Experiment 9
The Oscilloscope and Function Generator

Introduction

The oscilloscope is one of the most important electronic instruments available for making circuit measurements. It displays a curve plot of time-varying voltage on the oscilloscope screen. The oscilloscope provided with *Multisim Electronics Workbench* is a dual trace oscilloscope that looks and acts like a real oscilloscope. A dual trace oscilloscope allows the user to display and compare two time-varying voltages at one time.

The controls on the oscilloscope are as follows:

1. The TIME BASE control adjusts the time scale on the horizontal axis in time per division when Y/T is selected. When B/A is selected, the horizontal axis no longer represents time. The horizontal axis now represents the voltage on the channel A input and vertical axis represents the voltage on channel B input. When A/B is selected, the horizontal axis represents the voltage on the channel B input and the vertical axis represents the voltage on the channel A input. The X_POS control determines the horizontal position where the curve plot begins.
2. The CHANNEL A control adjusts the volts per division on the vertical axis for the channel A curve plot. The Y-POS control determines the vertical position of the channel A curve plot relative to the horizontal axis. Selecting AC places a capacitance between the channel A vertical input and the circuit testing point. Selecting “0” connects channel A vertical input to ground.
3. The CHANNEL B control adjusts the volts per division of the vertical axis for the channel B curve plot. The Y-POS determines the vertical position of the channel B curve plot relative to the horizontal axis. Selecting AC places a capacitance between the channel B vertical input and the circuit test point. Selecting “0” connects the channel B vertical input to ground.
4. The trigger settings control the conditions under which a curve plot is triggered (begins to display). Triggering can be internal (based on one of the input signals) or external (based on a signal applied to the oscilloscope external trigger input). With internal triggering AUTO, A, or B. If A is selected, the curve plot will be triggered by channel A input signal. If |B is selected, the curve plot will be triggered by channel B input signal. If you expect a flat input waveshape or you want the curve plot displayed as soon as possible, select AUTO. The display can be set to start on positive or negative slope of the input by selecting the appropriate EDGE selection. The trigger LEVEL control determines the voltage level of the input signal waveform, in divisions on the vertical axis, before the waveform will begin to display.

Once a circuit simulation has been activated and a voltage curve plot has been displayed on the oscilloscope screen, the oscilloscope probes can be moved to other test points in the circuit without running the simulation again. Moving the probes automatically redraws the voltage curve plot for the new test point. You can also fine tune the settings either during or after a simulation and the display will be redrawn on the screen automatically. You can

‘pause’,’resume’ through the “Analysis Option”. The zoom feature can be used by using “Expand”. Normal size will be restored by clicking “Reduce”. You can learn other features through the help menu.

The Function Generator

The function generator is a voltage source that supplies different time-varying voltage functions. The *Multisim Electronics Workbench* can supply sine wave, square wave, and triangular wave voltage functions. The waveshape, frequency, amplitude, duty cycle, and dc offset can be easily changed. It has three voltage output terminals. Connect the COM terminal to ground symbol. The +ve terminal provides output voltage that is positive with respect to the COM terminal and the –ve terminal proves an output voltage that is negative with respect to the COM terminal.

The controls on the function generator are as follows:

1. You can select a waveshape by clicking the appropriate waveshape on the top of the function generator.
2. The frequency control allows you adjust the frequency of the output voltage up to 999 MHz. Click up or down arrow to adjust the frequency, or click the frequency box and type the desired frequency.
3. The AMPLITUDE control allows you to adjust the amplitude of the output voltage measured from the reference level (common) to **peak** level. The peak to peak value is twice the amplitude setting.
4. The OFFSET control adjusts the dc level of the voltage curve generated by the function generator. An offset of 0 positions the curve plot along the x-axis with an equal positive and negative voltage setting. A positive offset raises the curve plot above the x-axis and a negative offset lowers the curve plot below the x-axis.

Consult the *Multisim Electronics Workbench* User and Reference manuals for more details on the oscilloscope and function generator.

Procedure

1. From the instrument panel pull down the Function generator and Oscilloscope and connect them as shown in Figure 1. You can select different colors of the wires by double clicking the line and choosing the colors. Select sine wave from the function generator. Set frequency to 1 kHz and amplitude to 10V. On the oscilloscope start with the Time Base of 0.2ms/div and channel A, B settings of 5V/div.

