

# ***MATRIXx™***

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## **SystemBuild™ Interactive Animation User Guide**

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# Conventions

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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 note, which alerts you to important information.



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

**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. This font 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.

**`monospace bold`** Bold text in this font denotes the messages and responses that the computer automatically prints to the screen. This font also emphasizes lines of code that are different from the other examples.

*`monospace italic`* Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

**Platform** Text in this font denotes a specific platform and indicates that the text following it applies only to that platform.

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# Introduction

The Interactive Animation (IA) module provides the capability to create, edit, and operate displays for interacting with and monitoring models executing in a simulation environment. The IA package provides multiple palettes of icons, which can be used to build .pic files for command-driven simulation, or can be integrated into SystemBuild block diagrams for Interactive Simulation (ISIM).

## Manual Organization

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This guide includes the following chapters:

- Chapter 1, *Introduction*, introduces Interactive Animation.
- Chapter 2, *IA Builder*, explains the Builder utility, which is used to create the pictures that you use while simulating and interacting with your model.
- Chapter 3, *IA Compiler and Utilities*, provides instructions on how to use the IA compiler and utility modules.
- Chapter 4, *Animation Configuration File*, explains how to use the IA configuration file.
- Chapter 5, *IA Connection Editor*, describes the method for connecting icons together.
- Chapter 6, *Creating an Interactive Animation Picture*, provides a detailed account of how to use the IA features.

This guide also has an *Index*.

# Support for the IA Module

This module is available to new users but has been superseded by the Altia Design and Altia FacePlate software packages. Existing users (those upgrading an existing Altia license) can use IA as follows:

- If you are a current user of Interactive Animation, NI recommends that you convert your Interactive Animation picture files (\*.pic) to Altia Design or Altia FacePlate (\*.dsn) files. You can use the pictodsx Xmath command to convert .pic files to .dsn files as described in the Altia documentation on the documentation CD.
- If you choose to continue using the Interactive Animation module described in this document, please be aware that this module may be discontinued in a future MATRIXx release.

## Starting IA from SystemBuild



To start IA from SystemBuild, load a model—for example, the SuperCruise demo—and then click the IA button on the toolbar. The **Animation Palette** appears, as shown in Figure 1-1.

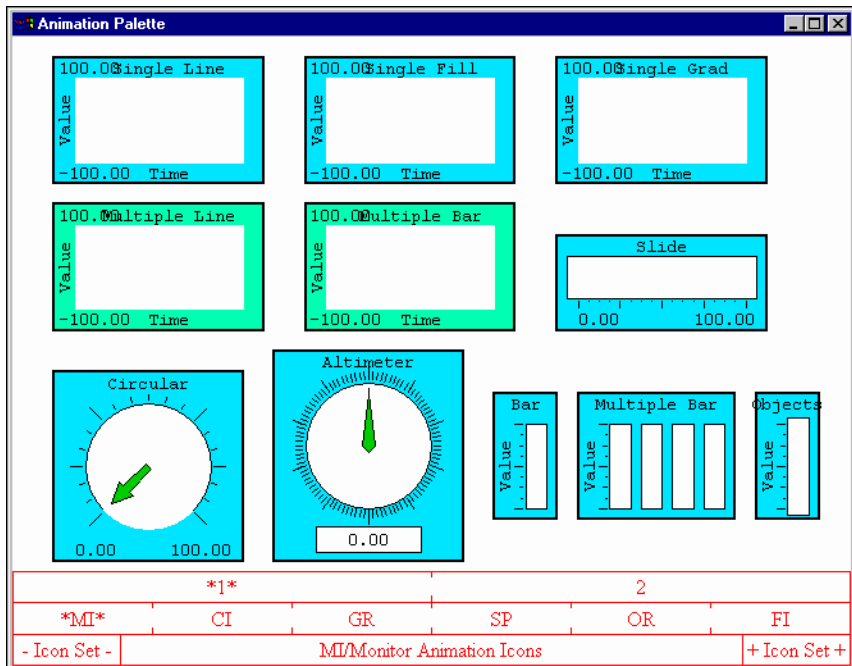


Figure 1-1. Animation Palette

The focus of the palette is indicated by leading and trailing asterisks—for example, \*MI\* for the measurement icons as shown in Figure 1-1.

The following palette views are available:

*MI*	Monitor icons where view 1 (MI-1) is for gauges and view 2 (MI-2) is for LEDs
CI	Analog and digital control icons where view 1 is for switches and view 2 is for multiplexor and two demultiplexor and Demux icons
GR	Miscellaneous graphical shapes
SP	Special clip-art graphics
OR	The ORiginal animation icons (pumps, pipes, and valves)
AL	Alarm icons when running simulation
FI	Scaling icons

For more information on these palettes, refer to the *Icon Palettes* section of Chapter 2, *IA Builder*.

## Using IA

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IA icons can be used for simulation in two ways:

- Using icons
- Using .pic files

### Using Icons

You can use the IA icon palettes directly from the **Animation Palette**, or you can access the icons from Interactive Simulation (ISIM) mode. For a description of ISIM, refer to Chapter 9, *Interactive Simulation*, of the *SystemBuild User Guide*.

To view the **Animation Palette**, click the **IA** button on the **SuperBlock Editor** toolbar. Use your mouse to select and place these icons on the SystemBuild workspace. You can connect these icons to any other SystemBuild block for monitoring and interaction. A SuperBlock that contains only IA can function as a display panel. For details of using IA icons directly, refer to Chapter 6, *Creating an Interactive Animation Picture*.

Previous IA users can use the IA translate option to translate picture files from earlier versions to SystemBuild SuperBlocks. The translated SuperBlock will then be viewable when running ISIM. Refer to the [IA Translator](#) section of Chapter 3, [IA Compiler and Utilities](#), for a description of how to use the IA translate capability.

## Using .pic Files

IA icons can be placed on the IA workspace and used to create a .pic file. The IA picture files can be linked to the simulation and used to display and interact with simulations. IA is automatically linked with the simulation and any UserCode Block files. To run IA with a .pic file display, complete the following steps:

1. Copy your .pic files to a local directory.
2. Select a **UserCode Block** from the **User Programmed** palette.
3. Specify `usrial` (or 0) in the **Function Name** text box and make the **File Name** text box blank. Connect the model inputs and outputs.
4. To simulate, select **Simulation** from the **Analysis** menu, or use the `sim( )` function from the **Xmath Commands** window. Notice that you must make a new executable, but you do not need to exit Xmath to do so.

## Starting IA from the Operating System Prompt

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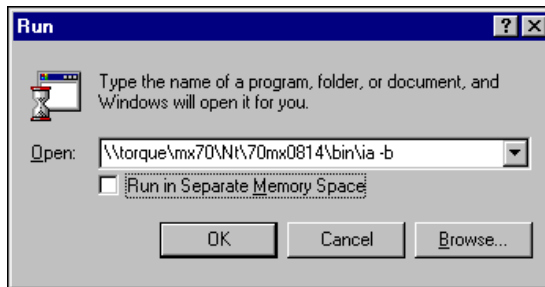
To start IA from the operating system prompt, you can use the `ia` command. The `ia` command runs a script that invokes the IA Builder, Translator, Compiler, or Demo. The `ia` command syntax is as follows:

```
ia[[-v argument] [-]b [-]t [-]c [-]d]
```

`-v` runs the version designated by `argument`. This option is necessary if you are running an earlier version of Interactive Animation with MATRIXx 6.x or later. If you specify `-v`, it must be the first option.

- `-b` Invokes the IA Builder. This is the default if no options are entered. Refer to the [Operations](#) section of Chapter 2, [IA Builder](#).
- `-t` Invokes the IA Translator. Refer to the [IA Translator](#) section of Chapter 3, [IA Compiler and Utilities](#).
- `-c` Invokes the IA Compiler. Refer to the [IA Compiler](#) section of Chapter 3, [IA Compiler and Utilities](#).
- `-d` Invokes the IA Demo menu. Refer to the [IA Demo](#) section of Chapter 3, [IA Compiler and Utilities](#).

As an alternative, you can select **Start»Run** and enter the `ia` command in the **Run** dialog box, as shown in Figure 1-2.



**Figure 1-2.** Run Dialog Box

---

# IA Builder

The Interactive Animation (IA) Builder utility is used to create IA pictures for use in modeling and interacting with a SystemBuild model. Constructing standalone picture files allows you to build up separate display screens to control SystemBuild models. This contrasts with Interactive Simulation (ISIM), which allows you to mix IA-style icons with your SystemBuild blocks, but which runs with simulation only. An IA picture can contain both interactive and display icons, and you can select from several palettes of icons.

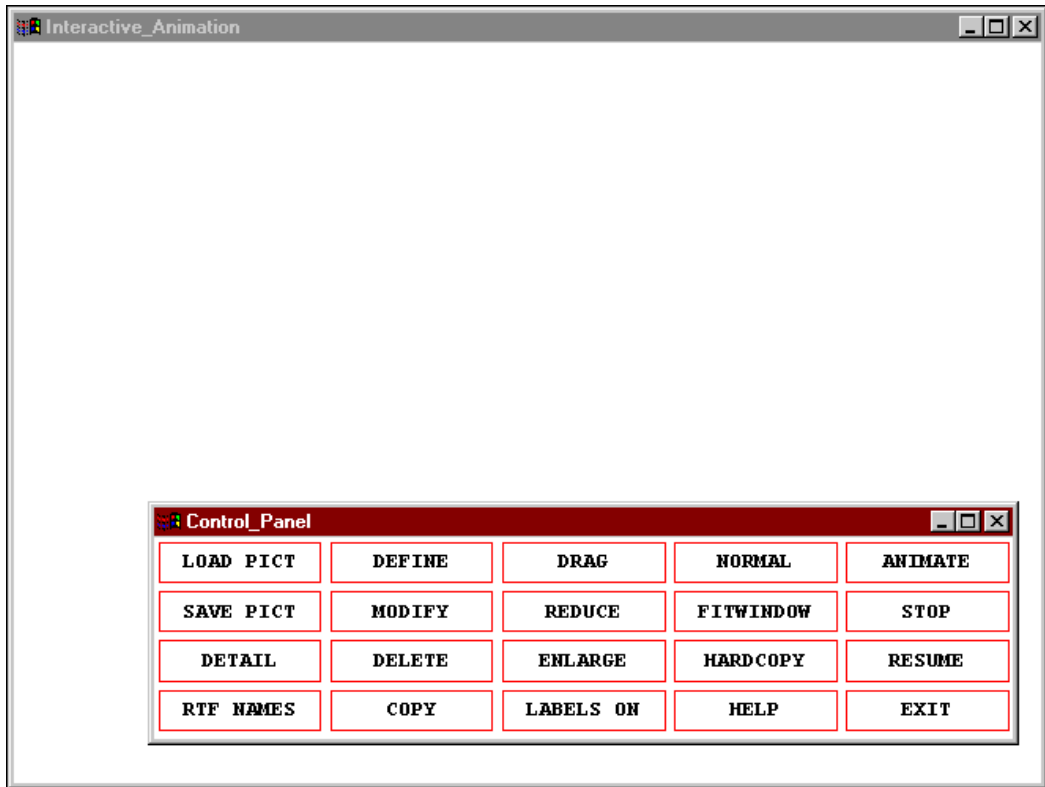
To invoke the IA Builder, use Windows Explorer to select:

```
path-to-MATRIXx\bin\ia.bat
```

or type the following at the operating system prompt or from the **Run** dialog box:

```
path-to-MATRIXx/bin/ia -b
```

When you invoke the IA Builder, two windows appear as shown in Figure 2-1, the IA Builder **build** window and the IA Builder **Control\_Panel**. You create pictures in the **build** window using the animation palettes and the **Control\_Panel**.



