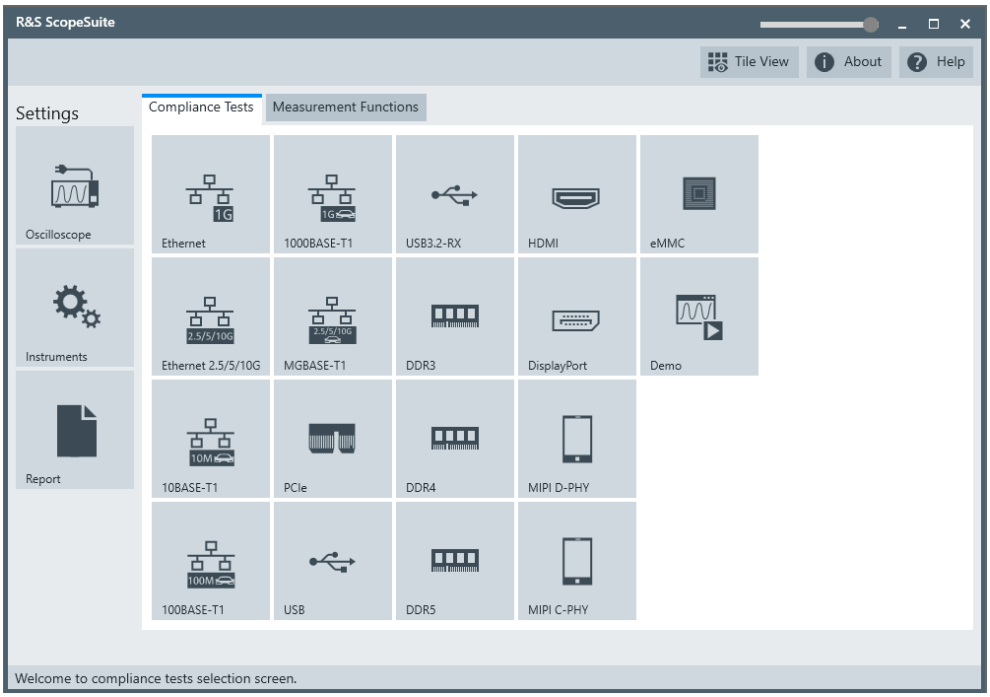
► In the "Apps" dialog, open the "Compliance" tab.
For load pull measurement, in the "Apps" dialog, open "RF" tab > "Load Pull".

2.5 Connecting the R&S RTP

If the R&S ScopeSuite is installed directly on the instrument, the software detects the R&S RTP firmware automatically, and the "Oscilloscope" button is not available in the R&S ScopeSuite.

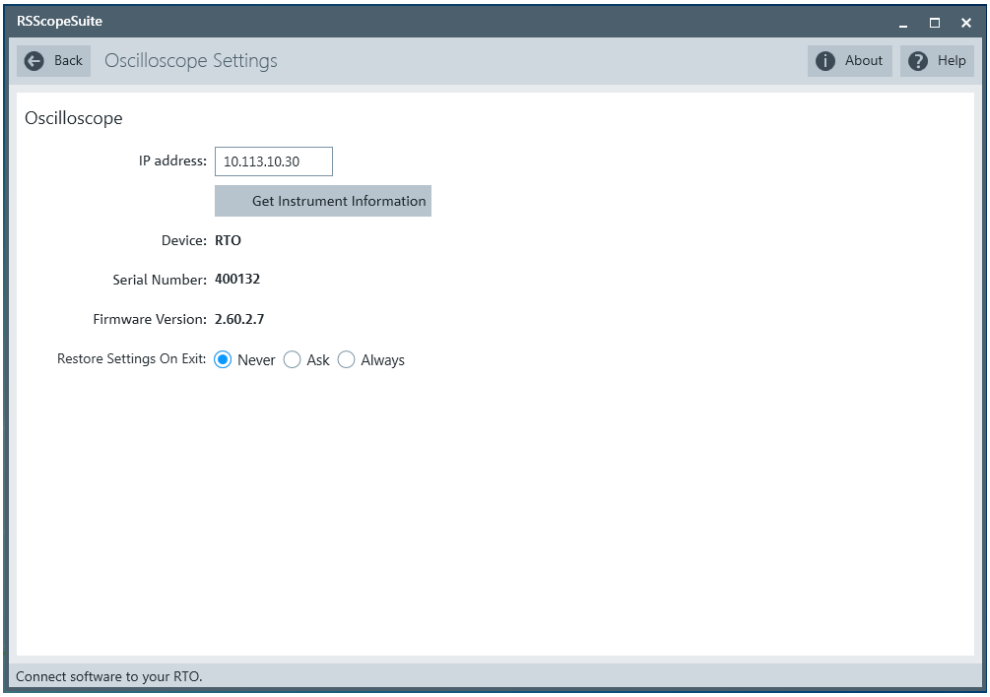
If the R&S ScopeSuite software runs on a test computer, the computer and the testing oscilloscope require a LAN connection, see Section 2.3, "Setting up the network", on page 10. The R&S ScopeSuite software needs the IP address of the oscilloscope to establish connection.

1. Start the R&S RTP.
2. Start the R&S ScopeSuite software.
3. Click "Settings" > "Oscilloscope".



4. Enter the IP address of the oscilloscope.
   To obtain the IP address: press the Rohde & Schwarz logo at the top-right corner of the oscilloscope's display.
5. Click "Get Instrument Information".

   The computer connects with the instrument and gets the instrument data.



   If the connection fails, an error message is shown.

2.6 Connecting the vector signal generator

The vector signal generator (VSG) is required to perform modulated load pull measurements.

