VisSim/Real-TimePRO

Version 3

For use with VisSim/Real-TimePRO and VisSim DACQ

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INCORPORATED

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Contents

Preface

VisSim/Real-TimePRO extends VisSim for use in interactive, real-time data acquisition and control. VisSim/Real-TimePRO's highly intuitive block diagram interface makes it easy to acquire and display data, and conduct real-time analysis. With VisSim's MMI blocks, you can build realistic instrumentation panels to observe and control system performance. Audio and visual alarms warn you when system behavior crosses a boundary, hits a limit, or meets any other arbitrary condition.

This manual describes how to use VisSim/Real-TimePRO and VisSim DACQ. If you've purchased VisSim DACQ, be sure to read "For VisSim DACQ users," on page viii, for a list of specifics about your version of the software.

Registering your software

Before you begin using VisSim/Real-TimePRO or VisSim DACQ, please fill out the enclosed registration card and mail it to us. As a registered user, you will receive a free subscription to The flexWire, along with discount promotions and VisSim workshop schedules.

Conventions used in this book

This manual assumes that you are already familiar with the VisSim graphical user interface. If you need to review the interface, consult your *VisSim User's Guide* or the online help.

The following typographical conventions are used in this manual:

Typographical convention	Where it's used
Shortcut key combinations	Shortcut key combinations are joined with a plus sign (+). For example, the command CTRL+C means to hold down the CTRL key while you press the C key.
Hot keys	Hot keys are the underlined keys in VisSim's menus, commands, and dialog boxes. To use a hot key, press ALT and then the key for the underlined character. For instance, to execute the File menu's Real Time Config command, hold down the ALT key while you press the F key, then release both keys and press the R key.
SMALL CAPS	To indicate the names of keys on the keyboard.
ALL CAPS	To indicate directory names, file names, and acronyms.
Initial Caps	To indicate menu names and command names.

In addition, unless specifically stated otherwise, when you read "click the mouse..." or "click on...," it means to click the left mouse button.

For VisSim DACQ users

If you have purchased VisSim DACQ, you will receive VisSim/Real-TimePRO along with a compact version of VisSim that imposes a 100-block limit on each block diagram you create.

Getting help

To help you get the most out of VisSim, the following online information is available:

- **Online help.** The online help contains step-by-step instructions for using VisSim features.
- **Online release notes.** A file named READMERT.TXT is installed in your main VisSim directory. This file contains last minute information and changes that were discovered after this manual went to print. For your convenience, you should read this file immediately and print a copy of it to keep with this manual.

Online help

VisSim's Help program provides online instructions for using VisSim.

▶ **To open Help**

- Do one of the following:

To	Do this
Access the top level of help	Select Help from the menu bar or press ALT+H.
Access help on the selected block	Click on the Help command button in the dialog box for the block.

▶ **To close Help**

- In the Help window, choose File > Exit, or press ALT+F4.

Technical support

When you need assistance with a Visual Solutions product, first look in the manual, read the README.WRI file, and consult the online Help program. If you cannot find the answer, contact the Technical Support group via toll call between 9:00 am and 6:00 pm Eastern Standard Time, Monday through Friday, excluding holidays. The phone number is **978-392-0100.**

When you call in, please have the following information at hand:

- The version of VisSim and VisSim/Real-TimePRO (or VisSim DACQ), and the version of the software operating environment that you are using
- All screen messages
- What you were doing when the problem happened
- How you tried to solve the problem

Visual Solutions also has the following fax and email addresses:

Address/Number	What it's for
978-692-3102	Fax number
bugs@vissol.com	Bug report
doc@vissol.com	Documentation errors and suggestions
sales@vissol.com	Sales, pricing, and general information
tech@vissol.com	Technical support

Chapter 1

The Basics

Simulating in real-time mode has the effect of retarding a simulation so that one simulation second equals one second in real time. Typically, you use real-time mode for data acquisition or hardware-in-the-loop control situations. For this, however, you need a VisSim/Real-TimePRO or VisSim DACQ.

Real-time drivers

The real-time drivers supplied with VisSim/Real-TimePRO and VisSim DACQ are 32-bit drivers that include:

- A protected-mode VxD that is automatically installed
- A VisSim Dynamic Link Library (DLL) file that provides a Windows *protected mode interface* to the VxD

All real-time drivers support up to sixteen boards simultaneously. You can mix different boards and drivers or use multiple instances of the same board. You set the base I/O port address for the board through the File menu's Real Time Config command, as described in Chapter 2, "Configuring I/O Boards."

Supported boards

The following table lists the I/O boards supported by VisSim/Real-TimePRO and VisSim DACQ. Because Visual Solutions is continually expanding the boards it supports, please call Technical Support for the latest list of supported boards. Phone and fax numbers can be found on page ix.

Vendor	Board name
Advantech	PCL-711
	PCL-711S
	PCL-718
	PCL-812
	PCL-812PG
	PCL-818
	PCL-818PG
Interface	PCLD-789
Analog Devices	RTI 815
ComputerBoards	
Analog Input	CIO-DAS08
	CIO-DAS08/AO
	CIO-DAS08/AOH
	CIO-DAS08/AOL
	CIO-DAS08/Jr
	CIO-DAS08-PGA
	CIO-DAS08-PGH
	CIO-DAS08-PGL
	CIO-DAS16
	CIO-DAS16/Jr
	CIO-DAS16/330
	CIO-DAS16/330-I
	CIO-DAS48[1]
	CIO-DAS48PGA
	CIO-DAS1601/12
	CIO-DAS1602/12
	CIO-DAS1602/16
Analog Output	CIO-DAC02
	CIO-DAC08
	CIO-DAC08-I
	CIO-DAC16
	CIO-DAC16-I
	CIO-DDA06

