IMAQ™

NI-IMAQ™ VI Reference Manual

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About This Manual

This manual describes the features, functions, and operation of the image acquisition (IMAQ) virtual instruments (VIs) for LabVIEW. To use this manual effectively, you must be familiar with image processing, LabVIEW or BridgeVIEW, and your IMAQ hardware device.

Organization of This Manual

The *NI-IMAQ VI Reference Manual* is organized as follows:

- Chapter 1, *How to Use NI-IMAQ VIs*, describes how to use National Instruments G programming and application software, such as LabVIEW, BridgeVIEW, and IMAQ Vision, with your IMAQ hardware and NI-IMAQ VIs.
- Chapter 2, *NI-IMAQ VIs*, describes the NI-IMAQ and IMAQ Vision VIs included with your NI-IMAQ software.
- Appendix A, *IMAQ Attributes*, lists the attributes used with the IMAQ Attribute VI.
- Appendix B, *StillColor Reference*, lists the attributes used with the IMAQ StillColor Attribute VI and the image representations used with the IMAQ StillColor Setup VI.
- Appendix C, *Error Codes*, lists the error codes for the NI-IMAQ VIs.
- Appendix D, *Customer Communication*, contains forms you can use to request help from National Instruments or to comment on our products and manuals.
- The *Glossary* contains an alphabetical list and description of terms used in this manual, including abbreviations, acronyms, metric prefixes, mnemonics, and symbols.
- The *Index* contains an alphabetical list of key terms and topics in this manual, including the page where you can find each one.

Conventions Used in This Manual

The following conventions are used in this manual:

<>	Angle brackets enclose the name of a key on the keyboard (for example, <option>). Angle brackets containing numbers separated by an ellipsis represent a range of values associated with a bit or signal name (for example, DBIO<3..0>).
[]	Square brackets enclose optional items (for example, [`response`]).
-	A hyphen between two or more key names enclosed in angle brackets denotes that you should simultaneously press the named keys (for example, <Control-Alt-Delete>).
»	The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options» Substitute Fonts** directs you to pull down the **File** menu, select the **Page Setup** item, select **Options**, and finally select the **Substitute Fonts** options from the last dialog box.
☞	This icon to the left of bold italicized text denotes a note, which alerts you to important information.
bold	Bold text denotes the names of menus, menu items, parameters, dialog box, dialog box buttons or options, icons, windows, Windows 95 tabs, or LEDs.
bold italic	Bold italic text denotes a note, caution, or warning.
italic	Italic text denotes emphasis, a cross reference, an operation, or an introduction to a key concept. This font also denotes text from which you supply the appropriate word or value, as in Windows 3.*x*.
`monospace`	Text in this font denotes text or characters that you should literally 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, and for statements and comments taken from programs.
`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 that you must enter the appropriate words or values in the place of these items.
paths	Paths in this manual are denoted using backslashes (\) to separate drive names, directories, folders, and files.

Customer Communication

National Instruments wants to receive your comments on our products and manuals. We are interested in the applications you develop with our products, and we want to help if you have problems with them. To make it easy for you to contact us, this manual contains comment and configuration forms for you to complete. These forms are in Appendix D, *Customer Communication*, at the end of this manual.

1

How to Use NI-IMAQ VIs

This chapter describes how to use National Instruments G programming and application software, such as LabVIEW, BridgeVIEW, and IMAQ Vision, with your IMAQ hardware and NI-IMAQ VIs.

Introduction

LabVIEW and BridgeVIEW feature interactive graphics, a state-of-the-art user interface, and a powerful graphical programming language, G. The G NI-IMAQ VI Library, a series of virtual instruments (VIs) for using LabVIEW and BridgeVIEW with your IMAQ device, is included with your NI-IMAQ software.

IMAQ Vision for G is an image processing and analysis library that consists of more than 400 VIs for use with LabVIEW and BridgeVIEW. If you have not purchased the IMAQ Vision image processing and analysis libraries, you can use the four IMAQ Vision VIs included with your NI-IMAQ software. If you use these basic functions, you can later upgrade your programs to use IMAQ Vision without any changes to your image acquisition VIs.

Before you start building your IMAQ application, you should know the following basic G IMAQ concepts:

- Location of the NI-IMAQ examples
- Location of the NI-IMAQ VIs in LabVIEW or BridgeVIEW
- Common NI-IMAQ VI parameters
- Error handling
- Buffer management
- NI-IMAQ acquisition types
- StillColor acquisition
- Triggering
- Image display
- NI-IMAQ attributes
- Camera attributes

Location of NI-IMAQ Examples

The NI-IMAQ examples for G illustrate some common applications used with NI-IMAQ in LabVIEW and BridgeVIEW. You can find these examples in the `labview\examples\imaq` directory for LabVIEW and `bridgeview\examples\g examples\imaq` for BridgeVIEW. For a brief description of any example, open the example VI and choose **Windows»Show VI Info** for a text description of the example.

Location of the NI-IMAQ VIs

You can find the NI-IMAQ VIs in the **Functions** palette from your block diagram in LabVIEW and BridgeVIEW. Select the IMAQ icon near the bottom of the **Functions** palette, as shown in Figures 1-1 and 1-2, to pop up the **Image Acquisition** palette.

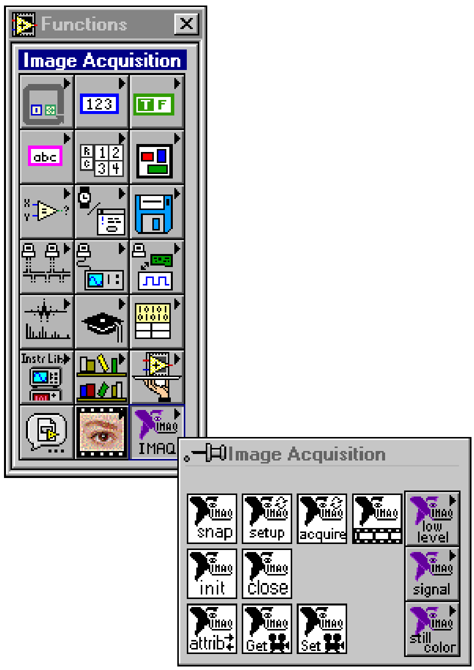


Figure 1-1. LabVIEW Functions Palette with IMAQ Palette

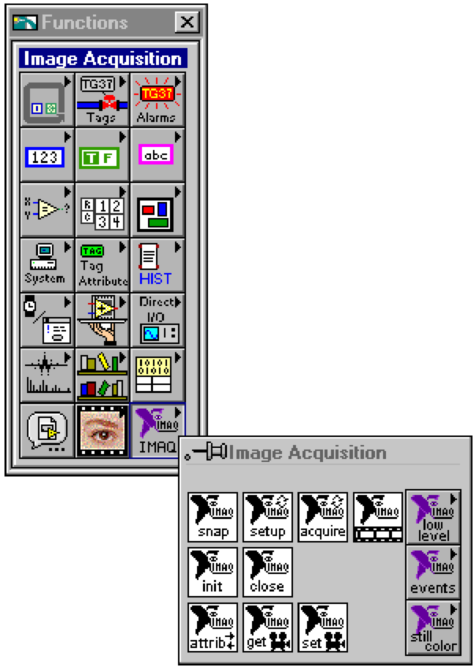


Figure 1-2. BridgeVIEW Functions Palette with IMAQ Palette

The most commonly used VIs are on the **Image Acquisition** palette. VIs are provided for basic acquisition and changing attributes. See the *HIgh-Level and Attribute VIs* section in Chapter 2, *NI-IMAQ VIs*, for more information on these VIs.

The **Image Acquisition»IMAQ Low Level** palette contains VIs for more advanced applications. See the *Low-Level VIs* section in Chapter 2, *NI-IMAQ VIs*, for more information on the **Low-Level** VI palette.

The **Image Acquisition»IMAQ Events** palette contains VIs for using triggers and pulse generation with IMAQ devices. See the *Signal I/O VIs* section in Chapter 2, *NI-IMAQ VIs*, for more information on the **Events** VI palette.

The **Image Acquisition»IMAQ Color** palette contains VIs for using color VIs with IMAQ devices. See the *Color VIs* section in Chapter 2, *NI-IMAQ VIs*, for more information on the **Color VI** palette.

Common NI-IMAQ VI Parameters

IMAQ Refnum is a unique identifier that specifies the Interface file used for the acquisition. It is produced by the IMAQ Init VI and used as an input to all other NI-IMAQ VIs. **IMAQ Refnum Out**, which is identical to **IMAQ Refnum**, is used to simplify dataflow programming and is similar to the duplicate file refnums provided by the file I/O functions. The High-Level Acquisition VIs—IMAQ Snap, IMAQ Grab Setup, and IMAQ Sequence—require you to wire **IMAQ Refnum In** only if you are using an interface other than the default `img0`, you are using multiple boards, or you need to set IMAQ attributes before the acquisition.

Many acquisition VIs require that you supply an image buffer to receive the captured image. You can create this image buffer with the IMAQ Create VI. Consult the *Buffer Management* section of this chapter for more information. The input that receives the image buffer is **Image in**. The **Image out** output returns the captured image.

The acquisition VIs use the **Region of Interest** input to specify a rectangular portion of an image frame to be captured, which you can use to reduce the size of the image you want to capture. **Region of Interest** is an array of four elements with the elements defined as Left, Top, Right, Bottom. The width [Right-Left] must be a multiple of eight. If **Region of Interest** is not wired, the entire image acquisition window is captured. You configure the default acquisition window using the IMAQ Configuration Utility.

The acquisition VIs use the **Step x** and **Step y** inputs to specify a horizontal and vertical sampling step. The sampling step causes a reduction in spatial resolution; however, the entire acquisition window is transferred. Using a sampling step allows you to reduce the size of the image by trading spatial resolution for field of view.

Error Handling

Every NI-IMAQ VI contains an **error in** input cluster and an **error out** output cluster, as shown in Figure 1-3. The clusters contain a Boolean that indicates whether an error occurred, the code for the error, and the source or the name of the VI that returned the error. If **error in** indicates an error, the VI passes the error information to **error out** and does not execute any NI-IMAQ function.

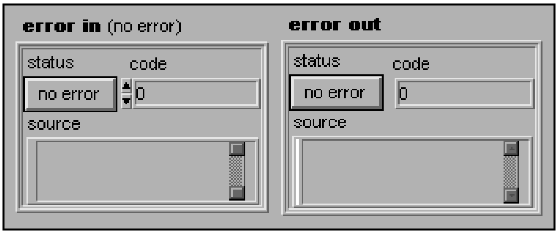


Figure 1-3. Error Clusters

You can use the Simple Error Handler VI (**Functions»Time&Dialog**) to check for errors that occur while executing a VI. If you wire an error cluster to the Simple Error Handler VI, the VI deciphers the error information and displays a dialog box that describes the error. If no error occurred, the Simple Error Handler VI does nothing. Figure 1-4 shows how to wire an NI-IMAQ VI to the Simple Error Handler VI.

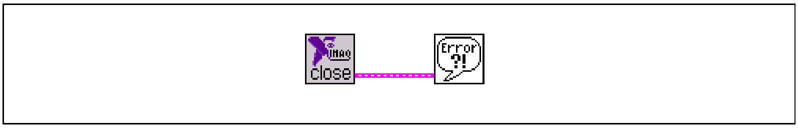


Figure 1-4. Error Checking using the Simple Error Handler VI

Figure 1-5 shows an example of the dialog box Simple Error Handler displays when an error occurs.

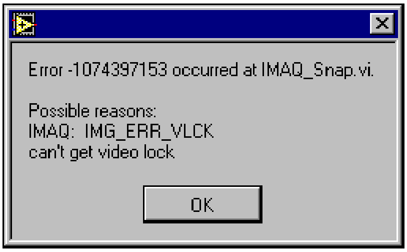


Figure 1-5. Simple Error Handler Dialog Box

For more information on error handling, see Appendix C, *Error Codes*.

Buffer Management

IMAQ Create and IMAQ Dispose manage image buffers in LabVIEW and BridgeVIEW. IMAQ Create, shown in Figure 1-6, allocates an image buffer. **Image Name** is a label for the buffer created. Each buffer must have a unique name. **ImageType** specifies the type of image being created. Use **8 bits** for 8-bit monochrome images, **16 bits** for 10-, 12-, and 14-bit monochrome images, and **RGB Chunky** for color images.

New Image contains pointer information to the buffer, which is initially empty. When you wire **New Image** to the **Image in** input of an image acquisition VI, the image acquisition VI allocates the correct amount of memory for the acquisition. If you are going to process the image, you might need to wire to **Border Size**. **Border Size** is the width in pixels created around an image. Some image processing functions, such as labeling or morphology, require a border.

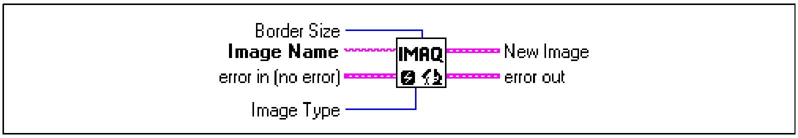


Figure 1-6. IMAQ Create

IMAQ Dispose, shown in Figure 1-7, frees the memory allocated for the image buffer. Call this VI only after the image is no longer required for processing.

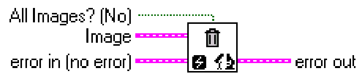


Figure 1-7. IMAQ Dispose

NI-IMAQ Acquisition Types

Four NI-IMAQ image acquisition types are available in LabVIEW and BridgeVIEW—snap, grab, sequence, and ring. The following sections describe each acquisition type and give examples.

Snap

A snap acquires a single image into a memory buffer. Use this acquisition mode to acquire a single frame or field to a buffer. When you invoke a snap, it initializes the board and acquires the next incoming video frame (or field) to a buffer. A snap is appropriate for low-speed or single-capture applications.

Use the IMAQ Snap VI for snap applications. Figure 1-8 shows a simplified block diagram for using IMAQ Snap.

Figure 1-8. Acquiring an Image Using Snap

Grab

A grab is a continuous, high-speed acquisition of data to a single buffer in host memory. This function performs an acquisition that loops continually on one buffer. You can get a copy of the acquisition buffer by grabbing a copy to a G image buffer.

You must use two VIs, IMAQ Grab Setup and IMAQ Grab Acquire, for a grab acquisition in G. IMAQ Grab Setup, which you call only once, initializes the acquisition and starts capturing the image to an internal software buffer. IMAQ Grab Acquire, which you can call multiple times, copies the image currently stored in the internal buffer to a G image buffer. The **Immediate?** input to IMAQ Grab Acquire determines if the copy takes place immediately or if it waits for the next vertical blank. If **Immediate?** is FALSE, IMAQ Grab waits for the next vertical blank signal and then transfers the image from the internal buffer to the G image buffer. If **Immediate?** is TRUE, IMAQ Grab immediately transfers the image from the internal buffer to the G image buffer, which could result in portions of the image transferred being acquired at different times. A typical application for an immediate transfer is the acquisition of images of stationary objects. After the program is finished copying images, IMAQ Close should be called once to shut down the acquisition.