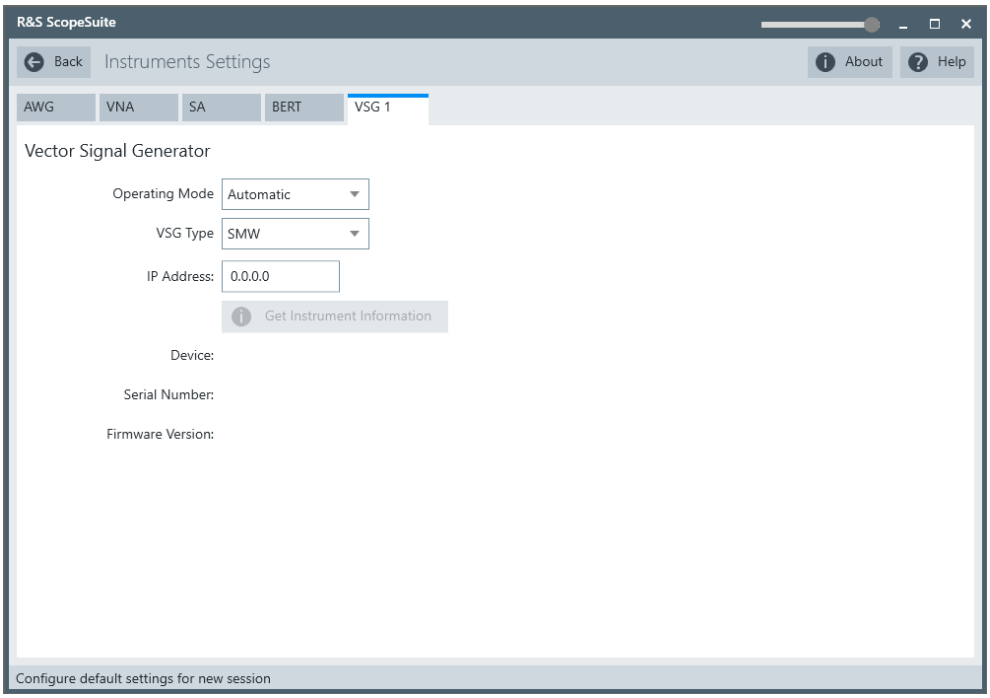
The VSG can be used in automatic or manual mode. You can use the automatic mode only with supported instruments. A LAN connection and a VISA installation on the computer that is running the R&S ScopeSuite is required. If the R&S ScopeSuite is installed on the R&S RTP, no installation is needed because VISA is already installed on the instrument.

In manual mode, you connect the vector signal generator to the test board and configure the instrument manually.

To connect the vector signal generator for automatic testing

1. Connect the computer and the VSG. Set up the LAN connection, see Section 2.3, "Setting up the network", on page 10.
2. In the R&S ScopeSuite, click "Instruments".

3. Click the "VSG 1" tab.
4. Select the "Automatic" operating mode.
5. Select the "VSG Type" and enter its IP address.
6. Click "Get Instrument Information".

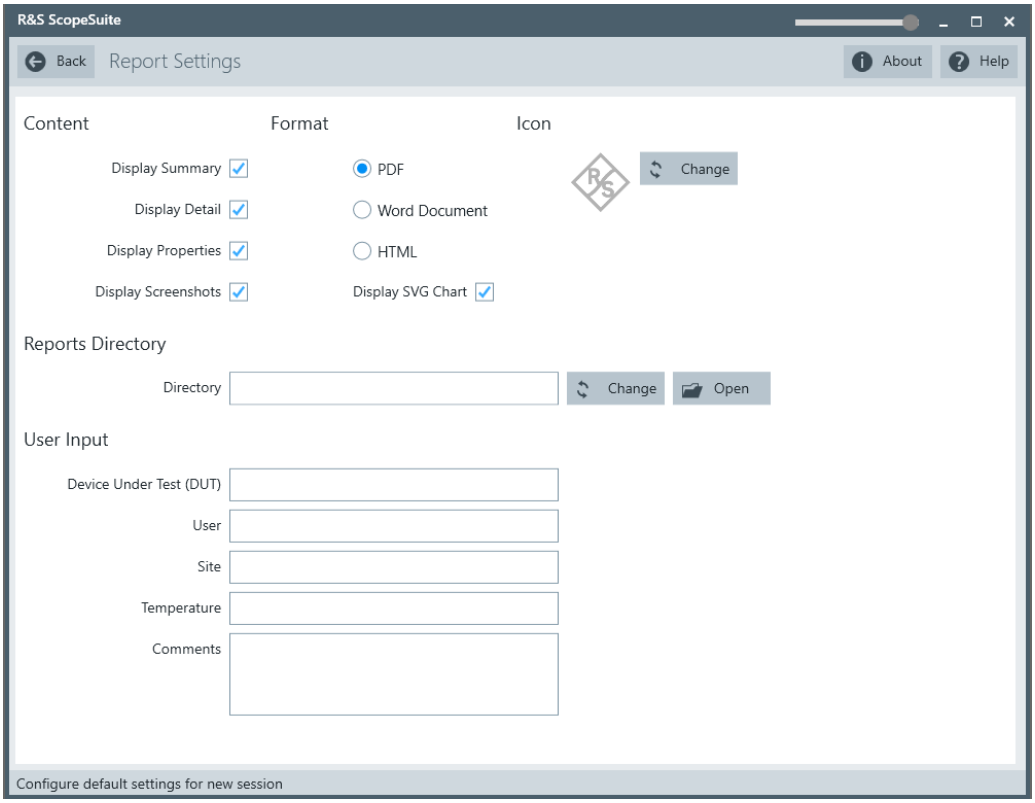


The computer or R&S RTP connects with the instrument and retrieves the instrument data.

2.7 Report configuration

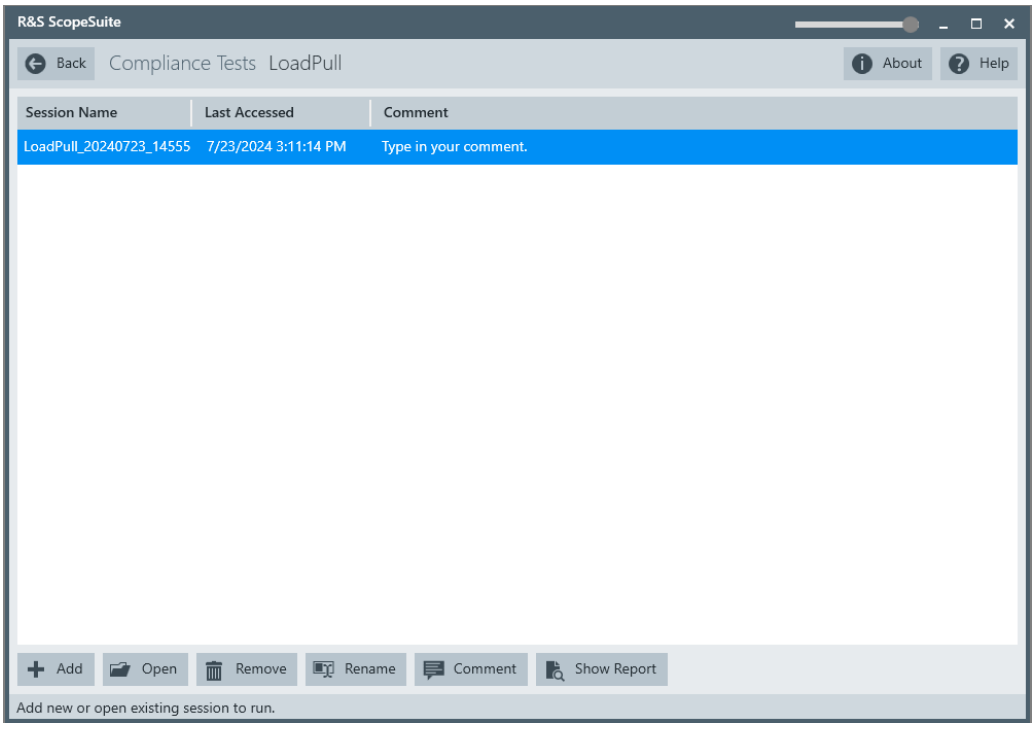
In the "Report Configuration" menu, you can select the format of the report and the details to be included in the report. You can also select an icon that is displayed in the upper left corner of the report.

