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# *LabVIEW Basics*



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# *LabVIEW*

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*LabVIEW is a data acquisition software package commonly used with hardware acquisition boards*

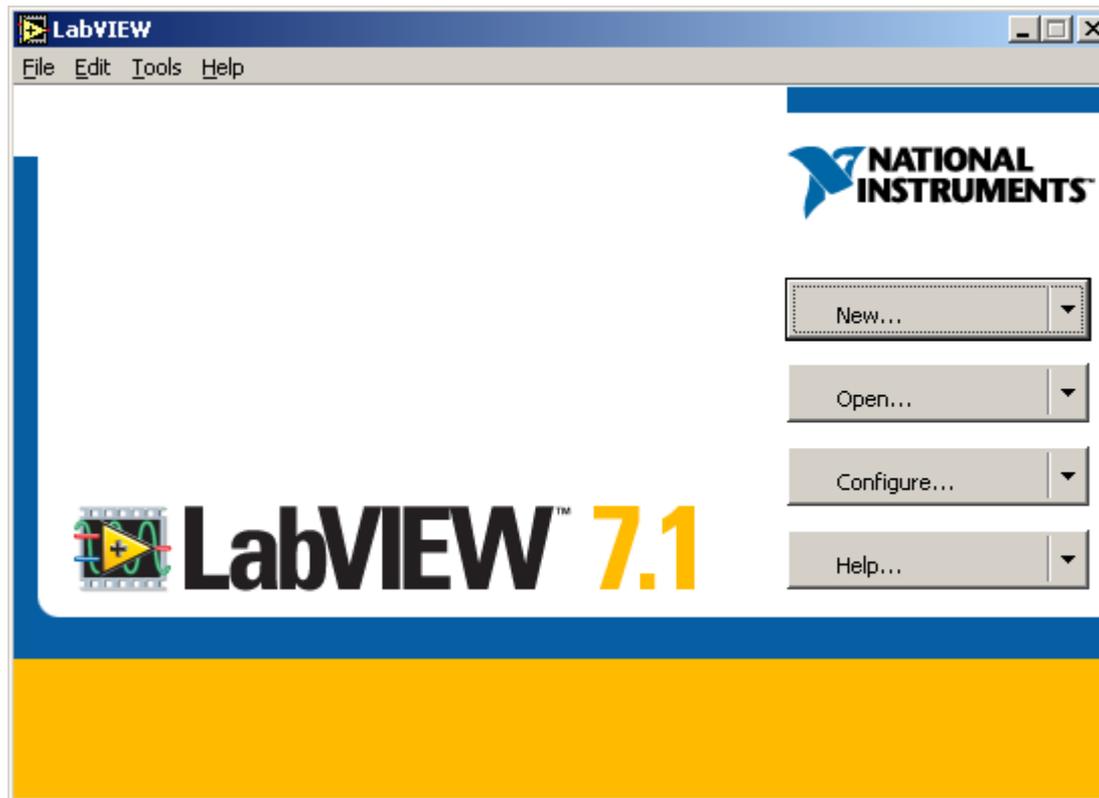
*LabVIEW has many features for data acquisition and processing of either measured data or simulated signals.*



# LabVIEW - Start Up

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*LabVIEW will be explored using some simple signals*

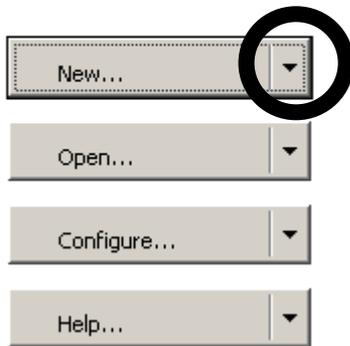


# LabVIEW - Start Up

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*LabVIEW will be explored using some simple signals*

