

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

8/1/24 AGBell

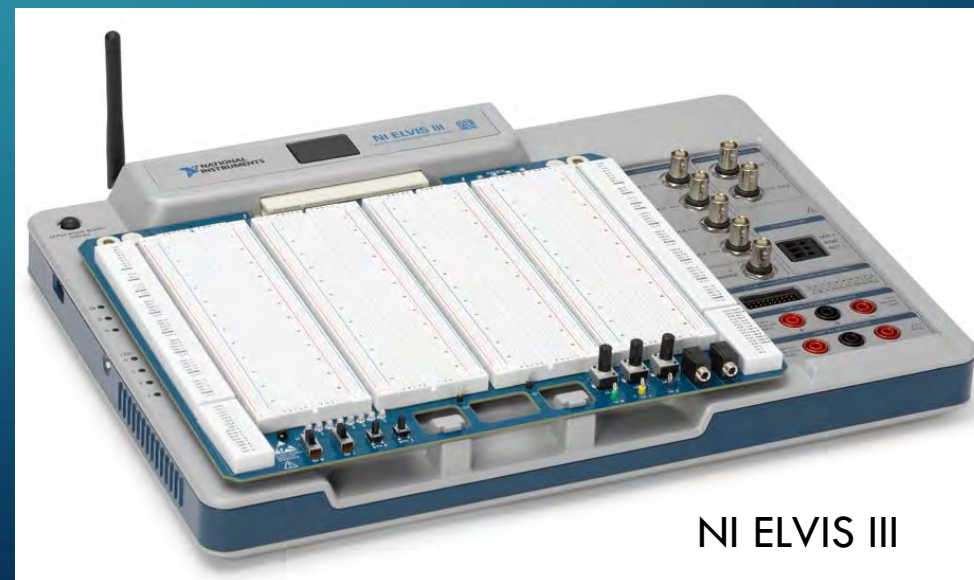


Using NI Elvis and MyDAQ to Support Remote Labs for STEM Education

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



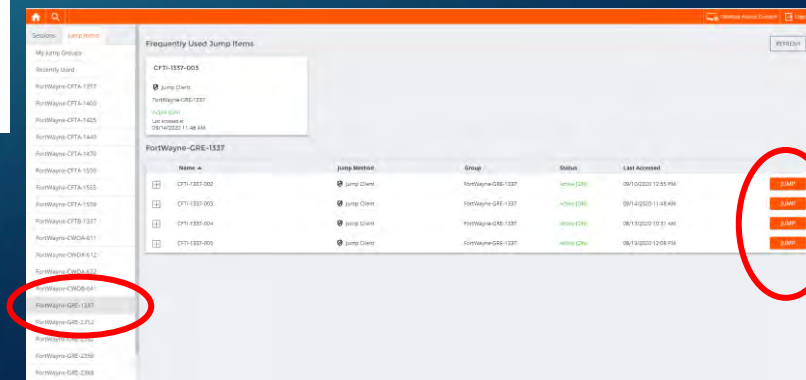
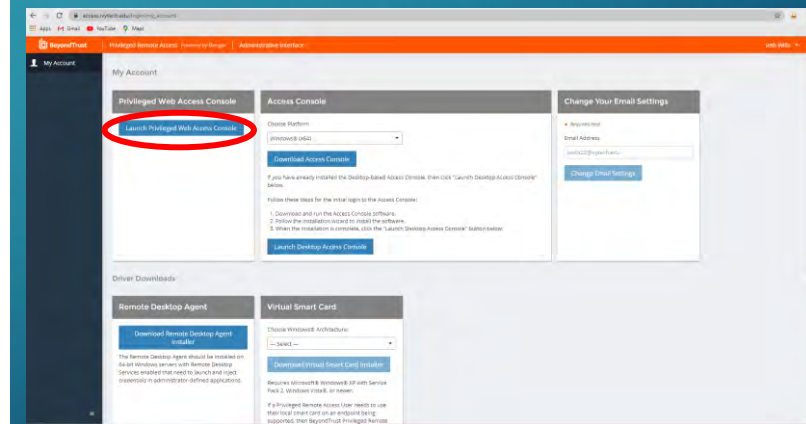
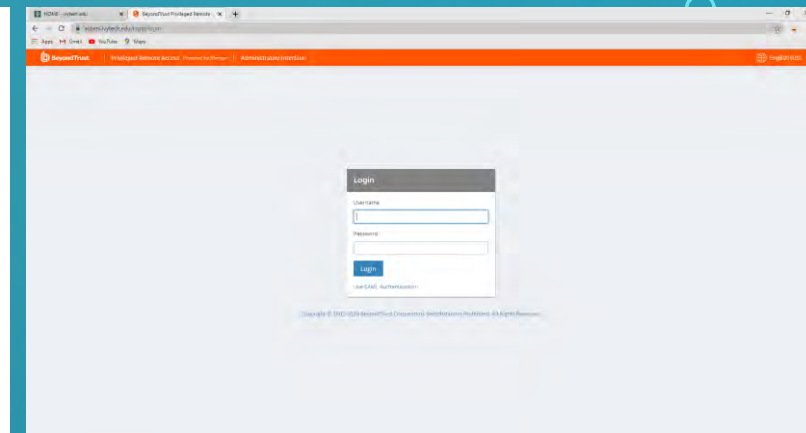
NI ELVIS III

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 ...



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

G. The windows login screen should appear.

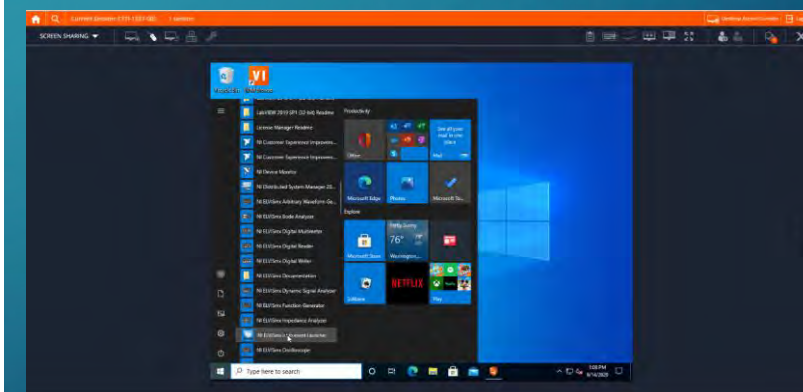
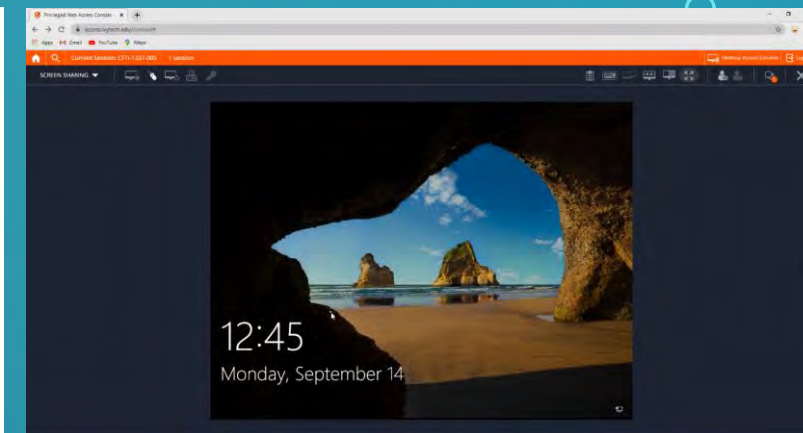
H. Treat this window like Windows desktop pick the student account and enter the common password

