R&S®ESRP
EMI Test Receiver
Getting Started

ROHDE & SCHWARZ

Make ideas real

This manual describes the following R&S®ESRP models with firmware version 3.36 and higher:

- R&S®ESRP3 (1316.4500K03)
- R&S®ESRP7 (1316.4500K07)

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

Contents

1   Safety and Regulatory Information

The product documentation helps you use the product safely and efficiently. Follow the instructions provided here and in the following chapters.

Intended use

The product is intended for the development, production and verification of electronic components and devices in industrial, administrative, and laboratory environments. Use the product only for its designated purpose. Observe the operating conditions and performance limits stated in the data sheet.

Where do I find safety information?

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

- In Chapter 1.1, "Safety Instructions", on page 9. The same information is provided in many languages as printed "Safety Instructions". The printed "Safety Instructions" are delivered with the product.

- Throughout the documentation, safety instructions are provided when you need to take care during setup or operation.

1.1   Safety Instructions

Products from the Rohde & Schwarz group of companies are manufactured according to the highest technical standards. To use the products safely, follow the instructions provided here and in the product documentation. Keep the product documentation nearby and offer it to other users.

Use the product only for its intended use and within its performance limits. Intended use and limits are described in the product documentation such as the data sheet, manuals and the printed "Safety Instructions". If you are unsure about the appropriate use, contact Rohde & Schwarz customer service.

Using the product requires specialists or specially trained personnel. These users also need sound knowledge of at least one of the languages in which the user interfaces and the product documentation are available.

Never open the casing of the product. Only service personnel authorized by Rohde & Schwarz are allowed to repair the product. If any part of the product is damaged or broken, stop using the product. Contact Rohde & Schwarz customer service at http://www.customersupport.rohde-schwarz.com.

Lifting and carrying the product

The maximum weight of the product is provided in the data sheet. To move the product safely, you can use lifting or transporting equipment such as lift trucks and forklifts. Follow the instructions provided by the equipment manufacturer.

The product is heavy. Do not move or carry the product by yourself. A single person can only carry a maximum of 18 kg safely depending on age, gender and physical condition. Look up the maximum weight in the data sheet. Use the product handles to move or carry the product. Do not lift by the accessories mounted on the product. Accessories are not designed to carry the weight of the product.

To move the product safely, you can use lifting or transporting equipment such as lift trucks and forklifts. Follow the instructions provided by the equipment manufacturer.

Choosing the operating site

Only use the product indoors. The product casing is not waterproof. Water that enters can electrically connect the casing with live parts, which can lead to electric shock, serious personal injury or death if you touch the casing. If Rohde & Schwarz provides accessories designed for your product, e.g. a carrying bag, you can use the product outdoors.

Unless otherwise specified, you can operate the product up to an altitude of 2000 m above sea level. The product is suitable for pollution degree 2 environments where nonconductive contamination can occur. For more information on environmental conditions such as ambient temperature and humidity, see the data sheet.

Setting up the product

Always place the product on a stable, flat and level surface with the bottom of the product facing down. If the product is designed for different positions, secure the product so that it cannot fall over.

If the product has foldable feet, always fold the feet completely in or out to ensure stability. The feet can collapse if they are not folded out completely or if the prod-

uct is moved without lifting it. The foldable feet are designed to carry the weight of the product, but not an extra load.

If stacking is possible, keep in mind that a stack of products can fall over and cause injury.

If you mount products in a rack, ensure that the rack has sufficient load capacity and stability. Observe the specifications of the rack manufacturer. Always install the products from the bottom shelf to the top shelf so that the rack stands securely. Secure the product so that it cannot fall off the rack.

Connecting to power

The product is an overvoltage category II product. Connect the product to a fixed installation used to supply energy-consuming equipment such as household appliances and similar loads. Keep in mind that electrically powered products have risks, such as electric shock, fire, personal injury or even death.

Take the following measures for your safety:

- Before switching on the product, ensure that the voltage and frequency indicated on the product match the available power source. If the power adapter does not adjust automatically, set the correct value and check the rating of the fuse.

- If a product has an exchangeable fuse, its type and characteristics are indicated next to the fuse holder. Before changing the fuse, switch off the instrument and disconnect it from the power source. How to change the fuse is described in the product documentation.

- Only use the power cable delivered with the product. It complies with country-specific safety requirements. Only insert the plug into an outlet with protective conductor terminal.

- Only use intact cables and route them carefully so that they cannot be damaged. Check the power cables regularly to ensure that they are undamaged. Also ensure that nobody can trip over loose cables.

- If the product needs an external power supply, use the power supply that is delivered with the product or that is recommended in the product documentation or a power supply that conforms to the country-specific regulations.

- Only connect the product to a power source with a fuse protection of maximum 20 A.

- Ensure that you can disconnect the product from the power source at any time. Pull the power plug to disconnect the product. The power plug must be easily accessible. If the product is integrated into a system that does not meet

these requirements, provide an easily accessible circuit breaker at the system level.

Using laser products

Lasers are classified according to their potential risk. If exposure to the laser beam is possible, the product is labeled as shown in the table explaining the safety labels.

Class 1M lasers

Safe for the naked eye. If you look into the laser beam with optical instruments such as binoculars or eye loupes, you risk damaging your eyes.

Class 2 lasers

If you stare into the beam, you risk damaging your eyes.

Handling batteries safely

The product contains exchangeable or built-in lithium polymer or lithium ion cells or batteries. The use of the word battery in the following always means all types. Only the battery contents are potentially hazardous. As long as a battery is undamaged and the seals remain intact, there is no danger.

Impact, shock or heat can cause damage such as dents, punctures and other deformations. A damaged battery poses a risk of personal injury. Handle a damaged or leaking battery with extreme care. Immediately ventilate the area since the battery releases harmful gases. If you come into contact with the battery fluid, immediately remove all contaminated clothing. Irritation can occur if the battery fluid comes in contact with your skin or eyes. Immediately and thoroughly rinse your skin or eyes with water and seek medical aid.

For safe handling, follow these rules:

- Do not short-circuit the battery.
- Do not mechanically damage the battery. Do not open or disassemble the battery.
- Do not expose the battery to high temperatures such as open flames, hot surfaces and sunlight.
- Only use the battery with the designated Rohde & Schwarz product.

- Only use the appropriate Rohde & Schwarz charger to charge the batteries. If the batteries are improperly charged, there is a risk of explosion. For charging and discharging temperature ranges, see the product documentation.
- Replace exchangeable batteries only with the same battery type.
- Store the battery in the product or use the product packaging.
- Dispose of exchangeable batteries separately from normal household waste as specified by the local waste disposal agency.

If you disregard these rules, you risk serious personal injury or even death due to explosion, fire or hazardous chemical substances. The product documentation provides further details.

If exchangeable batteries or products with built-in batteries are defective, contact the Rohde & Schwarz customer service. Rohde & Schwarz classifies the severity of the defect. When returning batteries or Rohde & Schwarz products containing batteries, use a carrier qualified to transport dangerous goods and notify the carrier of this classification. Follow the carrier's transport stipulations in line with IATA-DGR, IMDG-Code, ADR or RID.

Connecting headphones

Take the following measures to prevent hearing damage. Before using headphones, check the volume and reduce it if necessary. If you monitor varying signal levels, take off the headphones and wait until the signal has settled. Then adjust the volume.

Cleaning the product

Use a dry, lint-free cloth to clean the product. When cleaning, keep in mind that the casing is not waterproof. Do not use liquid cleaning agents.

Meaning of safety labels

Safety labels on the product warn against potential hazards.

⚠️	Potential hazard Read the product documentation to avoid personal injury or product damage.
⚠️	Heavy product Be careful when lifting, moving or carrying the product. Carrying the product requires a sufficient number of persons or transport equipment.

⚡	Electrical hazard Indicates live parts. Risk of electric shock, fire, personal injury or even death.
♨	Hot surface Do not touch. Risk of skin burns. Risk of fire.
⏚	Protective conductor terminal Connect this terminal to a grounded external conductor or to protective ground. This connection protects you against electric shock if an electric problem occurs.
☢	Warning: laser beam The product contains a laser.
🚫	Avoid exposure to direct or reflected laser beam.

1.2   Warning Messages in the Documentation

A warning message points out a risk or danger that you need to be aware of. The signal word indicates the severity of the safety hazard and how likely it will occur if you do not follow the safety precautions.

WARNING

Potentially hazardous situation. Could result in death or serious injury if not avoided.

CAUTION

Potentially hazardous situation. Could result in minor or moderate injury if not avoided.

NOTICE

Potential risks of damage. Could result in damage to the supported product or to other property.

1.3   Korea certification class A

이 기기는 업무용(A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

2 Documentation Overview

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

www.rohde-schwarz.com/manual/esrp

2.1 Getting Started Manual

Introduces the R&S ESRP 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

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.

The contents of the user manuals are available as help in the R&S ESRP. The help offers quick, context-sensitive access to the complete information.

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 ESRP 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 ESRP. It also lists the options and their order numbers as well as optional accessories.

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

www.rohde-schwarz.com/brochure-datasheet/esrp

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.

www.rohde-schwarz.com/firmware/esrp

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

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

www.rohde-schwarz.com/application/esrp

3 Conventions Used in the Documentation

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.
`Filenames, commands, program code`	Filenames, 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.

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.

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.

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 ESRP.

4.1   The Front Panel

The front panel of the R&S ESRP is shown in Figure 4-1. Each element (function keys and connectors) is described in more detail in the subsequent sections.

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

1   = Function keys
2   = USB interface
3   = Power button
4   = Display
5   = Access to operating system and online keyboard
6   = Display options
7   = Navigation options for menus
8   = Measurement configuration
9   = Marker functions
10 = Measurement control
11 = Measurement start
12 = Data entry keys
13 = Rotary knob
14 = Navigation keys

15 = Undo / redo function
16 = AF output incl. volume control
17 = Noise source control
18 = Supply voltage for accessories
19 = Supply voltage for accessories
20 = Tracking generator output
21 = RF input 2
22 = RF input 1

4.1.1 Touchscreen Display

The touchscreen on the front panel of the R&S ESRP 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.
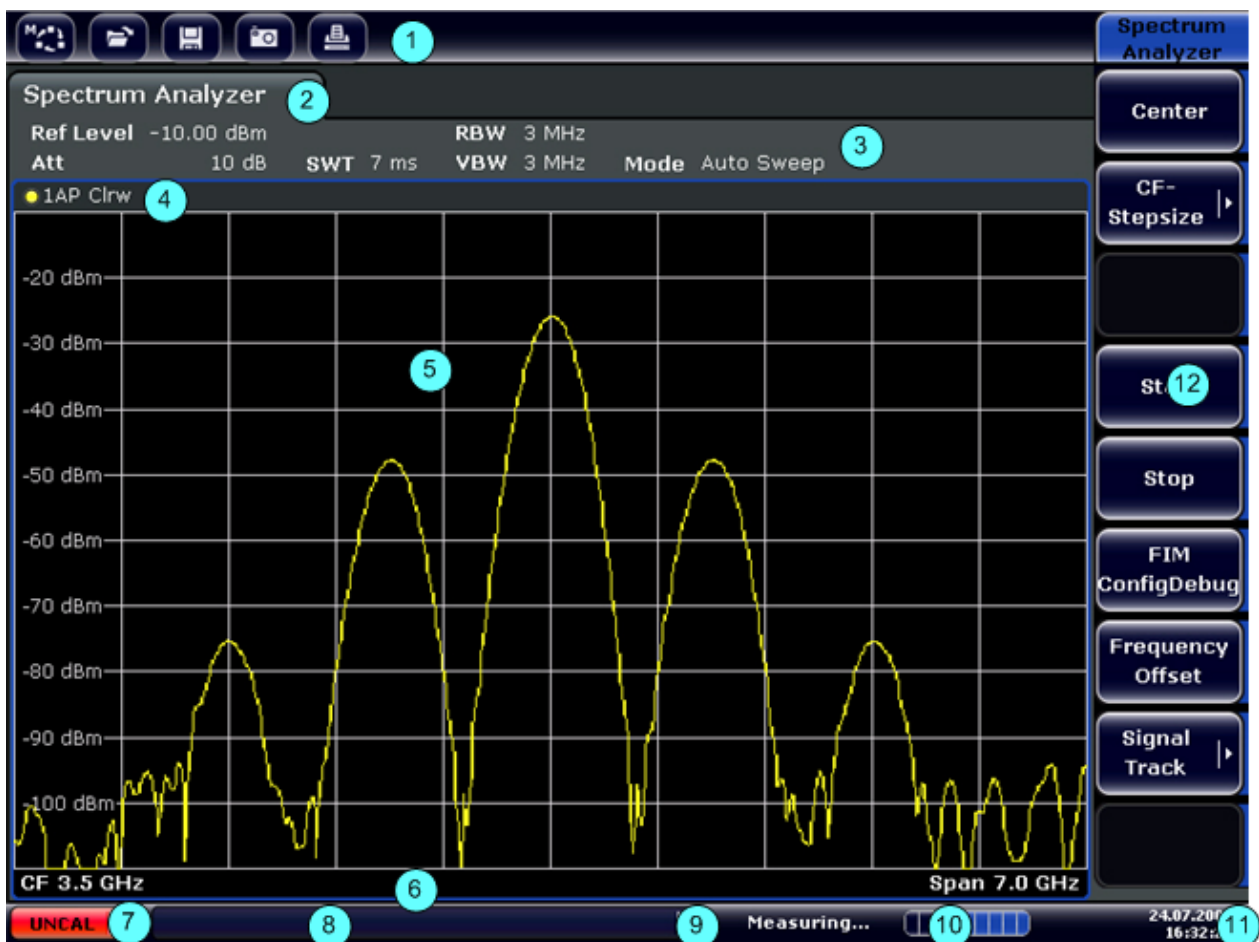
Figure 4-2: Touchscreen elements

1 = Toolbar with standard application functions, e.g. print, save/open file etc.
2 = Tabs for individual measurement tasks
3 = Channel information bar for current measurement settings
4 = Diagram header with diagram-specific (trace) information
5 = Measurement results area
6 = Diagram footer with diagram-specific information, depending on measurement mode
7 = Error indicator
8 = Error message, if available
9 = Device status
10 = Progress bar for measurement
11 = Date and time display
12 = Softkeys for menu access

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

- Selecting a new evaluation method

- Scrolling through a result list

- Saving or printing results and settings

4.1.2   Function Keys on the Front Panel

A detailed description of the corresponding menus and the other function keys is provided in chapter 6 "Instrument Functions" of the Operating Manual.

Table 4-1: Function keys

⏻	Turns the instrument on and off.
PRESET	Restores the default configuration of the R&S ESRP.
SAVE / RCL	Provides functionality to save, restore and manage instrument settings and other files.

SETUP	Provides functionality for general instrument configuration, for example: • to configure the display • to set the date and time • to establish a LAN connection
PRINT	Provides functionality to configure printers and hardcopys.
HELP	Displays the online help.
MODE	Selects the operating mode or firmware application.
(Windows)	Opens the Windows "Start" menu
(keyboard)	Turns the on-screen keyboard on and off. Repeatedly pressing the key changes the position of the keyboard (top or bottom of the display).
(keypad)	Selects alphanumeric characters.
DISPLAY	Opens a dialog box to turn screen elements on or off.
(split/max)	Switches between maximized and split display of focus area.
(focus)	Switches focus area between table and diagram.
USER	Allows you to define and use softkeys to load custom configurations.
HOME	Opens the root menu of the current application.
FREQ (CHANNEL)	Provides functionality to define frequency parameters, for example: • the center or receiver frequency • the frequency offset (CHANNEL is for special applications)

SPAN	Provides functionality to configure the frequency span.
AMPT (SCALE)	Provides functionality to configure amplitude or level characteristics, for example: • the reference level • 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 the resolution and video bandwidth.
SWEEP	Provides functionality to configure the sweep, for example: • the measurement time • the number of measurement points • the measurement mode (single or continuous measurements)
TRACE	Provides functionality to configure data acquisition and analyze measured data, for example: • the trace mode • the detector
TRIG	Provides functionality to configure triggered and gated measurements, for example:
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 FUNC	Provides additional analysis functions of the measurement markers, for example: • the frequency counter • the noise measurement • the phase noise measurement • the AM/FM audio demodulator
MKR➜	Provides functionality to position and control markers, for example: • to position the marker on the center frequency • to define the marker search area • to configure the peak excursion

MEAS	Provides the measurement functions, for example: • the bargraph measurement (in Receiver mode) • the scan and final measurement (in Receiver mode) • the AF demodulation (in Receiver mode) • IF analysis (in Receiver mode with option R&S ESRP-K56) • the channel power and ACLR measurement (in Spectrum mode) • the occupied bandwidth measurement (in Spectrum mode) • the Spectrum Emission Mask (SEM) measurement (in spectrum mode) • the spurious emission measurement (in spectrum mode) • the signal statistics (in spectrum mode)
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 single measurement.
RUN CONT	Starts a continuous measurement.
UNDO	Reverts the last operation.
REDO	Repeats previously reverted operation.

4.1.3 USB Interface

The front panel provides two female USB connectors to connect devices like an external keyboard or mouse. You can also connect a memory stick to save and restore instrument settings and measurement data.

4.1.4 Noise Source Control

The noise source control female connector is used to provide the supply voltage for an external noise source, for example to measure the noise figure and gain of amplifiers and frequency converting DUTs.

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.

4.1.5 RF Input 50Ω

The R&S ESRP provides an RF input for connection of a device under test (DUT) to the R&S ESRP. The DUT is connected to the RF Input via cable and an approriate connector (for example a male N connector).

The RF Input supports a frequency range from 9 kHz to f_{max} and an attenuation range from 0 dB to 70 dB.

With option R&S R&S ESRP-B29, the minimum frequency is extended to 10 Hz.

4.1.6   Probe Power

The R&S ESRP provides two connectors to supply accessories like transducers or probes with power.

The probe power connector with five pins supports supply voltages of ±10 V and ground. The maximum permissible current is 200 mA. This probe power connector is suitable, for example, for transducers from Rohde & Schwarz.

The probe power connector with three pins 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 from Agilent.

4.1.7   AF Output

Headphones equipped with a miniature jack plug can be connected to the AF output female connector. The internal impedance is 10 Ω. The output voltage can be set by using the volume control to the right of the female connector. If a plug is connected, the internal loudspeaker is automatically switched off.

See also

4.1.8   Tracking Generator Output (Optional)

The R&S ESRP is equipped with an optional tracking generator and therefore provides a tracking generator output connector.

The output of the tracking generator is connected to the DUT via a cable equipped with a male N connector. The female connector is available only with the tracking generator option (R&S FSV-B9).

ⓘ **Sensitive DUTs concerning matching**

For DUTs with sensitive RF characteristics with regard to matching (VSWR) at the input, insert a 10 dB attenuator between the DUT and the tracking generator.

4.2   Rear Panel View

The rear panel of the R&S ESRP is shown in Figure 4-3. Each element is described in more detail in the subsequent sections.

Figure 4-3: R&S ESRP rear panel

1 = LAN interface
2 = Trigger output
3 = IF / Video connector
4 = USB interface
5 = AUX port
6 = External trigger / gate input
7 = VGA interface
8 = Reference in
9 = Reference out
10 = GPIB interface
11 = AC power supply and main switch

4.2.1   AC Power Supply Connection and Main Power Switch

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

The main power switch works as follows.

- Position "I": The instrument is supplied with power and in operation.
  The OCXO reference frequency is warmed up.
- Position "O": The instrument is disconnected from the AC power supply.

For more information see Chapter 5.7, "Connecting the AC Power", on page 36.

4.2.2   LAN

The LAN interface can be used to connect the R&S ESRP to a local network for remote control, printouts and 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*).

4.2.3   VGA Interface

The female VGA connector is used to connect an external monitor. Instructions on how to connect an external monitor are provided in Chapter 5.12, "Connecting an External Monitor", on page 41.

