

AUTOMATION TECHNIQUES FOR VNA MEASUREMENT

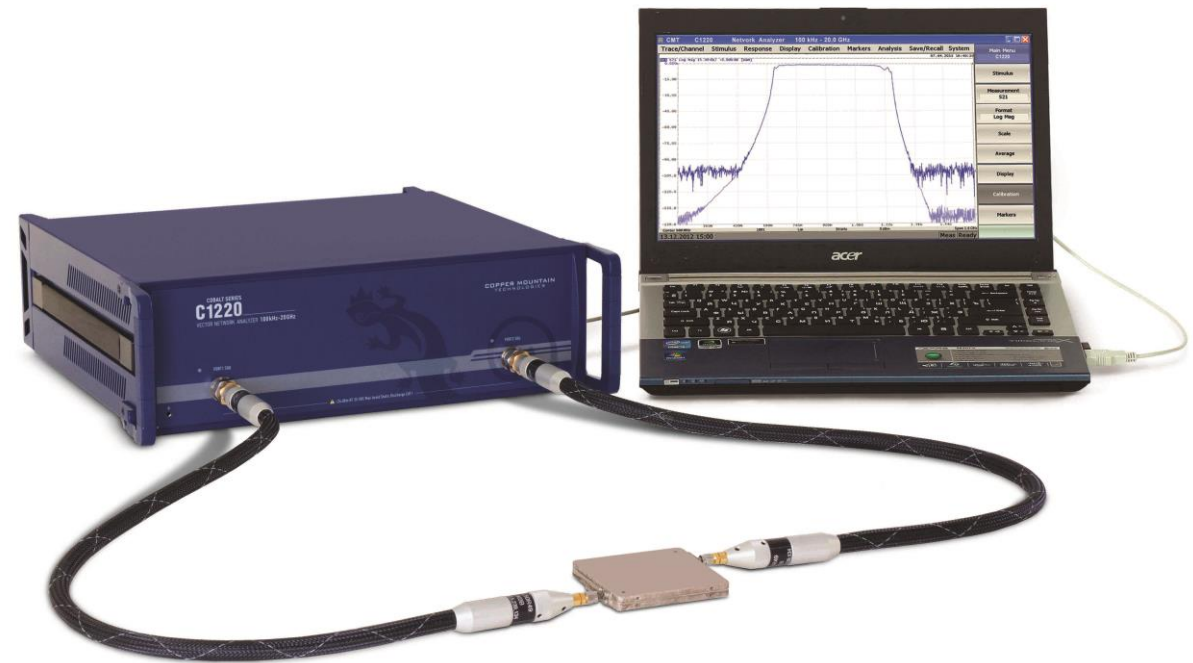
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WHY AUTOMATE VNA MEASUREMENTS?

- Operating a VNA through automation is an extremely powerful technique
- There is a learning curve, but hopefully this webinar will jump-start the process!



LOADING PYTHON

- Many programming platforms are available: Python, C++, C#, VBE among others
 - I'll focus here on Python 3.x, which is open source with lots of useful libraries and is therefore a great choice of instrument automation
1. Navigate to [Anaconda.com](https://anaconda.com) on your browser and download the executable for Windows or Linux
 2. After installation is complete, load the Virtual Instrument Software Architecture, pyvisa library. Do this by adding a new library source to Anaconda, conda-forge
 3. From the start menu, launch Anaconda Prompt; this will bring up an Anaconda command console
 4. Type "conda config --show channels" and it should return "defaults"

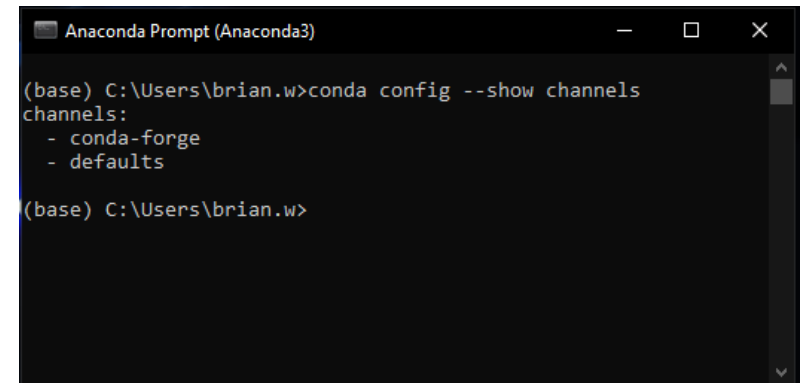
LOADING PYTHON

5. Enter “conda config -- add channels conda-forge”. This will add the library source, conda-forge, to the list.

- Type “conda config --show channels” and you’ll see the new addition

6. Now, type “conda install pyvisa” and answer “y” if asked to continue

- In the future, if Python states “module not found” for a library, use “conda install” in an Anaconda Prompt window to add it. Do not use “PIP”!
- With this, Python will be ready for instrument control



```
Anaconda Prompt (Anaconda3)
(base) C:\Users\brian.w>conda config --show channels
channels:
- conda-forge
- defaults
(base) C:\Users\brian.w>
```

ABOUT SCPI

- We use SCPI commands to control the VNA through software automation
- Standard Commands for Programmable Instruments, or SCPI, is a standardized language for instrument control
- These are ASCII strings which are sent to a computer socket assigned to an instrument
- Instruments of the same type *should* respond identically to SCPI commands
- All SCPI commands are detailed in the VNA operating and programming manual

CONNECTING TO THE VNA

- Make sure that the VNA software is running (RVNA, TRVNA, S2VNA, or S4VNA)
- Navigate to **System>Misc Setup>Network Remote Control Settings**
- Ensure that the Socket Server is ON and set to Port 5025
- For SNVNA, look under **Settings**

CONNECTING TO THE VNA

1. In Python, set up a visa resource manager:

```
rm = visa.ResourceManager()
```

2. Assign it to VNA default port 5025 and name it “CMT”

```
CMT = rm.open_resource('TCPIP0::localhost::5025::SOCKET')
```

- Local host or 127.0.0.1 refers to the machine on which the VNA software is running
 - If on another machine, enter that IP address

3. Set Carriage Return as a query termination, and set a long timeout for long sweeps

```
CMT.read_termination='\n'
```

```
CMT.timeout = 100000
```

SCPI COMMAND EXAMPLE

- To set up a VNA measurement with 1GHz Start, 5 GHz Stop, 801 points and 10 kHz IF Bandwidth, the SCPI Commands would be:

```
SENS:FREQ:STAR 1E9  
SENS:FREQ:STOP 5E9  
SENS:SWE:POIN 801  
SENS:BWID 10000
```

- Set trace 1 to measure S11:

```
CALC:PAR1:DEF S11
```

- Set sweep to programmatic triggering:

```
TRIG:SOUR:BUS
```



Example code with class statement

SCPI COMMAND EXAMPLE

- Sweep once:

TRIG:SEQ:SING

*OPC? (OPC query hangs until sweep is complete)

- Get the frequency points (comma separated data in string format):

Freq = SENS:FREQ:DATA?

- Get the reflection data in RI format (comma separated R,I,R,I,R,I...):

Data = CALC:TRAC1:DATA:SDAT?

- The data can now be formatted in any way desired and plotted using the matplotlib library

LET'S TRY IT!

