MODULE-IV
PLOTTING DATA

INTRODUCTION

Graphical display of data is an important aspect of programming in LabVIEW.

A good knowledge of arrays and clusters is important for graphical operations. VIs with graph usually collects the data in an array and then plots the data to the graph to obtain a waveform.

Two-dimensional X-Y displays are required in most situations. Charts and graphs let you display plots of data in a graphical form. Charts interactively plot data, appending new data to old so that you can see the current value in the context of previous data, as the new data become available. Graphs plot pre-generated arrays of values in a more traditional fashion without retaining previously-generated data.

TYPES OF WAVEFORMS

LabVIEW includes the following types of graphs and charts:

- **Waveform graphs and charts**: Display data typically acquired at a constant rate.
- **XY Graphs:** Display data acquired at a non-constant rate and data for multivalued functions.
- **Intensity graphs and charts:** Display 3D data on a 2D plot by using color to display the values of the third Dimension.
- **Digital waveform graphs:** Display data as pulses or groups of digital lines.
- **Windows 3D Graphs:** Display 3D data on a 3D plot in an ActiveX object on the front panel.

WAVEFORM GRAPHS

LabVIEW includes the waveform graph and chart to display data typically acquired at a constant rate.

The waveform graph displays one or more plots of evenly sampled measurements.

The waveform graph plots only single-valued functions, as in y = f (x), with points evenly distributed along the x-axis, such as acquired time-varying waveforms.

Figure 7.1 shows an example of a waveform graph. The waveform graph can display plots containing any number of points.

The graph also accepts several data types, which minimizes the extent to which you must manipulate data before you display it

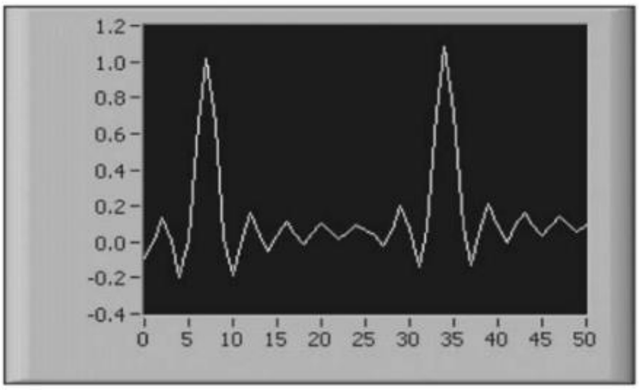


Figure 7.1 Waveform Graph.

Displaying a Single Plot on Waveform Graphs

The waveform graph accepts several data types for single-plot waveform graphs.

The graph accepts a single array of values, interprets the data as points on the graph and increments the *x* index by one starting at $x = 0$. The graph accepts cluster of an initial *x* value, a delta *x* and an array of *y* data.

The graph also accepts the waveform data type, which carries the data, start time and delta *t* of a waveform.

The waveform graph also accepts the dynamic data type, which is for use with Express VIs. In addition to the data associated with a signal, the dynamic data type includes attributes that provide information about the signal such as the name of the signal or the date and time the data was acquired.

Attributes specify how the signal appears on the waveform graph. When the dynamic data type includes a single numeric value, the graph plots the single value and automatically formats the plot legend and *x*-scale time stamp.

When the dynamic data type includes a single channel, the graph plots the whole waveform and automatically formats the plot legend and *x*-scale time stamp.

Displaying Multiple Plots on Waveform Graphs

The waveform graph accepts several data types for displaying multiple plots.

The waveform graph accepts a 2D array of values, where each row of the array is a single plot.

The graph interprets the data as points on the graph and increments the x index by one, starting at x = 0. Wire a 2D array data type to the graph, right-click the graph and select Transpose Array from the shortcut menu to handle each column of the array as a plot. This is particularly useful when you sample multiple channels from a DAQ device because the device can return the data as 2D arrays with each channel stored as a separate column.

The waveform graph also accepts a cluster of an initial x value, a delta x value, and a 2D array of y data. The graph interprets the y data as points on the graph and increments the x index by delta x, starting at the initial x value. This data type is useful for displaying multiple signals that are sampled at the same regular rate.

The waveform graph accepts a plot array where the array contains clusters. Each cluster contains a 1D array that contains the y data. The inner array describes the points in a plot, and the outer array has one cluster for each plot.

The front panel in Figure 7.2 shows the array of the y cluster.

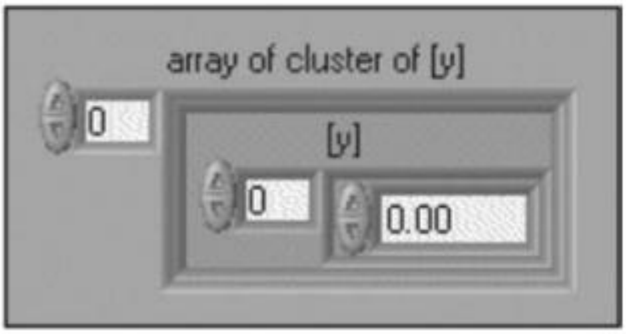


Figure 7.2 Array of the *y* cluster.

Use a plot array instead of a 2D array if the number of elements in each plot is different. For example, when you sample data from several channels using different time amounts from each channel, use this data structure instead of a 2D array because each row of a 2D array must have the same number of elements.

The number of elements in the interior arrays of an array of clusters can vary. The waveform graph accepts a cluster of an initial x value, a delta x value, and array that contains clusters. Each cluster contains a 1D array that contains the y data.

