10 Network and Remote Operation

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

- Connecting the instrument to a (LAN) network
- Using the LXI browser interface in a LAN network
- Using the Windows Remote Desktop application in a LAN network
- Connecting a PC via the GPIB interface

How to configure the remote control interfaces is described in chapter 10.5, "How to Set Up a Network and Remote Control", on page 598.

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10.1 Remote Control Basics

Basic information on operating an instrument via remote control is provided here. this information applies to all applications and operating modes on the R&S FSW.

10.1.1 Remote Control Interfaces and Protocols

The instrument supports different interfaces for remote control. The following table gives an overview.

Table 10-1: Remote control interfaces and protocols

Interface	Protocols, VISA*) address string	Remarks

Local Area Network (LAN)	Protocols:
	VXI-11, HiSLIP
	VISA*) address string:
	`TCPIP::host_address[::LAN_device_name][::INSTR]`
	Raw socket
	VISA*) address string:
	`TCPIP::host_address::port::SOCKET`
		A LAN connector is located on the rear panel of the instrument.
		The interface is based on TCP/IP and supports various protocols.
		For a description of the protocols refer to:
		VXI-11 Protocol
		HiSLIP Protocol
		Socket Communication

GPIB (IEC/IEEE Bus Interface)	VISA*) address string: `GPIB::primary address[::INSTR]` (no secondary address)	A GPIB bus interface (option R&S FSW-B10) according to the IEC 625.1/IEEE 488.1 standard is located on the rear panel of the instrument. For a description of the interface refer to 10.1.1.2 GPIB Interface (IEC 625/IEEE 418 Bus Interface).
USB	VISA*) address string: `USB::<vendor ID>::<product_ID>::<serial_number>[::INSTR]`	USB connectors are located on the rear panel of the instrument. For a description of the interface refer to 10.1.1.3 USB Interface.
*) 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 (see also chapter 10.1.3, "VISA Libraries", on page 558).		

Within this interface description, the term GPIB is used as a synonym for the IEC/IEEE bus interface.

10.1.1.1 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.

VISA library

Instrument access is usually achieved from high level programming platforms using VISA as an intermediate abstraction layer. VISA encapsulates the low level VXI, GPIB, LAN or USB function calls and thus makes the transport interface transparent for the user. See chapter 10.1.3, "VISA Libraries", on page 558 for details.

The R&S FSW supports various LAN protocols such as LXI, RSIB, raw socket or the newer HiSLIP protocol.

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 sub-instrument;
  - `inst0` selects the VXI-11 protocol (default)
  - `hislip0` selects the newer 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 name is *FSW-123456*; the valid resource string using HiSLIP is:
  `TCPIP::FSW-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 means of the resource string.

For details on configuring the LAN connection, see chapter 10.5.1, "How to Configure a Network", on page 599.

VXI-11 Protocol

The VXI-11 standard is based on the ONC RPC (Open Network Computing Remote Procedure Call) protocol which in turn relies on TCP/IP as the network/transport layer. The TCP/IP network protocol and the associated network services are preconfigured. TCP/IP ensures connection-oriented communication, where the order of the exchanged messages is adhered to and interrupted links are identified. With this protocol, messages cannot be lost.

HiSLIP Protocol

The HiSLIP (**Hi**gh **S**peed **L**AN **I**nstrument **P**rotocol) is the successor protocol for VXI-11 for TCP-based instruments specified by the IVI foundation. The protocol uses two TCP sockets for a single connection - one for fast data transfer, the other for non-sequential control commands (e.g. `Device Clear` or `SRQ`).

HiSLIP has the following characteristics:

- High performance as with raw socket network connections
- Compatible IEEE 488.2 support for Message Exchange Protocol, Device Clear, Serial Poll, Remote/Local, Trigger, and Service Request
- Uses a single IANA registered port (4880), which simplifies the configuration of firewalls
- Supports simultaneous access of multiple users by providing versatile locking mechanisms
- Usable for IPv6 or IPv4 networks

Note that HiSLIP data is sent to the device using the "fire and forget" method with immediate return, as opposed to VXI-11, where each operation is blocked until a VXI-11 device handshake returns. Thus, a successful return of a VISA operation such as `viWrite()` does not guarantee that the instrument has finished or started the requested command, but is delivered to the TCP/IP buffers.

For more information see also the application note at: http://www.rohde-schwarz.com/appnote/1MA208.

Socket Communication

An alternative way for remote control of the software is to establish a simple network communication using sockets. The socket communication, also referred to as "Raw Ethernet communication", does not necessarily require a VISA installation on the remote controller side. It is available by default on all operating systems.

The simplest way to establish socket communication is to use the built-in telnet program. The telnet program is part of every operating system and supports a communication with the software on a command-by-command basis. For more convenience and to enable automation by means of programs, user-defined sockets can be programmed.

Socket connections are established on a specially defined port. The socket address is a combination of the IP address or the host name of the instrument and the number of the port configured for remote-control. All Signal and Spectrum Analyzers use port number 5025 for this purpose. The port is configured for communication on a command-to-command basis and for remote control from a program.

10.1.1.2 GPIB Interface (IEC 625/IEEE 418 Bus Interface)

A GPIB interface is integrated on the rear panel of the instrument. By connecting a PC to the R&S FSW 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 10.5.1.5, "How to Change the GPIB Instrument Address", on page 605). 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 FSW.

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 lenth 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.

10.1.1.3 USB Interface

For remote control via the USB connection, the PC and the instrument must be connected via the USB type B interface. A USB connection requires the VISA library to be installed. VISA detects and configures the R&S instrument automatically when the USB connection is established. You do not have to enter an address string or install a separate driver.

USB address

The used USB address string is:

`USB::<vendor ID>::<product ID>::<serial number>[::INSTR]`

where:

- <vendor ID> is the vendor ID for Rohde&Schwarz
- <product ID> is the product ID for the R&S instrument
- <serial number> is the individual serial number on the rear of the instrument

Example:

`USB::0x0AAD::0x00C6::100001::INSTR`

0x0AAD is the vendor ID for Rohde&Schwarz

0xC6 is the product ID for the R&S FSW13

100001 is the serial number of the particular instrument

10.1.2 SCPI (Standard Commands for Programmable Instruments)

SCPI commands - messages - are used for remote control. Commands that are not taken from the SCPI standard follow the SCPI syntax rules. The instrument supports the SCPI version 1999. The SCPI standard is based on standard IEEE 488.2 and aims at the standardization of device-specific commands, error handling and the status registers. The tutorial "Automatic Measurement Control - A tutorial on SCPI and IEEE 488.2" from John M. Pieper (R&S order number 0002.3536.00) offers detailed information on concepts and definitions of SCPI.

Tables provide a fast overview of the bit assignment in the status registers. The tables are supplemented by a comprehensive description of the status registers.

10.1.3 VISA Libraries

VISA is a standardized software interface library providing input and output functions to communicate with instruments. The I/O channel (LAN or TCP/IP, USB, GPIB,...) is selected at initialization time by means of the channel–specific address string ("VISA resource string") indicated in table 10-1, or by an appropriately defined VISA alias (short name).

A VISA installation is a prerequisite for remote control using the following interfaces:

- chapter 10.1.1.1, "LAN Interface", on page 554
- chapter 10.1.1.2, "GPIB Interface (IEC 625/IEEE 418 Bus Interface)", on page 557
- chapter 10.1.1.3, "USB Interface", on page 558

For more information about VISA refer to the user documentation.

10.1.4 Messages

The messages transferred on the data lines are divided into the following categories:

- Interface messages
  Interface messages are transmitted to the instrument on the data lines, with the attention line being active (LOW). They are used to communicate between the controller and the instrument. Interface messages can only be sent by instruments that have GPIB bus functionality. For details see the sections for the required interface.
- Instrument messages
  Instrument messages are employed in the same way for all interfaces, if not indicated otherwise in the description. Structure and syntax of the instrument messages are described in chapter 10.1.5, "SCPI Command Structure", on page 560. A detailed description of all messages available for the instrument is provided in the chapter "Remote Control Commands".
  There are different types of instrument messages, depending on the direction they are sent:
  – Commands
  – Instrument responses

Commands

Commands (program messages) are messages the controller sends to the instrument. They operate the instrument functions and request information. The commands are subdivided according to two criteria:

- According to the effect they have on the instrument:
  – **Setting commands** cause instrument settings such as a reset of the instrument or setting the frequency.
  – **Queries** cause data to be provided for remote control, e.g. for identification of the instrument or polling a parameter value. Queries are formed by directly appending a question mark to the command header.
- According to their definition in standards:
  – **Common commands**: their function and syntax are precisely defined in standard IEEE 488.2. They are employed identically on all instruments (if implemented). They refer to functions such as management of the standardized status registers, reset and self test.
  – **Instrument control commands** refer to functions depending on the features of the instrument such as frequency settings. Many of these commands have also been standardized by the SCPI committee. These commands are marked as "SCPI confirmed" in the command reference chapters. Commands without this SCPI label are device-specific; however, their syntax follows SCPI rules as permitted by the standard.

Instrument responses

Instrument responses (response messages and service requests) are messages the instrument sends to the controller after a query. They can contain measurement results, instrument settings and information on the instrument status.

10.1.5 SCPI Command Structure

SCPI commands consist of a so-called header and, in most cases, one or more parameters. The header and the parameters are separated by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). The headers may consist of several mnemonics (keywords). Queries are formed by appending a question mark directly to the header.

The commands can be either device-specific or device-independent (common commands). Common and device-specific commands differ in their syntax.

10.1.5.1 Syntax for Common Commands

Common (=device-independent) commands consist of a header preceded by an asterisk (*) and possibly one or more parameters.

Examples:

*RST	RESET	Resets the instrument.
*ESE	EVENT STATUS ENABLE	Sets the bits of the event status enable registers.
*ESR?	EVENT STATUS QUERY	Queries the contents of the event status register.
*IDN?	IDENTIFICATION QUERY	Queries the instrument identification string.

10.1.5.2 Syntax for Device-Specific Commands

Not all commands used in the following examples are necessarily implemented in the instrument.

For demonstration purposes only, assume the existence of the following commands for this section:

- `DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`
- `FORMat:READings:DATA <type>[,<length>]`
- `HCOPy:DEVice:COLor <Boolean>`
- `HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`
- `HCOPy[:IMMediate]`
- `HCOPy:ITEM:ALL`
- `HCOPy:ITEM:LABel <string>`
- `HCOPy:PAGE:DIMensions:QUADrant[<N>]`
- `HCOPy:PAGE:ORIentation LANDscape | PORTrait`
- `HCOPy:PAGE:SCALe <numeric value>`
- `MMEMory:COPY <file_source>,<file_destination>`
- `SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
- `SENSe:FREQuency:STOP <numeric value>`
- `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`

Long and short form

The mnemonics feature a long form and a short form. The short form is marked by upper case letters, the long form corresponds to the complete word. Either the short form or the long form can be entered; other abbreviations are not permitted.

Example:

`HCOPy:DEVice:COLor ON` is equivalent to `HCOP:DEV:COL ON`.

Case-insensitivity

Upper case and lower case notation only serves to distinguish the two forms in the manual, the instrument itself is case-insensitive.

Numeric suffixes

If a command can be applied to multiple instances of an object, e.g. specific channels or sources, the required instances can be specified by a suffix added to the command. Numeric suffixes are indicated by angular brackets (<1...4>, <n>, <i>) and are replaced by a single value in the command. Entries without a suffix are interpreted as having the suffix 1.

Example:

Definition: `HCOPy:PAGE:DIMensions:QUADrant[<N>]`

Command: `HCOP:PAGE:DIM:QUAD2`

This command refers to the quadrant 2.

Different numbering in remote control

For remote control, the suffix may differ from the number of the corresponding selection used in manual operation. SCPI prescribes that suffix counting starts with 1. Suffix 1 is the default state and used when no specific suffix is specified.

Some standards define a fixed numbering, starting with 0. If the numbering differs in manual operation and remote control, it is indicated for the corresponding command.

Optional mnemonics

Some command systems permit certain mnemonics to be inserted into the header or omitted. These mnemonics are marked by square brackets in the description. The instrument must recognize the long command to comply with the SCPI standard. Some commands are considerably shortened by these optional mnemonics.

Example:

Definition: `HCOPy[:IMMediate]`

Command: `HCOP:IMM` is equivalent to `HCOP`

Optional mnemonics with numeric suffixes

Do not omit an optional mnemonic if it includes a numeric suffix that is relevant for the effect of the command.

Example:

Definition:`DISPlay[:WINDow<1...4>]:MAXimize <Boolean>`

Command: `DISP:MAX ON` refers to window 1.

In order to refer to a window other than 1, you must include the optional `WINDow` parameter with the suffix for the required window.

`DISP:WIND2:MAX ON` refers to window 2.

Parameters

Parameters must be separated from the header by a "white space". If several parameters are specified in a command, they are separated by a comma (,). For a description of the parameter types, refer to chapter 10.1.5.3, "SCPI Parameters", on page 563.

Example:

Definition:`HCOPy:DEVice:CMAP:COLor:RGB <red>,<green>,<blue>`

Command:`HCOP:DEV:CMAP:COL:RGB 3,32,44`

Special characters

|	**Parameters**
	A vertical stroke in parameter definitions indicates alternative possibilities in the sense of "or". The effect of the command differs, depending on which parameter is used.
	Example:
	Definition:`HCOPy:PAGE:ORIentation LANDscape | PORTrait`
	Command `HCOP:PAGE:ORI LAND` specifies landscape orientation
	Command `HCOP:PAGE:ORI PORT` specifies portrait orientation
	Mnemonics
	A selection of mnemonics with an identical effect exists for several commands. These mnemonics are indicated in the same line; they are separated by a vertical stroke. Only one of these mnemonics needs to be included in the header of the command. The effect of the command is independent of which of the mnemonics is used.
	Example:
	Definition`SENSE:BANDwidth|BWIDth[:RESolution] <numeric_value>`
	The two following commands with identical meaning can be created:
	`SENS:BAND:RES 1`
	`SENS:BWID:RES 1`

[ ]	Mnemonics in square brackets are optional and may be inserted into the header or omitted. **Example**: `HCOPy[:IMMediate]` `HCOP:IMM` is equivalent to `HCOP`

{ }	Parameters in curly brackets are optional and can be inserted once or several times, or omitted.
	Example: `SENSe:LIST:FREQuency <numeric_value>{,<numeric_value>}`
	The following are valid commands:
	`SENS:LIST:FREQ 10`
	`SENS:LIST:FREQ 10,20`
	`SENS:LIST:FREQ 10,20,30,40`

10.1.5.3 SCPI Parameters

Many commands are supplemented by a parameter or a list of parameters. The parameters must be separated from the header by a "white space" (ASCII code 0 to 9, 11 to 32 decimal, e.g. blank). Allowed parameters are:

- Numeric values
- Special numeric values
- Boolean parameters
- Text
- Character strings
- Block data

The parameters required for each command and the allowed range of values are specified in the command description.

Numeric values

Numeric values can be entered in any form, i.e. with sign, decimal point and exponent. Values exceeding the resolution of the instrument are rounded up or down. The mantissa may comprise up to 255 characters, the exponent must lie inside the value range -32000 to 32000. The exponent is introduced by an "E" or "e". Entry of the exponent alone is not allowed. In the case of physical quantities, the unit can be entered. Allowed unit prefixes are G (giga), MA (mega), MOHM and MHZ are also allowed), K (kilo), M (milli), U (micro) and N (nano). If the unit is missing, the basic unit is used.

Example: `SENS:FREQ:STOP 1.5GHz` = `SENS:FREQ:STOP 1.5E9`

Units

For physical quantities, the unit can be entered. Allowed unit prefixes are:

- G (giga)
- MA (mega), MOHM, MHZ
- K (kilo)
- M (milli)
- U (micro)
- N (nano)

If the unit is missing, the basic unit is used.

Example:

`SENSe:FREQ:STOP 1.5GHz` = `SENSe:FREQ:STOP 1.5E9`

Some settings allow relative values to be stated in percent. According to SCPI, this unit is represented by the `PCT` string.

Example:

```
HCOP:PAGE:SCAL 90PCT
```

Special numeric values

The texts listed below are interpreted as special numeric values. In the case of a query, the numeric value is provided.

- **MIN/MAX**
  MINimum and MAXimum denote the minimum and maximum value.
- **DEF**
  DEFault denotes a preset value which has been stored in the EPROM. This value conforms to the default setting, as it is called by the *RST command.
- **UP/DOWN**
  UP, DOWN increases or reduces the numeric value by one step. The step width can be specified via an allocated step command for each parameter which can be set via UP, DOWN.
- **INF/NINF**

INFinity, Negative INFinity (NINF) represent the numeric values 9.9E37 or -9.9E37, respectively. INF and NINF are only sent as instrument responses.

- **NAN**
  Not A Number (NAN) represents the value 9.91E37. NAN is only sent as a instrument response. This value is not defined. Possible causes are the division of zero by zero, the subtraction of infinite from infinite and the representation of missing values.

Example:

Setting command: `SENSe:LIST:FREQ MAXimum`

Query: `SENS:LIST:FREQ?, Response: 3.5E9`

Queries for special numeric values

The numeric values associated to `MAXimum/MINimum/DEFault` can be queried by adding the corresponding mnemonics to the command. They must be entered following the quotation mark.

Example: `SENSe:LIST:FREQ? MAXimum`

Returns the maximum numeric value as a result.

Boolean Parameters

Boolean parameters represent two states. The "ON" state (logically true) is represented by "ON" or a numeric value 1. The "OFF" state (logically untrue) is represented by "OFF" or the numeric value 0. The numeric values are provided as the response for a query.

Example:

Setting command: `HCOPy:DEV:COL ON`

Query: `HCOPy:DEV:COL?`

Response: `1`

Text parameters

Text parameters observe the syntactic rules for mnemonics, i.e. they can be entered using a short or long form. Like any parameter, they have to be separated from the header by a white space. In the case of a query, the short form of the text is provided.

Example:

Setting command: `HCOPy:PAGE:ORIentation LANDscape`

Query: `HCOP:PAGE:ORI?`

Response: `LAND`

Character strings

Strings must always be entered in quotation marks (' or ").

Example:

`HCOP:ITEM:LABel "Test1"` or `HCOP:ITEM:LABel 'Test1'`

Block data

Block data is a format which is suitable for the transmission of large amounts of data. A command using a block data parameter has the following structure:

Example:

`FORMat:READings:DATA #45168xxxxxxxx`

The ASCII character # introduces the data block. The next number indicates how many of the following digits describe the length of the data block. In the example the 4 following digits indicate the length to be 5168 bytes. The data bytes follow. During the transmission of these data bytes all end or other control signs are ignored until all bytes are transmitted.

#0 specifies a data block of indefinite length. The use of the indefinite format requires a `NL^END` message to terminate the data block. This format is useful when the length of the transmission is not known or if speed or other considerations prevent segmentation of the data into blocks of definite length.

10.1.5.4 Overview of Syntax Elements

The following table provides an overview of the syntax elements:

:	The colon separates the mnemonics of a command. In a command line the separating semicolon marks the uppermost command level.
;	The semicolon separates two commands of a command line. It does not alter the path.
,	The comma separates several parameters of a command.
?	The question mark forms a query.
*****	The asterisk marks a common command.
' ' **"**	Quotation marks introduce a string and terminate it (both single and double quotation marks are possible).
#	The hash symbol introduces binary, octal, hexadecimal and block data. • Binary: #B10110 • Octal: #O7612 • Hexa: #HF3A7 • Block: #21312
	A "white space" (ASCII-Code 0 to 9, 11 to 32 decimal, e.g. blank) separates the header from the parameters.

10.1.5.5 Structure of a command line

A command line may consist of one or several commands. It is terminated by one of the following:

- a <New Line>

- a <New Line> with EOI
- an EOI together with the last data byte

Several commands in a command line must be separated by a semicolon ";". If the next command belongs to a different command system, the semicolon is followed by a colon.

Example:

```
MMEM:COPY "Test1","MeasurementXY";:HCOP:ITEM ALL
```

This command line contains two commands. The first command belongs to the MMEM system, the second command belongs to the HCOP system.

If the successive commands belong to the same system, having one or several levels in common, the command line can be abbreviated. To this end, the second command after the semicolon starts with the level that lies below the common levels. The colon following the semicolon must be omitted in this case.

Example:

```
HCOP:ITEM ALL;:HCOP:IMM
```

This command line contains two commands. Both commands are part of the `HCOP` command system, i.e. they have one level in common.

When abbreviating the command line, the second command begins with the level below HCOP. The colon after the semicolon is omitted. The abbreviated form of the command line reads as follows:

```
HCOP:ITEM ALL;IMM
```

A new command line always begins with the complete path.

Example:

```
HCOP:ITEM ALL
HCOP:IMM
```

10.1.5.6 Responses to Queries

A query is defined for each setting command unless explicitly specified otherwise. It is formed by adding a question mark to the associated setting command. According to SCPI, the responses to queries are partly subject to stricter rules than in standard IEEE 488.2.

- The requested parameter is transmitted without a header.
  Example: `HCOP:PAGE:ORI?`, Response: `LAND`
- Maximum values, minimum values and all other quantities that are requested via a special text parameter are returned as numeric values.
  Example: `SENSe:FREQuency:STOP? MAX`, Response: `3.5E9`
- Numeric values are output without a unit. Physical quantities are referred to the basic units or to the units set using the `Unit` command. The response `3.5E9` in the previous example stands for 3.5 GHz.
- Truth values (Boolean values) are returned as `0` (for OFF) and `1` (for ON).

Example:
Setting command: `HCOPy:DEV:COL ON`
Query: `HCOPy:DEV:COL?`
Response: `1`

- Text (character data) is returned in a short form.
  Example:
  Setting command: `HCOPy:PAGE:ORIentation LANDscape`
  Query: `HCOP:PAGE:ORI?`
  Response: `LAND`

10.1.6 Command Sequence and Synchronization

IEEE 488.2 defines a distinction between overlapped and sequential commands:

- A sequential command is one which finishes executing before the next command starts executing. Commands that are processed quickly are usually implemented as sequential commands.
- An overlapping command is one which does not automatically finish executing before the next command starts executing. Usually, overlapping commands take longer to process and allow the program to do other tasks while being executed. If overlapping commands do have to be executed in a defined order, e.g. in order to avoid wrong measurement results, they must be serviced sequentially. This is called synchronization between the controller and the instrument.

Setting commands within one command line, even though they may be implemented as sequential commands, are not necessarily serviced in the order in which they have been received. In order to make sure that commands are actually carried out in a certain order, each command must be sent in a separate command line.

Example: Commands and queries in one message

The response to a query combined in a program message with commands that affect the queried value is not predictable.

The following commands always return the specified result:

`:FREQ:STAR 1GHZ;SPAN 100;:FREQ:STAR?`

Result:

`1000000000` (1 GHz)

Whereas the result for the following commands is not specified by SCPI:

`:FREQ:STAR 1GHz;STAR?;SPAN 1000000`

The result could be the value of `STARt` before the command was sent since the instrument might defer executing the individual commands until a program message terminator is received. The result could also be 1 GHz if the instrument executes commands as they are received.

As a general rule, send commands and queries in different program messages.

Example: Overlapping command with *OPC

The instrument implements `INITiate[:IMMediate]` as an overlapped command. Assuming that `INITiate[:IMMediate]` takes longer to execute than `*OPC`, sending the following command sequence results in initiating a sweep and, after some time, setting the `OPC` bit in the `ESR`:

```
INIT; *OPC.
```

Sending the following commands still initiates a sweep:

```
INIT; *OPC; *CLS
```

However, since the operation is still pending when the instrument executes `*CLS`, forcing it into the "Operation Complete Command Idle" State (OCIS), `*OPC` is effectively skipped. The `OPC` bit is not set until the instrument executes another `*OPC` command.

10.1.6.1 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. By suitable programming, the controller can be forced to wait for the corresponding action to occur.

Table 10-2: Synchronization using *OPC, *OPC? and *WAI

Command	Action	Programming the controller
*OPC	Sets the Operation Complete bit in the 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 is only the case after the Operation Complete bit has been set in the ESR. This bit indicates that the previous setting has been completed.	Sending *OPC? directly after the command whose processing should be terminated before other commands can be executed.
*WAI	Stops further command processing until all commands sent before *WAI have been executed.	Sending *WAI directly after the command whose processing should be terminated before other commands are executed.

Command synchronization using *WAI or *OPC? appended to an overlapped command is a good choice if the overlapped command takes only little time to process. The two synchronization techniques simply block overlapped execution of the command.

For time consuming overlapped commands it is usually desirable to 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. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Set bit no. 5 in the SRE: *SRE 32 to enable ESB service request.
3. Send the overlapped command with *OPC

4. Wait for a service request

   The service request indicates that the overlapped command has finished.

***OPC? with a service request**

1. Set bit no. 4 in the SRE: *SRE 16 to enable MAV service request.
2. Send the overlapped command with *OPC?
3. Wait for a service request

   The service request indicates that the overlapped command has finished.

Event Status Register (ESE)

1. Set the OPC mask bit (bit no. 0) in the ESE: *ESE 1
2. Send the overlapped command without *OPC, *OPC? or *WAI
3. Poll the operation complete state periodically (by means of a timer) using the sequence: *OPC; *ESR?

   A return value (LSB) of 1 indicates that the overlapped command has finished.

***OPC? with short timeout**

1. Send the overlapped command without *OPC, *OPC? or *WAI
2. Poll the operation complete state periodically (by means of a timer) using the sequence: <short timeout>; *OPC?
3. A return value (LSB) of 1 indicates that the overlapped command has finished. In case of a timeout, the operation is ongoing.
4. Reset timeout to former value
5. Clear the error queue with `SYStem:ERRor?` to remove the "-410, Query interrupted" entries.

Using several threads in the controller application

As an alternative, provided the programming environment of the controller application supports threads, separate threads can be used for the application GUI and for controlling the instrument(s) via SCPI.

A thread waiting for a *OPC? thus will not block the GUI or the communication with other instruments.

10.1.7 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 (`STATus`... commands, see chapter 11.11, "Using the Status Register", on page 956).

10.1.7.1 Hierarchy of Status Registers

As shown in the following figure, the status information is of hierarchical structure.

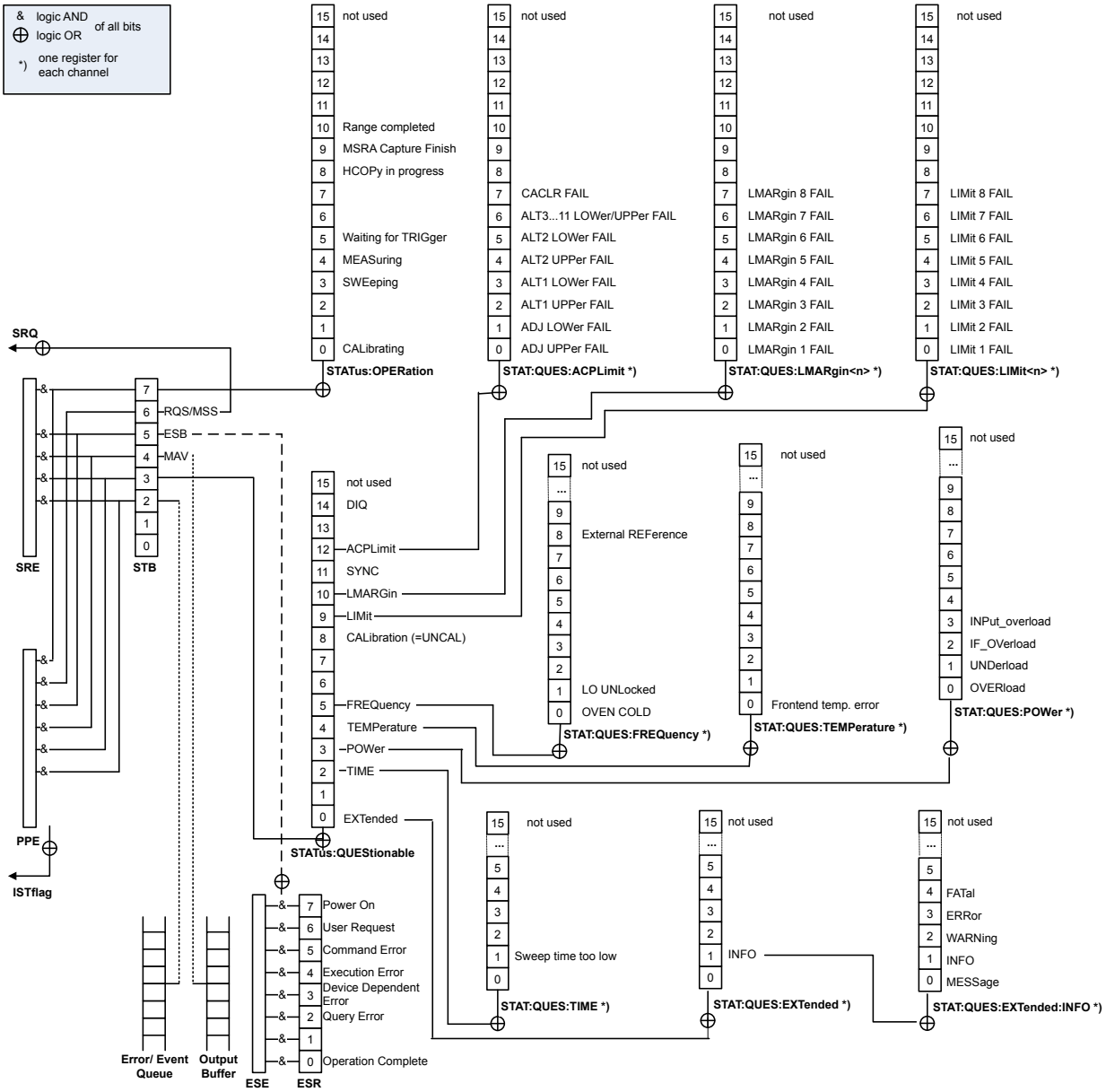


Fig. 10-1: Graphical overview of the R&S FSW status registers hierarchy

- **STB, SRE**
  The STatus Byte (`STB`) register and its associated mask register Service Request Enable (`SRE`) form the highest level of the status reporting system. The `STB` provides a rough overview of the instrument status, collecting the information of the lower-level registers.
- **ESR, SCPI registers**
  The STB receives its information from the following registers:

– The Event Status Register (ESR) with the associated mask register standard Event Status Enable (ESE).
– The STATus:OPERation and STATus:QUEStionable registers which are defined by SCPI and contain detailed information on the instrument.

- **IST, PPE**
  The IST flag ("Individual STatus"), like the SRQ, combines the entire instrument status in a single bit. The PPE fulfills the same function for the IST flag as the SRE for the service request.
- **Output buffer**
  The output buffer contains the messages the instrument returns to the controller. It is not part of the status reporting system but determines the value of the MAV bit in the STB and thus is represented in the overview.

All status registers have the same internal structure.

SRE, ESE

The service request enable register SRE can be used as ENABle part of the STB if the STB is structured according to SCPI. By analogy, the ESE can be used as the ENABle part of the ESR.

10.1.7.2 Structure of a SCPI Status Register

Each standard SCPI register consists of 5 parts. Each part has a width of 16 bits and has different functions. The individual bits are independent of each other, i.e. each hardware status is assigned a bit number which is valid for all five parts. Bit 15 (the most significant bit) is set to zero for all parts. Thus the contents of the register parts can be processed by the controller as positive integers.

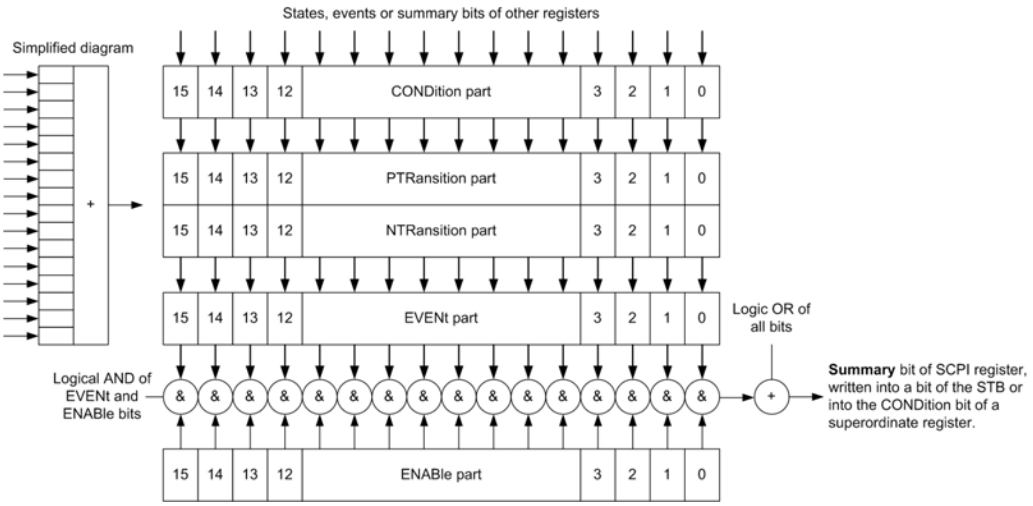


Fig. 10-2: The status-register model

Description of the five status register parts

The five parts of a SCPI register have different properties and functions:

- **CONDition**
  The CONDition part is written into directly by the hardware or the sum bit of the next lower register. Its contents reflect the current instrument status. This register part can only be read, but not written into or cleared. Its contents are not affected by reading.
- **PTRansition / NTRansition**
  The two transition register parts define which state transition of the CONDition part (none, 0 to 1, 1 to 0 or both) is stored in the EVENt part.
  The **Positive-TRansition** part acts as a transition filter. When a bit of the CONDition part is changed from 0 to 1, the associated PTR bit decides whether the EVENt bit is set to 1.
  – PTR bit =1: the EVENt bit is set.
  – PTR bit =0: the EVENt bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.
  The **Negative-TRansition** part also acts as a transition filter. When a bit of the CONDition part is changed from 1 to 0, the associated NTR bit decides whether the EVENt bit is set to 1.
  – NTR bit =1: the EVENt bit is set.
  – NTR bit =0: the EVENt bit is not set.

  This part can be written into and read as required. Its contents are not affected by reading.
- **EVENt**
  The EVENt part indicates whether an event has occurred since the last reading, it is the "memory" of the condition part. It only indicates events passed on by the transition filters. It is permanently updated by the instrument. This part can only be read by the user. Reading the register clears it. This part is often equated with the entire register.
- **ENABle**
  The ENABle part determines whether the associated EVENt bit contributes to the sum bit (see below). Each bit of the EVENt part is "ANDed" with the associated ENABle bit (symbol '&'). The results of all logical operations of this part are passed on to the sum bit via an "OR" function (symbol '+').
  ENABle bit = 0: the associated EVENt bit does not contribute to the sum bit
  ENABle bit = 1: if the associated EVENt bit is "1", the sum bit is set to "1" as well.
  This part can be written into and read by the user as required. Its contents are not affected by reading.

Sum bit

The sum bit is obtained from the EVENt and ENABle part for each register. The result is then entered into a bit of the CONDition part of the higher-order register.

The instrument automatically generates the sum bit for each register. Thus an event can lead to a service request throughout all levels of the hierarchy.

10.1.7.3 Contents of the Status Registers

In the following sections, the contents of the status registers are described in more detail.

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 10-3: 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.
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 (master 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.

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 (see "Parallel Poll" on page 584) 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?.

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 10-4: 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.
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.

STATus:OPERation Register

The `STATus:OPERation` register contains information on current activities of the R&S FSW. It also contains information on activities that have been executed since the last read out.

You can read out the register with `STATus:OPERation:CONDition?` or `STATus:OPERation[:EVENt]?`.

Table 10-5: 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 In applications, this bit is not used.
4	`MEASuring` Measurement is being performed in base unit (applications are not considered); identical to bit 3 In applications, this bit is not used.
5	`Waiting for TRIgger` Instrument is ready to trigger and waiting for trigger signal
6-7	Not used
8	`HardCOPy` in progress This bit is set while the instrument is printing a hardcopy.
9	For data acquisition in MSRA mode only: `MSRA capture finish` This bit is set if a data acquisition measurement was completed successfully in MSRA operating mode and data is available for evaluation For details on the MSRA operating mode see the R&S FSW MSRA User Manual.
10	`Range completed` This bit is set when a range in the sweep list has been completed if "Stop after Range" has been activated.
11-14	Not used
15	This bit is always 0.

STATus:QUEStionable Register

The STATus:QUEStionable register contains information on instrument states that do not meet the specifications.

The `STAT:QUES:SYNC` register is used by the applications and is thus described in the individual applications' User Manuals.

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 10-6: 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.
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.
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 FSW is unaligned ("UNCAL" display)
9	LIMit (device-specific) 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 (device-specific) 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 FSW is not synchronized to the signal that is applied. The R&S FSW is not synchronized if: • it cannot synchronize to midamble during a measurement or premeasurement • it cannot find a burst during a measurement or premeasurement • the results deviate too much from the expected value during premeasurements
12	ACPLimit (device-specific) 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.

Bit No.	Meaning
13	Unused
14	Digital I/Q (device-specific) This bit is set if a connection error occurs at the Digital Baseband Interface (R&S FSW-B17) For details see the R&S FSW I/Q Analyzer User Manual.
15	This bit is always 0.

STATus:QUEStionable:ACPLimit Register

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 10-7: 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 limit is exceeded in one of the gap (CACLR) channels.
8 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:EXTended Register

The `STATus:QUEStionable:EXTended` register contains further status information not covered by the other status registers of the R&S FSW. 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 10-8: 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.

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 FSW. 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 952.

Table 10-9: 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.

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 10-10: 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
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.

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.

You can read out the register with `STATus:QUEStionable:LIMit<n>:CONDition?` or `STATus:QUEStionable:LIMit<n>[:EVENt]?`.

Table 10-11: 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.

Bit No.	Meaning
7	LIMit 8 FAIL This bit is set if limit line 8 is violated.
8 to 14	Unused
15	This bit is always 0.

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 10-12: 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.

STATus:QUEStionable:POWer Register

The `STATus:QUEStionable:POWer` register contains information about possible overload situations that may occur during operation of the R&S FSW. 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 10-13: 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 FSW displays the keyword "RF OVLD".
1	UNDerload This bit is set if an underload occurs at the RF input. The R&S FSW displays the keyword "UNLD".
2	IF_OVerload This bit is set if an overload occurs in the IF path. The R&S FSW displays the keyword "IF OVLD".
3	Input Overload This bit is set if the signal level at the RF input connector exceeds the maximum (see chapter 6.2.1.1, "RF Input Protection", on page 275). 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 (see `INPut:ATTenuation:PROTection:RESet` on page 795). The R&S FSW displays the keyword "INPUT OVLD".
4 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:TEMPerature Register

The STATus:QUEStionable:TEMPerature register contains information about possible temperature deviations that may occur during operation of the R&S FSW. 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 10-14: 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 0. For details see "Temperature check" on page 513.
1 to 14	Unused
15	This bit is always 0.

STATus:QUEStionable:TIMe Register

The STATus:QUEStionable:TIMe register contains information about possible time errors that may occur during operation of the R&S FSW. A separate time register exists for each active channel.

You can read out the register with `STATus:QUEStionable:TIME:CONDition?` or `STATus:QUEStionable:TIME[:EVENt]?`

Table 10-15: 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 and thus calibration fails. Note: the STATus:QUEStionable bit for CALibration is not affected by this error.
2 to 14	Unused
15	This bit is always 0.

10.1.7.4 Application of the Status Reporting System

The purpose of the status reporting system is to monitor the status of one or several devices in a measuring system. To do this and react appropriately, the controller must receive and evaluate the information of all devices. The following standard methods are used:

- **Service request** (SRQ) initiated by the instrument
- **Serial poll** of all devices in the bus system, initiated by the controller in order to find out who sent a SRQ and why
- **Parallel poll** of all devices
- Query of a **specific instrument status** by means of commands
- Query of the **error queue**

Service Request

Under certain circumstances, the instrument can send a service request (SRQ) to the controller. Usually this service request initiates an interrupt at the controller, to which the control program can react appropriately. As evident from figure 10-1, an SRQ is always initiated if one or several of bits 2, 3, 4, 5 or 7 of the status byte are set and enabled in the SRE. Each of these bits combines the information of a further register, the error queue or the output buffer. The `ENABle` parts of the status registers can be set such that arbitrary bits in an arbitrary status register initiate an SRQ. In order to make use of the possibilities of the service request effectively, all bits should be set to "1" in enable registers SRE and ESE.

Use of the command *OPC to generate an SRQ at the end of a sweep

1. `CALL InstrWrite(analyzer, "*ESE 1")` 'Set bit 0 in the ESE (Operation Complete)
2. `CALL InstrWrite(analyzer, "*SRE 32")` 'Set bit 5 in the SRE (ESB)
3. `CALL InstrWrite(analyzer, "*INIT;*OPC")` ' Generate an SRQ after operation complete

   After its settings have been completed, the instrument generates an SRQ.

The SRQ is the only possibility for the instrument to become active on its own. Each controller program should cause the instrument to initiate a service request if errors occur. The program should react appropriately to the service request.

A detailed example for a service request routine can be found in chapter 11.14.1, "Service Request", on page 998.

Serial Poll

In a serial poll, just as with command `*STB`, the status byte of an instrument is queried. However, the query is realized via interface messages and is thus clearly faster.

The serial poll method is defined in IEEE 488.1 and used to be the only standard possibility for different instruments to poll the status byte. The method also works for instruments which do not adhere to SCPI or IEEE 488.2.

The serial poll is mainly used to obtain a fast overview of the state of several instruments connected to the controller.

Parallel Poll

In a parallel poll, up to eight instruments are simultaneously requested by the controller using a single command to transmit 1 bit of information each on the data lines, i.e., to set the data line allocated to each instrument to a logical "0" or "1".

In addition to the SRE register, which determines the conditions under which an SRQ is generated, there is a Parallel Poll Enable register (PPE) which is ANDed with the STB bit by bit, considering bit 6 as well. This register is ANDed with the STB bit by bit, considering bit 6 as well. The results are ORed, the result is possibly inverted and then sent as a response to the parallel poll of the controller. The result can also be queried without parallel poll using the command `*IST?`.

The instrument first has to be set for the parallel poll using the command `PPC`. This command allocates a data line to the instrument and determines whether the response is to be inverted. The parallel poll itself is executed using `PPE`.

The parallel poll method is mainly used to find out quickly which one of the instruments connected to the controller has sent a service request. To this effect, SRE and PPE must be set to the same value.

Query of an instrument status

Each part of any status register can be read using queries. There are two types of commands:

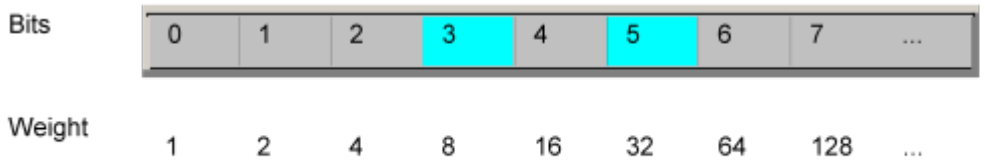
- The common commands `*ESR?`, `*IDN?`, `*IST?`, `*STB?` query the higher-level registers.
- The commands of the `STATus` system query the SCPI registers (`STATus:QUEStionable...`)

The returned value is always a decimal number that represents the bit pattern of the queried register. This number is evaluated by the controller program.

Queries are usually used after an SRQ in order to obtain more detailed information on the cause of the SRQ.

Decimal representation of a bit pattern

The STB and ESR registers contain 8 bits, the SCPI registers 16 bits. The contents of a status register are specified and transferred as a single decimal number. To make this possible, each bit is assigned a weighted value. The decimal number is calculated as the sum of the weighted values of all bits in the register that are set to 1.



Example:

The decimal value 40 = 32 + 8 indicates that bits no. 3 and 5 in the status register (e.g. the `QUEStionable` status summary bit and the `ESB` bit in the `STatus` Byte) are set.

Error Queue

Each error state in the instrument leads to an entry in the error queue. The entries of the error queue are detailed plain text error messages that can be looked up in the Error Log or queried via remote control using `SYSTem:ERRor[:NEXT]?` or `SYSTem:ERRor:ALL?`. Each call of `SYSTem:ERRor[:NEXT]?` provides one entry from the error queue. If no error messages are stored there any more, the instrument responds with 0, "No error".

The error queue should be queried after every SRQ in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

10.1.7.5 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 10-16: 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	-	-	-	-

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 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.						

10.1.8 General Programming Recommendations

Initial instrument status before changing settings

Manual operation is designed for maximum possible operating convenience. In contrast, the priority of remote control is the "predictability" of the instrument status. Thus, when a 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.

Command sequence

As a general rule, send commands and queries in different program messages. Otherwise, the result of the query may vary depending on which operation is performed first (see also chapter 10.1.6.1, "Preventing Overlapping Execution", on page 569).

Reacting to malfunctions

The service request is the only possibility for the instrument to become active on its own. Each controller program should instruct the instrument to initiate a service request in case of malfunction. The program should react appropriately to the service request.

Error queues

The error queue should be queried after every service request in the controller program as the entries describe the cause of an error more precisely than the status registers. Especially in the test phase of a controller program the error queue should be queried regularly since faulty commands from the controller to the instrument are recorded there as well.

10.2 GPIB Languages

The R&S FSW analyzer family supports a subset of the GPIB commands used by other devices. Thus it can emulate other devices in order to use existing remote control programs.

The device model to be emulated is selected manually using "SETUP > Network + Remote > GPIB tab > Language". Via the GPIB interface using the `SYSTem:LANGuage` on page 961 command.

In order to emulate device models that are not part of the selection list of the GPIB "Language" setting, you can modify the identification string received in response to the ID command ("Identification String" setting). Thus, any device model whose command set is compatible with one of the supported device models can be emulated.

Supported languages

Language	Comment
SCPI	
71100C	Compatible to 8566A/B
71200C	Compatible to 8566A/B
71209A	Compatible to 8566A/B
8560E	
8561E	
8562E	
8563E	
8564E	
8565E	
8566A	Command sets A and B are available. Command sets A and B differ in the rules regarding the command structure.
8566B	
8568A	Command sets A and B are available. Command sets A and B differ in the rules regarding the command structure.
8568A_DC	Uses DC input coupling by default if supported by the instrument

Language	Comment
8568B	Command sets A and B are available. Command sets A and B differ in the rules regarding the command structure.
8568B_DC	Uses DC input coupling by default if supported by the instrument
8591E	Compatible to 8594E
8594E	Command sets A and B are available. Command sets A and B differ in the rules regarding the command structure.
FSEA	
FSEB	
FSEM	
FSEK	
PSA89600	

Notes:

- If you select a language other than "SCPI", the GPIB address is set to 18 if it was 20 before.
- The Start/stop frequency, reference level and number of sweep points are adapted to the selected instrument model.
- When you switch between remote control languages, the following settings or changes are made:
  SCPI:
  The instrument performs a PRESET.
  8566A/B, 8568A/B, 8594E; FSEA, FSEB, FSEM; FSEK:
  – The instrument performs a PRESET.
  – The following instrument settings are changed:

Table 10-17: Instrument settings for emulation of 8566A/B, 8568A/B, 8594E; FSEA, FSEB, FSEM; FSEK instruments

Model	# of Trace Points	Start Freq.	Stop Freq.	Ref Level	Input Coupling
8566A/B	1001	2 GHz	22 GHz	0 dBm	AC
8568A/B	1001	0 Hz	1.5 GHz	0 dBm	AC
8560E	601	0 Hz	2.9 GHz	0 dBm	AC
8561E	601	0 Hz	6.5 GHz	0 dBm	AC
8562E	601	0 Hz	13.2 GHz	0 dBm	AC
8563E	601	0 Hz	26.5 GHz	0 dBm	AC
8564E	601	0 Hz	40 GHz	0 dBm	AC
8565E	601	0 Hz	50 GHz	0 dBm	AC
8594E	401	0 Hz	3 GHz	0 dBm	AC
FSEA	500	0 Hz	3.5 GHz	-20 dBm	AC

Model	# of Trace Points	Start Freq.	Stop Freq.	Ref Level	Input Coupling
FSEB	500	0 Hz	7 GHz	-20 dBm	AC
FSEM	500	0 Hz	26.5 GHz	-20 dBm	AC
FSEK	500	0 Hz	40 GHz	-20 dBm	AC

Note: The stop frequency indicated in the table may be limited to the corresponding frequency of the R&S FSW, if required.

10.3 The IECWIN Tool

The R&S FSW 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 FSW User Manuals.

Starting IECWIN

IECWIN is available from the Windows task bar on the R&S FSW, or by executing the following file:

```
C:\Program Files (x86)\Rohde-Schwarz\FSW\<1.10 or higher>\
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 FSW you want to control. If you are using the tool directly on the R&S FSW, 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.

10.4 Network and Remote Control Settings

The network and remote control settings are defined in the "Network + Remote" dialog box which is displayed when you press the SETUP key and then select "Network + Remote".

The remote commands required to define these settings are described in chapter 11.10.6, "Configuring the Network and Remote Control", on page 947.

Step-by-step instructions are provided in chapter 10.5, "How to Set Up a Network and Remote Control", on page 598.

- General Network Settings.....590
- GPIB Settings.....592
- Compatibility Settings.....594
- LXI Settings.....597

10.4.1 General Network Settings

The R&S FSW can be operated in a local area network (LAN), for example to control the instrument from a remote PC or use a network printer.

The general network settings are defined in the "Network" tab of the "Network + Remote" dialog box.

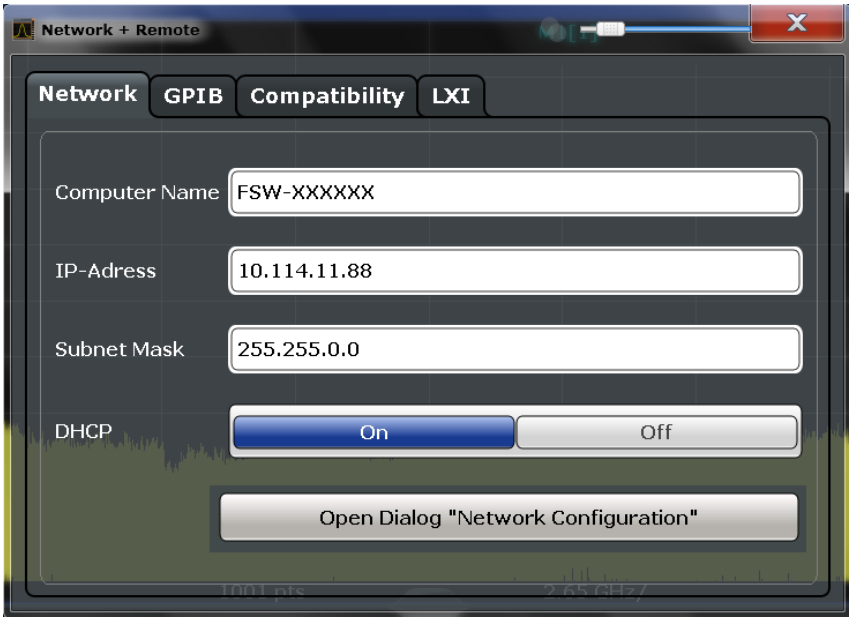
NOTICE

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 10.5.1, "How to Configure a Network", on page 599.

For step-by-step instructions see chapter 10.5, "How to Set Up a Network and Remote Control", on page 598.

For details on setting up the R&S FSW for remote control, see chapter 10.5, "How to Set Up a Network and Remote Control", on page 598.



Computer Name....591
IP Address....591
Subnet Mask....592
DHCP....592
Network Configuration....592

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.

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.

10.4.2 GPIB Settings

Alternatively to connecting the R&S FSW to a LAN, the GPIB interface can be used to connect a remote PC. For details see chapter 10.1.1.2, "GPIB Interface (IEC 625/IEEE 418 Bus Interface)", on page 557).

The GPIB settings are defined in the "GPIB" tab of the "Network + Remote" dialog box.

GPIB Address....593
Identification String....593
Reset to Factory String....593
Remote Display Update....593
GPIB Terminator....593
*IDN Format....593
I/O Logging....593

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 947

Identification String
Defines the identification string for the device which is provided as a response to the `*IDN?` query. Maximum 36 characters are allowed.

Remote command:
`SYSTem:IDENtify[:STRing]` on page 948

Reset to Factory String
Restores the default identification string. Each instrument has a unique ID according to the following syntax:

Rohde&Schwarz,FSW,<Unique number>

Remote command:
`SYSTem:IDENtify:FACTory` on page 948

Remote Display Update
Defines whether the instrument display is updated or switched off when changing from manual operation to remote control.

Remote command:
`SYSTem:DISPlay:UPDate` on page 948

GPIB Terminator
Changes the GPIB receive terminator.

According to the standard, the terminator in ASCII is <LF> and/or <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 changing the receive terminator to EOI.

Remote command:
`SYSTem:COMMunicate:GPIB[:SELF]:RTERminator` on page 948

***IDN Format**
Defines the response format to the remote command `*IDN?` (see `*IDN?` on page 620). This function is intended for re-use of existing control programs together with the R&S FSW.

"Leg" Legacy format, compatible to the R&S FSP/FSU/FSQ family

"New" R&S FSW format

Remote command:
`SYSTem:FORMat:IDENt` on page 953

I/O Logging
Activates or deactivates the SCPI error log function. All remote control commands received by the R&S FSW are recorded in the following log file:

C:\R_S\instr\ScpiLogging\ScpiLog.txt

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 930

10.4.3 Compatibility Settings

The R&S FSW can emulate the GPIB interface of other signal and spectrum analyzers, e.g. in order to use existing control applications.

Compatibility with former R&S signal and spectrum analyzers

As a rule, the R&S FSW supports most commands from previous R&S signal and spectrum analyzers such as the FSQ, FSP, FSU, or FSV. However, the default values, in particular the number of sweep points or particular bandwidths, may vary. Therefore, the R&S FSW can emulate these other devices, including their default values, in order to repeat previous measurements or support existing control applications as in legacy systems.

The required settings are configured in the "Compatibility" tab of the "Network +Remote" dialog box.

Language....595
IF Gain....595
Sweep Repeat....595
Coupling....596
Wideband....596
Revision String....596
Resetting the Factory Revision....596

Language
Defines the system language used to control the instrument.

For details on the available GPIB languages, see chapter 11.12.2, "Reference: GPIB Commands of Emulated HP Models", on page 963.

Note: Emulating previous R&S signal and spectrum analyzers. As of firmware version 1.60, this function is also used to emulate previous R&S signal and spectrum analyzers. As a rule, the R&S FSW supports most commands from previous R&S signal and spectrum analyzers such as the FSQ, FSP, FSU, or FSV. However, the default values, in particular the number of sweep points or particular bandwidths, may vary. Therefore, the R&S FSW can emulate these other devices, including their default values, in order to repeat previous measurements or support existing control applications as in legacy systems.

Note: For PSA89600 emulation, the option is indicated as "B7J" for the `*OPT?` query ("B7J, 140" or "B7J, 122" if Wideband is activated, see `SYST:PSA:WIDeband` on page 961).

Remote command:
`SYSTem:LANGuage` on page 961

IF Gain
Configures the internal IF gain settings in HP emulation mode due to the application needs. This setting is only taken into account for resolution bandwidth < 300 kHz.

NORM	Optimized for high dynamic range, overload limit is close to reference level.
PULS	Optimized for pulsed signals, overload limit up to 10 dB above reference level.

This setting is only available if an HP language is selected (see "Language" on page 595).

Remote command:
`SYSTem:IFGain:MODE` on page 960

Sweep Repeat
Controls a repeated sweep of the E1 and MKPK HI HP model commands (for details on the commands refer to chapter 11.12.2, "Reference: GPIB Commands of Emulated HP Models", on page 963). If the repeated sweep is OFF, the marker is set without sweeping before.

Note: In single sweep mode, switch off this setting before you set the marker via the E1 and MKPK HI commands in order to avoid sweeping again.

This setting is only available if a HP language is selected (see "Language" on page 595).

Remote command:
SYSTem:RSW on page 963

Coupling
Controls the default coupling ratios in the HP emulation mode for:

- span and resolution bandwidth (Span/RBW)
- resolution bandwidth and video bandwidth (RBW/VBW)

For FSx, the standard parameter coupling of the instrument is used. As a result, in most cases a shorter sweep time is used than in case of HP.

This setting is only available if a HP language is selected (see "Language" on page 595).

Remote command:
SYSTem:HPCoupling on page 960

Wideband
This setting 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.

"Off"	No wideband is used. The option is indicated as "B7J".
"40 MHz"	The 40 MHz wideband is used. The option is indicated as "B7J, 140".
"80 MHz"	The 80 MHz wideband is used. The option is indicated as "B7J, 122".

Remote command:
SYST:PSA:WIDeband on page 961

Revision String
Defines the response to the REV? query for the revision number (HP emulation only, see "GPIB Address" on page 593). Max. 36 characters are allowed.

Remote command:
SYSTem:REVision[:STRing] on page 962

Resetting the Factory Revision
Resets the response to the REV? query for the revision number to the factory default (HP emulation only, see "Language" on page 595).

Remote command:
SYSTem:REVision:FACTory on page 962

10.4.4 LXI Settings

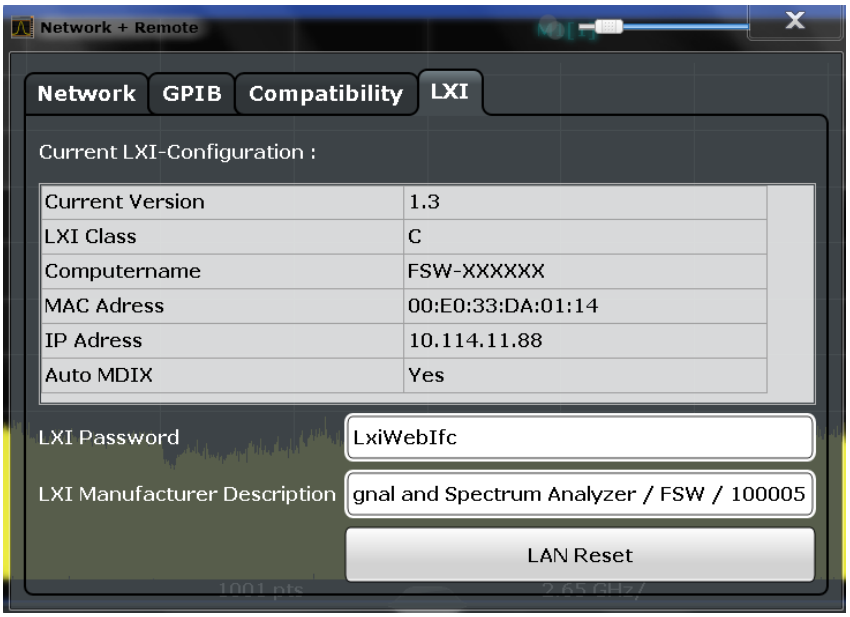
On the R&S FSW the LXI Class C functionality is already installed and enabled; thus, the instrument can be accessed via any web browser (e.g. the Microsoft Internet Explorer) to perform the following tasks:

- modifying network configurations
- modifying device configurations
- monitoring connections from the device to other devices

The "LXI" tab of the "Network + Remote" dialog box provides basic LXI functions and information for the R&S FSW.

Alternatively, you can change the LAN settings using the LXI Web browser interface, see chapter 10.5.1.4, "How to Configure the LAN Using the LXI Browser Interface", on page 602.

Only user accounts with administrator rights are able to use LXI functionality.



Current LXI Configuration....597
LXI Password....598
LXI Manufacturer Description....598
LAN Reset....598

Current LXI Configuration
Displays the current LXI information from the R&S FSW (read-only).

"Current version"	Current LXI version
"LXI Class"	LXI device class
"Computer name"	Name of the R&S FSW as defined in the operating system (see also "Computer Name" on page 591)

"MAC address" Media Access Control address (MAC address), a unique identifier for the network card in the R&S FSW

"IP address" IP address of the R&S FSW as defined in the operating system (see also "IP Address" on page 591).

"Auto MDIX" Enables the use of the built-in Auto-MDI(X) Ethernet functionality.

Remote command:
SYSTem:LXI:INFo? on page 949

LXI Password
Password for LAN configuration. The default password is *LxiWebIfc*.

Remote command:
SYSTem:LXI:PASSword on page 949

LXI Manufacturer Description
Instrument description of the R&S FSW

Remote command:
SYSTem:LXI:MDEScription on page 949

LAN Reset
Resets the LAN configuration to its default settings (LCI function).

According to the LXI standard, an LCI must set the following parameters to a default state.

Parameter	Value
TCP/IP Mode	DHCP + Auto IP Address
Dynamic DNS	Enabled
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 LXI Browser interface.

Remote command:
SYSTem:LXI:LANReset on page 949

10.5 How to Set Up a Network and Remote Control

NOTICE

Risk of network failure

Before connecting the instrument to the network or configuring the network, consult your network administrator. Errors may affect the entire network.

Remote operation

Remote operation of the instrument from a connected computer is possible using SCPI commands (see chapter 10.1.2, "SCPI (Standard Commands for Programmable Instruments)", on page 558). Sending remote commands requires the instrument to be configured in a LAN network or connected to a PC via the GPIB interface as described in chapter 10.5.1, "How to Configure a Network", on page 599.

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 FSW 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 FSW. For details refer to the Windows operating system documentation.

10.5.1 How to Configure a Network

A precondition for operating or monitoring the R&S FSW remotely is that it is connected to a LAN network or a PC connected to the GPIB interface. This is described here.

Windows Firewall Settings

A firewall protects an instrument by preventing unauthorized users from gaining access to it through a network. Rohde & Schwarz highly recommends the use of the firewall on your instrument. R&S instruments are shipped with the Windows firewall enabled and preconfigured in such a way that all ports and connections for remote control are enabled. For more details on firewall configuration see the R&S White Paper "Malware Protection" (available at http://www.rohde-schwarz.com/appnote/1EF73) and the Windows help system.

10.5.1.1 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 is directly connected to the instrument. The use of hubs, switches, or gateways is not required, however, data transfer is still

performed using the TCP/IP protocol. An IP address has to be assigned to the instrument and the computer, see chapter 10.5.1.2, "How to Assign the IP Address", on page 600.
Note: As the R&S FSW uses a 1 GBit LAN, a crossover cable is not necessary (due to Auto-MDI(X) functionality).

► 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.

10.5.1.2 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. This means that it is safe to establish a physical connection to the LAN without any previous instrument configuration.

NOTICE

Risk of network errors

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

Assigning the IP address on the R&S FSW

1. Press the SETUP key.
2. Press the "Network + Remote" softkey.
3. Select the "Network" tab.
4. In the "Network + Remote" dialog, toggle the "DHCP On/Off" setting to the required mode.
If DHCP is "Off", you must enter the IP address manually, as described in the following steps.

Note: When DHCP is changed from "On" to "Off", the previously set IP address and subnet mask are retrieved.
If DHCP is "On", the IP address of the DHCP server is obtained automatically. The configuration is saved, and you are prompted to restart the instrument. You can skip the remaining steps.
Note: When a DHCP server is used, a new IP address may be assigned each time the instrument is restarted. This address must first be determined on the instrument itself. Thus, when using a DHCP server, it is recommended that you use the permanent computer name, which determines the address via the DNS server.

5. Enter the "IP Address", for example *10.0.0.10*. The IP address consists of four number blocks separated by dots. Every block contains 3 numbers in maximum.
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 3 numbers in maximum.
7. Close the dialog box.

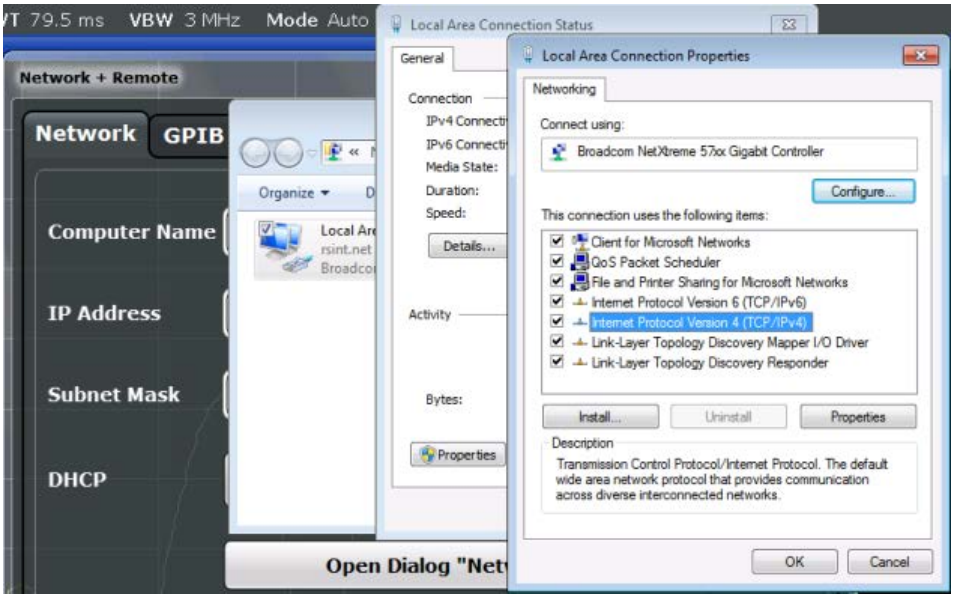
   If you have entered an invalid IP address or subnet mask, the message "out of range" is displayed in the status line. If the settings are correct, the configuration is saved, and you are prompted to restart the instrument.
8. Confirm the displayed message ("Yes" button) to restart the instrument.

Using a DNS server to determine the IP address

If a DNS server is configured on the R&S FSW, 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 10.5.1.3, "How to Change the Instrument Name", on page 602).
2. Press the SETUP key and then the "Network + Remote" softkey.
3. In the "Network" tab, select the "Open Dialog 'Network Connections'" button.
4. Double-tap the "Local Area Network" icon.
5. In the "Local Area Connection Status" dialog box, select the "Properties" button.

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



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

   For more information refer to the Windows operating system Help.

10.5.1.3 How to Change the Instrument Name

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

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

To change the computer name

1. Press the SETUP key and then the "Network + Remote" softkey.
   The current "Computer Name" is displayed in the "Network" tab.
2. Enter the new computer name and close the dialog box.

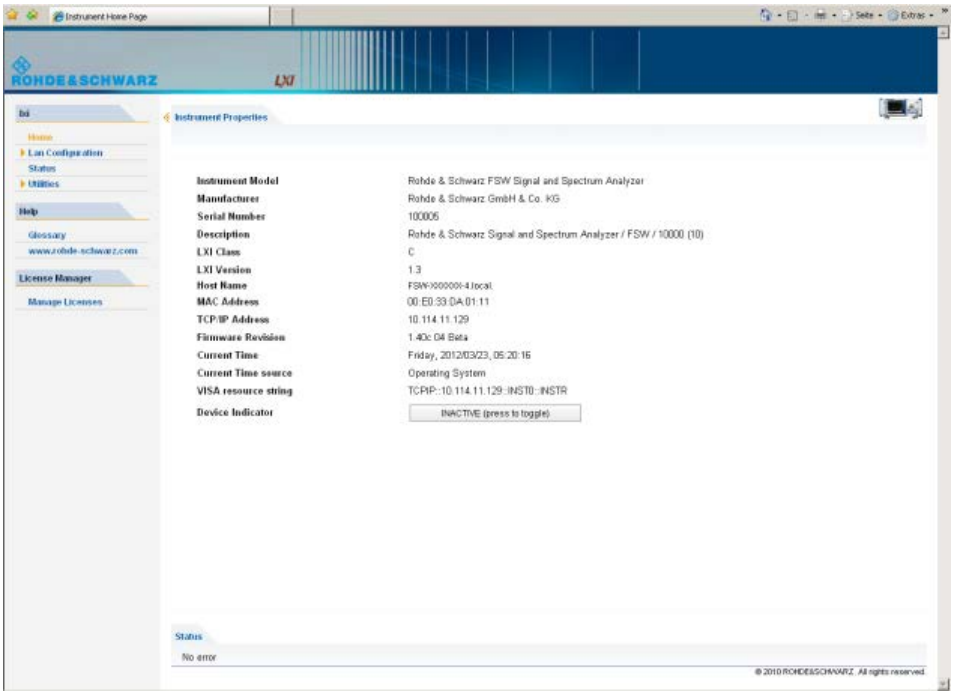
   The configuration is saved, and you are prompted to restart the instrument.
3. Confirm the displayed message ("Yes" button) to restart the instrument.

10.5.1.4 How to Configure the LAN Using the LXI Browser Interface

The instrument's LXI 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 the device information required by the LXI standard including the VISA resource string in read-only format.

► Press the "Device Indicator" button on the "Instrument Home Page" to activate or deactivate the LXI status icon on the status bar of the R&S FSW. A green LXI status symbol indicates that a LAN connection has been established; a red symbol indicates an error, for example, that no LAN cable is connected. When a device is connecting to the instrument, the LXI logo blinks. The "Device Indicator" setting is not password-protected.

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 LXI status of the instrument.
- "Help > Glossary" opens a document with a glossary of terms related to the LXI standard.

LAN Configuration

The LAN configuration consists of three parts:

- "IP configuration" provides all mandatory LAN parameters.

- "Advanced LAN Configuration" provides LAN settings that are not declared mandatory by the LXI standard.
- "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 10.5.1.2, "How to Assign the IP Address", on page 600). 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 *LxiWeblfc* (notice upper and lower case characters).

You can change the LXI password in the "Network + Remote" dialog box, see chapter 10.4.4, "LXI Settings", on page 597.

Advanced LAN Configuration

The "LAN Configuration > Advanced LAN Configuration" parameters are used as follows:

- The "Negotiation" configuration field provides different Ethernet speed and duplex mode settings. In general, the "Auto Detect" mode is sufficient.
- "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. According to the standard, LXI devices must use VXI-11 to provide a detection mechanism; other additional detection mechanisms are permitted.
- 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

Ping Client

Ping is a utility that verifies the connection between the LXI-compliant 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 LXI-compliant 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".

10.5.1.5 How to Change the GPIB Instrument Address

In order 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 FSW, 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
```

10.5.2 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 "Reactivating the automatic login mechanism" on page 607.

10.5.3 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 administrator account, i.e. login with unrestricted access is carried out automatically in the background. By default, the user name for the administrator account is "Instrument", and the user name for the standard user account is "NormalUser". 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). Refer to chapter 9, "General Instrument Setup", on page 512 to find out which functions are affected.

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.

10.5.3.1 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 automatic login) in the network. Thus, a matching user must be created in the R&S FSW and in the network, the password must be adapted to the network password, and the automatic login mechanism must then be deactivated.

The network administrator is responsible for creating new users in the network. A new user can be created on the instrument using the "User Account" dialog box:

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. In the "Start" menu, select "Control Panel" and then select "User Accounts."
3. Select "Give other users access to this computer" and then "Add".
   The "Add New User" dialog box is displayed.
4. Enter the name of the new user in the text field and select "Next".
5. Define the level of access you want to allow the new user:
   - Select "Standard" to create an account with limited rights.
   - Select "Administrator" to create an account with administrator rights.

