NI Multisim Analog Devices Edition

Getting Started with NI Multisim Analog Devices Edition

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NATIONAL INSTRUMENTS™
ELECTRONICS WORKBENCH GROUP

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The following conventions are used in this manual:

»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.
	This icon denotes a tip, which alerts you to advisory information.
	This icon denotes a note, which alerts you to important information.
bold	Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.
italic	Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.
`monospace`	Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

Contents

1

NI Multisim Analog Devices Edition Tutorial

This chapter contains a tutorial that introduces you to Multisim and its many functions.

Overview

This tutorial leads you through the circuit design flow, from schematic capture, through simulation and analysis. After following the steps outlined on the following pages, you will have designed a circuit that samples a small analog signal, amplifies it and then counts the occurrences of the signal on a simple digital counter.

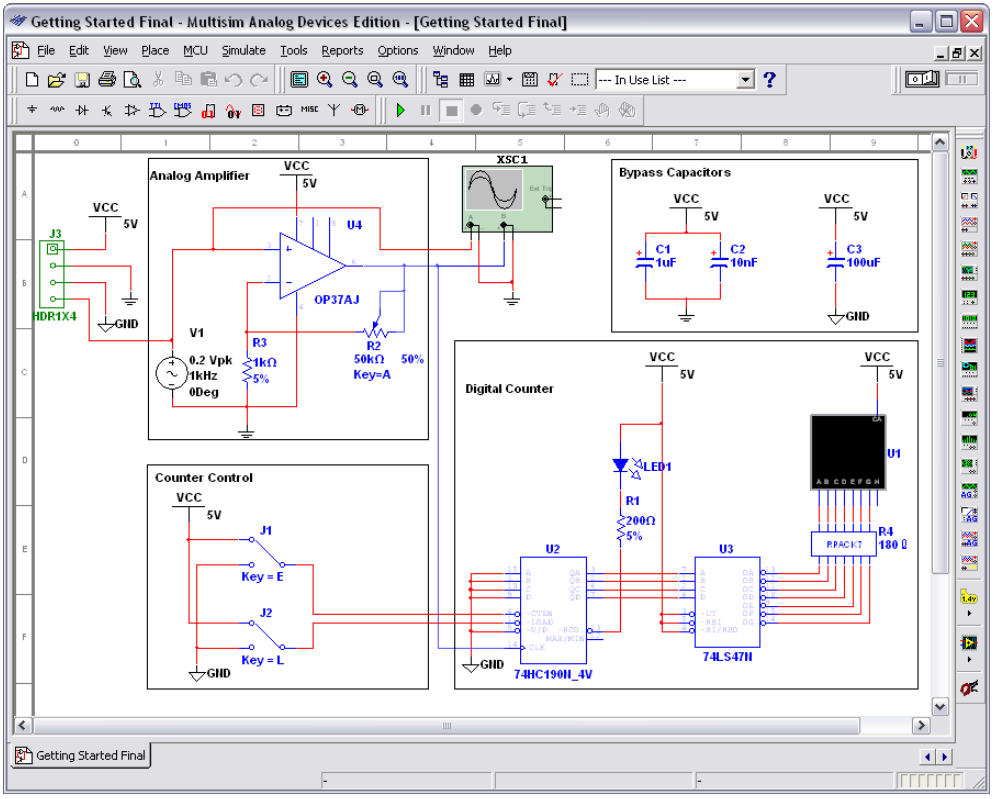
Helpful tips are indicated by the presence of an icon in the left column, as in the following example:

Tip You can access the online help at any time by pressing F1 on your keyboard, or by clicking on the **Help** button in a dialog box.

When you get to the wiring section of this tutorial, you can carry on with the circuit you created in the component placement section, or open the file `Getting Started 1.ms10` (which has all components properly placed) from the `Getting Started` folder (found inside the `samples` folder) and proceed. When you arrive at the simulation section, you can carry on with the circuit you wired, or open the file `Getting Started 2.ms10` (which has all components properly wired).

Schematic Capture

In this section, you will place and wire the components in the circuit shown below.



Opening and Saving the File

To launch Multisim:

1. Select **Start»All Programs»National Instruments»Multisim Analog Devices Edition 10.0»Multisim Analog Devices Edition**. A blank file opens on the workspace called `Circuit1`.

To save the file with a new name:

1. Select **File»Save As** to display a standard Windows Save dialog.
2. Navigate to the location where you wish the file to reside, enter `MyGettingStarted` as the filename, and click the **Save** button.

Tip To guard against accidental loss of data, set up a timed auto-backup of the file in the **Save** tab of the **Preferences** dialog box.

