

# LibreVNA SCPI Programming Guide

March 13, 2025

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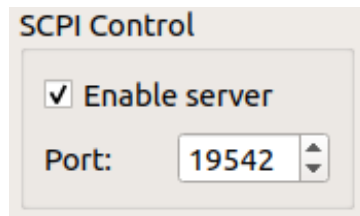
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## 1 Introduction

The LibreVNA-GUI contains a TCP server that can be used to control the LibreVNA with SCPI commands.

## 2 SCPI Server Configuration

The server is configurable in the preferences: Window Preferences General



If enabled, it will accept any TCP connection at the configured port. Once the connection is established, it can be used to send SCPI commands and receive replies. Only one connection at a time is possible, if a second connection is created, the first one will be closed by the LibreVNA-GUI. Alternatively, a port can be manually configured by setting the “port” argument:

```
./LibreVNA-GUI --port 1234
```

This enables the SCPI server at the specified port, regardless of what is configured in the preferences (useful for starting multiple instances at different ports at the same time). If no graphical user interface is required, the LibreVNA-GUI can be hidden:

```
./LibreVNA-GUI --port 1234 --no-gui
```

## 3 General Syntax

The syntax follows the usual SCPI rules:

- All commands are case insensitive (implicitly converted to uppercase before evaluated)
- The command tree is organized in branches, separated by a colon:

```
VNA:TRACE:LIST?
```

- Multiple commands can be concatenated in one line using a semicolon:

```
DEVIce:CONNECT;;DEVIce:INFo:FWRRevision?
```

- If a subsequent command starts with a colon it is evaluated from the root branch, otherwise the last used branch is assumed:

```
VNA:FREQuency:START 1000000;STOP 2000000 #No colon, VNA:FREQuency  
branch was used before
```

- Branches and commands can be abbreviated by using only the uppercase part of their name, the following commands are identical:

```
DEVIce:INFo:LIMits:MINFrequency?  
DEV:INF:LIM:MINF?
```

- Every query generates a response, terminated with a newline character (exceptions exist for a few queries which return more than one line)

- Some commands require additional arguments that have to be passed after the command (separated by spaces):

```
DEV:REF:OUT 10
```

- Two types of commands are available:
  - **Events** change a setting or trigger an action. They have no response
  - **Queries** request information. They end with a question mark.
 Some commands are both events and queries, depending on whether the question mark is present:

```
VNA:FREQ:SPAN 50000000 # Set the span
VNA:FREQ:SPAN? # Read the current span
```

## 4 Commands

### 4.1 General Commands

#### 4.1.1 \*IDN

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the identifications string                |
| <b>Syntax:</b>       | *IDN?   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | LibreVNA,LibreVNA-GUI,<serial>,<software version> |

- The serial number is the serial number from the connected LibreVNA. If none is connected, it will be set to “Not connected”
- The software version is the version of the LibreVNA-GUI, not the firmware version of the connected LibreVNA

#### 4.1.2 \*RST

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Resets the GUI (and any connected device) to the default state |
| <b>Syntax:</b>     | *RST   |
| <b>Parameters:</b> | None   |

#### 4.1.3 \*CLS

Event:

|                    |                                  |
|--------------------|----------------------------------|
| <b>Effect:</b>     | Clears the event status register |
| <b>Syntax:</b>     | *CLI                             |
| <b>Parameters:</b> | None                             |

#### 4.1.4 \*ESE

Event:

|                |   |
|----------------|---|
| <b>Effect:</b> | Configures the event status enable register |
| <b>Syntax:</b> | *ESE  |

|                    |                        |
|--------------------|------------------------|
| <b>Parameters:</b> | <enabled_bits_decimal> |
|--------------------|------------------------|

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the event status enable register |
| <b>Syntax:</b>       | *ESE?                                    |
| <b>Parameters:</b>   | None                                     |
| <b>Return value:</b> | <enabled_bits_decimal>                   |

#### 4.1.5 \*ESR

Query:

|                      |                                   |
|----------------------|-----------------------------------|
| <b>Effect:</b>       | Returns the event status register |
| <b>Syntax:</b>       | *ESR?                             |
| <b>Parameters:</b>   | None                              |
| <b>Return value:</b> | <set_bits_decimal>                |

The bits are used according to IEEE 488:

| Bitvalue | Name | Meaning                           |
|----------|------|-----------------------------------|
| 1        | OPC  | Operation complete                |
| 2        | RQC  | Request control (not used)        |
| 4        | QYE  | Query error (not used)            |
| 8        | DDE  | Device dependent error (not used) |
| 16       | EXE  | Execution error (not used)        |
| 32       | CME  | Command error                     |
| 64       | URQ  | User request (not used)           |
| 128      | PON  | Power on (not used)               |

#### 4.1.6 \*OPC

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the OPC bit in the event status register after all operations are complete |
| <b>Syntax:</b>     | *OPC  |
| <b>Parameters:</b> | None  |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns a 1 after every active operation has completed |
| <b>Syntax:</b>       | *OPC?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | 1  |

#### 4.1.7 \*WAI

Event:

|                |   |
|----------------|---|
| <b>Effect:</b> | Blocks further command parsing until all active operations are complete |
| <b>Syntax:</b> | *WAI  |

|                    |      |
|--------------------|------|
| <b>Parameters:</b> | None |
|--------------------|------|

#### 4.1.8 \*LST

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Lists all available commands           |
| <b>Syntax:</b>       | *LST?                                  |
| <b>Parameters:</b>   | None                                   |
| <b>Return value:</b> | List of commands, separated by newline |

## 4.2 Device Commands

This section contains general device commands, available regardless of the current mode.

#### 4.2.1 DEVICE:DISConnect

Event:

|                    |                             |
|--------------------|-----------------------------|
| <b>Effect:</b>     | Disconnects from the device |
| <b>Syntax:</b>     | DEVICE:DISConnect           |
| <b>Parameters:</b> | None                        |

#### 4.2.2 DEVICE:CONNeCT

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Connects to a device. If no serialnumber is specified, the connection is made with the first device found |
| <b>Syntax:</b>     | DEVICE:CONNeCT [<serialnumber>]   |
| <b>Parameters:</b> | <serialnumber> Serialnumber of the device that should be connected  |

Example

```
:DEV:CONN 206039903350
```

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the serial number of the connected device |
| <b>Syntax:</b>       | DEVICE:CONNeCT?                                   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <serialnumber> or "Not connected"                 |

Example

```
:DEV:CONN?  
206039903350
```



#### 4.2.3 DEVice:LIST

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Lists all available devices by their serial numbers |
| <b>Syntax:</b>       | DEVice:LIST?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | List of serialnumbers                               |

Example

```
:DEV:LIST?  
206039903350,208939A23350
```

#### 4.2.4 DEVice:PREferences

This command provides read/write access to the preferences. The recommended way is usually to change the preferences manually in the GUI. But if for some reason that is not an option, this is also possible through the SCPI server. There is no complete documentation for all available preferences, refer to the source code.

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Set a preferences entry   |
| <b>Syntax:</b>     | DEVice:PREferences <name> <value>   |
| <b>Parameters:</b> | <name> Name of the preferences entry<br><value> New value for the preferences entry |

Example

```
:DEV:PREF Startup.ConnectToFirstDevice false
```

Most settings take effect immediately but some (such as changing the port for the SCPI server) are only applied when the preferences are saved. Also see command 4.2.5.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns a preferences entry            |
| <b>Syntax:</b>       | DEVice:PREferences? <name>             |
| <b>Parameters:</b>   | <name> Name of the preferences entry   |
| <b>Return value:</b> | Current value of the preferences entry |

#### 4.2.5 DEVice:APPLYPREferences

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Permanently stores the preferences after a setting has been changed |
| <b>Syntax:</b>     | DEVice:APPLYPREferences   |
| <b>Parameters:</b> | None  |

#### 4.2.6 DEVice:MODE

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Switches the device to the specified mode  |
| <b>Syntax:</b>     | DEVIce:MODE <mode>   |
| <b>Parameters:</b> | <mode>:<br>VNA: set to vector analyzer<br>GEN: set to signal generator<br>SA: set to spectrum analyzer |

#### Example

```
: DEV : MODE VNA
```

#### Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the currently active mode  |
| <b>Syntax:</b>       | DEVIce:MODE?   |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | <mode>:<br>VNA: set to vector analyzer<br>GEN: set to signal generator<br>SA: set to spectrum analyzer |

#### Example

```
: DEV : MODE ?  
VNA
```

### 4.2.7 DEVIce:SETUP:SAVE

#### Event:

|                    |                               |
|--------------------|-------------------------------|
| <b>Effect:</b>     | Saves the GUI setup to a file |
| <b>Syntax:</b>     | DEVIce:SETUP:SAVE             |
| <b>Parameters:</b> | <filename>                    |

Important points when saving/loading setup files through SCPI commands:

- Filenames must be either absolute or relative to the location of the GUI application.
- If the LibreVNA-GUI (and thus also the SCPI server) is running on a different machine than the SCPI client, the setup files will be saved/loaded from the machine that runs the GUI.
- If no (or a wrong) file ending is specified, “.setup” is automatically added to the filename.

### 4.2.8 DEVIce:SETUP:LOAD

#### Query:

|                      |                    |
|----------------------|--------------------|
| <b>Effect:</b>       | Loads a setup file |
| <b>Syntax:</b>       | DEVIce:SETUP:LOAD? |
| <b>Parameters:</b>   | <filename>         |
| <b>Return value:</b> | TRUE or FALSE      |

- Filenames must be either absolute or relative to the location of the GUI application.
- The filename must include the file ending “.setup”.

