

MICROSCAN®

DMx AutoID+™ User Manual

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Welcome!

Purpose of This Manual

This manual is a comprehensive guide for setting up, installing, and using the DMx AutoID+™ software and related hardware. It also includes information on Data Matrix symbology and image acquisition.

Manual Conventions

The following typographical conventions are used throughout this manual.

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

CHAPTER 1 **DMx AutoID+™**

This chapter provides an overview of the DMx AutoID+™, including product description and components, system requirements and specifications.

Overview

The DMx AutoID+™ is an advanced, high-performance symbology reader, capable of reading barcodes including all common 1D, PDF-417, Data Matrix, and QR Code, and performing Optical Character Recognition (OCR) for SEMI, OCR-A and OCR-B font. The optional inline verification supports all public print quality standards for 1D barcodes and Data Matrix and also offers the Microscan patented DPM Verification technology. Powerful, state-of-the-art image processing algorithms and the Microsoft Windows software interface allow the DMx AutoID+™ to solve the most demanding shop-floor automatic identification and data collection problems.

The DMx AutoID+™ supports up to four 0300 boards. Each board supports up to four cameras, which can be triggered individually or synchronously via the optional Mini Opto I/O board or Combination I/O board. The versatile system auto-discriminates between major 2D and 1D Barcodes, and can read multiple barcodes, Data Matrix, and OCR in the same Field of View (FOV). The DMx AutoID+™ performs up to 1800 reads/minute in high-resolution mode, and achieves 3600 reads/minute in low-resolution modes.

The DMx AutoID+™ provides on-screen images and data display for each camera input in its easy-to-use Windows-based GUI. Supporting a variety of marking techniques, the system decodes damaged and low-contrast codes

robustly and verifies barcode/Data Matrix quality at high speed with accurate and repeatable results. The decode and verification results can be sent to other devices or applications via RS-232, TCP/IP, or as input to Windows applications via keyboard emulation (wedge), or logged to files for further data processing. Utilizing the ActiveX controls provided by DMx AutoID+™, the user can quickly introduce barcode reading and verification capabilities into custom Windows programs written in Microsoft Visual Basic.

System Components

Standard

- DMx AutoID+™ software
- Single-slot 0300 board with interface to RS-170 and CCIR cameras and onboard digital I/O
- An I/O Port Connector bezel that replaces a blank port access cover
- Internal cabling for connecting:
 - I/O connector on the 0300 board to the I/O port connector
 - PC power to the 0300 board camera power connector

Optional

- Camera, stand, lens, light source
- Mini I/O or Combination I/O board

Configuration

- 0300 board
- Camera Cables
- DMx AutoID+™ Software (CD only)
- DMx AutoID+™ License Key
 - If the 0300 board is installed:
 - You need a License Key for OCR
 - You need a License Key for inline verification
 - If no 0300 board is installed:
 - You need a License Key for Barcode/Data Matrix
 - You need a License Key for OCR
 - You need a License Key for inline verification
- DMx AutoID+™ User Manual

Minimum Host PC Requirements

- Pentium III class CPU (350 MHz or higher)
- 128 MB memory required
- 2 GB hard disk (Enhanced IDE)
- SVGA display (800x600 with 256 colors)
- Disk Space — Approximately 20 MB free to install the software
- One open PCI slot (necessary for 0300 board installation only)
- Microsoft Windows 2000/XP with Service pack 2

DMx AutoID+™ Specifications

Physical

Half-length PCI board

Symbologies

- Data Matrix
- PDF-417
- Code 39
- Codabar
- Code 128
- Code 93
- Interleaved 2 of 5
- UPC/EAN
- UPC-E
- UPC Supplementals
- RSS
- QR Code
- Postnet
- Pharmacode
- Optical Character Recognition (SEMI, OCR-A, B)

Operational

- Up to 30 reads per second with full 640x480 resolution or 25 reads per second with full 768x572 resolution
- Up to 60 reads per second with 320x240 resolution or 50 reads per second with 384x286 resolution
- RS-170 or CCIR video inputs
- Reading results with debugging outputs
- Methods to reformatting the reading results
- Simple and effective learn mode
- Four-camera asynchronous or synchronous image acquisition with strobe output per 0300 board
- Continuous mode with retry upon failure
- 16 programmable digital I/O
- Multiple image display options
- Ethernet TCP/IP connectivity
- Fiducial finding capability
- Code quality verification
- Password protection mode
- Support for up to four 0300 boards
- Windows GUI with ActiveX control programming support

Environmental

- Operating Temperature: +32° to 104° F (0° to 40° C)
- Storage Temperature: -4° to 149° F (-20° to 65° C)
- Humidity: Up to 95% non-condensing

DMx AutoID+™ Installation

This chapter explains the complete software and hardware installation procedures. For first time installations, you must install the software prior to installing the 0300 board.

Software Installation

Before installing the DMx AutoID+™ software, exit from other applications and disable any virus protection software you are running. You may re-enable the virus protection software after installation is complete.

The DMx AutoID+™ software can run on Windows 2000 and XP platforms.

To install or upgrade to DMx AutoID+™ 2.0, double click the setup.exe icon in the Install folder in the installation CD. Reboot as required. For upgrading, there is no need to uninstall any previous version prior to upgrading to the new version.

If you are upgrading from previous versions of DMx AutoID+™ with a 0300 board already installed, you only need to perform the Software Installation section to upgrade the software to version 2.0. When you need to install a new 0300 board, follow the Hardware Installation section after first installing the software.

Hardware Installation

Basic Setup Procedures

The setup and installation procedure for your DMx AutoID+™ involves:

- Unpacking the 0300 board
- Installing the 0300 board
- Installing the Camera Power cable
- Mounting the cameras
- Connecting all cables and power
- Installing the Software Protection Key (also called Dongle) to your PC's parallel or USB port
- Optionally installing the Mini Opto I/O or Combination I/O Board and associated hardware (see Appendix A, "Optional Hardware Installation," for more information)

General Location Considerations

You can situate the 0300 board in most environments without any concern for special enclosures or cabinets.

Consider the following when determining site selection:

- Ensure that the camera cable is long enough to reach your PC.
- Avoid severe vibrations.
- Locate the components to avoid accidental bumping.
- Protect your PC and components against dust, humidity, extreme temperatures, and extremely harsh environments.

Environmental Requirements

The environment of your PC is important for maintaining a reliable system. You should consider the humidity, temperature, foot traffic, and fresh air-flow before permanently mounting your system.

- Fan Performance — 38 CFM minimum
- Typical Temperature Rise — 6.0oC, on every component on the 0300 board

Recommended Tools

You will need the tools listed below for the basic installation. However, you may need additional tools for custom installations.

- Small straight-edge screwdriver
- Small Phillips screwdriver
- Microscan-provided ESD ground strap

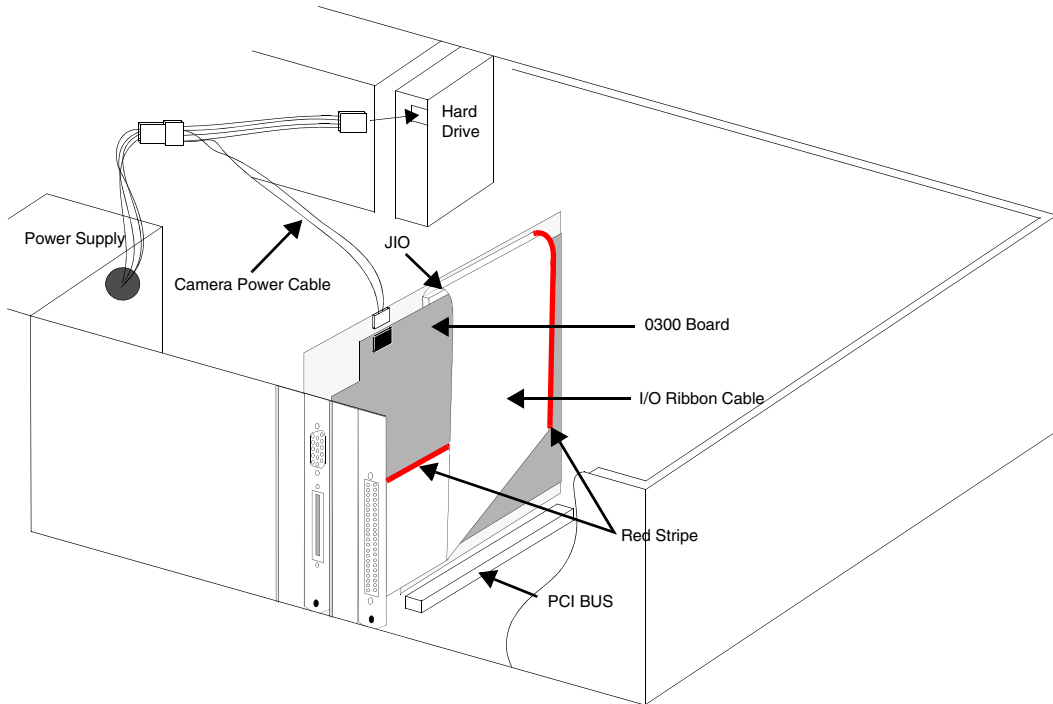
Installing the 0300 Board

1. Remove the cover of your PC.
2. Locate an open PCI slot.
3. Unscrew the Port Access Covers on the PC.
4. Install the 0300 board by aligning the gold fingers and pressing the module firmly into the slot.
5. Fasten the 0300 board with port access screws.

Installing the Internal Camera Power Cable

1. Connect the small connector of the internal Camera Power Cable to the Camera Power connector on the 0300 Board, as shown in Figure 2-1.

FIGURE 2-1. Internal Cabling

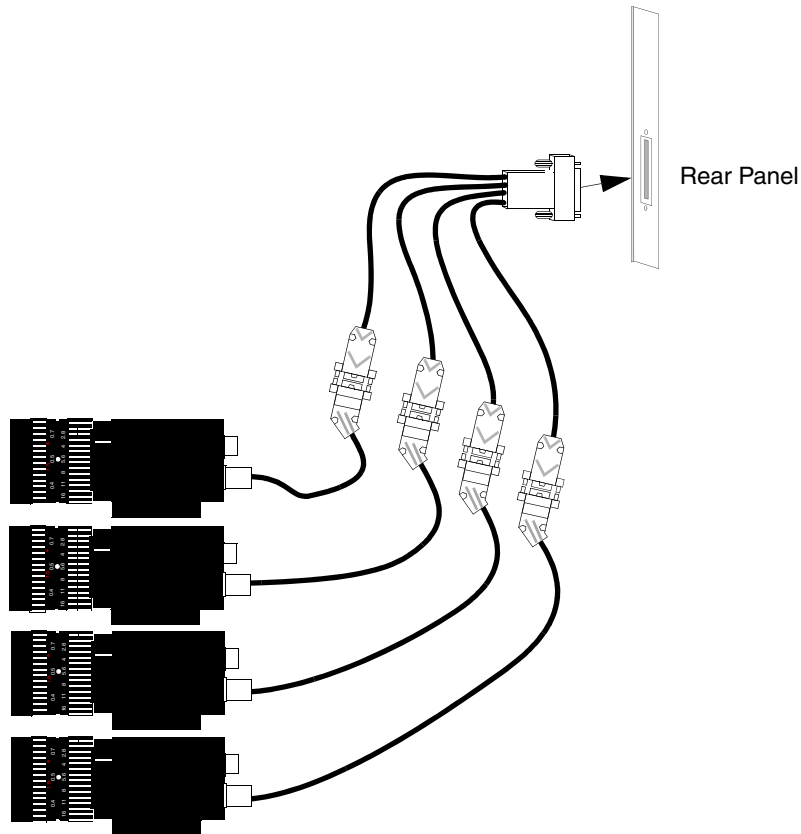


2. Connect the middle connector to an unused Hard Drive power cable in the PC.

Connecting the Camera Cable

For analog camera operation, connect the multiple-camera cable to the camera port on your PC and connect the camera cable from the camera to the other end of the multiple-camera cable, as shown in Figure 2–2.

FIGURE 2–2. Camera Cabling

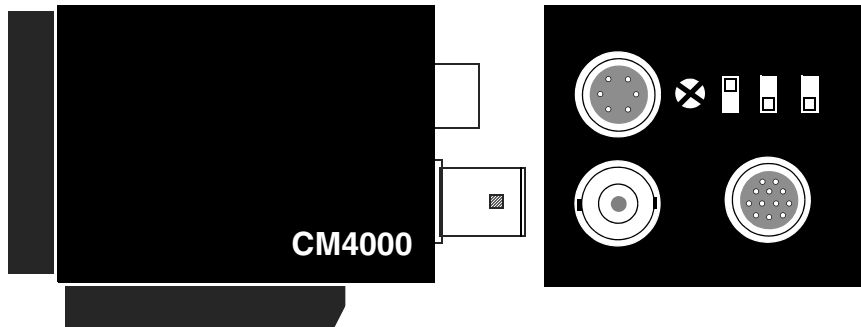


Note: For detailed information about analog cameras, refer to the 0300 Board User Manual.

Figure 2–3 shows an example of an RS170 factory-modified CM4000 camera. The connectors at the rear of the camera supply power and sync to the camera, and send video from the camera to the 0300 board. The *IRIS* and *VIDEO*

connectors are not used for normal operations. Set the switches to *I.O*, *MGC*, and *FRM*.

FIGURE 2-3. CM4000 Camera



Camera Mount

The camera mount holds the camera in a fixed position. If the camera moves, the results of the inspection may not be valid. Refer to Appendix B, “Creating A Good Image,” for more information.

Note: Mount the camera in a low-vibration environment. Otherwise, use a strobe in low ambient light.

Checklist

- Ensure that the camera is grounded only by the camera cable back to the camera port on the PC.

The CM4000 camera case is connected to the camera’s return circuit. This means that a camera affixed to an earth-grounded metallic fixture has the potential for creating a ground loop. A ground loop is an undesirable circuit created when grounds are connected at two or more locations. Return signals tend to flow through both ground circuits which results in noise and/or distortion in the camera’s video signal.

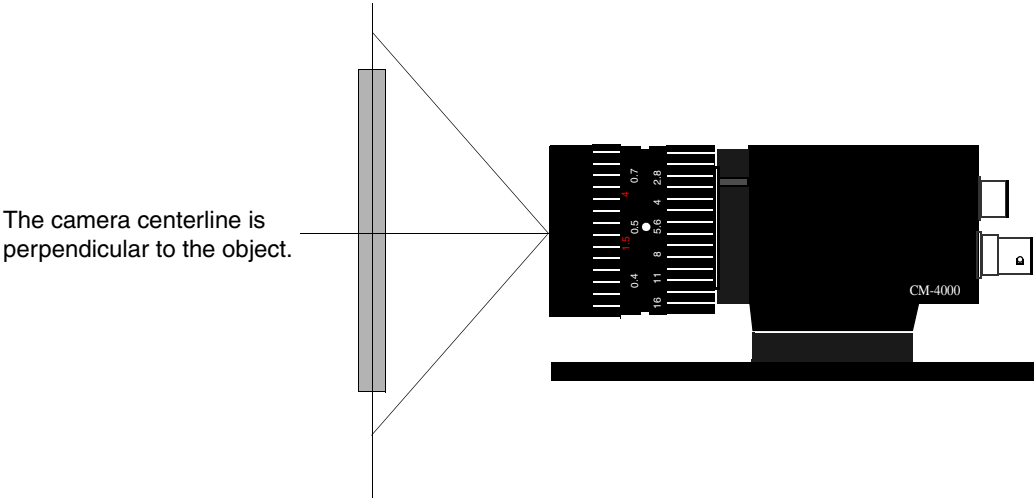
Isolate the camera’s body from grounded fixtures. You could use plastic mounting bolts in conjunction with an insulating pad or mount the camera to a non-metallic mount and then install the camera/mount assembly as a unit.

- Position the camera to get the best Field of View (FOV), e.g., optimum viewing of the part and features. Please refer to Appendix B, “Creating A Good Image,” for more information.
- If the camera needs to be adjusted in the X, Y, or Z axis, the mount must be able to adjust in those directions.
- Provide a way to clamp the lens to minimize image movement.
- Provide strain relief for the camera cable.
- Build a shroud to prevent accidental damage to the camera and to prevent dirt or dust from getting on the lens.
- Ensure that the camera mount is strong enough to prevent bending if accidentally hit. Ensure that you minimize or eliminate vibrations.

Ensuring Optimum Field Of View

It is best to mount the camera assembly so that its centerline is as perpendicular as possible to the desired Field Of View, as shown in Figure 2-4.

FIGURE 2-4. Camera Centerline



This reduces the chance of errors due to:

- Poor Depth of Field — The range of distance with acceptably sharp focus at the front and back of the subject, is improper for the application.

- Foreshortening — One axis of the image appears shorter than the another.

The decision of where to mount your camera is important because it influences which lens you will use.

Adjusting the Camera Position

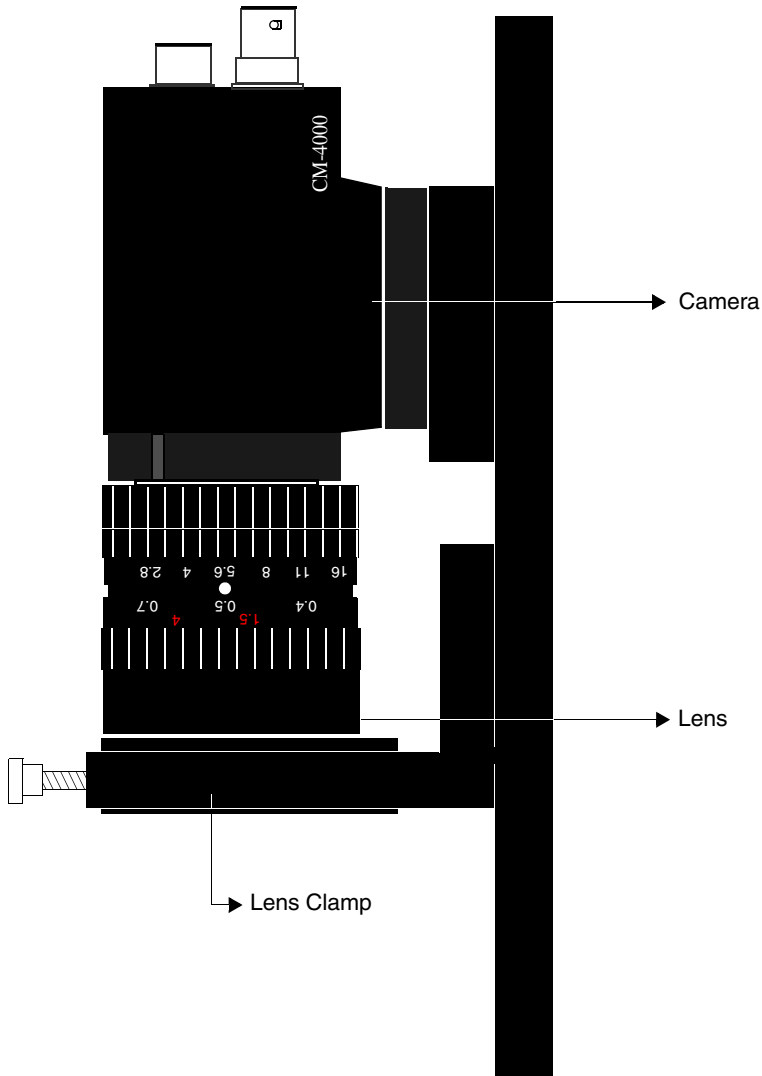
After you determine the best FOV for your application and determine the type of lens and its distance from the object being viewed, determine whether it is necessary to move the camera. For example, you may be viewing different parts on one line and each part may require a different X (horizontal), Y (vertical), or Z (in and out) position. Refer to Appendix B, “Creating A Good Image,” for more information.

The most common change is in the X and Y position. A screw-adjusted slide on the camera mount allows the best camera adjustment.

Clamping the Lens

Any lens movement, either by changing the focus or the f-stop, can seriously affect the results of the inspection. Ensure that the lens cannot move once it has been set. The best method to inhibit movement is to clamp the lens, as shown in Figure 2–5. This ensures that the focus and f-stop will not change, and should also prevent mechanical stress from being transferred to the camera.

FIGURE 2-5. Lens Clamp



Optional Hardware Assembly

Refer to Appendix A, “Optional Hardware Installation,” to install the I/O board and related hardware.

Starting DMx AutoID+™

Note: Prior to launching the software, if needed, securely attach the optional License Key to the PC's parallel or USB port. For more information about the optional License Key, see "Configuration" on page 1-3

To launch the DMx AutoID+™:

1. Click the **Start** button from the Windows taskbar.
2. Select **Program Files**, the DMx AutoID+™ folder, then the DMx AutoID+™ program.

This chapter provides three DMx AutoID+™ tutorials that demonstrate setting parameters, learning a Data Matrix (samples vs. actual), and running inspection. Use these tutorials to become better acquainted with the DMx AutoID+™ program prior to full operation.

Note: This chapter serves as a guide. Your results may vary. Refer to Chapter 4, “DMx AutoID+™ Reference Guide,” for comprehensive descriptions of the DMx AutoID+™ GUI.

To launch the DMx AutoID+™ from your Windows desktop, click the Start button, choose Programs, and then select DMx AutoID+™. This displays the DMx AutoID+™ main menu (GUI), as shown in Figure 3–1.

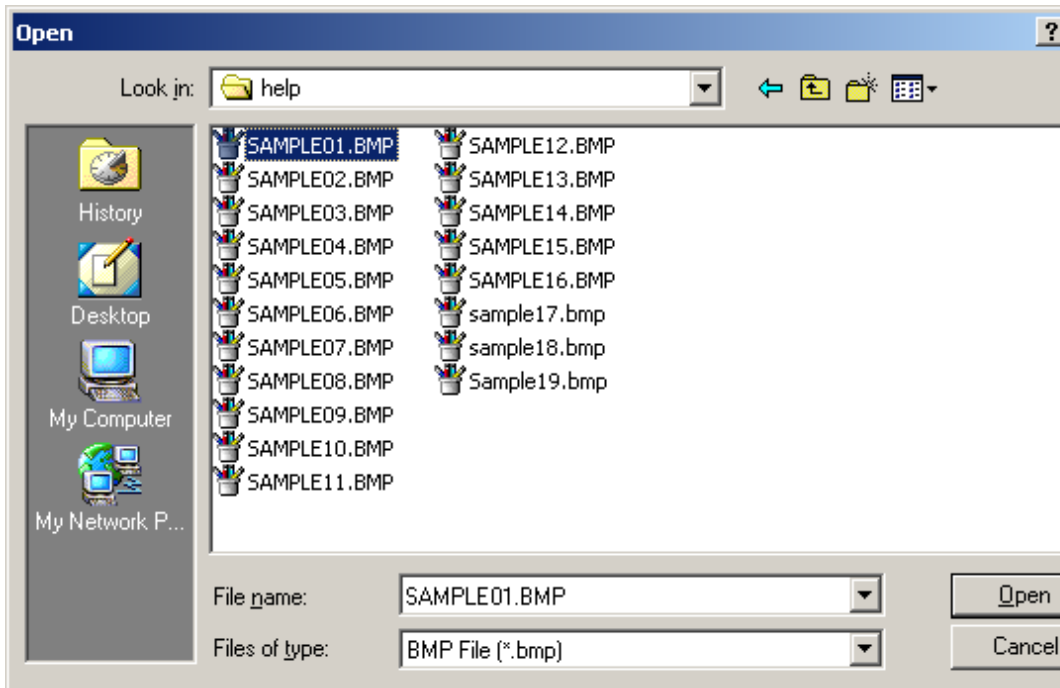
FIGURE 3–1. DMx AutoID+™ Main Menu (GUI)



Tutorial #1 — Reading Sample Data Matrix from File

1. From the main menu, open the File menu and select Open. This displays the Open dialog box, as shown in Figure 3–2.

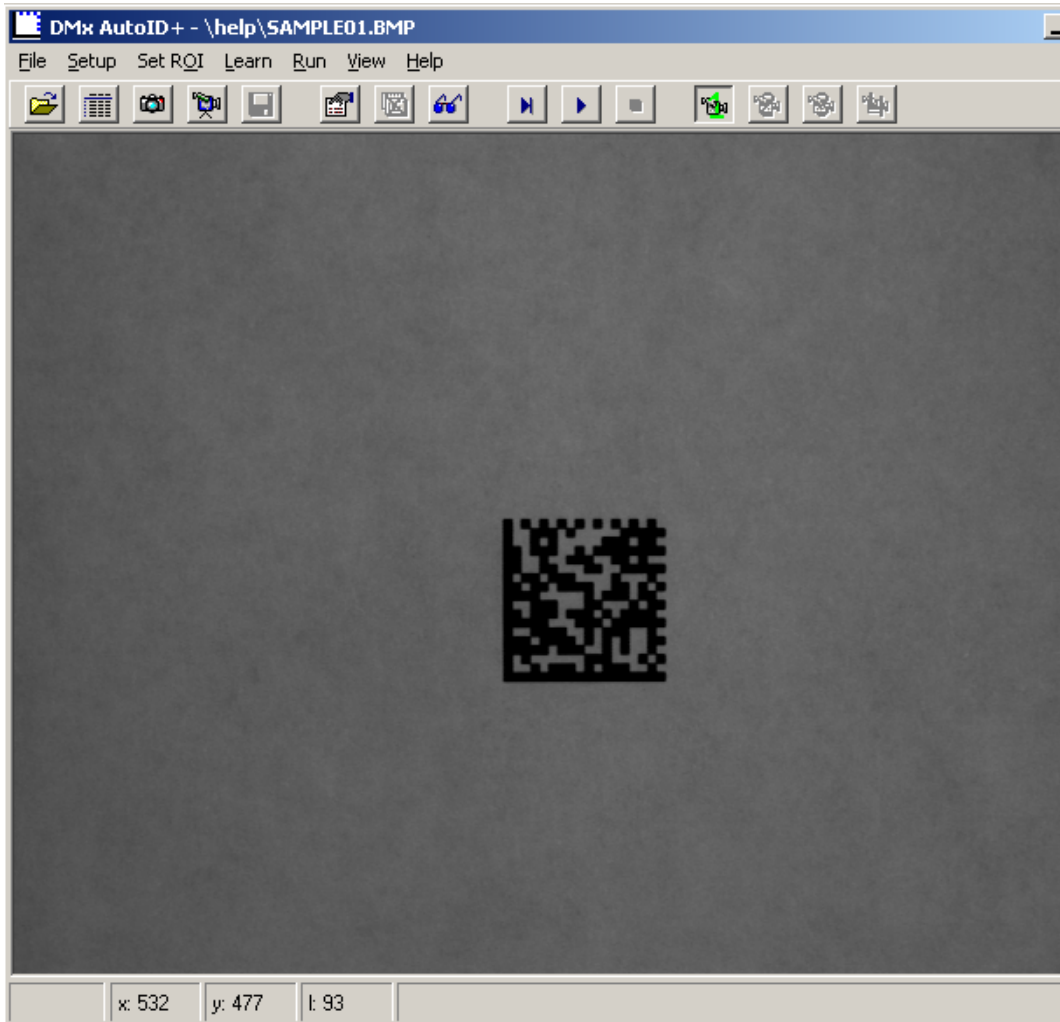
FIGURE 3–2. Open Dialog Box



Tutorial #1 — Reading Sample Data Matrix from File

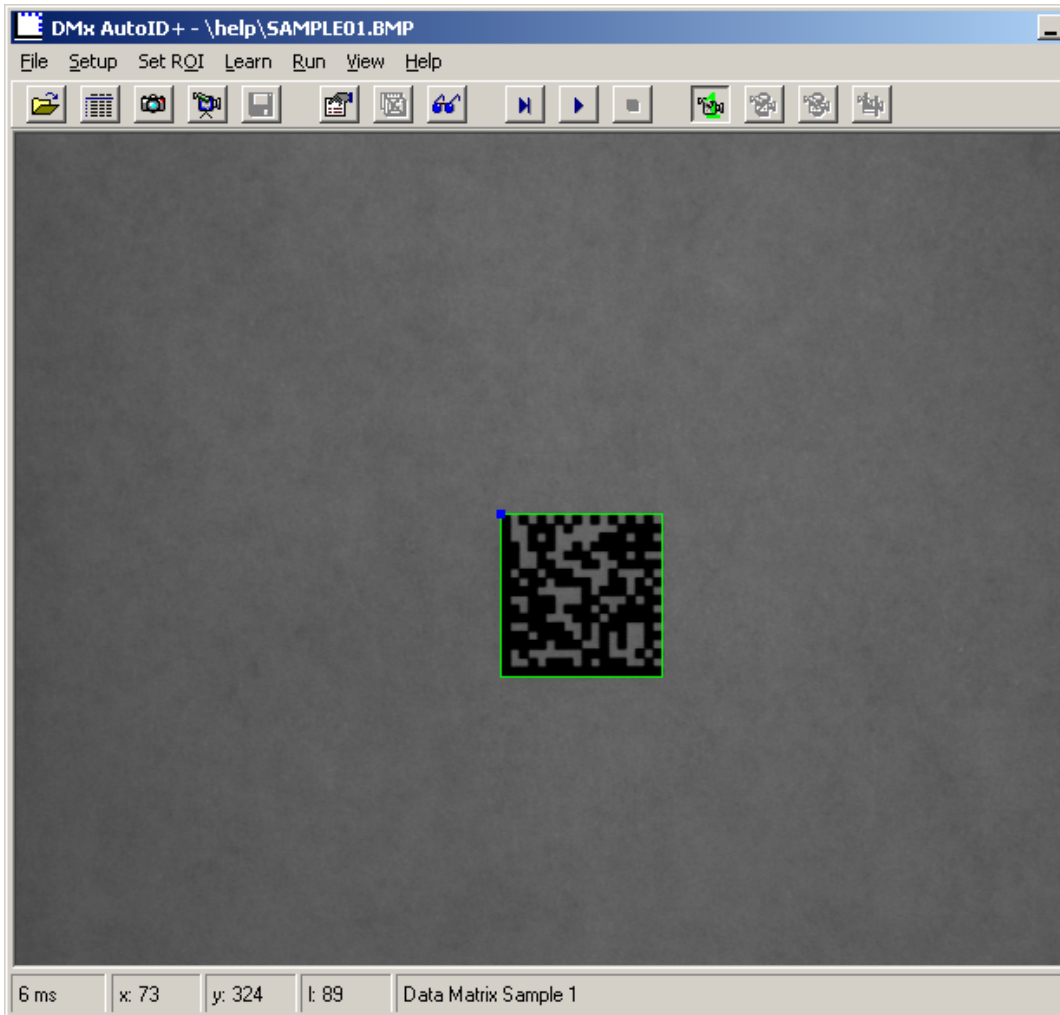
2. Select *sample1* and click **Open**. The image is displayed, as shown in Figure 3–3.

FIGURE 3–3. Sample 1



3. Open the Learn menu and select **Data Matrix**. The Data Matrix will be learned immediately with results displayed in the Status Bar, as shown in Figure 3–4. This menu item is detailed in “Learn>Data Matrix” on page 4-99.

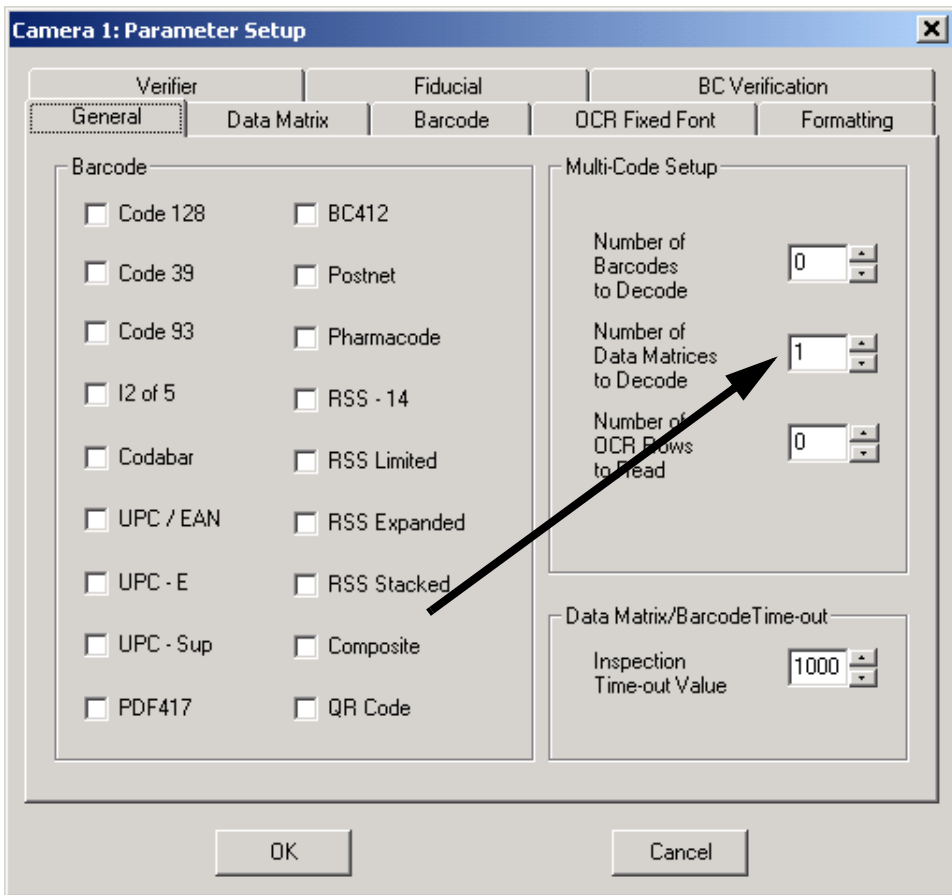
FIGURE 3–4. Shows Learned Data Matrix



Tutorial #1 — Reading Sample Data Matrix from File

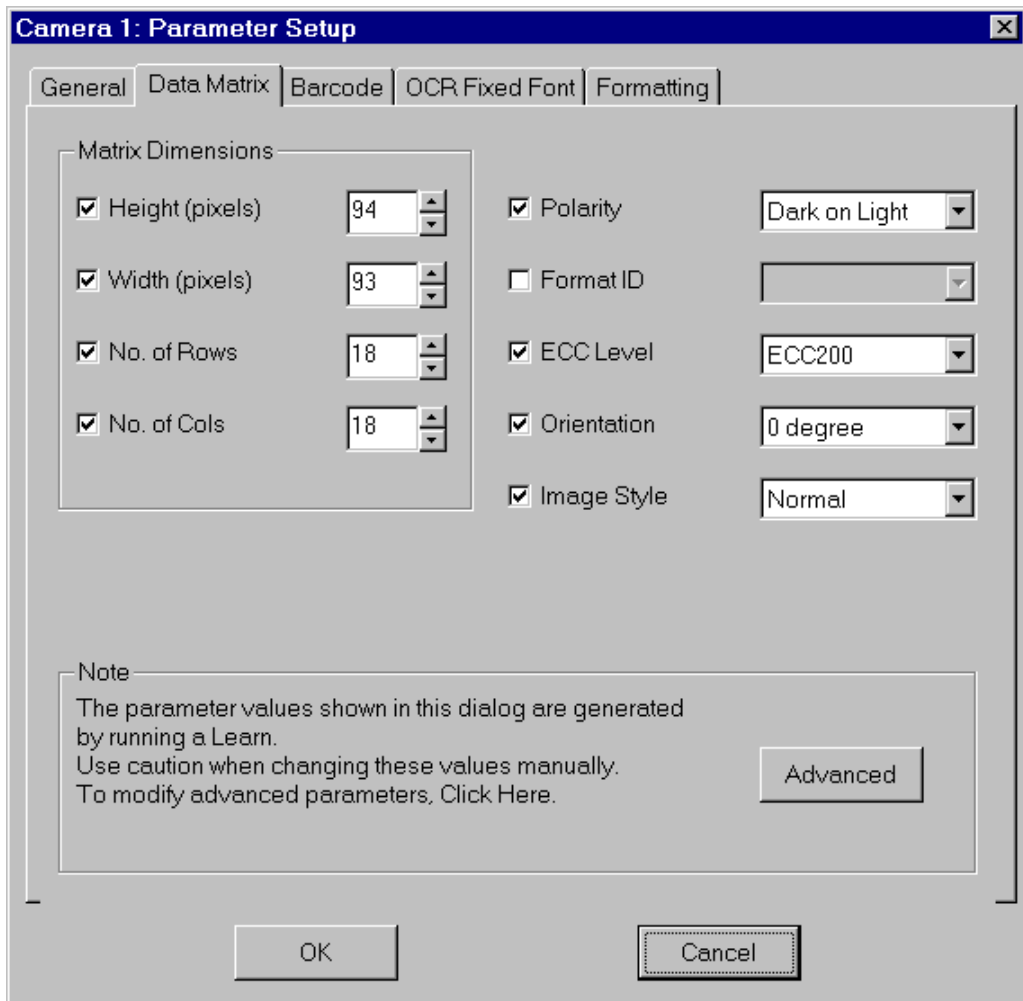
4. Notice the Status Bar panel.
 - The first field displays the time taken to learn the Data Matrix which, in this example, is 6 milliseconds.
 - The next three fields display the current coordinate values of the mouse pointer. In this example, the panel shows pixel coordinates of *x: 73*, *y: 324*, with a grayscale value of *l: 89*.
 - The last field displays the decoded result of the Data Matrix which, in this example is *Data Matrix Sample 1*.
5. The DMx AutoID+™ is configured to read one Data Matrix of similar size and orientation in the entire Field Of View (FOV). To view these settings, open the Setup menu and select **Parameters**. This displays the Parameter Setup — General dialog box, as shown in Figure 3–5. This menu item is detailed in “Setup>Parameters>General” on page 4-18.

FIGURE 3-5. Parameter Setup — General Dialog Box



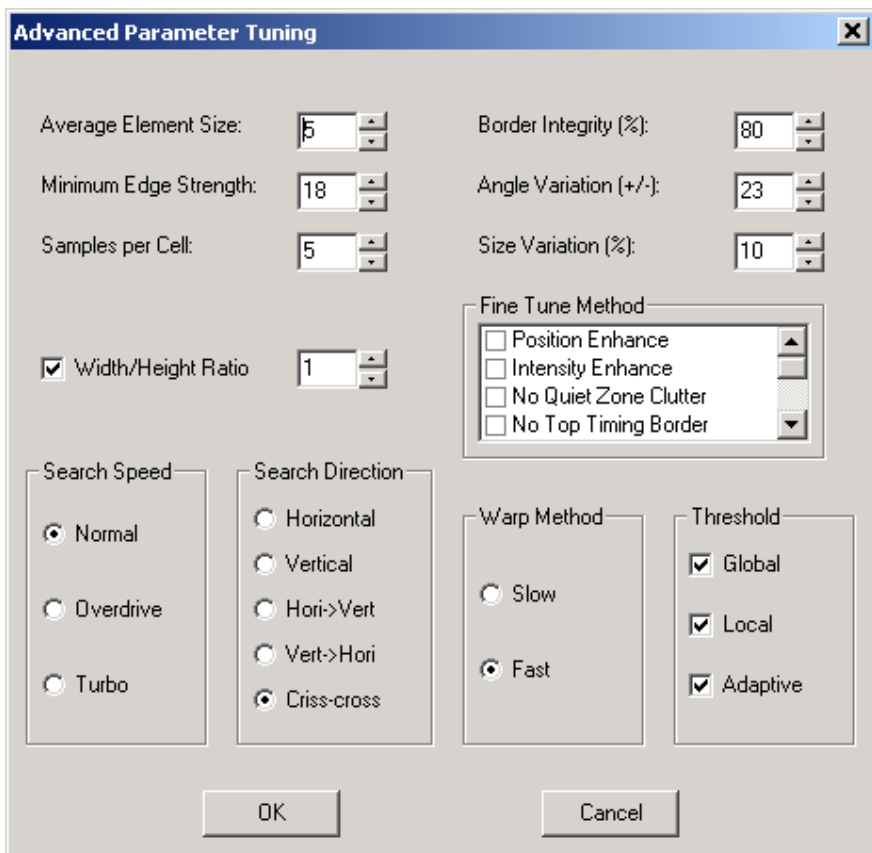
6. Notice that the setting for Number of Data Matrices to Decode in the Multi-Code Setup box has been configured to read 1 Data Matrix.
7. To display the *Learned* Data Matrix settings, click the Data Matrix tab. This displays the Parameter Setup — Data Matrix dialog box, as shown in Figure 3-6.

FIGURE 3-6. Parameter Setup — Data Matrix Dialog Box



8. Click **Advanced** to display the Advanced Parameter Tuning dialog box, as shown in Figure 3–7. This menu item is detailed in Figure 4–13, “Advanced Parameter Tuning Dialog Box,” on page 4-23.

FIGURE 3–7. Advanced Parameter Tuning Dialog Box



9. Notice that **Average Element Size** is set to 5 pixels. This is highly recommended in order to achieve fastest speed and most robust performance when configuring a typical Data Matrix size in the FOV. If necessary, refer to a complete description of **Average Element Size** in Figure 4–13, “Advanced Parameter Tuning Dialog Box,” on page 4-23.
10. To perform a Data Matrix reading, open the Run menu and select **Run Continuously**. This menu item is detailed in “Run>Run Continuously” on page 4-127.

Tutorial #1 — Reading Sample Data Matrix from File

11. The same Data Matrix is repeatedly decoded and the total number of reads is displayed in the second field along the Status Bar panel. Our example, as shown in Figure 3–8, displays *102* reads.

FIGURE 3–8. Status Bar Showing Number of Decode Reads

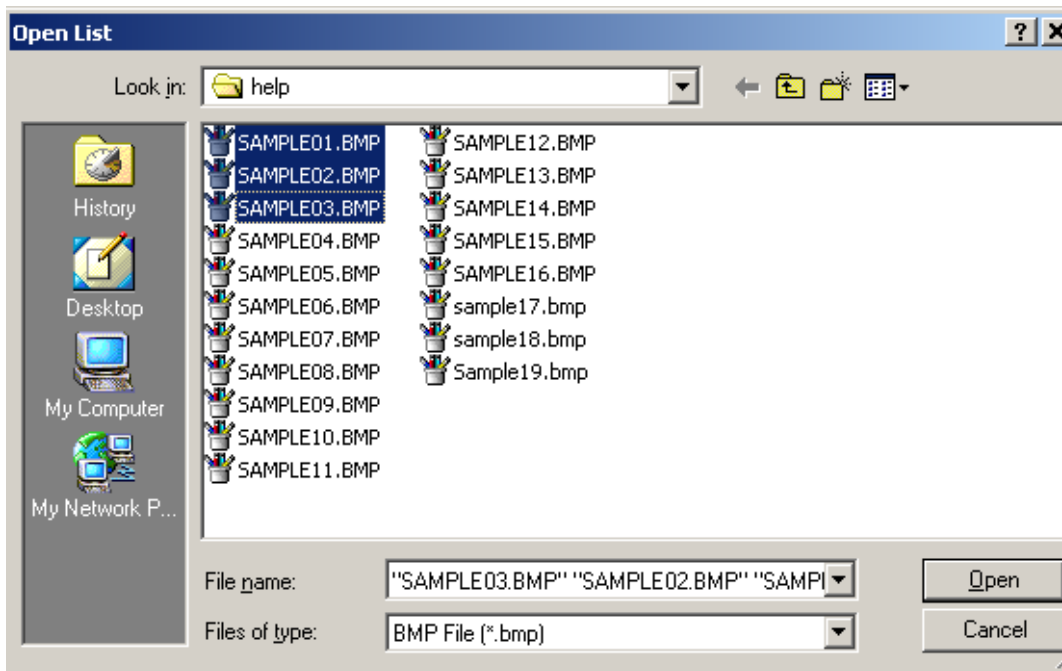


12. During the running sequence, you are allowed only one action: to *stop* the execution. To do so, click the **Stop** button on the Toolbar.

Tutorial #2 — Reading Sample Data Matrices from File List

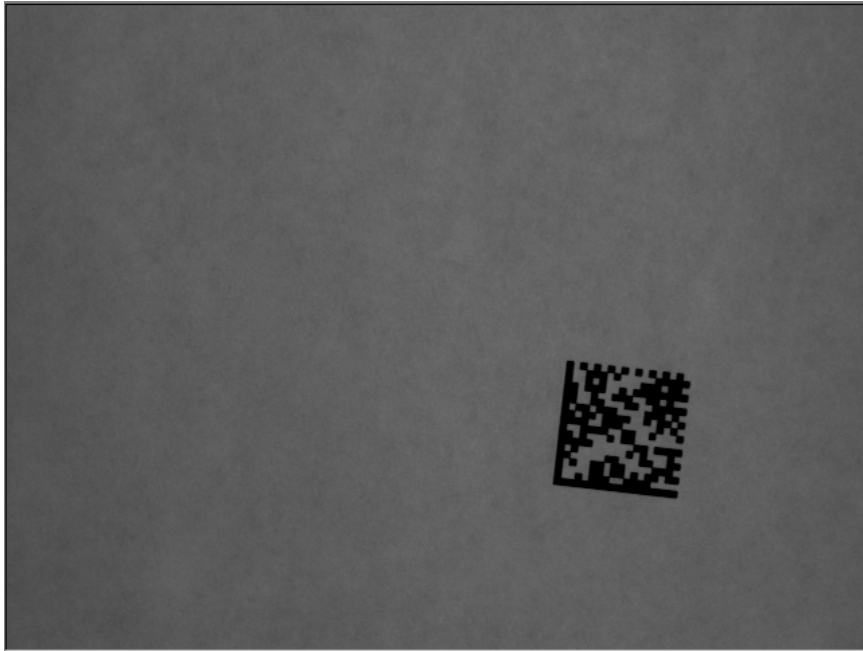
1. From the main menu (Figure 3-1 on page 3-1), open the File menu and select Open List. This displays the Open List dialog box, as shown in Figure 3-9.

FIGURE 3-9. Open List Dialog Box




2. Press and hold *Ctrl*, and then *left-click* to select the first three sample image files. Click **Open** to access and display the first image (*sample3.bmp*, in our example). The image window showing Sample 3 Data Matrix is in Figure 3-10.

FIGURE 3–10. Sample 3 Data Matrix Image Window



3. Since the Data Matrices in our 3 sample images contain similar properties to the Data Matrix learned in Step 3 on page 3-4, it is not necessary to repeat another *Learn*. Instead, to read all three consecutively, open the Run menu and select **Run Continuously**. This menu item is detailed in “Run>Run Continuously” on page 4-127.

Tutorial #3 — Reading Actual Data Matrix via Live Camera

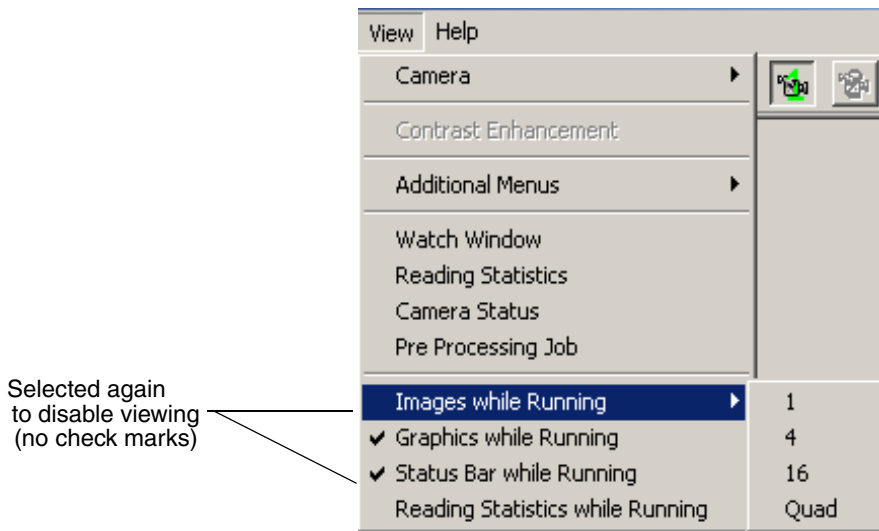
1. From the main menu (Figure 3–1 on page 3-1), open the File menu and select **Live** to display live images. This selection is detailed in “File>Live” on page 4-4.
2. Place an actual Data Matrix label in the Field of View (FOV). Center it properly in the FOV. Focus accordingly. Refer to Appendix B, “Creating A Good Image,” for additional guidance.
3. Open the File menu and select **Live** again to stop the *Live Mode*. Notice that the Data Matrix image has been captured and displayed in the DMx AutoID+™ GUI.
4. Open the Learn menu and select **Data Matrix**. This allows you to *learn* the Data Matrix. This menu item is detailed in “Learn>Data Matrix” on page 4-99.
5. To perform a Data Matrix reading on your live sample, open the Run menu and select **Run Continuously**. This menu item is detailed in “Run>Run Continuously” on page 4-127.
6. To achieve the fastest reading speed, you should stop the run first by clicking  along the Toolbar. Then perform these steps:
 - a. Open the Setup menu and select **Parameters**. Click the **Data Matrix** tab to display the Parameter Setup — Data Matrix dialog box, as shown in Figure 3–6 on page 3-7. This menu item is detailed in “Setup>Parameters>Data Matrix” on page 4-20.
 - b. Click the **Advanced** button to display the Advanced Parameter Tuning box, as shown in Figure 3–7 on page 3-8. This menu item is detailed in Figure 4–13, “Advanced Parameter Tuning Dialog Box,” on page 4-23.
 - c. Ensure that **Average Element Size** is set to a value of 5 if possible, as this is an optimum setting for the FOV. If not, change the FOV and repeat Step 1 through Step 5 in order to achieve a value as *close* as possible to 5.
 - d. Ensure that the following settings have also been made in the Advanced Parameter Tuning box. These help to optimize the fastest, yet somewhat less robust, reading performance:
 - **Samples per Cell** — 1 (when Data Matrix cells are solid)

Tutorial #3 — Reading Actual Data Matrix via Live Camera

- Fine Tune Method — No Quiet Zone Clutter (when Data Matrix background is clean)
 - Search Speed — Turbo
 - Warp Method — Fast
7. The display of images and Status Bar uses up significant PC resources. You have the option to disable them in order to achieve maximum throughput. To do so, select View, Images While Running and Status Bar While Running, respectively.

These menu items are detailed in “View Menu” on page 4-129. Notice that, when you make these selections, the check marks are toggled off, as shown in Figure 3–11.

FIGURE 3–11. View Menu with Display Items Disabled



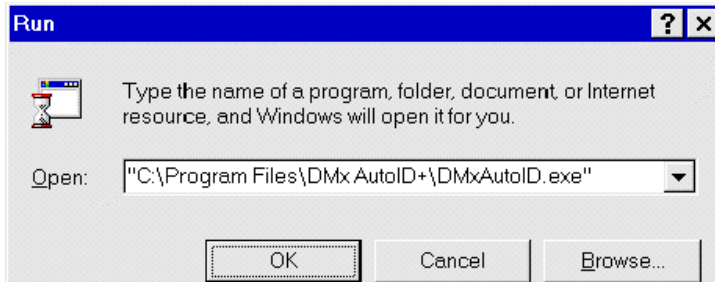
DMx AutoID+™ Reference Guide

This chapter provides a complete reference guide for DMx AutoID+™ operation. It explains the menu items, toolbar buttons, dialog boxes, and image windows provided in this product.

Launching the DMx AutoID+™

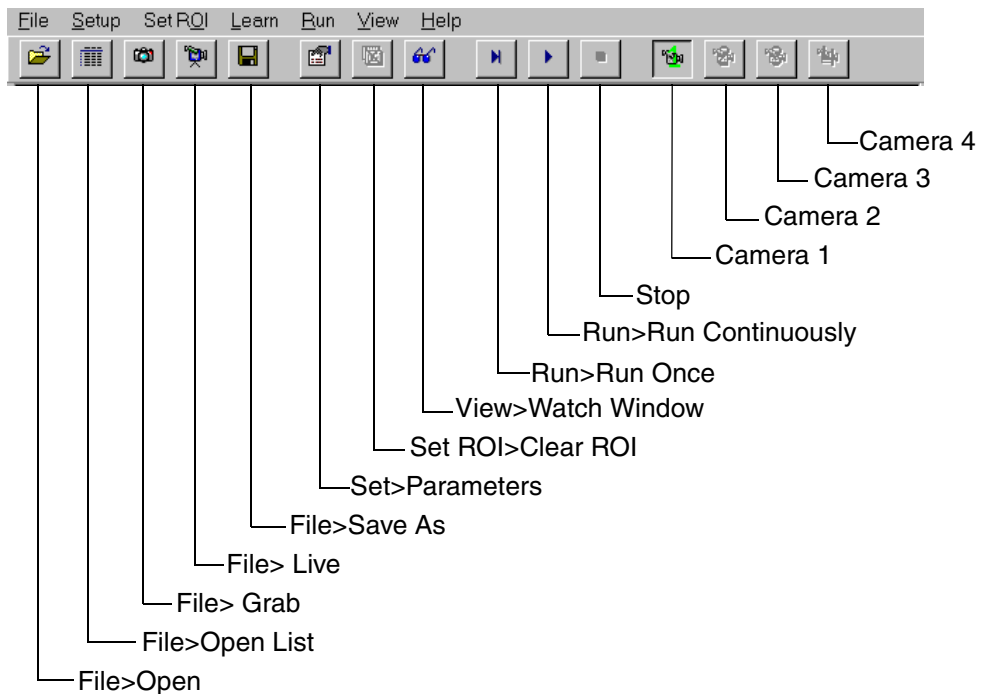
During the installation, the DMx AutoID+™ can be installed under the DMx AutoID+™ Program Group (default), or the StartUp Program Group. If you wish to run the DMx AutoID+™ program automatically every time you power up the computer, then use the StartUp Program Group. If the DMx AutoID+™ Program Group is selected in the installation, then you need to manually launch the DMx AutoID+™ program. You can either select Windows **Start**, DMx AutoID+™ (folder), and DMx AutoID+™ (program), to run the program, or select Windows **Start**, and **Run**, and then click **OK**.

FIGURE 4-1. Run Dialog Box



When the application is launched either manually or automatically upon power-up, the main menu and toolbar of the DMx AutoID+™ Graphic User Interface (GUI) is displayed, as shown in Figure 4-2.

FIGURE 4-2. DMx AutoID+™ Main Menu & Toolbar



DMx AutoID+™ Graphic User Interface

This section contains complete details on menu items, dialog boxes, image windows, and toolbar buttons that are available in the DMx AutoID+™ GUI.

