LibreVNA SCPI Programming Guide

April 15, 2021

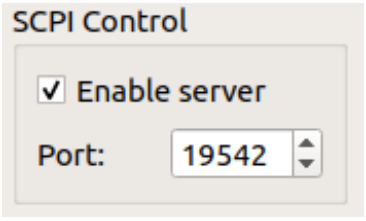
Contents

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:FWRevision?
```

- If a 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 command generates a (possibly empty) response, terminated with a newline character.

- 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 usually have an empty response (unless there was an error).
  - **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:

Effect:	Returns the identifications string
Syntax:	*IDN?
Parameters:	None
Return value:	LibreVNA-GUI

4.1.2 *LST

Query:

Effect:	Lists all available commands
Syntax:	*LST?
Parameters:	None
Return value:	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:

Effect:	Disconnects from the device
Syntax:	DEVice:DISConnect
Parameters:	None

4.2.2 DEVice:CONNect

Event:

Effect:	Connects to a device. If no serialnumber is specified, the connection is made with the first device found

Syntax:	DEVice:CONNect [<serialnumber>]
Parameters:	<serialnumber> Serialnumber of the device that should be connected

Example

```
:DEV:CONN 206039903350
```

Query:

Effect:	Queries the serial number of the connected device
Syntax:	DEVice:CONNect?
Parameters:	None
Return value:	<serialnumber> or “Not connected”

Example

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

4.2.3 DEVice:LIST

Query:

Effect:	Lists all available devices by their serial numbers
Syntax:	DEVice:LIST?
Parameters:	None
Return value:	List of serialnumbers

Example

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

4.2.4 DEVice:MODE

Event:

Effect:	Switches the device to the specified mode
Syntax:	DEVice:MODE <mode>
Parameters:	<mode>: VNA: set to vector analyzer GEN: set to signal generator SA: set to spectrum analyzer

Example

```
:MODE VNA
```

Query:

Effect:	Queries the currently active mode
Syntax:	DEVice:MODE?
Parameters:	None
Return value:	<mode>: VNA: set to vector analyzer GEN: set to signal generator SA: set to spectrum analyzer

Example

```
:MODE?
VNA
```

4.2.5 DEVice:REFerence:OUT

Event:

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

Query:

Effect:	Queries the reference output frequency
Syntax:	DEVice:REFerence:OUT?
Parameters:	None
Return value:	Output frequency in MHz

4.2.6 DEVice:REFerence:IN

Event:

Effect:	Set the reference input mode
Syntax:	DEVice:REFerence:IN <mode>
Parameters:	<mode>: INT: use internal reference EXT: use external reference AUTO: automatic reference switching

Query:

Effect:	Queries the reference source
Syntax:	DEVice:REFerence:IN?
Parameters:	None
Return value:	INT or EXT

4.2.7 DEVice:STAtus:UNLOcked

Query:

Effect:	Queries the PLL lock error flag

Syntax:	DEVice:STAtus:UNLOcked?
Parameters:	None
Return value:	TRUE or FALSE

4.2.8 DEVice:STAtus:ADCOVERload

Query:

Effect:	Queries the ADC overload error flag
Syntax:	DEVice:STAtus:ADCOVERload?
Parameters:	None
Return value:	TRUE or FALSE

4.2.9 DEVice:STAtus:UNLEVel

Query:

Effect:	Queries the output level error flag
Syntax:	DEVice:STAtus:UNLEVel?
Parameters:	None
Return value:	TRUE or FALSE

4.2.10 DEVice:INFo:FWREVision

Query:

Effect:	Returns the firmware revision of the connected device
Syntax:	DEVice:INFo:FWREVision?
Parameters:	None
Return value:	<mayor>.<minor>.<patch>

Example

