Function Generator 1.7.3 User Manual

Overview

Function Generator is an application available in three versions for use on Macintosh, Windows, or Linux computers. These applications were built with LabVIEW 6.1 and require the LabVIEW 6.1 Run-Time Engine, which is included with the package you downloaded.

The program requires LabPro Operating System (OS) 6.22 or newer. This can be downloaded from our web site (www.vernier.com) and is free.

This program is available in several other forms. The LabVIEW VI used to create these applications are also available for those who own LabVIEW. They can be used in Windows, Macintosh, or Linux computers. This will allow you to modify the program as you want. Note that you will need the 6.1 version of LabVIEW. The Windows and Linux versions of this program work only using a serial computer connection to LabPro. The Mac version will work with a USB connection as long as you have installed the LabPro USB extension, which is normally installed whenever you install our Logger *Pro* program.

This program allows you to use LabPro as a function generator by simply connecting the standard LabPro voltage leads to CH4. Sine, Square, Ramp, Triangle, and DC outputs are allowed.

Ideas for using Function Generator

We have used this LabPro function generator for a number of interesting experiments and demonstrations:

- Drive a stretched string (about a meter long) to produce standing waves. Glue a paper clip to the cone of a small speaker. Mount the speaker in a clamp. Attach a string to the paper clip and stretch it horizontally, tying the other end to a ringstand. (We have had good results using elastic cord for this.). You can also simply hold the other end of the string in your hand so that you can adjust the tension in the string. Drive the speaker with the output from LabPro. Experiment with various frequencies. We have been able to produce very nice standing waves for the fundamental and all of the first 9 or so harmonics.

- Drive a spring with a small mass string with the function generator: Glue a paper clip to the cone of a small speaker. Mount the speaker in a clamp. Hang a small spring from the paper clip and then hang a small mass from the spring. Drive the speaker with the output from LabPro. Experiment with various frequencies. Try to find the resonance frequency. Experiment with how the amplitude varies with time if the frequency is just slightly off resonance. You can put a motion detector on the floor below the mass and plot the oscillation with a separate LabPro and Logger Pro software.

- Connect a small lamp and a current probe in series to the function generator (note the 100 mA limit). The lamps with 50 ohms resistance which come with the Castle kits work well for this. Set the function generator on a slow Ramp Up output. Study how the current through the lamp varies as the voltage applied to the lamp varies. The change in the resistance of the lamp as the filament heats up will be quite noticeable.

- Control a sonometer to study vibrations in strings.

- Control a DC voltage as part of an experiment.

- Experiment with RC circuits

There are also versions of a similar program for all the TI graphing calculators which work with LabPro.

Technical Specifications

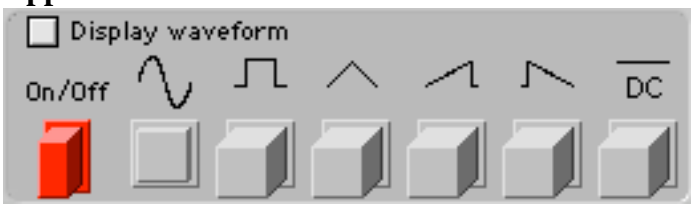
Signal Generation:

Frequency range:	.5 Hz to 200 Hz
Period steps	integer milliseconds from 5 to 2000
Amplitude range:	0V to 4V*
Max current:	100 mAmps

Signal Reading:

Sampling Rate:	20 points per second (for signals between 0 and 3 Hz) 1400 points per second (for signals between 3.1 and 200 Hz)

Application Controls



Waveform- These buttons control which of the possible waveforms is generated. The waveforms that LabPro can generate, in order, are: sine, square, triangle, ramp up, ramp down, and DC.

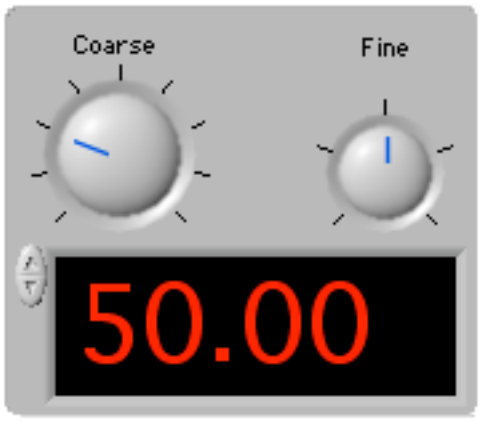
* The Sine wave is only able to operate at amplitudes of 1, 2, and 4 volts due to the nature of the signal generation on LabPro. Values other than these entered for a Sine amplitude will be coerced to the nearest acceptable value.

Display waveform- This checkbox will toggle the voltage monitoring module of the function generator. Display waveform defaults to false because the program tends to run slower when voltage monitoring is on. Also, there is a slight variation in the output waveform at the moment that that the voltages are monitored. As a result, if you want the very best output from the function generator, you may want to uncheck the Display Waveform box.

On/Off- This switch will toggle the voltage output. When "On" the waveform selected will be generated, when "Off" a 0V DC waveform will be generated.

