Windows-10 64-Bit Z-Meter Installation Guide

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This document describes the steps you will take to download and install software that controls the Z-Meter instrument and displays measurement results. Please refer to the *QEX* magazine article, "A Simple Inexpensive Accurate Vector Impedance Meter," by James A. Koehler, VE5FP. See pages 23--31 in the January-February issue. For information about QEX, please visit www.arrl.org/qex.

Before you start to follow these instructions you should know how to use:

- A Windows web browser to download files from web sites.
- The Windows *File Explorer* program to locate, save, and add files and folders.
- The Start menu or text window in the bottom-left corner of the Windows display.

The numbered sections below refer to major task. Detailed instructions follow in sub sections.

1. Copy Z-Meter Files into Your User Directory

1.a. Go to the ARRL download site at http://www.arrl.org/qexfiles and download the files associated with this project. At present you should find a "zipped" folder, although the revision number might change:

`QEXfiles-2001-Koehler-impedance-rev1.zip`

Your browser will automatically put this downloaded file in your **`C:\Users\yourname\Downloads`** folder. Click on it and drag it onto your Windows Desktop.

1.b. Use Windows' *File Explorer* to locate and open the **`C:\Users`** folder on your PC. In the list of **`Users`** folders, find the one with your user name, for example:

`joesmith`. Click twice on your user name to display a new list for:

`C:\Users\yourname`

Then find and open the **AppData** sub folder, and finally, open the **Local** subfolder.

The line above the list of files and folders should show:

This PC>Windows(C:)>Users>yourname>AppData>Local

Thus, applications would use the "path" below to find the **Local** subfolder:

C:\Users*yourname*\AppData\Local

1.c. Within the **Local** folder, use Windows' *File Explorer* to create new a subfolder and name it: **Z_Meter**. (Note the underscore.) Move the downloaded folder,

QEXfiles-2001-Koehler-impedance-rev1.zip

from your Desktop into the new **Z_Meter** folder.

1.d. In your **Z_Meter** folder, right click on the file you just dragged in:

QEXfiles-2001-Koehler-impedance-rev1.zip

After a new menu drops appears on your screen, choose *Extract All...* All compressed files in the **zip** folder will now appear in the **Z_Meter** folder. Among the extracted files and folders, locate the folder labeled:

`Z_Meter_Win10_64bit_20190709`

The 8-digit number for your folder might vary based on the release date of the Windows-10 application package.

Keep this folder open.

2. Download and Install Python 3

2.a. In these steps you will download and install the 64-bit version of Python 3, a programming language. The Z-Meter software might not run if you use the 32-bit version of Python. Use the Web browser on your Windows-10 PC to go to the site www.python.org/downloads.

You will see the message shown in **Figure 1a**. Click on Windows.

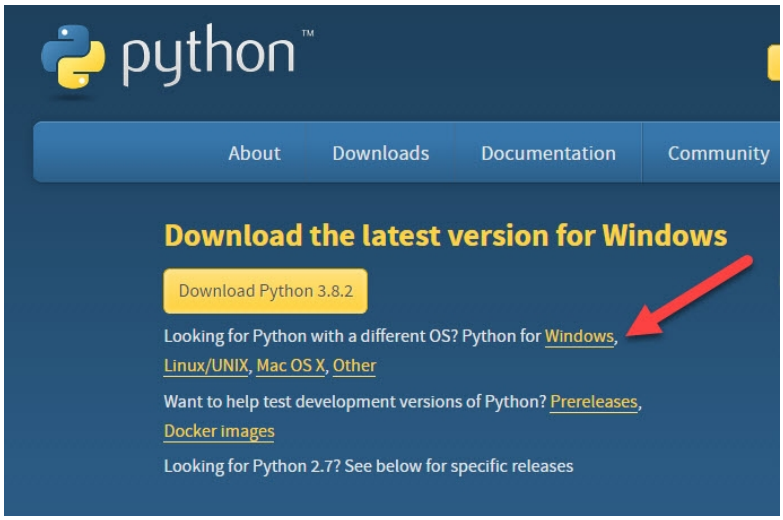

Fig. 1a. *Download screen at Python.org. Click on Windows (red arrow).*

In the line, "Looking for Python with a different OS? Python for Windows,.." Click on the name Windows and you will see a new display that lists, "Python Releases for Windows." You might need to scroll down to see a list of these software releases. Look for the newest releases.