Vendor	Board name
ComputerBoards (*continued*)	
Digital Input and Output	CIO-DIO24[2]
	CIO-DIO24DD
	CIO-DIO24H
	CIO-DIO48[3]
	CIO-DIO48DD
	CIO-DIO48H[3]
	CIO-DIO96[4]
	CIO-DIO192[5]
	CIO-PDIS08
Interface Boards to Digital I/O	CIO-DUAL-AC5
	CIO-ERB08
	CIO-ERB24
	CIO-ERB48
	SSR-RACK08
	SSR-RACK24
	SSR-RACK48
PCMCIA (laptop)	PCM-DAC02[6]
	PCM-DAC08[6]
	PCM-DAS16[6]
	PCM-DAS16/12[6]
	PCM-DAS16S/12[6]
	PCM-DAS16/16[6]
Counter Timer	CIO-CTR05
	CIO-CTR05/H50
	CIO-CTR10[7]
	CIO-CTR10/H50[8]
Data Translations	DTI-2811PGH
	DTI-2811PGL
Keithley MetraByte	
Analog Input	DAS-08
	DAS-08/AO
	DAS-08/LT
	DAS-08/PGA
	DAS-16
	DAS-1400
	DAS-1600
Analog Output	DAC-02
	DAC-16
	DDA-06

Vendor	Board name
Keithley MetraByte (*continued*)	
Digital Input & Output	PDISO8
	PIO-24
National Instruments[4]	Lab-PC+
	PC-AO-2DC
	PC-DIO-24
	PC-DIO-96[9]
PCMCIA (laptop)	DAQCard-1200
	DAQCard-AO-2DC
	DAQCard-DIO-24
Precision Micro Dynamics	MFIO-3A (3 axis quadrature encoder with 3 16-bit analog outputs)

1. Equivalent to three CIO-DAS16 on a single board.
2. Also supported in 24 input and 24 output modes.
3. Equivalent to two CIO-DIO24 on a single board.
4. Equivalent to four CIO-DIO24 on a single board.
5. Equivalent to eight CIO-DIO24 on a single board.
6. Supported by VisSim/Real-TimePRO under Windows 95 only.
7. Equivalent to two CIO-CTR05 on a single board.
8. Equivalent to two CIO-CTR05/H50 on a single board.
9. Equivalent to four PC-DIO-24 on a single board.

The Real Time blocks

VisSim/Real-TimePRO and VisSim DACQ offer five blocks:

Block	What it's for
`rt-DataIn`	Configuring input channels
`rt-DataOut`	Configuring output channels
`PWM`	Producing pulse width modulated output
`frequency`	Measuring frequency input
`encoder`	Reading encoder input

These blocks are located under the Real Time category in the Blocks menu. After VisSim/Real-TimePRO or VisSim DACQ has been successfully installed, the `rt-`

`DataIn` and `rt-DataOut` blocks are available for use. The `PWM`, `frequency`, and `encoder` blocks are available only if you have installed the following boards:

To use this block	One of the following boards must be installed
`PWM`	***Analog Devices*****:** RTI 815; ***ComputerBoards*****:** CIO-CTR05, CIO-CTR05/H50, CIO-CTR10, CIO-CTR10/H50
`frequency`	***Analog Devices*****:** RTI 815; ***ComputerBoards*****:** CIO-CTR05, CIO-CTR05/H50, CIO-CTR10, CIO-CTR10/H50
`encoder`	***Precision Micro Dynamics*****:** MFIO-3A

Data acquisition guidelines

Since Windows is not a multitasking operating system you must be careful about what you do while acquiring data to avoid missing a sampling interval. Because VisSim calculates all blocks before it begins each sampling interval, any one block that runs slowly can disturb the acquisition process. Additionally, since there is only one processor to calculate and draw the Windows graphics, you should avoid any operation that causes Windows to repaint the screen. These operations include:

- Running DOS shells
- Digital display read-outs, strip charts, histograms, meters, and plots for greater than 200 Hz sampling rates (shown in order, from most costly to least costly)
- Calling up a block's Properties dialog box
- Expanding a plot to full screen
- Changing diagram layers

Performance degradation

The performance degradation due to graphics use depends heavily on the speed of the base processor and the graphics card. You should experiment with different sampling rates and graphics usage to determine the limits of your system.

Chapter 2

Configuring I/O Boards

This chapter covers the following information:

- Installing and configuring I/O boards
- Verifying I/O board settings
- Configuring VisSim/Real-TimePRO and VisSim DACQ to recognize your I/O boards

Installing and configuring I/O boards

Typically, the installation and configuration of your I/O boards involves setting base addresses, adjusting jumpers, and setting analog and digital ranges. Because this information is unique to each board, it is important that you refer to the vendor's documentation for installing, configuring, and testing the board.

Keeping a record of your I/O board base address

You will need your I/O board's base address later on when you configure VisSim/Real-TimePRO or VisSim DACQ to recognize the board. Therefore, it is recommended that you write down your boards' base addresses and keep them in a safe place.

Finding out an I/O board's base address

If you need to determine the base address of one of your installed I/O boards, refer to the vendor's documentation. In many cases, the vendor distributes software that allows you to check installed board settings.

Also, you may be able to use the Control Panel to determine base addresses for installed boards. For instance, on the Windows 95 platform, you can find many boards' settings by using the Device Manager under Settings > Control Panel > Device Manager. Refer to your Windows documentation for information on finding I/O board settings.