Figure 1-9 shows a simplified block diagram for using IMAQ Grab Setup and IMAQ Grab Acquire. In this example, you perform an immediate copy by wiring a TRUE to the **Immediate?** input.

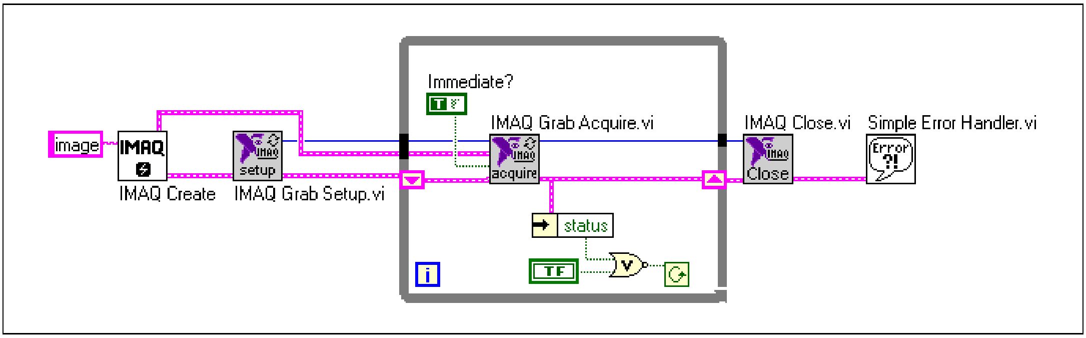


Figure 1-9. Acquiring Images Using Grab

Sequence

A sequence initiates a variable-length and variable-delay transfer to multiple buffers. A sequence is appropriate for applications that process multiple images. You can configure a sequence to acquire every frame or skip a variable number of frames between each image.

The VI you use for sequence applications is IMAQ Sequence. IMAQ Sequence starts, acquires, and releases a sequence acquisition. The input **Skip Table** is an array containing the number of frames to skip between images. IMAQ Sequence does not return until the entire sequence is acquired.

Figure 1-10 shows a simplified block diagram for using IMAQ Sequence. IMAQ Create is used inside a For Loop to create an array of images for the

Images in input to IMAQ Sequence. To Decimal and Concatenate Strings illustrate a useful method to create a unique name for each image in the array.

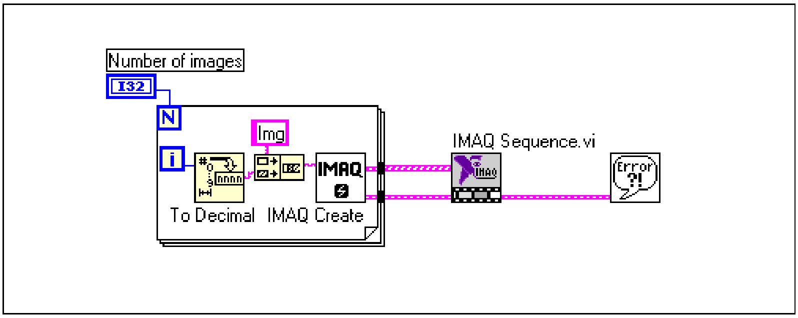


Figure 1-10. Acquiring Images Using Sequence

Ring

A ring initiates a continuous high-speed acquisition to multiple buffers. A ring is appropriate for high-speed applications where you need to perform processing on every image. You must use multiple buffers because processing times may vary, depending on other applications and processing results.

You can configure a ring to acquire every frame or to skip a fixed number of frames between acquisitions. In G, you must use the NI-IMAQ low-level VIs to perform a ring.

Acquisition VIs

Two acquisition VI types are available in LabVIEW and BridgeVIEW—high-level and low-level.

High-Level

You can use the high-level acquisition VIs for basic image acquisition applications. VIs are included for snap, grab, and sequence as described in the *NI-IMAQ Acquisition Types* section. Examples of using the high-level acquisition VIs are included in the `examples\imaq\imaq high level.llb` file.

Low-Level

You can use the low-level acquisition VIs for more advanced image acquisition applications, including ring acquisitions and acquisitions to onboard memory. The low-level VIs consist of VIs to configure an acquisition, start an acquisition, retrieve the acquired images, and stop an acquisition. These VIs can be used in conjunction with the event VIs to construct advanced IMAQ applications.

To perform a low-level acquisition, first call IMAQ Init to initialize the board and create an **IMAQ Refnum**. Next, configure the acquisition with IMAQ Configure List and IMAQ Configure Buffer. IMAQ Configure List configures a buffer list to be used in an acquisition. The buffer list contains a specific number of buffers that will contain the acquired images. The buffers can be stored either in system memory or in onboard memory (for boards with onboard memory such as the IMAQ PCI-1424). Call IMAQ Configure Buffer once for each buffer in the buffer list. The buffer contains the channel from which to acquire and how many frames to skip before acquiring into the buffer. After configuring the buffer list and individual buffers, call IMAQ Start to start the acquisition asynchronously. IMAQ Start will return immediately after the acquisition has started.

After the acquisition is in progress, you can access the acquired images several ways. IMAQ Get Buffer will return acquired images from the buffer list and is normally used for snap and sequence acquisitions. IMAQ Get Buffer will wait until the requested buffer has been acquired to return the image. You can also use this VI to return all images in the buffer list. IMAQ Get Buffer can retrieve images from a continuous acquisition only if the acquisition has been stopped. IMAQ Extract Buffer extracts a buffer from a continuous acquisition and allows for the examination of a buffer during acquisition. The buffer is removed from the acquisition and new data will not be written into the buffer until this VI is called again. Use IMAQ Extract Buffer in ring acquisitions when you must process images during the acquisition. IMAQ Copy returns a copy of an acquired image. IMAQ Copy allows you to create a copy of any buffer at any time during the acquisition.

After an acquisition, you must release the resources associated with the acquisition using IMAQ Close. IMAQ Close will also stop the acquisition if one is in progress. If you would like to stop the acquisition without releasing the resources (such as the image buffers), use IMAQ Stop.

Examples of the low-level acquisition VIs are included in `examples/imaq/IMAQ Low Level.llb`.

StillColor Acquisition

You can use an IMAQ PCI/PXI-1408 to acquire color images from either a color composite or RGB camera.

Composite Snap

A StillColor composite snap acquires a single color image into a memory buffer from a color composite camera. You can use a StillColor composite snap for high-quality color images of still or very slowly moving objects. For more information on StillColor, refer to Appendix B, *StillColor*, of the *NI-IMAQ User Manual*.

To perform a StillColor composite snap, use the IMAQ Snap VI for acquisition. You must also call the IMAQ StillColor Setup VI to set up the device for a color acquisition.

Figure 1-11 shows a simplified block diagram for performing a StillColor snap. First, you must always use the IMAQ Init VI to generate an **IMAQ Refnum** for StillColor acquisition. Then, use the IMAQ StillColor Setup VI to set up the IMAQ device. The input to **Set StillColor mode** is an enumerated constant. To create the enumerated constant, pop up on the **Set StillColor mode** input and choose **Create Constant**. Click on the created constant with the Operating Tool and select **Composite**. The input to **Set image representation** is also an enumerated type. This input specifies the type of image data to be returned by the IMAQ Snap VI, which is RGB 32-bit in this example. The IMAQ Create VI must create an image buffer that corresponds to the image type specified by **Set image representation**. Refer to Appendix B, *StillColor Reference*, for a list of image representations and the corresponding image types. Finally, the IMAQ Snap VI acquires the image from the IMAQ device.

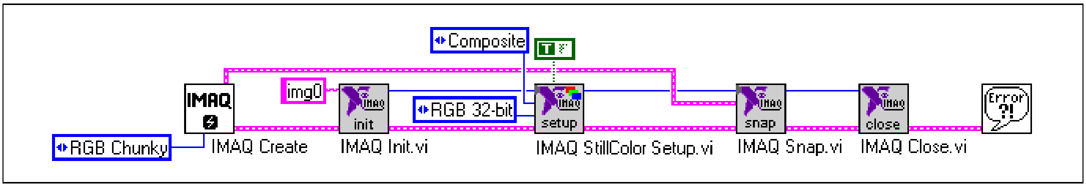


Figure 1-11. Acquiring a StillColor Composite Image

RGB Snap

An RGB snap acquires a single color image into a memory buffer from an RGB camera. You can use an RGB snap for acquiring high-quality color images of still or very slowly moving objects. For more information on StillColor RBG refer to Appendix B, *StillColor*, in the *NI-IMAQ User Manual*.

To perform an RGB snap, use the IMAQ Snap VI for acquisition. You must also call IMAQ StillColor Setup VI to set up the board for a color acquisition.

Figure 1-12 shows a simplified block diagram for performing an RGB snap. First, you must always use the IMAQ Init VI to generate an **IMAQ Refnum** for StillColor acquisition. Then, use the IMAQ StillColor Setup VI to set up the IMAQ device. The input to **Set StillColor mode** is an enumerated constant. To create the enumerated constant, pop up on the **Set StillColor mode** input and choose **Create Constant**. Click on the created constant with the Operating Tool and select **RGB**. The input to **Set image representation** is also an enumerated type. This input specifies the type of image data to be returned by IMAQ Snap, which is RGB 32-bit in this example. The IMAQ Create VI must create an image buffer that corresponds to the image type specified by **Set image representation**. Refer to Appendix B, *StillColor Reference*, for a list of image representations and the corresponding image types. Finally, the IMAQ Snap VI acquires the image from the IMAQ device.

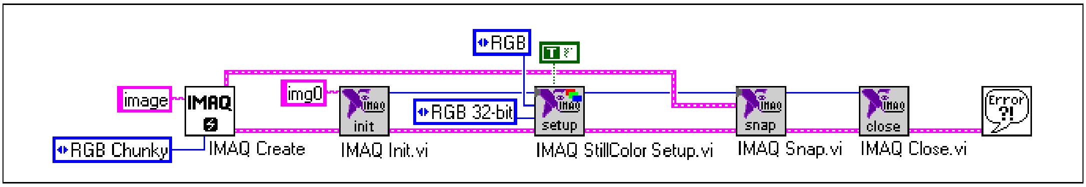


Figure 1-12. Acquiring an RGB Image

Triggering

Often you may need to link or coordinate a vision action or function with events external to the computer, such as the receipt of a strobe pulse for lighting or a pulse from an infrared detector that indicates the position of an item on an assembly line. A trigger on an IMAQ device can be any TTL-level signal. All of the trigger lines are fully bidirectional so that the device can generate or receive the triggers on any line. The IMAQ PCI/PXI-1408 and PCI-1424 have four external trigger lines and seven Real-Time System Integration (RTSI) lines for general purpose use. The RTSI triggers are for coordination with other National Instruments boards, such as data acquisition (DAQ) cards, which support the RTSI bus.

Note ***Only four of the seven RTSI triggers can be used at once.***

Use IMAQ Configure Trigger to configure the trigger conditions for an acquisition. You must call IMAQ Configure Trigger before the acquisition VI. The **Trigger line** input specifies which external or RTSI trigger will receive the incoming trigger signal. Each trigger line has a programmable polarity which is specified with **Trigger polarity**. **Frame timeout** specifies the amount of time to wait for the trigger. Figure 1-13 shows how to use IMAQ Configure Trigger to cause a snap acquisition to occur based on a trigger.

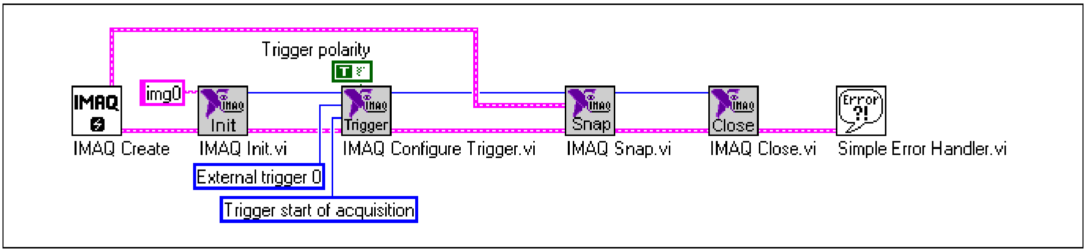


Figure 1-13. IMAQ Triggering

Image Display

Many image acquisition applications require that one or more images be displayed. Two options are available for displaying images in LabVIEW and BridgeVIEW.

If you have IMAQ Vision for G, the image processing and analysis software for LabVIEW and BridgeVIEW, you can use IMAQ WindDraw. IMAQ WindDraw (**IMAGE»Display(basics)**) displays an image in an image window. Figure 1-14 illustrates using IMAQ WindDraw to display an image acquired using IMAQ Snap. Images can be displayed in the same way using any acquisition type. For more information on the display capabilities of IMAQ Vision, consult the *IMAQ Vision for G Reference Manual*.

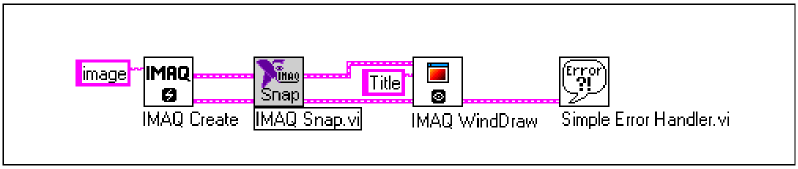


Figure 1-14. Displaying an Image Using IMAQ WindDraw

If you do not have IMAQ Vision, you can display an image on a G Intensity Graph. Before you can properly display an image, you need to make some minor changes to the default properties of the Intensity Graph.

After you place the Intensity Graph on the front panel, pop up on the graph and choose **Transpose Array**. To create the correct grayscale color palette, pop up on the marker labeled `50` on the color ramp and choose **Delete Marker**. Also, change the maximum value on the color palette from 100 to the maximum pixel value in your image—255 for 8-bit images, 1,023 for 10-bit images, and 4,095 for 12-bit images. Next, change the Y axis so that it is inverted. You might also need to change the ranges of the X and Y axes to match the width and height of the image. Your intensity graph now should appear similar to the image shown in Figure 1-15. For more information on the Intensity Graph, consult the *LabVIEW User Manual* or the *G Programming Reference Manual*.

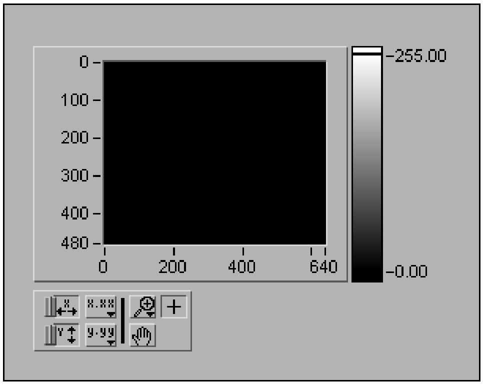


Figure 1-15. Intensity Graph for Image Display

Use the IMAQ ImageToArray VI to copy an image from an image buffer into a G array. Then you can wire this array directly to an Intensity Graph for display. Figure 1-16 illustrates using an Intensity Graph to display an image acquired using IMAQ Snap.