#### 4.2.9 DEVIce:REFerence:OUT

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the reference output frequency           |
| <b>Syntax:</b>     | DEVIce:REFerence:OUT <freq>                   |
| <b>Parameters:</b> | <freq> in MHz, either 0 (disabled), 10 or 100 |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the reference output frequency |
| <b>Syntax:</b>       | DEVIce:REFerence:OUT?                  |
| <b>Parameters:</b>   | None                                   |
| <b>Return value:</b> | Output frequency in MHz                |

#### 4.2.10 DEVIce:REFerence:IN

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Set the reference input mode   |
| <b>Syntax:</b>     | DEVIce:REFerence:IN <mode>   |
| <b>Parameters:</b> | <mode>:<br>INT: use internal reference<br>EXT: use external reference<br>AUTO: automatic reference switching |

Query:

|                      |                              |
|----------------------|------------------------------|
| <b>Effect:</b>       | Queries the reference source |
| <b>Syntax:</b>       | DEVIce:REFerence:IN?         |
| <b>Parameters:</b>   | None                         |
| <b>Return value:</b> | INT or EXT                   |

#### 4.2.11 DEVIce:STatus:UNLOcked

Query:

|                      |                                 |
|----------------------|---------------------------------|
| <b>Effect:</b>       | Queries the PLL lock error flag |
| <b>Syntax:</b>       | DEVIce:STatus:UNLOcked?         |
| <b>Parameters:</b>   | None                            |
| <b>Return value:</b> | TRUE or FALSE                   |

#### 4.2.12 DEVIce:STatus:ADCOVERload

Query:

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Effect:</b>       | Queries the ADC overload error flag |
| <b>Syntax:</b>       | DEVIce:STatus:ADCOVERload?          |
| <b>Parameters:</b>   | None                                |
| <b>Return value:</b> | TRUE or FALSE                       |

#### 4.2.13 DEVIce:STAtus:UNLEVel

Query:

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Effect:</b>       | Queries the output level error flag |
| <b>Syntax:</b>       | DEVIce:STAtus:UNLEVel?              |
| <b>Parameters:</b>   | None                                |
| <b>Return value:</b> | TRUE or FALSE                       |

#### 4.2.14 DEVIce:INFo:FWREVision

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the firmware revision of the connected device |
| <b>Syntax:</b>       | DEVIce:INFo:FWREVision?                               |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <major>.<minor>.<patch>                               |

Example

```
: DEV : INF : FWREV ?  
1 . 0 . 0
```

#### 4.2.15 DEVIce:INFo:HWREVision

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the hardware revision of the connected device |
| <b>Syntax:</b>       | DEVIce:INFo:HWREVision?                               |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <revision>, single char                               |

Example

```
: DEV : INF : HWREV ?  
B
```

#### 4.2.16 DEVIce:INFo:LIMits:MINFrequency

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the lowest frequency the device can measure |
| <b>Syntax:</b>       | DEVIce:INFo:LIMits:MINFrequency?                    |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | lowest frequency in Hz                              |

#### 4.2.17 DEVIce:INFo:LIMits:MAXFrequency

Query:

|                |  |
|----------------|--|
| <b>Effect:</b> | Queries the highest frequency the device can measure |
|----------------|--|

|                      |                                  |
|----------------------|----------------------------------|
| <b>Syntax:</b>       | DEVIce:INFo:LIMits:MAXFrequency? |
| <b>Parameters:</b>   | None                             |
| <b>Return value:</b> | highest frequency in Hz          |

#### 4.2.18 DEVIce:INFo:LIMits:MINIFBW

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the lowest IF bandwidth setting |
| <b>Syntax:</b>       | DEVIce:INFo:LIMits:MINIFBW?             |
| <b>Parameters:</b>   | None                                    |
| <b>Return value:</b> | lowest possible IF bandwidth in Hz      |

#### 4.2.19 DEVIce:INFo:LIMits:MAXIFBW

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the highest IF bandwidth setting |
| <b>Syntax:</b>       | DEVIce:INFo:LIMits:MAXIFBW?              |
| <b>Parameters:</b>   | None                                     |
| <b>Return value:</b> | highest possible IF bandwidth in Hz      |

#### 4.2.20 DEVIce:INFo:LIMits:MAXPoints

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the maximum number of points per sweep |
| <b>Syntax:</b>       | DEVIce:INFo:LIMits:MAXPoints?                  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | maximum number of points                       |

#### 4.2.21 DEVIce:INFo:LIMits:MINPOWer

Query:

|                      |                                  |
|----------------------|----------------------------------|
| <b>Effect:</b>       | Queries the minimum output power |
| <b>Syntax:</b>       | DEVIce:INFo:LIMits:MINPOWer?     |
| <b>Parameters:</b>   | None                             |
| <b>Return value:</b> | minimum output power in dBm      |

#### 4.2.22 DEVIce:INFo:LIMits:MAXPOWer

Query:

|                      |                                  |
|----------------------|----------------------------------|
| <b>Effect:</b>       | Queries the maximum output power |
| <b>Syntax:</b>       | DEVIce:INFo:LIMits:MAXPOWer?     |
| <b>Parameters:</b>   | None                             |
| <b>Return value:</b> | maximum output power in dBm      |

#### 4.2.23 DEVice:INFo:LIMits:MINRBW

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the lowest resolution bandwidth setting |
| <b>Syntax:</b>       | DEVice:INFo:LIMits:MINRBW?                      |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | lowest possible resolution bandwidth in Hz      |

#### 4.2.24 DEVice:INFo:LIMits:MAXRBW

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the highest resolution bandwidth setting |
| <b>Syntax:</b>       | DEVice:INFo:LIMits:MAXRBW?                       |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | highest possible resolution bandwidth in Hz      |

#### 4.2.25 DEVice:INFo:LIMits:MAXHARMonicfrequency

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the (theoretical) maximum frequency when using harmonic mixing in VNA mode |
| <b>Syntax:</b>       | DEVice:INFo:LIMits:MAXHARMonicfrequency?   |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | maximum frequency in Hz  |

### 4.3 VNA Commands

These commands change or query VNA settings. Although most of them are available regardless of the current device mode, they usually only have an effect once the VNA mode is active (e.g. it is possible to change the span while in signal generator mode but it does not effect the LibreVNA until the mode is switched to VNA). Certain commands (like taking a calibration measurement) are only available in VNA mode and will return an error if another mode is active.

#### 4.3.1 VNA:SWEEP

Event:

|                    |                                   |
|--------------------|-----------------------------------|
| <b>Effect:</b>     | Sets the type of the sweep        |
| <b>Syntax:</b>     | VNA:SWEEP                         |
| <b>Parameters:</b> | <type>, either FREQUENCY or POWER |

Query:

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Effect:</b>       | Queries the currently selected type |
| <b>Syntax:</b>       | VNA:SWEEP?                          |
| <b>Parameters:</b>   | None                                |
| <b>Return value:</b> | <type>, either FREQUENCY or POWER   |

#### 4.3.2 VNA:FREQuency:SPAN

##### Event:

|                    |                            |
|--------------------|----------------------------|
| <b>Effect:</b>     | Sets the span of the sweep |
| <b>Syntax:</b>     | VNA:FREQuency:SPAN         |
| <b>Parameters:</b> | <span>, in Hz              |

##### Query:

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Effect:</b>       | Queries the currently selected span |
| <b>Syntax:</b>       | VNA:FREQuency:SPAN?                 |
| <b>Parameters:</b>   | None                                |
| <b>Return value:</b> | span in Hz                          |

#### 4.3.3 VNA:FREQuency:START

##### Event:

|                    |                                       |
|--------------------|---------------------------------------|
| <b>Effect:</b>     | Sets the start frequency of the sweep |
| <b>Syntax:</b>     | VNA:FREQuency:START                   |
| <b>Parameters:</b> | <start frequency>, in Hz              |

##### Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the currently selected start frequency |
| <b>Syntax:</b>       | VNA:FREQuency:START?                           |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | start frequency in Hz                          |

#### 4.3.4 VNA:FREQuency:CENTer

##### Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the center frequency of the sweep |
| <b>Syntax:</b>     | VNA:FREQuency:CENTer                   |
| <b>Parameters:</b> | <center frequency>, in Hz              |

##### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected center frequency |
| <b>Syntax:</b>       | VNA:FREQuency:CENTer?                           |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | center frequency in Hz                          |

#### 4.3.5 VNA:FREQuency:STOP

##### Event:

|                    |                                      |
|--------------------|--------------------------------------|
| <b>Effect:</b>     | Sets the stop frequency of the sweep |
| <b>Syntax:</b>     | VNA:FREQuency:STOP                   |
| <b>Parameters:</b> | <stop frequency>, in Hz              |

---

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected stop frequency |
| <b>Syntax:</b>       | VNA:FREQuency:STOP?                           |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | stop frequency in Hz                          |

#### 4.3.6 VNA:FREQuency:FULL

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the device to the maximum span possible |
| <b>Syntax:</b>     | VNA:FREQuency:FULL                           |
| <b>Parameters:</b> | None   |

#### 4.3.7 VNA:FREQuency:ZERO

Event:

|                    |                                   |
|--------------------|-----------------------------------|
| <b>Effect:</b>     | Sets the device to zero span mode |
| <b>Syntax:</b>     | VNA:FREQuency:ZERO                |
| <b>Parameters:</b> | None                              |

#### 4.3.8 VNA:POWer:START

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the start power of the power sweep |
| <b>Syntax:</b>     | VNA:POWer:START                         |
| <b>Parameters:</b> | <start power>, in dBm                   |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the currently selected start power |
| <b>Syntax:</b>       | VNA:POWer:START?                           |
| <b>Parameters:</b>   | None                                       |
| <b>Return value:</b> | start power in dBm                         |

#### 4.3.9 VNA:POWer:STOP

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the stop power of the power sweep |
| <b>Syntax:</b>     | VNA:POWer:STOP                         |
| <b>Parameters:</b> | <stop power>, in dBm                   |

