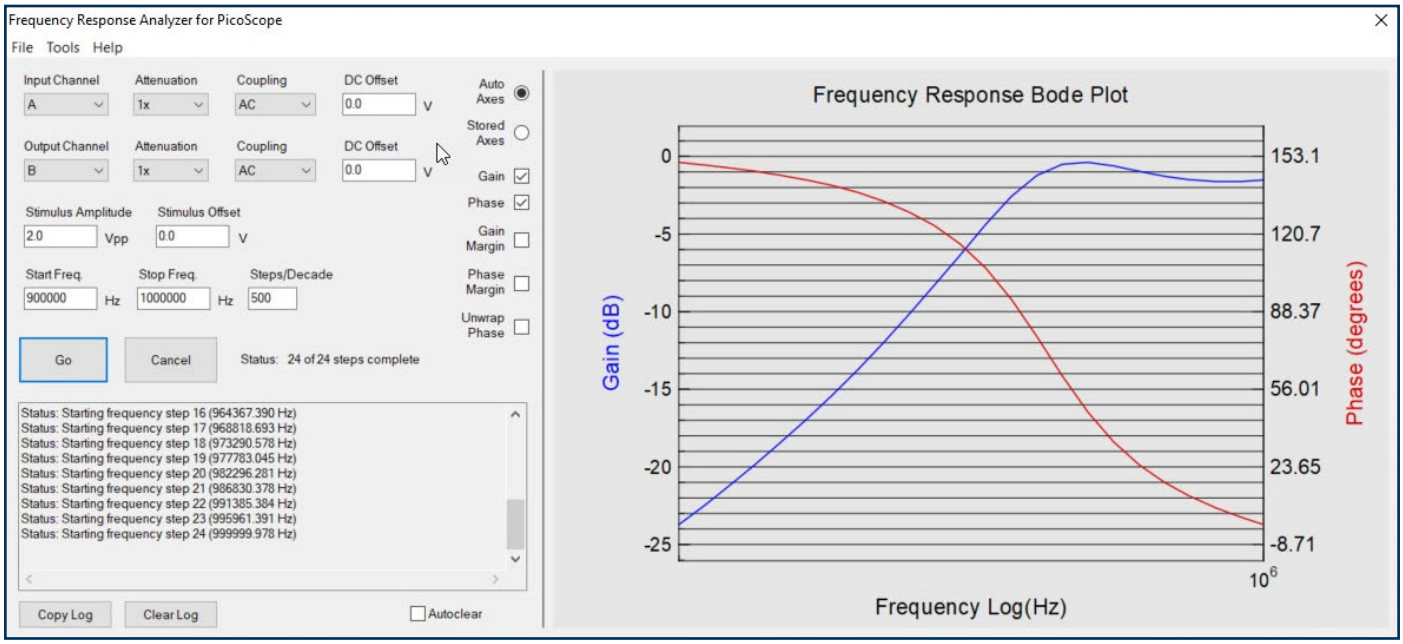
Application Note

FRA4PicoScope



Introduction

This is a guide to installing and using FRA4PicoScope, the frequency response analyzer (FRA) created by Aaron Hexamer, a member of the Pico Technology Test & Measurement Forum. The FRA is available to download free of charge. It requires at least two analog channels plus a built-in function generator and works with most PicoScope instruments on a Windows PC.

An FRA is often an expensive high-precision measurement instrument. It is used to analyze components, circuits and systems (known as devices under test, or DUTs) in the frequency domain.

Some typical applications include:

- Filter characterization
- Filter design
- Control loop stability analysis
- Audio amplifier design
- Transformer performance evaluation, particularly for signals

An FRA typically generates a sinusoidal signal and injects it into a DUT. This signal is measured at the point of injection using one of the input channels on the FRA, usually Channel 1. The injection signal travels through the DUT and the FRA measures the same signal simultaneously at a second reference point—normally the output of the system—using Channel 2. The use of sinewaves allows the frequency domain behavior (the frequency response) of a system to be determined.

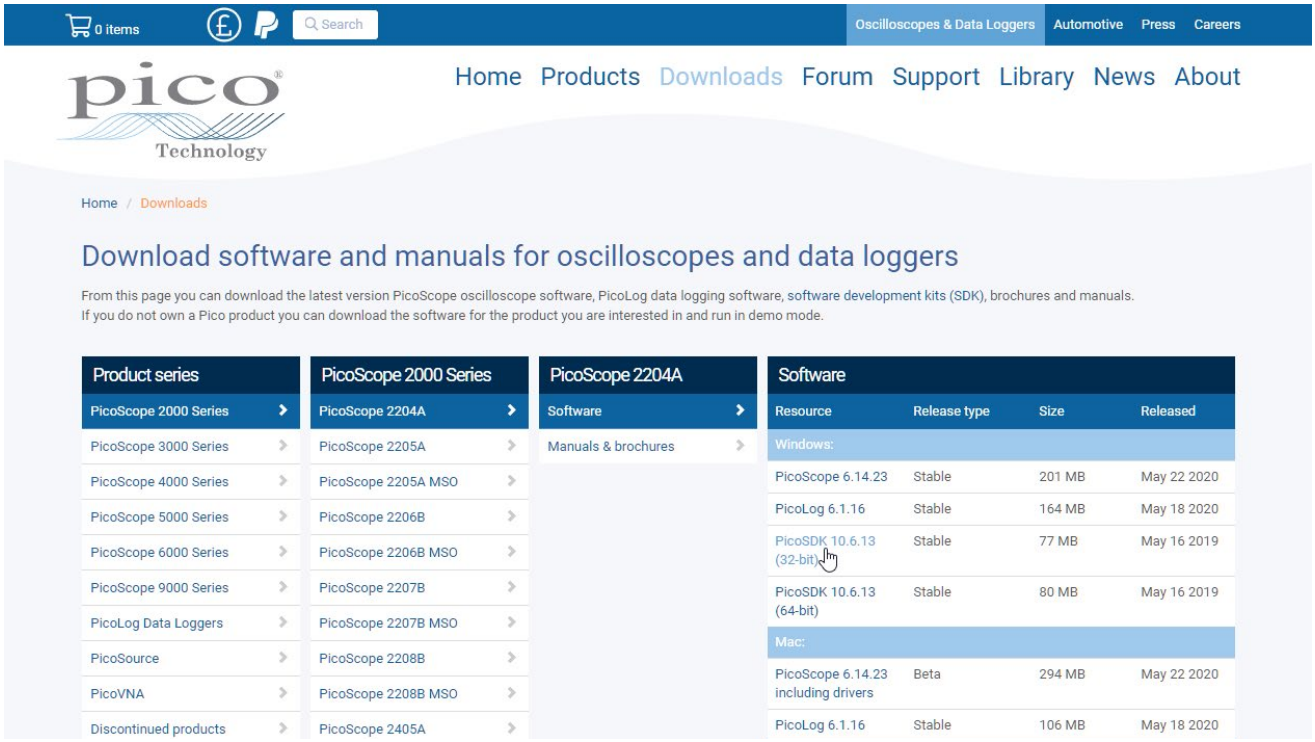
PicoScope instruments are particularly suitable for frequency response analysis: nearly all of our real-time oscilloscopes have a built-in function generator. The addition of this FRA application, which will operate with your choice of computer, makes for a very compact design compared to many standalone FRAs. Many will be familiar with the PicoScope software available for free download from our website. If you are an existing PicoScope owner then you can also use the FRA Software.