4.2.4   Ext Trigger / Gate In

The female connector for external trigger or gate input is used to control the measurement by means of an external signal. The voltage levels can range from 0.5 to 3.5 V. The default value is 1.4 V. The typical input impedance is 10 kΩ.

4.2.5   Ref In

As a reference signal, you can either use the internal reference, or connect an external one. The setup menu is used to switch between the internal and an external reference. The REF IN female connector is used as an input for a 1-20 MHz reference signal. The required input level is 0-10 dBm.

4.2.6   Ref Out

This connector can be used to provide an external reference signal (e.g. the OCXO) to other devices that are connected to this instrument. The REF OUT female connector can output a 10 MHz reference signal with an output level of 0 dBm.

4.2.7   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 information, refer to the user manual.

4.2.8   Trigger Output

The female BNC connector can be used to provide a signal to another device. The signal is TTL compatible (0 V / 5 V).

You can control the trigger output with the functionality provided in the "In-/Output" menu ([INPUT/OUTPUT] key).

The trigger output also controls signals by the frequency mask trigger available in realtime mode (R&S ESR-K55).

4.2.9   IF / Video

The female BNC connector can be used for various outputs:

- Intermediate frequency (IF) output of 32 MHz
- Video output (1 V)

You can select between IF and video output with the functionality provided in the "In-/Output" menu ([INPUT/OUTPUT] key).

4.2.10   USB

The rear panel provides two female USB connectors to connect devices like an external keyboard or mouse. You can also connect a memory stick to save and restore instrument settings and measurement data.

4.2.11   AUX Port

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

Pin	Signal	Description
1	+5 V / max. 250 mA	Supply voltage for external circuits
2	I/O	Control Phase N
3	I/O	Controls the 150 kHz highpass filter
4	I/O	Controls Phase L3
5	I/O	not used
6	I/O	Controls Phase L1
7	I/O	Controls Phase L2
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.

4.2.12   OCXO option (R&S FSV-B4)

This option generates a very precise 10 MHz reference signal. If installed, this signal is used as an internal reference. It can also be used to synchronize other connected devices via the REF OUT 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 Device ID

The unique device identifier is provided as a barcode sticker on the rear panel of the R&S ESRP.

It consists of the device order number and a serial number.

💡 The serial number is used to define the **default instrument name**, which is:

<Type><variant>-<serial_number>

For example, `ESRP3-123456`.

The instrument name is required to establish a connection to the instrument in a LAN.

5   Preparing For Use

Here, you can find basic information about setting up the product for the first time.

5.1   Lifting and Carrying

The carrying handles are designed to lift or carry the instrument. Do not apply excessive external force to the handles.

See "Lifting and carrying the product" on page 10.

5.2   Unpacking and Checking

1. Unpack the R&S ESRP carefully.

2. Retain the original packing material. Use it when transporting or shipping the R&S ESRP later.

3. Using the delivery notes, check the equipment for completeness.

4. Check the equipment for damage.

    If the delivery is incomplete or equipment is damaged, contact
    Rohde & Schwarz.

5.3   Choosing the Operating Site

Specific operating conditions ensure proper operation and avoid damage to the product and connected devices. For information on environmental conditions such as ambient temperature and humidity, see the data sheet.

See also "Choosing the operating site" on page 10.

Electromagnetic compatibility classes

The electromagnetic compatibility (EMC) class indicates where you can operate the product. The EMC class of the product is given in the data sheet under "General data".

*   Class B equipment is suitable for use in:
    –   Residential environments
    –   Environments that are directly connected to a low-voltage supply network that supplies residential buildings
*   Class A equipment is intended for use in industrial environments. It can cause radio disturbances in residential environments due to possible conducted and radiated disturbances. It is therefore not suitable for class B environments.
    If class A equipment causes radio disturbances, take appropriate measures to eliminate them.

5.4   Setting up the R&S ESRP

See also:
*   "Setting up the product" on page 10
*   "Intended use" on page 9

5.5   Placing the R&S ESRP on a Bench Top

To place the product on a bench top

1. Place the product on a stable, flat and level surface. Ensure that the surface can support the weight of the product. For information on the weight, see the data sheet.

2. **CAUTION!** Foldable feet can collapse. See "Setting up the product" on page 10.

    Always fold the feet completely in or out. With folded-out feet, do not place anything on top or underneath the product.

3. **WARNING!** A stack of products can fall over and cause injury. Never stack more than three products on top of each other. Instead, mount them in a rack.

    Stack as follows:

    ● If the products have foldable feet, fold them in completely.
    ● All products must have the same dimensions (width and length).
    ● Do not exceed a total load of 50 kg placed on the product at the bottom of the stack.
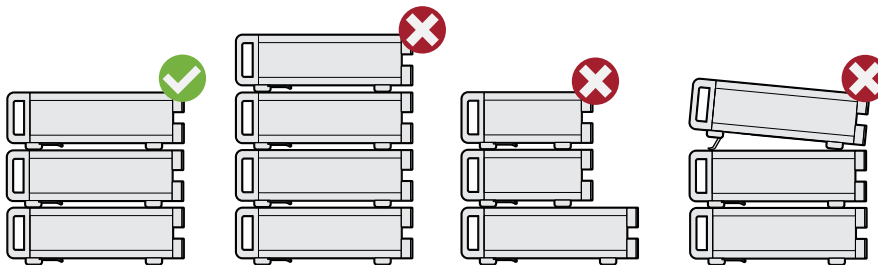
    Left   = Stacked correctly
    Middle left   = Stacked incorrectly, too many products
    Middle right = Stacked incorrectly, different dimensions
    Right   = Stacked incorrectly, different dimensions, folded-out feet

4. **NOTICE!** Overheating can damage the product.

    Prevent overheating as follows:

    ● Keep a minimum distance of 10 cm between the fan openings of the product and any object in the vicinity.
    ● Do not place the product next to heat-generating equipment such as radiators or other products.

5.6 Mounting the R&S ESRP in a Rack

To prepare the rack

1. Observe the requirements and instructions in "Setting up the product" on page 10.

2. **NOTICE!** Insufficient airflow can cause overheating and damage the product.

   Design and implement an efficient ventilation concept for the rack.

To mount the R&S ESRP in a rack

1. Use an adapter kit to prepare the R&S ESRP for rack mounting.

   a) Order the rack adapter kit designed for the R&S ESRP. For the order number, see the data sheet.
   b) Mount the adapter kit. Follow the assembly instructions provided with the adapter kit.

2. Lift the R&S ESRP to shelf height.

3. Grab the handles and push the R&S ESRP onto the shelf until the rack brackets fit closely to the rack.

4. Tighten all screws in the rack brackets with a tightening torque of 1.2 Nm to secure the R&S ESRP in the rack.

To unmount the R&S ESRP from a rack

1. Loosen the screws at the rack brackets.

2. Remove the R&S ESRP from the rack.

3. If placing the R&S ESRP on a bench top again, unmount the adapter kit from the R&S ESRP. Follow the instructions provided with the adapter kit.

5.7 Connecting the AC Power

The R&S ESRP is equipped with an AC power supply connector.

The R&S ESRP 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.

For safety information, see "Connecting to power" on page 11.

To connect the AC power

1. Plug the AC power cable into the AC power connector on the rear panel of the instrument. Only use the AC power cable delivered with the R&S ESRP.

2. Plug the AC power cable into a power outlet with ground contact.
   The required ratings are listed next to the AC power connector and in the data sheet.
   For details on the connector, refer to Chapter 4.2.1, "AC Power Supply Connection and Main Power Switch", on page 29.

3. Install the remaining cables before switching on the product.

5.8 Connecting to a DC Power Source (Optional)

You can equip the R&S ESRP with the optional DC power supply adapter (R&S FSV-B30) and connect it to a DC power source, for example a battery. The DC power supply adapter allows you to operate the instrument with a DC voltage of 10 V to 28 V.

To connect the DC power

1. Install the DC power supply adapter to the R&S ESRP.
   For more information about the installation process, refer to the installation guide delivered with the adapter.
   Using external power supplies to supply the R&S ESRP with DC safety extra low voltage (SELV) can lead to physical injuries resulting from an electrical shock.
   To avoid physical injuries, make sure the requirements for reinforced or double insulation are met, according to DIN/EN/IEC 61010 (UL61010, CAN CSA C22.2 No. 61010) or DIN/EN/IEC 60950 (UL60950, CAN CSA C22.2 No. 60950). Use a cable with a maximum length of 3 m.

2. Connect an appropriate DC power cable to the DC power supply adapter.

3. Connect the cable to the DC power source.

4. Set the switch on the DC power supply adapter to "I".
   A green LED indicates that the DC power supply is ready for operation.

   Note: The DC power supply switches off automatically in case of overvoltage or undervoltage.
   This state is indicated by means of a red LED.

5.9   Switching the Instrument On and Off

Table 5-1: Overview of power states

Status	LED on Power key	Position of main power switch
Off	⚪ gray	[0]
Standby	🟠 orange	[I]
Ready	🟢 green	[I]

To switch on the R&S ESRP

The R&S ESRP is off but connected to power.

1. Set the switch on the power supply to position [I].
   See Chapter 4.2.1, "AC Power Supply Connection and Main Power Switch", on page 29.

   The LED of the Power key is orange.
   See Chapter 4.1.2, "Function Keys on the Front Panel", on page 23.

2. Press the Power key.
   See Chapter 4.1.2, "Function Keys on the Front Panel", on page 23.

   The LED changes to green.
   The R&S ESRP boots.

   After booting, the instrument is ready for operation.

ⓘ **Warm-up time for OCXO**

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

To shut down the product

The product is in the ready state.

► Press the [Power] key.

The operating system shuts down. The LED changes to orange.

ⓘ If the instrument temperature exceeds the limit specified in the data sheet, the R&S ESRP automatically shuts down to protect the instrument from damage.

To disconnect from power

The R&S ESRP is in the standby state.

1. **NOTICE!** Risk of data loss. If you disconnect the product from power when it is in the ready state, you can lose settings and data. Shut it down first.

   Set the switch on the power supply to position [0].
   See Chapter 4.2.1, "AC Power Supply Connection and Main Power Switch", on page 29.

   The LED of the Power key is switched off.

2. Disconnect the R&S ESRP from the power source.

5.10 Connecting to LAN

You can connect the instrument to a LAN for remote operation via a PC.

For details on the connector, see Chapter 4.2.2, "LAN", on page 29.

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

● 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

Network environment

Before connecting the product to a local area network (LAN), consider the following:

- Install the latest firmware to reduce security risks.

- For internet or remote access, use secured connections, if applicable.

- Ensure that the network settings comply with the security policies of your company. Contact your local system administrator or IT department before connecting your product to your company LAN.

- When connected to the LAN, the product may potentially be accessed from the internet, which may be a security risk. For example, attackers might misuse or damage the product. For more information about IT security and how to operate the product in a secure LAN environment, see the Rohde & Schwarz white paper 1EF96: Malware Protection Windows 10.

► **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.

  Connect the R&S ESRP to the LAN via the LAN interface on the rear panel of the instrument.

  Windows automatically detects the network connection and activates the required drivers.

  By default, the R&S ESRP is configured to use DHCP and no static IP address is configured.

The default instrument name is <Type><variant>-<serial_number>, for example, ESRP3-123456. For information on determining the serial number, see Chapter 4.2.13, "Device ID", on page 32.

For more information on LAN configuration, see the R&S ESRP user manual.

5.11 Connecting a Keyboard

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

To configure the keyboard language

1. To access the Windows operating system, press the Windows key on the external keyboard.

2. Select "Start > Settings > Time & language > Region & language > Add a language" .

5.12 Connecting an External Monitor

You can connect an external monitor to the "MONITOR" connector on the instrument's rear panel.

For details on the connector refer to Chapter 4.2.3, "VGA Interface", on page 29.

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

2. Press the [SETUP] key.

3. Press the "General Setup" softkey.

4. Press the "More" softkey.

5. Press the "Configure Monitor" softkey.

   The configuration of the connected monitor is determined and displayed in the standard Windows configuration dialog box.

6. In the configuration dialog box, you can switch from the internal monitor (laptop icon) to the external monitor (monitor icon), or both (double monitor icon).

   If the external monitor is selected, the R&S ESRP display is disabled. The screen content (measurement screen) formerly displayed on the R&S ESRP is displayed on the external screen. If you select both monitors, the R&S ESRP screen and the external screen are both active.

5.13   Windows Operating System

The instrument contains the Windows 7 operating system which has been configured according to the instrument's features and needs. Changes in the system setup are only required when peripherals like a keyboard or a printer are installed or if the network configuration does not comply with the default settings. After the R&S ESRP is started, the operating system boots and the instrument firmware is started automatically.

Tested software

The drivers and programs used on the instrument under Windows 7 are adapted to the instrument. Only install update software released by Rohde & Schwarz to modify existing instrument software.

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 following program packages have been tested:

- Symantec Endpoint Security – virus-protection software
- FileShredder - for reliable deletion of files on the hard disk

Service packs and updates

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

Firewall settings

A firewall protects an instrument by preventing unauthorized users from gaining access to it through a network. Rohde & Schwarz highly recommends using the firewall on your instrument. Rohde & Schwarz instruments are shipped with the Windows firewall enabled. All ports and connections for remote control are enabled.

Note that changing firewall settings requires administrator rights.

Virus protection

Take appropriate steps to protect your instruments from infection. Use strong firewall 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. However, 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

To access the "Start" menu

The Windows "Start" menu provides access to the Windows 7 functionality and installed programs.

► Press the "Windows" key on the front panel, or press the "Windows" key or the [CTRL + ESC] key combination on the (external) keyboard.

The "Start" menu and the Windows taskbar are displayed.

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 or "Start" menu.

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

All necessary system settings can be defined in the "Start > Settings" menu.

For required settings, refer to the Windows 7 documentation and to the hardware description.

5.14   Logging On

Windows 7 requires that users identify themselves by entering a user name and password in a login window. By default, the R&S ESRP provides two user accounts:

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

Some administrative tasks require administrator rights (e.g. the configuration of a LAN network). Refer to the description of the basic instrument Setup ([Setup] menu) to find out which functions are affected.

Passwords

For all default user accounts, the initial password is *894129*. Note that this password is very weak, and we recommend changing the password for both users after initial login. An administrator can change the password in Windows 7 for any user at any time via "Start" > "Settings" > "Account" > "SignIn Options" > "Password" > "Change".

Auto-login

When shipped, the instrument automatically logs on the default "Instrument" user to Windows 7 using the default password. This function is active until an administrator explicitly deactivates it or changes the password.

ⓘ   **Changing the password and use of auto-login function**
Note that when you change the default password, the default auto-login function no longer works!

In this case, you must enter the new password manually to log on.

Deactivating the automatic login function

1. Select the "Windows" icon on the front panel to access the operating system of the R&S ESRP (see also).

2. In the Windows "Start" menu, select "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.
   The auto-login function is reactivated with the changed password. It will be applied the next time the instrument is switched on.

Adapting the auto-login function to a new password

If you change the password that is used during auto-login, this function no longer works. Adapt the settings for the auto-login function first.

1. Select the "Windows" icon on the front panel to access the operating system of the R&S ESRP (see also "To access the "Start" menu" on page 43).

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

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

4. Save the changes to the file.

5. In the Windows "Start" menu, select "Run".
   The "Run" dialog box is displayed.

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

7. Press the [ENTER] key to confirm.
   The auto-login function is reactivated with the changed password. It will be applied the next time the instrument is switched on.

Switching users when using the auto-login function

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

1. Select the "Windows" icon on the front panel to access the operating system of the R&S ESRP (see also "To access the "Start" menu" on page 43).

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.

5.15 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 Info" softkey.

3. Press the "Versions + Options" softkey.

   A list with hardware and firmware information is displayed.

4. Check the availability of the hardware options as indicated in the delivery note.
   For an overview of the available options, refer to the datasheet.

5.16 Performing a Self Alignment and a Self Test

(i) **Operating temperature**

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

Performing a self alignment

1. Press the [SETUP] key.

2. Press the "Alignment" softkey.

3. Press the "Self Alignment" softkey.

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

(i) **To display the alignment results again later**
   ● Press the [SETUP] key.
   ● Press the "Alignment" softkey.
   ● Press the "Show Align Results" softkey.

Performing a self test

The self test 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 "More" softkey.

3. Press the "Service" softkey.

4. Press the "Selftest" softkey.

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

5.17   Considerations for Test Setup

Cable selection and electromagnetic interference (EMI)

Electromagnetic interference (EMI) can affect the measurement results.

To suppress electromagnetic radiation during operation:

- Use high-quality shielded cables, for example, double-shielded RF and LAN cables.
- Always terminate open cable ends.
- Ensure that connected external devices comply with EMC regulations.

Preventing electrostatic discharge (ESD)

Electrostatic discharge is most likely to occur when you connect or disconnect a DUT.

► **NOTICE!** Risk of electrostatic discharge. Electrostatic discharge can damage the electronic components of the product and the device under test (DUT).

   Ground yourself to prevent electrostatic discharge damage:

   a) Use a wrist strap and cord to connect yourself to ground.
   b) Use a conductive floor mat and heel strap combination.

Signal input and output levels

Information on signal levels is provided in the data sheet and on the instrument, next to the connector. Keep the signal levels within the specified ranges to avoid damage to the R&S ESRP and connected devices.

6   Basic Operations

This chapter gives an overview on how to work with the R&S ESRP. It describes what kind of information is displayed in the diagram area, how to operate the R&S ESRP via the front panel keys and other interaction methods, and how to use the Online Help.

💡 **Remote control**

In addition to working with the R&S ESRP 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
- Using the web 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 R&S ESRP user manual.

6.1   Information in the Diagram Area

The following figure shows a measurement diagram during analyzer operation. All different information areas are labeled. They are explained in more detail in the following sections.
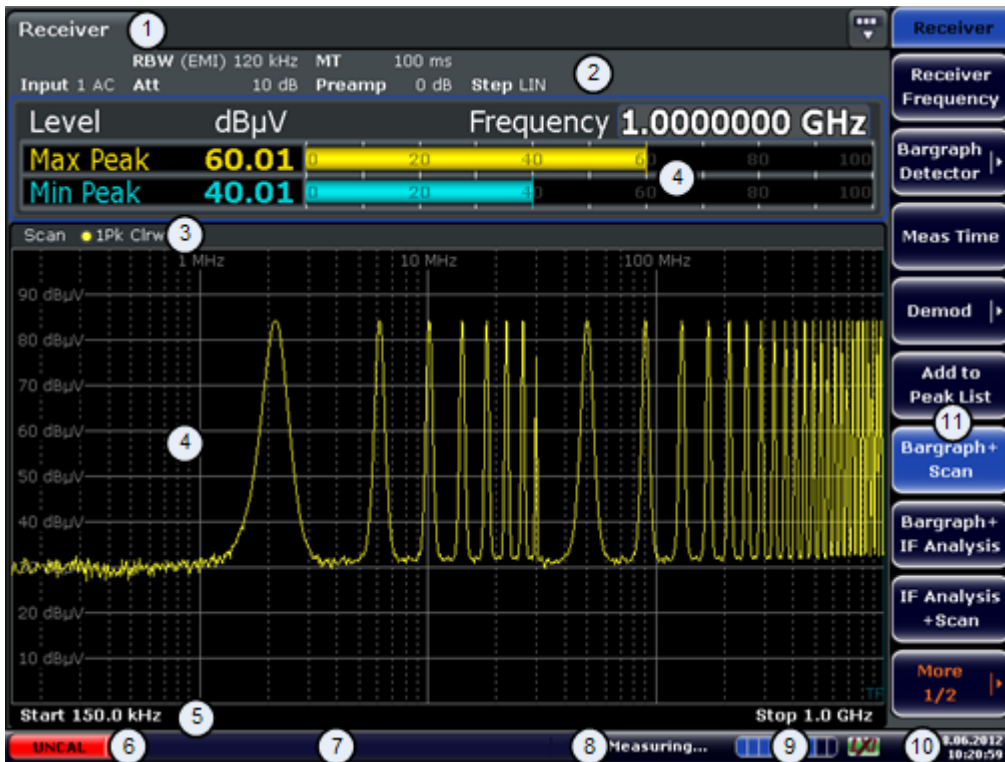
1 = Operation mode tabs
2 = Hardware information
3 = Header of the result display containing trace information
4 = Result display
5 = Footer of the result display containing general measurement settings
6 = Calibration status
7 = Error messages
8 = Measurement status information
9 = Measurement progress bar
10 = Date and time
11 = Softkeys

6.1.1   Channel Display

Using the R&S ESRP you can handle several different measurement tasks (chan-nels) 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 press the corresponding tab.

