MICROSCAN

Visionscape® FrontRunner™ User Manual

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Contents

PREFACE

Welcome

Purpose of This Manual

- Chapter 1 is a generic overview of the Visionscape product family.
- Chapter 2 describes the FrontRunner user interface.
- Chapter 3 is a guide to camera calibration using FrontRunner.
- Chapter 4 provides specific information about the Part Queue.

Manual Conventions

The following typographical conventions are used throughout this manual.

- Items emphasizing important information are **bolded**.
- Menu selections, menu items and entries in screen images are indicated as: Run (triggered), Modify..., etc.

CHAPTER 1 Visionscape Overview

This chapter covers the basic Visionscape concepts in terms of the hardware and vision application development.

Introduction

At its highest level, Visionscape is a set of software and hardware that allows you to create and operate machine vision applications without having to consider the details of data connection and information flows in the software or how the underlying hardware is configured.

All Visionscape applications, commonly referred to as “jobs,” have the following components and characteristics:

- A Machine Vision Program — Commonly referred to as an “AVP” or “job”. A job is a collection of Visionscape steps.
- Visionscape Steps — Steps are completely encapsulated machine vision operations and tools. Steps pass information to each other and take care of all hardware and memory management. A Visionscape job is a tree of steps. The order of the tree defines the order of execution and flow of data.
- A Vision System Step is present at the top of each job. The Vision System Step represents the hardware on which the job is to run - either a smart camera, a Vision System comprised of GigE Cameras, or a software system.
- All Steps contain Datums, which represent the inputs to and outputs from a Step or Tool.

Visionscape Product Family

The hardware platform on which Visionscape Software runs is generically called a vision system. Visionscape supports several types of vision systems:

- **Visionscape GigE System —** A vision system with one or more Visionscape GigE Cameras.
- **Vision HAWK Smart Camera —** A networked smart camera for use in machine vision and traceability applications. It features integrated lighting, optics, image processing, I/O, and communications. A C-Mount version is also available.
- **Vision MINI Smart Camera —** A networked smart camera for use in machine vision and traceability applications. It features integrated lighting, optics, image processing, I/O, and communications.
- **Vision MINI Xi Smart Camera —** A networked smart camera for use in machine vision and traceability applications. It features industrial connectivity, Ethernet, integrated lighting, optics, image processing, I/O, and communications.
- **Visionscape Software System —** Visionscape can mimic a hardware system by running a software emulator (SoftSys). The software system may be used for application development using stored images. A software key is typically required for full Visionscape operation.
- **AutoVISION Software —** Visionscape software is also the basis for AutoVISION, which is intended for vision applications of basic to moderate complexity. It allows process engineers and manufacturing engineers with minimal machine vision experience to deploy a system that meets their traceability, inspection, and quality control requirements.

Visionscape FrontRunner Overview

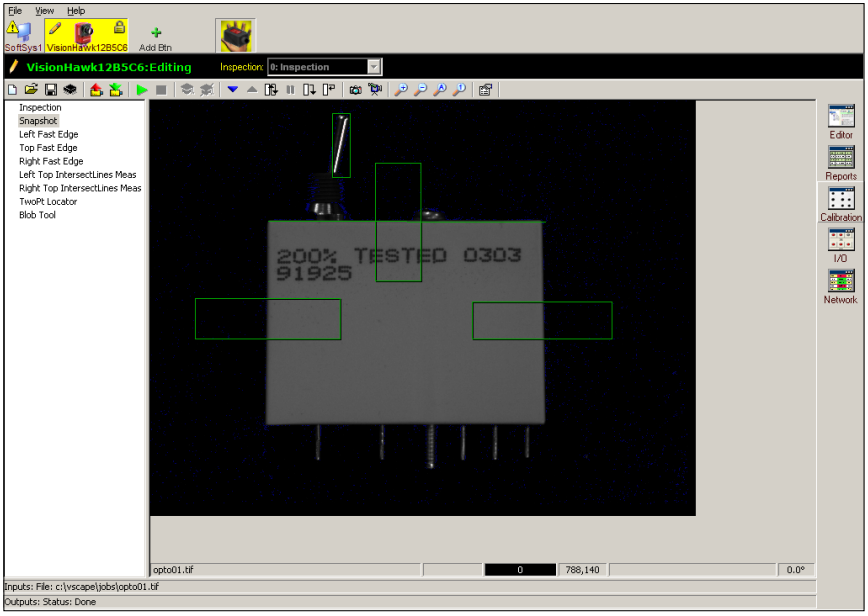
FrontRunner is an application development and monitoring GUI. FrontRunner gives you full access to Visionscape tools.

Note: You must have Administrator privileges to install and run AutoVISION and Visionscape.

Using FrontRunner, you can:

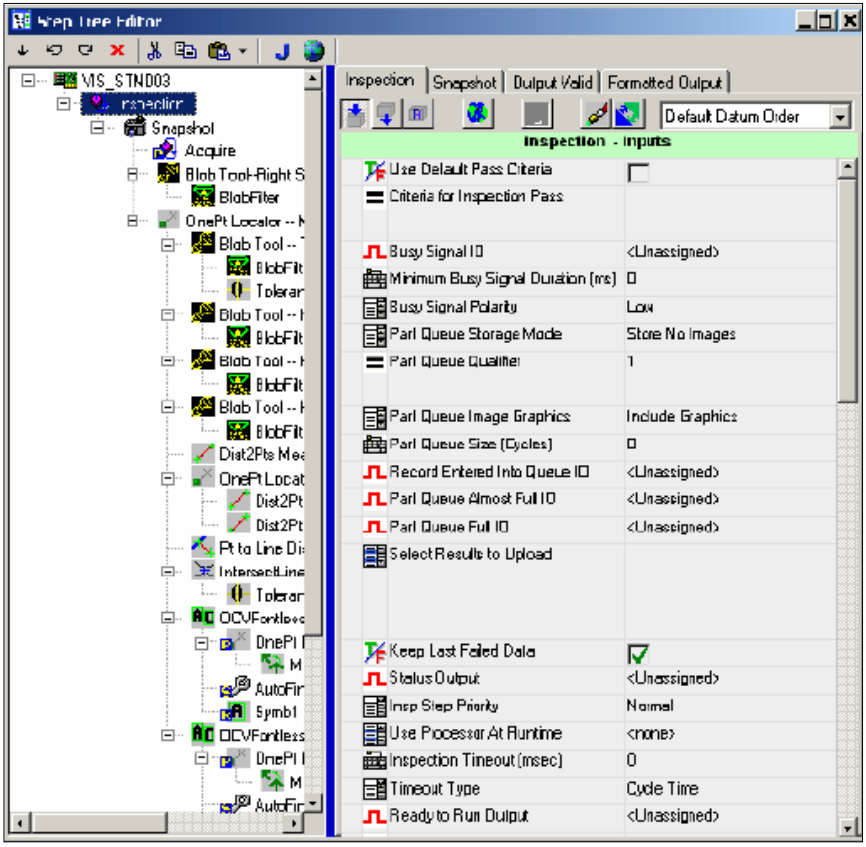
- Train, try out, and download a job to a Vision System (see Figure 1-1).

FIGURE 1–1. Train, Try Out, and Download



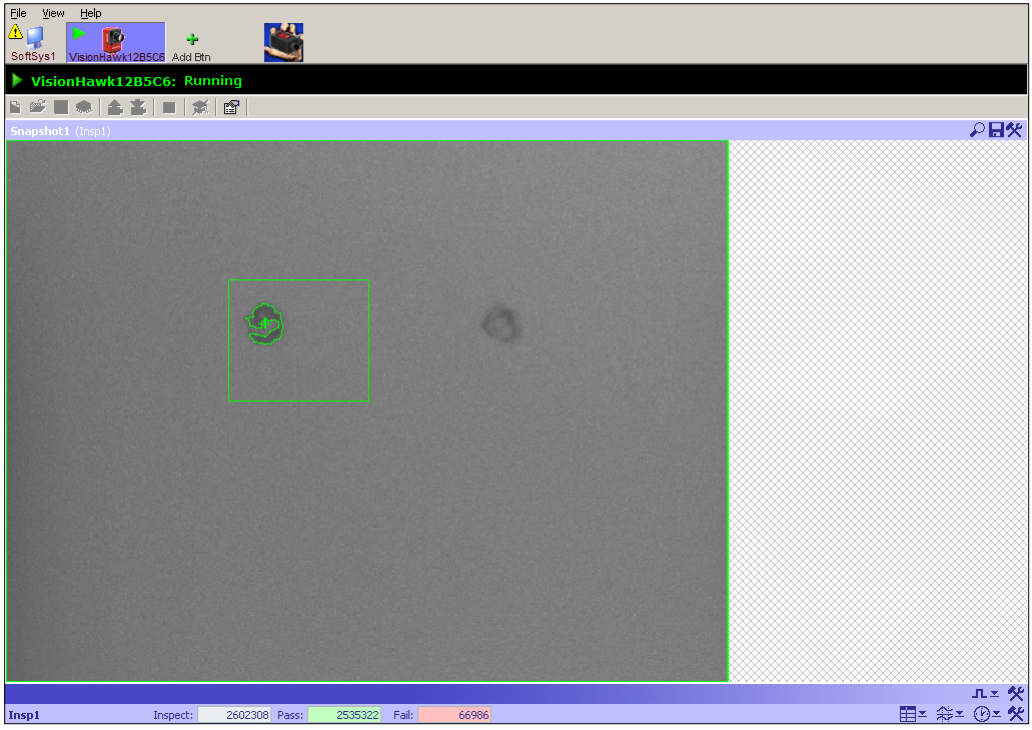
- Assemble jobs and adjust parameters (see Figure 1-2).

FIGURE 1–2. Assemble Jobs and Adjust Parameters



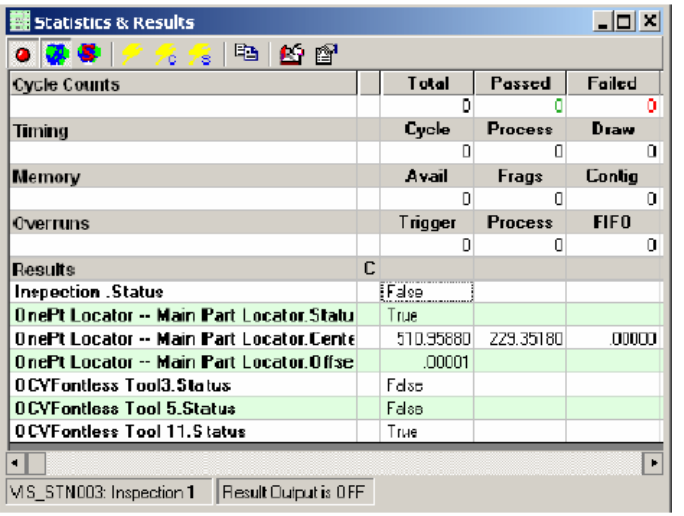
- Monitor a Vision System (see Figure 1-3).

FIGURE 1–3. Monitor Vision System



- Monitor results (see Figure 1-4).

FIGURE 1–4. Monitor Results



The Visionscape toolkit is comprehensive, and includes:

- Image preprocessing
- Image arithmetic, warping, binary and gray scale morphology, edge enhancement, other filtering, etc
- Image analysis
- Flaw detection, blob analysis, edge detection and fitting, vector edge detection, template find, etc
- Calibrated dimensional measurements
- Line intersection, point to point distance, point to line normal, etc.
- Automatic identification
- Data Matrix and barcode reading, OCR, etc
- Custom processing options
- Custom measurements and custom scripted tools

Setup and Runtime

When working with Visionscape applications, you access the Visionscape Vision hardware in one of two modes:

- In Setup mode, the setup objects control the hardware. You can train and try out tools and debug your vision application.
- In Runtime mode, you download your vision applications to the runtime hardware objects for full speed operations. The runtime objects control the hardware, and the setup objects cannot be used to edit the job. You can start and stop vision inspections at runtime, as well as receive inspection results and runtime images.

Note: Setup and Runtime modes are mutually exclusive. That is, only one mode can control a vision system.

Visionscape 7.x Firmware

Note: If you open a Visionscape 6.x job using Visionscape 7.x, the job automatically becomes a 7.x job, even if no changes are made to the job.

You can monitor, but not program, a 6.x job on a smart camera with FrontRunner. Also, you can upload a 6.x job and save it to your PC, at which time it becomes a 7.x job.

The IntelliFind® Tool

IntelliFind is a very capable and robust object locator tool that is invariant to many changes in the images, such as contrast, intensity variation, scale, translation, rotation, noise, and occlusion. IntelliFind allows a feature or object to be found, and it can significantly reduce the complexity of locating features in an image. It is well suited where an object reference must be found before it is inspected or gauged.

When building a job in FrontRunner (for more information, see Chapter 2), you can insert an IntelliFind tool by selecting it from the Insert Tool dialog box (Image/Pre-Processing tab). You can always insert and use IntelliFind in a job, even if a key cannot be found to unlock it. In this case, IntelliFind runs in demonstration mode, with recurring messages requesting that you insert the key. You can make changes to try out the job, but you cannot save the job to disk. When connected to a smart camera IntelliFind model, no hardware dongle is required to try out the job. Essentially, the camera acts as a hardware dongle, but only for that camera currently selected in FrontRunner (focused device).

Note: You cannot upgrade a non-IntelliFind smart camera in the field.

Visionscape Software Structure and Concepts

Steps and Trees

A Step represents a piece of vision functionality in Visionscape. Applications are a collection of steps. To provide order to this collection, the steps are arranged in a Tree. The Tree represents not only the containment of a set of steps, but also represents a data connection between these steps. In other words, a step can receive a set of data inputs, act on this data, and produce a set of data outputs. The tree represents the connection of particular data outputs to data inputs.

The most common piece of data to be passed from one step to another is a buffer. A buffer is a piece of memory that contains image data.

In Figure 1-5, a Snapshot generates a buffer that is passed to the Sobel Filter. The Sobel Filter then executes a Sobel algorithm on the buffer and generates a new buffer, which is passed to the Edge Tool. The Edge Tool finds an edge on that buffer and reports a result. A step that generates output can have other steps or tools inserted into it. The inserted tools then connect their inputs to the outputs of the parent step.

FIGURE 1–5. Sample Job Tree

Many tools also have a region of interest (ROI) that defines an area on the input buffer for that tool. In the case of the Sobel Filter, the ROI defines the area where the Sobel Filter executes its algorithm. Its output buffer (or input buffer to the Edge Tool), is the size of its ROI.

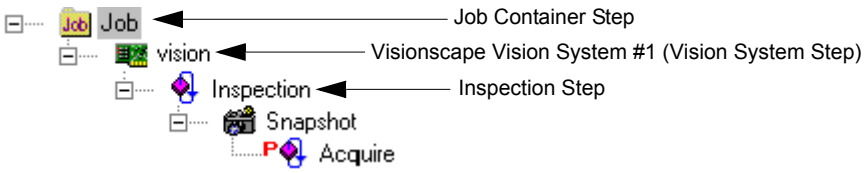
Many steps are not vision based steps like Sobel Filter or Edge Tool, but actually represent other useful pieces of functionality like I/O, image acquisition, or a thread-of-execution. Several steps are common to every job you create. These are Job, VisionSystem, Inspection, and Snapshot/Acquire.

Job Step

The Job Step is the root of all steps in the Job Tree. When you create a new application, you are creating a new job that contains a Vision System Step that represent the Visionscape Vision System installed in the system. A Vision System is an object that can use hardware to execute vision. The hardware can be a GigE camera, a smart camera, or software that is not connected to any specific hardware at all. The Job Step contains all Vision System Steps in the tree and is used as the single entry point of the tree.

The Job Step performs no special function and does not contain any results. Essentially, the Job Step is a collection of Vision System Steps. Each Vision System Step represents a single Visionscape Vision System, but the Job Step represents a set of Visionscape Vision Systems (see Figure 1-6).

FIGURE 1–6. Job Tree



In Visionscape 7.x, FrontRunner can open and save single Vision System Step files. This opens or saves a specific Vision System Step tree rather than all systems at once, allowing you to work with each system exclusively.

Vision System Step

The Vision System Step is the step representation of a Vision System itself. A Vision System is an object that can use hardware to execute vision programs. The hardware can be a GigE Camera, a smart camera, or software that is not connected to any specific hardware at all. The Vision System Step can take control of a specific Vision System on the AvpBackplane, and can be changed later to assume a different Vision System. The Vision System Step has parameters that allow you to set the camera type to be used by the system, set the parameters of the bufferpool for this Vision System, and set the general purpose I/O configuration. Essentially, the step provides the parameters to configure the actual hardware of the Vision System.

The Vision System Step also contains all the Inspections that are used by the Vision System, as shown in Figure 1-7.

FIGURE 1–7. Three Inspections

Inspection

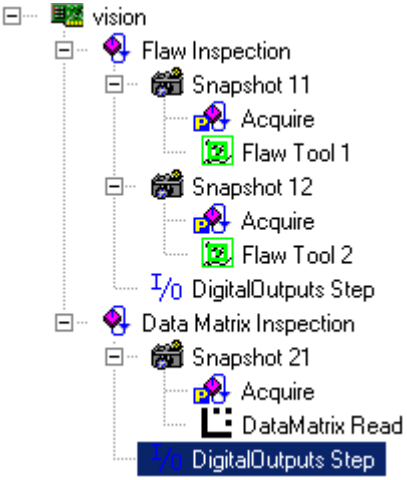
The Inspection Step represents one thread of execution for your vision application. The Inspection is the entry point for execution whether you are setting up your application or executing your application. You can create any number of Inspections in a Vision System, and each can be started and stopped asynchronously. In a typical inspection, you use a Snapshot/Acquire to acquire an image, execute vision tools on that image, and then report results either through I/O or through the Inspection Report.

Creating multiple inspections allows you to create inspections with tools that execute either synchronously or asynchronously.

Note: The preceding statement is generally applicable to Visionscape. In the case of smart cameras: while multiple inspections are still supported, care should be taken to make sure that multiple Snapshot steps do not attempt to use the single “camera” at the same time.

In Figure 1-8, the job contains two Inspection steps renamed to Flaw Inspection and Data Matrix Inspection for clarity.

FIGURE 1–8. Job with Multiple Inspection Steps



The Flaw Inspection contains two Snapshots. The first Snapshot (11) contains a Flaw tool that might be used to detect scratches on a part. The second Snapshot (12) in this inspection might be taken at a longer exposure to detect some subtle defects in a specified region. Because Snapshot 12 follows Snapshot 11 in the same inspection, it will not take place until the Flaw tool runs. Snapshot 21 is in a separate inspection. Both it and Snapshot 11 should be separately triggered in a manner that will ensure that they do not both use the sensor at the same time.

Snapshot and Acquire

The Snapshot and Acquire steps work together to provide image acquisition capabilities for the job. Acquire is the image creator; Snapshot is the image receiver.

Acquire is a special step that knows how to capture images from the camera or disk, utilizing triggers and strobes. You can program the camera selection, trigger, and strobe in the Acquire step. When executing, the Acquire sets up the Camera I/O Card or smart camera digitizer according to your selection and captures images into a list, called a frame list. When an image is set into the list, the Snapshot can then pull the frame from the list and turn it into a buffer that is then passed along to its contained steps.

The execution of the Acquire depends on your trigger selection. The letter “P” at the left of the Acquire step in the job Tree means the Acquire step is a preprocessing step of the Snapshot. Though it is a child of the Snapshot, it is executed before the Snapshot. When no triggers are selected (see Figure 1–8, “Job with Multiple Inspection Steps,” on page 1-14), the Flaw Inspection tree is executed in the following order:

- Acquire
- Snapshot
- FlawTool1
- Acquire
- Snapshot
- Flaw Tool2
- Digital Outputs Step

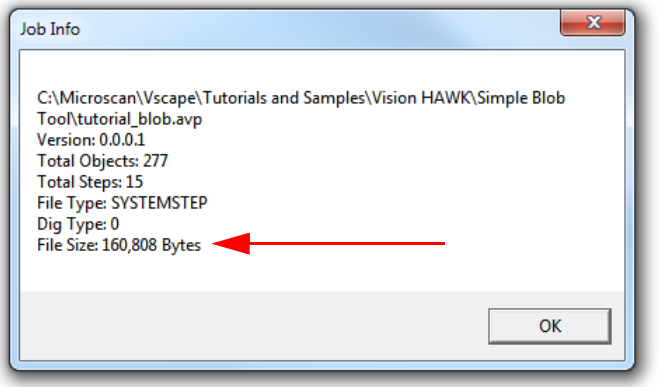
This changes when you select a trigger. In order to maximize image acquisition along with inspection execution, when a trigger is selected, the images are pipelined to the running Inspection. The hardware acquires images from the camera when the trigger is fired using the appropriate acquisition definition and instruct the Acquire Step that an image frame (or buffer) is available. The Acquire Step creates a Frame Datum from the image and pushes it onto its frame list. The Snapshot, running within the Inspection thread, will remove the images from the frame list when it executes. In this way, a triggered acquisition pipelines the image to the running inspection. This allows multiple images to be captured so the vision on the system production line does not miss parts.

Jobs

Jobs and Storage in Non-Volatile Memory

To determine the size of an avp job from FrontRunner, select File > Show Job Info... and navigate to the avp file on the disk. FrontRunner displays a dialog that shows the File Size of the avp and other statistics about the job.

FIGURE 1–9. File Size of Job



Determine support file sizes by adding up the file sizes of the models, fonts, perl scripts, and tiff images used in the avp (these are usually stored in \Vscape\Jobs). Overall, the maximum size used (avp + support files) cannot exceed the 16MB (or 6MB) available in flash memory.

Combining Jobs for Operation as a Multi-Inspection Job

Because the smart camera Non-Volatile Memory file system does not support multiple separate avp files in this release, separate inspection jobs that would live in separate avp files for other devices must be combined into a single avp with multiple inspections for the purpose of running on the smart camera. This is done by loading each avp into a separate Software System (which does not change the camera definition selected and other system dependent parameters like IO assignment), and then copying all the Inspections of the second avp and pasting them into the first avp. Then, the first avp can be saved to disk and loaded/flashed later onto the desired device.

2

CHAPTER 2 FrontRunner

Overview

FrontRunner is a comprehensive vision development environment you use to create, edit, try out, and run vision applications.

Note: Use AppRunner to monitor a job on the device (see *Visionscape AppRunner User Manual*).

When working with Visionscape applications, you access the Visionscape Vision hardware in one of two modes:

- In Setup mode, the setup objects control the hardware. You can train and try out tools and debug your job.
- In Runtime mode, you download your job to the GigE Camera or smart camera for full speed operations. The runtime objects control the hardware; the set-up objects cannot be used to edit the job. You can start and stop vision inspections at runtime, as well as receive inspection results and runtime images.

Note: The Setup and Runtime modes are mutually exclusive – only one mode can control a vision system.

FrontRunner supports single or multiple Visionscape Vision Systems. You can create and save vision jobs in FrontRunner, train tools, examine Inspection reports, and monitor I/O activity. FrontRunner is equally

applicable to Visionscape GigE Camera products and smart camera vision systems. It is the GUI you should use to develop and train vision applications for the smart camera.

Note: Visionscape 7.x does not support AppFactory.

When Visionscape is installed, a Visionscape program folder is created on your Start Menu. A shortcut for starting FrontRunner is located there. Start FrontRunner using this icon. Alternatively, select Start > Visionscape > Visionscape FrontRunner.

Visionscape 7.x Firmware

Note: If you open a Visionscape 6.x job using Visionscape 7.x, the job automatically becomes a 7.x job, even if no changes are made to the job.

You can monitor, but not program, a 6.x job on a camera with FrontRunner. Also, you can upload a 6.x job and save it to your PC, at which time it becomes a 7.x job.

Basic Concepts

Before you do anything with your smart camera, make sure it is mounted properly and wired correctly.

Device Toolbar and Device Buttons

When you start FrontRunner for the very first time, if you have not installed any Visionscape GigE Cameras or created any Software Systems, you will see the following:

- A Device Toolbar that contains no devices (Figure 2–1).
- The dialog box in Figure 2–2.

FIGURE 2–1. Device Toolbar with No Devices

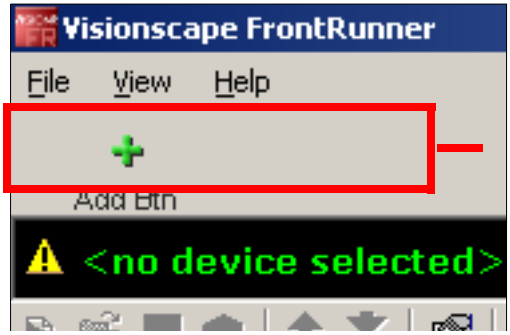
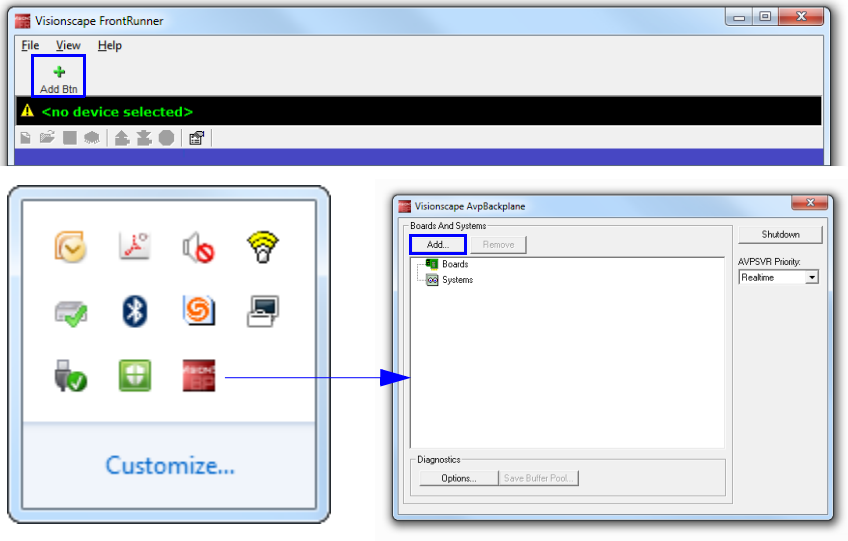


FIGURE 2–2. Initial FrontRunner Startup - No Cameras or Software Systems



Click on the Visionscape Backplane icon in the system tray to open the Visionscape AvpBackplane dialog.

FrontRunner needs a Device on which to operate. The dialog in Figure 2–2 enables you to add a button for a smart camera. See “Adding and Controlling a Smart Camera” on page 2-7.

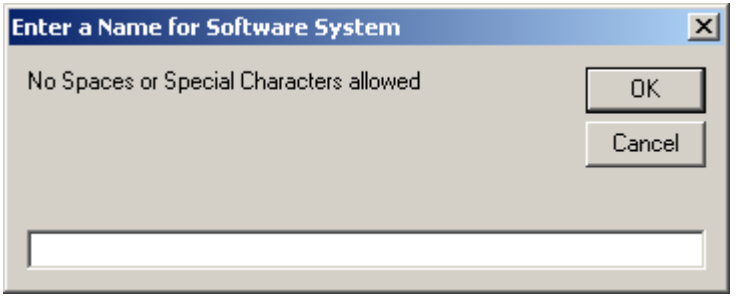
You can also add a software system by clicking the **Add** button in the Backplane dialog.

Adding a Software System

To add a Software System:

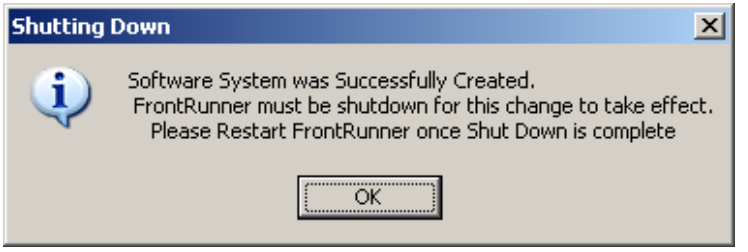
1. From the Visionscape AvpBackplane dialog shown in Figure 2-2, click Add Software System.

   FrontRunner displays the following dialog box:



2. Enter a name for the Software System, and click OK.

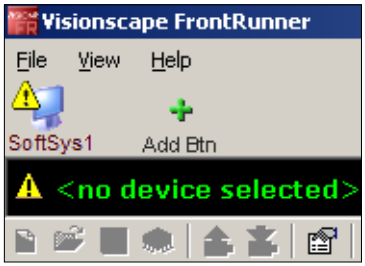
   FrontRunner displays the following dialog box:



3. Click OK.

FrontRunner will shutdown automatically. When you restart FrontRunner, the Device Toolbar will contain an icon for the Software System you specified (see the example in Figure 2–3):

FIGURE 2–3. **Device Toolbar with Software System**

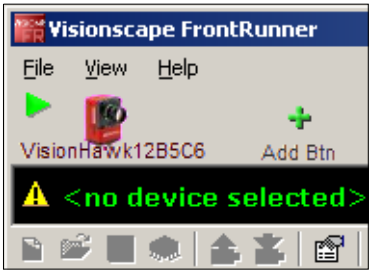


Adding and Controlling a Smart Camera

When you look at the devices on your network, you'll see numerous cameras. Before you can build a job to read a part on any of those smart cameras, you have to "add" the camera so that it is connected to your PC. After you add the camera, and before you start building a job, you have to take control of the camera on which you want to build a job. Other users can still see the camera on the network, they just can't do anything with it while you have control. To add a camera:

1. With a smart camera that is properly and securely mounted, and connected to the network, start FrontRunner (either double click the FrontRunner icon, or select Start > Visionscape > Visionscape FrontRunner). FrontRunner starts up and displays its main window.
2. Click Add Btn. FrontRunner displays the Select Device dialog box.
3. Highlight a camera name and click OK. FrontRunner adds the new smart camera icon to the Device Toolbar, as shown in Figure 2–4:

FIGURE 2–4. Device Toolbar with Smart Camera



Now that you've added the smart camera, you'll want to control the camera so that no other users can use it while you're creating your job. To control the camera:

1. Click on the camera button for the smart camera you just added.
2. Click Take Control. FrontRunner displays the Login to Device dialog box.
3. Type in a user name.
4. Click OK. Now you have control of the camera.
5. Click Create New Program to begin the process of building a job. FrontRunner displays its main window, which contains the key steps that are a part of every job.

Before you build your job, you so read the fhepul ollowing information about the Acquire Step, the Snapshot Step, and the Vision System Step.

Note: Clicking the right mouse button while positioned over the camera icon presents the operator with the option to "Remove this button" or "Reboot this device". The first option removes the icon from the Device Toolbar. The second option reboots the camera provided you have control of the device.