Configuring VisSim/Real-TimePRO or VisSim DACQ to recognize your I/O boards

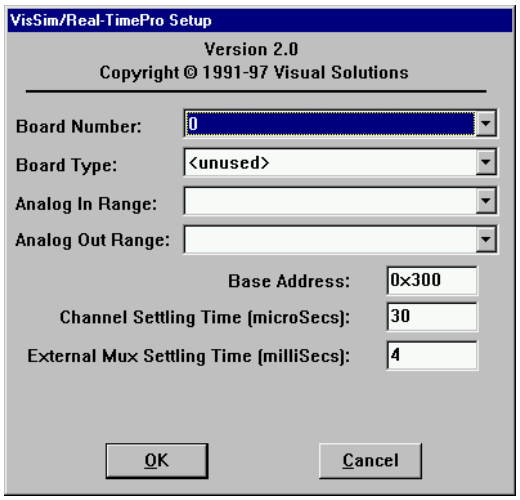
Any time you install or reconfigure an I/O board, you must also configure or reconfigure VisSim/Real-TimePRO or VisSim DACQ to recognize the board. You use the File > Real-Time Config command to perform these tasks.

Using the File > Real Time Config command

After installing your I/O board, follow these steps to configure VisSim/Real-TimePRO or VisSim DACQ to recognize it:

1. Start VisSim or VisSim DACQ.
2. Choose File > Real Time Config.

   A setup dialog box appears.



3. Select the hardware and software settings for the I/O board that will work with the process or controller whose data you are acquiring or measuring. (See the descriptions below for more information about each parameter.)
4. Click on the OK button, or press ENTER.

Setting the board type and number

The Board Number box lets you identify your I/O board with a unique number in the range of 0 through 15. For instance, to differentiate two installed I/O boards, you can assign one board number 0 and the other board number 1. The number you enter here is used to identify your board later on when setting its input and output channels.

The Board Type box identifies the model of your I/O board. When you click in the box or on the DOWN ARROW, a list of available board types are displayed from which you can choose.

Setting the analog input and output ranges

The Analog Input Range box lists the available analog input ranges for the selected board type, while the Analog Output Range box lists the available analog output ranges for the selected board type. Click on the DOWN ARROW to reveal a list of additional ranges.

Setting the base address

The base address indicates the I/O port register address through which the real-time driver commands the board. The base address was set at the time the board was installed and configured. Enter the base address as a hexadecimal number in the following format:

0x*hexNumber*

Base addresses are configurable between 0x110 and 0x3FF.

If you do not know the base address of your board, see page 8.

Setting the channel settling time

The channel settling time is the time taken for the voltage to settle between channels for multichannel reads. The settling time is entered in microseconds (µsec). The first time you configure a board, it is recommended to use the default setting; you can always change the setting later if it is too fast or too slow.

Most boards have a default settling time of 30 µsec.

Setting the external mux settling time

The external mux settling time is the time taken for the voltages to settle when using the I/O boards with multiplexed subchannels. The default is 4 milliseconds (msec).

Chapter 3

Setting Input and Output Channels

This chapter covers the following information:

- Setting input channels using `rt-DataIn` blocks
- Setting output channels using `rt-DataOut` blocks

Input and output channel basics

The `rt-DataIn` and `rt-DataOut` blocks let you set the input and output channels for your I/O boards. Each block sets a single channel. Thus, if you are using a 4 input, 4 output I/O board, you will need four `rt-DataIn` blocks and four `rt-DataOut` blocks.

For each channel, you can specify a channel title, channel class, and channel type. In addition, if you are setting the input channel on an I/O board with multiplexed subchannels, you can also set the multiplex subchannel, mux gain, and cold junction compensation for thermocouple linearization.

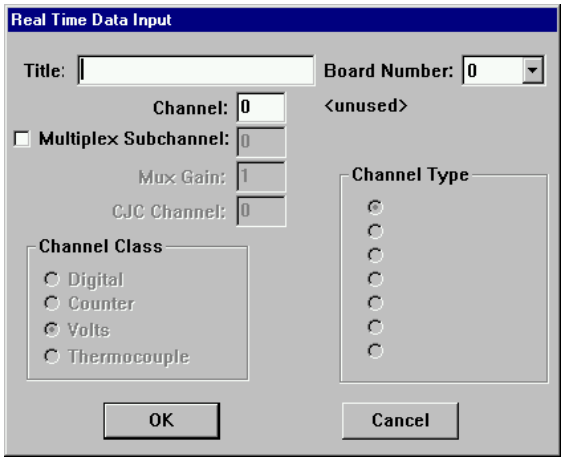
Using the rt-DataIn block

To set an input channel on your I/O board, you use the `rt-DataIn` block.

▶ **To set up an input channel**

1. Choose Blocks > Real Time and drag an `rt-DataIn` block into the work area.
2. Do one of the following:
   - Choose Edit > Block Properties and click the mouse over the `rt-DataIn` block.
   - Click the right mouse button over the `rt-DataIn` block.

   The Real Time Data Input dialog box appears.



3. Make the appropriate selections. (See the descriptions below for more information about each parameter.)
4. Click on the OK button, or press ENTER.

Specifying the board number

In the Board Number box, enter the board number of the I/O board whose input channel is to be configured. The board number was established with the File > Real Time Config command, as described on page 9. If you are not sure of the board number, click on the DOWN ARROW to reveal the list of configured board numbers. When you select a board number, the board type is displayed beneath the board number.

Specifying a channel title

When you configure a multi-channel I/O board, you can identify each channel with a unique title. These titles appear on the `rt-DataIn` blocks making it easier to recognize which block is assigned to each channel.

Specifying a channel number

In the Channel box, you enter a number that corresponds with the channel number on the screw terminal or termination panel supplied with your I/O board. The `rt-DataIn` block uses channel 0 as the first channel, even if the documentation supplied by the board vendor describes the first channel as channel 1.

8255-based digital I/O boards: If you are using an 8255-based digital I/O board, you can connect `rt-DataIn` channels to electrical connector terminals in several different ways. Boards with an 8255 chip are listed below:

Vendor	Board
ComputerBoards	CIO-DIO24
	CIO-DIO24H
Keithley MetraByte	PIO-12
	PIO-24
National Instruments	PC-DIO-24
	PC-DIO-96
	DAQCard-1200

See Appendix A, “Connecting to Boards with an 8255 Chip” for more information.

