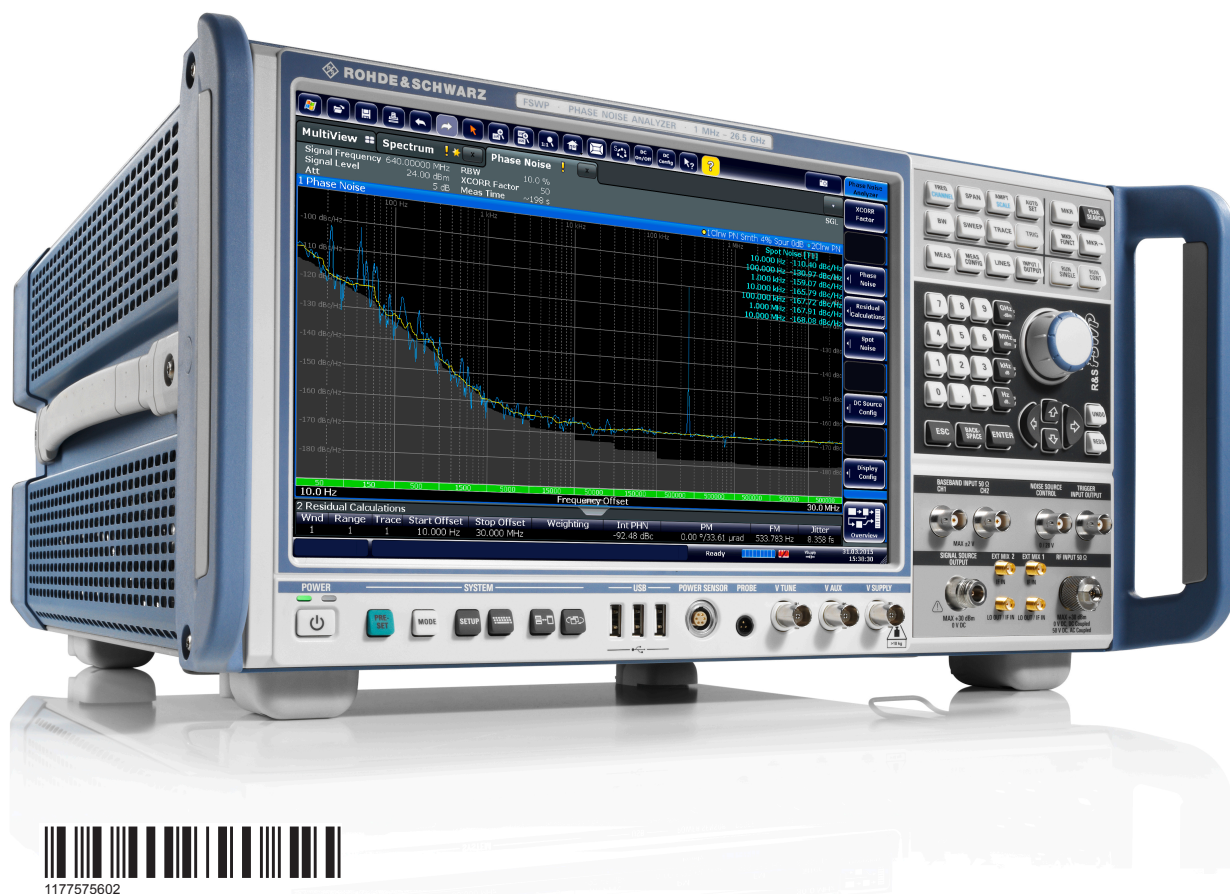# R&S®FSWP
Phase Noise Analyzer
Getting Started

ROHDE&SCHWARZ

This manual describes the following R&S®FSWP models with firmware version 1.70 or higher:

- R&S®FSWP8 (1322.8003K08)
- R&S®FSWP26 (1322.8003K26)
- R&S®FSWP50 (1322.8003K50)

Throughout this manual, products from Rohde & Schwarz are indicated without the ® symbol , e.g. R&S®FSWP is indicated as R&S FSWP.

Safety Instructions
Instrucciones de seguridad
Sicherheitshinweise
Consignes de sécurité

⚠ WARNING

Risk of injury and instrument damage

The instrument must be used in an appropriate manner to prevent electric shock, fire, personal injury or instrument damage.

- Do not open the instrument casing.

- Read and observe the "Basic Safety Instructions" delivered as printed brochure with the instrument.

- Read and observe the safety instructions in the following sections.
  Note that the data sheet may specify additional operating conditions.

- Keep the "Basic Safety Instructions" and the product documentation in a safe place and pass them on to the subsequent users.

⚠ ADVERTENCIA

Riesgo de lesiones y daños en el instrumento

El instrumento se debe usar de manera adecuada para prevenir descargas eléctricas, incendios, lesiones o daños materiales.

- No abrir la carcasa del instrumento.

- Lea y cumpla las "Instrucciones de seguridad elementales" suministradas con el instrumento como folleto impreso.

- Lea y cumpla las instrucciones de seguridad incluidas en las siguientes secciones.
  Se debe tener en cuenta que las especificaciones técnicas pueden contener condiciones adicionales para su uso.

- Guarde bien las instrucciones de seguridad elementales, así como la documentación del producto, y entréguelas a usuarios posteriores.

⚠ WARNUNG

Gefahr von Verletzungen und Schäden am Gerät

Betreiben Sie das Gerät immer ordnungsgemäß, um elektrischen Schlag, Brand, Verletzungen von Personen oder Geräteschäden zu verhindern.

- Öffnen Sie das Gerätegehäuse nicht.

- Lesen und beachten Sie die "Grundlegenden Sicherheitshinweise", die als gedruckte Broschüre dem Gerät beiliegen.

- Lesen und beachten Sie die Sicherheitshinweise in den folgenden Abschnitten; möglicherweise enthält das Datenblatt weitere Hinweise zu speziellen Betriebsbedingungen.

- Bewahren Sie die "Grundlegenden Sicherheitshinweise" und die Produktdokumentation gut auf und geben Sie diese an weitere Benutzer des Produkts weiter.

⚠ AVERTISSEMENT

Risque de blessures et d'endommagement de l'appareil

L'appareil doit être utilisé conformément aux prescriptions afin d'éviter les électrocutions, incendies, dommages corporels et matériels.

- N'ouvrez pas le boîtier de l'appareil.

- Lisez et respectez les "consignes de sécurité fondamentales" fournies avec l'appareil sous forme de brochure imprimée.

- Lisez et respectez les instructions de sécurité dans les sections suivantes. Il ne faut pas oublier que la fiche technique peut indiquer des conditions d'exploitation supplémentaires.

- Gardez les consignes de sécurité fondamentales et la documentation produit dans un lieu sûr et transmettez ces documents aux autres utilisateurs.

Customer Support

Technical support – where and when you need it

For quick, expert help with any Rohde & Schwarz equipment, contact one of our Customer Support Centers. A team of highly qualified engineers provides telephone support and will work with you to find a solution to your query on any aspect of the operation, programming or applications of Rohde & Schwarz equipment.

Up-to-date information and upgrades

To keep your instrument up-to-date and to be informed about new application notes related to your instrument, please send an e-mail to the Customer Support Center stating your instrument and your wish.
We will take care that you will get the right information.

Europe, Africa, Middle East	Phone +49 89 4129 12345 customersupport@rohde-schwarz.com
North America	Phone 1-888-TEST-RSA (1-888-837-8772) customer.support@rsa.rohde-schwarz.com
Latin America	Phone +1-410-910-7988 customersupport.la@rohde-schwarz.com
Asia/Pacific	Phone +65 65 13 04 88 customersupport.asia@rohde-schwarz.com
China	Phone +86-800-810-8228 / +86-400-650-5896 customersupport.china@rohde-schwarz.com

ROHDE & SCHWARZ

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Contents

1 Preface

This chapter provides safety-related information, key features of the instrument, and the conventions used in the documentation.

1.1 For Your Safety

The R&S FSWP is designated for use in industrial, administrative, and laboratory environments. Use the R&S FSWP only for its designated purpose. Observe the safety and usage instructions documented in the user manual, as well as operating conditions and performance limits stated in the data sheet.

The product documentation helps you use the R&S FSWP safely and efficiently. Keep the product documentation in a safe place and pass it on to subsequent users.

Safety information is part of the product documentation. It warns you about potential dangers and gives instructions how to prevent personal injury or damage caused by dangerous situations. Safety information is provided as follows:

- In the "Basic Safety Instructions", safety issues are grouped according to subjects. For example, one subject is electrical safety. The "Basic Safety Instructions" are delivered with the R&S FSWP in different languages in print.

- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation. Always read the safety instructions carefully. Make sure to comply fully with them. Do not take risks and do not underestimate the potential danger of small details such as a damaged power cable.

1.2 Key Features

The R&S FSWP phase noise analyzer and VCO tester with the following key features.

Measuring phase and amplitude noise with high sensitivity:

- Extremely low phase noise from internal sources
- Cross-correlation to improve phase noise sensitivity

- Accuracy of amplitude noise measurements significantly higher than with diode detectors
- Display of improvement in sensitivity through cross-correlation
- Up to 300 MHz frequency offset for phase noise measurements, up to 1 GHz for pure noise measurement

Phase noise measurements on pulsed sources at the push of a button:

- Simple test setup
- High sensitivity despite desensitization
- Automatic pulse parameter measurement

Internal source for measuring residual phase noise, also on pulsed signals:

- Simple and fast measurement
- Higher sensitivity through cross-correlation
- Residual phase noise on pulsed signals
- Additional inputs for an external source

More features:

- Signal and spectrum analyzer and phase noise analyzer up to 50 GHz in a single box
- High measurement speed
- Low-noise internal DC sources for VCO characterization
- Measuring transients or frequency hops (transient analysis)

1.3 Conventions Used in the Documentation

1.3.1 Typographical Conventions

The following text markers are used throughout this documentation:

Convention	Description
"Graphical user interface elements"	All names of graphical user interface elements on the screen, such as dialog boxes, menus, options, buttons, and softkeys are enclosed by quotation marks.
[Keys]	Key and knob names are enclosed by square brackets.

Convention	Description
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
Input	Input to be entered by the user is displayed in italics.
Links	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

1.3.2   Conventions for Procedure Descriptions

When operating the instrument, several alternative methods may be available to perform the same task. In this case, the procedure using the touchscreen is described. Any elements that can be activated by touching can also be clicked using an additionally connected mouse. The alternative procedure using the keys on the instrument or the on-screen keyboard is only described if it deviates from the standard operating procedures.

The term "select" may refer to any of the described methods, i.e. using a finger on the touchscreen, a mouse pointer in the display, or a key on the instrument or on a keyboard.

1.3.3   Notes on Screenshots

When describing the functions of the product, we use sample screenshots. These screenshots are meant to illustrate as many as possible of the provided functions and possible interdependencies between parameters. The shown values may not represent realistic usage scenarios.

The screenshots usually show a fully equipped product, that is: with all options installed. Thus, some functions shown in the screenshots may not be available in your particular product configuration.

2   Documentation Overview

This section provides an overview of the R&S FSWP user documentation. Unless specified otherwise, you find most of the documents on the R&S FSWP product page at:

www.rohde-schwarz.com/manual/fswp

2.1   Getting Started Manual

Introduces the R&S FSWP and describes how to set up and start working with the product. Includes basic operations, typical measurement examples, and general information, e.g. safety instructions, etc.

A printed version is delivered with the instrument. A PDF version is available for download on the Internet.

2.2   User Manuals and Help

Separate user manuals are provided for the base unit and the firmware applications:

● Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.

● Manuals for (optional) firmware applications
  Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S FSWP is not included.

The contents of the user manuals are available as help in the R&S FSWP. The help offers quick, context-sensitive access to the complete information for the base unit and the firmware applications.

All user manuals are also available for download or for immediate display on the Internet.

2.3 Service Manual

Describes the performance test for checking the rated specifications, module replacement and repair, firmware update, troubleshooting and fault elimination, and contains mechanical drawings and spare part lists.

The service manual is available for download for registered users on the global Rohde & Schwarz information system (GLORIS):

https://gloris.rohde-schwarz.com

2.4 Instrument Security Procedures

Deals with security issues when working with the R&S FSWP in secure areas. It is available for download on the Internet.

2.5 Basic Safety Instructions

Contains safety instructions, operating conditions and further important information. The printed document is delivered with the instrument.

2.6 Data Sheets and Brochures

The data sheet contains the technical specifications of the R&S FSWP. It also lists the options and their order numbers, and optional accessories.

The brochure provides an overview of the instrument and deals with the specific characteristics.

See www.rohde-schwarz.com/brochure-datasheet/fswp

2.7 Release Notes and Open Source Acknowledgment (OSA)

The release notes list new features, improvements and known issues of the current firmware version, and describe the firmware installation.

The open source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/fswp

2.8 Application Notes, Application Cards, White Papers, etc.

These documents deal with special applications or background information on particular topics.

See www.rohde-schwarz.com/application/fswp

3   Preparing for Use

3.1   Putting into Operation

This section describes the basic steps to be taken when setting up the R&S FSWP for the first time.

⚠ WARNING

Risk of injury due to disregarding safety information

Observe the information on appropriate operating conditions provided in the data sheet to prevent personal injury or damage to the instrument. Read and observe the basic safety instructions provided with the instrument, in addition to the safety instructions in the following sections. In particular:

- Do not open the instrument casing.

NOTICE

Risk of instrument damage due to inappropriate operating conditions

Specific operating conditions are required to ensure accurate measurements and to avoid damage to the instrument. Observe the information on appropriate operating conditions provided in the basic safety instructions and the instrument's data sheet.

NOTICE

Instrument damage caused by electrostatic discharge

Electrostatic discharge (ESD) can damage the electronic components of the instrument and the device under test (DUT). Electrostatic discharge is most likely to occur when you connect or disconnect a DUT or test fixture to the instrument's test ports. To prevent electrostatic discharge, use a wrist strap and cord and connect yourself to the ground, or use a conductive floor mat and heel strap combination.

NOTICE

Risk of instrument damage due to inappropriate operating conditions

An unsuitable operating site or test setup can damage the instrument and connected devices. Before switching on the instrument, observe the information on appropriate operating conditions provided in the data sheet. In particular, ensure the following:

* All fan openings are unobstructed and the airflow perforations are unimpeded. The minimum distance from the wall is 10 cm.
* The instrument is dry and shows no sign of condensation.
* The instrument is positioned as described in the following sections.
* The ambient temperature does not exceed the range specified in the data sheet.
* Signal levels at the input connectors are all within the specified ranges.
* Signal outputs are connected correctly and are not overloaded.

EMI impact on measurement results

Electromagnetic interference (EMI) may affect the measurement results.

To suppress generated electromagnetic interference (EMI):

* Use suitable shielded cables of high quality. For example, use double-shielded RF and LAN cables.
* Always terminate open cable ends.
* Note the EMC classification in the data sheet.

3.1.1 Unpacking and Checking the Instrument

Check the equipment for completeness using the delivery note and the accessory lists for the various items. Check the instrument for any damage. If there is damage, immediately contact the carrier who delivered the instrument. Make sure not to discard the box and packing material.

> **⚠ WARNING**
>
> **Risk of injury during transportation**
>
> The carrying handles at the front and side of the casing are designed to lift or carry the instrument. Do not apply excessive force to the handles. If a handle is ripped off, the falling instrument can cause injury.
>
> Be aware of the weight of the instrument when lifting it. Observe the information on transporting heavy instruments in the basic safety instructions provided with the instrument.

> **ⓘ Packing material**
>
> Retain the original packing material. If the instrument needs to be transported or shipped later, you can use the material to protect the control elements and connectors.

3.1.2 Accessory List

The instrument comes with the following accessories:

- Power cable
- Printed Getting Started manual

3.1.3   Placing or Mounting the Instrument

The R&S FSWP is designed for use under laboratory conditions, either on a bench top or in a rack.

Bench Top Operation

If the R&S FSWP is operated on a bench top, the surface should be flat. The instrument can be used in horizontal position, standing on its feet, or with the support feet on the bottom extended.

⚠ **WARNING**

Risk of injury when stacking instruments

A stack of instruments can tilt over and cause injury if not stacked correctly. Furthermore, the instruments at the bottom of the stack can be damaged due to the load imposed by the instruments on top.

Observe the following instructions when stacking instruments:

- Never stack more than three instruments. If you need to stack more than three instruments, install them in a rack.

- The overall load imposed on the lowest instrument must not exceed 500 N.

- It is best if all instruments have the same dimensions (width and length). If you need to stack smaller instruments on the top, the overall load imposed on the lowest instrument must not exceed 250 N.

- If the instruments have foldable feet, fold them in completely.

Correct   Too many instruments   Different dimensions   Feet folded out

---
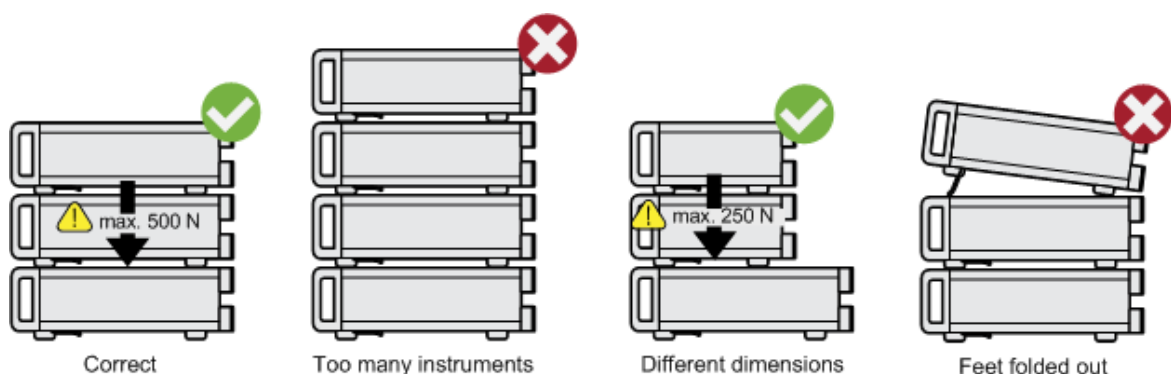
⚠ **WARNING**

Risk of injury if feet are folded out

The feet can fold in if they are not folded out completely or if the instrument is shifted. Collapsing feet can cause injury or damage the instrument.

