

DC Ohmmeter Lab 0:

ALICE 1.3 Desktop is a multi-purpose and useful set of tools for measuring electronic circuits in lab projects and experiments. But with all its capabilities it can be a little intimidating at first to get comfortable using all of the tools. In this Tutorial we are going to go over one of those features (The DC Ohmmeter) so that you can get the most out of the software.

1.0 Background:

The ALM1000 contains two 16 bit 100KSPS analog to digital converters (ADC). These voltage inputs are often used to measure time varying waveforms as in the ALICE oscilloscope interface. However, there are often times when simple, accurate, DC measurements are all that is required. The following simple user interface is provided for that purpose.

1.1 Required files:

The DC Ohmmeter Tool Windows executable program is included with the ALICE 1.3 desktop installer package. Instructions for installing the software on Windows can be found at the following link:

https://wiki.analog.com/_media/university/tools/m1k/alice/alice-install-procedure.pdf

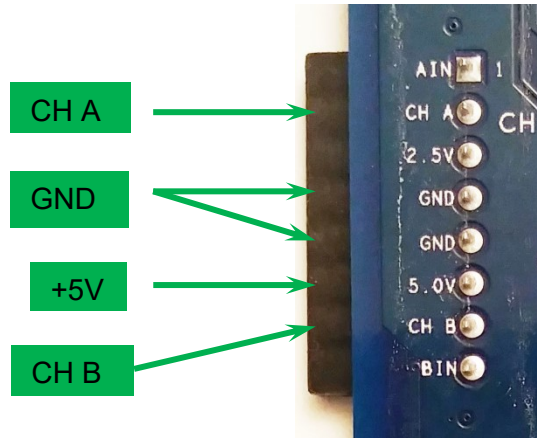
The Python source code is also available from the Analog Devices GitHub repository and is generally compatible with version 2.7 of Python. Other than the pysmu library bindings the program only imports modules generally included with standard Python installation packages.

1.2 Connections:

It is assumed that the reader is somewhat familiar with the functionality and capabilities of the ADALM1000 hardware. For more on the ADALM1000 hardware please refer to the documents listed in the main ALICE User Guide:

First a few notes on nomenclature used in this document:

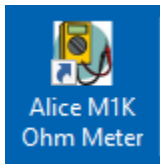
CH A refers to the Channel A SMU input / output pin on the 8 pin connector
CH B refers to the Channel B SMU input / output pin on the 8 pin connector



ADALM1000 8 Pin Connector

1.3 Screen Setup:

Once the program is run by double clicking on the desktop icon:



The main screen, as shown in figure 1, should appear. Be sure that the ALM1000 is plugged into the USB port before starting the program.

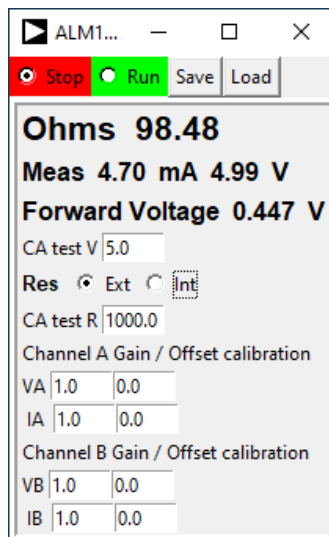


Figure 1, Ohmmeter Window

At the top of the screen are two buttons to run and stop (pause) the program looping and taking measurements continuously. The Load and Save Buttons are not important at this point so we will be ignoring them for now. Likewise the Channel Gain and Offset entries at the bottom of the frame are not important at this point so we will be ignoring them as well.

The frame below the Run Stop Buttons displays the measured resistance and auto scales to Ohms or Kilo Ohms. The measured test current and test voltage are displayed below the resistance. Additionally the voltage drop across the component being testes is displayed below that. This is especially useful when using the Ohmmeter to test diodes or LEDs. Below that there is a place to set / adjust the test voltage sourced by CH A. It is generally better to use as high a test voltage as possible but only up to the proper allowed current for a given device under test (or the 200 mA current limit of the CH A output).

There are two ways to set up the ohmmeter to test an unknown resistor. The first way is to compare the unknown resistor to a known external resistor. The second is to compare the unknown resistor to the known internal 50 Ω resistor built into the M1k. The Res Ext / Int selector buttons choose between the two methods. Below the selector buttons there is a place to enter the value of the known external resistor.

Figure 2 shows how to connect the unknown and known resistors for the internal and external modes. When the internal 50 Ω resistor is used simple connect the unknown resistor to be tested between the CH A and CH B pins as shown on the left. When using a known external resistor, connect the known resistor between CH A and CH B and connect the unknown resistor to be tested between the CH B pin and the GND pin as shown on the right.