   Note: Full firmware functionality requires administrator rights.
6. Select the "Finish" button.
   The new user is created.

10.5.3.2 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. This is also done using the "User Accounts" dialog box.

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 in the upper text line and repeat it in the following line.
6. Press ENTER.
   The new password is now active.

10.5.3.3 How to Activate or Deactivate the Automatic Login Mechanism

Deactivating the automatic login mechanism

When shipped, the instrument is already configured to automatically log on under Windows. To deactivate the automatic login mechanism, perform the following steps:

1. In the "Start" menu, select "Run".
   The "Run" dialog box is displayed.
2. Enter the command `C:\R_S\INSTR\USER\NO_AUTOLOGIN.REG`.
3. Press the ENTER key to confirm.
   The automatic login mechanism is deactivated. The next time you switch on the instrument, you are prompted to enter your user name and password before the firmware is started.

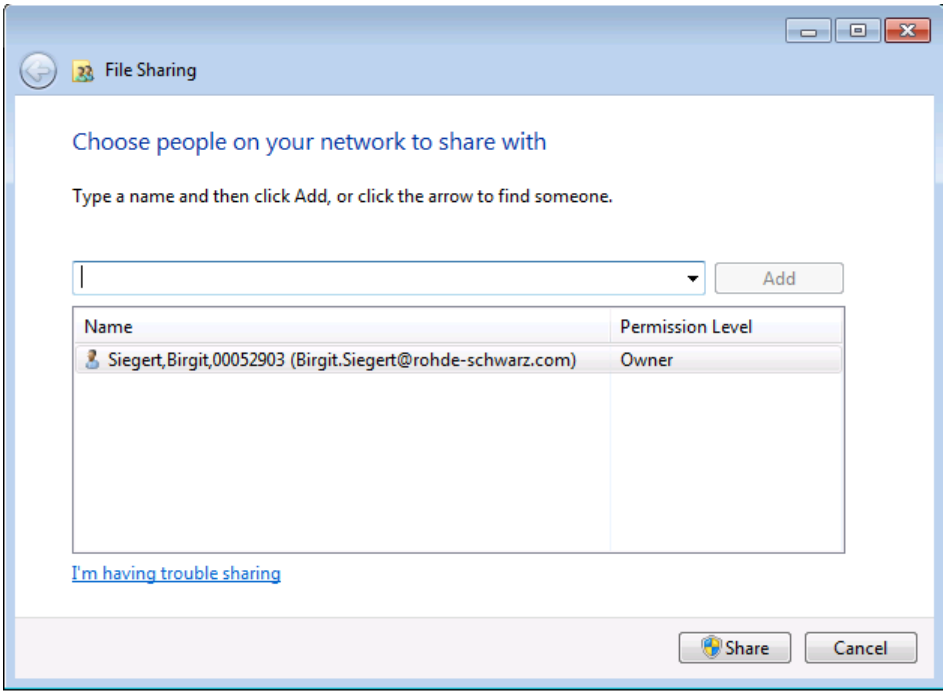
Reactivating the automatic login mechanism

1. In the "Start" menu, select "Run".
   The "Run" dialog box is displayed.
2. Enter the command `C:\R_S\INSTR\USER\AUTOLOGIN.REG`.
3. Press the ENTER key to confirm.
   The automatic login mechanism is reactivated. It will be applied the next time the instrument is switched on.

10.5.4 How to Share Directories (only with Microsoft Networks)

Sharing directories makes data available for other users. This is only possible in Microsoft networks. Sharing is a property of a file or directory.

1. In the "Start" menu, select "Programs", "Accessories" and then select "Windows Explorer".
2. Select the desired folder with the right mouse button.
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 and select the "Add" button.
5. Select the "Share" button.
6. Select "Done" to close the dialog box.
   The drive is shared and can be accessed by the selected users.

10.5.5 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 FSW is possible.

With Windows7, Remote Desktop Client is part of the operating system. For other versions of Windows, Microsoft offers the Remote Desktop Client as an add-on.

This section provides basic instructions on setting up the Remote Desktop for the R&S FSW. For details refer to the Windows operating system documentation.

10.5.5.1 How to Configure the R&S FSW for Remote Operation via Remote Desktop

1. Create a fixed IP address for the TCP/IP protocol as described in "Assigning the IP address on the R&S FSW" on page 600.

   Note: To avoid problems, use a fixed IP address.

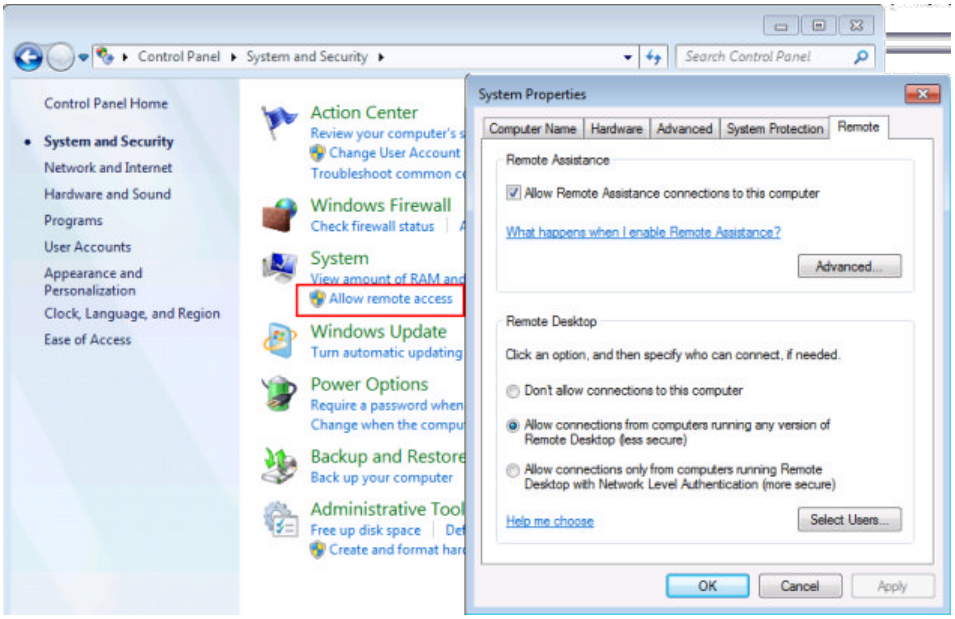
When a DHCP server is used, a new IP address is assigned each time the instrument is restarted. This address must first be determined on the instrument itself. Thus, using a DHCP server is not suitable for remote operation of the R&S FSW via Remote Desktop.

2.

   Select the "Windows" icon in the toolbar to access the operating system.

3. In the "Start" menu, select the "Control Panel" and then "System and Security".

4. In the "System" area, select "Allow remote access".



5. In the "Remote" tab, in the "Remote Desktop" area, activate the "Allow connections from computers running Remote Desktop" option.

6. Define which users are to be given access to the R&S FSW via Remote Desktop.
   Note: The user account under which configuration is carried out is automatically enabled for Remote Desktop.

   a) Select the "Select Users" button.
   b) Select the users or create new user accounts as described in chapter 10.5.3.1, "How to Create Users", on page 606.
   c) Select "OK" to confirm the settings.

7. The R&S FSW is now ready for connection setup with the Remote Desktop program of the controller.

10.5.5.2 How to Add or Remove Users to the Remote Desktop Users Group

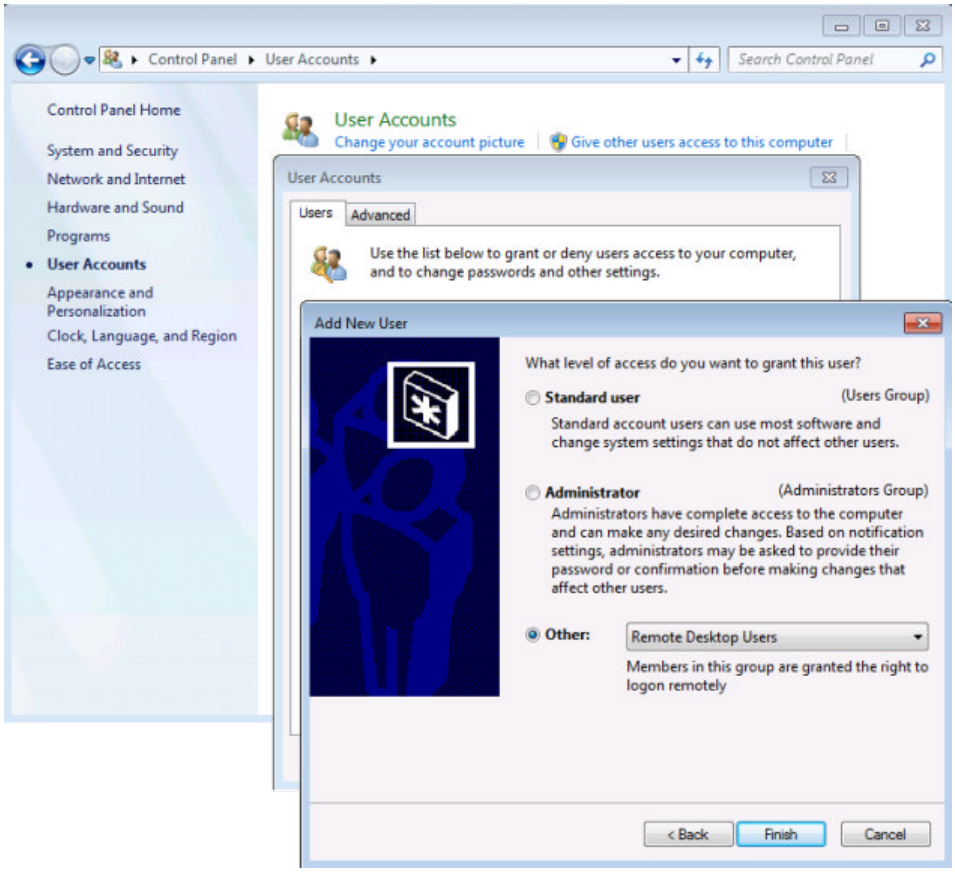
Only users in the Remote Desktop Users Group are allowed to connect to the R&S FSW via Remote Desktop. You can add the users to this group directly when you allow remote

access on the R&S FSW, as described in chapter 10.5.5, "How to Set Up Remote Desktop", on page 608. Furthermore, you can add or remove users to this group at any time.

1.

   Select the "Windows" icon in the toolbar to access the operating system.
2. In the "Start" menu, select "Control Panel" and then select "User Accounts."
3. Select "Give other users access to this computer".
   The "User Accounts" dialog box is displayed with a list of users and the user group they are assigned to.
4. Give existing users the right to access the R&S FSW via Remote Desktop:
   a) Select the user from the list and then select the "Properties" button.
   b) As the level of access you want to allow the user, select "Other", then select "Remote Desktop Users" from the dropdown list.
   c) Select the "Finish" button.
   The user is added to the Remote Desktop Users Group.
5. Create new users who may access the R&S FSW via Remote Desktop:
   a) Select "Add".
   b) Enter the name of the new remote user in the text field and select "Next".

c) As the level of access you want to allow the new user, select "Other", then select "Remote Desktop Users" from the dropdown list.



d) Select the "Finish" button.
The user is created.

6. Remove users from the Remote Desktop Users Group:

   a) Select the user from the list and then select the "Remove" button.
   b) Select "OK" to confirm the action.

   Note: Users with administrator rights retain their access rights via Remote Desktop even when they have been removed from the Remote Desktop Users Group.

7. Select "OK" to close the dialog box.

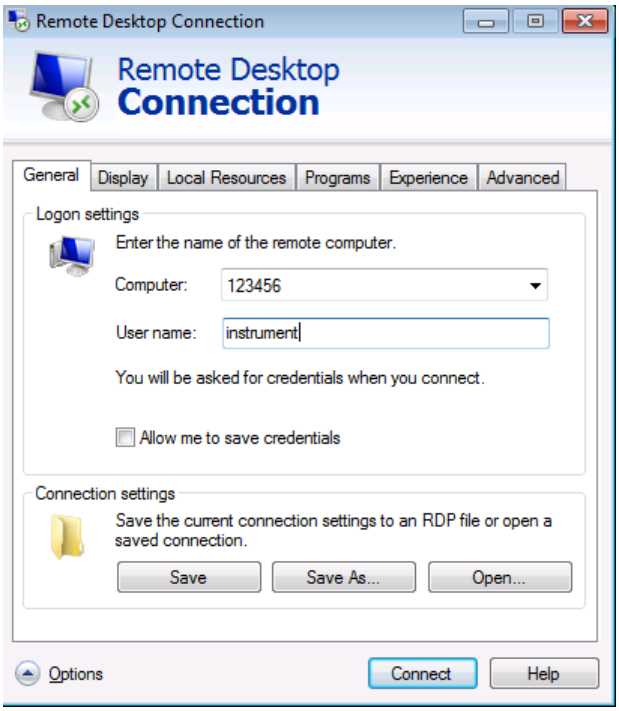
10.5.5.3 How to Configure the Controller

Remote Desktop Client

With Windows7, 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. In the "Start" menu of the controller, select "All Programs > Accessories > Remote Desktop Connection".
   The "Remote Desktop Connection" dialog box is displayed.
2. Select the "Options >>" button.
   The dialog box is expanded to display the configuration data.



3. Open the "Experience" tab.
   The settings on this tab are used to select and optimize the connection speed.
4. 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.
5. To improve the performance, you can deactivate the "Desktop background", "Show window contents while dragging" and "Menu and window animation" options.
6. Open the "Local Resources" tab to enable printers, local drives and serial interfaces.
7. If you will need to access drives of the controller from the R&S FSW (e.g. in order to store settings or to copy files from the controller to the R&S FSW), activate the "Disk drives" option.
   Windows will then map drives of the controller to the corresponding network drives.
8. To use printers connected to the controller while accessing them from the R&S FSW, activate the "Printers" options. Do not change the remaining settings.
9. Open the "Display" tab.
   The options to configure the R&S FSW screen display are displayed.

10. Under "Remote desktop size", you can set the size of the R&S FSW window on the desktop of the controller.
11. Under "Colors", do not change the settings.
12. 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 FSW will appear 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 FSW screen in full screen mode is to select "Disconnect" from the "Start" menu.

10.5.5.4 How to Start and Close the Remote Desktop

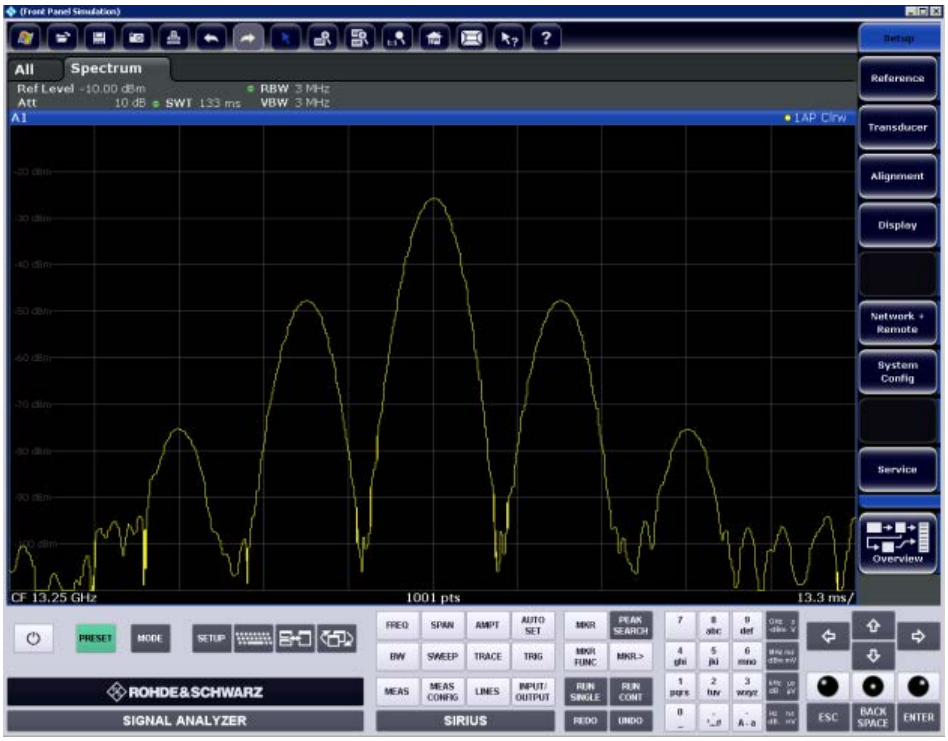
To set up a connection to the R&S FSW

1. In the "Remote Desktop Connection" dialog box (see chapter 10.5.5.3, "How to Configure the Controller", on page 611), open the "General" tab.
2. In the "Computer" field, enter the IP address of the R&S FSW.
   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 the "Save As" button.
      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 the "Open" button.
      The "Open" dialog box is displayed.
   b) Select the `*.RDP` file.
5. Select the "Connect" button.
   The connection is set up.
6. If the "Disk drives" option is activated on the "Local Resources" tab, a warning is displayed indicating that the drives are enabled for access from the R&S FSW. Select "OK" to confirm the warning.
7. After a few moments, the R&S FSW screen is displayed.
   If a dark screen appears or a dark square appears in the upper left-hand corner of the screen, you must restart the R&S FSW in order to see the modified screen resolution.

	• Press the key combination ALT + F4. • The R&S FSW firmware is shut down, which may take a few seconds. • On the desktop, double-tap the "Analyzer" icon.

The firmware restarts and then automatically opens the "Soft Front Panel", i.e. the user interface on which all front panel controls and the rotary knob are mapped to buttons. For details see chapter 9.6.7, "How to Work with the Soft Front Panels", on page 551.

8. To deactivate or activate the "Softfrontpanel", press the F6 key.
   After the connection is established, the R&S FSW screen is displayed in the "Remote Desktop" application window.



   The Windows "Start" menu can be made available by expanding the "Remote Desktop" window to full size.
   During the connection with the controller, the login entry is displayed on the R&S FSW screen.

To terminate Remote Desktop control

The connection can be terminated by the controller or by a user at the R&S FSW:

1. On the controller, close the "Remote Desktop" window at any time.
   The connection to the R&S FSW is terminated.
2. On the R&S FSW, a user logs on.
   The connection to the controller is terminated as a result. 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 FSW

Follow the instructions above for setting up a connection to the R&S FSW. If the connection is terminated and then restored, the R&S FSW remains in the same state.

10.5.5.5 How to Shut Down the R&S FSW via Remote Operation

1. Select the R&S FSW softfrontpanel and close the application with the key combination ALT + F4.
2. Select the desktop and 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.
3. Respond to the safety query with "Yes".
   The connection with the controller is terminated and the R&S FSW is shut down.

10.5.6 How to Start a Remote Control Session from a PC

When you switch on the instrument, 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 948).

   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 FSW 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 on the power-save mode for the display. For more details on this mode refer to the "Overview".

10.5.7 How to Return to Manual Operation

Before you switch back to manual operation, all remote command processing must be completed. Otherwise, the instrument will switch back to remote control immediately.

► Select the "Local" softkey or the PRESET key, or use the following GPIB command:
`status = viGpibControlREN(vi, VI_GPIB_REN_ADDRESS_GTL)`

11 Remote Commands

The commands required to perform measurements in the Spectrum application in a remote environment are described here. It is assumed that the R&S FSW has already been set up for remote operation in a network as described in chapter 10.5, "How to Set Up a Network and Remote Control", on page 598.

Compatibility with former R&S signal and spectrum analyzers

As a rule, the R&S FSW supports most commands from previous R&S signal and spectrum analyzers such as the FSQ, FSP, FSU, or FSV. However, the default values, in particular the number of sweep points or particular bandwidths, may vary. Therefore, the R&S FSW can emulate these other devices, including their default values, in order to repeat previous measurements or support existing control applications as in legacy systems.

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11.1 Conventions used in SCPI Command Descriptions

Note the following conventions 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 explicitely.
- **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 FSW 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.
- **Manual operation**
  If the result of a remote command can also be achieved in manual operation, a link to the description is inserted.

11.2 Common Suffixes

In the Spectrum application, the following common suffixes are used in remote commands:

Suffix	Value range	Description
<ch>	1..18 (TX channel) 1..11 (ALT channel)	Channel
<k>	1..8 (Limit line) 1 | 2 (Display line)	Line
<m>	1..16	Marker
<n>	1..16	Window
<t>	1..6	Trace

11.3 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?....619
*CLS....619
*ESE....619
*ESR?....619
*IDN?....620
*IST?....620

*OPC....620
*OPT?....620
*PCB....621
*PRE....621
*PSC....621
*RST....621
*SRE....622
*STB?....622
*TRG....622
*TST?....622
*WAI....622

***CAL?**

Calibration Query

Initiates a calibration of the instrument and subsequently queries the calibration status. Responses > 0 indicate errors.

Usage: Query only

Manual operation: See "Starting a Self-alignment" on page 523

***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 subsequently 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>,<serial number>,<firmware version>"

Example: `Rohde&Schwarz,FSW-26,1312.8000K26/100005,1.30`

Usage: Query only

Manual operation: See "*IDN Format" on page 593

***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 form writes a "1" into the output buffer as soon as all preceding commands have been executed. This is used 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 CD-ROM.

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
For PSA89600 emulation, the option is indicated as "B7J" for the `*OPT?` query ("B7J, 140" if `SYST:PSA:WIDeband` is activated).

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`.

Note that the factory set default values can be modified to user-defined settings (see `MMEMory:LOAD:STATe` on page 916). For more details on default values see chapter 8.1, "Restoring the Default Instrument Configuration (Preset)", on page 489.

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 (Manual Trigger). This common command complements the commands of the `TRIGger` subsystem.

`*TRG` corresponds to the `INITiate:IMMediate` command (see `INITiate[:IMMediate]` on page 635).

Usage: Event

***TST?**

self TeST query

Triggers selftests of the instrument and returns an error code in decimal form (see Service Manual supplied with the instrument). "0" indicates no errors occured.

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

11.4 Selecting the Operating Mode and Application

The following commands are required to select the operating mode or the application and to configure a Sequencer in a remote environment. The tasks for manual operation are described in chapter 4, "Applications and Operating Modes", on page 88.

- Selecting the Mode and Applications....623
- Performing a Sequence of Measurements....628
- Programming Example: Performing a Sequence of Measurements....630

11.4.1 Selecting the Mode and Applications

DISPlay:ATAB....623
INSTrument:CREate:DUPLicate....623
INSTrument:CREate[:NEW]....624
INSTrument:CREate:REPLace....624
INSTrument:DELete....625
INSTrument:LIST?....625
INSTrument:MODE....626
INSTrument:REName....626
INSTrument[:SELect]....627

DISPlay:ATAB <State>

This command switches between the MultiView tab and the most recently displayed measurement channel.

Parameters:

<State> ON | OFF

ON
The MultiView tab is displayed.

OFF
The most recently displayed measurement channel is displayed.

*RST: OFF

INSTrument:CREate:DUPLicate

This command duplicates the currently selected measurement channel, i.e starts a new measurement channel of the same type and with the identical measurement settings. The name of the new channel is the same as the copied channel, extended by a consecutive number (e.g. "Spectrum" -> "Spectrum 2").

The channel to be duplicated must be selected first using the `INST:SEL` command.

This command is not available if the MSRA Master channel is selected.

Example:

```
INST:SEL 'Spectrum'
INST:CRE:DUPL
```

Duplicates the channel named 'Spectrum' and creates a new measurement channel named 'Spectrum 2'.

Usage: Event

Manual operation: See "Duplicate Current Channel" on page 96

INSTrument:CREate[:NEW] <ChannelType>, <ChannelName>

This command adds an additional measurement channel. The number of measurement channels you can configure at the same time depends on available memory.

See also

- `INSTrument[:SELect]` on page 627
- `INSTrument:DELete` on page 625

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see table 11-1.

<ChannelName> String containing the name of the channel. The channel name is displayed as the tab label for the measurement channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see table 11-1).

Example:
```
INST:CRE SAN, 'Spectrum 2'
```
Adds an additional spectrum display named "Spectrum 2".

Manual operation: See "New Channel" on page 96

INSTrument:CREate:REPLace <ChannelName1>,<ChannelType>,<ChannelName2>

This command replaces a measurement channel with another one.

Parameters:

<ChannelName1> String containing the name of the measurement channel you want to replace.

<ChannelType> Channel type of the new channel.
For a list of available channel types see table 11-1.

<ChannelName2> String containing the name of the new channel.
Note: If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel (see table 11-1).

Example:
```
INST:CRE:REPL 'Spectrum2',IQ,'IQAnalyzer'
```
Replaces the channel named 'Spectrum2' by a new measurement channel of type 'IQ Analyzer' named 'IQAnalyzer'.

Manual operation: See "Replace Current Channel" on page 96

INSTrument:DELete <ChannelName>

This command deletes a measurement channel. If you delete the last measurement channel, the default "Spectrum" channel is activated.

Parameters:

<ChannelName> String containing the name of the channel you want to delete.
A measurement channel must exist in order to be able delete it.

Example: `INST:DEL 'Spectrum4'`
Deletes the spectrum channel with the name 'Spectrum4'.

INSTrument:LIST?

This command queries all active measurement channels. This is useful in order to obtain the names of the existing measurement channels, which are required in order to replace or delete the channels.

Return values:

<ChannelType>, <ChannelName> For each channel, the command returns the channel type and channel name (see table 11-1).
Tip: to change the channel name, use the `INSTrument:REName` command.

Example: `INST:LIST?`
Result for 3 measurement channels:
`'ADEM','Analog Demod','IQ','IQ Analyzer','SANALYZER','Spectrum'`

Usage: Query only

Table 11-1: Available measurement channel types and default channel names

Application	<ChannelType> Parameter	Default Channel Name*)
Spectrum	SANALYZER	Spectrum
I/Q Analyzer	IQ	IQ Analyzer
Pulse (R&S FSW-K6)	PULSE	Pulse
Analog Demodulation (R&S FSW-K7)	ADEM	Analog Demod
GSM (R&S FSW-K10)	GSM	GSM
Multi-Carrier Group Delay (R&S FSW-K17)	MCGD	MC Group Delay
Noise (R&S FSW-K30)	NOISE	Noise
Phase Noise (R&S FSW-K40)	PNOISE	Phase Noise
VSA (R&S FSW-K70)	DDEM	VSA
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

Application	<ChannelType> Parameter	Default Channel Name*)
3GPP FDD BTS (R&S FSW-K72)	BWCD	3G FDD BTS
3GPP FDD UE (R&S FSW-K73)	MWCD	3G FDD UE
TD-SCDMA BTS (R&S FSW-K76)	BTDS	TD-SCDMA BTS
TD-SCDMA UE (R&S FSW-K77)	MTDS	TD-SCDMA UE
cdma2000 BTS (R&S FSW-K82)	BC2K	CDMA2000 BTS
cdma2000 MS (R&S FSW-K83)	MC2K	CDMA2000 MS
1xEV-DO BTS (R&S FSW-K84)	BDO	1xEV-DO BTS
1xEV-DO MS (R&S FSW-K85)	MDO	1xEV-DO MS
WLAN (R&S FSW-K91)	WLAN	WLAN
LTE (R&S FSW-K10x)	LTE	LTE
Note: the default channel name is also listed in the table. If the specified name for a new channel already exists, the default name, extended by a sequential number, is used for the new channel.		

INSTrument:MODE <OpMode>

The operating mode of the R&S FSW determines which applications are available and active. Whenever you change the operating mode, the currently active measurement channels are stored. The default operating mode is Signal and Spectrum Analyzer mode, however, the presetting can be changed.

For details on operating modes and applications see chapter 4, "Applications and Operating Modes", on page 88.

Parameters:

<OpMode> SANalyzer | MSRanalyzer

Example: `INST:MODE MSR`
Switches to MSRA mode.

Usage: SCPI confirmed

INSTrument:REName <ChannelName1>, <ChannelName2>

This command renames a measurement channel.

Parameters:

<ChannelName1> String containing the name of the channel you want to rename.

<ChannelName2> String containing the new channel name.
Note that you can not assign an existing channel name to a new channel; this will cause an error.

Example: `INST:REN 'Spectrum2','Spectrum3'`
Renames the channel with the name 'Spectrum2' to 'Spectrum3'.

INSTrument[:SELect] <ChannelType> | <ChannelName>

This command activates a new measurement channel with the defined channel type, or selects an existing measurement channel with the specified name.

Also see

- `INSTrument:CREate[:NEW]` on page 624
- chapter 11.4.3, "Programming Example: Performing a Sequence of Measurements", on page 630

Parameters:

<ChannelType> Channel type of the new channel.
For a list of available channel types see table 11-1.

<ChannelName> String containing the name of the channel.

Example: `INST SAN`
Activates a measurement channel for the Spectrum application.
`INST 'MySpectrum'`
Selects the measurement channel named 'MySpectrum' (for example before executing further commands for that channel).

Usage: SCPI confirmed

Manual operation: See "Spectrum" on page 90
See "1xEV-DO BTS" on page 90
See "1xEV-DO MS" on page 91
See "3G FDD BTS" on page 91
See "3G FDD UE" on page 91
See "Analog Demodulation" on page 91
See "cdma2000 BTS" on page 91
See "cdma2000 MS" on page 91
See "(Multi-Carrier) Group Delay" on page 92
See "GSM" on page 92
See "I/Q Analyzer" on page 92
See "LTE" on page 92
See "Noise Figure" on page 92
See "Phase Noise" on page 92
See "Pulse Measurements" on page 93
See "TD-SCDMA BTS" on page 93
See "TD-SCDMA UE" on page 93
See "Vector Signal Analysis (VSA)" on page 93
See "WLAN" on page 93
See "New Channel" on page 96

11.4.2 Performing a Sequence of Measurements

The following commands control the sequencer.

For details on the Sequencer see chapter 4.5.1, "The Sequencer Concept", on page 96.

INITiate:SEQuencer:ABORt....628
INITiate:SEQuencer:IMMediate....628
INITiate:SEQuencer:MODE....628
SYSTem:SEQuencer....629

INITiate:SEQuencer:ABORt

This command stops the currently active sequence of measurements. The Sequencer itself is not deactivated, so you can start a new sequence immediately using `INITiate:SEQuencer:IMMediate` on page 628.

To deactivate the Sequencer use `SYSTem:SEQuencer` on page 629.

Usage: Event

Manual operation: See "Sequencer State" on page 98

INITiate:SEQuencer:IMMediate

This command starts a new sequence of measurements by the Sequencer. Its effect is similar to the `INITiate[:IMMediate]` command used for a single measurement.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 629).

Example:
```
SYST:SEQ ON
```
Activates the Sequencer.
```
INIT:SEQ:MODE SING
```
Sets single sequence mode so each active measurement will be performed once.
```
INIT:SEQ:IMM
```
Starts the sequential measurements.

Usage: Event

Manual operation: See "Sequencer State" on page 98

INITiate:SEQuencer:MODE <Mode>

This command selects the way the R&S FSW application performs measurements sequentially.

Before this command can be executed, the Sequencer must be activated (see `SYSTem:SEQuencer` on page 629).

A detailed programming example is provided in chapter 11.4.3, "Programming Example: Performing a Sequence of Measurements", on page 630.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

Note: In order to synchronize to the end of a sequential measurement using *OPC, *OPC? or *WAI you must use `SINGle` Sequence mode.

For details on synchronization see chapter 10.1.6, "Command Sequence and Synchronization", on page 568

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Parameters:

<Mode>

SINGle
Each measurement is performed once (regardless of the channel's sweep mode), considering each channels' sweep count, until all measurements in all active channels have been performed.

CONTinuous
The measurements in each active channel are performed one after the other, repeatedly (regardless of the channel's sweep mode), in the same order, until the Sequencer is stopped.

CDEFined
First, a single sequence is performed. Then, only those channels in continuous sweep mode (`INIT:CONT ON`) are repeated.

*RST: CONTinuous

Example:

`SYST:SEQ ON`
Activates the Sequencer.
`INIT:SEQ:MODE SING`
Sets single sequence mode so each active measurement will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.

Manual operation: See "Sequencer Mode" on page 99

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 will occur.

A detailed programming example is provided in chapter 11.4.3, "Programming Example: Performing a Sequence of Measurements", on page 630.

A detailed programming example is provided in the "Operating Modes" chapter in the R&S FSW User Manual.

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 will be performed once.
`INIT:SEQ:IMM`
Starts the sequential measurements.
`SYST:SEQ OFF`

Manual operation: See "Sequencer State" on page 98

11.4.3 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 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 second 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
```

11.5 Configuring and Performing Measurements

The following commands are required to configure measurements in a remote environment. The tasks for manual operation are described in chapter 5, "Measurements", on page 101.

- Performing Measurements....632
- Configuring Power Measurements....639
- Measuring the Channel Power and ACLR....643
- Measuring the Carrier-to-Noise Ratio....670
- Measuring the Occupied Bandwidth....671
- Measuring the Spectrum Emission Mask....673
- Measuring Spurious Emissions....699
- Analyzing Statistics (APD, CCDF)....712
- Measuring the Time Domain Power....721
- Measuring the Harmonic Distortion....729
- Measuring the Third Order Intercept Point....732
- Measuring the AM Modulation Depth....734
- Remote Commands for EMI Measurements....736
- List Evaluations....745
- Measuring the Pulse Power....750

11.5.1 Performing Measurements

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11.5.1.1 Commands

Useful commands for performing measurements described elsewhere

- `INITiate:ESPectrum` on page 674
- `INITiate:SPURious` on page 700

Remote commands exclusive for performing measurements

ABORt....633
INITiate:CONMeas....634
INITiate:CONTinuous....634
INITiate[:IMMediate]....635
[SENSe:]SWEep:COUNt:CURRent?....636

ABORt

This command aborts a current measurement 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 `ABOR` and before the next command.

For details see chapter 10.1.6.1, "Preventing Overlapping Execution", on page 569.

For details see the "Remote Basics" chapter in the R&S FSW User Manual.

To abort a sequence of measurements by the Sequencer, use the `INITiate:SEQuencer:ABORt` on page 628 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 and the remote channel (GPIB, LAN or other interface) to the R&S FSW is blocked for further commands. In this case, you must interrupt processing on the remote channel first in order to abort the measurement.

To do so, send a "Device Clear" command from the control instrument to the R&S FSW 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 performing the measurement.

Example: `ABOR;:INIT:IMM`
Aborts the current measurement and immediately starts a new one.

Example: `ABOR;*WAI`
`INIT:IMM`
Aborts the current measurement and starts a new one once abortion has been completed.

Usage: SCPI confirmed

INITiate:CONMeas

This command restarts a (single) measurement that has been stopped (using `INIT:CONT OFF`) or finished in single sweep mode.

The measurement is restarted at the beginning, not where the previous measurement was stopped.

As opposed to `INITiate[:IMMediate]`, this command does not reset traces in max-hold, minhold or average mode. Therefore it can be used to continue measurements using maxhold or averaging functions.

Example: (for Spectrum application:)
`INIT:CONT OFF`
Switches to single sweep mode.
`DISP:WIND:TRAC:MODE AVER`
Switches on trace averaging.
`SWE:COUN 20`
Setting the sweep counter to 20 sweeps.
`INIT;*WAI`
Starts the measurement and waits for the end of the 20 sweeps.
`INIT:CONM;*WAI`
Continues the measurement (next 20 sweeps) and waits for the end.
Result: Averaging is performed over 40 sweeps.

Manual operation: See "Continue Single Sweep" on page 373

INITiate:CONTinuous <State>

This command controls the sweep mode.

Note that in single sweep mode, you can synchronize to the end of the measurement with *OPC, *OPC? or *WAI. In continuous sweep mode, synchronization to the end of the measurement is not possible. Thus, it is not recommended that you use continuous sweep mode in remote control, as results like trace data or markers are only valid after a single sweep end synchronization.

For details on synchronization see chapter 10.1.6, "Command Sequence and Synchronization", on page 568

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

If the sweep mode is changed for a measurement channel while the Sequencer is active (see `INITiate:SEQuencer:IMMediate` on page 628) the mode is only considered the next time the measurement in that channel is activated by the Sequencer.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Continuous sweep

OFF | 0
Single sweep

*RST: 1

Example:
```
INIT:CONT OFF
```
Switches the sweep mode to single sweep.
```
INIT:CONT ON
```
Switches the sweep mode to continuous sweep.

Manual operation: See "Frequency Sweep" on page 102
See "Zero Span" on page 102
See "Continuous Sweep/RUN CONT" on page 373

INITiate[:IMMediate]

This command starts a (single) new measurement.

With sweep count or average count > 0, this means a restart of the corresponding number of measurements. With trace mode MAXHold, MINHold and AVERage, the previous results are reset on restarting the measurement.

You can synchronize to the end of the measurement with *OPC, *OPC? or *WAI.

For details on synchronization see chapter 10.1.6, "Command Sequence and Synchronization", on page 568

For details on synchronization see the "Remote Basics" chapter in the R&S FSW User Manual.

Example: (For Spectrum application:)
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
DISP:WIND:TRAC:MODE AVER
```
Switches on trace averaging.
```
SWE:COUN 20
```
Sets the sweep counter to 20 sweeps.
```
INIT;*WAI
```
Starts the measurement and waits for the end of the 20 sweeps.

Manual operation: See "Frequency Sweep" on page 102
See "Zero Span" on page 102
See "Single Sweep/ RUN SINGLE" on page 373

[SENSe:]SWEep:COUNt:CURRent?

This query returns the current number of started sweeps or measurements. This command is only available if a sweep count value is defined and the instrument is in single sweep mode.

Example:
```
SWE:COUNt 64
```
Sets sweep count to 64
```
INIT:CONT OFF
```
Switches to single sweep mode
```
INIT
```
Starts a sweep (without waiting for the sweep end!)
```
SWE:COUN:CURR?
```
Queries the number of started sweeps

Usage: Query only

11.5.1.2 Programming Example: Performing a Basic Frequency Sweep

This example demonstrates how to configure and perform a basic frequency sweep measurement in a remote environment.

```
//--------------Preparing the measurement ---------------------
*RST
//Resets the instrument
INIT:CONT OFF
//Selects single sweep mode.

//--------------Configuring the Frequency and Span-------------
FREQ:CENT 100MHz
//Defines the center frequency
FREQ:SPAN 200MHz
//Sets the span to 100 MHz on either side of the center frequency.

//Activate signal tracking to keep the center frequency on the signal peak:
CALC:MARK:FUNC:STR ON
CALC:MARK:FUNC:STR:BAND 20MHz
CALC:MARK:FUNC:STR:THR -90dBm
CALC:MARK:FUNC:STR:TRAC 1
//After each sweep the maximum on trace 1 is searched within a range of 20 MHz
//around the center frequency. It must have a minimum power of -90dBm.

//--------------Configuring the Bandwidth----------------------
BAND:AUTO OFF
BAND 1MHz
BAND:TYPE RRC
//Defines the RBW as 1 MHz using an RRC filter

BAND:VID:AUTO OFF
BAND:VID 500kHz
//Decouples the VBW from the RBW and decreases it to smooth the trace.
```

```
//--------------Configuring the Sweep--------------------------
SENS:SWE:COUN 10
//Defines 10 sweeps to be performed in each measurement.
SENS:SWE:POIN 500
//During each sweep, 500 trace points will be measured.
SENS:SWE:TIME:AUTO OFF
SENS:SWE:TIME 50ms
//Decouples the sweep time from the RBW,VBW and span and increases it to
//make the measurement more precise.

//--------------Configuring Attenuation------------------------
//Only if electronic attenuator is available:
//INP:EATT:STAT ON
//Switches on the electronic attenuator.
//INP:EATT 30dB
//Sets the electronic attenuation to 30 dB.
INP:ATT 10dB
//Sets the mechanical attenuation to 10 dB and couples the reference level
//to the attenuation instead of vice versa.

//--------------Configuring the Amplitude and Scaling----------
DISP:TRAC1:Y:RLEV -10dBm
//Sets the reference level to -10 dBm.
DISP:TRAC1:Y:RLEV:OFFS 10dB
//Shifts the trace display in the diagram up by 10dB.
CALC:UNIT:POW V
//Sets the unit of the y-axis to Volt. The reference level is now 70.711 mV.
DISP:TRAC1:Y:SPAC LOG
//Uses logarithmic scaling with absolute values (V).
DISP:TRAC1:Y 110dB
//Increases the displayed range of the y-axis to 110 dB.
DISP:TRAC1:Y:RPOS 80PCT
//Shifts the display of the reference level down, it is no longer the top line
//in the diagram. The reference level is displayed as a red line.

//--------------Triggering-------------------------------------
TRIG:SOUR IFP
TRIG:LEV:IFP -10dBm
TRIG:SLOP POS
TRIG:DTIM 50ms
TRIG:IFP:HYST 5dB
TRIG:HOLD 10ms
//Defines triggering when the second intermediate frequency rises to a level
//of -10 dBm, with a dropout time of 50 ms, a hysteresis of 5 dB and a delay
//of 10 ms.


SWE:EGAT ON
SWE:EGAT:TYPE EDGE
```

```
SWE:EGAT:LENG 5ms
//Defines gating. Values are measured for 5 ms after triggering.

OUTP:TRIG2:DIR OUTP
OUTP:TRIG2:OTYP UDEF
OUTP:TRIG2:LEV HIGH
OUTP:TRIG2:PULS:LENG 100us
OUTP:TRIG2:PULS:IMM
//Configures a high trigger signal with a pulse length of 100 us to be output at
//the front TRIGGER INPUT/OUTPUT connector once.

//--------------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

SENS:DET1 POS
SENS:DET2 RMS
SENS:DET3 POS
//Configures traces 1 and 3 to use the positive peak detector; trace 2 uses
//the RMS detector.

TRAC:COPY TRACE4,TRACE1
//Copies trace 1 to a new trace 4 which will then be averaged.

SENS:AVER:STAT4 ON
SENS:AVER:COUN 10
SENS:AVER:TYPE LIN
//Configures trace 4 to be averaged linearly over 10 sweeps.

CALC:MATH:STAT ON
CALC:MATH:MODE LIN
CALC:MATH (TRACE1-TRACE2)
CALC:MATH:POS 100
//Calculates the linear difference between the measured and average values.
//The resulting trace is displayed at the top of the diagram.

//--------------Performing the Measurement---------------------
INIT;*WAI
//Initiates a new measurement and waits until the last sweep has finished.

//---------------Retrieving Results----------------------------
TRAC:DATA? TRACE1
TRAC:DATA? TRACE2
TRAC:DATA? TRACE3
TRAC:DATA? TRACE4
//Returns one power and one frequency value per sweep point for each trace.
```

11.5.2 Configuring Power Measurements

The following commands work for several power measurements.

CALCulate<n>:MARKer<m>:FUNCtion:POWer:MODE....639
CALCulate:MARKer:FUNCtion:POWer:RESult?....639
CALCulate<n>:MARKer<m>:FUNCtion:POWer:SELect....641
CALCulate<n>:MARKer<m>:FUNCtion:POWer[:STATe]....641
[SENSe:]POWer:ACHannel:PRESet....642
[SENSe:]POWer:ACHannel:PRESet:RLEVel....642
[SENSe:]POWer:TRACe....642

CALCulate<n>:MARKer<m>:FUNCtion:POWer:MODE <Mode>

This command selects the trace display mode for power measurements.

Parameters:

<Mode>

WRITe
The power is calculated from the current trace.

MAXHold
The power is calculated from the current trace and compared with the previous power value using a maximum algorithm.

Manual operation: See "Power Mode" on page 125

CALCulate:MARKer:FUNCtion:POWer:RESult? <Measurement>

This command queries the results of power measurements.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Query parameters:

<Measurement>

ACPower | MCACpower
ACLR measurements (also known as adjacent channel power or multicarrier adjacent channel measurements).
Returns the power for every active transmission and adjacent channel. The order is:
• power of the transmission channels
• power of adjacent channel (lower,upper)
• power of alternate channels (lower,upper)
MSR ACLR results:
For MSR ACLR measurements, the order of the returned results is slightly different:
• power of the transmission channels
• total power of the transmission channels for each subblock
• power of adjacent channels (lower, upper)
• power of alternate channels (lower, upper)
• power of gap channels (lower1, upper1, lower2, upper2)
The unit of the return values depends on the scaling of the y-axis:
• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W

CN
Carrier-to-noise measurements.
Returns the C/N ratio in dB.

CN0
Carrier-to-noise measurements.
Returns the C/N ratio referenced to a 1 Hz bandwidth in dBm/Hz.

CPOWer
Channel power measurements.
Returns the channel power. The unit of the return values depends on the scaling of the y-axis:
• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W
For SEM measurements, the return value is the channel power of the reference range.

PPOWer
Peak power measurements.
Returns the peak power. The unit of the return values depends on the scaling of the y-axis:
• logarithmic scaling returns the power in the current unit
• linear scaling returns the power in W
For SEM measurements, the return value is the peak power of the reference range.

OBANdwidth | OBWidth
Occupied bandwidth.
Returns the occupied bandwidth in Hz.

Usage: Query only

Manual operation: See "Ch Power ACLR" on page 103
See "C/N, C/No" on page 103
See "OBW" on page 103
See "Spectrum Emission Mask" on page 104
See "C/N" on page 157
See "C/No" on page 157

CALCulate<n>:MARKer<m>:FUNCtion:POWer:SELect <MeasType>

This command selects a power measurement and turns the measurement on.

Parameters:

<MeasType>

ACPower | MCACpower
Adjacent channel leakage ratio (ACLR) aka adjacent channel power or multicarrier adjacent channel.
The R&S FSW performs the measurement on the trace selected with `[SENSe:]POWer:TRACe`.

CPOWer
Channel power measurement with a single carrier.
The R&S FSW performs the measurement on the trace selected with `[SENSe:]POWer:TRACe`.

OBANdwidth | OBWidth
Occupied bandwidth measurement.
The R&S FSW performs the measurement on the trace that marker 1 is positioned on.

CN
Carrier-to-noise ratio measurement.

CN0
Carrier-to-noise ratio measurement referenced to 1 Hz bandwidth

Manual operation: See "Ch Power ACLR" on page 103
See "C/N, C/No" on page 103
See "OBW" on page 103
See "C/N" on page 157
See "C/No" on page 157

CALCulate<n>:MARKer<m>:FUNCtion:POWer[:STATe] <State>

This command turns a power measurement on and off.

You can select a particular power measurement with `CALCulate<n>:MARKer<m>:FUNCtion:POWer:SELect`.

Parameters:

<State>

ON | OFF

*RST: OFF

Manual operation: See "C/N" on page 157
See "C/No" on page 157

[SENSe:]POWer:ACHannel:PRESet <Measurement>

This command determines the ideal span, bandwidths and detector for the current power measurement.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Parameters:

<Measurement>

ACPower | MCACpower
ACLR measurement

CPOWer
channel power measurement

OBANdwidth | OBWidth
Occupied bandwidth measurement

CN
Carrier to noise ratio

CN0
Carrier to noise ration referenced to a 1 Hz bandwidth

Manual operation: See "Optimized Settings (Adjust Settings)" on page 125
See "Adjust Settings" on page 157
See "Adjust Settings" on page 162

[SENSe:]POWer:ACHannel:PRESet:RLEVel

This command determines the ideal reference level for the current measurement.

This automatic routine makes sure that the that the signal power level does not overload the R&S FSW or limit the dynamic range by too small a S/N ratio.

To determine the best reference level, the R&S FSW aborts current measurements and performs a series of test sweeps. After it has finished the test, it continues with the actual measurement.

To get a valid result, you have to perform a complete sweep with synchronization to the sweep end. This is only possible in single sweep mode.

Usage: Event

[SENSe:]POWer:TRACe <TraceNumber>

This command selects the trace channel power measurements are performed on.

For the measurement to work, the corresponding trace has to be active.

Parameters:

<TraceNumber>

Range: 1 to 6
*RST: 1

Example:

```
POW:TRAC 2
```

Assigns the measurement to trace 2.

Manual operation: See "Selected Trace" on page 124

11.5.3 Measuring the Channel Power and ACLR

All remote control commands specific to channel power or ACLR measurements are described here.

See also chapter 11.5.2, "Configuring Power Measurements", on page 639.

- Managing Measurement Configurations....643
- Configuring the Channels....644
- Defining Weighting Filters....648
- Selecting the Reference Channel....650
- Checking Limits....651
- General ACLR Measurement Settings....655
- Configuring MSR ACLR Measurements....656
- Performing an ACLR Measurement....664
- Analyzing Measurement Results....665
- Programming Examples for Channel Power Measurements....666

11.5.3.1 Managing Measurement Configurations

The following commands control measurement configurations for ACLR measurements.

CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet....643
CALCulate<n>:MARKer<m>:FUNCtion:POWer:STANdard:CATalog?....644
CALCulate<n>:MARKer<m>:FUNCtion:POWer:STANdard:DELete....644
CALCulate<n>:MARKer<m>:FUNCtion:POWer:STANdard:SAVE....644

CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet <Standard>

This command loads a measurement configuration.

The measurement configuration for power measurements consists of weighting filter, channel bandwidth and spacing, resolution and video bandwidth, detector and sweep time.

If the "Multi-Standard Radio" standard is selected (see "Standard" on page 121), different commands are required to configure ACLR measurements (see chapter 11.5.3.7, "Configuring MSR ACLR Measurements", on page 656.

Parameters:

<Standard> For more information see chapter 5.2.8, "Reference: Predefined CP/ACLR Standards", on page 153.
If you want to load a customized configuration, the parameter is a string containing the file name.

Manual operation: See "Standard" on page 121
See "Predefined Standards" on page 121
See "User-Defined Standards" on page 121

CALCulate<n>:MARKer<m>:FUNCtion:POWer:STANdard:CATalog?

This command queries all files containing ACLR standards.

Return values:
<Standards> List of standard files.

Usage: Query only

Manual operation: See "Standard" on page 121
See "User-Defined Standards" on page 121

CALCulate<n>:MARKer<m>:FUNCtion:POWer:STANdard:DELete <Standard>

This command deletes a file containing an ACLR standard.

Parameters:
<Standard> String containing the file name of the standard.

Usage: Event

Manual operation: See "Standard" on page 121
See "User-Defined Standards" on page 121

CALCulate<n>:MARKer<m>:FUNCtion:POWer:STANdard:SAVE <Standard>

This command saves the current ACLR measurement configuration as a new ACLR standard.

The measurement configuration for power measurements consists of weighting filter, channel bandwidth and spacing, resolution and video bandwidth, detector and sweep time.

Parameters:
<Standard> String containing the file name. The file format is xml.

Manual operation: See "Standard" on page 121
See "User-Defined Standards" on page 121

11.5.3.2 Configuring the Channels

The following commands configure channels for channel power and ACLR measurements.

[SENSe:]POWer:ACHannel:ACPairs....645
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel....645
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<ch>....645
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel<ch>]....646
[SENSe:]POWer:ACHannel:NAME:ACHannel....646

[SENSe:]POWer:ACHannel:NAME:ALTernate<ch>....646
[SENSe:]POWer:ACHannel:NAME:CHANnel<ch>....646
[SENSe:]POWer:ACHannel:SPACing[:ACHannel]....646
[SENSe:]POWer:ACHannel:SPACing:ALTernate<ch>....647
[SENSe:]POWer:ACHannel:SPACing:CHANnel<ch>....647
[SENSe:]POWer:ACHannel:TXCHannel:COUNt....648

[SENSe:]POWer:ACHannel:ACPairs <ChannelPairs>

This command defines the number of pairs of adjacent and alternate channels.

Parameters:

<ChannelPairs> Range: 0 to 12
*RST: 1

Manual operation: See "Number of Channels (Tx, ADJ)" on page 123
See "Number of Adjacent Channels (ADJ Count)" on page 139

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ACHannel <Bandwidth>

This command defines the channel bandwidth of the adjacent channel.

The adjacent channel is the first pair of channels next to the transmission channels. If you set the channel bandwidth for these channels, the R&S FSW sets the bandwidth of the alternate channels to the same value.

Steep-edged channel filters are available for fast ACLR measurements.

Parameters:

<Bandwidth> Range: 100 Hz to 1000 MHz
*RST: 14 kHz

Manual operation: See "Channel Bandwidths" on page 127
See "Adjacent Channel Definition" on page 140
See "Adjacent Channel Bandwidths" on page 140

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:ALTernate<ch> <Bandwidth>

This command defines the channel bandwidth of the alternate channels.

If you set the channel bandwidth for the first alternate channel, the R&S FSW sets the bandwidth of the other alternate channels to the same value, but not the other way round. The command works hierarchically: to set a bandwidth of the 3rd and 4th channel, you have to set the bandwidth of the 3rd channel first.

Steep-edged channel filters are available for fast ACLR measurements.

Parameters:

<Bandwidth> Range: 100 Hz to 1000 MHz
*RST: 14 kHz

Manual operation: See "Channel Bandwidths" on page 127
See "Adjacent Channel Definition" on page 140
See "Adjacent Channel Bandwidths" on page 140

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel<ch>] <Bandwidth>

This command defines the channel bandwidth of the transmission channels.

Steep-edged channel filters are available for fast ACLR measurements.

Parameters:

<Bandwidth> Range: 100 Hz to 1000 MHz
*RST: 14 kHz

Manual operation: See "Channel Bandwidths" on page 127
See "Channel Bandwidth" on page 157
See "Channel Bandwidth" on page 162

[SENSe:]POWer:ACHannel:NAME:ACHannel <Name>

This command defines a name for the adjacent channel.

For MSR ACLR measurements, the channel names cannot be defined manually. In this case, this command is for query only.

Parameters:

<Name> String containing the name of the channel
*RST: ADJ

Manual operation: See "Channel Names" on page 129

[SENSe:]POWer:ACHannel:NAME:ALTernate<ch> <Name>

This command defines a name for an alternate channel.

For MSR ACLR measurements, the channel names cannot be defined manually. In this case, this command is for query only.

Parameters:

<Name> String containing the name of the channel
*RST: ALT<1...11>

Manual operation: See "Channel Names" on page 129

[SENSe:]POWer:ACHannel:NAME:CHANnel<ch> <Name>

This command defines a name for a transmission channel.

Parameters:

<Name> String containing the name of the channel
*RST: TX<1...12>

Manual operation: See "Channel Names" on page 129

[SENSe:]POWer:ACHannel:SPACing[:ACHannel] <Spacing>

This command defines the distance from transmission channel to adjacent channel.

For MSR signals, this command defines the distance from the CF of the first Tx channel in the first subblock to the lower adjacent channel, and the distance from the CF of the last Tx channel in the last subblock to the upper adjacent channel.

A change of the adjacent channel spacing causes a change in the spacing of all alternate channels below the adjacent channel.

Parameters:

<Spacing> Range: 100 Hz to 2000 MHz
*RST: 14 kHz

Usage: SCPI confirmed

Manual operation: See "Channel Spacings" on page 127
See "Adjacent Channel Definition" on page 140
See "Adjacent Channel Spacings" on page 140

[SENSe:]POWer:ACHannel:SPACing:ALTernate<ch> <Spacing>

This command defines the distance from transmission channel to alternate channels.

For MSR signals, this command defines the distance from the CF of the first Tx channel in the first subblock to the lower alternate channel, and the distance from the CF of the last Tx channel in the last subblock to the upper alternate channel.

If you set the channel spacing for the first alternate channel, the R&S FSW adjusts the spacing of alternate channels of a lower order, but not the other way round. The command works hierarchically: to set a distance from the transmission channel to the 2nd and 3rd alternate channel, you have to define a spacing for the 2nd alternate channel first.

Parameters:

<Spacing> Range: 100 Hz to 2000 MHz
*RST: 40 kHz (ALT1), 60 kHz (ALT2), 80 kHz (ALT3), ...

Manual operation: See "Channel Spacings" on page 127
See "Adjacent Channel Definition" on page 140
See "Adjacent Channel Spacings" on page 140

[SENSe:]POWer:ACHannel:SPACing:CHANnel<ch> <Spacing>

This command defines the distance between transmission channels.

If you set the channel spacing for a transmission channel, the R&S FSW sets the spacing of the lower transmission channels to the same value, but not the other way round. The command works hierarchically: to set a distance between the 2nd and 3rd and 3rd and 4th channel, you have to set the spacing between the 2nd and 3rd channel first.

Parameters:

<Spacing> Range: 14 kHz to 2000 MHz
*RST: 20 kHz

Manual operation: See "Channel Spacings" on page 127

[SENSe:]POWer:ACHannel:TXCHannel:COUNt <Number>

This command defines the number of transmission channels.

The command works for measurements in the frequency domain.

Parameters:
<Number> Range: 1 to 18
*RST: 1

Manual operation: See "Number of Channels (Tx, ADJ)" on page 123

11.5.3.3 Defining Weighting Filters

The following commands define weighting filters for ACLR measurements.

[SENSe:]POWer:ACHannel:FILTer:ALPHa:ACHannel....648
[SENSe:]POWer:ACHannel:FILTer:ALPHa[:ALL]....648
[SENSe:]POWer:ACHannel:FILTer:ALPHa:ALTernate<ch>....648
[SENSe:]POWer:ACHannel:FILTer:ALPHa:CHANnel<ch>....649
[SENSe:]POWer:ACHannel:FILTer[:STATe]:ACHannel....649
[SENSe:]POWer:ACHannel:FILTer[:STATe]:ALL....649
[SENSe:]POWer:ACHannel:FILTer[:STATe]:ALTernate<ch>....649
[SENSe:]POWer:ACHannel:FILTer[:STATe]:CHANnel<ch>....650

[SENSe:]POWer:ACHannel:FILTer:ALPHa:ACHannel <Alpha>

This command defines the roll-off factor for the adjacent channel weighting filter.

Parameters:
<Alpha> Roll-off factor
Range: 0 to 1
*RST: 0.22

Manual operation: See "Weighting Filters" on page 129
See "Adjacent Channel Definition" on page 140
See "Weighting Filters" on page 141

[SENSe:]POWer:ACHannel:FILTer:ALPHa[:ALL] <Value>

This command defines the alpha value for the weighting filter for all channels.

Parameters:
<Value> <numeric value>
*RST: 0,22

Example: `POW:ACH:FILT:ALPH:ALL 0,35`

[SENSe:]POWer:ACHannel:FILTer:ALPHa:ALTernate<ch> <Alpha>

This command defines the roll-off factor for the alternate channel weighting filter.

Parameters:
<Alpha> Roll-off factor
Range: 0 to 1
*RST: 0.22

Manual operation: See "Weighting Filters" on page 129
See "Adjacent Channel Definition" on page 140
See "Weighting Filters" on page 141

[SENSe:]POWer:ACHannel:FILTer:ALPHa:CHANnel<ch> <Alpha>

This command defines the roll-off factor for the transmission channel weighting filter.

Parameters:
<Alpha> Roll-off factor
Range: 0 to 1
*RST: 0.22

Manual operation: See "Weighting Filters" on page 129

[SENSe:]POWer:ACHannel:FILTer[:STATe]:ACHannel <State>

This command turns the weighting filter for the adjacent channel on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Weighting Filters" on page 129
See "Adjacent Channel Definition" on page 140
See "Weighting Filters" on page 141

[SENSe:]POWer:ACHannel:FILTer[:STATe]:ALL <State>

This command turns the weighting filters for all channels on and off.

Parameters:
<State> ON | OFF
*RST: OFF

[SENSe:]POWer:ACHannel:FILTer[:STATe]:ALTernate<ch> <State>

This command turns the weighting filter for an alternate channel on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Weighting Filters" on page 129
See "Adjacent Channel Definition" on page 140
See "Weighting Filters" on page 141

[SENSe:]POWer:ACHannel:FILTer[:STATe]:CHANnel<ch> <State>

This command turns the weighting filter for a transmission channel on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Weighting Filters" on page 129

11.5.3.4 Selecting the Reference Channel

The following commands define the reference channel for relative ACLR measurements.

[SENSe:]POWer:ACHannel:REFerence:AUTO ONCE....650
[SENSe:]POWer:ACHannel:REFerence:TXCHannel:AUTO....650
[SENSe:]POWer:ACHannel:REFerence:TXCHannel:MANual....650

[SENSe:]POWer:ACHannel:REFerence:AUTO ONCE

This command sets the channel power as the reference for relative ACLR measurements.

Example: `POW:ACH:REF:AUTO ONCE`

Usage: Event

Manual operation: See "Setting a Fixed Reference for Channel Power Measurements (Set CP Reference)" on page 125

[SENSe:]POWer:ACHannel:REFerence:TXCHannel:AUTO <RefChannel>

This command selects the reference channel for relative measurements.

You need at least one channel for the command to work.

Parameters:
<RefChannel>
MINimum
Transmission channel with the lowest power
MAXimum
Transmission channel with the highest power
LHIGhest
Lowest transmission channel for lower adjacent channels and highest transmission channel for upper adjacent channels

Example: `POW:ACH:REF:TXCH:AUTO MAX`
Selects the channel with the peak power as reference channel.

Manual operation: See "Reference Channel" on page 123

[SENSe:]POWer:ACHannel:REFerence:TXCHannel:MANual <ChannelNumber>

This command defines a reference channel for relative ACLR measurements.

You need at least one channel for the command to work.

Note that this command is not available for MSR ACLR measurements (see CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet on page 643).

Parameters:

<ChannelNumber> Range: 1 to 18
*RST: 1

Manual operation: See "Reference Channel" on page 123

11.5.3.5 Checking Limits

The following commands configure and query limit checks for channel power and ACLR measurements.

The results of the power limit checks are also indicated in the STAT:QUES:ACPL status registry (see "STATus:QUEStionable:ACPLimit Register" on page 578).

CALCulate:LIMit:ACPower:ACHannel:ABSolute....651
CALCulate:LIMit:ACPower:ACHannel:ABSolute:STATe....652
CALCulate:LIMit:ACPower:ACHannel[:RELative]....652
CALCulate:LIMit:ACPower:ACHannel:RESult?....652
CALCulate:LIMit:ACPower:ACHannel[:RELative]:STATe....653
CALCulate:LIMit:ACPower:ALTernate<ch>:ABSolute....653
CALCulate:LIMit:ACPower:ALTernate<ch>:ABSolute:STATe....653
CALCulate:LIMit:ACPower:ALTernate<ch>[:RELative]....654
CALCulate:LIMit:ACPower:ALTernate<ch>:RESult?....654
CALCulate:LIMit:ACPower:ALTernate<ch>[:RELative]:STATe....654
CALCulate:LIMit:ACPower[:STATe]....655

CALCulate:LIMit:ACPower:ACHannel:ABSolute <LowerLimit>, <UpperLimit>

This command defines the absolute limit of the adjacent channels.

If you have defined an absolute limit as well as a relative limit, the R&S FSW uses the lower value for the limit check.

Parameters:

<LowerLimit>, <UpperLimit> The first value defines the limit of the lower adjacent channel, the second value the limit of the upper adjacent channel.

Range: -200 dBm to 200 dBm
*RST: -200 dBm

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ACHannel:ABSolute:STATe <State>

This command turns the absolute limit check for the adjacent channels on and off.

You have to activate the general ACLR limit check before using this command with `CALCulate:LIMit:ACPower[:STATe]`.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ACHannel[:RELative] <LowerLimit>, <UpperLimit>

This command defines the relative limit of the adjacent channels. The reference value for the relative limit is the measured channel power.

If you have defined an absolute limit as well as a relative limit, the R&S FSW uses the lower value for the limit check.

Parameters:

<LowerLimit>, <UpperLimit> The first value defines the limit of the lower adjacent channel, the second value the limit of the upper adjacent channel.

Range: 0 dB to 100 dB
*RST: 0 dB
Default unit: dB

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ACHannel:RESult?

This command queries the state of the limit check for the adjacent channels in an ACLR measurement.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<LowerACH>, <UpperACH> text value

The command returns two results. The first is the result for the lower, the second for the upper adjacent channel.

PASSED
Limit check has passed.

FAIL
Limit check has failed.

Example:
```
INIT:IMM;*WAI;
CALC:LIM:ACP:ACH:RES?
PASSED,PASSED
```

Usage: Query only

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ACHannel[:RELative]:STATe <State>

This command turns the relative limit check for the adjacent channels on and off.

You have to activate the general ACLR limit check before using this command with `CALCulate:LIMit:ACPower[:STATe]`.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ALTernate<ch>:ABSolute <LowerLimit>, <UpperLimit>

This command defines the absolute limit of the alternate channels.

If you have defined an absolute limit as well as a relative limit, the R&S FSW uses the lower value for the limit check.

Parameters:
<LowerLimit>, <UpperLimit> The first value defines the limit of the lower alternate channel, the second value the limit of the upper alternate channel.
Range: -200 dBm to 200 dBm
*RST: -200 dBm

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ALTernate<ch>:ABSolute:STATe <State>

This command turns the absolute limit check for the alternate channels on and off.

You have to activate the general ACLR limit check before using this command with `CALCulate:LIMit:ACPower[:STATe]`.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ALTernate<ch>[:RELative] <LowerLimit>, <UpperLimit>

This command defines the relative limit of the alternate channels. The reference value for the relative limit is the measured channel power.

If you have defined an absolute limit as well as a relative limit, the R&S FSW uses the lower value for the limit check.

Parameters:

<LowerLimit>, <UpperLimit>
The first value defines the limit of the lower alternate channel, the second value the limit of the upper alternate channel.

Range: 0 dB to 100 dB
*RST: 0 DB
Default unit: dB

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower:ALTernate<ch>:RESult?

This command queries the state of the limit check for the adjacent or alternate channels in an ACLR measurement.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<LowerChan>, <UpperChan>
text value

The command returns two results. The first is the result for the lower, the second for the upper adjacent or alternate channel.

PASSED
Limit check has passed.

FAIL
Limit check has failed.

Example:
```
INIT:IMM;*WAI;
CALC:LIM:ACP:ACH:RES?
PASSED,PASSED
```

Usage: Query only

CALCulate:LIMit:ACPower:ALTernate<ch>[:RELative]:STATe <State>

This command turns the relative limit check for the alternate channels on and off.

You have to activate the general ACLR limit check before using this command with CALCulate:LIMit:ACPower[:STATe].

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Limit Checking" on page 128
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141

CALCulate:LIMit:ACPower[:STATe] <State>

This command turns the limit check for ACLR measurements on and off.

In addition, limits must be defined and activated individually for each channel (see CALCulate:LIMit:ACPower:ACHannel[:RELative]:STATe, CALCulate:LIMit:ACPower:ALTernate<ch>[:RELative]:STATe, CALCulate:LIMit:ACPower:GAP<gap>:ABSolute:STATe and CALCulate:LIMit:ACPower:GAP<gap>[:RELative:]STATe).

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Limit Checking" on page 128
See "Limit Checking" on page 139
See "Adjacent Channel Definition" on page 140
See "Limit Checking" on page 141
See "Gap (CACLR) Channel Definition" on page 142
See "Limit Checking" on page 143

11.5.3.6 General ACLR Measurement Settings

The following commands control the measurement algorithm.

Useful commands for the ACLR measurement described elsewhere:

- [SENSe:]POWer:NCORrection on page 776
- [SENSe:]POWer:ACHannel:PRESet on page 642
- [SENSe:]POWer:ACHannel:PRESet:RLEVel on page 642
- [SENSe:]POWer:TRACe on page 642
- CALCulate<n>:MARKer<m>:FUNCtion:POWer:MODE on page 639

Remote commands exclusive to ACLR measurement

[SENSe:]POWer:HSPeed.....656

[SENSe:]POWer:HSPeed <State>

This command turns high speed ACLR and channel power measurements on and off.

If on, the R&S FSW performs a measurement on each channel in the time domain. It returns to the frequency domain when the measurement is done.

In some telecommunications standards, high speed measurements use weighting filters with characteristic or steep-edged channel filters for band limitation.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `POW:HSP ON`

Manual operation: See "Fast ACLR" on page 124

11.5.3.7 Configuring MSR ACLR Measurements

If the "Multi-Standard Radio" standard is selected (see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643), the channels for the ACLR measurement are configured differently. (For more information see chapter 5.2.3.4, "Measurement on Multi-Standard Radio (MSR) Signals", on page 116.)

In this case, use the following commands.

Useful commands for configuring MSR ACLR measurements described elsewhere:

- `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643
- `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643
- `CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult:PHZ` on page 665
- `CALCulate<n>:MARKer<m>:FUNCtion:POWer:MODE` on page 639
- `CALCulate:LIMit:ACPower[:STATe]` on page 655
- `[SENSe:]POWer:ACHannel:REFerence:TXCHannel:AUTO` on page 650
- `[SENSe:]POWer:NCORrection` on page 776
- `[SENSe:]POWer:TRACe` on page 642
- `[SENSe:]POWer:ACHannel:MODE` on page 665
- `[SENSe:]POWer:ACHannel:PRESet` on page 642

Remote commands exclusive to configuring MSR ACLR measurements

CALCulate:LIMit:ACPower:GAP<gap>:ABSolute....657
CALCulate:LIMit:ACPower:GAP<gap>:ABSolute:STATe....657
CALCulate:LIMit:ACPower:GAP<gap>[:RELative]....658
CALCulate:LIMit:ACPower:GAP<gap>[:RELative:]STATe....658
CALCulate:LIMit:ACPower:GAP<gap>:RESult?....658
[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:GAP<gap>....659
[SENSe:]POWer:ACHannel:FILTer:ALPHa:GAP<gap>....659
[SENSe:]POWer:ACHannel:FILTer:ALPHa:SBLock<sb>:CHANnel<ch>....660

[SENSe:]POWer:ACHannel:FILTer:STATe:GAP<gap>....660
[SENSe:]POWer:ACHannel:FILTer:STATe:SBLock<sb>:CHANnel<ch>....660
[SENSe:]POWer:ACHannel:SBCount....661
[SENSe:]POWer:ACHannel:SBLock<sb>:BANDwidth|BWIDth[:CHANnel<ch>]....661
[SENSe:]POWer:ACHannel:SBLock<sb>:CENTer[:CHANnel<ch>]....661
[SENSe:]POWer:ACHannel:SBLock<sb>:FREQuency:CENTer....662
[SENSe:]POWer:ACHannel:SBLock<sb>:NAME[:CHANnel<ch>]?....662
[SENSe:]POWer:ACHannel:SBLock<sb>:RFBWidth....662
[SENSe:]POWer:ACHannel:SBLock<sb>:TECHnology[:CHANnel<ch>]....663
[SENSe:]POWer:ACHannel:SBLock<sb>:TXCHannel:COUNt....663
[SENSe:]POWer:ACHannel:SPACing:GAP<gap>....664

CALCulate:LIMit:ACPower:GAP<gap>:ABSolute <Limit>, <Reserved>

This command defines the absolute limit of the specified gap (CACLR) channel.

If you have defined an absolute limit as well as a relative limit, the R&S FSW uses the lower value for the limit check.

Suffix:
<gap> 1 | 2
Gap (CACLR) channel number

Parameters:
<Limit> Defines the absolute limit of the specified gap channel in dBm.

<Reserved> Ignored.