- Fold the feet completely in or out to ensure stability of the instrument. Never shift the instrument when the feet are folded out.

- When the feet are folded out, do not work under the instrument or place anything underneath.

- The feet can break if they are overloaded. The overall load on the folded-out feet must not exceed 500 N.
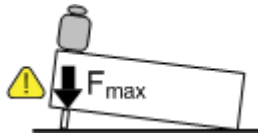
Rackmounting

The R&S FSWP can be installed in a rack using a rack adapter kit (order no. see data sheet). The installation instructions are part of the adapter kit.

NOTICE

Risk of instrument damage due to insufficient airflow in a rack

If the instrument is run with insufficient airflow for a longer period, the instrument overheats, which can disturb the operation and even cause damage.

Make sure that all fan openings are unobstructed, that the airflow perforations are unimpeded, and that the minimum distance from the wall is 10 cm.

3.1.4   Connecting the AC Power

In the standard version, the R&S FSWP is equipped with an AC power supply connector. The R&S FSWP can be used with different AC power voltages and adapts itself automatically to it. Refer to the datasheet for the requirements of voltage and frequency. The AC power connector is located on the rear panel of the instrument.

For details on the connector refer to Chapter 4.2.2, "AC Power Connector and Main Power Switch", on page 56.

► Connect the R&S FSWP to the AC power supply using the supplied power cable.
Since the instrument is assembled in line with the specifications for safety class EN61010, it may only be connected to an outlet that has a ground contact.

3.1.5   Switching the Instrument On and Off

Switching the instrument on

► Press the AC power switch on the rear panel to position "I".

The instrument is supplied with AC power. After booting, the instrument is ready for operation. A green LED above the [POWER] key indicates this. An orange LED indicates the instrument is in standby mode

Warm-up time for OCXO

When the instrument is switched on, the OCXO requires an extended warm-up time (see data sheet).

Switching the instrument off

1. Press the [POWER] key on the front panel.

   The R&S FSWP switches to standby mode.

2. Set the AC power switch on the rear panel to position "O", or disconnect the instrument from the AC power supply.

   The R&S FSWP changes into off mode.

NOTICE

Risk of losing data

If you switch off the running instrument using the rear panel switch or by disconnecting the power cord, the instrument loses its current settings. Furthermore, program data can be lost.

Press the Power key first to shut down the application properly.

3.1.6 Performing a Self-Alignment and a Selftest

During instrument start, the installed hardware is checked against the current firmware version to ensure the hardware is supported. If not, an error message is displayed ("WRONG_FW") and you are asked to update the firmware. Until the firmware version is updated, self-alignment fails.

(For details refer to the R&S FSWP User Manual).

Furthermore, it may be necessary to align the data to a reference source by performing a self-alignment when strong temperature changes occur.

Operating temperature

Before performing this functional test, make sure that the instrument has reached its operating temperature (for details, refer to the data sheet).

A message in the status bar ("Instrument warming up...") indicates that the operating temperature has not yet been reached.

Performing a self-alignment

1. Press the [SETUP] key.

2. Press the "Alignment" softkey.

3. Select the "Start Self-Alignment" button in the "Alignment" dialog box.

   Once the system correction values have been calculated successfully, a message is displayed.

> **To display the alignment results again later**
> - Press the [SETUP] key.
> - Press the "Alignment" softkey.

Performing a selftest

The selftest does not need to be repeated every time the instrument is switched on. It is only necessary when instrument malfunction is suspected.

1. Press the [SETUP] key.

2. Press the "Service" softkey.

3. Switch to the "Selftest" tab in the "Service" dialog box.

4. Select the "Start Selftest" button.

   Once the instrument modules have been checked successfully, a message is displayed.

3.1.7   Checking the Supplied Options

The instrument may be equipped with both hardware and firmware options. In order to check whether the installed options correspond to the options indicated on the delivery note, proceed as follows.

1. Press the [SETUP] key.

2. Press the "System Config" softkey.

3. Switch to the "Versions + Options" tab in the "System Configuration" dialog box.

   A list with hardware and firmware information is displayed.

4. Check the availability of the hardware options as indicated in the delivery note.

3.2   Windows Operating System

The instrument contains the Microsoft Windows operating system which has been configured according to the instrument's features and needs. Changes in the sys-

tem setup are only required when peripherals like keyboard or a printer are instal-
led or if the network configuration does not comply with the default settings. After
the R&S FSWP is started, the operating system boots and the instrument firm-
ware is started automatically.

To ensure that the instrument software functions properly, certain rules must be
adhered to concerning the operating system.

NOTICE

Risk of rendering instrument unusable

The instrument is equipped with the Microsoft Windows operating system.
You can install additional software on the instrument, however, additional
software can impair instrument function. Thus, run only programs that
Rohde & Schwarz has tested for compatibility with the instrument software.

The drivers and programs used on the instrument under Microsoft Windows
are adapted to the instrument. Only install update software released by
Rohde & Schwarz to modify existing instrument software.

The following program packages have been tested:
- Symantec Endpoint Security – virus-protection software
- FileShredder - for reliable deletion of files on the hard disk

3.2.1   Virus Protection

Take appropriate steps to protect your instruments from infection. Use strong fire-
wall settings and scan any removable storage device used with a
Rohde & Schwarz instrument regularly. It is also recommended that you install
anti-virus software on the instrument. Rohde & Schwarz does NOT recommend
running anti-virus software in the background ("on-access" mode) on Windows-
based instruments, due to potentially degrading instrument performance. How-
ever, Rohde & Schwarz does recommend running it during non-critical hours.

For details and recommendations, see the following Rohde & Schwarz white
paper:
- 1EF96: Malware Protection Windows 10

3.2.2 Service Packs and Updates

Microsoft regularly creates security updates and other patches to protect Windows-based operating systems. These are released through the Microsoft Update website and associated update server. Instruments using Windows, especially those that connect to a network, should be updated regularly.

For details and recommendations, see the Rohde & Schwarz White Paper 1EF96: Malware Protection Windows 10.

3.2.3 Login

Microsoft Windows requires that users identify themselves by entering a user name and password in a login window. By default, the R&S FSWP provides two user accounts:

- **"Instrument"**: an administrator account with unrestricted access to the computer/domain
- **"NormalUser"**: a standard user account with limited access

---

ⓘ **Secure user mode**

If the secure user mode option (R&S FSWP-K33) is installed, an additional account is provided: the **"SecureUser"**.

The "SecureUser" is a standard user account with limited functionality. In particular, administrative tasks such as LAN configuration or general instrument settings are not available. Furthermore, for a "SecureUser", data that the R&S FSWP normally stores on the solid-state drive is redirected to volatile memory instead. You can access data that is stored in volatile memory during the current instrument session. However, when the instrument's power is removed, all data in volatile memory is erased.

For details, see Chapter 3.7, "Protecting Data Using the Secure User Mode", on page 38.

Automatic login

For the administrator account, an automatic login function is active by default. If activated, login is carried out automatically for the administrator (with full access) in the background when the R&S FSWP is started, without having to enter a password. This function is active until you explicitly deactivate it or change the password.

For information on how to deactivate or reactivate the automatic login, refer to Chapter 3.2.3.1, "Automatic Login Function", on page 25.

Passwords

For all default user accounts, the initial password is *894129*. Note that this password is very weak, and it is recommended that you change the password for both users after initial login.

You can change the password in Microsoft Windows for any user at any time via "Start > Settings > Account > SignIn Options > Password > Change".

When the secure user mode is activated the first time after installation, the user is prompted to change the passwords for all user accounts to improve system security.

Changing the password and use of auto-login function

Note that when you change the default passwords, the default auto-login function no longer works! Reactivate it manually as described in "Reactivating the automatic login function" on page 26.

3.2.3.1   Automatic Login Function

When shipped, the instrument automatically logs on the default "Instrument" user to Microsoft Windows using the default password.

Switching users when using the automatic login function

Which user account is used is defined during login. If automatic login is active, the login window is not displayed. However, you can also switch the user account to be used when the automatic login function is active.

1. Select the "Windows" icon in the toolbar to access the operating system of the R&S FSWP (see also Chapter 3.2.4, "Accessing the Start Menu", on page 27).

2. Press [CTRL + ALT + DEL], then select "Sign out".

   The "Login" dialog box is displayed, in which you can enter the different user account name and password.

Deactivating the automatic login function

To deactivate the automatic login function, perform the following steps:

1. Select the "Windows" icon in the toolbar to access the operating system of the R&S FSWP (see also Chapter 3.2.4, "Accessing the Start Menu",
   on page 27).

2. In the "Start" menu, select "All applications > Windows System > Run".
   The "Run" dialog box is displayed.

3. Enter the command `C:\R_S\INSTR\USER\NO_AUTOLOGIN.REG`.

4. Press the [ENTER] key to confirm.
   This command deactivates the automatic login function. The next time you switch on the instrument, the operating system prompts you to enter your user name and password before it starts the firmware.

Adapting the automatic login function to a new password

If you change the "Instrument" user's password, which is used during automatic login, this function no longer works. Adapt the settings for the command that activates the auto login function first.

1. Open the `C:\R_S\INSTR\USER\NO_AUTOLOGIN.REG` file in any text editor (e.g. Notepad).

2. In the line `"DefaultPassword"="894129"`, replace the default password (`894129`) by the new password for automatic login.

3. Save the changes to the file.

Reactivating the automatic login function

1. Select the "Windows" icon in the toolbar to access the operating system of the R&S FSWP (see also Chapter 3.2.4, "Accessing the Start Menu",
   on page 27).

2. In the "Start" menu, select "All applications > Windows System > Run".
   The "Run" dialog box is displayed.

3. Enter the command `C:\R_S\INSTR\USER\AUTOLOGIN.REG`.

4. Press the [ENTER] key to confirm.
   This command reactivates automatic login function. It is active the next time the instrument reboots.

3.2.4   Accessing the Start Menu

The Windows "Start" menu provides access to the Microsoft Windows functionality and installed programs.

To open the "Start" menu:

► In Windows 10:

   Press the "Windows" key or the [CTRL + ESC] key combination on your (external) keyboard.

All necessary system settings can be defined in the "Start > Settings" menu (for required settings refer to the Microsoft Windows documentation and to the hardware description).

3.2.5   Accessing the Windows Taskbar

The Windows taskbar also provides quick access to commonly used programs, for example Paint or WordPad. IECWIN, the auxiliary remote control tool provided free of charge and installed by Rohde & Schwarz, is also available from the taskbar.

For details on the IECWIN tool, see the "Network and Remote Control" chapter of the R&S FSWP user manual.

To open the taskbar, select the "Windows" icon on the R&S FSWP toolbar, or press the "Windows" key or the [CTRL + ESC] key combination on your (external) keyboard.

3.3   Connecting USB Devices

The USB interfaces of the R&S FSWP allow you to connect USB devices directly to the instrument. Increase the number of possible connections using USB hubs. Due to the large number of available USB devices, there is almost no limit to the expansions that are possible with the R&S FSWP.

The following list shows various USB devices that can be useful:

- Memory stick for easy transfer of data to/from a computer (e.g. firmware updates)
- CD-ROM drives for easy installation of firmware applications
- Keyboard or mouse to simplify the entry of data, comments, filenames, etc.
- Printer for printing measurement results

Installing USB devices is easy under Windows, because all USB devices are plug&play. After a device is connected to the USB interface, the operating system automatically searches for a suitable device driver.

If Windows does not find a suitable driver, it prompts you to specify a directory that contains the driver software. If the driver software is on a CD, connect a USB CD-ROM drive to the instrument before proceeding.

When a USB device is then disconnected from the R&S FSWP, Windows immediately detects the change in hardware configuration and deactivates the corresponding driver.

All USB devices can be connected to or disconnected from the instrument during operation.

Connecting a memory stick or CD-ROM drive

If installation of a memory stick or CD-ROM drive is successful, Windows informs you that the device is ready to use. The device is made available as a new drive and is displayed in Windows Explorer. The name of the drive depends on the manufacturer.

Connecting a keyboard

The keyboard is detected automatically when it is connected. The default input language is English – US.

However, you can also connect foreign language keyboards; currently the following languages are supported for the R&S FSWP:

- German
- Swiss
- French
- Russian

Select "Start > Settings > Time & language > Region & language > Add a language" to configure the keyboard language. To access the Windows operating system, press the Windows key on the external keyboard.

Connecting a mouse

The mouse is detected automatically when it is connected.

Select "Start > Settings > Devices > Mouse & touchpad" to configure the mouse properties. To access the Windows operating system, press the Windows key on the external keyboard.

Connecting a printer

When printing a file, the instrument checks whether a printer is connected and turned on and whether the appropriate printer driver is installed. If necessary, printer driver installation is initiated. You only have to install a printer driver once.

To install a printer, select "Start > Settings > Devices > Add a printer or scanner". To access the Windows operating system, press the Windows key on the external keyboard.

You can load updated and improved driver versions or new drivers from an installation disk, USB memory stick or another external storage medium. If the instrument is integrated in a network, you can also install driver data stored in a network directory.

Select "Start > Settings > Devices > Device Manager > Update Device drivers" to install the driver.

3.4   Connecting an External Monitor

You can connect an external monitor (or projector) to the DVI or display port connector on the instrument's rear panel.

(See also Chapter 4.2.3, "DisplayPort and DVI", on page 56).

Screen resolution and format

The touchscreen of the R&S FSWP is calibrated for a 16:10 format. If you connect a monitor or projector using a different format (e.g. 4:3), the calibration will not be correct and the screen will not react to your touch actions properly.

The touchscreen has a screen resolution of 1280x800 pixels. Most external monitors have a higher screen resolution. If the screen resolution of the monitor is set higher than the instrument's resolution, the application window uses an area of 1280x800 pixels on the monitor display. For full screen display, adjust the monitor's screen resolution.

The R&S FSWP supports a minimum resolution of 1280x768 pixels.

---

1. Connect the external monitor to the R&S FSWP.

2. Press the [SETUP] key.

3. Press the "Display" softkey.

4. Select the "Configure Monitor" tab in the "Display" dialog box.

   The standard Windows "Screen Resolution" dialog box is displayed.
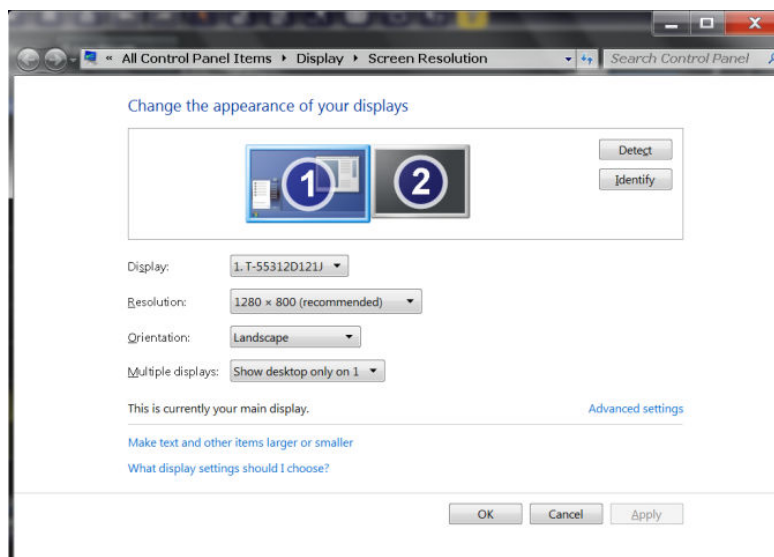
5. If necessary, change the screen resolution to be used. Consider the information in the note above.

6. Select the instrument to be used for display:
   - "Display 1": internal monitor only

- "Display 2": external monitor only
- "Duplicate": both internal and external monitor

7. Tap "Apply" to try out the settings before they are accepted permanently, then you can easily return to the previous settings, if necessary.

8. Select "OK" if the settings are suitable.

3.5   Setting Up a Network (LAN) Connection

A LAN connection is the prerequisite for all network operations. The LAN connection settings can be configured directly in the Windows operating system.

The R&S FSWP is equipped with a network interface and can be connected to an Ethernet LAN (local area network). Provided the network administrator has assigned you the appropriate rights and adapted the Windows firewall configuration, you can use the interface, for example:

- To transfer data between a controlling device and the test device, e.g. to run a remote control program.
  See chapter "Remote Control" in the R&S FSWP user manual.
- To access or control the measurement from a remote computer using the "Remote Desktop" application (or a similar tool)
- To connect external network devices (e.g. printers)
- To transfer data from a remote computer and back, e.g. using network folders

This section describes how to configure the LAN interface. It includes the following topics:

- Chapter 3.5.1, "Connecting the Instrument to the Network", on page 32
- Chapter 3.5.2, "Assigning the IP Address", on page 33

Note that only user accounts with administrator rights can configure LAN networks.

LXI

The R&S FSWP supports the LXI core features. LXI gives you direct access to the LAN settings described below.

For further information on the LXI interface, refer to the user manual.

3.5.1 Connecting the Instrument to the Network

There are two methods to establish a LAN connection to the instrument:

● A non-dedicated network (Ethernet) connection from the instrument to an existing network made with an ordinary RJ-45 network cable. The instrument is assigned an IP address and can coexist with a computer and with other hosts on the same network.

● A dedicated network connection (Point-to-point connection) between the instrument and a single computer made with a (crossover) RJ-45 network cable. The computer must be equipped with a network adapter and is directly connected to the instrument. The use of hubs, switches, or gateways is not required, however, data transfer is still performed using the TCP/IP protocol. You must assign an IP address to the instrument and the computer, see Chapter 3.5.2, "Assigning the IP Address", on page 33.
Note: As the R&S FSWP uses a 1 GBit LAN, a crossover cable is not necessary (due to Auto-MDI(X) functionality).

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:
● Connecting the instrument to the network
● Configuring the network
● Changing IP addresses
● Exchanging hardware

Errors can affect the entire network.

► To establish a non-dedicated network connection, connect a commercial RJ-45 cable to one of the LAN ports.
To establish a dedicated connection, connect a (crossover) RJ-45 cable between the instrument and a single PC.

If the instrument is connected to the LAN, Windows automatically detects the network connection and activates the required drivers.

The network card can be operated with a 1 GBit Ethernet IEEE 802.3u interface.

3.5.2   Assigning the IP Address

Depending on the network capacities, the TCP/IP address information for the instrument can be obtained in different ways.

● If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.