You use the Bundle function to bundle the arrays into clusters and you use the Build Array function to build the resulting clusters into an array. You also can use the Build Cluster Array function which creates arrays of clusters that contain the inputs you specify.

The waveform graph accepts an array of clusters of an x value, a delta x value and an array of y data. This is the most general of the multiple-plot waveform graph data types because you can indicate a unique starting point and increment for the x-scale of each plot.

The waveform graph also accepts the dynamic data type, which is for use with Express VIs. In addition to the data associated with a signal, the dynamic data type includes attributes that provide information about the signal, such as the name of the signal or the date and time the data was acquired.

Attributes specify how the signal appears on the waveform graph. When the dynamic data type includes multiple channels, the graph displays a plot for each channel and automatically formats the plot legend and x-scale time stamp

WAVEFORM CHARTS

The waveform chart is a special type of numeric indicator that displays one or more plots of data typically acquired at a constant rate.

Waveform charts can display single or multiple plots. Figure 7.3 shows the elements of a multiplot waveform chart.

Two plots are displayed: Raw Data and Running Avg. The waveform chart maintains a history of data or buffer from previous updates.

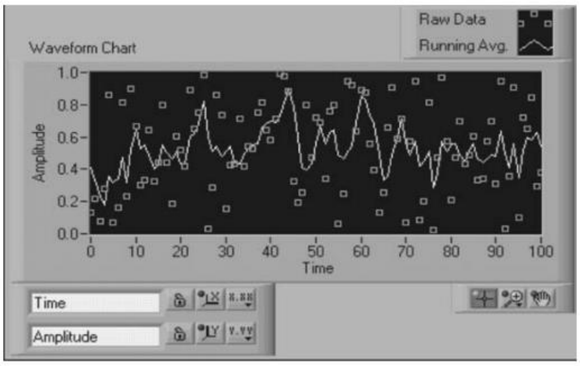


Figure 7.3 A waveform chart.

Displaying a Single Plot on Waveform Charts

You can wire a scalar output directly to a waveform chart. The waveform chart terminal shown in Figure 7.4 matches the input data type. If you pass the chart a single value or multiple values at a time, LabVIEW interprets the data as points on the chart and increments the x index by one starting at x = 0.

The chart treats these inputs as new data for a single plot. The waveform chart accepts the waveform data type which carries the data, start time and delta t of a waveform.

Use the Build Waveform function to plot time on the x-axis of the chart and automatically use the correct interval between markers on the x-scale of the chart.

A waveform that specifies t0 and a single-element Y array is useful for plotting data that is not evenly sampled because each data point has its own time stamp.

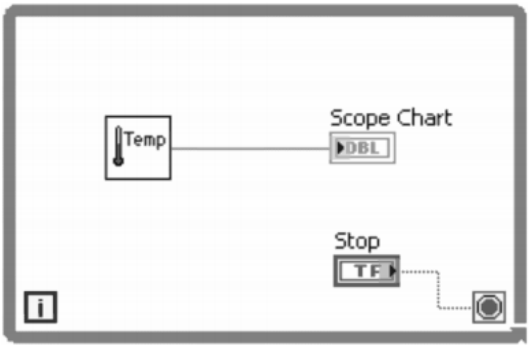


Figure 7.4 Scalar output wired directly to a waveform chart.

Displaying Multiple Plots on Waveform Charts

Waveform charts can display multiple plots together using the Bundle function located on the Cluster palette. In Figure 7.5, the Bundle function bundles the outputs of the three VIs to plot on the waveform chart.

The waveform chart terminal changes to match the output of the Bundle function. To add more plots, use the positioning tool to resize the Bundle function.

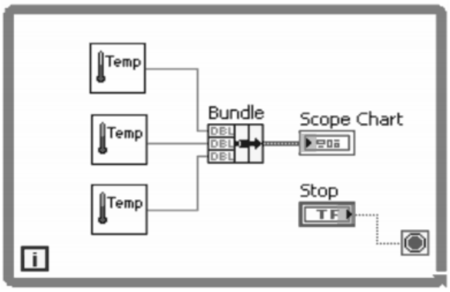


Figure 7.5 Bundle function bundles the outputs to plot on the waveform chart.

To pass data for multiple plots to a waveform chart, you can bundle the data together into acluster of scalar numeric values, where each numeric represents a single point for each of the plots.

If you want to pass multiple points per plot in a single update, wire an array of clusters of numeric values to the chart. Each numeric represents a single y value point for each of the plots

. You can use the waveform data type to create multiple plots on a waveform chart. Use the Build Waveform function to plot time on the x-axis of the chart and automatically use the correct interval between markers on the x-scale of the chart.

A 1D array of waveforms that each specifies t0 and a single-element Y array is useful for plotting data that is not evenly sampled because each data point has its own time stamp.

If you cannot determine the number of plots you want to display until run time, or you want to pass multiple points for multiple plots in a single update, wire a 2D array of numeric values or waveforms to the chart. By default, the waveform chart treats each column in the array as a single plot. Wire a 2D array data type to the chart, right-click the chart, and select Transpose Array from the shortcut menu to treat each row in the array as a single plot.

XY GRAPHS

The XY graph is a general-purpose, Cartesian graphing object that plots multivalued functions, such as circular shapes or waveforms with a varying time base. It displays any set of points, evenly sampled or not.

You also can display Nyquist planes, Nichols planes, S planes and Z planes on the XY graph. Lines and labels on these planes are the same colour as the Cartesian lines, and you cannot modify the plane label font. Figure 7.6 shows an example of an XY graph.