**Figure 2-1.** Interactive Animation Build Window and Control\_Panel

A model can have more than one IA picture connected to its top-level SuperBlock. During the simulation, selecting the IA picture displays your information. Only one IA picture can be displayed at a time in the **build** window. Using the process icon, you can “chain” between IA pictures in the IA window.

Conceptually, each IA picture is connected in parallel with the top-level SuperBlock. IA provides three types of pictures:

- **Main IA picture**—The IA picture to be loaded when the IA module starts executing an application.
- **Alarm IA picture**—The IA picture that contains alarm icons for use with the IA module alarm handler.



```

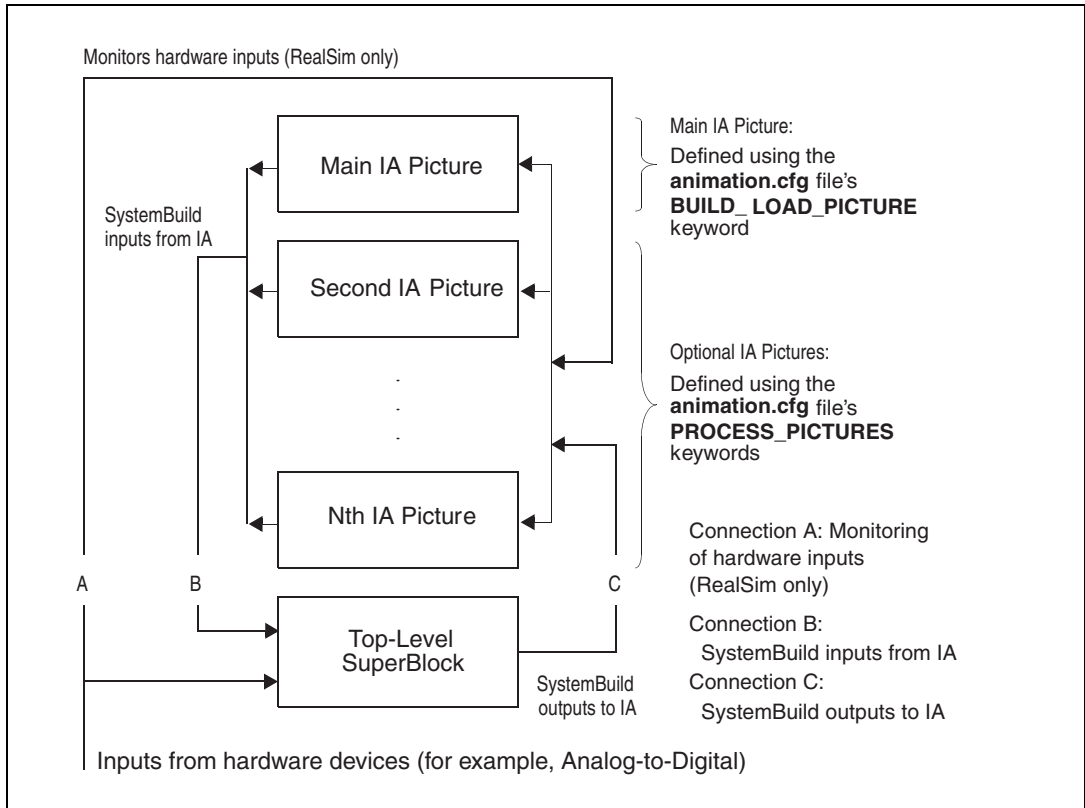
* THESE KEYWORDS INCLUDE THE FOLLOWING DEFAULTS: *
*
* ICON_DATA_FILE: 'etc:isim.sog' *
* ICON_DATA_FILE: 'etc:moni.sog' *
* ICON_DATA_FILE: 'etc:coni.sog' *
* ICON_DATA_FILE: 'etc:graf.sog' *
* ICON_DATA_FILE: 'etc:spec.sog' *
* ICON_DATA_FILE: 'etc:orig.sog' *
* ICON_DATA_FILE: 'etc:alarm.sog' *
*
* ICON_SOURCE_FILE: 'src:moni.src' *
*
* BUILD_CONTROL_PANEL: 'etc:control.sog' *
*
* SAVE_FILE_FORMAT: 'ASCII' or 'BINARY' or 'MATRIX' *
*
* PICTURE_SCALE_FACTOR: '1.0' (+ relative, - absolute) *
*
* THE FOLLOWING COMMANDS SHOULD ONLY BE USED FOR HARDWARE: *
*
* I/O_PROCESSING ==> 'I/O PROCESSING ON' *
*
* CODE_GENERATION_OUTPUT_FILE ==> 'pict.ada' *
*
* ADA_LIBRARY ==> 'pict.alb' *
*
* FREQUENCY_SCALE_FACTOR ==> '1.0' *
*
* HARDWARE_CONNECTION_EDITOR_FILE ==> 'pict.ioc' *
*
*****
*
* STATE YOUR DEFINITIONS BELOW *
*
*****

BUILD_LOAD_PICTURE: 'pict.pic'
SYSTEM_BUILD_RTF_FILE: 'pict.rtf'
SIMULATION_DATA_FILE: 'pict.sim'
SAVE_FILE_FORMAT: 'ASCII'
ALARM_PROCESSING: 'ALARM PROCESSING OFF'
ALARM_WINDOW_PICTURE: 'alarm.pic'

```

For a detailed description of the `animation.cfg` file, refer to Chapter 4, [Animation Configuration File](#).

Refer to Figure 2-2 for an example of multiple picture files.



**Figure 2-2.** Conceptual Layout of IA Pictures

# Operations

The **build** window supports the following operations for creating an IA picture.

- **Selecting Icon(s)**—Click an icon to select it. To select a group of icons, place a rubber-band (marquee) box around the icons.

When one or more icons are selected, a dashed outline appears around the icon(s) with a small square in the upper right corner of the outline.

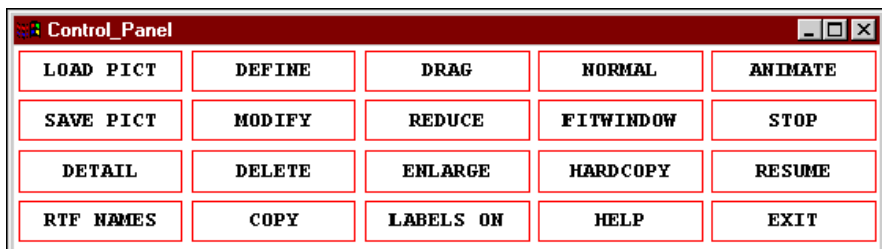
Selecting a single icon is useful for changing an icon's parameters or size. Selecting a group of icons is useful for group operations such as a copy or move.

To move a group of icons, click the upper left corner of the outlined selection box and drag the group to a new location.

- **Resizing an Icon**—To resize an individual icon, select it and then drag the small square in the upper right corner of the selection outline to enlarge or reduce the selection.
- **Refresh**—To refresh the current picture, left-click in the IA Builder workspace.

# Control\_Panel

Each of the **Control\_Panel** buttons is described following. The keywords that set many of the **Control\_Panel** buttons are specified in the `animation.cfg` file.



- **LOAD PICT**—Loads an animation diagram from a picture file and displays it in the **Builder Display** window. Clicking **LOAD PICT** first opens a dialog asking for the picture file name. The default name of the picture file to be loaded is read from the `BUILD_LOAD_PICTURE` keyword. A different picture file can be specified as long as it resides in the local directory. Binary or ASCII picture files can be loaded.

However, binary picture files can be loaded only if they were created on the same platform.

To clear the current build window, go to the **Filename []**: field and type a space. Click **DONE** in the **Load File** dialog box.

- **SAVE PICT**—Saves the current **IA Builder** window to a file. When you click **SAVE PICT**, a Save File dialog box appears. Click **DONE** or press the <Enter> key to save the picture. Click **CANCEL** to abort the operation. The default Save File name is taken from the previously loaded picture file, or the `BUILD_LOAD_PICTURE` keyword if no load was performed.

The picture file that is created is either ASCII or binary, as specified with the `SAVE_FILE_FORMAT` keyword. If you do not specify this keyword in the `animation.cfg` file, the default is ASCII. Pictures in the ASCII format are portable across platforms.

You can use the IA translator to translate picture files to either ASCII or binary, and to the SystemBuild SuperBlock form readable by Xmath or SystemBuild.

- **DETAIL**—Creates a more human-readable file than that produced by **SAVE PICT**. Returns an icon-by-icon listing of the parameters of every icon in the diagram currently displayed on the screen, along with all associated parameters necessary for recreation of the diagram, including data such as the total number of integer, real, and string variables used by the icons, and the stack allocation size for the real, integer, and character variables.

The information is written to an ASCII file identified by the picture name with a `.doc` extension—for example, `project_name.doc` or `picture_file_name.doc`. A context menu displays the message:

**Writing the Document File. Please wait one moment**

This is followed by the message **Document Generated**. You can examine the documentation file with any text editor.

- **RTF NAMES**—Loads the real-time `filename.rtf` file created by SystemBuild from the top-level SuperBlock. The top-level SuperBlock external input and output signal names are loaded for reference by the IA Connection Editor. When the icons are connected, the SystemBuild top level signal names are stored in each icon.

