Using NI Elvis and MyDAQ to Support Remote Labs for STEM Education

8/1/24 AGBell

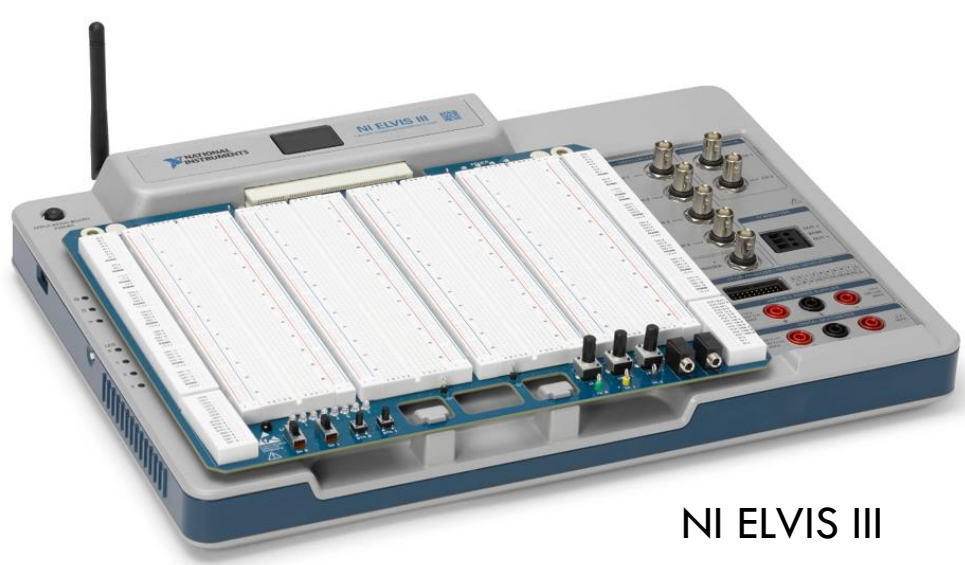
IVY TECH COMMUNITY COLLEGE

Abstract

Using NI Elvis and MyDAQ to Support Remote Labs for STEM Education

This presentation will discuss the detailed designs using NI MyDAQs and NI ELVIS IIIs to build circuits that can be remotely accessed from outside of the college. Lab experiments with RC and RL circuits, relays, MyDAQs, and the NI ELVISmx software suite can be used to evaluate RC and RL circuits. Likewise, lab experiments for active filters can be evaluated using NI ELVIS IIIs and NI Measurement Live software. Both the MyDAQ and ELVIS III boxes connect to computers via a USB interface. Each of the four rack-mounted computers is connected to both an ELVIS III and MyDAQ.

NI MyDAQ



NI ELVIS III

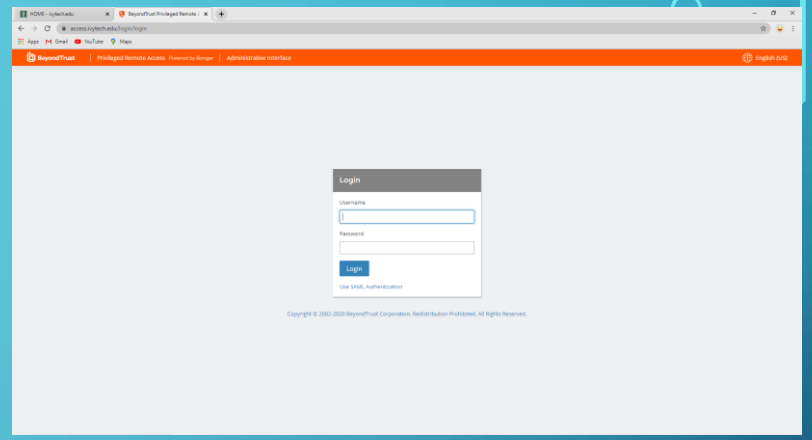
MyDAQ – remote access

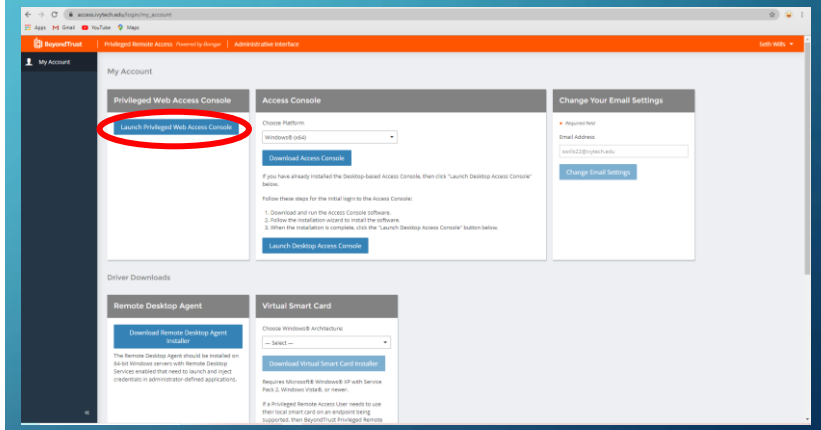
How to use GRE computers and associated equipment using Beyond Trust

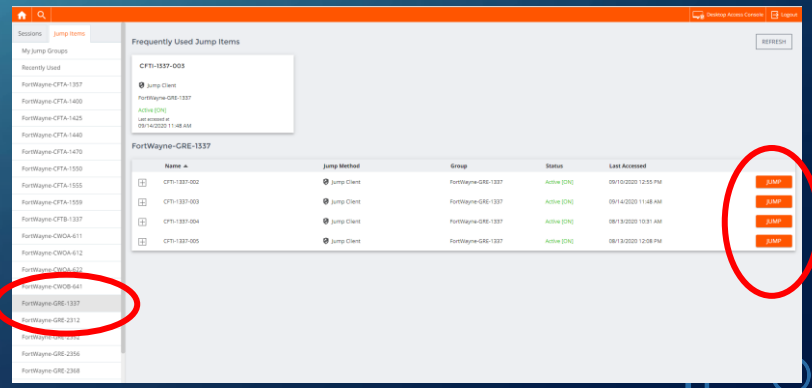
A. To access beyond go to https://access.ivytech.edu/login/login
B. Select Use SAML Authentication hyperlink under the Login button
C. Enter your Ivy Tech credentials
D. Select Launch Privileged Web Access Console
E. Under the Jump Items column highlight FortWayne-GRE-1337
   (4 servers should appear numbering 002-005)
F. Select which server you would like to use. (Depending on slots available)
   Select the orange JUMP button

We use a common username and password for the 4 GRE computers.

Due the cost of Beyond Trust we will be using a special VPN on the Ivy Tech this fall using Cisco AnyConnect. Students will still a common username and password, but they will need to load the Cisco AnyConnect software on their own computers …







MyDAQ – remote access

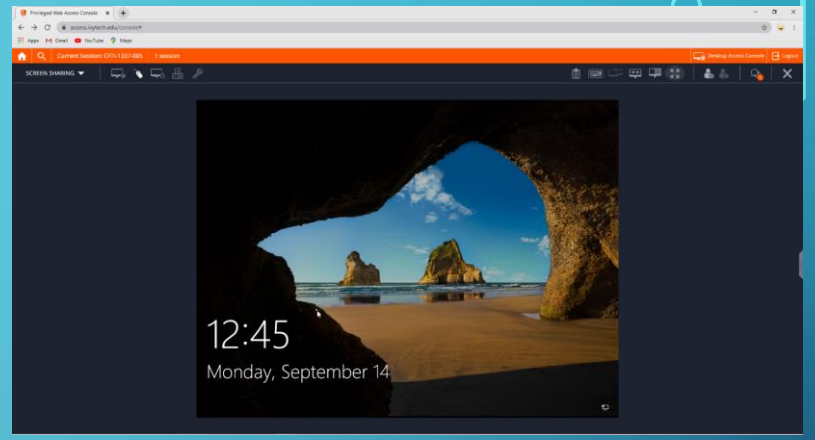
How to use GRE computers and associated equipment using Beyond Trust (cont)

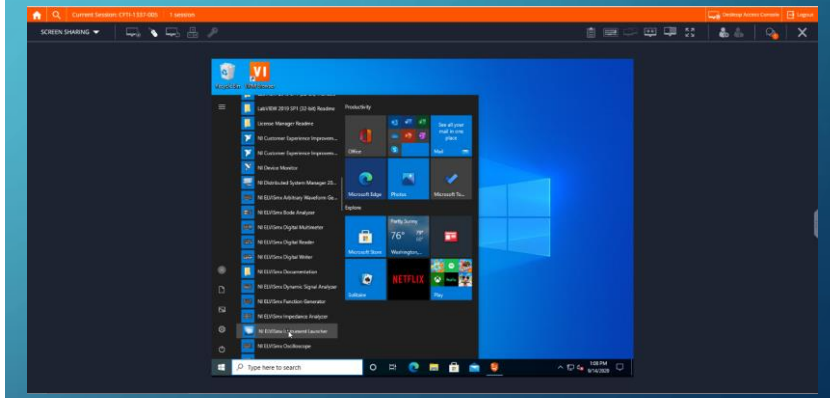
G. The windows login screen should appear.
H. Treat this window like Windows desktop pick the student account and enter the common password

II. Setup MyDAQ

A. National Instruments software suite
1. Navigate to windows icon in the left bottom corner
2. Find National Instruments drop down menu
3. Locate file shortcut NI ELVISmx Instrument Launcher and right click to start

B. Using the NI ELVISmx Instrument Launcher





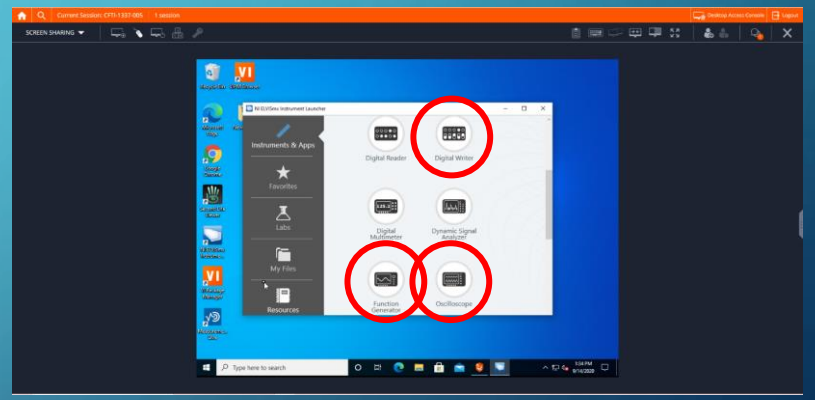
MyDAQ – remote access

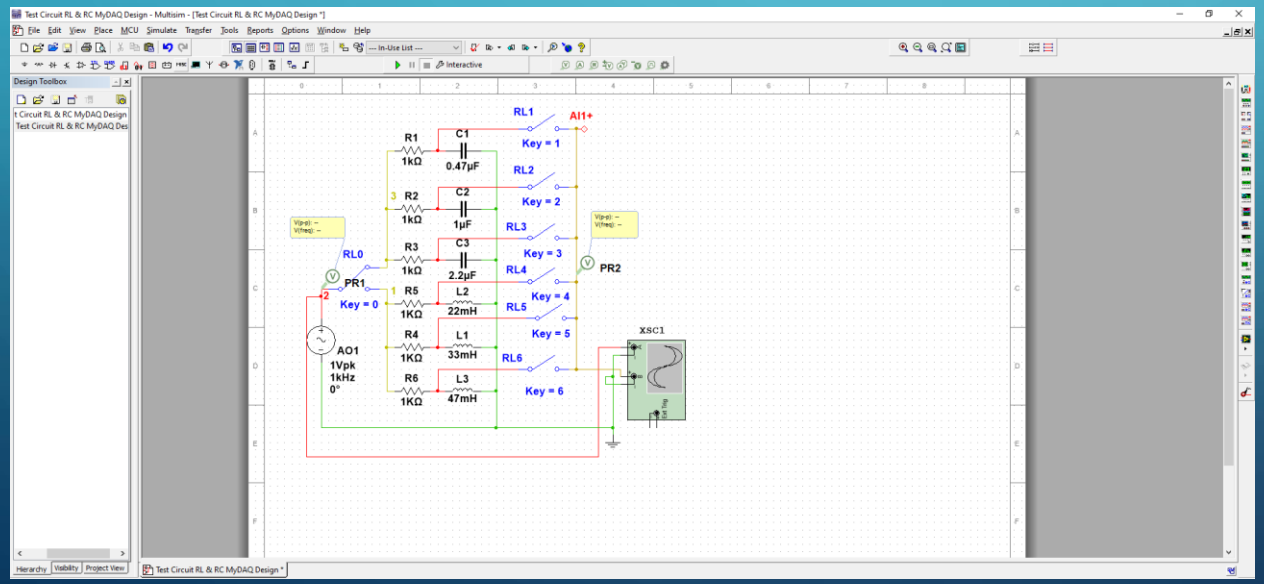
II. Setup MyDAQ (cont)

B. Using the NI ELVISmx Instrument Launcher

1. For an oscilloscope experiment start the following instruments: Oscilloscope >> Function generator >> Digital Writer

2. Schematic for the relay logic used for EECT series of experiments. AC input signal is diverted using rly0 to either feed capacitor or inductor side of circuit. The relays 1-6 are used to select the sample being tested.