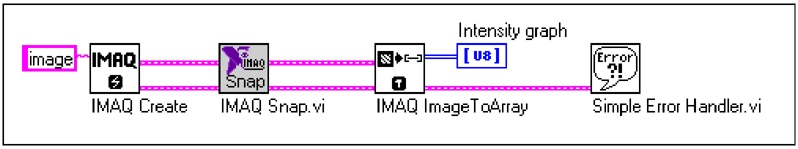


Figure 1-16. Displaying an Image Using an Intensity Graph

NI-IMAQ Attributes

Use the IMAQ Attribute VI to get or set attributes of the NI-IMAQ driver. The IMAQ attributes are described in Appendix A, *IMAQ Attributes*.

To use IMAQ Attribute to get the current value of an attribute, first wire a FALSE to the **Get/Set** input. Then pop up on the **Attribute** input and choose **Create Constant**. Click the created constant with the Operating Tool and select the desired attribute. The current value of that attribute returns in the **Get Value** output. Figure 1-17 shows how to use IMAQ Attribute to get the value of an attribute.

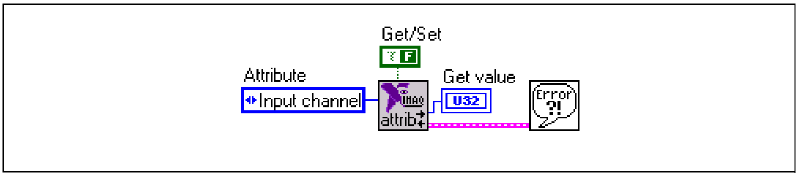


Figure 1-17. Getting the Value of an NI-IMAQ Attribute

To use IMAQ Attribute to set the value of an attribute, first wire a TRUE to the **Get/Set** input. Then pop up on the **Attribute** input and choose **Create Constant**. Click the created constant with the Operating Tool and select the desired attribute. Wire the new value of the attribute to the **Set value** input. Figure 1-18 shows how to use IMAQ Attribute to set the value of an attribute.

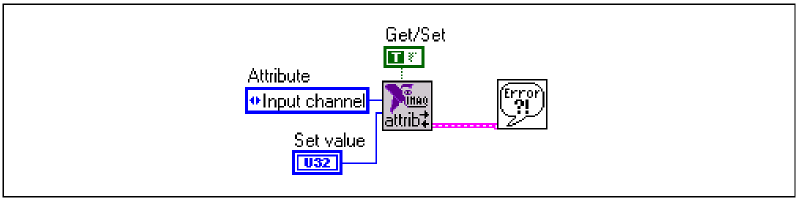


Figure 1-18. Setting the Value of an NI-IMAQ Attribute

Camera Attributes

The camera attribute VIs allow you to control camera functions, such as integration time and pixel binning, directly from LabVIEW or BridgeVIEW. These camera attributes are camera-specific and can also be set in the IMAQ Configuration Utility on the **Advanced** tab. You can find information about specific attributes for your camera in the `<my camera>.txt` file, which is in the `camera info` directory in your `ni-imaq` directory. For more information about your camera's attributes and their uses, please consult your camera documentation.

Note ***Currently only the IMAQ PCI-1424 supports camera attributes.***

Use the Set Camera Attribute VI to set the value of a camera attribute. The camera attribute file mentioned above lists all attributes for the camera where each attribute description contains four fields: **Attribute Name**, **Description**, **Data Type**, and **Possible Values**. The **Attribute Name** field contains the name of the attribute in quotes and should be wired to the **Camera Attribute** input on Set Camera Attribute VI. The **Data Type** field contains the data type of the attribute which can either be **String**, **Integer**, or **Float**. **String** indicates that there is a list of possible values which are listed in **Possible Values** in quotes. To set the value of a string attribute, wire the desired string value to **Attribute Value** on Set Camera Attribute.

Note *The spelling and syntax of the* **Attribute Name** *and string values must match the camera attribute file exactly. (You should not enter the quotes into the string control or constant in G.)*

A data type of **Integer** indicates that the string wired to **Attribute Value** will be converted to an integer. **Float** indicates that the string wired to **Attribute Value** will be converted to a floating point number. The valid numeric values for integer and float data types are listed in **Possible Values**. Use **Format into String** (**String** subpalette) to convert numerics into strings for use with the IMAQ Set Camera Attribute VI. Figure 1-19 shows how to use IMAQ Set Camera Attribute to set the value of a float camera attribute.

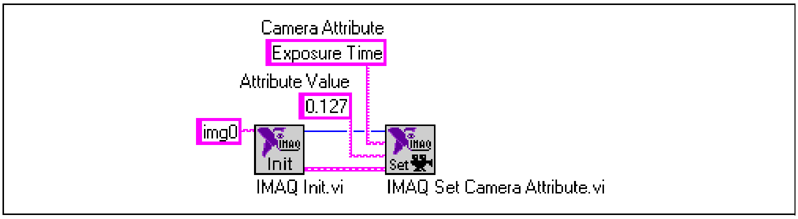


Figure 1-19. IMAQ Set Camera Attribute

Use the IMAQ Get Camera Attribute VI to get the value of a camera attribute. Use the camera attribute file described above to find information about the attributes for your camera. All camera attributes are returned in string format. If the data type of the attribute is integer or float, use the **Scan from String** (**String** subpalette) function to convert the string into a numeric. Figure 1-20 shows how to use IMAQ Get Camera Attribute with **Scan from String** to get the value of a float camera attribute.

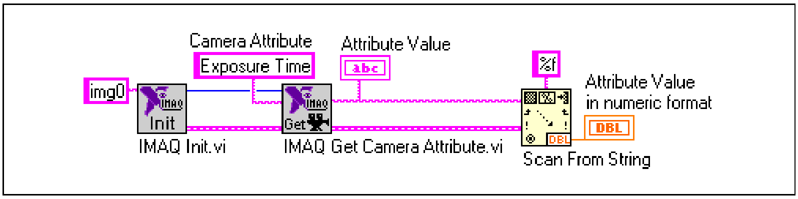


Figure 1-20. Using the IMAQ Get Camera Attribute

2

NI-IMAQ VIs

This chapter describes the NI-IMAQ and IMAQ Vision VIs included with your NI-IMAQ software.

NI-IMAQ VIs

The NI-IMAQ VIs gives you the basic functions to:

- Load information about boards and cameras from a configuration file
- Select a video channel
- Adjust the analog parameters
- Start or stop an acquisition
- Perform a StillColor or RGB acquisition
- Transfer an image from your IMAQ device memory to an IMAQ Vision image buffer
- Monitor and control the your IMAQ device trigger lines

The VIs described in this document are arranged according to type—High-Level and Attribute, Signal I/O, Low-Level, Color, and IMAQ Vision—and then in palette order.

High-Level and Attribute VIs

You can use high-level and attribute VIs to set up your IMAQ system and acquire images.

When you choose the **Function»Image Acquisition** palette, you will see the high-level VI palette shown in Figure 2-1.

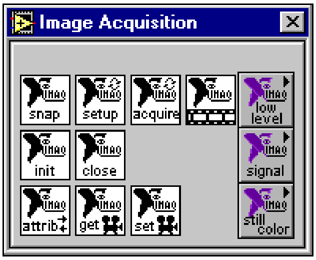
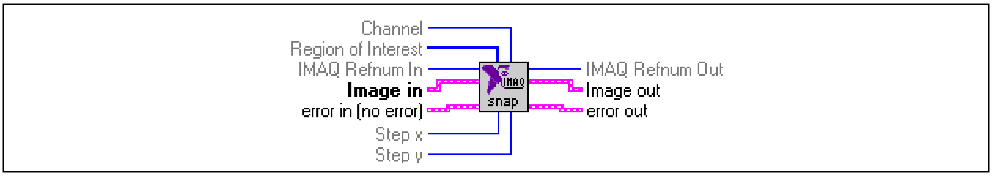


Figure 2-1. NI-IMAQ High-Level and Attribute VI Palette

The high-level NI-IMAQ VIs are sufficient for many applications. These VIs allow you to acquire images, open and close an interface, and get and set attributes.

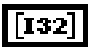
IMAQ Snap



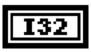
Acquires a single image into **Image out**. If necessary, this VI performs a system initialization using IMAQ Init before the acquisition. This function is asynchronous.

When you invoke a snap, it initializes the board and acquires the next incoming video frame (or field) to a buffer. A snap is appropriate for low-speed or single-capture applications where ease of programming is essential.

Channel specifies from which channel on the IMAQ device to acquire.



Region of Interest specifies a rectangular portion of the image to be captured. **Region of Interest** is defined by an array of four elements [Left, Top, Right, Bottom]. You must set the width [Right-Left] to a multiple of eight. If **Region of Interest** is not connected or empty, the entire acquisition window is captured.



IMAQ Refnum In is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

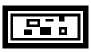
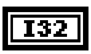
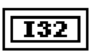


Image In is the reference to the image that will receive the captured pixel data.

Step x is a horizontal sampling step or horizontal reduction factor. If it is set to its default value of 1, each column of the image is transferred. If **Step x** is set to another value *n*, only one column every n columns is transferred. **Step x** only accepts values of 1, 2, 4, or 8.



Step y is a vertical sampling step or vertical reduction factor. If it is set to its default value of 1, each line of the image is transferred. If **Step y** is set to another value *n*, only one line every *n* lines is transferred. **Step y** only accepts values of 1, 2, 4, or 8.



IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

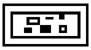
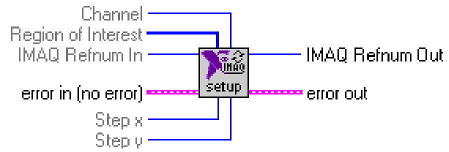


Image Out is the reference to the captured image.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Grab Setup



Starts a grab acquisition. This function performs an acquisition that loops continually on one buffer. Use the grab function for high-speed image acquisition. Use IMAQ Grab Acquire to copy an image out of the buffer.

If necessary, this VI performs a system initialization using IMAQ Init.

I32 **Channel** specifies from which channel on the IMAQ device to acquire.

[I32] **Region of Interest** specifies a rectangular portion of the image to be captured. **Region of Interest** is defined by an array of four elements [Left, Top, Right, Bottom]. You must set the width [Right-Left] to a multiple of eight. If **Region of Interest** is not connected or empty, the entire acquisition window is captured.

I32 **IMAQ Refnum In** is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

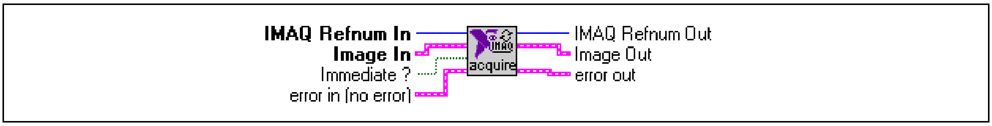
I32 **Step x** is a horizontal sampling step or horizontal reduction factor. If it is set to its default value of 1, each column of the image is transferred. If **Step x** is set to another value *n*, only one column every n columns is transferred. **Step x** only accepts values of 1, 2, 4, or 8.

I32 **Step y** is a vertical sampling step or vertical reduction factor. If it is set to its default value of 1, each line of the image is transferred. If **Step y** is set to another value *n*, only one line every *n* lines is transferred. **Step y** only accepts values of 1, 2, 4, or 8.

I32 **IMAQ Refnum Out** has the same value as **IMAQ Refnum In**.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Grab Acquire



Acquires an image from a grab acquisition. This function performs an acquisition that loops continually on one buffer. Use the grab function for high-speed image acquisition.

IMAQ Grab Acquire returns a copy of the current image. Use IMAQ Grab Setup to start the acquisition and IMAQ Stop to stop the acquisition.

IMAQ Refnum In is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

Image In is the reference to the image that will receive the captured pixel data.

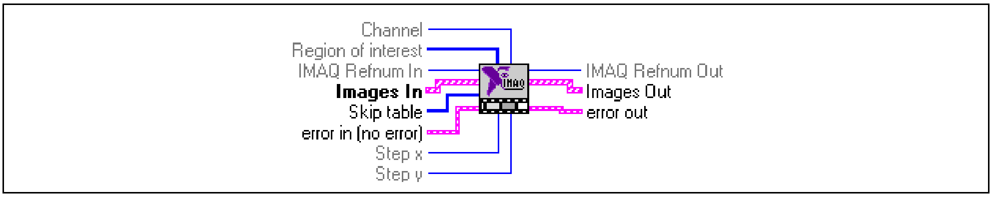
Immediate? determines if the grab operation synchronizes on vertical blank or does an immediate transfer. The default value is FALSE—synchronize on vertical blank.

IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Image Out is the reference to the captured image**.**

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Sequence



Starts, acquires, and releases a sequence acquisition. Use this VI to capture multiple images with fixed or variable delays between images. If necessary, this VI initializes the system using the IMAQ Init VI.

Channel specifies from which channel on the IMAQ device to acquire.

Region of Interest specifies a rectangular portion of the image to be captured. **Region of Interest** is defined by an array of four elements [Left, Top, Right, Bottom]. You must set the width [Right-Left] to a multiple of eight. If **Region of Interest** is not connected or empty, the entire acquisition window is captured.

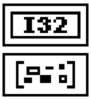
IMAQ Refnum In is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

Images In is an array of image references that will receive the captured pixel data.

Skip Table is an array containing the number of frames to skip before each acquiring each buffer. Each element in the array specifies the number of frames to skip before acquiring the corresponding buffer in the buffer list. **Skip Table** should contain the same number of elements as the **Images In** array.

Step x is a horizontal sampling step or horizontal reduction factor. If it is set to its default value of 1, each column of the image is transferred. If **Step x** is set to another value *n*, only one column every n columns is transferred. **Step x** only accepts values of 1, 2, 4, or 8.

Step y is a vertical sampling step or vertical reduction factor. If it is set to its default value of 1, each line of the image is transferred. If **Step y** is set to another value *n*, only one line every *n* lines is transferred. **Step y** only accepts values of 1, 2, 4, or 8.

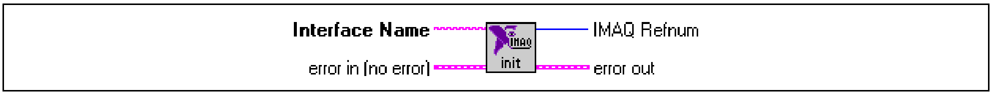


IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Images Out is the array of references to the captured images.

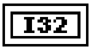
Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Init



Loads an NI-IMAQ configuration file and configures the IMAQ device. If no inputs are connected, this VI automatically loads the standard interface file (`img0`).