Also, you can enter common information on the test that is written in the "General Information" section of the test report.


R&S ScopeSuite
Back
Report Settings
About
Help
Content
Format
Icon
Display Summary
Display Detail
Display Properties
Display Screenshots
PDF
Word Document
HTML
Display SVG Chart
Change
Reports Directory
Directory
Change
Open
User Input
Device Under Test (DUT)
User
Site
Temperature
Comments
Configure default settings for new session

3 Performing tests

3.1 Starting a test session



After you open a compliance test or measurement function, the "Session Selection" dialog appears. In this dialog, you can create new sessions, open or view an existing report.

The following functions are available for handling test sessions:

Function	Description
"Add"	Adds a new session
"Open"	Opens the selected session
"Remove"	Removes the selected session
"Rename"	Changes the "Session Name"
"Comment"	Adds a comment
"Show report"	Generates a report for the selected session

To add a test session

1. In the R&S ScopeSuite window, select the measurement under the "Measurement Functions" tab.

2. In the "Session Selection" dialog press "Add".
3. If necessary, change the "Session Name"

To open a test session

1. In the R&S ScopeSuite window, select the measurement under the "Measurement Functions" tab.
2. In the "Session Selection" dialog, select the session you want to open and double-click it.
   Alternatively, select the session and press "Open".

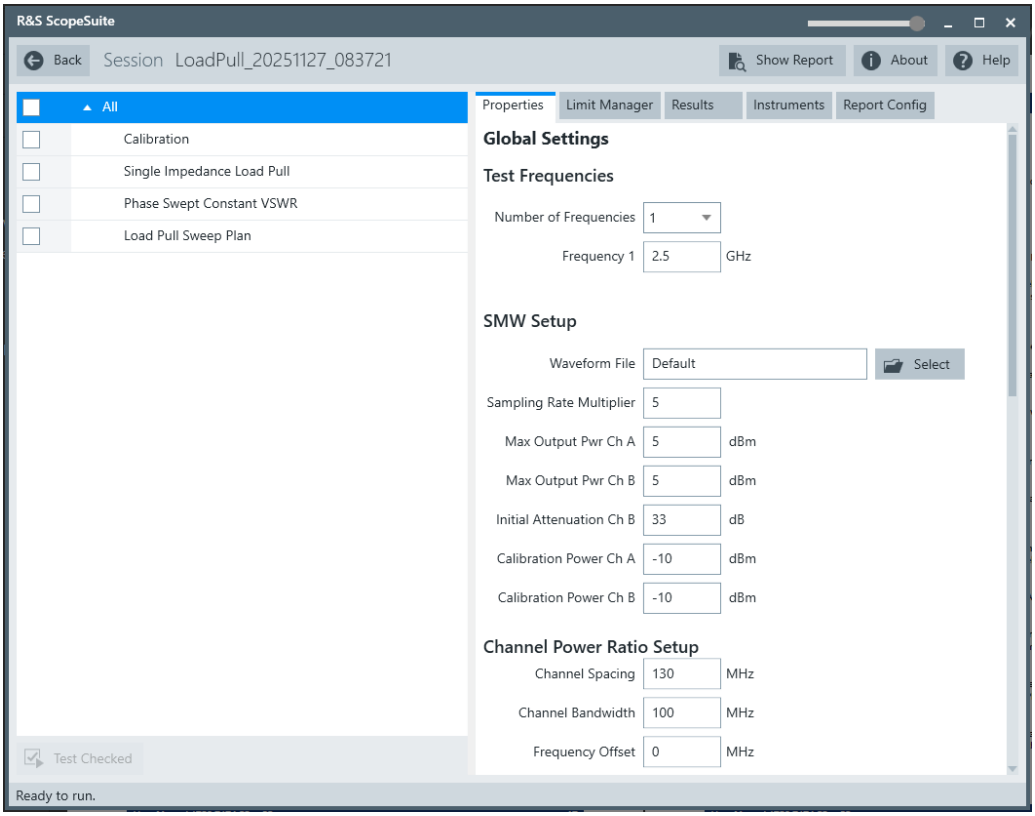
To show a report for a test session

1. In the R&S ScopeSuite window, select the measurement under the "Measurement Functions" tab.
2. In the "Session Selection" dialog, select the session you want the report for and click "Show report".

3.2 Configuring the test

1. In the R&S ScopeSuite window, select the "Measurement Functions".
2. Select "Load Pull".
3. Open a test session, see Section 3.1, "Starting a test session", on page 15.
4. Select the desired test case.
5. Configure the "Properties" settings for the test cases you want to perform.
6. You can configure the settings in the "Report Config" tab to the format and contents of the report. Otherwise, the settings defined in "RSScopeSuite" > "Settings" > "Report" are used. See Section 2.7, "Report configuration", on page 13.
7. Click "Test Checked"/"Test Single" and proceed as described in the relevant test case sections.

3.2.1 General test settings



Each session dialog is divided into several sections:

- "Properties": shows the settings that can be made for the test case selected on the left side of the dialog. You can differentiate between the properties for "All" tests or individual sub-tests.
  In the "All" > "Properties" tab, you can configure the settings for all test cases in the current session. Once you change and save a setting in this tab, the changes are updated for all tests in the session.
  At the same time, there will be a special marking for the functions that have different settings for different sub tests.
- "Limit Manager": shows the limits defined for each measurement. You can configure the measurement's criteria, or import and export the values.
- "Results": shows an overview of the available test results for this session.
- "Instruments": defines instruments settings for connecting to external devices that are specific for this test session.
  When a session is first created the global settings ("RSScopeSuite" > "Settings" > "Instruments") are copied to the session. This "Instruments" tab can be used to change those copied defaults.
- "Report Config": defines the format and contents of the report for this session.
  When a session is first created, the global settings ("RSScopeSuite" > "Settings" > "Report") are copied to the session. This "Report Config" tab can be used to change those copied defaults.