PCM-CIA DAS 16/12 and DAS 16/16 boards: If you are connecting to a ComputerBoards PCM-CIA DAS 16/12 or DAS 16/16, you can connect the `rt-DataIn` channels to electrical terminals in a specific way. See Appendix B, “Connecting to PCM-CIA DAS 16/12 and DAS 16/16 Boards,” for more information.

Specifying subchannels

When you are using an I/O board with multiplexed input channels, such as the CIO-DAS08 board from ComputerBoards, you use the Multiplex Subchannel parameter to connect the individual multiplex channels. Each multiplex board physically connects to all of the analog input channels on the I/O board, letting you daisy chain them. Electrically, each multiplex board only connects to one of the I/O board’s input channels. The electrical connection connects to only one of the analog input channels and depends on the jumper setting on the multiplex board. To set the jumper, refer to the documentation that accompanies the board.

When you activate the Multiplex Subchannel parameter, you must also enter a subchannel number in the accompanying Multiplex Subchannel text box. VisSim/Real-TimePRO or VisSim DACQ sends the multiplex subchannel number to the first four digital output channels, which the multiplex board uses as the multiplex subchannel specifier, and then reads the input channel. (You should not use the digital channels for other purposes.)

Specifying a mux gain for a multiplex board

The Mux Gain parameter indicates the gain applied to a multiplexed signal when it is read into VisSim/Real-TimePRO or VisSim DACQ. In order to render an accurate reading, VisSim/Real-TimePRO or VisSim DACQ uses this parameter to compensate for the gain applied to the signal by the multiplexor board.

The Mux Gain parameter value must match the gain setting specified on the multiplexor board to achieve accurate results.

When you change the mux gain on a channel, all the gains on all the multiplexed subchannels are changed.

Specifying a channel class

The `rt-DataIn` block recognizes six classes of inputs on I/O boards:

- Counter
- Current
- Digital
- Thermocouple
- Voltage

When you select a channel class, the options listed under the Channel Type box change accordingly. For example, when you select Volts, the voltage ranges are displayed.

In addition, before you select a channel class, make sure the hardware line has been connected to the specified channel number.

Counter channel class

The Counter parameter utilizes your I/O board's counter timer. A counter provides a high frequency pulse counting input. Pulses are generated by triggering on the leading edge of an incoming sinusoidally-shaped waveform. Most counters can count approximately 64,000 pulses before they overflow and reset. In VisSim/Real-TimePRO and VisSim DACQ, the counter value is reset at the end of every time step

of the simulation. If you accumulate more than 64,000 counts, you should reduce the step size using the Simulate > Simulation Properties command.

Most boards have at least one counter input. When using the counter channel, be particularly careful connecting the screw terminal to the signal source. Most board vendors re-use an existing digital channel for the counter input.

As an example of how Counter may be used, consider a sensor that generates a sinusoid with a frequency that corresponds to the velocity of a fluid. Typical frequencies can range from 1 to 10 kHz. Assuming that you have set the simulation step size to 0.1 sec, the number of pulses that occur in one step of the simulation can be computed by dividing the counter value (output of the `rt-DataIn` block configured to the counter) by the simulation time step.

Current channel class

The Current parameter supports current output applications. It is set to a range of 4 - 20 mA, which provides a full 12 bits of resolution over the range.

This channel class appears only if your I/O board has current.

Digital channel class

The Digital parameter provides an ON/OFF channel input. When Digital is activated, the input behaves like a current sink. When the voltage level on the digital input line goes low, current flows from the 5 V power supply to ground. When the digital input channel is activated, the voltage level of the channel goes low (turns off). Most digital input channels are capable of sinking 10 mA.

For digital inputs, the `rt-DataIn` block uses the vendor's specifications for TTL-level values.

Thermocouple channel class

The Thermocouple parameter provides thermocouple linearization input. A thermocouple produces a voltage corresponding to the temperature measured.

When Thermocouple is activated, the Channel Type box shows different types of thermocouples (B, E, J, K, R, S, and T).

VisSim/Real-TimePRO and VisSim DACQ provide for cold junction compensation for the thermocouple linearization; it uses channel 7 on the I/O board for reading the temperature from the solid state temperature device on the multiplexer board for cold junction compensation.

Volts channel class

The Volts parameter provides a time varying voltage input. The range of the voltage input is software-selectable for many boards. Boards with this characteristic are

referred to as *programmable gain* boards. If you are using a programmable gain board and you activate Volts, the voltage ranges are presented under the Channel Type box. These typically range from ±10 to ±.0.01 V and lower.

For boards without programmable gain, the input voltage range is normally set using a micro-switch on the I/O board itself. The corresponding voltage ranges, listed under the Channel Type box, are read-only settings.

The voltage channel is often called an A/D channel. Analog input signals are converted to digital representations using a converter. The converter consists of registers whose numbers determine the resolution. Most boards use 12-bit resolution converters; however, some boards use higher resolution converters for greater precision.

Channel resolution is proportional to channel read time. The higher the channel resolution, the longer it takes to read the channel. In cases where accuracy is less important than speed, you may reduce the resolution.

Specifying a channel type

The channel type varies according to the possible input ranges for the board. It is also dependent on your selection under Channel Class.

When you select this channel class	Channel Type contains this information
Counter	No channel types are listed. A special internal channel type is automatically selected.
Current	Allowable ranges.
Digital	No channel types are listed. A special internal channel type is automatically selected.
Thermocouple	Allowable thermocouple types: J: Iron/Constantan K CHROMEGA-ALOMEGA T: Copper/Constantan E: CHROMEGA/Constantan R: Pt 13% Rh/Pt S: Pt 10% Rh/Pt B: Pt 6% Rh/Pt 30% Rh
Volts (for a programmable gain board)	Allowable ranges.
Volts (for a non-programmable gain board)	Hardware settings for the input voltage range on the board.