The XY graph can display plots containing any number of points. It also accepts several data types, which minimizes the extent to which you must manipulate data before you display it

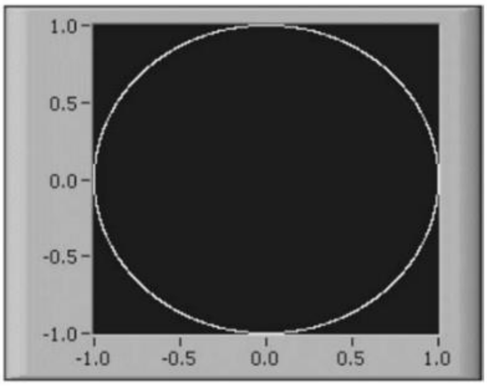


Figure 7.6 An *XY* graph.

Displaying a Single Plot on XY Graphs

The XY graph accepts three data types for single-plot XY graphs.

The XY graph accepts a cluster that contains an x array and a y array.

The XY graph also accepts an array of points where a point is a cluster that contains an x value and a y value. It also accepts an array of complex data in which the real part is plotted on the x-axis and the imaginary part is plotted on the y-axis.

Displaying Multiple Plots on XY Graphs

The XY graph accepts three data types for displaying multiple plots. It accepts an array of plots where a plot is a cluster that contains an x array and a y array.

The XY graph also accepts an array of clusters of plots where a plot is an array of points. A point is a cluster that contains an x value and a y value.

The XY graph also accepts an array of clusters of plots where a plot is an array of complex data, in which the real part is plotted on the x-axis and the imaginary part is plotted on the y-axis.

INTENSITY GRAPHS AND CHARTS

Use the intensity graph and chart to display 3D data on a 2D plot by placing blocks of color on a Cartesian plane.

For example, you can use an intensity graph or chart to display patterned data, such as temperature patterns and terrain, where the magnitude represents altitude.

The intensity graph and chart accept a 3D array of numbers. Each number in the array represents a specific color. The indexes of the elements in the 2D array set the plot locations for the colors. Figure 7.7 shows the concept of the intensity chart operation.

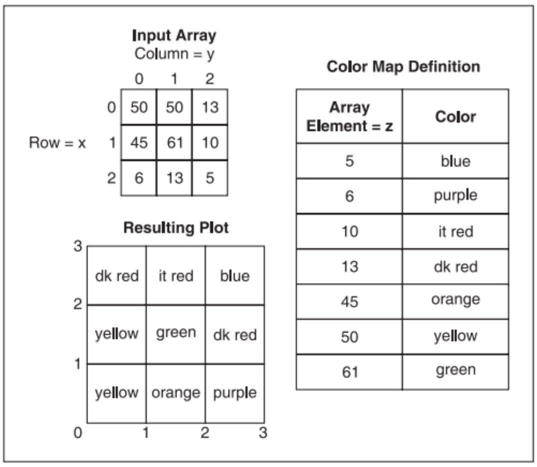


Figure 7.7 Intensity chart operation.

The rows of the data pass into the display as new columns on the graph or chart. If you want rows to appear as rows on the display, wire a 2D array data type to the graph or chart, right-click the graph or chart, and select Transpose Array from the shortcut menu.

The array indexes correspond to the lower-left vertex of the block of color. The block of color has a unit area which is the area between the two points, as defined by the array indexes. The intensity graph or chart can display up to 256 discrete colors.

Intensity Charts

After you plot a block of data on an intensity chart, the origin of the Cartesian plane shifts to the right of the last data block. When the chart processes new data, the new data values appear to the right of the old data values.

When a chart display is full, the oldest data values scroll off the left side of the chart.

This behavior is similar to the behavior of a strip chart. Figure 7.8 shows an example of an intensity chart. The intensity chart shares many of the optional parts of the waveform chart, including the scale legend and graph palette, which you can show or hide by right-clicking the chart and selecting Visible Items from the shortcut menu.

In addition, because the intensity chart includes color as a third dimension, a scale similar to a color ramp control defines the range and mappings of values to colors. Like the waveform chart, the intensity chart maintains a history of data, or buffer, from previous updates.

Right-click the chart and select Chart History Length from the shortcut menu to configure the buffer. The default size for an intensity chart is 128 data points. The intensity chart display can be memory intensive.

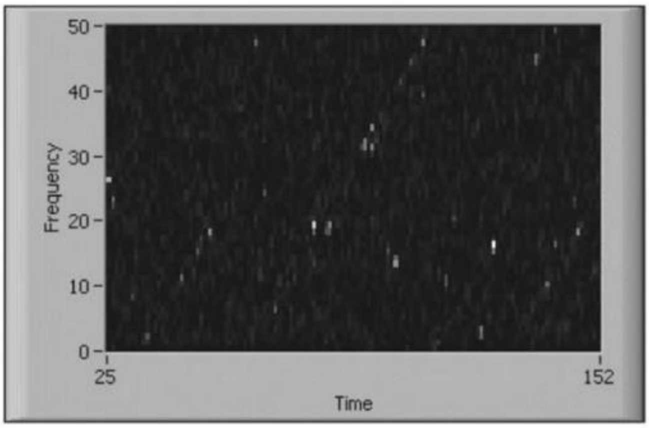


Figure 7.8 An intensity chart.

Intensity Graphs

The intensity graph works the same as the intensity chart, except it does not retain previous data values and does not include update modes. Each time new data values pass to an intensity graph; the new data values replace old data values.

