ECE65 Introduction to the Function Generator and the Oscilloscope Created by: Eldridge Alcantara (Spring 2007)

I. Getting Started with the Function Generator



- 1) Turn on the function generator.
- 2) Connect the function generator cable to the Output knob.



II. Getting Started with the Oscilloscope

1) **Turn on** the oscilloscope. The power button is located at the top of the oscilloscope.

2) **Resetting the oscilloscope.** Before you start taking any measurements, you should ALWAYS reset the settings on the oscilloscope to its default settings. Follow these instructions to reset the oscilloscope:

- a) Push Save/Recall
- b) Push subpanel button next to Setups/Waveforms to highlight Setups

c) Push subpanel button next to Recall Factory

d) Turn Ch.2 on by pushing Ch.2 Menu

e) Push Measure and then push Autoset

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3) **Changing the source channels.** Next, change the source channels so that the first two readings come from Ch1. and the last two come from Ch.2. Follow these instructions:

a) Push subpanel button next to Source/Type to highlight <u>Source</u>.

b) Push corresponding subpanel buttons to change the last two source channels.

4) **Changing the measurement types.** Next, change the measurement types to the following: Freq, Pk-Pk, Period, Pk-Pk. Follow these instructions:

a) Push subpanel button to highlight <u>Type</u>.

b) Push corresponding subpanel buttons until you find the desired measurement type.

5) Now connect the two scope probes to the oscilloscope, one on the Ch.1 knob and the other on the Ch.2 knob. Make sure both scope probes are set to X10.



III. Using the Function Generator with the Oscilloscope

1) Connect both the Ch.1 probe and the function generator cable to the input of your circuit. Connect Ch.2 to the output of your circuit

2) Push Autoset on the oscilloscope to see the input and output signals on the screen. By default, the function generator is set to generate a triangle wave.

3) Take note of the following measurements displayed on the right hand side of the oscilloscope:

a) Ch.1 Freq (the frequency of the generated input signal)

b) Ch.1 Pk-Pk (the peak to peak of the generated input signal)

c) Ch.2 Period (the period of the output signal)

d) Ch.2 Pk-Pk (the peak to peak of the output signal)

4) **Peak-to-Peak vs. Amplitude.** Note the difference between peak-to-peak and amplitude. Peak-to-Peak is a measure of the distance from the minimum point and the maximum point of the signal, while amplitude is a measure of the distance from the center of the graph to the maximum voltage of the signal. See figure below:





4) **Increasing the amplitude or peak-to-peak.** Turn the AMPL knob to the right. Watch the Ch.1 Pk-Pk reading on the oscilloscope and check that the peak-to-peak is indeed increasing as you turn the knob. If your signal goes past the top or bottom of the screen, push Autoset. Note the maximum peak-to-peak you can reach is approximately 20 V.

5) **Decreasing the amplitude or peak-to-peak.** Turn the AMPL knob to the left. If your signal gets too small for the oscilloscope, push Autoset. Note the minimum you can reach peak-to-peak is approximately 1 V.

6) **Generating small amplitude signals.** You can generate even smaller signals by following one of the methods:



a) **Using ATT -20 dB.** Push the ATT -20dB button to turn it on. This will attenuate the amplitude or peak-to-peak by a factor of 10, so that the knob will generate signals from 100 mV to 2 V peak-to-peak.

b) **Pull out AMPL knob.** You can attenuate another -20 dB by also pulling out the AMPL knob. This will give you signals ranging from 10 mV to 200 mV peak-to-peak.

7) **Changing the frequency**. You can change the frequency in two ways:



a) **Increasing and decreasing the frequency.** Increase the frequency by turning the frequency dial to the right. Watch the Ch.1 Freq increase as you turn the dial. It should go up. Turn the dial to the left, and watch the frequency go down.



b) **Setting a desired frequency.** To set a particular desired frequency, you will need to use both the frequency dial and the associated multiplier buttons. For example, to set the frequency to 1.2 kHz, turn the dial to 1.2 and push the 1k button. How this works: $1.2 \times 1 \text{k} = 1.2 \text{ kHZ}$.

8) **Generating different waveforms.** The function generate can generate any of the following three waveforms: a square wave, a triangle wave, and a sine wave. You can change the waveform simply pushing the corresponding button.

IV. Using the Oscilloscope

1) **Summarizing** the main items on the screen for a triangle wave with a 5 V amplitude and frequency of 1 kHz:



a) **Location of center or zero volts.** There is an arrow right next to the triangle wave, to the very left of the screen. This represents the center of the graph – that is, the point where the signal is at 0 V, and also where the time axis is located.

b) **Volts per division.** The Ch.1 reading at the very bottom of the oscilloscope represents the volts per division on the screen. A volts per division of 5 means the distance between each dotted line on the y-axis is 5.00 V. Note that there is also a volts per division reading for Ch.2 reading which can be different from Ch.1.

c) **Seconds per division.** The M reading represents the seconds per division reading on the screen. According to the current reading above, the distance between each dotted line on the x-axis is 250 µs. Note that there is only one seconds per division reading given on the oscilloscope. That is because both signals are on the same time axis.

2) **Changing the volts per division.** You can increase the volts per division of either channel by turning the corresponding VOLTS/DIV knob to the left. Note the changes on the screen. The volts per division will increase, and the graph gets smaller. You can also decrease the volts per division by turning the knob to the right. Note that your graph gets bigger. If your signal goes past the length of the screen, push Autoset.

3) **Changing the seconds per division.** Similarly, you can increase the seconds per division by turning the SEC/DIV knob to the left. Note the changes on the screen. The M value will increase and you get more cycles per second. You can decrease the seconds per division by turning the SEC/DIV knob to the right. Here, you will get less cycles per second. If there are too many or not enough cycles displayed on the screen, push Autoset.

4) **Moving the vertical position.** You can move the graph up and down by using the Ch.1 Vertical Position knob (the one on the left).

Note the reading on the display at the bottom of the screen as you move the graph: CH1 vertical position 0.88 divs (4.40V). This is telling you where the graph is centered in reference to the main axis of the oscilloscope.

5) **Moving the horizontal position.** You can move the graph left and right by using the Horizontal Position knob. Feel free to test this out.

- 6) Using the Cursor Function. Here are some general instructions:
 - a) Push Cursor to change from the measure function to the cursor function.
 - b) Notice the new boxes on the screen:

-Type: specifies what you are measuring (it can be voltage or time) -Source: specifies which channel you are measuring 7) **Measuring voltage using cursor.** Change the type to Voltage by pushing the corresponding supanel button. Change the Source to channel 1 or 2. Note the two horizontal cursors that come up. Each of the two cursors can be controlled through the vertical position knobs.

There are three important measurement boxes to note on the screen:

- -Delta: the distance (absolute value) in volts between the two cursors
- -Cursor 1: the voltage measurement of the first cursor
- -Cursor 2: the voltage measurement of the second cursor

8) **Measuring time using cursor.** Change the type to Time by pushing the corresponding subpanel button. Change the Source to channel 1 or 2. Note the change from the horizontal cursors to two vertical cursors. Again, each of the two cursors can be controlled through the vertical position knobs.

Also note the three important measurement boxes on the screen:

-Delta: the distance (absolute value) in time between the two cursors

-Cursor 1: the time measurement of the first cursor

-Cursor 2: the time measurement of the second cursor