ⓘ The ★ 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.

To start a new channel

1. Click the icon in the toolbar at the top of the screen (see also Chapter 6.2.1, "Toolbar", on page 58 on how to display the toolbar).

2. Select the softkey for the required measurement mode.
   A new tab is displayed for the new channel.

6.1.2   Display of Hardware Settings

Information on hardware settings are displayed in the channel bar above the diagram.
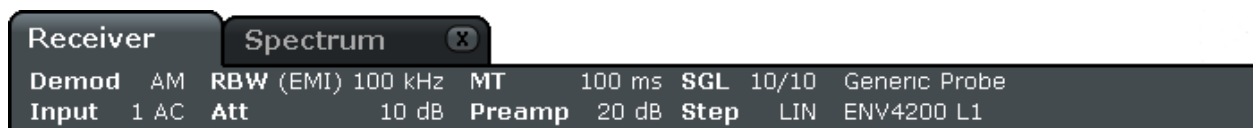
ⓘ **Invalid settings**

A bullet next to the hardware 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.

It is the user's responsibility to remedy such a situation.

💡 **Editing settings in the channel bar**

All settings that are displayed in the channel bar can easily be edited by touching the setting in the display (with a finger or mouse pointer). The corresponding (edit) dialog box is displayed where you can edit the setting.

In receiver mode, the R&S ESRP shows the following settings:

Demod	Active AF demodulation.
Input	Type of coupling currently used.

RBW	Resolution bandwidth currently used.
Att	Current (RF) attenuation level.
MT	Measurement time currently used.
Preamp	Current preamplification level.
SGL	Current scan count.
Step	Current frequency step mode.
no label	Active transducer factor.
no label	Active LISN.

In spectrum mode, the R&S ESRP shows the following settings:

Ref Level	Reference level
Att	RF attenuation level.
Ref Offset	Reference level offset
SWT	Sweep time that has been set.
	If the sweep time does not correspond to the value for automatic coupling, a bullet is displayed in front of the field. The color of the bullet turns red if the sweep time is set below the value for automatic coupling. In addition, the UNCAL flag is shown. In this case, the sweep time must be increased.
RBW	Resolution bandwidth that has been set.
	If the bandwidth does not correspond to the value for automatic coupling, a green bullet appears in front of the field.
VBW	Video bandwidth that has been set.
	If the bandwidth does not correspond to the value for automatic coupling, a green bullet is displayed in front of the field.
Compatible	Compatible device mode (FSP, FSU, default; default not displayed)
Mode	Indicates which sweep mode type is selected: • "Auto FFT": automatically selected FFT sweep mode • "Auto sweep": automatically selected swept sweep mode • "FFT": manually selected FFT sweep mode • "Sweep": manually selected swept sweep mode

6.1.3   Measurement Settings Information

In addition to the common hardware 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 in gray font and only when applicable for the current measurement, as opposed to the common hardware settings that are always displayed.

In Receiver mode, the R&S ESRP shows the following information.

TRG	Trigger source
	(for details see trigger settings in the "TRIG" menu in the Operating manual)
	• **EXT**: External
	• **VID**: Video
75 Ω	The input impedance of the instrument is set to 75 Ω.

In Spectrum mode, the following types of information may be displayed, if applicable.

Label	Description
SGL	The sweep is set to single sweep mode.
Sweep Count	The current signal count for measurement tasks that involve a specific number of subsequent sweeps
	(see "Sweep Count" setting in "Sweep" menu in the Operating manual)
TRG	Trigger source
	(for details see trigger settings in the "TRIG" menu in the Operating manual)
	• **EXT**: External
	• **VID**: Video
	• **RFP**: RF power
	• **IFP**: IF power
	• **TIM**: Time
	• **SQL**: Squelch
6dB/RRC/CHN	Filter type for sweep bandwidth
	(see BW menu in the Operating manual)
PA	The preamplifier is activated.
GAT	The frequency sweep is controlled via the [EXT TRIG/GATE IN] connector.
TDF	A transducer factor is activated.
75 Ω	The input impedance of the instrument is set to 75 Ω.

Label	Description
FRQ	A frequency offset ≠ 0 Hz is set.
DC/AC	An external DC or AC calibration signal is in use.
Inp	Input source: digital I/Q (option R&S FSV-B17 only)

6.1.4 Diagram-specific and Trace Information

Diagram-specific information, e.g. concerning traces, is indicated in the diagram header and footer.

Trace information in diagram header

The diagram header (above the diagram) contains the following trace information:

ⓘ The header may contain a user-defined introductory title, see Chapter 6.4.7, "Adding a Title to the Diagram Header", on page 80.
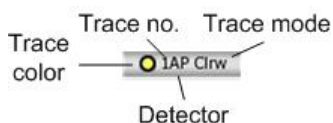
💡 **Editing settings in the diagram header**

All settings that are displayed in the diagram header can easily be edited by selecting the setting in the display (by tapping or clicking). The corresponding (edit) dialog box is displayed in which you can edit the setting.

Norm/NCor

Correction data is not used.

Trace color		Color of trace display in diagram
Trace no.		Trace number (1 to 6)
Detector		Selected detector:
	AP	AUTOPEAK detector
	Pk	MAX PEAK detector
	Mi	MIN PEAK detector

	Sa	SAMPLE detector
	Av	AVERAGE detector
	Rm	RMS detector
	QP	QUASIPEAK detector
	CA	CISPR Average detector
	RA	RMS Average detector
Trace Mode		Sweep mode:
	Clrw	CLEAR/WRITE
	Max	MAX HOLD
	Min	MIN HOLD
	Avg	AVERAGE (Lin/Log/Pwr)
	View	VIEW

Marker information in Diagram Grid

The x and y axis positions of the last 2 markers or delta markers that were set, as well as their index, are displayed within the diagram grid, if available. The value in the square brackets after the index indicates the trace to which the marker is assigned. (Example: M1[1] defines marker 1 on trace 1.) For more than 2 markers, a separate marker table is displayed beneath the diagram.

If applicable, the active measurement function for the marker and its main results are indicated, as well. The functions are indicated with the following abbreviations:

FXD	Reference fixed marker active
PHNoise	Phase noise measurement active
CNT	Frequency counter active
TRK	Signal track active
NOIse	Noise measurement active
MDepth	Measurement of the AM modulation depth active
TOI	TOI measurement active

Marker Information in Marker Table

In addition to the marker information displayed within the diagram grid, a separate marker table may be displayed beneath the diagram. This table provides the following information for all active markers:

Type	Marker type: N (normal), D (delta), T (temporary, internal), PWR (power sensor)
Dgr	Diagram number
Trc	Trace to which the marker is assigned
Stimulus	x-value of the marker
Response	y-value of the marker
Func	Activated marker or measurement function
Func .Result	Result of the active marker or measurement function

Mode-dependant Information in Diagram Footer

The diagram footer (beneath the diagram) contains the following information, depending on the current mode:

Mode	Label	Information
FREQ	CF	Center frequency (between start and stop)
	Span	Frequency span
SPAN	CF (1.0 ms/)	Zero span

For most modes, the number of sweep points shown in the display are indicated in the diagram footer. In zoom mode, the (rounded) number of currently displayed points are indicated.

The diagram footer can be removed from the display temporarily, see Chapter 6.4.8, "Removing the Diagram Footer", on page 80.

6.1.5   Instrument and Status Information

Global instrument settings, the instrument status and any irregularities are indicated in the status bar beneath the diagram.

> 💡 **Hiding the status bar**
>
> You can hide the status bar display, e.g. in order to enlarge the display area for the measurement results.

1. Press the [DISPLAY] key.

2. In the "Display Settings" dialog box, select "Status Bar State: Off".
   The status bar is no longer displayed.

- To display the status bar again, select "Status Bar State: On".

SCPI command:

`DISP:SBAR:STAT OFF`

The following information is displayed:

Instrument status

📶	The instrument is configured for operation with an external reference.

Progress

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

Date and time

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

6.2   Means of User Interaction

The instrument provides a user interface for operation that does not require an external keyboard, using the following means of interaction:

- Chapter 6.2.1, "Toolbar", on page 58
- Chapter 6.2.2, "Touchscreen", on page 59
- Chapter 6.2.3, "On-screen Keyboard", on page 60

All tasks necessary to operate the instrument can be performed using this user interface. Apart from instrument specific keys, all other keys that correspond to an external keyboard (e.g. 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, e.g. the keypad, rotary knob, or arrow and position keys

6.2.1 Toolbar

Standard functions can be performed via the icons in the toolbar at the top of the screen, if available (see Chapter 6, "Basic Operations", on page 49). By default, this toolbar is not displayed.

Displaying the toolbar

► Press the "Toolbar" icon to the right of the tabs in the display to toggle the toolbar on or off.

Alternatively:

1. Press the [SETUP] key.

2. Press the "Display Setup" softkey.

3. Press the "Tool Bar State On/Off" softkey.
   Or:

4. Press the [DISPLAY] key.

5. In the "Display Settings" dialog box, select "Tool Bar State: On".
   The toolbar is displayed at the top of the screen.

Remote:

`DISP:TBAR:STAT ON`

The following functions are available:

Table 6-1: Standard Application Functions in the Toolbar

Icon	Description
	Opens the "Select Mode" menu (see Chapter 6.1.1, "Channel Display", on page 50)
	Opens an existing measurement (settings) file
	Stores the current measurement file
	Prints the current measurement screen
	Saves the current measurement screen as a file (screenshot)
	Reverts last operation.
	Repeats previously reverted operation.
	Selection mode: the cursor can be used to select (and move) markers in a zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area. Can be repeated several times.
	Zoom off: the diagram is displayed in its original size

6.2.2 Touchscreen

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 (amoung others) can be performed by the tap of your finger:

- Changing a setting
- Changing the display
- Moving a marker
- Zooming into a diagram
- 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.

Deactivating and Activating the Touchscreen Function

The touchscreen function can be deactivated, e.g. when the instrument is being used for demonstration purposes and tapping the screen should not provoke an action.
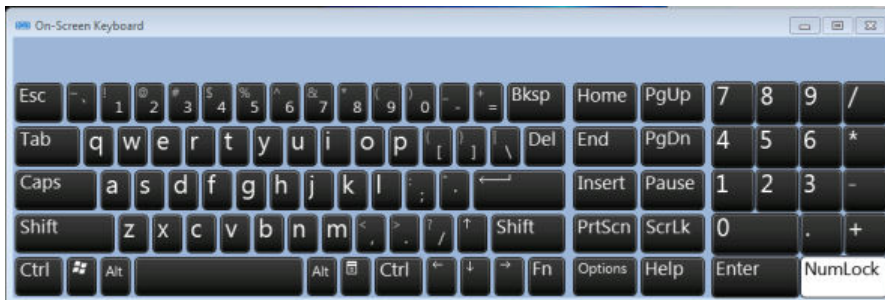
1. Press the [DISPLAY] key.

2. In the dialog box, select one of the following options:
   - "Touchscreen ON": touchscreen function is active for the entire screen
   - "Touchscreen OFF": touchscreen is deactivated for the entire screen
   - "DIAGRAM TOUCH OFF": touchscreen is deactivated for the diagram area of the screen, but active for the surrounding softkeys, toolbars and menus.

SCPI command:

```
DISP:TOUCh:STAT OFF
```

6.2.3 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.

6.2.4   Keypad

	The keypad is used to enter alphanumeric parameters. It contains the following keys: • Alphanumeric keys Enters numbers and (special) characters in edit dialog boxes. For details refer to Chapter 6.3.1, "Entering Numeric Parameters", on page 67 and Chapter 6.3.2, "Entering Alphanumeric Parameters", on page 68. • Decimal point Inserts a decimal point "." at the cursor position.

- Sign key
  Changes the sign of a numeric parameter. In the case of an alphanumeric parameter, inserts a "-" at the cursor position.

- Unit keys (GHz/-dBm MHz/dBm, kHz/dB and Hz/dB)
  These keys add the selected unit to the entered numeric value and complete the entry.
  In the case of level entries (e.g. in dB) or dimensionless values, all units have the value "1" as mulitplying factor. Thus, they have the same function as an ENTER key. The same is true for an alphanumeric entry.

- ESC key
  Closes all kinds of dialog boxes, if the edit mode is not active. Quits the edit mode, if the edit mode is active. In dialog boxes that contain a "Cancel" button it activates that button.
  For "Edit" dialog boxes the following mechanism is used:

  – 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.

- BACKSPACE key

  – If an alphanumeric entry has already been started, this key deletes the character to the left of the cursor.

- If no input field is currently active, the most recently entered value is undone, i.e. the previous value is retrieved. Thus, you can toggle between two values (e.g. spans).

- ENTER key

  - Concludes the entry of dimensionless entries. The new value is accepted.

  - With other entries, this key can be used instead of the "Hz/dB" unit key.

  - In a dialog box, presses the default or focused button.

  - In a dialog box, activates the edit mode for the focused area, if available. For details on the edit mode refer to Chapter 6.3.3, "Navigating in Dialog Boxes", on page 70.

  - In a dialog box, activates or deactivates the selected option of the focused area, if the edit mode is active.

6.2.5 Rotary Knob

	The rotary knob has several functions: - Increments (clockwise direction) or decrements (counter-clockwise direction) the instrument parameter at a defined step width in the case of a numeric entry. - Shifts the selection bar within focused areas (e.g. lists), if the edit mode is activated. - Shifts markers, limit lines, etc on the screen. - Acts like the ENTER key, when it is pressed. For details refer to Chapter 6.3.3, "Navigating in Dialog Boxes", on page 70. - Moves the scroll bar vertically, if the scroll bar is focused and the edit mode is activated. For details on the edit mode refer to Chapter 6.3.3, "Navigating in Dialog Boxes", on page 70.

6.2.6 Arrow Keys, UNDO/REDO Keys

The arrow keys are used for navigation. The [UNDO]/[REDO] keys support you during input.

UPARROW/DNARROW keys

The [UPARROW] or [DNARROW] keys do the following:

- In a numeric edit dialog box, increase or decrease the instrument parameter.
- In a list, scroll forward and backward through the list entries.
- In a table, move the selection bar vertically.
- In windows or dialog boxes with vertical scroll bar, move the scroll bar.

LEFTARROW/RIGHTARROW keys

The [LEFTARROW] or [RIGHTARROW] keys do the following:

- In an alphanumeric edit dialog box, move the cursor.
- In a list, scroll forward and backward through the list entries.
- In a table, move the selection bar horizontally.
- In windows or dialog boxes with horizontal scroll bar, move the scroll bar.

UNDO/REDO keys

- The [UNDO] key reverts the previously performed action, i.e. the status before the previous action is retrieved.
  The undo function is useful, for example, if you are performing a zero span measurement with several markers and a limit line defined and accidentally click the "ACP" softkey. In this case, very many settings would be lost. However, if you press [UNDO] immediately afterwards, the previous status is retrieved, i.e. the zero span measurement and all settings.
- The [REDO] key repeats the previously reverted action, i.e. the most recently performed action is repeated.

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

6.2.7 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 device. Softkeys are dynamic, i.e. 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. Each softkey can either represent a specific function, or a submenu that in turn represents several softkeys.

Selecting softkeys

► A particular softkey is selected by pressing the key on the screen with a finger, mouse pointer or other pointing device.

(i)   Softkeys can only be operated via the screen, there are (usually) no corresponding function keys.

Navigating in softkey menus

- The "More" softkey indicates that the menu contains more softkeys than can be displayed at once on the screen. When pressed, it displays the next set of softkeys.
- If the softkey label contains a ">" symbol, it represents a submenu of further softkeys. When you press it, the submenu is displayed.
- The "Up" key switches to the next higher level of the menu.
- The start menu of the current measurement mode is accessed directly by pressing the [HOME] key on the front panel.

Softkey actions

A softkey performs one of the following actions when pressed:

- Opens a dialog box to enter data.
- Switches a function on or off.
- Opens a submenu (only softkeys with a ">" symbol).

Recognizing the softkey status by color

In the factory configuration, a softkey is highlighted orange when a corresponding dialog box is open. If it is a toggle softkey, the current state is highlighted blue. If an instrument function is not available temporarily due to a specific setting, the associated softkey is deactivated and its text is colored gray.

Some softkeys belong to a certain (firmware) option. If this option is not implemented in your device, the associated softkeys are not displayed.

Hiding softkeys

You can hide the softkey display, e.g. when using remote control, in order to enlarge the display area for the measurement results. When you press a function key on the front panel, the softkeys are displayed temporarily, enabling you to perform a certain task with the softkeys. They are then automatically hidden again when they have not been used for a specified time. Any edit dialog boxes required for entry remain in the display.

1. Press the [DISPLAY] key.

2. In the "Display Settings" dialog box, select "Softkey Bar State: Off".
   The softkeys are no longer displayed.

► To display the softkeys again, select "Softkey Bar State: On".

Remote:

```
DISP:SKEY:STAT OFF
```

6.2.8   Context-sensitive Menus

Markers and traces in the display, as well as the information in the channel bar, have context-sensitive menus. If you right-click on a marker or trace in the display, or information in the channel bar (or touch 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 (see Chapter 6.2.7, "Softkeys", on page 63).
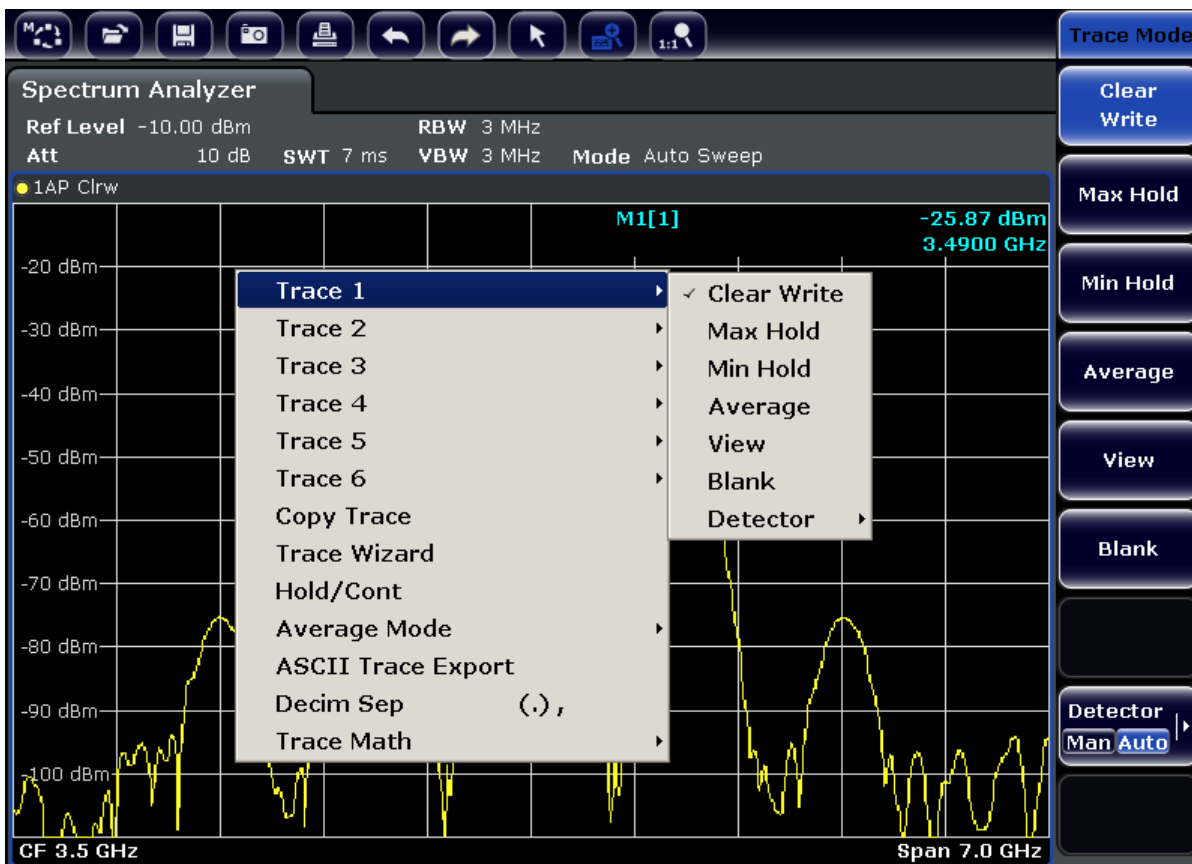
If a menu entry contains an arrow to the right of it, a submenu is available for that entry.