Clicking **RTF NAMES** displays a dialog that specifies the default real-time file identified by the `SYSTEM_BUILD_RTF_FILE` keyword. To load a different `.rtf` file, enter the new name and then click **DONE**. The newly loaded data replaces any currently stored information.

Load a blank `.rtf` file by typing a blank space with the spacebar at the **Filename []**: prompt on the System RTF File dialog box and then clicking **DONE**. This clears all SystemBuild signal names. You cannot use the connection editor until you load a real-time file.

- **DEFINE**—Displays the icon palettes that contain an assortment of IA icons to assemble into an animated diagram of the SystemBuild model. To change from one palette to another, click one of the abbreviations identifying palette type (the rectangles at the bottom of the palette window).



**Note** To display the palettes quickly, double-click the **IA builder** window workspace. The bar along the bottom lets you page through palettes.

- **MODIFY**—Raises a selected icon's definition dialog for entering or changing the icon's parameters.



**Note** To display the dialog for an icon, double-click the icon.

- **DELETE**—Deletes an icon or selected group of icons.
- **COPY**—Duplicates a selected object. Select an icon or a group of icons by clicking or lassoing. Next, click the **COPY** button and drag to the new location; the icons will be redrawn on the up-click. Single-clicking on selected objects will redraw them offset a half-centimeter to the right and above the selection. Click once to deselect grouped items.
- **DRAG**—Moves the entire IA picture in the **build** window. Click in an open space and drag. The pointer turns into a hand and all objects in the window are automatically dragged to new locations.



**Note** Right-click and drag to move the IA picture.

- **REDUCE**—To reduce the picture, click **REDUCE** and then click the screen to decrease the icon size by 10%.



**Note** Right-click in the **IA Builder** window workspace, outside any icons.

- **ENLARGE**—To enlarge the picture, click **ENLARGE** and then click the window to increase the icon size by 10%.



**Note** Double-click the right mouse button in the **IA Builder** window workspace, outside any icons.

- **LABELS ON/OFF**—Labels show the IA icon connections to the **SystemBuild** diagram. **ON** displays the icon labels on the screen; default **OFF** hides them. When labels are on, the button reads **LABELS OFF**, which tells you that the next selection of the button turns the labels off.
- **NORMAL**—Restores the IA picture to the size, but not necessarily the location, when first loaded.
- **FIT WINDOW**—Resizes and centers the contents of the window to allow all icons in the diagram to be displayed.
- **HARDCOPY**—Creates a PostScript (.ps) file of your **IA** screen in your local directory.
- **HELP**—Invokes the **HELP** window, which describes the **Control\_Panel** buttons and all mouse clicks. Left-click to step to the next screen, right-click to step to the previous screen, and click the middle mouse button to exit the **HELP** window. You can press and hold the left or right mouse button to move through multiple screens.
- **ANIMATE**—Runs an open-loop animation on the current **Builder** window based on inputs from a simulation data file containing vectors generated by Xmath. The system prompts for a name that identifies the file, which must be an Xmath ASCII **SAVE** file of  $t$  and  $y$  vectors. Refer to the *Xmath User Guide* for more information.
- **STOP**—Stops the execution of the simulation initiated by **ANIMATE**.
- **HOLD/RESUME**—A toggle that temporarily halts and then restarts the animation sequence initiated by **ANIMATE**. The simulation runs until you click **STOP** or **EXIT** or the time vector is exhausted.
- **EXIT**—Closes the **IA Builder**. If you have made any changes to the IA picture since you last used **SAVE PICT**, a dialog warns you that changes have not been saved. Click **CANCEL** to close the dialog and return to the **Control\_Panel**. Click **DONE** to exit IA without saving.

## Icon Palettes

---

Click **DEFINE** on the IA Builder **Control\_Panel** or double-click the left mouse button in the **IA Builder** window workspace to display palettes of IA icons. You can select icons from these palettes for your IA picture, similar to assembling the block diagrams in SystemBuild. Each icon has its own icon description dialog to define its text, display attributes, and input (Control) or output (Monitor) parameters. Each IA picture can contain up to 1,000 icons. Unless otherwise noted, control refers to signals or data sent to the SystemBuild block diagram from an IA icon or diagram, and Output, Monitor, or Display refer to data placed on the screen by an IA icon or diagram. Analog controls or displays are those that deal with real-valued information. Digital controls or displays work with ones and zeros only.

Each IA icon, with the exception of the text icons, which are not active in simulation, has one or more input or output pins; the meanings of most of the pins are self-explanatory. To view the names of the pins, place the icon in the **SuperBlock Editor** window and click as if to connect it to another block or External Input or Output. The **Connection Editor** displays the names of the pins.

The rest of this section describes the palettes and corresponding icons defined in this section. The monitor animation (MI) and control animation (CI) icons each occupy two palettes; click the numbers **1** and **2** at the bottom of the palette to switch between the palettes. The selected palette is indicated by two asterisks around the number—for example, \*1\* indicates view 1.

Graphics from all of the palettes displayed in this section are also used in the IA demos as described in Chapter 3, *IA Compiler and Utilities*.

- **Monitor Animation Icons, Palettes MI-1 and MI-2**—These palettes, shown in Figure 2-3 and Figure 2-4, contain monitor icons that display outputs of your simulation.

Figure 2-3 shows a palette of strip charts, single and multiple monitor bar charts, a moving object chart, a slide indicator, a circular indicator, and an altimeter indicator with double hands.

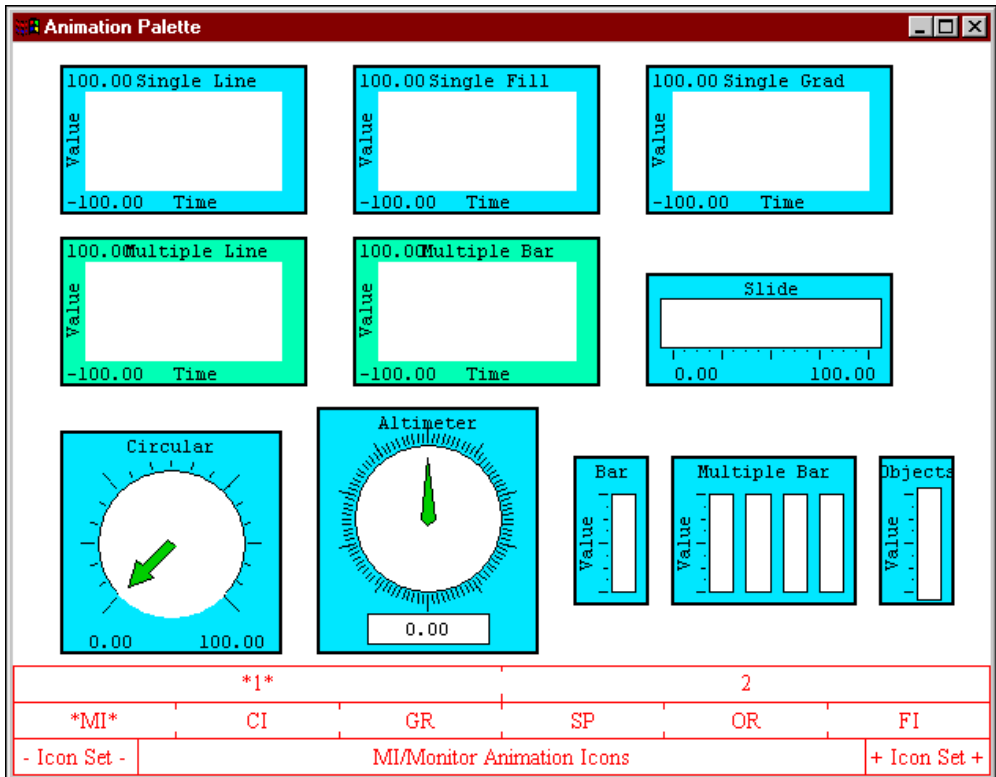
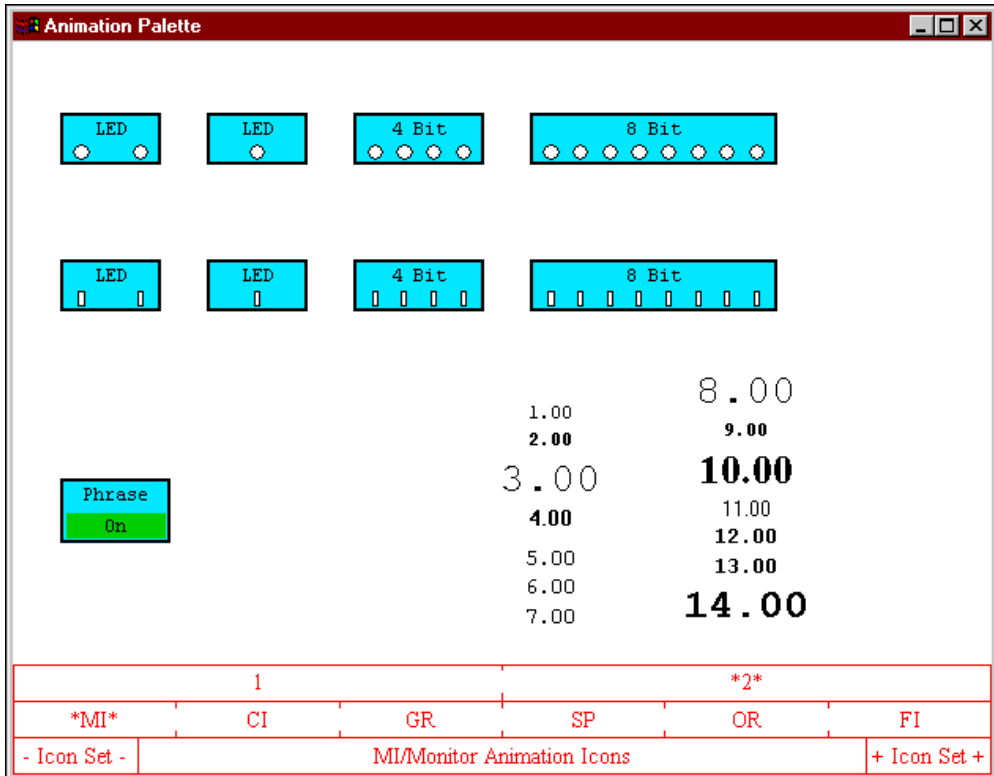


Figure 2-3. Monitor Animation Icons (Palette MI-1)

- Figure 2-4 illustrates eight digital display (LED) icons plus numerical displays and a switchable phrase display. The 4-bit and 8-bit LED displays operate as counters, indicating the values of discrete signals from the SystemBuild model in a binary format, which for 4-bit displays can range from 0 to 15, and for 8-bit displays can range in value from 0 to 255.