Specifying cold junction compensation

Cold junction compensation works in conjunction with a thermocouple. A thermocouple is a temperature measurement sensor that consists of two dissimilar

metals joined together at one end to form a junction. When the junction is heated, a small thermoelectric voltage is produced. Cold junction compensation compensates for the voltage generated on the mux board and subtracts it from the voltage at the junction. The `rt-DataIn` block uses the vendor's specification for the cold junction compensation. Typically, it is 0. If you physically change the cold junction compensation on the mux board, use this parameter to make the same change to the software.

The Cold Junction Compensation parameter is available for use only when the Thermocouple under Channel Class is activated.

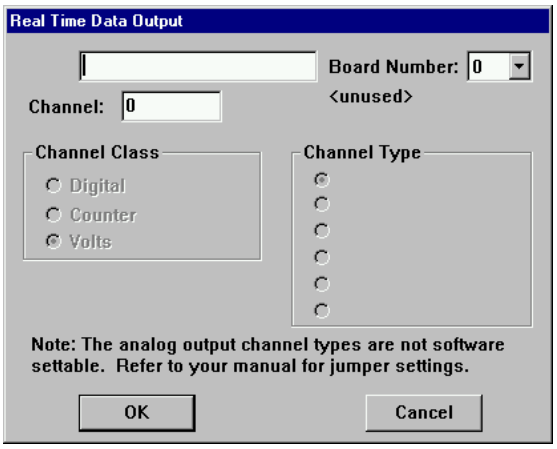
Using the rt-DataOut block

You use the `rt-DataOut` block to set an output channel on your I/O board.

▶ **To set up an output channel**

1. Choose Blocks > Real Time and drag an `rt-DataOut` block into the work area.
2. Do one of the following:
   - Choose Edit > Block Properties and click the mouse over the `rt-DataOut` block.
   - Click the right mouse button over the `rt-DataOut` block.

   The Real Time Data Output dialog box appears.



3. Make the appropriate selections. (See the descriptions below for more information about each parameter.)
4. Click on the OK button, or press ENTER.

Specifying the board number

In the Board Number box, enter the board number of the I/O board whose output channel is to be configured. The board number was established with the File > Real Time Config command, as described on page 9. If you are not sure of the board number, click on the DOWN ARROW to reveal the list of configured board numbers. When you click on a board number, the board type is displayed beneath the board number.

Specifying a channel title

You use the Title box to create titles for each output channel. If you are using more than one output channel on your I/O board, it is a good idea to use channel titles to distinguish each channel. Channel titles appear on the `rt-DataOut` blocks.

Specifying a channel number

In the Channel box, you enter a number that correspond to the channel number on the screw terminal or termination panel supplied with your I/O board. VisSim/Real-TimePRO and VisSim DACQ use channel 0 as the first channel, even if the documentation supplied by the board vendor describes the first channel as channel 1.

8255-based digital I/O boards: If you are using an 8255-based digital I/O board, you can connect `rt-DataOut` channels to electrical connector terminals in several different ways. Boards with an 8255 chip are listed below:

Vendor	Board
Keithley MetraByte	PIO-12
	PIO-24
ComputerBoards	CIO-DIO24
	CIO-DIO24H
National Instruments	PC-DIO-24
	PC-DIO-96
	DAQCard-1200

See Appendix A, “Connecting to Boards with an 8255 Chip” for more information.

PCM-CIA DAS 12/16 and DAS 16/16 boards: If you are connecting to a ComputerBoards PCM-CIA DAS 12/16 or DAS 16/16, you can connect the `rt-DataOut` channels to electrical terminals in a specific way. See Appendix B, “Connecting to PCM-CIA DAS 12/16 and DAS 16/16 Boards,” for more information.

Specifying a channel class

The `rt-DataOut` block recognizes three classes of output channels:

- Analog
- Digital
- Pulse

In general, when you select one of these channel classes, it is assumed that you have connected the hardware line to the specified channel number.

When you select a channel class, the options listed under the Channel Type box change accordingly. For example, when you select Volts, the voltage channel types appear under Channel Type.

Counter channel class

The Counter parameter outputs high frequency square waves. The counter output utilizes the board's counter timer and often re-uses an existing digital I/O channel. Refer to the documentation accompanying your board for information on wiring this channel. Data sampling rates of up to 20 KHz (counter-assisted) can be achieved.

As an example of how the counter output operates, consider the control of a stepper motor/drive system. The drive is capable of receiving command pulses from 0 to 5 kHz to regulate its speed. By connecting a `slider` block, with a range of 0 to 5,000, to the `rt-DataOut` block, configured for counter output, the motor speed can be controlled over its full range.

Digital channel class

The Digital parameter provides an ON/OFF channel output. When Digital is activated, the output behaves like a current sink. When the voltage level on the digital output line goes low, current flows from the 5 V power supply to ground. When the digital output channel is activated, the voltage level of the channel goes low (turns off). Most digital output channels are capable of sinking 10 mA. For real-time digital output, the inputs generated are Boolean in nature.

The voltages corresponding to the ON/OFF states of the digital channel obey TTL-level values. Low is less than 0.7 V, and high is greater than 2.5 V.

Digital I/O lines are especially useful for controlling equipment using ON/OFF signals. Most often, the channel itself will not have enough power to actuate. In these situations, an opto-isolated solid-state relay is used. These relays, supplied by the board vendor, are soldered onto the screw terminal panel. Instructions are provided by the board vendor.