Example: `CALC:LIM:ACP:GAP2:ABS 44.2dBm,0`

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Limit Checking" on page 143

CALCulate:LIMit:ACPower:GAP<gap>:ABSolute:STATe <State>

This command turns the absolute limit check for the specified gap (CACLR) channel on and off.

You have to activate the general ACLR limit check before using this command with `CALCulate:LIMit:ACPower[:STATe]`.

Suffix:
<gap> 1 | 2
Gap (CACLR) channel number

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Limit Checking" on page 143

CALCulate:LIMit:ACPower:GAP<gap>[:RELative] <Limit>, <Reserved>

This command defines the relative limit of the specified gap (CACLR) channel. The reference value for the relative limit is the measured channel power.

If you have defined an absolute limit as well as a relative limit, the R&S FSW uses the lower value for the limit check.

Suffix:
<gap> 1 | 2
Gap (CACLR) channel number

Parameters:
<Limit> Defines the relative limit of the specified gap channel in dB.

<Reserved> Ignored.

Example: CALC:LIM:ACP:GAP1:REL 3dB,0

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Limit Checking" on page 143

CALCulate:LIMit:ACPower:GAP<gap>[:RELative:]STATe <State>

This command turns the relative limit check for the specified gap (CACLR) channel on and off.

You have to activate the general ACLR limit check before using this command with `CALCulate:LIMit:ACPower[:STATe]`.

Suffix:
<gap> 1 | 2
Gap (CACLR) channel number

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:LIM:ACP:GAP1:REL:STAT ON

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Limit Checking" on page 143

CALCulate:LIMit:ACPower:GAP<gap>:RESult?

This command queries the state of the limit check for *all* gap (CACLR) channels in an MSR ACLR measurement.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

The results of the power limit checks are also indicated in the `STAT:QUES:ACPL` status registry (see "STATus:QUEStionable:ACPLimit Register" on page 578).

Suffix:
<gap> 1 | 2
irrelevant

Return values:
<LowerGap1>, <UpperGap1>, <LowerGap2>, <UpperGap2> The command returns the results for the four gap channels for each gap (max. 4).

PASSED
Limit check has passed.

FAIL
Limit check has failed.

NONE
No results available, e.g. because limit checking was deactivated

Example:
```
INIT:IMM;*WAI;
CALC:LIM:ACP:GAP2:RES?
PASSED,PASSED,
```

Usage: Query only

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Limit Checking" on page 143

[SENSe:]POWer:ACHannel:BANDwidth|BWIDth:GAP<gap> <Bandwidth>

This command defines the bandwidth of the specified MSR gap (CACLR) channel.

This command is for MSR signals only (see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643).

Suffix:
<gap> 1 | 2
Gap (CACLR) channel number

Parameters:
<Bandwidth> numeric value in Hz

*RST: 3.84 MHz

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Gap (CACLR) Channel Bandwidths" on page 142

[SENSe:]POWer:ACHannel:FILTer:ALPHa:GAP<gap> <Alpha>

This command defines the roll-off factor for the specified gap (CACLR) channel's weighting filter.

Suffix:
<gap> 1 | 2
Gap (CACLR) channel number

Parameters:

<Alpha> Roll-off factor

Range: 0 to 1
*RST: 0.22

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Weighting Filters" on page 142

[SENSe:]POWer:ACHannel:FILTer:ALPHa:SBLock<sb>:CHANnel<ch> <Alpha>

This command defines the roll-off factor for the specified transmission channel's weighting filter.

Suffix:

<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:

<Alpha> Roll-off factor

Range: 0 to 1
*RST: 0.22

Manual operation: See "Tx Channel Definition" on page 137
See "Weighting Filters" on page 138

[SENSe:]POWer:ACHannel:FILTer:STATe:GAP<gap> <State>

This command turns the weighting filter for the specified gap (CACLR) channel on and off.

Suffix:

<gap> 1 | 2
Gap (CACLR) channel number

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Weighting Filters" on page 142

[SENSe:]POWer:ACHannel:FILTer:STATe:SBLock<sb>:CHANnel<ch> <State>

This command turns the weighting filter for the specified transmission channel on and off.

Suffix:

<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<State> ON | OFF
*RST: W-CDMA: ON, other technologies: OFF

Manual operation: See "Tx Channel Definition" on page 137
See "Weighting Filters" on page 138

[SENSe:]POWer:ACHannel:SBCount <Number>

This command defines the number of subblocks, i.e. groups of transmission channels in an MSR signal.

For more information see chapter 5.2.3.4, "Measurement on Multi-Standard Radio (MSR) Signals", on page 116.

Parameters:
<Number> Range: 1 to 5
*RST: 1

Manual operation: See "Number of Subblocks" on page 133

[SENSe:]POWer:ACHannel:SBLock<sb>:BANDwidth|BWIDth[:CHANnel<ch>]
<Bandwidth>

This command defines the bandwidth of the specified MSR Tx channel.

This command is for MSR signals only (see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643).

Suffix:
<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<Bandwidth> Bandwidth in Hz

Manual operation: See "Tx Channel Definition" on page 137
See "Tx Channel Bandwidth" on page 138

[SENSe:]POWer:ACHannel:SBLock<sb>:CENTer[:CHANnel<ch>] <Frequency>

This command defines the (absolute) center frequency of the specified MSR Tx channel.

Note that the position of the first Tx channel in the first subblock and the last Tx channel in the last subblock also affect the position of the adjacent channels.

This command is for MSR signals only (see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643).

Suffix:
<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<Frequency> absolute frequency in Hz

Manual operation: See "Tx Channel Definition" on page 137
See "Tx Center Frequency" on page 137

[SENSe:]POWer:ACHannel:SBLock<sb>:FREQuency:CENTer <Frequency>

This command defines the center of the specified MSR subblock. Note that the position of the subblock also affects the position of the adjacent gap (CACLR) channels.

This command is for MSR signals only (see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643).

Suffix:
<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<Frequency> absolute frequency in Hz

Manual operation: See "Subblock Definition" on page 136
See "Subblock Center Frequency" on page 137

[SENSe:]POWer:ACHannel:SBLock<sb>:NAME[:CHANnel<ch>]? <Name>

This command queries the name of the specified MSR Tx channel.

In MSR ACLR measurements, TX channel names correspond to the specified technology, followed by a consecutive number. The assigned subblock (A,B,C,D,E) is indicated as a prefix (e.g. A: WCDMA1). Channel names cannot be defined manually.

This command is for MSR signals only (see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet` on page 643).

Suffix:
<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<Name> String containing the name of the channel

Example: `POW:ACH:SBL2:NAME:CHAN2?`
Result:
'B:WCDMA'

Usage: Query only

Manual operation: See "Tx Channel Definition" on page 137

[SENSe:]POWer:ACHannel:SBLock<sb>:RFBWidth <Bandwidth>

This command defines the bandwidth of the individual MSR subblock. Note that subblock ranges also affect the position of the adjacent gap channels (CACLR).

This command is for MSR signals only (see CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet on page 643).

Suffix:
<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<Bandwidth> Bandwidth in Hz

Manual operation: See "Subblock Definition" on page 136
See "RF Bandwidth" on page 137

[SENSe:]POWer:ACHannel:SBLock<sb>:TECHnology[:CHANnel<ch>] <Standard>

This command defines the technology used for transmission by the specified MSR Tx channel.

This command is for MSR signals only (see CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet on page 643).

Suffix:
<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<Standard> GSM | WCDMa | LTE_1_40 | LTE_3_00 | LTE_5_00 | LTE_10_00 | LTE_15_00 | LTE_20_00 | USER

Technology used for transmission

GSM
Transmission according to GSM standard

WCDMa
Transmission according to W-CDMA standard

LTE_1_40 | LTE_3_00 | LTE_5_00 | LTE_10_00 | LTE_15_00 | LTE_20_00
Transmission according to LTE standard for different channel bandwidths

USER
User-defined transmission; no automatic preconfiguration possible

Manual operation: See "Tx Channel Definition" on page 137
See "Technology Used for Transmission" on page 138

[SENSe:]POWer:ACHannel:SBLock<sb>:TXCHannel:COUNt <Number>

This command defines the number of transmission channels the specific subblock contains.

This command is for MSR signals only (see CALCulate<n>:MARKer<m>:FUNCtion:POWer:PRESet on page 643).

Suffix:
<sb> 1 | 2 | 3 | 4 | 5
Subblock number

Parameters:
<Number> Range: 1 to 18
*RST: 1

Manual operation: See "Subblock Definition" on page 136
See "Number of Tx Channels (Tx Count)" on page 137

[SENSe:]POWer:ACHannel:SPACing:GAP<gap> <Spacing>

This command defines the distance from subblock to the specified gap channel.

The channels in the upper gap are identical to those in the lower gap. Thus, in the R&S FSW MSR ACLR measurement, only 2 gap channels are configured.

The spacing for gap channels is defined in relation to the outer edges of the surrounding subblocks, i.e.

Spacing = [CF of the gap channel] - [left subblock center] + ([RF bandwidth of left sub-block] /2)

(See also figure 5-5 and figure 5-6.)

Suffix:
<gap> 1 | 2
Gap channel number

Parameters:
<Spacing> numeric value in Hz
*RST: 2.5 MHz

Usage: SCPI confirmed

Manual operation: See "Gap (CACLR) Channel Definition" on page 142
See "Gap (CACLR) Channel Spacings" on page 142

11.5.3.8 Performing an ACLR Measurement

The following commands are required to perform an ACLR measurement:

`CALC:MARK:FUNC:POW:SEL ACP`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:SELect` on page 641

`CALCulate<n>:MARKer<m>:FUNCtion:POWer[:STATe]` on page 641

`INITiate[:IMMediate]` on page 635, see chapter 11.5.1, "Performing Measurements", on page 632

11.5.3.9 Analyzing Measurement Results

The following commands analyze and retrieve measurement results for ACLR measurements.

Useful commands for channel power measurements described elsewhere

- `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 639
- `TRACe<n>[:DATA]` on page 853

Remote commands exclusive to channel power measurements

CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult:PHZ.....665
[SENSe:]POWer:ACHannel:MODE.....665

CALCulate<n>:MARKer<m>:FUNCtion:POWer:RESult:PHZ <State>

This command selects the way the R&S FSW returns results for power measurements.

You can query results with `CALCulate:MARKer:FUNCtion:POWer:RESult?`.

Parameters:

<State> ON | OFF

ON
Channel power density in dBm/Hz

OFF
Channel power in dBm

*RST: OFF

Example: `CALC:MARK:FUNC:POW:RES:PHZ ON`
Output of results referred to the channel bandwidth.

Manual operation: See "Channel Power Levels and Density (Power Unit)" on page 125

[SENSe:]POWer:ACHannel:MODE <Mode>

This command selects the way the R&S FSW displays the power of adjacent channels.

You need at least one adjacent channel for the command to work.

Parameters:

<Mode>

ABSolute
Shows the absolute power of all channels

RELative
Shows the power of adjacent and alternate channels in relation to the transmission channel

*RST: RELative

Manual operation: See "Absolute and Relative Values (ACLR Mode)" on page 124

11.5.3.10 Programming Examples for Channel Power Measurements

The following programming examples are meant to demonstrate the most important commands to perform channel power measurements in a remote environment.

- Example: Configuring and Performing an ACLR Measurement.....666
- Example: Configuring and Performing an MSR ACLR Measurement.....668

Example: Configuring and Performing an ACLR Measurement

In this example we will configure and perform an adjacent-channel power measurement. Note that this example is primarily meant to demonstrate the remote control commands, it does not necessarily reflect a useful measurement task. For most common measurement standards, the R&S FSW performs the measurement optimally with the predefined settings, without further configuration.

```
//-------------Preparing the measurement---------------------
*RST
//Resets the instrument
INIT:CONT OFF
//Selects single sweep mode.

CALC:MARK:FUNC:POW:SEL ACP
//Activates adjacent-channel power measurement.
CALC:MARK:FUNC:POW:PRES GSM
//Selects the user standard "GSM"

//---------------Setting Up Channels------------
POW:ACH:TXCH:COUN 1
//Creates one transmission channel.
POW:ACH:NAME:CHAN1 'TX Channel'
//Names the first transmission channel 'TX Channel'.
POW:ACH:ACP 2
//Creates two adjacent channels - one adjacent channel and one alternate channel.
POW:ACH:NAME:ACH 'ABC'
//Names the adjacent channel 'ABC'
POW:ACH:NAME:ALT1 'XYZ'
//Names the first alternate channel 'XYZ'.
POW:ACH:BWID:CHAN1 30kHz
//Defines a bandwidth of 30 kHz for the transmission channel.
POW:ACH:BWID:ACH 30kHz
//Defines a bandwidth of 30 kHz for the adjacent channel.
POW:ACH:BWID:ALT1 30kHz
//Defines a bandwidth of 30 kHz for the first alternate channel.
POW:ACH:SPAC 33kHz
//Defines a distance of 33 kHz from the center of the transmission channel to the
//center of the adjacent channel.
//Also adjusts the distance to the alternate channels (66 kHz).
POW:ACH:SPAC:ALT1 100kHz
//Defines a distance of 100 kHz from the center of the transmission channel to the
//center of the first alternate channel.
```

```
//---------------Selecting a Reference Channel--
POW:ACH:MODE REL
//Selects relative display of the channel power.
POW:ACH:REF:TXCH:MAN 1
//Defines transmission channel 1 as the reference channel.

//-----------Saving the settings as a user standard--------------
CALC:MARK:FUNC:POW:STAN:SAVE 'my_aclr_standard'
//Saves the user standard with the name "my_aclr_standard".
//Weighting filters can only be defined for user-defined standards.

//---------------Defining Weighting Filters-----
POW:ACH:FILT:ALPH:CHAN1 0.35
//Defines a roll-off factor of 0.35 for the weighting filter of the first
//transmission channel.
POW:ACH:FILT:CHAN1 ON
//Turns the weighting filter for the first transmission channel on.
POW:ACH:FILT:ALPH:ACH 0.35
//Defines a roll-off factor of 0.35 for the weighting filter of the adjacent
//channel.
POW:ACH:FILT:ACH ON
//Turns the weighting filter for the adjacent channel on.
POW:ACH:FILT:ALPH:ALT1 0.35
//Defines a roll-off factor of 0.35 for the weighting filter of the first
//alternate channel.
POW:ACH:FILT:ALT1 ON
//Turns the weighting filter for the first alternate channel on.

//---------------Working with Limits------------
CALC:LIM:ACP:ACH 30DB,30DB
//Defines a relative limit of 30 dB below the power of the reference channel
//for both adjacent channels.
CALC:LIM:ACP:ALT1 25DB,25DB
//Defines a relative limit of 25 dB below the power of the reference channel
//for the first alternate channels.
CALC:LIM:ACP:ACH:ABS -35DBM,-35DBM
//Defines an absolute limit of -35 dBm for both adjacent channels.
CALC:LIM:ACP ON
//Turns the ACLR limit check on.
CALC:LIM:ACP:ACH:STAT ON
//Turns the relative limit check for adjacent channels on.
CALC:LIM:ACP:ACH:ABS:STAT ON
//Turns the absolute limit check for adjacent channels on.
CALC:LIM:ACP:ALT1:ABS:STAT ON
//Turns the absolute limit check for the first alternate channel on.

//--------------Performing the Measurement-----
POW:ACH:PRES ACP;*WAI
//Determines the ideal ACLR measurement configuration.
```

```
POW:ACH:PRES:RLEV;*WAI
//Determines the ideal reference level for the measurement.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

//---------------Limit Check--------------------
CALC:LIM:ACP:ACH:RES?
//Queries the results of the limit check for the adjacent channels.
CALC:LIM:ACP:ALT1:RES?
//Queries the results of the limit check for the first alternate channels.

//---------------Retrieving Results-------------
CALC:MARK:FUNC:POW:RES? ACP
//Returns the results for the ACLR measurement.
```

Example: Configuring and Performing an MSR ACLR Measurement

This example demonstrates how to configure and perform an ACLR measurement on a multi-standard radio signal in a remote environment.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST

// Select ACLR measurement
:CALCulate:MARKer:FUNCtion:POWer:SELect ACPower

// Select MSR Standard :CALCulate:MARKer:FUNCtion:POWer:PRESet MSR

//Configure general measurement settings
:SENSe:FREQuency:CENTer 1.25GHz
:SENSe:FREQuency:SPAN 62.0MHz
:SENSe:POWer:ACHannel:SBCount 3

//----------------- Configuring SUBBLOCK A

:SENSe:POWer:ACHannel:SBLock1:TXCHannel:COUNt 3
:SENSe:POWer:ACHannel:SBLock1:FREQuency:CENTer 1.230GHZ
:SENSe:POWer:ACHannel:SBLock1:RFBWidth 12MHZ

:SENSe:POWer:ACHannel:SBLock1:CENTer:CHANnel1 1.226GHZ
:SENSe:POWer:ACHannel:SBLock1:CENTer:CHANnel2 1.230GHZ
:SENSe:POWer:ACHannel:SBLock1:CENTer:CHANnel3 1.234GHZ

:SENSe:POWer:ACHannel:SBLock1:TECHnology:CHANnel1 WCDMA
:SENSe:POWer:ACHannel:SBLock1:TECHnology:CHANnel2 WCDMA
:SENSe:POWer:ACHannel:SBLock1:TECHnology:CHANnel3 GSM


:SENSe:POWer:ACHannel:SBLock1:BANDwidth:CHANnel1 2.5MHZ
:SENSe:POWer:ACHannel:SBLock1:BANDwidth:CHANnel2 2.5MHZ
```

```
:SENSe:POWer:ACHannel:SBLock1:BANDwidth:CHANnel3 2.5MHZ

//----------------- Configuring SUBBLOCK B

:SENSe:POWer:ACHannel:SBLock2:TXCHannel:COUNt 1
:SENSe:POWer:ACHannel:SBLock2:FREQuency:CENTer 1.255GHZ
:SENSe:POWer:ACHannel:SBLock2:RFBWidth 4MHZ

:SENSe:POWer:ACHannel:SBLock2:CENTer:CHANnel1 1.255GHZ

:SENSe:POWer:ACHannel:SBLock2:TECHnology:CHANnel1 LTE_1_40

:SENSe:POWer:ACHannel:SBLock2:BANDwidth:CHANnel1 3.25MHZ

//----------------- Configuring SUBBLOCK C

:SENSe:POWer:ACHannel:SBLock3:TXCHannel:COUNt 2
:SENSe:POWer:ACHannel:SBLock3:FREQuency:CENTer 1.268GHZ
:SENSe:POWer:ACHannel:SBLock3:RFBWidth 8MHZ

:SENSe:POWer:ACHannel:SBLock3:CENTer:CHANnel1 1.266GHZ
:SENSe:POWer:ACHannel:SBLock3:CENTer:CHANnel2 1.270GHZ


:SENSe:POWer:ACHannel:SBLock3:BANDwidth:CHANnel1 2.75MHZ
:SENSe:POWer:ACHannel:SBLock3:BANDwidth:CHANnel2 2.75MHZ

//----------------- Configuring ADJ channels

:SENSe:POWer:ACHannel:BANDwidth:ACHannel 1.60MHZ
:SENSe:POWer:ACHannel:BANDwidth:ALTernate1 1.60MHZ

:SENSe:POWer:ACHannel:SPACing:ACHannel 3MHZ
:SENSe:POWer:ACHannel:SPACing:ALTernate1 5MHZ

//----------------- Configuring gap (CACLR) channels

:SENSe:POWer:ACHannel:SPACing:GAP1 2.0MHZ
:SENSe:POWer:ACHannel:SPACing:GAP2 5.0MHZ

:SENSe:POWer:ACHannel:BANDwidth:GAP1 2.0MHZ
:SENSe:POWer:ACHannel:BANDwidth:GAP2 2.0MHZ

//--------------Performing the Measurement-----

//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and wait until the sweep has finished.
INIT;*WAI
```

```
//---------------Retrieving Results-------------

//Return the results for the ACLR measurement.
CALC:MARK:FUNC:POW:RES? MCAC
//Results:
//Transmission channels in subblock A
//-13.2346727385,-13.2346723793,-13.2390131759,
//Transmission channels in subblock B
//-17.0863336597,
//Transmission channels in subblock C
//-13.2390127767,-13.2390134744,
//Totals for each subblock
//-8.4649064021,-17.0863336597,-10.2287131689,
//Adjacent channels
//-67.9740721019,-67.9740728014,-0.00434041734,-0.00434041734,
//CACLR channels
//-0.52933512766,-64.9990115835,-64.5012521492,-0.33507330922,
//-64.4924159646,-0.52932552499,-0.52932552495,-64.4934163414
```

11.5.4 Measuring the Carrier-to-Noise Ratio

The following commands are necessary to perform carrier-to-noise measurements.

- `CALC:MARK:FUNC:POW:SEL CN | CN0`, see `CALCulate<n>:MARKer<m>:FUNCtion:POWer:SELect`
- `CALCulate<n>:MARKer<m>:FUNCtion:POWer[:STATe]`
- `CALCulate:MARKer:FUNCtion:POWer:RESult?`
- `[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel<ch>]`
- `[SENSe:]POWer:ACHannel:PRESet`

Programming example

This programming example demonstrates how to perform a Carrier-to-noise measurement in a remote environment.

```
//----------Preparing the measurement------------
*RST
//Reset the instrument
FREQ:CENT 800MHz
//Sets the center frequency to the carrier frequency of 800 MHz.
CALC:MARK:FUNC:POW:SEL CN
//Activates carrier-to-noise ratio measurement.
POW:ACH:PRES CN
//Optimizes the instrument settings according to the channel bandwidth.
POW:ACH:PRES:RLEV
//Determines the ideal reference level for the measurement.

//--------------Performing the Measurement-----
INIT:CONT OFF
```

```
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

// Now turn off the carrier signal and repeat the measurement:
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

//---------------Retrieving Results-------------
CALC:MARK:FUNC:POW:RES? CN
//Returns the carrier-to-noise ratio.
```

11.5.5 Measuring the Occupied Bandwidth

All remote control commands specific to occupied bandwidth measurements are described here.

- Configuring the Measurement.....671
- Programming Example: OBW Measurement.....672

11.5.5.1 Configuring the Measurement

The following commands configure measurements of the occupied bandwidth.

Useful commands for occupied bandwidth measurements described elsewhere

Configuring the channel:

- `[SENSe:]POWer:ACHannel:BANDwidth|BWIDth[:CHANnel<ch>]`
- `[SENSe:]POWer:ACHannel:PRESet`
- `[SENSe:]POWer:ACHannel:PRESet:RLEVel`

Defining search limits:

- `CALCulate:MARKer:X:SLIMits[:STATe]` on page 862
- `CALCulate:MARKer:X:SLIMits:LEFT` on page 863
- `CALCulate:MARKer:X:SLIMits:RIGHT` on page 863

Performing the measurement:

- `CALCulate<n>:MARKer<m>:FUNCtion:POWer:SELect` on page 641
- `CALCulate<n>:MARKer<m>:FUNCtion:POWer[:STATe]` on page 641

Retrieving results:

- `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 639
- `CALCulate<n>:MARKer<m>:FUNCtion:POWer:SELect` on page 641
- `CALCulate<n>:MARKer<m>:FUNCtion:POWer[:STATe]` on page 641

Remote commands exclusive to occupied bandwidth measurements

[SENSe:]POWer:BANDwidth|BWIDth.....672

[SENSe:]POWer:BANDwidth|BWIDth <Percentage>

This command selects the percentage of the total power that defines the occupied bandwidth.

Parameters:

<Percentage> Range: 10 PCT to 99.9 PCT
*RST: 99 PCT

Example: `POW:BWID 95PCT`

Manual operation: See "% Power Bandwidth" on page 161

11.5.5.2 Programming Example: OBW Measurement

This programming example demonstrates the measurement example described in chapter 5.4.5, "Measurement Example", on page 163 in a remote environment.

```
//-------------Configuring the Measurement----------------------
*RST
//Resets the instrument
FREQ:CENT 800MHz
//Sets the center frequency to 800 MHz.
DISP:TRAC:Y:RLEV -10dBm
//Sets the reference level to -10 dBm.
CALC:MARK:FUNC:POW:SEL OBW
//Activates occupied bandwidth measurement.
POW:BWID 99PCT
//Sets the percentage of power to 99%.
POW:ACH:BAND 21kHz
//Sets the channel bandwidth to 21 kHz.
POW:ACH:PRES OBW
//Optimizes the instrument settings according to the channel bandwidth.
POW:ACH:PRES:RLEV
//Determines the ideal reference level for the measurement.
DET APE
//Sets the trace detector to positive peak.

//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

//---------------Retrieving Results-------------
CALC:MARK:FUNC:POW:RES? OBW
//Returns the occupied bandwidth.
```

11.5.6 Measuring the Spectrum Emission Mask

All remote control commands specific to spectrum emission mask measurements are described here.

See also chapter 11.5.2, "Configuring Power Measurements", on page 639.

- Managing Measurement Configurations....673
- Controlling the Measurement....674
- Configuring a Sweep List....675
- Configuring the Reference Range....687
- Configuring the Power Classes....689
- Configuring MSR SEM Measurements....693
- Configuring the List Evaluation....695
- Performing an SEM Measurement....696
- Retrieving Results....696
- Example: SEM Measurement....696

11.5.6.1 Managing Measurement Configurations

The following commands control measurement configurations for SEM measurements.

CALCulate:LIMit:ESPectrum:RESTore....673
[SENSe:]ESPectrum:PRESet[:STANdard]....673
[SENSe:]ESPectrum:PRESet:RESTore....674
[SENSe:]ESPectrum:PRESet:STORe....674

CALCulate:LIMit:ESPectrum:RESTore

This command restores the predefined limit lines for the selected Spectrum Emission Mask standard.

All modifications made to the predefined limit lines are lost and the factory-set values are restored.

Example: `CALC:LIM:ESP:REST`
Resets the limit lines for the current Spectrum Emission Mask standard to the default setting.

[SENSe:]ESPectrum:PRESet[:STANdard] <Standard>

This command loads a measurement configuration.

Standard definitions are stored in an xml file. The default directory for SEM standards is `C:\r_s\instr\sem_std`.

Parameters:

<Standard> String containing the file name.
If you have stored the file in a subdirectory of the directory mentioned above, you have to include the relative path to the file.

Return values:

<Standard> The query returns the name of the currently loaded standard.

[SENSe:]ESPectrum:PRESet:RESTore

This command restores the default configurations of predefined SEM standards.

Note that the command will overwrite customized standards that have the same name as predefined standards.

Usage: Event

Manual operation: See "Restore Standard Files" on page 183

[SENSe:]ESPectrum:PRESet:STORe <Standard>

This command saves the current SEM measurement configuration.

Standard definitions are stored in an xml file. The default directory for SEM standards is `C:\r_s\instr\sem_std`.

Parameters:

<Standard> String containing the file name.
You can save the file in a subdirectory of the directory mentioned above. In that case, you have to include the relative path to the file.

11.5.6.2 Controlling the Measurement

The following commands control the measurement itself.

INITiate:ESPectrum 674
[SENSe:]SWEep:MODE.....674

INITiate:ESPectrum

This command initiates a Spectrum Emission Mask measurement.

Usage: Event

[SENSe:]SWEep:MODE <Mode>

This command selects the spurious emission and spectrum emission mask measurements.

You can select other measurements with

- `CALCulate<n>:MARKer<m>:FUNCtion:POWer[:STATe]`

Parameters:

<Mode>

AUTO
Turns on basic spectrum measurements.

ESPectrum
Turns on spectrum emission mask measurements.

LIST
Turns on spurious emission measurements.

*RST: AUTO

Usage: SCPI confirmed

Manual operation: See "Spectrum Emission Mask" on page 104
See "Spurious Emissions" on page 104

11.5.6.3 Configuring a Sweep List

The following commands define a sweep list for SEM measurements.

See also:

- `CALCulate:LIMit:ESPectrum:PCLass<class>:LIMit[:STATe]` on page 691

[SENSe:]ESPectrum:HighSPeed....676
[SENSe:]ESPectrum:RANGe<range>:BANDwidth[:RESolution]....676
[SENSe:]ESPectrum:RANGe<range>:BANDwidth:VIDeo....676
[SENSe:]ESPectrum:RANGe:COUNt?....677
[SENSe:]ESPectrum:RANGe<range>:DELete....677
[SENSe:]ESPectrum:RANGe<range>:FILTer:TYPE....677
[SENSe:]ESPectrum:RANGe<range>[:FREQuency]:STARt....678
[SENSe:]ESPectrum:RANGe<range>[:FREQuency]:STOP....678
[SENSe:]ESPectrum:RANGe<range>:INPut:ATTenuation....679
[SENSe:]ESPectrum:RANGe<range>:INPut:ATTenuation:AUTO....679
[SENSe:]ESPectrum:RANGe<range>:INPut:GAIN....680
[SENSe:]ESPectrum:RANGe<range>:INPut:GAIN:STATe....680
[SENSe:]ESPectrum:RANGe<range>:INSert....680
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:ABSolute:STARt....681
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:ABSolute:STOP....681
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt....682
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt:ABS....682
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt:FUNCtion....683
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP....684
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP:ABSolute....684
[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP:FUNCtion....685
[SENSe:]ESPectrum:RANGe:LIMit<PClass>:STATe....685
[SENSe:]ESPectrum:RANGe<range>:RLEVel....686
[SENSe:]ESPectrum:RANGe<range>:SWEep:TIME....686
[SENSe:]ESPectrum:RANGe<range>:SWEep:TIME:AUTO....687
[SENSe:]ESPectrum:RANGe<range>:TRANsducer....687

[SENSe:]ESPectrum:HighSPeed <State>

This command turns high speed mode for SEM measurements on and off.

For more information including restrictions see chapter 5.5.4.3, "Fast SEM Measurements", on page 171.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `ESP:HSP ON`

Manual operation: See "Fast SEM" on page 174

[SENSe:]ESPectrum:RANGe<range>:BANDwidth[:RESolution] <RBW>

This command defines the resolution bandwidth for a SEM range.

In case of high speed measurements, the resolution bandwidth has to be identical for all ranges.

Suffix:

<range> 1...30
Selects the measurement range.

Parameters:

<RBW> Resolution bandwidth.
Refer to the data sheet for available resolution bandwidths.

*RST: 30.0 kHz
Default unit: Hz

Manual operation: See "RBW" on page 175

[SENSe:]ESPectrum:RANGe<range>:BANDwidth:VIDeo <VBW>

This command defines the video bandwidth for a SEM range.

In case of high speed measurements, the video bandwidth has to be identical for all ranges.

Suffix:

<range> 1...30
Selects the measurement range.

Parameters:

<VBW> Video bandwidth.
Refer to the data sheet for available video bandwidths.

*RST: 10.0 MHz
Default unit: Hz

Manual operation: See "VBW" on page 175

[SENSe:]ESPectrum:RANGe:COUNt? <Ranges>

This command queries the number of ranges in the sweep list.

Return values:
<Ranges> Number of ranges in the sweep list.

Usage: Query only

[SENSe:]ESPectrum:RANGe<range>:DELete

This command removes a range from the sweep list.

Note that

- you cannot delete the reference range
- a minimum of three ranges is mandatory.

Suffix:
<range> 1...30
Selects the measurement range.

Usage: Event

Manual operation: See "Delete Range" on page 177

[SENSe:]ESPectrum:RANGe<range>:FILTer:TYPE <FilterType>

This command selects the filter type for an SEM range.

In case of high speed measurements, the filter has to be identical for all ranges.

The EMI-specific filter types are available if the EMI (R&S FSW-K54) measurement option is installed, even if EMI measurement is not active. For details see chapter 5.13.3.1, "Resolution Bandwidth and Filter Types", on page 252.

Suffix:
<range> 1...30
Selects the measurement range.

Parameters:

<FilterType>

NORMal
Gaussian filters

CFILter
channel filters

RRC
RRC filters

CISPr | PULSe
CISPR (6 dB) - requires EMI (R&S FSW-K54) option
Return value for query is always `PULS`.

MIL
MIL Std (6 dB) - requires EMI (R&S FSW-K54) option

P5
5 Pole filters

*RST: NORM
Refer to the datasheet for available filter bandwidths.

Manual operation: See "Filter Type" on page 174

[SENSe:]ESPectrum:RANGe<range>[:FREQuency]:STARt <Frequency>

This command defines the start frequency of a SEM range.

Make sure to set an appropriate span. If you set a span that is

- smaller than the span the SEM sweep list covers, the R&S FSW will not measure the ranges that are outside the span - results may be invalid.
- greater than the span the SEM sweep list covers, the R&S FSW will adjust the start frequency of the first SEM range and the stop frequency of the last SEM range to the span

For more information see chapter 5.5.4.1, "Ranges and Range Settings", on page 167.

Suffix:

<range>

1...30
Selects the measurement range.

Parameters:

<Frequency>

Numeric value. Note that the minimum frequency range of a SEM range is 20 Hz.

*RST: -12.75 MHz (range 1), -2.515 MHz (range 2), 2.515 MHz (range 3)
Default unit: Hz

Manual operation: See "Range Start / Range Stop" on page 174

[SENSe:]ESPectrum:RANGe<range>[:FREQuency]:STOP <Frequency>

This command defines the stop frequency of a SEM range.

Make sure to set an appropriate span. If you set a span that is

- smaller than the span the SEM sweep list covers, the R&S FSW will not measure the ranges that are outside the span - results may be invalid.
- greater than the span the SEM sweep list covers, the R&S FSW will adjust the start frequency of the first SEM range and the stop frequency of the last SEM range to the span

For more information see chapter 5.5.4.1, "Ranges and Range Settings", on page 167.

Suffix:
<range> 1...30
Selects the measurement range.

Parameters:
<Frequency> Numeric value.
*RST: -2.52 MHz (range 1), 2.52 MHz (range 2), 250.0 MHz (range 3)
Default unit: Hz

Manual operation: See "Range Start / Range Stop" on page 174

[SENSe:]ESPectrum:RANGe<range>:INPut:ATTenuation <Attenuation>

This command defines the input attenuation for a SEM range.

In case of high speed measurements, the input attenuation has to be identical for all ranges.

Suffix:
<range> 1...20
Selects the measurement range.

Parameters:
<Attenuation> Numeric value.
Refer to the data sheet for the attenuation range.
*RST: 10 dB
Default unit: dB

Manual operation: See "RF Attenuator" on page 176

[SENSe:]ESPectrum:RANGe<range>:INPut:ATTenuation:AUTO <State>

This command turns automatic selection of the input attenuation for a SEM range on and off.

In case of high speed measurements, the input attenuation has to be identical for all ranges.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `ESP:RANG2:INP:ATT:AUTO OFF`
Deactivates the RF attenuation auto mode for range 2.

Manual operation: See "RF Att. Mode" on page 175

[SENSe:]ESPectrum:RANGe<range>:INPut:GAIN <Gain>

This command selects the level of preamplification for a SEM range.

In case of high speed measurements, the level of the preamplifier has to be identical for all ranges.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<Gain> 15 dB | 30 dB
The availability of preamplification levels depends on the R&S FSW model.
• R&S FSW8: 15dB and 30 dB
• R&S FSW13: 15dB and 30 dB
• R&S FSW26: 30 dB
All other values are rounded to the nearest of these two.
*RST: OFF

[SENSe:]ESPectrum:RANGe<range>:INPut:GAIN:STATe <State>

This command turns the preamplifier for a SEM range on and off.

In case of high speed measurements, the state of the preamplifier has to be identical for all ranges.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Preamp" on page 176

[SENSe:]ESPectrum:RANGe<range>:INSert <Mode>

This command inserts a new SEM range and updates the range numbers accordingly.

Suffix:
<range> 1..30
Selects the SEM range.

Parameters:
<Mode> **AFTer**
Inserts a range after the selected range.

BEFore
Inserts a range before the selected range.

Manual operation: See "Insert before/after Range" on page 177

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:ABSolute:STARt <Level>

This command defines an absolute limit for a SEM range.

Unlike manual operation, you can define an absolute limit anytime and regardless of the limit check mode.

Suffix:
<range> 1..30
Selects the measurement range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:
<Level> Absolute limit at the start frequency of a SEM range.

Range: -400 to 400
*RST: -13
Default unit: dBm

Example: `SENSe:ESPectrum:RANGe:LIMit:ABSolute:STARt -10`
For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Abs Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:ABSolute:STOP <Level>

This command defines an absolute limit for a SEM range.

Unlike manual operation, you can define an absolute limit anytime and regardless of the limit check mode.

Suffix:
<range> 1..30
Selects the measurement range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<Level> Absolute limit at the stop frequency of a SEM range.

Range: -400 to 400
*RST: -13
Default unit: dBm

Example: `SENSe:ESPectrum:RANGe:LIMit:ABSolute:STOP -15`
For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Abs Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt <Limit>

This command defines a relative limit for a SEM range.

Unlike manual operation, you can define a relative limit regardless of the limit check mode.

Suffix:

<range> 1..30
Selects the SEM range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<Level> Relative limit at the start frequency of a SEM range.

Range: -400 to 400
*RST: -50
Default unit: dBc

Example: `SENSe:ESPectrum:RANGe:LIMit:RELative:STARt -10`
For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Rel Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt:ABS <Limit>

This command defines an absolute limit for the MAX function of the relative limit for a SEM range.

For more information see "Relative limit line functions" on page 170.

Suffix:

<range> 1..30
Selects the SEM range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<Level> Absolute limit at the start frequency of a SEM range to be used in addition to the relative limit if the MAX function is enabled (see `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt:FUNCtion` on page 683).

Range: -400 to 400
*RST: -13
Default unit: dBm

Example: `SENSe:ESPectrum:RANGe:LIMit:RELative:STARt:ABSolute -10`
For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Rel Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt:FUNCtion
<Function>

This command enables the use of a function when defining the relative limit for a SEM range.

Suffix:

<range> 1..30
Selects the SEM range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<Function> Defines the function to be used to determine the relative limit line start value

MAX
The maximum of the relative *and* the absolute level is used as the limit start value. Use the `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt` and `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt:ABS` commands to define these values.

OFF
No function is used, the relative limit line is defined by a fixed relative start value. Use the `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STARt` command to define this value.

*RST: OFF

Example: `SENSe:ESPectrum:RANGe:LIMit:RELative:STARt:FUNCtion MAX`
For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Rel Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP <Limit>

This command defines a relative limit for a SEM range.

Unlike manual operation, you can define a relative limit anytime and regardless of the limit check mode.

Suffix:

<range> 1..30
Selects the SEM range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<Level> Relative limit at the stop frequency of a SEM range.

Range: -400 to 400
*RST: -50
Default unit: dBc

Example: `SENSe:ESPectrum:RANGe:LIMit:RELative:STOP -15`
For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Rel Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP:ABSolute <Limit>

This command defines an absolute limit for the MAX function of the relative limit for a SEM range.

For more information see "Relative limit line functions" on page 170.

Suffix:

<range> 1..30
Selects the SEM range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<Level> Absolute limit at the stop frequency of a SEM range to be used in addition to the relative limit if the MAX function is enabled (see `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP:FUNCtion` on page 685).

Range: -400 to 400
*RST: -13
Default unit: dBm

Example: `SENSe:ESPectrum:RANGe:LIMit:RELative:STOP:ABSolute -15`
For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Rel Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP:FUNCtion <Function>

This command enables the use of a function when defining the relative limit for a SEM range.

Suffix:

<range> 1..30
Selects the SEM range.

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<Function> Defines the function to be used to determine the relative limit line stop value

MAX
The maximum of the relative *and* the absolute level is used as the limit stop value. Use the `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP` and `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP:ABSolute` commands to define these values.

OFF
No function is used, the relative limit line is defined by a fixed relative stop value. Use the `[SENSe:]ESPectrum:RANGe<range>:LIMit<PClass>:RELative:STOP` command to define this value.

*RST: OFF

Example:

```
SENSe:ESPectrum:RANGe:LIMit:RELative:STOP:FUNCtion MAX
```

For a detailed example see chapter 11.5.6.10, "Example: SEM Measurement", on page 696.

Manual operation: See "Rel Limit Start/Stop" on page 176

[SENSe:]ESPectrum:RANGe:LIMit<PClass>:STATe <State>

This command selects the limit check mode for all SEM ranges.

Suffix:

<PClass> 1..4
Power class for which the limit is defined.

Parameters:

<State> ABSolute | RELative | AND | OR

ABSolute
Checks only the absolute limits defined.

RELative
Checks only the relative limits. Relative limits are defined as relative to the measured power in the reference range.

AND
Combines the absolute and relative limit. The limit check fails when both limits are violated.

OR
Combines the absolute and relative limit. The limit check fails when one of the limits is violated.

*RST: RELative

Manual operation: See "Limit Check 1-4" on page 176

[SENSe:]ESPectrum:RANGe<range>:RLEVel <RefLevel>

This command defines the reference level for a SEM range.

In case of high speed measurements, the reference level has to be identical for all ranges.

Suffix:

<range> 1..30
Selects the measurement range.

Parameters:

<RefLevel> Reference level.
Refer to the data sheet for the reference level range.

*RST: 0 dBm

Manual operation: See "Ref. Level" on page 175

[SENSe:]ESPectrum:RANGe<range>:SWEep:TIME <SweepTime>

This command defines the sweep time for a SEM range.

In case of high speed measurements, the sweep time has to be identical for all ranges.

Suffix:

<range> 1..30
Selects the measurement range.

Parameters:

<SweepTime> Sweep time.
The range depends on the ratios of the span to the RBW and the RBW to the VBW. Refer to the data sheet for more information.

Manual operation: See "Sweep Time" on page 175

[SENSe:]ESPectrum:RANGe<range>:SWEep:TIME:AUTO <State>

This command turns automatic selection of the sweep time for a SEM range on and off.

In case of high speed measurements, the sweep time has to be identical for all ranges.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `ESP:RANG3:SWE:TIME:AUTO OFF`
Deactivates the sweep time auto mode for range 3.

Manual operation: See "Sweep Time Mode" on page 175

[SENSe:]ESPectrum:RANGe<range>:TRANsducer <Transducer>

This command selects a transducer factor for a SEM range.

Note that

- the transducer must cover at least the span of the range
- the x-axis has to be linear
- the unit has to be dB

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<Transducer> String containing the transducer file name, including the path information.

Manual operation: See "Transd. Factor" on page 176

11.5.6.4 Configuring the Reference Range

The following commands define the reference range for the SEM sweep list.

[SENSe:]ESPectrum:BWID....687
[SENSe:]ESPectrum:FILTer[:RRC]:ALPHa....688
[SENSe:]ESPectrum:FILTer[:RRC][:STATe]....688
[SENSe:]ESPectrum:RRANge?....688
[SENSe:]ESPectrum:RTYPe....688

[SENSe:]ESPectrum:BWID <Bandwidth>

This command defines the channel bandwidth of the reference range.

The bandwidth is available if the power reference is the channel power.

Parameters:
<Bandwidth> minimum span ≤ value ≤ span of reference range
*RST: 3.84 MHz

Manual operation: See "Channel Power Settings" on page 179
See "Tx Bandwidth" on page 179

[SENSe:]ESPectrum:FILTer[:RRC]:ALPHa <Alpha>

This command defines the roll-off factor for the RRC filter.

The RRC filter is available if the power reference is the channel power.

Parameters:
<Alpha> Range: 0 to 1
*RST: 0.22

Manual operation: See "Channel Power Settings" on page 179
See "Alpha" on page 179

[SENSe:]ESPectrum:FILTer[:RRC][:STATe] <State>

This command turns the RRC filter in the reference range on and off.

The RRC filter is available if the power reference is the channel power.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Manual operation: See "Channel Power Settings" on page 179
See "RRC Filter State" on page 179

[SENSe:]ESPectrum:RRANge? <RefRange>

This command queries the reference range.

Return values:
<RefRange> Number of the current reference range.
Range: 1 to 30

Usage: Query only

[SENSe:]ESPectrum:RTYPe <Type>

This command defines the type of the power reference.

Parameters:

<Type>

PEAK
Measures the highest peak within the reference range.

CPOWer
Measures the channel power within the reference range (integral bandwidth method).

*RST: CPOWer

Manual operation: See "Power Reference Type" on page 178

11.5.6.5 Configuring the Power Classes

The following commands define the power classes for SEM measurements.

CALCulate:LIMit:ESPectrum:LIMits....689
CALCulate:LIMit:ESPectrum:MODE....690
CALCulate:LIMit:ESPectrum:VALue....690
CALCulate:LIMit:ESPectrum:PCLass:COUNt....691
CALCulate:LIMit:ESPectrum:PCLass<class>[:EXCLusive]....691
CALCulate:LIMit:ESPectrum:PCLass<class>:LIMit[:STATe]....691
CALCulate:LIMit:ESPectrum:PCLass<class>:MAXimum....692
CALCulate:LIMit:ESPectrum:PCLass<class>:MINimum....692

CALCulate:LIMit:ESPectrum:LIMits <Max1>,<Max2>,<Max3>

This command sets or queries up to 4 power classes in one step. You can only define values for the number of power classes defined by `CALCulate:LIMit:ESPectrum:PCLass:COUNt` on page 691.

Setting parameters:

<Max1>

Defines the value range for power class 1 as `-200 to <Max1>`.
Only available for `CALC:LIM:ESP:PCL:COUNT >=2`
If only 2 power classes are defined, the value range for power class 2 is defined as `<Max1> to 200`.

Range: -199 to + 199

<Max2>

Defines the value range for power class 2 as `<Max1> to <Max2>`.
Only available for `CALC:LIM:ESP:PCL:COUNT >=3`
If only 3 power classes are defined, the value range for power class 3 is defined as `<Max2> to 200`.

Range: -199 to + 199, <Max2> must be higher than <Max1>

<Max3>

Defines the value range for power class 3 as `<Max2> to <Max3>`.
The value range for power class 4 is defined as `<Max3> to 200`.
Only available for `CALC:LIM:ESP:PCL:COUNT = 4`

Range: -199 to + 199, <Max3> must be higher than <Max2>

Return values:

<RangeLimits> As a result of the query, the range limits including the beginning of the first power class (-200) and the end of the last power class (+200) are indicated.

Example: `CALC:LIM:ESP:LIM -50,50,70`
Defines the following power classes:
`<-200, -50>`
`<-50, 50>`
`<50, 70>`
`<70, 200>`
Query:
`CALC:LIM:ESP:LIM?`
Response:
`-200,-50,50,70,200`

CALCulate:LIMit:ESPectrum:MODE <Mode>

Which limit line is to be used for an SEM measurement depends on the power class the input signal power belongs to. This command defines wether the power class is determined automatically or manually.

Parameters:

<Mode>

AUTO
The power class (and thus the limit line) is assigned dynamically according to the currently measured channel power.

MANUAL
One of the specified power classes is selected manually for the entire measurement. The selection is made with the `CALCulate:LIMit:ESPectrum:PCLass<class>[:EXCLusive]` command.

*RST: AUTO

Example: `CALC:LIM:ESP:MODE AUTO`
Activates automatic selection of the limit line.

CALCulate:LIMit:ESPectrum:VALue <Power>

This command activates the manual limit line selection as and specifies the expected power as a value. Depending on the entered value, the associated predefined limit lines is selected.

This command has the same effect as a combination of the CALC:LIM:ESP:MODE MAN and the `CALCulate:LIMit:ESPectrum:PCLass<class>[:EXCLusive]` commands; however, the power class to be used is not defined directly, but via the expected power. As opposed to `CALC:LIM:ESP:MODE AUTO`, the power class is not reassigned to the input signal power dynamically, but only once when the command is executed.

Parameters:
<Power> integer
Range: -200 to 199
*RST: 0

Example: CALC:LIM:ESP:VAL 33
Activates manual selection of the limit line and selects the limit line for P = 33.

CALCulate:LIMit:ESPectrum:PCLass:COUNt <NoPowerClasses>

This command sets the number of power classes to be defined. This command must be executed before any new power class values can be defined using CALCulate:LIMit:ESPectrum:PCLass<class>:MAXimum and CALCulate:LIMit:ESPectrum:PCLass<class>:MINimum.

Parameters:
<NoPowerClasses> 1 to 4
*RST: 1

Example: CALC:LIM:ESP:PCL:COUN 2
Two power classes can be defined.

CALCulate:LIMit:ESPectrum:PCLass<class>[:EXCLusive] <State>

This command selects the power class used by the measurement if CALCulate:LIMit:ESPectrum:MODE is set to manual.

Note that:

- You can only use power classes for which limits are defined.

Suffix:
<class> 1...4
power class

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:LIM:ESP:PCL1 ON
Activates the first defined power class.

Manual operation: See "Used Power Classes" on page 180
See "Adding or Removing a Power Class" on page 180

CALCulate:LIMit:ESPectrum:PCLass<class>:LIMit[:STATe] <State>

This command selects the limit check mode for each power class.

Suffix:
<class> 1...4
power class

Parameters:
<State> **ABSolute**
Evaluates only limit lines with absolute power values

RELative
Evaluates only limit lines with relative power values

AND
Evaluates limit lines with relative and absolute power values. A negative result is returned if both limits fail.

OR
Evaluates limit lines with relative and absolute power values. A negative result is returned if at least one limit failed.

*RST: REL

Example: `CALC:LIM:ESP:PCL:LIM ABS`

Manual operation: See "Used Power Classes" on page 180

CALCulate:LIMit:ESPectrum:PCLass<class>:MAXimum <Level>

This command defines the upper limit of a particular power class.

Note:

- The last power class always has an upper limit of 200 dBm.
- The upper limit of a power class must always be the same as the lower limit of the subsequent power class.
- The power class must already exist (see `CALCulate:LIMit:ESPectrum:PCLass:COUNt` on page 691).

Suffix:
<class> 1...4
power class

Parameters:
<Level> Range: -199.9 dBm to 200 dBm

Example: `CALC:LIM:ESP:PCL1:MAX -40 dBm`
Sets the maximum power value of the first power class to -40 dBm.

Manual operation: See "PMin/PMax" on page 180

CALCulate:LIMit:ESPectrum:PCLass<class>:MINimum <Level>

This command defines the lower limit of a particular power class.

Note:

- The first power class always has a lower limit of -200 dBm.

- The lower limit of a power class must always be the same as the upper limit of the previous power class.
- The power class must already exist (see `CALCulate:LIMit:ESPectrum:PCLass:COUNt` on page 691).

Suffix:
<class> 1...4
power class

Parameters:
<Level> Range: -200 dBm to 199.9 dBm

Example: `CALC:LIM:ESP:PCL2:MIN -40 dBm`
Sets the minimum power value of the second power class to -40 dBm.

Manual operation: See "PMin/PMax" on page 180

11.5.6.6 Configuring MSR SEM Measurements

The following commands configure MSR SEM measurements. For details see chapter 5.5.4.4, "Multi-Standard Radio (MSR) SEM Measurements", on page 172.

For manual operation see chapter 5.5.5.4, "MSR Settings", on page 180.

[SENSe:]ESPectrum:MSR:APPLy....693
[SENSe:]ESPectrum:MSR:BCATegory....693
[SENSe:]ESPectrum:MSR:GSM:CPResent....694
[SENSe:]ESPectrum:MSR:LTE:CPResent....694
[SENSe:]ESPectrum:MSR:RFBWidth....694

[SENSe:]ESPectrum:MSR:APPLy

This command configures the SEM sweep list according to the MSR settings defined by previous commands.

Usage: Event

Manual operation: See "Apply to SEM" on page 182

[SENSe:]ESPectrum:MSR:BCATegory <Category>

This command defines the band category for MSR measurements, i.e. the combination of available carriers to measure.

Parameters:

<Category> 1 | 2 | 3

1
2 carriers: LTE FDD and W-CDMA

2
3 carriers: LTE FDD, W-CDMA and GSM/EDGE

3
2 carriers: LTE TDD and TD-SCDMA

*RST: 1

Manual operation: See "Band Category" on page 181

[SENSe:]ESPectrum:MSR:GSM:CPResent <State>

This command defines whether a GSM/Edge carrier is located at the edge of the specified RF bandwidth. In this case, the specification demands specific limits for the SEM ranges.

This command is only available for band category 2 (see `[SENSe:]ESPectrum:MSR:BCATegory` on page 693).

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Carrier Adjacent to RF Bandwidth Edge" on page 181

[SENSe:]ESPectrum:MSR:LTE:CPResent <State>

This command defines whether an LTE FDD 1.4 MHz or 3 MHz carrier is located at the edge of the specified RF bandwidth. In this case, the specification demands specific limits for the SEM ranges.

This command is only available for band category 2 (see `[SENSe:]ESPectrum:MSR:BCATegory` on page 693).

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Carrier Adjacent to RF Bandwidth Edge" on page 181

[SENSe:]ESPectrum:MSR:RFBWidth <Bandwidth>

This command defines the RF bandwidth of the base station for MSR measurements.

Parameters:

<Bandwidth> Bandwidth in Hz

*RST: 10.0 MHz

Manual operation: See "Base Station RF Bandwidth" on page 181

11.5.6.7 Configuring the List Evaluation

The following commands configure the list evaluation.

Useful commands for SEM measurements described elsewhere

- `MMEMory:STORe:LIST` on page 926

Remote commands exclusive to SEM measurements

CALCulate<n>:ESPectrum:PSEarch|PEAKsearch:AUTO....695
CALCulate<n>:ESPectrum:PSEarch|PEAKsearch[:IMMediate]....695
CALCulate<n>:ESPectrum:PSEarch|PEAKsearch:MARGin....695
CALCulate<n>:ESPectrum:PSEarch|PEAKsearch:PSHow....696

CALCulate<n>:ESPectrum:PSEarch|PEAKsearch:AUTO <State>

This command turns the list evaluation on and off.

Parameters:

<State> ON | OFF | 0 | 1
*RST: 1

Example: `CALC:ESP:PSE:AUTO OFF`
Deactivates the list evaluation.

Manual operation: See "List Evaluation State" on page 184
See "List Evaluation State" on page 204

CALCulate<n>:ESPectrum:PSEarch|PEAKsearch[:IMMediate]

This command initiates a list evaluation.

Usage: Event

CALCulate<n>:ESPectrum:PSEarch|PEAKsearch:MARGin <Threshold>

This command defines the threshold of the list evaluation.

Parameters:

<Margin> Range: -200 to 200
*RST: 200
Default unit: dB

Example: `CALC:ESP:PSE:MARG 100`
Sets the margin to 100 dB.

Manual operation: See "Margin" on page 184
See "Margin" on page 205

CALCulate<n>:ESPectrum:PSEarch|PEAKsearch:PSHow

This command turns the peak labels in the diagram on and off.

Peak labels are blue squares.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:ESP:PSE:PSH ON`
Marks all peaks with blue squares.

Manual operation: See "Show Peaks" on page 184
See "Show Peaks" on page 204

11.5.6.8 Performing an SEM Measurement

The following commands are required to perform an SEM measurement:

`SENS:SWE:MODE ESP`, see `[SENSe:]SWEep:MODE` on page 674

`INITiate[:IMMediate]` on page 635, see chapter 11.5.1, "Performing Measurements", on page 632

11.5.6.9 Retrieving Results

The following commands analyze and retrieve measurement results for SEM measurements.

- `CALCulate:LIMit<k>:FAIL` on page 905
- `CALCulate:MARKer:FUNCtion:POWer:RESult?` on page 639
- `TRACe<n>[:DATA]` on page 853
- `TRACe<n>[:DATA]:MEMory?` on page 854
- `TRACe<n>[:DATA]:X?` on page 854

11.5.6.10 Example: SEM Measurement

In this example we will configure and perform an SEM measurement. Note that this example is primarily meant to demonstrate the remote control commands, it does not necessarily reflect a useful measurement task. For most common measurement standards, the R&S FSW performs the measurement optimally with the predefined settings, without further configuration.

```
//------------ Preparing the measurement------------
*RST
//Resets the instrument
SWE:MODE ESP
//Activates SEM Measurement
//SEM has to be in single sweep mode to be configured
```

```
INIT:CONT OFF
//Turns on the SEM measurement.

//------------ Managing Measurement Configurations----------
ESP:PRES 'WCDMA\3GPP\UL\3GPP_UL.xml'
//Loads the 3GPP configuration stored in the file '3GPP_UL.xml'

//------------ Defining the Reference Range-----------------
ESP:RRAN?
//Queries the current reference range.
ESP:RTYP CPOW
//Selects the channel power as the power reference.
ESP:BWID 4 MHZ
//Defines a channel bandwidth of 4 MHz for the power reference.
ESP:FILT:RRC ON
ESP:FILT:ALPH 0.5
//Uses an RRC filter with a roll-off factor of 0.5 when measuring
//the reference power.

//------------ Configuring Power Classes--------------------
CALC:LIM:ESP:PCL:COUN 3
//Defines 3 power classes.
CALC:LIM:ESP:LIM -100,0
//Defines the value ranges of the three power classes as [dBm]:
//power class 1: -200 to -100
//power class 2: -100 to 0
//power class 3: 0 to 200
CALC:LIM:ESP:PCL1:LIM ABS
//Defines an absolute limit check for class 1.
CALC:LIM:ESP:PCL2:LIM REL
//Defines a relative limit check for class 2.
CALC:LIM:ESP:MODE MAN
//Defines a manual selection of the power class.
CALC:LIM:ESP:PCL2 ON
//Activates the use of the second power class for the entire measurement.

//------------ Configuring a Sweep List---------------------
ESP:RANG2:INS AFT
//Inserts a range after range 2.
ESP:RANG1:INS BEF
//Inserts a range before range 1.
ESP:RANG:COUNt?
//Returns the number of measurement ranges in the sweep list (currently 11).
ESP:RANG5:DEL

//Deletes the 11th range.
ESP:RANG1:STOP -10000000

//Defines a stop frequency of -9 MHz for range 1.
```

```
ESP:RANG2:STAR -9000000
//Defines a start frequency of -10 MHz for range 2.

ESP:HSP OFF
//Switches off Fast SEM mode so the ranges can be configured individually.

ESP:RANG2:BAND:RES 1000000
//Defines a resolution bandwidth of 1 MHz for range 2.

ESP:RANG2:FILT:TYPE RRC
//Selects an RRC filter for range 2.
ESP:RANG2:BAND:VID 5000000
//Defines a video bandwidth of 5 MHz for range 2.
ESP:RANG2:SWE:TIME 1
//Defines a sweep time of 1 second for range 2.
ESP:RANG2:RLEV 0
//Defines a reference level of 0 dBm for range 2.
ESP:RANG2:INP:ATT 10
//Defines an input attenuation of 10 dB for range 2.


// Create a transducer that can be used.
// It has to cover the corresponding frequency range

SENSe1:CORRection:TRANsducer:SELect 'Transducer'
SENSe1:CORRection:TRANsducer:UNIT 'DB'
SENSe1:CORRection:TRANsducer:COMMent 'Test Transducer'
// Frequency Span 0 MHz bis 20 Ghz
SENSe1:CORRection:TRANsducer:DATA 0e6,5, 20e9,3


ESP:RANG2:TRAN 'Transducer'
//Includes a transducer called 'transducer' for range 2.

//------------ Configuring the limit check-----------------

ESP:RANG:LIM1:STAT AND
//Checks the absolute and relative limits for all ranges in power class 1 and
//fails if both limits are violated. Since power class 2 is set to be used for
//the entire measurement, values for Limit Check 1 are irrelevant. They are
//defined here to demonstrate the use of the MAX function for relative limits.
ESP:RANG2:LIM1:REL:STAR:FUNC MAX
//Enables the use of maximum function for relative limit start. If the value
//exceeds the larger of the absolute (-13 dBm) and relative (-10 dBc) start
//values, the check fails.
ESP:RANG2:LIM1:REL:STAR -10
ESP:RANG2:LIM1:REL:STAR:ABS -13
ESP:RANG2:LIM1:REL:STOP:FUNC MAX
ESP:RANG2:LIM1:REL:STOP -10
ESP:RANG2:LIM1:REL:STOP:ABS -13
```

```
ESP:RANG:LIM2:STAT OR
//Checks the absolute and relative limits for all ranges in power class 2 and
//fails if either limit is violated. Since power class 2 is set to be used for
//the entire measurement, values for Limit Check 1 are irrelevant.
ESP:RANG2:LIM2:ABS:STAR 10
ESP:RANG2:LIM2:ABS:STOP 10
//Defines an absolute limit of 10 dBm for the entire range 2 for power class 2.
ESP:RANG2:LIM2:REL:STAR -20
ESP:RANG2:LIM2:REL:STOP -20
//Defines a relative limit of -20 dBc for the entire range 2 for power class 2.

//------------ Configuring List Evaluation-----------------
CALC:ESP:PSE:AUTO ON
//Activates list evaluation, i.e. the peak is determined for each range
//after each sweep.
CALC:ESP:PSE:MARG 10dB
//Defines a peak threshold of 10 dB.

//------------ Managing Measurement Configurations----------

ESP:PRES:STOR 'WCDMA\3GPP\UL\3GPP_UL_User.xml'
//Saves the current configuration in a new file named '3GPP_UL_User'
//in the same directory so the standard is not overwritten.

//------------ Performing the measurement------------------
INIT:IMM
//One sweep

//------------ Checking the Results-------------------------
CALC:LIM:FAIL?
//Queries the result of the limit check for all ranges.
TRAC:DATA? LIST
//Returns the peak for each range of the SEM measurement as a list.
```

11.5.7 Measuring Spurious Emissions

All remote control commands specific to spurious emissions measurements are described here.

- Initializing the Measurement....700
- Configuring a Sweep List....700
- Configuring the List Evaluation....708
- Performing a Spurious Measurement....709
- Retrieving and Saving Settings and Results....709
- Programming Example: Spurious Emissions Measurement....709

11.5.7.1 Initializing the Measurement

Note that with the R&S FSW, the spurious measurement must be initialized before you can start configuring the sweep list or list evaluation.

INITiate:SPURious....700

INITiate:SPURious

This command initiates a Spurious Emission measurement.

Usage: Event

11.5.7.2 Configuring a Sweep List

The following commands configure the sweep list for spurious emission measurements.

Useful commands for configuring the sweep described elsewhere:

- `[SENSe:]SWEep:MODE` on page 674

Remote commands exclusive to spurious measurements:

[SENSe:]LIST:RANGe<range>:BANDwidth[:RESolution]....700
[SENSe:]LIST:RANGe<range>:BANDwidth:VIDeo....701
[SENSe:]LIST:RANGe:BREak....701
[SENSe:]LIST:RANGe:COUNt?....701
[SENSe:]LIST:RANGe<range>:DELete....702
[SENSe:]LIST:RANGe<range>:DETector....702
[SENSe:]LIST:RANGe<range>:FILTer:TYPE....702
[SENSe:]LIST:RANGe<range>[:FREQuency]:STARt....703
[SENSe:]LIST:RANGe<range>[:FREQuency]:STOP....703
[SENSe:]LIST:RANGe<range>:INPut:ATTenuation....704
[SENSe:]LIST:RANGe<range>:INPut:ATTenuation:AUTO....704
[SENSe:]LIST:RANGe<range>:INPut:GAIN:STATe....705
[SENSe:]LIST:RANGe<range>:INPut:GAIN[:VALue]....705
[SENSe:]LIST:RANGe<range>:LIMit:STARt....705
[SENSe:]LIST:RANGe:LIMit:STATe....706
[SENSe:]LIST:RANGe<range>:LIMit:STOP....706
[SENSe:]LIST:RANGe<range>:POINts....706
[SENSe:]LIST:RANGe<range>:RLEVel....706
[SENSe:]LIST:RANGe<range>:SWEep:TIME....707
[SENSe:]LIST:RANGe<range>:SWEep:TIME:AUTO....707
[SENSe:]LIST:RANGe<range>:TRANsducer....707

[SENSe:]LIST:RANGe<range>:BANDwidth[:RESolution] <RBW>

This command defines the resolution bandwidth for a spurious emission measurement range.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<RBW> Resolution bandwidth.
Refer to the data sheet for available resolution bandwidths.
Default unit: Hz

Manual operation: See "RBW" on page 201

[SENSe:]LIST:RANGe<range>:BANDwidth:VIDeo <VBW>

This command defines the video bandwidth for a spurious emission measurement range.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<VBW> Video bandwidth.
Refer to the data sheet for available video bandwidths.
Default unit: Hz

Manual operation: See "VBW" on page 201

[SENSe:]LIST:RANGe:BREak <State>

This command controls the sweep.

Parameters:
<State> **ON**
The R&S FSW stops after measuring one range.
To continue with the next range, you have to use `INITiate:CONMeas`.
OFF
The R&S FSW sweeps all ranges in one go.
*RST: OFF

Manual operation: See "Stop After Sweep" on page 202

[SENSe:]LIST:RANGe:COUNt?

This command queries the number of ranges in the sweep list.

Return values:
<Ranges> Number of ranges in the sweep list.

Usage: Query only

[SENSe:]LIST:RANGe<range>:DELete

This command removes a range from the sweep list.

Note that

- you cannot delete the reference range
- a minimum of three ranges is mandatory.

Suffix:
<range> 1..30
Selects the measurement range.

Usage: Event

[SENSe:]LIST:RANGe<range>:DETector <Detector>

This command selects the detector for a spurious emission measurement range.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<Detector>

NEGative
minimum peak detector

POSitive
peak detector

SAMPle
sample detector

RMS
RMS detector

AVERage
average detector

*RST: RMS

Manual operation: See "Detector" on page 202

[SENSe:]LIST:RANGe<range>:FILTer:TYPE <FilterType>

This command selects the filter type for a spurious emission measurement range.

The EMI-specific filter types are available if the EMI (R&S FSW-K54) measurement option is installed, even if EMI measurement is not active. For details see chapter 5.13.3.1, "Resolution Bandwidth and Filter Types", on page 252.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:

<FilterType>

NORMal
Gaussian filters

CFILter
channel filters

RRC
RRC filters

CISPr | PULSe
CISPR (6 dB) - requires EMI (R&S FSW-K54) option
Return value for query is always `PULS`.

MIL
MIL Std (6 dB) - requires EMI (R&S FSW-K54) option

P5
5 Pole filters

*RST: NORM
The available bandwidths of the filters are specified in the data sheet.

Manual operation: See "Filter Type" on page 201

[SENSe:]LIST:RANGe<range>[:FREQuency]:STARt <Frequency>

This command defines the start frequency of a spurious emission measurement range.

Make sure to set an appropriate span. If you set a span that is

- smaller than the span the sweep list covers, the R&S FSW will not measure the ranges that are outside the span - results may be invalid.
- greater than the span the sweep list covers, the R&S FSW will adjust the start frequency of the first range and the stop frequency of the last range to the span

For more information see chapter 5.6, "Spurious Emissions Measurement", on page 195.

Suffix:

<range>

1..30
Selects the measurement range.

Parameters:

<Frequency>

Numeric value.

*RST: -12.75 MHz (range 1), -2.515 MHz (range 2), 2.515 MHz (range 3)
Default unit: Hz

Manual operation: See "Range Start / Range Stop" on page 201

[SENSe:]LIST:RANGe<range>[:FREQuency]:STOP <Frequency>

This command defines the stop frequency of a spurious emission measurement range.

Make sure to set an appropriate span. If you set a span that is

- smaller than the span the sweep list covers, the R&S FSW will not measure the ranges that are outside the span - results may be invalid.
- greater than the span the sweep list covers, the R&S FSW will adjust the start frequency of the first range and the stop frequency of the last range to the span

For more information seechapter 5.6, "Spurious Emissions Measurement", on page 195 .

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<Frequency> Numeric value.
*RST: -2.52 MHz (range 1), 2.52 MHz (range 2), 250.0 MHz (range 3)
Default unit: Hz

Manual operation: See "Range Start / Range Stop" on page 201

[SENSe:]LIST:RANGe<range>:INPut:ATTenuation <Attenuation>

This command defines the input attenuation for a spurious emission measurement range.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<Attenuation> Numeric value.
Refer to the data sheet for the attenuation range.
*RST: 10 dB
Default unit: dB

Manual operation: See "RF Attenuator" on page 202

[SENSe:]LIST:RANGe<range>:INPut:ATTenuation:AUTO <State>

This command turns automatic selection of the input attenuation for a spurious emission measurement range on and off.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Manual operation: See "RF Att. Mode" on page 202

[SENSe:]LIST:RANGe<range>:INPut:GAIN:STATe <State>

This command turns the preamplifier for a spurious emission measurement range on and off.

The preamplification is defined by `[SENSe:]LIST:RANGe<range>:INPut:GAIN[:VALue]` on page 705.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Preamp" on page 202

[SENSe:]LIST:RANGe<range>:INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level for the range.

The command requires option R&S FSW-B24.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<Gain> 15 dB | 30 dB
The availability of preamplification levels depends on the R&S FSW model.
• R&S FSW8: 15dB and 30 dB
• R&S FSW13: 15dB and 30 dB
• R&S FSW26: 30 dB
All other values are rounded to the nearest of these two.
*RST: OFF

[SENSe:]LIST:RANGe<range>:LIMit:STARt <Level>

This command defines an absolute limit for a spurious emission measurement range.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<Level> Absolute limit at the start frequency of a SEM range.
Range: -400 to 400
*RST: 13
Default unit: dBm

Manual operation: See "Abs Limit Start/Stop" on page 203

[SENSe:]LIST:RANGe:LIMit:STATe

This command turns the limit check for all spurious emission measurement ranges on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Limit Check" on page 203

[SENSe:]LIST:RANGe<range>:LIMit:STOP <Level>

This command defines an absolute limit for a spurious emission measurement range.

Suffix:

<range> 1..30
Selects the measurement range.

Parameters:

<Level> Absolute limit at the stop frequency of a SEM range.

Range: -400 to 400
*RST: 13
Default unit: dBm

Manual operation: See "Abs Limit Start/Stop" on page 203

[SENSe:]LIST:RANGe<range>:POINts <Points>

This command defines the number of sweep points in a spurious emission measurement range.

Suffix:

<range> 1..30
Selects the measurement range.

Parameters:

<Points> For more information on sweep points see chapter 6.5.1.8, "How Much Data is Measured: Sweep Points and Sweep Count", on page 366.

*RST: 691

Manual operation: See "Sweep Points" on page 202

[SENSe:]LIST:RANGe<range>:RLEVel <RefLevel>

This command defines the reference level for a spurious emission measurement range.

Suffix:

<range> 1..30
Selects the measurement range.

Parameters:
<RefLevel> Reference level.
Refer to the data sheet for the reference level range.
*RST: 0 dBm

Manual operation: See "Ref. Level" on page 202

[SENSe:]LIST:RANGe<range>:SWEep:TIME <SweepTime>

This command defines the sweep time for a spurious emission measurement range.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<SweepTime> Sweep time.
The range depends on the ratios of the span to the RBW and the RBW to the VBW. Refer to the data sheet for more information.

Manual operation: See "Sweep Time" on page 201

[SENSe:]LIST:RANGe<range>:SWEep:TIME:AUTO <State>

This command turns automatic selection of the sweep time for a spurious emission measurement range on and off.

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Manual operation: See "Sweep Time Mode" on page 201

[SENSe:]LIST:RANGe<range>:TRANsducer <Transducer>

This command selects a transducer factor for a spurious emission measurement range.

Note that

- the transducer must cover at least the span of the range
- the x-axis has to be linear
- the unit has to be dB

Suffix:
<range> 1..30
Selects the measurement range.

Parameters:

<Transducer> String containing the transducer file name, including the path information.

Manual operation: See "Transducer" on page 203

11.5.7.3 Configuring the List Evaluation

The following commands configure the list evaluation.

Useful commands for spurious emission measurements described elsewhere

- `MMEMory:STORe:LIST` on page 926

Remote commands exclusive to spurious emission measurements

CALCulate<n>:PSEarch|PEAKsearch:AUTO....708
CALCulate<n>:PSEarch|PEAKsearch:MARGin....708
CALCulate<n>:PSEarch|PEAKsearch:PSHow....708
CALCulate<n>:PSEarch|PEAKsearch:SUBRanges....709

CALCulate<n>:PSEarch|PEAKsearch:AUTO <State>

This command turns the list evaluation on and off.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `CALC:PSE:AUTO OFF`
Deactivates the list evaluation.

CALCulate<n>:PSEarch|PEAKsearch:MARGin <Threshold>

This command defines the threshold of the list evaluation.

Parameters:

<Margin> Range: -200 to 200
*RST: 200
Default unit: dB

Example: `CALC:PSE:MARG 100`
Sets the threshold to 100 dB.

CALCulate<n>:PSEarch|PEAKsearch:PSHow

This command turns the peak labels in the diagram on and off.

Peak labels are blue squares.

Parameters:

<State> ON | OFF

*RST: OFF

Example: CALC:PSE:PSH ON
Marks all peaks with blue squares.

CALCulate<n>:PSEarch|PEAKsearch:SUBRanges <NumberPeaks>

This command defines the number of peaks included in the peak list.

After this number of peaks has been found, the R&S FSW stops the peak search and continues the search in the next measurement range.

Parameters:

<NumberPeaks> Range: 1 to 50
*RST: 25

Example: CALC:PSE:SUBR 10
Sets 10 peaks per range to be stored in the list.

Manual operation: See "Peaks per Range" on page 205

11.5.7.4 Performing a Spurious Measurement

The following commands are required to perform a Spurious measurement:

SENS:SWE:MODE LIST, see [SENSe:]SWEep:MODE on page 674

INITiate[:IMMediate] on page 635, see chapter 11.5.1, "Performing Measurements", on page 632

11.5.7.5 Retrieving and Saving Settings and Results

The following commands analyze and retrieve measurement results for Spurious measurements.

Useful commands for spurious emission measurements described elsewhere

- CALCulate:LIMit<k>:FAIL on page 905
- TRACe<n>[:DATA] on page 853
- TRACe<n>[:DATA]:MEMory? on page 854
- TRACe<n>[:DATA]:X? on page 854

11.5.7.6 Programming Example: Spurious Emissions Measurement

In the following example, the Spurious Emissions measurement is configured by defining ranges and parameters to create the following sweep list.

Spurious Emissions

	Range 1	Range 2	Range 3
Range Start	10 MHz	100 MHz	100.0000...
Range Stop	100 MHz	100.0000...	1 GHz
Filter Type	RRC	Normal(3...	Normal(3...
Res BW	24.3 kHz	10 kHz	100 kHz
Video BW	5 MHz	30 kHz	300 kHz
Sweep Time Mode	Manual	Auto	Auto
Sweep Time	1 s	4.01 ms	32.1 ms
Detector	Sample	RMS	RMS
Ref. Level	-20 dBm	0 dBm	0 dBm
RF Att. Mode	Manual	Auto	Auto
RF Attenuator	10 dB	10 dB	10 dB
Preamp	On	Off	Off
Sweep Points	601	4001	32001
Stop After Sweep	Off	Off	Off
Transducer	None	None	None
Limit Check	Absolute	Absolute	Absolute
Abs Limit Start	10 dBm	-13 dBm	-13 dBm
Abs Limit Stop	10 dBm	-13 dBm	-13 dBm

Note that this example is primarily meant to demonstrate the remote control commands, it does not necessarily reflect a useful measurement task.