To open an existing file:

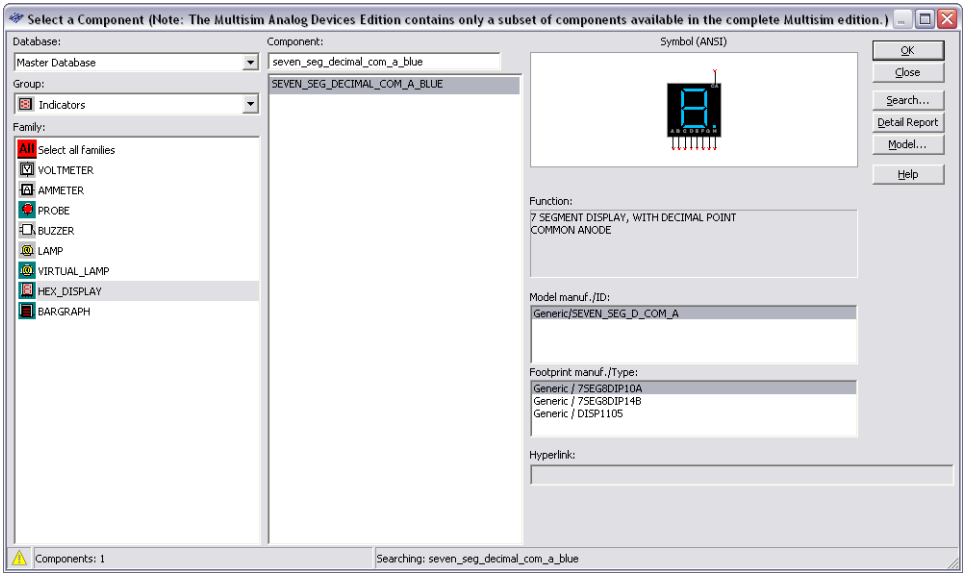
1. Select **File»Open**, navigate to the location where the file resides, highlight the file, and click on the **Open** button.

Placing the Components

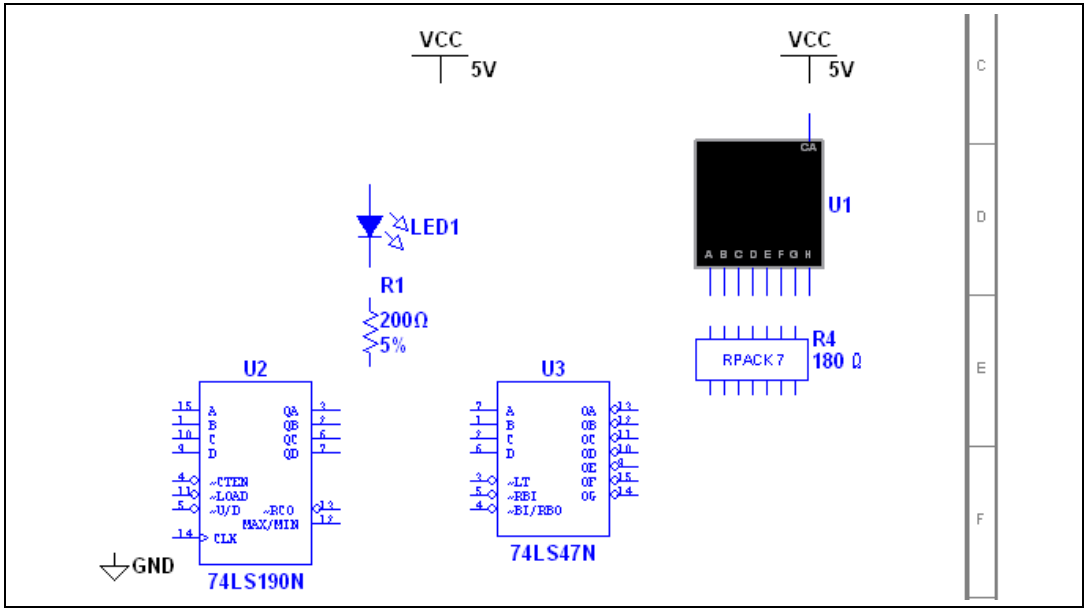
To start placing components:

1. Open `MyGettingStarted.ms10` as described above.
2. Select **Place»Component** to display the **Select a Component** browser, navigate to the 7-segment LED display as shown below and click **OK**. The component appears as a "ghost" on the cursor.

Tip Once you have selected the desired **Group** and **Family**, start typing the component's name in the browser's **Component** field. As you type, the string appears in the **Searching** field at the bottom of the browser. In the example below, type "`seven_seg_decimal_com_a_blue`". Matches are displayed as you type.