A general note about the frequency and amplitude controls:
These parameters can be controlled in three different ways: 1. turning the analog dials, 2. typing in the digital display, or 3. using the scroll up or down arrows next to the digital display. If you turn the analog dials, keep the cursor on top of the dial when you release the mouse button. If you release the mouse button with the cursor away from the dial, the change will take place.

Amplitude- This control changes the amplitude of the waveform. Changes made to either the dial or the digital control will affect the waveform and will be reflected in the other control. In other words these two controls perform exactly the same task and it is purely a matter of preference which one you use.



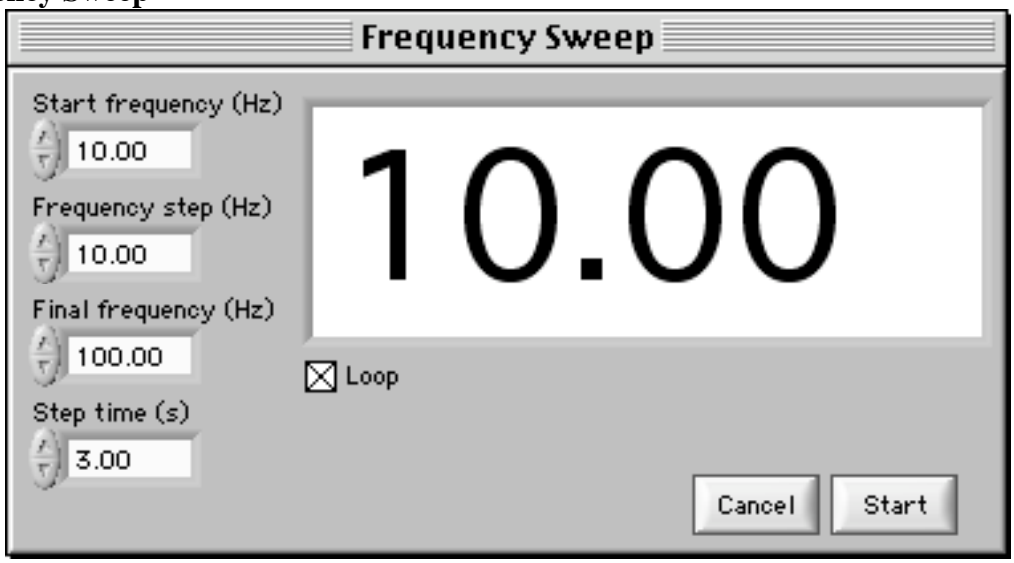
Frequency- This set of controls allow you to change the frequency of the waveform. The Coarse and Fine knobs mimic the function of their counterparts on analog function generators. The Coarse knob has a range of .1 to 198 Hz and the Fine know has a range of 0 to 2 Hz. Fine defaults to 1 so it has an effective range of ±1 Hz. The final frequency is the sum of these two knobs.

Because it is difficult to tune in precise frequencies using these knobs, it is also possible to manually enter a frequency in the text control below the knobs. Once you have entered a number in this box you must hit the [Enter] key on your keyboard for the change to take affect. This display will be updated when the knobs are changed and the knobs will update their positions when the display is changed. Like the Amplitude controls it is purely a matter of personal preference which control you decide to use.

LabPro's function generator is actually controlled by setting the period internally. The period can be set in integer millisecond steps from 5 to 2000. The result of this is that the allowed frequencies are widely separated at the high end of the frequency range. For example, the highest frequency allowed is 200 Hz (period = 5 ms). The next lowest allowed frequency is 167 Hz (period = 6 Hz). Down in the range of mechanical motions, the frequency can be controlled in very fine steps. For example at 10 Hz, the steps are about 0.1 Hz.

Note that although this control is not disabled when a DC waveform is displayed, changes will have no affect on a DC wave as a DC wave has no frequency.

Frequency Sweep



Frequency sweep is designed to demonstrate the principle of the various harmonics you can hit with a standing wave. The envisioned use of this feature is that the user will finely tune in the fundamental in the main function generator and then choose Frequency Sweep from the Advanced menu. If the first fundamental is being generated when the user decides to conduct a sweep the program automatically makes the necessary settings to hit every fundamental up to the maximum value entered.

Start frequency (Hz)- This is the frequency at which the scanner will start. By default this is the frequency that is being generated when you open the scanner.

Frequency step (Hz)- This is the amount by which the frequency will increment every time a step is made. By default this is the same as the starting frequency.

Final frequency- The upper limit of the scanner. No frequency above this value will be generated.

Step time (s)- The amount of time in seconds between each step. If you are generating a standing wave you probably want at least 3-4 seconds to allow the wave to properly form.

Loop- If this box is checked the scanner will loop back to the start frequency once it exceeds the final frequency. If it is unchecked the program will revert to the frequency it was generating before the sweep started.

This program was developed in a team effort at Vernier Software & Technology. All of the following people contributed: Adam Gibbs, David Vernier. Thanks also to Ian Honohan, John Wheeler, and Matt Bergman for their suggestions.