Installing the FRA application

Step 1: installing PicoSDK®

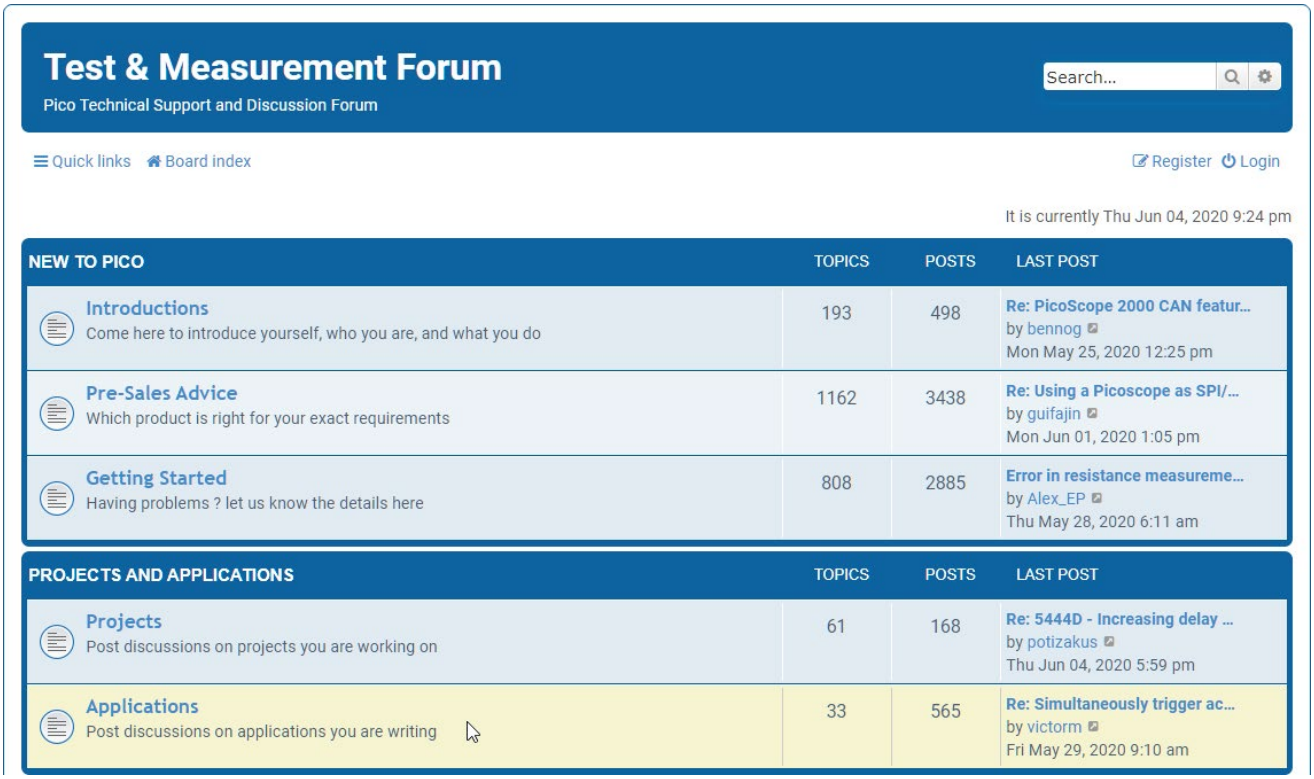
In order for the FRA software to run correctly, you will first need to install our software development kit, PicoSDK. To do this, visit the **Downloads page** on our website, and select your oscilloscope series and model from the lists.

Click **Software**, and download the 32-bit version of PicoSDK for Windows.