*NEW - template selector*

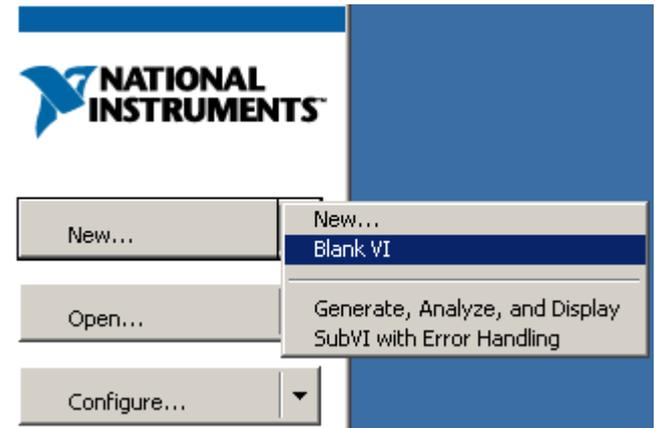


*or click on arrow for either*

*NEW,  
blank vi,*

*or*

*recently accessed*

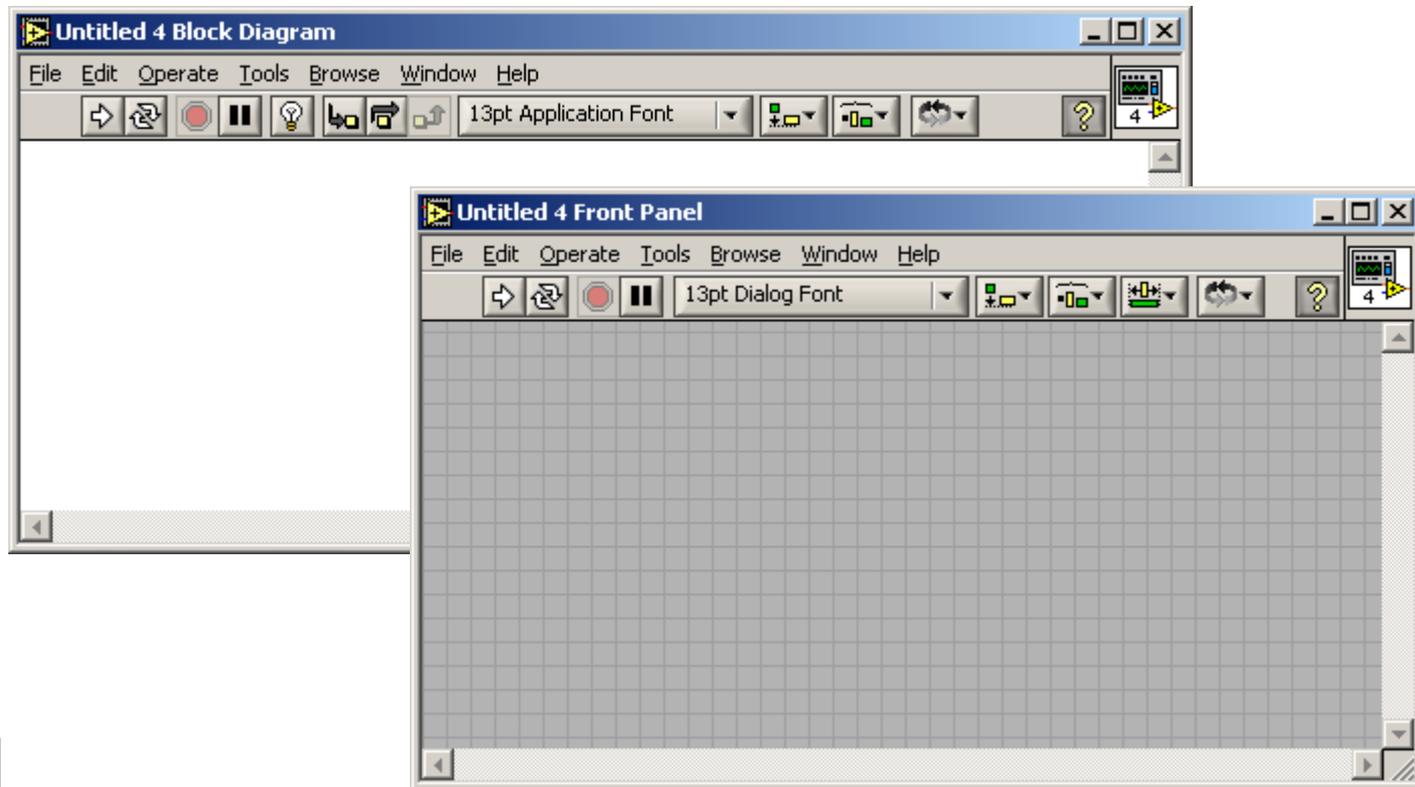


# LabVIEW - Blank vi

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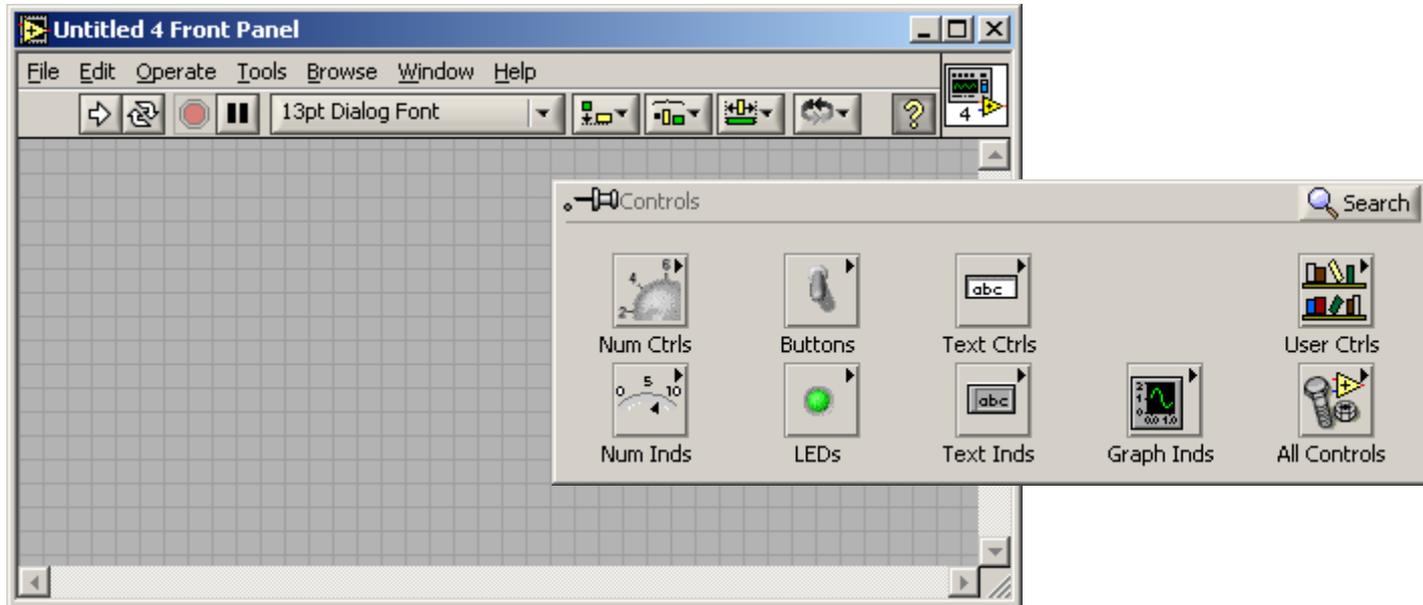
*Two windows appear -*

*'Block Diagram' & 'Front Panel'*



# LabVIEW - Front Panel

*Right mouse click to open important 'Controls' palette*

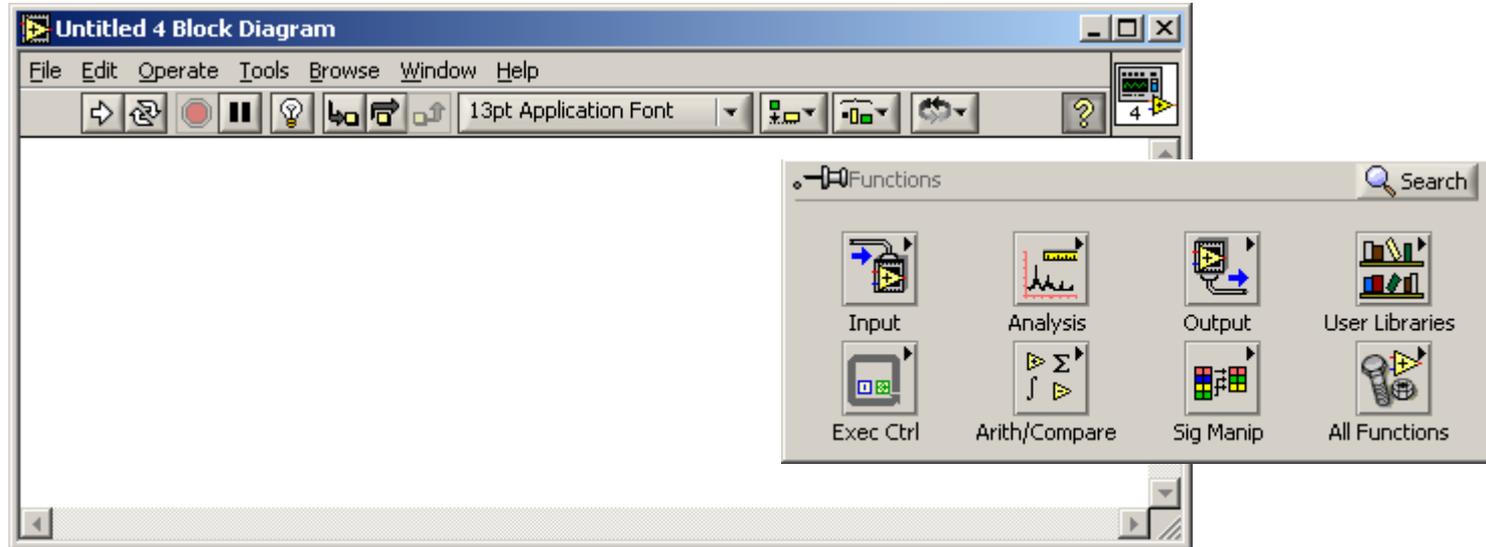


*These include graphical controls, knobs, sliders, text boxes, LEDs, switches, and other specialty items*  
*NOTE: Sub-categories may be available for each layer*



# LabVIEW- Block Diagram

*Right mouse click to open important 'Functions' palette*



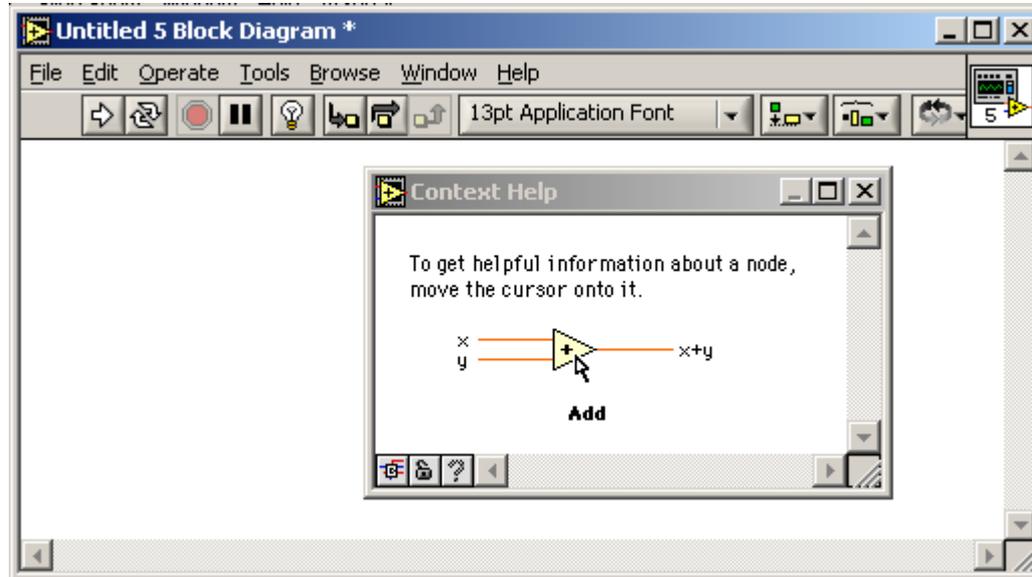
*These include acquisition tools, signal analysis, output devices, programming tools, arithmetic operators, and other processing tools  
NOTE: Sub-categories may be available for each layer*



# *LabVIEW - HELP - Exists in several forms*

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## *HELP -> Show Context HELP*



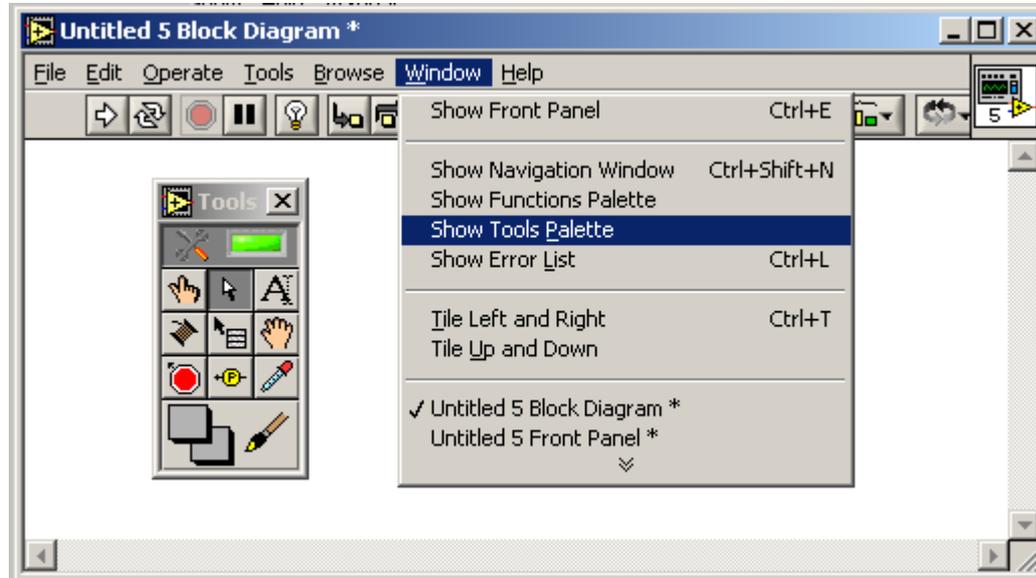
*Window reports general use characteristics for each icon the mouse passes over*