```
:DEV:INF:FWREV?
1.0.0
```

4.2.11 DEVice:INFo:HWREVision

Query:

Effect:	Returns the hardware revision of the connected device
Syntax:	DEVice:INFo:HWREVision?
Parameters:	None
Return value:	<revision>, single char

Example

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

4.2.12 DEVice:INFo:TEMPeratures

Query:

Effect:	Queries the temperatures of certain chips
Syntax:	DEVice:INFo:TEMPeratures?
Parameters:	None
Return value:	<source>/<1.LO>/<CPU>

Example

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

4.2.13 DEVice:INFo:MINFrequency

Query:

Effect:	Queries the lowest frequency the device can measure
Syntax:	DEVice:INFo:MINFrequency?
Parameters:	None
Return value:	lowest frequency in Hz

4.2.14 DEVice:INFo:MAXFrequency

Query:

Effect:	Queries the highest frequency the device can measure
Syntax:	DEVice:INFo:MAXFrequency?
Parameters:	None
Return value:	highest frequency in Hz

4.2.15 DEVice:INFo:MINIFBW

Query:

Effect:	Queries the lowest IF bandwidth setting
Syntax:	DEVice:INFo:MINIFBW?
Parameters:	None
Return value:	lowest possible IF bandwidth in Hz

4.2.16 DEVice:INFo:MAXIFBW

Query:

Effect:	Queries the highest IF bandwidth setting
Syntax:	DEVice:INFo:MAXIFBW?
Parameters:	None
Return value:	highest possible IF bandwidth in Hz

4.2.17 DEVice:INFo:MAXPoints

Query:

Effect:	Queries the maximum number of points per sweep
Syntax:	DEVice:INFo:MAXPoints?
Parameters:	None
Return value:	maximum number of points

4.2.18 DEVice:INFo:MINPOWer

Query:

Effect:	Queries the minimum output power
Syntax:	DEVice:INFo:MINPOWer?
Parameters:	None
Return value:	minimum output power in dBm

4.2.19 DEVice:INFo:MAXPOWer

Query:

Effect:	Queries the maximum output power
Syntax:	DEVice:INFo:MAXPOWer?
Parameters:	None
Return value:	maximum output power in dBm

4.2.20 DEVice:INFo:MINRBW

Query:

Effect:	Queries the lowest resolution bandwidth setting
Syntax:	DEVice:INFo:MINRBW?
Parameters:	None
Return value:	lowest possible resolution bandwidth in Hz

4.2.21 DEVice:INFo:MAXRBW

Query:

Effect:	Queries the highest resolution bandwidth setting
Syntax:	DEVice:INFo:MAXRBW?
Parameters:	None
Return value:	highest possible resolution bandwidth in Hz

4.2.22 DEVice:INFo:MAXHARMonicfrequency

Query:

Effect:	Queries the (theoretical) maximum frequency when using harmonic mixing in VNA mode
Syntax:	DEVice:INFo:MAXHARMonicfrequency?
Parameters:	None

Return value:	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:FREQuency:SPAN

Event:

Effect:	Sets the span of the sweep
Syntax:	VNA:FREQuency:SPAN
Parameters:	, in Hz

Query:

Effect:	Queries the currently selected span
Syntax:	VNA:FREQuency:SPAN?
Parameters:	None
Return value:	span in Hz

4.3.2 VNA:FREQuency:START

Event:

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

Query:

Effect:	Queries the currently selected start frequency
Syntax:	VNA:FREQuency:START?
Parameters:	None
Return value:	start frequency in Hz

4.3.3 VNA:FREQuency:CENTer

Event:

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

Query:

Effect:	Queries the currently selected center frequency
Syntax:	VNA:FREQuency:CENTer?

Parameters:	None
Return value:	center frequency in Hz

4.3.4 VNA:FREQuency:STOP

Event:

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

Query:

Effect:	Queries the currently selected stop frequency
Syntax:	VNA:FREQuency:STOP?
Parameters:	None
Return value:	stop frequency in Hz

4.3.5 VNA:FREQuency:FULL

Event:

Effect:	Sets the device to the maximum span possible
Syntax:	VNA:FREQuency:FULL
Parameters:	None

4.3.6 VNA:ACQuisition:IFBW

Event:

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

Query:

Effect:	Queries the currently selected IF bandwidth
Syntax:	VNA:ACQuisition:IFBW?
Parameters:	None
Return value:	IF bandwidth in Hz

4.3.7 VNA:ACQuisition:POINTS

Event:

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

Query:

Effect:	Queries the currently selected number of points

Syntax:	VNA:ACQuisition:POINTS?
Parameters:	None
Return value:	points

4.3.8 VNA:ACQuisition:AVG

Event:

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

Query:

Effect:	Queries the currently configured number of sweeps
Syntax:	VNA:ACQuisition:AVG?
Parameters:	None
Return value:	sweeps

4.3.9 VNA:STIMulus:LVL

Event:

Effect:	Sets the output power of the stimulus signal
Syntax:	VNA:STIMulus:LVL
Parameters:	<power>, in dBm

Query:

Effect:	Queries the currently selected output power
Syntax:	VNA:STIMulus:LVL?
Parameters:	None
Return value:	power in dBm

4.3.10 VNA:TRACe:LIST

Query:

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

Example

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

4.3.11 VNA:TRACe:DATA

Query:

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

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

4.3.12 VNA:TRACe:AT

Query:

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

Example

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

4.3.13 VNA:TRACe:NEW

Event:

Effect:	Creates a new trace
Syntax:	VNA:TRACe:NEW
Parameters:	<trace name>

4.3.14 VNA:TRACe:RENAME

Event:

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

4.3.15 VNA:TRACe:PAUSE

Event:

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

4.3.16 VNA:TRACe:RESUME

Event:

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

4.3.17 VNA:TRACe:PAUSED

Query:

Effect:	Queries whether a trace is paused
Syntax:	VNA:TRACe:PAUSED?
Parameters:	<trace>, either by name or by index
Return value:	TRUE or FALSE

4.3.18 VNA:TRACe:PARAMeter

Event:

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

Query:

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

4.3.19 VNA:TRACe:TYPE

Event:

Effect:	Sets the storage type of a trace
Syntax:	VNA:TRACe:TYPE
Parameters:	<trace>, either by name or by index <type>, options are OVERWRITE, MAXHOLD or MINHOLD

Query:

Effect:	Queries the storage type of a trace

Syntax:	VNA:TRACe:TYPE?
Parameters:	<trace>, either by name or by index
Return value:	OVERWRITE, MAXHOLD or MINHOLD

4.3.20 VNA:CALibration:TYPE

Event:

Effect:	Sets the calibration type. This command fails if the required measurements have not been taken yet
Syntax:	VNA:CALibration:TYPE
Parameters:	<type>, options are NONE, PORT_1, PORT_2, SOLT, NORMALIZE or TRL

Query:

Effect:	Queries the currently active calibration type
Syntax:	VNA:CALibration:TYPE?
Parameters:	None
Return value:	NONE, PORT_1, PORT_2, SOLT, NORMALIZE or TRL

4.3.21 VNA:CALibration:MEASure

Event:

Effect:	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.
Syntax:	VNA:CALibration:MEASure
Parameters:	<type>, options are: PORT_1_OPEN PORT_1_SHORT PORT_1_LOAD PORT_2_OPEN PORT_2_SHORT PORT_2_LOAD THROUGH ISOLATION LINE

4.3.22 VNA:CALibration:BUSY

Query:

Effect:	Queries whether a calibration measurement is ongoing
Syntax:	VNA:CALibration:BUSY?
Parameters:	None
Return value:	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:

Effect:	Sets the output frequeny
Syntax:	GENerator:FREQuency
Parameters:	<frequency>, in Hz

Query:

Effect:	Queries the selected output frequency
Syntax:	GENerator:FREQuency?
Parameters:	None
Return value:	frequency in Hz

4.4.2 GENerator:LVL

Event:

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

Query:

Effect:	Queries the selected output power
Syntax:	GENerator:LVL?
Parameters:	None
Return value:	output level in dBm

4.4.3 GENerator:PORT

Event:

Effect:	Sets the active output port
Syntax:	GENerator:PORT
Parameters:	<output port> 0: output disabled 1: output signal at port 1 2: output signal at port 2

Query:

Effect:	Queries the selected output
Syntax:	GENerator:PORT?
Parameters:	None
Return value:	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:

Effect:	Sets the span of the sweep
Syntax:	SA:FREQuency:SPAN
Parameters:	, in Hz

Query:

Effect:	Queries the currently selected span
Syntax:	SA:FREQuency:SPAN?
Parameters:	None
Return value:	span in Hz

4.5.2 SA:FREQuency:START

Event:

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

Query:

Effect:	Queries the currently selected start frequency
Syntax:	SA:FREQuency:START?
Parameters:	None
Return value:	start frequency in Hz

4.5.3 SA:FREQuency:CENTer

Event:

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

Query:

Effect:	Queries the currently selected center frequency
Syntax:	SA:FREQuency:CENTer?
Parameters:	None
Return value:	center frequency in Hz

4.5.4 SA:FREQuency:STOP

Event:

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

Query:

Effect:	Queries the currently selected stop frequency
Syntax:	SA:FREQuency:STOP?
Parameters:	None
Return value:	stop frequency in Hz

4.5.5 SA:FREQuency:FULL

Event:

Effect:	Sets the device to the maximum span possible
Syntax:	SA:FREQuency:FULL
Parameters:	None

4.5.6 SA:ACQuisition:RBW

Event:

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

Query:

Effect:	Queries the currently selected resolution bandwidth
Syntax:	SA:ACQuisition:IFBW?
Parameters:	None
Return value:	resolution bandwidth in Hz

4.5.7 SA:ACQuisition:WINDow

Event:

Effect:	Sets the type of window used in the acquisition
Syntax:	SA:ACQuisition:WINDow
Parameters:	<windowtype> NONE KAISER HANN FLATTOP

Query:

Effect:	Queries the currently selected type of window

Syntax:	SA:ACQuisition:WINDow?
Parameters:	None
Return value:	NONE, KAISER, HANN or FLATTOP

4.5.8 SA:ACQuisition:DETector

Event:

Effect:	Sets the detector type
Syntax:	SA:ACQuisition:DETector
Parameters:	<detector> +PEAK -PEAK NORMAL SAMPLE AVERAGE

Query:

Effect:	Queries the currently selected detector type
Syntax:	SA:ACQuisition:DETector?
Parameters:	None
Return value:	+PEAK, -PEAK, NORMAL, SAMPLE or AVERAGE

4.5.9 SA:ACQuisition:AVG

Event:

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

Query:

Effect:	Queries the currently configured number of sweeps
Syntax:	SA:ACQuisition:AVG?
Parameters:	None
Return value:	sweeps

4.5.10 SA:ACQuisition:SIGid

Event:

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

Query:

Effect:	Queries whether signal identification is enabled
Syntax:	SA:ACQuisition:SIGid?
Parameters:	None

Return value:	TRUE or FALSE

4.5.11 SA:TRACKing:ENable

Event:

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

Query:

Effect:	Queries whether tracking generator is enabled
Syntax:	SA:TRACKing:ENable?
Parameters:	None
Return value:	TRUE or FALSE

4.5.12 SA:TRACKing:PORT

Event:

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

Query:

Effect:	Queries the output port of the tracking generator
Syntax:	SA:TRACKing:PORT?
Parameters:	None
Return value:	1 or 2

4.5.13 SA:TRACKing:LVL

Event:

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

Query:

Effect:	Queries the selected output power of the tracking generator
Syntax:	SA:TRACKing:LVL?
Parameters:	None
Return value:	output level in dBm

4.5.14 SA:TRACKing:OFFset

Event:

Effect:	Sets the offset frequency of the tracking generator

Syntax:	SA:TRACKing:OFFset
Parameters:	<offset>, in Hz

Query:

Effect:	Queries the selected offset frequency of the tracking generator
Syntax:	SA:TRACKing:OFFset?
Parameters:	None
Return value:	offset in Hz

4.5.15 SA:TRACKing:NORMalize:ENable

Event:

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

Query:

Effect:	Queries whether tracking generator normalization is enabled
Syntax:	SA:TRACKing:NORMalize:ENable?
Parameters:	None
Return value:	TRUE or FALSE

4.5.16 SA:TRACKing:NORMalize:MEASure

Event:

Effect:	Triggers a new normalization measurement
Syntax:	SA:TRACKing:NORMalize:MEASure
Parameters:	None

4.5.17 SA:TRACKing:NORMalize:LVL

Event:

Effect:	Sets the reference level for the normalization
Syntax:	SA:TRACKing:NORMalize:LVL
Parameters:	<normalization level>, in dBm

Query:

Effect:	Queries the selected reference level for the normalization
Syntax:	SA:TRACKing:NORMalize:LVL?
Parameters:	None
Return value:	normalization level in dBm

4.5.18 SA:TRACe:LIST

Query:

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

Example

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

4.5.19 SA:TRACe:DATA

Query:

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

Example