MyDAQ – remote access

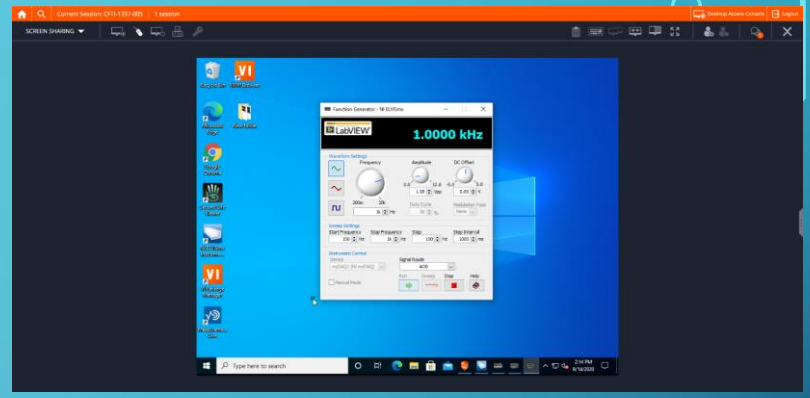
II. Setup MyDAQ (cont)

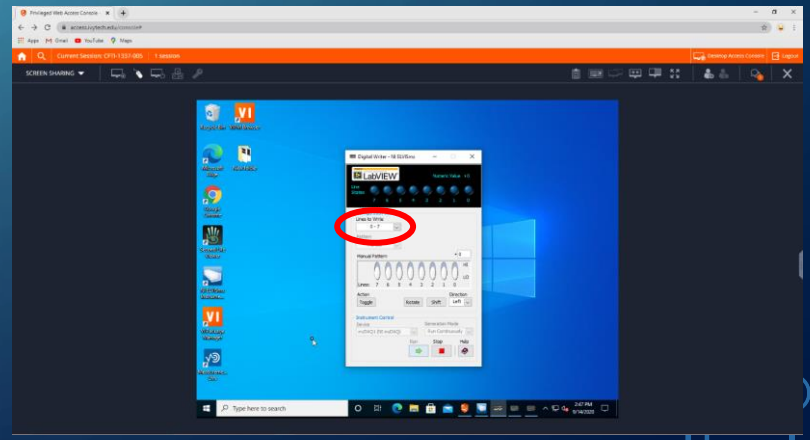
B. Using the NI ELVISmx Instrument Launcher

3. Function Generator operation type in frequency, Amplitude, then the Run button. (The frequency should appear)

4. Oscilloscope first enable channels AI0 and AI1 (with nothing selected on digital writer nothing selected both channels should look very similar in frequency and Vpp) Then press the Run button

5. Digital Writer open the Lines to Write drop down menu select 0 – 7





MyDAQ – remote access

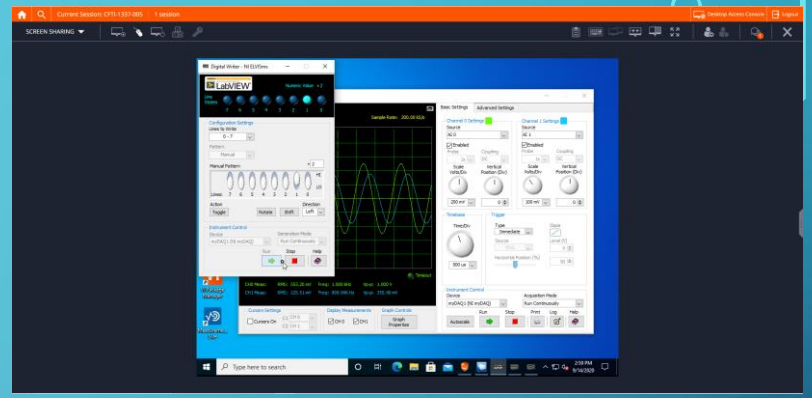
III. Conduct Experiment

B. Using the NI ELVISmx Instrument Launcher

a. Lay out is bit0 switches the function generator between the capacitors and the inductors. Bit1-3 selects capacitors, and bit4-6 selects the inductors to be tested

b. Each selector bit corresponds to the relay (bit1 = relay1, bit2 = relay2 … etc.) After selecting the desired bits press the Run button. You may switch between them

c. With the selector bit1 activated a 0.47uf and a 1k ohm resistor is being displayed (the signal on AI1(Blue) reflects the change). Take the measurement from channel 1 and compare to the results of the calculations. Note: The nominal value written on component may differ from the actual value.



MyDAQ – remote access

III. Conduct Experiment (cont)

B. Using the NI ELVISmx Instrument Launcher

d. DON'T FORGET TO DEACTIVATE THE BIT BEFORE MOVING ON TO THE NEXT EXPERIMENT!!!

e. After Deactivating the bit, move on to the next experiment

f. To access the inductor side of the experiment first select bit0 (this engages the switching relay), then select an inductor bit4-6

g. Performing the inductor set of experiments. Bit0 and bit4-6 is actuated, with 1kHz applied at 0.5Vpp.

MyDAQ – remote access

III. Conduct Experiment (cont)

B. Using the NI ELVISmx Instrument Launcher

6. AC Frequency Response - Bode plots

a. Within the NI ELVISmx Instrument Launcher window Bode Analyzer and Digital Writer.

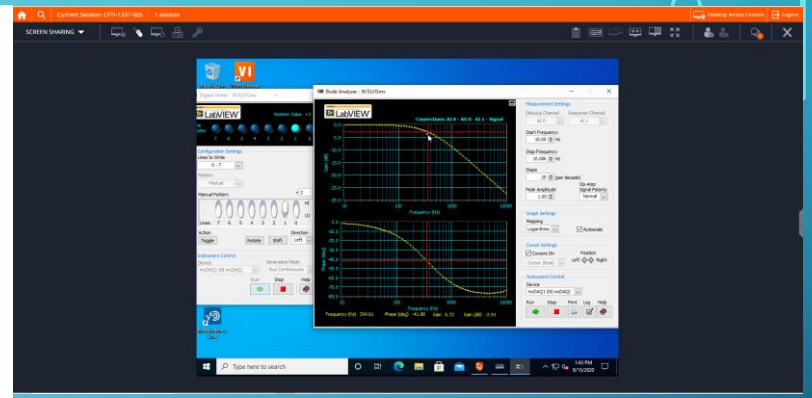
b. Control the relay bits the same way as in previous experiments apply the logic needed to examine the needed components

c. Set the frequency, turn the cursors on and run this may take a while to finish and the Run button

d. Set the next experiment logic up and repeat

Stop all running windows and log out

Results need to be saved to your Google Drive!



MyDAQ – tradeoff

Key feature

Pros

Very flexibility
Software and hardware are mature.
Cost is low and students can buy their own MyDAQ.
Could support active and passive circuits.
USB interface

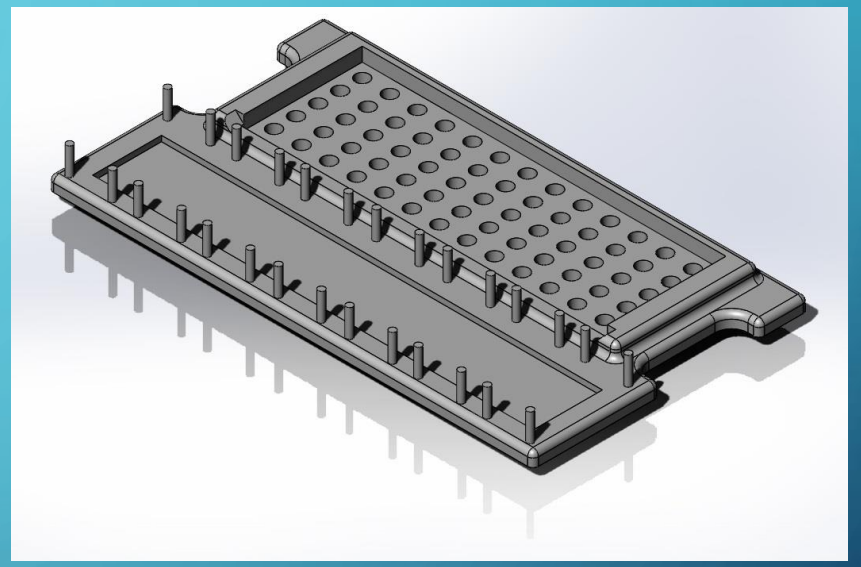
Cons

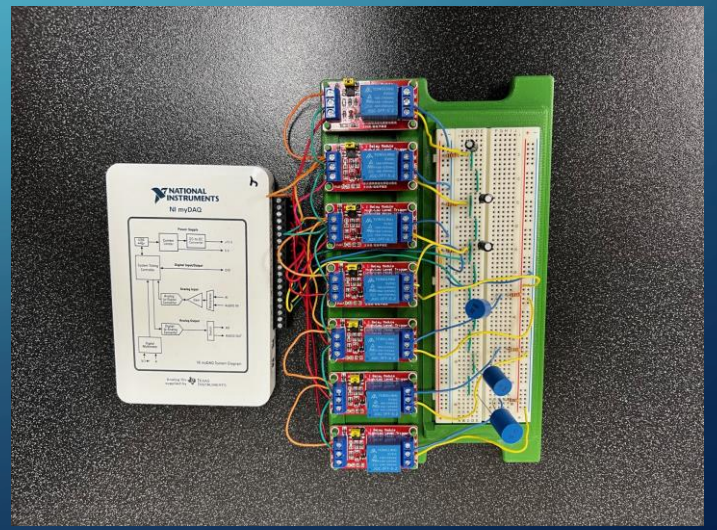
Bandwidth is not real high (20 KHz)
No LCR function
May be a little trick for some students to use.

NI MyDAQ

MyDAQ – Ivy Tech Implementation

Ivy Tech designed, and 3D printed a 7-relay holder using Solidworks that supported the used of a full-sized solderless breadboard and seven 5V relays.





Beyond Trust

access.ivytech.edu/console#

myivy | Ivy Tech | Ivy Tech Engineering | IvyLearn | BeyondTrust Privile... | Course Descriptions | Books | My Recordings - Zo... | Google | Collaborative Engin... | Robust Design Con... | Ivy Tech MEMS | My Channel | Shell Request | Other bookmarks

Desktop Access Console | Logout

Sessions | Jump Items

- My Jump Groups
- Recently Used
- FortWayne-CFCA-2306
- FortWayne-CFCA-2310
- FortWayne-CFTA-1346
- FortWayne-CFTA-1357
- FortWayne-CFTA-1400
- FortWayne-CFTA-1425
- FortWayne-CFTA-1440
- FortWayne-CFTA-1542
- FortWayne-CFTA-1550
- FortWayne-CFTA-1555
- FortWayne-CFTB-1337
- FortWayne-CWOA-611
- FortWayne-CWOA-612
- FortWayne-CWOA-622
- FortWayne-CWOB-641
- FortWayne-GRE-1337
- FortWayne-GRE-2312
- FortWayne-GRE-2352
- FortWayne-GRE-2356

Frequently Used Jump Items

REFRESH

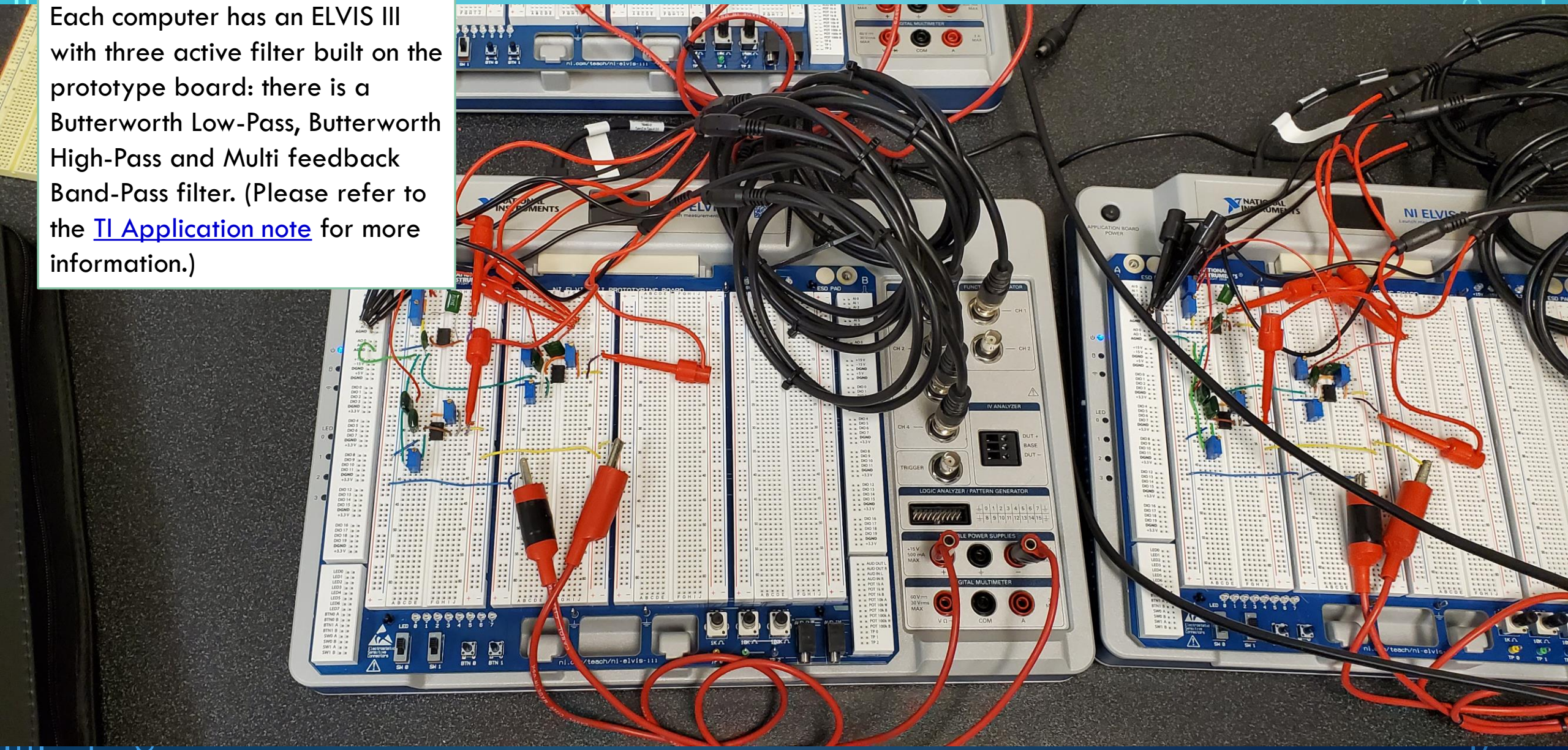
CFTI-1337-005	CFTI-1337-004	CFTI-1337-003	CFTB-1337-N01
Jump Client	Jump Client	Jump Client	Jump Client
FortWayne-GRE-1337	FortWayne-GRE-1337	FortWayne-GRE-1337	FortWayne-CFTB-1337
Active [ON]	Active [ON]	Active [ON]	Active [ON]
Last accessed at 03/16/2023 1:43 AM	Last accessed at 04/27/2023 9:40 AM	Last accessed at 04/27/2023 9:24 AM	Last accessed at 04/25/2023 6:32 PM