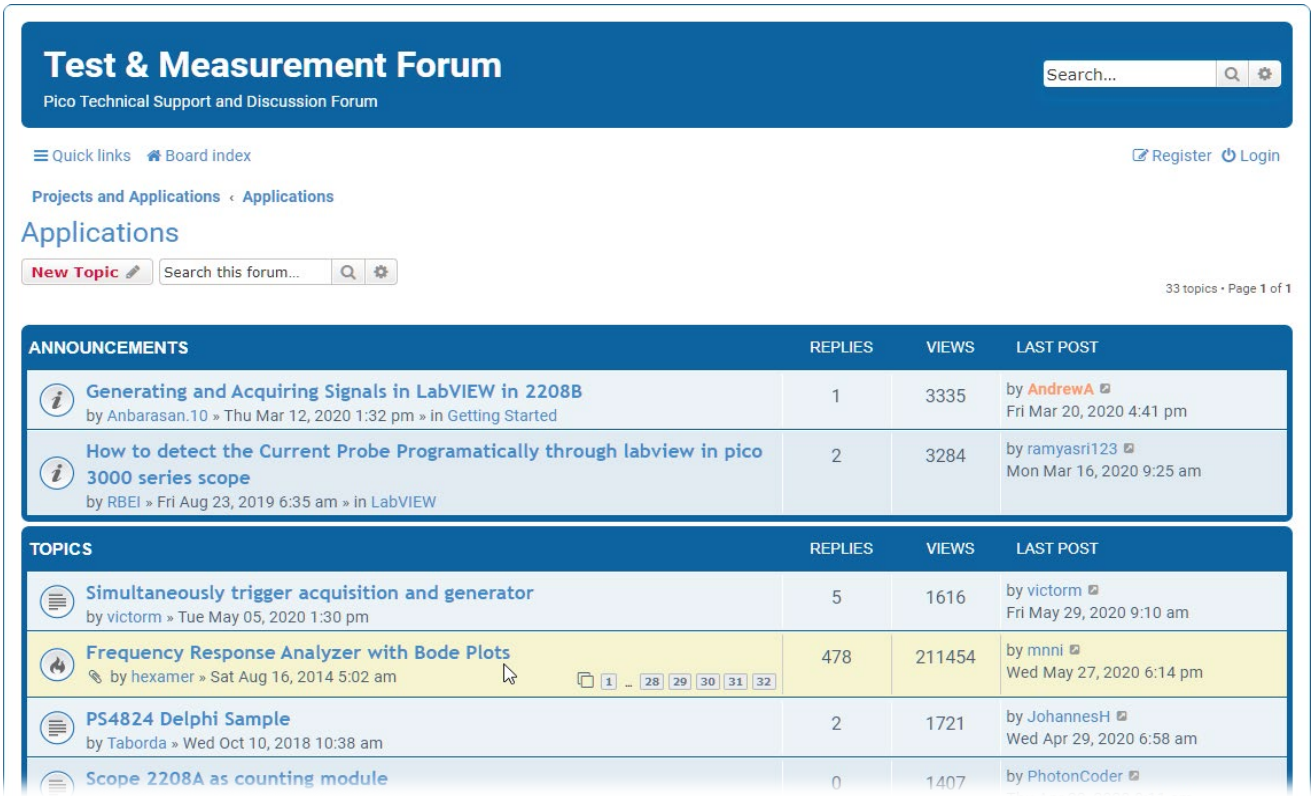
Step 2: find the FRA forum topic

Go to the [Pico Technology Test & Measurement Forum](), where users of Pico products can meet to ask and answer questions and share their applications.



Scroll down the page to **Projects and Applications**, and click **Applications**.

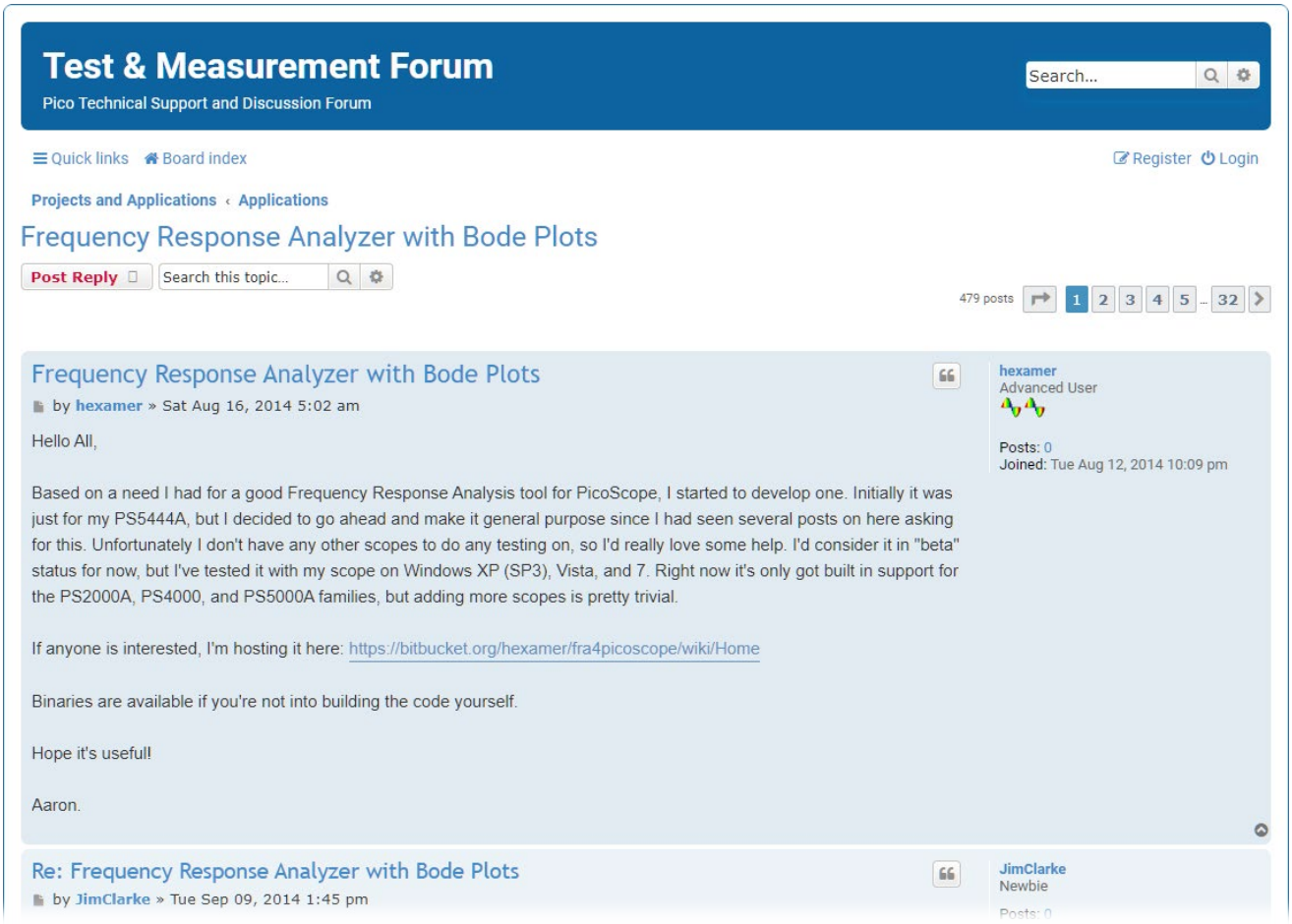
You will see the screen below. Select **Frequency Response Analyzer with Bode Plots**.