After you click on Windows (Fig. 1a.) you will see another window shown in **Figure 1b**.

Fig 1b. *Choose the 64-bit Windows executable installer for Python.*

Double click on the line:

Windows x86-64 executable installer

to start the download. After the download finishes, go to your PC's **Downloads** folder (**This PC > Downloads**) and look for the Python installation file with a name such as:

python-3.8.1-amd64.exe

The current version number, 3.8.1, will change as Python updates occur. You might find a more-recent version of the Windows-10 64-bit Python executable installer.

2.b. Double click on the file name: **python-3.8.1-amd64.exe** to run the Python
installation program. When asked:

Leave the "for all users" option selected,
Select the "add Python to PATH" option,
Select "Install Now" and then click "yes" to proceed.
Within the "Setup was Successful" window select "Disable Path Length Limit"
Finally, select "yes" to confirm the installation.

2.c. On the left end of the *Task Bar* located at the bottom of the *Windows Desktop* (main Windows display), find the *Type here to Search* box. Type Python and press the Enter key. A Python window should open and show::

```
Python 3.8.1  (tags/v3.8.1:1b293...
Type "help", "copyright",..
>>>
```

The numbers you see might differ from those shown here. The three carets, **>>>**, indicate Python is ready. If you do not see the information above, do not proceed. You MUST have Python installed and operating before you go on. If you have not had a successful installation, go back to Section 2.a. and try again. Ensure you download the file:

Windows x86-64 executable installer

2.d. Now you will install additional Python software packages. Go to your **Z_Meter** folder and find the file **Z_MeterInstall_PythonPkgs.bat**. Dou-

ble click on the file name and you should see these results in the Python window as the packages load.

```
python -m pip install -upgrade pip    pip3 install numpy
pip3 install scipy                    pip3 install sparse
pip3 install pathlib                  pip3 install pyserial
pip3 install pytest
```

2.e. In this step you'll confirm your PC provides the proper C++ supporting software for the **scipy** package; open-source software for mathematics, science, and engineering applications.

If you do not have a Python window open, start Python now. (See Section 2.c.)
At the Python prompt **>>>** type: **import scipy [Enter]**. (The notation [Enter] means press your keyboard's Enter key.)

It takes a few seconds to import this software package, after which you again see the Python prompt, **>>>**.

Now type: **scipy.test('full') [Enter]**

2.f. Now the Python window should display this information:

```
>>> import scipy
>>> scipy.test('full')
=====================
platform win32 -- Python 3.8.1. pytest...
rootdir: C:\User\username...
collecting XXXX items
```

Here, the XXXX shows the number of items collected during a test of the scientific routines. This value will increase to tens of thousands. When this value stops increasing simply close the Python window and go to **Section 4**.

If the test does not run properly, or if you do not see the information above, or if you see a "file not found" or other error messages, close your Python window. The errors indicate your PC lacks needed files you can easily load, and **Section 3** explains how.

3. Load C++ Redistributable Software

3.a. Microsoft provides the newest C++ redistributable software as a free download at its site:

https://support.microsoft.com/en-ca/help/2977003/the-latest-supported-visual-c-downloads

Double click on the link above to go to Microsoft's page labeled, "The latest supported Visual C++ downloads." Find the label **`X64: vc_redist.x64.exe`** and click on it to download the file. You may leave the file in your Download folder or put it on your Desktop. Next, double click on the file name to run the **.exe** installation program.

3.b. Go back to Section 2e and run the Python test again. If the test runs properly, go on to **Section 4**. Otherwise, return here and continue with Section 3.c.

3.c. Because your Python test failed after you installed the C++ redistributable software you must also install the *Microsoft Visual Studio Community* freeware as described next:

I obtained the following information obtained from the following web site: https://stackoverflow.com/questions/52299542/from-sparsetools-import-csr-tocsc-csr-tobsr-csr-count-blocks-intporterror

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You need to update your Windows C++ redistributable compiler to understand if this is the solution.