Important Visionscape Steps

After you click Create New Program, and before you add any steps or tools to your job, we'll look at the following steps, which are key steps in a Visionscape job:

- The Acquire Step
- The Snapshot Step
- The Vision System Step

The Acquire Step

The Acquire step is one of the most important steps in Visionscape, since it is the step where you can specify the following:

- Acquisition method, which is how the camera acquires images. Acquisitions can be triggered or non-triggered.
- Gain and Offset, which determine what is applied to the incoming video signal.

Note: The Visionscape Tools Reference contains detailed information about Gain and Offset:

Chapter 1 describes these advanced datums on the Acquire properties page.

Chapter 13 describes the GainOffset Filter in detail.

- Exposure time, which is the amount of time, in micro seconds, that the camera's CCD will integrate light. Exposure Time can freeze motion when not using a strobe, or if you are using a strobe, it can prevent ambient light from affecting your image.
- Photometry and Lighting, which is the light source powered by the camera.
- Triggers, which can be virtual or physical

The Acquire step is inserted automatically as a component of the Snapshot step. There is always a one-to-one relationship between Acquire and Snapshot. For complete information about the Acquire step, see Chapter 1 of the Visionscape Tools Reference.

The Snapshot Step

After the Acquire step acquires images, the Snapshot step pulls the image frames from the frame datum list and passes them on to the vision tools in the inspection for further processing.

When steps are inserted into a Snapshot, all their input buffer datums are automatically connected to the output buffer datum of Snapshot. The output buffer datum of Snapshot is the last image acquired. These steps then process or analyze this image.

The Snapshot step also defines a point of calibration in the step tree. When calibrated, the Snapshot contains a special Part tree that defines the calibration data. A typical calibration job is simply a Blob Step. The Blob Step is used by the Calibration Manager to find the calibration blobs in the image and update its “PhysCalDots” Point List datum, calculate the calibration matrices, then update the Calibration Result Datum in the Snapshot. The Calibration Result Datum (“CalResult”) contains the mean and max residuals, the pixels per unit and units per pixel in x and y, the camera angle, and the UX and VY perspectives. For complete information about the Snapshot step, see Chapter 1 of the Visionscape Tools Reference.

The Vision System Step

The Vision System step represents the vision system device that performs the inspection and can be a smart camera, GigE Camera, or software system. Some features, which you can configure, include:

- Buffer counts
- Camera selection
- Digitizer and digitizer mode
- I/O point configuration

A Vision System step is always created with an Inspection step, which represents an inspection task. You can add additional inspection steps. Multiple inspection steps are necessary when an application has to support multiple asynchronous inspections.

I/O consists of both physical I/O and virtual I/O. Virtual I/O provides the PC with a set of I/O points that behave much like physical I/O points, but can only be accessed by software. They have the advantage of being

both inputs and outputs at the same time, and they can hold 32-bit values instead of a binary state. This enables software on the PC to communicate with the job using a mechanism that is conceptually similar to using physical I/O but without requiring special hardware and wiring. By default, the system has 2048 virtual I/O points. For complete information about the Visions System step, see Chapter 1 of the Visionscape Tools Reference.

Focus and Lighting

Now that you have control of a smart camera, it's time to place a part in front of the lens and adjust the focus using Live Video. Live Video shows you exactly what the smart camera sees in real time. You want the part to be as clear and distinct as possible. Use the Zoom buttons (just to the right of the Live Video button) to enlarge the part as needed.

Lighting is extremely important for machine vision. If the part you want to read is not properly illuminated, then the results will be less than optimal. When lighting a part, consider the following:

- Surface Characteristics
- Geometry
- Size
- Region of Interest (ROI)

These considerations will determine what type of light you need to adequately illuminate your part.

Exposure Time

Depending on the lighting you use, you may have to adjust the exposure time for the camera. Exposure time is the amount of time, in micro seconds, that the camera's CCD integrates light. Exposure time can freeze motion when you are not using a strobe or, if you are using a strobe, it can prevent ambient light from affecting your image. You set the exposure time in the Exposure Time (us) property on the Acquire Step properties page from the Editor window. For more information about the Exposure Time (us) property in the Acquire Step, see Chapter 1 of the Visionscape Tools Reference. For more information about the Editor window, see "The Editor Window" on page 2-39.

Steps and Tools

We've seen that every Visionscape job starts with the same steps (Vision System, Inspection, Snapshot, Acquire). From this point on, it's up to you to add the steps and tools, building the job, that accomplishes the task that you want to accomplish. Visionscape tools fit into the following categories:

- Analysis tools
- Image and Pre-processing tools
- Measurement tools
- Program control tools
- Script tools

For complete information about Visionscape tools, see the Visionscape Tools Reference.

Adding Steps and Tools

Now that we're at the main FrontRunner window, it's time to add one or more tools. The procedure would be similar to the following:

1. Open the Editor window.
2. Add a tool.
3. Adjust properties.
4. Close or minimize the Editor window.
5. Acquire an image
6. Adjust the tool's region of interest (ROI).
7. Train the tool, if applicable.
8. Try out the job.
9. Download the job to the smart camera.
10. Start the job on the smart camera.

Training and Untraining Tools

Some tools (like the Barcode Tool and the Data Matrix Tool) can be trained. When you train a tool, you're "telling" the tool what to expect when it reads an image. For example, if you train the Data Matrix tool to read a Data Matrix with 12 rows and 12 columns, the Data Matrix tool will fail when it encounters a Data Matrix with 16 rows and 16 columns.

You can untrain a tool that's been trained. When you untrain a tool, you are effectively "opening it up" to read a larger variety of images. For example, if you untrain the Data Matrix tool that was trained to read a Data Matrix with 12 rows and 12 columns, it will read a Data Matrix with 12 rows and 12 columns, 16 rows and 16 columns, and so on.

Trying Out a Job

After you've built your job, and before you've downloaded it to a device to run it, you'll want to try out the job on the PC, to fine tune it. FrontRunner allows you to try out a step, try out the entire job on one image, or try out the entire job on multiple images.

Note: In the Settings dialog box  , notice the Acquire Images During Try Out option. When this option is checked, FrontRunner loads each image that you specified in the Acquire step, one at a time. If you uncheck this option, and click Try Out Program on PC Once and then Stop repeatedly, your job will run on only the image that is loaded currently.

Downloading a Job

After you've tried out the job and confirmed that it runs as you want it to, you can download it to the device using Download Program from PC to Device.

Saving a Job

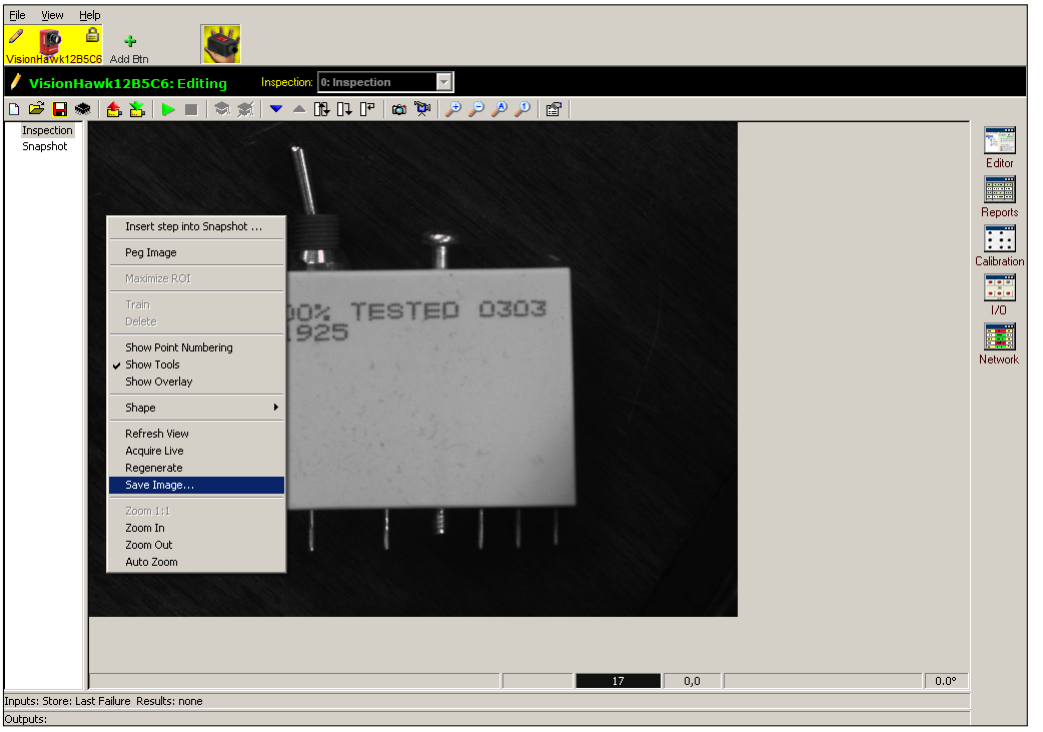
Use the Save Program button to save the current job to disk on the PC. If the job already resides on disk, FrontRunner will simply save the job without displaying the Save Job dialog box. If you want to save the current job with a different name, select File > Save Job As. In the File name text box, type a different name for the job you want to save, and then click Save.

Note: If the current job changes through editing, the Save button is red.

Saving an Image

Right click on the image. In the menu that is displayed (Figure 2–5), select Save Image... to save the current image to the disk on the PC. When the Save As dialog box is displayed, enter a name for the image you are saving.

FIGURE 2–5. Menu Displayed — Save Image



Starting a Job

Start the job on the device by clicking Start Program on Device.

Advanced Concepts

Multiple Views

FIGURE 2–6. **Control Bar, Snap Views, Device View, and Inspection**

Reports

FrontRunner allows you to view up to four inspections at a time. You define what and how information is displayed.

You can add or remove multiple views simply by clicking Snapshot buttons in the Control Bar (Figure 2–6).

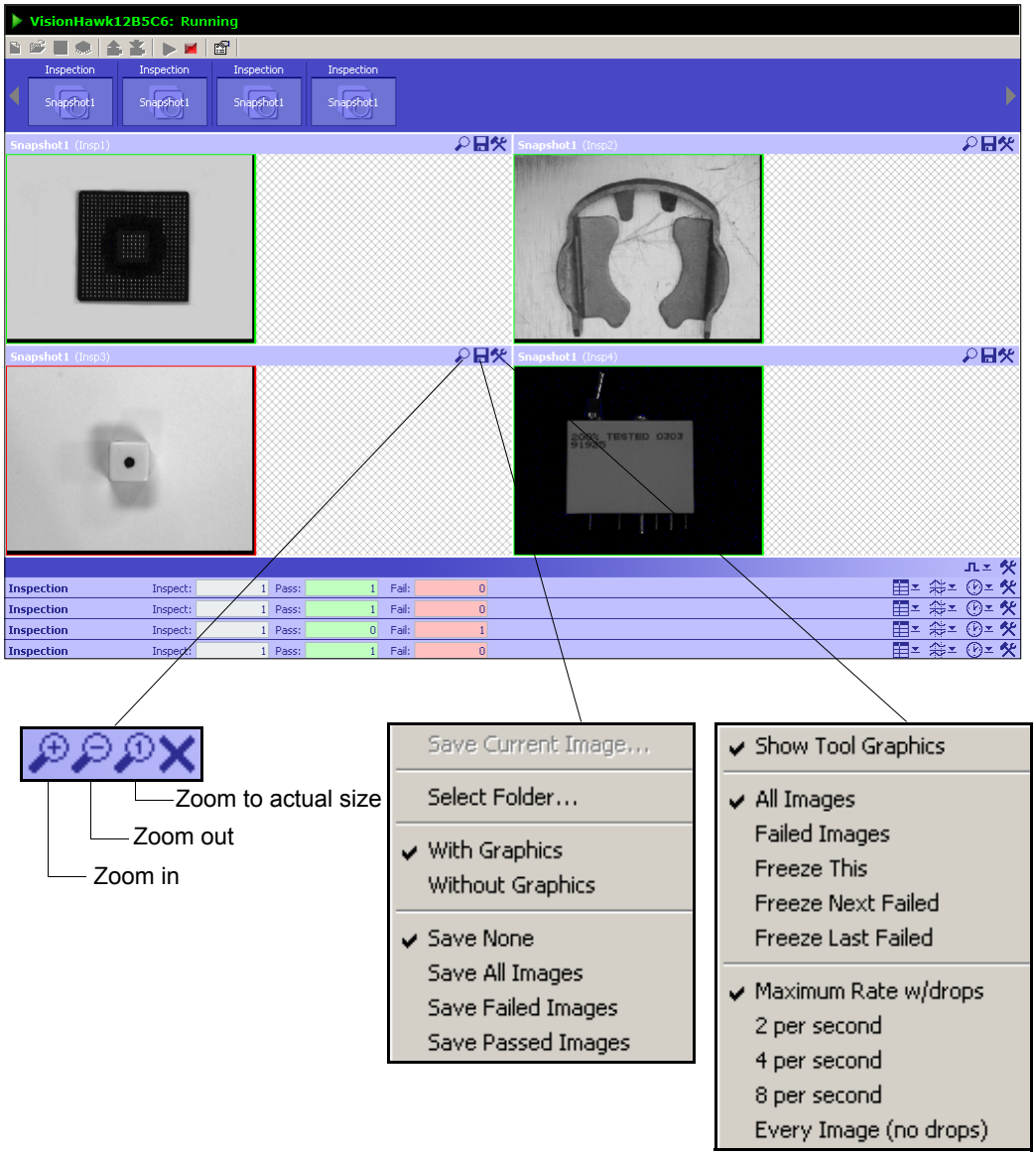
Note: Even though the Image Rate and selectors apply conceptually to a single Snapshot, within the same inspection, all image views share the same rate and selector. The last settings done to any image views applies to all the image views in that Inspection, regardless of which Image view rate and selector was changed.

The FrontRunner window has four major areas in the Runtime view:

- Control Bar — This toolbar allows you to select Inspections with their associated Snapshot (Camera views). There is a Camera view button for the focused Inspection to add/remove Snapshot view while the device (smart camera or GigE Camera) is running. You can select the layout to determine how the views are to be arranged for a particular Inspection. Use the Ctrl key to select multiple Snap Views.
- Snap View Area — This area displays the selected Snapshot views for the Inspection based on the layout you select. You can zoom the image, save graphics, and change the view refresh rate and freeze mode by operating a drop-down menu in the Snapview of interest.
- Inspection View Area — In this area, you can display output datums results and timing information. You can also show results associated with this Inspection.
- Device View — In this area, you operate controls to define a set of I/O buttons and status lights that monitor the device I/O or generate virtual triggers for any Inspections running on the device, either one shot or periodic (you enter the period).

Figure 2–7 shows four Snap views, with zoom buttons and drop-down menus expanded.

FIGURE 2–7. Four Snap Views, Zoom Buttons and Drop-Down Menus



- Save Current Image — Saves the current image as either a .tif file or a .bmp file. You will be prompted to specify a file name. You can specify where the file will be saved.

- Select Folder — Displays the Browse For Folder dialog box, which allows you to specify where images and reports are saved. Use the New Folder button to create a new folder for images and reports.
- With Graphics / Without Graphics — Specifies whether or not you want to include tool graphics with the saved images.
- Save None / Save All Images / Save Failed Images / Save Passed Images — Specifies what images you want to save (if any).
- Show Tool Graphics — By default, FrontRunner displays the tool graphics with the captured image.
- All Images / Failed Images — Specifies what kind of images FrontRunner should display.

Note: Any change you make apply to all snapshots in the Inspection.

- Freeze This / Freeze Next Failed / Freeze Last Failed — Specifies which image FrontRunner should freeze.

Note: Any change you make apply to all snapshots in the Inspection.

- Maximum Rate w/drops / ... / Every Image (no drops) — Specifies the rate at which FrontRunner should display images.

Note: Any change you make apply to all snapshots in the Inspection.

When the image rate is set to Maximum Rate w/Drops or any of the 2, 4, or 8 per second rates, priority is given to the running of the Inspection such that images are sent only when there is enough idle time to do so (for example, while waiting for the next image to be acquired from the camera). If there is little or no idle time, then the Image view may refresh very slowly and appear to either show always the same image or not refresh any image at all. This can happen in the most extreme cases in full pipeline with no idle time left; in this case, the display will freeze for long periods of time. If seeing a “live” image is required, then the avp should be designed to allow for some idle time while still maintaining the inspection rate required by the external triggering source. A special case of this are Software

Systems which do not have Hardware to assist in producing idle time (for example, while the digitizer is sending the image to memory). For this special case, either select the Every Image (no drops) or insert a WaitStep in the avp with a small wait time (let say 10 msec) to allow the image to be rendered on the screen.

Figure 2–8 shows four inspections, with output information displayed for the first inspection.

FIGURE 2–8. Output Information for Inspection 1

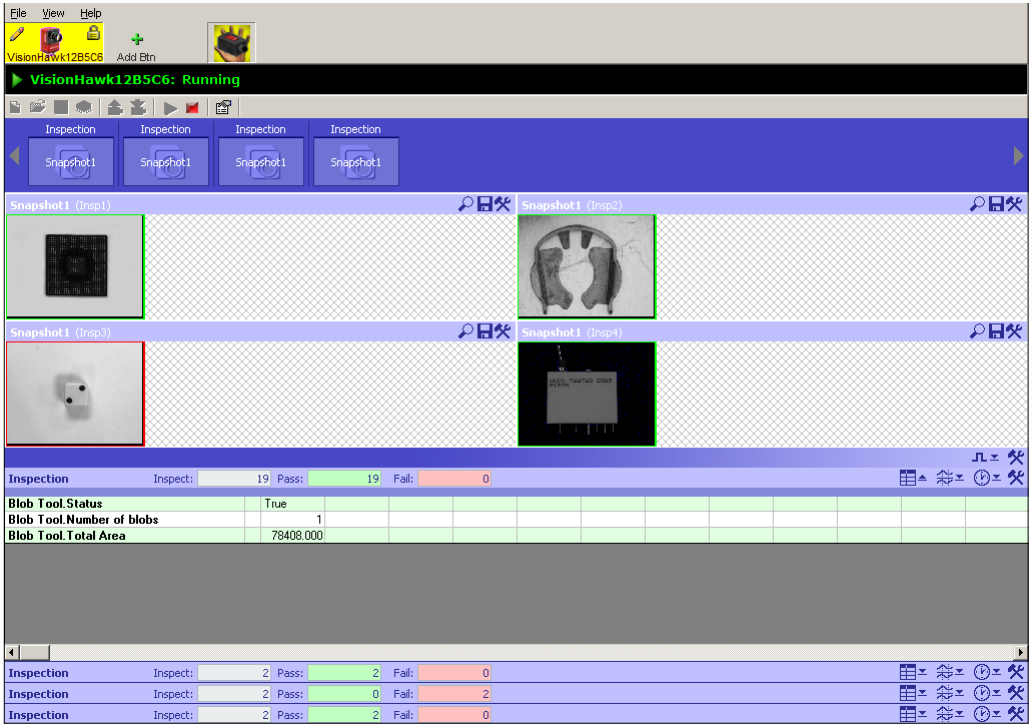


Figure 2–9 shows four inspections, with timing information displayed for the first inspection.

FIGURE 2–9. Timing Information for Inspection 1

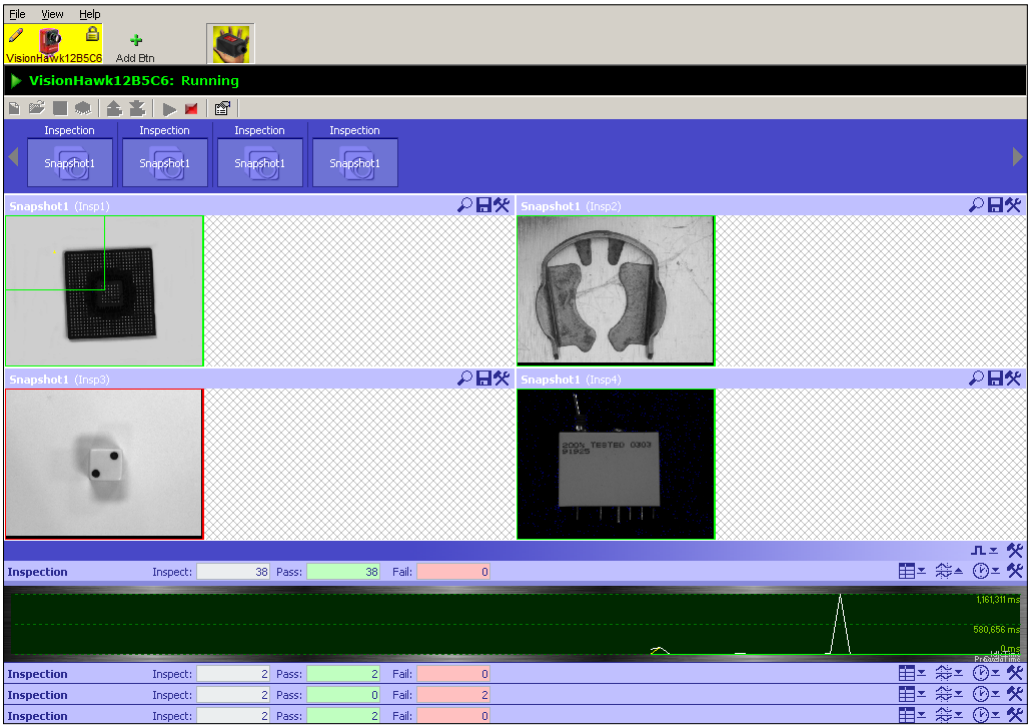
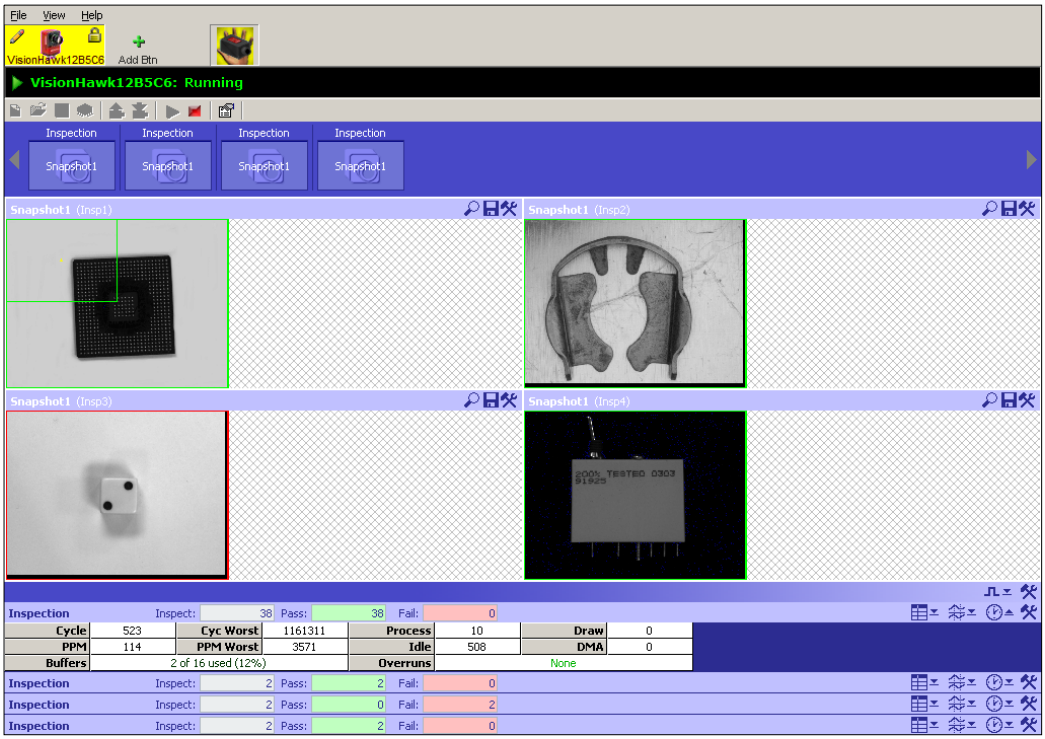


Figure 2–10 shows four inspections, with extended information displayed for the first inspection.

FIGURE 2–10. Extended Information for Inspection 1



Software Systems

Software Systems are full featured devices (Visionscape 7.x supports up to two Software Systems). Software Systems support Load Images from File mode to acquire an image while running in offline mode. Software Systems are not simulators or emulators of a GigE Camera or smart camera. Jobs that run on a Software System use the CPU resources and memory of the host PC. A dongle is required to run jobs on a Software Systems fully; otherwise, the jobs can be loaded or modified and run on a Software System, but they cannot be saved (this is the demonstration mode of Visionscape).

When loading a job created for a supported device, either GigE Camera or smart camera, the job is not changed and can be used as is. When loading a job onto a device, you are prompted to adjust the camera definition if the device is different from the one the job was created on. Warnings that require user action are shown if the I/O assignments are out of range for the device or if the job uses IntelliFind but is loaded on a device that does not support this tool.

Creating jobs for these Systems is the same as creating jobs for other physical devices with the following differences:

- No specific camera definitions for a specific device are programmed into the VisionSystemStep camera channels. The default for Software Systems is Sentech A33. You must change the camera definition in the VisionSystemStep properties page if a different (usually) image size is required, or if your are working offline and plan to load the job later on a physical device.
- By default, the Acquire Tool is programmed to Load Images from File, as there is no digitizer available on a Software System (Image List is empty originally and must be populated also). When loaded on a physical device, you must change the Acquire mode to Acquire from Camera to enable acquisition from the device CCD sensor.

For complete information about the Acquire and the Vision System step, see Chapter 1 of the Visionscape Tools Reference

Displaying I/O Transitions

The I/O Display (Figure 2–11) watches I/O transitions for Physical I/O, Sensors, Strobes, and all 2048 Virtual I/O points. You can also use the green Click to record transitions to a DSS file button to record transitions over time to a DSS file and examine the transitions using the Digital Soft Scope tool (see “Examining I/O Transitions (Digital Soft Scope)” on page 2-26). You can select the Vision System in the list at the top, then connect or disconnect the display using the green Connection button. I/O states are updated in the display as they occur. When an I/O point is asserted, the button turns red. You can also click the button to toggle the I/O point. For GPIO points programmed as inputs as well as for Sensors, clicking the button has no effect. You can display 128 points of the Virtual I/O at one time. Use the Range: list box to select the points you want to display.

Simulating Triggers

Note: For more information about triggers with smart cameras, see the Advanced Triggering Techniques section in Chapter 1 of the Visionscape Tools Reference.

FrontRunner allows you to simulate a trigger in a job for diagnostic purposes.

Use the following procedure to simulate a trigger:

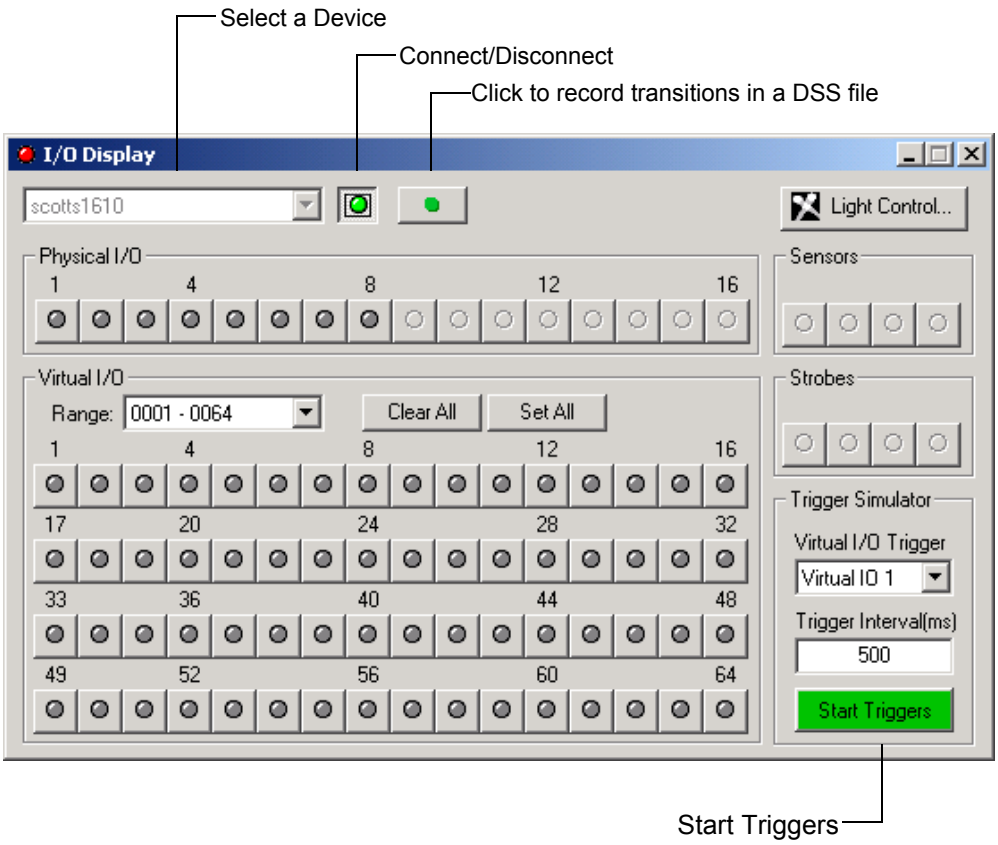
1. Create a new job or open an existing job.
2. Click Editor to display the Editor window.
3. In the left pane, select Acquire.

   Note: You may have to click the Acquire tab.

4. In the right pane, click to the right of the Trigger property.
5. From the leftmost pull-down menu, select Virtual Point.
6. To the right of Virtual Point, select a number. For example, 0001.
7. Close the Editor window.
8. Click the I/O button.

   FrontRunner displays the I/O Display window, as shown in Figure 2–11.

FIGURE 2–11. I/O Display Window



9. In the I/O Display window, select your smart camera.

10. Click Connect/Disconnect.

Note: When the Connect/Disconnect button is green, you are connected.

11. Select the Virtual I/O trigger (lower right hand side of screen) you selected previously in the Acquire properties page.

12. By default, the Trigger Interval is 500 ms.

13. In the FrontRunner window, click Settings.

    FrontRunner displays the Settings dialog box.

14. In the Settings dialog box, click to select Use I/O During Tryout and Use Triggers During Tryout.

15. Close the Settings dialog box.

16. Download the job to the smart camera.

17. Start the job.

18. In the I/O display window, click Start Triggers.

Important Note

When using Virtual I/O points to generate triggers at regular interval, as programmed in the Visionscape IO Display or the FrontRunner RunView IO bar the accuracy of the timing between triggers will depend on the Operating System the avp runs on and also on the number of Virtual I/O points programmed to be triggers. The following information provide guidelines based on Device/OS configurations:

- GigE Cameras and Software Systems — Triggers generated by the avp, IO display and FrontRunner IO bar.
  - Windows XP — Accuracy +/- 5 msec typical, trigger to trigger time increases as more triggers are generated.
  - Windows 2000 — Accuracy +/- 25 msec typical, trigger to trigger time increases as more triggers are generated.