- "Test Checked"/ "Test Single": starts the selected test.

3.2.2 Test configuration for Load Pull

The following settings are available for configuring the "Load Pull" measurements:

3.2.2.1 Test Frequencies

Number of frequencies
Sets the number of frequencies for the calibration test.

Frequency n
Sets the frequency to perform a calibration test and load pull measurements, where n refers to the Number of frequencies configured.

These frequencies are also automatically available for selection in the Frequency parameter in the "Single Impedance Load Pull" and "Phase Swept Constant VSWR" measurements.

3.2.2.2 SMW Setup

Waveform file
Selects an arbitrary waveform generator (ARB) file that serves as the test signal for load pull measurements.

For more details about the waveform files, refer to the manual of your signal generator.

Sampling Rate Multiplier
Defines the upsampling factor to be multiplied to the waveform defined in "Waveform file" on page 18 to obtain the oversampled rate at which the measurement is performed.

Max Output Pwr Ch n
Sets the maximum output power of the signal generator, where n refers to channel [A] or [B].

Initial Attenuation Ch B
Sets the initial attenuation at channel [B] of the signal generator.

Calibration Power Ch n
Sets the power level of the signal generator during calibration, where n refers to channel [A] or [B].

3.2.2.3 Channel Power Ratio Setup

Channel Spacing
Sets the difference between the center frequency of a channel and the center frequency of the adjacent channels for measuring the channel power ratio.

Channel Bandwidth
Sets the channel bandwidth over which the channel power ratio is calculated.

Frequency Offset
Sets the offset to the center frequency.

3.2.2.4 Miscellaneous

Enable Envelope Tracking
If enabled, tracks the input signal envelope during "Single Impedance Load Pull", "Phase Swept Constant VSWR" and "Load Pull Sweep Plan" measurements.

Requires a secondary SMW for the envelope tracking.

Do not generate charts
If enabled, charts are not generated during the measurement, hence enhancing the test execution speed.

3.2.2.5 Single Impedance Setup

Frequency
Selects the specific frequency at which the DUT performance is evaluated during measurement. The frequencies listed here are configured in the calibration test, see also "Frequency n" on page 18.

Gamma (Cartesian)
Sets the reflection coefficient at the load port of the DUT. The reflection coefficient is a complex number expressed in Cartesian coordinates.

"x" The resistive component of the reflection coefficient.

"y" The reactive component of the reflection coefficient.

Output Power
Sets the effective output power at Channel A of the signal generator. This value has to be smaller or equal to the signal generator's maximum output power sent to the DUT, see also Max Output Pwr Ch n.

Power On at End of Test
If enabled, keeps the power of the signal generator on at the end of the single impedance load pull test.

Debug Verbose
If enabled, collects debug data (`*.h5` file) and saves it in the debug log folder.

3.2.2.6 Phase Swept Constant VSWR Setup

Frequency
See "Frequency" on page 19.

Antenna Gamma
Sets the absolute gamma (magnitude) of the reflection coefficient associated with the antenna's load impedance being used in the test setup. Here, the antenna is the load.

Output Power
See "Output Power" on page 19.

Number of Sweeps
Sets the number of phase sweeps sent while maintaining a constant VSWR.

BPF1 File / BPF2 File
Selects the filter configuration file that defines the bandpass filter filtering criteria used for load pull measurement. Only files in touchstone `.s2p` format are supported.

The default file in the software (`allpass.s2p`) contains information on an allpass filter.

Note: If you use your custom files, to ensure smooth execution of the measurement, store them in `C:\Users\<your_user_name>\Documents\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Loadpull`.

OMN1 File / OMN2 File
Selects the frequency-dependent deembedding files that are used to remove any packaging or parasitic effects contained within the output block. Only files in touchstone `.s2p` format are supported.

The default file in the software (`allpass.s2p`) contains information on an allpass filter.

Note: If you use your custom files, to ensure smooth execution of the measurement, store them in `C:\Users\<your_user_name>\Documents\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Loadpull`.

3.2.2.7 LoadPull Sweep Plan Setup

LoadPull Sweep Settings
Defines the list of parameters that are of interest for the load pull measurements.

You can use the default settings available from the software or define your own.

The default settings file (`loadpullsweep_settings_default.csv`) is located in `C:\Users\<your_user_name>\Documents\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Loadpull`.

Note: If you use your custom files, to ensure smooth execution of the measurement, store them in `C:\Users\<your_user_name>\Documents\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Loadpull`.

"Select"

If you define your own sweep settings, create and select the file containing the following information. Only files in `.csv` format are supported.

- **Freq** [GHz]: the list of specific frequencies for load pull measurements.
- **Pin** [dBm]: the list of the input power levels to be applied to the DUT during the measurement.
- **OMN1** [`.s2p`]: the name of the filter file to be used, see OMN1 File / OMN2 File.
- **OMN2** [`.s2p`]: the name of the filter file to be used, see OMN1 File / OMN2 File.
- **BPF1** [`.s2p`]: the name of the filter file to be used, see BPF1 File / BPF2 File.
- **BPF2** [`.s2p`]: the name of the filter file to be used, see BPF1 File / BPF2 File.
- **ANT** ["x", "y"]: the set gamma, see Gamma (Cartesian).
- **SCPI Cmd Before** [`.xml`]: the file with SCPI commands executed just before a load pull measurement.
- **SCPI Cmd After** [`.xml`]: the file with SCPI commands executed after a load pull measurement.

The sweep parameters are indicated in each cell in the setting file. When you click "Convert to Test Plan", the software generates a complete test plan of all possible permutations automatically.

Example: Converting a sweep setting file

In the example below, the sweep settings file (Figure 3-1) includes two unique input power levels (Pin), and OMN 1 and OMN 2 files, respectively, and three different Gamma (Cartesian) values. All the other parameters are listed only once. The resulting generated test plan after conversion includes 24 different rows. Figure 3-2 shows a subset of the resulting test plan.