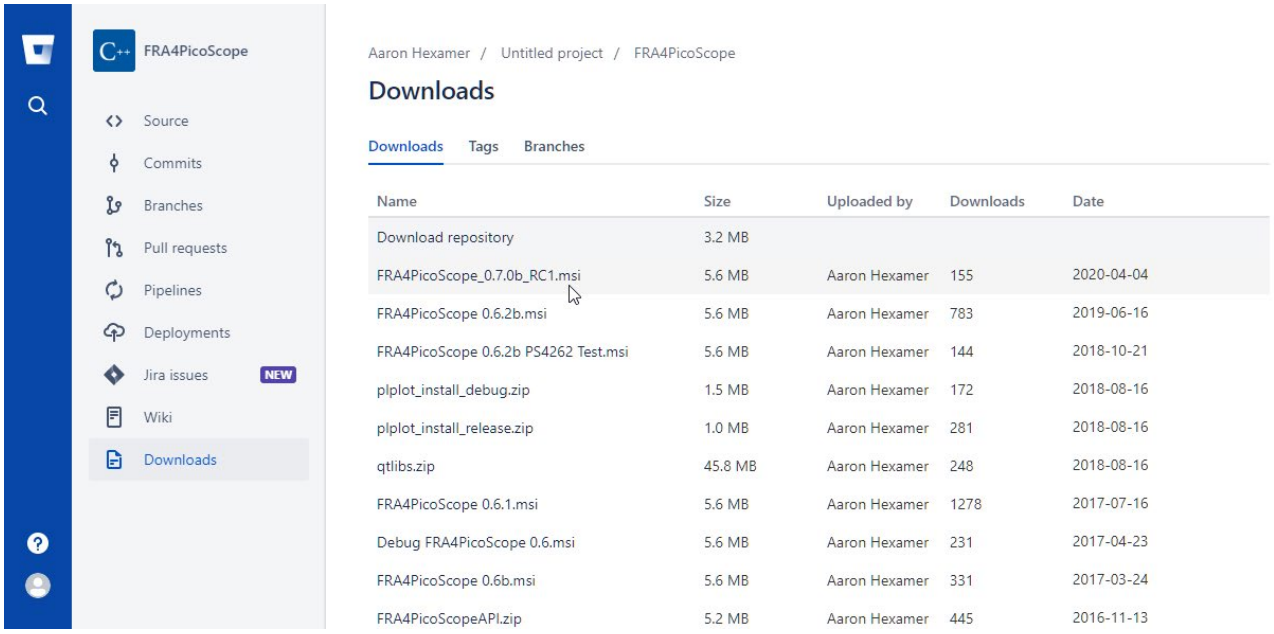
Step 3: download the app

You are now in the section of our forum that covers the frequency response analyzer.

In the very first post, you will see the link to Aaron Hexamer's Bitbucket page, where you can find out more about the application and download it free of charge – click the link.



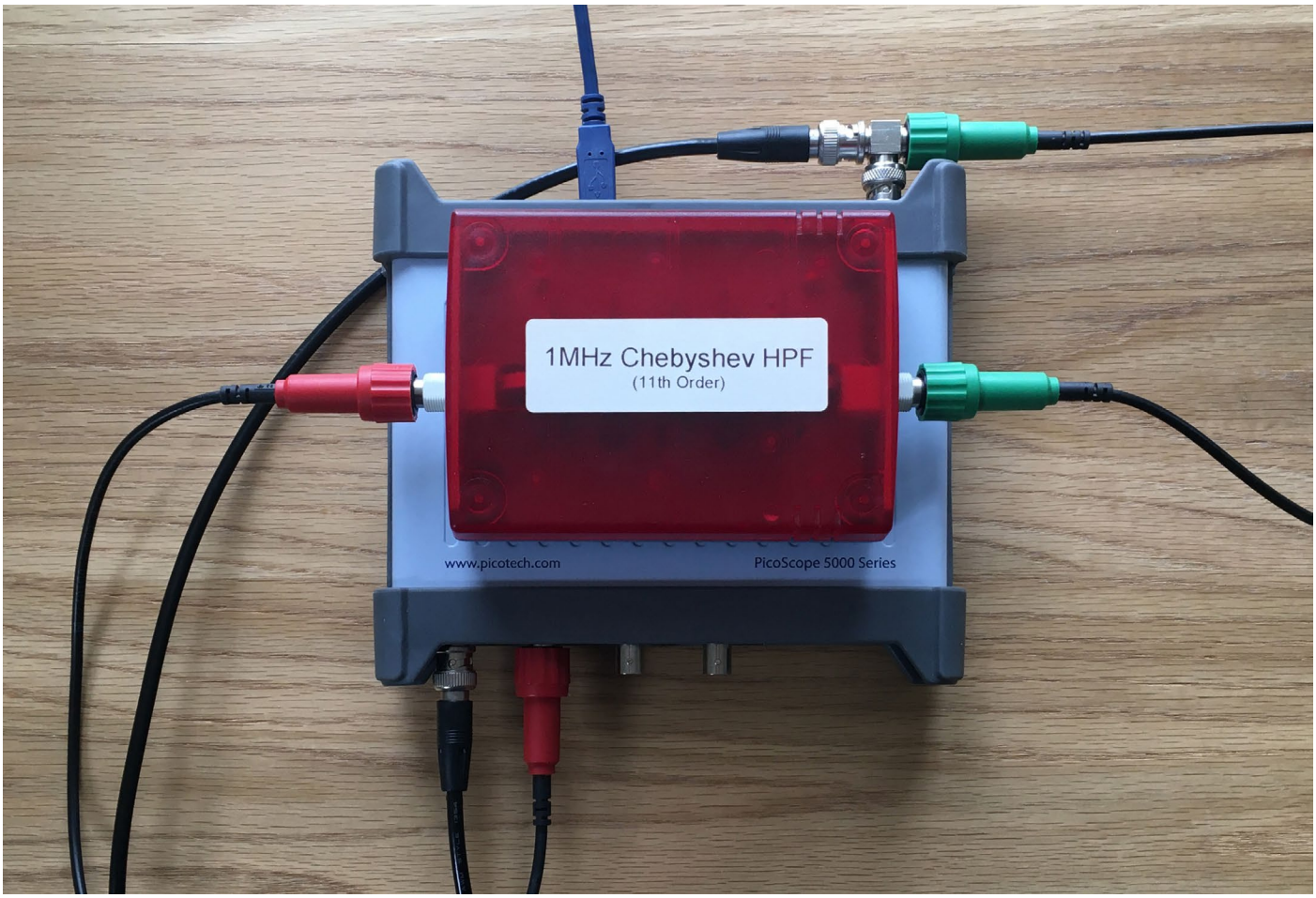
Select **Downloads** from the menu on the left, then click the most recent installation (*.msi) file in the list. Remember that you will also require the 32-bit version of PicoSDK, as advised in Step 1 above.