Note: The values above are typical and may vary from PC to PC. Accuracy should be measured/tested first for the particular avp for the particular PC. When greater accuracy than the Device allows is required, physical triggers should be used instead.

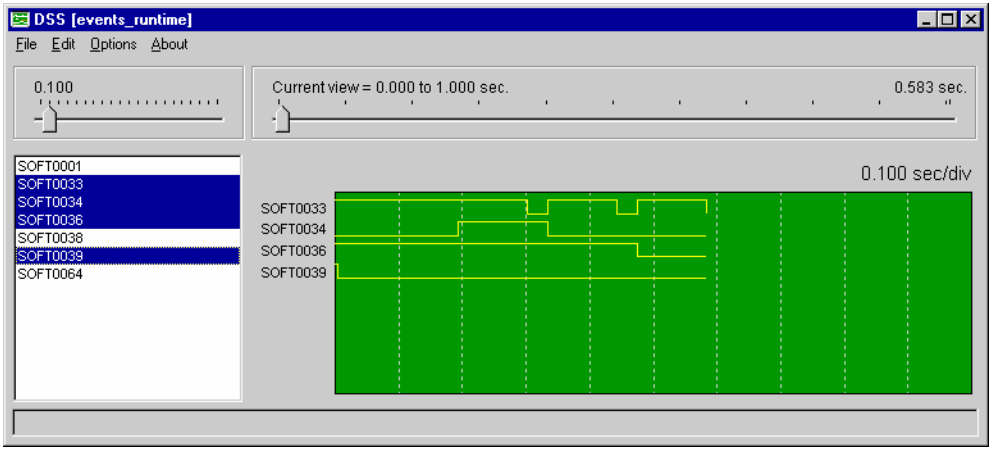
Examining I/O Transitions (Digital Soft Scope)

Digital Soft Scope examines I/O transitions recorded in a DSS file:

1. From the FrontRunner View menu, click Digital Soft Scope.
2. From the DSS File menu, select Open.
3. Select a DSS file (*.dss) and click Open.

   A window similar to the one in Figure 2–12 is displayed:

FIGURE 2–12. Digital Soft Scope Main Window



The resulting signal trace can be viewed graphically as a timing diagram useful for analyzing I/O timing and interaction.

To modify the time slice of the trace view, adjust the slider bar located at the top left. This changes the number of seconds per division in the view. Adjusting the Current View slider bar to the right scrolls the view window to display the signals in different time segments. The time segment and the total time of the recorded signals are displayed above this slider. A summary of transitions, or trace statistics, of each signal can be obtained by clicking on the name of that signal in the signal list. Clicking the right mouse button provides additional capabilities including time measurement, zooming, redrawing, and removal of signals. Once a signal is removed, you can add it to the trace again by clicking on that signal name in the signal list.

One of the most useful features of the Digital Soft Scope tool is the ability to measure signal lengths and time between transitions. A click in the signal window enables the measuring tool, which appears as a pair of white dotted lines that can be moved independently. When the lines are positioned, the time difference represented by the distance between them is displayed at the bottom of the main window. This time is continuously adjusted as the tools move.

Camera Calibration

For complete information about calibrating your camera, see Chapter 3, “Camera Calibration”.

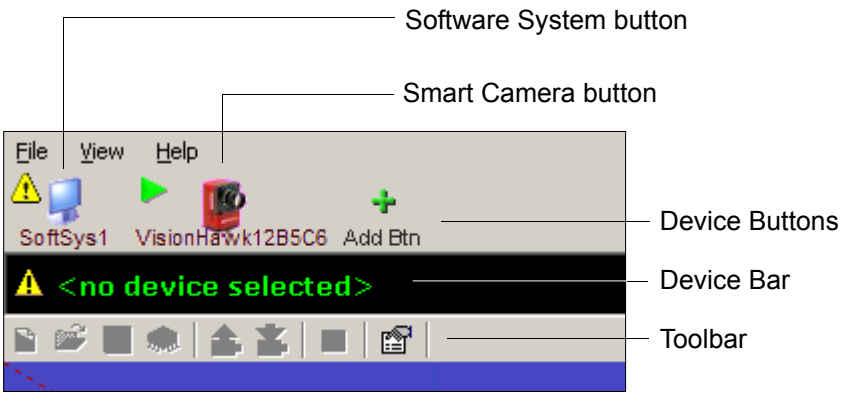
The Part Queue

For complete information about the Part Queue, see Chapter 4, “The Part Queue”.

Windows You'll See in FrontRunner

The Main FrontRunner Window

FIGURE 2–13. Main FrontRunner Window



This is the main FrontRunner window. Take a couple of moments to familiarize yourself with it. Notice the following:

- Device Buttons — This area contains device buttons for Software Systems, Visionscape GigE Cameras, and smart cameras on the network:
  - You can add and delete buttons for Software Systems:

    Note: You can start the AvpBackplane directly by selecting Start > Visionscape > Visionscape Backplane.

    To **add** a Software System button, first start and then exit FrontRunner. Right click on the VS tray icon. Click Display AvpBackplane. The Visionscape AvpBackplane dialog box is displayed. Click Add. Type in a name for the Software System and click OK. When you restart FrontRunner, the Software System button will be displayed in the Device Button area of FrontRunner (Figure 2–13).

    To **delete** a Software System button, right click on the VS tray icon. Click Display AvpBackplane. The Visionscape

AvpBackplane dialog box is displayed. Highlight the name of the Software System you want to delete. Click Remove, then Yes, and finally OK.

– You cannot add or delete buttons for the vision GigE Camera; this is done automatically.

– You can add and delete smart camera buttons. To add a smart camera button, click Add Button. FrontRunner displays the Select Device dialog box. Highlight (to select) a smart camera, and click OK. FrontRunner adds the button.

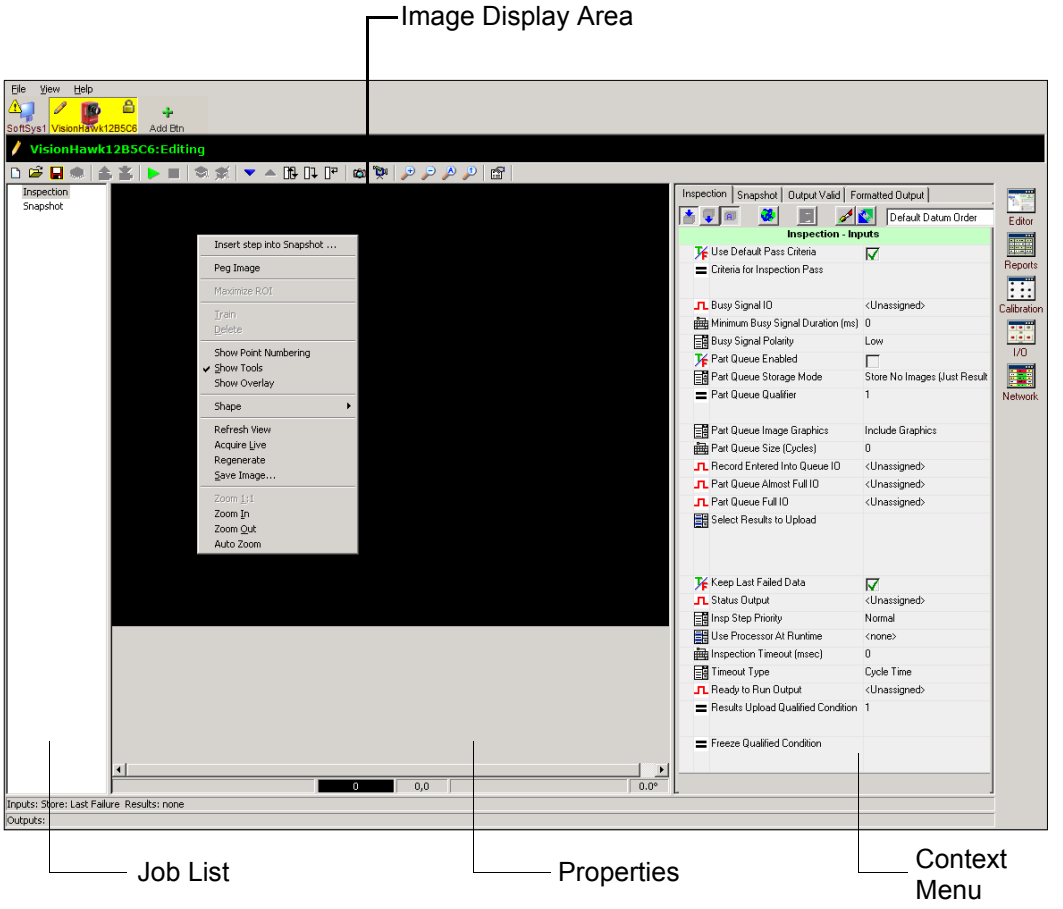
Note: A red diskette in a device button indicates that the current job on the device has been changed through editing.

- Device Bar — This area contains icons and messages that display information about devices to which you are connected:
  -  <no device selected>
  -  <device> Live Video
  -  <device> Editing
  -  <device> Tryout Mode
  -  <device> Running
  -  <device> Stopped
  -  FrontRunner is performing some operation (please wait)
- Toolbar — This dynamic toolbar contains icons for FrontRunner tools

The Setup Window

FrontRunner displays the Setup window after you click Create New Program or Open Existing Program. This is where you set up the focus and lighting, etc., for the camera before you acquire a new image. Take a couple of moments to familiarize yourself with the window.

FIGURE 2–14. Setup Window



Notice the button for the smart camera. This icon indicates the following:

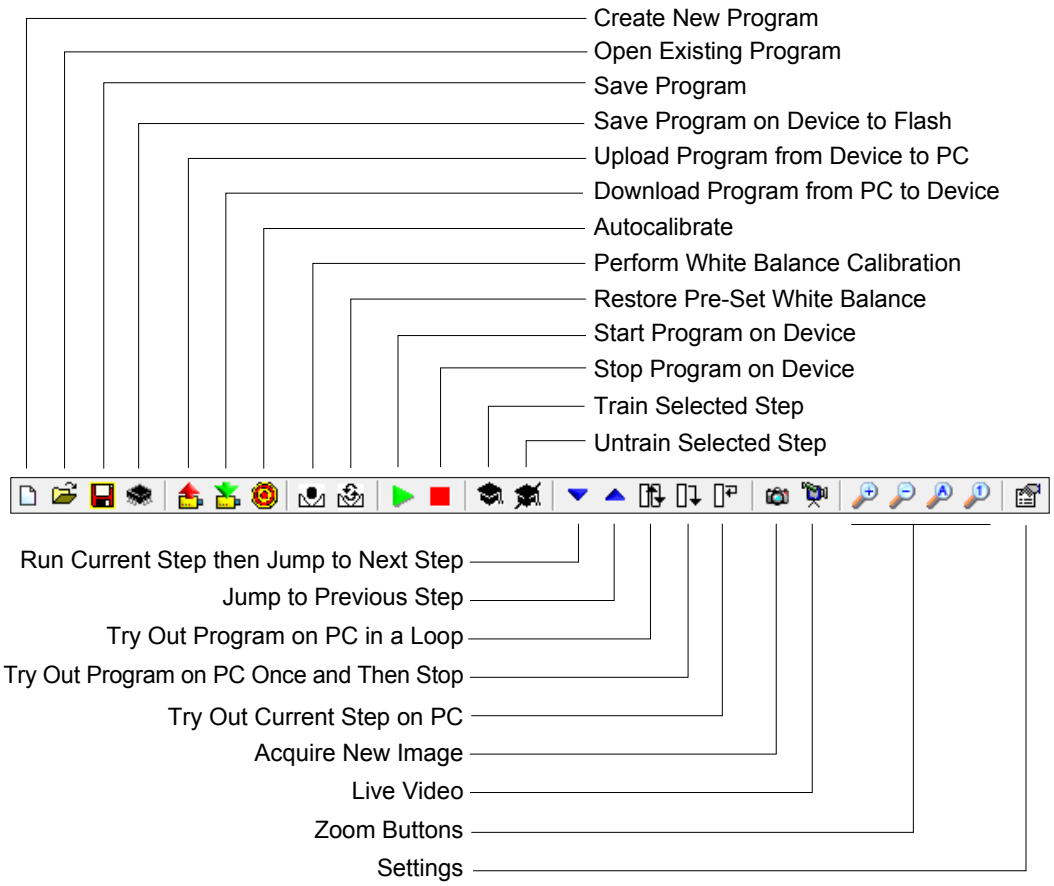
- The yellow background indicates that you have control of the smart camera

- The pencil indicates that the job on the PC is being edited
- The red diskette indicates that the current job on the device has been changed through editing
- The padlock indicates to users on the network that the smart camera is controlled

Setup Window Toolbar Buttons

The Setup Window Toolbar buttons are shown in Figure 2–15:

FIGURE 2–15. Setup Window Toolbar Buttons



- Create New Program — After you click this button, FrontRunner displays the Setup window (Figure 2–14).

- Open Existing Program — Opens a job that was previously saved to disk.
- Save Program — Saves the current job to disk on the PC. If the job already resides on disk, FrontRunner will simply save the job without displaying the Save Job dialog box. If you want to save the current job with a different name, select File > Save Job As. In the File name text box, type a different name for the job you want to save, and then click Save.

  Note: If the current job changes through editing, the Save button is red.

- Save Program on Device to Flash Memory — Saves the current job on the camera to Non-Volatile memory. You can only flash the smart camera when it is stopped. This operation takes some time.

  Note: Do not perform Save Program on Device to Flash Memory often (as a replacement for job changeover, for example).

- Upload Program from Device to PC — Uploads the current job on the camera to the PC.
- Download Program from PC to Device — Downloads the current job from the PC to the camera.
- Autocalibrate — Configures the camera's focus, exposure, and gain.
- Perform White Balance Calibration (Color Cameras Only) — Equalizes color channel gain such that white objects appear white.
- Restore Pre-Set White Balance (Color Cameras Only) — Returns color channel gain to factory preset.
- Start Program on Device / Stop Program on Device — Use these buttons to start and stop the current job.
- Train Selected Step — Some tools (like the Barcode Tool and the Data Matrix Tool) can be trained. When you train a tool, you are "telling" the tool what to expect when it reads an image. For example, if you train the Data Matrix tool to read a Data Matrix with 12 rows and 12 columns, the Data Matrix tool will fail when it encounters a Data Matrix with 16 rows and 16 columns. You will know a tool needs to be trained when you see:
  - A red x to the left of the tool name
  - The red Train button
- Untrain Selected Step — Just as some tools (Barcode and Data Matrix) need to be trained, those same tools may need to be

untrained when you want them to read a part that differs from the part they have been reading. For example, if you train a Data Matrix tool to read a Data Matrix with 8 rows and 32 columns, it will not read a Data Matrix with 16 rows and 16 columns until you untrain the tool. Use the following procedure to untrain a Data Matrix tool:

a. Highlight the Data Matrix tool in the left window pane.

b. Click Untrain. Now, you can train the tool to read a new part, or leave it "opened up" to read any Data Matrix.

- Run Current Step then Jump to Next Step / Jump to Previous Step — Use these buttons to walk through the Setup List and train/execute each trainable tool.
- Try Out Program on PC in a Loop — Runs the job on the PC until you click this button again.
- Try Out Program on PC Once and Then Stop — Runs the job on the PC once and then stops.
- Try Out Current Step on PC — Runs the current step on the PC.
- Acquire New Image — Acquires a new image.
- Live Video — Allows you to see exactly what the camera is seeing in real time. This makes it easier for you to adjust focus and lighting to get the best image possible.

Note: If the camera acquisition is triggered in the avp, Live Video will be triggered also. This behavior can be turned off in Tryout mode only from the Tryout Options dialog box in the case where triggers cannot be fed to the system during Live Video.

- Zoom In — Makes the image larger.
- Zoom Out — Makes the image smaller.
- Zoom To Fit Window — Sizes the image to fit the window.
- Zoom 1:1 — Displays the image in its actual size.
- Settings — Contains the following tabs:

– Edit — FrontRunner allows you to specify what action(s) will take place after you change a step or during tryout.

  • Automatic Run Step after Change — When checked, FrontRunner automatically runs the step after a change is made to its ROI or properties. By default, this is checked.

  • Acquire Images During Tryout — In Tryout mode, when this option is checked, FrontRunner loads each image that you specified in the Acquire step, one at a time. If you uncheck this option, and click Try Out Program on PC Once and Then Stop repeatedly, your job will run on only the image that is loaded currently.

  • Use I/O During Tryout — Enables/disables I/O during tryout.

  • Use Triggers During Tryout — Enables/disables triggers when running a tryout.

  • Automatic Train Step after Change — When checked, FrontRunner automatically trains (when appropriate) the step after a tool is inserted, moved, or resized.

  • Delay Between Steps in Tryout — When checked, FrontRunner slows down the “action” by adding a delay between each tool so that you can see specific tool activity.

  • Show Properties — Allows you to specify where a tool’s properties page is displayed in Tryout View:

    – Hide

    – Below View (default)

    – Right of View

– Timing — FrontRunner allows you to enable or disable (default) the uploading of timing data. To enable step timing:

  a. Create a new job or load an existing job onto your PC.

b. Click on the Settings button:

Settings

c. In the Settings dialog box, click the Timing tab, and then click on the Enable Step Timing check box.

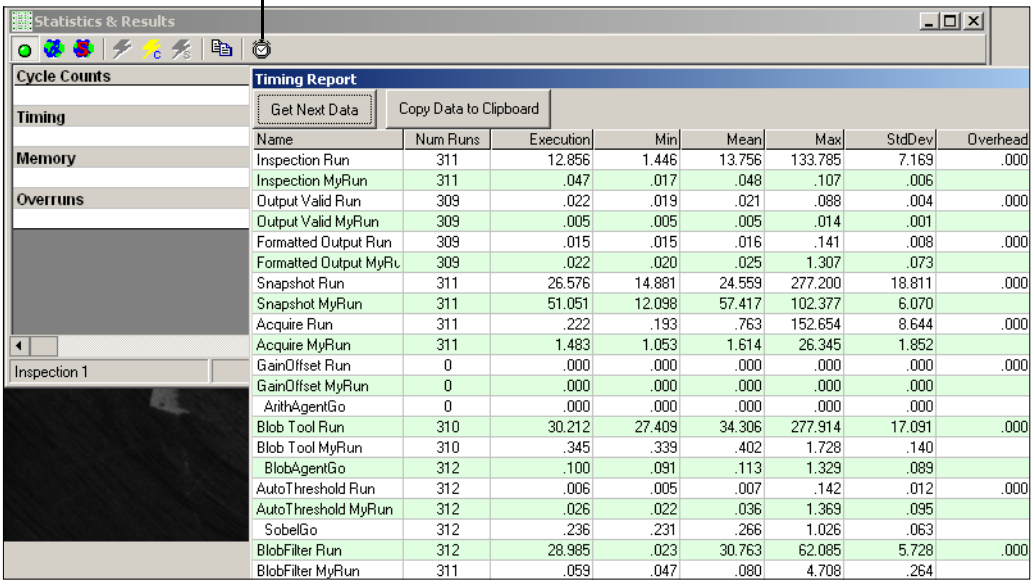
d. Close the Settings dialog box.

e. Try Out your job by clicking Try Out Program on PC in a Loop:

Try Out Program on PC in a Loop

f. Click the Reports button to display the Statistics and Results window. Notice that FrontRunner has added the Show Timing Report button to the Statistics and Results window. Click the Show Timing Report button to display the Timing Report:

Show Timing Report



Name	Num Runs	Execution	Min	Mean	Max	StdDev	Overhead
Inspection Run	311	12.856	1.446	13.756	133.785	7.169	.000
Inspection MyRun	311	.047	.017	.048	.107	.006	
Output Valid Run	309	.022	.019	.021	.088	.004	.000
Output Valid MyRun	309	.005	.005	.005	.014	.001	
Formatted Output Run	309	.015	.015	.016	.141	.008	.000
Formatted Output MyRu	309	.022	.020	.025	1.307	.073	
Snapshot Run	311	26.576	14.881	24.559	277.200	18.811	.000
Snapshot MyRun	311	51.051	12.098	57.417	102.377	6.070	
Acquire Run	311	.222	.193	.763	152.654	8.644	.000
Acquire MyRun	311	1.483	1.053	1.614	26.345	1.852	
GainOffset Run	0	.000	.000	.000	.000	.000	.000
GainOffset MyRun	0	.000	.000	.000	.000	.000	
ArithAgentGo	0	.000	.000	.000	.000	.000	
Blob Tool Run	310	30.212	27.409	34.306	277.914	17.091	.000
Blob Tool MyRun	310	.345	.339	.402	1.728	.140	
BlobAgentGo	312	.100	.091	.113	1.329	.089	
AutoThreshold Run	312	.006	.005	.007	.142	.012	.000
AutoThreshold MyRun	312	.026	.022	.036	1.369	.095	
SobelGo	312	.236	.231	.266	1.026	.063	
BlobFilter Run	312	28.985	.023	30.763	62.085	5.728	.000
BlobFilter MyRun	311	.059	.047	.080	4.708	.264	

- Windows Toolbar — This toolbar is displayed only when you are connected to a device that is stopped and a job is loaded into FrontRunner for editing. This area contains buttons for the following tools:

  – 

Editor (see “The Editor Window” on page 2-39)

  – 

Reports (see “The Reports Window” on page 2-41)

  – 

Calibration (see Chapter 3, “Camera Calibration”)

  – 

I/O (see “The I/O Display Window” on page 2-44)

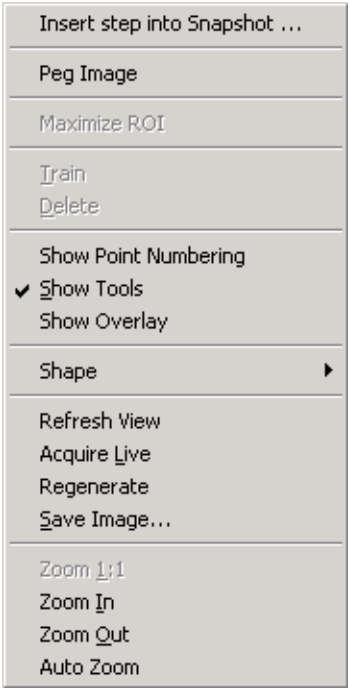
  – 

Network (see “The Network Overview Window” on page 2-44).

The Context Menu

To display the context menu, right click on the image display area.

FIGURE 2–16. Context Menu



- Insert Step Into Snapshot... — Opens up the Insert Tool Dialog Box into the Snapshot tool. The tool position will be defaulted towards the top-left of the image with size 100x100.

  Note: If this menu option is selected while the mouse is inside a tool in the Image, a new menu entry is available: "Insert Step into <current tool>...".

- Peg Image — In Try Out in a Loop or Try Once "pegs" the image currently being displayed so that any sub-image of other tools are not displayed in succession while the avp runs.
- Maximize ROI — Makes the current Step ROI be the size of the image it is in.
- Train — Same as the Toolbar Button Training Hat if the selected tool (i.e., ROI) is a trainable tool.

- Delete — Same as Step Editor Delete button for the currently selected tool (i.e., by its ROI).

Note: Not all tools can be deleted this way as some tools in the avp have no ROI and are not visible in the image.,

---

- Show Point Numbering — Number the vertices of the ROI. Clicking on these special points allows the ROI shape to be changed; clicking elsewhere simply moves the ROI.
- Show Tools — Hide all the Tools ROIs so that the image (with results graphics if the tools have run) can be seen without their clutter underneath.
- Show Overlay — If Custom VB code has written in the overlay for this image, these additional typically non-tool graphics can be hidden or shown on the image.
- Shape > Hide Current Shape — Add the current Tool ROI. This tool ROI can no longer be selected or changed.

Note: More than one ROI can be hidden this way.

- Shape > Show All — Restore all the ROIs so that they all appear again and can be edited with the mouse.
- Shape > Zoom To Shape — Zooms the image such that the selected ROI occupies the entire viewing area.
- Refresh View — Repaints the current image (including graphics).
- Acquire Live — Same as LiveVideo button in toolbar.
- Regenerate — If the image being displayed on the screen is the output of an Image Processing tool (i.e., Morphology, Sobel, etc.), then Regenerate takes a new Picture and runs the Image Processing tool to show the resulting output image.
- Save Image... — Saves the current Image in TIFF format with no graphics to disk. You are prompted for a file name and location.
- Zoom In — Makes the image larger.

- Zoom Out — Makes the image smaller.
- Zoom To Fit Window — Sizes the image to fit the window.
- Zoom 1:1 — Displays the image in its actual size.

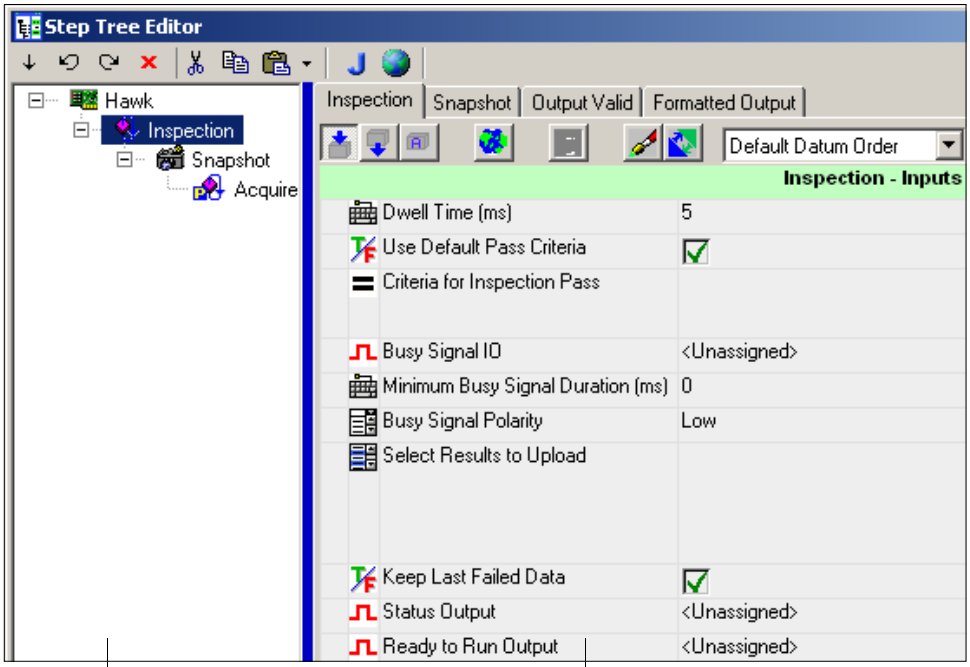
Saving an Image

Right click on the image you want to save. In the Context menu, select Save Image... to save the current image to the PC. When the Save As dialog box is displayed, enter a name for the image you are saving.

The Editor Window

FrontRunner displays the Editor window after you click Editor. This is where you adjust properties for a step or tool. Take a couple of moments to familiarize yourself with the window.

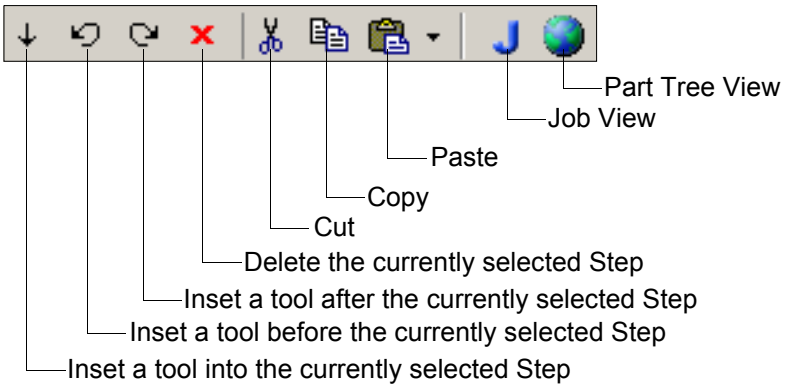
FIGURE 2–17. Editor Window



Editor Window Toolbar Buttons

The Editor window contains the following buttons:

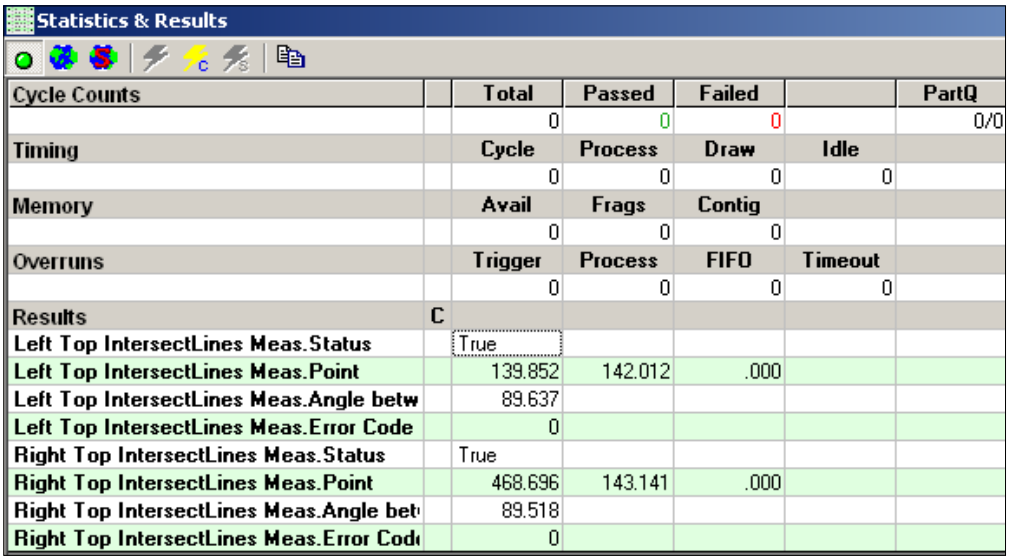
FIGURE 2–18. Editor Window Buttons



- Insert a tool (into, before, after) the currently selected Step — After you click one of these buttons, FrontRunner displays the Insert Step dialog box. Highlight the tool you want to insert and click OK. FrontRunner inserts the tool into the job.
- Delete the currently selected Step — FrontRunner deletes the currently selected step. FrontRunner will display a dialog box to which you must respond. Click Yes to delete the selected step; otherwise, click No.
- Cut — FrontRunner cuts the currently selected step. FrontRunner will display the Delete Step dialog box. To cut the selected step, click OK; otherwise, click Cancel.
- Copy — FrontRunner copies the currently selected step.
- Paste — FrontRunner pastes the currently selected step. The drop down menu contains the following items:
  - Paste Into
  - Paste Before
  - Paste After
- Job View — Displays all the Vision System Steps you have loaded.
- Part Tree View — Displays advanced parameters for calibration.