**Figure 2-4.** Monitor Animation Icons (Palette MI-2)

The 1-bit and 2-bit monitor displays operate not as counters but as 3-level detectors, with a different color available for each user-defined level. They include circular or rectangular LEDs with different colors denoting either two or three different conditions. You can change the shape of the LEDs from rectangular to circular and back, using the icon dialog box.

An icon that displays one of two or three phrases, depending on a monitor value, also is provided.

Numeric displays are provided in any of 14 supported fonts. The fonts are displayed in Figure 2-5.



**Figure 2-5.** Numeric/Text Display Fonts

- **Controller Animation Icons (CI-1 and CI-2)**—The **Controller Animation** palettes, shown in Figure 2-6 and Figure 2-7, provide signal sources to be sent to your SystemBuild simulation.
- **The CI-1 palette**—This palette, shown in Figure 2-6, provides analog and digital controls. The analog controls include dial, slide, and numeric controls. The digital controls look like switches. To assert a digital signal, click the switch condition you want to activate. When using the analog controls in the **Interactive Animation** module at run-time, you can vary the icon's control values while your simulation/control run is in progress, by clicking and dragging the sliding bar or dial to a different level, by clicking one of the graduations to move the bar or dial to that point, by clicking the middle mouse button on an arrow to display a dialog box for incrementing or decrementing numbers on the scale, or by left-clicking in the numeric display to bring up a dialog box for entering an exact output value.

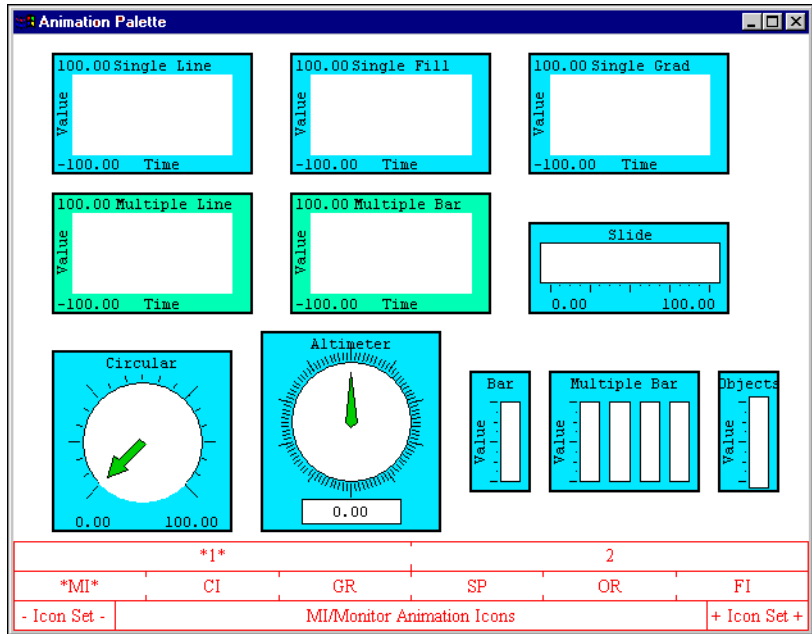
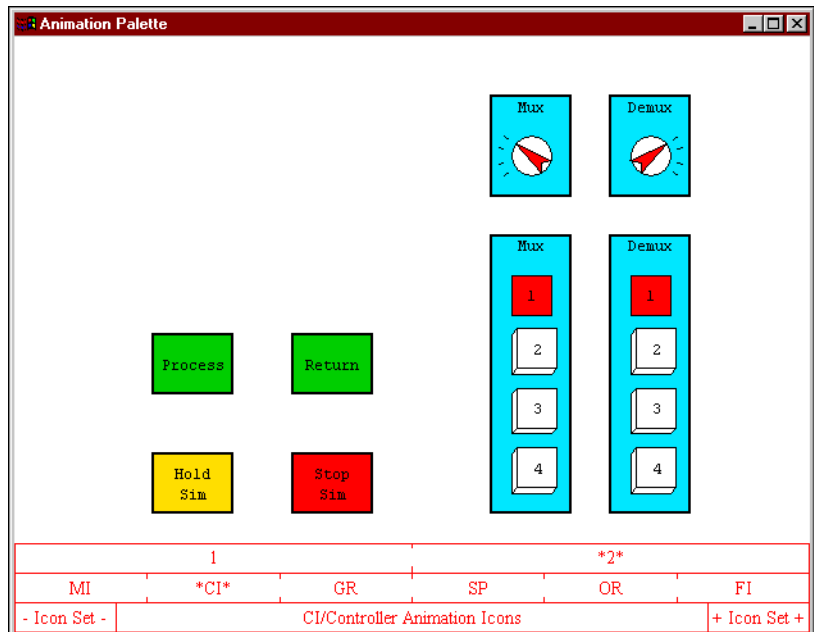


Figure 2-6. Controller Animation Icons (Palette CI-1)

- **The CI-2 Palette**—Figure 2-7 shows two multiplexor and two demultiplexor icons, plus the **Process**, **Return**, **Hold Sim**, and **Stop Sim** buttons.



**Figure 2-7.** Controller Animation Multiplexor Icons (CI-2 Palette)

The **Process** button provides access to other IA diagrams, and the **Return** button returns control to the most recent IA picture. With the **Process** and **Return** buttons, you can create a nest of IA diagrams up to 25 levels deep. The **Stop Sim** and **Hold Sim/Resume Sim** buttons permit you to halt or suspend a simulation run.

Multiplexing (**Mux**) and demultiplexing (**Demux**) buttons and dial icons also are shown. The 4-control **Mux** icon selects one of four controls to be passed to its output. The 4-output **Demux** icon passes its control input to one of four outputs.

The multiplexors accept up to four control inputs and switch one of them to the output, under control of the rotary switch or pushbutton switches. The demultiplexors accept one control and switch it to one of four outputs under control of the rotary switch or pushbutton switches.

- **Graphic Shapes Icons (Palette GR)**—Figure 2-8 shows a palette of general drawing icons that includes a square, lines, a circle and circle segments, arrows, triangles, an octagon, hexagons, various fonts of text, and a title box.

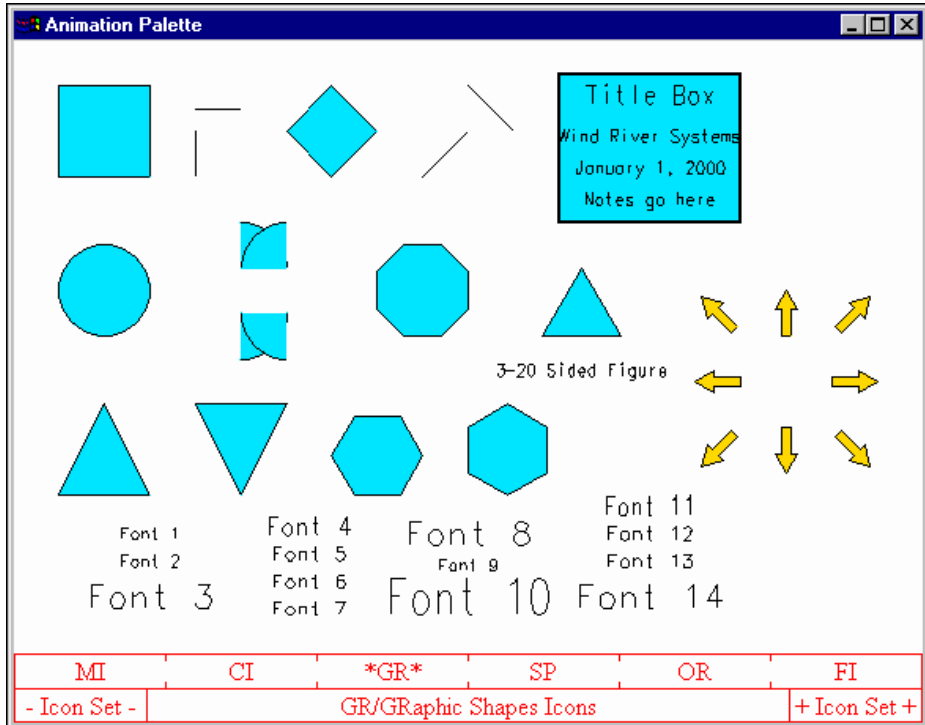


Figure 2-8. Graphic Shapes Icons (Palette GR)

## General Drawing Icon Parameters

- Figure Color: The color palette used in SystemBuild.
- Shade [Light/Medium/Dark]: 20, 60, and 80% shading.
- Border Width: Defined from 1 (normal size) to 5 (very thick). Numbers greater than 5 create distorted widths.

Border Type and Color: Type of line drawn for the border and color choice. Refer to line types in Table 2-1.

Line Widths: Line widths are defined from 1 (normal size) to 20 (very thick).

Line Types: Line types are defined from 0 to 6. Refer to Table 2-1 for the line types.

**Table 2-1.** General Drawing Line Types

Number	Type	Example
0	None	
1	Solid	_____
2	Dots	.....
3	Single-Spaced Dots	. . . . .
4	Double-Spaced Dots	. . . . .
5	Dot-Dash	. - . - . - . - .
6	Dashed Line	-----

- Special Animation Icons (SP Palette)**—The **Special Animation** palette, shown in Figure 2-9, offers a selection of special purpose drawings used in demonstration exercises, such as a battle tank, playing card, traffic light, robot, target, lunar lander, 1973 Corvette, Jet Fighter (top, front, and side views), a turn/slip indicator, and a selector panel (Actuator, Surface, Dynamics, and Sensor).

