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R&S®EPL1000
EMI Test Receiver
User Manual

1179587602
Version 02

ROHDE&SCHWARZ
Make ideas real

This manual applies to the following R&S®EPL1000 models with firmware version 1.00 and later:

- R&S®EPL1000 (1350.4444K10)

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1179.5876.02 | Version 02 | R&S®EPL1000

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

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1 Preface

1.1 About This Manual

This user manual describes general instrument functions and settings common to all applications and operating modes in the R&S EPL1000. Furthermore, it provides all the information specific to **EMI measurements in the receiver application**.

All other operating modes and applications are described in the specific application manuals.

The main focus in this manual is on the measurement results and the tasks required to obtain them. The following topics are included:

- **Welcome to the R&S EPL1000**
  Introduction to and getting familiar with the instrument
- **Operating modes and applications**
  The concept of using multiple operating modes
- **Measurements**
  Descriptions of the individual measurements in the receiver application, including result types and configuration settings.
- **Common measurement settings**
  Description of the measurement settings common to all measurement types with their corresponding remote control commands
- **Common measurement analysis and display functions**
  Description of the settings and functions provided to analyze results independently of the measurement type with their corresponding remote control commands
- **Data management**
  Description of general functions to handle data files (configuration and result data, not I/Q data)
- **General instrument setup**
  Description of general instrument settings and functions that are independent of the current operating mode
- **Network and remote operation**
  Information on setting up the instrument in a network and operating it remotely.
- **Remote commands**
  Remote commands required to configure and run measurements in a remote environment, sorted by tasks
  Remote commands required to set up the environment and to perform common tasks on the instrument, sorted by tasks
  Programming examples demonstrate the use of many commands and can usually be executed directly for test purposes
- **Maintenance**
  Information on tasks required to maintain operability of the instrument
- **Troubleshooting**
  Hints and tips on how to handle errors

- **List of commands**
  Alphabetical list of all remote commands described in the manual
- **Index**

1.2 Conventions used in the documentation

1.2.1 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.

1.2.2 Conventions for procedure descriptions

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

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

1.2.3 Notes on screenshots

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

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

2 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 2.1, "Safety instructions", on page 10. 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.

2.1 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.

Reconfigure or adjust the product only as described in the product documentation or the data sheet. Any other modifications can affect safety and are not permitted.

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 https://www.rohde-schwarz.com/support.

Lifting and carrying the product

The maximum weight of the product is provided in the data sheet. You can lift or carry the product by yourself, if you can manage the weight on your own. Alternatively, you can use lifting or transporting equipment. 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 product 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. Replace parts that are relevant to safety only by original parts, e.g. power cables or fuses.

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 product 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 you connect the product to an external power supply, use the one delivered with the product or recommended in the product documentation. The external power supply must conform 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.

Using 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.

2.2 Labels on R&S EPL1000

Labels on the casing inform about:

- Personal safety, see "Meaning of safety labels" on page 13
- Product and environment safety, see Table 2-1
- Identification of the product, see Chapter 6.2.14, "Device ID", on page 45

Table 2-1: Labels regarding R&S EPL1000 and environment safety

	Labeling in line with EN 50419 for disposal of electrical and electronic equipment after the product has come to the end of its service life. For more information, see "Disposing electrical and electronic equipment" on page 626.
	Labeling in line with directive 2006/66/EC for disposal of batteries after they have come to the end of their service life. For more information, see "Disposing electrical and electronic equipment" on page 626.

2.3 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.

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.

2.4 Korea certification class A

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

3 Documentation overview

This section provides an overview of the R&S EPL1000 user documentation. Unless specified otherwise, you find the documents at:

www.rohde-schwarz.com/manual/EPL1000

3.1 Getting started manual

Introduces the R&S EPL1000 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.

3.2 User manuals and help

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

- Base unit manual
  Contains the description of all instrument modes and functions. It also provides an introduction to remote control, a complete description of the remote control commands with programming examples, and information on maintenance, instrument interfaces and error messages. Includes the contents of the getting started manual.
- Firmware application manual
  Contains the description of the specific functions of a firmware application, including remote control commands. Basic information on operating the R&S EPL1000 is not included.

The contents of the user manuals are available as help in the R&S EPL1000. The help offers quick, context-sensitive access to the complete information for the base unit and the firmware applications.

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

3.3 Service manual

Describes the performance test for checking compliance with rated specifications, firmware update, troubleshooting, adjustments, installing options and maintenance.

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

https://gloris.rohde-schwarz.com

3.4 Instrument security procedures

Deals with security issues when working with the R&S EPL1000 in secure areas. It is available for download on the internet.

3.5 Printed safety instructions

Provides safety information in many languages. The printed document is delivered with the product.

3.6 Data sheets and brochures

The data sheet contains the technical specifications of the R&S EPL1000. It also lists the firmware applications and their order numbers, and optional accessories.

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

See www.rohde-schwarz.com/brochure-datasheet/EPL1000

3.7 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 software makes use of several valuable open source software packages. An open-source acknowledgment document provides verbatim license texts of the used open source software.

See www.rohde-schwarz.com/firmware/EPL1000

3.8 Application notes, application cards, white papers, etc.

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

See www.rohde-schwarz.com/application/EPL1000

3.9 Video tutorials

Video tutorials that show you how to get started and perform basic tasks with the R&S EPL1000 are available on the Rohde & Schwarz internet site:

https://www.rohde-schwarz.com/manual/r-s-fpl1000-trying-out-basic-measurement-tasks-manuals_78701-567115.html

3.10 Calibration certificate

The document is available on https://gloris.rohde-schwarz.com/calcert. You need the device ID of your instrument, which you can find on a label on the rear panel.

4 Key features

The R&S EPL1000 sets standards in RF performance and usability. Outstanding key features are:

One instrument for multiple applications

- Receiver measurements (CISPR compliant)
- Spectrum analysis

Solid RF performance

- Low spurious response
- Low displayed average noise level (DANL)
- 12.8 MHz signal analysis bandwidth
- Low level measurement uncertainty
- Precise spectral measurements due to low phase noise

Intuitive user interface

- High-resolution display
- Multipoint touchscreen
- Flexible arrangement of results and MultiView
- Toolbar
- Quiet operation

Fully portable

- Battery pack and 12 V/24 V power supply
- Carrying bag and shoulder harness
- Low power consumption

5 Preparing for use

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

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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 11.

5.2 Unpacking and checking

1. Unpack the R&S EPL1000 carefully.
2. Retain the original packing material. Use it when transporting or shipping the R&S EPL1000 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 11.

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.

- 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 EPL1000

The R&S EPL1000 is designed for use either on a bench top or in a rack, or as a portable instrument (with optional battery operation) in a transport bag in the field.

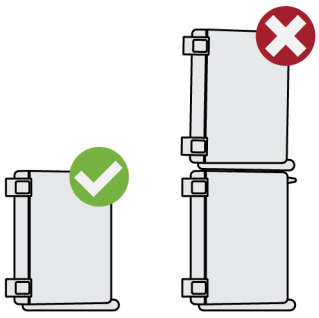
See also:

- "Setting up the product" on page 11
- "Intended use" on page 10

5.4.1 Placing the R&S EPL1000 on a bench top

To place the product on a bench top

1. Place the product on a stable, flat and level surface.
2. **CAUTION!** The top surface of the product is too small for stacking. If you stack another product on top of the product, the stack can fall over and cause injury.
   If you want to save space, mount several products in a rack.



3. **CAUTION!** Foldable feet can collapse. See "Setting up the product" on page 11.

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

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 to provide sufficient airflow and ventilation.
   - Do not place the product next to heat-generating equipment such as radiators or other products.

5.4.2 Mounting the R&S EPL1000 in a rack

To prepare the rack

1. Observe the requirements and instructions in "Setting up the product" on page 11.
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 EPL1000 in a rack

1. Use an adapter kit to prepare the R&S EPL1000 for rack mounting.
   a) Order the rack adapter kit designed for the R&S EPL1000. 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 EPL1000 to shelf height.
3. Grab the handles and push the R&S EPL1000 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 EPL1000 in the rack.

To unmount the R&S EPL1000 from a rack

1. Loosen the screws at the rack brackets.
2. Remove the R&S EPL1000 from the rack.
3. If placing the R&S EPL1000 on a bench top again, unmount the adapter kit from the R&S EPL1000. Follow the instructions provided with the adapter kit.

5.4.3 Portable operation

An optional carrying bag designed specifically for the R&S EPL1000 allows you to protect the instrument while working in the field. The bag includes ventilation areas at the position of the ventilation outlets in the casing to ensure air circulation. The transparent

cover allows you to operate the instrument without removing it from the bag. With the help of the optional vest holster, you can carry the R&S EPL1000 in its bag and keep your hands free. Together with the optional battery pack (see Chapter 5.5.3, "Optional battery pack", on page 25), and packed in the dedicated carrying bag, the R&S EPL1000 is ideally suited for operation directly in the field, even in rough environments.

► Inspect the carrying bag for wear and tear before placing the instrument in it.

For details on optional accessories, see the R&S EPL1000 data sheet.

5.5 Connecting to power

There are various options to supply power to the R&S EPL1000.

- The R&S EPL1000 is equipped with an AC power supply connector.
- The R&S EPL1000 can also be equipped with an optional (internal) DC power supply connector
  The optional DC power supply is available with R&S FPL1-B30.
- The R&S EPL1000 allows for battery operation if option R&S FPL1-B31 is installed.

5.5.1 Connecting the AC power

The R&S EPL1000 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 EPL1000.

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 6.2.1, "AC power supply connection and main power switch", on page 41.

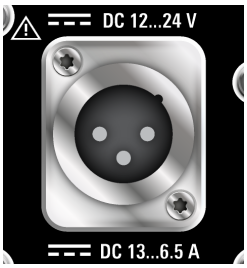
5.5.2 Connecting an optional DC power supply

The DC power supply is available with option R&S FPL1-B30.

The R&S EPL1000 can also be equipped with an optional DC power supply connector. If installed, the R&S EPL1000 can be operated by a DC voltage of +12 V to +24 V. For details on the connector see Chapter 6.2.2, "Li-Ion battery packs and DC power connector", on page 42.

If you use an external power supply unit to supply safety extra-low DC voltage (SELV) to the instrument, be sure to meet the requirements for reinforced/double insulation in accordance with DIN/EN/IEC 61010 (UL 3111, CSA C22.2 No. 1010.1) or DIN/EN/IEC 60950 (UL 1950, CSA C22.2 No. 950). Provide current limitation in accordance with DIN EN 61010-1 Appendix F2.1. Use a cable no longer than 3 m.

Also see "Connecting to power" on page 11.



DC connection

► Connect the DC power connector on the rear panel of the R&S EPL1000 to the DC power source using a cable as described above.

5.5.3 Optional battery pack

The optional battery pack is available with R&S FPL1-B31.

As an alternative to the fixed AC or DC power supply, the R&S EPL1000 also allows for battery operation. The "Battery Pack" option comprises two Li-ion batteries and an internal charger. The internal charger charges the batteries whenever the instrument is connected to AC power. During operation, if neither DC nor AC power is supplied, the R&S EPL1000 automatically switches to battery operation.

The battery pack can be retrofitted by Rohde & Schwarz service.

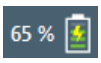
For safety information, see "Handling batteries safely" on page 12.

Charging batteries

Charge the batteries before using battery operation for the first time. Following a long storage period, it can be necessary to charge and discharge the batteries several times to reach full capacity.

For batteries from third parties, follow the instructions provided by the manufacturer. For batteries manufactured by Rohde & Schwarz, observe the following:

- If inserted in the R&S EPL1000, batteries are charged via the common AC or DC power supply.
- You can also use the external battery charger R&S FSV-B34 to charge up to 4 batteries.
- Charge in a temperature range from +0 °C to +45 °C. If the temperature is above or below these values, or the temparature varies strongly, charging is interrupted. If the battery temperature rises above +53 °C, charging is stopped.
- Try not to overcharge the battery too often because overcharging reduces the service life of the battery.



When the battery is being charged in standby mode, the [Power] LED blinks. During operation, the status bar indicates that the battery is being charged.

Remote command to determine the battery charge state:

`DIAGnostic:SERVice:BATTery:LEVel?` on page 568

Spare battery pack

The spare battery pack is available with R&S FPL1-Z4.

In addition to the optional internal battery pack, spare batteries are available for the R&S EPL1000. The spare battery pack comprises two additional Li-ion batteries.

Outside the R&S EPL1000, batteries can be charged using the external battery charger R&S FSV-B34. Even during battery operation, you can exchange the internal batteries while the R&S EPL1000 is running, as long as one battery remains in the instrument. However, it is not recommended to operate the R&S EPL1000 with only one battery for a longer period.

5.6 Switching on or 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 EPL1000

The R&S EPL1000 is off but connected to power.

1. Set the switch on the power supply to position [I].
   See Chapter 6.2.1, "AC power supply connection and main power switch", on page 41.

   The LED of the Power key is orange.

   See Chapter 6.1.2, "Power key", on page 37.

   Note: If the R&S EPL1000 was disconnected from power before it was switched off regularly, it automatically switches back on when the power is reconnected. Using a LAN-controlled power switch, you can take advantage of this behavior to switch the device on and off remotely.

2. Press the Power key.

   The LED changes to green.
   The instrument operates on battery, DC, or AC power, whichever is supplied. The R&S EPL1000 boots.

   After booting, the instrument is ready for operation.

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.

To disconnect from power

The R&S EPL1000 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 6.2.1, "AC power supply connection and main power switch", on page 41.

   The LED of the standby key is switched off.

2. Disconnect the R&S EPL1000 from the power source.

5.7 Connecting to LAN

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

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 EPL1000 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 EPL1000 is configured to use DHCP and no static IP address is configured.

The default instrument name is <Type><variant>-<serial_number>, for example, EPL1000-123456. For information on determining the serial number, see Chapter 6.2.14, "Device ID", on page 45.

For more information on LAN configuration, see Chapter 14.5, "How to set up a network and remote control", on page 347.

5.8 Connecting a keyboard

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

However, you can also connect foreign language keyboards; currently the following languages are supported for the R&S EPL1000:

- German
- Swiss
- French
- Russian

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" .

5.9 Connecting an external monitor

You can connect an external monitor (or projector) to the "DisplayPort" connector on the rear panel of the R&S EPL1000 (see also Chapter 6.2.13, "DisplayPort", on page 45).

Screen resolution and format

The touchscreen of the R&S EPL1000 is calibrated for a 16:10 format. If you connect a monitor or projector using a different format (e.g. 4:3), the calibration is not correct and the screen does not react to your touch actions properly.

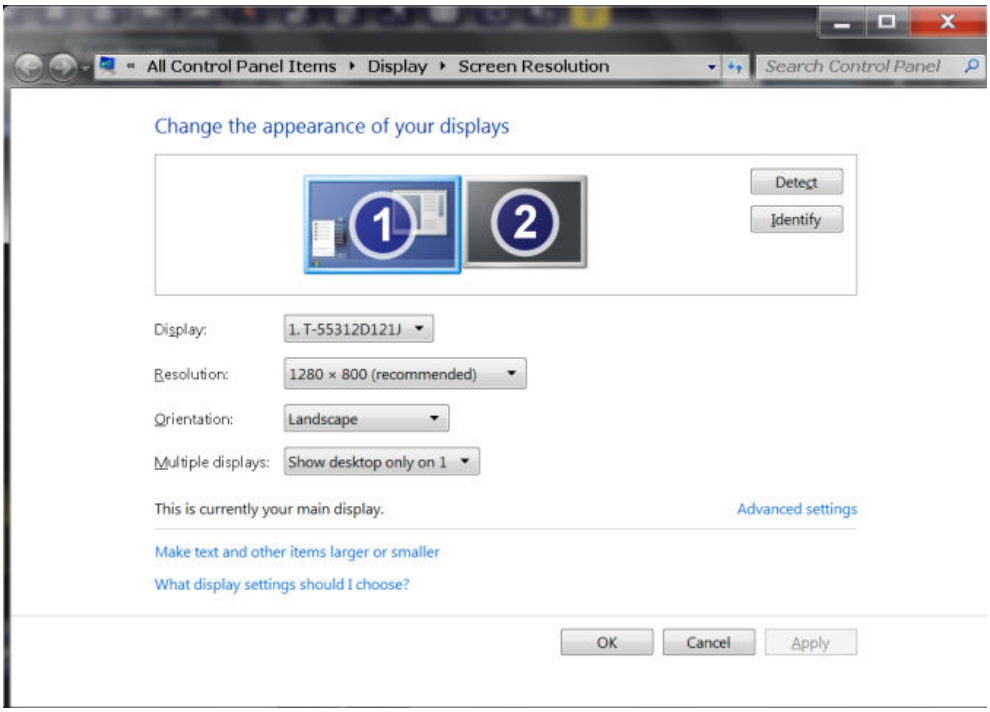
The touchscreen has a screen resolution of 1280x800 pixels. Usually, the display of the external monitor is a duplicate of the instrument's monitor.

If you configure the external monitor to be used as the *only* display in the Windows configuration dialog box ("Show only on 2"), the maximum screen resolution of the monitor is used. In this case, you can maximize the R&S EPL1000 application window and see even more details. You cannot change the monitor's screen resolution via the standard Windows configuration dialog box.

The R&S EPL1000 supports a minimum resolution of 1280x768 pixels.

1. Connect the external monitor to the R&S EPL1000.
2. Press the [Setup] key.
3. Press the "Display" softkey.
4. Select the "Configure Monitor" tab in the "Display" dialog box.

   The standard Windows "Screen Resolution" dialog box is displayed.



5. If necessary, change the screen resolution. Consider the information in the note above.
6. Select the instrument for display:
   - "Display 1": internal monitor only
   - "Display 2": external monitor only

- "Duplicate": both internal and external monitor

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

5.10 Windows operating system

The instrument contains the Windows 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 EPL1000 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 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 instru-

ment. 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 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.

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

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

5.11 Logging on

Windows requires that users identify themselves by entering a user name and password in a login window. By default, the R&S EPL1000 provides two user accounts:

- **"Instrument"**: a standard user account with limited access
- **"Admin"** (depends on firmware image): 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 strongly recommend that you change the password for both users after initial login. An administrator can change the password in Windows 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 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.

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 in the toolbar to access the operating system of the R&S EPL1000 (see also "To access the "Start" menu" on page 31).
2. Open the `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\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:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\AUTOLOGIN.REG`.
7. Press the [ENTER] key to confirm.
   The auto-login function is reactivated with the changed password. It is applied the next time you switch on the instrument.

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 in the toolbar to access the operating system of the R&S EPL1000 (see also "To access the "Start" menu" on page 31).
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.

For information on deactivating and reactivating the auto-login function, see "Deactivating the auto-login function" on page 356.

5.12 Checking the supplied options

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

1. Press the [SETUP] key.
2. Press the "System Config" softkey.
3. Switch to the "Versions + Options" tab in the "System Configuration" dialog box.

   A list with hardware and firmware information is displayed.
4. Check the availability of the hardware options as indicated in the delivery note.

5.13 Performing a self-alignment

When temperature changes occur in the environment of the R&S EPL1000, or after updating the firmware, you have to perform a self-alignment to align the data to a reference source.

During self-alignment, do not connect a signal to the RF input connector. Running a self-alignment with a signal connected to the RF input can lead to false measurement results.

Performing a self-alignment

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

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

Depending on the installation settings, an automatic self-alignment is performed after installation. A dialog box is displayed indicating how much warm-up time is still required before self-alignment can be performed.

1. Press the [Setup] key.
2. Press the "Alignment" softkey.
3. Select the "Start Self Alignment" button in the "Alignment" dialog box.

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

To display the alignment results again later

- Press the [SETUP] key.
- Press the "Alignment" softkey.

5.14 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!** 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.

► **NOTICE!** Risk of instrument damage. Electrostatic discharge can cause an RF overload.

If the level at the input mixer is too high, a protection mechanism automatically turns off the connection between RF input an input mixer.
To avoid an RF overload in general, select an appropriate attenuation (at least 10 dB) to protect the input mixer.

Refer to the instructions in Chapter 10.6.1, "Increasing measurement sensitivity (or avoiding an input mixer overload)", on page 150 for more information about avoiding an RF overload.

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 EPL1000 and connected devices.

Measuring unknown signals

When measuring unknown signals, apply signal attenuation of at least 10 dB. Using a 0 dB attenuation when measuring unknown signals can damage or destroy the input mixer.

6 Instrument tour

6.1 Front panel view

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

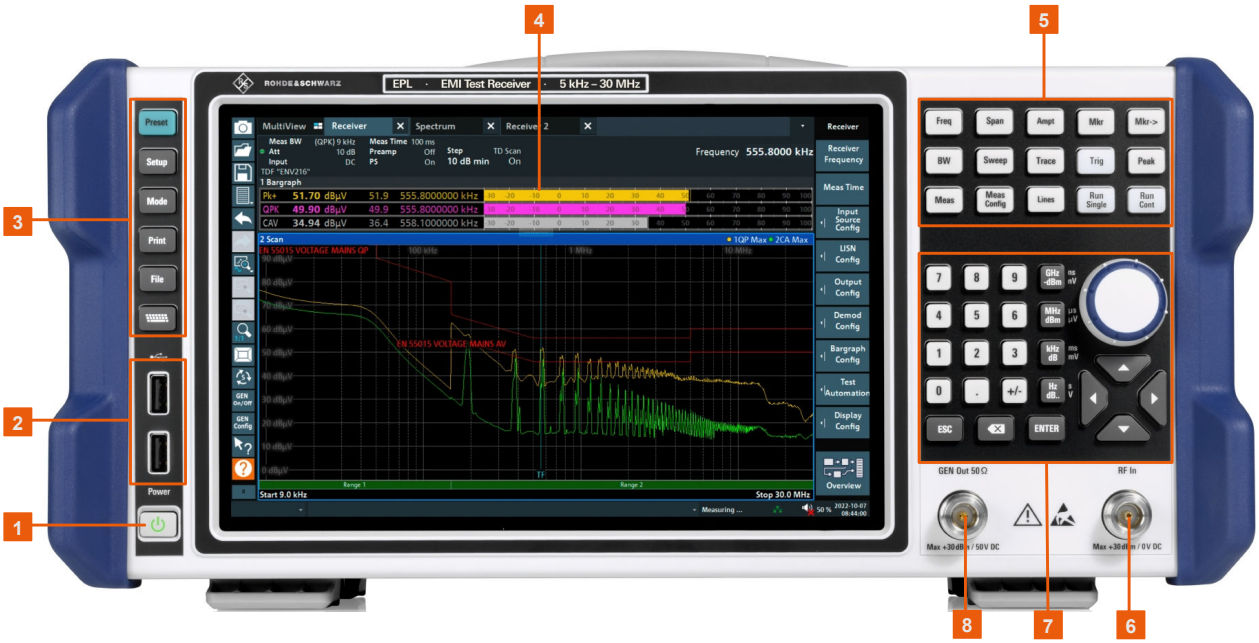


Figure 6-1: Front panel view of R&S EPL1000

1 = Power key
2 = USB (2.0) connectors
3 = System keys
4 = Touchscreen
5 = Function keys
6 = RF input 50 Ω connector
7 = Keypad + navigation controls
8 = Internal generator output 50 Ω connector (requires option R&S EPL1-B9 or R&S EPL1-B91)

6.1.1 Touchscreen

All measurement results are displayed on the screen on the front panel. 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 6-2: Touchscreen elements

1 = Toolbar with standard application functions, e.g. print, save/open file etc.
2 = Tabs for individual channel setups
3 = Channel setup bar for firmware and measurement settings
4 = Measurement results area
5 = Window title bar with diagram-specific (trace) information
6 = Softkeys for function access
7 = Diagram footer with diagram-specific information, depending on application
8 = Instrument status bar with error messages and date/time display

Any user interface elements that react to a click by a mouse pointer also react to a tap on the screen, and vice versa. Using touchscreen gestures, you can perform the following tasks (among others).

- Changing a setting
- Changing the display
- Changing the displayed result range in a diagram
- Moving a marker
- Zooming into a diagram
- Selecting a new evaluation method
- Scrolling through a result list or table
- 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.

For details on touchscreen gestures, see Chapter 7.5, "Touchscreen gestures", on page 60.

6.1.2 Power key

The [Power] key is located on the lower left corner of the front panel. It starts up and shuts down the instrument.

See also "Connecting to power" on page 11 and Chapter 5.5, "Connecting to power", on page 23.

6.1.3 USB

The front panel provides two female USB connectors (USB-A, 2.0 standard) to connect devices like a keyboard or a mouse. A memory stick can be connected to store and reload instrument settings and measurement data.

The rear panel provides further USB connectors (standard 3.0), see Chapter 6.2.11, "USB", on page 45.

6.1.4 System keys

System keys set the instrument to a predefined state, change basic settings, and provide print and display functions.

A detailed description of the corresponding functions is provided in the R&S EPL1000 user manual.

Table 6-1: System keys

System key	Assigned functions
[Preset]	Resets the instrument to the default state.
[Setup]	Provides basic instrument configuration functions, e.g.: • Reference frequency (external/internal) • Date, time, display configuration • LAN interface • Firmware update and enabling of options • Information about instrument configuration incl. firmware version and system error messages • Service support functions (self-test etc.) • Self-alignment (with spectrum analysis option)
[Mode]	Manages channel setups
[Print]	Provides configuration settings for the print function
[FILE]	Provides save/recall functions for instrument settings and measurement results
	Switches between the on-screen keyboard display: • At the top of the screen • At the bottom of the screen • Off

6.1.5 Function keys

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

A detailed description of the corresponding functions is provided in the R&S EPL1000 user manual.

Table 6-2: Function keys

Function key	Assigned functions
[Freq]	Sets the center frequency and the start and stop frequencies for the frequency range under consideration. This key is also used to set the frequency offset and the signal track function.
[Span]	Sets the frequency span to be analyzed
[Ampt]	Sets the reference level, the displayed dynamic range, the RF attenuation and the unit for the level display Sets the level offset and the input impedance Activates the (optional) preamplifier
[BW]	Sets the resolution bandwidth and the video bandwidth.
[Sweep]	Provides functionality to configure the measurement, for example: • the measurement mode (single or continuous measurements) • the measurement time
[Trace]	Configures the graphical analysis of the measurement data
[Meas]	Provides the measurement functions
[Meas Config]	Used to configure measurements and data input and output
[Lines]	Configures display lines and limit lines
[Mkr]	Sets and positions the absolute and relative measurement markers (markers and delta markers)
[Mkr->]	Used for search functions of the measurement markers (maximum/minimum of the trace) Assigns the marker frequency to the center frequency, and the marker level to the reference level Restricts the search area (Search Limits) and characterizes the maximum points and minimum points (Peak Excursion)
[Trig]	Sets the trigger mode, the trigger threshold, the trigger delay, and the gate configuration for gated sweep
[Peak]	Performs a peak search for active marker. If no marker is active, normal marker 1 is activated and the peak search is performed for it.
[Run Single]	Starts and stops a single new measurement (Single Sweep Mode)
[Run Cont]	Starts and stops a continuous measurement (Continuous Sweep Mode)

6.1.6 Keypad

The keypad is used to enter numeric parameters, including the corresponding units. It contains the following keys:

Table 6-3: Keys on the keypad

Type of key	Description
Decimal point	Inserts a decimal point "." at the cursor position.
Sign key	Changes the sign of a numeric parameter. For alphanumeric parameters, inserts a "-" at the cursor position.
Unit keys (GHz/-dBm MHz/dBm, kHz/dB, Hz/dB etc.)	Adds the selected unit to the entered numeric value and complete the entry. For level entries (e.g. in dB) or dimensionless values, all units have the value "1" as multiplying factor. Thus, they have the same function as an [ENTER] key.
[ESC]	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)	If an alphanumeric entry has already been started, this key deletes the character to the left of the cursor.
[ENTER]	• 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, selects the default or focused element.

6.1.7 Navigation controls

The navigation controls include a rotary knob and navigation keys. They allow you to navigate within the display or within dialog boxes.

Navigating in tables

The easiest way to navigate within tables (both in result tables and configuration tables) is to scroll through the entries with your finger on the touchscreen.

6.1.7.1 Rotary knob

The rotary knob has several functions:

- For numeric entries: increments (clockwise direction) or decrements (counter-clockwise direction) the instrument parameter at a defined step width
- In lists: toggles between entries
- For markers, limit lines, and other graphical elements on the screen: moves their position

- For active scroll bars: moves the scroll bar vertically
- For dialog boxes: Same effect as the Enter key when pressed

6.1.7.2 Navigation keys

The navigation keys can be used alternatively to the rotary knob to navigate through dialog boxes, diagrams or tables.

Arrow Up/Arrow Down Keys

The <arrow up> or <arrow down> keys do the following:

- For numeric entries: increments (Arrow Up) or decrements (Arrow Down) the instrument parameter at a defined step width
- In a list: scrolls forward and backward through the list entries
- In a table: moves the selection bar vertically
- In windows or dialog boxes with a vertical scroll bar: moves the scroll bar

Arrow Left/Arrow Right Keys

The <arrow left> or <arrow right> 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.

6.1.8 RF INPUT 50 Ohm

Provides RF input from a connected device under test (DUT) to the R&S EPL1000, which is then analyzed in an RF measurement. Connect the DUT to the "RF Input" on the R&S EPL1000 via a cable equipped with an appropriate connector. Do not overload the input. For maximum allowed values, see the data sheet.

See also Chapter 5.14, "Considerations for test setup", on page 34.

6.1.9 GEN output 50 Ohm

Provides signal output from the (optional) internal generator (requires Internal Generator option R&S EPL1-B9 or option R&S EPL1-B91). Output levels range from -60 dBm to +10 dBm, with a resolution of 0.1 dB. For details, see the data sheet.

6.2 Rear panel view

This figure shows the rear panel view of the R&S EPL1000. The individual elements are described in more detail in the subsequent sections.

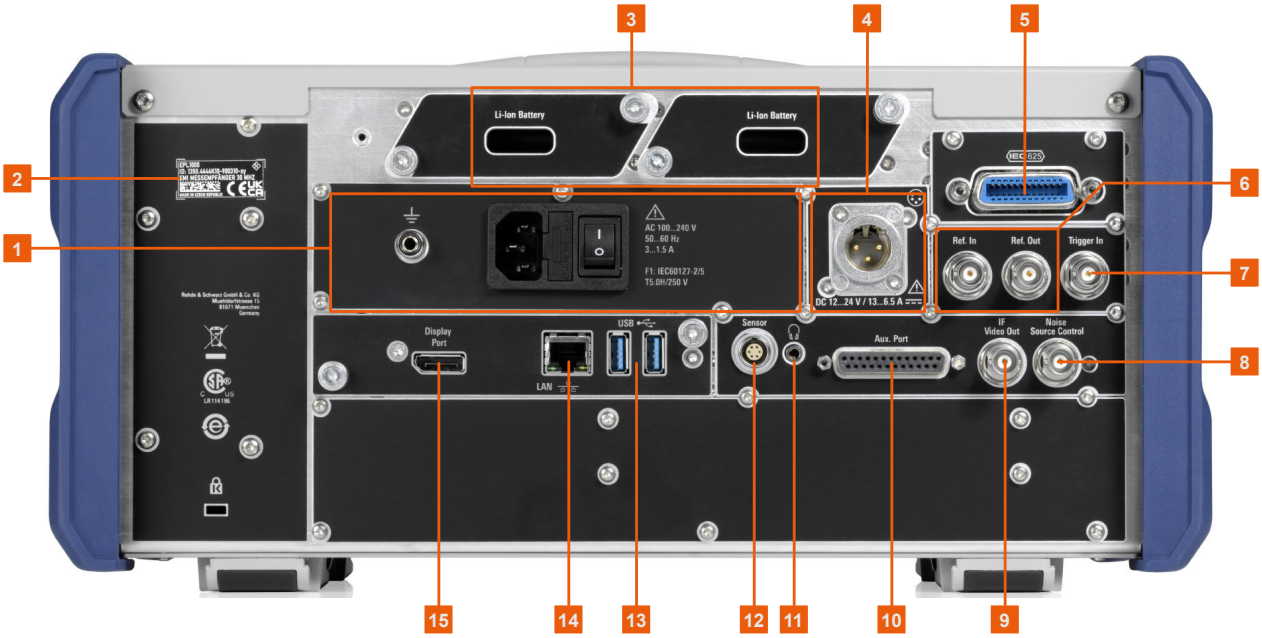


Figure 6-3: Rear panel view

1 = AC power supply, incl. main power switch with fuse and ground terminal
2 = Device ID with serial number and other labels
3 = Removable, rechargeable Li-Ion batteries
4 = DC power connector
5 = GPIB (IEC 625) interface
6 = Reference clock connectors
7 = Trigger input connector
8 = Noise source control
9 = "IF/Video out" connector
10 = Aux. Port
11 = Headphones connector
12 = Power sensor connector
13 = "USB" (3.0) connectors
14 = "LAN" connector
15 = "DisplayPort" connector for external display

The meanings of the labels on the R&S EPL1000 are described in Chapter 2.2, "Labels on R&S EPL1000", on page 14.

6.2.1 AC power supply connection and main power switch

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

Main power switch function:

Position 1: The instrument is in operation.

Position O: The entire instrument is disconnected from the AC power supply.

For details, refer to "Connecting to power" on page 11 and Chapter 5.5, "Connecting to power", on page 23.

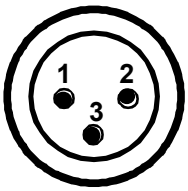
6.2.2 Li-Ion battery packs and DC power connector

The Li-Ion battery pack and DC power connector are available as an optional accessory (R&S FPL1-B31 and R&S FPL1-B30).

With the Li-ion battery pack, the R&S EPL1000 can be operated independently of an AC or DC power supply. The instrument can house 2 Li-ion batteries which can be charged both via AC or DC power supply.

For safety information concerning batteries, see "Handling batteries safely" on page 12.

As an alternative, a DC power supply connector is available. DC power supplies from +12 V to +24 V and from 13 A to 6.5 A can be used. Connect the connector according to the following diagram:

	Pin	Description
	1	Plus
	2	Ground
	3	Not used

If you use an external power supply unit to supply safety extra-low DC voltage (SELV) to the instrument, be sure to meet the requirements for reinforced/double insulation in accordance with DIN/EN/IEC 61010 (UL 3111, CSA C22.2 No. 1010.1) or DIN/EN/IEC 60950 (UL 1950, CSA C22.2 No. 950). Provide current limitation in accordance with DIN EN 61010-1 Appendix F2.1.

Also see "Connecting to power" on page 11.

6.2.3 GPIB interface

The GPIB interface is available as an optional feature (R&S FPL1-B10).

The optional 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 details, see Chapter 14.1, "Remote control interfaces and protocols", on page 318.

6.2.4 Ref. In / Ref. Out

The Ref. In connectors are used to provide an external reference signal to the R&S EPL1000.

The Ref. Out connectors can be used to provide a reference signal from the R&S EPL1000 to other devices that are connected to this instrument.

Various connectors are provided for different reference signals:

Connector	Reference signal	Usage
Ref. In	10 MHz 10 dBm	To provide an external reference signal on the R&S EPL1000.
Ref. Out	10 MHz 10 dBm	To provide the internal reference signal from the R&S EPL1000 to another device continuously. For the R&S EPL1000, this is also used to provide the optional OCXO reference signal to another device.

6.2.5 Trigger In

Use the female Trigger In connector to input an external trigger or gate data. Thus, you can control the measurement using an external signal. The voltage level is 1.4 V. The typical input impedance is 10 kΩ.

6.2.6 Noise Source Control

The Noise Source Control female connector is used to provide the supply voltage for an external noise source. For example, use it to measure the noise figure and gain of amplifiers and frequency converting devices.

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

6.2.7 IF/Video Output

The female BNC connector can be used for various outputs in the Spectrum application:

- Intermediate frequency (IF) output of approximately 20 MHz
- Video output (1V)

Which output is provided is defined in the software ("Overview" > "Output").

For details, see the R&S EPL1000 Spectrum Mode user manual.

6.2.8 Aux. Port

A 25-pole SUB-D male connector used as an input and output for low-voltage TTL control signals (max. 5 V).

NOTICE

Short-circuit hazard

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

Table 6-4: Pin assignment for AUX port

Pin	Signal	Description
1	GND	Ground
2		not used for spectrum analysis
3	GND	Ground
4		not used for spectrum analysis
5	GND	Ground
6		not used for spectrum analysis
7	GND	Ground
8 to 11		not used for spectrum analysis
12	GND	Ground
13	+5 V / max. 250 mA	Supply voltage for external circuits
14 to 19	I/O_<no.>	Control lines for user ports (see user manual)
20	GND	Ground
21	READY FOR TRIG-GER	Signal indicating that the instrument is ready to receive a trigger signal. The signal polarity is configurable.
22 to 25		not used for spectrum analysis
23	GND	Ground
24 to 25		not used for spectrum analysis

6.2.9 Headphones connector

The R&S EPL1000 provides demodulators for AM and FM signals, which can be routed to the headphone connector. With headphones or an external loudspeaker connected to the 3.5 mm headphone socket, the displayed signal can be identified acoustically.

Note the safety information provided in "Using headphones" on page 13.

For details, see the R&S EPL1000 Spectrum mode user manual.

6.2.10 Sensor connector

The LEMOSA female connector is used to connect power sensors of the R&S NRP-Zxy family. For a detailed list of supported sensors, see the data sheet.

6.2.11 USB

The rear panel provides two additional female USB (3.0 standard) connectors to connect external devices (see also Chapter 6.2.11, "USB", on page 45).

6.2.12 LAN

The R&S EPL1000 is equipped with a 1 GBit Ethernet IEEE 802.3u network interface with Auto-MDI(X) functionality. The assignment of the RJ-45 connector supports twisted-pair category 5 UTP/STP cables in a star configuration (UTP stands for *unshielded twisted pair*, and STP for *shielded twisted pair*).

For details, see Chapter 14, "Network operation and remote control", on page 318.

6.2.13 DisplayPort

You can connect an external monitor or other display device to the R&S EPL1000 via the DisplayPort connector to provide an enlarged display.

For details, see Chapter 5.14, "Considerations for test setup", on page 34.

6.2.14 Device ID

The unique device identifier is provided as a barcode sticker on the rear panel of the R&S EPL1000.

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, `EPL1000-123456`.
The instrument name is required to establish a connection to the instrument in a LAN.

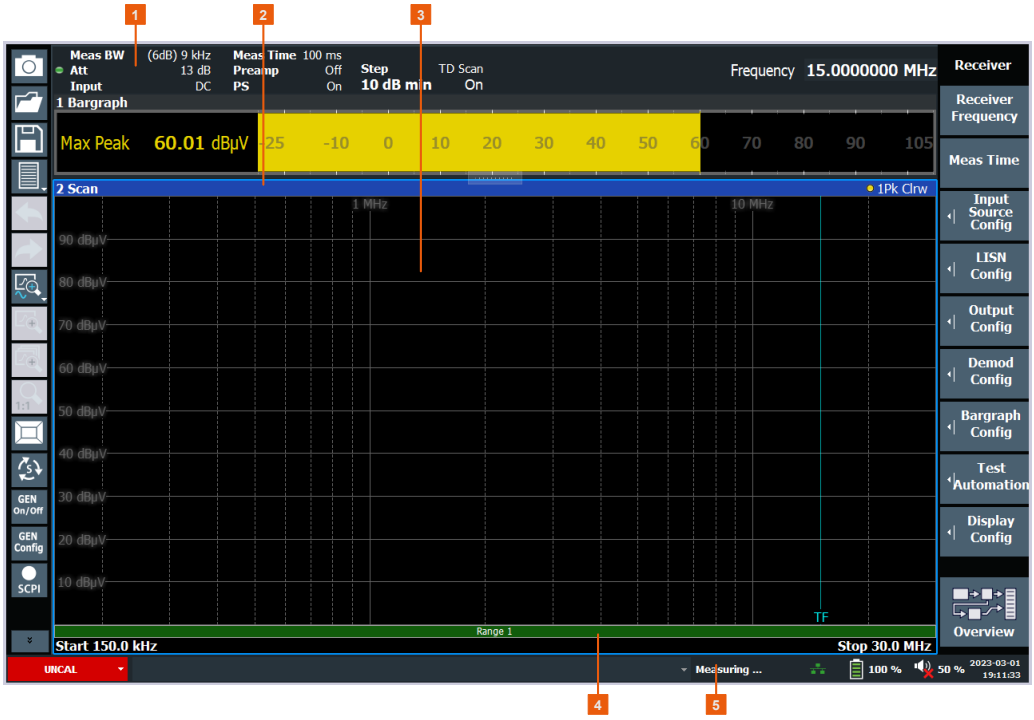
7 Operating the instrument

The following topics provide an overview on how to work with the R&S EPL1000. They describe what kind of information is displayed in the diagram area, how to interact with the R&S EPL1000, and how to use the online help.

- Understanding the display information....47
- Accessing functions....54
- Changing the focus....58
- Entering data....58
- Touchscreen gestures....60
- Displaying results....62
- Getting help....69
- Remote control....70

7.1 Understanding the display information

The following image shows the default display layout in the receiver application. All different information areas are labeled. They are explained in more detail in the following sections.



1 = Channel bar: shows firmware and measurement settings
2 = Window title bar: shows diagram-specific (trace) information
3 = Diagram area: contains the measurement results and other information related to the measurement (marker etc.)
4 = Diagram footer: shows diagram-specific information, depending on measurement application
5 = Instrument status bar: shows error messages, measurement progress, date/time etc.

Hiding elements in the display

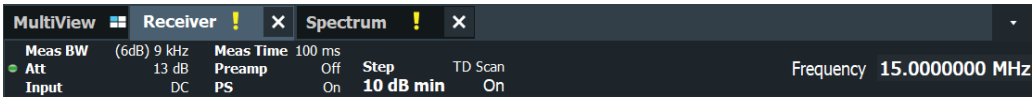
You can hide some of the elements in the display, for example the status bar or channel bar, to enlarge the display area for the measurement results ("Setup" > "Display" > "Displayed Items").

For details, see the R&S EPL1000 user manual.

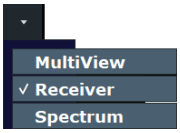
- Channel bar....48
- Window title bar....50
- Marker information....51
- Frequency and span information in diagram footer....52
- Instrument and status information....52
- Error information....53

7.1.1 Channel bar

Using the R&S EPL1000 you can handle several different measurement tasks (channels) at the same time (although they can only be performed asynchronously). For each channel, a separate tab is displayed on the screen. To switch from one channel display to another, simply select the corresponding tab.

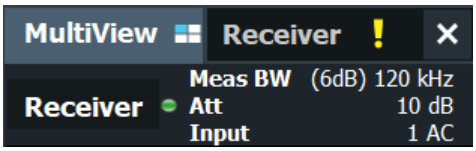


If many tabs are open, you can also select the tab selection list icon at the right end of the channel bar and select the channel you want to see.



MultiView tab

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



Icons in the channel bar

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

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

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

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

The channel bar above the diagram also contains information about instrument settings.

Table 7-1: Contents of the channel bar (receiver application)

Label	Information
"Meas BW"	Type and bandwidth of the currently selected resolution filter. The filter type label either reads "6 dB" or "MIL". For 3 dB filters, the label is not displayed.
"Att(enuation)"	Currently defined RF attenuation.
"Input"	Currently used RF input, including the input coupling (AC or DC).
"Meas Time"	Currently defined measurement time. For a scan count > 1, the measurement time is the sum of all single measurements.
"Preamp(lifier)"	Currently selected preamplifier state.
"PS"	Current state of the preselector.
"Step"	Currently selected scan type and frequency step mode. • "LIN": Stepped scan with linear frequency steps. The frequency step size is a fix value in Hz. • "TD Scan": Time domain scan.
"Out"	Currently selected output type. If phones output is on, a corresponding icon is displayed.
"LISN"	Currently selected LISN and LISN phase. For R&S ENV216, it also shows the state of the highpass filter. Only displayed when a LISN is included in the measurement.
"SGL"	Indicates the progress of single measurements. The first number is the current measurement. The second number is the total number of measurements. Only displayed for single measurements and if the scan count is greater than 1.
"Frequency"	Current receiver frequency.
"75 Ω"	75 Ω input impedance has been selected.

Label	Information
"TRG"	Currently selected trigger source.
"TDF"	Currently selected transducers, including the input they have been assigned to.

Icons for individual settings

In the **receiver application**, a bullet next to the setting indicates that automatic settings are used, not user-defined settings.

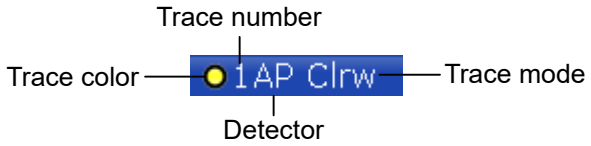
In **other applications**, a bullet next to the setting indicates that user-defined settings are used, not automatic settings. A green bullet indicates that this setting is valid and the measurement is correct. A red bullet indicates an invalid setting that does not provide useful results.

7.1.2 Window title bar

Each channel in the R&S EPL1000 display can contain several windows. Each window can display either a graph or a table as a result of the channel measurement. Which type of result evaluation is displayed in which window is defined in the display configuration (see Chapter 7.6, "Displaying results", on page 62). The window's title bar indicates which type of evaluation is displayed.

Trace information in window title bar

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



Trace color	Color of trace display in diagram
Trace no.	Number of the trace (1 to 6)

Detector	Abbreviation of the detector assigned to the trace: • AP Autopeak detector • Av Average detector • CA CISPR AV detector • Mi Min Peak / Negative Peak detector • Pk Max Peak / Positive Peak detector • QP Quasipeak detector • RA RMS Average detector • Rm RMS detector • Sa Sample detector
Trace Mode	Abbreviation of the trace mode: • Clrw Clear Write: Shows the currently measured values. • Max Max Hold: Shows the maximum values that have been measured. • Min Min Hold: Shows the minimum values that have been measured. • Average Average: Shows the averaged values that have been measured. • View View: Shows a trace which remains the same when you perform another measurement. • Transducer Transducer: Shows the correction values of active transducer factors.

7.1.3 Marker information

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

Marker information in diagram grid

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

Marker information in marker table

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

Label	Information
"Wnd"	Window type the marker is positioned in.
"Type"	Marker type: N (normal), D (delta), T (temporary, internal)
"Ref"	Reference (for delta markers)
"Trc"	Trace to which the marker is assigned
"X-value"	x-value of the marker
"Y-value"	y-value of the marker

7.1.4 Frequency and span information in diagram footer

The information in the diagram footer (beneath the diagram) depends on the current application.

The contents depend on the application and the result display.

Label	Information
CF	Center frequency
Span	Frequency span (frequency domain display)
ms/	Time per division (time domain display)
Pts	Number of measurement points or (rounded) number of currently displayed points in zoom mode
Start	Start frequency of the scan
Stop	Stop frequency of the scan

7.1.5 Instrument and status information

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

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

The following information is displayed:

Instrument status

	The R&S EPL1000 is configured for operation with an external reference. Selecting the "Ext Ref" icon opens a dialog box to configure the external reference.

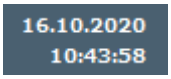
Progress

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

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

Date and time

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



Selecting the date and time icon opens a dialog box to configure the date and time.

Error messages and warnings

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

7.1.6 Error information

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

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

Table 7-2: Status bar information - color coding

Color	Type	Description
Red	Error	An error occurred at the start or during a measurement, e.g. due to missing data or wrong settings, so that the measurement cannot be started or completed correctly.
Orange	Warning	An irregular situation occurred during measurement, e.g. the settings no longer match the displayed results, or the connection to an external device was interrupted temporarily.
Gray	Information	Information on the status of individual processing steps.
No color	No errors	No message displayed - normal operation.
Green	Measurement successful	Some applications visualize that the measurement was successful by showing a message.

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

For a description of possible errors, see the R&S EPL1000 user manual.

7.2 Accessing functions

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

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

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

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

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

- Toolbar 54
- Softkeys 56
- Context menus 57
- On-screen keyboard 57

7.2.1 Toolbar

The icons in the toolbar provide access to general functions.

For more information about configuring the toolbar, see Chapter 13.6, "Toolbar configuration", on page 300.

You can hide the toolbar display, for example when using remote control, in order to enlarge the display area for the measurement results ("Setup > Display > Displayed Items"). See the R&S EPL1000 User Manual for details.

	Windows: opens the Windows "Start" menu and task bar.
	Open: opens a file from the instrument or an external device ("Save/Recall" menu).
	Store: stores data on the instrument or an external device ("Save/Recall" menu).
	Report Generator: opens the softkey menu to configure a report.
	Undo: reverts last operation
	Redo: repeats previously reverted operation
	Measurement zoom: applies to the next display you select; Displays a dotted rectangle in the diagram that can be expanded to define the zoom area; the selected diagram is replaced by a new diagram with adapted measurement settings which displays the selected extract of the trace. Also provides a context menu to determine the firmware behavior for touch gestures: • "Level Lock" (Default:) The reference level (and thus the attenuation) remains unchanged during touch gestures on the screen. • "X-Lock" The x-axis of the diagram is not changed during subsequent touch gestures. • "Y-Lock" The y-axis of the diagram is not changed during subsequent touch gestures. • "Adapt Measurement to Zoom (selected diagram)" Automatically adapts the measurement settings to the currently zoomed display
	Zoom mode: displays a dotted rectangle in the diagram that can be expanded to define the zoom area.
	Multiple zoom mode: multiple zoom areas can be defined for the same diagram.
	Zoom off: displays the diagram in its original size.
	SmartGrid: activates "SmartGrid" mode to configure the screen layout.
	Sequencer: opens the "Sequencer" menu to perform consecutive measurements.
	Generator state: turns the internal generator on and off.

	Generator config: Open the menu to configure the internal generator. Note that the full functionality of the internal generator is only available in the spectrum application.
	Help (+ Select): allows you to select an element for which context-specific help is displayed.
	Help: displays context-sensitive help topic for currently selected element.
	Create report: creates a new measurement report and deletes previous report data.
	Create report: creates a new measurement report without deleting previous report data.
	RF input off: Signal applied to the RF input is not measured (instead the signal path of the calibration signal is used). Note that this icon is only visible if you deliberately turn it on. ([SETUP] > "Display" > "Displayed Items" > "Input Terminator")
	Frequency lock: Frequency does not change when you turn the rotary knob. Only applies to the frequency. You can still change other parameters with the rotary knob.
	Print immediately: prints the current display (screenshot) as configured.

7.2.2 Softkeys

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

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

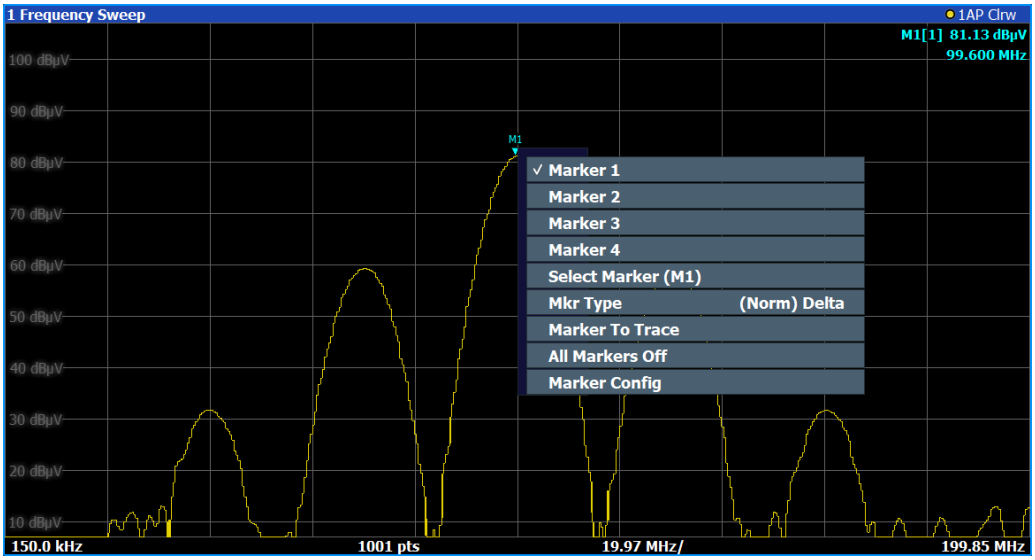
Recognizing the softkey status by color

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

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

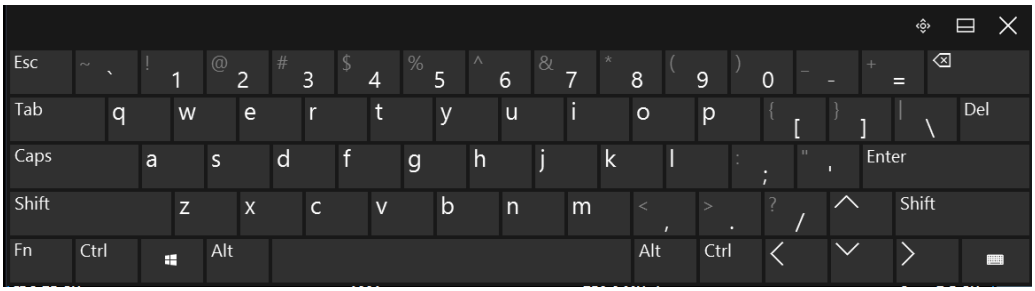
7.2.3 Context menus

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



7.2.4 On-screen keyboard

The on-screen keyboard is an additional means of interacting with the instrument without having to connect an external keyboard.



The on-screen keyboard display can be switched on and off as desired using the "On-Screen Keyboard" function key beneath the screen.

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

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

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

7.3 Changing the focus

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

7.4 Entering data

You can enter data in dialog boxes using any of the following methods:

- Using the touchscreen, via the on-screen keyboard
- Using other elements provided by the front panel, e.g. the keypad, rotary knob, or navigation keys
  The rotary knob acts like the [ENTER] key when it is pressed.
- Using a connected external keyboard

Transparent dialog boxes

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

To change the transparency, select the transparency icon at the top of the dialog box. A slider is displayed. To hide the slider, select the transparency icon again.

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

Particularities in Windows dialog boxes

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

7.4.1 Entering numeric parameters

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

1. Enter the parameter value using the keypad, or change the currently used parameter value by using the rotary knob (small steps) or the [UP] or [DOWN] keys (large steps).
2. After entering the numeric value via keypad, press the corresponding unit key.
   The unit is added to the entry.
3. If the parameter does not require a unit, confirm the entered value by pressing the [ENTER] key or any of the unit keys.
   The editing line is highlighted to confirm the entry.

Digit-based data entry

By default, when you enter a numeric value in an input field, you overwrite the existing value. If you edit the value using the arrow keys or rotary knob, the value is increased or decreased linearly. An extended digit-based data entry mode allows you to edit individual digits and change the unit quickly.

1. In the input field for a numeric value, select the pencil icon to switch to extended data entry mode.
2. Use the left and right arrow keys to scroll through the individual digits of the indicated value.
3. Change the required digit using the up and down arrow keys or the rotary knob to scroll through the values 0 to 9.

   The new value is applied immediately, without further confirmation.

   Note:
   - If you enter a digit using the keypad, the entire value is overwritten, as in normal data entry mode.
   - To add a digit to the existing value, you must return to normal data entry mode. Select the pencil icon to toggle between entry modes.
4. To change the unit:
   a) Press the right arrow key and scroll past the last digit to select the unit list.
   b) Use the up and down arrow keys to scroll through the available units.
   c) Press the left arrow key to return to the last digit of the numeric value.

   The new unit is applied immediately, without further confirmation.

5. Select the "X" to close the input field.

7.4.2 Entering alphanumeric parameters

If a field requires alphanumeric input, you can use the on-screen keyboard to enter numbers and (special) characters (see Chapter 7.2.4, "On-screen keyboard", on page 57).

7.5 Touchscreen gestures

A touchscreen allows you to interact with the software using various finger gestures on the screen. The basic gestures supported by the software and most applications are described here. Further actions using the same gestures may be possible.

Tapping

Touch the screen quickly, usually on a specific element.

You can tap most elements on the screen; in particular, any elements you can also click on with a mouse pointer.

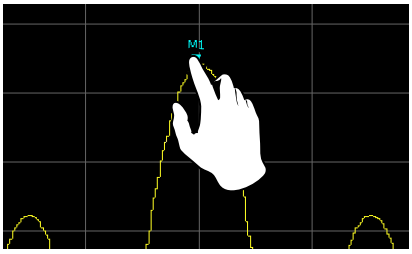
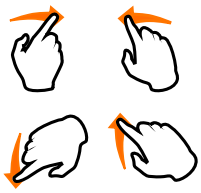


Figure 7-1: Tapping

Double-tapping

Tap the screen twice, in quick succession.

Double-tap a diagram or the window title bar to maximize a window in the display, or to restore the original size.



Dragging

Move your finger from one position to another on the display, keeping your finger on the display the whole time.

By dragging your finger over a table or diagram you can pan the displayed area of the table or diagram to show results that were previously out of view.

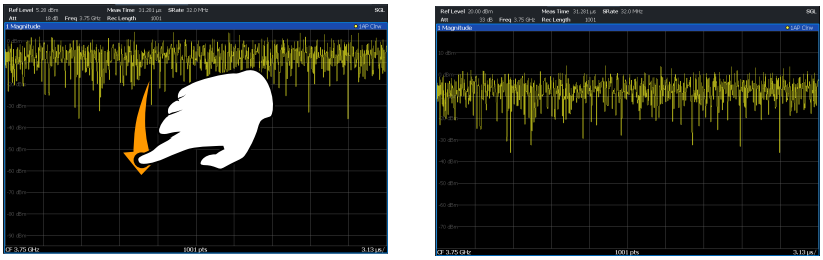
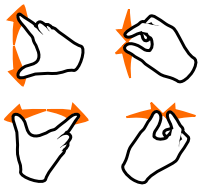


Figure 7-2: Dragging



Pinching and spreading two fingers

Move two fingers together on the display (pinch) or move two fingers apart on the display (spread).

When you pinch two fingers in the display, you decrease the size of the currently displayed area, showing the surrounding areas previously out of view.

When you spread two fingers in the display, you increase the size of the currently displayed area, showing more details.

You can pinch or spread your fingers vertically, horizontally, or diagonally. The direction in which you move your fingers determines which dimension of the display is changed.

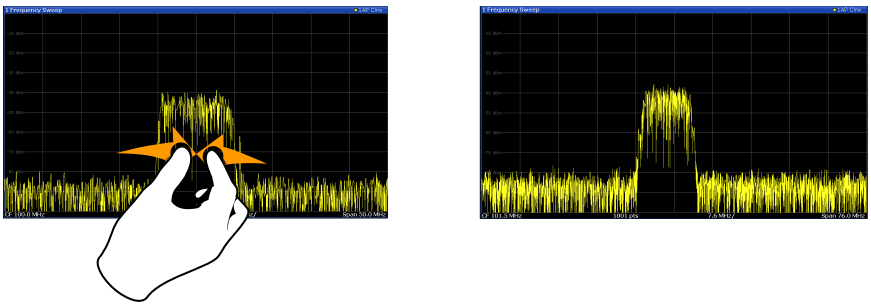


Figure 7-3: Pinching

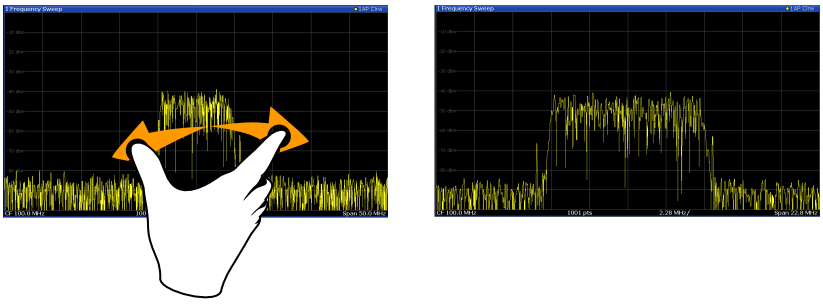


Figure 7-4: Spreading

Touch gestures in diagrams change measurement settings

When you change the display using touch gestures, the corresponding measurement settings are adapted. This is different to selecting an area on the screen in zoom mode, where merely the resolution of the displayed trace points is changed temporarily (graphical zoom).

Mouse vs. touch actions

Any user interface elements that react to actions by a mouse pointer also react to finger gestures on the screen, and vice versa. The following touch actions correspond to mouse actions:

Table 7-3: Correlation of mouse and touch actions

Mouse operation	Touch operation
Click	Tap
Double-click	Double-tap
Click and hold	Touch and hold
Right-click	Touch, hold for 1 second and release
Drag-&-drop (= click and hold, then drag and release)	Touch, then drag and release
n.a. (Change hardware settings)	Spread and pinch two fingers
Mouse wheel to scroll up or down	Swipe
Dragging scrollbars to scroll up or down, left or right	Swipe
In (graphical) Zoom mode only: dragging the borders of the displayed rectangle to change its size	Touch, then drag and release

Example:

You can scroll through a long table in conventional mouse operation by clicking in the table's scrollbar repeatedly. In touch operation, you would scroll through the table by dragging the table up and down with your finger.

7.6 Displaying results

The R&S EPL1000 provides several instrument applications for different analysis tasks and different types of signals, for example the Receiver application, the Spectrum application or the I/Q Analyzer. For each application, a new measurement channel is created and displayed in a separate tab on the screen.

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

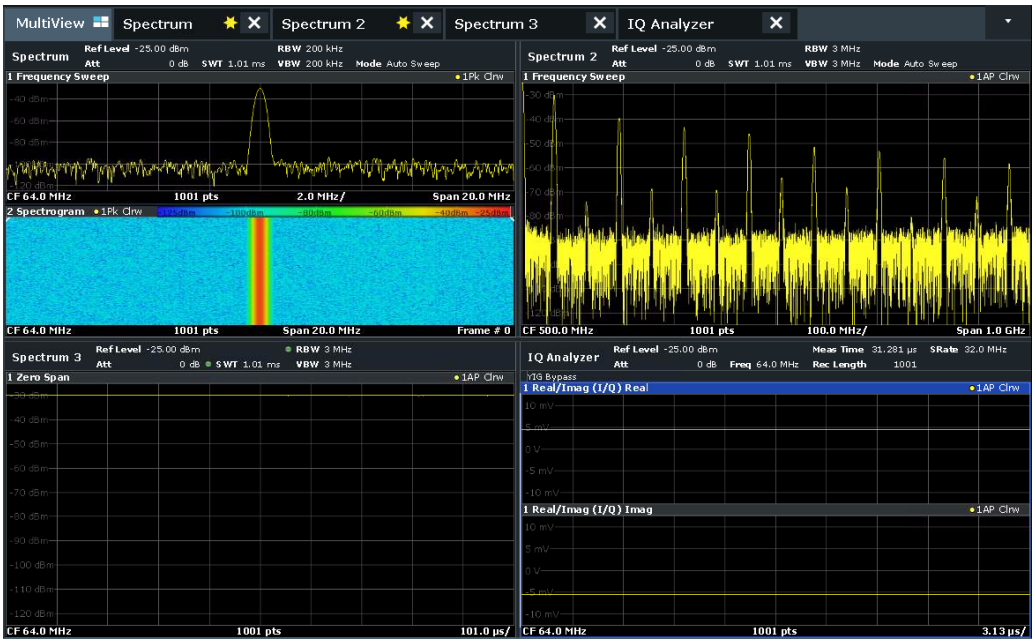
The R&S EPL1000 allows you to configure the display to suit your specific requirements and optimize analysis.

7.6.1 Activating and deactivating channels

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

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

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



To start a new channel

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

Remote command:

`INSTrument:CREate[:NEW]` on page 374/ `INSTrument:CREate:DUPLicate` on page 374

To change the application in an active channel

1. Select the tab of the channel you want to change.
2. Select the [Mode] key.
3. In the "Mode" dialog box, select the new application to be displayed on the "Replace Current Channel" tab.
   The selected application is displayed in the current channel.

Remote command:

`INSTrument:CREate:REPLace` on page 375

To close a measurement channel

►

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

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

Remote command:

`INSTrument:DELete` on page 375

7.6.2 Laying out the result display with the smartgrid

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

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

- Windows can be arranged in columns or in rows, or in a combination of both.
- Windows can be arranged in up to four rows and four columns.
- Windows are moved simply by dragging them to a new position on the screen, possibly changing the layout of the other windows, as well.
- All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar. If the evaluation bar contains more icons than can be displayed at once on the screen, it can be scrolled vertically. The same evaluation method can be displayed in multiple windows simultaneously.
- New windows are added by dragging an evaluation icon from the evaluation bar to the screen. The position of each new window depends on where you drop the evaluation icon in relation to the existing windows.

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

- Background information: the smartgrid principle....65
- How to activate smartgrid mode....66
- How to add a new result window....67
- How to close a result window....67
- How to arrange the result windows....67

7.6.2.1 Background information: the smartgrid principle

SmartGrid display

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

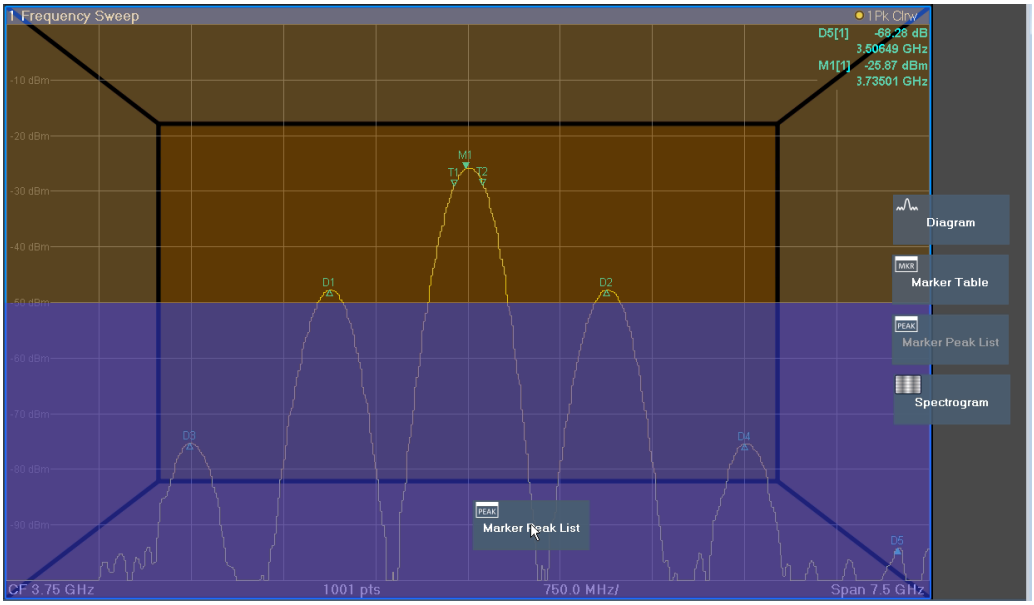


Figure 7-5: Moving a window in SmartGrid mode

The brown area indicates the possible "drop area" for the window, i.e. the area in which the window can be placed. A blue area indicates the (approximate) layout of the window as it would be if the icon were dropped at the current position. The frames indicate the possible destinations of the new window with respect to the existing windows: above/below, right/left or replacement (as illustrated in Figure 7-6). If an existing window would be replaced, the drop area is highlighted in a darker color shade.

Positioning the window

The screen can be divided into up to four rows. Each row can be split into up to four columns, where each row can have a different number of columns. However, rows

always span the entire width of the screen and may not be interrupted by a column. A single row is available as the drop area for the window in the SmartGrid. The row can be split into columns, or a new row can be inserted above or below the existing row (if the maximum of 4 has not yet been reached).

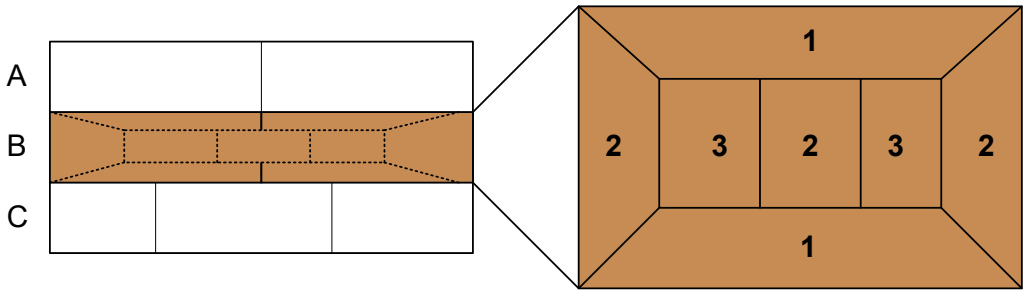


Figure 7-6: SmartGrid window positions

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

SmartGrid functions

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

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

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

7.6.2.2 How to activate smartgrid mode

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

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

-

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

The SmartGrid functions and the evaluation bar are displayed.

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

7.6.2.3 How to add a new result window

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

1. Activate SmartGrid mode.

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

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

3. Drag the required icon from the evaluation bar to the SmartGrid, which is displayed in the diagram area, and drop it at the required position. (See Chapter 7.6.2.5, "How to arrange the result windows", on page 67 for more information on positioning the window).

Remote command:

`LAYout:ADD[:WINDow]?` on page 453 / `LAYout:WINDow<n>:ADD?` on page 458

7.6.2.4 How to close a result window

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

Remote command:

`LAYout:REMove[:WINDow]` on page 456 / `LAYout:WINDow<n>:REMove` on page 459

7.6.2.5 How to arrange the result windows

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

2. Drag the evaluation over the SmartGrid.
   A blue area shows where the window will be placed.
3. Move the window until a suitable area is indicated in blue.
4. Drop the window in the target area.

   The windows are rearranged to the selected layout, and "Delete" and "Move" icons are displayed in each window.
5. To close a window, select the corresponding "Delete" icon.

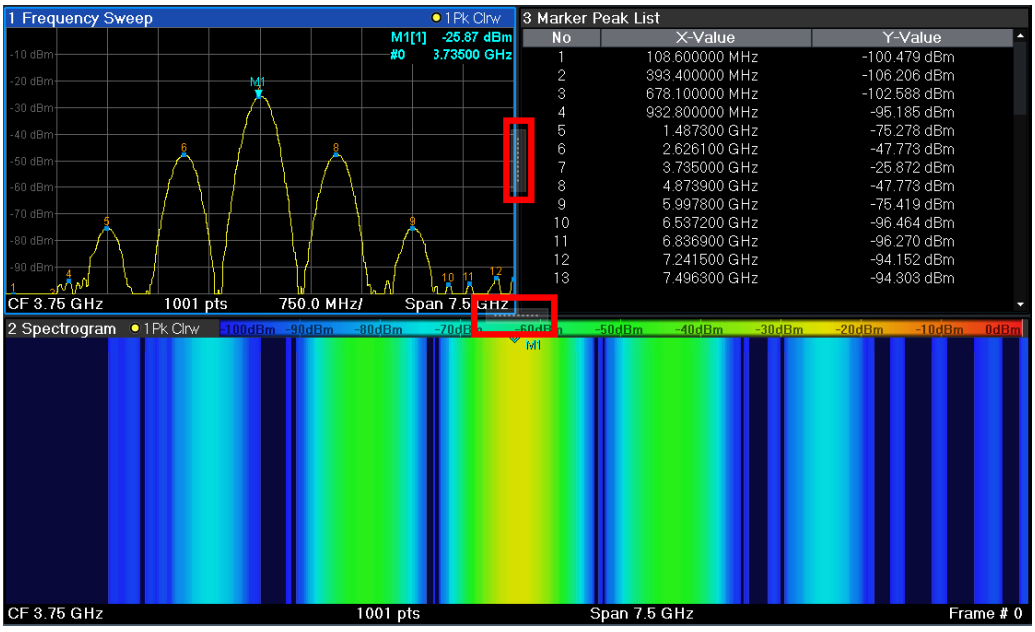
Remote command:

`LAYout:REPLace[:WINDow]` on page 456 / `LAYout:WINDow<n>:REPLace` on page 459

`LAYout:MOVE[:WINDow]` on page 455

7.6.3 Changing the size of windows

Each channel setup tab may contain several windows to evaluate the measurement results using different methods. A "splitter" allows you to change the size of neighboring windows.



The splitters are not available in SmartGrid mode.

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

7.6.4 Switching between a split and maximized window display

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

To switch between a split and a maximized display without having to close and re-open windows, double-tap on the diagram you want to maximize. In maximized display, the currently focused window is maximized. In split display, all active windows are displayed. Another double-tap splits the windows again.

7.6.5 Changing the display

The display can be optimized for your individual needs. The following display functions are available and are described in detail in Chapter 13.2, "Display settings", on page 276 and Chapter 11.1, "Result display configuration", on page 169.

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

7.7 Getting help

If any questions or problems concerning the R&S EPL1000 arise, an extensive online help system is provided on the instrument and can be consulted at any time. The help system is context-sensitive and provides information specifically for the current operation or setting to be performed. In addition, general topics provide an overview on complete tasks or function groups as well as background information.

The online help can be opened at any time by selecting one of the "Help" icons on the toolbar or by pressing the [F1] key on an external or the on-screen keyboard.

To call context-sensitive help

► To display the "Help" dialog box for the currently focused screen element, e.g. a softkey or a setting in an opened dialog box, select the "Help" icon on the toolbar.

The "Help" dialog box "View" tab is displayed. A topic containing information about the focused screen element is displayed.
If no context-specific help topic is available, a more general topic or the "Content" tab is displayed.

For standard Windows dialog boxes (e.g. File Properties, Print dialog etc.), no context-sensitive help is available.

To display a help topic for a screen element not currently focused

1. Select the "Help pointer" icon on the toolbar.

The pointer changes its shape to a "?" and an arrow.

2. Select the screen element to change the focus.

A topic containing information about the selected (now focused) screen element is displayed.

7.8 Remote control

In addition to working with the R&S EPL1000 interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC. Various methods for remote control are supported:

- Connecting the instrument to a (LAN) network
  (See the R&S EPL1000 user manual.)
- Using the Windows Remote Desktop application in a LAN network
- Connecting a PC via the GPIB interface

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

The R&S EPL1000 is delivered with *IECWIN* installed, the auxiliary remote control tool provided free of charge by Rohde & Schwarz.

For details on the IECWIN tool, see the "Network and Remote Control" chapter of the R&S EPL1000 User Manual.

7.8.1 Remote desktop connection

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

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

7.8.2 Connecting a PC via the GPIB interface

You can connect a PC to the R&S EPL1000 via the GPIB interface to send remote commands to control and operate the instrument. You can configure the GPIB address and the ID response string. The GPIB language is set as SCPI by default but can be changed to emulate other instruments.

A GPIB interface is available on the rear panel of the R&S EPL1000 if the option R&S FPL1-B10 is installed.

8 Applications

The R&S EPL1000 allows you to perform all sorts of different analysis tasks on different types of signals, e.g. analog demodulation, I/Q analysis or basic spectrum analysis. Depending on the task or type of signal, a different set of measurement functions and parameters are required. Therefore, the R&S EPL1000 provides various applications - some of which are included in the base unit, others are optional.

The default application when you start the R&S EPL1000 is the Receiver application, with measurement functions to perform EMC measurements.

Channel setups

When you activate an application, a new channel setup is created which determines the measurement settings for that application. The same application can be activated with different measurement settings by creating several channel setups for the same application.

The number of channels that can be configured at the same time depends on the available memory on the instrument.

- Available applications 72
- Starting an Application 73
- Running a sequence of measurements 75

8.1 Available applications

Access: [Mode]

The R&S EPL1000 provides some applications in the base unit while others are available only if the corresponding firmware options are installed.

Each application is described in a separate manual.

Spectrograms

Spectrogram measurements are not a separate application, but rather a trace evaluation method in the R&S EPL1000, thus they are available as an evaluation method in the "Display Config", not by creating a new channel setup. Spectrograms are configured and activated in the "Trace" settings.

Receiver

The Receiver application provides measurement functions to perform EMC measurements.

All functions of the Receiver application are described in this document.

Remote command:

`INST:SEL REC`, see `INSTrument[:SELect]` on page 377

Spectrum
In the Spectrum application the provided functions correspond to those of a conventional spectrum analyzer. The analyzer measures the frequency spectrum of the RF input signal over the selected frequency range with the selected resolution and sweep time. Alternatively, it displays the waveform of the video signal for a fixed frequency.

For details see the spectrum analyzer user manual.

Remote command:
`INST:SEL SAN`, see `INSTrument[:SELect]` on page 377

I/Q analyzer
The I/Q Analyzer application provides measurement and display functions for I/Q data.

For details see the I/Q analyzer user manual.

Remote command:
`INST:SEL IQ`, see `INSTrument[:SELect]` on page 377

AM/FM/PM analog demod
The AM/FM/PM analog demodulation application provides measurement functions for demodulating AM, FM, or PM signals.

This application requires the optional firmware R&S FPL1-K7 to be installed.

For details see the analog demodulation user manual.

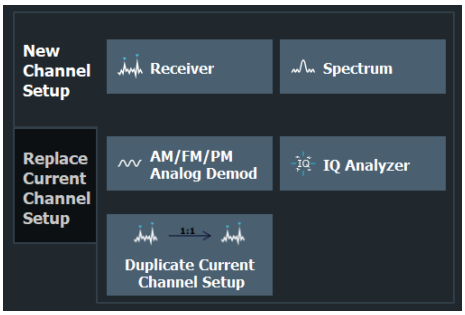
Remote command:
`INST:SEL ADEM`, see `INSTrument[:SELect]` on page 377

8.2 Starting an Application

Access

► [MODE] > "<application>"

The default application that is running when you start the R&S EPL1000 is the Receiver application.



The remote commands required to perform these tasks are described in Chapter 15.4, "Application selection", on page 374.

The measurement channels are labeled with their default name. If that name already exists, a sequential number is added.

You can define a different channel name by selecting (double-click) the corresponding label.

In remote control, the name of the measurement channel can also be changed. For details and an overview of default names see `INSTrument:LIST?` on page 376.

Switching between applications

When you enter a new application, a set of parameters is passed on from the current application to the new one, for example the measurement frequency or the attenuation.

You can also define a fix set of parameters that are synchronized between applications. For more information see Chapter 13.3, "Synchronizing measurement channel configuration", on page 286.

To deactivate a channel, simply close the corresponding tab.

New Channel setup....74
Replace Current Channel setup....74
Duplicate Current Channel....74

New Channel setup
The applications selected on this tab are started in a new measurement channel, i.e. a new tab in the display.

Remote command:
`INSTrument:CREate[:NEW]` on page 374
`INSTrument[:SELect]` on page 377

Replace Current Channel setup
The applications selected on this tab are started in the currently displayed measurement channel, replacing the current application.

Remote command:
`INSTrument:CREate:REPLace` on page 375

Duplicate Current Channel
The currently active channel setup can be duplicated, i.e. a new channel setup of the same type and with the identical measurement settings is started. The name of the new channel setup is the same as the copied channel setup, extended by a consecutive number (e.g. "Spectrum" -> "Spectrum 2").

Remote command:
`INSTrument:CREate:DUPLicate` on page 374

8.3 Running a sequence of measurements

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

- The sequencer concept 75
- Sequencer settings 77
- How to set up the sequencer 77

8.3.1 The sequencer concept

The instrument can only activate one specific channel setup at any time. Thus, only one measurement can be performed at any time, namely the one in the currently active channel setup. However, in order to perform the configured measurements consecutively, a Sequencer function is provided, which changes the channel setup of the instrument as required. If activated, the measurements configured in the currently defined "Channel"s are performed one after the other in the order of the tabs.

For each individual measurement, the sweep count is considered. Thus, each measurement may consist of several sweeps. The currently active measurement is indicated by a ❁ symbol in the tab label.

The result displays of the individual channel setups are updated in the tabs as the measurements are performed. Sequential operation itself is independent of the currently *displayed* tab.

Sequencer modes

Three different Sequencer modes are available:

- **Single Sequence**
  Similar to single sweep mode; each measurement is performed once, until all measurements in all defined "Channel"s have been performed.
- **Continuous Sequence**
  Similar to continuous sweep mode; the measurements in each defined "Channel" are performed one after the other, repeatedly, in the same order, until sequential operation is stopped. This is the default Sequencer mode.
- **Channel-defined Sequence**
  First, a single sequence is performed. Then, only "Channel"s in continuous sweep mode are repeated continuously.

Example: Sequencer procedure

Assume the following active channel setup definition:

Tab name	Application	Sweep mode	Sweep count
Spectrum	Spectrum	Cont. Sweep	5
Spectrum 2	Spectrum	Single Sweep	6
Spectrum 3	Spectrum	Cont. Sweep	2
IQ Analyzer	IQ Analyzer	Single Sweep	7

For **Single Sequence**, the following sweeps will be performed:

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer

For **Continuous Sequence**, the following sweeps will be performed:

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer,

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer,

...

For **Channel-defined Sequence**, the following sweeps will be performed:

5x Spectrum, 6x Spectrum 2, 2 x Spectrum 3, 7x IQ Analyzer,

5x Spectrum, 2 x Spectrum 3,

5x Spectrum, 2 x Spectrum 3,

...

Run Single/Run Cont and Single Sweep/Sweep Continuous keys

While the Sequencer is active, the [Run Single] and [Run Cont] keys control the Sequencer, not individual sweeps. [Run Single] starts the Sequencer in single mode, while [Run Cont] starts the Sequencer in continuous mode.

The "Single Sweep" and "Continuous Sweep"*softkeys* control the sweep mode for the currently selected channel setup only; the sweep mode only has an effect the next time the Sequencer activates that channel setup, and only for a channel-defined sequence. In this case, a channel setup in single sweep mode is swept only once by the Sequencer. A channel setup in continuous sweep mode is swept repeatedly.

8.3.2 Sequencer settings

The "Sequencer" menu is available from the toolbar.

Functions of the Sequencer in the Receiver application described elsewhere:

- "Performing sequenced measurements" on page 80

Sequencer State 77
Sequencer Mode 77

Sequencer State
Activates or deactivates the Sequencer. If activated, sequential operation according to the selected Sequencer mode is started immediately.

Remote command:
`SYSTem:SEQuencer` on page 383
`INITiate:SEQuencer:IMMediate` on page 382
`INITiate:SEQuencer:ABORt` on page 382

Sequencer Mode
Defines how often which measurements are performed. The currently selected mode softkey is highlighted blue. During an active Sequencer process, the selected mode softkey is highlighted orange.

"Single Sequence"
Each measurement is performed once, until all measurements in all active channel setups have been performed.

"Continuous Sequence"
The measurements in each active channel setup are performed one after the other, repeatedly, in the same order, until sequential operation is stopped.
This is the default Sequencer mode.

Remote command:
`INITiate:SEQuencer:MODE` on page 382

8.3.3 How to set up the sequencer

In order to perform the configured measurements consecutively, a Sequencer function is provided.

1. Configure a channel setup for each measurement configuration as required, including the sweep mode.

2. In the toolbar, select the "Sequencer" icon.

   The "Sequencer" menu is displayed.

3. Toggle the "Sequencer" softkey to "On".

   A continuous sequence is started immediately.

4. To change the Sequencer mode and start a new sequence immediately, select the corresponding mode softkey, or press the [Run Single] or [Run Cont] key.

   The measurements configured in the currently active channel setups are performed one after the other in the order of the tabs until the Sequencer is stopped. The result displays in the individual channel setups are updated as the measurements are performed.

To stop the sequencer

► To stop the Sequencer temporarily, press the highlighted [Run Single] or [Run Cont] key (not for a channel-defined sequence). To continue the Sequencer, press the key again.
To stop the Sequencer permanently, select the "Sequencer" icon in the toolbar and toggle the "Sequencer" softkey to "Off".

9 Measurements and result displays

The measurements and result displays available in the Receiver application allow you to analyze the frequency spectrum for possible interferers and the characteristics of those interferers.

- Performing measurements....79
- Bargraph configuration....81
- Test automation....85

9.1 Performing measurements

The R&S EPL1000 provides several approaches to do measurements and acquire the signal data.

Access: [SWEEP]

Functions in the "Sweep" menu described elsewhere:

- "Measurement Time" on page 84
- "Selecting the scan type" on page 97
- "Select Frame" on page 200
- Chapter 9.3.3.1, "Designing a scan table", on page 98

Performing continuous measurements.... 79
Performing single measurements.... 80
Performing sequenced measurements.... 80

Performing continuous measurements

When you measure continuously, the measurement is repeated until you deliberately stop it.

The duration of each individual measurement cycle (for example a single bargraph measurement) depends on the measurement time you have set for the measurement in question. After each measurement cycle, the data of the previous cycle is overwritten and replaced by the new data. Exception: When you are using a max or min hold function, the application keeps the highest or lowest values and replaces old data only if the current data contains a new maximum or minimum.

The R&S EPL1000 allows you to select the measurement mode for the bargraph and the scan separately. When you select a continuous bargraph measurement, IF analysis (including the spectrogram) is also performed continuously. When you select a continuous scan, the scan spectrogram is also updated continuously. Running a continuous final measurement is not possible.

▸ To start a continuous scan, press either the [RUN CONT] key on the front panel or the "Continuous Scan" softkey in the "Sweep" menu.

▸ To start a continuous bargraph measurement, press the "Continuous Bargraph" softkey in the "Sweep" menu.

Note: Pressing the [RUN CONT] key again interrupts the scan (see Chapter 9.3.3.2, "Interrupting a scan", on page 99) and does not stop it.

Continuous measurements are the default measurement mode.

Remote command:
Selection: `INITiate<n>:CONTinuous` on page 379
Initialization: `INITiate<n>[:IMMediate]` on page 381

Performing single measurements
When you run a single measurement, the measurement is performed once and then stopped. The duration of the measurement depends on the measurement time.

Note that a single measurement does not necessarily consist of a *single* measurement. A single measurement can consist of several measurements, whose number you can define with the Scan Count. In that case, the measurement stops when all measurements defined by the scan count or bargraph count are done.

The R&S EPL1000 allows you to select the measurement mode for the bargraph and the scan separately. When you select a single bargraph measurement, IF analysis also stops when the bargraph measurement stops. Note, however, that the time defined for a single bargraph measurement can result in more than one update of the IF analysis trace (including the IF spectrogram). When you select a single scan, the spectrogram update also stops when the scan stops, but it can consist of several new lines in the spectrogram, depending on the configuration.

▸ To start a single scan, press either the [RUN SINGLE] key on the front panel or the "Single Scan" softkey in the "Sweep" menu.

▸ To start a single bargraph measurement, press the "Single Bargraph" softkey in the "Sweep" menu.

Note: Pressing the [RUN SINGLE] key again interrupts the scan (see Chapter 9.3.3.2, "Interrupting a scan", on page 99) and does not stop it.

Note on performing continuous sequenced measurements:

When you are using the sequencer, you can select the measurement mode for each measurement channel that is part of the sequence.

Thus, the "Single Scan" and "Single Bargraph" softkeys only control the measurement mode for the currently selected measurement channel (for a channel defined sequence). In addition, the [RUN SINGLE] key in that case controls the sequencer, not a particular channel.

Remote command:
Selection: `INITiate<n>:CONTinuous` on page 379
Single scan or bargraph: `INITiate<n>[:IMMediate]` on page 381
Single final measurement: `INITiate<n>:FMEasurement` on page 380
Single test sequence: `INITiate<n>:EMITest` on page 380

Performing sequenced measurements
When you run a sequenced measurement, you can combine measurements of several applications into a sequence of measurements. This sequence of measurements is either performed once (single sequence), indefinitely (continuous sequence) or a mixture of both (channel defined sequence).

For more information regarding the general functionality of the sequencer, see Chapter 8.3, "Running a sequence of measurements", on page 75.

In the receiver application, you can select whether to:

- Run a bargraph measurement each time the receiver application has its turn.
- Run a scan each time the receiver application has its turn.
- Skip measurements in the receiver application.

When you include the bargraph measurement in the sequence, IF analysis (including the spectrogram) is also done. When you include the scan in the sequence, spectrogram data is also collected (and a peak search and a final measurement are performed when you have defined a test sequence that covers these measurements).

Note the following effects of performing a scan in a sequence of measurements.

- Stopping a scan or final measurement aborts that measurement and resumes the measurement sequence in the next channel.
- Interrupting a scan is not possible.
- Interactive final measurements are not available.

Tip: Performing a *continuous* sequence with a *single* (bargraph or scan) measurement resets max hold values every time the sequencer starts a measurement in that receiver channel. To keep max hold values, use continuous measurements in the channel.

▸ To select the measurement to include in a sequence, select [SWEEP] > "Sequencer" until the required measurement is highlighted blue.

If you want to include a bargraph measurement *and* a scan in the sequence of measurements, you have to use two measurement channels.

Remote command:
See Chapter 15.5, "Measurements and result displays", on page 377.

9.2 Bargraph configuration

Access: [MEAS CONFIG] > "Bargraph Config"

Alternatively, you can access the dialog box by clicking on the bargraph once.

The bargraph result display is designed for measurements on a single frequency. It is a basic result display that shows the signal level at a particular frequency numerically and graphically as a bargraph. The length of the bar depends on the signal level at the current receiver frequency. If necessary, you can control the way the signal is evaluated by selecting different detectors.

Figure 9-1: Overview of the bargraph result display

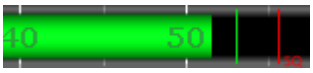
1 = detectors
2 = measured levels (numerically)
3 = measured levels (graphically)

The results in the bargraph are shown as soon as you enter the receiver application (for the frequency that is currently selected) and are updated continuously. The unit of the displayed power level is variable and depends on the unit you have set (by default, it is dBµV).

The bargraph range is always 100 dB, the minimum and maximum levels that are displayed are automatically adjusted, depending on the measurement configuration. When auto ranging has been turned off, the range depends on settings like the attenuation or gain. When auto ranging has been turned on, the range is adjusted to the signal level.

The R&S EPL1000 supports the simultaneous use of up to four different detectors in the bargraph result display. If you select an additional detector, the R&S EPL1000 adds the corresponding number of bargraphs to the result display. This way to display the signal levels provides an easy way to compare the signal level with different weighting factors.

Meaning of small vertical lines in the bargraph



Depending on the configuration, the following small vertical lines can appear in the bargraph.

- A small vertical line with the same color as the bargraph shows the highest value that has been measured on the currently selected frequency.
- A small red vertical line with an "SQ" label shows the squelch level that you have defined for audio output over headphones.

Max hold bargraph

The max hold bargraph information, when it has been turned on, shows the highest signal level that has been measured since the measurement has begun. The max hold value remains effective, even if you change any receiver settings (for example the frequency or the attenuation) and is only reset when you deliberately do so. One max hold value is displayed for each of the active detectors.

When you turn on the max hold information, the diagram information is expanded by the peak level that has been measured since the max hold has been last reset (as a numerical value and including the frequency that value has been measured on). If a new peak level has been detected, the max hold values are updated accordingly.

The live results and the highest signal level for a particular frequency are still shown in the bargraph diagram as usual.

Min peak detector levels

Note that for the min peak detector, the peak level is not the highest level, but the lowest level.

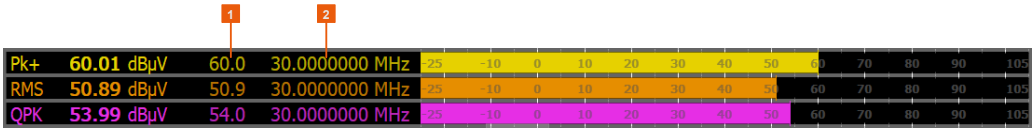


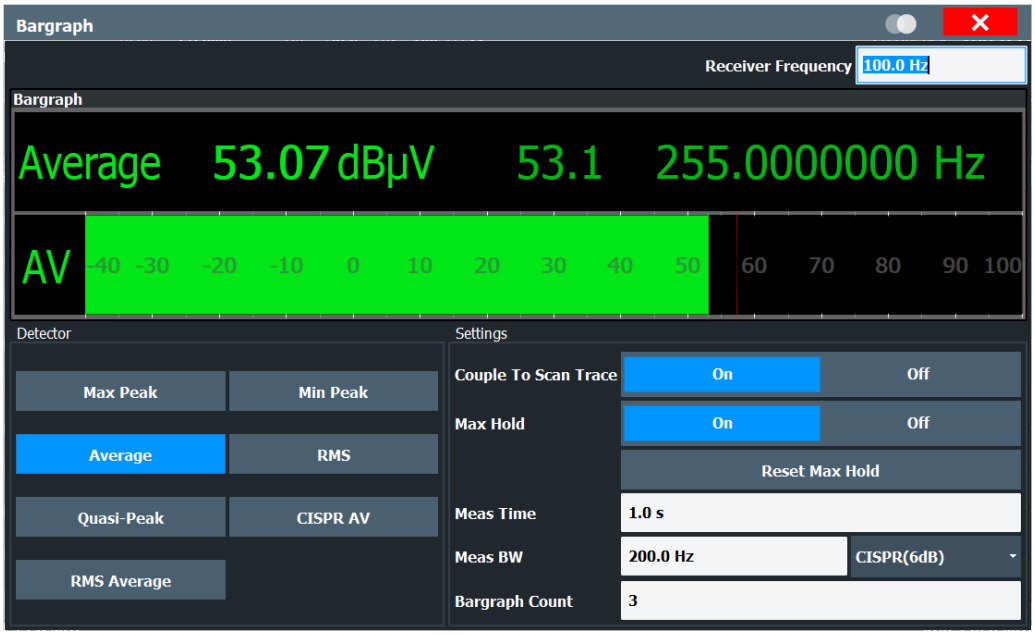
Figure 9-2: Screen layout of the bargraph result display with the max hold information

1 = maximum levels
2 = frequency on which the maximum level has been measured; note that the minimum and RMS peaks have been measured at frequency different to the current receiver frequency

The "Bargraph" dialog box contains a preview of the measurement and all settings that you can apply to the bargraph.

Bargraph configuration

When you are performing a scan that is not based on a scan table, the R&S EPL1000 applies the bargraph settings (detector, measurement time etc.) to the scan.



The remote commands required to configure the bargraph are described in Chapter 15.5.4, "Bargraph configuration", on page 389.

Functions to configure the bargraph described elsewhere:

- "Receiver Frequency" on page 159
- "Detector" on page 116

Couple to Scan Trace....84
Bargraph Max Hold....84
Measurement Time....84
Measurement Bandwidth....85
Filter Type....85

Couple to Scan Trace
Couples or decouples the bargraph detector and scan detectors.

Turning on the feature has the following effects.

- Turns on a scan detector for every active bargraph.
  If you add a new bargraph detector, the corresponding scan trace is automatically turned on.
- Matches the scan trace number to the number of the bargraph.

If you couple bargraph and scan trace, the R&S EPL1000 replaces the detectors of all other active scan traces with the new detector type.

Remote command:
`DISPlay:BARGraph:TCOupling[:STATe]` on page 390

Bargraph Max Hold
Turns the display of the highest level that has been measured on any frequency since the last "Max Hold Reset" on and off, regardless of the receiver settings.

When you turn on the max hold information, the R&S EPL1000 shows the highest level that has been measured for each active bargraph (detector), including the frequency where it was measured.

Note: The little vertical line displayed in the bargraph does not represent the max hold value. Instead it shows the highest level that has been measured for the current receiver frequency.

You can reset the max hold bargraph with the "Reset Max Hold" button. After you have reset the max hold bargraph, it starts collecting maximum values again.

More information

Remote command:
Bargraph state: `DISPlay:BARGraph:PHOLd[:STATe]` on page 390
Bargraph reset: `DISPlay:BARGraph:PHOLd:RESet` on page 389

Measurement Time
Defines the measurement time used to analyze the signal.

You can define a different measurement time for the bargraph, each scan range defined in the scan table and the final measurement. If you perform a scan that is not based on a scan table (Current parameters), the measurement time for the scan is the same as for the bargraph.

Tip: Make sure to select a measurement time that is appropriate for the analyzed signal and that allows the various filters and detectors in the signal path to settle.

Note that the measurement time for IF analysis is calculated automatically based on the measurement time of the bargraph.

Remote command:
Bargraph: `[SENSe:]SWEep:TIME` on page 391
Scan table: `[SENSe:]SCAN<sr>:TIME` on page 398
Final measurement: `[SENSe:]FMEasurement:TIME` on page 410

Measurement Bandwidth
Defines the measurement bandwidth (or resolution bandwidth) used for the measurement.

You can define a different bandwidth for the bargraph and each scan range defined in the scan table. The R&S EPL1000 displays an exclamation mark if the selected measurement bandwidth is not compatible to the bandwidth required by CISPR for the corresponding frequency range.

If you perform a scan that is not based on a scan table, the bandwidth for the scan is the same as for the bargraph.

The final measurement uses the bandwidths defined in the scan table, or, if the scan is not based on a scan table (Current parameters), the bandwidth of the bargraph.

The R&S EPL1000 supports a selected set of resolution bandwidths. If you enter a number that is not supported, the R&S EPL1000 rounds the value up to next available bandwidth.

More information

Remote command:
Bargraph: `[SENSe:]BANDwidth[:RESolution][:VALue]` on page 445
Scan table: `[SENSe:]SCAN<sr>:BANDwidth:RESolution` on page 394

Filter Type
Selects the type of resolution filter used in the measurement.

The available resolution bandwidths depend on the filter selection.

You can select from the following filter types.

- **Normal (3 dB)**
  Gaussian filter with a 3 dB bandwidth.
- **Gauss (6 dB)**
  Gaussian filter with a 6 bandwidth. 6 dB bandwidths that comply with CISPR and MIL standards are available.
- **CISPR (6 dB)**
  Gaussian filter with a 6 bandwidth. 6 dB bandwidths that comply with CISPR standards are available.
- **MIL (6 dB)**
  Gaussian filter with a 6 bandwidth. 6 dB bandwidths that comply with military standards are available.

6 dB bandwidths correspond approximately to the pulse bandwidth.

3 dB bandwidths correspond approximately to the noise bandwidth.

More information

Remote command:
`[SENSe:]BANDwidth[:RESolution]:TYPE` on page 446

9.3 Test automation

Access: "Overview" > "Test Automation"

The "Test Automation" dialog box is a tool to configure and perform measurements in the Receiver application. The dialog box contains a tab for each typical stage in an EMC measurement (scan, peak search and final measurement). The dialog box also summarizes the measurement results for these stages in separate tabs.

- Background information 86
- Selecting a test sequence 95
- Performing a scan 98
- Performing a peak search 105
- Performing final measurements 113
- Configuring line impedance stabilization networks (LISN) 119

9.3.1 Background information

The following topics contains information that can be useful to configure automated test sequences.

- Selecting the measurement bandwidth 86
- Calculating the number of measurement points 87
- Line impedance stabilization network (LISN) control 89
- Overview of receiver measurements 91

9.3.1.1 Selecting the measurement bandwidth

The measurement bandwidth corresponds to the bandwidth of the resolution filter. The RF signal is evaluated and displayed according to the bandpass characteristics of the resolution filter.

The receiver application supports the following types of resolution filter.

- Filters with a 3 dB bandwidth
  The R&S EPL1000 provides bandwidths with a stepsize of 1-2-3-5-10-.... For details, refer to the data sheet.
- Filters with a 6 dB bandwidth
  The 6 dB bandwidths are designed and required for receiver tests and measurements. The R&S EPL1000 provides bandwidths that comply to commercial and military standards. For details, refer to the data sheet.

Note that the available bandwidth is limited by the current receiver frequency. The measurement bandwidth must be less than or equal to half of the current receiver frequency:

$BW \leq f_{in} / 2$

The resolution filters are implemented as digital Gaussian bandpass filters. Concerning the attenuation characteristic, the filters behave like analog filters, but their measurement speed is much higher than the measurement speed of comparable analog filters. This is because the transient response can be compensated because the filters have an accurately defined behavior.

The highest sensitivity is obtained at the smallest bandwidth. If the bandwidth is increased, the reduction in sensitivity is proportional to the change in bandwidth.

Increasing the bandwidth by a factor of 3 increases the displayed noise by approx. 5 dB (4.77 dB precisely). If the bandwidth is increased by a factor of 10, the displayed noise increases by a factor of 10 (= 10 dB).

The higher spectral resolution with smaller bandwidths leads to longer measurement times at each frequency, because the measurement time has to allow the resolution filters to settle during a sweep at all signal levels and frequencies to be displayed.

For large measurement bandwidths, signal parts that are very far away (for example from a different signal) are considered in the measurement and distort the results. The displayed noise increases.

For small measurement bandwidths, the measurement time increases.

Bandwidths and detectors

If you use the Quasipeak, CISPR Average or RMS Average detector, the R&S EPL1000 by default couples the resolution bandwidth to the receiver frequency.

If you need a different bandwidth, you can decouple the bandwidth from the frequency. When decoupled, you can select any of the supported CISPR bandwidths.

9.3.1.2 Calculating the number of measurement points

The number of measurement points (or sweep points in some applications) determines the amount of data that is captured in one measurement. At each measurement point, the R&S EPL1000 collects one set of data, which contains, for example, the signal level at a given frequency.

The effect of the number of measurement points on the measurement is that its number defines how much of the entire span is covered by a single data point.

Example:

Consider the following settings:

- Start frequency: 100 MHz
- Stop frequency: 900 MHz
- Number of measurement points: 1001

With said settings, each measurement point would cover a frequency range of about 800 kHz.

By increasing the number of measurement points, you can increase the reliability of the individual data points and thus the accuracy of the analyzed results. All of these data points are stored on the instrument, occupying a large amount of memory, and each measurement point increases the overall measurement time.

For details on how the number of measurement points affect the trace results on the screen, see Chapter 11.3.1.1, "Working with trace detectors", on page 178.

Measurement points in receiver application

In the receiver application, the number of measurement points considered in a scan is determined by the frequency range and the selected frequency step size: the

R&S EPL1000 runs a measurement every x Hz, so the actual number of measurement points depends on frequency range you are scanning. The maximum number of measurement points that a scan supports is 10,000,001 (this is only possible with two or less active traces).

The frequency step size depends on the frequency step mode and the type of scan you are using.

- **Scans without a scan table:**
  The frequency step size depends on the measurement bandwidth.

Example:

Consider the following scan configuration:

- Start frequency: 150 kHz
- Stop frequency: 1 MHz
- Measurement bandwidth: 1 kHz

The measurement bandwidth of 1 kHz results in a frequency step size of 400 Hz. In that case, the number of measurement points in this example would be about 2100.

- **Scans with a scan table:**
  The frequency step size is either determined automatically (in which case it depends on the measurement bandwidth) or manually (in which case you define the required step size)

Example:

Consider the following scan table settings for a given scan range:

- Start frequency: 150 kHz
- Stop frequency: 30 MHz
- Step size mode: linear
- Step size: 4 kHz

With said settings, the R&S EPL1000 collects a dataset every 4 kHz, so the number of measurement points in this example would be about 7500.

Measurement points in spectrum application

In the spectrum application, a measurement point is called a sweep point. Instead of determining the number of measurement points based on other settings, you can select the number of measurement points manually. By default, the R&S EPL1000 measures 1001 points in one measurement.

For spectrum measurements, you can also define a sweep count. The sweep count defines the number of measurements a single sweep is made up out of. If the sweep count is 0 or 1, the R&S EPL1000 runs a single measurement from start to stop frequency. If the sweep count is greater than 1, the R&S EPL1000 repeats the measurement from start to stop frequency a corresponding number of times.

For more information on the effects of the sweep count on the measurement results, see Chapter 11.3.1.2, "Analyzing several traces - trace mode", on page 183.

9.3.1.3 Line impedance stabilization network (LISN) control

When you do measurements on power lines, a Line Impedance Stabilization Network (LISN) allows you to determine the interference caused by power supplies and cables. The R&S EPL1000 allows you to connect and control selected LISNs in such a test setup and considers the characteristics of the LISN during measurements. In addition to selecting a particular LISN Type, you can also select the Phase that you want to test for interference.

Control of a LISN and its phases is possible during scans and during the final measurement. You can control all available LISN phases as required and independently from each other.

If you select more than one phase, the R&S EPL1000 measures all phase combinations and determines the maximum value.

Table 9-1: Supported networks and controllable phases

Network	Controllable phases
Two-line V-networks	
R&S ESH3-Z5	N, L1
R&S ENV216	N, L1
R&S AMN6500	N, L1
Four-line V-networks	
R&S ESH2-Z5	N, L1, L2, L3
R&S ENV4200	N, L1, L2, L3
R&S ENV432	N, L1, L2, L3

When you are using the R&S ENV216 network, you can protect the input with a 150 kHz high-pass filter.

Connecting a LISN

A LISN is connected to the R&S EPL1000 via its user port. To connect the LISN to the R&S EPL1000, a control line and an adapter are required.

The control line (or cable) controls which phase of the LISN is to be tested and outputs the information to the user port. Control lines for the supported LISNs are available as accessories from Rohde & Schwarz.

Connecting the control line to the user port of the R&S EPL1000 also requires adapter R&S EZ-27 (order no. 1142.8271.02).

When you connect the LISN, make sure to use the correct pins on both sides of the test setup. Otherwise, the automatic phase control of the LISN might not work. The following illustrations show the correct pin assignment.

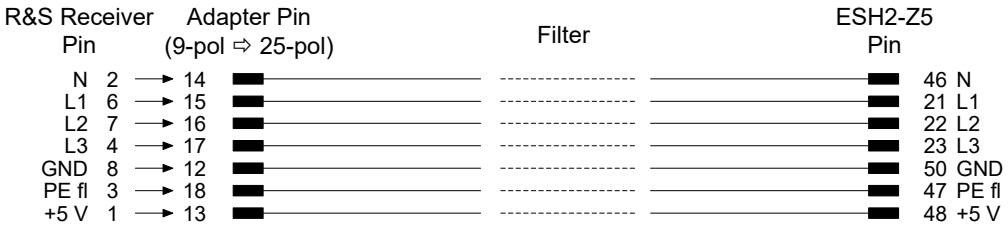


Figure 9-3: Connection from R&S EPL1000 to R&S ESH2-Z5

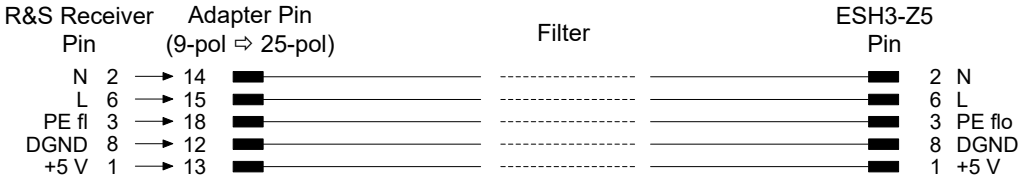


Figure 9-4: Connection from R&S EPL1000 to R&S ESH3-Z5

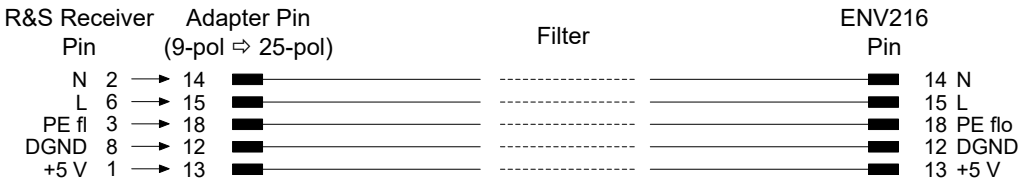


Figure 9-5: Connection from R&S EPL1000 to R&S ENV216 or R&S AMN6500

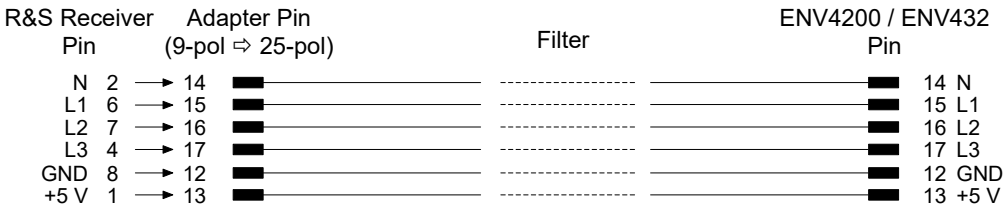


Figure 9-6: Connection from R&S EPL1000 to R&S ENV4200 or R&S ENV432

To control the phase selection and PE simulating network of the V-Networks R&S ESH2-Z5, R&S ESH3-Z5, R&S ENV4200 or R&S ENV432, the +5 V supply voltage and some control lines have to be routed through the wall of the shielded room.

You can also use a direct connection without a filter, e.g. when you use the R&S EPL1000 in a shielded room. In that case, you can use the following cables.

- R&S ESH2-Z5: EZ-5, EZ-13, EZ14
- R&S ESH3-Z5: EZ-6, EZ-14
- R&S ENV216 or R&S AMN6500: EZ14
- R&S ENV4200 or R&S ENV432: EZ-14, EZ-21

9.3.1.4 Overview of receiver measurements

The Receiver application provides several measurements and evaluation methods that are typical for EMC measurements.

- Scan 91
- Peak search 92
- Final measurement 94
- IF analysis 94

Scan

During a scan, the R&S EPL1000 measures the signal strength of discrete frequencies over a custom frequency range. The frequency step size and measurement time for each frequency are arbitrary.

The scan parameters are either based on the current receiver settings or on the settings defined in a Scan Table. You can take transducer factors or sets as well as limit lines into account. They can be defined and displayed separately, but are not included in the scan data record.

The scanned frequency range is defined by the start and stop frequency set independently of the scan table. A scan table can thus be defined for each measurement task.

You can either perform a continuous scan or a single scan. A single scan stops when it reaches the stop frequency. A continuous scan repeats the scan until you interrupt or abort it deliberately.

The maximal number of measured frequencies is limited to 4.000.000 per detector. The data can be stored for postprocessing. If the scan subranges are defined so that more than the possible values would be measured, a respective message is output upon the scan start. Afterwards the scan is performed up to the maximum value.

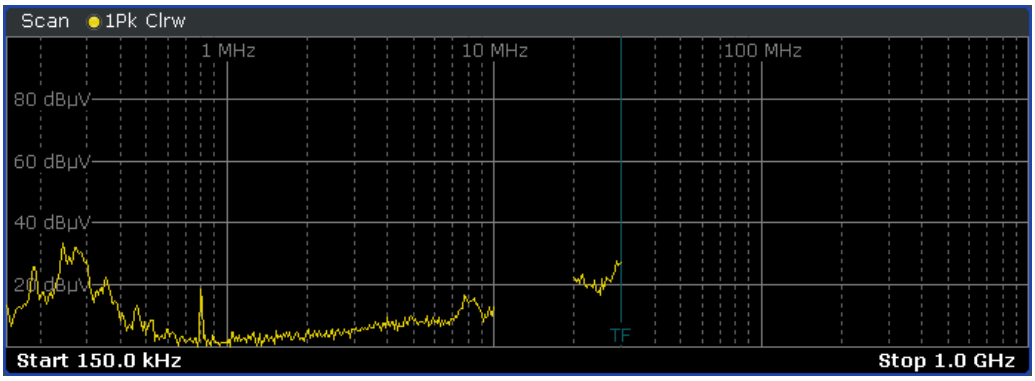


Figure 9-7: Scan on selected frequencies showing gaps in the trace

The R&S EPL1000 offers the following scan methods:

- **Stepped scan in the frequency domain**
  In stepped scan mode, step width and frequency spacing (step mode) can be selected.
- **Time domain scan in the frequency domain**

In time domain measurement systems, the spectrum at the receiver input is measured in parallel by using fast fourier transform (FFT) of frequency sections.

ADC calibration required

ADC calibration can become necessary if you have started a time domain scan during the warm-up period of the R&S EPL1000. If the message "ADC calibration required" appears, stop and restart the scan.

Stepped scans in the frequency domain

In stepped scan mode, the step width and the frequency spacing (step mode) can be selected. Linear, logarithmic or automatic frequency spacing is available. In automatic mode, the step width is selected so that it is always smaller than the bandwidth.

Receiver measurements may involve much time. Time saving procedures are explained in "Peak search" on page 92. They reduce the total measurement time by reducing the number of measurements to a minimum.

Nevertheless, this time is still very long, often in the order of hours, especially for the CISPR radiated emissions tests. A way out of this situation can be time-domain measurements.

Peak search

The Peak Search function of the R&S EPL1000 can be used to create a peak list containing only the measurement values of high interferers. In a fast prescan the signal is measured against a limit line, and the level values above the set margin are written into the peak list. The resulting peak list then is used for the final measurement where only the frequencies in the peak list are measured with the required detector.

If the scan uses the detector stipulated by the specifications, the peak list already provides the final measurement data.

Data reduction using the peak list

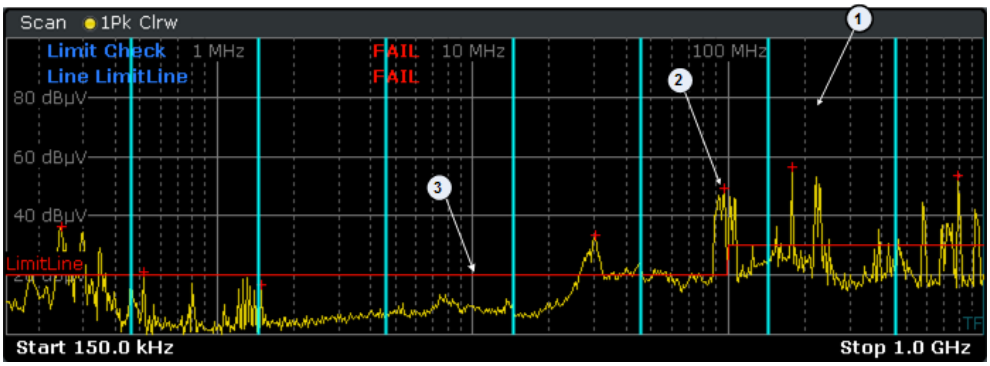
EMI measurements may take some time because the time constants of up to 160 ms prescribed by the standard for the quasipeak weighting lead to long measurement times per each value. In addition, some standards stipulate procedures for finding local EMI maxima such as shifting the absorbing clamp, variation of the test antenna height and rotating the DUT. Measuring with quasipeak weighting at each frequency and for each setting of the test configuration would lead to unacceptably long measurement times. For this reason, a method is used which reduces the time-consuming measurements to a minimum with an optimum reliability of detection.

Receiver measurements may take some time because of some specialties in the context of those measurements like variations of the test antenna or high time constants required by detectors or things like that. Because of this, the Receiver provides tools that reduce the efforts to a minimum while still providing an optimum measurement reliability.

The interference spectrum is first pre-analyzed in a fast prescan to optimize the duration of the measurement. Data reduction follows so that the time-consuming final measurement is performed only at critical frequencies.

Several data reduction methods are used:

- Generating subrange maxima (search method "Subranges").
  The whole frequency range is divided into equidistant frequency subranges. A selectable number of subrange maxima are determined for each subrange. In the final measurement, the interference spectrum is further analyzed at frequencies with the highest interference level of a frequency subrange.



1 = Subrange
2 = Subrange maximum
3 = Limit line

- Determination of a specific number of peak values relative to the limit lines with the level values being independent of their frequency spectral distribution (search method "Peaks").
  Determining the level maxima irrespective of their distribution in the frequency spectrum is suitable for measurement regulations that demand determination of the relatively highest level irrespective of the distribution in the measured frequency range, e.g. FCC.

If the prescan is performed in parallel with several detectors, typically Peak and Average, the maxima are determined separately for the two detectors so that the distribution of narrowband and wideband sources of interference can be taken into account.

For example, the frequency of the maximum determined with the average detector can be used for the final measurement performed with the CISPR Avg detector and the frequency found in the prescan carried out with the peak detector is taken for the final measurement using the quasipeak detector.

Consideration of the limit lines ensures that the final measurement is not performed at frequencies at which the inference level is far below the limit value. A margin below the limit line can be defined (in dB). Peak values measured in the margin area are also considered in the final measurement. The margin is valid for all limit lines. Each limit line is allocated to a trace, i.e. different limit lines are taken for the different detectors.

If no limit lines are activated, the measurement procedure is as if all measured values would exceed the limit line.

Data reduction by editing the peak list

As an alternative method, it is possible to preset a list of frequencies at which the final measurements are performed. A typical application is, for example, the statistical analysis of several units.

The peak list can be either edited manually or can be filled with desired values by adopting the marker values.

Final measurement

A final measurement is performed after data reduction, thus reducing the overall measurement time.

The final measurement analyzes only the data that still remains after the preliminary measurement stages, in other words those frequencies that have been collected in the peak list. Detectors defined for the final measurement replace those that have been used during preliminary measurements.

Because the peak list contains a manageable set of frequencies only, the final measurement is also usable in combination with a configuration that requires long measurement times. It is then still possible to perform the measurement in a reasonable time frame.

During the final measurement, the R&S EPL1000 performs a measurement on each frequency in the peak list. When done, it updates the preliminary results in the peak list with those found during the final measurement.

Automatic vs interactive final measurements

The R&S EPL1000 provides two methods to perform a final measurement: an automatic and interactive final measurement.

An automatic final measurement measures all frequencies in the peak list automatically. The measurement can be interrupted or aborted, or the measurement mode can be switched to interactive. Measurement settings can not be changed. The advantage is that the measurement runs on its own.

Control of the final measurement is possible in interactive final measurement mode.

In interactive final measurement mode, the R&S EPL1000 stops on each frequency of the peak list. If required, the frequency can be fine tuned, e.g. if the interferer has shifted. For fine tuning, the bargraph display can be used to find the new peak value. The level measurement is performed only after initialization by the user.

It is possible to start with an automatic measurement and later change into interactive mode. Likewise, it is possible to start measuring in interactive mode and later change into automatic mode.

IF analysis

The IF spectrum analysis is a very comfortable means for exact frequency tuning of the receiver and for identification of signals and of their bandwidth.

In IF spectrum analysis, the spectrum of the RF input signal is displayed in the vicinity of the receiver frequency. The center frequency of the displayed spectrum is always the current receiver frequency.

The IF analysis provides a fast overview of the assignment of the spectrum adjacent to the measuring channel proper, or, with a large resolution bandwidth, the spectral distribution of a modulated signal in the channel. Interference of the received useful signal can also be detected quickly, whether it is CW interference appearing as unmodulated

carrier or pulse-like interference which is represented in the form of narrow horizontal lines on the screen.

The accuracy of the frequency axis corresponds to the reference used (internal or external).

In contrast to normal spectrum analyzer operation, the measured values are determined using FFT from samples recorded from the A/D-converter. Thus the receiver stays tuned to the center frequency. It may continue to measure with the selected measurement time and display the signal level with the bargraph.

(For example, the quasipeak level measured with one second measurement time may be displayed in the upper half of the display while in the lower half the spectrum may be refreshed every few milliseconds.)

The measurement time of the bargraph may be longer than the measurement time of the IF analysis. If the measurement time of the bargraph is set to a smaller value then the measurement time of the IF analysis, the bargraph will as often be refreshed as the display of the IF analysis.

The level display of the IF analysis is unweighted. It is independent of the selected detector for the bargraph measurement, e.g. average or quasi peak. A maximum of three traces can be displayed in parallel. The display mode "Clear / Write", "Max Hold", "Min Hold", "Average", "View" or "Blank" may be selected independent for each trace.

The displayed level values do have the full accuracy of the instrument only at the center frequency. At all other frequencies, the level is typically lower due to the frequency response of the IF filter and the preselector.

IF Analysis always applies resolution filters with a 6 dB bandwidth, while filters with a 3 dB bandwidth are not supported.

9.3.2 Selecting a test sequence

Access: "Overview" > "Test Automation" > "Overview"

The first tab of the "Test Automation" dialog box ("Overview") represents the measurement stages in an interactive diagram. You can add or remove certain stages from the measurement as required: you can, for example, configure a measurement that consists of a scan and a peak search, but no final measurement.

Possible combinations are:

- Perform a scan only.
- Perform a scan with a subsequent peak search and creation of the peak list.
  (Remote command: `CALCulate<n>:PEAKsearch:AUTO` on page 400)
- Perform a scan with a subsequent peak search and a final measurement including the creation of a final peak list.
  (Remote command: `CALCulate<n>:FMEasurement[:AUTO]` on page 408)

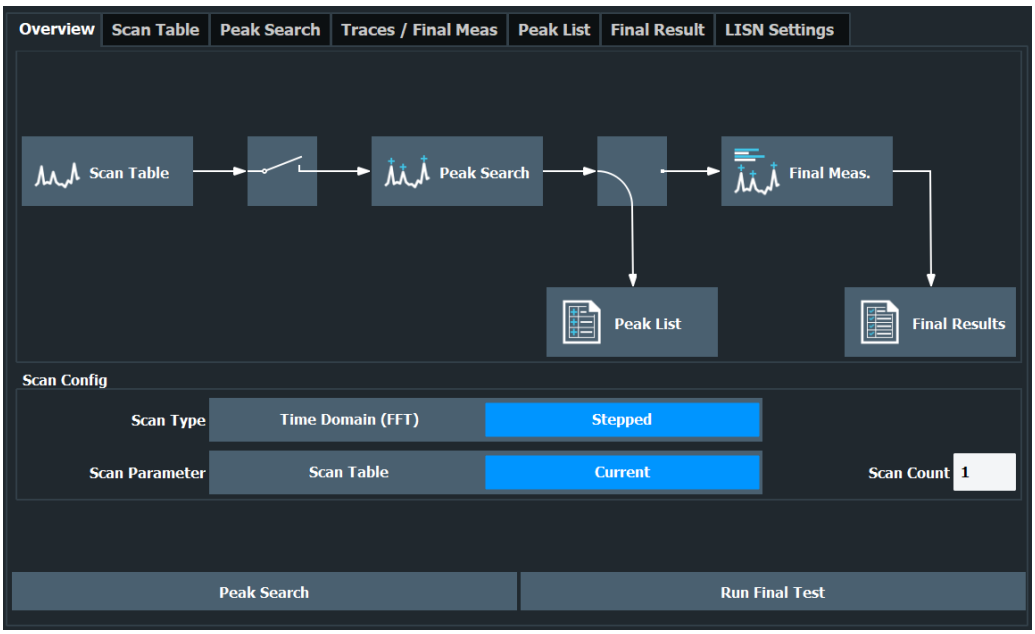


Figure 9-8: Overview of the test automation process

For more information on the individual measurement stages, see:

- **Scan**
  "Scan" on page 91
  Chapter 9.3.3, "Performing a scan", on page 98
- **Peak search**
  "Peak search" on page 92
  Chapter 9.3.4, "Performing a peak search", on page 105
- **Final measurement**
  "Final measurement" on page 94
  Chapter 9.3.5, "Performing final measurements", on page 113

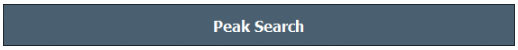
Starting a complete automated test sequence

► Press the [RUN SINGLE] key.

The R&S EPL1000 starts the test sequence. It stops the test sequence at the point you have defined (either after the scan, the peak search or the final measurement).
Note: If you start the test sequence with the [RUN CONT] key, the R&S EPL1000 starts a continuous scan. The test sequence is resumed only when you stop the scan deliberately.

Starting an independent peak search

► Press the "Peak Search" button.

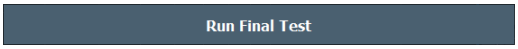


The R&S EPL1000 starts a peak search on the current trace(s) of the scan diagram. When it is done, it opens the peak list.

If you have not yet performed a scan, the peak search button is unavailable.

Starting an independent final measurement

► Press the "Run Final Test" button.



The R&S EPL1000 starts a final measurement based on the contents of the peak list. When it is done, it opens the final peak list.
If you have not yet performed a scan and peak search, the final measurement button is unavailable.

Selecting the scan type 97
Scan Count 97
Scan Parameter 97

Selecting the scan type
The R&S EPL1000 provides several scan types. Depending on the selected scan type, the R&S EPL1000 applies different methods to evaluate the applied signal.

The following scan types are supported.

- **Time Domain (FFT)**
  Simultaneous measurements based on FFT operations on all individual frequencies in the frequency range you have defined. The frequency step size is variable because it depends on the selected measurement bandwidth.
  (➞ "Scan Type" > "TDomain")
- **Stepped**
  Subsequent measurements on each individual frequency defined by the frequency range and the frequency step size.
  (➞ "Scan Type" > "Stepped")

Remote command:
`[SENSe:]FREQuency:MODE` on page 391

Scan Count
Defines the number of scans to be performed in a single measurement. The displayed trace represents an average over the scan count.

When you measure continuously, the R&S EPL1000 calculates a moving average over the scan count.

The scan count is always the same as the "Bargraph Count" (and vice versa). The "Bargraph Count" defines the number of bargraph measurements performed in a single sweep.

Note that a scan count = 0 is not possible. The same applies to the bargraph count.

Remote command:
`[SENSe:]SWEep:COUNt` on page 398

Scan Parameter
Turns the scan table on and off.