Using the FRA application: analyzing a 1 MHz highpass filter

Hardware setup

The setup pictured uses a PicoScope 5444D MSO, which is the high-end model in the flexible resolution (FlexRes®) PicoScope 5000 Series, with 200 MHz bandwidth, four analog channels and 16 digital inputs. The FRA application only requires two channels, however, and there is a wide range of suitable models in the PicoScope 2000, 3000, 4000 and 5000 Series. The PicoScope 6000 Series oscilloscopes will be compatible with the FRA app at a future date: contact our Technical Support team for more information.



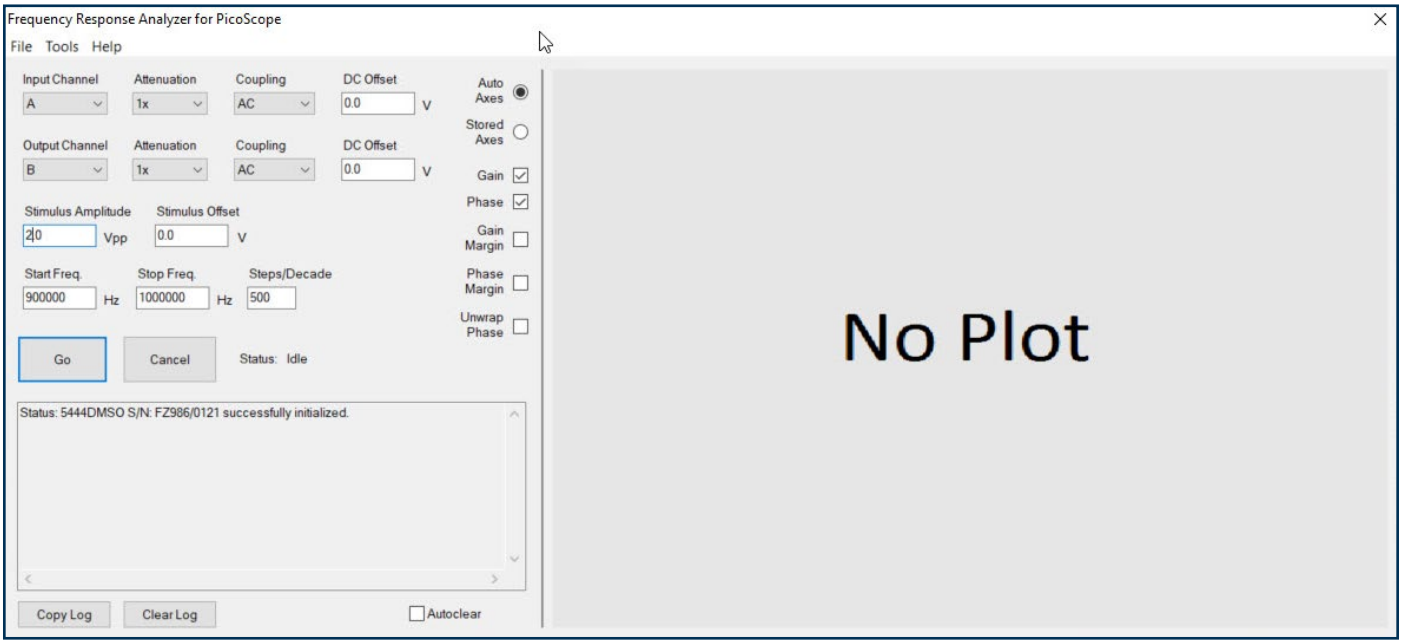
For an FRA to function it requires an input signal, typically sinusoidal. Here, a BNC splitter has been attached to the oscilloscope function generator output, with cables connecting it to the input of the highpass filter (HPF) and to Channel A of the oscilloscope. Another cable connects the HPF output to oscilloscope Channel B of the oscilloscope.

FRA software setup

The first time the application is run, it will search for an available oscilloscope device. If only one scope is connected to the PC, it will automatically use that one; otherwise it will ask you to select a device. From that point forward, the application will remember the most recently used scope and automatically open it on startup. To change the scope device, open the **File** menu and select **Connect Device**.