3. Move the cursor to the bottom-right of the workspace and left-click to place the component. Note that the Reference Designator for this component is “U1”.
4. Place the remaining components in the Digital Counter area as shown below.



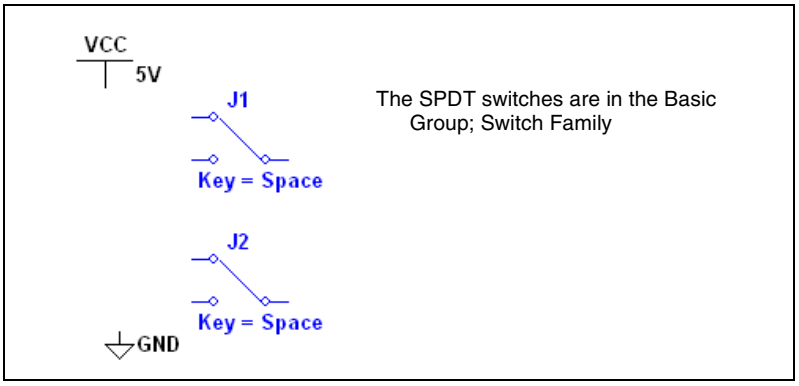
Note When placing resistors, inductors, or capacitors (RLC components), the **Select a Component** browser has slightly different fields than for other components. When placing any of these components, you can choose any combination of: the component’s value (for example, the resistance value); type (for example, carbon film); tolerance; footprint and manufacturer. If you are placing a component that will be ultimately exported to PCB layout, and become part of a **Bill of Materials**, you must be careful that the combination of values that you select in the **Select a Component** dialog box are available in a real-world, purchaseable component.

Tip When placing RLC components, type the value of the device that you want to place in the field at the top of the **Component** list. The value does not need to appear in the list to be placed on the schematic.

Tip While placing the 200-ohm resistor, rotate it to a vertical orientation by pressing <Ctrl-R> on your keyboard.

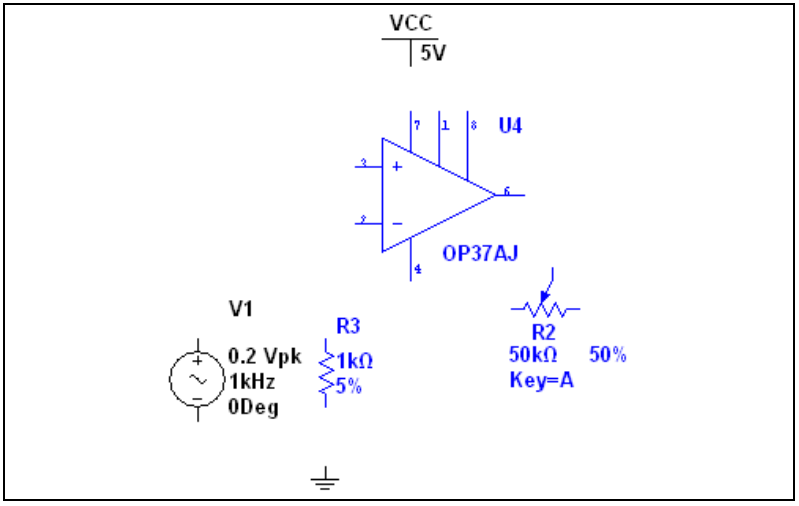
Tip Reference Designators (for example, U1, U2) are assigned in the order the components are placed. If you place components in a different order than in the original circuit, the numbering will differ. This will not affect the operation of the circuit in any way.

5. Place the parts in the Counter Control section. After placement, right-click on each of the SPDT switches and select **Flip Horizontal**.



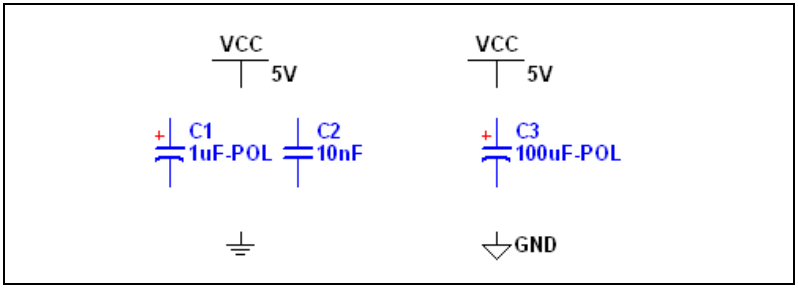
Tip When a part is on the workspace and you want to place the same part again, highlight it and select **Edit»Copy**, then **Edit»Paste**. You can also select it from the **In Use List** and click to place it on the workspace.