Like other graphs, the intensity graph can have cursors. Each cursor displays the x, y and z values for a specified point on the graph.

Using Color Mapping with Intensity Graphs and Charts

An intensity graph or chart uses color to display 3D data on a 2D plot. When you set the color mapping for an intensity graph or chart, you configure the color scale of the graph or chart.

The color scale consists of at least two arbitrary markers, each with a numeric value and a corresponding display color.

The colors displayed on an intensity graph or chart correspond to the numeric values associated with the specified colors. Color mapping is useful for visually indicating data ranges, such as when plot data exceeds a threshold value. You can set the color mapping interactively for the intensity graph and chart the same way you define the colors for a color ramp numeric control.

You can set the color mapping for the intensity graph and chart programmatically by using the property node in two ways. Typically, you specify the value-to-color mappings in the property node. For this method, specify the Z scale: Marker Values property. This property consists of an array of clusters in which each cluster contains a numeric limit value and the corresponding color to display for that value. When you specify the color mapping in this manner, you can specify an upper out-of-range color using the Z scale: High Color property and a lower out-of-range color using the Z scale: Low Color property.

The intensity graph and chart are limited to a total of 254 colors, with the lower and upper out-of-range colors bringing the total to 256 colors. If you specify more than 254 colors, the intensity graph or chart creates the 254-color table by interpolating among the specified colors. If you display a bitmap on the intensity graph, you specify a color table using the Color Table property. With this method, you can specify an array of up to 256 colors.

Data passed to the chart are mapped to indexes in this color table based on the color scale of the intensity chart. If the color scale ranges from 0 to 100, a value of 0 in the data is mapped to index 1, and a value of 100 is mapped to index 254 with interior values interpolated between 1 and 254. Anything below 0 is mapped to the out-of-range below color (index 0), and anything above 100 is mapped to the out of-range above color (index 255).

If you display a bitmap on the intensity graph, you specify a color table using the *Color Table* property. With this method, you can specify an array of up to 256 colors. Data passed to the chart are mapped to indexes in this color table based on the color scale of the intensity chart. If the color scale ranges from 0 to 100, a value of 0 in the data is mapped to index 1, and a value of 100 is mapped to index 254 with interior values interpolated between 1 and 254. Anything below 0 is mapped to the out-of-range below color (index 0), and anything above 100 is mapped to the out-of-range above color (index 255).

7.8 DIGITAL WAVEFORM GRAPHS

Use the digital waveform graph to display digital data, especially when you work with timing diagrams or logic analyzers. The digital waveform graph accepts the digital waveform data type, the digital data type, and an array of those data types as an input. By default, the digital waveform graph collapses digital buses, so the graph plots digital data on a single plot. If you wire an array of digital data, the digital waveform graph plots each element of the array as a different plot in the order of the array.

The digital waveform graph in Figure 7.9 shows the front panel plots digital data on a single plot. The VI converts the numbers in the *Numbers* array to digital data and displays the binary representations of the numbers in the *Binary Representations* digital data indicator. In the digital graph, the number 0 appears without a top line to symbolize that all the bit values are zero. The number 255 appears without a bottom line to symbolize that all the bit values are 1. Right-click the *y*-scale and select *Expand Digital Buses* from the shortcut menu to plot each sample of digital data. Each plot represents a different bit in the digital pattern. The digital waveform graph in Figure 7.10 shows the front panel displays the six numbers in the *Numbers* array.

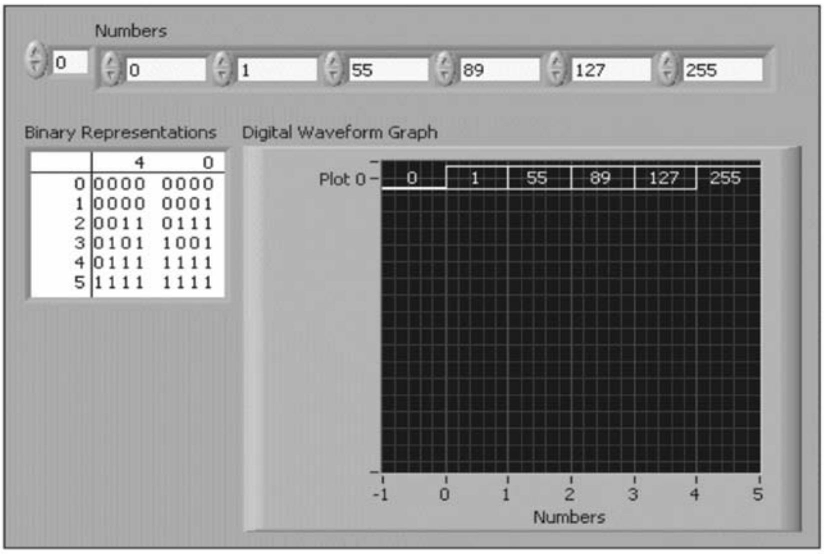


Figure 7.9 Digital waveform graph.

7.9 3D GRAPHS

For many real-world data sets such as the temperature distribution on a surface, joint time-frequency analysis and the motion of an airplane, you need to visualize data in three dimensions. With the 3D graphs, you can visualize three-dimensional data and alter the way that data appears by modifying the 3D graph properties.

LabVIEW includes the following types of 3D graphs:

- **3D surface graph:** Draws a surface in 3D space.
- **3D parametric surface graph:** Draws a parametric surface in 3D space.
- **3D curve graph:** Draws a line in 3D space.