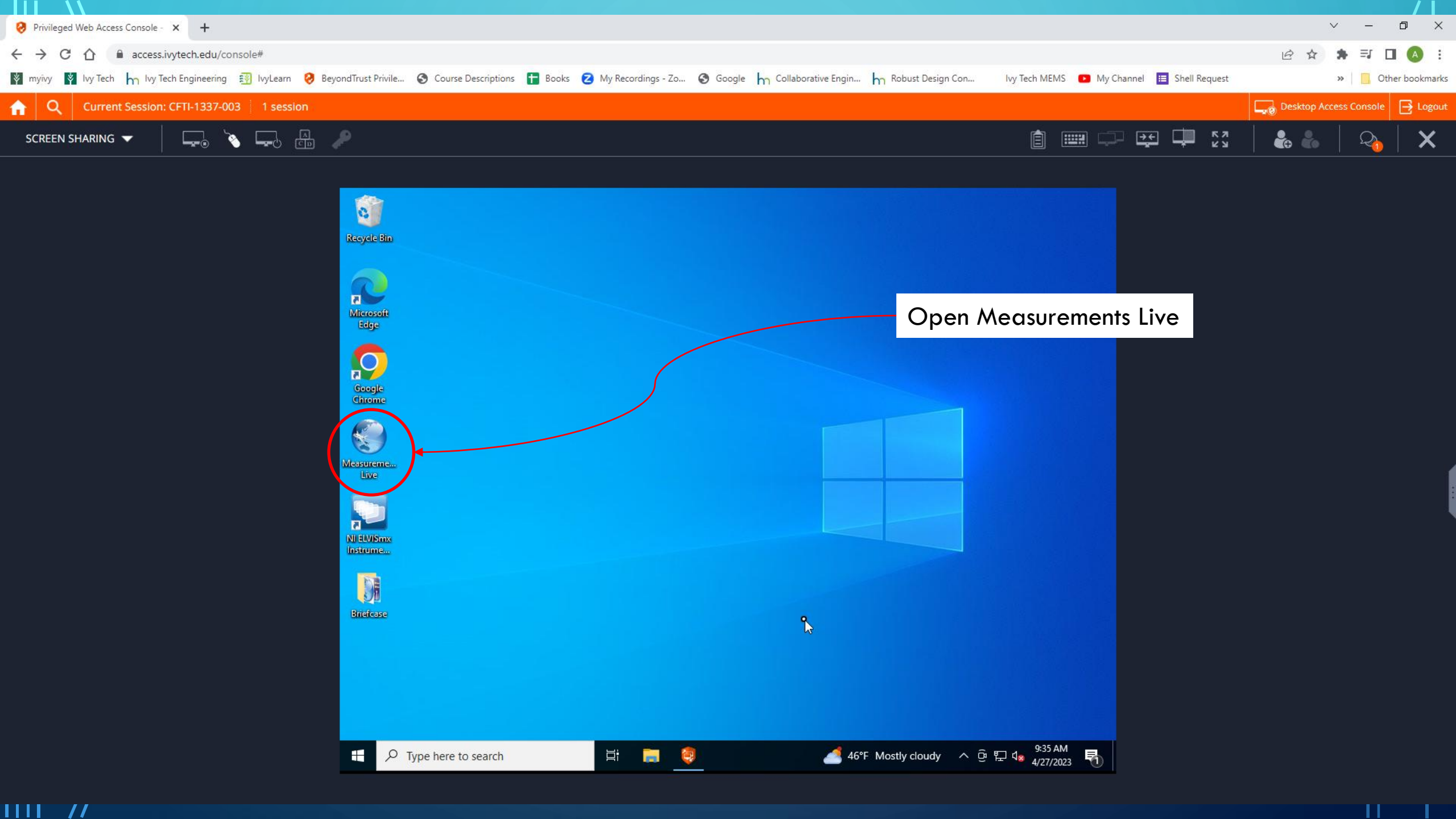
FortWayne-GRE-1337

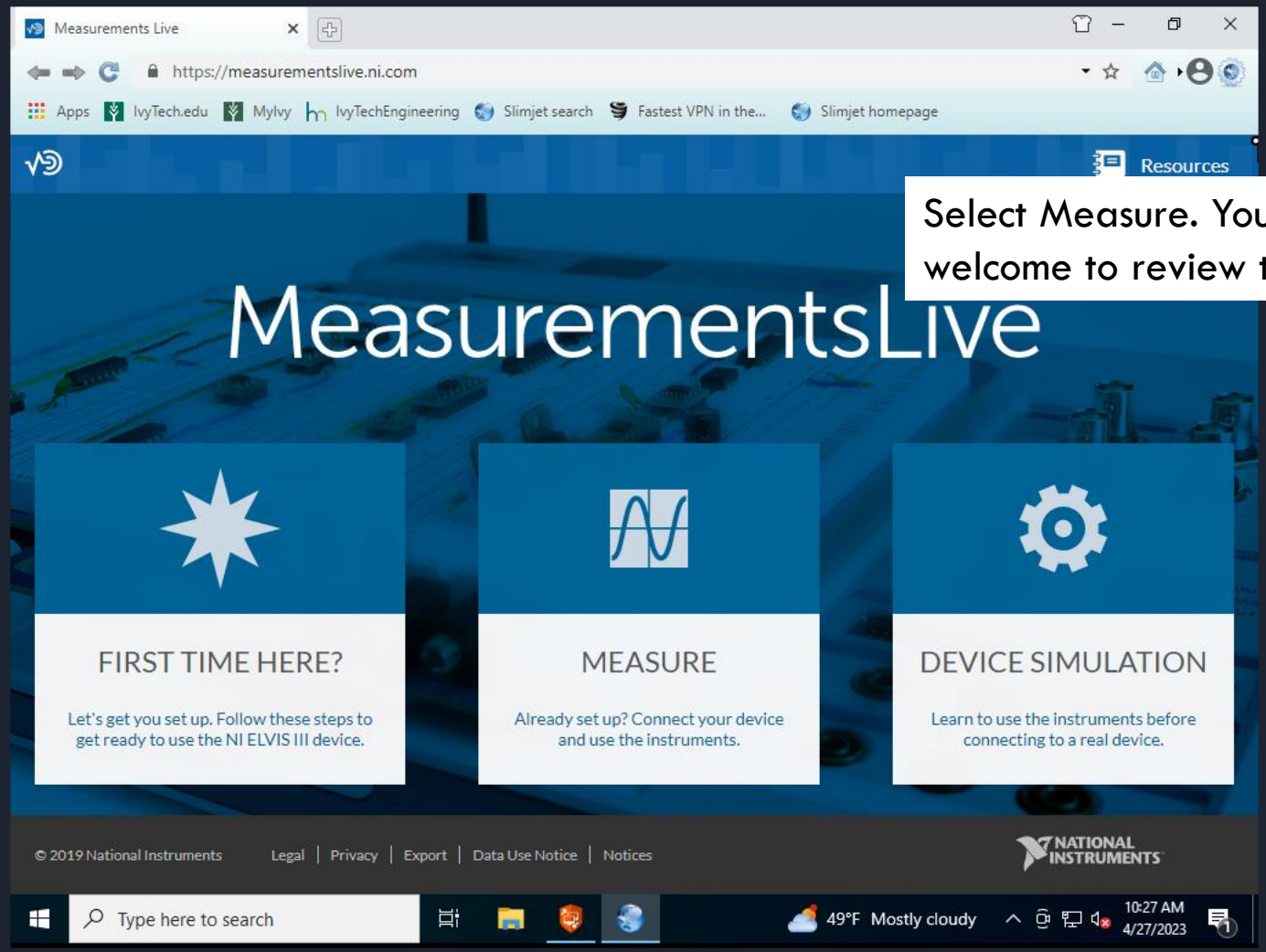
Name ▲	Jump Method	Group	Status	Last Accessed	
CFTI-1337-002	Jump Client	FortWayne-GRE-1337	Active [ON]	04/27/2023 9:12 AM	JUMP
CFTI-1337-003	Jump Client	FortWayne-GRE-1337	Active [ON]	04/27/2023 9:24 AM	JUMP
CFTI-1337-004	Jump Client	FortWayne-GRE-1337	Active [ON]	04/27/2023 9:40 AM	JUMP
CFTI-1337-005	Jump Client	FortWayne-GRE-1337	Active [ON]	03/16/2023 1:43 AM	JUMP

Launch BeyondTrust and select one of the FortWayne-GRE-1337 computers. If the computers are not online contact Professor Bell

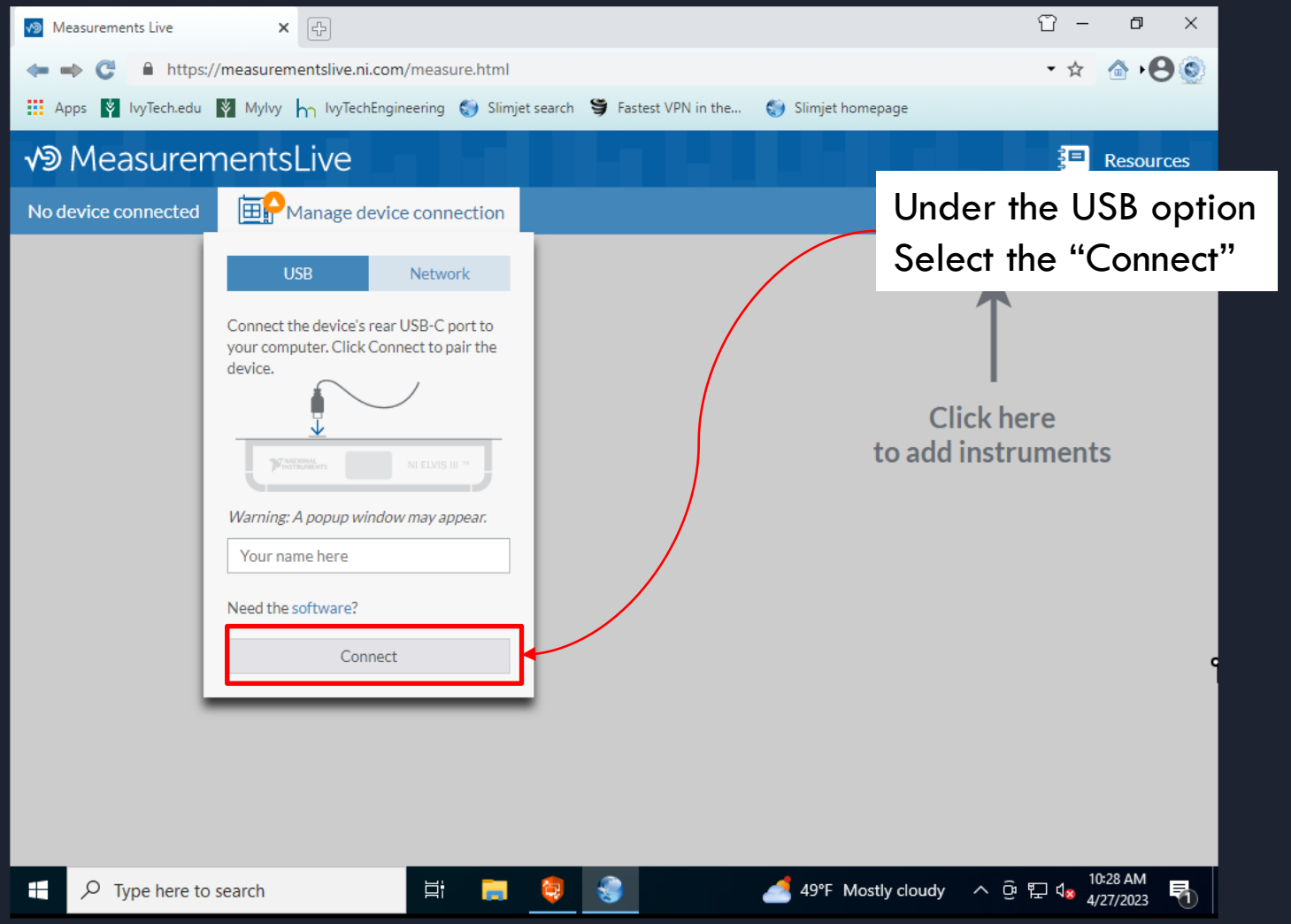
Each computer has an ELVIS III with three active filter built on the prototype board: there is a Butterworth Low-Pass, Butterworth High-Pass and Multi feedback Band-Pass filter. (Please refer to the TI Application note for more information.)