•Check what versions of Microsoft C++ redistributable you have installed.
If you're using Windows-10 type apps and features into the start bar and scroll down to where it says Microsoft visual C++ and look at the year. In my case I was using a version from 2010.

•If you aren't running the latest version download Microsoft visual studio 2019.

•Select the Visual Studio Community 2019.

•Once prompted to install specific packages, click on the menu item that says "individual components," it is located next to the menu item "Workloads".

•Scroll down and look for Visual C++ 2019 Redistributable Update •Install that restart your machine.•You'll be able to verify that this worked by running the following code from your Command Prompt. (Go to the bottom-left text window and type `command prompt`.)

Visual Studio Installer
Visual Studio Community>modify>Individual components
scroll down and find title 'compilers, build tools and run times'
check:
"C++ redistributable MSMs"
"C++ redistributable Update"
Scoll down and click on Install While Downloading

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4. Download and Install *123-Photo-Viewer* for Windows

To see the results of tests run by the Z-Meter instrument you need photo-viewer software. I tested several and found *123 Photo Viewer* the best for Z-Meter displays. The free version of *123 Photo Viewer* has a minor disadvantage--a pesky pop-up ad. You must acknowledged it once per day. Once acknowledged it does not pop again for the rest of the day so it's not much of issue, and if necessary it only takes about 10 seconds to open and close the company's website. Apparently a registration payment of less than $5 (US) disables the pop-up ad.

4.a. In Windows' **`Type here to search`** box, type **`microsoft store`**. Then search the store for *123 Photo Viewer* to find it. (You might need to jump through the usual Microsoft hoops to sign in and get the program.) Download the *123 Photo Viewer* application and install it

4.b. Because the Z-Meter software creates graphs in the Portable Network Graphics format (`png`), you must set *123 Photo Viewer* as the default application to open files with the **`png`** extension.

Open Windows' Control Panel. Go to Windows' "Type here to search" area and key in **`Control Panel [Enter]`**. After it opens, click on **`Default Programs`**. Another window opens and offers several options. Click on the line **`Associate a file type or protocol with a program`**.

A **`Default apps`** window will open. Scroll to the bottom of the window (perhaps hidden below the bottom border) and select: **Choose `default apps by file type`**.

My PC took about 30 seconds to create a list file types and their associated application software. Scroll down the list on the left side of this window and locate the line labeled **.png**. Click on the associated icon or plus sign (+) to the right of **.png**. A list of applications and icons should appear under the heading **Choose an app**. Within this list locate the *123 Photo Viewer* and click on it. The **.png** file association should change to the *123 Photo Viewe*r. (If you make a mistake, just repeat this section.)

4.c. Close the file-association and Control Panel windows. Go to the **Z_Meter** folder and find the **Wl0testl.png** file. Double click on this name to test the *123 Photo Viewer* association. You should see a sample graph of Impedance vs Frequency.

4.d. If you do not see a test image, go to the **Type here to search** window and key in **Settings [Enter]**. Find and click on the topic, **Privacy.** Locate the topic **Background Apps** near the bottom of the list of applications shown on the left side of the new window. Click on this topic. You will see a list of applications that should include *123 Photo Viewer*. To its right you will see a "switch." If this switch shows **Off**, move it to **On**.

Look again at the list of topics on the left side of this window. At the bottom you should see the topic, **File system**. Click on this topic. You can see a few applications that have access to your file system, and you can **Choose which apps can access your file system**. Set *123 Photo Viewer* to **On**.

Close the **Settings** window and go back to Section 4.c. The png file **Wl0testl.png** must open and you must see the graph before you continue.

5. Download and Install *GNUPlot for Windows*.

The Z-Meter programs require the *GNUPlot* software to create the graphic plots of impedance data. It creates generates **png** that the *123 Photo Viewer* program will display.

5.a. Go to the SourceForge code repository at

https://sourceforge.net/projects/gnuplot/files/gnuplot/5.2.7/gp527-win64-mingw.exe/download

Download the 64-bit *GNUPlot for Windows* installer. At the time of this writing the current release is version 5.2.7.

Install *GNUPlot for Windows* software in the default **C:\Program Files\gnuplot** directory and accept all default installation settings.

