

Agilent 34401A DMM

UTA Quick Guide



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Basic Controls

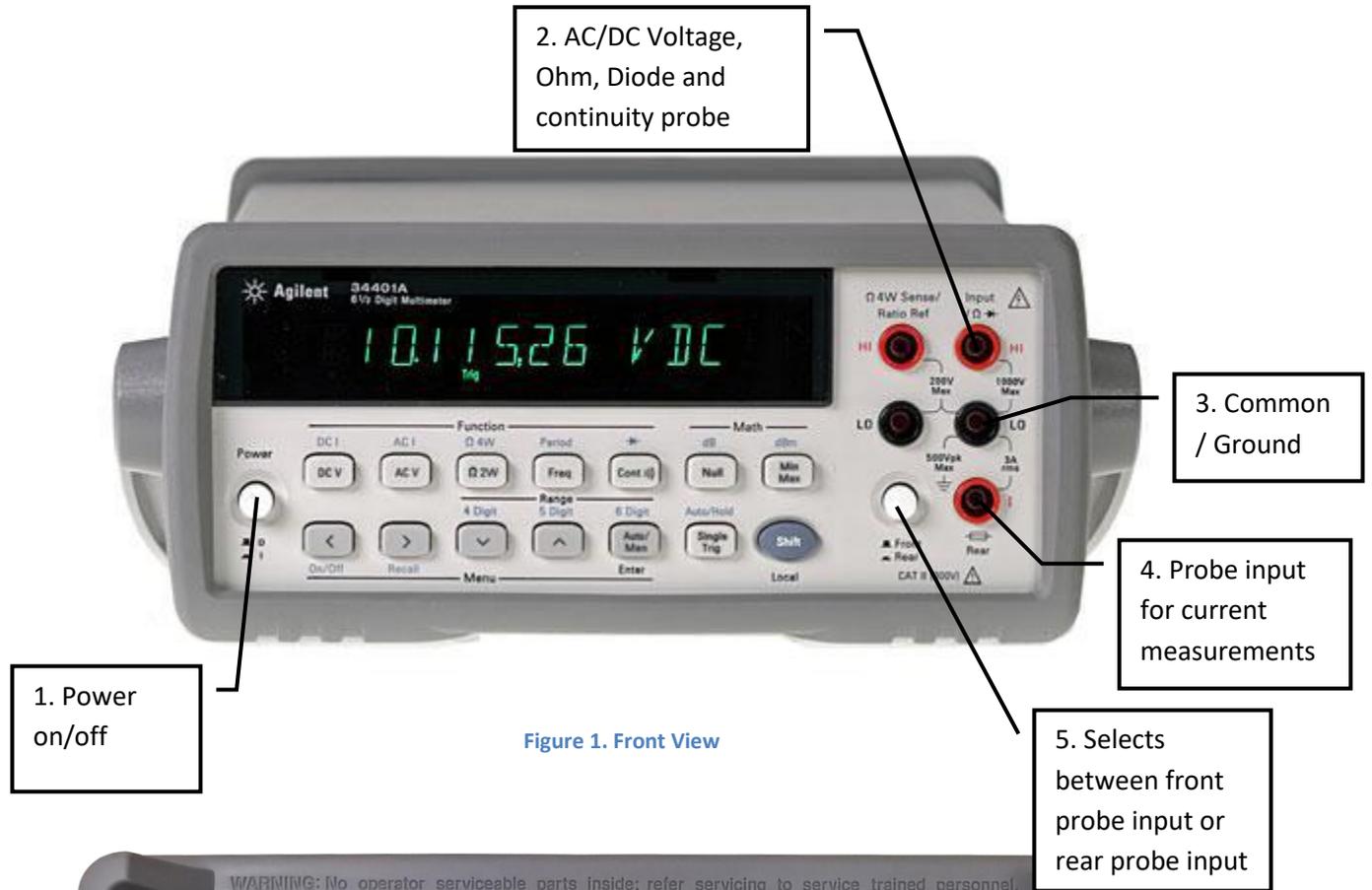


Figure 1. Front View

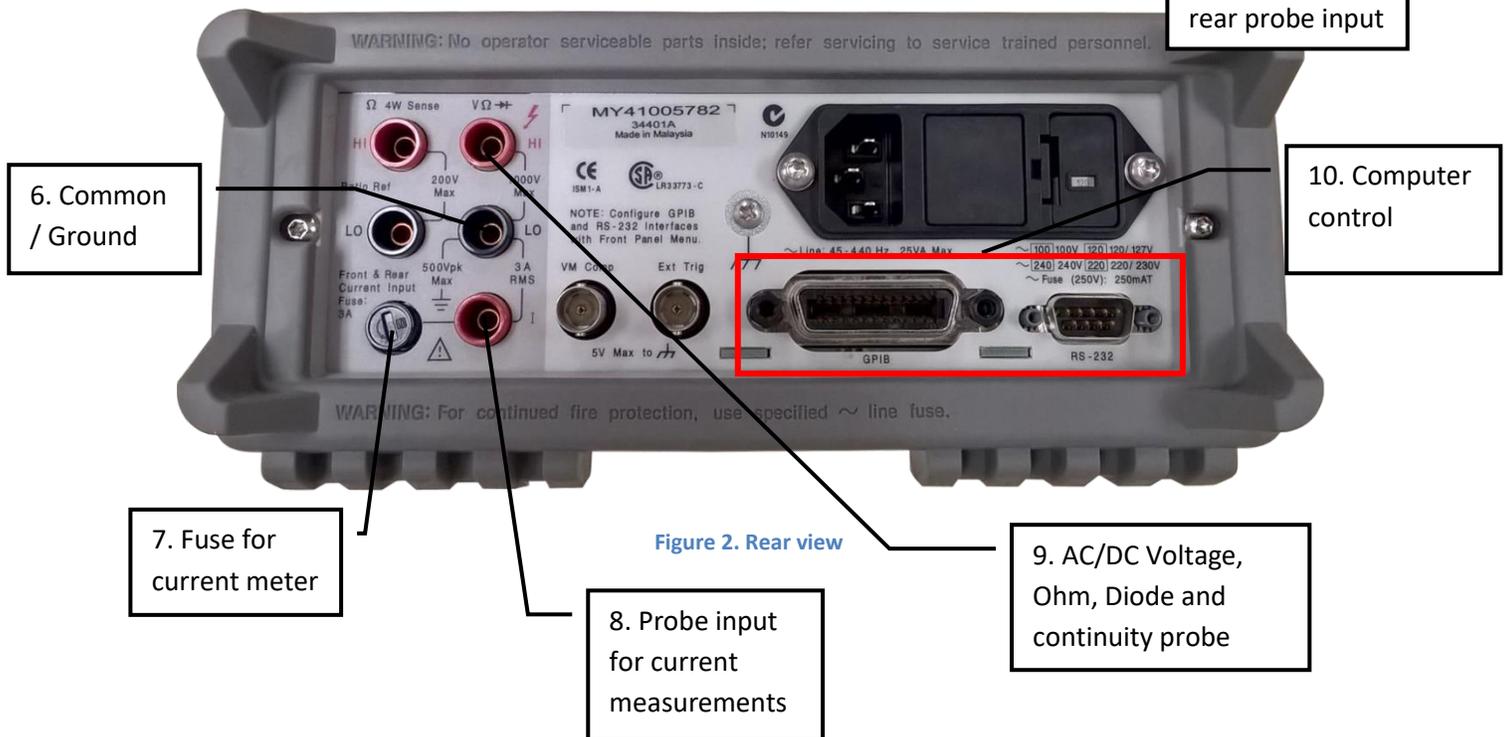


Figure 2. Rear view

Measuring DC Voltage

1. Turn on the Agilent 34401 DMM and confirm the rear / front selection button is set to front. (see Figure 1, item #5) Note: the DMM always starts with the selection measure DC Voltage. If VDC is not displayed on the DMM, press the [DC V] button now.
2. Turn on the Agilent E3620A power supply and set V1 voltage to 5 volts.
3. Connect a red Banana to test lead to the 34401A voltage input and a black Banana to test lead to the 34401A ground input. (See Figure 3).