Use the 3D graphs in conjunction with the 3D Graph VIs to plot curves and surfaces. A curve contains individual points on the graph, each point having an *x*, *y* and *z* coordinates. The VI then connects these points with a line. A curve is ideal for visualizing the path of a moving object, such as the flight path of an airplane. Figure 7.12 shows an example of a 3D curve graph.

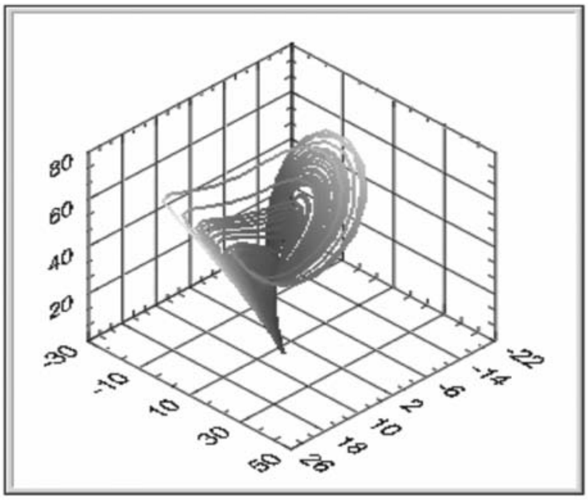
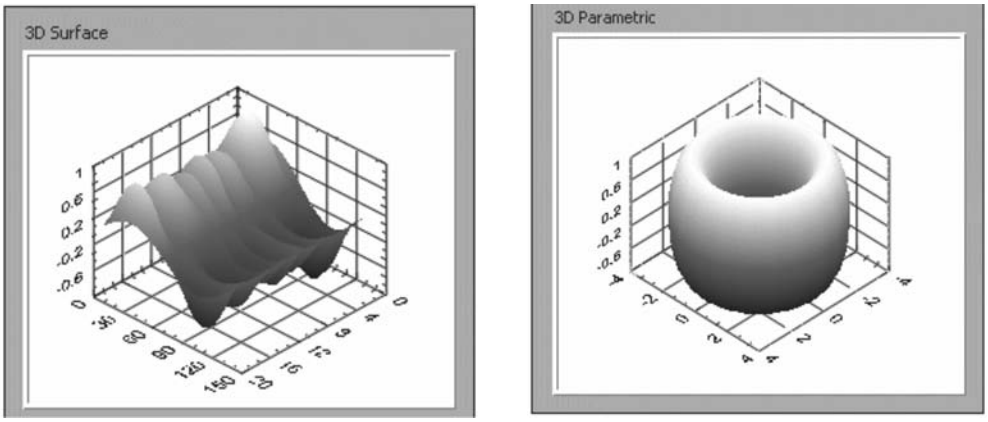


Figure 7.12 A 3D curve graph.

A surface plot uses *x*, *y* and *z* data to plot points on the graph. The surface plot then connects these points forming a three-dimensional surface view of the data. For example, you could use a surface plot for terrain mapping. Figure 7.13(a) shows examples of a 3D surface graph and Figure 7.13(b) shows a 3D parametric surface graph. The 3D graphs use ActiveX technology and VIs that handle 3D representation. When you select a 3D graph, LabVIEW places an ActiveX container on the front panel that contains a 3D graph control. LabVIEW also places a reference to the 3D graph control on the block diagram. LabVIEW wires this reference to one of the three 3D Graph VIs.



(a) (b)

Figure 7.13 (a) A 3D surface graph and (b) A 3D parametric surface graph.

7.10 CUSTOMIZING GRAPHS AND CHARTS

Each graph and chart includes many options that you can use to customize appearance, convey more information, or highlight data. Although graphs and charts plot data differently, they have several common options that you access from the shortcut menu. However, some options are available only for a specific type of graph or chart.

7.10.1 Using Multiple X- and Y-Scales

All graphs support multiple *x*- and *y*-scales, and all charts support multiple *y*-scales. Use multiple scales on a graph or chart to display multiple plots that do not share a common *x*- or *y*-scale. Right-click the scale of the graph or chart and select *Duplicate Scale* from the shortcut menu to add multiple scales to the graph or chart.

7.10.2 Autoscaling

All graphs and charts can automatically adjust their horizontal and vertical scales to fit the data you wire to them. This behavior is called *autoscaling*. Right-click the graph or chart and select *X Scale»AutoScale X* or *Y Scale»AutoScale Y* from the shortcut menu to turn autoscaling ON or OFF. By default, autoscaling is enabled for the graph or chart. However, autoscaling can slow performance. Use the operating tool or the labeling tool to change the horizontal or vertical scale directly.

7.10.3 Formatting X- and Y-Scales

Use the *Format and Precision* page of the *Properties* dialog box to specify how the scales of the *x*-axis and *y*-axis appear on the graph or chart. By default, the *x*-scale is configured to use floating-point notation and have a label of time, and the *y*-scale is configured to use automatic formatting and have a label of amplitude. To configure the scales for the graph or chart, right-click the graph or chart and select *Properties* from the shortcut menu to display the *Graph Properties* dialog box or *Chart Properties* dialog box.

Use the *Format and Precision* page of the *Properties* dialog box to specify a numeric format for the scales of a graph or chart. Click the *Scales* tab to rename the scale and to format the appearance of the axis scale. By default, a graph or chart scale displays up to six digits before automatically switching to exponential notation. On the *Format and Precision* page, select *Advanced editing mode* to display the text options that let you enter format strings directly. Enter format strings to customize the appearance and numeric precision of the scales.