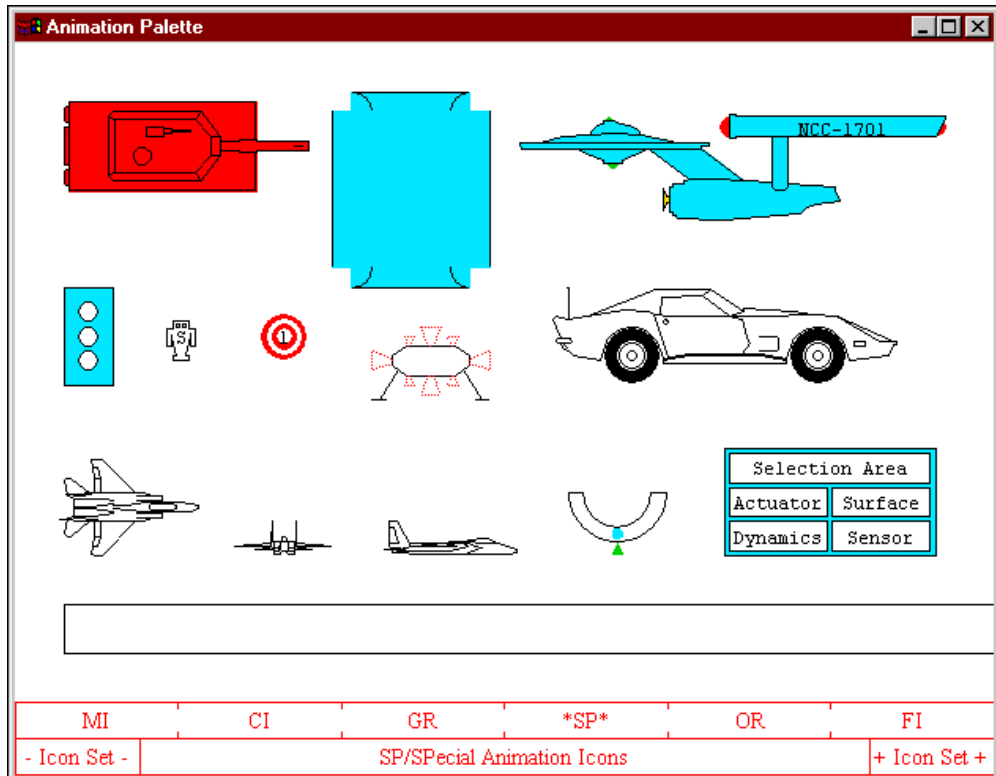
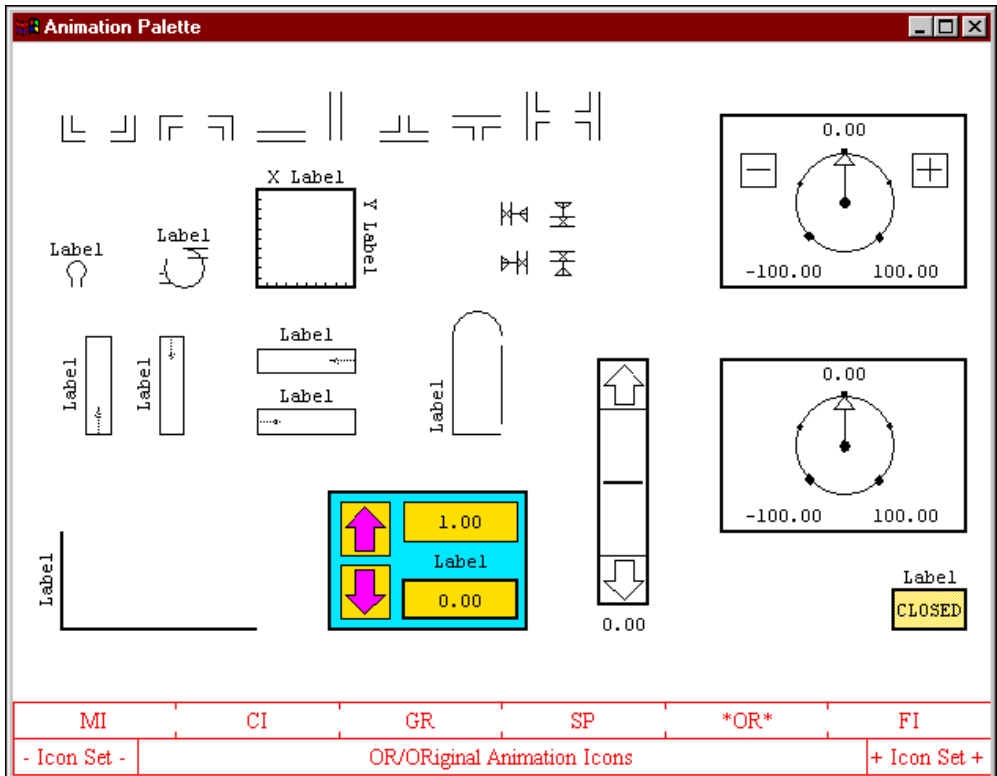


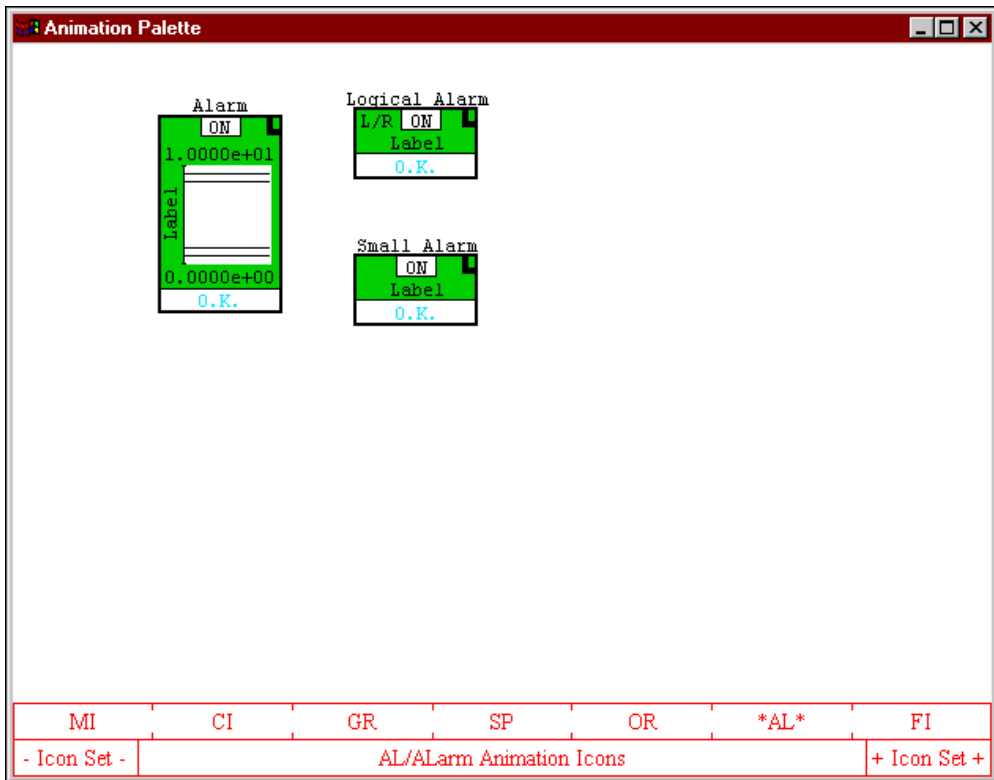
Figure 2-9. Special Animation Icons (SP Palette)

- **Original Animation Icons (OR)**—The original **Animation Icons Palette**, shown in Figure 2-10, contains the original set of IA icons (mainly pump, piping, and valve icons) used for industrial control systems.



**Figure 2-10.** Original Animation Icons (Palette OR)

- **Alarm Icons**—Alarms, as shown in Figure 2-11, call attention to events that may require operator intervention.



**Figure 2-11.** Alarm Icons (AL Palette)

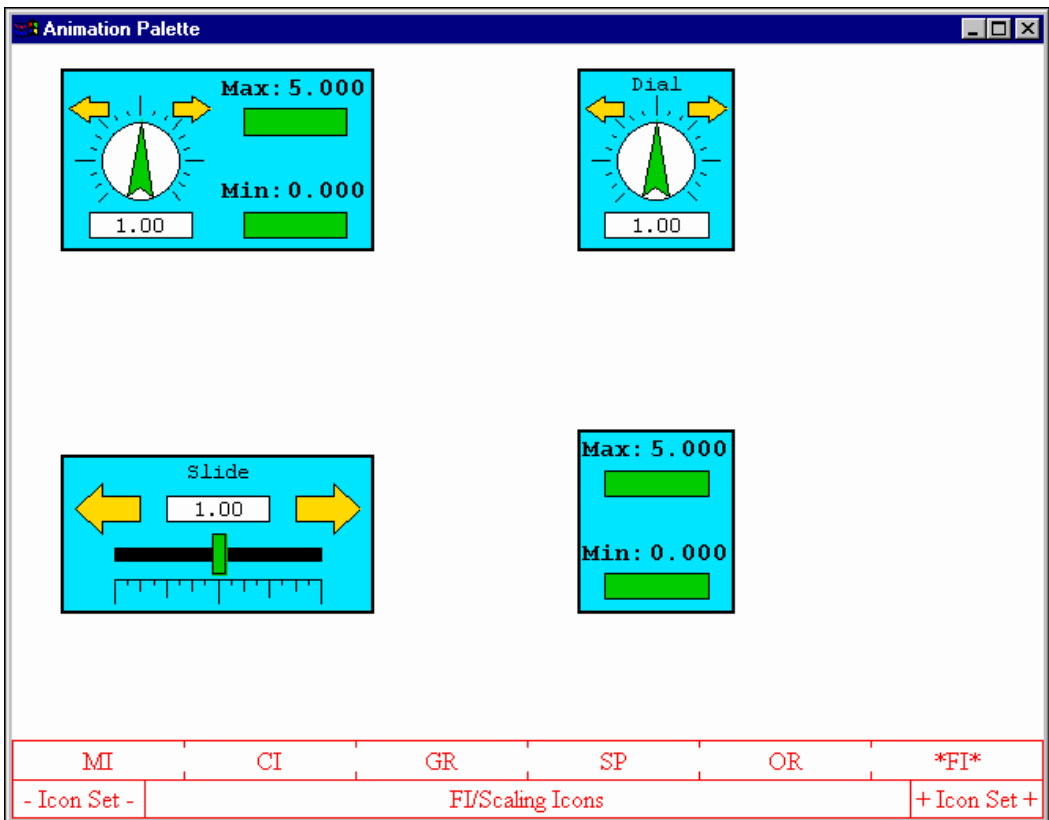
IA triggers alarms during simulation when a threshold is reached with a cushion of hysteresis values to prevent extraneous triggering by minor fluctuations. Messages are displayed to alert the operator.