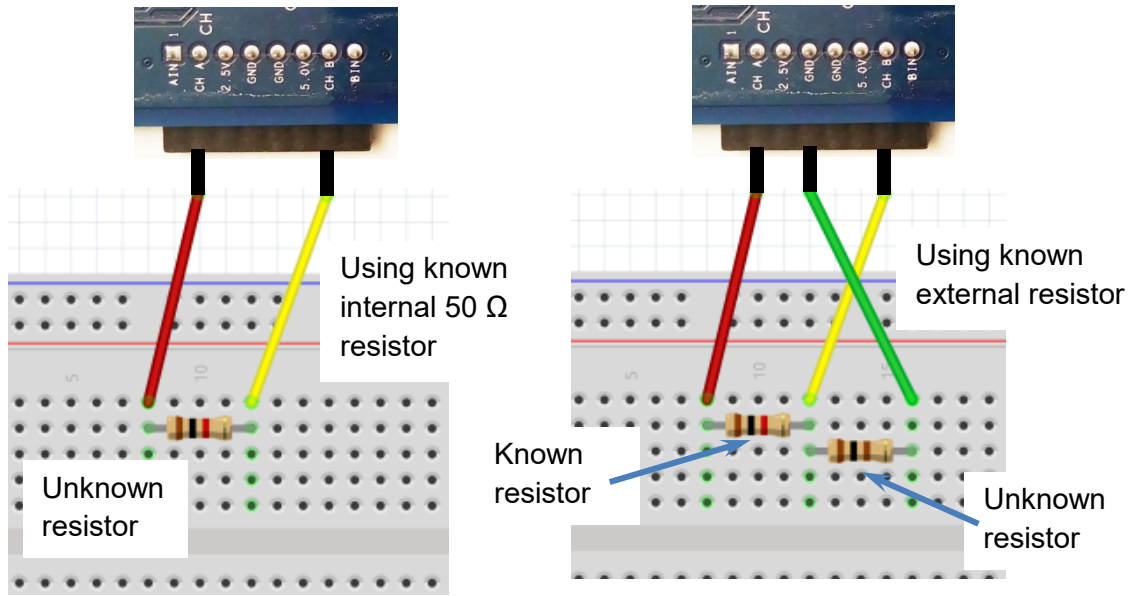


Figure 2, How to connect the test resistors.

1.4 Use Example:

To demonstrate how to use the Ohmmeter Tool connect the unknown resistor with brown, black, red stripes as shown connected to the M1k CH A and CH B pins on the left of figure 2. Configure the Ohmmeter controls as shown in figure 3 with the CA test voltage set to 5.0 and the Res Int checked.

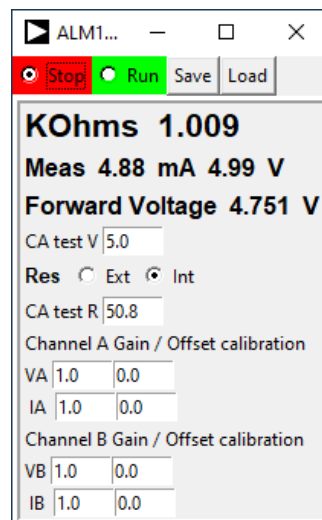


Figure 3, Ohmmeter control settings

The internal $50\ \Omega$ will be used but we see that the CA test R entry is actually set slightly more than 50, to 50.8 to account for the R_{on} resistance of the on board switch that connects the internal resistor to the CH B pin. Click the Run button to measure the resistor. We get a reading of 1.009 KOhms which is exactly what we expect for a resistor with brown, black, red stripes or 1 (brown) 0 (black) 00 (red) equals 1000 ohms.

1.5 Using the Ohmmeter to test diodes

The Ohmmeter tool can also be used to test the forward voltage drop of diodes. In the following examples we will use be using the internal $50\ \Omega$ resistor to test the diodes so be sure to set the controls to use Internal resistor. The displayed resistance value is of little use when testing non-linear components like diodes so disregard what is displayed. The measured Current and Forward voltage are what we are interested when testing diodes.

If the diode is connected between the CH A pin and the CH B pin, with the (+) end of the diode connected to CH A and the (-) end of the diode connected to CH B as shown in figure 4. Note the (-) negative end of the diode is the one with the black band around it. The diode needs to be connected the right way around to be forward biased and turn on.

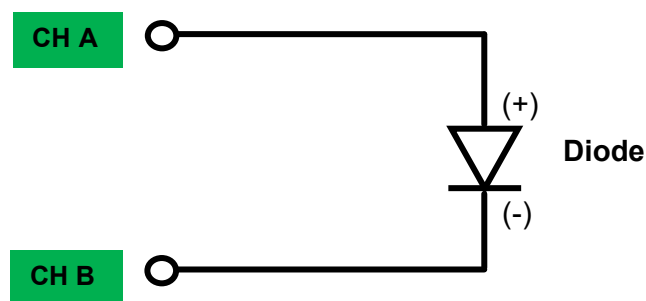


Figure 4, Connections to test the forward voltage of a diode

The forward voltage drop of a common Si diode such as the 1N914 is small at around 0.7 volts so start with the CA test voltage near that value and slowly increase it until the measured current is about 10 mA as we see in figure 5. 10 mA is a good test current for small signal diodes like the 1N914. For larger power

diodes (like a 1N4001) a higher test current (up to the 200 mA limit of M1k) can be used.