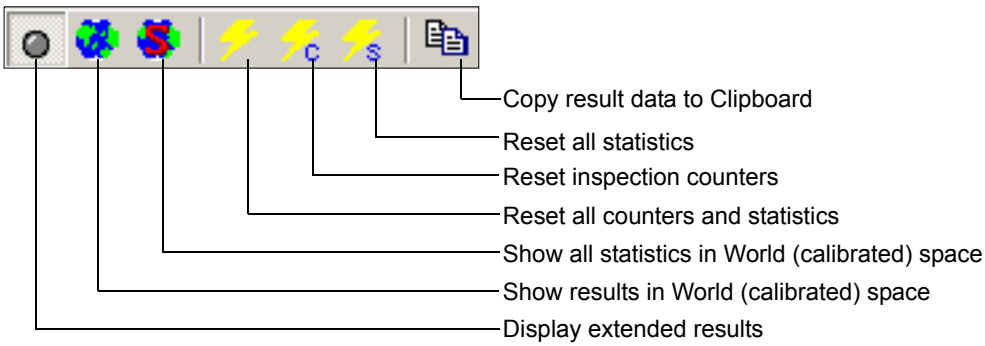
The Reports Window

FIGURE 2–19. Reports Window



This window displays the results that you selected for upload in the Inspection Step's Select Results to Upload datum. It displays inspection counts, overruns, and memory statistics. The Reports window contains the following buttons:

FIGURE 2–20. Statistics and Report Window Buttons



Button Descriptions

- Display Extended Results — This LED turns green if the inspection passed, and red if the inspection failed.
- Show results in World (calibrated) space — Shows results in a world coordinate versus a pixel coordinate system.
- Show all statistics in World (calibrated) space — Shows statistics in a world coordinate versus a pixel coordinate system.
- Reset all counters and statistics — Resets both the counters and the statistics to zero.
- Reset inspection counters — Resets only the counters to zero.
- Reset all statistics — Resets only the statistics to zero.
- Copy result data to Clipboard — Copies the data to the Clipboard as tab-delimited text.

Statistics

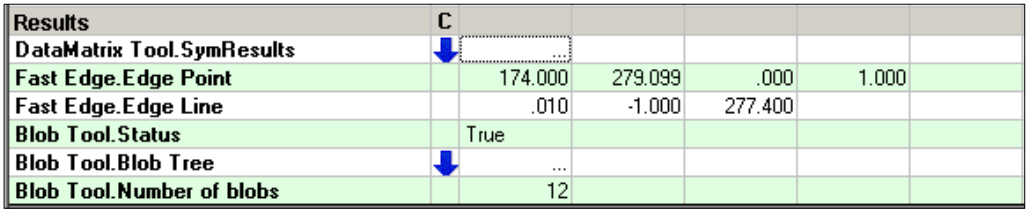
- Cycle Counts — Displays the total number of inspection cycles so far, as well as the number of passed and failed inspections. The “PartQ” column is only relevant if you have activated the Part Queue (see Chapter 4, “The Part Queue”) in your inspection. It displays the current number of entries in the Queue, and the maximum size of the Queue. So, if you’ve set the size of the Queue to be 20, and there are currently 5 entries in it, then “5/20” is displayed.
- Timing — Displays timing information on the last inspection cycle. All times are in milliseconds.
  - Cycle — Time between triggers.
  - Cycle Worst — Worst time between triggers.
  - Process — Actual time spent processing the image. This will not include image acquisition time in a standard triggered job.
  - Draw — Time spent rendering graphics.
  - PPM — Number of parts per minute.

  - PPM Worst — Worst number of parts per minute.
  - Idle — Amount of time within the cycle during which the inspection was doing nothing. When your Idle time is at or very close to 0, that is telling you that you are getting close to overrunning.

- Overruns — The total number of overruns that have occurred so far.

Results Section

FIGURE 2–21. Results

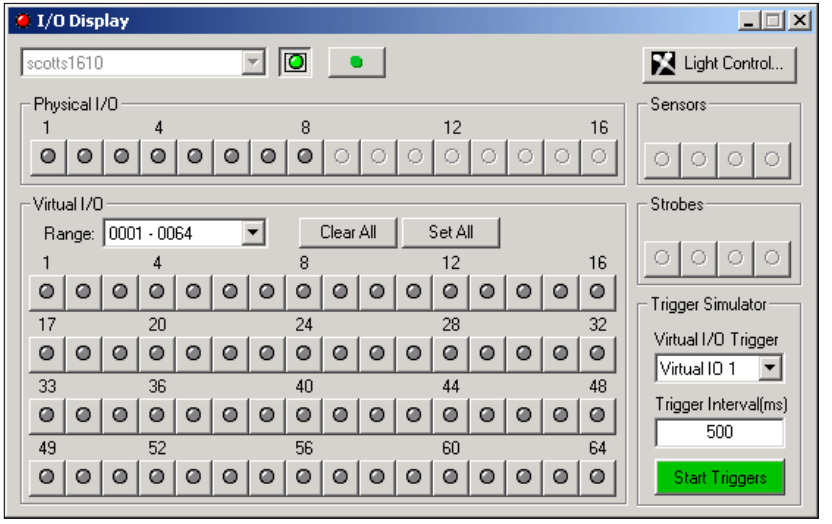


Results	C					
DataMatrix Tool.SymResults		...				
Fast Edge.Edge Point		174.000	279.099	.000	1.000	
Fast Edge.Edge Line		.010	-1.000	277.400		
Blob Tool.Status		True				
Blob Tool.Blob Tree		...				
Blob Tool.Number of blobs		12				

The results that you select for upload are displayed here. The name of the Step and datum are displayed in the left-most column, and the actual result data is displayed in the columns to the right. Most results in Visionscape are returned as either a single value (a distance, a tool status, the number of blobs, etc.), or as a one-dimensional array (a point, a line, etc.). These values are displayed immediately in the dialog. Some results are returned as two-dimensional arrays. We refer to these as "Complex Datums". When a Complex Datum is in the result list, we will not attempt to display its results every time. However, in the column labeled with a "C" (for Complex) you will see an arrow icon displayed. In the example above, you will notice the blue arrow next to the Data Matrix Tool's SymResults datum, and the Blob Tool's "Blob Tree" datum. If you wish to view the data for a complex result, simply click on the arrow, and it will expand the grid to show you the data.

The I/O Display Window

FIGURE 2–22. I/O Display Window



This window watches I/O transitions for Physical I/O, Sensors, Strobes, and all 2048 Virtual I/O points. You can also use the green Click to record transitions to a DSS file button to record transitions over time to a DSS file and examine the transitions using the Digital Soft Scope tool. You can select the Vision System in the list at the top, then connect or disconnect the display using the green Connection button. I/O states are updated in the display as they occur. When an I/O point is asserted, the button turns red. You can also click the button to toggle the I/O point. For GPIO points programmed as inputs as well as for Sensors, clicking the button has no effect. You can display 128 points of the Virtual I/O at one time. Use the Range: list box to select the points you want to display.

When using Virtual I/O points to generate triggers at regular interval, as programmed in the Visionscape IO Display or the FrontRunner RunView IO bar or from within the avp itself with an IO Inspection, the accuracy of the timing between triggers will depend on the Operating System the avp runs on and also on the number of Virtual I/O points programmed to be triggers. The following information provides guidelines based on Device/OS configurations:

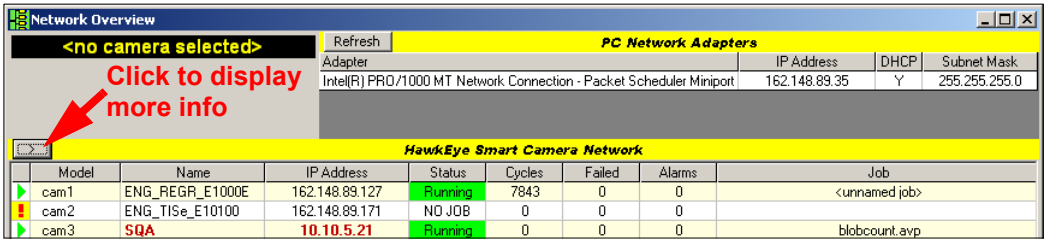
- Smart Cameras — Accuracy < 1 msec, independent of the number of virtual triggers generated by the avp. Trigger to trigger time depends on relative priority of Inspection.
- GigE Camera and Software Systems — Triggers generated by the avp, IO display and FrontRunner IO bar.
  - Windows XP — Accuracy +/- 5 msec typical, trigger to trigger time increases as more triggers are generated.
  - Windows 2000 — Accuracy +/- 25 msec typical, trigger to trigger time increases as more triggers are generated.

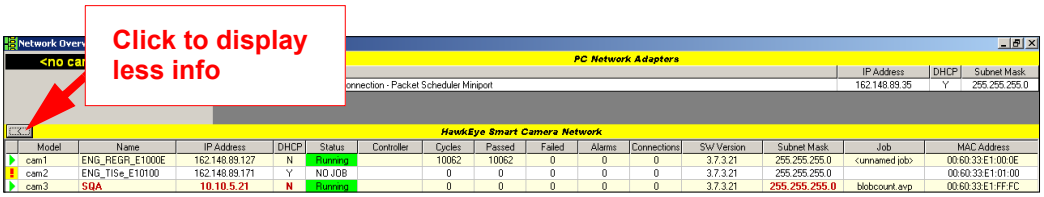
Note: The values above are typical and may vary from PC to PC. Accuracy should be measured/tested first for the particular avp for the particular PC. When greater accuracy than the Device allows is required, use physical triggers.

The Network Overview Window

You can display the Network Overview window in either of the following ways:

- From FrontRunner, select View > Network Overview.
- From the deskstop, select Start > Programs > Microscan Visionscape > Tools > Visionscape Network Browser.





The Network Overview window lists PC adapters and smart cameras on the network that the client PC can reach.

- Black text in the Name indicates that the client PC can reach a smart camera and connect to it.
- Red text in the Name indicates that the client PC can reach a smart camera but cannot connect to it. Such a device is on the same physical network as the client but its IP settings (IP address and network mask) are incompatible with the client PC, preventing any point-to-point TCP communication link.
- You can adjust the width of columns (one at a time).
- You can sort data by clicking on a column heading.

The Network Overview window displays information about GigE Cameras and smart cameras on the network (notice the < and >):

- Model — Is one of the following:
  - Smart Camera (can only monitor; jobs cannot be downloaded using Visionscape 7.x.)
  - Smart Camera standard resolution
  - Smart Camera high resolution
  - Smart Camera standard resolution with IntelliFind
  - Smart Camera high resolution with IntelliFind
- Name — The name of the smart camera
- IP Address — The IP address of the smart camera
- DHCP — Is either of the following:
  - Y — The smart camera is using dynamic IP addressing
  - N — The smart camera is using static IP addressing
- Status — The status of the smart camera
- Controller — The IP address of the PC that is controlling the smart camera
- Job — The name of the job that is loaded on the smart camera

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Note: For the job name to be displayed in the Network Overview window, you must first save the job to disk, then download it to the smart camera.

- Cycles — The total number of cycles
- Passed — The number of cycles that passed
- Failed — The number of cycles that failed
- Alarms — The total number of alarms
- Connections — The number of connections to the smart camera
- SW Version — The version of the software running on the smart camera
- Subnet Mask — The subnet mask of the smart camera
- MAC Address — The MAC address of the smart camera

Changing a Camera's Name

Note: You will need the user name and password for the camera whose name you want to change.

From the Network Overview window, you can change the name of the smart camera over Ethernet without a serial connection and HyperTerminal. This change is dynamic and does not require you to reboot the smart camera.

Use the following procedure to change the camera name:

1. Select View > Network Overview.

   FrontRunner displays the Network Overview window.

2. Click on the name of the camera whose name you want to change.

   FrontRunner displays the Change Network Settings button.

3. Click Change Network Settings.

   FrontRunner displays the Camera is Selected dialog box.

4. Click Yes.

5. Enter a user name.

   FrontRunner displays the Change Network Settings dialog box.

6. Double click (to highlight and select) the original camera name.

7. Type in a new name for the camera.

8. Click OK.

   FrontRunner changes the original camera name to the new camera name.

Changing a Camera's IP Settings

Note: You will need the user name and password for the camera whose IP settings you want to change.

From the Network Overview window, you can change the IP Settings (Static IP or DHCP) of the smart camera over Ethernet without a serial connection and HyperTerminal. After the changes, the smart camera will reboot automatically.

Use the following procedure to change the IP settings:

1. Select View > Network Overview.

   FrontRunner displays the Network Overview window.

2. Click Change Network Settings.

   FrontRunner displays the Change Network Settings dialog box.

3. Do either of the following:

   a. If a DHCP server is available on the same physical network as the device, then select Obtain an IP address automatically.

      Note: The smart camera may take up to one minute to acquire a new IP address.

   b. If no DHCP server is available, select Use the following IP address, and fill in the IP address and Subnet mask for the device.

      Note: Make sure the IP address and Subnet mask are compatible with one of the adapters in the PC.

4. Click OK.

   FrontRunner displays the “Login to device” dialog box.

5. Enter the user name and password for the camera.

6. Click OK.

   The smart camera reboots automatically, and the changes take effect.

Changing a Camera’s Password

Note: You’ll need the user name and password for the camera whose password you want to change.

Use the following procedure to change a camera’s password:

1. Start FrontRunner by clicking Start > Visionscape > Visionscape FrontRunner.

2. Click on the name of the camera whose password you want to change.

3. Click Take Control.

   FrontRunner displays the Login to Device dialog box.

4. Enter the user name for the camera.

5. Click OK.

Notice that the Take Control button changes color and becomes the Release button.

6. Right click on the Release button and highlight Change User ID and Password.

   FrontRunner displays the Change User Name and Password dialog box.

7. In the Password text box, type the new password for the camera

8. In the Confirm Password text box, re-type the new password for the camera.

9. Click OK.

   The camera's password has been changed.

Menus You'll See in FrontRunner

File Menu

The File menu contains the following menu items:

- New Job — Displays the Setup window.
- Open Job — Opens a job that was previously saved to disk.
- Close Job — Closes the current job.
- Upload Job — Uploads the current job on the camera to the PC.
- Save Job — Saves the current job to disk on the PC. If the job already resides on disk, FrontRunner will simply save the job without displaying the Save Job dialog box. If you want to save the current job with a different name, select File > Save Job As. In the File name text box, type a different name for the job you want to save, and then click Save.
- Save Job As — Allows you to save the current job to disk on the PC and give the job another name. FrontRunner displays the Save As dialog box. Specify a name and click Save.
- Dump Job to Text File — Creates a text file containing a listing of each loaded Vision System. After you select this menu item, FrontRunner displays the Save Vision System Tree as Text dialog box. Specify a name for the text file and click Save.
- Show Job Info — Displays the header information for a job:
  - Job name
  - Version of the software used to create the job
  - Total objects
  - Total steps
  - File type
  - Digitizer type

- Configure Device — Displays a dialog box containing tabs for the following:
  - Serial Ports — The COM ports are indexed to the target platform's available UARTs. The default is NONE, which will construct the output string datum but not transmit the result on any port.

    After you select Configure Device, FrontRunner displays the Configure dialog box. Configure the various parameters, then click Apply and then OK.

    Note: For smart cameras, the serial ports are named RS232-<Number>. For example, the smart camera single serial port is called RS232-1.
  - TCP Ports — The TCP ports are indexed according to the port settings specified in the Configure Device dialog box. For example, if Starting Serial TCP Port is 49211, then selecting TCP1 will output on port 49211, TCP2 on port 49212, etc. The default is NONE, which will construct the output string datum but not transmit the result on any port.

    After you select Configure Device, FrontRunner displays the Configure dialog box. Click the TCP Ports tab. Type in the appropriate information, then click Apply and then OK.

    Range: 2000 - 5000 and 49210 - 49500
- Options — Displays a dialog box containing tabs for the following:
  - Runtime
    - PC Runtime Priority — This setting is used when FrontRunner is running a vision application. When the application starts, the runtime priority of the process is changed using this setting. The options are "Normal", "High", and "Realtime".

      Note: You must be logged into an account that has access rights to change the process setting accordingly. By default, only Administrators and Power Users have this right. It can be changed for Windows XP in the Control Panel > Administrative Tools > Local Security Policy console. In the

console, select the Local Policies group, and then User Rights Assignments. You'll need to add your user account to the "Increase scheduling priority" setting if you are not running as an Administrator.

– Reports — From this page, you can set the start-up options for the report and decimal accuracy:

  • Number of x decimal places — Use this option to set the decimal accuracy of floating-point values in the report. The default is 3 for pixel decimal places; the default is 5 for world decimal places.

  • Use Calibrated Space when activated — When this option is checked and the report is activated, by default, the report will use calibrated space. Otherwise, values are shown in the report in pixel space when the report is started.

View Menu

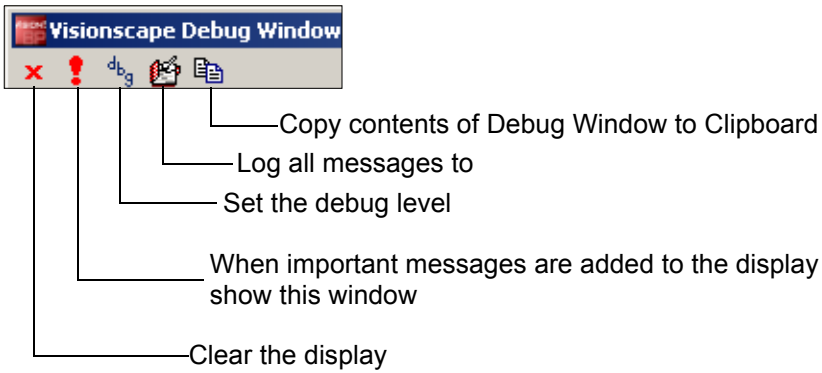
The View menu contains the following menu items:

- Network Overview — Displays the Network Overview window, which displays critical information about smart cameras on the network. See "The Network Overview Window" on page 2-46.

- Part Queue — Displays the Part Queue application, which maintains a Queue of the last n cycle images and results. You decide how large the queue will be and whether it stores results and images for every part, or just for passed parts, or just for failed parts. If you activate the Queue, the Part Queue Viewer allows you to upload it, and view any of the images and results that were stored on the device at runtime. For complete information about the Part Queue, see Chapter 4, "The Part Queue".

- Debug Output — Displays output messages from Perl scripts and internal messages from the Visionscape Framework and from FrontRunner.

FIGURE 2–23. Debug Window



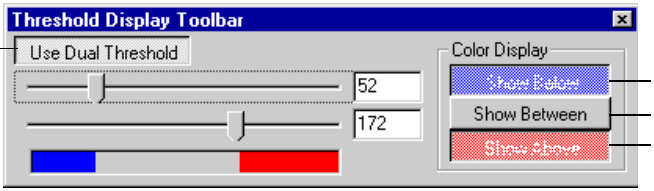
- Clear the display — Clears the Debug Output window.
- When important messages are added to the display, show this window — Automatically displays important messages when they are added to the window.
- Set the debug level — Allows you to set the importance of a message:
  - None (default)
  - Level x, where x is a value (1 - 6)
- Log all messages to — Starts/Stops active logging of debug messages.

  Note: Active logging of debug messages can affect Visionscape's ability to process jobs.
- Copy contents of Debug Window to Clipboard — Copies the contents to the Clipboard as tab-delimited text.

- I/O Display — See "The I/O Display Window" on page 2-44.
- Digital Soft Scope — Examines I/O transitions recorded in a DSS file. The resulting signal trace can be viewed graphically as a timing diagram useful for analyzing I/O timing and interaction. For more information, see "Examining I/O Transitions (Digital Soft Scope)" on page 2-26.

- Display Tools — Contains the following items:
  – Threshold Helper — Examines the effects of threshold settings on the current image using the Threshold Display Toolbar (Figure 2–24).

FIGURE 2–24. Threshold Display Toolbar



Dual Threshold When Depressed; Otherwise, Single Threshold

Show Below

Show Between

Show Above

When activated, the current image is displayed using a threshold color scheme determined by the settings in the toolbar. You can use a single or dual threshold, and show colors or gray-scales below, between, or above the thresholds using the buttons in the Color Display options. The threshold(s) are displayed in the toolbar along with sliders. You can type in the thresholds directly or use the sliders to change the current values. The linear effect of the thresholds is displayed at the bottom in the appropriate colors. This can be used as a "key" to decipher the image display.

When a tool that has thresholds is selected and the toolbar is used, the thresholds in the tool are automatically updated and the tool is re-executed when you release the slider.

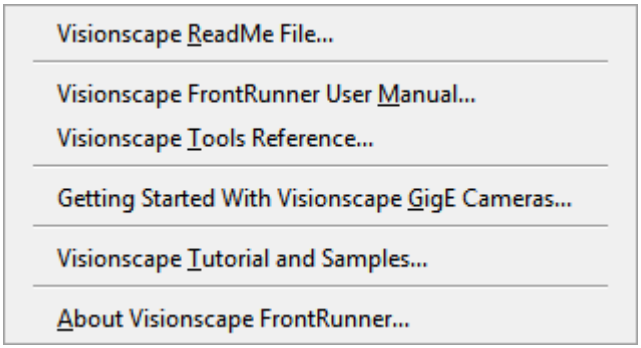
Note: If the tool has auto-threshold capabilities, then the tool is not updated and is not executed. This is because the auto-threshold in the tool will override any manual settings.

– Mask Tools — Using this floating toolbar, you can select different drawing tools to draw a mask in the ROI of a mask-oriented tool.

You can enable the mask capability of an appropriate tool by selecting the tool in the Step Tree. The Lightbulb button in the Masking Toolbar is enabled. When you click it, it "lights up", enabling the mask in the tool and enabling the drawing tool buttons of the toolbar. You can then select any of the drawing tools, and draw the mask using the mouse or select the "pointer" to return to standard tool selection/insertion with the mouse.

- Fill ROI — Fills the entire ROI of the masked tool.
- Clear ROI — Erases the entire ROI of the masked tool.

Help Menu



The Help menu contains the following menu items:

- **Visionscape ReadMe File —** Click on this menu item to open the Visionscape ReadMe.
- **Visionscape FrontRunner User Manual —** Click on this menu item to open the Visionscape FrontRunner User Manual.
- **Visionscape Tools Reference —** Click on this menu item to open the Visionscape Tools Reference Manual.
- **Getting Started with Visionscape GigE Cameras —** Click on this menu item to open Getting Started with Visionscape GigE Cameras.
- **Visionscape Tutorials and Samples —** Click on this menu item to display tutorials and sample jobs.
- **About Visionscape FrontRunner —** Displays the FrontRunner Version, and Build number. Click OK to close the window.

Color Image Display Options

Color Image File Name Format

When you save a color image from a Vision HAWK, Vision MINI, or Vision MINI Xi in FrontRunner, two .tif images are saved. One is in the file name format **<file name>.tif**. and the other is in the file name format **<file name>-rawbayerdata.tif**.

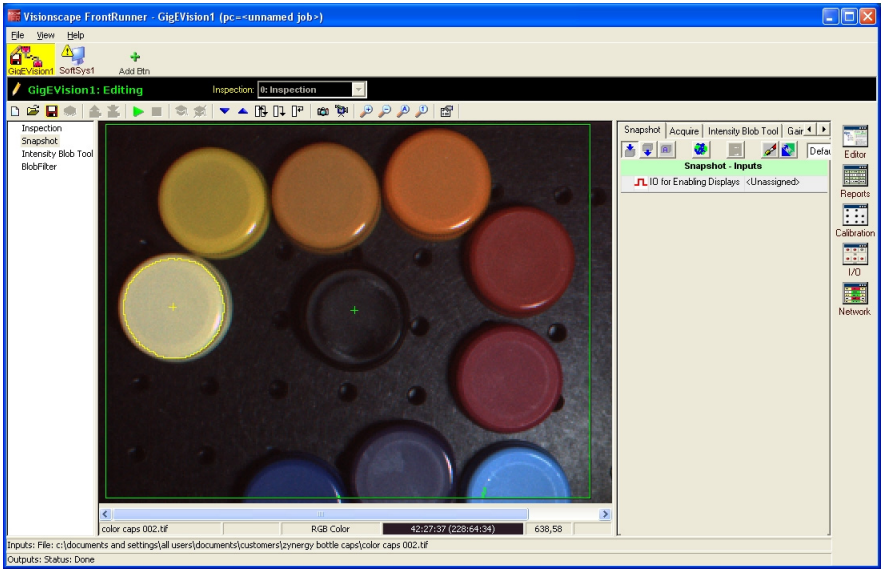
For example, a file called “colortest” would be saved in the formats **colortest.tif** and **colortest-rawbayerdata.tif**.

If you wish to run a job from a stored color image, you must select the file whose name is in the format **<file name>-rawbayerdata.tif** and not **<file name>.tif**.

Color Image Display in FrontRunner

The Snapshot step shows the color image as acquired from the camera. The buffer manager control in FrontRunner shows both the RGB and HSI (red = 0) values under the cursor if the image acquired is a color image. Zooming fully into the image will show the individual RGB values for each pixel of a color image.

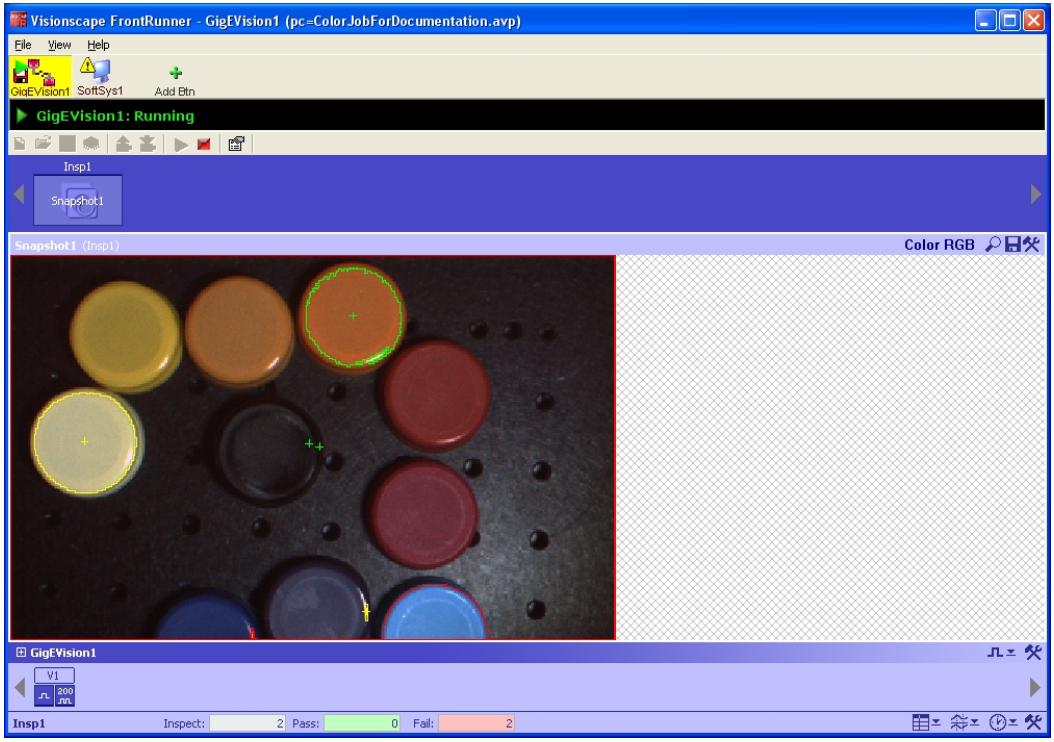
FIGURE 2–25. Color Buffer Display of Zoomed Image



Running Color Plane Selection

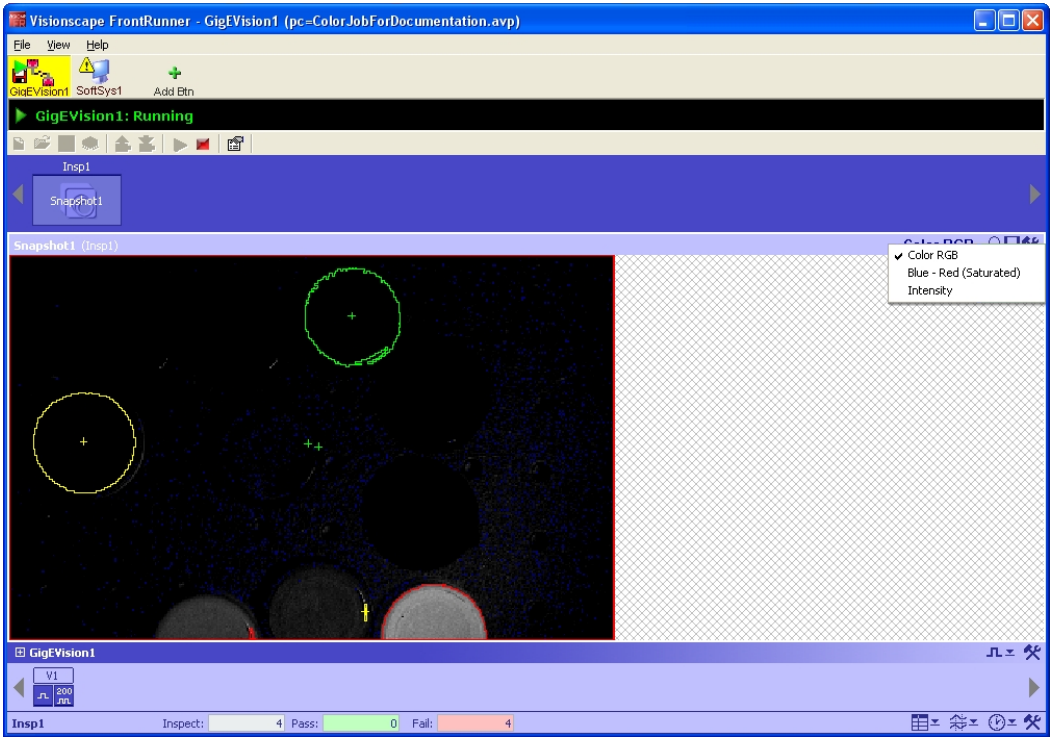
When displaying images from a color camera, the upper right of the image display includes the text of the current image plane displayed. The default is the RGB color image. Channel selection will be limited to those channels used by vision tools that are inserted in the current Snapshot.