The small alarm icon takes up less screen space than the regular alarm, but displays less information. The logical alarm reacts to a falling or rising edge of control values rather than maximum or minimum.



**Note** The alarm icons will not show up on the palette or in the IA diagram unless the ALARM\_PROCESSING keyword is set to ALARM PROCESSING ON in the animation.cfg file.

- **Scaling Icons (FI palette)**—The scaling icons, shown in Figure 2-12, include a dial, minimum and maximum indicators, and a slider.



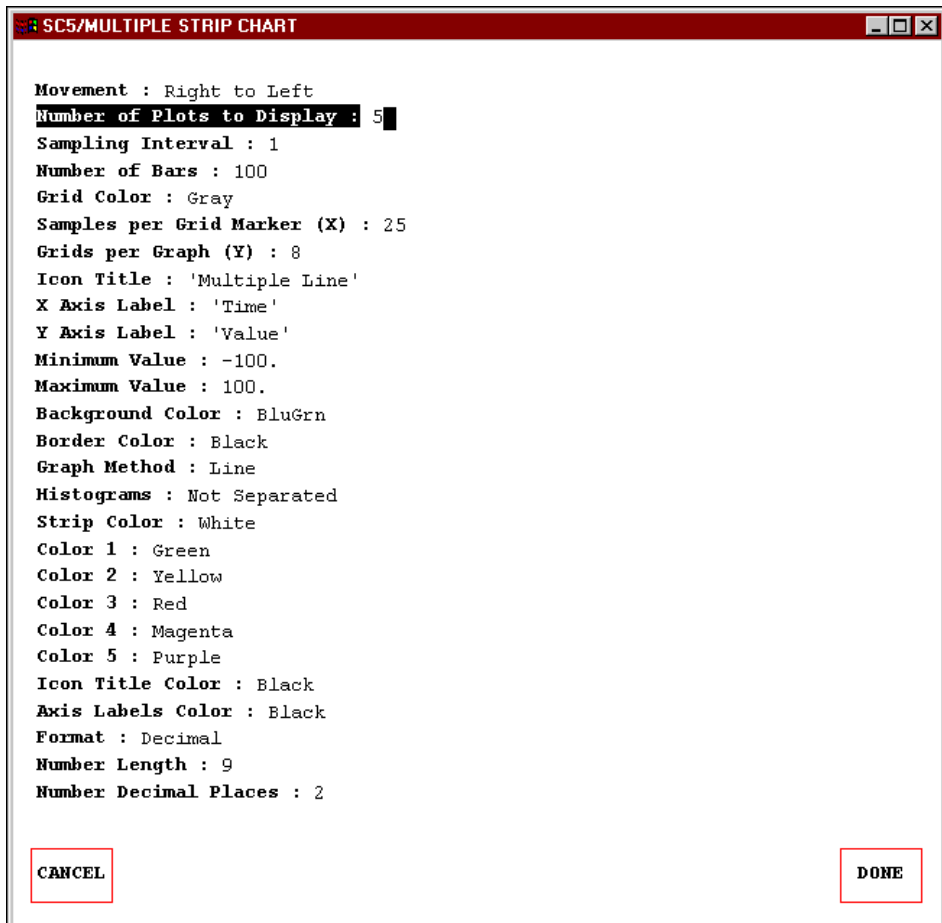
**Figure 2-12.** Scaling Icons (FI Palette)



**Note** The icon on the top left is divided into separate icons on the right (top and bottom).

## Icon Description Dialog

When you double-click an IA icon, its description dialog appears, as shown in Figure 2-13. The icon description dialog is used to enter parameters describing the icon's appearance. After entering information, click **DONE** to apply the changes or **CANCEL** to abort the operation.



**Figure 2-13.** Icon Dialog for the Line Strip Chart Display Icon

The following list provides definitions of the parameters of an icon dialog box. Similar parameters exist for all icons.

- **Movement Left to Right, Right to Left**—Click the **Movement** field to select the direction the strip chart display should move.
- **Number of Plots to Display**—Self-explanatory.

- **Sampling Interval**—The sampling interval that is to be used when sampling the strip chart monitor for display. Click this field to set the sampling interval. For example, a sampling interval of 2 causes the icon to display every second display value received. All display icon values are updated at the same time.
- **Number of Bars**—The number of bars to use in the strip chart. Click this field to set the number of display values in the chart.
- **Graph Input**—The SystemBuild label name providing the source for the strip chart display.
- **Icon Title**—The title for the strip chart. Click this field and then use the keyboard to enter the title.
- **X Axis Label**—X axis label for the strip chart. Click this field and use the keyboard to enter the label.
- **Y Axis Label**—Y axis label for the strip chart. Click this field and use the keyboard to enter the label.
- **Minimum Value**—The minimum value for the display area of the strip chart. Click this field and use the keyboard to enter the minimum (numeric real) value.
- **Maximum Value**—The maximum value for the display area of the strip chart. Click this field and use the keyboard to enter the maximum (real) value.
- **First Threshold to Change Color**—When the monitored value is above this value and below the Second Threshold to Change Color, the First Threshold Color is used to draw the strip chart. Click this field to set the color.
- **Second Threshold to Change Color**—When the monitored value is above this value, the Second Graphing Color is used to draw the strip chart. Click this field to set the color.
- **Background Color**—Color to use for the background of the strip chart. Click this field to set the color.
- **Border Color**—Color to use for the border of the strip chart. Click this field to set the color.
- **Graph Method**—Defines how to display the strip chart. The available choices are **Line**, **Line Fill**, **Grad** (graduated), **Bar**, and **Bar Fill**. Click this field to set the graph method. **Line** displays a line. **Line Fill** displays a line with a solid color fill below the line. **Grad** displays a set of graduated bars. **Bar** displays individual bars for each point. **Bar Fill** fills the bars with color.

- **Histograms**—Sets the strip chart histograms. Click this field to set the histograms. The choices are **Not Separated** and **Separated**.
- **Basic Graphing Color**—Color to use when drawing the graph when the monitored value presented to the strip chart is less than the **First Threshold to Change Color** value.
- **First Threshold Color**—Color to use when drawing the graph when the monitored value presented to the strip chart is greater than the **First Threshold to Change Color** value and less than the **Second Threshold to Change Color**.
- **Second Threshold Color**—Color to use when drawing the graph when the monitored value presented to the strip chart is greater than the **Second Threshold to Change Color** value.
- **Icon Title Color**—Color for strip chart title. Click this field to set the color.
- **Axis Labels Color**—Color for strip chart X and Y axes. Click this field to set the color.
- **Format**—The display for the Y axis range. Click this field to set the format display. The choices are **Exponential** or **Decimal**.
- **Number Length**—Field length for the displayed Y axis ranges. Click and use the keyboard to enter the range (positive integer).
- **Number Decimal Places**—The number of decimal places to use when displaying the Y axis ranges.

---

# IA Compiler and Utilities

This chapter describes the IA compiler, and the IA Translator and IA Demo utilities.

## IA Compiler

---

The IA compiler is used to compile any user-written icon source code or user-modified NI source code. The default source code is in `$SYSBLD/src/` as source files `coni.src`, `moni.src`, `graf.src`, `spec.src`, `orig.src`, and `alarm.src`. These files are furnished as examples. You can add your own icons to one of these source code files, or create a new file. After modifying the file, you must recompile it.

To invoke the IA compiler, type the following command from the operating system prompt:

```
path-to-MATRIXx/bin/ia -c
```

You will be prompted for the required input and output file names and output file type. The file types are `a` = ASCII, `b` = Binary, `m` = MATRIXx.<sup>1</sup> You also can furnish a source and output file and a format:

```
ia -c source_file output_file a
```

## IA Translator

---

The IA Translator provides the capability to translate between binary and ASCII picture files, as well as from ASCII picture files to SystemBuild SuperBlocks for use with ISIM. Invoke the IA Translator to translate to SuperBlock form.

To invoke the IA Translator, type the following command from the operating system prompt:

```
path-to-MATRIXx/bin/ia -t
```

---

<sup>1</sup> ASCII output file format offers inter-platform transportability for IA pictures. MATRIXx format is provided for transferring picture files to ISIM in SystemBuild for translation to SuperBlocks.

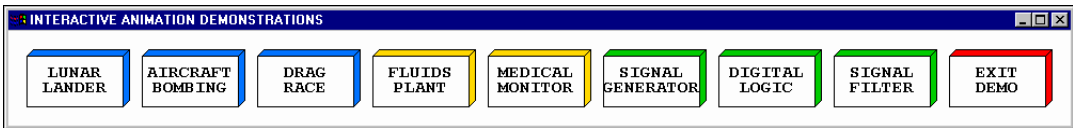
You will be prompted for the file name and the output file format: ([A]scii [B]inary or [M]atrixx). The translated file will be readable by SystemBuild, and appears in the catalog as SuperBlock **animation panel**.

## IA Demo

The IA Demo option provides examples of picture files. The files are run in the animated mode to allow the simulations to be viewed. To invoke the IA demos, type the following command from the operating system prompt:

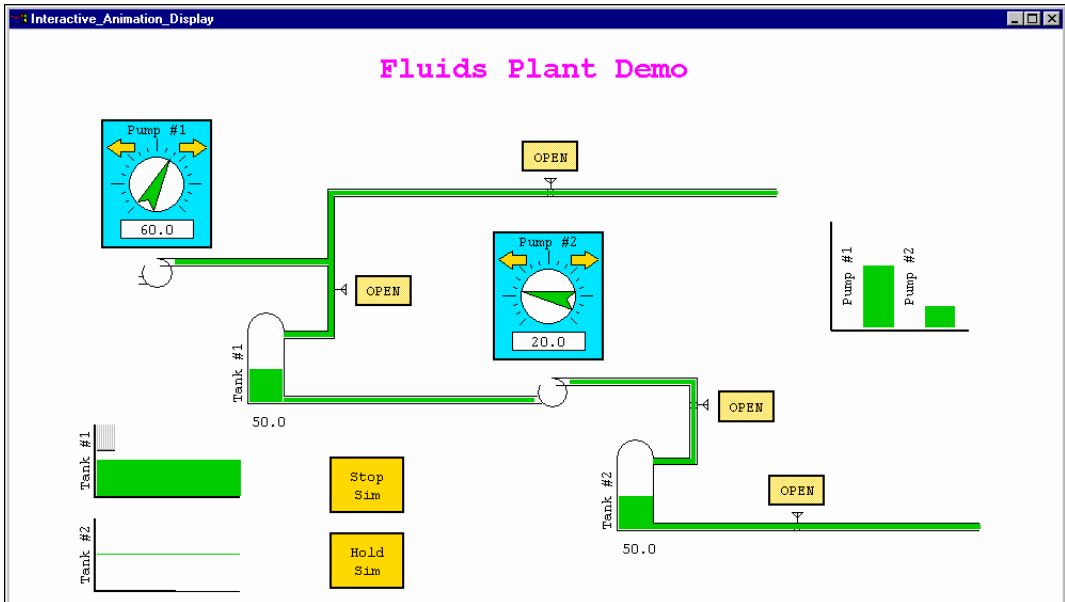
```
path-to-MATRIXx/bin/ia -d
```

The INTERACTIVE ANIMATION DEMONSTRATION strip appears with buttons for the various simulations.



