Cairo University

Faculty of Engineering - Credit Hours System

EECS100 - Laboratory

Digital Signal Generator and Spectrum Analyzer

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Design Procedure:

Our design of the Digital Signal generator and Digital Spectrum Analyzer Set consists of two main components.

1. Front Panel
2. Block Diagram

Front Panel:

This is the user interface that consists of knobs, wave selector, graphs, and other buttons.

The front panel consists of mainly 2 devices.

1) Function generator that generates a digital signal and provides an input to the spectrum analyzer.
2) Spectrum analyzer to measure the power spectrum of the generated signal.

We selected the graph waveform from the control's menu from the front panel. It has a significant feature that is auto scales the scope and adjusts its vertical and horizontal scales to display easy to read waves for the user.

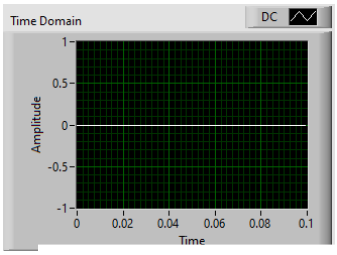

Fig 1: Graph Waveform

We used knobs as out input controls to pass in the frequency, phase, amplitude, offset, and noise amplitude of the generated signal.

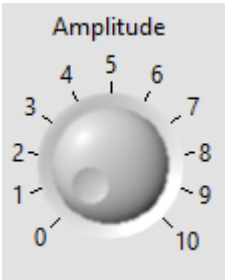

Fig 2: Knob

Then, we used enum to act as our wave selector to insert type of waveform to function generator.

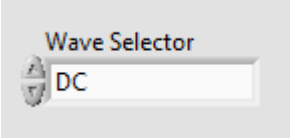

Fig 3: Knob

Block Diagram:

Here are the items we used in the block diagram

1. Numerical control (knob)
2. Enum
3. Delay
4. Graphical Display
5. Ps/psd (FFT)

Then these icons are connected with other blocks available on the block diagram to make a functional development environment.

1) Function Generator

First, we have the controls that pass the generated signal parameters such as frequency, phase, offset, and amplitude. Followed by a case structure that selects the type of wave to be generated with those parameters based on the user's choice via the waveform enum. Then, we have got the noise control knob to allow the user to choose if he wants a noisy signal with a specific amplitude or not. Then both the generated signal and the noise are added up using an addition block and displayed on the first waveform graph

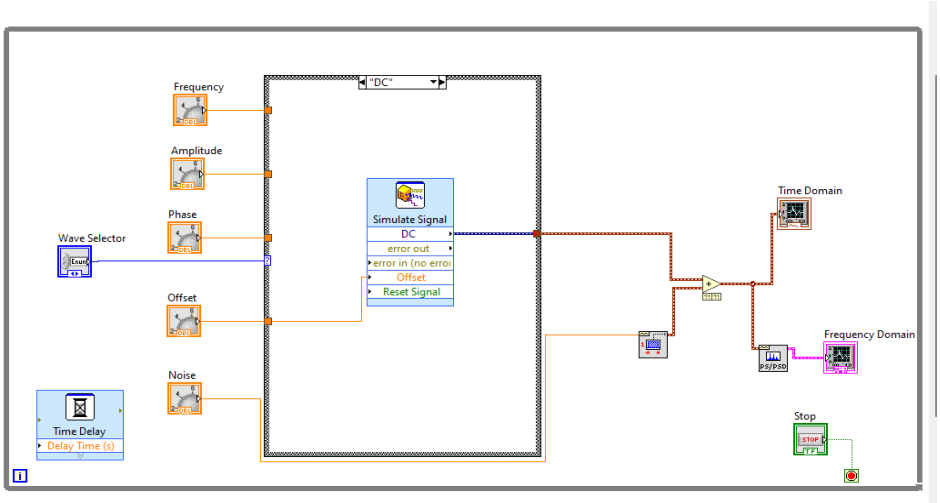

Fig 4: Block Diagram

2) Spectrum Analyzer

We used FFT (Fast Fourier Transform) to convert from time domain to frequency domain. Utilized a digital signal processing block called ps/psd which stands for power spectrum/power spectral density. This performs the action of spectrum analyser and hence could be used to simulate the time to frequency converter.