7.10.4 Using the Graph Palette

Use the graph palette, shown as follows, to interact with a graph or chart while the VI is running.

With the graph palette, you can move cursors, zoom and pan the display. Right-click the graph or chart and select *Visible Items»Graph Palette* from the shortcut menu to display the graph palette. The graph palette appears with the following buttons, in order from left to right:

Cursor movement tool (graph only)—Moves the cursor on the display.

Zoom—Zooms in and out of the display.

Panning tool—Picks up the plot and moves it around on the display.

Click a button in the graph palette to enable moving the cursor, zooming the display, or panning the display. Each button displays a green LED when it is enabled.

7.10.5 Customizing Graph and Chart Appearance

Customize the appearance of a graph or chart by showing or hiding options. Right-click the graph or chart and select *Visible Items* from the shortcut menu to display or hide the following options:

- **Plot legend**—Defines the color and style of plots. Resize the legend to display multiple plots.
- **Scale legend**—Defines labels for scales and configures scale properties.
- **Graph palette**—Allows you to move the cursor and zoom and pan the graph or chart while a VI runs.
- ***X* scale and *Y* scale**—Formats the *x*- and *y*-scales.
- **Cursor legend** (graph only)—Displays a marker at a defined point coordinate. You can display multiple cursors on a graph.
- **X scrollbar**—Scrolls through the data in the graph or chart. Use the scroll bar to view data that the graph or chart does not currently display.
- **Digital display** (waveform chart only)—Displays the numeric value of the chart.

7.10.6 Exporting Images of Graphs, Charts, and Tables

You can include black and white images of graphs, charts, tables, and digital data and digital waveform controls and indicators into presentations, email, text documents, and so on. When you export a simplified image, LabVIEW exports only the control or indicator, digital display, plot legend, and index display and does not export scrollbars, the scale legend, the graph palette or the cursor palette.

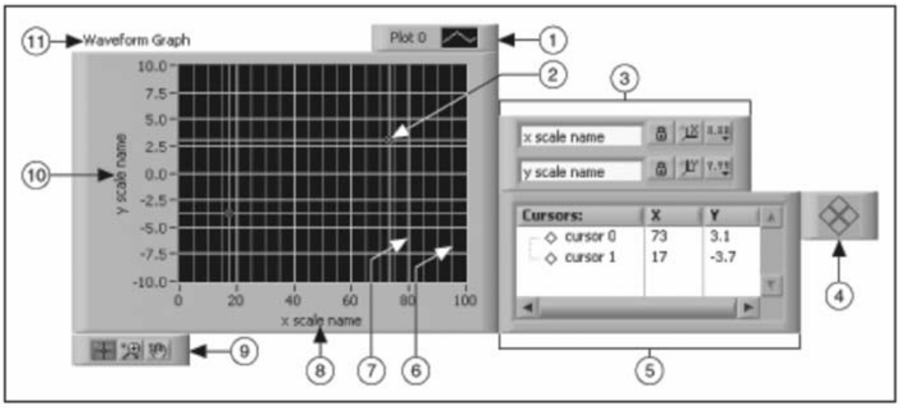
You can export images into the following formats:

Windows .emf, .bmp and .eps files
Mac .pict, .bmp and .eps files
Linux .bmp and .eps files

You can save the image to the clipboard or to disk.

7.11 CUSTOMIZING GRAPHS 7.11 IS NOT IN THE SYLLABUS

Each graph includes options that you can use to customize the graph to match your data display requirements. For example, you can modify the behavior and appearance of graph cursors or configure graph scales. Figure 7.14 shows the elements of a graph.



1 Plot legend	4 Cursor mover	7 Grid mark	10 Y-scale
2 Cursor	5 Cursor legend	8 X-scale	11 Label
3 Scale legend	6 Minor-grid mark	9 Graph palette	

Figure 7.14 The elements of a graph.

You add most of the items listed in the legend above by right-clicking the graph, selecting *Visible Items* from the shortcut menu, and selecting the appropriate element. Right-click the graph and select the option from the shortcut menu to set the graph option.

7.11.1 Using Graph Cursors

Use a cursor on a graph to read the exact value of a point on a plot or a point in the plot area. The cursor value displays in the cursor legend. Figure 7.15 shows an example of a graph using multiple cursors. Right-click the graph and select *Visible Items»Cursor Legend* from the shortcut menu to view the cursor legend. Add a cursor to the graph by right-clicking anywhere in the cursor legend, selecting *Create Cursor*, and selecting a cursor mode from the shortcut menu.

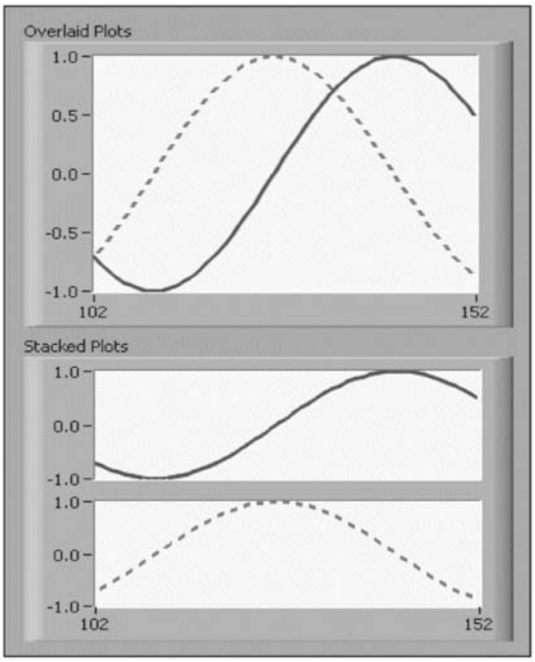


Figure 7.18 Overlaid plots and stacked plots.