# *LabVIEW - HELP - Exists in several forms*

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## *WINDOWS -> Show Tools Palette*



*Extremely useful panel for assigning a specific tool function to the mouse.*

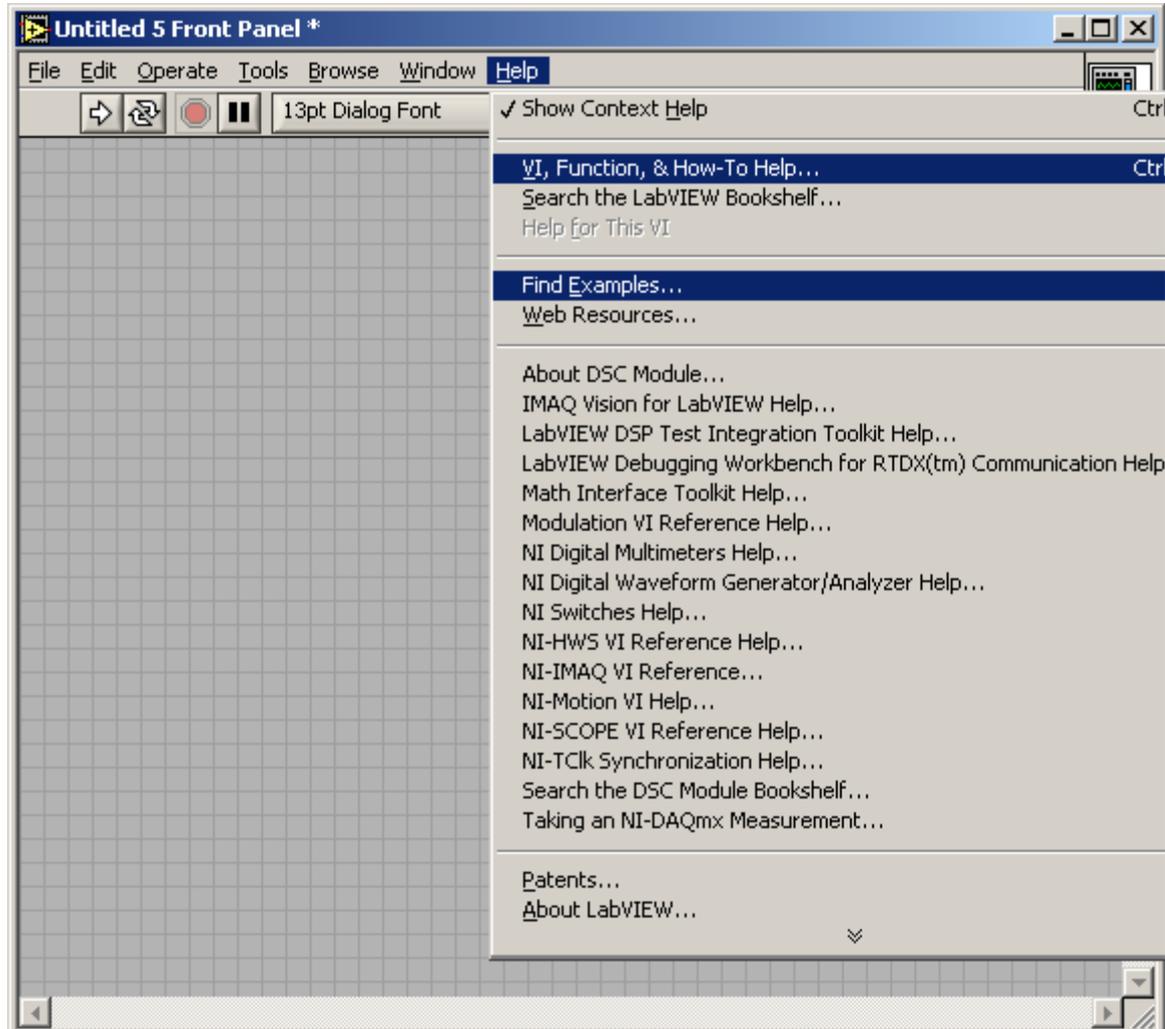


# LabVIEW - HELP - Exists in several forms

**HELP ->**

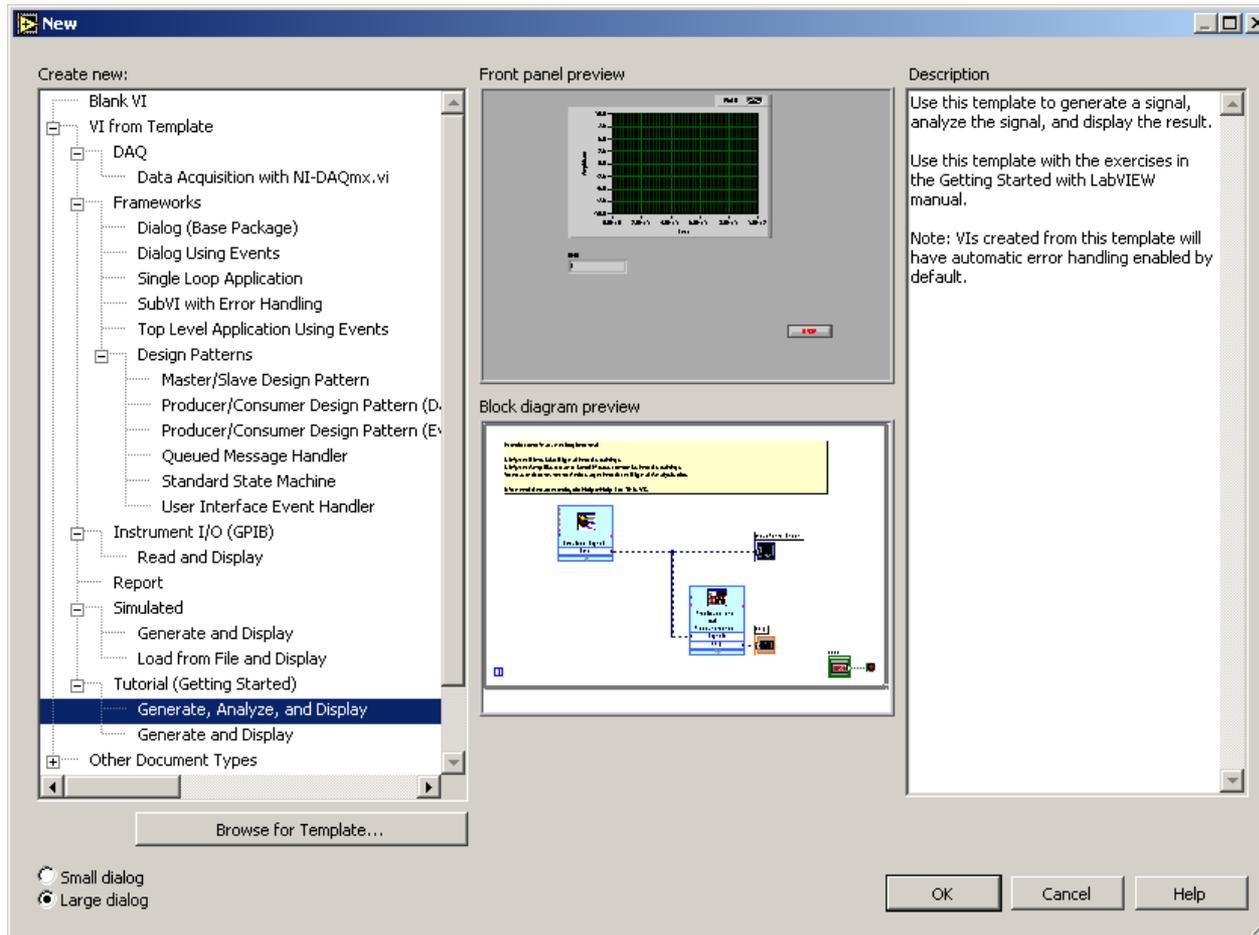
**VI,  
function  
& how to**

**Find  
examples**



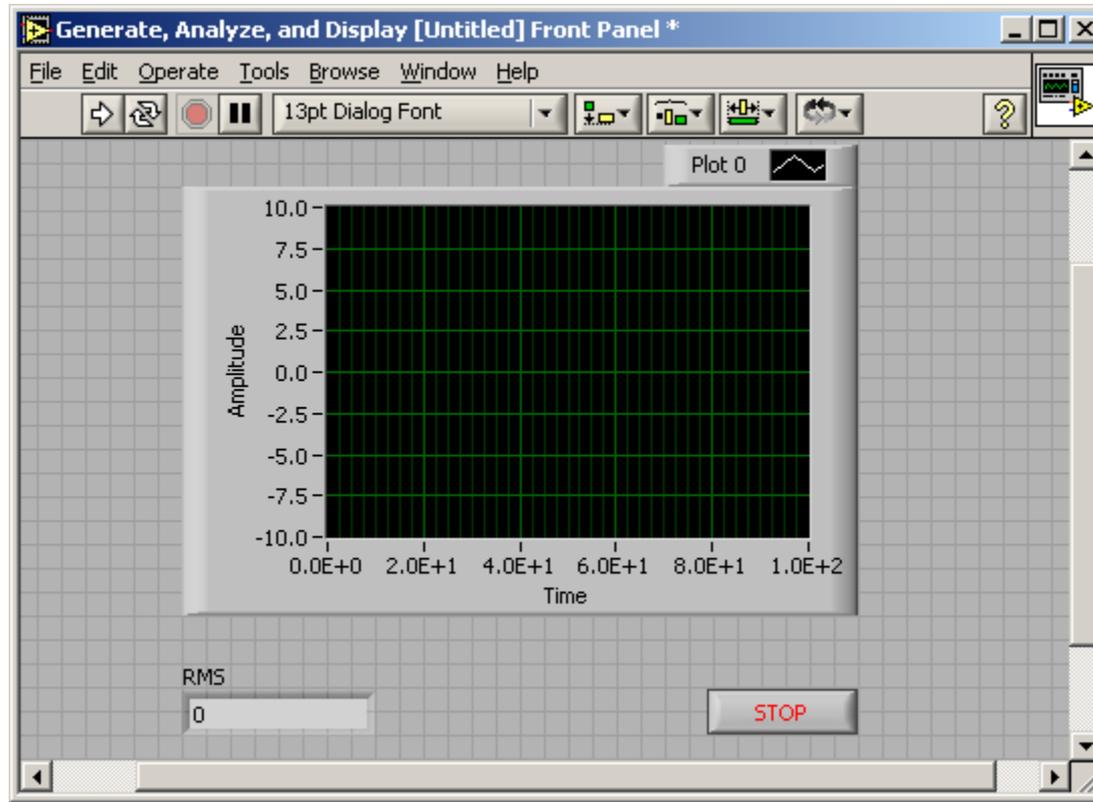
# LabVIEW - Tutorial (Getting Started)