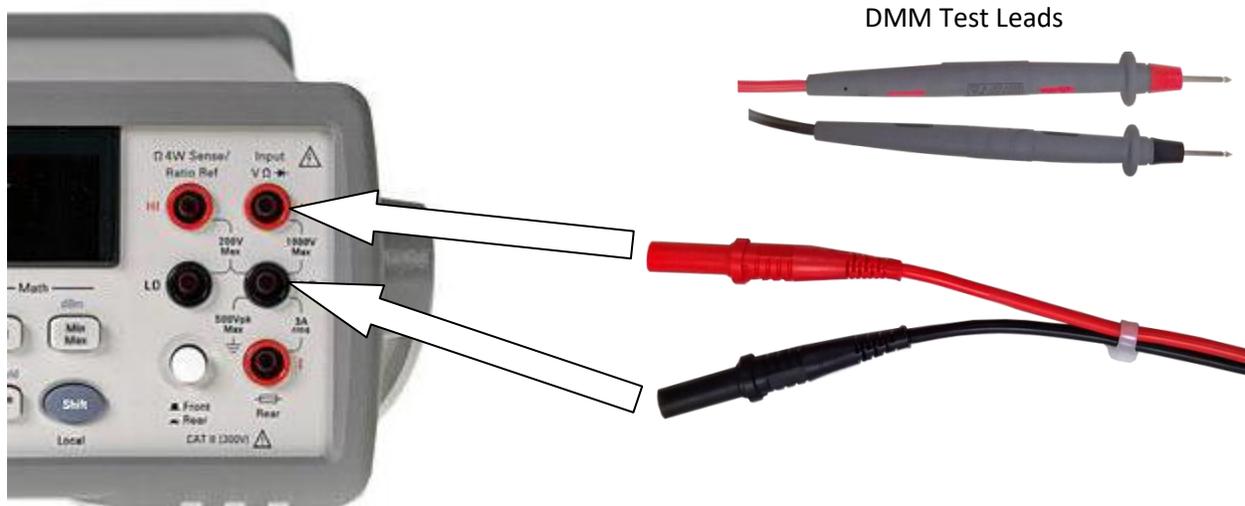


Figure 3: DMM Banana connector to DMM voltage input

4. Measure the V1 output of the Power Supply. Touch the red DMM probe to the V1 output and the Black DMM probe to the negative terminal "-". (See Figure 4)



Figure 4: Directly measure the DC voltage from the power supply.

5. Connect a red and black double banana to alligator clip to the **E3620A Power Supply**. (See Figure 5) **Be careful not to touch the red and black alligator clips together! This is known as a short.**

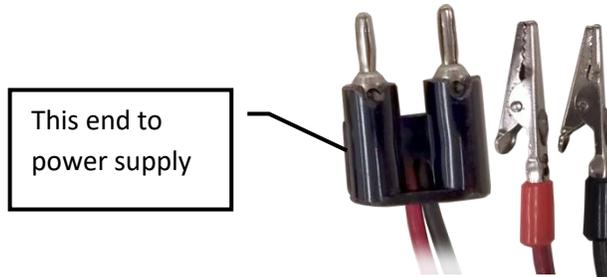


Figure 5: Double Banana to Alligator clip

6. Connect the red alligator clip to the red DMM test lead and the black alligator clip to the black DMM test lead being careful the red and black connectors do not touch or “short”.
7. The 34401A DMM should now read the 5 volts from the power supply.
8. The range of the display is set to automatic when you turn on the DMM. Press the [Auto/Man] button to enter the manual mode. Press  to manually decrease the range and  to manually increase the range. Pressing  will remove the least significant digit while pressing  will display more digits and result in a more accurate reading. Normally you will have the DMM in Auto mode, so go ahead and press [Auto/Man] again to return to automatic mode.
9. You can quickly display 4, 5 or 6 digits by pressing the shift key then the appropriate range key. (See Figure 6)



Figure 6: Pressing Shift will allow you to access the blue alternate keys.