► To close the menu, press the ESC key or click in the display outside of the menu.

6.2.9   Dialog Boxes

In most cases, the R&S ESRP dialog boxes are designed to enter a numeric value. In the documentation, these dialog boxes are called "edit dialog boxes". Dialog boxes that are not only designed for parameter entry have a more complex structure and, in the documentation, are called "dialog boxes". The navigation in Windows dialog boxes differs in some aspects from the navigation in R&S ESRP dialog boxes. For details, see

The following figure shows an example of a edit dialog box:
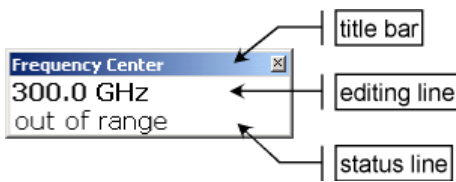
Figure 6-1: Edit dialog box for parameter entry

The title bar shows the name of the parameter that was selected. The entry is performed in the editing line. When the dialog box is displayed, the focus is on the editing line and it contains the currently used parameter value and its unit. The optional third line shows status and error messages which always refer to the current entry.

6.3 Setting Parameters

This section describes how to perform the following basic tasks in the R&S ESRP:

- Chapter 6.3.1, "Entering Numeric Parameters", on page 67
- Chapter 6.3.2, "Entering Alphanumeric Parameters", on page 68
- Chapter 6.3.3, "Navigating in Dialog Boxes", on page 70

6.3.1 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 UPARROW or DNARROW 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 one of the unit keys.
   The editing line is highlighted in order to confirm the entry.

6.3.2   Entering Alphanumeric Parameters

If a field requires alphanumeric input, you can use the on-screen keyboard to enter numbers and (special) characters (see also Chapter 6.2.3, "On-screen Keyboard", on page 60).
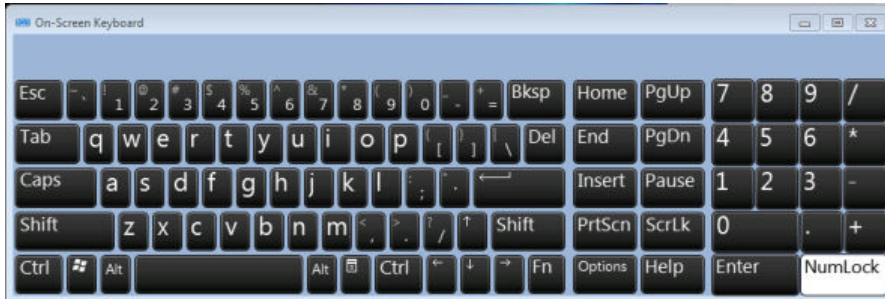
Figure 6-2: On-screen keyboard

Alternatively, you can use the keypad. Every alphanumeric key provides several characters and one number. The decimal point key (.) provides special characters, and the sign key (-) toggles between capital and small letters. For the assignment refer to Table 6-2.

Entering 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 6-2.

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.

Entering a blank

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

Correcting 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.

3. The entry to the left of the cursor is deleted.

4. Enter your correction.

Completing the entry

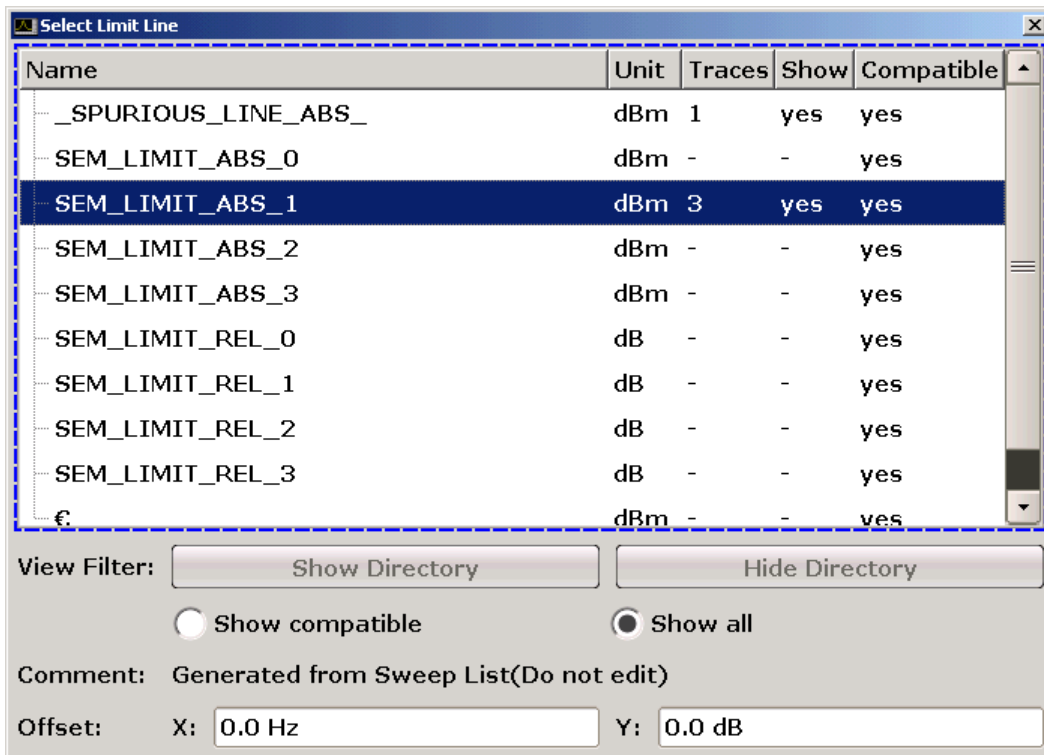► Press the [ENTER] key or the rotary knob.

Aborting the entry

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

Table 6-2: 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
2	T U V 2 Ü
3	W X Y Z 3
0	<blank> 0 – @ + / \ < > = % &
.	. * : _ , ; " ' ? ( ) #
–	<toggles between capital and small letters>

6.3.3   Navigating in Dialog Boxes

Some of the dialog boxes are not only for parameter entry, and therefore have a more complex structure. The following figure shows an example.

Name	Unit	Traces	Show	Compatible
_SPURIOUS_LINE_ABS_	dBm	1	yes	yes
SEM_LIMIT_ABS_0	dBm	-	-	yes
SEM_LIMIT_ABS_1	dBm	3	yes	yes
SEM_LIMIT_ABS_2	dBm	-	-	yes
SEM_LIMIT_ABS_3	dBm	-	-	yes
SEM_LIMIT_REL_0	dB	-	-	yes
SEM_LIMIT_REL_1	dB	-	-	yes
SEM_LIMIT_REL_2	dB	-	-	yes
SEM_LIMIT_REL_3	dB	-	-	yes
€	dBm	-	-	yes

View Filter: [Show Directory] [Hide Directory]
( ) Show compatible (●) Show all

Comment: Generated from Sweep List(Do not edit)

Offset: X: 0.0 Hz   Y: 0.0 dB

Changing the focus

The focus on the graphical user interface is moved by pressing an element on the screen, or via the rotary knob. The focused area is marked with a blue frame (see Figure 6-3). If this area consists of more than one element, e.g. lists of options or tables, you must first switch to the edit mode in order to make changes. A focused area in the edit mode is marked with a dashed blue frame (see Figure 6-4).
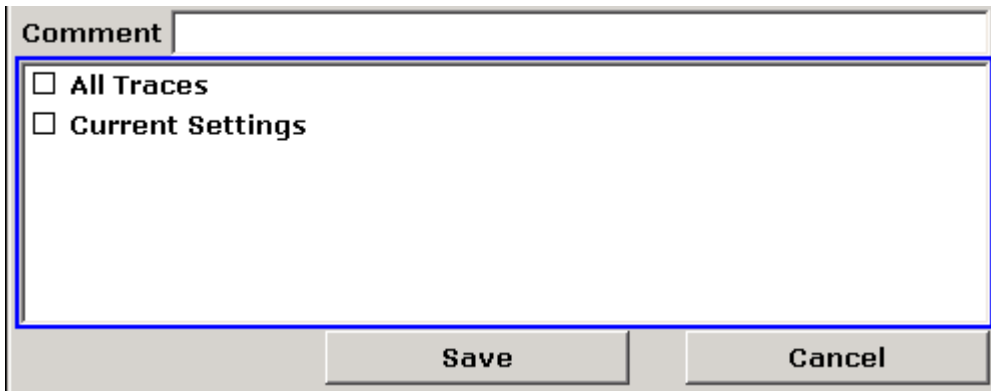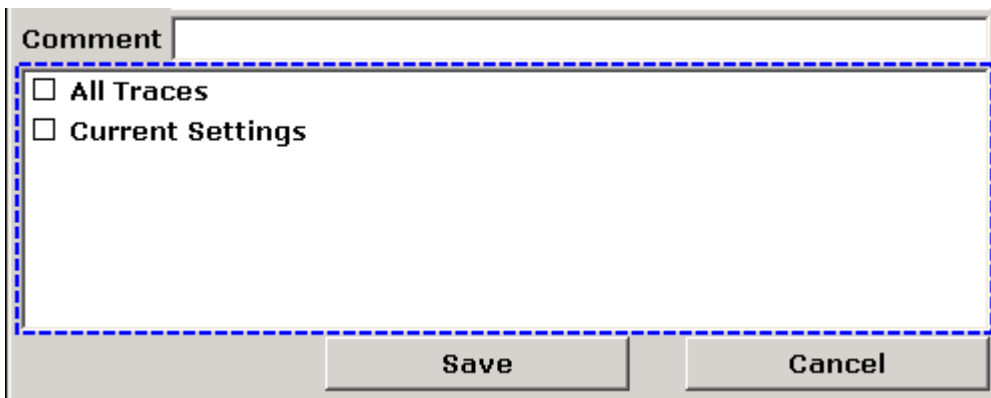
Figure 6-3: Focused area

Figure 6-4: Focused area in edit mode

(i) **Edit mode**

When using the touchscreen for focus changes, all focused areas are in the edit mode automatically, if available. Otherwise, you must switch to edit mode manually.

Switching to edit mode

1. Press the [ENTER] key.

2. To quit the edit mode, press the [ESC] key.

Working in dialog boxes

● To edit alphanumeric parameters, use the keypad or the on-screen keyboard. For details see Chapter 6.3.1, "Entering Numeric Parameters", on page 67

and Chapter 6.3.2, "Entering Alphanumeric Parameters", on page 68. If you edit fields, the edit mode is activated automatically when you start typing.

● To move the focus to the next interface element (e.g. field, option, list), press it on the screen, or turn the rotary knob.

● To select or deselect an option, press the option on the screen.
  Alternatively:

  – If the focused area consists of more than one option and the edit mode is not active, change into the edit mode.

  – Scroll through the list of options using the arrow keys or the rotary knob (only for vertical direction) until the option you want to activate or deactivate is highlighted.

  – Press the rotary knob or the [ENTER] key to confirm your selection.
    The option is activated or deactivated, depending on its previous setting.

  – To leave the edit mode, press the [ESC] key.

● To open a drop-down list, press the arrow next to the list. Alternatively, press the [ENTER] key or the rotary knob. When opened, the list is in edit mode.

● To select an entry without opening a drop-down list, use the arrow keys to browse through the list entries.

● To select a list entry, press the entry on the screen.
  Alternatively:

  – If the edit mode is not active, change into the edit mode.

  – Scroll through the list using the arrow keys or the rotary knob until the list entry you want to select is highlighted.

  – Confirm your choice by pressing the rotary knob or the [ENTER] key.
    If a drop-down list was opened, it is closed.

● To change from one tab to the next, press the tab on the screen.

● To press a button in a dialog box, press the button on the screen.
  Alternatively:

  – Place the focus on the desired button using the rotary knob.

  – Confirm your choice by pressing the rotary knob or the [ENTER] key.

● To close the dialog box and accept the changes, press the "OK" button.

● To close the dialog box without accepting the changes, press the [ESC] key or the "Cancel" button.

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 navigation behavior is different to the one you are used to from R&S ESRP applications. In the following, the important differences and useful tips are listed:

● The rotary knob and function keys do not work. Do not use them. Use the touchscreen instead.

6.4   Changing the Display

6.4.1   Changing the Focus

Any selected function is always performed on the currently focussed element in the display, e.g. a dialog field, diagram, or table row. Which element is focussed 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 on the screen between any displayed diagrams or tables, press the "Change focus" function 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.

6.4.2   Switching between Split and Maximized Display

	In some measurement modes, a table with markers or measurement results is displayed beneath the diagram. In this case, you may wish to maximize the diagram or table display in order to see more details.

Press the [SPLIT/MAXIMIZE] key on the front panel to switch between a split screen and a full screen (maximized display). In maximized display, the table or diagram currently focused is maximized. In split display, both the diagram and any available tables are displayed in one screen.

SCPI command:

`DISP:WIND:SIZE`

6.4.3　Soft and Mini Soft Front Panel Display

When working with an external monitor or operating via remote control on a computer, it is useful to be able to interact with the R&S ESRP without requiring the keypad and keys located on the front panel of the instrument. Therefore, a "Soft Front Panel" display is available, which simulates the entire front panel of the instrument (except for the external connectors) on the screen. You can switch between "normal" screen display and extended display. In the extended display, the keys and other hardware controls of the instrument are simulated on the screen.

If you require a Soft Front Panel but do not want to lose too much space for results in the display area, a mini soft Front Panel is available. The mini version displays only the hardkeys in a separate window in the display area. This window can be closed automatically after pressing a key, or remain open, as desired. Using the Mini Front Panel, the R&S ESRP interface is fully operable from a monitor with a resolution of 1024x768 pixels.

Switching to soft Front Panel display

1. Press the SETUP key.

2. Press the "General Setup" softkey.

3. Press the "More" softkey.

4. Press the "Soft Front Panel" softkey.
   Alternatively:

5. Press the [DISPLAY] key.

6. In the "Display Settings" dialog box, select "Front Panel State: On".
   The extended display appears on the screen.
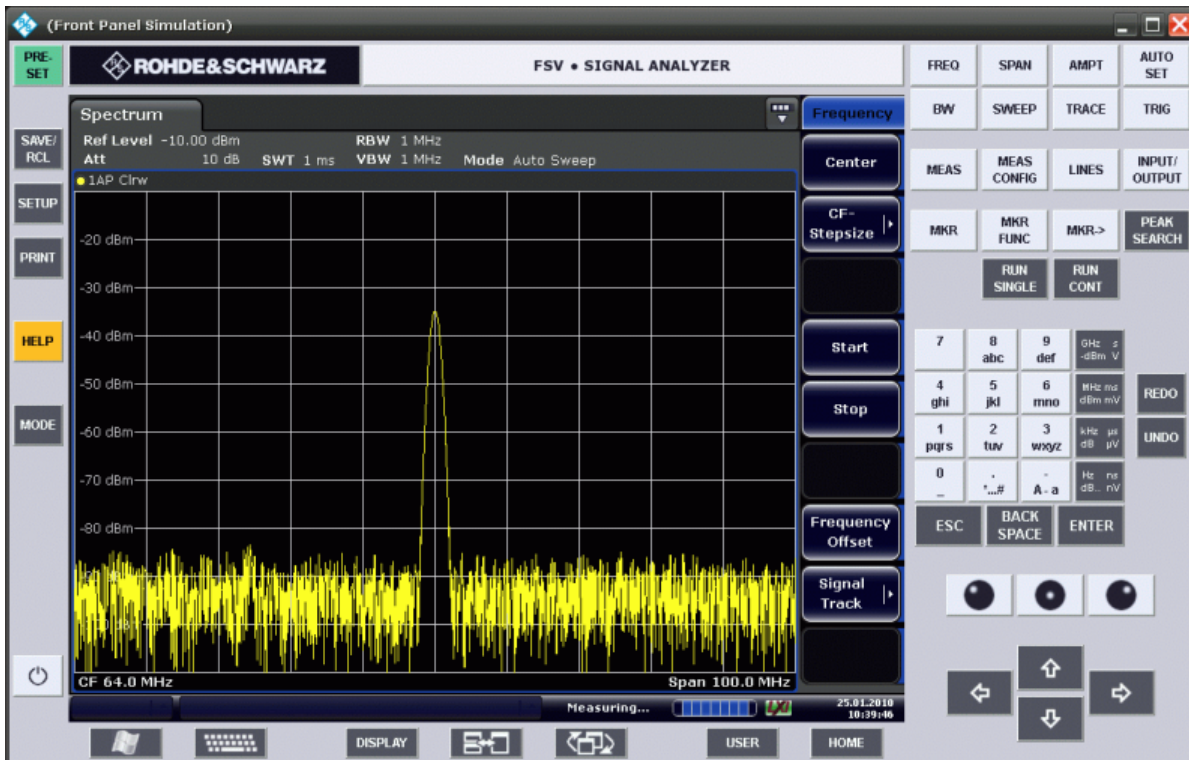
Using the F6 key you can toggle the Front Panel display on and off.

Remote: `SYST:DISP:FPAN:STAT ON`

Working with the Soft Front Panel

Basic operation with the soft Front Panel is identical to normal operation. To activate a key, either press the key on the touchscreen, or click on it with the mouse pointer. To simulate the use of the rotary knob, use the additional keys displayed between the keypad and the arrow keys:

Icon	Function
●	Turn left
●	Enter
●	Turn right

Switching to Mini Front Panel display

1. Press the [DISPLAY] key.

2. In the "Display Settings" dialog box, select "Mini Front Panel State: On".
The "Mini Front Panel" window appears on the screen. It can be moved any-where on the screen where it does not interfere with your current task.

Using the key combination [ALT + M] you can toggle the Mini Front Panel display on and off.
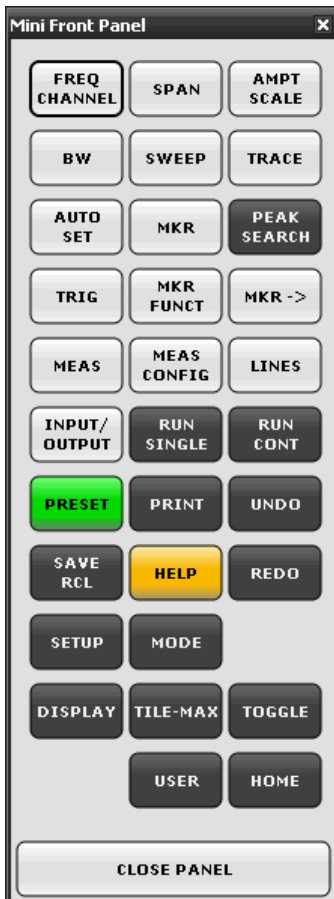
Auto close option

By default, the "Auto close" option is activated and the Mini Front Panel window closes automatically after you select a key. This is useful if you only require the Front Panel display to press a single function key.