● If the network does not support DHCP, or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

By default, the instrument is configured to use dynamic TCP/IP configuration and obtain all address information automatically. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

NOTICE

Risk of network errors

Connection errors can affect the entire network. If your network does not support DHCP, or if you choose to disable dynamic TCP/IP configuration, you must assign valid address information before connecting the instrument to the LAN. Contact your network administrator to obtain a valid IP address.

Assigning the IP address on the instrument

1. Press the [SETUP] key.

2. Press the "Network + Remote" softkey.

3. Select the "Network" tab.

4. In the "Network + Remote" dialog, toggle the "DHCP On/Off" setting to the required mode.
   If DHCP is "Off", you must enter the IP address manually, as described in the following steps.
   Note: When DHCP is changed from "On" to "Off", the previously set IP address and subnet mask are retrieved.
   If DHCP is "On", the IP address of the DHCP server is obtained automatically. The configuration is saved, and you are prompted to restart the instrument. You can skip the remaining steps.
   Note: When a DHCP server is used, a new IP address may be assigned each time the instrument is restarted. This address must first be determined on the instrument itself. Thus, when using a DHCP server, it is recommended that

you use the permanent computer name, which determines the address via the DNS server
(See "Using a DNS server to determine the IP address" on page 34 and Chapter 3.5.3, "Using Computer Names", on page 36).

5. Enter the "IP Address", for example *192.0.2.0*. The IP address consists of four number blocks separated by dots. Every block contains a maximum of 3 numbers.

6. Enter the "Subnet Mask", for example *255.255.255.0*. The subnet mask consists of four number blocks separated by dots. Every block contains a maximum of 3 numbers.

7. Select "Configure Network".

   If you have entered an invalid IP address or subnet mask, the message "out of range" is displayed in the status line. If the settings are correct, the configuration is saved, and you are prompted to restart the instrument.

8. Confirm the displayed message ("Yes" button) to restart the instrument.

Using a DNS server to determine the IP address

If a DNS server is configured on the R&S FSWP, the server can determine the current IP address for the connection using the permanent computer name.

1. Obtain the name of your DNS domain and the IP addresses of the DNS and WINS servers on your network.

2. Press the "Windows" key on the external keyboard or the [CTRL + ESC] key combination on your keyboard to access the operating system.

3. Select "Start > Settings > Network & Internet > Ethernet > Network and Sharing Center > Connections: Ethernet".
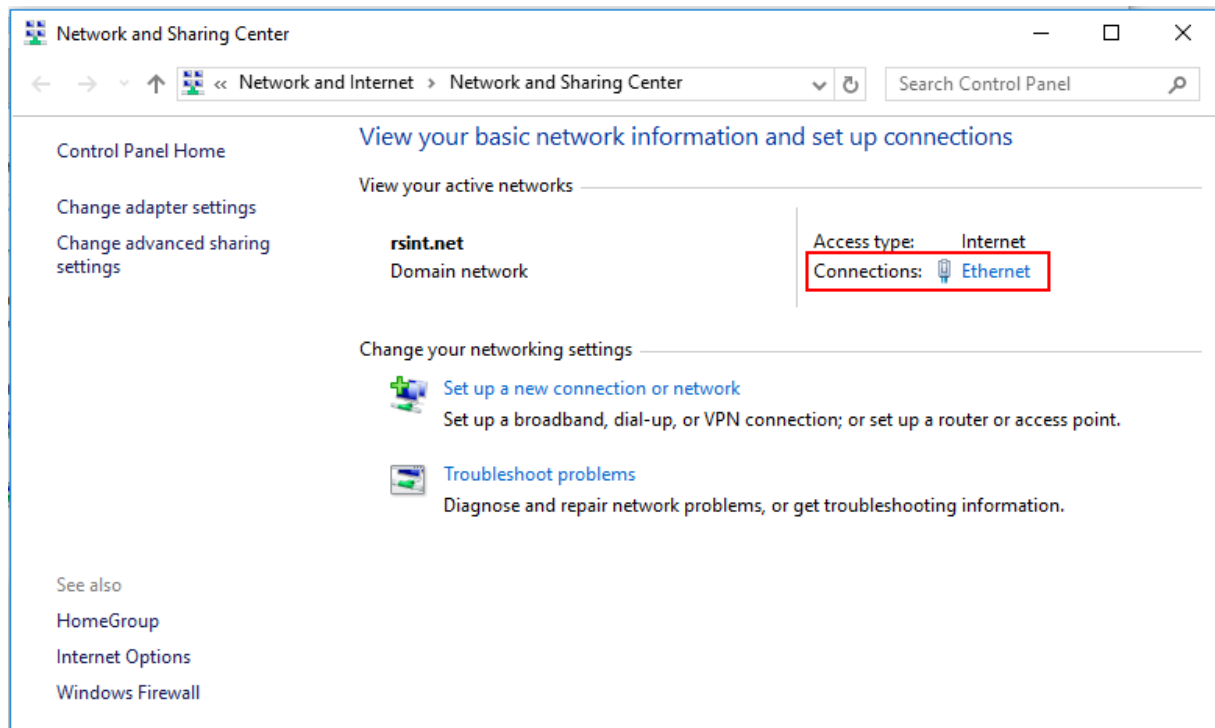
4. In the "Ethernet Status" dialog box, select the "Properties" button.

The items used by the LAN connection are displayed.
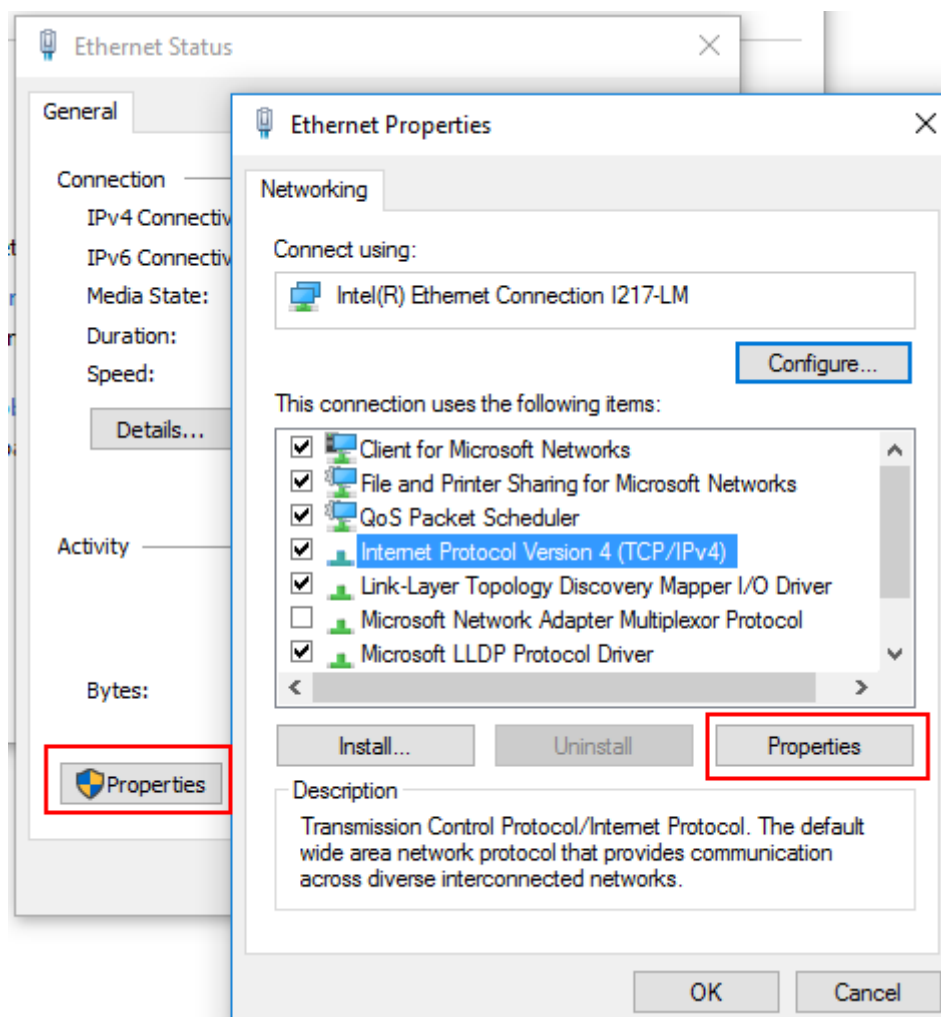
5. Tap the entry named "Internet Protocol Version 4 (TCP/IPv4)" to highlight it.

6. Select the "Properties" button.

7. On the "General" tab, select "Use the following DNS server addresses" and enter your own DNS addresses.

   For more information, refer to the Windows operating system help.

3.5.3 Using Computer Names

In a LAN that uses a DNS server (Domain Name System server), each PC or instrument connected in the LAN can be accessed via an unambiguous computer name instead of the IP address. The DNS server translates the host name to the IP address. This is especially useful when a DHCP server is used, as a new IP address may be assigned each time the instrument is restarted.

Each instrument is delivered with an assigned computer name, but this name can be changed.

The default instrument name is a non-case-sensitive string with the following syntax:

<Type><variant>-<serial_number>

The serial number can be found on the rear panel of the instrument. It is the third part of the device ID printed on the bar code sticker:

For example, FSWP26-123456

To change the computer name

1. Press the [Setup] key and then the "Network + Remote" softkey.
   The current "Computer Name" is displayed in the "Network" tab.

2. Enter the new computer name.

3. Close the dialog box.

3.5.4 Changing the Windows Firewall Settings

A firewall protects an instrument by preventing unauthorized users from gaining access to it through a network. Rohde & Schwarz highly recommends the use of the firewall on your instrument. Rohde & Schwarz instruments are shipped with the Windows firewall enabled and preconfigured in such a way that all ports and connections for remote control are enabled.

For more details on firewall configuration, see the following Rohde & Schwarz White Paper:

● 1EF96: Malware Protection Windows 10

Note that changing firewall settings requires administrator rights.

3.6   Setting the Date and Time

Users with administrator rights can set the date and time for the internal real time clock as follows:

Opening the Date and Time Properties dialog box

1. Press the [SETUP] key.

2. Press the "Display" softkey.

3. Select the "General" tab in the "Display" dialog box.

4. Press the "Set Date and Time" button to open the standard Windows "Date and Time Properties" dialog box.

5. If necessary, toggle the "Date and Time Format" between German (DE) and US.

   After you have made a change and closed the dialog box, the new date and time is also adopted by the instrument.

3.7   Protecting Data Using the Secure User Mode

During normal operation, the R&S FSWP uses a solid-state drive to store its operating system, instrument firmware, instrument self-alignment data, and any user data created during operation. If necessary, the solid-state drive can be removed from the R&S FSWP and locked in a secure place to protect any classified data it may contain.

Redirecting storage to volatile memory

Alternatively, to avoid storing any sensitive data on the R&S FSWP permanently, the *secure user mode* was introduced (option R&S FSWP-K33). In secure user mode the instrument's solid-state drive is write-protected so that no information can be written to memory permanently. Data that the R&S FSWP normally stores on the solid-state drive is redirected to volatile memory instead, which remains available only until the instrument is switched off. This data includes:

- Windows operating system files
- Firmware shutdown files containing information on last instrument state

- Self-alignment data
- General instrument settings such as the IP address
- Measurement settings
- User data created during operation
- Any data created by other applications installed on the R&S FSWP, for example text editors (Notepad), the Clipboard, drawing tools, etc.

Users can access data that is stored in volatile memory just as in normal operation. However, when the instrument's power is switched off, all data in this memory is cleared. Thus, in secure user mode, the instrument always starts in a defined, fixed state when switched on.

To store data such as measurement results permanently, it must be stored to an external storage device, such as a memory stick.

Limited storage space

The volatile memory used to store data in secure user mode is restricted to 256 MB. Thus, a "Memory full" error can occur although the hard disk indicates that storage space is still available.

Storing required data permanently

Any data that is to be available for subsequent sessions with the R&S FSWP must be stored on the instrument permanently, *before activating the secure user mode*. This includes predefined instrument settings, transducer factors and self-alignment data.

Self-alignment data

Note that self-alignment data becomes invalid with time and due to temperature changes. Therefore, to achieve optimal accuracy, it may be preferable to perform a new self-alignment at the start of each new session on the R&S FSWP.

Restricted operation

Since permanent storage is not possible, the following functions are not available in secure user mode:

- Firmware update
- Activating a new option key

Furthermore, since the "SecureUser" used in secure user mode does not have administrator rights, **administrative tasks** such as LAN configuration and some general instrument settings are not available. Refer to the description of the basic instrument setup ([SETUP] menu) to find out which functions are affected.

Activating and deactivating secure user mode

Only a user with administrator rights can activate the secure user mode. Once activated, a restart is required. The special user "SecureUser" is then logged on to the R&S FSWP automatically using the automatic login function. While the secure user mode is active, a message is displayed in the status bar at the bottom of the screen.

> **Secure Passwords**
>
> By default, the initial password for both the administrator account ("Instrument") and the "SecureUser" account is "894129". When the secure user mode is activated the first time after installation, you are prompted to change the passwords for all user accounts to improve system security. Although it is possible to continue without changing the passwords, it is strongly recommended that you do so.
>
> You can change the password in Microsoft Windows for any user at any time via "Start > Settings > Account > SignIn Options > Password > Change".

To deactivate the secure user mode, the "SecureUser" must log off and the "Instrument" user (administrator) must log on.

> **Switching users when using the automatic login function**
>
> In the "Start" menu, select the arrow next to the "Shut down" button and then "Log off".
>
> The "Login" dialog box is displayed, in which you can enter the different user account name and password.

The secure user mode setting and automatic login is automatically deactivated when the "Instrument" user logs on. The "SecureUser" is no longer available.

For administrators ("Instrument" user), the secure user mode setting is available in the general system configuration settings ([Setup] key > "System Configura-

tion" softkey > "Config" tab > "Secure User Mode": "ON", see the R&S FSWP
User Manual).

Remote control

Initially after installation of the R&S FSWP-K33 option, secure user mode must be
enabled manually once before remote control is possible.

This is necessary to prompt for a change of passwords.

4   Instrument Tour

On the instrument tour, you can learn about the different control elements and connectors on the front and back panel of the R&S FSWP.

4.1   The Front Panel

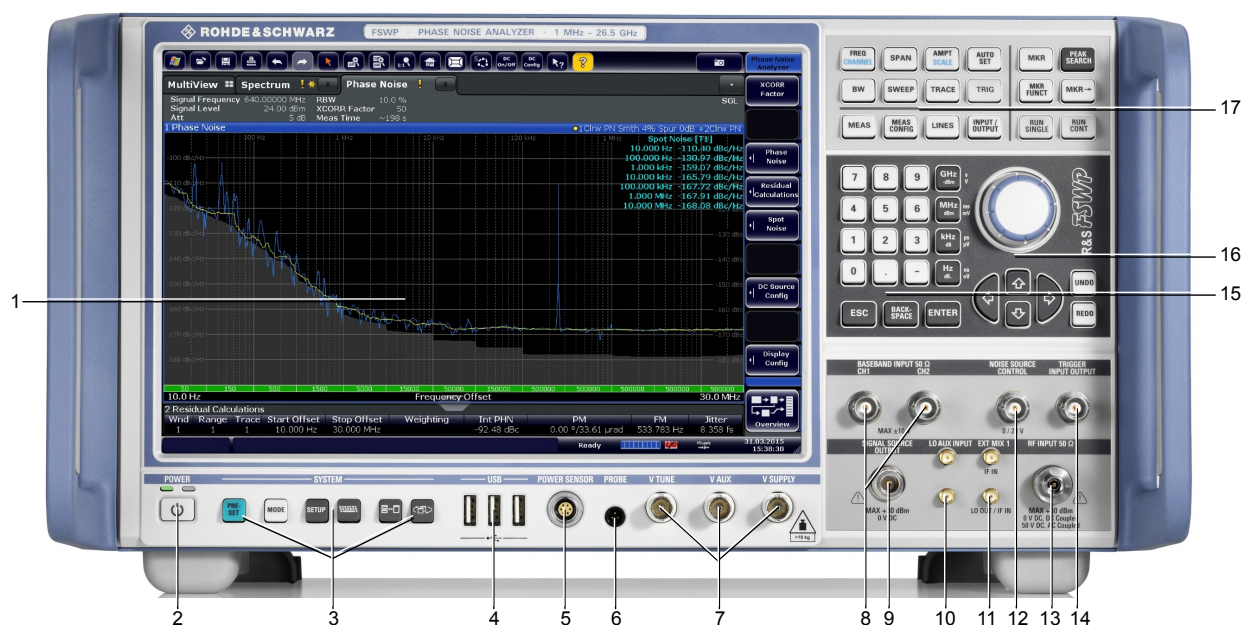This chapter describes the front panel, including all function keys and connectors.

Figure 4-1: Front panel of the R&S FSWP

1   = Display (touchscreen)
2   = Power key
3   = System control keys
4   = USB 2.0 interfaces
5   = Power sensor connector
6   = Probe power connector
7   = DC power connectors
8   = Baseband connectors
9   = Signal source output (optional)
10 = External LO input (optional)
11 = External mixer ports (optional)

12 = Noise source control
13 = RF input
14 = Trigger in- and output
15 = Keypad
16 = Navigation control
17 = Function keys

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances such as solvents (thinners, acetone, etc.), acids, bases, or other substances. Solvents can damage the front panel labeling, plastic parts, or screens, for example.

Never use cleaning agents to clean the outside of the instrument. Use a soft, dry, lint-free dust cloth instead.

4.1.1　Display (Touchscreen)

The touchscreen on the front panel of the R&S FSWP displays the measurement results. Additionally, the screen display provides status and setting information and allows you to switch between various measurement tasks. The screen is

touch-sensitive, offering an alternative means of user interaction for quick and easy handling of the instrument.

NOTICE

Risk of touchscreen damage

Inappropriate tools or excessive force can damage the touchscreen.

Observe the following instructions when operating the touchscreen:

- Never touch the screen with ball point pens or other sharp objects, use your fingers instead.
  As an alternative, you can use a stylus pen with a smooth soft tip.

- Never apply excessive force to the screen. Touch it gently.

- Never scratch the screen surface, for example with a finger nail.

- Never rub the screen surface strongly, for example with a dust cloth.
  For instructions on cleaning the screen, see the Maintenance chapter in the R&S FSWP user manual.