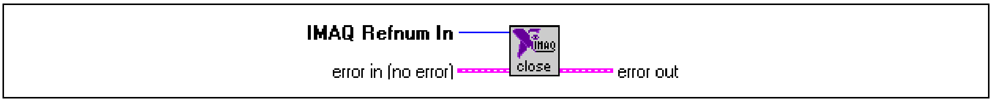
Interface Name is the name of the interface to be loaded. The name must match the configuration file name used in the NI-IMAQ Configuration Utility. The default value is `img0`.



IMAQ Refnum is a unique identifier to an IMAQ session that identifies the Interface file.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Close

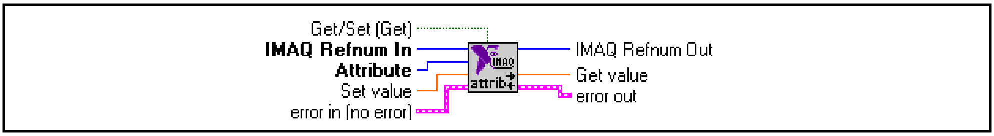


Stops the acquisition if one is in progress, releases resources associated with the acquisition, and closes the specified **IMAQ Refnum**.

IMAQ Refnum In is a unique identifier that identifies the Interface file.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

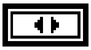
IMAQ Attribute



Gets or sets any attribute of the NI-IMAQ driver. See Appendix A, *IMAQ Attributes*, for a list of attributes and descriptions.

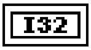
Get/Set (Get) specifies whether you want to read the current values or set new values. The default value is FALSE (get current values).

IMAQ Refnum In is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

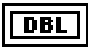


Attribute specifies the attribute to get or set.

Set value represents the value of the attribute to be set.

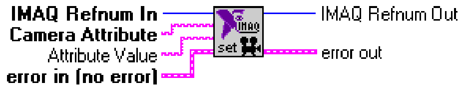


IMAQ Refnum Out has the same value as **IMAQ Refnum In**.



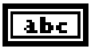
Get value outputs the value of the specified attribute.

IMAQ Set Camera Attribute



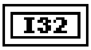
Sets the value of camera attributes. Consult the `<my camera>.txt` file in the `ni-imaq\camera` directory for more information on valid attributes for your camera.

IMAQ Refnum In is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.



Camera Attribute is the attribute name as documented in the `<my camera>.txt` file.

Attribute Value is the new value of the attribute.



IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

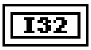
Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Get Camera Attribute

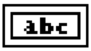
Gets the value of camera attributes. Consult the <my camera>.txt file in the ni-imaq\camera directory for more information on valid attributes for your camera.

IMAQ Refnum In is a unique identifier that identifies the Interface file. If you are using the default interface, img0, no connection is needed.

Camera Attribute is the attribute name as documented in the <my camera>.txt file.



IMAQ Refnum Out has the same value as **IMAQ Refnum In**.



Attribute Value is the current value of the attribute.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

Signal I/O VIs

You will see the Signal I/O VI palette shown in Figure 2-2 when you choose the **Function»Image Acquisition»Image Acquisition»Signal I/O VIs** palette.

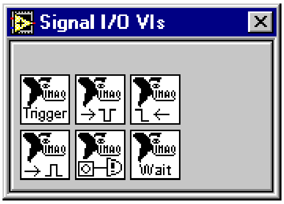
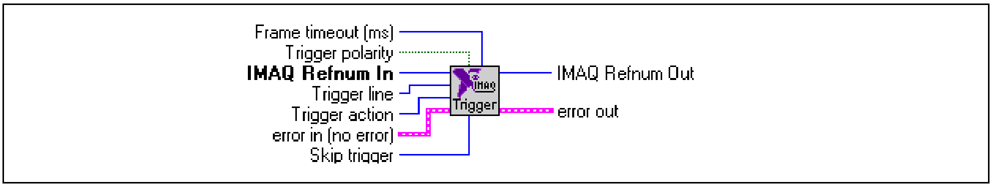


Figure 2-2. NI-IMAQ Event VI Palette

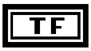
The Signal I/O VIs allow you to control the trigger lines, generate pulses, and wait for a hardware event.

IMAQ Configure Trigger



Configures the trigger conditions for an acquisition. Use this VI before any acquisition VI to setup a triggered image acquisition.

Frame timeout (ms) specifies the amount of time in milliseconds that NI-IMAQ waits for the trigger to occur and the image to be captured.



Trigger polarity specifies the polarity of the trigger signal. FALSE indicates LOW-TRUE; TRUE indicates HIGH-TRUE. The default is LOW-TRUE.

IMAQ Refnum In is a unique identifier that identifies the Interface file.

Trigger line specifies the source of the trigger signal. Values are:

External trigger 0 (0)	RTSI line 2 (6)
External trigger 1 (1)	RTSI line 3 (7)
External trigger 2 (2)	RTSI line 4 (8)
External trigger 3 (3)	RTSI line 5 (9)
RTSI line 0 (4)	RTSI line 6 (10)
RTSI line 1 (5)	

Trigger action specifies if an assertion edge of this trigger line should start an acquisition. Values are:

Disabled (0)	Triggering is disabled
Trigger start of acquisition (1)	When the assertion edge of the trigger is received, the acquisition is started.
Trigger start of each buffer list (2)	When the assertion edge of a trigger is received, the buffer list is acquired. If the acquisition is continuous, buffer index 0 will always wait on a trigger before acquiring.
Trigger each buffer (3)	Each buffer waits for a trigger before acquiring an image into the buffer.

Trigger each line (4)	Each line is triggered. This is useful when using an encoder to acquire line scan images.

Note ***The Trigger each line value is valid only for line scan cameras used with the IMAQ PCI-1424.***

U32

Skip trigger is the number of triggers to skip between lines. This is useful when using an encoder to trigger lines. For example, you may have an encoder that outputs 1,000 ticks per revolution. If you only need 100 lines per revolution, set **Skip trigger** to 10.

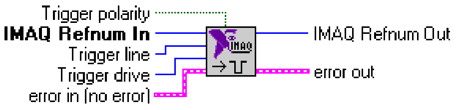
Note ***This input is valid only when using a line scan camera with the IMAQ PCI-1424. Set this input to 0 when using an area scan camera.***

I32

IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Note ***See Appendix C,*** *Error Codes**, for error input and output information and error codes.***

IMAQ Trigger Drive



Drives a trigger line with a specified signal.

Trigger polarity specifies the polarity of the trigger signal. FALSE indicates LOW-TRUE; TRUE indicates HIGH-TRUE. The default is LOW-TRUE.

IMAQ Refnum In is a unique identifier that identifies the Interface file.

Trigger line specifies the source of the trigger signal. Values are:

External trigger 0 (0)	RTSI line 2 (6)
External trigger 1 (1)	RTSI line 3 (7)
External trigger 2 (2)	RTSI line 4 (8)
External trigger 3 (3)	RTSI line 5 (9)
RTSI line 0 (4)	RTSI line 6 (10)
RTSI line 1 (5)	

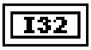
Trigger drive specifies the signal which will drive the trigger line. Values are:

Disabled (0)	The trigger line is disabled.
Acquisition in Progress (1)	High when acquisition is in progress.
Acquisition done (1)	Asserted when the entire acquisition is finished.
Frame start (2)	High when a frame is being captured.
Frame done (3)	Asserted at the end of each frame that is captured.
Buffer complete (4)	Asserted when a buffer has been transferred to memory.
Pixel Clock (5)	Pixel clock times the sampling of pixels.
Horizontal Synchronization Signal (6)	Horizontal synchronization signal produced at the beginning of each line by the camera.

Vertical Synchronization Signal (7)
: Vertical synchronization signal produced at the beginning of each field by the camera.

Asserted (8)

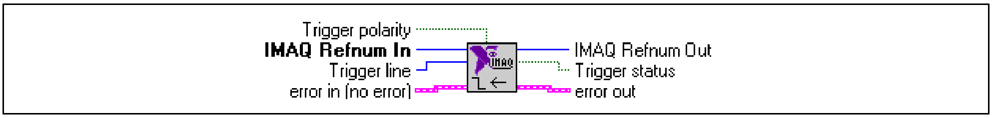
Unasserted (9)



IMAQ Refnum out has the same value as **IMAQ Refnum In**.

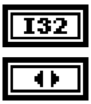
Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Trigger Read



Reads the current value of a trigger line.

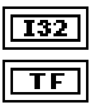
Trigger polarity specifies the polarity of the trigger signal. FALSE indicates LOW-TRUE; TRUE indicates HIGH-TRUE. The default is LOW-TRUE.



IMAQ Refnum in is a unique identifier that identifies the Interface file.

Trigger line specifies the source of the trigger signal to read. Values are:

External trigger 0 (0)	RTSI line 2 (6)
External trigger 1 (1)	RTSI line 3 (7)
External trigger 2 (2)	RTSI line 4 (8)
External trigger 3 (3)	RTSI line 5 (9)
RTSI line 0 (4)	RTSI line 6 (10)
RTSI line 1 (5)	

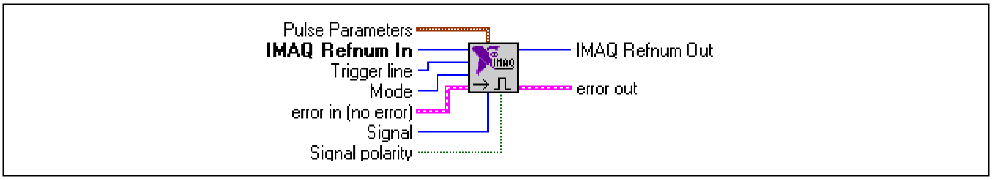


IMAQ Refnum out has the same value as **IMAQ Refnum In**.

Trigger status specifies the current value on the trigger line.

☞ **Note** ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Generate Pulse



Generates a pulse on a trigger line. IMAQ Generate Pulse can generate a pulse immediately or on the assertion edge of a status or trigger signal.

Note ***Currently, pulses can be generated only by the IMAQ PCI-1424.***

Pulse Parameters specifies parameters used to describe a pulse.

DBL **Pulse Delay (μs)** is the desired duration of the first phase of the signal in microseconds. If pulse delay = 0.0, the VI selects a minimum delay of one cycle of the timebase used.

DBL **Pulse Width (μs)** is the desired duration of the second phase of the pulse, in microseconds. If pulse width = 0.0, the VI selects a minimum width of one cycle of the timebase used.

Pulse Polarity (high:0) is the polarity of second phase (period two) of each delayed pulse.

0: high pulse: the pulse starts at a low TTL level and ends at a high level (default)

1: low pulse: the pulse starts at a high TTL level and ends at a low level.

I32 **IMAQ Refnum In** is a unique identifier that identifies the Interface file.

U16 **Trigger line** specifies the line on which the pulse will be generated. Values are:

External trigger 0 (0)	RTSI line 2 (6)
External trigger 1 (1)	RTSI line 3 (7)
External trigger 2 (2)	RTSI line 4 (8)
External trigger 3 (3)	RTSI line 5 (9)
RTSI line 0 (4)	RTSI line 6 (10)
RTSI line 1 (5)	

Mode indicates if the pulse is repeated. Values are:

Pulse train (0)	Generate a continuous pulse train on the first assertion edge of **Signal**.
Single pulse(1)	Generate a pulse on the first assertion edge of **Signal**.
Rearmed Single pulse (2)	Generate a pulse on all assertion edges of **Signal**
Stop (3)	Stop the generation of pulses on **Trigger line**.

Signal specifies the signal which will cause the pulse to be generated. The assertion edge of the following signals can initiate pulse generation. Values are:

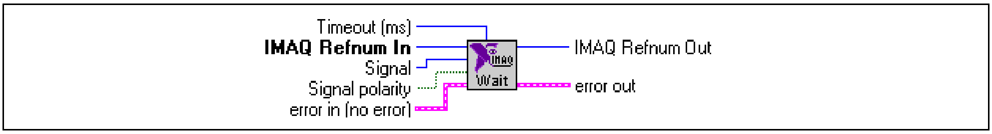
Acquisition in progress (0)	Asserted when the acquisition begins
Acquisition done (1)	Asserted when the entire acquisition is finished
Frame start (2)	Asserted at the beginning of each frame that is captured
Frame done (3)	Asserted at the end of each frame that is captured
Buffer complete (4)	Asserted when a buffer has been transferred to memory
Assertion of external trigger 0 (5)	
Assertion of external trigger 1 (6)	
Assertion of external trigger 2 (7)	
Assertion of external trigger 3 (8)	
Assertion of RTSI line 0 (9)	
Assertion of RTSI line 1 (10)	
Assertion of RTSI line 2 (11)	
Assertion of RTSI line 3 (12)	
Assertion of RTSI line 4 (13)	
Assertion of RTSI line 5 (14)	
Assertion of RTSI line 6 (15)	
Immediate (16)	Asserted immediately when the VI is called

Signal Polarity indicates the polarity of the **Signal** input. FALSE indicates LOW-TRUE; TRUE indicates HIGH-TRUE. The default is LOW-TRUE.

IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Wait Signal



Waits for either a status or trigger signal to be asserted. IMAQ Wait Signal will not return until the specified signal is asserted or a timeout occurs.

DBL

Timeout (ms) specifies the amount of time to wait for the assertion edge of Signal in milliseconds. The VI will return with a timeout error if the assertion edge does not occur within the specified time.

I32

IMAQ Refnum In is a unique identifier to an IMAQ session that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

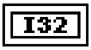
U16

Signal specifies the assertion edge of the signal which will cause the VI to return. Values are:

Acquisition in progress (0)	Asserted when the acquisition begins
Acquisition done (1)	Asserted when the entire acquisition is finished
Frame start (2)	Asserted at the beginning of each frame that is captured
Frame done (3)	Asserted at the end of each frame that is captured
Buffer complete (4)	Asserted when a buffer has been transferred to memory
Assertion of external trigger 0 (5)	
Assertion of external trigger 1 (6)	
Assertion of external trigger 2 (7)	
Assertion of external trigger 3 (8)	
Assertion of RTSI line 0 (9)	
Assertion of RTSI line 1 (10)	
Assertion of RTSI line 2 (11)	
Assertion of RTSI line 3 (12)	
Assertion of RTSI line 4 (13)	
Assertion of RTSI line 5 (14)	
Assertion of RTSI line 6 (15)	

TF

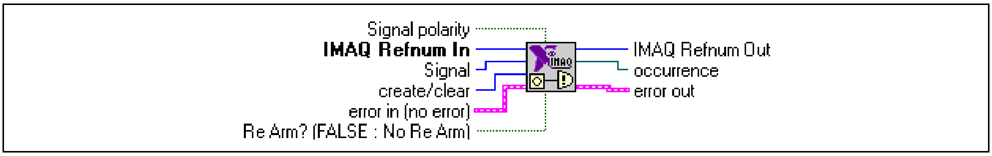
Signal Polarity indicates the polarity of the Signal input. FALSE indicates LOW-TRUE; TRUE indicates HIGH-TRUE. The default is LOW-TRUE.