Query:

|                |   |
|----------------|---|
| <b>Effect:</b> | Queries the currently selected stop power |
| <b>Syntax:</b> | VNA:POWer:STOP?                           |



|                      |                   |
|----------------------|-------------------|
| <b>Parameters:</b>   | None              |
| <b>Return value:</b> | stop power in dBm |

#### 4.3.10 VNA:SWEEPTYPE

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Selects between linear and logarithmic sweeps |
| <b>Syntax:</b>     | VNA:SWEEPTYPE                                 |
| <b>Parameters:</b> | <type>, either “LIN” or “LOG”                 |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected sweep type |
| <b>Syntax:</b>       | VNA:SWEEPTYPE?                            |
| <b>Parameters:</b>   | None                                      |
| <b>Return value:</b> | “LIN” or “LOG”                            |

#### 4.3.11 VNA:ACQuisition:RUN

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Puts the VNA into run mode (sweep active) |
| <b>Syntax:</b>     | VNA:ACQuisition:RUN                       |
| <b>Parameters:</b> | None                                      |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether the VNA is in run mode |
| <b>Syntax:</b>       | VNA:ACQuisition:RUN?                   |
| <b>Parameters:</b>   | None                                   |
| <b>Return value:</b> | TRUE or FALSE                          |

#### 4.3.12 VNA:ACQuisition:STOP

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Puts the VNA into stop mode (sweep inactive) |
| <b>Syntax:</b>     | VNA:ACQuisition:STOP                         |
| <b>Parameters:</b> | None   |

#### 4.3.13 VNA:ACQuisition:IFBW

Event:

|                    |                       |
|--------------------|-----------------------|
| <b>Effect:</b>     | Sets the IF bandwidth |
| <b>Syntax:</b>     | VNA:ACQuisition:IFBW  |
| <b>Parameters:</b> | <IF bandwidth>, in Hz |

Query:

|  |  |
|--|--|
|  |  |
|--|--|

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected IF bandwidth |
| <b>Syntax:</b>       | VNA:ACQuisition:IFBW?                       |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | IF bandwidth in Hz                          |

#### 4.3.14 VNA:ACQuisition:POINTS

Event:

|                    |                                     |
|--------------------|-------------------------------------|
| <b>Effect:</b>     | Sets the number of points per sweep |
| <b>Syntax:</b>     | VNA:ACQuisition:POINTS              |
| <b>Parameters:</b> | <points>                            |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected number of points |
| <b>Syntax:</b>       | VNA:ACQuisition:POINTS?                         |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | points  |

#### 4.3.15 VNA:ACQuisition:AVG

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the number of sweeps over which a moving average is calculated |
| <b>Syntax:</b>     | VNA:ACQuisition:AVG   |
| <b>Parameters:</b> | <averaging sweeps>  |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently configured number of sweeps |
| <b>Syntax:</b>       | VNA:ACQuisition:AVG?                              |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <averaging sweeps>                                |

#### 4.3.16 VNA:ACQuisition:AVGLEVel

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the number of sweeps that have been acquired by the average function. |
| <b>Syntax:</b>       | VNA:ACQuisition:AVGLEVel?   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <acquired sweeps>   |

<acquired sweeps> resets to zero whenever a setting is changed. It is incremented at the end of each sweep, but will not go above the number of configured sweeps for the averaging.

Example (assuming <averaging sweep> = 3):

|                   |  |                   |
|-------------------|--|-------------------|
| # of active sweep |  | <acquired sweeps> |
|-------------------|--|-------------------|

|   |   |
|---|---|
| 1 | 0 |
| 2 | 1 |
| 3 | 2 |
| 4 | 3 |
| 5 | 3 |

#### 4.3.17 VNA:ACQuisition:FINished

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether the average filter has reached a steady state (that is <acquired sweeps> = <averaging sweeps>) |
| <b>Syntax:</b>       | VNA:ACQuisition:FINished?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE  |

#### 4.3.18 VNA:ACQuisition:LIMit

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of limits that maybe set up on any graph |
| <b>Syntax:</b>       | VNA:ACQuisition:LIMit?                                      |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | PASS or FAIL  |

#### 4.3.19 VNA:ACQuisition:SINGLE

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Configures the VNA for single or continuous sweep |
| <b>Syntax:</b>     | VNA:ACQuisition:SINGLE                            |
| <b>Parameters:</b> | TRUE or FALSE                                     |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether the VNA is set up for single sweep |
| <b>Syntax:</b>       | VNA:ACQuisition:SINGLE?                            |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE                                      |

If single sweep is enabled, the acquisition is stopped when the required number of averages have been reached. There are two ways to trigger a new sweep:

- Change any sweep setting (e.g. center frequency)
- Issue the command again (i.e. VNA:ACQ:SINGLE TRUE always triggers a new sweep)

#### 4.3.20 VNA:STIMulus:LVL

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the output power of the stimulus signal when sweep type is frequency |
| <b>Syntax:</b>     | VNA:STIMulus:LVL  |
| <b>Parameters:</b> | <power>, in dBm   |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected output power |
| <b>Syntax:</b>       | VNA:STIMulus:LVL?                           |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | power in dBm                                |

#### 4.3.21 VNA:STIMulus:FREQuency

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the frequency of the stimulus signal when sweep type is power |
| <b>Syntax:</b>     | VNA:STIMulus:FREQuency   |
| <b>Parameters:</b> | <freq>, in Hz  |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the currently selected frequency |
| <b>Syntax:</b>       | VNA:STIMulus:FREQuency?                  |
| <b>Parameters:</b>   | None                                     |
| <b>Return value:</b> | frequency in Hz                          |

#### 4.3.22 VNA:TRACe:LIST

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Lists the names of all available traces |
| <b>Syntax:</b>       | VNA:TRACe:LIST?                         |
| <b>Parameters:</b>   | None                                    |
| <b>Return value:</b> | comma-separated list of trace name      |

Example

```
VNA:TRAC:LIST?  
S11,S12,S21,S22
```

#### 4.3.23 VNA:TRACe:DATA

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the data of a trace                          |
| <b>Syntax:</b>       | VNA:TRACe:DATA?                                      |
| <b>Parameters:</b>   | <trace>, either by name or by index                  |
| <b>Return value:</b> | comma-separated list of tuples [x, real(y), imag(y)] |

Depending on the sweep and possible configured math operations, x may be either frequency, power or time.

### Example

```
:VNA:TRAC:DATA? S11
[1e+6,0.400172,0.0377869],
[6.67556e+8,-0.0922281,-0.00990373],
[1.33411e+9,-0.0341439,-0.0331184],
[2.00067e+9,0.00750893,0.0490847],
[2.66722e+9,0.0472666,-0.175552],
[3.33378e+9,-0.106545,-0.00952825],
[4.00033e+9,-0.102039,0.0890605],
[4.66689e+9,0.0464292,0.118183],
[5.33344e+9,0.13223,-0.00780554],
[6e+9,-0.0314859,-0.246024]
```

Note: actual response will not include newlines between data points, only at the end

#### 4.3.24 VNA:TRACe:AT

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the data at a specific frequency (possibly interpolated) |
| <b>Syntax:</b>       | VNA:TRACe:AT?  |
| <b>Parameters:</b>   | <trace>, either by name or by index<br><frequency>, in Hz        |
| <b>Return value:</b> | real,imag (or “NaN,NaN” if specified frequency is invalid)       |

### Example

```
:VNA:TRAC:AT? S11 1200000000
-0.0458452,-0.028729
```

#### 4.3.25 VNA:TRACe:TOUCHSTONE

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the content of multiple trace according to the touchstone format |
| <b>Syntax:</b>       | VNA:TRACe:TOUCHSTONE?  |
| <b>Parameters:</b>   | <trace1>,<trace2>,<trace3>,...   |
| <b>Return value:</b> | Touchstone file content in ASCII   |

Some additional constraints apply:

- The number of specified traces must be a square number. The number of ports in the touchstone file is inferred from that.
- Only frequency domain traces are allowed.
- All traces must have the same number of points and the same start/stop frequency.
- The order in which the traces are specified matters and depending on its index and each trace must be a reflection or transmission measurement:
  - Assuming that  $n$  is the number of ports of the desired touchstone file, the  $n * n$  number of traces must be specified in this order:

$$S_{11}...S_{1n}, S_{21}...S_{2n}, ..., S_{n1}...S_{nn}$$

- For every trace  $S_{ij}$ , the trace must contain a reflection measurement if  $i = j$  and a transmission measurement if  $i \neq j$ .

- Traces can be specified either by name or by index.
- A deviation from any of these points (invalid number of traces, non-existing trace, wrong order, ...) will result in an error being returned.