---

1 = Toolbar: contains general functionality of the firmware (print, save etc.).
2 = Channel tabs: each tab contains a measurement channel.
3 = Channel bar: shows measurement settings and allows you to change those settings easily.

---

4 = Result display: contains the measurement results.
5 = Window title bar: contains diagram-specific (trace) information.
6 = Status bar: contains system messages, progress bar and date and time.
7 = Input field.
8 = Diagram footer: contains diagram-specific information.
9 = Softkeys: provide access to measurement functions.

A touchscreen is a screen that is touch-sensitive, i.e. it reacts in a specified way when a particular element on the screen is tapped by a finger or a pointing device, for example. Any user interface elements that can be clicked on by a mouse pointer can also be tapped on the screen to trigger the same behavior, and vice versa.

Using the touchscreen, the following tasks (among others) can be performed by the tap of your finger:

- Changing a setting
- Changing the display
- Moving a marker
- Zooming into a diagram
- Selecting a new evaluation method
- Scrolling through a result list
- Saving or printing results and settings

To imitate a right-click by mouse using the touchscreen, for example to open a context-sensitive menu for a specific item, press the screen for about 1 second.

4.1.2   Power Key

The Power key on the front panel turns the instrument on and off.

	The color of the LED above the key shows its current state.
(power symbol)	- Orange: instrument is in stand-by mode.
	- Green: instrument is running.

For more information see Chapter 3.1.5, "Switching the Instrument On and Off", on page 20.

4.1.3   System Control Keys

System control keys provide access to the basic instrument configuration.

Please refer to the User Manual for an extensive description of the system configuration functionality.

PRE-SET	Resets the instrument to its default configuration.
MODE	Selects a particular measurement application or operating mode.
SETUP	Provides functionality to configure basic instrument characteristics, for example: ● the LAN connection ● the date and time ● the display configuration ● the reference frequency ● firmware update and application installation ● service functions ● transducer configuration
	Provides access to the on-screen keyboard.
	Turns full screen mode on and off.
	Selects a window in split screen mode or browses through active windows in full screen mode.

4.1.4 The Function Keys

Function keys provide access to the most common measurement settings and functions.

Please refer to the User Manual for an extensive description of the measurement settings and functions.

FREQ CHANNEL	Provides functionality to define frequency parameters, for example: ● the measurement range ● the signal frequency
SPAN	Provides functionality to configure the measurement range.

AMPT **SCALE**	Provides functionality to configure amplitude or level characteristics, for example: • the attenuation • the input impedance • the scale of the level axis • the preamplifier
AUTO SET	Provides functionality to automatically define various parameters like the level or frequency.
BW	Provides functionality to define various filter bandwidths.
SWEEP	Provides functionality to configure the measurement, for example: • the measurement mode (single or continuous measurements) • the number of measurements
TRACE	Provides functionality to configure data acquisition and analyze measured data, for example: • the trace mode • the displayed result
TRIG	n/a
MKR	Provides functionality to activate and position absolute and relative markers (markers and delta markers).
PEAK SEARCH	Performs a peak search for active markers. If no marker is active, Marker 1 is activated and the peak search is performed for it.
MKR FUNCT	n/a
MKR→	Provides functionality to position and control markers, for example: • to configure the marker search • to configure the peak excursion
MEAS	Provides the measurement functions, for example: • the Phase Moise measurement
MEAS CONFIG	Provides functionality to configure the measurement.
LINES	Provides functionality to control display and limit lines.
INPUT / OUTPUT	Provides functionality to configure inputs and outputs.

RUN SINGLE	Starts a measurement in single measurement mode.
RUN CONT	Starts a measurement in continuous measurement mode.

4.1.5   The Keypad

The alphanumeric keys allow you to enter alphanumeric characters where necessary (for example in dialog boxes or input fields). The keypad containing the alphanumeric keys also provides keys that select a particular unit.

0 ... **9**	Provide access to numbers and (special) characters.
.	Inserts a decimal point at the cursor position (".").
–	Changes the sign of a numeric value or inserts a dash character ("-") in case of alphanumeric input.
Hz dB.. ... **GHz** -dBm	Selects a particular unit for a numeric value. The labels on and next to the key state the units it selects.
	Pressing one of the unit keys also completes the entry of a numeric value. Note that in case of level entries (dB, dBm etc.) or dimensionless values, all unit keys have the value "1" as multiplying factor and thus work like the [ENTER] key..
ESC	Provides the following functions:
	In dialog boxes:
	• Closes all kinds of dialog boxes if edit mode is not active.
	• Quits edit mode if it is active.
	• Selects the "Cancel" button when available.
	In "Edit" dialog boxes:
	• If data entry has been started, it retains the original value and closes the dialog box.
	• If data entry has not been started or has been completed, it closes the dialog box.

BACK-SPACE	Deletes the character to the left of the cursor (if an (alpha)numeric entry has been started already.
ENTER	Provides the following functions: • Completes the entry of input made with the alphanumeric keys (numeric or alphanumeric) and accepts the input. If you enter a numeric value that has a unit, the [ENTER] key works like the [HZ/DB] key. • Selects the default or focused element in dialog boxes.

4.1.6   Navigation Control

Navigation control consists of a rotary knob and cursor keys. These keys allow you to navigate within the display or within dialog boxes.

In addition to the rotary knob and the cursor keys, the navigation control also provides undo / redo functionality.

Rotary knob

The rotary knob allows you to do several things:

- It increases or decreases any kind of numeric value. In most cases, the rotary knob changes numeric values with a fixed step size.
  Turning it to the right corresponds to an increase, turning it to the left to a decrease of a numeric value.

- It works like a cursor key in dialog boxes or lists (for example dropdown menus). In that case you can navigate to one of the items with the rotary knob. If the dialog box covers more than one screen page, it also scrolls through the dialog box.
  Turning it to the right corresponds to a downward movement. Moving it to the left to an upward movement.

- It moves around markers and other graphical elements on the screen. In most cases, the step size is fix.

- Pressing the rotary knob has the same effect as pressing the [ENTER] key as it confirms an entry or selection.

Cursor keys

The cursor keys allow you to do several things:

- The up and down keys increase or decrease any kind of numeric value if an input field is active.
  The cursor keys change numeric values with a fixed step size.

- The cursor keys navigate through dialog boxes or lists (for example dropdown menus).
- The left and right keys move the cursor in an input field in the corresponding direction.
- The up and down keys move markers around.
  The step size is fix.
- The cursor keys allow you to navigate to a cell in a table.
- The cursor keys move a scroll bar (vertical or horizontal) in dialog boxes that have one.

Undo and redo functionality

UNDO	Reverts the software to an older state by erasing the last change you have applied. The undo function is useful, for example, if you are performing a measurement with several markers and a limit line and accidentally select a different measurement. In this case, a lot of settings would be lost. However, if you press [UNDO] immediately afterwards, the previous status is retrieved.
REDO	Reverses an undo action or repeats the most recently performed action.

The [UNDO] function is not available after a [PRESET] or "RECALL" operation. When these functions are used, the history of previous actions is deleted.

4.1.7   RF Input (50 Ω)

The RF Input allows you to connect a device under test (or DUT) to the R&S FSWP, usually via cable and an appropriate connector (for example a male N connector).

The supported frequency range depends on the R&S FSWP model you have. Refer to the datasheet for details.

The RF Input also serves as an attenuator in case you are measuring signal with high levels. The supported attenuation range depends on the R&S FSWP model you have. Refer to the datasheet for details..

> **NOTICE**
>
> **Risk of instrument damage**
>
> Do not overload the RF input. For maximum allowed values, see the data sheet.
>
> When measuring unknown signals, always apply attenuation to protect the input mixer. Otherwise, the input mixer may be damaged or destroyed.
>
> For AC coupling, a DC input voltage of 50 V must never be exceeded. For DC coupling, DC voltage must not be applied at the input. In both cases, noncompliance will destroy the input mixers.

4.1.8   Signal Source Output

The optional "Signal Source" output allows you to generate a signal that can be fed into the DUT or other external accessories like frequency dividers or amplifiers. You can connect the DUT or accessories with a cable that has a male N connector.

> **NOTICE**
>
> **Risk of damage to the R&S FSWP**
>
> The maximum supported reverse power is 30 dBm. Make sure that this value is not exceeded to avoid damage to the R&S FSWP.

The maximum DC output voltage is 0 V.

For details on configuring the signal source output and generating a signal, see the User Manual.

4.1.9   USB Ports

The three USB ports on the front panel (type A) allow you to connect devices like keyboards, mouses or memory sticks.

The R&S FSWP provides additional USB ports (including one type B port) on the rear panel.

All USB ports support standard 2.0.

4.1.10 Power Sensors

The female Lemosa connector allows you to connect power sensors of the R&S NRP-Zxy family to the R&S FSWP.

For an extensive list of supported power sensors, refer to the data sheet.

For details on configuring and using power sensors, see the User Manual.

4.1.11 Probe Power Connector (3 Pins)

The Probe Power connector allows you to supply external equipment with power (for example probes or transducers).

The three-pinned probe power connector supports supply voltages from +15 V to -12.6 V and ground. The maximum permissible current is 150 mA. This probe power connector is suitable, for example, for high-impedance probes.

4.1.12 Noise Source Control

The female BNC connector labeled "Noise Source" allows you to connect and control an external noise source, and supplies the required supply voltage.

You can use a noise source, for example, to measure the noise figure and gain of amplifiers and frequency converting devices.

Conventional noise sources require a voltage of +28 V in order to be switched on and 0 V to be switched off. The output supports a maximum load of 100 mA.

4.1.13 Trigger Input and Output

The female BNC connector labeled "Trigger Input / Output" allows you to receive an external trigger signal or send a trigger signal to another device.

When you are using the connector as a trigger input, you can apply voltages in the range from 0.5 V to 3.5 V (the default value is 1.4 V). The typical input impedance is 10 kΩ.

When you are using the connector as a trigger output, the TTL compatible signal is transmitted (0 V / 5 V).

Note that you can find another connector for trigger input and output on the rear panel.

For more information about controlling and configuring trigger input and output, refer to the User Manual.

4.1.14 Baseband Input

The two connectors labeled "Baseband Input 50 Ω" are two female BNC connectors that you can use to connect a DUT for Baseband Noise measurements.

When you perform measurements with two external mixers, the "Ch2" connector is the IF input for the second mixer. This function is available with the optional external mixer support.

NOTICE

Risk of instrument damage

Do not overload the baseband input. An overload condition can damage or destroy the baseband inputs.

For maximum allowed values, see the data sheet.

4.1.15 External Mixer (Optional)

The two (optional) SMA connectors (LO OUT/IF IN and IF IN) allow you to connect external mixers.

External mixers increase the available frequency range. The way to connect an external mixer depends on the type of mixer and thes test setup. For more information about connecting and controlling external mixers refer to the User Manual.

If not in use, it is recommended to cover the SMA connectors with the provided protective caps.

4.1.16   DC Power Supply

The female BNC connectors labeled "V_{Tune}", "V_{Aux}" and "V_{Supply}" allow you to supply external devices, for example a DUT or an external reference oscillator, with the required voltage.

The V_{Supply} connector provides supply voltage from 0 V to +16 V, for example to provide voltage for an oscillator. The supported maximum current is 2000 mA.

The V_{Tune} connector provides tuning voltage from -10 V to +28 V. The supported maximum current is 20 mA.

The V_{Aux} connector provides DC voltage from -10 V to +10 V. The supported maximum current is 100 mA.

For more information about configuring the DC Power supply, refer to the User Manual.

4.1.17   LO AUX Input (Optional)

The two optional connectors labeled "LO AUX Input - Ch1" and "LO AUX Input - Ch2" are two female SMA connectors that you can use to connect an external local oscillator (LO). The external LO requires two connectors ("Ch1" and "Ch2") to work properly.

The "LO AUX Input" connectors are part of the optional Signal Source.

> **NOTICE**
>
> **Risk of instrument damage**
>
> Do not overload the LO AUX input. An overload condition can damage or destroy the inputs.
>
> For maximum allowed values, see the data sheet.

4.2   The Rear Panel

The rear panel contains various connectors for various purposes.
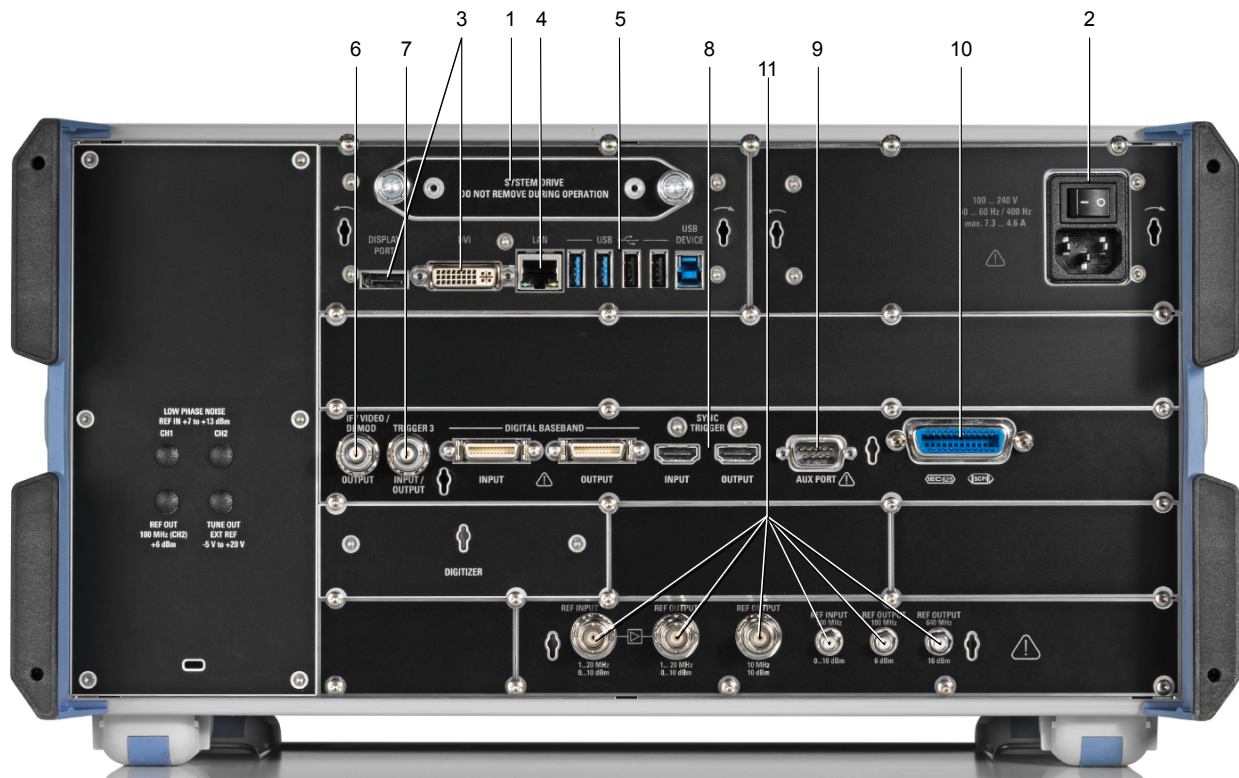
Figure 4-2: Rear panel of the R&S FSWP

1 = Removable hard disk
2 = AC power connector and power switch
3 = DisplayPort and DVI
4 = LAN interface
5 = USB ports
6 = IF / Video / Demod output
7 = Trigger in- / output
8 = Sync trigger input and output
9 = AUX port
10 = GPIB interface
11 = Ref input and output

For information about the trigger in- and output available on the rear panel, see

The digital baseband in- and outputs shown in the image above are not supported by the R&S FSWP.

4.2.1   Removable Hard Disk

The removable hard disk is accessible from the rear of the instrument.

In addition to the operating system and the firmware, the R&S FSWP also stores measurement data on that disk. When you remove the hard disk, you can store it and the data on it somewhere secure.

4.2.2   AC Power Connector and Main Power Switch

The AC power supply and main power switch are located in a unit on the rear panel of the instrument.

The main power switch has the following states.
- Position "1": The instrument is supplied with power.
- Position "0": The instrument is disconnected from the power supply.

For details refer to Chapter 3.1.5, "Switching the Instrument On and Off", on page 20.

4.2.3   DisplayPort and DVI

You can connect an external monitor or other display device to the R&S FSWP. Another display device allows you to view the user interface on a bigger screen. Two different types of connectors are provided for this purpose:

- DisplayPort
- DVI (Digital Visual Interface)

For details see Chapter 3.4, "Connecting an External Monitor", on page 29.

4.2.4   LAN Connector

The LAN interface allows you to connect the R&S FSWP to a local network for remote control, printouts or data transfer. The assignment of the RJ-45 connector supports twisted-pair category 5 UTP/STP cables in a star configuration (UTP stands for *unshielded twisted pair*, and STP for *shielded twisted pair*).

For details see Chapter 3.5, "Setting Up a Network (LAN) Connection", on page 31.

4.2.5   USB Ports

The four USB ports on the rear panel (type A) allow you to connect devices like keyboards, mouses or memory sticks.

The male USB connector (type B) allows you to connect the R&S FSWP to a computer and establish a remote control connection, for example.

All USB connectors support standard 2.0.

4.2.6   IF / Video / Demod Output

The two female BNC connectors can be used for various outputs:

● Output of the intermediate frequency (IF)
● Output of the video signal

Details about configuring the output type and characteristics are part of the user manual.

Note that you can use this connector for applications available with the optional spectrum analyzer hardware and analog demodulation application.

4.2.7   IF Wide Out

You can extend the signal analysis bandwidth of the R&S FSWP by installing a hardware option. The bandwidth extension allows for a linear bandwidth up to 320 MHz.

You can activate and deactivate the bandwidth extension manually in the I/Q analyzer that is integral part of the optional spectrum analyzer (R&S FSWP-B1) or other optional applications that require the spectrum analyzer hardware.

Together with the bandwidth extension an additional IF output connector is provided (if wide output). As opposed to the default IF / Video / Demod Output connector, the IF output frequency of the optional connector cannot be defined manually, but is determined automatically depending on the center frequency. For details on the used frequencies, see the data sheet. The if wide output connector is used automatically when the bandwidth extension is activated (i.e. for bandwidths > 80 MHz).