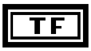
IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Occurrence Config



Creates occurrences that are set by image acquisition signals such as the assertion of a status or trigger signal. Occurrences produced by this VI are used as inputs to the Wait on Occurrence primitive. Anything dependent on the execution of this primitive will sleep until the occurrence is set.



Signal Polarity indicates the polarity of the Signal input. FALSE indicates LOW-TRUE; TRUE indicates HIGH-TRUE. The default is LOW-TRUE.

IMAQ Refnum in is a unique identifier that identifies the Interface file.

Signal specifies the assertion edge of the signal which will cause the occurrence to be set. Values are:

Acquisition in progress (0)	Asserted when the acquisition begins
Acquisition done (1)	Asserted when the entire acquisition is finished
Frame start (2)	Asserted at the beginning of each frame that is captured
Frame done (3)	Asserted at the end of each frame that is captured
Buffer complete (4)	Asserted when a buffer has been transferred to memory
Assertion of external trigger 0 (5)	
Assertion of external trigger 1 (6)	
Assertion of external trigger 2 (7)	
Assertion of external trigger 3 (8)	
Assertion of RTSI line 0 (9)	
Assertion of RTSI line 1 (10)	
Assertion of RTSI line 2 (11)	
Assertion of RTSI line 3 (12)	
Assertion of RTSI line 4 (13)	
Assertion of RTSI line 5 (14)	
Assertion of RTSI line 6 (15)	

create/clear instructs this VI to create an occurrence or to clear all occurrences that have been created for the IMAQ device identified **IMAQ Refnum**. Values are:

create an occurrence (0)
clear all occurrences (1)

Re Arm? (FALSE : No Re Arm) indicates whether the occurence needs to be generated once or multiple times.

IMAQ Refnum out has the same value as **IMAQ Refnum In**.

occurrence is the occurrence value created. Wire this output to a wait on occurrence primitive. Wire the output of the primitive to the part of your diagram you wish to execute when the IMAQ event happens and the occurrence is set. If LabVIEW is unable to create an occurrence the occurrence value is set to the **Not a Refnum** file I/O constant.

☞ **Note** ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

Low-Level VIs

You will see the low-level VI palette shown in Figure 2-3 when you choose the **Function»IMAQ Library»Image Acquisition»IMAQ Low-Level Acquisition** palette.

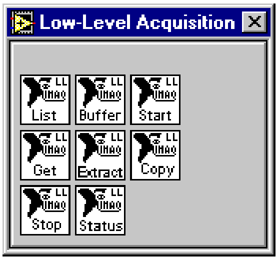
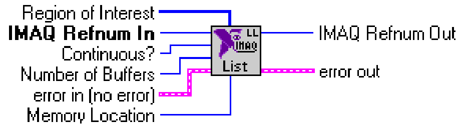


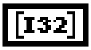
Figure 2-3. NI-IMAQ Low-Level VI Palette

The low-level NI-IMAQ VIs give you more direct hardware control.

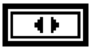
IMAQ Configure List



Configures a buffer list to be used in an acquisition. The buffers must be configured individually with IMAQ Configure Buffer.



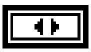
Region of Interest specifies a rectangular portion of the image to be captured. **Region of Interest** is defined by an array of four elements [Left, Top, Right, Bottom]. You must set the width [Right-Left] to a multiple of eight. If **Region of Interest** is not connected or empty, the entire acquisition window is captured.



IMAQ Refnum In is a unique identifier that identifies the Interface file.

Continuous? specifies if the acquisition is continuous or one-shot. Values are:

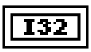
One-Shot (0)	Images are acquired into the buffer list once.
Continuous (1)	Images are acquired continuously into the buffer list until the acquisition is stopped.



Number of Buffers is the number of buffers to allocate in the buffer list.

Memory Location specifies if the acquired images will be stored in system memory or in onboard memory on the IMAQ device. Values are:

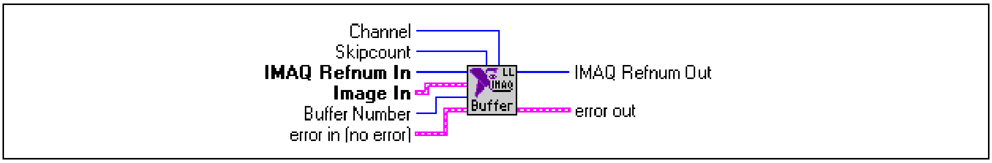
System (0)	Images stored in system memory.
Onboard (1)	Images stored in RAM on the IMAQ device.



IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Configure Buffer



Configures individual buffers in the buffer list. You must call IMAQ Configure Buffer for each buffer in the buffer list.

Channel is the video source to acquire from the IMAQ device. If **Channel** is not connected or empty, the default channel from the Interface file will be used.

Skipcount is the number of frames or fields to skip before the acquisition into this buffer.

IMAQ Refnum In is a unique identifier that identifies the Interface file.

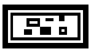
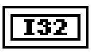


Image In is the reference to the image that will receive the captured pixel data.

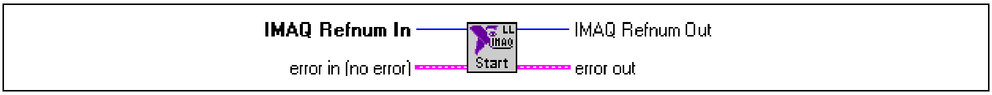
Buffer Number is the number of the buffer in the buffer list to configure.



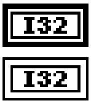
IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Start



Starts an asynchronous image acquisition. IMAQ Start will return immediately after the acquisition has started. Before calling this VI, you must configure the acquisition with IMAQ Configure List and IMAQ Configure Buffer.

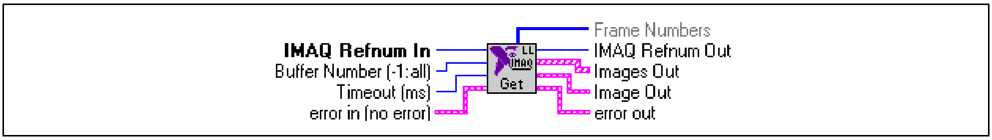


IMAQ Refnum In is a unique identifier that identifies the Interface file.

IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

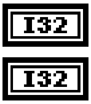
Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Get Buffer



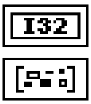
Returns an acquired image (or all acquired images.) IMAQ Get Buffer will wait until the requested buffer has been acquired before returning an image. Furthermore, this VI will return an error if the acquisition is continuous and has not been stopped before calling this VI.

If the image was acquired into onboard memory, the image will be copied into a buffer in system memory and then returned.



IMAQ Refnum In is a unique identifier that identifies the Interface file.

Buffer Number (-1 : all) is the number of the acquired buffer to return. If Buffer Number is -1, all image buffers will be returned in the **Images Out** output.



IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Images Out is the array of references to the captured images. Contains all images in the buffer list if Buffer Number is equal to -1.

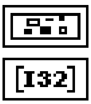
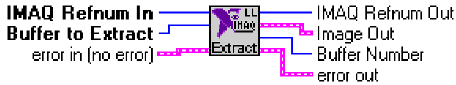


Image Out is the reference to the captured image.

Frame Numbers returns the actual cumulative frame number of each buffer in the **Images Out** array. Useful for determining the order of images returned after a ring acquisition.

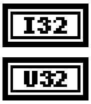
Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Extract Buffer



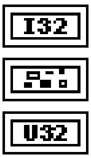
Extracts a buffer from a continuous acquisition. IMAQ Extract Buffer allows for the examination of buffer during acquisition. The buffer is extracted from the acquisition and new data will not be written into the buffer until IMAQ Extract Buffer is called again.

When IMAQ Extract Buffer is called, any currently extracted buffers are reinserted into the buffer list.



IMAQ Refnum In is a unique identifier that identifies the Interface file.

Buffer to Extract is the buffer to extract from the buffer list, as specified by the cumulative buffer index. Input a -1 to release the currently extracted buffer without extracting a new buffer.



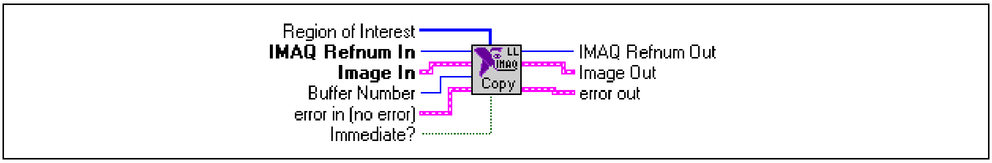
IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Image Out is the reference to the captured image.

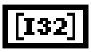
Buffer Number is the cumulative buffer number of the buffer in the list that was returned in **Image Out**.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Copy



Returns a copy of an acquired image. IMAQ Copy allows for a copy from onboard memory to system memory or from system to system memory.



Region of Interest specifies a rectangular portion of the image to be captured. **Region of Interest** is defined by an array of four elements [Left, Top, Right, Bottom]. You must set the width [Right-Left] to a multiple of eight. If **Region of Interest** is not connected or empty, the entire acquisition window is captured.

IMAQ Refnum In is a unique identifier that identifies the Interface file.

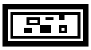
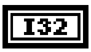
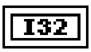


Image In is the reference to the image that will receive the copied pixel data.



Buffer Number is the number of the acquired buffer to copy into **Image In**.

Immediate? determines whether the copy is done immediately or if the copy occurs after the completion of the next acquisition into the buffer. The default value is FALSE, wait for next acquisition.



IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

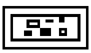
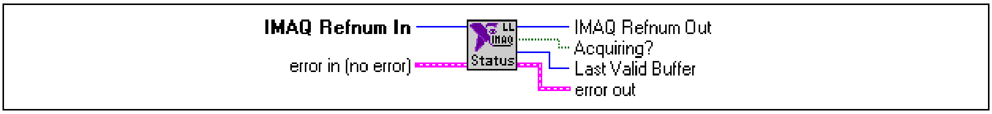


Image Out is the reference to the captured image.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Status



Returns status information about the acquisition such as the state of the acquisition and the last valid buffer acquired.

IMAQ Refnum In is a unique identifier that identifies the Interface file.

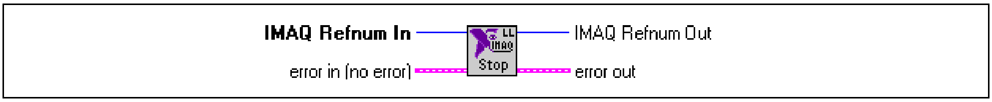
IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Acquiring ? specifies if the IMAQ device is acquiring images. **Acquiring ?** is TRUE if the device is acquiring.

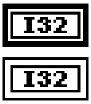
Last Valid Buffer is the last buffer that has received an acquired image.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ Stop



Stops the currently executing acquisition on the IMAQ device specified by **IMAQ Refnum**; however, it does not free the resources associated with the acquisition. Call IMAQ Close to free resources.



IMAQ Refnum In is a unique identifier that identifies the Interface file.

IMAQ Refnum Out has the same value as **IMAQ Refnum In**.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

Color VIs

You will see the color VI palette shown in Figure 2-4 when you choose the **Functions»IMAQ Acquisition»StillColor Acquisition** palette.

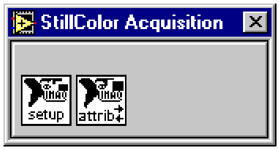
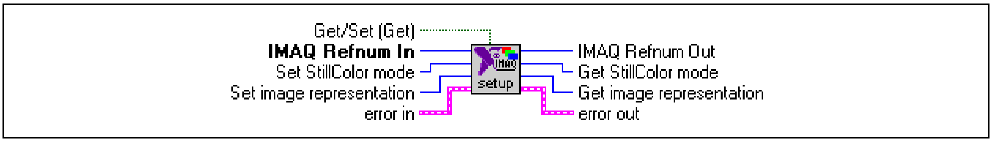


Figure 2-4. NI-IMAQ StillColor VI Palette

The color NI-IMAQ VIs allow you to perform a StillColor acquisition with an IMAQ PCI/PXI-1408. For more information on StillColor acquisition, refer to Appendix B, *StillColor*, of the *NI-IMAQ User Manual*.

IMAQ StillColor Setup



Sets up the PCI/PXI-1408 for a StillColor or RGB acquisition. Use this VI to enable IMAQ Snap VI for a color acquisition.

TF **Get/Set (Get)** specifies whether you want to read the current values or set new values. The default value is FALSE (get current values).

I32 **IMAQ Refnum In** is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

Set StillColor mode specifies the StillColor mode to use for acquisition. The options are:

Disabled	monochrome acquisition
RGB	enables acquisition from an RGB camera
Composite	enables acquisition from a composite (NTSC or PAL) color camera.

Set image representation specifies the type of image data that is returned by the IMAQ Snap VI. The default output is RGB 32-bit, which corresponds to a basic 32-bit RGB color image. See Appendix B, *StillColor Reference*, for a list of the image representations and their descriptions.

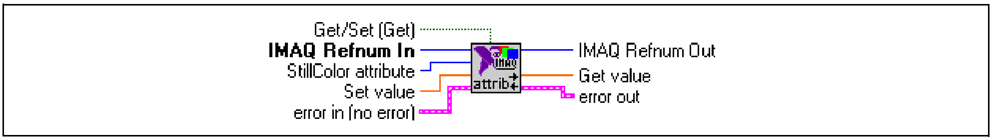
I32 **IMAQ Refnum Out** has the same value as **IMAQ Refnum In**.

Get StillColor mode returns the color acquisition mode used.

Get image representation returns the type of image data that will be returned by IMAQ Snap VI.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ StillColor Attribute



Gets or sets the NI-IMAQ color attributes. See Appendix B, *StillColor Reference*, for a list of attributes and descriptions.

TF **Get/Set (Get)** specifies whether you want to read the current values or set new values. The default value is FALSE (get current values).

I32 **IMAQ Refnum In** is a unique identifier that identifies the Interface file. If you are using the default interface, `img0`, no connection is needed.

StillColor Attribute specifies the StillColor attribute to get or set.

DBL **Set value** represents the value of the attribute to be set.

I32 **IMAQ Refnum Out** has the same value as **IMAQ Refnum In**.

DBL **Get value** outputs the value of the specified attribute.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Vision VIs

This section describes some basic IMAQ Vision for G functions that you can use with NI-IMAQ VIs. The VIs support creating and disposing of images and the conversion of images to arrays. After you convert an image to an array, you can use standard LabVIEW or BridgeVIEW techniques to process and display the images.

You can find the IMAQ Vision VIs in the **Functions** palette from your block diagram. If you have not purchased IMAQ Vision, the palette shown in Figure 2-5 will appear. If you have IMAQ Vision installed, your palette will contain more functions.