"Scan Table" The R&S EPL1000 performs scans based on the configuration defined in the scan table.

"Current" The R&S EPL1000 performs scans on the general receiver configuration. The scan table becomes unavailable.

Remote command:
not supported

9.3.3 Performing a scan

- Designing a scan table....98
- Interrupting a scan....99
- Configuring the scan table....100

9.3.3.1 Designing a scan table

The scan table is a tool that reduces the effort of performing a scan. It divides a given frequency range into smaller portions.

In that way you are able to:

- keep the measurement times as low as possible by creating several frequency ranges and configuring each one most effectively
- configure some frequency ranges differently than others if the test scenario requires so and still run one measurement only
- skip parts of the spectrum that are of no interest for the measurement.

If you do not use the scan table (Current parameters), the R&S EPL1000 uses the current instrument settings for the scan.

You can define up to 100 scan subranges within the complete scan range. The size of each subrange is arbitrary, depending on the measurement requirements. Just make sure that the ranges are within the overall scan range defined by the general start and stop frequencies. If the scan table defines a frequency range greater than the scan range, frequencies outside the scan range are not considered in the measurement.

To avoid situations like this, you can align the start and stop frequency of the scan to the frequency range defined by the scan ranges (see "Adjusting the frequency axis" on page 101).

Example:

In the picture below, the frequency range highlighted in red is covered by the scan table, but not by the overall scan range. Thus, it would not be considered in the scan.

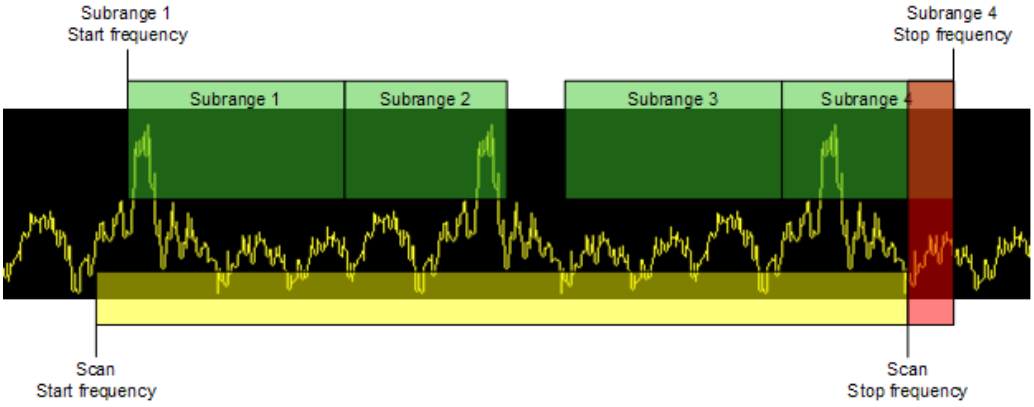


Figure 9-9: Scan range vs subranges of a scan

There may be gaps between the stop frequency of one range and the start frequency of the next, for example if parts of the spectrum are not necessary to be tested. Gaps between ranges are not considered in the scan.

9.3.3.2 Interrupting a scan

Access: [RUN SGL] / [RUN CONT] > "Hold Scan"

The R&S EPL1000 allows you to hold a scan any time with the "Hold Scan" feature. If you hold it, the scan is interrupted immediately. When held, you can change settings that have a direct effect on the scan, for example the frequency.

When you are finished changing the configuration, you have several options on how to proceed.

- Continue at the receiver frequency
  Resumes the scan at the receiver frequency the R&S EPL1000 is currently tuned to. This is any frequency that is equal to or smaller than the hold frequency.
  If you do not change the frequency, resuming the scan at the receiver frequency is the same as resuming the scan at the hold frequency.
- Continue at the hold frequency
  Resumes the scan at the frequency it has been interrupted at.
  For example, when you interrupt the scan at 20 MHz, the scan would continue at that frequency.
- Stop the scan
  Aborts the scan altogether.

Changing channels while a scan is running

When you change the measurement channel while a scan is running (for example switch to a spectrum channel), the R&S EPL1000 holds the scan. When you change back to the receiver channel in which the scan is running, you can resume the scan from the hold frequency.

9.3.3.3 Configuring the scan table

Access: "Overview" > "Test Automation" > "Scan Table"

By default, the scan table already contains one scan range with a typical configuration for these frequency ranges.

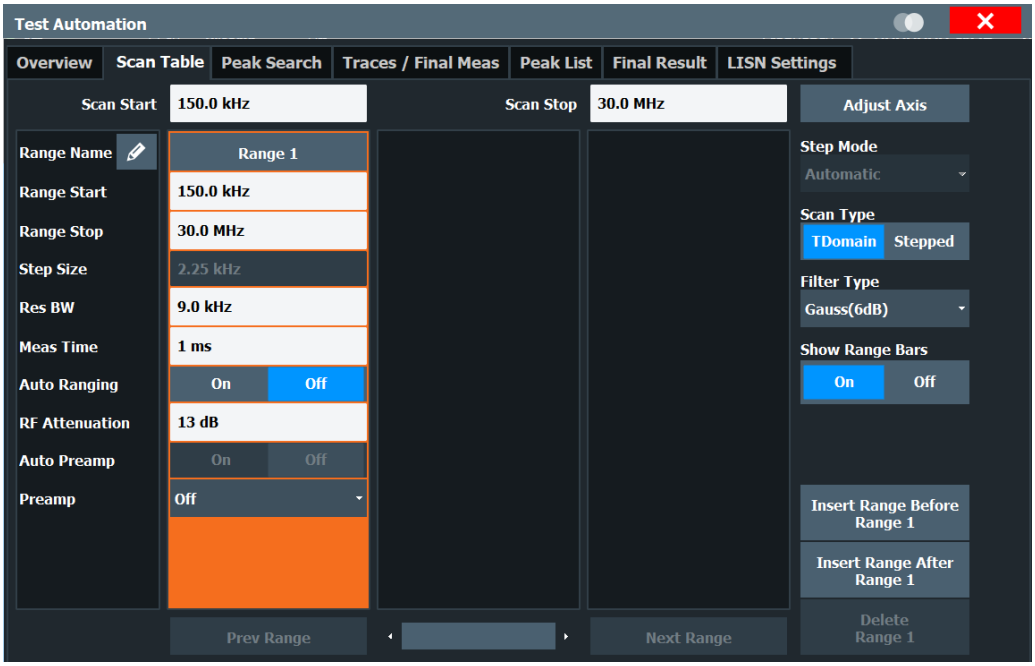


Figure 9-10: Overview of the "Scan Table"

The remote commands required to design a scan table are described in Chapter 15.5.6, "Scan table configuration", on page 392.

Functions in the "Scan Table" dialog box described elsewhere:

- Scan Type
- Filter Type

Adding and removing scan ranges....101
Defining a frequency range for the scan....101
Adjusting the frequency axis....101
Selecting the frequency step mode....102
Displaying range bars....102
Configuring scan ranges....102
└ Range Start and Range Stop....103
└ Step Size....103

└ Measurement Bandwidth 103
└ Measurement Time 104
└ Auto Range 104
└ Attenuation 105
└ Preamplifier 105

Adding and removing scan ranges

The scan table splits the frequency range into several smaller ranges (up to 100 ranges).

By default, there is already a predefined scan range (labeled "Range 1"). If necessary, you can add additional scan ranges or delete scan ranges that you no longer need.

You have the following options when you design the scan table.

- Add a new range to the left of the currently selected range (→ "Insert Range Before Range <x>" button).
- Add a new range to the right of the currently selected range (→ "Insert Range After Range <x>" button).
- Delete the currently selected range (→ "Delete Range <x>" button).
  (The selected range is the range that is highlighted in orange. To select a range, select the "Range x" button at the top of each column, or navigate through the ranges with the "Prev Range" or "Next Range" buttons.)

Remote command:
Number of ranges: `[SENSe:]SCAN<sr>:RANGes[:COUNt]` on page 396
Tip: Selecting a range via SCPI is done with the suffix at `SCAN<range>`.
Delete a range: not supported by remote control

Defining a frequency range for the scan

The start and stop frequencies ("Scan Start" and "Scan Stop") define the global frequency range considered during a scan.

The minimum and maximum frequencies supported by the R&S EPL1000 depend on the instrument model and are defined in the datasheet.

Note: Make sure that all scan ranges are within the global frequency range. Frequencies outside the global frequency range will not be considered in the measurement.

Remote command:
Start frequency: `[SENSe:]FREQuency:STARt` on page 393
Stop frequency: `[SENSe:]FREQuency:STOP` on page 394

Adjusting the frequency axis

When you design a scan table, the frequency range of the scan ranges may not be the same as the global frequency range you have defined for the scan.

The "Adjust Axis" button adjusts the global frequency range to the frequency range covered by the scan ranges.

Example: the global frequency range defines a range from 150 kHz to 500 MHz, while the scan ranges define a range from 150 kHz to 1 GHz. When you adjust the frequency, the R&S EPL1000 automatically expands the global frequency range to 1 GHz.

On the other hand, when the global frequency range is larger than the scan ranges, adjusting the frequency contracts the global frequency range.

This feature is useful when the global frequency range is smaller than the scan ranges, because frequencies outside the global range are not considered in a scan based on a scan table.

Remote command:
not supported

Selecting the frequency step mode
The frequency step mode defines the way the measurement frequencies are selected within a scan range.

Note that the frequency stepsize for time domain scans is always selected automatically.

"AUTO" Linear frequency steps: the Step Size is coupled to the current resolution bandwidth and is about a third of the resolution bandwidth.
In this way, the probability to detect all signals in the scan range is very high.

"Manual" Linear frequency steps: the Step Size is a fix value in Hz.

Remote command:
`[SENSe:]SWEep:SPACing` on page 399

Displaying range bars
The range bar is a green bar displayed at the bottom of the scan diagram. You can turn it on or off as you like with the "Show Range Bars" toggle button.

The range bar carries various useful information.

- The shade of green shows the measurement progress.
  - Dark green
    Indicates that the scan of the corresponding scan range is done.
  - Light green
    Indicates that the scan of the corresponding scan range is currently in progress.
    If you interrupt the scan, the bar remains light green. The bar of the last scan range also remains light green when the scan is done completely.
- The bar contains the names of the corresponding scan ranges as defined in the scan table (for example "Range 1", "Range 2", etc.).

Remote command:
`[SENSe:]SCAN<sr>:BARS` on page 394

Configuring scan ranges
The main part of the scan table contains the configuration for each scan range. Each column of the table represents one scan range (labeled "Range 1", "Range 2", etc. by default).

You can change the labels of the scan ranges and assign a custom name to each range. When you select the pencil icon (), you can edit the range labels. To stop editing, select the pencil icon again.

For each scan range, you can customize the following parameters.

- "Range Start and Range Stop" on page 103
- "Step Size" on page 103
- "Measurement Bandwidth" on page 85

- "Measurement Time" on page 84
- "Auto Range" on page 104
- "Attenuation" on page 105
- "Preamplifier" on page 105

Remote command:
[SENSe:]SCAN<sr>:NAME on page 396

Range Start and Range Stop ← Configuring scan ranges
Defines the frequency range of the selected scan range.

To avoid overlapping scan ranges, the start and stop frequencies of the next and previous ranges are adjusted if necessary.

Tip: Make sure that the start and stop frequencies of the scan ranges are within the global frequency range.

Remote command:
Start frequency: [SENSe:]SCAN<sr>:STARt on page 397
Stop frequency: [SENSe:]SCAN<sr>:STOP on page 397

Step Size ← Configuring scan ranges
Defines the frequency step size of the selected scan range that is applied during a scan.

In case of a stepped scan, the value depends on the selected step mode.

- When you have selected the automatic step mode, the step size is determined automatically. It is not possible to change the step size manually (however, it is displayed in the corresponding table cell as a read-only value).
- When you have selected manual step mode, the step size is a value in Hz (a measurement performed every x Hz).
  Example: a step size of 4 kHz and a start frequency of 100 kHz does a measurement at 100 kHz, 104 kHz, 108 kHz etc.

For a time domain scan, the step size depends on the measurement bandwidth. It is displayed in the "Step Size" table cell as a read-only value.

Remote command:
[SENSe:]SCAN<sr>:STEP on page 397

Measurement Bandwidth ← Configuring scan ranges
Defines the measurement bandwidth (or resolution bandwidth) used for the measurement.

You can define a different bandwidth for the bargraph and each scan range defined in the scan table. The R&S EPL1000 displays an exclamation mark if the selected measurement bandwidth is not compatible to the bandwidth required by CISPR for the corresponding frequency range.

If you perform a scan that is not based on a scan table, the bandwidth for the scan is the same as for the bargraph.

The final measurement uses the bandwidths defined in the scan table, or, if the scan is not based on a scan table (Current parameters), the bandwidth of the bargraph.

The R&S EPL1000 supports a selected set of resolution bandwidths. If you enter a number that is not supported, the R&S EPL1000 rounds the value up to next available bandwidth.

More information

Remote command:
Bargraph: `[SENSe:]BANDwidth[:RESolution][:VALue]` on page 445
Scan table: `[SENSe:]SCAN<sr>:BANDwidth:RESolution` on page 394

Measurement Time ← Configuring scan ranges
Defines the measurement time used to analyze the signal.

You can define a different measurement time for the bargraph, each scan range defined in the scan table and the final measurement. If you perform a scan that is not based on a scan table (Current parameters), the measurement time for the scan is the same as for the bargraph.

Tip: Make sure to select a measurement time that is appropriate for the analyzed signal and that allows the various filters and detectors in the signal path to settle.

Note that the measurement time for IF analysis is calculated automatically based on the measurement time of the bargraph.

Remote command:
Bargraph: `[SENSe:]SWEep:TIME` on page 391
Scan table: `[SENSe:]SCAN<sr>:TIME` on page 398
Final measurement: `[SENSe:]FMEasurement:TIME` on page 410

Auto Range ← Configuring scan ranges
Turns automatic configuration of the attenuation and gain on and off.

When you turn on auto ranging ("State"), the R&S EPL1000 automatically selects an attenuation (and gain, if auto mode for the preamplifier is on) that allows for an ideal analysis of the received signal (without overloading the RF input).

Depending on your measurement task, select one of the following **auto range modes** ("Overview" > "Amplitude" > "Auto Range Mode").

- **Normal**
  The "Normal" mode selects an attenuation and gain that results in a good signal-to-noise ratio.
  Thus, it reduces the display of spurious products. It also leads to an increased display of the inherent noise (because of a higher attenuation).
- **Low noise**
  The "Low Noise" mode selects an attenuation and gain that increases the sensitivity of the R&S EPL1000.
  This mode gives a better impression of spurious products and is thus useful to analyze signals whose level is near the noise level. However, the signal-to-noise ratio in general can deteriorate.

Both auto range modes are designed to maintain the best dynamic range possible.

The auto ranging feature in the receiver remains active even if you change the attenuation and preamplifier properties in other measurement channels and then return to the receiver application.

Notice: For more information, see Chapter 10.6.1, "Increasing measurement sensitivity (or avoiding an input mixer overload)", on page 150.

Remote command:
General: `INPut<ip>:ATTenuation:AUTO` on page 443
Scan range: `[SENSe:]SCAN<sr>:INPut:ATTenuation:AUTO` on page 395
Auto range mode: `INPut<ip>:ATTenuation:AMODe` on page 442

Attenuation ← Configuring scan ranges
Defines the attenuation of the signal.

You can attenuate the signal in 1 dB steps. The range is specified in the datasheet. Attenuation of less than 10 dB is only possible if you turn off 10 dB Minimum Attenuation.

For more information, see Chapter 10.6.1.2, "Using the preamplifier", on page 151.

Notice: For more information, see Chapter 10.6.1, "Increasing measurement sensitivity (or avoiding an input mixer overload)", on page 150.

The auto ranging feature in the receiver remains active even if you change the attenuation and preamplifier properties in other measurement channels and then return to the receiver application.

The R&S EPL1000 also allows you to determine the best attenuation automatically.
- In the receiver application, turn on the "Auto Ranging" feature.
- In the other applications, select attenuation "Mode" → "Auto"

Remote command:
Global: `INPut<ip>:ATTenuation[:VALue]` on page 442
Scan range: `[SENSe:]SCAN<sr>:INPut:ATTenuation[:VALue]` on page 395
Attenuation mode: `INPut<ip>:ATTenuation:AUTO` on page 443

Preamplifier ← Configuring scan ranges
Configures the preamplifier.

The preamplifier amplifies the signal by 20 dB.

More information.

Remote command:
State (global): `INPut<ip>:GAIN:STATe` on page 444
State (scan range): `[SENSe:]SCAN<sr>:INPut:GAIN:STATe` on page 395
Mode (global): `INPut<ip>:GAIN:AUTO` on page 443
Mode (scan range): `[SENSe:]SCAN<sr>:INPut:GAIN:AUTO` on page 395
`INPut<ip>:GAIN:STATe` on page 444

9.3.4 Performing a peak search

A peak search is meant to find signal peaks in the spectrum that you are analyzing. The results of the peak search are written into a peak list, which in turn is the basis for a final measurement.

This approach reduces the efforts required for the final measurement in that you have to test only a few selected frequencies that probably carry interfering signals.

Defining peak characteristics (or "When is a peak a peak?")

If a signal is, for example, very flat, contains a lot of noise or does not contain many peaks, the R&S EPL1000 might miss potential peaks or detect peaks that really are no peaks.

To avoid such situations, you can define what a peak is according to the following criteria.

- **Peak excursion**
  The peak excursion is a relative threshold. The signal level must increase by the threshold value before falling again before a peak is detected.
  To avoid identifying noise peaks instead of a real signal peak, enter a peak excursion that is higher than the difference between the highest and the lowest value measured for the displayed inherent noise.
- **Limit lines** (not mandatory)
  The signal level must be above the limit line (= fail the limit check) to be considered as a peak.
- **Limit margin** (only if a limit line is active)
  The level margin defines the distance relative to a limit line that a signal may at most have so that it will be identified as a peak.

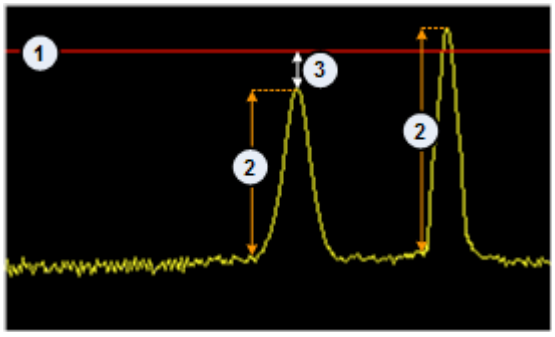


Figure 9-11: Peak definition

1 = Limit line
2 = Peak excursion
3 = Limit margin

Thus, a potential peak is written into the peak list under the following conditions.

Measurements without limit lines:

- If a signal meets the condition defined by the peak excursion.

Measurements with limit lines:

- If a signal level fails a limit check and meets the condition defined by the peak excursion.
- If a signal level passes a limit check, but is within the limit margin ("x dB below the limit"), and still meets the peak excursion.

In the diagram, the peaks are labeled with a colored symbol. Color and type of symbol depend on the trace the peak is on.

Selecting the search method (or "How the search is performed?")

The automatic peak search that is part of automated tests is an easy way to find peaks: the R&S EPL1000 searches for peaks after the scan is done based on the conditions you have defined for the peak search (peak excursion and limit margin). It then writes the peaks into the peak list.

Alternatively, the R&S EPL1000 allows you to edit peak lists and manually add or delete frequencies. To create a peak list manually, you can, for example, use markers to search for peaks, or, if you already know where peaks occur, add each frequency individually.

Controlling the size of the peak list

The size of the peak list is variable. The peak list can contain up to 500 entries (= frequencies). By default, the peak search adds peaks until the maximum size of the peak list has been reached and regardless of the distribution of the peaks. If there are more peaks than the size of the peak list allows for, the R&S EPL1000 removes the frequencies with the smallest signal levels. If there are fewer peaks than the list allows for, the size of the list is reduced accordingly.

The R&S EPL1000 also provides the possibility to split the spectrum into several equidistant subranges and look for a defined number of peaks in each subrange with the result that peak list entries are distributed equally over the measurement range.

- Configuring a peak search 107
- Modifying a peak list 110
- Modifying a peak list (alternate method) 112

9.3.4.1 Configuring a peak search

Access: "Overview" > "Test Automation" > "Peak Search"

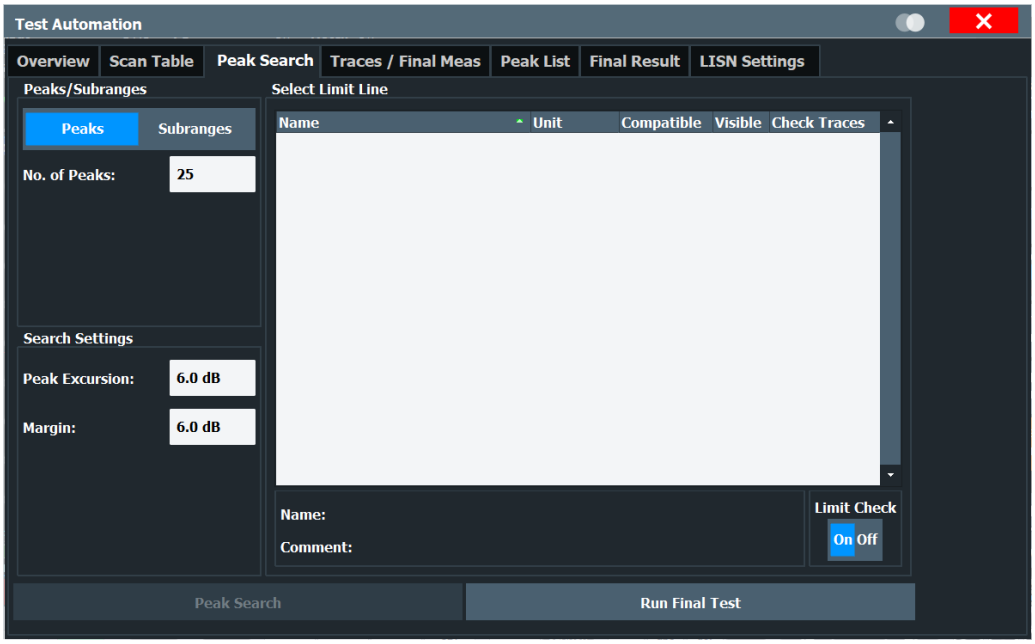


Figure 9-12: Overview of the "Peak Search" configuration

The remote commands required to configure the peak search are described in Chapter 15.5.7, "Peak search", on page 399.

Selecting the peak search method 108
Controlling the size of the peak list 108
Defining peak characteristics 109
Selecting a limit line 109
Enabling and disabling limit checks 109

Selecting the peak search method
Selects the peak search mode.

More information.

"Peaks" Looks for a particular number of peaks over the complete scan range.

"Subranges" Divides the scan range into smaller, equidistant subranges and looks for a particular number of peaks in each subrange.

Remote command:
`CALCulate<n>:PEAKsearch:METHod` on page 401

Controlling the size of the peak list
Defines the number of peaks that are transferred to the peak list.

The contents of the peak list depend on the selected search mode.

- **"Peaks"**
  When you have selected the "Peaks" search mode, define the **number of peaks** the R&S EPL1000 looks for during a peak search.
  The range is from 1 to 500 peaks.
- **"Subranges"**

When you have selected the "Subranges" search mode, define the **number of subranges** you want to split the frequency range into, and the **number of peaks** the R&S EPL1000 looks for in each subrange.
You can define up to 50 subranges, with each subrange containing a maximum number of 10 peaks. All subranges span the same frequency range.

Remote command:
Number of peaks: `CALCulate<n>:PEAKsearch:SUBRanges[:VALue]` on page 402
Number of subranges: `CALCulate<n>:PEAKsearch:SUBRanges[:VALue]` on page 402
Peaks per subrange: `CALCulate<n>:PEAKsearch:SUBRanges:PCOunt` on page 402

Defining peak characteristics
Defines the characteristics of a signal that identify it as a peak.

The **peak excursion** defines the minimum level by which a signal must rise or fall so that it will be identified as a maximum or a minimum during the peak search.

The **margin** defines the distance relative to a limit line that a signal may at most have so that it will be identified as a peak.

(Note: a limit line margin defined for the limit line itself (see Margin) is ignored for a peak search.)

For more information, see "Defining peak characteristics (or "When is a peak a peak?")" on page 106.

Remote command:
Peak excursion: `CALCulate<n>:MARKer<m>:PEXCursion` on page 399
Margin: `CALCulate<n>:PEAKsearch:MARGin` on page 401

Selecting a limit line
Selects one or more limit lines to evaluate for a peak search.

The table shows all limit lines available on the R&S EPL1000 that are compatible to the current measurement configuration. You can activate the limit line by marking the corresponding checkbox and assigning the limit line to a trace.

For more information on designing, editing and managing limit lines in general, see Chapter 11.5, "Display and limit lines", on page 223.

For more information on the effects of a limit line on the peak search, see "Defining peak characteristics (or "When is a peak a peak?")" on page 106.

Remote command:
See Chapter 15.7.5.2, "Limit lines", on page 503.

Enabling and disabling limit checks
Turns limit checks for pre-measurement on and off.

By disabling limit checks, FAIL messages for limit line violations during premeasurements will no longer be displayed.

9.3.4.2 Modifying a peak list

Access: "Overview" > "Test Automation" > "Peak List"

The peak list contains the frequencies on which the peak search has identified peaks. It can be used as the basis of the final measurement.

Modifying a peak list (alternate way)

The R&S EPL1000 also provides an alternate way to modify a peak list.

More information.

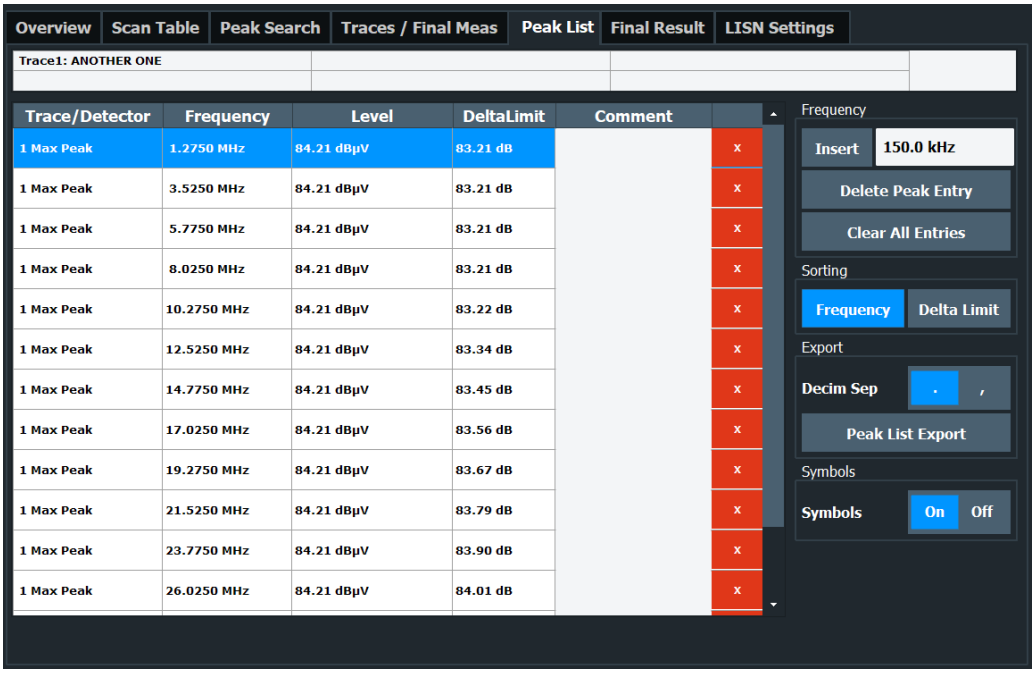


Figure 9-13: Overview of the peak list

Reading the peak list

The table at the top of the dialog contains information when you measure with limit lines. Each cell of the table represents a trace and shows the limit lines that are assigned to that trace. In the screenshot above, for example, the limit line named "Another One" is active and assigned to Trace 1.

The main table shows the following information for each peak in the peak list. The size of the table depends on the number of peaks that have been found.

- **Trace / Detector**
  Shows the number of the trace and the detector used for that trace.
- **Frequency**
  Shows the frequency where the peak was found.
- **Level**
  Shows the absolute level value of the peak. The unit depends on the unit you have selected.

- **Delta Limit**
  Shows the distance of the peak to the nearest limit line that has been assigned to the corresponding trace. The distance is a value in dB. Available if you are using limit lines.
- **Comment**
  Allows you to add a comment to each peak as required (only possible after a peak search has been done).
-
  Deletes the corresponding row from the peak list.

Editing a peak list....111
└ Adding the current frequency to the peak list....111
Sorting the peak list....111
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Editing a peak list

The R&S EPL1000 allows you to edit a peak list that has been created, or even create a peak list that is not based on an automatic peak search.

- Add a new frequency
  To add a new peak to the peak list, enter a **frequency** in the corresponding field and add it to the list with the "Insert" button.
  Tip: Alternatively, you can add the current receiver frequency including the measured level with the Add to Peak List softkey.
  The new frequency is added to the list regardless if the level threshold conditions have been fulfilled for that frequency.
  Note that the frequency has to be in the displayed frequency range.
- Delete a frequency
  To remove a peak from the peak list, select the corresponding peak list row and delete it with the "Delete Peak Entry" button.
  Alternatively, use the button in the peak list itself.
  You can also delete the complete peak list with the "Clear All Entries" button.

Remote command:
Add frequency: `CALCulate<n>:PEAKsearch:ADD` on page 400
Clear list: `CALCulate<n>:PEAKsearch:CLEar[:IMMediate]` on page 401

Adding the current frequency to the peak list ← Editing a peak list

The receiver application allows you to add the current receiver frequency manually to the peak list.

Use one of the following ways to add a frequency to the peak list.

- Use the "Add to Peak List" softkey available in the "Meas Config" softkey menu.
- Use the "Add to Peak List" softkey available in the "Mkr →" softkey menu.
- Use the "Add to Peak List" button available in the "Peak List" result display.

Remote command:
`CALCulate<n>:PEAKsearch:ADD` on page 400

Sorting the peak list

By default, the R&S EPL1000 sorts the peaks by their "Frequency" in ascending order.

Alternatively, you can sort the peak list by the distance of a peak to the limit line (→ "Delta Limit"). This is also done in ascending order.

Sorting by the delta limit is available when a limit line is active and evaluated.

Remote command:
not supported

Exporting a peak list
The peak list can be exported to a file with the "Peak List Export" button.

This button opens a dialog box to export and save the contents of the peak list in ASCII format to a `.dat` file.

The file consists of a header and the results of the scan or the final measurement.

- The header is a list of general instrument settings and characteristics. It consists of three columns, each column separated by a semicolon: <parameter>;<value>;<unit>.
- The results are split into several data sections, one for each active trace. The data section begins with the entry `Trace <x> [Final]:`, followed by the trace characteristics and the peak list data itself.

For more information on exporting data, see Chapter 11.3.9.1, "Reference: ASCII file export format", on page 207.

By default, decimal places are separated by a point in the exported list. If necessary, you can use a comma instead of a point as the decimal separator.

Remote command:
Peak list of the scan: `MMEMory:STORe:PLISt` on page 404
Peak list of the final measurement: `MMEMory:STORe:FINal` on page 403
Decimal separator: `FORMat:DEXPort:DSEParator` on page 522

Displaying peaks as symbols
Turns the labels on the peak position in the diagram on and off.

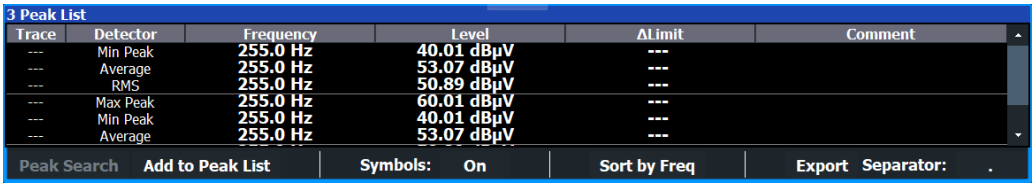
The peak labels have a different color and shape depending on the trace they are on. Trace 1, for example, has red crosses as the peak label. By default they are on.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:SYMBol` on page 403

9.3.4.3 Modifying a peak list (alternate method)

Access: > "Peak List"

In addition to the method described in Chapter 9.3.4.2, "Modifying a peak list", on page 110, the Receiver application provides another approach to modify and edit a peak list.



Reading the peak list

The peak list result display basically contains the same information as the "Peak List" dialog box.

More information

Note that the "Comment" column is read-only in the peak list result display. If you would like to add a comment to a peak, you have to do it in the "Peak List" dialog box.

Modifying the contents of the peak list

When the result display is active, you can modify the peak list directly from within the result display with the corresponding buttons (only visible if the result display spans the whole screen).

- **Peak Search**
  Performs a single peak search based on the current scan data.
- **Add to Peak List**
  → "Adding the current frequency to the peak list" on page 111
- **Symbols**
  → "Displaying peaks as symbols" on page 112
- **Sort by Freq** and **Sort by Delta**
  → "Sorting the peak list" on page 111
- **Export** and **Separator**
  → "Exporting a peak list" on page 112

9.3.5 Performing final measurements

During the final measurement, the R&S EPL1000 does a measurement on each frequency in the peak list. When done, it updates the preliminary results in the peak list with those found during the final measurement. To avoid several tests with different detectors, you can use several detectors at the same time during the final measurement.

In case you are using a scan table in the test sequence, the final measurement is based on the contents of the scan table. When the scan table has been turned off, the final measurement is based on the current bargraph configuration.

Automatic vs interactive final measurements

The R&S EPL1000 provides two methods to run a final measurement: an automatic final measurement and an interactive one.

An automatic final measurement measures all frequencies in the peak list automatically with limited means of interaction. During an automatic measurement, you can still interrupt ("Hold Final Meas") and resume the measurement or abort it completely ("Stop Final Meas"). But you will not be able to change the measurement configuration. The advantage is that you can let the measurement run on its own and do not have to operate the R&S EPL1000.

If you want to be able to control the final measurement, for example to change the configuration during the measurement, the R&S EPL1000 also provides an interactive final measurement (which you can select even after you have started an automatic final measurement).

When you use the interactive final measurement, the R&S EPL1000 interrupts the measurement before it measures a frequency part of the peak list. In this way, you can customize the measurement configuration for each frequency.

Availability of measurement parameters

When you interrupt the scan or the final measurement, you can change only parameters that have an immediate effect on the measurement. All other parameters (e.g. trigger settings) are unavailable.

Sequence for an interactive measurement

If you select the interactive final measurement, the R&S EPL1000 initiates the following sequence.

1. The R&S EPL1000 tunes to the first frequency in the peak list. The measurement configuration is as defined previously.
2. The R&S EPL1000 positions a marker on that frequency and interrupts the measurement.
3. While the measurement is interrupted, you can change any setting that is available.

   In addition, you have several options on how to proceed.
   - Skip the current frequency.
     Positions the marker on the next frequency in the peak list without performing a final measurement on the current frequency.
   - Get max hold result for the current frequency.
     Writes the highest level that was measured for that frequency during the scan to the final peak list without performing a final measurement.
   - Stop the final measurement.
   - Perform a measurement on the current frequency.
4. When the final measurement for the current frequency is done, the R&S EPL1000 replaces the scan result in the peak list with the result of the final measurement. If the frequency has drifted compared to the one of the scan, it also updates the frequency in the peak list.
5. The R&S EPL1000 continues with the next frequency in the peak list, positions the marker on that frequency etc.
6. When all frequencies in the peak list are finished, the R&S EPL1000 opens the "Final Peak List", a table that contains the results for the final measurement.

Note that it is possible to start with an automatic measurement and later change into interactive mode. Likewise, it is possible to start measuring in interactive mode and later change into automatic mode.

- Configuring traces 115
- Working with the final measurement results 117

9.3.5.1 Configuring traces

Access: "Overview" > "Test Automation" > "Trace / Final Meas"

Note that the dialog box to configure traces contains the same functions as the dialog box to configure the final measurement, but with a slightly different layout.

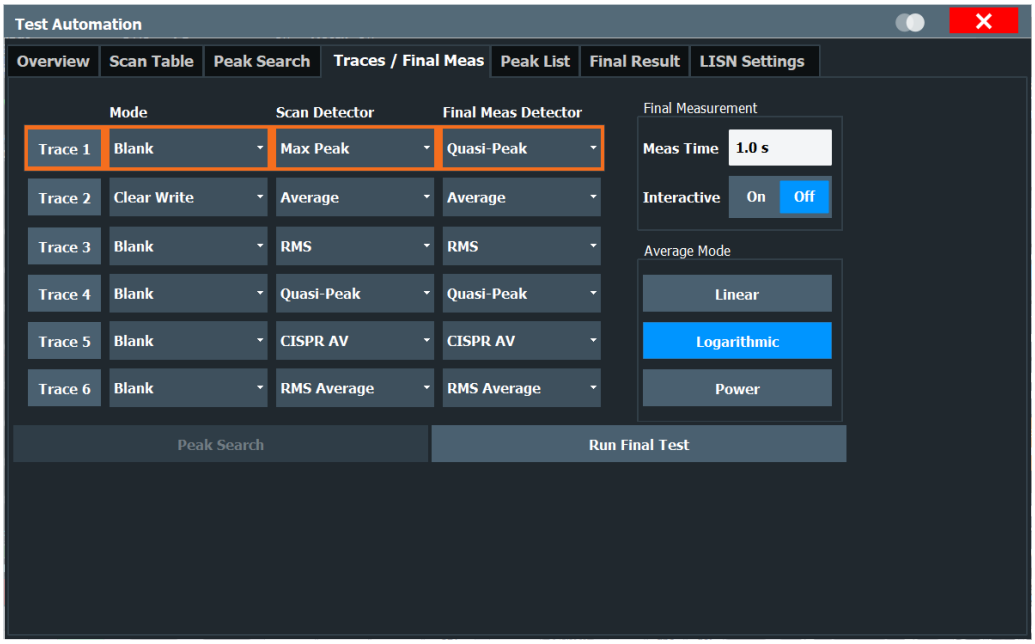


Figure 9-14: Overview of the Final Meas configuration

The remote commands required to configure the final measurement are described in Chapter 15.5.9, "Final measurement (and trace) configuration", on page 408.

Functions in the "Trace / Final Meas" dialog box described elsewhere:

- "Measurement Time" on page 84

Trace Mode 115
Detector 116
Interactive 117
Average Mode 117

Trace Mode
Defines the update mode for subsequent traces.

For more information, see Chapter 11.3.1.2, "Analyzing several traces - trace mode", on page 183.

"Clear Write"	Displays the level that has been measured last at each trace point. The old trace is overwritten.
"Max Hold"	Displays and saves the highest level that has been measured over several measurements at each trace point.
"Min Hold"	Displays and saves the lowest level that has been measured over several measurements at each trace point.
"Average"	Displays and saves the average level that has been determined over several measurements at each trace point. The number of measurements depends on the Scan Count.
"View"	Freezes the contents of the trace memory and displays the corresponding trace. The trace is not updated when you start another measurement.
"Blank"	Removes the trace from the diagram.
"Transducer"	Draws a trace that shows the correction values of all active transducer factors in the currently selected frequency range. In case transducer factors overlap each other, the correction values are aggregated. Available for Trace 1 and in the receiver application only. **Note**: When you select the "Transducer" trace, the application temporarily removes all other traces from the diagram. You can restore the scan traces by selecting the original trace mode of trace 1 again.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 410
View transducer: `[SENSe:]CORRection:TRANsducer:VIEW` on page 409

Detector
Selects the trace detector.

Note: In the receiver application, you can apply different detectors to the bargraph, the scan and the final measurement.

"Max Peak"	Selects the Max or Positive Peak detector.
"Min Peak"	Selects the Max or Positive Peak detector.
"RMS"	Selects the RMS detector.
"Average"	Selects the Average detector.
"Quasipeak"	Selects the Quasipeak detector.
"CISPR Average"	Selects the CISPR Average detector.
"RMS Average"	Selects the RMS Average detector.
"None"	Ignores the corresponding trace during the final measurement. Available for the final measurement.

Remote command:
Bargraph: `[SENSe:]DETector<t>:RECeiver[:FUNCtion]` on page 390
Scan: `[SENSe:]DETector<t>[:FUNCtion]` on page 393
Final measurement: `[SENSe:]DETector<t>:FMEasurement` on page 409

Interactive
Turns interactive measurements on and off.

For more information, see "Automatic vs interactive final measurements" on page 113.

Remote command:
[SENSe:]FMEasurement:AUTO on page 410

Average Mode
Defines the mode with which the trace is averaged over several measurements.

This setting is generally applicable if trace mode "Average" is selected.

For FFT sweeps, the setting also affects the VBW (regardless of whether the trace is averaged).

"Linear" The power level values are converted into linear units before averaging. After the averaging, the data is converted back into its original unit.

"Logarithmic" For logarithmic scaling, the values are averaged in dBm. For linear scaling, the behavior is the same as with linear averaging.

"Power" Activates linear power averaging.
The power level values are converted into unit Watt before averaging. After the averaging, the data is converted back into its original unit.
Use this mode to average power values in Volts or Amperes correctly. In particular, for small VBW values (smaller than the RBW), use power averaging mode for correct power measurements in FFT sweep mode.

Remote command:
[SENSe:]AVERage<n>:TYPE on page 412

9.3.5.2 Working with the final measurement results

Access: "Overview" > "Test Automation" > "Final Result"

When the final measurement is done, the R&S EPL1000 writes the results into a table that looks and feels similar to the peak list. Editing entries is, however, not possible.

The list contains all frequencies that have been measured during the final measurement.

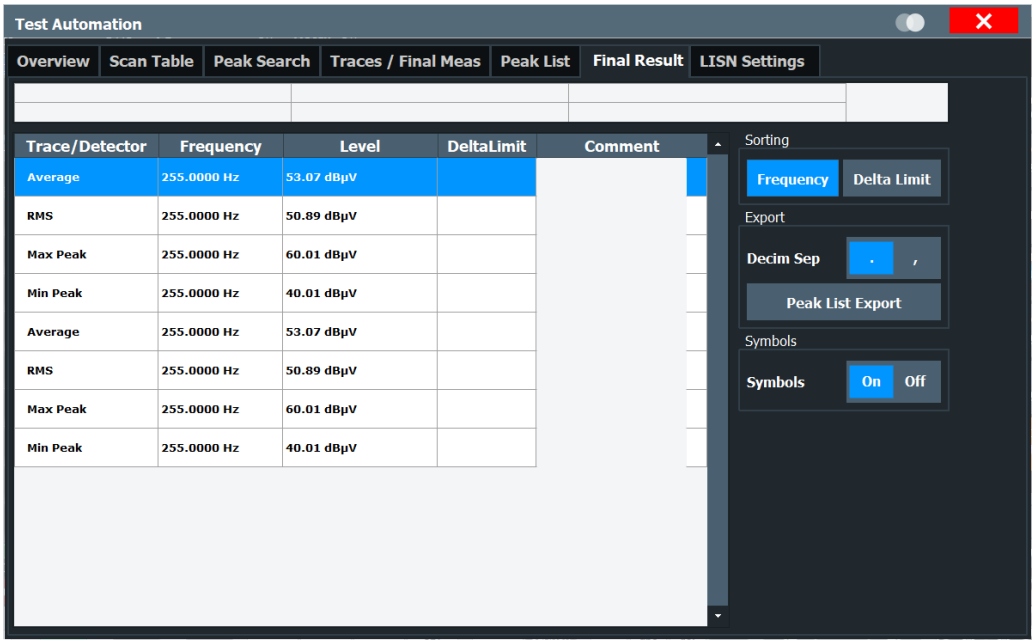


Figure 9-15: Overview of the "Final Results" table

The functionality and information provided by the final results dialog box is similar to that provided by the peak list.

Functions to manage final results described elsewhere:

- "Sorting the peak list" on page 111
- "Exporting a peak list" on page 112
- "Displaying peaks as symbols" on page 112

Alternate way to modify the final results

Like the peak list, you can also modify the final results directly via the "Final Meas" result display.

More information.

▸ Select the "SmartGrid" icon (⊞) and start the "Final Meas" result display.

The remote commands required to manage final results are described in Chapter 15.5.9, "Final measurement (and trace) configuration", on page 408 and Chapter 15.5.10, "Final results", on page 412.

Reading the peak list

The table at the top of the dialog contains information when you measure with limit lines. Each cell of the table represents a trace and shows the limit lines that are assigned to that trace.

The main table shows the following information for each frequency that has been measured. The size of the table depends on the number of peaks that have been found.

- **Rows with no highlighting**

Limit check for the corresponding frequency has passed.

- **Rows in red highlighting**
  Limit check for the corresponding frequency has failed. This indicates a potential interferer.
- **Rows in blue highlighting**
  Indicates the currently selected row.
- **Trace / Detector**
  Shows the number of the trace and the detector used for that trace.
- **Frequency**
  Shows the frequency where the peak was found.
- **Level**
  Shows the absolute level value of the peak. The unit depends on the unit you have selected.
  The result also contains information about the phase that was measured when you are working with a LISN (L1, L2, L3, N).
- **Delta Limit**
  Shows the distance of the peak to the nearest limit line that has been assigned to the corresponding trace. The distance is a value in dB. Available if you are using limit lines.
- **Comment**
  Allows you to add a comment to each result as required.

9.3.6 Configuring line impedance stabilization networks (LISN)

Access: "Overview" > "Test Automation" > "LISN"

The R&S EPL1000 supports several LISN models and provides functionality to control these devices.

For more information about using a LISN, see Chapter 9.3.1.3, "Line impedance stabilization network (LISN) control", on page 89.

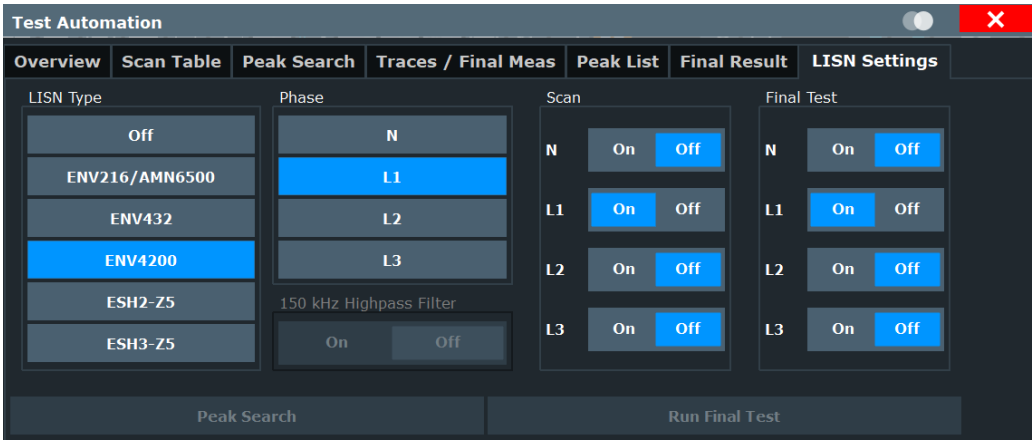


Figure 9-16: Overview of the "LISN" configuration

Note: the "Scan" and "Final Test" blocks are available in the Receiver application.

The remote commands required to configure the LISN are described in Chapter 15.5.11, "LISN configuration", on page 416.

LISN Type 120
Phase 120
High-Pass Filter 150 kHz 121

LISN Type
Selects the LISN used for the measurement.

The following LISNs are supported by the R&S EPL1000:

- R&S ENV216
- R&S AMN6500
- R&S ENV432
- R&S ENV4200
- R&S ESH2-Z5
- R&S ESH3-Z5

Select "Off" when you are performing measurements without a LISN.

More information

Remote command:
`INPut<ip>:LISN[:TYPE]` on page 418

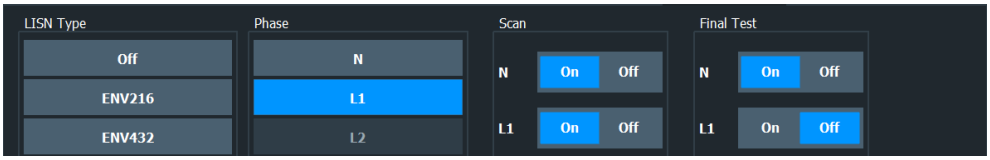
Phase
Selects the LISN phase to be measured.

Phases L2 and L3 are available when you are using the R&S ENV4200, R&S 432 or R&S ESH2-Z5 (four-line networks).

In the spectrum application, the I/Q analyzer and the analog demodulator, you can measure on one phase at a time (N, L1, L2 **or** L3).

In the receiver application, phase selection works as follows.

- You can measure more than one phase in a single measurement (N, L1, L2 **and / or** L3).
  Instead of selecting the phase in the "Phase" column of the dialog, select the phases you want to measure in the "Scan" or the "Final Test" column ("On" considers the phase in the measurement, "Off" ignores the phase in the measurement).
  If you are measuring more than one phase, the R&S EPL1000 performs a measurement for each of the selected phases.
- You can select different phase (combinations) for the scan and the final measurement.
  The selection in the "Scan" and "Final Test" blocks of the dialog box override the selection in the "Phase" block of the dialog.
  Example:
  • Phase L1 is selected in the "Phase" block.
  • Phase L1 and N are selected in the "Scan" block.
  • Phase L1 is off in the "Final Test" block, but phase N is on.



➞ During the scan, the R&S EPL1000 measures both selected phases.
➞ During the final measurement, the R&S EPL1000 measures phase N, but not phase L1.
➞ The phase selected in the "Phase" block is ignored for both the scan and the final measurement.
When scan and final measurement are done, the general phase (here: L1) becomes the selected phase again.

More information

Remote command:
`INPut<ip>:LISN:PHASe` on page 418
Scan: `[SENSe:]SCAN<sr>:LISN:PHASe` on page 417
Final measurement: `[SENSe:]FMEasurement:LISN:PHASe` on page 416

High-Pass Filter 150 kHz
Turns the high-pass filter on the LISN on and off.

The filter protects the receiver input from high signal levels below 150 kHz.

Available for measurements with R&S ENV216 and R&S AMN6500.

More information

Remote command:
`INPut<ip>:LISN:FILTer:HPASs[:STATe]` on page 417

10 Common measurement settings

Basic measurement settings that are common to many measurement tasks, regardless of the application or operating mode, are described here. If you are performing a specific measurement task, or an application other than the receiver application, be sure to check the specific application or mode description for settings that may deviate from these common settings.

- Using the fast access panel 122
- Using the user port panel 124
- The notes display 125
- Configuration overview 126
- Data input and output 127
- Amplitude and vertical axis configuration 149
- Frequency and span configuration 155
- Bandwidth and filter configuration 162
- Trigger configuration 163

10.1 Using the fast access panel

Access: > "Fast Access"

The "Fast Access" panel is designed to provide fast access to a (predefined) set of settings that you are using regularly, and change these settings without accessing dialog boxes or softkey menus. The contents of the fast access panel are user-definable.

When you add the fast access panel to the user interface, it shows the settings that you can control through the panel. Using the "Up" ( ) or "Down" ( ) feature changes the value of the corresponding setting. The stepsize is the same as if you were using the cursor keys on the front panel.

The advantage of the fast access panel is that it is easier and faster to change various settings in a single panel without having to find and access dialog boxes or softkey menus first. In addition, you can still view results while changing parameters, without dialog boxes blocking the view.

Example: Steps necessary to change the attenuation without the fast access panel

1. Press the [AMPT] key.
2. Press the "Ampt Config" softkey.
3. Select the "Attenuation" parameter.
4. Turn the rotary knob or enter the attenuation manually to change the attenuation.
   When you want to change the attenuation again, you have to repeat that procedure. Plus, almost the whole time, the result displays are blocked by a dialog box.
5. (...)

Example: Steps necessary to change the attenuation when you have assigned that parameter to the fast access panel

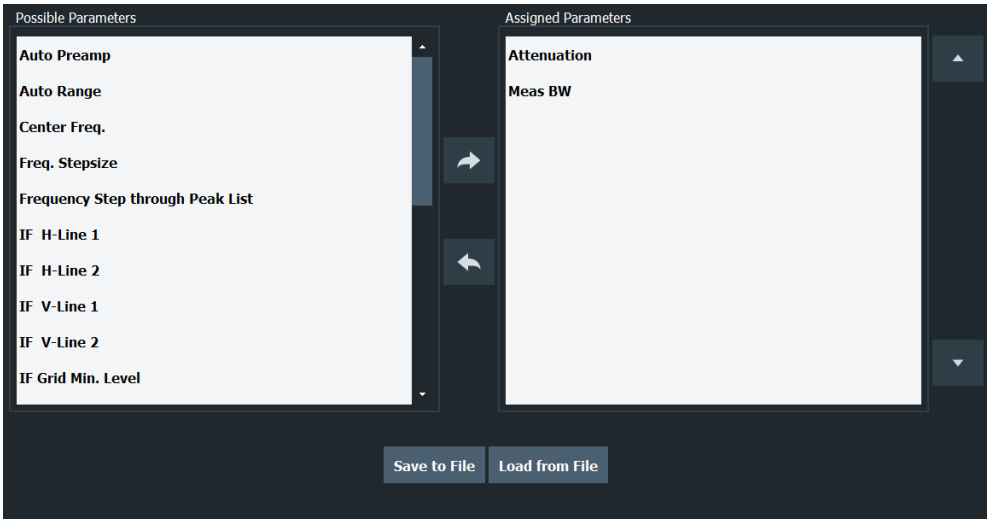
1. Add the fast access panel to the user interface.
2. Use the cursor keys in the panel to increase or decrease the attenuation.
   When you want to change the attenuation again, simply hit the "Up" or "Down" key.
   Plus, you are able to see the results all the time.

   Note: The parameter stepsize of the knobs is the same as if you were using the cursor keys.

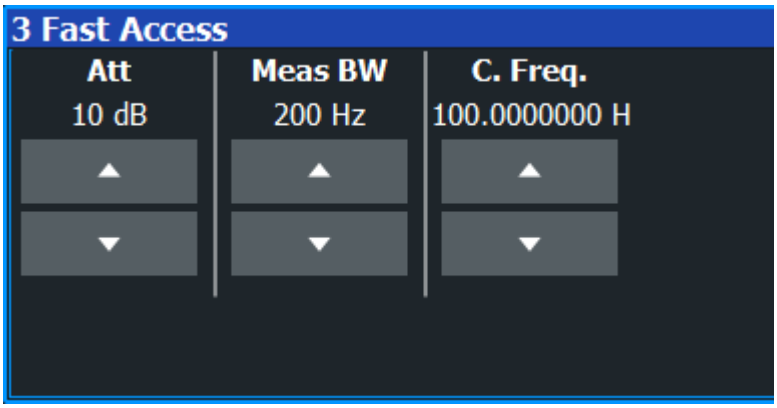
The fast access panel carries a few predefined settings. However, you can substitute the predefined settings, or add a few more, and thus define the contents of the fast access panel as you like.

Assigning functions to the fast access panel

1. Select "Setup" > "Fast Access".
   The R&S EPL1000 opens a dialog box to configure the fast access display.
   You can access the fast access display via the SmartGrid .



2. To assign an additional function to the panel, select one of the parameters in the left menu and move it to the right menu with the right arrow key ( ). Alternatively, you can move items via drag & drop.



3. To remove a function from the panel, select one of the parameters in the right menu and move it to the left menu with the left arrow key ( ).

4. Save the configuration to a file and restore it later on.
"File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.

10.2 Using the user port panel

Access: > "User Port"

The "User Port" panel is designed to configure the optional user port (AUX port) on the rear of the R&S EPL1000. Using the user port, you can transmit bit patterns in two directions, depending on the actual selected signal direction.

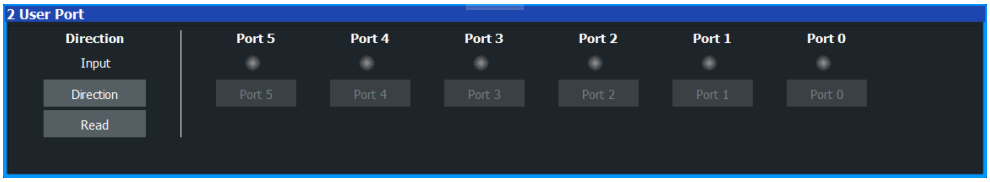
When you add the user port panel to the user interface, you can configure the user ports as required.

User port configuration.....124

User port configuration
You can configure the user port as an input or an output by selecting the signal "Direction".

- When you configure the user port as an output, you can select the required bit patterns by changing the state of the indivdiual ports ("Port <x>").
An active port shows a green LED.

- When you configure the user port as an input, you can read out the user port configuration. The value is displayed in the panel. Individual port selection becomes unavailable.



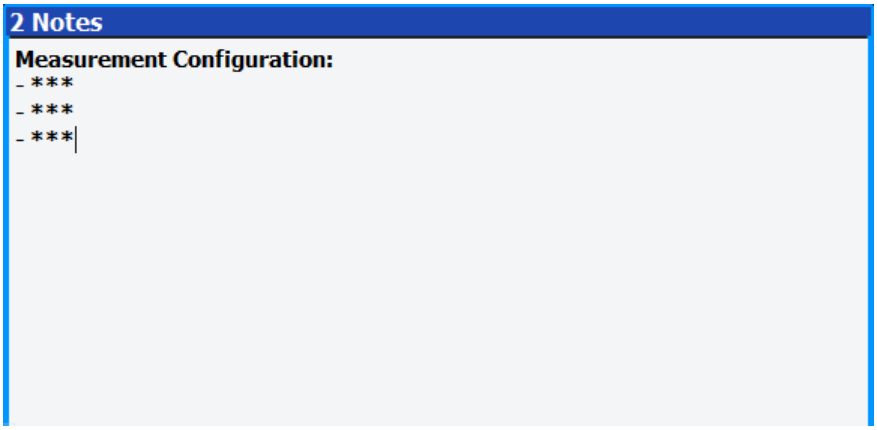
For more information about the pin to bit assignment, refer to the description of the remote command.

Remote command:
Output state: `OUTPut<up>:UPORt:STATe` on page 426
Set bit pattern: `OUTPut<up>:UPORt[:VALue]` on page 425
Input state: `INPut<ip>:UPORt:STATe` on page 424
Query bit pattern: `INPut<ip>:UPORt[:VALue]` on page 425

10.3 The notes display

Access: > "Notes"

The "Notes" display is designed to add comments or explanations to the current measurement.



The content of the "Notes" display can also be included in test reports, see Chapter 12.4.2, "Creating a test report", on page 272.

Remote commands:

Add notes display: `LAYout:ADD[:WINDow]?` on page 453

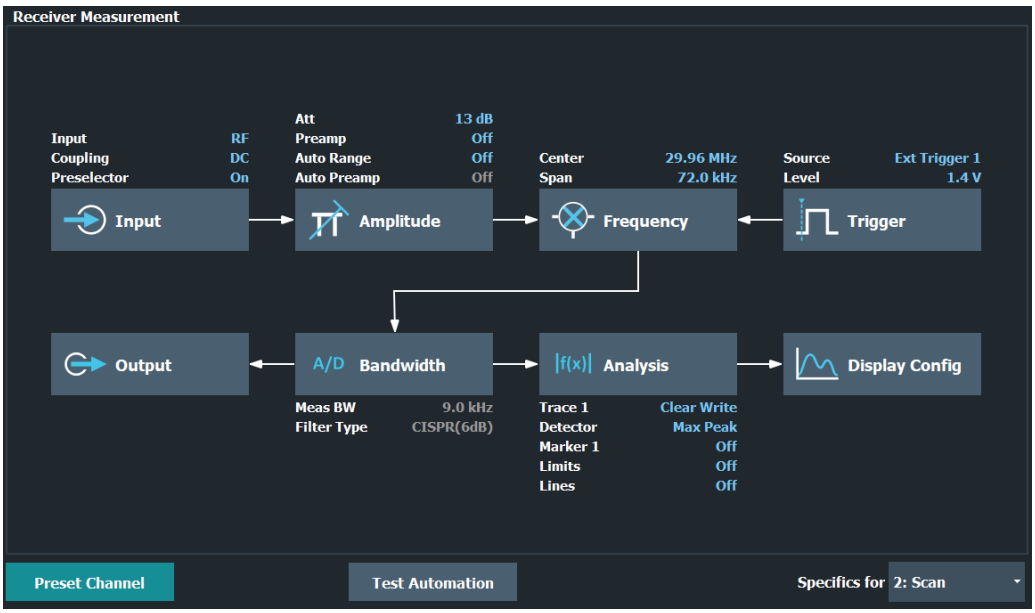
Set and query content: `DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:TEXT` on page 544

Append content: `DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:APPend:TEXT` on page 544

Clear notes display: `DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:CLEar` on page 544

10.4 Configuration overview

Throughout the measurement channel configuration, an overview of the most important currently defined settings is provided in the configuration "Overview". The configuration overview is displayed when you select the "Overview" softkey, which is available at the bottom of all softkey menus.



In addition to the main measurement settings, the configuration overview provides quick access to the main settings dialog boxes. Thus, you can easily configure an entire measurement channel from input over processing to output and analysis by stepping through the dialog boxes as indicated in the "Overview".

To configure settings

► Select any button to open the corresponding dialog box.

- Input
- Amplitude
- Frequency
- Trigger
- Output
- Bandwidth
- Analysis
- Display Config

(For more information about the "Test Automation" button, see Chapter 9.3, "Test automation", on page 85.)

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Specific Settings for....127

Preset Channel setup
Select the "Preset Channel" button in the lower left-hand corner of the "Overview" to restore all measurement settings *in the current channel setup* to their default values.

Note: Do not confuse the "Preset Channel" button with the [Preset] *key*, which restores the entire instrument to its default values and thus closes *all channel setups* on the R&S EPL1000 (except for the default channel setup)!

See "Preset Mode" on page 294

Remote command:
`SYSTem:PRESet:CHANnel[:EXEC]` on page 533

Specific Settings for
The channel setup can contain several windows for different results. Thus, the settings indicated in the "Overview" and configured in the dialog boxes vary depending on the selected window.

Select an active window from the "Specific Settings for" selection list that is displayed in the "Overview" and in all window-specific configuration dialog boxes.

The "Overview" and dialog boxes are updated to indicate the settings for the selected window.

When you select the "Bargraph" item from the dropdown menu, changes are also applied to the scan. If settings are not available for the Bargraph (for example trace settings), changes only apply to the scan. The same applies to numerical result displays (for example the "Peak List").

10.5 Data input and output

The R&S EPL1000 can analyze signals from different input sources and provide various types of output (such as video or trigger signals).

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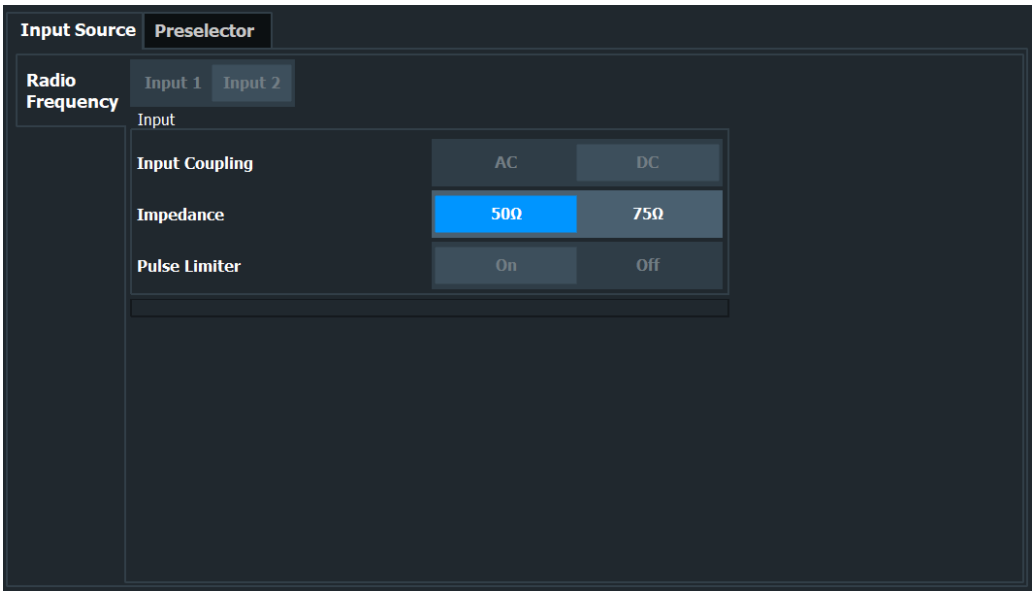
- Configuring the preselector....129
- Configuring outputs (IF / video / demodulation)....130
- Configuring LISNs....133
- Configuring additional outputs....133
- Internal generator....134

10.5.1 Configuring the input

Access: "Overview" > "Input" > "Input Source"

The default input source for the R&S EPL1000 is "Radio Frequency", i.e. the signal at the [RF Input] connector on the front panel of the R&S EPL1000. In the Receiver application, this is the only available input source.



Input Coupling 128
Impedance 128
Pulse Limiter 128

Input Coupling
The RF input is coupled by direct current (DC).

Make sure to protect the instrument from damaging DC input voltages. For details, refer to the data sheet.

Remote command:
n/a

Impedance
For some measurements, the reference impedance for the measured levels of the R&S EPL1000 can be set to 50 Ω or 75 Ω.

Select 75 Ω if the 50 Ω input impedance is transformed to a higher impedance using a 75 Ω adapter of the RAZ type. (That corresponds to 25Ω in series to the input impedance of the instrument.) The correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

This value also affects the unit conversion.

Remote command:
`INPut<ip>:IMPedance` on page 423

Pulse Limiter
The pulse limiter is a protection mechanism against high level pulses or signals (which can damage the input mixer).

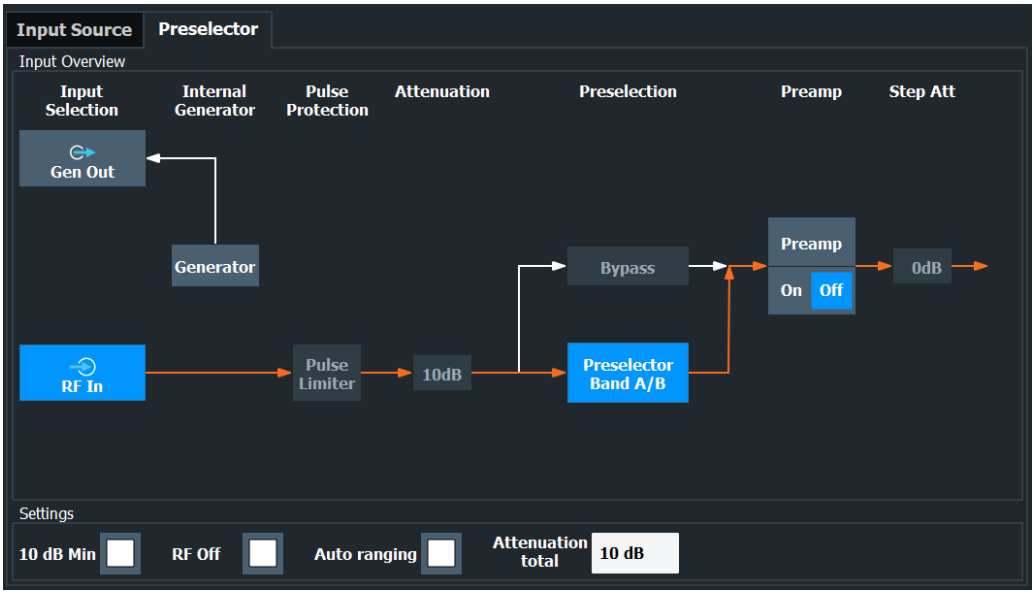
The pulse limiter is always on. However, it works only if the attenuation is at least 10 dB. The pulse limiter has no effect for attenuation smaller than 10 dB.

Remote command:
n/a

10.5.2 Configuring the preselector

Access: "Overview" > "Input" > "Preselector"

Preselector settings allow you to configure the signal path up to the input mixer, especially the preselector characteristics.



The orange arrow in the dialog box represents the current signal path. Grey arrows represent other possible signal paths.

Functions of the "Preselector" dialog box described elsewhere:

- Generator state
  The generator block in the diagram turns blue to indicate that the generator is on.
- "Pulse Limiter" on page 128
- "Attenuation" on page 105
  The preselector dialog indicates how the total attenuation is distributed over the individual attenuators (attenuator and step attenuator).
- "Preamplifier" on page 105
- "10 dB Minimum Attenuation" on page 153
- "Auto Range" on page 104

Generator....130
RF Off....130
Preselection filter....130

Generator
Turns the internal generator on and off.

For details, see Chapter 10.5.6, "Internal generator", on page 134.

Remote command:
`OUTPut<up>[:STATe]` on page 434

RF Off
Turns off the RF input. The R&S EPL1000 no longer processes signals if you turn off the RF input. You can also no longer configure the signal path.

Preselection filter
Selects the filter of the preselector.

In the receiver application, the preselection filter is always "Preselector Band A/B". The filter characteristics correspond to CISPR band A (9 kHz to 15 MHz) and CISPR band b (15 MHz to 30 MHz).

In other applications, you can bypass the filter.

An orange arrow in the diagram represents the path you have selected.

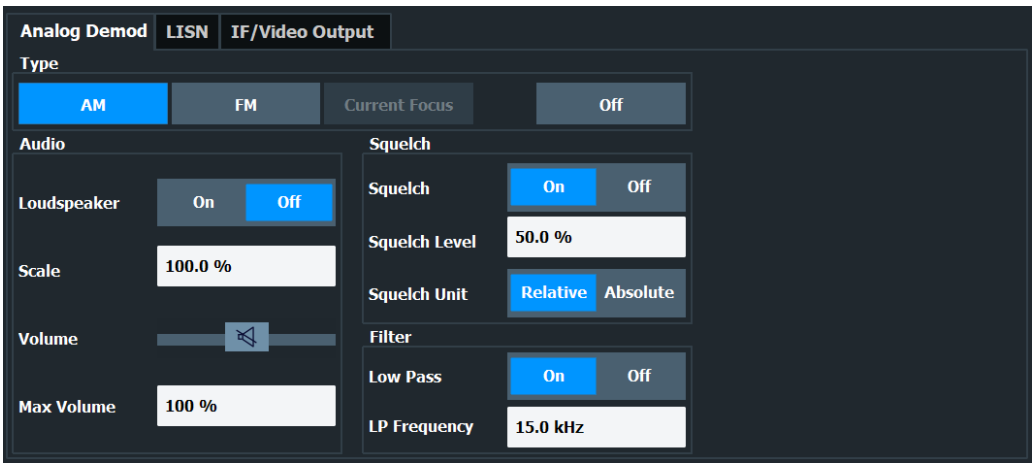
Remote command:
`INPut<ip>:PRESelection:BYPass` on page 424

10.5.3 Configuring outputs (IF / video / demodulation)

Access: "Overview" > "Output" > "Output Config"

The R&S EPL1000 provides several outputs. The R&S EPL1000 allows you to configure the output as required.

For details on the connectors refer to Chapter 6, "Instrument tour", on page 35.



The remote commands required to configure the outputs are described in Chapter 15.6.2, "Output configuration", on page 426.

Selecting the output type....131
└ Configuring the output of the IF signal....131
└ Configuring the output of the Video signal....131
└ Configuring the output of an AM signal....131
└ Configuring the output of an FM signal....132
Controlling and configuring the output....132
└ IF Output Frequency....132
└ Low Pass....132
└ Loudspeaker....132
└ Squelch....132
└ Scale....133
Controlling the volume....133

Selecting the output type
Selects the type of analog signal you want to output.

"IF Output" — Outputs the IF signal (see "Configuring the output of the IF signal" on page 131 for available settings).
Access: "Output" > "IF / Video Output"

"Video" — Outputs the video signal (see "Configuring the output of the Video signal" on page 131 for available settings).
Access: "Output" > "IF / Video Output"

"AM" — Outputs the AM demodulated signal (see "Configuring the output of an AM signal" on page 131 for available settings).
Access: "Output" > "Analog Demod"

"FM" — Outputs the FM demodulated signal (see "Configuring the output of an FM signal" on page 132 for available settings).
Access: "Output" > "Analog Demod"

"Current Focus" — Outputs the data of the currently selected measurement window (highlighted with a blue frame).
Available in the Analog Modulation Analysis application.

"Off" — Turns off the output.
Note that you can only turn off audio output (AM / FM). One of either IF or video output is always on.

Remote command:
`OUTPut<ou>:IF[:SOURce]` on page 428

Configuring the output of the IF signal ← Selecting the output type
For the output of the IF signal, you can adjust the following parameters.
- "IF Output Frequency" on page 132

Configuring the output of the Video signal ← Selecting the output type
Additional settings for video signal output are not supported.

Configuring the output of an AM signal ← Selecting the output type
For the output of AM demodulated signals, you can adjust the following parameters.
- "Scale" on page 133
- "Low Pass" on page 132

- "Loudspeaker" on page 132

Configuring the output of an FM signal ← Selecting the output type
For the output of FM demodulated signals, you can adjust the following parameters.

- "Scale" on page 133
- "Low Pass" on page 132
- "Loudspeaker" on page 132

Controlling and configuring the output
Depending on the selected output type, you can configure one or more of the following output characteristics.

IF Output Frequency ← Controlling and configuring the output
Defines the output frequency of the IF signal.

The IF signal has an fixed output frequency of 25 MHz.

Remote command:
not supported

Low Pass ← Controlling and configuring the output
Turns a low pass filter to control the frequencies that are output on and off.

When you turn on the filter, you can define its **cutoff frequency**. The available cutoff frequencies depend on the type of output and the individual settings of the selected output type.

Remote command:
`OUTPut<ou>:IF:LPASs[:STATe]` on page 427
`OUTPut<ou>:IF:LPASs:FREQuency:MANual` on page 427

Loudspeaker ← Controlling and configuring the output
Turns the loudspeaker on and off.

When you turn on this feature, you can listen to the signal with speakers or headphones connected to the headphone jack on the rear panel. To control the volume of the output, use either the volume control knob on the front panel or the volume slider.

Remote command:
`OUTPut<ou>:IF:AUDio` on page 426

Squelch ← Controlling and configuring the output
You can suppress noise during audio output over the headphone jack for demodulated AM or FM signals with the "Squelch" feature.

When you turn on this feature, you can define a relative "Squelch Level" in %, below which the signal is not demodulated (and thus not audible). The squelch level is indicated by a red line in the diagram.

Alternatively, you can define the squelch level as an absolute value ("Squelch Unit"). The unit depends on the unit you have currently selected for the measurement.

Remote command:
[SENSe:]DEMod:SQUelch[:STATe] on page 429
[SENSe:]DEMod:SQUelch:LEVel on page 428
Absolute squelch level: [SENSe:]DEMod:SQUelch:LEVel:ABSolute on page 429

Scale ← Controlling and configuring the output
Defines the scale for the data you are transferring.

The unit depends on the signal type you are transferring.
- AM signals: a value in %.
- FM signals: a value in Hz

Remote command:
OUTPut<ou>:IF:SCALe[:VALue] on page 427

Controlling the volume
CAUTION! Risk of hearing damage. To protect your hearing, make sure that the volume setting is not too high before putting on the headphones.

When you output an audio signal and listen to it with headphones, for example, you can control the volume of the output.

Use the **volume control slider** to define the volume. The volume is a percentage from 0 % to 100 % with 100 % being the loudest.

Tip: You can open the volume control easily with the loudspeaker icon the the status bar (50 %).

In addition to simply changing the volume, you can also define a **maximum volume level**. The maximum volume level limits the audio output to a certain level.

The slider will not go further than this level.

Remote command:
Volume: SYSTem:SPEaker:VOLume on page 430
Maximum volume: SYSTem:SPEaker:MAXVolume on page 430
Mute: SYSTem:SPEaker:MUTE on page 430

10.5.4 Configuring LISNs

For more information see Chapter 9.3.6, "Configuring line impedance stabilization networks (LISN)", on page 119.

10.5.5 Configuring additional outputs

Access: "Overview" > "Output" > "IF/Video Output"

The R&S EPL1000 provides additional outputs that you can use for various tasks.

Note that the "Noise Source" output is not available in the receiver application.

The remote commands required to configure the outputs are described in Chapter 15.6.2.2, "Additional output", on page 431.

Functions in the "IF/Video Output" dialog box described elsewhere:

- Output type IF and video

Noise Source Control 134

Noise Source Control
Enables or disables the 28 V voltage supply for an external noise source connected to the "Noise source control / Power sensor") connector. By switching the supply voltage for an external noise source on or off in the firmware, you can enable or disable the device as required.

External noise sources are useful when you are measuring power levels that fall below the noise floor of the R&S EPL1000 itself, for example when measuring the noise level of an amplifier.

In this case, you can first connect an external noise source (whose noise power level is known in advance) to the R&S EPL1000 and measure the total noise power. From this value, you can determine the noise power of the R&S EPL1000. Then when you measure the power level of the actual DUT, you can deduct the known noise level from the total power to obtain the power level of the DUT.

Remote command:
`DIAGnostic:SERVice:NSOurce` on page 431

10.5.6 Internal generator

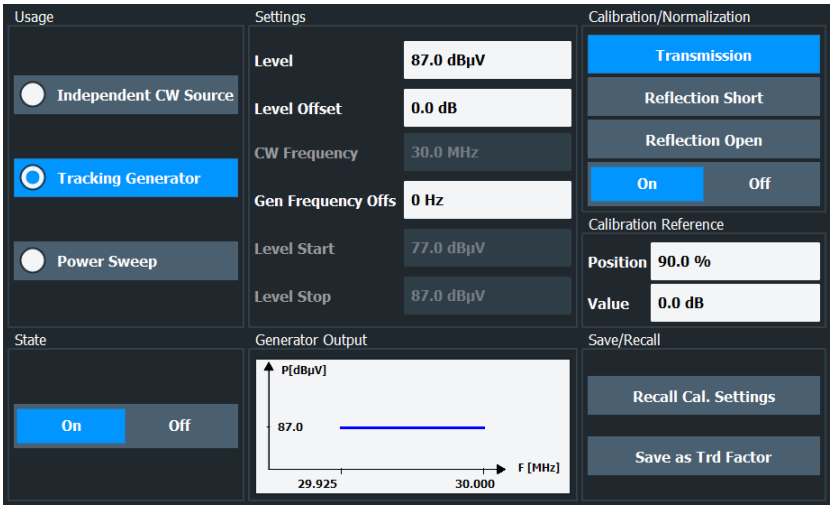
Access: "GEN State"

Access: "GEN Config"

The internal generator provides a signal at the generator output on the front panel of the R&S EPL1000.

Note that the full set of generator settings is only available in the spectrum application. The other applications only provide the following subset of settings.

- Generator state
- Output level
- Level offset
- Frequency



The remote commands required to configure the internal generator are described in Chapter 15.6.3, "Generator configuration", on page 431.

- Basics on the internal generator 135
- Configuring the generator 142
- How to work with the tracking generator 148

10.5.6.1 Basics on the internal generator

The internal generator emits a signal at a specified frequency. The generated signal is sent to the GEN Output 50 Ω connector. You can connect your DUT to the output connector, thus allowing the analyzer to control the input signal for the device directly.

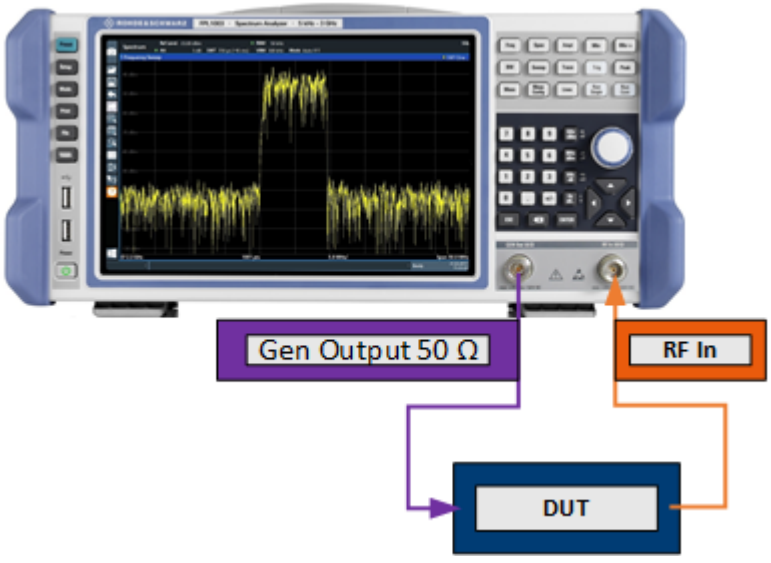
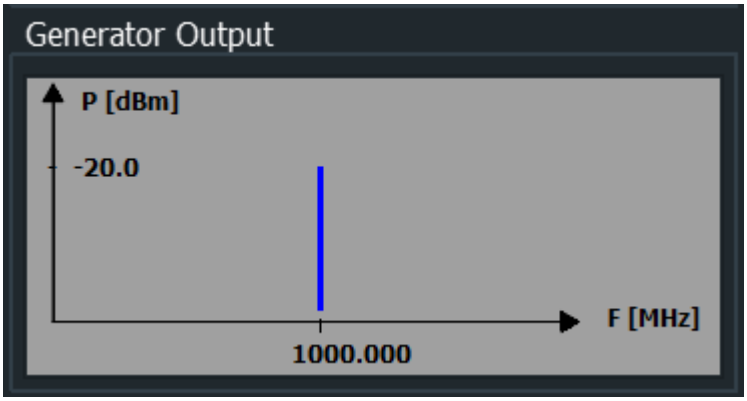


Figure 10-1: Test setup using the internal generator

You can enable or disable and configure the generator individually for each application. Different usages are provided for various measurement scenarios.

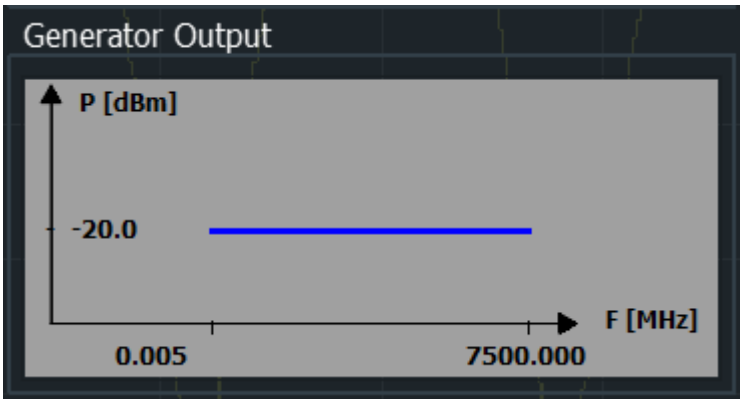
Independent CW source

The internal generator can be used as an independent CW source for a DUT in all applications on the R&S EPL1000. In this case, the frequency of the internal generator is independent of the analyzer input.



Tracking generator

The frequency of the internal generator can be coupled to the input frequency of the analyzer, so that the input signal for the DUT tracks (or follows) the input signal of the analyzer. This function is referred to as a tracking generator.



Frequency coupling is useful for test scenarios for which a signal generator is required, but an additional instrument is too expensive or takes up too much space.

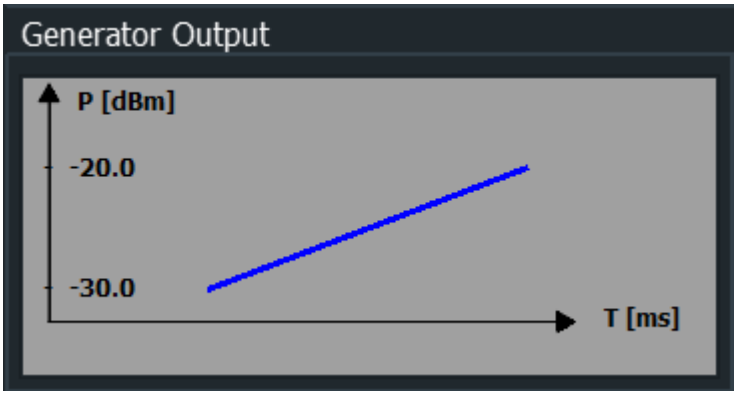
When using the internal generator as a tracking generator, the R&S EPL1000 also allows you to set a frequency offset for frequency-converting measurements.

Using the internal generator as a tracking generator is only available in the Spectrum application for frequency sweeps. If you switch to another application, a currently active tracking generator is disabled.

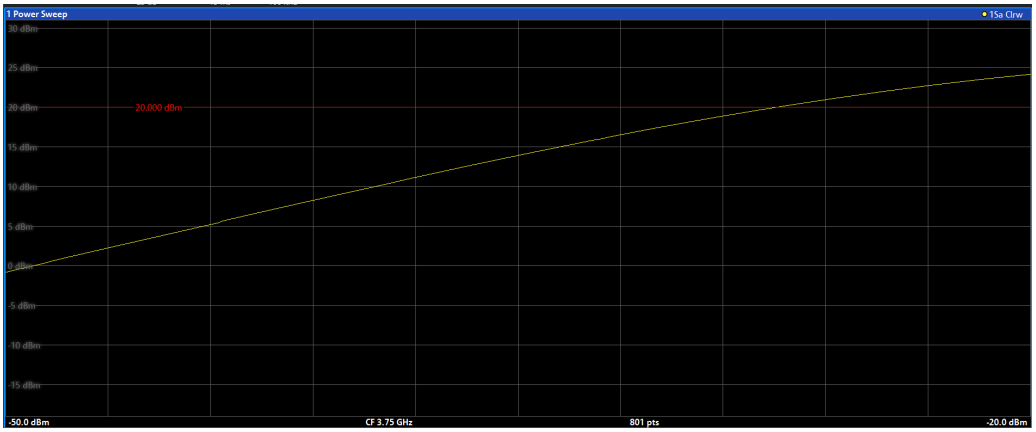
Power sweep

For a power sweep measurement, the internal generator signal remains at a fixed frequency, but increases its power level within a specified range over time. The default frequency of the internal generator is coupled to the (center) frequency of the analyzer

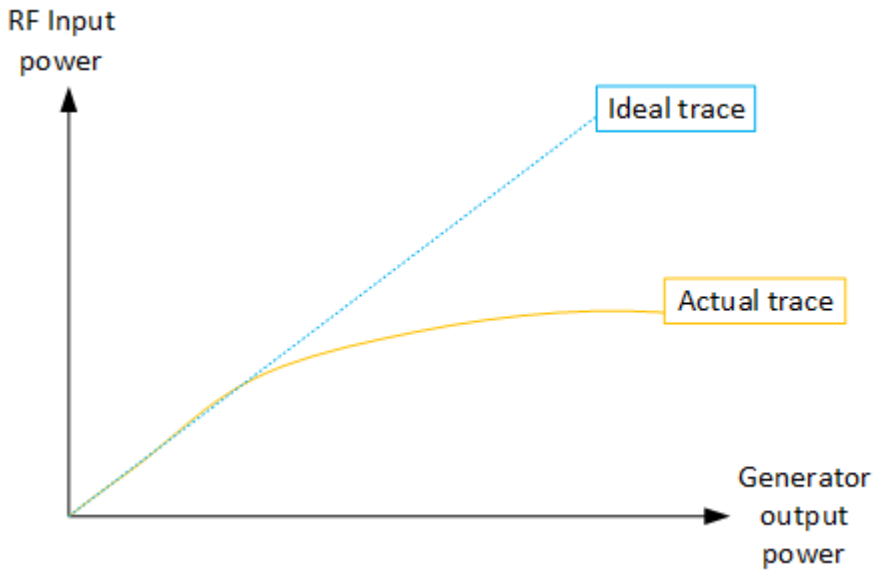
and can be set from 5 kHz to the maximum frequency of the R&S EPL1000. However, you can define an offset for the internal generator frequency.



As a result, the measured power levels at the RF input are displayed versus the provided power levels of the internal generator output.



Thus, you can use the internal generator signal as a reference input signal for your power-converting DUT. Then you can compare the DUT input to its output at the RF input of the analyzer. Ideally, the result is a linear trace, that is: the output is directly proportional to the input power. Any distortion to the linear trace indicates the effects of the DUT. This result is useful, for example, to determine the compression point for amplifiers.



Calibration mechanism

A common measurement setup includes a signal generator, a device under test (DUT), and a signal and spectrum analyzer. Therefore, it is useful to measure the attenuation or gain caused by the cables and connectors from the signal generator and the signal analyzer in advance. The known level offsets can then be removed from the measurement results to obtain accurate information on the DUT.

Calculating the difference between the currently measured power and a reference trace is referred to as *calibration*. Thus, the measurement results from the internal generator - including the inherent distortions - can be used as a reference trace to calibrate the measurement setup.

The inherent frequency and power level distortions can be determined by enabling the use of the internal generator as a tracking generator. The analyzer sends a predefined list of frequencies to the internal generator. The frequency list for the calibration sweep contains 201 values by default, divided in equidistant frequencies between the analyzer's start and stop frequency. The internal generator then sends a signal with the specified level at each frequency in the predefined list. The analyzer measures the signal and determines the level offsets to the expected values.

Saving calibration results

A reference dataset for the calibration results is stored internally as a table of value pairs (frequency/level), one for each sweep point. The measured offsets can then be used as calibration factors for subsequent measurement results. The calibration data can also be stored permanently with the instrument settings using the "Save" function in the toolbar.

The calibration can be performed using either transmission or reflection measurements. The selected type of measurement used to determine the reference trace is included in the reference dataset.

Normalization

Once the measurement setup has been calibrated and the reference trace is available, subsequent measurement results can be corrected according to the calibration factors, if necessary. Correction is done by subtracting the reference trace from the measurement results. The resulting level values are provided in dB. This process is referred to as *normalization*. Normalization is automatically enabled after calibration, but it can be enabled or disabled as required. If normalization is enabled, "NOR" is displayed in the channel bar, next to the indication that a tracking generator is being used ("Trk.Gen"). The normalized trace from the calibration sweep is a constant 0 dB line, as <calibration trace> - <reference trace> = 0.

As long as the same settings are used for measurement as for calibration, the normalized measurement results should not contain any inherent frequency or power distortions. Thus, the measured DUT values are very accurate.

Approximate normalization

If any of the calibration measurement settings are changed, the stored reference trace is no longer identical to the new measurement results. However, if the measurement settings do not deviate too much, the measurement results can still be normalized *approximately* using the stored reference trace. Approximate normalization is indicated by the "APX" label in the channel bar (instead of "NOR").

Approximate normalization occurs if one or more of the following values deviate from the calibration settings:

- Coupling (RBW, VBW, SWT)
- Reference level, RF attenuation
- Start or stop frequency
- Output level of internal generator
- Detector (max. peak, min. peak, sample, etc.)
- Frequency deviation at a maximum of 201 points within the set sweep limits (corresponds to a doubling of the span)

Differences in level settings between the reference trace and the current instrument settings are taken into account automatically. If the span is reduced, a linear interpolation of the intermediate values is applied. If the span increases, the values at the left or right border of the reference dataset are extrapolated to the current start or stop frequency, i.e. the reference dataset is extended by constant values.

Thus, the instrument settings can be changed in a wide area without giving up normalization. This reduces the necessity to carry out a new normalization to a minimum.

The normalized trace in the display

The normalized reference trace is also displayed in the spectrum diagram, by default at the top of the diagram (90% of the window height). It is indicated by a red line labeled "NOR", followed by the current reference value. However, it can be shifted vertically to reflect an attenuation or gain caused by the measured DUT (see also "Shifting the reference line (and normalized trace)" on page 141).

Restoring the calibration settings

If the measurement settings no longer match the instrument settings with which the calibration was performed (indicated by the "APX" or no label next to "Trk.Gen" in the channel bar), you can restore the calibration settings, which are stored with the reference dataset on the R&S EPL1000.

Storing the normalized reference trace as a transducer factor

The (inverse) normalized reference trace can also be stored as a *transducer factor* for use in other R&S EPL1000 applications that do not support the use of the tracking generator. The normalized trace data is converted to a transducer with unit dB and stored in a file with the specified name and the suffix `.tdf` under `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\trd`. The frequency points are allocated in equidistant steps between the start and stop frequency.

Defining transducer factors are useful, for example, to determine the effects of a particular device component and then remove these effects from a subsequent measurement which includes this component.

For an example, see "How to remove the effects of a particular component from measurement results using calibration" on page 149.

Note that the *normalized* measurement data is stored, not the original *reference* trace! Thus, if you store the normalized trace directly after calibration, without changing any settings, the transducer factor is 0 dB for the entire span (by definition of the normalized trace).

Reference trace, reference line and reference level

Reference trace

The calibration results are stored internally on the R&S EPL1000 as a *reference trace*. For each measured sweep point, the offset to the expected values is determined. If normalization is activated, the offsets in the reference trace are removed from the current measurement results to compensate for the inherent distortions.

Reference line

The reference line is defined by the Reference Value and Reference Position in the "Internal Generator" > "Source Calibration" settings. It is similar to the reference level defined in the "Amplitude" settings. However, as opposed to the reference *level*, this reference *line* only affects the y-axis scaling in the diagram. It has no effect on the expected input power level or the hardware settings.

The reference line determines the range and the scaling of the y-axis, just as the reference level does.

The normalized reference trace (0 dB directly after calibration) is displayed on this reference line, indicated by a red line in the diagram. By default, the reference line is displayed at the top of the diagram (90% of the window height). If you shift the reference line, the normalized trace is shifted, as well.

Shifting the reference line (and normalized trace)

You can shift the reference line - and thus the normalized trace - in the result display by changing the Reference Position or the Reference Value.

If the DUT inserts a gain or an attenuation in the measurement, this effect can be reflected in the result display on the R&S EPL1000. To reflect a power offset in the measurement trace, change the Reference Value.

Displayed information and errors

Channel bar

If internal generator control is active, some additional information is displayed in the channel bar.

Label	Description
"CWSource:" <source power>	Internal generator in operation as independent CW source with specified level
"Trk.Gen:" <source power>	Internal generator active; signal sent with <source power> level
"NOR"	Normalization on; No difference between reference setting and measurement
"APX" (approximation)	Normalization on; Deviation from the reference setting occurs

Error and status messages

The following status and error messages can occur during internal generator control.

Message	Description
"Generator Frequency Limits Exceeded!"	The allowed frequency ranges for the generator were exceeded (see data sheet)
"Generator Level Overrange" / "Generator Level Underrange"	The power level exceeds the range specified in the data sheet
"Generator Maximum Level Exceeded"	The power level exceeds the maximum available output level of the internal generator

NOTICE

Overloading

At a reference level of -13 dBm and at an internal generator output level of the same value, the R&S EPL1000 operates without overrange reserve. That means the R&S EPL1000 is in danger of being overloaded if a signal is applied whose amplitude is higher than the reference line. In this case, an overload message is displayed in the status line.

Overloading can be avoided as follows:

- Reducing the output level of the internal generator ("Level" on page 143)
- Increasing the reference level

10.5.6.2 Configuring the generator

You can select one of several types of signal provided by the internal generator:

- "Independent CW source settings" on page 142: constant frequency and power level
- "Tracking generator settings" on page 143: constant power level, frequency follows analyzer frequency (only available for frequency sweeps in the Spectrum application)
- "Power sweep" on page 136: constant frequency, linearly increasing power level (only available in the Spectrum application)

SCPI commands

`SOURce<si>:FREQuency:COUPling[:STATe]` on page 435

`SOURce<si>:POWer:MODE` on page 436

- Independent CW source settings....142
- Tracking generator settings....143
- Power sweep settings....146

Independent CW source settings

Access: "GEN Config" > "Independent CW Source"

The preview in the dialog box visualizes the configured signal from the internal generator.

State....142
Level....143
Level Offset....143
CW Frequency....143

State

Enables or disables the internal generator. The generator signal is output at the GEN Output 50 Ω connector on the front panel.

Remote command:
OUTPut<up>[:STATe] on page 434

Level
Defines the output power of the internal generator.

The default output power is -20 dBm. The range is from -60 dBm to +10 dBm.

Remote command:
SOURce<si>:POWer[:LEVel][:IMMediate][:AMPLitude] on page 435

Level Offset
Defines an offset to the output power of the internal generator.

Used to adapt the level display, for example to cable loss.

Remote command:
SOURce<si>:POWer[:LEVel][:IMMediate]:OFFSet on page 435

CW Frequency
Defines the frequency of the independent CW source. The step size depends on the measurement mode.

If the internal generator is used as a tracking generator, the frequency is coupled to the frequency of the analyzer. Thus, this setting is not available.

Remote command:
SOURce<si>:INTernal:FREQuency on page 434

Tracking generator settings

Access: "GEN Config" > "Tracking Generator"

The tracking generator signal is only available for frequency sweeps in the spectrum application.

The preview in the dialog box visualizes the configured signal from the internal tracking generator.

State....143
Level....144
Level Offset....144
CW Frequency....144
Frequency Offset....144
Calibrate Transmission....144
Calibrate Reflection Short....144
Calibrate Reflection Open....145
Normalization state....145
Reference Position....145
Reference Value....145
Recall Cal. Settings....146
Save as Trd Factor....146

State
Enables or disables the internal generator. The generator signal is output at the GEN Output 50 Ω connector on the front panel.

Remote command:
OUTPut<up>[:STATe] on page 434

Level
Defines the output power of the internal generator.

The default output power is -20 dBm. The range is from -60 dBm to +10 dBm.

Remote command:
SOURce<si>:POWer[:LEVel][:IMMediate][:AMPLitude] on page 435

Level Offset
Defines an offset to the output power of the internal generator.

Used to adapt the level display, for example to cable loss.

Remote command:
SOURce<si>:POWer[:LEVel][:IMMediate]:OFFSet on page 435

CW Frequency
Defines the frequency of the independent CW source. The step size depends on the measurement mode.

If the internal generator is used as a tracking generator, the frequency is coupled to the frequency of the analyzer. Thus, this setting is not available.

Remote command:
SOURce<si>:INTernal:FREQuency on page 434

Frequency Offset
Shifts the frequency of the internal generator by the defined offset.

The default frequency of the internal generator is coupled to the (center) frequency of the analyzer and can be set from 5 kHz to the maximum frequency of the R&S EPL1000.

Remote command:
SOURce<si>:INTernal:FREQuency:OFFSet on page 436

Calibrate Transmission
Starts a transmission type measurement to determine a reference trace. This trace is used to calculate the difference for the normalized values.

Remote command:
[SENSe:]CORRection:METHod on page 432

Calibrate Reflection Short
Starts a short-circuit reflection type measurement to determine a reference trace for calibration.

If both calibrations (open circuit, short circuit) are carried out, the calibration trace is calculated by averaging the two measurements. The order of the two calibration measurements is irrelevant.

Remote command:
[SENSe:]CORRection:METHod on page 432
Selects the reflection method.

[SENSe:]CORRection:COLLect[:ACQuire] on page 432
Starts the sweep for short-circuit calibration.

Calibrate Reflection Open
Starts an open-circuit reflection type measurement to determine a reference trace for calibration.

If both reflection-type calibrations (open circuit, short circuit) are carried out, the reference trace is calculated by averaging the two measurements. The order of the two calibration measurements is irrelevant.

Remote command:
[SENSe:]CORRection:METHod on page 432
Selects the reflection method.
[SENSe:]CORRection:COLLect[:ACQuire] on page 432
Starts the sweep for open-circuit calibration.

Normalization state
Switches the normalization of measurement results on or off. This function is only available if the memory contains a reference trace, that is, after a calibration has been performed.

Remote command:
[SENSe:]CORRection[:STATe] on page 431

Reference Position
Defines the position of the reference line in percent of the total y-axis range.

The top of the diagram is 100%, the bottom is 0%. By default, the 0 dB line is displayed at 90% of the diagram height.

This setting is only available if normalization is on (see " Normalization state" on page 145).

The reference line defined by the reference value and reference position is similar to the reference level defined in the "Amplitude" settings. However, this reference line only affects the y-axis scaling in the diagram, it has no effect on the expected input power level or the hardware settings.

The normalized trace (0 dB directly after calibration) is displayed on this reference line, indicated by a red line in the diagram. If you shift the reference line, the normalized trace is shifted, as well.

Remote command:
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition on page 433

Reference Value
Defines an offset for the position of the reference line.

This setting can be used to shift the reference line and thus the normalized trace, similar to the reference level defined in the "Amplitude" settings shifts the reference level *in the display*.

Shifting the normalized trace is useful, for example, to reflect an attenuation or gain caused by the measured DUT. If you then zoom into the diagram around the normalized trace, the measured trace still remains fully visible.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue` on page 434

Recall Cal. Settings
Restores the settings that were used during source calibration. This can be useful if instrument settings were changed after calibration (e.g. center frequency, frequency deviation, reference level, etc.).

Remote command:
`[SENSe:]CORRection:RECall` on page 433

Save as Trd Factor
Uses the normalized measurement data to generate a transducer factor. The trace data is converted to a transducer with unit dB and stored in a file with the specified name and the suffix `.trd` under `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\trd`. The frequency points are allocated in equidistant steps between start and stop frequency.

The generated transducer factor can be further adapted using the "Transducer" function in the [Setup] menu.

"File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.

Note: Note that the *normalized* measurement data is used, not the *reference* trace! Thus, if you store the normalized trace directly after calibration, without changing any settings, the transducer factor is 0 dB for the entire span (by definition of the normalized trace).

Remote command:
`[SENSe:]CORRection:TRANsducer:GENerate` on page 433

Power sweep settings

Access: "GEN Config" > "Power Sweep"

The power sweep is only available in the spectrum application.

The preview in the dialog box visualizes the configured signal from the internal tracking generator.

State 147
Level Offset 147
PS Frequency 147
Frequency Offset 147
Level Start / Level Stop 147
Calibrate Transmission 147
Normalization state 148

State
Enables or disables the internal generator. The generator signal is output at the GEN Output 50 Ω connector on the front panel.

Remote command:
OUTPut<up>[:STATe] on page 434

Level Offset
Defines an offset to the output power of the internal generator.

Used to adapt the level display, for example to cable loss.

Remote command:
SOURce<si>:POWer[:LEVel][:IMMediate]:OFFSet on page 435

PS Frequency
Defines the frequency of the internal generator signal for a power sweep measurement. This frequency corresponds to the center frequency of the RF measurement.

Remote command:
[SENSe:]FREQuency:CENTer on page 440

Frequency Offset
Shifts the frequency of the internal generator by the defined offset.

The default frequency of the internal generator is coupled to the (center) frequency of the analyzer and can be set from 5 kHz to the maximum frequency of the R&S EPL1000.

Remote command:
SOURce<si>:INTernal:FREQuency:OFFSet on page 436

Level Start / Level Stop
Defines the start and stop levels of the output power of the internal generator. The power increases linearly within this range. Only ascending values are allowed, that is: the level start value must be lower than the level stop value.

The range is from -60 dBm to +10 dBm.

If a Level Offset is defined, the "Level Start" / "Level Stop" values are indicated with the offset applied.

Remote command:
SOURce<si>:POWer:STARt on page 436
SOURce<si>:POWer:STOP on page 437

Calibrate Transmission
Starts a transmission type measurement to determine a reference trace. This trace is used to calculate the difference for the normalized values.

Remote command:
[SENSe:]CORRection:METHod on page 432

Normalization state
Switches the normalization of measurement results on or off. This function is only available if the memory contains a reference trace, that is, after a calibration has been performed.

Remote command:
`[SENSe:]CORRection[:STATe]` on page 431

10.5.6.3 How to work with the tracking generator

The following step-by-step instructions demonstrate how to work with the optional tracking generator.

For remote operation, see Chapter 15.6.9, "Programming example for a tracking generator", on page 451.

- How to calibrate a measurement setup using a tracking generator 148
- How to remove the effects of a particular component from measurement results using calibration 149
- How to compensate for additional gain or attenuation after calibration 149

How to calibrate a measurement setup using a tracking generator

1. If the measurement setup does not require the full span of the R&S EPL1000, change the "Frequency Start" and "Frequency Stop" values ([FREQ] > "Frequency Config").

2. Select the "GEN Config" tool on the toolbar.
3. Select the "Usage": "Tracking Generator".
4. Set the "State" to "On".
5. Define the generator output level as the "Level".
6. Optionally, to define a constant level offset for the tracking generator, define a "Level Offset".
7. Select the "Source Calibration" type: "Transmission" to perform a calibration sweep and store a reference trace for the measurement setup.

   Normalization is automatically set to "On".
8. Optionally, shift the reference line further down in the result display by decreasing the "Reference": "Position".

   The measurement setup is now calibrated. Subsequent measurement results are normalized, so that any unwanted effects from the cables and connectors are removed.

How to remove the effects of a particular component from measurement results using calibration

1. Set up the measurement, including the component, and perform a calibration as described in "How to calibrate a measurement setup using a tracking generator" on page 148.
2. After calibration, select "Save as Trd Factor" to store the normalized reference trace as a transducer factor.
3. Select [Setup] > "Transducer".
4. Select the stored transducer in the list of available transducers and select the "Active" setting for it.
5. Perform any measurement with the setup that contains the calibrated component.

   The measurement results do not include the effects from the component.

How to compensate for additional gain or attenuation after calibration

If a gain or an attenuation is inserted in the measurement after calibration, this effect can be reflected in the display of the normalized trace on the R&S EPL1000. Thus, the measured trace and the normalized trace are not so far apart in the display, so that you can zoom into the normalized trace without cropping the measurement trace.

Prerequisite: a calibration has been performed for the original measurement setup, except for the component causing an additional gain or attenuation (as described in "How to calibrate a measurement setup using a tracking generator" on page 148.)

1. Insert the additional component in the calibrated measurement setup and perform a new measurement.

2. Select the "GEN Config" tool on the toolbar.
3. With active normalization, set the "Calibration Reference":" Value" to the same value as the gain or attenuation the inserted component causes.
4. Optionally, shift the reference line further down in the result display by decreasing the "Calibration Reference": "Position".

   The normalized reference trace moves to the position of the measured trace.
5. Optionally, zoom into the measured trace by changing the y-axis scaling (or the range: "AMPT > Scale Config > Range").

   The measured trace is still fully visible, and the absolute values are still valid.

10.6 Amplitude and vertical axis configuration

In the Receiver application, measurement results usually consist of the measured signal levels (amplitudes) displayed on the vertical (y-)axis for the determined frequency

spectrum or for the measurement time (horizontal, x-axis). The settings for the vertical axis, regarding amplitude and scaling, are described here.

- Increasing measurement sensitivity (or avoiding an input mixer overload)..... 150
- Amplitude settings..... 152
- Diagram scale..... 154
- Preselector..... 155

10.6.1 Increasing measurement sensitivity (or avoiding an input mixer overload)

Measurements often confront you with unknown or unintentional signals with unknown signal levels (and often with pulse characteristics). Such signals can either have very weak signal levels, in which case you might miss them during the measurement. Or they can have very strong signal levels, in which case they can damage the input mixer.

Protecting the input mixer

Always consider how to protect the input mixer from damage when setting up a measurement.

► **NOTICE!** EMC measurements often measure unknown signals that contain pulses with possibly strong signal levels. Strong signal levels can damage the input mixer.

Read the following topics carefully before you apply a signal to learn more about protecting the input mixer and avoid an overload.

Note that pulses have different level characteristics. Refer to the data sheet for more information on the allowed maximum pulse energy.

The signal level at the input mixer is calculated as follows.

Mixer Level = Input Level - attenuation + gain

The R&S EPL1000 is equipped with an overload protection mechanism. This mechanism becomes active as soon as the signal level at the input mixer exceeds the specified limit. It ensures that the connection between RF input and input mixer is cut off.

In this case, you must decrease the level at the RF input connector and then close the message box. Then measurements are possible again.

- Using the RF attenuator..... 150
- Using the preamplifier..... 151
- Using the preselector..... 152

10.6.1.1 Using the RF attenuator

The first tool provided by the R&S EPL1000 to control measurement sensitivity is the RF attenuator.

The RF attenuator is available in all hardware configurations of the R&S EPL1000.

Attenuation has the following effects on the measurement:

- High attenuation protects the input mixer: the main purpose of the attenuator is to protect the input mixer.
- High attenuation makes sure that the measurement results are reliable (signals that are stronger than allowed can distort the results)
- High attenuation helps you to avoid intermodulation
- High attenuation increases inherent noise (i.e. the noise floor) and thus decreases measurement sensitivity: if you increase attenuation by 10 dB, the sensitivity is reduced by 10 dB (in other words: the displayed noise increases by 10 dB)

Depending on the required test setup, you must find a compromise between a high sensitivity, low intermodulation and input mixer protection. We recommend to let the R&S EPL1000 determine the ideal attenuation automatically.

You can determine the attenuation automatically with the auto ranging feature in the receiver application and the auto attenuation feature in the other applications. Determining the attenuation automatically might not necessarily utilize the maximum dynamic range, but still yields valid and reliable results.

When you select the attenuation manually and are measuring unknown signals, especially DUTs with a high RFI voltage, always select the highest possible attenuation level before you apply the signal.

If you need a better sensitivity or signal-to-noise ratio, make sure that the applied signal does not exceed the specified limits, before you lower the attenuation.

For further protection of the input mixer, the R&S EPL1000 does not allow you to select attenuation levels of less than 10 dB unless you explicitly turn on this feature ("10 dB Minimum Attenuation").

Protecting the input mixer

1. **NOTICE!** EMC measurements often measure unknown signals that contain pulses with possibly strong signal levels. Strong signal levels can damage the input mixer.

   Select an appropriate attenuation when you measure unknown signals or RFI voltage in combination with an artificial network (LISN). Do not apply a 0 dB attenuation for such measurements.
   During phase switching, such test setups generate very strong pulses which can damage the input mixer.

2. Make sure that the signal level at the RF input does not exceed the allowed limits when you allow attenuation of less than 10 dB in combination with auto ranging
   Exceeding the limits can damage the input mixer.

10.6.1.2 Using the preamplifier

The second tool that allows you to control measurement sensitivity is the preamplifier.

Signal gain has the following effects on the measurement:

- The preamplifier allows you to detect even weak signals.

- The preamplifier reduces the noise figure of the R&S EPL1000 and thus increases its sensitivity. Thus, it is recommended to use the preamplifier for measurements that require maximum sensitivity.
- The preamplifier reduces the dynamic range. To perform a measurement using the maximum dynamic range, turn off the preamplifier.
- The preamplifier is located after the preselection filters, reducing the risk of overloading the input mixer by strong out-of-band signals.

The gain of the preamplifier is automatically considered in the level display. The disadvantage of a lower large-signal immunity (intermodulation) is reduced by the "preselector".

10.6.1.3 Using the preselector

The "preselector" is another tool to control measurement sensitivity.

Preselection has the following effects on the measurement:

- Preselection rejects most of the spectral energy which helps to protect the input mixer and thus makes sure that the measurement results are valid and reliable.
- Preselection filters out signals that you do not want to be displayed (selectivity) and thus allows you to analyze only the frequency range you are interested in.

The preselector of the R&S EPL1000 consists of several filters which are automatically applied during measurements. The filter that is used depends on the frequency that is currently measured. You can see the list of filters and the progress in the "Preselector" result display. The currently applied filter is indicated by a green LED, filters that are outside the scan range are ignored.

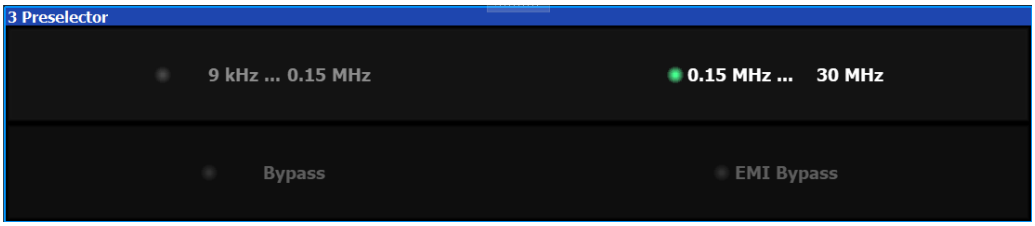


Figure 10-2: Preselector result display. The green LED indicates the currently applied filter.

Using the preselector

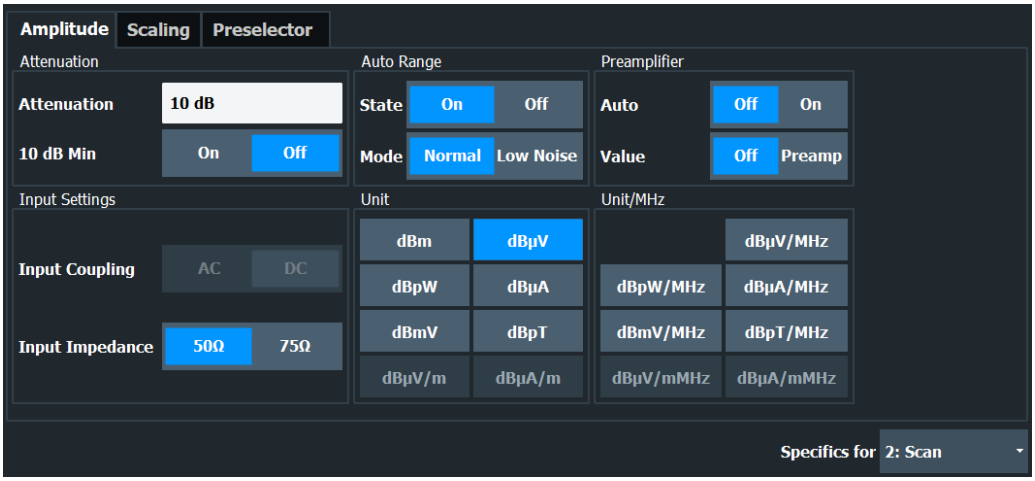
Switching the filters is a mechanical process. Avoid excessive filters switches, because the hardware can wear out.

Note that results in a frequency band are only displayed if there is at least one valid measurement point in the corresponding range. If a particular measurement point is captured by more than one filter, the R&S EPL1000 displays the combined results.

10.6.2 Amplitude settings

Access: "Overview" > "Amplitude" > "Amplitude"

Amplitude settings determine how the R&S EPL1000 processes or displays the input signals.



Functions in the "Amplitude" dialog box described elsewhere:

- "Attenuation" on page 105
- "Auto Range" on page 104
- "Preamplifier" on page 105
- "Input Coupling" on page 128
- "Impedance" on page 128

10 dB Minimum Attenuation 153
Unit 153
└ dBx/MHz 154

10 dB Minimum Attenuation
Turns the availability of attenuation levels of less than 10 dB on and off.

When you turn on this feature, the attenuation is always at least 10 dB. This minimum attenuation protects the input mixer and avoids accidental setting of 0 dB, especially if you measure EUTs with high RFI voltage.

When you turn it off, you can also select attenuation levels of less than 10 dB.

The setting applies to a manual selection of the attenuation as well as the automatic selection of the attenuation.

Notice: For more information, see Chapter 10.6.1, "Increasing measurement sensitivity (or avoiding an input mixer overload)", on page 150.

Remote command:
`INPut<ip>:ATTenuation:PROTection[:STATe]` on page 443

Unit
Selects the unit displayed on the vertical axis.

The unit on the vertical axis represents the unit the results are evaluated in. You can select one of the following units: dBm, dBµV, dBpW, dBµA, dBmV, dBpT.

Remote command:
CALCulate<n>:UNIT:POWer on page 441

dBx/MHz ← Unit
Turns the display of results in units relative to a 1 MHz bandwidth on and off.

You can normalize the following units to 1 MHz.

Unit	Relative unit
dBµV	dBµV/MHz
dBµV/m	dBµV/mMHz (Available for active transducers only.)
dBmV	dBmV/MHz
dBµA	dBµA/MHz
dBµA/m	dBµA/mMHz (Available for active transducers only.)
dBpW	dBpW/MHz
dBpT	dBpT/MHz

The conversion to 1 MHz bandwidth is realized via the pulse bandwidth of the selected resolution bandwidth.

Example:
Conversion example for dbµV:

$$P[dB\mu V/MHz] = P[dB\mu V] - 20 \cdot \log\left(\frac{B_{imp}[MHz]}{1MHz}\right)$$

P = Displayed level
B_{imp} = Pulse bandwidth of the selected RBW

If you are using another unit, replace "dBµV" with the corresponding unit.

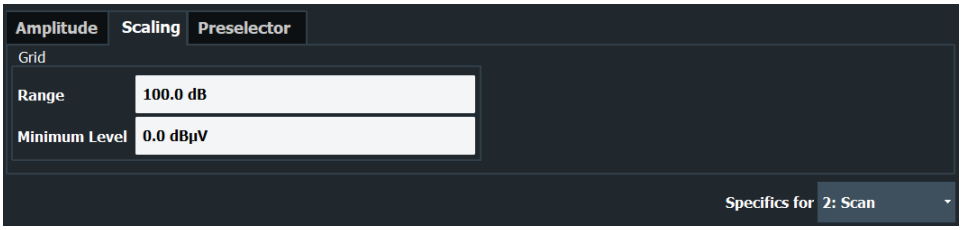
The conversion is also possible when a transducer defines the used unit.

Remote command:
CALCulate<n>:UNIT:POWer on page 441

10.6.3 Diagram scale

Access: "Overview" > "Amplitude" > "Scaling"

Scaling settings configure the vertical axis of diagrams.



Grid Range / Minimum Level.....155

Grid Range / Minimum Level
Defines the scale of the vertical diagram axis.

The display ranges go from 10 dB to 200 dB in 0.01 dB steps. Invalid entries or combinations of range and minimum level are rounded off to the nearest valid value.

- **"Range"**
  Defines the level display range for the scan diagram.
- **"Minimum Level"**
  Defines the minimum level of the display range.

Remote command:
Range: `DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]` on page 444
Min. level: `DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:BOTTom` on page 444

10.6.4 Preselector

For more information see Chapter 10.5.2, "Configuring the preselector", on page 129.

10.7 Frequency and span configuration

The frequency and span settings define the scope of the signal and spectrum that you want to analyze.

- Impact of the frequency and span settings..... 155
- Frequency and span settings.....158

10.7.1 Impact of the frequency and span settings

Some background knowledge on the impact of the described settings is provided here for a better understanding of the required configuration.

- Defining the scope of the measurement - frequency range..... 156
- Coping with large frequency ranges - logarithmic scaling.....156
- Keeping the center frequency stable - signal tracking..... 157

10.7.1.1 Defining the scope of the measurement - frequency range

The frequency range defines the scope of the signal and spectrum to be analyzed.

In the receiver application, the R&S EPL1000 supports several measurement concepts.

- Measurements over a specified frequency range
  The frequency range is defined by start and stop frequency. This concept is usually used by scans. If you are using a scan table, you can split the frequency range into several smaller subranges.
- Measurements on a single frequency
  The measurement is performed on a single frequency. This concept is used by bargraph measurements, for example.
- Measurements on a set of single frequencies
  The measurement is performed on a set of single frequencies that are within a specified frequency range. This concept is used by the final measurement, for example.
- Measurements within a frequency span around the receiver frequency
  The measurement shows the spectrum around the receiver frequency in greater detail. This concept is used by the IF analysis.

In any way, make sure that the receiver frequency is at least twice as large as the resolution bandwidth. If you use a frequency that is lower or equal to the measurement bandwidth, the R&S EPL1000 automatically reduces the measurement bandwidth.

10.7.1.2 Coping with large frequency ranges - logarithmic scaling

In a linear display, the frequencies are distributed linearly across the x-axis. That means the entire frequency range is divided by the number of measurement points, and the distance between measurement points is equal. Linear scaling is useful to determine precise frequencies within a small range.

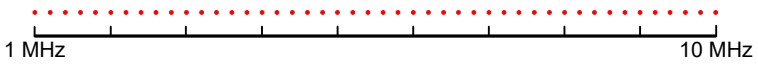


Figure 10-3: Linear x-axis scaling: the distance between the measurement points is equal, e.g. 200 kHz

However, if high and low frequencies appear in the same display, it is difficult to determine individual frequencies precisely or to distinguish frequencies that are close together.

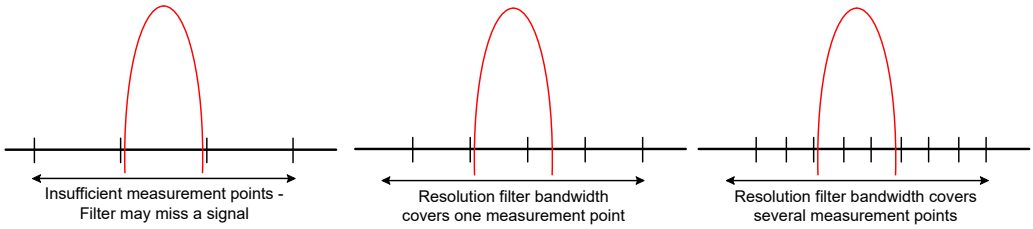
In a logarithmic display, lower frequencies are distributed among a much larger area of the display, while high frequencies are condensed to a smaller area. Now it is much easier to distinguish several lower frequencies, as they are spread over a wider area. Logarithmic scaling is useful for overview measurements when a large frequency range must be displayed in one diagram.

However, with logarithmic scaling, the frequency resolution between two measurement points deteriorates with higher frequencies.

Figure 10-4: Logarithmic x-axis scaling: the distance between measurement points is variable

In the spectrum from 10 Hz to 100 Hz, the distance is a few Hz. Between 100 MHz and 1 GHz, the distance is several MHz.

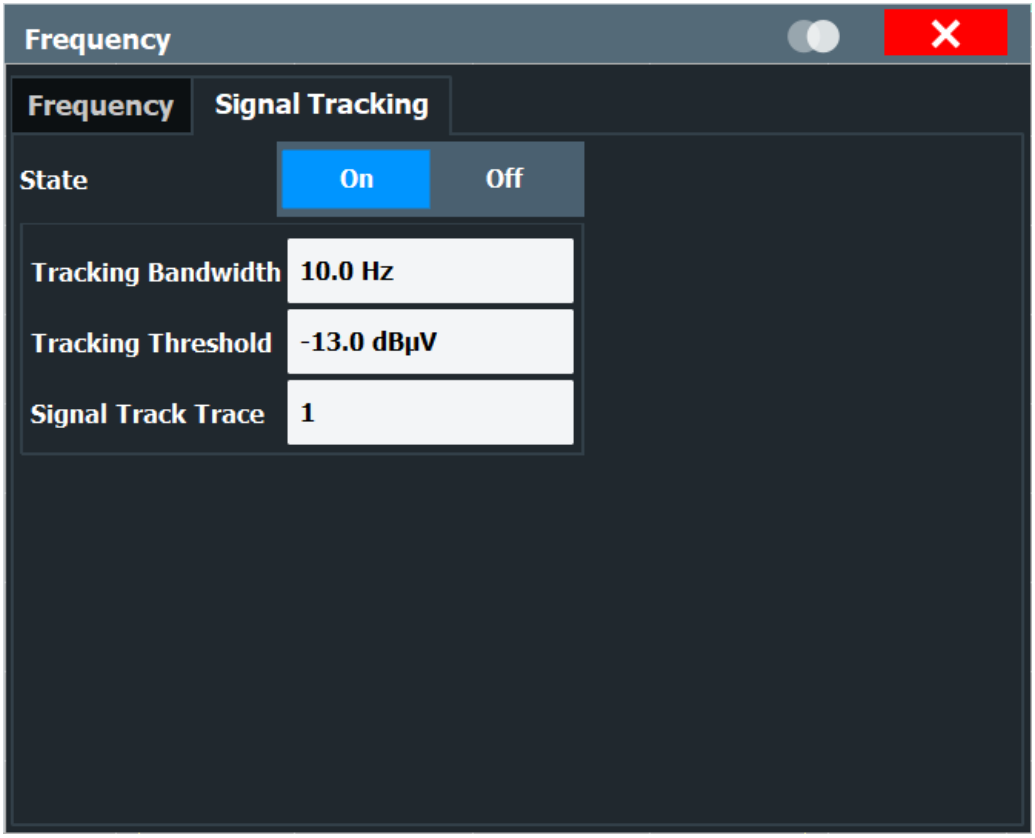
Thus, for logarithmic x-axis scaling, the number of measurement points must be sufficiently high in order to distinguish high frequencies precisely. The resolution bandwidth should cover at least one measurement point (that means: the distance between two measurement points should not exceed the RBW). If this condition is not met, signals or interferers could be missed, especially narrowband interferers.



10.7.1.3 Keeping the center frequency stable - signal tracking

Note: in the Receiver application, signal tracking is available for the IF analysis.

If the signal drifts on the display but you want to keep the center frequency on the signal peak, the center frequency can be adjusted automatically using **signal tracking**. In this case, the signal trace is surveyed in a specified bandwidth around the expected center frequency. After each sweep, the center frequency is set to the maximum signal found within the searched bandwidth. If no maximum signal above a defined threshold value is found in the searched bandwidth, the center frequency remains unchanged. The search bandwidth and the threshold value are shown in the diagram by red lines which are labeled as "TRK".