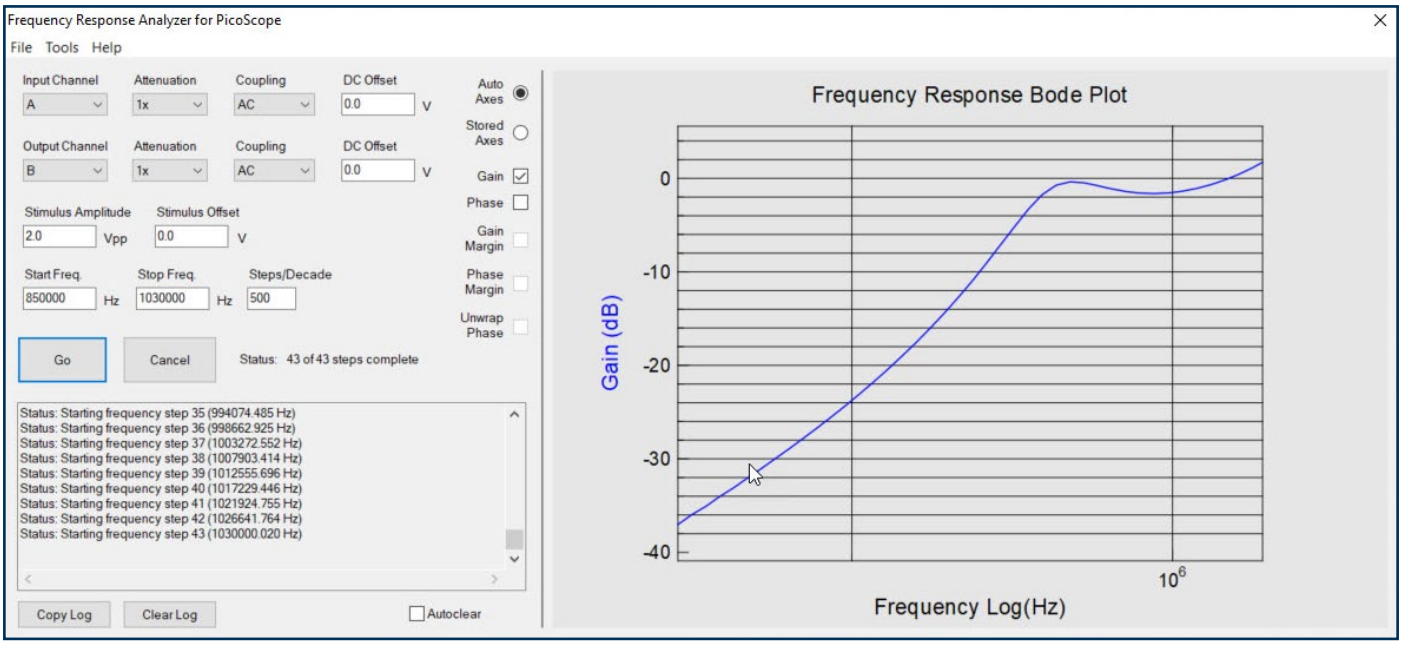
The first time a scope is opened, default FRA settings are provided each time a new scope is connected. Change these as appropriate. Once settings are entered and the circuit to be measured is connected, click **Go** to begin the execution. If you need to stop for any reason, click **Cancel**. Once the FRA execution is completed, you can export the plot image or raw data from the File menu.

Here you can see that the FRA has successfully connected to the PicoScope 5444D MSO, and that start and stop frequencies have been entered to analyze a 1 MHz highpass filter.