FIGURE 2–26. Runtime Displaying Color Image



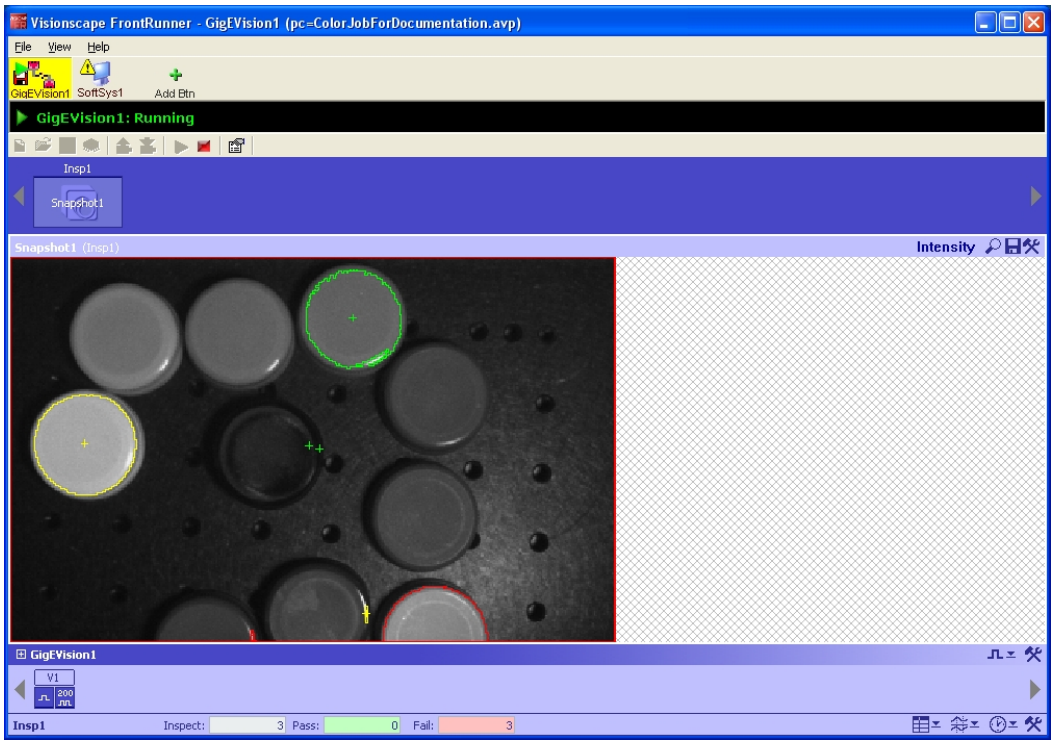
When you click **RGB Color** a dropdown menu will appear, allowing you to select from the image channels used in the job.

FIGURE 2–27. Runtime Image Channel Selection Dialog



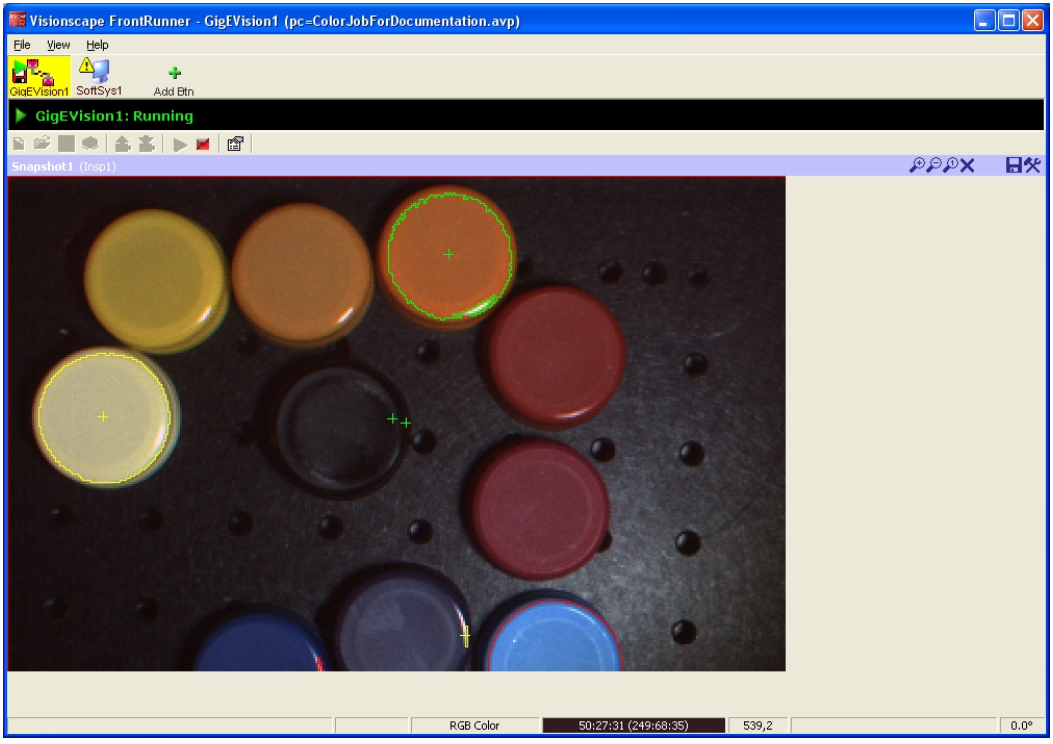
In the following example, the user has selected the **Intensity** image channel. At this point, the software will now display that channel.

FIGURE 2–28. Runtime Display of Intensity Channel



Finally, if you click the magnifying glass icon to zoom the image, the name of the image channel zoomed will appear in the image status bar next to the pixel value and location.

FIGURE 2–29. Zoom Options with Color Runtime Display



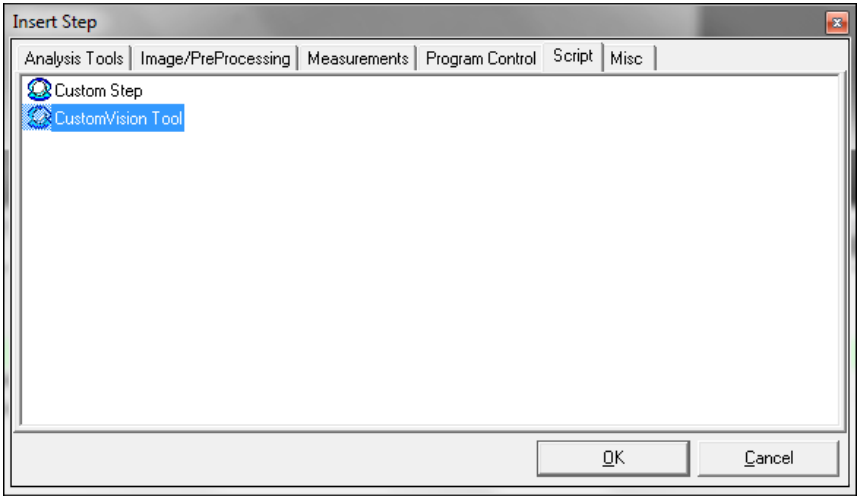
Note: You can select what image channel to display but ALL the enabled graphics for the job will be displayed regardless of which plane they are running in.

Color Perl Scripts

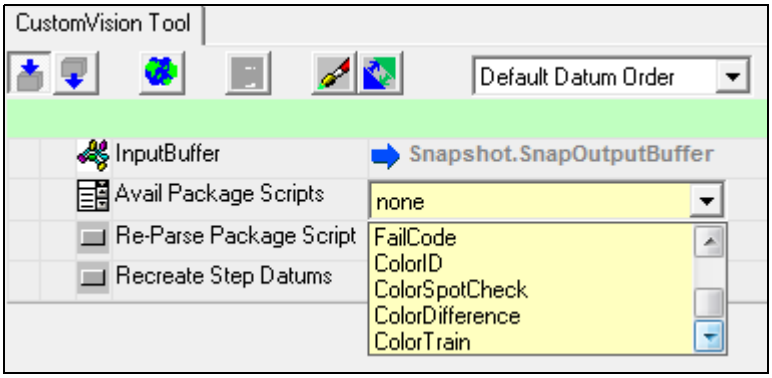
Color versions of the Vision HAWK, Vision MINI, Vision MINI Xi, and GigE Camera are supported by Visionscape FrontRunner. All FrontRunner tools can be used in different **color planes**.

Specific color-related functionality is available in the form of custom scripts. The white balance of the color Vision HAWK can also be set from FrontRunner.

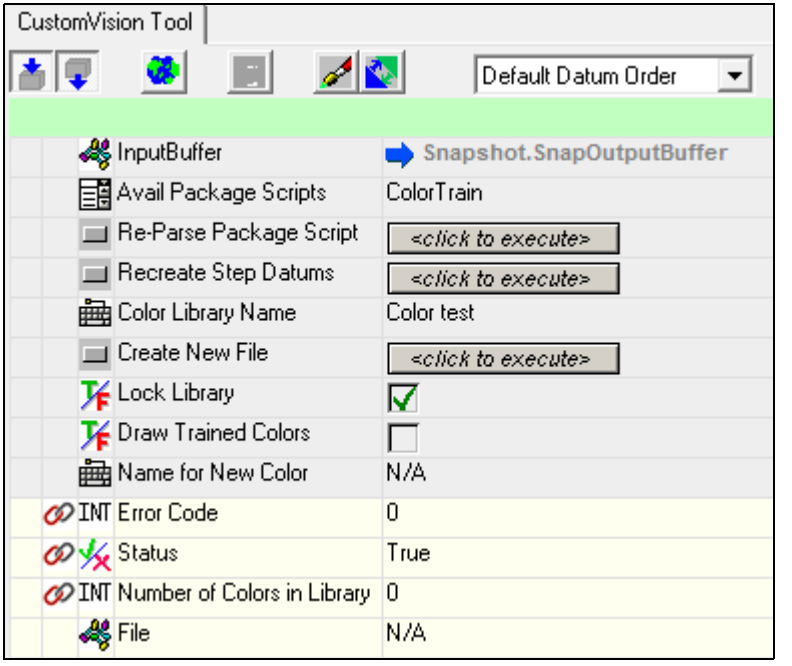
A set of Perl scripts is provided with the Visionscape installation that can perform analysis of color images. The scripts are automatically available in Visionscape and can be inserted into a job by navigating to the **Script** tab in the **Insert Step** dialog and selecting **Custom Vision Tool**.



Then, from the Custom Vision Tool Input datums, select the desired script by clicking the **Available Package Script**:



The tool will then be available:



ColorTrain and ColorID

These scripts are used together to train a library of colors and then check for those specific colors at runtime.

ColorTrain

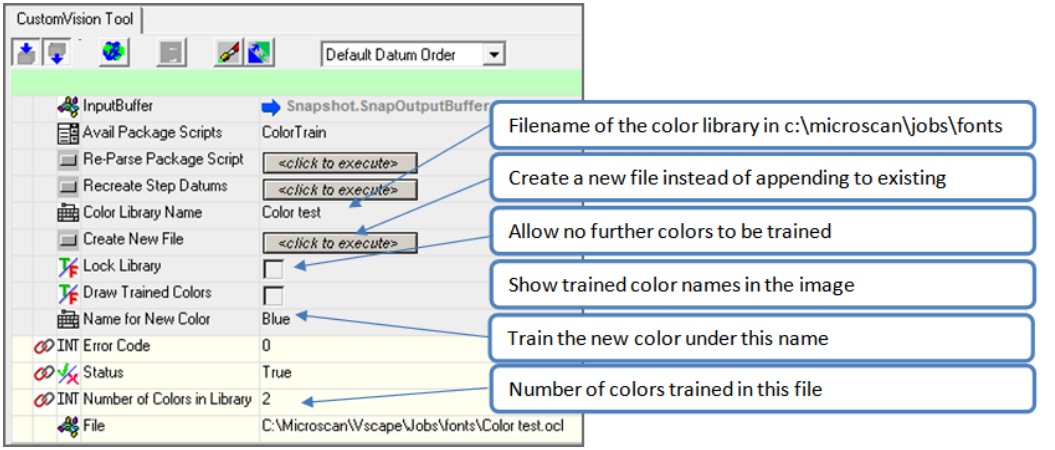
Purpose: Allows you to create libraries of trained colors.

Use:

- Drag and size the ROI over a solid color area that you wish to train.
- Select the “Color Library Name” datum and enter the name of an existing color library, or the name you wish to use for a new color library. If you want to create a new color library, check the “Create New File” datum.

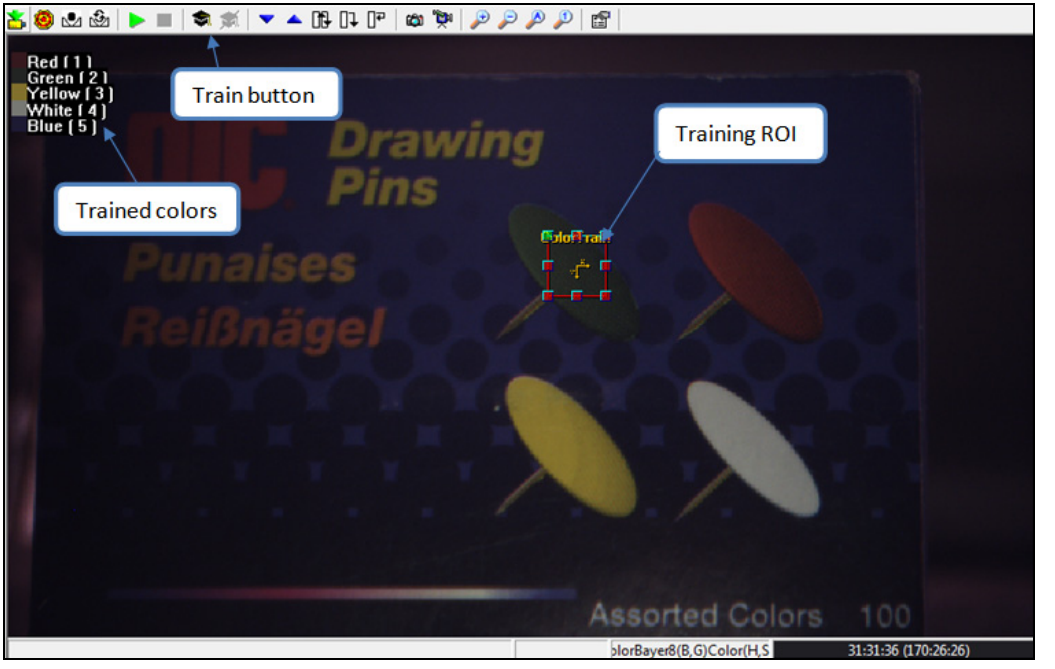
  Note: Color Libraries are always saved in the **\Microscan\Visionscape\Jobs\Fonts** folder with the extension OCL.
- To train a new color, enter the name of the color in the “Name for New Color” datum. Now train the Step, and your new color will be added.
- Check the “Draw Trained Colors” datum, and all trained colors will be drawn in the upper left corner of the image.
- Check the “Lock Library” datum if wish to prevent any more colors from being trained.

The **ColorTrain** tool has the following input and output parameters:



Training is done by positioning the ROI (region of interest) around the color area, entering a name for the new color, and clicking the Train button. This is an example of the

ColorTrain Tool Setup and Inspection:



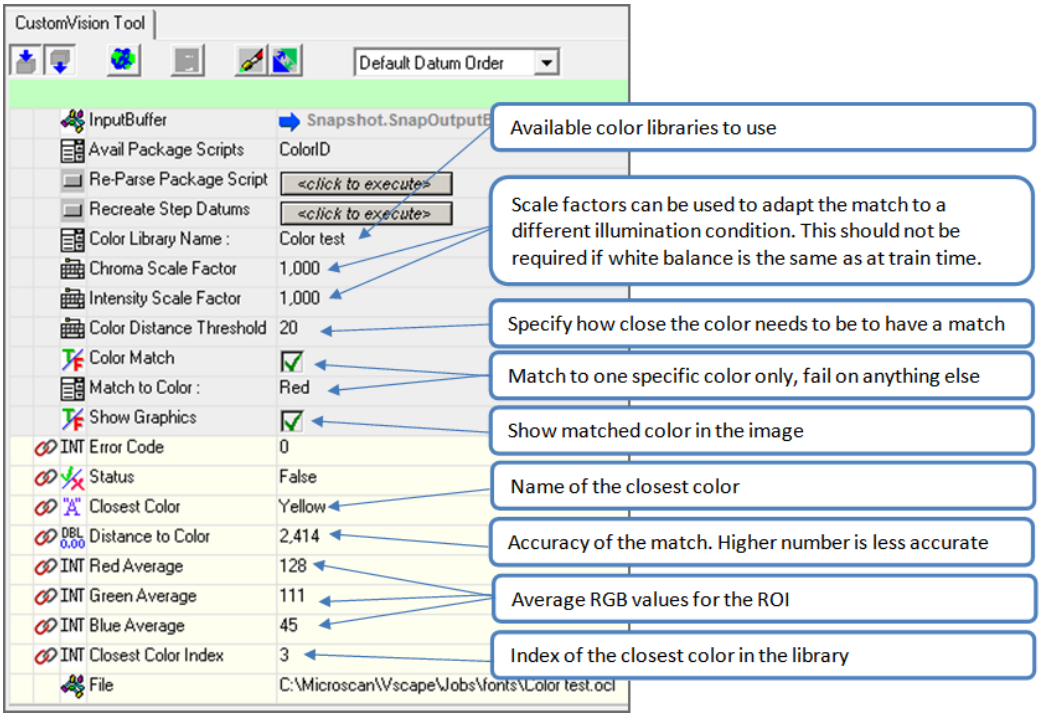
ColorID

Purpose: Attempts to identify a color by comparing the pixels within its ROI to the trained colors in a specified color library.

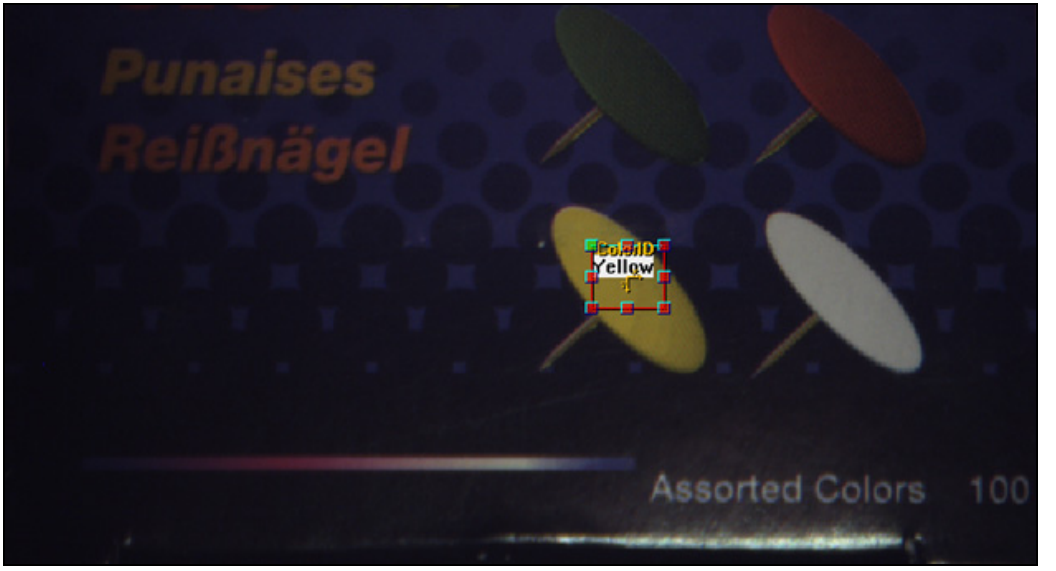
Use:

- Select the color library that will be used by the Step by specifying its name in the “Color Library Name” datum. If you have not created any color libraries, refer to the previous section on the ColorTrain script for a description of how to create one.
- The Step inspects the average color value within its ROI, and compare it to various colors trained in the library. The name and index of the closest color match will be output by the tool.
- The “Color Distance Threshold” can be used to specify how close a color must be to the trained value in order to be considered a match. Decrease this value to require a closer match, increase the value to allow a looser match.
- The Step can be made to check for a specific color, such that it will pass if the color is detected, and fail if any other color is detected. Check the “Color Match” datum to activate this mode, and then enter the name of the color to check for in the “Match to Color” datum.
- Check the “Show Graphics” datum if you want the name of the detected color to be drawn in the image at runtime.

The **ColorID** tool has the following input and output parameters:



ColorID Tool During an Inspection:



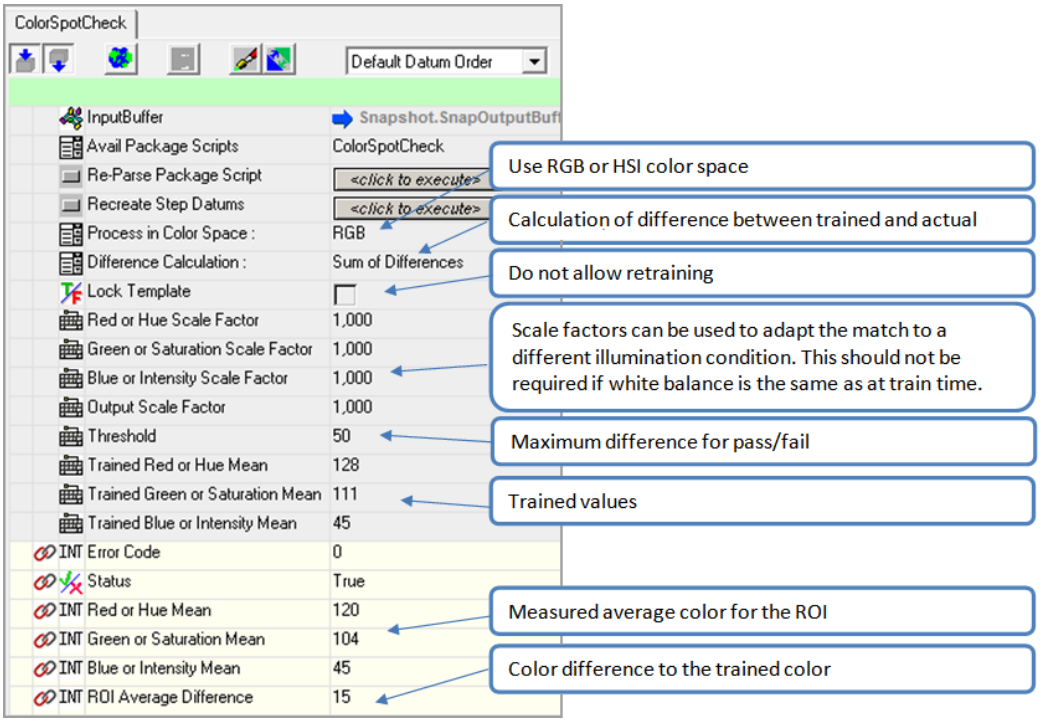
ColorSpotCheck

Purpose: Allows you to train on a single color in RGB or HSI. The Step will then pass only if the same color in RGB or HSI is detected in future images.

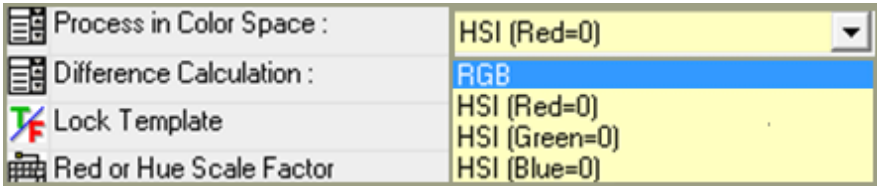
Use:

- Position the inner, smaller ROI of the Step over the color you wish to train on, and hit the Train button. The average Red, Green, and Blue values and Hue Saturation and Intensity values, within the ROI will be trained and stored in the Tool.
- Position the outer, larger ROI over the pixels to be inspected at runtime. During each cycle, the Step will pass if the average color value of the pixels within the larger ROI roughly matches the trained color. Otherwise it will fail.
- Use the “Threshold” datum to adjust how closely the trained color must match the inspected color. Increase the value to allow a looser color match, and decrease the value to produce a closer color match.

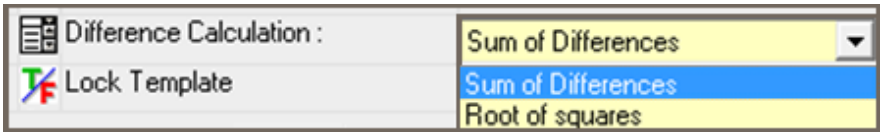
The **ColorSpotCheck** tool has the following parameters:



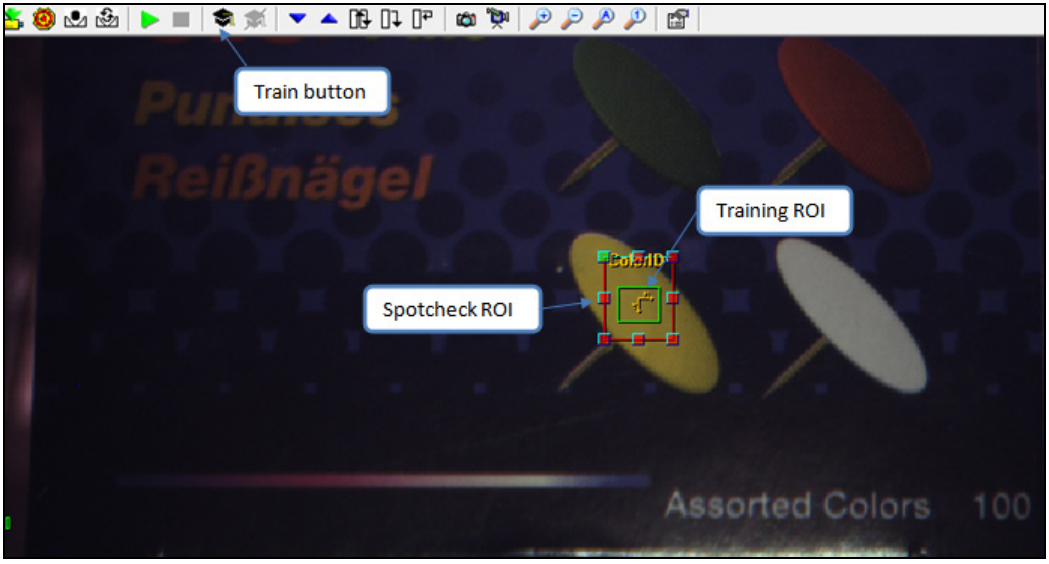
Color space selection options:



Difference calculation method options:



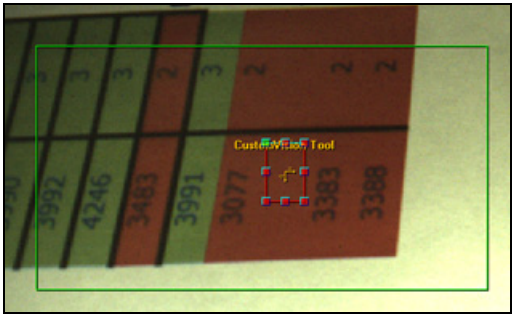
ColorSpotCheck Tool Setup and Inspection:



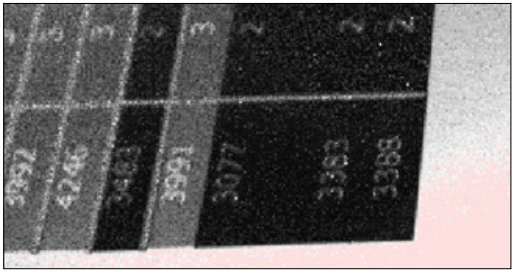
ColorDifference

Purpose: Outputs an image buffer that is the difference between the trained color and the current image. The resulting image should be near black when the pixels are close to the color that was trained, and will be brighter when they are a different color:

Color image, tool is trained on red:



Resulting output buffer:

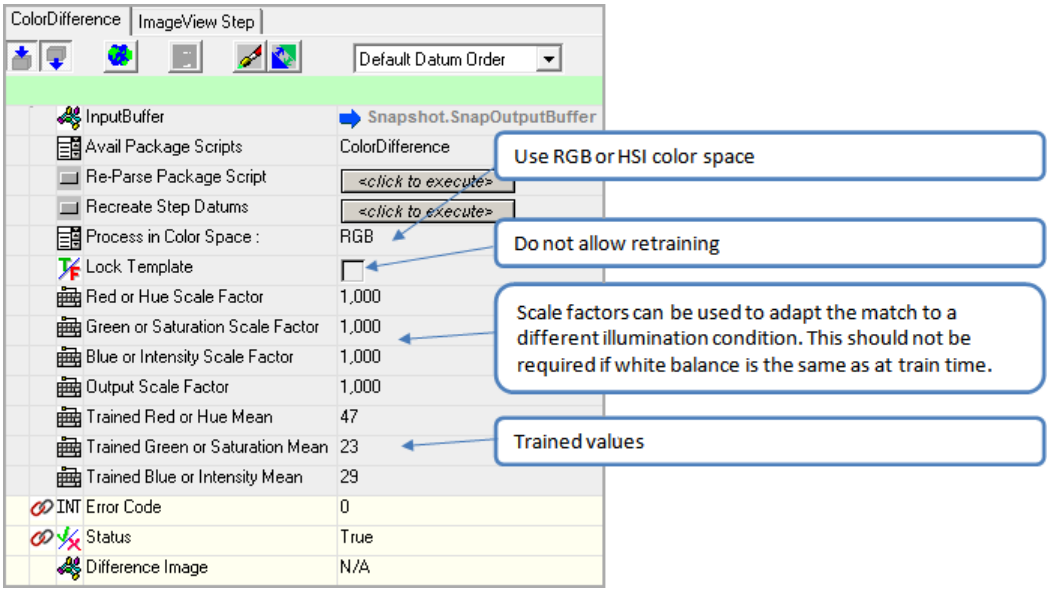


Note that the red pixels from the original image are black, whereas all other colors are brighter. This tool can be used to detect color changes within an area of an image.