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

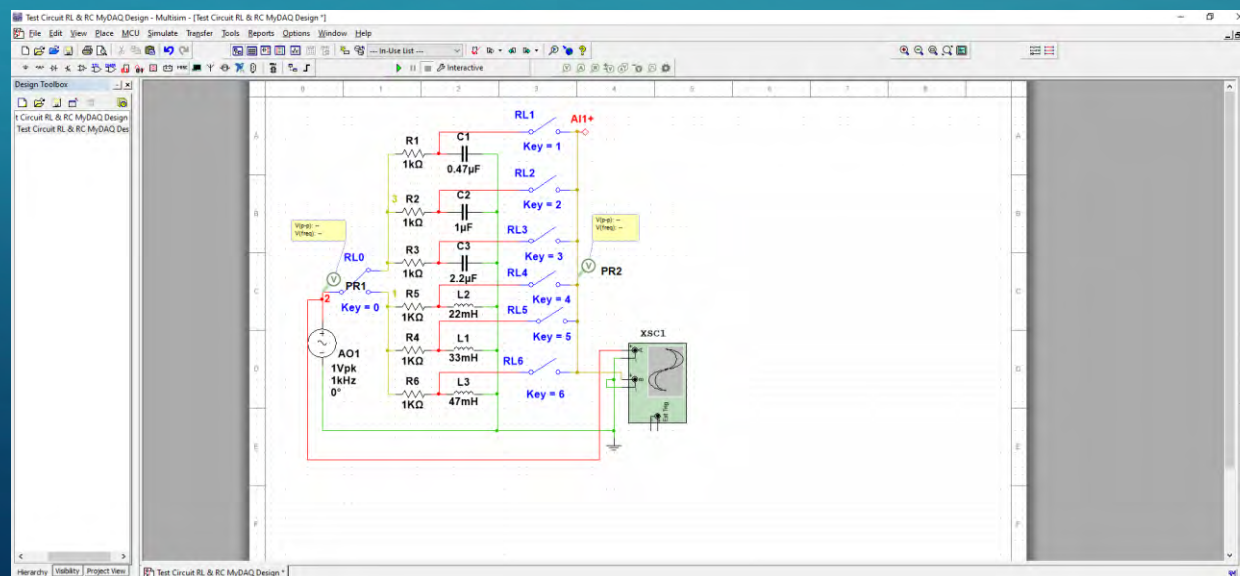
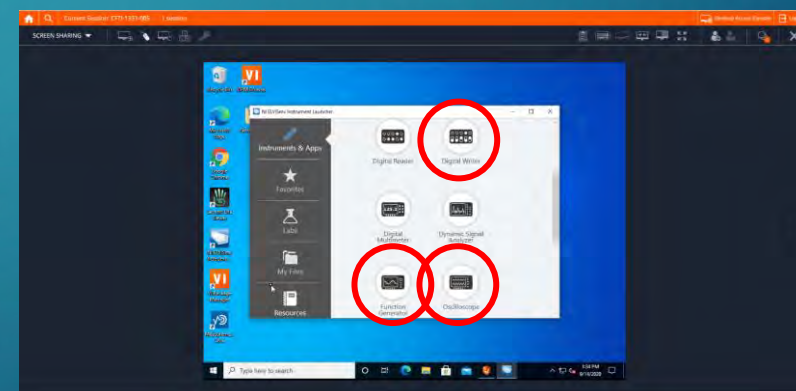
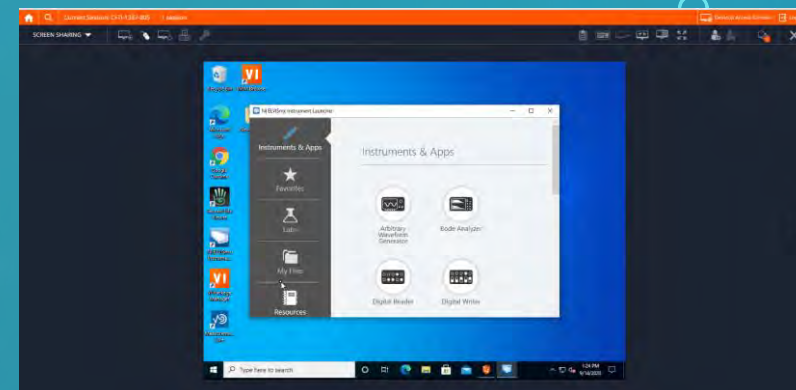
B. Using the NI ELVISmx Instrument Launcher



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.



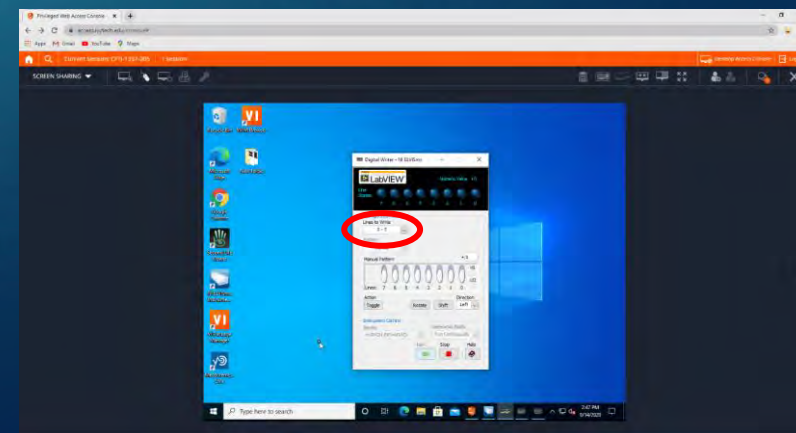
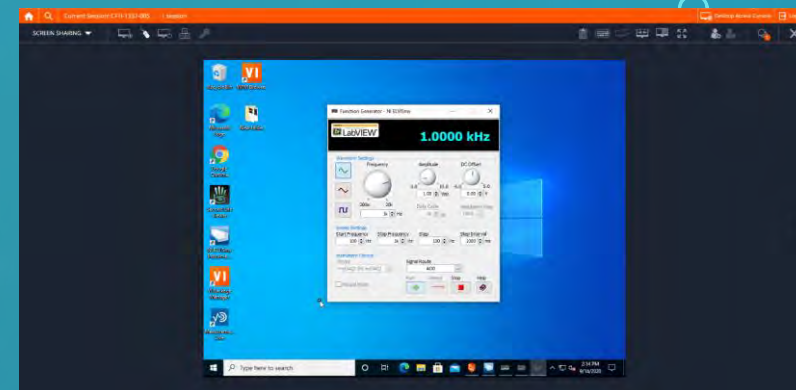
II. Setup MyDAQ (cont)

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 A10 and A11 (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



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.



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 1 kHz applied at 0.5Vpp.



III. Conduct Experiment (cont)

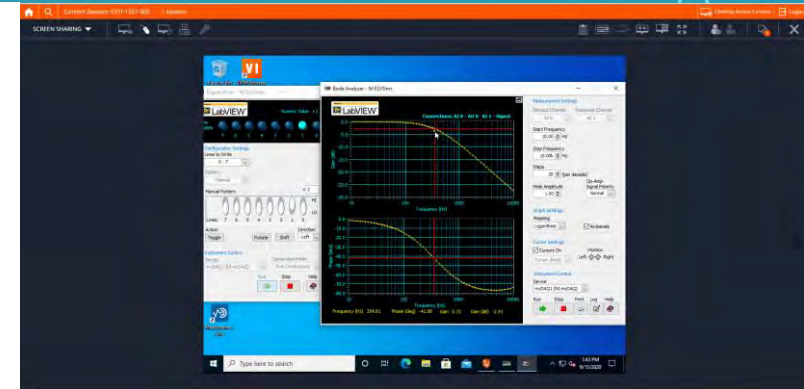
B. Using the NI ELVISmx Instrument Launcher

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!



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)

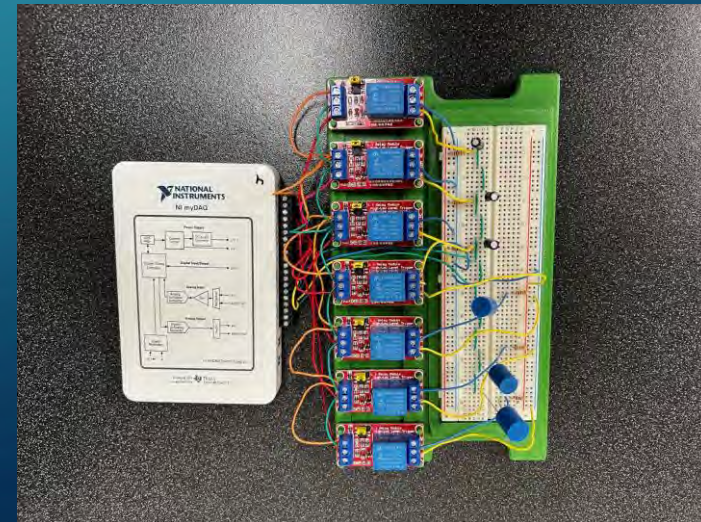
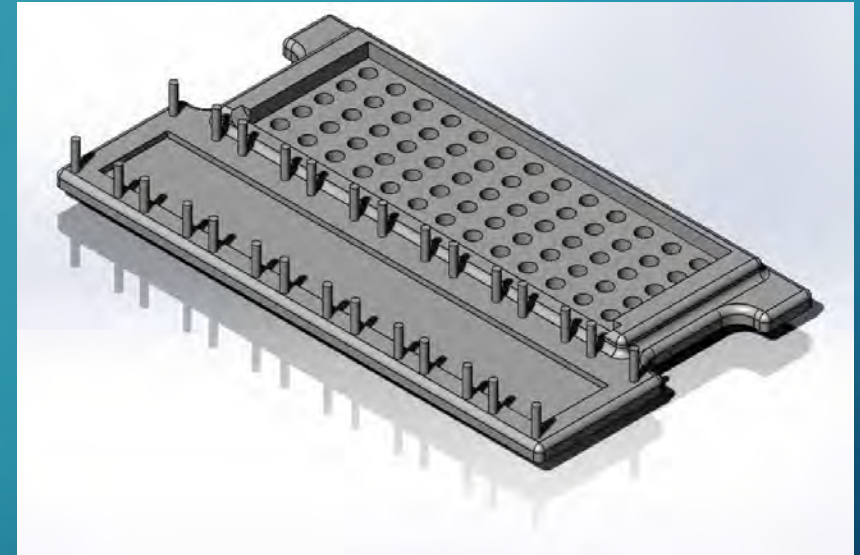
No LCR function

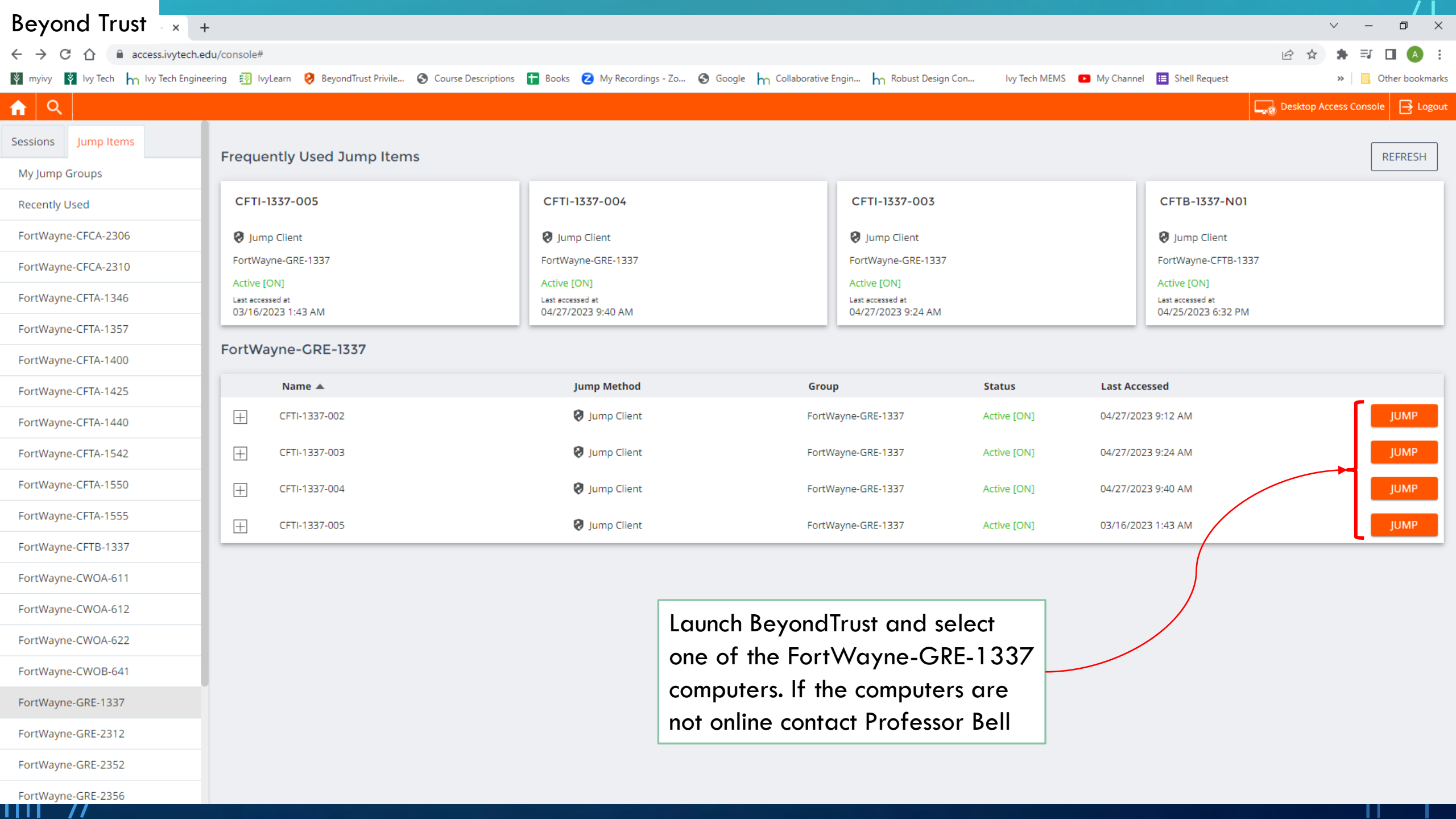
May be a little trick for some students to use.



NI MyDAQ

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.





Frequently Used Jump Items

REFRESH

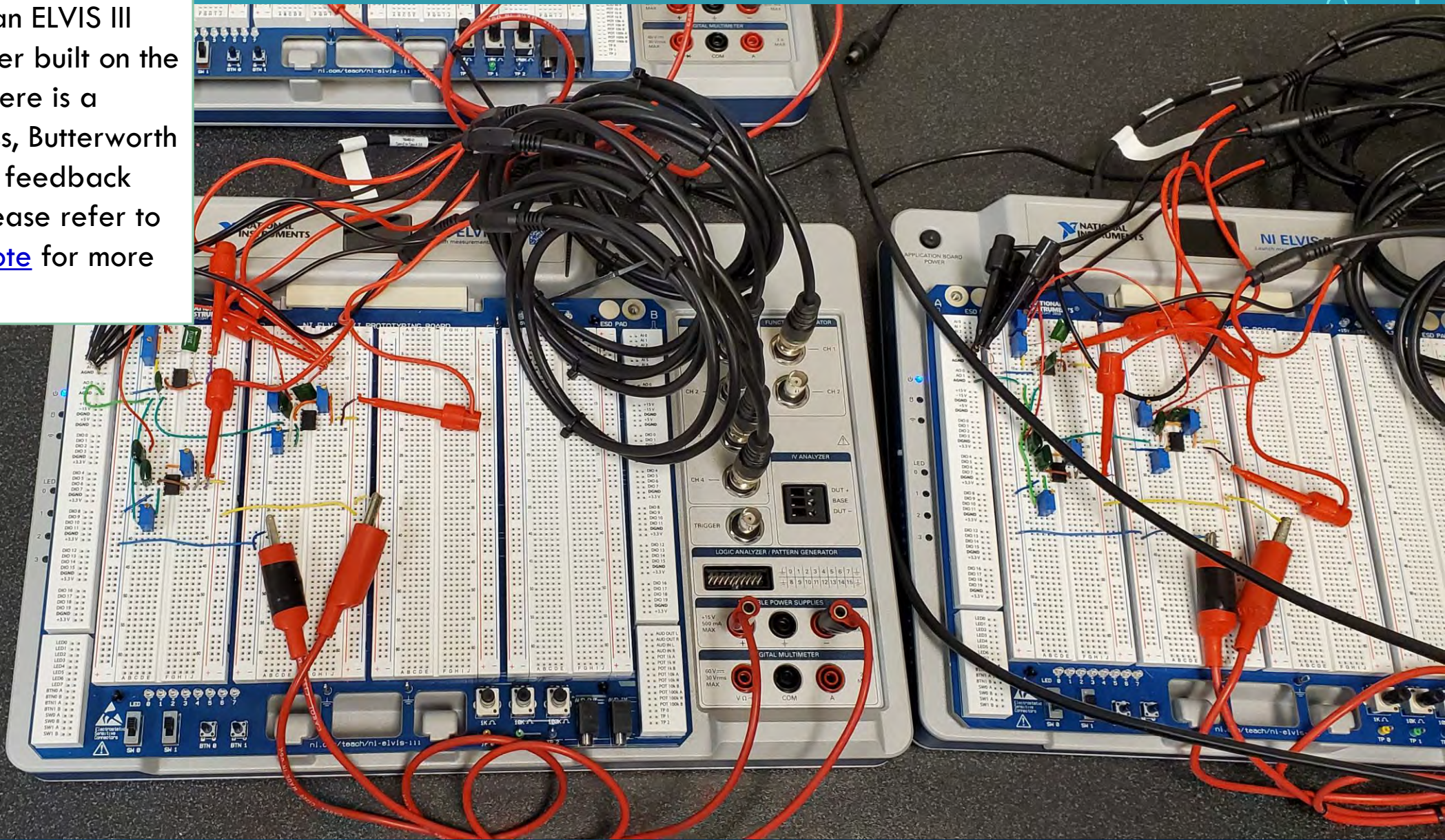
| | | | |
|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------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

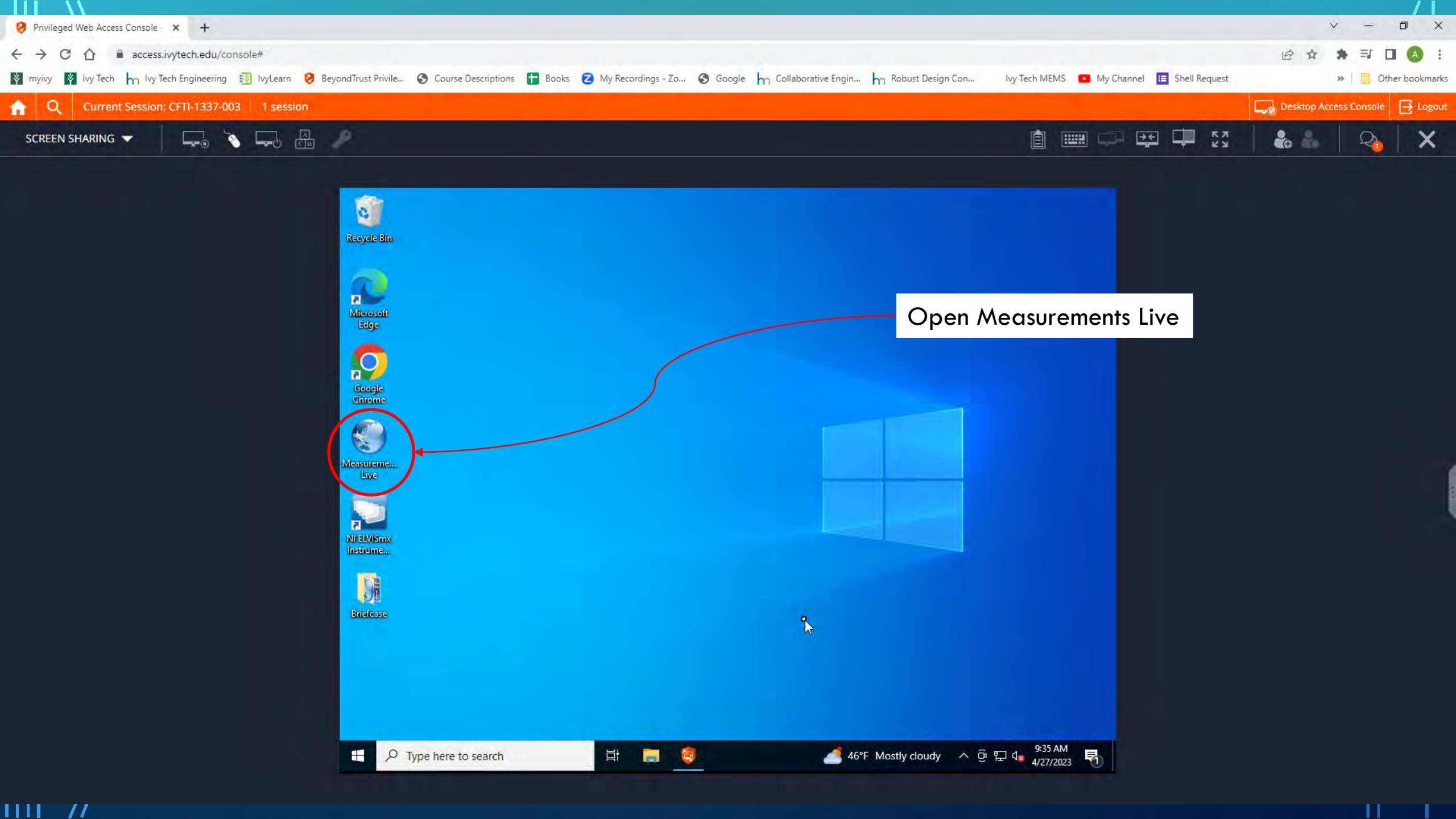
FortWayne-GRE-1337

| Name ▲ | Jump Method | Group | Status | Last Accessed | JUMP |
|-----------------|-------------|--------------------|-------------|--------------------|------|
| + 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 |

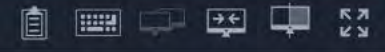
Launch BeyondTrust and select one of the FortWayne-GRE-1337 computers. If the computers are not online contact Professor Bell

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.)





SCREEN SHARING



Open Measurements Live



Measureme...
Live

NI ELVISmx
Instrume...


Briefcase

Type here to search


46°F Mostly cloudy 9:35 AM 4/27/2023

Measurements Live
https://measurementslive.ni.com
Apps IvyTech.edu MyIvy IvyTechEngineering Slimjet search Fastest VPN in the... Slimjet homepage
Resources


MeasurementsLive



FIRST TIME HERE?
Let's get you set up. Follow these steps to get ready to use the NI ELVIS III device.



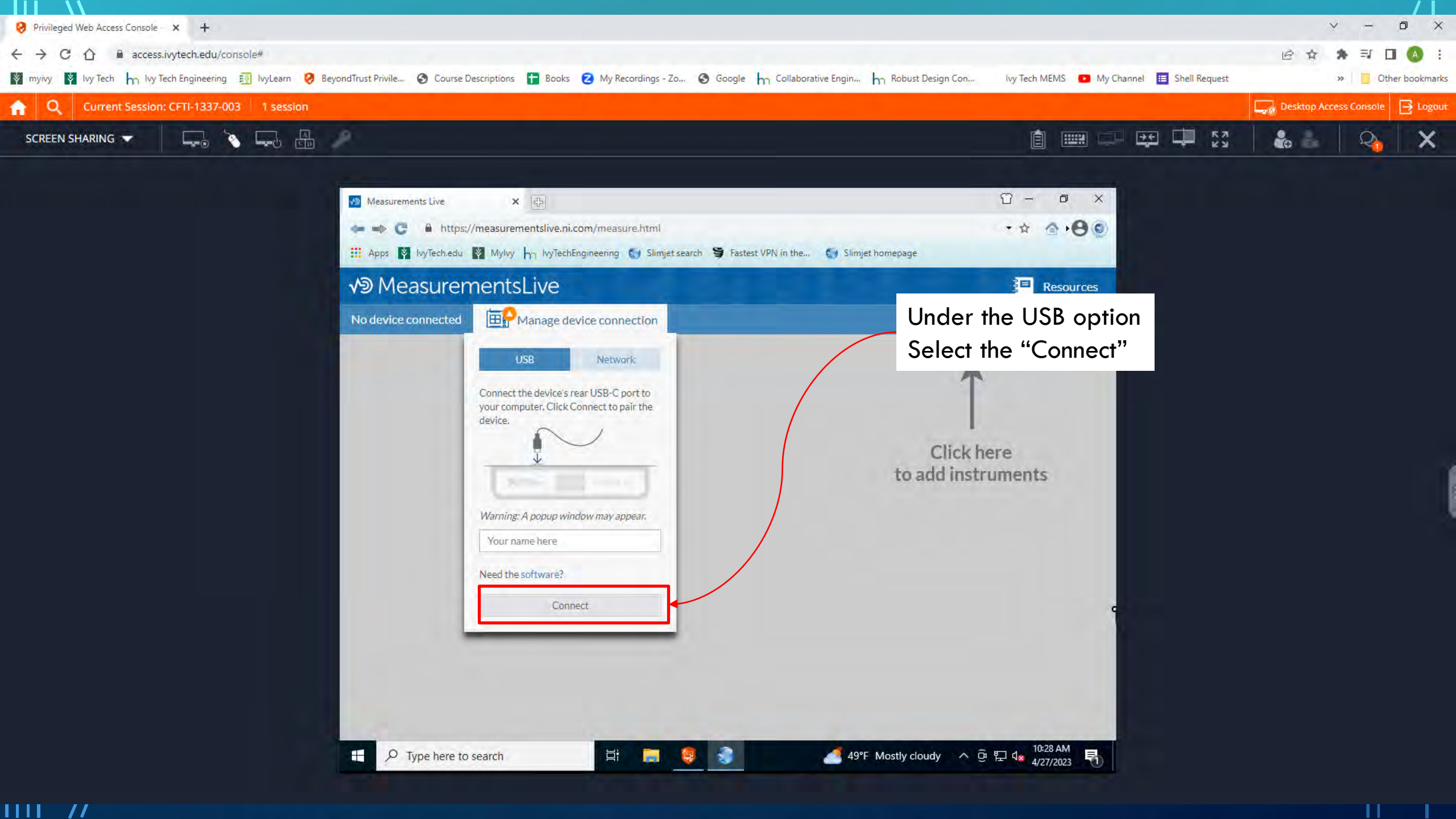
MEASURE
Already set up? Connect your device and use the instruments.



DEVICE SIMULATION
Learn to use the instruments before connecting to a real device.

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NATIONAL INSTRUMENTS

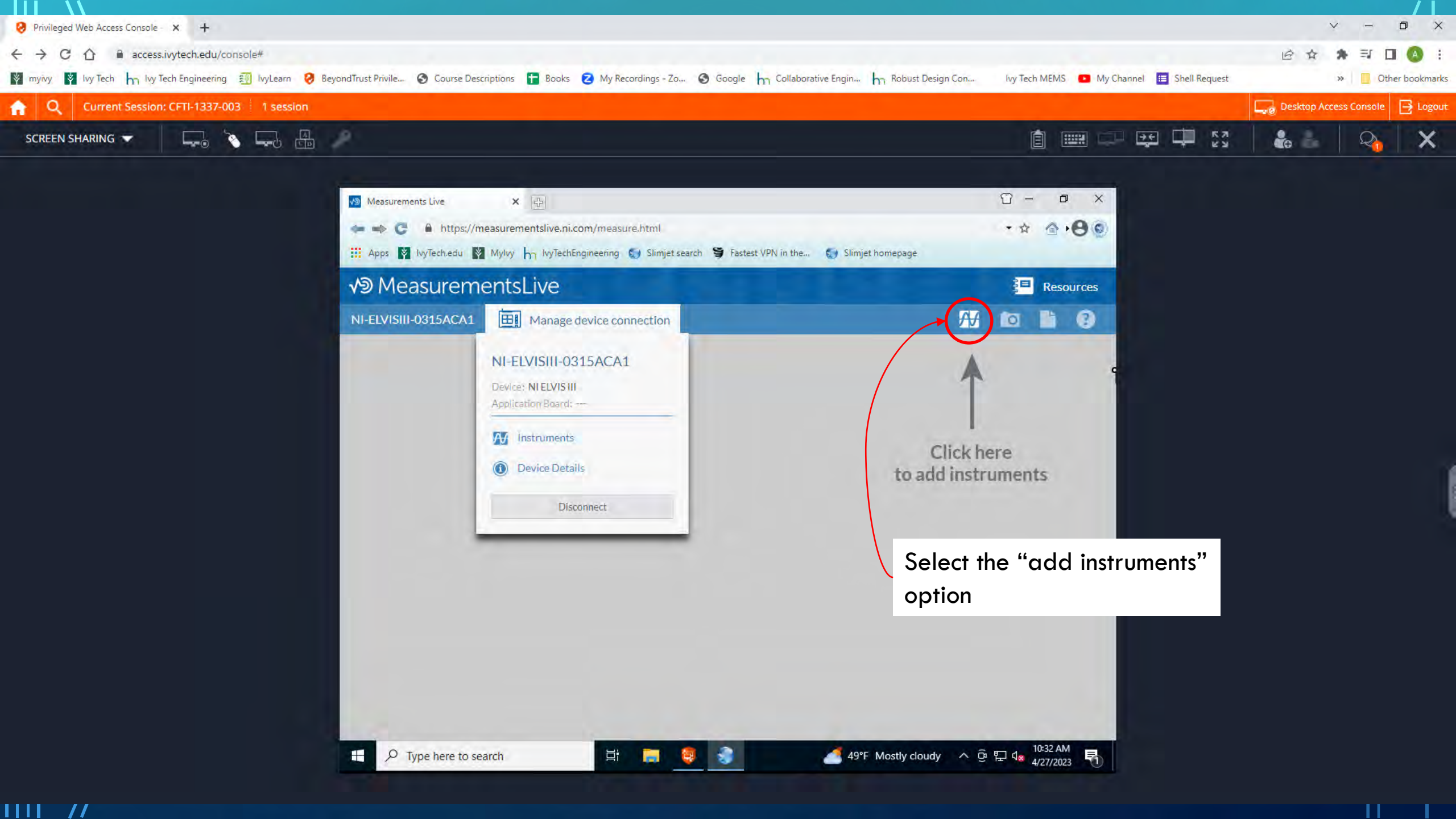
Select Measure. You are more than welcome to review the other options.



Under the USB option
Select the "Connect"

Click here
to add instruments

Connect



Measurements Live

https://measurementslive.ni.com/measure.html

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

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Select the Variable Power Supply and Bode Analyzer

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 [?]

Type here to search 49°F Mostly cloudy 10:35 AM 4/27/2023

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection
VPS Run
Positive (+) Static
Voltage - - - V
Current - - - A
Power - - - W
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

The screenshot shows the MeasurementsLive web interface. At the top, there's a navigation bar with the logo and 'Resources'. Below that, a header identifies the device as 'NI-ELVISIII-0315ACA1' and provides a 'Manage device connection' link. The main configuration area is for a 'VPS' (Virtual Power Source). It features a 'Run' button and a 'Power' section with a 'W' icon. Two channels are visible: a positive channel set to 9V and 500mA, and a negative channel set to -9V and -500mA. Each channel has a 'Voltage [?]' and 'Current limit [?]' field. A 'Negative (-)' dropdown is set to 'Static'. At the bottom, there are indicators for Voltage (V), Current (A), and Power (W). The Windows taskbar at the bottom shows the search bar, taskbar icons, and system tray with weather (51°F Mostly cloudy) and time (10:49 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.

Measurements Live
https://measurementslive.ni.com/measure.html
Apps IvyTech.edu MyIvy IvyTechEngineering Slimjet search Fastest VPN in the... Slimjet homepage

MeasurementsLive

NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer Run

Frequency Cu: Off

Power - - - W

9 V, 500 mA
Voltage [?] 9 V
Current limit [?] 500 mA

Negative (-) Static

Voltage - - - V
Current - - - A
Power - - - W

-9 V, -500 mA
Voltage [?] -9 V
Current limit [?] -500 mA

Type here to search 55°F 11:11 AM 4/27/2023

Select the Bode Analyzer also and it will launch.

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

Run

Frequency | Cu: Off

Stimulus channel

| | |
|------------------|----------------|
| Start frequency | Stop frequency |
| 10 Hz | 1 MHz |
| Steps per decade | Peak amplitude |
| 10 | 1 V |

FGen/Arb CH1 - Oscilloscope CH1 [?]

Response channels

| | |
|------------------|-------------------------------------|
| Response 1 | <input checked="" type="checkbox"/> |
| Oscilloscope CH2 | <input type="checkbox"/> |
| Response 2 | <input type="checkbox"/> |
| Response 3 | <input type="checkbox"/> |

Reference channels

| | |
|-------------|--------------------------|
| Reference 1 | <input type="checkbox"/> |
|-------------|--------------------------|

Voltage [?] -9 V

Current limit [?] -500 mA

Type here to search | 55°F | 11:12 AM 4/27/2023

If you select the little “gear” icon you can adjust the Start and Stop frequency (10 Hz to 1 MHz 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.

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

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 [checked] | Oscilloscope.CH2
Response 2 [unchecked]
Response 3 [unchecked]

Reference channels
Reference 1 [unchecked]

Gain (dB)
Phase (°)

1.25
1
500m
0
-250m
1.25
1
500m
0
-250m

100m 200m 300m

Current limit [?] 500 mA
Negative (-) Static
Voltage - - - V
Current - - - A
Power - - - W
-9 V, -500 mA
Voltage [?] -9 V
Current limit [?] -500 mA

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

MeasurementsLive
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer Run

Frequency Cu: Off

Gain (dB)
1.25
1
500m
0
-250m

Phase (°)
1.25
1
500m
0
-250m

100m 200m 300m

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

VPS Run

Power - - - W

Current - - - A

Power - - - W

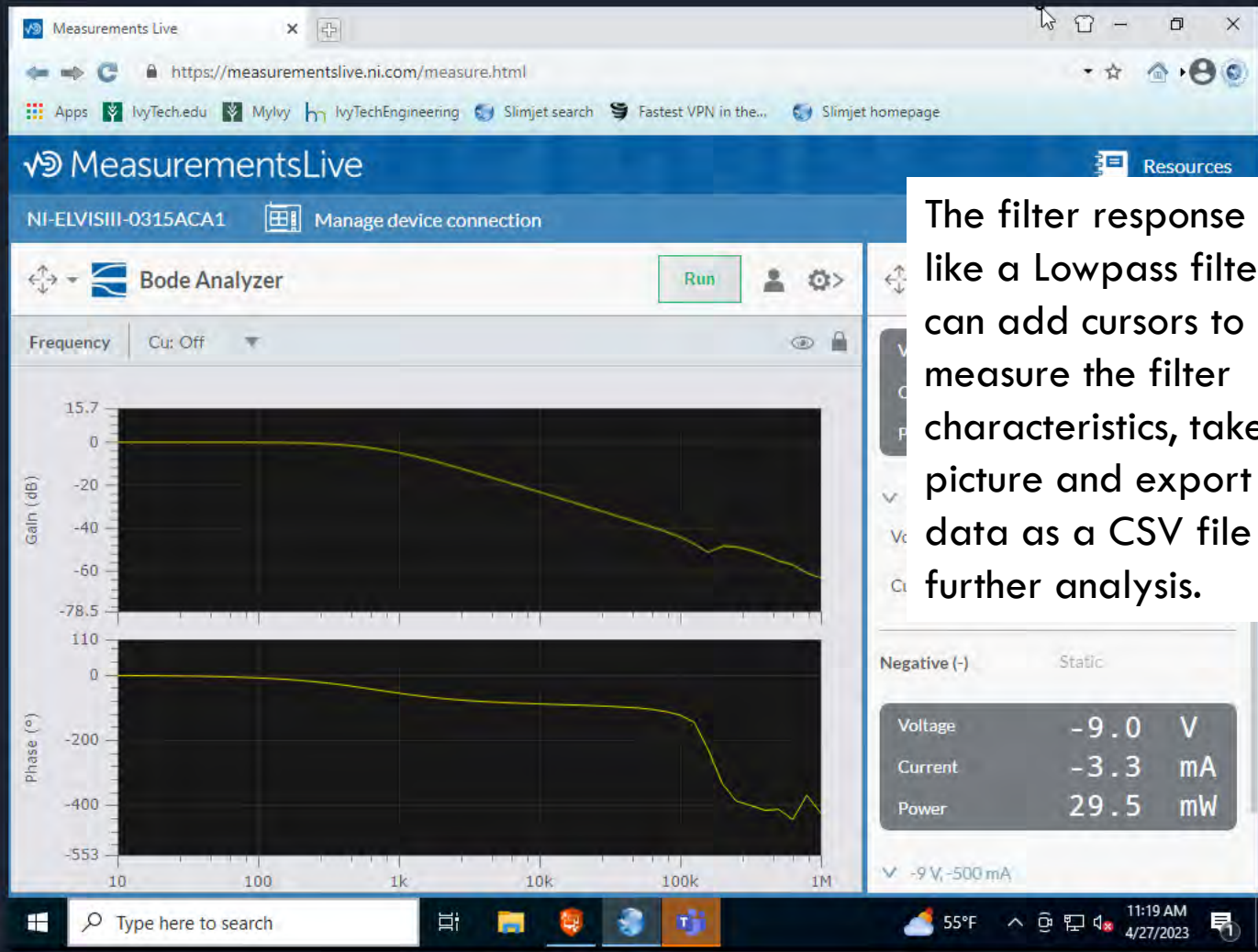
-9 V, -500 mA

Voltage [?] -9 V

Current limit [?] -500 mA

Type here to search 55°F 11:12 AM 4/27/2023

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.

| | Negative (-) | Static |
|---------|--------------|--------|
| Voltage | -9.0 V | |
| Current | -3.3 mA | |
| Power | 29.5 mW | |

-9 V, -500 mA

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

Frequency Cu: Manual

| | C1 Response 1 | C2 Response 1 | Δ Value |
|-----------|---------------|---------------|----------------|
| Frequency | 10 Hz | 709.53 Hz | 699.53 Hz |
| Gain | 0.01229 dB | -3.0546 dB | 3.0669 dB |
| Phase | -0.88144° | -45.415° | 44.534° |

Gain (dB)
Phase (°)

Static

| | |
|---------|---------|
| Voltage | -9.0 V |
| Current | -3.5 mA |
| Power | 31.1 mW |

-9 V, -500 mA

Type here to search 55°F 11:30 AM 4/27/2023

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.

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

Run

Frequency Cur: Manual

| | C1 Response 1 | C2 Response 1 | Δ Value |
|-----------|---------------|---------------|-----------|
| Frequency | 10 Hz | 709.53 Hz | 699.53 Hz |
| Gain | 0.01229 dB | -3.0546 dB | 3.0669 dB |
| Phase | -0.88144° | -45.415° | 44.534° |

Gain (dB)

Phase (°)

Current: 2.8 mA
Power: 25.3 mW

9 V, 500 mA
Voltage [?]: 9V
Current limit [?]: 500mA

Negative (-): Static

Voltage: -9.0 V
Current: -3.5 mA
Power: 31.1 mW

-9 V, -500 mA

Type here to search
55°F
11:30 AM
4/27/2023

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

MeasurementsLive
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer Run

| Frequency | C1 Response 1 | C2 Respo |
|-----------|---------------|-----------|
| Frequency | 10 Hz | 709.53 Hz |
| Gain | 0.0108 dB | -3.0559 |
| Phase | -0.79406° | -45.274° |

Stimulus channel
Start frequency: 10 Hz, Stop frequency: 1 MHz
Steps per decade: 10, Peak amplitude: 1 V

Response channels
Response 1: [checked]
Oscilloscope CH2: [unchecked]
Response 2: [unchecked]
Response 3: [unchecked]

Choose instrument(s) to capture
 Bode Analyzer
 Variable Power Supply
Take Screenshot

bode_20230427_1....png Show all x

Type here to search 62°F 2:37 PM 4/27/2023

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

Stimulus Channels

| Stimulus Channel | Start Frequency | Stop Frequency | Steps Per Decade | Peak Amplitude |
|------------------|-----------------|----------------|------------------|----------------|
| Stimulus 1 | 10 Hz | 1 MHz | 10 | 1 V |

Response Channels

| Response Name | State | Channel Label |
|---------------|----------|----------------|
| Response 1 | Enabled | CADRESCOPE CHC |
| Response 2 | Disabled | |
| Response 3 | Disabled | |

Reference Channels

| Reference Name | State | Mode | Source File Name | Channel |
|----------------|----------|------|------------------|---------|
| Reference 1 | Disabled | | | |
| Reference 2 | Disabled | | | |

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

MeasurementsLive
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

Run

| | C1 Response 1 | C2 Respo |
|-----------|-----------------|------------|
| Frequency | 10 Hz | 709.53 Hz |
| Gain | 0.0108 dB | -3.0559 dB |
| Phase | -0.79406° | -45.274° |

Stimulus channel
Start frequency: 10 Hz, Stop frequency: 1 MHz
Steps per decade: 10, Peak amplitude: 1 V

Response channels
Response 1:
Oscilloscope CH2:
Response 2:
Response 3:

Choose data to export
Bode Analyzer
 CSV
Export Data

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

bode_20230427_1....png Show all x

Type here to search
NASDAQ Composite... 2:42 PM 4/27/2023

Filter Response - Google Drive x +
https://drive.google.com/drive/folders/196Ky_s5RpQHwE8DMvhmwfNhnsjkYCMtN
Apps IvyTech.edu MyIvy IvyTechEngineering Slimjet search Fastest VPN in the... Slimjet homepage

Drive
Search in Drive
New
Priority
My Drive
Shared drives
Shared with me
Recent
Starred
Trash
Storage
400.35 GB used

M... > Filter R...
Files Name ↑
bode_20230427_143740.png
bode_20230427_144427.csv

Who has access
A
2 uploads complete
bode_20230427_144427.csv ✓
bode_20230427_143740.png ✓

Save your work in you Google Drive via MyIvy

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

Run

| Frequency | C1 Response 1 | C2 Respo |
|-----------|-----------------|------------|
| Frequency | 10 Hz | 709.53 Hz |
| Gain | 0.0108 dB | -3.0559 dB |
| Phase | -0.79406° | -45.274° |

Response channels:
Response 1
Response 2
Response 3

Reference channels:
Reference 1
Reference 2

9 V, 500 mA
Voltage [?] 9 V
Current limit [?] 500 mA
Negative (-) Static
Voltage -9.0 V
Current -3.7 mA

bode_20230427_14...xls

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

Measurements Live

https://measurementslive.ni.com/measure.html

NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

Run

| Frequency | 1.0061 kHz | 10.351 kHz | 9.3451 kHz |
|-----------|------------|-------------|------------|
| Gain | -3.0107 dB | -0.01201 dB | 2.9987 dB |
| Phase | -269.71° | -352.69° | 82.972° |

Gain (dB)

Phase (°)

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

| | |
|---------|---------|
| Voltage | 9.0 V |
| Current | 2.9 mA |
| Power | 25.7 mW |

9 V, 500 mA

Voltage [?] 9V

Current limit [?] 500mA

Negative (-) Static

| | |
|---------|---------|
| Voltage | -9.0 V |
| Current | -3.5 mA |

bode_20230427_14...xls

bode_20230427_14...xls

Show all

Type here to search

62°F 3:14 PM 4/27/2023

Measurements Live
https://measurementslive.ni.com/measure.html
NI-ELVISIII-0315ACA1 Manage device connection

Bode Analyzer

| | | | |
|-----------|-----------|------------|------------|
| 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° |

Gain (dB)
Phase (°)

Band-Pass center frequency @ 985Hz

| | |
|---------|---------|
| Voltage | 9.0 V |
| Current | 2.7 mA |
| Power | 24.7 mW |

9 V, 500 mA
Voltage [?] 9V
Current limit [?] 500 mA

Negative (-) Static

| | |
|---------|---------|
| Voltage | -9.0 V |
| Current | -3.5 mA |

bode_20230427_14...xls bode_20230427_14...xls Show all

Questions



Andy Bell
Department Chair – Engineering
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