Signal Tracking
Access: "Overview" > "Frequency" > "Signal Tracking" tab

Defines the settings for signal tracking. These settings are only available for spans > 0.

If activated, after each sweep, the center frequency is set to the maximum level of the specified "Signal Track Trace" found within the searched "Tracking Bandwidth".

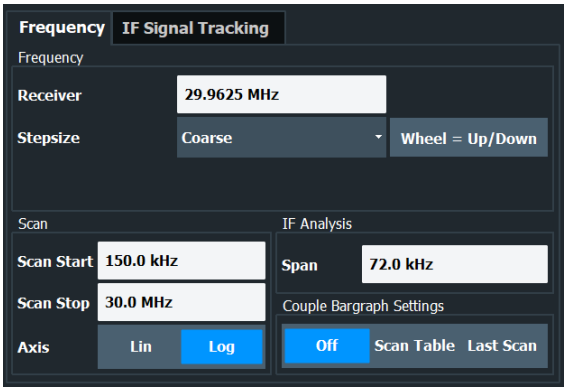
If the signal level does not pass the "Tracking Threshold", the center frequency is not changed.

Remote command:
`CALCulate<n>:MARKer<m>:FUNCtion:STRack[:STATe]` on page 438
`CALCulate<n>:MARKer<m>:FUNCtion:STRack:BANDwidth` on page 438
`CALCulate<n>:MARKer<m>:FUNCtion:STRack:THReshold` on page 438
`CALCulate<n>:MARKer<m>:FUNCtion:STRack:TRACe` on page 439

10.7.2 Frequency and span settings

Access (general frequency settings): "Overview" > "Frequency" > "Frequency"

Access (signal tracking): "Overview" > "Frequency" > "IF Signal Tracking"



Receiver Frequency 159
└ Synchronizing the receiver frequency to the marker frequency 159
Start / Stop Frequency 160
Frequency Axis Scale 160
Frequency Stepsize 160
Couple Bargraph Settings 161
IF Analysis 161
IF Signal Tracking 162

Receiver Frequency
Defines the receiver frequency.

For a scan, make sure to define a frequency that is at least twice as large as the resolution bandwidth. If you use a frequency that is lower, the R&S EPL1000 automatically reduces the bandwidth.

Tip: In the scan diagram, you can add a vertical line that represents the frequency that the R&S EPL1000 is currently tuned to (Tuned Frequency, available in the "Lines" menu).

Tip: You can lock the frequency with the corresponding button in the toolbar. If you turn on the frequency lock, the frequency does not change when you turn the rotary knob. Changing the frequency with the cursor keys or the numeric keys still works.

Remote command:
`[SENSe:]FREQuency:CENTer` on page 440

Synchronizing the receiver frequency to the marker frequency ← Receiver Frequency
When you are using a marker in the "Scan" result display, you can synchronize the receiver frequency with the current marker position by just moving the marker.

The R&S EPL1000 provides two methods to synchronize marker and receiver frequency.

- "Marker Tracking"
  Tracks the marker position when you move the marker and automatically synchronizes the receiver frequency with the new marker position.
  In that case, the bargraph always shows the level at the current marker position.
- "Tune to Marker"
  Synchronizes the receiver frequency and the current marker position once.

(In fact, this function only has an effect when "Marker Tracking" is turned off, because otherwise, the marker position and frequency are synchronized automatically.)

The R&S EPL1000 always synchronizes to the position of the currently selected marker, even if it is a relative delta marker.

The "Marker Tracking" and "Tune to Marker" softkeys are available in the "Marker To" softkey menu (accessible via the [MKR →] key).

Remote command:
Marker tracking: `CALCulate<n>:MARKer<m>:COUPled[:STATe]` on page 483
Tune to Marker: `CALCulate<n>:MARKer<m>:FUNCtion:CENTer` on page 437

Start / Stop Frequency
Defines the start and stop frequencies for the scan.

The range for the start frequency is f_{min} to (f_{max}- 10 Hz).

The range for the stop frequency is (f_{min} + 10 Hz) to f_{max}.

f_{min} and f_{max} are defined in the datasheet.

Remote command:
Start frequency: `[SENSe:]FREQuency:STARt` on page 393
Stop frequency: `[SENSe:]FREQuency:STOP` on page 394

Frequency Axis Scale
Selects the scale of the frequency axis.

Logarithmic scaling is only available for $f_{stop} \geq 1.4 * f_{start}$.

More information

"Linear" Selects a linear scaling of the frequency axis.

"Logarithmic" Selects a logarithmic scaling of the frequency axis.

Remote command:
`DISPlay[:WINDow<n>]:TRACe<t>:X:SPACing` on page 439

Frequency Stepsize
Defines the stepsize by which the receiver frequency is increased or decreased when you change it with the arrow keys or the rotary knob.

Note that the rotary knob and the arrow keys apply different steps.

When you turn on "Wheel = Up / Down", the rotary knob and cursor keys have the same step size (that of the cursor keys).

"Coarse" The stepsize is coupled to the receiver frequency.
- When you change the frequency with the rotary knob, the R&S EPL1000 increases or decreases the 4th digit of the receiver frequency.
- When you change the frequency with the arrow keys, the R&S EPL1000 increases or decreases the 2nd digit of the receiver frequency.

"Fine" The stepsize is coupled to the receiver frequency.
- When you change the frequency with the rotary knob, the R&S EPL1000 increases or decreases the 7th digit of the receiver frequency.
- When you change the frequency with the arrow keys, the R&S EPL1000 increases or decreases the 5th digit of the receiver frequency.

"Manual" The stepsize is a fixed custom value.
- When you change the frequency with the rotary knob, the R&S EPL1000 increases or decreases the frequency by 10 % of the manual stepsize.
- When you change the frequency with the arrow keys, the R&S EPL1000 increases or decreases the frequency by the manual stepsize.

"Frequency = Stepsize" The stepsize is equal to the current receiver frequency.
This option is useful for measurements of the harmonic content of a signal. Each change of the frequency selects the next harmonic.

"<x> * Meas BW" The stepsize is a percentage of the measurement bandwidth (10 %, 50 % or a custom percentage).

Remote command:
`[SENSe:]FREQuency:CENTer:STEP` on page 440

Couple Bargraph Settings
Couples or decouples the bargraph settings to the scan settings (or scan range if you are using a scan table).

"Off" Bargraph settings and scan settings are independent.

"Last Scan" Uses the configuration of the last scan.

"Scan Table" Uses the current configuration of the scan table, if you have changed it since the last scan.
(If you have not changed anything, the configuration of the last scan is still in effect.)

Remote command:
`[SENSe:]FREQuency:SCOupled` on page 441

IF Analysis
Defines the span and resolution bandwidth for IF analysis.

The **"Span"** defines the spectrum that is analyzed around the receiver frequency. When you change the span, the receiver frequency remains the same.

Tip: In the "IF Span" softkey menu, you can quickly set the **"Full IF Span"** and the **"Last IF Span"** with the corresponding softkeys. The last span is the span that was selected prior to the current span. You can access the "IF Span" menu via the [SPAN] key.

The **"Resolution Bandwidth"** (RBW) selects the width of the resolution filter that is used for IF spectrum analysis. Note that the available resolution bandwidths depend on the currently selected span.

In addition, you can couple the IF span to the Measurement Bandwidth (used for the bargraph).

When "IF Span Coupled" has been turned on, the IF span is a function of the measurement bandwidth.

Remote command:
Span: `[SENSe:]FREQuency:SPAN` on page 441
Full span: `[SENSe:]FREQuency:SPAN:FULL` on page 441
RBW: `[SENSe:]BANDwidth:IF` on page 445
IF span coupled: `[SENSe:]BANDwidth:SCPL` on page 446

IF Signal Tracking
Defines the characteristics for signal tracking.

When you turn on signal tracking, the R&S EPL1000 tracks the signal and updates the receiver frequency accordingly. The signal is assumed to be at highest level that has been found within the **tracking bandwidth**. The tracking bandwidth defines a search are around the receiver frequency.

You can also define a **tracking threshold**. If the signal level does not pass the threshold, the center frequency is not changed.

If you use more than one trace, you can select the **trace** signal tracking is applied to.

Signal tracking is available for IF spectrum analysis and for spans > 0.

More information.

Remote command:
State: `CALCulate<n>:MARKer<m>:FUNCtion:STRack[:STATe]` on page 438
Bandwidth: `CALCulate<n>:MARKer<m>:FUNCtion:STRack:BANDwidth` on page 438
Threshold: `CALCulate<n>:MARKer<m>:FUNCtion:STRack:THReshold` on page 438
Trace: `CALCulate<n>:MARKer<m>:FUNCtion:STRack:TRACe` on page 439

10.8 Bandwidth and filter configuration

The basic bandwidth, filter and sweep settings that apply to most measurements are described here. These parameters define how the data is measured and which filters are used.

- Impact of bandwidth and filter settings.....162
- Bandwidth and filter settings.....163

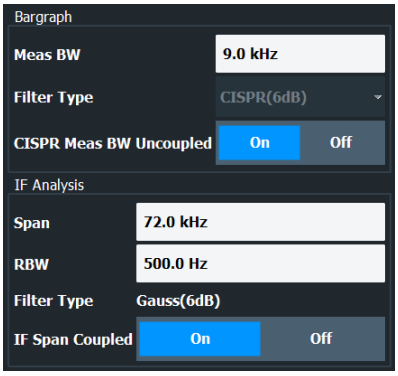
10.8.1 Impact of bandwidth and filter settings

For more background information about bandwidths and filters refer to the following topics:

- Chapter 9.3.1.1, "Selecting the measurement bandwidth", on page 86

10.8.2 Bandwidth and filter settings

Access: "Overview" > "Bandwidth"



Functions in the "Bandwidth" dialog box described elsewhere:

- "IF Analysis" on page 161
- "Measurement Bandwidth" on page 85
- "Filter Type" on page 85

CISPR RBW Uncoupled.....163

CISPR RBW Uncoupled
Cancels the coupling of the IF bandwidth to the frequency range with the activated quasipeak detector, CISPR average or RMS average detector.

See also Chapter 11.3.1.1, "Working with trace detectors", on page 178.

Remote command:
`[SENSe:]BANDwidth[:RESolution]:AUTO` on page 446

10.9 Trigger configuration

Triggering means to capture the interesting part of the signal. Choosing the right trigger type and configuring all trigger settings correctly allows you to detect various incidents in your signals.

- Basics on triggered measurements.....163
- Triggering measurements..... 166

10.9.1 Basics on triggered measurements

- Trigger offset..... 164
- Gated measurements.....164

10.9.1.1 Trigger offset

An offset can be defined to delay the measurement after the trigger event, or to include data before the actual trigger event in time domain measurements (pre-trigger offset). Pre-trigger offsets are possible because the R&S EPL1000 captures data continuously in the time domain, even before the trigger occurs.

See "Trigger Offset" on page 167.

10.9.1.2 Gated measurements

Like a gate provides an opening in a fence, a gated measurement lets data from the input signal pass in defined areas only. The *gate* controls exactly when data is included in the measurement results and when not. The gate is opened by the trigger source, which is also the gate source.

Gates can be used in two different modes:

- **Level:** The gate opens and the measurement starts when a defined level in the gate source is exceeded and stops when the gate source drops below the "Gate Level".
  Using a pulsed gate signal in level mode, the following behavior can be achieved: When the gate source signal is active, the input signal data is collected; when the gate signal is inactive, the input signal is ignored.
- **Edge:** The gate opens and the measurement starts when a defined level in the gate source is exceeded and stops when the defined "Gate Length" is reached.

Additionally, a delay time can be defined so that the first few measurement points after the gate opening are ignored.

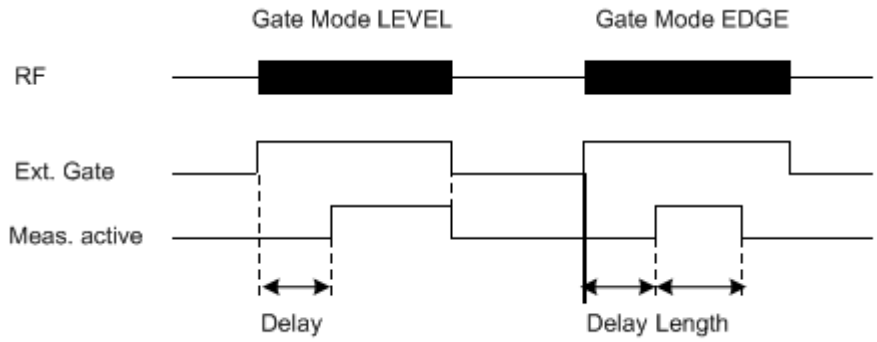


Figure 10-5: Effects of Gate mode, Gate delay and Gate length

Example:

By using a gate in sweep mode and stopping the measurement while the gate signal is inactive, the spectrum for pulsed RF carriers can be displayed without the superposition of frequency components generated during switching. Similarly, the spectrum can also be analyzed for an inactive carrier. The sweep can be controlled by an external gate or by the internal power trigger.

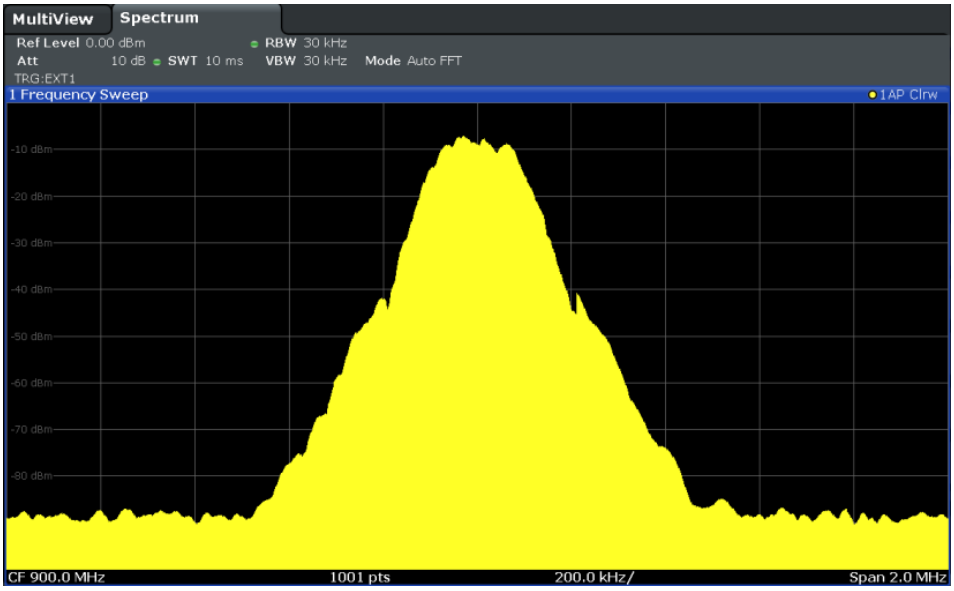


Figure 10-6: GSM signal with GATE OFF

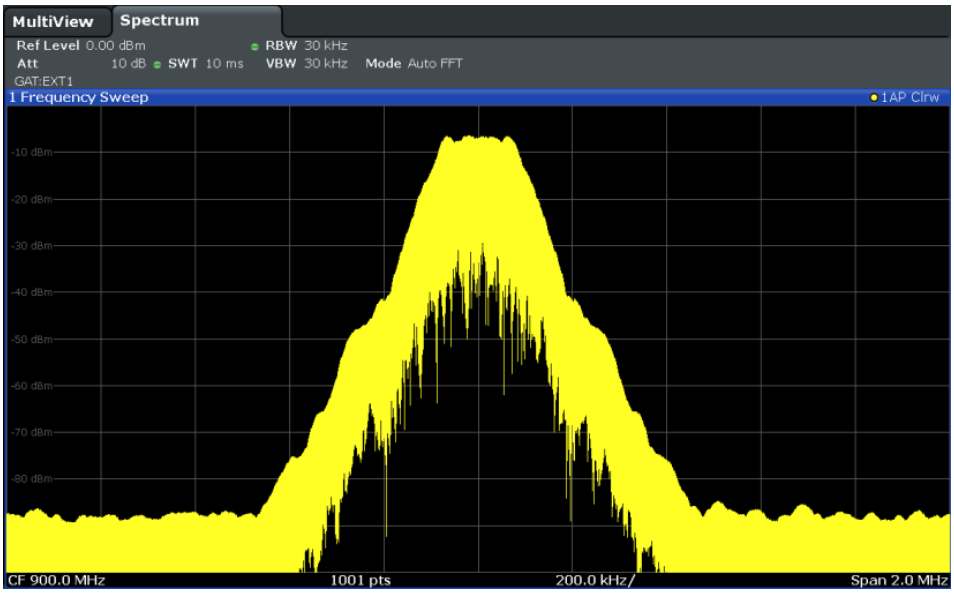


Figure 10-7: GSM signal with GATE ON

To indicate that a gate is used for the sweep, "GAT" and the gate source is displayed in the channel bar.

Gated measurements in receiver application

Gated measurements are also available in the receiver application. Basically, they work like gated measurements in the spectrum application with some distinctive features.

In the receiver application, a gated measurement affects the bargraph, scan and final measurement. They are useful, for example, when you only want to collect measurement data during times when a DUT is actually running and emits potential interfering signals, or in case you already know that interferers occur regularly and want to collect measurement data during the time when the interference is not present.

The following distinctive features apply.

- The scan is interrupted when the gate is closed. When it reopens, the scan is resumed on the last measured frequency (just like if you have interrupted the scan deliberately).
- Each measurement point is measured for a certain period of time (defined by the measurement time). If the gate closes before the R&S EPL1000 is done with any particular measurement point, the remaining time is measured when the gate opens again. The actual results in that case are the sum of the partial measurements.
  Example: The measurement time is 1 second. The gate closes after 0.6 seconds. The data that has already been collected is kept. When the gate opens again, the R&S EPL1000 resumes the measurement for another 0.4 seconds, and combines the two partial measurements.

10.9.2 Triggering measurements

Access (trigger source): "Overview" > "Trigger" > "Trigger Source"

Access (gate settings): "Overview" > "Trigger" > "Trigger Source"

Access (trigger input / output): "Overview" > "Trigger" > "Trigger In / Out"

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└ Free Run....167
└ External Trigger 1....167
Trigger Level....167
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Trigger Slope....167
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Gate Delay 168
Gate Length 168

Trigger Source
Selects the trigger source.

If you select a trigger source other than "Free Run", "TRG" is displayed in the channel bar and the trigger source is indicated.

Remote command:
`TRIGger<tp>[:SEQuence]:SOURce` on page 450

Free Run ← Trigger Source
No trigger source is considered. Data acquisition is started manually or automatically and continues until stopped explicitly.

In its default state, the R&S EPL1000 performs free run measurements.

Remote command:
`TRIGger<tp>[:SEQuence]:SOURce` on page 450

External Trigger 1 ← Trigger Source
Data acquisition starts when the TTL signal fed into the specified input connector meets or exceeds the specified trigger level.

For details, see the "Instrument Tour" chapter in the R&S EPL1000 Getting Started manual.

Remote command:
`TRIG:SOUR EXT`
`TRIGger<tp>[:SEQuence]:SOURce` on page 450

Trigger Level
Defines the trigger level for the selected trigger source.

The trigger level is always 1.4 V.

Remote command:
n/a

Trigger Offset
Defines the time offset between the trigger event and the start of the sweep.

For more information, see Chapter 10.9.1.1, "Trigger offset", on page 164.

"values > 0" Measurement starts after the trigger event has occurred.

"values < 0" Measurement starts before the trigger event occurs (pretrigger). The maximum allowed range is limited by the measurement time. Pretriggering is possible in the time domain.

Remote command:
`TRIGger<tp>[:SEQuence]:HOLDoff[:TIME]` on page 449

Trigger Slope
Selects the polarity of the trigger source.

The trigger slope is unavailable for the free run trigger.

"Rising" The measurement starts when the signal rises to the trigger level.

"Falling" The measurement starts when the signal falls down to the trigger level.

Remote command:
`TRIGger<tp>[:SEQuence]:SLOPe` on page 450

Gated Trigger
Switches gated triggering on or off.

Note: Gating is not available for time domain scans and measurements on I/Q based data.

Remote command:
`[SENSe:]SWEep:EGATe` on page 448

Gate Mode
Sets the gate mode.

For more information, see Chapter 10.9.1.2, "Gated measurements", on page 164

"Edge" The trigger event for the gate to open is the detection of the signal edge.
After the gate signal has been detected, the gate remains open until the gate length is over.

"Level" The trigger event for the gate to open is a particular power level.
After the gate signal has been detected, the gate remains open until the signal disappears.

Remote command:
`[SENSe:]SWEep:EGATe:TYPE` on page 449

Gate Delay
Defines the delay time between the gate signal and the continuation of the measurement.

In the Spectrum application, the delay position on the time axis in relation to the measurement is indicated by a line labeled "GD".

For more information, see Chapter 10.9.1.2, "Gated measurements", on page 164

Remote command:
`[SENSe:]SWEep:EGATe:HOLDoff` on page 447

Gate Length
Defines how long the gate is open when it is triggered.

The gate length can only be set in the edge-triggered gate mode. In the level-triggered mode the gate length depends on the level of the gate signal.

The gate length in relation to the sweep is indicated by a line labeled "GL".

In the Spectrum application, the gate length in relation to the measurement is indicated by a line labeled "GL".

For more information, see Chapter 10.9.1.2, "Gated measurements", on page 164

Remote command:
`[SENSe:]SWEep:EGATe:LENGth` on page 447

11 Common analysis and display functions

General methods and basic settings to display and analyze measurements, regardless of the operating mode, are described here. If you are performing a specific measurement task, using an application other than the Receiver application, be sure to check the specific application or mode description for settings and functions that may deviate from these common settings.

The analysis settings and functions are available via the "Analysis" dialog box, which is displayed when you select the "Analysis" button in the "Overview". Additional measurement-specific analysis functions may be available in separate tabs in the "Analysis" dialog box.

- Result display configuration 169
- Zoomed displays 174
- Trace configuration 178
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- Display and limit lines 223

11.1 Result display configuration

Measurement results can be evaluated in many different ways, for example graphically, as tables, statistical evaluations. Thus, the result display is highly configurable to suit your specific requirements and optimize analysis. Here you can find out how to work and lay out the result display.

General display settings that are usually configured during initial instrument setup, independently of the current measurement, for example which items or colors are displayed on the screen, are described in Chapter 13.2, "Display settings", on page 276.

- Basic evaluation methods 169
- Laying out the result display with the smartgrid 170

11.1.1 Basic evaluation methods

Measurement results can be displayed and evaluated using various different methods, also at the same time. You can control the type and number of results displays and evaluation methods with the SmartGrid functionality.

For more information about the features available through the SmartGrid, refer to the following topics.

- **Bargraph**
  - Chapter 9.2, "Bargraph configuration", on page 81
- **Scan**
  - "Scan" on page 91
  - Chapter 9.3.3, "Performing a scan", on page 98

- **IF analysis**
  - "IF analysis" on page 94
  - "IF Analysis" on page 161
- **Spectrogram** (for scan and IF analysis)
  - Chapter 11.3.1.3, "Working with spectrograms", on page 184
  - Chapter 11.3.7, "Spectrogram settings", on page 198
- **Marker table**
  - "Marker information in marker table" on page 211
- **Peak list**
  - Chapter 9.3.4, "Performing a peak search", on page 105
- **Final measurement**
  - "Final measurement" on page 94
  - Chapter 9.3.5, "Performing final measurements", on page 113
- **Preselector**
  - Chapter 10.5.2, "Configuring the preselector", on page 129
- **Fast access**
  - Chapter 10.1, "Using the fast access panel", on page 122
- **User port**
  - Chapter 10.2, "Using the user port panel", on page 124
- **Notes**
  - Chapter 10.3, "The notes display", on page 125

For more information about the SmartGrid in general, see Chapter 7.6.2, "Laying out the result display with the smartgrid", on page 64.

11.1.2 Laying out the result display with the smartgrid

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

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

- Windows can be arranged in columns or in rows, or in a combination of both.
- Windows can be arranged in up to four rows and four columns.
- Windows are moved simply by dragging them to a new position on the screen, possibly changing the layout of the other windows, as well.
- All evaluation methods available for the currently selected measurement are displayed as icons in the evaluation bar. If the evaluation bar contains more icons

than can be displayed at once on the screen, it can be scrolled vertically. The same evaluation method can be displayed in multiple windows simultaneously.

- New windows are added by dragging an evaluation icon from the evaluation bar to the screen. The position of each new window depends on where you drop the evaluation icon in relation to the existing windows.
- All display configuration actions are only possible in SmartGrid mode. When SmartGrid mode is activated, the evaluation bar replaces the current softkey menu display. When the SmartGrid mode is deactivated again, the previous softkey menu display is restored.

- Background information: the smartgrid principle....171
- How to activate smartgrid mode....172
- How to add a new result window....173
- How to close a result window....173
- How to arrange the result windows....174

11.1.2.1 Background information: the smartgrid principle

SmartGrid display

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

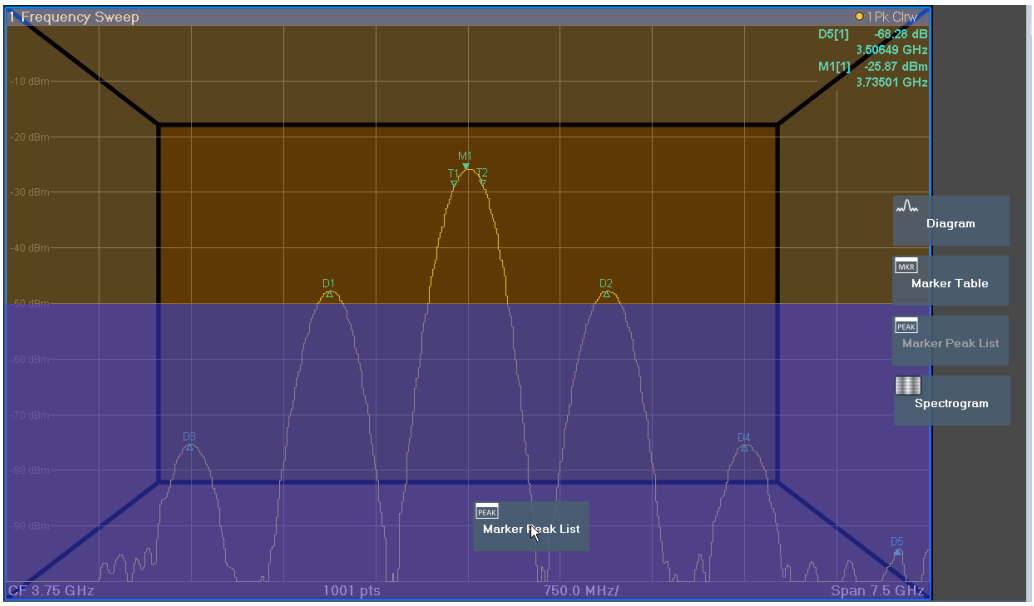

Figure 11-1: Moving a window in SmartGrid mode

The brown area indicates the possible "drop area" for the window, i.e. the area in which the window can be placed. A blue area indicates the (approximate) layout of the window as it would be if the icon were dropped at the current position. The frames indicate the possible destinations of the new window with respect to the existing windows:

above/below, right/left or replacement (as illustrated in Figure 7-6). If an existing window would be replaced, the drop area is highlighted in a darker color shade.

Positioning the window

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

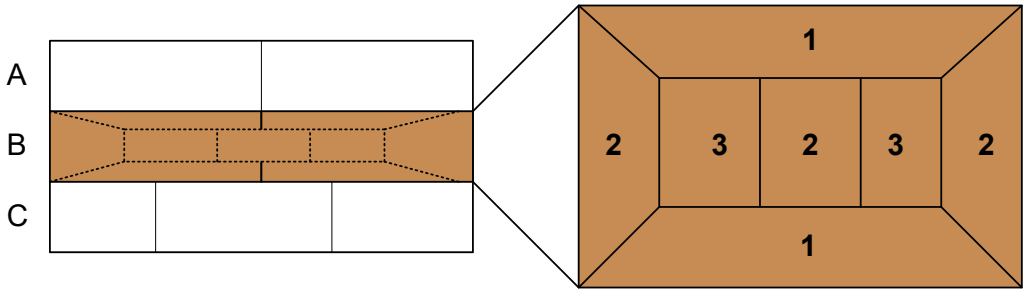

Figure 11-2: SmartGrid window positions

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

SmartGrid functions

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

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

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

11.1.2.2 How to activate smartgrid mode

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

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

-

  Select the "SmartGrid" icon from the toolbar.

- Select the "Display Config" button in the configuration "Overview".
- Select the "Display Config" softkey from the [Meas Config] menu.

The SmartGrid functions and the evaluation bar are displayed.

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

11.1.2.3 How to add a new result window

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

1. Activate SmartGrid mode.

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

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

3. Drag the required icon from the evaluation bar to the SmartGrid, which is displayed in the diagram area, and drop it at the required position. (See Chapter 7.6.2.5, "How to arrange the result windows", on page 67 for more information on positioning the window).

Remote command:

`LAYout:ADD[:WINDow]?` on page 453 / `LAYout:WINDow<n>:ADD?` on page 458

11.1.2.4 How to close a result window

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

Remote command:

`LAYout:REMove[:WINDow]` on page 456 / `LAYout:WINDow<n>:REMove` on page 459

11.1.2.5 How to arrange the result windows

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

2. Drag the evaluation over the SmartGrid.
   A blue area shows where the window will be placed.
3. Move the window until a suitable area is indicated in blue.
4. Drop the window in the target area.

   The windows are rearranged to the selected layout, and "Delete" and "Move" icons are displayed in each window.
5. To close a window, select the corresponding "Delete" icon.

Remote command:

`LAYout:REPLace[:WINDow]` on page 456 / `LAYout:WINDow<n>:REPLace` on page 459

`LAYout:MOVE[:WINDow]` on page 455

11.2 Zoomed displays

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.

Zooming into the diagram actually changes the scale of the two diagram axes. New start and stop frequencies are defined as well as a new range for the y-axis, depending on the area you have zoomed into.

For more information see Chapter 11.2.2, "How to zoom into the diagram in receiver mode", on page 177.

In the Receiver application, multiple zoom ( ) is not available.

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11.2.1 Zoom functions

Access:

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Multi-Zoom....175
Measurement Zoom....175
└ Level Lock....176
└ X-Lock....176
└ Y-Lock....176
└ Adapt Measurement to Zoom (selected diagram)....176
Restore Original Display....176

Single Zoom

A single zoom replaces the current diagram by a new diagram which displays an enlarged extract of the trace. This function can be used repetitively until the required details are visible.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe]` on page 463
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA` on page 462

Multi-Zoom

In multiple zoom mode, you can enlarge several different areas of the trace simultaneously. An overview window indicates the zoom areas in the original trace, while the zoomed trace areas are displayed in individual windows. The zoom area that corresponds to the individual zoom display is indicated in the lower right corner, between the scrollbars.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe]`
on page 464
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA`
on page 464

Measurement Zoom
As opposed to the graphical zoom, which is merely a visual tool, the measurement zoom adapts the measurement settings such that the data you are interested in is displayed in the required detail. In measurement zoom mode, you can change the display using touch gestures. This is the default operating mode of the R&S EPL1000.

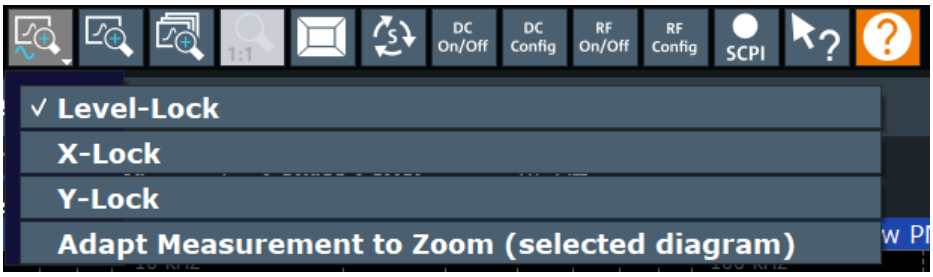
For details on touch gestures see "Operating Basics" in the R&S EPL1000 Getting Started manual.

Note: The measurement settings are adapted to practical values based on a suitable grid for the current settings, rather than to unwieldy values that reflect precisely the pixel you happen to tap.

If the measurement zoom leads to undesirable results, you can easily return to the original measurement settings using the "UNDO" function.

When you select the "Measurement Zoom" icon, then tap in a diagram, a dotted rectangle is displayed which you can drag to define the zoom area. This allows you to define the zoom area more precisely than by spreading two fingers in the display.

The measurement zoom function provides further options in a context-sensitive menu, which is displayed when you tap the icon for a second or so (or right-click it). These options concern the behavior of the firmware for subsequent touch gestures on the screen. Note that these settings remain unchanged after a channel preset.



Level Lock ← Measurement Zoom
If activated (default), the reference level (and thus the attenuation) is locked, that is: remains unchanged during touch gestures on the screen.

X-Lock ← Measurement Zoom
If activated, the x-axis of the diagram is not changed during subsequent touch gestures.

Y-Lock ← Measurement Zoom
If activated, the y-axis of the diagram is not changed during subsequent touch gestures.

Adapt Measurement to Zoom (selected diagram) ← Measurement Zoom
If you already performed a graphical zoom using the "Single Zoom" on page 175 or "Multi-Zoom" on page 175 functions, this function automatically adapts the measurement settings to maintain the currently zoomed display.

Restore Original Display

Restores the original display, that is, the originally calculated displays for the entire capture buffer, and closes all zoom windows.

Note: This function only restores graphically zoomed displays. Measurement zooms, for which measurement settings were adapted, are recalculated based on the adapted measurement settings. In this case, the zoomed display is maintained.

Remote command:
`DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe]` on page 463

11.2.2 How to zoom into the diagram in receiver mode

Basically, zooming into a diagram in Receiver mode works the same as in other applications. However, the zoom function in Receiver mode is not merely a visual tool, but actually changes settings. Also, the multiple zoom is not available.

The remote commands required to zoom into a display are described in Chapter 15.7.2, "Zoomed displays", on page 462.

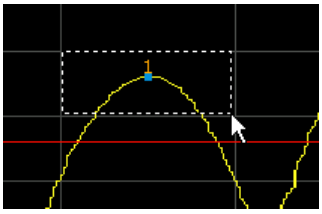
To zoom into the diagram at one position

1.

   Click on the "Single Zoom" icon in the toolbar.

   Zoom mode is activated.

2. Select the area in the diagram to be enlarged on the touchscreen. The selected area is indicated by a dotted rectangle.

   When you leave the touchscreen, the diagram is replaced by the zoomed trace area.
   When the zoom is done, the R&S EPL1000 changes the start and stop frequencies, based on the selected zoom area, and adjusts the range of the y-axis. Consequently, future meeasurements will only span the frequency range of the zoom area. Results yielded prior to the zoom may be lost.
   Note that a zoom may also change other measurement settings (for example the measurement bandwidth), depending on the characteristics of the zoom area compared to the original one.

Scrolling in the zoomed display

Because zooming defines a new measurement range, scrolling in diagrams that have been zoomed into is not possible.

Restoring the original display

To restore the original display, you have to restore the measurement configuration manually by entering the recent start and stop frequencies, bandwidths etc.

11.3 Trace configuration

A trace is a collection of measured data points. The trace settings determine how the measured data is analyzed and displayed on the screen.

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11.3.1 Basics on traces

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- Analyzing several traces - trace mode....183
- Working with spectrograms....184

11.3.1.1 Working with trace detectors

A trace displays the values measured at the measurement points (also known as sweep points in some applications). Usually, however, the number of measurement points considered during a measurement is much larger than the number of measurement points that can be displayed simultaneously.

For more information on measurement points, see Chapter 9.3.1.2, "Calculating the number of measurement points", on page 87.

Example:

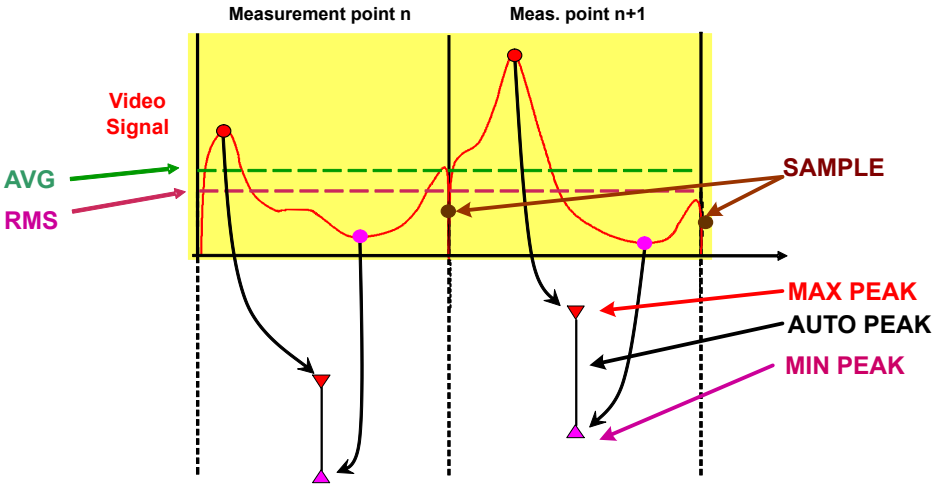
Consider the following configuration:

- Start frequency: 150 kHz
- Stop frequency: 30 MHz
- Step size: 4 kHz
- Measurement time: 100 ms

With said settings, the R&S EPL1000 measures with a dwell time of 100 ms every 4 kHz, so the number of measurement points in that example would be about 7500.

The trace detector's task is to find a good way to combine the measurement points.

The result obtained from the selected detector for any measurement point is displayed as the value at this frequency point in the trace.



The detectors of the R&S EPL1000 are implemented as digital devices. All detectors work in parallel in the background, which means that the measurement speed is independent of the detector combination used for different traces.

However, you should select a measurement time that is sufficient for the detector that requires the longest measurement time.

You can use several detectors simultaneously. The simultaneous use of several detectors (multiple detection) has advantages for EMC measurements, which often require different weightings: you can test different weightings with a single measurement. In the receiver application, you can even apply different detectors to the bargraph measurement, the scan and the final measurement.

The currently active detector is indicated in the trace information (see the abbreviation in brackets). Note that the detectors mentioned below may not be supported by all applications available for the R&S EPL1000.

Combining trace detectors

Some detector combinations are not supported in the receiver application. Possible combinations depend on the measurement type.

If you combine two or more detectors that are not compatible, the R&S EPL1000 automatically turns off one the traces.

Automatic selection of the detector

Available in the spectrum application.

The application automatically selects an appropriate detector, depending on the selected trace mode.

Trace mode	Detector
"Clear Write"	"Auto Peak"
"Max Hold"	"Positive Peak"
"Min Hold"	"Negative Peak"

Trace mode	Detector
"Average"	"Sample Peak"
"View"	–
"Blank"	–

The auto peak detector

Available in the spectrum application (but not for the Spectrum Emission Mask).

Combines the peak detectors (Positive and Negative Peak).

The auto peak detector determines the maximum and the minimum value of the levels measured at the individual frequencies which are displayed in one sample point.

The positive peak (or max peak) and negative peak (or min peak) detector

The positive and negative peak detectors display the maximum or minimum level that has been detected during the measurement.

Tips regarding measurement time:

- Unmodulated signals can be measured with the shortest possible measurement time.
- Pulsed signals require a measurement time that is longer than the expected pulse length. At least one pulse needs to be covered by the measurement time.

The peak detectors are digital detectors. Therefore, discharging is irrelevant even with long measurement times.

The average detector

The average detector displays the average level of the samples that have been captured during the measurement.

For average detection, the video voltage (envelope of IF signal) is averaged over the measurement time. Averaging is digital, i.e. the digitized values of the video voltage are summed up and divided by the number of samples at the end of the measurement time. This corresponds to a filtering with a rectangular window in the time domain and a filtering with sin x/x characteristic in the frequency domain.

Tips regarding measurement time:

- Unmodulated signals can be measured with the shortest possible measurement time.
- Modulated signals require a measurement time determined by the lowest modulation frequency to be averaged.
- Pulsed signals require a measurement time that is long enough to capture a sufficient number of pulses. For averaging, a sufficient number of pulses is a number greater than 10.

The RMS detector

The RMS detector evaluates the root mean square (RMS) value over the current measurement time and displays the resulting value. The integration time corresponds to the measurement time.

Tips regarding measurement time:

- Unmodulated signals can be measured with the shortest possible measurement time.
- Modulated signals require a measurement time determined by the lowest modulation frequency to be averaged.
- Pulsed signals require a measurement time that is long enough to capture a sufficient number of pulses. For averaging, a sufficient number of pulses is a number greater than 10.

The RMS detector and the video bandwidth

When you are using the RMS detector in the spectrum application, the video bandwidth (VBW) in the hardware is bypassed.

Duplicate trace averaging with small VBWs and the RMS detector is therefore not possible. However, the VBW is still considered for calculating the measurement time. This results in a longer measurement time for small VBW values. Thus, you can reduce the VBW to get more stable traces even when you are using the RMS detector. Normally, if the RMS detector is used the measurement time should be increased to get more stable traces.

The sample detector

The sample detector displays the first level value that has been measured in a particular statistical bin. All other values that have been measured in such a bin are ignored.

The quasipeak detector

The quasipeak detector displays the maximum value weighted to CISPR 16-1-1 that was detected during the measurement.

Depending on the selected frequency, the R&S EPL1000 automatically selects the detectors and IF bandwidths defined for bands A and B listed in the following table:

	Band A	Band B	Band C/D
Frequency range	< 150 kHz	150 kHz to 30 MHz	> 30 MHz
Resolution bandwidth	200 Hz	9 kHz	120 kHz

The coupling of the resolution bandwidth to the frequency range with activated quasipeak detector can be canceled using the "CISPR RBW uncoupled" softkey.

Tips regarding measurement time:

- The relatively long time constants of the quasipeak detector result in long measurement times to yield valid results.

- Unknown signals should be measured with a measurement time of at least 1 s. This ensures correct weighting of pulses down to a pulse frequency of 5 Hz.
- Known signals can be measured with a much shorter measurement time.

After internal switching, the R&S EPL1000waits until the measurement result has stabilized before it starts the actual measurement. Since the level does not change during a frequency scan, known signals (e.g. broadband RFI) can be correctly measured with a much shorter measurement time.

The CISPR average detector

The CISPR Average detector displays a weighted average signal level according to CISPR 16-1-1. The average value according to CISPR 16-1-1 is the maximum value of the linear average that has been detected during the measurement.

The detector is used, for example, to measure pulsed sinusoidal signals with a low pulse frequency. It is calibrated with the rms value of an unmodulated sinusoidal signal. Averaging is with lowpass filters of the 2nd order (simulation of a mechanical instrument).

The lowpass time constants and the IF bandwidths are fixed depending on the frequency. The main parameters are listed in the following table:

	Band A	Band B	Band C/D	Band E
Frequency range	< 150 kHz	150 kHz to 30 MHz	30 MHz to 1 GHz	> 1 GHz
Resolution bandwidth	200 Hz	9 kHz	120 kHz	1 MHz

The coupling of the resolution bandwidth to the frequency range with activated CISPR average detector can be canceled using the "CISPR RBW uncoupled" softkey.

Tips regarding measurement time:

- The relatively long time constants of the quasipeak detector result in long measurement times to yield valid results.
- Unknown signals should be measured with a measurement time of at least 1 s. This ensures correct weighting of pulses down to a pulse frequency of 5 Hz.
- Unmodulated sinusoidal signals and signals with a high modulation frequency can be measured with a much shorter measurement time.
- Slowly fluctuating signals or pulsed signals require longer measurement times.

Measurement times shorter than 20 ms

With measurement times shorter than 20 ms the detector weighting changes to plain average weighting.

When you change the receiver frequency or the attenuation, the R&S EPL1000 waits until the lowpass filter has settled before starting the measurement. The measurement time in that case depends on the resolution bandwidth and the characteristics of the signal.

The RMS average detector

The RMS Average detector is a combination of the RMS detector (for pulse repetition frequencies above a corner frequency) and the Average detector (for pulse repetition frequencies below the corner frequency). It thus achieves a pulse response curve with the following characteristics: 10 dB/decade above the corner frequency and 20 dB/decade below the corner frequency. The average value is determined by lowpass filters of the 2nd order (simulation of a mechanical instrument).

The detector is used, for example, to measure broadband emissions and may replace the quasipeak detector in the future.

The filter bandwidth of the detector are coupled to the receiver frequency.

Table 11-1: RMS Average detector

	Band A	**Band B**	**Band C/D**	**Band E**
Frequency range	< 150 kHz	150 kHz to 30 MHz	30 MHz to 1 GHz	> 1 GHz
Resolution bandwidth	200 Hz	9 kHz	120 kHz	1 MHz
Corner frequency	10 Hz	100 Hz	100 Hz	1 kHz

Regarding measurement time, see CISPR Average detector.

Measurement times shorter than 20 ms

With measurement times shorter than 20 ms the detector weighting changes to plain RMS weighting.

11.3.1.2 Analyzing several traces - trace mode

If several measurements are performed one after the other, or continuous measurements are performed, the trace mode determines how the data for subsequent traces is processed. After each measurement, the trace mode determines whether:

- The data is frozen ("View")
- The data is hidden ("Blank")
- The data is replaced by new values ("Clear Write")
- The data is replaced selectively ("Max Hold", "Min Hold", "Average")

Each time you change the trace mode, the selected trace memory is cleared.

The R&S EPL1000 supports the following trace modes:

Table 11-2: Overview of available trace modes

Trace Mode	Description
Blank	Hides the selected trace.
Clear Write	Overwrite mode: the trace is overwritten by each measurement. This is the default setting. All available detectors can be selected.
Max Hold	The maximum value is determined over several measurements and displayed. The R&S EPL1000 saves the measurement result in the trace memory only if the new value is greater than the previous one. This mode is especially useful with modulated or pulsed signals. The signal spectrum is filled up upon each measurement until all signal components are detected in a kind of envelope. This mode is not available for statistics measurements.
Min Hold	The minimum value is determined from several measurements and displayed. The R&S EPL1000 saves the measurement result in the trace memory only if the new value is lower than the previous one. This mode is useful for example for making an unmodulated carrier in a composite signal visible. Noise, interference signals or modulated signals are suppressed, whereas a CW signal is recognized by its constant level. This mode is not available for statistics measurements.
Average	The average is formed over several measurements and displayed.
Transducer	Draws a trace that shows the correction values of all active transducer factors in the currently selected frequency range.
View	The current contents of the trace memory are frozen and displayed.

If a trace is frozen ("View" mode), you can change the measurement settings, apart from scaling settings, without impact on the displayed trace. The fact that the displayed trace no longer matches the current measurement settings is indicated by a yellow asterisk on the tab label.

If you change any parameters that affect the scaling of the diagram axes, the R&S EPL1000 automatically adapts the trace data to the changed display range. Thus, you can zoom into the diagram after the measurement to show details of the trace.

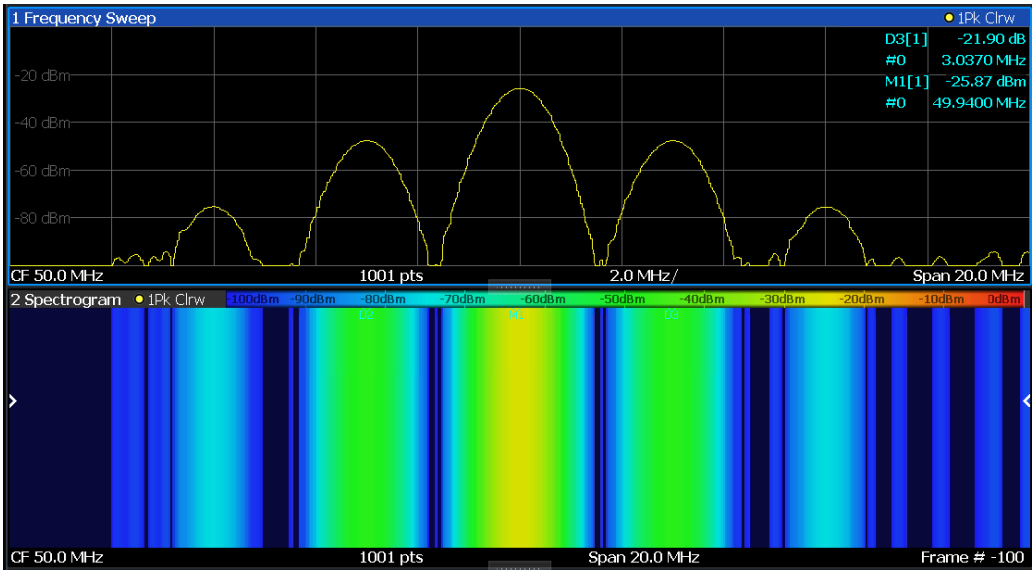
11.3.1.3 Working with spectrograms

In addition to the standard "level versus frequency" or "level versus time" traces, the R&S EPL1000 also provides a spectrogram display of the measured data.

A spectrogram shows how the spectral density of a signal varies over time. The x-axis shows the frequency, the y-axis shows the time. A third dimension, the power level, is indicated by different colors. Thus you can see how the strength of the signal varies over time for different frequencies.

Example:

(Note that this example is based on data recorded in the Spectrum application. The basic principle of a spectrogram in the Receiver application is the same.)



In this example, you see the spectrogram for the calibration signal of the R&S EPL1000, compared to the standard spectrum display. Since the signal does not change over time, the color of the frequency levels does not change over time, i.e. vertically. The legend above the spectrogram display describes the power levels the colors represent.

Result display

The spectrogram result can consist of the following elements:

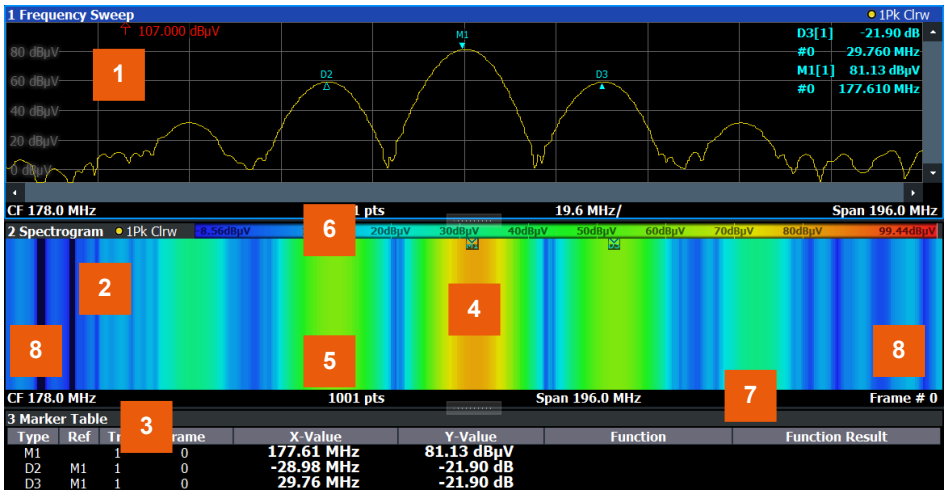


Figure 11-3: Screen layout of the spectrogram result display

1 = Spectrum result display
2 = Spectrogram result display
3 = Marker list
4 = Marker
5 = Delta marker
6 = Color map
7 = Timestamp / frame number
8 = Current frame indicator

For more information about spectrogram configuration, see Chapter 11.3.7, "Spectrogram settings", on page 198.

Remote commands:

Activating and configuring spectrograms:

Chapter 15.7.3.5, "Spectrogram configuration", on page 470

Storing results:

`MMEMory:STORe<n>:SPECtrogram` on page 557

- Time frames 186
- Markers in the spectrogram 187
- Color maps 187

Time frames

The time information in the spectrogram is displayed vertically, along the y-axis. Each line (or trace) of the y-axis represents one or more captured measurement and is called a **time frame** or simply "frame". As with standard spectrum traces, several measured values are combined in one measurement point using the selected detector.

Frames are sorted in chronological order, beginning with the most recently recorded frame at the top of the diagram (frame number 0). With the next measurement, the previous frame is moved further down in the diagram, until the maximum number of captured frames is reached. The display is updated continuously during the measurement, and the measured trace data is stored. Spectrogram displays are continued even after single measurements unless they are cleared manually.

The maximum number of frames that you can capture depends on the number of measurement points that are analyzed during the measurement.

The scaling of the time axis (y-axis) is not configurable. However, you can enlarge the spectrogram display by maximizing the window using the "Split/Maximize" key.

Tracking absolute time - timestamps

Alternatively to the frame count, the absolute time (that is: a *timestamp*) at which a frame was captured can be displayed. While the measurement is running, the timestamp shows the system time. In single measurement mode or if the measurement is

stopped, the timestamp shows the time and date at the end of the measurement.Thus, the individual frames can be identified by their timestamp or their frame count.

When active, the timestamp replaces the display of the frame number in the diagram footer (see Figure 11-3).

Displaying individual frames

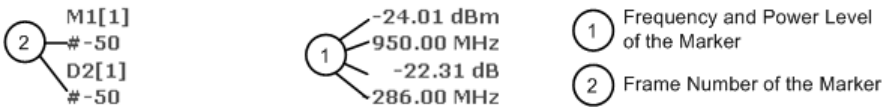
The spectrogram diagram contains all stored frames since it was last cleared. Arrows on the left and right border of the spectrogram indicate the currently selected frame. The scan or spectrum diagrams always display the spectrum for the currently selected frame.

The current frame number is indicated in the diagram footer, or alternatively a time-stamp, if activated. The current frame, displayed at the top of the diagram, is frame number 0. Older frames further down in the diagram are indicated by a negative index, e.g."-10". You can display the spectrum diagram of a previous frame by changing the current frame number.

Markers in the spectrogram

Markers and delta markers are shaped like diamonds in the spectrogram. They are only displayed in the spectrogram if the marker position is inside the visible area of the spectrogram. If more than two markers are active, the marker values are displayed in a separate marker table.

In the spectrum result display, the markers and their frequency and level values (1) are displayed as usual. Additionally, the frame number is displayed to indicate the position of the marker in time (2).



In the spectrogram result display, you can activate up to 16 markers or delta markers at the same time. Each marker can be assigned to a different frame. Therefore, in addition to the frequency you also define the frame number when activating a new marker. If no frame number is specified, the marker is positioned on the currently selected frame. All markers are visible that are positioned on a visible frame. Special search functions are provided for spectrogram markers.

In the spectrum result display, only the markers positioned on the currently selected frame are visible. In "Continuous Sweep" mode, this means that only markers positioned on frame 0 are visible. To view markers that are positioned on a frame other than frame 0 in the spectrum result display, you must stop the measurement and select the corresponding frame.

Color maps

The color display is highly configurable to adapt the spectrograms to your needs. You can define:

- Which colors to use (Color scheme)
- Which value range to apply the color scheme to

- How the colors are distributed within the value range, i.e where the focus of the visualization lies (shape of the color curve)

The individual colors are assigned to the power levels automatically by the R&S EPL1000.

The Color Scheme

- **Hot**

  Uses a color range from blue to red. Blue colors indicate low levels, red colors indicate high ones.

- **Cold**

  Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.
  The "Cold" color scheme is the inverse "Hot" color scheme.

- **Radar**

  Uses a color range from black over green to light turquoise with shades of green in between. Dark colors indicate low levels, light colors indicate high ones.

- **Grayscale**

  Shows the results in shades of gray. Dark gray indicates low levels, light gray indicates high ones.

The value range of the color map

If the measured values only cover a small area in the spectrogram, you can optimize the displayed value range. Then it becomes easier to distinguish between values that are close together. Display only parts of interest.

The shape and focus of the color curve

The color-mapping function assigns a specified color to a specified power level in the spectrogram display. By default, colors on the color map are distributed evenly. However, to visualize a certain area of the value range in greater detail than the rest, you can set the focus of the color mapping to that area. Changing the focus is performed by changing the shape of the color curve.

The color curve is a tool to shift the focus of the color distribution on the color map. By default, the color curve is linear. If you shift the curve to the left or right, the distribution becomes non-linear. The slope of the color curve increases or decreases. One end of the color palette then covers a large range of results, while the other end distributes several colors over a relatively small result range.

You can use this feature to put the focus on a particular region in the diagram and to be able to detect small variations of the signal.

Example:

In the color map based on the linear color curve, the range from -100 dBm to -60 dBm is covered by blue and a few shades of green only. The range from -60 dBm to -20 dBm is covered by red, yellow and a few shades of green.

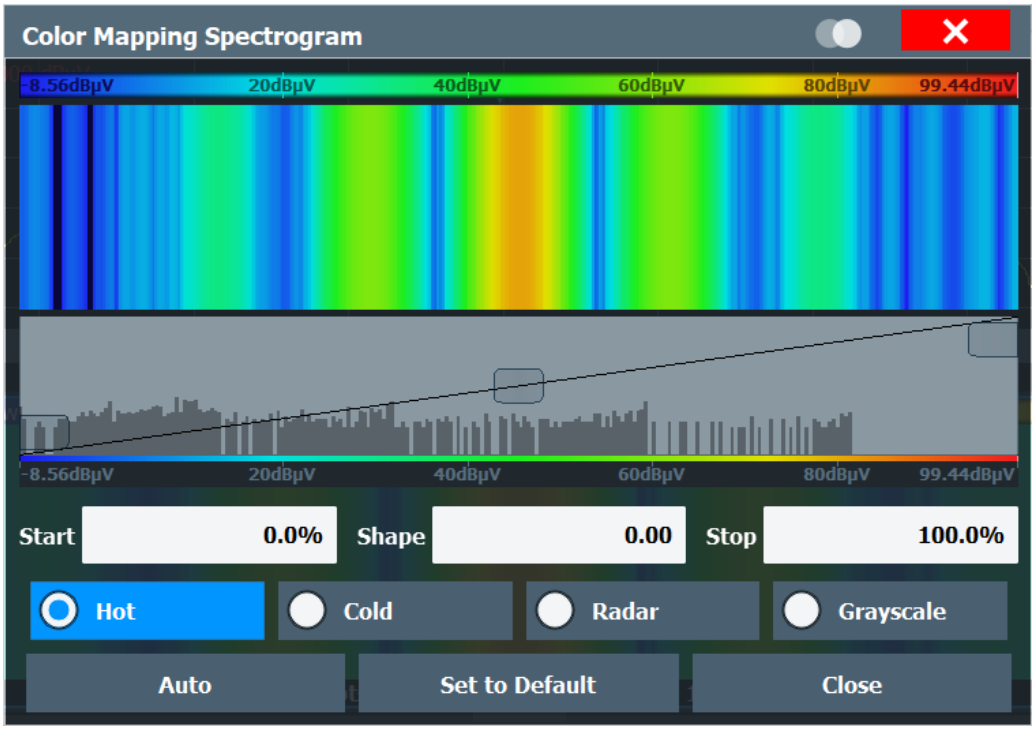


Figure 11-4: Spectrogram with (default) linear color curve shape = 0

The sample spectrogram is dominated by blue and green colors. After shifting the color curve to the left (negative value), more colors cover the range from -100 dBm to -60 dBm (blue, green and yellow). This range occurs more often in the example. The range from -60 dBm to -20 dBm, on the other hand, is dominated by various shades of red only.

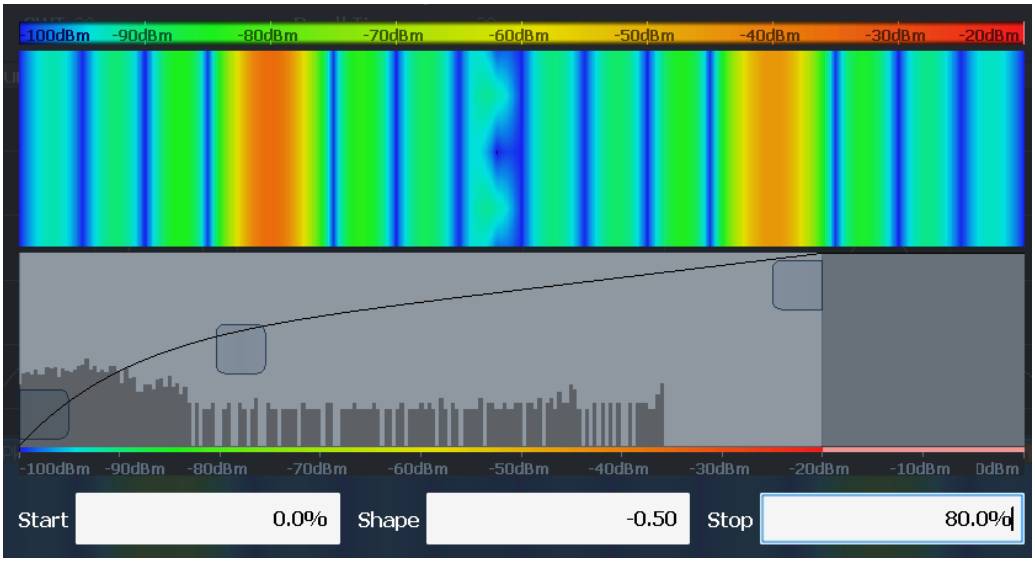


Figure 11-5: Spectrogram with non-linear color curve (shape = -0.5)

11.3.2 Trace configuration

A trace is a collection of measured data points. The trace settings determine how the measured data is analyzed and displayed on the screen.

Trace configuration for the scan diagram

The contents of the "Traces" tab of the "Trace Configuration" are the same as the Traces / Final Meas tab of the "Test Automation" dialog box.

Trace configuration for IF analysis

IF analysis supports a maximum of three traces. The "Traces" dialog box available for IF analysis supports the following functions:

- "Trace Mode" on page 115
- "Predefined Trace Settings - Quick Config" on page 191

Predefined Trace Settings - Quick Config 191

Predefined Trace Settings - Quick Config
Commonly required trace settings have been predefined and can be applied very quickly by selecting the appropriate button.

Function	Trace Settings	
Preset All Traces	Trace 1:	Clear Write
		Blank
Set Trace Mode Max | Avg | Min	Trace 1:	Max Hold
	Trace 2:	Average

Function	Trace Settings	
	Trace 3:	Min Hold
		Blank
Set Trace Mode Max | ClrWrite | Min	Trace 1:	Max Hold
	Trace 2:	Clear Write
	Trace 3:	Min Hold
		Blank

11.3.3 Trace export

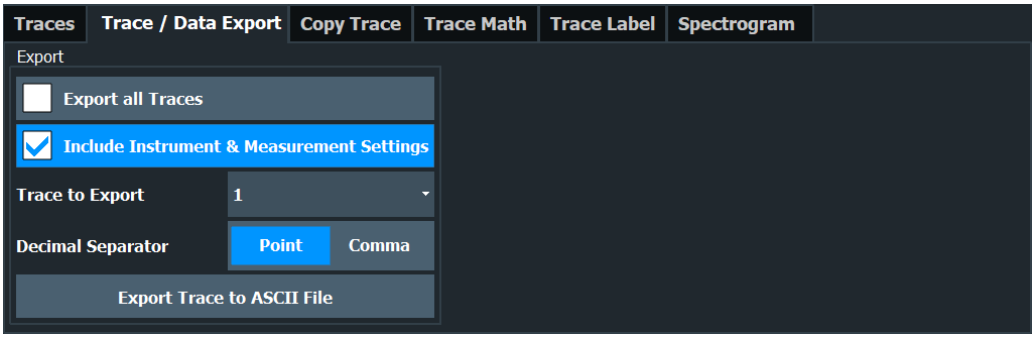
Access: "Overview" > "Analysis" > "Traces" > "Trace Export"

The R&S EPL1000 provides various evaluation methods for the results of the performed measurements. If you want to evaluate the data with other, external applications, you can export the measurement data to a standard ASCII format file (`DAT` or `CSV`).

You can also import existing trace data from a file, for example as a reference trace. The trace import is available in the spectrum application.

The standard data management functions (for example saving or loading instrument settings) that are available for all R&S EPL1000 applications are not described here.

Refer to the R&S EPL1000 user manual for a description of the standard functions.



The remote commands required to export traces are described in Chapter 15.7.3.1, "Trace export", on page 465.

Export all Traces and all Table Results 193
Include Instrument & Measurement Settings 193
Trace to Export 193
Decimal Separator 193
Export Trace to ASCII File 193
└ File Type 194

└ Decimal Separator 195
└ Column Separator 195
└ File Explorer 195

Export all Traces and all Table Results
Selects all displayed traces and result tables (e.g. "Result Summary", marker table etc.) in the current application for export to an ASCII file.

Alternatively, you can select one specific trace only for export (see Trace to Export).

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Remote command:
`FORMat:DEXPort:TRACes` on page 466

Include Instrument & Measurement Settings
Includes additional instrument and measurement settings in the header of the export file for result data.

Remote command:
`FORMat:DEXPort:HEADer` on page 466

Trace to Export
Defines an individual trace to be exported to a file.

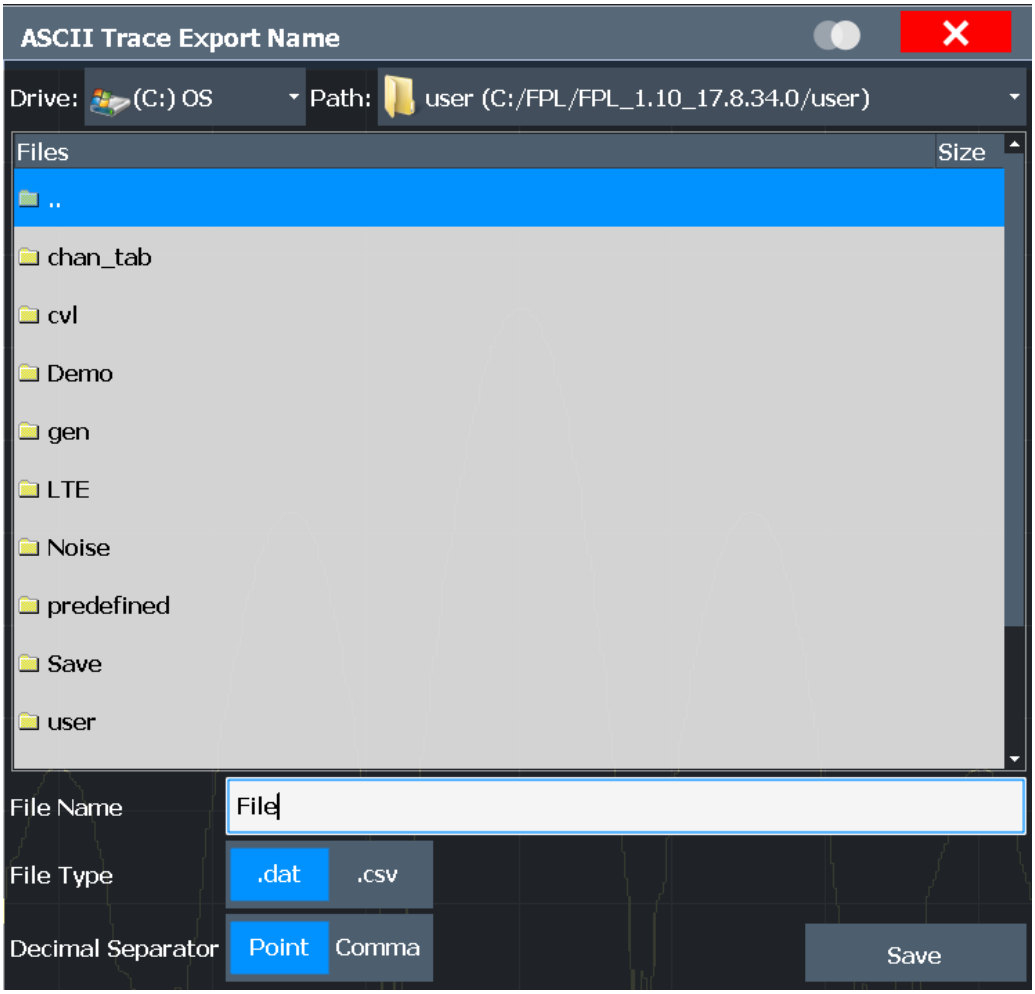
This setting is not available if Export all Traces and all Table Results is selected.

Decimal Separator
Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.

Remote command:
`FORMat:DEXPort:DSEParator` on page 522

Export Trace to ASCII File
Saves the selected trace or all traces in the currently active result display to the specified file and directory in the selected ASCII format.

"File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.



If the spectrogram display is selected when you perform this function, the entire histogram buffer with all frames is exported to a file. The data for a particular frame begins with information about the frame number and the time that frame was recorded. For large history buffers the export operation can take some time.

For details on the file format in the Spectrum application, see Chapter 11.3.9.1, "Reference: ASCII file export format", on page 207.

Remote command:
`MMEMory:STORe<n>:TRACe` on page 557
`MMEMory:STORe<n>:SPECtrogram` on page 557

File Type ← Export Trace to ASCII File
Determines the format of the ASCII file to be imported or exported.

Depending on the external program in which the data file was created or is evaluated, a comma-separated list (`CSV`) or a plain data format (`DAT`) file is required.

Remote command:
`FORMat:DEXPort:FORMat` on page 467

Decimal Separator ← Export Trace to ASCII File
Defines the decimal separator for floating-point numerals for the data export/import files. Evaluation programs require different separators in different languages.

Remote command:
FORMat:DEXPort:DSEParator on page 522

Column Separator ← Export Trace to ASCII File
Selects the character that separates columns in the exported ASCII file. The character can be either a semicolon, a comma or a tabulator (tab).

Example for semicolon:

```
Type;EPL1004;Version;1.00;Date;01.Jan 3000;
```

Example for comma:

```
Type,EPL1004,
Version,1.00,
Date,01.Jan 3000,
```

Example for tabulator (tab after the last column is not visible):

```
Type    EPL1004
Version    1.00
Date    01.Jan 3000
```

The selected column separator setting remains the same, even after a preset.

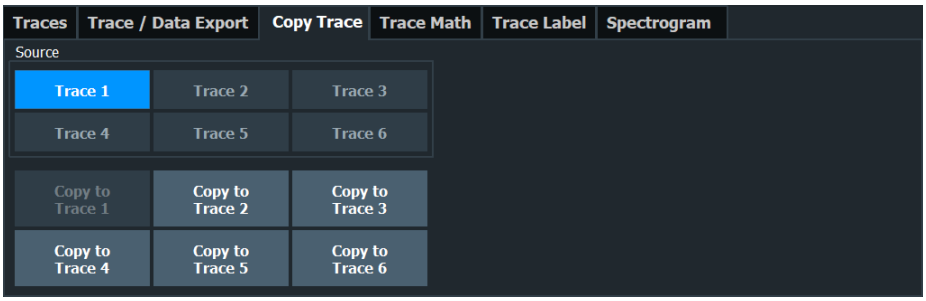
Remote command:
FORMat:DEXPort:CSEParator on page 465

File Explorer ← Export Trace to ASCII File
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

11.3.4 Copying traces

Access: "Overview" > "Analysis" > "Traces" > "Copy Trace"



The remote commands required to copy traces are described in Chapter 15.7.3, "Trace configuration", on page 465.

Copy Trace.....196

Copy Trace
Access: "Overview" > "Analysis" > "Traces" > "Copy Trace"

Or: [TRACE] > "Copy Trace"

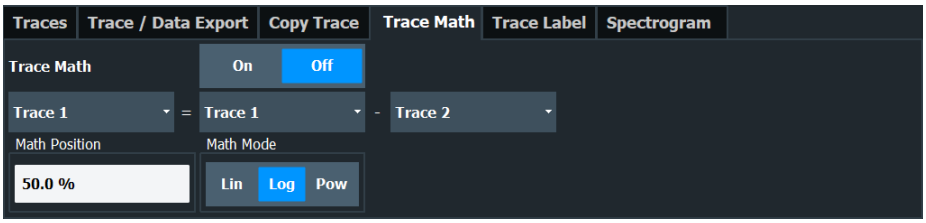
Copies trace data to another trace.

Remote command:
`TRACe<n>:COPY` on page 467

11.3.5 Trace mathematics

Access: "Overview" > "Analysis" > "Traces" > "Trace Math"

Trace mathematics allow you to combine the data of several traces and write the results to a new trace.



Trace Math Function 196
Trace Math Position 196
Trace Math Mode 197

Trace Math Function
Trace mathematics subtract the data of one trace from another trace and write the results to a third trace.

When you turn on trace mathematics, you can select all parameters in the equation arbitrarily from the corresponding dropdown menus (both operands and the result). For example, you can subtract trace 1 from trace 3 and write the results to trace 5.

The result is a trace in dB that refers to the zero point defined with the Trace Math Position setting.

Note that all traces in the equation must have a trace mode other than "Blank" or "View".

You can turn off all trace mathematics with the "Trace Math Off" feature.

Remote command:
`CALCulate<n>:MATH<t>:EXPRession[:DEFine]` on page 467
`CALCulate<n>:MATH<t>:STATe` on page 469

Trace Math Position
Defines the zero point on the y-axis of the resulting trace in % of the diagram height. The range of values extends from -100 % to +200 %.

Remote command:
`CALCulate<n>:MATH<t>:POSition` on page 468

Trace Math Mode
Defines the mode for the trace math calculations.

"Lin" Activates linear subtraction, which means that the power level values are converted into linear units prior to subtraction. After the subtraction, the data is converted back into its original unit.
This setting takes effect if the grid is set to a linear scale. In this case, subtraction is done in two ways (depending on the set unit):

- The unit is set to either W or dBm: the data is converted into W prior to subtraction, i.e. averaging is done in W.
- The unit is set to either V, A, dBmV, dBµV, dBµA or dBpW: the data is converted into V prior to subtraction, i.e. subtraction is done in V.

"Log" Activates logarithmic subtraction.
This subtraction method only takes effect if the grid is set to a logarithmic scale, i.e. the unit of the data is dBm. In this case the values are subtracted in dBm. Otherwise (i.e. with linear scaling) the behavior is the same as with linear subtraction.

"Power" Activates linear power subtraction.
The power level values are converted into unit Watt prior to subtraction. After the subtraction, the data is converted back into its original unit.
Unlike the linear mode, the subtraction is always done in W.

Remote command:
`CALCulate<n>:MATH<t>:MODE` on page 468

11.3.6 Trace Labels

Access: "Overview" > "Analysis" > "Traces" > "Trace Label"

Trace labels are a way to assign a descriptive label to traces instead of the general "Trace <x>" label (default). The labels you use are arbitrary and are displayed in the diagram area. The font color corresponds to the color of the respective trace (for example yellow trace: yellow font).

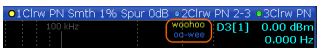
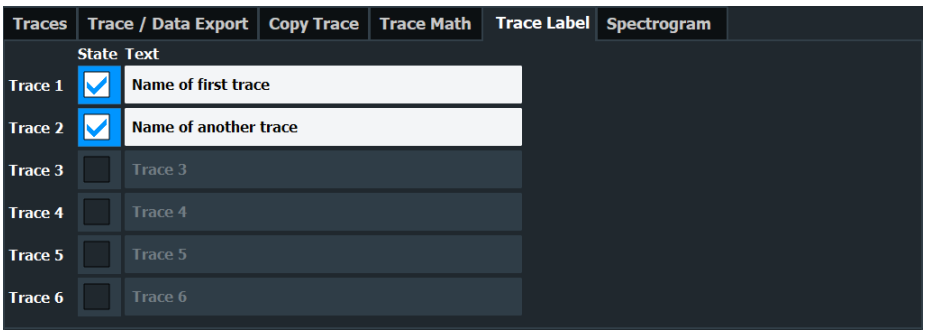


Figure 11-6: Example: the yellow and blue traces have a label.

You can define trace labels in the "Trace Label" tab of the "Trace" dialog box.



How to assign trace labels

Trace labels can be configured via the "Trace Labels" dialog box.

1. Turn on the trace label for a specific trace and assign a label in the corresponding input field.
   Note that a trace must be active. Otherwise assigning a label is not possible.
2. Move the trace label to any position on the display by dragging it to the new position.

Remote command:

State: `DISPlay[:WINDow<n>]:TRACe<t>:LABel[:STATe]` on page 469

Label: `DISPlay[:WINDow<n>]:TRACe<t>:LABel:TEXT` on page 470

11.3.7 Spectrogram settings

Access: "Overview" > "Analysis" > "Traces" > "Spectrogram"

Functions to configure spectrograms described elsewhere:

- Color mapping: Chapter 11.3.7.2, "Color map settings", on page 201
- Markers: Chapter 11.4.3.2, "Marker search (spectrogram)", on page 220

Spectrograms in the I/Q analyzer and analog demodulator

Basically, spectrograms in those applications work the same as in the Receiver or Spectrum application.

However, in the I/Q Analyzer and Analog Demodulator, they have the following distinctive features.

- Not all result displays support spectrograms.
- Compared to the Receiver or Spectrum application, a spectrogram can not be added as an independent result display. Instead, spectrograms relate to a certain measurement window (or result display). Result diagram and spectrogram are a single entity in that case and can not be divided.

To view results in a spectrogram, select a window (indicated by a blue frame), then select [TRACE] > "Spectrogram Config".

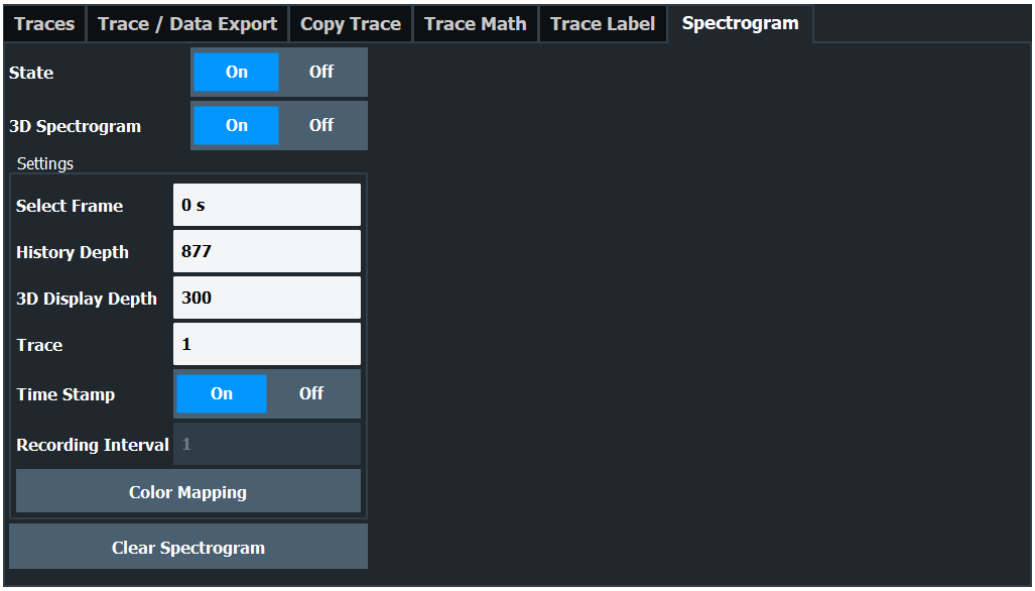
Spectrograms are either displayed in "Split" mode (spectrogram is displayed below the trace diagram), in "Full" mode (trace diagram is not displayed), or not displayed at all ("Off)".

When the "Spectrogram Config"softkey is greyed out, spectrograms are not supported by the selected result display.

- General spectrogram settings 199
- Color map settings 201

11.3.7.1 General spectrogram settings

Access: "Overview" > "Analysis" > "Traces" > "Spectrogram"



State 199
3D Spectrogram State 200
Select Frame 200
History Depth 200
3-D Display Depth 200
Trace 200
Time Stamp 200
Recording Interval 201
Color Mapping 201
Clear Spectrogram 201

State
Activates and deactivates the spectrogram result display.

In the receiver application, the R&S EPL1000 always records spectrogram data. The "State" function simply controls the spectrogram visibility.

Remote command:
`CALCulate<n>:SPECtrogram[:STATe]` on page 473

3D Spectrogram State
Activates and deactivates a 3-dimensional spectrogram. As opposed to the common 2-dimensional spectrogram, the power is not only indicated by a color mapping, but also in a third dimension, the z-axis.

Remote command:
`CALCulate<n>:SPECtrogram:THReedim[:STATe]` on page 474

Select Frame
Selects a specific frame, loads the corresponding trace from the memory, and displays it in the Spectrum window.

Note that activating a marker or changing the position of the active marker automatically selects the frame that belongs to that marker.

This function is only available in single sweep mode or if the sweep is stopped, and only if a spectrogram is selected.

The most recent frame is number 0, all previous frames have a negative number.

Remote command:
`CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 471

History Depth
Sets the number of frames that the R&S EPL1000 stores in its memory.

The maximum size of the spectrogram history depends on the available memory.

If the memory is full, the R&S EPL1000 deletes the oldest frames stored in the memory and replaces them with the new data.

Remote command:
`CALCulate<n>:SPECtrogram:HDEPth` on page 471

3-D Display Depth
Defines the number of frames displayed in a 3-dimensional spectrogram.

Trace
Selects the trace the spectrogram is based on.

You can select any trace that is currently active, including the trace that shows the results of trace mathematics.

Remote command:
`CALCulate<n>:SPECtrogram:TRACe` on page 472

Time Stamp
Activates and deactivates the timestamp. The timestamp shows the system time while the measurement is running. In single sweep mode or if the measurement is stopped, the timestamp shows the time and date of the end of the measurement.

When active, the timestamp replaces the display of the frame number.

Remote command:
`CALCulate<n>:SPECtrogram:TSTamp[:STATe]` on page 473
`CALCulate<n>:SPECtrogram:TSTamp:DATA?` on page 472

Recording Interval
Defines a recording interval for the IF spectrogram result display. For example if the recording interval is set to 5, only every fifth scan is taken from the IF analysis diagram and displayed in the IF spectrogram. This prevents the IF spectrogram from getting filled up too fast.

Remote command:
`CALCulate<n>:SPECtrogram:FRAMe:RINTerval` on page 474

Color Mapping
Opens the "Color Mapping" dialog.

For details see "Color maps" on page 187.

Clear Spectrogram
Resets the spectrogram result display and clears the history buffer.

This function is only available if a spectrogram is selected.

Remote command:
`CALCulate<n>:SPECtrogram:CLEar[:IMMediate]` on page 470

11.3.7.2 Color map settings

Access: "Overview" > "Analysis" > "Traces" > "Spectrogram" > "Color Mapping"

or: [TRACE] > "Spectrogram Config" > "Color Mapping"

In addition to the available color settings, the dialog box displays the current color map and provides a preview of the display with the current settings.

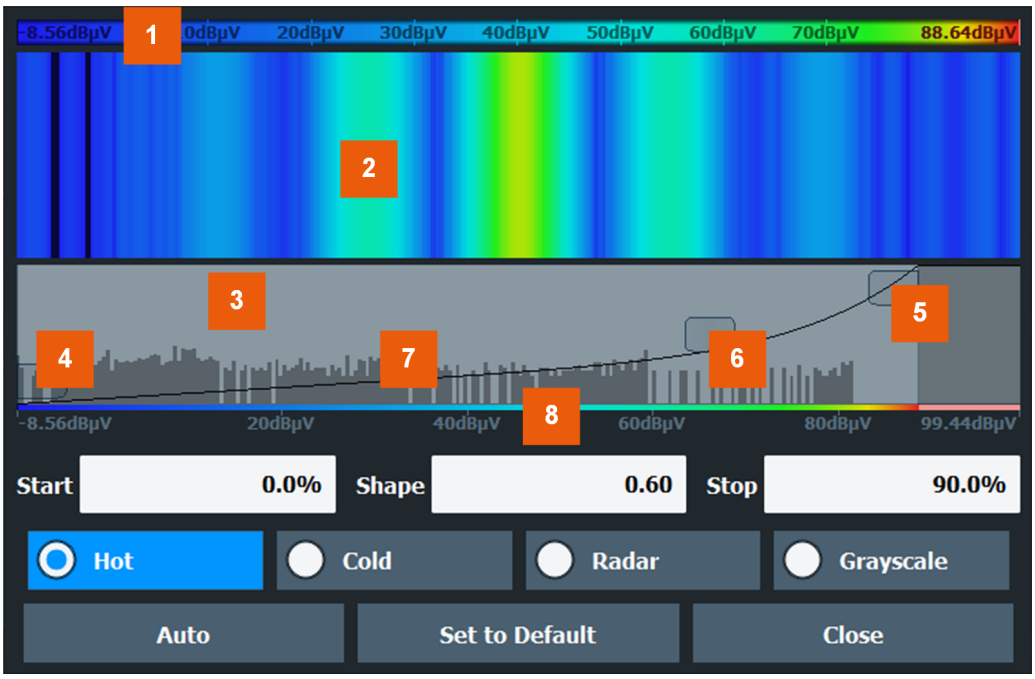


Figure 11-7: Color Mapping dialog box

1 = Color map: shows the current color distribution
2 = Preview pane: shows a preview of the spectrogram with any changes that you make to the color scheme
3 = Color curve pane: graphical representation of all settings available to customize the color scheme
4/5 = Color range start and stop sliders: define the range of the color map or amplitudes for the spectrogram
6 = Color curve slider: adjusts the focus of the color curve
7 = Histogram: shows the distribution of measured values
8 = Scale of the horizontal axis (value range)

The remote commands required to configure the color map are described in "Color map configuration" on page 474.

Start / Stop 202
Shape 202
Hot/Cold/Radar/Grayscale 202
Auto 202
Set to Default 202
Close 202

Start / Stop
Defines the lower and upper boundaries of the value range of the spectrogram.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer` on page 475
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer` on page 475

Shape
Defines the shape and focus of the color curve for the spectrogram result display.

"-1 to <0" More colors are distributed among the lower values
"0" Colors are distributed linearly among the values
">0 to 1" More colors are distributed among the higher values

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe` on page 475

Hot/Cold/Radar/Grayscale
Sets the color scheme for the spectrogram.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe]` on page 476

Auto
Defines the color range automatically according to the existing measured values for optimized display.

Set to Default
Sets the color mapping to the default settings.

Remote command:
`DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault` on page 475

Close
Saves the changes and closes the dialog box.

11.3.8 How to configure traces

- How to export trace data and numerical results....203
- How to display and configure a spectrogram....203

11.3.8.1 How to export trace data and numerical results

The measured trace data and numerical measurement results in tables can be exported to an ASCII file. For each measurement point, the measured trace position and value are output.

The file is stored with a `.DAT` or `.CSV` extension. For details on the storage format, see Chapter 11.3.9.1, "Reference: ASCII file export format", on page 207.

To export trace data and table results

1. Select [TRACE] > "Trace Config" > "Trace / Data Export" tab.
2. Select "Export all Traces and all Table Results" to export all available measurement result data for the current application, or select a specific "Trace to Export".
3. Optionally, select "Include Instrument & Measurement Settings" to insert additional information in the export file header.
4. Select "Export Trace to ASCII File".
5. In the file selection dialog box, select the storage location and file name for the export file.
6. If necessary, change the decimal separator for the ASCII export file.
7. Select the data format of the ASCII file.
8. Select "Save" to close the dialog box and export the data to the file.

11.3.8.2 How to display and configure a spectrogram

Step-by-step instructions on how to display and configure a spectrogram are provided here. For details on individual functions and settings see Chapter 11.3.7, "Spectrogram settings", on page 198.

The remote commands required to perform these tasks are described in Chapter 15.7.3.5, "Spectrogram configuration", on page 470.

The following tasks are described here:

- "To display a spectrogram" on page 204
- "To remove the spectrogram display" on page 204
- "To set a marker in the spectrogram" on page 204
- "To configure a spectrogram" on page 204
- "To select a color scheme" on page 205
- "To set the value range graphically using the color range sliders" on page 206

- "To set the value range of the color map numerically" on page 206
- "To set the color curve shape graphically using the slider" on page 207
- "To set the color curve shape numerically" on page 207

To display a spectrogram

1. In the "Overview", select "Display", then drag the evaluation type "Spectrogram" to the diagram area.
   Alternatively:
   a) Select the [TRACE] key and then the "Spectrogram Config" softkey.
   b) Toggle "Spectrogram" to "On".
2. To clear an existing spectrogram display, select "Clear Spectrogram".
3. Start a new measurement using [RUN SINGLE] or [RUN CONT].
   The spectrogram is updated continuously with each new sweep.
4. To display the spectrum diagram for a specific time frame:
   a) Stop the continuous measurement or wait until the single sweep is completed.
   b) Select the frame number in the diagram footer.
   c) Enter the required frame number in the edit dialog box.
   Note that the most recent sweep is frame number 0, all previous frames have negative numbers.

To remove the spectrogram display

1. Select the [TRACE] key and then the "Spectrogram Config" softkey.
2. Toggle "Spectrogram" to "Off".
   The standard spectrum display is restored.

To set a marker in the spectrogram

1. While a spectrogram is displayed, select the [MARKER] key.
2. Select a "Marker" softkey.
3. Enter the frequency or time (x-value) of the marker or delta marker.
4. Enter the frame number for which the marker is to be set, for example *0* for the current frame, or *-2* for the second to last frame. Note that the frame number is always 0 or a negative value!
   The marker is only visible in the spectrum diagram if it is defined for the currently selected frame. In the spectrogram result display all markers are visible that are positioned on a visible frame.

To configure a spectrogram

1. Configure the spectrogram frames:
   a) Select the [SWEEP] key.
   b) Select the "Sweep Config" softkey.

c) In the "Sweep/Average Count" field, define how many sweeps are to be analyzed to create a single frame.
d) In the "Frame Count" field, define how many frames are to be plotted during a single sweep measurement.
e) To include frames from previous sweeps in the analysis of the new frame (for "Max Hold", "Min Hold" and "Average" trace modes only), select "Continue Frame" = "On".

2. Define how many frames are to be stored in total:
   a) Select the [TRACE] key and then the "Spectrogram Config" softkey.
   b) Select the "History Depth" softkey.
   c) Enter the maximum number of frames to store.
3. Optionally, replace the frame number by a time stamp by toggling the "Time Stamp" softkey to "On".
4. If necessary, adapt the color mapping for the spectrogram to a different value range or color scheme as described in "How to configure the color mapping" on page 205.

How to configure the color mapping

The color display is highly configurable to adapt the spectrogram to your needs.

The settings for color mapping are defined in the "Color Mapping" dialog box. To display this dialog box, do one of the following:

- Select the color map in the window title bar of the "Spectrogram" result display.

To select a color scheme

You can select which colors are assigned to the measured values.

► In the "Color Mapping" dialog box, select the option for the color scheme to be used.

Editing the value range of the color map

The distribution of the measured values is displayed as a histogram in the "Color Mapping" dialog box. To cover the entire measurement value range, make sure the first and last bar of the histogram are included.

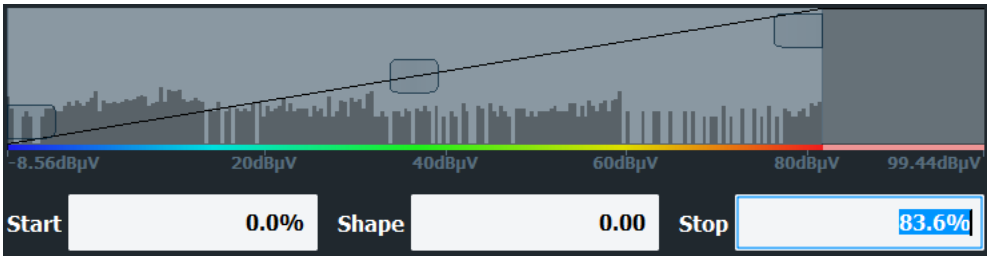
To ignore noise in a spectrogram, for example, exclude the lower power levels from the histogram.

The value range of the color map must cover at least 10% of the value range on the horizontal axis of the diagram, that means, the difference between the start and stop values must be at least 10%.

The value range of the color map can be set numerically or graphically.

To set the value range graphically using the color range sliders

1. Select and drag the bottom color curve slider (indicated by a gray box at the left of the color curve pane) to the lowest value you want to include in the color mapping.
2. Select and drag the top color curve slider (indicated by a gray box at the right of the color curve pane) to the highest value you want to include in the color mapping.



To set the value range of the color map numerically

1. In the "Start" field, enter the percentage from the left border of the histogram that marks the beginning of the value range.
2. In the "Stop" field, enter the percentage from the right border of the histogram that marks the end of the value range.

Example:

The color map starts at -110 dBm and ends at -10 dBm (that is: a range of 100 dB). In order to suppress the noise, you only want the color map to start at -90 dBm. Thus, you enter *10%* in the "Start" field. The R&S EPL1000 shifts the start point 10% to the right, to -90 dBm.

Adjusting the reference level and level range

Since the color map is configured using percentages of the total value range, changing the reference level and level range of the measurement (and thus the power value range) also affects the color mapping in the spectrogram.

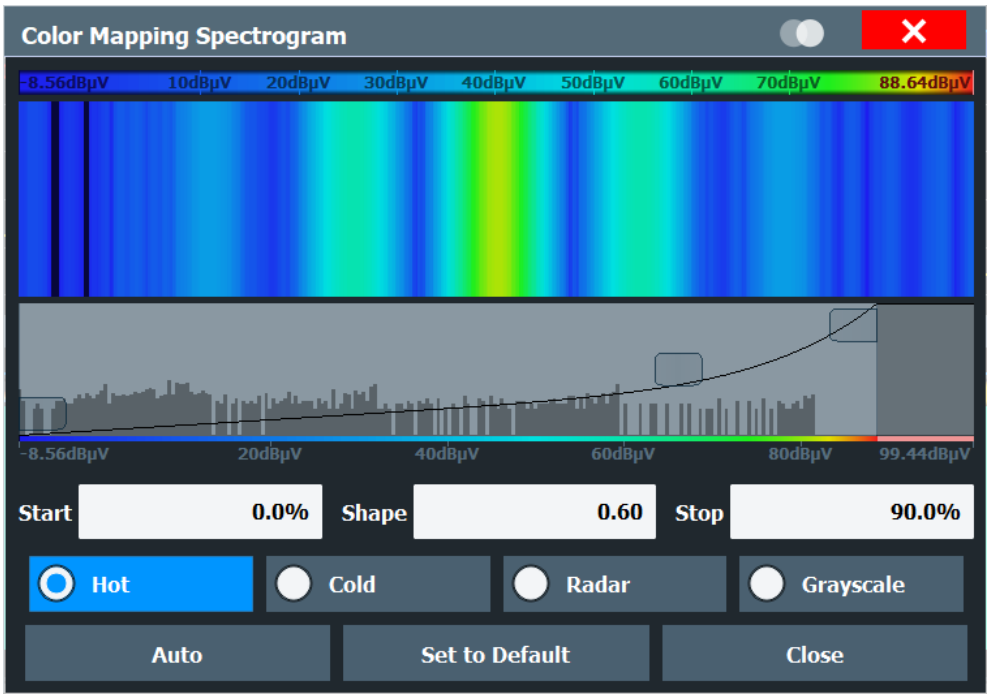
Editing the shape of the color curve

The color curve is a tool to shift the focus of the color distribution on the color map. By default, the color curve is linear, i.e. the colors on the color map are distributed evenly. If you shift the curve to the left or right, the distribution becomes non-linear. The slope of the color curve increases or decreases. One end of the color palette then covers a large number of results, while the other end distributes several colors over a relatively small result range.

The color curve shape can be set numerically or graphically.

To set the color curve shape graphically using the slider

► Select and drag the color curve shape slider (indicated by a gray box in the middle of the color curve) to the left or right. The area beneath the slider is focused, i.e. more colors are distributed there.



To set the color curve shape numerically

► In the "Shape" field, enter a value to change the shape of the curve:

- A negative value (-1 to <0) focuses the lower values
- 0 defines a linear distribution
- A positive value (>0 to 1) focuses the higher values

11.3.9 References

- Reference: ASCII file export format..... 207

11.3.9.1 Reference: ASCII file export format

Trace data can be exported to a file in ASCII format for further evaluation in other applications. This reference describes in detail the format of the export files for result data.

(For details see Chapter 11.3.8.1, "How to export trace data and numerical results", on page 203).

The file consists of the header information (general configuration of the measurement) and the measurement results. Optionally, the header can be excluded from the file.

The data of the file header consist of three columns, each separated by a semicolon: parameter name; numeric value; basic unit. The data section starts with the keyword "Trace <n>" (<n> = number of stored trace). The measured data follows in one or several columns (depending on the measurement), which are also separated by a semicolon.

The results are output in the same order as they are displayed on the screen: window by window, trace by trace, and table row by table row.

Generally, the format of this ASCII file can be processed by spreadsheet calculation programs, e.g. MS Excel. Different language versions of evaluation programs can require a different handling of the decimal point. Thus, you can define the decimal separator to use (decimal point or comma).

If the spectrogram display is selected when you select the "ASCII Trace Export" softkey, the entire histogram buffer with all frames is exported to a file. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded.

Header	
Type; <instrument_model>;	Instrument model
Version;1.00;	Firmware version
Date;01. Jan 3000;	Date of data set storage
Mode;Receiver;	Application
Start;150000.000000;Hz;	Scan start
Stop;1000000.000000;Hz;	Scan stop
X-Axis;LIN;	Scale of the x-axis
Scan Count;1;	Scan count
Transducer Input1;;;;;;;;	List of transducer on input 1
Transducer Input2;;;;;;;;	List of transducer on input 2
Preselector;	Preselector configuration
State;On;	
Filter Split;On;	
Notch Filter 1;On;	State of the first notch filter
Notch Filter 2;Off;	State of the second notch filter

Data section (scan ranges)	
Scan 1:	
Start;150000.000000;Hz;	Start frequency of the scan range
Stop;29998500.000000;Hz;	Stop frequency of the scan range
Step;4500.000000;Hz;	Frequency stepsize applied in the scan range
RBW;9000.000000;Hz;	Measurement bandwidth applied in the scan range
Meas Time;0.001000;s;	Measurement time in the scan range
Auto Ranging;OFF;	State of the auto ranging feature
RF Att;10.000000;dB;	Attenuation applied in the scan range
Auto Preamp;OFF; Preamp;0.000000;dB;	Preamplifier information for the scan range
RF Input;1;	RF input used in the scan range
Scan 2:	
(…)	

Data section (traces)	
Trace 1:	
Trace Mode;CLR/WRITE;	Trace mode
Scan Detector;MAX PEAK;	Detector type
X-Unit;Hz;	Unit of the x-axis
Y-Unit;Hz;	Unit of the y-axis
Values;1343;	Number of measurement points
150000.000000;3.541122; 154500.000000;5.776306;[...]	String of results
Trace 2:	
(…)	

11.4 Marker usage

Markers help you analyze your measurement results by determining particular values in the diagram. Thus you can extract numeric values from a graphical display both in the time and frequency domain.

Markers in spectrogram displays

In the spectrogram result display, you can activate up to 17 markers or delta markers at the same time. Each marker can be assigned to a different frame. Therefore, in addition to the frequency you also define the frame number when activating a new marker. If no frame number is specified, the marker is positioned on the currently selected frame. All markers are visible that are positioned on a visible frame.

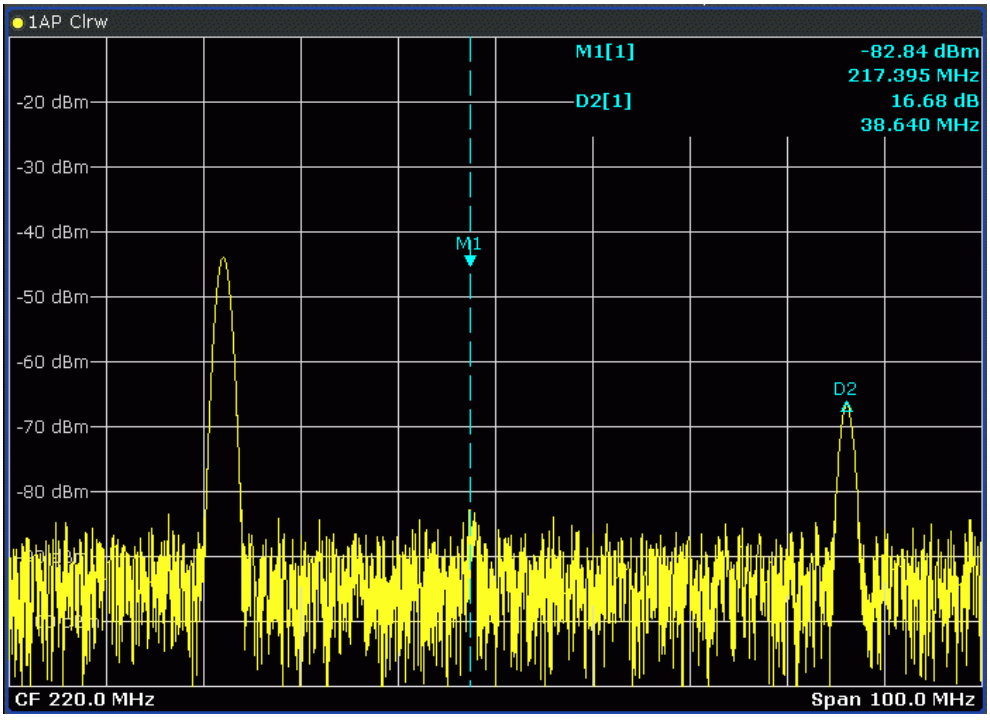
- Basics on markers....210
- Marker settings....214
- Marker search settings and positioning functions....218

11.4.1 Basics on markers

Some background knowledge on marker settings and functions is provided here for a better understanding of the required configuration settings.

Markers are used to mark points on traces, to read out measurement results and to select a display section quickly. The R&S EPL1000 provides 16 markers per display window. In the Spectrum application, the same markers are displayed in all windows.

- The easiest way to work with markers is using the touch screen. Simply drag the marker and drop it at the required position. When a marker label is selected, a vertical line is displayed which indicates the marker's current x-value.



- Alternatively, change the position of the selected marker using the rotary knob. By default, the marker is moved from one pixel to the next. If you need to position the marker more precisely, change the step size to move from one measurement point to the next (General Marker Setting).
- You can also set an active marker to a new position by defining its x-position numerically. When you select the softkey for a marker, an edit dialog box is displayed.
- The most commonly required marker settings and functions are also available as softkeys or via the context menu. Tap the marker on the touch screen and hold your finger for about 2 seconds until the context menu is opened, then select the required entry.
- Softkeys for active markers (displayed on the screen) are highlighted blue. The softkey for the currently selected marker (for which functions are performed) is highlighted orange.
- To set individual markers very quickly, use the softkeys in the "Marker" menu.
- To set up several markers at once, use the "Marker" dialog box.

- To position the selected marker to a special value, use the softkeys in the "Marker To" menu.

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- Searching for signal peaks.....212

11.4.1.1 Marker results

Normal markers point to a trace point on the x-axis and display the associated numeric value for that trace point. Delta markers indicate an offset between the level at the delta marker position and the level at the position of the assigned reference marker, in dB.

The results can be displayed directly within the diagram area or in a separate table. By default, the first two active markers are displayed in the diagram area. If more markers are activated, the results are displayed in a marker table.

Marker information in diagram area

By default, the results of the last two markers or delta markers that were activated are displayed in the diagram area.

The following information is displayed there:

- The marker type (M for normal, D for delta, or special function name)
- The marker number (1 to 16)
- The assigned trace number in square brackets [ ]
- The marker value on the y-axis, or the result of the marker function
- The marker position on the x-axis

Marker information in marker table

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

Table 11-3: Contents of the marker table in the Receiver application

Wnd	Window type the marker is positioned in.
Type	Marker type: N (normal), D (delta), T (temporary, internal) and number
Ref	Reference marker for delta markers
Trc	Trace to which the marker is assigned
X-value	X-value of the marker
Y-value	Y-value of the marker

11.4.1.2 Searching for signal peaks

A common measurement task is to determine peak values, i.e. maximum or minimum signal levels. The R&S EPL1000 provides various peak search functions and applications:

- Setting a marker to a peak value once (Peak Search)
- Searching for a peak value within a restricted search area (Search Limits)
- Creating a marker table with all or a defined number of peak values for one measurement (Marker Peak List)
- Updating the marker position to the current peak value automatically after each measurement (Auto Peak Search)
- Creating a fixed reference marker at the current peak value of a trace (Fixed Reference)

Note that the marker peak search is independent of the peak search available for automated test sequences. For more information, see Chapter 9.3.4, "Performing a peak search", on page 105.

Peak search limits

The peak search can be restricted to a search area. The search area is defined by limit lines which are also indicated in the diagram. In addition, a minimum value (threshold) can be defined as a further search condition.

When is a peak a peak? - Peak excursion

During a peak search, for example when a marker peak table is displayed, noise values may be detected as a peak if the signal is very flat or does not contain many peaks. Therefore, you can define a relative threshold ("Peak excursion"). The signal level must increase by the threshold value before falling again before a peak is detected. To avoid identifying noise peaks as maxima or minima, enter a peak excursion value that is higher than the difference between the highest and the lowest value measured for the displayed inherent noise.

Effect of peak excursion settings (example)

The following figure shows a trace to be analyzed.

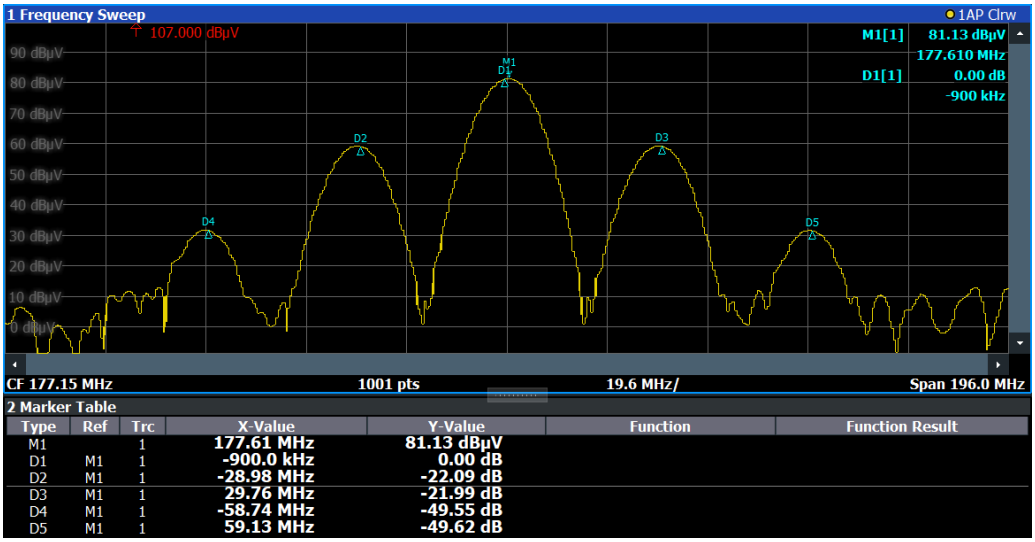

Figure 11-8: Trace example

The following table lists the peaks as indicated by the marker numbers in the diagram above, as well as the minimum decrease in amplitude to either side of the peak:

Marker #	Min. amplitude decrease to either side of the signal
1	30 dB
2	29.85 dB
3	20 dB
4	10 dB
5	18 dB

In order to eliminate the smaller peaks M3,M4 and M5 in the example above, a peak excursion of at least 20 dB is required. In this case, the amplitude must rise at least 20 dB before falling again before a peak is detected.

Marker peak list

The marker peak list determines the frequencies and levels of peaks in the spectrum. It is updated automatically after each measurement. How many peaks are displayed can be defined, as well as the sort order. In addition, the detected peaks can be indicated in the diagram. The peak list can also be exported to a file for analysis in an external application.

Automatic peak search

A peak search can be repeated automatically after each measurement in order to keep the maximum value as the reference point for a phase noise measurement. This is useful to track a drifting source. The delta marker 2, which shows the phase noise measurement result, keeps the delta frequency value. Therefore the phase noise measurement leads to reliable results in a certain offset although the source is drifting.

In the Receiver application, the R&S EPL1000 provides an automatic peak search. In that case, the R&S EPL1000 searches for peaks when a scan is over. The search results are added to the marker peak list as usual and are the basis for the final measurement. For more information, see Chapter 9.3.4, "Performing a peak search", on page 105.

Using a peak as a fixed reference marker

Some results are analyzed in relation to a peak value, for example a carrier frequency level. In this case, the maximum level can be determined by an initial peak search and then be used as a reference point for further measurement results.

11.4.2 Marker settings

Access: "Overview" > "Analysis" > "Marker"

The remote commands required to define these settings are described in Chapter 15.7.4, "Markers", on page 477

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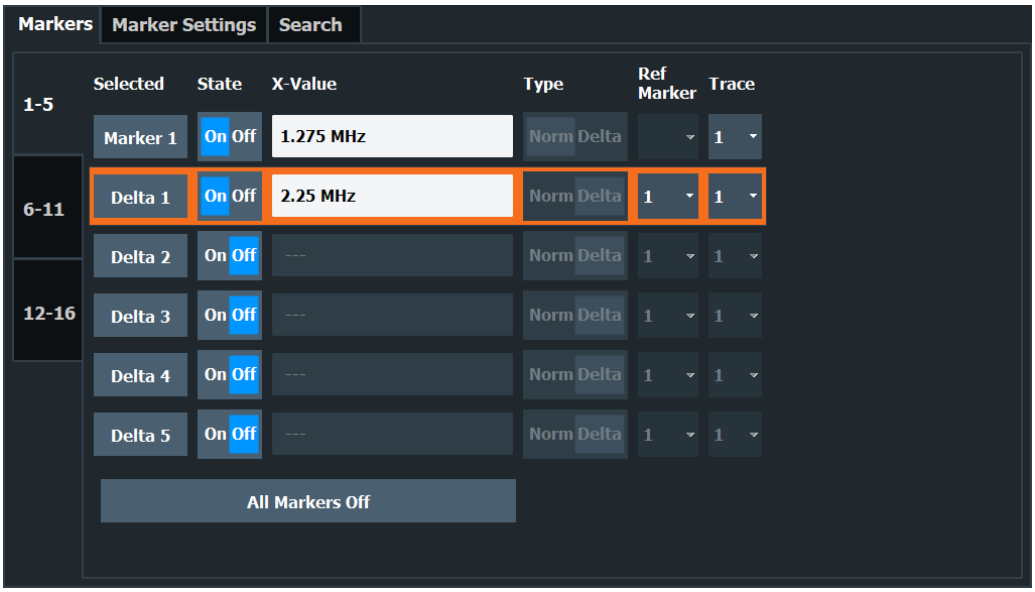
- General marker settings....217

11.4.2.1 Individual marker setup

Access: "Overview" > "Analysis" > "Marker" > "Markers"

Up to 17 markers or delta markers can be activated for each window simultaneously. Initial marker setup is performed using the "Marker" dialog box.



The markers are distributed among 3 tabs for a better overview. By default, the first marker is defined as a normal marker, whereas all others are defined as delta markers

with reference to the first marker. All markers are assigned to trace 1, but only the first marker is active.

Selected Marker....215
Marker State....215
Marker Position X-value....215
Frame (Spectrogram only)....215
Marker Type....215
Reference Marker....216
Assigning the Marker to a Trace....216
Select Marker....216
All Markers Off....217

Selected Marker
Marker name. The marker which is currently selected for editing is highlighted orange.

Remote command:
Marker selected via suffix <m> in remote commands.

Marker State
Activates or deactivates the marker in the diagram.

Remote command:
`CALCulate<n>:MARKer<m>[:STATe]` on page 480
`CALCulate<n>:DELTamarker<m>[:STATe]` on page 478

Marker Position X-value
Defines the position (x-value) of the marker in the diagram. For normal markers, the absolute position is indicated. For delta markers, the position relative to the reference marker is provided.

Remote command:
`CALCulate<n>:MARKer<m>:X` on page 481
`CALCulate<n>:DELTamarker<m>:X` on page 479

Frame (Spectrogram only)
Spectrogram frame the marker is assigned to.

Remote command:
`CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe` on page 492
`CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe` on page 497

Marker Type
Toggles the marker type.

The type for marker 1 is always "Normal", the type for delta marker 1 is always "Delta". These types cannot be changed.

Note: If normal marker 1 is the active marker, switching the "Mkr Type" activates an additional delta marker 1. For any other marker, switching the marker type does not activate an additional marker, it only switches the type of the selected marker.

"Normal" A normal marker indicates the absolute value at the defined position in the diagram.

"Delta" A delta marker defines the value of the marker relative to the specified reference marker (marker 1 by default).

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 480
CALCulate<n>:DELTamarker<m>[:STATe] on page 478

Reference Marker
Defines a marker as the reference marker which is used to determine relative analysis results (delta marker values).

Remote command:
CALCulate<n>:DELTamarker<m>:MREFerence on page 478

Assigning the Marker to a Trace
The "Trace" setting assigns the selected marker to an active trace. The trace determines which value the marker shows at the marker position. If the marker was previously assigned to a different trace, the marker remains on the previous frequency or time, but indicates the value of the new trace.

If a trace is turned off, the assigned markers and marker functions are also deactivated.

Remote command:
CALCulate<n>:MARKer<m>:TRACe on page 480

Select Marker
The "Select Marker" function opens a dialog box to select and activate or deactivate one or more markers quickly.

Remote command:
CALCulate<n>:MARKer<m>[:STATe] on page 480
CALCulate<n>:DELTamarker<m>[:STATe] on page 478

All Markers Off
Deactivates all markers in one step.

Remote command:
CALCulate<n>:MARKer<m>:AOFF on page 480

11.4.2.2 General marker settings

Access: "Overview" > "Analysis" > "Marker" > "Marker Settings"

Some general marker settings allow you to influence the marker behavior for all markers.

Marker Table Display....217
Marker Info....217
Settings Coupled....218

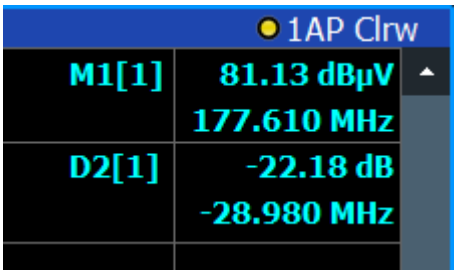
Marker Table Display
Defines how the marker information is displayed.

"On" Displays the marker information in a table in a separate area beneath the diagram.

"Off" No separate marker table is displayed.

Remote command:
DISPlay[:WINDow<n>]:MTABle on page 482

Marker Info
Turns the marker information displayed in the diagram on and off.



Remote command:
DISPlay[:WINDow<n>]:MINFo[:STATe] on page 482

Settings Coupled
Couples or decouples the receiver settings to the scan range settings when you use Tune to Marker.

When you turn on this feature, the R&S EPL1000 changes the receiver settings according to the scan range the marker frequency is currently in.

In addition, you can select which settings the R&S EPL1000 applies with the "Use Last Scan" feature.

- When you turn it on, the R&S EPL1000 uses the configuration of the last scan.
- When you turn it off, the R&S EPL1000 uses the current configuration of the scan table, if you have changed it since the last scan.
  (If you have not changed anything, the configuration of the last scan is still in effect.)

Remote command:
`CALCulate<n>:MARKer<m>:SCOupled[:STATe]` on page 482
`CALCulate<n>:MARKer<m>:SCOupled:LSCan` on page 481

11.4.3 Marker search settings and positioning functions

Several functions are available to set the marker to a specific position very quickly and easily, or to use the current marker position to define another characteristic value. In order to determine the required marker position, searches may be performed. The search results can be influenced by special settings.

Most marker positioning functions and the search settings are available in the [MKR →] menu.

Search settings are also available via the [Marker] key or in the vertical "Marker Config" tab of the "Analysis" dialog box (horizontal "Search Settings" tab).

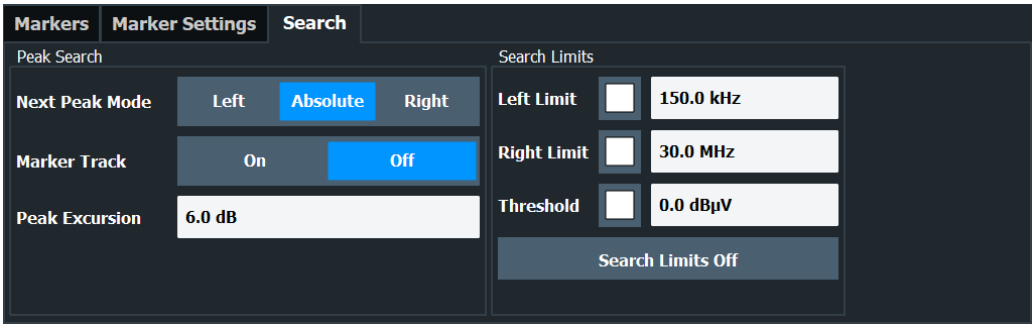
For more information on searching for signal peaks see Chapter 11.4.1.2, "Searching for signal peaks", on page 212.

- Marker search 218
- Marker search (spectrogram) 220
- Marker positioning 221

11.4.3.1 Marker search

Access: "Overview" > "Analysis" > "Marker" > "Search"

Markers are commonly used to determine peak values, i.e. maximum or minimum values, in the measured signal. Configuration settings allow you to influence the peak search results.



Search Mode for Next Peak....219
Peak Excursion....219
Search Limits (Left / Right)....219
Search Threshold....219
Search Limits Off....220

Search Mode for Next Peak
Selects the search mode for the next peak search.

"Left" Determines the next maximum/minimum to the left of the current peak.

"Absolute" Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:
Find a list of remote commands in Chapter 15.7.4, "Markers", on page 477.

Peak Excursion
Defines the minimum level value by which a signal must rise or fall so that it is identified as a maximum or a minimum by the search functions.

Entries from 0 dB to 80 dB are allowed; the resolution is 0.1 dB. The default setting for the peak excursion is 6 dB.

Remote command:
`CALCulate<n>:MARKer<m>:PEXCursion` on page 399

Search Limits (Left / Right)
If activated, limit lines are defined and displayed for the search. Only results within the limited search range are considered.

Remote command:
`CALCulate<n>:MARKer<m>:X:SLIMits[:STATe]` on page 483
`CALCulate<n>:MARKer<m>:X:SLIMits:LEFT` on page 484
`CALCulate<n>:MARKer<m>:X:SLIMits:RIGHt` on page 484

Search Threshold
Defines an absolute threshold as an additional condition for the peak search. If enabled, only peaks that exceed the threshold are detected.

Remote command:
CALCulate<n>:THReshold:STATe on page 485
CALCulate<n>:THReshold on page 485

Search Limits Off
Deactivates the search range limits.

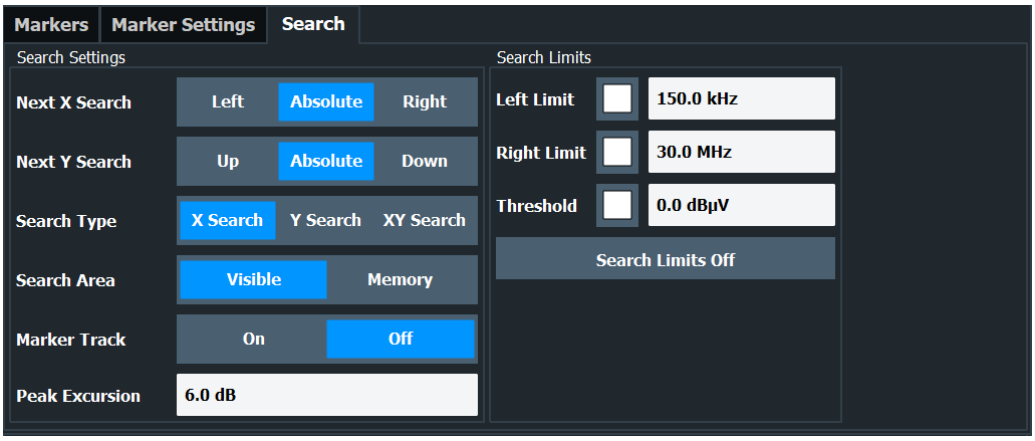
Remote command:
CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] on page 483
CALCulate<n>:THReshold:STATe on page 485

11.4.3.2 Marker search (spectrogram)

Access: "Overview" > "Analysis" > "Marker" > "Search"

These settings are only available for spectrogram displays.

Spectrograms show not only the current measurement results, but also the measurement history. Thus, when searching for peaks, you must define the search settings within a single time frame (x-direction) and within several time frames (y-direction).



Marker search functions for the spectrogram described elsewhere:

- Marker Track
- "Peak Excursion" on page 219
- "Search Limits (Left / Right)" on page 219
- "Search Threshold" on page 219
- "Search Limits Off" on page 220

Search Mode for Next Peak in X-Direction..... 220
Search Mode for Next Peak in Y-Direction..... 221
Marker Search Type..... 221
Marker Search Area..... 221

Search Mode for Next Peak in X-Direction
Selects the search mode for the next peak search within the currently selected frame.

"Left" Determines the next maximum/minimum to the left of the current peak.

"Absolute" Determines the next maximum/minimum to either side of the current peak.

"Right" Determines the next maximum/minimum to the right of the current peak.

Remote command:
Find a list of remote commands in Chapter 15.7.4.6, "Spectrogram markers", on page 492.

Search Mode for Next Peak in Y-Direction
Selects the search mode for the next peak search within all frames at the current marker position.

"Up" Determines the next maximum/minimum above the current peak (in more recent frames).

"Absolute" Determines the next maximum/minimum above or below the current peak (in all frames).

"Down" Determines the next maximum/minimum below the current peak (in older frames).

Remote command:
Find a list of remote commands in Chapter 15.7.4.6, "Spectrogram markers", on page 492.

Marker Search Type
Defines the type of search to be performed in the spectrogram.

"X-Search" Searches only within the currently selected frame.

"Y-Search" Searches within all frames but only at the current frequency position.

"XY-Search" Searches in all frames at all positions.

Remote command:
Find a list of remote commands in Chapter 15.7.4.6, "Spectrogram markers", on page 492.

Marker Search Area
Defines which frames the search is performed in.

"Visible" Only the visible frames are searched.

"Memory" All frames stored in the memory are searched.

Remote command:
`CALCulate<n>:MARKer<m>:SPECtrogram:SAREa` on page 493
`CALCulate<n>:DELTamarker<m>:SPECtrogram:SAREa` on page 497

11.4.3.3 Marker positioning

The following functions set the currently selected marker to the result of a peak search or set other characteristic values to the current marker value. These functions are available as softkeys in the "Marker To" menu, which is displayed when you press the [MKR →] key.

Functions to position markers in the Spectrum application described elsewhere:

- "Settings Coupled" on page 218

Peak Search....222
Search Next Peak....222
Search Minimum....222
Search Next Minimum....222

Peak Search
Sets the selected marker/delta marker to the maximum of the trace. If no marker is active, marker 1 is activated.

For spectrogram displays, define which frame the peak is to be searched in.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 486
`CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 489

Search Next Peak
Sets the selected marker/delta marker to the next (lower) maximum of the assigned trace. If no marker is active, marker 1 is activated.

For spectrogram displays, define which frame the next peak is to be searched in.

Remote command:
`CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 486
`CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 487
`CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 486
`CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 489
`CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 489
`CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 488

Search Minimum
Sets the selected marker/delta marker to the minimum of the trace. If no marker is active, marker 1 is activated.

For spectrogram displays, define which frame the minimum is to be searched in.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 487
`CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 490

Search Next Minimum
Sets the selected marker/delta marker to the next (higher) minimum of the selected trace. If no marker is active, marker 1 is activated.

For spectrogram displays, define which frame the next minimum is to be searched in.

Remote command:
`CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 487
`CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 487
`CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 488
`CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 490
`CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 489
`CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 490

11.5 Display and limit lines

Display and limit lines help you analyze a measurement trace.

Access: "Overview" > "Analysis" > "Lines"

For remote operation, see Chapter 15.7.5, "Display and limit line configuration", on page 500 .

- Display lines 223
- Limit lines 225

11.5.1 Display lines

11.5.1.1 Basics on display lines

Display lines help you analyze a trace – as do markers. The function of a display line is comparable to that of a ruler that can be shifted on the trace in order to mark absolute values. They are used exclusively to visually mark relevant frequencies or points in time (zero span), as well as constant level values. It is not possible to check automatically whether the points are below or above the marked level values - use limit lines for that task (see Chapter 11.5.2.1, "Basics on limit lines", on page 225).

Two different types of display lines are provided:

- Two horizontal lines: "Horizontal Line 1" and "Horizontal Line 2".
  These lines are continuous horizontal lines across the entire width of a diagram and can be shifted up and down.
- Four vertical lines: "Vertical Line 1" to "Vertical Line 4"
  The receiver application only supports two vertical lines.
  These lines are continuous vertical lines across the entire height of the diagram and can be shifted left and right.