10. If you wish to make a single measurement, press . To return to Auto mode press 
then  again.

Measuring AC Voltage

1. Turn on the Agilent 34401 DMM and confirm the rear / front selection button is set to front. (see Figure 1, item #5) Note: the DMM always starts with the selection measure DC Voltage. Press the [AC V] button now.
2. We will use the Agilent 33120A Function Generator as a source of AC voltage. Turn on the Agilent 33120A Signal Generator and connect the BNC end of the BNC to grabber cable to the output of the Signal Generator. Push the BNC onto the output and twist the BNC clockwise until it stops. (See Figure 7)



Figure 7: Grabber to BNC cable

3. In order to measure the AC voltage correctly, we will need to put the signal generator into “High Z” or “High Impedance” mode. On the Signal Generator press [Shift] then [Enter]. Press the right arrow  repeatedly until you scroll to D: SYS MENU. Press the down  arrow twice to see the OUT TERM Value. If the signal generator displays HIGH Z, then continue to step 4. If the signal generator displays 50 OHM, press the right  arrow to change it to HIGH Z. Press [ENTER] on the signal generator to save the changes.
4. Press  the sine wave button.
5. Press [Freq] -> [Enter Number] -> [1] “The sine wave” -> [kHz] “The down arrow”. This should give us 1 kHz or 1000 cycles per second alternating voltage.
6. Press [Ampl] -> [Enter Number] -> [.] “Enter number” -> [3] -> [5] -> [0] -> [Vpp] “Up arrow”.
7. Confirm the signal generator reads **350 mVPP**. If it does not, repeat step 6.
8. Now connect the red grabber (Figure 7) to the red DMM test lead (Figure 3) and the black grabber (Figure 7) to the black DMM test lead (Figure 3).
9. The Agilent 34401A DMM should now read around 0.123725 VAC. This depends on the number of digits you set the DMM to display.
10. The range of the display is set to automatic when you turn on the DMM. Press the [Auto/Man] button to enter the manual mode. Press  to manually decrease the range and  to manually increase the range. Pressing  will remove the least significant digit while pressing  will display more digits and result in a more accurate reading. Normally you will have the DMM in Auto mode, so go ahead and press [Auto/Man] again to return to automatic mode.

11. You can quickly display 4, 5 or 6 digits by pressing the shift key then the appropriate range key. (See Figure 6)
12. So why does the DMM read 0.123725 VAC when we set the signal generator to 350mVpp? The answer is the DMM only reads AC voltage RMS (root mean square).

$$\frac{V_{pp}}{2} * .707 = V_{peak} * .707 = V_{RMS} \quad \text{then, } \frac{.350}{2} * .707 = 0.175 * .707 = V_{RMS} = 0.123725 V$$

Measuring Frequency or Period

1. Turn on the Agilent 34401 DMM and confirm the rear / front selection button is set to front. (see Figure 1, item #5) Note: the DMM always starts with the selection measure DC Voltage. Press the [AC V] button now.
2. We will use the Agilent 33120A Function Generator as a source of AC voltage to measure frequency. Turn on the Agilent 33120A Signal Generator and connect the BNC end of the BNC to grabber cable to the output of the Signal Generator. Push the BNC onto the output and twist the BNC clockwise until it stops. (See Figure 8)



Figure 8: Grabber to BNC cable

3. In order to measure the amplitude correctly, we will need to put the signal generator into “High Z” or “High Impedance” mode. On the Signal Generator press [Shift] then [Enter]. Press the right arrow  repeatedly until you scroll to D: SYS MENU. Press the down  arrow twice to see the OUT TERM Value. If the signal generator displays HIGH Z, then continue to step 4. If the signal generator displays 50 OHM, press the right  arrow to change it to HIGH Z. Press [ENTER] on the signal generator to save the changes.
4. Press  the sine wave button.
5. Press [Freq] -> [Enter Number] -> [1] “The sine wave” -> [kHz] “The down arrow”. This should give us 1 kHz or 1000 cycles per second alternating voltage.

6. Now connect the red grabber (Figure 8) to the red DMM test lead (Figure 3) and the black grabber (Figure 6) to the black DMM test lead (Figure 3).
7. The DMM should read 1 kHz. The accuracy depends on the input level and frequency range being applied to the DMM.
8. To see the period press [Shift] then [Freq].