Freq	Pin	OMN1	OMN2	BPF1	BPF2	ANT	SCPI Cmd Before	SCPI Cmd After
2.5	-15	allpass.s2p	allpass.s2p	allpass.s2p	allpass.s2p	0.1250,0.0000	SCPI1.xml	SCPI2.xml
	-10	bpf1.s2p	lpf1.s2p			0.0625,0.1083		
						-0.0625,0.1083		

Figure 3-1: Example of sweep settings

Freq	Pin	OMN1	OMN2	BPF1	BPF2	ANT	SCPI Cmd Before	SCPI Cmd After
2.5	-15	allpass.s2p	allpass.s2p	allpass.s2p	allpass.s2p	0.1250,0.0000	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	allpass.s2p	allpass.s2p	0.0625,0.1083	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	allpass.s2p	allpass.s2p	-0.0625,0.1083	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	allpass.s2p	lpf1.s2p	0.1250,0.0000	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	allpass.s2p	lpf1.s2p	0.0625,0.1083	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	allpass.s2p	lpf1.s2p	-0.0625,0.1083	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	bpf1.s2p	allpass.s2p	0.1250,0.0000	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	bpf1.s2p	allpass.s2p	0.0625,0.1083	SCPI1.xml	SCPI2.xml
2.5	-15	allpass.s2p	allpass.s2p	bpf1.s2p	allpass.s2p	-0.0625,0.1083	SCPI1.xml	SCPI2.xml

Figure 3-2: Example of a sweep plan after conversion

"Convert to Test Plan"

Converts the load pull sweep settings to a test plan.

LoadPull Sweep Test Plan
A `.csv` file that contains the list of all the test points generated from the "LoadPull Sweep Settings".

You can use the default settings available from the software or add, delete or modify the test points.

The default settings file (`loadpullsweep_testplan_default.csv`) is located in `C:\Users\<your_user_name>\Documents\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Loadpull`.

3.3 Initiating the test

To perform a compliance test or measurement function, the device under test is connected to the test board in a test-specific way. Using a probe, the test board is connected with the R&S RTP. The probe connections are test-specific. The R&S ScopeSuite guides you step by step through the connection setup and the test sequence.

The procedure to perform a measurement function is the same.

1. Set the test setup on a nonconductive, static-approved work surface.
2. In the R&S ScopeSuite window, select the compliance test or measurement function.
3. Open a test session, see Section 3.1, "Starting a test session", on page 15.
4. Check the test configuration settings and adjust, if necessary.
5. Click "Test Checked" for starting all checked test cases or "Test Single" for starting only the selected test case.

   The R&S ScopeSuite test wizard explains the following individual setup steps. A detailed test description can be found in the following sections:
   - Section 4, "Load pull tests", on page 25

3.4 Getting test results

If you resume an existing session, new measurements are appended to the report, new diagrams and waveform files are added to the session folder. Existing files are not deleted or replaced. Sessions data remain until you delete them in the "Results" tab of the session.

The report format can be defined in "RSScopeSuite" > "Settings" > "Report" for all compliance tests or measurement functions (see also Section 2.7, "Report configuration", on page 13). If you want to use special report settings for a session, you can define the format and contents of the report in the "Report Config" tab of the session.

All test results are listed in the "Results" tab. Reports can be provided in PDF, MSWord, or HTML format. To view and print PDF reports, you need a PDF viewer, for example, the Acrobat Reader.

The test report file can be created at the end of the test, or later in the "Session Selection" dialog.

To show a test report

1. In the R&S ScopeSuite window, select the compliance test or measurement function to be performed.
2. Select the session name in the "Session Selection" dialog and click "Show report".

   The report opens in a separate application window, depending on the file format. You can check the test results and print the report.

To delete the results, diagrams and waveform files of a session

1. In the "Session Selection" dialog select the session and open it.
2. In the "Results" tab, select the result to be deleted.
3. Click "Remove".

3.5 Starting Load Pull tests

Before you run the test, do the following:

- Connect all the test equipment.
  See Section 2.1, "Test equipment", on page 8.
- Establish a LAN connection of the oscilloscope and the computer running the R&S ScopeSuite, see Section 2.5, "Connecting the R&S RTP", on page 11.
- Establish a signal generator connection, see Section 2.6, "Connecting the vector signal generator", on page 12.

1. In the R&S ScopeSuite start window, select the "Measurement Functions" tab.
2. Select "Load Pull".
3. Add a new test session.
4. Open the session. See also Section 3.1, "Starting a test session", on page 15.
5. If you want to run a single test case, select the test cases you want to run. Otherwise, select "All".

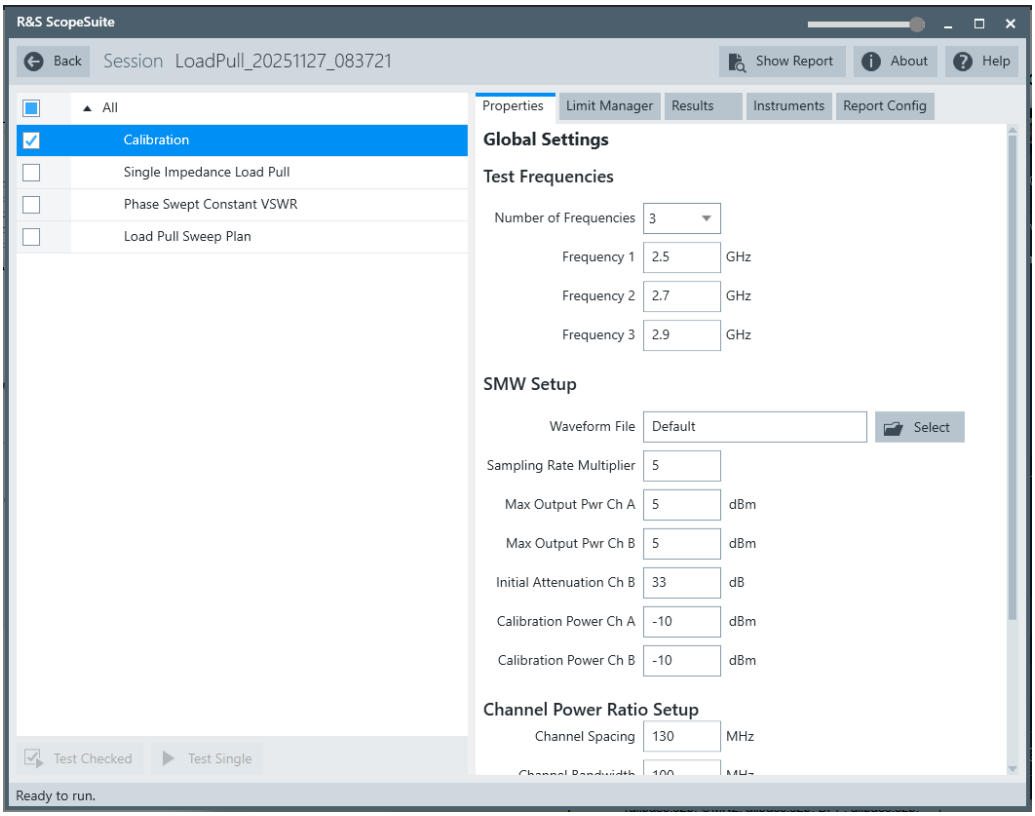
4 Load pull tests

4.1 Calibration

The calibration test measures the frequency, amplitude, phase and delay characteristics of the test setup and applies the corrections during load pull measurements.