6. Place the parts in the Analog Amplifier section as shown below, rotating as needed.

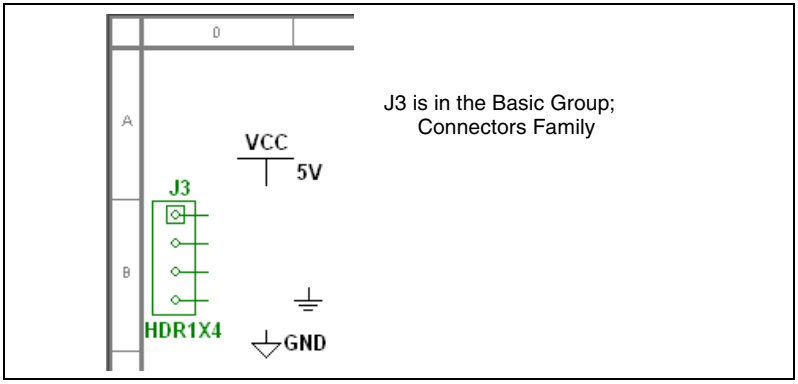


After you place the AC voltage signal source, double-click on it. Change the **Voltage (Pk)** to 0.2 V and click **OK** to close the dialog.

7. Place the parts in the Bypass Capacitors section as shown below.



8. Place the header and associated parts as shown below.



Tip Once you have wired a circuit, you can drop two-pinned passive components like resistors directly onto a wire. The connection is automatically made by Multisim.

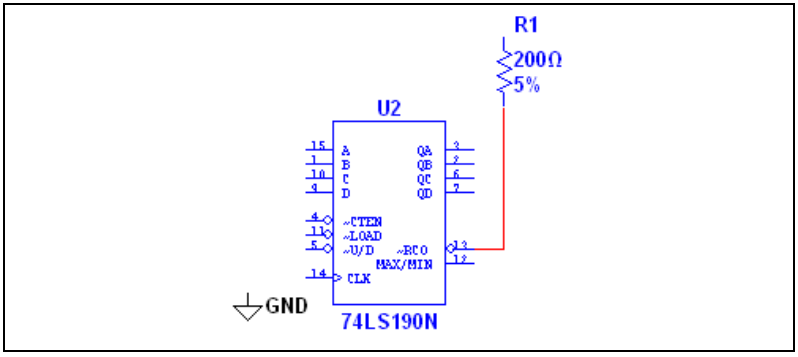
Wiring the Circuit

All components have pins that you use to wire them to other components or instruments. As soon as your cursor is over a pin, Multisim knows you want to wire and the pointer changes to a crosshair.

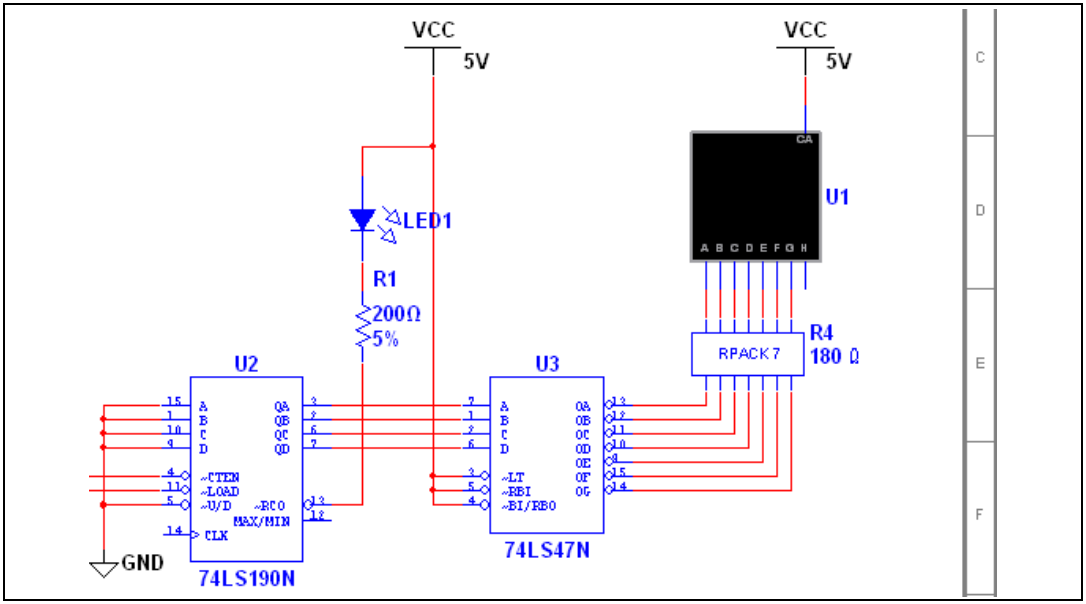
Tip You can wire the circuit that you placed on the workspace or you can use `Getting Started 1.ms10` from the `Getting Started` folder (found inside the `samples` folder).