4.2.8   Sync Trigger Input and Output

The "Sync Trigger Input / Output" connectors allow you to synchronize several devices (for example two R&S FSWPs) with respect to the trigger signal, but also the reference frequency. A 100 MHz signal can be output as a trigger or reference signal to another device, and an external trigger or reference signal can be received at the input connector by the R&S FSWP.

4.2.9   AUX Port

The 9 pole SUB-D male connector provides control signals for controlling external devices. The voltage levels are TTL compatible (max. 5 V).

Pin	Signal	Description
1	+5 V / max. 250 mA	Supply voltage for external circuits
2 to 7	I/O	Control lines for user ports (see User Manual)
8	GND	Ground
9	READY FOR TRIGGER	Signal indicating that the instrument is ready to receive a trigger signal (Low active = 0 V)

NOTICE

Short-circuit hazard

Always observe the designated pin assignment. A short-circuit can damage the port.

4.2.10   GPIB Interface

The GPIB interface is in compliance with IEEE488 and SCPI. A computer for remote control can be connected via this interface. To set up the connection, a shielded cable is recommended. For more details refer to "Setting Up Remote Control" in the User Manual.

4.2.11   External Generator Control (Optional)

The optional "External Generator Control" provides an additional GPIB interface and AUX port.

The GPIB connector can be used to connect an external generator to the R&S FSWP.

The AUX port is required for TTL synchronization, if supported by the generator (see Chapter 4.2.9, "AUX Port", on page 58).

For details on connecting an external generator see the "External Generator Control" section of the R&S FSWP User Manual.

4.2.12   OCXO (Optional)

This optional OCXO generates a 10 MHz reference signal with a very precise frequency. If installed, and if no external signal is used, this signal is used as an internal reference. It can also be used to synchronize other connected devices via the REF OUTPUT 10 MHz connector.

Warm-up time for OCXO

When the instrument is switched on, the OCXO requires an extended warm-up time (see data sheet).

4.2.13   REF INPUT / REF OUTPUT

The REF INPUT connectors are used to provide an external reference signal to the R&S FSWP.

The REF OUTPUT connectors can be used to provide an external reference signal (or the optional OCXO reference signal) from the R&S FSWP to other devices that are connected to this instrument.

Various connectors are provided for different reference signals:

Connector	Reference signal	Usage
REF INPUT	1...20 MHz 0...10 dBm	To provide an external reference signal on the R&S FSWP.
REF OUTPUT	1...20 MHz 0...10 dBm	To provide the same external reference signal received by the REF INPUT 1...20 MHz connector to another device, when available.
REF OUTPUT	10 MHz 10 dBm	To provide the internal reference signal from the R&S FSWP to another device continuously. Also used to provide OCXO reference signal to another device.
REF INPUT	100 MHz 0...10 dBm	To provide an external reference signal on the R&S FSWP.
REF OUTPUT	100 MHz 6 dBm	To provide a 100 MHz reference signal from the R&S FSWP to another device.
REF OUTPUT	640 MHz 16 dBm	To provide a 640 MHz reference signal from the R&S FSWP to another device.

SYNC TRIGGER

The SYNC TRIGGER connector can also be used to synchronize the reference frequency on several devices.

5   Trying Out the Instrument

Overview of tutorials

Initial Setup:

Measurement Selection

The Phase Noise Measurement

The Additive Noise Measurement

The Baseband Noise Measurement

The Pulsed Phase Noise Measurement

The Pulsed Additive Noise Measurement

Trace Smoothing

Integration Ranges

- "How to define integration ranges" on page 75

The Cross-Correlation Gain Indicator

- "How to control the cross-correlation gain indicator (gray area)" on page 76

Miscellaneous Evaluation Tools

- "Zooming into the results" on page 77
- "Exporting measurement data" on page 77

Frequency Configuration

- "How to define the measurement range" on page 78
- "How to search for signals" on page 78
- "How to define a carrier frequency manually" on page 79

The Half Decade Configuration Table

- "How to work with the half decade configuration table" on page 79

Pulsed Measurement Configuration

- "How to configure a gate for measurements on pulses" on page 80

Signal Generation

- "How to generate a CW signal" on page 81
- "How to generate a pulse" on page 81

DUT Power Supply

- "How to supply DUTs with current or voltage" on page 82

An in-depth description of all features, including remote commands, is available in the R&S FSWP User Manual.

5.1   Initial Setup

Preparing the R&S FSWP

1. Connect the R&S FSWP to an electrical outlet as described in Chapter 3.1.4, "Connecting the AC Power", on page 19.

2. Turn on the R&S FSWP as described in Chapter 3.1.5, "Switching the Instrument On and Off", on page 20.

Selecting the phase noise application

1. Select the [MODE] key.

2. Select the "Phase Noise" item in the "Mode" dialog box.

> 💡 **There's more than one way to skin a cat**
>
> In most cases, the firmware of the R&S FSWP provides several ways to change measurement parameters. For example, the measurement range can be defined via the [FREQ] key, the "MEAS CONFIG" key or the "Overview" dialog box.
>
> All procedures in this chapter use the "Overview" dialog box as a starting point (when possible). You can reach this dialog via the "Overview" softkey displayed at the bottom of the softkey bar on the right side of the diagram area.

Performing a preset

Before configuring and starting a new measurement, it is always recommended to perform a preset and restore the default configuration of the instrument or the measurement application.

1. Select the [PRESET] key on the front panel to restore the default state of the R&S FSWP.

2. Enter the "Overview" dialog box and select the "Preset Channel" item to restore the default state of the selected measurement channel. All other measurement channels keep their custom configuration.

5.2   Measurements

Measuring the phase noise characteristics of a DUT requires a simple measurement setup consisting of the R&S FSWP and a DUT.

Some measurements require additional equipment.

- For additive noise measurements, the R&S FSWP must be equipped with the optional Signal Source hardware.

- For pulsed noise measurements, the R&S FSWP must be equipped with the optional Pulsed Phase Noise Measurement application.

- For pulsed additive noise measurements, the R&S FSWP must be equipped with the optional Pulsed Phase Noise Measurement application and the optional Signal Source hardware.

5.2.1   Measurement Selection

Selecting a measurement

► Select the [MEAS] key.

The R&S FSWP opens a dialog box to select the measurement.
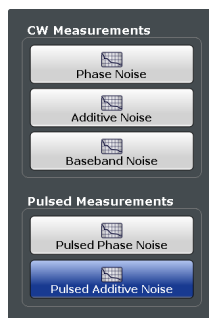
5.2.2   The Phase Noise Measurement

Test setup

Connect the DUT via cable to the RF input of the R&S FSWP as shown in the illustration.
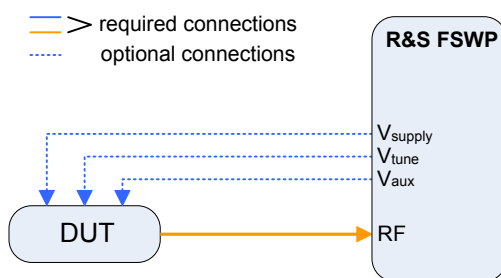
Figure 5-1: Typical test setup for basic noise measurements

Measuring phase noise

1. Perform a [PRESET].

   The application automatically starts a continuous measurement.
   First, it searches for a carrier signal (see How to search for signals). When one has been found, it measures the noise characteristics of the DUT in the default measurement (or frequency offset) range.
   If no carrier could be found, a corresponding error message is displayed in the status bar below the diagram.

2. You can stop the measurement (to analyze the measurement data in detail) with the [RUN SGL] or [RUN CONT] key; [RUN SGL] performs one more measurement, then stops, [RUN CONT] stops immediately.
   By default, two traces are displayed: the first trace shows the smoothed data without spurs, the second trace the raw data including spurs.

Measuring amplitude noise

The test setup is the same as shown above.

The default phase noise trace shows the phase noise characteristics of the DUT. In addition, you can also display the amplitude noise characteristics (or both together).

1. Enter the "Overview" dialog box and, from there, enter the "Analysis" dialog box.

2. Select the vertical "Trace" tab, and then the horizontal "Traces" tab.

3. For any trace, select "AM Noise" from the "Result" dropdown menu.
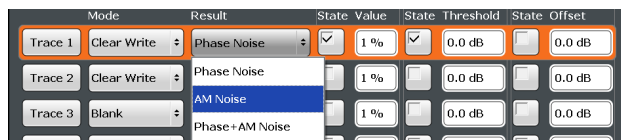
4. Start a new measurement to determine the AM noise of the DUT.
   (The "Phase + AM Noise" menu item displays the sum of phase and amplitude noise.)

   Tip: If you'd like to view both results separately at the same time, open two Phase Noise diagrams, one that shows the phase noise, the other showing the AM noise and perform a measurement.

In addition to the graphical representation of the phase noise characteristics, the application also provides several tables that show specific phase noise characteristics.

Measuring spurs

In addition to the graphical display of spurs in the diagram (long vertical lines), the application also features a spur table that contains a list of all detected spurs.

► Open the SmartGrid (▣) and drag the "Spurious List" item from the evaluation bar into the display.

   The list contains all detected spurs (including their characteristics) on all traces and all windows.
   For more information on the table contents see the R&S FSWP User Manual. A spur is detected if it is above a certain level threshold that you can define in the "Traces" dialog box.

Measuring spot noise

Spot noise is the phase noise or AM noise at a specific offset frequency (for example the phase noise at 500 kHz).

► Open the SmartGrid (▣) and drag the "Spot Noise" item from the evaluation bar into the display.

The table contains a list of spot noise values for selected frequency offsets (in the default state, these are the decade edges) on each active trace.

For more information on the table contents see the R&S FSWP User Manual.

Tip: You can define custom spot noise frequencies in the "Spot Noise" tab of the "Noise Config" dialog box.

Measuring integrated noise

Integrated measurements show various noise characteristics, like the residual noise, integrated over a certain offset frequency range.

► Open the SmartGrid (▣) and drag the "Integrated Measurements" item from the evaluation bar into the display.

The table contains a list of integrated measurement results.

For more information on the table contents see the R&S FSWP User Manual.

Tip: You can define custom integration ranges in the "Integration Ranges" tab of the "Noise Config" dialog box.

5.2.3   The Additive Noise Measurement

Additive noise measurements require the Signal Source output that is available as an optional hardware component.

Test setup

Connect the DUT via cable to the RF input and the Signal Source output of the R&S FSWP as shown in the illustration.
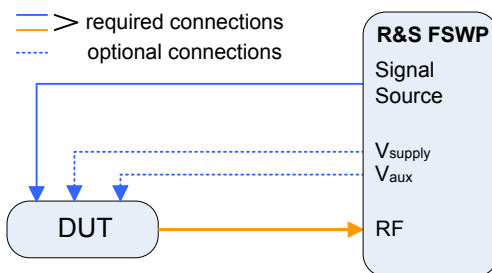
How to measure additive noise

1. Perform a [PRESET].

2. Select the "Additive Noise" measurement via the [MEAS] key.

3. Configure the signal source output as described in "How to generate a CW signal" on page 81.

4. Start the measurement ([RUN SGL] or [RUN CONT]).

    The application measures the additive noise on the output frequency of the signal source in the default measurement (or frequency offset) range.

5. You can stop the measurement (to analyze the measurement data in detail) with the [RUN SGL] or [RUN CONT] key; [RUN SGL] performs one more measurement, then stops, [RUN CONT] stops immediately.
   By default, two traces are displayed: the first trace shows the smoothed data without spurs, the second trace the raw data including spurs.

5.2.4   The Baseband Noise Measurement

Baseband Noise measurements measure the noise characteristics of a DUT over an absolute frequency span (not relative to carrier).

You can use either the RF input for these measurements, or the baseband inputs. The baseband inputs are DC coupled and extend the lower frequency range to 1 mHz (the lowest supported frequency on the RF input is 1 MHz). Using the baseband input, you can, for example, test the voltage supply of DC sources.

Test setup
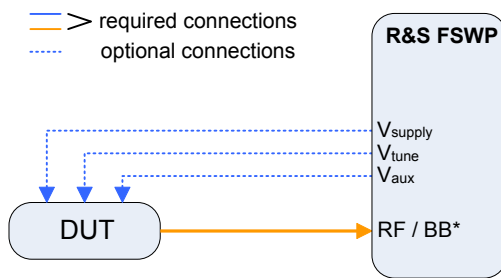
* = See text below for instructions on how to use the baseband input.

How to measure baseband noise at the RF input

For baseband noise measurements on the RF input, proceed as follows.

1. Connect the DUT to the RF input.

2. Perform a [PRESET].

   The application automatically starts a continuous measurement and measures the noise characteristics of the DUT in the default frequency range.

3. Select the "Baseband Noise" measurement via the [MEAS] key.

4. You can stop the measurement (to analyze the measurement data in detail) with the [RUN SGL] or [RUN CONT] key; [RUN SGL] performs one more measurement, then stops, [RUN CONT] stops immediately.
   By default, two traces are displayed: the first trace shows the smoothed data without spurs, the second trace the raw data including spurs.

   Tip: Integrated measurement results. Note that the "PM", "FM" and "Jitter" results are always "0" for baseband noise measurements.

5.2.5   The Pulsed Phase Noise Measurement

Noise measurements on pulses are available with the optional Pulsed Phase Noise Measurements firmware application.

Test setup
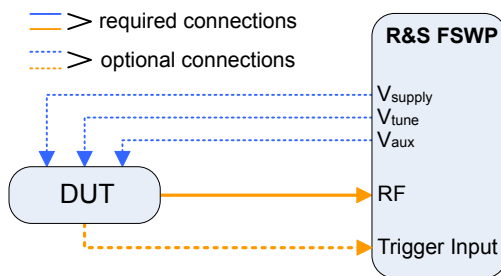
How to measure the phase noise of a pulse

1. Connect the DUT via cable to the RF input of the R&S FSWP as shown in the illustration.

2. Perform a [PRESET].

3. Select the [MEAS] key and select the "Pulsed Phase Noise" measurement.

    The application tries to detect a pulse in the signal you have applied, using two automatic mechanisms:
    • search for the pulse frequency
    • detection of the pulse characteristics
    If successful, it configures a gate based on the pulse characteristics and starts the noise measurement of the pulse.
    The results are displayed the same way as in the other measurements (two traces in the diagram and results for the integrated measurements).
    If no frequency or pulse could be found, a corresponding error message is displayed in the status bar below the diagram.
    If required, you can also define the frequency and the pulse characteristics manually.

5.2.6   The Pulsed Additive Noise Measurement

Additive noise measurements on pulses require the optional Pulsed Phase Noise Measurements firmware application and the optional Signal Source output.

The test setup depends on whether you use internal or external modulation with a pulse modulator.

Test setup (internal pulse modulation)
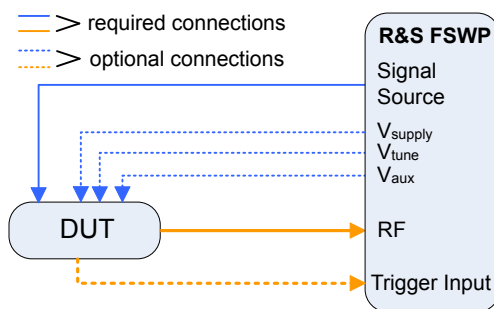
How to measure pulsed additive noise with an internally modulated pulse

1. Connect the Signal Source (supplies the pulse) to the DUT.
   The pulse is modulated internally and output on the Signal Source.

2. Connect the DUT to the RF input.

3. Perform a [PRESET].

4. Select the [MEAS] key and select the "Pulsed Additive Noise" measurement.

5. Enter the "Overview" dialog box, and from there, enter the "Output" dialog box.

6. Select the "Signal Source" tab and turn on the "Pulse Modulator".

7. Configure the pulse characteristics.

8. Start the measurement with [RUN SGL] or [RUN CONT].

> For pulsed measurements using the LO AUX input, do not apply pulses with a frequency below 1024 MHz. Pulses below that frequency will abort the measurement.

5.2.7 Adding Another Measurement Channel

Measuring the noise characteristics in two different measurement channels allows you, for example, to capture and analyze two different data streams with different measurement configurations.

Adding another measurement channel

1. Select the [MODE] key.

2. Select the "Phase Noise" item in the "Mode" dialog box.

   The firmware adds a second instance of the Phase Noise application which is independent of the first one.

5.3   Result Evaluation

The Phase Noise application provides several tools to control the data displayed in the various result displays. Some tools have an effect on the graphical result displays, other on the numerical results and still others on both graphical and numerical (for example in case the numerical results are based on the graphical results).

5.3.1   Trace Smoothing

How to smooth the trace by averaging the measurement data

When you average the trace, the application measures the data several times and builds an average over all measurements when it is done. Averaging measurement data yields a smoother trace.

Trace averaging is applied to all traces.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.

2. Define the number of measurements to be performed in the "Sweep / Average Count" input field, for example "10".

3. Start the measurement.

   - In case of a single measurement, the application performs x measurements over the frequency range you have defined. An average count of "10", for example, would result in 10 measurements.

● In case of continuous measurements, the application performs a moving average over the average count.

How to smooth the trace by adjusting the number of XCORR operations

When you apply cross-correlation operations, the application is able to determine the phase noise characteristics at a certain frequency offset more precisely.

You can improve cross-correlation performance with the corresponding hardware option.

For more information on how cross-correlation works refer to the R&S FSWP User Manual.

The number of cross-correlation operations applied in each half decade depends on a cross-correlation factor that you can define arbitrarily.

Cross-correlation operations are applied to all traces.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.

2. Define the cross-correlation factor as required in the "XCORR Factor" input field.

XCORR Factor	1		30.0 kHz	100.0 kHz	3.0 kHz	37
			100.0 kHz	300.0 kHz	10.0 kHz	130
XCORR Optimize	On	Off	300.0 kHz	1.0 MHz	30.0 kHz	400
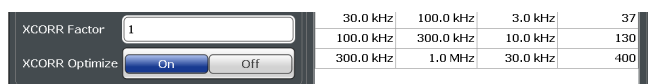
The application calculates the number of cross-correlations for each half decade based on this factor. You can see the resulting operations in the table of the "Noise Config" dialog box.
The number of operations calculated for each half decade targets a similar measurement time for all half decades, so that the measurement is done at roughly the same time in each half decade.
You can also see the resulting number of operations in the green bar at the bottom of the diagram area.

How to smooth the trace graphically

When you apply trace smoothing, the existing data remains the same. The trace is smoothed by applying mathematical operations

For more information on how this is done, refer to the R&S FSWP User Manual.