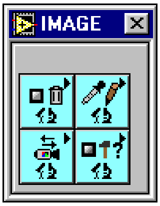
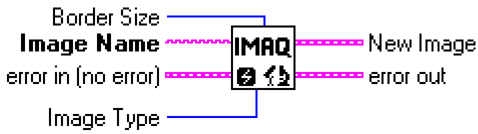


Figure 2-5. IMAQ Vision VI Palette

IMAQ Create



Creates an image buffer that can be input into any of the acquisition functions of your IMAQ device.

Border Size determines the width in pixels of the border created around an image. These pixels are required for certain image processing functions.

Image Name is the name that will be associated with the created image. If the application contains only a single image, then you do not have to name it.

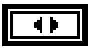
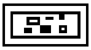


Image Type specifies the type of image that is being created. This input is an enumerated type with the following values:

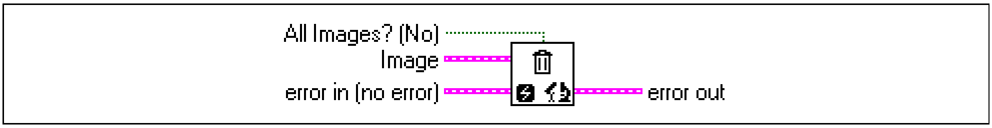
8 bits:	8-bit unsigned image used for monochrome images
16 bits:	16-bit signed image used for StillColor images and 10-, 12-, and 14-bit acquisitions on the IMAQ PCI-1424
Float:	32-bit floating point image, not used with IMAQ devices
Complex:	2 by 32-bit floating point image, not used with IMAQ devices
RGB Chunky:	32-bit standard color image used for StillColor images



New Image is the image structure that will be supplied as an input to all subsequent functions.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ Dispose



Disposes an image and frees the memory allocated for the image. Call IMAQ Dispose only when the image is no longer required for the remainder of the processing.

All images? (No) determines whether you want to dispose only the image input into this function or dispose all images. The default value is FALSE.

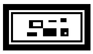
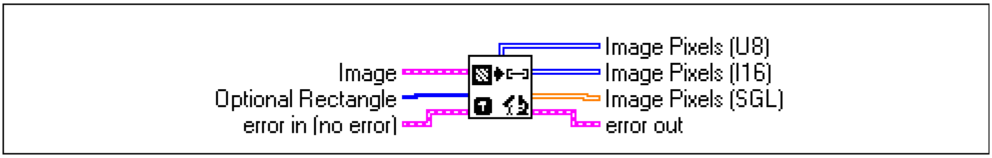


Image is the image to be disposed.

Note ***See Appendix C,*** *Error Codes****, for error input and output information and error codes.***

IMAQ ImageToArray



Copies the incoming image to a G array. This array can be used for pixel processing or displaying in a G intensity graph.

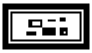


Image is the image to be copied. This image must be of an 8-bit or 16-bit type.

Optional Rectangle defines an array of four elements containing the coordinates [Left, Top, Right, Bottom} of the region to extract. The operation will be applied to the entire image if the input is empty or not connected.

Image Pixels (U8) returns the extracted pixel values into a 2D array [line, column]. This output is used with an 8-bit image type.

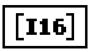


Image Pixels (I16) returns the extracted pixel values into a 2D array [line, column]. This output is used with a 16-bit image type, which is used only for StillColor acquisitions and with the IMAQ PCI-1424.

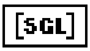
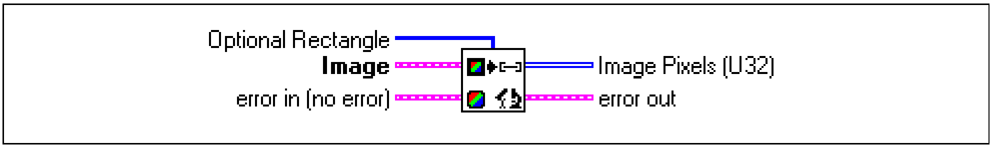


Image Pixels (SGL) is not used with IMAQ devices.

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

IMAQ ColorImageToArray



Copies the incoming color image to a G array. This VI returns the values as a 2D array of unsigned 32-bit integers.

Optional Rectangle defines an array of four elements containing the coordinates [Left, Top, Right, Bottom] of the region to extract. The operation will be applied to the entire image if the input is empty or not connected.

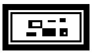


Image is the image to be copied. The image must be of type RGB Chunky.

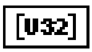


Image Pixels (32-bit) returns the pixel values as a 2D Array [line, column].

Note ***See Appendix C,*** *Error Codes*, ***for error input and output information and error codes.***

A

IMAQ Attributes

This appendix lists the attributes used with the IMAQ Attribute VI.

Attributes describe a specific property of an interface. A summary of IMAQ attributes is listed in Table A-1.

Attribute describes the constant name of the attribute. *Immediate* describes whether the effect of setting the attribute is immediate (Yes), or whether it requires a subsequent call to IMAQ Init to take effect (No). *R/W* describes whether the attribute is read only (R), write only (W), or both(R/W). *Description* describes what values the attribute can take and the effect the setting of the attribute has or what values are returned.

Table A-1. IMAQ Attributes

Attribute	Immediate	R/W	Description
Acquire Field	Yes	R/W	Sets the field acquired when **Frame/field** is set to Field mode. Possible values are: Even (0) Acquire even fields Odd (1) Acquire odd fields All (2) Acquire all fields Even and odd are valid only for interlaced cameras. All is the only option supported on the IMAQ PCI-1408.
Acquisition in progress	Yes	R	Is an acquisition in progress on the camera associated with this interface? FALSE (0) TRUE (1)
Acquisition window height	No	R/W	Get/set the acquisition window height of the camera/channel associated with this interface
Acquisition window left	No	R/W	Get/set the acquisition window left of the camera/channel associated with this interface
Acquisition window top	No	R/W	Get/set the acquisition window top of the camera/channel associated with this interface

Table A-1. IMAQ Attributes (Continued)

Attribute	Immediate	R/W	Description
Acquisition window width	No	R/W	Get/set the acquisition window width of the camera/channel associated with this interface
Antichrominance filter	Yes	R/W	Set/get the antichrominance filter to be used on analog IMAQ devices: Disabled (0) NTSC-coded signals (1) PAL-coded signals (2)
Bits per pixel	Yes	R	Returns the bits per pixel value of the camera/channel associated with this session
Black reference (volts)	Yes	R/W	The black reference value of the channel associated with this interface. Valid values are 0–1.26 V.
Buffer list locked	Yes	R	Is the interface's buffer list locked in memory? FALSE (0) TRUE (1)
Buffer X offset	No	R/W	Set/get the buffer x-left offset for image displacement. Use this attribute to acquire an image into a private buffer at a different location other than the top-left corner. You must use a private buffer when using this attribute.
Buffer Y offset	No	R/W	Set/get the buffer y-line offset for image displacement. Use this attribute to acquire an image into a private buffer at a different location other than the top-left corner. You must use a private buffer when using this attribute.
Bytes per pixel	Yes	R	Returns the bytes per pixel value of the camera/channel associated with this interface.
Callback	Yes	R	Not implemented
Color board	Yes	R	Is this board color-capable? FALSE (0) TRUE (1)
Current buffer list ID	Yes	R	Returns the BUFLIST_ID of the buffer list associated with this interface
Diagnostic restore			Not implemented

Table A-1. IMAQ Attributes (Continued)

Attribute	Immediate	R/W	Description
FIFO overflow			Not implemented
Flip image	No	R/W	Set/get the invert image mode: No invert (0)—image in memory is right-side up Invert (1)—image in memory is upside down
Frame count	Yes	R	Returns the number of frames acquired since the start of an acquisition
Frame timeout (ms)	No	R/W	Get/set the timeout value for a frame. Values are given in milliseconds.
Frame/field	Yes	R/W	Set/get the mode of the interface.: Field mode (0) Frame mode (1) If in Field mode, use the Acquire field attribute to set the field acquired. If in Frame mode, use the Start field attribute to set the field to acquire first
Free buffers	Yes	R	Returns the number of reserved driver buffers currently left
Horizontal scale	No	R/W	Set/get the horizontal hardware scaling factor for the channel associated with this session. Values are: None (0) Div2 (2) Div4 (4) Div8 (8)
Input channel	Yes	R	Returns the current channel selected on the interface (0–3)
Line count	Yes	R	Returns the current line count of the frame being acquired
Look-up table	Yes	R/W	Programs the lookup table for the given interface. Values 0–5 indicate the LUT used: 0—Normal 1—Inverse 2—Log 3—Inverse Log 4—Binary 5—Inverse Binary

Table A-1. IMAQ Attributes (Continued)

Attribute	Immediate	R/W	Description
Lost frames	Yes	R	Returns the number of retries on invalid frame acquisitions
Max. horizontal size	Yes	R	Returns the maximum horizontal resolution of the interface
Max. vertical size	Yes	R	Returns the maximum vertical resolution of the interface
Number of buffers	Yes	R	Returns the number of buffers in the buffer list associated with the interface
Onboard RAM	Yes	R	Does the interface board have onboard memory? FALSE (0) TRUE (1)
Pixel Clock Detect	No	R/W	Determines if NI-IMAQ checks for the existence of a pixel clock before starting an acquisition. The default value is TRUE. If your camera has a pixel clock less than 5 MHz, this detection may fail and you should set this attribute to FALSE. This attribute is valid only on the PCI-1424.
Pixel depth	Yes	R	Returns the maximum pixel depth of the interface board in bits
RAM size	Yes	R	Returns the size of the RAM on the interface board
Region of interest height	Yes	R/W	Get/set the region of interest height of the camera/channel associated with this interface
Region of interest left	Yes	R/W	Get/set the region of interest left of the camera/channel associated with this interface
Region of interest top	Yes	R/W	Get/set the region of interest top of the camera/channel associated with this interface
Region of interest width	Yes	R/W	Get/set the region of interest width of the camera/channel associated with this interface
Rowpixels	No	R/W	Get/set the true width of a horizontal line in memory in pixels

Table A-1. IMAQ Attributes (Continued)

Attribute	Immediate	R/W	Description
Start field	No	R/W	Get/set the start field setting of the camera when **Frame/field** is set to Frame mode. Possible values are: Even (0) Odd (1)
Trigger mode	No	R/W	Not implemented. Use the IMAQ Trigger Configure VI.
Valid buffer	Yes	R	Returns a buffer element number of the last received frame buffer
Vertical scale	No	R/W	Set/get the vertical hardware scaling factor for the channel associated with this session. Values are: None (0) Div2 (2) Div4 (4) Div8 (8)
Video type	Yes	R/W	Sets/gets the video type: Interlaced (0) Noninterlaced (progressive scan) (1)
White reference (volts)	Yes	R/W	The white reference value of the channel associated with this interface. Valid values are 0–1.26 V.

B

StillColor Reference

This appendix lists the attributes used with the IMAQ StillColor Attribute VI and the image representations used with the IMAQ StillColor Setup VI.

StillColor Attributes

Attributes describe a specific property of an interface. Table B-1 lists a summary of StillColor attributes used with the IMAQ StillColor Attribute VI.

Attribute describes the constant name of the attribute. *Immediate* describes whether the effect of setting the attribute is immediate (Yes), or whether it requires a subsequent call to the IMAQ Init VI to take effect (No). *HW/SW* specifies if changing this attribute affects a hardware setting of the board (HW) or only a post-processing function (SW). *Mode* specifies if the attribute is used for an RGB (R) or Composite (C) acquisition. *Description* describes what values the attribute can take and the effect of setting the attribute. For more information about StillColor acquisition, refer to Appendix B, *StillColor*, of the *Getting Started with Your PCI/PXI-1408 and the NI-IMAQ Software for Windows 95/NT* document.

Table B-1. StillColor Attributes

Attribute	Immediate	HW/ SW	Mode	Description
StillColor averaging count	Yes	SW	C, R	Set/get the number of color images to be acquired and averaged for one output image (1–128). Default value is 1.
StillColor black reference (in volts)	Yes	HW	C	Set/get the hardware white reference of your IMAQ device when StillColor is selected (0–1.26 V).
StillColor brightness	Yes	SW	C	Adjusts the brightness of the image. The unit is IRE (percentage of the white level). Default value is 0.
StillColor contrast	Yes	SW	C	Adjusts the contrast of the image. The value is a scaling factor applied to every pixel. The contrast adjustment is centered around the median pixel value. (For example, an 8-bit image would be centered around 128.) Default value is 1.
StillColor hue offset angle	Yes	SW	C, R	Set/get the offset angle for the hue calculation. A value of 0 (default) results in a red color to toggle between 0 and max (255 or 32,767). Changing this value will move the toggling point to other colors. The unit is degrees and corresponds to the rotation angle in the chromaticity space.
StillColor NTSC setup enable	Yes	SW	C (NTSC only)	Set/get the enabling of the NTSC setup compensation (StillColor NTSC only): Disabled (0) Enabled (1)
StillColor NTSC setup value	Yes	SW	C (NTSC only)	Set/get the NTSC setup compensation value. The unit is IRE (percentage of white level). Default value is 7.5%. (StillColor NTSC only)
StillColor saturation	Yes	SW	C	Set/get the color saturation of the image. Saturation of 0 corresponds to a monochrome image. Default value is 1.

Table B-1. StillColor Attributes (Continued)

Attribute	Immediate	HW/ SW	Mode	Description
StillColor SW chroma filter	Yes	SW	C (NTSC only)	Set/get the software filter to clean the chroma signal (StillColor NTSC only): Disabled (0) Enabled (1)
StillColor tint (chroma phase)	Yes	SW	C (NTSC only)	Set/get the tint of your image. Tint is specified in degrees and corresponds to the rotation of the UV color plane. Default value is 0.
StillColor white reference (in volts)	Yes	HW	C	Set/get the hardware white reference of your IMAQ device when StillColor is selected (0–1.26 V).

StillColor Image Representations

The *image representation* describes the type of image data that will be returned from the IMAQ Snap VI after a StillColor acquisition. Table B-2 lists a summary of the image representations.

Image representation is the constant name of the image representation. *Image type* specifies the image type of the image buffer returned by the IMAQ Snap VI after the StillColor acquisition. *Description* describes the image representation.