```
//------------Preparing the measurement-------------
*RST
//Resets the instrument

SWE:MODE LIST
//Activates spurious emissions measurement
//Spurious measurement has to be in single sweep mode to be configured

INIT:CONT OFF
//Selects single sweep mode.

//---------------Configuring a Sweep List----------

LIST:RANG:COUNt?
//Returns the number of measurement ranges in the sweep list.
LIST:RANG4:DEL
//Deletes the fourth range.
LIST:RANG1:STAR 10000000
//Defines a start frequency of 10 MHz for range 1.
LIST:RANG1:STOP 100000000
```

```
//Defines a stop frequency of 100 MHz for range 1.
LIST:RANG1:BAND 500000
//Defines a resolution bandwidth of 500 kHz in range 1.
LIST:RANG1:BAND:VID 5000000
//Defines a video bandwidth of 5 MHz for range 1.
LIST:RANG1:INP:ATT:AUTO OFF
//Turns automatic selection of the input attenuation in range 1 off.

LIST:RANG1:INP:ATT 10
//Defines a input attenuation of 10 dBm for range 1.


LIST:RANG1:FILT:TYPE CFILter
//Selects an Channel filter for range 1.
LIST:RANG1:DET SAMP
//Selects a sample detector for range 1.
LIST:RANG1:POIN 601
//Defines 601 sweep points for range 1.
LIST:RANG1:RLEV -20
//Defines a reference level of -20 dBm for range 1.
LIST:RANG1:SWE:TIME 5
//Defines a manual sweep time of 5 second for range 1.

// Create a transducer that can be used.
// It has to cover the corresponding frequency range
//
SENSe1:CORRection:TRANsducer:SELect 'Test'
SENSe1:CORRection:TRANsducer:UNIT 'DB'
SENSe1:CORRection:TRANsducer:COMMent 'Test Transducer'
// Frequency Span 0 MHz to 20 Ghz
SENSe1:CORRection:TRANsducer:DATA 0e6,5, 20e9,3

SENS:LIST:RANG1:TRAN 'Test'
//Includes a transducer called 'Test' for range 1.

LIST:RANG1:LIM:STAR 10
LIST:RANG1:LIM:STOP 10
//Defines an absolute limit of 10 dBm at the start and stop frequencies of range 1.
LIST:RANG:LIM:STAT ON
//Turns the limit check for all ranges on.

//---------------Configuring the List Evaluation----------
CALC:PSE:MARG 100
//Sets the threshold to 100 dB.
CALC:PSE:PSH ON
//Marks all peaks in the diagram with blue squares.
CALC:PSE:SUBR 10
//Sets 10 peaks per range to be stored in the list.

//--------------Performing the Measurement-----
```

```
INIT:SPUR; *WAI
//Performs a spurious emission measurement and waits until the sweep has finished.

//---------------Retrieving Results-------------
CALC:LIM1:FAIL?
//Queries the result of the check for limit line 1.
TRAC? SPUR
//Queries the peak list of the spurious emission measurement.
```

11.5.8 Analyzing Statistics (APD, CCDF)

All remote control commands specific to statistical measurements are described here.

- Activating Statistical Measurements....712
- Configuring Statistical Measurements....713
- Using Gate Ranges for Statistical Measurements....713
- Scaling the Diagram....715
- Performing a Statistical Measurement....718
- Retrieving Results....718
- Programming Example: Measuring Statistics....719

11.5.8.1 Activating Statistical Measurements

The following commands activate statistical measurements.

CALCulate<n>:STATistics:APD[:STATe]....712
CALCulate<n>:STATistics:CCDF[:STATe]....712

CALCulate<n>:STATistics:APD[:STATe] <State>

This command turns the APD measurement on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:STAT:APD ON`
Switches on the APD measurement.

Manual operation: See "APD" on page 104

CALCulate<n>:STATistics:CCDF[:STATe] <State>

This command turns the CCDF on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: CALC:STAT:CCDF ON
Switches on the CCDF measurement.

Manual operation: See "CCDF" on page 105

11.5.8.2 Configuring Statistical Measurements

The following commands configure the measurement.

Useful commands for configuring statistical measurements described elsewhere:

- [SENSe:]BANDwidth|BWIDth[:RESolution] on page 767

Remote commands exclusive to statistical measurements:

CALCulate<n>:MARKer<m>:Y:PERCent....713
CALCulate<n>:STATistics:NSAMples....713

CALCulate<n>:MARKer<m>:Y:PERCent <Probability>

This command sets a marker to a particular probability value. You can query the corresponding level with CALCulate<n>:MARKer<m>:X.

Using the command turns delta markers into normal markers.

This command is available for CCDF measurements.

Parameters:
<Probability> Range: 0 % to 100 %

Example: CALC1:MARK:Y:PERC 95PCT
Positions marker 1 to a probability of 95 %.

Manual operation: See "Percent Marker (CCDF only)" on page 214

CALCulate<n>:STATistics:NSAMples <Samples>

This command defines the number of samples included in the analysis of statistical measurement functions.

Parameters:
<Samples> Range: Min: 100, Max: depends on the RBW filter
*RST: 100000

Example: CALC:STAT:NSAM 500
Sets the number of measurement points to be acquired to 500.

Manual operation: See "Number of Samples" on page 214

11.5.8.3 Using Gate Ranges for Statistical Measurements

The following commands control gated statistical measurements.

[SENSe:]SWEep:EGATe:TRACe<k>:COMMent....714
[SENSe:]SWEep:EGATe:TRACe:PERiod....714
[SENSe:]SWEep:EGATe:TRACe<k>:STARt<range>....714
[SENSe:]SWEep:EGATe:TRACe<k>[:STATe<range>]....715
[SENSe:]SWEep:EGATe:TRACe<k>:STOP<range>....715

[SENSe:]SWEep:EGATe:TRACe<k>:COMMent <Comment>

This command defines a comment for the gate of a particular trace.

Parameters:
<Comment> String containing the comment.

Example: `SWE:EGAT:TRAC1:COMM 'MyComment'`
Defines a comment for the gate in trace 1.

Manual operation: See "Comment" on page 216

[SENSe:]SWEep:EGATe:TRACe:PERiod <Length>

This command defines the length of the gate for all traces.

The gate length applies to all traces.

Parameters:
<Length> Range: 100 ns to 1000 s
*RST: 2 ms

Example: `SWE:EGAT:TRAC1:PER 5ms`
Defines the period for gated triggering to 5 ms.

Manual operation: See "Period" on page 216

[SENSe:]SWEep:EGATe:TRACe<k>:STARt<range> <Time>

This command defines the start time for a gate range.

Suffix:
<range> 1...3
gate range

Parameters:
<Time> The value range depends on the gate period you have set for the selected trace with `[SENSe:]SWEep:EGATe:TRACe:PERiod`.
The following rules apply:
• the start time may not be higher than the length of the gate
• the start time may not be lower than the stop time of the gate range of a lower order
The reset values depend on the gate range.
• for gate range 1, the start time is 0 ms
• for gate range 3, the start time is 2 ms
• for gate range 5, the start time is 4 ms

Example: `SWE:EGAT:TRAC1:STAR1 3ms`
Sets the Starting point for range 1 on trace 1 at 3 ms.

Manual operation: See "Range <x> Start/Stop" on page 216

[SENSe:]SWEep:EGATe:TRACe<k>[:STATe<range>] <State>

This command includes or excludes a gate range for a particular trace.

Suffix:
<range> 1...3
gate range

Parameters:
<State> ON | OFF
*RST: OFF

Example: `SWE:EGAT:TRAC1:STAT1 ON`
Activates gate range 1 for trace 1.

Manual operation: See "Gated Trigger" on page 215
See "Range <x> Use" on page 216

[SENSe:]SWEep:EGATe:TRACe<k>:STOP<range> <Time>

This command defines the stop time for a gate range.

Suffix:
<range> 1...3
gate range

Parameters:
<Time> The value range depends on the gate period you have set for the selected trace with `[SENSe:]SWEep:EGATe:TRACe:PERiod`.
The following rules apply:
• the stop time may not be higher than the length of the gate
• the stop time may not be lower than the start time
The reset values depend on the gate range.
• for gate range 1, the stop time is 1 ms
• for gate range 3, the stop time is 3 ms
• for gate range 5, the stop time is 5 ms

Example: `SWE:EGAT:TRAC1:STOP1 5ms`
Sets the stopping point for range 1 on trace 1 at 5 ms.

Manual operation: See "Range <x> Start/Stop" on page 216

11.5.8.4 Scaling the Diagram

The following commands set up the diagram for statistical measurements.

CALCulate<n>:STATistics:PRESet....716
CALCulate<n>:STATistics:SCALe:AUTO ONCE....716
CALCulate<n>:STATistics:SCALe:X:RANGe....717
CALCulate<n>:STATistics:SCALe:X:RLEVel....717
CALCulate<n>:STATistics:SCALe:Y:LOWer....717
CALCulate<n>:STATistics:SCALe:Y:UNIT....717
CALCulate<n>:STATistics:SCALe:Y:UPPer....718

CALCulate<n>:STATistics:PRESet

This command resets the scale of the diagram (x- and y-axis).

- Reference level (x-axis)
  0.0 dBm
- Display range (x-axis) for APD measurements
  100 dB
- Display range (x-axis) for CCDF measurements
  20 dB
- Upper limit of the y-axis
  1.0
- Lower limit of the y-axis
  1E-6

Example: `CALC:STAT:PRES`
Resets the scaling for statistical functions

Usage: Event

Manual operation: See "Default Settings" on page 218

CALCulate<n>:STATistics:SCALe:AUTO ONCE

This command initiates an automatic scaling of the diagram (x- and y-axis).

To obtain maximum resolution, the level range is set as a function of the measured spacing between peak power and the minimum power for the APD measurement and of the spacing between peak power and mean power for the CCDF measurement. In addition, the probability scale for the number of test points is adapted.

To get valid results, you have to perform a complete sweep with synchronization to the end of the auto range process. This is only possible in single sweep mode.

Parameters:
ONCE

Example: `CALC:STAT:SCAL:AUTO ONCE;*WAI`
Adapts the level setting for statistical measurements.

Usage: Event

Manual operation: See "Adjust Settings" on page 215

CALCulate<n>:STATistics:SCALe:X:RANGe <Range>

This command defines the display range of the x-axis for statistical measurements. The effects are identical to `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]`.

Parameters:

<Range>
Range: 1 dB to 200 dB
*RST: 100 dB

Example:
```
CALC:STAT:SCAL:X:RANG 20dB
```

Manual operation: See "X-Axis" on page 218
See "Range" on page 218

CALCulate<n>:STATistics:SCALe:X:RLEVel <RefLevel>

This command sets the reference level for statistical measurements. The effects are identical to `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel`.

Note that in case of statistical measurements the reference level applies to the x-axis.

Parameters:

<RefLevel>
The unit is variable.
If a reference level offset is included, the range is adjusted by that offset.
Range: -130 dBm to 30 dBm
*RST: 0 dBm

Example:
```
CALC:STAT:SCAL:X:RLEV -60dBm
```

Manual operation: See "X-Axis" on page 218
See "Ref Level" on page 218

CALCulate<n>:STATistics:SCALe:Y:LOWer <Magnitude>

This command defines the lower vertical limit of the diagram.

Parameters:

<Magnitude>
The number is a statistical value and therefore dimensionless.
Range: 1E-9 to 0.1
*RST: 1E-6

Example:
```
CALC:STAT:SCAL:Y:LOW 0.001
```

Manual operation: See "Y-Axis" on page 218
See "Y-Max / Y-Min" on page 218

CALCulate<n>:STATistics:SCALe:Y:UNIT <Unit>

This command selects the unit of the y-axis.

Parameters:

<Unit> PCT | ABS

*RST: ABS

Example: `CALC:STAT:SCAL:Y:UNIT PCT`
Sets the percentage scale.

Manual operation: See "Y-Axis" on page 218
See "Y-Unit" on page 218

CALCulate<n>:STATistics:SCALe:Y:UPPer <Magnitude>

This command defines the upper vertical limit of the diagram.

Parameters:

<Magnitude> The number is a statistical value and therefore dimensionless.

Range: 1E-5 to 1.0
*RST: 1.0

Example: `CALC:STAT:SCAL:Y:UPP 0.01`

Manual operation: See "Y-Axis" on page 218
See "Y-Max / Y-Min" on page 218

11.5.8.5 Performing a Statistical Measurement

The following commands are required to perform a statistical measurement:

`INITiate[:IMMediate]` on page 635, see chapter 11.5.1, "Performing Measurements", on page 632

11.5.8.6 Retrieving Results

The following commands are required to retrieve the measurement results.

Useful commands for retrieving results described elsewhere:

- `CALCulate<n>:MARKer<m>:X` on page 860

Remote commands exclusive to statistical results

CALCulate<n>:STATistics:CCDF:X<t>?....718
CALCulate:STATistics:RESult<t>?....719

CALCulate<n>:STATistics:CCDF:X<t>? <Probability>

This command queries the results of the CCDF.

Query parameters:

<Probability>

P0_01
Level value for 0.01 % probability

P0_1
Level value for 0.1 % probability

P1
P1: Level value for 1 % probability

P10
Level value for 10 % probability

Example: `CALC:STAT:CCDF:X1? P10`
Returns the level values that are over 10 % above the mean value.

Usage: Query only

Manual operation: See "CCDF" on page 105

CALCulate:STATistics:RESult<t>? <ResultType>

This command queries the results of a CCDF or ADP measurement for a specific trace.

Parameters:

<ResultType>

MEAN
Average (=RMS) power in dBm measured during the measurement time.

PEAK
Peak power in dBm measured during the measurement time.

CFACtor
Determined crest factor (= ratio of peak power to average power) in dB.

ALL
Results of all three measurements mentioned before, separated by commas: <mean power>,<peak power>,<crest factor>

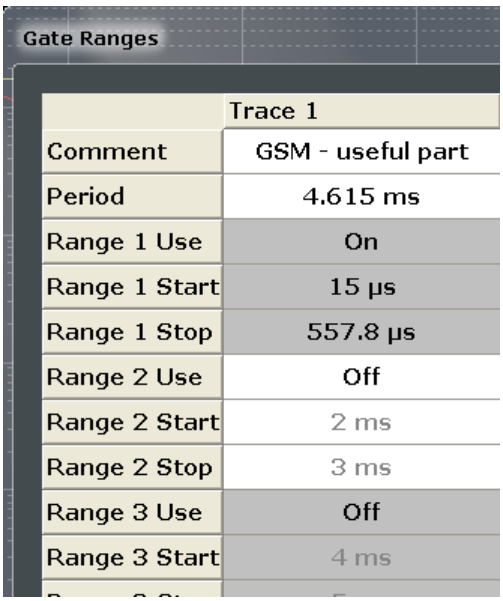
Example: `CALC:STAT:RES2? ALL`
Reads out the three measurement results of trace 2. Example of answer string: 5.56,19.25,13.69 i.e. mean power: 5.56 dBm, peak power 19.25 dBm, crest factor 13.69 dB

Usage: Query only

Manual operation: See "APD" on page 104
See "CCDF" on page 105

11.5.8.7 Programming Example: Measuring Statistics

This example demonstrates how to determine statistical values for a measurement in a remote environment using the gated statistics example described in chapter 5.7.4, "APD and CCDF Basics - Gated Triggering", on page 212.




```
//-----------Configuring the measurement ------------
*RST
//Reset the instrument
TRIG:SOUR EXT
//Defines the use of an external trigger.
TRIG:HOLD 25us
//Defines a trigger offset of 25 µs.
CALC:STAT:APD ON
//Activates APD measurement.
CALC:STAT:NSAM 1000
//Sets the number of samples to be included in the statistical evaluation to 1000.

//-------------Defining Gate ranges -----------------

SWE:EGAT:TRAC1:COMM 'GSM - useful part'
//Defines a comment for the gate
SWE:EGAT:TRAC1:PER 4.61536ms
//Sets the gate period to 4.61536ms.
SWE:EGAT:TRAC1:STAR1 15us
//Sets the start of range 1 to 15 µs.
SWE:EGAT:TRAC1:STOP1 557.8us
//Sets the end of range 1 to 15 µs (start time) + 542.77 µs (useful part) = 557.8 µs.
SWE:EGAT:TRAC1:STAT1 ON
//Activates the use of range 1.

//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.

//---------------Retrieving Results-------------
```

```
CALC:STAT:RES1? MEAN
//Returns the mean average power for the useful part of the GSM signal.

//------------- Determining the CCDF values-------------------

CALC:STAT:CCDF ON
//Activates CCDF measurement.
CALC:MARK2:Y:PERC 95PCT
//Sets marker 2 to the 95% probability value.
INIT;*WAI
//Initiates a new measurement and waits until the sweep has finished.
CALC:STAT:CCDF:X? P1
//Returns the level value for 10% probability for the CCDF.
CALC:MARK2:X?
//Returns the level for a probability of 95%.
```

11.5.9 Measuring the Time Domain Power

All remote control commands specific to time domain power measurements are described here.

- Configuring the Measurement....721
- Performing a Time Domain Power Measurement....724
- Retrieving Measurement Results....724
- Programming Example: Time Domain Power....727

11.5.9.1 Configuring the Measurement

The following remote commands measure the time domain power.

Useful commands for time domain power measurements described elsewhere

- `CALCulate:MARKer:X:SLIMits:LEFT`
- `CALCulate:MARKer:X:SLIMits:RIGHT`
- `CALCulate:MARKer:X:SLIMits[:STATe]`

Remote commands exclusive to time domain power measurements

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AOFF....722
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AVERage....722
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PHOLd....722
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary[:STATe]....722
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN[:STATe]....723
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PPEak[:STATe]....723
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:RMS[:STATe]....723
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:SDEViation[:STATe]....723

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AOFF

This command turns all time domain power evaluation modes off.

Usage: Event

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AVERage <State>

This command switches on or off averaging for the active power measurement in zero span in the window specified by the suffix <n>. If activated, a time domain value is calculated from the trace after each sweep; in the end, all values are averaged to calculate the final result.

The number of results required for the calculation of average is defined with `[SENSe:]AVERage:COUNt`.

Averaging is reset by switching it off and on again.

Synchronization to the end of averaging is only possible in single sweep mode.

Parameters:

<State> ON | OFF

*RST: OFF

Example:

```
INIT:CONT OFF
```
Switches to single sweep mode.
```
CALC:MARK:FUNC:SUMM:AVER ON
```
Switches on the calculation of average.
```
AVER:COUN 200
```
Sets the measurement counter to 200.
```
INIT;*WAI
```
Starts a sweep and waits for the end.

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PHOLd <State>

This command switches on or off the peak-hold function for the active power measurement in zero span in the window specified by the suffix <n>. If activated, the peak for each sweep is compared to the previously stored peak; the maximum of the two is stored as the current peak.

The peak-hold function is reset by switching it off and on again.

Parameters:

<State> ON | OFF

*RST: OFF

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary[:STATe] <State>

This command turns time domain power measurements on and off. This measurement in only available in zero span.

When you turn the measurement on, the R&S FSW activates a marker and positions it on the peak power level in the marker search range.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Time Domain Power" on page 105

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN[:STATe] <State>

This command turns the evaluation to determine the mean time domain power on and off.

The R&S FSW performs the measurement on the trace marker 1 is positioned on.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Results" on page 224

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PPEak[:STATe] <State>

This command turns the evaluation to determine the positive peak time domain power on and off.

The R&S FSW performs the measurement on the trace marker 1 is positioned on.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Results" on page 224

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:RMS[:STATe] <State>

This command turns the evaluation to determine the RMS time domain power on and off.

The R&S FSW performs the measurement on the trace marker 1 is positioned on.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "Results" on page 224

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:SDEViation[:STATe] <State>

This command turns the evaluation to determine the standard deviation of the time domain power on and off.

The R&S FSW performs the measurement on the trace marker 1 is positioned on.

Parameters:
<State> ON | OFF
*RST: OFF

11.5.9.2 Performing a Time Domain Power Measurement

The following commands are required to perform a Time Domain Power measurement:

`INITiate[:IMMediate]` on page 635, see chapter 11.5.1, "Performing Measurements", on page 632

11.5.9.3 Retrieving Measurement Results

The following commands query the results for time domain measurements.

Measuring the Mean Power

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN:AVERage:RESult?.....724
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN:PHOLd:RESult?.....724
CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN:RESult?.....725

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN:AVERage:RESult?

This command queries the average mean time domain power. The query is only possible if averaging has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AVERage` on page 722.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<MeanPower> Mean power of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN:PHOLd:RESult?

This command queries the maximum mean time domain power. The query is only possible if the peak hold function has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PHOLd`.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<MeanPower> Mean power of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:MEAN:RESult?

This command queries the mean time domain power.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<MeanPower> Mean power of the signal during the measurement time.

Usage: Query only

Manual operation: See "Results" on page 224

Measuring the Peak Power

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PPEak:AVERage:RESult?

This command queries the average positive peak time domain power. The query is only possible if averaging has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AVERage` on page 722.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Parameters:
<PeakPower> Peak power of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PPEak:PHOLd:RESult?

This command queries the maximum positive peak time domain power. The query is only possible if the peak hold function has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PHOLd`.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Parameters:
<PeakPower> Peak power of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PPEak:RESult?

This command queries the positive peak time domain power.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Parameters:
<PeakPower> Peak power of the signal during the measurement time.

Usage: Query only

Manual operation: See "Results" on page 224

Measuring the RMS Power

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:RMS:AVERage:RESult?

This command queries the average RMS of the time domain power. The query is only possible if averaging has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AVERage` on page 722.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<RMSPower> RMS power of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:RMS:PHOLd:RESult?

This command queries the maximum RMS of the time domain power. The query is only possible if the peak hold function has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PHOLd`.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<RMSPower> RMS power of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:RMS:RESult?

This command queries the RMS of the time domain power.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<RMSPower> RMS power of the signal during the measurement time.

Usage: Query only

Manual operation: See "Results" on page 224

Measuring the Standard Deviation

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:SDEViation:AVERage:RESult?

This command queries the average standard deviation of the time domain power. The query is only possible if averaging has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:AVERage` on page 722.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<StandardDeviation> Standard deviation of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:SDEViation:PHOLd:RESult?

This command queries the maximum standard deviation of the time domain power. The query is only possible if the peak hold function has been activated previously using `CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:PHOLd`.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<StandardDeviation> Standard deviation of the signal during the measurement time.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:SUMMary:SDEViation:RESult?

This command queries the standard deviation of the time domain power.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:
<StandardDeviation> Standard deviation of the signal during the measurement time.

Usage: Query only

11.5.9.4 Programming Example: Time Domain Power

This programming example demonstrates the measurement example described in chapter 5.8.6, "Measurement Example", on page 226 in a remote environment.

```
//-------------Configuring the Measurement----------------------
*RST
//Resets the instrument
```

```
INIT:CONT OFF
//Turns on single sweep mode.

FREQ:CENT 1.8GHz
//Sets the center frequency to 1.8 GHz.

BAND:RES 100kHz
//Sets the bandwidth to 100 kHz.

SWE:TIME 10ms
//Sets the sweep time to 640 µs.

FREQ:SPAN 0
//Sets the instrument to zero span.


CALC:MARK:FUNC:SUMM:STAT ON
//Turns on time domain power measurements.

CALC:MARK:FUNC:SUMM:MEAN ON
CALC:MARK:FUNC:SUMM:PPE ON
CALC:MARK:FUNC:SUMM:RMS ON
//Turns the evalution of the mean, peak and RMS time domain power.

CALC:MARK:X:SLIM ON
//Activates limit lines for evaluation.

CALC:MARK:X:SLIM:LEFT 1ms
//Sets the left limit line to 326 µs.

CALC:MARK:X:SLIM:RIGH 6ms
//Sets the right limit line to 538 µs.

//--------------Performing the Measurement-----------------------

INIT;*WAI
//Initiates the measurement and waits until the measurement is finished.

//-------------Retrieving the Results--------------------------------
CALC:MARK:FUNC:SUMM:MEAN:RES?
CALC:MARK:FUNC:SUMM:PPE:RES?
CALC:MARK:FUNC:SUMM:RMS:RES?
//Queries the mean, peak and RMS time domain power.
```

11.5.10 Measuring the Harmonic Distortion

All remote control commands specific to harmonic distortion measurements are described here.

- Activating the Measurement....729
- Configuring the Measurement....729
- Performing the Measurement....730
- Retrieving Results....731
- Example: Measuring the Harmonic Distortion....731

11.5.10.1 Activating the Measurement

The following command activates harmonic distortion measurement.

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics[:STATe]....729

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics[:STATe] <State>

This command turns the harmonic distortion measurement on and off.

Note the following:

- If you perform the measurement in the frequency domain, the search range for the frequency of the first harmonic, whose power is determined, is defined by the last span.
- If you perform the measurement in the time domain, the current center frequency is used as the frequency of the first harmonic. Thus, the frequency search is bypassed. The first harmonic frequency is set by a specific center frequency in zero span before the harmonic measurement is started.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK:FUNC:HARM ON`
Activates the harmonic distortion measurement.

Manual operation: See "Harmonic Distortion" on page 105

11.5.10.2 Configuring the Measurement

The following commands control the harmonic distortion measurement.

Useful commands for harmonic distortion measurements described elsewhere

- `CALCulate<n>:MARKer<m>:FUNCtion:CENTer` on page 762
- `[SENSe:]SWEep:TIME:AUTO` on page 773

Remote commands exclusive to harmonic distortion measurements

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:BANDwidth:AUTO.....730
CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:NHARmonics.....730
CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:PRESet.....730

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:BANDwidth:AUTO <State>

This command selects the resolution bandwidth of the harmonic in respect to the bandwidth of the first harmonic.

Parameters:

<State> ON | OFF | 0 | 1

OFF | 0
identical

ON | 1
a multiple

*RST: 1

Manual operation: See "Harmonic RBW Auto" on page 232

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:NHARmonics <NoHarmonics>

This command selects the number of harmonics that the R&S FSW looks for.

Parameters:

<NoHarmonics> Range: 1 to 26
*RST: 10

Manual operation: See "No. of Harmonics" on page 231

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:PRESet

This command initiates a measurement to determine the ideal configuration for the harmonic distortion measurement.

The method depends on the span.

- Frequency domain (span > 0)
  Frequency and level of the first harmonic are determined and used for the measurement list.
- Time domain (span = 0)
  The level of the first harmonic is determined. The frequency remains unchanged.

Usage: Event

Manual operation: See "Adjust Settings" on page 232

11.5.10.3 Performing the Measurement

The following commands are required to perform a harmonic distortion measurement:

INITiate[:IMMediate] on page 635, see chapter 11.5.1, "Performing Measurements", on page 632

11.5.10.4 Retrieving Results

The following commands retrieve the results of the harmonic distortion measurement.

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:DISTortion?.....731
CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:LIST?.....731

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:DISTortion? TOTal

This command queries the total harmonic distortion of the signal.

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 sweeps. See also INITiate:CONTinuous on page 634.

Return values:

<Result> <Distortion_%>,<Distortion_dB>
Pair of values, one showing the THD in %, one in dB.

Usage: Query only

Manual operation: See "Harmonic Distortion" on page 105

CALCulate<n>:MARKer<m>:FUNCtion:HARMonics:LIST?

This command queries the position of the harmonics.

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 sweeps. See also INITiate:CONTinuous on page 634.

Return values:

<Harmonics> Returns one value for every harmonic.
The first value is the absolute power of the first harmonic. The unit is variable.
The other values are power levels relative to the first harmonic. The unit for these is dB.

Usage: Query only

Manual operation: See "Harmonic Distortion" on page 105

11.5.10.5 Example: Measuring the Harmonic Distortion

```
//-------------Configuring the Measurement-------------
*RST
//Resets the instrument.

INIT:CONT OFF
```

```
//Turns on single sweep mode.

CALC:MARK:FUNC:HARM ON
//Turns on the harmonic distortion measurement.
CALC:MARK:FUNC:HARM:NHAR 3
//Defines three harmonics to be found.

CALC:MARK:FUNC:HARM:BAND:AUTO OFF
//Turns off automatic bandwidth selection.
CALC:MARK:FUNC:HARM:PRES
//Determines the ideal configuration.

//-------------Performing the Measurement-------------------

INIT;*WAI
//Initiates the measurement and finishes the sweep.

//-------------Retrieving the Results-----------------------
CALC:MARK:FUNC:HARM:LIST?
//Queries the position of the harmonics.
CALC:MARK:FUNC:HARM:DIST? TOT
//Queries the total harmonic distortion.
```

11.5.11 Measuring the Third Order Intercept Point

- Determining the TOI....732
- Programming Example: Measuring the TOI....734

11.5.11.1 Determining the TOI

All remote control commands specific to TOI measurements are described here.

Useful commands for TOI measurements described elsewhere

- `CALCulate<n>:DELTamarker<m>:X` on page 858
- `CALCulate<n>:DELTamarker<m>:X:RELative?` on page 870
- `CALCulate<n>:DELTamarker<m>:Y?` on page 870
- `CALCulate<n>:MARKer<m>:X` on page 860
- `CALCulate<n>:MARKer<m>:Y?` on page 871

Remote commands exclusive to TOI measurements

CALCulate<n>:MARKer<m>:FUNCtion:TOI[:STATe]....733
CALCulate:MARKer:FUNCtion:TOI:SEARchsignal ONCE....733
CALCulate<n>:MARKer<m>:FUNCtion:TOI:RESult?....733

CALCulate<n>:MARKer<m>:FUNCtion:TOI[:STATe] <State>

This command initiates a measurement to determine the third intercept point.

A two-tone signal with equal carrier levels is expected at the RF input of the instrument. Marker 1 and marker 2 (both normal markers) are set to the maximum of the two signals. Delta marker 3 and delta marker 4 are positioned to the intermodulation products. The delta markers can be modified separately afterwards with the `CALCulate<n>:DELTamarker<m>:X` command.

The third-order intercept is calculated from the level spacing between the normal markers and the delta markers.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK:FUNC:TOI ON`
Switches on the measurement of the third-order intercept.

Manual operation: See "TOI" on page 105

CALCulate:MARKer:FUNCtion:TOI:SEARchsignal ONCE

This command initiates a search for signals in the current trace to determine the third intercept point.

Parameters:

ONCE

Example: `CALC:MARK:FUNC:TOI:SEAR ONCE`
Executes the search for 2 signals and their intermodulation product at the currently available trace.

Usage: Event

Manual operation: See "Search Signals" on page 239

CALCulate<n>:MARKer<m>:FUNCtion:TOI:RESult?

This command queries the results for the third order intercept point measurement.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Parameters:

<TOI> Third order intercept point.

Example: `INIT:CONT OFF`
Switches to single sweep mode.
`CALC:MARK:FUNC:TOI ON`
Switches the intercept measurement.
`INIT;*WAI`
Starts a sweep and waits for the end.
`CALC:MARK:FUNC:TOI:RES?`
Outputs the measured value.

Usage: Query only

Manual operation: See "TOI" on page 105

11.5.11.2 Programming Example: Measuring the TOI

This example demonstrates how to determine the TOI in a remote environment.

```
//----------Configuring the measurement ------------
*RST
//Reset the instrument
CALC:MARK:FUNC:TOI ON
//Activate TOI measurement.

//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.

CALC:MARK:FUNC:TOI:SEAR ONCE
//Initiates a search for signals in the current trace.

//---------------Retrieving Results-------------
CALC:MARK:FUNC:TOI:RES?
//Returns the TOI.
```

11.5.12 Measuring the AM Modulation Depth

All remote control commands specific to AM modulation depth measurements are described here.

- Configuring and Performing the Measurement.....734
- Example: Measuring the AM Modulation Depth.....736

11.5.12.1 Configuring and Performing the Measurement

The following commands control the measurement.

Useful commands for AM modulation depth described elsewhere

- `CALCulate<n>:DELTamarker<m>:X` on page 858
- `CALCulate<n>:DELTamarker<m>:X:RELative?` on page 870

- CALCulate<n>:MARKer<m>:X on page 860

Remote commands exclusive to AM modulation depth measurements

CALCulate<n>:MARKer<m>:FUNCtion:MDEPth[:STATe]....735
CALCulate<n>:MARKer<m>:FUNCtion:MDEPth:SEARchsignal ONCE....735
CALCulate<n>:MARKer<m>:FUNCtion:MDEPth:RESult?....735

CALCulate<n>:MARKer<m>:FUNCtion:MDEPth[:STATe] <State>

This command turns the AM Modulation Depth measurement on and off.

To work correctly, the measurement requires an AM modulated signal.

Parameters:
<State> ON | OFF
*RST: OFF

Manual operation: See "AM Mod Depth" on page 105

CALCulate<n>:MARKer<m>:FUNCtion:MDEPth:SEARchsignal ONCE

This command initiates a search for the signals required for the AM depth measurement.

Note that the command does not perform a new measurement, but looks for the signals on the current trace.

Parameters:
ONCE

Example: CALC:MARK:FUNC:MDEP:SEAR ONCE
Executes the search of an AM modulated signal at the currently available trace.

Usage: Event

Manual operation: See "Search Signals" on page 244

CALCulate<n>:MARKer<m>:FUNCtion:MDEPth:RESult?

This command queries the results of the AM modulation depth measurement..

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 sweeps. See also INITiate:CONTinuous on page 634.

Return values:
<ModulationDepth> Modulation depth in %.

Usage: Query only

Manual operation: See "AM Mod Depth" on page 105

11.5.12.2 Example: Measuring the AM Modulation Depth

This example demonstrates how to determine the AM modulation depth in a remote environment. Note that without a real input signal this measurement will not return useful results.

```
//-----------Configuring the measurement ------------
*RST
//Reset the instrument
FREQ:CENT 100MHz
//Set center frequency
FREQ:SPAN 10KHz
// Set span
CALC:MARK:FUNC:MDEP ON
//Activate AM modulation depth measurement.

//--------------Performing the Measurement-----
INIT:CONT OFF
//Selects single sweep mode.
INIT:IMM
// Perform a single measurement
CALC:MARK:FUNC:MDEP:SEAR ONCE
//Initiates a search for signals in the current trace.

//---------------Retrieving Results-------------
CALC:MARK:FUNC:MDEP:RES?
//Queries the measurement results.

//If the results are not accurate, change the position of the
//the temporary markers manually.

//----Changing the position of the temp markers-----
CALC:MARK:X 100MHZ
//Positions the reference marker on 100 MHz.
CALC:DELT2:X 5KHZ
//Positions delta marker 2 and 3 at a distance of 5 kHz to the reference marker.
CALC:DELT3:X 1KHZ
//Corrects the position of delta marker 3 by 1 kHz.

CALC:MARK:FUNC:MDEP:RES?
//Queries the measurement results for the repositioned markers.
```

11.5.13 Remote Commands for EMI Measurements

The following commands are required to perform EMI measurements in a remote environment. This measurement requires the R&S FSW-K54 option.

The following tasks specific to the EMI application are described here:

- Activating EMI Measurement....737
- Configuring EMI Markers....737
- Configuring the EMI Final Test....738
- Configuring EMI Limit Lines....739
- Controlling LISN....739
- Retrieving EMI Results....740
- Evaluating the Results....743
- Programming Example: EMI Measurement....743

11.5.13.1 Activating EMI Measurement

EMI measurement must be activated explicitely.

CALCulate:MARKer:FUNCtion:FMEasurement:STATe....737

CALCulate:MARKer:FUNCtion:FMEasurement:STATe <State>

This command turns the EMI measurement marker functionality on and off.

Parameters:
<State> **ON | OFF**

Manual operation: See "EMI" on page 106

11.5.13.2 Configuring EMI Markers

The commands required to configure EMI markers are described here.

Useful commands for configuring EMI markers described elsewhere:

- `CALCulate<n>:MARKer<m>[:STATe]` on page 859
  `CALCulate<n>:DELTamarker<m>[:STATe]` on page 858
- `CALCulate<n>:MARKer<m>[:STATe]` on page 859
  `CALCulate<n>:DELTamarker<m>[:STATe]` on page 858
- `CALCulate<n>:DELTamarker<m>:MREF` on page 857
- `CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>` on page 859
  `CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>` on page 857
  `CALCulate<n>:DELTamarker<m>:LINK` on page 856
- `CALCulate<n>:MARKer<m>:TRACe` on page 859

Remote commands exclusive to configuring EMI markers

CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:DETector....737
CALCulate:MARKer<m>:FUNCtion:FMEasurement:DETector....738

CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:DETector <Detector>

This command selects the detector for a specific deltamarker during the final evaluation.

If the deltamarker is not yet active, the command also turns the deltamarker on.

Parameters:

<Detector>

OFF
no final measurement is performed

AVER
average detector

CAV
CISPR Average detector

CRMS
RMS Average detector

POS
maximum peak detector

QPE
quasipeak detector

*RST: OFF

Manual operation: See "Final Test Detector" on page 261

CALCulate:MARKer<m>:FUNCtion:FMEasurement:DETector <Detector>

This command selects the detector for a specific marker during the final measurement.

If the marker is not yet active, the command also turns the marker on.

Parameters:

<Detector>

OFF
no final measurement is performed

AVER
average detector

CAV
CISPR Average detector

CRMS
RMS Average detector

POS
maximum peak detector

QPE
quasipeak detector

*RST: OFF

Manual operation: See "Final Test Detector" on page 261

11.5.13.3 Configuring the EMI Final Test

The commands required to configure the EMI final test are described here.

Useful commands for configuring EMI final tests described elsewhere:

- `[SENSe:]BANDwidth|BWIDth[:RESolution]:TYPE` on page 769
- `[SENSe:]BANDwidth|BWIDth[:RESolution]` on page 767

- DISPlay[:WINDow<n>]:TRACe:X:SPACing on page 762

Remote commands exclusive to configuring EMI final tests

CALCulate:MARKer:FUNCtion:FMEasurement:PSEarch|PEAKsearch:AUTO.....739
CALCulate:MARKer:FUNCtion:FMEasurement:DWELl.....739

CALCulate:MARKer:FUNCtion:FMEasurement:PSEarch|PEAKsearch:AUTO <State>

This command turns an automatic peak search on and off. If enabled, the search is performed automatically after each sweep.

Parameters:

<State> ON | OFF | 0 | 1
*RST: 0

Example: CALC:MARK:FUNC:FME:PEAK:AUTO ON
Activates automatic marker peak search after each sweep.

Manual operation: See "Automatic Peak Search" on page 264

CALCulate:MARKer:FUNCtion:FMEasurement:DWELl <Time>

This command defines the dwell time during the final measurement.

Parameters:

<Time> Range: min value to max value
*RST: 1 s
Default unit: seconds

Manual operation: See "Dwell Time" on page 264

11.5.13.4 Configuring EMI Limit Lines

The commands required to define limit lines for EMI measurements are described in chapter 11.8.4, "Configuring Display and Limit Lines", on page 893.

11.5.13.5 Controlling LISN

The commands required to control a LISN are described here.

INPut:LISN:PHASe.....739
INPut:LISN:FILTer:HPASs[:STATe] 740
INPut:LISN:TYPE.....740

INPut:LISN:PHASe <Phase>

This command selects the phase of the LISN you want to measure.

Parameters:

<Phase>
L1
L2
L3
N
*RST: L1

Example: `INP:LISN:PHAS N`
Selects the N phase.

Manual operation: See "Phase" on page 266

INPut:LISN:FILTer:HPASs[:STATe] <State>

This command turns the 150 kHz highpass filter for the ENV216 network on and off.

Parameters:

<State>
ON | OFF
*RST: OFF

Example: `INP:LISN:HPAS ON`
Turns the filter on.

Manual operation: See "150 kHz Highpass Filter" on page 266

INPut:LISN:TYPE <LISNType>

This command selects the type of network.

Parameters:

<LISNType>
TWOPhase
2-Phase networks
FOURphase
4-Phase networks
ESH3z5
ESH2z5
ENV4200
ENV216
*RST: ---

Example: `INP:LISN:TYPE ESH3z5`
Selects the ESH3z5 network.

Manual operation: See "LISN Type" on page 266

11.5.13.6 Retrieving EMI Results

The commands required to retrieve EMI measurement results are described here.

Useful commands for retrieving EMI measurement results described elsewhere:

- CALCulate<n>:MARKer<m>:X on page 860
  CALCulate<n>:DELTamarker<m>:X on page 858
- CALCulate<n>:MARKer<m>:Y? on page 871
  CALCulate<n>:DELTamarker<m>:Y? on page 870

Remote commands exclusive to retrieving EMI measurement results

CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:RESult?.....741
CALCulate:MARKer<m>:FUNCtion:FMEasurement:RESult?.....741
CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:LIMit<k>:CONDition ?.....741
CALCulate:MARKer<m>:FUNCtion:FMEasurement:LIMit<k>:CONDition ?.....742
CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:LIMit<k>:DELTa?.....742
CALCulate:MARKer<m>:FUNCtion:FMEasurement:LIMit<k>:DELTa?.....742

CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:RESult? <Result>

This command queries the result of the EMI measurement at the deltamarker position.

Return values:

<Result> Absolute power level measured during final EMI measurement.

Example: `CALC:DELT3:FUNC:FME:RES?`
Queries the result of delta marker 3.

Usage: Query only

CALCulate:MARKer<m>:FUNCtion:FMEasurement:RESult? <Result>

This command queries the result of the EMI measurement at the marker position.

Return values:

<Result> Power level. The unit depends on the one you have currently set.

Example: `CALC:MARK1:FUNC:FME:RES?`
Queries the result of marker 1.

Usage: Query only

CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:LIMit<k>:CONDition ?
<Condition>

This command queries the condition of a deltamarker position in relation to a certain limit line.

Return values:

<Condition> **0**
The deltamarker has passed the limit check.

1
The deltamarker is inside the margins of a limit line.

2
The deltamarker has failed the limit check.

Example: `CALC:DELT2:FUNC:FME:LIM2:COND?`
Queries the condition of deltamarker 2 in relation to limit line 2.

Usage: Query only

CALCulate:MARKer<m>:FUNCtion:FMEasurement:LIMit<k>:CONDition ?
<Condition>

This command queries the condition of a marker position in relation to a certain limit line.

Return values:

<Condition> **0**
The marker has passed the limit check.

1
The marker is inside the margins of a limit line.

2
The marker has failed the limit check.

Example: `CALC:MARK1:FUNC:FME:LIM2:COND?`
Queries the condition of marker 1 in relation to limit line 2.

Usage: Query only

CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:LIMit<k>:DELTa?

This command queries the vertical distance from the deltamarker position to the limit line. The unit is dB.

If the deltamarker has been assigned to a different trace than the limit line, or if no limit ine is defined for the marker position, the command returns -200.

Return values:

<Amplitude> Vertical distance to the limit line in dB.

Example: `CALC:DELT3:FUNC:FME:LIM2:DELT?`
Queries the distance of deltamarker 3 to the second limit line.

Usage: Query only

CALCulate:MARKer<m>:FUNCtion:FMEasurement:LIMit<k>:DELTa? <Amplitude>

This command queries the vertical distance from the marker position to the limit line. The unit is dB.

If the marker has been assigned to a different trace than the limit line, or if no limit ine is defined for the marker position, the command returns -200.

Return values:

<Amplitude> Vertical distance to the limit line in dB.

Example: `CALC:MARK3:FUNC:FME:LIM2:DELT?`
Queries the distance of marker 3 to the second limit line.

Usage: Query only

11.5.13.7 Evaluating the Results

The commands required to control the demodulation of signals at the marker position are described in chapter 11.8.3.14, "Marker Demodulation", on page 891.

11.5.13.8 Programming Example: EMI Measurement

This example demonstrates how to detect electromagnetic interferences (EMI) in a remote environment.

```
//----------- Preparing the measurement ------------
//Reset the instrument
*RST
//Define the span to be analyzed
FREQ:STAR 150kHz
FREQ:STOP 1GHz
//Configure two traces, one with peak detector, one with average detector
DISP:TRAC1 ON
DISP:TRAC2 ON
DET1 POS
DET2 AVER


//----------- Configuring the measurement ------------
//Select EMI measurement
CALC:MARK:FUNC:FME:STAT ON
//Configure CISPR filter and RBW
BAND:TYPE CISP
BAND:RES 1MHz
//Define the dwell time
CALC:MARK:FUNC:FME:DWEL 1ms
//Configure an auto peak search
CALC:MARK:FUNC:FME:PEAK:AUTO ON
//Configure a logarithmic frequency scaling
DISP:TRAC:X:SPAC LOG
//Configure marker demodulation for marker 1
CALC:MARK:FUNC:DEM ON
//Increase the number of sweep points
SWE:POIN 200000
//Set the unit to V
```

```
CALC:UNIT:POW V

//----------- Configuring EMI markers ---------------
//Activate 6 normal EMI markers
CALC:MARK1 ON
CALC:MARK2 ON
CALC:MARK3 ON
CALC:MARK4 ON
CALC:MARK5 ON
CALC:MARK6 ON
//Set  markers 1 to 3  on trace 1. Set markers 4 to 6 on trace 2.
CALC:MARK1:TRAC 1
CALC:MARK2:TRAC 1
CALC:MARK3:TRAC 1
CALC:MARK4:TRAC 2
CALC:MARK5:TRAC 2
CALC:MARK6:TRAC 2
//Use CISPR average detector for all markers during final test
CALC:MARK1:FUNC:FME:DET CAV
CALC:MARK2:FUNC:FME:DET CAV
CALC:MARK3:FUNC:FME:DET CAV
CALC:MARK4:FUNC:FME:DET CAV
CALC:MARK5:FUNC:FME:DET CAV
CALC:MARK6:FUNC:FME:DET CAV

//----------- Configuring a limit check -------------
//Select EN55011A.LIN as limit line 1
CALC:LIM1:NAME "EN55011A.LIN"
//Configure trace 1 to be checked against limit line 1
CALC:LIM1:TRAC1:CHEC ON
//Clear the results of all previous limit checks
CALC:LIM:CLE

//----------- Performing the Measurement ------------
//Select single sweep mode.
INIT:CONT OFF
//Initiate a new measurement and wait until the sweep has finished.
INIT;*WAI


//------------ Retrieving Results -------------------
//Query the results for the EMI measurement
//First marker frequency, then final test level
CALC:MARK1:X?
CALC:MARK1:FUNC:FME:RES?
CALC:MARK2:X?
CALC:MARK2:FUNC:FME:RES?
CALC:MARK3:X?
CALC:MARK3:FUNC:FME:RES?
CALC:MARK4:X?
```

```
CALC:MARK4:FUNC:FME:RES?
CALC:MARK5:X?
CALC:MARK5:FUNC:FME:RES?
CALC:MARK6:X?
CALC:MARK6:FUNC:FME:RES?

//Query the result of the limit check for trace 1
CALC:LIM1:FAIL?
//Query the result of the limit check and the distance from the limit line
//for each marker
CALC:MARK1:FUNC:FME:LIM1:COND?
CALC:MARK1:FUNC:FME:LIM1:DELT?
CALC:MARK2:FUNC:FME:LIM1:COND?
CALC:MARK2:FUNC:FME:LIM1:DELT?
CALC:MARK3:FUNC:FME:LIM1:COND?
CALC:MARK3:FUNC:FME:LIM1:DELT?
CALC:MARK4:FUNC:FME:LIM1:COND?
CALC:MARK4:FUNC:FME:LIM1:DELT?
CALC:MARK5:FUNC:FME:LIM1:COND?
CALC:MARK5:FUNC:FME:LIM1:DELT?
CALC:MARK6:FUNC:FME:LIM1:COND?
CALC:MARK6:FUNC:FME:LIM1:DELT?
```

11.5.14 List Evaluations

A list evaluation is a mutliple power measurement that measures the power at up to 200 frequencies. The measurement itself is a time domain measurement. Note that if you set a span greater than 0, the R&S FSW aborts the list evaluation.

Noise cancellation in list evaluations

Nnoise cancellation is also available in zero span and thus also for list evaluations. See "Noise cancellation" on page 124 for details.

List evaluations allow for a different instrument setup for each frequency you want to measure. You can define most of the settings with the commands described here. Settings not covered by the commands listed below can be controlled with the common commands (see chapter 11.7, "Setting Basic Measurement Parameters", on page 761. Note that these commands have to be sent prior to the commands that control the list evaluation.

In case of a triggered measurement, a separate trigger event is required for each frequency to initiate that measurement. Note that you have to make changes to the trigger level in the time domain in order for it to take effect for the List Evaluation commands.

The list evaluation is incompatible to other measurement functions (e.g. marker functionality or statistics). If you use a command that controls those functions, the R&S FSW aborts the list evaluation.

The R&S FSW also aborts the list evaluation if you end the remote session.

The commands can be used in two different ways.

- Instrument setup, measurement and querying of the results in a single command line. This method causes the least delay between the measurement and the result output. However, it requires the control computer to wait for the response from the instrument.
- Instrument setup and querying of the result list at the end of the measurement: With this method, the control computer may be used for other activities while the measurement is being performed. However, more time is needed for synchronization via service request.

11.5.14.1 Performing List Evaluations

All remote control commands specific to list evaluations (which are available via remote control only) are described here.

Useful commands for list evaluation described elsewhere:

- `[SENSe:]POWer:NCORrection` on page 776

Remote commands exclusive to list evaluation

[SENSe:]LIST:POWer:RESult?....746
[SENSe:]LIST:POWer[:SEQuence]....747
[SENSe:]LIST:POWer:SET....748
[SENSe:]LIST:POWer:STATe....749

[SENSe:]LIST:POWer:RESult?

This command queries the results of the list evaluation.

This command may be used to obtain measurement results in an asynchronous way, using the service request mechanism for synchronization to the end of the measurement.

If there are no results, the command returns an error.

Return values:

<PowerLevel> Power level for each frequency included in the measurement.
The command returns up to 3 power levels for each frequency, depending on the number of evaluation modes you have turned on with `[SENSe:]LIST:POWer:SET`.
The result is a list of floating point values separated by commas.
The unit depends on `CALCulate<n>:UNIT:POWer`.

Usage: Query only

[SENSe:]LIST:POWer[:SEQuence] <Frequency>, <RefLevel>, <RFAttenuation>, <ElAttenuation>, <FilterType>, <RBW>, <VBW>, <MeasTime>, <TriggerLevel>

This command configures and initiates the List Evaluation measurement.

The list can contain up to 200 entries (frequencies). You can define a different instrument setup for each frequency that is in the list.

If you synchronize the measurement with `*OPC`, the R&S FSW produces a service request when all frequencies have been measured and the number of individual measurements has been performed.

Note that using the command as a query initiates the measurement and returns the results if all frequencies have been measured. For more information on querying the results see `[SENSe:]LIST:POWer:RESult?`.

Parameters:

<Frequency> Defines the receive frequency. Each frequency corresponds to one list entry.

Range: 0 to Fmax
Default unit: Hz

<RefLevel> Defines the reference level for a list entry.

Range: -130 to 30
Increment: 0.01
Default unit: dBm

<RFAttenuation> Defines the RF attenuation for a list entry.

Range: 0 to 70
Increment: 1
Default unit: dB

<ElAttenuation> Defines the electronic attenuation for a list entry.

Range: 0 to 30
Increment: 1
Default unit: dB

<FilterType> Selects the filter type for a list entry. For more information see `[SENSe:]BANDwidth|BWIDth[:RESolution]:TYPE`.

<RBW> Defines the resolution bandwidth for a list entry.

<VBW> Defines the video bandwidth for a list entry.

<MeasTime> Defines the measurement time for a list entry.

Range: 1 µs to 16000 s

<TriggerLevel> The trigger level must be 0.

Return values:

<PowerLevel> Power level for each frequency included in the measurement. The command returns up to 3 power levels for each frequency, depending on the number of evaluation modes you have turned on with `[SENSe:]LIST:POWer:SET`.
The result is a list of floating point values separated by commas. The unit depends on `CALCulate<n>:UNIT:POWer`.

[SENSe:]LIST:POWer:SET <PeakPower>, <RMSPower>, <AVGPower>, <TriggerSource>, <TriggerSlope>, <TriggerOffset>, <GateLength>

This command defines global List Evaluation parameters.

These parameters are valid for every frequency you want to measure.

The state of the first three parameters (<PeakPower>, <RMSPower> and <AVGPower>) define the number of results for each frequency in the list.

Note that you have to set the trigger level *after* sending this command.

Parameters:

<PeakPower> ON | OFF | 0 | 1
Turns peak power evaluation on and off.
*RST: 1

<RMSPower> ON | OFF | 0 | 1
Turns RMS power evaluation on and off.
*RST: 0

<AVGPower> ON | OFF | 0 | 1
Turns average power evaluation on and off.
*RST: 0

<TriggerSource> EXTernal | EXT2 | EXT3 | IMMediate | IFPower | RFPower | VIDeo
Selects a trigger source.
For more information see Configuring Triggered and Gated Measurements.

<TriggerSlope> NEGative | POSitive
Selects the trigger slop.

<TriggerOffset> Defines the trigger delay.
Range: negative measurement time to 30
*RST: 0
Default unit: s

<GateLength> Defines the gate length for gated measurements.
Setting 0 seconds turns gated measurements off.
To perform gated measurements, the trigger source must be different from `IMMediate`.

Range: 31.25 ns to 30 s
*RST: 0 s

[SENSe:]LIST:POWer:STATe <State>

This command turns the List Evaluation off.

Parameters:
<State> OFF

*RST: OFF

11.5.14.2 Example: Performing List Evaluation

The following example shows a list evaluation with the following configuration.

No	Freq [MHz]	Ref Level [dBm]	RF Attenuation [dB]	EI Attenuation [dB]	Filter	RBW	VBW	Meas Time	Trigger Level
1	935.2	0	10	---	Normal	1 MHz	3 MHz	440 µs	0
2	935.4	0	10	10	Channel	30 kHz	100 kHz	440 µs	0
3	935.6	0	10	20	Channel	30 kHz	100 kHz	440 µs	0

```
-----Measurement with synchronization via service request-----
*ESE 1
*SRE 32
// Configures the status reporting system to produce a service request.
LIST:POW:STAT ON
//Turns on the list evaluation.
LIST:POW:SET ON,ON,OFF,EXT,POS,10us,434us
//Configures the global list evaluation settings and evaluates the peak and RMS power.
LIST:POW
935.2MHZ,0,10,OFF,NORM,1MHZ,3MHZ,440us,0,
935.4MHZ,0,10,10,CFIL,30KHZ,100KHZ,440us,0,
935.6MHZ,0,10,20,CFIL,30KHZ,100KHZ,440us,0;
*OPC
//Defines a list with 3 entries and initiates the measurement with synchronization to the end
//Analyzer produces a service request
//On service request:
SENS:LIST:POW:RES?
//Returns the results of the measurements, two for each frequency (peak and RMS power).

-----Initiliazing the measurement and querying results simultaneously-----
```

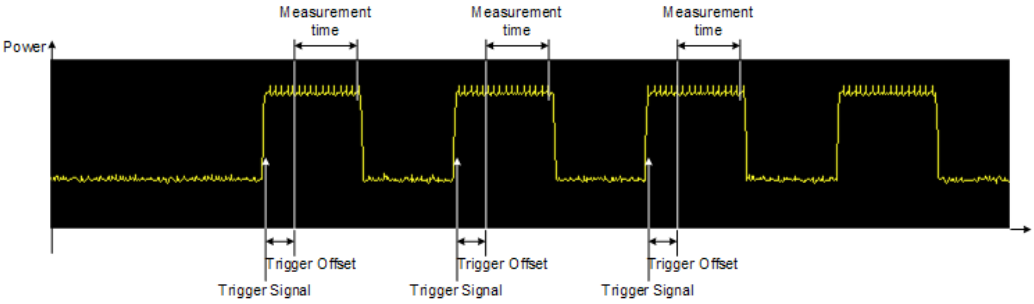
```
LIST:POW?
935.2MHZ,0,10,OFF,NORM,1MHZ,3MHZ,440us,0,
935.4MHZ,0,10,10,CFIL,30KHZ,100KHZ,440us,0,
935.6MHZ,0,10,20,CFIL,30KHZ,100KHZ,440us,0
//Defines a list with 3 entries, initiates the measurement and queries the results.
//Result example:
-28.3,-30.6,-38.1
```

11.5.15 Measuring the Pulse Power

All remote control commands specific to measuring the mean or peak pulse power (e.g. bursts in various telecommunications standards) are described here. This measurement is available via remote control only.

The Pulse Power measurement is a gated measurement that determines the power over a particular number of pulses. The measurement is controlled by an external trigger or the video signal. A separate trigger event is required for each burst included in the measurement. In case of an external trigger source, the trigger level corresponds to the TTL level. In case of a video signal, you can define any threshold.

The figure below shows the relations between the available trigger settings.



The measurement is always on trace 1, either with the peak detector to determine the peak power or the RMS detector to determine the RMS power. Overall, you can configure the measurement independent of the instrument setup with the commands listed below only, which results in faster measurements.

The Pulse Power measurement is incompatible to other measurement functions (e.g. marker functionality or statistics). If you use a command that controls those functions, the R&S FSW aborts the Pulse Power measurement.

The R&S FSW also aborts the Pulse Power measurement if you end the remote session.

The commands can be used in two different ways.

- Instrument setup, measurement and querying of the results in a single command line. With this method, there is the least delay between the measurement and the result output. However, it requires the control computer to wait for the response from the instrument.
- Instrument setup and querying of the result list at the end of the measurement: With this method, the control computer may be used for other activities while the mea-

surement is being performed. However, more time is needed for synchronization via service request.

11.5.15.1 Performing Pulse Power Measurements

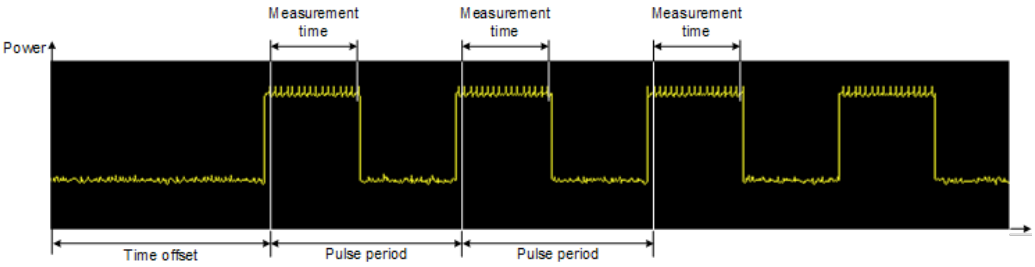
The following commands control pulse power measurements.

CALCulate<n>:MARKer<m>:FUNCtion:MSUMmary....751
[SENSe:]MPOWer:FTYPe....752
[SENSe:]MPOWer:RESult[:LIST]?....752
[SENSe:]MPOWer:[:SEQuence]....752
[SENSe:]MPOWer:RESult:MIN?....753

CALCulate<n>:MARKer<m>:FUNCtion:MSUMmary
<TimeOffset>,<MeasTime>,<PulsePeriod>,<#OfPulses>

This command configures power measurements on pulses in the time domain.

To evaluate the pulse power, the R&S FSW uses the data captured during a previous measurement. The data recorded during the set measurement time is combined to a measured value for each pulse according to the detector specified and the indicated number of results is output as a list.



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 sweeps. See also `INITiate:CONTinuous` on page 634.

Parameters:

<TimeOffset> Defines a time offset to start the measurement at the first pulse of a trace.
*RST: 0
Default unit: s

<MeasTime> Defines the measurement time.
Default unit: s

<PulsePeriod> Defines the pulse period

<#OfPulses> Defines the number of pulses to measure.

Example: `CALC:MARK:FUNC:MSUM 50US,450US,576.9US,8`
Evaluates data that contains 8 pulses during a measurement time of 450 µs and a pulse period of 576.9 µs. The evaluation starts with an offset of 50 µs.

[SENSe:]MPOWer:FTYPe <FilterType>

This command selects the filter type for pulse power measurements.

The EMI-specific filter types are available if the EMI (R&S FSW-K54) measurement option is installed, even if EMI measurement is not active. For details see chapter 5.13.3.1, "Resolution Bandwidth and Filter Types", on page 252.

Parameters:

<FilterType>

CFILter

NORMal

P5

RRC

CISPr | PULSe
CISPR (6 dB) - requires EMI (R&S FSW-K54) option
Return value for query is always `PULS`.

MIL
MIL Std (6 dB) - requires EMI (R&S FSW-K54) option

[SENSe:]MPOWer:RESult[:LIST]?

This command queries the results of the pulse power measurement.

This command may be used to obtain measurement results in an asynchronous way, using the service request mechanism for synchronization to the end of the measurement.

If there are no results, the command returns an error.

Return values:

<PulsePower> List of pulse powers.
The number of values depends on the number of pulses you have been measuring.
The unit is dBm.

Usage: Query only

[SENSe:]MPOWer:[:SEQuence] <Frequency>, <RBW>, <MeasTime>, <TriggerSource>, <TriggerLevel>, <TriggerOffset>, <Detector>, <#OfPulses>

This command configures and initiates the pulse power measurement.

The R&S FSW caches all measurement parameters that you can set with this command. If you use the command repeatedly, the R&S FSW only changes those settings that you have actually changed before initiating the measurement. Thus, measurement times are kept as low as possible.

If you synchronize the measurement with `*OPC`, the R&S FSW produces a service request when all frequencies have been measured and the number of individual measurements has been performed.

Note that using the command as a query initiates the measurement and returns the results if all frequencies have been measured. For more information on querying the results see `[SENSe:]LIST:POWer:RESult?`.

Parameters:

<Frequency> Defines the pulse frequency.
Range: 0 to Fmax
Default unit: Hz

<RBW> Defines the resolution bandwidth.

<MeasTime> Defines the measurement time.
Range: 1 µs to 30 s

<TriggerSource> EXTernal | EXT2 | EXT3 | VIDeo
Selects a trigger source.
For more information see Configuring Triggered and Gated Measurements.

<TriggerLevel> Defines a trigger level.
The trigger level is available for the video trigger. In that case, the level is a percentage of the diagram height.
In case of an external trigger, the R&S FSW uses a fix TTL level.
Range: 0 to 100
Default unit: PCT

<TriggerOffset> Defines the trigger delay.
Range: 0 s to 30 s
*RST: 0 s
Default unit: s

<Detector> Selects the detector and therefore the way the measurement is evaluated.
MEAN
Calculates the RMS pulse power.
PEAK
Calculates the peak pulse power.

<#OfPulses> Defines the number of pulses included in the measurement.
Range: 1 to 32001

Return values:

<PowerLevel> Pulse power level.
The result is a list of floating point values separated by commas.
The unit is dBm.

[SENSe:]MPOWer:RESult:MIN?

This command queries the lowest pulse power that has been measured during a pulse power measurement.

If there are no results, the command returns an error.

Return values:

<PulsePower> Lowest power level of the pulse power measurement. The unit is dBm.

Usage: Query only

11.5.15.2 Example: Performing a Pulse Power Measurement

The following example shows a pulse power measurement.

```
-----Measurement with synchronization via service request-----
*ESE 1
*SRE 32
// Configures the status reporting system to produce a service request.
MPOW:FTYP NORM
//Selects a Gaussian filter for the measurement.
MPOW 935.2MHZ,1MHZ,434us,VID,50,5us,MEAN,20;
*OPC
//Configures and initiates a measurement on 20 pulses with synchronization to the end.
//Analyzer produces a service request
//On service request:
MPOW:RES?
//Returns the results of the measurements (20 power levels).
MPOW:RES:MIN?
//Returns the lowest of the 20 power level that have been measured.

-----Initiliazing the measurement and querying results simultaneously-----
MPOW? 935.2MHZ,1MHZ,434us,VID,50,5us,MEAN,20
//Configures, initiates and queries the results of the measurement.
//Result example:
-105.225059509,-105.656074524,-105.423065186,-104.374649048,-103.059822083,-101.29511261,
-99.96534729,-99.7452468872,-99.6610794067,-100.327224731,-100.96686554,-101.450386047,
-102.150642395,-103.240142822,-105.95476532,-110.583129883,-115.7760849,-126.279388428,
-124.620399475,-116.97366333
```

11.6 Configuring the Result Display

The commands required to configure the screen display in a remote environment are described here.

The tasks for manual operation are described in chapter 7.1, "Result Display Configuration", on page 397.

- General Window Commands.....755
- Working with Windows in the Display.....755

11.6.1 General Window Commands

The following commands are required to configure general window layout, independant of the application.

Note that the suffix <n> always refers to the window *in the currently selected measurement channel* (see `INSTrument[:SELect]` on page 627).

DISPlay:FORMat....755
DISPlay[:WINDow<n>]:SIZE....755

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels (See chapter 4.1, "R&S MultiView", on page 89).

SINGle
Displays the measurement channel that was previously focused.

*RST: SPL

Example: `DISP:FORM SING`

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 758).

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:LARG`

11.6.2 Working with Windows in the Display

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* (see `INSTrument[:SELect]` on page 627).

LAYout:ADD[:WINDow]?....756
LAYout:CATalog[:WINDow]?....757
LAYout:IDENtify[:WINDow]?....757
LAYout:REMove[:WINDow]....757
LAYout:REPLace[:WINDow]....758
LAYout:SPLitter....758
LAYout:WINDow<n>:ADD?....760
LAYout:WINDow<n>:IDENtify?....760
LAYout:WINDow<n>:REMove....760
LAYout:WINDow<n>:REPLace....761

LAYout:ADD[:WINDow]? <WindowName>,<Direction>,<WindowType>

This command adds a window to the display.

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.

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.

Example:

```
LAY:ADD? '1',LEFT,MTAB
```

Result:

```
'2'
```

Adds a new window named '2' with a marker table to the left of window 1.

Usage: Query only

Manual operation: See "Diagram" on page 398
See "Marker Table" on page 398
See "Marker Peak List" on page 398
See "Result Summary" on page 399
See "Spectrogram" on page 399

Table 11-2: <WindowType> parameter values for the Spectrum application

Parameter value	Window type
DIAGram	Diagram
MTABle	Marker table
PEAKlist	Marker peak list
RSUMmary	Result summary
SGRam	Spectrogram

LAYout:CATalog[:WINDow]?

This command queries the name and index of all active windows 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.

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.

Usage: Query only

LAYout:REMove[:WINDow] <WindowName>

This command removes a window from the display.

Parameters:

<WindowName> String containing the name of the window.
In the default state, the name of the window is its index.

Usage: Event

LAYout:REPLace[:WINDow] <WindowName>,<WindowType>

This command replaces the window type (for example from "Diagram" to "Result Summary") of an already existing window while keeping its position, index and window name.

To add a new window, use the `LAYout:ADD[:WINDow]?` command.

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, 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 756 for a list of available window types.

Example: `LAY:REPL:WIND '1',MTAB`
Replaces the result display in window 1 with a marker table.

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.

As opposed to the `DISPlay[:WINDow<n>]:SIZE` on page 755 command, the `LAYout:SPLitter` changes the size of all windows to either side of the splitter permanently, it does not just maximize a single window temporarily.

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 will not work, but does not return an error.

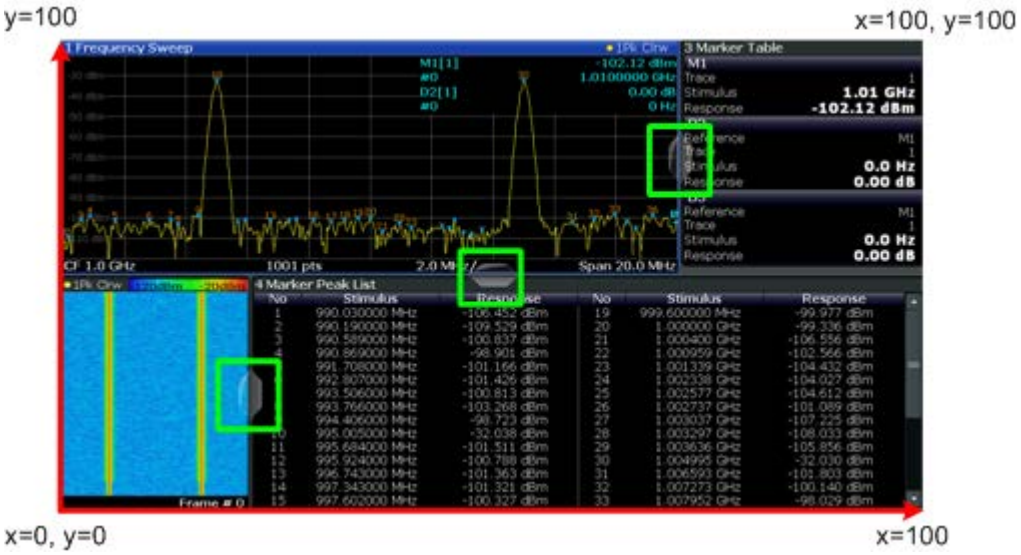


Fig. 11-1: SmartGrid coordinates for remote control of the splitters

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 11-1.)
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
```

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, as opposed to `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.