Before running other load pull measurements, you must calibrate the test setup at the desired frequencies.

You need a secondary vector signal generator to enable envelope tracking.



4.1.1 Performing the tests

1. Start the test as described in Section 3.5, "Starting Load Pull tests", on page 24.
2. Select "Calibration".
3. Click "Test Single".

4. Follow the instructions of the step-by-step guide.

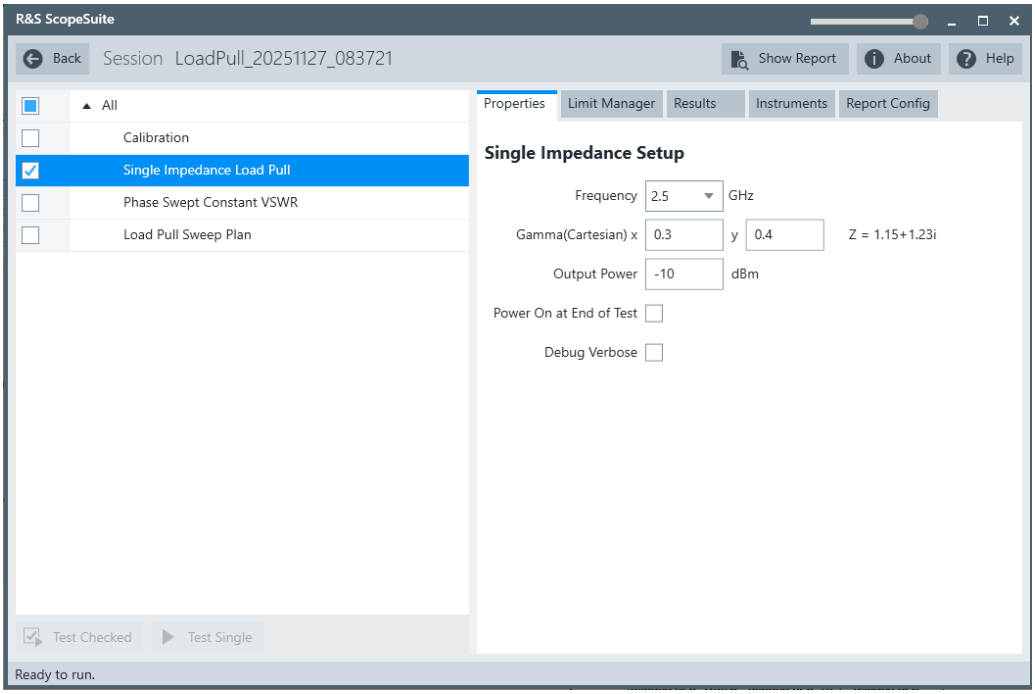
4.1.2 Measurements

The following actions are performed during the calibration test:

- Create an oversampled test signal from a waveform
- Measurement of wave a_1 relative to the DUT input
- Measurement of wave a_2 relative to the DUT output
- Open calibration for amplitude and phase of wave b with respect to the arriving wave a
- Short calibration for amplitude and phase of wave b_1 and b_2
- Through calibration between wave a_1 and b_2

4.2 Single Impedance Load Pull

The single impedance load pull test is used to characterize the performance of a DUT for a single, fixed target load impedance, and under default filter and deembedding settings. It is useful for initial evaluations, prototype testing, or when focusing on specific operating conditions.



4.2.1 Performing the tests

1. Start the test as described in Section 3.5, "Starting Load Pull tests", on page 24.
2. If not already done so, perform the "Calibration" test.
3. Select "Single Impedance Load Pull".
4. Click "Test Single".
5. Follow the instructions of the step-by-step guide.

4.2.2 Measurements

In the single impedance load pull measurement, the software adjusts the a_2 wave until the measured impedance matches the target impedance or reaches the signal generator's maximum output power.

Figure 4-1 shows sample results of a measurement at 2.5 GHz.

For each load pull measurement, the following graphs are generated:

- Amplitude-modulation-to-amplitude-modulation (AM/AM) plot
- Amplitude-modulation-to-phase-modulation (AM/PM) plot
- Gamma error spectrum plot
- Measured Gamma Smith chart

All resulting images and measurements are saved in `C:\ProgramData\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Sessions\LoadPull\<Session_ID>`.