Trace smoothing is applied to each trace individually.

1. Enter the "Overview" dialog box, and from there, enter the "Analysis" dialog box.

2. Select the vertical "Trace" tab, and then the horizontal "Traces" tab.

3. For any trace, turn on "Smoothing" and define the amount by which the trace should be smoothed (in %) in the corresponding input field.


Trace smoothing is applied immediately after you have applied it to a trace.

How to remove spurs from a trace

By default, the application already shows a trace without spurs (the yellow one). However, you can decide for each trace individually whether it shows spurs or not.

Spur removal is done after traces have been smoothed in any way.

1. Enter the "Overview" dialog box, and from there, enter the "Analysis" dialog box.

2. Select the vertical "Trace" tab, and then the horizontal "Traces" tab.

3. For any trace, remove or display spurs individually. You can also enter a threshold that defines a level from which a spur is recognized as a spur.
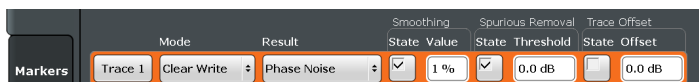
The application removes all signals that are above the threshold from the trace spur removal is applied to. Signals with levels below the threshold are not regarded as spurs and are still displayed.

For more information about spur removal, refer to the R&S FSWP User Manual.

Note: Note that the threshold is always taken into account in the spur table, regardless of whether spur removal is on or off.

5.3.2   Integration Ranges

How to define integration ranges

For the integrated measurements (Residual AM, FM and PM and Jitter), you can define custom integration ranges.

By default, the integration range corresponds to the measurement range defined by the frequency offsets. Custom integration ranges can have any range you desire.

Integration is done after traces have been smoothed in any way.

1. Enter the "Overview" dialog box and, from there, enter the "Noise Config" dialog box.

2. Select the "Integrated Measurements" tab.
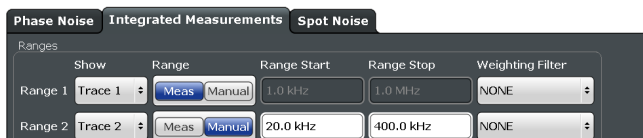
3. Select the "Trace" whose data you would like to integrate from the "Show "dropdown menu.

   Tip: If you select a trace that is currently not displayed in the diagram, no integrated measurement results will be displayed for the corresponding range.

4. Select "Manual" integration ranges.

5. Define the frequency ranges ("Range Start" and "Range Stop") over which you would like to integrate.

   The application calculates the measurement results as defined. Result in the Integrated Measurements result table are adjusted accordingly (see "Measuring integrated noise" on page 67 for a description on how to view that table).

Figure 5-2: Custom integration range results (frequency range from 3 kHz to 500 kHz, applied to trace 2)

Note that the integration ranges are displayed graphically in the Noise Diagram.
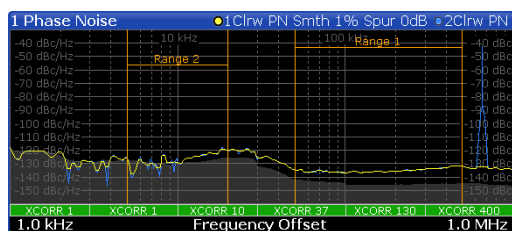
Figure 5-3: Custom integration ranges are represented in the diagram as colored lines

For more information on integrated measurement result calculation refer to the R&S FSWP User Manual.

5.3.3   The Cross-Correlation Gain Indicator

How to control the cross-correlation gain indicator (gray area)

The gray trace, or cross-correlation gain indicator, indicates the ideal position of the measurement trace for the current number of cross-correlation operations. Thus, the position of this area depends on the number of cross-correlations that are currently applied in each half decade.

This in turn indicates that measurement traces that are close to the gray area (even if only in places) can be improved by increasing the cross-correlation operations. On the other hand, when the measurement trace lies above the gray area throughout (about 10 dB), it is not possible to improve the results any more.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.

2. Select the "Noise Config" tab.

3. Change the "XCORR Factor", run a single measurement, and see how the position of the gray area changes.
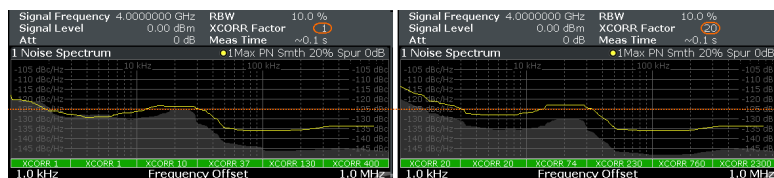
Figure 5-4: Increasing XCORR operations changes shape of gray area

4. If required, you can turn this area on and off as required with the "XCORR Gain Indicator" feature.

5.3.4 Miscellaneous Evaluation Tools

Zooming into the results

The zoom tool is useful if you want to see parts of the results in more detail.

1. Select the "Zoom" icon in the toolbar (⬛).

2. In the diagram, select the area you want to zoom in to (while doing this, the area is marked by a dotted line).

3. You can return to the full display any time with the "Unzoom" icon in the toolbar (⬛).

Exporting measurement data

Exporting measurement data to a .dat file allows you to archive that data in external programs like a spreadsheet.

1. Enter the "Overview" dialog box and, from there, enter the "Analysis" dialog box.

2. Select the vertical "Traces" tab and the horizontal "Trace / Data Export" tab.

3. Select the data types as required (trace data only or together with numerical results and / or measurement settings).

4. Select the "Export to ASCII File" button and select the destination where you want to save that data.

5. View the .dat file that has been created with your preferred program.

5.4 Measurement Configuration

The Phase Noise application provides several tools that make the measurement process easier to handle or allow you to customize the measurement configuration according to your needs.

5.4.1   Frequency Configuration

How to define the measurement range

The measurement range defines the carrier frequency offset over which the phase noise measurement takes place.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.

2. Select the "Noise Config" tab.

3. Define the measurement range with the "Start Offset" and "Stop Offset" properties.

Measurement Range	
Start Offset	1.0 kHz
Stop Offset	1.0 MHz

    The application adjusts the measurement range. You can see this change, for example, in the Noise diagram result display.
    Note: In case of baseband measurements, the measurement range is defined by an absolute start and stop frequency instead of offsets.
    For more information on the measurement range, refer to the R&S FSWP User Manual.

How to search for signals

The application allows you to search for a carrier signal, instead of defining the carrier frequency manually.

1. Enter the "Overview" dialog box, and from there, enter the "Frequency" dialog box.

2. Turn on the "Auto Search" feature (it is on by default).

3. Define the frequency range in which the search should take place ("Start" and "Stop"). By default the search is done in the maximum frequency range supported by the hardware.

4. Define a "Threshold" for the search. Signals below the threshold are ignored during the search.

    When the application finds a signal with appropriate characteristics, it starts a phase noise measurement in the measurement range you have defined.

Note: Automatic signal search is only available in phase noise and pulsed phase noise measurements.

How to define a carrier frequency manually

When you already know the frequency of the carrier signal, you can define it manually and reduce the measurement time.

1. Enter the "Overview" dialog box, and from there, enter the "Frequency" dialog box.

2. Turn off the "Auto Search" feature.

3. Define the "Signal Frequency".

   The application performs the measurement on the defined frequency.

5.4.2   The Half Decade Configuration Table

How to work with the half decade configuration table

The half decade configuration table contains the measurement configuration for each half decade that is analyzed during a measurement.

You can either enter the values for the measurement bandwidth and number of cross-correlation operations directly. Or you can let the application calculate ideal values for each half decade.

1. Enter the "Overview" dialog box, and from there, enter the "Noise Config" dialog box.

2. Select automatic or manual configuration mode with the "Half Decade Config" feature.

3. In case of an **automatic configuration**, define an "RBW" factor and an "XCORR Factor".

   From these values, the application calculates the best and least time-consuming absolute resolution bandwidth and cross-correlation operations for each half decade.

4. In case of a **manual configuration**, define the resolution bandwidth and number of cross-correlations for each half decade directly in the half decade configuration table as absolute values.

The relative "RBW" factor and "XCORR Factor" are ignored.

5.4.3 Pulsed Measurement Configuration

How to configure a gate for measurements on pulses

Noise measurements on pulses are available with the optional Pulsed Phase Noise Measurements firmware application.

By default, the application automatically detects the pulse characteristics and defines the gate characteristics based on the pulse. If required, you can also define these parameters manually.

1. Enter the Pulsed Phase Noise measurement.

2. Select the [MEAS CONFIG] key and enter the "Pulse" dialog box with the "Pulse Config" softkey.

3. In the "Pulse" dialog box, select "Manual" pulse detection.
   The input fields for the "Pulse Repetition Interval" and those for the "Gate Characteristics" become available. You can change them if required.

4. Configure the "Pulse Rep Interval" as required.

5. Configure the gate as required ("Gate Type", "Gate Level", "Gate Delay" and "Gate Length").
   The shape of the gate is represented by various lines and bars in the "Preview" diagram that is part of the dialog box.
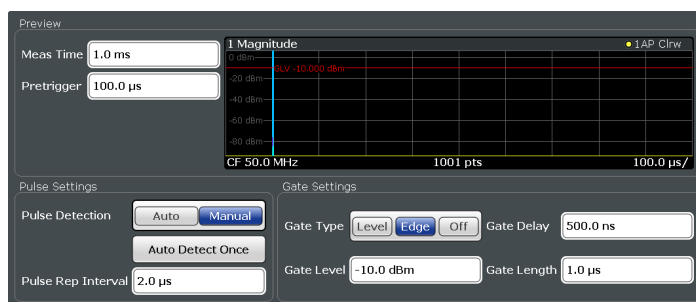
For more information on the gate configuration, refer to the R&S FSWP User Manual.

Tip: You can turn off the gate, if one is not required for the measurement. To do so, select "Gate Type: Off".

5.4.4   Signal Generation

How to generate a CW signal

Some measurement setups require you to feed a signal into the DUT. You can equip the R&S FSWP with an optional Signal Source that is able to generate such a signal.

Available only for additive noise measurements and with the optional Signal Source hardware component.

1. Enter the Additive Noise measurement.

2. Enter the "Overview" dialog box, and from there, enter the "Output" dialog box.

3. Select the "Signal Source" tab.

4. Define the frequency and level of the CW signal in the corresponding input fields.
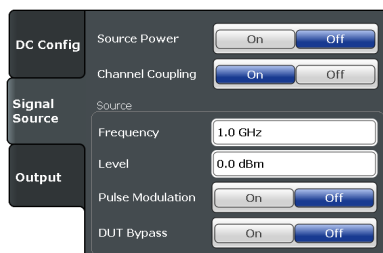
5. Turn on the signal source with the "Source Power" feature.

   Tip: You can turn the signal source on and off effectively with the "RF On/Off" button in the toolbar. The "RF Config" button provides access to a softkey menu that lets you change the signal source characteristics without entering a dialog box.
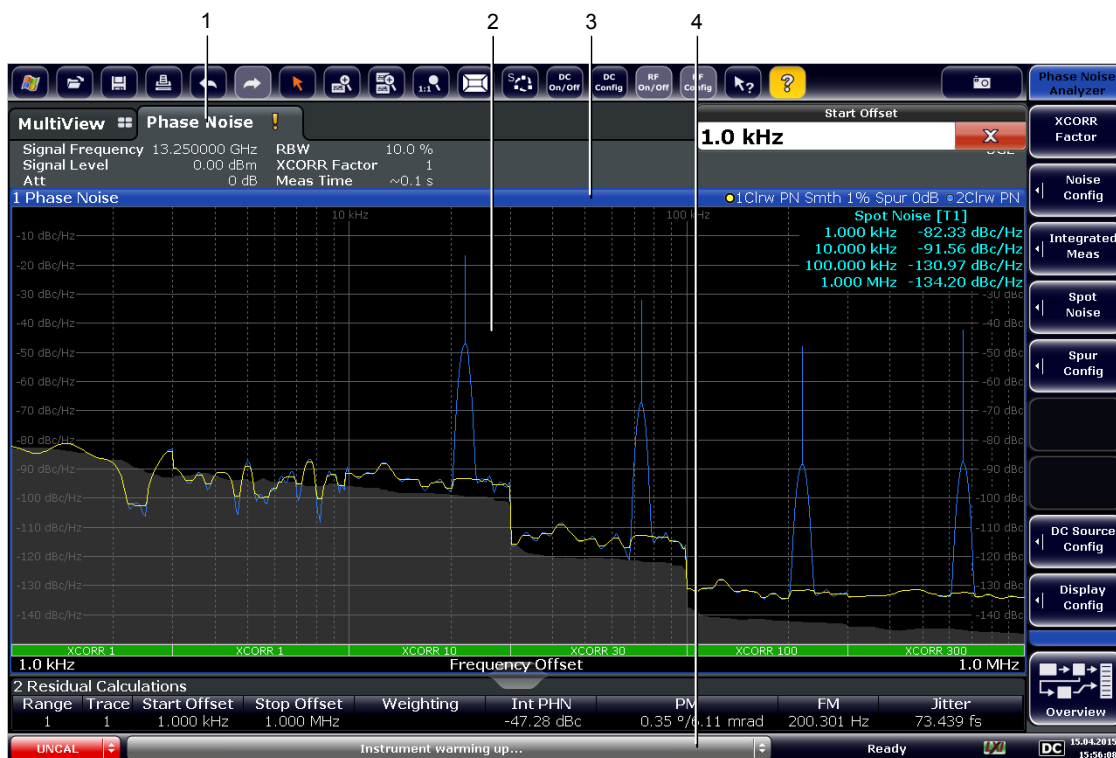
How to generate a pulse

Instead of a continuous wave signal, you can generate a pulse at the Signal Source output.

Available only for additive pulsed phase noise measurements and with the optional Signal Source hardware component.

1. Enter the "Overview" dialog box, and from there, enter the "Output" dialog box.

2. Select the "Signal Source" tab.

3. Turn on the (internal) "Pulse Modulator".
   When the "Pulse Modulator" is off, a CW signal is generated.

4. Define the required pulse "Width" and "Period".

5. Turn on the signal source with the "Source Power" feature.

   Tip: You can turn the signal source on and off easily with the "RF On/Off" button in the toolbar. The "RF Config" button provides access to a softkey menu that lets you change the signal source characteristics without entering a dialog box.

5.4.5   DUT Power Supply

How to supply DUTs with current or voltage

Some measurement setups or DUTs require you to supply them with either voltage or current.

The R&S FSWP can provide both, when you set it up that way.

1. Enter the "Overview" dialog box and, from there, enter the "Output" dialog box.

2. Select the "DC Config" tab.

   There you have the following options:
   ● Turn each of the three DC outputs on or off.
   ● Define the supplied voltage (or current in case of the V_{supply} output).
   ● Define limits for the outputs. When you define limits, the supplied voltage will not go below or above these.
     For more information on configuring DC outputs, refer to the R&S FSWP User Manual.

3. Turn on the output of voltage or current with the "DC Power" feature.

   Tip: You can turn the output on and off easily with the "DC On / Off" button in the toolbar. The "DC Config" button provides access to a softkey menu that lets you define the signal characteristics without entering a dialog box.

6   Operating the Instrument

The following topics provide an overview on how to work with the R&S FSWP.
They describe what kind of information is displayed in the diagram area, how to
operate the R&S FSWP via the front panel keys and other interaction methods,
and how to use the Online Help.

6.1   Understanding the Display Information

The following figure shows a measurement diagram in the Spectrum application.
All different information areas are labeled. They are explained in more detail in
the following sections.

1 = Channel bar for firmware and measurement settings
2 = Window title bar with diagram-specific (trace) information
3 = Diagram area with marker information
4 = Instrument status bar with, for example, error messages and progress bar.

> **Hiding elements in the display**
>
> You can hide some of the elements in the display, for example the status bar or channel bar, in order to enlarge the display area for the measurement results ("Setup > Display > Displayed Items").
>
> For details see the R&S FSWP User Manual.

6.1.1 Channel Bar

Using the R&S FSWP you can handle several different measurement tasks (channels) at the same time (although they can only be performed asynchronously). For each channel, a separate tab is displayed on the screen. In order to switch from one channel display to another, simply select the corresponding tab.

Alternatively, if many tabs are displayed, select the tab selection list icon at the right end of the channel bar and select the channel you want to switch to from the list.

MultiView tab

An additional tab labelled "MultiView" provides an overview of all active channels at a glance. In the "MultiView" tab, each individual window contains its own channel bar with an additional button. Tap this button to switch to the corresponding channel display quickly.
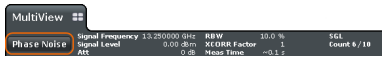
Icons in the channel bar

The star icon ( ) on the tab label indicates that the displayed trace no longer matches the current instrument settings. This may be the case, for example, if a trace is frozen and the instrument settings are changed. As soon as a new measurement is performed, the icon disappears.

The exclamation mark ("!" or) icon indicates that an error or warning is available for that measurement channel. This is particularly useful if the MultiView tab is displayed.

The ⚙ icon indicates the currently active channel during an automatic measurement sequence (**Sequencer** functionality).

Beneath the channel name, information on channel-specific settings for the measurement are displayed in the **channel bar**. Channel information varies depending on the active application.

In addition to the channel-specific settings, the channel bar above the diagram also displays information on instrument settings that affect the measurement results even though this is not immediately apparent from the display of the measured values. This information is displayed only when applicable for the current measurement.

The following table contains all labels that might be displayed in the Spectrum and Receiver applications.

Table 6-1: Channel settings displayed in the channel bar

Label	Information
Signal Frequency	Current carrier frequency of the applied signal.
Signal Level	Currently level measured on the carrier frequency.
Att	Current RF attenuation.
RBW	Current Resolution bandwidth (RBW). The RBW is a function of the start offset frequency of each half decade included in the measurement.

Label	Information
XCORR Factor	Current cross-correlation factor. The cross-correlation factor defines the number of cross-correlations are done in each half decade included in the measurement.
Meas Time (estimated)	Current estimated measurement time.
	The measurement time depends, among other things, on the offset frequency, the resolution bandwidth or the number of averages / cross-correlations that you have defined.
SGL	Current number of measurements performed in a single sweep. Only displayed if you are in single sweep measurement mode.
Count	The current signal count for measurement tasks that involve a specific number of subsequent sweeps.
Meas	Currently selected measurement (Phase Noise, Additive Phase Noise etc.).