The opto-isolators have a low power side and a high power side. The digital I/O communicates with the low power side. By connecting a high power source plus

equipment through the high power side, you can switch high AC or DC power using the digital I/O line.

Most vendors offer opto-isolator modules ranging from 3 A, with voltages to 280 V AC, to 45 A, with voltages to 650 V AC.

Volts channel class

The Volts parameter provides a time varying voltage output. The range of the voltage output is software-selectable for many boards. Boards with this characteristic are referred to as *programmable gain* boards. If you are using a programmable gain board and you activate Volts, the voltage ranges are presented under the Channel Type box. These typically range from ±10 V to ±0.01 V and lower.

For boards without programmable gain, the output voltage range is normally set using a micro-switch on the I/O board itself. The corresponding voltage ranges, listed under the Channel Type box, are read-only settings.

The voltage channel is often called a D/A channel. Analog input signals are converted to digital representations using a converter. The converter consists of registers whose numbers determine the resolution. Most boards use 12-bit resolution converters; however, some boards use higher resolution converters for greater precision.

Channel resolution is proportional to channel read time. The higher the channel resolution, the longer it takes to read the channel. In cases where accuracy is less important than speed, you may reduce the resolution.

Specifying a channel type

The channel type varies according to the possible output ranges for the I/O board.

When you select this channel class	The Channel Type contains this information
Counter (for programmable gain or range board)	There are no channel types listed. A special internal channel type is automatically selected.
Counter (for non-programmable gain or range board)	The range value specified with the File > Real Time Config command.
Digital	A special internal type. If the board does not support programmable ranges or gains, the channel type is set to the range value specified with the File > Real Time Config command. There are no other channel options. There are no other channel options.
Volts (for a programmable gain board)	The allowable ranges from which you can choose. These are read-only settings.
Volts (for non-programmable gain	The hardware settings for the output voltage range

board) on the board. These are read-only settings.

Chapter 4

Producing Pulse Width Modulated Output

This chapter describes how to use the PWM block to vary a signal's frequency or pulse width.

Boards supported by the PWM block

The PWM block is based on the 9513 chip. Any board based on that chip can use the PWM block. Currently, these boards include:

Vendor	Board
Analog Devices	RTI 815
ComputerBoards	CIO-CTR05
	CIO-CTR05/H50
	CIO-CTR10
	CIO-CTR10/H50

Because VisSim/Real-TimePRO is continually expanding the I/O boards it supports, it's a good idea to contact Visual Solutions for the most up-to-date list of supported boards.

Using the PWM block

The PWM block has two inputs: frequency and % Duty Cycle (or pulse width).

Combined, these two inputs form a signal with the specified frequency and duty cycle. The duty cycle indicates the percent of time the signal is in an ON state. The PWM block sends the signal to the specified channel on the 9513 counter output.

Although you can dynamically change the input values simultaneously, you typically vary one or the other input at a time. For example, for power modulation, keep the frequency fixed at a constant value while varying the pulse width. Conversely, for pure frequency output, fix the pulse width and vary the frequency.

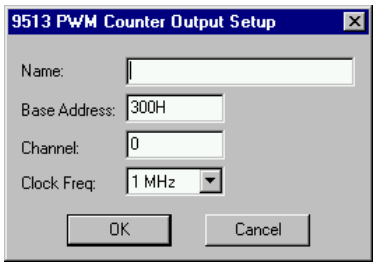
Specifying properties of the PWM block

Through the Setup dialog box for the PMW block, you define the base address and channel number to which the pulse width modulated waveform is sent. You also use the Setup dialog box to set the clock frequency and to provide the PMW block with a unique name.

▶ **To specify PWM block properties**

1. Choose Blocks > Real Time and drag a PWM block into the work area.
2. Do one of the following:
   - Choose Edit > Block Properties and click the mouse over the PWM block.
   - Click the right mouse button over the PWM block.

   The 9513 PWM Counter Output Setup dialog box appears.



3. Do one or more of the following:

Use this parameter	To
Name	Provide a unique name for your `PWM` block. By naming `PWM` blocks, you reduce the risk of misreading your diagram, particularly when you are using more than one `PWM` block.
Base Address	Indicate the I/O port register address through which the real-time driver commands the board. Enter the base address as a hexadecimal number, followed by an optional "H." If you are not sure of the board's base address, use the File > Real Time Config, as described on page 8, to display this information.
Channel	Enter a number that corresponds with the channel number on the screw terminal or termination panel supplied with your I/O board. VisSim/Real-TimePRO and VisSim DACQ use channel 0 as the first channel, even if the documentation supplied by the board vendor describes the first channel as channel 1.
Clock Freq.	Enter a value that corresponds with the base frequency crystal value set on your I/O board. If the value you enter does not match the base frequency crystal value, erroneous results are produced.

4. Click on the OK button, or press ENTER.

Chapter 5

Measuring Frequency Input

This chapter describes how to use the `frequency` block to measure input frequency of TTL-level edge transitions, from 0 to 5 V.

Boards supported by the frequency block

The `frequency` block is based on the 9513 chip. Any board based on that chip can use the `frequency` block. Currently, these boards include:

Vendor	Board
Analog Devices	RTI 815
ComputerBoards	CIO-CTR05
	CIO-CTR05/H50
	CIO-CTR10
	CIO-CTR10/H50

Because VisSim/Real-TimePRO is continually expanding the I/O boards it supports, it's a good idea to contact Visual Solutions for the most up-to-date list of supported boards.

Using the frequency block

The `frequency` block lets you access and read a particular channel on the 9513 counter and use the value of this signal in a VisSim diagram. Functionally, the `frequency` block performs the reverse options of the `PWM` block, described earlier on page 23.

