

Laboratory Goals

- ❑ Familiarize students with the oscilloscope
- ❑ Familiarize students with the function generator
- ❑ Apply a signal to a resistive circuit and measure both input and output signals
- ❑ Record a digital copy of the oscilloscope screen to a diskette

Pre-lab / lab reading

- ❑ *Student Reference Manual for Electronic Instrumentation Laboratories* by Stanley Wolf and Richard Smith, Copyright 1990.
- ❑ *Agilent 54621A Oscilloscope User's Guide* published by Agilent Technologies, Copyright 2000. (Copies of this reference book are available in the lab, or at the website)

Equipment needed

- ❑ Lab notebook, pen
- ❑ Agilent 54621A Digital Oscilloscope
- ❑ Agilent 33120A Function Generator/Arbitrary Waveform Generator
- ❑ 2 oscilloscope probes (already attached to the oscilloscope)
- ❑ 1 BNC/EZ Hook test lead

Parts needed

- ❑ Circuit breadboard
- ❑ Resistors (2), 1.5k Ohm, ¼ Watt

Lab safety concerns

- ❑ Make sure before you apply an input signal to a circuit, all connections are correct, and no shorted wires exist.
- ❑ Do not short the function generator signal and ground connections together
- ❑ Do not touch the circuit wiring while power is applied to it

1. Exploring the Oscilloscope

- ❑ Locate the Agilent 54621A Digital Oscilloscope
- ❑ Press the white **POWER** button to turn on the oscilloscope

- ❑ Press the **Getting Started** softkey (lower left side of the screen) Familiarize yourself with how the controls are changed using the dials, buttons, or softkeys
- ❑ Press the **Using Quick Help** softkey. (Note that if you press and hold *any button or softkey*, its function is shown on the screen until you release it)

- ❑ Press the **Save/Recall** button
- ❑ Press the **Default Setup** softkey to return the oscilloscope to the default state (Always use the default before you begin using the oscilloscope!)

- ❑ Clip the channel 1 (**CH 1**) probe (identified by green bands on the probe cable) to the **Probe Comp** test point (lower right side of the oscilloscope).
- ❑ Clip the probe's ground clip to the oscilloscope ground connection just above the **Probe Comp** test point
- ❑ Press the white **Auto-Scale** button to acquire the test waveform (i.e., a square wave)
- ❑ Change the vertical scale of the waveform using the **CH 1** Volts/Division knob
- ❑ Change the horizontal scale of the waveform using the Sec/Division knob
- ❑ Press the **Auto-Scale** button again to resize the waveform

- ❑ Press the **Quick Meas** button to display the frequency and amplitude of the square wave for **CH 1**
- ❑ Record the frequency and peak-to-peak voltage (V_{pp}) of the square wave in your lab notebook
- ❑ Press the **Clear Meas** softkey to clear the screen measurements
- ❑ Unclip the **CH 1** probe and ground clip from the oscilloscope test point and set them aside

- ❑ Clip the channel 2 (**CH 2**) probe (identified by blue bands on the probe cable) and ground clip to the **Probe Comp** and ground connections respectively
- ❑ Repeat the frequency and amplitude measurements for the **CH 2** waveform
- ❑ Press the **Clear Meas** softkey to clear the screen measurements
- ❑ Unclip the **CH 2** probe and ground clip from the oscilloscope, and set them aside

Always test both probes before taking measurements with them! The test signal from the oscilloscope should appear square and symmetrical, with no rounding.

2. Exploring the Function Generator

- ❑ Locate the Agilent 33120A Function Generator
- ❑ Press the white **Power** button to turn on the generator

- ❑ Press the **Recall** button to select a stored setup (RECALL 0 appears on the display)
- ❑ Press the **^** button to select **RECALL 1**
- ❑ Press the **Enter** button to return the generator to a known state