```
:SA:TRACE:DATA? PORT1
[9.5e+8,1.56378e-5,0],
[9.501e+8,1.66861e-5,0],
[9.502e+8,1.89638e-5,0],
[9.503e+8,1.87195e-5,0],
[9.504e+8,1.47292e-5,0],
[9.505e+8,1.40006e-5,0],
[9.506e+8,1.65665e-5,0],
[9.507e+8,1.48342e-5,0],
[9.508e+8,1.83062e-5,0],
[9.509e+8,1.66752e-5,0]
```

Note 1: actual response will not include newlines between data points, only at the end
Note 2: although the imaginary part is zero for all values, it is still included in the response

4.5.20 SA:TRACe:AT

Query:

Effect:	Returns the data at a specific frequency (possibly interpolated)
Syntax:	SA:TRACe:AT?
Parameters:	<trace>, either by name or by index <frequency>, in Hz
Return value:	real,imag (or "NaN,NaN" if specified frequeny is invalid)

Example

```
:SA:TRAC:AT? Port1 1000000000
-0.0458452,-0.028729
```

Note: although the imaginary part is always zero, it is still included in the response

4.5.21 SA:TRACe:NEW

Event:

Effect:	Creates a new trace
Syntax:	SA:TRACe:NEW
Parameters:	<trace name>

4.5.22 SA:TRACe:RENAME

Event:

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

4.5.23 SA:TRACe:PAUSE

Event:

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

4.5.24 SA:TRACe:RESUME

Event:

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

4.5.25 SA:TRACe:PAUSED

Query:

Effect:	Queries whether a trace is paused
Syntax:	SA:TRACe:PAUSED?
Parameters:	<trace>, either by name or by index
Return value:	TRUE or FALSE

4.5.26 SA:TRACe:PARAMeter

Event:

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

Query:

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

4.5.27 SA:TRACe:TYPE

Event:

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

Query:

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