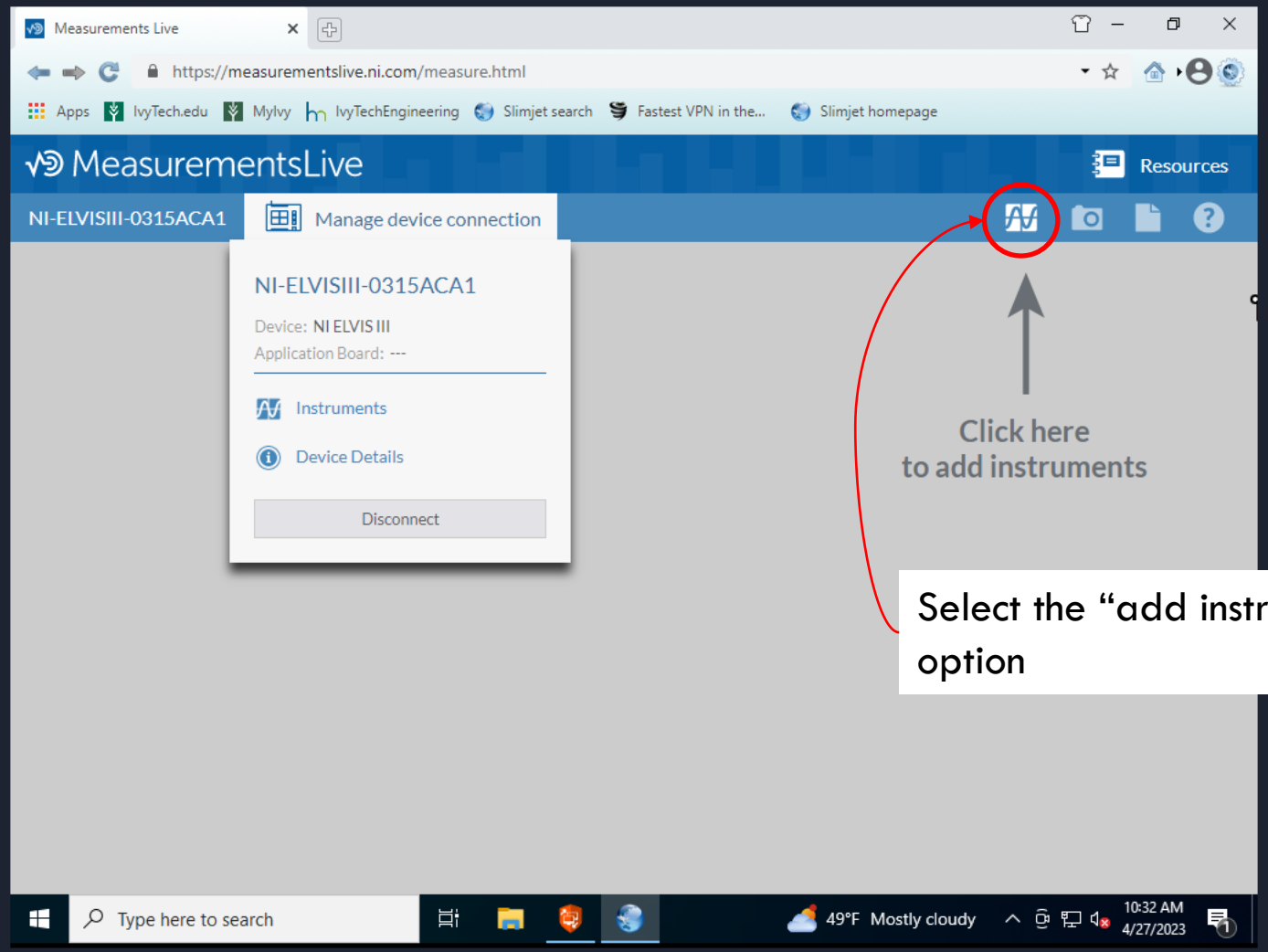


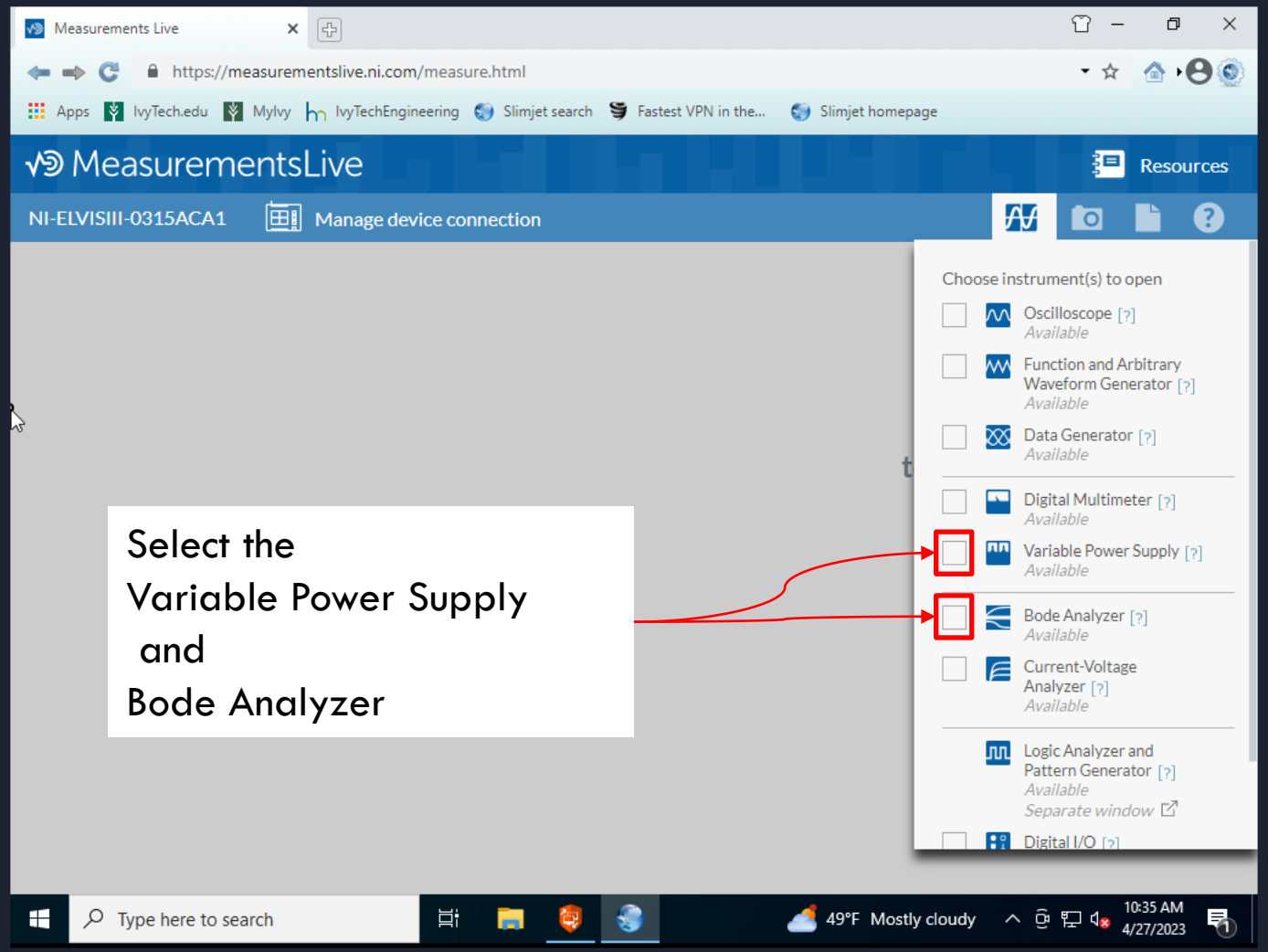

Privileged Web Access Console
access.ivytech.edu/console#
myivy
Ivy Tech
Ivy Tech Engineering
IvyLearn
BeyondTrust Privile...
Course Descriptions
Books
My Recordings - Zo...
Google
Collaborative Engin...
Robust Design Con...
Ivy Tech MEMS
My Channel
Shell Request
Other bookmarks
Current Session: CFTI-1337-003
1 session
Desktop Access Console
Logout
SCREEN SHARING
Recycle Bin
Microsoft Edge
Google Chrome
Measureme... Live
NI ELVISmx Instrume...
Briefcase
Open Measurements Live
Type here to search
46°F Mostly cloudy
9:35 AM
4/27/2023

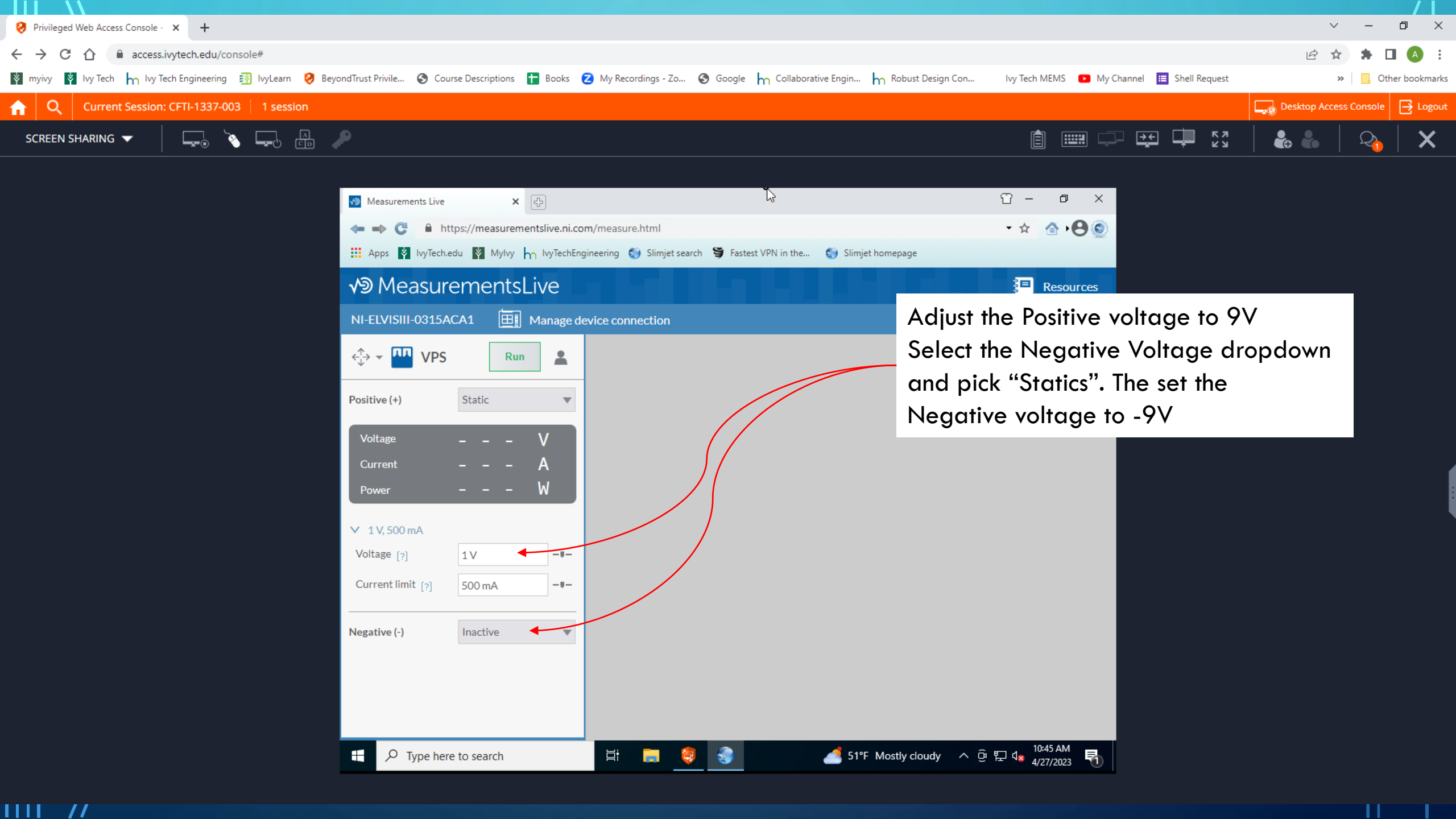


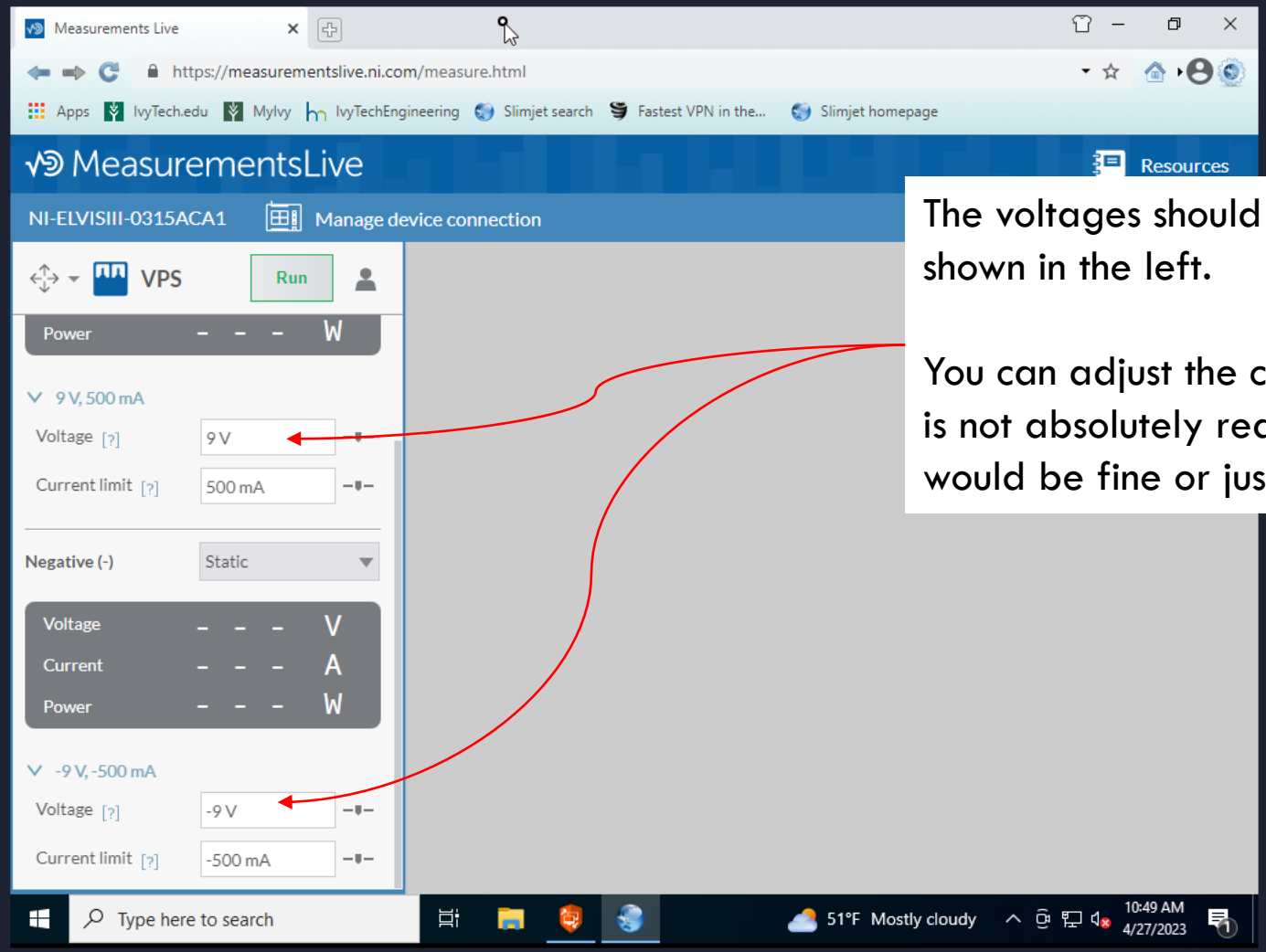
Select Measure. You are more than welcome to review the other options.