5.b. To ensure the Z-Meter programs can find the *GNUPlot* software you will next add the path for **wgnuplot.exe** to your **username** path-environment variable. These instructions assume you installed the *GNUPlot* software in its default **C:\Program Files\gnuplot\bin** folder.

Open or reopen Windows' Control Panel and click on **System**. In the upper left of the new window, click on **Advanced system settings** and in the new window that opens, go to the bottom-right corner and click on **Environment Variables...**.

A new window will open and show two areas, the lower **System variables** and the upper **User variables for your-user-name**. In the latter section under the **Variables** heading you should see the word **Path**. Click on **Path** to highlight it and then click on the **Edit...** button.

Now you will see a list of "paths" to various files and folders. Some start with **C:\Users\...** Click on the **New** button and in the blank highlighted line, carefully enter:

C:\Program Files\gnuplot\bin

Double check what you entered and correct any errors. When you have the correct line shown above, click on the **OK** button. You may now close the open environment-related windows: in the **Environment Variables** window, click on OK. In the **System Properties** window, click OK.

6. Set Up the Z-Meter Communication Port

The Z-Meter data-acquisition instrument connects to your PC via a USB communication (COM) port. The Windows operating system assigns a unique port number to each USB device as you connect it. Some people have several such devices assigned COM-port numbers, others might have none. To use the Z-Meter instrument you must determine the COM port Windows assigns it when you plug it in to a USB port.

6.a. Connect the Z-Meter microcontroller board to your PC via a USB cable. You should hear the PC chime as it connects to the board. Set-up software can handle the details. Within the **Z_Meter** folder locate the file named:

Z_MeterInstall_ComPort.bat

Double click on this name to run the batch (**.bat**) file. Follow the on-screen instructions.

6.b. Now you will check the COM-port number. If not still open, reopen Windows' **Control Panel** and click on the line, **Device Manager**. (If you do not see **Device Manager**, click on the **Hardware and Sound** line. A new window opens and you can find **Device Manager** under the **Devices and Printers** heading.)

The **Device Manager** window lists devices connected to your PC. Look in the list for the line: **Ports (COM & LPT)**. Then double click on this name or click once on the caret (**>**) to its left.

You will see a list of all COM-type devices attached to your USB ports. When your MCU board has connected to your PC, you should see:

USB Serial Device (COMX)

The value of X depends on what other USB COM devices already connect to your computer. If you do not see this or a similar line in the list of connected devices, your PC has not detected your Z-Meter microcontroller board. Disconnect your cable and go back to Section 6.a.

IMPORTANT: If you discover the Z-Meter no longer communicates with your computer first ensure you have a good physical connection with a USB cable. Then use Windows' **Device Manager** to find the COM port now assigned to your Z-Meter. If you routinely add and remove USB devices, the COM- port number originally assigned to the Z-Meter instrument might change. If you suspect a change, rerun the **Z_Meterlnstall_ComPort.bat** program.

6.c. OPTIONAL: You also can set the COM-port number as a system variable. Just as you added a path for the *GNUplot* software, you can add a port number. Follow the steps in Section 5.b. But instead of adding a new line such as: **C:\Program Files\gnuplot\bin**, you add a new line with this information:

Variable name: Z_METER_COM
Variable value: COM5

And you confirm the setting by opening the *Command Prompt* within the **Z_Meter** folder. At the prompt enter:

echo %Z_METER_COM%

This command should read the **Z_METER_COM** variable and show the COM-port number you added.

7. Install a Z_Meter Shortcut on the Desktop

Open the **Z_Meter** folder in Windows' *File Explorer* and RIGHT CLICK on and drag the **W10_zed_all.py** icon onto your PC's Desktop. Then select **Create shortcuts here**. This desktop shortcut provide quick access to all Z-Meter applications. You may test some applications now, but you won't get useful results until you calibrate the instrument, as described next.

8. Calibrate Your Z-Meter

Before you use the Z-Meter instrument I recommend you label the two BNC connectors, as shown in **Figure 2**. Connector P2 shown in the schematic diagram lets a circuit under test form the fourth "leg" of a 50-ohm bridge (resistors R12, R13, and R15.) Connector P1 has a 50-ohm input impedance and connects a signal to the input of the SA612 mixer at integrated circuit U4.

