Explore Circuit Behavior Using Simulation-Driven Instruments in NI Multisim

Publish Date: Feb 06, 2012

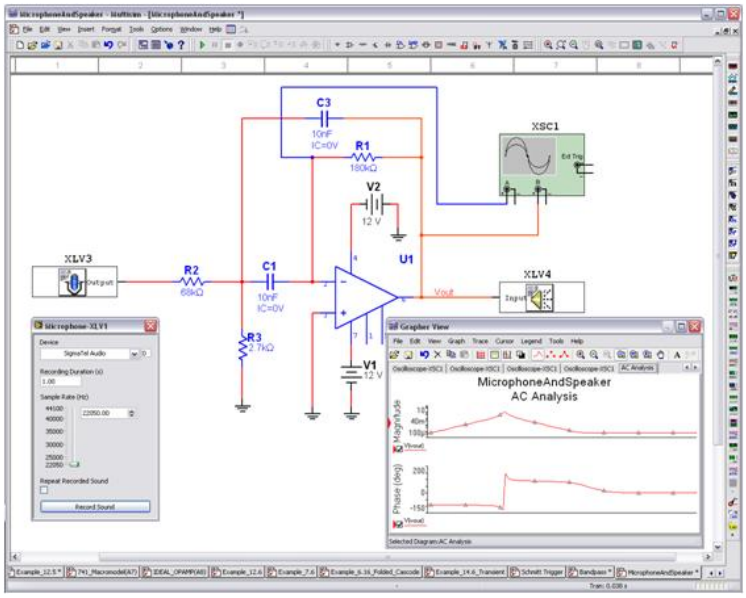
Overview

NI Multisim software provides simulation-driven instruments that you can use to drive your circuit, measure the behavior of the circuit, and examine simulation results. These instruments are set, used, and read just like their real-world equivalents. This article examines the three different types of simulation-driven instruments and how you can use these instruments to drive circuits, make measurements, probe, and troubleshoot a circuit.

Table of Contents

1. Introduction to Simulation-Driven Instruments

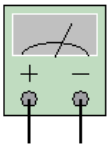
In addition to the components and wires used to capture a circuit, NI Multisim software contains a variety of simulation-driven instruments that wire into the schematic just like you connect a real instrument on the bench. These simulation-driven instruments, like their real-world counterparts, are fully interactive so you can change their settings while running a simulation and instantly see new results.



Simulation-driven instruments help you take advantage of the full power of simulation without having to be an expert in SPICE syntax. When you press a button on an instrument, an appropriate simulation command is automatically issued and results are immediately displayed on that instrument's user interface. You can save instrument settings and simulation results with the circuit file and resize the faceplates of instruments to adjust to different screen resolutions and presentation modes.

With Multisim, you can place simulation-driven instruments from the **Simulate»Instruments** menu or directly from the Instruments toolbar as seen below.

Simulation-driven instruments have three distinctive views to each instrument, which allows for selection, placement, wiring, setting configuration, data visualization, and so on.

Type	Description	View
Icon	• Represents an instrument in the Multisim Instruments toolbar	
Symbol	• Represents an instrument in a circuit • Use the instrument's terminals to wire it to a circuit • Double-click on an instrument's symbol to open the instrument panel	
Panel	Allows the user to interact with the instrument by • Setting parameters • Displaying data	

You can show or hide the instrument panel by double-clicking on the instrument's symbol. The instrument panel is always drawn on top of the main workspace so that the parameters are not hidden. You can place the instrument panel wherever you wish on your desktop and resize it to account for different screen resolutions and presentation modes. When you save your circuit, the instrument panel location and hide/show status are stored with the circuit. Also, any data contained in the instrument is saved, up to a maximum size.

2. Types of Simulation-Driven Instruments

The three distinct types of simulation-driven instruments are Multisim instruments, LabVIEW custom VIs, and NI-ELVISmx instruments. All of these instruments offer the following key capabilities:

- Adjust settings while the simulation is running
- Rewire terminal while simulation is running
- Use multiple instances of the same instrument in one circuit
- Save instrument settings and display data with the circuit file
- Populate displayed data in the Grapher view
- Resize instrument panel to account for screen resolution or presentation mode
- Easily export displayed data in TXT, LVM, and TDM format

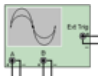
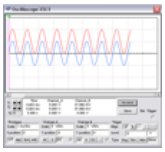
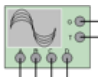
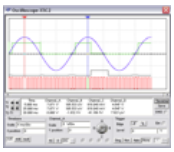
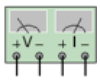
3. Multisim Instruments