Lables

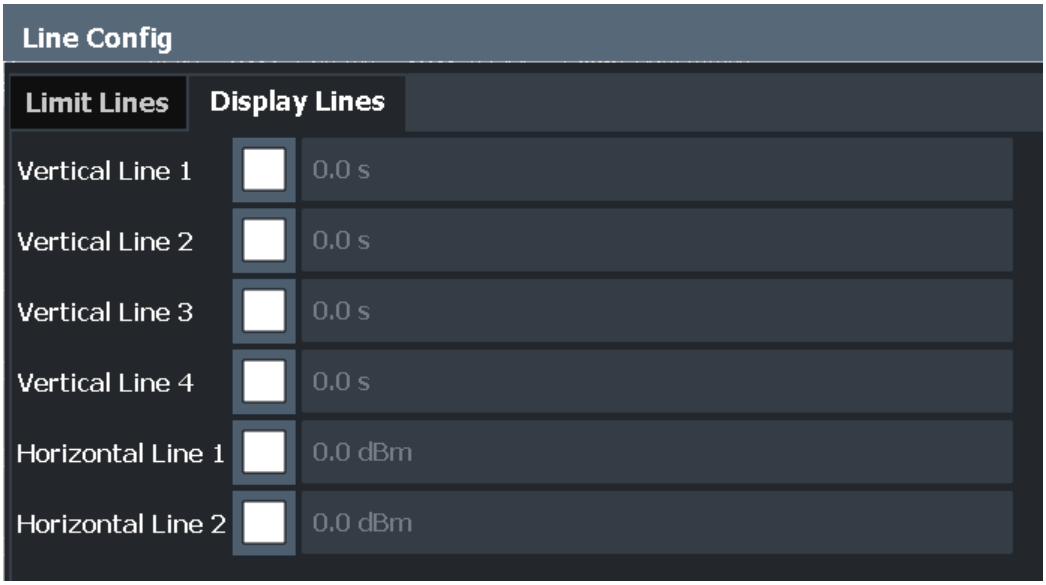
Each line is identified by one of the following abbreviations in the diagrams:

- H1: "Horizontal Line 1"
- H2: "Horizontal Line 2"
- V1: "Vertical Line 1"
- V2: "Vertical Line 2"
- V3: "Vertical Line 3"
- V4: "Vertical Line 4"
- Each label also shows the absolute position of the corresponding line, for example "H1 70.000 dBµV".
  If you turn on both horizontal lines or both vertical lines, the label of the first line also shows the distance to the second line, for example "H1 70.000 dBµV, Δ 8.250 dB".

11.5.1.2 Display line settings

Access: "Overview" > "Analysis" > "Lines" > "Display Lines"

Four vertical and two horizontal lines can be defined in the display.



Vertical Line <x>.....224
Horizontal Line 1/ Horizontal Line 2.....224
Tuned Frequency.....225

Vertical Line <x>
Activates a vertical display line in the diagram at the specified point of the x-axis, depending on the scale of the axis.

If you activate both vertical lines, the label of the first vertical line shows the distance to second vertical line.

Remote command:
`CALCulate<n>:FLINe<dl>` on page 501
`CALCulate<n>:TLINe<dl>` on page 502

Horizontal Line 1/ Horizontal Line 2
Activates a horizontal display line (H1 or H2) in the diagram at the specified point of the y-axis.

If you activate both horizontal lines, the label of the first horizontal line shows the distance to second vertical line.

Remote command:
`CALCulate<n>:DLINe<dl>` on page 501
`CALCulate<n>:DLINe<dl>` on page 501

Tuned Frequency
Turns a display line that represents the currently selected receiver frequency on and off.

The tuned frequency line is labeled "TF" in the diagram.

Remote command:
`CALCulate<n>:TFLine:STATe` on page 502

11.5.1.3 Defining display lines

1. Display lines are configured in the "Lines Config" dialog box. To display this dialog box, press the [Lines] key and then "Lines Config".
2. Select the "Display Lines" tab.
3. To define a vertical line:
   a) Select "Vertical Line 1", 2, 3, or 4.
   b) Enter the x-value at which the line is to be displayed.
4. To define a horizontal line:
   a) Select "Horizontal Line 1" or 2.
   b) Enter the y-value at which the line is to be displayed.

11.5.2 Limit lines

Limit lines allow you to check automatically whether the measured points are below or above specified values.

- Basics on limit lines....225
- Limit line settings and functions....229
- How to define limit lines....236
- Reference: limit line file format....240

11.5.2.1 Basics on limit lines

Limit lines are used to define amplitude curves or spectral distribution boundaries in the result diagram which are not to be exceeded. They indicate, for example, the upper limits for interference radiation or spurious waves which are allowed from a device under test (DUT). When transmitting information in TDMA systems (e.g. GSM), the amplitude of the bursts in a time slot must adhere to a curve that falls within a specified tolerance band. The lower and upper limits may each be specified by a limit line. Then, the amplitude curve can be controlled either visually or automatically for any violations of the upper or lower limits (GO/NOGO test).

The R&S EPL1000 supports limit lines with a maximum of 200 data points. Eight of the limit lines stored in the instrument can be activated simultaneously. The number of limit lines stored in the instrument is only limited by the capacity of the storage device used.

Limit line data can also be exported to a file in ASCII (CSV) format for further evaluation in other applications. Limit lines stored in the specified ASCII (CSV) format can also be imported to the R&S EPL1000 for other measurements.

Compatibility

Limit lines are compatible with the current measurement settings, if the following applies:

- The x unit of the limit line has to be identical to the current setting.
- The y unit of the limit line has to be identical to the current setting with the exception of dB based units; all dB based units are compatible with each other.

Validity

Only limit lines that fulfill the following conditions can be activated:

- Each limit line must consist of a minimum of 2 and a maximum of 200 data points.
- The frequencies/times for each data point must be defined in ascending order; however, for any single frequency or time, two data points may be entered (to define a vertical segment of a limit line).
- Gaps in frequency or time are not allowed. If gaps are desired, two separate limit lines must be defined and then both enabled.
- The entered frequencies or times need not necessarily be selectable in R&S EPL1000. A limit line may also exceed the specified frequency or time range. The minimum frequency for a data point is -200 GHz, the maximum frequency is 200 GHz. For the time range representation, negative times may also be entered. The allowed range is -1000 s to +1000 s.

Figure 11-9: Example for an upper limit line

Limits and Margins

Limit lines define strict values that must not be exceeded by the measured signal. A **margin** is similar to a limit, but less strict and it still belongs to the valid data range. It can be used as a warning that the limit is almost reached. The margin is not indicated by a separate line in the display, but if it is violated, a warning is displayed. Margins are defined as lines with a fixed distance to the limit line.

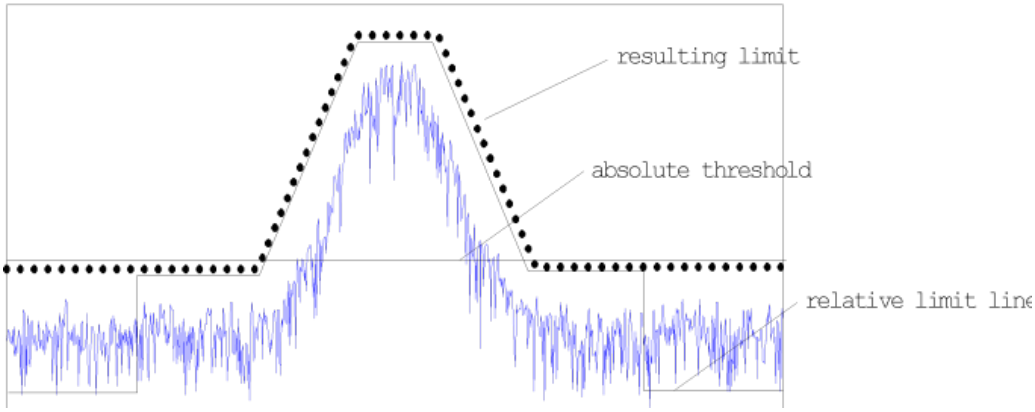
To check the signal for maximum levels you must define an **upper limit**, whereas to check the signal for minimum levels you must define a **lower limit**.

Limits can be defined relative to the reference level, the beginning of the time scale, or the center frequency, or as absolute values.

Relative scaling is suitable, for example, if masks for bursts are to be defined in zero span, or if masks for modulated signals are required in the frequency domain.

Thresholds

If the y-axis for the limit line data points uses relative scaling, an additional absolute **threshold** can be defined for the limit check. In this case, both the threshold value and the relative limit line must be exceeded before a violation occurs.



Offsets and Shifting

A configured limit line can easily be moved vertically or horizontally. Two different methods to do so are available:

- An **offset** moves the entire line in the diagram without editing the configured values or positions of the individual data points. This option is only available if relative scaling is used.
  Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally or vertically.
- Defining a **shift** width for the values or position of the individual data points changes the line configuration, thus changing the position of the line in the diagram.

Limit Check Results

A limit check is automatically performed as soon as any of the limit lines is activated ("Visibility" setting). Only the specified "Traces to be Checked" are compared with the

active limit lines. The status of the limit check for each limit line is indicated in the diagram. If a violation occurs, the limit check status is set to "MARG" for a margin violation, or to"Fail" for a limit violation.

Figure 11-10: Margin violation for limit check

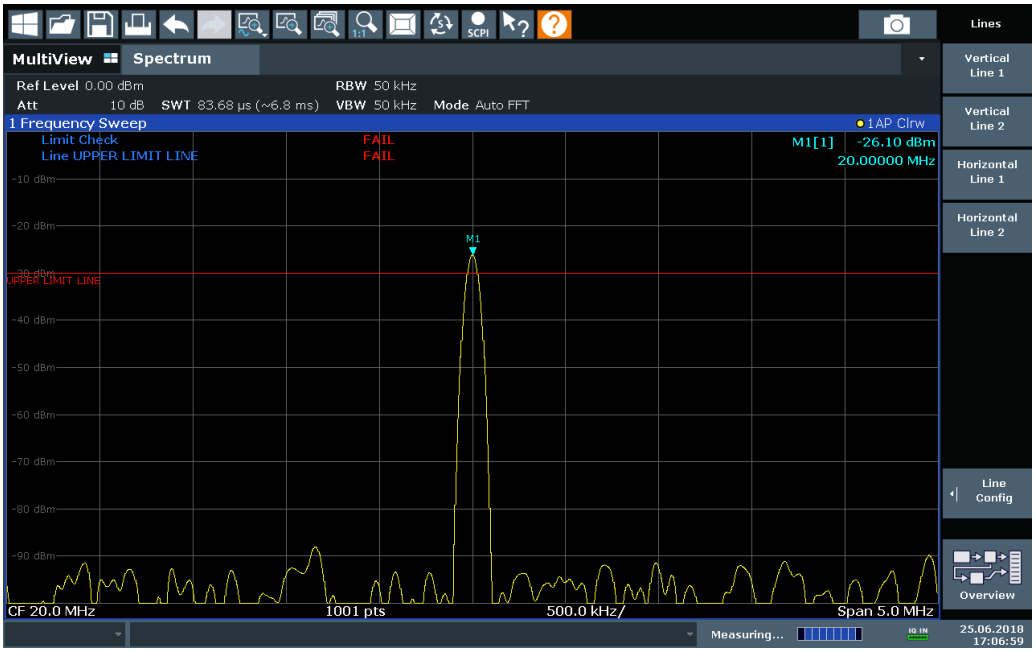


Figure 11-11: Limit violation for limit check

Storing and Recalling Limit Lines

Limit lines can be stored with the configuration settings so they can be recalled for other measurements at a later time (see Chapter 12.2, "Storing and recalling instrument settings and measurement data", on page 242). Note, however, that any changes made to the limit lines *after* storing the configuration file cannot be restored and will be overwritten by the stored values when the configuration file is recalled. Always remember to store the settings again after changing the limit line values.

After recalling measurement settings, the limit line values applied to the measurement may be different to those displayed in the "Limit Lines" dialog box; see "Saving and recalling transducer and limit line settings" on page 243.

11.5.2.2 Limit line settings and functions

Access: "Overview" > "Analysis" > "Lines"

or: [LINES] > "Line Config"

Up to 8 limit lines can be displayed simultaneously in the R&S EPL1000. Many more can be stored on the instrument.

Stored limit line settings

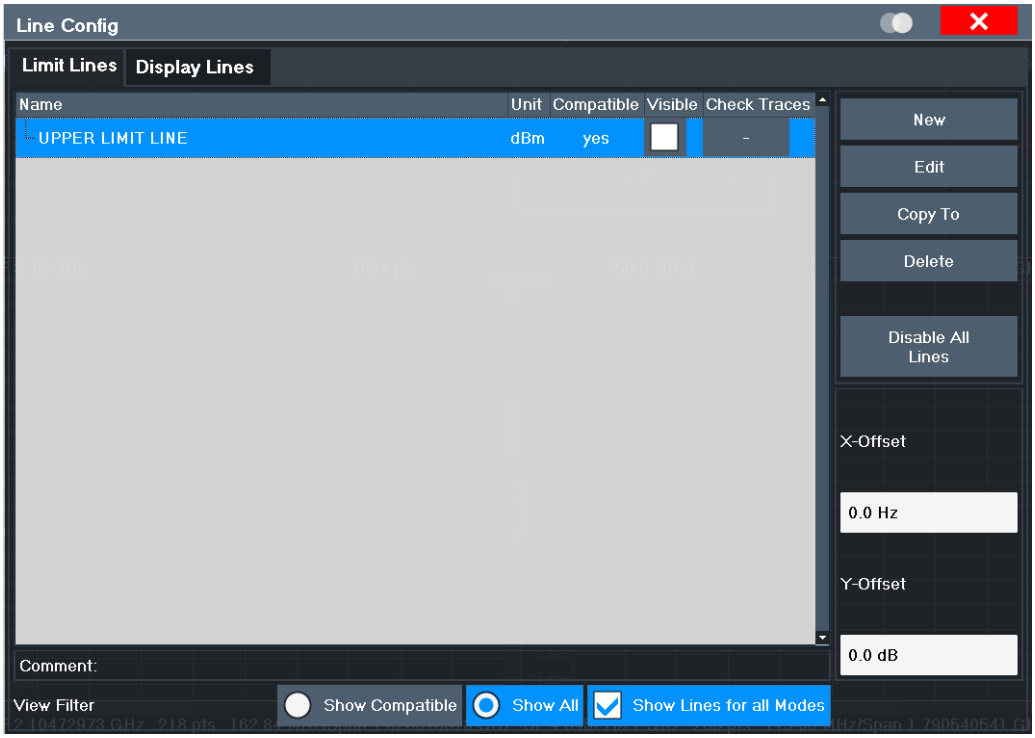
When storing and recalling limit line settings, consider the information provided in "Saving and recalling transducer and limit line settings" on page 243.

- Limit line management....229
- Limit line details....232

Limit line management

Access: "Overview" > "Analysis" > "Lines" > "Limit Lines"

or: [LINES] > "Line Config" > "Limit Lines"



For the limit line overview, the R&S EPL1000 searches for all stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder. The overview allows you to determine which limit lines are available and can be used for the current measurement.

For details on settings for individual lines see "Limit line details" on page 232.

For more basic information on limit lines see Chapter 11.5.2.1, "Basics on limit lines", on page 225.

Name....230
Unit....231
Compatibility....231
Visibility....231
Traces to be Checked....231
Comment....231
Included Lines in Overview (View Filter)....231
X-Offset....231
Y-Offset....231
Limit Check....232
Create New Line....232
Edit Line....232
Copy Line....232
Delete Line....232
Disable All Lines....232

Name
The name of the stored limit line.

Unit
The unit in which the y-values of the data points of the limit line are defined.

Compatibility
Indicates whether the limit line definition is compatible with the current measurement settings.

For more information on which conditions a limit line must fulfill to be compatible, see "Compatibility" on page 226.

Visibility
Displays or hides the limit line in the diagram. Up to 8 limit lines can be visible at the same time. Inactive limit lines can also be displayed in the diagram.

Remote command:
`CALCulate<n>:LIMit<li>:LOWer:STATe` on page 505
`CALCulate<n>:LIMit<li>:UPPer:STATe` on page 508
`CALCulate<n>:LIMit<li>:ACTive?` on page 504

Traces to be Checked
Defines which traces are automatically checked for conformance with the limit lines. As soon as a trace to be checked is defined, the assigned limit line is active. One limit line can be activated for several traces simultaneously. If any of the "Traces to be Checked" violate any of the active limit lines, a message is indicated in the diagram.

Remote command:
`CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 507

Comment
An optional description of the limit line.

Included Lines in Overview (View Filter)
Defines which of the stored lines are included in the overview.

"Show Compatible"	Only compatible lines Whether a line is compatible or not is indicated in the Compatibility setting.
"Show All"	All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder.

X-Offset
Shifts a limit line that has been specified for relative frequencies or times (x-axis) horizontally.

This setting does not have any effect on limit lines that are defined by absolute values for the x-axis.

Remote command:
`CALCulate<n>:LIMit<li>:CONTrol:OFFSet` on page 504

Y-Offset
Shifts a limit line that has relative values for the y-axis (levels or linear units such as volt) vertically.

This setting does not have any effect on limit lines that are defined by absolute values for the y-axis.

Remote command:
CALCulate<n>:LIMit<li>:LOWer:OFFSet on page 505
CALCulate<n>:LIMit<li>:UPPer:OFFSet on page 507

Limit Check
Turns limit checks for pre-measurement on and off.

Create New Line
Creates a new limit line.

Edit Line
Edit an existing limit line configuration.

Copy Line
Copy the selected limit line configuration to create a new line.

Remote command:
CALCulate<n>:LIMit<li>:COPY on page 504

Delete Line
Delete the selected limit line configuration.

Remote command:
CALCulate<n>:LIMit<li>:DELete on page 505

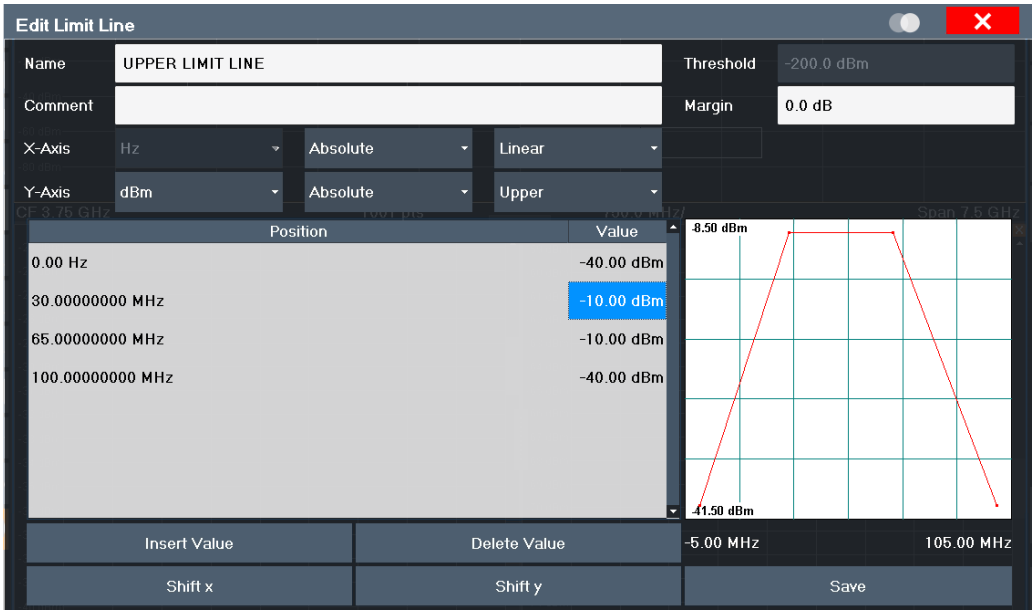
Disable All Lines
Disable all limit lines in one step.

Remote command:
CALCulate<n>:LIMit<li>:STATe on page 506

Limit line details

Access: "Overview" > "Analysis" > "Lines" > "Limit Lines" > "New" / "Edit" / "Copy To"

or: [LINES] > "Line Config" > "Limit Lines" > "New" / "Edit" / "Copy To"



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X-Axis....234
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Shift x....235
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Name
Defines the limit line name. All names must be compatible with Windows conventions for file names. The limit line data is stored under this name (with a `.LIN` extension).

Remote command:
`CALCulate<n>:LIMit<li>:NAME` on page 514

Comment
Defines an optional comment for the limit line.

Remote command:
`CALCulate<n>:LIMit<li>:COMMent` on page 509

Threshold
Defines an absolute threshold value (only for relative scaling of the y-axis).

Remote command:
CALCulate<n>:LIMit<li>:LOWer:THReshold on page 513
CALCulate<n>:LIMit<li>:UPPer:THReshold on page 516

Margin
Defines a margin for the limit line. The default setting is 0 dB (i.e. no margin).

Remote command:
CALCulate<n>:LIMit<li>:LOWer:MARGin on page 512
CALCulate<n>:LIMit<li>:UPPer:MARGin on page 515

X-Axis
Describes the horizontal axis on which the data points of the limit line are defined. Includes the following settings:

- Unit:
  – "Hz": for frequency domain
  – "s": for time domain
- Scaling mode: absolute or relative values
  For relative values, the frequencies are referred to the currently set center frequency. In the time domain, the left boundary of the diagram is used as the reference.
- Scaling: linear or logarithmic

Remote command:
CALCulate<n>:LIMit<li>:CONTrol:MODE on page 510
CALCulate<n>:LIMit<li>:CONTrol:DOMain on page 510
CALCulate<n>:LIMit<li>:CONTrol:SPACing on page 511

Y-Axis
Describes the vertical axis on which the data points of the limit line are defined. Includes the following settings:

- Level unit
- Scaling mode: absolute or relative (dB/%) values
  Relative limit values refer to the reference level.
- Limit type: upper or lower limit; values must stay above the lower limit and below the upper limit to pass the limit check

Remote command:
CALCulate<n>:LIMit<li>:UNIT on page 514
CALCulate<n>:LIMit<li>:LOWer:MODE on page 512
CALCulate<n>:LIMit<li>:UPPer:MODE on page 515
CALCulate<n>:LIMit<li>:LOWer:SPACing on page 513
CALCulate<n>:LIMit<li>:UPPer:SPACing on page 516

Data Points
Each limit line is defined by a minimum of 2 and a maximum of 200 data points. Each data point is defined by its position (x-axis) and value (y-value). Data points must be defined in ascending order. The same position can have two different values.

Remote command:
CALCulate<n>:LIMit<li>:CONTrol[:DATA] on page 509
CALCulate<n>:LIMit<li>:LOWer[:DATA] on page 511
CALCulate<n>:LIMit<li>:UPPer[:DATA] on page 514

Insert Value
Inserts a data point in the limit line above the selected one in the "Edit Limit Line" dialog box.

Delete Value
Deletes the selected data point in the "Edit Limit Line" dialog box.

Shift x
Shifts the x-value of each data point horizontally by the defined shift width (as opposed to an additive offset defined for the entire limit line, see "X-Offset" on page 231).

Remote command:
CALCulate<n>:LIMit<li>:CONTrol:SHIFt on page 511

Shift y
Shifts the y-value of each data point vertically by the defined shift width (as opposed to an additive offset defined for the entire limit line, see "Y-Offset" on page 231).

Remote command:
CALCulate<n>:LIMit<li>:LOWer:SHIFt on page 512
CALCulate<n>:LIMit<li>:UPPer:SHIFt on page 515

Save
Saves the currently edited limit line under the name defined in the "Name" field.

Import
Opens a file selection dialog box and loads the limit line from the selected file in `.CSV` format.

"File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.

Note that a valid import file must contain a minimum of required information for the R&S EPL1000.

Remote command:
MMEMory:LOAD<n>:LIMit on page 508

File Explorer ← Import
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

Export
Opens a file selection dialog box and stores the currently displayed limit line to the defined file in `.CSV` format.

"File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.

The limit line can be imported again later by the R&S EPL1000 for use in other measurements.

Remote command:
`MMEMory:STORe<n>:LIMit` on page 508

File Explorer ← Export
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

11.5.2.3 How to define limit lines

Access: "Overview" > "Analysis" > "Lines" > "Limit Lines"

or: [LINES] > "Line Config" > "Limit Lines"

The following tasks are described here:

- "How to find compatible limit lines" on page 236
- "How to activate and deactivate a limit check" on page 236
- "How to edit existing limit lines" on page 237
- "How to copy an existing limit line" on page 237
- "How to delete an existing limit line" on page 237
- "How to configure a new limit line" on page 237
- "How to move the limit line vertically or horizontally" on page 238

How to find compatible limit lines

► In the "Line Config" dialog box, select the "View Filter" option: "Show Compatible".

All stored limit lines with the file extension `.LIN` in the `limits` subfolder of the main installation folder of the instrument that are compatible to the current measurement settings are displayed in the overview.

How to activate and deactivate a limit check

A limit check is automatically performed as soon as any of the limit lines is activated.

1. To activate a limit check:
   Select the "Check Traces" setting for a limit line in the overview and select the trace numbers to be included in the limit check. One limit line can be assigned to several traces.

   The specified traces to be checked are compared with the active limit lines. The status of the limit check is indicated in the diagram.

2. To deactivate a limit line, deactivate all "Traces to be Checked" for it.
   To deactivate all limit lines at once, select the "Disable All Lines" button.

The limit checks for the deactivated limit lines are stopped and the results are removed form the display.

How to edit existing limit lines

Existing limit line configurations can be edited.

1. In the "Line Config" dialog box, select the limit line.
2. Select the "Edit" button.
3. Edit the line configuration as described in "How to configure a new limit line" on page 237.
4. Save the new configuration by selecting the "Save" button.

   If the limit line is active, the edited limit line is displayed in the diagram.

How to copy an existing limit line

1. In the dialog box, select the limit line.
2. Select the"Line Config" "Copy To" button.
3. Define a new name to create a new limit with the same configuration as the source line.
4. Edit the line configuration as described in "How to configure a new limit line" on page 237.
5. Save the new configuration by selecting the "Save" button.

   The new limit line is displayed in the overview and can be activated.

How to delete an existing limit line

1. In the "Line Config" dialog box, select the limit line.
2. Select the "Delete" button.
3. Confirm the message.

   The limit line and the results of the limit check are deleted.

How to configure a new limit line

1. In the "Line Config" dialog box, select the "New" button.

   The "Edit Limit Line" dialog box is displayed. The current line configuration is displayed in the preview area of the dialog box. The preview is updated after each change to the configuration.
2. Define a "Name" and, optionally, a "Comment" for the new limit line.
3. Define the x-axis configuration:
   - Time domain or frequency domain
   - Absolute or relative limits
   - Linear or logarithmic scaling

4. Define the y-axis configuration:
   - Level unit
   - Absolute or relative limits
   - Upper or lower limit line
5. Define the data points: minimum 2, maximum 200:
   a) Select "Insert Value".
   b) Define the x-value ("Position") and y-value ("Value") of the first data point.
   c) Select "Insert Value" again and define the second data point.
   d) Repeat this to insert all other data points.
   To insert a data point before an existing one, select the data point and then "Insert Value".
   To insert a new data point at the end of the list, move the focus to the line after the last entry and then select "Insert Value".
   To delete a data point, select the entry and then "Delete Value".
6. Check the current line configuration in the preview area of the dialog box. If necessary, correct individual data points or add or delete some.
   If necessary, shift the entire line vertically or horizontally by selecting the "Shift x" or "Shift y" button and defining the shift width.
7. Optionally, define a "Margin" at a fixed distance to the limit line.
   The margin must be within the valid value range and is not displayed in the diagram or preview area.
8. Optionally, if the y-axis uses relative scaling, define an absolute "Threshold" as an additional criteria for a violation.
9. Save the new configuration by selecting the "Save" button.

   The new limit line is displayed in the overview and can be activated.

How to move the limit line vertically or horizontally

A configured limit line can easily be moved vertically or horizontally. Thus, a new limit line can be easily generated based upon an existing limit line which has been shifted horizontally.

1. In the "Line Config" dialog box, select the limit line.
2. To shift the complete limit line parallel in the horizontal direction, select the "X-Offset" button and enter an offset value.
   To shift the complete limit line parallel in the vertical direction, select the "Y-Offset" button and enter an offset value.
3. To shift the individual data points of a limit line by a fixed value (all at once):
   a) Select the "Edit" button.
   b) In the "Edit Limit Line" dialog box, select the "Shift x" or "Shift y" button and define the shift width.
   c) Save the shifted data points by selecting the "Save" button.

   If activated, the limit line is shifted in the diagram.

How to export a limit line

Limit line configurations can be stored to an ASCII file for evaluation in other programs or to be imported later for other measurements.

1. In the "Line Config" dialog box, select the limit line.
2. Select the "New" or "Edit" button.
3. Define the limit line as described in "How to configure a new limit line" on page 237.
4. Select "Export" to save the configuration to a file.

   You are asked whether you would like to save the configuration internally on the R&S EPL1000 first.
5. Select a file name and location for the limit line.
6. Select the decimal separator to be used in the file.
7. Select "Save".

   The limit line is stored to a file with the specified name and the extension `.CSV`. For details on the file format see Chapter 11.5.2.4, "Reference: limit line file format", on page 240.

How to import a limit line

Limit line configurations that are stored in an ASCII file and contain a minimum of required data can be imported to the R&S EPL1000.

For details on the required file format see Chapter 11.5.2.4, "Reference: limit line file format", on page 240.

1. In the "Line Config" dialog box, select the limit line.
2. Select the "New" or "Edit" button.
3. Select "Import" to load a limit line from a file.

   You are asked whether you would like to save the current configuration on the R&S EPL1000 first.
4. Select the file name of the limit line.
5. Select the decimal separator that was used in the file.
6. Select "Select".

   The limit line is loaded from the specified file and displayed in the "Edit Limit Line" dialog box.
7. Activate the limit line as described in "How to activate and deactivate a limit check" on page 236.

11.5.2.4 Reference: limit line file format

Limit line data can be exported to a file in ASCII (CSV) format for further evaluation in other applications. Limit lines stored in the specified ASCII (CSV) format can also be imported to the R&S EPL1000 for other measurements (see "How to import a limit line" on page 239). This reference describes in detail the format of the export/import files for limit lines. Note that the **bold** data is **mandatory**, all other data is optional.

Different language versions of evaluation programs may require a different handling of the decimal point. Thus, you can define the decimal separator to be used (see "Decimal Separator" on page 193).

Table 11-4: ASCII file format for limit line files

File contents	Description
Header data	
sep=;	Separator for individual values (required by Microsoft Excel, for example)
Type;RS_LimitLineDefinition;	Type of data
FileFormatVersion;1.00;	File format version
Date;01.Oct 2006;	Date of data set storage
OptionID;SpectrumAnalyzer	Application the limit line was created for
Name;RELFREQ1	Limit line name
Comment;Defines the upper limit line	Description of limit line
Mode;UPPER	Type of limit line (upper, lower)
ThresholdUnit;LEVEL_DBM	Unit of threshold value
ThresholdValue;-200	Threshold value
MarginValue;0	Margin value
XAxisScaling;LINEAR	Scaling of x-axis linear (LIN) or logarithmic (LOG)
XAxisUnit;FREQ_HZ	Unit of x values
XAxisScaleMode;ABSOLUTE	Scaling of x-axis (absolute or relative)
YAxisUnit;LEVEL_DB	Unit of y values
YAxisScaleMode;ABSOLUTE	Scaling of y-axis (absolute or relative)
NoOfPoints;5	Number of points the line is defined by
Data section for individual data points	
-4500000000;-50	**x- and y-values of each data point defining the line**
-2000000000;-30	
-1000000000;0	
0;-30	
2500000000;-50	

12 Data management

The R&S EPL1000 allows you to save and recall measurement settings. Measurement data can be exported and imported for a later analysis, the graphical result display can be stored to a file or printed. In addition, various application-specific data can be saved and/or recalled.

General storage and import/export functions are available via the toolbar. Some special storage functions are (also) available via softkeys or dialog boxes in the corresponding menus, for example trace data export.

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- Storing and recalling instrument settings and measurement data..... 242
- Creating screenshots of current measurement results and settings..... 252
- Working with test reports..... 266

12.1 Restoring the default instrument configuration (preset)

When delivered, the R&S EPL1000 has a default configuration. You can restore this defined initial state at any time as a known starting point for measurements. This is often recommendable as a first step in troubleshooting when unusual measurement results arise.

Factory default configuration

The factory default configuration is selected such that the RF input is always protected against overload, provided that the applied signal levels are in the allowed range for the instrument.

Alternatively to the factory default settings, you can define user-specific recall settings to be restored after a preset or reboot, see "To recall settings automatically after preset or reboot" on page 251.

To restore the default instrument configuration for all channel setups at once

► Press the [PRESET] key.

After you use the [PRESET] function, the history of previous actions is deleted, i.e. any actions performed previously cannot be undone or redone using the [UNDO/REDO] keys.

Remote command:

`*RST` or `SYSTem:PRESet`

To restore the default configuration for a single channel setup

The default measurement settings can also be reset for an individual channel setup only, rather than resetting the entire instrument.

► In the "Overview", select the "Preset Channel" button.

The factory default settings are restored to the current channel setup. Note that a user-defined recall settings file is **NOT** restored.

Remote command:

`SYSTem:PRESet:CHANnel[:EXEC]` on page 533

12.2 Storing and recalling instrument settings and measurement data

Access: "Save"/ "Open" icon in the toolbar

Or: [FILE]

Possibly you would like to restore or repeat a measurement you performed under specific conditions on the instrument. Or you want to evaluate imported data in another application on the R&S EPL1000 and would like to restore the measurement settings applied during measurement. In these cases, you can store and recall instrument and measurement settings, and possibly other related measurement data.

Two different methods are available for managing instrument settings:

- Quick Save/Quick Recall - a defined set of instrument settings or channel setups are stored or recalled quickly in just one step
- Configurable Save/Recall - a user-defined set of instrument settings or channel setups are stored to a definable storage location

Restrictions when recalling measurement settings

When recalling a saved configuration file, the following restrictions apply:

- The R&S EPL1000 must support the frequency range defined in the configuration file.
- Configuration files created on a R&S EPL1000 with certain options in use do not work on an R&S EPL1000 without these options.
- Files created with newer firmware versions may not work with a previous version.
- Files created on an instrument other than the R&S EPL1000 do not work on the R&S EPL1000.

Saving and recalling transducer and limit line settings

If a transducer factors or limit lines file was in use when the save set was stored (with the save item "Current Settings" only) the R&S EPL1000 assumes that these transducer factors or limit lines values should remain valid after every recall of that save set. Thus, even if the transducer factors or limit lines file is changed and the original save set file is recalled later, the *originally stored* transducer factors or limit lines values are recalled and applied to the measurement. In the "Edit" transducer factors or limit lines dialog box, however, the *changed* transducer factors or limit lines file values are displayed, as no updated transducer factors or limit lines file was loaded.

The same applies to limit line settings.

The same applies to integrated measurements' weighting filter.

If you want to apply the changed transducer values after recalling the save set, you must force the application to reload the transducer file. To do so, simply open the "Edit Transducer" dialog box (see Chapter 13.7.2, "Working with transducers", on page 303) and toggle the "X-Axis" option from "Lin" to "log" and back. Due to that change, the transducer file is automatically reloaded, and the changed transducer values are applied to the current measurement. Now you can create a new save set with the updated transducer values.

Similarly, if you want to apply the changed limit values after recalling the save set, you must force the application to reload the limit file. To do so, simply open the "Edit Limit Line" dialog box (see Chapter 11.5.2.2, "Limit line settings and functions", on page 229) and toggle the "Y-Axis" unit. Due to that change, the limit line file is automatically reloaded, and the changed limit values are applied to the current measurement. Now a new save set with the updated limit values can be created.

- Quick save/quick recall 243
- Configurable storage and recall 245
- How to save and load instrument settings 250

12.2.1 Quick save/quick recall

The "Quick Save" and "Quick Recall" functions allow you to store instrument settings or channel setups very easily and quickly in one step. Up to ten different sets of settings can be stored to or recalled from "save sets". Each save set is identified by its storage date and type (instrument or specific "Channel") in the display. The save sets are stored in the `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\QuickSave` directory, in files named `QuickSave1.dfl` to `QuickSave10.dfl`. Only the current measurement settings are stored, not any additional data such as traces, limit line or transducer files (see Chapter 12.2.2.1, "Stored data types", on page 246).

Source calibration files for an optional internal generator, if available, are included.

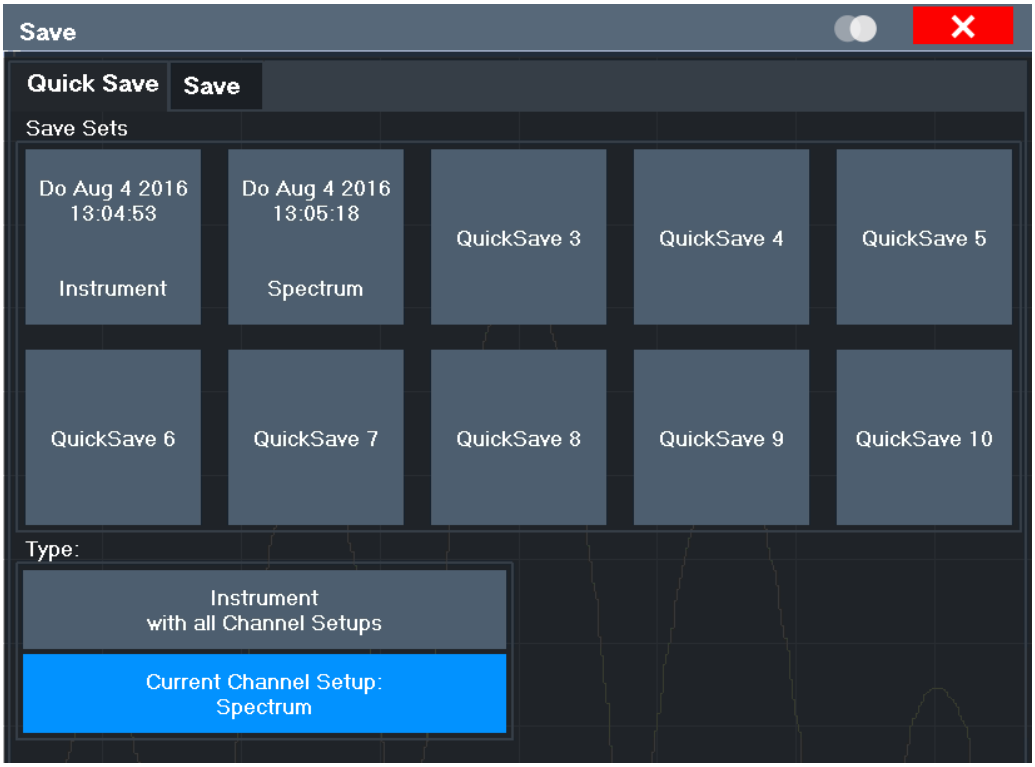
During recall, save sets of type "Instrument" replace the settings of the entire instrument. All other save sets start a new channel setup with the stored settings.

If a channel setup with the same name as the "Channel" to be restored is already active, the name for the new channel setup is extended by a consecutive number:

12.2.1.1 Quick save / quick recall settings

Access: "Save"/ "Open" icon in the toolbar > "Quick Save" / "Quick Recall"

Both dialog boxes are very similar and closely related.



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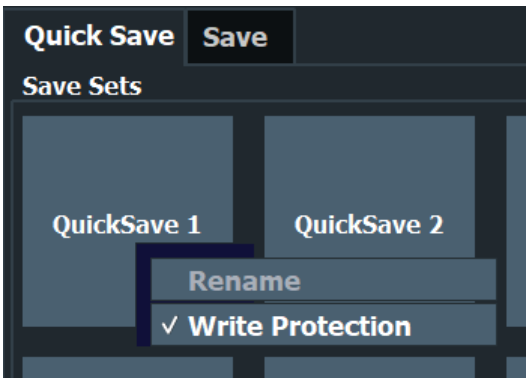
└ Rename 245
└ Write Protection 245
Storage Type (Save only) 245
Recall 245

QuickSave 1 / ... / QuickSave 10
Selects one of the save sets to store the current settings in or to be recalled. At the time of storage, the "QuickSave 1 / ... / QuickSave 10" placeholder is replaced by a label indicating the storage date and time and the storage type.

Right-click on one of the QuickSave buttons to display a context menu with additional functions for the save set.



During recall, save sets of type "Instrument" replace the settings of the entire instrument. All other save sets start a new channel setup with the stored settings.

Rename ← QuickSave 1 / ... / QuickSave 10
Displays an input field to rename the save set, if write protection is disabled.

Write Protection ← QuickSave 1 / ... / QuickSave 10
Enables or disables write protection for the save set. If enabled, the save set cannot be renamed or overwritten.

Storage Type (Save only)
Defines which type of settings are stored in the save set.

"Instrument with all Channels"	The instrument settings for all currently active "Channel"s are stored.
"Current Channel"	Only the instrument settings for the currently selected measurement "Channel"s are stored.

Recall
Restores the instrument settings as saved in the selected settings file. If the settings file contains settings for a specific "Channel" only, a new channel setup with the stored settings is activated, otherwise all "Channel"s and instrument settings are overwritten with the stored settings.

Note: After you use the "Recall" function, the history of previous actions is deleted, i.e. any actions performed previously cannot be undone or redone using the [UNDO/REDO] keys.

Remote command:
`MMEMory:LOAD:STATe` on page 531

12.2.2 Configurable storage and recall

The more sophisticated storage and recall functions allow you to define which settings are stored, and where the settings file is stored to. Any settings file can be selected for recall.

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- Storage location and filename....246
- Save and recall dialog boxes....246
- Startup recall settings....249

12.2.2.1 Stored data types

The following types of data can be stored to and loaded from files via the "Save" dialog box on the R&S EPL1000:

Table 12-1: Items that can be stored to files

Item	Description
Current Settings	Current instrument and measurement settings.
All Transducers	All transducer factor *files*. (Note: Restoring a saveset overwrites transducer factor files on the hard disk that have the same name as those in the saveset. For more information, see "Saving and recalling transducer and limit line settings" on page 243.)
All Traces	All active traces.
All Limit Lines	All limit line *files*.
Spectrograms	Spectrogram trace data (only available if spectrogram display is currently active).
Peak List	Information of the peak list.

12.2.2.2 Storage location and filename

The data is stored on the internal flash disk or, if selected, on a memory stick or network drive. The operating system, firmware and stored instrument settings are located on drive C.

The storage location and filename are selected in a file selection dialog box which is displayed when you perform a storage function.

By default, the name of a settings file consists of a base name followed by an underscore and three numbers, e.g. `limit_lines_005`. In the example, the base name is `limit_lines`. The base name can contain characters, numbers and underscores. The file extension `dfl` is added automatically. The default folder for settings files is `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\Save`.

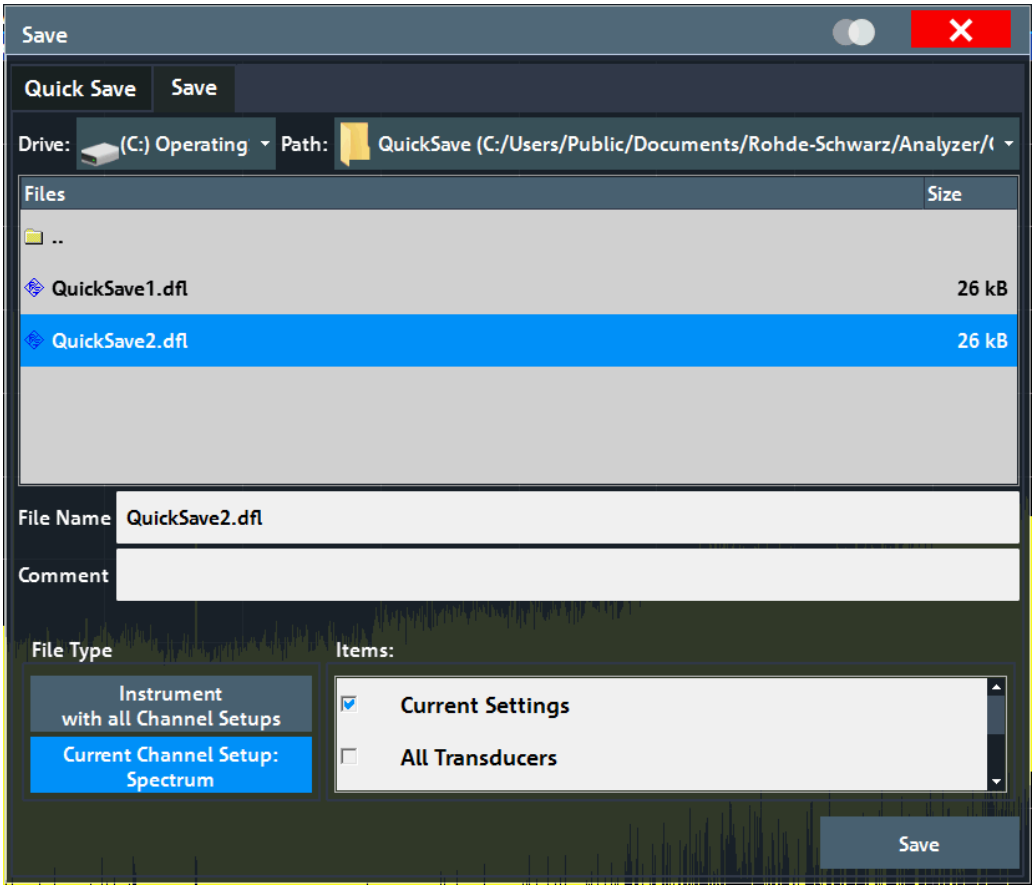
File name restrictions

File names must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

12.2.2.3 Save and recall dialog boxes

Access: "Save"/ "Open" icon in the toolbar > "Save" / "Recall"

Both dialog boxes are very similar and closely related.



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Recall in New Channel / Recall in Current Channel....248

Selecting Storage Location - Drive/ Path/ Files
Select the storage location of the file on the instrument or an external drive.

Remote command:
`MMEMory:CATalog` on page 522

File Name
Contains the name of the data file without the path or extension.

File names must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

For details on the filename and location, see Chapter 12.2.2.2, "Storage location and filename", on page 246.

Comment
An optional description for the data file. A maximum of 60 characters can be displayed.

Remote command:
`MMEMory:COMMent` on page 523

File Explorer
Opens the Microsoft Windows File Explorer.

Remote command:
not supported

File Type
Determines whether the global instrument settings with all "Channel"s are stored or recalled, or the current "Channel" settings only.

Items:
Defines which data and settings are stored or are recalled. Depending on the "File Type", either channel setups only, or global settings are available. Which items are available also depends on the installed options (see also Chapter 12.2.2.1, "Stored data types", on page 246).

Depending on the application, items may or may not be available. For example, saving spectrogram data is only possible in applications that feature a spectrogram.

Remote command:
`MMEMory:SELect[:ITEM]:ALL` on page 527
`MMEMory:SELect[:ITEM]:DEFault` on page 528
`MMEMory:SELect[:ITEM]:NONE` on page 529
`MMEMory:SELect[:ITEM]:HWSettings` on page 528
`MMEMory:SELect[:ITEM]:LINes:ALL` on page 528
`MMEMory:SELect[:ITEM]:SGRam` on page 529
`MMEMory:SELect[:ITEM]:TRACe<1...3>[:ACTive]` on page 529
`MMEMory:SELect[:ITEM]:TRANsducer:ALL` on page 530

Save File
Saves the settings file with the defined filename.

Remote command:
`MMEMory:STORe<1|2>:STATe` on page 532
`MMEMory:STORe<1|2>:STATe:NEXT` on page 532

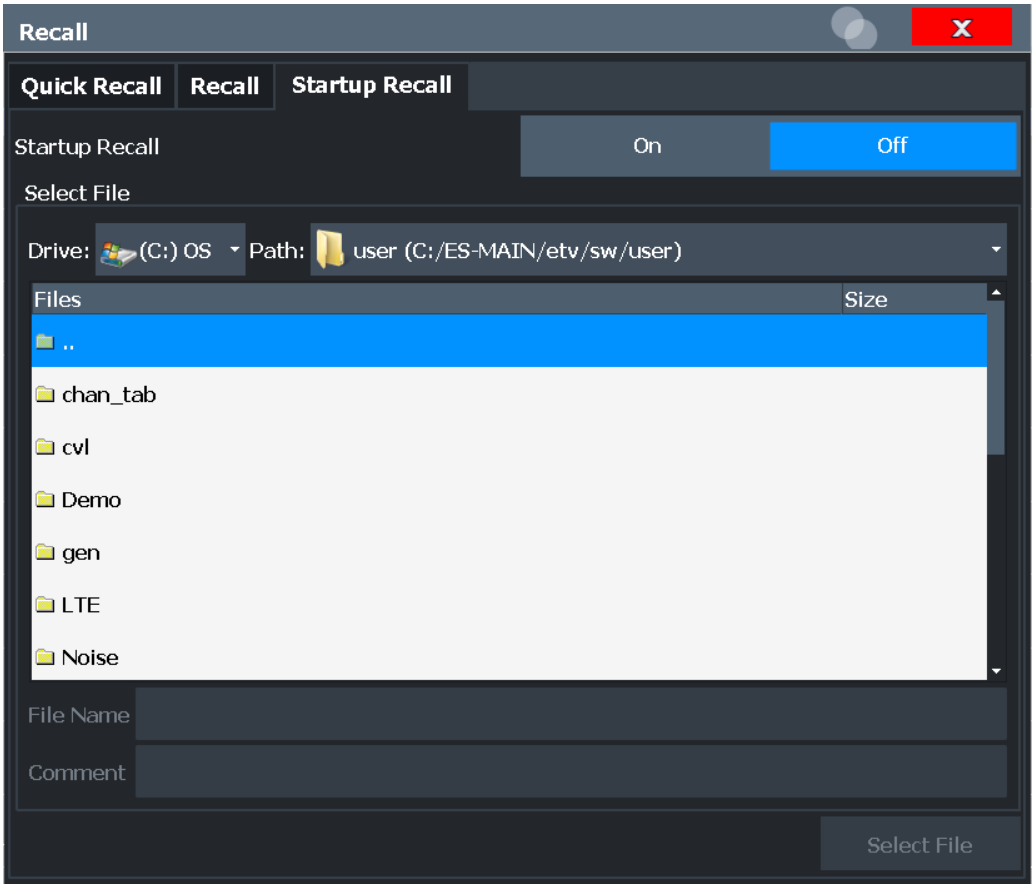
Recall in New Channel / Recall in Current Channel
Restores the instrument settings as saved in the selected settings file. If the settings file contains settings for a specific "Channel" only, select "Recall in New Channel" to activate a new channel setup with the stored settings. Select "Recall in Current Channel" to replace the current "Channel" settings.

Note: After you use the "Recall" function, the history of previous actions is deleted, i.e. any actions performed previously cannot be undone or redone using the [UNDO/ REDO] keys.

Remote command:
`MMEMory:LOAD:STATe` on page 531

12.2.2.4 Startup recall settings

Access: "Open" icon in the toolbar > "Startup Recall"



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File Name....250
Comment....250

Startup Recall
Activates or deactivates the startup recall function. If activated, the settings stored in the selected file are loaded each time the instrument is started or preset. If deactivated, the default settings are loaded.

Note that only *instrument* settings files can be selected for the startup recall function, not "Channel" files.

Remote command:
`MMEMory:LOAD:AUTO` on page 530

Selecting Storage Location - Drive/ Path/ Files
Select the storage location of the file on the instrument or an external drive.

Remote command:
`MMEMory:CATalog` on page 522

File Name
Contains the name of the data file without the path or extension.

File names must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

For details on the filename and location, see Chapter 12.2.2.2, "Storage location and filename", on page 246.

Comment
An optional description for the data file. A maximum of 60 characters can be displayed.

Remote command:
`MMEMory:COMMent` on page 523

12.2.3 How to save and load instrument settings

Instrument settings can be saved to a file and loaded again later, so that you can repeat the measurement with the same settings. Optionally, user-defined measurement settings can automatically be restored each time you start or preset the instrument.

To save and recall instrument settings using the Quick Save function

1. Select the "Save" icon from the toolbar.
2. Select whether the instrument settings for **all**"Channel"s are stored, or only those for the **current**"Channel".
3. Select one of the save sets in which the settings are stored ("QuickSaveX").

   The selected settings are stored to the file `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\QuickSave\QuickSaveX.dfl`.

   Note: If you make any changes to the settings *after* storing the configuration file, remember to save the settings again. Otherwise those settings cannot be restored and will be overwritten by the stored values when the configuration file is recalled.

4. To restore the settings, select the "Open" icon from the toolbar.
5. Select the save set in which the settings were stored ("QuickSaveX").

   The selected settings are restored to the instrument or channel setup.

To save configurable instrument settings

1. Select the "Save" icon from the toolbar.
2. In the "Save" dialog box, switch to the "Save" tab.
3. In the file selection dialog box, select a filename and storage location for the settings file.

4. Optionally, define a comment to describe the stored settings.
5. Select whether the instrument settings for **all**"Channel"s are stored, or only those for the **current**"Channel".
6. Select the items to be saved with the settings. Either the settings for the currently selected "Channel" only, or the settings for all "Channel"s can be stored. Various other items, such as lines or traces etc., can be stored as well (see Chapter 12.2.2.1, "Stored data types", on page 246).
7. Select "Save".

   A file with the defined name and path and the extension `.dfl` is created.

If you make any changes to the settings *after* storing the configuration file, remember to save the settings again. Otherwise those settings cannot be restored and will be overwritten by the stored values when the configuration file is recalled.

To recall configurable instrument settings

1. Select the "Open" icon from the toolbar.
2. In the "Recall" dialog box, switch to the "Recall" tab.
3. In the file selection dialog box, select the filename and storage location of the settings file.

   Note: The "File Type" indicates whether the file contains instrument settings for **all**"Channel"s, or only those for the current "Channel".
4. If several items were saved, select which items are restored.
5. If a "Channel" was saved, select whether the settings will replace the settings in the current "Channel", or whether a new channel setup with the saved settings will be opened.
6. Select "Recall".

   The settings and selected items from the saved measurement are restored and you can repeat the measurement with the same settings.
   Note that any changes made to the settings *after* storing the configuration file will be overwritten by the stored values when the configuration file is recalled.

To recall settings automatically after preset or reboot

You can define the settings that are restored when you preset or reboot the instrument.

1. Configure the settings as required and save them as described in "To save configurable instrument settings" on page 250.
2. In the "Save/Recall" menu, select "Startup Recall".
3. From the file selection dialog box, select the recall settings to restore.
4. Select "Select File".

5. Set "Startup Recall" to "On".

   Now when you press the [PRESET] key or reboot the instrument, the defined settings will be restored.

6. To restore the factory preset settings, set "Startup Recall" to "Off".

12.3 Creating screenshots of current measurement results and settings

To document the graphical results and the most important settings for the currently performed measurement, you can create a screenshot of the current display. Screenshots can either be printed or stored to a file.

- Print and screenshot settings....252
- How to store or print screenshots of the display....262
- Example for storing multiple measurement results to a PDF file....265

12.3.1 Print and screenshot settings

Access: [Print]

For step-by-step instructions, see Chapter 12.3.2, "How to store or print screenshots of the display", on page 262.

Remote commands for these settings are described in Chapter 15.8.4, "Screenshots and printouts", on page 534.

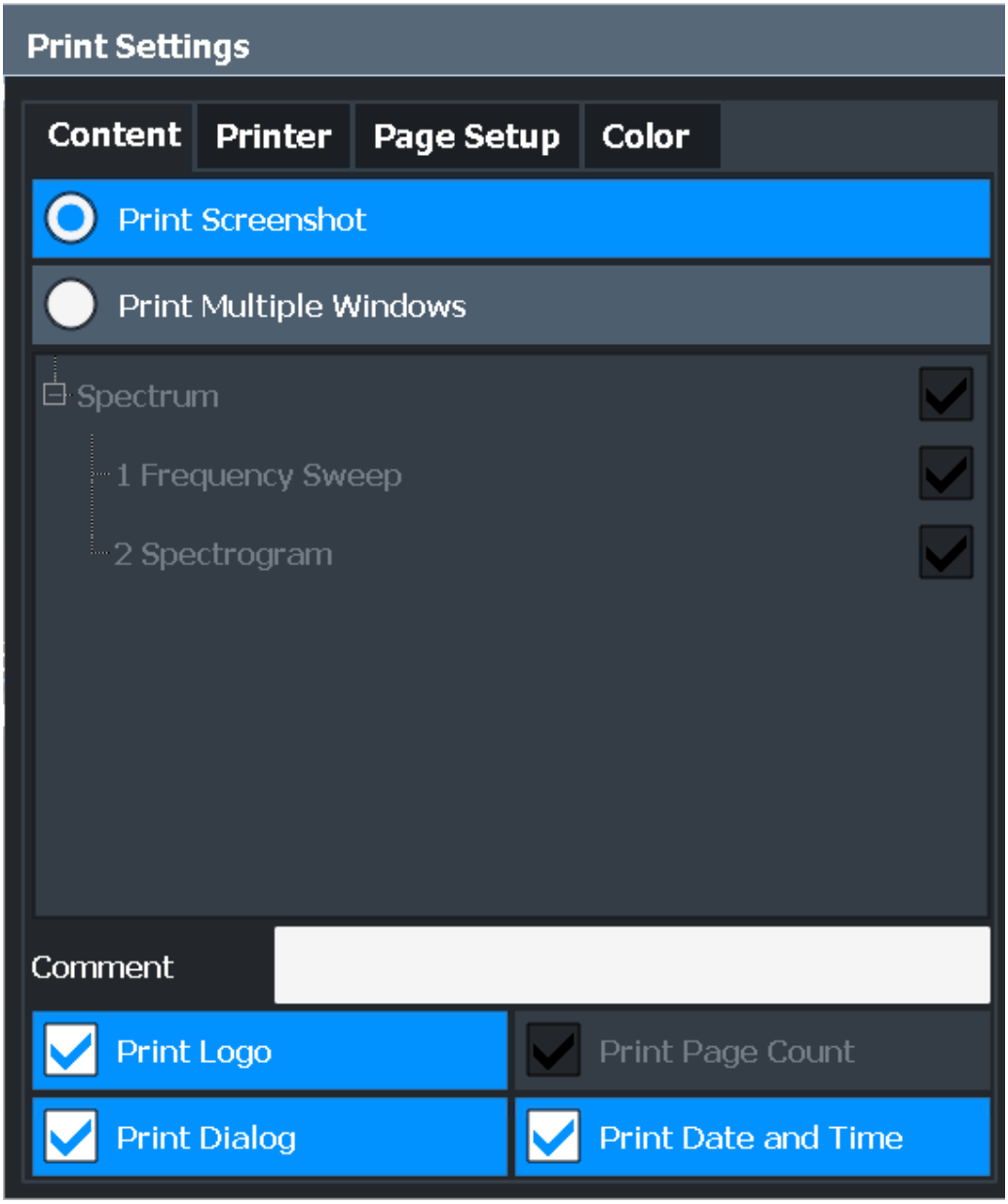
To print a screenshot of the current display with the current settings immediately, without switching to the "Print" menu, use the [Print] key.

- Print content settings....252
- Print preview functions....255
- Printer settings....257
- Page setup....260
- Print color settings....261

12.3.1.1 Print content settings

Access: "Print" > "Print Config" > "Content" tab

The content settings determine which data is included in the printout.



Print Screenshot....254
Print Multiple Windows....254
Comment....254
Print Logo....254
Print Page Count....254
Print Dialog....254
Print Date and Time....255

Print Screenshot
Selects all measurement results displayed on the screen for the current channel setup (or "MultiView"): diagrams, traces, markers, marker lists, limit lines, etc., including the channel bar and status bar, for printout on a single page. Displayed items belonging to the software user interface (e.g. softkeys) are not included. The position and size of the elements in the printout is identical to the display.

Remote command:
`HCOPy:CONTent` on page 535

Print Multiple Windows
Includes only the selected windows in the printout. All currently active windows for the current channel setup (or "MultiView") are available for selection. How many windows are printed on a single page of the printout is user-definable (see "Windows Per Page" on page 261).

This option is only available when printing on a printer or to a PDF file (see "Destination" on page 258). If the Destination is currently set to an image file or the clipboard, it is automatically changed to be a PDF file.

Remote command:
`HCOPy:CONTent` on page 535
`HCOPy:PAGE:WINDow:STATe` on page 542
`HCOPy:PAGE:WINDow:CHANnel:STATe` on page 541

Comment
Defines an optional comment to be included in the printout of the display. Maximum 120 characters are allowed. Up to 60 characters fit in one line. In the first line, a manual line-feed can be forced at any point by entering "@".

The comment is printed in the top left corner of each printout page. If a comment should not be printed, it must be deleted.

Tip: The current date and time can be inserted automatically, see "Print Date and Time" on page 255.

Remote command:
`HCOPy:ITEM:WINDow:TEXT` on page 539

Print Logo
Activates/deactivates the printout of the Rohde & Schwarz company logo in the upper right corner.

Remote command:
`DISPlay:LOGO` on page 534

Print Page Count
Includes the page number for printouts consisting of multiple windows ("Print Multiple Windows" on page 254).

Remote command:
`HCOPy:PAGE:COUNt:STATe` on page 539

Print Dialog
Includes any currently displayed dialog in the screenshot printout.

This setting is only available if Print Screenshot is selected.

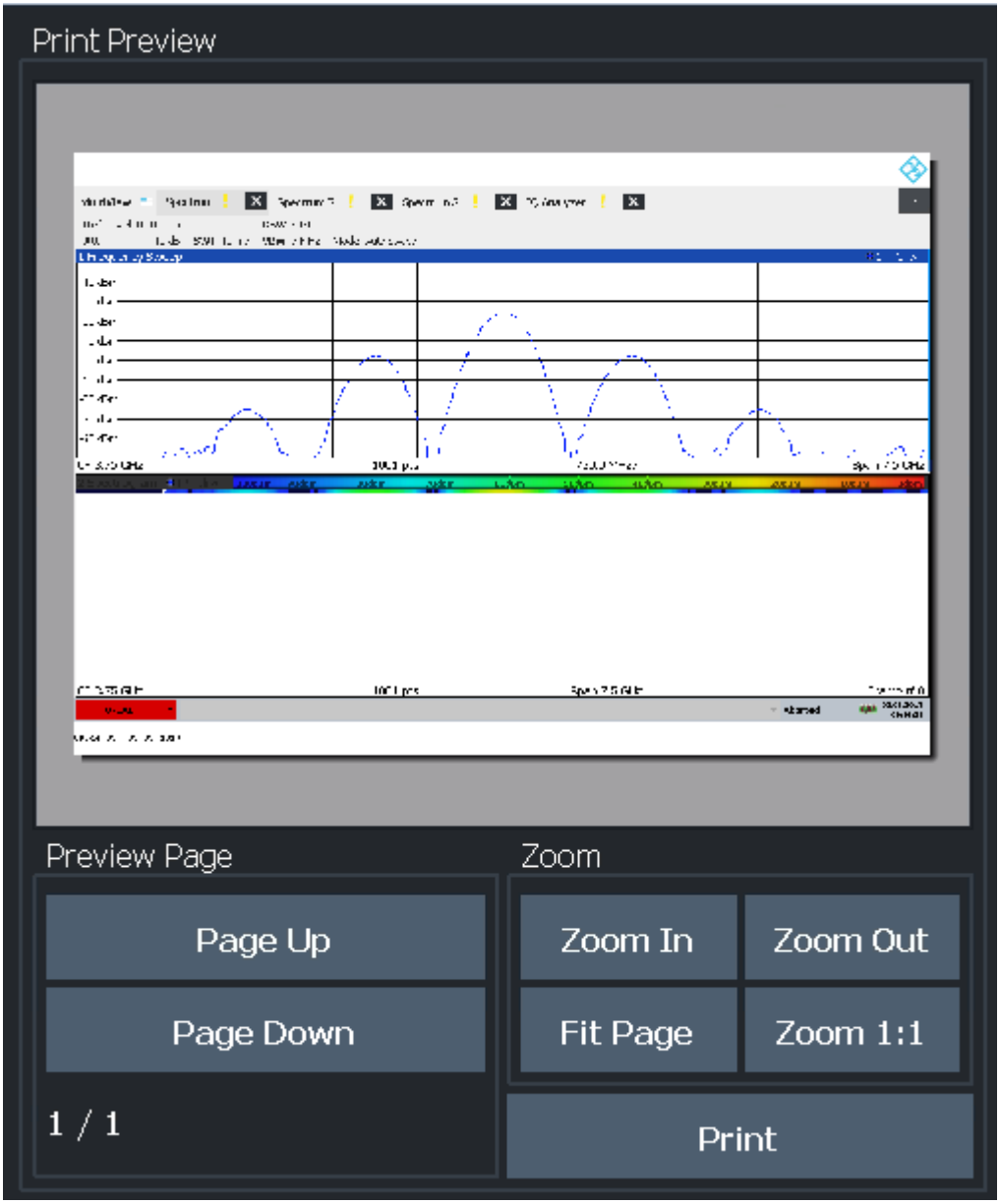
Print Date and Time
Includes or removes the current date and time at the bottom of the printout.

Remote command:
`HCOPy:TDSTamp:STATe` on page 543

12.3.1.2 Print preview functions

Access: [Print]

The "Print Preview" of the printout according to the current configuration is available in all "Print Settings" dialog tabs.



Zoom In / Zoom Out....256
Fit Page....257
Zoom 1:1....257
Page Up / Page Down....257
Print....257

Zoom In / Zoom Out
Zooms into (enlarges) or zooms out of (decreases) the preview display. Note that the zoom functions affect only the preview, not the printout itself.

Fit Page
Adapts the preview display zoom factor so that one complete page is visible as large as possible in the available display space. Note that the zoom functions affect only the preview, not the printout itself.

Zoom 1:1
Displays the printout in its original size, as it will be printed.

Page Up / Page Down
Depending on the selected contents (see Chapter 12.3.1.1, "Print content settings", on page 252), the printout can consist of multiple pages. Use these functions to scroll within the preview to see the individual pages.

Print
Starts to print or store the selected screen contents to a file (see Chapter 12.3.1.1, "Print content settings", on page 252).

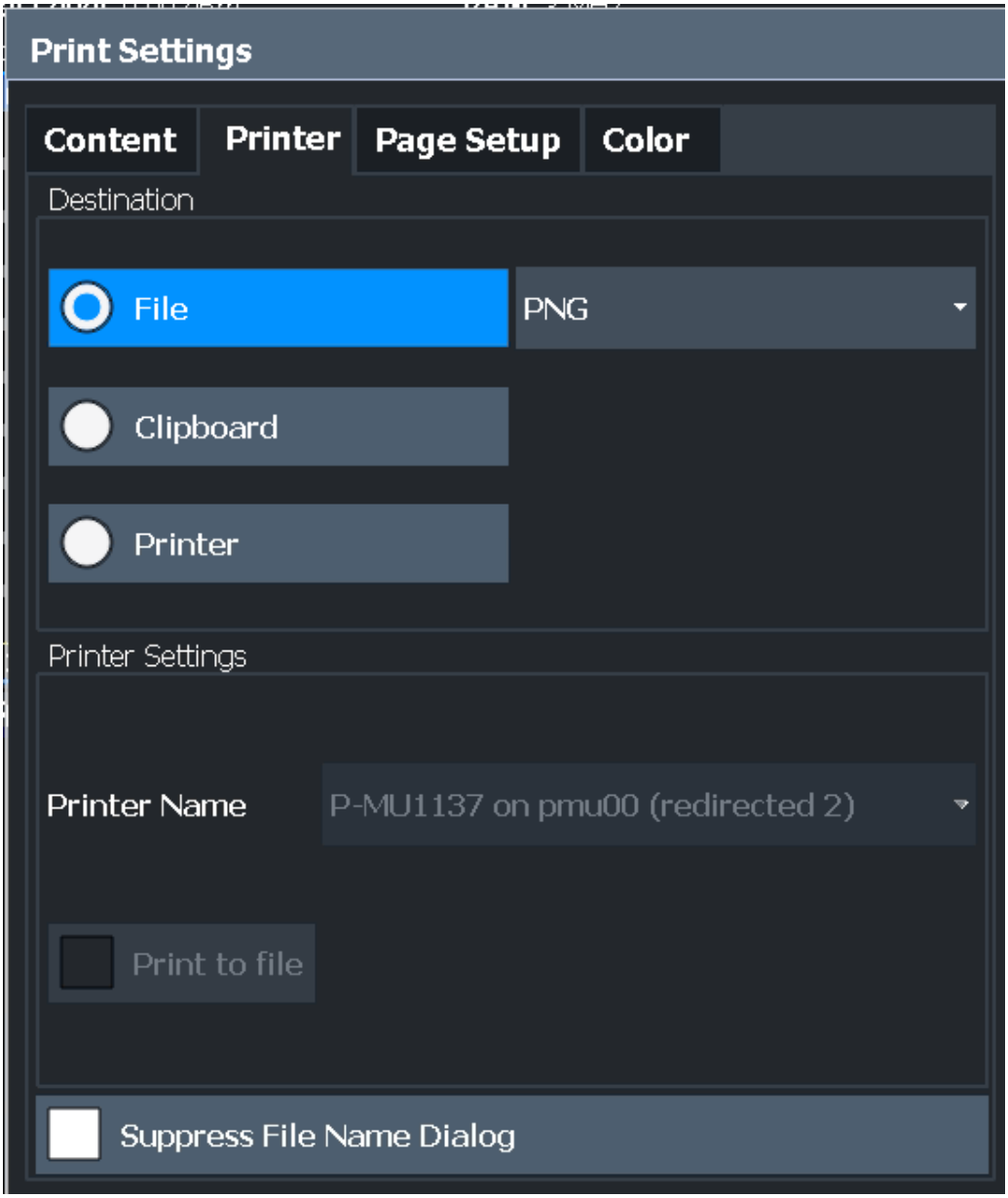
Whether the output is sent to the printer or stored in a file or the clipboard depends on the selected print settings (see Chapter 12.3.1.3, "Printer settings", on page 257).

If the output is stored to a file, a file selection dialog box is opened to select the file-name and location. The default path is C:\Users\Public\Documents\Rohde-Schwarz \Analyzer\user.

Remote command:
`HCOPy[:IMMediate]` on page 538
`HCOPy[:IMMediate]:NEXT` on page 539

12.3.1.3 Printer settings

Access: "Print" > "Print Config" > "Printer" tab



Destination 258
└ Destination: File 259
└ Destination: Clipboard 259
└ Destination: Printer 259
Suppress File Name Dialog 259
Printer Name 259
Print to file 259
Install Printer 260

Destination
Defines the medium to which the printout is output.

Destination: File ← Destination
Stores the printout to a file in the selected format. The filename is queried at the time of storage, or a default name is used (see Suppress File Name Dialog).

Multiple windows can only be printed to a file in PDF format. If you select an image file format, the content setting is automatically set to Print Screenshot. Page settings are not available for image files; however, you can configure the colors used for the screenshot (see Chapter 12.3.1.5, "Print color settings", on page 261).

Remote command:
`HCOPy:DEVice:LANGuage` on page 538

Destination: Clipboard ← Destination
Copies the printout to the clipboard. Since only single pages can be copied, only screenshots can be copied to this destination, not multiple windows (see Chapter 12.3.1.1, "Print content settings", on page 252). Page settings are not available; however, you can configure the colors used for the screenshot (see Chapter 12.3.1.5, "Print color settings", on page 261).

If you select the clipboard as the printing destination, the content setting is automatically set to Print Screenshot.

Remote command:
`HCOP:DEST1 'SYSTem:COMMunicate:CLIPboard'`

Destination: Printer ← Destination
Sends the printout to the printer selected from the Printer Name list.

Remote command:
`HCOP:DEST1 'SYSTem:COMMunicate:PRINter'`

Suppress File Name Dialog
If the Destination is a file, the file selection dialog box is not displayed. Instead, the default storage location and filename are used.

(C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user `\EPL_ScreenShot_<date and time>`).

Printer Name
Defines the printer to print to if a printer is selected as the Destination.

Any printers detected in the network are listed for selection.

Tip: the printout can also be stored in a print file using the selected printer driver, see "Print to file" on page 259.

Remote command:
`SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]` on page 543
`SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt` on page 543
`SYSTem:COMMunicate:PRINter:SELect<di>` on page 543

Print to file
If a printer is selected as the Destination, use this option to store the data in a `.prn` file using the selected printer driver.

Remote command:
To enable: `HCOP:DEST1 'MMEM'`
To disable: `HCOP:DEST1 'SYSTem:COMMunicate:PRINter'`

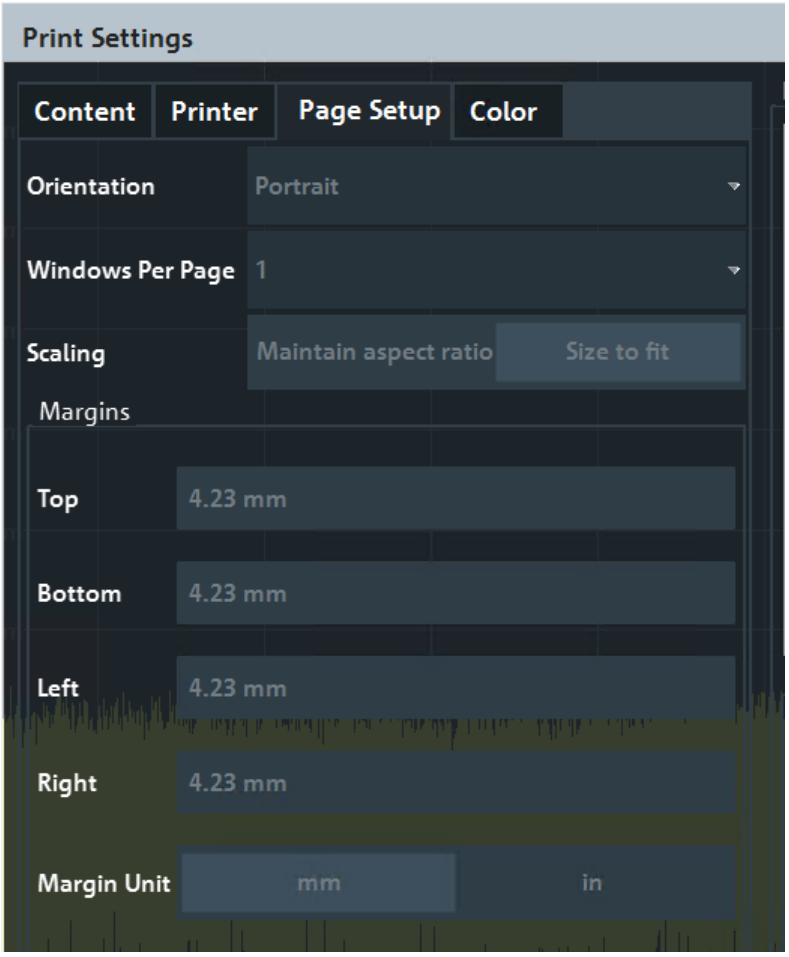
Install Printer
This softkey opens the standard Windows dialog box to install a new printer. All printers that are already installed are displayed.

Only user accounts with administrator rights can install a printer.

For further information, refer to the Microsoft Windows documentation.

12.3.1.4 Page setup

Access: "Print" > "Print Config" > "Page Setup" tab



Page settings are only available when printing on a printer or to a PDF file (see "Destination" on page 258).

Orientation....261
Windows Per Page....261
Scaling....261
Margins....261

Orientation
Selects the page orientation of the printout: portrait or landscape.

Remote command:
HCOPy:PAGE:ORIentation on page 541

Windows Per Page
Defines how many windows are displayed on a single page of the printout. This setting is only available if Print Multiple Windows is active (see Chapter 12.3.1.1, "Print content settings", on page 252).

If more than one window is printed on one page, each window is printed in equal size.

Remote command:
HCOPy:PAGE:WINDow:COUNt on page 541

Scaling
Determines the scaling of the windows in the printout if Print Multiple Windows is active (see Chapter 12.3.1.1, "Print content settings", on page 252).

If more than one window is printed on one page (see Windows Per Page), each window is printed in equal size.

"Maintain aspect ratio"	Each window is printed as large as possible while maintaining the aspect ratio of the original display.
"Size to fit"	Each window is scaled to fit the page size optimally, not regarding the aspect ratio of the original display.

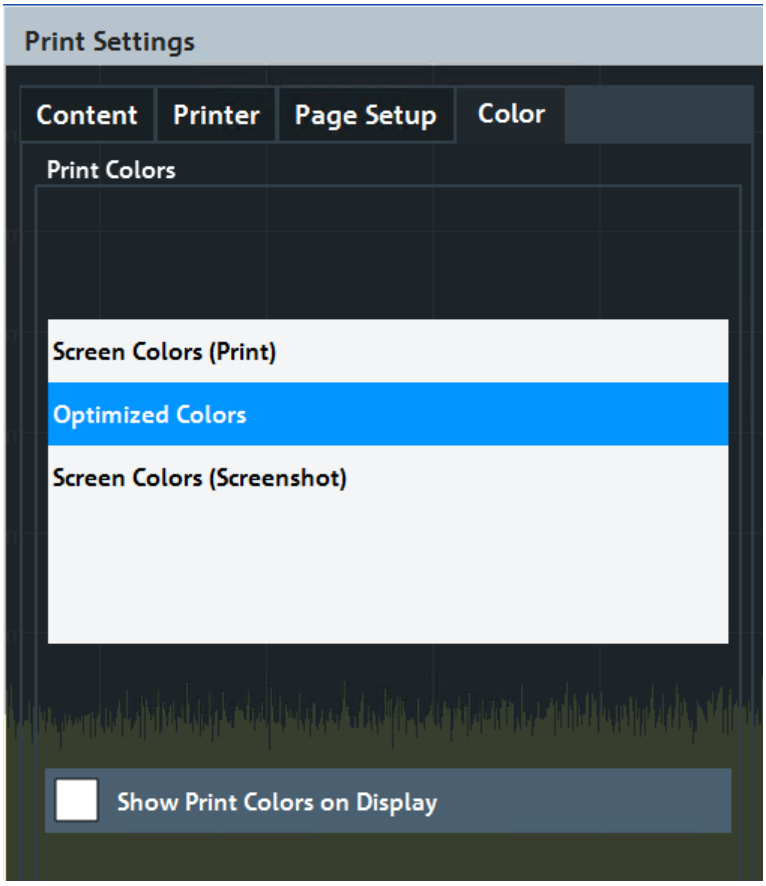
Remote command:
HCOPy:PAGE:WINDow:SCALe on page 542

Margins
Defines margins for the printout page on which no elements are printed. The margins are defined according to the selected unit.

Remote command:
HCOPy:PAGE:MARGin:BOTTom on page 539
HCOPy:PAGE:MARGin:LEFT on page 540
HCOPy:PAGE:MARGin:RIGHt on page 540
HCOPy:PAGE:MARGin:TOP on page 540
HCOPy:PAGE:MARGin:UNIT on page 540

12.3.1.5 Print color settings

Access: "Print" > "Print Config" > "Color" tab



The settings provided here are identical to those in the "Print Colors" section of the "Display" > "Theme + Color" dialog box.

See "Print Colors" on page 282.

12.3.2 How to store or print screenshots of the display

The measurement results displayed on the screen can be printed or stored to a file very easily.

For a programming example, see Chapter 15.8.8, "Examples: managing data", on page 558.

To start printing or storing results to a file

► If the R&S EPL1000 has already been set up according to your current requirements, simply press the "Print immediate" icon at the far right end of the toolbar.

The current measurement display is printed or stored to a file, as configured.

To print a screenshot

This configuration assumes a printer has already been installed. To install a new printer, use the Install Printer function (common Microsoft Windows procedure).

1. Select the [Print] key.

   The "Print Settings" dialog box is displayed.

2. In the "Content" tab, define the elements of the screen and additional information to be included in the printout.

   a) Select "Print Screenshot" to include all elements displayed on the screen in a single-page printout.
   b) Optionally, add a comment to be printed at the top of the printout.
   c) Optionally, activate the date and time or the logo so they are added to the printout.
   d) Optionally, activate "Print Dialog" to include any dialog boxes currently displayed on the screen in the printout. This is useful, for example, to document the used settings for a particular result.
   e) Check the "Print Preview" to make sure all relevant elements of the display are visible.

3. In the "Printer" tab, select "Printer" as the "Destination".

4. Select the "Printer Name" to print to from the list of installed printers.

5. In the "Page Setup" tab, configure the layout of the printout page.

   a) Select the page orientation.
   b) Define the page margins.
   c) Check the "Print Preview" to make sure all relevant elements of the display are visible.

6. In the "Color" tab, define the colors to be used for the printout.

   a) By default, "Optimized Colors" are used to improve the visibility of the colors. The background is always printed in white and the grid in black.
   For a printout that reflects exactly what you see on the screen, select "Screen Colors (Screenshot)".
   b) Check the "Print Preview" to find out if the setting is appropriate.

7. Select "Print" to execute the print function.

   The screenshot is printed on the printer as configured.

To store a printout containing multiple windows

1. Select the [Print] key.

   The "Print Settings" dialog box is displayed.

2. In the "Content" tab, define the elements of the screen and additional information to be included in the printout.

   a) Select "Print Selected Windows" to include the selected windows in the printout, possibly on multiple pages.

b) Select the result displays in the currently selected channel setup to be included in the printout.
Tip: Select the "MultiView" before configuring the printout to include result displays from any active channel setup.
c) Optionally, add a comment to be printed at the top of each page of the printout.
d) Optionally, activate the date and time or the logo so they are added to the printout pages.

3. Check the "Print Preview" to make sure all required result displays are included.
   a) Scroll through the individual pages of the printout using "Page Up" and "Page Down".
   b) Use the zoom functions to make sure all relevant parts of the result display are visible.
4. In the "Printer" tab, select "File" as the "Destination".
5. Select the file format from the selection list.
6. By default, you define the filename individually for each print operation. To avoid having the "File Selection" dialog box being displayed for each print operation, select "Suppress File Name Dialog". In this case, the previously used or default storage location and filename are used.
   (`C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\EPL_ScreenShot_<date and time>`).
7. In the "Page Setup" tab, configure the layout of the printout page.
   a) Select the page orientation.
   b) Define the page margins.
   c) Check the "Print Preview" to make sure all relevant elements of the display are visible.
8. In the "Color" tab, define the colors to be used for the printout.
   a) By default, "Optimized Colors" are used to improve the visibility of the colors. The background is always printed in white and the grid in black.
   For a printout that reflects the colors you see on the screen, but with a white background, select "Screen Colors (Print)".
   b) Check the "Print Preview" to find out if the setting is appropriate.
9. Select "Print" to execute the print function.
10. If you did not select the option to suppress the dialog, enter a filename in the file selection dialog box.

    The selected data elements are stored to the file as configured.

11. To store another file using the same configuration any other time, simply press the "Print immediate" icon

12.3.3 Example for storing multiple measurement results to a PDF file

The following example describes the procedure to store results from measurements in the Spectrum application and the I/Q Analyzer to a single PDF file.

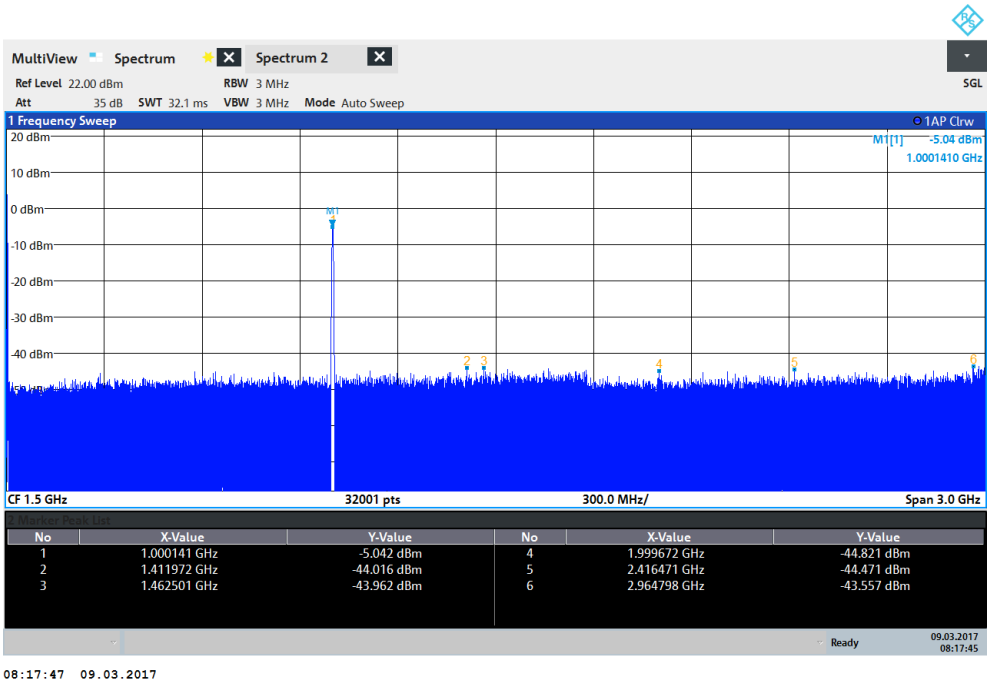
1. Configure and perform the measurements in the Spectrum application and I/Q Analyzer as required. Configure at least the following result displays:
   - Frequency Sweep, Spectrogram (Spectrum)
   - Magnitude, Spectrum (I/Q Analyzer)
2. Switch to the "MultiView" tab to display an overview of the result displays in all active channel setups.

3. Select the [Print] key.

   The "Print Settings" dialog box is displayed.
4. In the "Content" tab, select "Print Selected Windows".
5. Select the result displays listed in step 1.
6. Enter the comment *Measurement Test Report* to be inserted at the top of each page.
7. Select "Print Page Count" and "Print Date and Time".
8. In the "Content" tab, select "Print Selected Windows".
9. In the "Printer" tab, select "File" as the "Destination".
10. Select "PDF" from the file format selection list.
11. Select "Suppress File Name Dialog".
12. In the "Page Setup" tab, select "Landscape" as the "Orientation".

13. Select "Windows Per Page": *1* to print a single result display on each page.
14. Select the "Scaling" option "Size to fit" to maximize the result display on each page.
15. In the "Color" tab, select "Screen Colors (Print)" for a printout that reflects the colors you see on the screen, but with a white background.
16. Check the "Print Preview" to make sure all required result displays are included and all relevant data elements are visible.
    a) Scroll through the individual pages of the printout using "Page Up" and "Page Down".
    b) Use the zoom functions to make sure all relevant parts of the result display are visible.
17. Select "Print" to execute the print function.

    The selected data elements are stored to the file as configured.



12.4 Working with test reports

Access: Toolbar:

The R&S EPL1000 features a test report generator. A test report is a document that summarizes the results and configuration of measurements.

A test report is made up out of one or more datasets. Each dataset contains the results and configuration of one measurement.

- Designing a test report template 267
- Creating a test report 272

12.4.1 Designing a test report template

Access: > "Report menu" > "Templates"

The R&S EPL1000 allows you to create test report templates, for example if you handle different measurement tasks that require different information or a different layout in the test report. The following topics show you ways to customize your test reports and save those settings in a template.

Test report content selection 267
General properties of the test report document 268
Custom information about the measurement 269
Contents of the title page 270
Template management 271

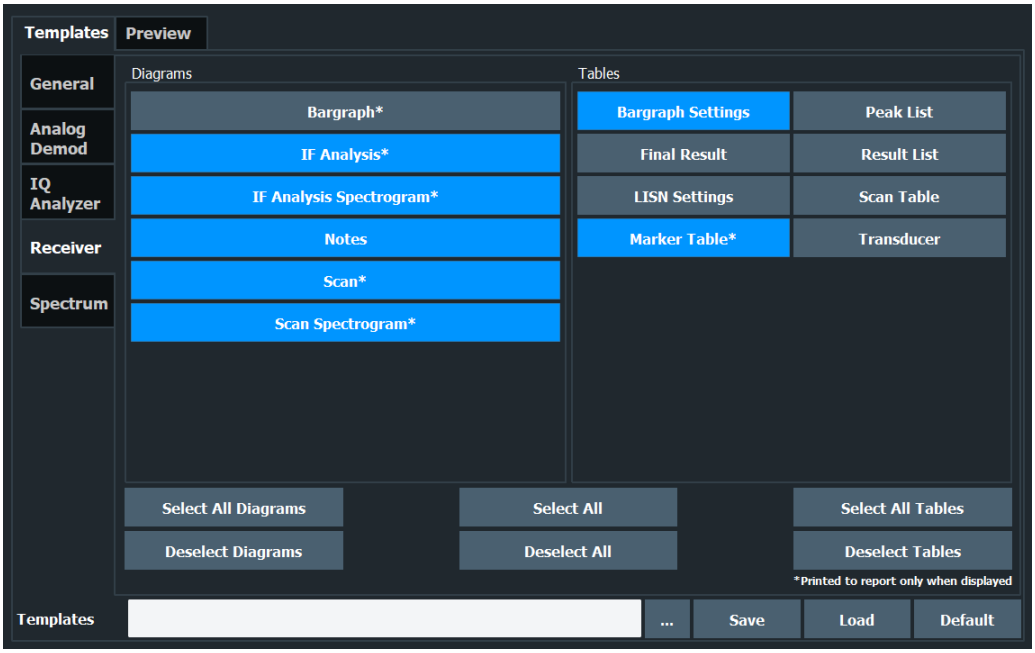
Test report content selection
The properties available in the "Templates" tab define the information that each dataset in the test report should contain. You can add or remove the items as required.

The contents of the dialog box depend on the application (Receiver, Spectrum etc.).

In all applications, you can add different graphical results ("Diagrams" category), numerical results or information about the measurement setup or configuration ("Tables" category). Information that is to be included in the test report is represented by a blue button. Information not included is represented by a gray button.

Refer the individual dialog boxes for a comprehensive list of information that you can add to a test report.

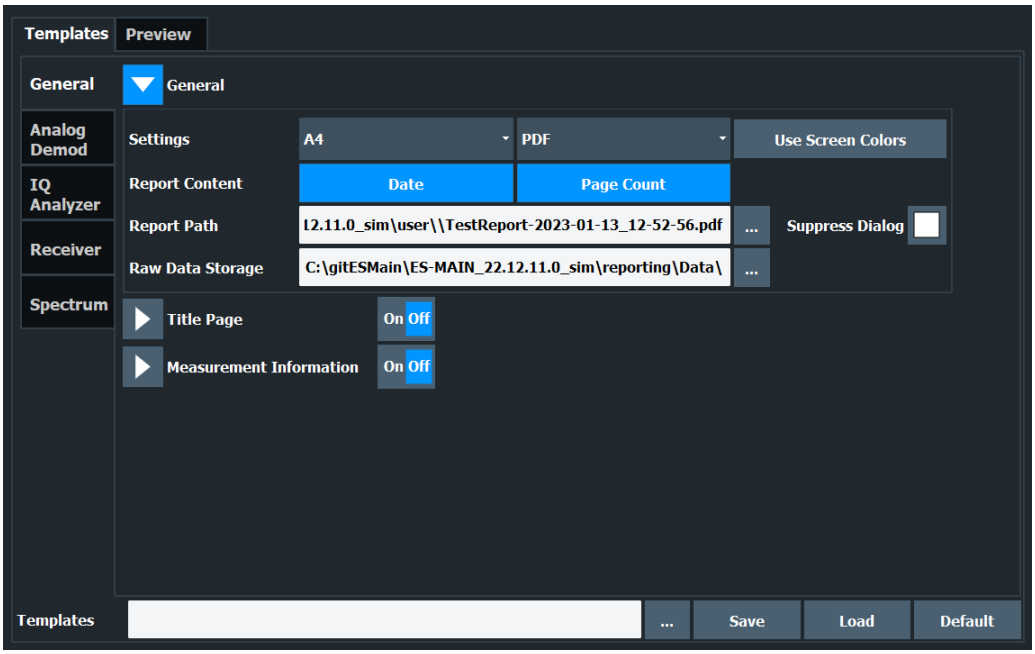
For more information about the "General" tab of the dialog box, see "Custom information about the measurement" on page 269 and "Contents of the title page" on page 270.



Remote command:
`HCOPy:TREPort:ITEM:SELect` on page 550
`HCOPy:TREPort:ITEM:DEFault` on page 546

General properties of the test report document
Access: ▣ > "Report menu" > "Templates" > "General" > "▽" > "General"

The "General" category defines general properties of the report document.



The following document properties are supported.

- **Format**

Selects the format of the document (A4 or Letter format).

- **File type**
  Selects the file type (.pdf or .doc)
- **Use Screen Colors**
  Turns the use of printer friendly color schemes on and off.
- **Date**
  Adds the current date to the report.
- **Page Count**
  Adds page numbers to the report.
- **Report Path**
  Defines the name of the report and the location where the report file is to be saved. You can specify the directory with the "..." button or by entering a path and filename into the input field.
  When you omit the path, the report is saved in the default directory.
  `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer`
  Note: This is the location of the actual test report. Templates are stored in a different location.
- **Suppress Dialog**
  Turns a confirmation dialog box that is shown when you save the report on and off. When the confirmation dialog is suppressed, reports are saved to the default directory with a generic name.
- **Raw Data Storage**
  Defines the location where the raw data used to create the report is stored.
  You can specify the directory with the "..." button or by entering a path into the input field.

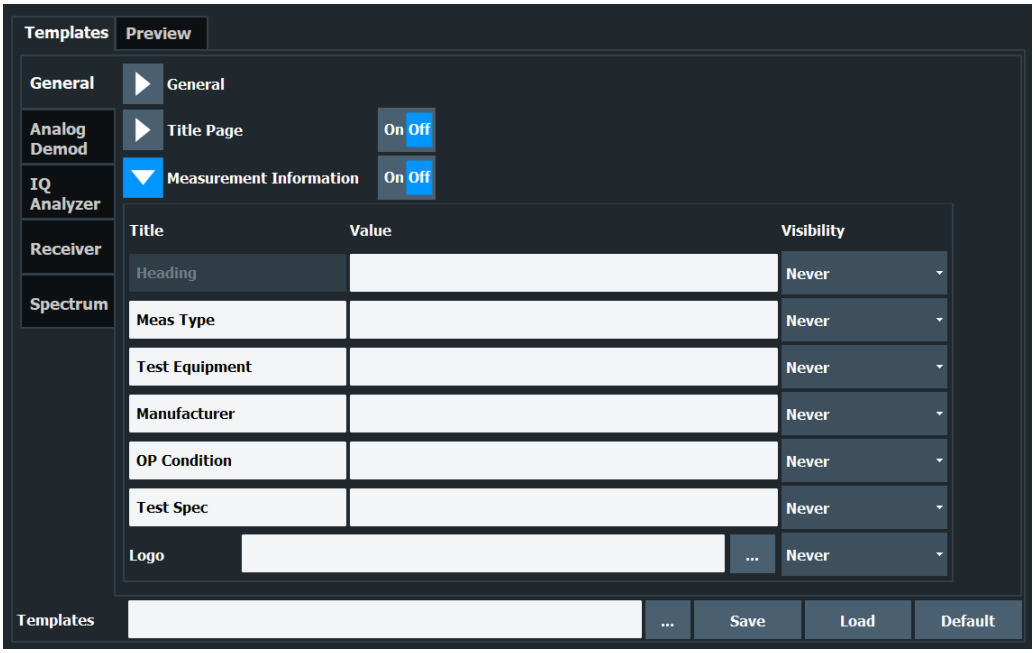
Remote command:
Format: `HCOPy:TREPort:PAGesize` on page 554
File type: `HCOPy:DEVice:LANGuage` on page 538
Page numbers: `HCOPy:TREPort:PAGecount:STATe` on page 553
Color: `HCOPy:TREPort:PCOLors:STATe` on page 554
Date and time: `HCOPy:TREPort:TDSTamp:STATe` on page 554

Custom information about the measurement
Access: ▤ > "Report menu" > "Templates" > "General" > "▽" > "Measurement Information"

When you turn it on, the "Measurement Information" category allows you to add custom information about the measurement to the report. You can also define how often that information is added to the report.

You can add up to **six lines** to the report, plus **one picture** (for example a company logo). Each of the six lines consists of a **title** and a **value** (which is displayed next to the title). In addition, you can select how each line in the header is treated (the **visibility**).

The title and value are arbitrary strings. The application, however, comes with several predefined titles (except for the "Heading" title, you can change all others).



- Title
  Defines a name for a variable that has different values depending on the measurement (for example the name of the EUT). The firmware comes with some predefined titles, but you can change and customize each title.
- Value
  Defines the value of the variable defined by the title.
- Visibility
  Selects if a line is displayed on every page in the header of the report ("Global"), below a main chapter title ("Subreport") or not at all ("Never").
  By default, the information is not displayed at all.

Adding a logo

The page header can also contain a picture or logo. You can upload a picture with the "..." symbol. The "..." symbol opens a dialog box to select a file.

Reports support pictures in `.bmp`, `.jpg`, `.png`, `.gif`, `.emf` or `.wmf` format.

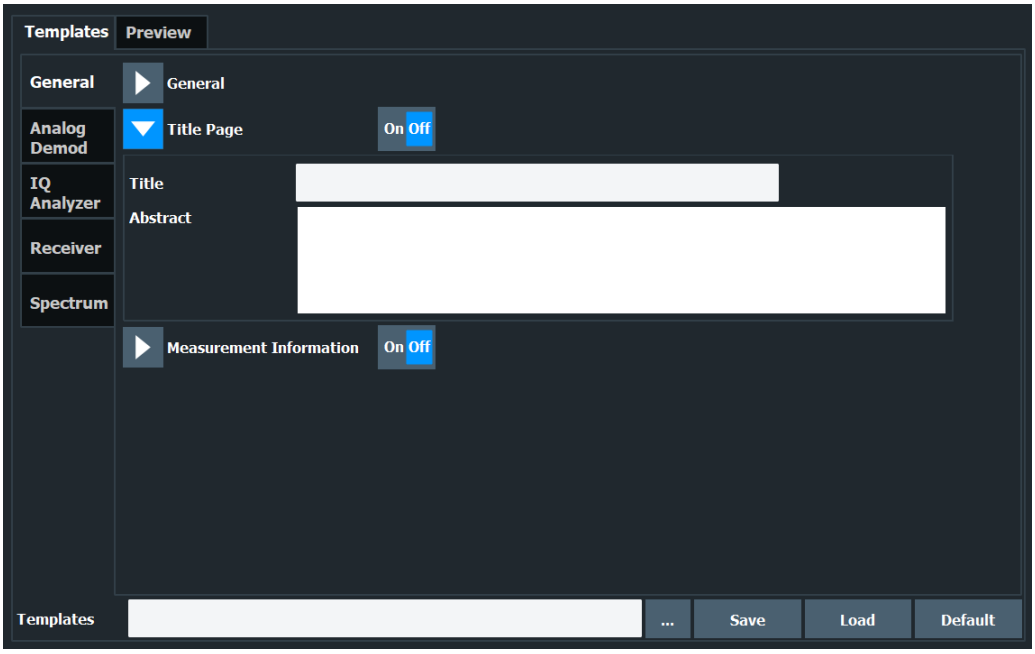
Similar to the alphanumeric lines in the header, you can select the visibility for the logo as well. By default, the logo is not displayed in the report.

Remote command:
State: `HCOPy:TREPort:ITEM:HEADer:STATe` on page 548
Title: `HCOPy:TREPort:ITEM:HEADer:LINE<li>:TITLe` on page 548
Value: `HCOPy:TREPort:ITEM:HEADer:LINE<li>:TEXT` on page 547
Visibility: `HCOPy:TREPort:ITEM:HEADer:LINE<li>:CONTrol` on page 546
Selection of logo: `HCOPy:TREPort:ITEM:LOGO` on page 549
Visibility of logo: `HCOPy:TREPort:ITEM:LOGO:CONTrol` on page 549

Contents of the title page
Access: > "Report menu" > "Templates" > "General" > "▽" > "Title Page"

When you turn it on, the "Title" category defines the contents of the first page of the test report (title page).

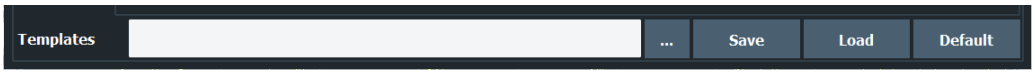
You can define a title for the test report, which is printed in big and bold letters on the first page, and a short description of the contents of the test report (or the name of the author or something similar). This description is also part of the first test report page, but is printed in normal letters.



Remote command:
State: `HCOPy:TREPort:TITLe:STATe` on page 556
Title: `HCOPy:TREPort:TITLe` on page 556
Description: `HCOPy:TREPort:DESCription` on page 546

Template management
The "Templates" category contains functions to manage test report templates.

Test report management functions are always visible (at the bottom).



- Load
  Restores the selected test report configuration.
- Save
  Saves the current test report configuration. Before you save the configuration as a template, enter a name for the template in the corresponding field.
  You can specify the directory with the "..." button or by entering a path and filename into the input field.
  When you omit the path, the report is saved in the default directory.
- Default
  Restores the default template configuration.

"File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.

Remote command:
Query available templates: `HCOPy:TREPort:ITEM:TEMPlate:CATalog?` on page 552
Save template: `HCOPy:TREPort:ITEM:TEMPlate:SAVE` on page 553
Load template: `HCOPy:TREPort:ITEM:TEMPlate:LOAD` on page 553
Default template: `HCOPy:TREPort:ITEM:DEFault` on page 546

12.4.2 Creating a test report

Access: > "Report menu" > "Preview"

Generating report data

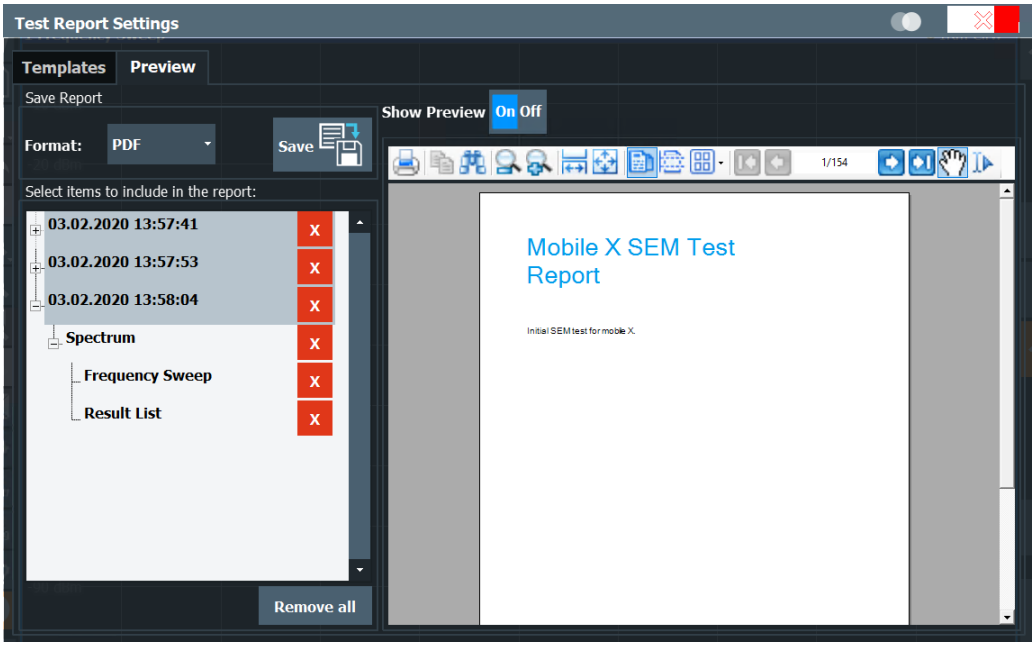
- Create a new dataset of the selected measurement channel from scratch: (Existing datasets will be deleted.)
- Append a new dataset of the selected measurement channel to an existing dataset:

Test report limitations

The size of the test report is limited to 50.000 measurement points per trace.

If the number of measurement points is greater than that value, only the first 50.000 values are written to the report. The rest is dismissed.

Try to do an ASCII file export when you have more measurement points.



Configuration and printout of the test report....273
Adding and removing datasets....273

Configuration and printout of the test report

You can save the test report either as a **pdf** document or an **doc** document in the corresponding dropdown menu in the "Report Content" dialog box.

The "Preview" feature, if it is turned on, opens a preview version of the test report in the corresponding pane of the dialog box. Note that it can take a short time until the preview has been created.

The "Save" button saves the test report. When you suppress the file dialog, the report is saved to the directory you have specified in the Report Path input field.

Remote command:
Print mode: `HCOPy:MODE` on page 545
Print report: `HCOPy[:IMMediate]` on page 538
Report name and directory: `MMEMory:NAME` on page 525

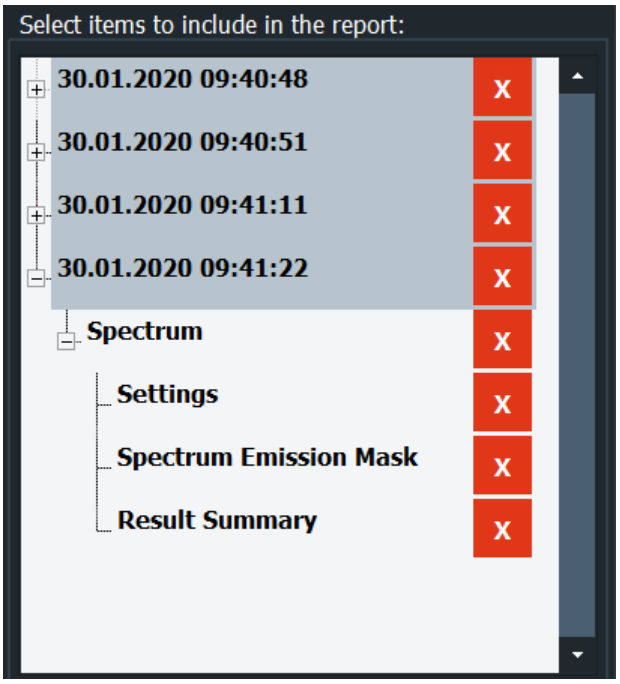
Adding and removing datasets

Before you can print a test report, you have to fill it with data.

Test report data is organized in datasets. Each dataset contains the results of one measurement or the settings of one measurement (which can result in several subsets):

You can generate datasets with the (generate new dataset) or (append data to the existing dataset).

After you have created a dataset, you can view the details in the "Select Items to Include in the Report" pane of the "Report Content" dialog box.



All datasets in the list are exported to the report. To delete a dataset, use the cross next to the dataset label.

The "Remove All" feature deletes all datasets.

Remote command:
New report: HCOPy:TREPort:NEW on page 553
Add dataset: HCOPy:TREPort:APPend on page 546
Remove dataset: HCOPy:TREPort:TEST:REMove on page 555
Remove all datasets: HCOPy:TREPort:TEST:REMove:ALL on page 556

13 General instrument setup

Access: [SETUP]

Some basic instrument settings can be configured independently of the selected operating mode or application. Usually, you configure most of these settings initially when you set up the instrument according to your personal preferences or requirements. Then you only adapt individual settings to special circumstances when necessary. Some special functions are provided for service and basic system configuration.

Network and remote settings

Settings for network and remote operation are described in Chapter 14.4, "Network and remote control settings", on page 338.

- Reference frequency....275
- Display settings....276
- Synchronizing measurement channel configuration....286
- System configuration settings....288
- Service functions....295
- Toolbar configuration....300
- Transducers....301
- Alignment....312

13.1 Reference frequency

Access: [Setup] > "Reference Int/Ext"

The R&S EPL1000 can use the internal reference source or an external reference source as the frequency standard for all internal oscillators. A 10 MHz crystal oscillator is used as the internal reference source. In the external reference setting, all internal oscillators of the R&S EPL1000 are synchronized to the external reference frequency.

External references are connected to one of the [REF INPUT] connectors on the rear panel. For details see the R&S EPL1000 "Getting Started" manual.

The default setting is the internal reference. When an external reference is used, "EXT REF" is displayed in the status bar.

OCXO option

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

The OCXO is available with option R&S FPL1-B4.

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

Remote command:

[SENSe:]ROSCillator:SOURce on page 569

13.2 Display settings

13.2.1 Display settings

Access: [Setup] > "Display"

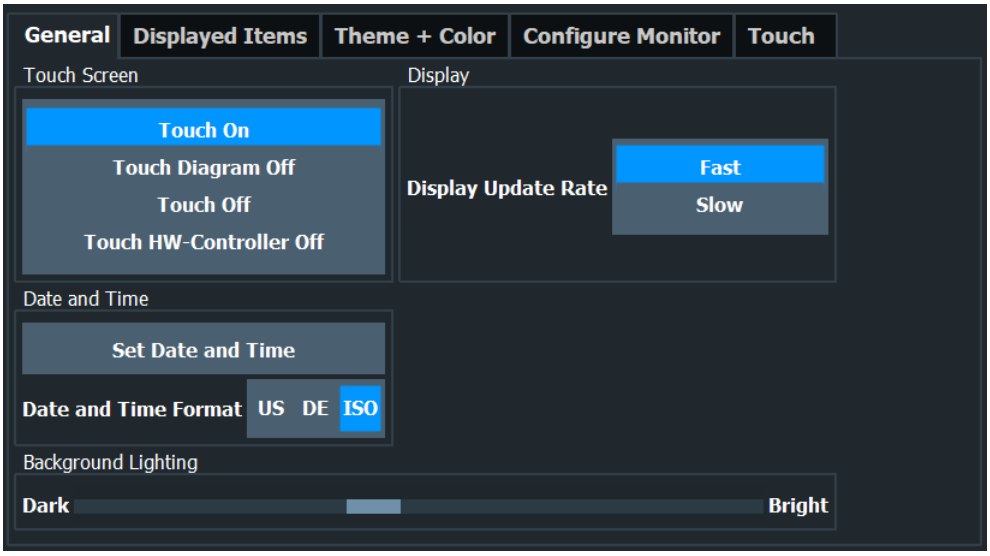
Some general display settings are available regardless of the current application or operating mode. For information on optimizing your display for measurement results, see Chapter 11.1, "Result display configuration", on page 169.

- General display settings....276
- Displayed items....278
- Display theme and colors....282
- External monitor settings....283
- Touch(screen) settings....284

13.2.1.1 General display settings

Access: [Setup] > "Display" > "General"

This section includes general screen display behavior and date and time display.



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Display Update Rate.... 277
Set Date and Time.... 277
Date and Time Format.... 277
Background Lighting.... 277

Deactivating and Activating the Touchscreen
The touchscreen function can be deactivated, e.g. when the instrument is being used for demonstration purposes and tapping the screen must not provoke an action.

To reactivate the touchscreen, simply press the [Setup] key on the front panel. The "Display" dialog box is opened automatically and the "Touch Screen" option is set to "On".

"Touch On" Touchscreen function is active for the entire screen.

"Touch Off" Touchscreen is deactivated for the entire screen.

"Touch Diagram Off"
Touchscreen is deactivated for the diagram area of the screen, but active for the surrounding softkeys, toolbars and menus.

"Touch HW Controller Off" Cuts off the touchscreen from the power supply to avoid interference during measurements.

Remote command:
`DISPlay:TOUChscreen[:STATe]` on page 578

Display Update Rate
By default, a fast update rate ensures the most recent measurement results on the display. However, when performance is poor due to slow data transfer (for example during remote control), it can be helpful to decrease the frequency with which the screen display is updated.

Set Date and Time
Sets the current date and time for the internal real-time clock on the instrument. This function uses the standard Windows "Date and Time Properties" dialog box. Setting the clock requires administrator rights.

Select the "Set Date and Time" button in the "Display" dialog box, or select the date and time display in the status bar to open the Windows dialog box.

Remote command:
`SYSTem:DATE` on page 562
`SYSTem:TIME` on page 562

Date and Time Format
Switches the time and date display on the screen between US, ISO and German (DE) format.

"DE" dd.mm.yyyy hh:mm:ss
24 hour format.

"US" mm/dd/yyyy hh:mm:ss
12 hour format.

"ISO" yyyy-mm-dd hh:mm:ss
24 hour format.

Remote command:
`DISPlay[:WINDow<n>]:TIME:FORMat` on page 579

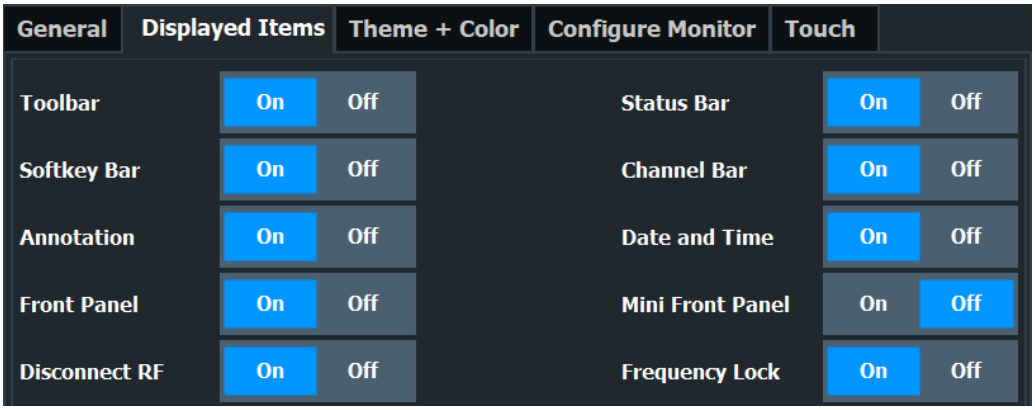
Background Lighting
Changes the brightness of the display in eight steps.

Remote command:
DISPlay:BLIGhting on page 580

13.2.1.2 Displayed items

Access: [Setup] > "Display" > "Displayed Items"

Several elements on the screen display can be hidden or shown as required, for example to enlarge the display area for the measurement results.



Toolbar 278
Status Bar 278
Softkey Bar 279
Channel Bar 279
Diagram Footer (Annotation) 279
Date and Time 279
Front Panel 279
Mini Front Panel 280
Lock Frequency 281
Disconnect RF 282

Toolbar
The toolbar provides access to frequently used functions via icons at the top of the screen. Some functions, such as zooming, finding help, printing screenshots or storing and loading files are not accessible at all without the toolbar.

Remote command:
DISPlay:TBAR[:STATe] on page 578

Status Bar
The status bar beneath the diagram indicates the global instrument settings, the instrument status and any irregularities during measurement or display.

Some of the information displayed in the status bar can be queried from the status registry via remote commands.

We recommend displaying the status bar at all times. If you hide the status bar, you can miss important error messages.

Remote command:
DISPlay:SBAR[:STATe] on page 578

Softkey Bar
Softkeys are virtual keys provided by the software. Thus, more functions can be provided than can be accessed directly via the function keys on the device.

The functions provided by the softkeys are often also available via dialog boxes. However, some functions are not accessible at all without the softkey bar.

Note: The softkey bar is hidden while the SmartGrid is displayed and restored automatically when the SmartGrid is closed.

Remote command:
DISPlay:SKEYs[:STATe] on page 578

Channel Bar
The channel setup bar provides information on firmware and measurement settings for a specific channel setup.

Remote command:
DISPlay:ANNotation:CBAR on page 577

Diagram Footer (Annotation)
The diagram footer beneath the diagram contains information on the x-axis of the diagram display, such as:

- The current center frequency and span settings
- The displayed span per division
- The number of sweep points

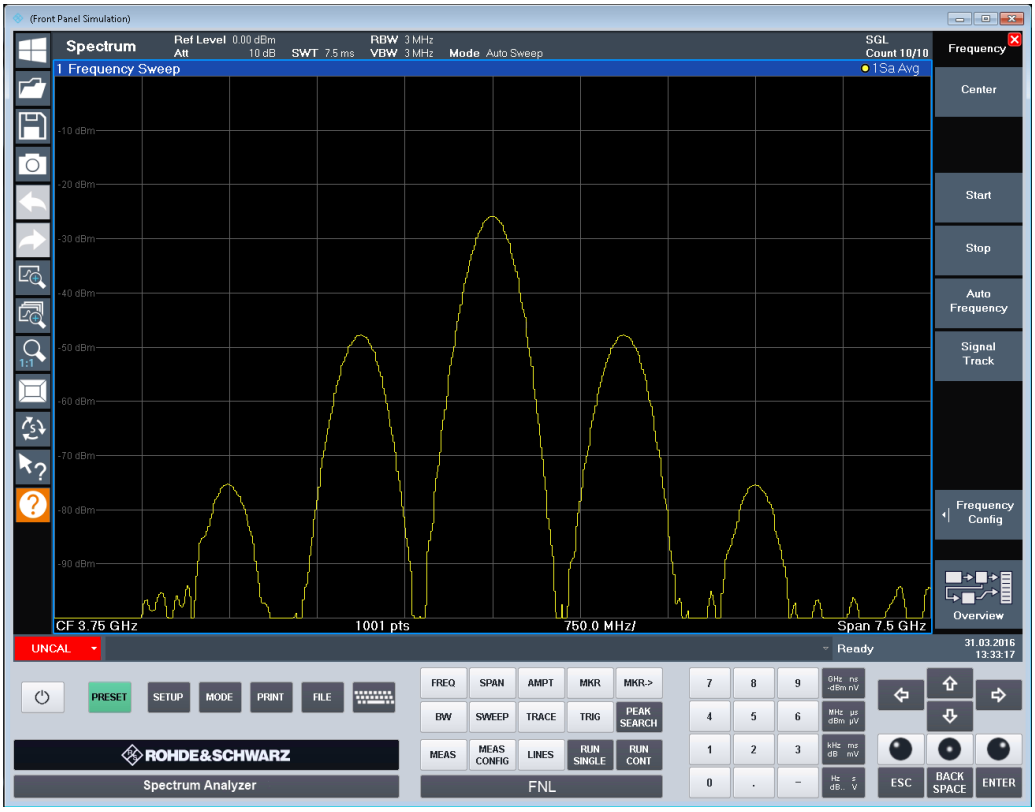
Remote command:
DISPlay:ANNotation:FREQuency on page 577

Date and Time
The date and time display can be switched off independently of the status bar.

You can set the current date and time and configure the display format in the "General" tab of the "Display" dialog box.

Remote command:
DISPlay[:WINDow<n>]:TIME on page 579

Front Panel
The "Front Panel" display simulates the entire front panel of the device (except for the external connectors) on the screen. Thus, you can interact with the R&S EPL1000 without the keypad and keys on the front panel of the device. That is useful, for example, when working with an external monitor or operating via remote control from a computer.



To activate or deactivate the front panel temporarily, press the [F6] key on the external keyboard (if available) or the remote computer.

For more information, see Chapter 13.2.2, "How to work with the soft front panels", on page 285.

Remote command:

`SYSTem:DISPlay:FPANel[:STATe]` on page 580

Mini Front Panel

If you require a front panel display but do not want to lose too much space for results in the display area, a mini front panel is available. The mini version displays only the main function keys in a separate window in the display area.

Note:
You can also activate the mini front panel using the key combination [ALT + m] (be aware of the keyboard language defined in the operating system!). That is useful when you are working from a remote PC and the front panel function is not active.

Remote command:
`SYSTem:DISPlay:FPANel[:STATe]` on page 580

Lock Frequency
Turns the display of the "Lock Frequency" icon in the toolbar on and off.

When the icon is part of the toolbar, you can turn the frequency lock on and off. When the lock is on, the frequency does not change when you turn the rotary knob.

Only applies to the frequency. You can still change other parameters with the rotary knob.

Remote command:
not supported

Disconnect RF
Turns the display of the "Disconnect RF" icon in the toolbar on and off.

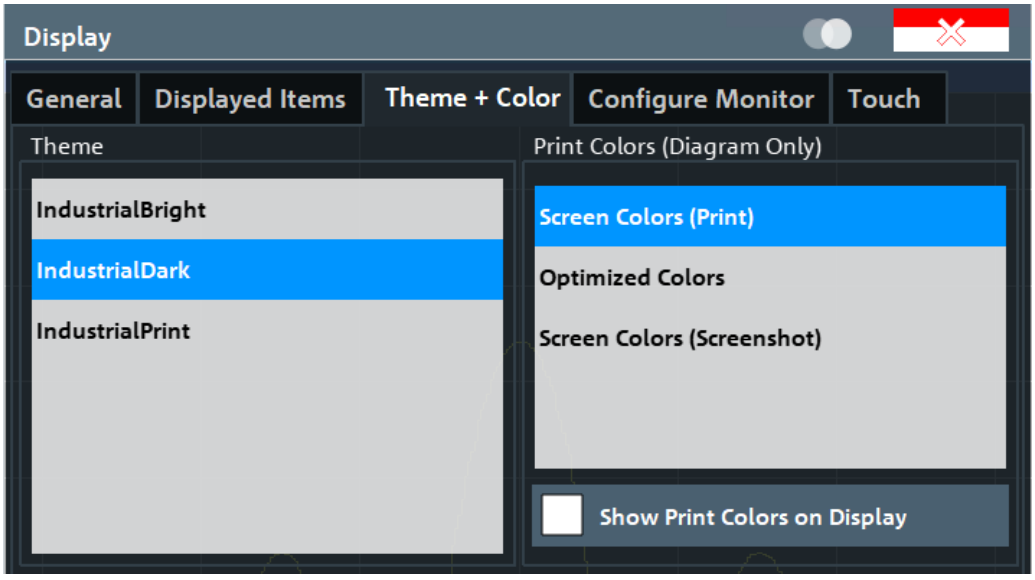
When the icon is part of the toolbar, you can cut off the (external) signal fed into the RF input quickly and easily.

Remote command:
`DISPlay:ITERm[:STATe]` on page 577
`INPut:TERMinator` on page 580

13.2.1.3 Display theme and colors

Access: [Setup] > "Display" > "Theme + Color"

You can configure the used colors and styles of display elements on the screen.



Theme....282
Print Colors....282
Showing Print Colors on Display....283

Theme
The theme defines the colors and style used to display softkeys and other screen objects.

The default theme is "IndustrialDark".

Remote command:
`DISPlay:THEMe:SELect` on page 581

Print Colors
Defines the color settings used for printout.

If "Show Print Colors on Display" is activated, the currently selected print colors are displayed as a preview for your selection.

Gui setting	Description	Remote command
"Optimized Colors"	Selects an optimized color setting for the printout to improve the visibility of the colors (default setting). Trace 1 is blue, trace 2 black, trace 3 green, and the markers are turquoise. The background is always printed in white and the grid in black.	`HCOP:CMAP:DEF2`
"Screen Colors (Print)"	Selects the current screen colors for the printout. The background is always printed in white and the grid in black.	`HCOP:CMAP:DEF1`
"Screen Colors (Screenshot)"	Selects the current screen colors without any changes for a screenshot.	`HCOP:CMAP:DEF4`

Remote command:
`HCOPy:CMAP<it>:DEFault<ci>` on page 535

Showing Print Colors on Display
Temporarily shows the currently selected print colors on the screen display. This function can be used as a preview for printing.

13.2.1.4 External monitor settings

Access: [Setup] > "Display" > "Configure Monitor"

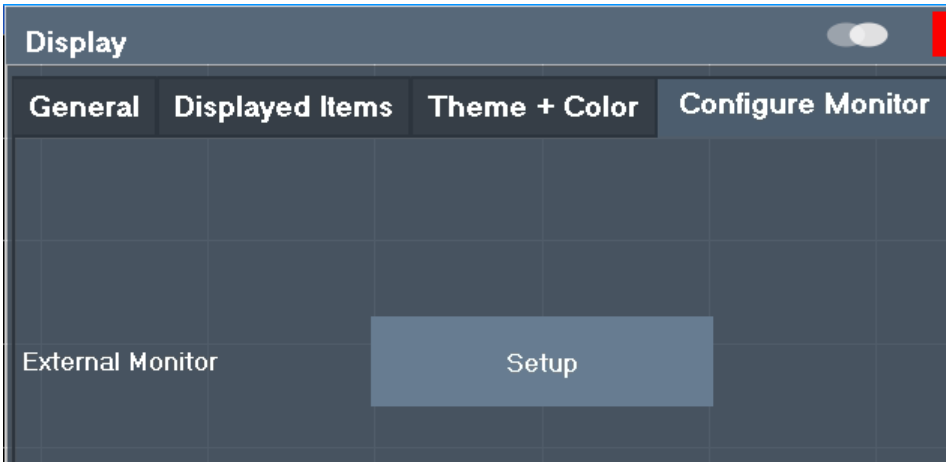
You can connect an external monitor (or projector) to the "DisplayPort" connector on the instrument's rear panel.

Screen resolution and format

The touchscreen of the R&S EPL1000 is calibrated for a 16:10 format. If you connect a monitor or projector using a different format (e.g. 4:3), the calibration is not correct and the screen does not react to your touch actions properly.