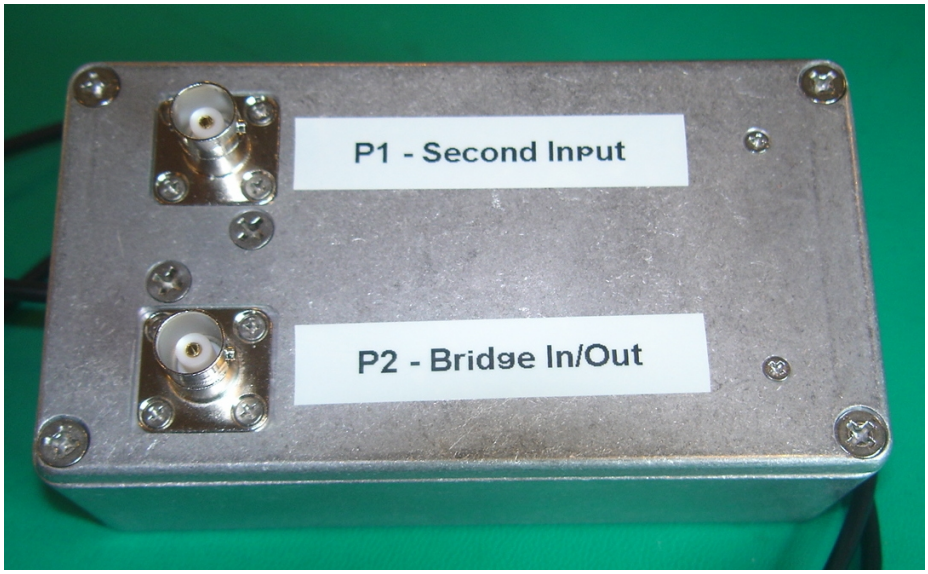
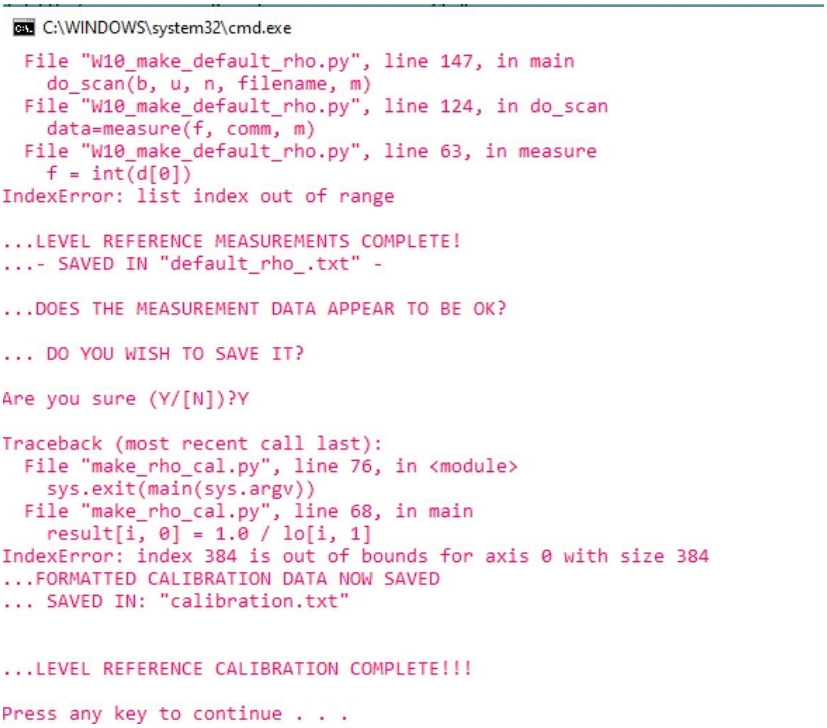


Fig. 2. *Suggested labels for the Z-Meter BNC connectors.*

After you have confirmed the Z-Meter instrument connects to your PC and you can display a test image you must calibrate the unit with a precision 50-ohm non-inductive reference resistance. Calibration takes into account variations in component values due to normal manufacturing processes. I recommend you use a 50-ohm reference resistance already manufactured with a BNC connector. Check Amazon and Ebay. One side of this this resistance connects the center pin at P2. The other side connects to ground via the BNC connector's outer shell and bayonet "latch."