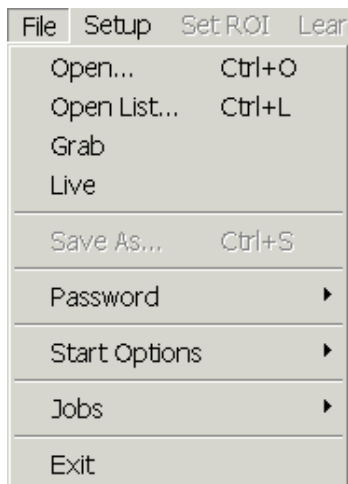
The remainder of this chapter describes the following menus:

- “File Menu” starting on page 4-3
- “Setup Menu” starting on page 4-8
- “Set ROI Menu” starting on page 4-98
- “Learn Menu” starting on page 4-99
- “Run Menu” starting on page 4-125
- “View Menu” starting on page 4-129
- “Pre Process Menu” starting on page 4-135
- “Help Menu” starting on page 4-141

File Menu

Figure 4–3 displays the File Menu:

FIGURE 4-3. File Menu



File>Open

This menu item opens an image file (.BMP, .TIF, .RAW, or ALL of these) from disk, display it and then decode it.

File>Open List

This menu item opens a list of image files (.BMP, .TIF, .RAW, or ALL of these) from disk, displays them and decodes them one by one, interactively or continuously.

File>Grab

This menu item captures an image from the 0300 board.

- If the Hardware Trigger option is **not checked**, an image will be captured immediately and displayed.
- If the Hardware Trigger option is **checked**, “Waiting for a Trigger” will be displayed in the Status Bar telling you that a new image will be captured after the first image is captured. No more images will be captured after the first image is captured.

The Grab mode can be cancelled by selecting it again before the hardware trigger occurs.

File>Live

This menu item displays live images from the 0300 board.

- If the Hardware Trigger option is **not checked**, the DMx AutoID+™ displays live images at the rate of up to 30 frames per second.
- If the Hardware Trigger option is **checked**, “Triggered Grab” will be displayed in the status bar telling you that new images will be captured whenever a hardware trigger occurs.

When live images are displayed, selecting Live again will stop the live image display mode.

For applications with hardware trigger enabled, anytime you want to display live images without having to send hardware triggers, you need to temporarily select the Hardware Trigger in Setup>System Configuration to uncheck it.

Remember to re-enable the hardware trigger after you exit the live image display.

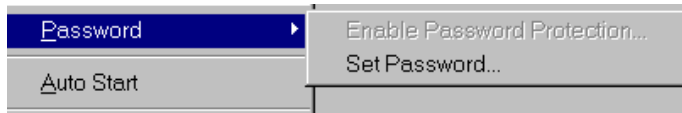
File>Save As

This menu item saves the image captured from the 0300 board as a .BMP image file.

File>Password

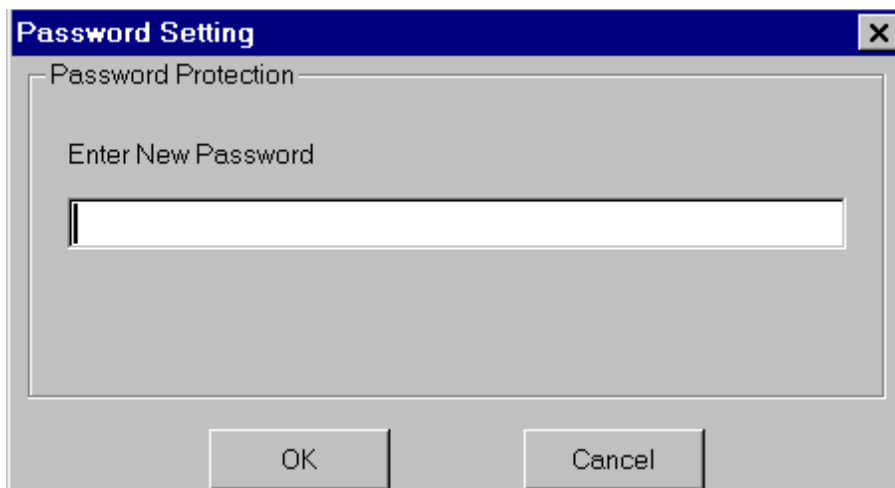
The Run Continuous mode can be protected by password so that barcode or OCR reading will not be interrupted. To use this capability, select **File > Password** to display two drop-down menu items, as shown in Figure 4-4.

FIGURE 4-4. Password Menu



When there is no password stored in the system, Enable Password Protection is grayed out unless Set Password is selected for entering a new password, as shown in Figure 4-5:

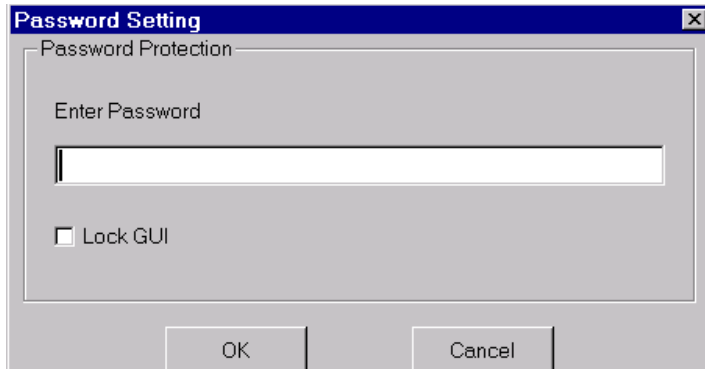
FIGURE 4-5. Password Setting Dialog Box



To enter a new password, you need to enter the password, select **OK**, and then reenter the same password, then select **OK** again. When the password is accepted by the system, you can select **Password > Enable Password Protection** to

enable the password protection mode by entering the correct password, as shown in Figure 4–6.

FIGURE 4–6. Password Setting Dialog Box



If you need to have access to the Run Continuously menu to start the reading (with or without hardware trigger), do not check the Lock GUI option. If DMx AutoID+™ is triggered by serial or TCP/IP command, then Lock GUI can be checked to ensure there is no unauthorized access to the Run menu.

If the system is configured properly (e.g., after Learn), you can select Run > Run Continuously to perform continuous reading or decoding with password protection enabled. The only way to stop the continuous reading is to type in the password from the keyboard. The password mode is not disabled when the continuous reading is stopped. This way you do not need to enable the password protection again before restarting the Run Continuously mode.

To disable the password mode, select File > Password > Disable Password Protection to display a password box. Enter the password then select OK. When the Password Protection is disabled, you can change the password by selecting File > Password > Change Password and following the dialog boxes step by step. Remember that once the password mode is disabled, you must re-enable it before you can resume the password protected mode.

File>Start Options

- **Auto Start** — When this mode is enabled (checked), the system will automatically enter Run Continuous mode as soon as the DMx AutoID+™ program is launched. When Auto Start is disabled (or unchecked), you can

enable it by selecting it. When Auto Start is enabled (or checked), you can disable it by selecting it.

- **Minimized** — When this mode is enabled, DMx AutoID+™ will run with the GUI minimized.

File>Jobs

- **Load>Default** — Reset all configuration parameters except password, number of cameras enabled, and Com port settings (baud rate, data bits, stop bits, parity, and flow control) to default factory settings.
- **Load>Job** — Load a previously saved job that contains all configuration parameters. This is useful for restoring previously configured parameters. To view the loaded job name, select **File > Jobs** if the system is not in Run Continuously mode. In Run Continuously mode, the job name is automatically displayed in the title bar of the program.
- **Save** — Save the current configuration parameters to a job file in the disk.
- **Delete** — Delete a job file from the disk.
- **Boot** — Specify a saved job to be used by the DMx AutoID+™ program when it is launched. After the job is selected, it can be viewed by displaying the Jobs menu item. To remove the Boot job or change to a different one, select **BOOT** again to display the dialog box.

Note: We recommend (although not required) that all jobs be stored in `\DMx AutoID+™\jobs` directory, which is normally under `C:\Program Files`.

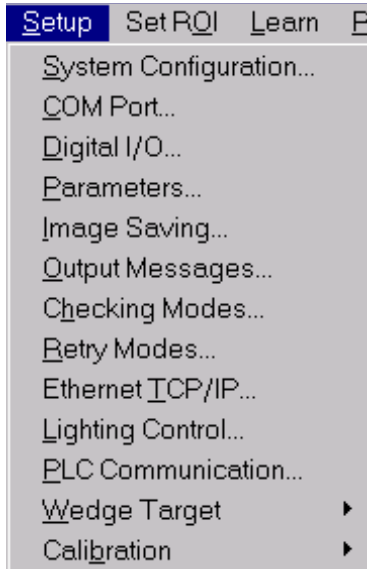
File>Exit

This menu item exits the program.

Setup Menu

The Setup menu (Figure 4–7) allows you to configure various DMx AutoID+™ system parameters.

FIGURE 4–7. Setup Menu



The remainder of this section describes the following Setup Menu selections:

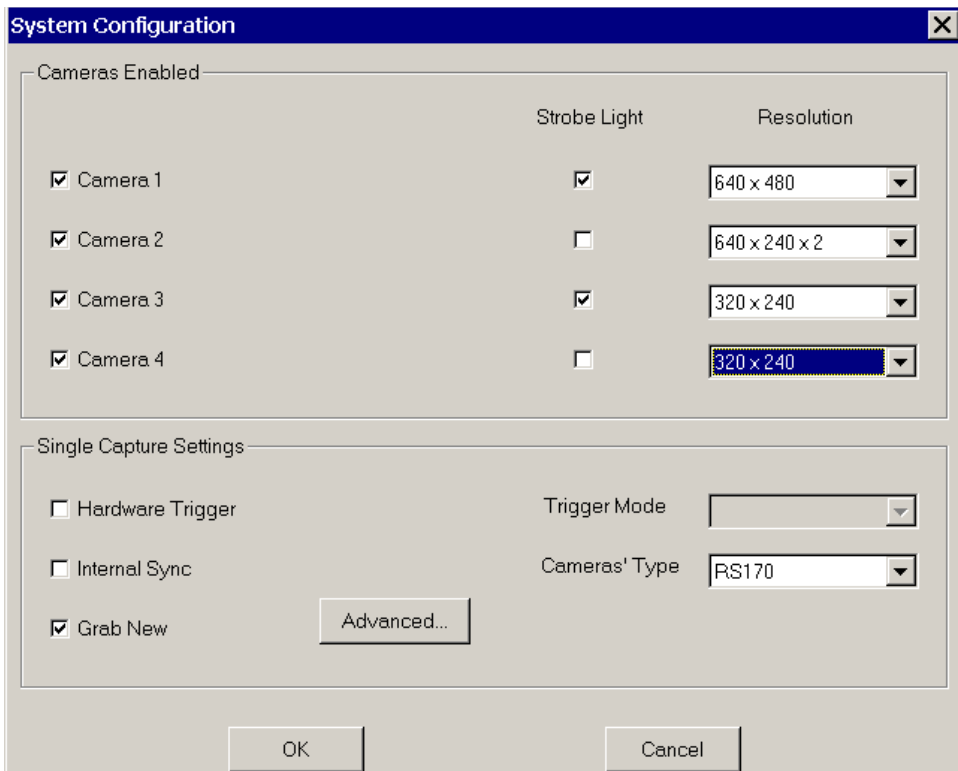
- “Setup>System Configuration” starting on page 4-9
- “Setup>Com Port” starting on page 4-13
- “Setup>Digital I/O” starting on page 4-15
- “Setup>Parameters” starting on page 4-17
- “Setup>Image Saving” starting on page 4-70
- “Setup>Output Messages” starting on page 4-72
- “Setup>Checking Modes” starting on page 4-72
- “Setup>Retry Modes” starting on page 4-74
- “Setup>Ethernet TCP/IP” starting on page 4-76

- “Setup>Lighting Control” starting on page 4-78
- “Setup>PLC Communication” starting on page 4-79
- “Setup>Wedge Target” starting on page 4-94
- “Setup>Calibration” starting on page 4-95

Setup>System Configuration

This menu item displays the System Configuration dialog box, as shown in Figure 4–8.

FIGURE 4–8. System Configuration Dialog Box



- **Cameras Enabled** — Click to select a camera(s) in the system. If a camera is enabled (checked), you can further enable or disable its corresponding Strobe Light option and select its corresponding camera resolution. For example, if the corresponding Strobe Light is enabled (checked) for camera

1, then, whenever camera 1 acquires an image of the specified resolution, the strobe signal for the camera will be output from the digital I/O board.

- **Single Capture Settings** — Click to enable appropriate features to be employed during the image capture (grab) sequence:
 - **Hardware Trigger** — When enabled, the capture sequence starts with the presence of a signal at each trigger input for the selected camera(s). The Asynchronous/Synchronous mode is used when more than one camera is enabled
 - In Asynchronous mode, each camera is independently triggered by its own trigger.
 - In Synchronous mode, all cameras are triggered at the same time by one trigger, which corresponds to the first camera (the camera with smallest index) in the list of enabled cameras.
 - **Internal Sync** — This option allows the DMx AutoID+™ to work with an internal sync camera. Check this option if the camera does not support external sync signal. Since the 0300 board has to sync with the camera's internal sync signal, only one internal sync camera is allowed to work with the 0300 board. Furthermore, more frames are needed before the 0300 board can sync with the camera when image acquisition starts or changes. Due to these limitations, you should always avoid internal sync cameras when possible.
 - **Grab New**
 - **List mode** — When a list of image files is selected and the Grab New is not selected, Run Once will operate on the currently displayed image in the list. If the Grab New is selected, Run Once will operate on the next image in the list.
 - **Live Camera mode** — If Grab New is not selected, Run Once will operate on the currently displayed image. If Grab New is selected, Run Once will acquire a new image and operate on it.
 - **Cameras Type** — Both RS170 and CCIR are supported.
 - **RS170** — All four cameras can have (mixed) resolution settings of high res (640x480), low res (640x240x2 or 320x240). The maximum reading speed is 30 reads per second for high res and 60

reads per second for low res (see “Throughput Estimation Guidelines” on page 4-12).

Note: You can use strobe or shuttering to freeze the motion. Using strobe can freeze the motion in both high res and low res settings. When camera shuttering is desired, however, only low res images can be obtained. The low res setting 640x240x2 preserves the high resolution in horizontal direction but achieves interpolated full resolution (480 pixels) in vertical direction. This mode is particularly useful for shuttered applications in which full horizontal resolution (640 pixels) is needed.

- CCIR — All four cameras can have (mixed) resolution settings of high res (768x572), low res (768x286x2 or 768x286). The maximum reading speed is 25 reads per second for high res and 50 reads per second for low res. Using strobe can freeze the motion in both high res and low res settings. When camera shuttering is desired, however, only low res images can be obtained. The low res setting 768x286x2 preserves the high resolution in horizontal direction but achieves interpolated full resolution (572 pixels) in vertical direction. This mode is particularly useful for shuttered applications in which full horizontal resolution (768 pixels) is needed.

In setup mode with Synchronous trigger enabled, when camera x is selected to acquire an image, the strobes connected to both camera x and camera 1 will fire at the same time. Therefore, if you always want to fire the strobe no matter which camera is selected, connect the strobe to camera 1.

To achieve consistent image quality in asynchronous or synchronous mode with strobe, we recommend that you use a shroud to block out the ambient light to ensure the camera sees only the strobe light.

When Strobe Light is checked, an advanced button allows the access to the “dead-zone” settings. The settings control when the strobe can or cannot fire. You should not change them for the CM4000 (RS170) and CM4001 (CCIR) cameras. For other types of cameras, please contact Microscan Technical Support (see the inside front cover for more information).

Throughput Estimation Guidelines

The DMx AutoID+™ is capable of performing up to 3,600 reads per minute. To estimate the maximum throughput for a given application, first obtain the shortest Inspection Time-out Value that is sufficient for each decode to complete successfully. In milliseconds, the total cycle time will be:

$$n1 + n2 + n3 + n4$$

Where:

- n1 is the greater of (10 + Inspection Time-out Value) and image acquisition time.
- n2 is 20 ms when View>Images while Running is set to 1.
- n3 is 10 ms when View>Status Bar while Running is checked.
- n4 is the time needed for Ethernet TCP/IP and/or serial transmission.

The image acquisition time is:

- 33~50 ms for high resolution RS170 camera.
- 17~33 ms for low resolution RS170 camera.
- 40~60 ms for high resolution CCIR camera.
- 20~40 ms for low resolution CCIR camera.

The low values for the image acquisition time can be used when hardware trigger and strobe are used.

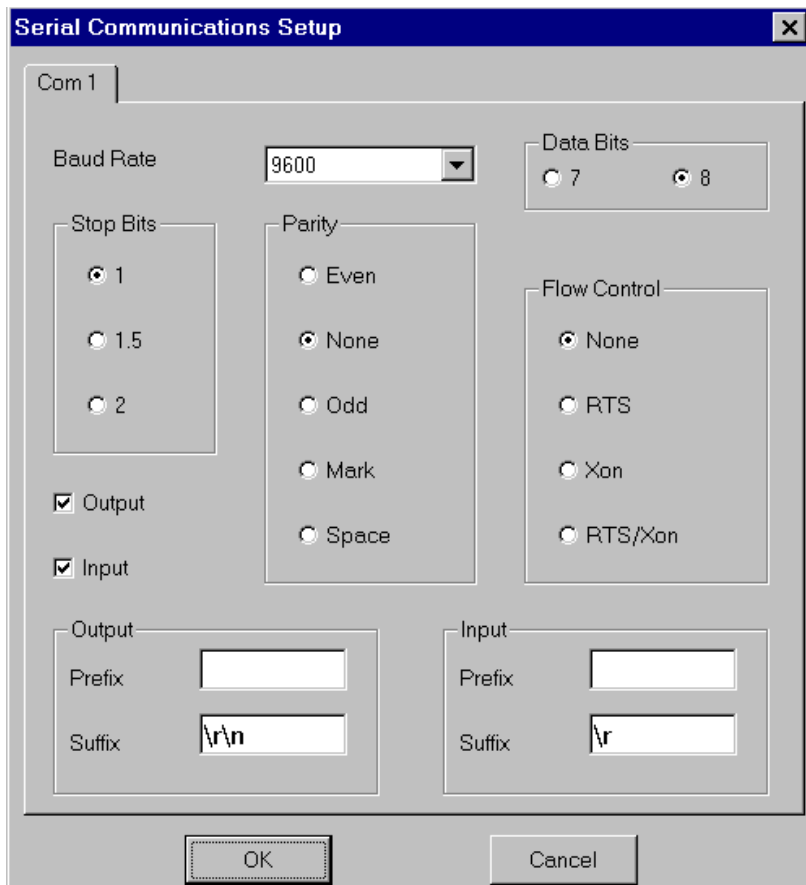
Assume that you can optimize the decode such that the Inspection Time-out Value of 7 ms is sufficient. Also assume that you are using only an opto I/O board for communicating read results without displaying images, status, or using serial/Ethernet. Then, you can achieve the 17 ms cycle time, which gives you 60 read per second or 3,600 reads per minute.

Note: The extra 10 ms per cycle added on top of the Inspection Time-out Value is needed for Windows Operating System.

Setup>Com Port

This menu item displays the Serial Communications Setup dialog box, as shown in Figure 4–9.

FIGURE 4–9. Serial Communications Setup Dialog Box



Make appropriate settings for Baud Rate, Data Bits, Stop Bits, Parity and Flow Control for Com 1 Serial Communications and/or Com 2 Serial Communications, as applicable.

By default, both the Output and Input boxes are checked to allow DMx AutoID+™ to send the read result to the COM port (e.g., output) and to receive serial commands from the COM port (e.g., input). You can specify prefixes and suffixes to be used when presenting data:

- **Output Prefix/Suffix** — Any output message transmitted from the COM port to other serial devices will be prepended by the Output Prefix and appended by the Output Suffix.
- **Input Prefix/Suffix** — DMx AutoID+™ can receive serial commands from other serial devices such as terminals or Programmable Logic Controllers (PLC). By specifying Prefix and Suffix, the DMx AutoID+™ will recognize the input messages from other devices formed by appending Prefix and Suffix to serial commands supported by DMx AutoID+™. For DMx AutoID+™ to accept the supported commands, an input suffix is always required.

Note: The Communications option configures the DMx AutoID+™ ports. The communication setup cannot be changed when it has been selected from the Run menu. To change it, you must de-select the communication port, configure the port, and then select the port again. Refer to the Run Menu for more information.

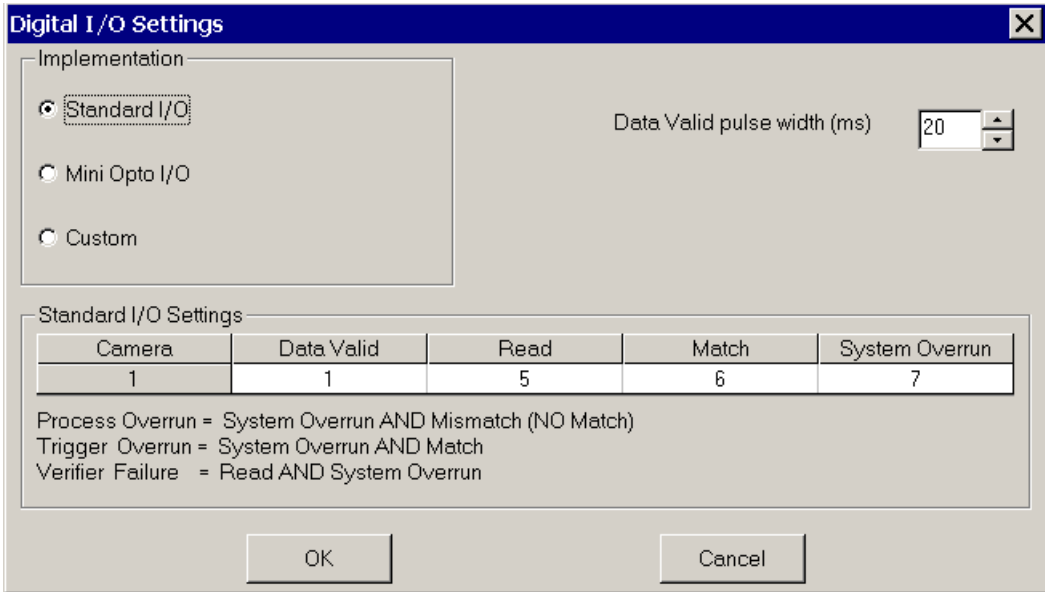
The above setup box varies with the number of COM ports in your PC.

If the reading application does not require full duplex serial communication (e.g., only Input or Output is required), then disabling the unused mode will improve system performance. If Output is unchecked, DMx AutoID+™ will not output decode data. If Output is unchecked and Input checked, the command Read to DMx AutoID+™ will not receive a response from the serial port. However, all other configuration commands will receive a command response over the serial port.

Setup>Digital I/O

This menu item displays the Digital I/O Settings dialog box, as shown in Figure 4–10. This dialog box configures the Digital I/O for the DMx AutoID+™.

FIGURE 4–10. Digital I/O Settings Dialog Box



Implementation

- **Standard I/O** — Select this to use the Combination Opto I/O board that has 16 General Purpose IO points (GPIO). DMx AutoID+™ determines all 16 GPIO as output points and controls them according to the Standard I/O Settings table.

When Standard I/O is selected, there are four digital outputs per camera in the pre-defined Standard I/O settings. For camera 1, the I/O points 1, 5, 6, and 7 are used for Data Valid, Read, Match, and System Overrun. The I/O points 2, 8, 9 and 10 are used for Data Valid, Read, Match, and System Overrun for camera 2. The I/O points 3, 11, 12, and 13 are used for camera 3. The I/O points 4, 14, 15, and 16 are used for camera 4.

Note: A high (+5V) indicates Success and a low (0V) indicates Failure.

- **Mini Opto I/O** — Select this to use the Mini Opto I/O board that has four outputs and two inputs. DMx AutoID+™ controls all 4 output points according to the Standard I/O Settings table.
- **Custom** — When this is selected, the DMx AutoID+™ stops controlling the I/O signal. The user can write program to control the I/O through DMx AutoID+™ via serial/TCP/IP commands or DMx ActiveX control.

Standard I/O Settings

- **Data Valid** — The I/O points 1, 2, 3, and 4 represent the data-valid pulses indicating that the data in I/O points 5-16 are valid.
- **System Overrun** — Consists of Process Overrun and Trigger Overrun, which can only happen in Run Continuously with hardware trigger enabled. When a hardware trigger occurs, a new image is acquired and placed into one of several pre-allocated image buffers as long as the image to be overwritten is no longer needed by the reading process.
 - **Process Overrun** (also called **Buffer Overrun**) occurs when the system cannot process the images fast enough and release the buffers, thus leaving no buffer available for a newly acquired image. Process Overrun is represented by System Overrun being set to high and the Match output set to low.
 - **Trigger Overrun** occurs when a new hardware trigger is received for a camera while it is still acquiring the previous image. Trigger Overrun is represented by System Overrun being set to high and the Match output set to high. In either case, Read output is always held at low.
- **Verifier Failure** — Indicates when a Data Matrix is successfully read but its print quality does not meet the specified grade. When this happens, the Read output is set to high and System Overrun output is set high. (See Verifier section under Parameter Setup for more information)
- **Data Valid Pulse Width (ms)** — Enter the width of the data valid pulse. It is limited to between 8 and 125 ms.

When Mini Opto I/O is selected, the pre-defined I/O behavior depends on the number of cameras used. If only one camera is used, it controls all four output points. When more than one camera is used, the camera numbers must be contiguous starting from camera 1. Each of the first two cameras controls two output points.

Setup>Parameters

The camera configuration parameters can be set independently of one another among all enabled cameras. When the caption of a dialog box contains a camera number, it means the parameters shown in the dialog box are applicable to that camera only. When there is more than one camera enabled, the parameters displayed in the dialog box correspond to current camera. The current camera is shown as checked in the **View>Camera** menu. It is also shown as the one that appears to be pushed down on the tool bar. To display the parameters belonging to a certain camera, you need to set that camera to be the current camera from the tool bar or from the **View>Camera** menu. This selection allows you to set up the following functions:

- Configure the DMx AutoID+™ to perform the image processing and data reduction tasks such as reading different types of symbologies, performing OCR, Data Matrix verification, and locating fiducial.
- Setup the Run parameters for each task in order to run faster or more robustly.
- Format the output data and select debug reporting information.

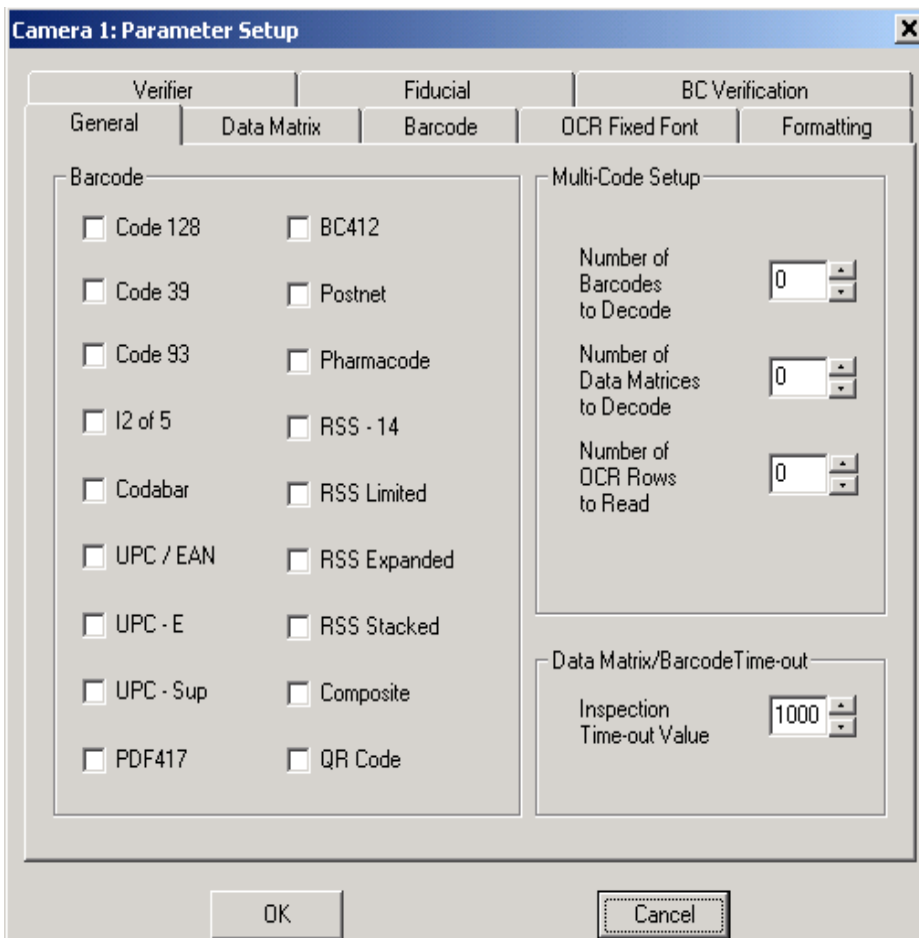
The remainder of the Setup>Parameters section discusses:

- “Setup>Parameters>General” on page 4-18
- “Setup>Parameters>Data Matrix” on page 4-20
- “Setup>Parameters>Barcode” on page 4-27
- “Setup>Parameters>OCR Fixed Font” on page 4-31
- “Setup>Parameters>Formatting” on page 4-37
- “Setup>Parameters>Verifier” on page 4-44
- “Setup>Parameters>Fiducial” on page 4-60
- “Setup>Parameters>Barcode Verification” on page 4-62

Setup>Parameters>General

This menu item displays the Parameter Setup dialog box (General tab), as shown in Figure 4–11.

FIGURE 4–11. Parameter Setup (General Tab) Dialog Box



Use this dialog box to set up symbology or OCR algorithms to search for the selected symbols or text. The Number of Barcodes, Data Matrices, and OCR Rows to Decode/Read tell the system how many symbol(s) should be decoded in the field of view.

- **Number of Barcodes to Decode** — Setting the number to 0 disables barcodes reading. The supported barcodes are listed in Barcode group. Only the enabled (checked) barcodes will be decoded.

Range: 0 to 5

- **Number of Data Matrices to Decode** — Setting to 0 disables Data Matrix reading.

Range: 0 to 5

- **Number of OCR Rows to Read** — Setting to 0 disables OCR (Optical Character Recognition).

Range: 0 to 4

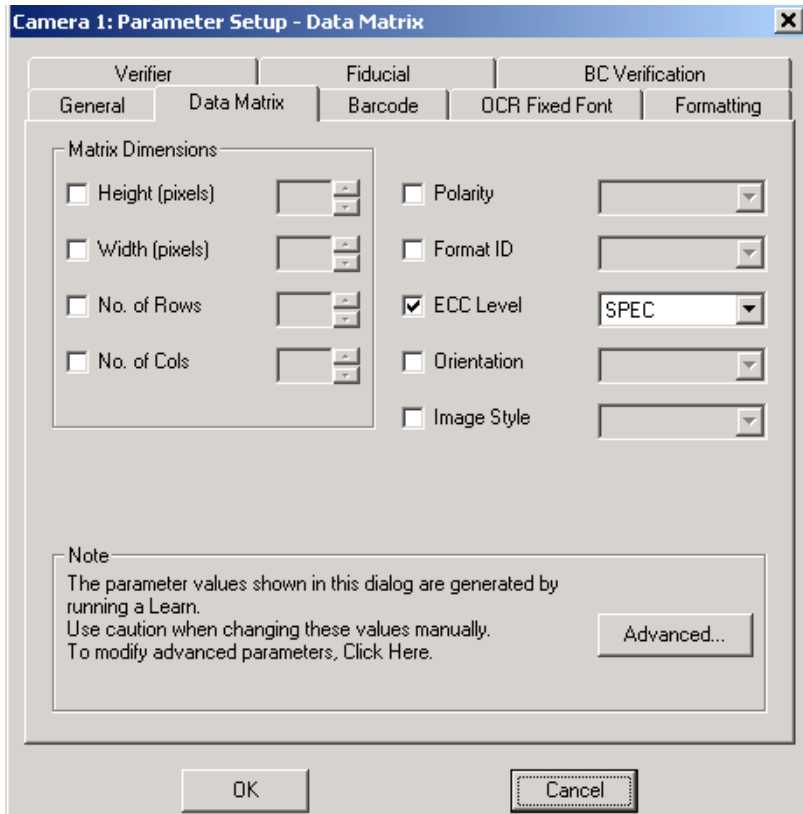
The system will in turn search Barcode items first, Data Matrix next, and OCR last, as defined in this dialog box and based on the respective quantities in Multi Code Setup.

To ensure that the Barcode/Data Matrix reading completes within a pre-defined time limit, the Inspection Time-out Value can be set to the time limit in milliseconds. Setting the value to 0 indicates that no limit is set. See “Important Settings Prior to Run” on page 4-125 for suggestions on how to set the time limit.

Setup>Parameters>Data Matrix

This menu item displays the Parameter Setup dialog box (Data Matrix tab), as shown in Figure 4–12.

FIGURE 4–12. Parameter Setup (Data Matrix Tab) Dialog Box



- **Height** — The height of non-rotated Data Matrix in pixels. When the Height value is specified and checked, the algorithm will attempt to locate a Data Matrix of the specified height, plus/minus the percentage value in Size Variation in Advanced Parameter Tuning below. If unchecked, the algorithm attempts to find a Data Matrix of arbitrary size.
- **Width** — The width of non-rotated Data Matrix in pixels. When Width value is specified and checked, the algorithm will attempt to locate a Data Matrix of the specified width, plus/minus the percentage value in Size Variation in

Advanced Parameter Tuning below. If unchecked, the algorithm attempts to find a Data Matrix of arbitrary size.

- **No. of Rows** — The number of rows of non-rotated Data Matrix. When checked, the algorithm uses the value specified without having to re-compute it from image to image.
- **No. of Cols** — The number of columns of non-rotated Data Matrix. When checked, the algorithm uses the value specified without having to re-compute it from image to image. Both Rows and Cols should be checked or unchecked at the same time.
- **Polarity** — The number of columns of non-rotated Data Matrix. When checked, the algorithm attempts to locate a Data Matrix with the specified polarity, Light on Dark, or Dark on Light. When unchecked, the algorithm locates either polarity.
- **Format ID** — The informational value displayed when a Non-ECC200 Data Matrix is learned. It cannot be set or changed and does not apply to ECC 200 Data Matrix.
- **ECC Level** — The Error Correction Level. ECC 200 employs Reed-Solomon error correction and is recommended for new applications. Other ECC levels (000, 050, 080, 100, 140) use the convolutional error encoding. ECC250 is customer-specific coding. The default value SPEC allows the algorithm to decode ECC000, 050, 080, 100, 140, and 200 that are included in the AIM/ISO Data Matrix Specification. If left unchecked, the older nonstandard Data Matrix such as ECC120 can also be decoded.
- **Orientation** — The angle formed by the bottom of the solid border “L” and the horizontal axis. Setting this to a fixed angle helps the algorithm locate the Data Matrix quicker but cannot be used to consistently reject a Data Matrix having a different orientation angle. If unchecked, the algorithm can find a Data Matrix of any orientation.
- **Image Style** — The Normal image or Mirror image of the Data Matrix.

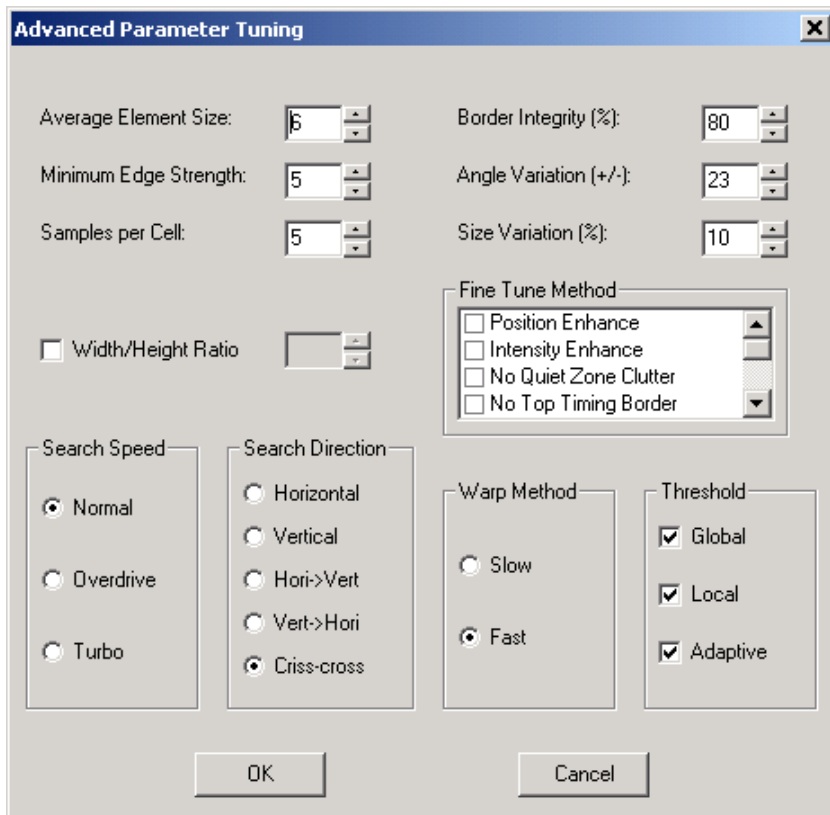
Normally, the parameters in the Data Matrix dialog box are automatically set by the DMx AutoID+™ system when a successful Learn is performed. These parameters generally will provide satisfactory Data Matrix reading performance in Run mode. In certain situations, some of the parameters can be adjusted or fine-tuned to improve the performance.

Fine-tuning serves two main purposes. Parameter fine-tuning after a successful Learn can accelerate the normal Run process, and/or make the Run process more robust. In the case when the Learn is not successful for a certain symbol, parameter fine-tuning may provide the DMx AutoID+™ program more information about the symbol, thus improving symbol decoding in the Run mode.

In Run mode, if any of the Data Matrix properties no longer applies to the Data Matrix to be read, such as Height, Width, No. of Rows, No. of Cols, ECC Level, Polarity, and Image Style, then the property should be disabled (unchecked). For example, if matrix height/width may change significantly during the inspection, leave Height and Width de-selected (unchecked). Always de-select (uncheck) Orientation if 360° reading is required.

Click the **Advanced** button on the Data Matrix dialog box to display the Advanced Parameters Tuning dialog box, as shown in Figure 4–13. This allows you to enter more information for parameter fine-tuning.

FIGURE 4–13. Advanced Parameter Tuning Dialog Box



- **Average Element Size** — Normally, the Field of View for the Data Matrix should be set such that, after a successful Learn, the cell size is reported at a value between 5 and 10. The element size reported reflects the actual cell size of the Data Matrix and is most suitable for the Run mode to perform robustly. When the quality of the Data Matrix is high, reducing the cell size value slightly will not affect the read rates but will accelerate the read cycle. When the element size drops below 4 pixels, however, the locate/decode time will increase, and the robustness of the algorithm may degrade.

Range: 2 to 20

- **Minimum Edge Strength** — For extremely low contrast images, the edge strength value can be set between 5 and 18 gray scale values. The edge strength can be raised to higher values when the Data Matrix is of relatively

high contrast and the background clutter is of relatively low contrast. With higher edge strength, the DMx AutoID+™ program will ignore most of the low contrast objects and get to the higher contrast matrix area quicker. A value of 18 allows the program to read the Data Matrix with contrast as low as 10%. If the label's contrast is unlikely to change (e.g., when a stable lighting source is employed), the level can be raised to 36 to produce the optimum run performance. The value can be set between 5 and 100.

- **Samples Per Cell** — Select a different cell sampling method to overcome some print quality issues. The DMx AutoID+™ program samples and averages portions of each cell to determine whether the cell is light or dark.
- **Border Integrity** — This is a percentage value.

Default: 80% (20% border mismatch or damage is tolerated)

Range: 75 to 100

- **Angle Variation (\pm)** — The orientation of a Data Matrix is set after a successful Learn. By default, the angle variation factor is set to $\pm 23^\circ$ (i.e., half of 45°). This means the Data Matrices in the inspection (READ) mode can rotate up to 23° from the Learned orientation. The variation value is ignored if the Orientation parameter in Data Matrix tab is unchecked. When the Data Matrices do not change their orientation by more than $\pm 10^\circ$, the angle variation factor can be set to 10.

Note: With today's fast CPUs, we suggest that you keep the default value of 23 for the angle variation for maximum robustness.

- **Size Variation (%)** — The size, representing the height and width of a Data Matrix, is set after a successful Learn. When the Data Matrices in subsequent inspections (READ) have similar size, the size learned applies to these matrices. The size variation factor default is 10%, which means the size can vary up to 10% from the nominal values determined from the Learn, regardless of the cell size used in the setup. The maximum size variation allowed is 25%. If the variation exceeds 25%, both Height and Width should be de-selected (unchecked).

- **Width/Height Ratio** — This tells the program to only search for a Data Matrix symbol with the specific aspect ratio when either Height or Width is unchecked. The value has no effect on the program when both Height and Width are specified. When neither Height, Width, nor Ratio is selected, the system will look for Data Matrix of any size and aspect ratio.

Range: 0.3 to 5.0

- **Fine Tune Method** — You have the following options:
 - **Position Enhance** — Enabling this option instructs the algorithm to locate the four corners of the Data Matrix more precisely and, in general, reduce the number of error correction used for severely underprinted or overprinted symbols. The default is *Off*.
 - **Intensity Enhance** — Designed to overcome dramatic intensity variation over the matrix border area. For example, certain poorly marked Data Matrix may have some cells that are almost invisible compared to the rest of the cells. Without enabling the option, the system may issue a status code indicating a certain edge cannot be found. Enabling the option will help read this type of Data Matrix more consistently. The default is *Off*.

Note: Refer to the Formatting tab for a description of DMx AutoID+™ status codes.

- **No Quiet Zone Clutter** — Enabling this option will speed up the reading process when Data Matrix has sufficient quiet zone. With sufficient quiet zone, a Data Matrix with irregular, curved, or distorted border(s) can be read more efficiently with the option checked. Typically, the border problem is associated with low quality inkjet or dot peen marks or when the Data Matrix is imaged at an angle.
- **Allow Steep Angle** — In some Data Matrix reading applications, it is not possible to set up the camera such that the focal plane is in parallel with the surface of the Data Matrix label. When the focal plane and the label surface form a steep angle, the Data Matrix in the image will have severe geometrical distortion. The following steps can be used in order to read severely distorted Data Matrix in any orientation:
 1. Select **File > Jobs > Load > Default** to clear Data Matrix configuration parameters.
 2. Select **Setup > Parameters > General**.

3. Set **Number of Data Matrices to Decode** to be at least 1.
 4. Select **Setup, Parameters, Data Matrix**, and finally **Advanced** to get to the **Advanced Parameter Tuning** box.
 5. In **Fine Tune Method**, enable (check) **Allow Steep Angle**.
 6. Select **OK** to exit **Advanced Parameter Tuning**.
 7. Select **OK** to exit **Parameter Setup**. Now the system is ready to read distorted **Data Matrix** in **Run** mode.
- **Allow Severe Damage** — Enabling this option will increase the robustness of the software in reading **Data Matrix** with severe border damages. To use it, first perform a successful **Learn** on a less damaged label. Then, enable (check) the option to read labels with more damages in **Run** mode.
 - **Ensure ROI** — Enabling this option ensures that no **Data Matrix** is located unless it is fully inside the **ROI**.
 - **Cell Outline** — Enabling the option helps the algorithm decode a **Data Matrix** with outlined cells only. In this case, the **On** and **Off** cells have little or no contrast but they are separated by edges of the cells.
 - **Search Speed** — The default for this setting is *Normal*, which is the most robust search speed. For a high contrast well formed **Data Matrix**, selecting **Overdrive** or **Turbo** mode may reduce the total locate/decode time.
 - **Search Direction** — The default is **Criss-cross**, which causes the **DMx AutoID+™** program to search horizontally and vertically at the same time. The search direction **Hori->Vert** causes the program to search horizontally for the **Data Matrix** first in the entire **ROI**. When no **Data Matrix** is found or decoded, the algorithm searches vertically for the **Data Matrix**. Selecting **Vert->Hori** causes the opposite search process.
 - **Warp Method** — The default is *Fast*. *Fast* typically produces satisfactory read rates with much higher speed, although *Slow* sometimes can be more robust than *Fast* for very poor images

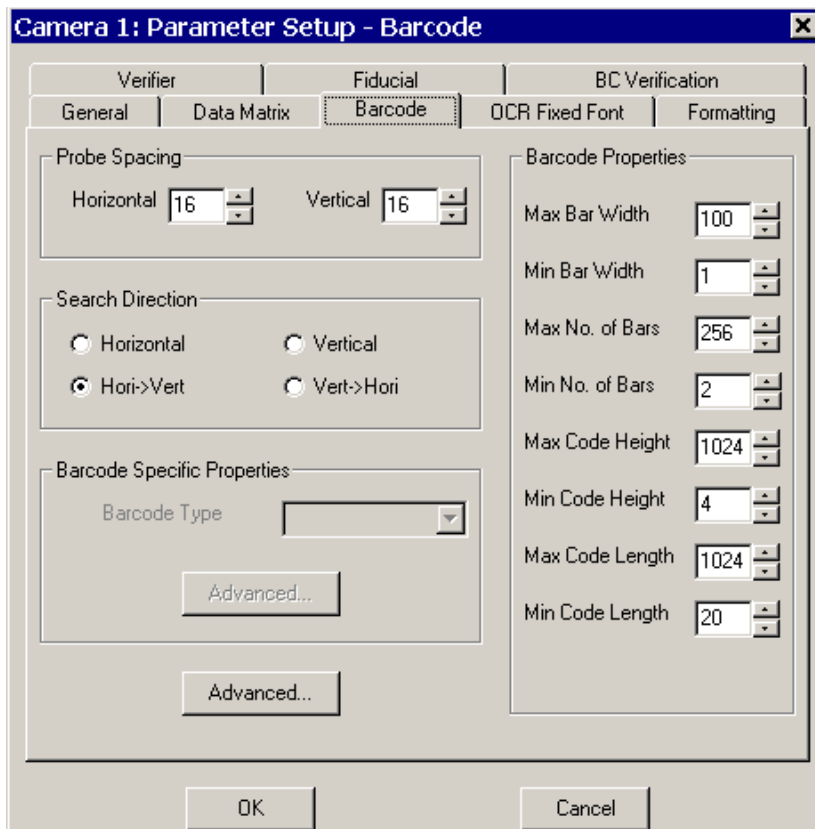
- Threshold —

Threshold Options	Description
Adaptive, Global, Local	Default
Adaptive	When the background of the Data Matrix is uneven due to poor marking or lighting, Adaptive may produce better decode results
Global	Local or Adaptive methods cannot replace the Global method because each is slower and less stable than Global when reading high quality marks
Local	For dot-peen marks or inkjet printer marks, the spacing between cells may not be even, in which case, Local may yield less error used in the error correction algorithm

Setup>Parameters>Barcode

This menu item displays the Parameter Setup dialog box (Barcode tab), as shown in Figure 4–14.

FIGURE 4–14. Parameter Setup (Barcode Tab) Dialog Box



- **Probe Spacing** — Defines the distance between barcode scanning probes in pixels. You must enter a value for Horizontal and Vertical.

Default: 16 pixels

- **Search Direction** — Sets the direction of the search, such as *Horizontal*, *Vert-> Horiz*, etc.
- **Barcode Properties** — The barcodes to be decoded should meet the dimensional requirements described by the following properties.
 - **Max/Min Bar Width** — The maximum/minimum width of bars in pixels.

Default: 1 to 100 pixels

- Max/Min No. of Bars — The maximum/minimum number of bars in the barcodes to be decoded.

Default: 2 to 256

- Max/Min Code Height — The maximum/minimum height of barcodes to be decoded.

Default: 20 to 1024 pixels

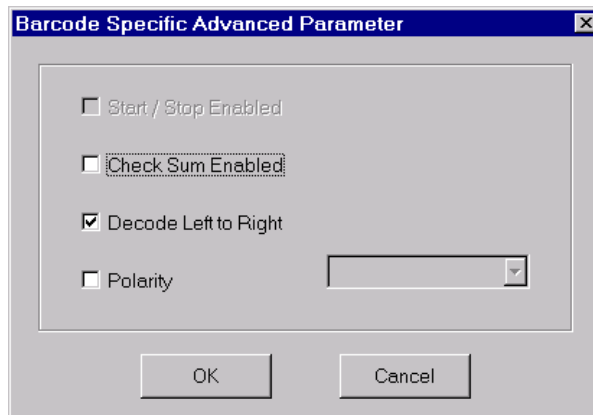
- Max/Min Code Length — The maximum/minimum length of barcodes to be decoded.

Default: 20 to 1024 pixels

Note: If barcodes of different type or size need to be decoded, each barcode should be learned separately and its barcode properties recorded by the user. To read them all, the barcode properties list should be manually set to contain all the barcode properties learned from each barcode. The corresponding barcode type in Barcode group in the General tab should be set accordingly.

Barcode Specific Properties group allows the properties that are unique to certain types of barcode to be displayed and modified. Currently, only BC412 contains special parameters. When BC412 is enabled in the General tab, the following part of the Barcode tab is enabled:

FIGURE 4–15. Barcode Specific Properties Dialog Box



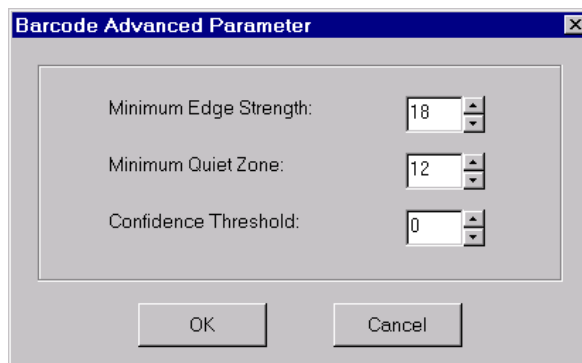
- **Barcode Type** — Sets parameters that apply only to a given barcode symbology. Selecting a barcode type from the drop-down list allows you to enable the barcode parameters. BC412 symbology is supported and the following parameters are only applicable to BC412 barcode.
- **Start/Stop Enabled** — Enabling this item requires that the BC412 barcode contains a start and stop pattern.
- **Check Sum Enabled** — Enabling this item requires that the BC412 barcode contains a checksum character.
- **Decode Left to Right** — Enables left-to-right decoding of data. When de-selected, the data will be decoded from right to left.

Note: This mode is only useful when Start/Stop Enabled is de-selected. This mode should not be used for SEMI BC412 barcode which contains both Start/Stop and Check Sum.

- **Polarity** — When the polarity is known, select either **Dark on Light**, or **Light on Dark** from the drop-down list. When polarity is not known, leave Polarity de-selected.

Clicking the **Advanced** button displays the Barcode Specific Advanced Parameter dialog box, as shown in Figure 4–16:

FIGURE 4–16. Barcode Specific Advanced Parameter Dialog Box



The three parameters listed above are applicable to all barcode types enabled in the General tab.

- **Minimum Edge Strength** — When the contrast of the barcodes is low, especially for low contrast BC412 images, the edge strength value can be set between 5 and 18 gray scale values. The edge strength can be raised to a higher value when the barcode has very high contrast. With higher edge strength, the DMx AutoID+™ program will ignore most of low contrast objects and get to the barcode area quicker. If the barcode's contrast is unlikely to change (e.g., when a stable lighting source is employed), the level can be raised to 36 to produce the optimum run performance. The value can be set between 5 and 100.
- **Minimum Quiet Zone** — The default minimum barcode quiet zone length is *12 pixels*. If for any reason the quiet zone is less in the image due to camera setup restrictions, the Minimum Quiet Zone parameter can be lowered in order for the algorithm to accept shorter space as quiet zone. On the other hand, if the barcode is big in the FOV such that some space between two adjacent bars exceeds the value specified in the Minimum Quiet Zone, then there is a possibility that this space will be detected as possible quiet zone. To avoid this situation, the Minimum Quiet Zone can be increased. The value can be set between 5 and 100.

Note: Do not adjust Minimum Edge Strength or Minimum Quiet Zone unless you understand how the change will affect the system performance. Since Learn Barcode uses the parameter values specified in the above dialog box, setting these values inappropriately may render the Learn Barcode to fail. If this happens, select File > Job > Load Default to reset the parameters to factory settings before attempting to perform Learn Barcode.

- **Confidence Threshold** — For barcodes that do not use checksum such as Code 39, I 2 of 5, Codabar, and BC412, the threshold value can help reduce potential mis-decode. When the value is raised, a certain number of decodes must agree before the decode is declared successful. On the other hand, if the value is set too high, then a normally decodable but imperfect barcode may not be decoded.

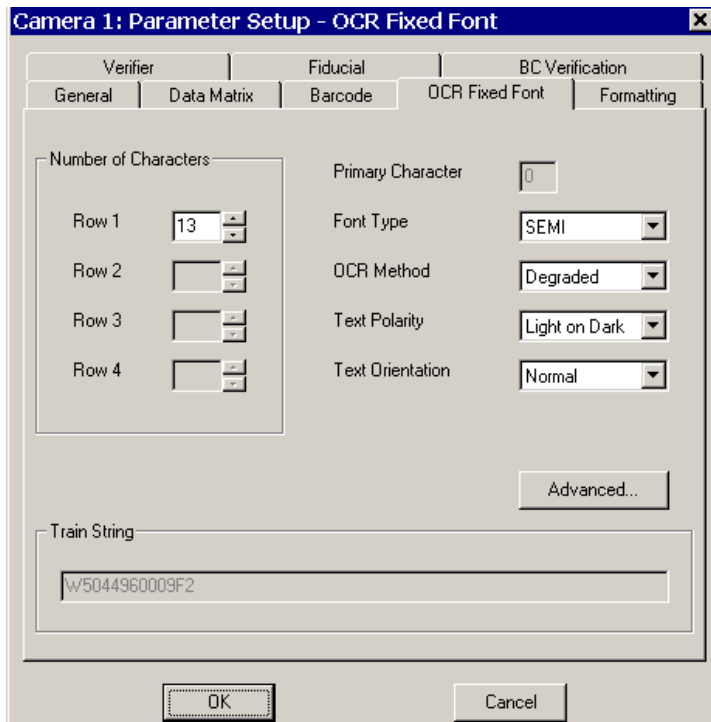
Default: 0 (Any possible decode is accepted)

Range: 0 to 100

Setup>Parameters>OCR Fixed Font

This menu item displays the Parameter Setup dialog box (OCR Fixed Font tab), as shown in Figure 4-17.