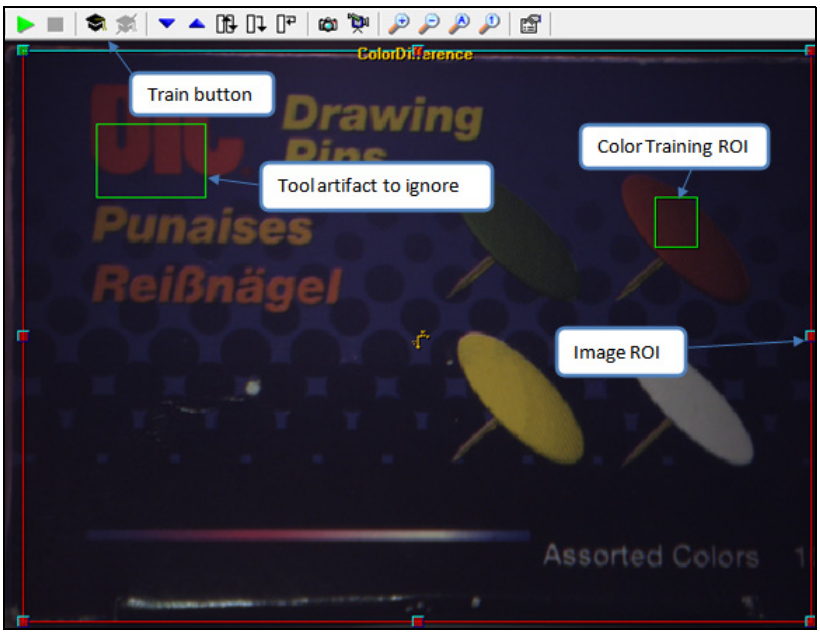
Use:

- This Tool provides two ROIs. The smaller, inner ROI is used to train on a color. The outer, larger ROI is used to specify the area of the image that you want to inspect. An output buffer will be produced that is the same size as this outer ROI.
- Position the inner ROI over a color and press the Train button in FrontRunner.
- Double-click within the outer ROI, and you will be shown the output buffer produced by this Tool. You can insert other steps within this output buffer, such as a Blob or Flaw Tool.

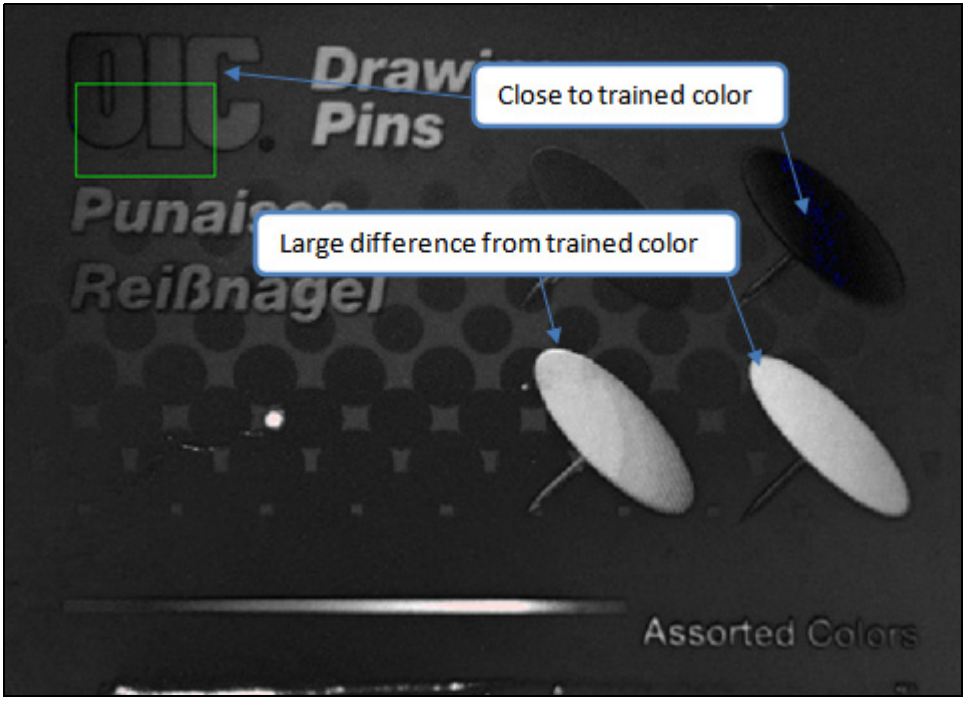
The **ColorDifference** tool has the following input parameters:



ColorDifference Tool Setup



ColorDifference Tool Output Image

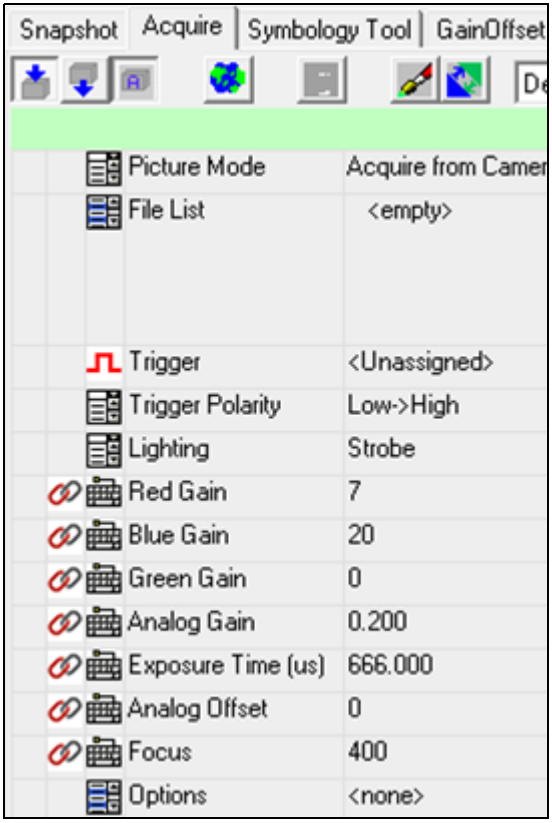


White Balance

This section outlines the white balance functionality for color smart cameras in FrontRunner.

White Balance Gain Values

The color channel gain values can be viewed by clicking the **Snapshot** step, selecting the **Acquire** tab and then activating the **Advanced** parameters as shown below:



The parameters are **Red Gain**, **Blue Gain**, and **Green Gain**. These values can be manually adjusted for optimal color fidelity or by using the white balance calibration operation outlined in the next section.

White Balance Calibration

Before running white balance calibration, place a white object such as a piece of paper in front of the camera at the current focus plane. Then initiate the white balance operation by selecting the white balance icon shown below. The color channel gain is then equalized such that the white object appears white.

After white balance calibration, the white balance gain values are updated and the results are saved as customer parameters.

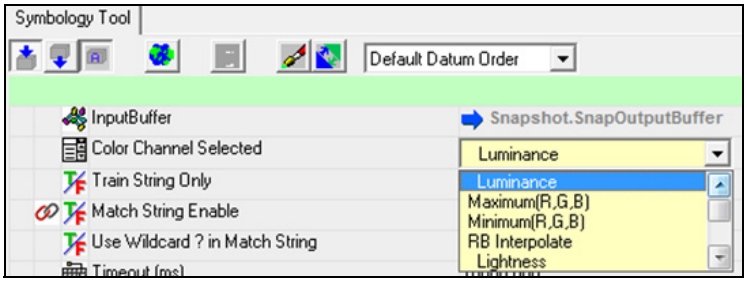
Restore Preset White Balance Configuration

The color smart camera is pre-configured with factory calibrated white balance settings. To restore the color channel gain to these preset values, select the preset white balance icon as illustrated below:

After this operation, the white balance gain values are restored to the factory preset values and saved as customer parameters.

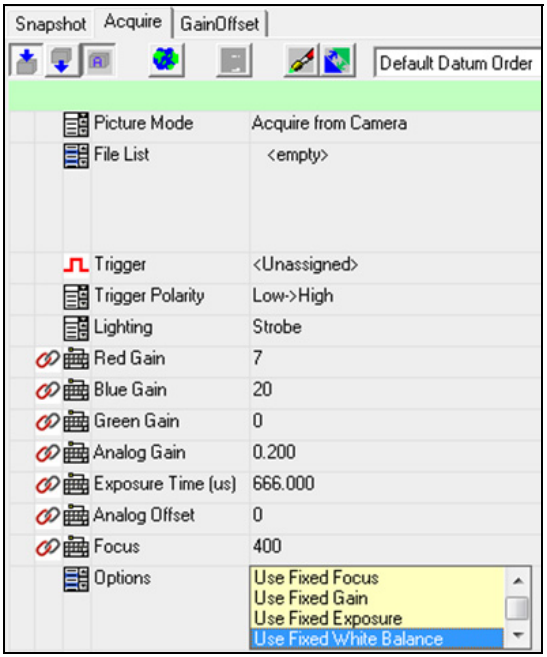
Color Channel Options

When a step is inserted in FrontRunner, the **Color Channel** or **Interpolation** operation can be selected or applied to the step as shown below:



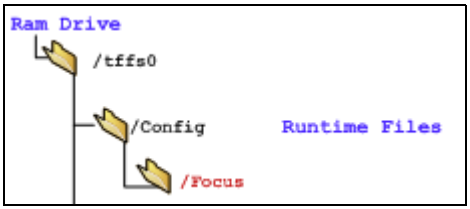
Use Fixed White Balance

The color channel gain values can be fixed by clicking the **Snapshot** step, selecting the **Acquire** tab and then activating the **Advanced** parameters. To fix white balance parameters, select the **Options** dropdown and click the **Use Fixed White Balance** option as show below:



Device parameters are referred to as camera parameters that are saved outside of a job, such that they can be applied globally or independent of a job as well as updated outside a job. These parameters include photometry settings (gain and exposure), focus, and white balance gain.

- A new job will always inherit the current “device data” so you do not need to re-calibrate the device.
- The device data for focus, photometry, white balance, and dimensional calibration exists in two places at all times:
  - In the job (copied from the device data at job creation);
  - On the device’s global /Config flash folder.



- Whenever the device parameters are calibrated, two things happen:
  - The device global data is updated in the /Config flash folder;
  - The job loaded in RAM is updated with the new data.
- The **Use Fixed White Balance** option controls whether the device parameters (white balance gains) are updated when the job is loaded from flash or downloaded to RAM with the device-wide values, or if the values last saved in the job are used instead.
  - **Normal:** Device parameters are updated when the job is loaded from flash or downloaded to RAM with the device-wide parameter values (from the **acqcfg** file).
    - If a job is opened on the PC or from a flash job slot on the device, and if a device parameter is unlocked, the value saved in the global device parameter file (acqcf) is used.
      - Job device parameter value (RAM) = Global device parameter value (/Config flash folder).

- Whenever an “unlocked” device parameter is updated, two things happen:
  - The device global data in RAM is updated;
  - The job loaded in RAM is updated.
- When a job is saved to a job slot, the device global data file in the /Config flash folder is updated.

– **Fixed:** Values last saved in the job are used.

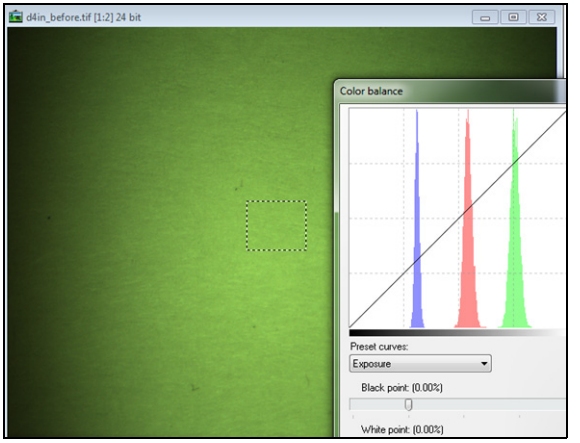
- If a job is opened on the PC or from a flash job slot on the device, and if a device parameter is locked, the value saved in the job is used.
  - Job device parameter loaded in RAM = Job device parameter opened (Flash Slot/PC).
  - The global device parameter file is untouched.
- Whenever a “locked” device parameter is updated, the job loaded in RAM is updated.

White Balance Implementation

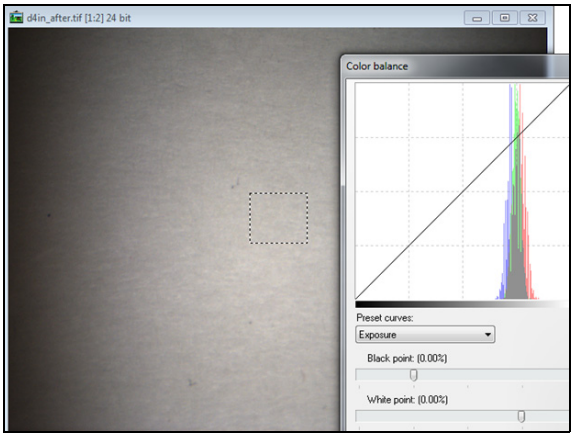
White balance is a processing operation performed to ensure proper color fidelity in a captured digital image. The image sensor does not detect light exactly as the human eye does, and so some processing or correction of the detected image is necessary to ensure that the final image realistically represents the colors of the original image. Proper white balance is required to take into account the “color temperature” of the light source, which refers to the relative “coolness” of white light. The main purpose of white balance as it relates to the Vision HAWK is to render neutral colors correctly (gray/white) and to provide consistent color results.

Factory pre-set white balance calibration should be satisfactory for most applications, but the color smart camera allows for user adjustment or calibration of the white balance to account for exposure to different lighting conditions.

Before white balance:



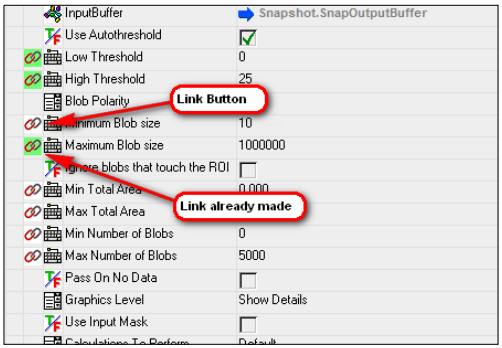
After white balance:



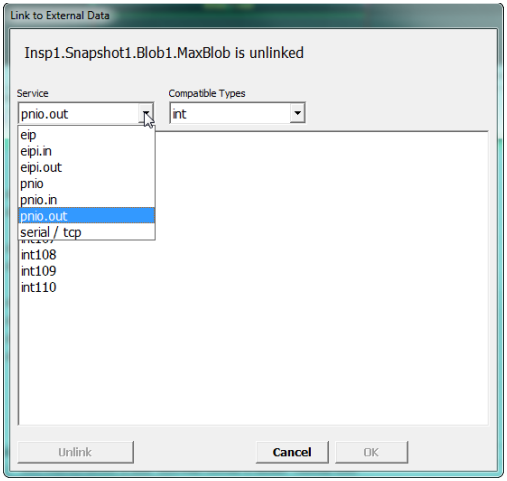
Linking Datums to Microscan Link Tags

FrontRunner allows you to link tool parameters to tags within the Global Data Service (GDS). This makes it possible to "set and get" the parameter values via any GDS-supported protocol, including serial, TCP, EtherNet/IP, and PROFINET I/O. Link buttons appear throughout the FrontRunner user interface. Linkable output parameters all have a Microscan Link icon displayed next to them.

Datums can be linked to Microscan Link tags by clicking the relevant Link button within the datum editor. These buttons only appear next to datums that are supported by Microscan Link. The button will display with a green background once a link is made.



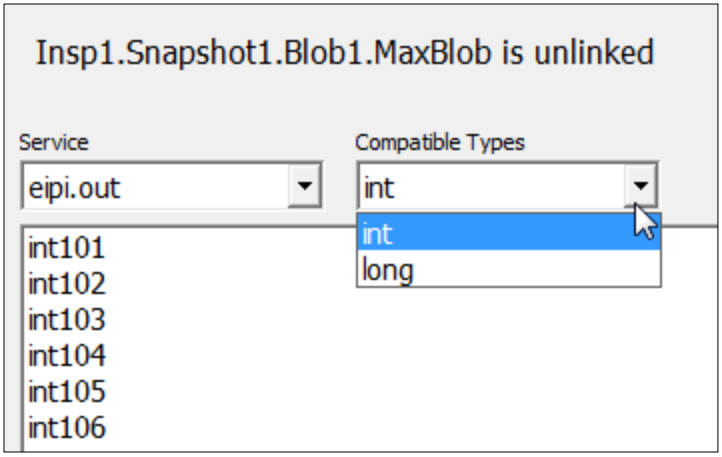
Clicking on a link button will bring up the **Link to External Data** dialog shown here.



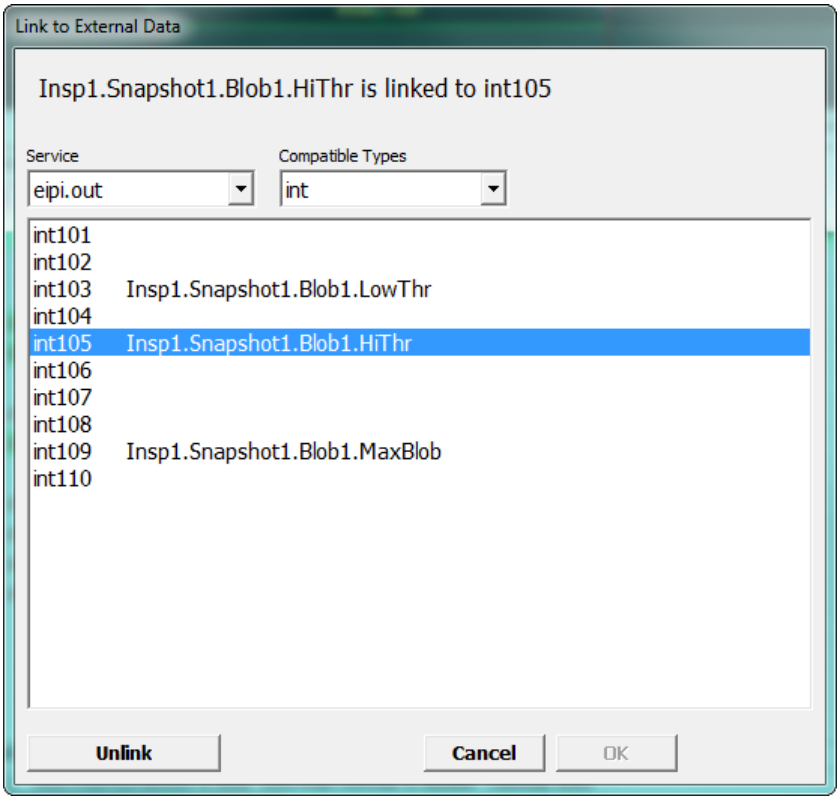
This dialog will allow you to link the datum to a Microscan Link tag. The list of tags to select can be filtered by using the first dropdown menu. The choices are:

eip	Show all tags accessible via EtherNet/IP.
eip.in	Only display tags that are part of the EtherNet/IP input assembly.
eip.out	Only display tags that are part of the EtherNet/IP output assembly.
pnio	Show all tags accessible via PROFINET I/O.
pnio.in	Only display tags that are part of a PROFINET I/O input slot.
pnio.out	Only display tags that are part of a PROFINET I/O output slot.
serial / tcp	Show all tags accessible via Serial/TCP commands.

The list can also be filtered by data type by selecting an item from the second dropdown menu. Only tags with a compatible type with the currently chosen datum are displayed:



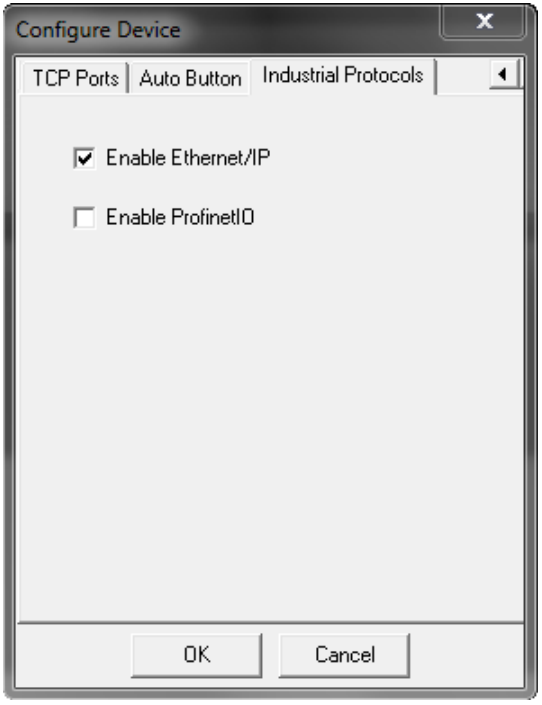
Tags that are already linked will display the path(s) of the relevant datums to the right of the tag name in the list.



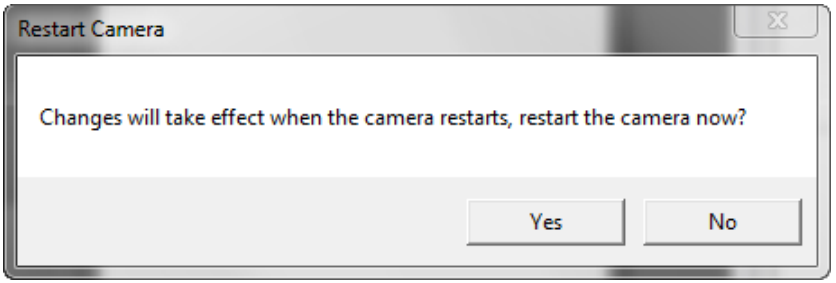
To unlink the currently selected datum, click the **Unlink** button at the bottom left of the dialog.

Switching between PROFINET I/O and EtherNet/IP

Go to the **File** menu and select **Configure Device**. Go to the **Industrial Protocols** tab.



Note: When changing protocols, the camera must be rebooted before the change will take effect. After clicking **OK**, you will be given the option to reboot the camera now or at a later time.



If you choose **No**, your newly selected protocol will not be active.

Miscellaneous

Displaying Important Information About a Camera

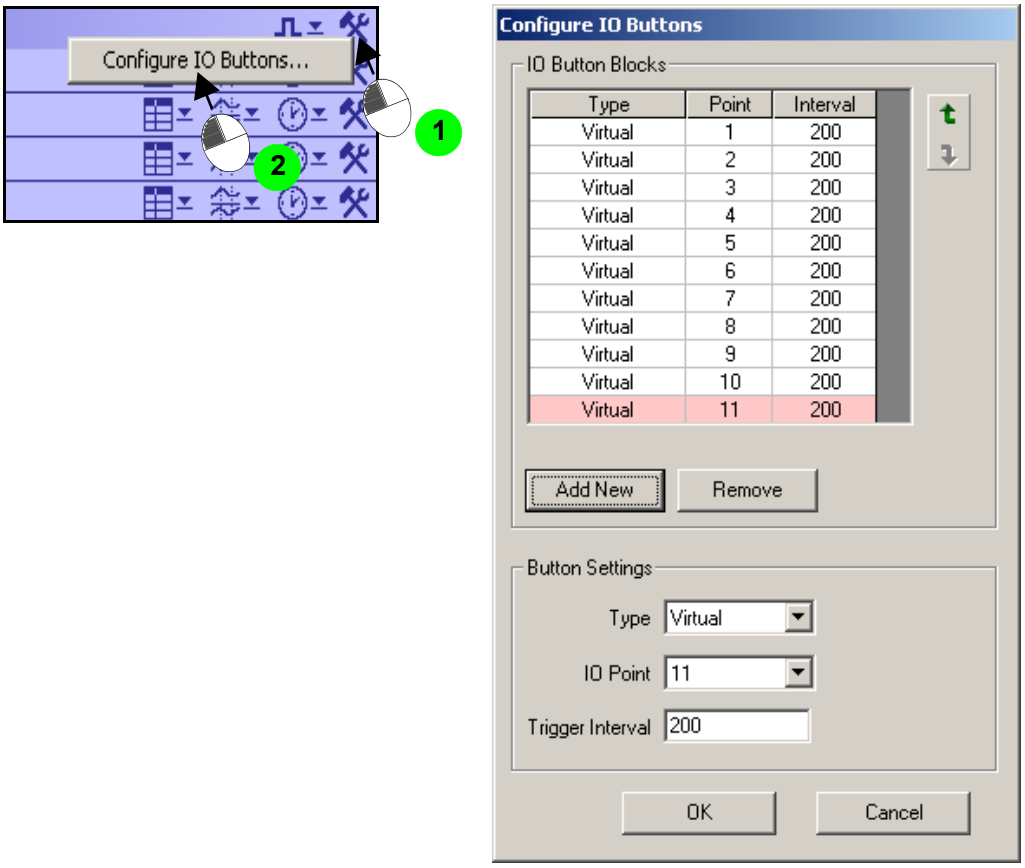
To display the important information about a smart camera, simply hover the mouse pointer over the camera button. Information includes:

- Type of smart camera
- IP address of PC controlling the camera
- Name of currently loaded job
- Date currently loaded job was created or modified
- Name of PC controlling camera
- IP address and MAC address of the camera
- Version of software on the camera

Configuring I/O Buttons

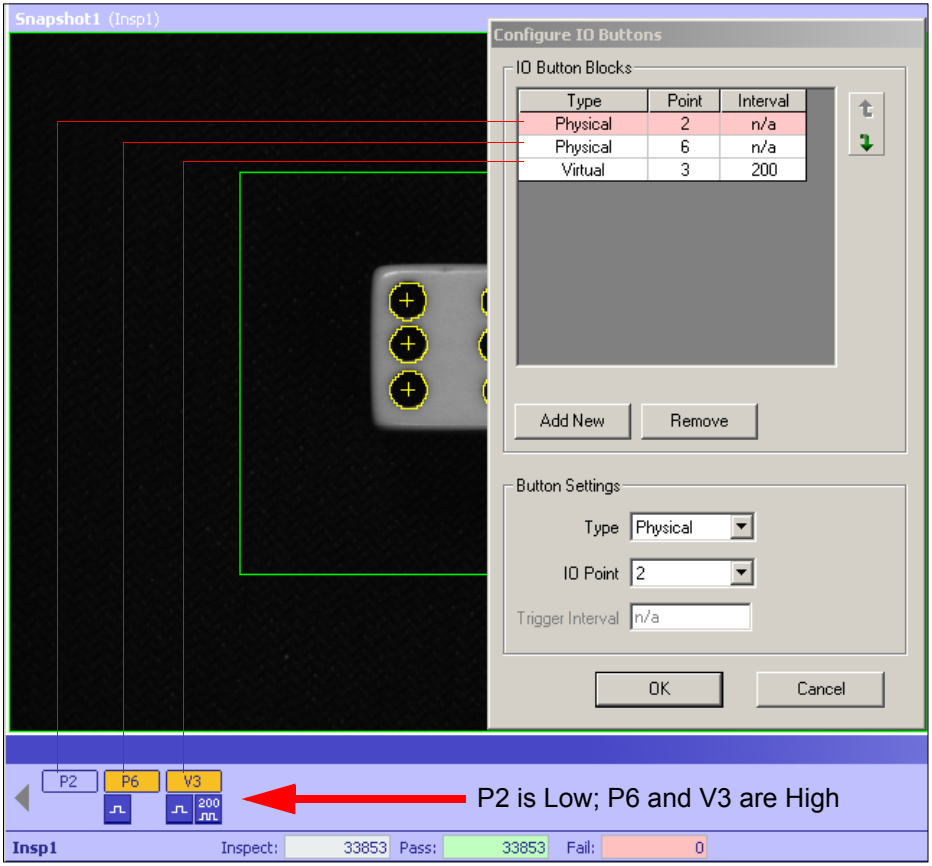
After a job has been downloaded to the device, and the device is in Run mode, you can configure I/O buttons, as shown in Figure 2–30.

FIGURE 2–30. Configure I/O Buttons



- Add New — When clicked, adds a new IO button.
- Remove — When clicked, removes an existing IO button
- Type — Is one of the following:
  - Virtual — Allows you to generate IO data using software.
  - Physical — Allows you to generate IO data using hardware.
  - Separator — Allows you to group IO data.
- IO Point — Is a number from 1 to 2048.
- Trigger Interval — Is a number from 1 to 9999.

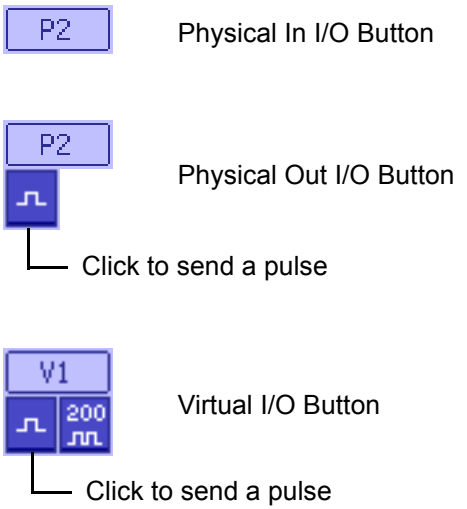
FIGURE 2–31. I/O Buttons Configured



What I/O Buttons Look Like

Figure 2–32 shows you what the I/O buttons look like.

FIGURE 2–32. I/O Buttons Described



Saving I/O Buttons

The I/O button configuration is saved in the job.

You must have the job in the PC memory to configure I/O buttons. So, if you want to add I/O buttons to a running job on a camera, you must do either of the following:

- Upload the job to the PC, configure the I/O buttons, and then download the job to the camera
- Load or create a job, configure the I/O buttons, and then download the job to the camera

Note: Make sure you save the job after you configure I/O buttons.

Note: If there is a job in PC memory that you are viewing or editing, be aware that the button configuration that you see is for the job in PC memory, and not for the job on the camera.

Enabling ROI Masking

To display the ROI Masking Toolbar, from the FrontRunner View menu, click Display Tools > Mask Tools.

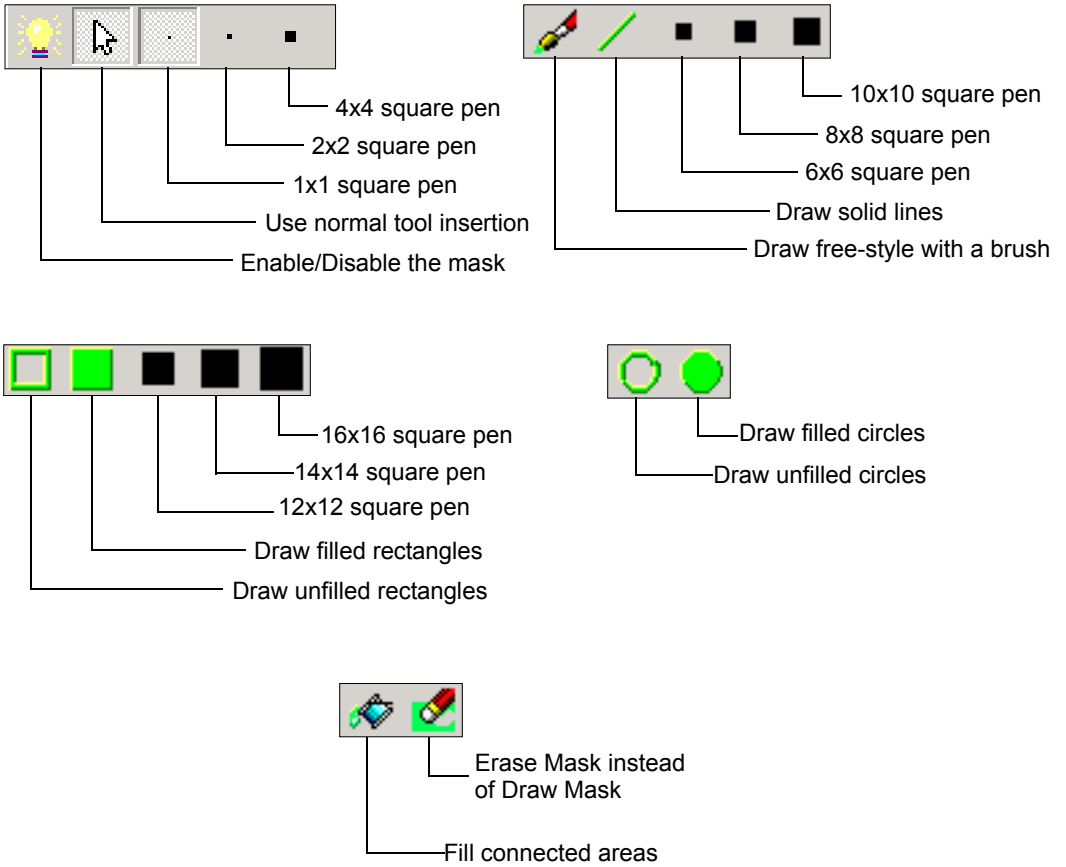
FrontRunner displays the ROI Masking Toolbar, as shown in Figure 2–33.