The touchscreen has a screen resolution of 1280x800 pixels. Usually, the display of the external monitor is a duplicate of the instrument's monitor.

If you configure the external monitor to be used as the *only* display in the Windows configuration dialog box ("Show only on 2"), the maximum screen resolution of the monitor is used. In this case, you can maximize the R&S EPL1000 application window and see even more details. You cannot change the monitor's screen resolution via the standard Windows configuration dialog box.



Setup....284

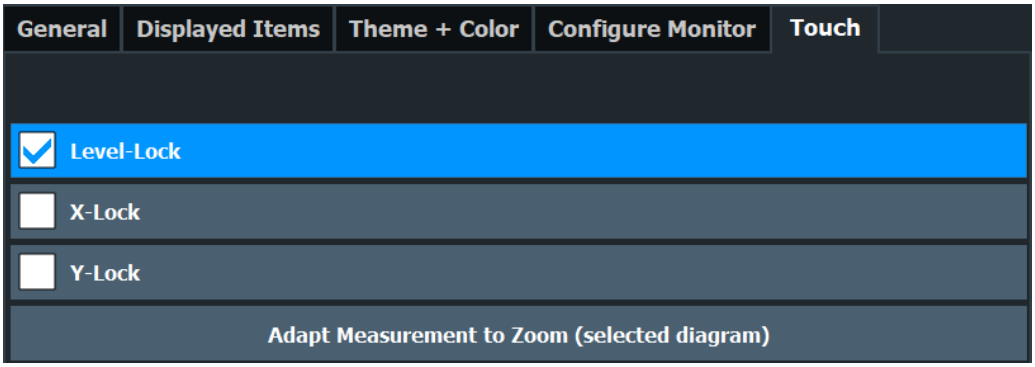
Setup
Opens the standard Windows configuration dialog box to configure the used display devices.

13.2.1.5 Touch(screen) settings

Access: [Setup] > "Display" > "Touch"

These options concern the behavior of the firmware for touch gestures on the screen.

Note that these settings remain unchanged after a channel preset.



Level Lock....284
X-Lock....285
Y-Lock....285
Adapt Measurement to Zoom (selected diagram)....285

Level Lock
If activated (default), the reference level (and thus the attenuation) is locked, that is: remains unchanged during touch gestures on the screen.

X-Lock
If activated, the x-axis of the diagram is not changed during subsequent touch gestures.

Y-Lock
If activated, the y-axis of the diagram is not changed during subsequent touch gestures.

Adapt Measurement to Zoom (selected diagram)
If you already performed a graphical zoom using the "Single Zoom" on page 175 or "Multi-Zoom" on page 175 functions, this function automatically adapts the measurement settings to maintain the currently zoomed display.

13.2.2 How to work with the soft front panels

Basic operation with the soft front panels is identical to normal operation, except for the following aspects:

To activate a key, select the key on the touchscreen.

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

Mini front panel

The mini front panel provides only the keys on the touchscreen, to operate the R&S EPL1000 via an external monitor or remote desktop.

To display the soft front panel or mini front panel

1. Press the [Setup] key and select the "Display" softkey.
2. Select the "Displayed Items" tab.
3. Select "Front Panel": "On" or "Mini Front Panel": "On".

To activate or deactivate the front panel temporarily, press the [F6] key on the external keyboard (if available) or on the remote computer.

If the softkey menu is visible, you can display the "Mini Front Panel" quickly and easily by double-clicking the title of the softkey menu.

To close the mini front panel, click the "Close" icon at the top of the panel.

13.3 Synchronizing measurement channel configuration

Access: [SETUP] > "Parameter Coupling"

Each of the applications of the R&S EPL1000 is usually treated as an independent entity regarding their configuration: changing a setting in one measurement channel does not automatically change the corresponding setting in another channel.

For example, changing the frequency in the receiver application does not, by default, change the frequency in the spectrum application.

However, sharing settings can be convenient for certain measurement tasks. The R&S EPL1000 provides a tool to couple (or synchronize) selected parameters across applications - the coupling manager.

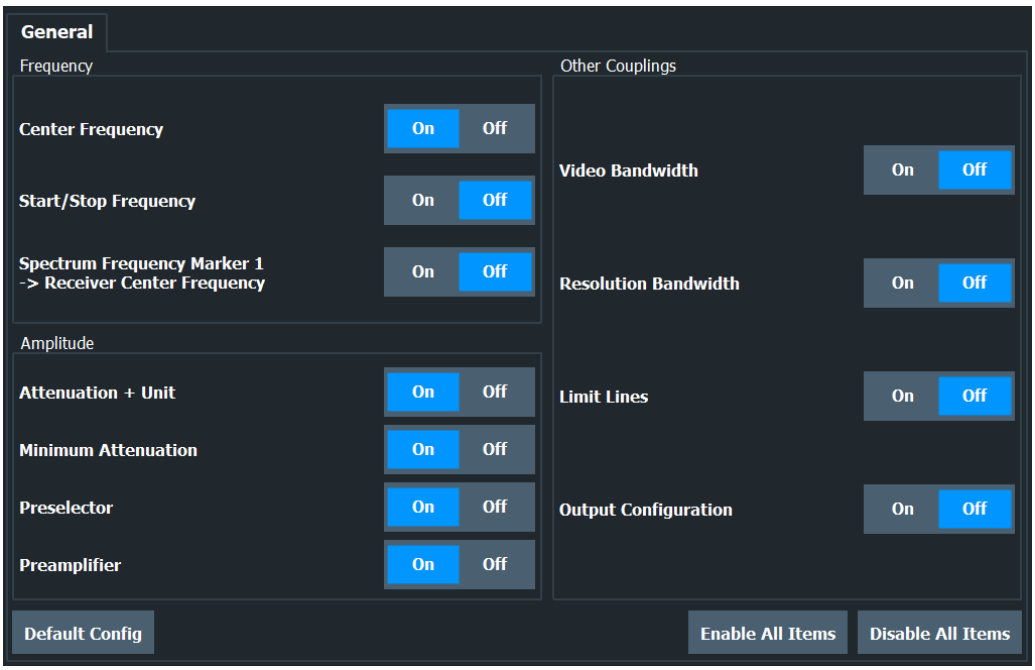
The coupling managers allows you not only to couple parameters, but also markers and lines accross applications.

- General parameter coupling.....286

13.3.1 General parameter coupling

Access: [SETUP] > "Parameter Coupling" > "General"

The "General" tab of the coupling manager contains several parameters that you can couple across all (active) measurement channels - if the channel supports the corresponding parameter.

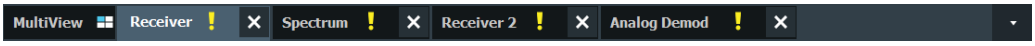


When you couple a parameter across all active measurement channels, a change in the currently selected application is passed on to all other active measurement channels.

Example:

You have opened one instance of the spectrum application, two instances of the receiver application and one instance of the AM/FM/PM Analog Demod application.

The currently selected channel is the first receiver channel (as shown in the picture).



When you turn the coupling of the frequency on, changing the frequency in the "Receiver" channel also changes the frequency in the "Spectrum", "Receiver 2" and "Analog Demod" channels.

Synchronizing parameters across all measurement channels.....287
Selecting all or no coupling mechanisms.....288
Restoring the default configuration.....288

Synchronizing parameters across all measurement channels

To synchronize a specific parameter, turn on the corresponding function.

Coupling	Effect when turned on
"Center Frequency"	Synchronizes the (center / receiver) frequency Remote command: `INSTrument:COUPle:CENTer` on page 583
"Start / Stop Frequency"	Synchronizes the start and stop frequencies for measurements in the frequency domain. **Note**: The start and stop frequencies can automatically change when you change another frequency parameter (like center frequency or span). Remote command: `INSTrument:COUPle:SPAN` on page 585
"Marker → Frequency"	Synchronizes the receiver frequency in the receiver application with the frequency of marker 1 in the spectrum application. **Note**: Simultaneous synchronization of center frequency, start and stop frequency and synchronization of marker and center frequency is not possible. Remote command: `INSTrument:COUPle:MARKer` on page 584
"Attenuation + Unit"	Synchronizes the attenuation and the unit of the level axis. Remote command: `INSTrument:COUPle:ATTen` on page 582
"Minimum Attenuation"	Synchronizes the 10 dB Minimum Attenuation feature. Remote command: `INSTrument:COUPle:PROT` on page 585
"Preamplifier"	Synchronizes the gain of the optional preamplifier. **Note**: If you have selected automatic selection of the ideal gain in a receiver application, only the calculated gain value is synchronized. Remote command: `INSTrument:COUPle:GAIN` on page 583
"Resolution Bandwidth"	Synchronizes the measurement bandwidth. **Note**: Simultaneous synchronization of the video bandwidth and the resolution bandwidth is not possible. Remote command: `INSTrument:COUPle:BWIDth` on page 582

Coupling	Effect when turned on
"Video Bandwidth"	Synchronizes the video bandwidth. **Note**: Simultaneous synchronization of the video bandwidth and the resolution bandwidth is not possible. Remote command: `INSTrument:COUPle:VBW` on page 586
"Limit Lines"	Activates the limit line over all channels. **Note**: Limit lines are only synchronized over channels if the limit line is compatible to the channel configuration (especially units of the x- and y-axis). Remote command: `INSTrument:COUPle:LIMit` on page 584
"Output Configuration"	Synchronizes the settings for signal output. Remote command: `INSTrument:COUPle:DEMod` on page 583
"Preselector"	Synchronizes the preselector configuration. Note that the preselector is always on in the receiver application. Therefore, the coupling only has an effect on spectrum, I/Q analyzer and analog demodulation channels. Remote command: `INSTrument:COUPle:PRESel` on page 585

Note that you cannot synchronize all parameters at the same time, because some parameters are interdependent. For example, you cannot synchronize the resolution and video bandwidth simultaneously, because the video bandwidth depends on the resolution bandwidth and vice versa.

Selecting all or no coupling mechanisms
Select all items available in the general coupling manager using the "Enable All Items" button.

Note that you cannot actually select all items, because some of them are mutually exclusive.

Deselect all items available in the coupling manager using the "Disable All Items" button.

Remote command:
not supported

Restoring the default configuration
You can restore the default parameter coupling configuration any time with the "Default Config" button.

Remote command:
not supported

13.4 System configuration settings

Access: [Setup] > "System Configuration"

- Hardware information....289
- Information on versions and options....289
- System messages....291

- Firmware updates 292
- General configuration settings 293
- Additional interfaces 294

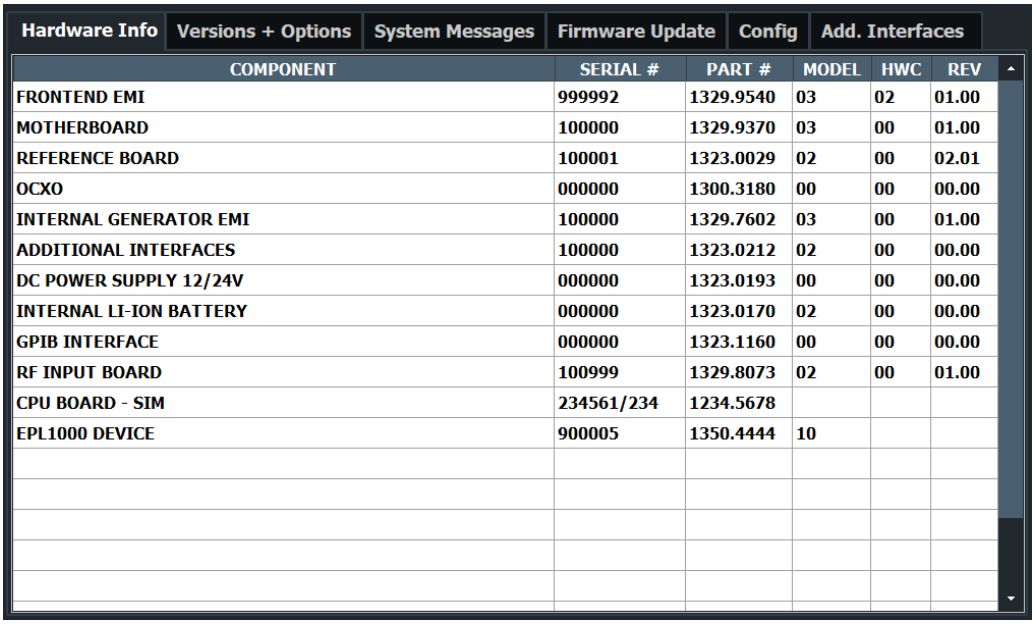
13.4.1 Hardware information

Access: [Setup] > "System Configuration" > "Hardware Info"

An overview of the installed hardware in your R&S EPL1000 is provided.

Every listed component is described by its serial number, part number, model information, hardware code, and hardware revision.

This information can be useful when problems occur with the instrument and you require support from Rohde & Schwarz.



COMPONENT	SERIAL #	PART #	MODEL	HWC	REV
FRONTEND EMI	999992	1329.9540	03	02	01.00
MOTHERBOARD	100000	1329.9370	03	00	01.00
REFERENCE BOARD	100001	1323.0029	02	00	02.01
OCXO	000000	1300.3180	00	00	00.00
INTERNAL GENERATOR EMI	100000	1329.7602	03	00	01.00
ADDITIONAL INTERFACES	100000	1323.0212	02	00	00.00
DC POWER SUPPLY 12/24V	000000	1323.0193	00	00	00.00
INTERNAL LI-ION BATTERY	000000	1323.0170	02	00	00.00
GPIB INTERFACE	000000	1323.1160	00	00	00.00
RF INPUT BOARD	100999	1329.8073	02	00	01.00
CPU BOARD - SIM	234561/234	1234.5678			
EPL1000 DEVICE	900005	1350.4444	10		

Remote command:

`DIAGnostic:SERVice:HWINfo?` on page 592

`DIAGnostic:SERVice:BATTery:LEVel?` on page 568

13.4.2 Information on versions and options

Access: [Setup] > "System Configuration" > "Versions + Options"

Information on the firmware version and options installed on your instrument is provided. The unique Rohde & Schwarz device ID is also indicated here, as it is required for license and option administration.

You can also install new firmware options in this dialog box.

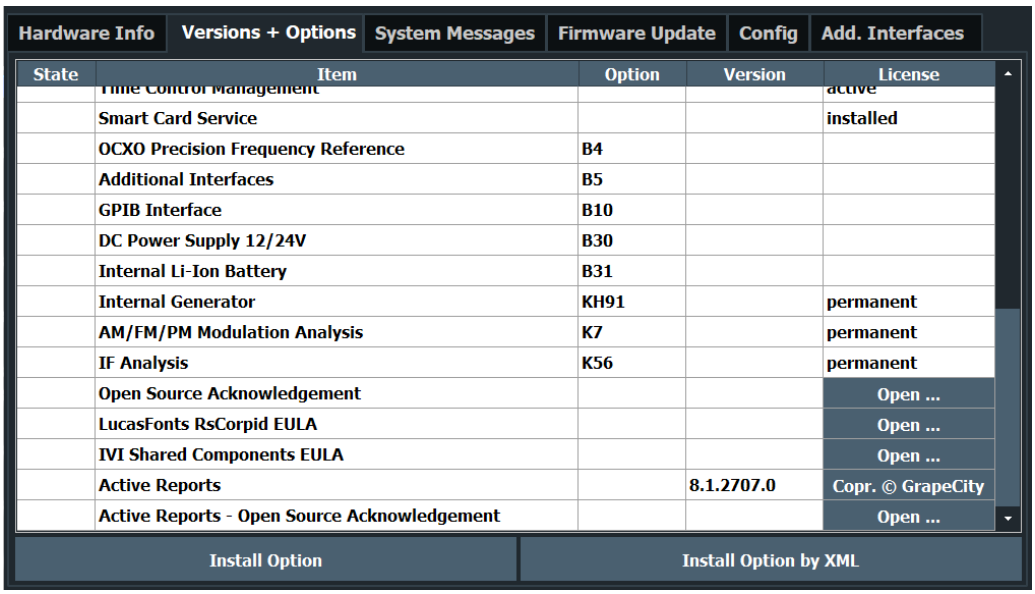
The table also contains:

- The open source acknowledgements (`PDF` file) for the firmware and other software packages used by the R&S EPL1000
- The European License Agreement (EULA) for LucasFonts RSCorpid

Expired option licenses

If an option is about to expire, a message box is displayed to inform you. You can then use the "Install Option" function to enter a new license key.

If an option has already expired, a message box appears for you to confirm. In this case, all instrument functions are unavailable (including remote control) until the R&S EPL1000 is rebooted. You must then use the "Install Option" function to enter the new license key.



Remote commands:

`DIAGnostic:SERVice:BIOSinfo?` on page 592

`DIAGnostic:SERVice:VERSinfo?` on page 593

LucasFonts RsCorpid EULA: Open

Displays a PDF file containing copyright information on the RsCorpid font used by the R&S EPL1000 firmware.

IVI Shared Components EULA: Open

Displays a PDF file containing copyright information on the IVI shared components used by the R&S EPL1000 firmware.

Install Option

Opens an edit dialog box to enter the license key for the option that you want to install.

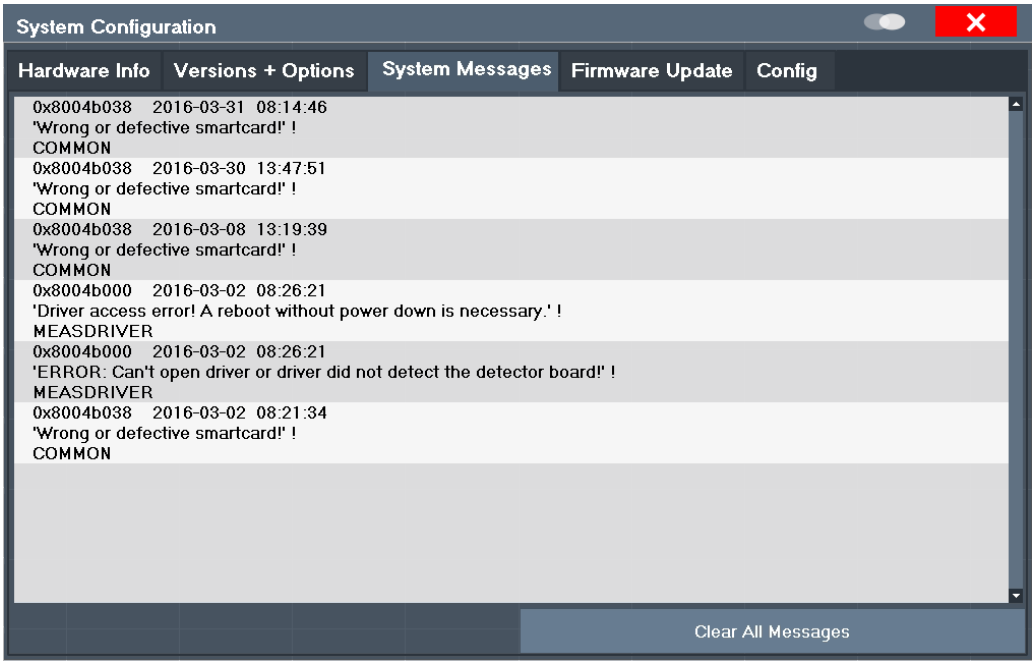
Install Option by XML
Opens a file selection dialog box to install an additional option to the R&S EPL1000 using an XML file. Enter or browse for the name of an XML file that contains the option key and select "Select".

13.4.3 System messages

Access: [Setup] > "System Configuration" > "System Messages"

The system messages generated by the R&S EPL1000 are displayed.

The messages are displayed in the order of their occurrence; the most recent messages are placed at the top of the list. Messages that have occurred since you last visited the system messages tab are marked with an asterisk '*'.



If the number of error messages exceeds the capacity of the error buffer, "Message Buffer Overflow" is displayed. To clear the message buffer, use the "Clear All Messages" button.

The following information is available:

No	device-specific error code
Message	brief description of the message
Component	hardware messages: name of the affected module
	software messages: name of the affected software
Date/Time	date and time of the occurrence of the message

Remote command:

SYSTem:ERRor:LIST? on page 594

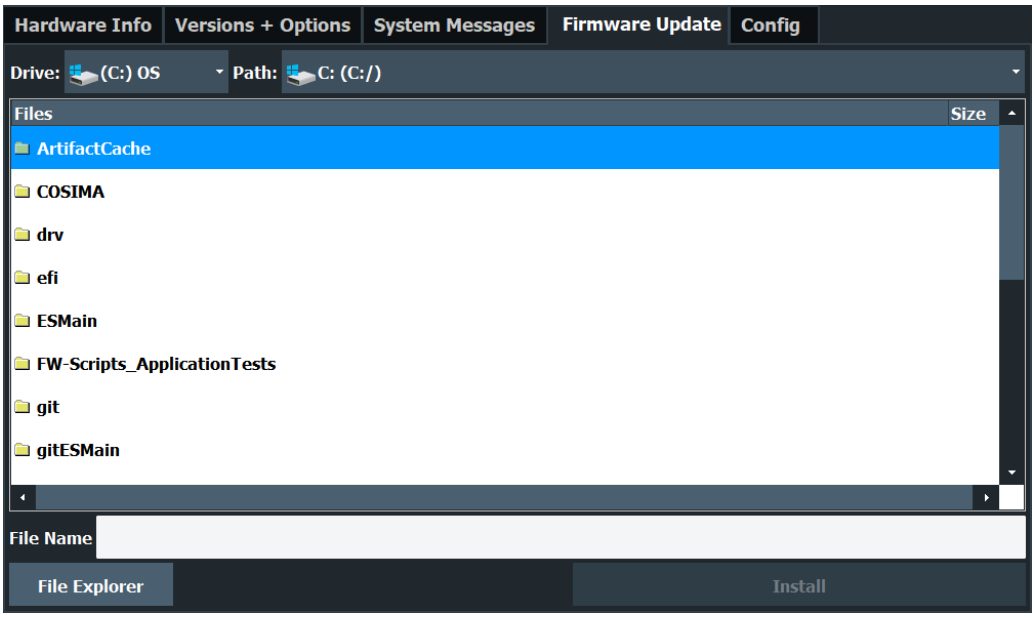
13.4.4 Firmware updates

Access: [Setup] > "System Configuration" > "Firmware Update"

During instrument start, the R&S EPL1000 checks the installed hardware against the current firmware version to ensure that the hardware is supported. If not, an error message is displayed ("Wrong Firmware Version") and you are asked to update the firmware. Until the firmware version is updated, self-alignment fails. To see which components are not supported, see the System messages.

Possibly, you also have to update the firmware on your R&S EPL1000 to enable additional new features or if reasons for improvement come up. Ask your sales representative or check the Rohde & Schwarz website for availability of firmware updates. A firmware update package includes at least a setup file and release notes.

Before updating the firmware on your instrument, read the release notes delivered with the firmware version.



Enter the name or browse for the firmware installation file and press the "Install" button.

Remote command:

SYSTem:FIRMware:UPDate on page 595

How to update the instrument firmware

1. Download the update package from the Rohde & Schwarz website and store it on a memory stick, on the instrument, or on a server network drive that the instrument can access.
2. **NOTICE!** Stop measurement. Do not update the firmware during a running measurement.

   If a measurement is running, stop it by pressing the highlighted [Run Cont] or [Run Single] key.
3. Select the [Setup] key.
4. Select the "System Config" softkey.
5. Select the "Firmware Update" tab.
6. In the file selection dialog box, select the `EPLSetup*.exe` file.
   "File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.
7. Select "Install" to start the update.
8. After the firmware update, the R&S EPL1000 reboots automatically.
9. Depending on the previous firmware version, a reconfiguration of the hardware might be required during the first startup of the firmware. The reconfiguration starts automatically, and a message box informs you about the process. When the reconfiguration has finished, the instrument again reboots automatically.

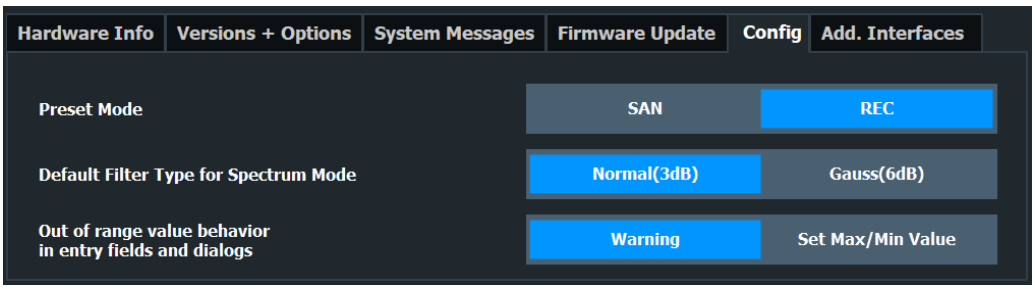
   Note: Do not switch off the instrument during the reconfiguration process.

   Now the firmware update is complete.
   It is necessary that you perform a self-alignment after the update (see Chapter 13.8.4, "How to align the instrument", on page 316).

13.4.5 General configuration settings

Access: [Setup] > "System Configuration" > "Config"

General system settings, for example concerning the initial behaviour of the R&S EPL1000 after booting, can also be configured.



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Default Filter Type for Spectrum Mode....294
Out-of-range value behavior....294

Preset Mode
The preset mode selects the application that is started after an instrument preset.

The presettings can be defined in the "Config" tab of the "System Configuration" dialog box.

For details on operating modes see Chapter 8, "Applications", on page 72.

"SAN" Signal and Spectrum Analyzer mode

"REC" Receiver application

Remote command:
`SYSTem:PRESet:COMPatible` on page 595

Default Filter Type for Spectrum Mode
Selects the type of resolution filter that is selected after a preset in the spectrum application.

"Normal (3 dB)" Selects 3 dB filter.

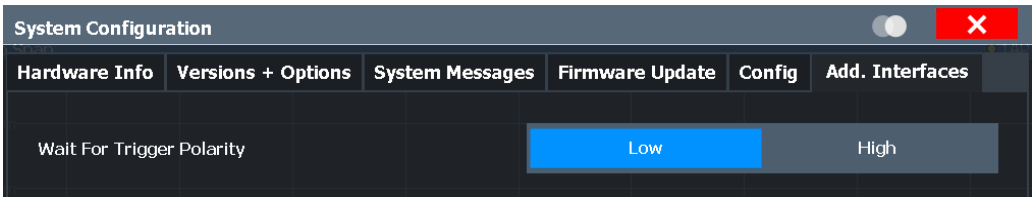
"Gauss (6 dB)" Selects 6 dB filter.
Note that in the receiver application, the default filter is always the 6 dB filter.

Remote command:
`SYSTem:PRESet:FILTer` on page 595

Out-of-range value behavior
By default, if you enter a value that is outside the valid range in an input field for a setting, a warning is displayed and the value is not accepted. Alternatively, entries below the minimum value can automatically be set to the minimum entry, and entries above the maximum value set to the maximum entry. This behavior avoids errors and facilitates setting correct values.

13.4.6 Additional interfaces

The following "Additional interfaces" are available on the R&S EPL1000.



Wait for Trigger Polarity
(For details on the connector see the R&S EPL1000 Getting Started manual).

The signal polarity that indicates the trigger availability is configurable.

"Low" A low signal (= 0 V) indicates the instrument is ready to receive a trigger.

"High" A high signal (= 5 V) indicates the instrument is ready to receive a trigger.

13.5 Service functions

Access: [Setup] > "Service"

When unexpected problems arise with the R&S EPL1000 some service functions may help you solve them.

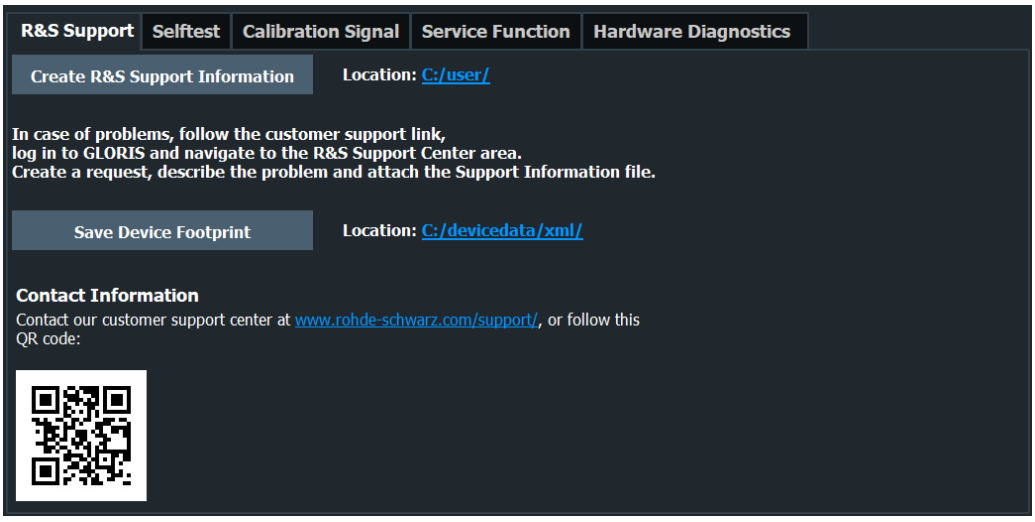
For more helpful information for support, see also Chapter 16.6, "Collecting information for support", on page 621

- R&S support information....295
- Self-test settings and results....296
- Calibration signal display....297
- Service functions....298
- Hardware diagnostics....299

13.5.1 R&S support information

Access: [Setup] > "Service" > "R&S Support"

In case of errors you can store useful information for troubleshooting and send it to your Rohde & Schwarz support center.



Create R&S Support Information....296
Save Device Footprint....296

Create R&S Support Information
Creates a *.zip file with important support information. The *.zip file contains the system configuration information ("Device Footprint"), the current eeprom data and a screenshot of the screen display.

This data is stored to the C:\Users\Public\Documents\Rohde-Schwarz\Analyzer directory on the instrument.

The file name consists of the unique device ID and the current date and time of the file creation.

If you contact the Rohde & Schwarz support to get help for a certain problem, send these files to the support in order to identify and solve the problem faster.

Remote command:
`DIAGnostic:SERVice:SINFo?` on page 597

Save Device Footprint
Creates an `*.xml` file with information on installed hardware, software, image and FPGA versions. The `*.xml` file is stored under `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\devicedata\xml\` on the instrument. It is also included in the service ZIP file (see "Create R&S Support Information" on page 296).

Remote command:
`SYSTem:DFPRint` on page 598

13.5.2 Self-test settings and results

Access: [Setup] > "Service" > "Selftest"

If the R&S EPL1000 fails you can perform a self-test of the instrument to identify any defective modules.

Once the self-test is started, all modules are checked consecutively and the test result is displayed. You can abort a running test.

In case of failure a short description of the failed test, the defective module, the associated value range and the corresponding test results are indicated.

A running Sequencer process is aborted when you start a self-test.

If you start a self-test remotely, then select the "Local" softkey while the test is still running, the instrument only returns to the manual operation state after the test is completed. In this case, the self-test cannot be aborted.

Remote command:

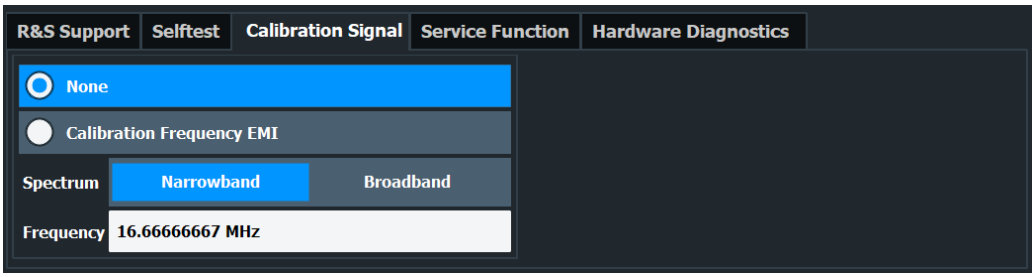
`*TST?` on page 373

`DIAGnostic:SERVice:STESt:RESult?` on page 568

13.5.3 Calibration signal display

Access: [Setup] > "Service" > "Calibration Signal"

As an alternative to the RF input signal from the front panel connector, you can use the instrument's calibration signal as the input signal, for example to perform service functions on.



NONE....297
Calibration Frequency EMI....297
└ Spectrum....297
└ Frequency....298

NONE
Uses the current RF signal at the input, i.e. no calibration signal (default).

Remote command:
`DIAGnostic:SERVice:INPut[:SELect]` on page 567

Calibration Frequency EMI
Uses the internal calibration signal as the RF input signal.

Remote command:
`DIAGnostic:SERVice:INPut[:SELect]` on page 567

Spectrum ← Calibration Frequency EMI
Defines whether a broadband or narrowband calibration signal is sent to the RF input.

"Narrowband" Used to calibrate the absolute level of the frontend.

"Broadband" Used to calibrate the IF filter.

Remote command:
DIAGnostic:SERVice:INPut:RF[:SPECtrum] on page 567

Frequency ← Calibration Frequency EMI
Defines the frequency of the internal broadband calibration signal to be used for IF filter calibration (max. 25 MHz).

13.5.4 Service functions

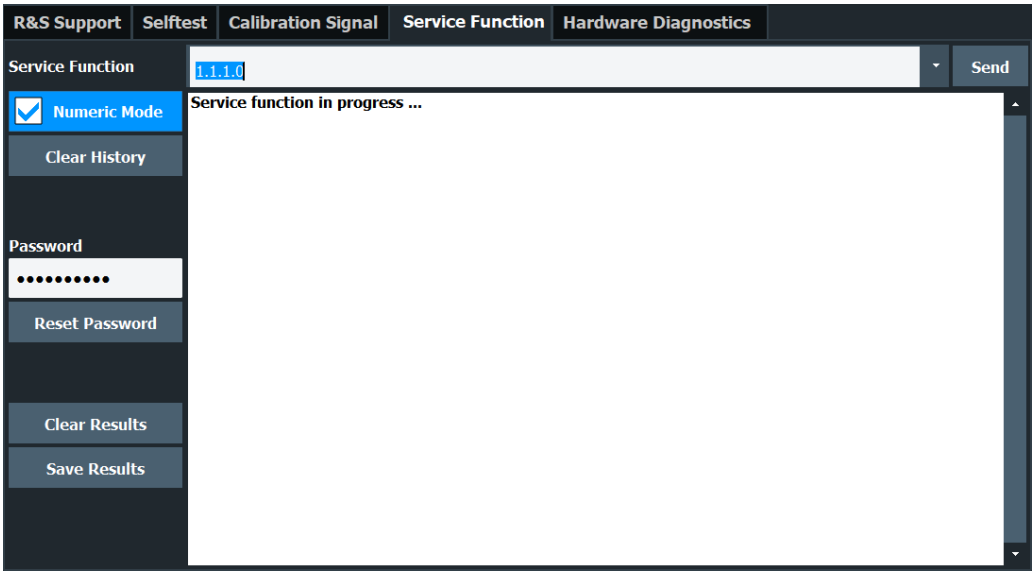
Access: [Setup] > "Service" > "Service Function"

NOTICE

Using service functions

The service functions are not necessary for normal measurement operation. Incorrect use can affect correct operation and/or data integrity of the R&S EPL1000.

Therefore, many of the functions can only be used after entering a password. These functions are described in the instrument service manual.



Service Function 298
Send 299
Clear History 299
Password 299
Clear Results 299
Save Results 299
Result List 299

Service Function
Selects the service function by its numeric code or textual name.

The selection list includes all functions previously selected (since the last "Clear History" action).

Remote command:
DIAGnostic:SERVice:SFUNction on page 596

Send
Starts the selected service function.

Remote command:
DIAGnostic:SERVice:SFUNction on page 596

Clear History
Deletes the list of previously selected service functions.

Password
Most service functions require a special password as they may disrupt normal operation of the R&S EPL1000. There are different levels of service functions, depending on how restrictive their use is handled. Each service level has a different password.

"Reset Password" clears any previously entered password and returns to the most restrictive service level.

Remote command:
SYSTem:PASSword[:CENable] on page 598
SYSTem:PASSword:RESet on page 598

Clear Results
Clears the result display for all previously performed service functions.

Remote command:
DIAGnostic:SERVice:SFUNction:RESults:DELete on page 596

Save Results
Saves the results of all previously performed service functions to a file stored as `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\results\Servicelog.txt`.

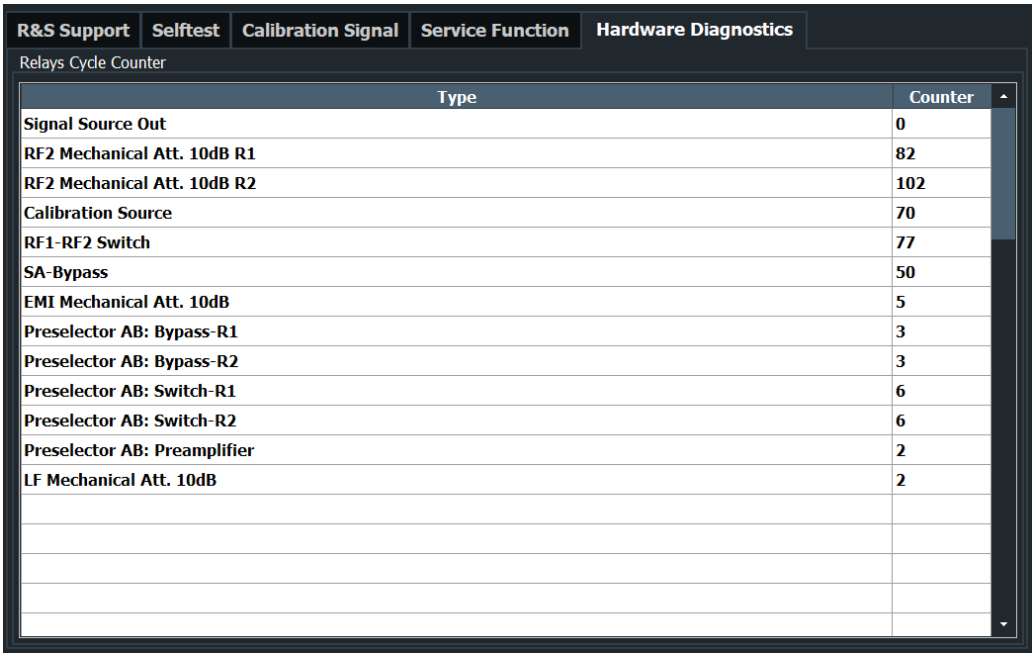
Remote command:
DIAGnostic:SERVice:SFUNction:RESults:SAVE on page 597

Result List
The Results List indicates the status and results of the executed service functions.

13.5.5 Hardware diagnostics

In case problems occur with the instrument hardware, some diagnostic tools provide information that may support troubleshooting.

The hardware diagnostics tools are available in the "Hardware Diagnostics" tab of the "Service" dialog box.



Relays Cycle Counter..... 300

Relays Cycle Counter
The hardware relays built into the R&S EPL1000 may fail after a large number of switching cycles (see data sheet). The counter indicates how many switching cycles the individual relays have performed since they were installed.

Remote command:
`DIAGnostic:INFO:CCOunt?` on page 591

13.6 Toolbar configuration

If the list of available icons becomes longer than the height of the screen, an arrow at the bottom of the toolbar indicates that further icons are available.

However, you can configure which icons are displayed in the toolbar, and in which order.

Toolbar configuration is saved when you shut down or preset the R&S EPL1000. It is not included in save sets (see Chapter 12.2, "Storing and recalling instrument settings and measurement data", on page 242).

To configure the toolbar

1. From the toolbar, select "More icons" > "Edit Toolbar".

   The toolbar is highlighted red to indicate it is in edit mode.

2. Drag and drop the icons in the toolbar to the required position. A blue line indicates the selected position.

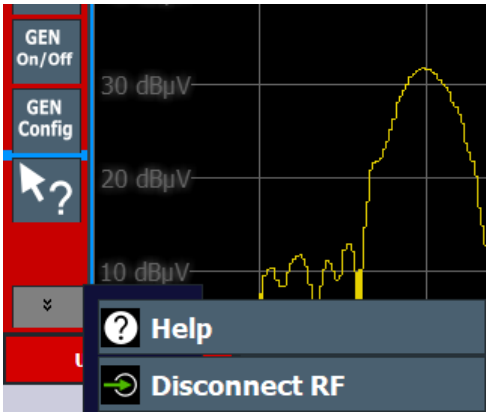


Figure 13-1: Inserting the Windows icon in the toolbar

3. To add an icon that is currently not visible:
   a) Select "More icons".
      All hidden icons are displayed in a menu.
   b) Drag the icon from the menu to the toolbar.
      The added icon is displayed. If the toolbar contains too many icons to display, the icons from the bottom move to the menu.

4. To hide an icon from the toolbar, drag and drop it outside the toolbar.
   The icon is moved to the menu of hidden icons ("More icons"). Empty spaces are indicated by a spacer.
5. To insert additional spaces between icons, for example to create groups of icons:
   a) Select "More icons" > "Drag Spacer".
   b) Drag and drop the "Drag Spacer" at the required position in the toolbar. Multiple spaces can be inserted.
6. To restore the default R&S EPL1000 toolbar, select "More icons" > "Set to Default".
7. To exit the toolbar edit mode, select "More icons" > "Stop Editing".

   The red highlighting is removed. Selecting an icon performs the assigned function as usual.

13.7 Transducers

13.7.1 Transducer

Many EMC test setups contain a transducer (for example antennas, cables, probes or current probes). A transducer is a device which generates a voltage signal that can be measured by the receiver. Therefore the level value is transformed into dBµV. This is

done for all transducer units except dBm and dB. In the latter case, the receiver displays the transducer unit and the level value shows the corresponding level in dBµV.

For example, an input level of 0 dBm equates to 107 dBµV (in case of an input impedance of 50 Ohms) if no transducer factor is active.

Because most transducers have a characteristic frequency response, it is necessary to correct the measurement results by the frequency characteristics of the transducer. These characteristics are defined in a transducer factor or transducer sets.

The visible effect of a transducer is therefore a vertical shift of the results by the amount defined in the transducer factor for each frequency point.

Transducer factors

A transducer factor takes the frequency response of a single transfer element into account. It consists of a series of reference values. Each reference value in turn consists of a frequency and the corresponding level (correction) value. The transducer factor can consist of up to 1001 reference values. Measurement points between the reference values are interpolated either linearly or logarithmically.

Note that the unit of the transducer overrides the unit you have selected for the measurement, because the R&S EPL1000 is seen as the same device as the transducer itself. Measurement results are automatically converted into the unit of the transducer factor. Inputs are only possible in the unit of the transducer. If you want to have access to other units as well, the correction values must be defined in dB. When you turn off the transducer, the R&S EPL1000 again uses the unit that was selected before.

Transducer factors are always applied to all active measurement windows.

Transducer sets

A transducer set consists of several transducer factors and thus takes the frequency response of several transducers into account. Using transducer sets is recommended if you are using different transducers in the measurement range or if cable attenuation or an amplifier have to be considered.

If you are using a transducer set, you can divide the complete frequency range defined for the transducer set into 10 smaller frequency ranges. Make sure, however, that the ranges have no gaps in between each other. The stop frequency of one range must always be the start frequency of the next one.

You can assign up to eight transducer factors to each subrange. Make sure that the frequency range of a particular (sub)range is covered completely by the frequency range defined for the transducer factor. In addition, the unit of all transducer factors that are part of a set has to be the same (or, alternatively, "dB"). Transducer factors that do not meet this condition will not be available for selection.

If necessary, you can configure the R&S EPL1000 to interrupt the scan when it reaches a range boundary. This interruption is called transducer break. While the scan is interrupted, exchange the transducer and continue the scan with the transducer factor assigned to the new range or turn off transducer use and continue the measurement without a transducer factor.

If the scan reaches a frequency not covered by the currently active transducer factor, the R&S EPL1000 shows a message in status bar ("No valid transducer for current receiver frequency").

Transducer management

The R&S EPL1000 provides functionality to store and use the transducer factors during a measurement.

For more information on creating and managing transducer factors, see Chapter 13.7.2, "Working with transducers", on page 303.

Transducers in the receiver application

The transducer is calculated for a set scan. The transducer is uniquely calculated for each frequency point and added to the result of the level measurement as the measurement results are stored internally and can be zoomed later.

Transducers in the spectrum application

The R&S EPL1000 calculates the correction values defined in the transducer factor for every displayed measurement point before you start the measurement. During the measurement, it adds the correction values to the measurement results. If you change the frequency range of the measurement, the R&S EPL1000 calculates the correction values again.

13.7.2 Working with transducers

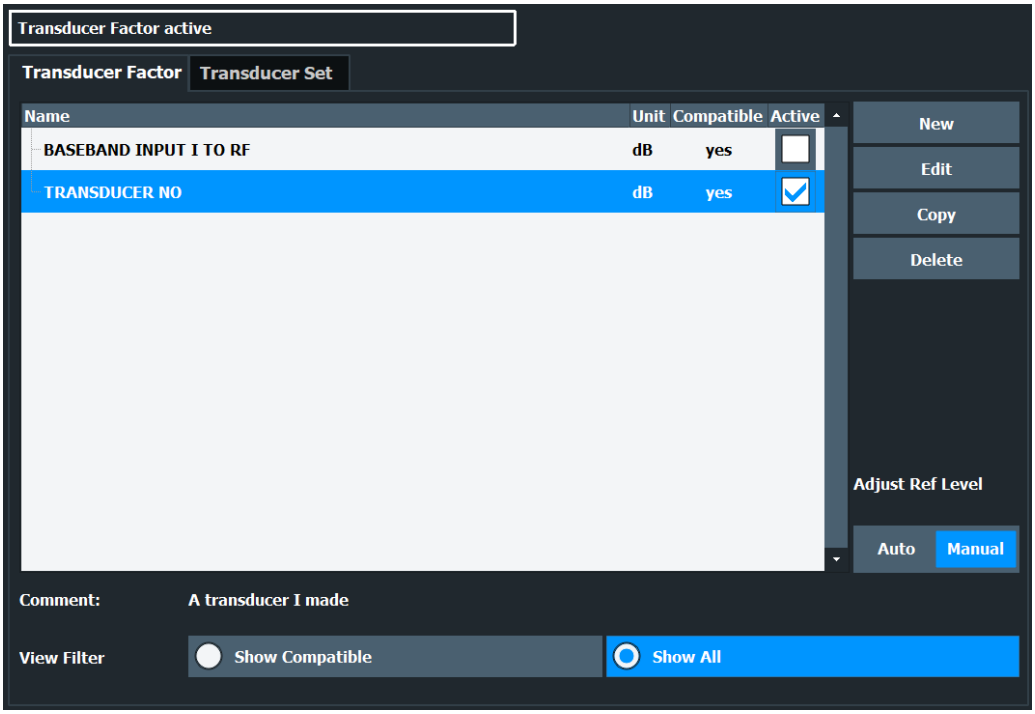
The R&S EPL1000 allows you to create or edit transducer factors and transducer sets. The corresponding functions are combined in a dialog box.

For more information about transducer factors in general, see Chapter 13.7.1, "Transducer", on page 301.

- Using transducers 303

13.7.2.1 Using transducers

Access: [SETUP] > "Transducer"



The dialog box contains several tabs, including one to configure transducer factors and one to configure transducer sets.

Basically, both tabs contain the following elements.

- A list of available transducer factors or transducer sets.
  The list shows the name of the transducer factor or set, its unit, if it is compatible with the current measurement configuration and its state.
- A button to filter the transducer factors that are displayed in the list (all factors or just the compatible ones).
  The filter is available for transducer factor selection.
- A line that shows the comment of a transducer factor or set.
  A comment is displayed only if one has been defined.
- Functions to create, edit and manage transducer factors and sets.

Displaying transducer characteristics

In the Receiver application, you can use the "Transducer"trace mode. Selecting this trace mode draws a trace that shows the correction values of all active transducers in the displayed frequency range.

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Design and management of transducer factors 305
Design and management of transducer sets 307

Applying a transducer factor

The R&S EPL1000 allows you to use either a transducer factor or a transducer set in a measurement. A combination of transducer factors and transducer sets is not possible.

A transducer factor or set becomes active when you check the box in the "Active" column.

When the transducer factor is active, all amplitude settings and outputs take on the unit of the transducer factor. It is no longer possible to select another unit. An exception is in case the transducer has the unit dB.

The name of the active transducer is displayed in the channel bar and in the "Transducer" dialog box.

Note that you can use up to eight transducer factors at the same time. If you want to use more transducer factors in the same measurement, you have to combine them in a transducer set.

Dynamic range with active transducers

The shift of the trace caused by the transducer factor by a certain amount deteriorates the dynamic range of the measurement results.

To restore the original dynamic range, you have to compensate for the transducer factor. You can do this by adjusting the reference level accordingly. If you turn on the automatic adjustment of the reference level (→"Adjust Ref Level"), the R&S EPL1000 restores the original dynamic range as best as possible by changing the reference level by the maximum level shift defined in the active transducer factor.

Remote command:
See Chapter 15.9.5, "Transducers", on page 569.

Design and management of transducer factors

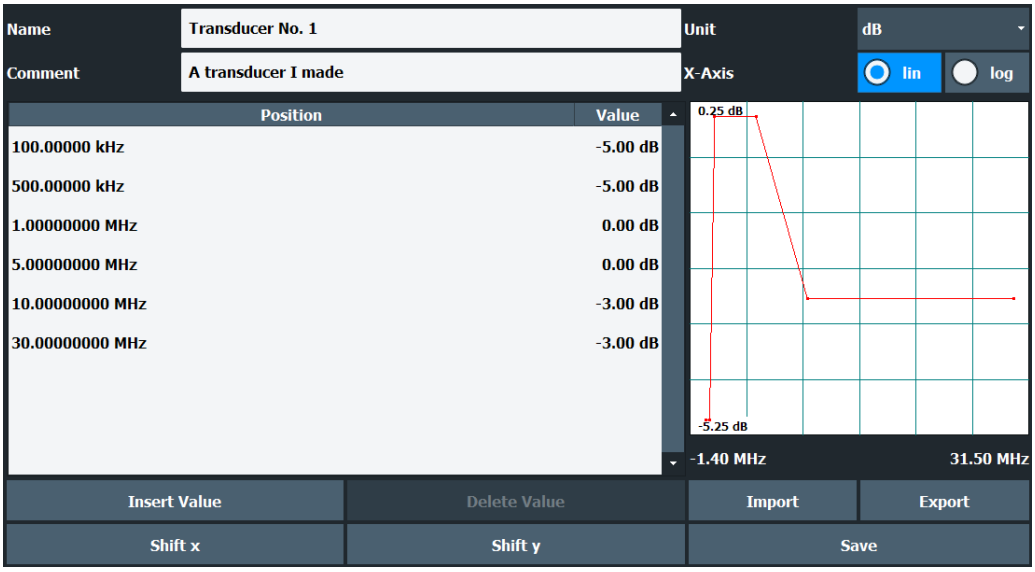
Before you define the characteristics of a transducer factor, make sure that you have actually selected the tab to configure transducer factors.

You can configure a transducer factor in several ways:

- Edit a transducer factor that already exists (→"Edit").
- Create a new transducer factor (→"New").
- Create a new transducer factor based on an existing one (→"Copy").

If necessary, you can delete the selected transducer factor at any time (→"Delete")

Each of the options opens the dialog box that contains the functionality to characterize a transducer factor.



- "Name" / "Comment"
  Defines a name and / or comment of the transducer factor.
- "Unit"
  Selects the unit of the transducer factor.
- "X-Axis"
  Selects linear or logarithmic scaling of the x-axis.
- "Position" and "Value"
  Define the data points of the transducer factor (including a graphical preview).
- "Insert Value"
  Insert a transducer factor data point. Alternatively, you can click in the table itself to add a new data point.
- "Delete Value"
  Deletes the currently selected data point. The currently selected data point is highlighted blue.
- "Shift x" / "Shift y"
  Shifts all data points of the transducer factor horizontally or vertically by a certain amount.
- "Import" / "Export"
  Imports or exports the information for a transducer factor to or from a csv file.
- "Save"
  Saves and stores the transducer factor on the internal hard disk of the R&S EPL1000.

A transducer factor can consist of up to 1001 data points. Each data point is a pair of values: the first value describes the frequency, the second value describes the level for that frequency.

You have to enter frequencies in ascending order. They must not overlap.

When you save the transducer factor, the R&S EPL1000 uses the name of the transducer factor as the file name. The file type is `*.tdf`. If a transducer factor of the same name already exists, the R&S EPL1000 asks before it overwrites the existing file.

The transducer factors and sets are stored in separate but fix directories on the internal memory of the R&S EPL1000. You can create subdirectories for a more concise file structure and display their contents with the "Show Directories" softkey (you have to select the directory first, though).

"File Explorer": Instead of using the file manager of the R&S EPL1000 firmware, you can also use the Microsoft Windows File Explorer to manage files.

Remote command:
See Chapter 15.9.5, "Transducers", on page 569.

Design and management of transducer sets

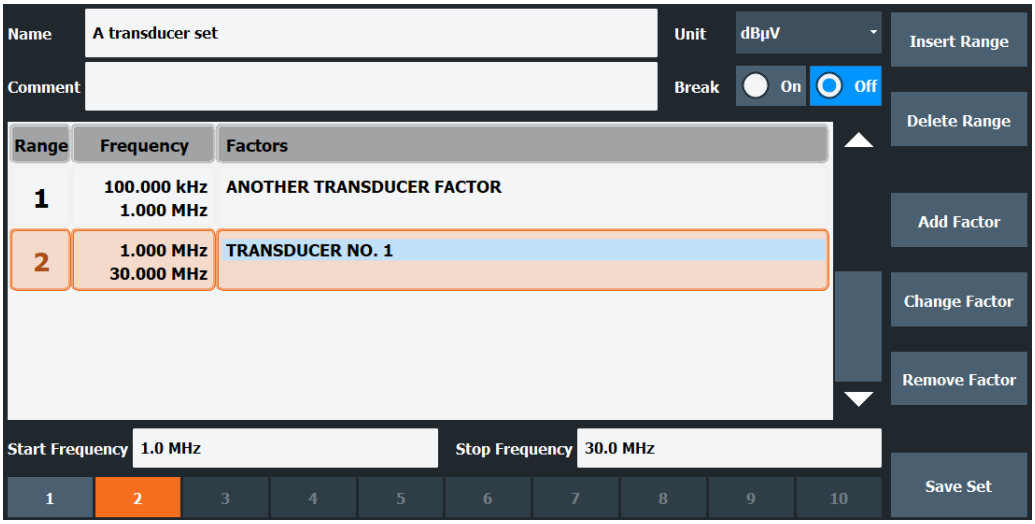
Before you define the characteristics of a transducer set, make sure that you have actually selected the tab to configure transducer sets.

You can configure transducer sets in several ways:

- Edit a transducer set that already exists (→"Edit").
- Create a new transducer set (→"New").
- Create a new transducer set based on an existing one (→"Copy").

If necessary, you can delete the selected transducer set at any time (→"Delete")

Each of the options opens the dialog box that contains the functionality to define a transducer set.



- "Name" / "Comment"
  Defines a name and / or comment of the transducer set.
- "Unit"
  Selects the unit of the transducer set.
- "Break"
  Turns the transducer break on and off.
- "Insert Range"
  Adds a new range to the transducer set. Each transducer set can consist of up to 10 ranges.
  To select a range, select the corresponding range in the table, or select it with the buttons on the bottom of the dialog box.
- "Delete Range"

Deletes the currently selected transducer set range. The currently selected range is highlighted orange.

- "Start Frequency" / "Stop Frequency"
  Defines the start and stop frequencies for the selected transducer set range.
- "Add Factor"
  Opens a list of transducer factors that you can apply to the transducer set range. You can assign up to eight transducer factors to each range, but only those whose characteristics (frequency range, unit) are compatible to the characteristics of the selected range.
- "Change Factor"
  Replaces the selected transducer factor with another one. The selected transducer factor is highlighted.
- "Remove Factor"
  Removes the selected transducer factor from the transducer set range.
- "Save Sets"
  Saves and stores the transducer set on the internal hard disk of the R&S EPL1000.

Remote command:
See Chapter 15.9.5, "Transducers", on page 569.

13.7.3 Reference: transducer factor file format

Transducer factor data can be exported to a file in ASCII (CSV) format for further evaluation in other applications. Transducer factors stored in the specified ASCII (CSV) format can also be imported to the R&S EPL1000 for other measurements.

For more information about transducer factors, see "Design and management of transducer factors" on page 305.

This reference describes in detail the format of the export/import files for transducer factors. Note that the **bold** data is **mandatory**, all other data is optional.

Different language versions of evaluation programs may require a different handling of the decimal point. Thus, you can define the decimal separator to be used (see "Decimal Separator" on page 193).

Table 13-1: ASCII file format for transducer factor files

File contents	Description
Header data	
sep=;	Separator for individual values (required by Microsoft Excel, for example)
Type;RS_TransducerFactor;	Type of data
FileFormatVersion;1.00;	File format version
Date;01.Oct 2006;	Date of data set storage
OptionID;SpectrumAnalyzer	Application the transducer factor was created for
Name;TestTDF1	Transducer factor name
Comment;Transducer for device A	Description of transducer factor

File contents	Description
XAxisScaling;LINEAR	Scaling of x-axis linear (LIN) or logarithmic (LOG)
YAxisUnit;LEVEL_DB	Unit of y values
YAxisScaleMode;ABSOLUTE	Scaling of y-axis (absolute or relative)
NoOfPoints;5	Number of points the line is defined by
Data section for individual data points	
100000000;-50.000000	**x- and y-values of each data point defining the line**
500000000;-30.000000	
1000000000;0.000000	
1500000000;-30.000000	
2500000000;-50.000000	

13.7.4 How to configure the transducer

Configuring the transducer is very similar to configuring transducer factors.

The transducer settings are defined in the "Transducer" dialog box which is displayed when you press the [Setup] key and then select "Transducer".

Stored transducer settings

When storing and recalling transducer settings, consider the information provided in "Saving and recalling transducer and limit line settings" on page 243.

The following tasks are described:

- "How to find compatible transducer lines" on page 309
- "How to activate and deactivate a transducer" on page 309
- "How to edit existing transducer lines" on page 310
- "How to copy an existing transducer line" on page 310
- "How to delete an existing transducer line" on page 310
- "How to configure a new transducer line" on page 311
- "How to move the transducer line vertically or horizontally" on page 311

How to find compatible transducer lines

► In the "Transducer" dialog box, select the "View Filter" option: "Show Compatible".

All transducer lines stored on the instrument that are compatible to the current measurement settings are displayed in the overview.

How to activate and deactivate a transducer

1. To activate a transducer select a transducer line in the overview and select the "Active" setting for it.

The trace is automatically recalculated for the next sweep after a transducer line is activated.

2. To deactivate a transducer line, deactivate the "Active" setting for it.

   After the next sweep, the originally measured values are displayed.

How to edit existing transducer lines

Existing transducer line configurations can be edited.

1. In the "Transducer" dialog box, select the transducer line.
2. Select the "Edit" button.
3. Edit the line configuration as described in "How to configure a new transducer line" on page 311.
4. Save the new configuration by selecting the "Save" button.

   The trace is automatically recalculated for the next sweep if the transducer line is active.

In order to store the changes to the transducer lines in a settings file, select the "Save" icon in the toolbar.

How to copy an existing transducer line

1. In the "Transducer" dialog box, select the transducer line.
2. Select the "Copy" button.

   The "Edit Transducer" dialog box is opened with the configuration of the selected transducer.
3. Define a new name to create a new transducer with the same configuration as the source line.
4. Edit the line configuration as described in "How to configure a new transducer line" on page 311.
5. Save the new configuration by selecting the "Save" button.

   The new transducer line is displayed in the overview and can be activated.

How to delete an existing transducer line

1. In the "Transducer" dialog box, select the transducer line.
2. Select the "Delete" button.
3. Confirm the message.

   The transducer line is deleted. After the next sweep, the originally measured values are displayed.

How to configure a new transducer line

1. In the "Transducer" dialog box, select the "New" button.

   The "Edit Transducer" dialog box is displayed. The current line configuration is displayed in the preview area of the dialog box. The preview is updated after each change to the configuration.

2. Define a "Name" and, optionally, a "Comment" for the new transducer line.

3. Define the scaling for the x-axis.

4. Define the data points: minimum 2, maximum 1001:

   a) Select "Insert Value".
   b) Define the x-value ("Position") and y-value ("Value") of the first data point.
   c) Select "Insert Value" again and define the second data point.
   d) Repeat this to insert all other data points.
   To insert a data point before an existing one, select the data point and then "Insert Value".
   To insert a new data point at the end of the list, move the focus to the line after the last entry and then select "Insert Value".
   To delete a data point, select the entry and then "Delete Value".

5. Check the current line configuration in the preview area of the dialog box. If necessary, correct individual data points or add or delete some.
   If necessary, shift the entire line vertically or horizontally by selecting the "Shift x" or "Shift y" button and defining the shift width.

6. Save the new configuration by selecting the "Save" button.

   The new transducer line is displayed in the overview and can be activated.

How to move the transducer line vertically or horizontally

A configured transducer line can easily be moved vertically or horizontally. Thus, a new transducer line can be easily generated based upon an existing transducer line which has been shifted.

1. In the "Line Config" dialog box, select the transducer line.

2. Select the "Edit" button.

3. In the "Edit Transducer Line" dialog box, select the "Shift x" or "Shift y" button and define the shift width.

4. Save the shifted data points by selecting the "Save" button.

   If activated, the trace is recalculated after the next sweep.

13.8 Alignment

13.8.1 Basics on alignment

When you put the instrument into operation for the first time or when strong temperature changes occur, align the data to a reference source (see "Temperature check" on page 313).

The firmware determines the correction data and characteristics required for the alignment. It compares the results at different settings with the known characteristics of the high-precision calibration signal source.

Basic operation of the R&S EPL1000 can be affected before or after a self-alignment in the following ways:

- Depending on the installation settings, an automatic self-alignment is performed directly after installation, and a dialog is displayed indicating how much warm-up time is still required before self-alignment can be performed.
- During instrument start, the firmware checks whether the installed hardware is supported. If not, an error message is displayed ("Wrong Firmware Version") and you are asked to update the firmware. Until the firmware version is updated, self-alignment fails.
- If you start a self-alignment remotely and then select the "Local" softkey while the alignment is still running, the instrument only returns to the manual operation state after the alignment is completed.
- During self-alignment, do not connect a signal to the RF input connector. Running a self-alignment with a signal connected to the RF input can lead to false measurement results.

Alignment results

The alignment results are displayed and contain the following information:

- Date and time of last correction data record
- Overall results of correction data record
- List of performed alignment steps

The results are classified as follows:

PASSED	Calibration successful without any restrictions
CHECK	Deviation of correction value larger than expected, correction could however be performed
FAILED	Deviations of correction value too large, no correction was possible. The found correction data is not applicable.

The results are available until the next self-alignment process is started or the instrument is switched off.

Temperature check

During self-alignment, the instrument's frontend temperature is measured (if activated, only after the instrument has warmed up completely, see "Await Warm-Up Operation before Self Alignment" on page 315). This temperature is used as a reference for a continuous temperature check during operation. If the current temperature deviates from the stored self-alignment temperature by a certain degree, a warning is displayed in the status bar. The warning indicates the resulting deviation in the measured power levels. A status bit in the `STATUs:QUEStionable:TEMPerature` register indicates a possible deviation. The current temperature of the frontend can be queried using a remote command (see `SOURce<si>:TEMPerature:FRONtend` on page 568).

Touchscreen alignment

When the device is delivered, the touchscreen is initially calibrated. However, to ensure that the touchscreen responds to the finger contact correctly, a touchscreen alignment is required.

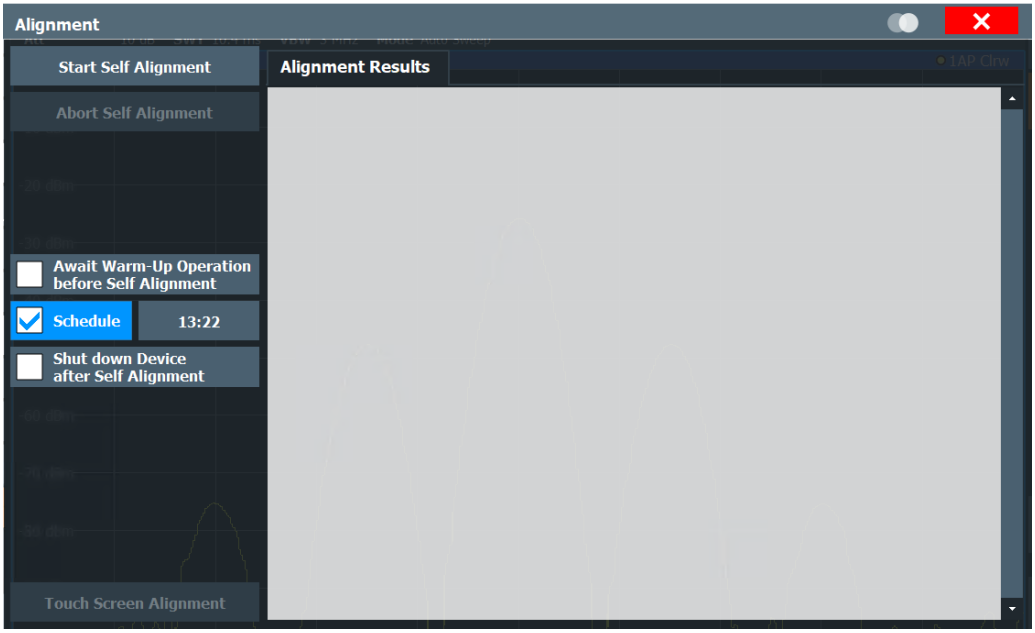
Alignment of the touchscreen is useful:

- At first use
- After an image update or after exchanging a hard disk
- If you notice that touching a specific point on the screen does not achieve the correct response
- If the position of the instrument has been changed and you cannot look straight on the screen
- If another person operates the instrument

13.8.2 Alignment settings

Access: [Setup] > "Alignment"

Both the instrument and the touchscreen can be aligned when necessary (see Chapter 13.8.1, "Basics on alignment", on page 312).



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Start Self Alignment
Starts recording correction data for the instrument. If the correction data acquisition fails or if the correction values are deactivated, a corresponding message is displayed in the status field.

For details, see Chapter 13.8.1, "Basics on alignment", on page 312.

Note:
A running Sequencer operation is aborted when you start a self-alignment.

During self-alignment, do not connect a signal to the RF input connector. Running a self-alignment with a signal connected to the RF input can lead to false measurement results.

Remote command:
`*CAL?` on page 370, see also `CALibration[:ALL]?` on page 563

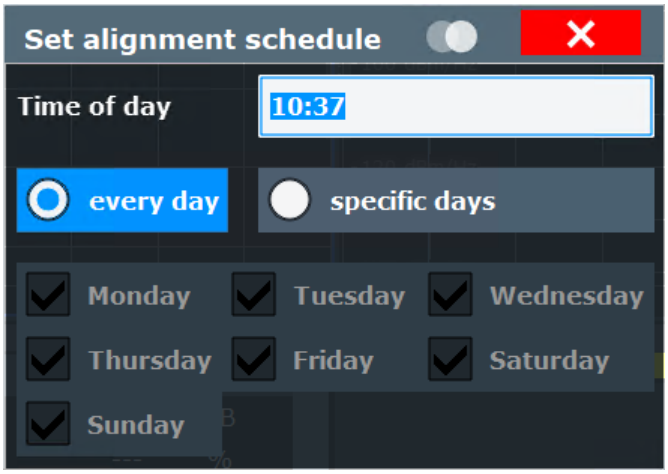
Abort Self Alignment
As long as the self-alignment data is being collected, the procedure can be canceled using the "Abort Self Alignment" button.

Note: If you start a self-alignment remotely, then select the "Local" softkey while the alignment is still running, the instrument only returns to the manual operation state after the alignment is completed. In this case, you cannot abort a self-alignment manually.

Await Warm-Up Operation before Self Alignment
Displays a message indicating the remaining warmup time required before self-alignment is performed. After the warmup operation has completed, self-alignment is started automatically.

Remote command:
`CALibration:DUE:WARMup` on page 564

Schedule
If enabled, a self-alignment is performed regularly at specific days and time.



Remote command:
`CALibration:DUE:SCHedule` on page 565
`CALibration:DUE:DAYS` on page 565
`CALibration:DUE:TIME` on page 566

Shut down Device after Self Alignment
If activated, the R&S EPL1000 is automatically shut down after self-alignment is completed. Note that the instrument cannot be restarted via remote control.

Remote command:
`CALibration:DUE:SHUTdown` on page 566

Starting Touch Screen Alignment
Starts the touchscreen alignment.

Tap the 4 markers on the screen as you are asked to do. The touchscreen is aligned according to the executed pointing operations.

Alignment Results:
Information on whether the alignment was performed successfully and on the applied correction data is displayed. The results are available until the next self-alignment process is started or the instrument is switched off.

Remote command:
`CALibration:RESult?` on page 564

13.8.3 How to perform a self-test

You do not have to repeat the self-test every time you switch on the instrument. It is only necessary when instrument malfunction is suspected.

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

1. Select [SETUP].
2. Select "Service".
3. Select "Selftest".

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

13.8.4 How to align the instrument

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

To perform a self-alignment

Make sure no signal is connected to the RF input connector. Running a self-alignment with a signal connected to the RF input can lead to false measurement results.

1. Select [SETUP].
2. Select "Alignment".
3. Select "Start Self Alignment".
4. To abort the self-alignment process, select "Abort Self Alignment".

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

To display the alignment results again later

► Select [SETUP] > "Alignment".

13.8.5 How to align the touchscreen

To align the touchscreen

1. Press the [Setup] key.
2. Select the "Alignment" softkey.
3. Select "Touch Screen Alignment".

   A blinking cross appears in the lower left corner of the screen.
4. Touch and hold the blinking cross until it stops blinking.
   Repeat this action for the crosses in the other corners.

14 Network operation and remote control

In addition to working with the R&S EPL1000 interactively, located directly at the instrument, it is also possible to operate and control it from a remote PC. Various methods for remote operation 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

Basic information on operating the R&S EPL1000 via remote control is provided here. This information applies to all applications and operating modes on the R&S EPL1000.

For additional information on remote control of spectrum analyzers see the following documents available from the Rohde & Schwarz website:

- Remote control via SCPI
- 1EF62: Hints and Tricks for Remote Control of Spectrum and Network Analyzers
- 1MA171: How to use Rohde & Schwarz Instruments in MATLAB
- 1MA208: Fast Remote Instrument Control with HiSLIP

How to configure the remote control interfaces is described in Chapter 14.5, "How to set up a network and remote control", on page 347.

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- The IECWIN tool....337
- Network and remote control settings....338
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14.1 Remote control interfaces and protocols

The instrument supports different interfaces and protocols for remote control. The following table gives an overview.

For a description of the protocols refer to Remote control via SCPI.

Table 14-1: Remote control interfaces and protocols

Interface	Protocols, VISA*) address string	Port **)	Remarks
Local Area Network (LAN)	**HiSLIP** High-Speed LAN Instrument Protocol (IVI-6.1) `TCPIP::host address::hislip0[::INSTR]`	TCP port: 4880	A LAN connector is located on the rear panel of the instrument.
	VXI-11 `TCPIP::host address::inst0[::INSTR]` Library: VISA	TCP or UDP port: 111 TCP port: well-known ports (600 - 1023) for Linux or registered ports (1024 - 49151) for Windows	
	socket communication (Raw Ethernet, simple Telnet) `TCPIP::host address[::LAN device name]::<port>::SOCKET` Library: VISA or socket controller	SCPI raw, TCP port: 5025, 5125 SCPI telnet, TCP port: 5024, 5124	
	VNC	via VNC client: 5800/5900 Device web: 5850	
	Device web / web control	80	
GPIB (IEC/IEEE Bus Interface)	VISA*) address string: `GPIB::primary address[::INSTR]` (no secondary address)		

*) VISA is a standardized software interface library providing input and output functions to communicate with instruments. A VISA installation on the controller is a prerequisite for remote control using the indicated interfaces.

**) By default, R&S EPL1000 use these ports for communication via LAN control interface. If necessary, adapt your firewall to allow for use of these ports.

Within this interface description, the term GPIB is used as a synonym for the IEC/IEEE bus interface.

14.1.1 LAN interface

To be integrated in a LAN, the instrument is equipped with a LAN interface, consisting of a connector, a network interface card and protocols. The network card can be operated with the following interfaces:

- 10 Mbit/s Ethernet IEEE 802.3
- 100 Mbit/s Ethernet IEEE 802.3u
- 1Gbit/s Ethernet IEEE 802.3ab

For remote control via a network, the PC and the instrument must be connected via the LAN interface to a common network with TCP/IP network protocol. They are connected using a commercial RJ45 cable (shielded or unshielded twisted pair category 5). The TCP/IP network protocol and the associated network services are preconfigured on the instrument. Software for instrument control and the VISA program library must be installed on the controller.

IP address

Only the IP address or a valid DNS host name is required to set up the connection. The host address is part of the "VISA resource string" used by the programs to identify and control the instrument.

The VISA resource string has the form:

```
TCPIP::host address[::LAN device name][::INSTR]
```

or

```
TCPIP::host address::port::SOCKET
```

where:

- **TCPIP** designates the network protocol used
- **host address** is the IP address or host name of the device
- **LAN device name** defines the protocol and the instance number of a subinstrument;
  - `inst0` selects the VXI-11 protocol (default)
  - `hislip0` selects the HiSLIP protocol
- **INSTR** indicates the instrument resource class (optional)
- **port** determines the used port number
- **SOCKET** indicates the raw network socket resource class

Example:

- Instrument has the IP address *192.1.2.3*; the valid resource string using VXI-11 protocol is:
  `TCPIP::192.1.2.3::INSTR`
- The DNS host name is *EPL1004-123456*; the valid resource string using HiSLIP is:
  `TCPIP::EPL1004-123456::hislip0`
- A raw socket connection can be established using:
  `TCPIP::192.1.2.3::5025::SOCKET`

Identifying instruments in a network

If several instruments are connected to the network, each instrument has its own IP address and associated resource string. The controller identifies these instruments by the resource string.

For details on configuring the LAN connection, see Chapter 14.5.1, "How to configure a network", on page 347.

- LAN web browser interface 320

14.1.1.1 LAN web browser interface

The LAN web browser interface allows for easy configuration of the LAN and remote control of the R&S EPL1000 without additional installation requirements.

The instrument's LAN web browser interface works correctly with all W3C compliant browsers.

Via the web browser interface to the R&S EPL1000 you can control the instrument remotely from another PC. Manual instrument controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available. Using this feature, several users can access *and operate* the R&S EPL1000 simultaneously. This is useful for troubleshooting or training purposes.

For details, see Chapter 14.5.1.4, "How to configure the LAN using the web browser interface", on page 352 and Chapter 14.5.5, "How to control the R&S EPL1000 via the web browser interface", on page 357.

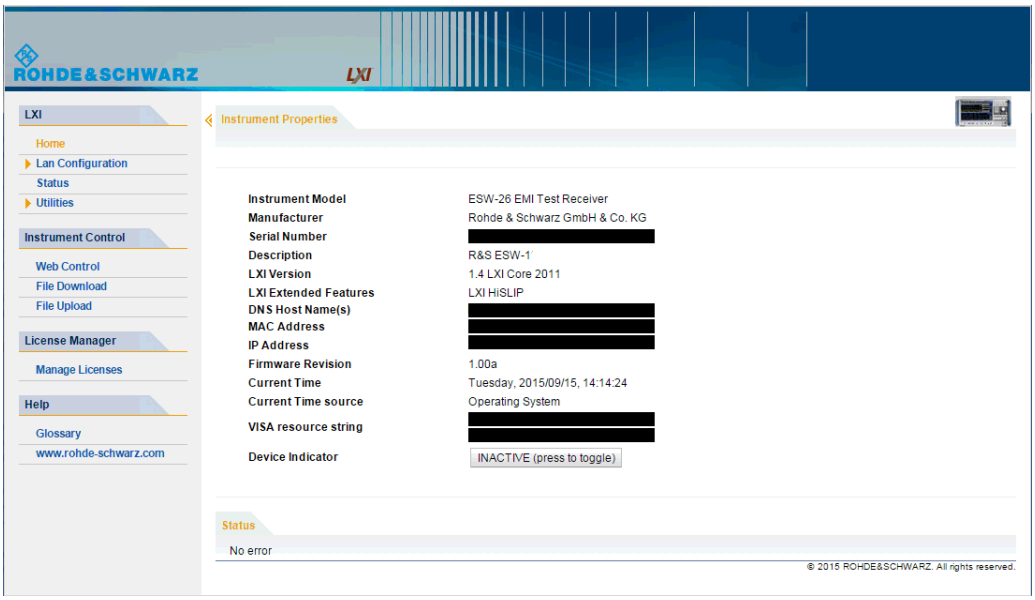
If you do not want other users in the LAN to be able to access and operate the R&S EPL1000 you can deactivate this function.

See Chapter 14.5.6, "How to deactivate the web browser interface", on page 359.

To display the LAN web browser interface

► In the address field of the browser on your PC, type the host name or IP address of the instrument, for example: *http://10.113.10.203*.

The instrument home page (welcome page) opens.



The navigation pane of the browser interface contains the following elements:

- "LAN"
  - "Home" opens the instrument home page.
    The home page displays device information, including the VISA resource string in read-only format.
    The "Device Indicator" button allows you to physically identify the instrument. This is useful if you have several instruments and want to know which instru-

ment the LAN home page belongs to. To identify the instrument, activate the "Device Indicator". Then check the "LAN Status" indicator of the instruments.

  - "LAN Configuration" allows you to configure LAN parameters and to initiate a ping.
    (See "Ping client" on page 353.)
  - "Utilities" provides access to an event log.
- "Instrument Control"
  - "Web Control" provides remote access to the instrument via VNC (no installation required). Manual instrument controls are available via the front panel simulation.
  - "File Download" downloads files from the instrument.
  - "File Upload" uploads files to the instrument.

  (See Chapter 14.5.5, "How to control the R&S EPL1000 via the web browser interface", on page 357.)
- "License Manager"
  - "License Manager" allows you to install or uninstall license keys and to activate, register or unregister licenses.
- "Help"
  "www.rohde-schwarz.com" opens the Rohde & Schwarz home page.

14.1.2 GPIB interface (IEC 625/IEEE 418 bus interface)

By connecting a PC to the R&S EPL1000 via the GPIB connection you can send remote commands to control and operate the instrument.

To be able to control the instrument via the GPIB bus, the instrument and the controller must be linked by a GPIB bus cable. A GPIB bus card, the card drivers and the program libraries for the programming language used must be provided in the controller. The controller must address the instrument with the GPIB bus address (see Chapter 14.5.1.5, "How to change the GPIB instrument address", on page 354). You can set the GPIB address and the ID response string. The GPIB language is set as SCPI by default and cannot be changed for the R&S EPL1000.

Notes and Conditions

In connection with the GPIB interface, note the following:

- Up to 15 instruments can be connected
- The total cable length is restricted to a maximum of 15 m or 2 m times the number of devices, whichever is less; the cable length between two instruments should not exceed 2 m.
- A wired "OR"-connection is used if several instruments are connected in parallel.
- Any connected IEC-bus cables should be terminated by an instrument or controller.

14.2 Status reporting system

The status reporting system stores all information on the current operating state of the instrument, and on errors which have occurred. This information is stored in the status registers and in the error queue. Both can be queried via GPIB bus or LAN interface using the `STATus...` commands.

(See Chapter 15.9.11, "Using the status register", on page 598).

For details on the status reporting system, see Remote control via SCPI.

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- Contents of the status registers 324
- Reset values of the status reporting system 336

14.2.1 Hierarchy of status registers

As shown in the following figure, the status information is of hierarchical structure.

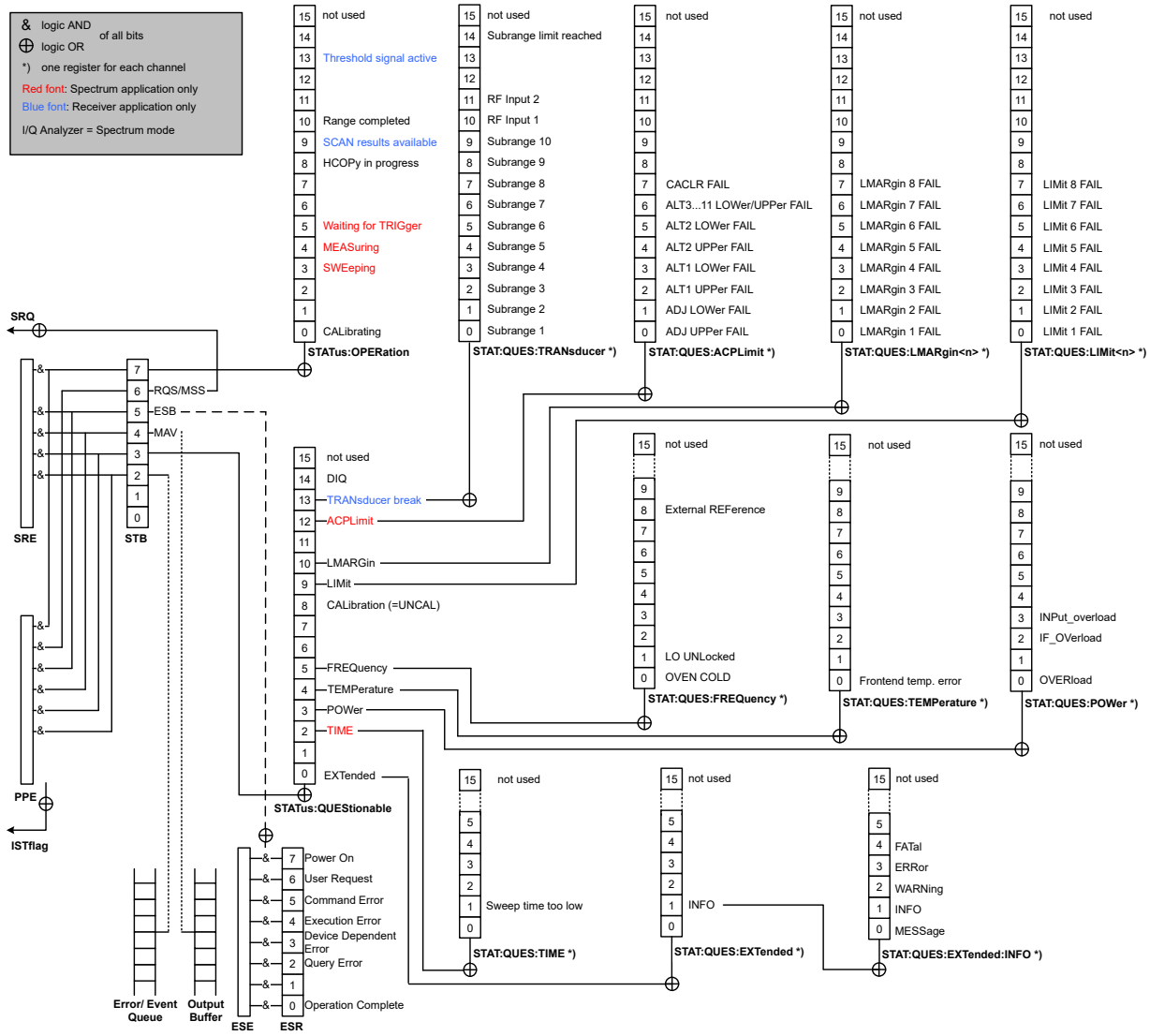


Figure 14-1: Graphical overview of the R&S EPL1000 status registers hierarchy

All status registers have the same internal structure.

14.2.2 Contents of the status registers

In the following sections, the contents of the status registers are described in more detail.

STATus:QUEStionable:SYNC register

The `STATus:QUEStionable:SYNC` register is used by the R&S EPL1000 applications and is described in the individual sections (manuals) for each application.

- Status byte (STB) and service request enable register (SRE)....325
- IST flag and parallel poll enable register (PPE)....326
- Event status register (ESR) and event status enable register (ESE)....326
- STATus:OPERation register....327
- STATus:QUEStionable register....328
- STATus:QUEStionable:ACPLimit register....329
- STATus:QUEStionable:EXTended register....330
- STATus:QUEStionable:EXTended:INFO register....331
- STATus:QUEStionable:FREQuency register....331
- STATus:QUEStionable:LIMit register....332
- STATus:QUEStionable:LMARgin register....332
- STATus:QUEStionable:POWer register....333
- STATus:QUEStionable:TEMPerature register....334
- STATus:QUEStionable:TIMe register....334
- STATus:QUEStionable:TRANsducer register....335

14.2.2.1 Status byte (STB) and service request enable register (SRE)

The `STatus Byte` (STB) is already defined in IEEE 488.2. It provides a rough overview of the instrument status by collecting the pieces of information of the lower registers. A special feature is that bit 6 acts as the sum bit of the remaining bits of the status byte.

The STB can thus be compared with the `CONDition` part of an SCPI register and assumes the highest level within the SCPI hierarchy.

The STB is read using the command `*STB?` or a serial poll.

The `STatus Byte` (STB) is linked to the `Service Request Enable` (SRE) register. Each bit of the STB is assigned a bit in the SRE. Bit 6 of the SRE is ignored. If a bit is set in the SRE and the associated bit in the STB changes from 0 to 1, a service request (SRQ) is generated. The SRE can be set using the command `*SRE` and read using the command `*SRE?`.

Table 14-2: Meaning of the bits used in the status byte

Bit No.	Meaning
0...1	Not used
2	Error Queue not empty The bit is set when an entry is made in the error queue. If this bit is enabled by the SRE, each entry of the error queue generates a service request. Thus an error can be recognized and specified in greater detail by polling the error queue. The poll provides an informative error message. This procedure is to be recommended since it considerably reduces the problems involved with remote control.
3	QUEStionable status register summary bit The bit is set if an `EVENt` bit is set in the `QUEStionable` status register and the associated `ENABle` bit is set to 1. A set bit indicates a questionable instrument status, which can be specified in greater detail by querying the `STATus:QUEStionable` status register.
4	MAV bit (message available) The bit is set if a message is available in the output queue which can be read. This bit can be used to enable data to be automatically read from the instrument to the controller.

Bit No.	Meaning
5	ESB bit Sum bit of the event status register. It is set if one of the bits in the event status register is set and enabled in the event status enable register. Setting of this bit indicates a serious error which can be specified in greater detail by polling the event status register.
6	MSS bit (main status summary bit) The bit is set if the instrument triggers a service request. This is the case if one of the other bits of this registers is set together with its mask bit in the service request enable register SRE.
7	`STATus:OPERation` status register summary bit The bit is set if an `EVENt` bit is set in the `OPERation` status register and the associated `ENABle` bit is set to 1. A set bit indicates that the instrument is just performing an action. The type of action can be determined by querying the `STATus:OPERation` status register.

14.2.2.2 IST flag and parallel poll enable register (PPE)

As with the SRQ, the IST flag combines the entire status information in a single bit. It can be read by means of a parallel poll or using the command `*IST?`.

The parallel poll enable register (PPE) determines which bits of the STB contribute to the IST flag. The bits of the STB are "ANDed" with the corresponding bits of the PPE, with bit 6 being used as well in contrast to the SRE. The IST flag results from the "ORing" of all results. The PPE can be set using commands `*PRE` and read using command *PRE?.

14.2.2.3 Event status register (ESR) and event status enable register (ESE)

The ESR is defined in IEEE 488.2. It can be compared with the `EVENt` part of a SCPI register. The event status register can be read out using command `*ESR?`.

The ESE corresponds to the `ENABle` part of a SCPI register. If a bit is set in the ESE and the associated bit in the ESR changes from 0 to 1, the ESB bit in the STB is set. The ESE register can be set using the command `*ESE` and read using the command `*ESE?`.

Table 14-3: Meaning of the bits used in the event status register

Bit No.	Meaning
0	Operation Complete This bit is set on receipt of the command *OPC exactly when all previous commands have been executed.
1	Not used
2	Query Error This bit is set if either the controller wants to read data from the instrument without having sent a query, or if it does not fetch requested data and sends new instructions to the instrument instead. The cause is often a query which is faulty and hence cannot be executed.

Bit No.	Meaning
3	Device-dependent Error This bit is set if a device-dependent error occurs. An error message with a number between -300 and -399 or a positive error number, which denotes the error in greater detail, is entered into the error queue.
4	Execution Error This bit is set if a received command is syntactically correct but cannot be performed for other reasons. An error message with a number between -200 and -300, which denotes the error in greater detail, is entered into the error queue.
5	Command Error This bit is set if a command is received, which is undefined or syntactically incorrect. An error message with a number between -100 and -200, which denotes the error in greater detail, is entered into the error queue.
6	User Request This bit is set when the instrument is switched over to manual control.
7	Power On (supply voltage on) This bit is set on switching on the instrument.

14.2.2.4 STATus:OPERation register

The `STATus:OPERation` register contains information on current activities of the R&S EPL1000. It also contains information on activities that have been executed since the last read out.

Table 14-4: Meaning of the bits used in the STATus:OPERation register

Bit No.	Meaning
0	`CALibrating` This bit is set as long as the instrument is performing a calibration.
1-2	Not used
3	`SWEeping` Sweep is being performed in base unit (applications are not considered); identical to bit 4 Available in the Spectrum application.
4	`MEASuring` Measurement is being performed in base unit (applications are not considered); identical to bit 3 Available in the Spectrum application.
5	`Waiting for TRIgger` Instrument is ready to trigger and waiting for trigger signal. Available in the Spectrum application.
6-7	Not used
8	`HardCOPy` in progress This bit is set while the instrument is printing a hardcopy.

Bit No.	Meaning
9	SCAN results available This bit is set when a block of scan results is available. Must be enabled by TRAC:FEED:CONTALWays. Available in the Receiver application.
10	Range completed In the Spectrum application, this bit is set when a range in the sweep list has been completed if "Stop after Range" has been activated. In the Receiver application, this bit is set when the end of a scan range has been reached. To resume the scan, use INITiate:CONMeas.
11-12	Not used
13	Threshold signal active Available for the Receiver application.
14	Not used
15	This bit is always 0.

14.2.2.5 STATus:QUEStionable register

The STATus:QUEStionable register contains information on instrument states that do not meet the specifications.

You can read out the register with STAT:QUES:COND or STAT:QUES:EVEN.

The STATus:QUEStionable register "sums up" the information from all subregisters (e.g. bit 2 sums up the information for all STATus:QUEStionable:TIMe registers). For some subregisters, there may be separate registers for each active channel. Thus, if a status bit in the STATus:QUEStionable register indicates an error, the error may have occurred in any of the channel-specific subregisters. In this case, you must check the subregister of each channel to determine which channel caused the error. By default, querying the status of a subregister always returns the result for the currently selected channel.

Table 14-5: Meaning of the bits used in the STATus:QUEStionable register

Bit No.	Meaning
0 - 1	Unused
2	TIMe This bit is set if a time error occurs in any of the active channels. The STATus:QUEStionable:TIMe register provides more information on the error type. Available in the Spectrum application.
3	POWer This bit is set if the measured power level in any of the active channels is questionable. The STATus:QUEStionable:POWer register provides more information on the error type.

Bit No.	Meaning
4	TEMPerature This bit is set if the temperature is questionable.
5	FREQuency This bit is set if there is anything wrong with the frequency of the local oscillator or the reference frequency in any of the active channels. The STATus:QUEStionable:FREQuency register provides more information on the error type.
6 - 7	Unused
8	CALibration This bit is set if the R&S EPL1000 is unaligned ("UNCAL" display)
9	LIMit This bit is set if a limit value is violated in any of the active channels in any window. The STATus:QUEStionable:LIMit register provides more information on the error type.
10	LMARgin This bit is set if a margin is violated in any of the active channels in any window. The STATus:QUEStionable:LMARgin register provides more information on the error type.
11	SYNC (device-specific) This bit is set if the R&S EPL1000 is not synchronized to the signal that is applied. The R&S EPL1000 is not synchronized if the results deviate too much from the expected value during premeasurements
12	ACPLimit This bit is set if a limit during ACLR measurements is violated in any of the active channels. The STATus:QUEStionable:ACPLimit register provides more information on the error type. Available in the Spectrum application.
13	TRANsducer break This bit is set if a transducer break occurs and indicates the next range. The Chapter 14.2.2.15, "STATus:QUEStionable:TRANsducer register", on page 335 provides more information on the error type.
14	Unused
15	This bit is always 0.

14.2.2.6 STATus:QUEStionable:ACPLimit register

Available for the Spectrum application.

The STATus:QUEStionable:ACPLimit register contains information about the results of a limit check during ACLR measurements. A separate ACPLimit register exists for each active channel.

You can read out the register with `STATus:QUEStionable:ACPLimit:CONDition?` or `STATus:QUEStionable:ACPLimit[:EVENt]?`

Table 14-6: Meaning of the bits used in the STATus:QUEStionable:ACPLimit register

Bit No.	Meaning
0	ADJ UPPer FAIL This bit is set if the limit is exceeded in the **upper adjacent** channel
1	ADJ LOWer FAIL This bit is set if the limit is exceeded in the **lower adjacent** channel.
2	ALT1 UPPer FAIL This bit is set if the limit is exceeded in the **upper 1st alternate** channel.
3	ALT1 LOWer FAIL This bit is set if the limit is exceeded in the **lower 1st alternate** channel.
4	ALT2 UPPer FAIL This bit is set if the limit is exceeded in the **upper 2nd alternate** channel.
5	ALT2 LOWer FAIL This bit is set if the limit is exceeded in the **lower 2nd alternate** channel.
6	ALT3 … 11 LOWer/UPPer FAIL This bit is set if the limit is exceeded in one of the lower or upper alternate channels 3 … 11.
7	CACLR FAIL This bit is set if the CACLR limit is exceeded in one of the gap channels.
8-14	Unused
15	This bit is always 0.

14.2.2.7 STATus:QUEStionable:EXTended register

The `STATus:QUEStionable:EXTended` register contains further status information not covered by the other status registers of the R&S EPL1000. A separate `EXTended` register exists for each active channel.

You can read out the register with `STATus:QUEStionable:EXTended:CONDition?` or `STATus:QUEStionable:EXTended[:EVENt]?`

Table 14-7: Meaning of the bits used in the STATus:QUEStionable:EXTended register

Bit No.	Meaning
0	not used
1	INFO This bit is set if a status message is available for the application. Which type of message occurred is indicated in the STATus:QUEStionable:EXTended:INFO register.
2 to 14	Unused
15	This bit is always 0.

14.2.2.8 STATus:QUEStionable:EXTended:INFO register

The `STATus:QUEStionable:EXTended:INFO` register contains information on the type of messages that occur during operation of the R&S EPL1000. A separate `INFO` register exists for each active channel.

You can read out the register with `STATus:QUEStionable:EXTended:INFO:CONDition?` or `STATus:QUEStionable:EXTended:INFO[:EVENt]?`. You can query all messages that occur for a specific channel using the command `SYSTem:ERRor:EXTended?` on page 593.

Table 14-8: Meaning of the bits used in the STATus:QUEStionable:EXTended:INFO register

Bit No.	Meaning
0	MESSage This bit is set if event or state has occurred that may lead to an error during further operation.
1	INFO This bit is set if an informational status message is available for the application.
2	WARNing This bit is set if an irregular situation occurs during measurement, e.g. the settings no longer match the displayed results, or the connection to an external device was interrupted temporarily.
3	ERRor This bit is set if an error occurs during a measurement, e.g. due to missing data or wrong settings, so that the measurement cannot be completed correctly.
4	FATal This bit is set if a serious error occurs in the application and regular operation is no longer possible.
5 to 14	Unused
15	This bit is always 0.

14.2.2.9 STATus:QUEStionable:FREQuency register

The STATus:QUEStionable:FREQuency register contains information about the condition of the local oscillator and the reference frequency. A separate frequency register exists for each active channel.

You can read out the register with `STATus:QUEStionable:FREQuency:CONDition?` or `STATus:QUEStionable:FREQuency[:EVENt]?`.

Table 14-9: Meaning of the bits used in the STATus:QUEStionable:FREQuency register

Bit No.	Meaning
0	OVEN COLD This bit is set if the reference oscillator has not yet attained its operating temperature. "OCXO" is displayed.
1	LO UNLocked This bit is set if the local oscillator no longer locks. "LOUNL" is displayed.
2 to 7	Not used

Bit No.	Meaning
8	EXTernalREFerence This bit is set if you have selected an external reference oscillator but did not connect a useable external reference source. In that case the synthesizer can not lock. The frequency in all probability is not accurate.
9 to 14	Not used
15	This bit is always 0.

14.2.2.10 STATus:QUEStionable:LIMit register

The STATus:QUEStionable:LIMit register contains information about the results of a limit check when you are working with limit lines.

A separate LIMit register exists for each active channel and for each window.

Table 14-10: Meaning of the bits used in the STATus:QUEStionable:LIMit register

Bit No.	Meaning
0	LIMit 1 FAIL This bit is set if limit line 1 is violated.
1	LIMit 2 FAIL This bit is set if limit line 2 is violated.
2	LIMit 3 FAIL This bit is set if limit line 3 is violated.
3	LIMit 4 FAIL This bit is set if limit line 4 is violated.
4	LIMit 5 FAIL This bit is set if limit line 5 is violated.
5	LIMit 6 FAIL This bit is set if limit line 6 is violated.
6	LIMit 7 FAIL This bit is set if limit line 7 is violated.
7	LIMit 8 FAIL This bit is set if limit line 8 is violated.
8 to 14	Unused
15	This bit is always 0.

14.2.2.11 STATus:QUEStionable:LMARgin register

This register contains information about the observance of limit margins.

A separate LMARgin register exists for each active channel and for each window.

It can be read using the commands
`STATus:QUEStionable:LMARgin:CONDition?` and
`STATus:QUEStionable:LMARgin[:EVENt]?`.

Table 14-11: Meaning of the bits used in the STATus:QUEStionable:LMARgin register

Bit No.	Meaning
0	LMARgin 1 FAIL This bit is set if limit margin 1 is violated.
1	LMARgin 2 FAIL This bit is set if limit margin 2 is violated.
2	LMARgin 3 FAIL This bit is set if limit margin 3 is violated.
3	LMARgin 4 FAIL This bit is set if limit margin 4 is violated.
4	LMARgin 5 FAIL This bit is set if limit margin 5 is violated.
5	LMARgin 6 FAIL This bit is set if limit margin 6 is violated.
6	LMARgin 7 FAIL This bit is set if limit margin 7 is violated.
7	LMARgin 8 FAIL This bit is set if limit margin 8 is violated.
8 to 14	Not used
15	This bit is always 0.

14.2.2.12 STATus:QUEStionable:POWer register

The `STATus:QUEStionable:POWer` register contains information about possible overload situations that may occur during operation of the R&S EPL1000. A separate power register exists for each active channel.

You can read out the register with `STATus:QUEStionable:POWer:CONDition?` or `STATus:QUEStionable:POWer[:EVENt]?`

Table 14-12: Meaning of the bits used in the STATus:QUEStionable:POWer register

Bit No.	Meaning
0	OVERload This bit is set if an overload occurs at the RF input, causing signal distortion but not yet causing damage to the device. The R&S EPL1000 displays the keyword "RF OVLD".
1	Unused

Bit No.	Meaning
2	IF_OVerload This bit is set if an overload occurs in the IF path. The R&S EPL1000 displays the keyword "IF OVLD".
3	Input Overload This bit is set if the signal level at the RF input connector exceeds the maximum. The RF input is disconnected from the input mixer to protect the device. In order to re-enable measurement, decrease the level at the RF input connector and reconnect the RF input to the mixer input. The R&S EPL1000 displays the keyword "INPUT OVLD". (Available in the Spectrum application.)
4 to 14	Unused
15	This bit is always 0.

14.2.2.13 STATus:QUEStionable:TEMPerature register

The STATus:QUEStionable:TEMPerature register contains information about possible temperature deviations that may occur during operation of the R&S EPL1000. A separate temperature register exists for each active channel.

You can read out the register with `STATus:QUEStionable:TEMPerature:CONDition?` or `STATus:QUEStionable:TEMPerature[:EVENt]?`

Table 14-13: Meaning of the bits used in the STATus:QUEStionable:TEMPerature register

Bit No.	Meaning
0	This bit is set if the frontend temperature sensor deviates by a certain degree from the self-alignment temperature. During warmup, this bit is always 1. For details see "Temperature check" on page 313.
1 to 14	Unused
15	This bit is always 0.

14.2.2.14 STATus:QUEStionable:TIMe register

Available for the Spectrum application.

The `STATus:QUEStionable:TIMe` register contains information about possible time errors that may occur during operation of the R&S EPL1000. A separate time register exists for each active channel.

Table 14-14: Meaning of the bits used in the STATus:QUEStionable:TIMe register

Bit No.	Meaning
0	not used
1	Sweep time too low This bit is set if the sweep time is too low.

Bit No.	Meaning
2 to 14	Unused
15	This bit is always 0.

14.2.2.15 STATus:QUEStionable:TRANsducer register

Available for the Receiver application.

The STATus:QUEStionable:TRANsducer register contains information about the state and condition of measurements with transducer sets. A separate TRANsducer register exists for each active channel.

It indicates that a transducer break has been reached. It also indicates the next range that is to be swept. You can continue the sweep with `INITiate<n>:CONMeas` on page 379.

You can read out the register with `STATus:QUEStionable:TRANsducer:CONDition?` or `STATus:QUEStionable:TRANsducer[:EVENt]?` on page 600.

Table 14-15: Meaning of the bits used in the STATus:QUEStionable:ACPLimit register

Bit No.	Meaning
0	Range 1 This bit is set if subrange 1 has been reached.
1	Range 2 This bit is set if subrange 2 has been reached.
2	Range 3 This bit is set if subrange 3 has been reached.
3	Range 4 This bit is set if subrange 4 has been reached.
4	Range 5 This bit is set if subrange 5 has been reached.
5	Range 6 This bit is set if subrange 6 has been reached.
6	Range 7 This bit is set if subrange 7 has been reached.
7	Range 8 This bit is set if subrange 8 has been reached.
8	Range 9 This bit is set if subrange 9 has been reached.
9	Range 10 This bit is set if subrange 10 has been reached.
10	RF Input 1 This bit is set if the transducer has been assigned to RF input 1.

Bit No.	Meaning
11	RF Input 2 This bit is set if the transducer has been assigned to RF input 2.
12 to 13	Unused
14	Subrange limit This bit is set when the transducer is at the point of changeover from one subrange to another.
15	This bit is always 0.

14.2.3 Reset values of the status reporting system

The following table contains the different commands and events causing the status reporting system to be reset. None of the commands, except `*RST` and `SYSTem:PRESet`, influence the functional instrument settings. In particular, `DCL` does not change the instrument settings.

Table 14-16: Resetting the status reporting system

Event	Switching on supply voltage Power-On-Status-Clear		DCL, SDC (Device Clear, Selected Device Clear)	*RST or SYS-Tem:PRE Set	STA-Tus:PRE-Set	*CLS
Effect	0	1				
Clear STB, ESR	-	yes	-	-	-	yes
Clear SRE, ESE	-	yes	-	-	-	-
Clear PPE	-	yes	-	-	-	-
Clear EVENt parts of the registers	-	yes	-	-	-	yes
Clear ENABle parts of all OPERation and QUEStionable registers; Fill ENABle parts of all other registers with "1".	-	yes	-	-	yes	-
Fill PTRansition parts with "1"; Clear NTRansition parts	-	yes	-	-	yes	-
Clear error queue	yes	yes	-	-	-	yes
Clear output buffer	yes	yes	yes	1)	1)	1)
Clear command processing and input buffer	yes	yes	yes	-	-	-
1) The first command in a command line that immediately follows a <PROGRAM MESSAGE TERMINATOR> clears the output buffer.						

14.3 The IECWIN tool

The R&S EPL1000 is delivered with *IECWIN* installed, an auxiliary tool provided free of charge by R&S. IECWIN is a program to send SCPI commands to a measuring instrument either interactively or from a command script.

The R&S IECWIN32 tool is provided free of charge. The functionality may change in a future version without notice.

IECWIN offers the following features:

- Connection to instrument via several interfaces/protocols (GPIB, VISA, named pipe (if IECWIN is run on the instrument itself), RSIB)
- Interactive command entry
- Browsing available commands on the instrument
- Error checking following every command
- Execution of command scripts
- Storing binary data to a file
- Reading binary data from a file
- Generation of a log file

For command scripts, IECWIN offers the following features:

- Synchronization with the instrument on every command
- Checking expected result for query commands (as string or numeric value)
- Checking for expected errors codes
- Optional pause on error
- Nested command scripts
- Single step mode
- Conditional execution, based on the *IDN and *OPT strings

You can use the IECWIN to try out the programming examples provided in the R&S EPL1000 User Manuals.

Starting IECWIN

IECWIN is available from the Windows "Start" menu on the R&S EPL1000, or by executing the following file:

`C:\ProgramData\Rohde-Schwarz\ZNL-FPL\iecwin32.exe`

You can also copy the program to any Windows PC or laptop. Simply copy the `iecwin32.exe`, `iecwin.chm` and `rsib32.dll` files from the location above to the same folder on the target computer.

When the tool is started, a "Connection settings" dialog box is displayed. Define the connection from the computer the IECWIN tool is installed on to the R&S EPL1000 you want to control. If you are using the tool directly on the R&S EPL1000, you can use an

NT Pipe (COM Parser) connection, which requires no further configuration. For help on setting up other connection types, check the tool's online help (by clicking the "Help" button in the dialog box).

The IECWIN offers an online help with extensive information on how to work with the tool.

14.4 Network and remote control settings

Access: [SETUP] > "Network + Remote"

The remote commands required to define these settings are described in Chapter 15.9.8, "Network and remote control configuration", on page 586.

Step-by-step instructions are provided in Chapter 14.5, "How to set up a network and remote control", on page 347.

- General network settings 338
- Remote settings 340
- LAN settings 343
- Remote errors 345
- Returning to manual mode ("local") 346

14.4.1 General network settings

Access: [SETUP] > "Network + Remote" > "Network" tab

The R&S EPL1000 can be operated in a local area network (LAN), for example to control the instrument from a remote PC or use a network printer.

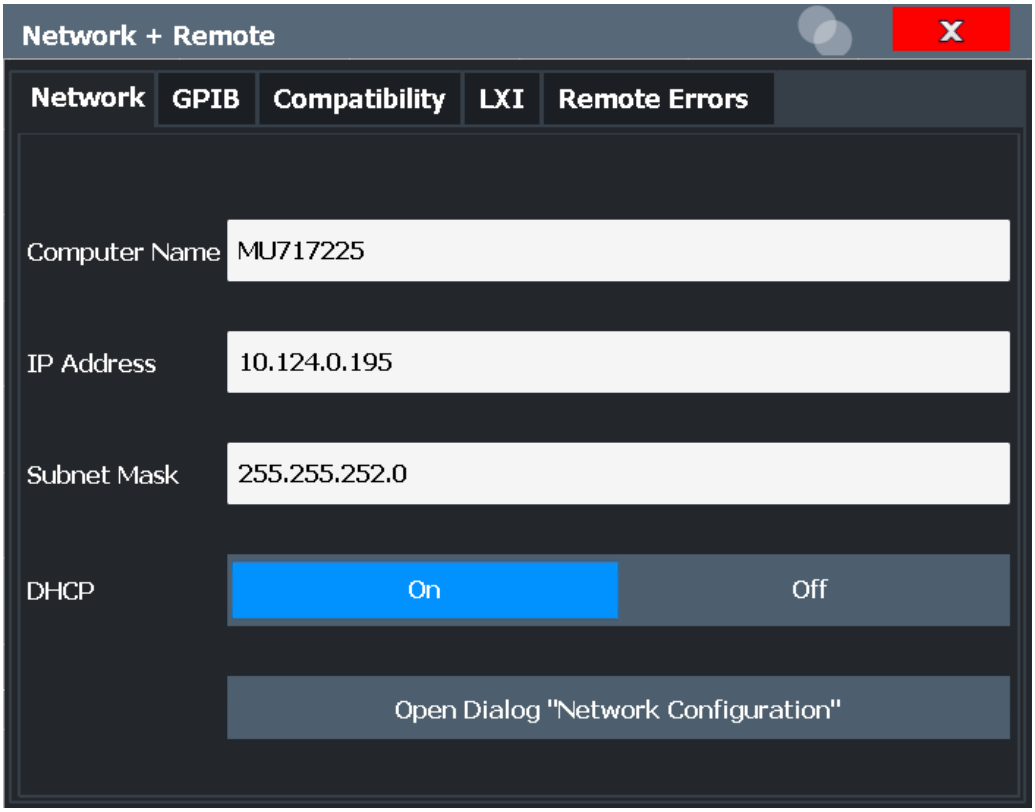
Network settings can only be edited in the firmware if a LAN cable is connected to the R&S EPL1000.

NOTICE

Risk of network problems

All parameters can be edited here; however, beware that changing the computer name has major effects in a network.

For details, see Chapter 14.5, "How to set up a network and remote control", on page 347.



Computer Name....339
IP Address....340
Subnet Mask....340
DHCP....340
Network Configuration....340

Computer Name

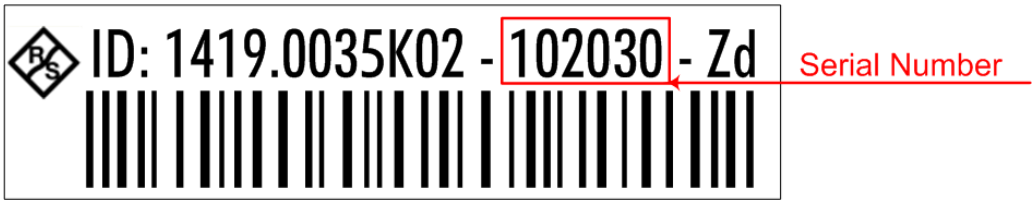
Each instrument is delivered with an assigned computer name, but this name can be changed. The naming conventions of Windows apply. If too many characters and/or numbers are entered, an error message is displayed in the status line.

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

<Type><variant>-<serial_number>

For example `EPL1000-123456`

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



IP Address
Defines the IP address. The TCP/IP protocol is preinstalled with the IP address 10.0.0.10. If the DHCP server is available ("DHCP On"), the setting is read-only.

The IP address consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a block (as an example see the preinstalled address).

Subnet Mask
Defines the subnet mask. The TCP/IP protocol is preinstalled with the subnet mask 255.255.255.0. If the DHCP server is available ("DHCP On"), this setting is read-only.

The subnet mask consists of four number blocks separated by dots. Each block contains 3 numbers in maximum (e.g. 100.100.100.100), but also one or two numbers are allowed in a block (as an example see the preinstalled address).

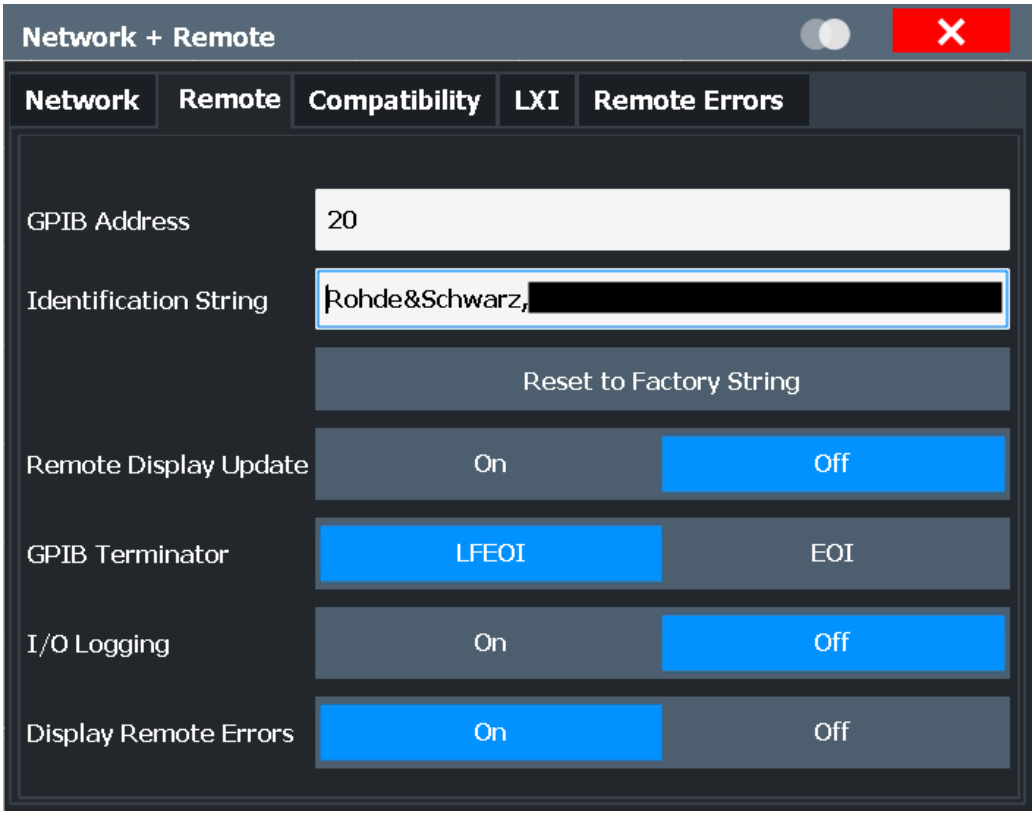
DHCP
Switches between DHCP server available (On) or not available (Off). If a DHCP server is available in the network, the IP address and subnet mask of the instrument are obtained automatically from the DHCP server.

Network Configuration
Opens the standard Windows "Network Configuration" dialog box for further configuration.

14.4.2 Remote settings

Access: [Setup] > "Network + Remote" > "Remote" tab

GPIB-specific settings are only available if option R&S FPL1-B10 is installed on the R&S EPL1000.



GPIB Address 341
Identification String 341
Reset to Factory String 341
Remote Display Update 342
GPIB Terminator 342
I/O Logging 342
Display Remote Errors 342

GPIB Address
Defines the GPIB address. Values from 0 to 30 are allowed. The default address is 20.

Remote command:
`SYSTem:COMMunicate:GPIB[:SELF]:ADDRess` on page 587

Identification String
Defines the identification string for the R&S EPL1000 which is provided as a response to the `*IDN?` query. Maximum 36 characters are allowed.

Remote command:
`SYSTem:IDENtify[:STRing]` on page 589

Reset to Factory String
Restores the default identification string. Each R&S EPL1000 has a unique ID according to the following syntax:

Rohde&Schwarz,EPL1000,<Unique number>,1.00

Remote command:
SYSTem:IDENtify:FACTory on page 589

Remote Display Update
Defines whether the display of the R&S EPL1000 is updated when changing from manual operation to remote control.

Turning off the display update function improves performance during remote control.

Note: Usually, this function remains available on the display during remote operation. However, it can be disabled remotely. In this case, the display is not updated during remote operation, and cannot be turned on again locally until local operation is resumed.

Remote command:
SYSTem:DISPlay:UPDate on page 588
SYSTem:DISPlay:LOCK on page 588

GPIB Terminator
Changes the GPIB receive terminator.

"LFEOI" According to the standard, the terminator in ASCII is <LF> and/or <EOI>.

"EOI" For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by using only the receive terminator EOI.

Remote command:
SYSTem:COMMunicate:GPIB[:SELF]:RTERminator on page 587

I/O Logging
Activates or deactivates the SCPI error log function. All remote control commands received by the R&S EPL1000 are recorded in a log file. The files are named according to the following syntax:

C:
\Users\Public\Documents\Rohde-Schwarz\Analyzer\ScpiLogging\ScpiLog.<no.>

where <no.> is a sequential number

A new log file is started each time logging was stopped and is restarted.

Logging the commands may be extremely useful for debug purposes, e.g. in order to find misspelled keywords in control programs.

Remote command:
SYSTem:CLOGging on page 562

Display Remote Errors
Activates and deactivates the display of errors that occur during remote operation of the R&S EPL1000. If activated, the R&S EPL1000 displays a message box at the bottom of the screen that contains the type of error and the command that caused the error.

The error message remains in place when you switch to "Local" mode. To close the message box, select the "Close" icon.

Only the most recent error is displayed in remote mode. However, in local mode, all errors that occurred during remote operation are listed in a separate tab of the "Network + Remote" dialog box (see Chapter 14.4.4, "Remote errors", on page 345).

Remote command:
`SYSTem:ERRor:DISPlay` on page 589
`SYSTem:ERRor:CLEar:REMote` on page 589

14.4.3 LAN settings

Access: [SETUP] > "Network + Remote" > "LAN" tab

In a LAN network, the R&S EPL1000 can be accessed via any web browser (e.g. the Microsoft Internet Explorer) to perform the following tasks:

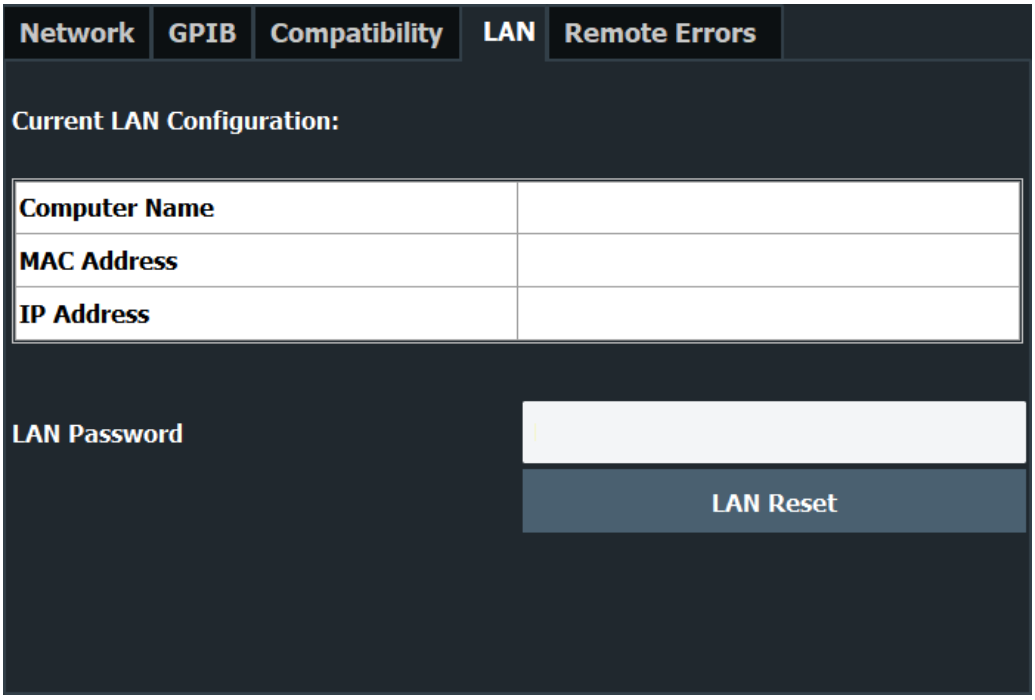
- Modifying network configurations
- Modifying device configurations
- Monitoring connections from the device to other devices

The "LAN" tab of the "Network + Remote" dialog box provides basic LAN configuration functions and information for the R&S EPL1000.

Alternatively, you can change the LAN settings using the web browser interface.

For details see Chapter 14.5.1.4, "How to configure the LAN using the web browser interface", on page 352.

Only user accounts with administrator rights are able to use LAN configuration and web browser functionality.



Current LAN Configuration....344
LAN Password....344
LAN Reset....344

Current LAN Configuration
Displays the current LAN information from the R&S EPL1000 (read-only).

"Computer name" Name of the R&S EPL1000 as defined in the operating system (see also "Computer Name" on page 339)

"MAC address" Media Access Control address (MAC address), a unique identifier for the network card in the R&S EPL1000

"IP address" IP address of the R&S EPL1000 as defined in the operating system (see also "IP Address" on page 340).

LAN Password
Password for LAN configuration. The default password is *LxiWebIfc*.

Remote command:
`SYSTem:LXI:PASSword` on page 590

LAN Reset
Resets the "LAN" configuration to its default settings (LCI function).

Parameter	Value
TCP/IP Mode	DHCP + Auto IP Address
Dynamic DNS	Enabled

Parameter	Value
ICMP Ping	Enabled
Password for "LAN" configuration	LxiWebIfc

The LAN settings are configured in the "Network" tab of the "Network + Remote" dialog box or using the instrument's "LAN" web browser interface.

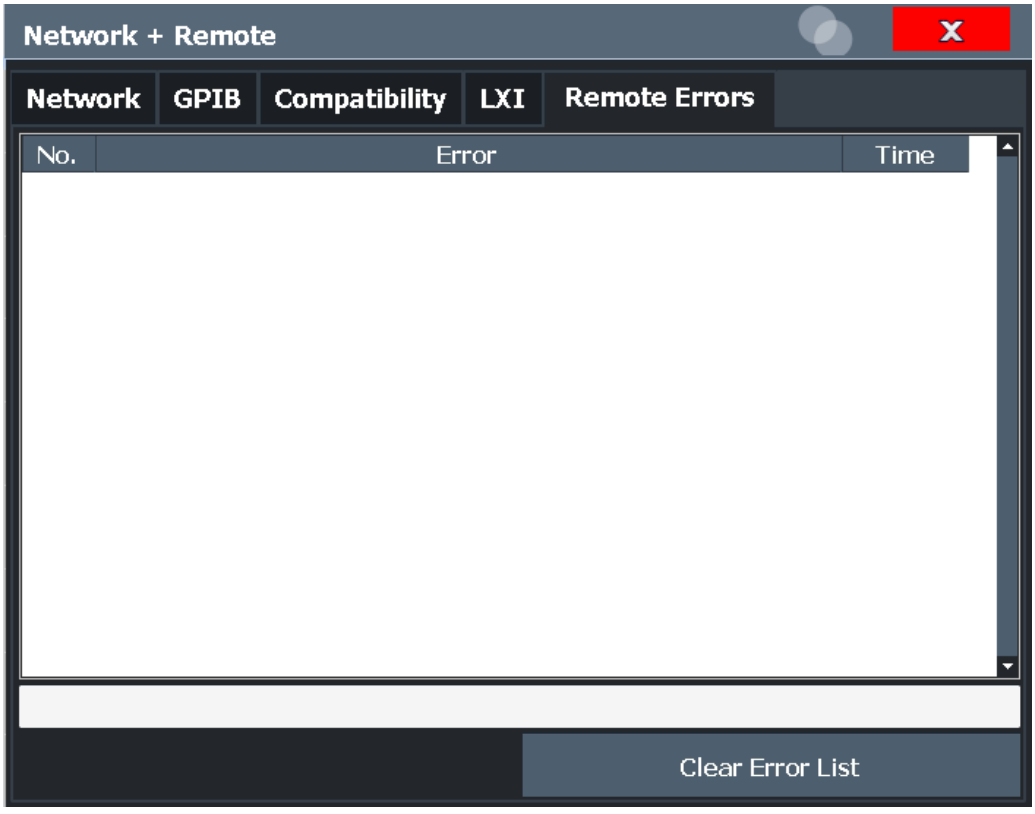
Remote command:
`SYSTem:LXI:LANReset` on page 590

14.4.4 Remote errors

Access: [SETUP] > "Network + Remote" > "Remote Errors " tab

The error messages generated by the R&S EPL1000 during remote operation are displayed here.

The messages are displayed in the order of their occurrence; the most recent messages are placed at the top of the list.



The most recent error message during remote operation can be displayed on the screen, see "Display Remote Errors" on page 342.

If the number of error messages exceeds the capacity of the error buffer, the oldest error message is removed before the newest one is inserted. To clear the message buffer use the "Clear Error List" button. It is automatically cleared when the R&S EPL1000 is shut down.

The following information is available:

No	Device-specific error code
Error	Brief description of the error
Date/Time	Time the message occurred

Remote command:

`SYSTem:ERRor:LIST?` on page 594

Clear Error List
Deletes the error message buffer for remote operation.

Note: The remote error list is automatically cleared when the R&S EPL1000 is shut down.

Remote command:
`SYSTem:ERRor:CLEar:REMote` on page 589

14.4.5 Returning to manual mode ("local")

When switched on, the instrument is always in the manual measurement mode and can be operated via the front panel. As soon as the instrument receives a remote command, it is switched to the remote control mode.

In remote control mode, all keys of the instrument except the [PRESET] key are disabled. The "LOCAL" softkey and the Remote Display Update softkey are displayed.

Local
The instrument switches from remote to manual operation.

Note:
- If the local lockout function (`LLO` or `SYST:KLOC ON`) has been activated in the remote control mode, manual operation is no longer available until `GTL` (or `SYST:KLOC OFF`) is executed.
- Before you switch back to manual operation, all remote command processing must be completed. Otherwise, the instrument will switch back to remote control immediately.
- If you select the "Local" softkey while a self-alignment or a self-test is still running (which was started remotely), the instrument only returns to the manual operation state when the alignment or test is completed.