FIGURE 4–17. Parameter Setup (OCR Fixed Font Tab) Dialog Box



The OCR Fixed Font program can read up to four lines of character strings having the same font. Only three standard fixed fonts are supported, namely, SEMI, OCR-A, and OCR-B. Each line can have up to 30 characters. When the Number of OCR Rows to Read in the General tab is set to a positive value (up to 4), the number of characters in each available row in the Number of Characters group will be enabled for editing.

Note: The Degraded OCR method only works with one line of text.

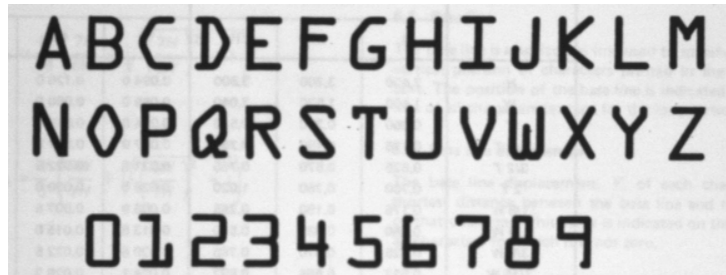
- **Primary Character** — The single character selected during the Learn OCR process. The character should be chosen such that the size of the character reflects the average size of the characters in the string.
- **Font Type** — Indicates the font of characters in the text string. Options include SEMI, OCR-A, and OCR-B. Default is SEMI font. The SEMI font contains 0 ~ 9, A ~ Z, and five special characters such as “.”, “-”, “/”, “#” ,

and the space. The currently supported OCR-A and B fonts contain 0 ~ 9 and A ~ Z. They are illustrated as follows:

- SEMI: A~Z, 0~9, and five separators: ., -, /, #, and the space.

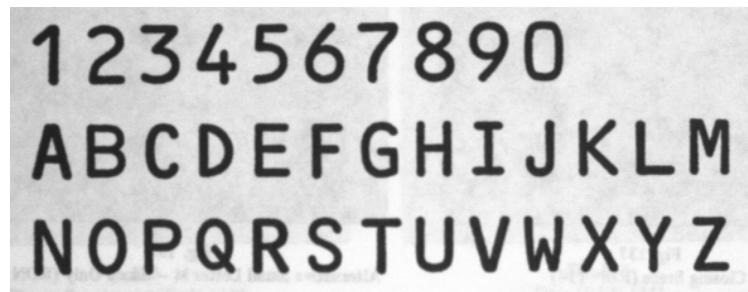
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
0 1 2 3 4 5 6 7 8 9 . -

- OCR-A: A~Z, 0~9.



A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
0 1 2 3 4 5 6 7 8 9

- OCR-B: A~Z, 0~9

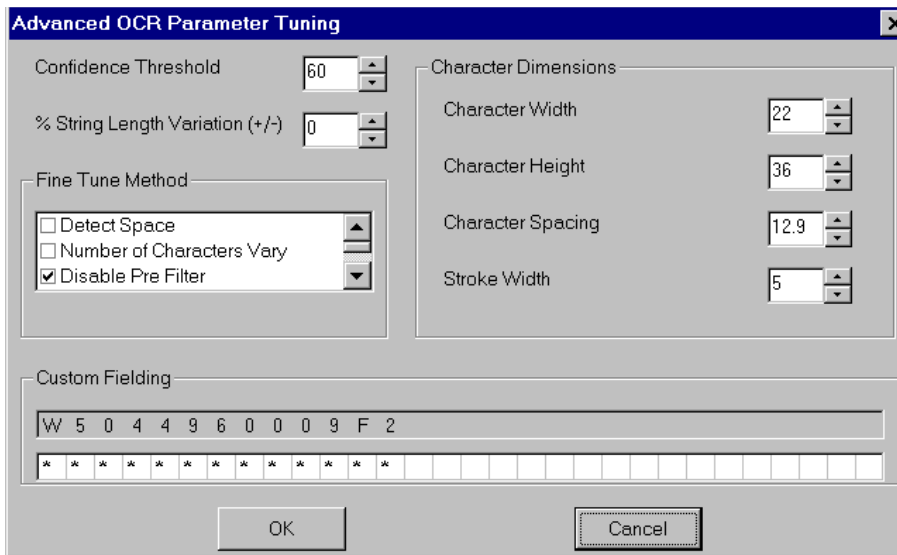


1 2 3 4 5 6 7 8 9 0
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z

Note: If the OCR-A or OCR-B string contains one of the separators used in the SEMI font and the position of the separator is fixed, then the string can still be read by specifying the separator in the fielding. An example in the Learn > Fixed Font OCR illustrates how this can be done.

- **OCR Method** — Indicates which method is to be used in locating and decoding the characters. The default is *Degraded*. Options include:
 - **Standard** — This method works on clean characters with no significant background noise. The method allows the text string to rotate up to 15° from the horizontal or vertical orientation. The speed of the method is relatively fast. The number of characters to be read during the run is allowed to vary from the number used in Learn.
 - **Dot Matrix** — This method is the Standard method optimized for Dot Matrix characters. It has the similar performance as the Standard method except that it is more tolerant of background noise.
 - **Degraded** — This method is the most robust of all three methods and should be used whenever possible. It is capable of reading characters with damages and noise. It allows minor rotation from the horizontal or vertical orientation. The speed of the OCR reading is slower than the above two methods.
- **Text Polarity** — Indicates whether the characters are Dark on Light or Light on Dark. With Degraded OCR method, if the text polarity may vary from image to image in the Run mode after the Learn, then select **Unknown**. Since using Unknown Polarity reduces the robustness in locating characters, this mode should be avoided whenever possible. The Unknown polarity is only available for Degraded OCR method.
- **Text Orientation** — Indicates whether the character string(s) is placed Normal, Top to Bottom, Upside Down, or Bottom to Top.
- **Train String** — During the Learn OCR process, one row of characters in the image should be entered in the Train String box.

Clicking the **Advanced** button displays the Advanced OCR Parameter Tuning dialog box, as shown in Figure 4–18:

FIGURE 4–18. Advanced OCR Parameter Tuning Dialog Box

- **Confidence Threshold** — This confidence threshold value is useful in rejecting the decoded character string in which the minimum confidence of all characters is below this value. The confidence value measures how well a character matches its ideal shape. Raising the threshold value will reduce the ability to read poorly formed or damaged characters and also reduces the possibility of mis-decoding characters (e.g., substitution error).

Default: 60

Range: 0 to 100

Note: If the OCR string is successfully read but the minimum confidence value is less than the threshold value, then the status code 6001 will be reported, indicating OCR confidence checking failure. To see the status code, select **Formatting** tab and check **OCR Debug Report: Status Code**.

- **% String Length Variation** — Can be set to up to $\pm 10\%$ variation from the string length used in Learn. This parameter is only applicable to Degraded OCR Method. The default value 0 is adequate from most of the OCR applications in which the text string length (in pixels) does not vary from part to part. A positive percentage number should be used when the length does vary significantly, up to 10%.

- **Fine Tune Method** — Indicates which options should be used in Run mode after a successful Learn. Some of the options are set automatically by the Learn process. You set the rest based on the OCR application.
 - **Detect Space** — Allows a ‘space’ character to be found. This option is automatically set by the Learn process if there is at least one space character in the Train String.
 - **Number of Characters Vary** — Allows the number of characters to vary in Run after Learn. This option is supported by Standard and Dot Matrix OCR methods.
 - **Disable Prefilter** — Disables certain filtering steps to prevent the prefilter from removing too much image detail in certain applications.
 - **Character Size/Space Vary** — Allows the character size and spacing between characters to vary from the image used in Learn. It also enables the software to handle character size and/or spacing nonuniformity.
 - **Speed Enhance** — Uses a fast but less robust version of the OCR algorithm.
 - **Remove Noise** — Uses a fast but less robust version of the OCR algorithm. This option is automatically enabled by Learn process in degraded method. If the image is clean and no noise is present, then you can remove the option to reduce the read time.
 - **SEMI M-Checksum** — Tells the program to verify if the read text string passed the SEMI Checksum test.
- **Character Dimensions** — When Learn is successful, the learned parameters such as Character Width, Character Height, Character Spacing, and Stroke Width (thickness), in pixels, are displayed. Using the character 0 as an example, Character Width is the horizontal distance between the center of the left stroke and that of the right stroke, and Character Height is the vertical distance between the center of the top stroke and that of the bottom stroke. Using the character dimensions obtained from the OCR learn, the nominal character width and the nominal character height can be computed. The nominal character width is the horizontal distance between the leftmost pixel and the rightmost pixel of a character and is obtained as the sum of Character Width and Stroke Width. The nominal character height is the vertical distance between the topmost pixel and the bottommost pixel of a character and is the sum of Character Height and Stroke Width. To assure the

most reliable and efficient reading, the recommended nominal character width and height are 20 (± 5) pixels and 35 (± 15) pixels respectively.

- **Custom Fielding** — Allows the user to specify to which fielding option each character position belongs. The Fielding Option group is enabled only after the OCR Fixed Font parameters have been learned. By default, each character position uses Alphanumeric fielding represented by '*'. To set certain position to be either Alpha only, or Numeric only, or other custom combination, click the '*' to display the Fielding Options section and then select the expected option by pressing down its corresponding radio button. When the **Other** option is selected, the possible character(s) that can appear in that position can be entered in the box following the 'Other' option. For example, 123A can be entered if certain character position can be either 1 or 2 or 3, or A. If certain character position corresponds to a character that will never change in Run mode, you can enter that character in the 'Other' fielding option for that position. This is typically done for separators such as 'space' character, '-', '.' for Semi font. When only one character is entered in the 'Other' fielding option for certain position, the reading result will always output that character in that position with confidence value of 100. In particular, if a certain character position always corresponds to the 'space' character, then enter 'space' in the 'Other' fielding option for that position and disable Detect Space in Finetune method. Detect Space is necessary when a certain character position can be both the space character and other characters.

Setup>Parameters>Formatting

This menu item displays the Parameter Setup dialog box (Formatting tab), as shown in Figure 4–19. It defines the data output format and reported debug information.

FIGURE 4–19. Parameter Setup (Formatting Tab) Dialog Box

Camera 1: Parameter Setup - Formatting

Verifier | Fiducial | BC Verification

General | Data Matrix | Barcode | OCR Fixed Font | **Formatting**

Output Formatting

Prefix

Suffix

Label Separator

Status Separator

Advanced...

OCR Debug Report

Status Code

String Confidence

Char Confidence

Char Corners

Timing

Symbology Debug Report

Status Code

Symbol Angle

Symbol Corners

Symbol Contrast

Total Error Bits

Damage Percent

Border Match Percent

Threshold Value

Timing

Output Formatting

- **Prefix** — Defines the prefix string that will be prepended to the symbology/OCR data string for each camera read.
- **Suffix** — Defines the suffix string that will be appended to the symbology/OCR data string for each camera read.
- **Label Separator** — Character that delimits the data from different symbols when multiple symbols are decoded in the same image.

- **Status Separator** — Character that delimits the Status code and other debug data from each other.

Symbology/OCR Debug Report

Report data that is formatted down the left column, then down the right column, and is separated by a Status Separator Character. Data may be enabled for reporting or disabled (unchecked) as follows:

- **Status Code for Data Matrix, Barcode (excluding QR Code) and OCR:**

TABLE 4-1. Status Code For Data Matrix, Barcode & OCR

Numeric Code	Description
0	Read Success, No Verification Enabled
1	Read Success, Verification Status Poor
2	Read Success, Verification Status Fair
3	Read Success, Verification Status Good
3048	Symbology Decode Failed
4301	Trigger Overrun
4303	String Mismatch
4304	Angle Match Failed
4305	Excessive Damage
4310	Process Overrun
4601	No Edge Candidate Found
4604	First Edge Not Found or Too Small
4605	Second Edge Not Found
4611	Third Edge Not Found
4612	Fourth Edge Not Found
4620	Symbology Corner Out of Image
4621	Size Test Failed
4622	Unable to Find Row/Column
4630	Inspection Timed Out
4633	Border Match Failed
4700	Read Success but Verification Process Error
4701	Read Success but Verification Unsupported

TABLE 4-1. Status Code For Data Matrix, Barcode & OCR (continued)

Numeric Code	Description
4702	Read Success but Verification Timed Out
4710	Read Success but ISO Requires ECC200
4711	Read Success but ISO Aperture Too Small
4712	Read Success but ISO Aperture Too Large
4713	Read Success but ISO Insufficient Space
4714	Read Success but ISO Fails RDA_Step_F1
4715	Read Success but ISO Fails RDA_Step_F2
4716	Read Success but ISO Fails RDA_Step_F3
4717	Read Success but ISO Fails RDA_Step_AE
6001	OCR Conformance Failure
6002	OCR General Error
9999	Dongle Missing

Note: 4700 is reported when at least one of the Data Matrix borders is less than one cell size (1X) from the image border or the damage to the border is too severe; 4702 is reported when a barcode is read but the verification is not supported, or Data Matrix DPM or IAQG verification is attempted on a Non-ECC200 Data Matrix that is greater than 26x26; 4702 is reported when the Data Matrix is read but the verification cannot be completed before the Inspection Timeout Value is reached.

- Status Code for QR Code:

TABLE 4-2. Status Code for QR Code

Numeric Code	Description
6001	QR IP General Error
6002	QR IP Ratio Error
6003	QR IP Finder Error
6004	QR IP Line Fit Error
6005	QR IP Line Geometry Error
6006	QR IP Line Corner Error

TABLE 4-2. Status Code for QR Code (continued)

Numeric Code	Description
6020	QR DEC General Error
6021	QR Invalid RS Level
6022	QR Format Info Failed
6023	QR Version Info Failed
6024	QR Invalid Rows or Columns
6025	QR Invalid Data Codeword
6026	QR Invalid Total Codeword
6027	QR Invalid Mode Indicator
6028	QR Mode Unimplemented
6029	QR RS Dec Failed
6030	QR BCH15 Decode Error
6031	QR Invalid Model

- **Symbol Angle** — Angle formed by the bottom solid side of each Data Matrix symbol with the horizontal (x) axis, or Angle formed by the barcode/OCR string orientation with the horizontal (x) axis.

Range: 0° to 359° in increments of 1°
- **Symbol Corners** — Contains the coordinates of the four corners of each Data Matrix/Barcode found.
- **Symbol Contrast** — Symbol contrast from 0% through 100% in each Data Matrix symbol.
- **Total Error Bits** — Number of error bits found in each decoded Data Matrix. For ECC200, this is obtained by multiplying the number of codewords corrected by 8.
- **Damage Percent** — Number of error bits/number of total bits in each Data Matrix symbol.
- **Border Match Percent** — Measures how good the border of each Data Matrix is, when compared to ideal.
- **Threshold Value** — Value used in determining the color of cells in each Data Matrix.

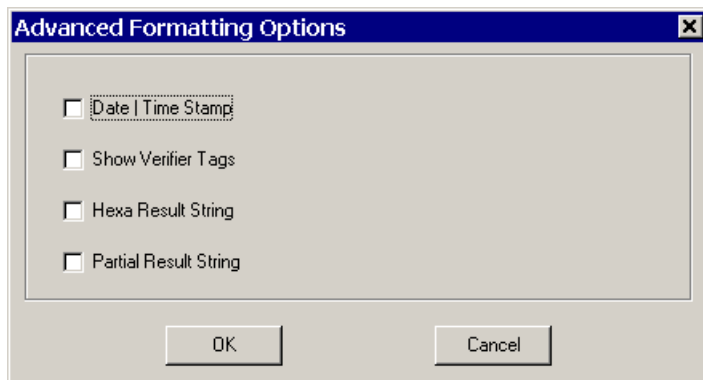
- **Timing** — Total time to decode all barcodes, then all Data Matrix symbols, in an entire image, or total time to perform OCR.

OCR Debug Report

- **Char Confidence** — OCR confidence level for each read character.
- **String Confidence** — OCR confidence for the read text string. This is the minimum of all char confidence.
- **Char Corners** — Contains the coordinates of four corners of each character found in OCR.

Clicking the Advanced button inside the Output Formatting displays the Advanced Formatting dialog box, as shown in Figure 4–20:

FIGURE 4–20. Advanced Formatting Options (Formatting Tab) Dialog Box



- **Date/Time Stamp** — The date and time stamp will be appended to the decoded data string for each camera read when checked.
- **Show Verifier Tags** — When this is checked, tags are inserted before each type of the parameters measured in Data Matrix and barcode verification results.
 - The tags for Data Matrix verification are:
 - ad — angle of distortion
 - an — axial nonuniformity
 - bm — border match

- cf — cell fill rate
 - cm — cell modulation
 - co — center offset
 - cs — cell size
 - pg — print growth
 - sc — symbol contrast
 - so — size offset
 - uec — unused error correction
- The tags for barcode verification are:
- 1X — one X dimension
 - dc — decodability
 - df — defects
 - ec — min. edge contrast
 - ed — edge determination
 - md — modulation
 - qz — quiet zone
 - rd — reference decode
 - rf — reflectance (max and min)
 - sc — symbol contrast
 - sg — scan grade
- **Hex Result String** — Check this to report decode data containing non-printable ASCII characters. Each character of the decode data will be displayed as its ASCII value in hexadecimal representation. A space is inserted between two adjacent hex values for better readability.
 - **Partial Result String** — You can report a portion of the decode data by specifying the Data Length and Data Start. For example, to send out 10 bytes

of the decode string starting at position 4, set Data Length to 10 and Data Start to 4.

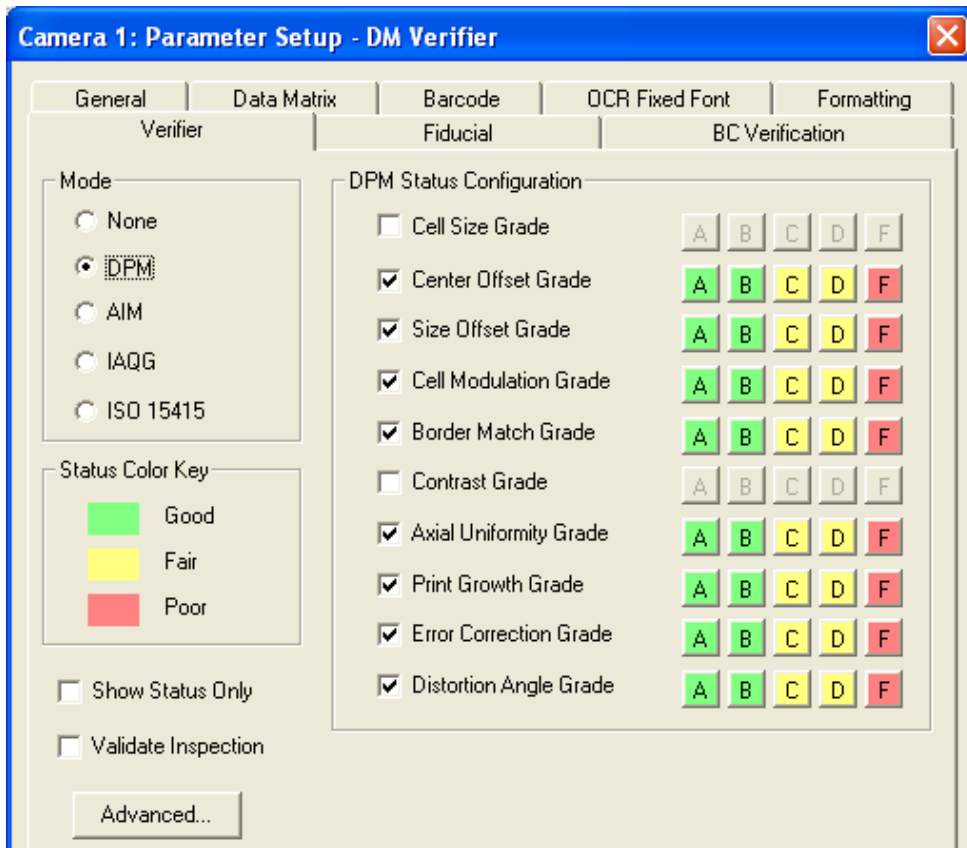
Setup>Parameters>Verifier

You can use the verifier to measure the Data Matrix mark quality as it is decoded. The inline verifier is a useful tool for grading and monitoring the Data Matrix marking process such that poorly marked or marginally decodable Data Matrix marks can be identified. If the Data Matrix code is not decodable, no mark quality measurement results can be obtained. To achieve accurate and repeatable verification results, the nominal cell size reported from each verification method (except for AIM) should be at least 5 pixels. It is recommended that 10 pixels be achieved whenever possible.

Nominal cell size is the average value of the two values: X Nominal Cell Size and Y Nominal Cell Size. X Nominal Cell Size is the Data Matrix width in pixels divided by the number of columns; Y Nominal Cell Size is the Data Matrix height in pixels divided by the number of rows.

Click the Verifier tab and select the DPM mode to display the in-line verification dialog box, as shown in Figure 4–21.

FIGURE 4–21. In-line Verification Dialog Box



- **Mode** — The options are None, DPM, AIM, IAQG, ISO 15415. The default option is None, indicating no verification is performed after reading the Data Matrix. When AIM is selected, the verifier will perform mark quality measurements based on the AIM specifications on Data Matrix. In addition to displaying the reading results specified in the formatting tab, the measurement results and AIM grading will be displayed. When IAQG is selected, the verifier will perform mark quality measurement based on the AS9132 specifications on Data Matrix. If the Mode is set to ISO 15415, then the verification is performed based on the ISO/IEC 15415 specification. The AIM/IAQG/ISO 15415 Status Configuration is enabled when the mode is set to AIM, IAQG, or ISO 15415. When DPM is selected, the verifier will perform mark quality measurement for the Direct Part Marks (DPM) and the DPM Status Configuration will be enabled.

- **Show Status Only** — When this is checked, only the verification status value is reported. The verification grades and values are not sent out in the report. Note that the Status Code must be checked first in the Formatting tab in order to report the verification status.
- **Validate Inspection** — Defines how the verification failure affects the inspection result. When verification fails and Validate Inspection is checked, the inspection will fail even if the Data Matrix was decoded. In this case, the Read I/O will not be raised in and the Read failure is indicated. When verification fails and Validate Inspection is unchecked, the inspection will not fail, both the Read I/O and Overrun I/O will be raised.
- **Target Print Growth** — When Mode is set to DPM and Print Growth Grade is checked in the DPM Status Configuration, the Advanced button will be enabled. Clicking Advanced button displays the Target Print Growth Advance Setup box. Target Print Growth represents the best print growth value required for the marking application, and it defaults to 0. For dot peen marks, you may choose to mark the dot size to be a certain percentage smaller than the nominal cell size. A target print growth value of -0.10 indicates that the best print growth should be 10 percent smaller than the nominal cell size.

AIM Verification Parameters

The following parameters are measured based on AIM Uniform Symbology Specification - Data Matrix, or ISO 16022 document. The method described in the document parallels in many ways the ANSI X3.182-1990 guideline for assessing print quality of linear bar code symbols. The parameters are mostly applicable to high contrast printed labels or certain laser marks on clean surfaces.

- **Symbol Contrast (SC)** — Contrast of the Data Matrix measured from the image. The grade is:
 - A if $SC \geq 75$
 - B if $SC \geq 55$
 - C if $SC \geq 40$
 - D if $SC \geq 20$
 - F if $SC < 20$
- **Axial Nonuniformity (AN)** — Check if the spacing between Data Matrix rows and the spacing between Data Matrix columns are similar to each other. The smaller the score the better the quality. The grade is:

A if AN \leq 0.06
B if AN \leq 0.08
C if AN \leq 0.10
D if AN \leq 0.12
F if AN $>$ 0.12

- **Print Growth (PG)** — Measures how much the cells comprising the Data Matrix have grown or shrunk from nominal cell size. Two measurements are made by sampling the centerline of two alternating patterns or timing borders independently to arrive at X Print Growth and Y Print Growth. For example, if the cell size has grown 20% over the nominal cell size in the X direction, then the X Print Growth is 0.20. If the cell size has shrunk 20% from the nominal cell size in Y direction, then the Y Print Growth is -0.20. The closer the score is to 0 the better the quality. The Print Growth is the X and Y print growth that has the larger absolute value. The grade is:

A if |PG| \leq 0.15
B if |PG| \leq 0.21
C if |PG| \leq 0.26
D if |PG| \leq 0.30
F if |PG| $>$ 0.30

Note that, in the Data Matrix Spec, a D' value was introduced as the Print Growth. In fact, $D' = 3.3 \times PG$. Therefore, the above grading criteria can also be written as:

A if |D'| \leq 0.50
B if |D'| \leq 0.70
C if |D'| \leq 0.85
D if |D'| \leq 1.00
F if |D'| $>$ 1.00

- **Unused Error Correction (UEC)** — The Error Correction Used measures how many cells (for ECC050, ECC080, ECC100, and ECC140) or codewords (each consisting of eight cells for ECC200) have been corrected in order to decode the Data Matrix. The UEC is the full error correction capacity (normalized to 1) minus the Error Correction Used. The greater the score the better the quality. The grade is:

A if UEC \geq 0.62
B if UEC \geq 0.50
C if UEC \geq 0.37

D if UEC ≥ 0.25

F if UEC < 0.25

- **Overall Grade** — Lowest of the parameter grades achieved from above four parameters.

IAQG Verification Parameters

The following parameters are measured based on AS 9132 (Rev A), Data Matrix (2D) Coding Quality Requirements for Parts Marking, International Aerospace Quality Group.

- **Dot Size** — Check how much the size of all modules varies. The value Dot Size Count1 is the percentage of the modules that are either smaller than 70% or greater than 90% of the nominal module size. The value Dot Size Count2 is the percentage of modules that are either smaller than 60% or greater than 105% of the nominal module size. The Dot Size Grade is:

A (Excellent) if Dot Size Count1 is no more than 2%

B (Acceptable) if Dot Size Count2 is no more than 2%

F (Fail) if Dot Size Count2 is greater than 2%

- **Dot Center Offset** — Check if modules are marked in the correct locations. The value Dot Center Offset Count1 is the percentage of modules whose dot center offset exceeds 10% of the nominal module size. The value Dot Center Offset Count2 is the percentage of modules whose dot center offset exceeds 20% of the nominal module size. The Dot Center Offset Grade is:

A (Excellent) if Dot Center Offset Count1 is no more than 2%

B (Acceptable) if Dot Center Offset Count2 is no more than 2%

F (Fail) if Dot Center Offset Count2 is greater than 2%

- **Angle of Distortion** — Measure the angular deviation of 90° plane between the two solid borders. The Angle of Distortion Grade is:

A (Excellent) if the Angle of Distortion is no more than $\pm 3.5^\circ$

B (Acceptable) if no more than $\pm 7^\circ$

F (Fail) if more than $\pm 7^\circ$

- **Nominal Module Size** — Same as Nominal Cell Size on page 4–44.
- **Module Fill Rate** — Average module size divided by the nominal module size in both X and Y direction; provided as a reference only.

- **Ovality** — A module has poor ovality if the width and height of the module differ by more than 20% of the nominal module size. The Ovality Value is the percentage of modules that have poor ovality. The Ovality Grade is:

A and B if Ovality Value is no more than 2%
F if Ovality Value is greater than 2%
- **Symbol Contrast** — Defined as the gray density difference between the marking and its substrate. For image based contrast measurement, the camera system first must be calibrated to match the Scale of Gray Density chart shown in AS9132. The contrast is then measured as the difference in reflectance (measured by grayscale values) between the light and dark modules of the symbol. The arithmetic mean of the darkest 10% of the pixels and that of the lightest 10% pixels within the Data Matrix area are computed. Symbol Contrast is the difference of the two means divided by the full gray scale range. This parameter is not graded but provided as a reference.
- **Overall Grade** — Lowest grade of all graded parameters.

ISO 15415 Verification Parameters

The following parameters are measured based on ISO/IEC 15415, Bar code symbol print quality test specification - Two-dimensional symbols, using the measuring aperture 05. To correctly apply the aperture 05, the camera must be calibrated first using **Setup > Calibration** menu.

- **Reference Decode** — Use the symbology Reference Decode Algorithm to decode the Data Matrix. Reference Decode is graded as:

A if the Data Matrix is successfully decoded
F if the Data Matrix cannot be decoded
- **Symbol Contrast (SC)** — Difference between the highest and lowest reflectance values in the Data Matrix area including the quiet zone. It is graded as:

A if $SC \geq 70\%$
B if $SC \geq 55\%$
C if $SC \geq 40\%$
D if $SC \geq 20\%$
F if $SC < 20\%$
- **Axial Nonuniformity** — Same as AIM Verification.

- **Grid Nonuniformity (GN)** — Measures and grades the largest vector deviation of the grid intersections from their ideal theoretical position. The grid intersections are determined by the reference decode algorithm from the binarized image of the Data Matrix from the cells within the alternating patterns only. Grid Nonuniformity is graded as:
 - A if $GN \leq 0.38$
 - B if $GN \leq 0.50$
 - C if $GN \leq 0.63$
 - D if $GN \leq 0.75$
 - F if $GN > 0.75$
- **Unused Error Correction** — Same as AIM Verification.
- **Fixed Pattern Damage** — Measured based on modules in each of the four fixed patterns (two solid borders and two alternating patterns or timing borders) and its corresponding quiet zone, and when present, modules in or around the internal alignment patterns. Up to five segments are individually graded and then the average grade is determined. Finally, the grade for Fixed Pattern Damage is chosen to be the lowest of the segment grades and the distributed damage grade. There is no final value for Fixed Pattern Damage that corresponds to the grade for reporting.
- **Modulation** — Measure the uniformity of reflectance of the dark and light modules, respectively. First, Modulation for each codeword is computed and graded based on the reflectance value of each module in the codeword. Then, the modulation grade is determined using codeword based modulation grades by applying an overlay procedure. Only the modulation grade is reported. There is no final value for Modulation to report.
- **Print Growth** — Measured the same way as in the AIM Verification but is not graded. It is reported as an informative measure for the purposes of process control.
- **Overall Grade** — Lowest grade of all ISO 15415 parameters described in this section except for Print Growth.

DPM Verification Parameters

The following parameters are measured based on Microscan's extensive experience in Data Matrix reading and verification of Direct Part Marks (DPM).

- **Cell Size (CS)** — Test if Nominal Cell Size exceeds the minimum requirement. To ensure accurate and repeatable measurement results, it is

recommended that nominal cell size be no less than 10 pixels. For good quality images, a minimum of 5 pixels may be sufficient. The grade is:

A if CS \geq 10
B if CS \geq 9
C if CS \geq 7
D if CS \geq 5
F if CS $<$ 5

Note that, for calibrated system, the cell size is reported in Mils (0.001 inch) instead of Pixels but the grading is always based on the pixel values.

- **Center Offset (CO)** — Check if On cells are precisely placed according to the nominal Data Matrix grid. If a cell is out of alignment, its center offset error is computed as the distance from the center of the cell to its nominal location (in pixels) divided by the nominal cell size. The Center Offset of the Data Matrix is the average of center offset errors for all the On cells normalized to achieve the proper range between 0 and 10. The measurement is most useful for gauging the quality of dot peen or inkjet marks. The smaller the score the better the quality. The grade is:

A if CO \leq 2.5
B if CO \leq 5
C if CO \leq 7.5
D if CO \leq 10
F if CO $>$ 10

- **Size Offset (SO)** — Check if all matrix On cells have similar size. The size offset is computed as the standard deviation of the cell area for all On cells, normalized to achieve the proper range between 0 and 10. The measurement is most useful in detecting the matrix cell size variation. The smaller the score the better the quality. The grade is:

A if SO \leq 2.5
B if SO \leq 5
C if SO \leq 7.5
D if SO \leq 10
F if SO $>$ 10

- **Cell Modulation (CM)** — Measures the spread of the gray scale values of cells of the same polarity. On Cell Modulation is computed for all On cells and Off Cell Modulation for all Off cells. A high On Cell Modulation indicates that all On cells have similar gray scale values and the spread is

small. A high Off Cell Modulation indicates all Off Cells (background cells) have similar gray scale values. The Cell Modulation is the smaller of the On and Off Cell Modulation. The cell modulation value ranges from 0 to 100.

The grade is:

A if CM \geq 90
B if CM \geq 80
C if CM \geq 70
D if CM \geq 60
F if CM $<$ 60

- **Border Match (BM)** — Check if all border cells are present. The border match is 100 % for a Data Matrix with perfect borders. The grade is:

A if BM \geq 95
B if BM \geq 90
C if BM \geq 85
D if BM \geq 80
F if BM $<$ 80

- **Symbol Contrast (SC)** — Contrast of the Data Matrix measured from the image. The value is sensitive to the lighting change; thus, uncalibrated value has little meaning. To use this parameter properly, contrast calibration must be performed first. The range is from 1 to 100. The grade is:

A if SC \geq 75
B if SC \geq 55
C if SC \geq 40
D if SC \geq 20
F if SC $<$ 20

- **Axial Nonuniformity (AN)** — Check if the spacing between matrix rows and the spacing between matrix columns are similar to each other. The smaller the score the better the quality. The grade is:

A if AN \leq 0.06
B if AN \leq 0.08
C if AN \leq 0.10
D if AN \leq 0.12
F if AN $>$ 0.12

- **Print Growth (PG)** — Measures how much the Data Matrix cells are over or under printed/marked in both X and Y directions. X Print Growth (XPG) is computed as the difference between the average width of all On cells and

the X Nominal Cell Size, divided by the X Nominal Cell Size. Y Print Growth (YPG) is computed as the difference between the average height of all On cells and the Y Nominal Cell Size, divided by the Y Nominal Cell Size. Print Growth (PG) is defined as the larger value of $|XPG - TPG|$ and $|YPG - TPG|$ where TPG is the Target Print Growth. Target Print Growth represents the best print growth value required for the marking application and is default to 0. For dot peen marks, you may choose to mark the dot size to be a certain percentage smaller than the nominal cell size and set the TPG to be a negative value such as -0.10 or -0.20. Print Growth is graded as:

A if $PG \leq 0.10$
 B if $PG \leq 0.20$
 C if $PG \leq 0.30$
 D if $PG \leq 0.40$
 F if $PG > 0.40$

- **Unused Error Correction (UEC)** — The Error Correction Used measures how many cells (for ECC050, ECC080, ECC100, and ECC140) or codewords (each consisting of eight cells for ECC200) have been corrected in order to decode the Data Matrix. The UEC is the full error correction capacity (normalized to 1) minus the Error Correction Used. The greater the score the better the quality. The grade is:

A if $UEC \geq 0.62$
 B if $UEC \geq 0.50$
 C if $UEC \geq 0.37$
 D if $UEC \geq 0.25$
 F if $UEC < 0.25$

- **Angle of Distortion (AD)** — Measures how much the “L” angle (the angle formed by the two solid borders) deviates from the right angle. The grade is:

A if $|AD| \leq 2$
 B if $|AD| \leq 4$
 C if $|AD| \leq 6$
 D if $|AD| \leq 7$
 F if $|AD| > 7$

- **Overall Grade** — The overall grade is the lowest grade received by all enabled verification parameters. By default, all parameters except Cell Size and Symbol Contrast are enabled. Since it is not always possible to achieve the recommended 10 pixels per cell or good contrast for DPM parts, and the two parameters Cell Size and Symbol Contrast are usually less important,

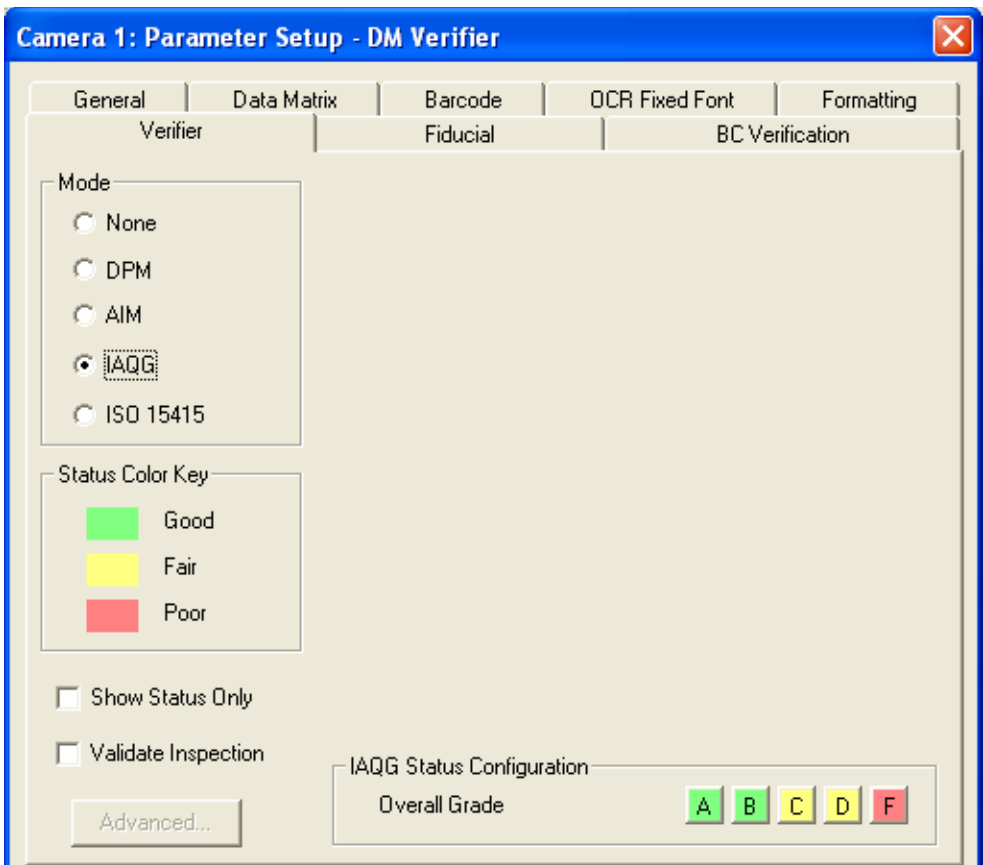
they are disabled in order to avoid lowering the overall grade of an otherwise good Data Matrix mark. Sometimes, you may also find other parameters that receive low grades due to the improper camera setup. These parameters have to be disabled so that the overall grade is determined by the remaining important parameters more suitable for the application. For example, a laser mark that has perfect center offset and size offset may report a low grade for both parameters if the camera has to be mounted at an angle that is not perpendicular to the mark surface. Based on the assumption that both the center and size offset are not contributing factors to the low quality of the mark, the verification can be done after disabling the two parameters.

Verification Status

The Verification Status is used to indicate Verification Pass/Fail or Verification Good/Fair/Poor. It is configured based on the individual parameter grade for DPM verification or the Overall Grade for AIM, IAQG, and ISO 15415 verifications. The verification status is such that the grade A is always Good and grade F is always Poor, and that grade B, C, or D can be configured to be any of the Good, Fair, and Poor status as long as no lower grade is assigned a better status. If the Fair status is not used, then the verification status has two outcomes only, Good (or Pass) and Poor (or Fail).

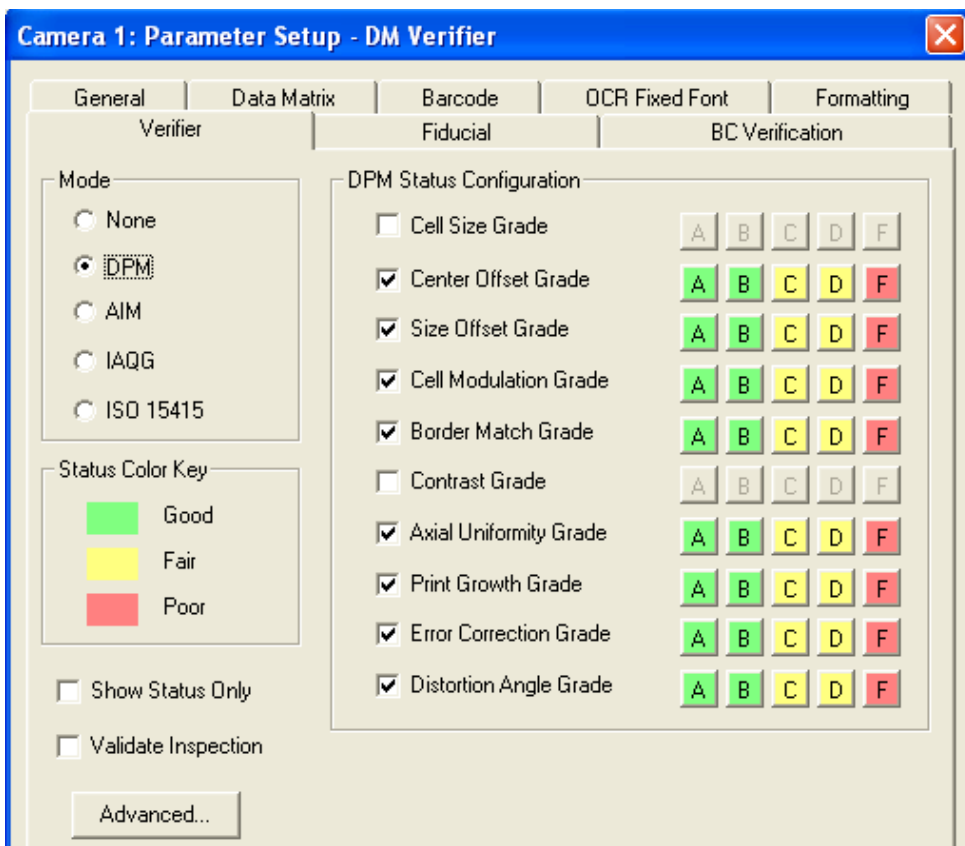
For AIM, IAQG, and ISO 15415 Data Matrix verification, the verification status is configured using the Overall Grade. The default configuration is that grade B is Good, grade C and D are Fair.

FIGURE 4–22. IAQG Verification



For DPM verification, the verification status is not configured using the Overall grade. Instead, the verification status for each parameter is individually configured and determined by its grade. The verification status for the DPM verification is chosen as the lowest verification status of all enabled parameters.

FIGURE 4–23. DPM Verification



Verification Results Display

Verification results are sent to serial port, TCP port, or log file the same way as they appear in the status bar of DMx AutoID+™. In the following, we use Decode Data to refer to the Data Matrix decode string and the Symbology Debug Report specified in the formatting tab. When the Data Matrix is not decoded, the decoded string will be substituted with the default LOCATE FAILURE or DECODE FAILURE message. When the Data Matrix is decoded, the verification results are displayed in the following ways:

- AIM Mode (ISO 16022):
 - Decode Data (decode string and debug output when specified)

- Symbology/Verification Status Code (if Status Code is checked in Formatting tab)
 - Symbology/Verification Timing (if Timing is checked in Formatting tab)
 - Overall Grade
 - Symbol Contrast Grade
 - Symbol Contrast
 - Axial Nonuniformity Grade
 - Axial Nonuniformity
 - Print Growth Grade
 - X Print Growth
 - Y Print Growth
 - UEC Grade
 - Unused Error Correction
- IAQG Mode (AS9132):
- Decode Data (decode string and debug output when specified)
 - Symbology/Verification Status Code (if Status Code is checked in Formatting tab)
 - Symbology/Verification Timing (if Timing is checked in Formatting tab)
 - Overall Grade
 - Dot Size Grade
 - Dot Size Count1
 - Dot Size Count2
 - Dot Center Offset Grade
 - Dot Center Offset Count1

- Dot Center Offset Count2
- Angle of Distortion Grade
- Angle of Distortion
- Nominal Module Size
- Module Fill Rate X
- Module Fill Rate Y
- Ovality Grade
- Ovality Value
- Symbol Contrast
- ISO 15415 Mode:
 - Decode Data (decode string and debug output when specified)
 - Symbology/Verification Status Code (if Status Code is checked in Formatting tab)
 - Symbology/Verification Timing (if Timing is checked in Formatting tab)
 - Overall Grade
 - Reference Decode Grade
 - Symbol Contrast Grade
 - Symbol Contrast Value
 - Axial Nonuniformity Grade
 - Axial Nonuniformity Value
 - Grid Nonuniformity Grade
 - Grid Nonuniformity Value
 - UEC Grade
 - UEC Value

- Fixed Pattern Damage Grade
- Modulation Grade
- Print Growth Value X
- Print Growth Value Y
- Nominal Cell Size Value
- DPM Mode:
 - Decode Data (decode string and debug output when specified)
 - Symbology/Verification Status Code (if Status Code is checked in Formatting tab)
 - Symbology/Verification Timing (if Timing is checked in Formatting tab)
 - Overall Grade
 - Nominal Cell Size Grade
 - Nominal Cell Size
 - Center Offset Grade
 - Center Offset
 - Size Offset Grade
 - Size Offset
 - Cell Modulation Grade
 - On Cell Modulation
 - Off Cell Modulation
 - Border Match Grade
 - % Border Match
 - Symbol Contrast Grade
 - Symbol Contrast

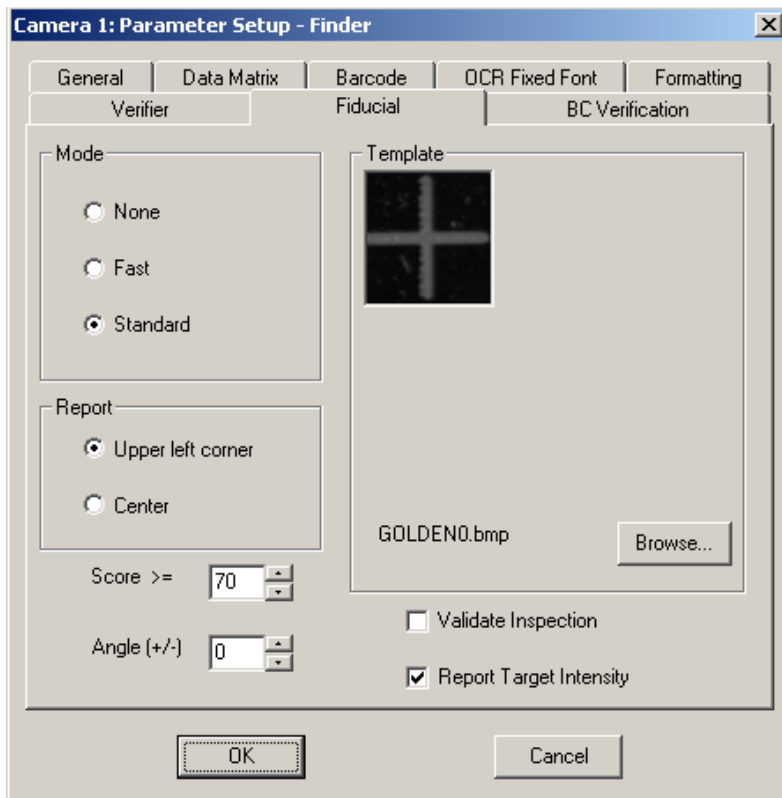
- Axial Nonuniformity Grade
- Axial Nonuniformity
- Print Growth Grade
- X Print Growth
- Y Print Growth
- UEC Grade; UEC
- Distortion Angle Grade
- Angle of Distortion

Setup>Parameters>Fiducial

To use the fiducial finder, you first need to perform a Learn. For more information, see “Learn>Fiducial” on page 4-120

The Fiducial tab allows you to configure the correlation based fiducial finder to search for a target in the image.

FIGURE 4–24. Parameter Setup (Fiducial Finder) Dialog Box



- **Mode** — Allows you to select one of the following:
 - Select **None** if you want to keep the learned target but do not want to enable the fiducial finder in Run mode yet.
 - Select **Fast** if you want to enable the fiducial finder to run a fast but somewhat less robust algorithm.
 - Select **Standard** to select the more robust algorithm. Sometimes, the Standard mode may take less time to find the target than the Fast mode. This happens when the less robust Fast mode fails to find the target quickly and extra algorithm steps are performed. Therefore, you need to experiment with the template you choose to determine whether the Fast mode is consistently faster than the Standard mode.

- **Report** — Enabled for editing only when the fiducial finder is enabled. Report the Finder result as Xout: b; (x, y, score, intensity) where b is 1 (found) or 0 (not found), (x, y) are the coordinates of the found target that are specified by Upper left corner or Center, score is the correlation score, intensity is the average intensity of the target.
- **Score >=** — Enabled for editing only when the fiducial finder is enabled. You can set the threshold for correlation score here. The higher the score, the better the template match. If you want to allow a less perfect fiducial mark to be found, then you might need to lower the threshold.

Default: 70

Range: 20 to 100

- **Angle (±)** — Enabled for editing only when the fiducial finder is enabled. If you need to allow up to 5° rotation angle in the fiducial search, set the angle here accordingly.

Default: 0 (No rotation is allowed)

- **Template** — This is the golden template needed in the correlation search algorithm. It is a bitmap image of the target learned in the **Learn>Fiducial** step and saved in the job folder under the DMx AutoID+™ application folder. You can use **Browse** to select a different template.
- **Validate Inspection** — The fiducial finder can be enabled to work together with regular inspection, e.g., reading Data Matrix, and/or barcode, and/or OCR. When **Validate Inspection** is unchecked, the status of the inspection is not affected by the success or failure of the fiducial finder. When **Validate Inspection** is checked, the status of the inspection will fail whenever the fiducial finder fails to find a target, regardless of whether the correct number of Data Matrices, and/or barcodes, and/or OCR strings have been read or not.
- **Report Target Intensity** — If checked, the average intensity of the found target is reported after the correlation score.

Setup>Parameters>Barcode Verification

The implementation of barcode print quality verification is based on the ANSI X3.182-1990 Bar Code Print Quality - Guideline (or ISO15416). A total of 10 scans are made to get 10 scan reflectance profiles of the barcode. The scans are approximately equally spaced within the barcode and are made parallel to the length of the barcode.

For each scan reflectance profile, these parameters are graded:

- Decodability
- Defects
- Edge Determination
- Minimum Edge Contrast
- Minimum Reflectance
- Modulation
- Quiet Zone
- Reference Decode
- Symbol Contrast

Each parameter is given a grade (A, B, C, D, F) that corresponds to a numeric value of 4, 3, 2, 1, or 0, respectively. The lowest grade received from these parameters is used as the Overall Profile Grade for the scan profile. The Final Symbol Grade Score is the simple average of all the overall profile grades using the standard weighting:

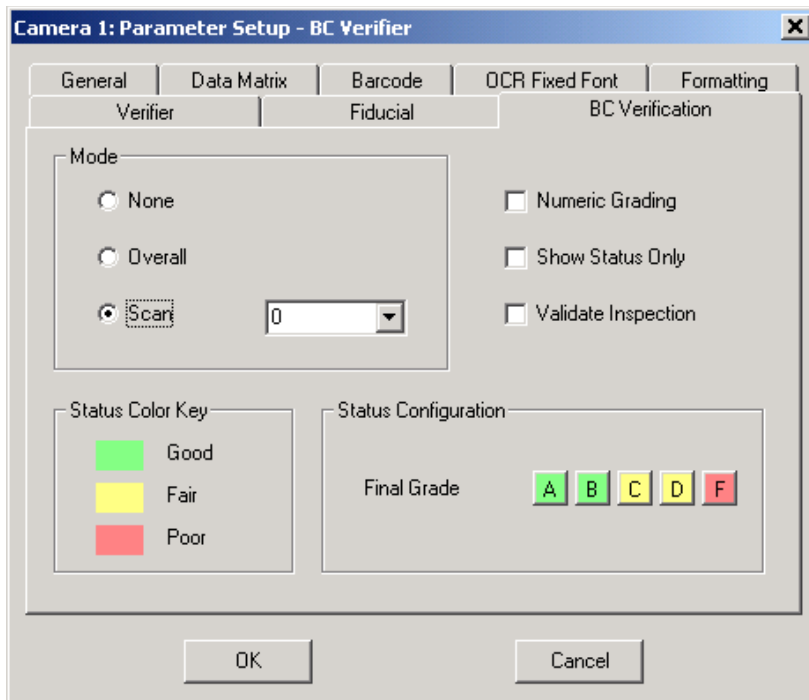
- 4 = A
- 3 = B
- 2 = C
- 1 = D
- 0 = F

The average is converted to the Final Symbol Grade:

- $3.5 \leq A \leq 4.0$
- $2.5 \leq B < 3.5$
- $1.5 \leq C < 2.5$
- $0.5 \leq D < 1.5$
- $F < 0.5$

The BC Verification dialog box (Figure 4–25) allows you to enable barcode verification and report either the overall results or each individual scan results (but not both at the same time).

FIGURE 4–25. Parameter Setup (Barcode Verification) Dialog Box



Grading Criteria

The following information describes briefly how each parameter is graded based on a scan reflectance profile.

- Decodability is graded as:
 - A — At least 0.62
 - B — At least 0.50
 - C — At least 0.37
 - D — At least 0.25
 - F — Otherwise
- Defects is graded as:

- A — At most 0.15
- B — At most 0.20
- C — At most 0.25
- D — At most 0.30
- F — Otherwise

- Edge Determination is graded as A (pass) or F (fail) depending on whether all element edges are correctly identified.

- Minimum Edge Contrast is graded as:

- A if it is at least 15%
- F otherwise

- Minimum Reflectance is graded as:

- A if max reflectance value is at least twice min reflectance value
- F otherwise

- Modulation is graded as:

- A — At least 0.70
- B — At least 0.60
- C — At least 0.50
- D — At least 0.40
- F — Otherwise

- Reference Decode is graded as A or F depending on whether the reference decode passes or fails. Both Start and Stop Quiet Zone must be at least 10X for the reference decode to pass.

- Symbol Contrast is graded as:

- A — At least 70%
- B — At least 55%
- C — At least 40%
- D — At least 20%
- F — Otherwise

Barcode Verification

Currently, DMx AutoID+™ supports barcode print quality verification for Code 128, Code 39, Code 93, I 2 of 5, UPC-A, EAN13, EAN8, and RSS. To ensure the verification to be accurate and consistent, you need to set the barcode in the FOV

such that the 1X dimension is between 2.5 to 4 pixels. The barcode needs to be evenly illuminated with good contrast and no image saturation.

Once a good image is obtained:

1. Select **Learn > Barcode** to configure the barcode reading first.
2. Once the Learn is successful, use **Setup > Parameters...** to display the Parameter Setup dialog.
3. Select BC Verification tab, and then select Overall mode.
4. To exit the dialog box, click OK.
5. Click Run Once to view the verification results following the decode data.