To view a particular demo, click one of the eight demo buttons.

For example, **Fluids Plant** displays the following demo.



To stop a particular demo, click **Stop Sim**. To pause a demo, click **Hold Sim**. Continue by clicking **Resume Sim**. To exit from the demo, click **Exit Demo** (the last button on the right of the demo strip).

---

# Animation Configuration File

The animation configuration is saved in the `animation.cfg` configuration file. This ASCII file contains configuration information needed by SystemBuild. To change the animation configuration, you must edit the local `animation.cfg` file. If an `animation.cfg` file does not exist, copy a template version from the directory `$SYSBLD/etc`.

Accepting the default file names is recommended, since the files required by many of the functions are identified by the names in the `animation.cfg` file. A sample `animation.cfg` file is shown in Example 4-1.

## Config File Entries

---

The `animation.cfg` file starts with the following header line:

```
WS_DRAW CONFIGURATION FILE (ANIMATION.CFG) VERSION 6.00
```

The rest of the file consists of configuration (keyword) lines and comments. All non-keyword lines are treated as comments. A keyword line starts with the keyword name followed by a colon and then a parameter string enclosed in single quotes. The parameter string cannot contain single quotes.

The following is an example of a keyword line:

```
BUILD_LOAD_PICTURE: 'project_name.pic'
```

The keyword descriptions are as follows:

- `ICON_SOURCE_FILE`—This optional keyword is the name of a user-created icon source file; the file is used by the IA Compiler. If no filename is specified, the compiler looks in the current directory for a file named `myicon.src`.

- `ICON_DATA_FILE`—This multiple keyword identifies the icon database files to be loaded by the IA Builder.<sup>1</sup> These database files define the icons that are to be used when creating IA pictures. The `ICON_DATA_FILE` keywords also are referred to as `.sog` files. The default `ICON_DATA_FILE` keywords that appear in `animation.cfg` correspond to the different icon palettes that appear in the **IA Builder** window.

You can create your own multiple `.sog` files to accommodate specialized icon types in multiple icon palette sets. The `.sog` files are specified in the default `$(SYSBLD)/etc/animation.cfg` file, using multiple `ICON_DATA_FILE` keywords. To add your own `.sog` files, copy the `animation.cfg` file to your local directory for modification. Inside `animation.cfg`, the default icon `.sog` files are listed between pairs of asterisks, as shown in Example 4-1. Any `.sog` files you add, however, must be placed toward the end of the file, after the line that reads `STATE YOUR DEFINITIONS BELOW`, and after all the asterisks.

The `.sog` files are created as `.src` files and must be compiled and copied into your local directory, as discussed in the *IA Compiler* section of Chapter 3, *IA Compiler and Utilities*. After an IA picture file is created with a particular `.sog` file, they must always be used together.

- `BUILD_CONTROL_PANEL`—This optional keyword identifies the file containing the **IA Builder Control Panel**. The default file is `$(SYSBLD)/etc/control.sog` on UNIX systems. This file name is used by the IA Builder and should not be changed.
- `SAVE_FILE_FORMAT`—This keyword specifies the type (ASCII or binary) of icon data file or picture file to be created when running the IA compiler or IA Builder. In general, binary icon data files are smaller and improve the efficiency of IA, and ASCII files can be transferred more easily to other platforms. The default save type is ASCII.
- `BUILD_LOAD_PICTURE`—This keyword specifies the main IA picture to be loaded by the IA module when running host simulations. The default `BUILD_LOAD_PICTURE` file name is `project_name.pic`. You can change the names of picture files, but NI recommends that you continue to use the `.pic` extension.

---

<sup>1</sup> These files also are used by SystemBuild for ISIM. If you have not purchased the IA option, the default ISIM `.sog` file is named `isim.sog`. Refer to the *SystemBuild User Guide*.

- `SYSTEM_BUILD_RTF_FILE`—This keyword defines the model or project name. The keyword parameter must be `project_name.rtf`. `Project_name` must be the name of your top level SuperBlock which is used to generate the real-time file (`project_name.rtf`). This file is used by AutoCode to produce the generated C or Ada source code.
- `SIMULATION_DATA_FILE`—This keyword names the default Xmath ASCII file to be loaded into the IA simulator, which is then invoked by clicking **ANIMATE** on the **IA Builder Control Panel**.
- `ALARM_PROCESSING`—This toggle keyword determines the availability of the IA alarm processing for a model when executing with the Interactive Animation module. The default value is `ALARM_PROCESSING OFF`, which disables alarm processing and prevents alarm icons from displaying on the **IA Builder Process/Simulation** and **Alarm Icons** palette (Palette AL). To use alarm processing, you must set the keyword value to `ALARM_PROCESSING ON`. This can be done in your local directory, your home directory, or in the `$$SYSBLD/etc/` directory. If the change is made in `$$SYSBLD/etc/animation.cfg`, the change affects all users on your system who do not have local copies of `animation.cfg`.
- `ALARM_WINDOW_PICTURE`—This keyword identifies the `.pic` file to be used for the alarm window if the `ALARM_PROCESSING` toggle is set to **ON**.
- `PROCESS_PICTURES`—This keyword names a picture file which can be used by the IA process and return icons. These files are loaded by the Interactive Animation module when running a host simulation.  
Each `PROCESS_PICTURE` keyword identifies a picture file created by the IA Builder. You can have more than one `PROCESS_PICTURE` keyword in your `animation.cfg` file. All `.pic` files that are to be used with a simulation must be specified here. By convention, the picture file names must have a `.pic` extension.

## Example animation.cfg File

Example 4-1 is a sample `animation.cfg` file. Notice that the first line of the file must be:

```
WS_DRAW CONFIGURATION FILE (ANIMATION.CFG) VERSION X.XX
```

Also notice that all configuration lines (the definition lines) start with a keyword followed by a colon, followed by the name of the file in single quotes. File names are lowercase. Keywords and other names are in uppercase. Comment lines begin with the asterisk (\*) character.

### Example 4-1 Typical animation.cfg File

```
WS_DRAW CONFIGURATION FILE (ANIMATION.CFG) VERSION 6.00
*****
* The first line of the config file must be: *
*     WS_DRAW CONFIGURATION FILE (ANIMATION.CFG) VERSION X.XX *
* All meaningful lines must start with the key words and COLON, *
*     followed by the name of the file in single quotes. *
* By convention, files are lower case, keywords and others *
*     are upper case. Blank and comment lines are allowed. *
* * * * *
* THESE KEYWORDS MAY HAVE MORE THAN ONE FILE POSSIBLE: *
* * * * *
*     ICON_DATA_FILE      ==> 'project1.sog' *
*     ICON_DATA_FILE      ==> 'project2.sog' *
*     ICON_DATA_FILE      ==> 'project3.sog' *
* * * * *
*     BUILD_LOAD_PICTURE  ==> 'pict1.pic' *
*     BUILD_LOAD_PICTURE  ==> 'pict2.pic' *
*     BUILD_LOAD_PICTURE  ==> 'pict3.pic' *
* * * * *
*     PROCESS_PICTURES    ==> 'proc1.pic' *
*     PROCESS_PICTURES    ==> 'proc2.pic' *
*     PROCESS_PICTURES    ==> 'proc3.pic' *
* * * * *
* THESE KEYWORDS INCLUDE THE FOLLOWING DEFAULTS: *
* * * * *
*     ICON_DATA_FILE:     'etc:isim.sog' *
*     ICON_DATA_FILE:     'etc:moni.sog' *
*     ICON_DATA_FILE:     'etc:coni.sog' *
*     ICON_DATA_FILE:     'etc:graf.sog' *
*     ICON_DATA_FILE:     'etc:spec.sog' *
```

```

*      ICON_DATA_FILE:          'etc:orig.sog'          *
*      ICON_DATA_FILE:          'etc:alarm.sog'        *
*      ICON_DATA_FILE:          'etc:fixpt.sog'        *
*
*      ICON_SOURCE_FILE:        'myicons.src'          *
*
*      BUILD_CONTROL_PANEL:     'etc:control.sog'      *
*
*      SAVE_FILE_FORMAT:        'ASCII' or 'BINARY' or 'MATRIX' *
*
*      PICTURE_SCALE_FACTOR:    '1.0'    (+ relative, - absolute) *
*
*
* THE FOLLOWING ARE COMMANDS SHOULD ONLY BE USED FOR HARDWARE: *
*
*      I/O_PROCESSING           ==> 'I/O PROCESSING ON' *
*
*      CODE_GENERATION_OUTPUT_FILE ==> 'pict.ada'      *
*
*      ADA_LIBRARY              ==> 'pict.alb'        *
*
*      FREQUENCY_SCALE_FACTOR   ==> '1.0'           *
*
*      HARDWARE_CONNECTION_EDITOR_FILE ==> 'pict.ioc' *
*
*****
*
*           STATE YOUR DEFINITIONS BELOW
*
*****
BUILD_LOAD_PICTURE:      'pict.pic'
SYSTEM_BUILD_RTF_FILE:  'pict.rtf'
SIMULATION_DATA_FILE:   'pict.sim'
SAVE_FILE_FORMAT:       'ASCII'
ALARM_PROCESSING:       'ALARM PROCESSING OFF'
ALARM_WINDOW_PICTURE:   'alarm.pic'

```

---

# IA Connection Editor

The IA Connection Editor is used to make connections between icons in IA pictures and the top-level SuperBlock using the top-level `.rtf` file. Connections must be made for each IA picture you create.

The top-level SuperBlock external input and output signal names for your application are saved in the real-time file generated by SystemBuild from your top-level SuperBlock. You must load these signal names into IA through the **RTF NAMES** button on the **IA Builder Control\_Panel** to use the IA Connection Editor.