From 7.15

7.14 DYNAMICALLY FORMATTING WAVEFORM GRAPHS

Wire a dynamic data type output to a waveform graph to automatically format the plot legend and *x*-scale time stamp for the graph. For example, if you configure the Simulate Signal Express VI to generate a sine wave and to use absolute time and wire the output of the Simulate Signal Express VI to a waveform graph, the plot legend of the graph automatically updates the plot label to sine, and the *x*-scale displays the time and date when you run the VI. Right-click the graph and select *Ignore Attributes* from the shortcut menu to ignore the plot legend label the dynamic data includes. Right-click the graph and select *Ignore Time Stamp* from the shortcut menu to ignore the time stamp configuration the dynamic data includes.

7.15 CONFIGURING A GRAPH OR CHART

Right-click a graph or chart and select one of the following shortcut menu options to configure a graph or chart.

Stack Plots—Stacks the plots. Remove the checkmark from this shortcut menu option to overlay the plots. This option is available only for charts.

Chart History Length—Launches the *Chart History Length* dialog box. This option is available only for charts.

Transpose Array—Switches the *x*- and *y*-data before plotting. You also can use the *Transpose Array* property to switch the *x*- and *y*-data before plotting programmatically.

Autosize Legend—Automatically resizes the plot legend to the width of the longest plot name visible in the legend.

You also can configure the *x*- and *y*-axes on a graph or chart.

7.16 DISPLAYING SPECIAL PLANES ON THE XY GRAPH

You can display Nyquist planes, Nichols planes, *S* planes and *Z* planes on the *XY* graph.

7.16.1 Displaying a Nyquist Plane

Complete the following steps to display a Nyquist plane.

Step 1: Place an *XY* graph on the front panel.

Step 2: Double-click the minimum and maximum values on the *x*- and *y*-scale and change both minimum values to –1 and both maximum values to 1.

Step 3: Right-click the *XY* graph and select *Optional Plane»Nyquist* from the shortcut menu.

Step 4: (Optional) To view the Nyquist plane without labels, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show Nyquist Labels* shortcut menu item.

Step 5: (Optional) To view the Nyquist plane without the Cartesian lines, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show Cartesian Lines* shortcut menu item.

To remove the Nyquist plane, right-click the *XY* graph and select *Optional Plane»None* from the shortcut menu. Figure 7.19 shows a Nyquist plane without the Cartesian lines.

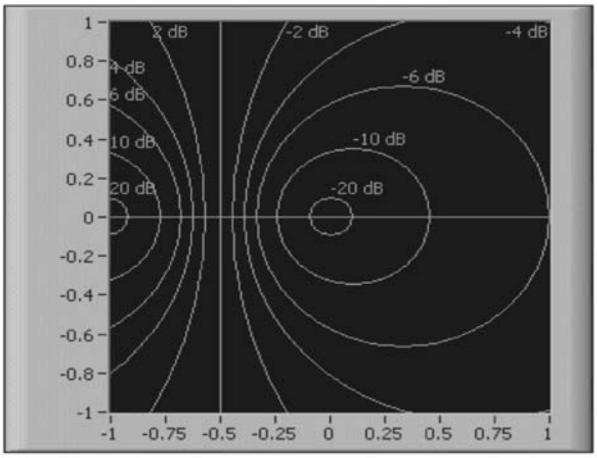


Figure 7.19 Nyquist plane without the Cartesian lines.

7.16.2 Displaying a Nichols Plane

Complete the following steps to display a Nichols plane.

Step 1: Place an *XY* graph on the front panel.

Step 2: Double-click the minimum and maximum values on the *x*-scale and change the minimum value to 0 and the maximum value to 360.

Step 3: Double-click the minimum and maximum values on the *y*-scale and change the minimum value to –40 and the maximum value to 20.

Step 4: Right-click the *XY* graph and select *Optional Plane»Nichols* from the shortcut menu.

Step 5: (Optional) To view the Nichols plane without labels, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show Nichols Labels* shortcut menu item.

Step 6: (Optional) To view the Nichols plane without the Cartesian lines, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show Cartesian Lines* shortcut menu item.

To remove the Nichols plane, right-click the *XY* graph and select *Optional Plane»None* from the shortcut menu. Figure 7.20 shows a Nichols plane without the Cartesian lines.

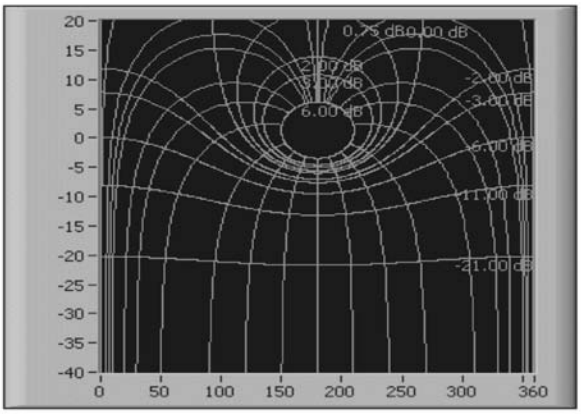


Figure 7.20 Nichols plane without the Cartesian lines.

7.16.3 Displaying an S Plane

Complete the following steps to display an S plane.

Step 1: Place an *XY* graph on the front panel.