Table B-2. StillColor Image Representations

Image Representation	Image Type	Description
Blue 8-bit	8-bit	The blue plan encoded in 8 bits extracted from the RGB image.
Green 8-bit	8-bit	The green plan encoded in 8 bits extracted from the RGB image.
HSI 32-bit	32-bit	A color image encoded in 32 bits, 8 bits unused and 8 bits for the Hue, Saturation, and Intensity planes.
HSL 32-bit	32-bit	A color image encoded in 32 bits, 8 bits unused and 8 bits for the Hue, Saturation, and Luminance planes.
Hue 8-bit	8-bit	The hue information encoded in 8 bits extracted from the RGB image. The hue is calculated as: H = ATN2(Y, X) where Y = (Green - Blue) / $\sqrt{2}$ and X = (2 × Red - Green - Blue) / $\sqrt{6}$
Hue 16-bit	16-bit	The hue information encoded in 16 bits extracted from the RGB image. The hue is calculated as: H = ATN2(Y, X) where Y = (Green - Blue) / $\sqrt{2}$ and X = (2 × Red - Green - Blue) / $\sqrt{6}$
Intensity 8-bit	8-bit	The intensity information encoded in 8 bits extracted from the RGB image. The intensity is calculated as: I = (Red + Green + Blue) / 3

Table B-2. StillColor Image Representations (Continued)

Image Representation	Image Type	Description
Intensity 16-bit	16-bit	The intensity information encoded in 16 bits extracted from the RGB image. The intensity is calculated as: I = (Red + Green + Blue) / 3
Luminance 8-bit	8-bit	The luminance information encoded in 8 bits extracted from the RGB image. The luminance is calculated as: $Y = 0.299 \times Red + 0.587 \times Green + 0.114 \times Blue$
Luminance 16-bit	16-bit	The luminance information encoded in 16 bits extracted from the RGB image. The luminance is calculated as $Y = 0.299 \times Red + 0.587 \times Green + 0.114 \times Blue$
Red 8-bit	8-bit	The red plan encoded in 8 bits extracted from the RGB image.
Reserved (RGB 24-bit)	N/A	Not implemented
Reserved (RGB 48-bit)	N/A	Not implemented
RGB 16-bit	16-bit	A color image encoded in 16 bits—5 bits each for the Red, Green, and Blue planes: (0RRR RRGG GGGB BBBB)
RGB 32-bit	RGB Chunky	A color image encoded in 32 bits—8 bits for the alpha channel (which is not used) and 8 bits each for the Red, Green, and Blue planes.
Saturation 8-bit	8-bit	The saturation information encoded in 8 bits extracted from the RGB image. The saturation is calculated as: $S = \sqrt{X^2 + Y^2}$ where $Y = (Green - Blue) / \sqrt{2}$ and $X = (2 \times Red - Green - Blue) / \sqrt{6}$
Saturation 16-bit	16-bit	The saturation information encoded in 16 bits extracted from the RGB image. The saturation is calculated as: $S = \sqrt{X^2 + Y^2}$ where $Y = (Green - Blue) / \sqrt{2}$ and $X = (2 \times Red - Green - Blue) / \sqrt{6}$

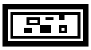
C

Error Codes

This appendix lists the error format and codes for the NI-IMAQ VIs.

Format

Error format for all NI-IMAQ VIs is the same, as follows:

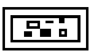


error in (no error) is a cluster that describes the error status before this VI executes. If **error in** indicates that an error occurred before this VI was called, this VI may choose not to execute its function, but just pass the error through to its error out cluster. If no error has occurred, then this VI executes normally and sets its own error status in error out. Use the error handler VIs to look up the error code and to display the corresponding error message. Using **error in** and **error out** clusters is a convenient way to check errors and to specify execution order by wiring the error output from one subVI to the error input of the next.

status is TRUE if an error occurred before this VI was called, or FALSE if not. If status is TRUE, code is a non-zero error code. If status is FALSE, code can be zero or a warning code.

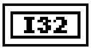
code is the number identifying an error or warning. If status is TRUE, code is a non-zero error code. If status is FALSE, code can be zero or a warning code. Use the error handler VIs to look up the meaning of this code and to display the corresponding error message.

source is a string that indicates the origin of the error, if any. Usually source is the name of the VI in which the error occurred.

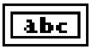


error out is a cluster that describes the error status after this VI executes. If an error occurred before this VI was called, **error out** is the same as **error in**. Otherwise, **error out** shows the error, if any, that occurred in this VI. Use the error handler VIs to look up the error code and to display the corresponding error message. Using **error in** and **error out** clusters is a convenient way to check errors and to specify execution order by wiring the error output from one subVI to the error input of the next.

status is TRUE if an error occurred, or FALSE if not. If **status** is TRUE, code is a non-zero error code. If **status** is FALSE, code can be zero or a warning code.



code is the number identifying an error or warning. If **status** is TRUE, code is a non-zero error code. If status is FALSE, code can be zero or a warning code. Use the error handler VIs to look up the meaning of this code and to display the corresponding error message.



source is a string that indicates the origin of the error, if any. Usually **source** is the name of the VI in which the error occurred.

Error Codes

Table C-1 lists the NI-IMAQ VI error codes.

Table C-1. NI-IMAQ VI Error Codes

Error Code	Error Name	Description
–1074397114	IMG_ERR_NRTSI	Too many RTSI triggers mapped
–1074397115	IMG_ERR_BADFILEXT	File extension not supported
–1074397116	IMG_ERR_BADFILFMT	Pixel depth not supported with this file format
–1074397117	IMG_ERR_HYBRID	Cannot mix system and onboard memory
–1074397118	IMG_ERR_NSAT	Non-settable attribute
–1074397119	IMG_ERR_PLNS	Pulse not started
–1074397119	IMG_ERR_BPMD	Bad pulse mode
–1074397120	IMG_ERR_BAD_TRANS	Bad pattern generation transitions defined
–1074397121	IMG_ERR_PG_TOO_MANY	Too many pattern generation transitions
–1074397122	IMG_ERR_SERIAL_TIMO	Serial transmit/receive timeout
–1074397123	IMG_ERR_BPID	Bad pulse ID
–1074397124	IMG_ERR_MXPI	Exhausted pulse IDs
–1074397125	IMG_ERR_SERIAL	Serial port error
–1074397126	IMG_ERR_HWNC	Hardware not capable of supporting this function

Table C-1. NI-IMAQ VI Error Codes (Continued)

Error Code	Error Name	Description
–1074397127	IMG_ERR_BITP	Bad interface type
–1074397128	IMG_ERR_BFRQ	Bad frequency values
–1074397129	IMG_ERR_PALKEYDTCT	PAL key detection error
–1074397130	IMG_ERR_BADCAMPARAM	Bad camera parameter in configuration file
–1074397131	IMG_ERR_BADPIXTYPE	Camera not supported; must be an 8-bit camera
–1074397132	IMG_ERR_BADCAMTYPE	Bad camera type; camera needs to be of type NTSC or PAL
–1074397133	IMG_ERR_ALLOC	Error during large buffer allocation
–1074397134	IMG_ERR_SMALLALLOC	Error during small buffer allocation
–1074397135	IMG_ERR_SCC1	Channel not set to 1 when using StillColor RGB acquisition
–1074397136	IMG_ERR_SCLM	Field scaling mode not supported
–1074397137	IMG_ERR_NEPK	No external pixel clock
–1074397138	IMG_ERR_ILCK	Interface locked
–1074397139	IMG_ERR_PLCK	Partial lock—cannot perform acquisition
–1074397140	IMG_ERR_FIFO	FIFO overflow caused acquisition to halt
–1074397141	IMG_ERR_BTAC	No trigger action—acquisition will time out
–1074397145	IMG_ERR_NINF	No interface found
–1074397146	IMG_ERR_BTRG	Trigger loopback problem—cannot drive trigger with action enabled
–1074397147	IMG_ERR_HLPR	Bad parameter to low level—check attributes and high level arguments
–1074397148	IMG_ERR_ZBUF	Zero buffer size—no bytes filled
–1074397149	IMG_ERR_NBUF	No buffers available—too early in acquisition
–1074397150	IMG_ERR_TIMO	Wait timed out—acquisition not complete
–1074397151	IMG_ERR_AIOP	Cannot perform request—acquisition in progress

Table C-1. NI-IMAQ VI Error Codes (Continued)

Error Code	Error Name	Description
–1074397152	IMG_ERR_BDMA	Bad DMA transfer
–1074397153	IMG_ERR_VCLK	Cannot get video lock
–1074397154	IMG_ERR_NAIP	No acquisition in progress
–1074397155	IMG_ERR_BBLB	A buffer list buffer is null
–1074397156	IMG_ERR_BBLE	Buffer list does contain an invalid command
–1074397157	IMG_ERR_BBLF	Buffer list does not contain a valid final command
–1074397158	IMG_ERR_NCFG	Invalid action—no buffers configured for session
–1074397159	IMG_ERR_NVBL	Not successful because of hardware limitations
–1074397160	IMG_ERR_BCMF	Bad camera file (check syntax)
–1074397161	IMG_ERR_BROI	ROI width is greater than rowbytes
–1074397162	IMG_ERR_BROW	Rowbytes is less than region of interest
–1074397163	IMG_ERR_BINT	Bad interface
–1074397164	IMG_ERR_NCAM	No camera defined for this channel
–1074397165	IMG_ERR_NCLK	Buffer list is not locked
–1074397166	IMG_ERR_BBUF	Bad buffer pointer in list
–1074397167	IMG_ERR_DISE	Error releasing the image buffer
–1074397168	IMG_ERR_ECLK	Cannot lock buffers down, no more memory
–1074397169	IMG_ERR_MXBI	Exhausted buffer IDs
–1074397170	IMG_ERR_BSIZ	Buffer size used is too small for minimum acquisition frame
–1074397171	IMG_ERR_DLLE	DLL internal error, bad logic state
–1074397172	IMG_ERR_MXBF	Too many buffers already allocated
–1074397173	IMG_ERR_PAR7	Function specific; see function description
–1074397174	IMG_ERR_PAR6	Function specific; see function description

Table C-1. NI-IMAQ VI Error Codes (Continued)

Error Code	Error Name	Description
–1074397175	IMG_ERR_PAR5	Function specific; see function description
–1074397176	IMG_ERR_PAR4	Function specific; see function description
–1074397177	IMG_ERR_PAR3	Function specific; see function description
–1074397178	IMG_ERR_PAR2	Function specific; see function description
–1074397179	IMG_ERR_PAR1	Function specific; see function description
–1074397180	IMG_ERR_OSER	Operating system error occurred
–1074397181	IMG_ERR_EMEM	Not enough memory to perform the operation
–1074397182	IMG_ERR_OVRN	Too many interfaces open
–1074397183	IMG_ERR_NCAP	Function not implemented

D

Customer Communication

For your convenience, this appendix contains forms to help you gather the information necessary to help us solve your technical problems and a form you can use to comment on the product documentation. When you contact us, we need the information on the Technical Support Form and the configuration form, if your manual contains one, about your system configuration to answer your questions as quickly as possible.

National Instruments has technical assistance through electronic, fax, and telephone systems to quickly provide the information you need. Our electronic services include a bulletin board service, an FTP site, a fax-on-demand system, and e-mail support. If you have a hardware or software problem, first try the electronic support systems. If the information available on these systems does not answer your questions, we offer fax and telephone support through our technical support centers, which are staffed by applications engineers.

Electronic Services

Bulletin Board Support

National Instruments has BBS and FTP sites dedicated for 24-hour support with a collection of files and documents to answer most common customer questions. From these sites, you can also download the latest instrument drivers, updates, and example programs. For recorded instructions on how to use the bulletin board and FTP services and for BBS automated information, call 512 795 6990. You can access these services at:

United States: 512 794 5422
Up to 14,400 baud, 8 data bits, 1 stop bit, no parity

United Kingdom: 01635 551422
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

France: 01 48 65 15 59
Up to 9,600 baud, 8 data bits, 1 stop bit, no parity

FTP Support

To access our FTP site, log on to our Internet host, `ftp.natinst.com`, as `anonymous` and use your Internet address, such as `joesmith@anywhere.com`, as your password. The support files and documents are located in the `/support` directories.

Fax-on-Demand Support

Fax-on-Demand is a 24-hour information retrieval system containing a library of documents on a wide range of technical information. You can access Fax-on-Demand from a touch-tone telephone at 512 418 1111.

E-Mail Support (Currently USA Only)

You can submit technical support questions to the applications engineering team through e-mail at the Internet address listed below. Remember to include your name, address, and phone number so we can contact you with solutions and suggestions.

`support@natinst.com`

Telephone and Fax Support

National Instruments has branch offices all over the world. Use the list below to find the technical support number for your country. If there is no National Instruments office in your country, contact the source from which you purchased your software to obtain support.

Country	Telephone	Fax
Australia	03 9879 5166	03 9879 6277
Austria	0662 45 79 90 0	0662 45 79 90 19
Belgium	02 757 00 20	02 757 03 11
Brazil	011 288 3336	011 288 8528
Canada (Ontario)	905 785 0085	905 785 0086
Canada (Québec)	514 694 8521	514 694 4399
Denmark	45 76 26 00	45 76 26 02
Finland	09 725 725 11	09 725 725 55
France	01 48 14 24 24	01 48 14 24 14
Germany	089 741 31 30	089 714 60 35
Hong Kong	2645 3186	2686 8505
Israel	03 6120092	03 6120095
Italy	02 413091	02 41309215
Japan	03 5472 2970	03 5472 2977
Korea	02 596 7456	02 596 7455
Mexico	5 520 2635	5 520 3282
Netherlands	0348 433466	0348 430673
Norway	32 84 84 00	32 84 86 00
Singapore	2265886	2265887
Spain	91 640 0085	91 640 0533
Sweden	08 730 49 70	08 730 43 70
Switzerland	056 200 51 51	056 200 51 55
Taiwan	02 377 1200	02 737 4644
United Kingdom	01635 523545	01635 523154
United States	512 795 8248	512 794 5678

Technical Support Form

Photocopy this form and update it each time you make changes to your software or hardware, and use the completed copy of this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

If you are using any National Instruments hardware or software products related to this problem, include the configuration forms from their user manuals. Include additional pages if necessary.

Name ____

Company ____

Address ____

____

Fax (___) ________________Phone (___) __________________________________

Computer brand____________ Model ___________________Processor_____________________

Operating system (include version number) ____________________________________

Clock speed ______MHz RAM _____MB Display adapter __________________________

Mouse ___yes ___no Other adapters installed___________________________________

Hard disk capacity _____MB Brand____

Instruments used ____

____

National Instruments hardware product model _____________ Revision ____________________

Configuration ____

National Instruments software product ___________________ Version ____________________

Configuration ____

The problem is: ____

____

____

____

____

List any error messages: ____

____

____

The following steps reproduce the problem: _____________________________________

____

____

____

____

IMAQ Hardware and Software Configuration Form

Record the settings and revisions of your hardware and software on the line to the right of each item. Complete a new copy of this form each time you revise your software or hardware configuration, and use this form as a reference for your current configuration. Completing this form accurately before contacting National Instruments for technical support helps our applications engineers answer your questions more efficiently.

