

Computer Automated Measurements

Connecting a computer to laboratory instruments makes possible the automation of many laboratory tasks. Data measurement, processing, storage, and display can be automated. The mechanisms to connect pcs to laboratory instruments are LAN, GPIB, USB, and RS232.

Bode Plots

A Bode plot is a graph of the gain and phase of a two port versus the frequency of excitation. The gain is normally plotted in decibels and the phase in degrees and the frequency in Hertz. The two linear graphs are usually plotted in cascaded windows so that the behavior can be determined at a specific frequency.

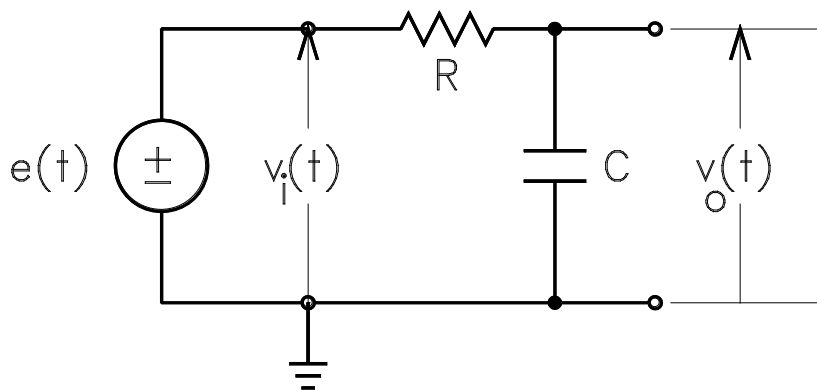


Figure 1. RC LPF Two Port Network

Shown in Fig. 1 is a two port network. The input port is the two terminals across which the input voltage $v_i(t)$ is connected and the output port is the two terminals across which the output voltage $v_o(t)$ is connected. A voltage source $e(t)$ is used as the input. The amplitude of the input source is held constant while the frequency is swept from a start to a stop frequency. The input and output

voltages may be measured with either ac voltmeters (DMM set to measure AC voltage) or an oscilloscope. A voltmeter can only measure the magnitude of an AC voltage; if phase measurements are required an oscilloscope is necessary. If an oscilloscope is used both of the ground leads must be connected to the ground node shown in Fig. 1.

Magnitude Bode Plot with Agilent FG and DMM

Assemble the circuit shown in Fig. 1 on **YOUR** breadboard (do not use the ELVIS breadboard). Use $R = 15 \text{ k}\Omega$ and $C = 0.01 \text{ }\mu\text{F}$. Connect the Agilent FG to the input [it is $e(t)$] using a coaxial cable BNC to alligator clip lead. Connect the DMM (voltage inputs in upper right of instruments) to the output using two banana jack leads. Download the program from the class web page known as LabVIEW Amplitude Frequency Response. (If a program called LabVIEW Signal Express starts, close it). Launch the program by pressing Run on the top tile. After the program loads there will be a LabVIEW front panel on the screen of the pc. To the lower left of the generic frequency response plot there is a drop down box to select the location of the FG. Select USB0. Set the Start Frequency to 100 Hz and the Stop Frequency to 100 kHz. Press Run. After the frequency sweep has concluded, use the mouse on the pc to place a cursor at the minus 3 dB frequency for the circuit. The Cursor can be dragged down from the top of the plot. Press Print Screen and use Paint to place the screen shot into the laboratory report. Also, obtain a Verification Signature. Close the LabVIEW program and answer each question with NO.

Download the program called VEE Amplitude Frequency Response from the class web page. Press Run. Do not change frequency range. Right click on the plot. Go to properties. On the left side of the menu scroll down to markers. Use the drop down box to select one cursor and turn the other parameter on. Position a cursor at the minus 3 dB frequency. Do a Print Screen and use Paint to paste the Screen Shot into the lab report. Obtain a Verification Signature. Close the program. Remove the connections from the circuit to the DMM.

Magnitude Bode and Phase Plots with Agilent FG and Tektronix Scope

Connect CH1 of the scope to the input of the circuit and the output to CH2 using BNC to alligator clips coaxial leads. The output of the function generator is still connected to the input. On the scope press the Measurements button and clear all measurements. Both CH1 and CH2 should be turned on and the Math function turned off. Select as Measurement 1 the rms voltage on CH1, Measurement 2 the rms voltage on CH2, and Measurement 3 the Phase from CH2 to CH1. Print the display. Download the program VEE Amplitude Phase Frequency Response from the class web page. Load it and press Run. Click check box to turn cursor on. Place a cursor at the minus 3 dB frequency and use Print Screen and Paint to place the result in the lab report. Disconnect all leads connected to the function generator, the DMM, and the scope.

Magnitude Bode and Phase Plots with ELVIS

ELVIS can also be used to obtain both magnitude and phase Bode plots. The ELVIS function generator provides the input and analog inputs 1 and 2 measure the input and output of the circuit.

Transfer the first-order circuit from your breadboard to the ELVIS breadboard. Start the National Instruments Launcher on the pc. Start Programs, All Programs, National Instruments, NI ELVISmx..., NI ELVISmx Instruments Launcher, Bode. On the Bode Panel it will indicate the Stimulus Channel and the Response Channel. Switch them from the default to AI0 as the Stimulus and AI1 Connect the ELVIS FG and AI0+ to the input to the circuit and AI1+ to the output with jumper wires. Connect AI0- and AI1- to the system ground located on the lower left side of panel next to the breadboard (the vertical trace on the ELVIS breadboard is broken half way down so a jumper will be necessary). **These ELVIS connections are on the breadboard section on the far left;** they are difficult to read; position yourself directly over the breadboard when making the connections.

Press Run on the ELVIS front panel on the screen of the computer. Turn on the cursors and position them to the half power frequency. Press Print Screen and use Paint to paste the result into the laboratory report. Remove all the jumper wires and components from ELVIS and turn it off.

Voltage Transfer Characteristic

For the circuits specified by the Laboratory Instructor obtain the Voltage Transfer Characteristic (VTC). This program is found under Software Applications on the class web page. It is a LabVIEW program. After it opens there are three tabs. It can be used with either ELVIS or MyDAQ. Click on the tab that determines the device. Then run it and it should detect ELVIS. After the VTC has been obtained for each circuit do a print screen and use paint to obtain a sketch that can be pasted into the lab report.

Arbitrary Waveform Generator

Perform the procedure on the main class web page titled Arbitrary Waveform Generator.