Measurements Live
https://measurementslive.ni.com/measure.html
MeasurementsLive
Resources
No device connected
Manage device connection
USB
Network
Connect the device's rear USB-C port to your computer. Click Connect to pair the device.
Warning: A popup window may appear.
Your name here
Need the software?
Connect
Under the USB option
Select the "Connect"
Click here
to add instruments
Type here to search
49°F Mostly cloudy
10:28 AM
4/27/2023


Measurements Live
https://measurementslive.ni.com/measure.html
MeasurementsLive
Resources
NI-ELVISIII-0315ACA1
Manage device connection
NI-ELVISIII-0315ACA1
Device: NI ELVIS III
Application Board: ---
Instruments
Device Details
Disconnect
Click here
to add instruments
Select the “add instruments” option
Type here to search
49°F Mostly cloudy
10:32 AM
4/27/2023

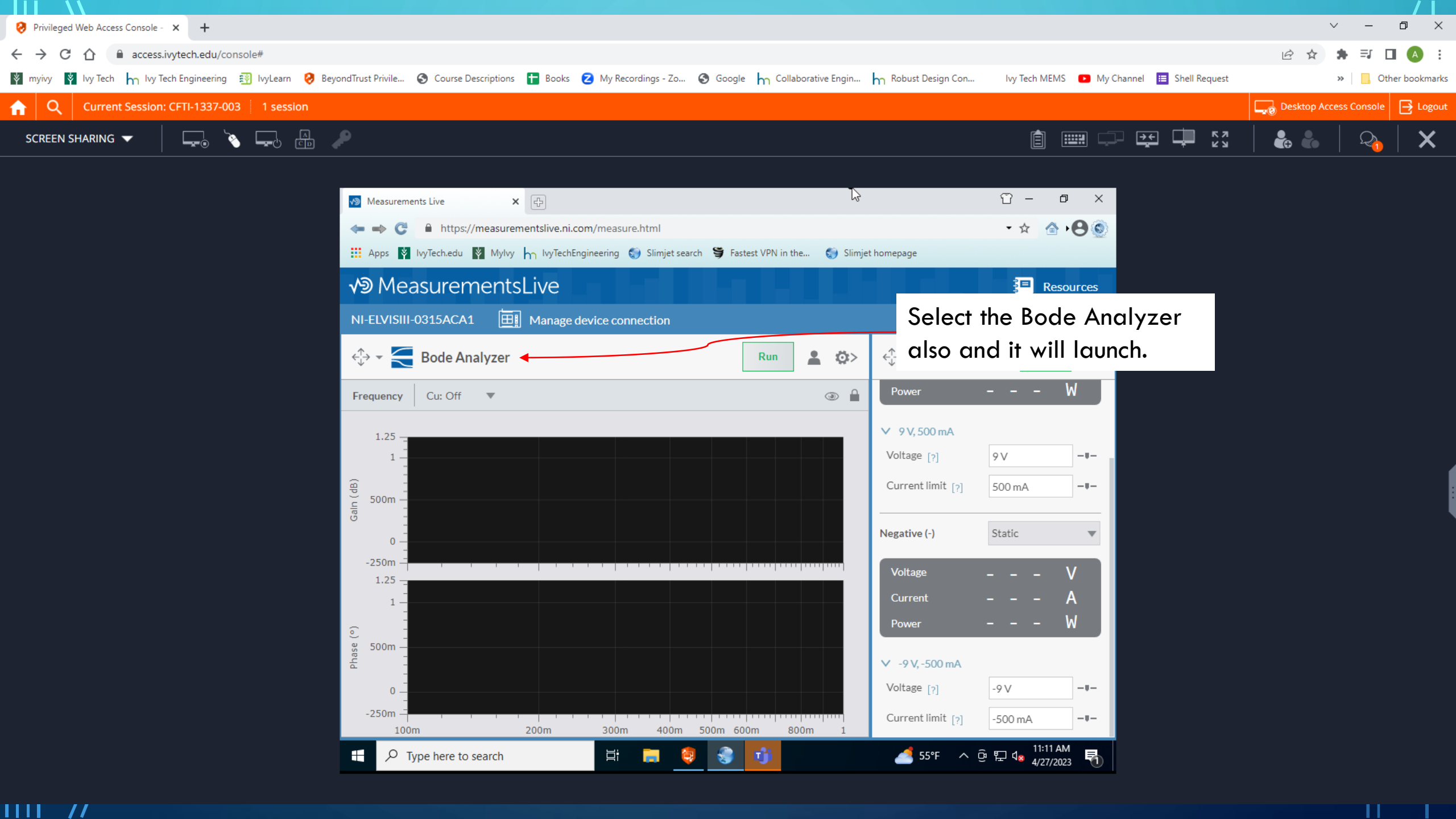

Measurements Live
https://measurementslive.ni.com/measure.html
MeasurementsLive
Resources
NI-ELVISIII-0315ACA1
Manage device connection
Choose instrument(s) to open
Oscilloscope [?]
Available
Function and Arbitrary Waveform Generator [?]
Available
Data Generator [?]
Available
Digital Multimeter [?]
Available
Variable Power Supply [?]
Available
Bode Analyzer [?]
Available
Current-Voltage Analyzer [?]
Available
Logic Analyzer and Pattern Generator [?]
Available
Separate window
Digital I/O [?]
Select the
Variable Power Supply
and
Bode Analyzer
Type here to search
49°F Mostly cloudy
10:35 AM
4/27/2023

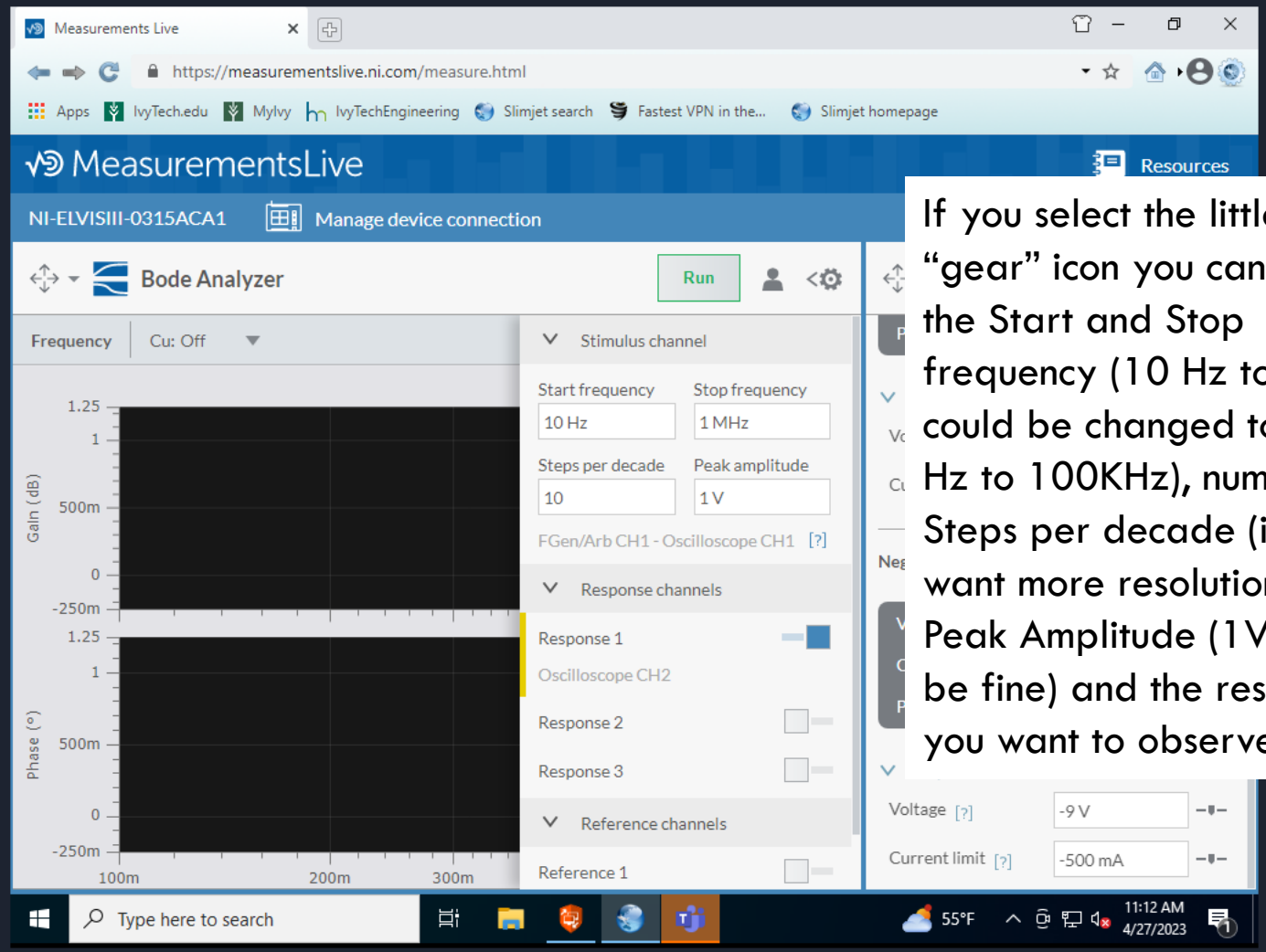

Privileged Web Access Console
access.ivytech.edu/console#
Current Session: CFTI-1337-003
1 session
Desktop Access Console
Logout
SCREEN SHARING
Measurements Live
https://measurementslive.ni.com/measure.html
MeasurementsLive
Resources
NI-ELVISIII-0315ACA1
Manage device connection
VPS
Run
Positive (+)
Static
Voltage
Current
Power
1 V, 500 mA
Voltage [?]
1 V
Current limit [?]
500 mA
Negative (-)
Inactive
Adjust the Positive voltage to 9V
Select the Negative Voltage dropdown and pick “Statics”. The set the Negative voltage to -9V
Type here to search
51°F Mostly cloudy
10:45 AM
4/27/2023



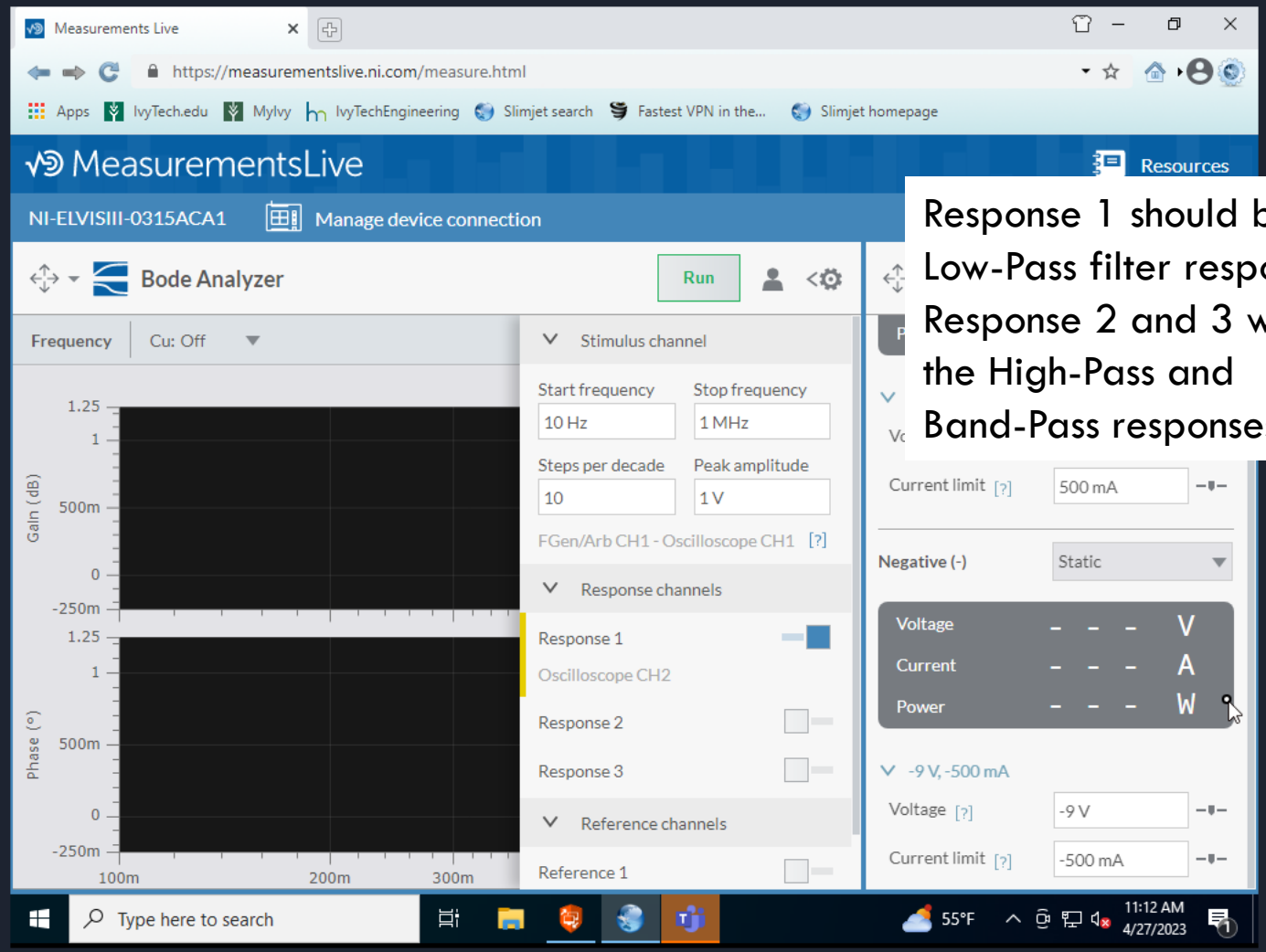
The voltages should look like what is shown in the left.

You can adjust the current limits but this is not absolutely required. +/- 10 mA would be fine or just leave it alone.

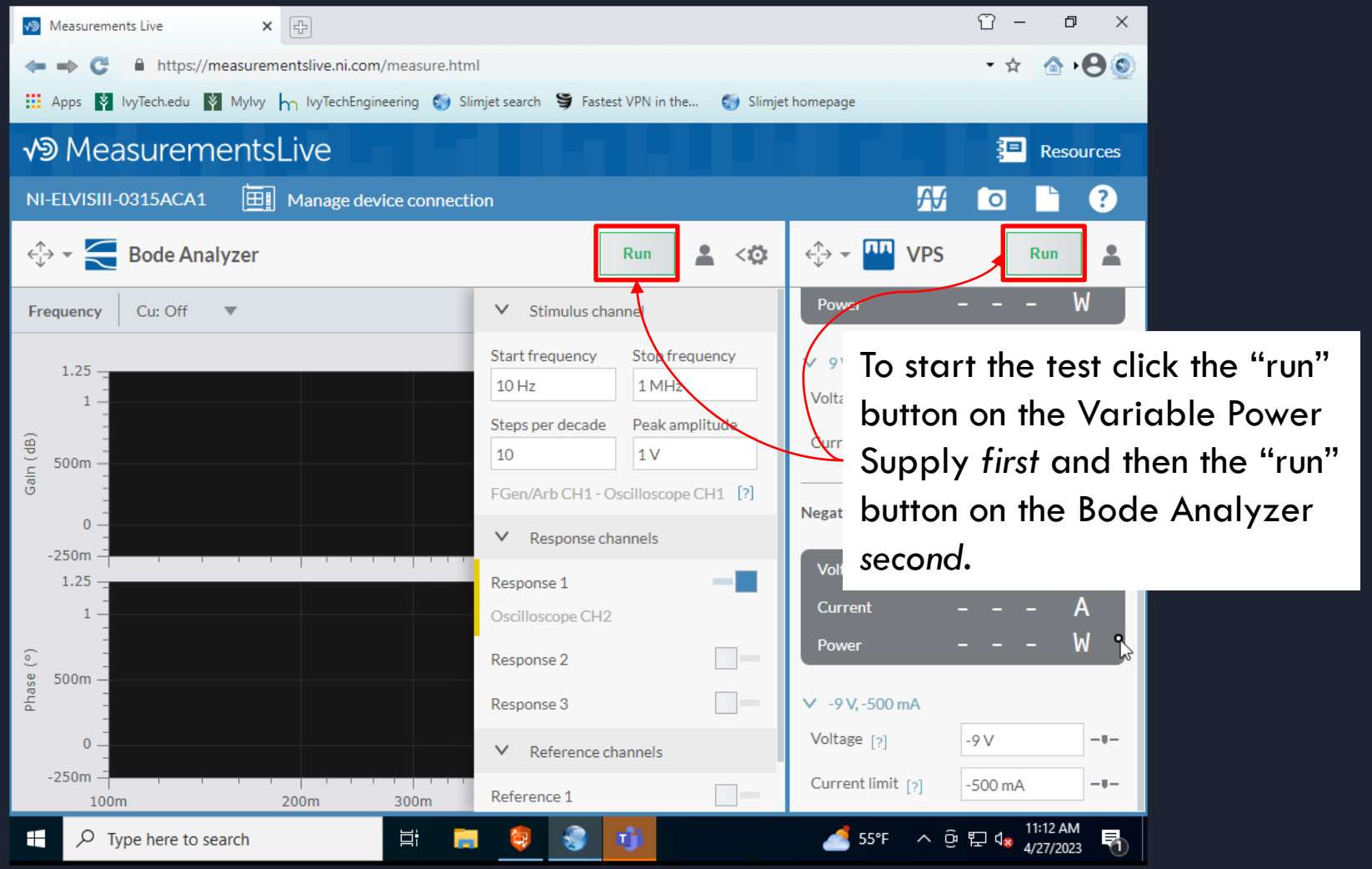

Privileged Web Access Console
access.ivytech.edu/console#
Current Session: CFTI-1337-003
1 session
Desktop Access Console
Logout
SCREEN SHARING
Measurements Live
https://measurementslive.ni.com/measure.html
MeasurementsLive
Resources
NI-ELVISIII-0315ACA1
Manage device connection
Bode Analyzer
Run
Frequency
Cu: Off
Gain (dB)
Phase (°)
Power
9 V, 500 mA
Voltage [?]
9 V
Current limit [?]
500 mA
Negative (-)
Static
Voltage
Current
-9 V, -500 mA
-9 V
-500 mA
Select the Bode Analyzer also and it will launch.
Type here to search
55°F
11:11 AM
4/27/2023