User Manual

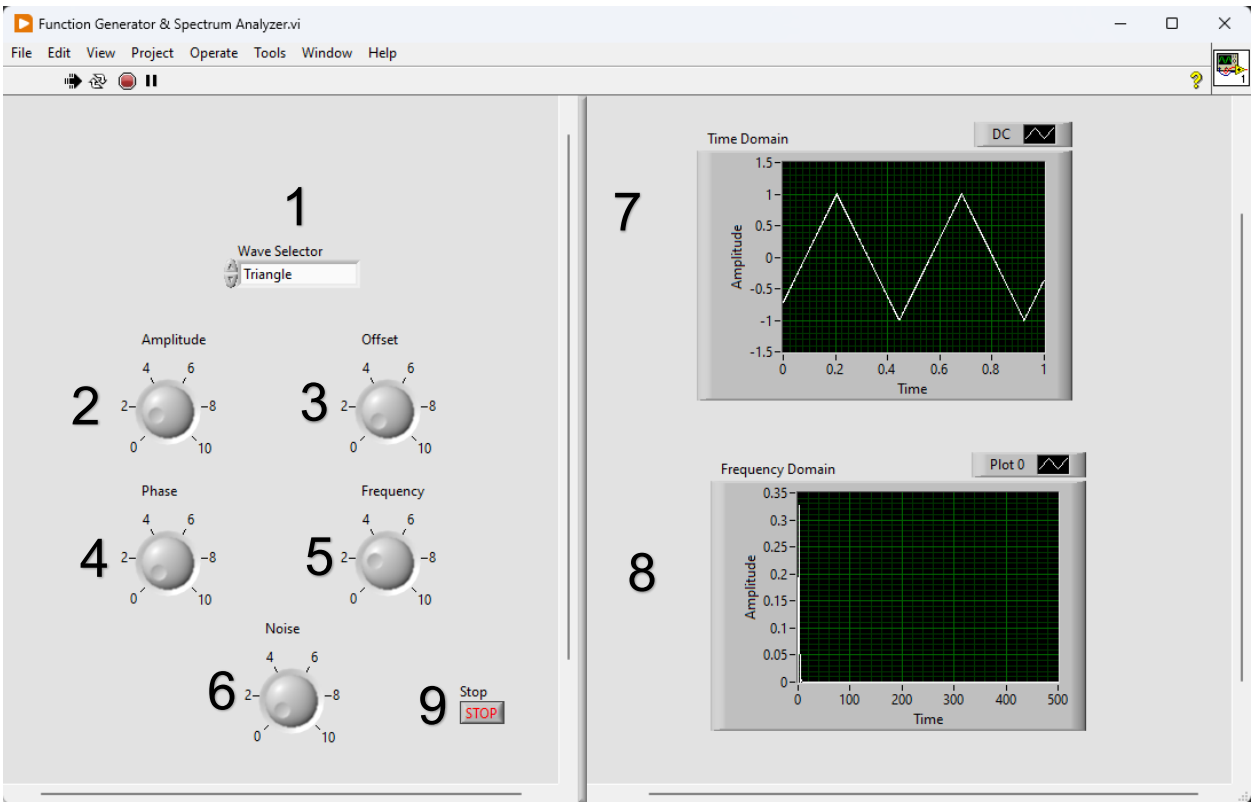

Fig 5: User Manual

Code	Component	Function
1	Wave Selector	It allows the user to choose the type of wave to generate.
2	Amplitude knop	It controls the amplitude of the signal generated.
3	Offset knop	It controls the offset of the generated signal.
4	Phase Knop	It controls the phase shift of the generated signal.
5	Frequency Knop	It controls the frequency of the generated signal.
6	Noice Amplitude	It controls the amplitude of the added noises.
7	Display screen of Function Generator	It shows the output signal as a function of time.
8	Display screen of Spectrum Analyzer	It shows the output signal as a function of frequency.
9	Stop	Stop the simulation.