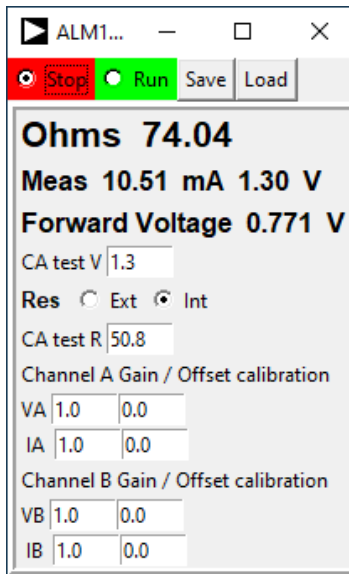


Figure 5, Testing a 1N914 diode

Another type of diode to test is the LED. Connect an LED with the same forward polarity as you did for the 1N914 diode. Note that the LED has a longer and a shorter lead. The longer lead is the positive (+) terminal and the shorter lead is the negative terminal (-). The LED must be connected the right way around in order to turn on and light up.

The forward voltage drop across most LEDs is around 1.8 volts so start with the CA test voltage near that value and slowly increase it until the measured current is about 10 mA as we see in figure 6. 10 mA is a common test current manufactures list in the product datasheets for LEDs.

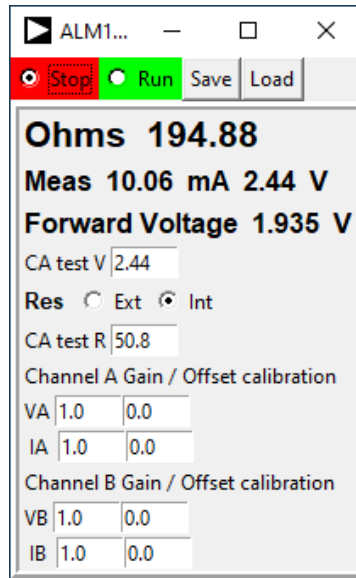


Figure 6, Testing a Red LED

A Zener diode is another type of diode that can be tested with the Ohmmeter if the reverse breakdown voltage is less than 5V. The ADALP2000 parts kit contains a 1N4735 3.3 V breakdown voltage Zener. To test the reverse breakdown voltage of a Zener the (-) end with the black band is connected to the CH A pin and the (+) is connected to the CH B pin.

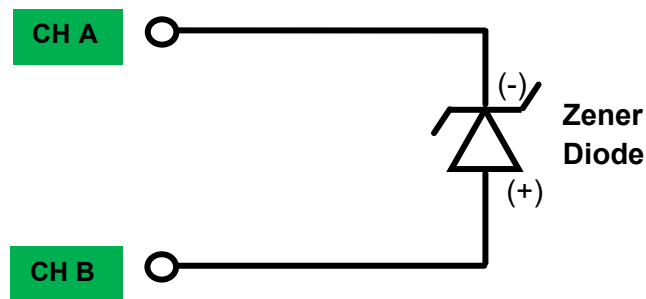


Figure 7, Connecting a Zener diode

The reverse voltage drop across the 1N4735 is around 3.3 volts so start with the CA test voltage near that value and slowly increase it until the measured current is about 5 mA as we see in figure 8. The 1N4735 is a low power, low voltage Zener so 5 mA is a good test current to use.

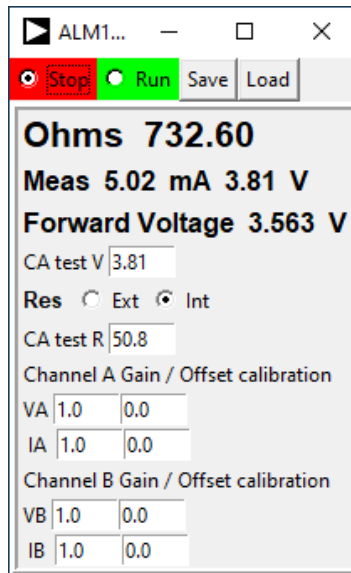


Figure 8, Testing 1N4735 Zener Diode (3.5V at 5 mA)

3.0 Next Steps – Time to Tinker!:

There are more things you can do with the interface but these are the basics to get you started. You can explore the rest by exploring or tinkering on your own. The best way to become familiar with your M1k and the ALICE tools is to start tinkering with electronics. Using some parts from your parts kit put together some other simple circuits that you might have seen or been interested in learning more about (measuring the M1k fixed power supply rails, a resistor voltage divider, powering LEDs or a DC motor, etc.) or explore new electrical components or circuits. Eventually you will be building and analyzing more and more complex circuits.