**Tutorial Name: 'Generate, Analyze, and Display'**



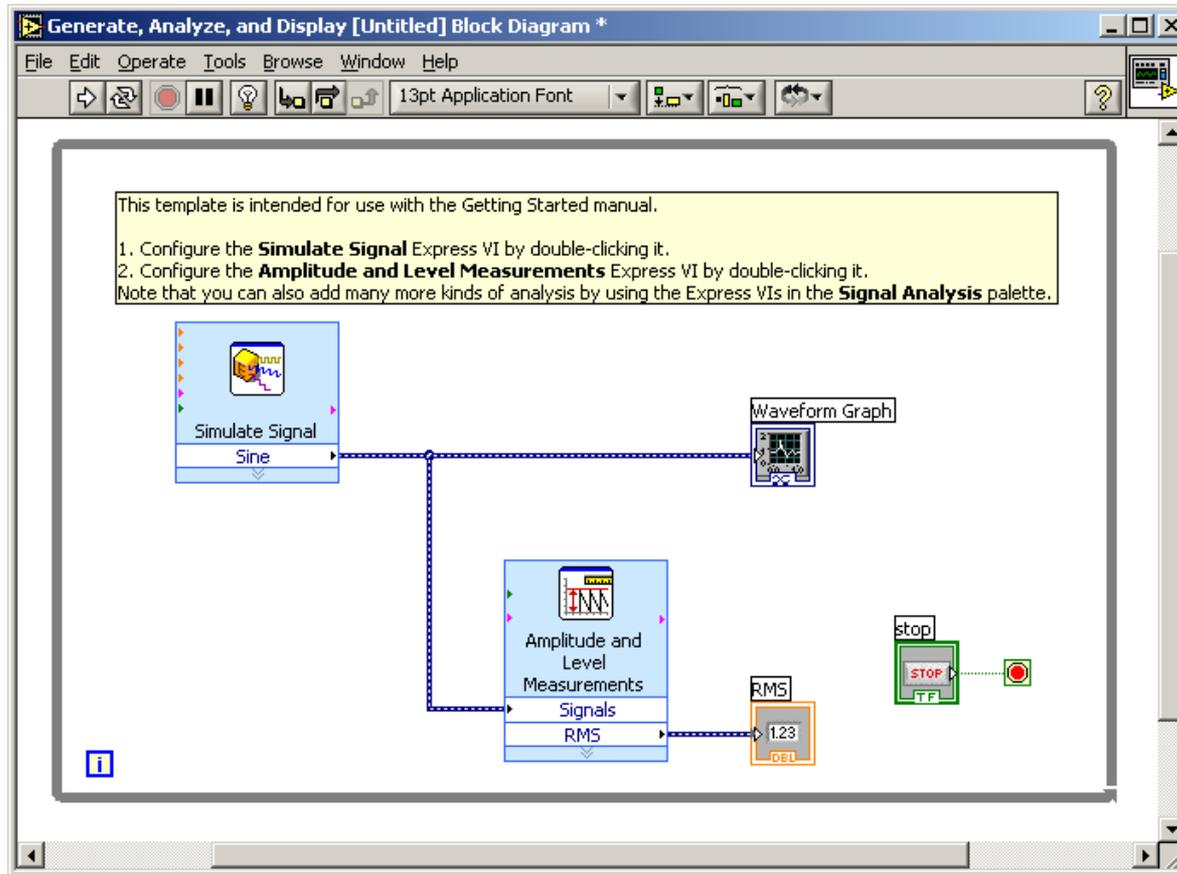
# LabVIEW - Starting Front Panel

*Front Panel has a display for output*



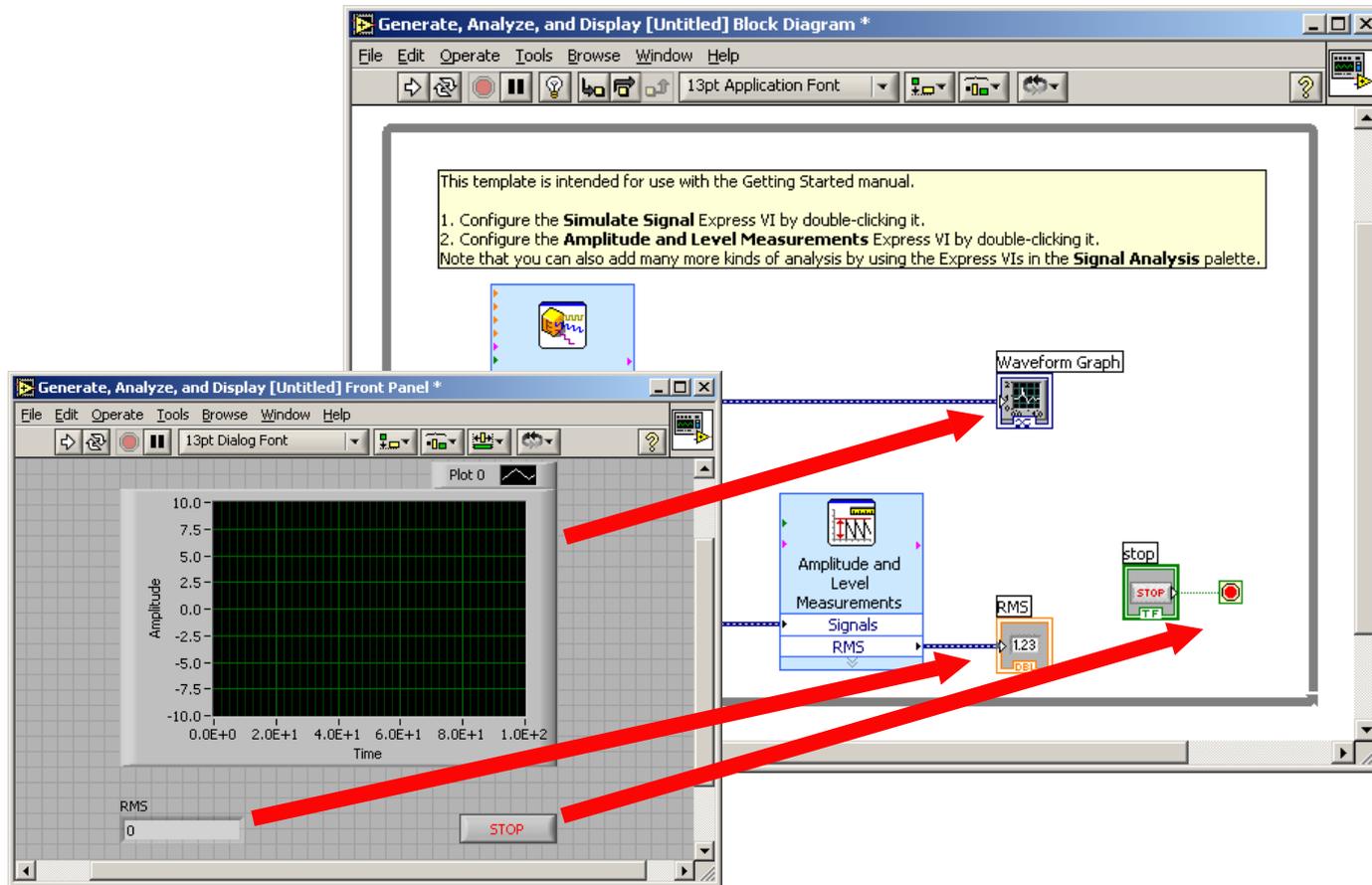
# LabVIEW - Starting Block Diagram

*Block Diagram illustrates how system is assembled.*



# LabVIEW - Tutorial (Getting Started)

## Relationship between Block Diagram and Front Panel



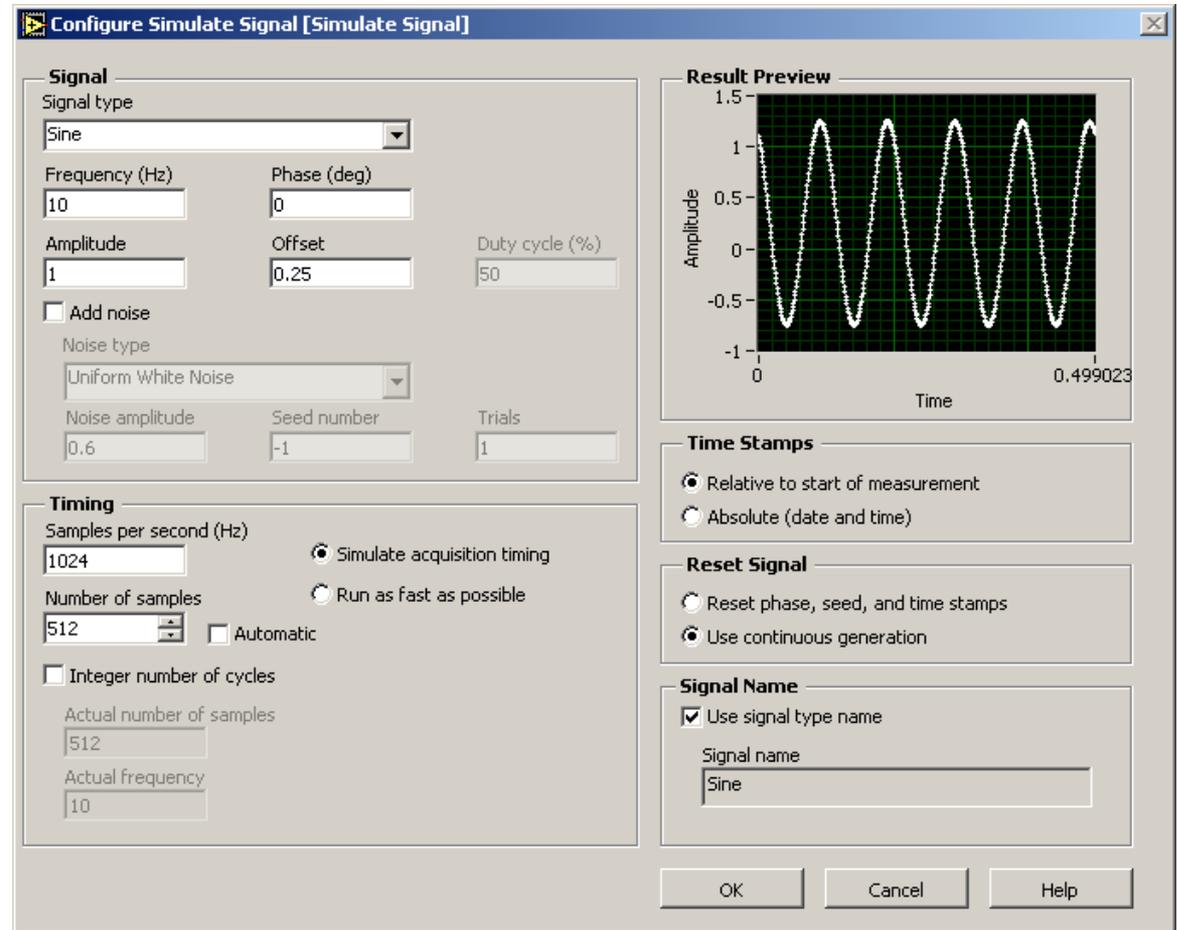
# LabVIEW - Simulate Signal

*A sine signal is generated using*

*Simulate Signal*



*Double click for properties*



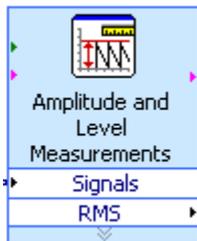
*Sine at 10 Hz with 1 volt peak and offset at 0.25  
Sampling 1024 samples per second and 512 samples*



# LabVIEW - Amplitude and Level Measurements

*Signals can be interrogated*

*Amplitude  
Level Measurement*



*Double click  
for properties*

The 'Configure Amplitude and Level Measurements' dialog box is shown. It has four main sections: 'Amplitude Measurements', 'Input Signal', 'Results', and 'Result Preview'. The 'Amplitude Measurements' section has checkboxes for DC, RMS (checked), Apply window, Maximum peak, Minimum peak, Peak to peak, Cycle average, and Cycle RMS. The 'Input Signal' section shows a plot of a signal with 'Sample Data' overlaid. The 'Results' section contains a table with the following data:

Measurement	Result
RMS	1.004861

The 'Result Preview' section shows a plot of the signal with 'Sample Result' overlaid. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

*Measurements of DC, RMS, peak, etc can be obtained*



# LabVIEW - Amplitude and Level Measurements

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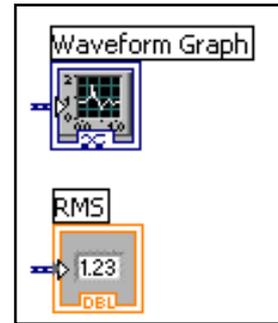
## Operators

*These have selectable elements based on desired parameters of interest*



## Indicators

*Are used to export output to the front panel*



*Many tools available*



# *LabVIEW - Amplitude and Level Measurements*

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*As items are added to each of the Functions, Indicators and Controls, these selected items will appear in the Front Panel and/or Block Diagram.*