#### Example

```
:VNA:TRACE:TOUCHSTONE? S11 S12 S21 S22
# GHZ S RI R 50
1.000000000000 1.000497817993 0.010679213330 0.000013886895
-0.000054684886 -0.000023392624 -0.000021111371
0.401717424393 0.702864229679
1.002000000000 1.000323534012 0.010577851906 -0.000011075452
-0.000013504875 0.000000477609 -0.000007789199
0.413144201040 0.696514129639
...
```

#### 4.3.26 VNA:TRACe:MAXFrequency

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the highest frequency contained in the trace |
| <b>Syntax:</b>       | VNA:TRACe:MAXFrequency?                              |
| <b>Parameters:</b>   | <trace>, either by name or by index                  |
| <b>Return value:</b> | maximum frequency in Hz                              |

#### 4.3.27 VNA:TRACe:MINFrequency

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the lowest frequency contained in the trace |
| <b>Syntax:</b>       | VNA:TRACe:MINFrequency?                             |
| <b>Parameters:</b>   | <trace>, either by name or by index                 |
| <b>Return value:</b> | maximum frequency in Hz                             |

#### 4.3.28 VNA:TRACe:MAXAmplitude

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the datapoint with the highest amplitude in the trace |
| <b>Syntax:</b>       | VNA:TRACe:MAXAmplitude?                                       |
| <b>Parameters:</b>   | <trace>, either by name or by index                           |
| <b>Return value:</b> | <frequency>,<real>,<imag> of the highest amplitude point      |

#### Example

```
:VNA:TRAC:MAXA? S21
5.66406e+9, -6.21766e-5, -0.000795846
```

#### 4.3.29 VNA:TRACe:MINAmplitude

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the datapoint with the lowest amplitude in the trace |
| <b>Syntax:</b>       | VNA:TRACe:MINAmplitude?                                      |
| <b>Parameters:</b>   | <trace>, either by name or by index                          |
| <b>Return value:</b> | <frequency>,<real>,<imag> of the lowest amplitude point      |

#### 4.3.30 VNA:TRACe:NEW

Event:

|                    |                     |
|--------------------|---------------------|
| <b>Effect:</b>     | Creates a new trace |
| <b>Syntax:</b>     | VNA:TRACe:NEW       |
| <b>Parameters:</b> | <trace name>        |

#### 4.3.31 VNA:TRACe:DELeTe

Event:

|                    |                                     |
|--------------------|-------------------------------------|
| <b>Effect:</b>     | Deletes a trace                     |
| <b>Syntax:</b>     | VNA:TRACe:DELeTe                    |
| <b>Parameters:</b> | <trace>, either by name or by index |

#### 4.3.32 VNA:TRACe:RENAME

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Changes the name of a trace                       |
| <b>Syntax:</b>     | VNA:TRACe:RENAME                                  |
| <b>Parameters:</b> | <trace>, either by name or by index<br><new name> |

#### 4.3.33 VNA:TRACe:PAUSE

Event:

|                    |                                     |
|--------------------|-------------------------------------|
| <b>Effect:</b>     | Pauses (freezes) a trace            |
| <b>Syntax:</b>     | VNA:TRACe:PAUSE                     |
| <b>Parameters:</b> | <trace>, either by name or by index |

#### 4.3.34 VNA:TRACe:RESUME

Event:

|                    |                                     |
|--------------------|-------------------------------------|
| <b>Effect:</b>     | Resumes (unfreezes) a trace         |
| <b>Syntax:</b>     | VNA:TRACe:RESUME                    |
| <b>Parameters:</b> | <trace>, either by name or by index |

#### 4.3.35 VNA:TRACe:PAUSED

Query:

|                |                                   |
|----------------|-----------------------------------|
| <b>Effect:</b> | Queries whether a trace is paused |
| <b>Syntax:</b> | VNA:TRACe:PAUSED?                 |

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Parameters:</b>   | <trace>, either by name or by index |
| <b>Return value:</b> | TRUE or FALSE                       |

#### 4.3.36 VNA:TRACe:DEEMBedding:ACTive

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Enables/disables de-embedding on a trace                              |
| <b>Syntax:</b>     | VNA:TRACe:DEEMBedding:ACTive  |
| <b>Parameters:</b> | <trace>, either by name or by index<br><enable>, either TRUE or FALSE |

If no de-embedding is configured for the selected trace, enabling the de-embedding will fail.

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries whether de-embedding is active for the selected trace |
| <b>Syntax:</b>       | VNA:TRACe:DEEMBedding:ACTive?                                 |
| <b>Parameters:</b>   | <trace>, either by name or by index                           |
| <b>Return value:</b> | TRUE or FALSE   |

#### 4.3.37 VNA:TRACe:DEEMBedding:AVAILable

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether de-embedding is available for the selected trace |
| <b>Syntax:</b>       | VNA:TRACe:DEEMBedding:AVAILable?                                 |
| <b>Parameters:</b>   | <trace>, either by name or by index                              |
| <b>Return value:</b> | TRUE or FALSE  |

#### 4.3.38 VNA:TRACe:PARAMeter

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the measurement parameter that is stored in the trace                           |
| <b>Syntax:</b>     | VNA:TRACe:PARAMeter  |
| <b>Parameters:</b> | <trace>, either by name or by index<br><parameter>, options are S11, S12, S21 or S22 |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the measurement parameter of a trace |
| <b>Syntax:</b>       | VNA:TRACe:PARAMeter?                         |
| <b>Parameters:</b>   | <trace>, either by name or by index          |
| <b>Return value:</b> | S11, S12, S21 or S22                         |

#### 4.3.39 VNA:TRACe:TYPE

Event:

|                |                                  |
|----------------|----------------------------------|
| <b>Effect:</b> | Sets the storage type of a trace |
| <b>Syntax:</b> | VNA:TRACe:TYPE                   |



|                    |  |
|--------------------|--|
| <b>Parameters:</b> | <trace>, either by name or by index<br><type>, options are OVERWRITE, MAXHOLD or MINHOLD |
|--------------------|--|

Query:

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Effect:</b>       | Queries the storage type of a trace |
| <b>Syntax:</b>       | VNA:TRACe:TYPE?                     |
| <b>Parameters:</b>   | <trace>, either by name or by index |
| <b>Return value:</b> | OVERWRITE, MAXHOLD or MINHOLD       |

#### 4.3.40 VNA:CALibration:ACTivate

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Activates a specific calibration. This command fails if the required measurements have not been taken yet |
| <b>Syntax:</b>     | VNA:CALibration:ACTivate  |
| <b>Parameters:</b> | <type>  |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently available calibration types   |
| <b>Syntax:</b>       | VNA:CALibration:ACTivate?                           |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | comma-separated list of available calibration types |

#### 4.3.41 VNA:CALibration:ACTIVE

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently active calibration type |
| <b>Syntax:</b>       | VNA:CALibration:ACTIVE?                       |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | Currently active calibration type             |

#### 4.3.42 VNA:CALibration:NUMber

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the number of available calibration measurements |
| <b>Syntax:</b>       | VNA:CALibration:NUMber?                                  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | <number of configured measurements>                      |

#### 4.3.43 VNA:CALibration:RESET

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Resets the calibration. Deactivates the calibration and deletes all measurements. |
| <b>Syntax:</b>     | VNA:CALibration:RESET   |
| <b>Parameters:</b> | None  |

#### 4.3.44 VNA:CALibration:ADD

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Adds a new empty calibration measurement.  |
| <b>Syntax:</b>     | VNA:CALibration:ADD  |
| <b>Parameters:</b> | <type> Measurement type, one of:<br>OPEN<br>SHORT<br>LOAD<br>THROUGH<br>ISOLATION<br>[<standard>], calibration kit standard name, optional |

#### 4.3.45 VNA:CALibration:TYPE

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the type of the specified measurement                              |
| <b>Syntax:</b>       | VNA:CALibration:TYPE?  |
| <b>Parameters:</b>   | <measurement number>   |
| <b>Return value:</b> | Measurement type, one of:<br>OPEN<br>SHORT<br>LOAD<br>THROUGH<br>ISOLATION |

#### 4.3.46 VNA:CALibration:PORT

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the port for the specified measurement |
| <b>Syntax:</b>     | VNA:CALibration:PORT                        |
| <b>Parameters:</b> | <measurement number> <port number>          |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the port for the specified measurement |
| <b>Syntax:</b>       | VNA:CALibration:PORT?                          |
| <b>Parameters:</b>   | <measurement number>                           |
| <b>Return value:</b> | <port number>                                  |

#### 4.3.47 VNA:CALibration:STANDARD

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the calibration standard which will be used for the specified measurement |
| <b>Syntax:</b>     | VNA:CALibration:STANDARD   |
| <b>Parameters:</b> | <measurement number> <standard name>   |

---

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the standard name for the specified measurement  |
| <b>Syntax:</b>       | VNA:CALibration:STANDARD?                                |
| <b>Parameters:</b>   | <measurement number>                                     |
| <b>Return value:</b> | Name of used calibration standard (from calibration kit) |

#### 4.3.48 VNA:CALibration:MEASure

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Starts a calibration measurement. This command fails if no device is connected, the VNA mode is not active or a calibration measurement is already in progress. |
| <b>Syntax:</b>     | VNA:CALibration:MEASure   |
| <b>Parameters:</b> | <measurement 1>,<measurement 2>,...   |

Any number of measurements can be specified (by their number). These measurements will be taken simultaneously. This only works if they are measuring different ports (e.g. measure SHORT on port 1 and OPEN on port 2). If colliding measurements are specified (e.g. SHORT on port 1 and LOAD on port 1), an error is returned and no measurements are started.

#### 4.3.49 VNA:CALibration:BUSY

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether a calibration measurement is ongoing |
| <b>Syntax:</b>       | VNA:CALibration:BUSY?                                |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE  |

#### 4.3.50 VNA:CALibration:SAVE

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Saves the active calibration to a file |
| <b>Syntax:</b>     | VNA:CALibration:SAVE                   |
| <b>Parameters:</b> | <filename>                             |

Important points when saving/loading calibration files through SCPI commands:

- Filenames must be either absolute or relative to the location of the GUI application.
- If the LibreVNA-GUI (and thus also the SCPI server) is running on a different machine than the SCPI client, the calibration files will be saved/loaded from the machine that runs the GUI.

#### 4.3.51 VNA:CALibration:LOAD

Query:

|                    |                          |
|--------------------|--------------------------|
| <b>Effect:</b>     | Loads a calibration file |
| <b>Syntax:</b>     | VNA:CALibration:LOAD?    |
| <b>Parameters:</b> | <filename>               |

|                      |               |
|----------------------|---------------|
| <b>Return value:</b> | TRUE or FALSE |
|----------------------|---------------|

#### 4.3.52 VNA:CALibration:KIT:SAVE

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Saves the active calibration kit to a file |
| <b>Syntax:</b>     | VNA:CALibration:KIT:SAVE                   |
| <b>Parameters:</b> | <filename>                                 |

Important points when saving/loading calibration kit files through SCPI commands:

- Filenames must be either absolute or relative to the location of the GUI application.
- If the LibreVNA-GUI (and thus also the SCPI server) is running on a different machine than the SCPI client, the calibration kit files will be saved/loaded from the machine that runs the GUI.