Measuring Continuity and Resistance

Continuity

Continuity measurements are helpful to test if connections are electrically connected. It is convenient if the resistance is low (a connection is good) that the DMM make a beeping sound so you don't have to keep looking at the meter and you can concentrate on checking connections.

1. Turn on the Agilent 34401 DMM and confirm the rear / front selection button is set to front. (see Figure 1, item #5) Note: the DMM always starts with the selection measure DC Voltage. Press the [Cont] button now.
2. Connect the red and black DMM cables to the 34401A.
3. Touch the red and black DMM cables together and your continuity read should show very low ohms and the unit will beep.
4. Anything below 10 ohms will sound the buzzer on the DMM.
5. The continuity can be adjusted to beep below 1 ohm to 1000 ohms. See lab personnel if you need to change the continuity reference level.

Resistance

The Agilent 34401A's Ohm meter can use 2 or 4 wires to measure resistance. The 4 wire probes can measure resistance with great accuracy. We will only use the 2 wire connections for the undergraduate labs.

1. Turn on the Agilent 34401 DMM and confirm the rear / front selection button is set to front. (see Figure 1, item #5) Note: the DMM always starts with the selection measure DC Voltage. Press the  button now. The Greek letter Omega (Ω) is used in electronics to represent Ohms. So this button reads Ohms – 2 wire.
2. Connect a red Banana to test lead to the 34401A voltage input and a black Banana to test lead to the 34401A ground input. (See Figure 3).
3. To increase the accuracy of your measurement we will cancel out any resistance in your DMM probes themselves.
4. Short (connect) the red and black DMM probes and press the [NULL] button. This sets the resistance at the probe tips to zero.
5. You can now measure resistance. **WARNING: NEVER MEASURE RESISTANCE WITH POWER APPLIED TO YOUR CIRCUIT!**

Measuring AC/DC Current

Current measurements are always made in series with the circuit you wish to measure. The current meter in the 34401A DMM is protected by a 3 Amp fuse. You can safely measure up to 3 Amps RMS. Therefore you can measure up to 3 Amps Direct Current (DC) or up to 4.25 Vac peak or 8.5 Amps peak to peak.

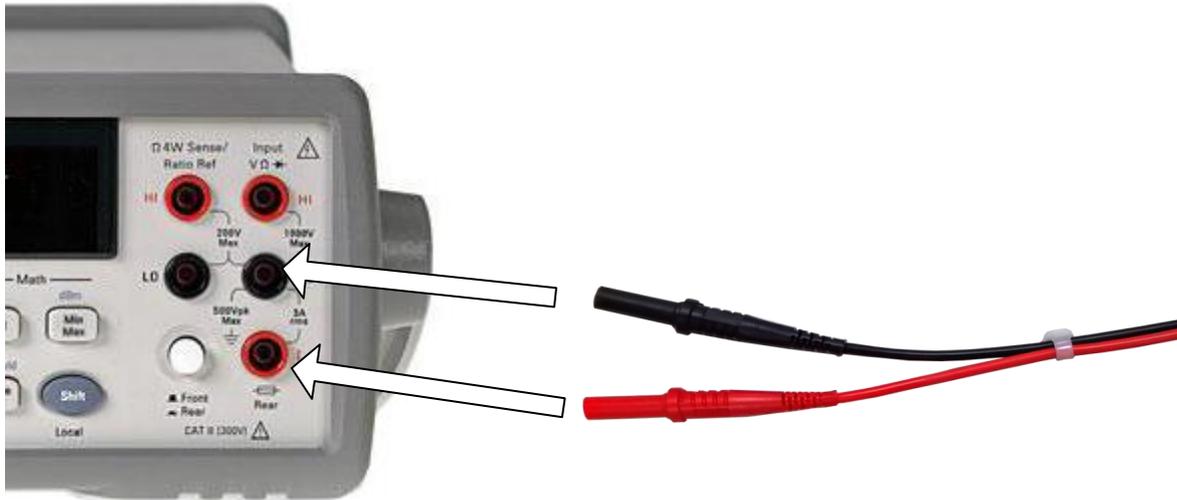


Figure 9: You must connect the red probe to the “I” (current) input.