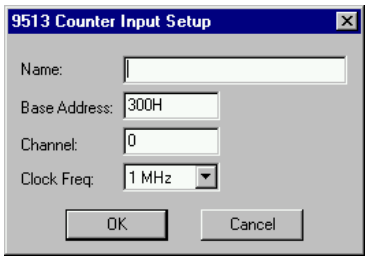
Specifying properties of a frequency block

The `frequency` block measures a signal on an I/O board at the specified base address and channel number and outputs the frequency in hertz.

▶ **To specify frequency block properties**

1. Choose Blocks > Real Time and drag a `frequency` block into the work area.
2. Do one of the following:
   - Choose Edit > Block Properties and click the mouse over the `frequency` block.
   - Click the right mouse button over the `frequency` block.

   The 9513 Counter Input Setup dialog box appears.



3. Do one or more of the following:

Use this parameter	To
Name	Provide a unique name for your `frequency` block. By naming `frequency` blocks, you reduce the risk of misreading your diagram, particularly when you are using more than one `frequency` block.
Base Address	Indicate the I/O port register address through which the real-time driver commands the board. Enter the base address as a hexadecimal number, followed by an "H." If you are not sure of the board's base address, use the File > Real Time Config, as described on page 8, to display this information.

Use this parameter	To
Channel	Enter a number that corresponds with the channel number on the screw terminal or termination panel supplied with your I/O board. VisSim/Real-TimePRO and VisSim DACQ use channel 0 as the first channel, even if the documentation supplied by the board vendor describes the first channel as channel 1.
Clock Freq.	Enter a value that corresponds with the base frequency crystal value set on your I/O board. If the value you enter does not match the base frequency crystal value, erroneous results are produced.

4. Click on the OK button, or press ENTER.

Specifying a sampling rate

To obtain an accurate measurement, set VisSim's sampling interval (that is, its simulation time step) larger than the sample interval of the events you are measuring.

Chapter 6

Reading Encoder Input

This chapter describes how to use the `encoder` block to read quadrature encoded inputs.

Boards supported by the encoder block

Currently, only the MFIO-3A board from Precision Micro Dynamics is supported. However, because VisSim/Real-TimePRO and VisSim DACQ are continually expanding the I/O boards they support, it is a good idea to contact Visual Solutions for the most up-to-date list of supported boards.

Using the encoder block

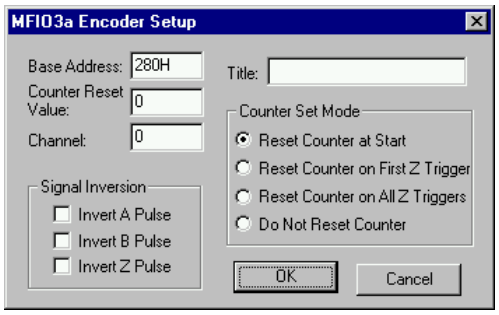
Because the MFIO-3A board has quadrature encoder inputs, to access all three encoder inputs, use three `encoder` blocks.

Specifying properties of an encoder block

▶ **To set up the encoder block**

1. Choose Blocks > Real Time and drag a `encoder` block into the work area.
2. Do one of the following:
   - Choose Edit > Block Properties and click the mouse over the `encoder` block.
   - Click the right mouse button over the `encoder` block.

The MFIO3a Encoder Setup dialog box appears.



3. Make the appropriate selections. (See the descriptions below for more information about each parameter.)
4. Click on the OK button, or press ENTER.

Specifying a title

You use the Title box to create a name for the particular encoder channel that is accessed with the encoder block. By giving unique names to different encoder inputs, you can easily distinguish between them.

Specifying the base address

The base address indicates the I/O port register address through which the real-time driver commands the board. Enter the base address as a hexadecimal number, followed by an “H.”

If you are not sure of the board’s base address, use the File > Real Time Config, as described on page 8, to display this information.

Specifying the counter reset value

The Counter Reset Value box lets you reset the value of the index pulse on the occurrence of the index pulse and according to the counter set mode.

Specifying the channel

In the Channel box, you enter a number that corresponds with the channel number on the screw terminal or termination panel supplied with your MFIO-3A board. VisSim/Real-TimePRO and VisSim DACQ use channel 0 as the first channel, even if the documentation supplied by the board vendor describes the first channel as channel 1.

Specifying the signal inversion

Each channel on the MFIO-3A board has an A, B, and Z axis. You can invert one or more axes to get phasing information.

Specifying the counter set mode value

The Counter Set Mode lets you reset the counter on your MFIO-3A board to the value specified in the Counter Reset Value box. You have the following choices:

- You can reset the counter at the start of the simulation.
- You can reset the counter at the first occurrences of the index pulse (which is also known as the Z trigger).
- You can reset the counter at every occurrence of the index pulse.

You can alternatively not ever reset the counter.

Determining the direction of rotation value

The two pulse, A and B, are shifted by a quarter of a cycle with respect to each other. The shift between the two signals enables the controller or the simulation to determine the direction of rotation, according to whether pulse A leads pulse B, or vice versa.

Appendix A

Connecting to Boards with an 8255 Chip

The Keithley MetraByte PIO-24 board; ComputerBoards CIO-DIO24 and CIO-DIO24H boards; and National Instruments PC-DIO-24, PC-DIO-96, and DAQCard-1200 offer several ways to connect VisSim channels to the electrical connector terminals. These boards are capable of 24 channels of digital I/O, and can be configured as all digital inputs, all digital outputs, or byte-wise combinations of both. The DIO24 can be configured as all input channels; all output channels; or 12 input and 12 output channels.