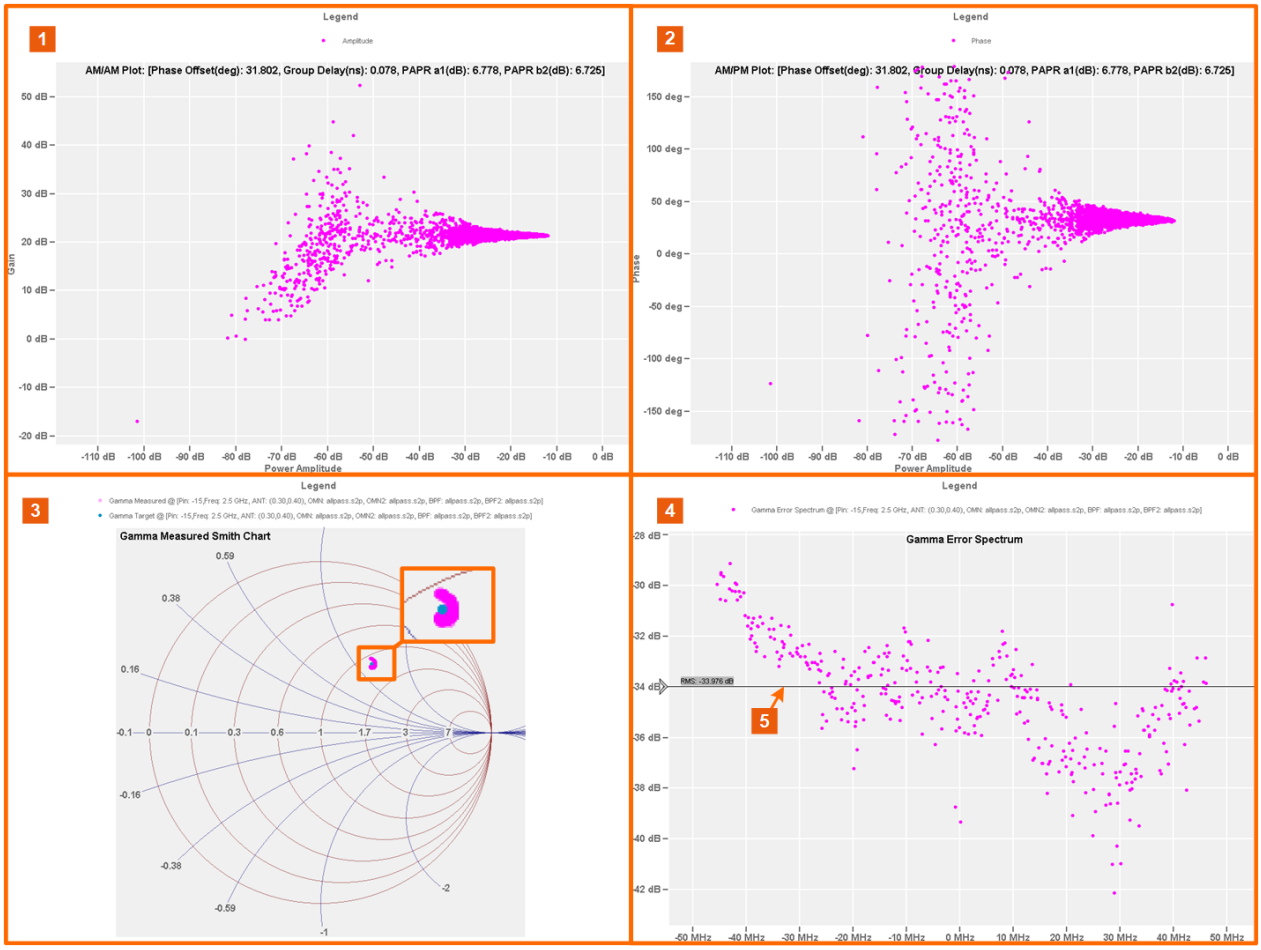
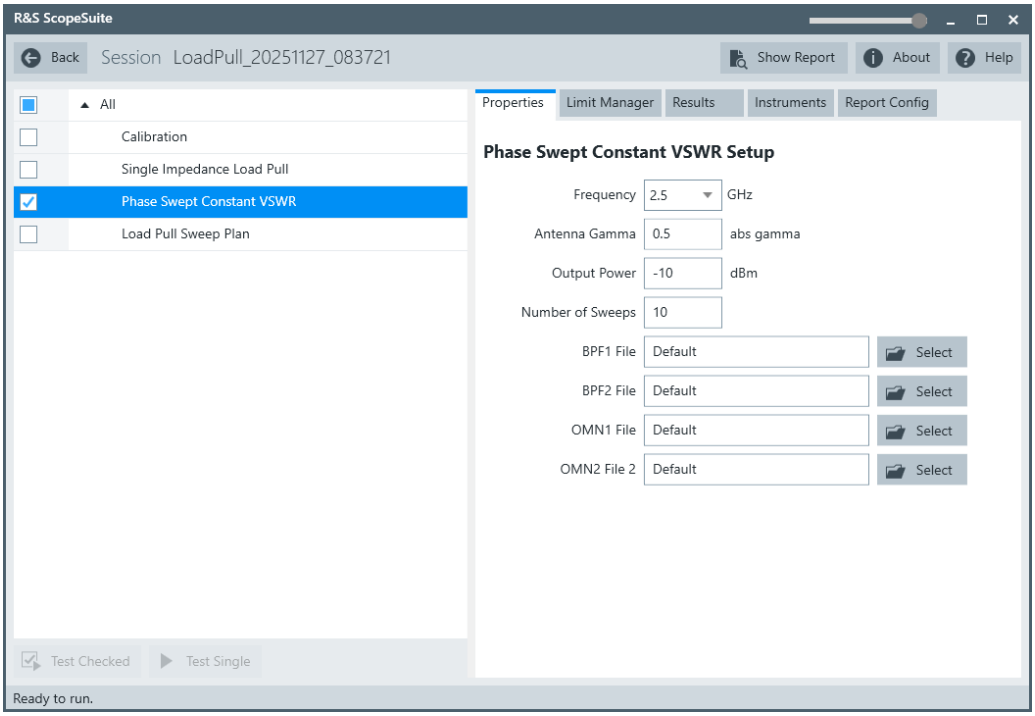


Figure 4-1: An example of the single impedance load pull measurement at 2.5 GHz

1 = AM/AM plot
2 = AM/PM plot
3 = A Smith Chart plot with the enlarged view of the wanted and measured gamma
4 = A spectrum plot of gamma error against intermediate frequency
5 = Root-mean-square measured gamma error at the target frequency

4.3 Phase Swept Constant VSWR

The phase-swept constant VSWR test is used to characterize DUT performance over target gamma with fixed reflection coefficient magnitudes and varying phase. The phase is defined by the number of sweeps. You can specify filter files ("BPF1", "BPF2", "OMN1" and "OMN2") to simulate realistic matching networks.



4.3.1 Performing the tests

1. Start the test as described in Section 3.5, "Starting Load Pull tests", on page 24.
2. If not already done so, perform the "Calibration" test.
3. Select "Phase Swept Constant VSWR".
4. Click "Test Single".
5. Follow the instructions of the step-by-step guide.

4.3.2 Measurement

In the "Phase Swept Constant VSWR" measurement, the target gamma amplitude remains constant, while the phase varies. The phase is determined by the number of test points. The test is repeated for each phase under constant gamma amplitude.

Figure 4-2 shows a heat map of the peak-to-average power ratio (PAPR) results from varying the phase for fixed target gamma amplitude, target power and target frequency. It also shows the spread of measured gamma against the set gamma.

All resulting images and measurements are saved in `C:\ProgramData\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Sessions\LoadPull\<Session_ID>`.