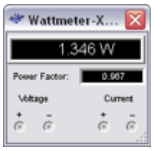
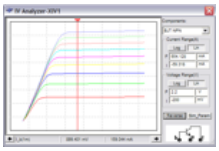
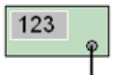
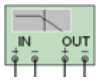
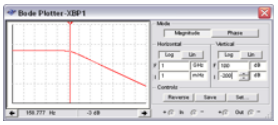
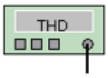
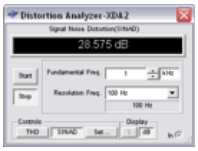
Multisim instruments are simulation-driven instruments that are innate in the Multisim environment. You can group them into six categories to better organize them:

- AC and DC instruments
- Digital and logic instruments
- RF instruments
- Simulated vendor instruments
- Measurement probes
- LabVIEW VIs

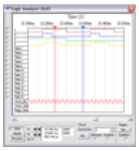
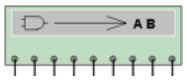
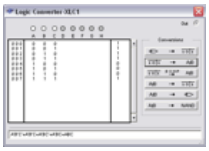
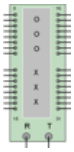
Note: Pictures and icons seen in this document are reduced in size and quality.

AC and DC Instruments

Name	Function	Icon	Symbol	Panel
Function Generator	• Sine, triangular, and square wave • Frequency • Duty cycle • Amplitude • Offset			
Multimeter	• AC and DC • Current • Voltage • Resistance • Decibel loss			
2-Channel Oscilloscope	• Up to 2 channels • Y and X scaling • Y offset • Trigger • Cursor			
4-Channel Oscilloscope	• Up to 4 channels • Y and X scaling • Y offset • Trigger • Cursor			
Wattmeter	• Power measurement • Power factor			

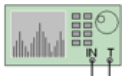
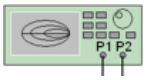
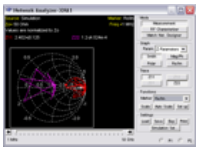
				
IV Analyzer	• Diodes • PNP BJT • NPN BJT • PMOS • NMOS			
Frequency Counter	• Frequency • Period • Pulse • Rise/fall time • AC or DC coupling • Trigger			
Bode Plotter	• Frequency response • Gain and phase shift • Up to 10 GHz			
Distortion Analyzer	• Intermodulation distortion • Total harmonic distortion			

Digital and Logic Instruments

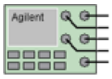
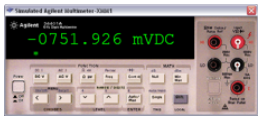
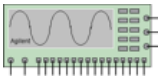
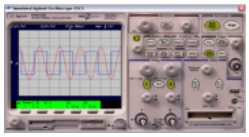
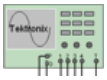
Name	Function	Icon	Symbol	Panel
Logic Analyzer	• 16 channels • Cursor • Data history • Trigger • Internal/external clock			
Logic Converter	• Digital circuit to truth table and Boolean expression • Truth table to digital circuit • Boolean expression to digital circuit			
Word Generator	• Cycle, burst, and step updates • Hex, DEC, Boolean, and ASCII data view • Timing • Trigger			

RF Instruments

Name	Function	Icon	Symbol	Panel

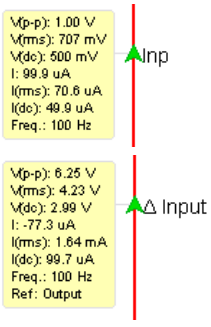
Spectrum Analyzer	• Amplitude versus frequency • Signal components (power and frequency) • Zero, full, and custom span			
Network Analyzer	• Digital circuit to truth table and Boolean expression • Truth table to digital circuit • Boolean expression to digital circuit			

Simulated Vendor Instruments

Name	Function	Icon	Symbol	Panel
Agilent Waveform Generator	• Type: 33120A • Reflects the behavior of the real instruments			
Agilent DMM	• Type: 34401A • Reflects the behavior of the real instruments			
Agilent Oscilloscope	• Type: 54622D • Reflects the behavior of the real instruments			
Tektronix Oscilloscope	• Type: TDS 2024 • Reflects the behavior of the real instruments			

Measurement Probes

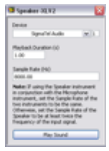
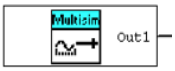
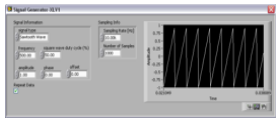
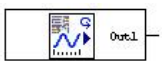
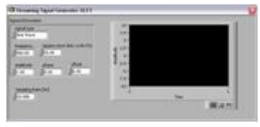
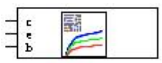
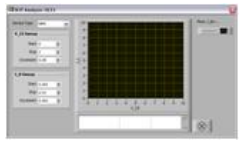
Name	Function	Icon	Symbol	Panel