Parameters:

<Direction> LEFT | RIGHt | ABOVe | BELow

<WindowType> Type of measurement window you want to add.
See `LAYout:ADD[:WINDow]?` on page 756 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).

Note: to query the **index** of a particular window, use the `LAYout:IDENtify[:WINDow]?` command.

Return values:

<WindowName> String containing the name of a window.
In the default state, the name of the window is its index.

Usage: Query only

LAYout:WINDow<n>:REMove

This command removes the window specified by the suffix <n> from the display.

The result of this command is identical to the `LAYout:REMove[:WINDow]` command.

Usage: Event

LAYout:WINDow<n>:REPLace <WindowType>

This command changes the window type of an existing window (specified by the suffix <n>).

The result of this command is identical to the `LAYout:REPLace[:WINDow]` command.

To add a new window, use the `LAYout:WINDow<n>:ADD?` command.

Parameters:

<WindowType> Type of measurement window you want to replace another one with.
See `LAYout:ADD[:WINDow]?` on page 756 for a list of available window types.

11.7 Setting Basic Measurement Parameters

All commands that set measurement-independant parameters are described here.

- Defining the Frequency and Span....761
- Configuring Bandwidth and Sweep Settings....767
- Configuring the Vertical Axis (Amplitude, Scaling)....774
- Configuring Triggered and Gated Measurements....781
- Adjusting Settings Automatically....792
- Configuring the Data Input and Output....795

11.7.1 Defining the Frequency and Span

The commands required to configure the frequency and span settings in a remote environment are described here. The tasks for manual operation are described in chapter 6.3, "Frequency and Span Configuration", on page 344.

- Defining the Frequency Range....761
- Configuring Signal Tracking....766

11.7.1.1 Defining the Frequency Range

CALCulate<n>:MARKer<m>:FUNCtion:CENTer....762
CALCulate<n>:MARKer<m>:FUNCtion:CSTep....762
DISPlay[:WINDow<n>]:TRACe:X:SPACing....762
[SENSe:]FREQuency:CENTer....762
[SENSe:]FREQuency:CENTer:STEP....763
[SENSe:]FREQuency:CENTer:STEP:AUTO....763
[SENSe:]FREQuency:CENTer:STEP:LINK....764
[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor....764
[SENSe:]FREQuency:OFFSet....764
[SENSe:]FREQuency:SPAN....765

[SENSe:]FREQuency:SPAN:FULL....765
[SENSe:]FREQuency:STARt....765
[SENSe:]FREQuency:STOP....765

CALCulate<n>:MARKer<m>:FUNCtion:CENTer

This command matches the center frequency to the frequency of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.

Example: `CALC:MARK2:FUNC:CENT`
Sets the center frequency to the frequency of marker 2.

Usage: Event

Manual operation: See "Harmonic Distortion" on page 105
See "Center Frequency = Marker Frequency" on page 458

CALCulate<n>:MARKer<m>:FUNCtion:CSTep

This command matches the center frequency step size to the current marker frequency.

The command turns delta markers into normal markers.

Usage: Event

DISPlay[:WINDow<n>]:TRACe:X:SPACing <ScalingType>

This command selects the scaling of the x-axis.

Parameters:
<ScalingType>
LOGarithmic
Logarithmic scaling.

LINear
Linear scaling.

*RST: LINear

Example: `DISP:TRAC:X:SPAC LOG`

Manual operation: See "Frequency Axis Scaling" on page 264

[SENSe:]FREQuency:CENTer <Frequency>

This command defines the center frequency.

Parameters:

<Frequency> The allowed range and f_{max} is specified in the data sheet.

UP
Increases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

DOWN
Decreases the center frequency by the step defined using the `[SENSe:]FREQuency:CENTer:STEP` command.

*RST: fmax/2
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Usage: SCPI confirmed

Manual operation: See "Center" on page 348
See "Preview" on page 384
See "Frequency" on page 384

[SENSe:]FREQuency:CENTer:STEP <StepSize>

This command defines the center frequency step size.

You can increase or decrease the center frequency quickly in fixed steps using the `SENS:FREQ UP` AND `SENS:FREQ DOWN` commands, see `[SENSe:]FREQuency:CENTer` on page 762.

Parameters:

<StepSize> f_{max} is specified in the data sheet.

Range: 1 to fMAX
*RST: 0.1 x span
Default unit: Hz

Example:
```
FREQ:CENT 100 MHz
FREQ:CENT:STEP 10 MHz
FREQ:CENT UP
```
Sets the center frequency to 110 MHz.

Manual operation: See "Center Frequency Stepsize" on page 350

[SENSe:]FREQuency:CENTer:STEP:AUTO <State>

This command couples or decouples the center frequency step size to the span.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: FREQ:CENT:STEP:AUTO ON
Activates the coupling of the step size to the span.

[SENSe:]FREQuency:CENTer:STEP:LINK <CouplingType>

This command couples and decouples the center frequency step size to the span or the resolution bandwidth.

Parameters:
<CouplingType>
SPAN
Couples the step size to the span. Available for measurements in the frequency domain.
RBW
Couples the step size to the resolution bandwidth. Available for measurements in the time domain.
OFF
Decouples the step size.
*RST: SPAN

Example: FREQ:CENT:STEP:LINK SPAN

Manual operation: See "Center Frequency Stepsize" on page 350

[SENSe:]FREQuency:CENTer:STEP:LINK:FACTor <Factor>

This command defines a step size factor if the center frequency step size is coupled to the span or the resolution bandwidth.

Parameters:
<Factor>
1 to 100 PCT
*RST: 10

Example: FREQ:CENT:STEP:LINK:FACT 20PCT

Manual operation: See "Center Frequency Stepsize" on page 350

[SENSe:]FREQuency:OFFSet <Offset>

This command defines a frequency offset.

If this value is not 0 Hz, the application assumes that the input signal was frequency shifted outside the application. All results of type "frequency" will be corrected for this shift numerically by the application.

See also "Frequency Offset" on page 350.

Parameters:
<Offset>
Range: -100 GHz to 100 GHz
*RST: 0 Hz

Example: FREQ:OFFS 1GHZ

Usage: SCPI confirmed

Manual operation: See "Frequency Offset" on page 350

[SENSe:]FREQuency:SPAN <Span>

This command defines the frequency span.

If you set a span of 0 Hz in the Spectrum application, the R&S FSW starts a measurement in the time domain.

Parameters:

<Span> The minimum span for measurements in the frequency domain is 10 Hz. For SEM and spurious emission measurements, the minimum span is 20 Hz.

Range: 0 Hz to fmax
*RST: Full span

Usage: SCPI confirmed

Manual operation: See "Zero Span" on page 102
See "Span" on page 348
See "Last Span" on page 350

[SENSe:]FREQuency:SPAN:FULL

This command restores the full span.

Usage: Event
SCPI confirmed

Manual operation: See "Full Span" on page 349
See "Zero Span" on page 349

[SENSe:]FREQuency:STARt <Frequency>

This command defines a start frequency for measurements in the frequency domain.

Parameters:

<Frequency> 0 to (fmax - min span)

*RST: 0

Example: `FREQ:STAR 20MHz`

Usage: SCPI confirmed

Manual operation: See "Frequency Sweep" on page 102
See "Start / Stop" on page 349

[SENSe:]FREQuency:STOP <Frequency>

This command defines a stop frequency for measurements in the frequency domain.

Parameters:
<Frequency> min span to fmax

*RST: fmax

Example: `FREQ:STOP 2000 MHz`

Usage: SCPI confirmed

Manual operation: See "Frequency Sweep" on page 102
See "Start / Stop" on page 349

11.7.1.2 Configuring Signal Tracking

When signal tracking is activated, the maximum signal is determined after each frequency sweep and the center frequency is set to the frequency of this signal. Thus with drifting signals the center frequency follows the signal.

For more details see chapter 6.3.1, "Impact of the Frequency and Span Settings", on page 344..

CALCulate:MARKer:FUNCtion:STRack[:STATe] 766
CALCulate:MARKer:FUNCtion:STRack:BANDwidth 766
CALCulate:MARKer:FUNCtion:STRack:THReshold 767
CALCulate:MARKer:FUNCtion:STRack:TRACe 767

CALCulate:MARKer:FUNCtion:STRack[:STATe] <State>

This command turns signal tracking on and off.

Parameters:
<State> ON | OFF

*RST: OFF

Manual operation: See "Signal Tracking" on page 351
See "Signal Tracking State" on page 351

CALCulate:MARKer: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.

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 351
See "Tracking Bandwidth" on page 351

CALCulate:MARKer: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.

Parameters:

<Level> The unit depends on `CALCulate<n>:UNIT:POWer`.

Range: -130 dBm to 30 dBm
*RST: -120 dBm

Manual operation: See "Signal Tracking" on page 351
See "Tracking Threshold" on page 351

CALCulate:MARKer:FUNCtion:STRack:TRACe <TraceNumber>

This command selects the trace on which the largest signal is searched for.

Parameters:

<TraceNumber> 1 to 6

Range: 1 to 6
*RST: 1

Manual operation: See "Signal Tracking" on page 351
See "Signal Track Trace" on page 351

11.7.2 Configuring Bandwidth and Sweep Settings

The commands required to configure the bandwidth, sweep and filter settings in a remote environment are described here. The tasks for manual operation are described in chapter 6.5, "Bandwidth, Filter and Sweep Configuration", on page 361.

- Configuring the Bandwidth and Filter....767
- Configuring the Sweep....770

11.7.2.1 Configuring the Bandwidth and Filter

[SENSe:]BANDwidth|BWIDth[:RESolution]....767
[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO....768
[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio....768
[SENSe:]BANDwidth|BWIDth[:RESolution]:TYPE....769
[SENSe:]BANDwidth|BWIDth:VIDeo....769
[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO....769
[SENSe:]BANDwidth|BWIDth:VIDeo:RATio....770
[SENSe:]BANDwidth|BWIDth:VIDeo:TYPE....770

[SENSe:]BANDwidth|BWIDth[:RESolution] <Bandwidth>

This command defines the resolution bandwidth and decouples the resolution bandwidth from the span.

For statistics measurements, this command defines the **demodulation** bandwidth.

For measurements on I/Q data in the frequency domain, the maximum RBW is 1 MHz.

Parameters:
<Bandwidth> refer to data sheet
*RST: RBW: AUTO is set to ON; DBW: 3MHz

Example: `BAND 1 MHz`
Sets the resolution bandwidth to 1 MHz

Usage: SCPI confirmed

Manual operation: See "Analysis Bandwidth" on page 214
See "RBW" on page 264
See "Res BW CISPR" on page 265
See "Res BW MIL" on page 265
See "Preview" on page 384
See "RBW" on page 384

[SENSe:]BANDwidth|BWIDth[:RESolution]:AUTO <State>

This command couples and decouples the resolution bandwidth to the span.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `BAND:AUTO OFF`
Switches off the coupling of the resolution bandwidth to the span.

Usage: SCPI confirmed

Manual operation: See "RBW" on page 264
See "Default Coupling" on page 371

[SENSe:]BANDwidth|BWIDth[:RESolution]:RATio <Ratio>

This command defines the ratio between the resolution bandwidth (Hz) and the span (Hz).

Note that the ratio defined with the remote command (RBW/span) is reciprocal to that of the manual operation (span/RBW).

Parameters:
<Ratio> Range: 0.0001 to 1
*RST: 0.01

Example: `BAND:RAT 0.1`

Manual operation: See "Span/RBW" on page 370

[SENSe:]BANDwidth|BWIDth[: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.

The EMI-specific filter types are available if the EMI (R&S FSW-K54) measurement option is installed, even if EMI measurement is not active. For details see chapter 5.13.3.1, "Resolution Bandwidth and Filter Types", on page 252.

Parameters:

<FilterType>

CFILter
channel filters

NORMal
Gaussian filters

P5
5-pole filters
The 5-pole filter is not available for FFT sweeps.

RRC
RRC filters

CISPr | PULSe
CISPR (6 dB) - requires EMI (R&S FSW-K54) option
Return value for query is always `PULS`.

MIL
MIL Std (6 dB) - requires EMI (R&S FSW-K54) option

*RST: NORMal

Example:
```
BAND:TYPE NORM
```

Manual operation: See "Filter Type" on page 263
See "Res BW CISPR" on page 265
See "Res BW MIL" on page 265

[SENSe:]BANDwidth|BWIDth:VIDeo <Bandwidth>

This command defines the video bandwidth.

The command decouples the video bandwidth from the resolution bandwidths.

Parameters:

<Bandwidth>

refer to data sheet

*RST: AUTO is set to ON

Example:
```
BAND:VID 10 kHz
```

Manual operation: See "VBW" on page 369

[SENSe:]BANDwidth|BWIDth:VIDeo:AUTO <State>

This command couples and decouples the video bandwidth to the resolution bandwidth.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `BAND:VID:AUTO OFF`

Manual operation: See "VBW" on page 369
See "RBW/VBW " on page 370
See "Default Coupling" on page 371

[SENSe:]BANDwidth|BWIDth:VIDeo:RATio <Ratio>

This command defines the coupling ratio of the video bandwidth to the resolution bandwidth (RBW/VBW).

Parameters:

<Ratio> Range: 0,001 to 1000
*RST: 1

Example: `BAND:VID:RAT 3`
Sets the coupling of video bandwidth to video bandwidth = 3*resolution bandwidth

Manual operation: See "RBW/VBW " on page 370

[SENSe:]BANDwidth|BWIDth:VIDeo:TYPE <Mode>

This command selects the position of the video filter in the signal path.

Changing the video filter position is possible only if the resolution bandwidth is ≤ 100 kHz.

Parameters:

<Mode>

LINear
The video filter is applied in front of the logarithmic amplifier.
In linear mode, measurements with a logarithmic level scale result in flatter falling edges compared to logarithmic mode. The reason is the conversion of linear power values into logarithmic level values: if you halve the linear power, the logarithmic level decreases by 3 dB.

LOGarithmic
The video filter is applied after the logarithmic amplifier

*RST: LINear

Example: `BAND:VID:TYPE LIN`
Video filter ahead of the logarithmic amplifier

11.7.2.2 Configuring the Sweep

Useful commands for configuring sweeps described elsewhere:

- `[SENSe:]AVERage:COUNt` on page 842

- [SENSe:]AVERage<n>[:STATe<t>] on page 843
- [SENSe:]AVERage<n>:TYPE on page 843

Remote commands exclusive to configuring sweeps:

[SENSe:]SWEep:COUNt....771
[SENSe:]SWEep:OPTimize....771
[SENSe:]SWEep:POINts....772
[SENSe:]SWEep:TIME....772
[SENSe:]SWEep:TIME:AUTO....773
[SENSe:]SWEep:TYPE....773
[SENSe:]SWEep:TYPE:USED....773
[SENSe:]BANDwidth|BWIDth[:RESolution]:FFT....773

[SENSe:]SWEep:COUNt <SweepCount>

This command defines the number of sweeps that the application uses to average traces.

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweep measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<SweepCount> If you set a sweep count of 0 or 1, the R&S FSW performs one single sweep in single sweep mode.
In continuous sweep mode, if the sweep count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Example:

```
SWE:COUN 64
```
Sets the number of sweeps to 64.
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a sweep and waits for its end.

Usage: SCPI confirmed

Manual operation: See "Sweep/Average Count" on page 371

[SENSe:]SWEep:OPTimize <Mode>

This command selects the sweep type optimization mode.

Parameters:

<Mode>

AUTO
Automatically applies the sweep optimization mode that is best for the current measurement.

DYNamic
Optimizes the sweep mode for a large dynamic range.

SPEed
Optimizes the sweep mode for high performance.

*RST: AUTO

Example: `SWE:OPT DYN`
Select dynamic sweep mode.

Manual operation: See "Optimization" on page 372

[SENSe:]SWEep:POINts <SweepPoints>

This command defines the number of measurement points analyzed during a sweep.

Note that the number of sweep points is limited to 10001 when measuring spurious emissions.

For EMI measurements, 200001 sweep points are available.

Parameters:

<SweepPoints>

Range: 101 to 32001
*RST: 1001

Example: `SWE:POIN 251`

Usage: SCPI confirmed

Manual operation: See "Sweep Points" on page 372

[SENSe:]SWEep:TIME <Time>

This command defines the sweep (or: data capture) time.

In the Spectrum application, the command decouples the sweep time from the span and resolution and video bandwidths.

Parameters:

<Time>

refer to data sheet

*RST: (AUTO is set to ON)

Example: `SWE:TIME 10s`

Usage: SCPI confirmed

Manual operation: See "Sweep Time" on page 126
See "Sweep Time" on page 370
See "Preview" on page 384
See "Sweep Time" on page 384

[SENSe:]SWEep:TIME:AUTO <State>

This command couples and decouples the sweep time to the span and the resolution and video bandwidths.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `SWE:TIME:AUTO ON`
Activates automatic sweep time.

Usage: SCPI confirmed

Manual operation: See "Harmonic Sweep Time" on page 232
See "Sweep Time" on page 370
See "Default Coupling" on page 371

[SENSe:]SWEep:TYPE <Type>

This command selects the sweep type.

Parameters:

<Type> **AUTO**
Automatic selection of the sweep type between sweep mode and FFT.

FFT
FFT mode

*RST: AUTO

Example: `SWE:TYPE FFT`

Manual operation: See "Sweep Type" on page 372

[SENSe:]SWEep:TYPE:USED

This command queries the sweep type if you have turned on automatic selection of the sweep type.

Return values:

<Type> **SWE**
Normal sweep

FFT
FFT mode

[SENSe:]BANDwidth|BWIDth[:RESolution]:FFT <FilterMode>

Defines the filter mode to be used for FFT filters by defining the partial span size. The partial span is the span which is covered by one FFT analysis.

This command is only available when using the sweep type "FFT".

Note: this command is maintained for compatibility reasons only. For new remote control programs, use the `[SENSe:]SWEep:OPTimize` command.

Parameters:

<FilterMode> WIDE | AUTO | NARRow

AUTO
Automatically applies the sweep optimization mode that is best for the current measurement.

NARRow
Optimizes the sweep mode for a large dynamic range.

WIDE
Optimizes the sweep mode for high performance.

*RST: AUTO

Example: `BAND:TYPE FFT`
Select FFT filter.

Example: `BAND:FFT NARR`
Select narrow partial span for FFT filter.

11.7.3 Configuring the Vertical Axis (Amplitude, Scaling)

The following commands are required to configure the amplitude and vertical axis settings in a remote environment.

- Amplitude Settings....774
- Configuring the Attenuation....776
- Configuring a Preamplifier....778
- Scaling the Y-Axis....779

11.7.3.1 Amplitude Settings

The tasks for manual configuration are described in chapter 6.4.2, "Amplitude Settings", on page 355.

Useful commands for amplitude configuration described elsewhere:

- `[SENSe:]ADJust:LEVel` on page 795

Remote commands exclusive to amplitude configuration:

CALCulate<n>:MARKer<m>:FUNCtion:REFerence....774
CALCulate<n>:UNIT:POWer....775
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel....775
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet....775
[SENSe:]POWer:NCORrection....776

CALCulate<n>:MARKer<m>:FUNCtion:REFerence

This command matches the reference level to the power level of a marker.

If you use the command in combination with a delta marker, that delta marker is turned into a normal marker.

Example: `CALC:MARK2:FUNC:REF`
Sets the reference level to the level of marker 2.

Usage: Event

Manual operation: See "Reference Level = Marker Level" on page 458

CALCulate<n>:UNIT:POWer <Unit>

This command selects the unit of the y-axis.

The unit applies to all measurement windows.

Parameters:
<Unit> DBM | V | A | W | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere

*RST: dBm

Example: `CALC:UNIT:POW DBM`
Sets the power unit to dBm.

Manual operation: See "Reference Level" on page 356
See "Unit" on page 357

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel <ReferenceLevel>

This command defines the reference level.

With a reference level offset ≠ 0, the value range of the reference level is modified by the offset.

Parameters:
<ReferenceLevel> The unit is variable.

Range: see datasheet
*RST: 0 dBm

Example: `DISP:TRAC:Y:RLEV -60dBm`

Usage: SCPI confirmed

Manual operation: See "Reference Level" on page 356

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RLEVel:OFFSet <Offset>

This command defines a reference level offset.

Parameters:
<Offset> Range: -200 dB to 200 dB
*RST: 0dB

Example: `DISP:TRAC:Y:RLEV:OFFS -10dB`

Manual operation: See "X-Axis" on page 218
See "Shifting the Display (Offset)" on page 218
See "Reference Level" on page 356
See "Shifting the Display (Offset)" on page 356

[SENSe:]POWer:NCORrection <State>

This command turns noise cancellation on and off.

If noise cancellation is on, the R&S FSW performs a reference measurement to determine its inherent noise and subtracts the result from the channel power measurement result (first active trace only).

For more information see "Noise cancellation" on page 124.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `POW:NCOR ON`

Manual operation: See "Noise cancellation" on page 124

11.7.3.2 Configuring the Attenuation

INPut:ATTenuation....776
INPut:ATTenuation:AUTO....777
INPut:EATT....777
INPut:EATT:AUTO....777
INPut:EATT:STATe....778

INPut:ATTenuation <Attenuation>

This command defines the total attenuation for RF input.

If an electronic attenuator is available and active, the command defines a mechanical attenuation (see `INPut:EATT:STATe` on page 778).

If you set the attenuation manually, it is no longer coupled to the reference level, but the reference level is coupled to the attenuation. Thus, if the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:
<Attenuation> Range: see data sheet
Increment: 5 dB
*RST: 10 dB (AUTO is set to ON)

Example: `INP:ATT 30dB`
Defines a 30 dB attenuation and decouples the attenuation from the reference level.

Usage: SCPI confirmed

Manual operation: See "RF Attenuation" on page 357
See "Attenuation Mode / Value" on page 357

INPut:ATTenuation:AUTO <State>

This command couples or decouples the attenuation to the reference level. Thus, when the reference level is changed, the R&S FSW determines the signal level for optimal internal data processing and sets the required attenuation accordingly.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `INP:ATT:AUTO ON`
Couples the attenuation to the reference level.

Usage: SCPI confirmed

Manual operation: See "RF Attenuation" on page 357
See "Attenuation Mode / Value" on page 357

INPut:EATT <Attenuation>

This command defines an electronic attenuation manually. Automatic mode must be switched off (`INP:EATT:AUTO OFF`, see `INPut:EATT:AUTO` on page 777).

If the current reference level is not compatible with an attenuation that has been set manually, the command also adjusts the reference level.

Parameters:
<Attenuation> attenuation in dB
Range: see data sheet
Increment: 1 dB
*RST: 0 dB (OFF)

Example:
```
INP:EATT:AUTO OFF
INP:EATT 10 dB
```

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 358

INPut:EATT:AUTO <State>

This command turns automatic selection of the electronic attenuation on and off.

If on, electronic attenuation reduces the mechanical attenuation whenever possible.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `INP:EATT:AUTO OFF`

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 358

INPut:EATT:STATe <State>

This command turns the electronic attenuator on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:EATT:STAT ON`
Switches the electronic attenuator into the signal path.

Manual operation: See "Using Electronic Attenuation (Option B25)" on page 358

11.7.3.3 Configuring a Preamplifier

INPut:GAIN:STATe....778
INPut:GAIN[:VALue]....778

INPut:GAIN:STATe <State>

This command turns the preamplifier on and off.

The command requires option R&S FSW-B24.

For R&S FSW 26 models, the input signal is amplified by 30 dB if the preamplifier is activated.

For R&S FSW 8 or 13 models, the preamplification is defined by `INPut:GAIN[:VALue]`.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INP:GAIN:STAT ON`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Input Settings" on page 358
See "Preamplifier (option B24)" on page 358

INPut:GAIN[:VALue] <Gain>

This command selects the preamplification level if the preamplifier is activated (`INP:GAIN:STAT ON`, see `INPut:GAIN:STATe` on page 778).

The command requires option R&S FSW-B24.

Parameters:

<Gain> 15 dB | 30 dB

The availability of preamplification levels depends on the R&S FSW model.
- R&S FSW8: 15dB and 30 dB
- R&S FSW13: 15dB and 30 dB
- R&S FSW26: 30 dB

All other values are rounded to the nearest of these two.

*RST: OFF

Example: `INP:GAIN:VAL 30`
Switches on 30 dB preamplification.

Usage: SCPI confirmed

Manual operation: See "Input Settings" on page 358
See "Preamplifier (option B24)" on page 358

11.7.3.4 Scaling the Y-Axis

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe] 779
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE 779
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE 780
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition 780
DISPlay[:WINDow<n>]:TRACe:Y:SPACing 780

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe] <Range>

This command defines the display range of the y-axis.

Note that the command works only for a logarithmic scaling. You can select the scaling with `DISPlay[:WINDow<n>]:TRACe:Y:SPACing`.

Parameters:

<Range> Range: 1 dB to 200 dB
*RST: 100 dB

Example: `DISP:TRAC:Y 110dB`

Usage: SCPI confirmed

Manual operation: See "Range" on page 360

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:AUTO ONCE

Automatic scaling of the y-axis is performed once, then switched off again.

Usage: SCPI confirmed

Manual operation: See "Auto Scale Once" on page 360

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:MODE <Mode>

This command selects the type of scaling of the y-axis.

When the display update during remote control is off, this command has no immediate effect.

Parameters:

<Mode>

ABSolute
absolute scaling of the y-axis

RELative
relative scaling of the y-axis

*RST: ABSolute

Example:
```
DISP:TRAC:Y:MODE REL
```

Manual operation: See "Scaling" on page 360

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

For measurements with the external generator (R&S FSW-B10) the command defines the position of the reference value.

Parameters:

<Position>

0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.

*RST: 100 PCT = frequency display; 50 PCT = time display

Example:
```
DISP:TRAC:Y:RPOS 50PCT
```

Usage: SCPI confirmed

Manual operation: See "Reference Position" on page 309
See "Ref Level Position" on page 360

DISPlay[:WINDow<n>]:TRACe:Y:SPACing <ScalingType>

This command selects the scaling of the y-axis.

Parameters:

<ScalingType>

LOGarithmic
Logarithmic scaling.

LINear
Linear scaling in %.

LDB
Linear scaling in the specified unit.

PERCent
Linear scaling in %.

*RST: LOGarithmic

Example: `DISP:TRAC:Y:SPAC LIN`
Selects linear scaling in %.

Usage: SCPI confirmed

Manual operation: See "Scaling" on page 360

11.7.4 Configuring Triggered and Gated Measurements

The commands required to configure a triggered or gated measurement in a remote environment are described here. The tasks for manual operation are described in chapter 6.6, "Trigger and Gate Configuration", on page 377.

*OPC should be used after requesting data. This will hold off any subsequent changes to the selected trigger source, until after the sweep is completed and the data is returned.

- Configuring the Triggering Conditions....781
- Configuring Gated Measurements....787
- Configuring the Trigger Output....789

11.7.4.1 Configuring the Triggering Conditions

TRIGger[:SEQuence]:DTIMe....781
TRIGger[:SEQuence]:HOLDoff[:TIME]....782
TRIGger[:SEQuence]:IFPower:HOLDoff....782
TRIGger[:SEQuence]:IFPower:HYSTeresis....782
TRIGger[:SEQuence]:LEVel[:EXTernal<port>]....783
TRIGger[:SEQuence]:LEVel:IFPower....783
TRIGger[:SEQuence]:LEVel:IQPower....784
TRIGger[:SEQuence]:LEVel:RFPower....784
TRIGger[:SEQuence]:LEVel:VIDeo....784
TRIGger[:SEQuence]:SLOPe....784
TRIGger[:SEQuence]:SOURce....785
TRIGger[:SEQuence]:TIME:RINTerval....786

TRIGger[:SEQuence]:DTIMe <DropoutTime>

Defines the time the input signal must stay below the trigger level before a trigger is detected again.

Parameters:
<DropoutTime> Dropout time of the trigger.
Range: 0 s to 10.0 s
*RST: 0 s

Manual operation: See "Trigger Settings" on page 384
See "Drop-Out Time" on page 388

TRIGger[:SEQuence]:HOLDoff[:TIME] <Offset>

Defines the time offset between the trigger event and the start of the sweep (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 will affect the trigger offset as well.

Parameters:

<Offset> For measurements in the frequency domain, the range is 0 s to 30 s.
For measurements in the time domain, the range is the negative sweep time to 30 s.
*RST: 0 s

Example: `TRIG:HOLD 500us`

Manual operation: See "Trigger Settings" on page 384
See "Trigger Offset" on page 388

TRIGger[:SEQuence]:IFPower:HOLDoff <Period>

This command defines the holding time before the next trigger event.

Note that this command is available for **any trigger source**, not just IF Power.

Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q data measurements.

Parameters:

<Period> *RST: 0 s

Example: `TRIG:SOUR IFP`
Sets the IF power trigger source.
`TRIG:IFP:HOLD 200 ns`
Sets the holding time to 200 ns.

Manual operation: See "Trigger Settings" on page 384
See "Trigger Holdoff" on page 388

TRIGger[:SEQuence]:IFPower:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis, which is only available for "IF Power" trigger sources.

Parameters:

<Hysteresis> Range: 3 dB to 50 dB
*RST: 3 dB

Example: TRIG:SOUR IFP
Sets the IF power trigger source.
TRIG:IFP:HYST 10DB
Sets the hysteresis limit value.

Manual operation: See "Trigger Settings" on page 384
See "Hysteresis" on page 388

TRIGger[:SEQuence]:LEVel[:EXTernal<port>] <TriggerLevel>

This command defines the level the external signal must exceed to cause a trigger event.

Note that the variable INPUT/OUTPUT connectors (ports 2+3) must be set for use as input using the OUTPut:TRIGger<port>:DIRection command.

Suffix:
<port> 1 | 2 | 3
Selects the trigger port.
1 = trigger port 1 (TRIGGER INPUT connector on front panel)
2 = trigger port 2 (TRIGGER INPUT/OUTPUT connector on front panel)
3 = trigger port 3 (TRIGGER3 INPUT/OUTPUT connector on rear panel)

Parameters:
<TriggerLevel> Range: 0.5 V to 3.5 V
*RST: 1.4 V

Example: TRIG:LEV 2V

Manual operation: See "Trigger Settings" on page 384
See "Trigger Level" on page 387

TRIGger[:SEQuence]:LEVel:IFPower <TriggerLevel>

This command defines the power level at the third intermediate frequency that must be exceeded to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

Parameters:
<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -10 dBm

Example: TRIG:LEV:IFP -30DBM

Manual operation: See "Trigger Settings" on page 384
See "Trigger Level" on page 387

TRIGger[:SEQuence]:LEVel:IQPower <TriggerLevel>

This command defines the magnitude the I/Q data must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<TriggerLevel> Range: -130 dBm to 30 dBm
*RST: -20 dBm

Example: `TRIG:LEV:IQP -30DBM`

Manual operation: See "Trigger Settings" on page 384
See "Trigger Level" on page 387

TRIGger[:SEQuence]:LEVel:RFPower <TriggerLevel>

This command defines the power level the RF input must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed. If defined, a reference level offset is also considered.

The input signal must be between 500 MHz and 8 GHz.

Parameters:

<TriggerLevel> For details on available trigger levels and trigger bandwidths see the data sheet.
*RST: -20 dBm

Example: `TRIG:LEV:RFP -30dBm`

Manual operation: See "Trigger Settings" on page 384
See "Trigger Level" on page 387

TRIGger[:SEQuence]:LEVel:VIDeo <Level>

This command defines the level the video signal must exceed to cause a trigger event. Note that any RF attenuation or preamplification is considered when the trigger level is analyzed.

Parameters:

<Level> Range: 0 PCT to 100 PCT
*RST: 50 PCT

Example: `TRIG:LEV:VID 50PCT`

Manual operation: See "Trigger Settings" on page 384
See "Trigger Level" on page 387

TRIGger[:SEQuence]:SLOPe <Type>

For all trigger sources except time you can define whether triggering occurs when the signal rises to the trigger level or falls down to it.

Parameters:

<Type> POSitive | NEGative

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: `TRIG:SLOP NEG`

Manual operation: See "Trigger Settings" on page 384
See "Slope" on page 389

TRIGger[:SEQuence]:SOURce <Source>

This command selects the trigger source.

For details on trigger sources see "Trigger Source" on page 384.

Using a trigger or gated measurements turns the squelch off (see `[SENSe:]DEMod:SQUelch[:STATe]` on page 893).

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 this situation is avoided in your remote control programs.

For troubleshooting tips see "Uncompleted sequential commands - blocked remote channels" on page 1008.

Parameters:

<Source>

IMMediate
Free Run

EXTernal
Trigger signal from the TRIGGER INPUT connector.

EXT2
Trigger signal from the TRIGGER INPUT/OUTPUT connector.
Note: Connector must be configured for "Input".

EXT3
Trigger signal from the TRIGGER 3 INPUT/ OUTPUT connector.
Note: Connector must be configured for "Input".

RFPower
First intermediate frequency

IFPower
Second intermediate frequency

TIME
Time interval

VIDeo
Video mode is available in the time domain and only in the Spectrum application.

PSEN
External power sensor

*RST: IMMediate

Example:

```
TRIG:SOUR EXT
```

Selects the external trigger input as source of the trigger signal

Manual operation:

See "Using the power sensor as an external trigger" on page 288
See "Trigger Settings" on page 384
See "Trigger Source" on page 384
See "Free Run" on page 385
See "External Trigger 1/2/3" on page 385
See "Video" on page 385
See "IF Power" on page 386
See "Baseband Power" on page 386
See "RF Power" on page 386
See "Power Sensor" on page 387
See "Time" on page 387

TRIGger[:SEQuence]:TIME:RINTerval <Interval>

This command defines the repetition interval for the time trigger.

Parameters:

<Interval>

2.0 ms to 5000

Range: 2 ms to 5000 s
*RST: 1.0 s

Example: TRIG:SOUR TIME
Selects the time trigger input for triggering.
TRIG:TIME:RINT 50
The sweep starts every 50 s.

Manual operation: See "Trigger Settings" on page 384
See "Repetition Interval" on page 387

11.7.4.2 Configuring Gated Measurements

[SENSe:]SWEep:EGATe....787
[SENSe:]SWEep:EGATe:HOLDoff....787
[SENSe:]SWEep:EGATe:LENGth....788
[SENSe:]SWEep:EGATe:POLarity....788
[SENSe:]SWEep:EGATe:SOURce....788
[SENSe:]SWEep:EGATe:TYPE....789

[SENSe:]SWEep:EGATe <State>

This command turns gated measurements on and off.

In case of measurements with an external gate, the measured values are recorded as long as the gate is opened. During a sweep the gate can be opened and closed several times. The synchronization mechanisms with *OPC, *OPC? and *WAI remain completely unaffected.

The measurement ends when a particular number of measurement points has been recorded (see [SENSe:]SWEep:POINts on page 772).

Performing gated measurements turns the squelch off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: SWE:EGAT ON
Switches on the external 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.

[SENSe:]SWEep:EGATe:HOLDoff <DelayTime>

This command defines the length of the trigger delay.

The trigger delay has no effect on

- measurements using the "Level" gate mode

- frequency sweep, FFT sweep, zero span and I/Q mode measurements using an IF Power trigger.

Parameters:
<DelayTime> Range: 0 s to 30 s
*RST: 0 s

Example: `SWE:EGAT:HOLD 100us`

Manual operation: See "Gate Settings" on page 390
See "Gate Delay" on page 390

[SENSe:]SWEep:EGATe:LENGth <GateLength>

This command defines the gate length.

Parameters:
<GateLength> Range: 125 ns to 30 s
*RST: 400µs

Example: `SWE:EGAT:LENG 10ms`

Manual operation: See "Gate Settings" on page 390
See "Gate Length" on page 391

[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`

Manual operation: See "Trigger Settings" on page 384
See "Slope" on page 389

[SENSe:]SWEep:EGATe:SOURce <Source>

This command selects the signal 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).

For more information see "Trigger Source" on page 384.

Parameters:
<Source> EXTernal | EXT2 | EXT3 | IFPower | IQPower | VIDeo | RFPower | PSEN
*RST: IFPower

Example: SWE:EGAT:SOUR IFP
Switches the gate source to IF power.

Manual operation: See "Trigger Settings" on page 384
See "Trigger Source" on page 384
See "External Trigger 1/2/3" on page 385
See "Video" on page 385
See "IF Power" on page 386
See "RF Power" on page 386
See "Power Sensor" on page 387

[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.
Note: If you perform gated measurements in combination with the IF Power trigger, the R&S FSW ignores the holding time for frequency sweep, FFT sweep, zero span and I/Q mode measurements.

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 delay is over.

*RST: EDGE

Example: SWE:EGAT:TYPE EDGE

Manual operation: See "Gate Settings" on page 390
See "Gate Mode" on page 390

11.7.4.3 Configuring the Trigger Output

The following commands are required to send the trigger signal to one of the variable TRIGGER INPUT/OUTPUT connectors. The tasks for manual operation are described in "Trigger 2/3" on page 343.

OUTPut:TRIGger<port>:DIRection....789
OUTPut:TRIGger<port>:LEVel....790
OUTPut:TRIGger<port>:OTYPe....790
OUTPut:TRIGger<port>:PULSe:IMMediate....791
OUTPut:TRIGger<port>:PULSe:LENGth....791

OUTPut:TRIGger<port>:DIRection <Direction>

This command selects the trigger direction.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Direction> **INPut**
Port works as an input.

OUTPut
Port works as an output.

*RST: INPut

Manual operation: See "Trigger 2/3" on page 343

OUTPut:TRIGger<port>:LEVel <Level>

This command defines the level of the signal generated at the trigger output.

This command works only if you have selected a user defined output with `OUTPut:TRIGger<port>:OTYPe`.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:
<Level> **HIGH**
TTL signal.

LOW
0 V

*RST: LOW

Manual operation: See "Trigger 2/3" on page 343
See "Output Type" on page 343
See "Level" on page 344

OUTPut:TRIGger<port>:OTYPe <OutputType>

This command selects the type of signal generated at the trigger output.

Suffix:
<port> 2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<OutputType>

DEVice
Sends a trigger signal when the R&S FSW has triggered internally.

TARMed
Sends a trigger signal when the trigger is armed and ready for an external trigger event.

UDEFined
Sends a user defined trigger signal. For more information see `OUTPut:TRIGger<port>:LEVel`.

*RST: DEVice

Manual operation: See "Trigger 2/3" on page 343
See "Output Type" on page 343

OUTPut:TRIGger<port>:PULSe:IMMediate

This command generates a pulse at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Usage: Event

Manual operation: See "Trigger 2/3" on page 343
See "Output Type" on page 343
See "Send Trigger" on page 344

OUTPut:TRIGger<port>:PULSe:LENGth <Length>

This command defines the length of the pulse generated at the trigger output.

Suffix:

<port>

2 | 3
Selects the trigger port to which the output is sent.
2 = trigger port 2 (front)
3 = trigger port 3 (rear)

Parameters:

<Length>

Pulse length in seconds.

Manual operation: See "Trigger 2/3" on page 343
See "Output Type" on page 343
See "Pulse Length" on page 344

11.7.5 Adjusting Settings Automatically

The commands required to adjust settings automatically in a remote environment are described here. The tasks for manual operation are described in chapter 6.7, "Adjusting Settings Automatically", on page 394.

MSRA operating mode

In MSRA operating mode, settings related to data acquisition (measurement time, hysteresis) can only be adjusted automatically in the MSRA Master, not in the MSRA applications.

[SENSe:]ADJust:ALL....792
[SENSe:]ADJust:CONFigure:DURation....792
[SENSe:]ADJust:CONFigure:DURation:MODE....793
[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer....793
[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer....794
[SENSe:]ADJust:CONFigure:TRIG....794
[SENSe:]ADJust:FREQuency....794
[SENSe:]ADJust:LEVel....795

[SENSe:]ADJust:ALL

This command initiates a measurement to determine and set the ideal settings for the current task automatically (only once for the current measurement).

This includes:

- Center frequency
- Reference level

Example: `ADJ:ALL`

Usage: Event

Manual operation: See "Adjusting all Determinable Settings Automatically (Auto All)" on page 394

[SENSe:]ADJust:CONFigure:DURation <Duration>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command defines the length of the measurement if `[SENSe:]ADJust:CONFigure:DURation:MODE` is set to `MANual`.

Parameters:

<Duration> Numeric value in seconds

Range: 0.001 to 16000.0
*RST: 0.001
Default unit: s

Example: ADJ:CONF:DUR:MODE MAN
Selects manual definition of the measurement length.
ADJ:CONF:LEV:DUR 5ms
Length of the measurement is 5 ms.

Manual operation: See "Changing the Automatic Measurement Time (Meastime Manual)" on page 395

[SENSe:]ADJust:CONFigure:DURation:MODE <Mode>

In order to determine the ideal reference level, the R&S FSW performs a measurement on the current input data. This command selects the way the R&S FSW determines the length of the measurement .

Parameters:

<Mode>

AUTO
The R&S FSW determines the measurement length automatically according to the current input data.

MANual
The R&S FSW uses the measurement length defined by [SENSe:]ADJust:CONFigure:DURation on page 792.

*RST: AUTO

Manual operation: See "Resetting the Automatic Measurement Time (Meastime Auto)" on page 395
See "Changing the Automatic Measurement Time (Meastime Manual)" on page 395

[SENSe:]ADJust:CONFigure:HYSTeresis:LOWer <Threshold>

When the reference level is adjusted automatically using the [SENSe:]ADJust:LEVel on page 795 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines a lower threshold the signal must fall below (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>

Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: SENS:ADJ:CONF:HYST:LOW 2
For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level falls below 18 dBm.

Manual operation: See "Lower Level Hysteresis" on page 396

[SENSe:]ADJust:CONFigure:HYSTeresis:UPPer <Threshold>

When the reference level is adjusted automatically using the `[SENSe:]ADJust:LEVel` on page 795 command, the internal attenuators and the preamplifier are also adjusted. In order to avoid frequent adaptation due to small changes in the input signal, you can define a hysteresis. This setting defines an upper threshold the signal must exceed (compared to the last measurement) before the reference level is adapted automatically.

Parameters:

<Threshold>
Range: 0 dB to 200 dB
*RST: +1 dB
Default unit: dB

Example: `SENS:ADJ:CONF:HYST:UPP 2`

Example: For an input signal level of currently 20 dBm, the reference level will only be adjusted when the signal level rises above 22 dBm.

Manual operation: See "Upper Level Hysteresis" on page 395

[SENSe:]ADJust:CONFigure:TRIG <State>

Defines the behaviour of the measurement when adjusting a setting automatically (using `SENS:ADJ:LEV ON`, for example). See "Adjusting settings automatically during triggered measurements" on page 394.

Parameters:

<State>
ON | 1
The measurement for automatic adjustment waits for the trigger.
OFF | 0
The measurement for automatic adjustment is performed immediately, without waiting for a trigger.
*RST: 1

[SENSe:]ADJust:FREQuency

This command sets the center frequency to the highest signal level in the current frequency range.

Example: `ADJ:FREQ`

Usage: Event

Manual operation: See "Adjusting the Center Frequency Automatically (Auto Freq)" on page 395

[SENSe:]ADJust:LEVel

This command initiates a single (internal) measurement that evaluates and sets the ideal reference level for the current input data and measurement settings. This ensures that the settings of the RF attenuation and the reference level are optimally adjusted to the signal level without overloading the R&S FSW or limiting the dynamic range by an S/N ratio that is too small.

Example: `ADJ:LEV`

Usage: Event

Manual operation: See "Reference Level" on page 356
See "Setting the Reference Level Automatically (Auto Level)" on page 357

11.7.6 Configuring the Data Input and Output

- RF Input....795
- Using External Mixers....798
- Setting up Probes....812
- External Generator Control....814
- Working with Power Sensors....825
- Configuring the Outputs....836

11.7.6.1 RF Input

INPut:ATTenuation:PROTection:RESet....795
INPut:CONNector....796
INPut:COUPling....796
INPut:FILTer:HPASs[:STATe]....796
INPut:FILTer:YIG[:STATe]....797
INPut:IMPedance....797
INPut:SELect....797
INPut:UPORt:STATe....798
INPut:UPORt[:VALue]?....798

INPut:ATTenuation:PROTection:RESet

This command resets the attenuator and reconnects the RF input with the input mixer after an overload condition occured 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.

(See `STATus:QUEStionable:POWer[:EVENt]?` on page 957 and "STATus:QUESTionable:POWer Register" on page 581).

The command works only if the overload condition has been eliminated first.

For details on the protection mechanism see chapter 6.2.1.1, "RF Input Protection", on page 275.

Usage: Event

INPut:CONNector <ConnType>

Determines whether the RF input data is taken from the RF input connector or the optional Analog Baseband I connector. This command is only available if the Analog Baseband interface (R&S FSW-B71) is installed and active for input.

For more information on the Analog Baseband Interface (R&S FSW-B71) see the R&S FSW I/Q Analyzer and I/Q Input User Manual.

Parameters:

<CouplingType> **RF**
RF input connector

AIQI
Analog Baseband I connector

*RST: RF

Example: `INP:CONN:AIQI`

Usage: SCPI confirmed

Manual operation: See "Input Connector" on page 281

INPut:COUPling <CouplingType>

This command selects the coupling type of the RF input.

Parameters:

<CouplingType> **AC**
AC coupling

DC
DC coupling

*RST: AC

Example: `INP:COUP:DC`

Usage: SCPI confirmed

Manual operation: See "Input Coupling" on page 280

INPut:FILTer:HPASs[:STATe] <State>

Activates an additional internal high-pass filter for RF input signals from 1 GHz to 3 GHz. This filter is used to remove the harmonics of the R&S FSW in order to measure the harmonics for a DUT, for example.

This function requires option R&S FSW-B13.

(Note: for RF input signals outside the specified range, the high-pass filter has no effect. For signals with a frequency of approximately 4 GHz upwards, the harmonics are suppressed sufficiently by the YIG filter.)

Parameters:
<State> ON | OFF
*RST: OFF

Usage: SCPI confirmed

Manual operation: See "High-Pass Filter 1...3 GHz" on page 280

INPut:FILTer:YIG[:STATe] <State>

This command turns the YIG-preselector on and off.

Note the special conditions and restrictions for the YIG filter described in "YIG-Preselector" on page 280.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1 (0 for I/Q Analyzer, GSM, VSA and MC Group Delay measurements)

Example: `INP:FILT:YIG OFF`
Deactivates the YIG-preselector.

Manual operation: See "YIG-Preselector" on page 280

INPut:IMPedance <Impedance>

This command selects the nominal input impedance of the RF input.

75 Ω should be selected if the 50 Ω input impedance is transformed to a higher impedance using a matching pad of the RAZ type (= 25 Ω in series to the input impedance of the instrument). The power loss correction value in this case is 1.76 dB = 10 log (75Ω/50Ω).

Parameters:
<Impedance> 50 | 75
*RST: 50 Ω

Example: `INP:IMP 75`

Usage: SCPI confirmed

Manual operation: See "Impedance" on page 280
See "Reference Level" on page 356
See "Unit" on page 357

INPut:SELect <Source>

This command selects the signal source for measurements, i.e. it defines which connector is used to input data to the R&S FSW. If no additional options are installed, only RF input is supported.

Parameters:

<Source>

RF
Radio Frequency ("RF INPUT" connector)

DIQ
Digital IQ data (only available with optional Digital Baseband Interface R&S FSW-B17)
For details on I/Q input see the R&S FSW I/Q Analyzer User Manual.

AIQ
Analog Baseband signal (only available with optional Analog Baseband Interface R&S FSW-B71)
For details on Analog Baseband input see the R&S FSW I/Q Analyzer User Manual.

*RST: RF

Manual operation: See "Radio Frequency State" on page 280

INPut: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 FSW.

See the R&S FSW Getting Started manual for details.

Parameters:

<State>

ON | 1
User port is switched to INPut

OFF | 0
User port is switched to OUTPut

*RST: 1

INPut:UPORt[:VALue]?

This command queries the control lines of the user ports.

Example: `INP:UPOR?`

Usage: Query only

11.7.6.2 Using External Mixers

The commands required to work with external mixers in a remote environment are described here. Note that these commands require the R&S FSW-B21 option to be installed and an external mixer to be connected to the front panel of the R&S FSW. In MSRA mode, external mixers are not supported.

For details on working with external mixers see chapter 6.2.5.1, "Basics on External Mixers", on page 318.

- Basic Settings....799
- Mixer Settings....801
- Conversion Loss Table Settings....805
- Programming Example: Working with an External Mixer....810

Basic Settings

The basic settings concern general usage of an external mixer.

[SENSe:]MIXer[:STATe]....799
[SENSe:]MIXer:BIAS:HIGH....799
[SENSe:]MIXer:BIAS[:LOW]....799
[SENSe:]MIXer:LOPower....800
[SENSe:]MIXer:SIGNal....800
[SENSe:]MIXer:THReshold....800

[SENSe:]MIXer[:STATe] <State>

Activates or deactivates the use of a connected external mixer as input for the measurement. This command is only available if the R&S FSW-B21 option is installed and an external mixer is connected.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `MIX ON`

Manual operation: See "External Mixer State" on page 327

[SENSe:]MIXer:BIAS:HIGH <BiasSetting>

This command defines the bias current for the high (second) range.

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 799).

Parameters:

<BiasSetting> *RST: 0.0 A
Default unit: A

Manual operation: See "Bias Settings" on page 331

[SENSe:]MIXer:BIAS[:LOW] <BiasSetting>

This command defines the bias current for the low (first) range.

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 799).

Parameters:

<BiasSetting> *RST: 0.0 A
Default unit: A

Manual operation: See "Bias Settings" on page 331

[SENSe:]MIXer:LOPower <Level>

This command specifies the LO level of the external mixer's LO port.

Parameters:

<Level> numeric value

Range: 13.0 dBm to 17.0 dBm
Increment: 0.1 dB
*RST: 15.5 dBm

Example: `MIX:LOP 16.0dBm`

Manual operation: See "LO Level" on page 330

[SENSe:]MIXer:SIGNal <State>

This command specifies whether automatic signal detection is active or not.

Note that automatic signal identification is only available for measurements that perform frequency sweeps (not in vector signal analysis or the I/Q Analyzer, for instance).

Parameters:

<State> **OFF | ON | AUTO | ALL**

OFF
No automatic signal detection is active.

ON
Automatic signal detection (Signal ID) is active.

AUTO
Automatic signal detection (Auto ID) is active.

ALL
Both automatic signal detection functions (Signal ID+Auto ID) are active.

*RST: OFF

Manual operation: See "Signal ID" on page 331
See "Auto ID" on page 331

[SENSe:]MIXer:THReshold <Value>

This command defines the maximum permissible level difference between test sweep and reference sweep to be corrected during automatic comparison (see `[SENSe:]MIXer:SIGNal` on page 800).

Parameters:

<Value> <numeric value>

Range: 0.1 dB to 100 dB
*RST: 10 dB

Example: `MIX:PORT 3`

Manual operation: See "Auto ID Threshold" on page 331

Mixer Settings

The following commands are required to configure the band and specific mixer settings.

[SENSe:]MIXer:FREQuency:HANDover....801
[SENSe:]MIXer:FREQuency:STARt?....801
[SENSe:]MIXer:FREQuency:STOP?....802
[SENSe:]MIXer:HARMonic:BAND:PRESet....802
[SENSe:]MIXer:HARMonic:BAND[:VALue]....802
[SENSe:]MIXer:HARMonic:HIGH:STATe....803
[SENSe:]MIXer:HARMonic:HIGH[:VALue]....803
[SENSe:]MIXer:HARMonic:TYPE....803
[SENSe:]MIXer:HARMonic[:LOW]....804
[SENSe:]MIXer:LOSS:HIGH....804
[SENSe:]MIXer:LOSS:TABLe:HIGH....804
[SENSe:]MIXer:LOSS:TABLe[:LOW]....804
[SENSe:]MIXer:LOSS[:LOW]....805
[SENSe:]MIXer:PORTs....805
[SENSe:]MIXer:RFOVerrange[:STATe]....805

[SENSe:]MIXer:FREQuency:HANDover <Frequency>

This command defines the frequency at which the mixer switches from one range to the next (if two different ranges are selected). The handover frequency for each band can be selected freely within the overlapping frequency range.

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 799).

Parameters:

<Frequency> numeric value

Example: `MIX ON`
Activates the external mixer.
`MIX:FREQ:HAND 78.0299GHz`
Sets the handover frequency to 78.0299 GHz.

Manual operation: See "Handover Freq." on page 328

[SENSe:]MIXer:FREQuency:STARt?

This command queries the frequency at which the external mixer band starts.

Example: `MIX:FREQ:STAR?`
Queries the start frequency of the band.

Usage: Query only

Manual operation: See "RF Start / RF Stop" on page 327

[SENSe:]MIXer:FREQuency:STOP?

This command queries the frequency at which the external mixer band stops.

Example: `MIX:FREQ:STOP?`
Queries the stop frequency of the band.

Usage: Query only

Manual operation: See "RF Start / RF Stop" on page 327

[SENSe:]MIXer:HARMonic:BAND:PRESet

This command restores the preset frequency ranges for the selected standard waveguide band.

Note: Changes to the band and mixer settings are maintained even after using the PRESET function. Use this command to restore the predefined band ranges.

Example: `MIX:HARM:BAND:PRES`
Presets the selected waveguide band.

Usage: Event

Manual operation: See "Preset Band" on page 328

[SENSe:]MIXer:HARMonic:BAND[:VALue] <Band>

This command selects the external mixer band. The query returns the currently selected band.

This command is only available if the external mixer is active (see `[SENSe:]MIXer[:STATe]` on page 799).

Parameters:

<Band> KA | Q | U | V | E | W | F | D | G | Y | J | USER
Standard waveguide band or user-defined band.

Manual operation: See "Band" on page 328

Table 11-3: Frequency ranges for pre-defined bands

Band	Frequency start [GHz]	Frequency stop [GHz]
KA (A) *)	26.5	40.0
Q	33.0	50.0
U	40.0	60.0
V	50.0	75.0
E	60.0	90.0
W	75.0	110.0
F	90.0	140.0
***)** The band formerly referred to as "A" is now named "KA".		

Band	Frequency start [GHz]	Frequency stop [GHz]
D	110.0	170.0
G	140.0	220.0
J	220.0	325.0
Y	325.0	500.0
USER	32.18 (default)	68.22 (default)
***)** The band formerly referred to as "A" is now named "KA".		

[SENSe:]MIXer:HARMonic:HIGH:STATe <State>

This command specifies whether a second (high) harmonic is to be used to cover the band's frequency range.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `MIX:HARM:HIGH:STAT ON`

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Range 1/2" on page 329

[SENSe:]MIXer:HARMonic:HIGH[:VALue] <HarmOrder>

This command specifies the harmonic order to be used for the high (second) range.

Parameters:

<HarmOrder numeric value

Range: 2 to 61 (USER band); for other bands: see band definition

Example: `MIX:HARM:HIGH 2`

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Harmonic Order" on page 329

[SENSe:]MIXer:HARMonic:TYPE <OddEven>

This command specifies whether the harmonic order to be used should be odd, even, or both.

Which harmonics are supported depends on the mixer type.

Parameters:

<OddEven> **ODD | EVEN | EODD**

*RST: EVEN

Example: `MIX:HARM:TYPE ODD`

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Harmonic Type" on page 329

[SENSe:]MIXer:HARMonic[:LOW] <HarmOrder>

This command specifies the harmonic order to be used for the low (first) range.

Parameters:
<HarmOrder> numeric value
Range: 2 to 61 (USER band); for other bands: see band definition
*RST: 2 (for band F)

Example: `MIX:HARM 3`

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Harmonic Order" on page 329

[SENSe:]MIXer:LOSS:HIGH <Average>

This command defines the average conversion loss to be used for the entire high (second) range.

Parameters:
<Average> numeric value
Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example: `MIX:LOSS:HIGH 20dB`

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Conversion loss" on page 329

[SENSe:]MIXer:LOSS:TABLe:HIGH <FileName>

This command defines the file name of the conversion loss table to be used for the high (second) range.

Parameters:
<FileName> string ('<file name>')

Example: `MIX:LOSS:TABL:HIGH 'MyCVLTable'`

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Conversion loss" on page 329

[SENSe:]MIXer:LOSS:TABLe[:LOW] <FileName>

This command defines the file name of the conversion loss table to be used for the low (first) range.

Parameters:
<FileName> string ('<file name>')

Example: `MIX:LOSS:TABL 'mix_1_4'`
Specifies the conversion loss table *mix_1_4*.

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Conversion loss" on page 329

[SENSe:]MIXer:LOSS[:LOW] <Average>

This command defines the average conversion loss to be used for the entire low (first) range.

Parameters:
<Average> numeric value

Range: 0 to 100
*RST: 24.0 dB
Default unit: dB

Example: `MIX:LOSS 20dB`

Manual operation: See "Mixer Settings (Harmonics Configuration)" on page 328
See "Conversion loss" on page 329

[SENSe:]MIXer:PORTs <PortType>

This command specifies whether the mixer is a 2-port or 3-port type.

Parameters:
<PortType> **2 | 3**

*RST: 2

Example: `MIX:PORT 3`

Manual operation: See "Mixer Type" on page 328

[SENSe:]MIXer:RFOVerrange[:STATe] <State>

If enabled, the band limits are extended beyond "RF Start" and "RF Stop" due to the capabilities of the used harmonics.

Parameters:
<State> ON | OFF

*RST: OFF

Manual operation: See "RF Overrange" on page 328

Conversion Loss Table Settings

The following settings are required to configure and manage conversion loss tables.

[SENSe:]CORRection:CVL:BAND....806
[SENSe:]CORRection:CVL:BIAS....806
[SENSe:]CORRection:CVL:CATAlog?....807
[SENSe:]CORRection:CVL:CLEAr....807
[SENSe:]CORRection:CVL:COMMent....807
[SENSe:]CORRection:CVL:DATA....808
[SENSe:]CORRection:CVL:HARMonic....808
[SENSe:]CORRection:CVL:MIXer....808
[SENSe:]CORRection:CVL:PORTs....809
[SENSe:]CORRection:CVL:SELect....809
[SENSe:]CORRection:CVL:SNUMber....809

[SENSe:]CORRection:CVL:BAND <Type>

This command defines the waveguide band for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Band> K | A | KA | Q | U | V | E | W | F | D | G | Y | J | USER

Standard waveguide band or user-defined band.
Note: The band formerly referred to as "A" is now named "KA"; the input parameter "A" is still available and refers to the same band as "KA".
For a definition of the frequency range for the pre-defined bands, see table 11-3).

*RST: F (90 GHz - 140 GHz)

Example:

```
CORR:CVL:SEL 'LOSS_TAB_4'
```
Selects the conversion loss table.
```
CORR:CVL:BAND KA
```
Sets the band to KA (26.5 GHz - 40 GHz).

Manual operation: See "Band" on page 335

[SENSe:]CORRection:CVL:BIAS <BiasSetting>

This command defines the bias setting to be used with the conversion loss table.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809.

This command is only available with option B21 (External Mixer) installed.

Parameters:
<BiasSetting> numeric value
*RST: 0.0 A
Default unit: A

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:BIAS 3A`

Manual operation: See "Bias Settings" on page 331
See "Write to <CVL table name>" on page 332
See "Bias" on page 335

[SENSe:]CORRection:CVL:CATAlog?

This command queries all available conversion loss tables saved in the `C:\r_s\instr\user\cvl\` directory on the instrument.

This command is only available with option B21 (External Mixer) installed.

Usage: Query only

[SENSe:]CORRection:CVL:CLEAr

This command deletes the selected conversion loss table. Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809).

This command is only available with option B21 (External Mixer) installed.

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:CLE`

Usage: Event

Manual operation: See "Delete Table" on page 333

[SENSe:]CORRection:CVL:COMMent <Text>

This command defines a comment for the conversion loss table. Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809).

This command is only available with option B21 (External Mixer) installed.

Parameters:
<Text>

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:COMM 'Conversion loss table for FS_Z60'`

Manual operation: See "Comment" on page 335

[SENSe:]CORRection:CVL:DATA <Freq>,<Level>

This command defines the reference values of the selected conversion loss tables. The values are entered as a set of frequency/level pairs. A maximum of 50 frequency/level pairs may be entered. Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Freq> numeric value

The frequencies have to be sent in ascending order.

<Level>

Example:
```
CORR:CVL:SEL 'LOSS_TAB_4'
```
Selects the conversion loss table.
```
CORR:CVL:DATA 1MHZ,-30DB,2MHZ,-40DB
```

Manual operation: See "Position/Value" on page 336

[SENSe:]CORRection:CVL:HARMonic <HarmOrder>

This command defines the harmonic order for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809.

This command is only available with option B21 (External Mixer) installed.

Parameters:

<HarmOrder> numeric value

Range: 2 to 65

Example:
```
CORR:CVL:SEL 'LOSS_TAB_4'
```
Selects the conversion loss table.
```
CORR:CVL:HARM 3
```

Manual operation: See "Harmonic Order" on page 335

[SENSe:]CORRection:CVL:MIXer <Type>

This command defines the mixer name in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<Type> string

Name of mixer with a maximum of 16 characters

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX 'FS_Z60'`

Manual operation: See "Mixer Name" on page 335

[SENSe:]CORRection:CVL:PORTs <PortNo>

This command defines the mixer type in the conversion loss table. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<PortType> 2 | 3

*RST: 2

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:PORT 3`

Manual operation: See "Mixer Type" on page 336

[SENSe:]CORRection:CVL:SELect <FileName>

This command selects the conversion loss table with the specified file name. If <file_name> is not available, a new conversion loss table is created.

This command is only available with option B21 (External Mixer) installed.

Parameters:

<FileName> '<File name>'

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`

Manual operation: See "New Table" on page 333
See "Edit Table" on page 333
See "File Name" on page 334

[SENSe:]CORRection:CVL:SNUMber <SerialNo>

This command defines the serial number of the mixer for which the conversion loss table is to be used. This setting is checked against the current mixer setting before the table can be assigned to the range.

Before this command can be performed, the conversion loss table must be selected (see `[SENSe:]CORRection:CVL:SELect` on page 809).

This command is only available with option B21 (External Mixer) installed.

Parameters:

<SerialNo> Serial number with a maximum of 16 characters

Example: `CORR:CVL:SEL 'LOSS_TAB_4'`
Selects the conversion loss table.
`CORR:CVL:MIX '123.4567'`

Manual operation: See "Mixer S/N" on page 335

Programming Example: Working with an External Mixer

This example demonstrates how to work with an external mixer in a remote environment. It is performed in the Spectrum application in the default layout configuration. Note that without a real input signal and connected mixer, this measurement will not return useful results.