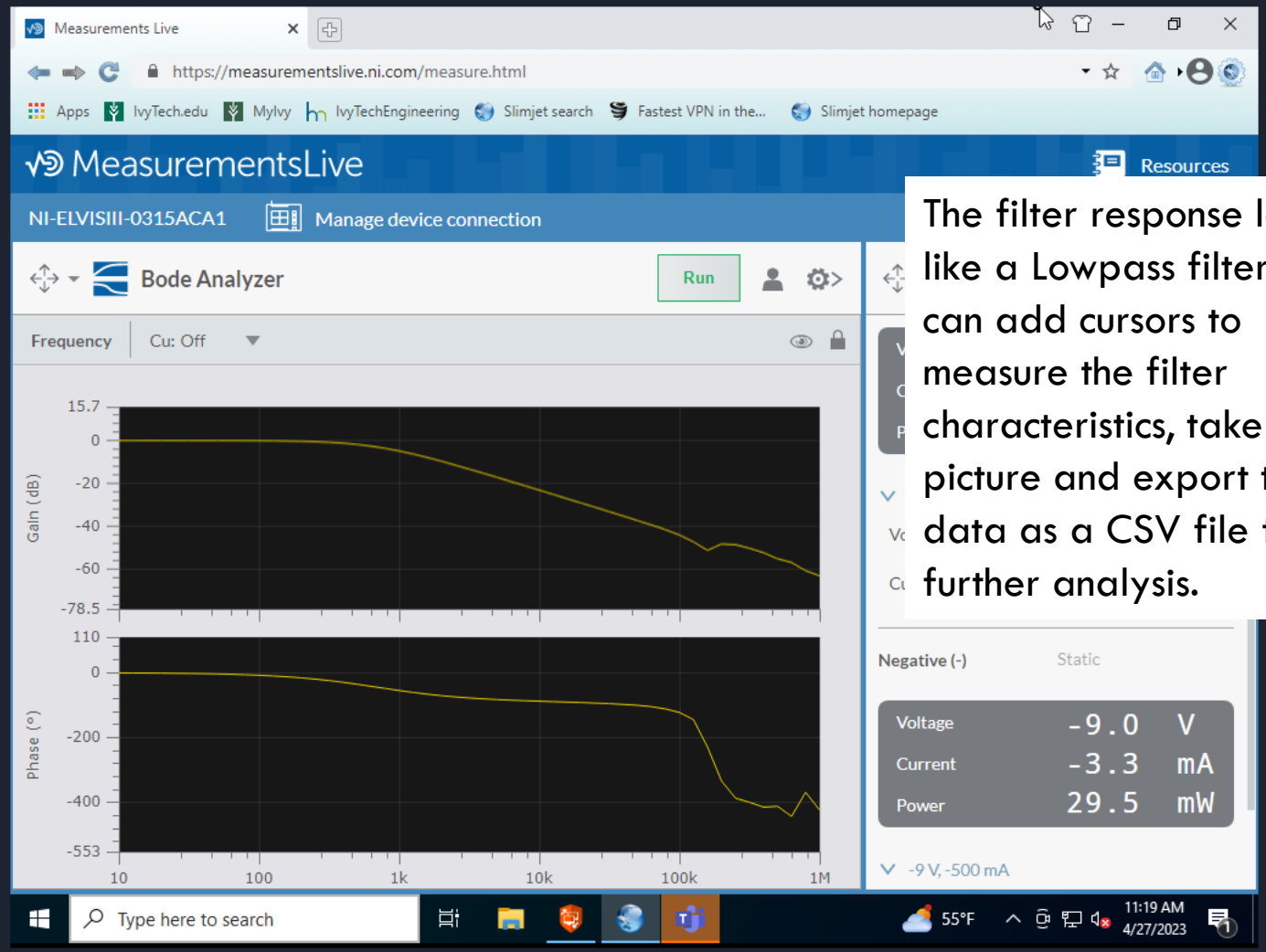


If you select the little "gear" icon you can adjust the Start and Stop frequency (10 Hz to 1MHz could be changed to 100 Hz to 100KHz), number of Steps per decade (if you want more resolution), Peak Amplitude (1V should be fine) and the response you want to observe.

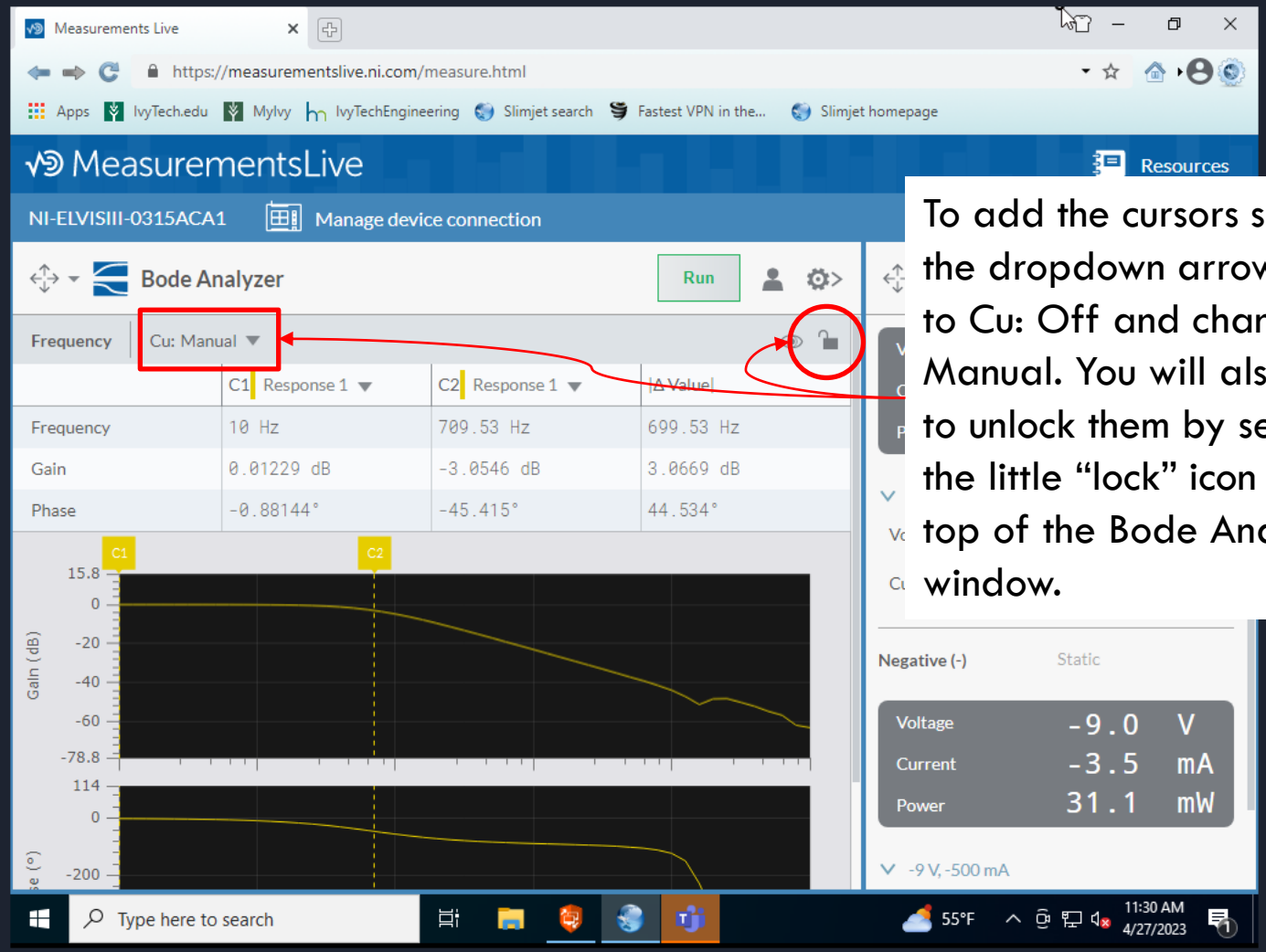


Response 1 should be the Low-Pass filter response. Response 2 and 3 will be the High-Pass and Band-Pass responses.

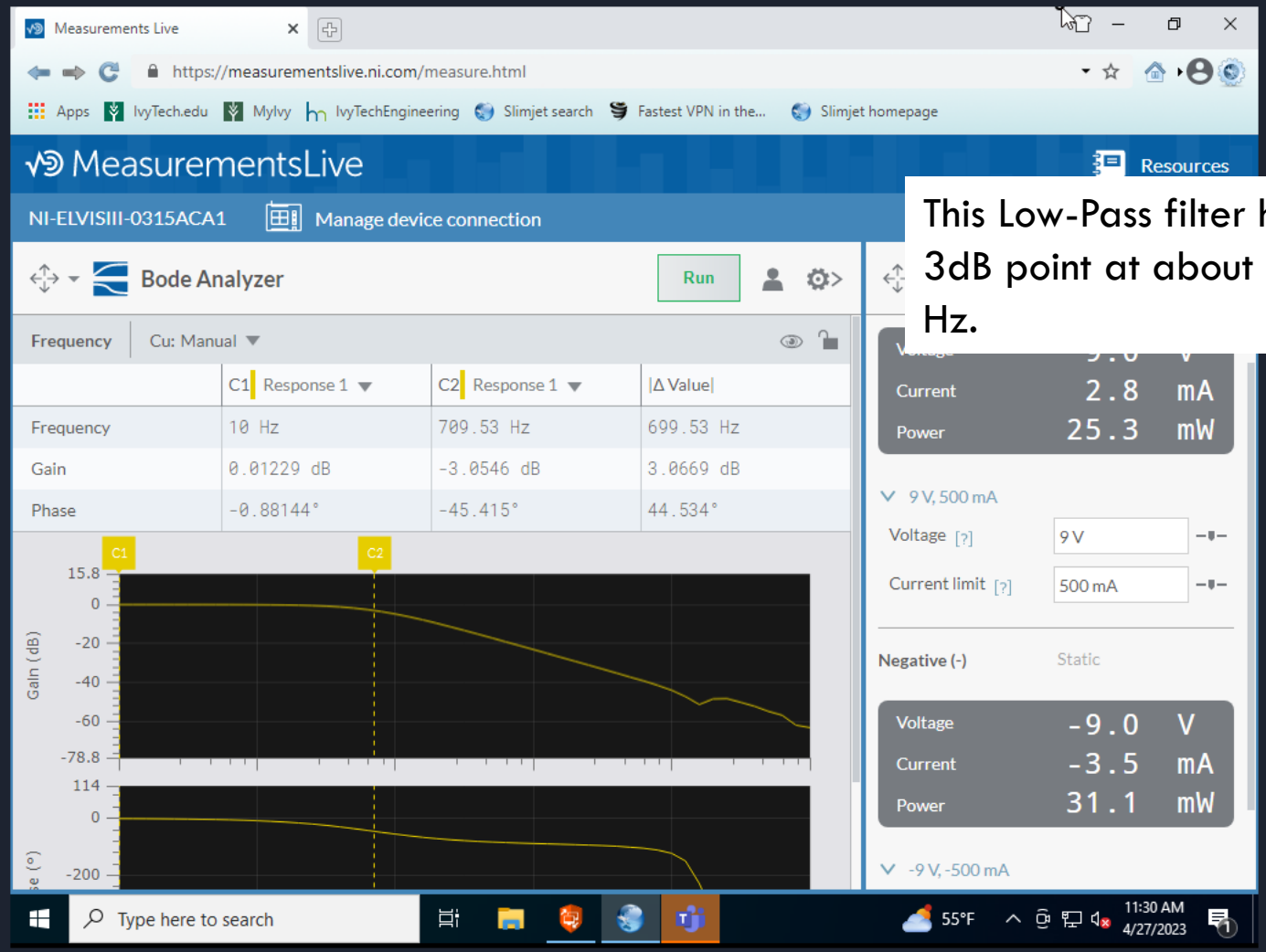

Measurements Live
https://measurementslive.ni.com/measure.html
MeasurementsLive
Resources
NI-ELVISIII-0315ACA1
Manage device connection
Bode Analyzer
Run
VPS
Run
Frequency
Cu: Off
Stimulus channel
Start frequency
10 Hz
Stop frequency
1 MHz
Steps per decade
10
Peak amplitude
1 V
FGen/Arb CH1 - Oscilloscope CH1
Response channels
Response 1
Oscilloscope CH2
Response 2
Response 3
Reference channels
Reference 1
Gain (dB)
Phase (°)
Power
Current
Power
-9 V, -500 mA
Voltage
-9 V
Current limit
-500 mA
To start the test click the "run" button on the Variable Power Supply *first* and then the "run" button on the Bode Analyzer *second*.