Do not connect anything to the BNC connector labeled P1 - Second Input.

To perform this calibration run the ***`cal_Levels.bat`*** file within the **`Z_Meter`** folder. After you start the calibration you must wait for as long as 30 minutes for the software to finish. When the calibration ends you should save the data. You can recalibrate the instrument with your 50-ohm reference whenever you wish. You must calibrate your Z-Meter instrument before you can use it to get useful data.



At the end of the calibration sequence you will see results similar to those in **Figure. 3**.

Fig. 3. The calibration software asks if you want to save your calibration data for a 50-ohm resistor. You can answer yes (**`y [Enter]`**) to all questions. When you press "any key," this window will close.

9. Run a Test

After you calibrate your instrument, double click on the **`W10_zed...`** icon (a Windows shortcut on the main Windows display) to run an impedance test on the 50-ohm calibration resistor. In the **`Select Impedance Program`** window, click on the **`Impedance`** line and the **`Impedance Program`** window opens. **Figure 4** shows test conditions you can use.

Fig. 4. Choices to set for an impedance vs. frequency test of the 50-ohm calibration resistor.

Now click on **Scan** and the test begins. After a test runs you will see at the top of its setup display Impedance Program (W10) (Not Responding), for example. DO NOT PANIC. This message simply indicates the scan ended and next you will see the results displayed as a graph.The program displays the results as an x-y plot of impedance vs. frequency as shown in **Figure 5**. Note the impedance measurements appear on a logarithmic scale.

