

Keysight U3900DAQ Multiplexing Solution

Demo Guide

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Demo Guide Overview

The demo guide is to help you to promote key values of Keysight Data Acquisition and Switching Solutions to the audiences. Please always convey these messages to the audience before the demo. For more info, please refer to [keysight.com](https://www.keysight.com)

The Keysight U3900DAQ is an automated test system with excellent measurement performance on accuracy, resolution, and speed. Powered by an industry-proven and software-controlled switching system, the U3900DAQ covers a broad spectrum of switching and routing requirements for the teaching lab. Is easy to use for data logging and monitoring applications, either stand-alone or with a computer.

Solution feature and benefits

- A complete selection of plug-in modules provides high-quality measurement, switching, and control capabilities
- 20 Channel Multiplexer + 2 Channels for dedicated current measurement
- 20 Channel Actuator/General Purpose Switch
- Dual 4 Channel RF Multiplexer

Demo Guide

There are 2 demos for selection:

- [Demo 1](#): For Basic Electronics Lab – U3900DAQ + ME3000 (DUT). To demonstrate the capabilities of performing switching and multiple measurements with a single setup.

Ordering information:

1. U3900DAQ (is included in the demo transit case with all the accessories needed)
2. Oscilloscope (proposed model DSO1002A 60 MHz Oscilloscope or equivalent)
3. 2x oscilloscope probes (N2863A 10:1 ratio probe)
4. Function/Arbitrary Waveform Generator (proposed model 33220A 20 MHz or equivalent)

- [Demo 2](#): For RF Lab – U3900DAQ (DAQM905A) + U3851A (DUT). To demonstrate the RF switching capability of the RF Mux, hence realizing the remote learning.

Ordering information:

1. U3900DAQ (is included in the demo transit case with all the accessories needed)
2. U3851A
3. Keysight FieldFox N9917A

Demo 1: Basic Electronics

Overview

This demo will demonstrate a half-wave rectifier circuit as shown in Figure 1. When the sinusoidal input voltage (V_i) goes positive, the diode is forward biased and conducts current through the load resistor. The current produces an output voltage (V_o) across the load which has the same shape as the positive cycle of the input voltage. When the input voltage goes negative, the diode is reverse biased. Thus, there is no current or voltage flow across the load. The net result is only the positive half cycle of the input signal appearing across the load as shown in Figure 2(b).

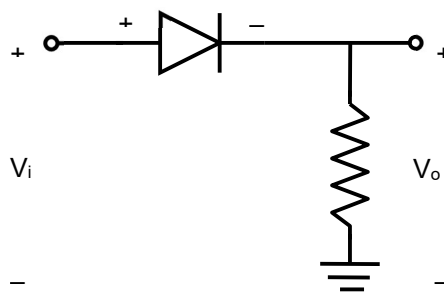


Figure 1 – Half-Wave Rectifier Schematic Diagram

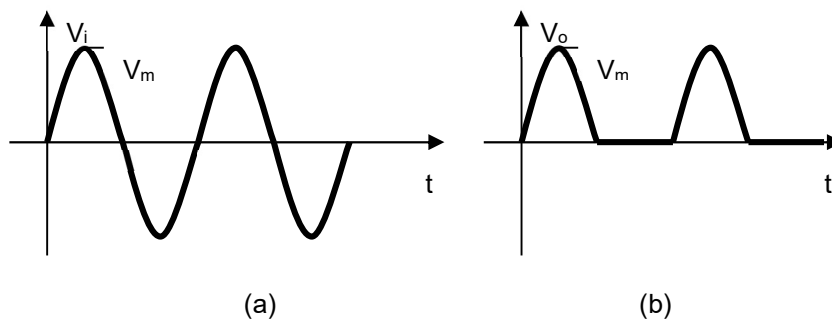


Figure 2 – Half-Wave Rectifier Input and Output Voltages

Objectives

- i. To demonstrate the operation of half-wave rectifier circuits
- ii. To demonstrate the switching concept through DAQ and measure the output voltage waveform with different load and capacitor filters on various rectifier circuits.

Equipment and Accessories Required

Provided in the U3900DAQ transit case:

- i. Keysight DAQ970A Data Acquisition System (pre-slotted with 3 modules)
- ii. ME3000 Analog Electronics Training Kit
- iii. 1 x BNC(m)-to-grabber clips coaxial cable
- iv. 1 x antistatic wrist strap
- v. 8x grabber clips to pigtail jumper cables.
- vi. 11x pigtail to 2-ways 2.54mm connector (F) jumper cables pair

NOT provided:

- 1. Windows 10 Laptop/PC
- 2. Keysight DSO1002A 60 MHz Oscilloscope
- 3. 2x oscilloscope probes (10:1 ratio probe)
- 4. Keysight 33220A 20 MHz Function/Arbitrary Waveform Generator

Software Required

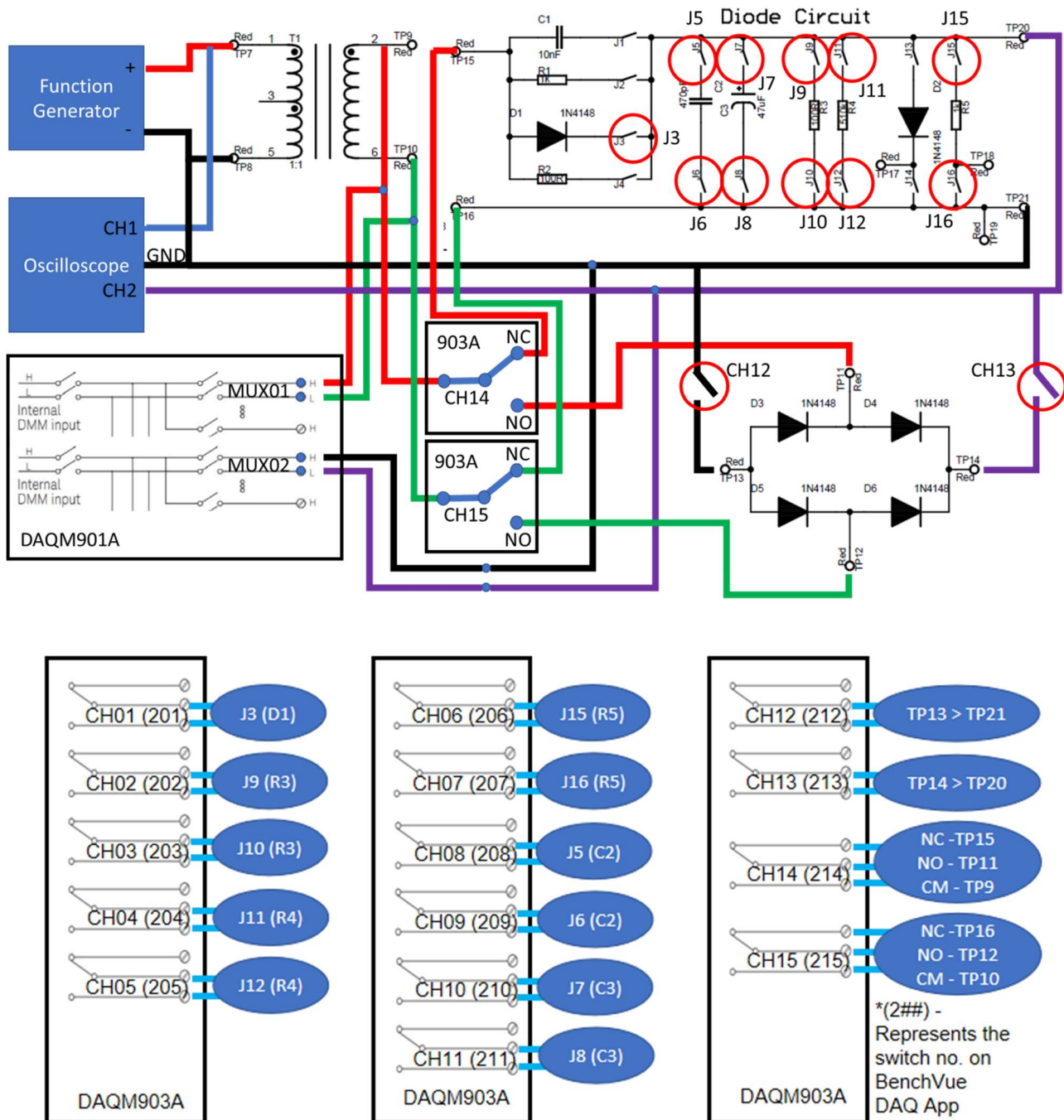
- i). Keysight BenchVue PC software with the following BenchVue app installed:
 - a. DAQ app
 - b. OSC app
 - c. FG App
- ii). Keysight Connection Expert

Caution:

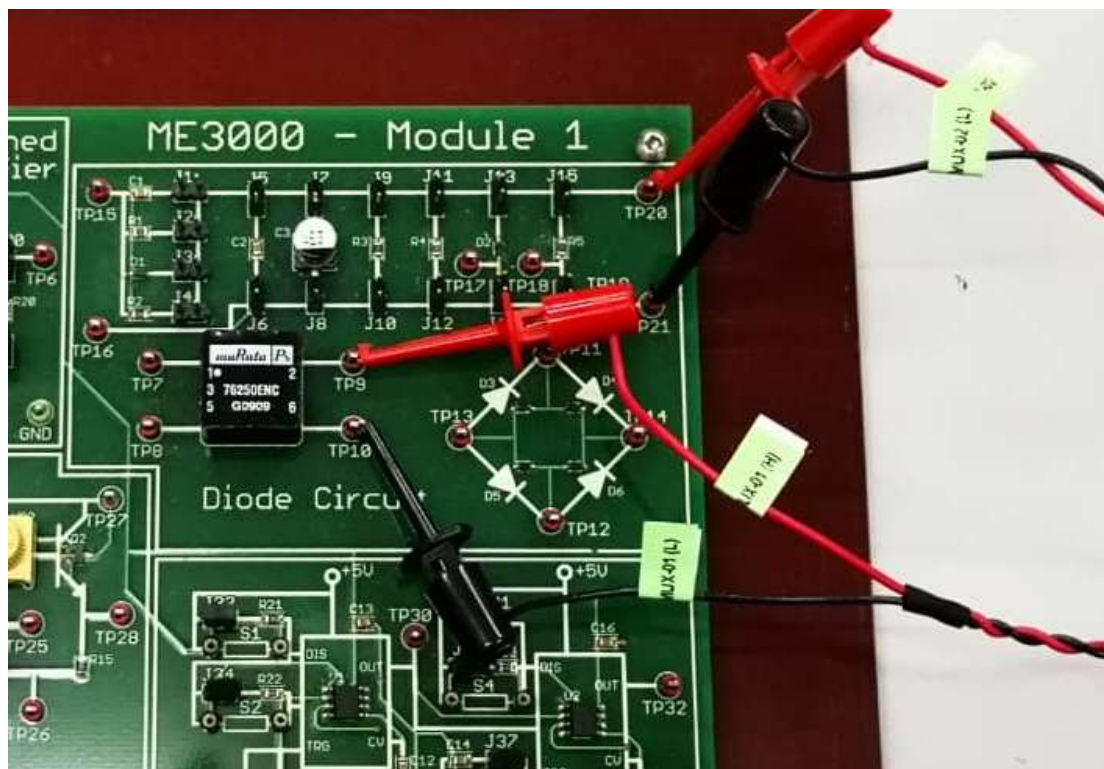
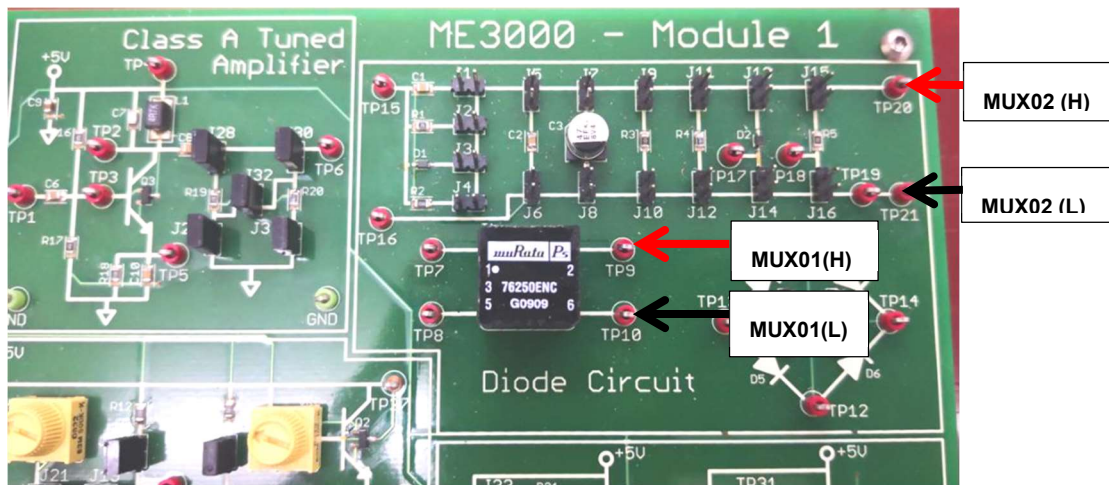
An electrostatic discharge generated by a person or an object coming in contact with electrical components may damage or destroy the training kit. To avoid the risk of electrostatic discharge, please wear the antistatic wrist strap and observe the handling precautions and recommendations contained in the EN100015-1 standard. Do not connect or disconnect the device while it is being energized.

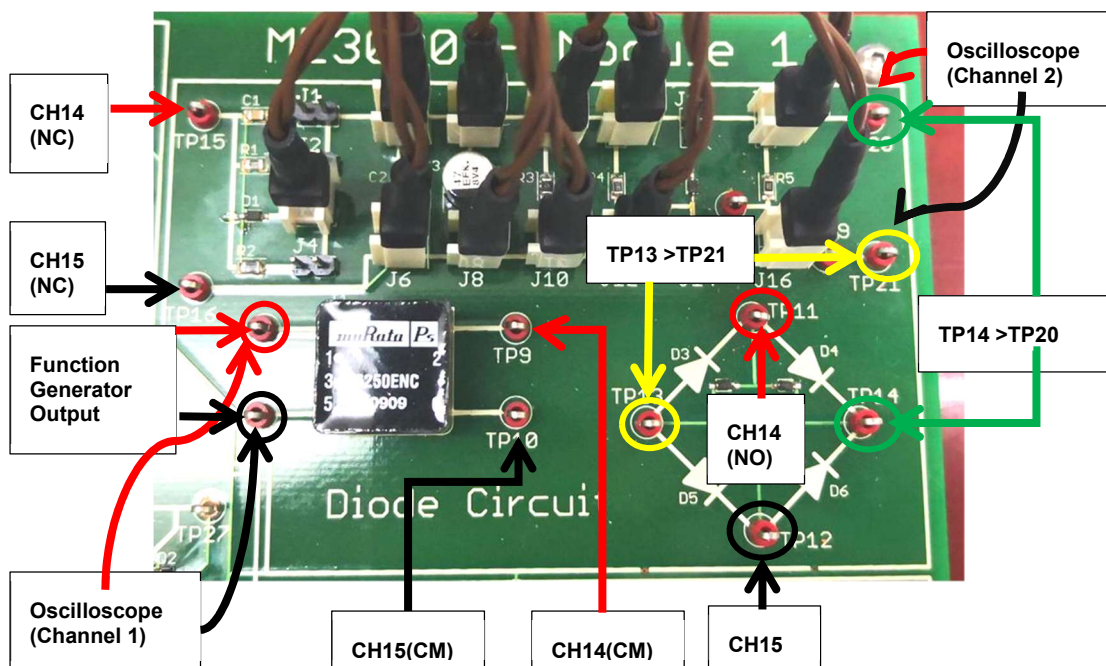
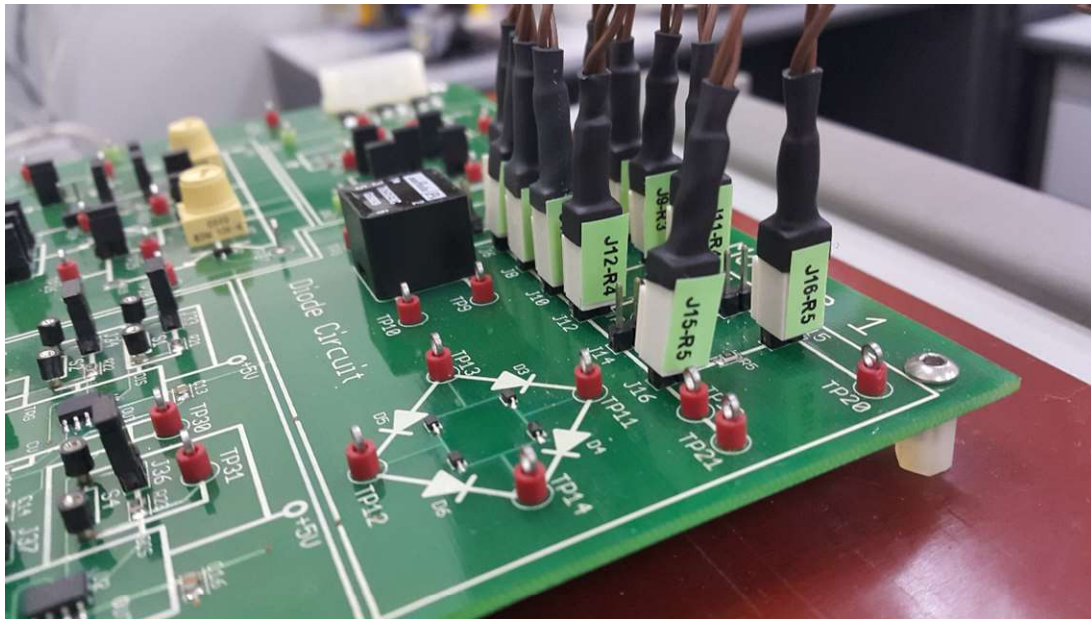
Setting up the DUT with ME3000

1. Please ensure all the connector (F) jumper cables and grabber clips are connected to the DUT according to the Test Point (TP0 and Jumper (J) location.
2. Locate the Diode Circuit section on the ME3000-M1 training kit.
3. Disconnect all the jumpers located in the Diode Circuit section.
4. Connect the Function Generator, Oscilloscope, ME3000 training kit and the DAQ970A according to the diagram below:



DUT Connection Setup





Instrument Setup

1. Connect the Oscilloscope, Function Generator and DAQ to your PC using their provided USB cables.
2. Turn ON the Oscilloscope, Function Generator and DAQ instruments.
3. Run the Keysight BenchVue software and **launch the Keysight BenchVue DAQ App** and load the attached DAQ instrument state (.state file) for Half Wave.



ME3000_HalfWave
rectifier.state

NOTE: Drag and drop the state file to your PC to use it with BenchVue software.

NOTE

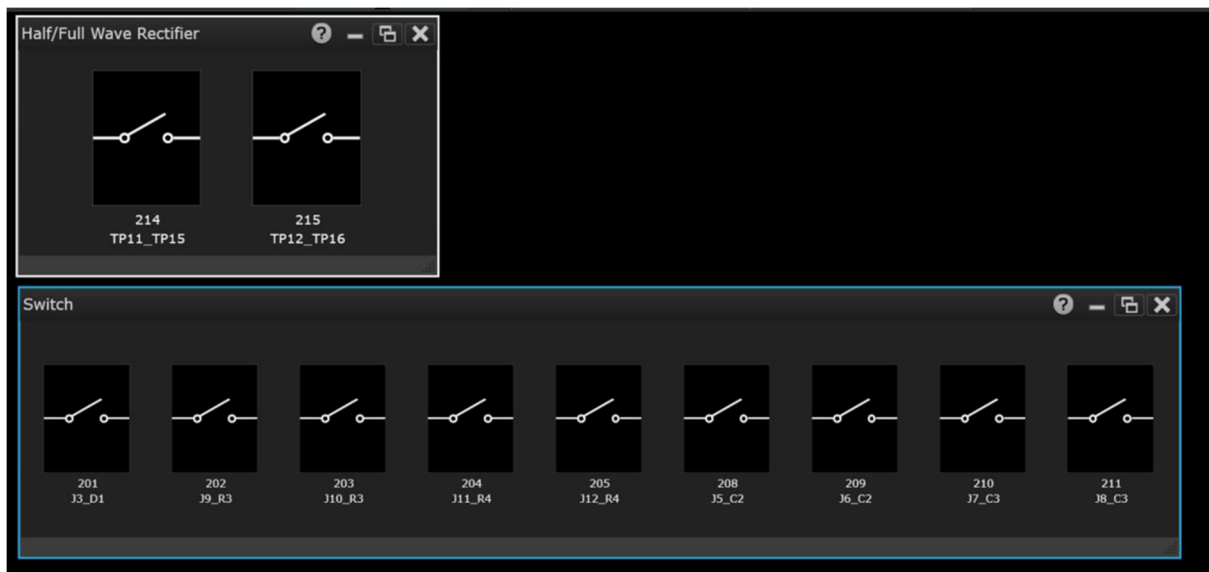
If you are asked to load a configuration, select **Create NEW (Default)**.

5. Please ensure Keysight DAQ970A Data Acquisition System pre-slotted with the following modules installed:
 - a. Slot #1: Keysight DAQM901A 20 channels Multiplexer
 - b. Slot #2: Keysight DAQM903A 20 channels Actuator/GP Switch
 - c. Slot #3: Keysight DAQM905A Dual RF Switch

IMPORTANT

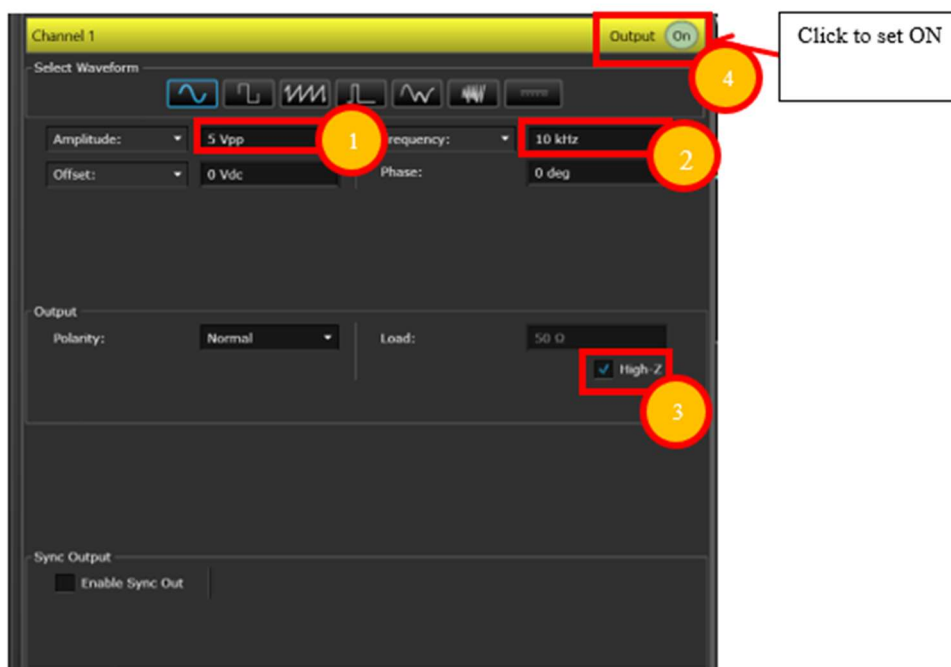
Make sure that the DAQ modules are installed to the specified slots according to the list above. Failure to do so will cause the provided instrument state files unable to be restored successfully.

4. After loading the state file, you should see the switch set up according to the picture below:



Setting Up the Function Generator

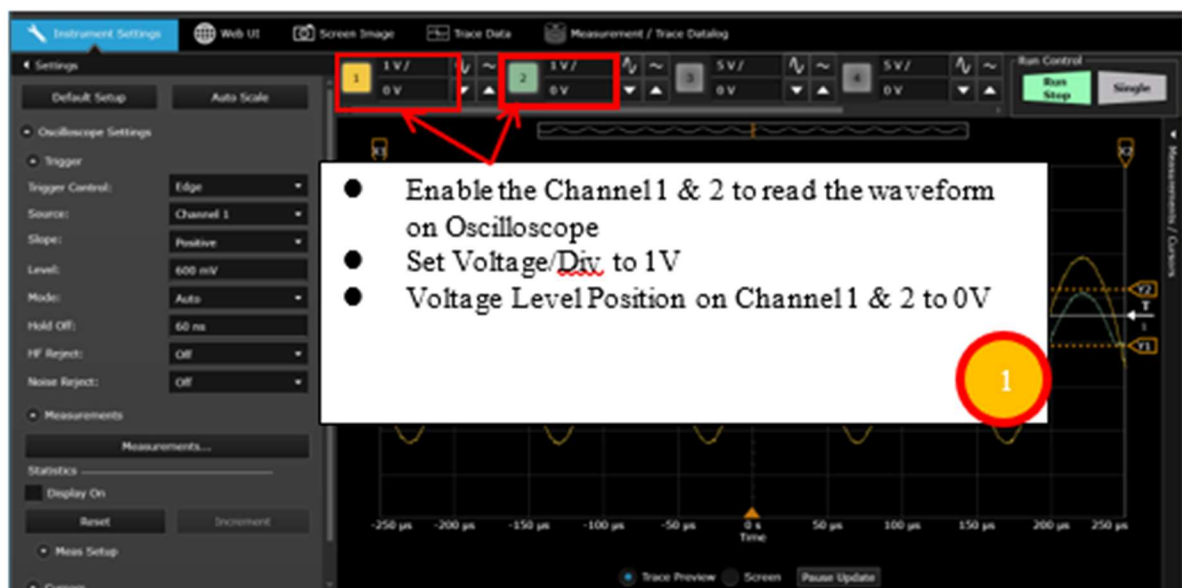
1. Launch Function Generator App by double-click the Keysight 33220A, which is located on the Instrument Tab (on the right side of the screen).
2. Set the function generator output to a 10 kHz sine wave. Adjust the amplitude to 5 V peak-to-peak. On the Output function tab, **set the Load to High-Z by enabling it**. After that, set the Output to **ON**.

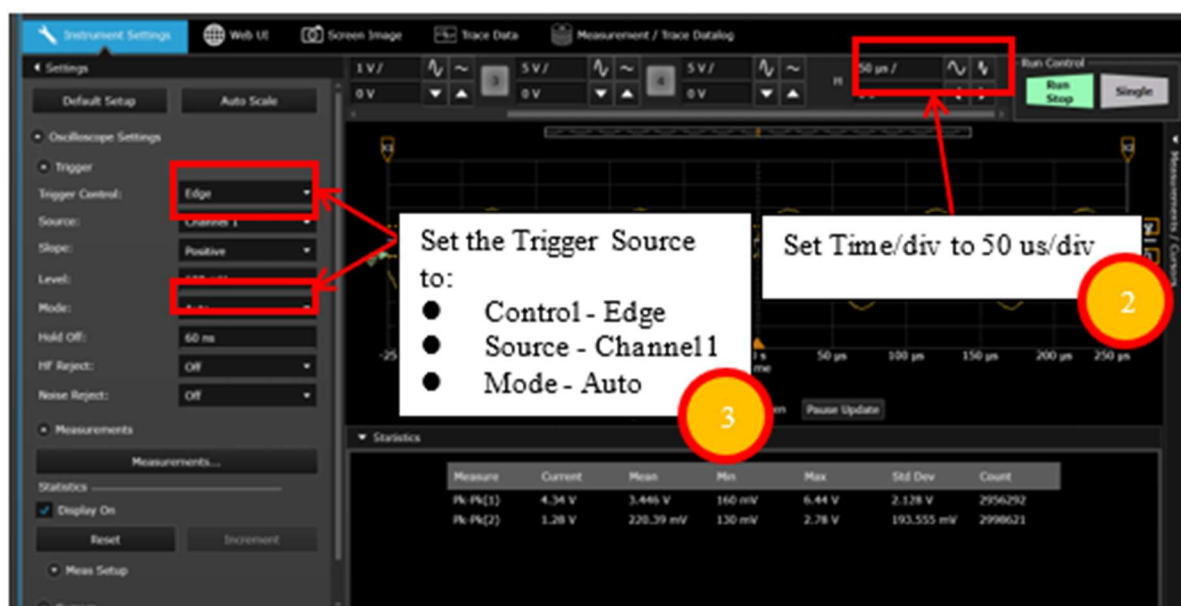


Setting Up the Oscilloscope

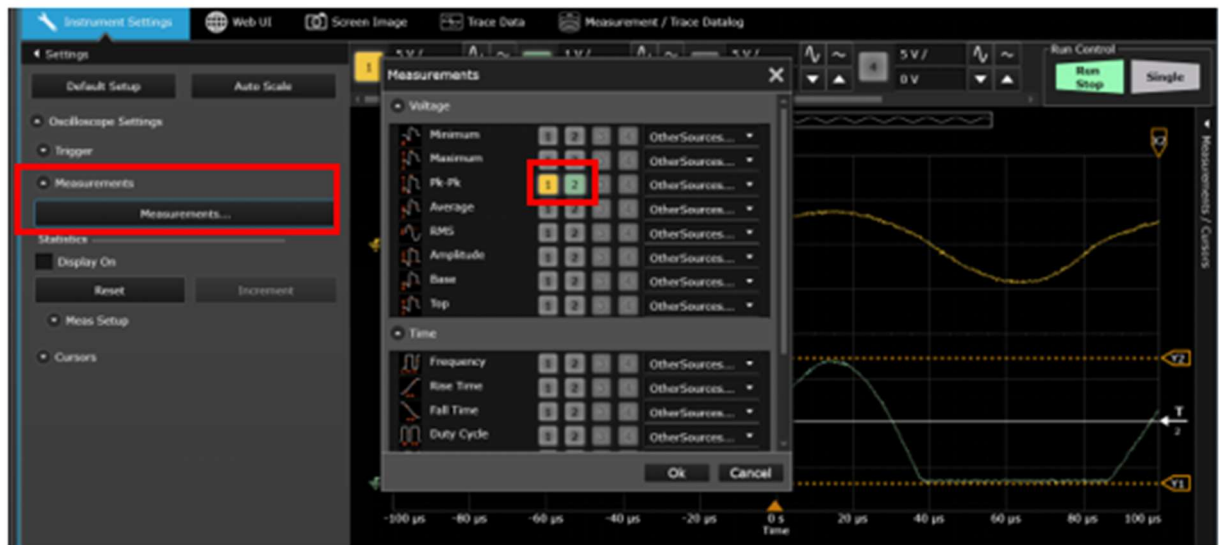
1. Launch Keysight BenchVue Oscilloscope by double-click the Keysight DSO1002A which is located on Instrument Tab (on the right side of the screen). We will be setting the Oscilloscope according to the table below:

Setting	Value
Voltage /Div	1V
Voltage Level Position	0V
Time/div	50 us
Trigger Control	Edge
Trigger Source	Channel 1
Trigger Mode	Auto





- To obtain the peak-peak voltage (Vpp) reading on Channel 1 & 2, Click “Measurement” and enable Channel 1 on 2 on **Vpp** section

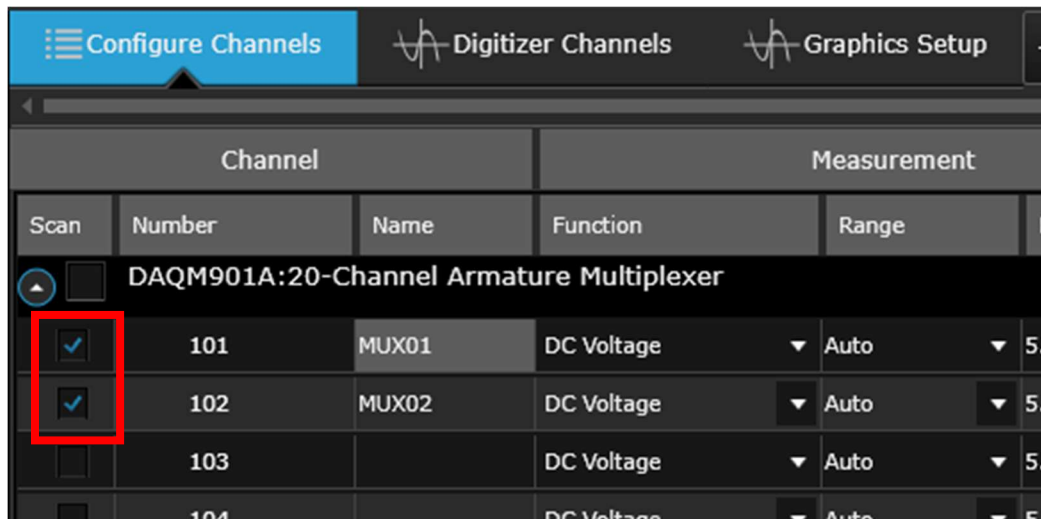


- Click the Display on to show the measurement reading on Channel 1 and Channel 2

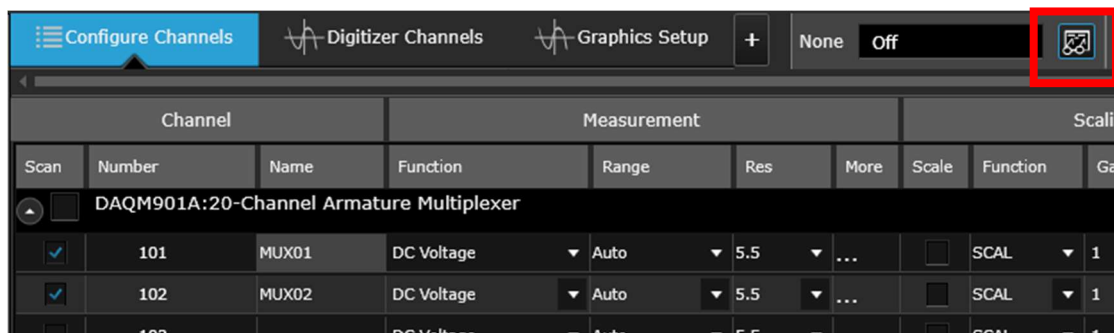


Setting Up the DAQ Internal DMM

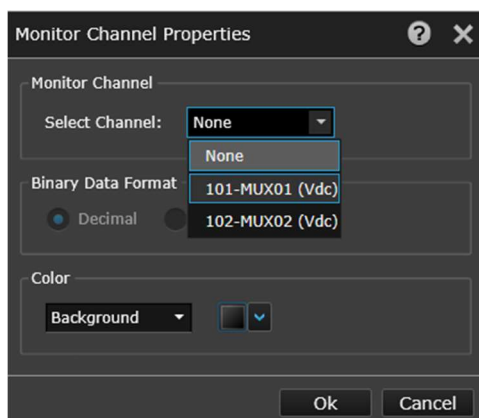
1. Use the built-in DMM to measure the circuit output. Go to the DAQ app > Configure Channels.
2. Select MUX01 and MUX02 for scanning.



3. Click the monitoring button.



4. Select MUX01 to get DC voltage reading of the transformer output.



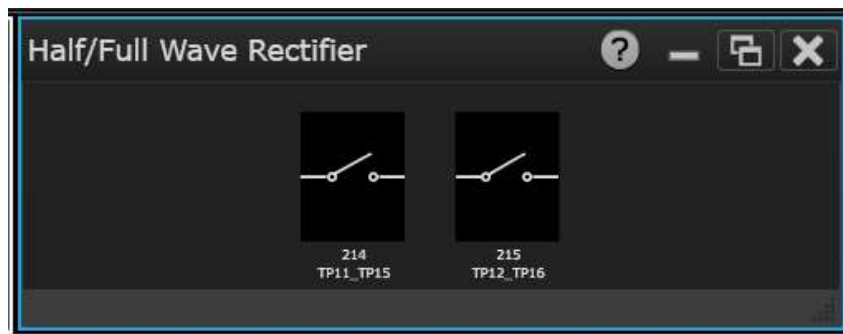
5. You will be able to see the reading.



Note: You can switch to MUX02 to get the Vdc reading of the circuit output.

Begin Labwork

1. Go to the BenchVue DAQ App and **switch 214 & switch 215 remains off by default.** This is to connect FG to the diode circuit (via TP9 & TP10) to TP15 & TP16) and to form a Half Wave rectifier setup.



2. Close **J3_D1**, **J9_R3** and **J10_R3** switches.



3. You have now constructed the Half-Wave Rectifier circuit and you can now observe the waveform on the BenchVue Oscilloscope App.

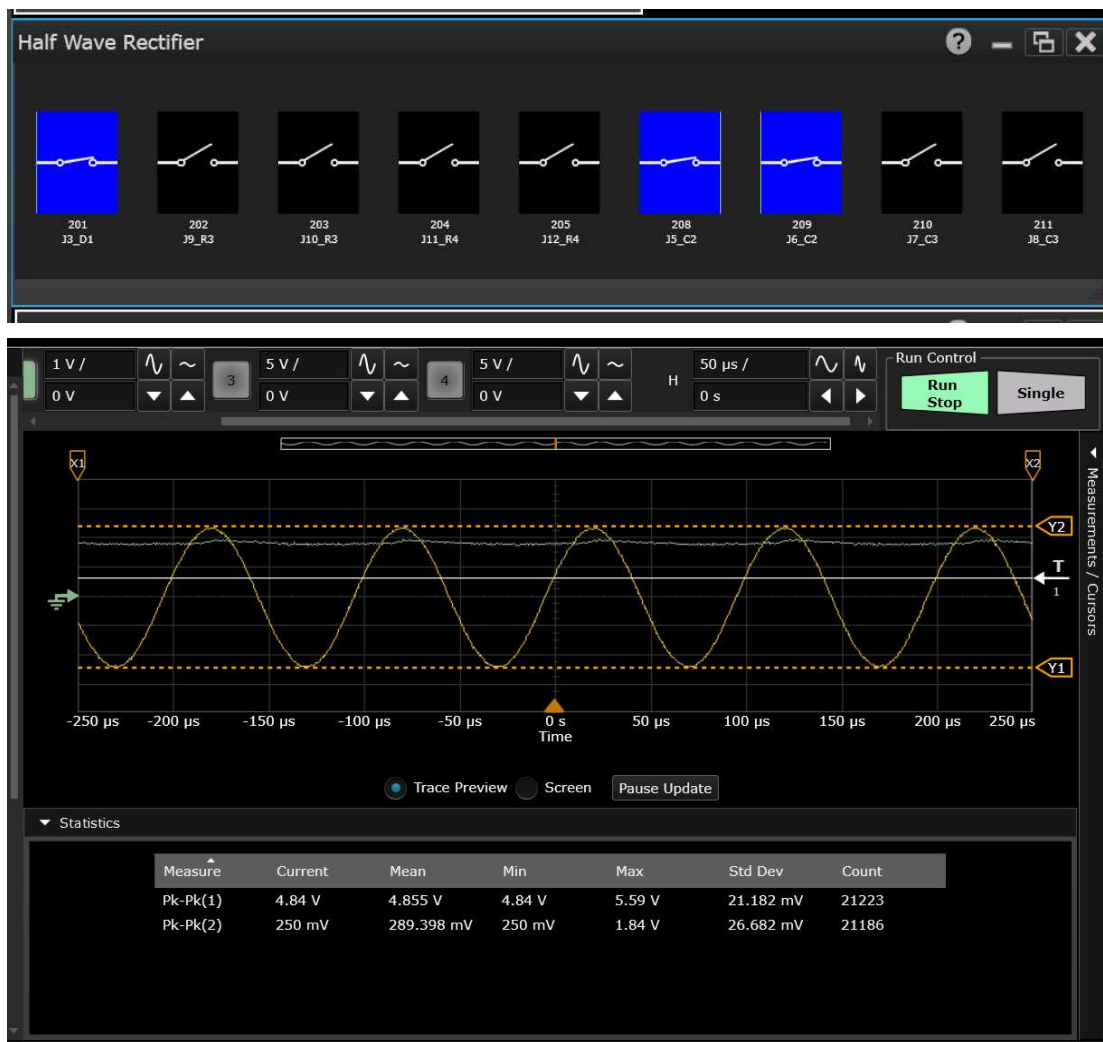


4. **Open J9_R3 and J10_R3 and then close J11_R4 and J12_R4 switches.**

This will replace the **R3** with **R4** as the load.



13. **Open J11_R4 and J12_R4** and then **close J5_C2 and J6_C2** switches. This will replace **R4** with **C2** as the load.



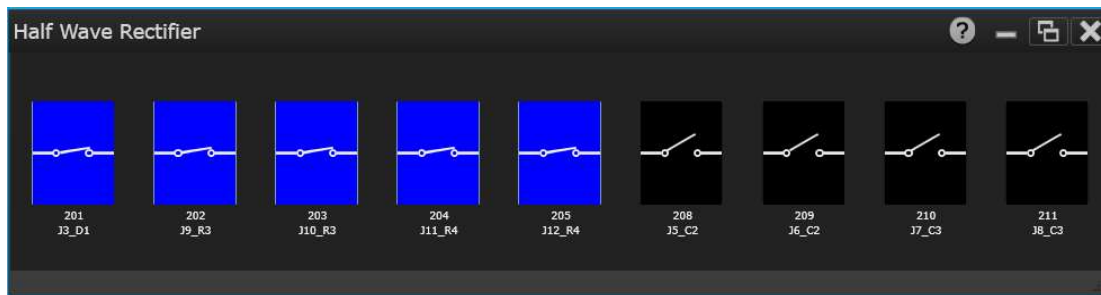
NOTE

You can set the time/div from 50 us to 150 us on BenchVue Oscilloscope App to observe clearer rippled output voltage on Channel 2(Green).

- Open **J5_C2** and **J6_C2** and then close **J7_C3** and **J8_C3** switches. This will replace **C2** with **C3** as the load.



6. **Open J7_C3 and J8_C3** and then **close J9_R3, J10_R3, J11_R4 and J12_R4** switches.
This will replace **C3** with **R3 & R4** in parallel as load.

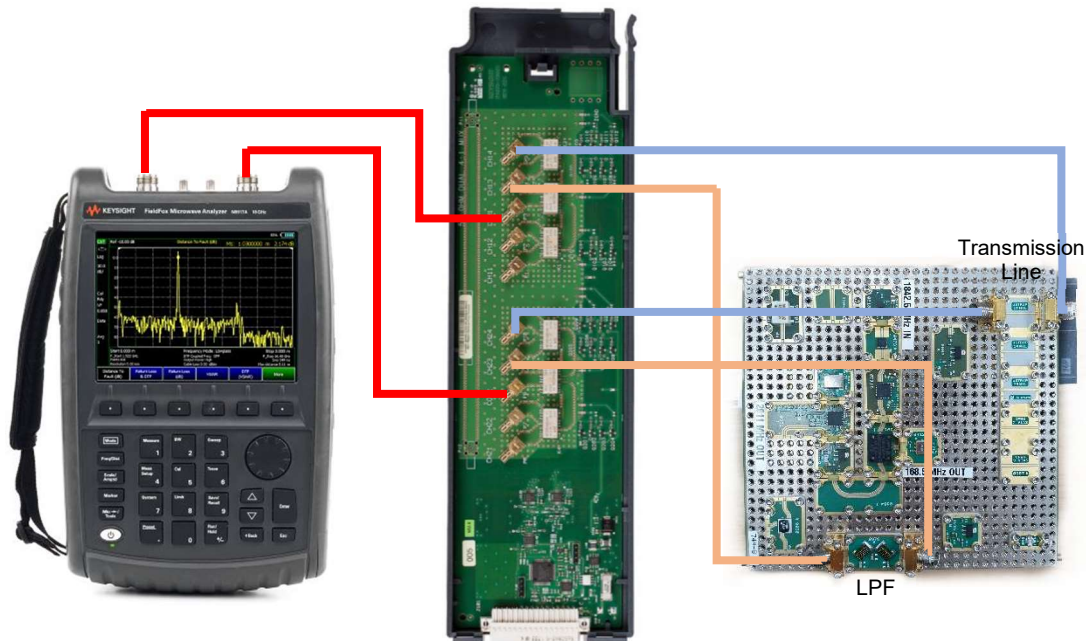


7. Open all MUX and switches.

Demo 2: RF Labs

Overview

This demo will demonstrate the capability of the RF Multiplexer which offer broadband switching. The capability is one of the keys to realize the RF lab remote learning. In this demo, we will make S-parameter of two DUT: a lowpass filter and a transmission line. Once the connection is set up as below, we will make use of BenchVue as the user interface for to achieve the remote-control portion.



Equipments and Accessories Required

In the U3900DAQ

- i). Keysight DAQ970A Data Acquisition System with DAQM905A (pre-slotted slot 3)
- ii). USB Type A to Type B cable x1
- iii). X-microwave coaxial connector U3851-22100 x1

In the U3851A

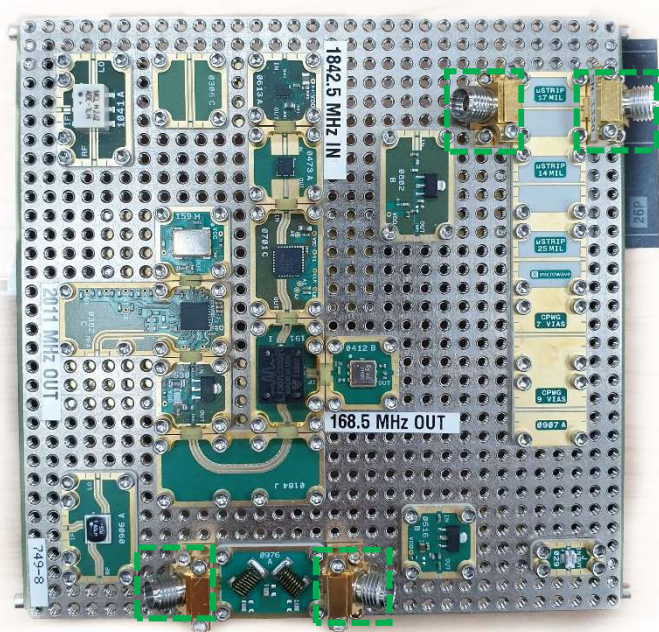
- iv). Education hardware kit U3851-66500 x1
- v). SMA M-M cables U3851-61700 x2
- vi). N type (M) to SMA (F) adaptors U3800-37603 x2
- vii). 8lb-in, 5/16 Inch torque wrench 8710-1765x1
- viii). Hex screwdriver U3851-33801 x1
- ix). LAN Cable 34980-61614 x1
- x). Keysight FieldFox N9917A or anything similar
- xi). Windows 10 PC

Software Required

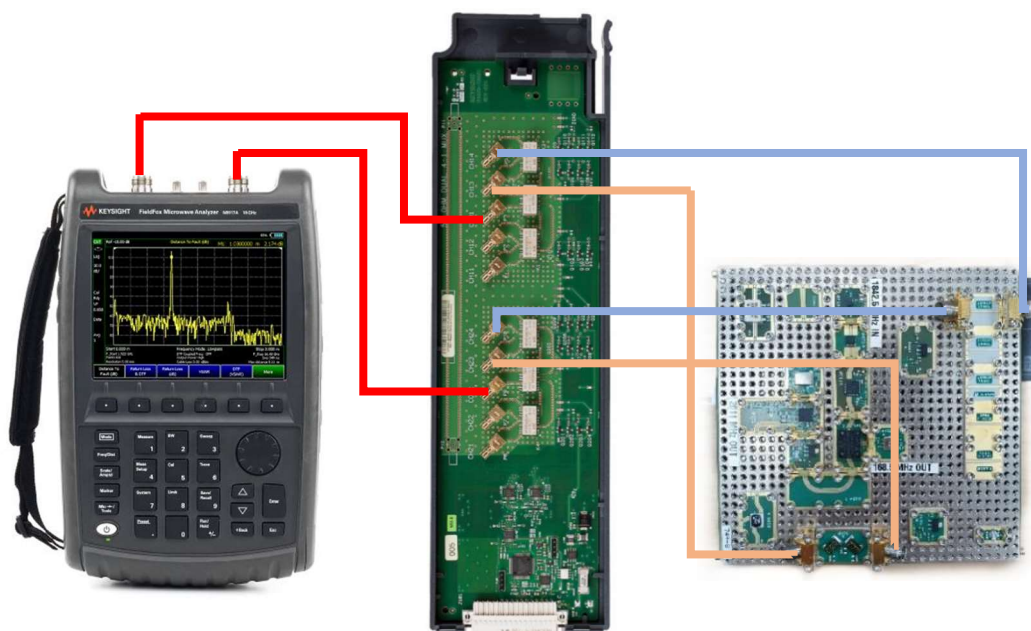
- iii). Keysight BenchVue PC software with the following BenchVue app installed:
 - a. DAQ App
 - b. FieldFox App
- iv). Keysight Connection Expert

Demo Setup

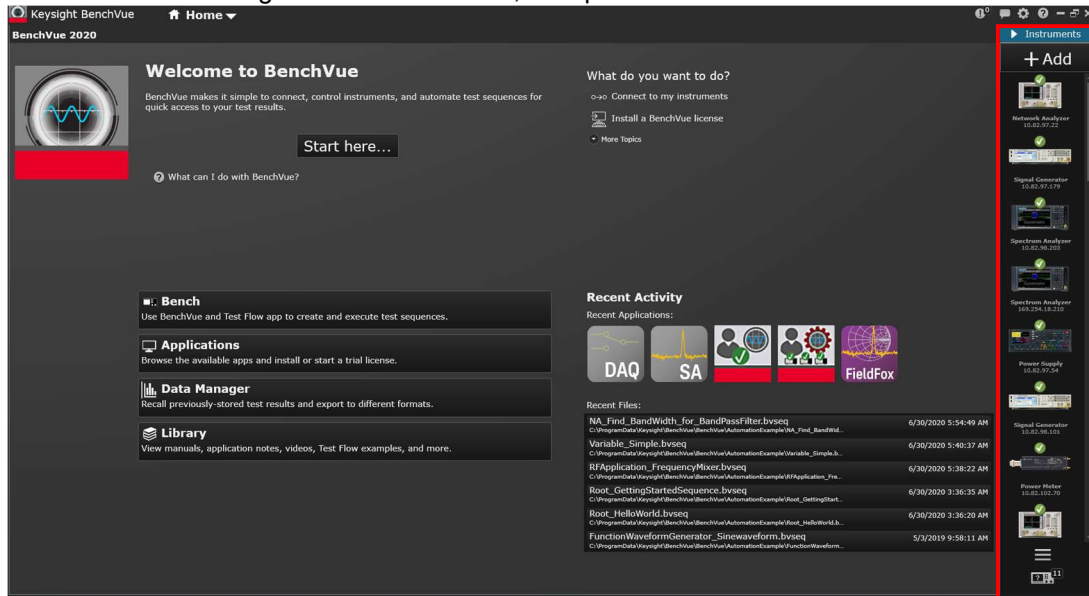
1. **Place the X-Microwave probes on below locations** as shown below. By default, there are only 3 X-microwave probes on the education hardware kit, please get the 4th one from U3900ADAQ. You may use hex screwdriver in helping move those X-Microwave probes.



2. **Connect** the educational hardware kit, FieldFox, and DAQ following the diagram below. The **yellow labels** on the SMA(M)-SMB(F) cables will help you setting the connection up. Do take note that the polarity is not important as both DUTs are passive component.



3. Connect the FieldFox and the DAQ to the PC with LAN cables (in the U3851A) and USB cable (in the U3900ADAQ) respectively.
4. Launch the BenchVue software. Make sure all the instrument that will be used in this demo can be found at the right-hand side column, else please **add them in**.



5. Launch the FieldFox App and choose the “**NA Mode**”. The FieldFox App is used for network analysis. Results can be viewed real time here.

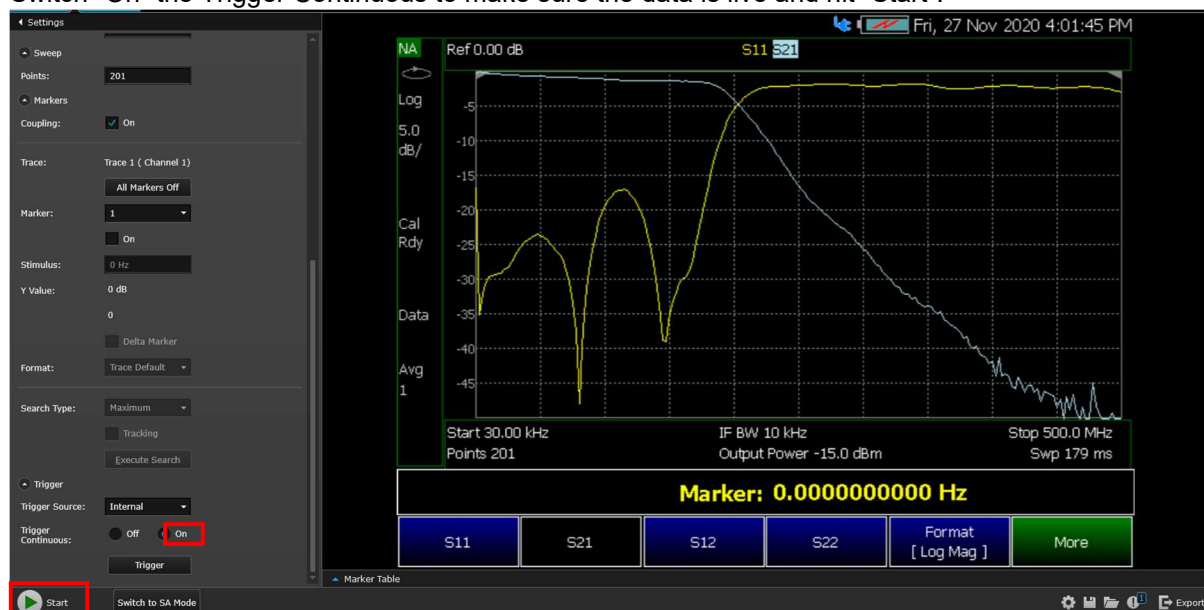


6. Next is to setup up the screen to view result that is making sense. The low pass filter has a cutoff frequency $\sim 200\text{MHz}$. My advice will be setting up S11 and S21 trace with start and stop frequencies at 30kHz to 500MHz respectively. The state file here was created with N9917A. That should work on all FieldFox on BenchVue.

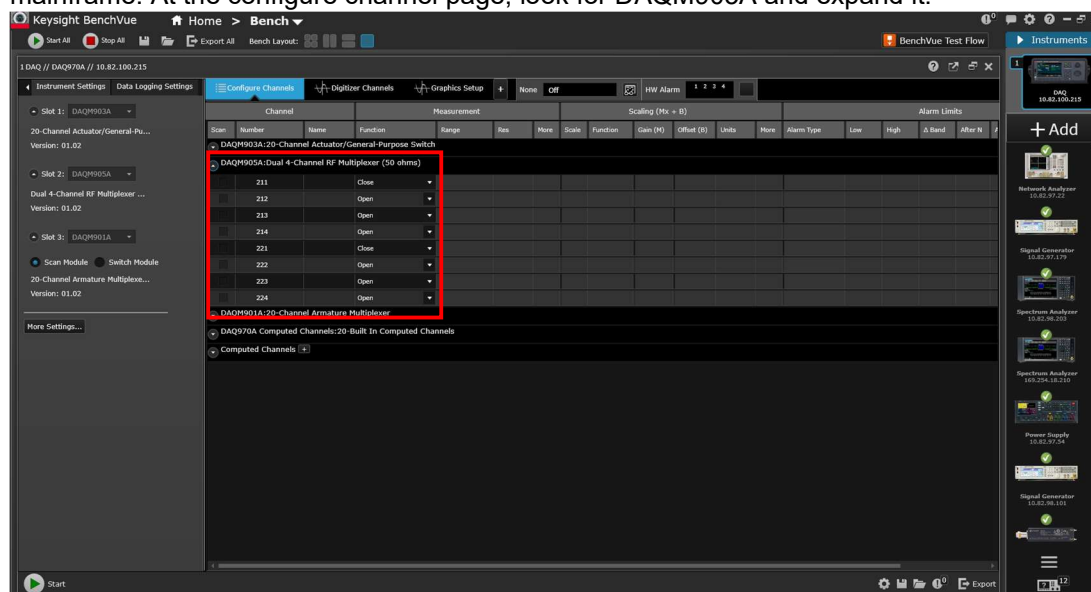


N9917A State.state

- Switch “On” the Trigger Continuous to make sure the data is live and hit “Start”.



- Launch the DAQ app.** The DAQ App used for changing the path of DUT that connects to the DAQ. The DAQ app will automatically detect all modules that are slotted in the DAQ970A mainframe. At the configure channel page, look for DAQM905A and expand it.



The table below shows the connected switches connected to the DUT. The switches will come in **pairs**. Make sure the switches are in “**Close**” mode if you want to measure the DUT.

DUT	Switches
Filter	313,323
Transmission Line	314,324

- Interchange between the two DUT and look at the S parameters on the BenchVue FieldFox App.