Furthermore, when you return to manual operation, the following happens:
- All front panel keys are enabled.
- The main softkey menu of the current mode is displayed.
- The measurement diagrams, traces and display fields are displayed again.

- If, at the time of pressing the "LOCAL" softkey, the synchronization mechanism via `*OPC`, `*OPC?` or `*WAI` is active, the currently running measurement procedure is aborted and synchronization is achieved by setting the corresponding bits in the registers of the status reporting system.
- Bit 6 (User Request) of the Event Status Register is set.
  If the status reporting system is configured accordingly, this bit immediately causes the generation of a service request (SRQ) to inform the control software that the user wishes to return to front panel control. For example, this can be used to interrupt the control program and to correct instrument settings manually. This bit is set each time the "LOCAL" softkey is pressed.

Remote command:
`SYST:COMM:INT:REM OFF`, see `SYSTem:COMMunicate:INTernal:REMote` on page 586

14.5 How to set up a network and remote control

Remote operation

You can operate the instrument remotely from a connected computer using SCPI commands. Before you send remote commands, configure the instrument in a LAN network or connect it to a PC via the GPIB interface as described in Chapter 14.5.1, "How to configure a network", on page 347.

Remote Desktop

In production test and measurement, a common requirement is central monitoring of the T&M instruments for remote maintenance and remote diagnostics. Equipped with the Remote Desktop software of Windows, the R&S EPL1000 ideally meets requirements for use in production. The computer that is used for remote operation is called "controller" here.

The following tasks can be performed using Remote Desktop:

- Access to the control functions via a virtual front panel (soft front panel)
- Printout of measurement results directly from the controller
- Storage of measured data on the controller's hard disk

This documentation provides basic instructions on setting up the Remote Desktop for the R&S EPL1000. For details refer to the Windows operating system documentation.

14.5.1 How to configure a network

A precondition for operating or monitoring the instrument remotely is that it is connected to a LAN network or a PC connected to the GPIB interface. Setup is described here.

Windows Firewall Settings

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

For more details on firewall configuration, see the Windows help system and the Rohde & Schwarz white paper (available from the Rohde & Schwarz website):

1EF96: Malware Protection Windows 10

14.5.1.1 How to connect the instrument to the network

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

- A non-dedicated network (Ethernet) connection from the instrument to an existing network made with an ordinary RJ-45 network cable. The instrument is assigned an IP address and can coexist with a computer and with other hosts on the same network.
- A dedicated network connection (Point-to-point connection) between the instrument and a single computer made with a (crossover) RJ-45 network cable. The computer must be equipped with a network adapter and be directly connected to the instrument. The use of hubs, switches, or gateways is not required, however, data transfer is still performed using the TCP/IP protocol. You have to assign an IP address to the instrument and the computer, see Chapter 14.5.1.2, "How to assign the IP address", on page 349.
  Note: As the R&S EPL1000 uses a 1 GBit LAN, a crossover cable is not necessary (due to Auto-MDI(X) functionality).

NOTICE

Risk of network failure

Consult your network administrator before performing the following tasks:

- Connecting the instrument to the network
- Configuring the network
- Changing IP addresses
- Exchanging hardware

Errors can affect the entire network.

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

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

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

14.5.1.2 How to assign the IP address

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

- If the network supports dynamic TCP/IP configuration using the Dynamic Host Configuration Protocol (DHCP), all address information can be assigned automatically.
- If the network does not support DHCP, or if the instrument is set to use alternate TCP/IP configuration, the addresses must be set manually.

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

When a DHCP server is used, a new IP address can be assigned each time the PC is restarted. You have to determine this address on the PC itself. Thus, when using a DHCP server, we recommend using the permanent computer name, which determines the address via the DNS server (see "Using a DNS server to determine the IP address" on page 350).

Assigning the IP address on the instrument

NOTICE

Risk of network errors

Connection errors can affect the entire network. Contact your network administrator to obtain a valid IP address.

1. Press the [SETUP] key.
2. Press the "Network + Remote" softkey.
3. Select the "Network" tab.
4. In the "Network + Remote" dialog, toggle the "DHCP On/Off" setting to the required mode.
   If DHCP is "Off", you must enter the IP address manually, as described in the following steps.
   Note: When you switch DHCP from "On" to "Off", the previously set IP address and subnet mask are retrieved.
   If DHCP is "On", the instrument obtains the IP address of the DHCP server automatically. The configuration is saved, and the R&S EPL1000 prompts you to restart the instrument. You can skip the remaining steps.
   Note: When a DHCP server is used, a new IP address can be assigned each time you restart the instrument. You have to determine this address on the instrument

itself. Thus, when using a DHCP server, we recommend using the permanent computer name. Then the address is determined via the DNS server.
(See "Using a DNS server to determine the IP address" on page 350 and Chapter 14.5.1.3, "How to change the instrument name", on page 351).

5. Enter the "IP Address", for example *192.0.2.0*. The IP address consists of four number blocks separated by dots. Every block contains a maximum of 3 numbers.
6. Enter the "Subnet Mask", for example *255.255.255.0*. The subnet mask consists of four number blocks separated by dots. Every block contains a maximum of 3 numbers.
7. Close the dialog box.

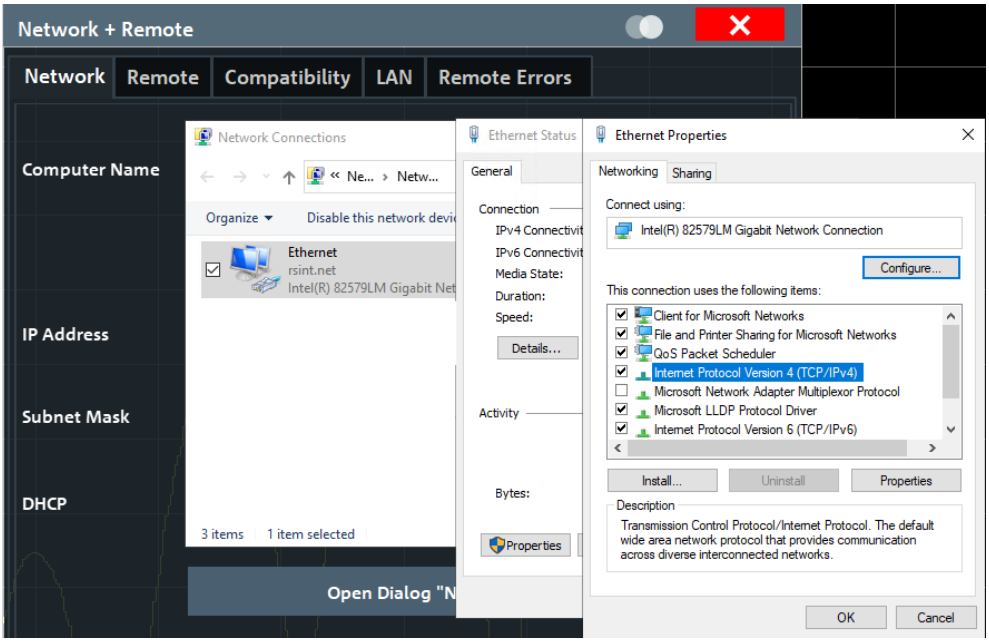
   If you have entered an invalid IP address or subnet mask, the message "out of range" is displayed in the status line. If the settings are correct, the configuration is saved, and you are prompted to restart the instrument.
8. Confirm the displayed message to restart the instrument.

Using a DNS server to determine the IP address

If a DNS server is configured on the R&S EPL1000, the server can determine the current IP address for the connection using the permanent computer name.

1. Obtain the name of your DNS domain and the IP addresses of the DNS and WINS servers on your network (see Chapter 14.5.1.3, "How to change the instrument name", on page 351).
2. Select [Setup] > "Network + Remote".
3. In the "Network" tab, select "Open Dialog 'Network Connections'".
4. Double-tap "Ethernet".
5. In the "Ethernet Status" dialog box, select "Properties".

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



7. Select "Properties".
8. On the "General" tab, select "Use the following DNS server addresses".
9. Enter your own DNS addresses.

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

14.5.1.3 How to change the instrument name

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

Each instrument is delivered with an assigned computer name, but you can change this name.

To change the instrument's computer name

1. Press the [Setup] key and then the "Network + Remote" softkey.
   The current "Computer Name" is displayed in the "Network" tab.
2. Enter the new computer name.
3. Close the dialog box.

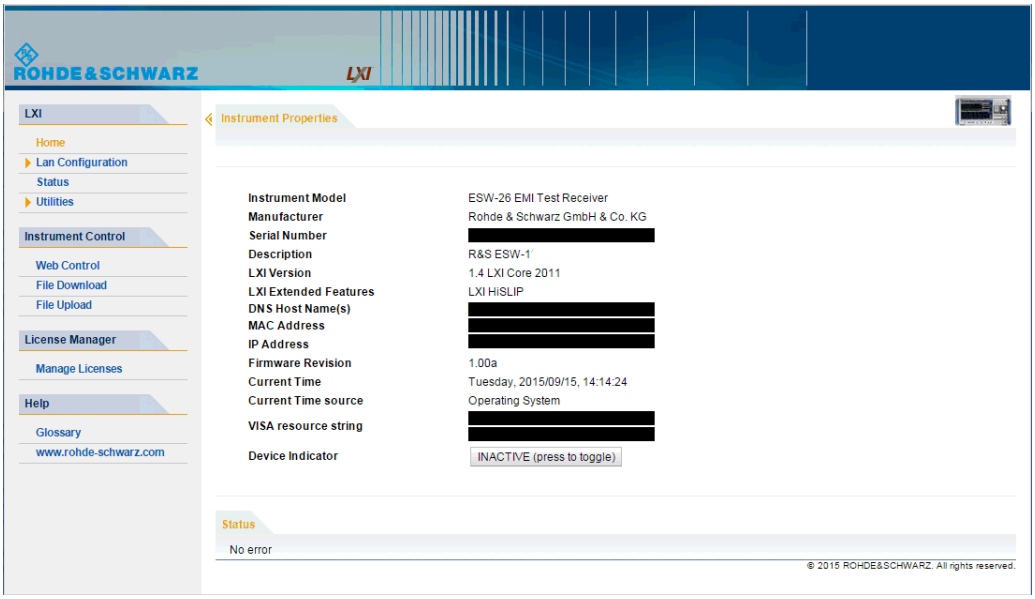
   The configuration is saved, and you are prompted to restart the instrument.
4. Confirm the displayed message to restart the instrument.

14.5.1.4 How to configure the LAN using the web browser interface

The instrument's "LAN" web browser interface works correctly with all W3C compliant browsers.

► In the web browser, open the `http://<instrument-hostname>` or `http://<instrument-ip-address>` page, e.g. *http://10.113.10.203*.
The default password to change "LAN" configurations is *LxiWebIfc*.

The "Instrument Home Page" (welcome page) opens.



The instrument home page displays device information, including the VISA resource string, in read-only format.

► On the "Instrument Home Page", select "Device Indicator" to activate or deactivate the "LAN" status LED to the right of the button. The "Device Indicator" setting is not password-protected.

A green "LAN" status LED indicates that a LAN connection is established.
A red status LED indicates an error, for example, that no LAN cable is connected.
When a device is connecting to the instrument, the "LAN" status LED blinks.

The most important control elements in the navigation pane of the browser interface are the following:

- "LAN Configuration" opens the menu with configuration pages.
- "Status" displays information about the "LAN" status of the instrument.

LAN configuration

The LAN configuration consists of three parts:

- "IP configuration" provides all mandatory LAN parameters.

- "Advanced LAN Configuration" provides further LAN settings.
- "Ping Client" provides the ping utility to verify the connection between the instrument and other devices.

IP configuration

The "LAN Configuration > IP configuration" web page displays all mandatory LAN parameters and allows their modification.

The "TCP/IP Mode" configuration field controls how the IP address for the instrument gets assigned (see also Chapter 14.5.1.2, "How to assign the IP address", on page 349).

For the manual configuration mode, the static IP address, subnet mask, and default gateway are used to configure the LAN. The automatic configuration mode uses DHCP server or Dynamic Link Local Addressing (Automatic IP) to obtain the instrument IP address.

Changing the LAN configuration is password-protected. The default password is *LxiWebIfc* (notice upper and lower case characters).

You can change the LAN password in the "Network + Remote" dialog box, see Chapter 14.4.3, "LAN settings", on page 343.

Advanced LAN configuration

The "LAN Configuration > Advanced LAN Configuration" parameters are used as follows:

- "mDNS and DNS-SD" are two additional protocols: Multicast DNS and DNS Service Discovery. They are used for device communication in zero configuration networks working without DNS and DHCP
- "ICMP Ping" must be enabled to use the ping utility.
- "VXI-11" is the protocol that is used to detect the instrument in the LAN.

Ping client

Ping is a utility that verifies the connection between the instrument and another device. The ping command uses the `ICMP` echo request and echo reply packets to determine whether the LAN connection is functional. Ping is useful for diagnosing IP network or router failures. The ping utility is not password-protected.

To initiate a ping between the instrument and a second connected device:

To initiate a ping between the instrument and a second connected device

1. Enable "ICMP Ping" on the "Advanced LAN Configuration" page (enabled after an LCI).
2. Enter the IP address of the second device **without the ping command and without any further parameters** into the "Destination Address" field (e.g. *10.113.10.203*).

3. Select "Submit".

14.5.1.5 How to change the GPIB instrument address

To operate the instrument via remote control, it must be addressed using the GPIB address. The remote control address is factory-set to 20, but it can be changed if it does not fit in the network environment. For remote control, addresses 0 through 30 are allowed. The GPIB address is maintained after a reset of the instrument settings.

Setting the GPIB address

1. On the R&S EPL1000, press the [SETUP] key.
2. Press the "Network + Remote" softkey.
3. In the "Network + Remote" dialog box, select the "GPIB" tab.
4. In the "GPIB Address" field, enter a value between 0 and 30.

Remote command:

```
SYST:COMM:GPIB:ADDR 18
```

14.5.2 How to operate the instrument without a network

To operate the instrument without a network connection either temporarily or permanently, no special measures are necessary. Windows automatically detects the interruption of the network connection and does not set up the connection when the instrument is switched on.

If you are not prompted to enter the user name and password, proceed as described in Chapter 14.5.3.3, "How to configure the automatic login mechanism", on page 356.

14.5.3 How to log on to the network

Windows requires that users identify themselves by entering a user name and password in a login window. You can set up two types of user accounts, either an administrator account with unrestricted access to the computer/domain or a standard user account with limited access.

The instrument provides an auto-login function for the standard account, i.e. login with unrestricted access is carried out automatically in the background. By default, the user name for the standard account is "Instrument", and the user name for the administrator user account is "Admin".

In both cases the initial password is "894129". You can change the password in Windows for any user at any time. Some administrative tasks require administrator rights (e.g. firmware updates or the configuration of a LAN network). If so, it is mentioned in the function descriptions.

At the same time you log on to the operating system, you are automatically logged on to the network. As a prerequisite, the user name and the password must be identical on the instrument and on the network.

14.5.3.1 How to create users

After the software for the network has been installed, the instrument issues an error message the next time it is switched on because there is no user named "instrument" (= default user ID for Windows auto-login) in the network. Thus, a matching user must be created in the R&S EPL1000 and in the network, the password must be adapted to the network password, and the auto-login mechanism must then be deactivated.

The network administrator is responsible for creating new users in the network.

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. Select "Start > Settings > Accounts > Other users".
3. Select "Add someone else to this PC".
4. In the "Microsoft account" dialog box, enter the new user name and password.
5. Select "OK".
6. Select "Finish".
   The new user is created.

14.5.3.2 How to change the user password

After the new user has been created on the instrument, the password must be adapted to the network password.

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. Press [Ctrl + Alt + Delete], then select "Change a password".
3. Enter the user account name.
4. Enter the old password.
5. Enter the new password twice.
6. Press [Enter].
   The new password is now active.

14.5.3.3 How to configure the automatic login mechanism

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 in the toolbar to access the operating system of the R&S EPL1000 (see also "To access the "Start" menu" on page 31).
2. Open the `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\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:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\AUTOLOGIN.REG`.
7. Press the [ENTER] key to confirm.
   The auto-login function is reactivated with the changed password. It is applied the next time you switch on the instrument.

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 in the toolbar to access the operating system of the R&S EPL1000 (see also "To access the "Start" menu" on page 31).
2. Press [CTRL] + [ALT] + [DEL], then select "Sign out".

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

Deactivating the auto-login function

When shipped, the instrument is already configured to log on the "instrument" user automatically under Windows. To deactivate the auto-login function, perform the following steps:

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

2. Enter the command
   `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\NO_AUTOLOGIN.REG`.
3. Press the [ENTER] key to confirm.
   The auto-login function is deactivated. The next time you switch on the instrument, the R&S EPL1000 prompts you to enter your user name and password before the firmware is started.

Reactivating the auto-login function

To reactivate the auto-login function after manually deactivating it, perform the following steps:

1. In the "Start" menu, select "Run".
   The "Run" dialog box is displayed.
2. Enter the command
   `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\AUTOLOGIN.REG`.
3. Press the [ENTER] key to confirm.
   The auto-login function is reactivated. It is applied the next time you switch on the instrument.

14.5.4 How to share directories (only with Microsoft networks)

Sharing directories makes data available for other users. Sharing directories is only possible in Microsoft networks. Sharing is a property of a file or directory.

1. In the "Start" menu, select "Programs" > "Accessories" > "Windows Explorer".
2. Right-click the desired folder.
3. In the context menu, select "Sharing with" > "Specific people".
   The dialog box for sharing a directory is displayed.
4. Select a user from the list or add a new name.
5. Select "Add"
6. Select "Share".
7. Select "Done" to close the dialog box.
   The drive is shared and the selected users can access it.

14.5.5 How to control the R&S EPL1000 via the web browser interface

Via the LAN web browser interface to the R&S EPL1000, one or more users can control the instrument remotely from another PC without additional installation. Most instru-

ment controls are available via the front panel simulation. File upload and download between the instrument and the remote PC is also available.

To access the R&S EPL1000 via the web browser interface

1. Start a web browser that supports html5 (W3C compliant).
2. Enter the IP address of the R&S EPL1000 in the browser's address bar.

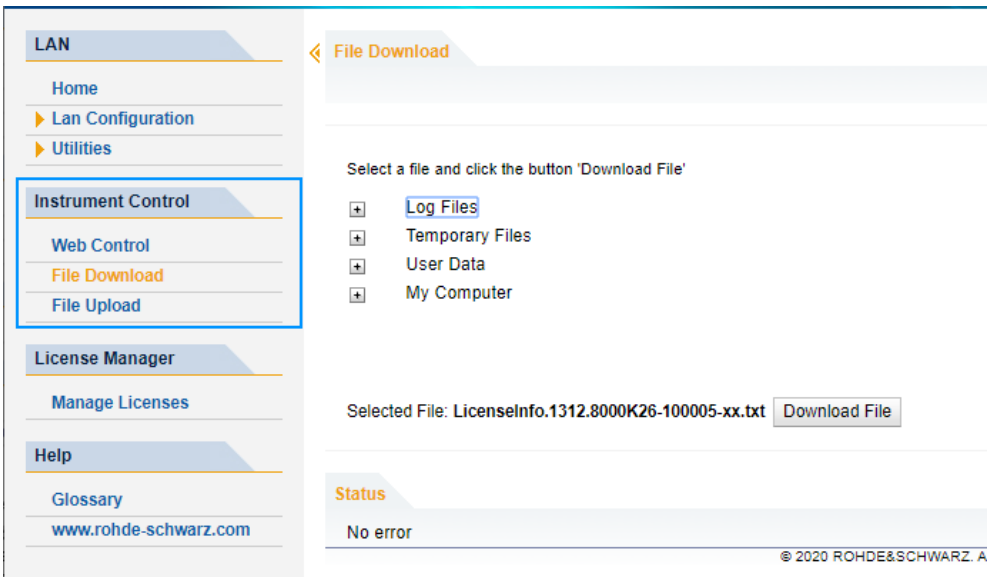
   The R&S EPL1000's Welcome page is displayed.
3. In the navigation pane, select "Instrument Control > Web Control".

   The instrument's display is shown in a new browser window, with a software front panel displayed beside or below it.
4. Use the mouse cursor to access the functionality in the software front panel or in the display as you would directly on the instrument's front panel.

To exchange files with the R&S EPL1000

You can download files, for example stored measurement data, from the R&S EPL1000 to the remote PC, or upload files, for example limit line definitions, from the PC to the R&S EPL1000.

1. In the web browser, select the Welcome page window.
2. In the navigation pane, select "Instrument Control" > "File Upload" or "File Download".



   The most commonly used folders on the instrument are displayed. For example, folders that contain user data. From the top-most folder, `My Computer`, you can access all other folders on the instrument.
3. To download a file from the R&S EPL1000:

   a) Select the file from the displayed folders.

b) Select "Download File".

4. To upload a file to the R&S EPL1000:
   a) From the displayed folders in the web browser window, select the folder on the R&S EPL1000 to which you want to copy a file.
   b) Under "File to Upload", select "Browse".
   c) From the file selection dialog box, select the required file on the PC.
   d) Select "Upload" to copy the file from the PC to the defined folder on the R&S EPL1000.

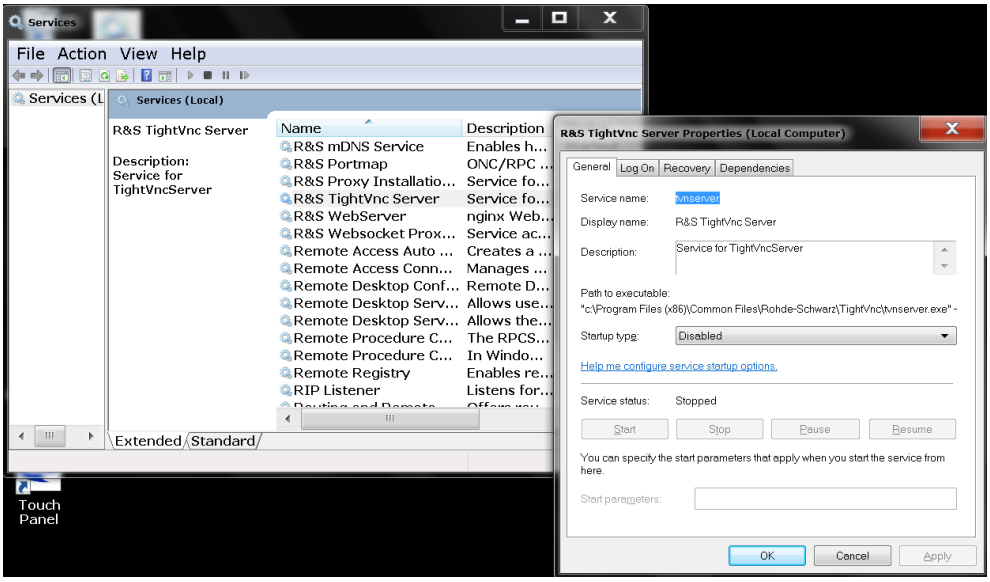
14.5.6 How to deactivate the web browser interface

If you want to prevent other users in the LAN from accessing or operating the R&S EPL1000 via its LAN web browser interface, you must deactivate this function. Note that **after a firmware update** the function is **automatically active** again until you deactivate it manually.

To deactivate the LAN web browser interface

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. In the "Start" menu, select "Control Panel".
3. Select "System and Security" > "Administrative Tools".
4. From the list on the right, select "Services".
5. From the list of local services, select "R&S TightVNC Server".



6. Set "Startup type" to "Disabled".
7. Select "Stop".
8. Select "Apply".

   The next time a user enters the IP address of the instrument in a web browser, an error message is displayed:
   `Failed to connect to server (code. 1006)`

14.5.7 How to set up remote desktop

Remote Desktop is a Windows application which can be used to access and control the instrument from a remote computer through a LAN connection. While the instrument is in operation, the instrument screen contents are displayed on the remote computer, and Remote Desktop provides access to all of the applications, files, and network resources of the instrument. Thus, remote operation of the R&S EPL1000 is possible.

With Windows, Remote Desktop Client is part of the operating system. For other versions of Windows, Microsoft offers the Remote Desktop Client as an add-on. For details refer to the Windows operating system documentation.

With the factory settings, the default "instrument" user can connect to the R&S EPL1000 with the Remote Desktop program of the controller immediately. No further configuration is required. However, if the connection fails or other users need to connect, this section provides basic instructions on setting up the Remote Desktop for the R&S EPL1000.

14.5.7.1 How to configure the R&S EPL1000 for remote operation via remote desktop

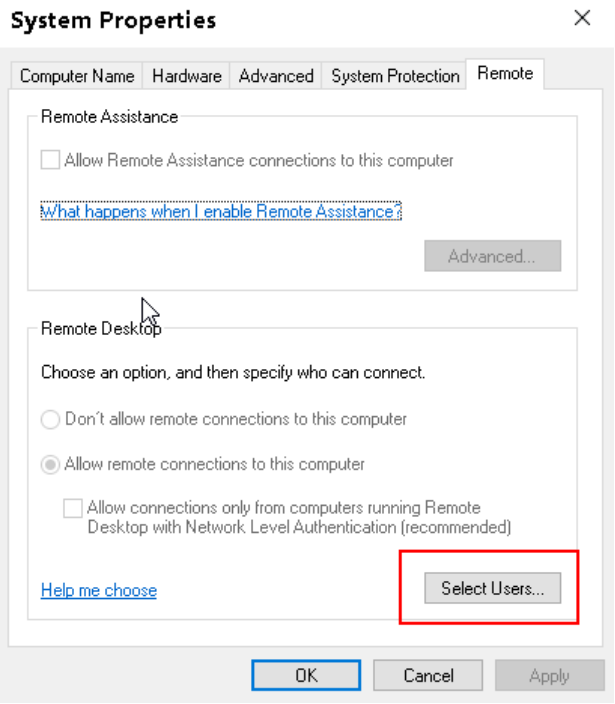
1. Create a fixed IP address for the TCP/IP protocol as described in Chapter 14.5.1.2, "How to assign the IP address", on page 349.

   Note: To avoid problems, use a fixed IP address.
   When a DHCP server is used, a new IP address is assigned each time the instrument is restarted. This address must first be determined on the instrument itself. Thus, using a DHCP server is not suitable for remote operation of the R&S EPL1000 via Remote Desktop.

2.

   Select the "Windows" icon in the toolbar to access the operating system.

3. In the Windows "Start" menu, select "Settings > System".
4. Search for "remote access".
5. Select "Allow remote access to your computer".
6. Define which users can access the R&S EPL1000 via Remote Desktop.
   Note: The currently used user account is automatically enabled for Remote Desktop.



   a) Select "Select Users".
   b) Select the users or create new user accounts as described in Chapter 14.5.3.1, "How to create users", on page 355.

c) Select "OK" to confirm the settings.

7. The R&S EPL1000 is now ready for connection setup with the Remote Desktop program of the controller.

14.5.7.2 How to configure the controller

Remote Desktop Client

With Windows, Remote Desktop Client is part of the operating system and can be accessed via "Start > Programs > Accessories > Remote Desktop Connection".

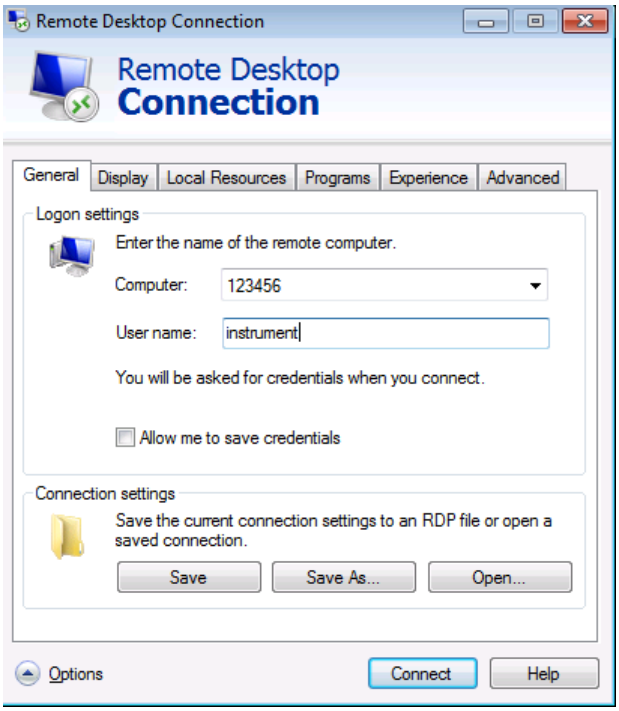
For other versions of Windows, Microsoft offers the Remote Desktop Client as an add-on.

1.

   Select the "Windows" icon in the toolbar to access the operating system.

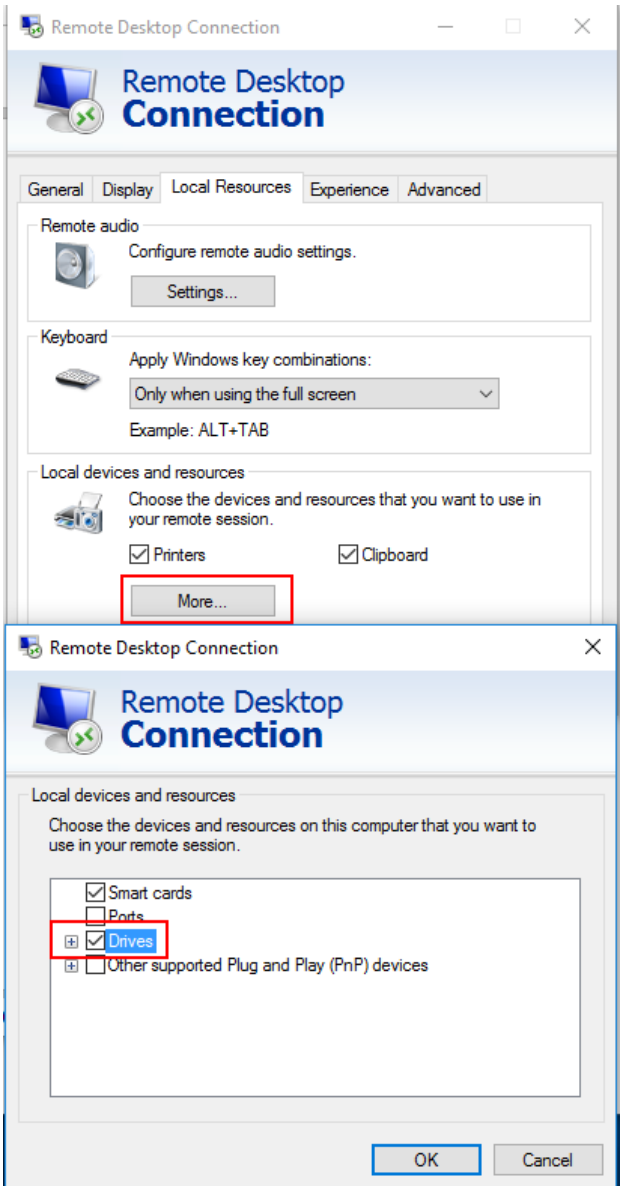
2. From the "Start" menu, select "All Programs" > "Accessories" > "Remote Desktop Connection".
   The "Remote Desktop Connection" dialog box is displayed.

3. Select "Options >>".
   The dialog box is expanded to display the configuration data.



4. Open the "Experience" tab.
   The settings on this tab select and optimize the connection speed.

5. In the list, select the appropriate connection (for example: "LAN (10 Mbps or higher)").
   Depending on your selection (and how powerful the connection is), the options are activated or deactivated.
6. To improve the performance, you can deactivate the "Desktop background", "Show contents of window while dragging" and "Menu and window animation" options.
7. Open the "Local Resources" tab to enable printers, local drives and serial interfaces.
8. To access drives of the controller from the R&S EPL1000, e.g. to store settings or to copy files from the controller to the R&S EPL1000:
   a) Select "More".



   b) Enable the "Drives" option.

Windows maps drives of the controller to the corresponding network drives.

9. To use printers connected to the controller while accessing them from the R&S EPL1000, activate the "Printers" option. Do not change the remaining settings.
10. Open the "Display" tab.
    The options for configuring the R&S EPL1000 screen display are displayed.
11. Under "Remote desktop size", you can set the size of the R&S EPL1000 window on the desktop of the controller.
12. Under "Colors", do not change the settings.
13. Set the "Display the connection bar when I use the full screen" option:
    - If activated, a bar showing the network address of the R&S EPL1000 appears at the top edge of the screen. You can use this bar to reduce, minimize or close the window.
    - If deactivated, the only way you can return to the controller desktop from the R&S EPL1000 screen in full screen mode is to select "Disconnect" from the "Start" menu.

14.5.7.3 How to start and close the remote desktop

To set up a connection to the R&S EPL1000

1. In the "Remote Desktop Connection" dialog box (see Chapter 14.5.7.2, "How to configure the controller", on page 362), open the "General" tab.
2. In the "Computer" field, enter the IP address of the R&S EPL1000.
   In the "User name" field, enter *instrument* to log in as an administrator, or *Normal User* to log in as a standard user.
   In the "Password" field, enter *894129*.
3. To save the connection configuration for later use:
   a) Select "Save As".
      The "Save As" dialog box is displayed.
   b) Enter the name for the connection information (`*.RDP`).
4. To load an existing connection configuration:
   a) Select "Open".
      The "Open" dialog box is displayed.
   b) Select the `*.rdp` file.
5. Select "Connect".
   The connection is set up.
6. If the "Disk drives" option is enabled on the "Local Resources" tab, a warning is displayed indicating that the drives are enabled for access from the R&S EPL1000. Select "OK" to confirm the warning.

After a few moments, the R&S EPL1000 screen is displayed.

7. If a dark screen appears or a dark square appears in the upper left-hand corner of the screen, restart the R&S EPL1000 to see the modified screen resolution.

   a) Press the key combination [ALT] + [F4].
   The R&S EPL1000 firmware is shut down, which can take a few seconds.

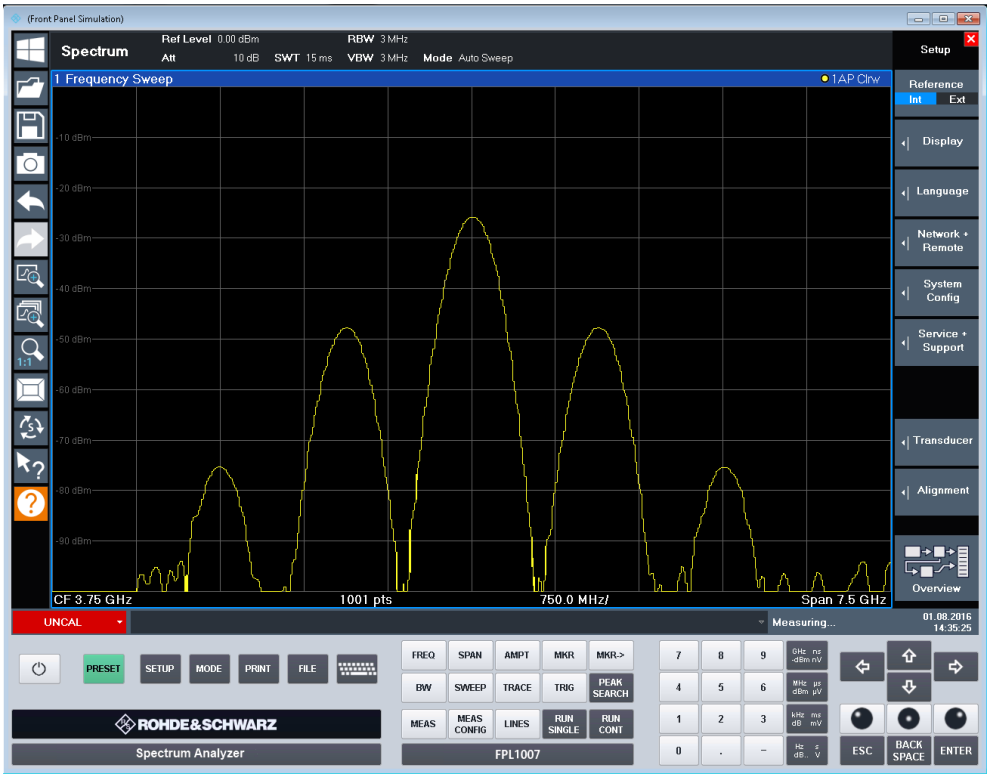
   b)

   On the desktop, double-tap the "Analyzer" icon.

   The firmware restarts and then automatically opens the "Softfrontpanel", i.e. the user interface on which all front panel controls and the rotary knob are mapped to buttons.
   For more information, see Chapter 13.2.2, "How to work with the soft front panels", on page 285.

8. To deactivate or activate the "Softfrontpanel", press the [F6] key.

   After the connection is established, the R&S EPL1000 screen is displayed in the "Remote Desktop" application window.



To access the Windows "Start" menu, expand the "Remote Desktop" window to full size.
During the connection with the controller, the login dialog box is displayed on the R&S EPL1000 screen.

To terminate Remote Desktop control

The controller or a user at the R&S EPL1000 can terminate the remote connection:

► • On the controller, close the "Remote Desktop" window at any time.
The connection to the R&S EPL1000 is terminated.
• On the R&S EPL1000, log on.
The connection to the controller is terminated. A message is displayed on the controller display indicating that another user has assumed control of the instrument.

Restoring the connection to the R&S EPL1000

Follow the instructions above to set up a connection to the R&S EPL1000. If the connection is terminated and then restored, the R&S EPL1000 remains in the same state.

14.5.7.4 How to shut down the R&S EPL1000 via remote operation

1. Select the R&S EPL1000 softfrontpanel.
2. Close the application with the key combination [ALT] + [F4].
3. Select the desktop.
4. Press the key combination [ALT] + [F4].
A safety query is displayed to warn you that the instrument cannot be reactivated via remote operation and asks you whether you want to continue the shutdown process.
5. Respond to the safety query with "Yes".
The connection with the controller is terminated and the R&S EPL1000 is shut down.

14.5.8 How to start a remote control session from a PC

When you switch on the R&S EPL1000, it is always in manual operation state ("local" state) and can be operated via the front panel.

To start remote control

1. Send an addressed command (`GTR` - Go to Remote) from a controller to the instrument.

   The instrument is switched to remote control ("remote" state). Operation via the front panel is disabled. Only the "Local" softkey is displayed to return to manual operation. The instrument remains in the remote state until it is reset to the manual state via the instrument or via remote control interfaces. Switching from manual operation to remote control and vice versa does not affect the other instrument settings.

2. During program execution, send the `SYSTem:DISPlay:UPDate ON` command to activate the display of results (see `SYSTem:DISPlay:UPDate` on page 588).

   The changes in the device settings and the recorded measurement values are displayed on the instrument screen.

3. To obtain optimum performance during remote control, send the `SYSTem:DISPlay:UPDate OFF` command to hide the display of results and diagrams again (default setting in remote control).

4. To prevent unintentional return to manual operation, disable the keys of the instrument using the universal command `LLO`.

   Switching to manual mode is only possible via remote control then. This function is only available for the GPIB interface.

5. To enable the keys of the R&S EPL1000 again, switch the instrument to local mode (`GTL` - Go to Local), i.e. deactivate the `REN` line of the remote control interface.

If the instrument is operated exclusively in remote control, it is recommended that you switch off the display. For details see "Remote Display Update" on page 342.

14.5.9 How to return to manual operation

Before you switch back to manual operation, all remote command processing must be completed. Otherwise, the instrument switches back to remote control immediately.

► • Manual operation: Select the "Local" softkey.
  • Remote operation: Use the following GPIB command:

```
status = viGpibControlREN(vi, VI_GPIB_REN_ADDRESS_GTL)
```

If you select the "Local" softkey while a self-alignment or a self-test is still running (which was started remotely), the instrument only returns to the manual operation state when the alignment or test is completed.

15 Remote commands in the receiver application

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15.1 Conventions used in SCPI command descriptions

The following conventions are used in the remote command descriptions:

- **Command usage**
  If not specified otherwise, commands can be used both for setting and for querying parameters.
  If a command can be used for setting or querying only, or if it initiates an event, the usage is stated explicitly.
- **Parameter usage**
  If not specified otherwise, a parameter can be used to set a value and it is the result of a query.
  Parameters required only for setting are indicated as **Setting parameters**.
  Parameters required only to refine a query are indicated as **Query parameters**.
  Parameters that are only returned as the result of a query are indicated as **Return values**.
- **Conformity**
  Commands that are taken from the SCPI standard are indicated as **SCPI confirmed**. All commands used by the R&S EPL1000 follow the SCPI syntax rules.
- **Asynchronous commands**
  A command which does not automatically finish executing before the next command starts executing (overlapping command) is indicated as an **Asynchronous command**.
- **Reset values (*RST)**
  Default parameter values that are used directly after resetting the instrument (`*RST` command) are indicated as ***RST** values, if available.
- **Default unit**
  The default unit is used for numeric values if no other unit is provided with the parameter.
- **Manual operation**

If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

15.2 Common suffixes

In the Receiver application, the following common suffixes are used in remote commands:

Table 15-1: Common suffixes used in remote commands in the Receiver application

Suffix	Value range	Description
<m>	1..16	Marker
<n>	1..16	Window (**in the currently selected channel setup**)
<t>	1..6	Trace
	1 to 8	Limit line
<k>	1..8 (Limit line) 1 | 2 (Display line)	Selects a limit or display line.
<peak>	1..3000	Selects a peak.
<ou>	irrelevant	

Selecting windows in multiple channel setups

Note that the suffix <n> always refers to a window in the currently selected channel setup.

15.3 Common commands

Common commands are described in the IEEE 488.2 (IEC 625-2) standard. These commands have the same effect and are employed in the same way on different devices. The headers of these commands consist of "*" followed by three letters. Many common commands are related to the Status Reporting System.

Available common commands:

*CAL?....370
*CLS....370
*ESE....370
*ESR?....370
*IDN?....371
*IST?....371
*OPC....371
*OPT?....371
*PCB....372
*PRE....372
*PSC....372

*RST....372
*SRE....372
*STB?....373
*TRG....373
*TST?....373
*WAI....373

***CAL?**

Calibration query

Initiates a calibration of the instrument and then queries the calibration status. Responses > 0 indicate errors.

Note: If you start a self-alignment remotely, then select the "Local" softkey while the alignment is still running, the instrument only returns to the manual operation state after the alignment is completed.

Usage: Query only

Manual operation: See "Start Self Alignment" on page 314

***CLS**

Clear status

Sets the status byte (STB), the standard event register (ESR) and the `EVENt` part of the `QUEStionable` and the `OPERation` registers to zero. The command does not alter the mask and transition parts of the registers. It clears the output buffer.

Usage: Setting only

***ESE** <Value>

Event status enable

Sets the event status enable register to the specified value. The query returns the contents of the event status enable register in decimal form.

Parameters:
<Value> Range: 0 to 255

***ESR?**

Event status read

Returns the contents of the event status register in decimal form and then sets the register to zero.

Return values:
<Contents> Range: 0 to 255

Usage: Query only

***IDN?**

Identification

Returns the instrument identification.

Return values:

<ID> "Rohde&Schwarz,<device type>,<part number>/<serial number>,<firmware version>"

Example: `Rohde&Schwarz,EPL1000,1350.4444K10/100005,1.50`

Usage: Query only

***IST?**

Individual status query

Returns the contents of the IST flag in decimal form. The IST flag is the status bit which is sent during a parallel poll.

Return values:

<ISTflag> 0 | 1

Usage: Query only

***OPC**

Operation complete

Sets bit 0 in the event status register when all preceding commands have been executed. This bit can be used to initiate a service request. The query writes a "1" into the output buffer when all preceding commands have been executed, which is useful for command synchronization.

***OPT?**

Option identification query

Queries the options included in the instrument. For a list of all available options and their description, refer to the data sheet.

Return values:

<Options> The query returns a list of all installed and activated options, separated by commas, where:
B<number> describes hardware options.
K<number> describes software options.
Note that K9 (Power Meter), K14 (Spectrograms), and K54 (EMI measurement) are displayed for compatibility reasons only; in fact, they are standard functionality of the R&S EPL1000 base unit and do not require additional ordering.

Usage: Query only

***PCB** <Address>

Pass control back

Indicates the controller address to which remote control is returned after termination of the triggered action.

Setting parameters:
<Address> Range: 0 to 30

Usage: Setting only

***PRE** <Value>

Parallel poll register enable

Sets parallel poll enable register to the indicated value. The query returns the contents of the parallel poll enable register in decimal form.

Parameters:
<Value> Range: 0 to 255

***PSC** <Action>

Power on status clear

Determines whether the contents of the `ENABle` registers are preserved or reset when the instrument is switched on. Thus a service request can be triggered when the instrument is switched on, if the status registers ESE and SRE are suitably configured. The query reads out the contents of the "power-on-status-clear" flag.

Parameters:
<Action> 0 | 1

0
The contents of the status registers are preserved.

1
Resets the status registers.

***RST**

Reset

Sets the instrument to a defined default status. The default settings are indicated in the description of commands.

The command is equivalent to `SYSTem:PRESet`.

Usage: Setting only

***SRE** <Contents>

Service request enable

Sets the service request enable register to the indicated value. This command determines under which conditions a service request is triggered.

Parameters:

<Contents> Contents of the service request enable register in decimal form. Bit 6 (MSS mask bit) is always 0.

Range: 0 to 255

***STB?**

Status byte query

Reads the contents of the status byte in decimal form.

Usage: Query only

***TRG**

Trigger

Triggers all actions waiting for a trigger event. In particular, *TRG generates a manual trigger signal. This common command complements the commands of the `TRIGger` subsystem.

`*TRG` corresponds to the `INITiate:IMMediate` command.

Usage: Event

***TST?**

Self-test query

Initiates self-tests of the instrument and returns an error code.

Note: If you start a self-test remotely, then select the "Local" softkey while the test is still running, the instrument only returns to the manual operation state after the test is completed. In this case, the self-test cannot be aborted.

Return values:

<ErrorCode> **integer > 0 (in decimal format)**
An error occurred.

0
No errors occurred.

Usage: Query only

***WAI**

Wait to continue

Prevents servicing of the subsequent commands until all preceding commands have been executed and all signals have settled (see also command synchronization and `*OPC`).

Usage: Event

15.4 Application selection

DISPlay:ATAB....374
INSTrument:CREate:DUPLicate....374
INSTrument:CREate[:NEW]....374
INSTrument:CREate:REPLace....375
INSTrument:DELete....375
INSTrument:LIST?....376
INSTrument:REName....376
INSTrument[:SELect]....377

DISPlay:ATAB <State>

This command switches between the MultiView tab and the most recently displayed channel setup. If only one channel setup is active, this command has no effect.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

INSTrument:CREate:DUPLicate

This command duplicates the currently selected channel setup, i.e creates a new channel setup of the same type and with the identical measurement settings. The name of the new channel setup is the same as the copied channel setup, extended by a consecutive number (e.g. "IQAnalyzer" -> "IQAnalyzer 2").

The channel setup to be duplicated must be selected first using the `INST:SEL` command.

Example:
```
INST:SEL 'Receiver'
INST:CRE:DUPL
```
Duplicates the channel setup named 'Receiver' and creates a new channel setup named 'Receiver 2'.

Usage: Event

Manual operation: See "Duplicate Current Channel" on page 74

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

This command adds a measurement channel. You can configure up to 10 measurement channels at the same time (depending on available memory).

See also

- INSTrument[:SELect] on page 377
- INSTrument:DELete on page 375

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types, see INSTrument:LIST? on page 376.

<ChannelName> String containing the name of the channel.
Note that you cannot assign an existing channel name to a new channel. If you do, an error occurs.

Example: INST:CRE SAN, 'Spectrum 2'
Adds a spectrum display named "Spectrum 2".

Manual operation: See "New Channel setup" on page 74

INSTrument:CREate:REPLace <ChannelName1>,<ChannelType>,<ChannelName2>

This command replaces a channel setup with another one.

Setting parameters:

<ChannelName1> String containing the name of the channel setup you want to replace.

<ChannelType> Channel type of the new channel setup.
For a list of available channel setup types, see INSTrument:LIST? on page 376.

<ChannelName2> String containing the name of the new channel setup.
Note: If the specified name for a new channel setup already exists, the default name, extended by a sequential number, is used for the new channel setup (see INSTrument:LIST? on page 376).
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: INST:CRE:REPL 'Receiver',REC,'REC2'
Replaces the channel setup named "Receiver" by a new channel setup of type "Receiver" named "REC2".

Usage: Setting only

Manual operation: See "Replace Current Channel setup" on page 74

INSTrument:DELete <ChannelName>

This command deletes a channel setup.

If you delete the last channel setup, the default "Receiver" channel setup is activated.

Setting parameters:

<ChannelName> String containing the name of the channel setup you want to delete.
A channel setup must exist to delete it.

Example: `INST:DEL 'Receiver'`
Deletes the channel setup with the name 'Receiver'.

Usage: Setting only

INSTrument:LIST?

This command queries all active channel setups. The query is useful to obtain the names of the existing channel setups, which are required to replace or delete the channel setups.

Return values:

<ChannelType>, <ChannelName> For each channel setup, the command returns the channel setup type and channel setup name (see tables below).
Tip: to change the channel setup name, use the `INSTrument:REName` command.

Example: `INST:LIST?`
Result for 2 channel setups:
`'REC','Receiver','REC','Receiver 2'`

Usage: Query only

Table 15-2: Available channel setup types and default channel setup names

Application	<ChannelType> Parameter	Default Channel setup Name*)
Receiver	RECeiver	Receiver
Spectrum	SANalyzer	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Analog Modulation Analysis	ADEMod	Analog Demod
Note: the default channel setup name is also listed in the table. If the specified name for a new channel setup already exists, the default name, extended by a sequential number, is used for the new channel setup.		

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a channel setup.

Setting parameters:

<ChannelName1> String containing the name of the channel setup you want to rename.

<ChannelName2> String containing the new channel setup name.
Note that you cannot assign an existing channel setup name to a new channel setup. If you do, an error occurs.
Channel names can have a maximum of 31 characters, and must be compatible with the Windows conventions for file names. In particular, they must not contain special characters such as ":", "*", "?".

Example: `INST:REN 'Receiver','REC'`
Renames the channel setup with the name 'Receiver' to 'REC'.

Usage: Setting only

INSTrument[:SELect] <ChannelType> | <ChannelName>

This command activates a new channel setup with the defined channel setup type, or selects an existing channel setup with the specified name.

Also see

- `INSTrument:CREate[:NEW]` on page 374

Parameters:

<ChannelType> Channel type of the new channel setup.
For a list of available channel setup types see `INSTrument:LIST?` on page 376.

<ChannelName> String containing the name of the channel setup.

Example: `INST IQ`
Activates a channel setup for the I/Q Analyzer application (evaluation mode).
`INST 'MyIQSpectrum'`
Selects the channel setup named 'MyIQSpectrum' (for example before executing further commands for that channel setup).

Manual operation: See "Receiver" on page 72
See "Spectrum" on page 73
See "I/Q analyzer" on page 73
See "AM/FM/PM analog demod" on page 73
See "New Channel setup" on page 74

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15.5.1 Measurement control

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ABORt

This command aborts the measurement in the current measurement channel and resets the trigger system.

To prevent overlapping execution of the subsequent command before the measurement has been aborted successfully, use the `*OPC` or `*WAI` command after `ABORt` and before the next command.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` command.

Note on blocked remote control programs:

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish. The remote channel to the R&S EPL1000 is blocked for further commands. In this case, you must interrupt processing on the remote channel first to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S EPL1000 on a parallel channel to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

- **Visa**: `viClear()`
- **GPIB**: `ibclr()`
- **RSIB**: `RSDLLibclr()`

Now you can send the `ABORt` command on the remote channel that runs the measurement.

Example: `ABOR;INIT:IMM`
Aborts the measurement and restarts it.

Usage: Event

HOLD

This command interrupts (holds) a scan.

To resume the scan, use `INITiate<n>[:IMMediate]` on page 381.

Example: `HOLD`
Interrupts the scan.

Usage: Event

INITiate<n>:CONMeas

This command resumes a scan that was interrupted by a transducer stop at the current receiver frequency.

If the scan was interrupted by the `HOLD` command, you have to resume it with `INITiate<n>[:IMMediate]`.

Suffix:
<mt> INITiate1 is irrelevant.
INITiate2 resumes the scan.

Example: //Configure a single measurement that is averaged over 20 measurements
```
INIT2:CONT OFF
SWE:COUN 20
```
//Start the measurement and wait for the end of the 20 scans
```
INIT2;*WAI
```
//Continue the measurement (next 20 sequences) and wait for the end
```
INIT2:CONM;*WAI
```

Usage: Event

INITiate<n>:CONTinuous <State>

This command controls the measurement mode for an individual channel setup.

Note that in single measurement mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous measurement mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous measurement mode in remote control, as results like trace data or markers are only valid after a single measurement end synchronization.

For details on synchronization see Remote control via SCPI.

If the measurement mode is changed for a channel setup while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 382), the mode is only considered the next time the measurement in that channel setup is activated by the Sequencer.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

ON | 1
Continuous measurement

OFF | 0
Single measurement

*RST: 0

Example: `INIT:CONT OFF`
Switches the measurement mode to single measurement.
`INIT:CONT ON`
Switches the measurement mode to continuous measurement.

Manual operation: See "Performing continuous measurements" on page 79
See "Performing single measurements" on page 80

INITiate<n>:EMITest

This command initiates an automated test sequence.

The sequence consists of a scan, a peak search and a final measurement.

When you are running a continuous measurement, you have to stop the scan deliberately (with `ABORt`) before the peak search is performed. For a single measurement, the R&S EPL1000 automatically performs the peak search after number of scans defined by the scan count has been performed.

Suffix:
<mt> irrelevant

Example: //Start the test sequence
`INIT2:EMIT`

Usage: Event

Manual operation: See "Performing single measurements" on page 80

INITiate<n>:FMEasurement

This command initiates a final measurement based on the peak list.

Suffix:
<mt> irrelevant

Example: //Start the final measurement
`INIT2:FME`

Usage: Event

Manual operation: See "Performing single measurements" on page 80

INITiate<n>[:IMMediate]

The command initiates a new measurement.

For a single measurement, the R&S EPL1000 stops measuring when it has reached the end frequency. When you start a continuous measurement, it stops only if you abort it deliberately.

If you are using trace modes MAXHold, MINHold and AVERage, previous results are reset when you restart the measurement.

- **Single measurements**
  Synchronization to the end of the measurement is possible with `*OPC`, `*OPC?` or `*WAI`.
- **Continuous measurements**
  Synchronization to the end of the measurement is not possible.
  It is thus recommended to use a single measurement for remote controlled measurements, because results like trace data or markers are only valid after synchronization.

Suffix:

<mt> INITiate1 initiates a bargraph measurement.
INITiate2 initiates a scan.

Example: //Start a single scan (with a scan count = 20), and wait until the measurement is done

```
INIT2:CONT OFF
SWE:COUN 20
INIT2;*WAI
```

Usage: Event

Manual operation: See "Performing continuous measurements" on page 79
See "Performing single measurements" on page 80

15.5.2 Measurement sequences

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CONFigure:RECeiver:MEASurement[:DEFault] <Measurement>

This command selects the measurement performed in a receiver channel during measurement sequences.

More information

Parameters:

<Measurement> **BARGraph**
Performs a bargraph measurement.

NONE
Performs no measurement.

SCAN
Performs a scan.

*RST: SCAN

Example: //Perform a bargraph measurement in a measurement sequence
`CONF:REC:MEAS BARG`

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements.

You can start a new sequence any time using `INITiate:SEQuencer:IMMediate` on page 382.

Usage: Event

Manual operation: See "Sequencer State" on page 77

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 383).

Example: `SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement is performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

Manual operation: See "Sequencer State" on page 77

INITiate:SEQuencer:MODE <Mode>

Defines the capture mode for the entire measurement sequence and all measurement groups and channels it contains.

Note: To synchronize to the end of a measurement sequence using `*OPC`, `*OPC?` or `*WAI`, use `SINGle` Sequencer mode.

Parameters:
<Mode>

SINGle
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence is finished.

CONTinuous
Each measurement group is started one after the other in the order of definition. All measurement channels in a group are started simultaneously and performed once. After *all* measurements are completed, the next group is started. After the last group, the measurement sequence restarts with the first one and continues until it is stopped explicitly.

*RST: CONTinuous

Manual operation: See "Sequencer Mode" on page 77

SYSTem:SEQuencer <State>

This command turns the Sequencer on and off. The Sequencer must be active before any other Sequencer commands (`INIT:SEQ...`) are executed, otherwise an error occurs.

A detailed programming example is provided in Chapter 15.5.13, "Programming example: performing a sequence of measurements", on page 420.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
The Sequencer is activated and a sequential measurement is started immediately.

OFF | 0
The Sequencer is deactivated. Any running sequential measurements are stopped. Further Sequencer commands (`INIT:SEQ...`) are not available.

*RST: 0

Example:

```
SYST:SEQ ON
```
Activates the Sequencer.
```
INIT:SEQ:MODE SING
```
Sets single Sequencer mode so each active measurement is performed once.
```
INIT:SEQ:IMM
```
Starts the sequential measurements.
```
SYST:SEQ OFF
```

Manual operation: See "Sequencer State" on page 77

15.5.3 Result retrieval

- Trace data and result query 384

15.5.3.1 Trace data and result query

This section contains information on the TRACe:DATA command and a detailed description of the characteristics of that command. Basically, the command queries the results of the current measurement. The command supports various SCPI parameters in combination with the query. Each SCPI parameter returns a different aspect of the measurement.

The format of the return values is either in ASCII or binary characters and depends on the format you have set with FORMat[:DATA] on page 521.

Querying trace data

The SCPI parameters TRACE1 | ... | TRACE6 return the trace data for the corresponding trace.

Example:

```
TRAC? TRACE1
```

The number of results depends on the currently selected number of sweep points. For each sweep point, the command returns one level value. The unit depends on the measurement and on the unit you have currently set.

The trace has to be active for the command to work.

When you have selected trace modeTRD, only the TRACE1 parameter is available. It returns the characteristics of the transducer's correction values over the currently selected frequency range.

Querying bargraph results

The SCPI parameters SINGLE and PHOLD return the results of the bargraph measurement.

SINGLE returns the current bargraph results for each active bargraph detector.

The order of detectors is as shown in the user interface. Inactive detectors are ignored.

Example:

```
TRAC? SINGLE
```

PHOLD returns the bargraph maxhold results for each active bargraph detector.

Each result is made up out of two values:

- Absolute level
- Frequency

The order of detectors is as shown in the user interface. Inactive detectors are ignored.

Example:

```
TRAC? PHOLD
```

Querying scan characteristics

The SCPI parameter `SCAN` returns the scan characteristics while the scan is running.

The number of returned results depends on the scan settings.

The type of returned data is as follows:

- 4 byte, trace status:
  ➞ bit 0 to 9 represent the number of the scan range
  ➞ bit 10 represents the last block of a scan range
  ➞ bit 11 represents the last block of the last scan range
  ➞ bit 12 represents the last of all blocks (for multiple scans after the last scan)
  When number of scan ranges greater than 10:
  ➞ bit 16 to 31 represent a value that has to be added to the bit coded range number (bit 0 to bit 9) to get the number of scan ranges. Example: bit 16 to 31 represent the value "20", bit 0 to 9 represent the value "5"; in that case the complete number of scan ranges is "25".
- 4 byte, number *n* of measurement results contained in one trace
- 4 byte, bit 0 represents the state of trace 1 (0/1)
- 4 byte, bit 0 represents the state of trace 2 (0/1)
- 4 byte, bit 0 represents the state of trace 3 (0/1)
- 4 byte, bit 0 represents the state of trace 4 (0/1)
  Note:
  If more than 4 traces are active, the state of trace 5 and 6 is indicated by an additional bit (bit 8) in the UINT32 field of trace 1 and 2.
- n*4 byte, measurement results for trace 1; only if trace 1 is active
- n*4 byte, measurement results for trace 2; only if trace 2 is active
- n*4 byte, measurement results for trace 3; only if trace 3 is active
- n*4 byte, measurement results for trace 4; only if trace 4 is active
- n*4 byte, measurement results for trace 5; only if trace 5 is active
- n*4 byte, measurement results for trace 6; only if trace 6 is active
- n*1 byte, status information for each measurement result
  ➞ bit 2 represents overrange for trace 1 to trace 6

The data is always returned in binary format (`FORM REAL,32`).

Note that the `SCAN` parameter only works while the scan is actually running.

Example:

```
TRAC? SCAN
```

Querying results for a peak search

The SCPI parameters `PLIST1` | ... | `PLIST6` returns the results of a peak search for a particular trace or detector (1 to 6).

Each result is made up out of three values:

- 4 byte, frequency
- 4 byte, absolute level

- 4 byte, Delta between absolute level and limit line value at corresponding frequency
  If no limit line is active, the delta value is set to 0.0

The trace has to be active for the command to work.

Example:

```
TRAC? PLIST3
```

Querying results for the final measurement

The SCPI parameters `FINAL1` | ... | `FINAL6` return the results of the final measurement for a particular trace or detector (1 to 6).

Each result is made up out of three values:

- 4 byte, frequency
- 4 byte, absolute level
- 4 byte, Delta between absolute level and limit line value at corresponding frequency
  If no limit line is active, the delta value is set to 0.0

The trace has to be active for the command to work.

Querying the status of the measurement results

The SCPI parameter `STATUS` returns the status information for each measurement result. Thus, the number of returned values depends on the number of measurement results *n*. For each measurement result, the parameter queries 1 byte of status information.

➞ bit 2 represents overrange for trace 1 to trace 6

Note that the `SCAN` parameter only works while the scan is actually running.

Example:

```
TRAC? STATUS
```

Querying spectrogram data

The SCPI parameter `SGRam` returns the contents of the spectrogram.

For every frame (horizontal line) in the spectrogram, the command returns the power levels that have been measured, one for each sweep or measurement point. The number of frames depends on the size of the history depth. The power level depends on the unit you have currently set.

Querying LISN settings

The SCPI parameters `PHASe1` to `PHASe6` return the LISN settings for each phase.

If trace mode "Max Hold" is selected, the R&S EPL1000 combines the maximum values for the measurements run on each phase into a single trace containing all phases.

TRACe<n>[:DATA]? <ResultType>

This command queries current trace data and measurement results.

The data format depends on `FORMat[:DATA]`.

Reading out trace data in IF analysis is possible with `TRACe<n>:IF[:DATA]`.

Suffix:
<n> Window

Query parameters:
<ResultType>

TRACE1 | ... | TRACE6
See "Querying trace data" on page 384.

FINAL1 | ... | FINAL6
See "Querying results for the final measurement" on page 386.

PLIST1 | ... | PLIST6
See "Querying results for a peak search" on page 385.

PHASe1 | ... | PHASe6
See "Querying LISN settings" on page 386.

PHOLd
See "Querying bargraph results" on page 384.

SCAN
See "Querying scan characteristics" on page 385.

SGRam | SPECtrogram
See "Querying spectrogram data" on page 386.

SINGle
See "Querying bargraph results" on page 384.

STATus
See "Querying scan characteristics" on page 385.

Return values:
<Result>

Example: //Query level for each trace point of trace 1.
`TRAC? TRACE1`

Usage: Query only

TRACe<n>:FEED:CONTrol <Occasion>

This command turns block data transmission during a scan on and off.

The availability of data is reported in the `STATus:OPERation` register.

The block size depends on scan time and the upper limit defined by `TRACe<n>:POINts` on page 388.

Suffix:
<n> irrelevant

Parameters:
<Occasion> **ALWays**
Block data transmission is on.

NEVer
Block data transmission is off.

*RST: NEVer

Example: //Select block data transmission
`TRAC:FEED:CONT ALW`

TRACe<n>:IF[:DATA] <ResultType>

This command queries current trace data and measurement results for IF analysis.

The data format depends on `FORMat[:DATA]`.

Suffix:
<n> 1..n
irrelevant

Parameters:
<ResultType> **TRACE1 | ... | TRACE3**
Returns the level values displayed on the corresponding trace.

Example: //Query the level for each trace point of trace 1
`TRAC:IF? TRACE1`

TRACe<n>:POINts <LIMit>, <Points>

This command defines the maximum number of measurement points that are transferred in one block after using `TRAC? SCAN`.

The total number of bytes which is transferred depends on the number of active traces.

Suffix:
<n> irrelevant

Parameters:
<LIMit>

<Points> Range: 1 to 10000
*RST: 1000

Example: //Transfer a maximum of 8000 measurement values per trace with a single query
`TRAC:POIN LIM, 8000`

15.5.4 Bargraph configuration

DISPlay:BARGraph:LEVel:LOWer?....389
DISPlay:BARGraph:LEVel:UPPer?....389
DISPlay:BARGraph:PHOLd:RESet....389
DISPlay:BARGraph:PHOLd[:STATe]....390
DISPlay:BARGraph:TCOupling[:STATe]....390
[SENSe:]DETector<t>:RECeiver[:FUNCtion]....390
[SENSe:]SWEep:TIME....391

DISPlay:BARGraph:LEVel:LOWer?

This command queries the level range of the bargraph.

Return values:

<Level> Lowest level displayed on the bargraph scale.
Default unit: depends on the selected unit

Example: //Query bargraph minimum level
`DISP:BARG:LEV:LOW?`
would return, e.g.
`10`

Usage: Query only

DISPlay:BARGraph:LEVel:UPPer?

This command queries the level range of the bargraph.

Return values:

<Level> Highest level displayed on the bargraph scale.
Default unit: depends on the selected unit

Example: //Query bargraph peak level
`DISP:BARG:LEV:UPP?`
would return, e.g.
`110`

Usage: Query only

DISPlay:BARGraph:PHOLd:RESet

This command resets the bargraph max hold.

Example: //Reset the max hold value
`DISP:BARG:PHOL:RES`

Usage: Event

Manual operation: See "Bargraph Max Hold" on page 84

DISPlay:BARGraph:PHOLd[:STATe] <State>

This command turns the bargraph max hold function on and off.

Parameters:

<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on the bargraph max hold
`DISP:BARG:PHOL ON`

Manual operation: See "Bargraph Max Hold" on page 84

DISPlay:BARGraph:TCOupling[:STATe] <State>

This command couples or decouples the bargraph detector and trace detector used for the scan.

Parameters:

<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Couple the type and color of bargraph and scan trace
`DISP:BARG:TCO ON`

Manual operation: See "Couple to Scan Trace" on page 84

[SENSe:]DETector<t>:RECeiver[:FUNCtion] <Detector>...

This command selects the detector for the bargraph measurement.

Suffix:

<t> Trace

Parameters:

<Detector> You can select up to four detectors, one for each active bargraph:
<Detector>, [<Detector>, <Detector>, <Detector>]

AVERage
Selects the Average detector.

CAVerage
Selects the CISPR Average detector.

CRMS
Selects the CISPR RMS detector.

NEGative
Selects the Min Peak detector.

POSitive
Selects the Max Peak detector.

QPEak
Selects the Quasipeak detector.

RMS
Selects the RMS detector.
*RST: AVERage

Example: //Select bargraph detector
`DET:REC POS,AVER,RMS`

Manual operation: See "Detector" on page 116

[SENSe:]SWEep:TIME <Time>

This command defines the measurement or acquisition time for bargraph measurements.

For scans not based on a scan table, the command also defines the measurement time for the scan.

Parameters:
<Time> <numeric value>
Range: 100 µs to 100 s
*RST: 0.1
Default unit: s

Example: //Define measurement time
`SWE:TIME 10s`

Manual operation: See "Measurement Time" on page 84

15.5.5 Scan configuration

Commands to configure scans described elsewhere.

- See Chapter 15.5.6, "Scan table configuration", on page 392.

[SENSe:]FREQuency:MODE....391
[SENSe:]SCAN<sr>:TDOMain....392

[SENSe:]FREQuency:MODE <Mode>

This command selects the scan mode.

Parameters:
<Mode> **SCAN | SWEep**
Selects stepped scans in the frequency domain.
Define the frequency range with:
- `[SENSe:]FREQuency:STARt`
- `[SENSe:]FREQuency:STOP`
- `[SENSe:]SCAN<sr>:STARt`
- `[SENSe:]SCAN<sr>:STOP`

TDOMain
Selects time domain scans in the frequency domain.
Define the frequency range with the commands for stepped scans.

*RST: TDOMain

Example: //Select stepped scan
```
FREQ:MODE SCAN
```

Manual operation: See "Selecting the scan type" on page 97

[SENSe:]SCAN<sr>:TDOMain <Time>

This command defines the measurement time for fixed frequency scans.

Suffix:
<sr> 1..n
irrelevant

Parameters:
<Time> <numeric value>

Measurement time in seconds.
The range indicated below is the maximum range. The actual range depends on the measurement time defined with `[SENSe:]SWEep:TIME` on page 391.

Range: 10 ms to 10000 s
Default unit: s

Example: //Define measurement time
```
SCAN:TDOM 100 s
```

15.5.6 Scan table configuration

[SENSe:]DETector<t>[:FUNCtion] 393
[SENSe:]FREQuency:STARt 393
[SENSe:]FREQuency:STOP 394
[SENSe:]SCAN<sr>:BANDwidth:RESolution 394
[SENSe:]SCAN<sr>:BARS 394
[SENSe:]SCAN<sr>:INPut:ATTenuation:AUTO 395
[SENSe:]SCAN<sr>:INPut:ATTenuation[:VALue] 395
[SENSe:]SCAN<sr>:INPut:GAIN:AUTO 395
[SENSe:]SCAN<sr>:INPut:GAIN:STATe 395
[SENSe:]SCAN<sr>:NAME 396
[SENSe:]SCAN<sr>:RANGes[:COUNt] 396
[SENSe:]SCAN<sr>:STARt 397
[SENSe:]SCAN<sr>:STEP 397
[SENSe:]SCAN<sr>:STOP 397
[SENSe:]SCAN<sr>:TIME 398
[SENSe:]SWEep:COUNt 398
[SENSe:]SWEep:SPACing 399

[SENSe:]DETector<t>[:FUNCtion] <Detector>

This command selects the detector for the scan.

In the Spectrum application, it selects the detector in general.

Suffix:
<t> 1..n
Trace

Parameters:
<Detector>

AVERage
Selects the Average detector.

CAVerage
Selects the CISPR Average detector.

CRMS
Selects the CISPR RMS detector.

NEGative
Selects the Min Peak detector.

POSitive
Selects the Max Peak detector.

QPEak
Selects the Quasipeak detector.

RMS
Selects the RMS detector.

*RST: POSitive

Example:
```
//Select scan detector
DET RMS
```

Manual operation: See "Detector" on page 116

[SENSe:]FREQuency:STARt <Frequency>

This command defines the start frequency of a scan.

In the spectrum application, the command defines the start frequency of a measurement.

Parameters:
<Frequency> <numeric value>

Range: Refer to the datasheet
*RST: depends on application
Default unit: Hz

Example:
```
//Define start frequency
FREQ:STAR 30 kHz
```

Manual operation: See "Defining a frequency range for the scan" on page 101
See "Start / Stop Frequency" on page 160

[SENSe:]FREQuency:STOP <Frequency>

This command defines the stop frequency of a scan.

In the Spectrum application, the command defines the stop frequency of a measurement.

Parameters:

<Frequency> <numeric value>

Range: Refer to the datasheet
*RST: depends on application
Default unit: Hz

Example: //Define stop frequency
```
FREQ:STOP 100MHz
```

Manual operation: See "Defining a frequency range for the scan" on page 101
See "Start / Stop Frequency" on page 160

[SENSe:]SCAN<sr>:BANDwidth:RESolution <Bandwidth>

This command defines the resolution bandwidth applied in the selected scan range.

Suffix:

<sr> Selects the scan range.

Parameters:

<Bandwidth> <numeric value>

If you enter a resolution bandwidth that is not supported, the R&S EPL1000 uses the next available bandwidth instead.

Range: Refer to datasheet
Default unit: Hz

Example: //Define a measurement bandwidth for the 4th scan range
```
SCAN4:BAND:RES 1MHz
```

Manual operation: See "Measurement Bandwidth" on page 85

[SENSe:]SCAN<sr>:BARS <State>

This command turns the display of the bars indicating the size of a scan range on and off.

Suffix:

<sr> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn on range bars
```
SCAN:BARS ON
```

Manual operation: See "Displaying range bars" on page 102

[SENSe:]SCAN<sr>:INPut:ATTenuation:AUTO <State>

This command turns auto ranging in a scan range on and off.

Suffix:
<sr> irrelevant

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn off auto ranging in the 4th scan range
```
SCAN4:INP:ATT:AUTO OFF
```

Manual operation: See "Auto Range" on page 104

[SENSe:]SCAN<sr>:INPut:ATTenuation[:VALue] <Attenuation>

This command defines the attenuation level applied in the selected scan range.

Suffix:
<sr> Selects the scan range.

Parameters:
<Attenuation> <numeric value> (integer only)
Range: 0 dB to 79 dB
Increment: 1 dB
*RST: 10 dB
Default unit: dB

Example: //Define attenuation for the 4th scan range.
```
SCAN4:INP:ATT 30dB
```

Manual operation: See "Attenuation" on page 105

[SENSe:]SCAN<sr>:INPut:GAIN:AUTO <State>

This command includes and excludes the preamplifier from the auto ranging feature.

Suffix:
<sr> Selects the scan range.

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Automatically determine if the preamplifier is used or not
```
SCAN1:INP:GAIN:AUTO ON
```

Manual operation: See "Preamplifier" on page 105

[SENSe:]SCAN<sr>:INPut:GAIN:STATe <State>

This command turns the preamplifier in a scan range on and off.

The command is available with the optional preamplifier.

Suffix:
<sr> Selects the scan range.

Parameters:
<State> **ON | 1**
Turns on the preamplifier.
OFF | 0
Turns off the preamplifier.
*RST: OFF

Example: //Turn on preamplifier for 4th scan range.
```
SCAN4:INP:GAIN:STAT ON
```

Manual operation: See "Preamplifier" on page 105

[SENSe:]SCAN<sr>:NAME <Name>

This command changes the name of a scan range.

Suffix:
<sr> Selects the scan range.

Parameters:
<Name> String containing the name of the scan range.

Example: //Change name of scan range 4
```
SCAN4:NAME 'Fourth Range'
```

Manual operation: See "Configuring scan ranges" on page 102

[SENSe:]SCAN<sr>:RANGes[:COUNt] <Range>

This command defines the number of scan ranges.

Suffix:
<sr> irrelevant

Parameters:
<Range> <numeric value> (integer only)
Number of ranges in the scan table.
If you enter the value "0", the R&S EPL1000 ignores the configuration of the scan table. Instead, it performs the measurement based on the current receiver configuration.
Range: 0 to 100
*RST: 2

Example: //Define number of scan ranges
```
SCAN:RANG:COUN 4
```

Manual operation: See "Adding and removing scan ranges" on page 101

[SENSe:]SCAN<sr>:STARt <Frequency>

This command defines the start frequency of a scan range.

Suffix:
<sr> Selects the scan range.

Parameters:
<Frequency> <numeric value>

Range: Refer to the datasheet
*RST: Depends on the scan range.
Default unit: Hz

Example: //Define start frequency for 4th scan range
```
SCAN4:STAR 30MHz
```

Manual operation: See "Range Start and Range Stop" on page 103

[SENSe:]SCAN<sr>:STEP <Frequency>

This command defines the frequency stepsize applied in the selected scan range

Available for linear and logarithmic step mode (`[SENSe:]SWEep:SPACing`).

Suffix:
<sr> Selects the scan range.

Parameters:
<Frequency> <numeric value>

Linear step mode: numeric value in %.
Logarithmic step mode: numeric value in Hz.

*RST: Depends on the scan and frequency range.
Default unit: HZ

Example: //Define step size for 4th scan range
```
SWE:SPAC LIN
SCAN4:STEP 100KHZ
```

Manual operation: See "Step Size" on page 103

[SENSe:]SCAN<sr>:STOP <Frequency>

This command defines the stop frequency of a scan range.

Suffix:
<sr> Selects the scan range.

Parameters:
<Frequency> <numeric value>

Range: Refer to the datasheet
*RST: Depends on the scan range.
Default unit: Hz

Example: //Define stop frequency for 4th scan range
```
SCAN4:STOP 500MHz
```

Manual operation: See "Range Start and Range Stop" on page 103

[SENSe:]SCAN<sr>:TIME <Time>

This command defines the measurement time applied in the selected scan range.

Suffix:
<sr> Selects the scan range.

Parameters:
<Time> <numeric value>

Range: 100 µs to 100 s
*RST: depends on the range
Default unit: s

Example: //Define measurement time for 4th scan range
```
SCAN4:TIME 1 ms
```

Manual operation: See "Measurement Time" on page 84

[SENSe:]SWEep:COUNt <Measurements>

This command defines the number of measurements that the application uses to average traces.

For continuous measurements, the application calculates the moving average over the average count.

For single measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:
<Measurements> <numeric value> (integer only)

Number of measurements considered in calculating an average trace.
When you set a count of 1, the R&S EPL1000 performs a single measurement over the selected scan range.

Range: 0 to 32767
*RST: 0

Example: //Define 10 measurements in single measurement mode
```
SWE:COUN 10
INIT:CONT OFF
```
//Start sweep and wait for its end
```
INIT;*WAI
```

Manual operation: See "Scan Count" on page 97

[SENSe:]SWEep:SPACing <StepMode>

This command selects the frequency step mode.

Note that the command has no effect on the scale and display of the frequency axis.

Parameters:

<StepMode>

LINear
Linear frequency steps with a fix stepsize.

AUTO
The stepsize is coupled to the resolution bandwidth to get the best measurement results.

*RST: AUTO

Example:

//Select logarithmic frequency steps
`SWE:SPAC LIN`

Manual operation: See "Selecting the frequency step mode" on page 102

15.5.7 Peak search

Commands to configure the peak search described elsewhere.

- `FORMat:DEXPort:DSEParator` on page 522

CALCulate<n>:MARKer<m>:PEXCursion....399
CALCulate<n>:PSEarch:ADD....400
CALCulate<n>:PEAKsearch:ADD....400
CALCulate<n>:PSEarch:AUTO....400
CALCulate<n>:PEAKsearch:AUTO....400
CALCulate<n>:PSEarch:CLEar[:IMMediate]....401
CALCulate<n>:PEAKsearch:CLEar[:IMMediate]....401
CALCulate<n>:PSEarch[:IMMediate]....401
CALCulate<n>:PEAKsearch[:IMMediate]....401
CALCulate<n>:PSEarch:MARGin....401
CALCulate<n>:PEAKsearch:MARGin....401
CALCulate<n>:PSEarch:METHod....401
CALCulate<n>:PEAKsearch:METHod....401
CALCulate<n>:PSEarch:SUBRanges:PCOunt....402
CALCulate<n>:PEAKsearch:SUBRanges:PCOunt....402
CALCulate<n>:PSEarch:SUBRanges....402
CALCulate<n>:PEAKsearch:SUBRanges[:VALue]....402
DISPlay[:WINDow<n>]:TRACe<t>:SYMBol....403
MMEMory:STORe:FINal....403
MMEMory:STORe:PLISt....404

CALCulate<n>:MARKer<m>:PEXCursion <Excursion>

This command defines the peak excursion (for *all* markers in *all* windows).

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Excursion> The excursion is the distance to a trace maximum that must be attained before a new maximum is recognized, or the distance to a trace minimum that must be attained before a new minimum is recognized

*RST: 6 dB

Example: `CALC:MARK:PEXC 10dB`
Defines peak excursion as 10 dB.

Manual operation: See "Defining peak characteristics" on page 109
See "Peak Excursion" on page 219

CALCulate<n>:PSEarch:ADD <Frequency>
CALCulate<n>:PEAKsearch:ADD <Frequency>

This command manually adds a particular frequency to the peak list, regardless if the level threshold conditions have been fulfilled for that frequency.

Note that the frequency has to be in the displayed frequency range.

Suffix:
<n> irrelevant

Setting parameters:
<Frequency>

Example: //Add a frequency to the peak list
`CALC:PEAK:ADD 93MHz`

Usage: Setting only

Manual operation: See "Editing a peak list" on page 111
See "Adding the current frequency to the peak list" on page 111

CALCulate<n>:PSEarch:AUTO <State>
CALCulate<n>:PEAKsearch:AUTO <State>

This command turns an automatic test sequence on and off.

An automated test sequence includes a scan and a peak search, but no final measurement.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on the automated peak search
```
CALC:PEAK:AUTO ON
```

CALCulate<n>:PSEarch:CLEar[:IMMediate]
CALCulate<n>:PEAKsearch:CLEar[:IMMediate]

This command deletes the contents of a peak list.

Suffix:
<n> irrelevant

Example: //Clear the peak list
```
CALC:PEAK:CLE
```

Usage: Event

Manual operation: See "Editing a peak list" on page 111

CALCulate<n>:PSEarch[:IMMediate]
CALCulate<n>:PEAKsearch[:IMMediate]

This command initiates a peak search.

Suffix:
<n> irrelevant

Example: //Initiate a peak search
```
CALC:PEAK
```

Usage: Event

CALCulate<n>:PSEarch:MARGin <Margin>
CALCulate<n>:PEAKsearch:MARGin <Margin>

This command defines the limit line margin that is considered during a peak search.

Suffix:
<n> irrelevant

Parameters:
<Margin> Default unit: dB

Example: //Define a limit line margin
```
CALC:PEAK:MARG 2
```

Manual operation: See "Defining peak characteristics" on page 109

CALCulate<n>:PSEarch:METHod <Method>
CALCulate<n>:PEAKsearch:METHod <Method>

This command selects the way the R&S EPL1000 creates a peak list.

Suffix:
<n> irrelevant

Parameters:
<Method>

SUBRange
Divides the scan range into smaller subranges and looks for a particular number of peaks in each subrange.

PEAK
Looks for a particular number of peaks over the complete scan range.

*RST: PEAK

Example: //Divide the scan range into smaller subranges for the peak search
```
CALC:PEAK:METH SUBR
```

Manual operation: See "Selecting the peak search method" on page 108

CALCulate<n>:PSEarch:SUBRanges:PCOunt <Peaks>
CALCulate<n>:PEAKsearch:SUBRanges:PCOunt <Peaks>

This command defines the number of peaks to be found in each subrange.

Prerequisites for this command

- Select subrange peak search mode (`CALCulate<n>:PEAKsearch:METHod`).
- Define number of subranges (`CALCulate<n>:PEAKsearch:SUBRanges[:VALue]`).

Suffix:
<n> irrelevant

Parameters:
<Peaks>

Number of peaks in one subrange.
Note that the maximum number of peaks is 500. Thus, the maximum number of peaks per subrange depends on the number of subranges you have defined.

*RST: 1

Example:
```
CALC:PEAK:METH SUBR
CALC:PEAK:SUBR 20
CALC:PEAK:SUBR:PCO 5
```
Looks for 5 peaks in each of 20 subranges.

Manual operation: See "Controlling the size of the peak list" on page 108

CALCulate<n>:PSEarch:SUBRanges <Peaks> | <Subranges>
CALCulate<n>:PEAKsearch:SUBRanges[:VALue] <Peaks | Subranges>

The effects of this command depend on the peak search mode that you have selected.

Suffix:
<n> irrelevant

Parameters:

<Peaks | Subranges> If you have selected the "Peaks" search mode, the command defines the number of peaks to look for during the peak search.

Range: 1 to 500
*RST: 50

Example: //Select subrange search and define 25 subranges
```
CALC:PEAK:METH SUBR
CALC:PEAK:SUBR 25
```

Manual operation: See "Controlling the size of the peak list" on page 108

DISPlay[:WINDow<n>]:TRACe<t>:SYMBol <Symbol>

This command turns the peak labels in the diagram on and off.

Suffix:

<n> irrelevant

<t> irrelevant

Parameters:

<Symbol>

CROSs
Each peak is labeled by a symbol. The symbol and its color depend on the trace the peak is on.

OFF
Peak labels are off.

*RST: CROSs

Example: //Turn on peak labels
```
DISP:TRAC:SYMB CROS
```

Manual operation: See "Displaying peaks as symbols" on page 112

MMEMory:STORe:FINal <FileName>

This command exports the contents of the final measurement peak list to a file in ASCII format.

Setting parameters:

<FileName> String containing the file name. The extension of the file is `*.dat`.

Example: //Export the peak list
```
MMEM:STOR:FIN 'A:\TEST.DAT'
```

Usage: Setting only

Manual operation: See "Exporting a peak list" on page 112

MMEMory:STORe:PLISt <FileName>

This command exports the contents of the final measurement peak list to a file in ASCII format.

Setting parameters:

<FileName> String containing the file name. The extension of the file is `*.dat`.

Example: //Export the peak list
`MMEM:STOR:PLIS 'A:\TEST.DAT'`

Usage: Setting only

Manual operation: See "Exporting a peak list" on page 112

15.5.8 Peak list

CALCulate<n>:PSEarch:PLISt<peak>:ALL? 404
CALCulate<n>:PEAKsearch:PLISt<pi>:ALL? 404
CALCulate<n>:PSEarch:PLISt<peak>:COMMent 405
CALCulate<n>:PEAKsearch:PLISt<pi>:COMMent 405
CALCulate<n>:PSEarch:PLISt<peak>:DELete 405
CALCulate<n>:PEAKsearch:PLISt<pi>:DELete 405
CALCulate<n>:PSEarch:PLISt<peak>:DELTa? 405
CALCulate<n>:PEAKsearch:PLISt<pi>:DELTa? 405
CALCulate<n>:PSEarch:PLISt<peak>:DETector? 406
CALCulate<n>:PEAKsearch:PLISt<pi>:DETector? 406
CALCulate<n>:PSEarch:PLISt<peak>:FREQuency? 406
CALCulate<n>:PEAKsearch:PLISt<pi>:FREQuency? 406
CALCulate<n>:PSEarch:PLISt<peak>:LEVel? 407
CALCulate<n>:PEAKsearch:PLISt<pi>:LEVel 407
CALCulate<n>:PSEarch:PLISt<peak>:SIZE? 407
CALCulate<n>:PEAKsearch:PLISt<pi>:SIZE? 407
CALCulate<n>:PSEarch:PLISt<peak>:TRACe? 407
CALCulate<n>:PEAKsearch:PLISt<pi>:TRACe? 407
CALCulate<n>:PSEarch:PLISt<peak>[:DATA]? 408
CALCulate<n>:PEAKsearch:PLISt<pi>[:DATA]? 408

CALCulate<n>:PSEarch:PLISt<peak>:ALL?
CALCulate<n>:PEAKsearch:PLISt<pi>:ALL?

This command queries the information for all peaks found in the peak search.

Suffix:

<n> irrelevant

<pi> irrelevant

Return values:

<Peaks> List of values representing all measured peaks. The size of the list depends on the number of peaks found in the peak search. For each peak, the command returns the following information.

<TraceNumber>,<Detector>,<Frequency>,<Level>,
<DeltaLimit>,<Comment>,...
<DeltaLimit> is '0' if you use no limit line.
<comment> is empty if you have not entered one for the corresponding peak.

Example: //Query peak information
```
CALC:PEAK:PLIS:ALL?
```
would return, e.g.
```
'TRACE1,Quasi-Peak,
4.5e+07,53.99,0,yahoo,TRACE2,Average,
4.5e+07,53.07,0,,TRACE3,RMS,
4.5e+07,50.89,0,,TRACE4,Quasi-Peak,
4.5e+07,53.99,0,,[...]'
```

Usage: Query only

CALCulate<n>:PSEarch:PLISt<peak>:COMMent <Comment>
CALCulate<n>:PEAKsearch:PLISt<pi>:COMMent <Comment>

This command assigns a comment to a peak found in the peak search.

Suffix:
<n> irrelevant

<pi> 1..n
Peak

Parameters:
<Comment> String that contains the comment.

Example: //Define a comment for a peak
```
CALC:PEAK:PLIS4:COMM 'Woohoo'
```

CALCulate<n>:PSEarch:PLISt<peak>:DELete
CALCulate<n>:PEAKsearch:PLISt<pi>:DELete

This command deletes a peak from the peak list.

Suffix:
<n> irrelevant

<pi> Peak

Example: //Deletes a peak from the peak list
```
CALC:PEAK:PLIS4:DEL
```

Usage: Event

CALCulate<n>:PSEarch:PLISt<peak>:DELTa?
CALCulate<n>:PEAKsearch:PLISt<pi>:DELTa?

This command queries the distance of a peak to the nearest limit line in the peak search.

Suffix:
<n> irrelevant

<pi> Peak

Return values:
<Level> If you are using no limit line, the return value is '0'.

Example: //Query distance to limit line
```
CALC:PEAK:PLIS4:DELT?
```
//would return, e.g.
```
3.23
```

Usage: Query only

CALCulate<n>:PSEarch:PLISt<peak>:DETector?
CALCulate<n>:PEAKsearch:PLISt<pi>:DETector?

This command queries the detector with which a peak was found in the peak search.

Suffix:
<n> irrelevant

<pi> Peak

Return values:
<Detector> String that contains the name of the detector.

Example: //Query detector the peak was measured with
```
CALC:PEAK:PLIS4:DET?
```
//would return, e.g.
```
'Average'
```

Usage: Query only

CALCulate<n>:PSEarch:PLISt<peak>:FREQuency?
CALCulate<n>:PEAKsearch:PLISt<pi>:FREQuency?

This command queries the frequency of a peak found in the peak search.

Suffix:
<n> irrelevant

<pi> Peak

Return values:
<Frequency>

Example: //Query frequency of a peak
```
CALC:PEAK:PLIS4:FREQ?
```
//would return, e.g.
```
69420000
```

Usage: Query only

CALCulate<n>:PSEarch:PLISt<peak>:LEVel?
CALCulate<n>:PEAKsearch:PLISt<pi>:LEVel <Level>

This command queries the level of a peak found in the peak search.

Suffix:
<n> irrelevant

<pi> Peak

Parameters:
<Level> <numeric value>

The unit depends on your selection (`CALCulate<n>:UNIT:POWer`).

Example: //Query level of the fourth peak
```
CALC:PEAK:PLIS4:LEV?
```
//would return, e.g.
```
-53.99
```

CALCulate<n>:PSEarch:PLISt<peak>:SIZE?
CALCulate<n>:PEAKsearch:PLISt<pi>:SIZE?

This command queries the number of peaks found in the peak search.

Suffix:
<n> irrelevant

<pi> irrelevant

Return values:
<Peaks>

Example: //Query size of peak list
```
CALC:PEAK:PLIS:SIZE
```
//would return, e.g.
```
100
```

Usage: Query only

CALCulate<n>:PSEarch:PLISt<peak>:TRACe?
CALCulate<n>:PEAKsearch:PLISt<pi>:TRACe?

This command queries the trace that a peak found in the peak search is located on.

Suffix:
<n> irrelevant

<pi> Peak

Return values:
<Trace> String that contains the trace number.

Example: //Query trace the peak is on
`CALC:PEAK:PLIS4:TRAC`
//would return, e.g.
`'TRACE1'`

Usage: Query only

CALCulate<n>:PSEarch:PLISt<peak>[:DATA]?
CALCulate<n>:PEAKsearch:PLISt<pi>[:DATA]?

This command queries the information for a peak found in the peak search.

Suffix:
<n> irrelevant

<pi> Peak

Return values:
<PeakResults> String that contains a list of values for the selected peak.
The command returns the following information.
`<TraceNumber>,<Detector>,<Frequency>,<Level>,`
`<DeltaLimit>,<Comment>,...`
`<DeltaLimit>` is '0' if you use no limit line.
`<comment>` is empty if you have not entered one for the corresponding peak.

Example: //Query the information for a peak
`CALC:PEAK:PLIS4?`
//would return, e.g.
`'TRACE2,Average,4.5e+07,53.07,0,Woohoo'`

Usage: Query only

15.5.9 Final measurement (and trace) configuration

CALCulate<n>:FMEasurement[:AUTO] 408
[SENSe:]CORRection:TRANsducer:VIEW 409
[SENSe:]DETector<t>:FMEasurement 409
[SENSe:]FMEasurement:AUTO 410
[SENSe:]FMEasurement:TIME 410
DISPlay[:WINDow<n>]:TRACe<t>:MODE 410
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] 411
[SENSe:]AVERage<n>:TYPE 412

CALCulate<n>:FMEasurement[:AUTO] <State>

This command turns a full automated test sequence on and off.

A full automated test sequence includes a scan, a peak search and a final measurement.

Suffix:
<n> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on automated test sequence.

```
CALC:FME ON
```

[SENSe:]CORRection:TRANsducer:VIEW <State>

This command turns the "Transducer" trace mode on and off.

Also possible with `DISPlay[:WINDow<n>]:TRACe<t>:MODE` on page 410.

Parameters:

<State>

ON | 1
Turns on the transducer trace.
The transducer trace represents the correction values of all active transducers over the currently selected frequency range. When you turn on the transducer trace, all other traces are temporarily removed.

OFF | 0
Turns off the transducer trace, and restores the original scan traces.

*RST: 0

Example:

```
CORR:TRAN:VIEW ON
TRAC? TRACE1
```

Turns on the transducer trace and queries the correction values.

Manual operation: See "Trace Mode" on page 115

[SENSe:]DETector<t>:FMEasurement <Detector>

This command selects the detector for the final measurement.

Suffix:

<t> Trace

Parameters:

<Detector>

AVERage
Selects the Average detector.

CAVerage
Selects the CISPR Average detector.

CRMS
Selects the CISPR RMS detector.

NEGative
Selects the Min Peak detector.

NONE
Ignores the corresponding trace during the final measurement.

POSitive
Selects the Max Peak detector.

QPEak
Selects the Quasipeak detector.

RMS
Selects the RMS detector.

*RST: QPEak

Example: //Select final measurement detector
```
DET:FME POS
```

Manual operation: See "Detector" on page 116

[SENSe:]FMEasurement:AUTO <State>

This command turns a full automated test sequence on and off.

A full automated test sequence includes a scan, a peak search and a final measurement.

Parameters:
<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn on automated test sequence.
```
FME:AUTO ON
```

Manual operation: See "Interactive" on page 117

[SENSe:]FMEasurement:TIME <Time>

This command defines the time each frequency in the peak list is measured during the final measurement.

Parameters:
<Time> <numeric value>

*RST: 1 s
Default unit: s

Example: //Define final measurement time
```
FME:TIME 1us
```

Manual operation: See "Measurement Time" on page 84

DISPlay[:WINDow<n>]:TRACe<t>:MODE <DisplayMode>

This command selects the trace mode.

To turn on the transducer trace mode, use `[SENSe:]CORRection:TRANsducer:VIEW` on page 409.

Suffix:
<n> irrelevant

<t> Trace

Parameters:

<DisplayMode>

AVERage
Draws a trace based on the average over several measurements.
You can define the number of measurements considered in the averaging process with `[SENSe:]SWEep:COUNt`.

BLANk
Removes the trace from the display.

MAXHold
Draws a trace based on the highest values that have been measured over several measurements.
You can define the number of measurements with `[SENSe:]SWEep:COUNt`.

MINHold
Draws a trace based on the lowest values that have been measured over several measurements.
You can define the number of measurements with `[SENSe:]SWEep:COUNt`.

TRD
Draws a trace that shows the correction values of all active transducer factors in the currently selected frequency range.
See also `[SENSe:]CORRection:TRANsducer:VIEW` on page 409.

VIEW
Freezes the trace.
Even if you continue the measurement, the trace remains as it is.

WRITe
Overwrites the trace when a new measurement begins.

*RST: Depends on the trace number.

Example:

```
//Select trace mode and display the highest value obtained over 5 measurements
DISP:TRAC2:MODE MAXH
SENS:SWE:COUN 5
```

Manual operation: See "Trace Mode" on page 115

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Suffix:

<n> Window
Irrelevant in the Receiver application.

<w> subwindow
Not supported by all applications

<t> Trace

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:TRAC3 ON`

[SENSe:]AVERage<n>:TYPE <Mode>

This command selects the trace averaging mode.

Suffix:
<n> 1..n
Window

Parameters:
<Mode>

LOGarithmic
The logarithmic power values are averaged.

LINear
The power values are averaged before they are converted to logarithmic values.

POWer
The power level values are converted into unit Watt prior to averaging. After the averaging, the data is converted back into its original unit.

Example: `AVER:TYPE LIN`
Switches to linear average calculation.

Manual operation: See "Average Mode" on page 117

15.5.10 Final results

CALCulate<n>:FMEasurement:PLISt<pi>:ALL? 413
CALCulate<n>:FMEasurement:PLISt<pi>:COMMent 413
CALCulate<n>:FMEasurement:PLISt<pi>:DELTa? 413
CALCulate<n>:FMEasurement:PLISt<pi>:DETector 414
CALCulate<n>:FMEasurement:PLISt<pi>:FREQuency? 414
CALCulate<n>:FMEasurement:PLISt<pi>:LEVel 415
CALCulate<n>:FMEasurement:PLISt<pi>:SIZE? 415
CALCulate<n>:FMEasurement:PLISt<pi>:TRACe? 415
CALCulate<n>:FMEasurement:PLISt<pi>[:DATA]? 416

CALCulate<n>:FMEasurement:PLISt<pi>:ALL?

This command queries the information for all peaks measured in the final measurement.

Suffix:
<n> irrelevant

<pi> irrelevant

Return values:
<FinalResults> List of values representing all measured peaks. The size of the list depends on the number of peaks measured in the final measurement.
For each peak, the command returns the following information.
`<TraceNumber>,<Detector>,<Frequency>,<Level>,<DeltaLimit>,<Comment>,...`
`<DeltaLimit>` is '0' if you use no limit line.
`<comment>` is empty if you have not entered one for the corresponding peak.

Example: //Query peak information
```
CALC:FME:PLIS?
```
would return, e.g.
```
'TRACE1,Quasi-Peak,
4.5e+07,53.99,0,yahoo,TRACE2,Average,
4.5e+07,53.07,0,,TRACE3,RMS,
4.5e+07,50.89,0,,TRACE4,Quasi-Peak,
4.5e+07,53.99,0,,[...]'
```

Usage: Query only

CALCulate<n>:FMEasurement:PLISt<pi>:COMMent <Comment>

This command defines a comment for a peak measured in the final measurement.

Suffix:
<n> irrelevant

<pi> Peak

Parameters:
<Comment> String that contains the comment.

Example: //Define a comment for the fourth peak in the peak list
```
CALC:FME:PLIS4:COMM 'Woohoo'
```

CALCulate<n>:FMEasurement:PLISt<pi>:DELTa?

This command queries the distance of a peak to the nearest limit line in the final measurement.

Suffix:
<n> irrelevant

<pi> Peak

Return values:

<Level> <numeric value>

If you are using no limit line, the return value is '0'.

Default unit: dB

Example: //Query distance of a peak to a limit line

```
CALC:FME:PLIS4:DELT?
```

//would return, e.g.

```
3.23
```

Usage: Query only

CALCulate<n>:FMEasurement:PLISt<pi>:DETector <Detector>

This command queries the detector with which a peak was measured in the final measurement.

Suffix:

<n> irrelevant

<pi> Peak

Parameters:

<Detector> String that contains the name of the detector.

Example: //Query detector the peak was measured with

```
CALC:FME:PLIS4:DET?
```

//would return, e.g.

```
'Average'
```

CALCulate<n>:FMEasurement:PLISt<pi>:FREQuency?

This command queries the frequency of a peak measured in the final measurement.

Suffix:

<n> irrelevant

<pi> Peak

Return values:

<Frequency> <numeric value>

Default unit: Hz

Example: //Query frequency of a peak

```
CALC:FME:PLIS4:FREQ?
```

//would return, e.g.

```
69420000
```

Usage: Query only

CALCulate<n>:FMEasurement:PLISt<pi>:LEVel <Level>

This command queries the level of a peak measured in the final measurement.

Suffix:
<n> irrelevant

<pi> Peak

Parameters:
<Level> <numeric value>

The unit depends on your selection (`CALCulate<n>:UNIT:POWer`).

Example: //Query level of the fourth peak
```
CALC:FME:PLIS4:LEV?
```
//Return value example:
```
-53.99
```

CALCulate<n>:FMEasurement:PLISt<pi>:SIZE?

This command queries the number of peaks measured in the final measurement.

Suffix:
<n> irrelevant

<pi> irrelevant

Return values:
<Peaks>

Example: //Query size of peak list
```
CALC:FME:PLIS:SIZE
```
Return value example:
```
100
```

Usage: Query only

CALCulate<n>:FMEasurement:PLISt<pi>:TRACe?

This command queries the trace that a peak measured in the final measurement is located on.

Suffix:
<n> irrelevant

<pi> Peak

Return values:
<Trace> String that contains the trace number.

Example: //Query trace of the peak
```
CALC:FME:PLIS4:TRAC
```
//would return, e.g.
```
'TRACE1'
```

Usage: Query only

CALCulate<n>:FMEasurement:PLISt<pi>[:DATA]?

This command queries the information for a peak measured in the final measurement.

Suffix:
<n> irrelevant

<pi> Peak

Return values:
<PeakResults> List of values for the selected peak.
The command returns the following information.
`<TraceNumber>,<Detector>,<Frequency>,<Level>,<DeltaLimit>,<Comment>,...`
`<DeltaLimit>` is '0' if you use no limit line.
`<comment>` is empty if you have not entered one for the corresponding peak.

Example: //Query peak information
`CALC:FME:PLIS4?`
//Return value example:
`'TRACE2,Average,4.5e+07,53.07,0,Woohoo'`

Usage: Query only

15.5.11 LISN configuration

[SENSe:]FMEasurement:LISN:PHASe....416
[SENSe:]SCAN<sr>:LISN:PHASe....417
INPut<ip>:LISN:FILTer:HPASs[:STATe]....417
INPut<ip>:LISN:PHASe....418
INPut<ip>:LISN[:TYPE]....418

[SENSe:]FMEasurement:LISN:PHASe <Phase>...

This command selects the LISN phases to be measured in a final measurement.

Parameters:
<Phase> You can select several phases for the final measurement:
<Phase>,[<Phase>,<Phase>,<Phase>]

L1

L2
Available for networks with four phases (R&S ESH2Z5, R&S ENV4200 and R&S ENV432)

L3
Available for networks with four phases (R&S ESH2Z5, R&S ENV4200 and R&S ENV432)

N

*RST: L1

Example: //Select phases for the final measurement
`FME:LISN:PHAS L1,N`

Manual operation: See "Phase" on page 120

[SENSe:]SCAN<sr>:LISN:PHASe <Phase>...

This command selects the LISN phases to be measured in a scan.

Suffix:
<sr> irrelevant

Parameters:
<Phase> You can select several phases for the scan:
<Phase>,[<Phase>,<Phase>,<Phase>]

L1

L2
Available for networks with four phases (R&S ESH2Z5, R&S ENV4200 and R&S ENV432)

L3
Available for networks with four phases (R&S ESH2Z5, R&S ENV4200 and R&S ENV432)

N

*RST: L1

Example: //Select phases to be measured in the scan
`SCAN:LISN:PHAS L1,N`

Manual operation: See "Phase" on page 120

INPut<ip>:LISN:FILTer:HPASs[:STATe] <State>

This command turns the 150 kHz highpass filter of the ENV216 network on and off.

Prerequisites for this command

- Select ENV216 network (`INPut<ip>:LISN[:TYPE]`).

Suffix:
<ip> irrelevant

Parameters:
<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on high pass filter
`INP:LISN:TYPE ENV216`
`INP:LISN:FILT:HPAS ON`

Manual operation: See "High-Pass Filter 150 kHz" on page 121

INPut<ip>:LISN:PHASe <Phase>

This command selects one LISN phase to be measured.

The command is available in all applications (spectrum, receiver, I/Q analyzer and analog demodulator).

Suffix:
<ip> irrelevant

Parameters:
<Phase> **L1**

L2
Available for networks with four phases (R&S ESH2Z5, R&S ENV4200 and R&S ENV432)

L3
Available for networks with four phases (R&S ESH2Z5, R&S ENV4200 and R&S ENV432)

N

*RST: L1

Example: //Select phase L1
```
INP:LISN:PHAS L1
```

Manual operation: See "Phase" on page 120

INPut<ip>:LISN[:TYPE] <Type>

This command turns automatic control of a LISN on and off. It also selects the type of network.

Suffix:
<ip> irrelevant

Parameters:
<Type> **ENV216**
R&S ENV 216: two phases and highpass are controllable.

ENV432
R&S ENV 432: four phases are controllable.

ENV4200
R&S ENV 4200: four phases are controllable.

ESH2Z5
R&S ESH2-Z5: four phases (incl. protective earth) are controllable.

ESH3Z5
R&S ESH3-Z5: two phases (incl. protective earth) are controllable.

FOURphase
R&S ESH2-Z5: four phases (incl. protective earth) are controllable.

OFF
Turns off control of the LISN.

TWOPhase
R&S ESH3-Z5: two phases (incl. protective earth) are controllable.

*RST: OFF

Example: //Select LISN
```
INP:LISN:TYPE TWOP
```

Manual operation: See "LISN Type" on page 120

15.5.12 Preventing overlapping execution

To prevent an overlapping execution of commands, one of the commands `*OPC`, `*OPC?` or `*WAI` can be used. All three commands cause a certain action only to be carried out after the hardware has been set. The controller can be forced to wait for the corresponding action to occur.

Table 15-3: Synchronization using *OPC, *OPC? and *WAI

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the Standard Event Status Register (ESR) after all previous commands have been executed.	• Setting bit 0 in the ESE • Setting bit 5 in the SRE • Waiting for service request (SRQ)
*OPC?	Stops command processing until 1 is returned. This occurs when all pending operations are completed.	Send *OPC? directly after the command whose processing must be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before Wait-to-Continue Command (WAI) have been executed.	Send *WAI directly after the command whose processing must be terminated before other commands are executed.

Command synchronization using `*WAI` or `*OPC?` is a good choice if the overlapped command takes only little time to process. The two synchronization commands simply block overlapping execution of the command. Append the synchronization command to the overlapped command, for example:

```
SINGle; *OPC?
```

For time consuming overlapped commands, you can allow the controller or the instrument to do other useful work while waiting for command execution. Use one of the following methods:

***OPC with a service request**

1. Execute `*ESE 1`
   Sets the OPC mask bit (bit No. 0) of the Standard Event Status Register (ESR) to 1
2. Execute `*SRE 32`

Sets the Event Status Bit (ESB - bit No. 5) of the Service Request Enable Register (SRE) to 1 to enable ESB service request.

3. Send the overlapped command with `*OPC`
   Example: `INIT; *OPC`
4. Wait for an ESB service request.

   The service request indicates that the overlapped command has finished.

***OPC? with a service request**

1. Execute `*SRE 16`

   Sets the Message Available bit (MAV - bit No. 4) of the Service Request Enable Register (SRE) to 1 to enable MAV service request.
2. Send the overlapped command with `*OPC?`
   Example: `INIT; *OPC?`
3. Wait for an MAV service request.

   The service request indicates that the overlapped command has finished.

Event status enable register (ESE)

1. Execute `*ESE 1`

   Sets the OPC mask bit (bit No. 0) of the Standard Event Status Register (ESR) to 1
2. Send the overlapped command without `*OPC`, `*OPC?` or `*WAI`.
   Example: `INIT; *OPC?`
3. Poll the operation complete state periodically (with a timer) using the sequence: `*OPC; *ESR?`

   A return value (LSB) of 1 indicates that the overlapped command has finished.

15.5.13 Programming example: performing a sequence of measurements

This example demonstrates how to perform several measurements in a sequence in a remote environment.

```
//2xSpectrumanalyzer + 2xIQ, start Sequencer at the end, test OPC?
// ----------------------------------------------------------------------


//------Preparing the instrument and first and second channel -----------
*RST
//Activate new IQ channel
INSTrument:CREate:NEW IQ,'IQ 1'
//Set sweep count for new IQ channel
SENS:SWEEP:COUNT 6
```

```
//Change trace modes for IQ channel
DISP:TRAC1:MODE BLANK
DISP:TRAC2:MODE MAXH
DISP:TRAC3:MODE MINH
//Switch to single sweep mode
INIT:CONT OFF
//switch back to first (default) analyzer channel
INST:SEL 'Spectrum';*WAI
//Switch into SEM
SENSe:SWEep:MODE ESPectrum
//Load Sem standard file for W-CDMA
SENSe:ESPectrum:PRESet:STANdard 'WCDMA\3GPP\DL\3GPP_DL.xml'
//Set sweep count in Spectrum channel
SENS:SWEEP:COUNT 5

//----------Creating a third measurement channel ----------------

//Create second IQ channel
INSTrument:CREate:NEW IQ,'IQ 2'
//Set sweep count
SENS:SWEEP:COUNT 2
//Change trace modes
DISP:TRAC1:MODE MAXH
DISP:TRAC2:MODE MINH
//Create new analyzer channel
INSTrument:CREate:NEW SANalyzer,'Spectrum 2'
//Activate ACLR measurement in channel 'Spectrum 2'
CALCulate:MARKer:FUNCtion:POWer:SELect ACPower
//Load W-CDMA Standard
CALCulate:MARKer:FUNCtion:POWer:PRESet FW3Gppcdma
//Change trace modes
DISP:TRAC2:MODE MAXH
DISP:TRAC1:MODE MINH

//--------Performing a sweep and retrieving results----------------

//Change sweep count
SENS:SWEep:COUNt 7
//Single Sweep mode
INIT:CONT OFF
//Switch back to first IQ channel
INST:SEL 'IQ 1';*WAI
//Perform a measurement
INIT:IMM;*OPC?
//Retrieve results
CALC:MARK:Y?
//Activate Multiview
DISPlay:ATAB     ON

//---------Performing a sequence of measurements with the Sequencer------------
```

```
//Activate Sequencer
SYSTem:SEQuencer ON
//Start sweep in Sequencer
INITiate:SEQuencer:IMMediate;*OPC?
//Switch into first IQ channel to get results
INST:SEL 'IQ 1';*WAI
CALCulate:MARKer:MAXimum
CALC:MARK:Y?
//Change sweep time in IQ
SENS:SWE:TIME 300us
//Switch to single Sequencer mode
INITiate:SEQuencer:MODE SINGle
//Sweep all channels once, taking the sweep count in each channel into account
INITiate:SEQuencer:IMMediate;*OPC?
//Set marker to maximum in IQ1 and query result
CALCulate:MARKer:MAXimum
CALC:MARK:Y?
//Switch to second IQ channel and retrieve results
INST:SEL 'IQ 2';*WAI
CALCulate:MARKer:MIN
CALC:MARK:Y?
//Switch to first Spectrum channel
INST:SEL 'Spectrum';*WAI
//Query one of the SEM results
CALCulate:MARKer:FUNCtion:POWer:RESult? CPOWer
//Switch to second Spectrum channel
INST:SEL 'Spectrum 2';*WAI
//Query channel power result
CALCulate:MARKer:FUNCtion:POWer:RESult? ACPower
```

15.6 Configuration

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15.6.1 Input configuration

- RF input configuration....423
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15.6.1.1 RF input configuration

INPut<ip>:IMPedance....423
INPut:ATTenuation:PROTection:RESet....423

INPut<ip>:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input. In some applications, only 50 Ω are supported.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<Impedance> 50 | 75
*RST: 50 Ω
Default unit: OHM

Example: `INP:IMP 75`

Manual operation: See "Impedance" on page 128

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer for the R&S EPL1000 after an overload condition occurred and the protection mechanism intervened. The error status bit (bit 3 in the `STAT:QUES:POW` status register) and the `INPUT OVLD` message in the status bar are cleared.

The command works only if the overload condition has been eliminated first.

For more information, see Chapter 10.6.1, "Increasing measurement sensitivity (or avoiding an input mixer overload)", on page 150.

Example: `INP:ATT:PROT:RES`

15.6.1.2 Preselector configuration

INPut<ip>:PRESelection[:STATe]....423
INPut<ip>:PRESelection:BYPass....424

INPut<ip>:PRESelection[:STATe] <State>

This command turns the preselector on and off.

The preselector is always on in the receiver application.

Suffix:
<ip> irrelevant

Parameters:
<State> ON | OFF | 1 | 0
*RST: Depends on application.

Example: //Turn on preselector
```
INP:PRES ON
```

INPut<ip>:PRESelection:BYPass <State>

This command turns the preselector on and off.

It basically has the same effect as `INPut<ip>:PRESelection[:STATe]`.

Suffix:
<ip> irrelevant

Parameters:
<State> **ON | 1**
Turns off (bypasses) the preselector.
Unavailable in the receiver application.
OFF | 0
Turns on the preselector.
*RST: OFF

Example: //Bypass preselector
```
INP:PRES:BYP ON
```

Manual operation: See "Preselection filter" on page 130

15.6.1.3 User port configuration (AUX port)

INPut<ip>:UPORt:STATe....424
INPut<ip>:UPORt[:VALue]....425
OUTPut<up>:UPORt[:VALue]....425
OUTPut<up>:UPORt:STATe....426

INPut<ip>:UPORt:STATe <State>

This command toggles the control lines of the user ports for the **AUX PORT** connector. This 9-pole SUB-D male connector is located on the rear panel of the R&S EPL1000.

See the R&S EPL1000 Getting Started manual for details.

Suffix:
<ip> 1 | 2
irrelevant

Parameters:
<State> **ON | 1**
User port is switched to INPut
OFF | 0
User port is switched to OUTPut

*RST: 1

Manual operation: See "User port configuration" on page 124

INPut<ip>:UPORt[:VALue]

This command queries the control lines of the user ports.

For details see `OUTPut<up>:UPORt[:VALue]` on page 425.

Suffix:
<ip> 1 | 2
irrelevant

Return values:
<Level> bit values in hexadecimal format
TTL type voltage levels (max. 5V)
Range: #B00000000 to #B00111111

Example:
```
INP:UPOR?
//Result: #B00100100
```
Pins 5 and 7 are active.

Manual operation: See "User port configuration" on page 124

OUTPut<up>:UPORt[:VALue] <Value>

This command sets the control lines of the user ports.

The assignment of the pin numbers to the bits is as follows:

Bit	7	6	5	4	3	2	1	0
Pin	N/A	N/A	5	3	4	7	6	2

Bits 7 and 6 are not assigned to pins and must always be 0.

The user port is written to with the given binary pattern.

If the user port is programmed to input instead of output (see `INPut<ip>:UPORt:STATe` on page 424), the output value is temporarily stored.

Suffix:
<up> irrelevant

Parameters:
<Value> bit values in hexadecimal format
TTL type voltage levels (max. 5V)
Range: #B00000000 to #B00111111

Example:
```
OUTP:UPOR #B00100100
```
Sets pins 5 and 7 to 5 V.

Manual operation: See "User port configuration" on page 124

OUTPut<up>:UPORt:STATe <State>

This command toggles the control lines of the user ports for the **AUX PORT** connector. This 9-pole SUB-D male connector is located on the rear panel of the R&S EPL1000.

Suffix:
<up> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
User port is switched to INPut

ON | 1
User port is switched to OUTPut

Example: `OUTP:UPOR:STAT ON`

Manual operation: See "User port configuration" on page 124

15.6.2 Output configuration

- IF / video / demodulation....426
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15.6.2.1 IF / video / demodulation

OUTPut<ou>:IF:AUDio....426
OUTPut<ou>:IF:LPASs:FREQuency:MANual....427
OUTPut<ou>:IF:LPASs[:STATe]....427
OUTPut<ou>:IF:SCALe[:VALue]....427
OUTPut<ou>:IF[:SOURce]....428
[SENSe:]DEMod:SQUelch:LEVel....428
[SENSe:]DEMod:SQUelch:LEVel:ABSolute....429
[SENSe:]DEMod:SQUelch[:STATe]....429
SYSTem:SPEaker:MAXVolume....430
SYSTem:SPEaker:MUTE....430
SYSTem:SPEaker:VOLume....430

OUTPut<ou>:IF:AUDio <State>

This command turns additional signal output on the headphone jack on and off.

Suffix:
<ou> irrelevant

Parameters:
<State> ON | OFF | 1 | 0

Example: //Turn on audio output
`OUTP:IF:AUD ON`

Manual operation: See "Loudspeaker" on page 132

OUTPut<ou>:IF:LPASs:FREQuency:MANual <Frequency>

This command defines the cutoff frequency of the low pass filter available for signal output.

Available for the following output types:

- Video
- AM
- FM
- PM

This command is available after you have turned on the low pass filter with `OUTPut<ou>:IF:LPASs[:STATe]`.

Suffix:
<ou> Output

Parameters:
<Frequency> Default unit: Hz

Example:
```
//Turn on low pass filter with a cutoff frequency of 100 kHz
OUTP:IF:LPAS ON
OUTP:IF:LPAS:FREQ:MAN 100KHZ
```

Manual operation: See "Low Pass" on page 132

OUTPut<ou>:IF:LPASs[:STATe] <State>

This command turns a low pass filter to control the output on and off.

Available for the following output types:

- Video
- AM
- FM
- PM

Suffix:
<ou> Output

Parameters:
<State> ON | OFF | 1 | 0

Example:
```
//Turn on low pass filter with a cutoff frequency of 100 kHz
OUTP:IF:LPAS ON
OUTP:IF:LPAS:FREQ:MAN 100KHZ
```

Manual operation: See "Low Pass" on page 132

OUTPut<ou>:IF:SCALe[:VALue] <Scale>

This command defines the scale of the transferred signal.

Available for the following output types:

- AM
- FM

Suffix:
<ou> Output

Parameters:
<Scale> Numeric value whose unit depends on the output type:
• % for AM output
• Hz for FM output

Example: //Select a scale of 100 kHz for FM output on output 1
```
OUTP:IF FM
OUTP:IF:SCAL 100KHZ
```

Manual operation: See "Scale" on page 133

OUTPut<ou>:IF[:SOURce] <Type>

This command selects the type of signal data that is output.

Suffix:
<ou> Output

Parameters:
<Type>

AM
Outputs the AM signal.

FM
Outputs the FM signal.

FOCus
Outputs the data of the currently selected measurement window.
Available for Analog Modulation Analysis.

IF
Outputs the IF signal.
Unavailable for audio output.

OFF
Turns off the output.

VIDeo
Outputs the video signal.
Unavailable for audio output.

Example: //Select output of AM signal data
```
OUTP:IF:SOUR AM
```

Manual operation: See "Selecting the output type" on page 131

[SENSe:]DEMod:SQUelch:LEVel <Level>

This command defines the relative squelch level for audio output, below which the output is not demodulated.

To define an absolute squelch level, use `[SENSe:]DEMod:SQUelch:LEVel:ABSolute`.

If you are using the "Marker Demodulation" marker function in the spectrum application, the command instead selects the level below which the signal at the marker position is not demodulated.

Parameters:

<Level> <numeric value>

Default unit: PCT

Example: //Configure squelch for audio output

```
DEM:SQU ON
DEM:SQU:LEV 10
```

Manual operation: See "Squelch" on page 132

[SENSe:]DEMod:SQUelch:LEVel:ABSolute <Level>

This command defines the absolute squelch level for audio output, below which the output is not demodulated.

To define a relative squelch level, use `[SENSe:]DEMod:SQUelch:LEVel`.

Parameters:

<Level> <numeric value>

The unit depends on `CALCulate<n>:UNIT:POWer`.

Example: //Configure squelch in dBmV for audio output

```
CALC:UNIT:POW DBMV
DEM:SQU ON
DEM:SQU:LEV:ABS 10
```

Manual operation: See "Squelch" on page 132

[SENSe:]DEMod:SQUelch[:STATe] <State>

This command turns a squelch for the audio output on and off.

The squelch is available for the following outputs.

- AM
- FM

If you are using the "Marker Demodulation" marker function in the spectrum application, the command instead turns selective demodulation at the marker position on and off. For selective demodulation, the R&S EPL1000 turns on a video trigger whose level corresponds to the squelch level. Therefore it turns off other triggers or gates.

In both cases, you can define the squelch level with `[SENSe:]DEMod:SQUelch:LEVel`.

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Configure squelch for audio output

```
DEM:SQU ON
DEM:SQU:LEV 10
```

Manual operation: See "Squelch" on page 132

SYSTem:SPEaker:MAXVolume <Volume>

This command defines the maximum volume level for audio output (for example over headphones).

Parameters:

<Volume> Numeric value between 0 and 1, with 1 being the loudest.

Example: //Define a maximum volume of 60 %

```
SYST:SPE:MAXV 0.6
```

Manual operation: See "Controlling the volume" on page 133

SYSTem:SPEaker:MUTE

This command turns off audio output.

To turn the volume back on again, use `SYSTem:SPEaker:VOLume`.

Example: //Turn off audio output

```
SYST:SPE:MUTE
```

//Turn audio output back on

```
SYST:SPE:VOL 25
```

Usage: Event

Manual operation: See "Controlling the volume" on page 133

SYSTem:SPEaker:VOLume <Volume>

This command defines the volume with which audio signals are output.

Parameters:

<Volume> Numeric value between 0 and 1, with 1 being the loudest.
Note that if you have defined a maximum volume level with `SYSTem:SPEaker:MAXVolume`, the value range is limited by the maximum volume.

Example: //Define a volume of 25 %.

```
SYST:SPE:VOL 0.25
```

Manual operation: See "Controlling the volume" on page 133

15.6.2.2 Additional output

DIAGnostic:SERVice:NSOurce....431

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled [noise source control] on the R&S EPL1000 on and off.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source Control" on page 134

15.6.3 Generator configuration

[SENSe:]CORRection[:STATe]....431
[SENSe:]CORRection:COLLect[:ACQuire]....432
[SENSe:]CORRection:METHod....432
[SENSe:]CORRection:RECall....433
[SENSe:]CORRection:TRANsducer:GENerate....433
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition....433
DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue....434
OUTPut<up>[:STATe]....434
SOURce<si>:INTernal:FREQuency....434
SOURce<si>:POWer[:LEVel][:IMMediate][:AMPLitude]....435
SOURce<si>:POWer[:LEVel][:IMMediate]:OFFSet....435
SOURce<si>:FREQuency:COUPling[:STATe]....435
SOURce<si>:INTernal:FREQuency:OFFSet....436
SOURce<si>:POWer:MODE....436
SOURce<si>:POWer:STARt....436
SOURce<si>:POWer:STOP....437

[SENSe:]CORRection[:STATe] <State>

This command turns correction of measurement results (normalization) on and off.

The command is available after you have created a reference trace for the selected measurement type with `[SENSe:]CORRection:COLLect[:ACQuire]` on page 432.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `CORR ON`
Activates normalization.

Manual operation: See " Normalization state" on page 145

[SENSe:]CORRection:COLLect[:ACQuire] <MeasType>

This command initiates a reference measurement (calibration). The reference measurement is the basis for the measurement normalization. The result depends on whether a reflection measurement or transmission measurement is performed (see `[SENSe:]CORRection:METHod` on page 432).

To obtain a correct reference measurement, a complete sweep with synchronization to the end of the sweep must have been carried out. This is only possible in the single sweep mode.

Setting parameters:

<MeasType> THRough | OPEN

THRough
"TRANsmission" mode: calibration with direct connection between generator and device input
"REFLection" mode: calibration with short circuit at the input

OPEN
only allowed in "REFLection" mode: calibration with open input

Example:
```
INIT:CONT OFF
```
Selects single sweep operation
```
CORR:METH TRAN
```
Selects a transmission measurement.
```
CORR:COLL THR;*WAI
```
Starts the measurement of reference data using direct connection between generator and device input and waits for the sweep end.

Usage: Setting only

Manual operation: See "Calibrate Reflection Short" on page 144
See "Calibrate Reflection Open" on page 145

[SENSe:]CORRection:METHod <Type>

This command selects the type of measurement to be performed with the generator.

Parameters:

<Type>

REFLection
Selects reflection measurements.

TRANsmission
Selects transmission measurements.

*RST: TRANsmission

Example: `CORR:METH TRAN`
Sets the type of measurement to "transmission".

Manual operation: See "Calibrate Transmission" on page 144
See "Calibrate Reflection Short" on page 144
See "Calibrate Reflection Open" on page 145

[SENSe:]CORRection:RECall

This command restores the measurement configuration used for calibration.

Example: `CORR:REC`

Manual operation: See "Recall Cal. Settings" on page 146

[SENSe:]CORRection:TRANsducer:GENerate <Name>

This command uses the normalized measurement data to generate a transducer factor with up to 1001 points. The trace data is converted to a transducer with unit dB and stored in a file with the specified name and the suffix `.trd` under `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\trd`. The frequency points are allocated in equidistant steps between start and stop frequency.

Parameters:
<Name> '<name>'

Example: `CORR:TRAN:GEN 'MyGenerator'`
Creates the transducer file `C:\r_s\instr\trd\MyGenerator.trd`.

Manual operation: See "Save as Trd Factor" on page 146

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid (for all traces).