To wire the circuit:

1. Click on a pin on a component to start the connection (your pointer turns into a crosshair) and move the mouse. A wire appears, attached to your cursor.
2. Click on a pin on the second component to finish the connection. Multisim automatically places the wire, which conveniently snaps to an appropriate configuration, as shown below. This feature saves a great deal of time when wiring large circuits.



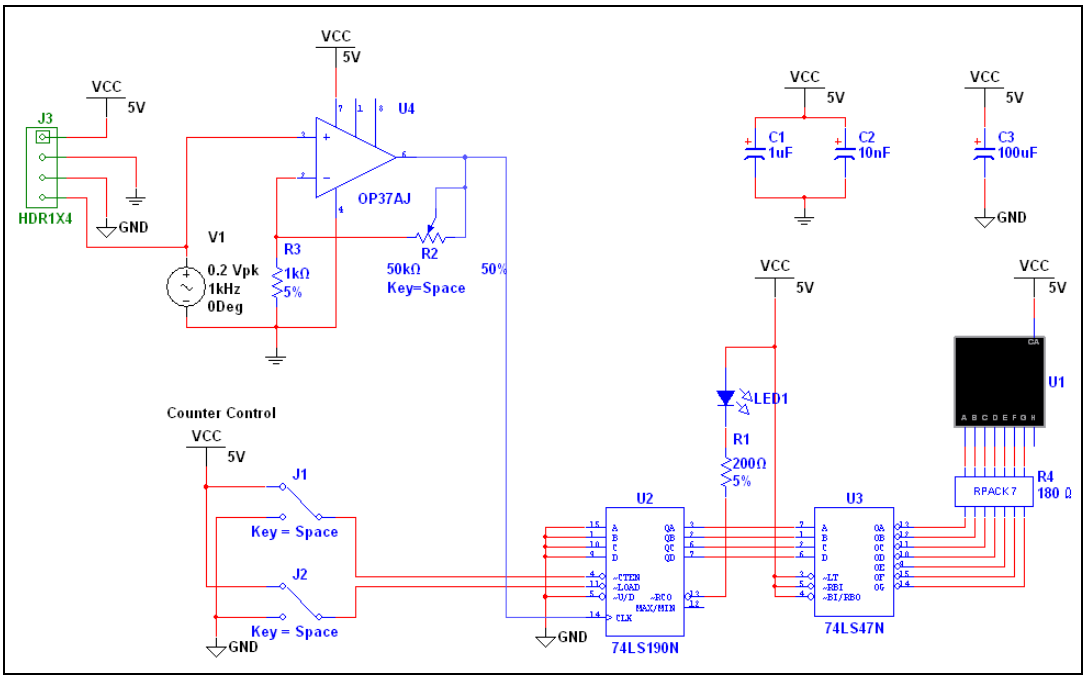
3. You can also control the flow of the wire by clicking on points as you move the mouse. Each click “fixes” the wire to that point.
4. Finish wiring the Digital Counter section as shown below.



Tip Use *Bus Vector Connect* to wire multi-pinned devices like U3 and R4 together. Refer to the *Multisim User Guide* for details.

Tip *Virtual Wiring*—To avoid clutter, you could use virtual connections between the Counter Control and Digital Counter sections. When two nets have the same net name, they are virtually connected.

5. Finish wiring the circuit as shown below.



Simulation

Simulating your circuits with Multisim catches errors early in the design flow, saving time and money.

Virtual Instrumentation

In this section, you will simulate the circuit with the virtual oscilloscope.

Tip You can also use `Getting Started 2.ms10` from the `Getting Started` folder (found inside the `samples` folder).