#### 4.3.53 VNA:CALibration:KIT:LOAD

**Query:**

|                      |                              |
|----------------------|------------------------------|
| <b>Effect:</b>       | Loads a calibration kit file |
| <b>Syntax:</b>       | VNA:CALibration:KIT:LOAD?    |
| <b>Parameters:</b>   | <filename>                   |
| <b>Return value:</b> | TRUE or FALSE                |

### 4.4 Signal Generator Commands

These commands change or query signal generator settings. Although most of them are available regardless of the current device mode, they usually only have an effect once the generator mode is active.

#### 4.4.1 GENerator:FREQuency

**Event:**

|                    |                           |
|--------------------|---------------------------|
| <b>Effect:</b>     | Sets the output frequency |
| <b>Syntax:</b>     | GENerator:FREQuency       |
| <b>Parameters:</b> | <frequency>, in Hz        |

**Query:**

|                      |                                       |
|----------------------|---------------------------------------|
| <b>Effect:</b>       | Queries the selected output frequency |
| <b>Syntax:</b>       | GENerator:FREQuency?                  |
| <b>Parameters:</b>   | None                                  |
| <b>Return value:</b> | frequency in Hz                       |

#### 4.4.2 GENerator:LVL

**Event:**

|                    |                        |
|--------------------|------------------------|
| <b>Effect:</b>     | Sets the output power  |
| <b>Syntax:</b>     | GENerator:LVL          |
| <b>Parameters:</b> | <output level>, in dBm |

---

Query:

|                      |                                   |
|----------------------|-----------------------------------|
| <b>Effect:</b>       | Queries the selected output power |
| <b>Syntax:</b>       | GENerator:LVL?                    |
| <b>Parameters:</b>   | None                              |
| <b>Return value:</b> | output level in dBm               |

#### 4.4.3 GENerator:PORT

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the active output port   |
| <b>Syntax:</b>     | GENerator:PORT  |
| <b>Parameters:</b> | <output port><br>0: output disabled<br>1: output signal at port 1<br>2: output signal at port 2 |

Query:

|                      |                             |
|----------------------|-----------------------------|
| <b>Effect:</b>       | Queries the selected output |
| <b>Syntax:</b>       | GENerator:PORT?             |
| <b>Parameters:</b>   | None                        |
| <b>Return value:</b> | output port                 |

### 4.5 Spectrum Analyzer Commands

These commands change or query spectrum analyzer settings. Although most of them are available regardless of the current device mode, they usually only have an effect once the spectrum analyzer mode is active.

#### 4.5.1 SA:FREQuency:SPAN

Event:

|                    |                            |
|--------------------|----------------------------|
| <b>Effect:</b>     | Sets the span of the sweep |
| <b>Syntax:</b>     | SA:FREQuency:SPAN          |
| <b>Parameters:</b> | <span>, in Hz              |

Query:

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Effect:</b>       | Queries the currently selected span |
| <b>Syntax:</b>       | SA:FREQuency:SPAN?                  |
| <b>Parameters:</b>   | None                                |
| <b>Return value:</b> | span in Hz                          |

#### 4.5.2 SA:FREQuency:START

##### Event:

|                    |                                       |
|--------------------|---------------------------------------|
| <b>Effect:</b>     | Sets the start frequency of the sweep |
| <b>Syntax:</b>     | SA:FREQuency:START                    |
| <b>Parameters:</b> | <start frequency>, in Hz              |

##### Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the currently selected start frequency |
| <b>Syntax:</b>       | SA:FREQuency:START?                            |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | start frequency in Hz                          |

#### 4.5.3 SA:FREQuency:CENTer

##### Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the center frequency of the sweep |
| <b>Syntax:</b>     | SA:FREQuency:CENTer                    |
| <b>Parameters:</b> | <center frequency>, in Hz              |

##### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected center frequency |
| <b>Syntax:</b>       | SA:FREQuency:CENTer?                            |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | center frequency in Hz                          |

#### 4.5.4 SA:FREQuency:STOP

##### Event:

|                    |                                      |
|--------------------|--------------------------------------|
| <b>Effect:</b>     | Sets the stop frequency of the sweep |
| <b>Syntax:</b>     | SA:FREQuency:STOP                    |
| <b>Parameters:</b> | <stop frequency>, in Hz              |

##### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected stop frequency |
| <b>Syntax:</b>       | SA:FREQuency:STOP?                            |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | stop frequency in Hz                          |

#### 4.5.5 SA:FREQuency:FULL

##### Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the device to the maximum span possible |
| <b>Syntax:</b>     | SA:FREQuency:FULL                            |
| <b>Parameters:</b> | None   |

#### 4.5.6 SA:FREQuency:ZERO

##### Event:

|                    |                                   |
|--------------------|-----------------------------------|
| <b>Effect:</b>     | Sets the device to zero span mode |
| <b>Syntax:</b>     | SA:FREQuency:ZERO                 |
| <b>Parameters:</b> | None                              |

#### 4.5.7 SA:ACQuisition:RUN

##### Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Puts the spectrum analyzer into run mode (sweep active) |
| <b>Syntax:</b>     | SA:ACQuisition:RUN                                      |
| <b>Parameters:</b> | None  |

##### Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether the spectrum analyzer is in run mode |
| <b>Syntax:</b>       | SA:ACQuisition:RUN?                                  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE  |

#### 4.5.8 SA:ACQuisition:STOP

##### Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Puts the spectrum analyzer into stop mode (sweep inactive) |
| <b>Syntax:</b>     | SA:ACQuisition:STOP  |
| <b>Parameters:</b> | None   |

#### 4.5.9 SA:ACQuisition:RBW

##### Event:

|                    |                               |
|--------------------|-------------------------------|
| <b>Effect:</b>     | Sets the resolution bandwidth |
| <b>Syntax:</b>     | SA:ACQuisition:IFBW           |
| <b>Parameters:</b> | <resolution bandwidth>, in Hz |

##### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected resolution bandwidth |
| <b>Syntax:</b>       | SA:ACQuisition:IFBW?                                |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | resolution bandwidth in Hz                          |

#### 4.5.10 SA:ACQuisition:WINDow

##### Event:

|                |   |
|----------------|---|
| <b>Effect:</b> | Sets the type of window used in the acquisition |
| <b>Syntax:</b> | SA:ACQuisition:WINDow                           |

|                    |   |
|--------------------|---|
| <b>Parameters:</b> | <windowtype><br>NONE<br>KAISER<br>HANN<br>FLATTOP |
|--------------------|---|

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently selected type of window |
| <b>Syntax:</b>       | SA:ACQuisition:WINDow?                        |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | NONE, KAISER, HANN or FLATTOP                 |

#### 4.5.11 SA:ACQuisition:DETECTOR

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the detector type                                      |
| <b>Syntax:</b>     | SA:ACQuisition:DETECTOR                                     |
| <b>Parameters:</b> | <detector><br>+PEAK<br>-PEAK<br>NORMAL<br>SAMPLE<br>AVERAGE |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the currently selected detector type |
| <b>Syntax:</b>       | SA:ACQuisition:DETECTOR?                     |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | +PEAK, -PEAK, NORMAL, SAMPLE or AVERAGE      |

#### 4.5.12 SA:ACQuisition:AVG

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the number of sweeps over which a moving average is calculated |
| <b>Syntax:</b>     | SA:ACQuisition:AVG  |
| <b>Parameters:</b> | <sweeps>  |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the currently configured number of sweeps |
| <b>Syntax:</b>       | SA:ACQuisition:AVG?                               |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | sweeps  |



#### 4.5.13 SA:ACQuisition:AVGLEVel

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the number of sweeps that have been acquired by the average function. |
| <b>Syntax:</b>       | SA:ACQuisition:AVGLEVel?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <acquired sweeps>   |

<acquired sweeps> resets to zero whenever a setting is changed. It is incremented at the end of each sweep, but will not go above the number of configured sweeps for the averaging.

Example (assuming <averaging sweep> = 3):

| # of active sweep | <acquired sweeps> |
|-------------------|-------------------|
| 1                 | 0                 |
| 2                 | 1                 |
| 3                 | 2                 |
| 4                 | 3                 |
| 5                 | 3                 |

#### 4.5.14 SA:ACQuisition:FINished

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether the average filter has reached a steady state (that is <acquired sweeps> = <averaging sweeps>) |
| <b>Syntax:</b>       | SA:ACQuisition:FINished?   |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE  |

#### 4.5.15 SA:ACQuisition:LIMit

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of limits that maybe set up on any graph |
| <b>Syntax:</b>       | SA:ACQuisition:LIMit?                                       |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | PASS or FAIL  |

#### 4.5.16 SA:ACQuisition:SINGLE

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Configures the spectrum analyzer for single or continuous sweep |
| <b>Syntax:</b>     | SA:ACQuisition:SINGLE   |
| <b>Parameters:</b> | TRUE or FALSE   |

Query:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Queries whether the spectrum analyzer is set up for single sweep |
| <b>Syntax:</b>     | SA:ACQuisition:SINGLE?   |
| <b>Parameters:</b> | None   |

|                      |               |
|----------------------|---------------|
| <b>Return value:</b> | TRUE or FALSE |
|----------------------|---------------|

If single sweep is enabled, the acquisition is stopped when the required number of averages have been reached. There are two ways to trigger a new sweep:

- Change any sweep setting (e.g. center frequency)
- Issue the command again (i.e. SA:ACQ:SINGLE TRUE always triggers a new sweep)

#### 4.5.17 SA:ACQuisition:SIGid

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Enables/disables signal identification    |
| <b>Syntax:</b>     | SA:ACQuisition:SIGid                      |
| <b>Parameters:</b> | <enabled>, option are TRUE, FALSE, 1 or 0 |