Alternatively, you can configure the DMx AutoID+™ to verify all types of barcodes listed above by following these steps:

1. Use **File > Jobs > Load > Default** to clear the existing barcode configuration.
2. In **Setup > Parameters > General**, check Code 128, Code 39, Code 93, I 2 of 5, UPC/EAN, UPC-E, and all types of RSS. Set the Number of Barcodes to Read to be 1 or up to the number of the barcodes in the same FOV.
3. Select BC Verification tab and check Overall in Mode. Click OK to exit the dialog.
4. Click Run Once to view the verification results.

Reporting Verification Results

By setting the Mode to Overall or Scan, full ANSI barcode verification is performed once the barcode in the image is decoded. The verification results are reported differently depending on the mode chosen. Typically, you only need to use Overall to report the final grade and the overall grade for each scan profile. Alternatively, you can select Scan to examine a certain scan line in order to get detailed results on all measured parameters.

Numeric Grading — Checking this will report the grade:

- A = 4
- B = 3

- C = 2
- D = 1
- F = 0

Show Status Only — Checking this will only display the verifier status. See **Verification Results Display** below for the verifier status.

Validate Inspection — Defines how the verification failure affects the inspection result. When verification fails and Validate Inspection is checked, the inspection will fail even if the barcode was decoded. In this case, the Read I/O will not be raised signaling the Read failure. When verification fails and Validate Inspection is unchecked, the inspection will not fail; both the Read I/O and Overrun I/O will be raised.

Verification Status — Can be configured to indicate Verification Pass/Fail or Verification Good/Fair/Poor. It is configured based the Final Grade. The verification status is such that the grade A is always Good and grade F is always Poor, and that grade B, C, or D can be configured to be any of the Good, Fair, and Poor status as long as no lower grade is assigned a better status. If the Fair status is not used, then the verification status has two outcomes only, Good (or Pass) and Poor (or Fail).

Verification Results Display — The results are sent to serial ports, via TCPIP, or logged to a log file the same way as they appear in the status bar of DMx AutoID+™. In the following description, we use Decode Data to refer to the decoded string and the debug items checked in Symbology Debug Report of the formatting tab. When the barcode is not decoded, the decoded string will be substituted with the default LOCATE FAILURE or DECODE FAILURE message. When the barcode is decoded, the verification results are displayed in the following ways:

- Overall Mode
 - Decode Data (decode string and debug output when specified)
 - Symbology/Verification Status Code (if Status Code is checked in Formatting tab)
 - Symbology/Verification Timing (if Timing is checked in Formatting tab)
 - Final Symbol Grade

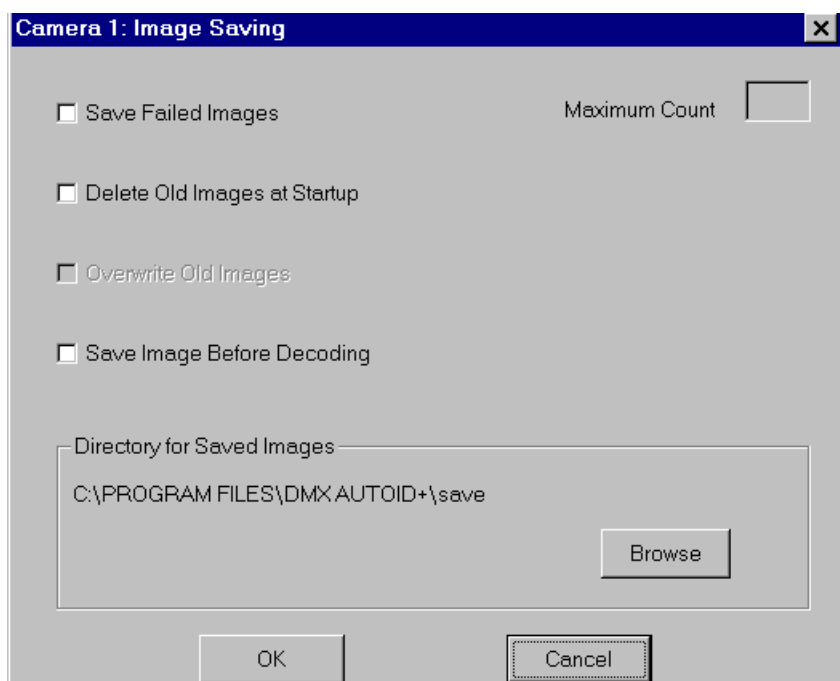
- Final Symbol Grade score (Range: 0.0 to 4.0)
- scan 0 overall grade
- scan 1 overall grade
- scan 2 overall grade
- scan 3 overall grade
- scan 4 overall grade
- scan 5 overall grade
- scan 6 overall grade
- scan 7 overall grade
- scan 8 overall grade
- scan 9 overall grade
- 1X dimension (Note: Average width of the narrow bar widths, in pixels)
- ratio 1 (Note: Average wide bar width to 1X dimension)
- ratio 2 (Note: Next widest bar to 1X dimension, applicable to multi-width barcode only)
- ratio 3 (Note: Widest bar to 1X dimension, applicable to multi-width barcode only)
- Scan Mode (You need to specify a scan number from 0 to 9)
 - Decode Data (decode string and debug output when specified)
 - Symbology/Verification Status Code (if Status Code is checked in Formatting tab)
 - Symbology/Verification Timing (if Timing is checked in Formatting tab)
 - overall scan grade
 - edge determination grade
 - min reflectance grade

- % max reflectance (Note: Percentage value of reflectance of lightest space)
- % min reflectance (Note: Percentage value of reflectance of darkest bar)
- ref decode grade
- min edge contrast grade
- % min edge contrast (Note: Percentage value of minimum edge contrast)
- symbol contrast grade
- % symbol contrast (Note: Percentage value of symbol contrast)
- modulation grade
- modulation (Note: 0.00 ~ 1.00)
- defects grade
- defects (Note: 0.00 ~ 1.00)
- decodability grade
- decodability (Note: 0.00 ~ 1.00)
- start quiet zone (0.0 ~ 10.0)
- stop quiet zone (0.0 ~ 10.0)

Setup>Image Saving

This menu item displays the Image Saving dialog box, as shown in Figure 4–26.

FIGURE 4–26. Image Saving Dialog Box



- **Save Failed Images** — Enable to save the images that cannot be located/decoded to the Directory for saved images, described below. Images are saved as FAILxnnn.BMP, where:
 - x — Represents the zero-based index of the camera from which the image was taken.
 - nnn — Represents the 3-digit numbering index for each image. The allowable range for nnn is from 000 to 1 less than the Maximum count (as described next), not to exceed 999.
- **Maximum count** — Since each image requires approximately 300K of disk space in 640x480 resolution, this parameter limits the number of camera images that are saved when enabled.

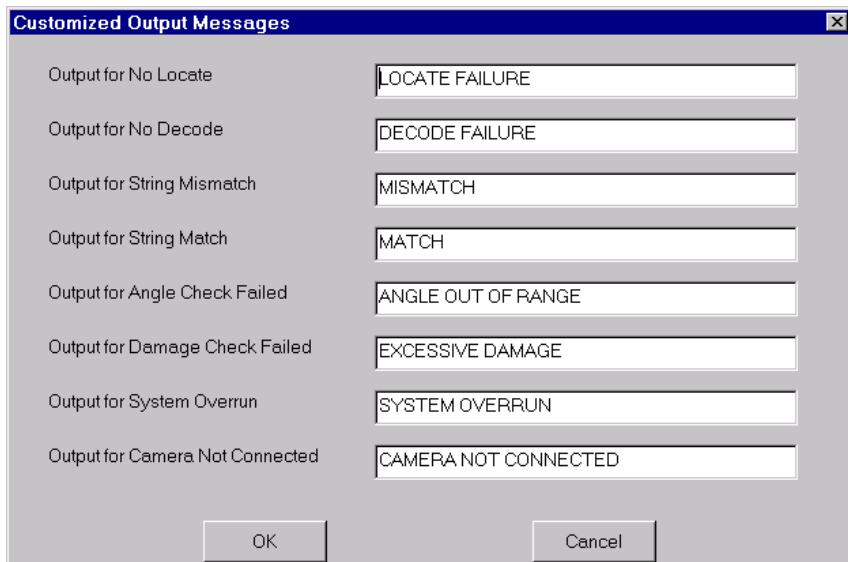
Range: 1 to 999

- **Delete Old Images at Startup** — Enable this item to delete all the failed images stored in the Directory for failed images at system startup.
- **Overwrite Old Images** — Enable this item to overwrite images when the image name already exists. When the DMx AutoID+™ program is not configured to overwrite old images, it will stop saving failed images once the maximum count is reached.
- **Save Image Before Decoding** — Enable to save each image before the symbology or OCR decoding algorithms are performed. Each camera saves its image to a single file *BEFORE_x.BMP*, where *x* is the zero-based index of the camera. These files are always overwritten. Do not use this option unless you suspect a serious decoding software problem and attempt to debug it.
- **Directory for Saved Images** — The failed images are normally saved in the folder Save under the application directory DMx AutoID+™. You can change the directory by selecting the **Browse** button to display a dialog box and entering the new directory in the dialog box. If the directory does not already exist, it will be created.

Setup>Output Messages

This menu item displays the Customized Output Messages dialog box, as shown in Figure 4–27.

FIGURE 4–27. Customized Output Messages Dialog Box



The strings in the edit boxes can be modified. All enabled cameras report the same string for the same error condition. To add prefix, select **Setup**, then **Parameters**, and finally **Formatting** to indicate the camera number.

Setup>Checking Modes

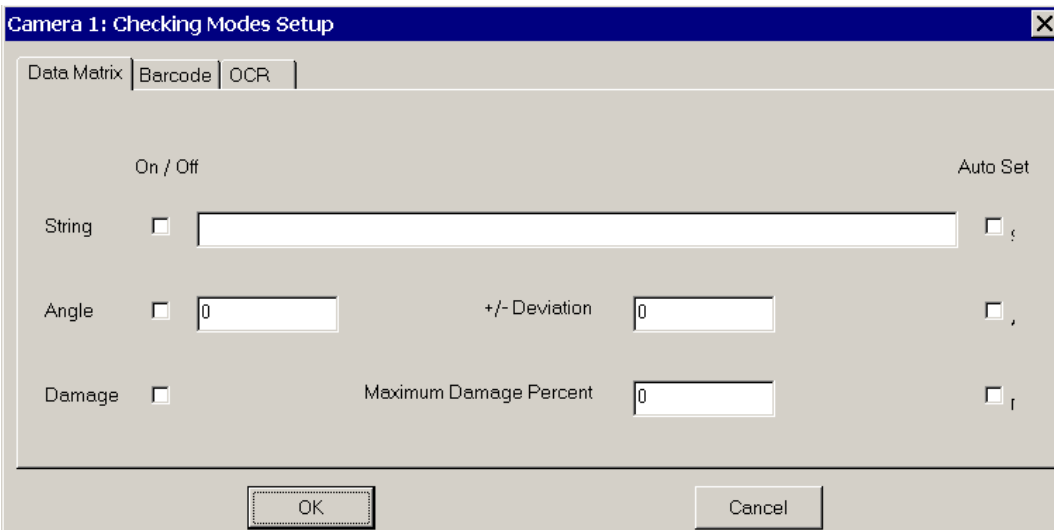
The String, Angle, and Damage Checking are performed only when enabled. To perform the checking, the barcode, Data Matrix, or OCR should be successfully decoded. Each camera has separate checking parameters for Barcode, Data Matrix, and OCR, that can be enabled or disabled.

- **String Checking Mode** — Data decoded from an inspection is compared to a defined string. You can enter the check string in uppercase and/or lowercase characters, but the entry *must* match the data being read (e.g., string length and case of each character in the string). Wild card can be used. That is, if you want to ignore part of the string in checking mode, replace each character of that part with a question mark '?’.

- **Angle Checking Mode** — Use this mode to verify that the matrix/barcode being decoded is at a specified angle with a specified tolerance. The angle and deviation are specified in degrees, with the angle increasing as the matrix is rotated counter-clockwise.
- **Damage Checking Mode** — Use this mode to make sure that the Data Matrix being decoded contains less than the specified percent of damage to the data cells. The maximum allowed damage ranges from 0% to 99%.

Open the Setup menu and select **Checking Modes** to display the Data Matrix Checking Mode dialog box, as shown in Figure 4–28.

FIGURE 4–28. Checking Modes Setup (Data Matrix Tab) Dialog Box



You can either manually enter the match string, angle, deviation, and damage percent, or set them automatically by checking the Auto Set option before Learn is performed. To enable a certain type of checking, check its corresponding On/Off box.

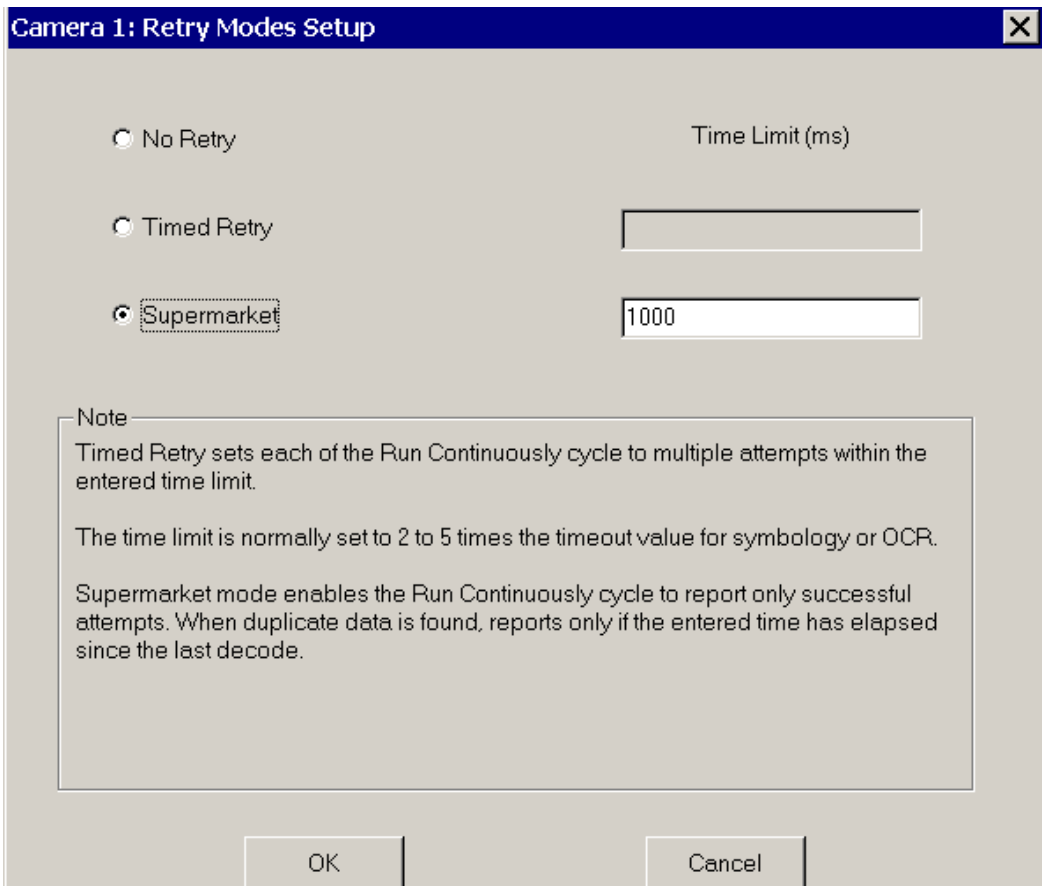
In Barcode Checking Mode, the Damage Checking is not supported. Only String Checking is supported in OCR Checking Mode.

Note: The Checking Mode can only be enabled when the DMx AutoID+™ program is configured to read one Data Matrix, one barcode, or one row of OCR text. It is not allowed to work with Retry Supermarket mode.

Setup>Retry Modes

Retry Modes define the inspection (Run) cycle. Several retry modes are available. This menu item displays the Retry Modes Setup dialog box, as shown in Figure 4–29.

FIGURE 4–29. Retry Modes Setup Dialog Box



- **No Retry** — This is the default Retry mode. In this mode, no retry is attempted upon failure.
- **Timed Retry** — When this option is selected, you must enter the time limit for the retry process and the Inspection Time-out Value specified in the General Tab of the Parameter box. The time limit should be at least twice the Inspection Time-out. A retry cycle usually consists of several read cycles. A

read cycle includes acquiring a new image and reading the symbology or OCR according to the configuration parameters. A trigger (hardware trigger or serial/TCP/IP command READ) is required to start the first read cycle of the retry cycle. When a trigger is received, the system performs the first read cycle. If the reading is successful, no further read cycles are needed. If the reading is not successful and if there is enough time remaining, the next read cycle is performed. The retry cycle will terminate as soon as the reading is successful or until the corresponding retry time limit is reached. The reading results are reported when the retry cycle ends. Before the retry cycle ends, the system will ignore any new triggers for any cameras. We recommend that you set the retry time limit to be significantly less than the duration between two triggers. When there are more than one camera enabled in the system, you can enable Timed Retry for specific camera(s) up to all enabled cameras. It is important to set the retry time limit long enough to allow several read cycles to be performed.

There are two main trigger configurations:

- Send a software trigger to DMx AutoID+™ for a specified camera using serial/TCP/IP command READ. Usually, a serial command is generated from a PLC (Programmable Logic Controller). A TCP/IP command is generated from another Windows program communicating with DMx AutoID+™ through TCP/IP protocol. If hardware trigger is unchecked in **Setup>System Configuration** box, then the retry cycle for the specified camera is started as soon as the command READ is received by DMx AutoID+™. If hardware trigger is checked, then the retry cycles will not start until a hardware trigger for the specified camera is received after the command READ is received by DMx AutoID+™.
- Start the Run Continuous mode with Timed Retry mode. If the hardware trigger is unchecked in System Configuration box, the system will cycle through all enabled and configured cameras and perform timed retry for each camera that has the timed retry mode checked. If the hardware trigger is checked and the trigger mode is set to asynchronous, then the retry cycle for a camera that has the retry mode enabled will start only when a hardware trigger arrives for that camera. Once the camera enters retry cycle, any new triggers from the same camera or other enabled cameras will be ignored. Therefore it is essential that no trigger be generated before a retrying camera completes its retry cycle. This also means that the triggers for multiple cameras are not truly asynchronous although the trigger mode needs to be set to asynchronous in the System

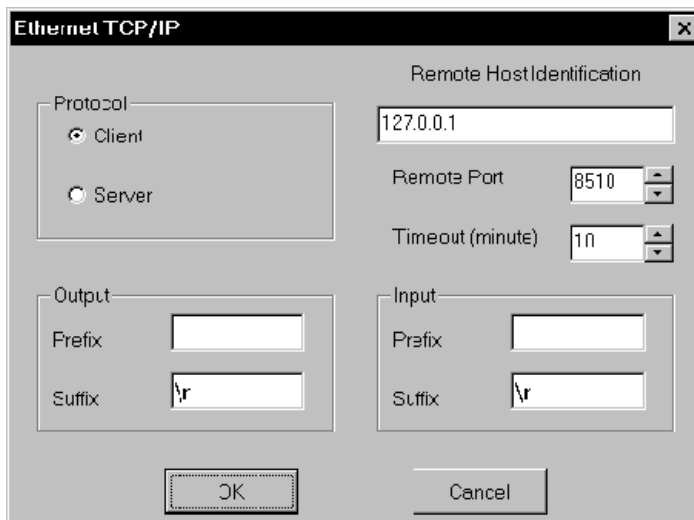
Configuration. The retry mode is not entered (not implemented) when the trigger mode is set to synchronous.

- **Supermarket Retry** — In this mode, the inspections are continuously performed and only successful attempts are reported. In order not to report duplicate data decoded from the same image, a time limit must be specified. The time limit ensures that the duplicate data will not be reported until the specified time has elapsed since the last decode output. This mode is only applicable to reading one Data Matrix or one barcode.

Setup>Ethernet TCP/IP

You can set up DMx AutoID+™ as either TCP/IP server or client to communicate with another Windows program running TCP/IP protocol (see Figure 4–30).

FIGURE 4–30. Retry Modes Setup Dialog Box



- **Protocol** — If you need to set up DMx AutoID+™ to communicate with another program that's configured as a TCP/IP server, select **Client** here. If another program is configured as a TCP/IP client, select **Server** here.
- **Remote Host Identification** — If the Protocol is set to Client, you need to enter the Server computer's name or IP address in the Remote Host Identification. If the Server program communicating with DMx AutoID+™

is running on the same PC, enter the default value 127.0.0.1. If the program is running on a different PC, enter the name or IP address of that PC.




- **Remote Port** — Enter the port number to match the Local Port number used in the Server program on which the Server is listening.

Default: 8510
Range: 0 to 32000

- **Local Port** — This Local Port is available when the Protocol is set to Server. Select a Local Port number on which the DMx AutoID+™ Server will be listening.

Default: 8500
Range: 0 to 32000

- **Timeout (minute)** — Setting this to a positive value will ensure the DMx AutoID+™ will attempt to reconnect to the other program within the specified Timeout limit should the connection be terminated for any reason.
- **Input Prefix/Suffix** — DMx AutoID+™ can receive TCP/IP commands from other programs running TCP/IP protocol. By specifying Prefix and Suffix, the DMx AutoID+™ will recognize the commands from other programs by searching for the Prefix and Suffix in the TCP/IP buffer. For the DMx AutoID+™ to recognize the supported commands, an input suffix is always required.
- **Output Prefix/Suffix** — Any output message transmitted from the DMx AutoID+™ TCP/IP port to other programs will be prepended by the Output Prefix and appended by the Output Suffix. An output suffix is required if the output data needs to be processed by a Windows program, for example, a custom VB program.

Note: To establish a TCP/IP connection, you need to check **Run>Ethernet TCP/IP**. Before a connection is established, if DMx AutoID+™ is configured as a client, the icon  is displayed in the status bar; if DMx AutoID+™ is configured as a server, the icon  is displayed. Both icons change  when a connection is established.

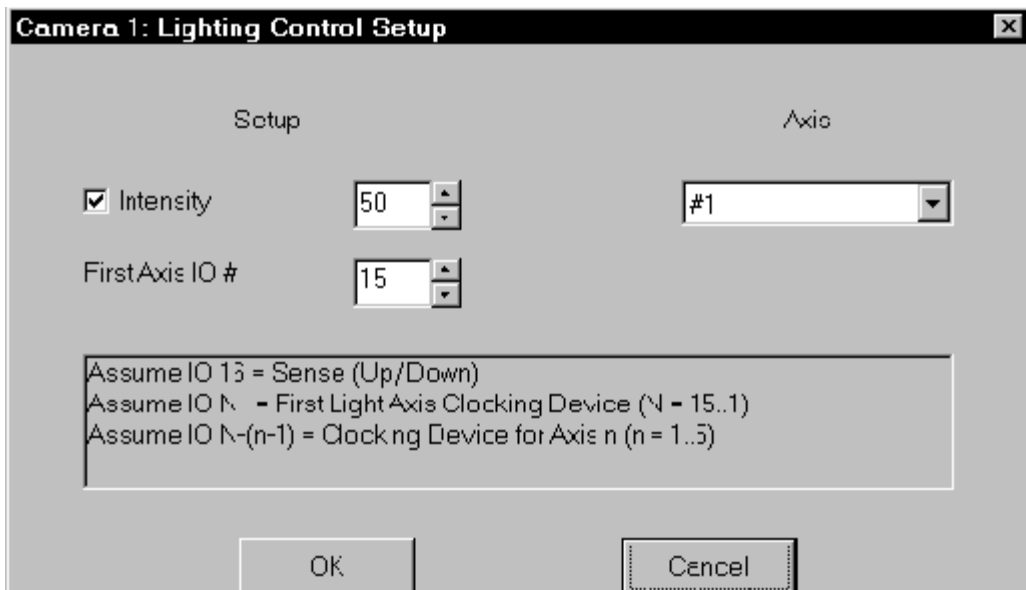
The Ethernet TCP/IP setup parameters cannot be changed when it has been selected from the Run menu. To change, you must de-select **Run>Ethernet**

TCP/IP, configure the TCP/IP settings, and then select Run>Ethernet TCP/IP again. Refer to Run Menu for more information.

Setup>Lighting Control

The Lighting Control dialog box (Figure 4-31) allows you to control a multi-axis imager from NER. For each axis (currently limited to five), you can set the light intensity from 0 (darkest) to 100 (brightest). Out of the 16 I/O points available from the 0300 board, the last point (i.e., IO 16) is used as the Sense (i.e., intensity Up/Down control), IO 15 is used for the first axis, IO 14 for the second axis, IO 13 for the third axis, IO 12 for the fourth axis, IO 11 for the fifth axis. To change the intensity of a certain axis (from 1 to 5), select the axis number, and then check the intensity check box and adjust the intensity value.

FIGURE 4-31. Retry Modes Setup Dialog Box

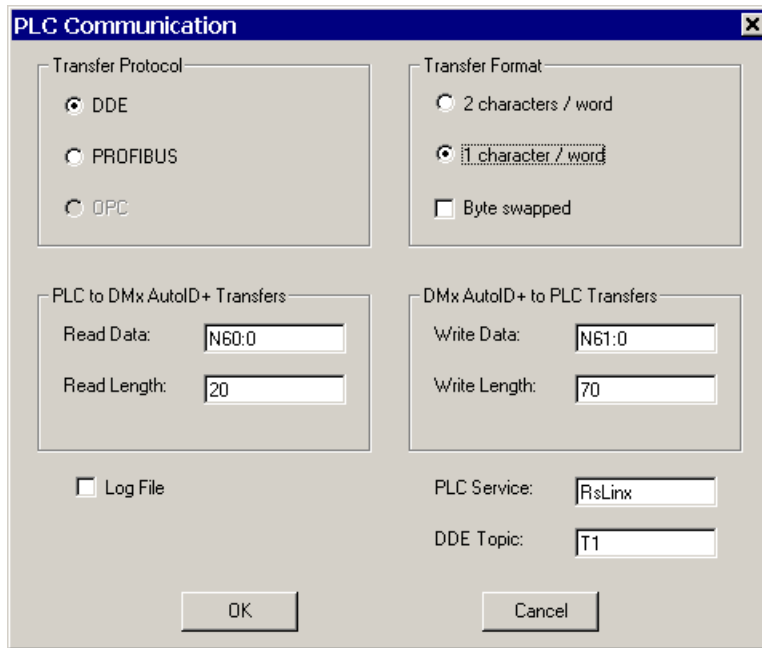


Note: By default, the First Axis IO# is set to 15. This cannot be changed unless a custom cable is made. To change it, always set the Axis to #1 to enabled the edit box.

Setup>PLC Communication

This menu item is visible only when the PLC Interface is checked in View>Additional Menus. Selecting it displays the PLC Communication dialog box (Figure 4–32) that can be used for configuring the DMx AutoID+™ to communicate with PLC software via DDE or Profibus protocol.

FIGURE 4-32. PLC Communication Dialog Box



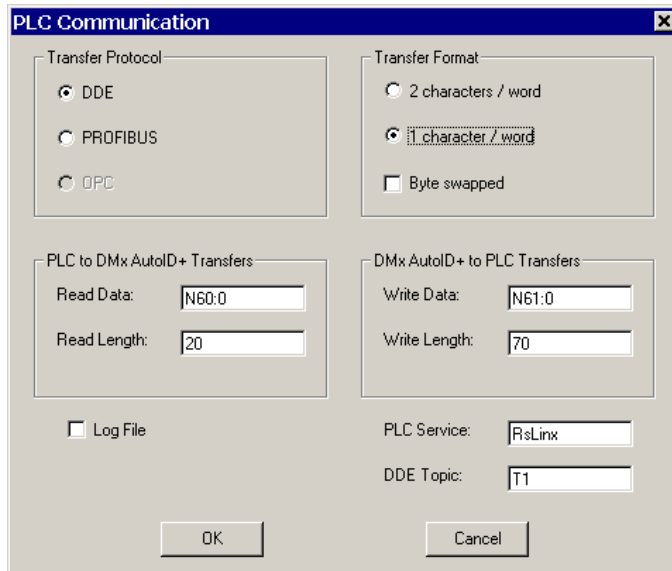
Transfer Protocol — You can select either DDE or Profibus.

PLC Service — Set to RsLinx for DDE protocol or Profibus for PROFIBUS protocol.

Note: The PLC Communication setup parameters cannot be changed when it has been selected from the Run menu. To change the parameters, de-select PLC Communication from the Run menu, change the PLC setup parameters, and then select PLC Communication again.

DDE Protocol

FIGURE 4-33. PLC Communications Dialog Box — DDE



When DDE is selected and Run>PLC is checked, DMx AutoID+™ continuously attempts to establish a DDE hot link to the PLC software for receiving DMx AutoID+™ commands. Decode data from DMx AutoID+™ is sent across a manual DDE link to the PLC software. If the DDE connection is broken (by exiting the PLC software for instance), DMx AutoID+™ attempts to reconnect.

PLC to DMx AutoID+™ Transfers — For the PLC software to send commands to DMx AutoID+™, both Read Data and Read Length are required. Read Data is the starting data table element in the PLC registers from which the commands to the DMx AutoID+™ will be sent. Read Length is the maximum amount of words that the PLC will be sending to the DMx AutoID+™.

DMx AutoID+™ to PLC Transfers — For the PLC software to receive the decode data from the DMx AutoID+™, both Write Data and Write Length are required. Write Data is the starting data table element in the PLC registers where the decode data will be sent. Write Length is the maximum amount of words that the PLC can receive from the DMx AutoID+™. If the decode data is less than the Write Length, then spaces will be added at the end.

- **Transfer Format** — Supported for DDE protocol. Each PLC word or register has two bytes. You have the option to use one character per word or two characters per word. For each word, the data can be stored with or without the byte swap. The command packet format from the PLC to DMx AutoID+™ is:

length (1 word), transaction # (1 word), command (multiple words)

The decode data packet format from DMx AutoID+™ to the PLC is:

length (1 word), echoing transaction # (1 word), decode data (multiple words)

The first word/register value is the number of “applicable” words/registers that are updated by the read/write, which is the total number of words in the packet format. We use the DMx AutoID+™ command READ as an example to describe the packet format:

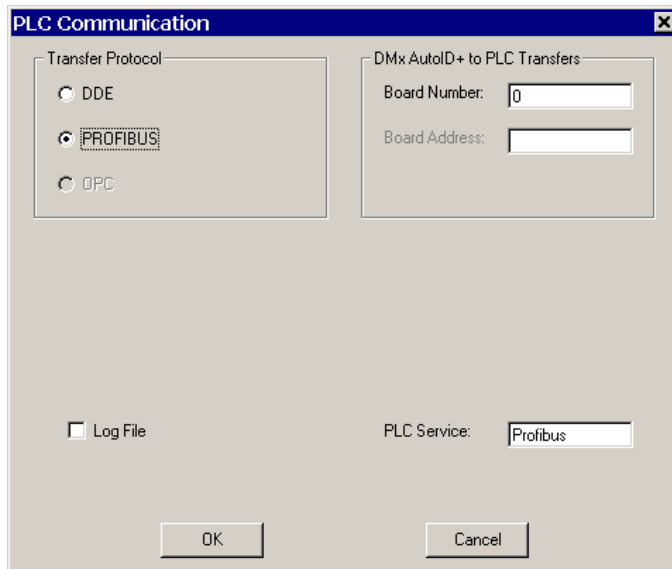
- 1 char / no byte swapping: 06 01 82 69 65 68
 - 06 is the total number of words
 - 01 is the transaction #
 - 82, 69, 65, 68 are ASCII representations of characters R, E, A, D, respectively
- 2 char / no byte swapping: 04 01 21061 16708
 - 04 is the total number of words
 - 01 is the transaction #
 - $21061 = 82 \times 256 + 69$
 - $16708 = 65 \times 256 + 68$
- 1 char / byte swapped: 1536 256 20992 17664 16640 17408
 - $1536 = 6 \times 256$, 6 is the total number of words
 - $256 = 1 \times 256$, 1 is the transaction #
 - $20992 = 82 \times 256$
 - $17664 = 69 \times 256$

- $16640 = 65 \times 256$
- $17408 = 68 \times 256$
- 2 char / byte swapped: 1024 256 17746 17473
 - $1024 = 4 \times 256$, 4 is the total number of words
 - $256 = 1 \times 256$, 1 is the transaction #
 - $17746 = 69 \times 256 + 82$
 - $17473 = 68 \times 256 + 65$

DDE Topic — This is displayed when you select DDE in Transfer Protocol. Set the topic to match the DDE element defined at the PLC software.

Profibus Protocol

FIGURE 4-34. PLC Communications Dialog Box — Profibus



DMx AutoID+™ functions as a slave device on a Profibus DP network through a slave interface card. The current supported card is Hilscher CIF 50-DPS (Communication Interface PCI Profibus-DP Slave). A Board Number of 0 indicates one such board is used for the Profibus communication purpose.

DMx AutoID+™ can either receive a command trigger from a master (typically a PLC) or be triggered independently of a master (typically via a sensor/hardware trigger). A simple handshaking data-exchange protocol is implemented to ensure the decode data from DMx AutoID+™ is received by the master.

Configuring the Profibus Network

Follow the steps below to configure DMx AutoID+™ as a slave on a Profibus network using the CIF 50-DPS slave card.

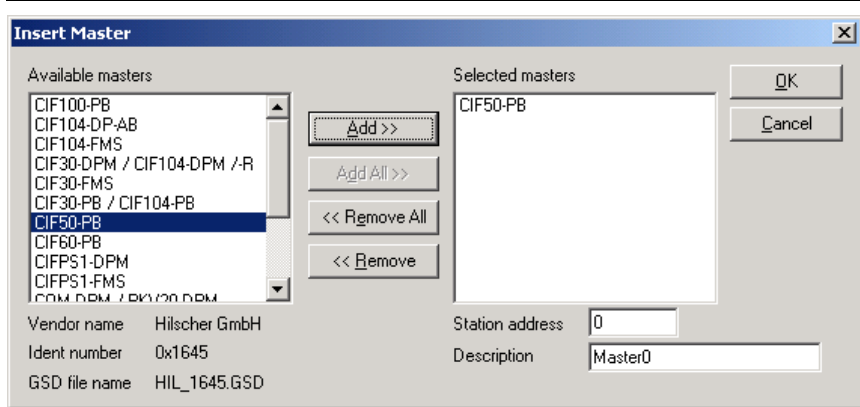
Note: The Windows administrator privilege is required

1. Install the DMx AutoID+™ software and the 0300 board. Refer to the Readme file on the DMx AutoID+™ Installation CD for more details.
2. Install the Hilscher CIF50-DPS according to the manufacturer's instructions. Make sure the correct driver is installed.
3. Run CIF Device Driver programs from the Windows Start>Programs menu to ensure the CIF50-DPS functions properly.
4. Install the SyCon program supplied by the board manufacturer for configuring the DMx AutoID+™ as a slave device.

Note: No license code is required by the manufacturer for installing SyCon for configuring a single slave device.

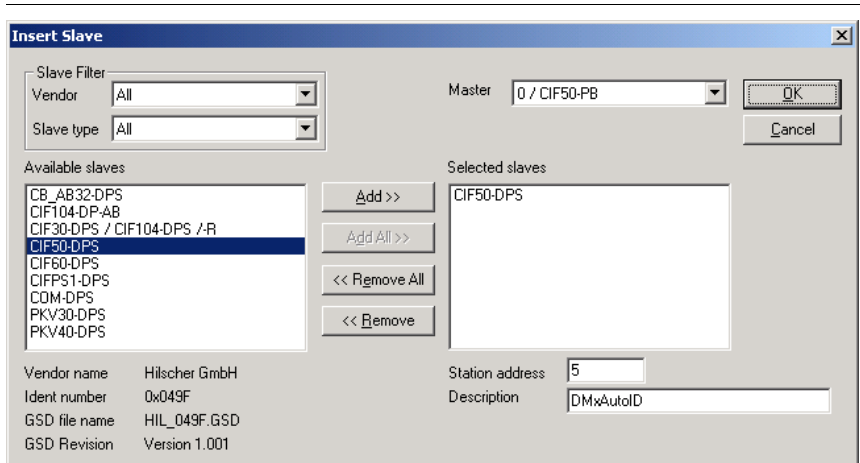
5. Use the SyCon program to configure the DMx AutoID+™ slave device. Configure the station address for the DMx AutoID+™ and the input and output modules for data exchange. Create a dummy master and slave network as follows:
 - a. Use File>New to select PROFIBUS as the fieldbus.
 - b. Select Insert>Master... then left click in the client area of the SyCon program to display the Insert Master dialog box, as shown in Figure 4–35. Double-click on CIF50-PB in Available masters so that CIF50-PB is displayed in Selected masters. Click OK to exit the dialog.

FIGURE 4–35. Insert Master Dialog Box



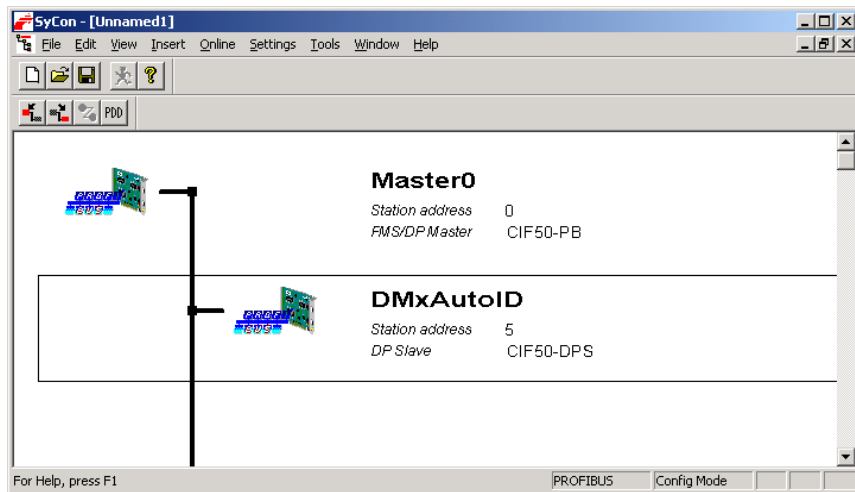
- c. Select Insert>Slave... then left click in the client area of the SyCon program to display the Insert Slave dialog box, as shown in Figure 4–36. Double-click on CIF50-DPS in Available slaves to show CIF50-DPS in Selected slaves. Suppose we choose 5 as the Station address. The default value is 1, and the value must be between 1 and 125. We can also change the Description to be something more meaningful, such as DMxAutoID. Click OK to exit the dialog.

FIGURE 4–36. Insert Slave Dialog Box



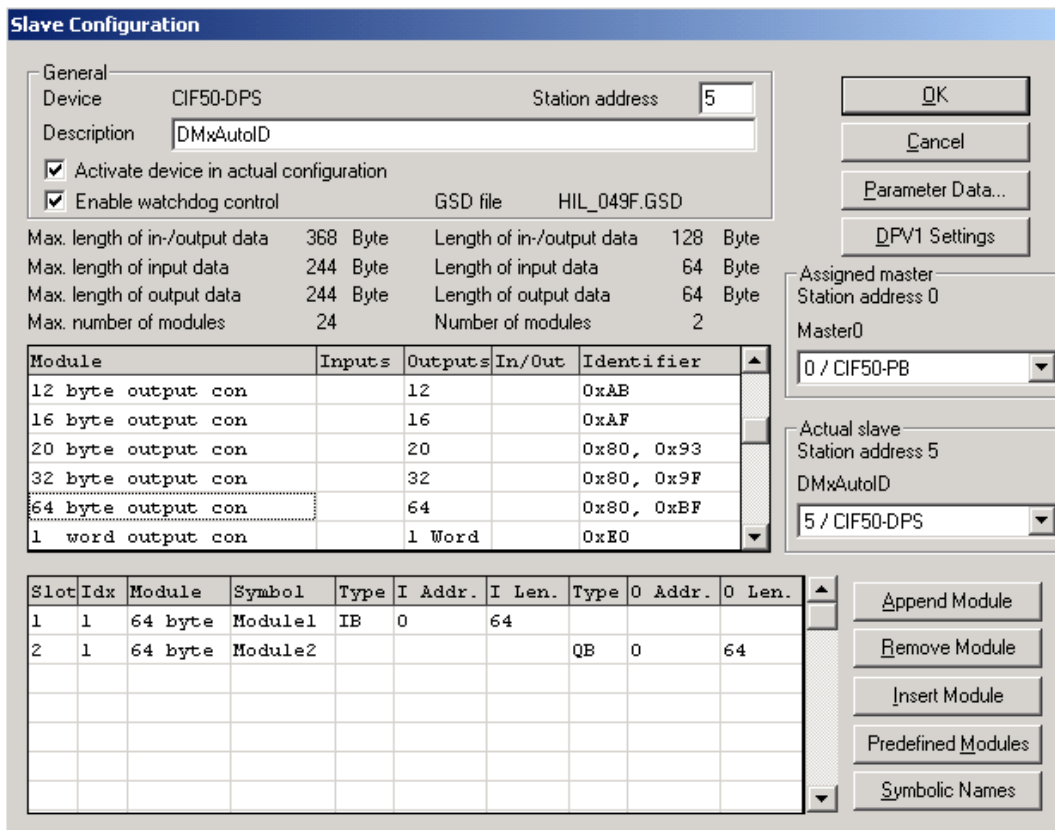
- d. The SyCon program now displays the network shown in Figure 4–37.

FIGURE 4–37. Sycon Window



- e. Right click on the DMxAutoID text inside SyCon to display a drop-down menu and select **Slave Configuration...** to display the Slave Configuration dialog box, as shown in Figure 4–38. Scroll-down to find 64 byte input con module and double-click on it. Scroll down further to find 64 byte output con and double-click on it. Now, both the input and output modules are configured for data exchange as follows:

FIGURE 4–38. Slave Configuration Dialog Box



Click OK to exit the dialog.

- f. With DMxAutoID slave highlighted by a rectangle, select Online>Download... to download the new slave configuration to the CIF-50 DPS board. Answer Yes to confirm that you really want to download. The slave board is now configured with a Station Address of 5 and an input module (to the master) of 64 bytes and an output module (from the master) of 64 bytes.

Note: Once the configuration is downloaded to the board, it will remain unchanged until it is modified/downloaded again with the SyCon program.

The input module of 64 bytes is used for transferring the decode data

from DMx AutoID+™ to the Profibus master. The output module of 64 bytes is used for getting a command or an acknowledgement from the Profibus master. Two bytes out of the 64 bytes are used as the protocol header, so a maximum of 62 bytes of decode data can be transfer in a single packet. When the decode data is greater than 62 bytes, multiple packets will be sent to the master. The master must acknowledge the receipt of every packet sent by DMx AutoID+™ with a two-byte acknowledgement packet. For more details, see “Profibus Data Exchange Protocol” on page 4-88.

6. Configure the Profibus (master) network with DMx AutoID/CIF50-DPS functioning as a slave on the network. Follow the steps below:
 - a. Obtain the GSD for the CIF50-DPS board, HIL_049F.GSD, from the Hilscher CD, and install in the appropriate directory of the Profibus configuration tool. For example, when SyCon is installed and used, the GSD file is already installed in the folder:

```
\Program Files\HilScher\SyCon\Fieldbus\PROFIBUS\GSD
```

- b. Obtain the DIB files, C50DPS_S.DIB, C50DPS_R.DIB, and C50DPS_D.DIB, and install them in the appropriate directory of the Profibus configuration tool. For example, when SyCon is installed and used, the DIB files are already installed in the folder:

```
\Program Files\HilScher\SyCon\Fieldbus\PROFIBUS\BMP
```

- c. Using the Profibus configuration tool, add and configure the DMxAutoID/CIF50-DPS on the logical network as a slave. Make sure the Station address is set to the value previously chosen in Step 5c. Configure the input and output modules of DMxAutoID/CIF50-DPS to be the same as those already downloaded to the CIF50-DPS board in Step 5e, in this case, 64 byte input con for data packets coming from DMxAutoID to the master and 64 byte output con for commands from the master to the slave, respectively.
 - d. Generate the configuration file for loading to the Profibus master. For example, when SyCon is used, select **Online>Download** to download the master/slave configuration.
7. Physically connect the DMxAutoID/CIF50-DPS to the Profibus network using appropriate cables and terminator settings.
8. Start Profibus communication.

9. Launch DMx AutoID+™ program.
 - a. Check View>Additional Menus>PLC Interface if it is not already checked.
 - b. Use Setup>PLC Communication... to display the PLC Communication dialog.
 - c. Select PROFIBUS as the Transfer Protocol.
 - d. Click OK to exit the dialog.
10. In the DMx AutoID+™ program, select Run>PLC to check it. A small icon showing two connected monitors is displayed in the status panel of the program. Communication is established when both monitors have the same light blue color. The data exchange can now begin. You can also use View>PLC Status to display the communication status.

Profibus Data Exchange Protocol

A simple data exchange protocol is implemented to ensure that a data packet sent from DMx AutoID+™ is always delivered and processed by the master before DMx AutoID+™ can send a new packet of data. Every time DMx AutoID+™ sends a new data packet to the master, it must wait for the master to acknowledge the packet with an acknowledgement packet. DMx AutoID+™ will not send a new data packet to the master until it receives acknowledgment on the previously sent packet from the master.

The size of the data packet sent from DMx AutoID+™ to the master is the input module size of 64 bytes configured in Step 6c. If the data to be sent to the master exceeds 62 bytes, then another or more data packets will be needed for sending the remaining data. The size of the data packet sent from the master to DMx AutoID+™ is the output module size of 64 bytes.

Table 4–3 shows the data packet format.

TABLE 4–3. Data Packet Format

Byte	Meaning
Byte 1	Packet or Transaction number (0~ 255)
Byte 2	Length of valid data in the packet starting from byte 3, in bytes
Byte (3-64)	Data section starting from byte 3 whose length is specified in byte 2

The second byte in the data packet can be between 0 and 62 so that the receiver can extract the valid data portion correctly.

A data packet sent from the master to DMx AutoID+™ can be either a one-byte acknowledgement packet or a command packet. An acknowledgement packet from the master to DMx AutoID+™ is a one-byte data packet consisting of the same packet number as the data packet it is acknowledging. Only in the acknowledgement packet may the same packet number be used. A command packet contains a single command that is up to 62-byte long. For example, if the command READ 2 triggers a read on camera 2 with packet number 5, the command packet should be 05 06 82 69 65 68 32 50.

In a packet sent from DMx AutoID+™, the valid data can be as long as 62 bytes. When DMx AutoID+™ is ready to send the data to the master, if the data is no more than 62 bytes, then byte 2 of the packet will contain the data length up to 62. If the data to be sent exceeds 62 bytes, then byte 2 of the packet will contain 63 instead of 62 to indicate to the master that a new data packet will be sent for the remaining data. Once the master gets the value 63, it extracts 62 bytes of valid data, acknowledges the packet, and prepares itself for processing the subsequent packet from DMx AutoID+™. Once the master receives all the data from the DMx AutoID+™, it can identify the beginning and the end of data from each read by using the Prefix and/or Suffix specified in the Formatting tab of DMx AutoID+™ under the Setup>Parameters... menu.

On the other hand, a single packet from the master is required for sending a complete command from the DMx AutoID+™. Therefore, the output module size must be chosen to be large enough to accommodate the longest commands supported. Typically, the size of 64 byte input is sufficient for all the commands.

Profibus Command Set

The DMx AutoID+™ Profibus command set is identical to the serial command set. This means that every serial command can be issued from the Profibus master. The most commonly used commands are READ n and READ ON/OFF.

When the master sends a command to DMx AutoID+™, it will receive a command response from the DMx AutoID+™. This is true for all the commands except the commands READ ON and READ OFF. The commands READ ON and READ OFF enable/disable the Run Continuously mode when hardware trigger is used. When READ ON is sent to DMx AutoID+™, DMx AutoID+™ starts the Run Continuously mode and displays Wait for a Trigger status. No response is sent to the master from the DMx AutoID+™. The command READ OFF disables the Run Continuously mode. If DMx AutoID+™ receives the

command READ OFF when it has no more data to send, it stops the Run Continuously mode and replies to the master with the command response READ OFF SUCCESS. If it receives the command READ OFF when it still has more data to send, it stops the Run Continuously mode and continues to send out the remaining data without sending the command response READ OFF SUCCESS.

Profibus Communication Examples

Example 1

A two-camera DMx AutoID+™ is triggered by the PLC via command READ. Camera 1 decodes Data Matrix 1 and returns 35 bytes of data including prefix and suffix. Camera 2 decodes Data Matrix 2 and returns 80 bytes of data including prefix and suffix.

1. PLC sends command READ 1 to trigger a read from camera 1:

```
00 06 82 69 65 68 32 49
```

2. DMx AutoID+™ receives the command, successfully reads the Data Matrix 1, and replies with:

```
01 35 xx xx xx ... xx
```

3. PLC extracts 35 bytes of data and acknowledges with 01. The PLC is now ready to send the next command.

4. DMx AutoID+™ receives the acknowledgement and does nothing since there is no more data to send.

5. PLC sends command READ 2 to trigger a read from camera 2:

```
02 06 82 69 65 68 32 50
```

6. DMx AutoID+™ receives the command, successfully read Data Matrix 2, and replies with:

```
03 63 xx xx xx ... xx
```

7. PLC extracts 62 bytes of data and acknowledges with 03. Since the value 63 was received, the PLC must prepare itself to receive the next packet from DMx AutoID+™. The PLC is not allowed to send a new command before the final packet is received containing 62 or less in byte 1.

8. DMx AutoID+™ receives the acknowledgement and sends the next packet with the remaining data:

04 18 xx xx xx ... xx

9. PLC extracts the 18 bytes of data and acknowledges with 04.
10. DMx AutoID+™ receives the acknowledgement and does nothing since there is no more data to send.

Note: The PLC is allowed to send a command immediately after it acknowledges the receipt of the data packet from the DMx AutoID+™ only when the second byte of data packet contains a value of 62 or less. This means that DMx AutoID+™ has no more data to send out. For example, if Step 5 happens immediately after Step 3, then there is a possibility that Step 4 will not happen in the sense that the DMx AutoID+™ sees the command instead of the acknowledgement. This will not affect the normal communication.

Example 2

A single camera DMx AutoID+™ is triggered with hardware triggers in Run Continuously mode to decode a Data Matrix containing 40 bytes of data. The Run Continuously mode can be enabled/disabled using the Profibus command READ ON | OFF.

1. The PLC sends the command READ ON with packet:

01 07 82 69 65 68 32 79 78

2. DMx AutoID+™ receives the command and enables the Run Continuously mode that displays Waiting for a trigger in the status bar.
3. DMx AutoID+™ receives a trigger, successfully reads the Data Matrix, and sends the data packet:

01 40 xx xx ... xx

4. PLC extracts 40 bytes of data and acknowledges with packet:

01

5. DMx AutoID+™ receives the acknowledgment and does nothing if there is no more data to send.

6. DMx AutoID+™ receives a new hardware trigger, reads the Data Matrix, and sends the data packet:

02 40 xx xx ... xx

7. Assume PLC is busy and does not acknowledge before DMx AutoID+™ is triggered consecutively twice; two new reads are performed and a total of 80 bytes of new data will be kept in DMx AutoID+™ but will not be sent pending the acknowledgement from the PLC.
8. PLC gets a chance to acknowledge with packet:

02

9. DMx AutoID+™ receives the acknowledgement and sends the data packet:

03 63 xx xx ... xx

The remaining 12 bytes of data need to be sent in the next packet.

10. If DMx AutoID+™ receives the acknowledgement packet 03 before it is triggered again, the data packet 04 12 xx xx ... xx will be sent. If DMx AutoID+™ received the acknowledgement packet 03 after it is triggered again and the Data Matrix is decoded, then the data packet 04 52 xx xx ... xx will be sent instead.
11. To disable the Run Continuously mode, PLC sends command READ OFF with packet:

05 08 82 69 65 68 32 79 70 70.

Protocol Error Handling

Table 4–4 and Table 4–5 show how DMx AutoID+™ responds to various inputs from a PROFIBUS master including possible erroneous inputs. The protocol allows the communication to resume without compromising the data integrity in the presence of erroneous inputs from the PROFIBUS master program.

Error Handling in Run Once Mode

In the Run Once mode (i.e., the Run Continuously mode is not entered), DMx AutoID+™ receives the READ command from the master (a PLC) and sends the decode data back to the PLC.

TABLE 4-4. Error Handling in Run Once Mode

When DMx AutoID+™ Receives...	DMx AutoID+™ Responds With...
A valid command (other than READ, READ ON/OFF) with packet number n	Command response with packet n+1
Command READ	Decode data or failure message
Command READ ON	No response is sent but it enters the Run Continuously mode
Acknowledgement	Data up to 62 bytes with no more data left to send, or data of 62 bytes with more data to be sent
An unexpected command with packet number m (A valid command is unexpected when it is received while DMx AutoID+™ has more data to send)	Information packet consisting of two bytes: m+1 0
A packet m containing an invalid command (PLC packet that is none of the three types above: a misspelled command or incorrect command length in byte 1	Data packet consisting of the words Invalid command: m+1 15 73 110 118 97 108 105 100 32 67 111 109 109 97 110 100

Error Handling in Run Continuously Mode

The master (a PLC) sets the Run Continuously mode of DMx AutoID+™ by sending the command READ ON. DMx AutoID+™ is then triggered by hardware triggers and sends the decode data back to the master.

TABLE 4-5. Error Handling in Run Continuously Mode

When DMx AutoID+™ Receives...	DMx AutoID+™ Responds With...
Command READ OFF with packet number n while there is no more data to send.	Command response READ OFF SUCCESS with packet n+1.
Command READ OFF with packet number n while there are more data to send.	A new packet n+1 for the remaining data.
Anything else from the master is treated as an acknowledgement packet. These include: A true acknowledgement packet; A valid or invalid command with an arbitrary number that is different from the previous one.	Data up to 62 bytes with no more data left to send, or data of 62 bytes with more data to be sent.

Working with Multiple Input Modules

The previous sections have shown how to choose 64 byte input con and 64 byte output con in configuring the data exchange modules. It has been stated previously that 64 byte output con is sufficient to handle all command or acknowledgement packet. You can also choose smaller input and/or output modules if your application requires sending much less than 64 bytes of data and/or receiving short commands such as READ n. For example, you can choose 32 byte input con and 8 byte output con if the master needs to receive a 32 byte packet and send a 8 byte command packet.

Note: You should do the same in SyCon for both the master and the slave.