1. J1, J2 and R2 are interactive components.

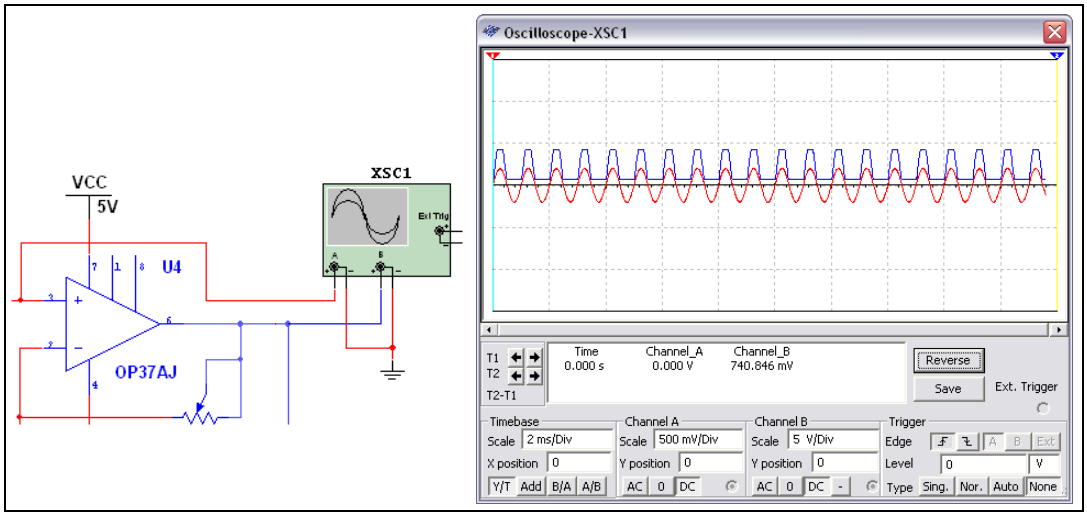
   Set up the interactive keys for J1, J2 and R2 by double-clicking on each. In the **Key** field, enter “E” for J1, “L” for J2, and “A” for R2.

   Press “E” to enable the counter, or just click on the widened switch arm that appears when you hover the cursor over J1.

2. Select **Simulate»Instruments»Oscilloscope** to place the oscilloscope on the workspace. Wire the instrument as shown in step 4.

Tip To easily differentiate between traces on the oscilloscope, right-click on the wire connected to the scope's "B" input and select **Segment Color** from the pop-up. Select a color that differs from the wire connected to the "A" input, for example blue. (Simulation cannot be running when changing wire color or performing any other editing function).

3. Double-click on the scope's icon to show the instrument face. Select **Simulate»Run**. The output of the opamp appears on the scope.
4. Adjust the Timebase to 2mS/Div and Channel A's Scale to 500mV/Div. You will see the following displayed on the scope.



As the circuit simulates, the 7-segment display counts up and the LED flashes at the end of each count cycle.

5. Press "E" on your keyboard while the simulation is running to enable or disable the counter. Enable is Active Low.

   Press "L" to load zeros into the counter. Load is Active Low.

   Press "Shift-A" to observe the effect of changing the potentiometer's setting. Repeat, pressing "A".

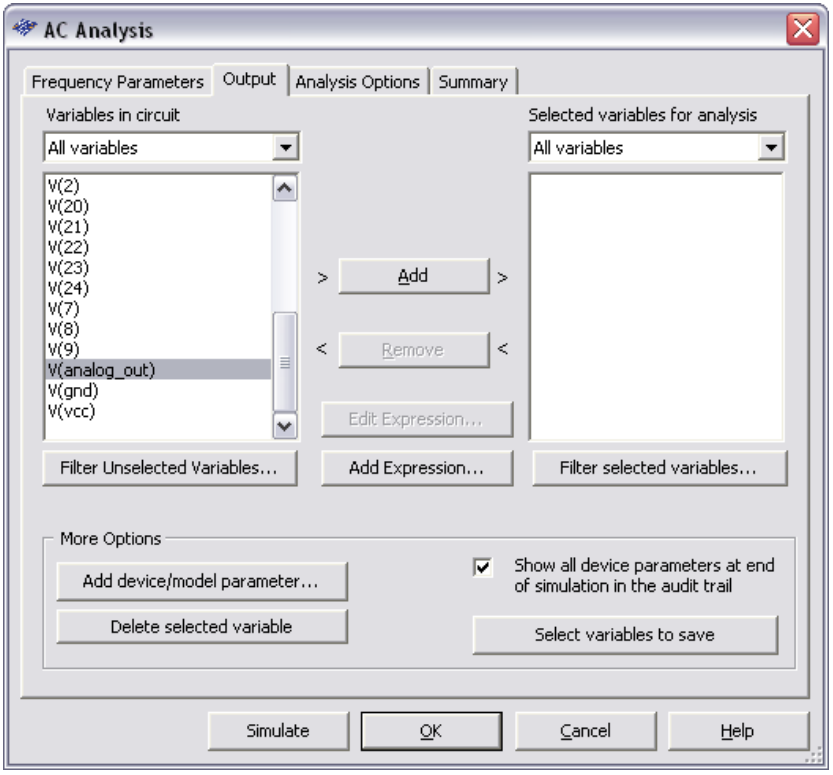
Tip Instead of pressing the above-mentioned keys, you can directly manipulate the interactive components on the schematic with your mouse.