If you want the window to remain open, deactivate the "Auto close" option. You can close the window manually by clicking "Close Panel" or the key combination [ALT + M].

6.4.4   Enlarging the Display Area
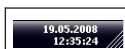
19.05.2008 12:35:24	You can enlarge the screen display area if you are using an external monitor or the Soft and Mini Soft Frontpanel display (see Chapter 6.4.3, "Soft and Mini Soft Front Panel Display", on page 74). To do so, drag the lower right corner of the window to the required size. In standard display, a small icon is displayed in the lower right corner of the screen.

6.4.5   Displaying the Toolbar

Standard file functions can be performed via the icons in the toolbar at the top of the screen (see the Chapter 6.2.1, "Toolbar", on page 58). By default, this toolbar is not displayed.

To display the toolbar:

1. Press the DISPLAY key.

2. Under "Select Tool Bar State", select "On".

Alternatively:

1. Press the SETUP key.

2. Press the "Display Setup" softkey.

3. Press the "Tool Bar State On/Off" softkey.

    The toolbar is displayed at the top of the screen.

6.4.6   Zooming into the Diagram

You can zoom into the diagram to visualize the measurement results in greater detail. Using the touchscreen or a mouse pointer you can easily define the area to be enlarged.

ⓘ **Zoom and the number of sweep points**

Note that zooming is merely a visual tool, it does not change any measurement settings, such as the number of sweep points!

You should increase the number of sweep points before zooming, as otherwise the function has no real effect (see the "Sweep Points" softkey, described in the Operating Manual and online help).

To zoom into the diagram

1. Display the toolbar as described in Chapter 6.4.5, "Displaying the Toolbar", on page 77.

2. 🔍
   Click on the "Zoom On" icon in the toolbar.
   A dotted rectangle is displayed in the diagram.
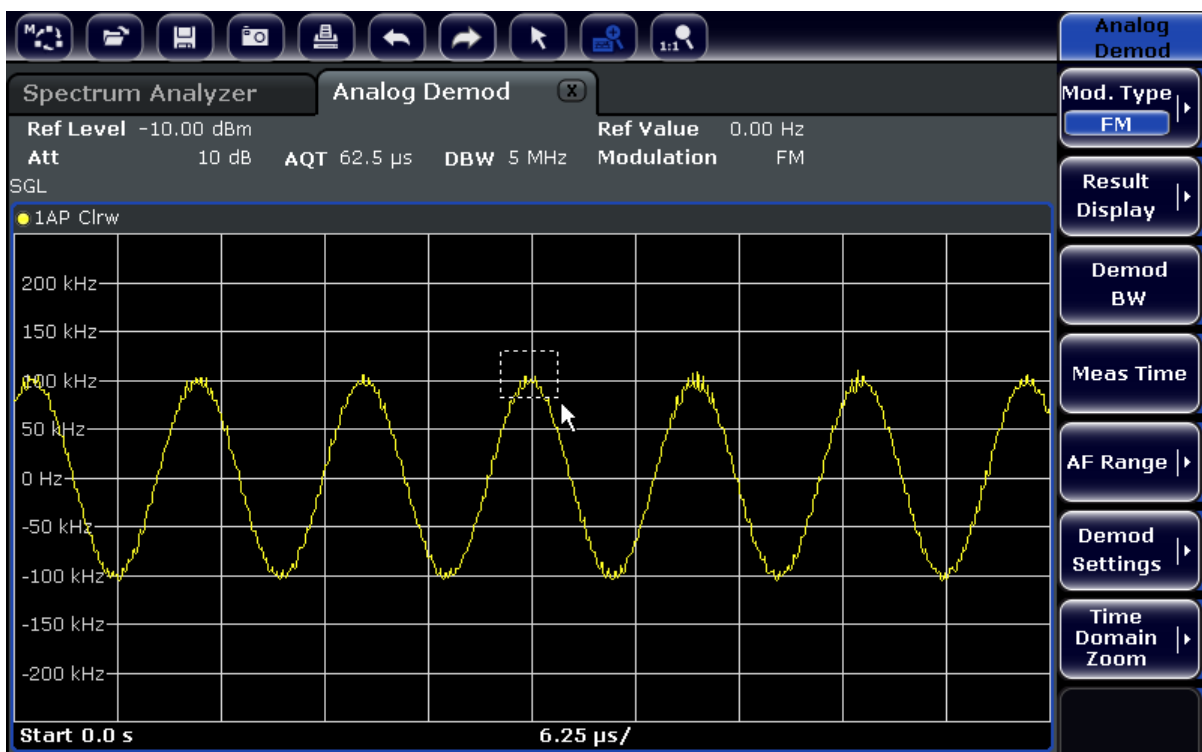
3. Drag the lower right corner of the rectangle (either via touchscreen or a mouse pointer) to define the area in the diagram to be enlarged.

4. Repeat these steps, if necessary, to enlarge the diagram further.

💡 **Scrolling in the zoomed display**

You can scroll the diagram area to display the entire diagram using the scrollbars at the right and at the bottom of the diagram.

To return to selection mode in the diagram

While you are in zoom mode, touching the screen changes the zoom area. In order to select or move a trace or marker, you must switch back to selection mode:

► Click on the "Selection mode" icon in the toolbar.

To return to original display

► Click on the "Zoom Off" icon in the toolbar.
  A dotted rectangle is displayed in the diagram.

Remote commands:

1. Activate the zoom mode:
   DISP:ZOOM ON

2. Define the zoom area:

```
DISP:ZOOM:AREA 5,30,20,100
```

3. Hide the overview window:
   ```
   DISP:ZOOM:OVER OFF
   ```

6.4.7   Adding a Title to the Diagram Header

You can add an introductory title to the trace information in the diagram header.

1. Press the SETUP key.

2. Press the "Display Setup" softkey.

3. Press the "Screen Title On/Off" softkey.
   An edit dialog box is displayed.

4. Enter the title and press "ENTER".
   The title is displayed at the beginning of the diagram header.

6.4.8   Removing the Diagram Footer

Some additional diagram-specific information is displayed in the diagram footer
(see Chapter 6.1.4, "Diagram-specific and Trace Information", on page 54). This
footer can be removed from display if necessary.

1. Press the SETUP key.

2. Press the "Display Setup" softkey.

3. Press the "Annotation On/Off" softkey.
   The footer is displayed beneath the diagram or removed from display.

6.4.9   Selecting a Theme

You can select a theme for the screen display. The theme defines the colors used
for keys and screen elements, for example. The default theme is "BlueOcean".

Selecting a theme

1. Press the SETUP key.

2. Press the "Display Setup" softkey.

3. Press the "More" softkey.

4. Press the "Theme Selection" softkey. A list of available themes is displayed.

5. Select the desired theme from the list.
    The screen display changes according to the selected theme.

SCPI command:

`DISPlay:THEMe:SELect`

6.4.10 Displaying and Setting the Date and Time

You can switch the date and time display in the diagram footer on or off. By default, it is displayed. You can also switch between German and US format.

Switching the date and time display off

1. Press the SETUP key.

2. Press the "Display Setup" softkey.

3. Press the "Time+Date" softkey to "Off".

Changing the format

1. Press the SETUP key.

2. Press the "Display Setup" softkey.

3. Press the "Time+Date Format" softkey until the required format is selected.

Setting the date and time

To set the date and time, click on the date and time display in the diagram footer. The standard Windows "Date and Time Properties" dialog is displayed and you can set the correct date and time.

6.4.11 Changing the Display Update Rate

When performance is poor due to slow data transfer (for example during remote control), it may be helpful to decrease the frequency with which the screen display is updated.

To descrease the display update rate

1. Press the [DISPLAY] key.

   The "Display Settings" dialog box is opened.

2. Under "Display Update Rate", select "Slow".

   The display is updated less frequently, and performance for measurements should improve. When data transfer is no longer a problem, you can set the update rate back to "Fast" in the same way.

7   Basic Measurement Examples

The following measurement examples are intended as an introduction to operating the R&S ESRP. The User Manual contains additional and more advanced examples. Refer to chapter "Advanced Measurement Examples" to find the following topics:

- High-Sensitivity Harmonics Measurements
- Separating Signals by Selecting an Appropriate Resolution Bandwidth
- Intermodulation Measurements
- Measuring Signals in the Vicinity of Noise
- Measuring Noise Power Density
- Measurement of Noise Power within a Transmission Channel
- Measuring Phase Noise
- Measuring Channel Power and Adjacent Channel Power

For a more detailed description of the basic operating steps, e.g. selecting menus and setting parameters, refer to Chapter 6, "Basic Operations", on page 49.

7.1   Measuring a Sinusoidal Signal

One of the most common measurement tasks that can be handled by using a signal analyzer is determining the level and frequency of a signal. When measuring an unknown signal, you can usually start with the presettings.

Test setup

1. **NOTICE!** Risk of instrument damage. Signal levels exceeding 30 dBm can damage the RF attenuator or the input mixer. For the level calculation, take the total power of all occuring signals into account.

   If you measure signals higher than +30 dBm (= 1 W), insert a power attenuator before the RF input of the analyzer.

2. Connect the RF output of the signal generator to the RF input of R&S ESRP.

Table 7-1: Signal generator settings (e.g. R&S SMU)

Frequency	128 MHz
Level	-30 dBm

7.1.1 Measuring the Level and Frequency Using Markers

The level and frequency of a sinusoidal signal can be measured easily by using the marker function. The R&S ESRP always displays its amplitude and frequency at the marker position. The frequency measurement uncertainty is determined by the frequency reference of the R&S ESRP, the resolution of the marker frequency display and the number of sweep points.

1. Reset the instrument by pressing the [PRESET] key.

2. Select "Spectrum" mode.

3. Connect the signal to be measured to the *RF INPUT* analyzer input on the instrument front panel.

4. Set the center frequency to *128 MHz*.

   a) Press the [FREQ] key.
      The dialog box for the center frequency is displayed.
   b) In the dialog box, enter *128* using the numeric keypad and confirm the entry with the MHz key.

5. Reduce the frequency span to *1 MHz*.

   a) Press the [SPAN] key.
   b) In the dialog box, enter *1* using the numeric keypad and confirm the entry by pressing the [MHz] key.

   Note: Coupled settings. When the frequency span is defined, the resolution bandwidth, the video bandwidth and the sweep time are automatically adjusted, because these functions are defined as coupled functions in the presettings.

6. Measure the level and frequency using the marker by pressing the [MKR] key.
   The marker is activated and automatically set on the maximum of the trace.
   The level and frequency values measured by the marker are displayed in the marker field at the top edge of the screen. They can be taken as the measurement result.

M1[1]	-30.00 dBm
	128.00000 MHz

The field header indicates the number of the marker (Marker 1) and the trace on which the marker is located ([1] = Trace 1).

Note: Performing a peak search. When a marker is initially activated, it automatically performs the peak search function (as shown in the example).
If a marker was already active, you have to press the [Peak Search] key on the front panel or the "Peak" softkey in the [MKR >] menu in order to set the currently active marker to the maximum of the displayed signal.

7.1.1.1   Increasing the Frequency Resolution

The frequency resolution of the marker is predefined by the pixel resolution of the trace. A trace uses 691 pixels, i.e. if the frequency span is 1 MHz, each pixel corresponds to a span of approx. 1.4 kHz. This corresponds to a maximum uncertainty of +/- 0.7 kHz.

You can increase the pixel resolution of the trace by reducing the frequency span.

Reducing the frequency span to 10 kHz

1. Press the [SPAN] key.

2. Using the numeric keypad, enter *10* in the dialog box and confirm the entry with the [kHz] key.

The generator signal is measured using a span of 10 kHz. The pixel resolution of the trace is now approx. 14 Hz (10 kHz span / 691 pixels) , i.e. the precision of the marker frequency display increases to approx. ±7 Hz.

7.1.1.2   Setting the Reference Level

With signal analyzers, the reference level is the level at the upper limit of the diagram. To achieve the widest dynamic range possible for a spectrum measurement, use the entire level span of the signal analyzer. In other words, the highest level that occurs in the signal should be located at the top edge of the diagram (=reference level) or immediately below it.

ⓘ **Low Reference Levels**

If the selected reference level is lower than the highest signal that occurs in the spectrum, the signal path in the R&S ESRP is overloaded.

In this case, the message "IFOVL" is displayed in the error message field.

In the presettings, the value of the reference level is -10 dBm. If the input signal is -30 dBm, the reference level can be reduced by 20 dB without causing the signal path to be overloaded.

Reducing the reference level by 20 dB

1. Press the [AMPT] key.
   The amplitude menu is displayed. The "Ref Level" softkey is highlighted in red to indicate that it is activated for data entry. The dialog box for the reference level is also opened.

2. Using the numeric keypad, enter *30* and confirm the entry with the [- dBm] key.
   The reference level is set to -30 dBm. The maximum of the trace is near the maximum of the measurement diagram. However, the increase in the displayed noise is not substantial. Thus, the distance between the signal maximum and the noise display (=dynamic range) has increased.

Setting the marker level equal to the reference level

The marker can also be used to shift the maximum value of the trace directly to the top edge of the diagram. If the marker is located at the maximum level of the trace (as in this example), the reference level can be moved to the marker level as follows:

1. Press the [MKR] key.

2. Press the "Ref Lvl = Mkr Lvl" softkey.

The reference level is set equal to the measured level where the marker is located.

Thus, setting the reference level is reduced to two keystrokes.

7.1.2   Measuring the Signal Frequency Using the Frequency Counter

The built-in frequency counter allows you to measure the frequency more accurately than measuring it with the marker. The frequency sweep is stopped at the marker, and the R&S ESRP measures the frequency of the signal at the marker position.

In the following example, the frequency of the generator at 128 MHz is shown by using the marker.

Prerequisite

In this example, a precise frequency measurement is to be performed. Therefore, connect the signal generator's "Ref OUT" connector to the analyzer's "Ref IN" connector.

1. Set the signal analyzer to the default state by pressing the [PRESET] key.
   The R&S ESRP is set to its default state.

2. Select "Spectrum" mode.

3. Set the center frequency and the span.
   a) Press the [FREQ] key and enter 128 MHz.
      The center frequency of the R&S ESRP is set to 128 MHz.
   b) Press the [SPAN] key and enter *1 MHz*.
      The frequency span of the R&S ESRP is set to 1 MHz.

4. In the "Setup" menu, select "Reference Ext".

5. Activate the marker by pressing the [MKR] key.
   The marker is activated and set to the signal maximum. The level and the frequency of the marker are displayed in the marker field (diagram header or marker table).

6. Activate the frequency counter by pressing the "Sig Count On/Off" softkey in the "MKR FUNC" menu.
   The result of frequency counting is displayed in the selected resolution in the marker field.

Figure 7-1: Measurement of the frequency with the frequency counter

ⓘ **Prerequisites for using the internal frequency counter**

In order to obtain a correct result when measuring the frequency with the internal frequency counter, an RF sinusoidal signal or a spectral line must be available. The marker must be located more than 25 dB above the noise level to ensure that the specified measurement accuracy is adhered to.

7.2 Measuring Harmonics of Sinusoidal Signals

Measuring the harmonics of a signal is a very common task that can be performed optimally by using a Signal and Spectrum Analyzer.

In the following example, the generator signal with 128 MHz and -20 dBm is used again.

Measuring the Suppression of the First and Second Harmonic of an Input Signal

1. Set the signal analyzer to the default state by pressing the [PRESET] key.
   The R&S ESRP is in the default state.

2. Select "Spectrum" mode.

3. Set the start frequency to 100 MHz and the stop frequency to 400 MHz.
   a) Press the [FREQ] key.
   b) Press the "Start" softkey and enter *100 MHz*.
   c) Press the "Stop" softkey and enter *400 MHz*.
      The R&S ESRP displays the fundamental and the first and second harmonics of the input signal.

4. To average (smooth) the noise, reduce the video bandwidth.
   a) Press the [BW] key.
   b) Press the "Video BW Manual" softkey and enter *100 kHz*.

5. Set the attenuation to 0 dB.
   a) Press the [AMPT] key.
   b) Press the "RF Atten Manual" softkey.
   c) Enter *0 dB* in the edit dialog box.

6. Activate the marker by pressing the [MKR] key.
   "Marker 1" is activated and positioned to the signal maximum (fundamental at 128 MHz). The level and frequency of the marker is displayed in the marker field.

7. Activate the delta marker and measure the harmonic suppression.
   a) In the "MKR" menu, press the "Marker 2" softkey.
      "Marker 2" is activated as a delta marker ("D2 [1]"). It is automatically set on the largest harmonic of the signal. The frequency offset and level offset from marker 1 are displayed in the channel information bar.
   b) In the "MKR" menu, press the "Marker 3" softkey.
      "Marker 3" is activated as a delta marker ("D3 [1]"). It is automatically set on the next largest harmonic of the signal. The frequency offset and level offset from marker 1 on the fundamental are displayed in the channel information bar (see Figure 7-2).

Figure 7-2: Measuring the harmonic suppression of the internal reference generator.

Delta markers D2 [1] and D3 [1] show the offset of the first and second harmonics from the fundamental.

Reducing Noise

The signal analyzer offers three methods to differentiate the harmonics of a signal from the noise effectively:

● Reducing the video bandwidth

● Averaging the trace

● Reducing the resolution bandwidth

Reducing the video bandwidth and averaging the traces cause the noise from the analyzer or the DUT to be reduced, depending on which component is larger. Both averaging methods reduce the measurement uncertainty, particularly in the case of small signal-to-noise ratios, because the measurement signal is also separated from the noise.