Within an IA picture, the IA Connection Editor allows you to connect:

- External outputs of the top-level SuperBlock to monitor icons.
- User control icons to external inputs of the top-level SuperBlock.
- External inputs of the top-level SuperBlock to monitor icons.

Connecting an IA picture to the SystemBuild model top-level SuperBlock with the IA Connection Editor is similar to the SystemBuild Connection Editor method.

When you make a connection, the IA Connection Editor for the desired connection will appear. To add a new connection, click the **Add** box, then click a SystemBuild block connector box and the corresponding IA icon connector box to connect the two. To delete a connection, click the **Del** box, then click one of the connected boxes to clear the connection. Click **DONE** to save the connections, or click **CANCEL** to discard all work completed in the dialog box.

---

## Connecting SB External Outputs to Display Icons

To connect the SystemBuild (SB) top level SuperBlock external outputs to display icons, click the middle mouse button in the **IA Builder Build** window workspace (outside the icon), then move the cursor inside the icon and click the middle mouse button. The IA Connection Editor for this type of connection appears, as shown in Figure 5-1.

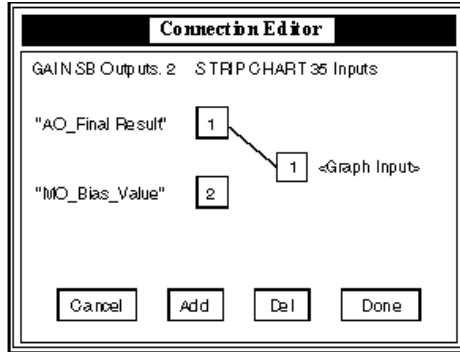


Figure 5-1. IA Connection Editor for SB External Outputs to Display Icons

## Connecting User Control Icons to SB External Inputs

To connect user control icons to the SystemBuild (SB) top level SuperBlock external inputs, click the middle mouse button in the icon, then move the cursor to the **IA Builder Build** window workspace outside the icon and click the middle mouse button.

The IA Connection Editor for this type of connection appears, as shown in Figure 5-2.

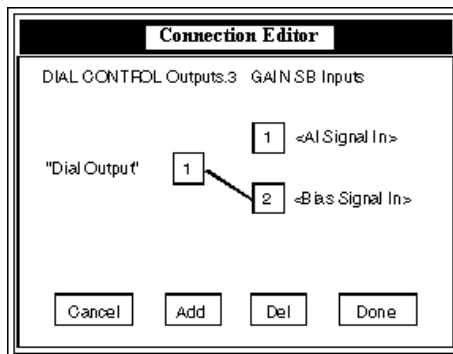


Figure 5-2. IA Connection Editor for User Control Icons to SB External Inputs

## Connecting SB External Inputs to Display Icons

To connect the SystemBuild (SB) top level SuperBlock external inputs to display icons, double-click the right mouse button in the icon. The IA Connection Editor for this type of connection appears.

The IA Connection Editor for this type of connection lists each of the external inputs to the top level SuperBlock on the left of the dialog box. The display icon inputs are displayed on the right side of the dialog box, as shown in Figure 5-3.

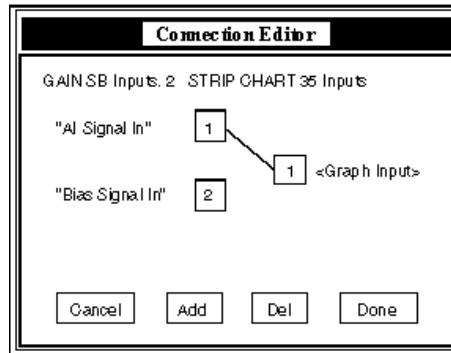


Figure 5-3. IA Connection Editor for SB Inputs to Monitoring Display Icons

## Displaying the Connections

When you turn labels on by clicking the **LABELS ON** button in the **IA Builder Control\_Panel**, any display icon inputs or user control icon outputs which have not been connected will appear in your picture as horizontal lines. By convention, display icon inputs are displayed on the left of the icon, and user control icon outputs are displayed on the right of the icon. Connections which have been made will appear as external input/output arrows as in SystemBuild, with the signal name from the top-level SuperBlock displayed above the line.

## Error Messages

---

Error messages will be generated by clicking in the wrong order or in the wrong place. If you are in doubt about the actual extent of an icon on the screen, click inside it until its outline changes from dark to light with a small box appearing in the upper right corner.

- Trying to connect an icon to itself or to another icon will result in the message:

**Illegal Connection**

- Trying to connect an icon which does not produce a control output to an input signal to the SystemBuild model will result in the message:

**No Output Pointers to Connect**

- Trying to join a SystemBuild external output to any IA icon other than a monitoring display icon will produce the message:

**No Animation Pointers to Connect**

---

# Creating an Interactive Animation Picture

The Interactive Animation Builder provides the tools to build up full display panels using the IA icons. It also allows you to create multiple display panels which can be linked together and displayed during simulation.

Complete the following steps to create an Interactive Animation picture.

1. Start by laying out how your IA pictures should appear. Figure 2-2, *Conceptual Layout of IA Pictures*, illustrates how multiple IA pictures can be linked together for viewing during simulation. IA pictures are composed of icons selected from palettes. Refer to Chapter 2, *IA Builder*, for more information about the icons.
2. You need an `animation.cfg` file in your local directory. Copy the template `animation.cfg` file from the `$$SYSBLD/etc` directory or from the `%SYSBLD%\etc` directory. To define your animation configuration, edit the `animation.cfg` file and complete the following steps:
  - a. Set the process picture keywords only if you are using multiple or “chained” pictures. Each additional IA picture must be defined in a `PROCESS_PICTURE` keyword.

```
PROCESS_PICTURE: 'filename1.pic'  
PROCESS_PICTURE: 'filename2.pic'  
PROCESS_PICTURE: 'filename3.pic'
```



**Note** The `process_picture` keyword file name must be lowercase.

- b. Enable alarm processing if you are going to perform alarm monitoring: To do this, set:

```
ALARM_PROCESSING_ON'
```
- c. Set the `BUILD_LOAD_PICTURE` keyword to `project_name.pic` and the `ALARM_WINDOW_PICTURE` keyword to `project_name_alarm.pic`. `project_name.pic` is the main IA picture which is initially loaded when by the IA module when

it executes your application. From the main IA picture, you can access other IA pictures through the process icon. Do not change the settings of these keywords.

The `I/O_PROCESSING` keyword in `animation.cfg` is not used for PC simulations; it is only used for hardware.

3. Invoke the IA Builder by entering the following:

```
ia -b
```

at the operating system prompt or from the **Run** dialog box.

Two windows will appear on your PC, as shown in Figure 2-1, *Interactive Animation Build Window and Control\_Panel*. The large window with the title **Interactive\_Animation** is the **IA Builder** window. This is where you create IA pictures. The smaller window is the **IA Builder Control\_Panel**.

4. Start by building your main IA picture. This picture is initially loaded by the Interactive Animation module when running a simulation. To do this, you need to place icons in the picture. Complete the following steps:
  - a. Open the desired Icon Palette. To do this, double-click the workspace of the **IA Builder Build** window or click the **DEFINE** button of the **IA Builder Control\_Panel**. You then can click the lower border of the palette window to select the desired palette. To display a particular palette, click the palette name abbreviation button. If you have created your own palette sets by changing one or more `.sog` files, you can access the new palettes by clicking the `+` or `-` buttons.
  - b. Open the desired icon in the picture. To do this, click and drag the icon from the palette to the desired location in the **IA Builder Build** window.
  - c. Define the icon parameters. The icon parameters are set through the icon description dialog. You can double-click an icon to bring up its description dialog box. After entering the information, left-click the **DONE** button in the description dialog box to save the new icon parameters.

Repeat these steps until you have completed your main IA picture.

If you plan on using multiple pictures and/or alarms, you must include process icons in your main IA picture. The process icon is used to link the main IA picture to additional IA pictures.

When executing an application, if you click a Process icon, the IA picture defined by the `Filename` parameter of the icon description dialog box is loaded in the IA window. The IA picture containing the

process icon which was clicked is referred to as the *calling IA picture*. Except in the Alarm IA picture, a Return icon is used to return to the calling IA picture. In the alarm IA picture, no Return icon is needed, because clicking in the upper right corner of the alarm icon will return to the calling IA picture. Returning to the calling IA picture is referred to as *chaining up*.

5. To connect the IA icons to your model, load the real-time file for your project (generated from the top-level SuperBlock). Click **RTF NAMES** to load your project's real-time file. An inquiry dialog appears. Click **DONE** to accept the default or enter the correct file specification.



**Note** The top-level SuperBlock will be the highest level in your model without the `usr1a1` UCB. To use the IA without picture files for a simulation, you must add a UCB from the SystemBuild User Programmed palette to your model. Open the UCB dialog box and type `usr1a1` in the **Function Name** field. Leave the **File Name** field blank and click **DONE**. Interactive Animation will be automatically linked to the SystemBuild executable when you invoke the simulator. After the UCB is defined, connect the appropriate inputs and outputs from your top level model SuperBlock to the UCB.

6. Use the IA Connection Editor to connect the appropriate icons to SystemBuild external inputs and external outputs. Refer to Chapter 5, [IA Connection Editor](#), for more information.

You may want to display the external input and output labels of the SystemBuild top level SuperBlock which are connected to IA icons. Click the **LABELS ON** toggle button on the **Control\_Panel** to display the labels.

7. Save your picture. Left-click the **SAVE PICT** button on the **Control\_Panel**. An inquiry dialog box appears. Click **DONE** to accept the default or enter the correct file specification.
8. Build any additional IA pictures and/or the alarm IA picture.
9. To run the simulation, analyze the model and type the following in the Xmath **Commands** window:

```
y = sim("model", t, u)
```



---

# Technical Support and Professional Services

Visit the following sections of the National Instruments Web site at [ni.com](http://ni.com) for technical support and professional services:

- **Support**—Online technical support resources at [ni.com/support](http://ni.com/support) include the following:
  - **Self-Help Resources**—For immediate answers and solutions, visit the award-winning National Instruments Web site for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on.
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- **Training and Certification**—Visit [ni.com/training](http://ni.com/training) for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, NI Alliance Program members can help. To learn more, call your local NI office or visit [ni.com/alliance](http://ni.com/alliance).

If you searched [ni.com](http://ni.com) and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of [ni.com/niglobal](http://ni.com/niglobal) to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

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