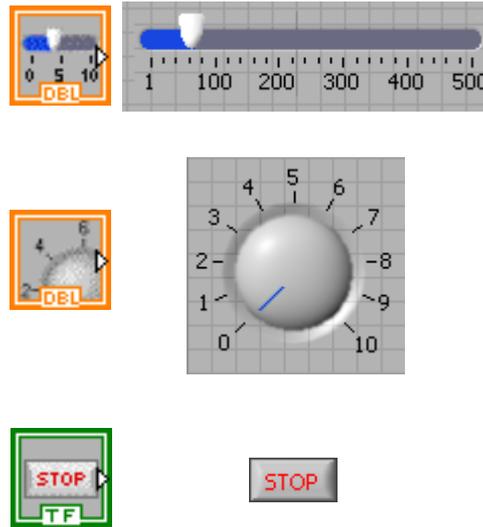
*These need to be wired into the diagram and initial parameters identified.*



# LabVIEW - Amplitude and Level Measurements

## Controls

*These have selectable elements used for changing parameters of interest*



## Operators

*These have selectable elements based on desired parameters of interest*



*You can change the data range of the control by right-clicking on control and selecting 'Properties'. Adjust 'Data Range' and 'Scale' tabs.*

*Many tools available*



# *LabVIEW - Amplitude and Level Measurements*

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*Add several features such as*

*Input Box for DC offset of sine wave*

*Dial for Frequency Controls*

*Slider for Amplitude*



# LabVIEW - Amplitude and Level Measurements

*Select another output parameter such as DC*

*Notice RMS is already hooked up but DC needs to be attached to some output device*

The image shows a LabVIEW block diagram and a screenshot of the front panel. On the left, the 'Amplitude and Level Measurements' block is expanded to show 'RMS' and 'Mean (DC)'. The 'RMS' block is connected to a numeric indicator showing '1.23'. The 'Mean (DC)' block is also connected to a numeric indicator showing '1.23'. A red arrow points from the 'Mean (DC)' block to a context menu. The context menu is open, showing options like 'Visible Items', 'Help', 'Description and Tip...', 'Set Breakpoint', 'Select Input/Output', 'Insert Input/Output', 'Remove Output', 'Signal Analysis Palette', 'Waveform Palette', 'Create', 'Replace', 'Open Front Panel', 'Size To Text', 'View As Icon', and 'Properties'. The 'Create' option is selected, and a sub-menu is open showing 'Constant', 'Control', 'Graph Indicator', and 'Numeric Indicator'. A red arrow points from 'Numeric Indicator' to the front panel screenshot. The front panel screenshot shows a plot window titled 'Plot 0' with a grid. Below the plot, there are two numeric indicators: 'RMS' with a value of '0' and 'Mean (DC)' with a value of '0'. The 'Mean (DC)' indicator is highlighted with a red box.