2. Click the on-off switch to run the analysis. Connect the positive output of the function generator to oscilloscope channel A input and negative output to channel B input. You may use red color for Ch. A and blue to Ch. B, if you wish.

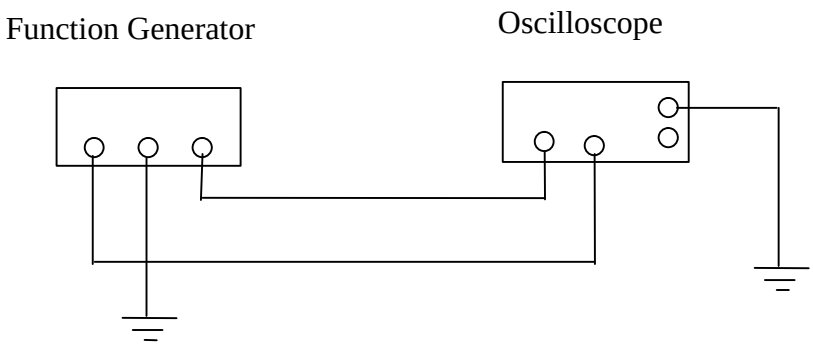


Figure 1: The function generator and oscilloscope connection

3. Select the “0” on the oscilloscope channel B input and run the analysis again.

Question: What change occurred on the oscilloscope Channel B curve plot? Explain.

4. Change the oscilloscope channel A to 10V/div.

Question: What change occurred on the oscilloscope Channel A curve plot? Explain.

5. Change the oscilloscope Time Base to 0.1ms/div and run the analysis again.

Question: What change occurred on the oscilloscope Channel A curve plot? Explain.

6. Change the oscilloscope Channel A Y-POS to 1.00 and run the analysis again.

Question: What change occurred on the oscilloscope Channel A curve plot? Explain.

7. Change the channel A Y-POS back to 0.00 and select DC on channel B input and run the analysis again.

Question: What change occurred on the oscilloscope curve plot? Explain.

8. Return the oscilloscope time base to the settings you started with and select “0” on the channel B input again. Select the triangular wave shape on the function generator and run the analysis again.

Question: What change occurred on the oscilloscope curve plot? Explain.

9. Select the square wave on the function generator and run the analysis again.

Question: What change occurred on the oscilloscope curve plot? Explain.

10. Change the AMPLITUDE on the function generator to 5V and run the analysis again.

Question: What change occurred on the oscilloscope curve plot? Explain.

11. Change the frequency on the function generator to 2KHZ and run the analysis again.

Question: What change occurred on the oscilloscope curve plot? Explain.

12. Change the offset on the function generator to 3 and run the analysis again.

Question: What change occurred on the oscilloscope curve plot? Explain.

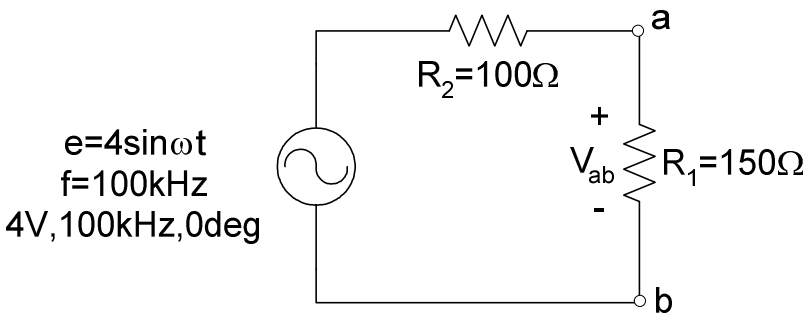
13. Change the oscilloscope channel A input to AC and run the analysis again.

Question: What change occurred on the oscilloscope curve plot? Explain.

14. Click ‘expand’ on the oscilloscope. Measure the time period T of one cycle on the waveshape

Question: What was the time period (T) of one cycle on the wave shape?

Repeat the steps above with the laboratory Function Generator and Oscilloscope and record your answers in the same order as the workbench. State any difficulties you encountered in carrying the steps.


a
R2=100Ω
+
Vab
R1=150Ω
-
e=4sinωt
f=100kHz
4V,100kHz,0deg
b