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//----------- Configuring basic mixer behavior -------------
//Set the LO level of the mixer's LO port to 15 dBm.
SENS:MIX:LOP 15dBm
//Set the bias current to -1 mA .
SENS:MIX:BIAS:LOW -1mA
//----------- Configuring the mixer and band settings -------------
//Use band "V" to full possible range extent for assigned harmonic (6).
SENS:MIX:HARM:BAND V
SENS:MIX:RFOV ON
//Query the possible range
SENS:MIX:FREQ:STAR?
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)
//Use a 3-port mixer type
SENS:MIX:PORT 3
//Split the frequency range into two ranges;
//range 1 covers 47.48 GHz GHz to 80 GHz; harmonic 6, average conv. loss of 20 dB
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:LOW  20dB
SENS:MIX:HARM:HIGH 8
SENS:MIX:LOSS:HIGH 30dB
//--------- Activating automatic signal identification functions -----------
//Activate both automatic signal identification functions.
SENS:MIX:SIGN ALL
```

```
//Use auto ID threshold of 8 dB.
SENS:MIX:THR 8dB

//--------------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data for the input signal without distortions
//(default screen configuration)
TRAC:DATA? TRACE3
```

Configuring a conversion loss table for a user-defined band

```
//--------------Preparing the instrument -----------
//Reset the instrument
*RST
//Activate the use of the connected external mixer.
SENS:MIX ON
//--------------Configuring a new conversion loss table --------------
//Define cvl table for range 1 of band as described in previous example
// (extended V band)
SENS:CORR:CVL:SEL 'UserTable'
SENS:CORR:CVL:COMM 'User-defined conversion loss table for USER band'
SENS:CORR:CVL:BAND USER
SENS:CORR:CVL:HARM 6
SENS:CORR:CVL:BIAS -1mA
SENS:CORR:CVL:MIX 'FS_Z60'
SENS:CORR:CVL:SNUM '123.4567'
SENS:CORR:CVL:PORT 3
//Conversion loss is linear from 55 GHz to 75 GHz
SENS:CORR:CVL:DATA 55GHZ,-20DB,75GHZ,-30DB
//----------- Configuring the mixer and band settings -------------
//Use user-defined band and assign new cvl table.
SENS:MIX:HARM:BAND USER
//Define band by two ranges;
//range 1 covers 47.48 GHz to 80 GHz; harmonic 6, cvl table 'UserTable'
//range 2 covers 80 GHz to 138.02 GHz; harmonic 8, average conv.loss of 30 dB
SENS:MIX:HARM:TYPE EVEN
SENS:MIX:HARM:HIGH:STAT ON
SENS:MIX:FREQ:HAND 80GHz
SENS:MIX:HARM:LOW 6
SENS:MIX:LOSS:TABL:LOW 'UserTable'
SENS:MIX:HARM:HIGH 8

SENS:MIX:LOSS:HIGH 30dB
//Query the possible range
SENS:MIX:FREQ:STAR?
```

```
//Result: 47480000000 (47.48 GHz)
SENS:MIX:FREQ:STOP?
//Result: 138020000000 (138.02 GHz)

//--------------Performing the Measurement-----
//Select single sweep mode.
INIT:CONT OFF
//Initiate a basic frequency sweep and wait until the sweep has finished.
INIT;*WAI
//---------------Retrieving Results-------------
//Return the trace data (default screen configuration)
TRAC:DATA? TRACe1
```

11.7.6.3 Setting up Probes

Probes can be connected to the optional BASEBAND INPUT connectors, if the Analog Baseband interface (option R&S FSW-B71) is installed.

[SENSe:]PROBe<p>:ID:PARTnumber?....812
[SENSe:]PROBe<p>:ID:SRNumber?....812
[SENSe:]PROBe<p>:SETup:MODE....813
[SENSe:]PROBe<p>:SETup:NAME?....813
[SENSe:]PROBe<p>:SETup:STATe?....814
[SENSe:]PROBe<p>:SETup:TYPE?....814

[SENSe:]PROBe<p>:ID:PARTnumber?

Queries the R&S part number of the probe.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<PartNumber> Part number in a string.

Usage: Query only

[SENSe:]PROBe<p>:ID:SRNumber?

Queries the serial number of the probe.

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:
<SerialNo> Serial number in a string.

Usage: Query only

[SENSe:]PROBe<p>:SETup:MODE <Mode>

Select the action that is started with the micro button on the probe head.

See also: "Microbutton Action" on page 282.

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Parameters:
<Mode> **RSINgle**
Run single: starts one data acquisition.
NOACtion
Nothing is started on pressing the micro button.
*RST: RSINgle

Manual operation: See "Microbutton Action" on page 282

[SENSe:]PROBe<p>:SETup:NAME?

Queries the name of the probe.

Suffix:
<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:
<Name> Name string

Usage: Query only

[SENSe:]PROBe<p>:SETup:STATe?

Queries if the probe at the specified connector is active (detected) or not active (not detected). To switch the probe on, i.e. activate input from the connector, use `INP:SEL:AIQ` (see `INPut:SELect` on page 797).

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<State> DETected | NDETected
*RST: NDETected

Usage: Query only

[SENSe:]PROBe<p>:SETup:TYPE?

Queries the type of the probe.

Suffix:

<p> 1 | 2 | 3
Selects the connector:
1 = Baseband Input I
2 = Baseband Input Q
3 = RF (currently not supported; use "1" with RF Input Connector setting "Baseband Input I")

Return values:

<Type> String containing one of the following values:
– None (no probe detected)
– active differential
– active single-ended

Usage: Query only

11.7.6.4 External Generator Control

External generator control commands are available if the R&S FSW External Generator Control option (R&S FSW-B10) is installed. For each measurement channel one external generator can be configured. To switch between different configurations define multiple measurement channels.

For more information on external generator control see chapter 6.2.4.2, "Basics on External Generator Control", on page 292.

- Measurement Configuration....815
- Interface Configuration....818
- Source Calibration....820
- Programming Example for External Generator Control....823

Measurement Configuration

The following commands are required to activate external generator control and to configure a calibration measurement with an external tracking generator.

SOURce:EXTernal:FREQuency....815
SOURce:EXTernal:FREQuency:COUPling[:STATe]....815
SOURce:EXTernal:FREQuency[:FACTor]:DENominator....816
SOURce:EXTernal:FREQuency[:FACTor]:NUMerator....816
SOURce:EXTernal:FREQuency:OFFSet....816
SOURce:EXTernal:POWer[:LEVel]....817
SOURce:EXTernal[:STATe]....817
SOURce:POWer[:LEVel][:IMMediate]:OFFSet....817

SOURce:EXTernal:FREQuency <Frequency>

This command defines a fixed source frequency for the external generator.

Parameters:

<Frequency> Source frequency of the external generator.

*RST: 1100050000

Example: SOUR:EXT:FREQ 10MHz

Manual operation: See "(Manual) Source Frequency" on page 306

SOURce:EXTernal:FREQuency:COUPling[:STATe] <State>

This command couples the frequency of the external generator output to the R&S FSW.

Parameters:

<State> ON | OFF | 0 | 1

ON | 1
Default setting: a series of frequencies is defined (one for each sweep point), based on the current frequency at the RF input of the R&S FSW; the RF frequency range covers the currently defined span of the R&S FSW (unless limited by the range of the signal generator)

OFF | 0
The generator uses a single fixed frequency, defined by `SOURce:EXTernal:FREQuency`.

*RST: 1

Example: SOUR:EXT:FREQ:COUP ON

Manual operation: See "Source Frequency Coupling" on page 306

SOURce:EXTernal:FREQuency[:FACTor]:DENominator <Value>

This command defines the denominator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator.

Select the multiplication factor such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

$$\text{Source Freq} = \text{RF} \cdot \frac{\text{Numerator}}{\text{Denominator}} + \text{Offset}$$

Parameters:

<Value> <numeric value>

*RST: 1

Example: `SOUR:EXT:FREQ:NUM 4"`
`"SOUR:EXT:FREQ:DEN 3"`
Sets a multiplication factor of 4/3, i.e. the transmit frequency of the generator is 4/3 times the analyzer frequency.

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 306

SOURce:EXTernal:FREQuency[:FACTor]:NUMerator <Value>

This command defines the numerator of the factor with which the analyzer frequency is multiplied in order to obtain the transmit frequency of the selected generator.

Select the multiplication factor such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

$$\text{Source Freq} = \text{RF} \cdot \frac{\text{Numerator}}{\text{Denominator}} + \text{Offset}$$

Parameters:

<Value> <numeric value>

*RST: 1

Example: `SOUR:EXT:FREQ:NUM 4"`
`"SOUR:EXT:FREQ:DEN 3"`
Sets a multiplication factor of 4/3, i.e. the transmit frequency of the generator is 4/3 times the analyzer frequency.

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 306

SOURce:EXTernal:FREQuency:OFFSet <Offset>

This command defines the frequency offset of the generator with reference to the analyzer frequency.

Select the offset such that the frequency range of the generator is not exceeded if the following formula is applied to the start and stop frequency of the analyzer:

$$\text{Source Freq} = \text{RF} \cdot \frac{\text{Numerator}}{\text{Denominator}} + \text{Offset}$$

Parameters:

<Offset> <numeric value>, specified in Hz, kHz, MHz or GHz, rounded to the nearest Hz

*RST: 0 Hz

Example: `SOUR:EXT:FREQ:OFFS 10HZ`
Sets an offset of the generator output frequency compared to the analyzer frequency of 10 Hz.

Manual operation: See "(Automatic) Source Frequency (Numerator/Denominator/Offset)" on page 306

SOURce:EXTernal:POWer[:LEVel] <Level>

This command sets the output power of the selected generator.

Parameters:

<Level> <numeric value>

*RST: -20 dBm

Example: `SOUR:EXT:POW -30dBm`
Sets the generator level to -30 dBm

Manual operation: See "Source Power" on page 306

SOURce:EXTernal[:STATe] <State>

This command activates or deactivates the connected external generator.

Parameters:

<State> ON | OFF

*RST: OFF

Manual operation: See "Source State" on page 305

SOURce:POWer[:LEVel][:IMMediate]:OFFSet <Offset>

This command defines a level offset for the external generator level. Thus, for example, attenuators or amplifiers at the output of the external generator can be taken into account for the setting.

Parameters:

<Offset> Range: -200 dB to +200 dB
*RST: 0dB

Example: `SOUR:POW:OFFS -10dB`
Sets the level offset of the external generator to – 20 dBm.

Usage: SCPI confirmed

Manual operation: See "Source Offset" on page 306

Interface Configuration

The following commands are required to configure the interface for the connection to the external generator.

SOURce:EXTernal:ROSCillator[:SOURce]....818
SYSTem:COMMunicate:GPIB:RDEVice:GENerator:ADDRess....818
SYSTem:COMMunicate:RDEVice:GENerator:INTerface....819
SYSTem:COMMunicate:RDEVice:GENerator:LINK....819
SYSTem:COMMunicate:RDEVice:GENerator:TYPE....819
SYSTem:COMMunicate:TCPip:RDEVice:GENerator:ADDRess....820

SOURce:EXTernal:ROSCillator[:SOURce] <Source>

This command controls selection of the reference oscillator for the external generator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Parameters:

<Source>

INTernal
the internal reference is used

EXTernal
the external reference is used; if none is available, an error flag is displayed in the status bar

EAUTo
the external reference is used as long as it is available, then the instrument switches to the internal reference (Spectrum application only)

*RST: INT

Example: `SOUR:EXT:ROSC EXT`
Switches to external reference oscillator

Manual operation: See "Reference" on page 304

SYSTem:COMMunicate:GPIB:RDEVice:GENerator:ADDRess <Number>

Changes the IEC/IEEE-bus address of the external generator.

Parameters:

<Number>

Range: 0 to 30
*RST: 28

Example: `SYST:COMM:GPIB:RDEV:GEN:ADDR 15`

Manual operation: See "GPIB Address / TCP/IP Address" on page 304

SYSTem:COMMunicate:RDEVice:GENerator:INTerface <Type>

Defines the interface used for the connection to the external generator.

This command is only available if external generator control is active (see `SOURce:EXTernal[:STATe]` on page 817).

Parameters:

<Type> GPIB | TCPip

*RST: GPIB

Example: `SYST:COMM:RDEV:GEN:INT TCP`

Manual operation: See "Interface" on page 304

SYSTem:COMMunicate:RDEVice:GENerator:LINK <Type>

This command selects the link type of the external generator if the GPIB interface is used.

The difference between the two GPIB operating modes is the execution speed. While, during GPIB operation, each frequency to be set is transmitted to the generator separately, a whole frequency list can be programmed in one go if the TTL interface is also used. Frequency switching can then be performed per TTL handshake which results in considerable speed advantages.

This command is only available if external generator control is active (see `SOURce:EXTernal[:STATe]` on page 817).

Parameters:

<Type> GPIB | TTL

GPIB
GPIB connection without TTL synchronization (for all generators of other manufacturers and some Rohde & Schwarz devices)

TTL
GPIB connection with TTL synchronization (if available; for most Rohde&Schwarz devices)

*RST: GPIB

Example: `SYST:COMM:RDEV:GEN:LINK TTL`
Selects GPIB + TTL interface for generator operation.

Manual operation: See "TTL Handshake" on page 304

SYSTem:COMMunicate:RDEVice:GENerator:TYPE <Type>

This command selects the type of external generator.

For a list of the available generator types see "Overview of Generators Supported by the R&S FSW-B10 Option" on page 294.

Parameters:

<Name> <Generator name as string value>

*RST: SMU02

Example: `SYST:COMM:RDEV:GEN2:TYPE 'SME02'`
Selects SME02 as generator 2

Manual operation: See "Generator Type" on page 303

SYSTem:COMMunicate:TCPip:RDEVice:GENerator:ADDRess <Address>

Configures the TCP/IP address for the external generator.

Parameters:
<Address> TCP/IP address between 0.0.0.0 and 0.255.255.255
*RST: 0.0.0.0

Example: `SYST:COMM:TCP:RDEV:GEN:ADDR 130.094.122.195`

Manual operation: See "GPIB Address / TCP/IP Address" on page 304

Source Calibration

The following commands are required to activate the calibration functions of the external tracking generator. However, they are only available if external generator control is active (see `SOURce:EXTernal[:STATe]` on page 817).

Useful commands for source calibration described elsewhere:

- chapter 11.10.4, "Working with Transducers", on page 937

Remote commands exclusive to source calibration:

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition....820
DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue....821
[SENSe:]CORRection:COLLect[:ACQuire]....821
[SENSe:]CORRection:METHod....822
[SENSe:]CORRection:RECall....822
[SENSe:]CORRection[:STATe]....822
[SENSe:]CORRection:TRANsducer:GENerator....823

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RPOSition <Position>

This command defines the vertical position of the reference level on the display grid.

The R&S FSW adjusts the scaling of the y-axis accordingly.

For measurements with the external generator (R&S FSW-B10) the command defines the position of the reference value.

Parameters:
<Position> 0 PCT corresponds to the lower display border, 100% corresponds to the upper display border.
*RST: 100 PCT = frequency display; 50 PCT = time display

Example: `DISP:TRAC:Y:RPOS 50PCT`

Usage: SCPI confirmed

Manual operation: See "Reference Position" on page 309
See "Ref Level Position" on page 360

DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]:RVALue <Value>

The command defines the power value assigned to the reference position in the grid.

For external generator calibration measurements (requires External Generator Control option R&S FSW-B10), this command defines the power offset value assigned to the reference position.

Parameters:
<Value> *RST: 0 dBm, coupled to reference level

Example: `DISP:TRAC:Y:RVAL -20dBm`
Sets the power value assigned to the reference position to -20 dBm

Manual operation: See "Reference Value" on page 309

[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 822).

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.

This command is only available if external generator control is active (see `SOURce:EXTernal[:STATe]` on page 817).

Parameters:
<MeasType>

THRough
"TRANsmission" mode: calibration with direct connection between external 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
SCPI confirmed

Manual operation: See "Calibrate Reflection Short" on page 308
See "Calibrate Reflection Open" on page 308

[SENSe:]CORRection:METHod

This command selects the type of measurement to be performed with the external generator.

This command is only available if external generator control is active (see `SOURce:EXTernal[:STATe]` on page 817).

Parameters:

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 308
See "Calibrate Reflection Short" on page 308
See "Calibrate Reflection Open" on page 308

[SENSe:]CORRection:RECall

This command restores the measurement configuration used for calibration.

This command is only available if external generator control is active (see `SOURce:EXTernal[:STATe]` on page 817).

Example: `CORR:REC`

Usage: Event
SCPI confirmed

Manual operation: See "Recall" on page 309

[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 821.

This command is only available if external generator control is active (see `SOURce:EXTernal[:STATe]` on page 817).

Parameters:

<State> ON | OFF

*RST: OFF

Example: CORR ON
Activates normalization.

Usage: SCPI confirmed

Manual operation: See "Source Calibration Normalize" on page 308

[SENSe:]CORRection:TRANsducer:GENerator <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:\r_s\instr\trd`. The frequency points are allocated in equidistant steps between start and stop frequency.

The generated transducer factor can be further adapted using the commands described in chapter 11.10.4, "Working with Transducers", on page 937).

Parameters:
<Name> '<name>

Example: CORR:TRAN:GEN 'SMU01'
Creates the transducer file `C:\r_s\instr\trd\SMU01.trd`.

Usage: SCPI confirmed

Manual operation: See "Save As Trd Factor" on page 309

Programming Example for External Generator Control

The following example demonstrates how to work with an external generator in a remote environment. It assumes a signal generator of the type SMU04 is connected to the R&S FSW, including TTL synchronization, as described in "External Generator Connections" on page 292.

```
//--------------Preparing the instrument -----------

//Reset the instrument
*RST

//Set the frequency span.
SENS:FREQ:STAR 10HZ
SENS:FREQ:STOP 1MHZ

//--------------Configuring the interface -----------

//Set the generator type to SMU04 with a frequency range of 100 kHz to 4GHz
SYST:COMM:RDEV:GEN:TYPE 'SMU04'

//Set the interface used to the GPIB address 28
SYST:COMM:RDEV:GEN:INT GPIB
SYST:COMM:GPIB:RDEV:GEN:ADDR 28

//Activate the use of TTL synchronization to optimize measurement speed
```

```
SYST:COMM:RDEV:GEN:LINK TTL

//Activate the use of the external reference frequency at 10 MHz on the generator
SOUR:EXT:ROSC EXT

//--------------Configuring the calibration measurement -----------

//Activate external generator control.
SOUR:EXT:STAT ON
//Set the generator output level to -10 dBm.
SOUR:EXT:POW -10DBM
//Set the frequency coupling to automatic
SOUR:EXT:FREQ:COUP:STAT ON

//--------------Configuring the generator frequency range -----------

//Define a series of frequencies (one for each sweep point) based on the current
//frequency at the RF input of the analyzer; the generator frequency is half the
//frequency of the analyzer, with an offset of 100 kHz;
// analyzer start:            10 Hz
// analyzer stop:             1 MHz
// analyzer span:             999.99 KHz
// generator frequency start: 100.005 KHz
// generator frequency stop:  600 KHz
// generator span:            499.995 KHz

SOUR:EXT:FREQ:FACT:NUM 1
SOUR:EXT:FREQ:FACT:DEN 2
SOUR:EXT: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 - 600 kHz)
TRAC:DATA:X? TRACE1

//Retrieve the measured power levels; = 0 between 10 Hz and 100 kHz (below
//generator minimum frequency); nominal -5dBm as of 100 kHz;
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
```

11.7.6.5 Working with Power Sensors

The following commands describe how to work with power sensors.

- Configuring Power Sensors....825
- Configuring Power Sensor Measurements....826
- Triggering with Power Sensors....833

Configuring Power Sensors

SYSTem:COMMunicate:RDEVice:PMETer<p>:CONFigure:AUTO[:STATe]....825
SYSTem:COMMunicate:RDEVice:PMETer:COUNt?....825
SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine....826

SYSTem:COMMunicate:RDEVice:PMETer<p>:CONFigure:AUTO[:STATe] <State>

This command turns automatic assignment of a power sensor to the power sensor index on and off.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: `SYST:COMM:RDEV:PMET:CONF:AUTO OFF`

Manual operation: See "Select" on page 286

SYSTem:COMMunicate:RDEVice:PMETer:COUNt?

This command queries the number of power sensors currently connected to the R&S FSW.

Parameters:
<NumberSensors> Number of connected power sensors.

Example: `SYST:COMM:RDEV:PMET:COUN?`

Usage: Query only

Manual operation: See "Select" on page 286

SYSTem:COMMunicate:RDEVice:PMETer<p>:DEFine <Placeholder>, <Type>, <Interface>, <SerialNo>

This command assigns the power sensor with the specified serial number to the selected power sensor index (configuration).

The query returns the power sensor type and serial number of the sensor assigned to the specified index.

Suffix:

<p> 1...4
Power sensor index

Setting parameters:

<Placeholder> Currently not evaluated

<SerialNo> Serial number of a connected power sensor

Query parameters:

<Type> The power sensor type, e.g. "NRP-Z81".

<Interface> Currently not evaluated

Return values:

<Placeholder> Currently not used

<Type> Detected power sensor type, e.g. "NRP-Z81".

<Interface> Interface the power sensor is connected to; always "USB"

<SerialNo> Serial number of the power sensor assigned to the specified index

Example: `SYST:COMM:RDEV:PMET2:DEF '','NRP-Z81','','123456'`
Assigns the power sensor with the serial number '123456' to the configuration "Power Sensor 2".
`SYST:COMM:RDEV:PMET2:DEF?`
Queries the sensor assigned to "Power Sensor 2".
Result:
`'','NRP-Z81','USB','123456'`
The NRP-Z81 power sensor with the serial number '123456' is assigned to the "Power Sensor 2".

Manual operation: See "Select" on page 286

Configuring Power Sensor Measurements

CALibration:PMETer<p>:ZERO:AUTO ONCE....827
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]....827
CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE....827
CALCulate<n>:PMETer<p>:RELative:STATe....828
FETCh:PMETer<p>?....828
READ:PMETer<p>?....828
[SENSe:]PMETer<p>:DCYCle[:STATe]....829
[SENSe:]PMETer<p>:DCYCle:VALue....829
[SENSe:]PMETer<p>:FREQuency....829

[SENSe:]PMETer<p>:FREQuency:LINK....830
[SENSe:]PMETer<p>:MTIMe....830
[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt....830
[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe]....831
[SENSe:]PMETer<p>:ROFFset[:STATe]....831
[SENSe:]PMETer<p>[:STATe]....832
[SENSe:]PMETer<p>:UPDate[:STATe]....832
UNIT<n>:PMETer<p>:POWer....832
UNIT<n>:PMETer<p>:POWer:RATio....833

CALibration:PMETer<p>:ZERO:AUTO ONCE

This commands starts to zero the power sensor.

Note that you have to disconnect the signals from the power sensor input before you start to zero the power sensor. Otherwise, results are invalid.

Suffix:
<p> 1...4
Power sensor index

Parameters:
ONCE

Example: `CAL:PMET2:ZERO:AUTO ONCE;*WAI`
Starts zeroing the power sensor 2 and delays the execution of further commands until zeroing is concluded.

Usage: Event

Manual operation: See "Zeroing Power Sensor" on page 286

CALCulate<n>:PMETer<p>:RELative[:MAGNitude] <RefValue>

This command defines the reference value for relative measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<RefValue> Range: -200 dBm to 200 dBm
*RST: 0

Example: `CALC:PMET2:REL -30`
Sets the reference value for relative measurements to -30 dBm for power sensor 2.

Manual operation: See "Reference Value" on page 287

CALCulate<n>:PMETer<p>:RELative[:MAGNitude]:AUTO ONCE

This command sets the current measurement result as the reference level for relative measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
ONCE

Example: `CALC:PMET2:REL:AUTO ONCE`
Takes the current measurement value as reference value for relative measurements for power sensor 2.

Usage: Event

Manual operation: See "Setting the Reference Level from the Measurement (Meas->Ref)" on page 287

CALCulate<n>:PMETer<p>:RELative:STATe <State>

This command turns relative power sensor measurements on and off.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:PMET2:REL:STAT ON`
Activates the relative display of the measured value for power sensor 2.

FETCh:PMETer<p>?

This command queries the results of power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Return values:
<Level> Power level that has been measured by a power sensor.
The unit is either dBm (absolute measurements) or dB (relative measurements).

Usage: Query only

READ:PMETer<p>?

This command initiates a power sensor measurement and queries the results.

Suffix:
<p> 1...4
Power sensor index

Usage: Query only

[SENSe:]PMETer<p>:DCYCle[:STATe] <State>

This command turns the duty cycle correction on and off.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF
*RST: OFF

Example: `PMET2:DCYC:STAT ON`

Manual operation: See "Duty Cycle" on page 288

[SENSe:]PMETer<p>:DCYCle:VALue <Percentage>

This command defines the duty cycle for the correction of pulse signals.

The power sensor uses the duty cycle in combination with the mean power to calculate the power of the pulse.

Suffix:
<p> 1...4
Power sensor

Parameters:
<Percentage> Range: 0.001 to 99.999
*RST: 99.999
Default unit: %

Example: `PMET2:DCYC:STAT ON`
Activates the duty cycle correction.
`PMET2:DCYC:VAL 0.5`
Sets the correction value to 0.5%.

Manual operation: See "Duty Cycle" on page 288

[SENSe:]PMETer<p>:FREQuency <Frequency>

This command defines the frequency of the power sensor.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Frequency> The available value range is specified in the data sheet of the power sensor in use.
*RST: 50 MHz

Example: `PMET2:FREQ 1GHZ`
Sets the frequency of the power sensor to 1 GHz.

Manual operation: See "Frequency Manual" on page 286

[SENSe:]PMETer<p>:FREQuency:LINK <Coupling>

This command selects the frequency coupling for power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Coupling> **CENTer**
Couples the frequency to the center frequency of the analyzer
MARKer1
Couples the frequency to the position of marker 1
OFF
Switches the frequency coupling off
*RST: CENTer

Example: `PMET2:FREQ:LINK CENT`
Couples the frequency to the center frequency of the analyzer

Manual operation: See "Frequency Coupling" on page 287

[SENSe:]PMETer<p>:MTIMe <Duration>

This command selects the duration of power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Duration> SHORt | NORMal | LONG
*RST: NORMal

Example: `PMET2:MTIM SHOR`
Sets a short measurement duration for measurements of stationary high power signals for the selected power sensor.

Manual operation: See "Meas Time/Average" on page 287

[SENSe:]PMETer<p>:MTIMe:AVERage:COUNt <NumberReadings>

This command sets the number of power readings included in the averaging process of power sensor measurements.

Extended averaging yields more stable results for power sensor measurements, especially for measurements on signals with a low power, because it minimizes the effects of noise.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<NumberReadings> An average count of 0 or 1 performs one power reading.
Range: 0 to 256
Increment: binary steps (1, 2, 4, 8, ...)

Example: `PMET2:MTIM:AVER ON`
Activates manual averaging.
`PMET2:MTIM:AVER:COUN 8`
Sets the number of readings to 8.

Manual operation: See "Average Count (Number of Readings)" on page 288

[SENSe:]PMETer<p>:MTIMe:AVERage[:STATe] <State>

This command turns averaging for power sensor measurements on and off.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF
*RST: OFF

Example: `PMET2:MTIM:AVER ON`
Activates manual averaging.

Manual operation: See "Meas Time/Average" on page 287

[SENSe:]PMETer<p>:ROFFset[:STATe] <State>

This command includes or excludes the reference level offset of the analyzer for power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> **ON | 1**
Includes the reference level offset in the results.
OFF | 0
Ignores the reference level offset.
*RST: 1

Example: PMET2:ROFF OFF
Takes no offset into account for the measured power.

Manual operation: See "Use Ref Lev Offset" on page 288

[SENSe:]PMETer<p>[:STATe] <State>

This command turns a power sensor on and off.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF
*RST: OFF

Example: PMET1 ON
Switches the power sensor measurements on.

Manual operation: See "State" on page 285
See "Select" on page 286

[SENSe:]PMETer<p>:UPDate[:STATe] <State>

This command turns continuous update of power sensor measurements on and off.

If on, the results are update even if a single sweep is complete.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF
*RST: OFF

Example: PMET1:UPD ON
The data from power sensor 1 is updated continuously.

Manual operation: See "Continuous Value Update" on page 286

UNIT<n>:PMETer<p>:POWer <Unit>

This command selects the unit for absolute power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Unit> DBM | WATT | W
*RST: DBM

Example: `UNIT:PMET:POW DBM`

Manual operation: See "Unit/Scale" on page 287

UNIT<n>:PMETer<p>:POWer:RATio <Unit>

This command selects the unit for relative power sensor measurements.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Unit> DB | PCT
*RST: DB

Example: `UNIT:PMET:POW:RAT DB`

Manual operation: See "Unit/Scale" on page 287

Triggering with Power Sensors

[SENSe:]PMETer<p>:TRIGger:DTIMe....833
[SENSe:]PMETer<p>:TRIGger:HOLDoff....833
[SENSe:]PMETer<p>:TRIGger:HYSTeresis....834
[SENSe:]PMETer<p>:TRIGger:LEVel....834
[SENSe:]PMETer<p>:TRIGger:SLOPe....835
[SENSe:]PMETer<p>:TRIGger[:STATe]....835

[SENSe:]PMETer<p>:TRIGger:DTIMe <Time>

This command defines the time period that the input signal has to stay below the IF power trigger level before the measurement starts.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Time> Range: 0 s to 1 s
Increment: 100 ns
*RST: 100 µs

Example: `PMET2:TRIG:DTIMe 0.001`

[SENSe:]PMETer<p>:TRIGger:HOLDoff <Holdoff>

This command defines the trigger holdoff for external power triggers.

Suffix:
<p> 1...4
Power sensor index

Parameters:

<Holdoff> Time period that has to pass between the trigger event and the start of the measurement, in case another trigger event occurs.

Range: 0 s to 1 s
Increment: 100 ns
*RST: 0 s

Example: `PMET2:TRIG:HOLD 0.1`
Sets the holdoff time of the trigger to 100 ms

Manual operation: See "Using the power sensor as an external trigger" on page 288
See "Trigger Holdoff" on page 289

[SENSe:]PMETer<p>:TRIGger:HYSTeresis <Hysteresis>

This command defines the trigger hysteresis for external power triggers.

The hysteresis in dB is the value the input signal must stay below the IF power trigger level in order to allow a trigger to start the measurement.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Hysteresis>

Range: 3 dB to 50 dB
Increment: 1 dB
*RST: 0 dB

Example: `PMET2:TRIG:HYST 10`
Sets the hysteresis of the trigger to 10 dB.

Manual operation: See "Using the power sensor as an external trigger" on page 288
See "Hysteresis" on page 289

[SENSe:]PMETer<p>:TRIGger:LEVel <Level>

This command defines the trigger level for external power triggers.

This command requires the use of an R&S NRP-Z81 power sensor.

Suffix:

<p> 1...4
Power sensor index

Parameters:

<Level> -20 to +20 dBm

Range: -20 dBm to 20 dBm
*RST: -10 dBm

Example: `PMET2:TRIG:LEV -10 dBm`
Sets the level of the trigger

Manual operation: See "Using the power sensor as an external trigger" on page 288
See "External Trigger Level" on page 288

[SENSe:]PMETer<p>:TRIGger:SLOPe <Edge>

This command selects the trigger condition for external power triggers.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<Edge> **POSitive**
The measurement starts in case the trigger signal shows a positive edge.

NEGative
The measurement starts in case the trigger signal shows a negative edge.

*RST: POSitive

Example: `PMET2:TRIG:SLOP NEG`

Manual operation: See "Using the power sensor as an external trigger" on page 288
See "Slope" on page 289

[SENSe:]PMETer<p>:TRIGger[:STATe] <State>

This command turns the external power trigger on and off.

This command requires the use of an R&S NRP-Z81 power sensor.

Suffix:
<p> 1...4
Power sensor index

Parameters:
<State> ON | OFF

*RST: OFF

Example: `PMET2:TRIG ON`
Switches the external power trigger on

Manual operation: See "Using the power sensor as an external trigger" on page 288

11.7.6.6 Configuring the Outputs

Configuring trigger input/output is described in chapter 11.7.4.3, "Configuring the Trigger Output", on page 789.

DIAGnostic:SERVice:NSOurce....836
OUTPut:IF[:SOURce]....836
OUTPut:IF:IFFRequency....837
OUTPut:UPORt:STATe....837
OUTPut:UPORt[:VALue]....837

DIAGnostic:SERVice:NSOurce <State>

This command turns the 28 V supply of the BNC connector labeled NOISE SOURCE CONTROL on the front panel on and off.

For details see chapter 6.2.1.4, "Input from Noise Sources", on page 277.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DIAG:SERV:NSO ON`

Manual operation: See "Noise Source" on page 343

OUTPut:IF[:SOURce] <Source>

Defines the type of signal sent to the IF/VIDEO/DEMOD connector on the rear panel of the R&S FSW.

The command is only available in the time domain.

For restrictions and more information see chapter 6.2.1.6, "IF and Video Signal Output", on page 278.

Parameters:

<Source>

IF
Sends the measured IF value at the frequency defined using `OUTPut:IF:IFFRequency` to the IF/VIDEO/DEMOD output connector.

VIDeo
Sends the displayed video signal (i.e. the filtered and detected IF signal, 200mV) to the IF/VIDEO/DEMOD output connector. This setting is required to send demodulated audio frequencies to the output.

*RST: IF

Example: `OUTP:IF VID`
Selects the video signal for the IF output connector.

Manual operation: See "IF/Video Output" on page 342

OUTPut:IF:IFFRequency <Frequency>

This command defines the frequency for the IF output. The IF frequency of the signal is converted accordingly.

This command is available in the time domain and if the IF/VIDEO/DEMOD output is configured for IF.

For more information see chapter 6.2.1.6, "IF and Video Signal Output", on page 278.

Parameters:
<Frequency> *RST: 50.0 MHz

Manual operation: See "IF (Wide) Out Frequency" on page 342

OUTPut: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 FSW.

Parameters:
<State>
ON
User port is switched to OUTPut
OFF
User port is switched to INPut
*RST: OFF

OUTPut: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:UPORt:STATe` on page 798), the output value is temporarily stored.

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.

11.8 Analyzing Measurements (Basics)

The commands for general analysis tasks are described here.

- Zooming into the Display....838
- Configuring the Trace Display and Retrieving Trace Data....840
- Working with Markers....855
- Configuring Display and Limit Lines....893

11.8.1 Zooming into the Display

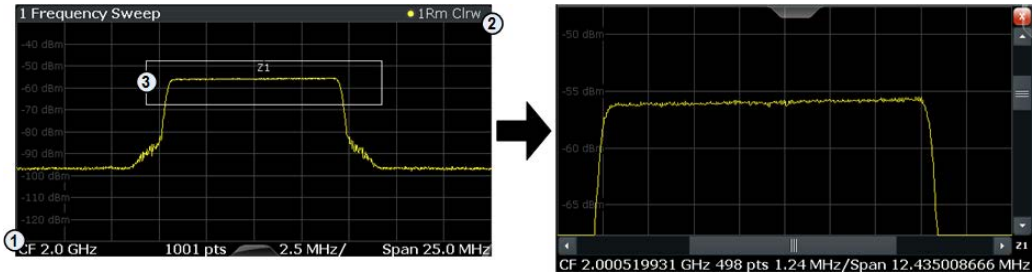
11.8.1.1 Using the Single Zoom

DISPlay[:WINDow<n>]:ZOOM:AREA....838
DISPlay[:WINDow<n>]:ZOOM:STATe....838

DISPlay[:WINDow<n>]: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)

Parameters:

<x1>,<y1>, <x2>,<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 402

DISPlay[:WINDow<n>]:ZOOM:STATe <State>

This command turns the zoom on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DISP:ZOOM ON`
Activates the zoom mode.

Manual operation: See "Single Zoom" on page 402
See "Restore Original Display" on page 402
See "Deactivating Zoom (Selection mode)" on page 402

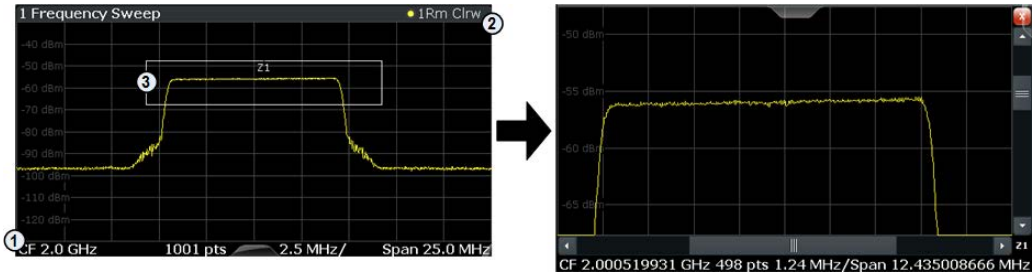
11.8.1.2 Using the Multiple Zoom

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:AREA.....839
DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe.....839

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>: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:

<zoom> 1...4
Selects the zoom window.

Parameters:

<x1>,<y1>, <x2>,<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 "Multiple Zoom" on page 402

DISPlay[:WINDow<n>]:ZOOM:MULTiple<zoom>:STATe <State>

This command turns the mutliple zoom on and off.

Suffix:
<zoom> 1...4
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
*RST: OFF

Manual operation: See "Multiple Zoom" on page 402
See "Restore Original Display" on page 402
See "Deactivating Zoom (Selection mode)" on page 402

11.8.2 Configuring the Trace Display and Retrieving Trace Data

The commands required to work with traces are described here.

Commands required to export traces (and other result data) are described in chapter 11.9.5, "Storing Measurement Results", on page 925.

- Configuring Standard Traces....840
- Configuring Spectrograms....845
- Using Trace Mathematics....850
- Retrieving Trace Results....852
- Formats for Returned Values: ASCII Format and Binary Format....855

11.8.2.1 Configuring Standard Traces

Useful commands for trace configuration described elsewhere

- `DISPlay[:WINDow<n>]:TRACe:Y:SPACing` on page 780
- `DISPlay[:WINDow<n>]:TRACe:Y[:SCALe]` on page 779

Remote commands exclusive to trace configuration

DISPlay[:WINDow<n>]:TRACe<t>:MODE....841
DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous....841
DISPlay[:WINDow<n>]:TRACe<t>[:STATe]....842
[SENSe:]AVERage:COUNt....842
[SENSe:]AVERage<n>[:STATe<t>]....843
[SENSe:]AVERage<n>:TYPE....843
[SENSe:][WINDow:]DETector<trace>[:FUNCtion]....843
[SENSe:][WINDow:]DETector<trace>[:FUNCtion]:AUTO....844
TRACe<n>:COPY....844

DISPlay[:WINDow<n>]:TRACe<t>:MODE <Mode>

This command selects the trace mode.

In case of max hold, min hold or average trace mode, you can set the number of single measurements with `[SENSe:]SWEep:COUNt`. Note that synchronization to the end of the measurement is possible only in single sweep mode.

Parameters:

<Mode>

WRITe
Overwrite mode: the trace is overwritten by each sweep. This is the default setting.

AVERage
The average is formed over several sweeps. The "Sweep/Average Count" determines the number of averaging procedures.

MAXHold
The maximum value is determined over several sweeps and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is greater than the previous one.

MINHold
The minimum value is determined from several measurements and displayed. The R&S FSW saves the sweep result in the trace memory only if the new value is lower than the previous one.

VIEW
The current contents of the trace memory are frozen and displayed.

BLANk
Hides the selected trace.

*RST: Trace 1: WRITe, Trace 2-6: BLANk

Example:

```
INIT:CONT OFF
```
Switching to single sweep mode.
```
SWE:COUN 16
```
Sets the number of measurements to 16.
```
DISP:TRAC3:MODE WRIT
```
Selects clear/write mode for trace 3.
```
INIT;*WAI
```
Starts the measurement and waits for the end of the measurement.

Manual operation: See "Trace Mode" on page 418

DISPlay[:WINDow<n>]:TRACe<t>:MODE:HCONtinuous <State>

This command turns an automatic reset of a trace on and off after a parameter has changed.

The reset works for trace modes min hold, max hold and average.

Note that the command has no effect if critical parameters like the span have been changed to avoid invalid measurement results

Parameters:

<State>

ON
The automatic reset is off.

OFF
The automatic reset is on.

*RST: OFF

Example: `DISP:WIND:TRAC3:MODE:HCON ON`
Switches off the reset function.

Manual operation: See "Hold" on page 419

DISPlay[:WINDow<n>]:TRACe<t>[:STATe] <State>

This command turns a trace on and off.

The measurement continues in the background.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1 for TRACe1, 0 for TRACe 2 to 6

Example: `DISP:TRAC3 ON`

Usage: SCPI confirmed

Manual operation: See "Trace 1/Trace 2/Trace 3/Trace 4 (Softkeys)" on page 421

[SENSe:]AVERage:COUNt <AverageCount>

This command defines the number of sweeps that the application uses to average traces.

In case of continuous sweeps, the application calculates the moving average over the average count.

In case of single sweep measurements, the application stops the measurement and calculates the average after the average count has been reached.

Parameters:

<AverageCount>

If you set a average count of 0 or 1, the application performs one single sweep in single sweep mode.
In continuous sweep mode, if the average count is set to 0, a moving average over 10 sweeps is performed.

Range: 0 to 200000
*RST: 0

Usage: SCPI confirmed

Manual operation: See "Sweep/Average Count" on page 371
See "Average Count" on page 420

[SENSe:]AVERage<n>[:STATe<t>] <State>

This command turns averaging for a particular trace in a particular window on and off.

Parameters:
<State> ON | OFF

Usage: SCPI confirmed

[SENSe:]AVERage<n>:TYPE <Mode>

This command selects the trace averaging mode.

Parameters:
<Mode>

VIDeo
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.

*RST: VIDeo

Example: `AVER:TYPE LIN`
Switches to linear average calculation.

Usage: SCPI confirmed

Manual operation: See "Average Mode" on page 420

[SENSe:][WINDow:]DETector<trace>[:FUNCtion] <Detector>

Defines the trace detector to be used for trace analysis.

For details see chapter 7.3.1.1, "Mapping Samples to Sweep Points with the Trace Detector", on page 406.

For EMI measurements, the trace detector is used for the initial peak search only, not for the final test. The detector for the final test is configured using `CALCulate:MARKer<m>:FUNCtion:FMEasurement:DETector` on page 738.

If the EMI (R&S FSW-K54) measurement option is installed and the filter type "CISPR" is selected, additional detectors are available, even if EMI measurement is not active. For details see chapter 5.13.3.2, "Detectors and Dwell Time", on page 252.

Parameters:

<Detector>

APEak
Autopeak

NEGative
Negative peak

POSitive
Positive peak

QPEak
Quasipeak (CISPR filter only)

SAMPle
First value detected per trace point

RMS
RMS value

AVERage
Average

CAVerage
CISPR Average (CISPR filter only)

CRMS
CISPR RMS (CISPR filter only)

*RST: APEak

Example: `DET POS`
Sets the detector to "positive peak".

Manual operation: See "Detector" on page 419

[SENSe:][WINDow:]DETector<trace>[:FUNCtion]:AUTO <State>

This command couples and decouples the detector to the trace mode.

Parameters:

<State>

ON | OFF | 0 | 1

*RST: 1

Example: `DET:AUTO OFF`
The selection of the detector is not coupled to the trace mode.

Manual operation: See "Detector" on page 419

TRACe<n>:COPY <TraceNumber>, <TraceNumber>

This command copies data from one trace to another.

Parameters:

<TraceNumber>, <TraceNumber>

TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6
The first parameter is the destination trace, the second parameter is the source.

Example: `TRAC:COPY TRACe1,TRACe2`
Copies the data from trace 2 to trace 1.

Usage: SCPI confirmed

Manual operation: See "Copy Trace" on page 421

11.8.2.2 Configuring Spectrograms

In addition to the standard "level versus frequency" or "level versus time" spectrum traces, the R&S FSW 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. The commands required to configure spectrograms in a remote environment are described here. For details and manual operation see chapter 7.3.1.6, "Spectrograms", on page 411.

When configuring spectrograms, the window suffix is irrelevant. The settings are always applied to the spectrogram window, or to all spectrogram windows, if several are active for the same measurement channel.

For commands to set markers in spectrograms, see chapter 11.8.3.6, "Marker Search (Spectrograms)", on page 871.

Configuring a Spectrogram Measurement....845
Configuring the Color Map....848

Configuring a Spectrogram Measurement

CALCulate:SGRam:CLEar[:IMMediate]....845
CALCulate:SGRam:CONT....845
CALCulate:SGRam:FRAMe:COUNt....846
CALCulate:SGRam:FRAMe:SELect....846
CALCulate:SGRam:HDEPth....847
CALCulate:SGRam:TSTamp:DATA?....847
CALCulate:SGRam:TSTamp[:STATe]....848
CALCulate:SGRam[:STATe]....848

CALCulate:SGRam:CLEar[:IMMediate]

This command resets the spectrogram and clears the history buffer.

Example: `CALC:SGR:CLE`
Resets the result display and clears the memory.

Usage: Event

Manual operation: See "Spectrogram Frames" on page 374
See "Clear Spectrogram" on page 374

CALCulate:SGRam:CONT <State>

This command determines whether the results of the last measurement are deleted before starting a new measurement in single sweep mode.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `INIT:CONT OFF`
Selects single sweep mode.
`INIT;*WAI`
Starts the sweep and waits for the end of the sweep.
`CALC:SGR:CONT ON`
Repeats the single sweep measurement without deleting the results of the last measurement.

Manual operation: See "Spectrogram Frames" on page 374
See "Continue Frame" on page 374
See "State" on page 426

CALCulate:SGRam:FRAMe:COUNt <Frames>

This command defines the number of frames to be recorded in a single sweep.

Parameters:

<Frames> The maximum number of frames depends on the history depth.

Range: 1 to history depth
Increment: 1
*RST: 1

Example: `INIT:CONT OFF`
Selects single sweep mode.
`CALC:SGR:FRAM:COUN 200`
Sets the number of frames to 200.

Manual operation: See "Spectrogram Frames" on page 374
See "Frame Count" on page 374

CALCulate:SGRam: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.

Parameters:

<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.

<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 "Spectrogram Frames" on page 374
See "Select frame" on page 374

CALCulate:SGRam:HDEPth <History>

This command defines the number of frames to be stored in the R&S FSW memory.

Parameters:

<History> The maximum number of frames depends on the number of sweep points.

Range: 781 to 20000
Increment: 1
*RST: 3000

Example: CALC:SGR:SPEC 1500
Sets the history depth to 1500.

Manual operation: See "History Depth" on page 426

CALCulate:SGRam:TSTamp:DATA? <Frames>

This command queries the time stamp of the frames.

The frame results themselves are returned with TRACe<n>[:DATA].

Query parameters:

<Frames> **CURRent**
Returns the time stamp of the current frame.

ALL
Returns the time stamps of all frames. The results are sorted in descending order, beginning with the current frame.

Return values:

<Date> The return values consist of four values for each frame.
• date of the measurement in seconds that have passed since 01.01.1970
• milliseconds of the date for a higher resolution
These numbers are appropiate for relative uses, but you can also calculate the absolute date and time as displayed on the screen.
The third and fourth value are reserved for future uses.
If the Spectrogram is empty, the command returns '0,0,0,0'

Example: CALC:SGR:TST ON
Activates the time stamp.
CALC:SGR:TST:DATA? ALL
Returns the time stamp of all frames sorted in a descending order.

Usage: Query only

Manual operation: See "Time Stamp" on page 427

CALCulate:SGRam: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:DELTamarker<m>:SGRam:FRAMe` on page 876
- `CALCulate:MARKer<m>:SGRam:FRAMe` on page 872
- `CALCulate:SGRam:FRAMe:SELect` on page 846

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:SGR:TST ON`
Activates the time stamp.

Manual operation: See "Time Stamp" on page 427

CALCulate:SGRam[:STATe] <State>

This command turns the spectrogram on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:SGR ON`
Activates the Spectrogram result display.

Manual operation: See "State" on page 426

Configuring the Color Map

DISPlay:WINDow:SGRam:COLor:DEFault....848
DISPlay:WINDow:SGRam:COLor:LOWer....849
DISPlay:WINDow:SGRam:COLor:SHAPe....849
DISPlay:WINDow:SGRam:COLor:UPPer....849
DISPlay:WINDow:SGRam:COLor[:STYLe]....849

DISPlay:WINDow:SGRam:COLor:DEFault

This command restores the original color map.

Usage: Event

Manual operation: See "Set to Default" on page 429

DISPlay:WINDow:SGRam:COLor:LOWer <Percentage>

This command defines the starting point of the color map.

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 428

DISPlay:WINDow:SGRam:COLor:SHAPe <Shape>

This command defines the shape and focus of the color curve for the spectrogram result display.

Parameters:

<Shape> Shape of the color curve.

Range: -1 to 1
*RST: 0

Manual operation: See "Shape" on page 428

DISPlay:WINDow:SGRam:COLor:UPPer <Percentage>

This command defines the end point of the color map.

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 428

DISPlay:WINDow:SGRam: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 429

11.8.2.3 Using Trace Mathematics

The following commands control trace mathematics.

CALCulate<n>:MATH[:EXPression][:DEFine] 850
CALCulate<n>:MATH:MODE 851
CALCulate<n>:MATH:POSition 851
CALCulate<n>:MATH:STATe 851

CALCulate<n>:MATH[:EXPression][:DEFine] <Expression>

This command selects the mathematical expression for trace mathematics.

Before you can use the command, you have to turn trace mathematics on.

Parameters:

<Expression>

(TRACE1-TRACE2)
Subtracts trace 2 from trace 1.

(TRACE1-TRACE3)
Subtracts trace 3 from trace 1.

(TRACE1-TRACE4)
Subtracts trace 4 from trace 1.

(TRACE1-TRACE5)
Subtracts trace 5 from trace 1.

(TRACE1-TRACE6)
Subtracts trace 6 from trace 1.

Example:
```
CALC:MATH:STAT ON
```
Turns trace mathematics on.
```
CALC:MATH:EXPR:DEF (TRACE1-TRACE3)
```
Subtracts trace 3 from trace 1.

Usage: SCPI confirmed

Manual operation: See "Trace Math Function" on page 422

CALCulate<n>:MATH:MODE <Mode>

This command selects the way the R&S FSW calculates trace mathematics.

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 423

CALCulate<n>:MATH:POSition <Position>

This command defines the position of the trace resulting from the mathematical operation.

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 423

CALCulate<n>:MATH:STATe <State>

This command turns the trace mathematics on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MATH:STAT ON`
Turns on trace mathematics.

Usage: SCPI confirmed

Manual operation: See "Trace Math Function" on page 422
See "Trace Math Off" on page 423

11.8.2.4 Retrieving Trace Results

This chapter describes how to retrieve data from standard traces.

For spectrograms see also chapter 11.8.3.6, "Marker Search (Spectrograms)", on page 871.

For details on the format of the retrieved trace data see also chapter 11.8.2.5, "Formats for Returned Values: ASCII Format and Binary Format", on page 855.

Commands required to export traces (and other result data) are described in chapter 11.9.5, "Storing Measurement Results", on page 925.

FORMat[:DATA] 852
TRACe<n>[:DATA] 853
TRACe<n>[:DATA]:MEMory? 854
TRACe<n>[:DATA]:X? 854

FORMat[:DATA] <Format>

This command selects the data format that is used for transmission of trace data from the R&S FSW to the controlling computer.

Note that the command has no effect for data that you send to the R&S FSW. The R&S FSW automatically recognizes the data it receives, regardless of the format.

For details on data formats see chapter 11.8.2.5, "Formats for Returned Values: ASCII Format and Binary Format", on page 855.

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 may be.

REAL,32
32-bit IEEE 754 floating-point numbers in the "definite length block format".
In the Spectrum application, the format setting `REAL` is used for the binary transmission of trace data.
For I/Q data, 8 bytes per sample are returned for this format setting.

*RST: ASCII

Example: `FORM REAL,32`

Usage: SCPI confirmed

TRACe<n>[:DATA] <Trace>,<Data> | <ResultType>

This command queries current trace data and measurement results.

If you use it as a setting command, it transfers trace data from an external source to the R&S FSW.

The data format depends on `FORMat[:DATA]`.

Parameters:

<Trace> Selects the trace to write the data to.

TRACE1 | ... | TRACE6

<Data> Contains the data to transfer.

Query parameters:

<ResultType> Selects the type of result to be returned.

TRACE1 | ... | TRACE6
Returns the trace data for the corresponding trace.
For details see table 11-4.

LIST
Returns the results of the peak list evaluation for Spurious Emission and Spectrum Emission Mask measurements.
For details see table 11-5.

SPURious
Returns the peak list of Spurious Emission measurements.

SPECtrogram | SGRam
Returns the results of the spectrogram result display.
For details see table 11-6.

Return values:

<TraceData> For more information see tables below.

Example:
```
TRAC TRACE1,+A$
```
Transfers trace data ('+A$') to trace 1.

Example:
```
TRAC? TRACE3
```
Queries the data of trace 3.

Usage: SCPI confirmed

Manual operation: See "Spectrum Emission Mask" on page 104
See "Spurious Emissions" on page 104
See "List Evaluation State" on page 184
See "List Evaluation State" on page 204

Table 11-4: Return values for TRACE1 to TRACE6 parameter

The trace data consists of a list of power levels that have been measured. The number of power levels in the list depends on the currently selected number of sweep points. The unit depends on the measurement and on the unit you have currently set.
If you are measuring with the auto peak detector, the command returns positive peak values only.
For SEM or Spurious Emission measurement results, the x-values should be queried as well, as they are not equi-distant (see `TRACe<n>[:DATA]:X?` on page 854).

Table 11-5: Return values for LIST parameter

For every measurement range you have defined (range 1...n), the command returns eight values in the following order.

<No>,<StartFreq>,<StopFreq>,<RBW>,<PeakFreq>,<PowerAbs>,<PowerRel>,<PowerDelta>,<LimitCheck>,<Unused1>,<Unused2>

- <No>: range number
- <StartFreq>,<StopFreq>: start and stop frequency of the range
- <RBW>: resolution bandwidth
- <PeakFreq>: frequency of the peak in a range
- <PowerAbs>: absolute power of the peak in dBm
- <PowerRel>: power of the peak in relation to the channel power in dBc
- <PowerDelta>: distance from the peak to the limit line in dB, positive values indicate a failed limit check
- <LimitCheck>: state of the limit check (0 = PASS, 1 = FAIL)
- <Unused1>,<Unused2>: reserved (0.0)

Table 11-6: Return values for SPECtrogram parameter

For every frame in the spectrogram, the command returns the power levels that have been measured, one for each sweep point. The number of frames depends on the size of the history depth. The power level depends on the unit you have currently set.

TRACe<n>[:DATA]:MEMory? <Trace>,<OffsSwPoint>,<NoOfSwPoints>

This command queries the previously captured trace data for the specified trace from the memory. As an offset and number of sweep points to be retrieved can be specified, the trace data can be retrieved in smaller portions, making the command faster than the `TRAC:DATA?` command. This is useful if only specific parts of the trace data are of interest.

If no parameters are specified with the command, the entire trace data is retrieved; in this case, the command is identical to `TRAC:DATA? TRACE1`

For details on the returned values see the TRAC:DATA? <TRACE...> command.

Query parameters:

<Trace>	TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6
<OffsSwPoint>	The offset in sweep points related to the start of the measurement at which data retrieval is to start.
<NoOfSwPoints>	Number of sweep points to be retrieved from the trace.
Example:	`TRAC:DATA:MEM? TRACE1,25,100` Retrieves 100 sweep points from trace 1, starting at sweep point 25.
Usage:	Query only

TRACe<n>[:DATA]:X? <TraceNumber>

This command queries the horizontal trace data for each sweep point in the specified window, for example the frequency in frequency domain or the time in time domain measurements. This is especially useful for traces with non-equidistant x-values, e.g. for SEM or Spurious Emissions measurements.

Query parameters:

<TraceNumber> Trace number.

TRACE1 | ... | TRACE6

Example: `TRAC3:X? TRACE1`
Returns the x-values for trace 1 in window 3.

Usage: Query only

Manual operation: See "Spectrum Emission Mask" on page 104

11.8.2.5 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]`. 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,32):
  The data is stored as binary data (Definite Length Block Data according to IEEE 488.2), each measurement value being formatted in 32 Bit IEEE 754 Floating-Point-Format.
  The schema of the result string is as follows:
  `#41024<value1><value2>…<value n>` with

#4	number of digits (= 4 in the example) of the following number of data bytes
1024	number of following data bytes (= 1024 in the example)
<Value>	4-byte floating point value

Reading out data in binary format is quicker than in ASCII format. Thus, binary format is recommended for large amounts of data.

11.8.3 Working with Markers

The commands required to work with markers and marker functions in a remote environment are described here. The tasks for manual operation are described in chapter 7.4, "Marker Usage", on page 435.

In the Spectrum application, markers are identical in all windows. Thus, the suffix <n> for the window is generally irrelevant.

- Setting Up Individual Markers....856
- General Marker Settings....860
- Configuring and Performing a Marker Search....861

- Positioning the Marker....864
- Retrieving Marker Results....869
- Marker Search (Spectrograms)....871
- Fixed Reference Marker Settings....878
- Marker Peak Lists....880
- Noise Measurement Marker....882
- Phase Noise Measurement Marker....883
- Band Power Marker....885
- n dB Down Marker....887
- Signal Count Marker....890
- Marker Demodulation....891

11.8.3.1 Setting Up Individual Markers

The following commands define the position of markers in the diagram.

CALCulate<n>:DELTamarker:AOFF....856
CALCulate<n>:DELTamarker<m>:LINK....856
CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>....857
CALCulate<n>:DELTamarker:MODE....857
CALCulate<n>:DELTamarker<m>:MREF....857
CALCulate<n>:DELTamarker<m>[:STATe]....858
CALCulate<n>:DELTamarker<m>:TRACe....858
CALCulate<n>:DELTamarker<m>:X....858
CALCulate<n>:MARKer<m>:AOFF....859
CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>....859
CALCulate<n>:MARKer<m>[:STATe]....859
CALCulate<n>:MARKer<m>:TRACe....859
CALCulate<n>:MARKer<m>:X....860

CALCulate<n>:DELTamarker:AOFF

This command turns all delta markers off.

Example: `CALC:DELT:AOFF`
Turns all delta markers off.

Usage: Event

CALCulate<n>:DELTamarker<m>:LINK <State>

This command links delta marker <m> to marker 1.

If you change the horizontal position (x-value) of marker 1, delta marker <m> changes its horizontal position to the same value.

Tip: to link any marker to a different marker than marker 1, use the `CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2>` or `CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2>` commands.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:DELT2:LINK ON`

Manual operation: See "Linking to Another Marker" on page 261

CALCulate<n>:DELTamarker<m1>:LINK:TO:MARKer<m2> <State>

This command links delta marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, delta marker <m1> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:DELT4:LINK:TO:MARK2 ON`
Links the delta marker 4 to the marker 2.

Manual operation: See "Linking to Another Marker" on page 261

CALCulate<n>:DELTamarker:MODE <Mode>

This command selects the delta marker mode.

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>:MREF <Reference>

This command selects a reference marker for a delta marker other than marker 1.

The reference may be another marker or the fixed reference.

Parameters:
<Reference>
1 to 16
Selects markers 1 to 16 as the reference.
FIXed
Selects the fixed reference as the 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 261

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.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:DELT2 ON`
Turns on delta marker 2.

Manual operation: See "Marker State" on page 260
See "Marker Type" on page 260

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.

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.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The position is relative to the reference marker.
To select an absolute position you have to change the delta marker mode with `CALCulate<n>:DELTamarker:MODE` on page 857.
A query returns the absolute position of the delta marker.

Range: The value range and unit depend on the measurement and scale of the x-axis.

Example: `CALC:DELT:X?`
Outputs the (absolute) x-value of delta marker 1.

Manual operation: See "Marker 1/2/3/4" on page 239
See "Marker 1/2/3" on page 244
See "Marker Position (X-value)" on page 260

CALCulate<n>:MARKer<m>:AOFF

This command turns all markers off.

Example: `CALC:MARK:AOFF`
Switches off all markers.

Usage: Event

Manual operation: See "All Markers Off" on page 448

CALCulate<n>:MARKer<m1>:LINK:TO:MARKer<m2> <State>

This command links normal marker <m1> to any active normal marker <m2>.

If you change the horizontal position of marker <m2>, marker <m1> changes its horizontal position to the same value.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK4:LINK:TO:MARK2 ON`
Links marker 4 to marker 2.

Manual operation: See "Linking to Another Marker" on page 261

CALCulate<n>:MARKer<m>[:STATe] <State>

This command turns markers on and off. If the corresponding marker number is currently active as a deltamarker, it is turned into a normal marker.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3 ON`
Switches on marker 3.

Manual operation: See "Marker State" on page 260
See "Marker Type" on page 260

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.

Parameters:

<Trace> **1 to 6**
Trace number the marker is assigned to.

Example: `CALC:MARK3:TRAC 2`
Assigns marker 3 to trace 2.

Manual operation: See "Assigning the Marker to a Trace" on page 261

CALCulate<n>:MARKer<m>:X <Position>

This command moves a marker to a particular 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.

Parameters:

<Position> Numeric value that defines the marker position on the x-axis.
The unit is either Hz (frequency domain) or s (time domain) or dB (statistics).

Range: The range depends on the current x-axis range.

Example: `CALC:MARK2:X 1.7MHz`
Positions marker 2 to frequency 1.7 MHz.

Manual operation: See "Marker 1/2/3/4" on page 239
See "Marker 1/2/3" on page 244
See "Marker Position (X-value)" on page 260
See "Marker Table" on page 398
See "Marker Peak List" on page 398

11.8.3.2 General Marker Settings

The following commands control general marker functionality.

Remote commands exclusive to general marker functionality

DISPlay:MTABle....860
CALCulate:MARKer:X:SSIZe....861

DISPlay:MTABle <DisplayMode>

This command turns the marker table on and off.

Parameters:

<DisplayMode>

ON
Turns the marker table on.

OFF
Turns the marker table off.

AUTO
Turns the marker table on if 3 or more markers are active.

*RST: AUTO

Example: `DISP:MTAB ON`
Activates the marker table.

Manual operation: See "Marker Table Display" on page 449

CALCulate:MARKer:X:SSIZe <StepSize>

This command selects the marker step size mode.

The step size defines the distance the marker moves when you move it with the rotary knob. It therefore takes effect in manual operation only.

Parameters:

<StepSize>

STANdard
the marker moves from one pixel to the next

POINts
the marker moves from one sweep point to the next

*RST: POINts

Example: `CALC:MARK:X:SSIZ STAN`
Sets the marker step size to one pixel.

Manual operation: See "Marker Stepsize" on page 449

11.8.3.3 Configuring and Performing a Marker Search

The following commands control the marker search.

CALCulate:MARKer:LOEXclude....861
CALCulate<n>:MARKer:PEXCursion....862
CALCulate:MARKer:X:SLIMits[:STATe]....862
CALCulate:MARKer:X:SLIMits:LEFT....863
CALCulate:MARKer:X:SLIMits:RIGHT....863
CALCulate:MARKer:X:SLIMits:ZOOM[:STATe]....863
CALCulate:THReshold....864
CALCulate:THReshold:STATe....864

CALCulate:MARKer:LOEXclude <State>

This command turns the suppression of the local oscillator during automatic marker positioning on and off.

Parameters:
<State> ON | OFF | 0 | 1
*RST: 1

Example: CALC:MARK:LOEX ON

Manual operation: See "Exclude LO" on page 451

CALCulate<n>:MARKer:PEXCursion <Excursion>

This command defines the peak excursion.

The peak excursion sets the requirements for a peak to be detected during a peak search.

The unit depends on the measurement.

Application/Result display	Unit
Spectrum	dB

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 in the Spectrum application and RF displays

Example: CALC:MARK:PEXC 10dB
Defines peak excursion as 10 dB.

Manual operation: See "Peak Excursion" on page 452

CALCulate:MARKer:X:SLIMits[:STATe] <State>

This command turns marker search limits on and off.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:MARK:X:SLIM ON
Switches on search limitation.

Manual operation: See "Search Limits (Left / Right)" on page 162
See "Deactivating All Search Limits" on page 162
See "Limit State" on page 225
See "Search Limits" on page 452
See "Search Limits" on page 456

CALCulate:MARKer:X:SLIMits:LEFT <SearchLimit>

This command defines the left limit of the marker search range.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Parameters:

<SearchLimit> The value range depends on the span or sweep time.
The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: left diagram border

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 162
See "Left Limit / Right Limit" on page 225
See "Search Limits" on page 452
See "Search Limits" on page 456

CALCulate:MARKer:X:SLIMits:RIGHT <SearchLimit>

This command defines the right limit of the marker search range.

If you perform a measurement in the time domain, this command limits the range of the trace to be analyzed.

Parameters:

<Limit> The value range depends on the span or sweep time.
The unit is Hz for frequency domain measurements and s for time domain measurements.

*RST: right diagram border

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 162
See "Left Limit / Right Limit" on page 225
See "Search Limits" on page 452
See "Search Limits" on page 456

CALCulate:MARKer:X:SLIMits:ZOOM[:STATe] <State>

This command adjusts the marker search range to the zoom area.

Parameters:

<State> ON | OFF

*RST: OFF

Example: CALC:MARK:X:SLIM:ZOOM 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" on page 452
See "Using Zoom Limits" on page 453
See "Search Limits" on page 456

CALCulate:THReshold <Level>

This command defines a threshold level for the marker peak search.

Parameters:
<Level> Numeric value. The value range and unit are variable.
*RST: -120 dBm

Example: CALC:THR -82DBM
Sets the threshold value to -82 dBm.

Manual operation: See "Search Limits" on page 452
See "Search Threshold" on page 453
See "Search Limits" on page 456

CALCulate:THReshold:STATe <State>

This command turns a threshold for the marker peak search on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:THR:STAT ON
Switches on the threshold line.

Manual operation: See "Deactivating All Search Limits" on page 162
See "Search Limits" on page 452
See "Search Limits" on page 456

11.8.3.4 Positioning the Marker

This chapter contains remote commands necessary to position the marker on a trace.

- Positioning Normal Markers 864
- Positioning Delta Markers....867

Positioning Normal Markers

The following commands position markers on the trace.

CALCulate<n>:MARKer<m>:MAXimum:AUTO....865
CALCulate<n>:MARKer<m>:MAXimum:LEFT....865
CALCulate<n>:MARKer<m>:MAXimum:NEXT....865

CALCulate<n>:MARKer<m>:MAXimum[:PEAK]....865
CALCulate<n>:MARKer<m>:MAXimum:RIGHt....866
CALCulate<n>:MARKer<m>:MINimum:AUTO....866
CALCulate<n>:MARKer<m>:MINimum:LEFT....866
CALCulate<n>:MARKer<m>:MINimum:NEXT....866
CALCulate<n>:MARKer<m>:MINimum[:PEAK]....867
CALCulate<n>:MARKer<m>:MINimum:RIGHt....867

CALCulate<n>:MARKer<m>:MAXimum:AUTO <State>

This command turns an automatic marker peak search for a trace maximum on and off. The R&S FSW performs the peak search after each sweep.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:MARK:MAX:AUTO ON`
Activates the automatic peak search function for marker 1 at the end of each particular sweep.

Manual operation: See "Auto Max / Min Peak Search" on page 452

CALCulate<n>:MARKer<m>:MAXimum:LEFT

This command moves a marker to the next lower peak.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Mode for Next Peak in X Direction" on page 454

CALCulate<n>:MARKer<m>:MAXimum:NEXT

This command moves a marker to the next lower peak.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Mode for Next Peak in X Direction" on page 454
See "Search Next Peak" on page 457

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 highest 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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455
See "Peak Search" on page 457

CALCulate<n>:MARKer<m>:MAXimum:RIGHt

This command moves a marker to the next lower peak.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Mode for Next Peak in X Direction" on page 454

CALCulate<n>:MARKer<m>:MINimum:AUTO <State>

This command turns an automatic marker peak search for a trace minimum on and off. The R&S FSW performs the peak search after each sweep.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK:MIN:AUTO ON`
Activates the automatic minimum value search function for marker 1 at the end of each particular sweep.

Manual operation: See "Auto Max / Min Peak Search" on page 452

CALCulate<n>:MARKer<m>:MINimum:LEFT

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Mode for Next Peak in X Direction" on page 454

CALCulate<n>:MARKer<m>:MINimum:NEXT

This command moves a marker to the next minimum value.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Mode for Next Peak in X Direction" on page 454
See "Search Next Minimum" on page 458

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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455
See "Search Minimum" on page 458

CALCulate<n>:MARKer<m>:MINimum:RIGHt

This command moves a marker to the next minimum value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Mode for Next Peak in X Direction" on page 454

Positioning Delta Markers

The following commands position delta markers on the trace.

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT....867
CALCulate<n>:DELTamarker<m>:MAXimum:NEXT....868
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]....868
CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt....868
CALCulate<n>:DELTamarker<m>:MINimum:LEFT....868
CALCulate<n>:DELTamarker<m>:MINimum:NEXT....868
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]....869
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt....869

CALCulate<n>:DELTamarker<m>:MAXimum:LEFT

This command moves a delta marker to the next higher value.

The search includes only measurement values to the left of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451

CALCulate<n>:DELTamarker<m>:MAXimum:NEXT

This command moves a marker to the next higher value.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Next Peak" on page 457

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 highest 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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455
See "Peak Search" on page 457

CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt

This command moves a delta marker to the next higher value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451

CALCulate<n>:DELTamarker<m>:MINimum:LEFT

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451

CALCulate<n>:DELTamarker<m>:MINimum:NEXT

This command moves a marker to the next higher minimum value.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451
See "Search Next Minimum" on page 458

CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]

This command moves a delta marker to the minimum level.

In the spectrogram, the command moves a delta 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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455
See "Search Minimum" on page 458

CALCulate<n>:DELTamarker<m>:MINimum:RIGHt

This command moves a delta marker to the next higher minimum value.

The search includes only measurement values to the right of the current marker position.

In the spectrogram, the vertical marker position remains the same.

Usage: Event

Manual operation: See "Search Mode for Next Peak" on page 451

11.8.3.5 Retrieving Marker Results

The following commands are used to retrieve the results of markers.

You can use the marker values to position the center frequency or reference level directly using the following commands:

- `CALCulate<n>:MARKer<m>:FUNCtion:CENTer` on page 762
- `CALCulate<n>:MARKer<m>:FUNCtion:REFerence` on page 774

Useful commands for retrieving results described elsewhere:

- `CALCulate<n>:DELTamarker<m>:X` on page 858
- `CALCulate<n>:MARKer<m>:X` on page 860
- `CALCulate:MARKer:FUNCtion:FPEaks:COUNt?` on page 880
- `CALCulate:MARKer:FUNCtion:FPEeaks:X?` on page 882
- `CALCulate:MARKer:FUNCtion:FPEeaks:Y?` on page 882
- `CALCulate<n>:MARKer<m>:FUNCtion:NOISe:RESult?` on page 883
- `CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise:RESult?` on page 884

- CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:RESult? on page 887
- CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:RESult? on page 885
- CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:RESult? on page 888
- CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:FREQuency? on page 888
- CALCulate:MARKer:FUNCtion:NDBDown:QFACtor? on page 888
- CALCulate<n>:MARKer<m>:COUNt:FREQuency? on page 890

Remote commands exclusive to retrieving marker results

CALCulate<n>:DELTamarker<m>:X:RELative?....870
CALCulate<n>:DELTamarker<m>:Y?....870
CALCulate<n>:MARKer<m>:Y?....871

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.

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

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

Manual operation: See "Marker 1/2/3/4" on page 239
See "Marker 1/2/3" on page 244

CALCulate<n>:DELTamarker<m>:Y?

This command queries the relative position of a delta marker on the y-axis.

If necessary, the command activates the delta marker first.

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 sweeps. See also INITiate:CONTinuous on page 634.

The unit depends on the application of the command.

Table 11-7: Base unit

Parameter, measuring function or result display	Output unit
DBM | DBPW | DBUV | DBMV | DBUA	dB (lin/log)
WATT | VOLT | AMPere	dB (lin), % (log)
statistics function (APD or CCDF) on	dimensionless output

Return values:

<Position> Position of the delta marker in relation to the reference marker or the fixed reference.

Example:
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
INIT;*WAI
```
Starts a sweep and waits for its end.
```
CALC:DELT2 ON
```
Switches on delta marker 2.
```
CALC:DELT2:Y?
```
Outputs measurement value of delta marker 2.

Usage: Query only

CALCulate<n>:MARKer<m>:Y?

This command queries the position of a marker on the y-axis.

If necessary, the command activates the marker first.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<Result> Result at the marker position.
The unit is variable and depends on the one you have currently set.

Example:
```
INIT:CONT OFF
```
Switches to single measurement mode.
```
CALC:MARK2 ON
```
Switches marker 2.
```
INIT;*WAI
```
Starts a measurement and waits for the end.
```
CALC:MARK2:Y?
```
Outputs the measured value of marker 2.

Usage: Query only

Manual operation: See "Marker Table" on page 398
See "Marker Peak List" on page 398

11.8.3.6 Marker Search (Spectrograms)

The following commands automatically define the marker and delta marker position in the spectrogram.

Using Markers

The following commands control spectrogram markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the markers.

- `CALCulate<n>:MARKer<m>:MAXimum:LEFT` on page 865
- `CALCulate<n>:MARKer<m>:MAXimum:NEXT` on page 865
- `CALCulate<n>:MARKer<m>:MAXimum[:PEAK]` on page 865
- `CALCulate<n>:MARKer<m>:MAXimum:RIGHt` on page 866
- `CALCulate<n>:MARKer<m>:MINimum:LEFT` on page 866
- `CALCulate<n>:MARKer<m>:MINimum:NEXT` on page 866
- `CALCulate<n>:MARKer<m>:MINimum[:PEAK]` on page 867
- `CALCulate<n>:MARKer<m>:MINimum:RIGHt` on page 867

Remote commands exclusive to spectrogram markers

CALCulate:MARKer<m>:SGRam:FRAMe....872
CALCulate:MARKer:SGRam:SARea....873
CALCulate:MARKer<m>:SGRam:XY:MAXimum[:PEAK]....873
CALCulate:MARKer<m>:SGRam:XY:MINimum[:PEAK]....873
CALCulate:MARKer<m>:SGRam:Y:MAXimum:ABOVe....873
CALCulate:MARKer<m>:SGRam:Y:MAXimum:BELow....873
CALCulate:MARKer<m>:SGRam:Y:MAXimum:NEXT....874
CALCulate:MARKer<m>:SGRam:Y:MAXimum[:PEAK]....874
CALCulate:MARKer<m>:SGRam:Y:MINimum:ABOVe....874
CALCulate:MARKer<m>:SGRam:Y:MINimum:BELow....874
CALCulate:MARKer<m>:SGRam:Y:MINimum:NEXT....874
CALCulate:MARKer<m>:SGRam:Y:MINimum[:PEAK]....875

CALCulate:MARKer<m>:SGRam:FRAMe <Frame> | <Time>

This command positions a marker on a particular frame.

Parameters:

<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.

<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 447

CALCulate:MARKer:SGRam:SARea <SearchArea>

This command defines the marker search area for all markers.

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 455

CALCulate:MARKer<m>:SGRam:XY:MAXimum[:PEAK]

This command moves a marker to the highest level of the spectrogram.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

CALCulate:MARKer<m>:SGRam:XY:MINimum[:PEAK]

This command moves a marker to the minimum level of the spectrogram.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:MARKer<m>:SGRam: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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

Using Delta Markers

The following commands control spectrogram delta markers.

Useful commands for spectrogram markers described elsewhere

The following commands define the horizontal position of the delta markers.

- `CALCulate<n>:DELTamarker<m>:MAXimum:LEFT` on page 867
- `CALCulate<n>:DELTamarker<m>:MAXimum:NEXT` on page 868
- `CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]` on page 868
- `CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt` on page 868
- `CALCulate<n>:DELTamarker<m>:MINimum:LEFT` on page 868
- `CALCulate<n>:DELTamarker<m>:MINimum:NEXT` on page 868
- `CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]` on page 869
- `CALCulate<n>:DELTamarker<m>:MINimum:RIGHt` on page 869

Remote commands exclusive to spectrogram markers

CALCulate:DELTamarker<m>:SGRam:FRAMe....876
CALCulate:DELTamarker<m>:SGRam:SARea....876
CALCulate:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]....876
CALCulate:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]....876
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe....877
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum:BELow....877
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum:NEXT....877
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK]....877
CALCulate:DELTamarker<m>:SGRam:Y:MINimum:ABOVe....878
CALCulate:DELTamarker<m>:SGRam:Y:MINimum:BELow....878
CALCulate:DELTamarker<m>:SGRam:Y:MINimum:NEXT....878
CALCulate:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]....878

CALCulate:DELTamarker<m>:SGRam:FRAMe <Frame> | <Time>

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.

Parameters:

<Frame> Selects a frame directly by the frame number. Valid if the time stamp is off.
The range depends on the history depth.

<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: `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.

CALCulate:DELTamarker<m>:SGRam:SARea <SearchArea>

This command defines the delta marker search area.

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 455

CALCulate:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]

This command moves a marker to the highest level of the spectrogram over all frequencies.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

CALCulate:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]

This command moves a delta marker to the minimum level of the spectrogram over all frequencies.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Search Mode for Next Peak in Y Direction" on page 454

CALCulate:DELTamarker<m>:SGRam: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.

Usage: Event

Manual operation: See "Marker Search Type" on page 455

11.8.3.7 Fixed Reference Marker Settings

The following commands configure a fixed reference marker.

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]....879
CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X....879
CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y....879
CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y:OFFSet....880

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]

This command moves the fixed reference marker to the peak power.

Example: `CALC:DELT:FUNC:FIX:RPO:MAX`
Sets the reference point level for delta markers to the peak of the selected trace.