National Instruments Products

DAQ hardware ______________________________

Interrupt level of hardware ______________________________

DMA channels of hardware ______________________________

Base I/O address of hardware ______________________________

Programming choice ______________________________

NI-IMAQ, IMAQ Vision, LabVIEW, or BridgeVIEW version ______________________________

Other boards in system ______________________________

Base I/O address of other boards ______________________________

DMA channels of other boards ______________________________

Interrupt level of other boards ______________________________

Other Products

Computer make and model ______________________________

Microprocessor ______________________________

Clock frequency or speed ______________________________

Type of video board installed ______________________________

Operating system version ______________________________

Operating system mode ______________________________

Programming language ______________________________

Programming language version ______________________________

Other boards in system ______________________________

Base I/O address of other boards ______________________________

DMA channels of other boards ______________________________

Interrupt level of other boards ______________________________

Documentation Comment Form

National Instruments encourages you to comment on the documentation supplied with our products. This information helps us provide quality products to meet your needs.

Title: *NI-IMAQ VI Reference Manual*

Edition Date: June 1998

Part Number: 371446A-01

Please comment on the completeness, clarity, and organization of the manual.

____
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____
____
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____

If you find errors in the manual, please record the page numbers and describe the errors.

____
____
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Thank you for your help.

Name ____

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Glossary

Prefix	Meanings	Value
p-	pico	10^{-12}
n-	nano-	10^{-9}
µ-	micro-	10^{-6}
m-	milli-	10^{-3}
k-	kilo-	10^{3}
M-	mega-	10^{6}
G-	giga-	10^{9}

Numbers/Symbols

+5V 5 V signal

– negative of, or minus

Ω ohm

/ per

% percent

± plus or minus

+ positive of, or plus

A

A amperes

AC alternating current

acquisition window the image size specific to a video standard or camera resolution

active line region	the region of lines actively being stored; defined by a line start (relative to VSYNC) and a line count
active pixel region	the region of pixels actively being stored; defined by a pixel start (relative to HSYNC) and a pixel count
A/D	analog-to-digital
ADC	analog-to-digital converter—an electronic device, often an integrated circuit, that converts an analog voltage to a digital number
address	character code that identifies a specific location (or series of locations) in memory
ANSI	American National Standards Institute
antichrominance filter	removes the color information from the video signal
API	application programming interface
AQ_DONE	signals that the acquisition of a frame or field is completed
AQ_IN_PROGRESS	signals that the acquisition of video data is in progress
area	a rectangular portion of an acquisition window or frame that is controlled and defined by software
array	ordered, indexed set of data elements of the same type
ASIC	Application-Specific Integrated Circuit—a proprietary semiconductor component designed and manufactured to perform a set of specific functions for a specific customer
aspect ratio	the ratio of a picture or image's width to its height

B

b	bit—one binary digit, either 0 or 1
B	byte—eight related bits of data, an eight-bit binary number; also used to denote the amount of memory required to store one byte of data
back porch	the area of the video signal between the rising edge of the horizontal sync signal and the active video information

black reference level	the level that represents the darkest an image can get. *See also* white reference level.
buffer	temporary storage for acquired data
bus	the group of conductors that interconnect individual circuitry in a computer, such as the PCI bus; typically the expansion vehicle to which I/O or other devices are connected

C

C	Celsius
cache	high-speed processor memory that buffers commonly used instructions or data to increase processing throughput
CCIR	Comite Consultatif International des Radiocommunications—a committee that developed standards for color video signals
chrominance	the color information in a video signal
CMOS	complementary metal-oxide semiconductor
compiler	a software utility that converts a source program in a high-level programming language, such as Basic, C or Pascal, into an object or compiled program in machine language. Compiled programs run 10 to 1,000 times faster than interpreted programs. *See also* Interpreter.
conversion device	device that transforms a signal from one form to another; for example, analog-to-digital converters (ADCs) for analog input and digital-to-analog converters (DACs) for analog output
CPU	central processing unit
CSYNC	composite sync signal; a combination of the horizontal and vertical sync pulses
CSYNCIN	composite sync in signal
CSYNCOUT	composite sync out signal

D

D/A	digital-to-analog
DAC	digital-to-analog converter; an electronic device, often an integrated circuit, that converts a digital number into a corresponding analog voltage or current
DAQ	data acquisition—(1) collecting and measuring electrical signals from sensors, transducers, and test probes or fixtures and inputting them to a computer for processing; (2) collecting and measuring the same kinds of electrical signals with A/D or DIO boards plugged into a computer, and possibly generating control signals with D/A and/or DIO boards in the same computer
dB	decibel—the unit for expressing a logarithmic measure of the ratio of two signal levels: dB = 20log10 V1/V2, for signals in volts
DC	direct current
default setting	a default parameter value recorded in the driver; in many cases, the default input of a control is a certain value (often 0) that means *use the current default setting*
DIN	Deutsche Industrie Norme
DMA	direct memory access—a method by which data can be transferred to and from computer memory from and to a device or memory on the bus while the processor does something else; DMA is the fastest method of transferring data to/from computer memory
DRAM	dynamic RAM
drivers	software that controls a specific hardware device such as an IMAQ or DAQ device
dynamic range	the ratio of the largest signal level a circuit can handle to the smallest signal level it can handle (usually taken to be the noise level), normally expressed in decibels

E

EEPROM	electrically erasable programmable read-only memory—ROM that can be erased with an electrical signal and reprogrammed
external trigger	a voltage pulse from an external source that triggers an event such as A/D conversion

F

field	For an interlaced video signal, a field is half the number of horizontal lines needed to represent a frame of video; the first field of a frame contains all the odd-numbered lines, the second field contains all of the even-numbered lines.
FIFO	first-in first-out memory buffer—the first data stored is the first data sent to the acceptor; FIFOs are used on IMAQ devices to temporarily store incoming data until that data can be retrieved. For example, an analog input FIFO stores the results of A/D conversions until the data can be retrieved into system memory, a process that requires the servicing of interrupts and often the programming of the DMA controller. This process can take several milliseconds in some cases. During this time, data accumulates in the FIFO for future retrieval.
flash ADC	an ADC whose output code is determined in a single step by a bank of comparators and encoding logic
frame	a complete image; in interlaced formats, a frame is composed of two fields
front porch	the area of a video signal between the start of the horizontal blank and the start of the horizontal sync
ft	feet
function	a set of software instructions executed by a single line of code that may have input and/or output parameters and returns a value when executed; examples of functions are: y = COS (x) **status** = `AO_config`(**board**, **channel**, **range**)

G

gamma	the nonlinear change in the difference between the video signal's brightness level and the voltage level needed to produce that brightness
genlock	circuitry that aligns the video timing signals by locking together the horizontal, vertical, and color subcarrier frequencies and phases and generates a pixel clock to clock pixel data into memory for display or into another circuit for processing
GND	ground signal
GUI	graphical user interface—an intuitive, easy-to-use means of communicating information to and from a computer program by means of graphical screen displays; GUIs can resemble the front panels of instruments or other objects associated with a computer program.

H

h	hour
hardware	the physical components of a computer system, such as the circuit boards, plug-in boards, chassis, enclosures, peripherals, cables, and so on
HSYNC	horizontal sync signal—the synchronization pulse signal produced at the beginning of each video scan line that keeps a video monitor's horizontal scan rate in step with the transmission of each new line
HSYNCIN	horizontal sync input signal
hue	represents the dominant color of a pixel. The hue function is a continuous function that covers all the possible colors generated using the R, G, and B primaries. *See also* RGB.
Hz	hertz—the number of scans read or updates written per second

I

IC	integrated circuit
ID	identification
IEEE	Institute of Electrical and Electronics Engineers

in.	inches
INL	integral nonlinearity—A measure in LSB of the worst-case deviation from the ideal A/D or D/A transfer characteristic of the analog I/O circuitry
instrument driver	a set of high-level software functions, such as NI-IMAQ, that controls specific plug-in computer boards; instrument drivers are available in several forms, ranging from a function callable from a programming language to a virtual instrument (VI) in LabVIEW
interlaced	a video frame composed of two interleaved fields; the number of lines in a field are half the number of lines in an interlaced frame
interpreter	a software utility that executes source code from a high-level language such as Basic, C or Pascal, by reading one line at a time and executing the specified operation. *See also* compiler.
interrupt	a computer signal indicating that the CPU should suspend its current task to service a designated activity
interrupt level	the relative priority at which a device can interrupt
I/O	input/output—the transfer of data to/from a computer system involving communications channels, operator interface devices, and/or data acquisition and control interfaces
IRE	a relative unit of measure (named for the Institute of Radio Engineers). 0 IRE corresponds to the blanking level of a video signal, 100 IRE to the white level. Note that for CIR/PAL video the black level is equal to the blanking level or 0 IRE, while for RS-170/NTSC video the black level is at 7.5 IRE.
IRQ	interrupt request

K

k	kilo—the standard metric prefix for 1,000, or 10^3, used with units of measure such as volts, hertz, and meters
K	kilo—the prefix for 1,024, or 2^{10}, used with B in quantifying data or computer memory
kbytes/s	a unit for data transfer that means 1,000 or 10^3 bytes/s

Kword	1,024 words of memory

L

library	a file containing compiled object modules, each comprised of one of more functions, that can be linked to other object modules that make use of these functions.
line count	the total number of horizontal lines in the picture
LSB	least significant bit
luminance	the brightness information in the video picture. The luminance signal amplitude varies in proportion to the brightness of the video signal and corresponds exactly to the monochrome picture.
LUT	look-up table—a selection in the IMAQ Configuration Utility that contains formulas that let you implement simple imaging operations such as contrast enhancement, data inversion, gamma manipulation, or other nonlinear transfer functions

M

m	meters
M	(1) Mega, the standard metric prefix for 1 million or 10^6, when used with units of measure such as volts and hertz; (2) mega, the prefix for 1,048,576, or 2^{20}, when used with B to quantify data or computer memory
MB	megabytes of memory
Mbytes/s	a unit for data transfer that means 1 million or 10^6 bytes/s
memory buffer	*See* buffer.
memory window	continuous blocks of memory that can be accessed quickly by changing addresses on the local processor
MSB	most significant bit
MTBF	mean time between failure

mux	multiplexer—a switching device with multiple inputs that selectively connects one of its inputs to its output

N

NI-IMAQ	driver software for National Instruments IMAQ hardware
noninterlaced	a video frame where all the lines are scanned sequentially, instead of divided into two frames as in an interlaced video frame
NTSC	National Television Standards Committee—the committee that developed the color video standard used primarily in North America, which uses 525 lines per frame. *See also* PAL.
NVRAM	nonvolatile RAM—RAM that is not erased when a device loses power or is turned off

O

operating system	base-level software that controls a computer, runs programs, interacts with users, and communicates with installed hardware or peripheral devices

P

PAL	Phase Alternation Line—one of the European video color standards; uses 625 lines per frame. *See also* NTSC.
PCI	Peripheral Component Interconnect—a high-performance expansion bus architecture originally developed by Intel to replace ISA and EISA; it is achieving widespread acceptance as a standard for PCs and workstations and offers a theoretical maximum transfer rate of 132 Mbytes/s
PCLK	pixel clock signal—times the sampling of pixels on a video line
PCLKIN	pixel clock in signal
PFI	programmable function input
PGIA	programmable gain instrumentation amplifier

picture aspect ratio	the ratio of the active pixel region to the active line region; for standard video signals like RS-170 or CCIR, the full-size picture aspect ratio normally is 4/3 (1.33)
pixel	picture element—the smallest division that makes up the video scan line; for display on a computer monitor, a pixel's optimum dimension is square (aspect ratio of 1:1, or the width equal to the height)
pixel aspect ratio	the ratio between the physical horizontal size and the vertical size of the region covered by the pixel; an acquired pixel should optimally be square, thus the optimal value is 1.0, but typically it falls between 0.95 and 1.05, depending on camera quality
pixel clock	divides the incoming horizontal video line into pixels
pixel count	the total number of pixels between two HYSNCs; the pixel count determines the frequency of the pixel clock
PLL	phase-locked loop—circuitry that provides a very stable pixel clock that is referenced to another signal, for example, an incoming HSYNC signal
protocol	the exact sequence of bits, characters, and control codes used to transfer data between computers and peripherals through a communications channel
pts	points

R

RAM	random-access memory
real time	a property of an event or system in which data is processed as it is acquired instead of being accumulated and processed at a later time
relative accuracy	a measure in LSB of the accuracy of an ADC; it includes all nonlinearity and quantization errors but does not include offset and gain errors of the circuitry feeding the ADC
resolution	the smallest signal increment that can be detected by a measurement system; resolution can be expressed in bits, in proportions, or in percent of full scale. For example, a system has 12-bit resolution, one part in 4,096 resolution, and 0.0244 percent of full scale.

RGB	red, green, and blue—the three primary colors used to represent a color picture. An RGB camera is a camera that deliver three signals, one for each primary.
ribbon cable	a flat cable in which the conductors are side by side
ROI	region-of-interest— a hardware-programmable rectangular portion of the acquisition window
ROM	read-only memory
RS-170	the U.S. standard used for black-and-white television
RTSI bus	Real-Time System Integration Bus—the National Instruments timing bus that connects IMAQ and DAQ boards directly, by means of connectors on top of the boards, for precise synchronization of functions

S

s	seconds
saturation	the richness of a color. A saturation of zero corresponds to no color, that is, a gray pixel. Pink is a red with low saturation.
scaling down circuitry	circuitry that scales down the resolution of a video signal
scatter-gather DMA	a type of DMA that allows the DMA controller to reconfigure on-the-fly
SRAM	static RAM
StillColor	a post-processing algorithm that allows the acquisition of high-quality color images generated either by an RGB or composite (NTSC or PAL) camera using a monochrome video acquisition board.
sync	tells the display where to put a video picture; the horizontal sync indicates the picture’s left-to-right placement and the vertical sync indicates top-to-bottom placement
syntax	the set of rules to which statements must conform in a particular programming language
system RAM	RAM installed on a personal computer and used by the operating system, as contrasted with onboard RAM

T

transfer rate	the rate, measured in bytes/s, at which data is moved from source to destination after software initialization and set up operations; the maximum rate at which the hardware can operate
TRIG	trigger signal
trigger	any event that causes or starts some form of data capture
trigger control and mapping circuitry	circuitry that routes, monitors, and drives the external and RTSI bus trigger lines; you can configure each of these lines to start or stop acquisition on a rising or falling edge.
TTL	transistor-transistor logic

U

UV plane	*See* YUV.

V

V	volts
VCO	voltage-controlled oscillator—an oscillator that changes frequency depending on a control signal; used in a PLL to generate a stable pixel clock
VI	Virtual Instrument—(1) a combination of hardware and/or software elements, typically used with a PC, that has the functionality of a classic stand-alone instrument (2) a LabVIEW software module (VI), which consists of a front panel user interface and a block diagram program
video line	a video line consists of a HSYNC, back porch, active pixel region, and a front porch
VSYNC	vertical sync signal—the synchronization pulse generated at the beginning of each video field that tells the video monitor when to start a new field
VSYNCIN	vertical sync in signal

W

white reference level — the level that defines what is white for a particular video system. *See also* black reference level.

Y

YUV — a representation of a color image used for the coding of NTSC or PAL video signals. The luminance information is called Y, while the chrominance information is represented by two components, U and V representing the coordinates in a color plane.

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