Examples

Example 1:

Input Signal Wave	DC
Frequency (Hz)	0
Amplitude (V)	0
Phase (Degrees)	0
Offset (V)	2
Noise Amplitude (V)	0

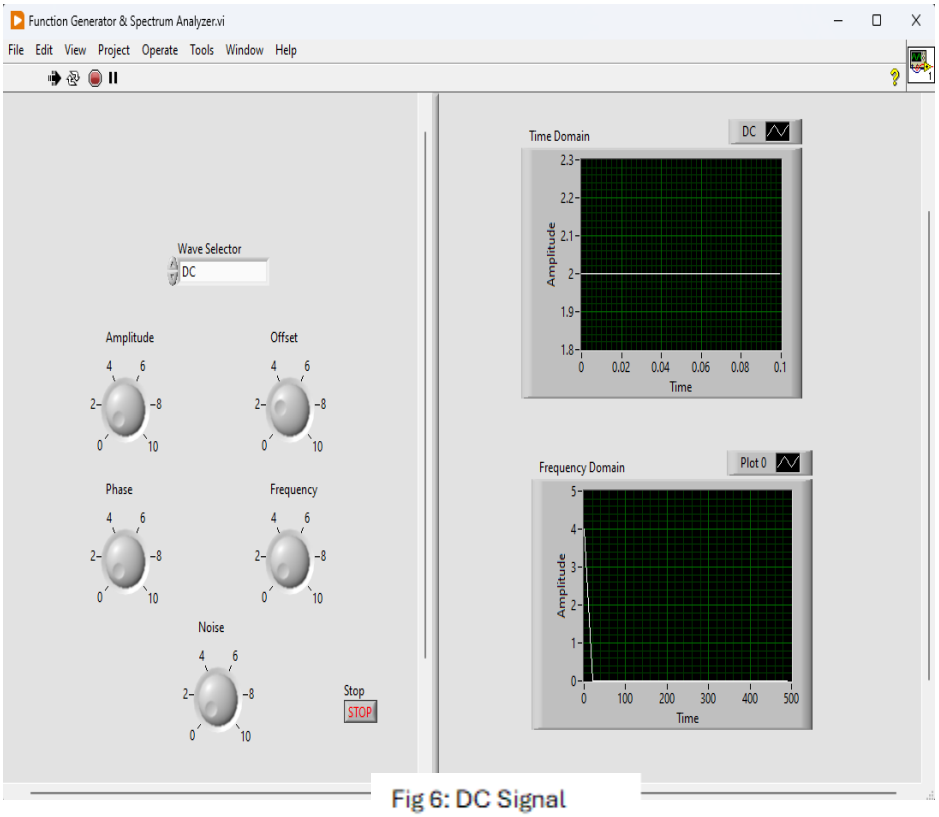

Fig 6: DC Signal

Description:

The input is a pure DC signal with no frequency or noise, shifted by a 2V offset, resulting in a constant 2V output. It contains only a 0 Hz component, making it ideal for testing DC response.

Example 2

Input Signal Wave	Triangle signal
Frequency (Hz)	2
Amplitude (V)	1
Phase (Degrees)	0
Offset (V)	0
Noise Amplitude (V)	0