Step 2: Double-click the minimum and maximum values on the *x*-scale and change the minimum value to –1 and the maximum value to 0.

Step 3: Double-click the minimum and maximum values on the *y*-scale and change the minimum value to –1 and the maximum value to 1.

Step 4: Right-click the *XY* graph and select *Optional Plane»S Plane* from the shortcut menu.

Step 5: (Optional) To view the S plane without labels, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show S Plane Labels* shortcut menu item.

Step 6: (Optional) To view the S plane without the Cartesian lines, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show Cartesian Lines* shortcut menu item.

To remove the *S* plane, right-click the *XY* graph and select *Optional Plane»None* from the shortcut menu. Figure 7.21 shows an *S* plane without the Cartesian lines.

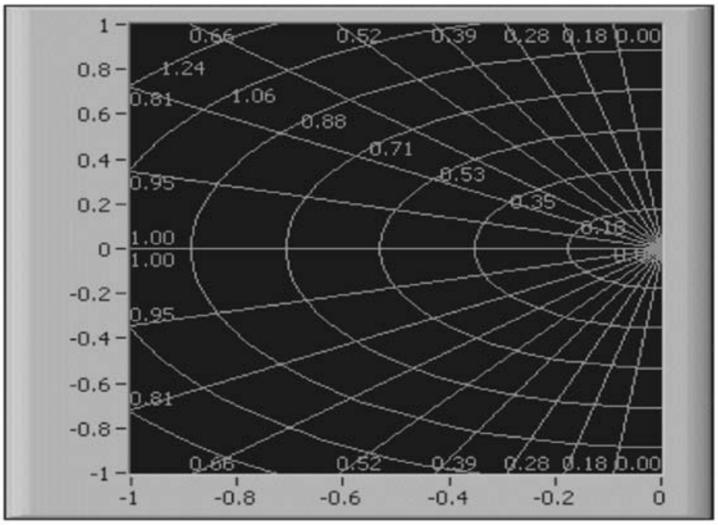


Figure 7.21 S plane without the Cartesian lines.

7.16.4 Displaying a *Z* Plane

Complete the following steps to display a *Z* plane.

Step 1: Place an *XY* graph on the front panel.

Step 2: Double-click the minimum and maximum values on the *x*- and *y*-scale and change both minimum values to –1 and both maximum values to 1.

Step 3: Right-click the *XY* graph and select *Optional Plane»Z Plane* from the shortcut menu.

Step 4: (Optional) To view the *Z* plane without labels, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show Z Plane Labels* shortcut menu item.

Step 5: (Optional) To view the *Z* plane without the Cartesian lines, right-click the *XY* graph and remove the checkmark from the *Optional Plane»Show Cartesian Lines* shortcut menu item.

To remove the *Z* plane, right-click the *XY* graph and select *Optional Plane»None* from the shortcut menu. Figure 7.22 shows a *Z* plane without the Cartesian lines.

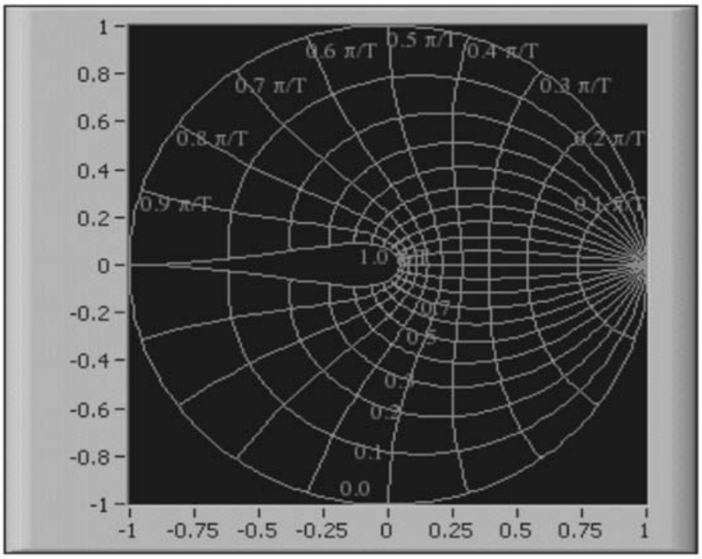


Figure 7.22 *Z* plane without the Cartesian lines.

SUMMARY

- The waveform chart is a special numeric indicator that displays one or more plots.
- The waveform chart has the following three update modes:
  - A strip chart shows running data continuously scrolling from left to right across the chart.
  - A scope chart shows one item of data, such as a pulse or wave, scrolling partway across the chart from left to the right.
  - A sweep display is similar to an EKG display. A sweep works similarly to a scope except it shows the old data on the right and the new data on the left separated by a vertical line.
- Waveform graphs and *XY* graphs display data from arrays.
- Right-click a waveform chart or graph or its components to set attributes of the chart and its plots.
- You can display more than one plot on a graph using the *Build Array* function located on the *Functions»All Functions»Array* palette and the *Bundle* function located on the *Functions»All Functions»Cluster* palette for charts and *XY* graphs. The graph becomes a multiplot graph when you wire the array of outputs to the terminal.
- You can use intensity charts and graphs to plot three-dimensional data. The third dimension is represented by different colors corresponding to a color mapping that you define. Intensity charts and graphs are commonly used in conjunction with spectrum analysis, temperature display, and image processing.
- When you wire data to charts and graphs, use the *Context Help* window to determine how to wire them.
- You can display Nyquist planes, Nichols planes, *S* planes, and *Z* planes on the *XY* graph.