Reducing the noise by reducing the video bandwidth

1. Press the [BW] key.

2. Press the "Video BW Manual" softkey.

3. Reduce the video bandwidth to 1 kHz (for example), by entering *1 kHz*. This smoothes the noise significantly, and the sweep time is increased to 200 ms. In other words, the measurement will take significantly more time. The video bandwidth that is displayed is marked with a bullet to indicate that it is no longer coupled to the resolution bandwidth (see Figure 7-3).
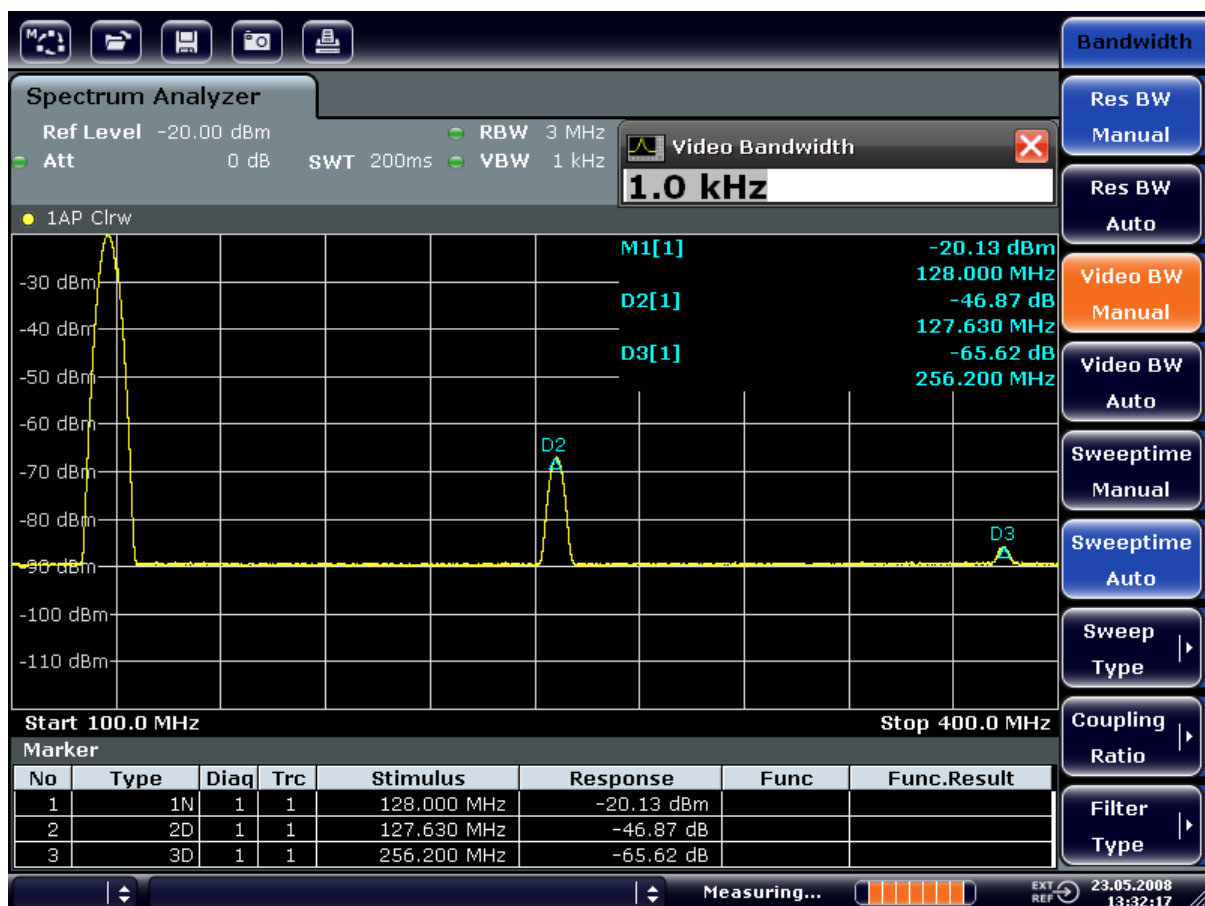
Figure 7-3: Suppression of noise during harmonics measurement by reducing video bandwidth

4. Recouple the video bandwidth to the resolution bandwidth.

   a) Press the [BW] key.
   b) Press the "Video BW Auto" softkey.

Reducing the noise by averaging the trace

1. Press the [TRACE] key.

2. Press the "Trace Wizard" softkey.

3. For "Trace 1", press the button in the "Trace Mode" column and select "Average" from the list.
   The noise component of the trace is smoothed by averaging 10 successive traces.

4. Switch off trace averaging by pressing the button in the "Trace Mode" column and selecting "Clear Write" from the list.

Reducing the noise by reducing the measurement bandwidth

The noise is reduced in proportion to the bandwidth by reducing the resolution bandwidth, i.e. reducing the resolution bandwidth by a factor of 10 also reduces the noise by a factor of 10 (which corresponds to 10 dB). The amplitude of sinusoidal signals is not affected by reducing the resolution bandwidth.

1. Set the resolution bandwidth to 10 kHz.
   a) Press the [BW] key.
   b) Press the "Res BW Manual" softkey and enter *10 kHz*.
      The noise decreases by approx. 25 dB compared to the previous setting. Since the video bandwidth is coupled to the resolution bandwidth, it is reduced to 30 kHz in proportion to the resolution bandwidth. This causes the sweep time to increase to 3.0 seconds.

2. Reset the resolution bandwidth (couple it to the span) by pressing the "Res BW Auto" softkey in the "BW" menu.

7.3   Measuring Signal Spectra with Multiple Signals

7.3.1   Separating Signals by Selecting the Resolution Bandwidth

A basic feature of a Signal and Spectrum Analyzer is the ability to separate the spectral components of a mixture of signals. The resolution at which the individual components can be separated is determined by the resolution bandwidth. Selecting a resolution bandwidth that is too large may make it impossible to distinguish between spectral components, i.e. they are displayed as a single component.

An RF sinusoidal signal is displayed using the passband characteristic of the defined resolution filter (RBW). Its specified bandwidth is the 3 dB bandwidth of the filter.

Two signals with the same amplitude can be resolved if the resolution bandwidth is smaller than or equal to the frequency spacing of the signal. If the resolution bandwidth is equal to the frequency spacing, the spectrum display shows a level drop of 3 dB precisely in the center of the two signals. Decreasing the resolution bandwidth makes the level drop larger, which thus makes the individual signals clearer.

Higher spectral resolution at a narrower bandwidth is accomplished through longer sweep times at the same span. Reducing the resolution bandwidth by a factor of 3 increases the sweep time by a factor of 9.

Example:

Separating Two Signals

The two signals have a level of -30 dBm each at a frequency spacing of 30 kHz
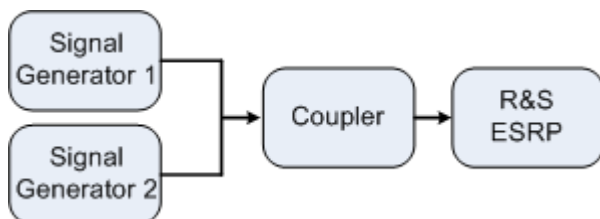
Table 7-2: Signal generator settings (e.g. R&S SMU)

	Level	Frequency
Signal generator 1	-30 dBm	128,00 MHz
Signal generator 2	-30 dBm	128,03 MHz

1. Set the signal analyzer to the default state by pressing the [PRESET] key. The R&S ESRP is set to its default state.

2. Select "Spectrum" mode.

3. Set the center frequency to 128.015 MHz and the frequency span to 300 kHz.
    a) Press the [FREQ] key and enter 128.015 MHz.
    b) Press the [SPAN] key and enter *300 kHz*.

4. Set the resolution bandwidth to 30 kHz and the video bandwidth to 1 kHz.
    a) Press the [BW] key

b) Press the "Res BW Manual" softkey and enter *30 kHz*.

c) Press the "Video BW Manual" softkey and enter *1 kHz*.

Note: Larger video bandwidths. The video bandwidth is set to 1 kHz in order to make the level drop in the center of the two signals clearly visible. At larger video bandwidths, the video voltage that results from envelope detection is not sufficiently suppressed. This produces additional voltages, which are visible in the trace, in the transition area between the two signals.
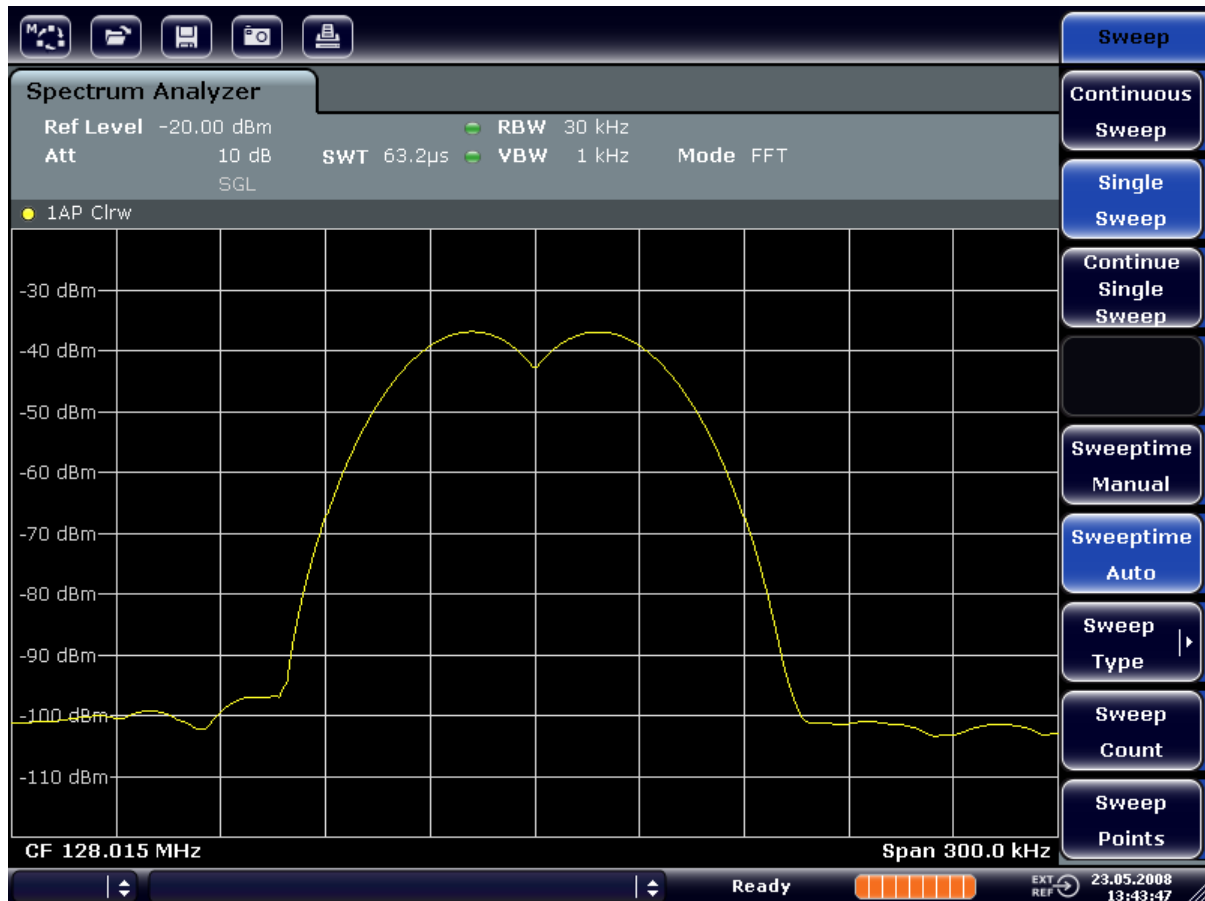
Figure 7-4: Measurement of two equally-leveled RF sinusoidal signals with the resolution bandwidth which corresponds to the frequency spacing of the signals

Matching generator and R&S ESRP frequencies

The level drop is located exactly in the center of the screen only if the generator frequencies match the frequency display of the R&S ESRP exactly. To achieve exact matching, the frequencies of the generators and the R&S ESRP must be synchronized.

5. Set the resolution bandwidth to 100 kHz. To do so, in the bandwidth menu, press the "Res BW Manual" softkey and enter *100 kHz*.
   It is no longer possible to clearly distinguish the two generator signals.
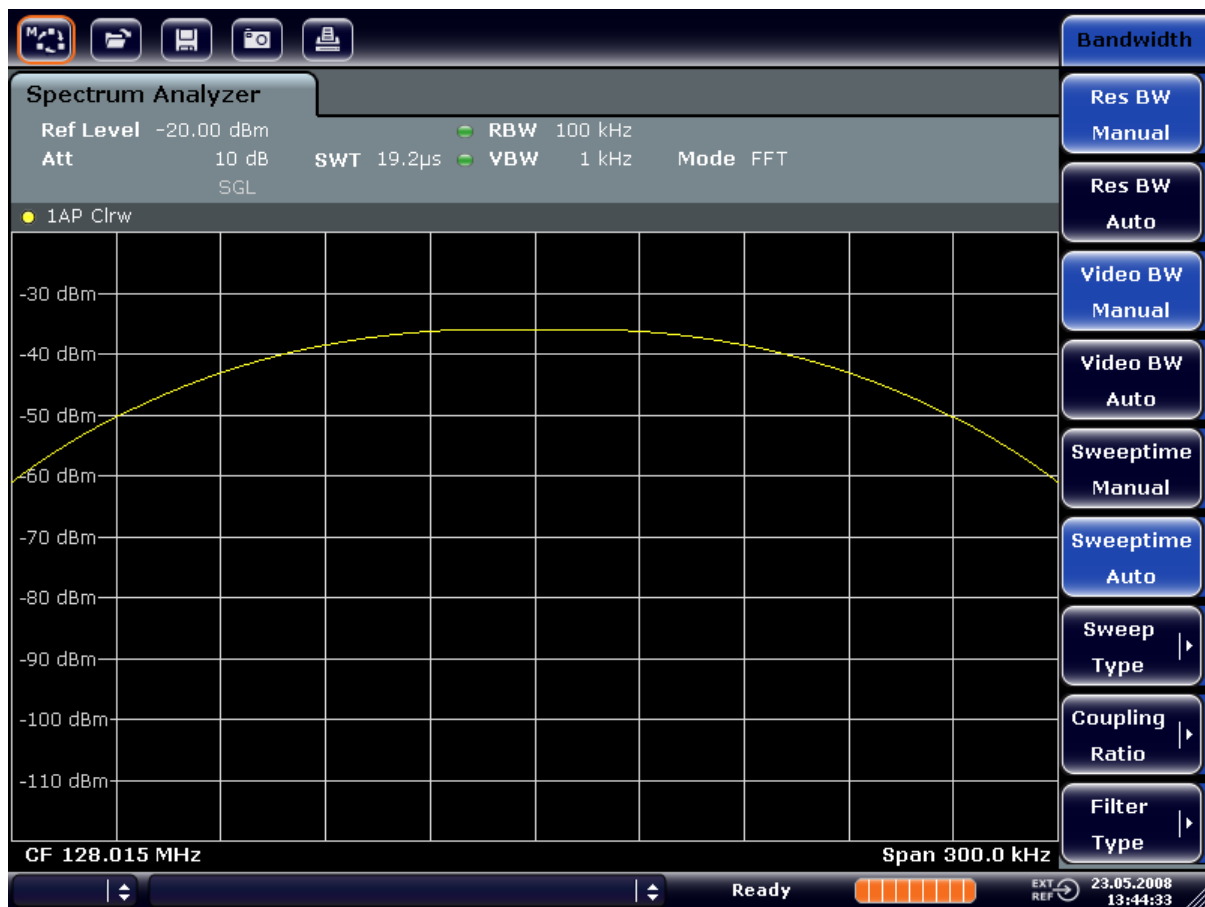
Figure 7-5: Measurement of two equally-leveled RF sinusoidal signals with a resolution bandwidth which is larger than their frequency spacing

Note: Reducing the resolution bandwidth. The resolution bandwidth (RBW) can be reduced again by turning the rotary knob counterclockwise, thus yielding a higher frequency resolution.

6. Set the resolution bandwidth to 1 kHz. To do so, in the bandwidth menu, press the "Res BW Manual" softkey and enter *1 kHz*.
   The two generator signals are shown with high resolution. However, the sweep time becomes longer. At smaller bandwidths, the noise display decreases simultaneously (10 dB decrease in noise floor for a decrease in bandwidth by a factor of 10).
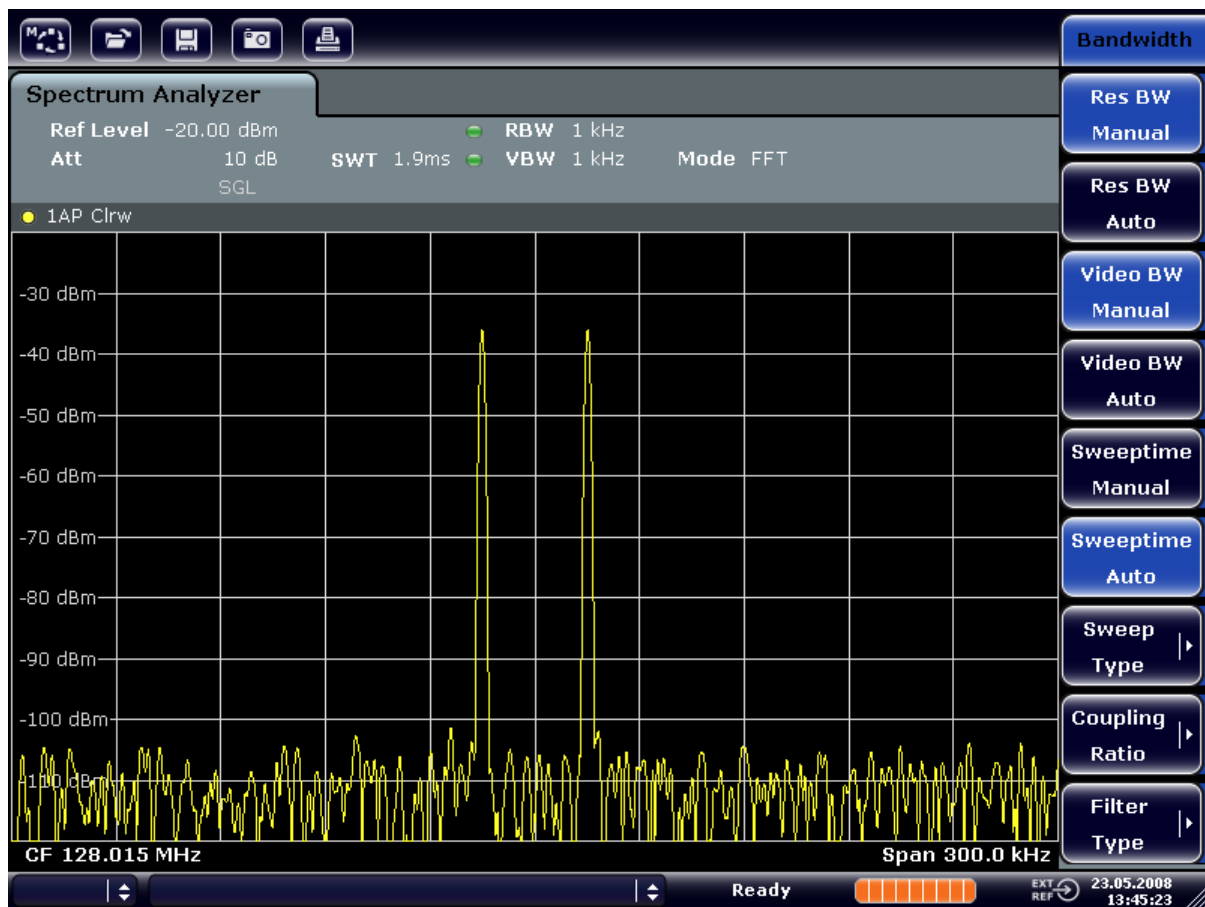
Figure 7-6: Measurement of two equally-leveled RF sinusoidal signals with a resolution bandwidth (1 kHz) which is significantly smaller than their frequency spacing

7.3.2 Measuring the Modulation Depth of an AM-Modulated Carrier (Span > 0)

In the frequency range display, the AM side bands can be resolved with a narrow bandwidth and measured separately. The modulation depth of a carrier modulated with a sinusoidal signal can then be measured. Since the dynamic range of a signal analyzer is very large, extremely small modulation depths can also be measured precisely. For this purpose, the R&S ESRP provides measurement routines that output the modulation depth numerically in % directly.

Test setup
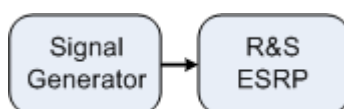
Table 7-3: Signal generator settings (e.g. R&S SMU)

Frequency	128 MHz
Level	-30 dBm
Modulation	50 % AM, 10 kHz AF

1. Set the signal analyzer to the default state by pressing the [PRESET] key.
   The R&S ESRP is set to its default state.

2. Select "Spectrum" mode.

3. Set the center frequency to 128 MHz and span to 50 kHz.

   a) Press the [FREQ] key and enter *128 MHz*.
   b) Press the [SPAN] key and enter *50 kHz*.