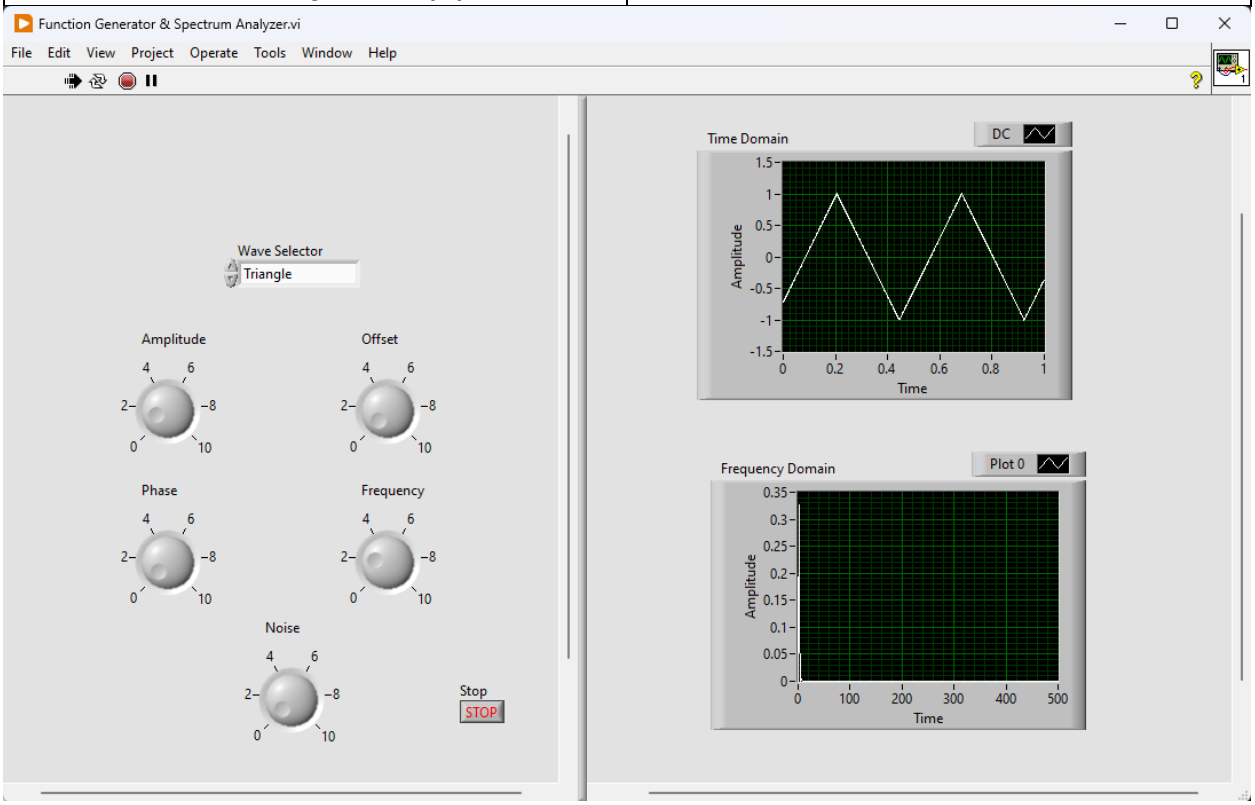

Fig 7: Triangle

Description:

This is a triangle wave with a frequency 2 Hz, amplitude of 1 V with no noise and offset present.

Example 3

Input Signal Wave	Sine Wave
Frequency (Hz)	4
Amplitude (V)	1
Phase (Degrees)	0
Offset (V)	0
Noise Amplitude	2

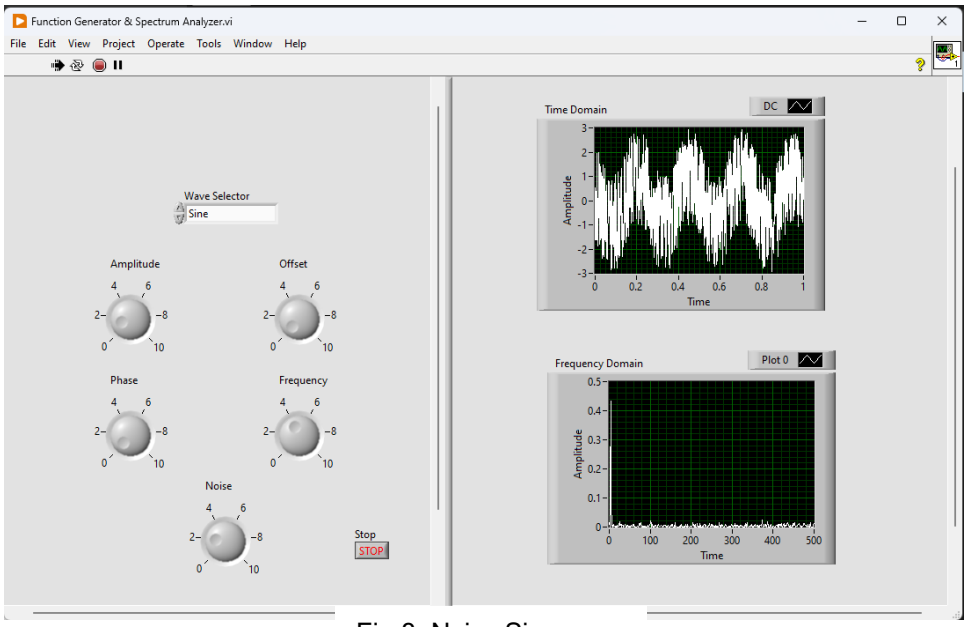

Fig 8: Noisy Sine

Description:

This is a noisy sine wave with frequency 4 Hz, amplitude 1 and with noise amplitude is of value 2V.