**Query:**

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries whether signal identification is enabled |
| <b>Syntax:</b>       | SA:ACQuisition:SIGid?                            |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE                                    |

#### 4.5.18 SA:TRACKing:ENable

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Enables/disables the tracking generator   |
| <b>Syntax:</b>     | SA:TRACKing:ENable                        |
| <b>Parameters:</b> | <enabled>, option are TRUE, FALSE, 1 or 0 |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries whether tracking generator is enabled |
| <b>Syntax:</b>       | SA:TRACKing:ENable?                           |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE                                 |

#### 4.5.19 SA:TRACKing:PORT

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the output port of the tracking generator |
| <b>Syntax:</b>     | SA:TRACKing:PORT                               |
| <b>Parameters:</b> | <port>, either 1 or 2                          |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the output port of the tracking generator |
| <b>Syntax:</b>       | SA:TRACKing:PORT?                                 |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | 1 or 2  |

#### 4.5.20 SA:TRACKing:LVL

##### Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the output power of the tracking generator |
| <b>Syntax:</b>     | SA:TRACKing:LVL                                 |
| <b>Parameters:</b> | <output level>, in dBm                          |

##### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the selected output power of the tracking generator |
| <b>Syntax:</b>       | SA:TRACKing:LVL?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | output level in dBm   |

#### 4.5.21 SA:TRACKing:OFFset

##### Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the offset frequency of the tracking generator |
| <b>Syntax:</b>     | SA:TRACKing:OFFset                                  |
| <b>Parameters:</b> | <offset>, in Hz                                     |

##### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the selected offset frequency of the tracking generator |
| <b>Syntax:</b>       | SA:TRACKing:OFFset?   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | offset in Hz  |

#### 4.5.22 SA:TRACKing:NORMalize:ENable

##### Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Enables/disables normalization. If the span has changed since the last active normalization, a normalization measurement is also started. |
| <b>Syntax:</b>     | SA:TRACKing:NORMalize:ENable  |
| <b>Parameters:</b> | <enabled>, option are TRUE, FALSE, 1 or 0   |

##### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries whether tracking generator normalization is enabled |
| <b>Syntax:</b>       | SA:TRACKing:NORMalize:ENable?                               |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 4.5.23 SA:TRACKing:NORMalize:MEASure

##### Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Triggers a new normalization measurement |
| <b>Syntax:</b>     | SA:TRACKing:NORMalize:MEASure            |
| <b>Parameters:</b> | None                                     |

#### 4.5.24 SA:TRACKing:NORMAlize:LVL

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the reference level for the normalization |
| <b>Syntax:</b>     | SA:TRACKing:NORMAlize:LVL                      |
| <b>Parameters:</b> | <normalization level>, in dBm                  |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the selected reference level for the normalization |
| <b>Syntax:</b>       | SA:TRACKing:NORMAlize:LVL?                                 |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | normalization level in dBm                                 |

#### 4.5.25 SA:TRACe:LIST

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Lists the names of all available traces |
| <b>Syntax:</b>       | SA:TRACe:LIST?                          |
| <b>Parameters:</b>   | None                                    |
| <b>Return value:</b> | comma-separated list of trace name      |

Example

```
VNA : TRAC : LIST ?
Port1 , Port2
```

#### 4.5.26 SA:TRACe:DATA

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the data of a trace             |
| <b>Syntax:</b>       | SA:TRACe:DATA?                          |
| <b>Parameters:</b>   | <trace>, either by name or by index     |
| <b>Return value:</b> | comma-separated list of tuples [x, dBm] |

Example

```
: SA : TRACE : DATA ? PORT1
[9.75e+8 , -100.351] ,
[9.7505e+8 , -95.7394] ,
[9.751e+8 , -97.5749] ,
[9.7515e+8 , -96.9667] ,
[9.752e+8 , -96.2391] ,
[9.7525e+8 , -94.8761] ,
[9.753e+8 , -96.0805] ,
[9.7535e+8 , -95.7997] ,
[9.754e+8 , -95.2021] ,
[9.7545e+8 , -96.3472]
```

Note: actual response will not include newlines between data points, only at the end

#### 4.5.27 SA:TRACe:AT

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the data at a specific frequency (possibly interpolated) |
| <b>Syntax:</b>       | SA:TRACe:AT?   |
| <b>Parameters:</b>   | <trace>, either by name or by index<br><frequency>, in Hz        |
| <b>Return value:</b> | <dBm> or “NaN” if specified frequency is invalid)                |

Example

```
:SA:TRAC:AT? Port1 1000000000  
-96.424
```

#### 4.5.28 SA:TRACe:MAXFrequency

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the highest frequency contained in the trace |
| <b>Syntax:</b>       | SA:TRACe:MAXFrequency?                               |
| <b>Parameters:</b>   | <trace>, either by name or by index                  |
| <b>Return value:</b> | maximum frequency in Hz                              |

#### 4.5.29 SA:TRACe:MINFrequency

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the lowest frequency contained in the trace |
| <b>Syntax:</b>       | SA:TRACe:MINFrequency?                              |
| <b>Parameters:</b>   | <trace>, either by name or by index                 |
| <b>Return value:</b> | maximum frequency in Hz                             |

#### 4.5.30 SA:TRACe:MAXAmplitude

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Returns the datapoint with the highest amplitude in the trace |
| <b>Syntax:</b>       | SA:TRACe:MAXAmplitude?  |
| <b>Parameters:</b>   | <trace>, either by name or by index                           |
| <b>Return value:</b> | <frequency>,<dBm> of the highest amplitude point              |

Example

```
:SA:TRAC:MAXA? Port1  
9.63e+8,-12.534
```

#### 4.5.31 SA:TRACe:MINAmplitude

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Returns the datapoint with the lowest amplitude in the trace |
| <b>Syntax:</b>       | SA:TRACe:MINAmplitude?                                       |
| <b>Parameters:</b>   | <trace>, either by name or by index                          |
| <b>Return value:</b> | <frequency>,<dBm> of the lowest amplitude point              |

#### 4.5.32 SA:TRACe:NEW

Event:

|                    |                     |
|--------------------|---------------------|
| <b>Effect:</b>     | Creates a new trace |
| <b>Syntax:</b>     | SA:TRACe:NEW        |
| <b>Parameters:</b> | <trace name>        |

#### 4.5.33 SA:TRACe:DELeTe

Event:

|                    |                                     |
|--------------------|-------------------------------------|
| <b>Effect:</b>     | Deletes a trace                     |
| <b>Syntax:</b>     | VNA:TRACe:DELeTe                    |
| <b>Parameters:</b> | <trace>, either by name or by index |

#### 4.5.34 SA:TRACe:RENAME

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Changes the name of a trace                       |
| <b>Syntax:</b>     | SA:TRACe:RENAME                                   |
| <b>Parameters:</b> | <trace>, either by name or by index<br><new name> |

#### 4.5.35 SA:TRACe:PAUSE

Event:

|                    |                                     |
|--------------------|-------------------------------------|
| <b>Effect:</b>     | Pauses (freezes) a trace            |
| <b>Syntax:</b>     | SA:TRACe:PAUSE                      |
| <b>Parameters:</b> | <trace>, either by name or by index |

#### 4.5.36 SA:TRACe:RESUME

Event:

|                    |                                     |
|--------------------|-------------------------------------|
| <b>Effect:</b>     | Resumes (unfreezes) a trace         |
| <b>Syntax:</b>     | SA:TRACe:RESUME                     |
| <b>Parameters:</b> | <trace>, either by name or by index |

#### 4.5.37 SA:TRACe:PAUSED

Query:

|                |                                   |
|----------------|-----------------------------------|
| <b>Effect:</b> | Queries whether a trace is paused |
| <b>Syntax:</b> | SA:TRACe:PAUSED?                  |

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Parameters:</b>   | <trace>, either by name or by index |
| <b>Return value:</b> | TRUE or FALSE                       |

#### 4.5.38 SA:TRACe:PARAMeter

Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the measurement parameter that is stored in the trace                      |
| <b>Syntax:</b>     | SA:TRACe:PARAMeter  |
| <b>Parameters:</b> | <trace>, either by name or by index<br><parameter>, options are PORT1 and PORT2 |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the measurement parameter of a trace |
| <b>Syntax:</b>       | SA:TRACe:PARAMeter?                          |
| <b>Parameters:</b>   | <trace>, either by name or by index          |
| <b>Return value:</b> | PORT1 or PORT2                               |

#### 4.5.39 SA:TRACe:TYPE

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the storage type of a trace   |
| <b>Syntax:</b>     | SA:TRACe:TYPE  |
| <b>Parameters:</b> | <trace>, either by name or by index<br><type>, options are OVERWRITE, MAXHOLD or MINHOLD |

Query:

|                      |                                     |
|----------------------|-------------------------------------|
| <b>Effect:</b>       | Queries the storage type of a trace |
| <b>Syntax:</b>       | SA:TRACe:TYPE?                      |
| <b>Parameters:</b>   | <trace>, either by name or by index |
| <b>Return value:</b> | OVERWRITE, MAXHOLD or MINHOLD       |

## 5 Custom Driver Commands

The LibreVNA-GUI is mainly intended to be used with the LibreVNA. However, the interface between the LibreVNA-GUI and the actual VNA is abstracting certain hardware features to allow the LibreVNA-GUI to interact with other devices as well. This is mainly intended for future extensions and only very few other devices are supported for testing and demonstration purposes.

Each device driver may implement additional SCPI commands that are too specific to be useful with every device. These commands are only available when the LibreVNA-GUI is connected to the device.

### 5.1 LibreVNA Version 1

The following commands are available when connected to a LibreVNA (hardware version 1):

### 5.1.1 DEVice:UPDATE

#### Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Updates the firmware of the connected device |
| <b>Syntax:</b>     | DEVice:UPDATE <fw_file>                      |
| <b>Parameters:</b> | <fw_file> Path to the firmware file          |

Important points when saving/loading setup files through SCPI commands:

- The path must be either absolute or relative to the location of the GUI application.
- If the LibreVNA-GUI (and thus also the SCPI server) is running on a different machine than the SCPI client, the firmware file must be stored on the machine that runs the GUI.