4. Activate the marker function for measuring the AM modulation depth.

   a) Press the [MEAS] key.
   b) Press the "More" key.
   c) Press the "AM Mod Depth" softkey.
      The R&S ESRP automatically sets a marker to the carrier signal in the
      center of the diagram and one delta marker each to the upper and lower
      AM sidebands. The R&S ESRP calculates the AM modulation depth from
      the level differences of the delta markers to the main marker and outputs
      the numeric value in the marker field.
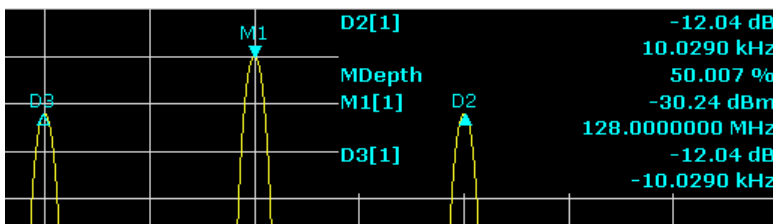
Figure 7-7: Measurement of the AM modulation depth

The modulation depth is displayed as "MDepth". The frequency of the AF signal
can be obtained from the frequency display of the delta marker.

7.3.3   Measuring AM-Modulated Signals

The signal analyzer rectifies the RF input signal and displays it as a magnitude
spectrum. The rectification also demodulates AM-modulated signals. The AF volt-

age can be displayed in zero span if the modulation sidebands fall within the res-
olution bandwidth.

Displaying the AF of an AM-modulated signal (Zero Span)

Test setup
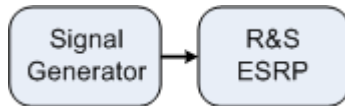
Table 7-4: Signal generator settings (e.g. R&S SMU)

Frequency	128 MHz
Level	-30 dBm
Modulation	50 % AM, 1 kHz AF

1. Set the signal analyzer to the default state by pressing the [PRESET] key.
    The R&S ESRP is set to its default state.

2. Select "Spectrum" mode.

3. Set the center frequency to 128 MHz and the span to 0 Hz.

    a) Press the [FREQ] key and enter *128 MHz*.
    b) Press the [SPAN] key and enter *0 Hz* or press the "Zero Span" softkey.

4. Set the sweep time to 2.5 ms.

    a) Press the [SWEEP] key.
    b) Press the "Sweeptime Manual" softkey.
    c) Enter *2.5 ms*.

5. Set the reference level to +6 dBm and the display range to linear.

    a) Press the [AMPT] key and enter *6 dBm*.
    b) Press the "Range" softkey.
    c) Press the "Range Linear %" softkey.

6. Set triggering in response to the AF signal by using the video trigger to pro-
    duce a static image.

    a) Press the [TRIG] key.
    b) Press the "Trg/Gate Source" softkey and select "Video" using the arrow
        keys.

c) Press the "Trg/Gate Level" softkey and enter *50%*.
The trigger level is displayed as a horizontal line across the entire measurement diagram. The R&S ESRP displays the 1 kHz AF signal as a static image in zero span. Use a headset to listen to the AF.

7. Activate the internal AM demodulator.

a) Press the [MKR FUNC] key.

b) Press the "Marker Demod" softkey.
The R&S ESRP automatically switches on the AM audio demodulator. A 1 kHz tone can be heard over headset. If necessary, use the volume control knob for AF OUTPUT on the front panel to turn up the volume.

7.4 Measurements in Zero Span

For radio transmission systems that use the TDMA method (e.g. GSM or IS136), transmission quality is determined not only by spectral characteristics but also by characteristics in zero span. A timeslot is assigned to each user since several users share the same frequency. Smooth operation is ensured only if all users adhere exactly to their assigned timeslots.

Both the power during the send phase as well as the timing and duration of the TDMA burst, and rise and fall times of the burst, are important.

7.4.1 Measuring the Power Characteristic of Burst Signals

To measure power in zero span, the R&S ESRP offers easy-to-use functions that measure the power over a predefined time.

7.4.1.1 Measuring the Power of a GSM Burst During the Activation Phase

Test setup
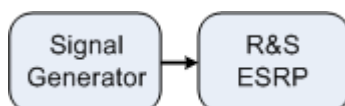
Table 7-5: Signal generator settings (e.g. R&S SMU)

Frequency	890 MHz
Level	0 dBm
Modulation	GSM, one timeslot activated

1. Set the signal analyzer to the default state by pressing the [PRESET] key.
   The R&S ESRP is set to its default state.

2. Select "Spectrum" mode.

3. Set the center frequency to 890 MHz, the span to 0 Hz and the resolution bandwidth to 1 MHz.

   a) Press the [FREQ] key and enter *890 MHz*.
   b) Press the [SPAN] key and enter *0 Hz*, or press the "Zero Span" softkey.

4. Set the reference level of the R&S ESRP to 10 dBm (= level of the signal generator +10 dB) and set the attenuation to 20 dB.

   a) Press the [AMPT] key.
   b) Enter *10 dBm*.
   c) Press the "Rf Atten Manual" softkey.
   d) Enter *20 dB*.

5. Set the sweep time to 1 ms.

   a) Press the [SWEEP] key.
   b) Press the "Sweeptime Manual" softkey and enter *1 ms*.
      The R&S ESRP shows the GSM burst continuously across the display.

6. By using the video trigger, set triggering on the rising edge of the burst.

   a) Press the [TRIG] key.
   b) Press the "Trg/Gate Source" softkey and select "Video" using the arrow keys.
   c) Press the "Trg/Gate Level" softkey and enter *70%*.
      The R&S ESRP shows a static image with the GSM burst at the start of the trace. The trigger level is displayed as a horizontal line labeled with the absolute level for the trigger threshold in the measurement diagram.

7. Configure power measurement in zero span.

   a) Press the [MEAS] key.
   b) Press the "Time Domain Power" softkey to open the submenu.
   c) Switch the "Limits" softkey to "On."
   d) Press the "Left Limit" softkey.

e) By turning the rotary knob clockwise, move the vertical line to the start of the burst.
f) Press the "Right Limit" softkey.
g) By turning the rotary knob counterclockwise, set the second vertical line to the end of the burst.

The R&S ESRP displays the average (mean) power during the activation phase of the burst.
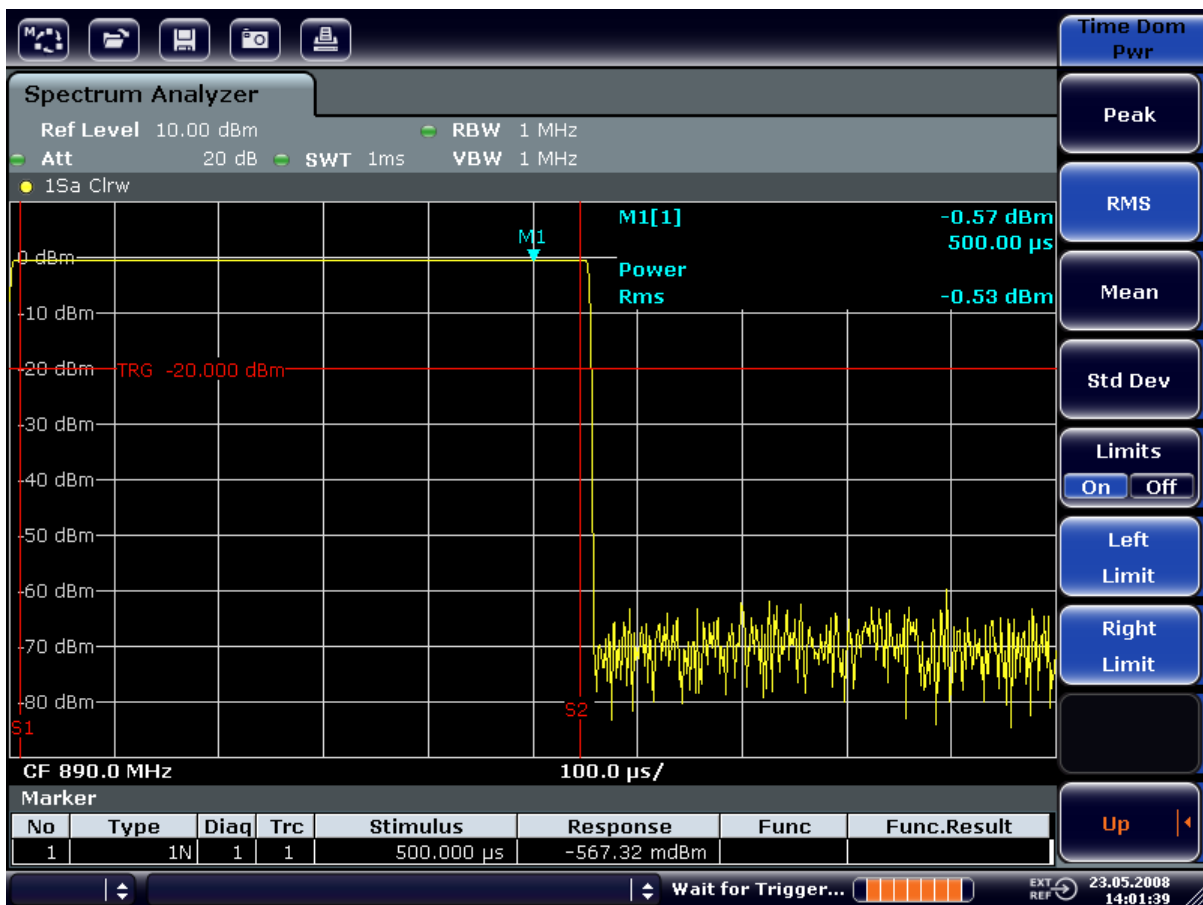
Figure 7-8: Measurement of the average power during the burst of a GSM signal

7.4.1.2 Measuring the Edges of a GSM Burst with High Time Resolution

Because of the high time resolution of the R&S ESRP at the 0 Hz display range, the edges of TDMA bursts can be measured precisely. The edges can be shifted to the screen area by using the trigger offset.

Test setup
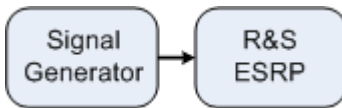
Table 7-6: Signal generator settings (e.g. R&S SMU)

Frequency	890 MHz
Level	0 dBm
Modulation	GSM, one timeslot activated

The measurement is based on the setting in the example above for measuring the power of the GSM during the activation phase.

1. Switch off the power measurement.

   a) Press the [MEAS] key.
   b) Press the "All Functions Off" softkey.

2. Increase the time resolution to 100 µs.

   a) Press the [SWEEP] key.
   b) Press the "Sweeptime Manual" softkey and enter *100 µs*.

3. Using the trigger softkey, shift the rising edge of the GSM burst to the center of the screen.

   a) Press the [TRIG] key.
   b) Press the "Trigger Offset" softkey.

c) By turning the rotary knob counterclockwise, move the trigger offset until the burst edge can be seen in the center of the screen, or enter *-50 μs*. The R&S ESRP displays the rising edge of the GSM burst.
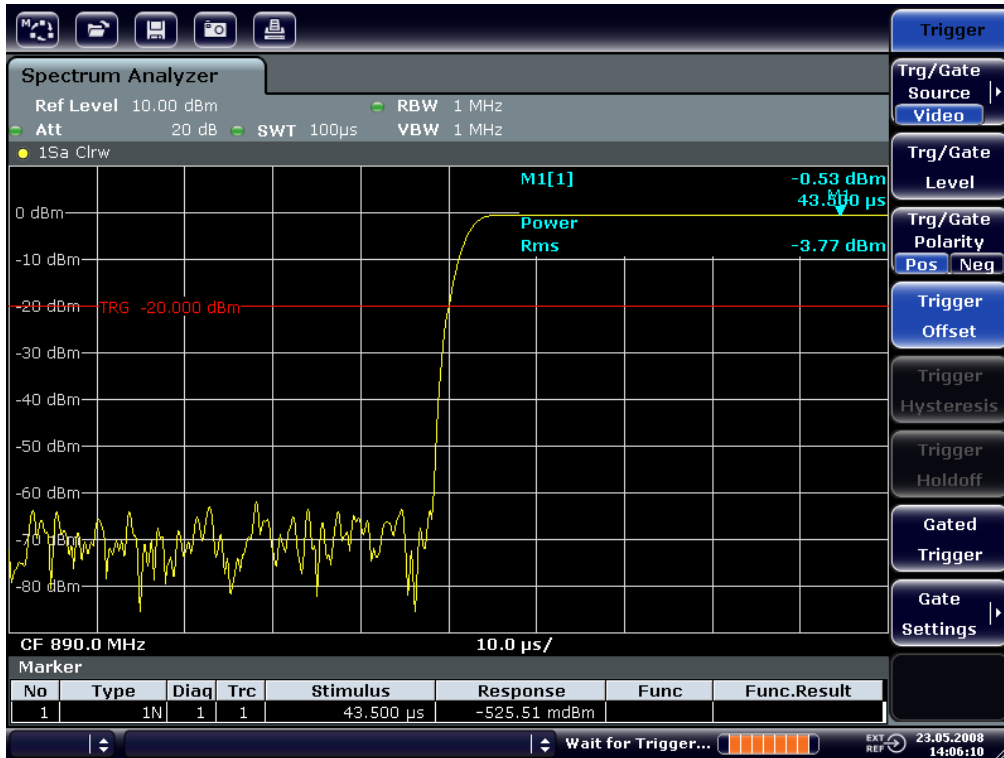
Figure 7-9: Rising edge of the GSM burst displayed with high time resolution

4. Using the trigger offset, move the falling edge of the burst to the center of the screen. To do so, switch the "Trg/Gate Polarity" softkey to "Neg".
   The R&S ESRP displays the falling edge of the GSM burst.
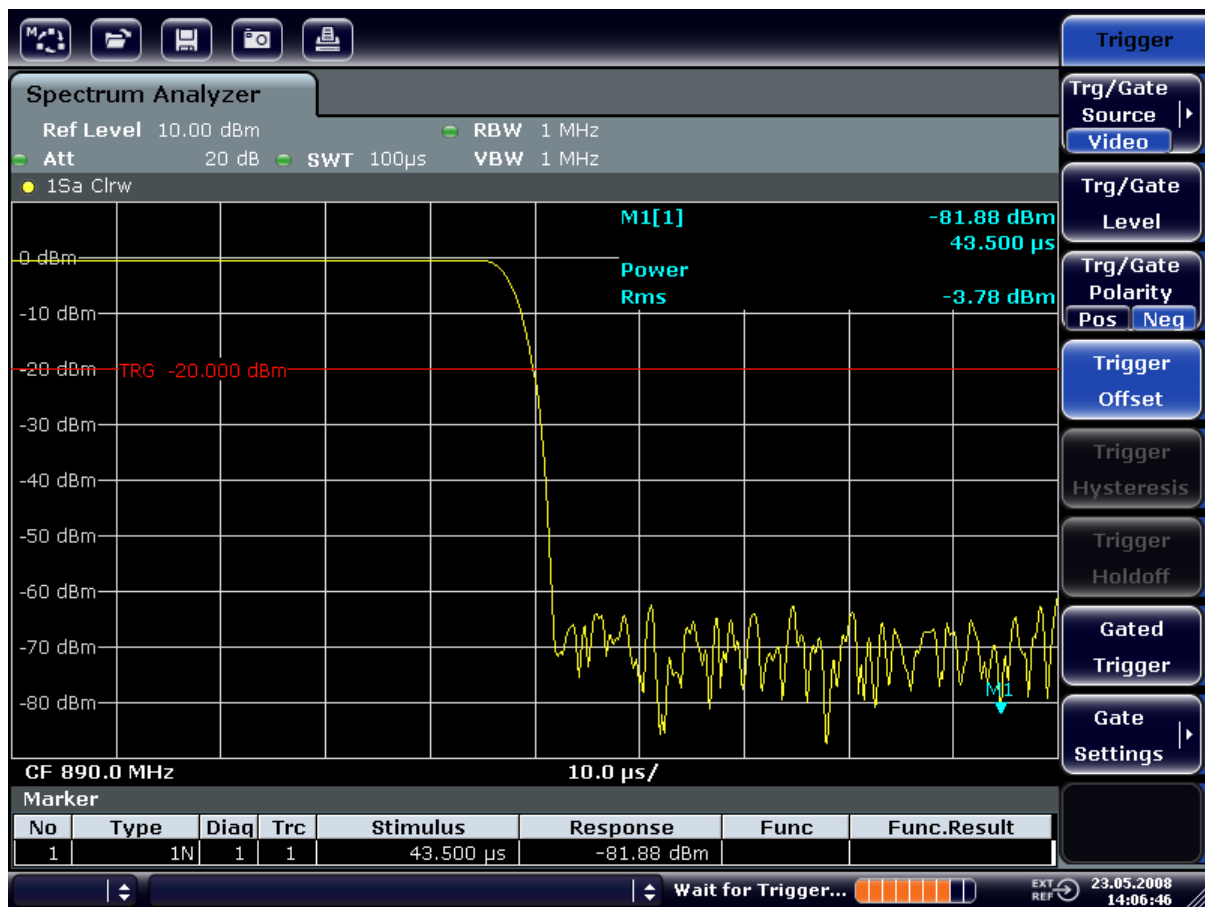
Figure 7-10: Falling edge of the GSM burst displayed with high time resolution

7.4.2 Measuring the Signal-to-Noise Ratio of Burst Signals

When TDMA transmission methods are used, the signal-to-noise ratio or the deactivation dynamic range can be measured by comparing the power values during the activation phase and the deactivation phase of the transmission burst. For this purpose, the R&S ESRP provides the function for measuring absolute and relative power in zero span. In the following example, the measurement is performed using a GSM burst.

Signal-to-Noise Ratio of a GSM Signal

Test setup
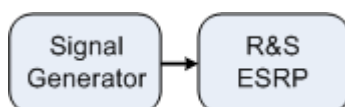
Table 7-7: Signal generator settings (e.g. R&S SMU)

Frequency	890 MHz
Level	0 dBm
Modulation	GSM, one time slot is switched on

1. Set the signal analyzer to the default state by pressing the [PRESET] key. The R&S ESRP is set to its default state.

2. Select "Spectrum" mode.

3. Set the center frequency to 890 MHz, the span to 0 Hz and the resolution bandwidth to 1 MHz.

   a) Press the [FREQ] key and enter *890 MHz*.
   b) Press the [SPAN] key and enter 0 Hz or press the "Zero Span" softkey.
   c) Press the [BW] key.
   d) Press the "Res BW Manual" softkey and enter *1 MHz*.

4. Set the reference level of the R&S ESRP to 0 dBm (= level of the signal generator) by pressing the [AMPT] key and entering *0 dBm*.

5. Set the sweep time to 2 ms.

   a) Press the [SWEEP] key.
   b) Press the "Sweeptime Manual" softkey and enter *2 ms*.
   The R&S ESRP shows the GSM burst continuously across the display.

6. Use the trigger source "Video" and the trigger polarity "Pos" to trigger on the rising edge of the burst and shift the start of burst to the center of the screen.

   a) Press the [TRIG] key.
   b) Press the "Trg/Gate Source" softkey and select "Video" using the arrow keys.
   c) Press the "Trg/Gate Level" softkey and enter *70%*.
   The R&S ESRP shows a static image with the GSM burst at the start of the trace.
   d) Press the "Trigger Offset" softkey and enter *-1 ms*.
   The R&S ESRP shows the GSM burst in the right half of the measurement diagram.