The R&S EPL1000 adjusts the scaling of the y-axis accordingly.

Suffix:
<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:

<Position> 0 PCT corresponds to the lower display border, 100 percent corresponds to the upper display border.

*RST: frequency display: 90 PCT; time display: 50 PCT; AF spectrum display (K7): 100 PCT;

Default unit: PCT

Example: `DISP:TRAC:Y:RPOS 50PCT`

Manual operation: See "Reference Position" on page 145

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe]:RVALue <Value>

This command defines the reference value assigned to the reference position in the specified window. Separate reference values are maintained for the various displays.

Suffix:

<n> Window

<w> subwindow

<t> irrelevant

Parameters:

<Value> Default unit: DB

Example: `DISP:TRAC:Y:RVAL 0`
Sets the value assigned to the reference position to 0 Hz

Manual operation: See "Reference Value" on page 145

OUTPut<up>[:STATe] <State>

Suffix:

<up>

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `OUTP ON`

Manual operation: See "Generator" on page 130
See "State" on page 142

SOURce<si>:INTernal:FREQuency <Frequency>

Suffix:

<si> irrelevant

Parameters:

<Frequency>
Range: 5 kHz to 3 GHz
Increment: 0.1 Hz
*RST: 1 GHz
Default unit: HZ

Example: `SOUR:INT:FREQ 2 GHz`

Manual operation: See "CW Frequency" on page 143

SOURce<si>:POWer[:LEVel][:IMMediate][:AMPLitude] <Amplitude>

Suffix:

<si> irrelevant

Example: `SOUR:POW -30dBm`

Manual operation: See "Level" on page 143

SOURce<si>:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

Suffix:

<si> irrelevant

Parameters:

<Offset>
Range: -200 dB to +200 dB
*RST: 0dB
Default unit: DB

Example: `SOUR:POW:OFFS -10dB`

Manual operation: See "Level Offset" on page 143

SOURce<si>:FREQuency:COUPling[:STATe] <State>

Enables or disables the usage of the internal generator as a tracking generator. The tracking generator is only available for frequency sweeps in the Spectrum application.

Suffix:

<si> 1..n

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the tracking generator off

ON | 1
Switches the tracking generator on

*RST: 0

Example: `SOUR:FREQ:COUP:STAT ON`

SOURce<si>:INTernal:FREQuency:OFFSet <FreqOffset>

Defines an offset of the tracking generator signal to the analyzer frequency.

Suffix:
<si> 1..n

Parameters:
<FreqOffset> Default unit: HZ

Example:
```
SOUR:INT:FREQ:OFFS 10kHz
```

Manual operation: See "Frequency Offset" on page 144

SOURce<si>:POWer:MODE <Mode>

Enables or disables a power sweep.

Suffix:
<si> irrelevant

Parameters:
<Mode> FIXed | SWEep

FIXed
Fixed power level. Required for tracking generator.

SWEep
Increasing power level. Required for power sweep.

*RST: FIXed

Example:
```
SOUR:POW:MODE:SWE
SOUR:POW:STAR -50
SOUR:POW:STOP -10
```

SOURce<si>:POWer:STARt <StartLevel>

Defines the start power level of the internal generator signal for power sweeps. This value must be lower than the stop level (see `SOURce<si>:POWer:STOP` on page 437).

Suffix:
<si> irrelevant

Parameters:
<StartLevel> Range: -60 to +10
*RST: -30
Default unit: DBM

Example:
```
SOUR:POW:MODE:SWE
SOUR:POW:STAR -50
SOUR:POW:STOP -10
```

Manual operation: See "Level Start / Level Stop" on page 147

SOURce<si>:POWer:STOP <StopLevel>

Defines the end power level of the internal generator signal for power sweeps. This value must be higher than the start level (see `SOURce<si>:POWer:STARt` on page 436).

Suffix:
<si> irrelevant

Parameters:
<StopLevel> Range: -60 to +10
*RST: -20
Default unit: DBM

Example:
```
SOUR:POW:MODE:SWE
SOUR:POW:STAR -50
SOUR:POW:STOP -10
```

Manual operation: See "Level Start / Level Stop" on page 147

15.6.4 Frequency configuration

CALCulate<n>:MARKer<m>:FUNCtion:CENTer....437
CALCulate<n>:MARKer<m>:FUNCtion:STRack[:STATe]....438
CALCulate<n>:MARKer<m>:FUNCtion:STRack:BANDwidth....438
CALCulate<n>:MARKer<m>:FUNCtion:STRack:THReshold....438
CALCulate<n>:MARKer<m>:FUNCtion:STRack:TRACe....439
CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESTore....439
DISPlay[:WINDow<n>]:TRACe<t>:X:SPACing....439
[SENSe:]FREQuency:CENTer....440
[SENSe:]FREQuency:CENTer:STEP....440
[SENSe:]FREQuency:SCOupled....441
[SENSe:]FREQuency:SPAN....441
[SENSe:]FREQuency:SPAN:FULL....441

CALCulate<n>:MARKer<m>:FUNCtion:CENTer

This command matches the receiver frequency to the frequency of a marker.

Suffix:
<n> Window

<m> Marker

Example:
```
CALC:MARK2:FUNC:CENT
```
Sets the receiver frequency to the frequency of marker 2.

Usage: Event

Manual operation: See "Synchronizing the receiver frequency to the marker frequency" on page 159

CALCulate<n>:MARKer<m>:FUNCtion:STRack[:STATe] <State>

This command turns signal tracking on and off.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example:
```
//Activate signal tracking to keep the center frequency on the signal pea
//After each sweep the maximum on trace 1 is searched within a range of 2
//around the center frequency. It must have a minimum power of -90dBm.
CALC:MARK:FUNC:STR ON
CALC:MARK:FUNC:STR:BAND 20MHz
CALC:MARK:FUNC:STR:THR -90dBm
CALC:MARK:FUNC:STR:TRAC 1
```

Manual operation: See "Signal Tracking" on page 158
See "IF Signal Tracking" on page 162

CALCulate<n>:MARKer<m>:FUNCtion:STRack:BANDwidth <Bandwidth>

This command defines the bandwidth around the center frequency that is included in the signal tracking process.

Note that you have to turn on signal tracking before you can use the command.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Bandwidth> Range: 10 Hz to Max span
*RST: (= span/10 on activating the function)
Default unit: Hz

Manual operation: See "Signal Tracking" on page 158
See "IF Signal Tracking" on page 162

CALCulate<n>:MARKer<m>:FUNCtion:STRack:THReshold <Level>

This command defines the threshold level for the signal tracking process.

Note that you have to turn on signal tracking before you can use the command.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Level> The unit depends on `CALCulate<n>:UNIT:POWer`.

Range: -130 dBm to 30 dBm
*RST: -120 dBm
Default unit: DBM

Manual operation: See "Signal Tracking" on page 158
See "IF Signal Tracking" on page 162

CALCulate<n>:MARKer<m>:FUNCtion:STRack:TRACe <TraceNumber>

This command selects the trace on which the largest signal is searched for.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<TraceNumber> 1 to 6

Range: 1 to 6
*RST: 1

Manual operation: See "Signal Tracking" on page 158
See "IF Signal Tracking" on page 162

CALCulate<n>:MARKer<m>:FUNCtion:POWer<sb>:RESTore

Restores ACLR user standards.

Suffix:
<n> irrelevant

<m> irrelevant

<sb> irrelevant

Usage: Event

DISPlay[:WINDow<n>]:TRACe<t>:X:SPACing <Scale>

This command selects the scale of the x-axis.

Suffix:
<n> irrelevant

<t> irrelevant

Parameters:

<Scale> **LINear**
Linear scale of the frequency axis.

LOGarithmic
Logarithmic scale of the frequency axis.

*RST: LOGarithmic

Example: //Select a linear scale for the x-axis
`DISP:TRAC:X:SPAC LIN`

Manual operation: See "Frequency Axis Scale" on page 160

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the measurement frequency for measurements in the frequency or time domain.

Parameters:

<Frequency> <numeric value>

Numeric value in Hz.

Range: Refer to the datasheet
*RST: fmax / 2
Default unit: Hz

Example: //Define receiver frequency
`FREQ:CENT 100MHz`

Manual operation: See "PS Frequency" on page 147
See "Receiver Frequency" on page 159

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

Parameters:

<StepSize> <numeric value>

Numeric value in Hz.

Example: //Define frequency step size
`FREQ:CENT:STEP 4KHZ`

Manual operation: See "Frequency Stepsize" on page 160

[SENSe:]FREQuency:SCOupled <State>

This command couples or decouples the bargraph settings to the scan settings.

Parameters:

<State>

LSC
Couples the bargraph settings to the settings of the last scan that has been performed.

OFF
Decouples the bargraph settings from the scan settings.

SCAN
Couples the bargraph settings to the current scan settings or the settings of the current scan range.

*RST: OFF

Example:
//Couple bargraph settings to settings of last scan
```
FREQ:SCO LSC
```

Manual operation: See "Couple Bargraph Settings" on page 161

[SENSe:]FREQuency:SPAN <Span>

This command defines the frequency span.

Parameters:

<Span>
Available for IF analysis in the receiver application.

Default unit: Hz

Manual operation: See "IF Analysis" on page 161

[SENSe:]FREQuency:SPAN:FULL

This command restores the full span.

The full span depends on the current receiver frequency.

Manual operation: See "IF Analysis" on page 161

15.6.5 Amplitude configuration

CALCulate<n>:UNIT:POWer 441
INPut<ip>:ATTenuation[:VALue] 442
INPut<ip>:ATTenuation:AMODe 442
INPut<ip>:ATTenuation:AUTO 443
INPut<ip>:ATTenuation:PROTection[:STATe] 443
INPut<ip>:GAIN:AUTO 443
INPut<ip>:GAIN:STATe 444

CALCulate<n>:UNIT:POWer <Unit>

This command selects the unit for the y-axis.

Suffix:
<n> irrelevant

Parameters:
<Unit> DBM | V | A | W | DBPW | DBPW_MHZ | DBUV | DBUV_MHZ | DBMV | DBMV_MHZ | DBUA | DBUA_MHZ | DBPT | DBPT_MHZ | DBUV_M | DBUV_MMHZ | DBUA_M | DBUA_MMHZ

*RST: dBµV

Example: //Select unit
```
CALC:UNIT:POW DBM
```

Manual operation: See "Unit" on page 153
See "dBx/MHz" on page 154

INPut<ip>:ATTenuation[:VALue] <Attenuation>

This command defines the attenuation at the RF input.

To protect the input mixer, attenuation levels of 10 dB or less are possible only if you have turned off the input protection with `INPut<ip>:ATTenuation:PROTection[:STATe]` on page 443.

Suffix:
<ip> irrelevant

Parameters:
<Attenuation> Range: 0 dB to 79 dB
*RST: 10 dB
Default unit: dB

Example: //Define attenuation
```
INP:ATT 40dB
```

Manual operation: See "Attenuation" on page 105

INPut<ip>:ATTenuation:AMODe <State>

This command selects the auto ranging mode.

Suffix:
<ip> irrelevant

Parameters:
<State> **LOWNoise**
Selects the low noise mode.

NORMal
Selects the normal mode.

*RST: NORMal

Example: //Select low noise auto ranging mode
```
INP:ATT:AMOD LOWN
```

Manual operation: See "Auto Range" on page 104

INPut<ip>:ATTenuation:AUTO <State>

This command turns automatic determination of the attenuation level on and off.

When you turn it on, the R&S EPL1000 selects an attenuation that results in a good signal-to-noise ratio without overloading the RF input.

Suffix:
<ip> irrelevant

Parameters:
<State> ON | OFF

ON
Turns on the auto ranging feature.

OFF
Turns off the auto ranging feature.

*RST: ON

Example: //Turn on auto ranging
```
INP:ATT:AUTO ON
```

Manual operation: See "Auto Range" on page 104
See "Attenuation" on page 105

INPut<ip>:ATTenuation:PROTection[:STATe] <State>

This command turns the availability of attenuation levels of 10 dB or less on and off.

Suffix:
<ip> irrelevant

Parameters:
<State> ON | OFF | 1 | 0

*RST: 1

Example: //Turn on input protection
```
INP:ATT:PROT ON
```

Manual operation: See "10 dB Minimum Attenuation" on page 153

INPut<ip>:GAIN:AUTO <State>

This command includes and excludes the preamplifier from the auto ranging feature.

Suffix:
<ip> irrelevant

Parameters:
<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Consider preamplifier for auto ranging
`INP:GAIN:AUTO ON`

Manual operation: See "Preamplifier" on page 105

INPut<ip>:GAIN:STATe <State>

This command turns the preamplifier on and off.

Suffix:
<ip> irrelevant

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Turn on preamplifier
`INP:GAIN:STAT ON`

Manual operation: See "Preamplifier" on page 105

15.6.6 Diagram scale

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe] 444
DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:BOTTom 444

DISPlay[:WINDow<n>][:SUBWindow<w>]:TRACe<t>:Y[:SCALe] <Range>

This command defines the display range of the y-axis (for all traces).

Suffix:
<n> Window

<w> subwindow
Not supported by all applications

<t> irrelevant

Parameters:
<Range> Range: 1 dB to 200 dB
*RST: 100 dB
Default unit: HZ

Example:
`DISP:TRAC:Y 110dB`

Manual operation: See "Grid Range / Minimum Level" on page 155

DISPlay[:WINDow<n>]:TRACe<t>:Y[:SCALe]:BOTTom <Level>

This command defines the minimum level displayed on the vertical diagram axis.

Suffix:
<n> Window

<t> irrelevant

Parameters:

<Level> Minimum displayed level. The unit and value range depend on the unit you have selected.

*RST: 0 dBµV

Example: //Define a minimum grid level
`DISP:TRAC:Y:BOTT -20`

Manual operation: See "Grid Range / Minimum Level" on page 155

15.6.7 Bandwidth and filter configuration

[SENSe:]BWIDth:IF....445
[SENSe:]BANDwidth:IF....445
[SENSe:]BWIDth[:RESolution]....445
[SENSe:]BANDwidth[:RESolution][:VALue]....445
[SENSe:]BWIDth:SCPL....446
[SENSe:]BANDwidth:SCPL....446
[SENSe:]BWIDth[:RESolution]:AUTO....446
[SENSe:]BANDwidth[:RESolution]:AUTO....446
[SENSe:]BWIDth[:RESolution]:TYPE....446
[SENSe:]BANDwidth[:RESolution]:TYPE....446

[SENSe:]BWIDth:IF <Bandwidth>
[SENSe:]BANDwidth:IF <Bandwidth>

This command defines the resolution bandwidth for IF analysis.

Parameters:

<Bandwidth> <numeric value>

The available bandwidths depend on the span.

Default unit: Hz

Example: //Define resolution bandwidth for IF analysis
`BAND:IF 10KHZ`

Manual operation: See "IF Analysis" on page 161

[SENSe:]BWIDth[:RESolution] <Bandwidth>
[SENSe:]BANDwidth[:RESolution][:VALue] <Bandwidth>

This command defines the measurement (or resolution) bandwidth.

The available bandwidths depend on the selected filter type.

A change of the resolution bandwidth automatically turns the coupling to the frequency off.

Parameters:

<Bandwidth> <numeric value>
Refer to the datasheet for available bandwidths.
Default unit: Hz

Example: //Select measurement bandwidth
```
BAND 3MHZ
```

Manual operation: See "Measurement Bandwidth" on page 85

[SENSe:]BWIDth:SCPL <State>
[SENSe:]BANDwidth:SCPL <State>

This command couples or decouples the IF span to the measurement bandwidth used for the bargraph.

Parameters:

<State> ON | OFF | 1 | 0
*RST: ON

Example: //Decouple span from the measurement bandwidth.
```
BAND:SCPL OFF
```

Manual operation: See "IF Analysis" on page 161

[SENSe:]BWIDth[:RESolution]:AUTO <State>
[SENSe:]BANDwidth[:RESolution]:AUTO <State>

This command couples or decouples the resolution bandwidth to the selected frequency.

The resolution bandwidth is coupled to the frequency only if you have selected the Quasipeak, CISPR Average or CISPR RMS detector.

Parameters:

<State> ON | OFF | 1 | 0
*RST: ON

Example: //Decouple measurement bandwidth from frequency range
```
BAND:AUTO OFF
```

Manual operation: See "CISPR RBW Uncoupled" on page 163

[SENSe:]BWIDth[:RESolution]:TYPE <FilterType>
[SENSe:]BANDwidth[:RESolution]:TYPE <FilterType>

This command selects the resolution filter type.

When you change the filter type, the command selects the next larger filter bandwidth if the same bandwidth is unavailable for that filter.

Parameters:

<FilterType>

CFILter
Channel filters
Available in the spectrum application.

NORMal
Gaussian filters

CISPr | PULSe
CISPR (6 dB)
Return value for query is always `PULS`.

MIL
MIL Std (6 dB)

*RST: NORMal

Example: `BAND:TYPE NORM`

Manual operation: See "Filter Type" on page 85

15.6.8 Trigger configuration

[SENSe:]SWEep:EGATe:HOLDoff....447
[SENSe:]SWEep:EGATe:LENGth....447
[SENSe:]SWEep:EGATe:POLarity....448
[SENSe:]SWEep:EGATe:SOURce....448
[SENSe:]SWEep:EGATe....448
[SENSe:]SWEep:EGATe:TYPE....449
TRIGger<tp>[:SEQuence]:HOLDoff[:TIME]....449
TRIGger<tp>[:SEQuence]:SLOPe....450
TRIGger<tp>[:SEQuence]:SOURce....450

[SENSe:]SWEep:EGATe:HOLDoff <DelayTime>

This command defines the delay time between the gate signal and the continuation of the measurement.

Parameters:

<DelayTime>

Range: 0 s to 30 s
*RST: 0 s
Default unit: S

Example: `SWE:EGAT:HOLD 100us`

Manual operation: See "Gate Delay" on page 168

[SENSe:]SWEep:EGATe:LENGth <GateLength>

This command defines the gate length.

Parameters:

<GateLength> Range: 125 ns to 30 s
*RST: 400µs
Default unit: S

Example: `SWE:EGAT:LENG 10ms`

Manual operation: See "Gate Length" on page 168

[SENSe:]SWEep:EGATe:POLarity <Polarity>

This command selects the polarity of an external gate signal.

The setting applies both to the edge of an edge-triggered signal and the level of a level-triggered signal.

Parameters:

<Polarity> POSitive | NEGative
*RST: POSitive

Example: `SWE:EGAT:POL POS`

[SENSe:]SWEep:EGATe:SOURce <TriggerSource>

This command selects a trigger source for gated measurements.

If an IF power signal is used, the gate is opened as soon as a signal at > -20 dBm is detected within the IF path bandwidth (10 MHz).

Parameters:

<TriggerSource> **EXTernal**
Selects the external trigger connector.
IMMediate
Free Run mode (= no trigger)
*RST: IMMediate

Example: //Turn on a gated measurement using the first trigger input
```
SWE:EGAT ON
SWE:EGAT:SOUR EXT
```

[SENSe:]SWEep:EGATe <State>

This command turns gated measurements on and off.

Parameters:

<State> ON | OFF | 0 | 1
OFF | 0
Switches the function off
ON | 1
Switches the function on

Example:
```
SWE:EGAT ON
```
Switches on the gate mode.
```
SWE:EGAT:TYPE EDGE
```
Switches on the edge-triggered mode.
```
SWE:EGAT:HOLD 100US
```
Sets the gate delay to 100 µs.
```
SWE:EGAT:LEN 500US
```
Sets the gate opening time to 500 µs.
```
INIT;*WAI
```
Starts a sweep and waits for its end.

Manual operation: See "Gated Trigger" on page 168

[SENSe:]SWEep:EGATe:TYPE <Type>

This command selects the way gated measurements are triggered.

Parameters:

<Type>

LEVel
The trigger event for the gate to open is a particular power level. After the gate signal has been detected, the gate remains open until the signal disappears.

EDGE
The trigger event for the gate to open is the detection of the signal edge.
After the gate signal has been detected, the gate remains open until the gate length is over.

*RST: EDGE

Example:
```
SWE:EGAT:TYPE EDGE
```

Manual operation: See "Gate Mode" on page 168

TRIGger<tp>[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the measurement (data capturing).

A negative offset is possible for time domain measurements.

For the trigger sources "External" or "IF Power", a common input signal is used for both trigger and gate. Therefore, changes to the gate delay affect the trigger offset as well.

Suffix:

<tp> irrelevant

Parameters:

<Offset>

Range for measurements in the frequency domain:
0 s to 10 s
Range for measurements in the time domain:
negative sweep time to 10 s

*RST: 0 s

Default unit: s

Example: //Define a trigger offset
`TRIG:HOLD 500us`

Manual operation: See "Trigger Offset" on page 167

TRIGger<tp>[:SEQuence]:SLOPe <Type>

This command selects the trigger slope.

Suffix:
<tp> irrelevant

Parameters:
<Type> **POSitive**
Triggers when the signal rises to the trigger level (rising edge).

NEGative
Triggers when the signal drops to the trigger level (falling edge).

*RST: POSitive

Example: //Select trigger slope
`TRIG:SLOP NEG`

Manual operation: See "Trigger Slope" on page 167

TRIGger<tp>[:SEQuence]:SOURce <Source>

This command selects the trigger source.

Note on external triggers:

If a measurement is configured to wait for an external trigger signal in a remote control program, remote control is blocked until the trigger is received and the program can continue. Make sure that this situation is avoided in your remote control programs.

For troubleshooting tips, see "Incompleted sequential commands - blocked remote channels" on page 617.

Suffix:
<tp> irrelevant

Parameters:
<Source> See table below.

*RST: IMMediate

Example: //Select external trigger input as source of the trigger signal
`TRIG:SOUR EXT`

Manual operation: See "Trigger Source" on page 167
See "Free Run" on page 167
See "External Trigger 1" on page 167

Table 15-4: Available trigger sources

SCPI parameter	Trigger source
EXTernal	Trigger signal from the [Trigger Input] connector.

15.6.9 Programming example for a tracking generator

The following example demonstrates how to work with a tracking generator in a remote environment. It requires the Tracking Generator option (R&S EPL1-B9) to be installed on the R&S EPL1000.

```
//--------------Preparing the instrument -----------

//Reset the instrument
*RST

//Set the frequency span.
SENS:FREQ:STAR 10HZ
SENS:FREQ:STOP 1MHZ

//--------------Configuring the use of the internal generator -----------
OUTP ON
SOUR:FREQ:COUP ON
//Set the generator output level to -10 dBm.
SOUR:POW -10DBM
//Define a frequency offset of 100kHz
SOUR:INT:FREQ:OFFS 100KHZ

//--------------Performing the calibration measurement -----------

//Perform a transmission measurement with direct connection between the generator
//and the analyzer and wait till the end
SENS:CORR:METH TRAN
SENS:CORR:COLL:ACQ THR; *WAI

//--------------Retrieving the calibration trace results -----------

//Retrieve the measured frequencies (10 Hz - 10 MHz)
TRAC:DATA:X? TRACE1

//Retrieve the measured power levels;
TRAC:DATA? TRACE1

//--------------Normalizing the calibration trace results -----------

//Retrieve the normalized power levels (= power offsets from calibration results)
//Should be 0 for all sweep points directly after calibration
SENS:CORR:STAT ON
TRAC:DATA? TRACE1
```

```
//--------------Changing the display of the calibration results -----------
//Shift the reference line so the -5 dB level is displayed in the center
DISP:TRAC:Y:SCAL:RVAL -5DB
DISP:TRAC:Y:SCAL:RPOS 50PCT
```

15.7 Analysis

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15.7.1 Result display configuration

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15.7.1.1 General window commands

Note that the suffix <n> always refers to the window in the currently selected measurement channel.

DISPlay:FORMat....452
DISPlay[:WINDow<n>]:SIZE....453

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels

SINGle
Displays the measurement channel that was previously focused.

*RST: SING

Example:

```
DISP:FORM SPL
```

DISPlay[:WINDow<n>]:SIZE <Size>

This command maximizes the size of the selected result display window *temporarily*. To change the size of several windows on the screen permanently, use the `LAY:SPL` command (see `LAYout:SPLitter` on page 456).

Suffix:
<n> Window

Parameters:
<Size>

LARGe
Maximizes the selected window to full screen.
Other windows are still active in the background.

SMALl
Reduces the size of the selected window to its original size.
If more than one measurement window was displayed originally, these are visible again.

*RST: SMALl

Example: `DISP:WIND2:SIZE LARG`

15.7.1.2 Screen layout

The following commands are required to change the evaluation type and rearrange the screen layout for a measurement channel as you do using the SmartGrid in manual operation. Since the available evaluation types depend on the selected application, some parameters for the following commands also depend on the selected measurement channel.

Note that the suffix <n> always refers to the window in the currently selected measurement channel.

LAYout:ADD[:WINDow]?....453
LAYout:CATalog[:WINDow]?....454
LAYout:IDENtify[:WINDow]?....455
LAYout:MOVE[:WINDow]....455
LAYout:REMove[:WINDow]....456
LAYout:REPLace[:WINDow]....456
LAYout:SPLitter....456
LAYout:WINDow<n>:ADD?....458
LAYout:WINDow<n>:IDENtify?....458
LAYout:WINDow<n>:REMove....459
LAYout:WINDow<n>:REPLace....459

LAYout:ADD[:WINDow]? <WindowName>, <Direction>, <WindowType>

This command adds a window to the display in the active channel setup.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

To replace an existing window, use the `LAYout:REPLace[:WINDow]` command.

Query parameters:

<WindowName> String containing the name of the existing window the new window is inserted next to.
By default, the name of a window is the same as its index. To determine the name and index of all active windows, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow
Direction the new window is added relative to the existing window.

<WindowType> text value
Type of result display (evaluation method) you want to add.
See the table below for available parameter values.

Return values:

<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Usage: Query only

Table 15-5: <WindowType> parameter values for the receiver application

Parameter value	Window type
BGRaph	Bargraph
DIAGram	Scan diagram
FACCess	Fast access panel
FMEas	Final measurement
IFANalysis	IF analysis diagram
IFSGram	IF analysis spectrogram
MTABle	Marker table
NOTes	Notes display
PLISt	Marker peak list
PRESelection	"Preselector" configuration
SCAN	Scan diagram
SCSGram	Scan spectrogram

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows in the active channel setup from top left to bottom right. The result is a comma-separated list of values for each window, with the syntax:

<WindowName_1>,<WindowIndex_1>..<WindowName_n>,<WindowIndex_n>

Return values:

<WindowName> string
Name of the window.
In the default state, the name of the window is its index.

<WindowIndex> **numeric value**
Index of the window.

Example: `LAY:CAT?`
Result:
`'2',2,'1',1`
Two windows are displayed, named '2' (at the top or left), and '1' (at the bottom or right).

Usage: Query only

LAYout:IDENtify[:WINDow]? <WindowName>

This command queries the **index** of a particular display window in the active channel setup.

Note: to query the **name** of a particular window, use the `LAYout:WINDow<n>:IDENtify?` query.

Query parameters:

<WindowName> String containing the name of a window.

Return values:

<WindowIndex> Index number of the window.

Example: `LAY:IDEN:WIND? '2'`
Queries the index of the result display named '2'.
Response:
`2`

Usage: Query only

LAYout:MOVE[:WINDow] <WindowName>, <WindowName>, <Direction>

Setting parameters:

<WindowName> String containing the name of an existing window that is to be moved.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel setup, use the `LAYout:CATalog[:WINDow]?` query.

<WindowName> String containing the name of an existing window the selected window is placed next to or replaces.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel setup, use the `LAYout:CATalog[:WINDow]?` query.

<Direction> LEFT | RIGHt | ABOVe | BELow | REPLace
Destination the selected window is moved to, relative to the reference window.

Example: `LAY:MOVE '4','1',LEFT`
Moves the window named '4' to the left of window 1.

Example: `LAY:MOVE '1','3',REPL`
Replaces the window named '3' by window 1. Window 3 is deleted.

Usage: Setting only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display in the active channel.

Setting parameters:

<WindowName> String containing the name of the window. In the default state, the name of the window is its index.

Example: `LAY:REM '2'`
Removes the result display in the window named '2'.

Usage: Setting only

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window in the active channel setup while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

Setting parameters:

<WindowName> String containing the name of the existing window.
By default, the name of a window is the same as its index. To determine the name and index of all active windows in the active channel setup, use the `LAYout:CATalog[:WINDow]?` query.

<WindowType> Type of result display you want to use in the existing window.
See `LAYout:ADD[:WINDow]?` on page 453 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

Usage: Setting only

LAYout:SPLitter <Index1>, <Index2>, <Position>

This command changes the position of a splitter and thus controls the size of the windows on each side of the splitter.

Note that windows must have a certain minimum size. If the position you define conflicts with the minimum size of any of the affected windows, the command does not work, but does not return an error.

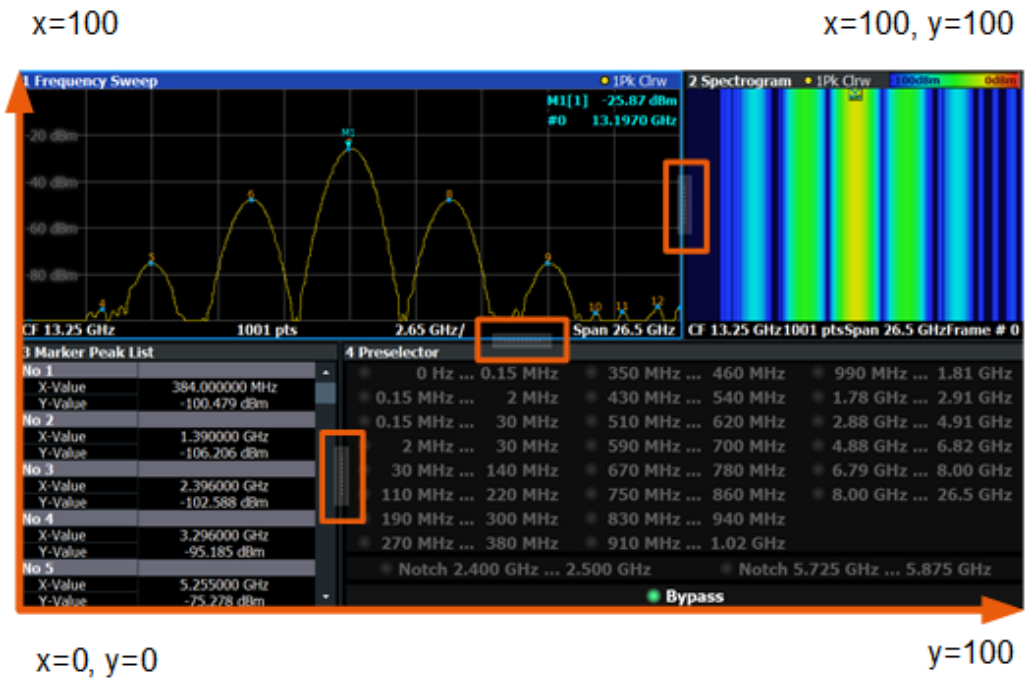


Figure 15-1: SmartGrid coordinates for remote control of the splitters

Setting parameters:

<Index1> The index of one window the splitter controls.

<Index2> The index of a window on the other side of the splitter.

<Position> New vertical or horizontal position of the splitter as a fraction of the screen area (without channel and status bar and softkey menu).
The point of origin (x = 0, y = 0) is in the lower left corner of the screen. The end point (x = 100, y = 100) is in the upper right corner of the screen. (See Figure 15-1.)
The direction in which the splitter is moved depends on the screen layout. If the windows are positioned horizontally, the splitter also moves horizontally. If the windows are positioned vertically, the splitter also moves vertically.

Range: 0 to 100

Example: `LAY:SPL 1,3,50`
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Table"') to the center (50%) of the screen, i.e. in the figure above, to the left.

Example: LAY:SPL 1,4,70
Moves the splitter between window 1 ('Frequency Sweep') and 3 ('"Marker Peak List"') towards the top (70%) of the screen.
The following commands have the exact same effect, as any combination of windows above and below the splitter moves the splitter vertically.
LAY:SPL 3,2,70
LAY:SPL 4,1,70
LAY:SPL 2,1,70

Usage: Setting only

LAYout:WINDow<n>:ADD? <Direction>,<WindowType>

This command adds a measurement window to the display. Note that with this command, the suffix <n> determines the existing window next to which the new window is added. Unlike LAYout:ADD[:WINDow]?, for which the existing window is defined by a parameter.

To replace an existing window, use the LAYout:WINDow<n>:REPLace command.

This command is always used as a query so that you immediately obtain the name of the new window as a result.

Suffix:
<n> Window

Query parameters:
<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See LAYout:ADD[:WINDow]? on page 453 for a list of available window types.

Return values:
<NewWindowName> When adding a new window, the command returns its name (by default the same as its number) as a result.

Example: LAY:WIND1:ADD? LEFT,MTAB
Result:
'2'
Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

LAYout:WINDow<n>:IDENtify?

This command queries the **name** of a particular display window (indicated by the <n> suffix) in the active channel setup.

Note: to query the **index** of a particular window, use the LAYout:IDENtify[:WINDow]? command.

Suffix:
<n> Window

Return values:
<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Example: `LAY:WIND2:IDEN?`
Queries the name of the result display in window 2.
Response:
`'2'`

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display in the active channel setup.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Suffix:
<n> Window

Example: `LAY:WIND2:REM`
Removes the result display in window 2.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>) in the active channel setup.

The effect of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Suffix:
<n> Window

Setting parameters:
<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 453 for a list of available window types.

Example: `LAY:WIND2:REPL MTAB`
Replaces the result display in window 2 with a marker table.

Usage: Setting only

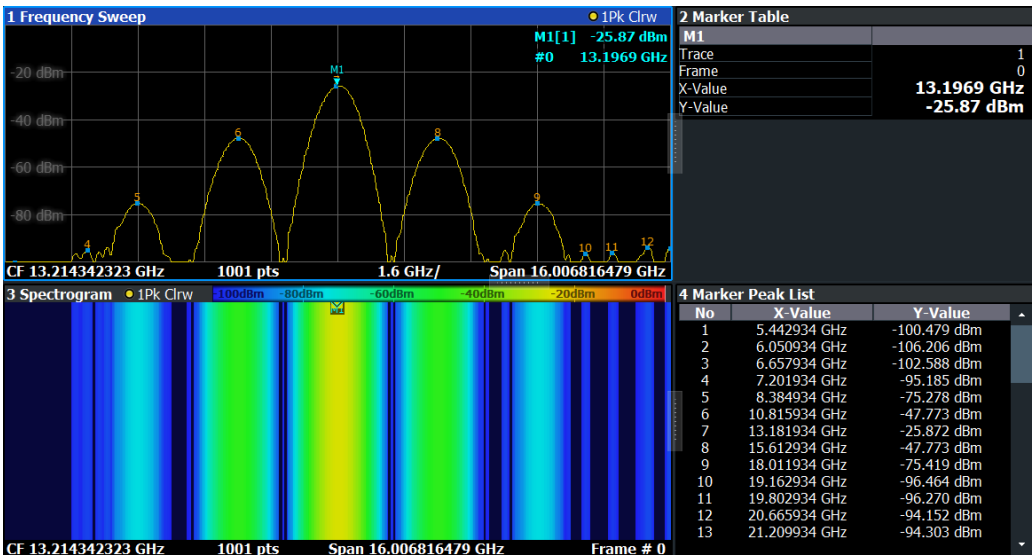
15.7.1.3 Examples: configuring the result display

The following example demonstrates how to configure result displays in a remote environment.

Example 1: adding and arranging windows

Starting from the default initial display in the Spectrum application (Frequency Sweep), we will configure the following result displays:

1 Frequency Sweep	3 "Marker Table"
2 Spectrogram	4 "Marker Peak List"



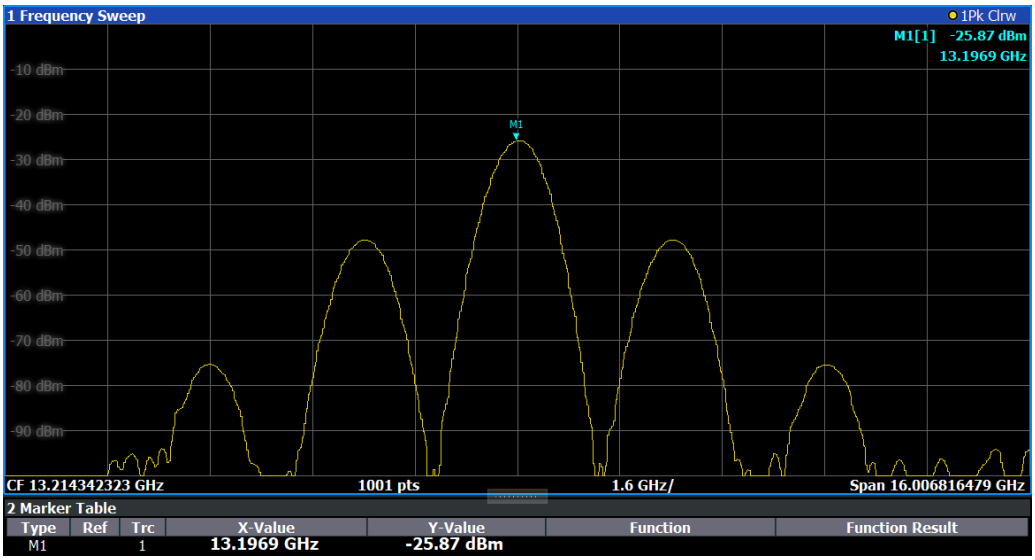

```
//--------------Resetting the instrument -----------
*RST
//--------------- Adding new windows --------------------
//Add a Spectrogram window beneath the Frequency Sweep window
LAY:ADD? '1',BEL,SGR
//Result: window number: '2'
//Add a Marker Table window to the right of the Frequency Sweep window
LAY:ADD? '1',RIGH,MTAB
//Result: window number: '3'
//Add a Marker Peak List window to the right of the Spectrogram window
LAY:WIND2:ADD? RIGH,PEAK
//Result: window number: '4'

//--------------- Changing the size of individual windows -------------
//Move the splitter between the Frequency Sweep window and the Marker Table
//window to enlarge the spectrum display to 60% of the entire width.
LAY:SPL 1,3,60
//Move the splitter between the Spectrogram window and the Marker Peak List
//window to enlarge the Spectrogram display to 60% of the entire width.
LAY:SPL 2,4,60
```

```
//--------------- Querying all displayed windows ------------------
//Query the name and number of all displayed windows
//(from top left to bottom right)
LAY:CAT?
//Result : '1',1,'2',2,'3',3,'4',4

//------------- Maximizing a Window ------------------
//Maximize the window "2 Spectrogram"
DISP:WIND2:SIZE LARG

//-------------Restore multiple window display -----------
DISP:WIND2:SIZE SMAL
```

Example 2: replacing and removing windows

Starting from the display configured in Example 1: adding and arranging windows, we will remove and replace result displays to obtain the following configuration:

1 Frequency Sweep
4 "Marker Table"




```
//-------------- Preparing the configuration from example 1 -----------
*RST
LAY:ADD? '1',BEL,SGR
LAY:ADD? '1',RIGH,MTAB
LAY:WIND2:ADD? RIGH,PEAK
LAY:CAT?
//Result : '1',1,'2',2,'3',3,'4',4
```

```
//Remove Spectrogram
LAY:WIND2:REM //Remove Marker Table window
LAY:REM '3'
//Replace Marker Peak List window by Marker Table
LAY:REPL '4',MTAB

//--------------- Querying all displayed windows ------------------
//Query the name and number of all displayed windows (from top left to bottom right)
LAY:CAT?
//Result : '1',1,'4',4

//--------------- Changing the size of individual windows -------------
//Move the splitter between the Frequency Sweep window and the Marker Table window
//to enlarge the spectrum display to 80% of the entire height.
LAY:SPL 1,4,80
```

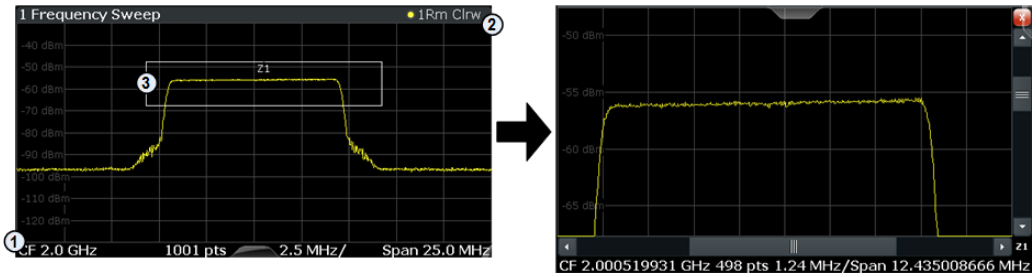
15.7.2 Zoomed displays

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA 462
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] 463
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] 464
DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA 464

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:AREA <x1>,<y1>,<x2>,<y2>

This command defines the zoom area.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Parameters:

<x1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<y1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<x2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

Manual operation: See "Single Zoom" on page 175

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM[:STATe] <State>

This command turns the zoom on and off.

Suffix:

<n> Window

<w> subwindow
Not supported by all applications

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `DISP:ZOOM ON`
Activates the zoom mode.

Manual operation: See "Single Zoom" on page 175
See "Restore Original Display" on page 176

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>[:STATe] <State>

This command turns the multiple zoom on and off.

Suffix:
<n> Window

<w> subwindow
Not supported by all applications

<zn> Selects the zoom window.
If you turn off one of the zoom windows, all subsequent zoom windows move up one position.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

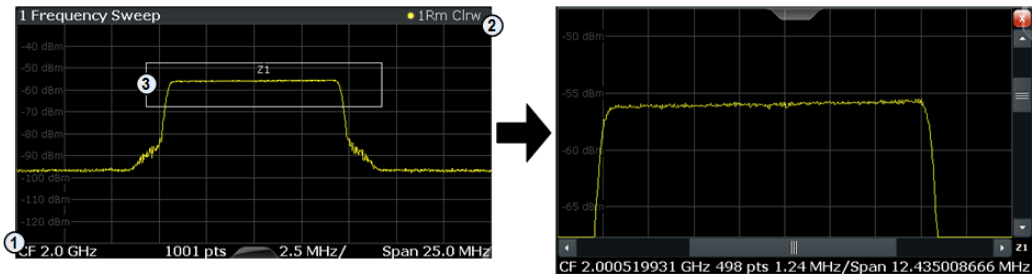
ON | 1
Switches the function on

Manual operation: See "Multi-Zoom" on page 175

DISPlay[:WINDow<n>][:SUBWindow<w>]:ZOOM:MULTiple<zn>:AREA
<x1>,<y1>,<x2>,<y2>

This command defines the zoom area for a multiple zoom.

To define a zoom area, you first have to turn the zoom on.



1 = origin of coordinate system (x1 = 0, y1 = 0)
2 = end point of system (x2 = 100, y2= 100)
3 = zoom area (e.g. x1 = 60, y1 = 30, x2 = 80, y2 = 75)

Suffix:
<n> Window

<w> subwindow
Not supported by all applications

<zn> Selects the zoom window.

Parameters:

<x1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<y1> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<x2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

<y2> Diagram coordinates in % of the complete diagram that define the zoom area.
The lower left corner is the origin of coordinate system. The upper right corner is the end point of the system.
Range: 0 to 100
Default unit: PCT

Manual operation: See "Multi-Zoom" on page 175

15.7.3 Trace configuration

15.7.3.1 Trace export

Commands to export traces described elsewhere.

- `FORMat:DEXPort:DSEParator` on page 522

FORMat:DEXPort:CSEParator 465
FORMat:DEXPort:HEADer 466
FORMat:DEXPort:TRACes 466
FORMat:DEXPort:FORMat 467

FORMat:DEXPort:CSEParator <Separator>

This command selects the column separator for exported trace data.

The selected value is not affected by a preset. The command therefore has no reset value.

Parameters:

<Separator>

COMMa
Selects a comma as a separator.

SEMicolon
Selects a semicolon as a separator.

TAB
Selects a tabulator as a separator.

*RST: n/a

Example:
//Select column separator
`FORM:DEXP:CSEP TAB`

Manual operation: See "Column Separator" on page 195

FORMat:DEXPort:HEADer <State>

If enabled, additional instrument and measurement settings are included in the header of the export file for result data. If disabled, only the pure result data from the selected traces and tables is exported.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Include Instrument & Measurement Settings" on page 193

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 557).

For details on exporting data, see Chapter 11.3.3, "Trace export", on page 192.

Parameters:

<Selection> SINGle | ALL

SINGle
Only a single trace is selected for export, namely the one specified by the `MMEMory:STORe<n>:TRACe` command.

ALL
Selects all active traces and result tables (e.g. "Result Summary", marker peak list etc.) in the current application for export to an ASCII file.
The <trace> parameter for the `MMEMory:STORe<n>:TRACe` command is ignored.

*RST: SINGle

Manual operation: See "Export all Traces and all Table Results" on page 193

FORMat:DEXPort:FORMat <FileFormat>

Determines the format of the ASCII file to be imported or exported. Depending on the external program that creates the data file or evaluates it, a comma-separated list (CSV) or a plain data format (DAT) file is required.

Parameters:
<FileFormat> CSV | DAT
*RST: DAT

Example: `FORM:DEXP:FORM CSV`

Manual operation: See "File Type" on page 194

15.7.3.2 Traces copy

TRACe<n>:COPY 467

TRACe<n>:COPY <TraceNumber>, <TraceNumber>

This command copies data from one trace to another.

Suffix:
<n> Window

Parameters:
<TraceNumber> **TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6**
The first parameter is the destination trace, the second parameter is the source.
(Note the 'e' in the parameter is required!)

Example: `TRAC:COPY TRACE1,TRACE2`
Copies the data from trace 2 to trace 1.

Manual operation: See "Copy Trace" on page 196

15.7.3.3 Trace mathematics

CALCulate<n>:MATH<t>:EXPRession[:DEFine] 467
CALCulate<n>:MATH<t>:MODE 468
CALCulate<n>:MATH<t>:POSition 468
CALCulate<n>:MATH<t>:STATe 469

CALCulate<n>:MATH<t>:EXPRession[:DEFine] <Expression>

This command selects the mathematical expression for trace mathematics.

Prerequisites for this command

- Turn on trace mathematics (`CALCulate<n>:MATH<t>:STATe`).

Suffix:
<n> Window

<t> Trace that the result of the trace mathematics is written to.

Parameters:

<Expression> (TRACE<x> - TRACE<y>)

The expression selects the two traces that are subtracted from each other. You can select any trace you like as the two operands.
The result is shown in the trace defined by the suffix `<t>` at the `MATH` syntax element of the command.

Example: //Subtract trace 2 from trace 3 and write the result to trace 4

```
CALC:MATH:STAT ON
CALC:MATH4:EXPR (TRACE3-TRACE2)
```

Manual operation: See "Trace Math Function" on page 196

CALCulate<n>:MATH<t>:MODE <Mode>

This command selects the way the R&S EPL1000 calculates trace mathematics.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Mode> For more information on the way each mode works see Trace Math Mode.

LINear
Linear calculation.

LOGarithmic
Logarithmic calculation.

POWer
Linear power calculation.

*RST: LOGarithmic

Example:

```
CALC:MATH:MODE LIN
```

Selects linear calculation.

Manual operation: See "Trace Math Mode" on page 197

CALCulate<n>:MATH<t>:POSition <Position>

This command defines the position of the trace resulting from the mathematical operation.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<Position> Vertical position of the trace in % of the height of the diagram area.
100 PCT corresponds to the upper diagram border.

Range: -100 to 200
*RST: 50
Default unit: PCT

Example: `CALC:MATH:POS 100`
Moves the trace to the top of the diagram area.

Manual operation: See "Trace Math Position" on page 196

CALCulate<n>:MATH<t>:STATe <State>

This command turns the trace mathematics on and off.

Suffix:

<n> Window

<t> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on trace mathematics
`CALC:MATH:STAT ON`

Manual operation: See "Trace Math Function" on page 196

15.7.3.4 Trace labels

DISPlay[:WINDow<n>]:TRACe<t>:LABel[:STATe] 469
DISPlay[:WINDow<n>]:TRACe<t>:LABel:TEXT 470

DISPlay[:WINDow<n>]:TRACe<t>:LABel[:STATe] <State>

This command turns the display of the trace label for a specific trace on and off.

The command can only be applied to active traces.

Suffix:

<n> 1..n
Window

<t> 1..n
Trace

Parameters:

<State> ON | OFF | 1 | 0

*RST: OFF

Example: //Turn on the label for trace 2
```
DISP:TRAC2:LAB ON
```

DISPlay[:WINDow<n>]:TRACe<t>:LABel:TEXT <Label>

This command defines the contents of a trace label.

Suffix:
<n> 1..n
Window

<t> 1..n
Trace

Parameters:
<Label> String containing the trace label.

Example: //Assign a label to trace 2.
```
DISP:TRAC2:LAB:TEXT 'A YELLOW TRACE'
```

15.7.3.5 Spectrogram configuration

Commands to configure spectrograms described elsewhere.

- Chapter 15.7.4.6, "Spectrogram markers", on page 492

- Spectrogram settings....470
- Color map configuration....474

Spectrogram settings

CALCulate<n>:SGRam:CLEar[:IMMediate]....470
CALCulate<n>:SPECtrogram:CLEar[:IMMediate]....470
CALCulate<n>:SGRam:FRAMe:SELect....471
CALCulate<n>:SPECtrogram:FRAMe:SELect....471
CALCulate<n>:SGRam:HDEPth....471
CALCulate<n>:SPECtrogram:HDEPth....471
CALCulate<n>:SGRam:TRACe....472
CALCulate<n>:SPECtrogram:TRACe....472
CALCulate<n>:SGRam:TSTamp:DATA?....472
CALCulate<n>:SPECtrogram:TSTamp:DATA?....472
CALCulate<n>:SGRam:TSTamp[:STATe]....473
CALCulate<n>:SPECtrogram:TSTamp[:STATe]....473
CALCulate<n>:SGRam[:STATe]....473
CALCulate<n>:SPECtrogram[:STATe]....473
CALCulate<n>:SGRam:FRAMe:RINTerval....474
CALCulate<n>:SPECtrogram:FRAMe:RINTerval....474
CALCulate<n>:SPECtrogram:THReedim[:STATe]....474

CALCulate<n>:SGRam:CLEar[:IMMediate]
CALCulate<n>:SPECtrogram:CLEar[:IMMediate]

This command resets the spectrogram and clears the history buffer.

Suffix:
<n> Window

Example: //Reset the result display and clear the memory
`CALC:SGR:CLE`

Manual operation: See "Clear Spectrogram" on page 201

CALCulate<n>:SGRam:FRAMe:SELect <Frame> | <Time>
CALCulate<n>:SPECtrogram:FRAMe:SELect <Frame> | <Time>

This command selects a specific frame for further analysis.

The command is available if no measurement is running or after a single sweep has ended.

Suffix:
<n> Window

Parameters:
<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.
Default unit: S

<Time> Selects a frame via its time stamp. Valid if the time stamp is on. The number is the distance to frame 0 in seconds. The range depends on the history depth.

Example:
```
INIT:CONT OFF
```
Stop the continuous sweep.
```
CALC:SGR:FRAM:SEL -25
```
Selects frame number -25.

Manual operation: See "Select Frame" on page 200

CALCulate<n>:SGRam:HDEPth <History>
CALCulate<n>:SPECtrogram:HDEPth <History>

This command defines the number of frames to be stored in the R&S EPL1000 memory.

Suffix:
<n> Window

Parameters:
<History> The maximum number of frames depends on the number of sweep points.
Range: 781 to 20000
Increment: 1
*RST: 3000

Example: //Set the history depth to 1500
`CALC:SGR:SPEC 1500`

Manual operation: See "History Depth" on page 200

CALCulate<n>:SGRam:TRACe
CALCulate<n>:SPECtrogram:TRACe <Trace>

This command selects the trace the spectrogram is based on.

Suffix:
<n> Receiver application: Window
I/Q Analyzer: Window
Spectrum application: irrelevant

Parameters:
<Trace> Number of the trace. The range depends on the result display: Scans support six traces, IF Analysis supports three traces.

Example: //Assign trace two to the spectrogram result display
`CALC:SPEC:TRAC 2`

Manual operation: See "Trace" on page 200

CALCulate<n>:SGRam:TSTamp:DATA? <Frames>
CALCulate<n>:SPECtrogram:TSTamp:DATA? <Frames>

This command queries the starting time of the frames.

The return values consist of four values for each frame. If the "Spectrogram" is empty, the command returns '0,0,0,0'. The times are given as delta values, which simplifies evaluating relative results; however, you can also calculate the absolute date and time as displayed on the screen.

The frame results themselves are returned with `TRAC:DATA? SGR`

Suffix:
<n> Window

Query parameters:
<Frames> **CURRent**
Returns the starting time of the current frame.

ALL
Returns the starting time for all frames. The results are sorted in descending order, beginning with the current frame.

Return values:
<Seconds> Number of seconds that have passed since 01.01.1970 until the frame start

<Nanoseconds> Number of nanoseconds that have passed *in addition to the <Seconds>* since 01.01.1970 until the frame start.

<Reserved> The third value is reserved for future uses.

<Reserved> The fourth value is reserved for future uses.

Example: `CALC:SGR:TST:DATA? ALL`
Returns the starting times of all frames sorted in a descending order.

Usage: Query only

Manual operation: See "Time Stamp" on page 200

CALCulate<n>:SGRam:TSTamp[:STATe] <State>
CALCulate<n>:SPECtrogram:TSTamp[:STATe] <State>

This command activates and deactivates the time stamp.

If the time stamp is active, some commands do not address frames as numbers, but as (relative) time values:

- `CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe` on page 497
- `CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe` on page 492
- `CALCulate<n>:SPECtrogram:FRAMe:SELect` on page 471

Suffix:
<n> 1..n
Window

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: //Activates the time stamp
`CALC:SGR:TST ON`

Manual operation: See "Time Stamp" on page 200

CALCulate<n>:SGRam[:STATe] <State>
CALCulate<n>:SPECtrogram[:STATe] <State>

This command turns the spectrogram on and off.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:SGR ON`
Activates the Spectrogram result display.

Manual operation: See "State" on page 199

CALCulate<n>:SGRam:FRAMe:RINTerval
CALCulate<n>:SPECtrogram:FRAMe:RINTerval <Interval>

Defines a recording interval for the IF spectrogram result display. For example if the recording interval is set to 5, only every fifth scan is taken from the IF analysis diagram and displayed in the IF spectrogram. This prevents the IF spectrogram from getting filled up too fast.

Suffix:
<n> irrelevant

Parameters:
<Interval> Recording interval

Example: `CALC:SGR:FRAM:RINT 5`

Manual operation: See "Recording Interval" on page 201

CALCulate<n>:SPECtrogram:THReedim[:STATe] <State>

Activates or deactivates a 3-dimensional spectrogram for the selected result display.

Suffix:
<n> Window

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `CALC:SPEC:THR:STAT ON`

Manual operation: See "3D Spectrogram State" on page 200

Color map configuration

DISPlay[:WINDow<n>]:SGRam:COLor:DEFault....475
DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault....475
DISPlay[:WINDow<n>]:SGRam:COLor:LOWer....475
DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer....475
DISPlay[:WINDow<n>]:SGRam:COLor:SHAPe....475
DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe....475
DISPlay[:WINDow<n>]:SGRam:COLor:UPPer....475
DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer....475
DISPlay[:WINDow<n>]:SGRam:COLor[:STYLe]....476
DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe]....476

DISPlay[:WINDow<n>]:SGRam:COLor:DEFault
DISPlay[:WINDow<n>]:SPECtrogram:COLor:DEFault

This command restores the original color map.

Suffix:
<n> Window

Manual operation: See "Set to Default" on page 202

DISPlay[:WINDow<n>]:SGRam:COLor:LOWer <Percentage>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:LOWer <Percentage>

This command defines the starting point of the color map.

Suffix:
<n> Window

Parameters:
<Percentage> Statistical frequency percentage.

Range: 0 to 66
*RST: 0
Default unit: %

Example: `DISP:WIND:SGR:COL:LOW 10`
Sets the start of the color map to 10%.

Manual operation: See "Start / Stop" on page 202

DISPlay[:WINDow<n>]:SGRam:COLor:SHAPe <Shape>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:SHAPe <Shape>

This command defines the shape and focus of the color curve for the spectrogram result display.

Suffix:
<n> Window

Parameters:
<Shape> Shape of the color curve.

Range: -1 to 1
*RST: 0

Manual operation: See "Shape" on page 202

DISPlay[:WINDow<n>]:SGRam:COLor:UPPer <Percentage>
DISPlay[:WINDow<n>]:SPECtrogram:COLor:UPPer <Percentage>

This command defines the end point of the color map.

Suffix:
<n> Window

Parameters:

<Percentage> Statistical frequency percentage.

Range: 0 to 66
*RST: 0
Default unit: %

Example: `DISP:WIND:SGR:COL:UPP 95`
Sets the start of the color map to 95%.

Manual operation: See "Start / Stop" on page 202

DISPlay[:WINDow<n>]:SGRam:COLor[:STYLe] <ColorScheme>
DISPlay[:WINDow<n>]:SPECtrogram:COLor[:STYLe] <ColorScheme>

This command selects the color scheme.

Parameters:

<ColorScheme>

HOT
Uses a color range from blue to red. Blue colors indicate low levels, red colors indicate high ones.

COLD
Uses a color range from red to blue. Red colors indicate low levels, blue colors indicate high ones.

RADar
Uses a color range from black over green to light turquoise with shades of green in between.

GRAYscale
Shows the results in shades of gray.

*RST: HOT

Example: `DISP:WIND:SPEC:COL GRAY`
Changes the color scheme of the spectrogram to black and white.

Manual operation: See "Hot/Cold/Radar/Grayscale" on page 202

15.7.3.6 Formats for returned values: ASCII format and binary format

When trace data is retrieved using the `TRAC:DATA` or `TRAC:IQ:DATA` command, the data is returned in the format defined using the `FORMat[:DATA]` on page 521. The possible formats are described here.

- ASCII Format (FORMat ASCII):
  The data is stored as a list of comma-separated values (CSV) of the measured values in floating point format.
- Binary Format (FORMat REAL,16/32/64):
  The data is stored as binary data (definite length block data according to IEEE 488.2), each measurement value being formatted in 16-bit/32-bit/64-bit IEEE 754 floating-point-format.
  The schema of the result string is as follows:

`#<Length of length><Length of data><value1><value2>…<value n>`
with:

<Length of length>	Number of digits of the following number of data bytes
<Length of data>	Number of following data bytes
<Value>	2-byte/4-byte/8-byte floating point value

Example: `#41024`<Data>... contains 1024 data bytes

Data blocks larger than 999,999,999 bytes

According to SCPI, the header of the block data format allows for a maximum of 9 characters to describe the data length. Thus, the maximum REAL 32 data that can be represented is 999,999,999 bytes. However, the R&S EPL1000 is able to send larger data blocks. In this case, the length of the data block is placed in brackets, e.g. `#(1234567890)`<value1><value2>…

Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

15.7.4 Markers

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15.7.4.1 Individual marker configuration

CALCulate<n>:DELTamarker<m>:AOFF....477
CALCulate<n>:DELTamarker<m>:MODE....478
CALCulate<n>:DELTamarker<m>:MREFerence....478
CALCulate<n>:DELTamarker<m>[:STATe]....478
CALCulate<n>:DELTamarker<m>:TRACe....479
CALCulate<n>:DELTamarker<m>:X....479
CALCulate<n>:MARKer<m>:AOFF....480
CALCulate<n>:MARKer<m>[:STATe]....480
CALCulate<n>:MARKer<m>:TRACe....480
CALCulate<n>:MARKer<m>:X....481

CALCulate<n>:DELTamarker<m>:AOFF

This command turns off *all* delta markers.

Suffix:
<n> Window

<m> irrelevant

Example: CALC:DELT:AOFF
Turns off all delta markers.

CALCulate<n>:DELTamarker<m>:MODE <Mode>

This command defines whether the position of a delta marker is provided as an absolute value or relative to a reference marker. Note that this setting applies to *all* windows.

Note that when the position of a delta marker is *queried*, the result is always an absolute value (see CALCulate<n>:DELTamarker<m>:X on page 479)!

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<Mode>

ABSolute
Delta marker position in absolute terms.

RELative
Delta marker position in relation to a reference marker.

*RST: RELative

Example: CALC:DELT:MODE ABS
Absolute delta marker position.

CALCulate<n>:DELTamarker<m>:MREFerence <Reference>

This command selects a reference marker for a delta marker other than marker 1.

Suffix:
<n> Window

<m> Marker

Parameters:
<Reference>

Example: CALC:DELT3:MREF 2
Specifies that the values of delta marker 3 are relative to marker 2.

Manual operation: See "Reference Marker" on page 216

CALCulate<n>:DELTamarker<m>[:STATe] <State>

This command turns delta markers on and off.

If necessary, the command activates the delta marker first.

No suffix at DELTamarker turns on delta marker 1.

Suffix:
<n> Window

<m> Marker

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker State" on page 215
See "Marker Type" on page 215
See "Select Marker" on page 216

CALCulate<n>:DELTamarker<m>:TRACe <Trace>

This command selects the trace a delta marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace> Trace number the marker is assigned to.

Example: `CALC:DELT2:TRAC 2`
Positions delta marker 2 on trace 2.

CALCulate<n>:DELTamarker<m>:X <Position>

This command moves a delta marker to a particular coordinate on the x-axis.

If necessary, the command activates the delta marker and positions a reference marker to the peak power.

Suffix:
<n> Window

<m> Marker

Example: `CALC:DELT:X?`
Outputs the absolute x-value of delta marker 1.

Manual operation: See "Marker Position X-value" on page 215

CALCulate<n>:MARKer<m>:AOFF

This command turns off all markers.

Suffix:
<n> Window

<m> Marker

Example: `CALC:MARK:AOFF`
Switches off all markers.

Manual operation: See "All Markers Off" on page 217

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a delta marker, it is turned into a normal marker.

Suffix:
<n> Window

<m> Marker

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker State" on page 215
See "Marker Type" on page 215
See "Select Marker" on page 216

CALCulate<n>:MARKer<m>:TRACe <Trace>

This command selects the trace the marker is positioned on.

Note that the corresponding trace must have a trace mode other than "Blank".

If necessary, the command activates the marker first.

Suffix:
<n> Window

<m> Marker

Parameters:
<Trace>

Example: //Assign marker to trace 1
`CALC:MARK3:TRAC 2`

Manual operation: See "Assigning the Marker to a Trace" on page 216

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a specific coordinate on the x-axis.

If necessary, the command activates the marker.

If the marker has been used as a delta marker, the command turns it into a normal marker.

Suffix:
<n> Window

<m> Marker

Parameters:
<Position> Numeric value that defines the marker position on the x-axis. The unit depends on the result display.

Range: The range depends on the current x-axis range.
Default unit: Hz

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker Position X-value" on page 215

15.7.4.2 General marker configuration

CALCulate<n>:MARKer<m>:SCOupled:LSCan....481
CALCulate<n>:MARKer<m>:SCOupled[:STATe]....482
DISPlay[:WINDow<n>]:MINFo[:STATe]....482
DISPlay[:WINDow<n>]:MTABle....482

CALCulate<n>:MARKer<m>:SCOupled:LSCan <State>

This command selects the measurement configuration to be applied when you couple receiver settings to scan range settings.

Prerequisites for this command

- Couple receiver settings to scan range settings (`CALCulate<n>:MARKer<m>:COUPled[:STATe]`).

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<State> **ON | 1**
Applies the configuration used during the last scan.

OFF | 0
Applies the current configuration.
This has an effect only if you have changed anything since the last scan.

*RST: OFF

Example: //Couple receiver settings to the scan range settings
```
CALC:MARK:COUP ON
CALC:MARK:SCO:LSC ON
```

Manual operation: See "Settings Coupled" on page 218

CALCulate<n>:MARKer<m>:SCOupled[:STATe] <State>

This command couples or decouples the marker frequency to the scan range settings.

Suffix:
<n> Marker

<m> irrelevant

Parameters:
<State> ON | OFF | 1 | 0

*RST: ON

Example: //Couple scan range settings to the marker frequency
```
CALC:MARK:SCO ON
```

Manual operation: See "Settings Coupled" on page 218

DISPlay[:WINDow<n>]:MINFo[:STATe] <State>

This command turns the marker information in all diagrams on and off.

Suffix:
<n> irrelevant

Parameters:
<State>

ON | 1
Displays the marker information in the diagrams.

OFF | 0
Hides the marker information in the diagrams.

*RST: 1

Example:
```
DISP:MINF OFF
```
Hides the marker information.

Manual operation: See "Marker Info" on page 217

DISPlay[:WINDow<n>]:MTABle <DisplayMode>

This command turns the marker table on and off.

Suffix:
<n> irrelevant

Parameters:
<DisplayMode> **ON | 1**
Turns on the marker table.
OFF | 0
Turns off the marker table.
*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 217

15.7.4.3 Marker search

Commands to configure a marker search described elsewhere.

- `CALCulate<n>:MARKer<m>:PEXCursion` on page 399

CALCulate<n>:MARKer<m>:COUPled[:STATe] 483
CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] 483
CALCulate<n>:MARKer<m>:X:SLIMits:LEFT 484
CALCulate<n>:MARKer<m>:X:SLIMits:RIGHt 484
CALCulate<n>:THReshold 485
CALCulate<n>:THReshold:STATe 485

CALCulate<n>:MARKer<m>:COUPled[:STATe] <State>

This command couples or decouples the receiver frequency to the current marker frequency.

Suffix:
<n> Marker

<m> irrelevant

Parameters:
<State> ON | OFF | 1 | 0
*RST: OFF

Example: //Couples receiver frequency to marker frequency
`CALC:MARK:COUP ON`

Manual operation: See "Synchronizing the receiver frequency to the marker frequency" on page 159

CALCulate<n>:MARKer<m>:X:SLIMits[:STATe] <State>

This command turns marker search limits on and off for *all* markers in *all* windows.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:MARK:X:SLIM ON`
Switches on search limitation.

Manual operation: See "Search Limits (Left / Right)" on page 219
See "Search Limits Off" on page 220

CALCulate<n>:MARKer<m>:X:SLIMits:LEFT <SearchLimit>

This command defines the left limit of the marker search range for *all* markers in *all* windows.

Suffix:

<n> irrelevant

<m> irrelevant

Parameters:

<SearchLimit> The value range depends on the frequency range or measurement time.
The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: left diagram border
Default unit: HZ

Example: `CALC:MARK:X:SLIM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:LEFT 10MHz`
Sets the left limit of the search range to 10 MHz.

Manual operation: See "Search Limits (Left / Right)" on page 219

CALCulate<n>:MARKer<m>:X:SLIMits:RIGHt <SearchLimit>

This command defines the right limit of the marker search range for *all* markers in *all* windows.

Suffix:

<n> irrelevant

<m> irrelevant

Example: `CALC:MARK:X:SLIM ON`
Switches the search limit function on.
`CALC:MARK:X:SLIM:RIGH 20MHz`
Sets the right limit of the search range to 20 MHz.

Manual operation: See "Search Limits (Left / Right)" on page 219

CALCulate<n>:THReshold <Level>

This command defines a threshold level for the marker peak search (for *all* markers in *all* windows).

Note that you must enable the use of the threshold using `CALCulate<n>:THReshold:STATe` on page 485.

Suffix:
<n> irrelevant

Parameters:
<Level> Numeric value. The value range and unit are variable.

*RST: -120 dBm
Default unit: DBM

Example: `CALC:THR:STAT ON`

Example: `CALC:THR -82DBM`
Enables the search threshold and sets the threshold value to -82 dBm.

Manual operation: See "Search Threshold" on page 219

CALCulate<n>:THReshold:STATe <State>

This command turns a threshold for the marker peak search on and off (for *all* markers in *all* windows).

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:THR:STAT ON`
Switches on the threshold line.

Manual operation: See "Search Threshold" on page 219
See "Search Limits Off" on page 220

15.7.4.4 Marker positioning

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- Delta markers....488

Markers

CALCulate<n>:MARKer<m>:MAXimum:LEFT....486
CALCulate<n>:MARKer<m>:MAXimum:NEXT....486
CALCulate<n>:MARKer<m>:MAXimum[:PEAK]....486
CALCulate<n>:MARKer<m>:MAXimum:RIGHt....487
CALCulate<n>:MARKer<m>:MINimum:LEFT....487
CALCulate<n>:MARKer<m>:MINimum:NEXT....487
CALCulate<n>:MARKer<m>:MINimum[:PEAK]....487
CALCulate<n>:MARKer<m>:MINimum:RIGHt....488

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next positive peak.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 222

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next positive peak.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 222

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]

This command moves a marker to the highest level.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Peak Search" on page 222

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next positive peak.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 222

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 222

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum peak value.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 222

CALCulate<n>:MARKer<m>:MINimum[:PEAK]

This command moves a marker to the minimum level.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Minimum" on page 222

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 222

Delta markers

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT 488
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT 489
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK] 489
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt 489
CALCulate<n>:DELTamarker<m>:MINimum:LEFT 489
CALCulate<n>:DELTamarker<m>:MINimum:NEXT 490
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK] 490
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt 490

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next positive peak value.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 222

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next positive peak value.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> 1..n
Window

<m> 1..n
Marker

Manual operation: See "Search Next Peak" on page 222

CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]

This command moves a delta marker to the highest level.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Peak Search" on page 222

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next positive peak value on the trace.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the maximum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Peak" on page 222

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 222

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next minimum peak value.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 222

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

If the marker is not yet active, the command first activates the marker.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Minimum" on page 222

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next minimum peak value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the command moves a marker horizontally to the minimum level in the currently selected frame. The vertical marker position remains the same.

Suffix:
<n> Window

<m> Marker

Manual operation: See "Search Next Minimum" on page 222

15.7.4.5 Marker results

Commands to retrieve the marker position described elsewhere.

- CALCulate<n>:DELTamarker<m>:X on page 479
- CALCulate<n>:MARKer<m>:X on page 481

CALCulate<n>:DELTamarker<m>:X:RELative? 491
CALCulate<n>:DELTamarker<m>:Y? 491
CALCulate<n>:MARKer<m>:Y? 491

CALCulate<n>:DELTamarker<m>:X:RELative?

This command queries the relative position of a delta marker on the x-axis.

If necessary, the command activates the delta marker first.

Suffix:

<n> Window

<m> Marker

Return values:

<Position> Position of the delta marker in relation to the reference marker.

Example: CALC:DELT3:X:REL?
Outputs the frequency of delta marker 3 relative to marker 1 or relative to the reference position.

Usage: Query only

CALCulate<n>:DELTamarker<m>:Y?

Queries the result at the position of the specified delta marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:

<Result> Result at the position of the delta marker.
The unit is variable and depends on the one you have currently set.
Default unit: DBM

Usage: Query only

CALCulate<n>:MARKer<m>:Y?

Queries the result at the position of the specified marker.

Suffix:

<n> 1..n

<m> 1..n

Return values:
<Result> Default unit: DBM

Usage: Query only

15.7.4.6 Spectrogram markers

Marker configuration

Commands to configure markers in spectrograms described elsewhere.

- `CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 486
- `CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 486
- `CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 486
- `CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 487
- `CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 487
- `CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 487
- `CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 487
- `CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 488

CALCulate<n>:MARKer<m>:SGRam:FRAMe....492
CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe....492
CALCulate<n>:MARKer<m>:SGRam:SARea....493
CALCulate<n>:MARKer<m>:SPECtrogram:SARea....493
CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK]....493
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MAXimum[:PEAK]....493
CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]....494
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MINimum[:PEAK]....494
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVe....494
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:ABOVe....494
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:BELow....494
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:BELow....494
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:NEXT....494
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:NEXT....494
CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum[:PEAK]....495
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum[:PEAK]....495
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:ABOVe....495
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:ABOVe....495
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELow....495
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:BELow....495
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT....495
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:NEXT....495
CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]....496
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum[:PEAK]....496

CALCulate<n>:MARKer<m>:SGRam:FRAMe <Frame> | <Time>
CALCulate<n>:MARKer<m>:SPECtrogram:FRAMe <Frame> | <Time>

This command positions a marker on a particular frame.

Suffix:
<n> Window

<m> Marker

Parameters:
<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.
Default unit: S

<Time> Selects a frame via its time stamp. Valid if the time stamp is on.
The number is the (negative) distance to frame 0 in seconds.
The range depends on the history depth.

Example: `CALC:MARK:SGR:FRAM -20`
Sets the marker on the 20th frame before the present.
`CALC:MARK2:SGR:FRAM -2s`
Sets second marker on the frame 2 seconds ago.

Manual operation: See "Frame (Spectrogram only)" on page 215

CALCulate<n>:MARKer<m>:SGRam:SAREa <SearchArea>
CALCulate<n>:MARKer<m>:SPECtrogram:SAREa <SearchArea>

This command defines the marker search area for all spectrogram markers in the channel setup.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<SearchArea> **VISible**
Performs a search within the visible frames.
Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory
Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See "Marker Search Area" on page 221

CALCulate<n>:MARKer<m>:SGRam:XY:MAXimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MAXimum[:PEAK]

This command moves a marker to the highest level of the spectrogram.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:XY:MINimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:XY:MINimum[:PEAK]

This command moves a marker to the minimum level of the spectrogram.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:ABOVe
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:ABOVe

This command moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:BELow
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:BELow

This command moves a marker vertically to the next lower peak level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum:NEXT
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum:NEXT

This command moves a marker vertically to the next lower peak level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MAXimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MAXimum[:PEAK]

This command moves a marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:ABOVe
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:ABOVe

This command moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:BELow
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:BELow

This command moves a marker vertically to the next higher minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum:NEXT
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum:NEXT

This command moves a marker vertically to the next higher minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:MARKer<m>:SGRam:Y:MINimum[:PEAK]
CALCulate<n>:MARKer<m>:SPECtrogram:Y:MINimum[:PEAK]

This command moves a marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command first looks for the peak level for all frequencies and moves the marker vertically to the minimum level.

Suffix:
<n> Window

<m> Marker

Delta marker configuration

Commands to configure delta markers in spectrograms described elsewhere.

- `CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 488
- `CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 489
- `CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 489
- `CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 489
- `CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 489
- `CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 490
- `CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 490
- `CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 490

CALCulate<n>:DELTamarker<m>:SGRam:FRAMe....497
CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe....497
CALCulate<n>:DELTamarker<m>:SGRam:SARea....497
CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea....497
CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]....498
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MAXimum[:PEAK]....498
CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]....498
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MINimum[:PEAK]....498
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe....498
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:ABOVe....498
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELow....498
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:BELow....498
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:NEXT....499
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:NEXT....499
CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK]....499
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum[:PEAK]....499
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:ABOVe....499
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:ABOVe....499
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:BELow....499

CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:BELow 499
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:NEXT 500
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:NEXT 500
CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum[:PEAK] 500
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum[:PEAK] 500

CALCulate<n>:DELTamarker<m>:SGRam:FRAMe <Frame> | <Time>
CALCulate<n>:DELTamarker<m>:SPECtrogram:FRAMe <Frame>

This command positions a delta marker on a particular frame. The frame is relative to the position of marker 1.

The command is available for the spectrogram.

Suffix:
<n> Window

<m> Marker

Parameters:
<Frame> Selects a frame either by its frame number or time stamp.
The frame number is available if the time stamp is off. The range depends on the history depth.
The time stamp is available if the time stamp is on. The number is the distance to frame 0 in seconds. The range depends on the history depth.

Default unit: S

Example: `CALC:DELT4:SGR:FRAM -20`
Sets fourth deltamarker 20 frames below marker 1.
`CALC:DELT4:SGR:FRAM 2 s`
Sets fourth deltamarker 2 seconds above the position of marker 1.

Manual operation: See "Frame (Spectrogram only)" on page 215

CALCulate<n>:DELTamarker<m>:SGRam:SARea <SearchArea>
CALCulate<n>:DELTamarker<m>:SPECtrogram:SARea <SearchArea>

This command defines the marker search area for *all* spectrogram markers in the channel setup.

Suffix:
<n> irrelevant

<m> irrelevant

Parameters:
<SearchArea> **VISible**
Performs a search within the visible frames.
Note that the command does not work if the spectrogram is not visible for any reason (e.g. if the display update is off).

MEMory
Performs a search within all frames in the memory.

*RST: VISible

Manual operation: See "Marker Search Area" on page 221

CALCulate<n>:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MAXimum[:PEAK]

This command moves a marker to the highest level of the spectrogram over all frequencies.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:XY:MINimum[:PEAK]

This command moves a delta marker to the minimum level of the spectrogram over all frequencies.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:ABOVe

This command moves a marker vertically to the next higher level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:BELow
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:BELow

This command moves a marker vertically to the next higher level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum:NEXT
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum:NEXT

This command moves a delta marker vertically to the next higher level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MAXimum[:PEAK]

This command moves a delta marker vertically to the highest level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command looks for the peak level in the whole spectrogram.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:ABOVe
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:ABOVe

This command moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames above the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window

<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:BELow
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:BELow

This command moves a delta marker vertically to the next minimum level for the current frequency.

The search includes only frames below the current marker position. It does not change the horizontal position of the marker.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum:NEXT
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum:NEXT

This command moves a delta marker vertically to the next minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

Suffix:
<n> Window
<m> Marker

CALCulate<n>:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]
CALCulate<n>:DELTamarker<m>:SPECtrogram:Y:MINimum[:PEAK]

This command moves a delta marker vertically to the minimum level for the current frequency.

The search includes all frames. It does not change the horizontal position of the marker.

If the marker hasn't been active yet, the command first looks for the peak level in the whole spectrogram and moves the marker vertically to the minimum level.

Suffix:
<n> Window
<m> Marker

15.7.5 Display and limit line configuration

- Display lines....500
- Limit lines....503

15.7.5.1 Display lines

CALCulate<n>:DLINe<dl>....501
CALCulate<n>:DLINe<dl>:STATe....501
CALCulate<n>:FLINe<dl>....501
CALCulate<n>:FLINe<dl>:STATe....502
CALCulate<n>:TFLine:STATe....502
CALCulate<n>:TLINe<dl>....502
CALCulate<n>:TLINe<dl>:STATe....503

CALCulate<n>:DLINe<dl> <Position>

This command defines the (horizontal) position of a display line.

Suffix:
<n> Window

<dl> 1 | 2

Parameters:
<Position> The value range is variable.
You can use any unit you want, the R&S EPL1000 then converts the unit to the currently selected unit. If you omit a unit, the R&S EPL1000 uses the currently selected unit.

*RST: (state is OFF)
Default unit: DBM

Example: `CALC:DLIN2 -20dBm`
Positions the second display line at -20 dBm.

Manual operation: See "Horizontal Line 1/ Horizontal Line 2" on page 224

CALCulate<n>:DLINe<dl>:STATe <State>

This command turns a display line on and off

Suffix:
<n> Window

<dl> 1 | 2

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:DLIN2:STAT ON`
Turns on display line 2.

CALCulate<n>:FLINe<dl> <Frequency>

This command defines the position of a frequency line.

Suffix:
<n> Window

<dl> 1 to 4
frequency line

Parameters:

<Frequency> Note that you can not set a frequency line to a position that is outside the current span.

Range: 0 Hz to Fmax
*RST: (STATe to OFF)
Default unit: HZ

Example: `CALC:FLIN2 120MHz`
Sets frequency line 2 to a frequency of 120 MHz.

Manual operation: See "Vertical Line <x>" on page 224

CALCulate<n>:FLINe<dl>:STATe <State>

This command turns a frequency line on and off

Suffix:

<n> Window

<dl> 1 | 2
frequency line

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:FLIN2:STAT ON`
Turns frequency line 2 on.

CALCulate<n>:TFLine:STATe <State>

This command turns the frequency line representing the current receiver frequency on and off.

Suffix:

<n> irrelevant

Parameters:

<State> ON | OFF | 1 | 0

*RST: ON

Example: //Turn on the frequency line
`CALC:TFL:STAT ON`

Manual operation: See "Tuned Frequency" on page 225

CALCulate<n>:TLINe<dl> <Time>

This command defines the position of a time line.

Suffix:
<n> Window

<dl> 1 to 4
time line

Parameters:
<Time> Note that you can not set a time line to a position that is higher than the current sweep time.

Range: 0 s to 1600 s
*RST: (STATe to OFF)
Default unit: S

Example: `CALC:TLIN 10ms`
Sets the first time line to 10 ms.

Manual operation: See "Vertical Line <x>" on page 224

CALCulate<n>:TLINe<dl>:STATe <State>

This command turns a time line on and off

Suffix:
<n> Window

<dl> 1 | 2
time line

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:TLIN:STAT ON`
Turns the first time line on.

15.7.5.2 Limit lines

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- Limit line design....509
- Limit check....516
- Programming example: using limit lines....517

Limit line management

CALCulate<n>:LIMit<li>:ACTive?....504
CALCulate<n>:LIMit<li>:CONTrol:OFFSet....504
CALCulate<n>:LIMit<li>:COPY....504
CALCulate<n>:LIMit<li>:DELete....505
CALCulate<n>:LIMit<li>:LOWer:OFFSet....505
CALCulate<n>:LIMit<li>:LOWer:STATe....505

CALCulate<n>:LIMit<li>:STATe....506
CALCulate<n>:LIMit<li>:TRACe<t>....506
CALCulate<n>:LIMit<li>:TRACe<t>:CHECk....507
CALCulate<n>:LIMit<li>:UPPer:OFFSet....507
CALCulate<n>:LIMit<li>:UPPer:STATe....508
MMEMory:LOAD<n>:LIMit....508
MMEMory:STORe<n>:LIMit....508

CALCulate<n>:LIMit<li>:ACTive?

This command queries the names of *all* active limit lines.

Suffix:
<n> irrelevant

 irrelevant

Return values:
<LimitLines> String containing the names of all active limit lines in alphabetical order.

Example: `CALC:LIM:ACT?`
Queries the names of all active limit lines.

Usage: Query only

Manual operation: See "Visibility" on page 231

CALCulate<n>:LIMit<li>:CONTrol:OFFSet <Offset>

This command defines an offset for a complete limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Offset> Numeric value.
The unit depends on the scale of the x-axis.
*RST: 0
Default unit: HZ

Manual operation: See "X-Offset" on page 231

CALCulate<n>:LIMit<li>:COPY <Line>

This command copies a limit line.

Suffix:
<n> Window

 Limit line

Parameters:

<Line> **1 to 8**
number of the new limit line

<name>
String containing the name of the limit line.

Example: `CALC:LIM1:COPY 2`
Copies limit line 1 to line 2.
`CALC:LIM1:COPY 'FM2'`
Copies limit line 1 to a new line named FM2.

Manual operation: See "Copy Line" on page 232

CALCulate<n>:LIMit<li>:DELete

This command deletes a limit line.

Suffix:

<n> Window

 Limit line

Manual operation: See "Delete Line" on page 232

CALCulate<n>:LIMit<li>:LOWer:OFFSet <Offset>

This command defines an offset for a complete lower limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Suffix:

<n> Window

 Limit line

Parameters:

<Offset> Numeric value.

*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 231

CALCulate<n>:LIMit<li>:LOWer:STATe <State>

This command turns a lower limit line on and off.

Before you can use the command, you have to select a limit line with `CALCulate<n>:LIMit<li>:NAME` on page 514.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Visibility" on page 231

CALCulate<n>:LIMit<li>:STATe <State>

This command turns the limit check for a specific limit line on and off.

To query the limit check result, use `CALCulate<n>:LIMit<li>:FAIL?`.

Note that a new command exists to activate the limit check and define the trace to be checked in one step (see `CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 507).

Suffix:

<n> irrelevant

 Limit line

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:LIM:STAT ON`
Switches on the limit check for limit line 1.

Manual operation: See "Disable All Lines" on page 232

CALCulate<n>:LIMit<li>:TRACe<t> <TraceNumber>

This command links a limit line to one or more traces.

Note that this command is maintained for compatibility reasons only. Limit lines no longer need to be assigned to a trace explicitly. The trace to be checked can be defined directly (as a suffix) in the new command to activate the limit check (see `CALCulate<n>:LIMit<li>:TRACe<t>:CHECk` on page 507).

Suffix:

<n> Window

 Limit line

<t> irrelevant

Example: `CALC:LIM2:TRAC 3`
Assigns limit line 2 to trace 3.

CALCulate<n>:LIMit<li>:TRACe<t>:CHECk <State>

This command turns the limit check for a specific trace on and off.

To query the limit check result, use `CALCulate<n>:LIMit<li>:FAIL?`.

Note that this command replaces the two commands from previous signal and spectrum analyzers (which are still supported, however):

- `CALCulate<n>:LIMit<li>:TRACe<t>` on page 506
- `CALCulate<n>:LIMit<li>:STATe` on page 506

Suffix:
<n> Window

 Limit line

<t> Trace

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Example: `CALC:LIM3:TRAC2:CHEC ON`
Switches on the limit check for limit line 3 on trace 2.

Manual operation: See "Traces to be Checked" on page 231

CALCulate<n>:LIMit<li>:UPPer:OFFSet <Offset>

This command defines an offset for a complete upper limit line.

Compared to shifting the limit line, an offset does not actually change the limit line definition points.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Offset> Numeric value.

*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 231

CALCulate<n>:LIMit<li>:UPPer:STATe <State>

This command turns an upper limit line on and off.

Before you can use the command, you have to select a limit line with `CALCulate<n>:LIMit<li>:NAME` on page 514.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

Manual operation: See "Visibility" on page 231

MMEMory:LOAD<n>:LIMit <FileName>

Loads the limit line from the selected file in `.CSV` format.

Suffix:
<n> irrelevant

Parameters:
<FileName> String containing the path and name of the `CSV` import file.

Example:
```
MMEM:LOAD:LIM 'C:\TEST.CSV'
```

Manual operation: See "Import" on page 235

MMEMory:STORe<n>:LIMit <FileName>, <LimitLineName>

This command exports limit line data to an ASCII (CSV) file.

Suffix:
<n> irrelevant

Parameters:
<FileName> String containing the path and name of the target file.

<LimitLineName> Name of the limit line to be exported.

Example:
```
MMEM:STOR:LIM 'C:\TEST', 'UpperLimitLine'
```
Stores the limit line named "UpperLimitLine" in the file `TEST.CSV`.

Manual operation: See "Export" on page 235

Limit line design

CALCulate<n>:LIMit<li>:COMMent 509
CALCulate<n>:LIMit<li>:CONTrol[:DATA] 509
CALCulate<n>:LIMit<li>:CONTrol:DOMain 510
CALCulate<n>:LIMit<li>:CONTrol:MODE 510
CALCulate<n>:LIMit<li>:CONTrol:SHIFt 511
CALCulate<n>:LIMit<li>:CONTrol:SPACing 511
CALCulate<n>:LIMit<li>:LOWer[:DATA] 511
CALCulate<n>:LIMit<li>:LOWer:MARGin 512
CALCulate<n>:LIMit<li>:LOWer:MODE 512
CALCulate<n>:LIMit<li>:LOWer:SHIFt 512
CALCulate<n>:LIMit<li>:LOWer:SPACing 513
CALCulate<n>:LIMit<li>:LOWer:THReshold 513
CALCulate<n>:LIMit<li>:NAME 514
CALCulate<n>:LIMit<li>:UNIT 514
CALCulate<n>:LIMit<li>:UPPer[:DATA] 514
CALCulate<n>:LIMit<li>:UPPer:MARGin 515
CALCulate<n>:LIMit<li>:UPPer:MODE 515
CALCulate<n>:LIMit<li>:UPPer:SHIFt 515
CALCulate<n>:LIMit<li>:UPPer:SPACing 516
CALCulate<n>:LIMit<li>:UPPer:THReshold 516

CALCulate<n>:LIMit<li>:COMMent <Comment>

This command defines a comment for a limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Comment> String containing the description of the limit line.

Manual operation: See "Comment" on page 233

CALCulate<n>:LIMit<li>:CONTrol[:DATA] <LimitLinePoints>

This command defines the horizontal definition points of a limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<LimitLinePoints> Variable number of x-axis values.
Note that the number of horizontal values has to be the same as the number of vertical values set with `CALCulate<n>:LIMit<li>:LOWer[:DATA]` or `CALCulate<n>:LIMit<li>:UPPer[:DATA]`. If not, the R&S EPL1000 either adds missing values or ignores surplus values.

*RST: -
Default unit: HZ

Manual operation: See "Data Points" on page 234

CALCulate<n>:LIMit<li>:CONTrol:DOMain <SpanSetting>

This command selects the domain of the limit line.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<SpanSetting> FREQuency | TIME

FREQuency
For limit lines that apply to a range of frequencies.

TIME
For limit lines that apply to a period of time.

*RST: FREQuency

Example: `CALC:LIM:CONT:DOM FREQ`
Select a limit line in the frequency domain.

Manual operation: See "X-Axis" on page 234

CALCulate<n>:LIMit<li>:CONTrol:MODE <Mode>

This command selects the horizontal limit line scaling.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Mode>

ABSolute
Limit line is defined by absolute physical values (Hz or s).

RELative
Limit line is defined by relative values related to the center frequency (frequency domain) or the left diagram border (time domain).

*RST: ABSolute

Manual operation: See "X-Axis" on page 234

CALCulate<n>:LIMit<li>:CONTrol:SHIFt <Distance>

This command moves a complete limit line horizontally.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Distance> Numeric value.
The unit depends on the scale of the x-axis.
Default unit: HZ

Manual operation: See "Shift x" on page 235

CALCulate<n>:LIMit<li>:CONTrol:SPACing <InterpolMode>

This command selects linear or logarithmic interpolation for the calculation of limit lines from one horizontal point to the next.

Suffix:
<n> Window

 Limit line

Parameters:
<InterpolMode> LINear | LOGarithmic
*RST: LIN

Example: `CALC:LIM:CONT:SPAC LIN`

Manual operation: See "X-Axis" on page 234

CALCulate<n>:LIMit<li>:LOWer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of a lower limit line.

Suffix:
<n> irrelevant

 Limit line

Parameters:

<LimitLinePoints> Variable number of level values.
Note that the number of vertical values has to be the same as the number of horizontal values set with `CALCulate<n>:LIMit<li>:CONTrol[:DATA]`. If not, the R&S EPL1000 either adds missing values or ignores surplus values.

*RST: Limit line state is OFF
Default unit: DBM

Manual operation: See "Data Points" on page 234

CALCulate<n>:LIMit<li>:LOWer:MARGin <Margin>

This command defines an area around a lower limit line where limit check violations are still tolerated.

Suffix:

<n> irrelevant

 Limit line

Parameters:

<Margin> **numeric value**

*RST: 0
Default unit: dB

Manual operation: See "Margin" on page 234

CALCulate<n>:LIMit<li>:LOWer:MODE <Mode>

This command selects the vertical limit line scaling.

Suffix:

<n> Window

 Limit line

Parameters:

<Mode> **ABSolute**
Limit line is defined by absolute physical values.
The unit is variable.

RELative
Limit line is defined by relative values related to the reference level (dB).

*RST: ABSolute

Manual operation: See "Y-Axis" on page 234

CALCulate<n>:LIMit<li>:LOWer:SHIFt <Distance>

This command moves a complete lower limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Suffix:
<n> Window

 Limit line

Parameters:
<Distance> Defines the distance that the limit line moves.
Default unit: DB

Manual operation: See "Shift y" on page 235

CALCulate<n>:LIMit<li>:LOWer:SPACing <InterpolType>

This command selects linear or logarithmic interpolation for the calculation of a lower limit line from one horizontal point to the next.

Suffix:
<n> Window

 Limit line

Parameters:
<InterpolType> LINear | LOGarithmic
*RST: LIN

Manual operation: See "Y-Axis" on page 234

CALCulate<n>:LIMit<li>:LOWer:THReshold <Threshold>

This command defines a threshold for relative limit lines.

The R&S EPL1000 uses the threshold for the limit check, if the limit line violates the threshold.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Threshold> Numeric value.
The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 514.
*RST: -200 dBm
Default unit: DBM

Manual operation: See "Threshold" on page 233

CALCulate<n>:LIMit<li>:NAME <Name>

This command selects a limit line that already exists or defines a name for a new limit line.

Suffix:
<n> Window

 Limit line

Parameters:
<Name> String containing the limit line name.
*RST: REM1 to REM8 for lines 1 to 8

Manual operation: See "Name" on page 233

CALCulate<n>:LIMit<li>:UNIT <Unit>

This command defines the unit of a limit line.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Unit> If you select a dB-based unit for the limit line, the command automatically turns the limit line into a relative limit line.
*RST: DBM

Manual operation: See "Y-Axis" on page 234

CALCulate<n>:LIMit<li>:UPPer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of an upper limit line.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<LimitLinePoints> Variable number of level values.
Note that the number of vertical values has to be the same as the number of horizontal values set with `CALCulate<n>:LIMit<li>:CONTrol[:DATA]`. If not, the R&S EPL1000 either adds missing values or ignores surplus values.
*RST: Limit line state is OFF
Default unit: DBM

Manual operation: See "Data Points" on page 234

CALCulate<n>:LIMit<li>:UPPer:MARGin <Margin>

This command defines an area around an upper limit line where limit check violations are still tolerated.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Margin> **numeric value**

*RST: 0
Default unit: dB

Manual operation: See "Margin" on page 234

CALCulate<n>:LIMit<li>:UPPer:MODE <Mode>

This command selects the vertical limit line scaling.

Suffix:
<n> Window

 Limit line

Parameters:
<Mode> **ABSolute**
Limit line is defined by absolute physical values.
The unit is variable.

RELative
Limit line is defined by relative values related to the reference level (dB).

*RST: ABSolute

Manual operation: See "Y-Axis" on page 234

CALCulate<n>:LIMit<li>:UPPer:SHIFt <Distance>

This command moves a complete upper limit line vertically.

Compared to defining an offset, this command actually changes the limit line definition points by the value you define.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Distance> Defines the distance that the limit line moves.

Manual operation: See "Shift y" on page 235

CALCulate<n>:LIMit<li>:UPPer:SPACing <InterpolType>

This command selects linear or logarithmic interpolation for the calculation of an upper limit line from one horizontal point to the next.

Suffix:
<n> Window

 Limit line

Parameters:
<InterpolType> LINear | LOGarithmic
*RST: LIN

Manual operation: See "Y-Axis" on page 234

CALCulate<n>:LIMit<li>:UPPer:THReshold <Limit>

This command defines an absolute limit for limit lines with a relative scale.

The R&S EPL1000 uses the threshold for the limit check, if the limit line violates the threshold.

Suffix:
<n> irrelevant

 Limit line

Parameters:
<Limit> Numeric value.
The unit depends on `CALCulate<n>:LIMit<li>:UNIT` on page 514.
*RST: -200
Default unit: dBm

Manual operation: See "Threshold" on page 233

Limit check

CALCulate<n>:LIMit<li>:CLEar[:IMMediate] 516
CALCulate<n>:LIMit<li>:FAIL? 517

CALCulate<n>:LIMit<li>:CLEar[:IMMediate]

This command deletes the result of the current limit check.

The command works on *all* limit lines in *all* measurement windows at the same time.

Suffix:
<n> Window

 irrelevant

Example: `CALC:LIM:CLE`
Deletes the result of the limit check.

CALCulate<n>:LIMit<li>:FAIL?

This command queries the result of a limit check in the specified window.

To get a valid result, you have to perform a complete measurement with synchronization to the end of the measurement before reading out the result. This is only possible for single measurement mode.

See also `INITiate<n>:CONTinuous` on page 379.

Suffix:

<n> Window

 Limit line

Return values:

<Result> **0**
PASS
1
FAIL

Example: `INIT;*WAI`
Starts a new sweep and waits for its end.
`CALC2:LIM3:FAIL?`
Queries the result of the check for limit line 3 in window 2.

Usage: Query only

Programming example: using limit lines

The following examples demonstrate how to work with limit lines in a remote environment.

- Example: configuring limit lines....517
- Example: performing a limit check....518

Example: configuring limit lines

This example demonstrates how to configure 2 limit lines - an upper and a lower limit - for a measurement in a remote environment.

```
//------------- Configuing the limit lines --------------------
CALC:LIM1:NAME 'FM1'
//Names limit line 1 'FM1'.

CALC:LIM1:CONT:MODE ABS
//Selects absolute scaling for the horizontal axis.
CALC:LIM1:CONT 1 MHz,50MHz,100 MHz,150MHz,200MHz
//Defines 5 horizontal definition points for limit line 1.
CALC:LIM1:UPP:MODE ABS
//Selects an absolute vertical scale for limit line 1.
CALC:LIM1:UNIT DBM
//Selects the unit dBm for limit line 1.
CALC:LIM1:UPP -10,-5,0,-5,-10
//Defines 5 definition points for limit line 1.
```

```
CALC:LIM1:UPP:MARG 5dB
//Defines an area of 5 dB around limit line 1 where limit check violations
//are still tolerated.

CALC:LIM1:UPP:SHIF -10DB
//Shifts the limit line 1 by -10 dB.
CALC:LIM1:UPP:OFFS -3dB
//Defines an additional -3 dB offset for limit line 1.

CALC:LIM3:NAME 'FM3'
//Names limit line 3 'FM3'.

CALC:LIM3:LOW:MODE REL
//Selects a relative vertical scale for limit line 3.
CALC:LIM3:UNIT DB

CALC:LIM3:CONT 1 MHz,50MHz,100 MHz,150MHz,200MHz
//Defines 5 horizontal definition points for limit line 3.
CALC:LIM3:LOW -90,-60,-40,-60,-90
//Defines 5 definition points relative to the reference level for limit line 3.

CALC:LIM3:LOW:SHIF 2
//Shifts the limit line 3 by 2dB.
CALC:LIM3:LOW:OFFS 3
//Defines an additional 3 dB offset for limit line 3.

CALC:LIM3:LOW:THR -200DBM
//Defines a power threshold of -200dBm that must be exceeded for limit to be checked

CALC:LIM3:LOW:MARG 5dB
//Defines an area of 5dB around limit line 3 where limit check violations
//are still tolerated.

//-------------- Storing the limit lines -----------------------
MMEM:SEL:CHAN:LIN:ALL ON
MMEM:STOR:TYPE CHAN
MMEM:STOR:STAT 1,'LimitLines_FM1_FM3'
```

Example: performing a limit check

This example demonstrates how to perform a limit check during a basic frequency sweep measurement in a remote environment. The limit lines configured in "Example: configuring limit lines" on page 517 are assumed to exist and be active.

```
//--------------Preparing the instrument ---------------------
*RST
//Resets the instrument
INIT:CONT OFF
//Selects single sweep mode.
```

```
//--------------Configuring the measurement -------------
FREQ:CENT 100MHz
//Defines the center frequency
FREQ:SPAN 200MHz
//Sets the span to 100 MHz on either side of the center frequency.
SENS:SWE:COUN 10
//Defines 10 sweeps to be performed in each measurement.
DISP:TRAC1:Y:RLEV 0dBm
//Sets the reference level to 0 dBm.
TRIG:SOUR IFP
TRIG:LEV:IFP -10dBm
//Defines triggering when the second intermediate frequency rises to a level
//of -10 dBm.

//--------------Configuring the Trace--------------------------
DISP:TRAC2 ON
DISP:TRAC2:MODE AVER
DISP:TRAC3 ON
DISP:TRAC3:MODE MAXH
//Configures 3 traces: 1 (default): clear/write; 2: average; 3: max hold

//------------- Configuring the limit check -------------------
MMEM:LOAD:TYPE REPL
MMEM:LOAD:STAT 1,'LimitLines_FM1_FM3'
//Loads the limit lines stored in 'LimitLines_FM1_FM3'
CALC:LIM1:NAME 'FM1'
CALC:LIM1:UPP:STAT ON
//Activates upper limit FM1 as line 1.
CALC:LIM3:NAME 'FM3'
CALC:LIM3:LOW:STAT ON
//Activates lower limit line FM3 as line 3.
CALC:LIM:ACT?
//Queries the names of all active limit lines
//Result: 'FM1,FM3'
CALC:LIM1:TRAC3:CHEC ON
//Activates the upper limit to be checked against trace3 (maxhold trace)
CALC:LIM3:TRAC2:CHEC ON
//Activates the upper limit to be checked against trace2 (average trace)
CALC:LIM:CLE
//Clears the previous limit check results

//------------- Performing the measurement---------------------
INIT;*WAI
//Initiates a new measurement and waits until the last sweep has finished.

//-------------- Retrieving limit check results----------------------------

CALC:LIM1:FAIL?
//Queries the result of the upper limit line check
```

```
CALC:LIM3:FAIL?
//Queries the result of the lower limit line check
```

15.8 Data management

The commands required to store and load instrument settings and import and export measurement results in a remote environment are described here. The tasks for manual operation are described in Chapter 12, "Data management", on page 241.

Addressing drives

The various drives can be addressed via the "mass storage instrument specifier" <msis> using the conventional Windows syntax. The internal hard disk is addressed by "C:". For details on storage locations refer to Chapter 12.2.2.2, "Storage location and filename", on page 246.

The file names (<FileName> parameter) are given as string parameters enclosed in quotation marks. They also comply with Windows conventions. Windows file names do not distinguish between uppercase and lowercase notation.

Wildcards

The two characters "*" and "?" can be used as "wildcards". Wildcards are variables for a selection of several files. The question mark "?" replaces exactly one character, the asterisk replaces any of the remaining characters in the file name. "*.*" thus means all files in a directory.

Path names

Storage locations can be specified either as absolute (including the entire path) or relative paths (including only subfolders of the current folder). Use the `MMEM:CDIR?` query to determine the current folder.

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- Items to store 527
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- Notes display 544
- Test reports 545
- Measurement result export 557
- Examples: managing data 558

15.8.1 File management

FORMat[:DATA] 521
FORMat:DEXPort:DSEParator 522
MMEMory:CATalog 522
MMEMory:CATalog:LONG 523
MMEMory:CDIRectory 523

MMEMory:COMMent....523
MMEMory:COPY....523
MMEMory:DATA....524
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MMEMory:MOVE....525
MMEMory:MSIS....525
MMEMory:NAME....525
MMEMory:NETWork:DISConnect....525
MMEMory:NETWork:MAP....526
MMEMory:NETWork:UNUSeddrives....526
MMEMory:NETWork:USEDdrives....526
MMEMory:RDIRectory....527

FORMat[:DATA] <Format>[, <BitLength>]

This command selects the data format that is used for transmission of trace data from the R&S EPL1000 to the controlling computer.

Note that the command has no effect for data that you send to the R&S EPL1000. The R&S EPL1000 automatically recognizes the data it receives, regardless of the format.

For details on data formats, see Chapter 15.7.3.6, "Formats for returned values: ASCII format and binary format", on page 476.

Parameters:

<Format>

ASCii
ASCii format, separated by commas.
This format is almost always suitable, regardless of the actual data format. However, the data is not as compact as other formats can be.

REAL
Floating-point numbers (according to IEEE 754) in the "definite length block format".
The format setting `REAL` is used for the binary transmission of trace data.

<BitLength>

Length in bits for floating-point results

16
16-bit floating-point numbers.
Compared to `REAL,32` format, half as many numbers are returned.

32
32-bit floating-point numbers
For I/Q data, 8 bytes per sample are returned for this format setting.

64
64-bit floating-point numbers
Compared to `REAL,32` format, twice as many numbers are returned.

Example: `FORM REAL,32`

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator> POINt | COMMa

COMMa
Uses a comma as decimal separator, e.g. *4,05*.

POINt
Uses a point as decimal separator, e.g. *4.05*.

*RST: *RST has no effect on the decimal separator. Default is POINt.

Example: `FORM:DEXP:DSEP POIN`
Sets the decimal point as separator.

Manual operation: See "Exporting a peak list" on page 112
See "Decimal Separator" on page 193

MMEMory:CATalog <FileName>

This command returns the contents of a particular directory.

Parameters:

<FileName> String containing the path and directory
If you leave out the path, the command returns the contents of the directory selected with `MMEMory:CDIRectory` on page 523.
The path may be relative or absolute. Using wildcards ('*') is possible to query a certain type of files only.
If you use a specific file as a parameter, the command returns the name of the file if the file is found in the specified directory, or an error if the file is not found (`"-256,"File name not found"`).

Example: `MMEM:CAT? 'C:\Data\SPOOL?.PNG'`
Returns all files in `C:\Data\` whose names start with `SPOOL`, have 6 characters and the extension `.PNG`, e.g.:
`SPOOL1.PNG,SPOOL2.PNG,SPOOL3.PNG`

Example: `MMEM:CAT? 'C:\Data\SPOOL6.PNG'`
Query whether the file '`SPOOL6.PNG`' also exists in the directory; Result:
`-256,"File name not found;:MMEMory:CATalog? 'C:\Data\SPOOL6.PNG'`

Manual operation: See "Selecting Storage Location - Drive/ Path/ Files" on page 247

MMEMory:CATalog:LONG <Directory>

This command returns the contents of a particular directory with additional information about the files.

Parameters:

<Directory> String containing the path and directory.
If you leave out the path, the command returns the contents of the directory selected with `MMEMory:CDIRectory` on page 523.
The path may be relative or absolute. Using wildcards ('*') is possible to query a certain type of files only.

MMEMory:CDIRectory <Directory>

This command changes the current directory.

Parameters:

<Directory> String containing the path to another directory.
The path may be relative or absolute.

MMEMory:COMMent <Comment>

This command defines a comment for the stored settings.

Parameters:

<Comment> String containing the comment.

Example:
```
MMEMory:COMMent "ACP measurement with Standard Tetra from 23.05."
MMEMory::MMEMory:STORe1:STATe 1, "ACP_T"
```
As a result, in the selection list for recall settings, the comment `"ACP measurement with Standard Tetra from 23.05."` is added to the ACP entry.

Manual operation: See "Comment" on page 248

MMEMory:COPY <FileName>, <FileName>

This command copies one or more files to another directory.

Parameters:

<FileName> String containing the path and file name of the source file.

<FileName> String containing the path and name of the target file.
The path may be relative or absolute.

MMEMory:DATA <FileName>[, <Data>]
MMEMory:DATA? <FileName>

This command writes block data into a file. The delimiter must be set to EOI to obtain error-free data transfer.

When you query the contents of a file, you can save them in a file on the remote control computer.

The command is useful for reading stored settings files or trace data from the instrument or for transferring them to the instrument

Parameters:

<Data> <block_data>

Data block with the following structure.
#
Hash sign.
<number>
Length of the length information.
<number>
Length information of the binary data (number of bytes).
<data>
Binary data with the indicated <number> of bytes.

Parameters for setting and query:

<FileName>

Example:

```
MMEM:NAME '\Public\User\Testfile.txt'
```
Creates a new file called 'testfile.txt'.
```
MMEM:DATA 'Testfile.txt',#220Contents of the
file
```
The parameter means:
#2: hash sign and length of the length information (20 bytes = 2 digits)
20: indicates the number of subsequent binary data bytes.
Contents of the file: store 20 binary bytes (characters) to the file.
```
MMEM:DATA? 'Testfile.txt'
```
Returns the contents of the file.

MMEMory:DELete:IMMediate <FileName>

This command deletes a file.

Parameters:

<FileName> String containing the path and file name of the file to delete. The path may be relative or absolute.

MMEMory:MDIRectory <Directory>

This command creates a new directory.

Parameters:

<Directory> String containing the path and new directory name
The path may be relative or absolute.

MMEMory:MOVE <FileName>, <FileName>

This command moves a file to another directory.

The command also renames the file if you define a new name in the target directory.

If you do not include a path for <NewFileName>, the command just renames the file.

Parameters:

<FileName> String containing the path and file name of the source file.

<FileName> String containing the path and name of the target file.

Example: `MMEM:MOVE 'C:\TEST01.CFG','SETUP.CFG'`
Renames TEST01.CFG in SETUP.CFG in directory C:\.

MMEMory:MSIS <Drive>

This command selects the default storage device used by all MMEMory commands.

Parameters:

<Drive> 'A:' | 'C:' | … | 'Z:'
String containing the device drive name
*RST: n.a.

MMEMory:NAME <FileName>

This command has several purposes, depending on the context it is used in.

- It creates a new and empty file.
- It defines the file name for screenshots taken with `HCOPy[:IMMediate]`. Note that you have to route the printer output to a file.
- It defines the name and directory of a test report.

Parameters:

<FileName> String containing the path and name of the target file.

Example: `MMEM:NAME 'C:\Data\PRINT1.BMP'`
Selects the file name.

Manual operation: See "Configuration and printout of the test report" on page 273

MMEMory:NETWork:DISConnect <Drive>[, <State>]

This command disconnects a network drive.

Parameters:

<Drive> String containing the drive name.

<State> 1 | 0 | ON | OFF

Optional: determines whether disconnection is forced or not

1 | ON
Disconnection is forced.

0 | OFF
Disconnect only if not in use.

*RST: 0

MMEMory:NETWork:MAP <FilePath>, <IP>[, <UserName>, <Password>, <State>]

This command maps a drive to a server or server directory of the network.

Note that you have to allow sharing for a server or folder in Microsoft networks first.

Parameters:

<FilePath> String containing the drive name or path of the directory you want to map.

<IP> String containing the host name of the computer or the IP address and the share name of the drive.
'<\host name or IP address\share name>'

<UserName> String containing a user name in the network.
The user name is optional.

<Password> String containing the password corresponding to the <User-Name>.
The password is optional.

<State> ON | OFF | 1 | 0

ON | 1
Reconnects at logon with the same user name.

OFF | 0
Does not reconnect at logon.

MMEMory:NETWork:UNUSeddrives

This command returns a list of unused network drives.

MMEMory:NETWork:USEDdrives [<State>]

This command returns a list of all network drives in use.

Parameters:

<State> You do not have to use the parameter. If you do not include the parameter, the command returns a list of all drives in use.
This is the same behavior as if you were using the parameter OFF.

ON | 1
Returns a list of all drives in use including the folder information.

OFF | 0
Returns a list of all drives in use.

MMEMory:RDIRectory <arg0>

This command deletes the indicated directory.

Parameters:

<arg0> String containing the path of the directory to delete.
Note that the directory you want to remove must be empty.

15.8.2 Items to store

The following commands select the items to be included in the configuration file.

Depending on the used command, either the items from the entire instrument (`MMEMory:SELect[:ITEM]...`), or only those from the currently selected channel (`MMEM:SELect:CHANnel[:ITEM]...`) are stored.

MMEMory:SELect:CHANnel[:ITEM]:ALL....527
MMEMory:SELect[:ITEM]:ALL....527
MMEMory:SELect:CHANnel[:ITEM]:DEFault....528
MMEMory:SELect[:ITEM]:DEFault....528
MMEMory:SELect:CHANnel[:ITEM]:HWSettings....528
MMEMory:SELect[:ITEM]:HWSettings....528
MMEMory:SELect:CHANnel[:ITEM]:LINes:ALL....528
MMEMory:SELect[:ITEM]:LINes:ALL....528
MMEMory:SELect:CHANnel[:ITEM]:NONE....529
MMEMory:SELect[:ITEM]:NONE....529
MMEMory:SELect:CHANnel[:ITEM]:SGRam....529
MMEMory:SELect[:ITEM]:SGRam....529
MMEMory:SELect:CHANnel[:ITEM]:TRACe[:ACTive]....529
MMEMory:SELect[:ITEM]:TRACe<1...3>[:ACTive]....529
MMEMory:SELect:CHANnel[:ITEM]:TRANsducer:ALL....530
MMEMory:SELect[:ITEM]:TRANsducer:ALL....530

MMEMory:SELect:CHANnel[:ITEM]:ALL
MMEMory:SELect[:ITEM]:ALL

This command includes all items when storing or loading a configuration file.

The items are:

- Hardware configuration: `MMEMory:SELect[:ITEM]:HWSettings` on page 528
- Limit lines: `MMEMory:SELect[:ITEM]:LINes:ALL` on page 528
- Spectrogram data: `MMEMory:SELect[:ITEM]:SGRam` on page 529
- Trace data: `MMEMory:SELect[:ITEM]:TRACe<1...3>[:ACTive]` on page 529

- Transducers: MMEMory:SELect[:ITEM]:TRANsducer:ALL on page 530

Example: MMEM:SEL:ALL

Manual operation: See "Items:" on page 248

MMEMory:SELect:CHANnel[:ITEM]:DEFault
MMEMory:SELect[:ITEM]:DEFault

This command selects the current settings as the only item to store to and load from a configuration file.

Manual operation: See "Items:" on page 248

MMEMory:SELect:CHANnel[:ITEM]:HWSettings <State>
MMEMory:SELect[:ITEM]:HWSettings <State>

This command includes or excludes measurement (hardware) settings when storing or loading a configuration file.

Measurement settings include:

- general channel configuration
- measurement hardware configuration including markers
- limit lines
  Note that a configuration may include no more than 8 limit lines. This number includes active limit lines as well as inactive limit lines that were used last. Therefore the combination of inactivate limit lines depends on the sequence of use with MMEMory:LOAD:STATe on page 531.
- color settings
- configuration for the hardcopy output

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: MMEM:SEL:HWS ON

Manual operation: See "Items:" on page 248

MMEMory:SELect:CHANnel[:ITEM]:LINes:ALL <State>
MMEMory:SELect[:ITEM]:LINes:ALL <State>

This command includes or excludes all limit lines (active and inactive) when storing or loading a configuration file.

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Example: MMEM:SEL:LIN:ALL ON

Manual operation: See "Items:" on page 248

MMEMory:SELect:CHANnel[:ITEM]:NONE
MMEMory:SELect[:ITEM]:NONE

This command does not include any of the following items when storing or loading a configuration file.

- Hardware configuration: `MMEMory:SELect[:ITEM]:HWSettings` on page 528
- Limit lines: `MMEMory:SELect[:ITEM]:LINes:ALL` on page 528
- Spectrogram data: `MMEMory:SELect[:ITEM]:SGRam` on page 529
- Trace data: `MMEMory:SELect[:ITEM]:TRACe<1...3>[:ACTive]` on page 529
- Transducers: `MMEMory:SELect[:ITEM]:TRANsducer:ALL` on page 530

Example: `MMEM:SEL:NONE`

Manual operation: See "Items:" on page 248

MMEMory:SELect:CHANnel[:ITEM]:SGRam <State>
MMEMory:SELect[:ITEM]:SGRam <State>

This command includes or excludes spectrogram data when storing or loading a configuration file.

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Example: `MMEM:SEL:SGR ON`
Adds the spectrogram data to the list of data subsets.

Manual operation: See "Items:" on page 248

MMEMory:SELect:CHANnel[:ITEM]:TRACe[:ACTive] <State>
MMEMory:SELect[:ITEM]:TRACe<1...3>[:ACTive] <State>

This command includes or excludes trace data when storing or loading a configuration file.

Suffix:
<1...3> irrelevant

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0, i.e. no traces are stored

Example: `MMEM:SEL:TRAC ON`

Manual operation: See "Items:" on page 248

MMEMory:SELect:CHANnel[:ITEM]:TRANsducer:ALL <State>
MMEMory:SELect[:ITEM]:TRANsducer:ALL <State>

This command includes or excludes transducer factors when storing or loading a configuration file.

Parameters:

<State> ON | OFF | 1 | 0
*RST: 0

Example: `MMEM:SEL:TRAN:ALL ON`

Manual operation: See "Items:" on page 248

15.8.3 Instrument setting management

MMEMory:CLEar:ALL....530
MMEMory:CLEar:STATe....530
MMEMory:LOAD:AUTO....530
MMEMory:LOAD:STATe....531
MMEMory:STORe<1|2>:STATe....532
MMEMory:STORe<1|2>:STATe:NEXT....532
MMEMory:STORe<1|2>:TYPE....533
SYSTem:PRESet....533
SYSTem:PRESet:CHANnel[:EXEC]....533

MMEMory:CLEar:ALL

This command deletes all instrument configuration files in the current directory.

You can select the directory with `MMEMory:CDIRectory` on page 523.

Example: `MMEM:CLE:ALL`

MMEMory:CLEar:STATe <1>, <FileName>

This command deletes an instrument configuration file.

Parameters:

<1>

<FileName> String containing the path and name of the file to delete.
The string may or may not contain the file's extension.

Example: `MMEM:CLE:STAT 1,'TEST'`

MMEMory:LOAD:AUTO <1>, <FileName>

This command restores an instrument configuration and defines that configuration as the default state.

The default state is restored after a preset (*RST) or after you turn on the R&S EPL1000.

Parameters:
<1>

<FileName> **'Factory'**
Restores the factory settings as the default state.

'<file_name>
String containing the path and name of the configuration file.
Note that only *instrument* settings files can be selected for the startup recall function; channel setup files cause an error.

Example:
```
MMEM:LOAD:AUTO 1,'C:
\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\TEST'
```

Manual operation: See "Startup Recall" on page 249

MMEMory:LOAD:STATe <1>, <FileName>

This command restores and activates the instrument configuration stored in a *.dfl file.

Note that files with other formats cannot be loaded with this command.

The contents that are reloaded from the file are defined by the last selection made either in the "Save/Recall" dialogs (manual operation) or through the MMEMory:SELect[:ITEM] commands (remote operation; the settings are identical in both cases).

By default, the selection is limited to the user settings ("User Settings" selection in the dialogs, HWSettings in SCPI). The selection is not reset by [Preset] or *RST.

As a consequence, the results of a SCPI script using the MMEMory:LOAD:STATe command without a previous MMEMory:SELect[:ITEM] command may vary, depending on previous actions in the GUI or in previous scripts, even if the script starts with the *RST command.

It is therefore recommended that you use the appropriate MMEMory:SELect[:ITEM] command before using MMEMory:LOAD:STATe.

Parameters:
<1>

<FileName> String containing the path and name of the file to load.
The string may or may not include the file's extension.

Example:
```
MMEM:SEL:ALL
```
//Save all items (User Settings, All Traces, All Limit Lines) from the R&S EPL1000.
```
MMEM:LOAD:STAT 1,'C:
\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\TEST01
```
//Reloads all items
In the "Recall" dialog, select only "User Settings" and "All Limit Lines".
```
MMEM:LOAD:STAT 1,'C:
\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\TEST01
```
//Reloads user settings and all limit lines.
```
*RST
```
//Reset instrument.
```
MMEM:LOAD:STAT 1,'C:
\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\TEST01
```
//Selected items are retained. Reloads user settings and all limit lines.
Restart the instrument.
(Switch the [ON/OFF] key off and on).
```
MMEM:LOAD:STAT 1,'C:
\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\TEST01
```
// Selected items are set to default. Reloads only the user settings.

Manual operation: See "Recall" on page 245
See "Recall in New Channel / Recall in Current Channel" on page 248

MMEMory:STORe<1|2>:STATe <1>, <FileName>

This command saves the current instrument configuration in a *.dfl file.

Suffix:
<1|2> irrelevant

Parameters:
<1>

<FileName> String containing the path and name of the target file.
The file extension is .dfl.

Example:
```
MMEM:STOR:STAT 1,'Save'
```
Saves the current instrument settings in the file `Save.dfl`.

Manual operation: See "Save File" on page 248

MMEMory:STORe<1|2>:STATe:NEXT

This command saves the current instrument configuration in a *.dfl file.

The file name depends on the one you have set with `MMEMory:STORe<1|2>:STATe` on page 532. This command adds a consecutive number to the file name.

Suffix:
<1|2> irrelevant

Example: `MMEM:STOR:STAT 1,'Save'`
Saves the current instrument settings in the file `Save.dfl`.
`MMEM:STOR:STAT:NEXT`
Saves the current instrument settings in the file `Save_001.dfl`
`MMEM:STOR:STAT:NEXT`
Saves the current instrument settings in the file `Save_002.dfl`

Manual operation: See "Save File" on page 248

MMEMory:STORe<1|2>:TYPE <Type>

This command defines whether the data from the entire instrument or only from the current channel setup is stored with the subsequent `MMEM:STOR...` command.

Suffix:
<1|2> irrelevant

Parameters:
<Type> INSTrument | CHANnel

INSTrument
Stores data from the entire instrument.

CHANnel
Stores data from an individual channel setup.

*RST: INST

Example: `INST:SEL 'SPECTRUM2'`
Selects channel setup`'SPECTRUM2'`.
`MMEM:STOR:TYPE CHAN`
Specifies that channel setup data is to be stored.

SYSTem:PRESet

This command presets the R&S EPL1000. It is identical to `*RST`.

Example: `SYST:PRES`

Usage: Event

SYSTem:PRESet:CHANnel[:EXEC]

This command restores the default instrument settings in the current channel setup.

Use `INST:SEL` to select the channel setup.

Example: `INST:SEL 'Spectrum2'`
Selects the channel setup for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2"channel setup.

Usage: Event

Manual operation: See "Preset Channel setup" on page 127

15.8.4 Screenshots and printouts

Commands to take and store screenshots described elsewhere.

- `MMEMory:NAME` on page 525

DISPlay:LOGO 534
HCOPy:ABORt 535
HCOPy:CMAP<it>:DEFault<ci> 535
HCOPy:CONTent 535
HCOPy:DESTination<di> 536
HCOPy:DEVice:COLor 537
HCOPy:DEVice:LANGuage 538
HCOPy[:IMMediate] 538
HCOPy[:IMMediate]:NEXT 539
HCOPy:ITEM:WINDow:TEXT 539
HCOPy:PAGE:COUNt:STATe 539
HCOPy:PAGE:MARGin:BOTTom 539
HCOPy:PAGE:MARGin:LEFT 540
HCOPy:PAGE:MARGin:RIGHt 540
HCOPy:PAGE:MARGin:TOP 540
HCOPy:PAGE:MARGin:UNIT 540
HCOPy:PAGE:ORIentation 541
HCOPy:PAGE:WINDow:CHANnel:STATe 541
HCOPy:PAGE:WINDow:COUNt 541
HCOPy:PAGE:WINDow:SCALe 542
HCOPy:PAGE:WINDow:STATe 542
HCOPy:TDSTamp:STATe 543
SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt 543
SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT] 543
SYSTem:COMMunicate:PRINter:SELect<di> 543

DISPlay:LOGO <State>

Activates/deactivates the printout of the Rohde & Schwarz company logo at the top of each page.

Parameters:

<State> 1 | 0 | ON | OFF

1 | ON
Logo is printed.

0 | OFF
Logo is not printed.

*RST: 1

Example:

```
DISP:LOGO OFF
```

Manual operation: See "Print Logo" on page 254

HCOPy:ABORt

This command aborts a running hardcopy output.

Example: `HCOP:ABOR`

HCOPy:CMAP<it>:DEFault<ci>

This command defines the color scheme for print jobs.

Suffix:
<it> Irrelevant.

<ci> See table below

Example: `HCOP:CMAP:DEF2`
Selects the optimized color set for the color settings of a printout.

Manual operation: See "Print Colors" on page 282

Gui setting	Description	Remote command
"Screen Colors (Print)"	Selects the current screen colors for the printout. The background is always printed in white and the grid in black.	`HCOP:CMAP:DEF1`
"Optimized Colors"	Selects an optimized color setting for the printout to improve the visibility of the colors (default setting). Trace 1 is blue, trace 2 black, trace 3 green, and the markers are turquoise. The background is always printed in white and the grid in black.	`HCOP:CMAP:DEF2`
"Screen Colors (Screenshot)"	Selects the current screen colors without any changes for a screenshot.	`HCOP:CMAP:DEF4`

HCOPy:CONTent <Content>

This command determines the type of content included in the printout.

Parameters:
<Content> WINDows | HCOPy

WINDows
Includes only the selected windows in the printout. All currently active windows for the current channel setup (or "MultiView") are available for selection. How many windows are printed on a each page of the printout is defined by `HCOPy:PAGE:WINDow:COUNt` on page 541.
This option is not available when copying to the clipboard (`HCOP:DEST 'SYST:COMM:CLIP'` or an image file (see `HCOPy:DEVice:LANGuage` on page 538).
If the destination is currently set to an image file or the clipboard, it is automatically changed to be a PDF file.

HCOPy
Selects all measurement results displayed on the screen for the current channel setup (or "MultiView"): diagrams, traces, markers, marker lists, limit lines, etc., including the channel setup bar and status bar, for printout on a single page. Displayed items belonging to the software user interface (e.g. softkeys) are not included. The size and position of the elements in the printout is identical to the screen display.

*RST: HCOPy

Example:

```
HCOP:DEST1 'SYST:COMM:CLIP'
HCOP:CONT WIND
HCOP:DEST1?
//Result: 'MMEM'
HCOP:DEV:LANG1?
//Result: 'PDF'
```

"Print to clipboard" is automatically switched to "print to PDF file" when the contents are switched to "multiple windows".

Manual operation: See "Print Screenshot" on page 254
See "Print Multiple Windows" on page 254

HCOPy:DESTination<di> <Destination>

This command selects the destination of a print job.

Note: To print a screenshot to a file, see `HCOPy:DEVice:LANGuage` on page 538.