Usage: Event

Manual operation: See "Defining a Fixed Reference" on page 449
See "Defining a Reference Point" on page 463

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X <RefPoint>

This command defines the horizontal position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Parameters:
<RefPoint> Numeric value that defines the horizontal position of the reference.
For frequency domain measurements, it is a frequency in Hz.
For time domain measurements, it is a point in time in s.
*RST: Fixed Reference: OFF

Example: `CALC:DELT:FUNC:FIX:RPO:X 128 MHz`
Sets the frequency reference to 128 MHz.

Manual operation: See "Defining a Fixed Reference" on page 449
See "Defining a Reference Point" on page 463

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y <RefPointLevel>

This command defines the vertical position of the fixed delta marker reference point. The coordinates of the reference may be anywhere in the diagram.

Parameters:
<RefPoint> Numeric value that defines the vertical position of the reference.
The unit and value range is variable.
*RST: Fixed Reference: OFF

Example: `CALC:DELT:FUNC:FIX:RPO:Y -10dBm`
Sets the reference point level for delta markers to -10 dBm.

Manual operation: See "Defining a Fixed Reference" on page 449
See "Defining a Reference Point" on page 463

CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y:OFFSet <Offset>

This command defines a level offset for the fixed delta marker reference point.

Parameters:

<Offset> Numeric value

*RST: 0
Default unit: dB

11.8.3.8 Marker Peak Lists

Useful commands for peak lists described elsewhere

- `CALCulate<n>:MARKer:PEXCursion` on page 862
- `MMEMory:STORe:LIST` on page 926

Remote commands exclusive to peak lists

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe] 880
CALCulate:MARKer:FUNCtion:FPEaks:COUNt? 880
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks[:IMMediate] 881
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE 881
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT 881
CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STAT 882
CALCulate:MARKer:FUNCtion:FPEeaks:X? 882
CALCulate:MARKer:FUNCtion:FPEeaks:Y? 882

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:ANNotation:LABel[:STATe]
<State>

This command turns labels for peaks found during a peak search on and off.

The labels correspond to the marker number in the marker peak list.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Example: `CALC:MARK:FUNC:FPE:ANN:LAB:STAT OFF`
Removes the peak labels from the diagram

Manual operation: See "Displaying Marker Numbers" on page 470

CALCulate:MARKer:FUNCtion:FPEaks:COUNt?

This command queries the number of peaks that have been found during a peak search.

The actual number of peaks that have been found may differ from the number of peaks you have set to be found because of the peak excursion.

Return values:
<NumberOfPeaks>

Example: `CALC:MARK:FUNC:FPE:COUN?`
Queries the number of peaks.

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks[:IMMediate] <Peaks>

This command initiates a peak search.

Parameters:
<Peaks> This parameter defines the number of peaks to find during the search.
Note that the actual number of peaks found during the search also depends on the peak excursion you have set with `CALCulate<n>:MARKer:PEXCursion`.

Range: 1 to 200

Example: `CALC:MARK:PEXC 5`
Defines a peak excursion of 5 dB, i.e. peaks must be at least 5 dB apart to be detected as a peak.
`CALC:MARK:FUNC:FPE 10`
Initiates a search for 10 peaks on the current trace.

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:LIST:SIZE <MaxNoPeaks>

This command defines the maximum number of peaks that the R&S FSW looks for during a peak search.

Parameters:
<MaxNoPeaks> Maximum number of peaks to be determined.

Range: 1 to 200
*RST: 50

Example: `CALC:MARK:FUNC:FPE:LIST:SIZE 10`
The marker peak list will contain a maximum of 10 peaks.

Manual operation: See "Maximum Number of Peaks" on page 470

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT <SortMode>

This command selects the order in which the results of a peak search are returned.

Parameters:
<SortMode> **X**
Sorts the peaks according to increasing position on the x-axis.

Y
Sorts the peaks according to decreasing position on the y-axis.

*RST: X

Example: CALC:MARK:FUNC:FPE:SORT Y
Sets the sort mode to decreasing y values

Manual operation: See "Sort Mode" on page 470

CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:STAT <State>

This command turns a peak search on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:MARK:FUNC:FPE:STAT ON
Activates marker peak search

Manual operation: See "Peak List State" on page 469

CALCulate:MARKer:FUNCtion:FPEeaks:X?

This command queries the position of the peaks on the x-axis.

The order depends on the sort order that has been set with CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT.

Return values:
<PeakPosition> Position of the peaks on the x-axis. The unit depends on the measurement.

Usage: Query only

CALCulate:MARKer:FUNCtion:FPEeaks:Y?

This command queries the position of the peaks on the y-axis.

The order depends on the sort order that has been set with CALCulate<n>:MARKer<m>:FUNCtion:FPEaks:SORT.

Return values:
<PeakPosition> Position of the peaks on the y-axis. The unit depends on the measurement.

Usage: Query only

11.8.3.9 Noise Measurement Marker

The following commands control the noise measurement marker function.

CALCulate<n>:MARKer<m>:FUNCtion:NOISe:RESult?.....883
CALCulate<n>:MARKer<m>:FUNCtion:NOISe[:STATe].....883

CALCulate<n>:MARKer<m>:FUNCtion:NOISe:RESult?

This command queries the result of the noise measurement.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<NoiseLevel> Current noise level. The unit is the one currently active.

Example:

```
INIT:CONT OFF
```
Switches to single sweep mode.
```
CALC:MARK2 ON
```
Switches on marker 2.
```
CALC:MARK:FUNC:NOIS ON
```
Switches on noise measurement.
```
INIT;*WAI
```
Starts a sweep and waits for the end.
```
CALC:MARK2:NOIS:RES?
```
Outputs the noise result of marker 2.

Usage: Query only

Manual operation: See "Noise Measurement State" on page 462

CALCulate<n>:MARKer<m>:FUNCtion:NOISe[:STATe] <State>

This command turns the noise measurement at the marker position on and off.

Parameters:

<State> ON | OFF

*RST: OFF

Example:

```
CALC:MARK:FUNC:NOIS ON
```
Switches on the noise measurement.

Manual operation: See "Noise Measurement State" on page 462
See "Switching All Noise Measurements Off" on page 462

11.8.3.10 Phase Noise Measurement Marker

The following commands control the phase noise measurement marker function.

Useful commands for phase noise markers described elsewhere

- `CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:MAXimum[:PEAK]`
- `CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:X`
- `CALCulate<n>:DELTamarker<m>:FUNCtion:FIXed:RPOint:Y`

Remote commands exclusive to phase noise markers

CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise:AUTO.....884
CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise:RESult?.....884
CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise[:STATe].....884

CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise:AUTO <State>

This command turns an automatic peak search for the fixed reference marker at the end of a sweep on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:DELT:FUNC:PNO:AUTO ON`
Activates an automatic peak search for the reference marker in a phase-noise measurement.

Manual operation: See "Defining a Reference Point" on page 463

CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise:RESult?

This command queries the result of a phase noise measurement.

If necessary, the command activates the measurement first.

Return values:
<PhaseNoise>

Example: `CALC:DELT2:FUNC:PNO:RES?`
Outputs the result of phase-noise measurement of the delta-marker 2.

Usage: Query only

Manual operation: See "Phase Noise Measurement State" on page 463

CALCulate<n>:DELTamarker<m>:FUNCtion:PNOise[:STATe] <State>

This command turns the phase noise measurement at the delta marker position on and off.

The reference marker for phase noise measurements is either a normal marker or a fixed reference. If necessary, the command turns on the reference marker.

The correction values for the bandwidth and the log amplifier are taken into account in the measurement.

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:DELT:FUNC:PNO ON
Switches on the phase-noise measurement with all delta markers.
CALC:DELT:FUNC:FIX:RPO:X 128 MHZ
Sets the frequency reference to 128 MHz.
CALC:DELT:FUNC:FIX:RPO:Y 30 DBM
Sets the reference level to +30 dBm

Manual operation: See "Phase Noise Measurement State" on page 463
See "Switching All Phase Noise Measurements Off" on page 464

11.8.3.11 Band Power Marker

The following commands control the marker for band power measurements.

Using Markers

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:MODE....885
CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:RESult?....885
CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:SPAN....886
CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe]....886

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:MODE <Mode>

This command selects the way the results for a band power marker are displayed.

Parameters:
<Mode>
POWer
Result is displayed as a power in dBm.
DENSity
Result is displayed as a density in dBm/Hz.
*RST: POWer

Example: CALC:MARK4:FUNC:BPOW:MODE DENS
Configures marker 4 to show the measurement results in dBm/Hz.

Manual operation: See "Power Mode" on page 467

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:RESult?

This command queries the results of the band power measurement.

Return values:
<Power> Signal power over the marker bandwidth.

Example: Activate the band power marker:
`CALC:MARK:FUNC:BPOW:STAT ON`
Select the density mode for the result:
`CALC:MARK:FUNC:BPOW:MODE DENS`
Query the result:
`CALC:MARK:FUNC:BPOW:RES?`
Response:
`20dBm/Hz`

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer:SPAN <Span>

This command defines the bandwidth around the marker position.

Parameters:
<Span> Frequency. The maximum span depends on the marker position and R&S FSW model.
*RST: 5% of current span
Default unit: Hz

Example: `CALC:MARK:FUNC:BPOW:SPAN 2MHz`
Measures the band power over 2 MHz around the marker.

Manual operation: See "Span" on page 467

CALCulate<n>:MARKer<m>:FUNCtion:BPOWer[:STATe] <State>

This command turns markers for band power measurements on and off.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK4:FUNC:BPOW:STAT ON`
Activates or turns marker 4 into a band power marker.

Manual operation: See "Band Power Measurement State" on page 466
See "Switching All Band Power Measurements Off" on page 467

Using Delta Markers

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:MODE....886
CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:RESult?....887
CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:SPAN....887
CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe]....887

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:MODE <Mode>

This command selects the way the results for a band power delta marker are displayed.

Parameters:

<Mode>

POWer
Result is displayed as a power in dBm.

DENSity
Result is displayed as a density in dBm/Hz.

*RST: POWer

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:RESult?

This command queries the results of the band power measurement.

Return values:

<Power> Signal power over the delta marker bandwidth.

Usage: Query only

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer:SPAN <Span>

This command defines the bandwidth around the delta marker position.

Parameters:

<Span> Frequency. The maximum span depends on the marker position and R&S FSW model.

*RST: 5% of current span
Default unit: Hz

CALCulate<n>:DELTamarker<m>:FUNCtion:BPOWer[:STATe] <State>

This command turns delta markers for band power measurements on and off.

If neccessary, the command also turns on a reference marker.

Parameters:

<State> ON | OFF

*RST: OFF

11.8.3.12 n dB Down Marker

The following commands control the n dB down markers.

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown....887
CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:FREQuency?....888
CALCulate:MARKer:FUNCtion:NDBDown:QFACtor?....888
CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:RESult?....888
CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:STATe....889
CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:TIME....889

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown <Distance>

This command defines the distance of the n dB down markers to the reference marker.

Parameters:

<Distance> Distance of the temporary markers to the reference marker in dB.

*RST: 6dB

Example: `CALC:MARK:FUNC:NDBD 3dB`
Sets the distance to the reference marker to 3 dB.

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:FREQuency?

This command queries the position of the n dB down markers on the x-axis when measuring in the frequency domain.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<Frequency> **<frequency 1>**
absolute frequency of the n dB marker to the left of the reference marker in Hz

<frequency 2>
absolute frequency of the n dB marker to the right of the reference marker in Hz.

Example: `INIT:CONT OFF`
Switches to single sweep mode.
`CALC:MARK:FUNC:NDBD ON`
Switches on the n dB down function.
`INIT;*WAI`
Starts a sweep and waits for the end.
`CALC:MARK:FUNC:NDBD:FREQ?`
This command would return, for example, 100000000, 200000000, meaning that the first marker position is at 100 MHz, the second marker position is at 200 MHz

Usage: Query only

Manual operation: See "n dB down Delta Value" on page 465

CALCulate:MARKer:FUNCtion:NDBDown:QFACtor?

This command queries the Q factor of n dB down measurements.

Return values:

<QFactor>

Usage: Query only

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:RESult?

This command queries the distance of the n dB down markers from each other.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<Distance> The result depends on the span.
In case of frequency domain measurements, the command returns the bandwidth between the two n dB down markers in Hz.
In case of time domain measurements, the command returns the pulse width between the two n dB down markers in seconds.

Example:
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
CALC:MARK:FUNC:NDBD ON
```
Switches on the n dB down function.
```
INIT;*WAI
```
Starts a sweep and waits for the end.
```
CALC:MARK:FUNC:NDBD:RES?
```
Outputs the measured value.

Usage: Query only

Manual operation: See "n dB down Marker State" on page 464

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:STATe <State>

This command turns the n dB Down marker function on and off.

Parameters:

<State> ON | OFF
*RST: OFF

Example:
```
CALC:MARK:FUNC:NDBD:STAT ON
```
Turns the n dB Down marker on.

Manual operation: See "n dB down Marker State" on page 464

CALCulate<n>:MARKer<m>:FUNCtion:NDBDown:TIME

This command queries the position of the n dB down markers on the x-axis when measuring in the time domain.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<Time> **<time 1>**
absolute position in time of the n dB marker to the left of the reference marker in seconds

<time 2>
absolute position in time of the n dB marker to the right of the reference marker in seconds

Example:
```
INIT:CONT OFF
```
Switches to single sweep mode
```
CALC:MARK:FUNC:NDBD ON
```
Switches on the n dB down function.
```
INIT;*WAI
```
Starts a sweep and waits for the end.
```
CALC:MARK:FUNC:NDBD:TIME?
```
Outputs the time values of the temporary markers.

Manual operation: See "n dB down Delta Value" on page 465

11.8.3.13 Signal Count Marker

The following commands control the frequency counter.

CALCulate<n>:MARKer<m>:COUNt....890
CALCulate<n>:MARKer<m>:COUNt:FREQuency?....890
CALCulate<n>:MARKer<m>:COUNt:RESolution....891

CALCulate<n>:MARKer<m>:COUNt <State>

This command turns the frequency counter at the marker position on and off.

The frequency counter works for one marker only. If you perform a frequency count with another marker, the R&S FSW deactivates the frequency count of the first marker.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Parameters:

<State> ON | OFF

*RST: OFF

Example:
```
INIT:CONT OFF
```
Switches to single sweep mode.
```
CALC:MARK ON
```
Switches on marker 1.
```
CALC:MARK:COUN ON
```
Switches on the frequency counter for marker 1.
```
INIT;*WAI
```
Starts a sweep and waits for the end.
```
CALC:MARK:COUN:FREQ?
```
Outputs the measured value.

Manual operation: See "Signal Count Marker State" on page 460

CALCulate<n>:MARKer<m>:COUNt:FREQuency?

This command queries the frequency at the marker position.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Before you can use the command, you have to turn on the frequency counter.

Return values:

<Frequency> Frequency at the marker position.

Example:

```
INIT:CONT OFF
```
Switches to single sweep mode.
```
CALC:MARK ON
```
Switches on marker 2.
```
CALC:MARK:COUN ON
```
Activates the frequency counter for marker 1.
```
INIT;*WAI
```
Starts a sweep and waits for the end.
```
CALC:MARK:COUN:FREQ?
```
Outputs the measured value of marker 1.

Usage: Query only

Manual operation: See "Signal Count Marker State" on page 460

CALCulate<n>:MARKer<m>:COUNt:RESolution <Resolution>

This command defines the resolution of the frequency counter.

Parameters:

<Resolution> 0.001 | 0.01 | 0.1 | 1 | 10 | 100 | 1000 | 10000 Hz

*RST: 0.1 Hz

Example:

```
CALC:MARK:COUN:RES 1kHz
```
Sets the resolution of the frequency counter to 1 kHz.

Manual operation: See "Resolution" on page 460

11.8.3.14 Marker Demodulation

The following commands control the demodulation of AM and FM signals at the marker position.

CALCulate<n>:MARKer<m>:FUNCtion:DEModulation:CONTinuous....891
CALCulate<n>:MARKer<m>:FUNCtion:DEModulation:HOLDoff....892
CALCulate<n>:MARKer<m>:FUNCtion:DEModulation:SELect....892
CALCulate<n>:MARKer<m>:FUNCtion:DEModulation[:STATe]....892
[SENSe:]DEMod:SQUelch:LEVel....893
[SENSe:]DEMod:SQUelch[:STATe]....893

CALCulate<n>:MARKer<m>:FUNCtion:DEModulation:CONTinuous <State>

This command turns continuous demodulation of the signal at the marker position in the frequency domain on and off.

In the time domain continuous demodulation is always on.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC2:MARK3:FUNC:DEM:CONT ON`
Switches on the continuous demodulation.

Manual operation: See "Continuous Demodulation" on page 468

CALCulate<n>:MARKer<m>:FUNCtion:DEModulation:HOLDoff <Duration>

This command defines for how long the the signal at the marker position is demodulated.

In the time domain continuous demodulation is always on.

Parameters:
<Duration> Range: 10 ms to 1000 s
*RST: Marker demodulation = OFF

Example: `CALC:MARK:FUNC:DEM:HOLD 3s`

Manual operation: See "Marker Stop Time" on page 468

CALCulate<n>:MARKer<m>:FUNCtion:DEModulation:SELect <DemodMode>

This command selects the demodulation mode at the marker position.

Parameters:
<DemodMode> **AM**
AM demodulation
FM
FM demodulation
*RST: AM

Example: `CALC:MARK:FUNC:DEM:SEL FM`

Manual operation: See "Modulation" on page 468

CALCulate<n>:MARKer<m>:FUNCtion:DEModulation[:STATe] <State>

This command turns the audio demodulator on and off when the measurement reaches a marker position.

Parameters:
<State> ON | OFF
*RST: OFF

Example: `CALC:MARK3:FUNC:DEM ON`
Switches on the demodulation for marker 3.

Manual operation: See "Marker Demodulation State" on page 468

[SENSe:]DEMod:SQUelch:LEVel <Threshold>

This command defines the threshold for selective demodulation.

All signals below the threshold are not demodulated.

Parameters:

<Threshold> Percentage of the display height.

Range: 0 to 100
*RST: 50

Example: `DEM:SQU:LEV 80`
Sets the squelch level to 80% of the displayed signal.

Manual operation: See "Squelch level" on page 469

[SENSe:]DEMod:SQUelch[:STATe] <State>

This command turns selective demodulation at the marker position on and off.

For selective demodulation, the R&S FSW turns on a video trigger whose level corre-ponds to the squelch level. Therefore it turns other triggers or gates off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DEM:SQU ON`
Signals below the level threshold are not sent to the audio output.

Manual operation: See "Squelch" on page 468

11.8.4 Configuring Display and Limit Lines

The commands required to configure display and limit lines in a remote environment are described here. The tasks for manual operation are described in chapter 7.5.4, "How to Work with Display and Limit Lines", on page 485.

- Configuring Display Lines....893
- Defining Limit Checks....895

11.8.4.1 Configuring Display Lines

The following commands configure vertical and horizontal display lines.

CALCulate<n>:DLINe<k>....894
CALCulate<n>:DLINe<k>:STATe....894
CALCulate<n>:FLINe<k>....894
CALCulate<n>:FLINe<k>:STATe....894
CALCulate<n>:TLINe<Line>....895
CALCulate<n>:TLINe<Line>:STATe....895

CALCulate<n>:DLINe<k> <Position>

This command defines the (vertical) position of a display line.

Parameters:

<Position> The value range is variable.
You can use any unit you want, the R&S FSW then converts the unit to the currently selected unit. If you omit a unit, the R&S FSW uses the currently selected unit.
*RST: (state is OFF)

Example: `CALC:DLIN -20dBm`
Positions the display line at -20 dBm.

Manual operation: See "Horizontal Line 1/2" on page 479

CALCulate<n>:DLINe<k>:STATe <State>

This command turns a display line on and off

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:DLIN2:STAT ON`
Turns on display line 2.

CALCulate<n>:FLINe<k> <Frequency>

This command defines the position of a 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)

Example: `CALC:FLIN2 120MHz`
Sets frequency line 2 to a frequency of 120 MHz.

Manual operation: See "Vertical Line 1/2" on page 479

CALCulate<n>:FLINe<k>:STATe <State>

This command turns a frequency line on and off

Parameters:

<State> ON | OFF
*RST: OFF

Example: `CALC:FLIN2:STAT ON`
Turns frequency line 2 on.

CALCulate<n>:TLINe<Line> <Time>

This command defines the position of a 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)

Example: `CALC:TLIN 10ms`
Sets the first time line to 10 ms.

Manual operation: See "Vertical Line 1/2" on page 479

CALCulate<n>:TLINe<Line>:STATe <State>

This command turns a time line on and off

Parameters:

<State> ON | OFF

*RST: OFF

Example: `CALC:TLIN:STAT ON`
Turns the first time line on.

11.8.4.2 Defining Limit Checks

Note that in remote control, upper and lower limit lines are configured using separate commands. Thus, you must decide in advance which you want to configure. The x-values for both upper and lower limit lines are defined as a common control line. This control line is the reference for the y-values for both upper and lower limit lines.

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Configuring Limit Lines

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CALCulate:LIMit<k>:UPPer:SHIFt....901
CALCulate:LIMit<k>:UPPer:SPACing....902
CALCulate:LIMit<k>:UPPer:STATe....902
CALCulate:LIMit<k>:UPPer:THReshold....902

CALCulate:LIMit:COMMent <Comment>

This command defines a comment for a limit line.

Parameters:

<Comment> String containing the description of the limit line. The comment may have up to 40 characters.

Manual operation: See "Comment" on page 483

CALCulate:LIMit<k>:CONTrol[:DATA] <LimitLinePoints>

This command defines the horizontal definition points of a 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:LIMit<k>:LOWer[:DATA]` or `CALCulate:LIMit<k>:UPPer[:DATA]`. If not, the R&S FSW either adds missing values or ignores surplus values.
The unit is Hz or s.

*RST: -

Usage: SCPI confirmed

Manual operation: See "Data points" on page 484

CALCulate:LIMit<k>:CONTrol:DOMain <SpanSetting>

This command selects the domain of the limit line.

Parameters:

<SpanSetting> FREQuency | TIME

*RST: FREQuency

Manual operation: See "X-Axis" on page 484

CALCulate:LIMit<k>:CONTrol:MODE <Mode>

This command selects the horizontal limit line scaling.

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

CALCulate:LIMit<k>: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.

Parameters:

<Offset>

Numeric value.
The unit depends on the scale of the x-axis.

*RST: 0

Manual operation: See "X-Offset" on page 481

CALCulate:LIMit<k>: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.

Parameters:

<Distance>

Numeric value.
The unit depends on the scale of the x-axis.

Manual operation: See "Shift x" on page 485

CALCulate:LIMit<k>:CONTrol:SPACing <InterpolMode>

This command selects linear or logarithmic interpolation for the calculation of limit lines from one horizontal point to the next.

Parameters:

<InterpolMode>

LINear | LOGarithmic

*RST: LIN

Example:

```
CALC:LIM:CONT:SPAC LIN
```

CALCulate:LIMit<k>:LOWer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of a lower 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:LIMit<k>:CONTrol[:DATA]`. If not, the R&S FSW either adds missing values or ignores surplus values.
The unit depends on `CALCulate:LIMit<k>:UNIT` on page 900.

*RST: Limit line state is OFF

Usage: SCPI confirmed

Manual operation: See "Data points" on page 484

CALCulate:LIMit<k>:LOWer:MARGin <Margin>

This command defines an area around a lower limit line where limit check violations are still tolerated.

Parameters:

<Margin> **numeric value**

*RST: 0
Default unit: dB

Manual operation: See "Margin" on page 484

CALCulate:LIMit<k>:LOWer:MODE <Mode>

This command selects the vertical limit line scaling.

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 "X-Axis" on page 484

CALCulate:LIMit<k>: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.

Parameters:

<Offset> Numeric value.

*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 482

CALCulate:LIMit<k>: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.

Parameters:

<Distance> Defines the distance that the limit line moves.
The unit depends on `CALCulate:LIMit<k>:UNIT` on page 900.

Manual operation: See "Shift y" on page 485

CALCulate:LIMit<k>: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.

Parameters:

<InterpolType> LINear | LOGarithmic

*RST: LIN

Manual operation: See "X-Axis" on page 484
See "Y-Axis" on page 484

CALCulate:LIMit<k>: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:LIMit<k>:NAME` on page 900.

Parameters:

<State> ON | OFF

*RST: OFF

Usage: SCPI confirmed

Manual operation: See "Visibility" on page 481

CALCulate:LIMit<k>:LOWer:THReshold <Threshold>

This command defines a threshold for relative limit lines.

The R&S FSW uses the threshold for the limit check, if the limit line violates the threshold.

Parameters:

<Threshold> Numeric value.
The unit depends on `CALCulate:LIMit<k>:UNIT` on page 900.

*RST: -200 dBm

Manual operation: See "Threshold" on page 483

CALCulate:LIMit<k>:NAME <Name>

This command selects a limit line that already exists or defines a name for a new 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 483

CALCulate:LIMit<k>:UNIT <Unit>

This command defines the unit of a limit line.

Parameters:

<Unit> DBM | DBPW | WATT | DBUV | DBMV | VOLT | DBUA | AMPere | DB | DBUV_M | DBUA_M | (unitless)

If you select dB as the limit line unit, the command automatically turns the limit line into a relative limit line.

*RST: DBM

Manual operation: See "Y-Axis" on page 484

CALCulate:LIMit<k>:UPPer[:DATA] <LimitLinePoints>

This command defines the vertical definition points of an upper 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:LIMit<k>:CONTrol[:DATA]`. If not, the R&S FSW either adds missing values or ignores surplus values.
The unit depends on `CALCulate:LIMit<k>:UNIT` on page 900.

*RST: Limit line state is OFF

Usage: SCPI confirmed

Manual operation: See "Data points" on page 484

CALCulate:LIMit<k>:UPPer:MARGin <Margin>

This command defines an area around an upper limit line where limit check violations are still tolerated.

Parameters:

<Margin> **numeric value**

*RST: 0
Default unit: dB

Manual operation: See "Margin" on page 484

CALCulate:LIMit<k>:UPPer:MODE <Mode>

This command selects the vertical limit line scaling.

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 "X-Axis" on page 484

CALCulate:LIMit<k>: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.

Parameters:

<Offset> Numeric value.

*RST: 0
Default unit: dB

Manual operation: See "Y-Offset" on page 482

CALCulate:LIMit<k>: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.

Parameters:

<Distance> Defines the distance that the limit line moves.
The unit depends on `CALCulate:LIMit<k>:UNIT` on page 900.

Usage: Event

Manual operation: See "Shift y" on page 485

CALCulate:LIMit<k>: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.

Parameters:

<InterpolType> LINear | LOGarithmic

*RST: LIN

Manual operation: See "X-Axis" on page 484
See "Y-Axis" on page 484

CALCulate:LIMit<k>: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:LIMit<k>:NAME` on page 900.

Parameters:

<State> ON | OFF

*RST: OFF

Usage: SCPI confirmed

Manual operation: See "Visibility" on page 481

CALCulate:LIMit<k>:UPPer:THReshold <Limit>

This command defines an absolute limit for limit lines with a relative scale.

The R&S FSW uses the threshold for the limit check, if the limit line violates the threshold.

Parameters:

<Limit> Numeric value.
The unit depends on `CALCulate:LIMit<k>:UNIT` on page 900.

*RST: -200
Default unit: dBm

Manual operation: See "Threshold" on page 483

Managing Limit Lines

CALCulate:LIMit:ACTive?....903
CALCulate:LIMit<k>:COPY....903
CALCulate:LIMit<k>:DELete....903
CALCulate:LIMit<k>:STATe....903
CALCulate:LIMit<k>:TRACe<t>:CHECk....904

CALCulate:LIMit:ACTive?

This command queries the names of all active limit lines.

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 481

CALCulate:LIMit<k>:COPY <Line>

This command copies a 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 482

CALCulate:LIMit<k>:DELete

This command deletes a limit line.

Usage: Event

Manual operation: See "Delete Line" on page 482

CALCulate:LIMit<k>:STATe <State>

This command turns the limit check for a specific limit line on and off.

To query the limit check result, use `CALCulate:LIMit<k>:FAIL`.

Note that a new command exists to activate the limit check and define the trace to be checked in one step (see CALCulate:LIMit<k>:TRACe<t>:CHECk on page 904).

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:LIM:STAT ON
Switches on the limit check for limit line 1.

Usage: SCPI confirmed

Manual operation: See "Disable All Lines" on page 482

CALCulate:LIMit<k>: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:LIMit<k>:FAIL.

Note that this command replaces the two commands from previous signal and spectrum analyzers (which are still supported, however):

- CALCulate:LIMit<k>:TRACe on page 995
- CALCulate:LIMit<k>:STATe on page 903

Parameters:
<State> ON | OFF
*RST: OFF

Example: CALC:LIM3:TRAC2:CHEC ON
Switches on the limit check for limit line 3 on trace 2.

Usage: SCPI confirmed

Manual operation: See "Traces to be Checked" on page 481

Checking the Results of a Limit Check

CALCulate:LIMit:CLEar[:IMMediate] 904
CALCulate:LIMit<k>:FAIL 905

CALCulate:LIMit: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.

Example: CALC:LIM:CLE
Deletes the result of the limit check.

Usage: SCPI confirmed

CALCulate:LIMit<k>:FAIL

This command queries the result of a limit check.

Note that for SEM measurements, the limit line suffix <k> is irrelevant, as only one specific SEM limit line is checked for the currently relevant power class.

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 sweeps. See also `INITiate:CONTinuous` on page 634.

Return values:

<Result>

0
PASS

1
FAIL

Example:

```
INIT;*WAI
```
Starts a new sweep and waits for its end.
```
CALC:LIM3:FAIL?
```
Queries the result of the check for limit line 3.

Usage: SCPI confirmed

Manual operation: See "Spectrum Emission Mask" on page 104
See "Limit Check 1-4" on page 176
See "Limit Check" on page 203

11.9 Managing Settings and Results

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 8, "Data Management", on page 489.

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 8.2.2.2, "Storage Location and File Name", on page 494.

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", i.e., they 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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11.9.1 General Data Storage and Loading Commands

See also:

- `FORMat[:DATA]` on page 852

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MMEMory:CATalog?....907
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MMEMory:NETWork:DISConnect....911
MMEMory:NETWork:MAP....911
MMEMory:NETWork:UNUSeddrives?....911
MMEMory:NETWork:USEDdrives?....911
MMEMory:RDIRectory....912

FORMat:DEXPort:DSEParator <Separator>

This command selects the decimal separator for data exported in ASCII format.

Parameters:

<Separator>

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 "Saving the Evaluation List" on page 184
See "Saving the Evaluation List" on page 205
See "Decimal Separator" on page 424
See "Exporting the Peak List" on page 470

MMEMory:CATalog?

This command returns the contents of a particular directory.

Query parameters:

<Path> String containing the path and directory.
If you leave out the path, the command returns the contents of the directory selected with `MMEMory:CDIRectory`.
The path may be relative or absolute. Using wildcards ('*') is possible to query a certain type of files only.

Return values:

<FileNames> List of file and directory names, separated by commas

Example: `MMEM:CAT? 'C:\R_S\Instr\user\SPOOL?.PNG'`
Returns all files in C:\R_S\Instr\user whose names start with SPOOL, have 6 letters and the extension ".PNG", e.g.:
`SPOOL1.PNG,SPOOL2.PNG,SPOOL3.PNG`

Usage: Query only
SCPI confirmed

Manual operation: See "Selecting the Storage Location - Drive/ Path/ Files" on page 182

MMEMory:CATalog:LONG? <Path>

This command returns the contents of a particular directory with additional information about the files.

Query parameters:

<Path> String containing the path and directory.
If you leave out the path, the command returns the contents of the directory selected with `MMEMory:CDIRectory`.
The path may be relative or absolute. Using wildcards ('*') is possible to query a certain type of files only.

Return values:

<UsedDiskSpace> Byte size of all files in the directory.

<FreeDiskSpace> Remaining disk space in bytes.

<FileInfo> <NameFileN>,<SuffixFileN>,<SizeFileN>
Describes the individual file.
<NameFileN>
Name of the file.
<SuffixFileN>
Type of the file. Possible suffixes are: ASCii, BINary, DIRectory, STAT
<SizeFileN>
Size of the file in bytes.

Usage: Query 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.

Usage: SCPI confirmed

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 496

MMEMory:COPY <SourceFile>,<DestinationFile>

This command copies one or more files to another directory.

Parameters:
<SourceFile> String containing the path and file name of the source file.

<DestinationFile> String containing the path and name of the target file.
The path may be relative or absolute.

Usage: SCPI confirmed

MMEMory:DATA <FileName>, [<Block>]

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:

<FileName> String containing the path and name of the target file.

<Block> 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.

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.

Usage: SCPI confirmed

MMEMory:DELete <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.

Usage: Event
SCPI confirmed

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.

Usage: Event

MMEMory:MOVE <SourceFile>,<NewFileName>

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:

<SourceFile> String containing the path and file name of the source file.

<NewFileName> 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:\.

Usage: Event
SCPI confirmed

MMEMory:MSIS <Device>

This command selects the default storage device used by all MMEMory commands.

Parameters:

<Device> 'A:' | 'C:' | … | 'Z:'
String containing the device drive name
*RST: 'C:'

Usage: SCPI confirmed

MMEMory:NAME <FileName>

This command creates a new and empty file.

It also sets the file name for screenshots taken with `HCOPy[:IMMediate<device>]` on page 922. Note that you have to route the printer output to a file.

Parameters:

<FileName> String containing the path and name of the target file.

Example: `MMEM:NAME 'C:\R_S\instr\user\PRINT1.BMP'`
Selects the file name.

Usage: Event
SCPI confirmed

MMEMory:NETWork:DISConnect <Drive>

This command disconnects a network drive.

Parameters:

<Drive> String containing the drive name.

Usage: Event

MMEMory:NETWork:MAP <Drive>, <HostName> [, <UserName>, <Password>][, <Reconnect>]

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:

<Drive> String containing the drive name or path of the directory you want to map.

<HostName> 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 containg the password corresponding to the <UserName>.
The password is optional.

<Reconnect> ON | OFF

ON
Reconnects at logon with the same user name.

OFF
Doe not reconnect at logon.

Usage: Event

MMEMory:NETWork:UNUSeddrives?

This command returns a list of unused network drives.

Return values:

<DriveName> List of network drives in alphabetically descending order, e.g. 'W:,V:,U:,...'

Usage: Query only

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 are using the parameter OFF.

ON
Returns a list of all drives in use including the folder information.

OFF
Returns al list of all drives in use.

Usage: Query only

MMEMory:RDIRectory <Directory>

This command deletes the indicated directory.

Parameters:

<Directory>
String containing the path of the directory to delete.
Note that the directory you want to remove may contain no contents.

Usage: Event

11.9.2 Selecting the 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....912
MMEMory:SELect[:ITEM]:ALL....912
MMEMory:SELect:CHANnel[:ITEM]:DEFault....913
MMEMory:SELect[:ITEM]:DEFault....913
MMEMory:SELect:CHANnel[:ITEM]:HWSettings....913
MMEMory:SELect[:ITEM]:HWSettings....913
MMEMory:SELect:CHANnel[:ITEM]:LINes:ALL....914
MMEMory:SELect[:ITEM]:LINes:ALL....914
MMEMory:SELect:CHANnel[:ITEM]:NONE....914
MMEMory:SELect[:ITEM]:NONE....914
MMEMory:SELect:CHANnel[:ITEM]:SGRam....914
MMEMory:SELect[:ITEM]:SGRam....914
MMEMory:SELect:CHANnel[:ITEM]:TRACe[:ACTive]....914
MMEMory:SELect[:ITEM]:TRACe[:ACTive]....914
MMEMory:SELect:CHANnel[:ITEM]:TRANsducer:ALL....915
MMEMory:SELect[:ITEM]:TRANsducer:ALL....915

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`
- Limit lines: `MMEMory:SELect[:ITEM]:LINes:ALL`
- Spectrogram data: `MMEMory:SELect[:ITEM]:SGRam`
- Trace data: `MMEMory:SELect[:ITEM]:TRACe[:ACTive]`
- Transducers: `MMEMory:SELect[:ITEM]:TRANsducer:ALL`

Example: `MMEM:SEL:ALL`

Usage: Event

Manual operation: See "Items" on page 496

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 496

MMEMory:SELect:CHANnel[:ITEM]:HWSettings <State>
MMEMory:SELect[:ITEM]:HWSettings <State>

This command includes or excludes hardware settings when storing or loading a configuration file.

Hardware settings include:

- general instrument 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`.
- 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 496

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
*RST: OFF

Example: `MMEM:SEL:LIN:ALL ON`

Manual operation: See "Items" on page 496

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`
- Limit lines: `MMEMory:SELect[:ITEM]:LINes:ALL`
- Trace data: `MMEMory:SELect[:ITEM]:TRACe[:ACTive]`
- Transducers: `MMEMory:SELect[:ITEM]:TRANsducer:ALL`

Example: `MMEM:SEL:NONE`

Usage: Event

Manual operation: See "Items" on page 496

MMEMory:SELect:CHANnel[:ITEM]:SGRam <boolean>
MMEMory:SELect[:ITEM]:SGRam <boolean>

This command includes or excludes spectrogram data when storing or loading a configuration file.

Parameters:
<State> **ON | OFF**
*RST: OFF

Example: `MMEM:SEL:SGR ON`
Adds the spectrogram data to the list of data subsets.

MMEMory:SELect:CHANnel[:ITEM]:TRACe[:ACTive] <State>
MMEMory:SELect[:ITEM]:TRACe[:ACTive] <State>

This command includes or excludes trace data when storing or loading a configuration file.

Parameters:
<State> ON | OFF
*RST: OFF, i.e. no traces is stored

Example: `MMEM:SEL:TRAC ON`

Manual operation: See "Items" on page 496

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
*RST: OFF

Example: `MMEM:SEL:TRAN:ALL ON`

Manual operation: See "Items" on page 496
See "Save" on page 522

11.9.3 Storing and Loading Instrument Settings

See also:

- `INSTrument[:SELect]` on page 627 to select the channel.

MMEMory:CLEar:ALL....915
MMEMory:CLEar:STATe....916
MMEMory:LOAD:AUTO....916
MMEMory:LOAD:STATe....916
MMEMory:LOAD:TYPe:[CHANnel]....917
MMEMory:STORe:STATe....917
MMEMory:STORe:STATe:NEXT....917
MMEMory:STORe:TYPe....918
SYSTem:PRESet....918
SYSTem:PRESet:CHANnel[:EXECute]....918

MMEMory:CLEar:ALL

This command deletes all instrument configuration files in the current directory.

You can select the directory with `MMEMory:CDIRectory`.

Example: `MMEM:CLE:ALL`

Usage: Event

MMEMory:CLEar:STATe 1,<FileName>

This command deletes a 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'`

Usage: Event

MMEMory:LOAD:AUTO 1, 'Factory' | <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 FSW.

Parameters:
1

'Factory' | <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 settings files cause an error.

Example: `MMEM:LOAD:AUTO 1,'C:\R_S\Instr\user\TEST'`

Usage: Event

Manual operation: See "Startup Recall" on page 498

MMEMory:LOAD:STATe 1, <FileName>

This command restores and activates an instrument configuration stored in a `*.dfl` file.

Note that files with other formats cannot be loaded with this command.

Parameters:
1

<FileName> String containing the path and name of the file to delete.
The string may or may not include the file's extension.

Example: `MMEM:LOAD:STAT 1,'C:\R_S\Instr\user\TEST01'`

Usage: SCPI confirmed

Manual operation: See "Recall" on page 493
See "Recall in New Channel / Recall in Current Channel" on page 496

MMEMory:LOAD:TYPe:[CHANnel] <Mode>

This command defines whether the channel-specific settings that will be loaded with the subsequent `MMEM:LOAD:STAT` command will replace the current channel or activate a new channel.

Parameters:

<Mode> NEW | REPLace

NEW
The loaded settings will be activated in a new channel.

REPLace
The loaded settings will replace the currently active channel.

*RST: NEW

Example:

```
INST:SEL 'SPECTRUM2'
```
Selects measurement channel `'SPECTRUM2'`.
```
MMEM:STOR:TYP CHAN
```
Specifies that channel-specific data is to be stored.
```
MMEM:STOR:STAT 1, 'C:\R_S\Instr\user\Spectrum'
```
Stores the settings from channel `'SPECTRUM2'` to the file `'C:\R_S\Instr\user\Spectrum'`.
```
MMEM:LOAD:TYP NEW
```
Specifies that channel-specific settings are to be activated in a new channel.
```
MMEM:LOAD:STAT 1, 'C:\R_S\Instr\user\Spectrum'
```
Loads the channel-specific settings from the file `'C:\R_S\Instr\user\Spectrum'` to the new channel `'SPECTRUM2*'`.

MMEMory:STORe:STATe 1,<FileName>

This command saves the current instrument configuration in a *.dfl file.

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 device settings in the file `Save.dfl`.

Usage: Event
SCPI confirmed

Manual operation: See "Save File" on page 496
See "Save" on page 522

MMEMory:STORe: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:STATe`. This command adds a consecutive number to the file name.

Example: `MMEM:STOR:STAT 1,'Save'`
Saves the current device settings in the file `Save.dfl`.
`MMEM:STOR:STAT:NEXT`
Saves the current device settings in the file `Save_001.dfl`
`MMEM:STOR:STAT:NEXT`
Saves the current device settings in the file `Save_002.dfl`

Usage: Event

Manual operation: See "Save File" on page 496

MMEMory:STORe:TYPe <Mode>

This command defines whether the data from the entire instrument or only from the current channel is stored with the subsequent `MMEM:STOR...` command.

Parameters:
<Mode> INSTrument | CHANnel
*RST: INST

Example: `INST:SEL 'SPECTRUM2'`
Selects measurement channel `'SPECTRUM2'`.
`MMEM:STOR:TYP CHAN`
Specifies that channel-specific data is to be stored.
`MMEM:STOR:PEAK 'SpectrumPeaks'`
Stores the peak list from channel `'SPECTRUM2'` to the file `'SpectrumPeaks'`.

SYSTem:PRESet

This command presets the R&S FSW.

Example: `SYST:PRES`

Usage: Event
SCPI confirmed

SYSTem:PRESet:CHANnel[:EXECute]

This command restores the default instrument settings in the current channel.

Use `INST:SEL` to select the channel.

For details see chapter 8.1.1, "Factory Default Configuration", on page 490.

Example: `INST 'Spectrum2'`
Selects the channel for "Spectrum2".
`SYST:PRES:CHAN:EXEC`
Restores the factory default settings to the "Spectrum2" channel.

Usage: Event

Manual operation: See "Preset Channel" on page 274

11.9.4 Storing or Printing Screenshots

Useful commands to configure screenshots described elsewhere

- `MMEMory:NAME` on page 910

Remote commands exclusive to configure screenshots

HCOPy:ABORt....919
HCOPy:CMAP<item>:DEFault<colors>....919
HCOPy:CMAP<item>:HSL....920
HCOPy:CMAP<item>:PDEFined....920
HCOPy:DESTination<device>....921
HCOPy:DEVice:COLor....921
HCOPy:DEVice:LANGuage<device>....922
HCOPy[:IMMediate<device>]....922
HCOPy[:IMMediate<device>]:NEXT....922
HCOPy:ITEM:ALL....923
HCOPy:ITEM:WINDow:TEXT....923
HCOPy:PAGE:ORIentation<device>....923
HCOPy:TDSTamp:STATe<device>....923
SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?....924
SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]?....924
SYSTem:COMMunicate:PRINter:SELect<device>....924

HCOPy:ABORt

This command aborts a running hardcopy output.

Example: `HCOP:ABOR`

Usage: Event
SCPI confirmed

HCOPy:CMAP<item>:DEFault<colors>

This command defines the color scheme for print jobs.

Suffix:
<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 11.10.5.3, "CMAP Suffix Assignment", on page 945.

<colors> 1...4
1
Current colors with a white background and a black grid.
2
Optimized colors.
3
Customized colors.
4
Current screen colors (setting for hardcopies).

Example: `HCOP:CMAP:DEF2`
Selects the optimized color set for the color settings of a printout or a hardcopy.

Usage: Event

Manual operation: See "Print colors" on page 542

HCOPy:CMAP<item>:HSL <Color>

This command selects the color for various screen elements in print jobs.

Suffix:
<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 11.10.5.3, "CMAP Suffix Assignment", on page 945.

Parameters:
<Color>
hue
tint
sat
saturation
lum
brightness
The value range is 0 to 1 for all parameters.

Example: `HCOP:CMAP2:HSL 0.3,0.8,1.0`
Changes the grid color

Manual operation: See "Defining User-specific Colors" on page 543

HCOPy:CMAP<item>:PDEFined <Color>

This command selects a predefined color for various screen elements in print jobs.

Suffix:
<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 11.10.5.3, "CMAP Suffix Assignment", on page 945.

Parameters:

<Color> BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

Example: `HCOP:CMAP2:PDEF GRE`

Manual operation: See "Modifying User-Defined Colors" on page 542
See "Predefined Colors" on page 543

HCOPy:DESTination<device> <Destination>

This command selects the destination of a print job.

Suffix:

<device> 1 | 2
Printing device.

Parameters:

<Destination> **'MMEM'**
Sends the hardcopy to a file.
You can select the file name with `MMEMory:NAME`.
You can select the file format with `HCOPy:DEVice:LANGuage<device>`.

'SYST:COMM:PRIN'
Sends the hardcopy to a printer.
You can select the printer with `SYSTem:COMMunicate:PRINter:SELect<device>`.

'SYST:COMM:CLIP'
Sends the hardcopy to the clipboard.
The format should be WEMF.

*RST: 'SYST:COMM:CLIP'

Usage: SCPI confirmed

Manual operation: See "Device" on page 510

HCOPy:DEVice:COLor <State>

This command turns color printing on and off.

Parameters:

<State> **ON**
Color printing

OFF
Black and white printing

*RST: OFF

Example: `HCOP:DEV:COL ON`

Usage: SCPI confirmed

HCOPy:DEVice:LANGuage<device> <Format>

This command selects the file format for a print job.

Suffix:
<device> 1 | 2
Printing device.

Parameters:
<Format> **GDI**
Graphics Device Interface.
Default format for the output to a printer configured under Windows. Must be selected for the output to the printer interface. Can be used for the output to a file. The printer driver configured under Windows is used in this case and a printer-specific file format is thus generated.

BMP, JPG, PNG
Data format for output to files only.

Usage: SCPI confirmed

Manual operation: See "Device Setup" on page 508
See "Output Medium" on page 509

HCOPy[:IMMediate<device>]

This command initiates a print job.

If you are printing to a file, the file name depends on `MMEMory:NAME`.

Suffix:
<device> 1 | 2
Printing device.

Usage: Event
SCPI confirmed

Manual operation: See "Printing or Storing a Screenshot (Print Screen)" on page 508

HCOPy[:IMMediate<device>]: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.

Suffix:
<device> 1 | 2
Printing device.

Usage: Event

Manual operation: See "Printing or Storing a Screenshot (Print Screen)" on page 508

HCOPy:ITEM:ALL

This command includes all screen elements in the printout.

The screen elements include comments, title, time and date.

Usage: SCPI confirmed

Manual operation: See "Printing or Storing a Screenshot (Print Screen)" on page 508

HCOPy:ITEM:WINDow:TEXT <Comment>

This command defines a comment to be added to the printout.

Parameters:
<Comment> String containing the comment.

Usage: SCPI confirmed

Manual operation: See "Comment" on page 510

HCOPy:PAGE:ORIentation<device> <Orientation>

The command selects the format of the print job.

The command is only available if the output device is a printer.

Suffix:
<device> 1 | 2
Printing device.

Parameters:
<Orientation> LANDscape | PORTrait
*RST: PORTrait

Usage: SCPI confirmed

Manual operation: See "Device Setup" on page 508
See "Orientation" on page 510

HCOPy:TDSTamp:STATe<device> <State>

This command includes or excludes the time and date in the printout.

Suffix:
<device> 1 | 2
Printing device.

Parameters:
<State> ON | OFF
*RST: OFF

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]?`.

Return values:

<PrinterName> String containing the name of the first printer as defined in Windows.
If the command cannot find a printer, it returns an empty string (' ').

Usage: Query only

Manual operation: See "Device Setup" on page 508
See "Printer Name" on page 510

SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]?

This command queries the name of available printers.

You have to use `SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` for this command to work properly.

Return values:

<PrinterName> String containing the name of one printer as defined in Windows. To get a complete list of printers you have to send this query several times until no more printers could be found. In that case, the return value is an empty string (' '). Further queries after the empty string result in an error.

Usage: Query only

Manual operation: See "Device Setup" on page 508
See "Printer Name" on page 510

SYSTem:COMMunicate:PRINter:SELect<device> <PrinterName>

This command selects the printer that processes jobs sent by the R&S FSW.

Use `HCOPy:DESTination<device>` to select another output destination.

Suffix:

<device> 1 | 2
Printing device.

Parameters:

<PrinterName> String containing the printer name.
Use
- `SYSTem:COMMunicate:PRINter:ENUMerate:FIRSt?` and
- `SYSTem:COMMunicate:PRINter:ENUMerate[:NEXT]?`

to query all available printers.

*RST: NONE

Manual operation: See "Device Setup" on page 508
See "Printer Name" on page 510

11.9.5 Storing Measurement Results

The following commands can be used to store the results of a measurement.

Useful commands for storing results described elsewhere:

- `FORMat[:DATA]` on page 852

Remote commands exclusive to storing results:

FORMat:DEXPort:HEADer....925
FORMat:DEXPort:TRACes....925
MMEMory:STORe:LIST....926
MMEMory:STORe:PEAK....926
MMEMory:STORe:SGRam....926
MMEMory:STORe:SPURious....927
MMEMory:STORe<n>:TRACe....927

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.

See chapter 8.3.4.1, "Reference: ASCII File Export Format", on page 503 for details.

Parameters:

<State> ON | OFF | 0 | 1

*RST: 1

Usage: SCPI confirmed

Manual operation: See "Include Instrument Measurement Settings" on page 424

FORMat:DEXPort:TRACes <Selection>

This command selects the data to be included in a data export file (see `MMEMory:STORe<n>:TRACe` on page 927).

For details on exporting data see chapter 7.3.2.3, "Trace Export Settings", on page 423.

Parameters:

<Selection>

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

Usage: SCPI confirmed

Manual operation: See "Export all Traces and all Table Results" on page 424

MMEMory:STORe:LIST <FileName>

This command exports the SEM and spurious emission list evaluation to a file.

The file format is *.dat.

Parameters:

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:LIST 'test'`
Stores the current list evaluation results in the `test.dat` file.

Manual operation: See "Saving the Evaluation List" on page 184
See "Saving the Evaluation List" on page 205
See "Exporting the Peak List" on page 470

MMEMory:STORe:PEAK <FileName>

This command exports the marker peak list to a file.

The file format is *.dat.

Parameters:

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:PEAK 'test'`
Saves the current marker peak list in the file `test.dat`.

Usage: Event

MMEMory:STORe:SGRam <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.

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 425
See "Export" on page 501

MMEMory:STORe:SPURious <FileName>

This command exports the marker peak list available for spurious emission measurements to a file.

Parameters:

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR:SPUR 'test'`
Saves the current marker peak list in the file test.dat.

Usage: Event

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 8.3.4.1, "Reference: ASCII File Export Format", on page 503.

Parameters:

<Trace> Number of the trace to be stored
(This parameter is ignored if the option "Export all Traces and all Table Results" is activated in the Export configuration settings, see `FORMat:DEXPort:TRACes` on page 925).

<FileName> String containing the path and name of the target file.

Example: `MMEM:STOR1:TRAC 3,'TEST.ASC'`
Stores trace 3 from window 1 in the file `TEST.ASC`.

Usage: SCPI confirmed

Manual operation: See "Export Trace to ASCII File" on page 425
See "Export" on page 501

11.9.6 Examples: Managing Data

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- Loading Data....928
- Storing Instrument Settings....929

- Loading Instrument Settings....929
- Printing to a File....929
- Printing on a Printer....930

11.9.6.1 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 'T:','Server\ACLRTest'
//Maps drive T: to the directory 'Server\ACLRTest'
-----Saving data on the instrument-----
MMEM:MDIR 'C:\R_S\INST\USER\ACLRTest'
//Creates a directory called 'ACLRTest' on drive C:
MMEM:NAME 'C:\R_S\INST\USER\Test001.txt'
//Creates a file called 'Test001.txt'
MMEM:COMM 'ACLR test results'
//Creates a comment for the file.
MMEM:DATA 'Test001.txt',#212FileContents
//Writes 12 characters to the file 'Test001.txt'
-----Copying the data to another location---
MMEM:COPY 'C:\R_S\INST\USER\Results\Test001.txt','T:'
//Copies the specified file to network drive T:.
MMEM:DEL 'C:\R_S\INST\USER\Results\Test001.txt'
//Deletes the specified file from the instrument hard disk.
//or
MMEM:MOVE 'C:\R_S\INST\USER\Results\Test001.xml','D:\TestResults.txt'//
//Moves the file 'Test001.txt' to drive T:, renames it to 'Testresults.txt'
//and removes it from the instrument hard disk.
MMEM:RDIR 'C:\R_S\INST\USER\Results'
//Deletes the directory called 'Results' from drive C:, unless it still contains any content.
-----Disconnecting the network drive---
MMEM:NETW:DISC 'T:'
//Disconnect drive T:.
```

11.9.6.2 Loading Data

```
MMEM:CDIR?
//Returns the path of the current directory.
//e.g.
C:\R_S\Instr\user\
MMEM:CDIR 'C:\R_S\INST\USER\Results'
//Changes the current directory.
MMEM:CAT? 'C:\R_S\INST\USER\Results\*.xml'
//or
```

```
MMEM:CAT? '*.xml'
//Returns a list of all xml files in the directory 'C:\R_S\INST\USER\Results'.
MMEM:CAT:LONG? '*.xml'
//Returns additional information about the xml files in the directory 'C:\R_S\INST\USER\Result
```

11.9.6.3 Storing Instrument Settings

In this example we will store the instrument settings for the "Spectrum" channel.

```
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'.
```

11.9.6.4 Loading Instrument Settings

In this example we will load the hardware settings from the configuration file `Spectrum.dfl` to a new "Spectrum2" channel.

```
Folgende zeile hat maximale länge
01234567890123456789012345678901234567890123456789012345678901234567890123456789

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'.
```

11.9.6.5 Printing to a File

```
HCOP:DEST 'MMEM'
//Prints the data to a file.
HCOP:DEV:LANG BMP
//Selects bmp as the file format.
MMEM:NAME 'C:\R_S\INST\USER\Screenshot.bmp'
//Selects the file name for the printout.
HCOP:ITEM:ALL
//Prints all screen elements
HCOP:ITEM:WIND:TEXT 'ACLRResults'
//Adds a comment to the printout.
HCOP
```

```
//Stores the printout in a file called 'Screenshot.bmp'.
HCOP:NEXT
//Stores the printout in a file called 'Screenshot_001.bmp'.
```

11.9.6.6 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.
```

11.10 Configuring the R&S FSW

The remote commands required to set up the R&S FSW are described here.

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- Configuring the Reference Frequency....931
- Calibration and Temperature Checks....933
- Working with Transducers....937
- Customizing the Screen Layout....940
- Configuring the Network and Remote Control....947
- Checking the System Configuration....950
- Using Service Functions....954

11.10.1 Basic Instrument Setup

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SYSTem:SHUTdown....931

SYSTem:CLOGging <State>

This command turns logging of remote commands on and off.

Parameters:

<State> **ON**
Writes all remote commands that have been sent to a file. The destination is `C:\R_S\instr\ScpiLogging\ScpiLog.txt`.

OFF

*RST: OFF

Manual operation: See "I/O Logging" on page 593

SYSTem:SHUTdown

This command shuts down the R&S FSW.

Usage: Event

11.10.2 Configuring the Reference Frequency

[SENSe:]ROSCillator:O100 931
[SENSe:]ROSCillator:O640 931
SOURce:EXTernal:ROSCillator:EXTernal:FREQuency 932
[SENSe:]ROSCillator:SOURce 932
[SENSe:]ROSCillator:SOURce:EAUTo? 933
[SENSe:]ROSCillator:SYNC 933

[SENSe:]ROSCillator:O100 <State>

If enabled, a 100 MHz reference signal is provided to the REF OUTPUT 100 MHZ connector.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `ROSC:O100 ON`

Usage: SCPI confirmed

Manual operation: See "Reference Frequency Output" on page 517

[SENSe:]ROSCillator:O640 <State>

If enabled, a 640 MHz reference signal is provided to the REF OUTPUT 640 MHZ connector.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `ROSC:O640 ON`

Usage: SCPI confirmed

Manual operation: See "Reference Frequency Output" on page 517

SOURce:EXTernal:ROSCillator:EXTernal:FREQuency <Frequency>

This command defines the frequency of the external reference oscillator.

If the external reference oscillator is selected, the reference signal must be connected to the rear panel of the instrument.

Parameters:

<Frequency> Range: 1 MHz to 20 MHz

Example: `ROSC:EXT:FREQ 13MHZ`
Sets the frequency to 13 MHz.
`SOUR:EXT:ROSC:EXT:FREQ 13MHZ`

Manual operation: See "Reference Frequency Input" on page 516

[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 FSW.

Parameters:

<Source>

INTernal
the internal reference is used (10 MHz)

EXTernal
the external reference from REF INPUT 1..20 MHZ connector is used with a variable frequency; if none is available, an error flag is displayed in the status bar

E10
the external reference from REF INPUT 1..20 MHZ connector is used with a fixed 10 MHZ frequency; if none is available, an error flag is displayed in the status bar

E100
the external reference from REF INPUT 100 MHZ connector is used; if none is available, an error flag is displayed in the status bar

EAUTo
the external reference is used as long as it is available, then the instrument switches to the internal reference

SYNC
the external reference is used; if none is available, an error flag is displayed in the status bar

Example: `ROSC:SOUR EXT`

Usage: SCPI confirmed

Manual operation: See "Reference Frequency Input" on page 516
See "Behavior in case of missing external reference" on page 516

[SENSe:]ROSCillator:SOURce:EAUTo?

This command queries the current reference type in case you have activated an automatic switch to the internal reference if the external reference is missing.

Parameters:

<Reference> **INT**
internal reference
EXT
external reference

Example: `SENS:ROSC:SOUR:EAUT?`
Queries the currently available reference type.

Usage: Query only

Manual operation: See "Reference Frequency Input" on page 516
See "Behavior in case of missing external reference" on page 516

[SENSe:]ROSCillator:SYNC <State>

If enabled, a 100 MHz reference signal is provided to the SYNC TRIGGER OUTPUT connector.

Parameters:

<State> ON | OFF
*RST: OFF

Example: `ROSC:SYNC ON`

Usage: SCPI confirmed

Manual operation: See "Reference Frequency Output" on page 517

11.10.3 Calibration and Temperature Checks

The following commands control calibration and temperature checks on the R&S FSW.

CALibration[:ALL]?....934
CALibration:RESult?....934
DIAGnostic:SERVice:INPut:MC:DISTance....934
DIAGnostic:SERVice:INPut:PULSed:CFRequency....935
DIAGnostic:SERVice:INPut:RF:SPECtrum....935
DIAGnostic:SERVice:INPut:AIQ[:TYPE]....935
DIAGnostic:SERVice:INPut[:SELect]....936
DIAGnostic:SERVice:STESt:RESult?....936
SOURce:TEMPerature:FRONtend?....937

CALibration[:ALL]?

This command initiates a calibration 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:

<CalibrationState> **0**
The command returns a '0' if calibration was 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
SCPI confirmed

Manual operation: See "Starting a Self-alignment" on page 523

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 523

DIAGnostic:SERVice:INPut:MC:DISTance <Bandwidth>

This command selects the distance of the peaks of the microwave calibration signal for calibration of the YIG filter.

Parameters:

<Bandwidth>

SMALl
Small offset of combline frequencies.

WIDE
Wide offset of combline frequencies.

Manual operation: See "Calibration Frequency MW" on page 532

DIAGnostic:SERVice:INPut:PULSed: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]`.

Parameters:

<Frequency>

Possible frequencies of the calibration signal are fix.
If you define a frequency that is not available, the R&S FSW uses the next available frequency. Example: a frequency of 20 MHz is rounded up to the next available frequency (21.33 MHz).

*RST: 64 MHz
Default unit: Hz

Manual operation: See "Calibration Frequency RF" on page 531

DIAGnostic:SERVice:INPut:RF:SPECtrum <Bandwidth>

This command selects the bandwidth of the calibration signal.

Parameters:

<Bandwidth>

NARRowband
Narrowband signal for power calibration of the frontend.

BROadband
Broadband signal for calibration of the IF filter.

Manual operation: See "Calibration Frequency RF" on page 531
See "Spectrum" on page 531

DIAGnostic:SERVice:INPut:AIQ[:TYPE] <SignalType>

This command defines the type of calibration signal to be used for Analog Baseband.
This command is only available if the R&S FSW-B71 option is installed.

Parameters:

<SignalType>

AC
1.5625 MHz square wave AC signal

DC
DC signal

DCZ
no signal

*RST: AC

Example:
```
DIAG:SERV:INP:AIQ:TYPE DCZ
```

Manual operation:
See "Calibration Analog Baseband" on page 532
See "Calibration Signal Type" on page 532

DIAGnostic:SERVice:INPut[:SELect] <Signal>

This command activates or deactivates the use of an internal calibration signal as input for the R&S FSW.

Parameters:

<Signal>

CALibration
Uses the calibration signal as RF input.

MCALibration
Uses the calibration signal for the microwave range as RF input.

RF
Uses the signal from the RF input.

AIQ
Uses the Analog Baseband calibration signal as input to the optional Analog Baseband interface. This signal is only available if the R&S FSW-B71 option is installed.

*RST: RF

Example:
```
DIAG:SERV:INP CAL
```
Uses the calibration signal as RF input.

Manual operation:
See "None" on page 531
See "Calibration Analog Baseband" on page 532

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:TEMPerature:FRONtend?

This command queries the current frontend temperature of the R&S FSW.

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.

Return values:
<Temperature> Temperature in degrees Celsius.

Example: `SOUR:TEMP:FRON?`
Queries the temperature of the frontend sensor.

Usage: Query only

11.10.4 Working with Transducers

The following commands configure and control transducer factors.

Useful commands for transducer managament described elsewhere

- `MMEMory:SELect[:ITEM]:TRANsducer:ALL` on page 915

Remote commands exclusive to transducer management

[SENSe:]CORRection:TRANsducer:ADJust:RLEVel[:STATe] 937
[SENSe:]CORRection:TRANsducer:COMMent 938
[SENSe:]CORRection:TRANsducer:DATA 938
[SENSe:]CORRection:TRANsducer:DELete 938
[SENSe:]CORRection:TRANsducer:SCALing 938
[SENSe:]CORRection:TRANsducer:SELect 938
[SENSe:]CORRection:TRANsducer[:STATe] 939
[SENSe:]CORRection:TRANsducer:UNIT 939

[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
*RST: OFF

Manual operation: See "Adjusting the Reference Level" on page 520

[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)

Manual operation: See "Comment" on page 521

[SENSe:]CORRection:TRANsducer:DATA <Frequency>,<Level>

This command defines the shape of the transducer factor.

Parameters:
<Frequency>, <Level> The unit for <Frequency> is Hz. Frequencies have to be sorted in ascending order.
The unit for <Level> depends on `[SENSe:]CORRection:TRANsducer:UNIT`.

Manual operation: See "Data points" on page 522

[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`

Usage: Event

Manual operation: See "Delete Line" on page 520

[SENSe:]CORRection:TRANsducer:SCALing <ScalingType>

This command selects the frequency scaling of the transducer factor.

Parameters:
<ScalingType> LINear | LOGarithmic
*RST: LINear

Manual operation: See "X-Axis Scaling" on page 522

[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 FSW creates a transducer factor by that name.

Example: `CORR:TRAN:SEL 'FACTOR1'`

Manual operation: See "Activating/Deactivating" on page 519
See "Create New Line" on page 520
See "Name" on page 521

[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
*RST: OFF

Manual operation: See "Activating/Deactivating" on page 519

[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'`

Manual operation: See "Unit" on page 521

String	Unit
'DB'	dB
'DBM'	dBm
'DBMV'	dBmV
'DBUV'	dBµV
'DBUV/M'	dBµV/m
'DBUA'	dBµA
'DBUA/M'	dBµA/m
'DBPW'	dBpW
'DBPT'	dBpT

11.10.5 Customizing the Screen Layout

The remote commands required to set up the display of the R&S FSW are described here.

- General Display Settings and Items....940
- Colors and Themes....943
- CMAP Suffix Assignment....945

11.10.5.1 General Display Settings and Items

The following commands add, remove or customize general display and screen elements.

Useful commands for general display settings described elsewhere

- `DISPlay:MTABle` on page 860

Remote commands exclusive to general display settings

DISPlay:ANNotation:FREQuency....940
DISPlay:FORMat....940
DISPlay:PSAVe:HOLDoff....941
DISPlay:PSAVe[:STATe]....941
DISPlay:SBAR[:STATe]....941
DISPlay:SKEYs[:STATe]....942
DISPlay:TBAR[:STATe]....942
DISPlay:TOUChscreen:STATe....942
DISPlay[:WINDow]:TIME....942
DISPlay[:WINDow]:TIME:FORMat....943
SYSTem:DISPlay:FPANel[:STATe]....943

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`

Usage: SCPI confirmed

Manual operation: See "Diagram Footer (Annotation)" on page 539

DISPlay:FORMat <Format>

This command determines which tab is displayed.

Parameters:

<Format>

SPLit
Displays the MultiView tab with an overview of all active channels (See chapter 4.1, "R&S MultiView", on page 89).

SINGle
Displays the measurement channel that was previously focused.

*RST: SPL

Example: `DISP:FORM SING`

DISPlay:PSAVe:HOLDoff <Minutes>

This command defines the time until the R&S FSW turns the display power save mode on.

Parameters:

<Minutes>

Minutes until power save mode starts. Note that the number you enter may have no dimension.

Range: 1 to 100
*RST: 15

Example: `DISP:PSAV:HOLD 30`

Manual operation: See "Display Power Save Function" on page 537

DISPlay:PSAVe[:STATe] <State>

This command turns the power save mode of the display on and off.

Parameters:

<State>

ON | OFF

*RST: OFF

Example: `DISP:PSAVe ON`
Switches on the power-save mode.

Manual operation: See "Display Power Save Function" on page 537

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 538

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 539

DISPlay:TBAR[:STATe] <State>

This command turns the toolbar on or off.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DISP:TOOL ON`

Manual operation: See "Toolbar" on page 538

DISPlay:TOUChscreen:STATe <State>

This command controls the touch screen functionality.

Parameters:

<State> **ON | 1**
Touch screen is active for entire screen

OFF | 0
Touch screen is inactivate for entire screen

FRAMe
Touch screen is inactivate for the diagram area of the screen, but active for softkeys, toolbars and menus.

*RST: 1

Example: `DISP:TOUC:STAT ON`

Manual operation: See "Deactivating and Activating the Touch Screen" on page 536

DISPlay[:WINDow]:TIME <State>

This command adds or removes the date and time from the display.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `DISP:TIME ON`

Manual operation: See "Date and Time" on page 539

DISPlay[:WINDow]:TIME:FORMat <Format>

This command selects the time and date format.

Parameters:

<Format>

DE
dd.mm.yyyy hh:mm:ss
24 hour format.

US
mm/dd/yyyy hh:mm:ss
12 hour format.

*RST: DE

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 537

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 539
See "Mini Front Panel" on page 540

11.10.5.2 Colors and Themes

Useful commands to customize display colors described elsewhere

The HCOPY commands define the print colors and thus only take effect on the display colors, if the display shows the printing colors.

- `HCOPy:CMAP<item>:DEFault<colors>` on page 919
- `HCOPy:CMAP<item>:HSL` on page 920
- `HCOPy:CMAP<item>:PDEFined` on page 920

Remote commands exclusive to customize the display colors and themes

DISPlay:CMAP<item>:DEFault<colors>....944
DISPlay:CMAP<item>:HSL....944
DISPlay:CMAP<item>:PDEFined....945
DISPlay:THEMe:CATalog?....945
DISPlay:THEMe:SELect....945

DISPlay:CMAP<item>:DEFault<colors>

This command resets the color scheme for the display.

Suffix:

<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 11.10.5.3, "CMAP Suffix Assignment", on page 945.

<colors> 1...4
1
Current colors with a white background and a black grid.
2
Optimized colors.
3
Customized colors.
4
Current screen colors (setting for hardcopies).

Example: `DISP:CMAP:DEF2`
Selects default setting 2 for setting the colors.

Usage: Event
SCPI confirmed

Manual operation: See "Screen colors" on page 542

DISPlay:CMAP<item>:HSL <Color>

This command selects the color for various screen elements in the display.

Suffix:

<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 11.10.5.3, "CMAP Suffix Assignment", on page 945.

Parameters:

<Color> **hue**
tint

sat
saturation

lum
brightness

The value range is 0 to 1 for all parameters.

Example: `DISP:CMAP2:HSL 0.3,0.8,1.0`
Changes the grid color.

DISPlay:CMAP<item>:PDEFined <Color>

This command selects a predefined color for various screen elements.

Suffix:
<item> Selects the item for which the color scheme is to be defined.
For more information see chapter 11.10.5.3, "CMAP Suffix Assignment", on page 945.

Parameters:
<Color> BLACk | BLUE | BROWn | GREen | CYAN | RED | MAGenta | YELLow | WHITe | DGRAy | LGRAy | LBLUe | LGREen | LCYan | LRED | LMAGenta

Example: `DISP:CMAP2:PDEF GRE`

Manual operation: See "Restoring the User Settings to Default Colors" on page 544

DISPlay:THEMe:CATalog?

This command queries all available display themes.

Parameters:
<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 "OceanBlue"`

Manual operation: See "Theme" on page 542

11.10.5.3 CMAP Suffix Assignment

Several commands to change the color settings of individual items of the display or printout are available. Which item is to be configured is defined using a <CMAP> suffix. The following assignment applies:

Suffix	Description
CMAP1	Background
CMAP2	Grid
CMAP3 *)	Common Text
CMAP4 *)	Check Status OK
CMAP5 *)	Check Status Error
CMAP6 *)	Text Special 1
CMAP7 *)	Text Special 2
CMAP8	Trace 1
CMAP9	Trace 2
CMAP10	Trace 3
CMAP11	Marker Info Text
CMAP12	Limit Lines
CMAP13	Limit and Margin Check – "Pass"
CMAP14	Limit and Margin Check – "Fail"
CMAP15 *)	Softkey Text
CMAP16 *)	Softkey Background
CMAP17 *)	Selected Field Text
CMAP18 *)	Selected Field Background
CMAP19 *)	Softkey 3D Bright Part
CMAP20 *)	Softkey 3D Dark Part
CMAP21 *)	Softkey State "On"
CMAP22 *)	Softkey State "Dialog open"
CMAP23 *)	Softkey Text Disabled
CMAP24	Logo
CMAP25	Trace 4
CMAP26	Grid – Minorlines
CMAP27	Marker
CMAP28	Display Lines
CMAP29 *)	Sweepcount – Text
CMAP30	Limit and Margin Check – Text
CMAP31	Limit and Margin Check – \"Margin\"
CMAP32 *)	Table Overall – Title Text
CMAP33 *)	Table Overall – Title Background

Suffix	Description
CMAP34 *)	Table Overall – Text
CMAP35 *)	Table Overall – Background
CMAP36 *)	Table Value – Title Text
CMAP37 *)	Table Value – Title Background
CMAP38 *)	Table Value – Text
CMAP39 *)	Table Value – Background
CMAP40	Trace 5
CMAP41	Trace 6

*) these settings can only be defined via the theme (`DISPlay:THEMe:SELect`) and are thus ignored in the SCPI command

11.10.6 Configuring the Network and Remote Control

The following commands are required to configure a network or remote control for the R&S FSW.

Useful commands for configuring remote control described elsewhere:

- `SYSTem:LANGuage` on page 961

Remote commands exclusive to configuring a network and remote control

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess....947
SYSTem:COMMunicate:GPIB[:SELF]:RTERminator....948
SYSTem:DISPlay:UPDate....948
SYSTem:IDENtify:FACTory....948
SYSTem:IDENtify[:STRing]....948
SYSTem:LXI:INFo?....949
SYSTem:LXI:LANReset....949
SYSTem:LXI:MDEScription....949
SYSTem:LXI:PASSword....949

SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <Address>

This command sets the GPIB address of the R&S FSW.

Parameters:

<Address> Range: 0 to 30
*RST: (no influence on this parameter, factory default 20)

Example: `SYST:COMM:GPIB:ADDR 18`

Usage: SCPI confirmed

Manual operation: See "GPIB Address" on page 593

SYSTem:COMMunicate:GPIB[:SELF]:RTERminator <Terminator>

This command selects the GPIB receive terminator.

According to the standard the terminator in ASCII is <LF> and/or <EOI>. For binary data transfers (e.g. trace data) from the control computer to the instrument, the binary code (0AH) 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 changing the receive terminator to EOI.

Output of binary data from the instrument to the control computer does not require such a terminator change.

Parameters:

<Terminator> LFEOI | EOI

*RST: (no influence on this parameter, factory default LFEOI)

Example: `SYST:COMM:GPIB:RTER EOI`

Manual operation: See "GPIB Terminator" on page 593

SYSTem:DISPlay:UPDate <State>

This command turns the display during remote operation on and off.

If on, the R&S FSW 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

*RST: OFF

Example: `SYST:DISP:UPD ON`

Manual operation: See "Remote Display Update" on page 593

SYSTem:IDENtify:FACTory

This command resets the query to `*IDN?` to its default value.

Usage: Event

Manual operation: See "Reset to Factory String" on page 593

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 593

SYSTem:LXI:INFo?

This command queries the LXI settings.

Return values:

<LXIInfo> <current version> | <LXI class> | <Computername> | <MAC adress> | <IP adress> | <Auto MDIX>

String containing the current LXI parameters.
- <version>
- <LXIClass>
- <ComputerName>
- <MACAddress>
- <IPAddress>
- <AutoMDIX>

Usage: Query only

Manual operation: See "Current LXI Configuration" on page 597

SYSTem:LXI:LANReset

This command resets the LAN configuration as required by the LXI standard. The command also resets the LXI password and instrument description.

Usage: Event

Manual operation: See "LAN Reset" on page 598

SYSTem:LXI:MDEScription <Description>

This command defines the LXI instrument description.

Parameters:

<Description> String containing the instrument description.

Manual operation: See "LXI Manufacturer Description" on page 598

SYSTem:LXI:PASSword <Password>

This command defines the LXI password.

Parameters:

<Password> String containing the password.

Return values:

<Password> The query returns the current password.

Manual operation: See "LXI Password" on page 598

11.10.7 Checking the System Configuration

The following commands are required to check the system configuration on the R&S FSW.

Useful commands for obtaining system information described elsewhere:

- `DIAGnostic:SERVice:SINFo?` on page 955

Remote commands exclusive to obtaining system information:

DIAGnostic:INFO:CCOunter?....950
DIAGnostic:SERVice:BIOSinfo?....951
DIAGnostic:SERVice:HWINfo?....951
DIAGnostic:SERVice:VERSinfo?....951
SYSTem:ERRor:CLEar:ALL....952
SYSTem:ERRor:EXTended?....952
SYSTem:ERRor:LIST?....953
SYSTem:ERRor[:NEXT]?....953
SYSTem:FORMat:IDENt....953
SYSTem:PRESet:COMPatible....953

DIAGnostic:INFO:CCOunter? <Relay>

This command queries how many switching cycles the individual relays have performed since they were installed.

Query parameters:

<Relay>

ACDC
Mechanical Attenuation Coupling

ATT5
Mechanical Attenuation 05 DB

ATT10
Mechanical Attenuation 10 DB

ATT20
Mechanical Attenuation 20 DB

ATT40
Mechanical Attenuation 40 DB

CAL
Mechanical Calibration Source

EATT
Electrical Attenuation Bypass

PREamp
Preamplifier Bypass

Return values:

<Cycles> Number of switching cycles.

Example: `DIAG:INFO:CCO? CAL`

Usage: Query only

Manual operation: See "Relay Cycle Counter" on page 535

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

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 firmware options.

Example: `DIAG:SERV:VERS?`
Queries the version information.
Response:

```
Instrument Firmware |1.10
BIOS |FSW Analyzer BIOS V1.03-1-32-4-3 IPC10
Image Version |1.2.0
PCI-FPGA |9.01
SA-FPGA |2.43
MB-FPGA |2.0.8.0
SYNTH-FPGA |3.9.0.0
REF-FPGA |3.4.0.0
Data Sheet Version |01.00
Time Control Management |active
Analog Demod K7| |permanent
```

Usage: Query only
SCPI confirmed

SYSTem:ERRor:CLEar:ALL

This command deletes all contents of the "System Messages" table.

Example: `SYST:ERR:CLE:ALL`

Usage: Event

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 measurement channel (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 "STATus:QUEStionable:EXTended:INFO Register" on page 579).

Query parameters:

<MessageType> ALL | INFO | WARNing | ERRor | FATal | MESSage

<ChannelName> String containing the name of the channel.
The parameter is optional. If you omit it, the command works for the currently active channel.

Return values:

<Messages> String containing all messages of the selected type for the specified measurement channel. 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?

This command queries the system messages.

Return values:
<Messages> String containing all messages in the "System Messages" table.

Example: `SYST:ERR:LIST?`

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 10.1.7, "Status Reporting System", on page 570.

Usage: Query only

SYSTem:FORMat:IDENt <IDNFormat>

This command selects the response format to the `*IDN?` query.

Parameters:
<IDNFormat> **LEGacy**
Format is compatible to R&S FSP/FSU/FSQ/FSG family.
NEW | FSL
R&S FSW format
Format is also compatible to the R&S FSL and R&S FSV family
*RST: NEW

Example: `SYST:FORM:IDEN LEG`
Adapts the return value of *IDN? to the R&S FSP/FSU/FSQ family.

Manual operation: See "*IDN Format" on page 593

SYSTem:PRESet:COMPatible <OpMode>

This command defines the operating mode that is activated when you switch on the R&S FSW or press the PRESET key.

For details on operating modes see chapter 4, "Applications and Operating Modes", on page 88.

Parameters:

<OpMode>

MSRA
Defines MSRA as the default operating mode as the presetting.

SANalyzer
(Default:) Defines Signal and Spectrum Analyzer operating mode as the presetting.

*RST: SAN

Usage: Event

11.10.8 Using Service Functions

DIAGnostic:SERVice:SFUNction....954
DIAGnostic:SERVice:SFUNction:LASTresult?....954
DIAGnostic:SERVice:SFUNction:RESults:DELete....955
DIAGnostic:SERVice:SFUNction:RESults:SAVE....955
DIAGnostic:SERVice:SINFo?....955

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:

<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)

Usage: Event

Manual operation: See "Service Function" on page 533
See "Send" on page 533

DIAGnostic:SERVice:SFUNction:LASTresult?

This command queries the results of the most recent service function you have used.

Usage: Query only

DIAGnostic:SERVice:SFUNction:RESults:DELete

This command deletes the results of the most recent service function you have used.

Usage: Event

Manual operation: See "Clear Results" on page 534

DIAGnostic:SERVice:SFUNction:RESults:SAVE <FileName>

This command saves the results of the most recent service function you have used.

Parameters:
<FileName> String containing the file name.

Manual operation: See "Save Results" on page 534

DIAGnostic:SERVice:SINFo? <FileName>

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:\R_S\Instr\user\` directory on the instrument. As a result of this command, the created file name (including the drive and path) is returned. You can use the resulting file name information as a parameter for the `MMEM:COPY` command to store the file on the controller PC (see `MMEMory:COPY` on page 908).

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:\R_S\Instr\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 (see chapter 9.3.4.2, "Information on Versions and Options", on page 524)
<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:
\R&S\instr\user\FSW-26_1312.8000K26-100005-xx_20130116_165
```
Copy to controller PC:
```
MMEM:COPY "c:
\R&S\instr\user\FSW-26_1312.8000K26-100005-xx_20130116_165
\Debug\FSW-26_1312.8000K26-100005-xx_20130116_165858.zip"
```

Usage: Query only

Manual operation: See "Creating R&S Support Information" on page 529

11.11 Using the Status Register

For more information on the contents of the status registers see:

- "STATus:QUEStionable:ACPLimit Register" on page 578
- "STATus:QUEStionable:FREQuency Register" on page 579
- "STATus:QUEStionable:LIMit Register" on page 580
- "STATus:QUEStionable:LMARgin Register" on page 581
- "STATus:QUEStionable:POWer Register" on page 581
- "STATus:QUEStionable:TEMPerature Register" on page 582
- "STATus:QUEStionable:TIMe Register" on page 582

- General Status Register Commands....956
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- Controlling the Positive Transition Part....959

11.11.1 General Status Register Commands

STATus:PRESet....956
STATus:QUEue[:NEXT]?....956

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

11.11.2 Reading Out the CONDition Part

For more information on the condition part see chapter 10.1.7.2, "Structure of a SCPI Status Register", on page 572.