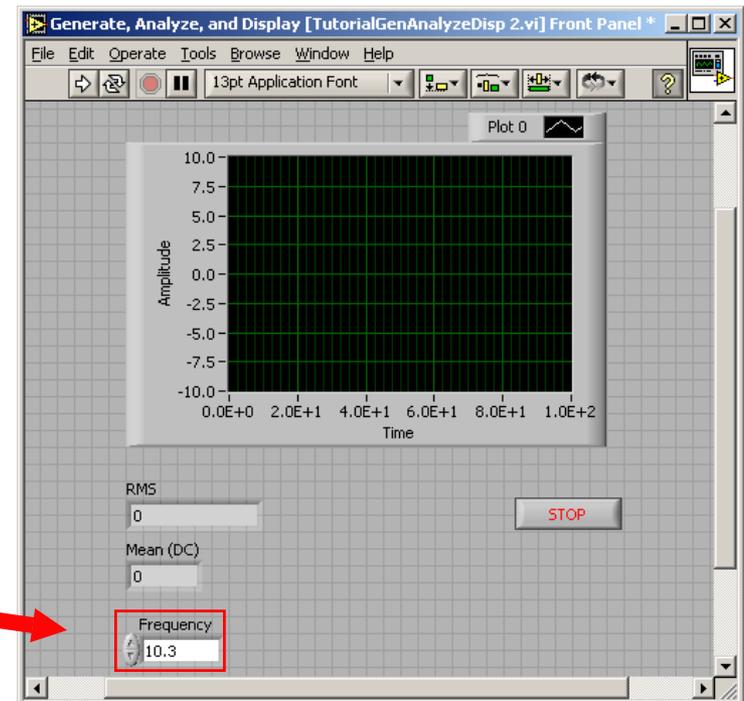
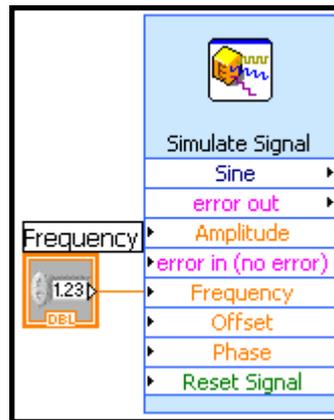
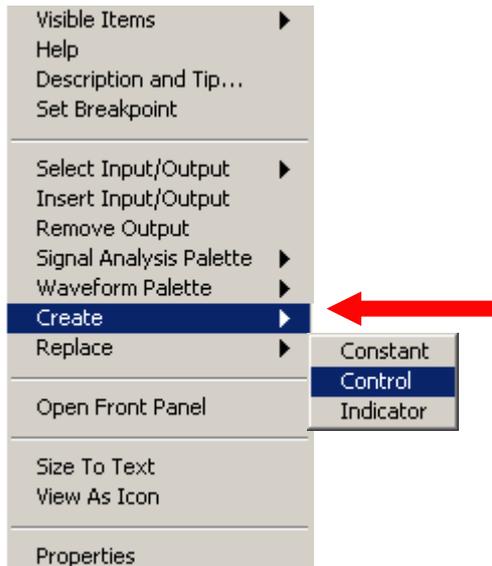


# LabVIEW - Amplitude and Level Measurements

*Create a dial to change frequency.*

*Expand the simulate signal VI by clicking and dragging the gray arrow on the bottom of the icon.*

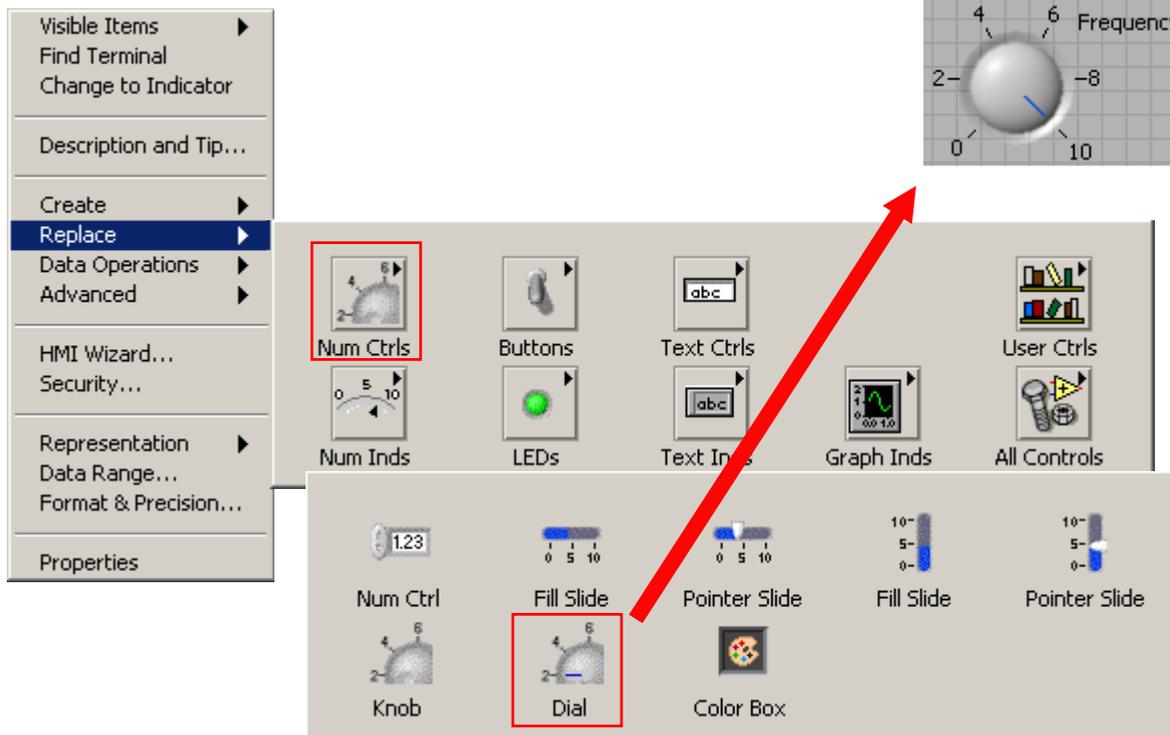
*Create control*



# LabVIEW - Amplitude and Level Measurements

*Create a dial to change frequency.*

*To change to a dial, right-click on control and:*



*Can change range, scale, precision, etc. by right-clicking on dial, and selecting properties*

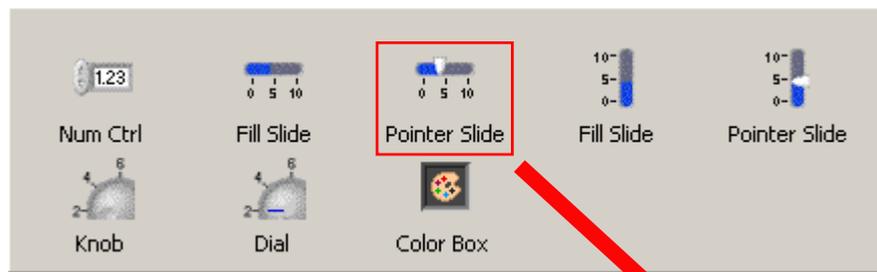


# LabVIEW - Amplitude and Level Measurements

*Create a slider to change amplitude.*

*Follow the previous steps for creating a dial, only this time do it for the amplitude property of the simulate signal VI.*