Measuring Direct Current

1. Turn on the Agilent 34401 DMM and confirm the rear / front selection button is set to front. (see Figure 1, item #5) Note: the DMM always starts with the selection measure DC Voltage.

Press [Shift] then the  button to select DC Current measurement mode.

2. We will use the Agilent E3620 Power Supply and a 1kOhm resistor to do a quick measurement of D.C. Amps.
3. Connect red and black banana to alligator clips to both the DMM and the power supply. (See figure 10) Connect the red alligator clips together and connect the black alligator clips to each side of the resistor. (See figure 10)

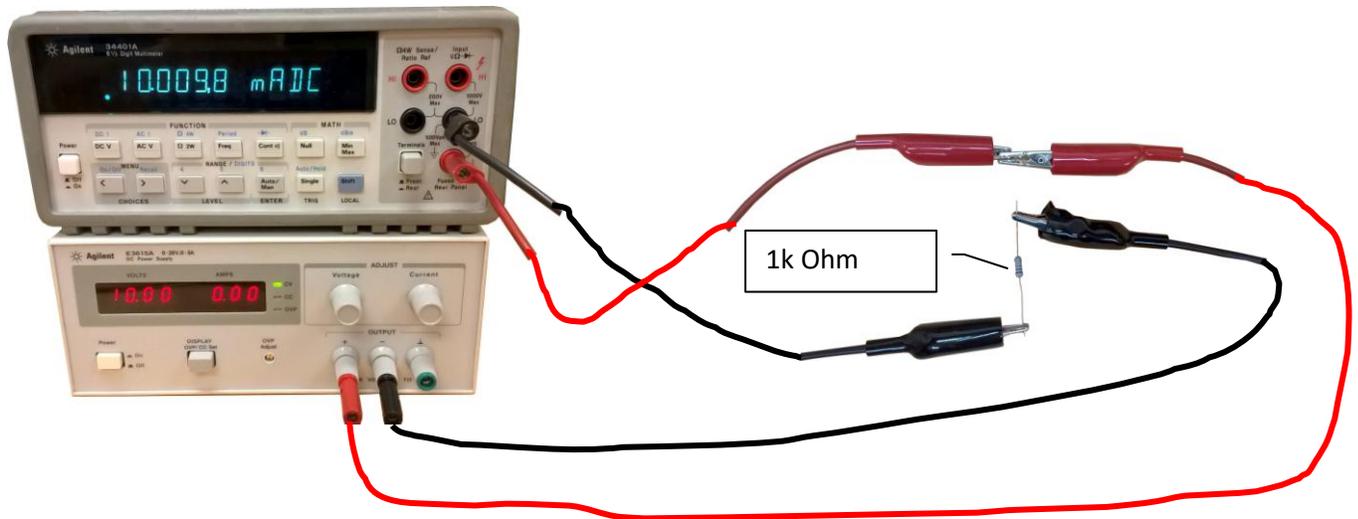


Figure 10: Setup to measure D.C. Current.

4. On the power supply, select the V1 output voltage selector and turn the voltage knob counterclockwise until it stops.
5. Turn the power supply on and set the voltage to 10V.
6. The DMM should read around 10 milliamps (or .01 Amps) DC.

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}} \quad \text{then} \quad \text{Current} = \frac{10V}{1000\Omega} = .01 \text{ Amps}$$

Measuring Alternating Current

1. Turn on the Agilent 34401 DMM and confirm the rear / front selection button is set to front. (see Figure 1, item #5) Note: the DMM always starts with the selection measure DC Voltage. Insert banana to alligator into the DMM ground and current inputs. (See Figure 8)
2. Press [Shift] then the  button to select AC Current measurement mode.
3. We will use the Agilent 33120A Function Generator as a source of Alternating Current. Turn on the Agilent 33120A Signal Generator and connect the BNC end of the BNC to grabber cable to the output of the Signal Generator. Push the BNC onto the output and twist the BNC clockwise until it stops. (See Figure 6)
4. In order to measure the current correctly, we will need to put the signal generator into “High Z” or “High Impedance” mode. On the Signal Generator press [Shift] then [Enter]. Press the right arrow  repeatedly until you scroll to D: SYS MENU. Press the down  arrow twice to see the OUT TERM Value. If the signal generator displays HIGH Z, then continue to step 5. If the signal generator displays 50 OHM, press the right  arrow to change it to HIGH Z. Press [ENTER] on the signal generator to save the changes.