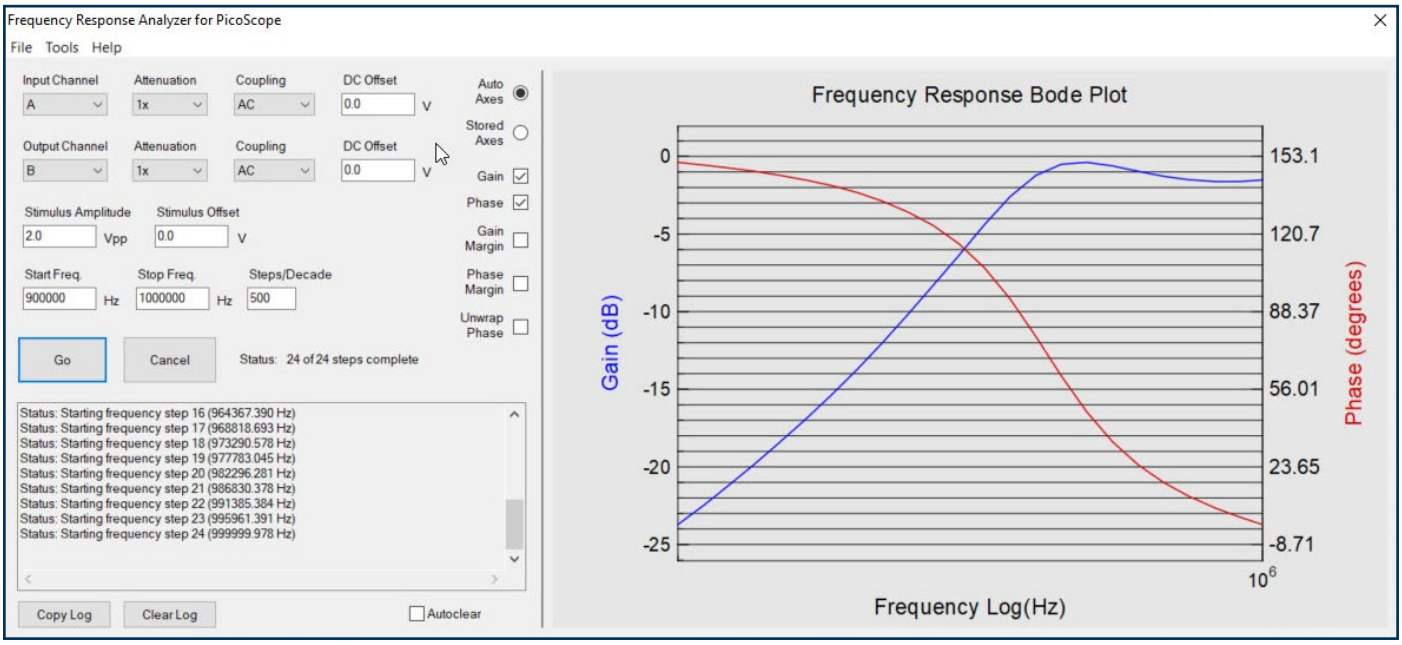


Analysis of the 1 MHz highpass filter

This image is an initial plot, showing only the gain, in order to reference the pass frequency of the filter.

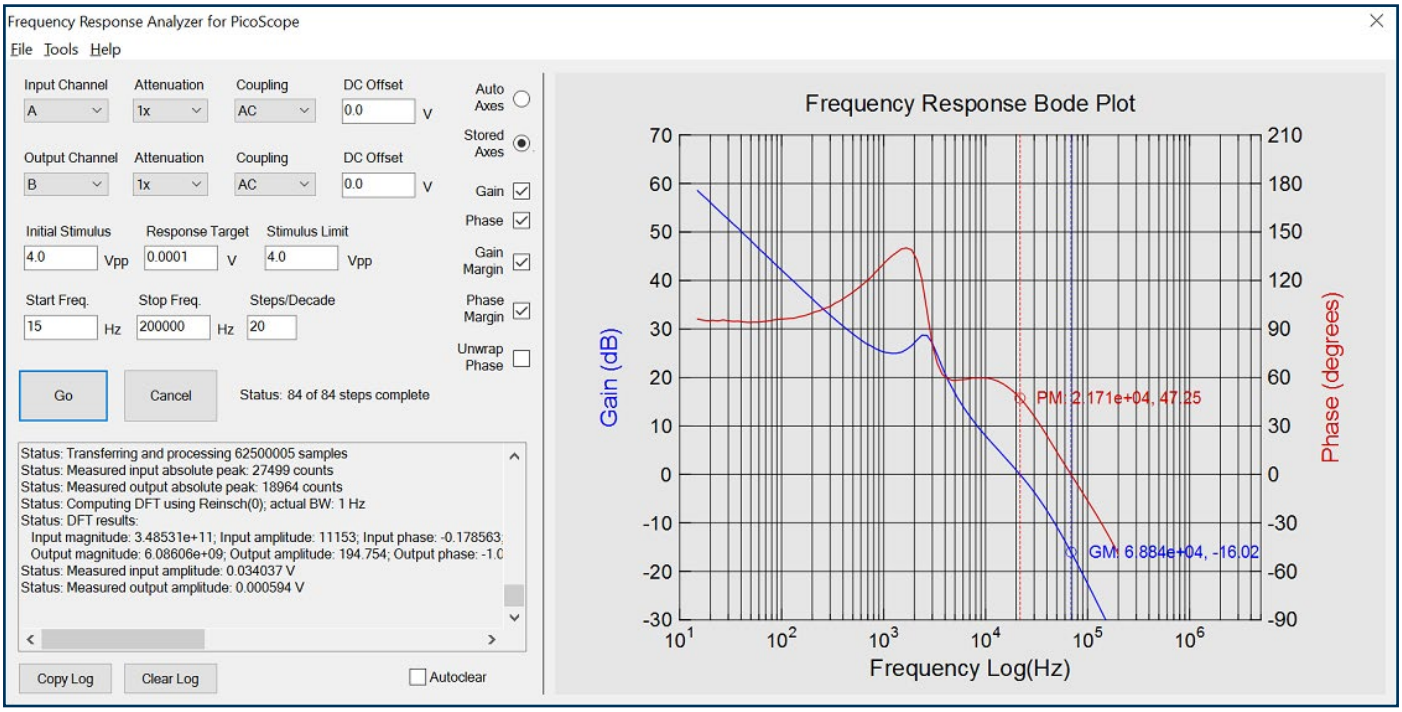


The image below shows the full frequency response Bode plot.