On the other hand, when your application requires reading high density Data Matrices and/or performing print quality verification, then you will need to transfer far more than 64 bytes for each read. Multiple data packets of 64-byte long will have to be sent to the master and to be acknowledged.

To improve the efficiency and reduce the number of acknowledgement packets, you can also configure multiple input modules to arrive at a larger packet number between 64 and 244 bytes. The Profibus protocol allows up to 244 bytes of data to be transferred as input or output; the sum of input and output modules should not exceed 368 bytes.

For example, you can configure multiple input modules of 64, 64, 64, 32, and 20 bytes in the exact same order in Steps 5e and 7c plus an output module of 64 bytes. Doing so will allow up to 242 bytes to be sent to the master in a single packet.

Setup>Wedge Target

This menu item is visible only when the Wedge option is checked in View>Additional Menus. You can have the output data sent from DMx AutoID+™ to a target text-processing program as though the data were typed in from the PC keyboard. Typical text-processing programs are Microsoft Notepad, WordPad, Word, Excel, etc. You can open a custom program by specifying the name of the .EXE program using Other... and then select Run>Keyboard Wedge to check it.

To reconfigure the Wedge program, you need to de-select Run>Keyboard Wedge first.

Setup>Calibration

Two types of calibrations can be performed for DMx AutoID+™:

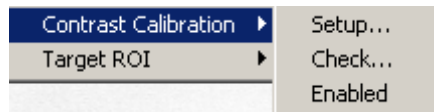
- “Contrast & Size Calibration” starting on page 4-95
- “Target ROI” starting on page 4-97

FIGURE 4–39. Calibration Dialog Box



Contrast & Size Calibration

FIGURE 4–40. Contrast Calibration



The DMx AutoID+™ system must be calibrated in order to report the cell/module size in mil (1/1000th of an inch) and the contrast as a NIST traceable value.

The Setup menu allows you to calibrate the camera system using the Microscan Calibration Test Card. Once the system is calibrated, you should not change the camera's FOV, focus, aperture, or lighting. The Check menu allows you to determine if the current calibrated setup needs to be re-calibrated. The menu Enabled should be displayed for reporting the calibrated values, however you have the option to report the non-calibrated values as well by clicking Enabled to change it to Disabled. If the calibration is disabled, the contrast value reported depends on and varies with the lighting and the cell size is reported in pixels rounded to one decimal place. If the calibration is enabled, the contrast value reported is based on NIST traceable density scale and will not vary with lighting and the nominal cell size is reported in mil (1000th of an inch) rounded to the nearest integer.

Before performing calibration, you should have already determined the correct Field of View (FOV) of your camera setup and lighting based on the size and the surface/marking reflectivity of the Data Matrix in your application. Then, you select File > Live to display live images of one of the Data Matrix targets on the Microscan Calibration Test Card. Choose the target that is about 1/3 to 1/2 of

FOV size. It is important that the same target be used in both Setup and Check processes.

Calibration Setup

1. Select File > Live. Place a Data Matrix target of suitable size near the center of the FOV. If necessary, adjust the lighting, the camera's f-stop (aperture), or focus to obtain good images. The images should not look too dark or saturated (i.e., the value of light pixels should not reach 255). Select File > Live to exit the live mode and capture an image.
2. Select Setup > Calibration > Contrast Calibration, and then select Setup. The following box is displayed for you to enter the contrast of the target shown on the Microscan Calibration Test Card. Enter it then hit OK.
3. If the calibration is successful, the following message will be displayed in the Status bar:

Calibration succeeded and enabled

You can verify that Calibration Mode is now enabled by selecting Setup > Calibration > Contrast Calibration to see that Enabled is displayed. If the calibration is unsuccessful, then one of the following messages will be displayed instead:

- Calibration failed. No Data Matrix found
- Calibration failed. Invalid calibration target
- Calibration failed. Adjust image

Calibration Check

For a calibrated system, you can check if it has changed from the last calibrated state such that it may require re-calibration. To do this, place in the center of the FOV the same target that was used in the calibration setup process, then select Setup > Calibration > Contrast Calibration > Check. If no re-calibration is necessary, you will get this message:

Calibration OK. No need to re-calibrate

Otherwise, you may be getting one of the following messages if incorrect target was used, or the light intensity or FOV has changed:

- Please use original calibration target

- Image too dark. Please re-calibrate
- Image too bright. Please re-calibrate
- Cell Size too small. Please re-calibrate
- Cell Size too large. Please re-calibrate
- Failed to decode. Please adjust image

Target ROI

FIGURE 4–41. Target ROI Dialog Box



The Setup in Target ROI allows you to set up a target ROI window (i.e., view finder) to be displayed with live images. Typically a Data Matrix mark placed in the image center area can be illuminated more uniformly. The use of the target ROI helps guide the user to place the Data Matrix marks of the same size in the center area so that more accurate and repeatable measurement results can be obtained. The following are the steps for setting up the target ROI:

1. Select Target ROI>Setup to display the target ROI view finder box.
2. Left click and drag the small red squares to resize the target ROI to the desired size. The target ROI menu is enabled and the target ROI will be displayed in the live image.

To display the target ROI view finder, select Target ROI>Enabled to change it to Disabled.

Set ROI Menu

FIGURE 4–42. SetROI Menu



The Define ROI (Region of Interest) menu, as shown in Figure 4–42, allows you to specify a Region of ROI within the selected camera's Field Of View by drawing a rectangular area using the mouse cursor.

Set ROI>Data Matrix

This menu item modifies the ROI containing the Data Matrix or matrices to decode. The default ROI for Data Matrix is the full FOV (Field of View). If no ROI is explicitly set by using this menu prior to Learn Data Matrix, then the default ROI is used for Data Matrix Learn and Run.

Set ROI>Barcode

This menu item modifies the ROI containing the barcode(s) to decode. The default ROI for barcode is the full FOV (Field of View). If no ROI is explicitly set by using this menu prior to Learn Barcode, then the default ROI is used for barcode Learn and Run.

Set ROI>OCR Fixed Font

This menu item modifies the ROI containing the text to read. The default ROI for OCR is the full FOV (Field of View). We recommend that the ROI for OCR be set to as small an area as possible for speed and robustness. The ROI is normally set during the Learn OCR Fixed Font process. After the Learn and prior to Run, select Set ROI and then OCR Fixed Font to modify the ROI, if necessary.

Set ROI>Fiducial

This menu item modifies the ROI for the fiducial target to find. The default ROI for Fiducial is the full FOV (Field of View). We recommend that you set the ROI for Fiducial to as small an area as possible for speed and robustness. The ROI is

normally set during the Learn Fiducial process. After the Learn and prior to Run, you can use **Set ROI>Fiducial** to modify the ROI, if necessary.

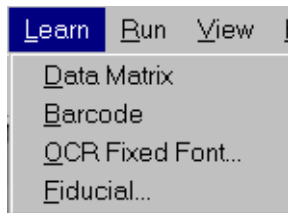
Set ROI>Clear ROI

This menu item removes the currently selected ROI. To clear Data Matrix ROI, first select **Set ROI** and then **Data Matrix** to display the ROI. Then, select **Set ROI** and **Clear ROI** to remove it, e.g., to set it to the full image size. Use the same process to **Clear ROI** for barcode, OCR, or Fiducial.

Learn Menu

The Learn menu, as shown in Figure 4–43, allows you to set up the parameters for reading Barcode, Data, OCR, or Fiducial.

FIGURE 4–43. Learn Menu



Learn>Data Matrix

To learn the Data Matrix parameters, you need to have an image containing a Data Matrix. Use the following steps to capture a Data Matrix image from Camera 1:

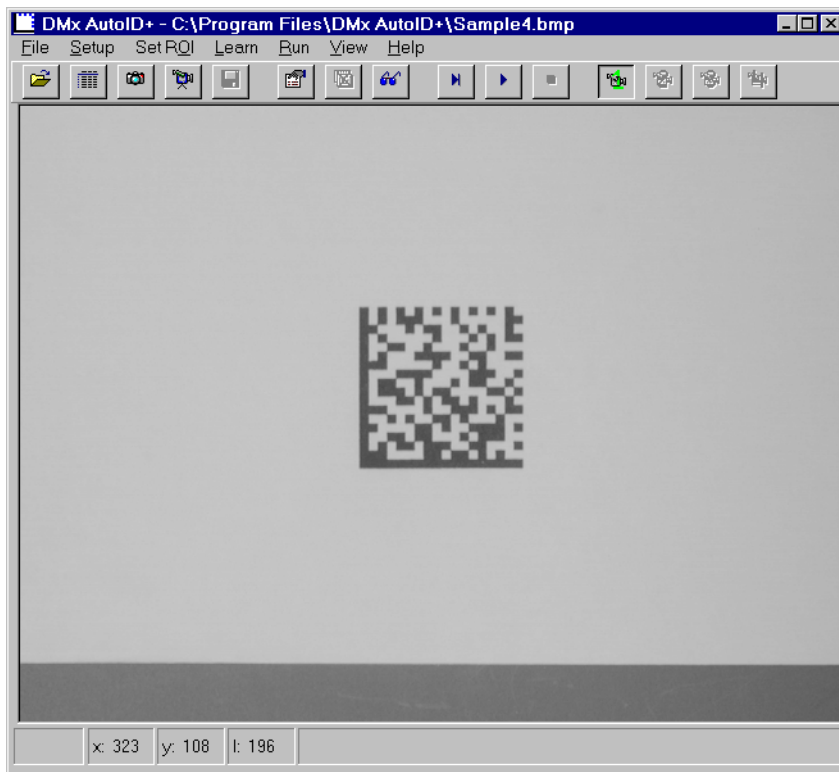
1. Select Camera 1 by pushing down the Camera 1 icon on the tool bar (this is not needed if only one camera is configured in the System Configuration box).
2. From the File menu, select **Live** to enable live camera display.
3. Put the Data Matrix label in Camera 1's FOV and capture the image by stopping the Live display.

In the following sections, we use saved sample images under the DMx AutoID+™ application directory.

1. Open *sample4.bmp*.

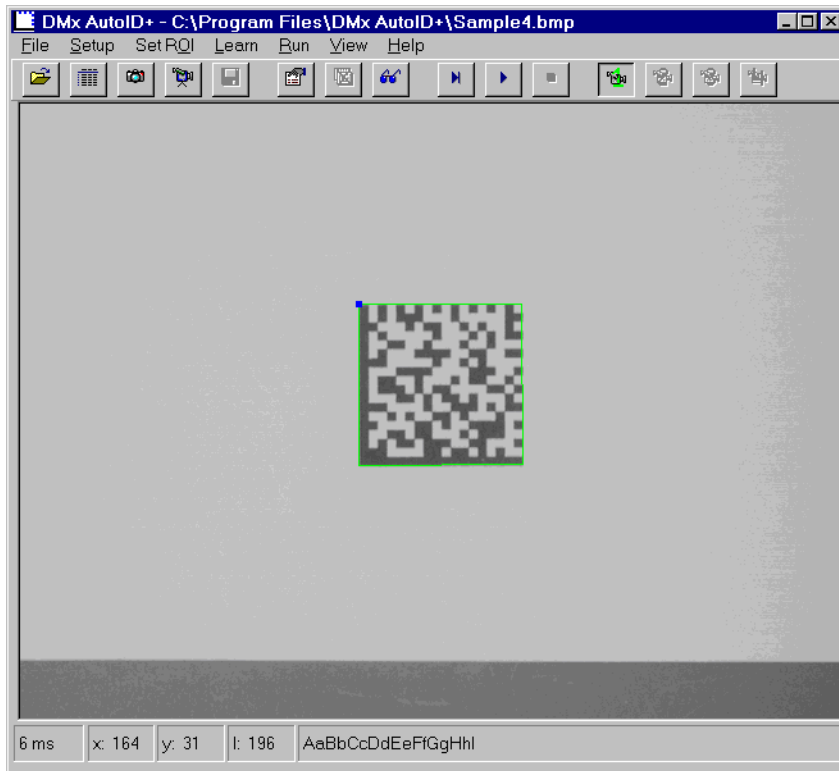
2. If you choose to use a smaller ROI than the full FOV, you can set the ROI now. Otherwise, the full ROI will always be used as the ROI for Data Matrix or barcode reading.
3. From the Learn menu, select Data Matrix to learn the Data Matrix parameters.

FIGURE 4–44. Data Matrix Image



4. When Learn is successful, the decoded data will be displayed on the right hand side of the status bar of the program, as shown in Figure 4–45.

FIGURE 4–45. Example — When Learn is Successful



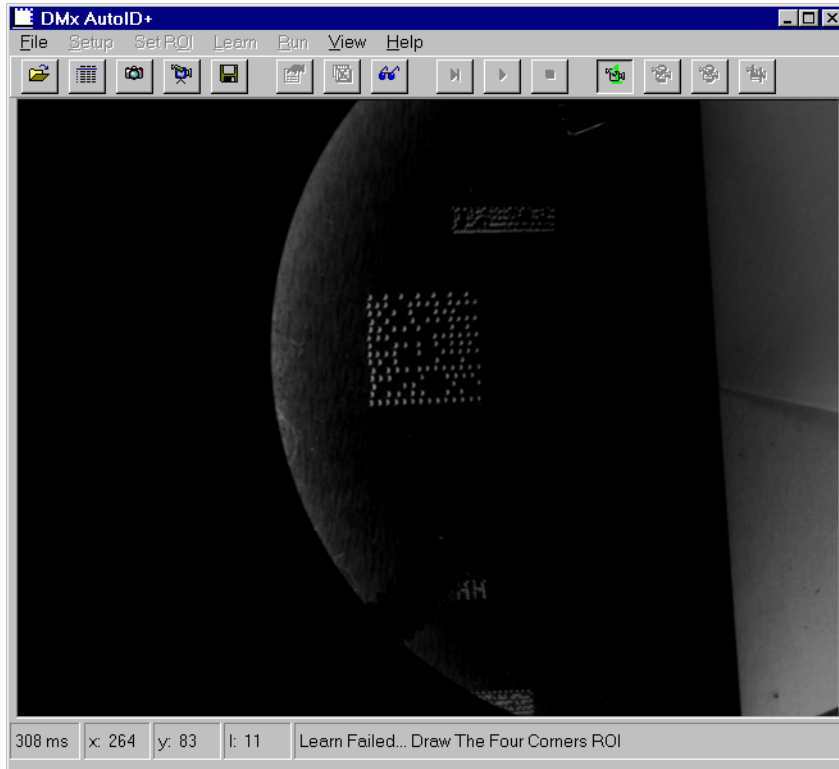
5. Now the DMx AutoID+™ program is ready to decode the same type of Data Matrix as indicated in **Setup>Parameters>General** and **Data Matrix** tab.

Sometimes, when the Data Matrix image quality is too poor, the learn process fails. The DMx AutoID+™ goes into the Assisted Learn mode. The following two examples demonstrate how this is done.

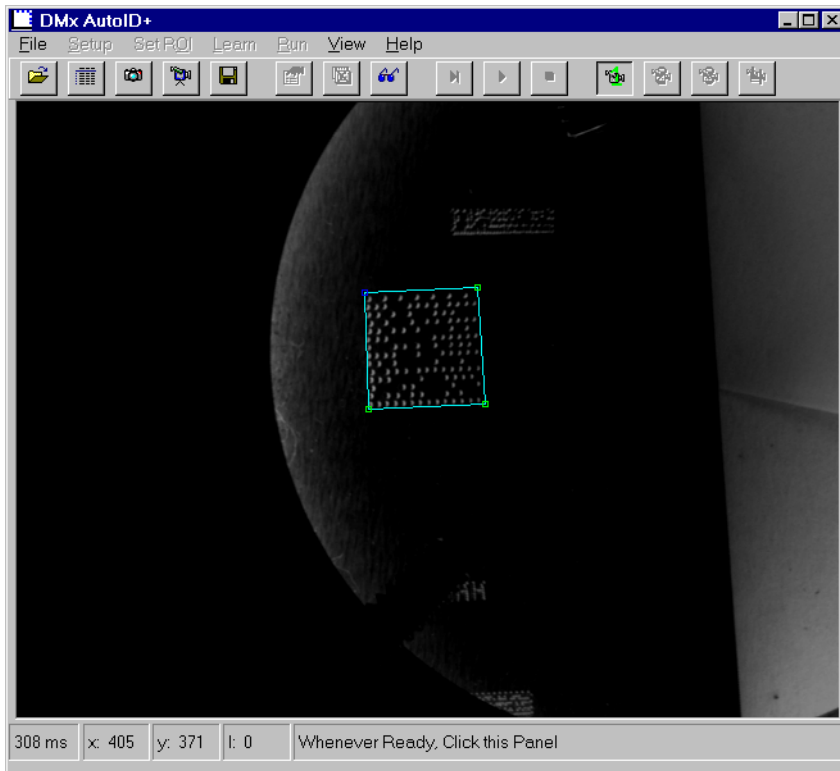
Data Matrix Assisted Learn Example

If Learn is not successful due to the poor quality of the Data Matrix image, such as in Figure 4–46, then instead of displaying the decoded data, the program displays the message “Learn Failed... Draw The Four Corners ROI”.

FIGURE 4–46. Example of Poor Quality Data Matrix Image

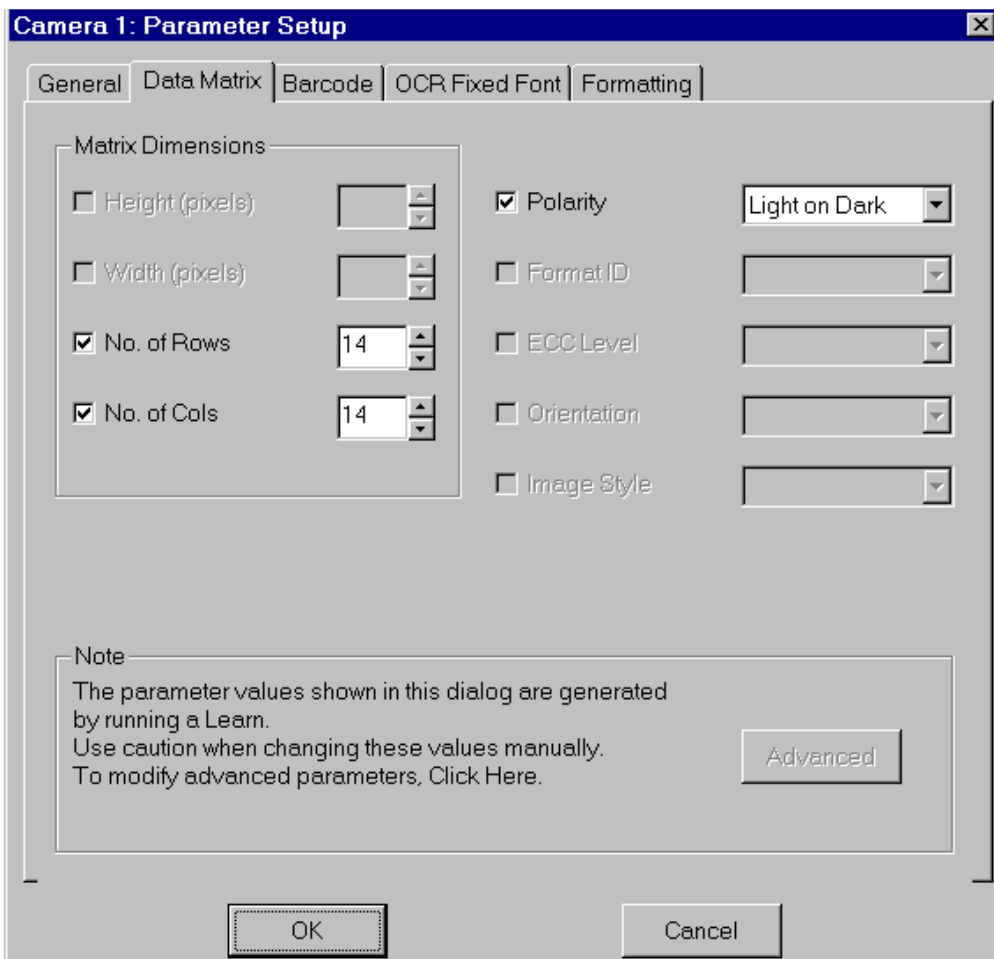


Use the mouse to draw a box specifying the four corners of the Data Matrix. Adjust the corner positions to indicate the precise locations of the corner points, as shown in Figure 4–47. When you are satisfied with the drawing, left click the panel with the mouse in the status bar displaying “Whenever Ready, Click this Panel”.

FIGURE 4–47. Example — Specifying Four Corners of the Data Matrix

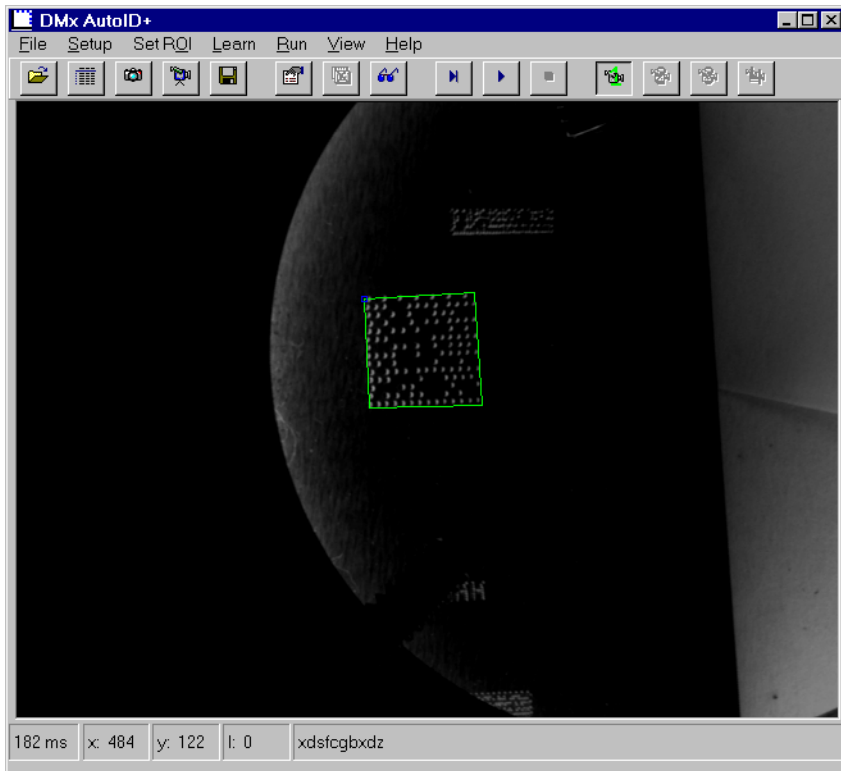
The Data Matrix Parameters tab will be displayed after you click the mouse. At this time, however, only Number of Rows and Columns, and Polarity are enabled for editing. The rest are all disabled. Make sure you enter the correct information. In the example in Figure 4–48, we enter 14 for number of rows and column, and Light on Dark for the matrix polarity.

FIGURE 4-48. Parameter Setup for Camera 1



Select OK, and the matrix parameters will be learned afterwards, as shown in Figure 4-49:

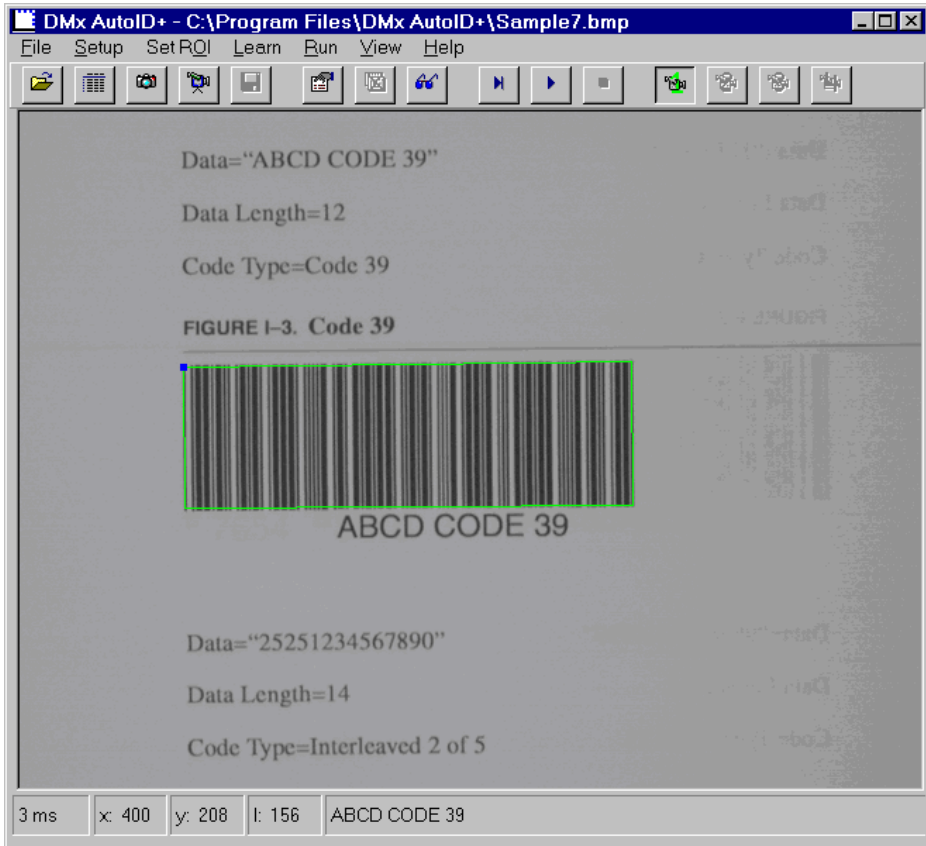
FIGURE 4–49. Matrix Parameters After Being Learned



Learn>Barcode

1. Open *sample7.bmp*.
2. From the Learn menu, select Barcode, as shown in Figure 4–50.

FIGURE 4-50. Example — Learn Barcode



When the Learn Barcode is successful, the decoded data is displayed in the status bar. The barcode reading is now enabled, as shown in Figure 4-51 and Figure 4-52:

FIGURE 4–51. Parameter Setup Dialog Box (General Tab)

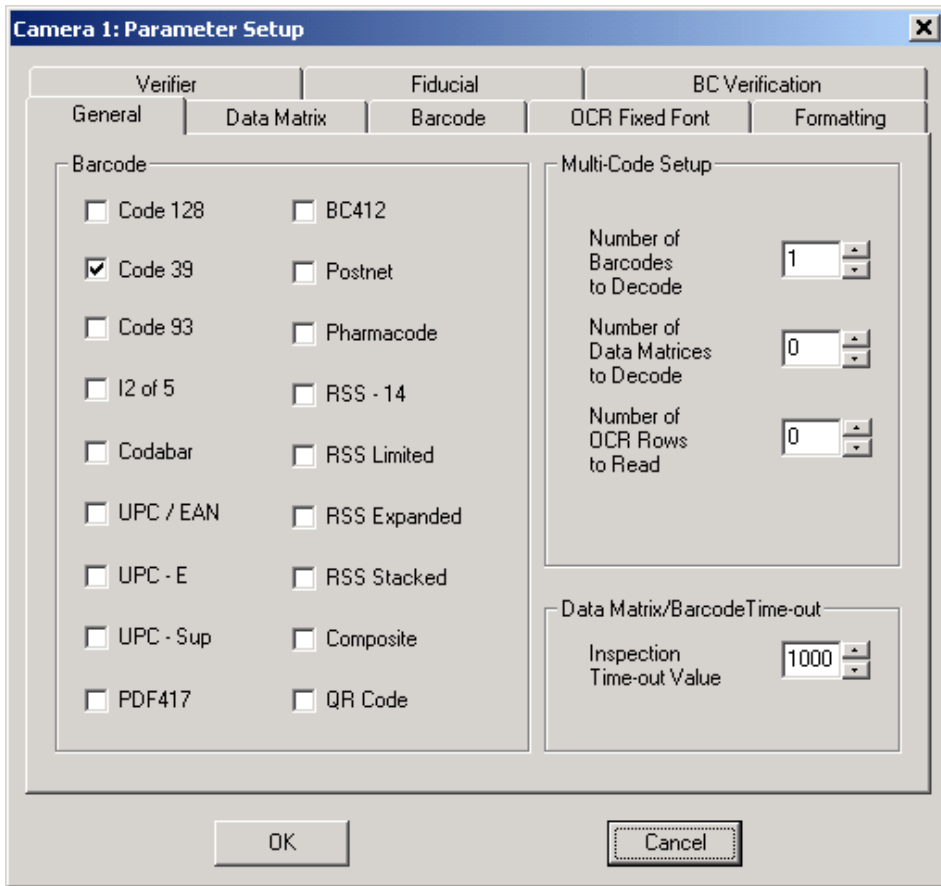
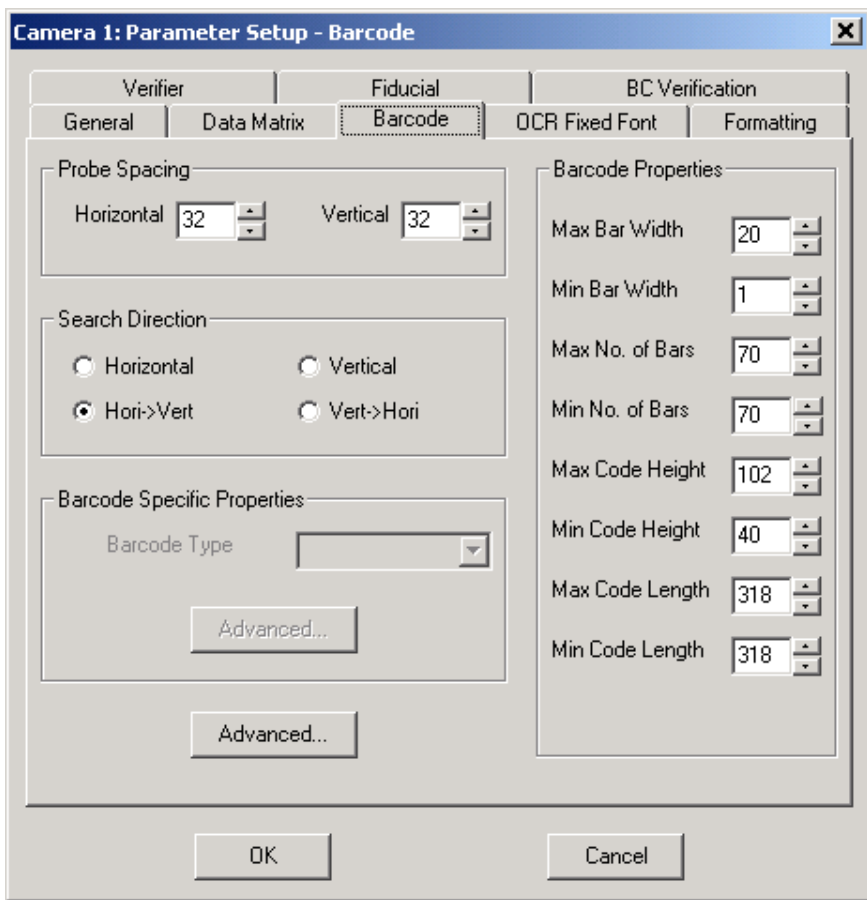


FIGURE 4–52. Parameter Setup Dialog Box (Barcode Tab)



The Learn Barcode auto-discriminates the type of barcodes presented in the image among the following barcode types: Code 128, 39, 93, I 2 of 5, Codabar, UPC/EAN, UPC-E, UPC Supplemental, PDF417, RSS-14, RSS Limited, RSS Expanded, RSS Stacked, Composite, and QR code.

Note: To read BC412, Postnet, or Pharmacode, you need to check the barcode type in General tab before performing Learn Barcode.

For reading the same type of barcode, the Learn Barcode process sets up the barcode parameters in the Barcode tab to increase the barcode reading robustness

in Run mode. If reading different types of barcodes is necessary, then the learned parameters for Bar Width, No. of Bars, Code Height, Code Width should be adjusted to cover all types of barcodes to ensure the maximum robustness. On the other hand, simply resetting the parameters to default values will allow barcodes of different type to be read. For example, select **File > Jobs > Load Default** to reset the barcode parameters.

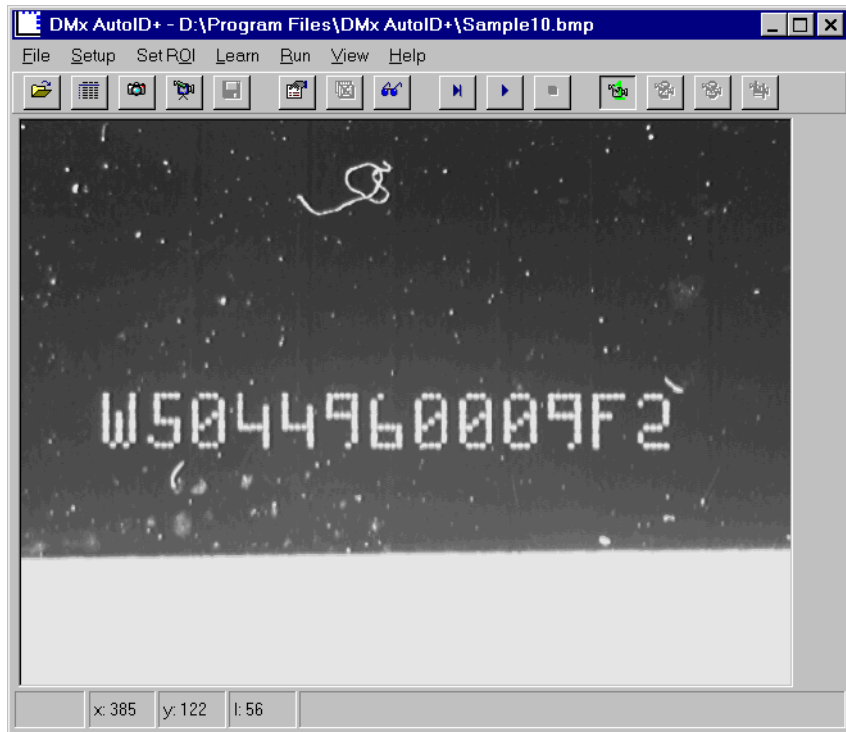
Open images *Sample7.bmp* for Code 39, *Sample8.bmp* for I 2 of 5, and *Sample9.bmp* for Code 128. Select **Code 128, Code 39, and I 2 of 5** in **Parameter Setup>General** tab and set **Number of Barcodes to Decode** to 1. Select **OK**. Select **Run** and then **Run Once** (or **Run Continuously**) to verify all three types of barcodes are decoded.

Learn>OCR Fixed Font

We use image *Sample10.bmp* to illustrate how to Learn OCR parameters.

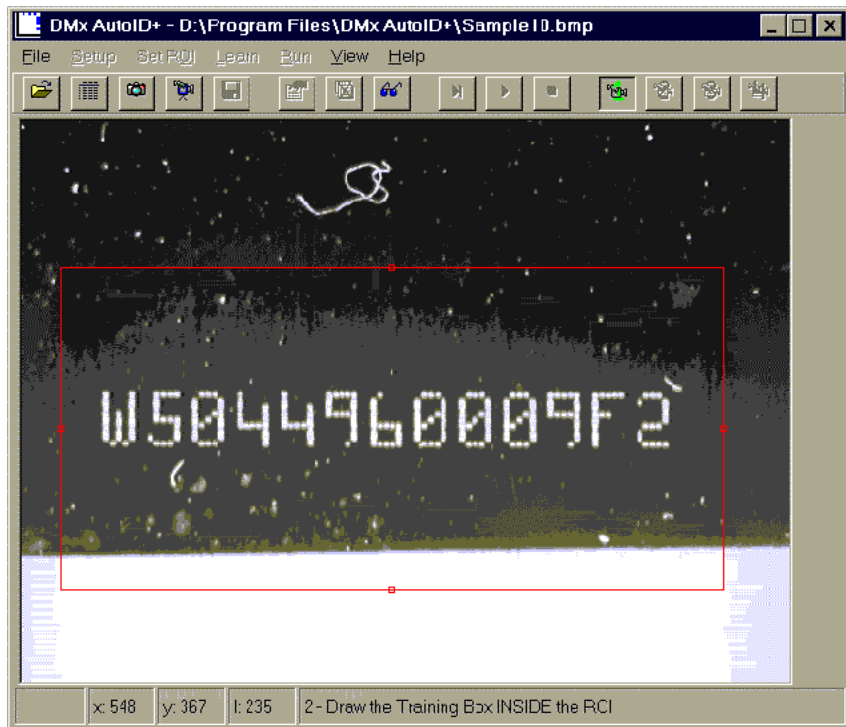
1. Open *sample10.bmp*.

FIGURE 4-53. Opening sample10.bmp



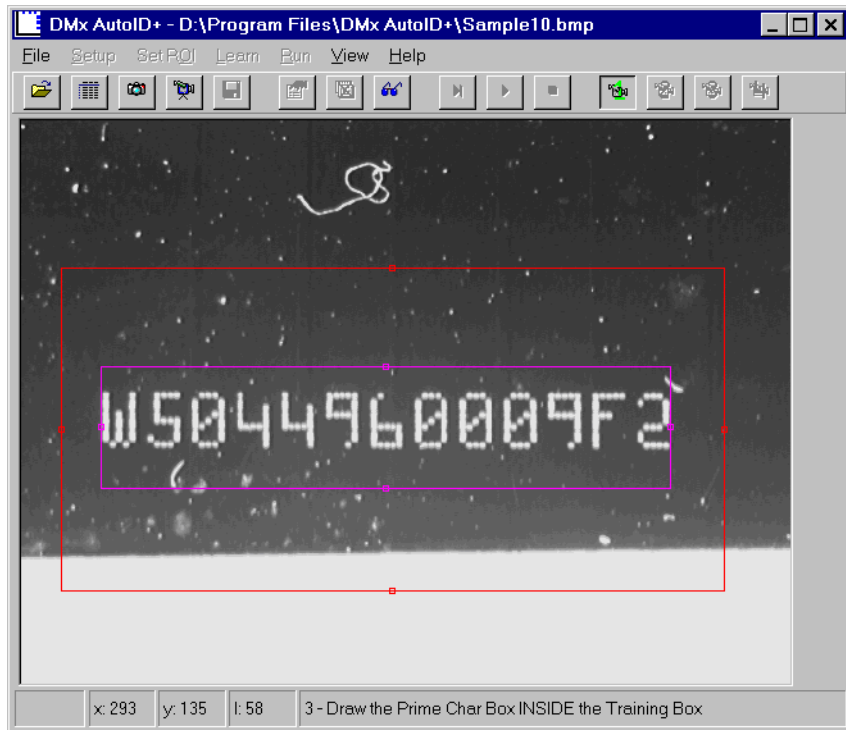
2. From the Learn menu, select the OCR Fixed Font. The DMx AutoID+™ program will instruct you to draw the ROI for OCR reading, as shown in Figure 4-54:

FIGURE 4-54. Drawing the ROI



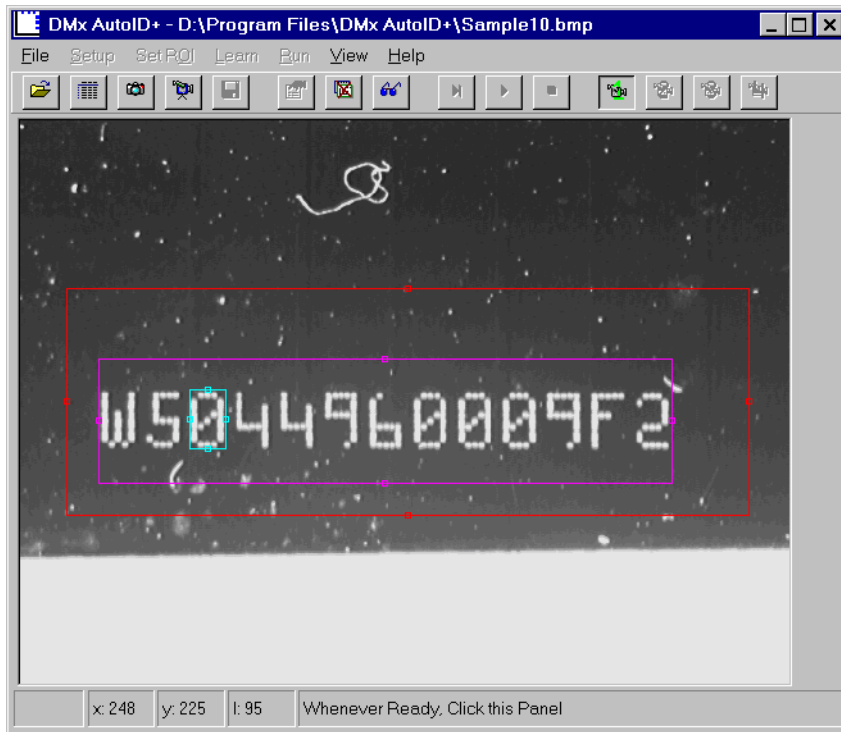
3. After drawing the ROI with the mouse, the program instructs you to draw the Train String Bounding box. Draw a rectangular box, starting precisely from the left side of the first character and ending precisely with the right side of the last character of the string, as shown in Figure 4-55. You can leave some space on the top and bottom of the text string.

FIGURE 4-55. Drawing Rectangular Box



4. Draw a tight bounding box indicating the size of one character. In Figure 4-56, we select the character 0 to be the primary character.

FIGURE 4-56. Drawing the Tight Bounding Box

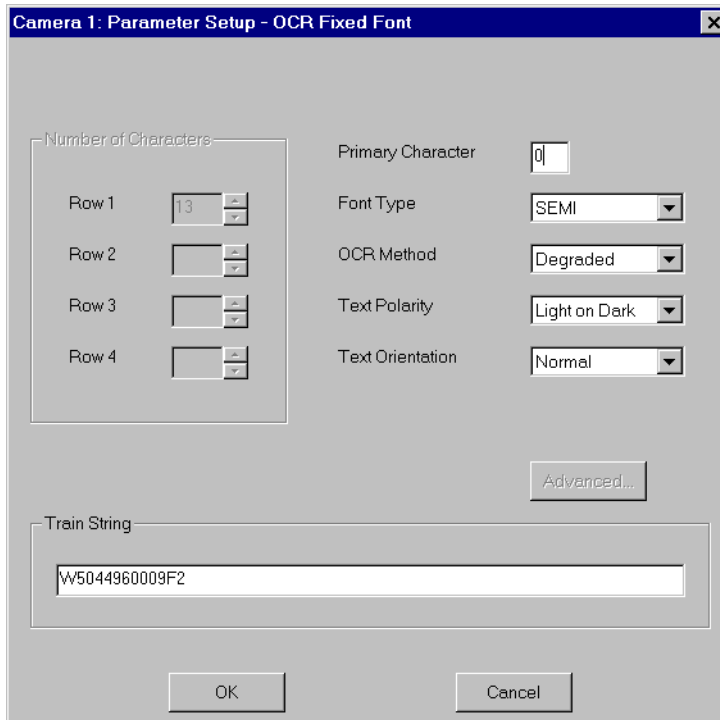


5. Left click the status bar to display the OCR parameters tab to enter more information.

Note: Before left clicking the mouse, you can further adjust the three boxes by placing the cursor near the smaller squares on the rectangular boxes and resize them by either moving the mouse or pressing the arrow keys on the keyboard.

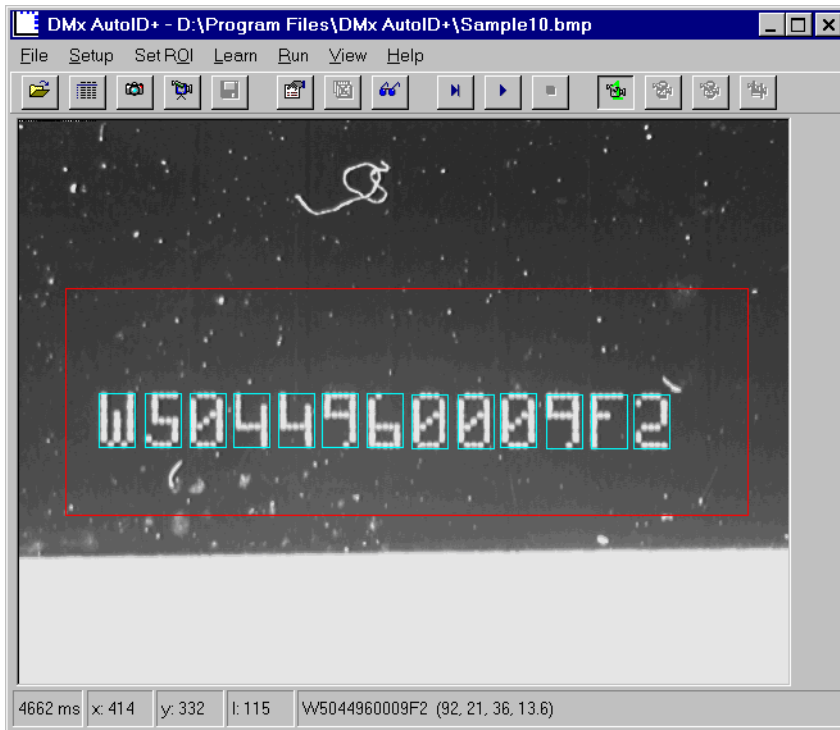
After left clicking the status bar, the Parameter Setup dialog box is displayed, as shown in Figure 4-57. You need to enter all relevant information correctly.

FIGURE 4–57. Parameter Setup Dialog Box



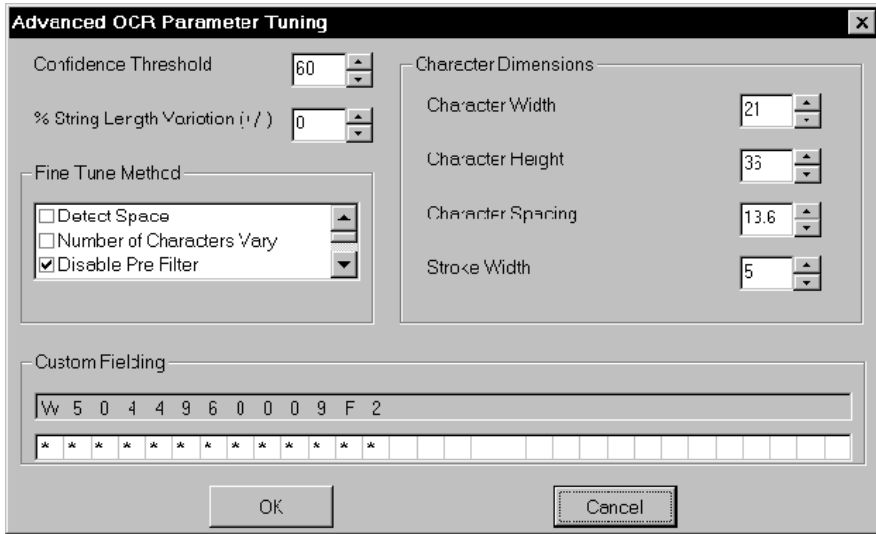
6. Click OK to finish the Learn process. It may take a while before the successful results are displayed, as shown in Figure 4–58:

FIGURE 4–58. Finishing the Learn Process



When the training is successful, the string confidence value, character width, height, and spacing are displayed behind the decoded text string in the Status Bar. The learned parameters can be seen from Advanced OCR Parameter Tuning box as well.

FIGURE 4–59. Advanced OCR Parameter Tuning



7. To test the OCR reading after the Learn, select **File > Open List** to open files *sample10.bmp* and *sample11.bmp*.
8. From the **Run** menu, select **Run Continuously**. You can speed up the reading by selecting (checking) **Speed Enhance** in **Fine Tune Method** in **Advanced OCR Parameter Tuning** box.

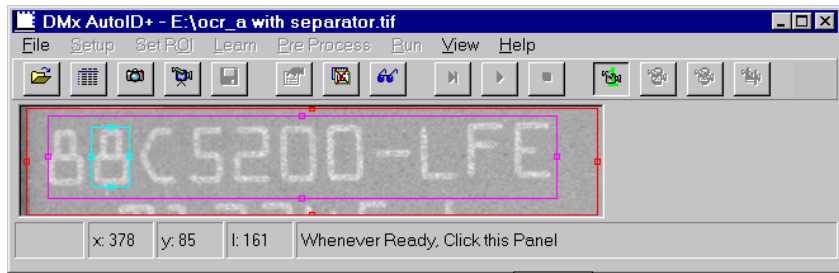
Note: No separator characters can be recognized in the OCR-A or OCR-B font. The following example illustrates how to read the OCR-A font containing separators.

Reading OCR-A with Separator (Example 1)

Since the five separators (., -, #, / and space) are not recognizable in OCR-A and OCR-B font, reading a string containing these separators requires special attention. This example illustrates how this can be done.

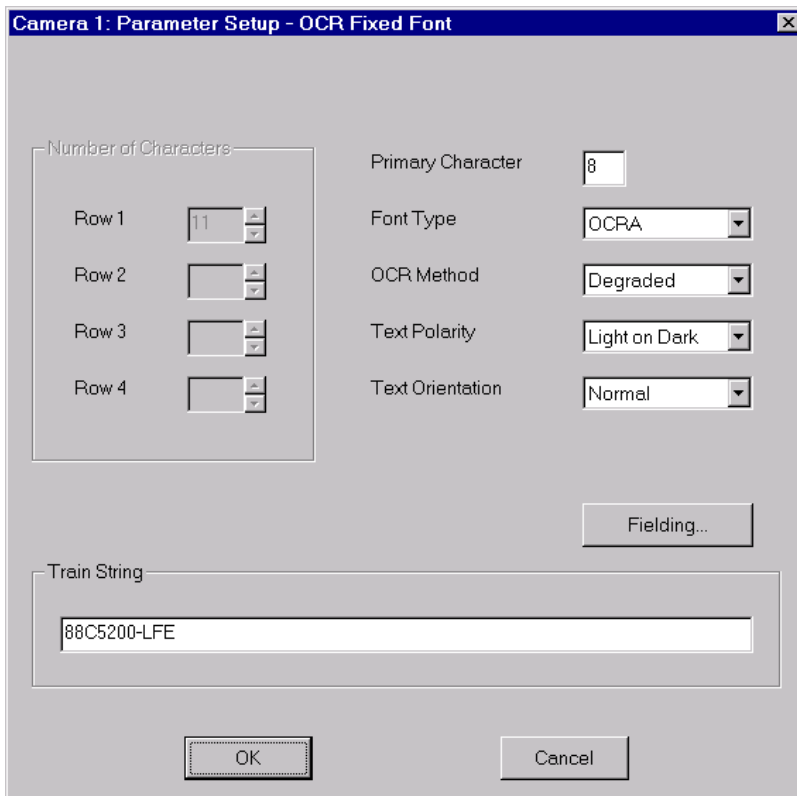
1. Set ROI, string box and character box.

FIGURE 4-60.



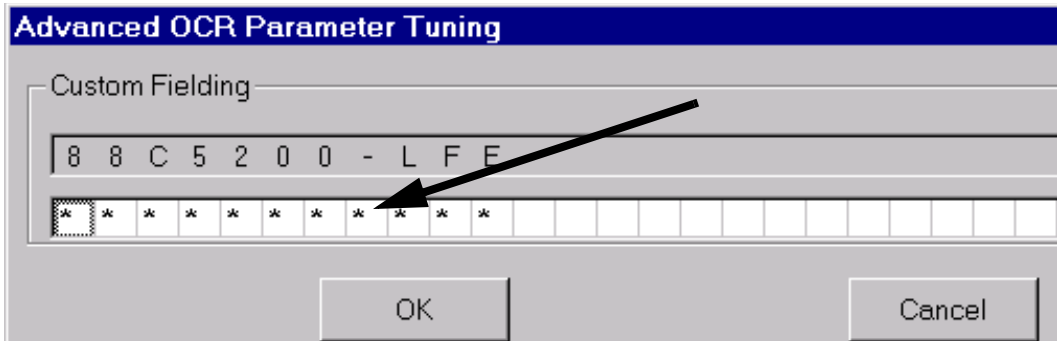
2. Click the panel to enter the following information, as shown in Figure 4-61.

FIGURE 4-61.



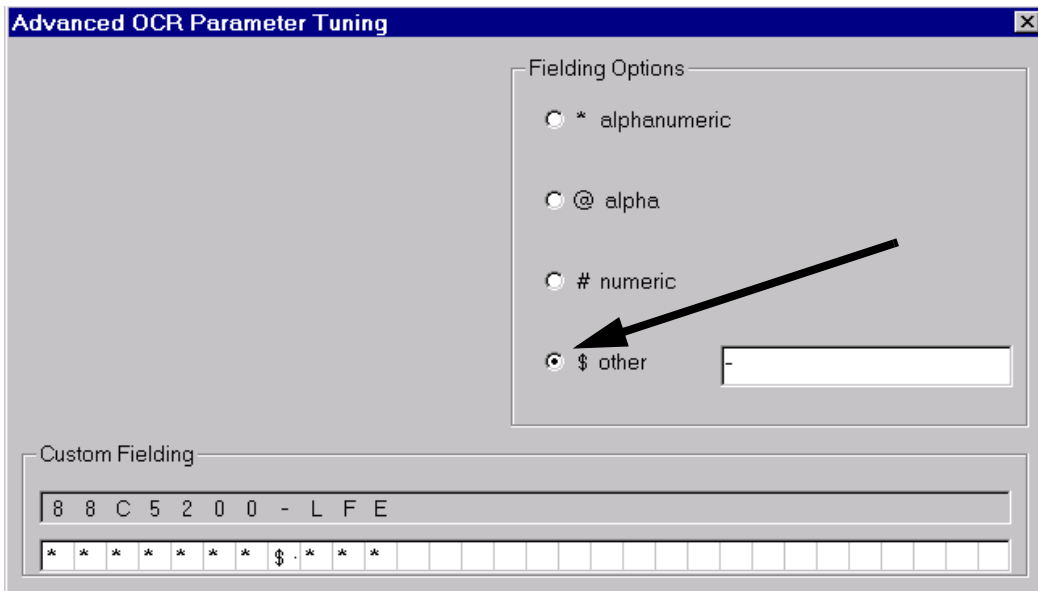
- Since the hyphen sign '-' is not recognizable in OCR-A, Learn will not succeed unless the Fielding is set for it. To do so, click the **Fielding** button to display the Custom Fielding dialog box, as shown in Figure 4–62:

FIGURE 4–62. Custom Fielding Dialog Box



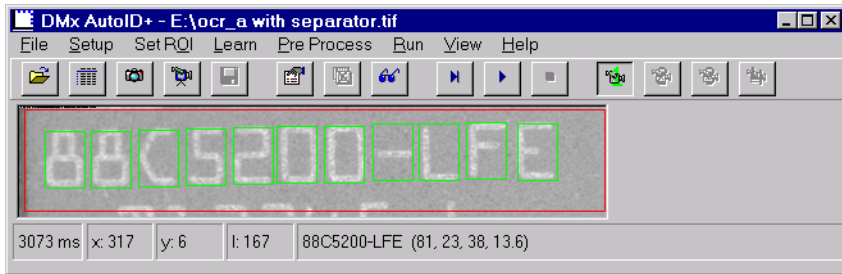
- Click on the * sign below the - sign (see Figure 4–62) to display the Fielding Options dialog box, as shown in Figure 4–63. In the Fielding Options area, select the “\$ other” radio button and enter the - sign in the edit box:

FIGURE 4–63. Fielding Options Dialog Box



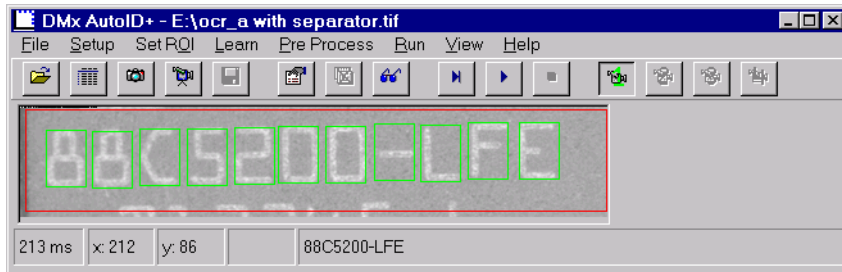
5. Click OK to go back to the Parameter Setup box, and then OK to complete the Learn process.