Icons for individual settings

A bullet next to the setting indicates that user-defined settings are used, not automatic settings. A green bullet indicates this setting is valid and the measurement is correct. A red bullet indicates an invalid setting that does not provide useful results.

6.1.2   Window Title Bar

Each channel in the R&S FSWP display may contain several windows. Each window can display either a graph or a table as a result of the channel measurement. Which type of result evaluation is displayed in which window is defined in the display configuration (see Chapter 6.5, "Displaying Results", on page 100). The window's title bar indicates which type of evaluation is displayed.

Trace Information in Window Title Bar

Information on the displayed traces is indicated in the window title bar.

Trace color	Color of trace display in diagram
Trace number	Number of the trace (1 to 6)
Trace Mode	Abbreviation of the trace mode: ● Clrw 　Clear Write trace ● Max 　Max Hold trace ● Min 　Min Hold trace ● Avg 　Average trace ● View 　Frozen trace ● WrH 　Write Hold trace
Result type	Type of result the trace represents. ● PN ● AM ● PN + AM
Trace smoothing	Trace smoothing characteristics. Only displayed if trace smoothing has been turned on for a trace.
Spur removal	Spur removal characteristics. Only displayed if spur removal has been turned on for a trace.
Trace offset	Trace offset characteristics. Only displayed if an offset has been defined for a trace.

6.1.3　Marker Information

Marker information is provided either in the diagram grid or in separate marker tables, depending on the configuration.

Marker information in diagram grid

Within the diagram, the x-axis and y-axis positions of the last 2 markers or delta markers that were set are displayed, if available, as well as their index. The value in the square brackets after the index indicates the trace to which the marker is assigned. (Example: M2[1] defines marker 2 on trace 1.) For more than 2 markers, a separate marker table is displayed beneath the diagram by default.

Marker information in marker table

In addition to the marker information displayed within the diagram grid, separate marker tables may be added to the display. These tables provide the following information for all active markers:

Table 6-2: Regular marker table

Label	Information
Wnd	Window type the marker is positioned in.
	(Only if there is more than one window containing a phase noise diagram.)
Type	Marker type: N (normal), D (delta), T (temporary, internal)
Ref	Reference (for delta markers)
Trc	Trace to which the marker is assigned
X-value	x-value of the marker
Y-value	y-value of the marker

6.1.4   Spot Noise Information

Spot noise information in diagram grid

The diagram contains information about all spot noise positions [T<x>]. Spot noise information is made up out of the position of the spot noise measurement on the x-axis and the y-axis. The value in the square brackets after the index indicates the trace to which the spot noise calculation is assigned (Example: [T1] indicates trace 1). Note that you can also display spot noise information in a separate table.

Spot noise information in spot noise table

The R&S FSWP also provides a numerical result table for the spot noise measurement. The spot noise table has to be added deliberately. Note that the spot noise table only contains information when the calculation of spot noise has been turned on.

Table 6-3: Spot noise information result table

Label	Information
Wnd	Measurement window that the spot noise has been calculated for.
	(Only if there is more than one window containing a phase noise diagram.)
Offset	Offset frequency or spot noise position on the x-axis of the Phase Noise diagram.
Noise [T<x>]	Measured noise on the spot noise position for each active trace.

6.1.5   Measurement Progress Information

The Phase Noise result display shows the progress of the measurement in a series of green bars at the bottom of the diagram area. For each half decade in the measurement, the R&S FSWP adds a bar that spans the frequency range of the corresponding half decade.

The bar has several features.

- Measurement times less than 1 s
  The numbers within the green bar indicate the number of cross-correlation operations applied to the corresponding half decade.

- Measurement times greater than 1 s
  The numbers within the green bar show the progress of the cross-correlation operations in the half decade the application currently works on.
  The first number is the current, the second number the total count of cross-correlations for that half decade. The bars of half decades in which a measurement is still running has a lighter tone of green than bars of half decades in which the measurement has already finished (see image below).

- A double-click on the bar opens the "Noise Config" dialog box to define the cross-correlation factor for that half decade.

- A right-click on the bar opens a context menu.
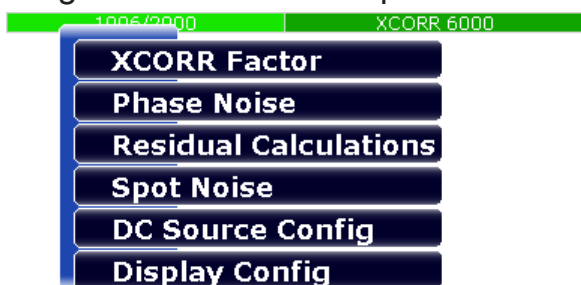
The context menu provides easy access to various parameters to set up the measurement.

6.1.6   Frequency Information in Diagram Footer

Graphical result displays contain information in the diagram footer. The information (beneath the diagram) depends on the result display.

The contents depend on the application and the result display.

Label	Information
Start offset	Start offset frequency
Stop offset	Stop offset frequency

6.1.7   Instrument and Status Information

Global instrument settings and functions (such as LXI configuration mode), the instrument status and any irregularities are indicated in the status bar beneath the diagram.

In the MultiView tab the status bar always displays the information for the currently selected measurement.

The following information is displayed:

Instrument status

DC	The state of the DC Power features. • white label = DC Power has been turned off • green label = DC Power has been turned on and is within the defined limits • red label = DC Power has been turned on and violates the defined limits
EXT REF	The R&S FSWP is configured for operation with an external reference.
LXI	The status of an LXI connection (green label = connection established, red label = connection not established).

Progress

The status of the current operation is displayed in the status bar.

In the MultiView tab, the progress bar indicates the status of the currently selected measurement, not the measurement currently being performed by a Sequencer, for example.

Date and time

The date and time settings of the instrument are displayed in the status bar.
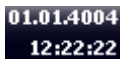
Error messages and warnings

If errors or irregularities are detected, a keyword and an error message, if available, are displayed in the status bar.

6.1.8   Error Information

If errors or irregularities are detected, a keyword and an error message, if available, are displayed in the status bar.

Depending on the type of message, the status message is indicated in varying colors.

Table 6-4: Status bar information - color coding

Color	Type	Description
red	Error	An error occurred at the start or during a measurement, e.g. due to missing data or wrong settings, so that the measurement cannot be started or completed correctly.
orange	Warning	An irregular situation occurred during measurement, e.g. the settings no longer match the displayed results, or the connection to an external device was interrupted temporarily.
gray	Information	Information on the status of individual processing steps.

Color	Type	Description
no color	No errors	No message displayed - normal operation.
green	Measurement successful	Some applications visualize that the measurement was successfull by showing a messsage.

> If any error information is available for a measurement channel, an exclamation mark is displayed next to the channel name (❗). This is particularly useful when the MultiView tab is displayed, as the status bar in the Multi-View tab always displays the information for the currently selected measurement only.

Table 6-5: Keywords in the status bar

Message	Meaning
IF OVLD	Overload of the IF signal path in the A/D converter or in the digital IF. Increase attenuation or remove the signal from the RF input.
LOUNL	Error in the instrument's frequency processing hardware was detected.
NO REF	Instrument was set to an external reference but no signal was detected on the reference input.
OVEN	The optional OCXO reference frequency has not yet reached its operating temperature. The message usually disappears a few minutes after power has been switched on.
UNCAL	One of the following conditions applies: • Correction data has been switched off. • No correction values are available, for example after a firmware update. • Record the correction data by performing a self alignment
WRONG_FW	The firmware version is out-of-date and does not support the currently installed hardware. Until the firmware version is updated, this error message is displayed and self-alignment fails. (For details refer to the R&S FSWP User Manual).

6.2   Accessing Functions

All tasks necessary to operate the instrument can be performed using the user interface. Apart from instrument specific keys, all other keys that correspond to an external keyboard (for example arrow keys, [Enter] key) operate conform to Microsoft.

For most tasks, there are at least 2 alternative methods to perform them:

- Using the touchscreen
- Using other elements provided by the front panel, for example the keypad, rotary knob, or arrow and position keys.

The measurement and instrument functions and settings can be accessed by selecting one of the following elements:

- System and function keys on the front panel of the instrument
- Softkeys on the touchscreen
- Context menus for specific elements on the touchscreen
- Icons on the tool bar in the touchscreen
- Displayed setting on the touchscreen

6.2.1   Toolbar

The icons in the toolbar provide access to general functions.

> You can hide the toolbar display, for example when using remote control, in order to enlarge the display area for the measurement results ("Setup > Display > Displayed Items"). See the R&S FSWP User Manual for details.

	Windows: opens the Windows "Start" menu and task bar.
	Open: opens a file from the instrument or an external device ("Save/Recall" menu).
	Store: stores data on the instrument or an external device ("Save/Recall" menu).
	Print: defines print settings ("Print" menu).

	Undo: reverts last operation
	Redo: repeats previously reverted operation
	Select: the cursor can be used to select (and move) elements in the display (markers, lines etc.).
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area.
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram.
	Zoom off: displays the diagram in its original size.
	SmartGrid: activates "SmartGrid" mode to configure the screen layout.
	Sequencer: opens the "Sequencer" menu to perform consecutive measurements.
	DC Power: turns the DC power output on and off.
	DC Configuration: provides quick access to configure the main parameters for DC power supply.
	Signal Source: turns the optional signal source output on and off. (Available when the optional signal source output is installed.)
	RF Config: provides quick access to configure the main parameters of the signal source. (Available when the optional signal source output is installed.)
	Help (+ Select): allows you to select an element for which context-specific help is displayed.
	Help: displays context-sensitive help topic for currently selected element.
	Print immediately: prints the current display (screenshot) as configured.

In "SmartGrid" mode only:

x	Close: Exit "SmartGrid" mode.

6.2.2   Softkeys

Softkeys are virtual keys provided by the software. Thus, more functions can be provided than those that can be accessed directly via the function keys on the instrument. Softkeys are dynamic: depending on the selected function key, a different list of softkeys is displayed on the right side of the screen.

A list of softkeys for a certain function key is also called a menu. Softkeys can either perform a specific function or open a dialog box.

Recognizing the softkey status by color

Color	Meaning
orange	associated dialog box is open
blue	associated function is active; for toggle keys: currently active state
gray	instrument function is temporarily not available due to a specific setting or missing option

You can hide the softkey display, e.g. when using remote control, in order to enlarge the display area for the measurement results ("Setup > Display > Displayed Items"). See the User Manual for details.

6.2.3   Context Menus

Several items in the diagram area have context menus (for example markers, traces or the channel bar). If you right-click on one of these items (or tap it for about 1 second), a menu is displayed which contains the same functions as the corresponding softkey. This is useful, for example, when the softkey display is hidden.
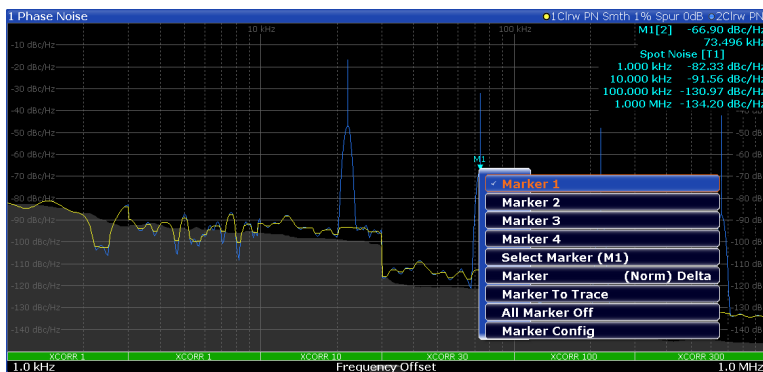
6.2.4   On-screen Keyboard

The on-screen keyboard is an additional means of interacting with the instrument without having to connect an external keyboard.
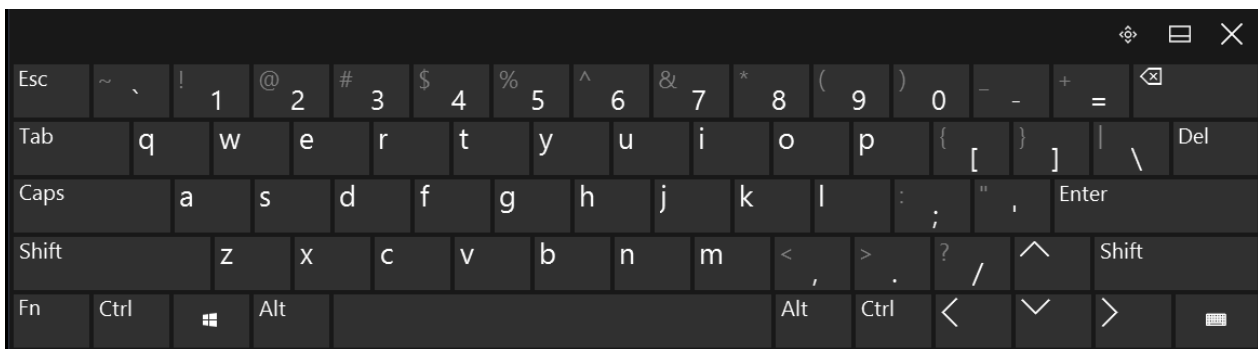
The on-screen keyboard display can be switched on and off as desired using the "On-Screen Keyboard" function key beneath the screen.

When you press this key, the display switches between the following options:

- Keyboard displayed at the top of the screen
- Keyboard displayed at the bottom of the screen
- No keyboard displayed

You can use the TAB key on the on-screen keyboard to move the focus from one field to another in dialog boxes.

6.3   Changing the Focus

Any selected function is always performed on the currently focused element in the display, e.g. a dialog field, diagram, or table row. Which element is focused is indicated by a blue frame (diagram, window, table) or is otherwise highlighted (softkey, marker etc.). Moving the focus is most easily done by tapping on the element on the touchscreen. Alternatively, use the "Tab" key on the on-screen keyboard or the rotary knob to move the focus from one element to the next on the display.

To move the focus between any displayed diagrams or tables in a window, press the "Change focus" key on the front panel. The focus moves from the diagram to the first table to the next table etc. and then back to the diagram, within the same window.

In fullscreen mode, where a single window is displayed in full size on the screen, this key switches the focus (and the display) from one active window to the next.

6.4   Entering Data

Data can be entered in dialog boxes using one of the following methods:

● Using the touchscreen, via the online keyboard

● Using other elements provided by the front panel, e.g. the keypad, rotary knob, or navigation keys
  The rotary knob acts like the [ENTER] key when it is pressed.

● Using a connected external keyboard

Transparent dialog boxes

You can change the transparency of the dialog boxes to see the results in the windows behind the dialog box. Thus, you can see the effects that the changes you make to the settings have on the results immediately.

To change the transparency, use the slider at the top of the dialog box.

(The title bar of the dialog box is always slightly transparent and is not affected by the slider.)

> ⓘ **Particularities in Windows dialog boxes**
>
> In some cases, e.g. if you want to install a printer, original Windows dialog boxes are used. In these dialog boxes, the rotary knob and function keys do not work. Use the touchscreen instead.

6.4.1   Entering Numeric Parameters

If a field requires numeric input, the keypad provides only numbers.

1. Enter the parameter value using the keypad, or change the currently used parameter value by using the rotary knob (small steps) or the [UP] or [DOWN] keys (large steps).

2. After entering the numeric value via keypad, press the corresponding unit key. The unit is added to the entry.

3. If the parameter does not require a unit, confirm the entered value by pressing the [ENTER] key or any of the unit keys.
   The editing line is highlighted to confirm the entry.

6.4.2   Entering Alphanumeric Parameters

If a field requires alphanumeric input, you can use the on-screen keyboard to enter numbers and (special) characters (see Chapter 6.2.4, "On-screen Keyboard", on page 96).

Alternatively, you can use the keypad. Every alphanumeric key represents several characters and one number. The decimal point key (.) represents special characters, and the sign key (-) toggles between capital and small letters. For the assignment, refer to Table 6-6.

To enter numbers and (special) characters via the keypad

1. Press the key once to enter the first possible value.

2. All characters available via this key are displayed.

3. To choose another value provided by this key, press the key again, until your desired value is displayed.

4. With every key stroke, the next possible value of this key is displayed. If all possible values have been displayed, the series starts with the first value again. For information on the series, refer to Table 6-6.

5. To change from capital to small letters and vice versa, press the sign key (-).

6. When you have chosen the desired value, wait for 2 seconds (to use the same key again), or start the next entry by pressing another key.

To enter a blank

► Press the "Space" bar, or press the "0" key and wait 2 seconds.

To correct an entry

1. Using the arrow keys, move the cursor to the right of the entry you want to delete.

2. Press the [BACKSPACE] key.

   The entry to the left of the cursor is deleted.

3. Enter your correction.

To complete the entry

► Press the [ENTER] key or the rotary knob.

To abort the entry

► Press the [ESC] key.
   The dialog box is closed without changing the settings.

Table 6-6: Keys for alphanumeric parameters

Key name (upper inscription)	Series of (special) characters and number provided
7	7 µ Ω ° € ¥ $ ¢
8	A B C 8 Ä Æ Å Ç
9	D E F 9 É
4	G H I 4
5	J K L 5
6	M N O 6 Ň Ö
1	P Q R S 1

Key name (upper inscription)	Series of (special) characters and number provided
2	T U V 2 Ü
3	W X Y Z 3
0	\<blank> 0 – @ + / \ < > = % &
.	. * : _ , ; " ' ? ( ) #
–	\<toggles between capital and small letters>

6.5   Displaying Results

The R&S FSWP provides several instrument applications for different analysis tasks and different types of signals, for example the Phase Noise application, the optional Spectrum application or the optional I/Q Analyzer. For each application, a new measurement channel is created and displayed in a separate tab on the screen.

The results of a measurement channel can be evaluated in many different ways, both graphically and numerically. For each evaluation method the results are displayed in a separate window in the tab.

The R&S FSWP allows you to configure the display to suit your specific requirements and optimize analysis.

6.5.1   Activating and Deactivating Channels

When you activate an application, a new measurement channel is created which determines the measurement settings for that application. The same application can be activated with different measurement settings by creating several channels for the same application. Whenever you switch channels, the corresponding measurement settings are restored. Each channel is displayed in a separate tab on the screen.

An additional tab ("MultiView") provides an overview of all currently active channels at once.