### 5.1.2 DEVice:INFo:TEMPeratures

#### Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the temperatures of certain chips |
| <b>Syntax:</b>       | DEVice:INFo:TEMPeratures?                 |
| <b>Parameters:</b>   | None                                      |
| <b>Return value:</b> | <source>/<I.LO>/<CPU>                     |

#### Example

```
: DEV : INF : TEMP ?  
45/51/31
```

### 5.1.3 MANual:STArt

#### Event:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Starts the manual device control dialog |
| <b>Syntax:</b>     | MANual:STArt                            |
| <b>Parameters:</b> | None                                    |

The manual device control dialog allows the user to directly access all the hardware components. This can be considered as a forth mode (in addition to VNA, signal generator and spectrum analyzer). As long as it is active, it takes priority over any other mode. After starting the manual control dialog, all hardware components are disabled by default. While the manual control dialog is active, additional SCPI commands are available to configure the hardware and retrieve ADC readings.

### 5.1.4 MANual:STOp

#### Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Stops the manual device control dialog |
| <b>Syntax:</b>     | MANual:STOp                            |
| <b>Parameters:</b> | None                                   |



#### 5.1.5 MANual:HSRC\_CE

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the chip enable for the highband source |
| <b>Syntax:</b>     | MANual:HSRC_CE                                   |
| <b>Parameters:</b> | TRUE or FALSE                                    |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the chip enable for the highband source |
| <b>Syntax:</b>       | MANual:HSRC_CE?   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 5.1.6 MANual:HSRC\_RFEN

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the RF enable for the highband source |
| <b>Syntax:</b>     | MANual:HSRC_RFEN                               |
| <b>Parameters:</b> | TRUE or FALSE                                  |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the RF enable for the highband source |
| <b>Syntax:</b>       | MANual:HSRC_RFEN?   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 5.1.7 MANual:HSRC\_LOCKed

Only available when the manual control dialog is active.

**Query:**

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the lock status of the highband source |
| <b>Syntax:</b>       | MANual:HSRC_LOCKed?                            |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE                                  |

#### 5.1.8 MANual:HSRC\_PWR

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the output power of the highband source                     |
| <b>Syntax:</b>     | MANual:HSRC_PWR  |
| <b>Parameters:</b> | <power>, output power in dBm, allowed values are -4, -1, 2 and 5 |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the output power of the highband source |
| <b>Syntax:</b>       | MANual:HSRC_PWR?                                |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <power>, output power in dBm                    |

#### 5.1.9 MANual:HSRC\_FREQ

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the target frequency of the highband source |
| <b>Syntax:</b>     | MANual:HSRC_FREQ                                 |
| <b>Parameters:</b> | <freq>, frequency in Hz                          |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the target frequency of the highband source |
| <b>Syntax:</b>       | MANual:HSRC_FREQ?                                   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <freq>, frequency in Hz                             |

#### 5.1.10 MANual:HSRC\_LPF

Only available when the manual control dialog is active.

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the lowpass filter of the highband source  |
| <b>Syntax:</b>     | MANual:HSRC_LPF   |
| <b>Parameters:</b> | <cutoff>, Cutoff frequency in MHz, allowed values are 947, 1880, 3500 and 0 (no filter) |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the lowpass filter setting of the highband source |
| <b>Syntax:</b>       | MANual:HSRC_LPF?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <cutoff>, Cutoff frequency in MHz                         |

#### 5.1.11 MANual:LSRC\_EN

Only available when the manual control dialog is active.

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Controls the enable signal for the lowband source |
| <b>Syntax:</b>     | MANual:LSRC_EN                                    |
| <b>Parameters:</b> | TRUE or FALSE                                     |

**Query:**

|                |  |
|----------------|--|
| <b>Effect:</b> | Queries the status of the enable signal for the lowband source |
| <b>Syntax:</b> | MANual:LSRC_EN?  |

|                      |               |
|----------------------|---------------|
| <b>Parameters:</b>   | None          |
| <b>Return value:</b> | TRUE or FALSE |

#### 5.1.12 MANual:LSRC\_PWR

Only available when the manual control dialog is active.

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the output power of the lowband source                   |
| <b>Syntax:</b>     | MANual:LSRC_PWR   |
| <b>Parameters:</b> | <power>, output power in mA, allowed values are 2, 4, 6 and 8 |

**Query:**

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the output power of the lowband source |
| <b>Syntax:</b>       | MANual:LSRC_PWR?                               |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | <power>, output power in mA                    |

#### 5.1.13 MANual:LSRC\_FREQ

Only available when the manual control dialog is active.

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the target frequency of the lowband source |
| <b>Syntax:</b>     | MANual:LSRC_FREQ                                |
| <b>Parameters:</b> | <freq>, frequency in Hz                         |

**Query:**

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the target frequency of the lowband source |
| <b>Syntax:</b>       | MANual:LSRC_FREQ?                                  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | <freq>, frequency in Hz                            |

#### 5.1.14 MANual:BAND\_SW

Only available when the manual control dialog is active.

**Event:**

|                    |                                      |
|--------------------|--------------------------------------|
| <b>Effect:</b>     | Controls the band selector switch    |
| <b>Syntax:</b>     | MANual:BAND_SW                       |
| <b>Parameters:</b> | TRUE for highband, FALSE for lowband |

**Query:**

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the status of the band selector switch |
| <b>Syntax:</b>       | MANual:BAND_SW?                                |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE for highband, FALSE for lowband           |

#### 5.1.15 MANual:ATTenuator

Only available when the manual control dialog is active.

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Sets the attenuator value                             |
| <b>Syntax:</b>     | MANual:ATTenuator                                     |
| <b>Parameters:</b> | <att>, Attenuation in dB, values between -31.75 and 0 |

**Query:**

|                      |                              |
|----------------------|------------------------------|
| <b>Effect:</b>       | Queries the attenuator value |
| <b>Syntax:</b>       | MANual:ATTenuator?           |
| <b>Parameters:</b>   | None                         |
| <b>Return value:</b> | <att>, Attenuation in dB     |

#### 5.1.16 MANual:AMP\_EN

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the enable signal for the amplifier |
| <b>Syntax:</b>     | MANual:AMP_EN                                |
| <b>Parameters:</b> | TRUE or FALSE                                |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the enable signal for the amplifier |
| <b>Syntax:</b>       | MANual:AMP_EN?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 5.1.17 MANual:PORT\_SW

Only available when the manual control dialog is active.

**Event:**

|                    |                                   |
|--------------------|-----------------------------------|
| <b>Effect:</b>     | Controls the port selector switch |
| <b>Syntax:</b>     | MANual:PORT_SW                    |
| <b>Parameters:</b> | <port>, either 1 or 2             |

**Query:**

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the status of the port selector switch |
| <b>Syntax:</b>       | MANual:PORT_SW?                                |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | <port>   |

#### 5.1.18 MANual:LOI\_CE

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the chip enable for the LOI PLL |
| <b>Syntax:</b>     | MANual:LOI_CE                            |
| <b>Parameters:</b> | TRUE or FALSE                            |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the chip enable for the LOI PLL |
| <b>Syntax:</b>       | MANual:LOI_CE?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 5.1.19 MANual:LOI\_RFEN

Only available when the manual control dialog is active.

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the RF enable for the LOI PLL |
| <b>Syntax:</b>     | MANual:LOI_RFEN                        |
| <b>Parameters:</b> | TRUE or FALSE                          |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the RF enable for the LOI PLL |
| <b>Syntax:</b>       | MANual:LOI_RFEN?                                    |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE                                       |

#### 5.1.20 MANual:LOI\_LOCKed

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the lock status of the LOI PLL |
| <b>Syntax:</b>       | MANual:LOI_LOCKed?                     |
| <b>Parameters:</b>   | None                                   |
| <b>Return value:</b> | TRUE or FALSE                          |

#### 5.1.21 MANual:LOI\_FREQ

Only available when the manual control dialog is active.

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the target frequency of the LOI PLL |
| <b>Syntax:</b>     | MANual:LOI_FREQ                          |
| <b>Parameters:</b> | <freq>, frequency in Hz                  |

Query:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Queries the target frequency of the LOI PLL |
| <b>Syntax:</b>     | MANual:LOI_FREQ?                            |
| <b>Parameters:</b> | None  |

|                      |                         |
|----------------------|-------------------------|
| <b>Return value:</b> | <freq>, frequency in Hz |
|----------------------|-------------------------|

#### 5.1.22 MANual:IF1\_FREQ

Only available when the manual control dialog is active.

**Event:**

|                    |                         |
|--------------------|-------------------------|
| <b>Effect:</b>     | Sets the IF1 frequency  |
| <b>Syntax:</b>     | MANual:IF1_FREQ         |
| <b>Parameters:</b> | <freq>, frequency in Hz |

**Query:**

|                      |                           |
|----------------------|---------------------------|
| <b>Effect:</b>       | Queries the IF1 frequency |
| <b>Syntax:</b>       | MANual:IF1_FREQ?          |
| <b>Parameters:</b>   | None                      |
| <b>Return value:</b> | <freq>, frequency in Hz   |

#### 5.1.23 MANual:LO2\_EN

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the enable signal for the LO2 PLL |
| <b>Syntax:</b>     | MANual:LO2_EN                              |
| <b>Parameters:</b> | TRUE or FALSE                              |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the enable signal for the LO2 PLL |
| <b>Syntax:</b>       | MANual:LO2_EN?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 5.1.24 MANual:LO2\_FREQ

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the target frequency of the LO2 PLL |
| <b>Syntax:</b>     | MANual:LO2_FREQ                          |
| <b>Parameters:</b> | <freq>, frequency in Hz                  |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the target frequency of the LO2 PLL |
| <b>Syntax:</b>       | MANual:LO2_FREQ?                            |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <freq>, frequency in Hz                     |

#### 5.1.25 MANual:IF2\_FREQ

Only available when the manual control dialog is active.