FIGURE 4-64.



6. Run Once.

FIGURE 4-65.



Learn>Fiducial

1. Open image file *Sample17.bmp*. From the Learn menu, select Fiducial. The status bar will display the instruction “Draw the Region of Interest”. Use the mouse to select the ROI, as shown in Figure 4–66:

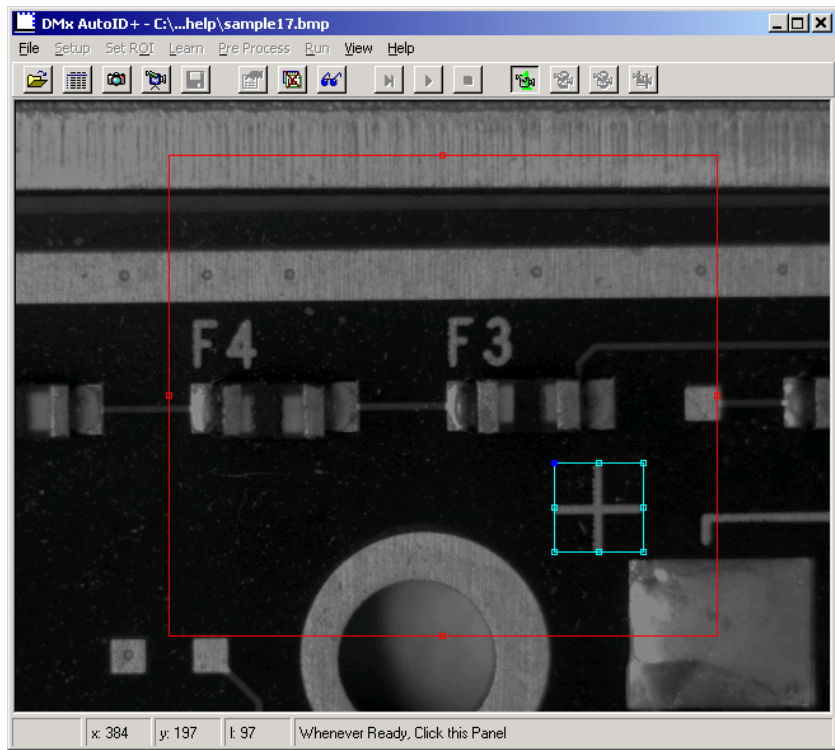
FIGURE 4–66. Drawing ROI



After the ROI is drawn, the status bar issues the instruction to Draw the Target Box **INSIDE** the ROI. This target will be the template used in the correlation search. Be careful to draw the target precisely the way it will appear in other images.

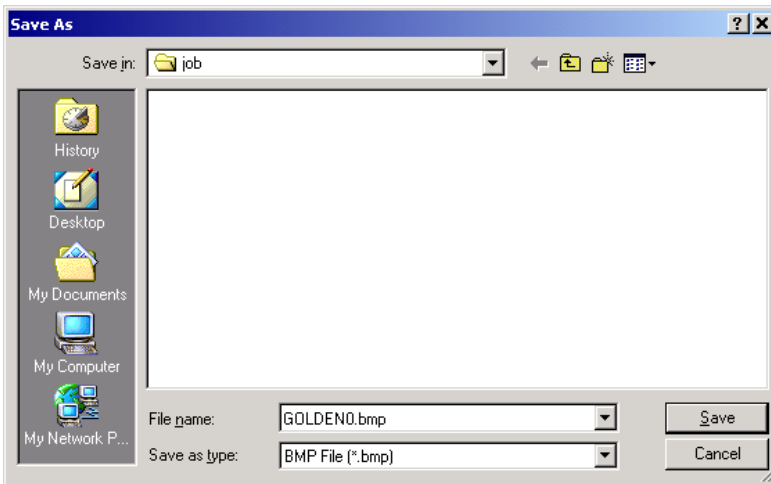
Note: You can adjust the drawing by dragging the borders with the mouse or you can place the mouse cursor on top of the border you want to adjust and then press the arrow keys on the keyboard.

FIGURE 4-67. Drawing the Target Box



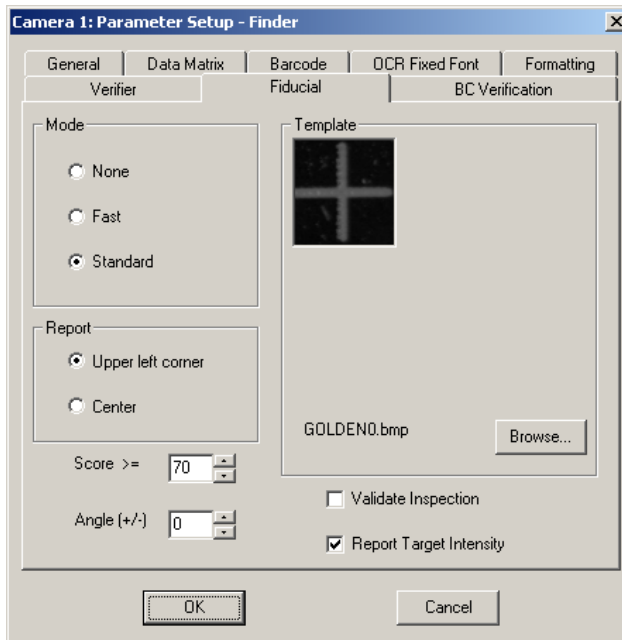
A small target has less data for the correlation algorithm. When the target is too small, a warning box will be displayed to tell you a small target is chosen. You can proceed to use the target or to re-select the target (you may need to reconfigure your FOV to make the feature larger in the FOV). When you are satisfied with the target selection, click the status bar panel to bring up the **Save As** dialog box for you to save the target portion of the image as the golden template used in the correlation search algorithm. See Figure 4-68.

FIGURE 4–68. Save As Dialog Box



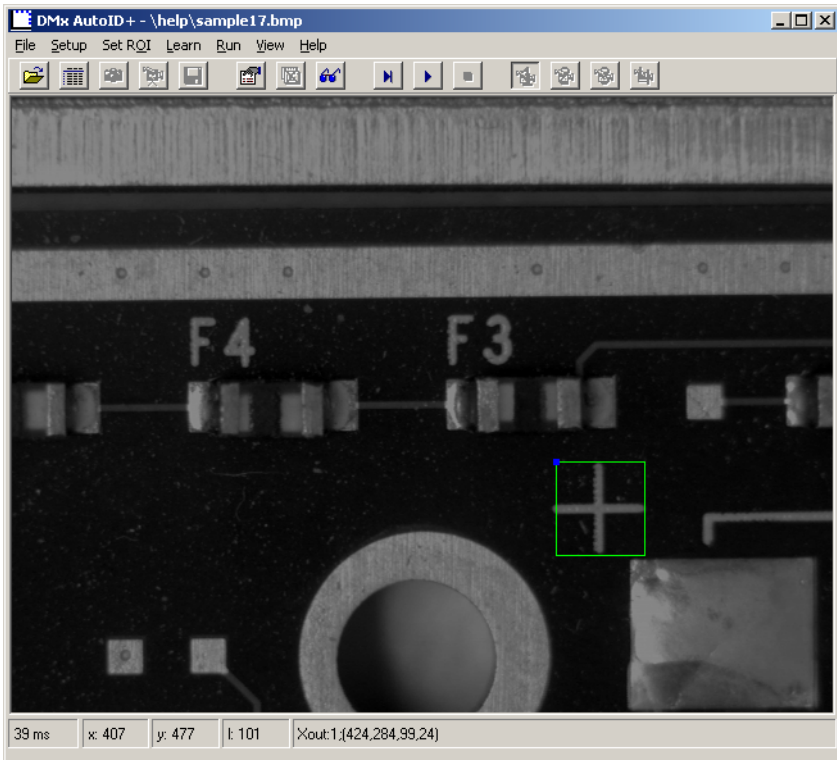
A file name will be generated automatically for you. You can modify it to a more meaningful name or you can accept the name as is.

2. Click **Save** to save the target image in the job folder under the DMx AutoID+™ application folder. Then, Figure 4–69 will be displayed to allow you to configure the fiducial finder parameters (for details, see page 4–60):

FIGURE 4–69. Parameter Setup — Finder Window

3. Configure the parameters as shown in Figure 4–69.
4. Select Run Once; you should see Figure 4–70:

FIGURE 4–70. After Selecting Run Once



The output of the fiducial finder has the following syntax:

Xout: single digit; (x coordinate, y coordinate, score, intensity)

If a target is found, the single digit is 1, and the x, y coordinates of the upper-left corner, correlation score, and average intensity of the target will be displayed. Otherwise, the single digit is 0, indicating that no target is found. No valid coordinates are displayed either.

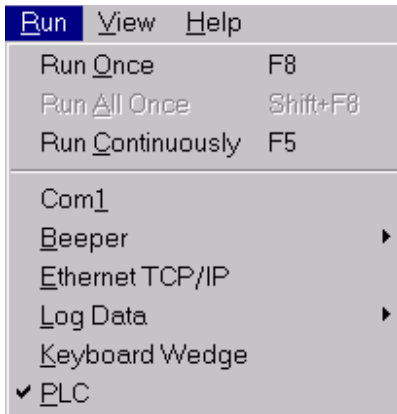
Instead of reporting the upper left corner, you can also choose to report the center of the target.

5. To test the fiducial finder on a different image, open image file *Sample18.bmp* and perform Run Once. You can also use File>Open List to open files *Sample17.bmp* and *Sample18.bmp* and select Run>Run Continuously.

Run Menu

The Run menu, as shown in Figure 4–71, allows you to perform various inspection sequences.

FIGURE 4–71. Run Menu



Before select Run Once or Run Continuously, always ensure that the settings in the Multi-Code Setup box in Setup>Parameters>General Tab are configured correctly.

By design, when a Learn Data Matrix is successful, the Number of Data Matrices to Decode is automatically set to 1 to read one Data Matrix, and the Number of Barcode to Decode and Number of OCR Rows to Read are both set to 0 to disable those readings. Consequently, when a Learn Barcode is performed, the Data Matrix parameters are retained but only the Barcode will be allowed to run.

The same strategy applies to OCR reading. In order to read Data Matrix, Barcode, and OCR, you must set each parameter - Number of Data Matrix to Decode, Number of Barcode to Read, and Number of OCR Rows to Read to a value greater than 0.

Important Settings Prior to Run

Refer to Search Direction in Setup>Parameters>Data Matrix tab and Inspection Time-out Value in Setup>Parameters>General tab. The setting for Search Direction determines how Inspection Time-out Value must be set.

- When Search Direction is set to the default Criss-cross or Horizontal only or Vertical Only, set Inspection Time-out Value based on the following

scenario: If the Data Matrix and Barcode reading takes x amount of milliseconds to complete, set Inspection Time-out Value to at least 1 times the amount of time in milliseconds.

- When Search Direction is set to Hori>Vert or Vert>Hori, you must set Inspection Time-out value based on the following scenario. If the Data Matrix and Barcode reading takes x amount of milliseconds to complete, set Inspection Time-out Value to at least 2 times the amount of time in milliseconds.

Run>Run Once

If the DMx AutoID+™ program is configured to receive hardware trigger, then after Run Once is selected, the program will acquire an image when the next trigger occurs and perform Data Matrix/Barcode/OCR reading if they are enabled in Setup>Parameters>General tab under Multi Code Setup group. All other subsequent triggers will be ignored. Figure 4–72 displays the status bar, which indicates that the program is waiting for a hardware trigger.

FIGURE 4–72. Status Bar — Waiting for Hardware Trigger



The Run Once mode can be cancelled by clicking the Run Once button before the trigger occurs.

If the Hardware Trigger option is not checked in Setup>System Configuration box, then Run Once will acquire one image immediately and perform Data Matrix/Barcode/OCR reading.

If you use File>Open List to store a list of images for DMx AutoID+™ program to perform the reading, then Run Once will take the next image in the list if the Grab New box is checked in Setup>System Configuration. If the box is unchecked, then Run Once will read the currently displayed image from the file list.

Run>Run All Once

When more than one camera is enabled and configured with the Learn, the Run All Once menu is enabled to run all cameras once. If the Hardware Trigger option is not checked, then Run All Once will acquire one image from each configured camera immediately and perform Data Matrix/Barcode/OCR reading. When

hardware trigger is used, Run All Once is completed when each of all configured cameras has been triggered at least once.

The Run All Once option is now allowed for image files. It is disabled once an image file is loaded.

Run>Run Continuously

If the DMx AutoID+™ program is configured to receive hardware triggers, then after Run Continuously is selected, the program will acquire a new image whenever the trigger occurs and perform Data Matrix/Barcode/OCR reading. The “Waiting for a Trigger” message will be displayed in the status bar before the first trigger occurs.

If no hardware trigger is used, then Run Continuously will acquire an image and then perform Data Matrix/Barcode/OCR reading. In the reading process, a new image will be acquired and read as soon as the reading process of the current image is finished.

If you use File>Open List to open a list of images saved before, then Run Continuously will read the images one by one and cycle through the list.

Run>Stop

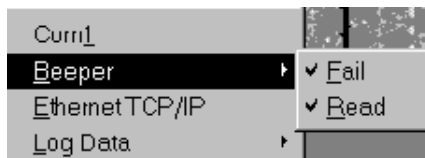
The Stop menu and tool bar will be displayed during Run Continuously mode to allow you to stop the running.

Run>Com 1 or Com 2

Open the Run menu and select Com1 (or Com2), as applicable. When either option is checked (enabled), the respective serial port (Com1 or Com2) is subsequently initialized. Decode data is sent from that Com serial port along with any associated prefix and/or suffix.

Run>Beeper

FIGURE 4-73. Beeper Window



The beeper has two tones indicating success or failure. Selecting **Beeper>Fail** (checked) enables the PC to beep when the inspection (reading) fails. Similarly, selecting **Beeper>Read** (checked) enables the PC to beep when the inspection (reading) succeeds.

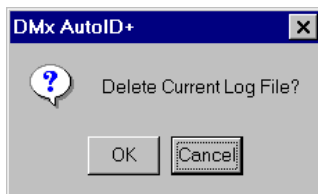
Run>Ethernet TCP/IP

Enable Ethernet TCP/IP by checking this option. Once checked, DMx AutoID+™ will attempt to establish the TCP/IP connection with the parameters specified in **Setup>Ethernet TCP/IP** box. Once connected, you can terminate the connection by unchecking the option.

Run>Log Data

Select **Run>Log Data>Log** to check the option if you want to log the data to the file `\DMx AutoID+™\job\mxAutoID.log`. Selecting this again will uncheck it to disable logging data. If the file already exists on the system, the **Delete** menu will be enabled. If you want to delete the log file, select **Delete** and click **OK** in the “Delete Current Log File” box, as shown in Figure 4–74.

FIGURE 4–74. Delete Current Log File Dialog Box



When the file is removed, and the **Run>Log Data>Log** is checked, any newly decoded data from **Run Once** or **Run Continuously** will be logged starting from the first line of the file. If the file already exists and **Run>Log Data>Log** is checked, any newly decoded data will be appended to the end of the file.

Note: You should not access the Log file during the **Run Continuously** process.

If **Log Data** is enabled in **List mode** with image files, then **Run Continuously** will go through the list of image files only once.

Run>Keyboard Wedge

This menu is available when **View>Additional Menus>Wedge** is checked. When **Run>Keyboard Wedge** is enabled (checked), output data, such as

decode results, is sent to an open Windows program that has the focus. This enables DMx AutoID+™ to send the data to a program such as Microsoft Excel, Word, Notepad that is specified in **Setup>Wedge Target**.

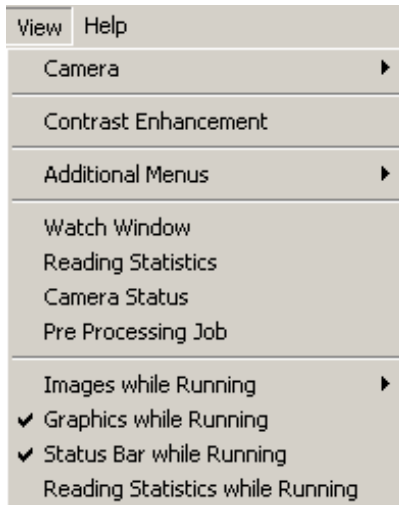
Run>PLC

This menu is available when **View>Additional Menus>PLC Interface** is checked. To enable DMx AutoID+™ to communicate with PLC software, you must first configure the parameters in **Setup>PLC Communication** and then select **Run>PLC** to check it. The communication is ended when **Run>PLC** is unchecked.

View Menu

The View menu, as shown in Figure 4–75, contains the options to configure the Run Time display behavior.

FIGURE 4–75. View Menu



View>Frame Grabber

The menu is visible only when more than one 0300 board is installed. The menu can display up to four 0300 boards that are supported by DMx AutoID+™. The checked 0300 board item is the *current* 0300 board, which corresponds to the *current* camera. Use this menu to select the desired 0300 board first in order to access the cameras connected to that 0300 board.

View>Camera

Use this menu to select the current camera among the list of cameras enabled in Setup>System Configuration.

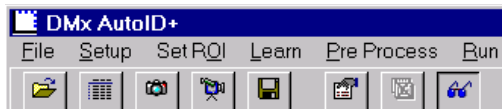
View>Contrast Enhancement

When the image displayed in the DMx AutoID+™ GUI is too dark or too bright to see the details of the Data Matrix, barcode, or the OCR text, you can select (check) Contrast Enhancement to display the contrast enhancement slider in the Status Bar area. You can click inside the slider or press arrow keys to adjust the image display. This feature only affects the image display and does not change the actual image used by the decoding software.

View>Additional Menus>Pre Process

Sometimes, for poor symbology or OCR images, a properly chosen preprocessing step can enhance the image quality and reduce the noise and, hence, improve the reading robustness. The Pre Process menu can be displayed by selecting Pre Processing under Additional Menu. When this is done, the Pre Process menu is inserted between the Learn and Run menus. You can hide the Pre Process menu by selecting View>Additional Menus>Pre Process again to uncheck it. The Pre Process menu is explained in the next section.

FIGURE 4-76. Pre Process Menu Item Displayed



View>Additional Menus>PLC Interface

DMx AutoID+™ can communicate with a PLC (Programmable Logic Controller) through the PLC software. You can select and check PLC Interface to display the PLC Communication in the Setup menu, the PLC option in the Run menu, and the PLC Status in the View menu.

View>Additional Menus>Keyboard Wedge

DMx AutoID+™ can send output data to an open Windows program that has the focus. You can select and check Keyboard Wedge to display the Wedge Target in the Setup menu and the Keyboard Wedge option in the Run menu.

View>Watch Window

When Watch Window is selected (checked), a text window will be displayed. This will allow you to see the full decoded data in Run Once or Run Continuously mode. To save the data to a file, use the Run>Log Data option.

View>Reading Statistics

When Reading Statistics is selected (checked), the reading statistics results will be displayed, as shown in Figure 4–77:

FIGURE 4–77. Reading Results Statistics Displayed

Camera	Read	No Read	Match	No Match	System Overrun
1	95	0	0	0	0 0

Refresh Rate (snap shot basis) 10

You can change the Refresh Rate from 1 to 50 to reduce the results updating frequency. The default Refresh Rate is to update every 10 inspections. Clicking Reset All will clear the statistics results.

View>PLC Status

This is available when View>Additional Menus>PLC Interface is checked. When PLC Status is checked, the PLC Communication status is displayed, as shown in Figure 4–78:

FIGURE 4–78. PLC Status Window

PLC Communication Status	
Transaction #	0
Sequence #	0
Data from PLC	<no data>
Data from DMx AutoID+	<no data>
DDE Send Status	<no data>

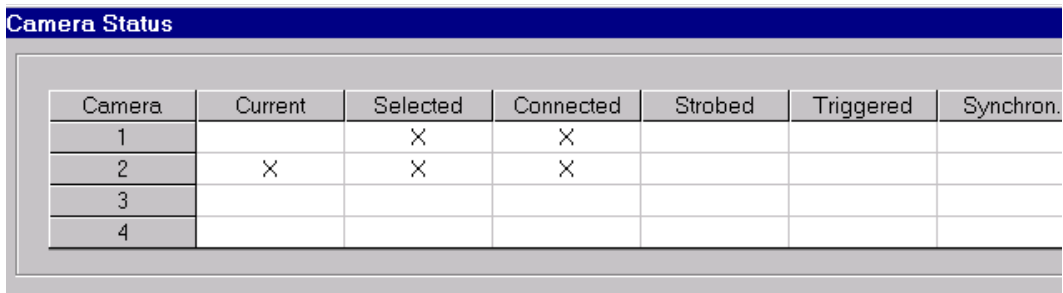
When PROFIBUS is chosen as the transfer protocol, the Data from PLC displays the command or the acknowledgement packet it has received from the

master. The **Data from DMx AutoID+™** displays the data that is being sent in the current packet. The **Profibus Send Status** typically shows <send complete> when there is no more data left to send or <more data to send > when there is more data in the buffer to be sent. In Run Once mode, when an unexpected command is received, the information packet containing no data is sent and no data is shown in **Data from DMx AutoID+™**, and the **Profibus Send Status** shows <Unexpected Command>. When an invalid command is received, the **Data from DMx AutoID+™** shows <Invalid Command> and a 17-byte data packet consisting of the same message is sent to the master. In Run Continuously mode, since DMx AutoID+™ is triggered by the hardware, not the software command, it is less important to filter out incorrect command. Therefore, any message other than the command READ OFF received by the DMx AutoID+™ from the Master is treated as an acknowledgement. There is no concept of unexpected or invalid command.

View>Camera Status

This menu item displays the cameras that are connected and working properly, as shown in Figure 4-79.

FIGURE 4-79. Camera Status Window



Camera	Current	Selected	Connected	Strobed	Triggered	Synchron.
1		X	X			
2	X	X	X			
3						
4						

View>Pre Processing Job

If a certain preprocessing step is applied during a successful Learn>Data Matrix, Learn>Barcode, or Learn>Fixed Font OCR process, it is used in the Run mode. You can use View>Pre Processing Job to display which preprocessing step is used internally in Run mode. Figure 4–80 displays a single camera job configuration that has Zoom In preprocessing enabled for Data Matrix and Barcode reading and Dilate preprocessing enabled for OCR, respectively.

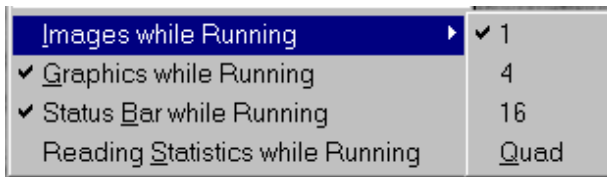
FIGURE 4–80. Processing Job Status

Processing Job Status			
Camera	Data Matrix	Barcode	OCR Fixed Font
1	Zoom In (x 1.5)	Zoom In (x 1.5)	Dilate (size 1)

View>Images While Running

Open the View menu and select Images while Running. This menu item allows you to view the current image during a Run sequence, as shown in Figure 4–81.

FIGURE 4–81. Images While Running Window



You have the following options for displaying images in Run time:

1	Display image in full resolution one at a time in the order it is acquired.
4	Display image in one fourth of the full resolution in the order it is acquired. A maximum of four images can be displayed before the oldest image is replaced with a new image.
16	Display image in one sixteenth of the full resolution in the order it is acquired. A maximum of sixteen images can be displayed before the oldest image is replaced with a new image.
Quad	Display images from camera 1, 2, 3 and 4 in the corresponding quadrant.

Since image display uses a significant amount of the computer resources, for high speed/high throughput application, try to display images in lower resolution or disable the image display whenever possible. To disable the image display, simply select the checked display option to uncheck it.

View>Graphics While Running

Open the View menu and select Graphics while Running. This menu item allows you to view the reading graphics during a Run sequence. Enabling graphics display will add very little overhead to each read cycle.

View>Status Bar While Running

Open the View menu and select Status Bar while Running. This menu item updates the status bar display. Enabling Status Bar update will add significant overhead to each read cycle. For high-speed application, disable the Status Bar while Running.

View>Reading Statistics While Running

Open the View menu and select Reading Statistics while Running. This menu item allows you to see the reading statistics in Run mode.

Pre Process Menu

Figure 4–82 displays the Pre Process Menu.

FIGURE 4–82. Pre Process Menu



The Pre Process menu can be displayed by checking View>Pre Processing. Any Pre Process step can be used for reading Data Matrix, barcode, OCR, or performing Data Matrix in-line verification, but is not applicable to the fiducial finder so far.

For challenging Data Matrix or OCR reading applications, sometimes utilizing a proper Pre Process step to enhance the image quality before reading can actually make the reading more consistent and robust. For example, when the cell size of a dot peen mark is much smaller than the nominal cell size, you can perform a dilation or erosion to make the cells larger to improve the reading performance. If reading a light on dark barcode is needed, you can use Invert to change the barcode polarity to dark on light for decoding. The Zoom x 1.5 pre-processing step can actually resample the image to be 150% larger in case the Data Matrix, barcode or OCR characters are too small to read in the image.

We use Data Matrix as an example in the following instructions. The same instructions can be applied to both barcode and OCR reading.

To use the Pre Process for reading Data Matrix, you need to follow these steps in order to embed the pre processing:

1. Acquire a Data Matrix image via **File>Grab**, **File>Open List**, or **File>Open**. This image is called the original image.
2. Set the Data Matrix ROI inside the image. The preprocessing step and Data Matrix reading step use this ROI. The smaller the ROI, the faster the preprocessing.
3. Select an appropriate option from the Pre Process menu. The original image now changes to the processed image.
4. Perform **Learn>Data Matrix**. Make sure the Learn is successful and fast. If not, select **Pre Process>Undo** to go back to the original image and then perform steps 2 through 4 with a different ROI and/or a different preprocessing option.
5. You can now test with **Run Once/Continuously** mode. In Run Once mode, with each of the three image modes described in (1), the image and decode graphics can be displayed differently depending on whether Run Once operates on a new image (i.e., whether the Grab New flag in **Setup>System Configuration** is checked or not). If no new image is acquired in Run Once mode, then the Data Matrix reading is based on the already processed image and the decode graphics is displayed in the usual green color. If a new image is acquired, then Run Once applies the preprocessing step and read the Data Matrix based on the processed image. The decoded graphics is displayed in light blue color. Since Run Continuously mode is not affected by the Grab New flag, the image and decode graphics are displayed the same way as the Run Once with Grab New checked. The following explains the design more specifically:
 - **File>Grab** — The original image was acquired from the 0300 board. In this mode, if Grab New is checked, then Run Once acquires a new image, perform the preprocessing step, then read the Data Matrix. The new image (before the preprocessing) is displayed with the decode graphics in light blue color. If Grab New is unchecked, then Run Once does NOT acquire a new image. Instead, it performs the preprocess step on the original image then reads the Data Matrix. This time however, the preprocessed image and the decode graphics are displayed.
 - **File>Open List** — You need to have at least two files. To test this mode, use **File>Open List** to open image files Sample1.bmp and Sample2.bmp. Assume Sample1.bmp is displayed in DMx AutoID+™ as the original image and you have performed steps 1 through 4. If Grab New is checked, then Run Once acquires the next image in the list,

performs the preprocessing step, then reads the Data Matrix. The image before the preprocessing is displayed with the decode graphics. If Grab New is unchecked, then Run Once operates on the same image Sample1.bmp and the preprocessed image and the decode graphics are displayed.

- **File>Open** — There is only one file available and Grab New has no effect. Run Once performs the preprocess step on the original image, reads the Data Matrix, and displays the preprocessed image along with the decode graphics. To display the original image with the decode graphics, you need to open the same (or a new) image again then do Run Once.

Note: When no ROI is chosen for Data Matrix or barcode before the Learn, the full image is used as the ROI. You can always use Set ROI then Clear ROI to set the full image as the ROI for Data Matrix, Barcode, or OCR. Although it is not required to use an ROI smaller than the full image for all the preprocessing options except for the Zoom x 1.5 and Rotate, we recommend that you set an ROI as small as possible to reduce the time required for performing the preprocessing step. An ROI is required for enabling the Zoom x1.5 or Rotate option.

The decode graphics can be displayed in two different colors, depending on whether preprocess is used or not. Green color is used for reading without preprocess while light blue color indicates that preprocess is used.

You can perform multiple erosion or dilation steps before performing the Learn. You can also perform a certain number of erosion steps followed by a different number of dilation steps (or vice versa) before performing the Learn.

Pre Process>Undo

Select this to undo any preprocessing step(s) to go back to the original image.

Pre Process>Invert

This is useful for inverting a light on dark barcode to dark on light for barcode decoding.

Pre Process>Zoom x 1.5

This is useful for enlarging the image to increase the resolution for reading small Data Matrix, barcode, or OCR characters. To use this option, you are required to draw the corresponding ROI first. (The ROI can be drawn as large as the full image but can not be set by **Set ROI>Clear ROI**) When the ROI is drawn, the Zoom x 1.5 option is enabled in the Pre Process drop down menu. Check the option by selecting it. An enlarged image of the ROI area is then displayed. Perform the Learn based on the image and ensure the Learn is successful. Use Run Once/Continuously to test the reading that has the preprocessing done internally.

Pre Process>Rotate

This is mainly useful for OCR applications. To use this option, you are required to draw the corresponding ROI first. When the ROI is drawn, the Rotate option is enabled in the Pre Process drop down menu. Once you select the Rotate option, the message “Use Arrow to Rotate the Image” is displayed in the status bar. Use the Up or Down arrow to rotate the image counterclockwise or clockwise 5° every time the key is pressed. Alternatively, use the Left or Right arrow for finer adjustment. Once the OCR string is leveled, perform the **Learn>OCR** and ensure the Learn is successful. Use Run Once/Continuously to test the reading that has the preprocessing done internally.

Pre Process>Erode

This menu item increases the dark cell size (of dark on light Data Matrix).

Pre Process>Dilate

This menu item increases the light cell size (of light on dark Data Matrix).

Pre Process>Open

This menu item removes minor light defects of dark cells.

Pre Process>Close

This menu item removes minor dark defects of light cells.

Pre Process>Top Hat

This menu item removes uneven background.

Pre Process>Well

This menu item removes uneven background.

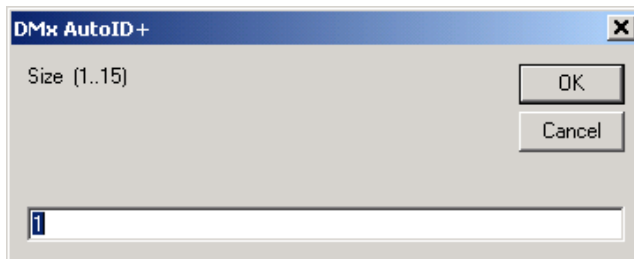
Pre Process>Max+Min

This menu item removes high frequency noise and defocuses the image.

Pre Process Example

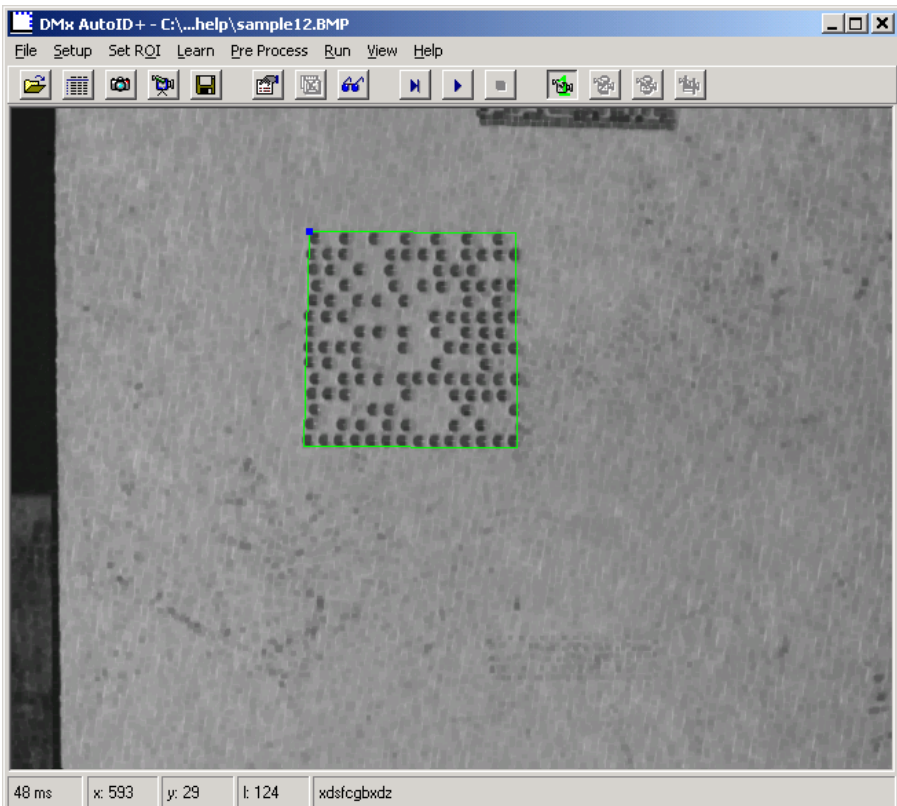
1. Open *sample12.bmp*.
2. From the Pre Process menu, select **Erode** to display the DMx AutoID+™ Size dialog box. You can enter 1 or 2 and then click **OK**. In this example, size 2 will produce a better image than size 1 but take more time to do the processing.

FIGURE 4–83. Size Dialog Box



3. From the Learn menu, select **Data Matrix** to ‘memorize’ the preprocess step and learn the Data Matrix.

FIGURE 4–84. Memorize Pre-Process Step



4. From the Run menu, select Run Continuously to decode the Data Matrix with preprocessing embedded.

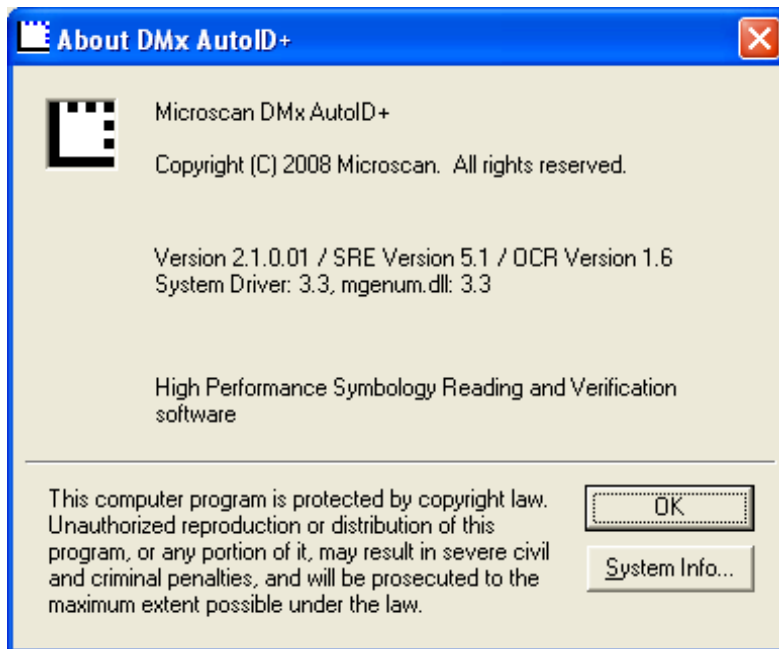
The preprocess step Invert or Max+Min can be applied only once with no configurable parameter. The rest of the preprocess steps have the size parameter, which can be set from 1 to 16. You should begin with size 1 and gradually increase the size to see which one produces the most satisfactory reading performance. For Erode and Dilate, you are allowed to perform certain size of Erode followed with certain size of Dilate, or vice versa.

Help Menu

Help>About

This menu item displays the About the DMx AutoID+™ dialog box, as shown in Figure 4–85:

FIGURE 4–85. About DMx AutoID+™ Dialog Box

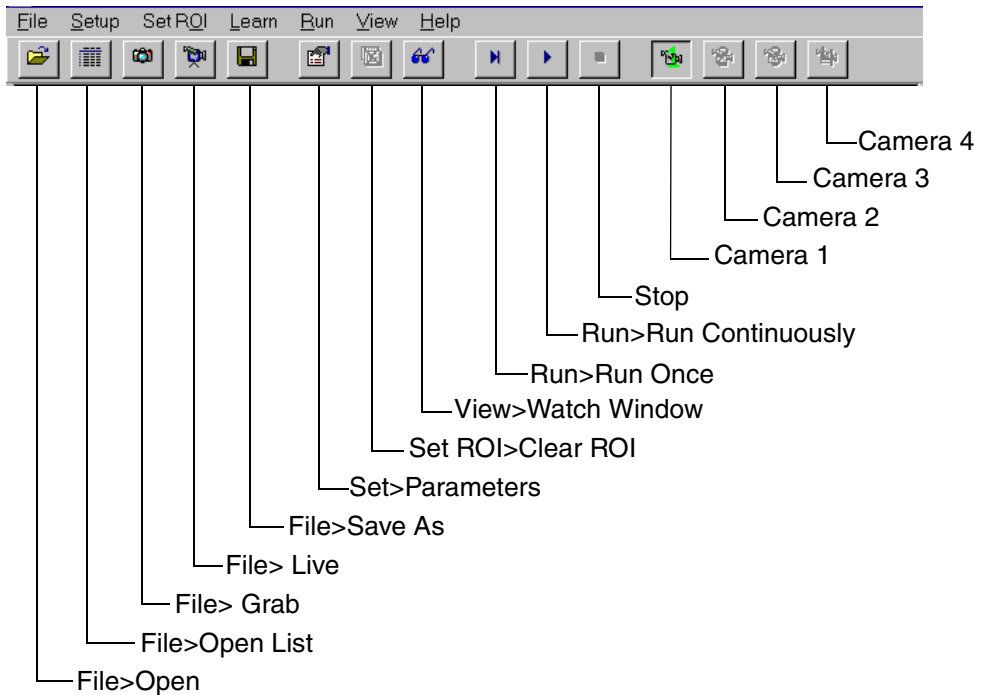


This provides critical information about *your* system including software versions, serial number, and your PC's system information. Use the information provided in this dialog box to expedite any technical questions you may have about the product.

Tool Bar

Figure 4–86 displays the DMx AutoID+™ tool bar.

FIGURE 4–86. DMx AutoID+™ Tool Bar



Status Bar

Figure 4–87 shows what’s displayed when DMx AutoID+™ stops:

FIGURE 4–87. What’s Displayed When DMx AutoID+™ Stops

9 ms	376	9	x: 323	y: 132	I: 141	xdsfcgbsdz
------	-----	---	--------	--------	--------	------------

- 9 ms — Duration of last decode (not including image capture).
- 376 — Total number of inspections.
- 9 — Total number of inspection failures. If system overrun occurs, the number of overruns will be displayed, within parentheses, after the total failure. The total number of inspection failures includes system overrun.
- x:323 — The x-coordinate of mouse location in the image.
- y:132 — The y-coordinate of mouse location in the image.
- I:141 — The gray scale value of the pixel at (x, y).
- xdsfcgbsdz — The decoded data.

During Running, the pixel coordinates and gray value will not be displayed. The rest will be updated and displayed at the end of each inspection cycle, if **View>Status Bar while Running** is checked. If **View>Status Bar while Running** is not checked, then only total number of inspections and failures will be displayed to minimize the CPU load.

DMx AutoID+™ Command Set

The DMx AutoID+™ commands are designed to enable a custom program to configure and control the DMx AutoID+™ system via serial communication or Ethernet TCP/IP. The same set of commands can also be used by PLC in order to control DMx AutoID+™ via RsLinx or Profibus. To ensure proper communication, each time the custom program sends a serial/TCP/IP command, it must wait for the command to respond. The next command cannot be sent before the event is acknowledged that notifies the previous command has been completed.

Most of the commands are tied to the current camera; you should always ensure the current camera is set correctly using the command CAMERA n. Commands that are only applicable to the current camera are said to be camera dependent. Commands that are not tied to a specific camera are called camera independent and are specifically noted.

- Items in ALL CAPS represent a system command or keyword.
- Items in *italics* should be replaced with a value or keyword corresponding to the parameter range specified.
- Curly brackets { } indicate that an item is required.
- Square brackets [] indicates that an item is optional.

BARCODE {COUNT} [*number*]

Use this command to set/change the Number of Barcodes to decode in the General parameter tab. The Number of Barcodes to Decode in the current camera configuration is returned if the optional *number* is not entered. The valid range for *number* is 0 - 5.

BARCODE ENABLEMASK [*mask*]

Use this command to set/change the type of barcodes to be checked in the General parameter tab. The barcode types that are checked in the current camera configuration are returned as a bitwise mask if the optional *mask* is not entered. The valid range for *mask* is 0 - &H2FFFF.

BCVERIFY [NONE | OVERALL | SCAN x]

Use this command to set the Barcode verifier mode. The value x in SCAN x mode is the scan line number from 0 to 9. If the optional parameter is omitted, the verifier mode in the current camera configuration is returned.

CAMERA [*number*]

Use this command to set the current camera from 1 to 16. Once the current camera is set, all camera dependent commands will refer to this camera. Since the DMx AutoID+™ may support up to four 0300 boards in one PC, the number of camera supported can be from 1 to 16.

Use this command without options to return the index of the current camera.

CAMERA COUNT

Use this command to return the number of cameras enabled.

CAMERA ENABLEMASK

Use this command to return the camera enabled mask. For example, if cameras 1 and 2 are enabled, the mask is &H03.

CELL SIZE [*value*]

Use `CELL SIZE value` to set the matrix cell size. The *value* ranges from 2 to 20 pixels.

Use `CELL SIZE` without a parameter to get the value.

CHECK STRING {1D | 2D | OCR} [ON | OFF | *str*]

The first (required) parameter selects the symbology type (barcode, Data Matrix, OCR).

The second (optional) parameter enables/disables match string mode, or sets up/changes the match string using *str*.

For example, to set up match string “1234567890” for Data Matrix, first enter the match string by typing:

```
CHECK STRING 2D 1234567890<Enter>
```

Then, enable the check string mode by typing:

```
CHECK STRING 2D ON<Enter>
```

To disable check string, type:

```
CHECK STRING 2D OFF<Enter>
```

To get the check string, type:

```
CHECK STRING 2D<Enter>
```

CHECK STRING {1D | 2D | OCR} READ

The required parameter selects the symbology type. The command sets the match string automatically on the next successful read. For example, to allow the barcode match string to be “learned” on the next successful read, type:

```
CHECK STRING 1D READ <Enter>.
```

Then, type `READ` to read a barcode successfully. The decoded data will be used as the match string data.

COLS [*value* | AUTO]

Use this command to set/get the number of matrix columns. The *value* ranges from 8 to 144. The AUTO should be used if the number of columns varies in READ. To get the number of columns of Data Matrix, type:

```
COLS<Enter>
```

DEL {*jobfile*}

Use this command to delete a saved job. No path is required if the job is in the default job folder. Otherwise, the complete path is required. This is camera independent.

DIR

Use this command to return all job file(s) saved in the default job directory. Return Invalid Command if there is no job. This is camera independent.

FORMAT {PREFIX | SUFFIX | STATUS | LABEL} [*str*]

Use this command to set/change the prefix, suffix, status separator, label separator, symbology enablemask, or OCR enablemask to *str* when *str* is entered. Only a single character is allowed as the *str* for FORMAT STATUS | LABEL. The symbology enablemask is a bitwise mask of the options in Symbol Debug Report. The first item, Status Code, corresponds to the LSB of the mask. The OCR enablemask is a bit-wise mask of the options in OCR Debug Report with Status Code being the LSB. When *str* is not entered, the current prefix, suffix, status separator, label separator, symbology enablemask, or OCR enablemask is returned.

GRAB [*filepath*]

Use this command to acquire an image from the 0300 board. For example, if you want to grab an image from camera 2, type:

```
CAMERA 2<Enter>
```

Then, type:

```
GRAB<Enter>
```

Load an image file when *filepath* is specified. The image is displayed and treated as though it were captured from the current camera. For example, to open and display a file named test.bmp on drive C., type:

```
GRAB c:\test.bmp<Enter>.
```

HEIGHT [*value* | AUTO]

Use this command to set/get the height of the Data Matrix. The *value* ranges from 20 to 1024 pixels.

To allow the matrix height to vary in READ mode, type:

```
HEIGHT AUTO<Enter>
```

To get the height of Data Matrix, type:

```
HEIGHT<Enter>
```

HELP

Use this command to display the list of serial commands. This is camera independent.

INVERT

Use this command to invert the current image that is acquired with GRAB or READ. Attempting to invert an already inverted image results in an error.

LEARN {1D | 2D}

Use this command to learn barcode or Data Matrix.

LIGHT {*axis*, *intensity*}

Use this command to configure a multi-axis imager from NER.

Axis: 1-5; *Intensity*: 0-99.

LOAD [*jobfile*]

Use this command to load job settings of a saved job. No path is required if the job is in the default job folder. Otherwise, the complete path is required. When *jobfile* is not specified, the default factory settings are loaded. This is camera independent.

LOCK [ON | OFF]

Lock the DMx AutoID+™ GUI so that it will not respond to mouse or keyboard input. Remove the GUI lock with LOCK OFF. This is camera independent.

MATRIX COUNT [*number*]

Use this command to set/change the Number of Data Matrices to Decode in the General parameter tab. The value in the current camera configuration is returned if the optional *number* is not entered. The valid range for number is 0 - 5.

MINIMIZE [ON | OFF]

Use this command to minimize/restore the DMx AutoID+™ GUI. The default for the optional value is ON. This is camera independent.

MORPH {ERODE | DILATE | OPEN | CLOSE | TOPHAT | WELL | MAX+MIN} [*number*]

Use this command to perform morphological preprocessing. Operates on the current acquired image. Use the optional *number* (from 1 to 8) to indicate the number of iterations. The *default* is 1.

OPTO INPUT {*point*} [*board*]

Use this command to get the value of one input I/O point configured by OPTO IOMASK command. The first parameter *point* is the input point; the second optional parameter *board* is the board number from 0 - 3. The return value is 1 for I/O state high and 0 for I/O state low.

OPTO IOEVENT {*input enablemask*} [*state*] [0-3]

Use this command to request the OPTO IOEVENT command response be sent when a digital input state changes.

The *input enablemask* parameter enables all or a subset of the input points configured by OPTO IOMASK. The enabled input points will generate the command response OPTO IOEVENT n once the state of input point n changes.

For the Combo I/O, the *input enablemask* ranges from 1 - &H3FF.

For the Mini Opto I/O, the *input enablemask* ranges from &H10 to &H30.

The *state* parameter indicates the initial state before the input state change (see Table 5-1).

TABLE 5-1. State Parameters

State	What It Means
0	An input state change from 0 to 1 generates the command response.
1	An input state change from 1 to 0 generates the command response.
2	Either a state change from 1 to 0 or from 0 to 1 generates the command response. This is the default.

The board parameter is the board number (0 - 3).

Once the OPTO IOEVENT command is sent, the program must wait for the OPTO IOEVENT n command response to be received before sending next command to perform some action based on the input. To detect the next input, OPTO IOEVENT must be sent again before the state change of the input is generated.

This is camera independent.

OPTO IOMASK {*value*} [*board*]

By default, the DMx AutoID+™ controls all 16 digital I/O points on the Combo I/O board with Standard (i.e., predetermined) I/O mode. Using the OPTO command, the I/O implementation can be set to Custom and the I/O behavior can then be changed. This command sets the Custom I/O mode and must be used once before any other OPTO commands can be used.

For Combo I/O, use parameter value between 0x0 and 0xFFFF to configure all General Purpose IO points (GPIO 1-16) to be either input or output. The optional parameter board from 0 - 3 indicates the 0300 boards. The default board number is 0, indicating the first board. When more than one board is used, the optional number tells DMx AutoID+™ to which 0300 board the Opto I/O board is connected. If no optional board number is specified, DMx AutoID+™ uses the current camera to determine which 0300 board the Opto I/O board is connected to. The first 4 cameras belong to board number 0, the next 4 cameras belong to board number 1, and so on. The following examples show how to program the I/O points to be either output or input. To set all GPIO 1-16 as output, type OPTO IOMASK 0<Enter>. To set GPIO 1 as input and GPIO 2-16 as output, type OPTO IOMASK &H1<Enter>. To set GPIO 1-2 as input and 3-16 as output, type OPTO IOMASK &H03<Enter>. To set GPIO 1 and 3 as input and the rest as output, type OPTO IOMASK &H05<Enter>. To set all GPIO as input, type OPTO IOMASK &HFFFF<Enter>

For Mini Opto I/O, the two inputs and four outputs cannot be changed. The first four points are outputs and the next two points are input and the only acceptable command is OPTO IOMASK &H30<Enter>. For description of the *board* parameter, see the preceding paragraph.

OPTO OUTPUT {*point*} {1 | 0} [*board*]

Use this command to set the state of one output I/O point configured by OPTO IOMASK command. The first parameter *point* is the output point; the second value is the I/O state, 1 for high and 0 for low; the third optional parameter *board* is the board number from 0 - 3.

This is camera independent.

POL [DL | LD | AUTO]

Use this command to set the matrix polarity to Dark on Light or Light on Dark. To allow the polarity to vary in READ, use AUTO. Type POL<Enter> to get the polarity.

READ [*number* | ALL | ON | OFF]

- **READ:** Run Once the current camera. The Run Once mode acquires a new image when the Grab New option is checked in the System Configuration. The Run Once operates on the already acquired image using GRAB command when the Grab New is unchecked.
- **READ *number*:** Run Once on camera specified by number from 1 to 16. This is equivalent to combining two commands CAMERA *number* and READ.
- **READ ALL:** Run all enabled cameras once.
- **READ ON:** Enter Run Continuously mode for all enabled cameras.
- **READ OFF:** Stop Run Continuously mode for all enabled cameras.

RETRY NONE

Use this command to disable retry and reset the read cycle to single attempt mode, i.e., one image acquisition per trigger.

RETRY SUPERMARKET {*time limit*}

Use this command to set the read cycle to supermarket mode, i.e., report only successful attempts; upon duplicate data, report only if the time limit has elapsed since last decode. The time limit ranges from 1 to 30000 milliseconds.

RETRY TIME {*time limit*}

Use this command to set the read cycle to multiple attempts within a specified *time limit* ranging from 50 to 30000 milliseconds.

ROI {1D | 2D | OCR | FIND} [CLEAR | *left, top, width, height*]

Use this command to set ROI for barcode, Data Matrix, OCR, or Fiducial Finder.

The first parameter selects the type of symbology or tool.

The second parameter or the set of parameters specify the size of the ROI. The values *left, top, width, and height* represent the x, y coordinates of the upper-left corner and the width and height of the ROI in pixels. For example, to set ROI as (10, 10, 300, 200) for Data Matrix, type:

```
ROI 2D 10,10,300,200<Enter>
```

To set ROI to the full image size, type:

```
ROI 2D CLEAR<Enter>
```

If the optional parameter is not entered, the command returns the ROI size in the order of left, top, width, height. If the ROI size has not been set (from GUI or using ROI command), the values -1, -1, 0, 0 are returned to indicate that the ROI is the full image.

ROWS [*value* | AUTO]

Use this command to set/get the number of matrix rows. The value ranges from 8 to 144. The AUTO should be used if the number of rows varies in READ. Type ROWS<Enter> to get the number of rows.

SAVE {*jobfile*}

Use this command to save current settings as a job. This is camera independent.

SAVEIMAGE [*filepath*]

Use this command to save the image acquired with GRAB or READ command to an image file specified by *filepath*.

SHUTDOWN

Use this command to exit the DMx AutoID+™ program.

This is camera independent.

STATS [RESET]

Use this command (STATS RESET) to reset the statistics.

Use this command (STATS) to get the reading statistics.

TCPIP {*host ID, port number*} [, *in prefix, in suffix, out prefix, out suffix*]

Use this command to set the parameters for TCP/IP protocol. The first required parameter is the IP address or the friendly name of the computer to connect. The second required parameter is the port number. You have the option to set/change input prefix, input suffix, output prefix, and output suffix.

This command can be used as a serial or Profibus command. It is not available as a TCP/IP command.

This is camera independent.

TEMPLATE {*filepath*}

Use this command to load a specified template image file for the fiducial finder. In DMx AutoID+™, when the fiducial finder is configured using Learn Fiducial, the configuration can be saved to a job file that contains the reference to the template image file. After the job has been loaded, the template can then be changed using the command TEMPLATE when needed.

UNDO

Use this command to undo Invert or Morph preprocessing.

VER

Use this command to display the version of the software.

This is camera independent.

VERIFY ENABLEMASK [*mask*]

Use this command to set/change the custom settings of the verifier. The range for the mask is 0x01 - 0x3FF. If *mask* is omitted, the current custom settings are returned as a bitwise mask.