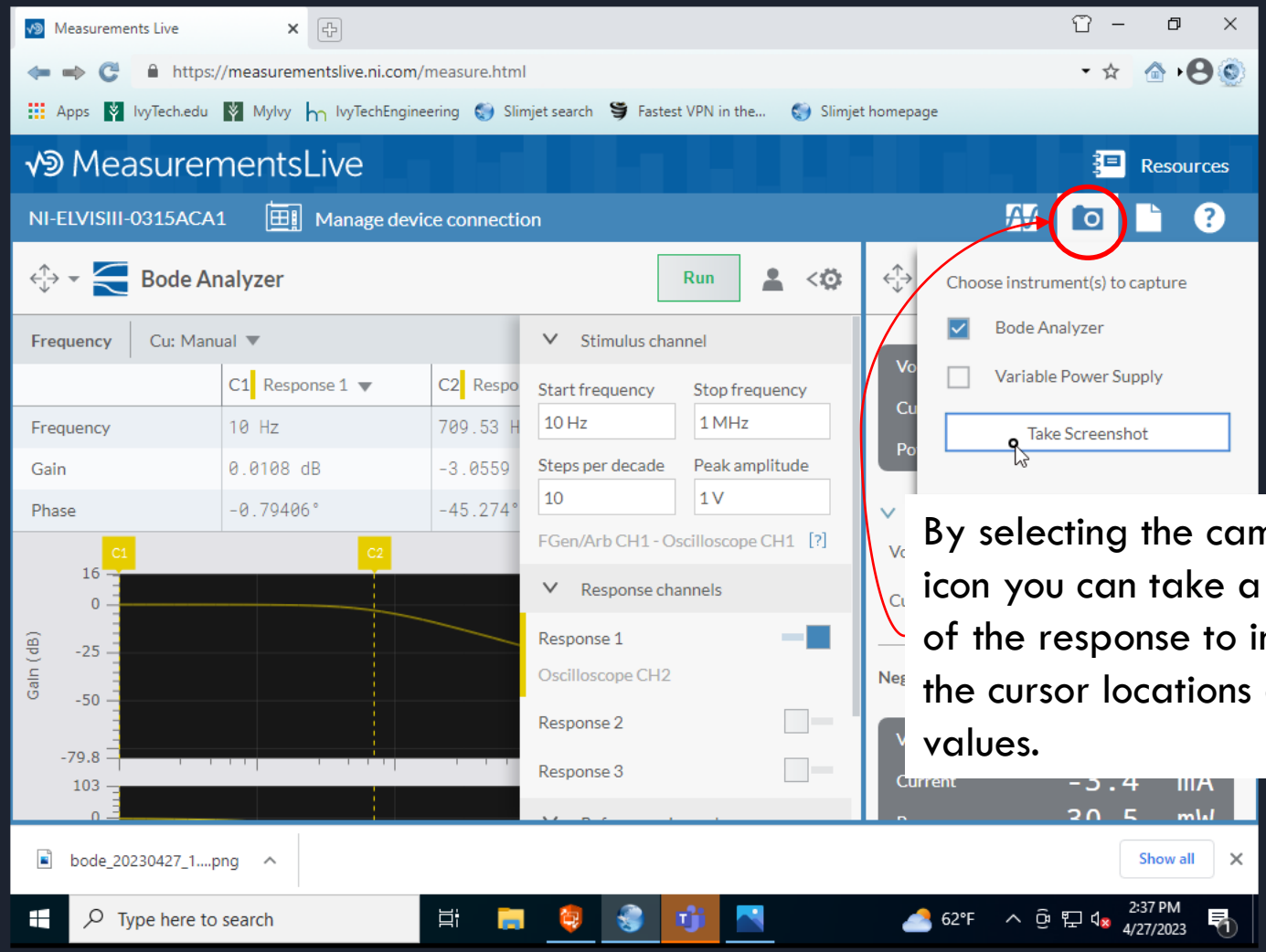
The filter response looks like a Lowpass filter. We can add cursors to measure the filter characteristics, take a picture and export the data as a CSV file for further analysis.



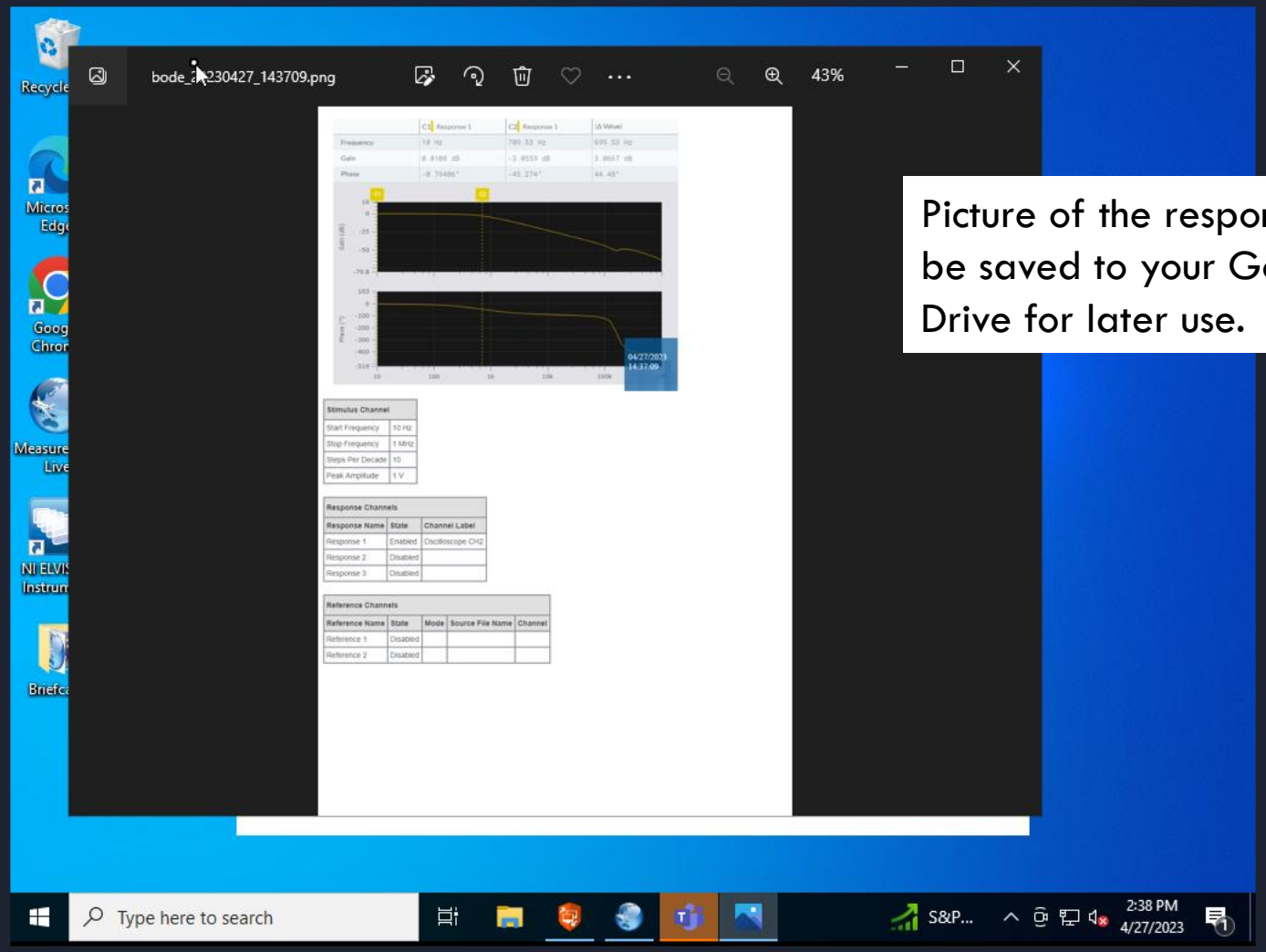
To add the cursors select the dropdown arrow next to Cu: Off and change to Manual. You will also need to unlock them by selecting the little “lock” icon at the top of the Bode Analyzer window.



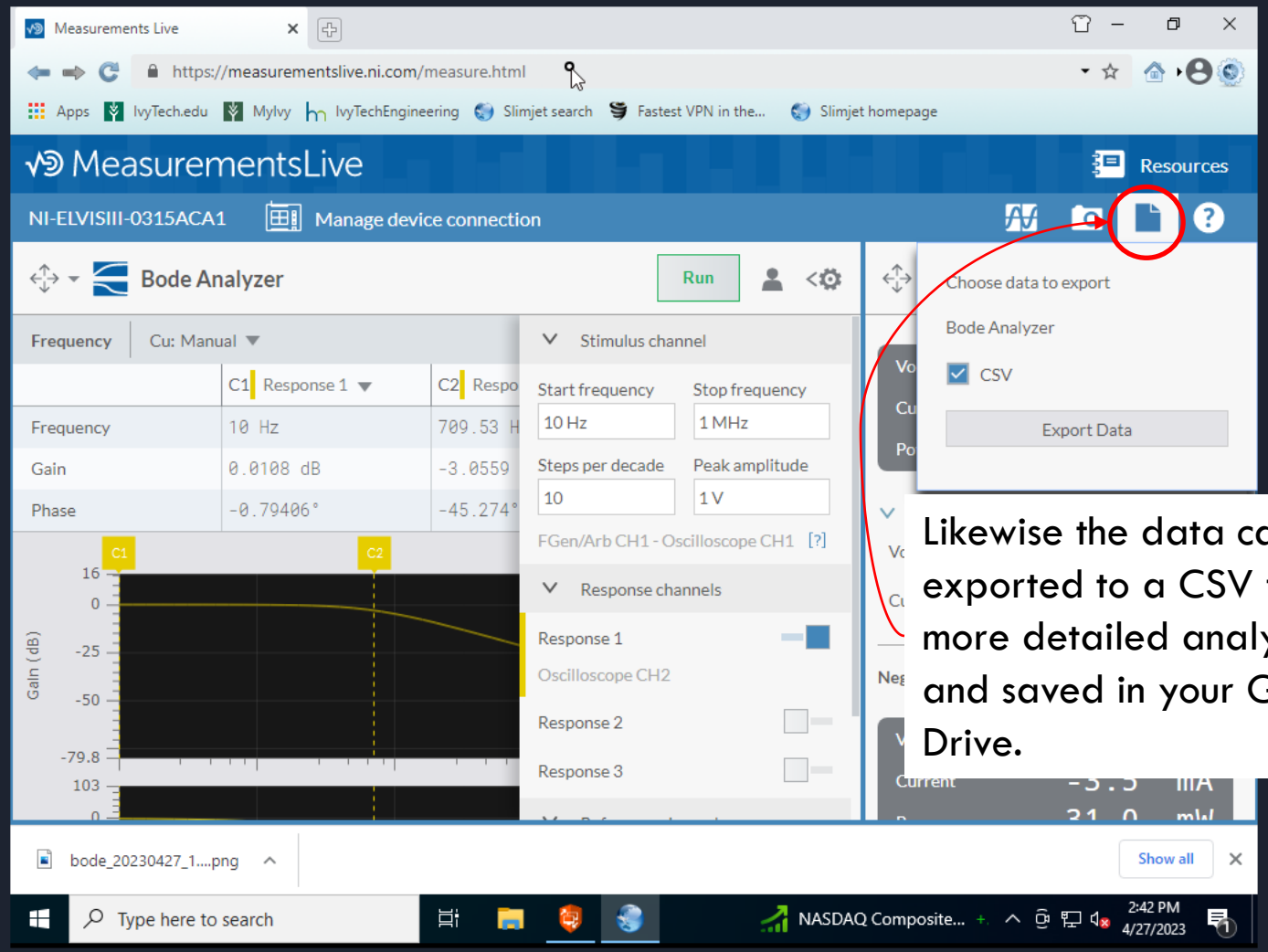
This Low-Pass filter has a 3dB point at about 700 Hz.



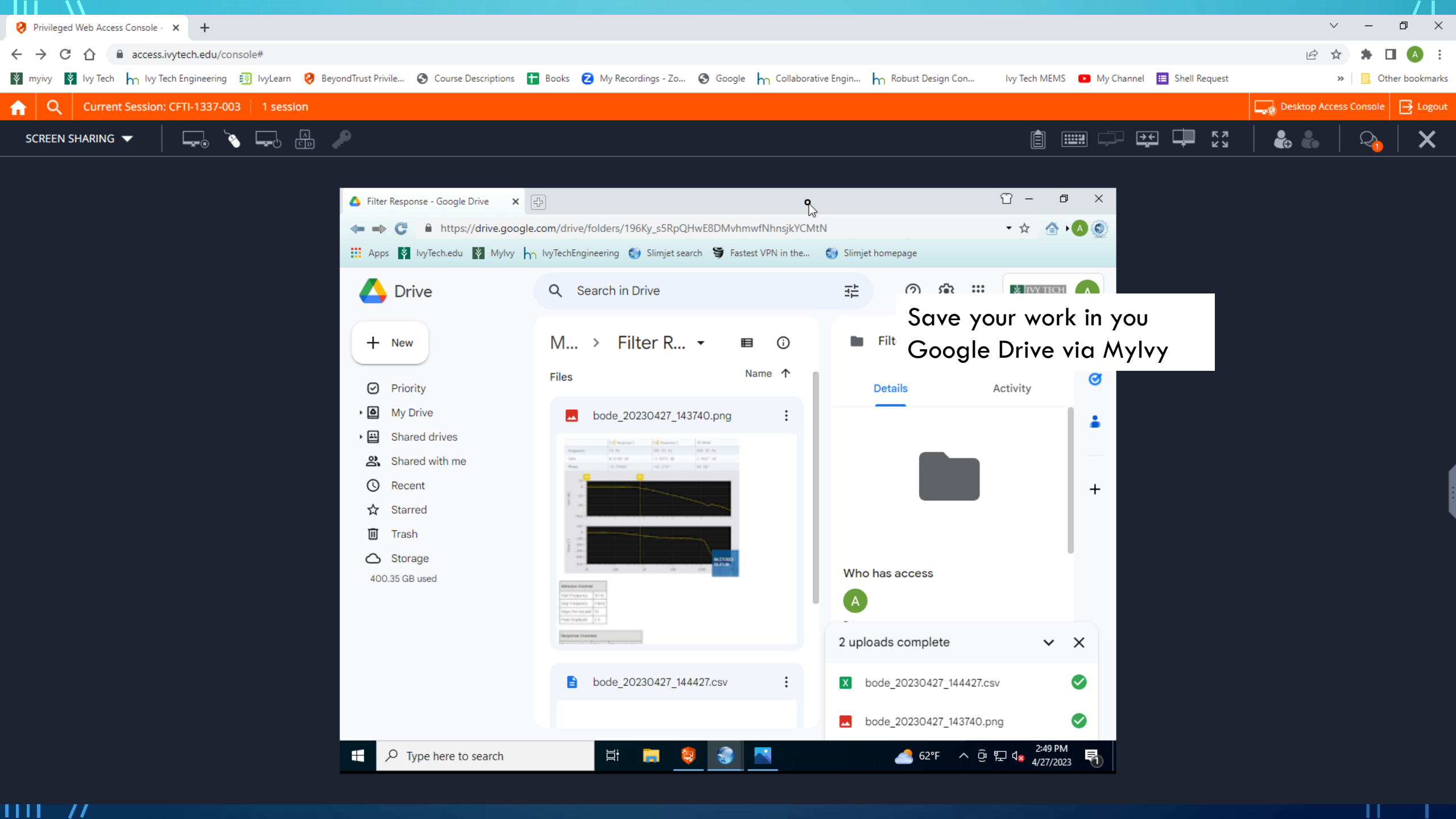
By selecting the camera icon you can take a picture of the response to include the cursor locations and values.