7. Configure the power measurement in zero span.

   a) Press the [MEAS] key.
   b) Press the "Time Domain Power" softkey to open the submenu.
   c) Switch the "Limits" softkey to "On."
   d) Press the "Left Limit" softkey.

e) Using the rotary knob, move the vertical line to the start of the burst.
f) Press the "Right Limit" softkey.
g) Using the rotary knob, move the second vertical line to the end of the burst.
The R&S ESRP displays the power during the activation phase of the burst.
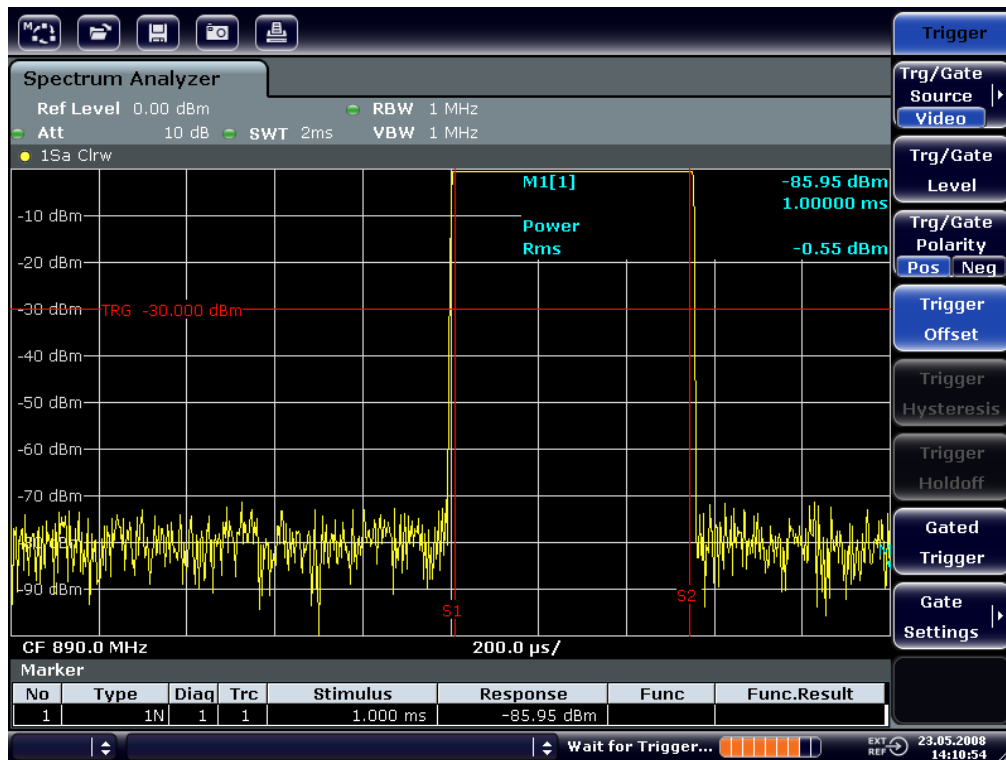
Figure 7-11: Power measurement during the activation phase of the burst

8. Measure the power during the deactivation phase of the burst.
    a) Press the [TRIG] key.

b) Switch the "Trg/Gate Polarity" softkey to "Neg."
The R&S ESRP initiates triggering in response to the falling edge of the burst. This shifts the burst to the left-hand half of the measurement diagram. The power is measured in the deactivation phase. The start of the burst is shifted to the center of the screen and the power during the deactivation phase is measured.
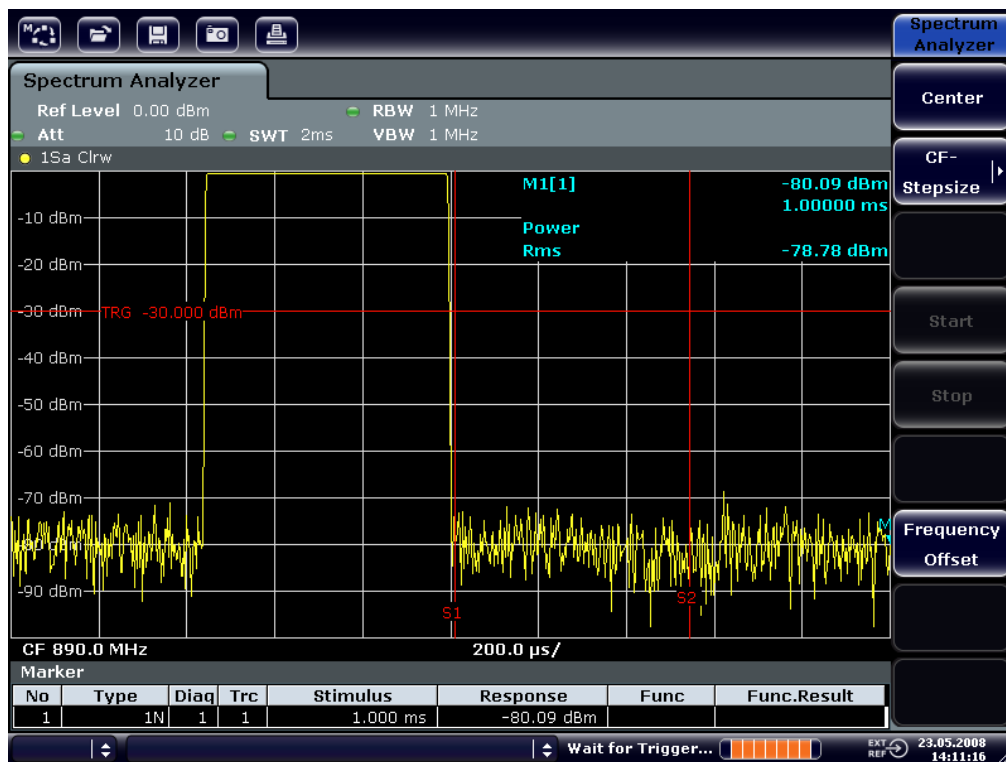
Figure 7-12: Measurement of the signal-to-noise ratio of a GSM burst signal in zero span.

7.4.3 Measuring FM-Modulated Signals

Since signal analyzers can display only the magnitude of the measurement signal by using the envelope detector, the modulation of FM-modulated signals cannot be measured directly as in the case of AM-modulated signals. The voltage at the output of the envelope detector remains constant for FM-modulated signals as long as the frequency deviation of the signal is located within the flat part of the passband characteristic of the employed resolution filter. Amplitude variation occurs only if the instantaneous frequency extends into a falling edge of the filter curve. This behavior can be used to demodulate FM-modulated signals. The center frequency of the analyzer is set in such a manner that the nominal frequency of the measurement signal is located on a filter edge (below or above the center

frequency). The resolution bandwidth and the frequency offset must be selected in such a manner that the instantaneous frequency is located in the linear part of the filter edge. As a result, the frequency variation of the FM-modulated signal is transformed into an amplitude variation that can be displayed on screen in zero span.

Displaying the AF of an FM-Modulated Carrier

Test setup
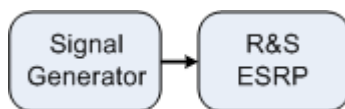
Table 7-8: Signal generator settings (e.g. R&S SMU)

Frequency	128 MHz
Level	-20 dBm
Modulation	FM 0 kHz deviation (i.e. FM modulation is deactivated), 1 kHz AF

1. Set the signal analyzer to the default state by pressing the [PRESET] key. The R&S ESRP is set to its default state.

2. Select "Spectrum" mode.

3. Set the center frequency to 127.50 MHz and the span to 300 kHz.

    a) Press the [FREQ] key and enter *127.50 MHz*.
    b) Press the [SPAN] key and enter *300 kHz*.

4. Set the resolution bandwidth to 300 kHz.

    a) Press the [BW] key.
    b) Press the "Res BW Manual" softkey and enter *300 kHz*.
    c) Press the "Video BW Manual" softkey and enter *30 kHz*.

5. Set the display range to 20 dB and shift the filter trace to the center of the screen.

    a) Press the [AMPT] key.
    b) Press the "Range" softkey
    c) Press the "Range Log Manual" softkey and enter *20 dB*.
    d) Press the "Up↑" softkey.
    e) Press the "More" softkey.
    f) Switch the "Grid" softkey to "Rel".
    g) Press the "Up↑" softkey.

h) Press the "Ref Level" softkey.
i) Using the rotary knob, set the reference level such that the filter edge at the center frequency intersects the -10 dB level line.
The filter edge of the 300 kHz filter is displayed. This corresponds to the demodulator characteristic for FM signals with a steepness of approx. 18 dB/140 kHz. This can be verified using the marker and delta marker.
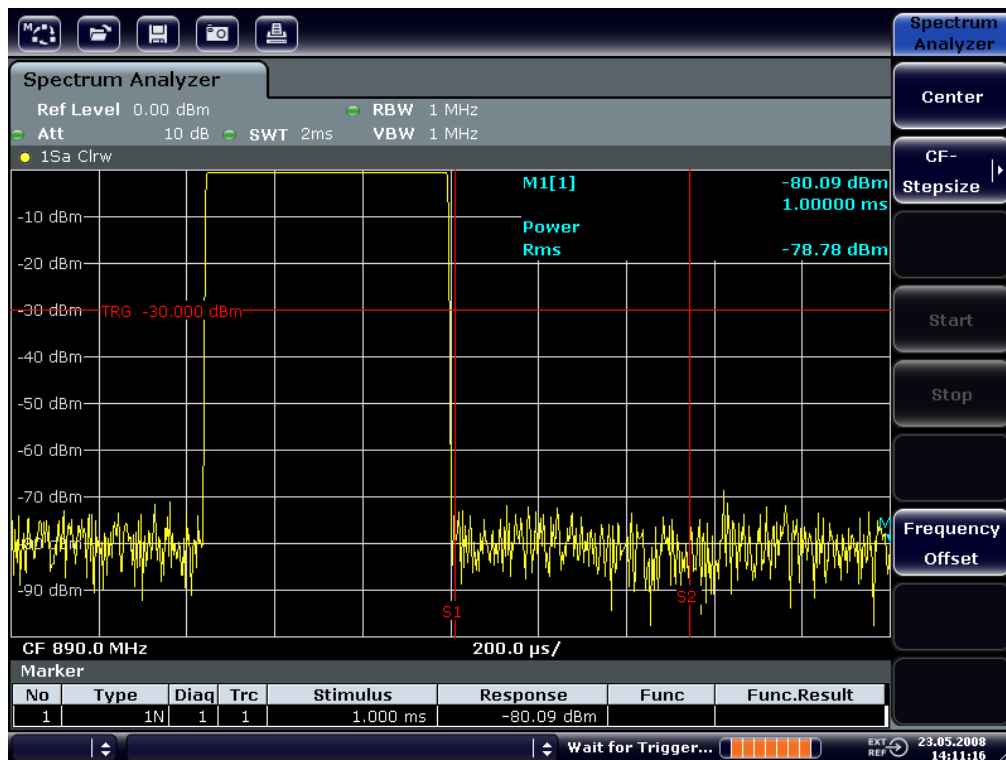
Figure 7-13: Display of the filter edge of the 300 kHz filter as an FM discriminator characteristic

6. Set the FM deviation to 50 kHz on the signal generator.

7. Set the span to 0 Hz on the R&S ESRP.

a) Press the [SPAN] key.
b) Press the "Zero Span" softkey.
The demodulated FM signal is displayed. The signal crosses the screen continuously.

8. Establish a stable display using video triggering.

a) Press the [TRIG] key.
b) Press the "Trg/Gate Source" softkey and select "Video" using the arrow keys.

c) Press the "Trg/Gate Level" softkey and enter *50%*.
A static image for the FM AF signal is produced.
Result: (-10 (5) dB; this yields a deviation of 100 kHz when the steepness
of the demodulator characteristic is 5 dB/100 kHz.
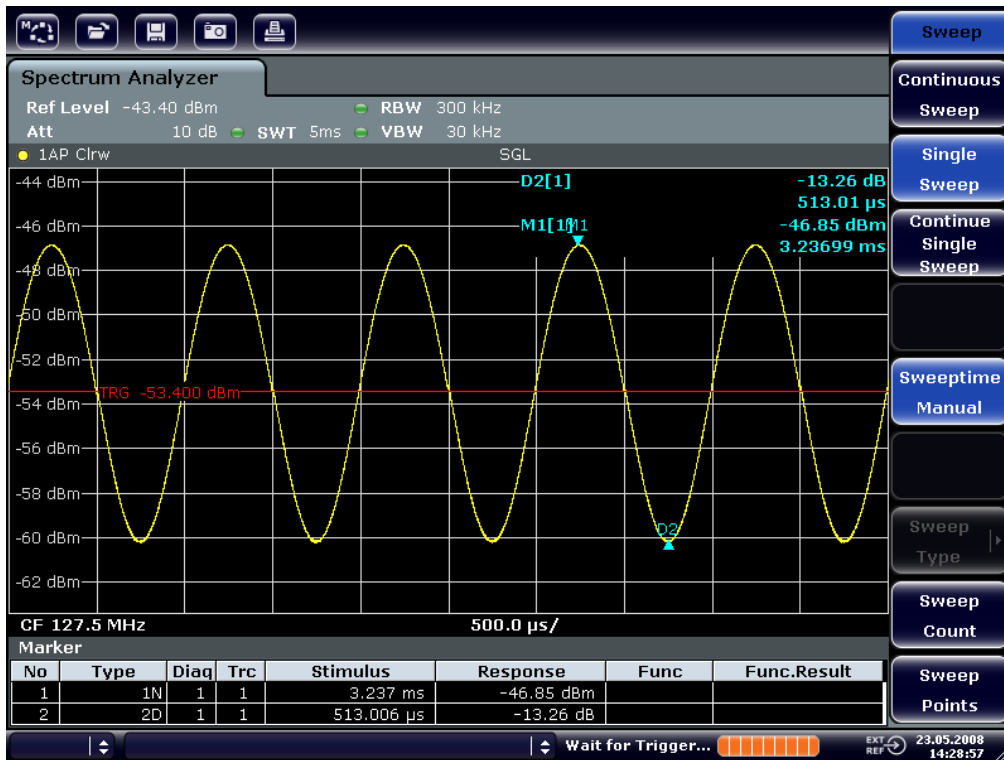
Figure 7-14: Demodulated FM signal

9. Determine the deviation.

   a) Press the [MKR] key.
      Marker 1 is activated and placed on the peak of the curve.
   b) Press the "Marker 2" softkey.
   c) Press the [MKR] key.
   d) Press the "More" softkey.
   e) Press the "Min" softkey.
      Marker 2 (delta marker) is placed on the minimum of the curve. The level
      difference is 13.3 dB, which corresponds to the peak-to-peak deviation.
      With the filter slope of 18 dB/140 kHz, the deviation can be calculated as
      follows:

$$deviation = \frac{1}{2} x \frac{13.3 \times 140}{18} kHz = \frac{1}{2} 103 kHz = 51.7 kHz$$

7.5 Storing and Loading Instrument Settings

The R&S ESRP can store complete instrument settings together with instrument configurations and measurement data in a settings file. The data is stored on the built-in hard disk or - if selected - on a USB device (e.g. memory stick) or on a network drive. The hard disk has the drive letter `C:`.

In the default state, the current settings are stored. This includes the settings of the measurement functions, the activated limit lines and the active transducer factor.

7.5.1 Storing an Instrument Configuration (without Traces)

1. Press the [SAVE/RCL] key.

2. Press the "Save" softkey.
   The dialog box for instrument configurations is displayed. The `File Name` field is in edit mode and contains a suggestion for a new name.
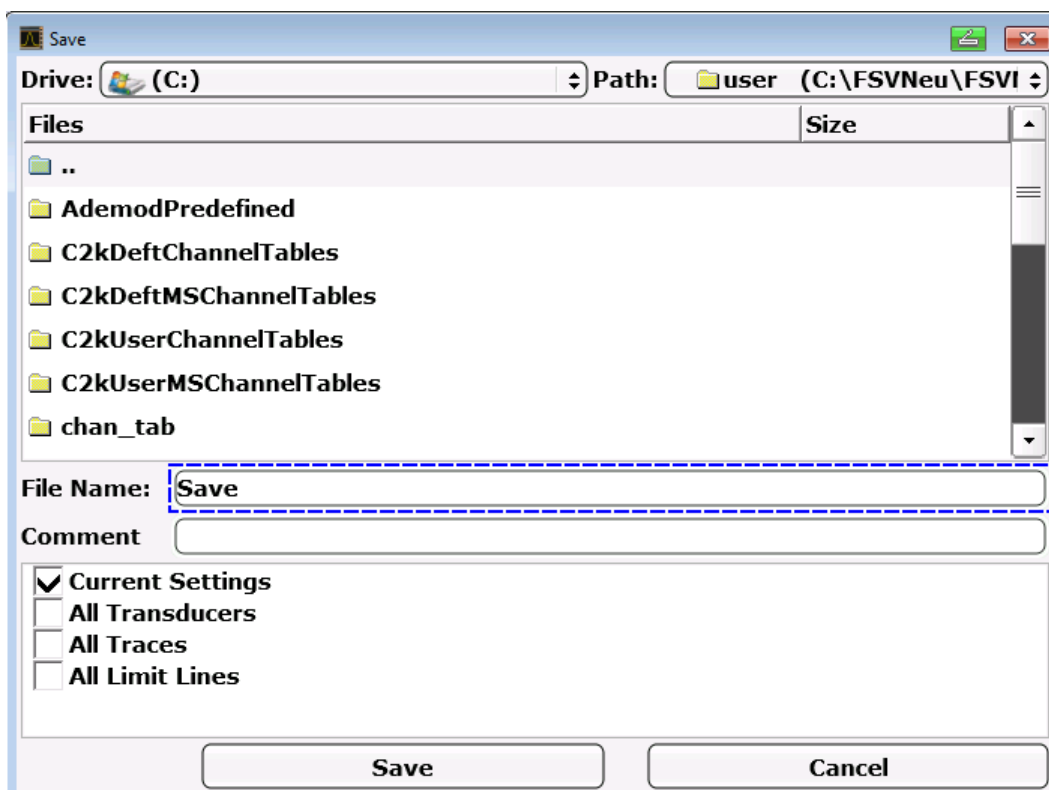
3. To change the suggested name, enter a name for the settings file to be stored.

The name may contain letters and digits. For details on alphanumeric entries see Chapter 6.3.2, "Entering Alphanumeric Parameters", on page 68.

4. To store the file in a directory different to the default directory, select the required path in the `Files` area.

   If the path is not changed, the default path for the instrument configurations (`C:\R_S\Instr\user`) is used.

   Note: The selected directory is automatically used for any further save and recall operations.

5. Press the "Save File" softkey.
   The settings file is stored and the dialog box is closed.

7.5.2   Storing Traces

Before you can store traces, you must first select the corresponding item entry. To do so, proceed as follows:

1. Press the [SAVE/RCL] key.

2. Press the "Save" softkey.

3. To change the suggested name, enter a file name.

4. Select the "All Traces" option.

5. Press the "SAVE" button.

7.5.3   Loading an Instrument Configuration (with Traces)

1. Press the [SAVE/RCL] key.

2. Press the "Recall" softkey.

3. If necessary, select the path under which the file to be loaded is stored.

4. Define the settings file to be loaded. One of the following ways is possible:
   - Click in the `File Name` field and enter the file name via the keyboard or keypad.
   - Select the file from the selection list using the touchscreen or mouse.
   Alternatively:

    a) Press the "Select File" softkey.
       The focus is set on the files list.

    b) Using the rotary knob or arrow keys, focus the settings file to be loaded
       and confirm by pressing the rotary knob or the [ENTER] key.

5. To load traces, select the "All Traces" option.

   Note: The "All Traces" option is only available if the selected file contains traces.

6. Press the "Recall" button in the dialog box, or the "Recall File" softkey.
   The settings file is loaded. During loading, the R&S ESRP detects which items the selected settings file contains and, if applicable, ignores any items that were selected but are not available.

7.5.4 Configuring Automatic Loading

If the R&S ESRP is switched on in the factory default state, it loads the instrument settings that it had when switched off (provided that it was switched off using the power button on the front panel; see Chapter 5.9, "Switching the Instrument On and Off", on page 38. If the instrument is preset, it loads the presettings.

You can alter these settings and define a settings file to be loaded. This requires performing the following procedure. Be aware that the chosen settings file is loaded both while booting and presetting.

1. Press the [SAVE/RCL] key.

2. Press the "Startup Recall" softkey.

3. Press the "Startup Recall (On/Off)" softkey to activate the recall function.

4. Press the "Select Dataset" softkey.
   The "Startup Recall" dialog box is displayed.

5. If necessary, select the path under which the file to be loaded is stored.

6. Select the settings file to be loaded (DFL file).

7. Press the "Select" button in the dialog box.

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