*Also select 'Pointer Slide' instead of 'Dial'*



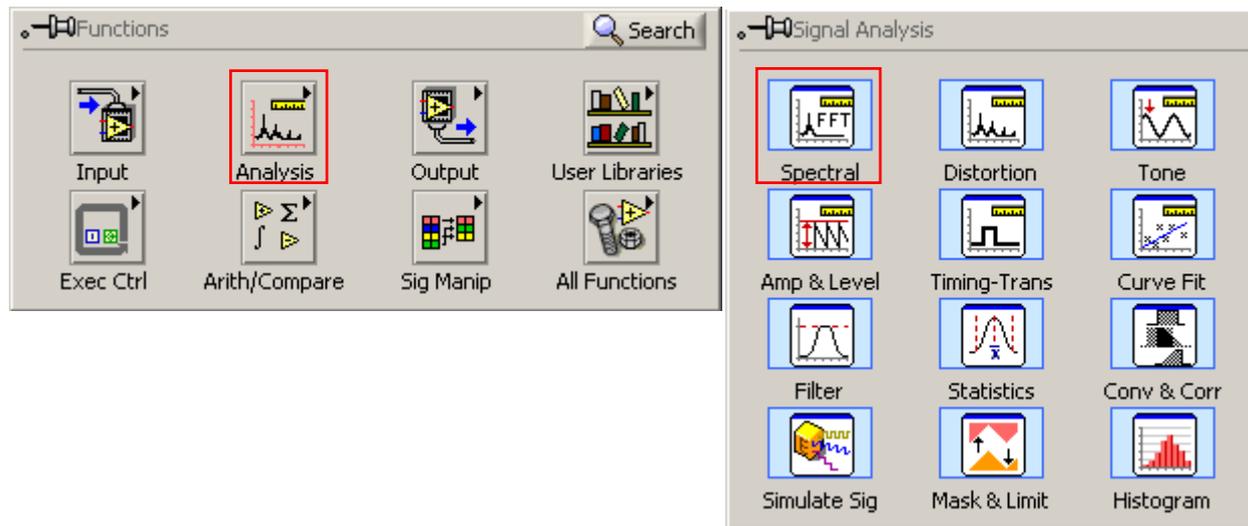
*Can change range, scale, precision, etc. by right-clicking on slider, and selecting properties*



# LabVIEW - FFT Express VI

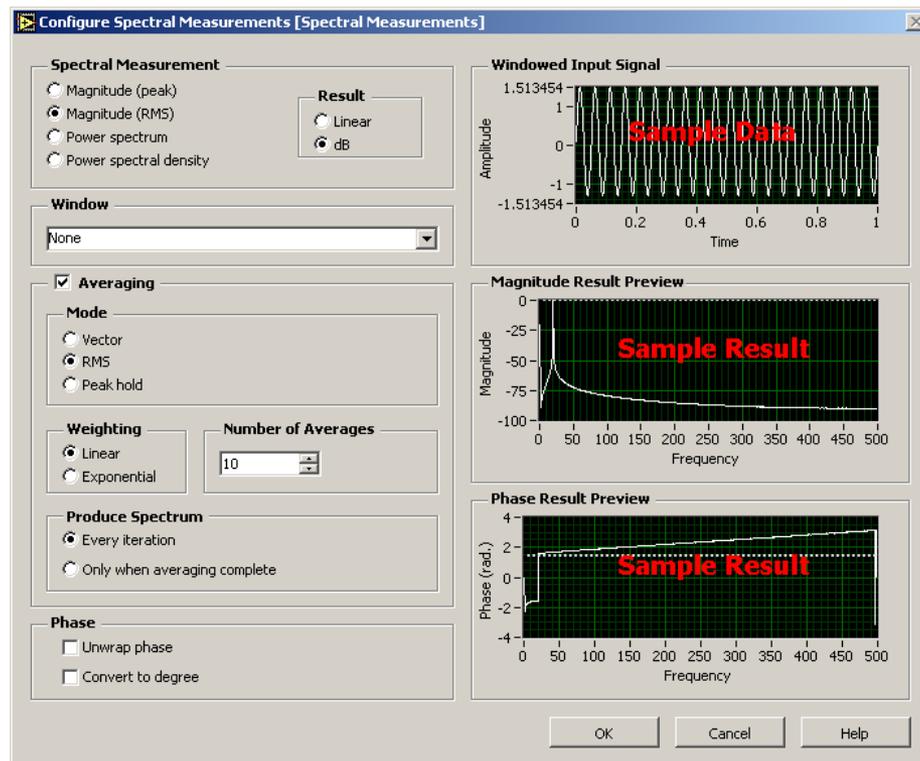
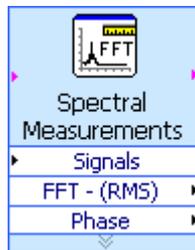
*Now the time signal can be converted to the frequency domain using the 'Spectral Measurements Block'*

*It can be found in:*



# LabVIEW - FFT Express VI

*A parameter window will appear once VI is placed on wire diagram. Here you can set desired output formats, windows, averages, etc.*

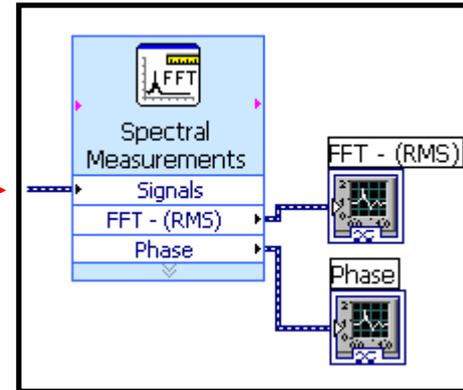


# LabVIEW - FFT Express VI

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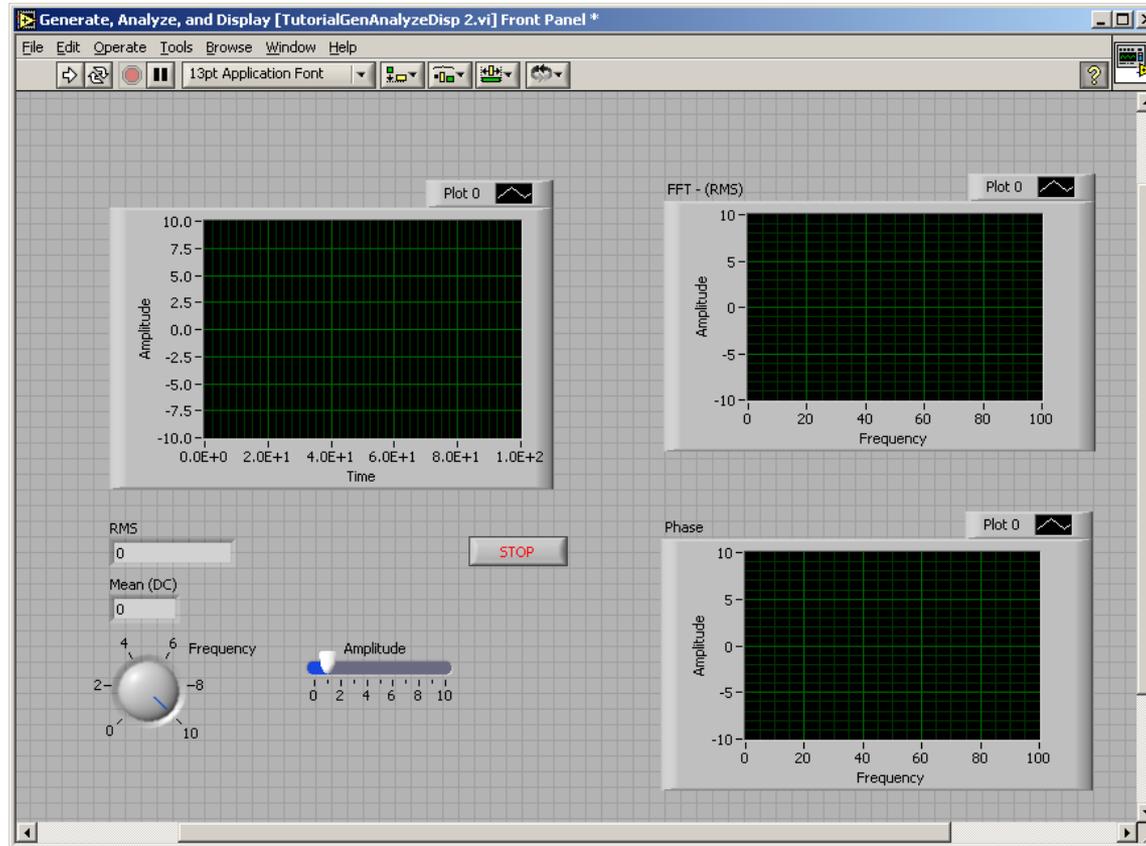
*Wire in the signal to be analyzed, and wire out graph indicators to display amplitude and phase.*

*From Simulate Signal* 



# LabVIEW - FFT Express VI

*The resulting front panel display is:*



## *LabVIEW - Task to be performed*

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*Start a new VI and generate a sine wave with both amplitude and frequency input controls - take the FFT of the sine wave (select the sine wave to satisfy the periodicity requirements of the Fourier Transform)*

*Generate harmonics of that sine wave to ultimately form a representation of a square wave in both the time and frequency domain*