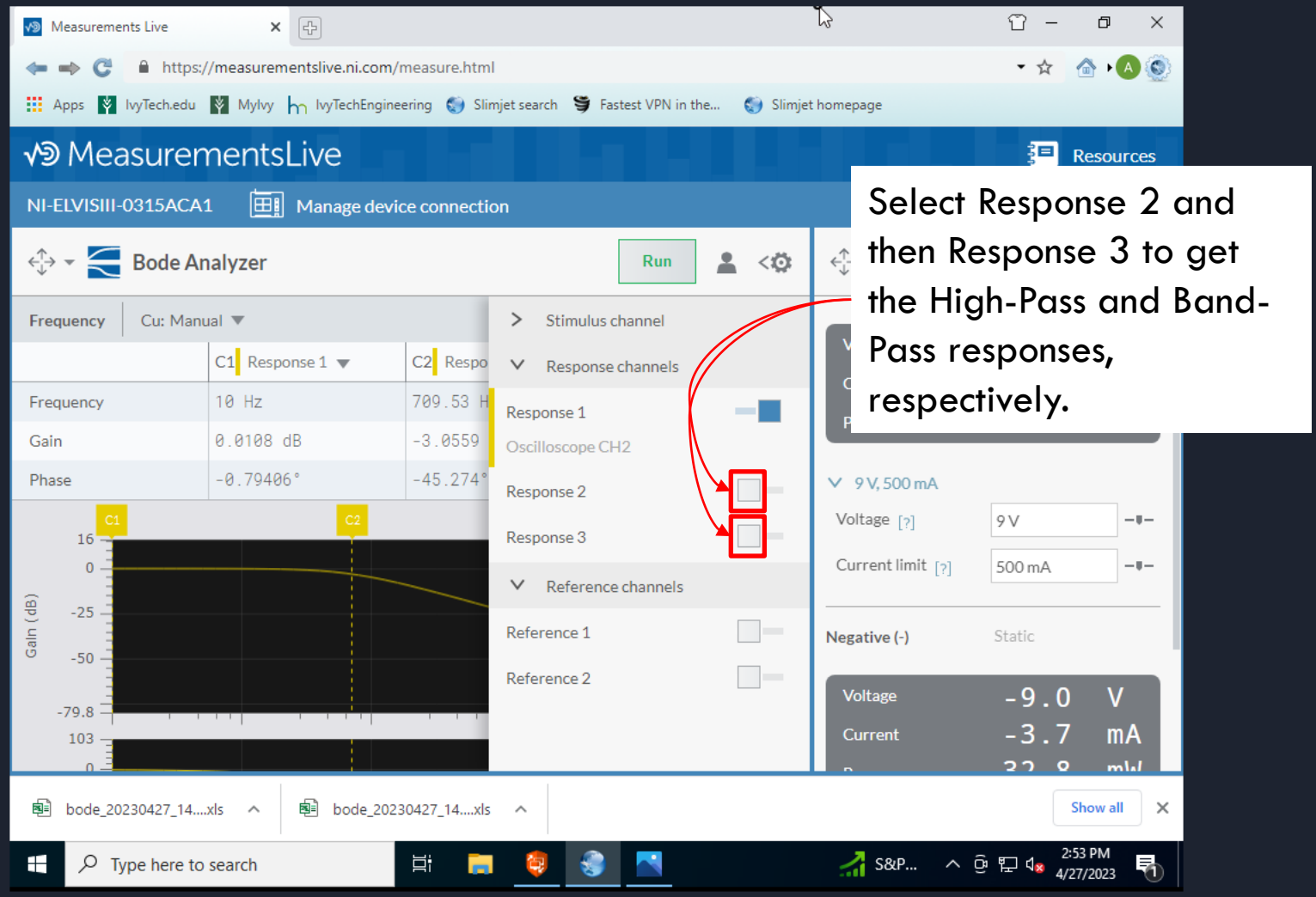


Picture of the response can be saved to your Google Drive for later use.

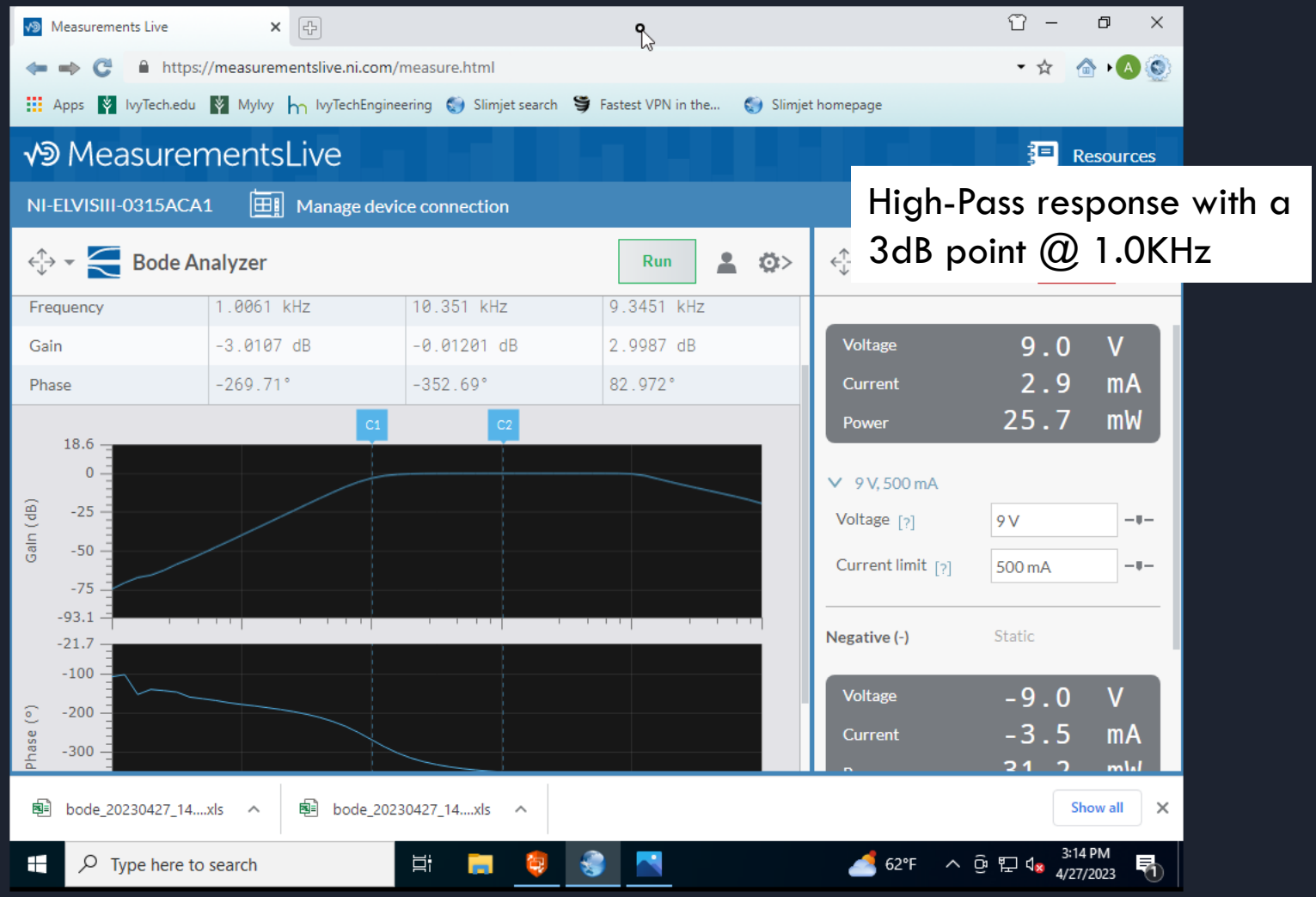


Likewise the data can be exported to a CSV file for more detailed analysis and saved in your Google Drive.

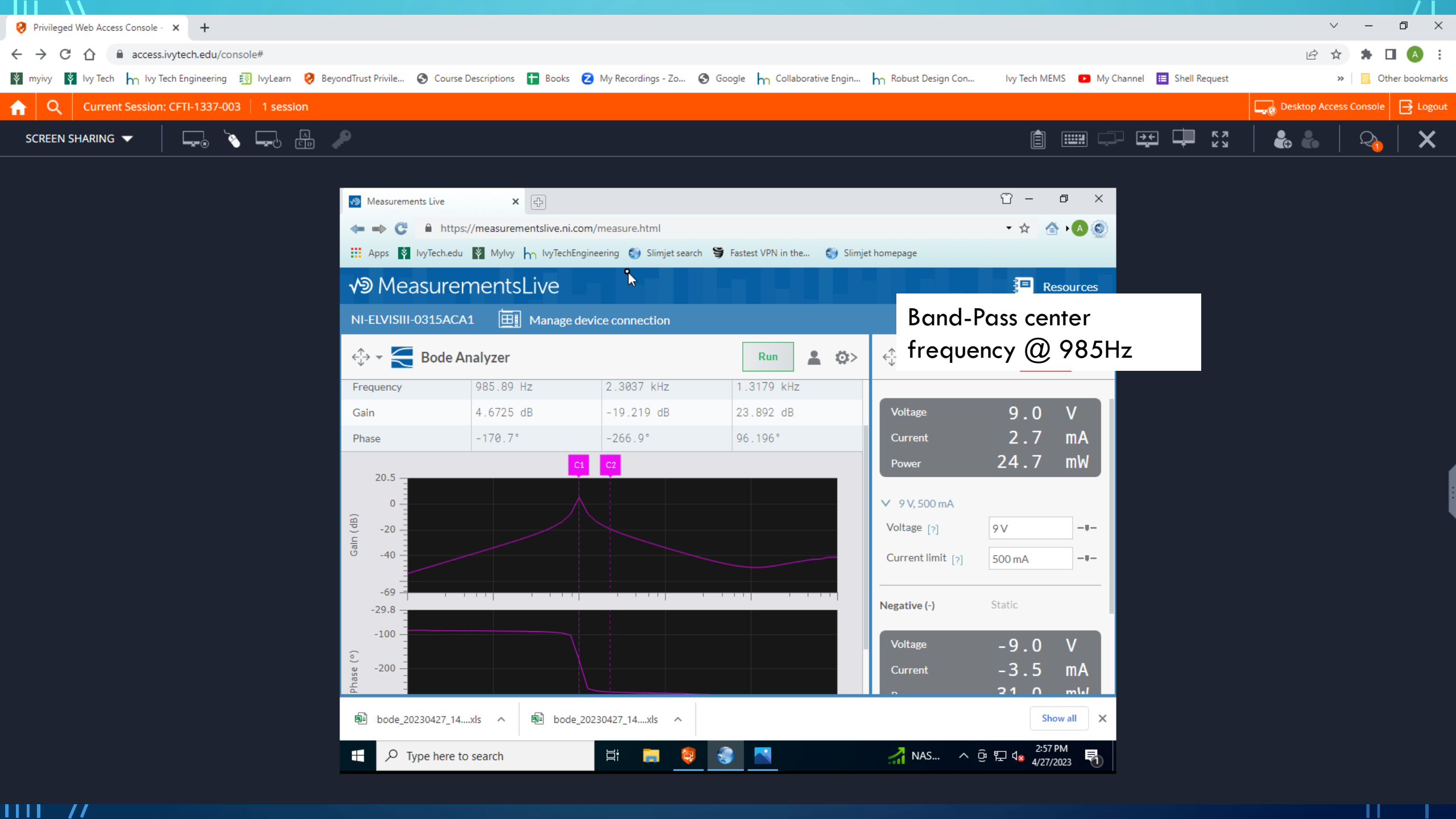

Privileged Web Access Console
access.ivytech.edu/console#
Current Session: CFTI-1337-003
1 session
Desktop Access Console
Logout
SCREEN SHARING
Filter Response - Google Drive
https://drive.google.com/drive/folders/196Ky_s5RpQHwE8DMvhmwfNhnsjkYCMtN
Drive
Search in Drive
New
Priority
My Drive
Shared drives
Shared with me
Recent
Starred
Trash
Storage
400.35 GB used
Files
Name
bode_20230427_143740.png
bode_20230427_144427.csv
Details
Activity
Who has access
2 uploads complete
bode_20230427_144427.csv
bode_20230427_143740.png
Save your work in you Google Drive via Mylvy
Type here to search
62°F
2:49 PM
4/27/2023



Select Response 2 and then Response 3 to get the High-Pass and Band-Pass responses, respectively.



High-Pass response with a 3dB point @ 1.0KHz


Privileged Web Access Console
access.ivytech.edu/console#
Current Session: CFTI-1337-003
1 session
Desktop Access Console
Logout
SCREEN SHARING
Measurements Live
https://measurementslive.ni.com/measure.html
MeasurementsLive
Resources
NI-ELVISIII-0315ACA1
Manage device connection
Bode Analyzer
Run
Frequency 985.89 Hz 2.3037 kHz 1.3179 kHz
Gain 4.6725 dB -19.219 dB 23.892 dB
Phase -170.7° -266.9° 96.196°
C1
C2
Gain (dB)
Phase (°)
Voltage 9.0 V
Current 2.7 mA
Power 24.7 mW
9 V, 500 mA
Voltage [?] 9 V
Current limit [?] 500 mA
Negative (-)
Static
Voltage -9.0 V
Current -3.5 mA
bode_20230427_14....xls
bode_20230427_14....xls
Show all
Type here to search
2:57 PM
4/27/2023
Band-Pass center frequency @ 985Hz

Questions

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