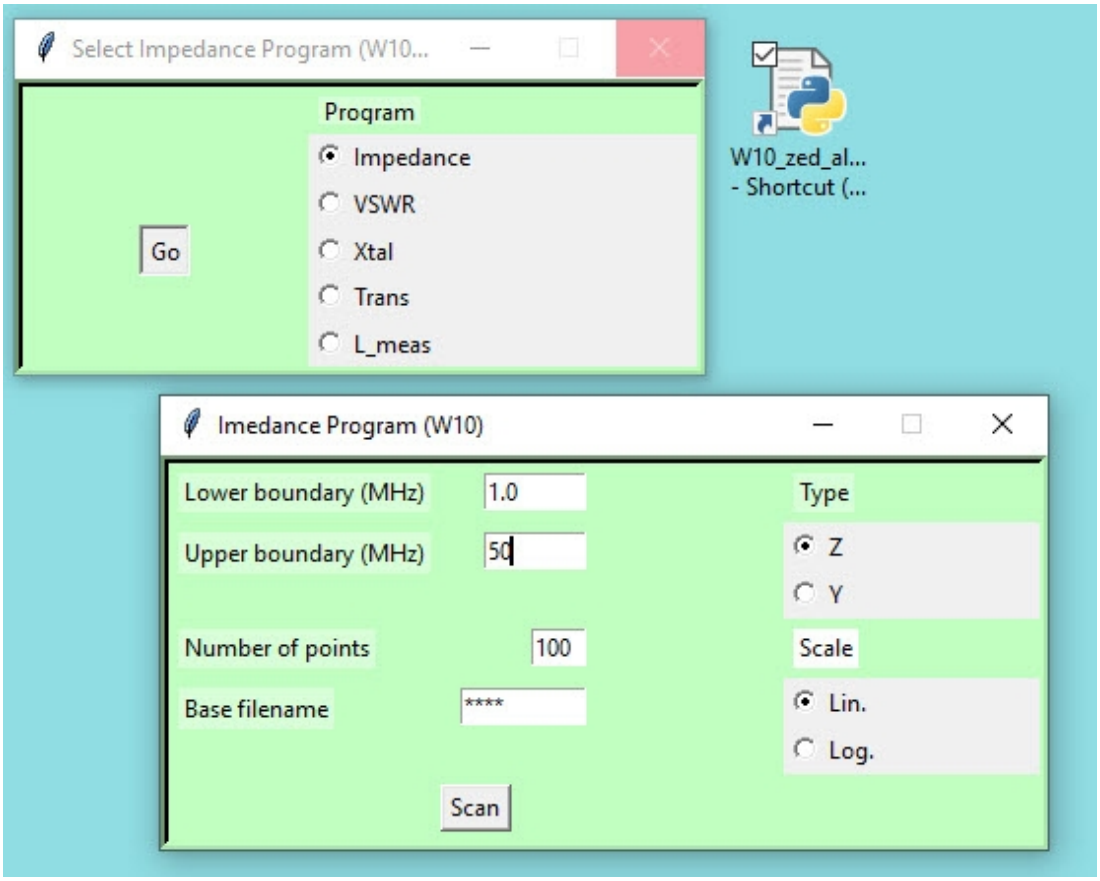
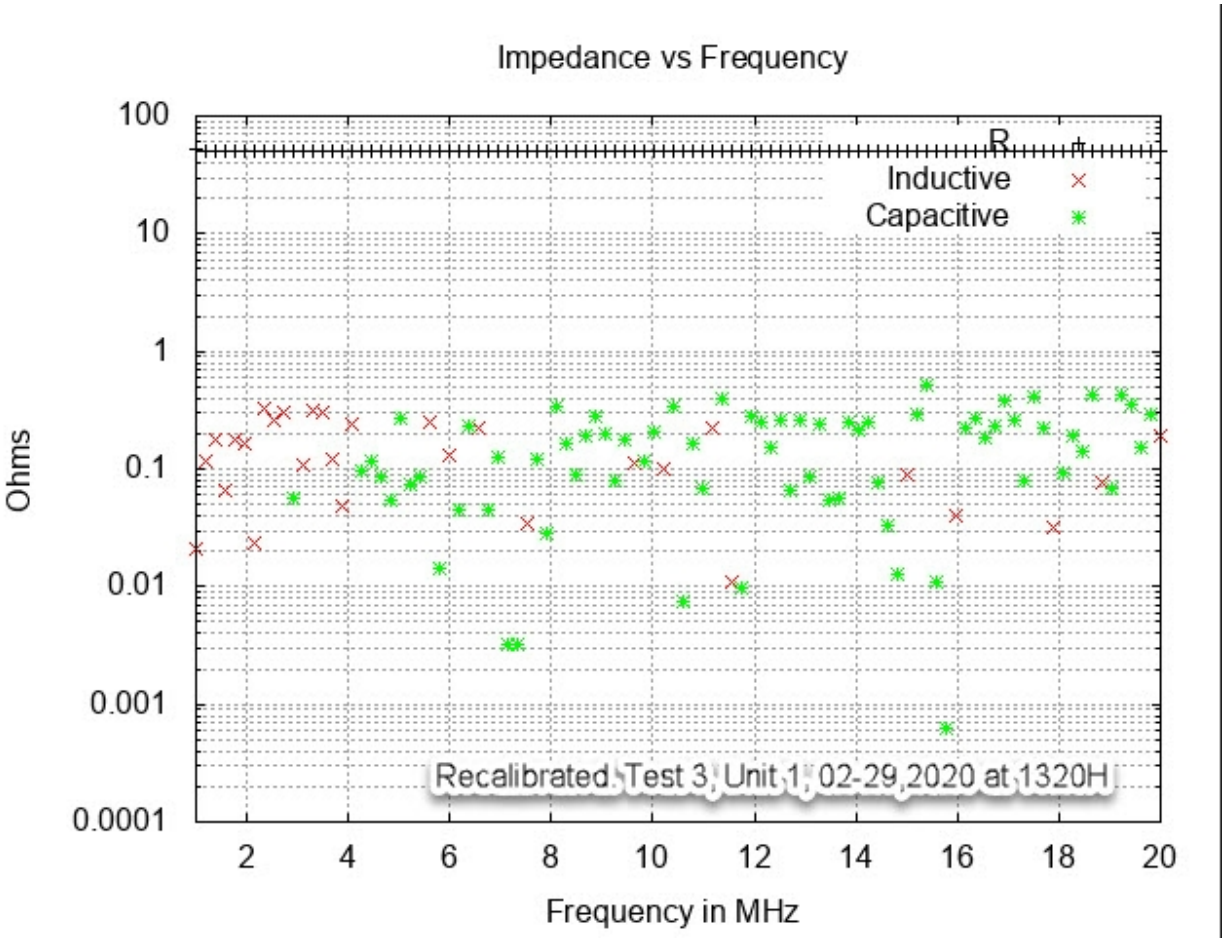


Fig. 5. An impedance-measurement plot for a 50-ohm calibration resistor.