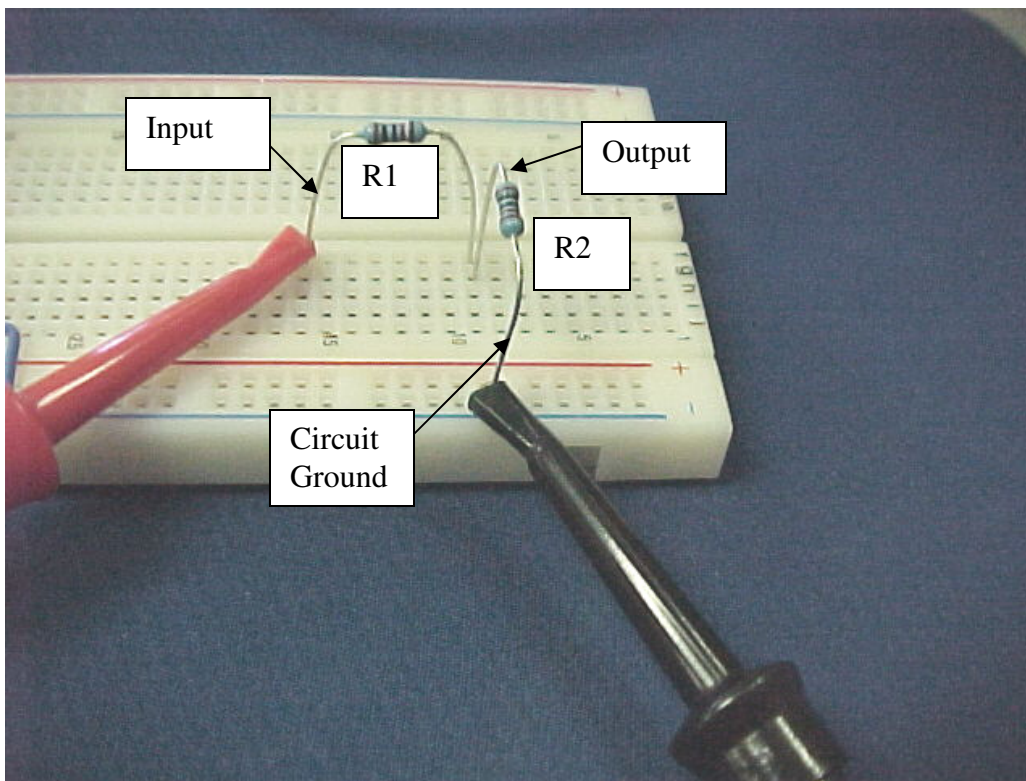
- ❑ You can select a waveform by pressing the button with the corresponding symbol (sine, square, triangle, or ramp):
 - Press the square wave button (notice the square wave symbol appears on the right side of the display)

- ❑ You can set the frequency three ways:
 - Direct entry
 - Press the **Freq** button
 - Press the **Enter Number** button (this button has green letters)
 - Enter the number, including decimal point if needed (note the green numerals, and decimal point next to the control buttons)
 - Press the **>**, **v**, **^** buttons as needed to select the **Hz**, **kHz**, or **MHz** range
 - Dial method
 - Press the **Freq** button (notice the flashing digit--this is the value that will be changed using the dial)
 - Use the **<** or **>** buttons to select which digit is flashing
 - Turn the dial forward or backwards to increase or decrease the flashing digit value
 - Arrow button method
 - Press the **Freq** button
 - Use the **<** or **>** buttons to select which digit is flashing
 - Use the **^** or **v** buttons to increase or decrease the flashing digit value

- ❑ You can select the desired signal amplitude using the same methods outlined above, except that you use the **Ampl** button, and the **>**, **v**, **^** buttons to select the **dBm**, **Vrms**, and **Vpp** voltage ranges, for the direct entry method
- ❑ Set the function generator to output a sine wave having a frequency of 455kHz and an amplitude of 1.2Vpp

3. Circuit Construction and Signal Measurement

- ❑ Construct the two-resistor circuit as shown below
- ❑ Connect the BNC end of the BNC/EZ Hook test lead to the function generator **OUTPUT**. (The BNC connector requires you to push, then gently twist the connector clockwise to lock it on the generator's connector)
- ❑ Connect the **red** and **black** EZ Hook ends of the test lead to the circuit input and ground connections respectively as shown below



Voltage Divider Circuit with the Input Signal Connected

- ❑ Clip the **CH 1** oscilloscope probe to the circuit input
- ❑ Clip the **CH 1** ground clip to the circuit ground
- ❑ Clip the **CH 2** oscilloscope probe to the circuit output
- ❑ Clip the **CH 2** ground clip to the circuit ground

- ❑ Press the **Auto-Scale** button to acquire the two waveforms
- ❑ To display **Quick Meas** data from *both channels*, you must first:
 - Press **Quick Meas** (shows the frequency and amplitude of the selected **Source** channel--**CH 1** in this case)
 - Select **CH 2** by pressing the **Source** softkey twice
 - To display the amplitude of **CH 2**, along with the **CH 1** values, press the **Peak-Peak** softkey
- ❑ Record the values in your lab notebook
- ❑ Create a copy of the oscilloscope screen and system settings using the **Quick Print** option:
 - Insert a diskette into the drive, located below the screen
 - Press the **Quick Print** button to save a TIF copy of the screen for pasting into your report
 - A text file is also copied to the disk, showing the current oscilloscope settings, which may be recalled later using the **Save/ Recall** button
- ❑ Experiment with any other features of the oscilloscope you choose!
- ❑ Record your observations in your lab notebook
- ❑ Unclip all connections to the circuit, then turn off the equipment

Before leaving the lab, take a few minutes to make sure all equipment and test leads are returned to your cabinet, and that you have cleaned up your work space.

4. Analysis

The summary report for this lab is written *after completing both parts (2a) and (2b)*.