Static Measurement Probe	• Current, voltages, and frequency
	• Referenced to circuit GND or any other probe
	• Fixed to a net or at mouse cursor
	• Triggers events
	• Choose from:
	  • From dynamic probe setting
	  • AC voltage
	  • AC current
	  • Instantaneous voltage
	  • Voltage with reference to probe
				

Current Probe				Use standard simulated instruments to display data

	• Emulates the behavior of industrial clamp-on current probes • Various voltage to current ratios			• Oscilloscope • Multimeter • And so on

Instruments Based on LabVIEW

Name	Function	Icon	Symbol	Panel
LabVIEW Microphone	• Interface with your PCs sound devices • Recording length • Sample rate			
LabVIEW Speaker	• Interface with your PCs sound devices • Update rate			
LabVIEW Signal Analyzer	• Time domain signal • Auto power spectrum • Running average			
LabVIEW Signal Generator	• Sine, triangular, square, and sawtooth • Frequency • Duty cycle • Amplitude • Offset • Phase			
LabVIEW Streaming Signal Generator	• Sine, triangular, square, and sawtooth • Frequency • Duty cycle • Amplitude • Offset • Phase • Sampling rate			
LabVIEW BJT Analyzer	• Current-voltage characteristics of PNP or NPN BJT • Device type • V_CE sweep • I_B sweep			
LabVIEW Impedance Meter	• Frequency sweep, frequency, impedance • Number of points • Scale type			

4. LabVIEW Custom VIs

Extend your simulation and analysis capabilities beyond the instrumentation in Multisim with the creation of custom VIs using the LabVIEW graphical development environment. VIs that you create using LabVIEW can take advantage of the full functionality of the LabVIEW development system, including data acquisition, instrument control, and mathematical analysis. For example, you can create the following kinds of VIs:

- A virtual instrument that acquires data from the real world using a National Instruments data acquisition device or modular instrument. Multisim then uses that data as a signal source for circuit simulation.
- A virtual instrument that displays simulation data simultaneously with multiple measurements (running average and power spectrum, for example) made from that simulation data.

LabVIEW VIs can be input instruments, output instruments, or input/output instruments.

Input instruments receive simulation data for display or processing.

Output instruments generate data to use as a signal source in simulation.

Input/output instruments both receive and generate simulation data.

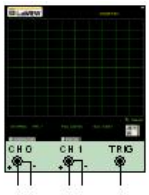
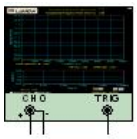
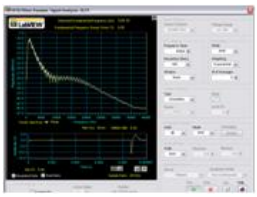
You can install these VIs created and customized in LabVIEW into Multisim, and they appear in the LabVIEW Instruments toolbar. For more information on building a LabVIEW VI and LabVIEW VI installation, view the Multisim Help file.

Download a sample LabVIEW custom VI to begin using them now»

5. NI-ELVISmx Instruments

By integrating NI ELVIS and Multisim, you can correlate simulated data with real-world measurements. NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) is a National Instruments hardware design and prototyping platform that contains 12 of the most commonly used instruments into one integrated platform that connects to your computer through a Hi-Speed USB connection.

Inside the Multisim environment, you can access eight of these instruments. With one click of the mouse, you can switch from simulated data generated by the Multisim SPICE simulation engine and the signals acquired from the hardware. This helps engineers prototype faster and educators reinforce theory with real-world signals.

Name	Function	Icon	Symbol	Panel
NI-ELVISmx Digital Multimeter	• AC voltage • AC current			
NI-ELVISmx Function Generator	• Triangle, sine, square • Up to 5 MHz • Amplitude • DC offset • Sweep settings			
NI-ELVISmx Oscilloscope	• 2-channel, coupling, scale volt/div • Time/div • Trigger • Acquisition mode • cursors			
NI-ELVISmx Dynamic Signal Analyzer	• Power spectrum and power spectral density • Frequency span, resolution, window • Averaging mode, weight, number of averages • Trigger • Units and mode to display			
NI-ELVISmx Digital Reader	• Acquisition mode			

NI-ELVISmx Digital Writer	• Pattern type • Toggle, rotate, shift • Generation mode • Direction			
NI ELVISmx Arbitrary Waveform Generator	• Waveform editor • Generation mode • Update rate • Upload waveform file • Set gain			
NI-ELVISmx Variable Power Supply	• +12 V/-12 V range • Sweep setting			

6. Additional Resources

Download “How To” Examples for NI Multisim Virtual Instruments

Download Instruments Based on LabVIEW

Learn How to Create a LabVIEW VI for Multisim

Visit the NI Circuit Design Technical Library

Read about the Top Reasons to Adopt NI ELVIS