FIGURE 2–33. ROI Masking Toolbar

Using this floating toolbar, you can select different drawing tools and draw a mask in the ROI of a mask-oriented tool.

You can enable the mask capability of an appropriate tool by selecting the tool in the Step Tree. The Lightbulb button in the Masking Toolbar is enabled. When you click it, it “lights up”, enables the mask in the tool and enables the drawing tool buttons of the toolbar. You can then select any of the drawing tools, and draw the mask using the mouse or select the “pointer” to return to standard tool selection/insertion with the mouse.

FIGURE 2–34. ROI Masking Toolbar Descriptions



- Fill ROI — Fills the entire ROI of the masked tool.
- Clear ROI — Erases the entire ROI of the masked tool.

CHAPTER 3 Camera Calibration

Calibration provides a way for measurement values in your job to be converted from pixels to world units (inches, millimeters, etc.). The Calibration dialog box provides you with three options for calibrating one or more Snapshot steps with a job. For additional information about calibration, see Chapter 2 of the Visionscape Tools Reference.

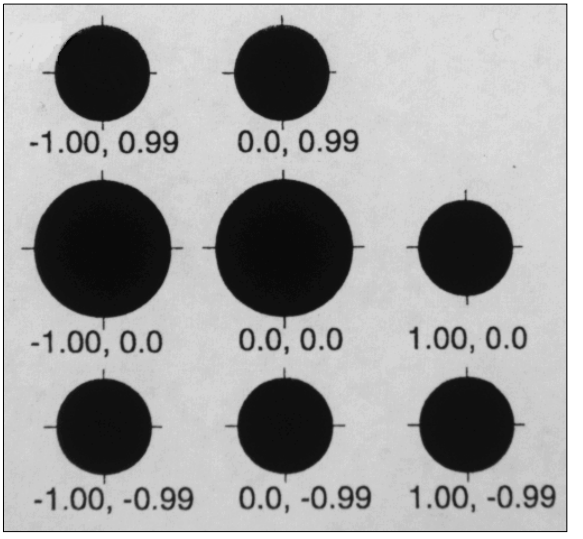
This remainder of this chapter contains information about:

Using Robust Calibration

Note: Before you begin this procedure, you need a valid calibration target similar to the one shown in Figure 3–1.

Robust Calibration uses a single Blob tool to find all of the dots on the Calibration target. The center position of each dot, in pixels, is compared to the position data you enter in the “Robust Calibration: Enter Cal Target Dot Locations” screen to calculate forward and backward transform matrices that are used to convert pixel values to world, and world values to pixels.

FIGURE 3–1. Calibration Target



Use the following procedure to robustly calibrate a camera:

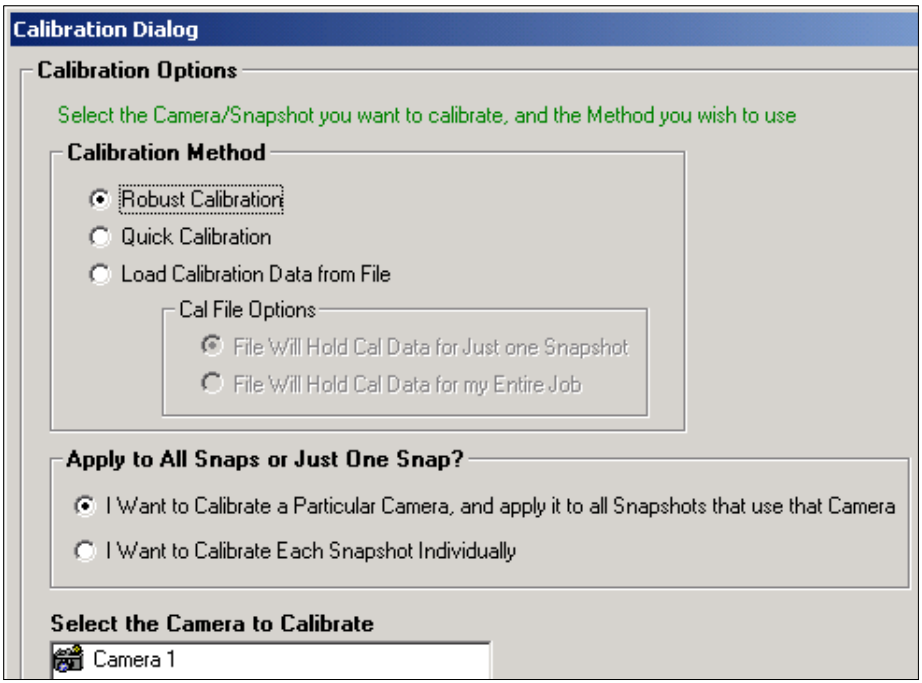
1. Create your job.
2. Place the calibration target under the camera.
3. Click 
4. Adjust the exposure and focus.

5. Click  again.

6. Click 

   FrontRunner displays the Calibration dialog box, as shown in Figure 3–2.

FIGURE 3–2. Calibration Dialog Box



7. Under “Calibration Method,” select Robust Calibration.

8. Under “Apply to All Snaps or Just One Snap,” select either of the following:

   – I Want to Calibrate a Particular Camera, and apply it to all Snapshots that use that Camera — You may have a job that contains many Inspections and many Snapshots. Many of those Snapshots may reference the same camera channel. In this case,

using this option, you can calibrate just one of the Snapshot steps, and the results are applied to all Snapshot steps that use the same camera. Thus, you do not have to calibrate each Snapshot individually.

– I Want to Calibrate Each Snapshot Individually — With this option, calibration is only applied to the Snapshot step that you select.

9. Under “Select the Camera to Calibrate”, highlight (to select) a camera.

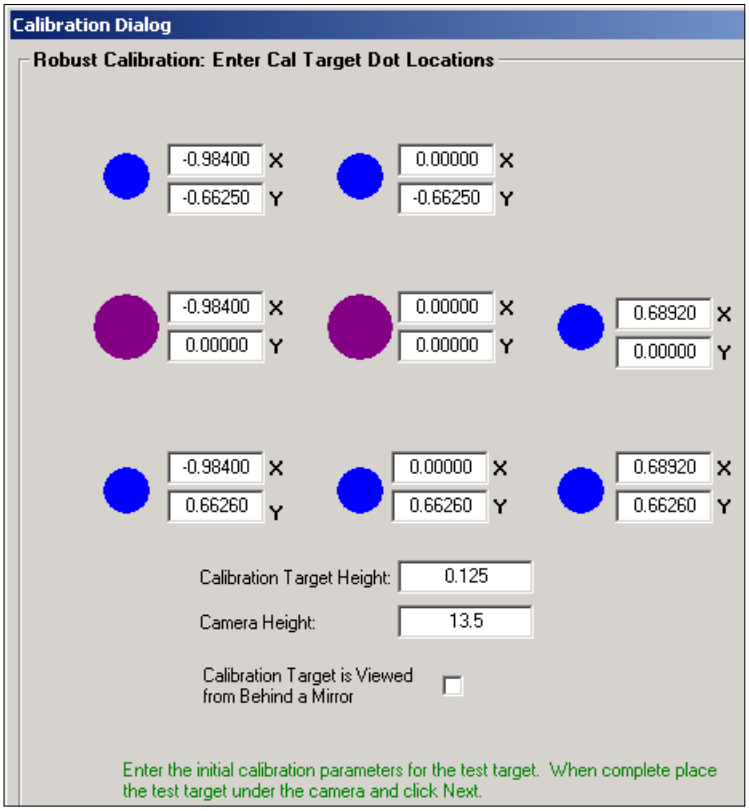
   – If you select “I Want to Calibrate a Particular Camera, and apply it to all Snapshots that use that Camera”, “Select the Camera to Calibrate” will list the cameras that are being used in the current job.

   – If you select “I Want to Calibrate Each Snapshot Individually”, then each Inspection step is listed, with each of its Snapshots underneath.

10. Click Next.

    FrontRunner displays the Calibration screen shown in Figure 3–3.

FIGURE 3–3. Robust Calibration



11. Enter the Calibration Dot locations for all targets.

12. Click Next.

    FrontRunner displays a screen similar to the one shown in Figure 3–4.

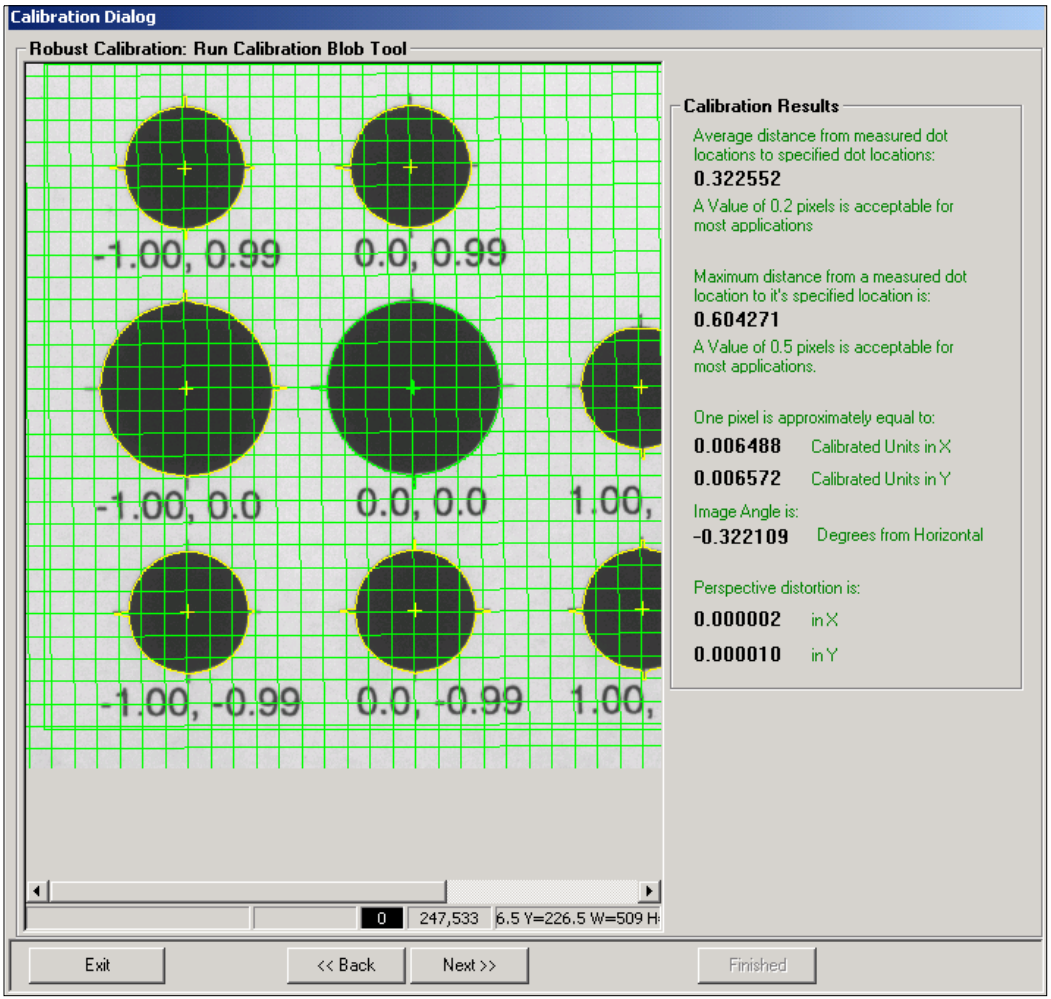
FIGURE 3–4. Run Calibration Blob Tool

Note: You may need to enlarge the window.

13. Adjust the Calibration Blob ROI.
14. Click Acquire.
15. Click Run Calibration.

    FrontRunner displays a screen similar to the one in Figure 3–5.

FIGURE 3–5. Calibration Results

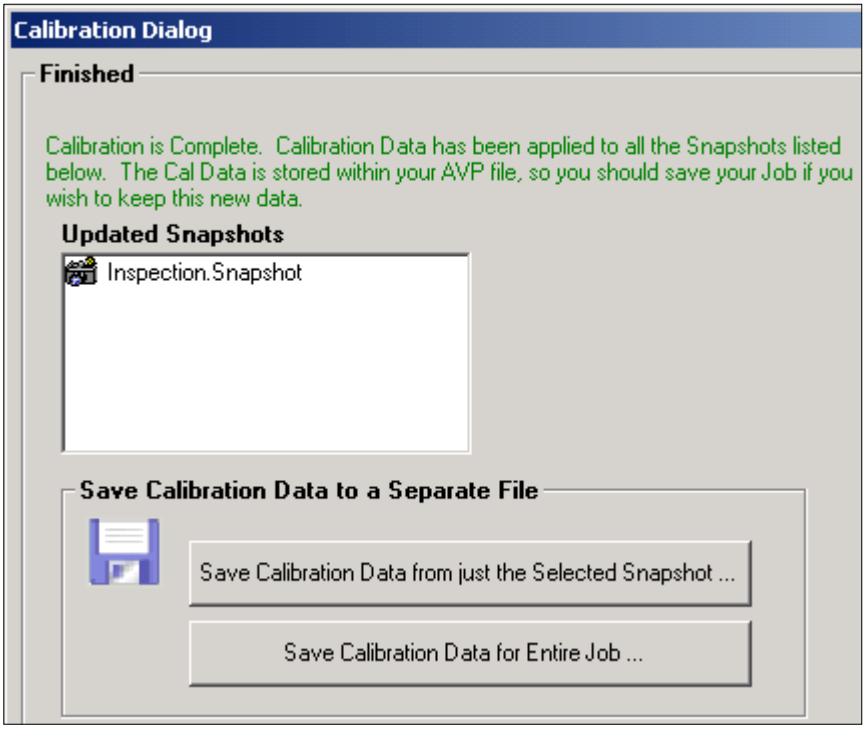


The grid lines are drawn to give you a sense of the angle of the target and the amount of perspective distortion that is present in your image. The “Calibration Results” panel on the right side of the dialog will give you some statistics on your calibration results. If you are not satisfied with the calibration results, click Back and return to the previous page where you can adjust your image or Blob parameters and try again.

16. Click Next.

FrontRunner displays the Finished screen, as shown in Figure 3–6.

FIGURE 3–6. Calibration Finished



17. Select either of the Save options:

    – Save Calibration Data from just the Selected Snapshot — This button allows you to save the calibration data for just the Snapshot that you just calibrated. Then, this data can be reloaded into any other Snapshot step in this job or any other job by using the Load Calibration Data From File option on the main Calibration page.

      If you select this save option, FrontRunner displays the Save Calibration from Current Snapshot dialog box. Type in a file name. Click Save, and then click Finished.

    – Save Calibration Data for Entire Job — This button saves the calibration data from every Snapshot in your job to a single file.

Then, this data can be reloaded into this job or some other job using the Load Calibration Data From File option on the main Calibration page, and then selecting the File Will Hold Cal Data for My Entire Job.

Note: You can only reload this data into a job that has the same number of Snapshots.

If you select this save option, FrontRunner displays the Save Calibration for Entire Job dialog box. Type in a file name, click Save, and then click Finished.

It's important to understand that when Calibration is performed, the data is stored in the Snapshot step(s) of the job, so the job needs to be saved when done. You do not need to use the Save options on this page unless you want to load the Calibration Data into another job, or unless you want to simply have a backup.

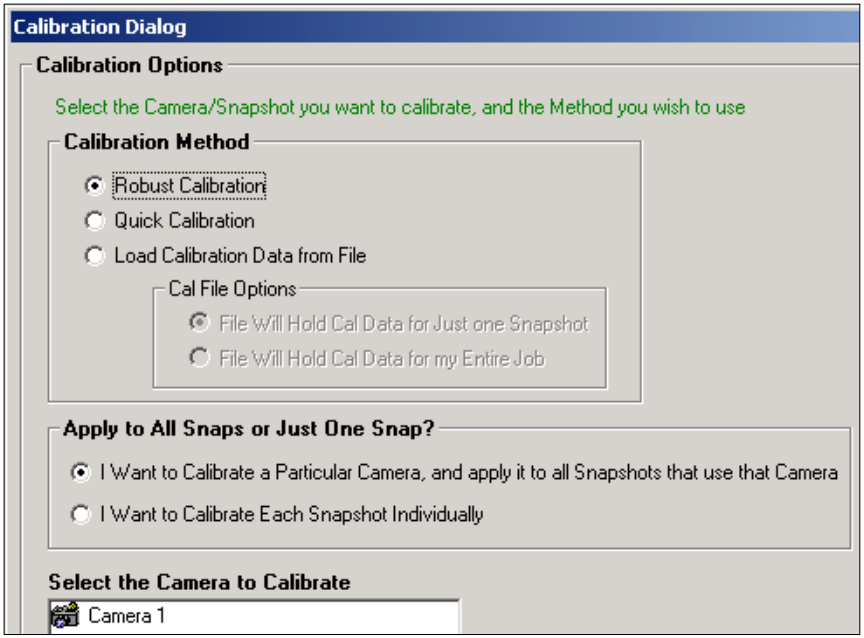
Using Quick Calibration

Use the following procedure to quick calibrate a camera:

1. Create your job.
2. Place the calibration target under the camera.
3. Click 
4. Adjust the exposure and focus.
5. Click  again.
6. Click 

   FrontRunner displays the Calibration dialog box, as shown in Figure 3–7.

FIGURE 3–7. Calibration Dialog Box



7. Under “Calibration Method,” select Quick Calibration.

8. Under “Apply to All Snaps or Just One Snap,” select either of the following:

   – I Want to Calibrate a Particular Camera, and apply it to all Snapshots that use that Camera — You may have a job that contains many Inspections and many Snapshots. Many of those Snapshots may reference the same camera channel. In this case, using this option, you can calibrate just one of the Snapshot steps, and the results are applied to all Snapshot steps that use the same camera. Thus, you do not have to calibrate each Snapshot individually.

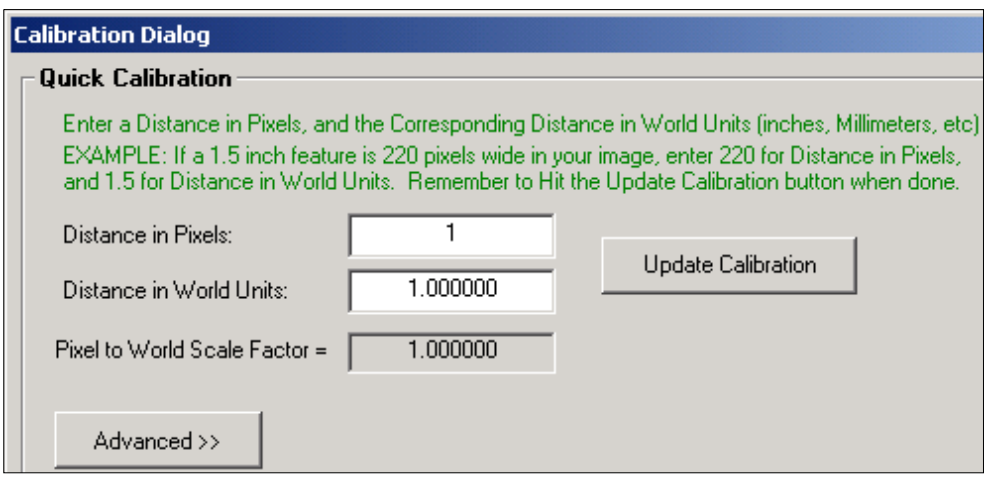
   – *I Want to Calibrate Each Snapshot Individually* — With this option, calibration is only applied to the Snapshot step that you select.

9. Under “Select the Camera to Calibrate,” highlight (to select) a camera.

10. Click Next.

    FrontRunner displays the screen shown in Figure 3–8.

FIGURE 3–8. Quick Calibration



Note: For information about the Advanced button, see “Advanced Options” on page 3-15.

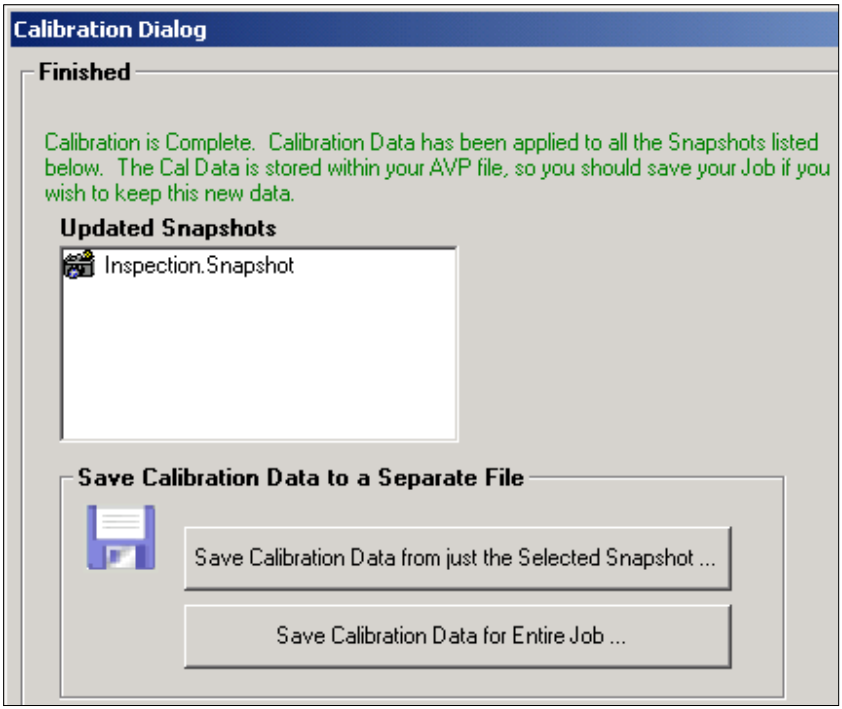
11. Manually enter in the scale factors that you wish to use for calibration.

    As the instructions at the top of the page indicate, simply enter a distance in pixels, and then a corresponding distance in world units (inches, millimeters, etc.) and click Update Calibration. For example, say you've taken a picture of the part that you wish to inspect, and you know that this part is 2 inches wide. By positioning an ROI over that part, or by using the mouse, you might determine that the part is 240 pixels wide in your image. So, you would enter “240” in the “Distance in Pixels” text box, and you would enter “2” in the “Distance in World Units” text box. After clicking Update Calibration, the “Pixel to World Scale Factor” is updated to show you the scale factor that is used to convert pixel values to world values. This scale factor is applied in both the X and Y direction. If you wish to have different X and Y scale factors, then you will need to use the advanced options.

12. Once you’re done with this page, click Next to move to the Finished page.

    FrontRunner displays the Finished screen, as shown in Figure 3–9.

FIGURE 3–9. Calibration Finished



13. Select either of the Save options:

- Save Calibration Data from Just the Selected Snapshot — This button allows you to save the calibration data for just the Snapshot that you just calibrated. Then, this data can be reloaded into any other Snapshot step in this job or any other job by using the Load Calibration Data From File option on the main Calibration page.

  If you select this save option, FrontRunner displays the Save Calibration from Current Snapshot dialog box. Type in a file name. Click Save, and then click Finished.

- Save Calibration Data for Entire Job — This button saves the calibration data from every Snapshot in your job to a single file. Then, this data can be reloaded into this job or some other job using the Load Calibration Data From File option on the main Calibration page, and then selecting the File Will Hold Cal Data for My Entire Job.

Note: You can only reload this data into a job that has the same number of Snapshots.

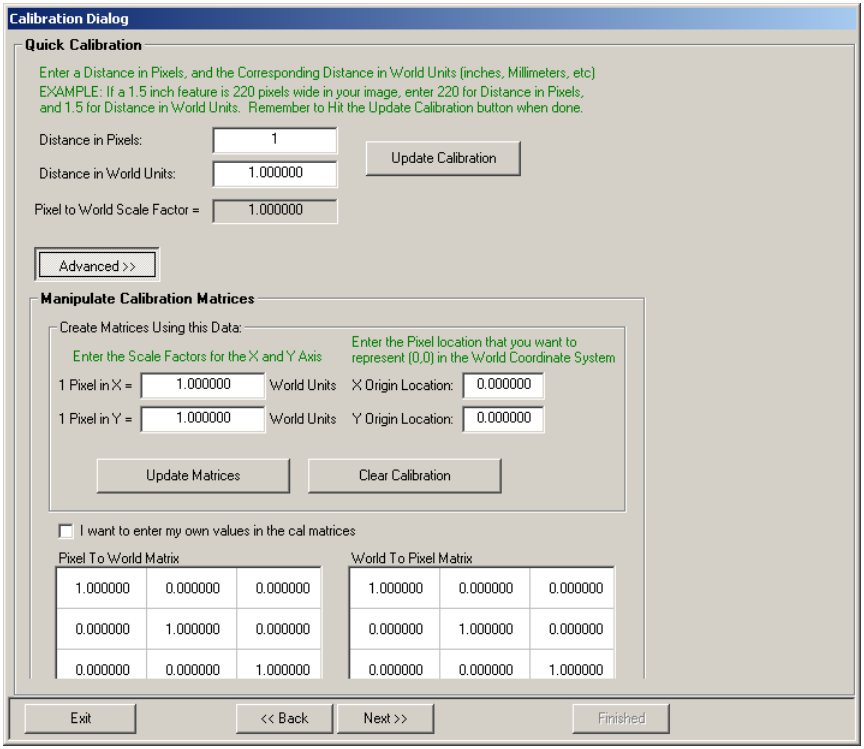
If you select this save option, FrontRunner displays the Save Calibration for Entire Job dialog box. Type in a file name. Click Save, and then click Finished.

It is important to understand that when Calibration is performed, the data is stored in the Snapshot step(s) of the job, so the job needs to be saved when done. You do not need to use the Save options on this page unless you want to load the Calibration Data into another job, or unless you want to simply have a back-up.

Advanced Options

Press Advanced to display a page with a new set of controls, as shown in Figure 3–10.

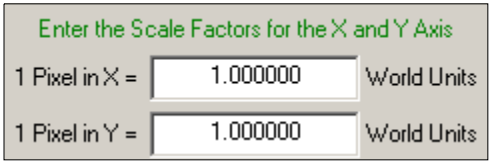
FIGURE 3–10. Quick Calibration Advanced Options



This screen gives you more control over the creation of the Forward and Backward Transform Matrices that are used for calibration by Visionscape. You can even manually modify the matrices directly, BUT YOU SHOULD NOT MODIFY THEM UNLESS YOU FULLY UNDERSTAND HOW THEY ARE USED.

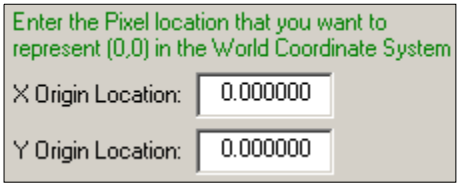
In general, you will expose the Advanced Options in order to make use of the “Create Matrices Using this Data” section.

FIGURE 3–11. Enter the Scale Factors Dialog Box



1. Using the text boxes in Figure 3–11, enter separate X and Y scale factors. Typically, you would do this if your camera is looking at an angle, or you know that your camera does not have square pixels.

FIGURE 3–12. Enter the Pixel Location Dialog Box



2. Using the text boxes Figure 3–12, set the pixel location in the image that should be considered (0,0) in the World Coordinate System. In most cases, you won't care about this, but if you are trying to get positional data back from your inspection, then this may be useful to you.

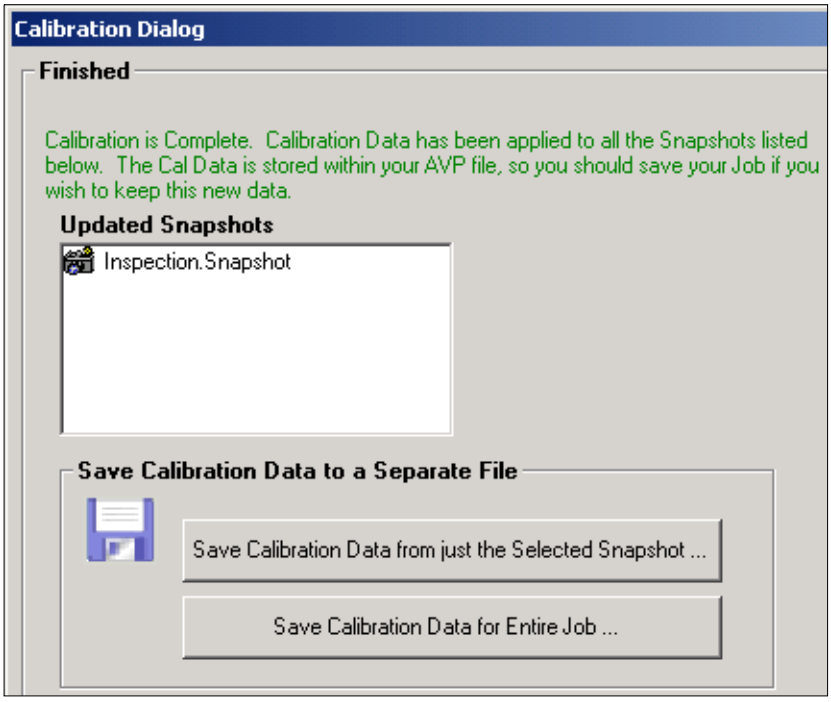
3. Click Update Matrices once you have entered your values in the text boxes, and the Calibration Matrices is updated using your new data.

