NEWTON
RESEARCH LABS

# Model 1000/1200

## High Performance Line Scan Vision System

# Model 4520/4550

## High Performance Line Scan Camera

# Installation and Reference Manual

Newton Research Labs, