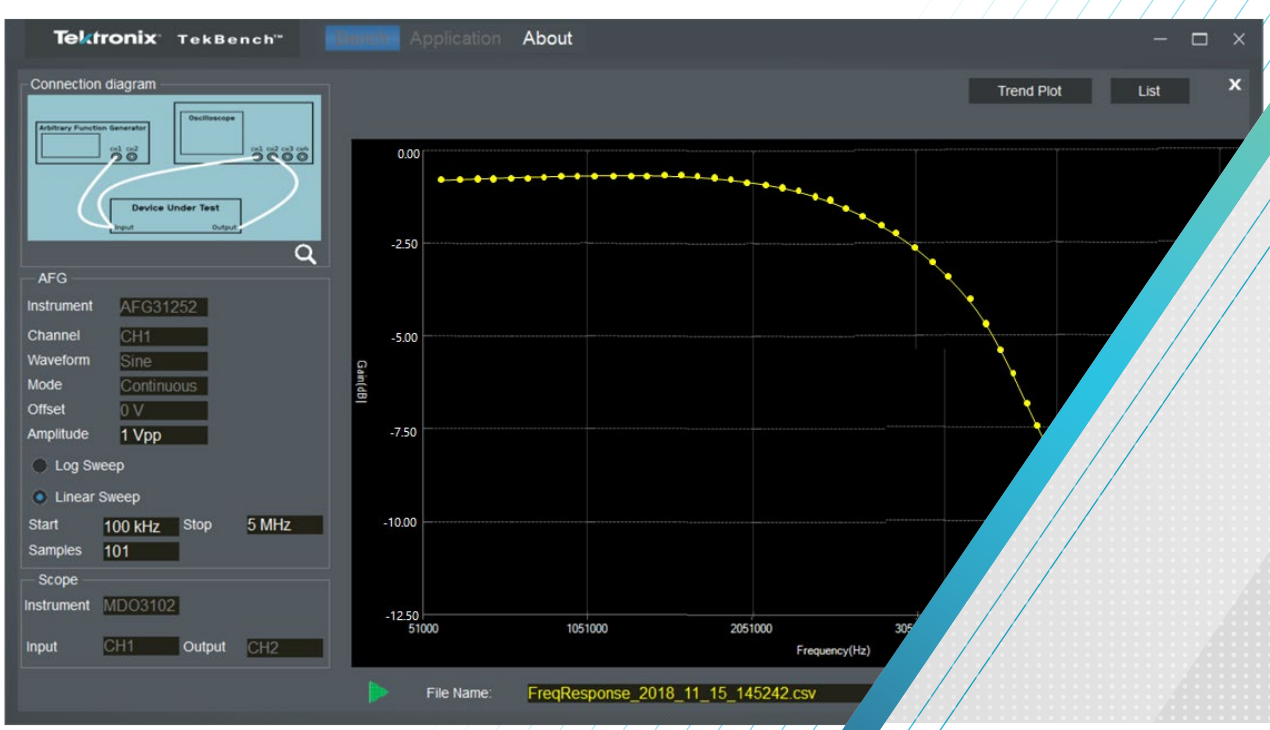
# Automated Frequency Response Measurement with AFG31000, MD03000 and TekBench™ Instrument Control Software

APPLICATION NOTE

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## Introduction

For undergraduate students in colleges and universities, frequency response testing is a common measurement to characterize their design, either a filter, an amplifier or many others. The following diagram shows how to perform the frequency response testing with an arbitrary function generator and an oscilloscope:

- Connect CH1 output of AFG and CH1 input of oscilloscope to the input of the circuit
- Connect CH2 input of oscilloscope to the output of the circuit

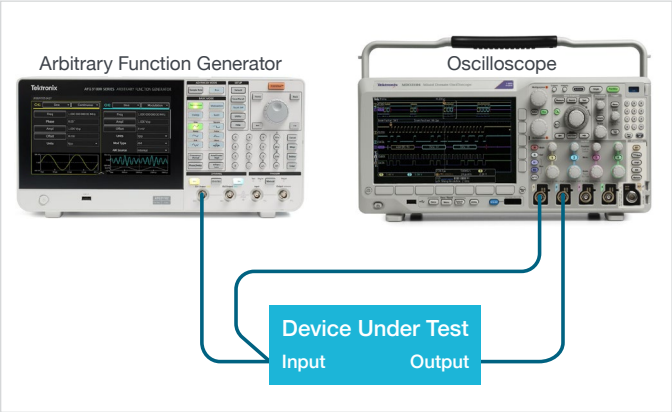


Figure 1. Frequency response testing connection diagram

In traditional labs, students have to set the output frequency of the arbitrary function generator and record the measurement of amplitude on the oscilloscope manually. They then need to change the frequency and record another measurement. Take the example of Frequency Response testing from a Start of 100 kHz to a Stop of 5 MHz with total 101 samples in Linear Sweep mode, students would have to create around 100 tests on different frequencies, which will take them more than one hour to finish. Furthermore, they need spend extra time to consolidate all the data to create the frequency response curve. This method of testing is time consuming and it is easy to make mistakes.

This application note describes how to use TekBench™ software and a Tektronix AFG31000 series arbitrary function generator and MDO3000 oscilloscope to perform the automated frequency response measurement effortlessly with just a few steps.

## Preparation

- TekBench™ software
  Visit www.tek.com/tekbench to download the latest version TekBench software and install it on a laptop with Win7 or win10 operation system.
- Oscilloscope * 1 unit Any model of MDO3000 series
- Arbitrary function generator * 1 unit Any model of AFG31000 series
- Circuit board—Student designed board, and we use a filter board as an example here
- Accessories
  Probes, USB cables etc.

1. Connect the arbitrary function generator and oscilloscope to the circuit board as shown in **Figure 1**.
2. Start the TekBench application in the laptop, then connect the instruments to the laptop using USB cables as shown below. TekBench will detect the instruments automatically within a few seconds.

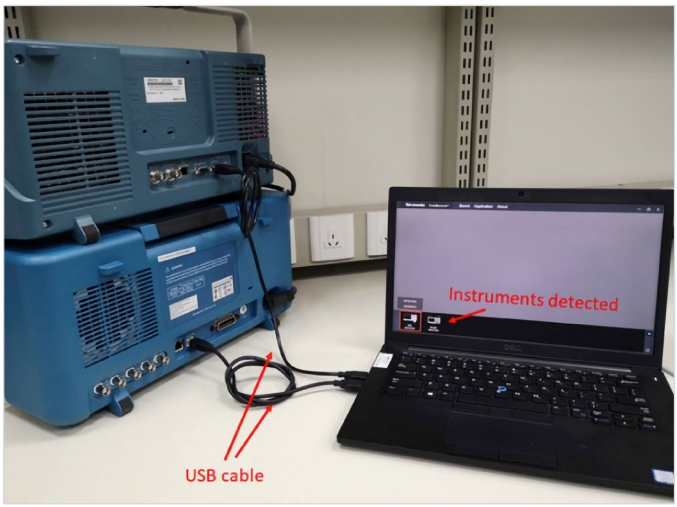


Figure 2. Connect instruments to laptop

## Configure frequency response testing

3. In TekBench software, click Application -> Frequency Response testing to enter the frequency response testing interface.

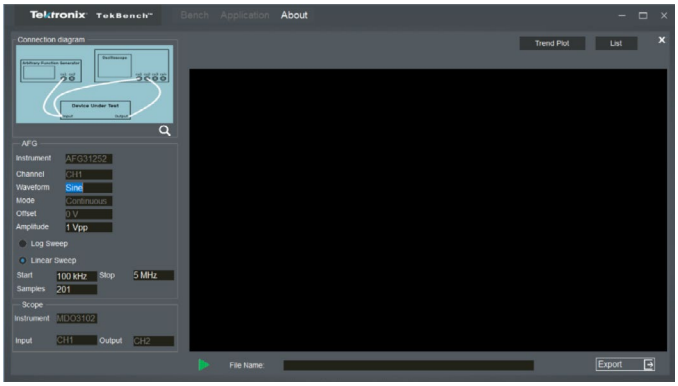

Figure 3. Frequency response testing interface

The CH1 parameters of arbitrary function generator is set as below automatically

Waveform: Sine wave

Mode: Continuous

Offset: 0

Amplitude: 1 Vp-p

4. Set the parameters in the software per testing requirement. Here is an example:

Amplitude: **1 Vp-p**

Sweep mode: **Linear sweep**

Start frequency: **100 kHz**

Stop frequency: **5 MHz**

Samples: **101**

5. Turn the arbitrary function generator CH1 and oscilloscope CH1, CH2 to be ON manually

6. Click Start icon to start the testing. The frequency of the arbitrary function generator will start to change automatically, and the amplitude of input and output is measured by oscilloscope after each change.

## Export result

Within just a few minutes, a frequency response curve, Frequency versus Gain, is created automatically.

*Gain = 20 $log_{10}$ (output amplitude / input amplitude)*

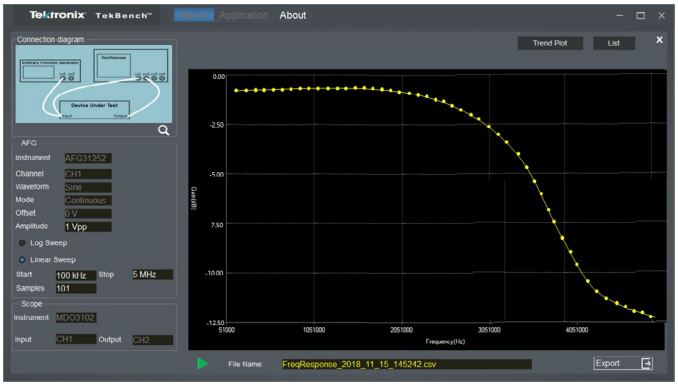

Figure 4. Frequency response curve

7. Click **List** button to check the result in detail

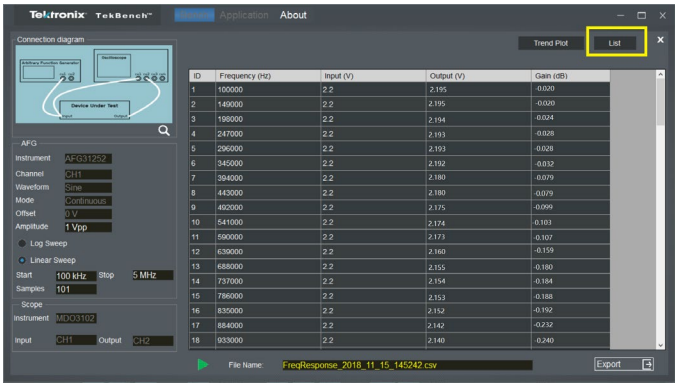

Figure 5. Data list

8. Click **Export** to export the result in *.csv file for further analysis.

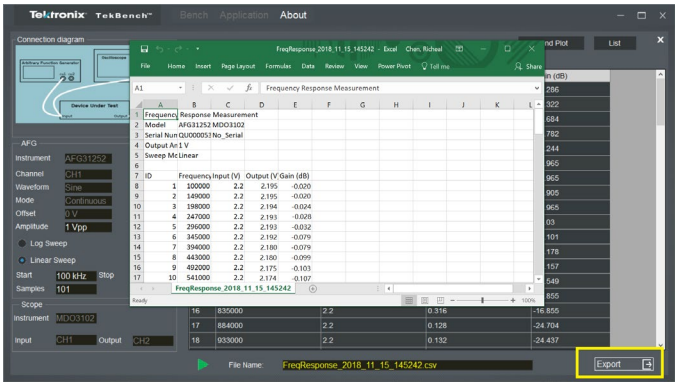

Figure 6. Export result

## Conclusion

TekBench software offers tools for intuitive instrument control and automated measurement data logging and automated frequency response testing, and it helps students to perform frequency response testing more efficiently. In addition to helping students reduce the time and effort required to complete their assigned lab assignments, TekBench can help students gain more insights into their designs.

For more information about TekBench software, visit www.tek.com/tekbench.

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Rev. 090617

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