Configured as all input channels

VisSim input channel	Terminal connector channel	VisSim input channel	Terminal connector channel
0	A0	12	B4
1	A1	13	B5
2	A2	14	B6
3	A3	15	B7
4	A4	16	C0
5	A5	17	C1
6	A6	18	C2
7	A7	19	C3
8	B0	20	C4

VisSim input channel	Terminal connector channel	VisSim input channel	Terminal connector channel
9	B1	21	C5
10	B2	22	C6
11	B3	23	C7

Configured as all output channels

VisSim output channel	Terminal connector channel	VisSim output channel	Terminal connector channel
0	A0	12	B4
1	A1	13	B5
2	A2	14	B6
3	A3	15	B7
4	A4	16	C0
5	A5	17	C1
6	A6	18	C2
7	A7	19	C3
8	B0	20	C4
9	B1	21	C5
10	B2	22	C6
11	B3	23	C7

Configured as 12 inputs and 12 outputs

VisSim input channel	Terminal connector channel	VisSim output channel	Terminal connector channel
0	A0	0	B0
1	A1	1	B1
2	A2	2	B2
3	A3	3	B3
4	A4	4	B4
5	A5	5	B5
6	A6	6	B6
7	A7	7	B7
8	C0	8	C4
9	C1	9	C5
10	C2	10	C6
11	C3	11	C7

Appendix B

Connecting to PCM-CIA DAS 16/12 and DAS 16/16 Boards

It is important to be aware of how to connect to ComputerBoards PCM-CIA DAS 16/12 and 16/16 boards. The following table describes how the VisSim channels map to the terminal connector channels.

Configured as four inputs and four outputs

VisSim input channel	Terminal connector channel	VisSim input channel	Terminal connector channel
0	DIO 0	0	DIO 4
1	DIO 1	1	DIO 5
2	DIO 2	2	DIO 6
3	DIO 3	3	DIO 7

Appendix C

Installation Procedures

This appendix covers the following information:

- Installing I/O boards
- Installing and upgrading VisSim/Real-TimePRO
- Installing and upgrading VisSim DACQ

Installing I/O boards

Installing a new I/O board in your computer is more than just inserting the board into an empty expansion slot and seating it to the connector. Before you reach this point, most boards require that you set their base addresses and adjust their jumpers. Because this information is unique to each board, it is important that you refer to the vendor's documentation for installing and testing the board.

Installing VisSim/Real-TimePRO

VisSim/Real-TimePRO runs on personal computers using the Intel 80386 or higher processor, including the IBM Personal System/2 Series, the IBM PC AT, and 100% compatibles. To use VisSim/Real-TimePRO, your computer must have the following components:

- Visual Solutions VisSim 3+
- 300K RAM

- 300K of free hard disk space
- 3½" disk drive
- EGA or higher resolution monitor

You use one of the following installation procedures whether you are installing VisSim/Real-TimePRO for the first time, upgrading from a previous version, or stepping up from VisSim/RT. The installation procedure assumes that you are installing from drive A. If you are installing from a different drive, please substitute the correct drive designation in the procedure below.

▶ To install, upgrade, or step up VisSim/Real-TimePRO on Windows 3.1 or Windows 95

1. Start Windows.
2. Insert the VisSim/Real-TimePRO disk into drive A.
3. Do one of the following:
   - Click on Start and choose Run.
   - Select File from the Program Manager menu bar and choose the Run command.
4. In the Command Line box, type A:INSTALL and click on the OK button, or press ENTER.

   A VisSim/Real-TimePRO dialog box appears.
5. Install asks you where you want to install VisSim/Real-TimePRO. You can accept the default path (C:\VISSIM30) or type in a different directory. Make sure that the VisSim/Real-TimePRO files are installed on the same disk and directory that contain your VISSIM32.EXE.

   If you choose to install VisSim/Real-TimePRO over an earlier version, Install replaces old VisSim files with new ones. You can control which existing VisSim files are overwritten as a result of the installation by activating the Ask Before Overwriting Existing Files check box. An X in the box activates confirmation.
6. To accept the information in the dialog box, click on the Continue button, or press ENTER.

   Install displays a dialog box that shows the progress of the installation.
7. When the installation is complete, VisSim displays a dialog box indicating that VisSim/Real-TimePRO has been successfully installed.
8. Click on the OK button, or press ENTER.

When you start up VisSim, the `rt-DataIn` and `rt-DataOut` blocks are available for use.

Installing VisSim DACQ

VisSim DACQ runs on personal computers using the Intel 80286 or higher processor, including the IBM Personal System/2 Series, the IBM PC AT, and 100% compatibles. To use VisSim DACQ, your computer must have the following components:

- Microsoft Windows 3.1+, 95, or NT
- One MB RAM
- One MB of free hard disk space
- 3½" disk drive
- EGA or higher resolution monitor

You use the following installation procedure whether you are installing VisSim DACQ for the first time or upgrading from a previous version. The installation procedure assumes that you are installing from drive A. If you are installing from a different drive, please substitute the correct drive designation in the procedure below.

▶ **To install or upgrade VisSim DACQ**

1. Start Windows.
2. Insert the VisSim/Real-TimePRO disk into drive A.
3. Do one of the following:
   - Click on Start and choose Run.
   - Select File from the Program Manager menu bar and choose the Run command.
4. In the Command Line box, type A:INSTALL and click on the OK button, or press ENTER.

   A VisSim DACQ dialog box appears.
5. Install asks you where you want to install VisSim DACQ. You can accept the default path or type in a different directory.

   If you choose to install VisSim DACQ over an earlier version, Install replaces old VisSim files with new ones. You can control which existing VisSim files are overwritten as a result of the installation by activating the Ask Before Overwriting Existing Files check box. An X in the box activates confirmation.

6. To accept the information in the dialog box, click on the Continue button, or press ENTER.

   Install displays a dialog box that shows the progress of the installation.

7. Insert the next disk when prompted.
8. When the installation is complete, a dialog box is displayed indicating that VisSim DACQ has been successfully installed.
9. Click on the OK button, or press ENTER.

VisSim DACQ creates a VisSim group with a VisSim DACQ icon.

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