Analysis

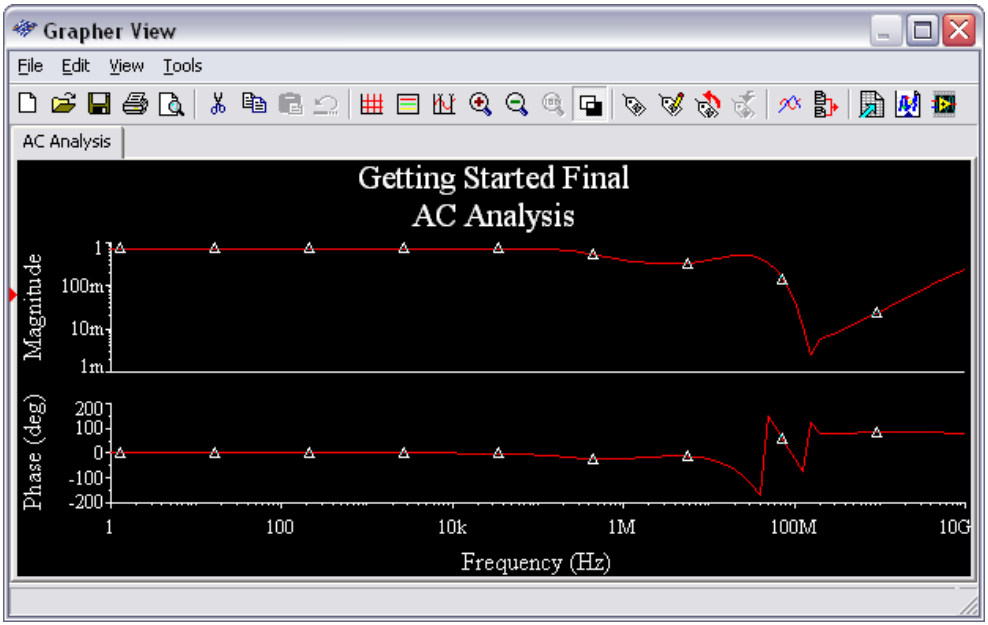
In this section, you will use **AC Analysis** to verify the frequency response of the amplifier.

To perform an **AC Analysis** at the output of the opamp:

1. Double-click on the wire that is attached to pin 6 of the opamp, and change the net name to `analog_out` in the **Net** dialog box.
2. Select **Simulate»Analyses»AC Analysis** and click on the **Output** tab.



3. Highlight `V(analog_out)` in the left column and click **Add**. `V(analog_out)` moves to the right column.
4. Click **Simulate**. The results of the analysis appear in the **Grapher**.

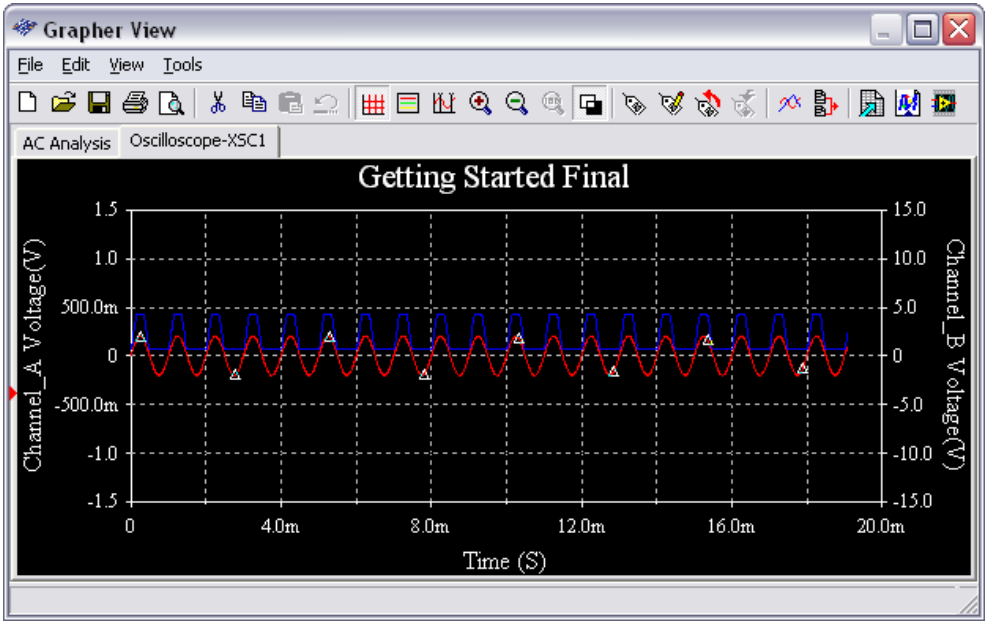


The Grapher

The **Grapher** is a multi-purpose display tool that lets you view, adjust, save and export graphs and charts. It is used to display the results of all Multisim analyses in graphs and charts and a graph of traces for some instruments (for example the results of the oscilloscope).