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: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.

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

11.11.3 Reading Out the EVENt Part

For more information on the event part see chapter 10.1.7.2, "Structure of a SCPI Status Register", on page 572.

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: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.

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

11.11.4 Controlling the ENABle Part

For more information on the enable part see chapter 10.1.7.2, "Structure of a SCPI Status Register", on page 572.

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: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.

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.

11.11.5 Controlling the Negative Transition Part

For more information on the positive transition part see chapter 10.1.7.2, "Structure of a SCPI Status Register", on page 572.

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: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.

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.

11.11.6 Controlling the Positive Transition Part

For more information on the negative transition part see chapter 10.1.7.2, "Structure of a SCPI Status Register", on page 572.

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: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.

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.

11.12 Emulating Other Instruments' Commands

The R&S FSW analyzer family supports a subset of the GPIB commands of several HP and PSA instruments.

For details see chapter 10.2, "GPIB Languages", on page 587.

- Setting up Instrument Emulation....960
- Reference: GPIB Commands of Emulated HP Models....963
- Reference: Command Set of Emulated PSA Models....991

11.12.1 Setting up Instrument Emulation

The following commands are required to set up the use of commands to emulate other instruments.

SYSTem:HPCoupling....960
SYSTem:IFGain:MODE....960
SYSTem:LANGuage....961
SYST:PSA:WIDeband....961
SYSTem:REVision:FACTory....962
SYSTem:REVision[:STRing]....962
SYSTem:RSW....963

SYSTem:HPCoupling <CouplingType>

Controls the default coupling ratios in the HP emulation mode for:

- span and resolution bandwidth (Span/RBW) and
- resolution bandwidth and video bandwidth (RBW/VBW)

For FSP (=FSW), the standard parameter coupling of the instrument is used. As a result, in most cases a shorter sweep time is used than in case of HP.

This command is only available if a HP language is selected using `SYSTem:LANGuage` on page 961.

Parameters:

<CouplingType> HP | FSP

*RST: FSP

Example: `SYSTem:HPC HP`

Manual operation: See "Coupling" on page 596

SYSTem:IFGain:MODE <Mode>

Configures the internal IF gain settings in HP emulation mode due to the application needs. This setting is only taken into account for resolution bandwidth < 300 kHz and is only available if a HP language is selected using `SYSTem:LANGuage`.

Parameters:

<Mode> NORM | PULS

NORM
Optimized for high dynamic range, overload limit is close to reference level.

PULS
Optimized for pulsed signals, overload limit up to 10 dB above reference level.

*RST: NORM

Example: `SYST:IFG:MODE PULS`

Manual operation: See "IF Gain" on page 595

SYSTem:LANGuage <Language>

This command defines the system language.

For details see chapter 10.2, "GPIB Languages", on page 587.

Note: as of firmware version 1.60, this command is also used to emulate previous R&S signal and spectrum analyzers, making the `SYST:COMP` command obsolete.

Note: For PSA89600 emulation, the option is indicated as "B7J" for the `*OPT?` query ("B7J, 140" if Wideband is activated).

Parameters:

<Language> "SCPI" | "8560E" | "8561E" | "8562E" | "8563E" | "8564E" | "8565E" | "8566A" | "8566B" | "8568A" | "8568A_DC" | "8568B" | "8568B_DC" | "8591E" | "8594E" | "71100C" | "71200C" | "71209A" | "PSA89600" | "FSP" | "FSU" | "FSQ" | "FSV" | "FSEA" | "FSEB" | "FSEM" | "FSEK"

*RST: SCPI

Example: `SYST:LANG '8560E'`
Sets the system language to 8560E to simulate the HP model.

Usage: SCPI confirmed

Manual operation: See "Language" on page 595

SYST: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

Manual operation: See "Language" on page 595
See "Wideband" on page 596

SYSTem:REVision:FACTory

Resets the response to the REV? query to the default value, e.g. after a user string was defined using the `SYSTem:REVision[:STRing]` command. (REV? query available for HP emulation only, see `SYSTem:LANGuage` on page 961.)

Example: Define the system language:
```
SYST:LANG '8563E'
```
Set the response back to factory setting:
```
SYS:REV:FACT
```
Query the revision:
```
REV?
```
Response:
```
920528
```

Manual operation: See "Resetting the Factory Revision" on page 596

SYSTem:REVision[:STRing] <Name>

Sets the response to the `REV?` query to the defined string (HP emulation only, see `SYSTem:LANGuage` on page 961).

Parameters:

<Name>

Example: Define the system language:
`SYST:LANG '8563E'`
Query the revision:
`REV?`
Response:
`920528`
Set the response to 'NewRevision':
`SYST:REV:STR 'NewRevision'`
Query the response:
`SYST:REV:STR?`
Response:
`NewRevision`

Manual operation: See "Revision String" on page 596

SYSTem:RSW <State>

Controls a repeated sweep of the E1 and MKPK HI HP model commands (for details on the commands refer to chapter 11.12.2, "Reference: GPIB Commands of Emulated HP Models", on page 963). If the repeated sweep is OFF, the marker is set without sweeping before.

This command is only available if a HP language is selected using `SYSTem:LANGuage` on page 961

Parameters:
<State> ON | OFF
*RST: OFF

Example: `SYSTem:RSW ON`

Manual operation: See "Sweep Repeat" on page 595

11.12.2 Reference: GPIB Commands of Emulated HP Models

The R&S FSW analyzer family supports a subset of the GPIB commands of HP models 8560E, 8561E, 8562E, 8563E, 8564E, 8565E, 8566A, 8566B, 8568A, 8568B and 8594E.

Despite the differences in system architecture and device features, the supported commands have been implemented in a way to ensure a sufficiently high degree of correspondence with the original.

This includes the support of syntax rules for not only newer device families (B and E models) but for the previous A family as well.

In many cases the selection of commands supported by the R&S FSW is sufficient to run an existing GPIB program without adaptation.

After the introduction, this section includes the following topics:

- Command Set of Models 8560E, 8561E, 8562E, 8563E, 8564E, 8565E, 8566A/B, 8568A/B, 8591E, 8594E, 71100C, 71200C, and 71209A....964
- Special Features of the Syntax Parsing Algorithms for 8566A and 8568A Models 987
- Special Behavior of Commands....988
- Model-Dependent Default Settings....989
- Data Output Formats....990
- Trace Data Output Formats....990
- Trace Data Input Formats....991
- GPIB Status Reporting....991

11.12.2.1 Command Set of Models 8560E, 8561E, 8562E, 8563E, 8564E, 8565E, 8566A/B, 8568A/B, 8591E, 8594E, 71100C, 71200C, and 71209A

As with the original units, the R&S FSW includes the command set of the A models in the command set of the B models.

The HP model 8591E is compatible to HP model 8594E, the HP models 71100C, 71200C, and 71209A are compatible to HP models 8566A/B.

Command	Supported subset	Function	Corresp. HP-Models	Status
A1	A1	Clear/Write A	HP 8566A/ HP 8568A	available
A2	A2	Max Hold A	HP 8566A/ HP 8568A	available
A3	A3	View A	HP 8566A/ HP 8568A	available
A4	A4	Blank A	HP 8566A/ HP 8568A	available
ABORT [1)]	ABORT	Stop previous function	HP 856xE/ HP 8566B/HP 8568B/HP 8594E	available
ADD		Add	HP 8566B/ HP 8568B/ HP 8594E	available
ADJALL	ADJALL	Adjust all	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
ADJCRT 2)	ADJCRT	Adjust CRT	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
ADJIF 2)	ADJIF	Auto adjust IF	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
AMB	AMB ON|OFF AMB 1|0 AMB?	Trace A – B -> Trace A	HP 856xE/ HP 8594E	available
AMBPL	AMBPL ON|OFF AMBPL 1|0 AMBPL?		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
AMPCORDATA	AMPCORDATA <freq>,<amp>,.. AMPCORDATA?	Amplitude Correction Data	HP 856xE	available
AMPCOR	AMPCOR ON|OFF AMPCOR 1|0 AMPCOR?	Amplitude Correction	HP 856xE	available
AMPCORSIZE	AMPCORSIZE?	Amplitude Correction Data Array Size	HP 856xE	available
AMPCORRCL	AMPCORRCL <numeric value>	Amplitude Correction Recall	HP 856xE	available
AMPCORSAVE	AMPCORSAVE <numeric value>	Amplitude Correction Save	HP 856xE	available
ANNOT	ANNOT ON|OFF ANNOT 1|0 ANNOT?	Annotation	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
APB	APB	Trace A + B -> Trace A	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
AT	AT <numeric_value> DB | DM AT DN AT UP AT AUTO AT?	Attenuation	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
AUNITS	AUNITS DBM | DBMV | DBUV | AUNITS?	Amplitude Units	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
AUTOCPL	AUTOCPL	Coupling default	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
AXB	AXB	Exchange trace A and B	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
B1	B1	Clear/Write B	HP 8566A/ HP 8568A	available
B2	B2	Max Hold B	HP 8566A/ HP 8568A	available
B3	B3	View B	HP 8566A/ HP 8568A	available
B4	B4	Blank B	HP 8566A/ HP 8568A	available
BL	BL	Trace B – Display Line -> Trace B	HP 8566A/ HP 8568A	available
BML	BML	Trace B – Display Line -> Trace B	HP 856xE/ HP8594E	available
BTC	BTC	Transfer Trace B -> C	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
BXC	BXC	Exchange Trace B and C	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
BLANK	BLANK TRA|TRB|TRC	Blank Trace	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
C1	C1	A-B off	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresp. HP-Models	Status
C2	C2	A-B -> A	HP 8566A/ HP 8568A	available
CA	CA	Couple Attenuation	HP 8566A/ HP 8568A	available
CAL [1)]	CAL ALL CAL ON CAL OFF	Start analyzer self alignment	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
CF	CF <numeric_value> HZ|KHZ|MHZ|GHZ CF UP CF DN CF?	Center Frequency	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
CHANPWR	CHANPWR TRA|TRB, <numeric_value>,?	Channel Power Measurement	HP 856xE/ HP 8594E	available
CHPWRBW	CHPWRBW <numeric_value> HZ|KHZ|MHZ|GHZ	Channel Power Bandwidth	HP 856xE/ HP 8594E	available
CLRW	CLRW TRA|TRB|TRC	Clear/Write Trace	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
CLS [1)]	CLS	Clear all status bits	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
CONTS	CONTS		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
COUPLE	COUPLE AC|DC	Input coupling	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
CR	CR	Couple RBW	HP 8566A/ HP 8568A	available
CS	CS	Couple Step Size	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresp. HP-Models	Status
CT	CT	Couple SWT	HP 8566A/ HP 8568A	available
CTA		Convert to absolute units	HP 8566B/ HP 8568B/ HP 8594E	available
CV	CV	Couple VBW	HP 8566A/ HP 8568A	available
D1 [2)]	D1	Display Size normal	HP 8566A/ HP 8568A	available
DA [2)]	DA	Display address		available
DEMOD [1)]	DEMOD ON|OFF|AM|FM	AF Demodulator	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
DEMODAGC [2)]	DEMODAGC ON|OFF|1|0 DEMODAGC?	Demodulation AGC	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
DEMODT	DEMODT <numeric_value> S|MS|US|SC DEMODT UP|DN DEMODT?	Demodulation time	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
DET	DET POS|SMP|NEG DET?	Detector	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
DISPOSE [2)]	ONEOS | TRMATH | ONSWP | ALL | <numeric_value>			available
DIV		Divide	HP 8566B/ HP 8568B/ HP 8594E	available
DL	DL <numeric_value> DB|DM DL DN DL UP DL ON DL OFF DL?	Display Line	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
DLE	DLE ON|OFF	Display Line enable	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
DONE	DONE DONE?	Done query	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
DW [2)]	DW	Write to display and increment address		available
E1	E1	Peak Search	HP 8566A/ HP 8568A	available
E2	E2	Marker to Center Freq.	HP 8566A/ HP 8568A	available
E3	E3	Deltamarker Step Size	HP 8566A/ HP 8568A	available
E4	E4	Marker to Ref. Level	available	available
EDITDONE		limit line edit done	HP 856xE	available
EDITLIML		edit limit line	HP 856xE	available
ERR	ERR 250 cal level error ERR 300 LO unlock ERR 472 cal error digital filter ERR 473 cal error analog filter ERR 552 cal error log amp ERR 902 unscale tracking generator ERR 906 oven cold ERR 117 numeric unit error ERR 112 Unrecognized Command	Now some FSx errors are mapped to HP errors.	HP8568A HP856xE	not yet available
ERR?	ERR?	Error queue query	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	not yet available
EX	EX	Exchange trace A and B	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresp. HP-Models	Status
FA	FA <numeric_value> HZ|KHZ|MHZ|GHZ FA UP FA DN FA?	Start Frequency	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
FB	FB <numeric_value> HZ|KHZ|MHZ|GHZ FB UP FB DN FB?	Stop Frequency	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
FDSP		Frequency display off	8560E 8561E 8562E 8563E 8564E 8565E	available
FOFFSET [1)]	FOFFSET <numeric_value> HZ|KHZ|MHZ|GHZ FOFFSET?	Frequency Offset	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
FREF	FREF INT|EXT	Reference Frequency	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
FS	FS	Full Span	HP 8566A/ HP 8568A	available
FUNCDEF		Define Function Function must be in one line between delimiters @	HP 8594E/ HP 856xE/ HP 8566B	available
GATE [1)]	GATE ON|OFF GATE 1|0		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
GATECTL [1)]	GATECTL EDGE|LEVEL GATECTL?		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
GD [1)]	GD <numeric_value> US|MS|SC GD DN GD UP GD?		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
GL [1)]	GL <numeric_value> US|MS|SC GL DN GL UP GL?		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
GP [1)]	GP POS|NEG GP?		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
GRAT [2)]	GRAT ON|OFF	Graticule	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
I1	I1		HP 8566A/ HP 8568A	available
I2	I2		HP 8566A/ HP 8568A	available
ID	ID ID?	Identify	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
INZ [1)]	INZ 75 INZ 50 INZ?	Input Impedance	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
IP	IP	Instrument preset	HP 8566A/ HP 8568A	available
KEYDEF	KEYDEF	Key definition	HP 8566B/ HP 856xE/ HP 859xE	available
KEYEXEC	KEYEXEC	Key execute	HP 8566B	available

Command	Supported subset	Function	Corresp. HP-Models	Status
KS=	KS= <numeric_value> HZ|KHZ|MHZ|GHZ KS= DN KS= UP KS=?	Marker Frequency Counter Resolution	HP 8566A/ HP 8568A	available
KS/	KS/	Manual Peaking	HP 8566A/ HP 8568A	available
KS(	KS(	Lock register	HP 8566A/ HP 8568A	available
KS)	KS)	Unlock register	HP 8566A/ HP 8568A	available
KS91	KS91	Read Amplitude Error	HP 8566A/ HP 8568A	available
KSA	KSA	Amplitude Units in dBm	HP 8566A/ HP 8568A	available
KSB	KSB	Amplitude Units in dBmV	HP 8566A/ HP 8568A	available
KSC	KSC	Amplitude Units in dBuV	HP 8566A/ HP 8568A	available
KSD	KSD	Amplitude Units in V	HP 8566A/ HP 8568A	available
KSE	KSE <numeric_value>| <char data>@	Title mode	HP 8566A/ HP 8568A	available
KSG	KSG KSG ON KSG <numeric_value>	Video Averaging on	HP 8566A/ HP 8568A	available
KSH	KSH	Video Averaging Off	HP 8566A/ HP 8568A	available
KSK		Marker to Next Peak	HP 8566A/ HP 8568A	available
KSL		Marker Noise off	HP 8566A/ HP 8568A	available
KSM		Marker Noise on	HP 8566A/ HP 8568A	available
KSO	KSO	Deltamarker to span	HP 8566A/ HP 8568A	available
KSP	KSP <numeric_value>	HPIB address	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresp. HP-Models	Status
KSQ [2)]	KSQ	Band lock off	HP 8566A/ HP 8568A	available
KST	KST	Fast Preset	HP 8566A/ HP 8568A	available
KSV	KSV <numeric_value> HZ|KHZ|MHZ|GHZ KSV?	Frequency Offset	HP 8566A/ HP 8568A	available
KSW	KSW	Error Correction Routine	HP 8566A/ HP 8568A	available
KSX	KSX	Correction Values On	HP 8566A/ HP 8568A	available
KSY	KSY	Correction Values Off	HP 8566A/ HP 8568A	available
KSZ	KSZ <numeric_value> DB KSZ?	Reference Value Offset	HP 8566A/ HP 8568A	available
KSa	KSa	Normal Detection	HP 8566A/ HP 8568A	available
KSb	KSb	Pos Peak Detection	HP 8566A/ HP 8568A	available
KSd	KSd	Neg Peak Detection	HP 8566A/ HP 8568A	available
KSe	KSe	Sample Detection	HP 8566A/ HP 8568A	available
KSg		CRT beam off		available
KSh		CRT beam on		available
KSj	KSj	View Trace C	HP 8566A/ HP 8568A	available
KSk	KSk	Blank Trace C	HP 8566A/ HP 8568A	available
KSl	KSl	Transfer B to C	HP 8566A/ HP 8568A	available
KSm	KSm	Graticule off	HP 8566A/ HP 8568A	available
KSn[2)]	KSn	Grid on	HP 8566A/ HP 8568A	available
KSo	KSn	Character display off	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresp. HP-Models	Status
KSp	KSp	Character display on	HP 8566A/ HP 8568A	available
KSr	KSr	Create service request	HP 8566A/ HP 8568A	available
KSt [2)]	KSt	Band lock on	HP 8566A/ HP 8568A	available
KSv [2)]	KSv	Signal ident on	HP 8566A/ HP 8568A	available
L0	L0	Display line off	HP 8566A/ HP 8568A	available
LB	LB <numeric_value>| <char data>@	Label	HP 8566A/ HP 8568A	available
LF	LF	Low frequency band pre-set	HP 8566A/ HP 8568A	available
LIMD		limit line delta	HP 856xE	available
LIMF		limit line frequency	HP 856xE	available
LIMIFAIL		limit fail query	HP 856xE	available
LIMIPURGE		purge limit line	HP 856xE	available
LIMIRCL		recall limit line	HP 856xE	available
LIMIREL		relative limit line	HP 856xE	available
LIMISAV		save limit line	HP 856xE	available
LIMITEST		limit line test	HP 856xE	available
LIML		lower limit line value	HP 856xE	available
LIMM		middle limit line value	HP 856xE	available
LIMTFL		flat limit line segment	HP 856xE	available
LIMTSL		slope limit line segment	HP 856xE	available
LIMU		upper limit line value	HP 856xE	available
LG	LG <numeric_value> DB | DM LG?	Amplitude Scale Log	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
LL [2)]	LL	Plot command	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresp. HP-Models	Status
LN	LN	Amplitude Scale Lin	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
M1	M1	Marker Off	HP 8566A/ HP 8568A	available
M2	M2 M2 <numeric_value> HZ|KHZ|MHZ|GHZ M2 DN M2 UP M2?	Marker Normal	HP 8566A/ HP 8568A	available
M3	M3 M3 <numeric_value> HZ| KHZ|MHZ|GHZ M3 DN M3 UP M3?	Delta Marker	HP 8566A/ HP 8568A	available
M4	M4 <numeric_value> HZ|KHZ|MHZ|GHZ	Marker Zoom	HP 8566A/ HP 8568A	available
MA	MA	Marker Amplitude	HP 8566A/ HP 8568A	available
MC0	MC0	Marker Count off	HP 8566A/ HP 8568A	available
MC1	MC1	Marker Count on	HP 8566A/ HP 8568A	available
MDS	MDS	Measurement data size	HP 8566B	available
MEAS		Measurement status	HP 856xE	available
MF	MF MF?	Marker Frequency	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MINH[1)]	MINH TRC	Minimum Hold	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
MKA	MKA <numeric_value> MKA?	Marker Amplitude	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKACT	MKACT 1 MKACT?	Select the active marker	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	not available
MKBW [1)]	MKBW <numeric_value> MKBW ON MKBW OFF	N dB Down	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKD	MKD MKD <numeric_value> HZ|KHZ| MHZ|GHZ MKD DN MKD UP MKD ON MKD OFF MKD?	Delta Marker	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKDR	MKDR <numeric_value> HZ|KHZ| MHZ|GHZ| S|SC|MS|MSEC| USMKDR?	Delta Marker reverse	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKDR?		Delta Marker reverse query		available
MKF	MKF <numeric_value> HZ|KHZ|MHZ|GHZ MKF?	Set Marker Frequency	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKFC	MKFC ON|OFF	Frequency Counter on/ off	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
MKFCR [1)]	MKFCR <numeric_value> HZ|KHZ| MHZ|GHZ MKFCR DN MKFCR UP MKFCR?	Frequency Counter Resolution	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKMIN	MKMIN	Marker -> Min	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKN	MKN MKN <numeric_value> HZ|KHZ|MHZ|GHZ MKN DN MKN UP MKN ON MKN OFF MKN?	Normal Marker	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKNOISE	MKNOISE ON|OFF MKNOISE 1|0 MKNOISE?	Noise Measurement	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKOFF	MKOFF MKOFF ALL	Marker off	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKP	MKP <numeric_value> MKP?	Marker position	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKPK	MKPK MKPK HI MKPK NH MKPK NR MKPK NL	Marker Search	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKPT	MKPT MKPT HI MKPT NH MKPT NR MKPT NL	Marker Peak Threshold	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
MKPX	MKPX <numeric_value> DB MKPX DN MKPX UP MKPX?	Peak Excursion	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKRL	MKRL	Ref Level = Marker Level	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKSP	MKSP	Deltamarker to span	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKSS	MKSS	CF Stepsize = Marker Freq	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKT	MKT <numeric_value> S|MS|US|SC MKT?	MKF = fstart + MKT/ SWT*Span	HP 856xE/ HP 8594E	available
MKTRACE	MKTRACE TRA|TRB|TRC	Marker to Trace	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKTRACK	MKTRACK ON|OFF MKTRACK 1|0 MKTRACK?	Signal Track	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MKTYPE	MKTYPE AMP MK TYPE?	Marker type	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
ML		Mixer level	HP 856xE	available
MOV	MOV TRA|TRB|TRC, TRA|TRB|T RC	Move Trace Contents	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
MPY		Multiply	HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
MT0	MT0	Marker Track Off	HP 8566A/ HP 8568A	available
MT1	MT1	Marker Track On	HP 8566A/ HP 8568A	available
MXMH	MXMH TRA|TRB	Maximum Hold	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
NORMALIZE	NORMALIZE	Normalize trace	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	not available available
NRL [1)]	NRL <numeric_value> DB | DM NRL?	Normalized Reference Level	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
NRPOS	NRPOS <numeric_value> NRL?	Normalize position	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
O1	O1	Format ASCII, Values 0 to 4095	HP 8566A/ HP 8568A	available
O2	O2	Format Binary, Values 0 to 4095	HP 8566A/ HP 8568A	available
O3	O3	Format ASCII	HP 8566A/ HP 8568A	available
OA	OA	Output All	HP 8566A/ HP 8568A	available
OL	OL <80 characters> OL?	Output Learn String	HP 8566A/ HP 8568A	available
OT	OT	Output Trace Annota-tions	HP 8566A/ HP 8568A	available
PA	PA <numeric_value>, <numeric_value	Plot command	HP 8566A/ HP 8568A	available
PD	PD <numeric_value>, <numeric_value	Plot command	HP 8566A/ HP 8568A	available
PH_MKF		Spot frequency in Hz	HP 856xE	available
PH_FMIN		Min offset frequency to be measured	HP 856xE	available

Command	Supported subset	Function	Corresp. HP-Models	Status
PH_FMAX		Max offset frequency to be measured	HP 856xE	available
PH_MKA		Queries amplitude at the spot frequency	HP 856xE	available
PH_DRIFT		0: for stable signals, 1: for drifty	HP 856xE	available
PH_RLVL		Reference level for the log plot	HP 856xE	available
PH_SMTHV		Trace smoothing	HP 856xE	available
PH_VBR		Filtering	HP 856xE	available
PH_RMSPT		Amount of data points to skip when doing the integration	HP 856xE	available
PH_RMSFL		Lower integration frequency in Hz	HP 856xE	available
PH_RMSFU		Upper integration frequency in Hz	HP 856xE	available
PH_EXIT		Quits phase noise	HP 856xE	available
PH_F_UDT		Updates internal frequency variables	HP 856xE	available
PH_LMT_L		Apply limits to PH_FMIN and PH_FMAX	HP 856xE	available
PH_MEAS		Generates log frequency plot	HP 856xE	available
PH_MKF_D		Updates the spot frequency	HP 856xE	available
PH_RMS		Requests the rms phase noise	HP 856xE	available
PH_RMSFT		Updates internal frequency variables	HP 856xE	available
PH_RMSX		Calculates the rms phase noise	HP 856xE	available
PH_SPOTF		Executes the spot frequency measurement	HP 856xE	available
PLOTORG [2)]	PLOTORG DSP|GRT	Plot command	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
PLOTSRC [2)]	PLOTSRC ANNT|GRT| TRB| TRA|ALLDSP|GRT	Plot command	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
PP	PP	Preselector Peaking	HP 8566A/ HP 8568A	available
PRINT [1)]	PRINT PRINT 1|0	Hardcopy	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
PSDAC [2)]	PSDAC <numeric_value> PSDAC UP|DN	Preselector DAC value	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
PSTATE [2)]	PSTATE ON|OFF|1|0	Protect State	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
PU	PU	Pen Up	HP 8566A/ HP 8568A	available
PWRBW	PWRBW	Power Bandwidth	HP 8566B/ HP 859x/ HP 856xE	available
R1	R1	Set Status Bit Enable	HP 8566A/ HP 8568A	available
R2	R2	Set Status Bit Enable	HP 8566A/ HP 8568A	available
R3	R3	Set Status Bit Enable	HP 8566A/ HP 8568A	available
R4	R4	Set Status Bit Enable	HP 8566A/ HP 8568A	available
RB	RB <numeric_value> HZ| KHZ|MHZ|GHZ RB DN RB UP RB AUTO RB?	Resolution Bandwidth	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
RBR	RBR <numeric_value> RBR DN RBR UP RBR?	Resolution Bandwidth Ratio	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
RC1…6	RC1…6	Recall Last State	HP 8566A/ HP 8568A	available

Command	Supported subset	Function	Corresp. HP-Models	Status
RCLS	RCLS <numeric_value>	Recall State Register	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
RCLT	RCLT TRA|TRB, <number>	Recall Trace	HP856xE/ HP8594E	available
RESET	RESET	Instrument preset	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
REV	REV REV?	Firmware revision	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
RL	RL <numeric_value> DB|DM RL DN RL UP RL?	Reference Level	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
RLCAL	RLCAL <numeric_value> RL?	Reference Level Calibration	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
RCLOSCAL	RCLOSCAL	Recall Open/Short Average	HP 856xE/ HP 8594E	not available
RCLTHRU	RCLTHRU	Recall Thru	HP 856xE/ HP 8594E	not available
RLPOS [1)]	RLPOS <numeric_value> RLPOS DN RLPOS UP RLPOS?	Reference Level Position	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
ROFFSET	ROFFSET <numeric_value> DB | DM ROFFSET?	Reference Level Offset	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
RQS	RQS	Service Request Bit mask	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
S1	S1	Continuous Sweep	HP 8566A/ HP 8568A	available
S2	S2	Single Sweep	HP 8566A/ HP 8568A	available
SADD		add a limit line segment	HP 856xE	available
SAVES	SAVES <numeric_value>	Save State Register	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
SAVET	SAVET TRA|TRB,<number>	Save Trace	HP856xE/ HP8594E	available
SDEL		delete limit line segment	HP 856xE	available
SDON		limit line segment done	HP 856xE	available
SEDI		edit limit line segment	HP 856xE	available
SMOOTH	SMOOTH TRA|TRB| TRC, <number of points>	Smooth Trace	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
SNGLS	SNGLS	Single Sweep	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
SQUELCH [2]	SQUELCH <numeric_value> DM | DB SQUELCH UP|DN SQUELCH ON|OFF	Squelch	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
SP	SP <numeric_value> HZ|KHZ|MHZ|GHZ SP DN SP UP SP?	Span	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
SRCNORM [1]	SRCNORM ON|OFF SRCNORM 1|0	Source Normalization	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	not available

Command	Supported subset	Function	Corresp. HP-Models	Status
SRCPOFS [1)]	SRCPOFS <numeric_value> DB | DM SRCPOFS DN SRCPOFS UP SRCPOFS?	Source Power Offset	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	not available
SRCPWR [1)]	SRCPWR <numeric_value> DB | DM SRCPWR DN SRCPWR UP SRCPWR ON SRCPWR OFF SRCPWR?	Source Power	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	not available
SS	SS <numeric_value> HZ| KHZ|MHZ|GHZ SS DN SS UP SS AUTO SS?	CF Step Size	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
ST	ST <numeric_value> US| MS|SC ST DN ST UP ST AUTO ST?	Sweep Time	HP 8566A/ HP 8568A/ HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
STB	STB	Status byte query	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
STOREOPEN	STOREOPEN	Store Open	HP 856xE/ HP 8594E	not available
STORESHORT	STORESHORT	Store Short	HP 856xE/ HP 8594E	not available
STORETHRU	STORETHRU	Store Thru	HP 856xE/ HP 8594E	not available
SUB		Subtract	HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
SUM		sum of trace amplitudes	HP 8566B/ HP 8568B/ HP 8594E	available
SV1…6	SV1…6	Save State	HP 8566A/ HP 8568A	available
SWPCPL [2)]	SWPCPL SA | SR SWPCPL?	Sweep Couple	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
SWPOUT [2)]	SWPOUT FAV|FAVA|RAMP SWPOUT?	Sweep Output	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
T0	T0	Threshold off	HP 8566A/ HP 8568A	available
T1	T1	Free Run Trigger	HP 8566A/ HP 8568A	available
T2 [2)]	T2	Line Trigger	HP 8566A/ HP 8568A	available
T3	T3	External Trigger	HP 8566A/ HP 8568A	available
T4	T4	Video Trigger	HP 8566A/ HP 8568A	available
TA	TA	Transfer A	HP 8566A/ HP 8568A	available
TACL	TACL?	Returns instantaneous measurement results. See TRACe<trace #>:IMMediate:LEVel? for full description.		not available
TBCL	TBCL?			
TCCL	TCCL?			
TACR	TACR?	Returns instantaneous measurement results. See TRACe<trace #>:IMMediate:LEVel? for full description.		not available
TBCR	TBCR?			
TCCR	TCCR?			

Command	Supported subset	Function	Corresp. HP-Models	Status
TB	TB	Transfer B	HP 8566A/ HP 8568A	available
TDF	TDF P TDF M TDF B TDF A TDF I	Trace Data Format	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
TH	TH <numeric_value> DB| DM TH DN TH UP TH ON TH OFF TH AUTO TH?	Threshold	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
THE	THE ON| OFF	Threshold Line enable	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
TIMEDSP [1)]	TIMEDSP ON|OFF TIMEDSP 1|0 TIMEDSP?	Time Display	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
TM	TM FREE|VID|EXT| LINE[2)] TM?	Trigger Mode	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
TM LINE [2)]	TM LINE	Trigger Line	HP 8566B	available
TRA	TRA B TRA A TRA I	Transfer A	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
TRB	TRB B TRB A TRB I	Transfer B	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
TRSTAT	TRSTAT?	Trace State Query	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available

Command	Supported subset	Function	Corresp. HP-Models	Status
TS	TS	Take Sweep	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
UR 2)	UR	Plot Command	HP 8566A/ HP 8568A	available
VARDEF	VARDEF	Variable definition, arrays are not supported	HP 8566B/ HP 8568B/ HP 8594E	available
VAVG	VAVG VAVG TRA|TRB|TRC	Video Averaging	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
VB	VB <numeric_value> HZ|KHZ|MHZ|GHZ VB DN VB UP VB AUTO VB?	Video Bandwidth	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
VBR 1)	VBR <numeric_value> VBR DN VBR UP VBR?	Video Bandwidth Ratio	HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
VIEW	VIEW TRA|TRB|TRC		HP 856xE/ HP 8566B/ HP 8568B/ HP 8594E	available
VTL	VTL <numeric_value> DB|DM VTL DN VTL UP VTL?	Video Trigger Level	HP 856xE/ HP 8594E	not available
1) HP 8594E only				
2) Command is accepted without error message, but is ignored				

11.12.2.2 Special Features of the Syntax Parsing Algorithms for 8566A and 8568A Models

The command syntax is very different for models A and B. Different names are assigned to identical instrument functions, and the command structure likewise differs considerably between models A and models B.

The command structure for models A is as follows:

```
<command>::= <command
code>[<SPC>][<data>|<step>][<SPC>][<delimiter>][<command
code>]…<delimiter>

<data>::= <Value>[<SPC>][<units
code>][<SPC>][<delimiter>][<SPC>][<data>]…

<step>::= UP|DN
```

where

<command code> = see Table "Supported Commands"

<Value> = integer or floating-point numerical value

<units code> = DM | -DM | DB | HZ | KZ | MZ | GZ | MV | UV | SC | MS | US

<delimiter> = <CR> | <LF> | <,> | <;> | <ETX>

<SPC> = 32_{10}

<ETX> = 3_{10}

Command sections given in [ ] are optional.

The R&S FSW GPIB hardware differs from that used in the HP analyzers. Therefore, the following constraint exists:

<LF>| <EOI> are still used as delimiters since the GPIB hardware is able to identify them. The other delimiters are identified and evaluated during syntax analysis.

11.12.2.3 Special Behavior of Commands

Command	Known Differences
ABORT	Does not automatically set the command complete bit (bit 4) in the status byte. An additional DONE is required for that purpose.
ANNOT	Only frequency axis annotation is affected.
AT	AT DN/UP: Step size
CAL	The CAL commands do not automatically set the command complete bit (bit 4) in the status byte. An additional DONE command is required for that purpose.
CF	Default value, range, step size
CR	Default ratio Span/RBW
CT	Formula for coupled sweep time
CV	Default ratio RBW/VBW
DEMOD	requires option R&S FSW-B3
DET	DET? returns SAMP instead of SMP on the R&S FSW. DET not automatically set the command complete bit (bit 4) in the status byte. An additional DONE is required for that purpose.

Command	Known Differences
ERR?	Deletes the error bit in the status register but always returns a '0' in response.
FA	Default value, range, step size
FB	Default value, range, step size
ID	Query of instrument ID. The instrument ID defined in "SETUP > Network + Remote > GPIB > Identification String" is returned.
M2	Default value, range, step size
M3	Default value, range, step size
MKACT	Only marker 1 is supported as the active marker.
MKBW	Default value
MKPT	Step size
MKPX	Step size
OL?	Storage of instrument settings: 80 characters are returned as information on the instrument settings. The contents of the 80 characters returned does not correspond to the original data contents of the 8566A/8568A family.
OL	Readout of instrument settings: The 80 characters read by means of OL? are accepted as information on the corresponding instrument settings. The contents of the 80 characters read does not correspond to the original data contents of the 8566A/8568A family.
RB	Default value, range, step size
RL	Default value, step size
RLPOS	Adapts the position of the reference level even if the tracking generator normalization is not active.
RQS	Supported bits: 1 (Units key pressed) 2 (End of Sweep) 3 (Device error) 4 (Command complete) 5 (Illegal command)

11.12.2.4 Model-Dependent Default Settings

If the GPIB language is switched over to an 85xx model, the GPIB address is automatically switched over to 18 provided that the default address of the R&S FSW (20) is still set. If a different value is set, this value is maintained. Upon return to SCPI, this address remains unchanged.

The following table shows the default settings obtained after a change of the GPIB language and for the commands IP, KST and RESET:

Model	# of Trace Points	Start Freq.	Stop Freq.	Ref Level	Input Coupling
8566A/B	1001	2 GHz	22 GHz	0 dBm	AC
8568A/B	1001	0 Hz	1.5 GHz	0 dBm	AC
8560E	601	0 Hz	2.9 GHz	0 dBm	AC
8561E	601	0 Hz	6.5 GHz	0 dBm	AC
8562E	601	0 Hz	13.2 GHz	0 dBm	AC
8563E	601	0 Hz	26.5 GHz	0 dBm	AC
8564E	601	0 Hz	40 GHz	0 dBm	AC
8565E	601	0 Hz	50 GHz	0 dBm	AC
8594E	401	0 Hz	3 GHz	0 dBm	AC

Stop frequency

The stop frequency given in the table may be limited to the corresponding frequency range of the R&S FSW.

Command LF sets the stop frequency for 8566A/B to a maximum value of 2 GHz.

Test points (trace points)

The number of trace points is switched over only upon transition to the REMOTE state.

11.12.2.5 Data Output Formats

In the case of the SCPI and IEEE488.2 standards, the output formats for numerical data are flexible to a large extent. The output format for the HP units, by contrast, is accurately defined with respect to the number of digits. The memory areas for reading instrument data have therefore been adapted accordingly in the remote-control programs for instruments of this series.

Therefore, in response to a query, the R&S FSW returns data of the same structure as that used by the original instruments; this applies in particular to the number of characters returned.

Two formats are currently supported when trace data is output: Display Units (command O1) and physical values (command O2, O3 or TDF P). As to the "Display Units" format, the level data of the R&S FSW is converted to match the value range and the resolution of the 8566/8568 series. Upon transition to the **REMOTE** state, the R&S FSW is reconfigured such that the number of test points (trace points) corresponds to that of the 85xx families (1001 for 8566A/B and 8568A/B, 601 for 8560E to 8565E, 401 for 8594E).

11.12.2.6 Trace Data Output Formats

All formats are supported for trace data output: display units (command O1), display units in two byte binary data (command O2 or TDF B and MDS W), display units in one byte binary data (command O4 or TDF B and MDS B) and physical values (commands O3 or

TDF P). With format "display units" the level data is converted into value range and resolution of the 8566/8568 models. On transition to REMOTE state the number of trace points are reconfigured in order to be conform to the selected instrument model (1001 for 8566A/B and 8568 A/B, 601 for 8560E to 8565E, 401 for 8594E).

11.12.2.7 Trace Data Input Formats

Trace data input is only supported for binary date (TDF B, TDF A, TDF I, MDS W, MDS B).

11.12.2.8 GPIB Status Reporting

The assignment of status bits by commands R1, R2, R3, R4, RQS is supported.

The STB command and the serial poll respond with an 8-bit value with the following assignment:

Bit enabled by RQS	Description
0	not used (value 0)
1	Units key pressed
2	End of Sweep
3	Device Error
4	Command Complete
5	Illegal Command
6	Service Request
7	not used (value 0)

Bits 0 and 7 are not used and always have the value 0.

Please note that the R&S FSW reports any key pressed on the front panel rather than only the unit keys if bit 1 was enabled.

Another difference is the behavior of bit 6 when using the STB? query. On the HP analyzers this bit monitors the state of the SRQ line on the bus. On the R&S FSW this is not possible. Therefore this bit is set, as soon as one of the bits 1 to 5 is set. It won't be reset by performing a serial poll.

11.12.3 Reference: Command Set of Emulated PSA Models

The R&S FSW analyzer family supports a subset of the GPIB commands of PSA89600 instruments.

Despite the differences in system architecture and device features, the supported commands have been implemented in a way to ensure a sufficiently high degree of correspondence with the original.

In many cases the selection of commands supported by the R&S FSW is sufficient to run an existing GPIB program without adaptation.

Supported 89600 commands
*CAL?
*CLS
*ESE
*ESR?
*IDN?
*IST?
*OPC
*OPT?
*PCB
*PRE
*PSC
*RST
*SRE
*STB?
*TRG
*TST?
*WAI
:CALibration:AUTO OFF|ON|ALERt
:CALibration:TCORrections AUTO|ON|OFF
:CONFigure:WAVeform
:DIAGnostic:EABY ON|OFF
:DIAGnostic:LATCh:VALue <numeric>
:DIAGnostic:LATCh:SELect <string>
:DISPlay:ANNotation:TITLe:DATA <string>
:DISPlay:ENABle OFF|ON
:DISPlay:WINDow:TRACe:Y:[SCALe]:PDIVision <numeric>
:DISPlay:WINDow:TRACe:Y:[SCALe]:RLEVel <numeric>
:DISPlay:WINDow:TRACe:Y:[SCALe]:RLEVel:OFFSet <numeric>
:FORMat:BORDer NORMal|SWAPped
:FORMat[:DATA] ASCii|REAL|UINT|MATLAB,<numeric>
:INITiate:CONTinuous OFF|ON

Supported 89600 commands
:INITiate[:IMMediate]
:INSTrument:CATalog?
:INSTrument:NSELect <numeric>
:MMEMory:CATalog? <dir_name>
:MMEMory:COPY <‘file_name1’>,<‘file_name2’>
:MMEMory:DATA <‘file_name’>,<definite_length_block>
:MMEMory:DELete <‘file_name’>
:MMEMory:LOAD:STATe 1,<‘file_name’>
:MMEMory:LOAD:TRACe 1,<‘file_name’>
:MMEMory:MDIRectory <‘dir_name’>
:MMEMory:MOVE <‘file_name1’>,<‘file_name2’>
:MMEMory:STORe:STATe 1,<‘file_name’>
:MMEMory:STORe:TRACe <numeric>,<‘file_name’>
:READ:WAVform?
[:SENSe]:FREQuency:CENTer <numeric>
[:SENSe]:FREQuency:STARt <numeric>
[:SENSe]:FREQuency:STOP <numeric>
[:SENSe]:FREQuency:SPAN <numeric>
[:SENSe]:POWer:ATTenuation <numeric>
[:SENSe]:ROSCillator:EXTernal:FREQuency <numeric>
[:SENSe]:ROSCillator:OUTPut OFF|ON
[:SENSe]:ROSCillator:SOURce INTernal|EXTernal|EAUTo
[:SENSe]:SPECtrum:TRIGger:SOURce EXTernal<1|2>|IF|IMMediate
[:SENSe]:WAVeform:ADC:RANGe P6
[:SENSe]:WAVeform:APER?
[:SENSe]:WAVeform:AVERage:TACount <numeric>
[:SENSe]:WAVeform:BWIDth:ACTive?
[:SENSe]:WAVeform:BWIDth:TYPE FLAT|GAUSsian
[:SENSe]:WAVeform:IFGain <numeric>
[:SENSe]:WAVeform:IFPath NARRow|WIDE
[:SENSe]:WAVeform:NCPTrace ON|OFF
[:SENSe]:WAVeform:PDIT ON|OFF
[:SENSe]:WAVeform:SRATe <numeric>

Supported 89600 commands
[:SENSe]:WAVeform:SWEep:TIME <numeric>
[:SENSe]:WAVeform:TRIGger:EOFFset?
[:SENSe]:WAVeform:TRIGger:INTerpolation ON|OFF
[:SENSe]:WAVeform:TRIGger:SOURce EXTernal<1|2>|IF|IMMediate
:STATus:QUEStionable:CONDition?
:STATus:QUEStionable:ENABle <number>
:STATus:QUEStionable:NTRansition <number>
:STATus:QUEStionable:PTRansition <number>
:STATus:QUEStionable[:EVENt]?
:STATus:QUEStionable:CALibration:CONDition?
:STATus:QUEStionable:CALibration:ENABle <number>
:STATus:QUEStionable:CALibration:NTRansition <number>
:STATus:QUEStionable:CALibration:PTRansition <number>
:STATus:QUEStionable:CALibration[:EVENt]?
:STATus:QUEStionable:FREQuency:CONDition?
:STATus:QUEStionable:FREQuency:ENABle <number>
:STATus:QUEStionable:FREQuency:NTRansition <number>
:STATus:QUEStionable:FREQuency:PTRansition <number>
:STATus:QUEStionable:FREQuency[:EVENt]?
:STATus:QUEStionable:INTegrity:CONDition?
:STATus:QUEStionable:INTegrity:ENABle <number>
:STATus:QUEStionable:INTegrity:NTRansition <number>
:STATus:QUEStionable:INTegrity:PTRansition <number>
:STATus:QUEStionable:INTegrity[:EVENt]?
:STATus:OPERation:CONDition?
:STATus:OPERation:ENABle <integer>
:STATus:OPERation:NTRansition <integer>
:STATus:OPERation:PTRansition <integer>
:STATus:OPERation[:EVENt]?
:SYSTem:COMMunicate:GPIB[:SELF]:ADDRess <integer>
:SYSTem:DATE <year>,<month>,<day>
:SYSTem:ERRor[:NEXT]?
:SYSTem:KLOCK?

Supported 89600 commands
:SYSTem:MESSage <string>
:SYSTem:PRESet
:SYSTem:TIME <hour>,<minute>,<second>
:SYSTem:VERSion?
:TRACe:COPY <src_trace>,<dest_trace>
:TRACe[:DATA] TRACE1 | TRACE2 | TRACE3 | TRACE4 | TRACE5 | TRACE6, <definite_length_block> | <comma_separated_ASCII_data>
:TRACe:MODE WRITe|MAXHold|MINHold|VIEW|BLANk
:TRIGger[:SEQuence]:DELay <numeric>
:TRIGger[:SEQuence]:DELay:STATe OFF|ON|0|1
:TRIGger[:SEQuence]:EXTermal:DELay <numeric>
:TRIGger[:SEQuence]:EXTermal:LEVel <numeric>
:TRIGger[:SEQuence]:EXTermal:SLOPe POSitive|NEGative
:TRIGger[:SEQuence]:HOLDoff <numeric>
:TRIGger[:SEQuence]:IF:DELay <numeric>
:TRIGger[:SEQuence]:IF:LEVel <numeric>
:TRIGger[:SEQuence]:IF:SLOPe POSitive|NEGative
:TRIGger[:SEQuence]:SLOPe POSitive|NEGative
:TRIGger[:SEQuence]:SOURce IMMediate|VIDeo|EXTernal<1|2>
:TRIGger[:SEQuence]:VIDeo:LEVel <numeric>
:TRIGger[:SEQuence]:VIDeo:LEVel:FREQuency <freq>

11.13 Commands for Compatibility

The following commands are provided for compatibility to other signal analyzers only. For new remote control programs use the specified alternative commands.

CALCulate:LIMit<k>:TRACe....995
DISPlay[:WINDow<n>]:STATe....996
DISPlay[:WINDow<n>]:TYPE....996
SOURce:EXTernal:FREQuency:SWEep[:STATe]....997
SYSTem:COMPatible....997
TRIGger[:SEQuence]:BBPower:HOLDoff....997
TRIGger[:SEQuence]:RFPower:HOLDoff....997

CALCulate:LIMit<k>:TRACe <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 explicitely. The trace to be checked can be defined directly (as a suffix) in the new command to activate the limit check (see `CALCulate:LIMit<k>:TRACe<t>:CHECk` on page 904).

Parameters:

<TraceNumber> 1 to 6

*RST: 1

Example: `CALC:LIM2:TRAC 3`
Assigns limit line 2 to trace 3.

DISPlay[:WINDow<n>]:STATe <State>

This command changes the display state of the selected measurement window.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs

(See chapter 11.6.2, "Working with Windows in the Display", on page 755).

Parameters:

<State> ON | OFF

OFF
The window is closed.

*RST: OFF

Usage: SCPI confirmed

DISPlay[:WINDow<n>]:TYPE <WindowType>

This command selects the results displayed in a measurement window.

Note that this command is maintained for compatibility reasons only. Use the `LAYout` commands for new remote control programs (see chapter 11.6.2, "Working with Windows in the Display", on page 755).

Parameters:

<WindowType>

DIAGram
Selects a diagram.

MTABle
Selects a marker table

PEAKlist
Selects a peak list

RSUMmary
Selects a result summary.

SGRam
Selects a spectrogram.

SOURce:EXTernal:FREQuency:SWEep[:STATe] <State>

Note that this command is maintained for compatibility reasons only. It is not required in new remote control programs.

This command activates or deactivates the frequency sweep for the selected generator.

Parameters:

<State> ON | OFF

*RST: OFF

Example: `SOUR:EXT:FREQ:SWE ON`

Activates the frequency sweep for the external generator.

SYSTem:COMPatible <Mode>

This command enables compatibility to other spectrum and signal analyzers by R&S.

Compatibility is necessary, for example, regarding the number of sweep points.

Note that this command is maintained for compatibility reasons only. Use the `SYST:LANG` command for new remote control programs (see `SYSTem:LANGuage` on page 961).

Parameters:

<Mode> DEFault | FSU | FSP | FSQ | FSV

Example: `SYST:COMP FSP`

TRIGger[:SEQuence]:BBPower:HOLDoff <Period>

This command defines the holding time before the baseband power trigger event.

The command requires the **Digital Baseband Interface (R&S FSW-B17)** or the **Analog Baseband Interface (R&S FSW-B71)**.

Note that this command is maintained for compatibility reasons only. Use the `TRIGger[:SEQuence]:IFPower:HOLDoff` on page 782 command for new remote control programs.

Parameters:

<Period> Range: 150 ns to 1000 s

*RST: 150 ns

Example: `TRIG:SOUR BBP`

Sets the baseband power trigger source.

`TRIG:BBP:HOLD 200 ns`

Sets the holding time to 200 ns.

TRIGger[:SEQuence]:RFPower:HOLDoff <Time>

This command defines the holding time before the next trigger event. Note that this command is available for any trigger source, not just RF Power.

Note that this command is maintained for compatibility reasons only. Use the TRIGger[:SEQuence]:IFPower:HOLDoff on page 782 command for new remote control programs.

Parameters:
<Time> Default unit: S

11.14 Programming Examples

Some advanced programming examples for complex measurement tasks are provided here.

- Service Request.....998

11.14.1 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.

11.14.1.1 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
        'FSW is alias, instead of use resource string.
                'For example on TCP use TCPIP0::192.168.1.2::inst0::INSTR
        mbSession = CType(ResourceManager.GetLocalManager().Open("FSW"), _
                                    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
```

11.14.1.2 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
```

11.14.1.3 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>)`.

11.14.1.4 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.

11.14.1.5 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
```

11.14.1.6 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
```

11.14.1.7 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
```

11.14.1.8 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
```

12 Maintenance

The R&S FSW does not require regular maintenance. Maintenance is essentially restricted to cleaning the R&S FSW. It is however advisable to check the nominal data from time to time.

NOTICE

Instrument damage caused by cleaning agents

Cleaning agents contain substances that may damage the instrument, for example cleaning agents that contain a solvent may damage the front panel labeling, plastic parts, or the display.

Never use cleaning agents such as solvents (thinners, acetone, etc), acids, bases, or other substances.

The outside of the instrument can be cleaned sufficiently using a soft, lint-free dust cloth.

The storage temperature range for the R&S FSW is specified in thr data sheet. The instrument must be protected against dust if it is to be stored for a long period.

When transporting or shipping the instrument, it is advisable to use the original packing material (especially the two protective covers for the front and rear panel).

13 Troubleshooting

If problems arise during measurement, try the following methods to solve them.

Uncompleted 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 (GPIB, LAN or other interface) to the R&S FSW 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

1. Send a "Device Clear" command from the control instrument to the R&S FSW to clear all currently active remote channels. Depending on the used interface and protocol, send the following commands:
   - **Visa**: `viClear()`
   - **GPIB**: `ibclr()`
   - **RSIB**: `RSDLLibclr()`

   The remote channel currently processing the uncompleted command is then ready to receive further commands again.
2. On the remote channel performing the measurement, send the SCPI command `ABORt` to abort the current measurement and reset the trigger system.

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.

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- Error Messages in Remote Control Mode....1010
- Obtaining Technical Support....1011

13.1 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 13-1: Status bar information - color coding

Color	Type	Description
red	Fatal	A serious error occurred in the application; regular operation is no longer possible.
red	Error	An error occurred during a measurement, e.g. due to missing data or wrong settings, so that the measurement cannot be 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.
gray	Message	An event or state has occurred that may lead to an error during further operation.
green	No errors	No messages displayed.

If any error information is available for a measurement channel, the ! icon is displayed next to the channel 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.

Furthermore, a status bit is set in the `STATus:QUEStionable:EXTended:INFO` register for the application concerned (see "STATus:QUEStionable:EXTended:INFO Register" on page 579). Messages of a specific type can be queried using the `SYST:ERR:EXT?` command, see `SYSTem:ERRor:EXTended?` on page 952.

The following keywords are used:

DATA ERR	For Digital Baseband Interface (R&S FSW-B17) only: Error in digital I/Q input data For details on the Digital Baseband Interface (R&S FSW-B17) see the R&S FSW I/Q Analyzer User Manual.
FIFO OVLD	For Digital Baseband Interface (R&S FSW-B17) only: Input sample rate from connected instrument is too high For details on the Digital Baseband Interface (R&S FSW-B17) see the R&S FSW I/Q Analyzer User Manual.
IF OVLD	Overload of the IF signal path after the input mixer. • Increase the reference level.
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. In order to re-enable measurement, decrease the level at the RF input connector and reconnect the RF input to the mixer input.
LOUNL	Error in the instrument's frequency processing hardware was detected.
NO REF	Instrument was set to an external reference but no signal was detected on the reference input.
OVEN	OCXO reference frequency (option R&S FSW-B4) has not yet reached its operating temperature. The message usually disappears a few minutes after power has beeen switched on.

OVLD	Overload of the input signal path after the input mixer (only when RF INPUT path is NOT used, e.g. for input from the Digital Baseband Interface (R&S FSW-B17) or the Analog Baseband Interface (R&S FSW-B71)). ● Reduce the input level.
PLL UNLOCK	For Digital Baseband Interface (R&S FSW-B17) only: Error in digital I/Q input data For details on the Digital Baseband Interface (R&S FSW-B17) see the R&S FSW I/Q Analyzer User Manual.
RF OVLD	Overload of the input mixer. ● Increase the RF attenuation (for RF input). ● Reduce the input level (for digital input)
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 (For details refer to chapter 3.1.1.6, "Performing a Self Alignment and a Self Test", on page 23).
WRONG_FW	The firmware version is out-of-date and does not support the currently installed hardware. Until the firmware version is updated, this error message is displayed and self-alignment fails. (For details refer to chapter 9.3.4.4, "Firmware Updates", on page 526).

13.2 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 FSW 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 13-2: 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 external 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.

Table 13-3: Power Sensor errors

Status bar message	Description
Zeroing could not be performed	Zeroing could not be performed because the RF power applied is too high.
Power sensor zero failed	

13.3 Obtaining Technical Support

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

Error messages are described in chapter 13, "Troubleshooting", on page 1008.

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

- **System Configuration:** The "System Configuration" dialog box (in the "Setup" menu) provides information on:
  - **Hardware Info:** hardware assemblies

  - **Versions and Options:** the status of all software and hardware options installed on your instrument
  - **System Messages:** messages on any errors that may have occurred

  An .xml file with information on the system configuration ("device footprint") can be created automatically.
- **Error Log:** The `RSError.log` file (in the log directory of the main installation directory) contains a chronological record of errors.
- **Support file:** a *.zip file with important support information can be created automatically. The *.zip file contains the system configuration information ("device footprint"), the current eeprom data and a screenshot of the screen display.

See also chapter 9.3.5, "Service Functions", on page 528.

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:\R_S\instr\user\service.zip`.

   Attach the support file to an e-mail in which you describe the problem and send it to the customer support address for your region as listed at the beginning of the R&S FSW Getting Started manual.

Packing and transporting the instrument

If the instrument needs to be transported or shipped, e.g. due to damage during delivery, observe the notes described in chapter 3.1.1.1, "Unpacking and Checking the Instrument", on page 19.

List of remote commands (base unit)

*CAL?....619
*CLS....619
*ESE....619
*ESR?....619
*IDN?....620
*IST?....620
*OPC....620
*OPT?....620
*PCB....621
*PRE....621
*PSC....621
*RST....621
*SRE....622
*STB?....622
*TRG....622
*TST?....622
*WAI....622
ABORt....633
CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:DETector....737
CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:LIMit<k>:CONDition ?....741
CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:LIMit<k>:DELTa?....742
CALCulate:DELTamarker<m>:FUNCtion:FMEasurement:RESult?....741
CALCulate:DELTamarker<m>:SGRam:FRAMe....876
CALCulate:DELTamarker<m>:SGRam:SARea....876
CALCulate:DELTamarker<m>:SGRam:XY:MAXimum[:PEAK]....876
CALCulate:DELTamarker<m>:SGRam:XY:MINimum[:PEAK]....876
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum:ABOVe....877
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum:BELow....877
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum:NEXT....877
CALCulate:DELTamarker<m>:SGRam:Y:MAXimum[:PEAK]....877
CALCulate:DELTamarker<m>:SGRam:Y:MINimum:ABOVe....878
CALCulate:DELTamarker<m>:SGRam:Y:MINimum:BELow....878
CALCulate:DELTamarker<m>:SGRam:Y:MINimum:NEXT....878
CALCulate:DELTamarker<m>:SGRam:Y:MINimum[:PEAK]....878
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CALCulate:LIMit:ACPower:ACHannel:ABSolute:STATe....652
CALCulate:LIMit:ACPower:ACHannel:RESult?....652
CALCulate:LIMit:ACPower:ACHannel[:RELative]....652
CALCulate:LIMit:ACPower:ACHannel[:RELative]:STATe....653
CALCulate:LIMit:ACPower:ALTernate<ch>:ABSolute....653
CALCulate:LIMit:ACPower:ALTernate<ch>:ABSolute:STATe....653
CALCulate:LIMit:ACPower:ALTernate<ch>:RESult?....654
CALCulate:LIMit:ACPower:ALTernate<ch>[:RELative]....654
CALCulate:LIMit:ACPower:ALTernate<ch>[:RELative]:STATe....654
CALCulate:LIMit:ACPower:GAP<gap>:ABSolute....657

CALCulate:LIMit:ACPower:GAP<gap>:ABSolute:STATe....657
CALCulate:LIMit:ACPower:GAP<gap>:RESult?....658
CALCulate:LIMit:ACPower:GAP<gap>[:RELative:]STATe....658
CALCulate:LIMit:ACPower:GAP<gap>[:RELative]....658
CALCulate:LIMit:ACPower[:STATe]....655
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CALCulate:LIMit:CLEar[:IMMediate]....904
CALCulate:LIMit:COMMent....896
CALCulate:LIMit:ESPectrum:LIMits....689
CALCulate:LIMit:ESPectrum:MODE....690
CALCulate:LIMit:ESPectrum:PCLass:COUNt....691
CALCulate:LIMit:ESPectrum:PCLass<class>:LIMit[:STATe]....691
CALCulate:LIMit:ESPectrum:PCLass<class>:MAXimum....692
CALCulate:LIMit:ESPectrum:PCLass<class>:MINimum....692
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CALCulate:LIMit<k>:LOWer:MARGin....898
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CALCulate:LIMit<k>:LOWer:OFFSet....898
CALCulate:LIMit<k>:LOWer:SHIFt....899
CALCulate:LIMit<k>:LOWer:SPACing....899
CALCulate:LIMit<k>:LOWer:STATe....899
CALCulate:LIMit<k>:LOWer:THReshold....899
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CALCulate:LIMit<k>:NAME....900
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CALCulate:LIMit<k>:UPPer:MODE....901
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CALCulate:LIMit<k>:UPPer:SHIFt....901
CALCulate:LIMit<k>:UPPer:SPACing....902
CALCulate:LIMit<k>:UPPer:STATe....902
CALCulate:LIMit<k>:UPPer:THReshold....902
CALCulate:LIMit<k>:UPPer[:DATA]....900
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CALCulate:MARKer:FUNCtion:FMEasurement:PSEarch|PEAKsearch:AUTO....739
CALCulate:MARKer:FUNCtion:FMEasurement:STATe....737
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CALCulate:MARKer<m>:FUNCtion:FMEasurement:DETector....738
CALCulate:MARKer<m>:FUNCtion:FMEasurement:LIMit<k>:CONDition ?....742
CALCulate:MARKer<m>:FUNCtion:FMEasurement:LIMit<k>:DELTa?....742
CALCulate:MARKer<m>:FUNCtion:FMEasurement:RESult?....741
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CALCulate:MARKer<m>:SGRam:Y:MINimum:BELow....874
CALCulate:MARKer<m>:SGRam:Y:MINimum:NEXT....874
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CALCulate<n>:DELTamarker<m>:MAXimum:RIGHt....868
CALCulate<n>:DELTamarker<m>:MAXimum[:PEAK]....868
CALCulate<n>:DELTamarker<m>:MINimum:LEFT....868
CALCulate<n>:DELTamarker<m>:MINimum:NEXT....868
CALCulate<n>:DELTamarker<m>:MINimum:RIGHt....869
CALCulate<n>:DELTamarker<m>:MINimum[:PEAK]....869
CALCulate<n>:DELTamarker<m>:MREF....857
CALCulate<n>:DELTamarker<m>:TRACe....858
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CALCulate<n>:DELTamarker<m>:Y?....870
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