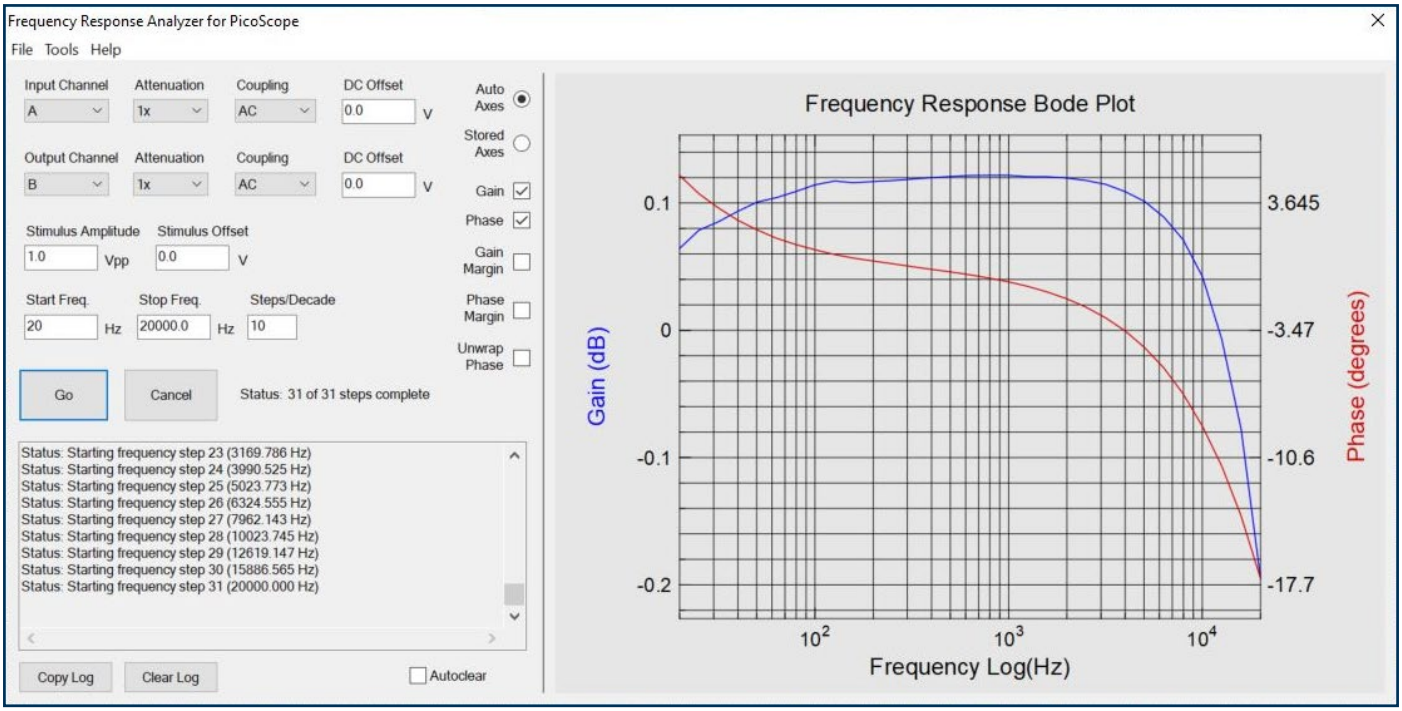


Further examples shared by customers using the FRA application

Here you can see a customer example measuring switched mode power supply stability.



Below is a customer example of an audio amplifier.



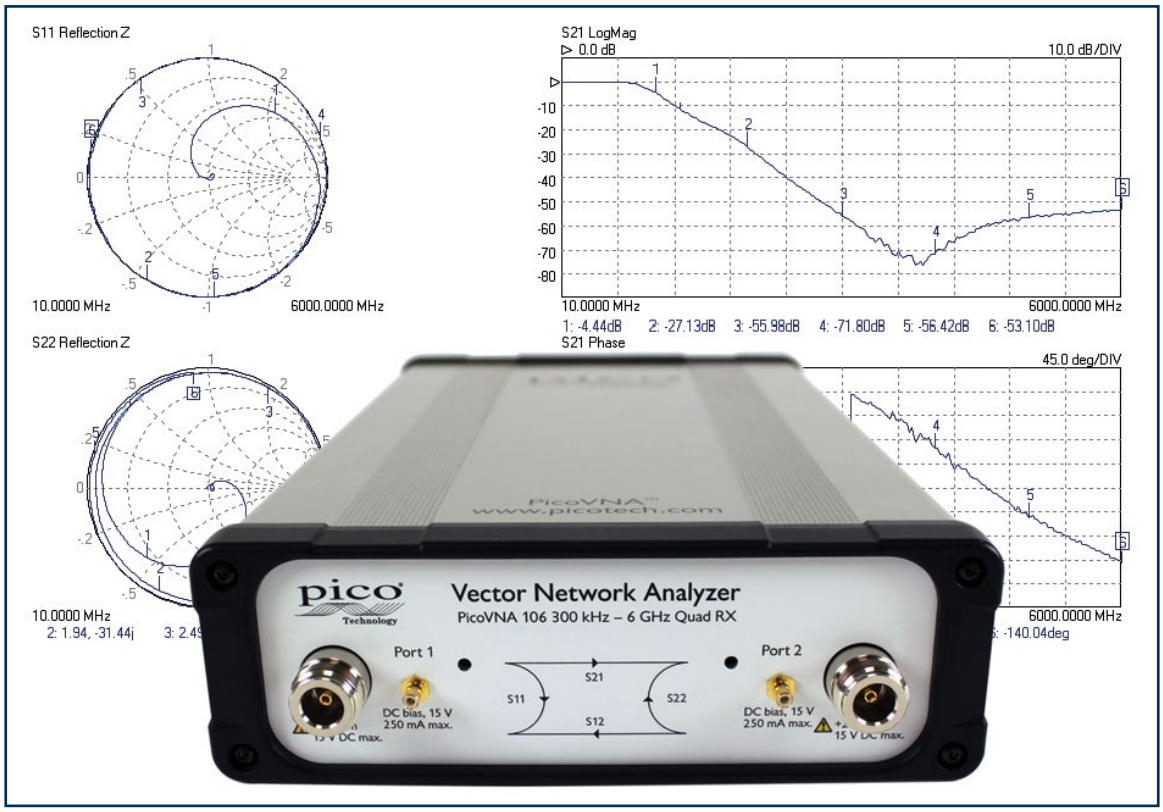
Vector network analysis

For vector network analysis applications, consider the PicoVNA® 106 6 GHz Vector Network Analyzer.

The PicoVNA 106's portability, light weight and low cost suit it to field service, installation test, OEM embedded and classroom applications. With its remote automation capability, it is also attractive in applications such as:

- Test automation, including multiple VNA control and measurement
- Integrating a reflectometry or transmission measurement core during manufacture
- Inspection, test, characterization and calibration in the manufacture, distribution and service center industries
- Electronics component, assembly and systems, and interface/interconnect ATE (cable, PCB and wireless)
- Material, geological, life-science and food sciences; tissue imaging; penetrating scan and radar
- Broadband cable and harness test and matching, at manufacture and installation, and fault-over-life monitoring
- Antenna matching and tuning

Drivers are supplied as part of the main software download, and programming examples in MATLAB (using the MATLAB RF toolbox), National Instruments LabVIEW, C# and Python are all available for download from Pico Technology's **GitHub organization page**. Examples include multiple-instrument addressing and control.



Click here to find out more about the PicoVNA-106.

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