5. Press  the sine wave button.
6. Press [Freq] -> [Enter Number] -> [1] “The sine wave” -> [kHz] “The down arrow”. This should give us 1 kHz or 1000 cycles per second alternating current.
7. Press [Ampl] -> [Enter Number] -> [2] -> [0] -> [Vpp] “Up arrow”. Confirm the signal generator reads **20 VPP**.
8. Using banana to alligator cables for the DMM and BNC to grabber cables for the signal generator, use a 1k Ohm resistor and construct the diagram in figure 11.

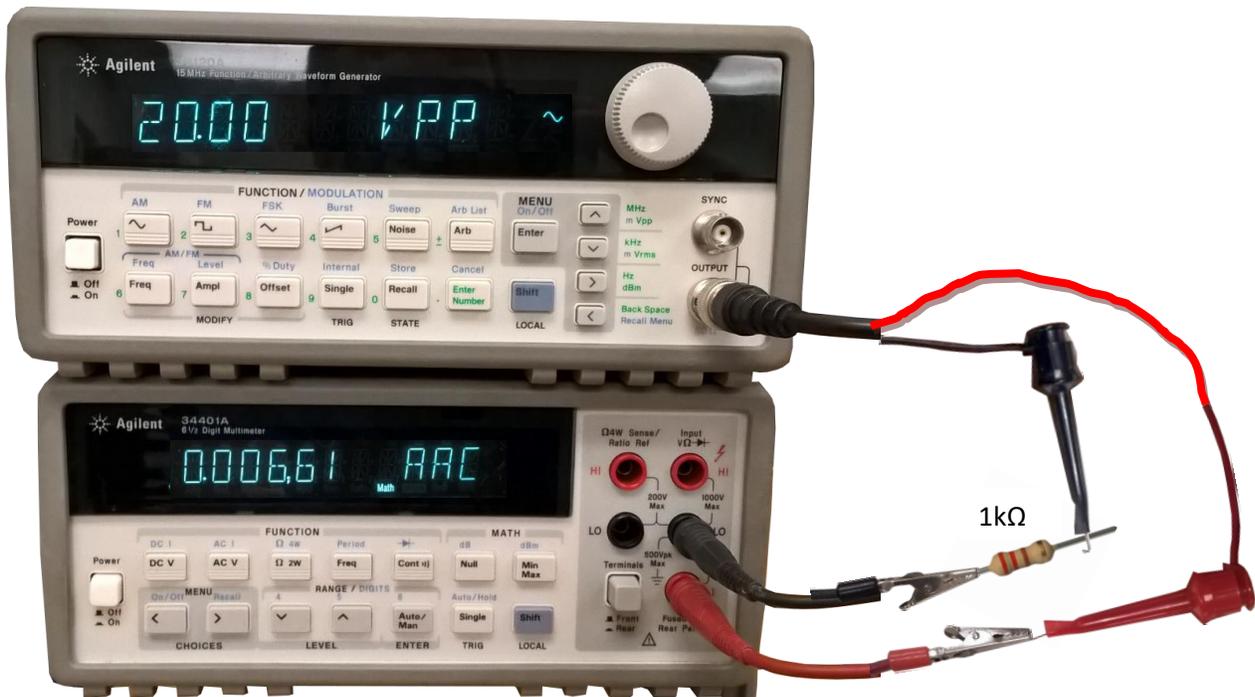


Figure 11: Setup to measure alternating current.

9. The DMM only measures alternating current RMS.

$$\frac{V_{pp}}{2} * .707 = V_{peak} * .707 = V_{RMS} \quad \text{then, } \frac{20}{2} * .707 = 10 * .707 = V_{RMS} = 7.07 V$$

Now we can calculate the current for this circuit...

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}} \quad \text{then } \text{Current} = \frac{7.07 V_{RMS}}{1000 \Omega} = .00707 \text{ Amps RMS}$$

10. Your measurement should be close to 0.00707 AMPS RMS.