VERIFY MODE [NONE | CUSTOM | AIM | IAQG | ISO15415]

Use this command to set the Data Matrix verifier mode. If the optional parameter is omitted, the verifier mode in the current camera configuration is returned.

Note: When you choose CUSTOM, you are actually selecting DPM mode.

WIDTH [*value* | AUTO]

Use this command to set/get the width of the Data Matrix. The value ranges from 20 to 1024 pixels.

Type WIDTH AUTO<Enter> if you want to allow the matrix width to vary in READ mode.

Type WIDTH<Enter> to get the width of Data Matrix.

DMx AutoID+™ Visual Basic Support

Microsoft Visual Basic 6.0 is required for creating custom VB applications that communicate with the DMx AutoID+™ application.

There are two approaches to adding DMx AutoID+™ functionality to a custom VB application. If the VB program is to be written to control or monitor the operation of the DMx AutoID+™ in the same PC or a remote PC, then the Serial or TCP/IP command support should be used. If you want to have a custom interface without DMx AutoID+™ running, then you should use the ActiveX control support. Sample VB projects can be found on the CD in the DMx AutoID+™ Visual Basic Support folder.

If you plan to write a VB program that uses the serial or TCP/IP command support to communicate with the DMx AutoID+™ program that is running on the same PC or a different PC, you can use the Microsoft ActiveX controls MSComm or Winsock for connecting the two programs. In your VB program, once a command is sent in one statement, it is your responsibility to ensure the response of the command is available before its data can be used in your program. In other words, you cannot assume the next statement immediately following the statement for sending a command can use the command response data without first ensuring the data is already available for use. The OLE TCPIP sample code shows how to send a command and process the response data via the function SendCommand.

TCP/IP Support

To write a custom VB program to communicate with the DMx AutoID+™ running in the same or a different PC, you need to use the Microsoft Winsock ActiveX control to enable the custom VB program to establish a TCP/IP connection with the DMx AutoID+™. Once a connection is established, the VB program can send a command to and receive the command response from DMx AutoID+™. The supported TCP/IP commands are listed in Chapter 5, “DMx AutoID+™ Command Set”.

Note: The command TCPIP is not supported as a TCP/IP command.

In the custom VB application, you have the option to set up the TCP/IP protocol as either server or client. By default, the DMx AutoID+™ application is configured as a TCP/IP client. We recommend that you configure the custom VB application as a TCP/IP server. When you create a server application, select a port (LocalPort property of the WinSock Control) on which to listen, and invoke the Listen method. When the DMx AutoID+™ computer requests a connection as a client, the ConnectionRequest event will occur. To complete the connection, invoke the Accept method within the ConnectionRequest event. In DMx AutoID+™, you need to set the Remote Host ID to be the server computer's name or IP address, and the Remote Port to match the Local Port on which the Server is listening.

On the other hand, if you need to configure the custom VB application as a TCP/IP client, you must set the DMx AutoID+™ as a TCP/IP server and select the Local Port on which the Server will be listening. In your client application, you must enter the DMx AutoID+™ computer's name or IP address in the RemoteHost property, and set the RemotePort property to match the Local Port set in the DMx AutoID+™. Then invoke the Connect method.

Note: DMx AutoID+™, as a TCP/IP server, does not support more than one client connection at the present time.

Once a connection has been made, either computer can send and receive data. To send data, invoke the SendData method. Whenever data is received, the DataArrival event occurs. Invoke the GetData method within the DataArrival event to retrieve the data.

TCP/IP Support with OLE

It is not possible to start up the DMx AutoID+™ program from the custom VB application itself using TCP/IP commands alone. DMx AutoID+™ must be already running before the custom VB application can connect to it (or vice versa) via TCP/IP commands. You can ensure the DMx AutoID+™ always starts up automatically by installing it in the Windows Startup folder, or you can start up the DMx AutoID+™ program from the custom VB application using the OLE mechanism when both the DMx AutoID+™ and your VB application are to run in the same PC.

The sample projects on the CD in the \DMx AutoID+™ Visual Basic Support\OLE TCPIP folder use the OLE mechanism to start up and terminate the DMx AutoID+™ application. The rest of communication between the VB application and the DMx AutoID+™ are based on the TCP/IP command for maximum robustness and efficiency.

Use the OLE mechanism to start up the DMx AutoID+™ from your VB application. In Form_Load():

1. Use GetObject to get a reference to the DMx AutoID+™ application object and set it to the object variable m_DmxID.

```
Set m_DMxID = GetObject(, "DMxAutoID.Application")
```

2. Set the TextOut property to a Text Box txtMessage so that the command response data from DMx AutoID+™ will generate the txtMessage_Change event.

```
Set m_DmxID.TextOut = txtMessage
```

3. Use the CommandLine Property to send the OLE command TCPIP to configure the TCP/IP settings of the DMx AutoID+™.

The response data of the TCPIP command is received by the VB application through the txtMessage_Change event. Make sure you get the correct response TCPIP SUCCESS before setting the TextOut property to Nothing. You can now use the SendCommand function to communicate with DMx AutoID+™ in TCP/IP for efficiency and robustness.

To terminate the DMx AutoID+™ program from your VB application, use m_DmxID.Quit and release the reference by setting it to Nothing in Form_Unload().

The function `SendCommand` should always be used for sending a command. If a command is sent successfully and its response is received in time, the function returns `True` and the response data can be further processed in your VB application. If, for whatever reason, no response data is received by the TCP/IP connection within the pre-specific timer timeout value, the function will return `False` and appropriate actions should be taken in your VB application.

To write a VB application that communicates with DMx AutoID+™ on a remote PC, you need to remove all above OLE references and ensure that DMx AutoID+™ can automatically start up with the correct TCP/IP configurations.

ActiveX Control Support

The DMx AutoID+™ software provides support that allows ActiveX container applications to access most of the DMx AutoID+™ functionality including the interfaces. The ActiveX Control support consists of a DMx AutoID+™ configuration and runtime (DMx AutoID Custom) control and image acquisition and display (DMx ImageView) control.

In the `\VB Support\ActiveX` folder of the DMx AutoID+™ installation CD, the `custom1.vbp` sample project shows how to access all of the DMx AutoID+™ functionality supported by the two ActiveX controls. If you write your application based on the `custom1` model, your application will have full access of all configuration parameters. The `custom2.vbp` is a simpler example showing how to use load a configuration job to configure the system and use a few buttons to modify some of the parameters. It also shows how to grab an image or open an image file, learn Data Matrix, run once, and program I/O points. You can use DMx AutoID+™ software to configure the system and generate a job (configuration) file to be used in your `custom2` type of application.

Most of the properties and methods are tied to the current camera and you should always ensure the current camera is set correctly using the `Camera` property. Properties or methods that are only applicable to the current camera are said to be camera dependent. Properties or methods that are not tied to a specific camera are called camera independent and are specifically noted.

In the following descriptions, the square brackets [] indicate that an item is optional. A mask is a string of binary bit patterns in hex format. An enable mask describes an array of check box options for enabled 0300 boards, cameras, barcodes, custom verifier options, symbology debug information, and OCR debug information. The topmost check box corresponds to the LSB and the bottommost to the MSB of the bit mask. For a value over 9, the string format

“&Hx” has to be used where x is the hex representation. For example, to represent a bit pattern of 1010, enter “&HA”. If a string value for a mask is between “&H0” and “&H9”, you can simply use a value between 0 and 9 for a write property. The corresponding read property returns a variant which can be retrieved as a string or long value.

DMx AutoID Custom Control

The DMx AutoID Custom Control is an ActiveX control that provides properties, methods, and events for DMx AutoID+™ system and parameter configurations, image acquisition, learn and read, image/job file open and save, digital I/O control, lighting control, etc.

The remainder of this section describes the following:

- “DMx AutoID Custom Control Properties” starting on page 6-5
- “DMx AutoID Custom Control Methods” starting on page 6-36
- “DMx AutoID Custom Control Events” starting on page 6-56

DMx AutoID Custom Control Properties

The properties exposed by the DMx AutoID Custom Control are listed in the following pages.

ApplicationPath Property

This property passes the current application path to the control. The application path can be useful for opening or saving an image or a job file. This is a write-only property that can be set only at runtime. This is camera independent.

Syntax

Object.**ApplicationPath** = *path*

Description

path: This is the file path that you want the DMx AutoID Custom Control to know as the application path. Typically, you get path using App. Path in VB and set it to the ApplicationPath property.

AssistedLearnEnable Property

The property is a Boolean setting that determines if the assisted learn mode (interactive learn mode) is allowed. This is a write-only property that can only be set at runtime. This is camera independent.

Syntax

Object. **AssistedLearnEnable** = *state*

Description

state:

- True — The interactive learn mode used in Data Matrix assisted learn and learn Fixed Font OCR and Learn Fiducial is allowed.
- False — The interactive learn mode is not allowed. This is the default.

BarcodeCount Property

This property is the Number of Barcodes to Read in the Setup | Parameter | General tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **BarcodeCount** [= *number*]

Description

number:

- 0 — No barcode is allowed to decode.
- 1 ~ 5 — Up to five barcodes can be decoded in the same field of view.

Return Value

A long value ranging from 0 to 5.

BarcodeEnableMask Property

This property is the bit mask of the barcodes enabled in the Setup | Parameter | General tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object.BarcodeEnableMask [= *str*]

Description

str: To enable certain barcodes, set the bits for the corresponding checkbox positions in the General tab accordingly. For example, to enable Code 128, Code 39, and PDF417, you need to set the binary bit mask to 100000011. Enter *str* in the hex value as “&H103”. The *str* ranges from “&H0” to “&H2FFFF”.

Return Value

The mask of enabled barcodes as a string.

BCVerify Property

This property configures barcode verifier mode in the Setup | Parameters | BC Verifier tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **BCVerify** [= *str*]

Description

str: String.

- None — Do not perform barcode verification.
- Overall — Perform ANSI verification and report the overall results.
- Scanx — Perform ANSI verification and report detailed scan result for scan line *x*, where *x* ranges from 0 to 9.

Return Value

A string of None, or Overall, or Scanx.

Camera Property

This property indicates the current camera index that is checked in the View | Camera menu. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object.Camera [= *index*]

Description

index: The current camera index ranges from 1 to 16.

Return Value

A long value ranging from 1 to 16.

CameraCount Property

This property returns the total number of cameras that are checked in Setup | System Configuration. This is a read-only property that can be retrieved in runtime. This is camera independent.

Syntax

Object. **CameraCount**

Return Value

A long value ranges from 1 to 16.

CameraEnableMask Property

This property returns in hex format the bit mask of enabled cameras in Setup | System Configuration. This is a read-only property that can be retrieved in runtime. This is camera independent.

Syntax

Object. **CameraEnableMask**

Return Value

The mask of enabled camera as a string ranging from “&H1” to “&HFFFF”.

CameraResol Property

This property corresponds to Camera Resolution in Setup | System Configuration. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **CameraResol** [= *index*]

Description

index:

- 0: 640x480 for RS170, or 768x572 for CCIR
- 1: 640x240x2 for RS170, or 768x286x2 for CCIR
- 2: 320x240 for RS170, or 384x286 for CCIR

Return Value

Long. Camera resolution index value of 0, 1, or 2.

CameraType Property

This property corresponds to Cameras' Type in Setup | System Configuration. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **CameraType** [= *str*]

Description

str: RS170 or CCIR.

Return Value

String. Camera type of “RS170” or “CCIR”.

CellSize Property

This property indicates the cell size of the Data Matrix in Setup | Parameters | Data Matrix | Advanced box. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **CellSize** [= *size*]

Description

size: The cell size value ranges from 2 to 20 pixels.

Return Value

A long value ranging from 2 to 20.

Cols Property

This property indicates the number of columns of the Data Matrix in the Setup | Parameters | Data Matrix tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **Cols** [= *str*]

Description

str: The *str* is either AUTO or ranges from 8 to 144.

Return Value

A string value of AUTO or that is between 8 to 144.

FormatLabel Property

This property describes the Label separator in the Setup | Parameters | Formatting tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **FormatLabel** [= *str*]

Description

str: The Label separator is a one-character string. The default value is “,”.

Return Value

The label separator as a one-character string.

FormatOCR Property

This property is the bit mask in hex format corresponding to the check boxes in the OCR Debug Report in the Setup | Parameters | Formatting tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **FormatOCR** [= *str*]

Description

str: You can have up to five bits enabled with Timing as the MSB. The *str* ranges from “&H0” to “&H1F”.

Return Value

The mask of the OCR formatting as a string.

FormatPrefix Property

This property is the Prefix in the Setup | Parameters | Formatting tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **FormatPrefix** [= *str*]

Description

str: String. Prefix string.

Return Value

The prefix as a string.

FormatStatus Property

This property describes the Status separator in the Setup | Parameters | Formatting tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **FormatStatus** [= *str*]

Description

str: The Status separator is a one-character string. The default value is “;”.

Return Value

The status separator as a single character string.

FormatSuffix Property

This property is the Suffix in the Setup | Parameters | Formatting tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **FormatSuffix** [= *str*]

Description

str: String. Suffix string.

Return Value

The suffix as a string.

FormatSymbol Property

This property is the hex format of the bit mask corresponding to the check boxes in the Symbol Debug Report in the Setup | Parameters | Formatting tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **FormatSymbol** [= *str*]

Description

str: You can have up to nine bits enabled with Timing being the MSB. The *str* ranges from “&H0” to “&H1FF”.

Return Value

The mask of the symbol formatting as a string.

GrabEnableMask Property

This property is the binary bit mask in hex format of up to four 0300 boards installed. This is a read/write property that can be retrieved and set in runtime. Camera independent.

Syntax

Object. **GrabEnableMask** [= *str*]

Description

str: The frame grabber 1 is the LSB and the frame grabber 4 is the MSB. The *str* ranges from “&H1” to “&HF”.

Return Value

The mask of the enabled 0300 boards as a string.

Remark

By default, the AutoID Custom Control tries to get the control on all 0300 boards available in the system. If you have a good reason to override the default, set the GrabEnableMask to the proper value before the Initialize property is set.

Height Property

This property corresponds to the Height in the Setup | Parameters | Data Matrix tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **Height** [= *str*]

Description

str: String. The *str* is either AUTO or ranges from 20 to 1024.

Return Value

A string value of AUTO or that is between 20 to 1024.

ImageControl Property

Set the property to the DMx ImageView ActiveX Control on your form so that the display of image, graphics, and text can be done automatically by the Control. For example, images obtained from the methods Grab and Live are shown without having to use the ImageDisplay method of the ImageView control, and default graphic drawing and text results are shown in the ImageView control as well for the methods Learn and Read. This is a write-only property that can only be set at runtime. This is camera independent.

Syntax

Object. **ImageControl** = *control*

Description

control: Set the *control* to the ImageView control on your form so that the image, graphics, and text data are automatically displayed when needed. If this optional property is not set, then no display is automatically done for you.

Remark

If there are more than one ImageView controls on your form, only one of them can be assigned to the ImageControl property. To display images for the rest of the controls, you need to use the ImageDisplay method explicitly.

Initialize Property

This property retrieves the software protection key (dongle) status. This is a read-only property that can only be retrieved at runtime. This is camera independent.

Syntax

Object. **Initialize**

Return Value

A long value ranging from 1 to 7.

- If the first bit (LSB) of the return value is 1, symbology (Data Matrix and Barcode) decoding is enabled.
- If the second bit is 1, OCR is enabled.
- If the third bit is 1, the inline verifier is enabled.

KeyCode Property

This property passes the KeyCode obtained by the DMx ImageView Control to the AutoID Custom Control to signal a certain key has been pressed. This is a write-only property that can only be set at runtime. This is camera independent.

Syntax

Object. **KeyCode** = *KeyCode*

Description

KeyCode: The KeyCode is generated by Windows when keyboard is pressed. It is obtained by the DMx ImageView Control and passed to the DMx AutoID Custom Control via the KeyDown event. Only the ESC and SPACE bar keys are allowed.

MatrixCount Property

This property is the Number of Matrices to Read in the Setup | Parameter | General tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **MatrixCount** [= *number*]

Description

number:

- 0 — No barcode is allowed to decode.
- 1 ~ 5 — Up to five Data Matrices can be decoded in the same field of view.

Return Value

A long value ranging from 0 to 5.

PanelClick Property

This property passes the panel item from the DMx ImageView Control to the AutoID Custom Control. This is a write-only property that can only be set at runtime. This is camera independent.

Syntax

Object. **PanelClick** = *item*

Description

item: The *item* is obtained by DMx ImageView Control and passed via the PanelClick event to the PanelClick property of the DMx AutoID Custom Control. There are seven panel items and only the last panel generates a PanelClick event for an item value of 7.

Pol Property

This property corresponds to the Polarity in the Setup | Parameters | Data Matrix tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **Pol** [= *polarity*]

Description

polarity: String.

- DL — Dark on light
- LD — Light on dark
- AUTO — Either dark on light or light on dark

Return Value

A string value of DL, LD, or AUTO.

Rows Property

This property indicates the number of rows of the Data Matrix in the Setup | Parameters | Data Matrix tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **Rows** [= *str*]

Description

str: String. The *str* is AUTO or ranges from 8 from 144.

Return Value

A string value of AUTO or that is between 8 and 144.

VerifyEnableMask Property

This property is the bit mask in hex format corresponding to the check boxes in the Custom Settings in the Setup | Parameters | Verifier tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **VerifyEnableMask** [= *str*]

Description

str: String. You can have up to 10 bits enabled with Cell Size check box option being the LSB. The *str* ranges from “&H0” to “&H2FF”.

Return Value

The mask of enabled verification parameters as a string.

VerifyMode Property

This property corresponds to the Mode in the Setup | Parameters | Verifier tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **VerifyMode** [= *str*]

Description

str: String.

- None — Do not perform Data Matrix verification
- Custom — Perform DPM verification
- AIM — Perform AIM verification standard
- IAQG — Perform IAQG verification standard
- ISO 51415 — Perform ISO 51415 verification standard

Return Value

A string of None, or Custom, or AIM, or IAQG.

Width Property

This property corresponds to the Width in the Setup | Parameters | Data Matrix tab. This is a read/write property that can be retrieved and set in runtime.

Syntax

Object. **Width** [= *str*]

Description

str: String. The *str* is AUTO or ranges from 20 to 1024 pixels.

Return Value

A long value of AUTO or that is between 20 and 1024.

DMx AutoID Custom Control Methods

The methods exposed by the DMx AutoID Custom Control are listed in the following pages.

FileNameQuery Method

Use the `FileNameQuery` method to get the full file path including the file name for image/job file opening or saving. Camera independent.

Syntax

Object. **FileNameQuery** [*strPath*], [*bImage*], [*bSave*]

Description

strPath: String. You have the option to set a file path so that the method will display the file path in the query dialog box.

bImage: Boolean.

- True — Image file. This is the default.
- False — Job file.

bSave: Boolean.

- False — Open file. This the default.
- True — Save file.

Return Value

The full path of the file to be opened or saved as a string. If the Cancel button is entered, an empty string is returned.

CheckString Method

Use the CheckString method to set or get a match string.

Syntax

Object. **CheckString** “*field1* [*field2*]”

Description

- *field1*: Use 1D, 2D or OCR to indicate the match string is for barcode, Data Matrix or OCR.
- *field2*: The *field2* can be ON, OFF, READ or *str*.
 - ON — Enable the match string checking.
 - OFF — Disable the match string checking.
 - READ — Automatically set the match string to the decode data with the next Read method.
 - *str* — Set the match string by type in the match string as *str* here.

Return Value

The match string as a string when *field2* is omitted.

DisableImageSaving Method

The DisableImageSaving method can disable the image saving for failed images. This is useful when you need to stop image saving in the custom program.

Syntax

Object. **DisableImageSaving** *index*

Description

index: Long. Camera index from 1 to 16.

GetImageSize Method

The GetImageSize method can get the image width and height of the current opened or grabbed image.

Syntax

Object. **GetImageSize** *width, height*

Description

width: Long. Image width. Declared as ByRef so that the width value will be obtained.

height: Long. Image height. Declared as ByRef so that the height value will be obtained.

Grab Method

The Grab method can be used for acquiring an image, opening an existing image file as a BMP, TIF, or RAW image files of certain sizes (640x480, 320x240), or uploading an image from the handheld MXi. The method is camera independent when *str* is specified.

Syntax

Object. **Grab** [*path*]

Description

str: String. If no *str* is provided, an image is acquired from the current camera. The optional string is needed for opening an image or uploading an MXi image from one of MXi's four buffers via serial port.

To open an image file, set *str* to the file path including the file name.

To upload an MXi image, set *str* to "MXi *port baud compress mode*" in which:

port is 1 (default) or 2

baud is the baud rate up to 115200 (default)

compress is the approximate compression ratio of 0 (no compression), 4, 8 (default), 16, and 32

mode indicates the image buffer to be uploaded: 0 (captured, default), 1 (decoded), 2 (frozen), 3 (downloaded)

Return Value

The address of the image buffer as a long.

Remark

You can set the ImageControl property to the ImageView control so that the image is displayed automatically.

Learn Method

Use the Learn method to configure Data Matrix, barcode, OCR, or Fiducial finder parameters from the image obtained from the Grab method.

Syntax

Object. **Learn** [*str*]

Description

str: String.

- 1D — learn barcode
- 2D — learn Data Matrix
- OCR — learn OCR
- FIND — learn Fiducial finder

Return Value

The results of the learn as a string.

Remark

To enable learn OCR, FIND or Data Matrix assisted learn, the AssistedLearnEnable property must be set to True.

Light Method

Use the Light method to control multi-axis light.

Syntax

Object. **Light** *axis, level*

Description

axis: Long. Select the axis to control. The axis ranges from 1 to 5.

level: Long. Set the light intensity level from 0 to 99.

Live Method

Use the Live method to display live images.

Syntax

Object. **Live**

Return Value

Long. The address of the last acquired image when the live mode is stopped.

Remark

You must set the ImageControl property to the ImageView control so that the image is displayed automatically. In your VB program, ensure the live mode is stopped by invoking the Live method again before you allow other action.

Load Method

The Load method loads a job file previously saved with the Save method. This is camera independent.

Syntax

Object. **Load** [*jobPath*]

Description

jobPath: String. Specifies the full path of the job file with the extension INI. The extension is not required. If only the file name with no path is supplied, the Load method attempts to load the file with the path specified by the ApplicationPath property. If no job file is supplied, the default configuration settings are loaded.

Return Value

An empty string if the job loaded does not contain a [Boot job] entry, or the full path of the boot job if the loaded job contains a [Boot job] entry.

OptoInput Method

Use the OptoInput method to get the state of an input point.

Syntax

Object. **OptoInput** *point*, [*index*]

Description

point: Long. The GPIO points from 1 to 16 that have been programmed as input by the OptoIOMask method.

index: Long. The 0300 board index from 0 to 3. The default is 0, the first 0300 board.

Return Value

A long value of 0 for state Low or 1 for state high. Attempting to read a write point will result in an error value of -1.

OptoIOEvent Method

Use OptoIOEvent method to configure the input GPIO points so that an event is generated when the state of a configured input point changes. Once the method is invoked, it will not return until some input point changes state.

Syntax

Object. **OptoIOEvent** *mask*, [*polarity*], [*index*]

Description

mask: String. Specify the input GPIO points that will generate an input event. This ranges from “&H0” to “&H3FF”.

Note: Only the first 10 bits can be configured as input points that can generate an event.

polarity: Long. Transition polarity.

- 0 — Low to high.
- 1 — High to low.
- 2 — Either direction generates an event. This is the default.

index: Long. The 0300 board index from 0 to 3. The default is 0, the first 0300 board.

Return Value

A long value of the *index* of the input point whose state has changed. The value ranges from 1 to 16.

OptoIOMask Method

Use the OptoIOMask method to configure the GPIO points to be input or output. This method must be invoked first before other methods OptoInput, OptoOutput, OptoIOEvent can be called.

Syntax

Object. **OptoIOMask** *mask*, [*index*]

Description

mask: String. The mask is a 16 bit value whose LSB corresponds to the first GPIO point. To configure a point to be input, set the corresponding point to 1. For example, to configure all points as input, set *mask* to “&HFFFF”. To configure all points as output, set *mask* to “&H0”. Only the first 10 points can generate an event.

index: Long. The 0300 board index from 0 to 3. The default is 0, the first 0300 board.

Remark

The two input points and four output points are fixed on the Mini Opto I/O board that cannot be re-assigned. The mask for Mini I/O board is “&H20”.

OptoOutput Method

Use the OptoOutput method to set the state of an output point.

Syntax

Object. **OptoOutput** *point, state, [index]*

Description

point: Long. The GPIO points from 1 to 16 that have been programmed as output by the OptoIOMask method.

state: Long. 0 — low, 1 — high

index: Long. The 0300 board index from 0 to 3. The default is 0, the first 0300 board.

Return Value

A long value that's same as state for success or -1 when writing to an input point.

Read Method

Use Read method to decode barcode, Data Matrix, OCR and/or locate Fiducial depending on their configuration. The Read method without the option “On/Off” is equivalent to Run Once while the Read “On” or “Off” are the same as Run Continuously or Stop. If the custom VB program knows when to trigger a read, then the Read method should be used. The method will return decode data immediately if no hardware trigger is configured. When hardware trigger is configured, the Read method will return decode data when the first trigger occurs. The VB program can also perform custom image display, saving, and processing. When continuous hardware triggers are received, and the custom program does not know when a trigger can occur, then the Read “On” method must be used. Once the Read “on” method is invoked, it won't return until the method Read “Off” is used. During the period, whenever a hardware trigger occurs, an image is acquired and decoded, and the decode data is reported using the ReadData event. Camera independent.

Syntax

Object. **Read** [*str*]

Description

str: String. Use “On” to enter Run Continuously mode and use “Off” to stop Run Continuously mode.

Return Value

String. Results for barcode, Data Matrix, OCR decoding or output of the Fiducial finder.

Remark

The Read method may or may not acquire a new image depending on how the Grab New in the system configuration is configured in the job that is loaded into the custom VB program. If the Grab New is checked, then the Read method acquires an image. If the Grab New is unchecked, then the Read method reads the image acquired by the Grab method. The Grab New is checked by default. The Grab New has no effect in Run Continuously mode.

ROI Method

Use ROI method to set or retrieve the region of the interest for Data Matrix, barcode, OCR, or Fiducial finder.

Syntax

Object. **ROI** "*field1* [*field2*]"

Description

field1: Set *field1* to 1D, 2D, OCR, and FIND for barcode ROI, Data Matrix ROI, OCR ROI and Fiducial finder ROI, respectively.

field2: The *field2* is optional. It can be set to CLEAR to configure the ROI to be the full image size, or a string formed by values "left, top, width, height". The values left and top are the x and y coordinates of the upper-left corner, respectively. The values width and height specify the width and height of the ROI.

Return Value

When *field2* is omitted, ROI *field1* returns the ROI string corresponding to the ROI specified by *field1*.

Save Method

The Save method saves the configuration setting to a job file. This is camera independent.

Syntax

Object. **Save** *jobPath*

Description

jobPath: String. Specifies the full path including the name of the job file. If only file name with no path is specified, the file is saved in the application folder.

Return Value

Boolean: True for success, False for failure (for example, when accessing an invalid path).

SaveImage Method

Use the SaveImage method to save the image in the buffer to a BMP file. The image can be acquired by the methods Grab, Live, or Read.

Syntax

Object. **SaveImage** *path*

Description

path: String. The path in the image file path can be obtained from the FileNameQuery method. If only file name with on path is specified, the file is saved in the application folder.

Return Value

Boolean. True for success, False for failure (when accessing an invalid path).

SetROI Method

Use SetROI method to set the extra ROI(s) needed in the interactive learn mode.

Syntax

Object. **SetROI** *type*, [*item*]

Description

type: String. 2D, OCR, FIND.

item: Long.

- 0 — Regular rectangular ROI for 1D, 2D, OCR, or FIND.
- 1 — The Data Matrix outline box for 2D, the training box for OCR, or the template box for FIND.
- 2 — The character box for OCR.

ShowOption Method

Use the ShowOption method to display the dialog boxes in the Setup Menu of the DMx AutoID+™.

Syntax

Object. **ShowOption** *option*

Description

option: String.

- BARCODE — Parameters | Barcode tab.
- BCVERIF — Parameters | BC Verification tab.
- DIGITALIO — Digital I/O Settings dialog.
- DMATRIX — Parameters | Data Matrix tab.
- FINDER — Parameters | Fiducial tab.
- FORMAT — Parameters | Formatting tab.
- GENERAL — Parameters | General tab.
- IMGSAVING — Image Saving dialog.

Note: Delete Old Images at Startup is not supported.

- LIGHTING — Lighting Control dialog.
- MATCHMODE — Checking Modes dialog.
- OCRFIXED — Parameters | Fixed Font OCR tab.
- OUTMESSAGES — Output Messages dialog.
- RETRYMODE — Retry Modes dialog.
- STATWINDOW — Reading Statistics window.
- SYSCONFIG — System Configuration dialog.
- VERIFIER — Parameters | Verifier tab.

Stats Method

Use the Stats method to get or reset the reading statistics.

Syntax

Object. **Stats** [*str*]

Description

str: String. Use RESET to reset the statistics.

Return Value

When “RESET” is omitted, a string of the reading statistics is returned.

DMx AutoID Custom Control Events

The events exposed by the DMx AutoID Custom Control are listed in the following pages.

Error Event

Occurs when an error is detected. This is camera independent.

Syntax

Object_Error (ByVal *nError* As Long)

Description

nError:

- eNCAMCONNECTED — Camera not connected.
- eNCONFIGPRT — Pointer to global config not set.
- eNCREATEIMAGE — Image memory allocation failure.
- eNERROR — Software key not detected.
- eNEXISTFILE — File does not exist.
- eNGRABINSTANCE — 0300 board not instantiated.
- eNSUPPORTFILE — File not supported.
- eNSUPPORTIMG — Image not supported.
- ePORTALRDYOPEN — Port not available, already open.
- eWRONGEXT — Wrong file extension.

ImageSizeChange Event

Occurs when an image of different size is loaded.

Syntax

Object.**ImageSizeChange** (ByVal *width* As Long, ByVal *height* As Long)

Description

width: Image width in pixels.

height: Image height in pixels.

CamEnableMaskChange Event

Occurs when a camera is added or removed from the enabled list.

Syntax

Object **CamEnableMaskChange** (ByVal *camEnablemask* As Long)

Description

camEnableMask: The bit mask formed by the enabled cameras.

CamIndexChange Event

Occurs when the index of the current camera changes.

Syntax

Object.**CamIndexChange** (ByVal *index* As Long)

Description

index: The index of the current camera. It ranges from 1 to 16.

GrabIndexChange Event

Occurs when the 0300 board index changes. The 0300 board index changes when you change a camera index to a new camera that is attached to a different 0300 board.

Syntax

*Object*_**GrabIndexChange** (ByVal *index* As Long)

Description

index: This is the index to the current 0300 board. It ranges from 0 to 3.

ReadData Event

Occurs when the Read “On” method is invoked. If hardware is enabled, the event is fired when a hardware trigger occurs and the associated image acquired and decoded. If hardware trigger is not enabled, the event is fired whenever a decode cycle is completed and decode data is available.

Syntax

Object_ReadData (ByVal *camItem* As Long, ByVal *strData* As String)

Description

camItem: data is decoded from this camera. It ranges from 0 to 15 for cameras 1 to 16.

strData: decode data when barcode is decoded, or output messages programmed in DMx AutoID+™. The output message can be Locate Failure, Decode Failure, Match, MisMatch, Overrun, etc. When message Overrun is received, a number of 1 (for process/buffer overrun) or 2 (for trigger overrun) is also reported.

DMx ImageView Control

The DMx ImageView ActiveX Control provides properties and methods for managing the image display, user input from mouse and keyboard, and managing the status panel. It also provides events so that the user inputs can be passed on to the DMx AutoID Custom Control.

The remainder of this section describes the following:

- “DMx ImageView Control Properties” starting on page 6-62
- “DMx ImageView Control Methods” starting on page 6-68
- “DMx ImageView Control Events” starting on page 6-70

DMx ImageView Control Properties

The properties exposed by the DMx ImageView Control are described in the following pages.

AutoSize Property

The AutoResize property determines if the ImageView Control can be resized. This is a write-only property that can be set in the runtime. This is camera independent.

Syntax

Object. **AutoSize** = *state*

Description

state: Boolean.

- True — Allow ImageView Control to resize.
- False — ImageView Control does not resize. This is the default.

MinHeight Property

The MinHeight property sets the minimum height of the ImageView control. This is used when AutoResize is set to True. This is a write-only property that can be set in the runtime. This is camera independent.

Syntax

Object. **MinHeight** = *height*

Description

height: Long. The height of the view of the ImageView control. The height cannot be less than 64 pixels.

MinWidth Property

The MinWidth property sets the minimum width of the ImageView control. This is used when AutoResize is set to True. This is a write-only property that can be set in the runtime. This is camera independent.

Syntax

Object. **MinWidth** = *width*

Description

width: Long. The width of view of the ImageView control. The width cannot be less than 64 pixels.

MouseEnable Property

Use the MouseEnable property to enable/disable Windows Mouse Move event. This is write-only property that can be set in runtime. This is camera independent.

Syntax

Object. **MouseEnable** = *state*

Description

state: Boolean.

- True — Enable MouseMove event.
- False — Disable MouseMove event.

StatusBarVisible Property

The StatusBarVisible property determines if the status bar in the DMx ImageView Control is shown or not. This is a write-only property that can be set in runtime. This is camera independent.

Syntax

Object. **StatusBarVisible** = *state*

Description

state: Boolean.

- True — Status bar is shown.
- False — Status bar is not shown. This is the default.

DMx ImageView Control Methods

The methods exposed by the DMx ImageView Control are described in the following pages.

GetImageRECTAOI Method

Use the GetImageRECTAOI method to retrieve the Region of Interest (ROI) set by the user and store it into a RECTAOI type.

Syntax

Object. **GetImageRECTAOI** *addr*, [*item*]

Description

addr: Long. The address of the first element of the RECTAOI type.

item: Long. An item of 0 indicates the ROI for 1D, 2D, OCR, or FIND.

SetImageSize Method

Use SetImageSIze method to set the size of the image display window. If the AutoResize property is set to False, the display size will not change even when an image of different size is loaded. If the AutoResize property is set to True, the display size will automatically resize within the constraints set by MinWidth and MinHeight properties. See also the ResizeView event and the GetImageSize method of AutoID Custom Control.

Syntax

Object. **SetImageSize** *width, height*

Description

width: Long. Image width in pixels.

height: Long. Image height in pixels.

DMx ImageView Control Events

The events exposed by the DMx ImageView Control are described in the following pages.

KeyDown Event

Occurs when a key is pressed. Use the KeyDown Event to pass the key code to AutoID Custom Control.

Syntax

Object_KeyDown (ByVal *KeyCode* As Integer, *Shift* As Integer)

Description

KeyCode: Only ESC and SPACE bar are allowed to generate an event.

Shift: Code for control characters. Not used.

MoveAOI Event

Occurs when an ROI (Region of Interest) is drawn within the image display area. You typically retrieve the ROI set by the user using the `GetImageRECTAOI` method and pass the ROI to the AutoID Custom Control using the `ROI` method of AutoID Custom Control.

Syntax

Object.**MoveAOI** (ByVal *item* As Long)

Description

item:

- 0 — Main ROI: Used as the ROI for Data Matrix, Barcode, OCR, and Fiducial Finder.
- 1 — Extra ROI: Used for the OCR Train string box, or Data Matrix outline box in assisted learn, or template box for Fiducial finder.
- 2 — Extra ROI: Used for the OCR character box.

PanelClick Event

Occurs when the status panel in the ImageView control is clicked. You typically pass the user click information to AutoID Custom Control when the event occurs.

Syntax

Object **PanelClick** (ByVal *item* As Long)

Description

item: There are seven panel items on the status panel and only the last panel item can generate a PanelClick event for an *item* value of 7.

ResizeView Event

Occurs when a new image is acquired whose size is different than the previously displayed image and the AutoResize property is set to True.

Syntax

Object_ **ResizeView** (ByVal *width* As Long, ByVal *height* As Long)

Description

width: width of the view in pixels.

height: height of the view in pixels.

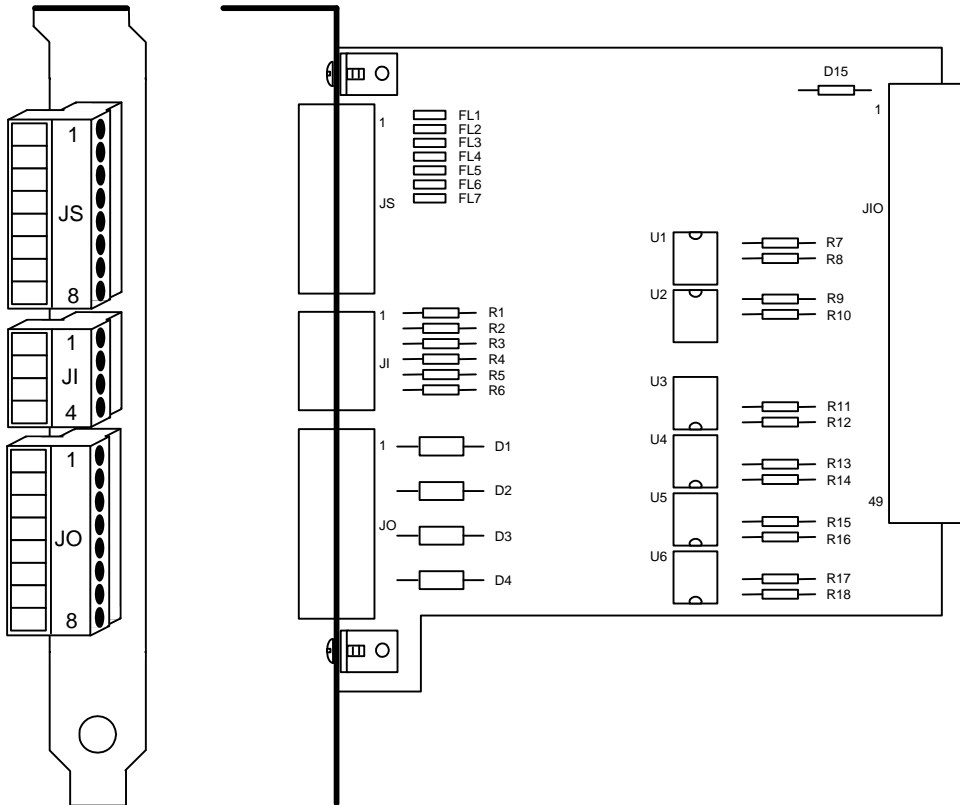
Optional Hardware Installation

Your DMx AutoID+™ system typically comes with the 0300 board for image acquisition. The Combo I/O board interface connector is also included. In order to use the sensor and strobe, you need to purchase the Mini Opto I/O board and/or the Combination I/O board. This section shows the strobe, sensor, and digital I/O connectors of the Mini Opto I/O board and the Combination I/O board. It also illustrates how to connect the strobe/sensor for the two boards.

Mini Opto I/O Board

The Mini Opto I/O board provides two sensor inputs, two strobes, two opto-isolated input points, and four opto-isolated output points.

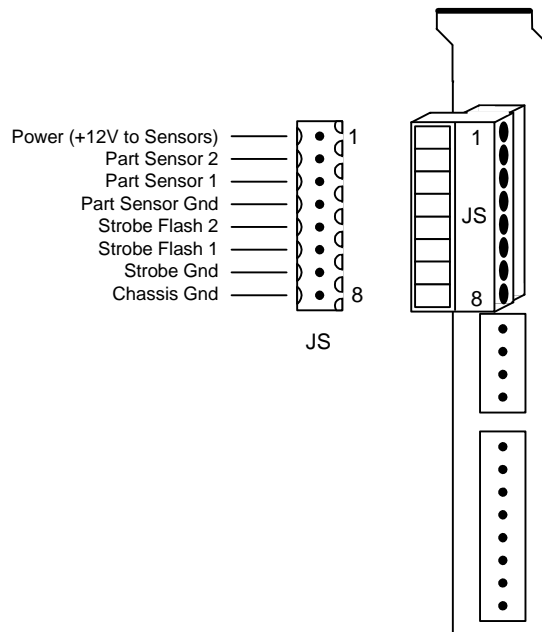
FIGURE A-1. Sensor and Strobes



Sensor/Strobes

The Sensor/Strobe connector JS is supplied with an 8-position mating screw terminal plug. It provides two non-isolated sensor inputs SENSOR1 on pin 3 and SENSOR2 on pin 2, a sensor return on pin 4 and +12V for sensor power SENSOR_PWR on pin 1. Each sensor input can operate from TTL to 30V DC.

FIGURE A-2. JS Connector



The JS connector also provides two non-isolated TTL strobe outputs STROBE1 on pin 6 and STROBE2 on pin 5, a strobe return on pin 7 and a CHASSIS GND on pin 8.

The internal voltage reference signal VREF is connected to SENSOR_PWR on the board, and is used to properly bias the sensor inputs.

For 12V sensors, supply power to your sensor using the sensor power SENSOR_PWR on pin 1 on the sensor strobe connector JS.

For 24V sensors (30 volts maximum), you must provide an external +24V power supply, which also sets the internal reference voltage VREF. Connect external +24V to sensor power SENSOR_PWR pin 1 on connector JS and supply power to your sensor using the sensor power SENSOR_PWR pin 1 on connector JS.

For TTL sensors, do not connect power to the sensor power SENSOR_PWR pin 1 on connector JS. You must remove jumper JMP1 on the Camera I/O Card. This will properly bias the sensor inputs for TTL levels.

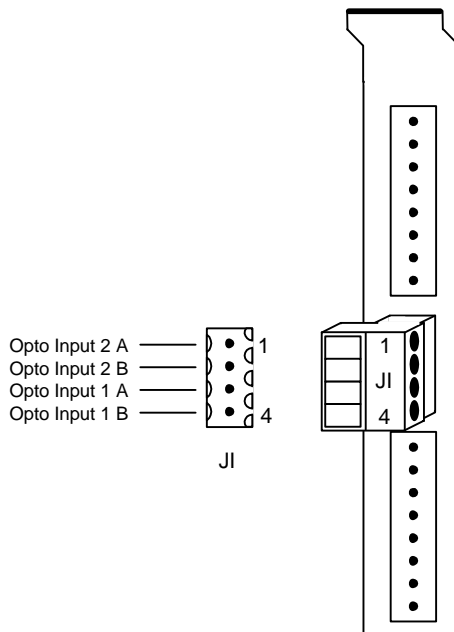
Note: Whenever the Sensor Power pin on JS is less than 12V, jumper JMP1 on the Camera I/O Card MUST be removed.

Caution: If you connect an external power supply that is less than 12V to the sensor power pin on the JS connector, you must remove jumper JMP1 on the camera I/O card. Failure to remove the jumper may cause damage to the mini opto I/O board and the camera I/O card.

Digital I/O

There are two dedicated input and four dedicated optically-isolated output points. The field wiring is terminated on the two screw terminal connectors JI and JO.

FIGURE A-3. JI Connector

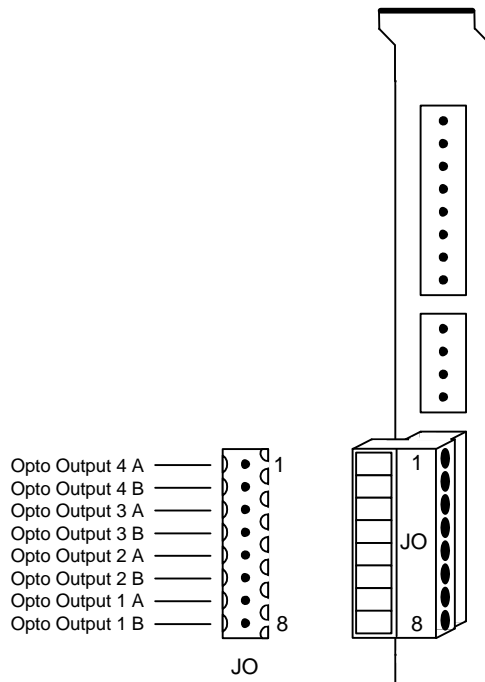


The digital input connector JI is supplied with a 4-position mating screw terminal plug. It provides two bi-directional Opto inputs:

- IN1 on pins 3 and 4
- IN2 on pins 1 and 2

Each input can operate with non-polarized DC signals from 5 to 50 volts with DC currents from 0.5 to 5ma.

FIGURE A-4. JO Connector



The digital output connector JO is supplied with an 8-position mating screw terminal plug. It provides four bi-directional opto outputs:

- OUT1 on pins 7 and 8
- OUT2 on pins 5 and 6
- OUT3 on pins 3 and 4
- OUT4 on pins 1 and 2

Appendix A Optional Hardware Installation

Each output has a contact resistance of less than 20 ohms and can operate with non-polarized AC or DC signals up to 50 volts at 100ma. Each output is protected by a current limiting foldback circuit.

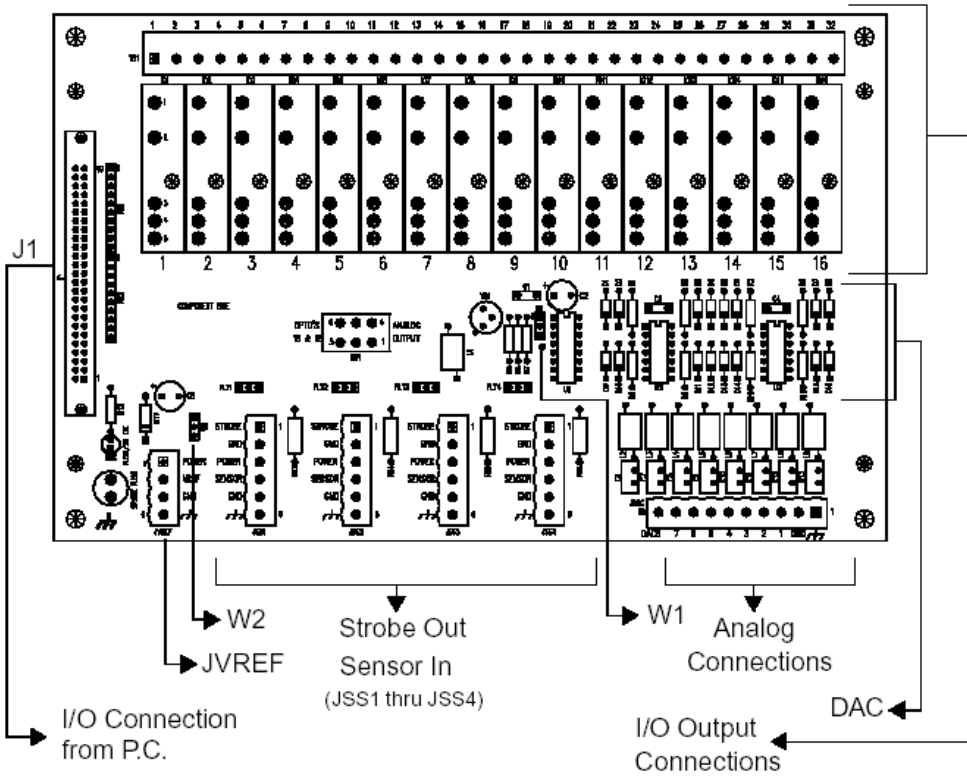
The I/O connector supplies the necessary +5 volts DC to operate the I/O board via the I/O cable. There is no external power supply connector.

Note: Do not attempt to connect an external +5 volts DC power supply to the Mini Opto I/O Board. There is no connector provided for this function. This board receives its power via the I/O cable. Connecting an external power supply will cause serious problems: the two power supplies will conflict with each other to produce unpredictable results and the external power supply's ground may cause ground loops to occur. Contact Customer Service at (603) 598-8400 for assistance.

Combination I/O Board

When more than 2 input or 4 output points are needed, the DMx AutoID+™ system uses the following external Combination I/O board.

FIGURE A-5. Combination I/O Board



Installing the Combination I/O Board & Ribbon Cable

The Combination I/O board can be installed or placed anywhere within reach of its ribbon cable and your opto connections. To install:

1. Place the Combination I/O board on any flat surface. As an alternative, you can permanently mount the board to any flat surface. Secure with four customer-supplied # 4 x 1" screws.
2. Connect one end of the ribbon cable into J1 of the Combination I/O Board and the other end into the I/O Port Interface Connector at the rear of your PC.

Note: Be careful not to bend the connector pins.

Strobe/Sensors

There are four Sensor/Strobe connectors, one for each camera, JSS1 thru JSS4. Each connector is supplied with a 6-position mating screw terminal plug and provides a strobe output labeled STROBE, a sensor input labeled SENSOR, and +12V for sensor power labeled POWER.

There is a voltage reference connector JVREF. This connector is supplied with a 4-position mating screw terminal plug and provides a reference voltage input labeled VREF, which is used to properly bias the sensor inputs and an input for sensor power labeled POWER.

For 12V sensors, supply power to your sensor using the sensor power pin POWER on the sensor strobe connectors JSS1 thru JSS4. You must connect the +12V to the reference voltage pin VREF on connector JVREF. In order to connect +12V to VREF, you must do either of the following:

- Set jumper W2 to positions 1 and 2 (factory set)
- Wire VREF to POWER on connector JVREF.

For 24V sensors, you must provide an external +24V power supply in one of two ways:

- Connect external +24V to sensor power pin POWER on connector JVREF and supply power to your sensor using the sensor power pin POWER on the sensor strobe connectors JSS1 thru JSS4. You must connect +24V to the

reference voltage pin VREF on connector JVREF. In order to connect +24V to VREF, you must do either of the following:

- Set jumper W2 to positions 1 and 2 (factory set)
- Wire VREF to POWER on connector JVREF.
- Wire external +24V to your sensors. You must connect +24V to the reference voltage pin VREF on connector JVREF. In order to connect 24V to VREF, you must wire external +24V to VREF on connector JVREF.

For TTL sensors, set jumper W2 to positions 2 and 3, VREF will default to TTL levels and remove jumper JMP1 on the Camera I/O Card.

Note: Whenever the External Reference Voltage or the Sensor Power pins on JVREF are less than 12V, jumper JMP1 on the Camera I/O Card MUST be removed. Removing this jumper will disable the analog outputs.

Caution: If you connect an external power supply that is less than 12V to the sensor power pin or VREF pins on the JVREF connector, you must remove jumper JMP1 on the camera I/O card. Failure to remove the jumper may cause damage to the combination I/O board and the camera I/O card.

Digital I/O

Sixteen (16) positions are available for industry-standard G4 type, optically-isolated input or output modules. The field wiring to these modules is terminated on the barrier strip TB1. Ports 1 through 16 may be configured as either inputs or outputs.

The Combination I/O Board accepts only 5-volt-logic solid-state relays (G4 Opto modules). The I/O connector supplies the necessary +5 volts DC to operate the I/O board through the I/O cable. There is no external power supply connector.

Note: Do not attempt to connect an external +5 volts DC power supply to the Combination I/O Board. There is no connector provided for this function. This board receives its power through the I/O cable. Connecting an external power supply will cause serious problems: the two power supplies will conflict with each other to produce unpredictable results and the external power supply's

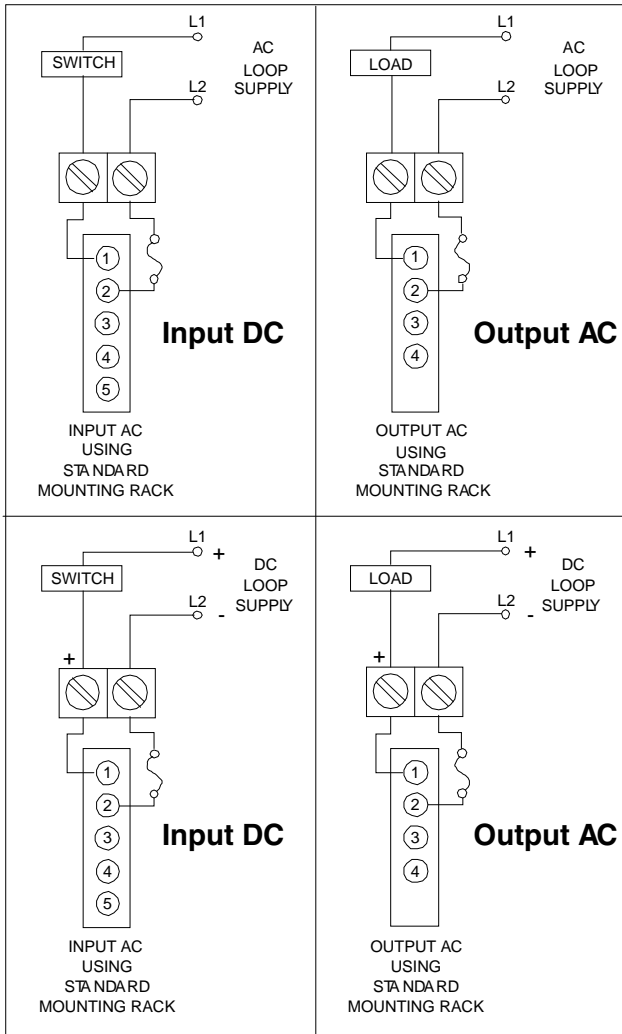
ground may cause ground loops to occur. Contact Customer Service at (603) 598-8400 for assistance.

In designing your reading application, you must decide which mix of input and output modules and which voltage and current levels you require.

Each opto module has two associated screw terminals. Wire them according to the manufacturer's recommendations and your company's electrical standards. Typically, one side of all input modules connect to the hot power terminal with input devices (e.g., switches) wired between the other contact and the common terminal. Output modules are often wired to the common terminal, with loads returning to the hot terminal.

Four sample wiring diagrams for: Input AC, Output AC, Input DC, and Output DC Opto modules are shown in the figure below. Note that correct polarity is critical for DC modules. The odd-numbered terminals on the I/O board are positive (+) and the even-numbered terminals are negative (-).

FIGURE A-6. Four Sample Wiring Diagrams



This gives you access to a combination of up to 16 input or output modules.