Suffix:
<di> Irrelevant.

Parameters:
<Destination>

'MMEM'
Activates "Print to file". Thus, if the destination of the print function is set to "printer" (see `HCOP:DEST1 'SYSTem:COMMunicate:PRINter'` or `HCOP:DEV:LANG GDI`), the output is redirected to a `.PRN` file using the selected printer driver.
Select the file name with `MMEMory:NAME`.
Note: To save a screenshot to a file, see `HCOPy:DEVice:LANGuage` on page 538.

'SYSTem:COMMunicate:PRINter'
Sends the hardcopy to a printer and deactivates "print to file".
Select the printer with `SYSTem:COMMunicate:PRINter:SELect<di>`.

'SYSTem:COMMunicate:CLIPboard'
Sends the hardcopy to the clipboard.

*RST: 'SYST:COMM:CLIP'

Example: To print on a printer:

```
//Destination: printer, deactivate "print to file"
HCOP:DEST1 'SYSTem:COMMunicate:PRINter'
//Define the printer name
SYST:COMM:PRIN:SEL 'myFavoritePrinter'
//Print
HCOP:IMM
```

Example: To print to a *PRN file:

```
//Destination: printer
HCOP:DEV:LANG GDI
//Define the printer name
SYST:COMM:PRIN:SEL 'myFavoritePrinter'
//Redirect the printer output to a file
HCOP:DEST1 'MMEM'
//Define file name
MMEM:NAME 'C:\R_S\instr\user\MeasurementTestReport.png'
//Print
HCOP:IMM
```

Manual operation: See "Destination: Clipboard" on page 259
See "Destination: Printer" on page 259
See "Print to file" on page 259

HCOPy:DEVice:COLor <State>

This command turns color printing on and off.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Color printing

OFF | 0
Black and white printing

*RST: 1

Example:

```
HCOP:DEV:COL ON
```

HCOPy:DEVice:LANGuage <Language>

This command selects the file format for a print job or to store a screenshot to a file.

Parameters:

<Language>

GDI
Graphics Device Interface
Default format for output to a printer configured under Windows.
Must be selected for output to the printer interface.
Can be used for output to a file. The printer driver configured under Windows is used to generate a printer-specific file format.

BMP | JPG | PNG | PDF | SVG
Data format for output to files

DOC | PDF
File type for test reports
Available for `HCOP:MODE REPort`

Example:

To print a screenshot to a PNG file:

```
//Destination: PNG file
HCOP:DEV:LANG PNG
//Define file name
MMEM:NAME 'C:\R_S\instr\user\MeasurementTestReport.png'
//Print
HCOP:IMM
```

Manual operation:

See "Destination: File" on page 259
See "General properties of the test report document" on page 268

HCOPy[:IMMediate]

This command initiates a print job.

If you are printing to a file, the file name depends on `MMEMory:NAME`.

The command also generates a measurement report when you have selected `HCOPy:MODE REPort`. Note that you have to add at least one dataset to the report with `HCOPy:TREPort:NEW` or `HCOPy:TREPort:APPend`. Otherwise creating the report results in an error. If no specific file name is defined using `MMEMory:NAME`, the current date and time is used as file name of the report.

Example:

```
HCOP:MODE REPort
MMEM:NAME 'C:\WooHoo.pdf'
HCOP:DEV:LANG PDF
HCOP:TREP:NEW
HCOP
```

Creates a measurement report (in pdf format).

Manual operation:

See "Print" on page 257
See "Configuration and printout of the test report" on page 273

HCOPy[:IMMediate]:NEXT

This command initiates a print job.

If you are printing to a file, the file name depends on `MMEMory:NAME`. This command adds a consecutive number to the file name.

Manual operation: See "Print" on page 257

HCOPy:ITEM:WINDow:TEXT <Comment>

This command defines a comment to be added to the printout.

Parameters:
<Comment> String containing the comment.

Manual operation: See "Comment" on page 254

HCOPy:PAGE:COUNt:STATe <State>

This command includes or excludes the page number for printouts consisting of multiple pages (`HCOPy:CONTent` on page 535).

Parameters:
<State> 1 | 0 | ON | OFF

1 | ON
The page number is printed.

0 | OFF
The page number is not printed.

*RST: 1

Example:
```
HCOP:PAGE:COUN:STAT ON
```

Manual operation: See "Print Page Count" on page 254

HCOPy:PAGE:MARGin:BOTTom <Bottom>

This command defines the margin at the bottom of the printout page on which no elements are printed. The margins are defined according to `HCOPy:PAGE:MARGin:UNIT` on page 540.

Parameters:
<Bottom> *RST: 4.23 mm

Example:
```
HCOP:PAGE:MARG2:BOTT 2
```

Manual operation: See "Margins" on page 261

HCOPy:PAGE:MARGin:LEFT <Left>

This command defines the margin at the left side of the printout page on which no elements are printed. The margins are defined according to `HCOPy:PAGE:MARGin:UNIT` on page 540.

Parameters:

<Left> *RST: 4.23 mm

Example: `HCOP:PAGE:MARG2:LEFT 2`

Manual operation: See "Margins" on page 261

HCOPy:PAGE:MARGin:RIGHt <Right>

This command defines the margin at the right side of the printout page on which no elements are printed. The margins are defined according to `HCOPy:PAGE:MARGin:UNIT` on page 540.

Parameters:

<Right> *RST: 4.23 mm

Example: `HCOP:PAGE:MARG2:RIGH 2`

Manual operation: See "Margins" on page 261

HCOPy:PAGE:MARGin:TOP <Top>

This command defines the margin at the top of the printout page on which no elements are printed. The margins are defined according to `HCOPy:PAGE:MARGin:UNIT` on page 540.

Parameters:

<Top> *RST: 4.23 mm

Example: `HCOP:PAGE:MARG2:TOP 2`

Manual operation: See "Margins" on page 261

HCOPy:PAGE:MARGin:UNIT <Unit>

This command defines the unit in which the margins for the printout page are configured.

Parameters:

<Unit> MM | IN

MM
millimeters

IN
inches

*RST: MM

Example: `HCOP:PAGE:MARG2:BOTT 2`

Manual operation: See "Margins" on page 261

HCOPy:PAGE:ORIentation <Orientation>

The command selects the page orientation of the printout.

The command is only available if the output device is a printer or a PDF file.

Parameters:

<Orientation> LANDscape | PORTrait

*RST: PORTrait

Example:
```
HCOP:DEV:LANG1 PDF
HCOP:PAGE:ORI2 LAND
```

Manual operation: See "Orientation" on page 261

HCOPy:PAGE:WINDow:CHANnel:STATe <Channel>, <State>

This command selects all windows of the specified channel setup to be included in the printout for `HCOPy:CONTent` on page 535.

Parameters:

<Channel> String containing the name of the channel setup.
For a list of available channel setup types use `INSTrument:LIST?` on page 376.

<State> 1 | 0 | ON | OFF

1 | ON
The channel setup windows are included in the printout.

0 | OFF
The channel setup windows are not included in the printout.

*RST: 1

Example:
```
HCOP:CONT WIND
HCOP:PAGE:WIND2:CHAN 'IQ Analyzer',0
HCOP:PAGE:WIND2:STAT 'IQ Analyzer','1',1
```
Prints only window 1 in the IQ Analyzer channel setup.

Manual operation: See "Print Multiple Windows" on page 254

HCOPy:PAGE:WINDow:COUNt <Count>

This command defines how many windows are displayed on a single page of the printout for `HCOPy:CONTent` on page 535.

Parameters:

<Count> integer

*RST: 1

Example:
```
HCOP:PAGE:WIND2:COUN 2
```

Manual operation: See "Windows Per Page" on page 261

HCOPy:PAGE:WINDow:SCALe <Scale>

This command determines the scaling of the windows in the printout for `HCOPy:CONTent` on page 535.

Parameters:

<Scale> 1 | 0 | ON | OFF

1 | ON
Each window is scaled to fit the page size optimally, not regarding the aspect ratio of the original display. If more than one window is printed on one page (see `HCOPy:PAGE:WINDow:COUNt` on page 541), each window is printed in equal size.
("Size to fit")

0 | OFF
Each window is printed as large as possible while maintaining the aspect ratio of the original display.
("Maintain aspect ratio")

*RST: 1

Example:
```
HCOP:PAGE:WIND2:SCAL 0
```

Manual operation: See "Scaling" on page 261

HCOPy:PAGE:WINDow:STATe <Channel>, <Window>, <State>

This command selects the windows to be included in the printout for `HCOPy:CONTent` on page 535.

Parameters:

<Channel> String containing the name of the channel setup.
For a list of available channel setup types use `INSTrument:LIST?` on page 376.

<Window> String containing the name of the existing window.
By default, the name of a window is the same as its index.
To determine the name and index of all active windows in the active channel setup, use the `LAYout:CATalog[:WINDow]?` query.

<State> 1 | 0 | ON | OFF

1 | ON
The window is included in the printout.

0 | OFF
The window is not included in the printout.

*RST: 1

Example:
```
HCOP:PAGE:WIND2:STAT 'IQ Analyzer','1',1
```

Manual operation: See "Print Multiple Windows" on page 254

HCOPy:TDSTamp:STATe <State>

This command includes or excludes the time and date in the printout.

Parameters:

<State> 1 | 0 | ON | OFF

1 | ON
The time and date are printed.

0 | OFF
The time and date are not printed.

*RST: 1

Manual operation: See "Print Date and Time" on page 255

SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt

This command queries the name of the first available printer.

To query the name of other installed printers, use `SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]` on page 543.

Manual operation: See "Printer Name" on page 259

SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]

This command queries the name of available printers.

You have to use `SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt` on page 543 for this command to work properly.

Manual operation: See "Printer Name" on page 259

SYSTem:COMMunicate:PRINter:SELect<di> <Printer>

This command selects the printer that processes jobs sent by the R&S EPL1000.

Use `HCOPy:DESTination<di>` to select another output destination.

Suffix:

<di> 1..n
Irrelevant.

Parameters:

<Printer> String containing the printer name.
Use
•`SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt` on page 543and
•`SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]` on page 543
to query all available printers.

*RST: NONE

Manual operation: See "Printer Name" on page 259

15.8.5 Notes display

Commands to configure the "Notes" display described elsewhere:

- `LAYout:ADD[:WINDow]?`

DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:APPend:TEXT....544
DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:CLEar....544
DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:TEXT....544

DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:APPend:TEXT <Text>

This command is used to append content to the notes display.

Suffix:
<n> Window

<w> subwindow

Setting parameters:
<Text>

Example: `DISPlay:NOTes:APPend:TEXT 'Measurement configuration'`
'Measurement configuration' is added to the existing content of the notes display.

Usage: Setting only

DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:CLEar

This command is used to clear the notes display.

Suffix:
<n> Window

<w> subwindow

Example: `DISPlay:NOTes:CLEar`
The notes display is cleared.

Usage: Event

DISPlay[:WINDow<n>][:SUBWindow<w>]:NOTes:TEXT <Text>

This command is used to set and query the content of the notes display.

Suffix:
<n> Window

<w> subwindow

Parameters:
<Text>

Example: `DISPlay:NOTes:TEXT 'Measurement configuration'`
'Measurement configuration' is added to the notes display. The existing content is replaced.

15.8.6 Test reports

Commands to create test reports described elsewhere.

- `HCOPy:DEVice:LANGuage` on page 538
- `HCOPy[:IMMediate]` on page 538
- `MMEMory:NAME` on page 525

HCOPy:MODE....545
HCOPy:TREPort:APPend....546
HCOPy:TREPort:DESCription....546
HCOPy:TREPort:ITEM:DEFault....546
HCOPy:TREPort:ITEM:HEADer:LINE<li>:CONTrol....546
HCOPy:TREPort:ITEM:HEADer:LINE<li>:TEXT....547
HCOPy:TREPort:ITEM:HEADer:LINE<li>:TITLe....548
HCOPy:TREPort:ITEM:HEADer:STATe....548
HCOPy:TREPort:ITEM:LIST....549
HCOPy:TREPort:ITEM:LOGO....549
HCOPy:TREPort:ITEM:LOGO:CONTrol....549
HCOPy:TREPort:ITEM:SELect....550
HCOPy:TREPort:ITEM:TEMPlate:CATalog?....552
HCOPy:TREPort:ITEM:TEMPlate:DELete....552
HCOPy:TREPort:ITEM:TEMPlate:LOAD....553
HCOPy:TREPort:ITEM:TEMPlate:SAVE....553
HCOPy:TREPort:NEW....553
HCOPy:TREPort:PAGecount:STATe....553
HCOPy:TREPort:PAGesize....554
HCOPy:TREPort:PCOLors:STATe....554
HCOPy:TREPort:TDSTamp:STATe....554
HCOPy:TREPort:TEST:REMove....555
HCOPy:TREPort:TEST:REMove:ALL....556
HCOPy:TREPort:TITLe....556
HCOPy:TREPort:TITLe:STATe....556
MMEMory:RAW....556

HCOPy:MODE <Mode>

Parameters:
<Mode> SCReen | REPort

Manual operation: See "Configuration and printout of the test report" on page 273

HCOPy:TREPort:APPend

This command adds the current measurement results to the test report.

The saved data depends on the items you have selected with `HCOPy:TREPort:ITEM:SELect` on page 550.

Example: Perform a measurement, then:
`HCOP:TREP:NEW`
Creates a new test report with the results of the first measurement.
Perform another measurement, then:
`HCOP:TREP:APP`
Adds the results of the second measurement to the test report.

Usage: Event

Manual operation: See "Adding and removing datasets" on page 273

HCOPy:TREPort:DESCription <Description>

This command defines the description of the test report as shown on its title page.

Parameters:
<Description> String containing the description of the test report.

Example:
```
HCOP:TREP:DESC 'A short summary of the test report.'
```
Adds a description to the test report.

Manual operation: See "Contents of the title page" on page 270

HCOPy:TREPort:ITEM:DEFault

This command restores the default configuration of the test report regarding the information that is part of the report.

It also restores the default names of the measurement information titles.

Usage: Event

Manual operation: See "Test report content selection" on page 267
See "Template management" on page 271

HCOPy:TREPort:ITEM:HEADer:LINE<li>:CONTrol <Repetition>

This command selects how often the items in the report header are displayed in the document.

Suffix:
 1..n
Selects the header line.

Parameters:
<Repetition> **GLOBal**
The selected header line is displayed at the top of every page of the report.

NEVer
The selected header line is displayed on no page of the report. Note that a line that does not contain anything is still displayed in the report as a blank line. If you select NEVer, the line is not displayed at all.

SECTion
The selected header line is displayed after the title of every subreport.

*RST: NEVer

Example:
```
HCOP:TREP:ITEM:HEAD:LINE4:TITL ''
HCOP:TREP:ITEM:HEAD:LINE4:TEXT ''
```
Defines an empty string for line 4 of the report header.
```
HCOP:TREP:ITEM:HEAD:LINE4:CONT NEV
```
Removes line 4 from the header of the test report.

Manual operation: See "Custom information about the measurement" on page 269

HCOPy:TREPort:ITEM:HEADer:LINE<li>:TEXT <Description>

This command defines a descriptive text for one of the items part of the report header.

You can define up to 6 items in the header.

Use `HCOPy:TREPort:ITEM:HEADer:LINE<li>:TITLe` on page 548 to define custom titles for each item.

Use `HCOPy:TREPort:ITEM:HEADer:LINE<li>:CONTrol` to select the condition under which each item is shown.

Suffix:
 1..n
Selects the header line.

Parameters:
<Description> String containing the description of one of the value fields.
By default, the value fields of the items are empty.

Example:
```
HCOP:TREP:ITEM:HEAD:LINE3:TITL 'Device under Test'
```
Renames the third title into "Device under Test".
```
HCOP:TREP:ITEM:HEAD:LINE3:TEXT 'Some Device'
```
Labels the third title as "Some Device".

Manual operation: See "Custom information about the measurement" on page 269

HCOPy:TREPort:ITEM:HEADer:LINE<li>:TITLe <Title>

This command defines a custom name for one of the items part of the report header.

You can define up to 6 items in the header.

Use `HCOPy:TREPort:ITEM:HEADer:LINE<li>:TEXT` on page 547 to add a value to each item.

Use `HCOPy:TREPort:ITEM:HEADer:LINE<li>:CONTrol` to select the condition under which each item is shown.

Suffix:

 1..n
Selects the header line.

Parameters:

<Title> String containing the title of the item.
The default titles are as follows:
• Line 1: "Heading"
• Line 2: "Meas Type"
• Line 3: "Equipment under Test"
• Line 4: "Manufacturer"
• Line 5: "OP Condition"
• Line 6: "Test Spec"
Make sure that the title string is not too long, because strings that are too long could mess up the layout of the report.

Example: `HCOP:TREP:ITEM:HEAD:LINE3:TITL 'Device under Test'`
Renames the third title into "Device under Test".

Manual operation: See "Custom information about the measurement" on page 269

HCOPy:TREPort:ITEM:HEADer:STATe <State>

This command includes or excludes the complete set of measurement information from the test report.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 1

Example: `HCOP:TREP:ITEM:HEAD:STAT ON`
Includes the measurement information in the test report.

Manual operation: See "Custom information about the measurement" on page 269

HCOPy:TREPort:ITEM:LIST [<ChannelType>]

This command queries the selected information to be included in the test report for a specific channel type.

Parameters:

<ChannelType> <char_data>

Selects the channel type that you want to query the test report configuration for.
When you omit the parameter, the command returns the configuration of the currently selected channel.

Example: `HCOP:TREP:ITEM:LIST? SAN`
Queries the items that are included in the test reports of the Spectrum application.

Table 15-6: Available <ChannelTypes>

<ChannelType>	
ADEM	Analog Demodulator
IQ	I/Q Analyzer
REC	Receiver
SAN	Spectrum

HCOPy:TREPort:ITEM:LOGO <FileName>

Parameters:

<FileName> String containing the location and name of the picture.
You can use the following file types: `bmp`, `jpg`, `png`, `gif`, `emf` or `wmf` format.

Example: `HCOP:TREP:ITEM:LOGO 'C:\aPicture.jpg'`
Includes a picture at the top of each page of the report.

Manual operation: See "Custom information about the measurement" on page 269

HCOPy:TREPort:ITEM:LOGO:CONTrol <Repetition>

This command selects how often the logo is displayed in the document.

Parameters:

<Repetition>

ALWays
The logo is displayed at the top of every page of the report.

NEVer
The logo is displayed on no page of the report.

ONCE
The logo is displayed on the first page of each dataset.

*RST: NEVer

Example: `HCOP:TREP:ITEM:LOGO 'c:\logo.png'`
Selects a picture to be displayed in the report document.
`HCOP:TREP:ITEM:LOGO:CONT GLOB`
Displays the logo on each page.

Manual operation: See "Custom information about the measurement" on page 269

HCOPy:TREPort:ITEM:SELect [<ChannelType>],'<Item>,<Item>,<Item>,...'

This command defines the type of information that a test report consists of.

Setting parameters:

<ChannelType> Optional parameter to define the channel type that the selection applies to.
When you omit the <ChannelType> parameter, the selection applies to the currently active channel.

<Item> String containing the information you want to include in the test report.
Note that the items, separated by commas, have to be written into one string (see example below).
The available items depend on the application you are using.
See the tables below for a short description of each item.
By default, some items are selected (see tables below).

Example: `HCOP:TREP:ITEM:SEL 'SETT,MARK,SRES,DIAG'`
Each dataset consists of the measurement settings, marker information, the scan results and a screenshot of the scan trace (for Receiver channels).

Example: `HCOP:TREP:ITEM:SEL REC,'BARG,LISN'`
A dataset in the Receiver application consists of the bargraph and the LISN settings.

Usage: Setting only

Manual operation: See "Test report content selection" on page 267

Table 15-7: Available <ChannelTypes>

<ChannelType>	Description
ADEM	Analog demodulator
IQ	I/Q analyzer
REC	Receiver
SAN	Spectrum

Table 15-8: Available <items> in receiver application

<Item>	Description	Default
BARGraph	Screenshot of the bargraph.	
DIAGram	Screenshot of the scan results.	x

<Item>	Description	Default
FRESults	Numerical results for the final measurement.	
IF	Screenshot of the results for IF analysis.	x
IFSPectrogram	Screenshot of the IF spectrogram.	x
LISN	Information about LISNs.	
MARKers	Contents of the marker table.	x
PRESults	Contents of the peak list.	
SCANtable	Measurement configuration as defined in the scan table.	
SETTings	Settings that have been used during a measurement.	x
SPECtrogram	Screenshot of the spectrogram.	x
SRESults	Numerical results for the scan.	
TRANsducer	Characteristics of the transducer.	

Table 15-9: Available <items> in spectrum application

<Item>	Description	Default
DIAGram	Screenshot of the scan results.	x
MARKers	Contents of the marker table.	x
PEAKlist	Contents of the peak list.	x
RESultlist	Numerical measurement results.	
RSUMmary	Contents of the result summary.	x
SETTings	Settings that have been used during a measurement.	x
SPECtrogram	Screenshot of the spectrogram.	x
TRANsducer	Characteristics of the transducer.	

Table 15-10: Available <items> in I/Q analyzer

<Item>	Description	Default
DIAGram	Screenshot of the result diagram.	x
FREQuency	Screenshot of the Spectrum results.	x
MAGNitude	Screenshot of the Magnitude results.	x
PEAKlist	Contents of the peak list.	x
RESultlist	Numerical measurement results.	x
RIMag	Screenshot of the Real / Imaginary results.	x
SETTings	Settings that have been used during a measurement.	x
TRANsducer	Characteristics of the transducer.	
VECTor	Screenshot of the I/Q Vector results.	x

Table 15-11: Available <items> in analog demodulation application

<Item>	Description	Default
AMSPectrum	Screenshot of the AM Spectrum.	
AMTDomain	Screenshot of the AM Time Domain.	
FMSPectrum	Screenshot of the FM Spectrum.	
FMTDomain	Screenshot of the FM Time Domain.	
MARKers	Contents of the marker table.	
PEAKlist	Contents of the peak list.	
PMSPectrum	Screenshot of the PM Spectrum.	
PMTDomain	Screenshot of the PM Time Domain.	
RFSPectrum	Screenshot of the RF Spectrum.	
RFTDomain	Screenshot of the RF Time Domain.	
RSUMmary	Contents of the result summary.	
SETTings	Settings that have been used during a measurement.	
TRANsducer	Characteristics of the transducer.	

HCOPy:TREPort:ITEM:TEMPlate:CATalog?

This command queries the test report templates available in the default report directory (and its subdirectories).

Return values:

<Templates> String containing the name of the templates as a comma-separated list.

Example: `HCOP:TREP:ITEM:TEMP:CAT?`
Returns, e.g.:
`'TemplateX, TemplateY, TemplateZ'`

Usage: Query only

Manual operation: See "Template management" on page 271

HCOPy:TREPort:ITEM:TEMPlate:DELete <Template>

This command deletes a test report template.

Setting parameters:

<Template> String containing the name of the template.

Example: `HCOP:TREP:ITEM:TEMP:DEL 'myTemplate'`
Deletes a test report template.

Usage: Setting only

HCOPy:TREPort:ITEM:TEMPlate:LOAD <Template>

This command loads a test report template.

Setting parameters:

<Template> String containing the name of the template.

Example: `HCOP:TREP:ITEM:TEMP:LOAD 'myTemplate'`
Loads a test report template.

Usage: Setting only

Manual operation: See "Template management" on page 271

HCOPy:TREPort:ITEM:TEMPlate:SAVE <Template>

This command saves a test report template in XML format.

Setting parameters:

<Template> String containing the name of the template. The `.xml` file extension is added automatically.

Example: `HCOP:TREP:ITEM:TEMP:SAVE 'myTemplate'`
Saves a test report template.

Usage: Setting only

Manual operation: See "Template management" on page 271

HCOPy:TREPort:NEW

This command creates a new dataset for a new test report.

Creating a new test report deletes all previously saved datasets. The current measurement results are added as the first dataset to the new report.

The R&S EPL1000 saves the data selected with `HCOPy:TREPort:ITEM:SELect` on page 550.

To save the report, use `HCOPy[:IMMediate]` on page 538.

Example: `HCOP:TREP:NEW`
Creates a dataset for a new test report.

Usage: Event

Manual operation: See "Adding and removing datasets" on page 273

HCOPy:TREPort:PAGecount:STATe <State>

This command includes or excludes page number from the test report.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `HCOP:TREP:PAG:STAT OFF`
Removes page numbers from the test report.

Manual operation: See "General properties of the test report document" on page 268

HCOPy:TREPort:PAGesize <Size>

This command selects the size of the test report document.

Parameters:
<Size> A4 | US

A4
Document pages have an A4 size.

US
Document pages have a US letter size.

*RST: A4

Example: `HCOP:TREP:PAG A4`
Selects the A4 size for the document.

Manual operation: See "General properties of the test report document" on page 268

HCOPy:TREPort:PCOLors:STATe <State>

This command turns the use of printer friendly colors on and off.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Manual operation: See "General properties of the test report document" on page 268

HCOPy:TREPort:TDSTamp:STATe <State>

This command includes or excludes date and time from the test report.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

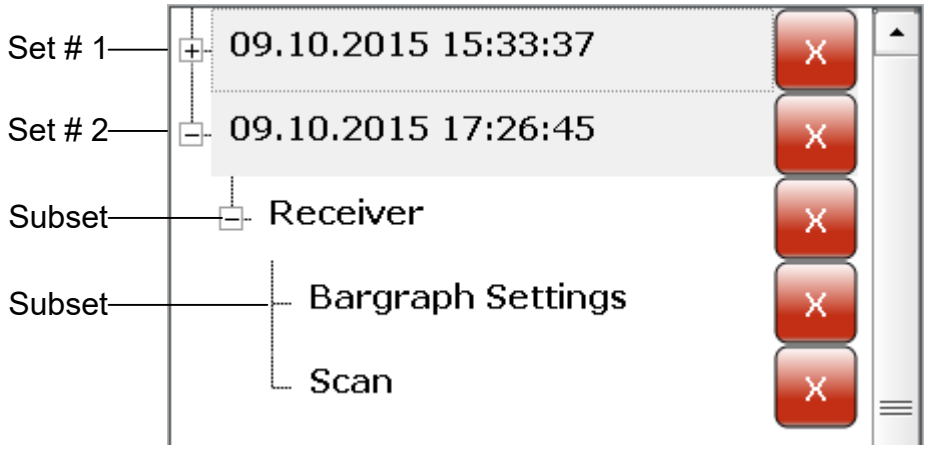
Example: `HCOP:TREP:TDST OFF`
Does not show any time or date information in the test report.

Manual operation: See "General properties of the test report document" on page 268

HCOPy:TREPort:TEST:REMove <Dataset>

This command deletes one of the datasets that are currently part of a test report.

Note that the command only deletes datasets as a whole (= complete chapters). Deleting individual items of a dataset is not possible.



Set # 1 = Number of the dataset would be "1".
Set # 2 = Number of the dataset would be "2".
Subset = Cannot be removed.

Setting parameters:

<Dataset> Index number of the dataset as shown in the "Test Report Content Selection" dialog box.
If the index number is greater than the number of available datasets, the command returns an error.

Example: `HCOP:TREP:TEST:REM 2`
Deletes the second dataset from the current test report.

Usage: Setting only

Manual operation: See "Adding and removing datasets" on page 273

HCOPy:TREPort:TEST:REMove:ALL

This command removes all existing datasets from the test report.

Example: `HCOP:TREP:TEST:REM:ALL`
Deletes all datasets that are currently in the test report.

Usage: Event

Manual operation: See "Adding and removing datasets" on page 273

HCOPy:TREPort:TITLe <Title>

This command defines the title for the test report as shown on its title page.

Parameters:
<Title> String containing the title.

Example: `HCOP:TREP:TITL 'My first test report'`
Defines a title for a test report.

Manual operation: See "Contents of the title page" on page 270

HCOPy:TREPort:TITLe:STATe <State>

This command includes or excludes the title page from the test report.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: `HCOP:TREP:TITL:STAT OFF`
Removes the title page from the test report.

Manual operation: See "Contents of the title page" on page 270

MMEMory:RAW <Path>

Defines the location where the measurement data sets for the report are stored until the report is created.

Parameters:
<Path> String containing the path of the preliminary data

15.8.7 Measurement result export

Commands to export measurement results described elsewhere.

- `FORMat[:DATA]` on page 521

MMEMory:STORe<n>:SGRam....557
MMEMory:STORe<n>:SPECtrogram....557
MMEMory:STORe<n>:TRACe....557

MMEMory:STORe<n>:SGRam <FileName>
MMEMory:STORe<n>:SPECtrogram <FileName>

This command exports spectrogram data to an ASCII file.

The file contains the data for every frame in the history buffer. The data corresponding to a particular frame begins with information about the frame number and the time that frame was recorded.

Note that, depending on the size of the history buffer, the process of exporting the data can take a while.

Suffix:
<n> Window

Parameters:
<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:SGR 'Spectrogram'`
Copies the spectrogram data to a file.

Manual operation: See "Export Trace to ASCII File" on page 193

MMEMory:STORe<n>:TRACe <Trace>, <FileName>

This command exports trace data from the specified window to an ASCII file.

For details on the file format, see Chapter 11.3.9.1, "Reference: ASCII file export format", on page 207.

Suffix:
<n> Window

Parameters:
<Trace> Number of the trace to be stored

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 1,'C:\TEST.ASC'`
Stores trace 1 from window 1 in the file `TEST.ASC`.

Manual operation: See "Export Trace to ASCII File" on page 193

15.8.8 Examples: managing data

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15.8.8.1 Storing data

```
MMEM:MSIS 'C:'
//Selects drive C: as the default storage device.

//-----Connecting a network drive--------
MMEM:NETW:USED?
//Returns a list of all drives in use in the network.
MMEM:NETW:UNUS?
//Returns a list of free drive names in the network.
MMEM:NETW:MAP 'Q:','Server\ACLRTest'
//Maps drive Q: to the directory 'Server\ACLRTest'

//-----Saving data on the instrument-----
MMEM:MDIR 'C:\R_S\INSTR\USER\Results'
//Creates a directory called 'Results' on drive C:
MMEM:NAME 'C:\R_S\INSTR\USER\Results\Test001.txt'
//Defines a file called 'Test001.txt'
MMEM:COMM 'ACLR test results'
//Creates a comment for the settings to be displayed in gui.
MMEM:DATA 'Test001.txt',#212FileContents
//Creates the file 'Test001.txt'and writes 12 characters to it

//-----Copying the data to another location---
MMEM:COPY 'C:\R_S\INSTR\USER\Results\Test001.txt','Q:'
//Copies the specified file to network drive Q:.
MMEM:DEL 'C:\R_S\INSTR\USER\Results\Test001.txt'
//Deletes the specified file from the instrument hard disk.
//or
//MMEM:MOVE 'C:\R_S\INSTR\USER\Results\Test001.xml','Q:\TestResults.txt'//
//Moves the file 'Test001.txt' to drive Q:, renames it to 'Testresults.txt'
//and removes it from the instrument hard disk.
MMEM:RDIR 'C:\R_S\INSTR\USER\Results'
//Deletes the directory called 'Results' from drive C:, unless it still
//contains any content.

//-----Disconnecting the network drive---
MMEM:NETW:DISC 'Q:'
//Disconnect drive Q:.
```

15.8.8.2 Loading data

```
MMEM:CDIR?
//Returns the path of the current directory.
//e.g.
C:\R_S\Instr\user\
MMEM:CDIR 'C:\R_S\INSTR\USER\Results'
//Changes the current directory.
MMEM:CAT? 'C:\R_S\INSTR\USER\Results\*.xml'
//or
MMEM:CAT? '*.xml'
//Returns a list of all xml files in the directory 'C:\R_S\INSTR\USER\Results'.
MMEM:CAT:LONG? '*.xml'
//Returns additional information about the xml files in the directory
// 'C:\R_S\INSTR\USER\Results'.
```

15.8.8.3 Storing instrument settings

In this example we will store the instrument settings for the "Spectrum" channel setup.

```
INST:SEL 'SPECTRUM'
//Selects measurement channel 'SPECTRUM'.
MEMM:STOR:TYPE CHAN
//Specifies that channel-specific data is to be stored.
MMEM:STOR:STAT 1, 'C:\R_S\Instr\user\Spectrum'
//Stores the channel settings from the 'Spectrum' channel
// to the file 'Spectrum.dfl'.
```

15.8.8.4 Loading instrument settings

In this example we will load the hardware settings from the configuration file `Spectrum.dfl` to a new "Spectrum2" channel setup.

```
MEMM:LOAD:TYPE NEW
//Specifies that settings will be loaded to a new channel besides the existing
//'Spectrum' channel.
MMEM:SEL:CHAN:HWS ON
//Selects only hardware settings to be loaded.
MMEM:LOAD:STAT 1, 'C:\R_S\Instr\user\Spectrum'
//Loads the channel-specific settings from the file 'C:\R_S\Instr\user\Spectrum.dfl'
//to a new channel. The new channel is named 'Spectrum2' to avoid a naming conflict
//with the existing 'Spectrum' channel.
INST:REN 'Spectrum2','Spectrum3'
//Renames the loaded channel to 'Spectrum3'.
```

15.8.8.5 Printing to a file

```
//Select bmp as the file format.
HCOP:DEV:LANG BMP
```

```
//Select the file name for the printout.
MMEM:NAME 'C:\R_S\INSTR\USER\Screenshot.bmp'
//Select all screen elements for printing
HCOP:ITEM:ALL
//Add a comment to the printout.
HCOP:ITEM:WIND:TEXT 'ACLRResults'
//Store the printout in a file called 'Screenshot.bmp'.
HCOP
//Store another printout in a file called 'Screenshot_001.bmp'.
HCOP:NEXT
```

15.8.8.6 Printing on a printer

```
HCOP:DEST2 'SYST:COMM:PRIN'
//Prints the data on a printer.
SYST:COMM:PRIN:ENUM:FIRS?
SYST:COMM:PRIN:ENUM?
//Returns the available printers, e.g.
//'LASER on LPT1'
//''
//Means that one printer is available.
SYST:COMM:PRIN:SEL2 'LASER on LPT1'
//Selects the printer for the print job on device 2.
HCOP:PAGE:ORI2 LAND
//Selects the landscape format for the printout.
HCOP:TDST:STAT2 ON
//Includes date and time on the printout.
HCOP:ITEM:ALL
//Prints all screen elements
HCOP
//Initiates the printout.
```

15.8.8.7 Storing multiple graphical measurement results to a PDF file

This example demonstrates how to store graphical results from measurements in the Spectrum application and the I/Q Analyzer to a single PDF file. It assumes the Spectrum and I/Q Analyzer measurements have already been configured and performed, with the following screen layout:

'Spectrum': 1 Frequency Sweep

'Spectrum': 2 Spectrogram

'IQ Analyzer': 1 Magnitude

'IQ Analyzer': 2 Spectrum

```
//Switch to MultiView tab
DISP:ATAB ON

//Select windows to be stored to file
```

```
HCOP:CONT WIND
HCOP:PAGE:WIND:STAT 'Spectrum','1',ON
HCOP:PAGE:WIND:STAT 'Spectrum','2',ON
HCOP:PAGE:WIND:STAT 'IQ Analyzer','1',ON
HCOP:PAGE:WIND:STAT 'IQ Analyzer','2',ON

//Define contents to be printed on each page (logo, timestamp, page count)
DISP:LOGO ON
HCOP:TDST:STAT ON
HCOP:PAGE:COUN:STAT ON
//Define comment to be printed on each page
HCOP:ITEM:WIND:TEXT 'Measurement Test Report'

//Configure page layout (landscape, 1 display per page, margins 2cm on each side)
HCOP:PAGE:ORI1 LAND
HCOP:PAGE:WIND1:COUN 1
HCOP:PAGE:WIND1:SCAL 1
HCOP:PAGE:MARG1:BOTT 20
HCOP:PAGE:MARG1:LEFT 20
HCOP:PAGE:MARG1:RIGH 20
HCOP:PAGE:MARG1:TOP 20

//Configure the use of optimized colors for printout
HCOP:CMAP:DEF2

//Set format of printout to PDF.
HCOP:DEV:LANG1 PDF
//Define file name of printout
MMEM:NAME 'C:\R_S\instr\user\MeasurementTestReport.pdf'

//Store pdf of printout to file
HCOP:IMM
```

15.9 General instrument setup

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15.9.1 Basic instrument setup

SYSTem:CLOGging 562
SYSTem:REBoot 562
SYSTem:DATE 562
SYSTem:TIME 562

SYSTem:CLOGging <State>

This command turns logging of remote commands on and off.

Parameters:

<State> ON | OFF | 1 | 0

ON | 1
Writes all remote commands that have been sent to a file.
The destination is `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\ScpiLogging\ScpiLog.<no.>`.
where <no.> is a sequential number
A new log file is started each time logging was stopped and is restarted.

OFF | 0

*RST: 0

Manual operation: See "I/O Logging" on page 342

SYSTem:REBoot

This command reboots the instrument, including the operating system.

SYSTem:DATE <Year>, <Month>, <Day>

Configures the date on the instrument.

Parameters:

<Year>

<Month>

<Day>

Example:

```
SYST:DATE 2020,04,23
```

Manual operation: See "Set Date and Time" on page 277

SYSTem:TIME <Year>, <Month>, <Day>

Configures the time on the internal real-time clock on the instrument.

Parameters:

<Hour> Range: 0 to 23

<Minutes> Range: 0 to 59

<Seconds> Range: 0 to 59

Example: `SYST:TIME 10,52,33`

Manual operation: See "Set Date and Time" on page 277

15.9.2 Calibration and temperature check

CALibration[:ALL]?....563
CALibration:RESult?....564
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CALibration:DUE:SCHedule....565
CALibration:DUE:DAYS....565
CALibration:DUE:TIME....566
CALibration:DUE:SHUTdown....566
DIAGnostic:SERVice:INPut:EMI:CFRequency....567
DIAGnostic:SERVice:INPut:EMI[:SPECtrum]....567
DIAGnostic:SERVice:INPut[:SELect]....567
DIAGnostic:SERVice:INPut:RF[:SPECtrum]....567
DIAGnostic:SERVice:STESt:RESult?....568
SOURce<si>:TEMPerature:FRONtend....568

CALibration[:ALL]?

This command initiates a calibration (self-alignment) routine and queries if calibration was successful.

During the acquisition of correction data the instrument does not accept any remote control commands.

In order to recognize when the acquisition of correction data is completed, the MAV bit in the status byte can be used. If the associated bit is set in the Service Request Enable (SRE) register, the instrument generates a service request after the acquisition of correction data has been completed.

Return values:

<CalibrationFailed> ON | OFF | 0 | 1

OFF | 0
Calibration was successful.

ON | 1
Calibration was not successful.

Example: `*CLS`
Resets the status management.
`*SRE 16`
Enables MAV bit in the Service Request Enable register.
`*CAL?`
Starts the correction data recording, and then a service request is generated.

Usage: Query only

Manual operation: See "Start Self Alignment" on page 314

CALibration:RESult?

This command returns the results collected during calibration.

Return values:
<CalibrationData> String containing the calibration data.

Example:
```
CAL:RES?
```
would return, e.g.
```
[...]
Total Calibration Status:
PASSED, Date (dd/mm/yyyy): 12/07/2004,
Time: 16:24:54,Runtime: 00.06
```

Usage: Query only

Manual operation: See "Alignment Results:" on page 315

CALibration:DUE:WARMup <State>

If enabled, self-alignment is started automatically after the warmup operation has completed.

Parameters:
<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:
//Schedule a self-alignment every Sunday at 2 AM after a warmup period, then shut down instrument.
```
CAL:DUE:WARM
CAL:DUE:SCH ON
CAL:DUE:DAYS SUND
CAL:DUE:TIME '2:00'
CAL:DUE:SHUT
```

Manual operation: See "Await Warm-Up Operation before Self Alignment" on page 315

CALibration:DUE:SCHedule <State>

If enabled, a self-alignment is performed regularly at specific days and time. Specify the date and time using the `CALibration:DUE:DAYS` and `CALibration:DUE:TIME` commands.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: //Schedule a self-alignment every Sunday at 2 AM after a warmup period, then shut down instrument.

```
CAL:DUE:WARM
CAL:DUE:SCH ON
CAL:DUE:DAYS SUND
CAL:DUE:TIME '2:00'
CAL:DUE:SHUT
```

Manual operation: See "Schedule" on page 315

CALibration:DUE:DAYS <Day1>[, <Day2>, <Day3>, <Day4>, <Day5>, <Day6>, <Day7>]

Defines the days on which a self-alignment is scheduled for `CALibration:DUE:SCHedule ON`. Up to 7 different days can be scheduled.

Parameters:

<Day1> ALL | MONDay | TUESday | WEDNesday | THURsday | FRIDay | SATurday | SUNDay

<Day2> ALL | MONDay | TUESday | WEDNesday | THURsday | FRIDay | SATurday | SUNDay

<Day3> ALL | MONDay | TUESday | WEDNesday | THURsday | FRIDay | SATurday | SUNDay

<Day4> ALL | MONDay | TUESday | WEDNesday | THURsday | FRIDay | SATurday | SUNDay

<Day5> ALL | MONDay | TUESday | WEDNesday | THURsday | FRIDay | SATurday | SUNDay

<Day6> ALL | MONDay | TUESday | WEDNesday | THURsday | FRIDay | SATurday | SUNDay

<Day7> ALL | MONDay | TUESday | WEDNesday | THURsday | FRIDay | SATurday | SUNDay

Example: //Schedule a self-alignment every Monday and Friday

```
CAL:DUE:DAYS MOND,FRID
```

Example: //Schedule a self-alignment every Sunday at 2 AM after a warmup period, then shut down instrument.

```
CAL:DUE:WARM
CAL:DUE:SCH ON
CAL:DUE:DAYS SUND
CAL:DUE:TIME '2:00'
CAL:DUE:SHUT
```

Manual operation: See "Schedule" on page 315

CALibration:DUE:TIME <Time>

Defines the time at which a self-alignment is scheduled for the days specified by `CALibration:DUE:DAYS`, if `CALibration:DUE:SCHedule ON`.

Parameters:

<Time> string with format 'hh:mm' (24 hours)

Example: //Schedule a self-alignment every Sunday at 2 AM after a warmup period, then shut down instrument.

```
CAL:DUE:WARM
CAL:DUE:SCH ON
CAL:DUE:DAYS SUND
CAL:DUE:TIME '2:00'
CAL:DUE:SHUT
```

Manual operation: See "Schedule" on page 315

CALibration:DUE:SHUTdown <State>

If activated, the R&S EPL1000 is automatically shut down after self-alignment is completed. Note that the instrument cannot be restarted via remote control.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example: //Schedule a self-alignment every Sunday at 2 AM after a warmup period, then shut down instrument.

```
CAL:DUE:WARM
CAL:DUE:SCH ON
CAL:DUE:DAYS SUND
CAL:DUE:TIME '2:00'
CAL:DUE:SHUT
```

Manual operation: See "Shut down Device after Self Alignment" on page 315

DIAGnostic:SERVice:INPut:EMI:CFRequency <Frequency>

This command defines the frequency of the calibration signal.

Before you can use the command, you have to feed in a calibration signal with `DIAGnostic:SERVice:INPut[:SELect]` on page 567.

Parameters:

<Frequency>
Possible frequencies of the calibration signal are fix.
If you define a frequency that is not available, the R&S EPL1000 uses the next available frequency. Example: a frequency of 20 MHz is rounded up to the next available frequency (25 MHz).

*RST: 16.66667 MHz
Default unit: Hz

DIAGnostic:SERVice:INPut:EMI[:SPECtrum] <Bandwidth>

This command selects the bandwidth of the EMI calibration signal.

Parameters:

<Bandwidth>
NARRowband
Narrowband signal for power calibration of the frontend.

BROadband
Broadband signal for calibration of the IF filter.

DIAGnostic:SERVice:INPut[:SELect] <Signal>

This command activates or deactivates the use of an internal calibration signal as input for the R&S EPL1000.

Parameters:

<Signal>
EMI
Uses the internal calibration signal in the EMI frequency range.

RF
Uses the signal from the RF input.

*RST: RF

Example:
//Select calibration signal source
```
DIAG:SERV:INP RF
```

Manual operation:
See "NONE" on page 297
See "Calibration Frequency EMI" on page 297

DIAGnostic:SERVice:INPut:RF[:SPECtrum] <Bandwidth>

This command selects the bandwidth of the calibration signal.

Parameters:

<Bandwidth>
NARRowband | BROadband

NARRowband
Narrowband signal for power calibration of the frontend.

BROadband
Broadband signal for calibration of the IF filter.

Manual operation: See "Spectrum" on page 297

DIAGnostic:SERVice:STESt:RESult?

This command queries the self-test results.

Return values:
<Results> String of data containing the results.
The rows of the self-test result table are separated by commas.

Example: `DIAG:SERV:STES:RES?`
would return, e.g.
`"Total Selftest Status: PASSED", "Date (dd/mm/yyyy): 09/07/2004 TIME: 16:24:54", "Runtime: 00:06", "...`

Usage: Query only

SOURce<si>:TEMPerature:FRONtend

This command queries the current frontend temperature of the R&S EPL1000.

During self-alignment, the instrument's (frontend) temperature is also measured (as soon as the instrument has warmed up completely). This temperature is used as a reference for a continuous temperature check during operation. If the current temperature deviates from the stored self-alignment temperature by a certain degree, a warning is displayed in the status bar indicating the resulting deviation in the measured power levels. A status bit in the `STATUs:QUEStionable:TEMPerature` register indicates a possible deviation.

Suffix:
<si> irrelevant

Return values:
<Temperature> Temperature in degrees Celsius.

Example: `SOUR:TEMP:FRON?`
Queries the temperature of the frontend sensor.

15.9.3 Battery level check

DIAGnostic:SERVice:BATTery:LEVel?.....568

DIAGnostic:SERVice:BATTery:LEVel?

Queries the joint charge state of the internal batteries (with internal battery pack option R&S EPL1-B31).

Return values:

<ChargeState> numeric value
Charge state in percent
Range: 0 to 100

Example: `DIAG:SERV:BATT:LEV?`

Usage: Query only

15.9.4 External reference configuration

[SENSe:]ROSCillator:SOURce 569

[SENSe:]ROSCillator:SOURce <Source>

This command selects the reference oscillator.

If you want to select the external reference, it must be connected to the R&S EPL1000.

Parameters:

<Source>

INTernal
The internal reference is used (10 MHz).

EXTernal
The external reference from the "REF INPUT 10 MHZ" connector is used; if none is available, an error flag is displayed in the status bar.

Example: `ROSC:SOUR EXT`

15.9.5 Transducers

Before making any changes to a transducer factor or set, you have to select one by name with `[SENSe:]CORRection:TSET:SELect`.

Compared to manual configuration of transducers, any changes made to a transducer factor or set via remote control are saved after the corresponding command has been sent.

Designing a transducer factor

```
//Select a transducer factor
CORR:TRAN:SEL 'Transducer1'
//Define a comment for the transducer factor
CORR:TRAN:COMM 'Correction values for device x'
//Define the transducer factor unit
CORR:TRAN:UNIT 'DB'
//Select the scale of the frequency axis
CORR:TRAN:SCAL LOG
//Define the data points of the transducer factor
```

```
CORR:TRAN:DATA 1MHZ,-10,10MHZ,-10,100MHZ,-15,1GHZ,-15
//Turn on the transducer
CORR:TRAN ON
//Automatically adjust the reference level
CORR:TRAN:ADJ:RLEV ON
```

Managing a transducer set

```
//Select or create a transducer set
CORR:TSET:SEL 'Transducer Set'
//Define a comment for the transducer set
CORR:TSET:COMM 'Transducer set example'
//Define a unit for the transducer set
CORR:TSET:UNIT 'DB'
//Turn the transducer break on
CORR:TSET:BRE ON
//Define the first transducer range
CORR:TSET:RANG1 150KHZ,1MHZ,'Transducer 1','Transducer 3'
CORR:TSET:RANG2 1MHZ,10MHZ,'Transducer 3','Transducer 4'
CORR:TSET:RANG3 10MHZ,30MHZ,'Transducer 3'
//Turn on the transducer set
CORR:TSET ON
```

Commands to configure transducers described elsewhere.

- `MMEMory:SELect[:ITEM]:TRANsducer:ALL` on page 530

MMEMory:LOAD<n>:TFACtor 570
MMEMory:STORe<n>:TFACtor 571
[SENSe:]CORRection:TRANsducer:ACTive 571
[SENSe:]CORRection:TRANsducer:ADJust:RLEVel[:STATe] 571
[SENSe:]CORRection:TRANsducer:CATalog? 571
[SENSe:]CORRection:TRANsducer:COMMent 572
[SENSe:]CORRection:TRANsducer:DATA 572
[SENSe:]CORRection:TRANsducer:DELete 573
[SENSe:]CORRection:TRANsducer:SCALing 573
[SENSe:]CORRection:TRANsducer:SELect 573
[SENSe:]CORRection:TRANsducer[:STATe] 573
[SENSe:]CORRection:TRANsducer:UNIT 574
[SENSe:]CORRection:TSET:BREak 574
[SENSe:]CORRection:TSET:CATalog 574
[SENSe:]CORRection:TSET:COMMent 575
[SENSe:]CORRection:TSET:DELete 575
[SENSe:]CORRection:TSET:RANGe<range> 575
[SENSe:]CORRection:TSET:SELect 576
[SENSe:]CORRection:TSET:UNIT 576
[SENSe:]CORRection:TSET[:STATe] 576

MMEMory:LOAD<n>:TFACtor <FileName>

Loads the transducer factor from the selected file in `.CSV` format.

Suffix:
<n> irrelevant

Parameters:
<FileName> String containing the path and name of the `CSV` import file.

Example: `MMEM:LOAD:TFAC 'C:\TEST.CSV'`

MMEMory:STORe<n>:TFACtor <FileName>, <TransdName>

This command exports transducer factor data to an ASCII (CSV) file.

For details on the file format see Chapter 13.7.3, "Reference: transducer factor file format", on page 308.

Suffix:
<n> irrelevant

Parameters:
<FileName> Name of the transducer factor to be exported.

<TransdName> Name of the transducer factor to be exported.

Example: `MMEM:STOR:TFAC 'C:\TEST', 'Transducer1'`
Stores the transducer factor named "Transducer1" in the file `TEST.CSV`.

[SENSe:]CORRection:TRANsducer:ACTive

This command queries the currently active transducer factor.

Return values:
<TransducerFactor> String containing the name of the transducer factor.
If no transducer factor is active, the string is empty.

Example: `CORR:TRAN:ACT?`
Queries the active transducer factor.

[SENSe:]CORRection:TRANsducer:ADJust:RLEVel[:STATe] <State>

This command turns an automatic adjustment of the reference level to the transducer on and off.

Before you can use the command, you have to select and turn on a transducer.

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

[SENSe:]CORRection:TRANsducer:CATalog?

This command queries all transducer factors stored on the R&S EPL1000.

After general data for the transducer storage directory, data for the individual files is listed.

The result is a comma-separated list of values with the following syntax:

<UsedMem>,<FreeMem>,<FileSize>,<FileName>[,<FileSize>,<FileName>]

More information

Return values:

<UsedDiskSpace> numeric value in bytes
Amount of storage space required by all transducers files in the `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\trd` directory (= sum of all individual <FileSize> values)

<FreeDiskSpace> numeric value in bytes
Amount of free storage space on the R&S EPL1000

<FileSize> numeric value in bytes
Size of a single transducer file

<FileName> string
Name of a single transducer file

Example:
```
SENSE:CORR:TRAN:CAT?
//Result: 2743,2312620544,720,'FactorGSM.TDF',2023,'FactorBTS.TDF'
```

Usage: Query only

[SENSe:]CORRection:TRANsducer:COMMent <Comment>

This command defines the comment for the selected transducer factor.

Before you can use the command, you have to select and turn on a transducer.

Parameters:

<Comment> *RST: (empty comment)

[SENSe:]CORRection:TRANsducer:DATA {<Frequency>, <Level>}...

This command configures transducer factors for specific trace points. A set of transducer factors defines an interpolated transducer line and can be stored on the instrument. You can define up to 1001 points.

More information

Parameters:

<Frequency> The unit for <Frequency> is Hz, which may or may not be omitted. Frequencies have to be sorted in ascending order.
Default unit: Hz

<Level> The unit for <Level> depends on `[SENSe:]CORRection:TRANsducer:UNIT`.

Example:
```
SENSe1:CORRection:TRANsducer:UNIT 'DB'
// Frequency Span 0 Hz to 4 Ghz
SENSe1:CORRection:TRANsducer:DATA 0,8,2GHz,5,4GHz,3
```

Table 15-12: Created transducer points in example

Frequency	Level
0 Hz	8 dB
2 GHz	5 dB
4 GHz	3 dB

[SENSe:]CORRection:TRANsducer:DELete

This command deletes the currently selected transducer factor.

Before you can use the command, you have to select a transducer.

Example:
```
CORR:TRAN:DEL
```

[SENSe:]CORRection:TRANsducer:SCALing <ScalingType>

This command selects the frequency scaling of the transducer factor.

Parameters:

<ScalingType> LINear | LOGarithmic
*RST: LINear

[SENSe:]CORRection:TRANsducer:SELect <Name>

This command selects a transducer factor.

Parameters:

<Name> String containing the name of the transducer factor.
If the name does not exist yet, the R&S EPL1000 creates a transducer factor by that name.

Example:
```
CORR:TRAN:SEL 'FACTOR1'
```

[SENSe:]CORRection:TRANsducer[:STATe] <State>

This command turns the selected transducer factor on or off.

Before you can use the command, you have to select a transducer.

Parameters:

<State> ON | OFF | 1 | 0
*RST: 0

[SENSe:]CORRection:TRANsducer:UNIT <Unit>

This command selects the unit of the transducer factor.

Before you can use the command, you have to select and turn on a transducer.

Parameters:

<Unit> string as defined in table below

*RST: DB

Example: `CORR:TRAN:UNIT 'DBUV'`

String	Unit
'DB'	dB
'DBM'	dBm
'DBMV'	dBmV
'DBUV'	dBµV
'DBUV/M'	dBµV/m
'DBUA'	dBµA
'DBUA/M'	dBµA/m
'DBPW'	dBpW
'DBPT'	dBpT

[SENSe:]CORRection:TSET:BREak <State>

This command turns a transducer break on and off.

Before you can use the command, you have to select a transducer set with `[SENSe:]CORRection:TSET:SELect`.

Parameters:

<State> ON | OFF

*RST: OFF

Example: See Chapter 15.9.5, "Transducers", on page 569.

[SENSe:]CORRection:TSET:CATalog

This command queries all transducer sets stored on the R&S EPL1000.

Return values:

<UsedDiskSpace> Size of all available files containing transducer factors in byte.

<FreeDiskSpace> Remaining disk space in bytes.

<FileInfo> String containing the file information.
'<NameFileN>,<SizeFileN>'

<NameFileN>
Name of the file.

<SizeFileN>
Size of the file in bytes.

Example: `CORR:TSET:CAT?`
would return, e.g.
`3298,34482896896,'SET1,1520','SET2,1756'`

[SENSe:]CORRection:TSET:COMMent <Comment>

This command defines a comment for a transducer set.

Before you can use the command, you have to select a transducer set with `[SENSe:]CORRection:TSET:SELect`.

Parameters:
<Comment> String containing the comment.

Example: See Chapter 15.9.5, "Transducers", on page 569.

[SENSe:]CORRection:TSET:DELete

This command deletes a transducer set.

Before you can use the command, you have to select a transducer set with `[SENSe:]CORRection:TSET:SELect`.

Example:
```
CORR:TSET:SEL 'Transducer Set'
CORR:TSET:DEL
```
Deletes the transducer set.

[SENSe:]CORRection:TSET:RANGe<range> <Frequency>, <Frequency>, <FileName>...

This command selects a set of transducer factors used for a particular frequency range.

Ranges 1 to 10 must be sent in ascending order.

Before you can use the command, you have to select a transducer set with `[SENSe:]CORRection:TSET:SELect`.

Suffix:
<range> 1...10
Selects the range.

Parameters:
<Frequency> Defines the start frequency of the frequency range.

<Frequency> Defines the stop frequency of the frequency range.

<FileName> String containing the name of the transducer factor.
Note that you can assign up to eight transducer factors to a particular frequency range. In that case, add additional strings containing the file name after the first one separated by comma.

Example: See Chapter 15.9.5, "Transducers", on page 569.

[SENSe:]CORRection:TSET:SELect <FileName>

This command creates or selects a transducer set.

Parameters:

<FileName> String containing the name of the transducer set.
If the name does not exist yet, the R&S EPL1000 creates a transducer set by that name.

Example: `CORR:TSET:SEL 'TSET1'`

Example: See Chapter 15.9.5, "Transducers", on page 569.

[SENSe:]CORRection:TSET:UNIT <Unit>

This command selects the unit of a transducer set.

Note that the unit of all transducer factors in a transducer set must be the same or in relative terms (dB).

Before you can use the command, you have to select a transducer set with `[SENSe:]CORRection:TSET:SELect`.

Parameters:

<Unit> String containing one of the following units:
DB | DBM | DBUV | DBUV_M | DBUA | DBUA_M | DBPW | DBPT

*RST: DB

Example: See Chapter 15.9.5, "Transducers", on page 569.

[SENSe:]CORRection:TSET[:STATe] <State>

This command turns a transducer set on and off.

Before you can use the command, you have to select a transducer set with `[SENSe:]CORRection:TSET:SELect`.

Parameters:

<State> ON | OFF

*RST: OFF

Example: See Chapter 15.9.5, "Transducers", on page 569.

15.9.6 Display layout and elements

- Screen element selection....577
- Colors and schemes....581

15.9.6.1 Screen element selection

Commands to configure screen elements described elsewhere.

- `DISPlay[:WINDow<n>]:MTABle` on page 482
- `DISPlay:FORMat` on page 452

DISPlay:ANNotation:CBAR....577
DISPlay:ANNotation:FREQuency....577
DISPlay:ITERm[:STATe]....577
DISPlay:SBAR[:STATe]....578
DISPlay:SKEYs[:STATe]....578
DISPlay:TBAR[:STATe]....578
DISPlay:TOUChscreen[:STATe]....578
DISPlay[:WINDow<n>]:TIME....579
DISPlay[:WINDow<n>]:TIME:FORMat....579
INPut:TERMinator....580
SYSTem:DISPlay:FPANel[:STATe]....580
DISPlay:BLIGhting....580

DISPlay:ANNotation:CBAR <State>

This command hides or displays the channel bar information.

Parameters:

<State> ON | OFF | 0 | 1
*RST: 1

Example: `DISP:ANN:CBAR OFF`

Manual operation: See "Channel Bar" on page 279

DISPlay:ANNotation:FREQuency <State>

This command turns the label of the x-axis on and off.

Parameters:

<State> ON | OFF | 0 | 1
*RST: 1

Example: `DISP:ANN:FREQ OFF`

Manual operation: See "Diagram Footer (Annotation)" on page 279

DISPlay:ITERm[:STATe] <State>

This command turns the display of the "Disconnect RF" icon on the toolbar on and off.

Note: This setting is maintained even after using the [PRESET] function.

Parameters:
<State> ON | OFF
*RST: ON

Example: `DISP:ITER ON`
Displays the icon in the toolbar.

Manual operation: See "Disconnect RF" on page 282

DISPlay:SBAR[:STATe] <State>

This command turns the status bar on and off.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `DISP:SBAR:OFF`

Manual operation: See "Status Bar" on page 278

DISPlay:SKEYs[:STATe] <State>

This command turns the softkey bar on and off.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `DISP:SKEY:OFF`

Manual operation: See "Softkey Bar" on page 279

DISPlay:TBAR[:STATe] <State>

This command turns the toolbar on or off.

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Example: `DISP:TBAR ON`

Manual operation: See "Toolbar" on page 278

DISPlay:TOUChscreen[:STATe] <State>

This command controls the touch screen functionality.

Parameters:
<State> ON | FRAMe | OFF | TCOFf

ON | 1
Touch screen is active for entire screen

OFF | 0
Touch screen is inactive for entire screen

FRAMe
Touch screen is inactivate for the diagram area of the screen, but active for softkeys, toolbars and menus.

TCOFf
Cuts off the touch screen from the power supply.

*RST: 1

Example: `DISP:TOUC:STAT ON`

Manual operation: See "Deactivating and Activating the Touchscreen" on page 277

DISPlay[:WINDow<n>]:TIME <State>

This command adds or removes the date and time from the display.

Suffix:
<n> irrelevant

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Example: `DISP:TIME ON`

Manual operation: See "Date and Time" on page 279

DISPlay[:WINDow<n>]:TIME:FORMat <Format>

This command selects the time and date format.

Suffix:
<n> irrelevant

Parameters:
<Format> US | DE | ISO

DE
dd.mm.yyyy hh:mm:ss
24 hour format.

US
mm/dd/yyyy hh:mm:ss
12 hour format.

ISO
yyyy-mm-dd hh:mm:ss
24 hour format.

*RST: ISO

Example: DISP:TIME ON
Switches the screen display of date and time on.
DISP:TIME:FORM US
Switches the date and time format to US.

Manual operation: See "Date and Time Format" on page 277

INPut:TERMinator <State>

This command turns the RF input on and off.

Note that the command works regardless of the state of DISPlay:ITERm[:STATe]. Only for usage via the user interface is it necessary to turn on the display of the toolbar icon.

Note: This setting is maintained even after using the [PRESET] function.

Parameters:
<State> ON | OFF

ON | 1
Cuts off the RF input.

OFF | 0
Turns on the RF input.

*RST: OFF

Example: INP:TERM ON

Manual operation: See "Disconnect RF" on page 282

SYSTem:DISPlay:FPANel[:STATe] <State>

This command includes or excludes the front panel keys when working with the remote desktop.

Parameters:
<State> ON | OFF | 0 | 1

*RST: 1

Manual operation: See "Front Panel" on page 279
See "Mini Front Panel" on page 280

DISPlay:BLIGhting <Brightness>

Changes the brightness of the display in eight steps.

Parameters:
<Brightness> integer

Range: 0 to 7
*RST: 3

Example: DISP:BLIG 3
Reduces the brightness of the display.

Manual operation: See "Background Lighting" on page 277

15.9.6.2 Colors and schemes

DISPlay:CMAP<it>:DEFault<ci> 581
DISPlay:THEMe:CATalog? 581
DISPlay:THEMe:SELect 581

DISPlay:CMAP<it>:DEFault<ci>

This command selects the color scheme for the display. The query returns the default color scheme.

Suffix:

<it> Irrelevant.

<ci> 1
Default color set 1 with a black background and white grid.
2
Default color set 2 with a white background and a black grid.
Suffix irrelevant for query

Return values:

<DefScheme> 1 | 2 | 3
The default color scheme used for the screen, as specified by the <ci> suffix.

Example: `DISP:CMAP:DEF2`
Selects default setting 2 (white background and a black grid) for screen colors.
`DISP:CMAP:DEF?`
`//Result: 2`

DISPlay:THEMe:CATalog?

This command queries all available display themes.

Return values:

<Themes> String containing all available display themes.

Example: `DISP:THEMe:CAT?`

Usage: Query only

DISPlay:THEMe:SELect <Theme>

This command selects the display theme.

Parameters:

<Theme> String containing the name of the theme.
*RST: SPL

Example: `DISP:THEM:SEL "BlueOcean"`

Manual operation: See "Theme" on page 282

15.9.7 Measurement channel synchronization

- General coupling manager 582

15.9.7.1 General coupling manager

INSTrument:COUPle:ATTen 582
INSTrument:COUPle:BANDwidth 582
INSTrument:COUPle:BWIDth 582
INSTrument:COUPle:CENTer 583
INSTrument:COUPle:DEMod 583
INSTrument:COUPle:GAIN 583
INSTrument:COUPle:LLINes 584
INSTrument:COUPle:LIMit 584
INSTrument:COUPle:MARKer 584
INSTrument:COUPle:PRESel 585
INSTrument:COUPle:PROT 585
INSTrument:COUPle:SPAN 585
INSTrument:COUPle:VBW 586

INSTrument:COUPle:ATTen <State>

This command turns synchronization of the attenuation and unit between measurement channels on and off.

Parameters:

<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: ALL

Example: `INST:COUP:ATT ALL`
Synchronizes the attenuation.

INSTrument:COUPle:BANDwidth <State>
INSTrument:COUPle:BWIDth <State>

This command turns synchronization of the resolution bandwidth (and filter type) between measurement channels on and off.

Parameters:

<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns on synchronization.

*RST: NONE

Example: `INST:COUP:BWID ALL`
Synchronizes the resolution bandwidth.

INSTrument:COUPle:CENTer <State>

This command turns synchronization of the frequency between measurement channels on and off.

Parameters:
<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: ALL

Example: `INST:COUP:CENT ALL`
Synchronizes the center frequency.

INSTrument:COUPle:DEMod <State>

This command turns synchronization of the audio demodulator configuration between measurement channels on and off.

Parameters:
<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: NONE

Example: `INST:COUP:DEM ALL`
Synchronizes the audio demodulator configuration.

INSTrument:COUPle:GAIN <State>

This command turns synchronization of the preamplifier configuration between measurement channels on and off.

Parameters:
<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: NONE

Example: `INST:COUP:GAIN ALL`
Synchronizes the preamplifier configuration.

INSTrument:COUPle:LLINes <State>
INSTrument:COUPle:LIMit <State>

This command turns synchronization of limit results between measurement channels on and off.

Parameters:
<State> ALL | NONE

ALL
Turns on synchronization.
Limit lines have to be compatible to the x-axis and y-axis configuration for successful synchronization.

NONE
Turns off synchronization.

*RST: ALL

Example: `INST:COUP:LIM ALL`
Synchronizes the limit values.

INSTrument:COUPle:MARKer <State>

This command turns synchronization of the marker frequency in the spectrum application and the receiver frequency on and off.

Parameters:
<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: NONE

Example: `INST:COUP:MARK ALL`
Synchronizes the receiver frequency and the marker frequency.

INSTrument:COUPle:PRESel <State>

This command turns synchronization of the preselector state between measurement channels on and off.

Parameters:

<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: ALL

Example: `INST:COUP:PRES ALL`
Synchronizes the preselector configuration.

INSTrument:COUPle:PROT <State>

This command turns synchronization of the input protection between measurement channels on and off.

Parameters:

<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: NONE

Example: `INST:COUP:PROT ALL`
Synchronizes the "10 dB Min" parameter.

INSTrument:COUPle:SPAN <State>

This command turns synchronization of the start and stop frequency between measurement channels on and off.

Parameters:

<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: NONE

Example: `INST:COUP:SPAN ALL`
Synchronizes the start and stop frequency.

INSTrument:COUPle:VBW <State>

This command turns synchronization of the video bandwidth between measurement channels on and off.

Parameters:

<State> ALL | NONE

ALL
Turns on synchronization.

NONE
Turns off synchronization.

*RST: NONE

Example: `INST:COUP:VBW ALL`
Synchronizes the video bandwidth.

15.9.8 Network and remote control configuration

SYSTem:COMMunicate:INTernal:REMote ... 586
SYSTem:COMMunicate:GPIB[:SELF]:ADDRess ... 587
SYSTem:COMMunicate:GPIB[:SELF]:RTERminator ... 587
SYSTem:DISPlay:LOCK ... 588
SYSTem:DISPlay:MESSage[:TEXT] ... 588
SYSTem:DISPlay:MESSage:STATe ... 588
SYSTem:DISPlay:UPDate ... 588
SYSTem:ERRor:CLEar:REMote ... 589
SYSTem:ERRor:DISPlay ... 589
SYSTem:IDENtify:FACTory ... 589
SYSTem:IDENtify[:STRing] ... 589
SYSTem:KLOCk ... 589
SYSTem:LXI:LANReset ... 590
SYSTem:LXI:MDEScription ... 590
SYSTem:LXI:PASSword ... 590
SYSTem:PSA:WIDeband ... 590

SYSTem:COMMunicate:INTernal:REMote <State>

The instrument switches between manual and remote operation.

Note: If the local lockout function (`LLO` or `SYST:KLOC ON`) has been activated in the remote control mode, manual operation is no longer available until `GTL` (or `SYST:KLOC OFF`) is executed.

For details, see Chapter 14.4.5, "Returning to manual mode ("local")", on page 346.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The instrument switches from remote to manual operation. You can operate the instrument locally.

ON | 1
The instrument switches from manual to remote operation.

*RST: 0

Example: `SYST:COMM:INT:REM OFF`
The instrument switches from remote to manual operation (corresponds to @LOC or selecting the "Local" softkey).

Manual operation: See "Local" on page 346

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

This command sets the GPIB address of the R&S EPL1000.

Parameters:
<Address> Range: 0 to 30
*RST: (no influence on this parameter, factory default 20)

Example: `SYST:COMM:GPIB:ADDR 18`

Manual operation: See "GPIB Address" on page 341

SYSTem:COMMunicate:GPIB[:SELF]:RTERminator <Terminator>

This command selects the GPIB receive terminator.

Output of binary data from the instrument to the control computer does not require such a terminator change.

Parameters:
<Terminator> LFEOI | EOI

LFEOI
According to the standard, the terminator in ASCII is <LF> and/or <EOI>.

EOI
For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code used for <LF> might be included in the binary data block, and therefore should not be interpreted as a terminator in this particular case. This can be avoided by using only the receive terminator `EOI`.

*RST: LFEOI

Example: `SYST:COMM:GPIB:RTER EOI`

Manual operation: See "GPIB Terminator" on page 342

SYSTem:DISPlay:LOCK <State>

Defines whether the "Display Update" function remains available in remote operation or not.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
The function remains available.

ON | 1
The function is not available and the display is not updated during remote operation.

*RST: 0

Manual operation: See "Remote Display Update" on page 342

SYSTem:DISPlay:MESSage[:TEXT] <Message>

Defines an additional text that is displayed during remote control operation.

To enable the text display, use `SYSTem:DISPlay:MESSage:STATe` on page 588.

Parameters:

<Message> String that contains the text.

Example:

```
SYST:DISP:MESS ON
SYST:DISP:MESS 'CONTROLLED BY DEVICE X'
```

SYSTem:DISPlay:MESSage:STATe <State>

Enables and disables the display of an additonal text in remote control.

To define the text, use `SYSTem:DISPlay:MESSage[:TEXT]` on page 588.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
Switches the function off

ON | 1
Switches the function on

*RST: 0

Example:

```
SYST:DISP:MESS ON
SYST:DISP:MESS 'CONTROLLED BY DEVICE X'
```

SYSTem:DISPlay:UPDate <State>

This command turns the display during remote operation on and off.

If on, the R&S EPL1000 updates the diagrams, traces and display fields only.

The best performance is obtained if the display is off during remote control operation.

Parameters:
<State> ON | OFF | 1 | 0
*RST: 0

Example: `SYST:DISP:UPD ON`

Manual operation: See "Remote Display Update" on page 342

SYSTem:ERRor:CLEar:REMote

This command deletes all contents of the "Remote Errors" table.

Note: The remote error list is automatically cleared when the R&S EPL1000 is shut down.

Example: `SYST:ERR:CLE:REM`

Manual operation: See "Display Remote Errors" on page 342
See "Clear Error List" on page 346

SYSTem:ERRor:DISPlay <State>

This command switches the error display during remote operation on and off.

If activated, the R&S EPL1000 displays a message box at the bottom of the screen that contains the most recent type of error and the command that caused the error.

Example: `SYST:ERR:DISP ON`

Manual operation: See "Display Remote Errors" on page 342

SYSTem:IDENtify:FACTory

This command resets the query to `*IDN?` to its default value.

Manual operation: See "Reset to Factory String" on page 341

SYSTem:IDENtify[:STRing] <String>

This command defines the response to `*IDN?`.

Parameters:
<String> String containing the description of the instrument.

Manual operation: See "Identification String" on page 341

SYSTem:KLOCk <State>

This command locks or unlocks manual operation.

Parameters:
<State>

ON
LLO (local lockout). The instrument can only be operated remotely, not locally.

OFF
Unlocks the manual operation mode. To operate the instrument locally again, you must execute `SYST:COMM:INT:REM OFF` or select the "Local" softkey first.

*RST: state not affected by *RST

Example: `SYST:KLOC ON`
Activates LLO (remote control only)

Example: `SYST:KLOC OFF`
`SYST:COMM:INT:REM OFF`
You can operate the instrument locally.

SYSTem:LXI:LANReset

This command resets the LAN configuration, as well as the "LAN" password and instrument description.

Manual operation: See " LAN Reset" on page 344

SYSTem:LXI:MDEScription <Description>

This command defines the "LAN" instrument description.

Parameters:
<Description> String containing the instrument description.

SYSTem:LXI:PASSword <Password>

This command defines the "LAN" password.

Parameters:
<Password> String containing the password.

Return values:
<Password>

Manual operation: See "LAN Password" on page 344

SYSTem:PSA:WIDeband <State>

This command defines which option is returned when the `*OPT?` query is executed, depending on the state of the wideband option.

It is only available for PSA89600 emulation.

Parameters:
<State> ON | OFF | HIGH

OFF
The option is indicated as "B7J"

ON
The 40 MHz wideband is used.
The option is indicated as "B7J, 140".

HIGH
The 80 MHz wideband is used.
The option is indicated as "B7J, 122".

*RST: OFF

15.9.9 System configuration check

Commands to check the system configuration described elsewhere.

- `DIAGnostic:SERVice:SINFo?` on page 597

DIAGnostic:INFO:CCOunt?....591
DIAGnostic:SERVice:BIOSinfo?....592
DIAGnostic:SERVice:HWINfo?....592
DIAGnostic:SERVice:VERSinfo?....593
SYSTem:ERRor:CLEar:ALL....593
SYSTem:ERRor:EXTended?....593
SYSTem:ERRor:LIST?....594
SYSTem:ERRor[:NEXT]?....594
SYSTem:FIRMware:UPDate....595
SYSTem:PRESet:COMPatible....595
SYSTem:PRESet:FILTer....595

DIAGnostic:INFO:CCOunt? <Relay>

This command queries how many switching cycles the individual relays have performed since they were installed.

Query parameters:
<Relay> See table below for an overview of supported parameters.

Return values:
<Cycles> Number of switching cycles.

Example: `DIAG:INFO:CCO? CAL`

Usage: Query only

Manual operation: See "Relays Cycle Counter" on page 300

SCPI parameter	Hardware component
CAL	Calibration source
EMIMatt10	EMI mechanical att. 10dB
INP2matt10r1	RF2 mechanical att. 10dB R1
INP2matt10r2	RF2 mechanical att. 10dB R2

SCPI parameter	Hardware component
LFMatt10	LF mechanical att. 10dB
PREamp	Preselector AB: Preamplifier
PRESab_bypr1	Preselector AB: bypass-R1
PRESab_bypr2	Preselector AB: bypass-R2
PRESab_swir1	Preselector AB: switch-R1
PRESab_swir2	Preselector AB: switch-R2
SIGSourout	Signal source output
SPAByp	SA-bypass
	RF1-RF2 Switch

DIAGnostic:SERVice:BIOSinfo?

This command queries the BIOS version of the CPU board.

Return values:

<BiosInformation> String containing the BIOS version.

Example: `DIAG:SERV:BIOS?`
Returns the BIOS version.

Usage: Query only

DIAGnostic:SERVice:HWINfo?

This command queries hardware information.

Return values:

<Hardware> String containing the following information for every hardware component.
<component>: name of the hardware component
<serial#>: serial number of the component
<order#>: order number of the component
<model>: model of the component
<code>: code of the component
<revision>: revision of the component
<subrevision>: subrevision of the component

Example: `DIAG:SERV:HWIN?`
Queries the hardware information.

```
"FRONTEND|100001/003|1300.3009|03|01|00|00",
"MOTHERBOARD|123456/002|1300.3080|02|00|00|00",
...
```

Usage: Query only

DIAGnostic:SERVice:VERSinfo?

This command queries information about the hardware and software components.

Return values:

<Information> String containing the version of hardware and software components including the types of licenses for installed options.

Example: `DIAG:SERV:VERS?`
Queries the version information.
Response:

```
Instrument Firmware |1.00,
R&S Device ID |1350.4444K10-900005-Be,
Operating System |Windows 10 Enterprise (Build: 19044),
BIOS |47.11, Image Version |0.0.0,
Device Installation Version |0.0.0,
PCIE-FPGA |1.11.0,
FE-FPGA (SPA) |1.0.0,
AUX-FPGA |1.0.3,
TG-FPGA |0.0.1,
Data Sheet Version |01.00,
Time Control Management ||active,
Smart Card Service ||installed,
OCXO Precision Frequency Reference B4||,
Additional Interfaces B5||
```

Usage: Query only

SYSTem:ERRor:CLEar:ALL

This command deletes all contents of the "System Messages" table.

Example: `SYST:ERR:CLE:ALL`

SYSTem:ERRor:EXTended? <MessageType>[, <ChannelName>]

This command queries all system messages, or all messages of a defined type, displayed in the status bar for a specific channel setup (application).

Note: This command queries the strings displayed for manual operation. For remote programs, do not define processing steps depending on these results. Instead, query the results of the `STATus:QUEStionable:EXTended:INFO` status register, which indicates whether messages of a certain type have occurred (see Chapter 14.2.2.8, "STATus:QUEStionable:EXTended:INFO register", on page 331).

Parameters:

<MessageType> ALL | INFO | WARNing | FATal | ERRor | MESSage

<ChannelName> String containing the name of the channel setup.
The parameter is optional. If you omit it, the command works for the currently active channel setup.

Return values:

<Messages> String containing all messages of the selected type for the specified channel setup. Each message is separated by a comma and inserted in parentheses. If no messages are available, empty parentheses are returned.

Example: `SYST:ERR:EXT? ALL`
Returns all messages for the currently active application, e.g. *"Message 1","Message 2"*.

Example: `SYST:ERR:EXT? FAT,'Spectrum2'`
Queries fatal errors in the 'Spectrum2' application. If none have occurred, the result is: *" "*.

Usage: Query only

SYSTem:ERRor:LIST? [<MessType>]

This command queries the error messages that occur during R&S EPL1000 operation.

Query parameters:

<MessType> SMSG | REMote

SMSG
(default) Queries the system messages which occurred during manual operation.

REMote
Queries the error messages that occurred during remote operation.
Note: The remote error list is automatically cleared when the R&S EPL1000 is shut down.

Return values:

<SystemMessages> String containing all messages in the "System Messages" table.

<RemoteErrors> <Error_no> | <Description> | <Command> | <Date> | <Time>

Comma-separated list of errors from the "Remote Errors" table, where:
`<Error_no>`: device-specific error code
`<Description>`: brief description of the error
`<Command>`: remote command causing the error
`<Date>|<Time>`: date and time the error occurred

Usage: Query only

SYSTem:ERRor[:NEXT]?

This command queries the most recent error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned.

For details on error queues see Chapter 14.2, "Status reporting system", on page 323.

Usage: Query only

SYSTem:FIRMware:UPDate <Directory>

This command starts a firmware update using the *.msi files in the selected directory. The default path is `D:\FW_UPDATE`. The path is changed via the `MMEMory:COMMent` command. To store the update files the `MMEMory:DATA` command is used.

Only user accounts with administrator rights can perform a firmware update.

Setting parameters:
<Directory>

Example: `SYST:FIRM:UPD 'D:\FW_UPDATE'`
Starts the firmware update from directory "`D:\FW_UPDATE`".

SYSTem:PRESet:COMPatible <OpMode>

This command defines the operating mode that is activated when you switch on the R&S EPL1000 or press the [PRESET] key.

Parameters:
<OpMode>

SANalyzer
Defines Signal and Spectrum Analyzer operating mode as the presetting.

RECeiver
Selects the receiver application as the default application (default value).

Manual operation: See "Preset Mode" on page 294

SYSTem:PRESet:FILTer <FilterType>

This command selects the resolution filter type that is selected after a preset in the Spectrum application.

Parameters:
<FilterType>

NORMal
Selects 3 dB filter.

NOISe
Selects 3 dB filter.
(NORMal and NOISe have the same effect.)

PULSe
Selects 6 dB filter.

*RST: NORMal

Example: //Select the 6 dB filters as the default filter type
`SYST:PRES:FILT PULS`

Manual operation: See "Default Filter Type for Spectrum Mode" on page 294

15.9.10 Service functions

DIAGnostic:SERVice:SFUNction....596
DIAGnostic:SERVice:SFUNction:LASTresult?....596
DIAGnostic:SERVice:SFUNction:RESults:DELete....596
DIAGnostic:SERVice:SFUNction:RESults:SAVE....597
DIAGnostic:SERVice:SINFo?....597
SYSTem:DFPRint....598
SYSTem:PASSword:RESet....598
SYSTem:PASSword[:CENable]....598

DIAGnostic:SERVice:SFUNction <ServiceFunction>
DIAGnostic:SERVice:SFUNction? <ServiceFunction>

This command starts a service function.

The service functions are available after you have entered the level 1 or level 2 system password.

Parameters for setting and query:

<ServiceFunction> String containing the ID of the service function.
The ID of the service function is made up out of five numbers, separated by a point.
- function group number
- board number
- function number
- parameter 1 (see the Service Manual)
- parameter 2 (see the Service Manual)

Return values:
<Result>

Example:
```
DIAG:SERV:SFUN 'Function1'
DIAG:SERV:SFUN? 'Function2'
```

Manual operation: See "Service Function" on page 298
See "Send" on page 299

DIAGnostic:SERVice:SFUNction:LASTresult?

This command queries the results of the most recent service function you have used.

Return values:
<Result>

Usage: Query only

DIAGnostic:SERVice:SFUNction:RESults:DELete

This command deletes the results in the output buffer for service functions you have used.

Usage: Event

Manual operation: See "Clear Results" on page 299

DIAGnostic:SERVice:SFUNction:RESults:SAVE [<FileName>]

This command saves the results in the output buffer for service functions you have used to a file.

If no <FileName> parameter is provided, the results are stored to `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\results\Servicelog.txt`.

Note that if the buffer is empty, the function returns an error.

Parameters:

<FileName> String containing the path and file name.

Manual operation: See "Save Results" on page 299

DIAGnostic:SERVice:SINFo?

This command creates a *.zip file with important support information. The *.zip file contains the system configuration information ("device footprint"), the current eeprom data and a screenshot of the screen display (if available).

This data is stored to the `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user` directory on the instrument.

As a result of this command, the created file name (including the drive and path) is returned.

If you contact the Rohde & Schwarz support to get help for a certain problem, send this file to the support in order to identify and solve the problem faster.

Return values:

<FileName> C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\<R&S Device ID>_<CurrentDate>_<CurrentTime>

String containing the drive, path and file name of the created support file, where the file name consists of the following elements:
<R&S Device ID>: The unique R&S device ID indicated in the "Versions + Options" information
<CurrentDate>: The date on which the file is created (<YYYYMMDD>)
<CurrentTime>: The time at which the file is created (<HHMMSS>)

Example: `DIAG:SERV:SINF?`
Result:
`"C:\ProgramData\Rohde-Schwarz\ZNL-FPL\user\EPL1000__20220103_`

Usage: Query only

Manual operation: See "Create R&S Support Information" on page 296

SYSTem:DFPRint

Creates an `*.xml` file with information on installed hardware, software, image and FPGA versions. The `*.xml` file is stored under `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\devicedata\xml\DeviceFootprint_*` on the instrument. It is also output to the remote interface as binary data.

Return values:
<xxx> Contents of the xml file in binary format.

Example: `SYST:DFPR?`

Manual operation: See "Save Device Footprint" on page 296

SYSTem:PASSword:RESet

Clears any previously provided password and returns to the most restrictive service level.

Manual operation: See "Password" on page 299

SYSTem:PASSword[:CENable] <arg0>

Provides a password for subsequent service functions.

Parameters:
<arg0> string

Example: `SYST:PASS:CEN '894129'`

Manual operation: See "Password" on page 299

15.9.11 Using the status register

For more information on the contents of the status registers see:

- Remote control via SCPI
- Chapter 14.2.2.4, "STATus:OPERation register", on page 327
- Chapter 14.2.2.6, "STATus:QUEStionable:ACPLimit register", on page 329
- Chapter 14.2.2.7, "STATus:QUEStionable:EXTended register", on page 330
- Chapter 14.2.2.9, "STATus:QUEStionable:FREQuency register", on page 331
- Chapter 14.2.2.10, "STATus:QUEStionable:LIMit register", on page 332
- Chapter 14.2.2.11, "STATus:QUEStionable:LMARgin register", on page 332
- Chapter 14.2.2.12, "STATus:QUEStionable:POWer register", on page 333
- Chapter 14.2.2.13, "STATus:QUEStionable:TEMPerature register", on page 334
- Chapter 14.2.2.14, "STATus:QUEStionable:TIMe register", on page 334

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- Reading out the EVENt part 600
- Controlling the ENABle part 600
- Controlling the negative transition part 601
- Controlling the positive transition part 602

15.9.11.1 General status register commands

STATus:PRESet 599
STATus:QUEue[:NEXT]? 599

STATus:PRESet

This command resets the edge detectors and `ENABle` parts of all registers to a defined value. All `PTRansition` parts are set to `FFFFh`, i.e. all transitions from 0 to 1 are detected. All `NTRansition` parts are set to 0, i.e. a transition from 1 to 0 in a `CONDition` bit is not detected. The `ENABle` part of the `STATus:OPERation` and `STATus:QUEStionable` registers are set to 0, i.e. all events in these registers are not passed on.

Usage: Event

STATus:QUEue[:NEXT]?

This command queries the most recent error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned.

This command is identical to the `SYSTem:ERRor[:NEXT]?` command.

Usage: Query only

15.9.11.2 Reading out the CONDition part

STATus:OPERation:CONDition?
STATus:QUEStionable:CONDition?
STATus:QUEStionable:ACPLimit:CONDition? <ChannelName>
STATus:QUEStionable:EXTended:CONDition? <ChannelName>
STATus:QUEStionable:EXTended:INFO:CONDition? <ChannelName>
STATus:QUEStionable:FREQuency:CONDition? <ChannelName>
STATus:QUEStionable:LIMit<n>:CONDition? <ChannelName>
STATus:QUEStionable:LMARgin<n>:CONDition? <ChannelName>
STATus:QUEStionable:POWer:CONDition? <ChannelName>
STATus:QUEStionable:TEMPerature:CONDition? <ChannelName>

STATus:QUEStionable:TRANsducer:CONDition? <ChannelName>
STATus:QUEStionable:TIME:CONDition? <ChannelName>

These commands read out the CONDition section of the status register.

The commands do not delete the contents of the CONDition section.

Suffix:
<n> Window

Query parameters:
<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

15.9.11.3 Reading out the EVENt part

STATus:OPERation[:EVENt]?
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:ACPLimit[:EVENt]? <ChannelName>
STATus:QUEStionable:EXTended[:EVENt]? <ChannelName>
STATus:QUEStionable:EXTended:INFO[:EVENt]? <ChannelName>
STATus:QUEStionable:FREQuency[:EVENt]? <ChannelName>
STATus:QUEStionable:LIMit<n>[:EVENt]? <ChannelName>
STATus:QUEStionable:LMARgin<n>[:EVENt]? <ChannelName>
STATus:QUEStionable:POWer[:EVENt]? <ChannelName>
STATus:QUEStionable:TEMPerature[:EVENt]? <ChannelName>
STATus:QUEStionable:TRANsducer[:EVENt]? <ChannelName>
STATus:QUEStionable:TIME[:EVENt]? <ChannelName>

These commands read out the EVENt section of the status register.

At the same time, the commands delete the contents of the EVENt section.

Suffix:
<n> Window

Query parameters:
<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

15.9.11.4 Controlling the ENABle part

STATus:OPERation:ENABle <SumBit>
STATus:QUEStionable:ENABle <SumBit>
STATus:QUEStionable:ACPLimit:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:ENABle <SumBit>,<ChannelName>

STATus:QUEStionable:FREQuency:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:TRANsducer:ENABle? <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:ENABle <SumBit>,<ChannelName>

These commands control the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to bereported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Suffix:
<n> Window

Parameters:
<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

15.9.11.5 Controlling the negative transition part

STATus:OPERation:NTRansition <SumBit>
STATus:QUEStionable:NTRansition <SumBit>
STATus:QUEStionable:ACPLimit:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TRANsducer:NTRansition? <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:NTRansition <SumBit>,<ChannelName>

These commands control the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:
<n> Window

Parameters:
<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

15.9.11.6 Controlling the positive transition part

STATus:OPERation:PTRansition <SumBit>
STATus:QUEStionable:PTRansition <SumBit>
STATus:QUEStionable:ACPLimit:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TRANsducer:PTRansition? <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:PTRansition <SumBit>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:
<n> Window

Parameters:
<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

15.10 Using the status register

For more information on the contents of the status registers see:

- Remote control via SCPI
- Chapter 14.2.2.4, "STATus:OPERation register", on page 327
- Chapter 14.2.2.6, "STATus:QUEStionable:ACPLimit register", on page 329
- Chapter 14.2.2.7, "STATus:QUEStionable:EXTended register", on page 330
- Chapter 14.2.2.9, "STATus:QUEStionable:FREQuency register", on page 331
- Chapter 14.2.2.10, "STATus:QUEStionable:LIMit register", on page 332
- Chapter 14.2.2.11, "STATus:QUEStionable:LMARgin register", on page 332
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15.10.1 General status register commands

STATus:PRESet....603
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STATus:PRESet

This command resets the edge detectors and `ENABle` parts of all registers to a defined value. All `PTRansition` parts are set to `FFFFh`, i.e. all transitions from 0 to 1 are detected. All `NTRansition` parts are set to 0, i.e. a transition from 1 to 0 in a `CONDition` bit is not detected. The `ENABle` part of the `STATus:OPERation` and `STATus:QUEStionable` registers are set to 0, i.e. all events in these registers are not passed on.

Usage: Event

STATus:QUEue[:NEXT]?

This command queries the most recent error queue entry and deletes it.

Positive error numbers indicate device-specific errors, negative error numbers are error messages defined by SCPI. If the error queue is empty, the error number 0, "No error", is returned.

This command is identical to the `SYSTem:ERRor[:NEXT]?` command.

Usage: Query only

15.10.2 Reading out the CONDition part

STATus:OPERation:CONDition?
STATus:QUEStionable:CONDition?
STATus:QUEStionable:ACPLimit:CONDition? <ChannelName>
STATus:QUEStionable:EXTended:CONDition? <ChannelName>
STATus:QUEStionable:EXTended:INFO:CONDition? <ChannelName>
STATus:QUEStionable:FREQuency:CONDition? <ChannelName>
STATus:QUEStionable:LIMit<n>:CONDition? <ChannelName>
STATus:QUEStionable:LMARgin<n>:CONDition? <ChannelName>
STATus:QUEStionable:POWer:CONDition? <ChannelName>
STATus:QUEStionable:TEMPerature:CONDition? <ChannelName>

STATus:QUEStionable:TRANsducer:CONDition? <ChannelName>
STATus:QUEStionable:TIME:CONDition? <ChannelName>

These commands read out the CONDition section of the status register.

The commands do not delete the contents of the CONDition section.

Suffix:
<n> Window

Query parameters:
<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

15.10.3 Reading out the EVENt part

STATus:OPERation[:EVENt]?
STATus:QUEStionable[:EVENt]?
STATus:QUEStionable:ACPLimit[:EVENt]? <ChannelName>
STATus:QUEStionable:EXTended[:EVENt]? <ChannelName>
STATus:QUEStionable:EXTended:INFO[:EVENt]? <ChannelName>
STATus:QUEStionable:FREQuency[:EVENt]? <ChannelName>
STATus:QUEStionable:LIMit<n>[:EVENt]? <ChannelName>
STATus:QUEStionable:LMARgin<n>[:EVENt]? <ChannelName>
STATus:QUEStionable:POWer[:EVENt]? <ChannelName>
STATus:QUEStionable:TEMPerature[:EVENt]? <ChannelName>
STATus:QUEStionable:TRANsducer[:EVENt]? <ChannelName>
STATus:QUEStionable:TIME[:EVENt]? <ChannelName>

These commands read out the EVENt section of the status register.

At the same time, the commands delete the contents of the EVENt section.

Suffix:
<n> Window

Query parameters:
<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Usage: Query only

15.10.4 Controlling the ENABle part

STATus:OPERation:ENABle <SumBit>
STATus:QUEStionable:ENABle <SumBit>
STATus:QUEStionable:ACPLimit:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:ENABle <SumBit>,<ChannelName>

STATus:QUEStionable:EXTended:INFO:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:ENABle <SumBit>,<ChannelName>
STATus:QUEStionable:TRANsducer:ENABle? <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:ENABle <SumBit>,<ChannelName>

These commands control the ENABle part of a register.

The ENABle part allows true conditions in the EVENt part of the status register to bereported in the summary bit. If a bit is 1 in the enable register and its associated event bit transitions to true, a positive transition will occur in the summary bit reported to the next higher level.

Suffix:
<n> Window

Parameters:
<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

15.10.5 Controlling the negative transition part

STATus:OPERation:NTRansition <SumBit>
STATus:QUEStionable:NTRansition <SumBit>
STATus:QUEStionable:ACPLimit:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:NTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TRANsducer:NTRansition? <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:NTRansition <SumBit>,<ChannelName>

These commands control the Negative TRansition part of a register.

Setting a bit causes a 1 to 0 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:
<n> Window

Parameters:
<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

15.10.6 Controlling the positive transition part

STATus:OPERation:PTRansition <SumBit>
STATus:QUEStionable:PTRansition <SumBit>
STATus:QUEStionable:ACPLimit:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:EXTended:INFO:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:FREQuency:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LIMit<n>:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:LMARgin<n>:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:POWer:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TEMPerature:PTRansition <SumBit>,<ChannelName>
STATus:QUEStionable:TRANsducer:PTRansition? <SumBit>,<ChannelName>
STATus:QUEStionable:TIME:PTRansition <SumBit>,<ChannelName>

These commands control the Positive TRansition part of a register.

Setting a bit causes a 0 to 1 transition in the corresponding bit of the associated register. The transition also writes a 1 into the associated bit of the corresponding EVENt register.

Suffix:
<n> Window

Parameters:
<SumBit> Range: 0 to 65535

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

15.11 Service request

The service request routine requires an extended initialization of the instrument in which the relevant bits of the transition and enable registers are set. In addition the service request event must be enabled in the VISA session.

15.11.1 Initiate service request

```
REM ---- Example of initialization of the SRQ in the case
' of errors -------
PUBLIC SUB SetupSRQ()
CALL InstrWrite (analyzer, "*CLS") 'Reset status reporting system
CALL InstrWrite (analyzer, "*SRE 168") 'Enable service request for
```

```
'STAT:OPER, STAT:QUES and ESR
'register
CALL InstrWrite (analyzer, "*ESE 60") 'Set event enable bit for
'command, execution, device-
'dependent and query error
CALL InstrWrite (analyzer, "STAT:OPER:ENAB 32767")
'Set OPERation enable bit for
'all events
CALL InstrWrite (analyzer, "STAT:OPER:PTR 32767")
'Set appropriate OPERation
'Ptransition bits
CALL InstrWrite (analyzer, "STAT:QUES:ENAB 32767")
'Set questionable enable bits
'for all events
CALL InstrWrite (analyzer, "STAT:QUES:PTR 32767")
'Set appropriate questionable
'Ptransition bits
CALL viEnableEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_QUEUE, 0)
'Enable the event for service
'request
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
 VI_NULL)
IF (status = VI_SUCCESS) THEN CALL Srq
'If SRQ is recognized =>
'subroutine for evaluation
END SUB
REM ***************************************************************************

Private mbSession As MessageBasedSession

Sub Main()
    Console.WriteLine("Example of initialization    _
                of the SRQ in the case of errors.")
    Dim SRQWaitTimeout = 4000 ' Timeout As Integer for WaitOnEvent
    'Opening session
    Try
        'Analyzer is alias, instead of using resource string.
                'For example on TCP use TCPIP0::192.168.1.2::inst0::INSTR
        mbSession = CType(ResourceManager.GetLocalManager().Open("Analyzer"), _
                                    MessageBasedSession)
        mbSession.TerminationCharacterEnabled = True
        Try
            mbSession.Write("*CLS") 'Reset status reporting system
            mbSession.Write("*SRE 168") 'Enable service request for
            'STAT:OPER, STAT:QUES and ESR register
            mbSession.Write("*ESE 60") 'Set event enable bit for
            'command, execution, device-dependent and query error
            mbSession.Write("STAT:OPER:ENAB 32767")
            'Set OPERation enable bit for all events
            mbSession.Write("STAT:OPER:PTR 32767")
```

```
            'Set appropriate OPERation Ptransition bits
            mbSession.Write("STAT:QUES:ENAB 32767")
            'Set questionable enable bits for all events
            mbSession.Write("STAT:QUES:PTR 32767")
            'Set appropriate questionable Ptransition bits
            Console.WriteLine("Wait on event - Blocking")
            mbSession.EnableEvent(MessageBasedSessionEventType.ServiceRequest, _
                                                EventMechanism.Queue)
            'Enable the event for service request

            '-----------------------------------------------
            ' Your command plase use here
            ' mbSession.Write("Your command")
            '-----------------------------------------------

            Dim Status = mbSession.WaitOnEvent( _
                                MessageBasedSessionEventType.ServiceRequest, SRQWaitTimeout)
            If (Status.EventType() = _
                                MessageBasedSessionEventType.ServiceRequest) Then
                Console.WriteLine("SRQ is recognized")
                'If SRQ is recognized => subroutine for evaluation
                Srq()
            End If
        Catch exp As Exception
            Console.WriteLine(exp.Message)
        End Try
    Catch exp As InvalidCastException
        Console.WriteLine("Resource selected must be a message-based session")
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try

    ' Close session
    mbSession.Dispose()
    ' Wait for end
    Console.WriteLine("Press any key to end")
    Console.ReadKey()
End Sub
```

15.11.2 Waiting for the arrival of a service request

There are basically two methods of waiting for the arrival of a service request:

Blocking (user inputs not possible):

This method is appropriate if the waiting time until the event to be signaled by an SRQ is short (shorter than the selected timeout), if no response to user inputs is required during the waiting time, and if – as the main criterion – the event is absolutely certain to occur.

Reason:

From the time the viWaitOnEvent() function is called until the occurrence of the expected event, it does not allow the program to respond to mouse clicks or key entries during the waiting time. Moreover, it returns an error if the SRQ event does not occur within the predefined timeout period.

The method is, therefore, in many cases not suitable for waiting for measurement results, especially when using triggered measurements.

The following function calls are required:

```
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, SRQWaitTimeout, VI_NULL,
 VI_NULL)
'Wait for service request user
'inputs are not possible during
'the waiting time!
IF (status = VI_SUCCESS) THEN CALL Srq
'If SRQ is recognized =>
'subroutine for evaluation


'--------- Sweep in first Spectrum Tab and query marker --------------------
Dim Status = mbSession.WaitOnEvent( _
MessageBasedSessionEventType.ServiceRequest, SRQWaitTimeout)
'Wait for service request user inputs are not possible
'during the waiting time!
If (Status.EventType() = MessageBasedSessionEventType.ServiceRequest) Then
'If SRQ is recognized => subroutine for evaluation
    Srq()
End If
```

Non-blocking (user inputs possible):

This method is recommended if the waiting time until the event to be signaled by an SRQ is long (longer than the selected timeout), and user inputs should be possible during the waiting time, or if the event is not certain to occur. This method is, therefore, the preferable choice for waiting for the end of measurements, i.e. the output of results, especially in the case of triggered measurements.

The method necessitates a waiting loop that checks the status of the SRQ line at regular intervals and returns control to the operating system during the time the expected event has not yet occurred. In this way, the system can respond to user inputs (mouse clicks, key entries) during the waiting time.

It is advisable to employ the Hold() auxiliary function, which returns control to the operating system for a selectable waiting time (see section Waiting without blocking the keyboard and mouse), so enabling user inputs during the waiting time.

```
result% = 0
For i = 1 To 10 'Abort after max. 10 loop
'iterations
Status = viWaitOnEvent(analyzer, VI_EVENT_SERVICE_REQ, VI_TMO_IMMEDIATE, VI_NULL,
 VI_NULL)
```

```
'Check event queue
If (status = VI_SUCCESS) Then
result% = 1
CALL Srq 'If SRQ is recognized =>
'subroutine for evaluation
Else
CALL Hold(20) 'Call hold function with
'20 ms 'waiting time. User inputs
'are possible.
Endif
Next i
If result% = 0 Then
Debug.Print "Timeout Error; Program aborted"'Output error message
STOP 'Stop software
Endif
```

15.11.3 Waiting without blocking the keyboard and mouse

A frequent problem with remote control programs using Visual Basic is to insert waiting times without blocking the keyboard and the mouse.

If the program is to respond to user inputs also during a waiting time, control over the program events during this time must be returned to the operating system. In Visual Basic, this is done by calling the `DoEvents` function. This function causes keyboard-or mouse-triggered events to be executed by the associated elements. For example, it allows the operation of buttons and input fields while the user waits for an instrument setting to be completed.

The following programming example describes the `Hold()` function, which returns control to the operating system for the period of the waiting time selectable in milliseconds.

```
Rem ************************************************************************
Rem The waiting function below expects the transfer of the desired
Rem waiting time in milliseconds. The keyboard and the mouse remain
Rem operative during the waiting period, thus allowing desired elements
Rem to be controlled
Rem ************************************************************************
Public Sub Hold(delayTime As Single)
Start = Timer 'Save timer count on calling the
'function
Do While Timer < Start + delayTime/1000 'Check timer count
DoEvents 'Return control to operating
'system to enable control of
'desired elements as long as
'timer has not elapsed
Loop
End Sub
Rem ************************************************************************
```

The waiting procedure is activated simply by calling `Hold(<Waiting time in milliseconds>)`.

15.11.4 Service request routine

A service request is processed in the service request routine.

The variables userN% and userM% must be pre-assigned usefully!

```
REM ------------ Service request routine ---------------------------------
Public SUB Srq()
ON ERROR GOTO noDevice 'No user existing
CALL viReadSTB(analyzer, STB%) 'Serial poll, read status byte
IF STB% > 0 THEN 'This instrument has bits set in
'the STB
SRQFOUND% = 1
IF (STB% AND 16) > 0 THEN CALL Outputqueue
IF (STB% AND 4) > 0 THEN CALL ErrorQueueHandler
IF (STB% AND 8) > 0 THEN CALL Questionablestatus
IF (STB% AND 128) > 0 THEN CALL Operationstatus
IF (STB% AND 32) > 0 THEN CALL Esrread
END IF
noDevice:
END SUB 'End of SRQ routine
REM *************************************************************************

REM ---------- Subroutine for evaluation Service Request Routine ----------

Public Sub Srq()
    Try
        Dim mySTB As Short = mbSession.ReadStatusByte()
                                'Serial poll, read status byte
        Console.WriteLine("Reading Service Request Routine:" + mySTB.ToString())
        If mySTB > 0 Then 'This instrument has bits set in the STB
            If (mySTB And 16) > 0 Then Call Outputqueue()
            If (mySTB And 4) > 0 Then Call ErrorQueueHandler()
            If (mySTB And 8) > 0 Then Call Questionablestatus()
            If (mySTB And 128) > 0 Then Call Operationstatus()
            If (mySTB And 32) > 0 Then Call Esrread()
        End If
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub 'End of SRQ routine
```

Reading out the status event registers, the output buffer and the error/event queue is effected in subroutines.

15.11.5 Reading out the output buffer

```
REM -------- Subroutine for the individual STB bits -----------------------
Public SUB Outputqueue() 'Reading the output buffer
result$ = SPACE$(100) 'Make space for response
CALL InstrRead(analyzer, result$)
Debug.Print "Contents of Output Queue:"; result$
END SUB
REM ***************************************************************************

REM -------- Subroutine for the output queue -----------------------
Public Sub Outputqueue() 'Reading the output buffer
    Try
        Dim result As String = mbSession.ReadString()
        Console.WriteLine("Contents of Output Queue:" + result)
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub
```

15.11.6 Reading error messages

```
REM -------- Subroutine for reading the error queue -----------------------
Public SUB ErrorQueueHandler()
ERROR$ = SPACE$(100) 'Make space for error variable
CALL InstrWrite (analyzer, "SYSTEM:ERROR?")
CALL InstrRead(analyzer, ERROR$)
Debug.Print "Error Description:"; ERROR$
END SUB
REM ***************************************************************************

REM -------- Subroutine for reading the error queue -----------------------
Sub ErrorQueueHandler()
    Dim result As String
    Dim hasErr As Boolean = True
    Do
        mbSession.Write("SYST:ERR?")
        result = mbSession.ReadString()
        Dim parts As String() = result.Split(",")
        If parts(0) = 0 Then
            hasErr = False
            Console.WriteLine(result)
        Else
            Console.WriteLine(result)
        End If
    Loop While hasErr
End Sub
```

15.11.7 Evaluation of SCPI status registers

```
REM ------ Subroutine for evaluating Questionable Status Register ---------
Public SUB Questionablestatus()
Ques$ = SPACE$(20)
'Preallocate blanks to text
'variable
CALL InstrWrite (analyzer, "STATus:QUEStionable:EVENt?")
CALL InstrRead(analyzer, Ques$)
Debug.Print "Questionable Status:"; Ques$
END SUB
REM ************************************************************************
REM ------ Subroutine for evaluating Operation Status Register ------------
Public SUB Operationstatus()
Oper$ = SPACE$(20) 'Preallocate blanks to text
'variable
CALL InstrWrite (analyzer, "STATus:OPERation:EVENt?")
CALL InstrRead(analyzer, Oper$)
Debug.Print "Operation Status:"; Oper$
END SUB
REM ************************************************************************
```

```
REM ------ Subroutine for evaluating Questionable Status Register ---------
Public Sub Questionablestatus()
    Dim myQSR As String = Nothing
    Try
        myQSR = mbSession.Query("STATus:QUEStionable:EVENt?") 'Read QSR
        Console.WriteLine("Questionable Status:" + myQSR)
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub

REM ------ Subroutine for evaluating Operation Status Register ------------
Public Sub Operationstatus()
    Dim myOSR As String = Nothing
    Try
        myOSR = mbSession.Query("STATus:OPERation:EVENt?") 'Read OSR
        Console.WriteLine("Operation Status:" + myOSR)
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub
```

15.11.8 Evaluation of event status register

```
REM ------ Subroutine for evaluating the Event Status Register ------------
Public SUB Esrread()
Esr$ = SPACE$(20) 'Preallocate blanks to text
```

```
'variable
CALL InstrWrite (analyzer, "*ESR?") 'Read ESR
CALL InstrRead(analyzer, Esr$)
IF (VAL(Esr$) AND 1) > 0 THEN Debug.Print "Operation complete"
IF (VAL(Esr$) AND 2) > 0 THEN Debug.Print "Request Control"
IF (VAL(Esr$) AND 4) > 0
THEN Debug.Print "Query Error"
IF (VAL(Esr$) AND 8) > 0
THEN Debug.Print "Device dependent error"
IF (VAL(Esr$) AND 16) > 0
THEN Debug.Print "Execution Error; Program aborted"'Output error message
STOP 'Stop software
END IF
IF (VAL(Esr$) AND 32) > 0
THEN Debug.Print "Command Error; Program aborted"'Output error message
STOP 'Stop software
END IF
IF (VAL(Esr$) AND 64) > 0 THEN Debug.Print "User request"
IF (VAL(Esr$) AND 128) > 0 THEN Debug.Print "Power on"END SUB
REM ***************************************************************

REM ------ Subroutine for evaluating the Event Status Register ------------
Public Sub Esrread()
    Try
        Dim myESR As Short = mbSession.Query("*ESR?") 'Read ESR
        If (myESR And 1) > 0 Then Console.WriteLine("Operation complete")
        If (myESR And 2) > 0 Then Console.WriteLine("Request Control")
        If (myESR And 4) > 0 Then Console.WriteLine("Query Error")
        If (myESR And 8) > 0 Then Console.WriteLine("Device dependent error")
        If (myESR And 16) > 0 Then
            Console.WriteLine("Execution Error; Program aborted") 'Output error message
            Stop 'Stop software
        End If
        If (myESR And 32) > 0 Then
            Console.WriteLine("Command Error; Program aborted") 'Output error message
            Stop 'Stop software
        End If
        If (myESR And 64) > 0 Then Console.WriteLine("User request")
        If (myESR And 128) > 0 Then Console.WriteLine("Power on")
    Catch exp As Exception
        Console.WriteLine(exp.Message)
    End Try
End Sub
```

16 Troubleshooting

If the results do not meet your expectations, the following sections may contain helpful hints and information.

- Error information 615
- Error messages in remote control mode 616
- Troubleshooting remote operation 617
- Miscellaneous troubleshooting hints 619
- System recovery 620
- Collecting information for support 621
- Contacting customer support 622

16.1 Error information

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

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

Table 16-1: Status bar information - color coding

Color	Type	Description
Red	Error	An error occurred at the start or during a measurement, e.g. due to missing data or wrong settings, so that the measurement cannot be started or completed correctly.
Orange	Warning	An irregular situation occurred during measurement, e.g. the settings no longer match the displayed results, or the connection to an external device was interrupted temporarily.
Gray	Information	Information on the status of individual processing steps.
No color	No errors	No message displayed - normal operation.
Green	Measurement successful	Some applications visualize that the measurement was successful by showing a message.

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

Table 16-2: List of keywords

Keyword	Description	Bit in status register
"INPUT OVLD"	The signal level at the RF input connector exceeds the maximum. The RF input is disconnected from the input mixer to protect the device. To re-enable measurement, decrease the level at the RF input connector and reconnect the RF input to the mixer input.	`STATus:QUEStionable:POWer`, bit 3
"RF OVLD"	Overload of the input mixer or of the analog IF path. • Increase the RF attenuation (for RF input). • Reduce the input level (for digital input)	`STATus:QUEStionable:POWer`, bit 0
"LO UNL"	Error in the instrument's frequency processing hardware was detected.	`STAT:QUES:FREQuency`, bit 1
"NO REF"	Instrument was set to an external reference but no signal was detected on the reference input.	`STAT:QUES:FREQuency`, bit 8
"UNCAL"	One of the following conditions applies: • Correction data has been switched off. • No correction values are available, for example after a firmware update. • Record the correction data by performing a self alignment	`STATus:QUEStionable`, bit 8
"WRONG_FW"	The firmware version is out-of-date and does not support the currently installed hardware. Until the firmware version is updated, this error message is displayed and self-alignment fails.	

16.2 Error messages in remote control mode

In remote control mode error messages are entered in the error/event queue of the status reporting system and can be queried with the command `SYSTem:ERRor?`. The answer format of R&S EPL1000 to the command is as follows:

```
<error code>, "<error text with queue query>;<remote control command concerned>"
```

The indication of the remote control command with prefixed semicolon is optional.

Example:

The command `TEST:COMMAND` generates the following answer to the query `SYSTem:ERRor?`

```
-113,"Undefined header;TEST:COMMAND"
```

There are two types of error messages:

- Error messages defined by SCPI are marked by negative error codes. These messages are defined and described in the SCPI standard and not listed here.
- Device-specific error messages use positive error codes. These messages are described below.

Table 16-3: Device-specific error messages

Error code	Error text in the case of queue poll Error explanation
1052	**Frontend LO is Unlocked** This message is displayed when the phase regulation of the local oscillator fails in the RF front-end.
1060	**Trigger-Block Gate Delay Error- gate length < Gate Delay** This message is displayed when the gate signal length is not sufficient for the pull-in delay with a predefined gate delay.
1064	**Tracking LO is Unlocked** This message is displayed when the phase regulation of the local oscillator fails on the internal generator module.
2028	**Hardcopy not possible during measurement sequence** This message is displayed when a printout is started during scan sequences that cannot be interrupted. Such sequences are for example: • Recording the system error correction data (alignment) • Instrument self-test In such cases synchronization to the end of the scan sequence should be performed prior to starting the printout.
2033	**Printer Not Available** This message is displayed when the selected printer is not included in the list of available output devices. A possible cause is that the required printer driver is missing or incorrectly installed.
2034	**CPU Temperature is too high** This message is displayed when the temperature of the processor exceeds 70 °C.

16.3 Troubleshooting remote operation

If problems arise during measurement in remote operation, try the following methods to solve them.

Incompleted sequential commands - blocked remote channels

If a sequential command cannot be completed, for example because a triggered sweep never receives a trigger, the remote control program will never finish and the remote channel to the R&S EPL1000 is blocked for further commands. In this case, you must interrupt processing on the remote channel in order to abort the measurement.

To regain control over a blocked remote channel

Usually, if you wait a minute for the VISA connection to detect the lost connection and clear the control channel by itself, you can then re-establish the connection again. If this fails, try the following:

1. Press "Local" on the front panel of the R&S EPL1000 to return to manual operation (if not disabled). Then re-establish the connection.

2. Send a "Device Clear" command from the control instrument to the R&S EPL1000 to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:

   - **Visa**: `viClear()`

   The remote channel currently processing the incompleted command is then ready to receive further commands again.

3. On the remote channel performing the measurement, send the SCPI command `ABORt` to abort the current measurement and reset the trigger system.

4. If the R&S EPL1000 still does not react to the remote commands, switch it off and back on.

Ignored commands

When a remote command attempts to define incompatible settings, the command is ignored and the instrument status remains unchanged, i.e. other settings are not automatically adapted. Therefore, control programs should always define an initial instrument status (e.g. using the *RST command) and then implement the required settings.

Detecting false commands - log file

If a remote program does not provide the expected results and you are using a GPIB connection, you can log the commands and any errors that may occur. To activate the SCPI error log function, in the "Network + Remote" dialog box, in the "GPIB" tab, select "I/O Logging".

All remote control commands received by the R&S EPL1000 are recorded in log files with the following syntax:

```
C:
\Users\Public\Documents\Rohde-Schwarz\Analyzer\ScpiLogging\ScpiLog.<xx>
```

where <xx> is a consecutive number, starting with 00;

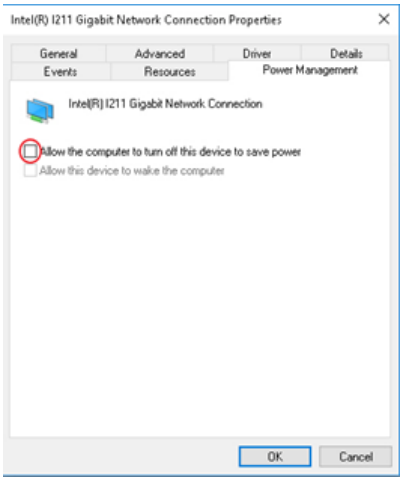
A new file is created each time you stop and restart the logging function. The lowest available number is used for the <xx> extension.

Logging the commands may be extremely useful for debug purposes, e.g. in order to find misspelled keywords in control programs. However, remember to turn off the logging function after debugging to avoid unnecessary access to the hard drive and use of storage space.

Interrupted VISA connection to R&S EPL1000

Sometimes, in combination with a certain LAN-switch (SMC Switch 210), the VISA remote connection to the R&S EPL1000 is interrupted. In this case, disable the power save mode for the network controller on the R&S EPL1000.

1. On the R&S EPL1000, open the Windows "Start" menu.
2. Search for the network connection properties.
3. On the "Power Management" tab, disable the power save option.



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Invalid trace display
If output to the [IF 2 GHz OUT] connector is activated, the measured values are no longer sent to the display; thus, the trace data currently displayed on the R&S EPL1000 becomes invalid. A message in the status bar indicates this situation.

Multiple user access to one instrument
Using the R&S EPL1000's web browser interface, several users can access *and operate* the same instrument simultaneously. This is useful for troubleshooting or training purposes.

Type the instrument's host name or IP address in the address field of the browser on your PC, for example "http://10.113.10.203". The instrument home page (welcome page) opens.

Note: This function can be deactivated for the instrument. After a firmware update, it is automatically activated again.

Web browser access to instrument fails
If an error message ("Failed to connect to server (code. 1006)") is displayed in the web browser instead of the instrument's user interface then the LAN web browser interface was probably deactivated.

The transducer factors/limit lines applied to my measurement are different to those displayed in the Transducer/Lines dialog box
If a transducer file was in use when the save set was stored (with the save item "Current Settings" only) it is anticipated that these transducer values should remain valid after every recall of that save set. Thus, even if the transducer file is changed and the original save set file is recalled later, the *originally stored* transducer values are recalled and applied to the measurement. In the "Transducer" dialog box, however, the *changed* transducer file values are displayed as no updated transducer file was loaded.

The same applies to limit line settings.

If you want to apply the changed transducer values after recalling the save set you must force the application to reload the transducer file. To do so, simply open the "Edit Transducer" dialog box and toggle the "X-Axis" option from "Lin" to "Log" and back. Due to that change, the transducer file is automatically reloaded, and the changed transducer values are applied to the current measurement. Now you can create a new save set with the updated transducer values.

Similarly, if you want to apply the changed limit values after recalling the save set you must force the application to reload the limit file. To do so, simply open the "Edit Limit Line" dialog box (see Chapter 11.5.2.2, "Limit line settings and functions", on page 229) and toggle the "Y-Axis" unit. Due to that change, the limit line file is automatically reloaded, and the changed limit values are applied to the current measurement. Now a new save set with the updated limit values can be created.

16.5 System recovery

The system drive of the R&S EPL1000 is delivered with a recovery partition that allows you to restore the original operating system image and firmware.

To restore the original operating system image and firmware

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

2. Open the Windows "Settings".
3. Select "Update & Security" > "Recovery".
4. In the "Advanced Startup" section, select "Restart Now".

   The "R&S Recovery Environment" starts.
5. In the "R&S Recovery Environment", select "Factory Default Restore".

   The default image is restored.
6. Reboot the instrument.

After the default image is restored, upgrade to the desired firmware version (see Chapter 13.4.4, "Firmware updates", on page 292).

16.6 Collecting information for support

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

In addition, our customer support centers are there to assist you in solving any problems that you may encounter with your R&S EPL1000. We will find solutions more quickly and efficiently if you provide us with the information listed below.

- **Windows Event Log Files**
  Windows records important actions of applications and the operating system in event logs. You can create event log files to summarize and save the existing event logs (see "To create windows event log files" on page 621).
- **System Configuration:** The "System Configuration" dialog box (in the "Setup" menu) provides information on:
  - **Hardware Info:** hardware assemblies
  - **Versions and Options:** the status of all software and hardware options installed on your instrument
  - **System Messages:** messages on any errors that may have occurred

  An .xml file with information on the system configuration ("Device Footprint") can be created automatically (using the `DIAGnostic:SERVice:SINFo` command or as described in "To collect the support information" on page 621).
- **Error Log:** The `RSError.log` file (in the `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\log` directory) contains a chronological record of errors.
- **Support file:** a *.zip file with important support information can be created automatically (in the `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\user` directory). The *.zip file contains the system configuration information ("Device Footprint"), the current eeprom data and a screenshot of the screen display.

See also Chapter 13.5.1, "R&S support information", on page 295.

To collect the support information

1. Press the [Setup] key.
2. Select "Service" > "R&S Support" and then "Create R&S Support Information".

   The file is stored as
   `C:\Users\Public\Documents\Rohde-Schwarz\Analyzer\user\<inst_model>_<serial-no>_<date_and_time>.zip`
   For example
   `C:\ProgramData\Rohde-Schwarz\ZNL-FPL\user\EPL1000__20220103_145113.zip`

To create windows event log files

1. Select the "Windows Start Button" in the bottom left corner.
2. Enter *Event Viewer* and select "Enter".
3. Select and expand "Windows Logs" in the "Console Tree".

4. Right-click on each subsection and select "Save All Events As...".

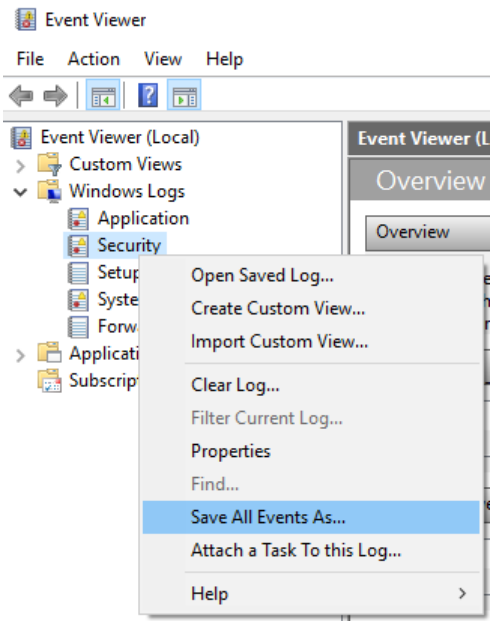

Figure 16-1: Event Viewer

5. Enter a file name and select "Save"

Collect the error information and attach it to an email in which you describe the problem. Send the email to the customer support address for your region as listed in Chapter 16.7, "Contacting customer support", on page 622.

Packing and transporting the instrument

If the instrument needs to be transported or shipped, observe the notes described in Chapter 17.5, "Transporting", on page 625.

16.7 Contacting customer support

Technical support – where and when you need it

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

Contact information

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

Figure 16-2: QR code to the Rohde & Schwarz support page

17 Maintenance, storage, transport and disposal

The product does not require regular maintenance. It only requires occasional cleaning. It is however advisable to check the nominal data from time to time.

17.1 Cleaning

How to clean the product is described in "Cleaning the product" on page 13.

Do not use any liquids for cleaning. Cleaning agents, solvents, acids and bases can damage the front panel labeling, plastic parts and display.

17.2 Changing fuses

If the R&S EPL1000 does not start, it is possible that a blown fuse is the cause. The fuse is located in the socket of the power supply.

1. **WARNING!** The fuse is part of the main power supply. Handling the fuse while the power is on can lead to electric shock.

   Before changing the fuse:

   a) Set the switch on the power supply to position [0].
   b) Disconnect the R&S EPL1000 from the power source.

2. Pull out the fuse holder.
3. Check the condition of the fuse.
4. Replace the blown fuse. Only use a fuse of the specified type.

   The fuse type and its characteristics are indicated next to the fuse holder.

5. Insert the fuse holder into the mains power inlet.

17.3 Handling batteries

Safe handling of batteries is described in "Handling batteries safely" on page 12. Maintenance information is provided here.

Keep the batteries clean and dry. If the terminals become soiled, clean them with a dry, clean cloth.

Charging batteries

Charge the battery before using it for the first time. Following a long storage period, it can be necessary to charge and discharge the battery several times to reach full capacity.

For details on charging batteries, see "Charging batteries" on page 25.

Storing batteries

Ideally, store the battery in the product and follow the instructions in <xref "Storage">. Otherwise, observe the following rules:

- Prevent short-circuiting of the batteries, which can happen if batteries touch each other or come into contact with metallic objects in the storage container. As storage container, you can use the product packaging.
- Do not expose to direct sunlight.
- Store the battery at room temperature.
- Store the battery at a state of charge between 50 % and 70 %.

17.4 Storage

Protect the product against dust. Ensure that the environmental conditions, e.g. temperature range and climatic load, meet the values specified in the data sheet.

17.5 Transporting

Lifting and carrying

See:

- "Lifting and carrying the product" on page 11
- Chapter 5.1, "Lifting and carrying", on page 20.

Packing

Use the original packaging material. It consists of antistatic wrap for electrostatic protection and packing material designed for the product.

If you do not have the original packaging, use similar materials that provide the same level of protection. You can also contact your local Rohde & Schwarz service center for advice.

Securing

When moving the product in a vehicle or using transporting equipment, make sure that the product is properly secured. Only use items intended for securing objects.

Transport altitude

The maximum transport altitude without pressure compensation is 4600 m above sea level.

17.6 Disposal

Rohde & Schwarz is committed to making careful, ecologically sound use of natural resources and minimizing the environmental footprint of our products. Help us by disposing of waste in a way that causes minimum environmental impact.

Disposing electrical and electronic equipment

A product that is labeled as follows cannot be disposed of in normal household waste after it has come to the end of its service life. Even disposal via the municipal collection points for waste electrical and electronic equipment is not permitted.

Figure 17-1: Labeling in line with EU directive WEEE

Rohde & Schwarz has developed a disposal concept for the eco-friendly disposal or recycling of waste material. As a manufacturer, Rohde & Schwarz completely fulfills its obligation to take back and dispose of electrical and electronic waste. Contact your local service representative to dispose of the product.

Disposing batteries

A product that contains a battery cannot be disposed of in the normal household waste after it has come to the end of its service life. It is labeled as follows:

Figure 17-2: Disposal information in line with EU battery directive

Dispose of batteries as specified by the local waste disposal agency. Alternatively, you can contact the Rohde & Schwarz local service representative.

For information on returning batteries to Rohde & Schwarz subsidiaries, see "Handling batteries safely" on page 12.

List of commands

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