   Clicking Clear Calibration resets the Cal Matrices back to the identity matrix, which essentially means that your Snapshot will no longer be calibrated. Use this button if you calibrated your Snapshot, but wish to return to a non-calibrated state.

4. Click Next.

   FrontRunner displays the Finished screen, as shown in Figure 3–6.

FIGURE 3–13. Calibration Finished



5. Select either of the Save options:

   – Save Calibration Data from just the Selected Snapshot — This button allows you to save the calibration data for just the Snapshot that you just calibrated. Then, this data can be reloaded into any other Snapshot step in this job or any other job by using the Load Calibration Data From File option on the main Calibration page.

     If you select this save option, FrontRunner displays the Save Calibration from Current Snapshot dialog box. Type in a file name. Click Save, and then click Finished.

   – Save Calibration Data for Entire Job — This button saves the calibration data from every Snapshot in your job to a single file. Then, this data can be reloaded into this job or some other job using the Load Calibration Data From File option on the main Calibration page, and then selecting the File Will Hold Cal Data for My Entire Job.

Note: You can only reload this data into an job that has the same number of Snapshots.

If you select this save option, FrontRunner displays the Save Calibration for Entire Job dialog box. Type in a file name. Click Save, and then click Finished.

It is important to understand that when Calibration is performed, the data is stored in the Snapshot step(s) of the job, so the job needs to be saved when done. You do not need to use the Save options on this page unless you want to load the Calibration Data into another job, or unless you want to simply have a back-up.

Using Previously Saved Calibration Data

When calibration is performed, FrontRunner stores the data in the Snapshot step(s) of the job. This means you must save a job after calibration is completed.

You do not need to use the Save options on this page unless you want to load the Calibration Data into another job, or unless you want to simply have a backup.

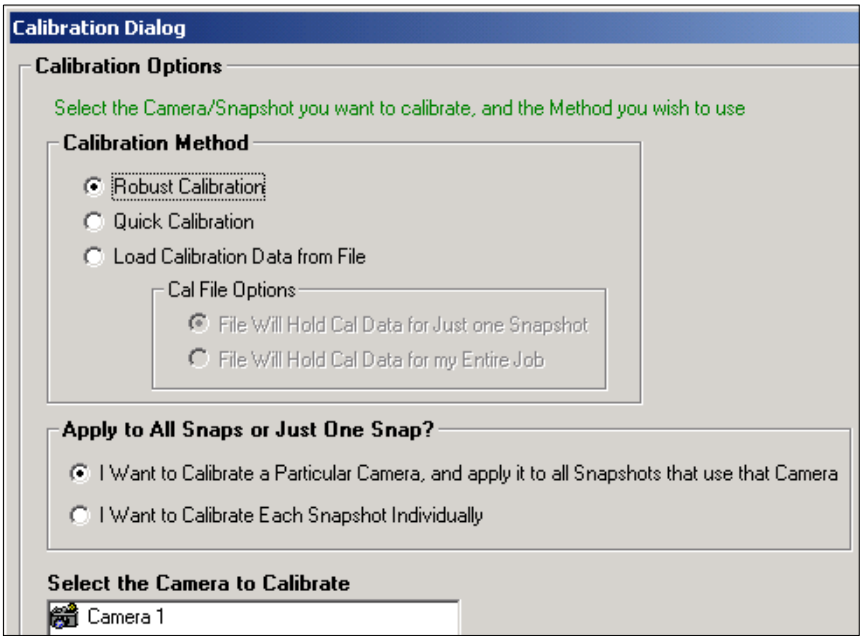
Use the following procedure to load calibration data that was previously saved:

1. Create a new job or open an existing job.

2. Click 

   FrontRunner displays the Calibration dialog box, as shown in Figure 3–14.

FIGURE 3–14. Calibration Dialog Box



3. Under “Calibration Method,” select Load Calibration Data from File.

Note: After you select Load Calibration Data from File, the Cal File Options are no longer grayed out.

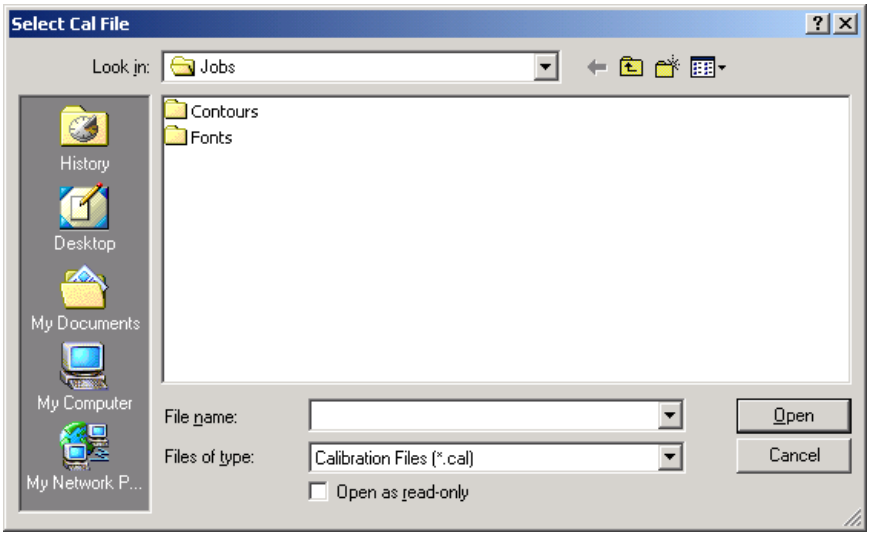
4. Select either of the Cal File options:
   - File Will Hold Cal Data for Just One Snapshot
   - File Will Hold Cal Data for My Entire Job
5. Under “Apply to All Snaps or Just One Snap,” select either of the following:
   - I Want to Calibrate a Particular Camera, and apply it to all Snapshots that use that Camera
   - I Want to Calibrate Each Snapshot Individually

6. Under “Select the Camera to Calibrate,” highlight (to select) a camera.

7. Click Next.

   FrontRunner displays the Select Cal File dialog box, as shown in Figure 3–15.

FIGURE 3–15. Cal File Dialog Box



8. Highlight (to select) a calibration file (.cal) and click Open.

   FrontRunner displays the Calibration Finished screen.

9. Click Finished.

10. Save your job.

    Your job now contains the calibration data your saved previously.

4

CHAPTER 4

The Part Queue

Every Inspection step maintains a queue of the last n cycle images and results. You decide how large the queue will be and what gets stored in it:

- Results and images for every part
- Results and images for passed parts
- Results and images for failed parts

If you activate the Queue, the Part Queue Viewer allows you to upload it, and view any of the images and results that were stored on the device at runtime.

Note: The Part Queue allows you to review runtime images only.

The remainder of this chapter contains information about:

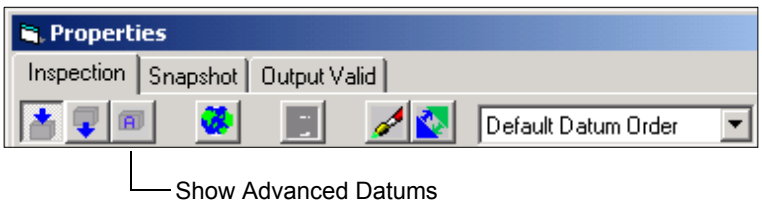
Setting Up and Starting the Part Queue

Use the following procedure to set up and start the Part Queue:

1. With a job loaded in FrontRunner, click 

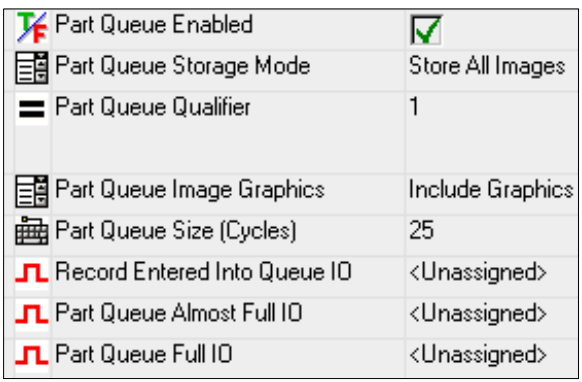
2. In the left pane of the editor, highlight the Inspection step in the Step Tree.
3. In the right pane of the editor, click Show Advanced Datums, as shown in Figure 4–1.

FIGURE 4–1. Show Advanced Datums Button



FrontRunner displays the Inspection Step properties page with the Part Queue properties displayed, as shown in Figure 4–2.

FIGURE 4–2. Inspection Step Properties Page (Partial Page Displayed)



4. Click to the right of Part Queue Enabled to enable the Part Queue.
5. Click to the right of Part Queue Storage Mode and select one of the following options for storing images:

- Store All Images
- Store Failed Images
- Store Passed Images
- Store Qualified Images (for more information about qualified images, see “Storing Qualified Images” on page 4-4)

Note: Clicking Store No Images (the default) stops the Part Queue.

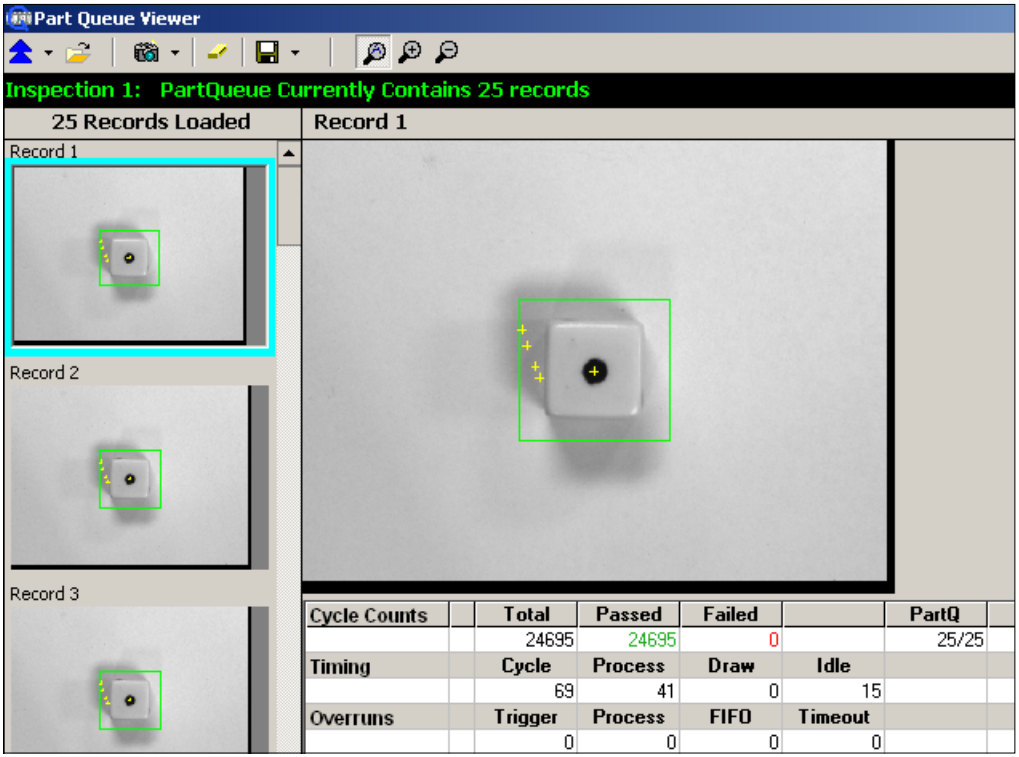
6. Click to the right of Part Queue Size (Cycles) and specify a value to indicate the number of images to be stored by the Inspection Step.

Note: Setting the size to 0 disables the Part Queue.

7. Minimize or close the Editor window
8. Click 
9. From the View Menu, select Part Queue.

   FrontRunner displays the main Part Queue window, as shown in Figure 4–3.

FIGURE 4–3. **Part Queue Main Window**



The status bar will increment as each image is saved in the Part Queue.

Storing Qualified Images

Visionscape allows you to store images that meet certain criteria that you specify in the Part Queue Qualifier. If Part Queue Qualifier evaluates to TRUE, then the image is saved in the Queue; if it evaluates to FALSE, then it is not. When an inspection runs and meets the image storage criteria, the inspection step saves all camera images in CPU memory for that part, which can then be stored to be reviewed at a later time.

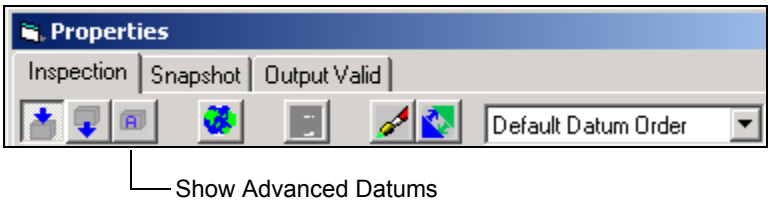
Use the following procedure to specify the criteria for storing qualified images:

1. Add and select a camera.

2. Take control of the camera.
3. From the Edit window in FrontRunner, click 

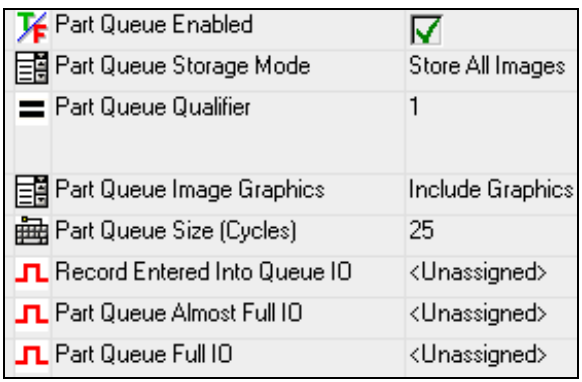
4. Highlight the Inspection step in the Step Tree.
5. Click Show Advanced Datums, as shown in Figure 4–4.

FIGURE 4–4. Show Advanced Datums Button



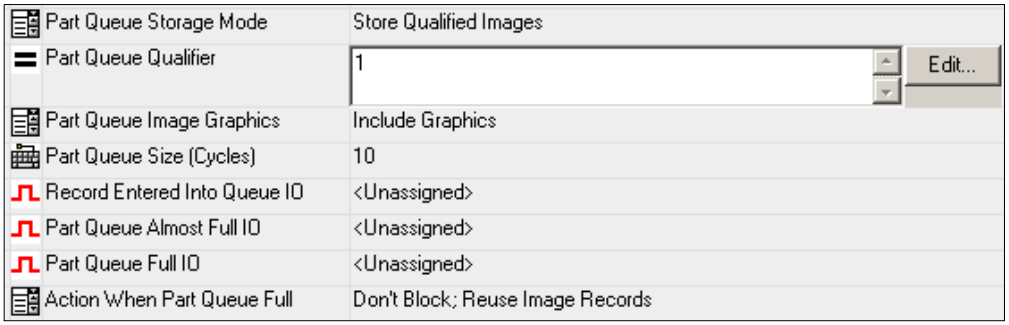
FrontRunner displays the Inspection Step properties page with the Part Queue properties displayed, as shown in Figure 4–5.

FIGURE 4–5. Inspection Step Properties Page (Partial Page Displayed)



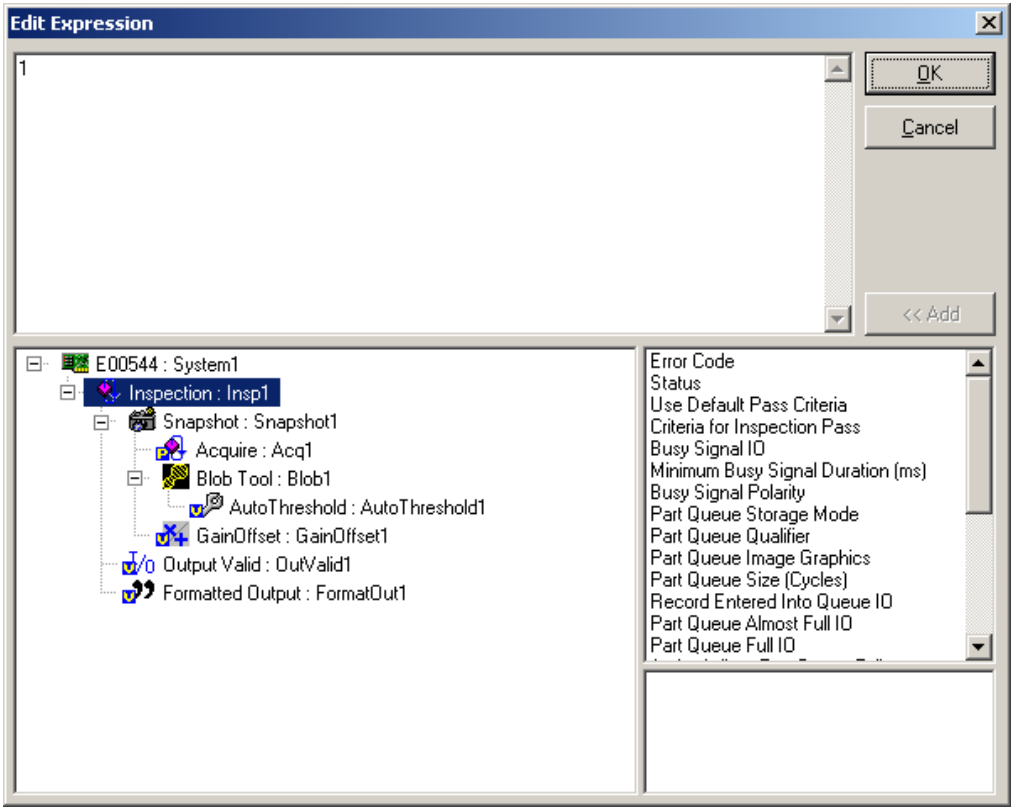
6. Click to the right of Part Queue Enabled to enable the Part Queue.
7. Click to the right of Part Queue Storage Mode and select *Store Qualified Images.*
8. Click to the right of Part Queue Qualifier. FrontRunner displays a text window and the Edit button to the right of Part Queue Qualifier, as shown in Figure 4–6.

FIGURE 4–6. Displaying Edit Button



9. Click Edit.... FrontRunner displays the Edit Expression dialog box, as shown in Figure 4–7.

FIGURE 4–7. Edit Expression Dialog Box



10. Notice the various expressions in the Edit Expression dialog box.

11. To add an expression so that it becomes part of the criteria by which an image is evaluated, highlight the expression in the lower right panel and click Add.

    FrontRunner adds the expression to the upper panel.

12. When you are finished adding expressions, click OK.

Note: For detailed information about expressions, see Chapter 8 of the Visionscape Tools Reference.

Viewing Images in the Part Queue

After setting up and starting the Part Queue, you can view images in the queue:

1. To upload Part Queue, click 

   Note: By default, this clears the camera.

   FrontRunner displays a screen similar to the one in Figure 4–8. This screen displays:

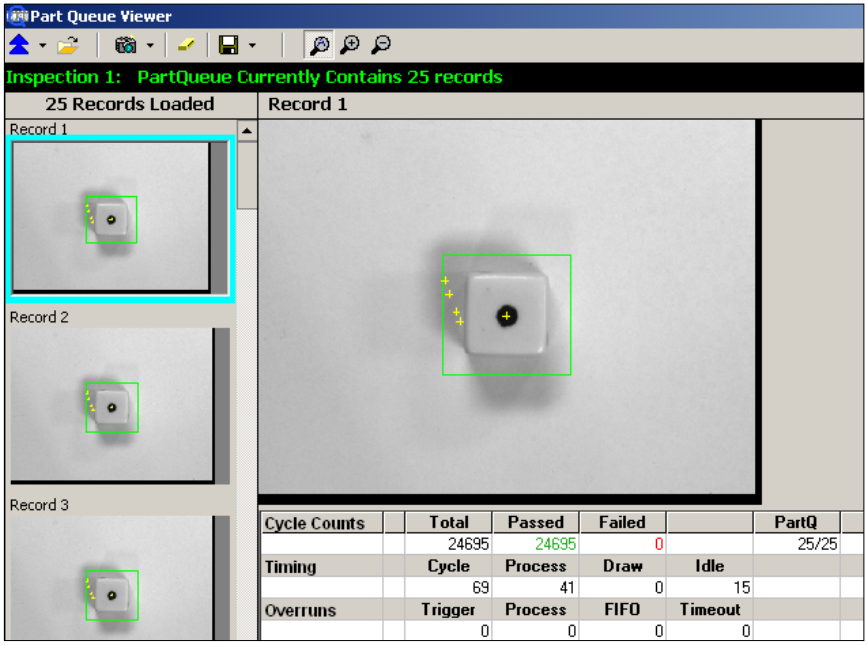
   – A vertical column of images in the queue

   – A green (pass)/red (fail) status for the currently selected image

   – Cycle information for the currently selected image

   – A larger image of the currently selected image

FIGURE 4–8. Image and Cycle Data



2. Click on the image in the filmstrip on the left that you want to display.

Saving Images and Records

From the Part Queue, you can save:

- The current image (with or without graphics)
- All images (with or without graphics)
- The current record
- All records

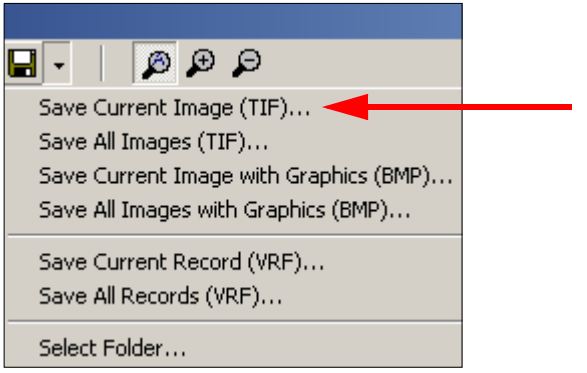
Note: A record is the image, the statistics, and the results of one inspection cycle.

Saving Current Image from the Part Queue

Use the following procedure to save the current image from the Part Queue:

1. From the Save drop down menu, click Save Current Image (TIF), as shown in Figure 4–9.

FIGURE 4–9. Save Current Image



FrontRunner saves the image in the Jobs folder using the naming convention:

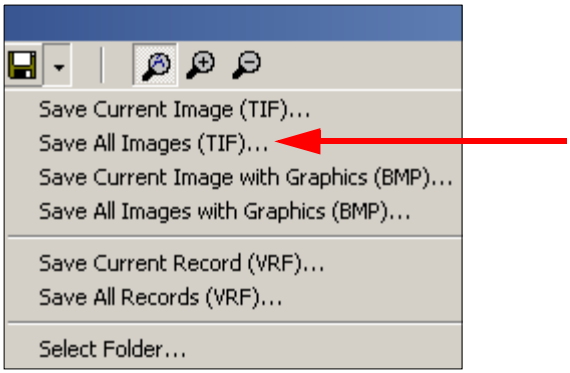
Inspection_CycleNumber_SnapshotNumber.tif

Saving All Images from the Part Queue

Use the following procedure to save all images from the Part Queue:

1. From the Save drop down menu, click Save All Images (TIF), as shown in Figure 4–10.

FIGURE 4–10. Save All Images



FrontRunner displays the Select Folder to Save All Images dialog box.

2. Select a folder and click OK.

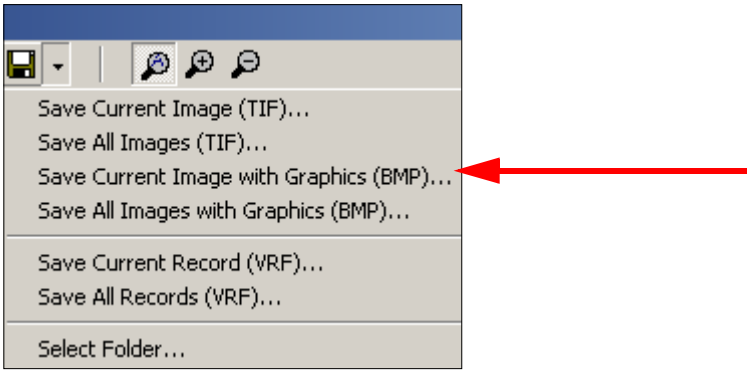
FrontRunner saves the images in the folder you specified.

Saving Current Image with Graphics from the Part Queue

Use the following procedure to save the current image, with graphics, from the Part Queue:

1. From the Save drop down menu, click Save Current Image with Graphics (BMP), as shown in Figure 4–11.

FIGURE 4–11. Save Current Image with Graphics



FrontRunner displays the Save Current Image With Graphics dialog box.

2. Select a folder and click Save.

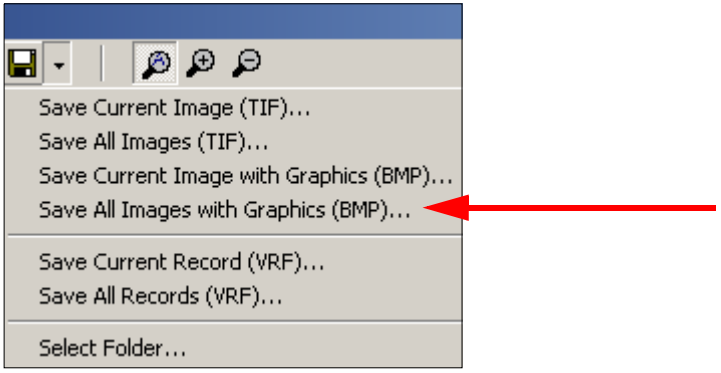
   FrontRunner saves the image, with graphics, in the folder you specified.

Saving All Images with Graphics from the Part Queue

Use the following procedure to save all images, with graphics, from the Part Queue:

1. From the Save drop down menu, click Save All Images with Graphics (BMP), as shown in Figure 4–12.

FIGURE 4–12. Save All Images with Graphics



FrontRunner displays the Select Folder to Save All Images dialog box.

2. Select a folder and click OK.

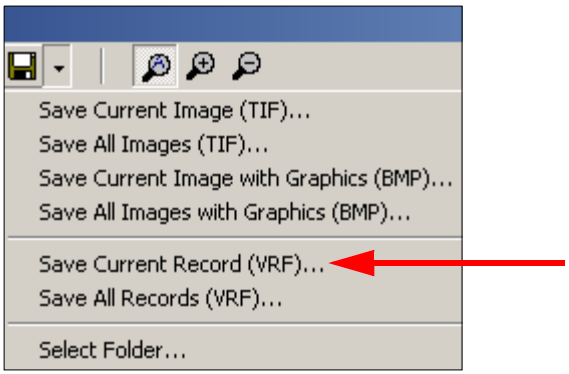
   FrontRunner saves the images, with graphics, in the folder you specified.

Saving the Current Record from the Part Queue

Use the following procedure to save the current record from the Part Queue:

1. From the Save drop down menu, click Save Current Record (VRF), as shown in Figure 4–13.

FIGURE 4–13. Save Current Record



   FrontRunner displays the Select Current Record dialog box.

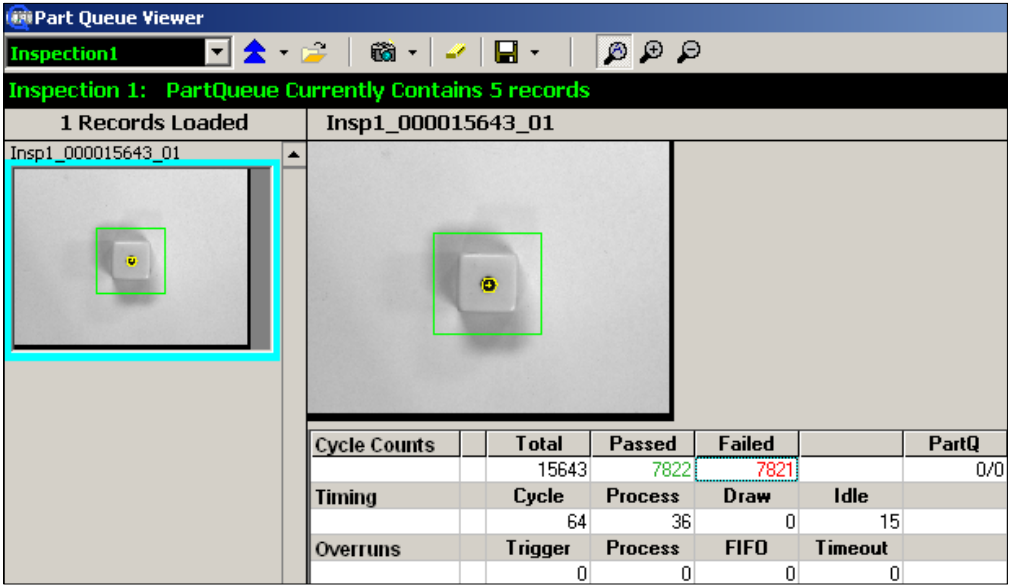
2. Select a folder and click Save.

   FrontRunner saves the record in the folder you specified. The file name format is similar to the following:

   Insp1_000015643.vrf

   Figure 4–14 shows record information for an inspection.

FIGURE 4–14. **Record Information**

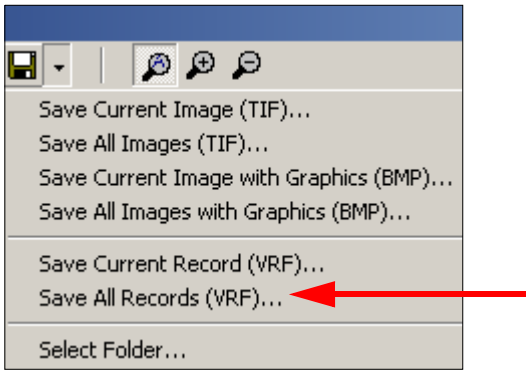


Saving All Records from the Part Queue

Use the following procedure to save all records from the Part Queue:

1. From the Save drop down menu, click Save All Records (VRF), as shown in Figure 4–15.

FIGURE 4–15. Save All Records



FrontRunner displays the Select Folder to Save All Q Records dialog box.

2. Select a folder and click OK.

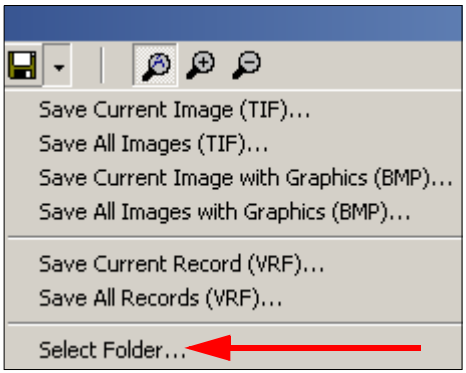
   FrontRunner saves all records in the folder you specified.

Selecting the Default Folder Location

Use the following procedure to select the default folder location:

1. From the Save drop down menu, click Select Folder, as shown in Figure 4–16.

FIGURE 4–16. Select Folder



FrontRunner displays the Select Default Folder Location dialog box.

2. Select a folder and click OK.

   FrontRunner selects the default folder.