Only one measurement can be performed at any time, namely the one in the currently active channel. However, in order to perform the configured measurements consecutively, a Sequencer function is provided.
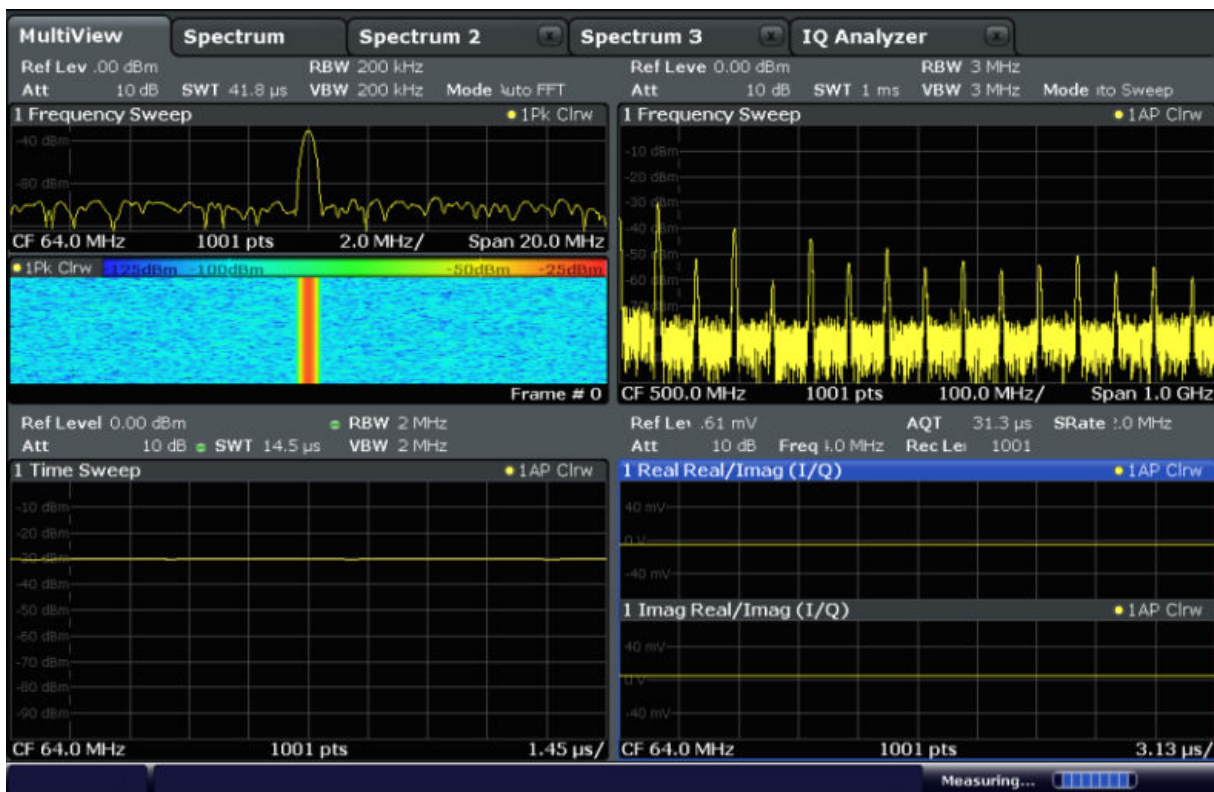
To start a new channel

1. Select the [Mode] key.

2. In the "Mode" dialog box, select the required application on the "New Channel" tab.
   A new tab is displayed for the new channel.

To change the application in an active channel

1. Select the tab of the channel you want to change.

2. Select the [Mode] key.

3. In the "Mode" dialog box, select the new application to be displayed on the "Replace Current Channel" tab.
   The selected application is displayed in the current channel.

To close a measurement channel

► ✕

Select the "Close" icon on the tab of the measurement channel.

The tab is closed, any running measurements are aborted, and all results for that channel are deleted.

6.5.2   Laying out the Result Display with the SmartGrid

Measurement results can be evaluated in many different ways, for example graphically, as summary tables, statistical evaluations etc. Each type of evaluation is displayed in a separate window in the channel tab. Up to 16 individual windows can be displayed per channel (i.e. per tab). To arrange the diagrams and tables on the screen, the Rohde & Schwarz SmartGrid function helps you find the target position simply and quickly.

(For details on evaluation methods see the User Manual.)

Principally, the layout of the windows on the screen is based on an underlying grid, the SmartGrid. However, the SmartGrid is dynamic and flexible, allowing for many different layout possibilities. The SmartGrid functionality provides the following basic features:

● Windows can be arranged in columns or in rows, or in a combination of both.
● Windows can be arranged in up to four rows and four columns.
● Windows are moved simply by dragging them to a new position on the screen, possibly changing the layout of the other windows, as well.
● All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar. If the evaluation bar contains more icons than can be displayed at once on the screen, it can be scrolled vertically. The same evaluation method can be displayed in multiple windows simultaneously.
● New windows are added by dragging an evaluation icon from the evaluation bar to the screen. The position of each new window depends on where you drop the evaluation icon in relation to the existing windows.
● All display configuration actions are only possible in SmartGrid mode. When SmartGrid mode is activated, the evaluation bar replaces the current softkey menu display. When the SmartGrid mode is deactivated again, the previous softkey menu display is restored.

6.5.2.1　Background Information: The SmartGrid Principle

SmartGrid display

During any positioning action, the underlying SmartGrid is displayed. Different colors and frames indicate the possible new positions. The position in the Smart-Grid where you drop the window determines its position on the screen.

Figure 6-1: Moving a window in SmartGrid mode

The brown area indicates the possible "drop area" for the window, i.e. the area in which the window can be placed. A blue area indicates the (approximate) layout of the window as it would be if the icon were dropped at the current position. The frames indicate the possible destinations of the new window with respect to the existing windows: above/below, right/left or replacement (as illustrated in Figure 6-2). If an existing window would be replaced, the drop area is highlighted in a darker color shade.

Positioning the window

The screen can be divided into up to four rows. Each row can be split into up to four columns, where each row can have a different number of columns. However, rows always span the entire width of the screen and may not be interrupted by a column. A single row is available as the drop area for the window in the Smart-Grid. The row can be split into columns, or a new row can be inserted above or below the existing row (if the maximum of 4 has not yet been reached).
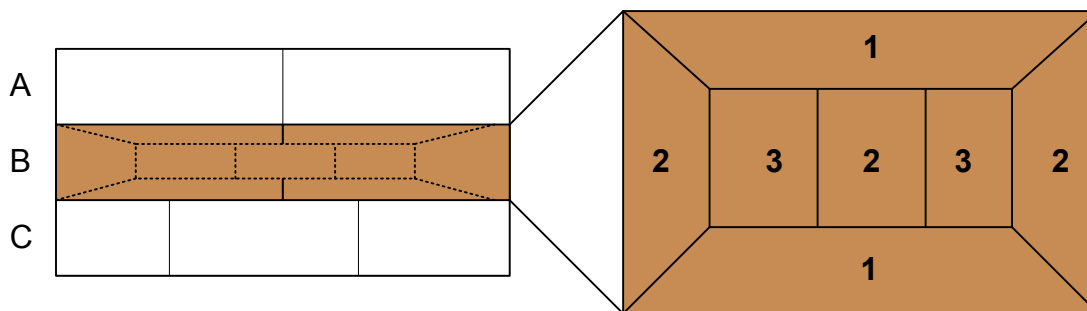
Figure 6-2: SmartGrid window positions

1 = Insert row above or below the existing row
2 = Create a new column in the existing row
3 = Replace a window in the existing row

SmartGrid functions

Once the evaluation icon has been dropped, icons in each window provide delete and move functions.

The "Move" icon allows you to move the position of the window, possibly changing the size and position of the other displayed windows.

The "Delete" icon allows you to close the window, enlarging the display of the remaining windows.

6.5.2.2　How to Activate SmartGrid Mode

All display configuration actions are only possible in SmartGrid mode. In Smart-Grid mode the evaluation bar replaces the current softkey menu display. When the SmartGrid mode is deactivated again, the previous softkey menu display is restored.

► To activate SmartGrid mode, do one of the following:

-

    Select the "SmartGrid" icon from the toolbar.
- Select the "Display Config" button in the configuration "Overview" .
- Select the "Display Config" softkey from the [MEAS CONFIG] menu.

The SmartGrid functions and the evaluation bar are displayed.

 To close the SmartGrid mode and restore the previous softkey menu select the "Close" icon in the right-hand corner of the toolbar, or press any key.

6.5.2.3   How to Add a New Result Window

Each type of evaluation is displayed in a separate window. Up to 16 individual windows can be displayed per channel (i.e. per tab).

1. Activate SmartGrid mode.

    All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar.

2. Select the icon for the required evaluation method from the evaluation bar. If the evaluation bar contains more icons than can be displayed at once on the screen, it can be scrolled vertically. Touch the evaluation bar between the icons and move it up or down until the required icon appears.

3. Drag the required icon from the evaluation bar to the SmartGrid, which is displayed in the diagram area, and drop it at the required position. (See Chapter 6.5.2.5, "How to Arrange the Result Windows", on page 106 for more information on positioning the window).

6.5.2.4   How to Close a Result Window

▶ To close a window, activate SmartGrid mode and select the "Delete" icon for the window.

6.5.2.5   How to Arrange the Result Windows

1. Select an icon from the evaluation bar or the "Move" icon for an existing evaluation window.

2. Drag the evaluation over the SmartGrid.
   A blue area shows where the window will be placed.

3. Move the window until a suitable area is indicated in blue.

4. Drop the window in the target area.

   The windows are rearranged to the selected layout, and "Delete" and "Move" icons are displayed in each window.

5. To close a window, select the corresponding "Delete" icon.

6.5.3   Changing the Size of Windows

Each channel tab may contain several windows to evaluate the measurement results using different methods. A "splitter" allows you to change the size of neighboring windows.
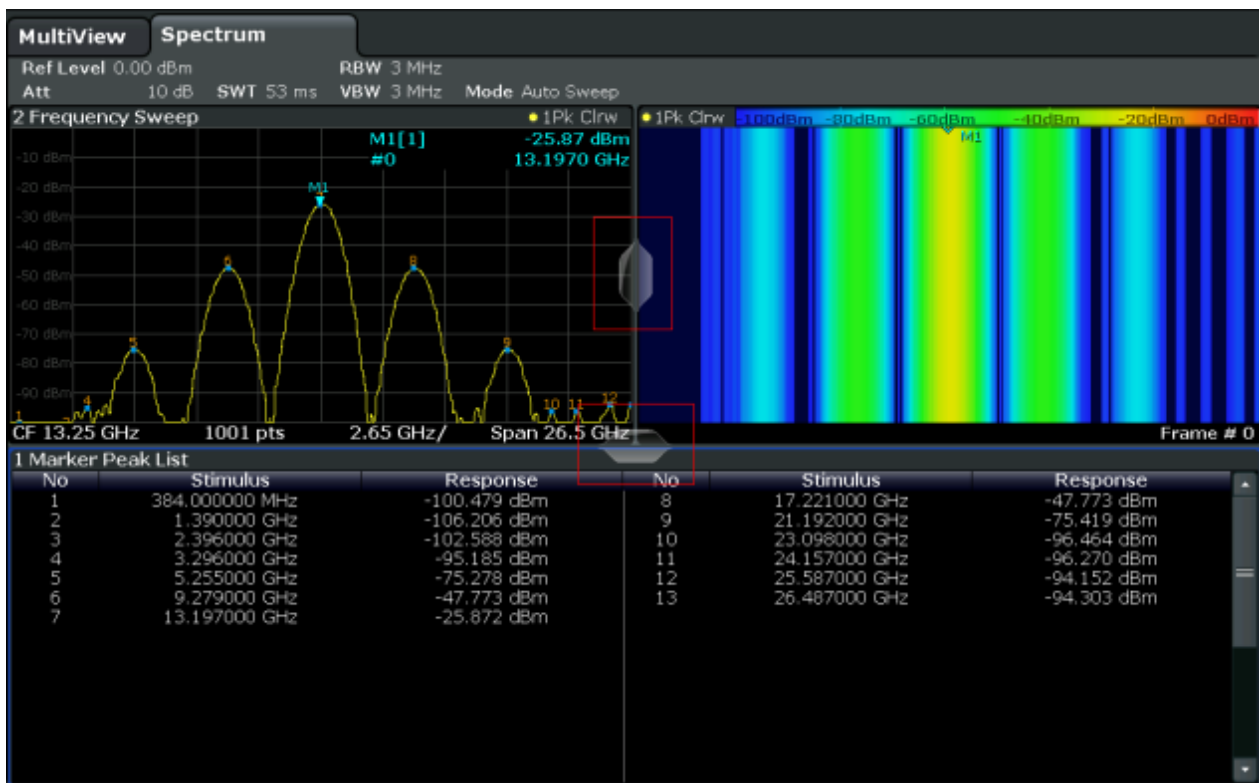
The splitters are not available in SmartGrid mode.

► To change the size of two neighboring windows, drag the splitter between the windows in either direction.

6.5.4 Switching Between a Split and Maximized Window Display

To get an overview of the results, displaying several windows at the same time may be helpful. However, the individual windows may become rather small. In this case it is useful to maximize an individual window to the entire screen temporarily in order to analyze the results in more detail.

To switch between a split and a maximized display without having to close and re-open windows, press the [SPLIT/MAXIMIZE] key on the front panel. In maximized display, the currently focused window is maximized. In split display, all active windows are displayed.

Alternatively, double-tap the title bar of a window to maximize it.

6.5.5 Changing the Display

The display can be optimized for your individual needs. The following display functions are available and are described in detail in the User Manual.

- Displaying a simulation of the entire front panel of the instrument on the screen ("Front Panel")
- Displaying the main function hardkeys in a separate window on the screen ("Mini Front Panel")
- Hiding or showing various screen elements
- Selecting a display theme and colors
- Changing the display update rate
- Activating or deactivating the touch-sensitivity of the screen
- Zooming into the diagram

6.6 Remote Control

In addition to working with the R&S FSWP interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC. Various methods for remote control are supported:

- Connecting the instrument to a (LAN) network (see Chapter 3.5, "Setting Up a Network (LAN) Connection", on page 31)
- Using the LXI browser interface in a LAN network
- Using the Windows Remote Desktop application in a LAN network
- Connecting a PC via the GPIB interface

How to configure the remote control interfaces is described in the User Manual.

The R&S FSWP is delivered with *IECWIN* installed, the auxiliary remote control tool provided free of charge by R&S.

For details on the IECWIN tool, see the "Network and Remote Control" chapter of the R&S FSWP User Manual.

6.6.1   Using the LXI Browser Interface in a LAN

LAN eXtensions for Instrumentation (LXI) is an instrumentation platform for measuring instruments and test systems that is based on standard Ethernet technology. LXI is intended to be the LAN-based successor to GPIB, combining the advantages of Ethernet with the simplicity and familiarity of GPIB. The LXI browser interface allows for easy configuration of the LAN and remote control of the R&S FSWP without additional installation requirements.

🛈 **Restrictions**

Only user accounts with administrator rights can make use of the LXI functionality.

For details see Chapter 3.2.3, "Login", on page 24.

Via the LXI browser interface to the R&S FSWP you can control the instrument remotely from another PC. Manual instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available. Using this feature, several users can access *and operate* the R&S FSWP simultaneously. This is useful for troubleshooting or training purposes. If necessary, this feature can be deactivated.

For details see the R&S FSWP User Manual.

6.6.2   Remote Desktop Connection

Remote Desktop is a Windows application which can be used to access and control the instrument from a remote computer through a LAN connection. While the instrument is in operation, the instrument screen contents are displayed on the remote computer. Remote Desktop provides access to all of the applications, files, and network resources of the instrument. Thus, remote operation of the instrument is possible.

The Remote Desktop Client is part of the installed Windows operating system. For other versions of Windows, Microsoft offers the Remote Desktop Client as an add-on.

6.6.3   Connecting a PC via the GPIB Interface

You can connect a PC to the R&S FSWP via the GPIB interface to send remote commands to control and operate the instrument. You can configure the GPIB address and the ID response string. The GPIB language is set as SCPI by default but can be changed to emulate other instruments.

A GPIB interface is integrated on the rear panel of the instrument.

7   Collecting Information for Technical Support

If problems occur, the instrument generates error messages which in most cases will be sufficient for you to detect the cause of an error and find a remedy.

Error messages are described in the "Troubleshooting" section of the user manuals.

In addition, our customer support centers are there to assist you in solving any problems that you may encounter with your R&S FSWP. We will find solutions more quickly and efficiently if you provide us with the information listed below.

- **System Configuration:** The "System Configuration" dialog box (in the "Setup" menu) provides information on:
  - **Hardware Info:** hardware assemblies
  - **Versions and Options:** the status of all software and hardware options installed on your instrument
  - **System Messages:** messages on any errors that may have occurred

  An .xml file with information on the system configuration ("Device Footprint") can be created automatically (using the `DIAGnostic:SERVice:SINFo` command or as described in "To collect the support information" on page 111).

- **Error Log:** The `RSError.log` file (in the
  `C:\Program Files (x86)\Rohde-Schwarz\FSWP\<version>\log`
  directory) contains a chronological record of errors.

- **Support file:** a *.zip file with important support information can be created automatically (in the
  `C:\Program Files (x86)\Rohde-Schwarz\FSWP\<version>\user`
  directory). The *.zip file contains the system configuration information ("Device Footprint"), the current eeprom data and a screenshot of the screen display.

See also the R&S FSWP User Manual, chapter "Service Functions".

To collect the support information

1. Press the [SETUP] key.

2. Select "Service" > "R&S Support" and then "Create R&S Support Information" .

The file is stored as

```
C:\Program Files (x86)\Rohde-Schwarz\FSWP\<version>\user\
<inst_model>_<serial-no>_<date_and_time>.zip
```

The file is stored as

```
C:\Program Files (x86)\Rohde-Schwarz\FSWP\<version>\user\
FSWP_*.zip.
```

Collect the error information and attach it to an email in which you describe the problem. Send the email to the customer support address for your region as listed on the Internet (http://www.customersupport.rohde-schwarz.com).

Packing and transporting the instrument

If the instrument needs to be transported or shipped, observe the notes described in Chapter 3.1.1, "Unpacking and Checking the Instrument", on page 17.

Index