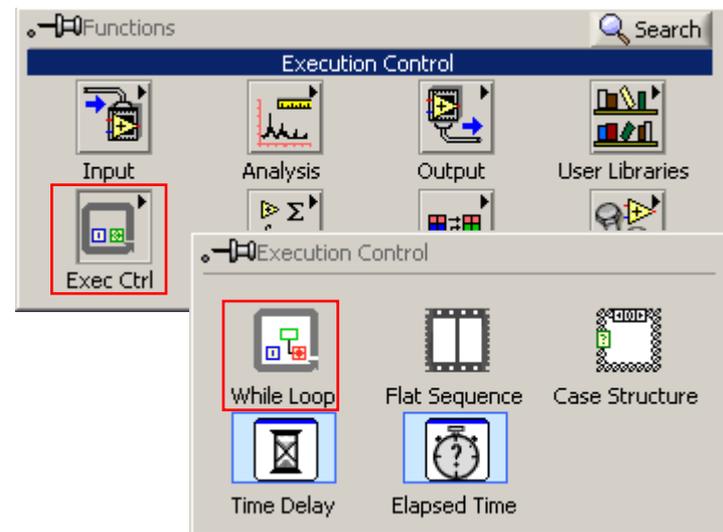
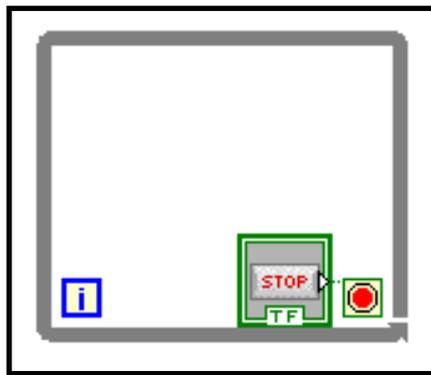
*Create a square wave that represents the true time and frequency of the signal for comparison*

*(Here are a few extra things you'll need to know)*



# LabVIEW - Extras - While Loop

*In order to have a program that will continue running and stop when a 'stop button' is pressed, a while loop can be used.*



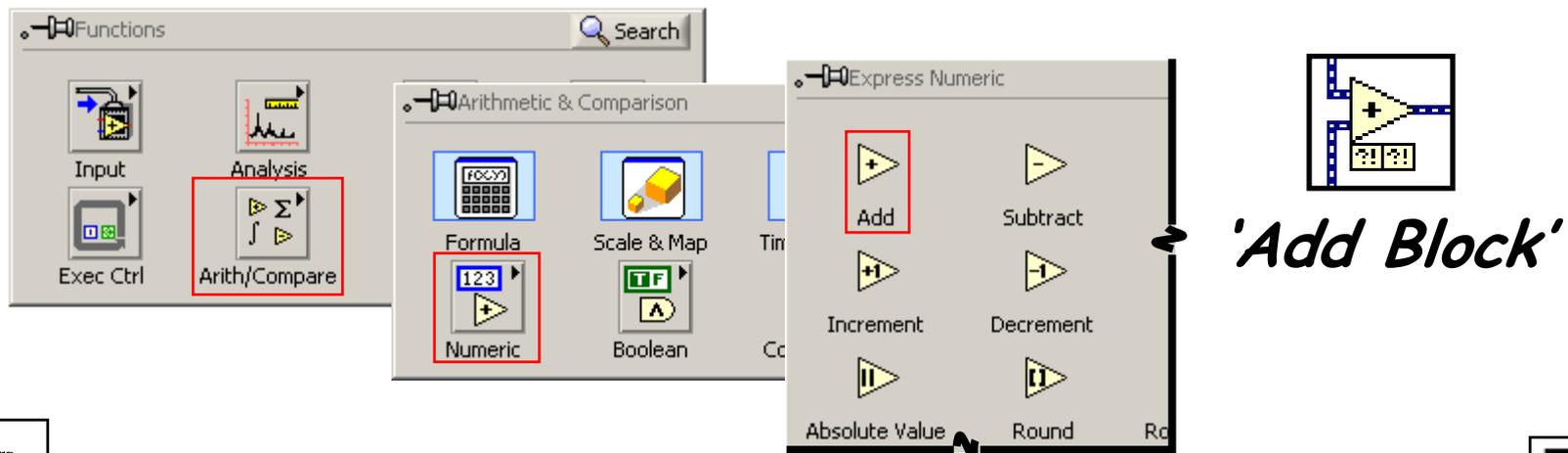
*Note: Unless in emergency situations, never use the 'abort button'. Always program in a 'stop button'.*



# LabVIEW - Extras - Summing Signals

*In order to sum signals together:*

- *Make sure each signal has the same number of samples*
- *Limited to only adding to signals together at a time*

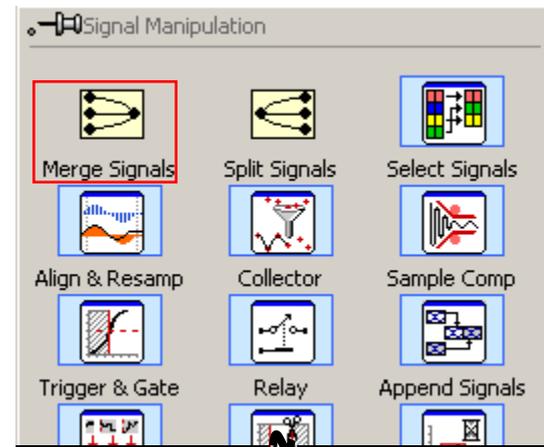
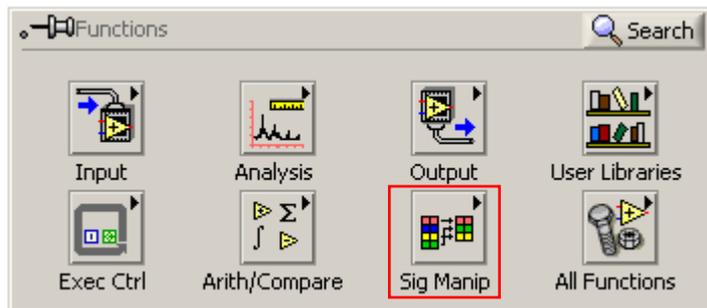


# LabVIEW - Extras - Manipulating Multiple Signals

*In order to run multiple signals through a VI (FFT, Waveform Graph...) signals must be run through a merge block.*



*The block can be resized to allow for more than two signals*



## *LabVIEW - Task to be performed*

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*Generate a low pass filter (1<sup>st</sup> order Butterworth) and apply it to your square wave approximation. You may want to investigate higher order filters as well.*

*Select a cutoff frequency (that is variable via a control) to filter the higher frequencies of the summed Fourier series of sine waves.*

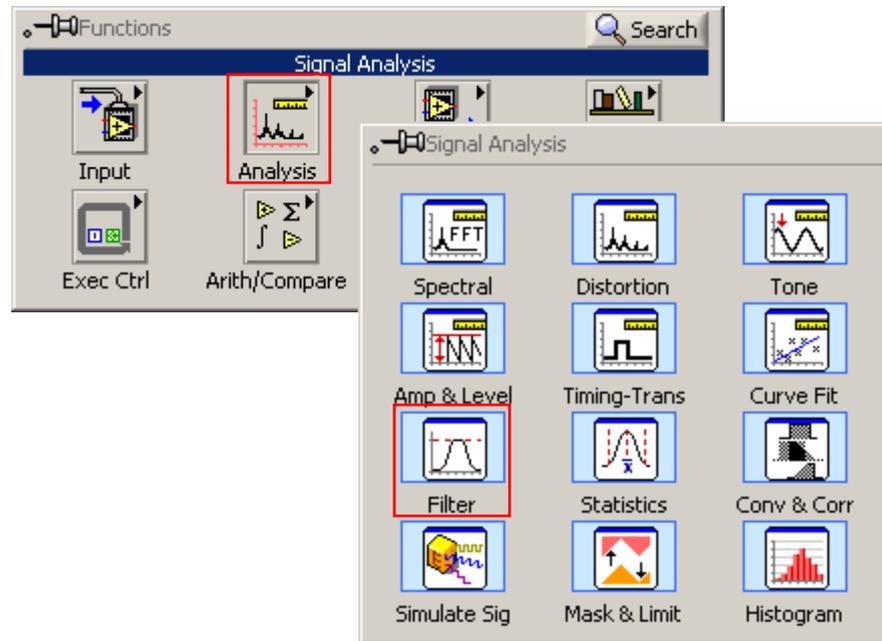
*Modify the low pass filter to make it a band pass filter for viewing tight bands around each sine wave that makes up the terms of the Fourier series. Note the effects of the filter on both the time and frequency signals.*

*(Here are a few extra things you'll need to know)*



# LabVIEW - Extras - Filter block

*Filtering of input signals can be done by using the 'Filter Block' found in:*



# LabVIEW - Extras - Filter block

*A parameter window will appear once VI is placed on wire diagram. Here you can set desired filter type, cutoff frequencies, topologies, etc.*