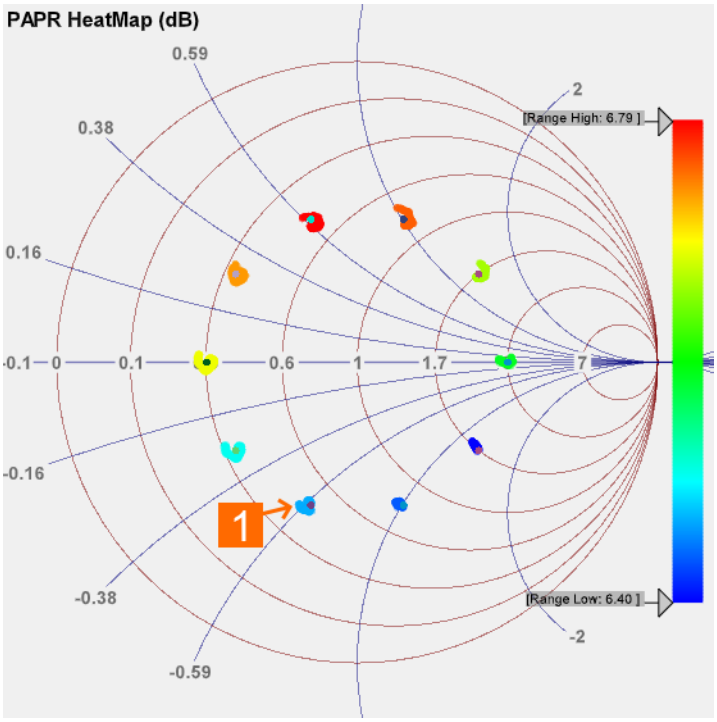
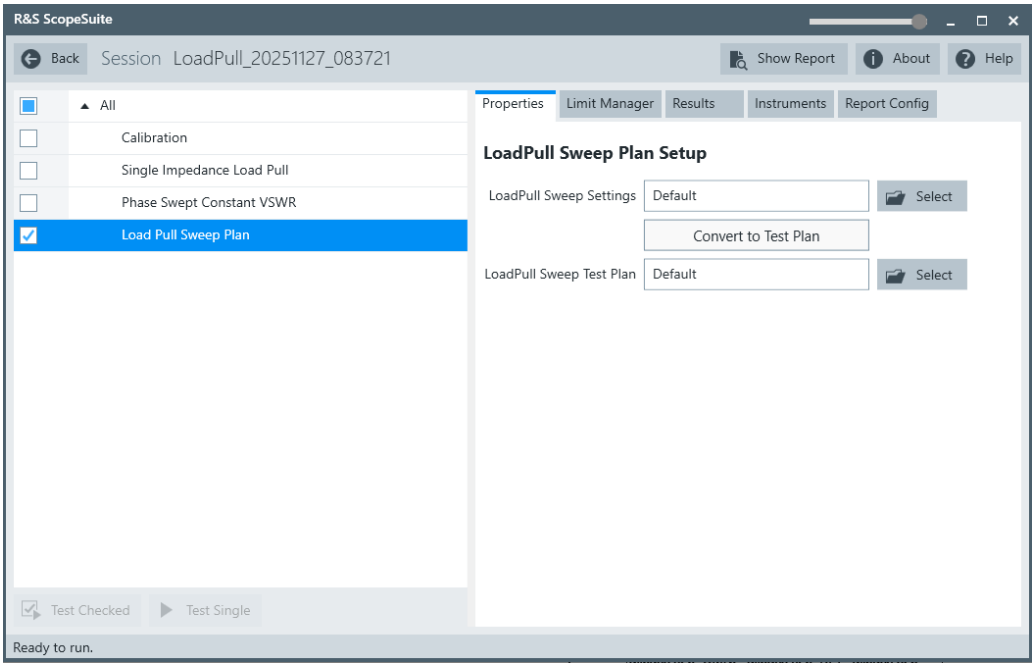


Figure 4-2: An example of the heat map plot after a Phase Swept Constant VSWR measurement

1 = Result from one of the sweep points

4.4 Load Pull Sweep Plan

The load pull sweep plan test performs iterative load pull measurements over several test points as defined by the "Load Pull Sweep Test Plan".



4.4.1 Performing the tests

1. Start the test as described in Section 3.5, "Starting Load Pull tests", on page 24.
2. If not already done so, perform the "Calibration" test.
3. Select "Load Pull Sweep Plan".
4. Click "Test Single".
5. Follow the instructions of the step-by-step guide.

4.4.2 Measurements

At the end of the "Load Pull Sweep Plan", contour plots are available for further analysis.

Figure 4-3 shows an example of the PAPR contour for 2.5 GHz.

All resulting images and measurements are saved in `C:\ProgramData\Rohde-Schwarz\RSScopeSuite\<SW_ver>\Sessions\LoadPull\<Session_ID>`.

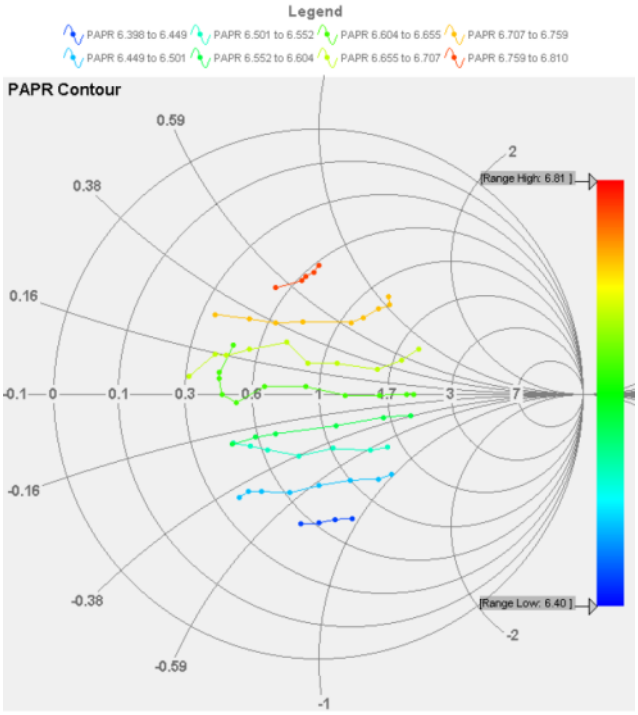


Figure 4-3: An example of the contour plot for the test plan

5 Contacting customer support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz product, contact our customer support center. A team of highly qualified engineers provides support and works with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz products.

Contact information

Contact our customer support center at www.rohde-schwarz.com/support, or follow this QR code:

Figure 5-1: QR code to the Rohde & Schwarz support page