Connecting Sensor & Strobe

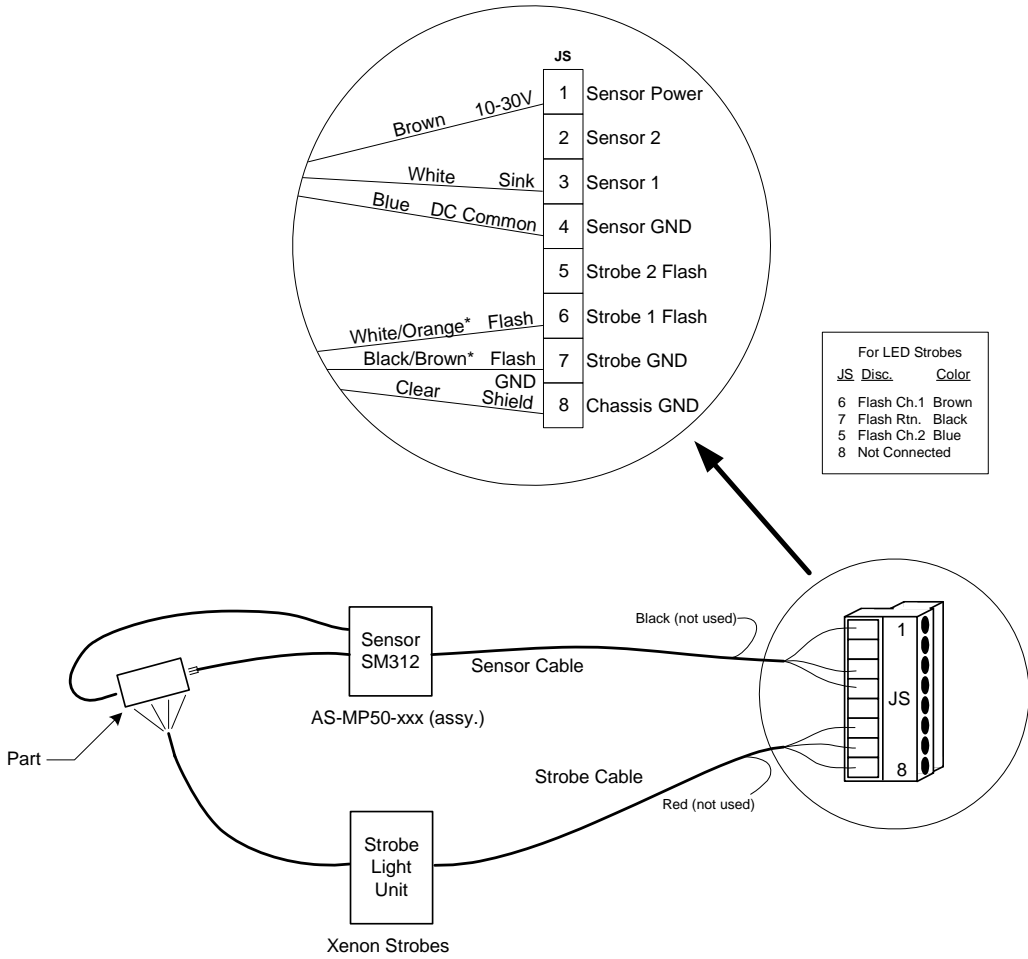
For continuous motion or high-speed indexing applications, a sensor and strobe will be required to freeze each part before the image can be acquired. The strobe unit may include a fiber-optic light pipe.

When choosing your part sensor, you must consider the time interval between the part passing into the sensing zone and an electrical signal being generated. When there is a large variation in process speed, considerable apparent motion of the part within the FOV may result. The DMx AutoID+™ Express system can compensate for this motion over a considerable range. However the sensor should be fast enough to minimize this apparent shift.

Mini Opto I/O High Speed Sensor And Strobe Connections

Figure A-7 illustrates how to connect a part sensor and strobe to the JS connector of the Mini Opto I/O board.

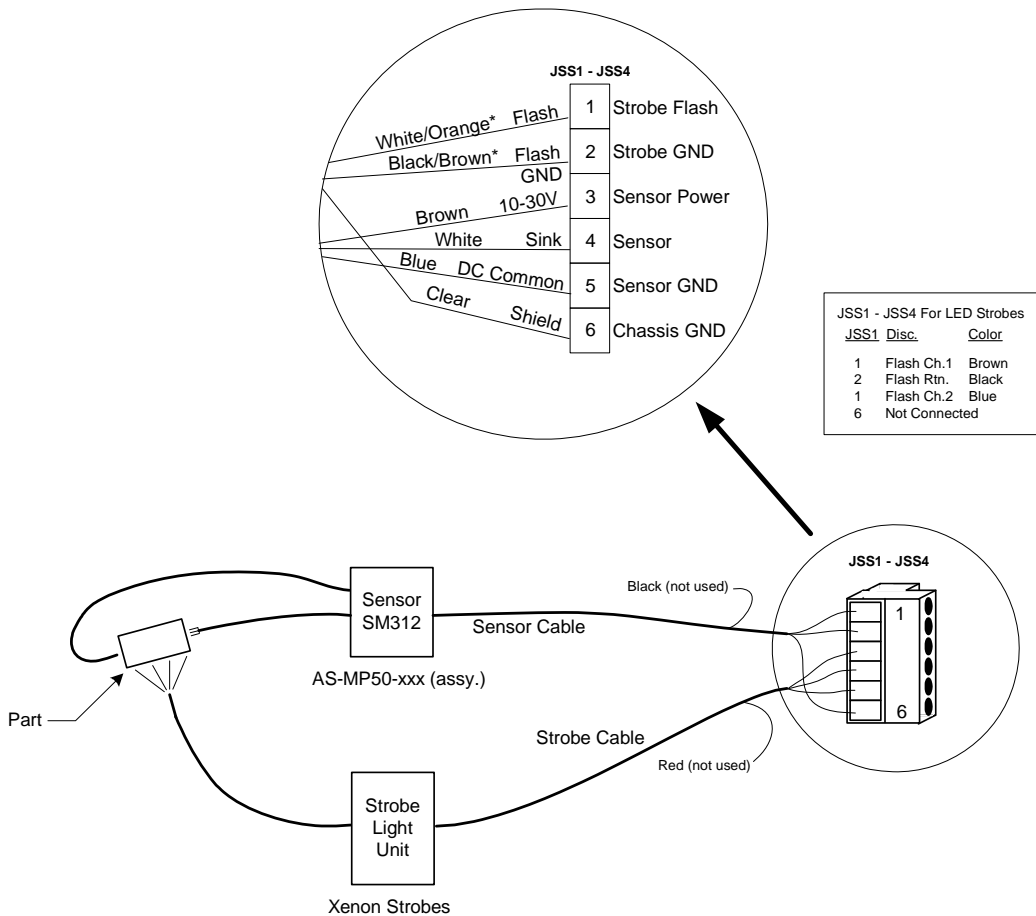
FIGURE A-7. Connecting Part Sensor and Strobe to JS Connector



Combination I/O High Speed Sensor & Strobe Connections

This following figure illustrates how to connect a part sensor and strobe to the JSS1 - JSS4 connectors of the Combination I/O board.

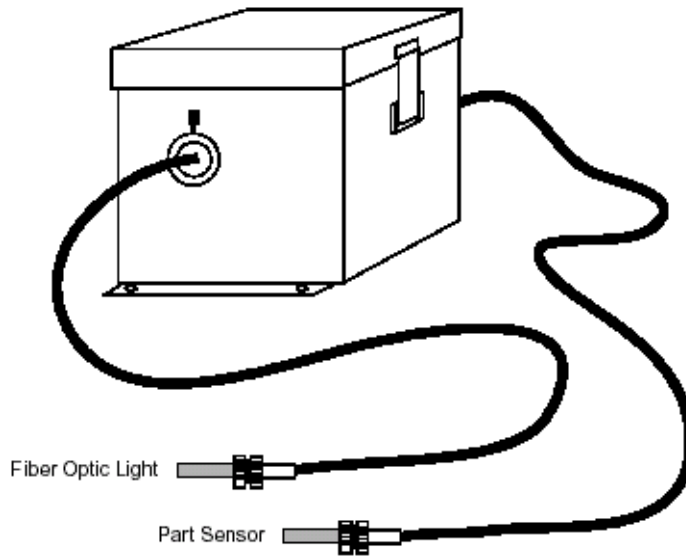
FIGURE A-8. Connecting Part Sensor and Strobe to JSS1 - JSS4



Strobe Unit Example

The following is a typical strobe light unit.

FIGURE A-9. Strobe Unit



Creating A Good Image

This appendix provides guidance on creating a good image.

Overview

To successfully use your 0300 board, you must know how to obtain a clear, precise image of the part and features you want to inspect. Factors that contribute to obtaining a good image include:

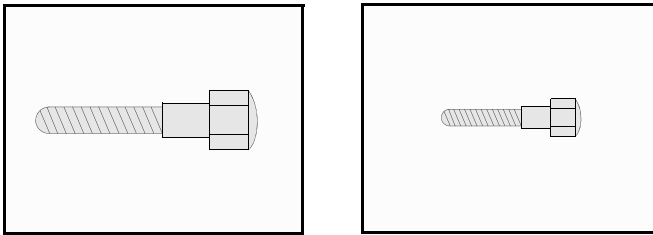
- Determining the Field of View (FOV)
- Selecting a lens
- Illuminating the part
- Advanced lighting
- Aperture
- Depth of Field
- Lighting tips

Determining the Field Of View (FOV)

Determining the best Field of View, that is, the area viewed by the camera, is your first consideration before setting up a camera for your application. The object of interest should appear as large as possible in the Field of View. The Field of View should clearly show the level of detail you want to see while ensuring that the part to be inspected is always seen by the camera.

The general rule is to fill the Field of View with the part you are inspecting, leaving enough space around the part to compensate for part positioning. This provides a superior image of the part and regions of interest for the system to see. In Figure B-1, the image on the left provides more detail, and thus a more desirable image than the one on the right.

FIGURE B-1. Fields of View



Selecting Lens

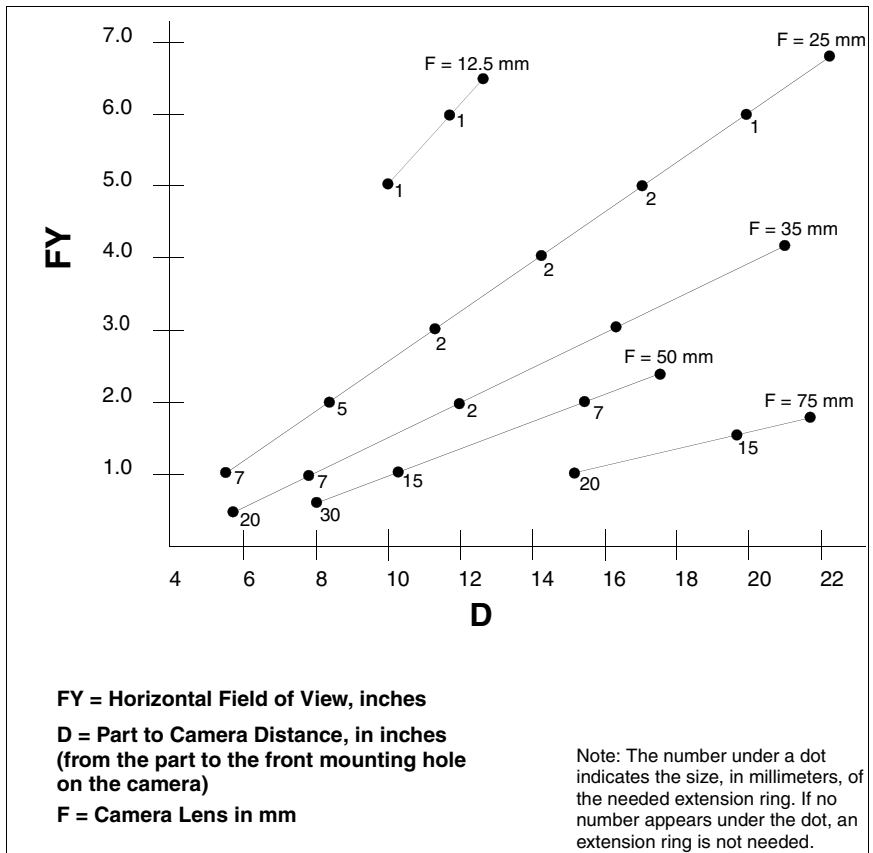
Selecting a lens is one of the most critical factors for obtaining a good image.

Lenses used for 35 mm SLR cameras are preferable for use with the 0300 board camera than standard C-mount lenses when performing accurate measurements. Lenses for 35 mm SLR cameras are more optically accurate and therefore, more expensive. However, they are larger than C-mount camera lenses and may cause a problem in mounting a camera in a particular enclosure.

To use a 35 mm SLR camera lens with your 0300 board camera, you need to use a C-mount to F-mount adapter.

Use the Lens Selection Chart, Figure B-2, to determine the lens size. As a general guideline, lenses that have a longer focal length make the object appear closer (larger) and show less of the background. For example, a 50 mm lens has a longer focal length than a 25 mm lens.

FIGURE B-2. Lens Selection Chart



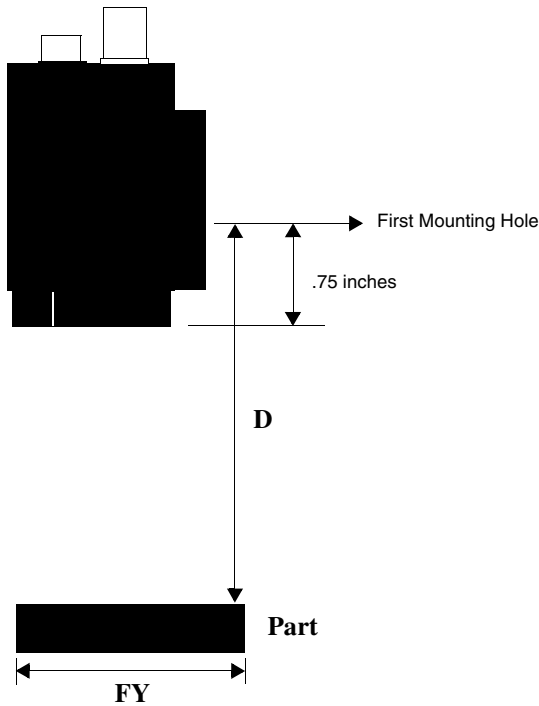
B
Creating A Good Image

Using the Lens Selection Chart

The Lens Selection Chart helps you choose the appropriate lens using *approximate* dimensions. For very precise measurements, you may need to use a precision, low-distortion lens. Contact Microscan Technical Support for a recommendation that is specific to your measurement task (see the inside front cover for more information).

First, determine the required *horizontal Field of View* (FY). Use a dimension of *0.75 inches* from the front of the camera to the *first mounting hole*, as shown in Figure B-3. Next, measure the distance from the part to the *first mounting hole* on the camera (D).

FIGURE B-3. Determining Lens Selection



Select a lens using the Lens Selection Chart. The chart also indicates if you need an extension ring. An extension ring decreases the distance from the lens to the part and causes a smaller Field of View.

Illuminating the Part

Proper illumination of the part is a critical factor influencing the effectiveness of the inspection operation. There is no absolute procedure to follow. However, the following basic lighting concepts, combined with some experimentation, will help you create good lighting.

Note: Never rely solely on ambient lighting. Always use task lighting designed for your application.

Lighting Considerations

The following features should be considered when selecting a lighting scheme to illuminate a part for vision analysis.

- **Surface Characteristics** — Surface characteristics, as they relate to light, is a critical element when selecting the correct lighting type. The type of surfaces listed below and their color must be considered before purchasing your illumination style.
 - Textured
 - Reflective
 - Diffuse
 - Absorptive
 - Color
- **Geometry** — The geometry may determine the direction of the illumination. Will the complete item require illumination?
- **Size** — The size of the part will determine the size of the light.
- **Region of Interest (ROI)** — How will the ROI compare to the rest of the part.

Types of Lighting

The advent of advanced lighting has provided a wider assortment of effective illumination types. This section summarizes some of these lighting considerations, including: basic vs. advanced, diffused, and point-source lighting option;, polarizers and light source placement. We highly recommend that you contact an illumination authority for complex lighting applications.

- **Basic Illumination**
 - Fluorescent
 - Incandescent
 - Laser
 - LED (Light Emitting Diode)

- Strobe
- Accessories
 - Fiber Optics
 - Diffusers
 - Beam Splitters
- Advanced Illumination
 - DOAL™
 - CDI™
 - SCDI™
 - MV_i™

Fluorescent Versus Incandescent Lighting

Preference for using fluorescent lighting, as presented in Table B-1, or incandescent lighting, as presented in Table B-2, depends on several factors. However, the general rule should be to use fluorescent lighting whenever possible.

TABLE B-1. Fluorescent Lighting

Positive Features	Negative Features
Diffuse	Flickering light
Usually easy to mount	Lack of intensity
Long life	Light output decays with age
Inexpensive	
Creates little heat	

Note: Fluorescent lighting tends to be diffuse and not concentrated on a part. If the part is being magnified by a lens or if the lens aperture is small (stopped down), you may find the light level insufficient.

TABLE B–2. Incandescent Lighting

Positive Features	Negative Features
High intensity	Shorter life than fluorescent
Inexpensive if you use home light bulbs	Expensive if fiber-optic lights are used
No flicker	Source of infrared light ^a
Light output constant over life of bulb	Creates excessive of heat ^b

a. It is usually necessary to place an infrared filter in front of the camera lens when using an incandescent light source. The camera has a high sensitivity to infrared light which reduces the contrast and resolution found in an image.

b. If you use fiber optics, the part being illuminated is not heated. If you use conventional bulbs, the part being inspected may get hot.

Lasers

A laser is an excellent source of light when you need to:

- Illuminate a small area
- Create a structured lighting effect
- Create a three-dimensional simulation, for example, measure depth

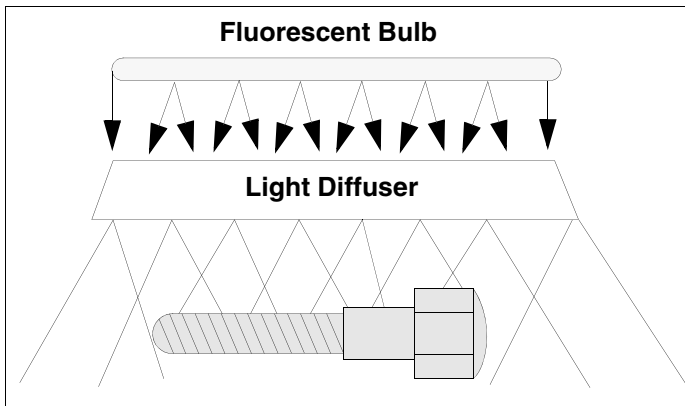
Strobe Lights

Use a strobe light when you need to freeze the image of a moving part. Strobes provide a very short-duration, high-intensity light. In most cases you should use fiber optics to project the light to the required area.

Diffuse Versus Point-Source Lighting

Diffuse light, as shown in Figure B–4, casts no shadows, minimizes glare, and appears to originate from no particular direction. Most inspection applications work best with diffuse light.

FIGURE B-4. Diffuse Light

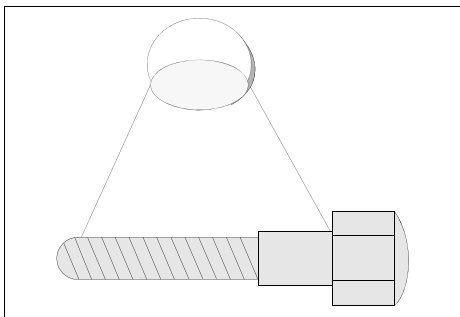


Good sources of diffuse light include:

- Fluorescent ring lights
- Long fluorescent bulbs with or without diffusers

Point-source lighting, as shown in Figure B-5, casts very strong shadows. This is desired when the presence or absence of a shadow can reveal information about the presence of depth. Point sources are effective for revealing surface defects.

FIGURE B-5. Point Source Light



Good point-source lights include:

- Incandescent spot lights
- Fiber-optic sources

- Unfrosted incandescent light bulbs
- Strobe lights

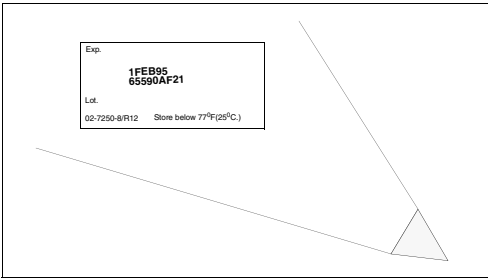
Placement of Light Sources

There are three basic light source positions: front, side, and back.

Front Lighting

Front lighting is good for the inspection of flat, two-dimensional surface features, such as a label, as shown in Figure B-6.

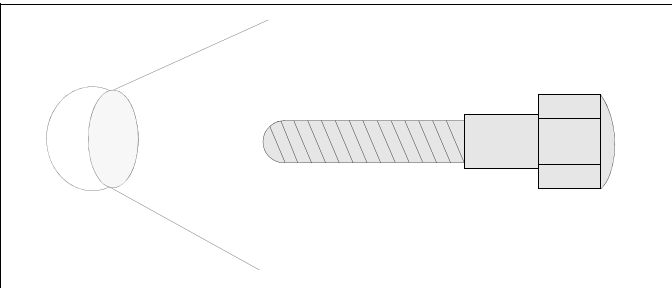
FIGURE B-6. Front Lighting



Side Lighting (Dark Field)

Side lighting helps to highlight three-dimensional features and surface imperfections, and reveals subtle details, as shown in Figure B-7.

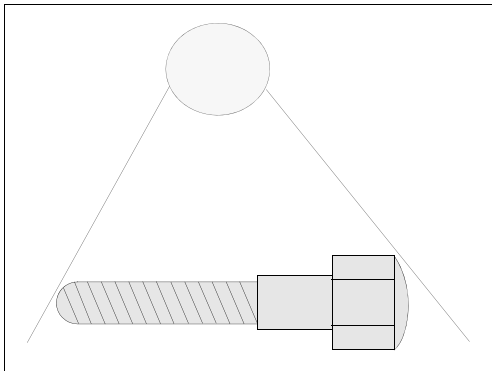
FIGURE B-7. Side Lighting



Back Lighting

Back lighting helps in the inspection of silhouettes, e.g., the outer edges of a part. It enhances the contrast between the part and the background. Think of Contrast refers to the grayscale variation between two areas. Back lighting is helpful in the inspection of holes, cutouts, and outline dimensions, as shown in Figure B–8.

FIGURE B–8. Back Lighting

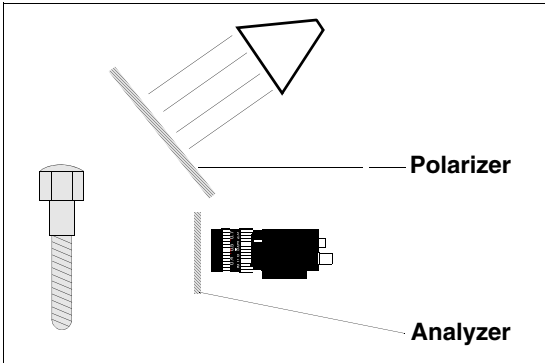


Polarized Light

Polarized light helps reduce glare on an object when the glare interferes with a visual inspection, such as when attempting to read a label.

To polarize light, place polarizing material over the light source, as shown in Figure B-9. Another piece of polarizing material (an analyzer) is placed in front of the camera lens and rotated until the glare, or mirror-like reflection, is minimized.

FIGURE B-9. Polarized Light

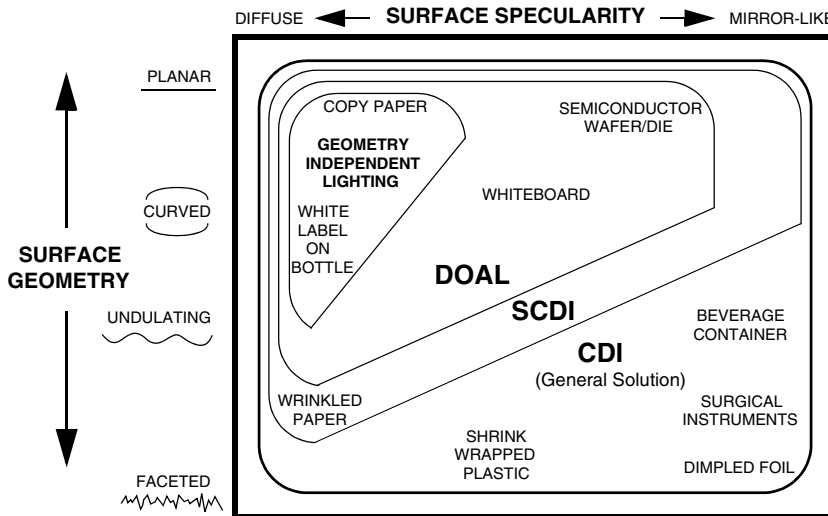


For some applications glare may be helpful and you would not want to eliminate it. For example, a hole in an object may be more easily detected on a surface that has glare. In all cases, you will want to adjust the rotation of the polarizing material to maximize the image contrast of the features you wish to inspect.

Advanced Lighting

NER is a recognized leading provider of lighting systems designed specifically for machine vision applications, as shown in Figure B-10. These products allow machine vision systems to perform reliably in difficult imaging applications involving highly reflective or uneven surfaces.

FIGURE B-10. Lighting Solutions for Image Absorptive Features



To address your lighting application issues, contact NER at:

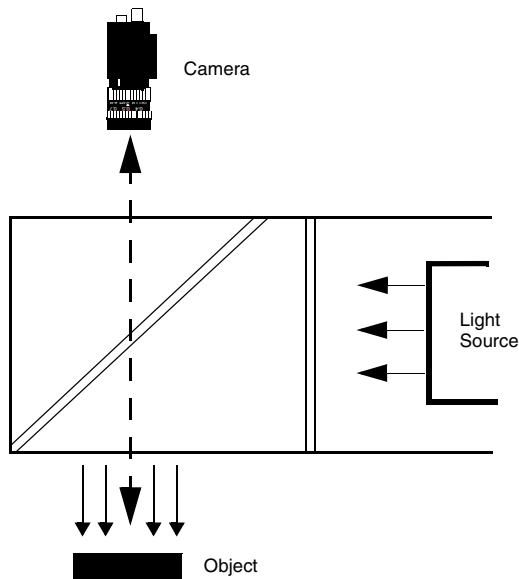
Microscan, Inc.
 486 Amherst St.
 Nashua, NH 03063
 Tel. 603-598-8400
 Fax 603-577-5976

DOAL

Ideal for flat specular surfaces. Diffused On-Axis Lighting (DOAL), as shown in Figure B-11, provides more than 300% greater angular coverage of the lighting envelope than a similarly sized fluorescent ring light. DOAL can be used at a distance to provide uniform wide-angle collimated illumination for imaging highly specular flat surfaces.

- Superior uniformity
- Significantly enhances image quality
- Improves the accuracy and repeatability of machine vision performance on specular surfaces
- Illumination sources include LED, fiber-optic and micro-fluorescent sources
- Flexible light-field / dark-field illumination characteristics depending on distance to target

FIGURE B-11. Diffused On-Axis Lighting

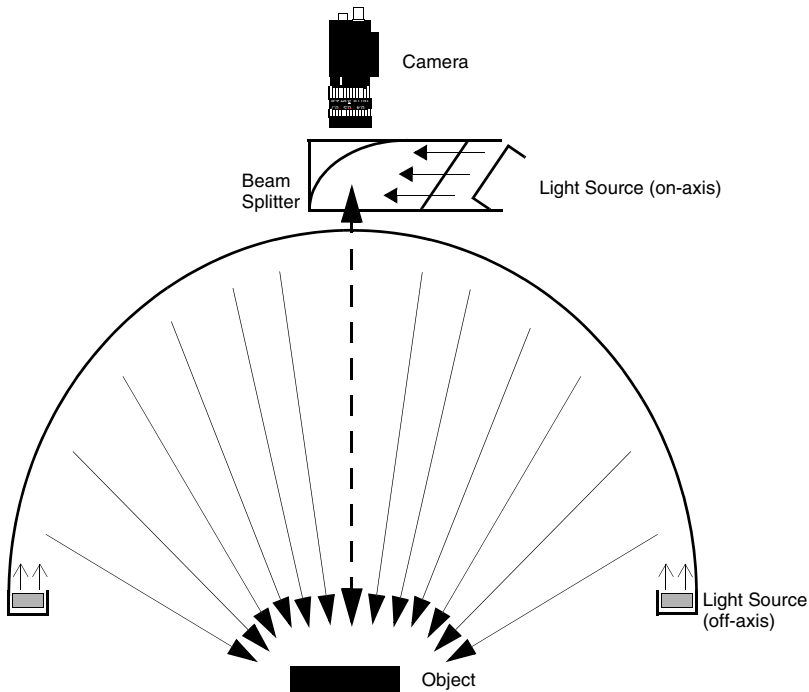


CDI

Ideal for very uneven specular surfaces. Continuous Diffuse Illumination (CDI), also known as Cloudy Day Illumination, as shown in Figure B–12, provides a hemisphere of diffuse, uniform illumination. The complete lighting envelope generates even lighting from all directions. The use of a curved beam splitter completes the horizon-to-horizon illumination. On-axis and off-axis lighting is controlled separately to ensure that uniformity remains in balance.

- Outstanding uniformity up to $\pm 10\%$ maximum deviation within the lighting envelope
- Illumination sources include LED, fiber-optic and white microfluorescent sources

FIGURE B–12. Continuous Diffuse Illumination

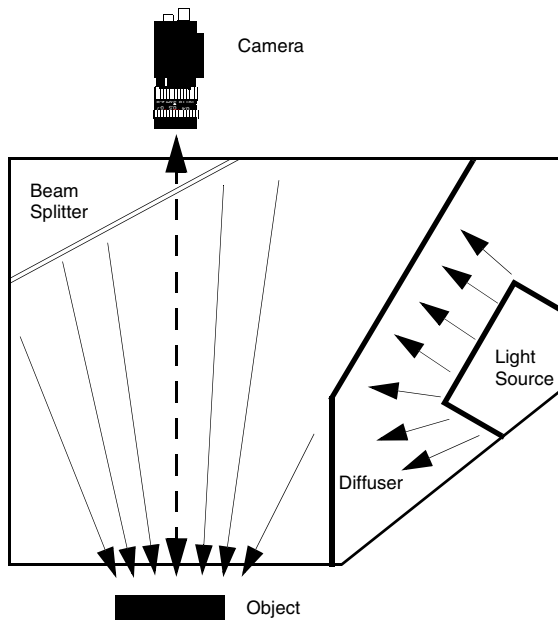


SCDI

Ideal for uneven specular surfaces. Square Continuous Diffuse Illumination (SCDI), as shown in Figure B–13, increases the uniformity of on-axis illumination by ensuring direct light from the diffuser is equally intense as light coming from the beam splitter and the lighting cavity. Increasing the diffuser width and elongating the chamber ensures any light directed to the object is uniform.

- Excellent uniformity $\pm 20\%$ across the lighting envelope at close range
- Extraordinary diffuse illumination
- Illumination source include LED and microfluorescent sources

FIGURE B–13. Square Continuous Diffuse Illumination



MVi Imager

Integrated system for enhanced ease of use. The MVi Imager integrates camera, lens, and light combination (machine vision imaging). As a result, these consolidated components cannot be improperly adjusted by operators or line technicians.

Aperture

The aperture is the adjustable opening in a lens that varies the amount of light reaching a target.

The f-stop indicates the size of the opening. The larger the number, the smaller the opening.

As you go from a smaller number to the next larger one, e.g., 11 to 16, the amount of light reaching the target in the camera is reduced by one-half.

The best image is obtained at the higher f-stops settings however, the aperture is smaller and less light enters the lens. You will have to experiment with the aperture setting to obtain the best image for your application and lighting.

Depth Of Field

Depth of field is the size of the front-to-back distance that is in focus. The aperture opening is the most important influence in determining the depth of field:

- When using a *small* aperture (high f-stop number), much of the area, both in the foreground and background of the object, will be in focus. More light is required when the aperture is small. This provides greater depth of field and reduces the effects of ambient light.
- When using a *large* aperture, the object is in focus, but the areas in the foreground and background of the object are out of focus.
- Many lenses are accompanied by an information sheet detailing depth of field at various F-stop settings and working distances.

Lighting Tips

- To light a round part, try using a round light source which provides even lighting on the inspected parts, such as CDI (Cloudy Day Illumination).
- Experiment with different light positions and sources until you find the best illumination for your part.
- If you place a point-source light close to the part, you will likely produce a harsh glare with black shadows.
- To *fill in* (minimize) shadows, use lighting sources with a diffuser, such as CDI.
- Your lighting should be much brighter than the room in which the inspection is taking place.
- It is often best to light the environment, *not* the part.
- An enclosure around the inspection station will minimize the impact of ambient light as well as protect lights and cameras.

Lighting provides a clear image that is not too bright or too dark and enables the 0300 board to identify the desired features and characteristics. Refer to Table B-3 for additional lighting information.

TABLE B-3. Additional Lighting Information

Lighting Type	Hardware Required	Representative Applications
EVEN - FRONT (DIFFUSED)		
Band	Fluorescent Tube - Straight or Circular	Simplest general purpose lighting. Always try first.
Zone	Diffuser Plate or Reflecting Panel DOAL CDI SCDI	Detect broken microscope slides.
POINT - FRONT		
Point Source	Fiberlight or Incandescent DOAL CDI SCDI	Use where high intensity lighting is required on small area. Also for shadow fill-in and general lighting touch-up.

TABLE B-3. Additional Lighting Information (continued)

Lighting Type	Hardware Required	Representative Applications
Multiple Point Sources	Multiple Fiberlights or Incandescents DOAL CDI SCDI	Symmetrical high-intensity illumination of microscopic fields-of-view such as electronic components.
EVEN - BACK		
Backlighting	Light Box or Uniform Surface	Dimensioning highly reflective parts, inspecting contours of parts with highly variable surfaces.
STRUCTURED		
On-Axis	DOAL Beam - Splitter	See flat dark reflective surfaces. Front-light deep holes.
Light Line	Laser with Cylinder Lens	Relative height measurements of surfaces. Non-contact gaging.
SPECIAL EFFECTS		
Polarizing	Polarizing on Light Sources and Lens	Minimize glare and variable glints on top-lit reflective surfaces
Color	Interference and Gelatin Filters	Discriminate copper and steel. Make variable colored parts appear more similar to camera.
Strobe	Strobe Source and Synch Box	Use wherever part moves more than one pixel in 17 milliseconds.

Data Matrix Symbology

This appendix describes the Data Matrix Symbology.

Data Matrix Certification

Data Matrix has been certified by AIM-USA and AIM-International as a fully public-domain symbology. AIM stands for Automatic Identification Manufacturers International, Inc. It is located on the Internet at <http://www.aimi.org/bib4.htm>, which provides the complete specification.

Data Matrix has also been selected as a standard for 2D marking by a majority of industry organizations such as Semiconductor Equipment & Materials International (SEMI), Electronics Industries Association (EIA), Air Transport Association (ATA), and Automotive Industry Action Group (AIAG).

What Is Data Matrix

The Data Matrix is a unique machine-readable symbol capable of storing a large amount of information within a small physical size. Examples are shown in Figure C-1.

FIGURE C-1. Data Matrix Examples



The Data Matrix symbology allows for two-dimensional encoding and decoding. For the first time, users are no longer constrained by the limitations of a printed symbol. Now, with the Data Matrix symbology, users have the ability to:

- Select output size ranging from 0.001 square inches to 14 square inches, regardless of the amount of data encoded.
- Encode up to 3116 numeric characters or 2335 alphanumeric characters in a single symbol.
- Encode and read many supported international languages.
- Easily integrate with existing computer systems.

Data Matrix symbols are capable of carrying 25 to 100 times more information than the typical barcode. This range is directly related to the image quality that the printer is capable of producing.

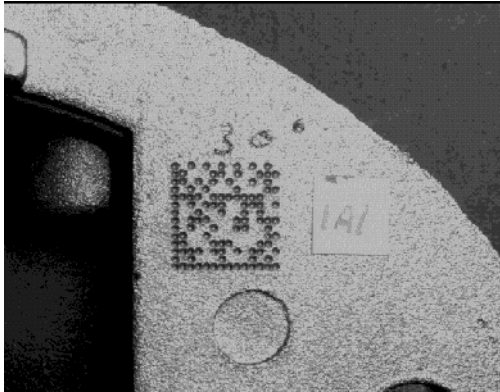
The following summarizes characteristics of 2D Data Matrix:

- Both height and width encode data.
- Works with contrast as low as 20%.
- Readable through 360° of rotation.
- Designed to survive harsh industrial environments.
- Codes can be marked on the surface of a part, without using a paper label.
- Every DM code is half black and half white to help ensure that cell damage will not harm readability.
- Several error correction schemes are available to optimize symbol damage recovery.

- Advanced image processing is used for higher read rates of cluttered and/or damaged symbols.

Figure C-2 illustrates a Data Matrix on an actual part.

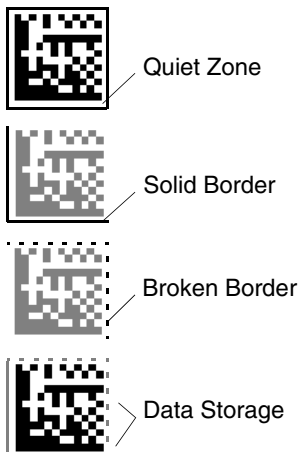
FIGURE C-2. Data Matrix Example



Data Matrix Components

Data Matrix consists of a solid border, a broken border, a data storage area, and a quiet zone, as shown in Figure C-3.

FIGURE C-3. Data Matrix Components

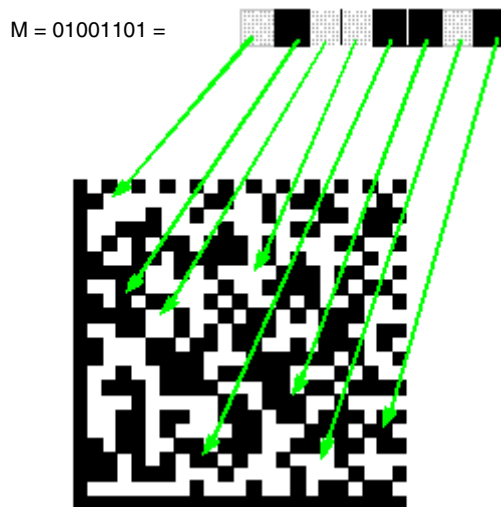


The DMx AutoID+™ uses the solid border to calculate the rotation of a Data Matrix symbol. The DMx AutoID+™ uses the broken border to identify the number of rows and columns in a symbol. The data storage area contains the binary information that was encoded during the construction of the Data Matrix.

The data storage area is illustrated in Figure C-4, showing how data is stored in 8-bit format. Each encoded data character can be represented by an 8-bit binary code. The character *M*, for example, is *01001101*:

- 1 — Dark cell
- 0 — Light cell
- *M* — Stored in the Data Matrix, as shown in Figure C-4

FIGURE C-4. Data Matrix Storage



The Quiet Zone is a clear white space surrounding the Data Matrix, without clutter or text of any kind. The width of the quiet zone must be at least the size of one cell. The quiet zone should be at least 10% of the width or height of the symbol in order to achieve an optimum read rate.

Data Matrix Error Correction

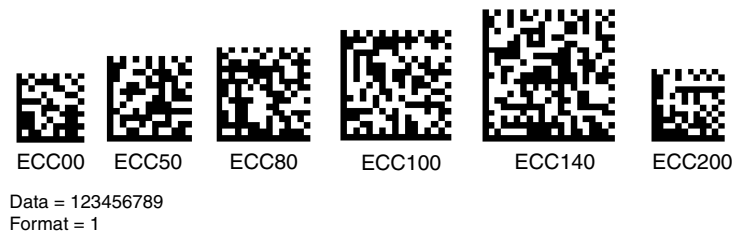
Error correction provides safeguards and additional capabilities for handling poorly printed or damaged symbols. Error Correction Codes (ECC) are selected by the user when encoding the Data Matrix symbol. Data Matrix is the only symbology which offers both Reed-Solomon (ECC 200) and Convolutional error correction codes (ECC 000-140). Reed-Solomon is a byte-correcting scheme preferred for block damage recovery. Convolutional code is a bit correcting scheme preferred for random damage recovery. With the proper choice of Error Correction Code for a given environment, a high rate of decoding can be achieved.

In Convolutional code, as the ECC level increases, data redundancy is added to the Data Matrix symbol, as well as increased overhead (OVHD) in ECC 000-140. Additionally, as the ECC levels increase, the physical marked area increases proportionally. The redundant data is randomly placed (encoded) inside the data storage area to increase the symbol's ability to recover from damage.

In Reed-Solomon code, the OVHD varies and is based on the size of matrix. Refer to Table C-4, "ECC 200 Symbol Attributes," on page C-8 for more information.

The examples in Figure C-5 illustrate Data Matrices with different ECC levels and how ECC affects symbol density.

FIGURE C-5. Data Matrix Examples with Different ECC Levels



Refer to Table C-1 for a correlation between ECC levels and required overhead.

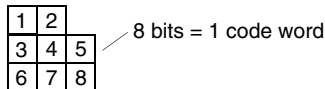
TABLE C-1. ECC Levels vs. Required Overhead

Selected ECC Levels	Required Overhead (%)
00	0
50	25
80	33
100	50
140	75
200	Various

Bit Versus Code Word

The ECC200 Data Matrix uses a byte-oriented (one Code Word) error detection and correction algorithm. The non-ECC200 uses a bit-oriented algorithm. Each ECC200 Data Matrix consists of multiple code words. Each code word contains 8 bits (also called elements or cells), as shown in Figure C-6.

FIGURE C-6. Shows 8 Bits as 1 Code Word



The AIM Specification is designed for ECC200, which is *code word*-based. If any cell within the code word is incorrectly identified, the code word is subsequently affected by that bit and thus requires error correction. Since it is the code word that matters in the error correction algorithm, one single bit can cause the same amount of damage as the eight wrong bits in the same code word. For example, if one bit within the code word is in error the entire code word is in error. Likewise, if multiple bits within the same code word (e.g., 2-8 bits) are in error, this still counts as *one* code word in error.

The DMx AutoID+™ is designed to cover both ECC200 and non-ECC200 Data Matrices. As a result, the number of wrong cells or bits (not code words) is displayed in the DMx AutoID+™. The code word affected by displayed bits can also be displayed for the ECC200 Data Matrix.

Data Matrix Encodation Schemes

This section describes ECC 000-140 and ECC 200.

ECC 000-140

The data is encoded using one of six encodation schemes (format strings). The encodation scheme is fixed for the entire symbol. As a result, the selection of the most appropriate encodation scheme allows the user to compress the symbol to its smallest form without wasting space on characters not used. Table C-2 Lists the six encodation schemes and their outputs.

TABLE C-2. Encodation Schemes — Format Strings

Encodation Scheme	Format Outputs and Description	Bits per Data Character
Format 1	500 numeric characters (0-9) with spaces	3.5
Format 2	500 uppercase alphabetic characters with spaces and punctuation	4.8
Format 3	500 uppercase alphanumeric characters with spaces, commas, periods, slashes, and minuses	5.25
Format 4	500 uppercase alphanumeric characters with spaces	5.5
Format 5	500 characters with full 7-bit ASCII keyboard	7
Format 6	500 characters with full 8-bit ISO for international languages	8

ECC 200

The data may be encoded using any combination of six encodation schemes listed in Table C-3.

TABLE C-3. Encodation Schemes — File Formats

Encodation Scheme	Characters	Bits per Data Character
ASCII	Double-digit numeric ASCII values 0-127 Extended ASCII values 128-255	4 8 16
C40	Primary upper-case alphanumeric	5.33
Text	Primary lower-case alphanumeric	5.33
X12	ANSI X12 EDI data set	5.33
EDIFACT	ASCII values 32-94	6
Base 256	All byte values 0-255	8

Table C-4 lists ECC symbol attributes.

TABLE C-4. ECC 200 Symbol Attributes

Symbol Size: ¹		Data Region:		Inter-leaved Blocks	Data Capacity:			Error Correction Overhead %	Max. Correctable Percentage %
Row	Col.	Size	No.		Num. Cap	Alphanu m. Cap	Byte Cap		
10	10	8x8	1	1	6	3	1	62.5	25
12	12	10x10	1	1	10	6	3	58.3	25
14	14	12x12	1	1	16	10	6	55.6	28/39**
16	16	14x14	1	1	24	16	10	50.0	25/38
18	18	16x16	1	1	36	25	16	43.8	22/34
20	20	18x18	1	1	44	31	20	45.0	23/38
22	22	20x20	1	1	60	43	28	40.0	20/34
24	24	22x22	1	1	72	52	34	40.0	20/35
26	26	24x24	1	1	88	64	42	38.9	19/35
32	32	14x14	4	1	124	91	60	36.7	18/34
36	36	16x16	4	1	172	127	84	32.8	16/30
40	40	18x18	4	1	228	169	112	29.6	15/28

TABLE C-4. ECC 200 Symbol Attributes (continued)

44	44	20x20	4	1	288	214	142	28.0	14/27
48	48	22x22	4	1	348	259	172	28.1	14/27
52	52	24x24	4	2	408	304	202	29.2	15/27
64	64	14x14	1 6	2	560	418	278	28.6	14/27
72	72	16x16	1 6	4	736	550	366	28.1	14/26
80	80	18x18	1 6	4	912	682	454	29.6	15/28
88	88	20x20	1 6	4	1152	862	574	28.0	14/27
96	96	22x22	1 6	4	1392	1042	694	28.1	14/27
104	104	24x24	1 6	6	1632	1222	814	29.2	15/28
120	120	18x18	3 6	6	2100	1573	104 8	28.0	14/27
132	132	20x20	3 6	8	2608	1954	130 2	27.6	14/26
144	144	22x22	3 6	8*	3116	2335	155 6	28.5	14/27
				2*					
Rectangular Symbols:									
8	18	6x16	1	1	10	6	3	58.3	25
8	32	6x14	2	1	20	13	8	52.4	24
1 2	26	10x24	1	1	32	22	14	46.7	23/37

TABLE C-4. ECC 200 Symbol Attributes (continued)

1 2	36	10x16	2	1	44	31	20	45.0	23/38
1 6	36	14x16	2	1	64	46	30	42.9	21/38
1 6	48	14x22	2	1	98	72	47	36.4	18/32

Note 1: Symbol size does not include a quiet zone.

Note*: In the largest symbol (144x144), the first eight Reed-Solomon blocks are 218 code words long encoding 156 data code words. The last two blocks encode 217 code words (155 data code words). All the blocks have 62 error correction code words.

Note**: The maximum correctable percentage can range between 28% and 39%.

Data Matrix Specification Details

This section provides excerpts from the AIM International Technical Specification – International Symbology Specification -- Data Matrix (1996). Refer to the AIM Specification for the complete text.

For new applications, ECC 200 is recommended. ECC 000-140 should only be used in closed applications where a single party controls both the production and reading of the symbols and is responsible for overall system performance.

The characteristics of the code consist of:

1. Encodable character set:
 - a. Values 0-127 in accordance with ANSI X3.4, i.e., all 128 ASCII characters (equivalent to the US national version of ISO 646).
 - b. Values 128-255 in accordance with ISO 8859-1; Latin Alphabet No. 1. These are referred to as extended ASCII.
2. Representation of data — A dark module is a binary 1 and a light module is a binary 0. In a reversed image (reverse polarity), a light module is a binary 1 and a dark module is a binary 0.
3. Symbol size in modules (not including the quiet zone):

ECC 000-140
9 by 9
to 49 by 49
Odd only

ECC 200
10 by 10
to 144 by 144
Even only

Note: Refer to Table C-4, “ECC 200 Symbol Attributes,” on page C-8 for more information.

4. Data characters per symbol (refers to maximum symbol size in ECC 200):

Alphanumeric data: up to 2335 characters

8-bit byte data: 1556 characters

Numeric data: 3116 digits

5. Selectable error correction:

ECC 000-140 — Four levels of convolutional error correction, plus the option to apply only error detection.

ECC 200 — Reed-Solomon error correction.

6. Code type: Matrix

7. Orientation independence: Yes

Summary of Additional Features

The following summarizes additional Data Matrix features, including whether inherent to the Data Matrix, or optional:

- Reflectance reversal: (Inherent) Symbols are intended to be read when marked such that the image is either dark on light or light on dark.
- Extended Channel Interpretations: (ECC 200 only, optional). This mechanism enables characters from other character sets (e.g., Arabic, Cyrillic, Greek, Hebrew) and other data interpretations or industry-specific requirements to be represented.
- Rectangular symbols: (ECC 200 only, optional). Six symbol formats are specified in a rectangular form.
- Structured append: (ECC 200 only, optional). This allows files of data to be represented in up to 16 Data Matrix symbols. The original data can be correctly reconstructed regardless of the order in which the symbols are scanned.

Symbol Structure

Each Data Matrix symbol consists of data regions, which contain nominally square modules, set out in a regular array. In larger ECC 200 symbols, data regions are separated by alignment patterns. The data region is surrounded by a finder pattern, and as a result is surrounded on all four sides by a quiet zone border.

The Finder Pattern is a perimeter to the data region and is one module wide. Two adjacent sides (left and lower sides) forming the L-shaped boundary, are solid dark lines. These sides primarily determine physical size, orientation and symbol distortion. The two opposite sides are made up of alternating dark and light modules. These are used primarily to define the cell structure of the symbol, but can also assist in determining physical size and distortion.

Regarding Symbol Sizes and Capacities, the ECC 000-140 symbols consist of an odd number of rows and columns. Symbols are square with sizes from 9x9 to 49x49 (modules) not including quiet zones. These symbols can be recognized by the upper-right corner module being dark. For an image of reversed polarity, it would be light. Complete attributes for ECC 000-140 symbols are provided in the *AIM International Technical Specification, International Symbolology Specification — Data Matrix (1996)*.

ECC 200 symbols consist of an even number of rows and columns. Some symbols may be square with sizes from 10x10 to 144x144 not including the quiet zone. Other symbols may be rectangular with sizes from 8x8 to 16x48 not including quiet zone. All ECC 200 symbols can be recognized by the upper right corner being light dark. For an image of reversed polarity, it will be dark. Complete attributes of ECC 200 symbols are provided in the *AIM International Technical Specification, International Symbolology Specification — Data Matrix (1996)*.

Sample Data Matrix Symbols

This appendix includes a number of sample Data Matrix symbols to ensure that your system is functioning properly.

FIGURE D-1. Data Matrix Sample #1



Data = "12345678901234567"
ECC = 0
Format ID = 1

FIGURE D-2. Data Matrix Sample #2



Data = "ABCDEFGHIJKLMNO PQ"
ECC = 50
Format ID = 2

FIGURE D-3. Data Matrix Sample #3



Data = "A,B.C/D-EFGHIJKLM"
ECC = 80
Format ID = 3

FIGURE D-4. Data Matrix Sample #4



Data = "A1B2C3D4E5F6G7H8I"
ECC = 100
Format ID = 4

FIGURE D-5. Data Matrix Sample #5



Data = "AaBbCcDdEeFfGgHhI"
ECC = 140
Format ID = 5

FIGURE D-6. Data Matrix Sample #6



Data = "AaBbCcDdEeFfGgHhI"
ECC = 200
Format ID = N/A

Sample Barcode Symbols

This appendix includes a number of sample 1D Barcode symbols to ensure that your system is functioning properly.

FIGURE E-1. Code 128



FIGURE E-2. Code 93



FIGURE E-3. Code 39



FIGURE E-4. Interleaved 2 of 5



FIGURE E-5. Codabar



FIGURE E-6. EAN 13



FIGURE E-7. EAN 8



FIGURE E-8. UPC A



FIGURE E-9. UPC E



FIGURE E-10. 5-Digit Postnet with Check Character



Sample Barcode Symbols

FIGURE E-11. SEMI BC412 with Both Start/Stop and Check Sum



FIGURE E-12. Pharmacode



FIGURE E-13. RSS-14



FIGURE E-14. RSS Limited



FIGURE E-15. RSS Expanded



FIGURE E-16. RSS Stacked



(01)00012345678905

FIGURE E-17. RSS Limited Composite



(01)13112345678906(17)010615(10)A123456

FIGURE E-18. RSS-14 Stacked Composite



(01)03412345678900(17)010200

FIGURE E-19. QR Code



QR Code symbol

IO Matrices

TABLE F-1. IO Matrix — Camera 1

Camera Number	IO Point			
Camera 1	1	5	6	7
Data Valid, No Read	ON	off	off	off
Data Valid, Good Read, Verifier Success (if enabled)	ON	ON	off	off
Data Valid, Good Read, No Match (if enabled)	ON	ON	off	off
Data Valid, Good Read, Good Match (if enabled)	ON	ON	ON	off
Data Valid, Process Overrun	ON	off	off	ON
Data Valid, Trigger Overrun	ON	off	ON	ON
Data Valid, Good Read, Verifier Failure (if enabled)	ON	ON	off	ON

TABLE F-2. IO Matrix — Camera 2

Camera Number	IO Point			
Camera 2	2	8	9	10
Data Valid, No Read	ON	off	off	off
Data Valid, Good Read, Verifier Success (if enabled)	ON	ON	off	off
Data Valid, Good Read, No Match (if enabled)	ON	ON	off	off
Data Valid, Good Read, Good Match (if enabled)	ON	ON	ON	off
Data Valid, Process Overrun	ON	off	off	ON
Data Valid, Trigger Overrun	ON	off	ON	ON
Data Valid, Good Read, Verifier Failure (if enabled)	ON	ON	off	ON

TABLE F-3. IO Matrix — Camera 3

Camera Number	IO Point			
Camera 3	3	11	12	13
Data Valid, No Read	ON	off	off	off
Data Valid, Good Read, Verifier Success (if enabled)	ON	ON	off	off
Data Valid, Good Read, No Match (if enabled)	ON	ON	off	off
Data Valid, Good Read, Good Match (if enabled)	ON	ON	ON	off
Data Valid, Process Overrun	ON	off	off	ON
Data Valid, Trigger Overrun	ON	off	ON	ON
Data Valid, Good Read, Verifier Failure (if enabled)	ON	ON	off	ON

TABLE F-4. IO Matrix — Camera 4

Camera Number	IO Point			
Camera 4	4	14	15	16
Data Valid, No Read	ON	off	off	off
Data Valid, Good Read, Verifier Success (if enabled)	ON	ON	off	off
Data Valid, Good Read, No Match (if enabled)	ON	ON	off	off
Data Valid, Good Read, Good Match (if enabled)	ON	ON	ON	off
Data Valid, Process Overrun	ON	off	off	ON
Data Valid, Trigger Overrun	ON	off	ON	ON
Data Valid, Good Read, Verifier Failure (if enabled)	ON	ON	off	ON

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