The inductive (red x) and capacitive (green asterisk) appear as noise. The black plus signs indicate a constant 50-ohm resistance across the selected frequency range.

Figure 6 shows the results of a test run with a 205-pF capacitor and an inductor in parallel. The resistance peaks at about 17 MHz. The red and green marks show how the load changes from inductive to capacitive at the same frequency.

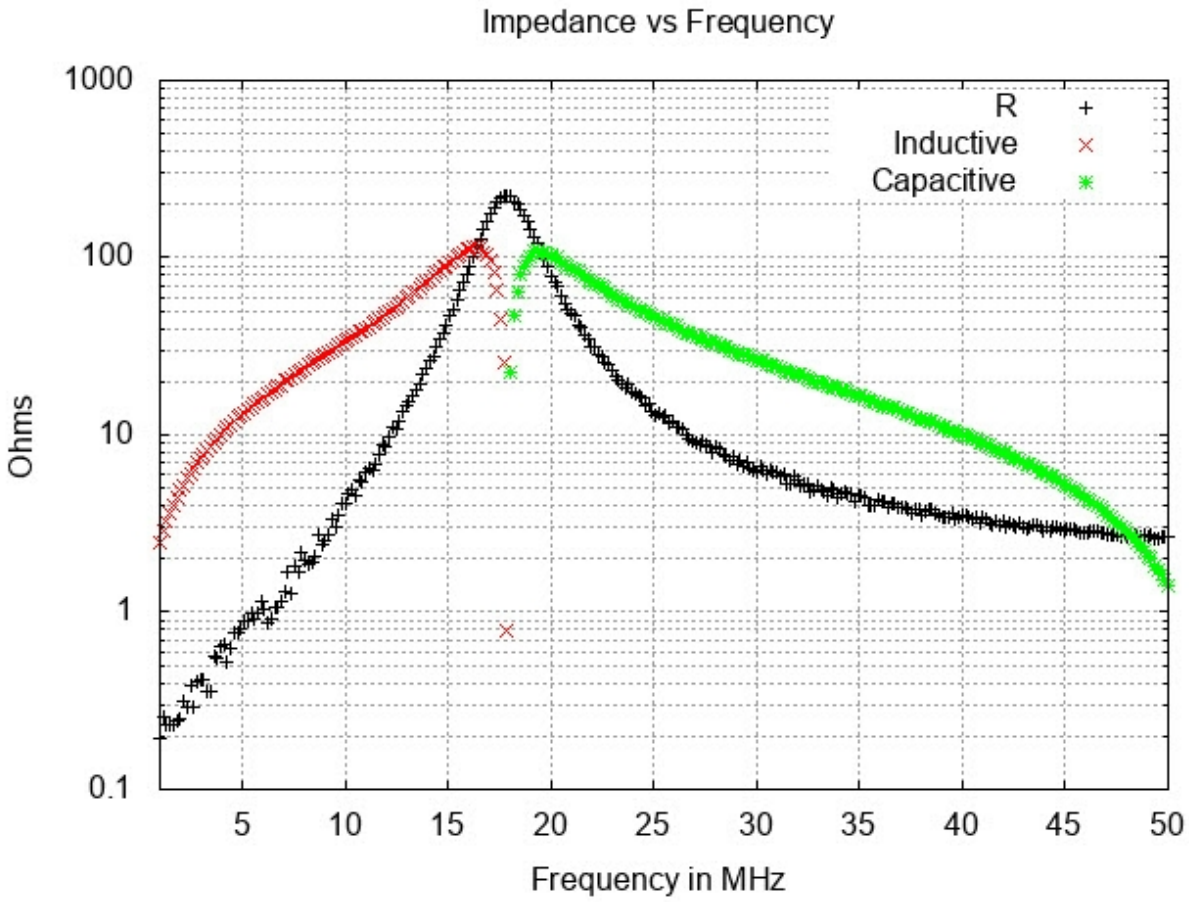


Fig. 6. Results plotted for a 205-pF capacitor and a 470 nH inductor connected in parallel.

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