**Event:**

|                    |                         |
|--------------------|-------------------------|
| <b>Effect:</b>     | Sets the IF2 frequency  |
| <b>Syntax:</b>     | MANual:IF2_FREQ         |
| <b>Parameters:</b> | <freq>, frequency in Hz |

**Query:**

|                      |                           |
|----------------------|---------------------------|
| <b>Effect:</b>       | Queries the IF2 frequency |
| <b>Syntax:</b>       | MANual:IF2_FREQ?          |
| <b>Parameters:</b>   | None                      |
| <b>Return value:</b> | <freq>, frequency in Hz   |

#### 5.1.26 MANual:PORT1\_EN

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the enable signal for the port 1 receiver |
| <b>Syntax:</b>     | MANual:PORT1_EN                                    |
| <b>Parameters:</b> | TRUE or FALSE                                      |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the enable signal for the port 1 receiver |
| <b>Syntax:</b>       | MANual:PORT1_EN?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 5.1.27 MANual:PORT2\_EN

Only available when the manual control dialog is active.

**Event:**

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Controls the enable signal for the port 2 receiver |
| <b>Syntax:</b>     | MANual:PORT2_EN                                    |
| <b>Parameters:</b> | TRUE or FALSE                                      |

**Query:**

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the status of the enable signal for the port 2 receiver |
| <b>Syntax:</b>       | MANual:PORT2_EN?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | TRUE or FALSE   |

#### 5.1.28 MANual:REF\_EN

Only available when the manual control dialog is active.

**Event:**

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Controls the enable signal for the reference receiver |
| <b>Syntax:</b>     | MANual:REF_EN   |
| <b>Parameters:</b> | TRUE or FALSE   |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the status of the enable signal for the reference receiver |
| <b>Syntax:</b>       | MANual:REF_EN?   |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | TRUE or FALSE  |

#### 5.1.29 MANual:SAMPLES

Only available when the manual control dialog is active.

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the number of ADC samples per reading                 |
| <b>Syntax:</b>     | MANual:SAMPLES   |
| <b>Parameters:</b> | <samples>, value between 16 and 131072 in increments of 16 |

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the number of ADC samples per reading |
| <b>Syntax:</b>       | MANual:SAMPLES?                               |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <samples>                                     |

#### 5.1.30 MANual:WINDOW

Only available when the manual control dialog is active.

Event:

|                    |  |
|--------------------|--|
| <b>Effect:</b>     | Sets the window for the DFT calculation        |
| <b>Syntax:</b>     | MANual:WINDOW                                  |
| <b>Parameters:</b> | <window>, either NONE, KAISER, HANN or FLATTOP |

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the window for the DFT calculation |
| <b>Syntax:</b>       | MANual:WINDOW?                             |
| <b>Parameters:</b>   | None                                       |
| <b>Return value:</b> | NONE, KAISER, HANN or FLATTOP              |

#### 5.1.31 MANual:PORT1\_MIN

Only available when the manual control dialog is active.

Query:

|                    |   |
|--------------------|---|
| <b>Effect:</b>     | Queries the minimum observed port 1 ADC value in the last sampling period |
| <b>Syntax:</b>     | MANual:PORT1_MIN?   |
| <b>Parameters:</b> | None  |



|                      |                   |
|----------------------|-------------------|
| <b>Return value:</b> | minimum ADC value |
|----------------------|-------------------|

#### 5.1.32 MANual:PORT<sub>I</sub>\_MAX

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the maximum observed port <sub>I</sub> ADC value in the last sampling period |
| <b>Syntax:</b>       | MANual:PORT <sub>I</sub> _MAX?   |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | maximum ADC value  |

#### 5.1.33 MANual:PORT<sub>I</sub>\_MAG

Only available when the manual control dialog is active.

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the observed magnitude at port <sub>I</sub> in the last sampling period |
| <b>Syntax:</b>       | MANual:PORT <sub>I</sub> _MAG?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | port <sub>I</sub> magnitude (linear unit, arbitrary scale)                      |

#### 5.1.34 MANual:PORT<sub>I</sub>\_PHase

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the observed phase at port <sub>I</sub> in the last sampling period        |
| <b>Syntax:</b>       | MANual:PORT <sub>I</sub> _PHase?   |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | phase in degree (random value because it is relativ to an internal sampling clock) |

#### 5.1.35 MANual:PORT<sub>I</sub>\_REferenced

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the observed signal at port <sub>I</sub> relative to the reference in the last sampling period |
| <b>Syntax:</b>       | MANual:PORT <sub>I</sub> _REferenced?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | <real>, <imag>   |

#### 5.1.36 MANual:PORT<sub>2</sub>\_MIN

Only available when the manual control dialog is active.

Query:

|                |  |
|----------------|--|
| <b>Effect:</b> | Queries the minimum observed port <sub>2</sub> ADC value in the last sampling period |
| <b>Syntax:</b> | MANual:PORT <sub>2</sub> _MIN?   |

|                      |                   |
|----------------------|-------------------|
| <b>Parameters:</b>   | None              |
| <b>Return value:</b> | minimum ADC value |

#### 5.1.37 MANual:PORT2\_MAX

Only available when the manual control dialog is active.

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the maximum observed port 2 ADC value in the last sampling period |
| <b>Syntax:</b>       | MANual:PORT2_MAX?   |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | maximum ADC value   |

#### 5.1.38 MANual:PORT2\_MAG

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the observed magnitude at port 2 in the last sampling period |
| <b>Syntax:</b>       | MANual:PORT2_MAG?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | port 1 magnitude (linear unit, arbitrary scale)                      |

#### 5.1.39 MANual:PORT2\_PHASE

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the observed phase at port 2 in the last sampling period                   |
| <b>Syntax:</b>       | MANual:PORT2_PHASE?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | phase in degree (random value because it is relativ to an internal sampling clock) |

#### 5.1.40 MANual:PORT2\_REFERENCED

Only available when the manual control dialog is active.

Query:

|                      |   |
|----------------------|---|
| <b>Effect:</b>       | Queries the observed signal at port 2 relative to the reference in the last sampling period |
| <b>Syntax:</b>       | MANual:PORT2_REFERENCED?  |
| <b>Parameters:</b>   | None  |
| <b>Return value:</b> | <real>, <imag>  |

#### 5.1.41 MANual:REF\_MIN

Only available when the manual control dialog is active.

Query:

|                |  |
|----------------|--|
| <b>Effect:</b> | Queries the minimum observed reference ADC value in the last sampling period |
|----------------|--|

|                      |                   |
|----------------------|-------------------|
| <b>Syntax:</b>       | MANual:REF_MIN?   |
| <b>Parameters:</b>   | None              |
| <b>Return value:</b> | minimum ADC value |

#### 5.1.42 MANual:REF\_MAX

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the maximum observed reference ADC value in the last sampling period |
| <b>Syntax:</b>       | MANual:REF_MAX?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | maximum ADC value  |

#### 5.1.43 MANual:REF\_MAG

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the observed magnitude at the reference receiver in the last sampling period |
| <b>Syntax:</b>       | MANual:REF_MAG?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | port 1 magnitude (linear unit, arbitrary scale)                                      |

#### 5.1.44 MANual:REF\_PHASE

Only available when the manual control dialog is active.

Query:

|                      |  |
|----------------------|--|
| <b>Effect:</b>       | Queries the observed phase at the reference receiver in the last sampling period   |
| <b>Syntax:</b>       | MANual:REF_PHASE?  |
| <b>Parameters:</b>   | None   |
| <b>Return value:</b> | phase in degree (random value because it is relativ to an internal sampling clock) |

## 6 Streaming data

The SCPI server works well for configuring the device and also for reading trace data once an acquisition is done. But it isn't very well suited for reading data while the device is capturing it. For some applications (e.g. when running continuous sweeps) it may be beneficial to process the data externally as it getting captured. For this purpose, the LibreVNA-GUI supports streaming the data over dedicated ports.

These streaming servers have to be enabled first. This can be done in **Window** > **Preferences** > **Streaming Servers**.

There are a total of 5 streaming servers available. They can all be enabled and used at the same time, although not all servers will output data all the time.

- **VNA raw data:** Outputs the raw S-parameters without any calibration applied. This output is always available, even when a calibration is enabled or de-embedding it active. Apart from averaging (if enabled) no processing is done on the data.

- **VNA calibrated data:** Outputs the calibrated S-parameters with the calibration applied. This output is only available when a calibration is enabled.
- **VNA de-embedded data:** Outputs the de-embedded S-parameters with the de-embedding and calibration (if enabled) applied. This output is only available when de-embedding is active.
- **SA raw data:** Outputs the raw (not normalized) power levels from the spectrum analyzer. This output is always available, even when normalizing is active.
- **SA normalized data:** Outputs the normalized power levels from the spectrum analyzer. This output is only available when normalizing is active.

All servers output a newline-terminated line of json formatted data for each measurement point in the sweep:

#### Example

```
{ "Z0": 50.0, "dBm": -20.0, "frequency": 42993000.0, "measurements": { "S11_imag": -0.061379313997181856, "S11_real": 0.023033630841401063, "S12_imag": 0.3205479840477101, "S12_real": -0.5742283570681822, "S21_imag": -0.3746074656570865, "S21_real": 0.6126114195570408, "S22_imag": 0.06312766256272641, "S22_real": -0.018668561526968372 }, "pointNum": 7 }
```

#### Example

```
{ "frequency": 2182396.0, "measurements": { "PORT1": 7.343487141042715e-06, "PORT2": 6.78117066854611e-06 }, "pointNum": 445 }
```