To view results of a simulation on the **Grapher**:

1. Run the simulation as described earlier.
2. Select **View»Grapher**.



The Postprocessor

Use the **Postprocessor** to manipulate the output from analyses performed on a circuit and plot the results on a graph or chart. Types of mathematical operations that can be performed on analysis results include arithmetic, trigonometric, exponential, logarithmic, complex, vector and logic.

Reports

Multisim allows you to generate a number of reports: Bill of Materials (BOM), Component Detail Report, Netlist Report, Schematic Statistics, Spare Gates and the Cross Reference Report. This section uses the **BOM** as an example for the tutorial circuit.

Bill of Materials

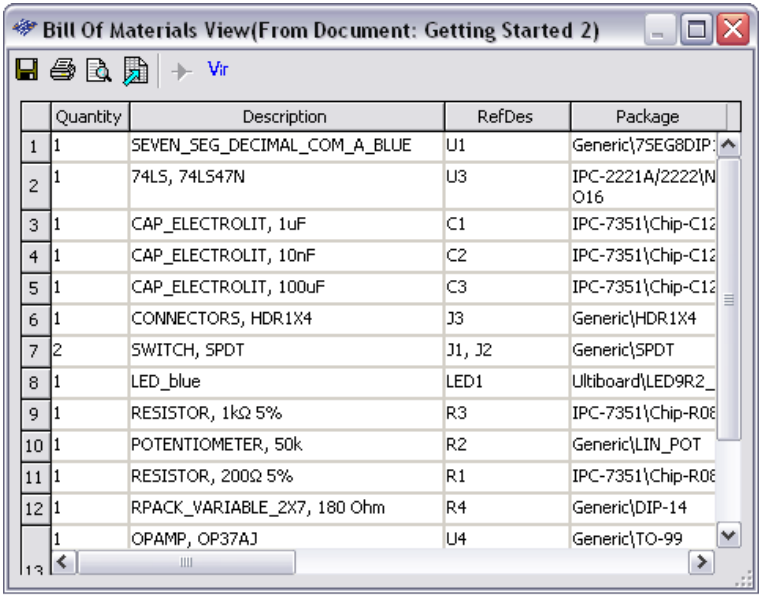
A bill of materials lists the components used in your design and therefore provides a summary of the components needed to manufacture the circuit board. Information provided includes:

- quantity of each component needed
- description, including the type of part (example: resistor) and value (example: 5.1 kohm)

- Reference Designator of each component
- package or footprint of each component

To create a **BOM** (bill of materials) for your circuit:

1. Click the **Reports** menu and choose **Bill of Materials** from the menu that appears.
2. The report appears, looking similar to this:



	Quantity	Description	RefDes	Package
1	1	SEVEN_SEG_DECIMAL_COM_A_BLUE	U1	Generic\7SEG8DIP:
2	1	74LS, 74LS47N	U3	IPC-2221A/2222\N O16
3	1	CAP_ELECTROLIT, 1uF	C1	IPC-7351\Chip-C12
4	1	CAP_ELECTROLIT, 10nF	C2	IPC-7351\Chip-C12
5	1	CAP_ELECTROLIT, 100uF	C3	IPC-7351\Chip-C12
6	1	CONNECTORS, HDR1X4	J3	Generic\HDR1X4
7	2	SWITCH, SPDT	J1, J2	Generic\SPDT
8	1	LED_blue	LED1	Ultiboard\LED9R2_
9	1	RESISTOR, 1kΩ 5%	R3	IPC-7351\Chip-R08
10	1	POTENTIOMETER, 50k	R2	Generic\LIN_POT
11	1	RESISTOR, 200Ω 5%	R1	IPC-7351\Chip-R08
12	1	RPACK_VARIABLE_2X7, 180 Ohm	R4	Generic\DIP-14
13	1	OPAMP, OP37AJ	U4	Generic\TO-99

To print the **Bill of Materials**, click the **Print** button. A standard Windows print screen appears, allowing you to choose the printer, number of copies, and so on.

To save the **Bill of Materials** to a file, click the **Save** button. A standard Windows file save dialog box appears, allowing you to specify the path and file name.

Because the **Bill of Materials** is primarily intended to assist in procurement and manufacturing, it includes only “real” parts—it excludes parts that are not real or able to be purchased, such as sources or virtual components.

To see a list of components in your circuit that are not “real” components, click the **Virtual** button. A separate window appears, showing these components only.

Detailed information on this and other reports can be found in the *Multisim User Guide*.

A

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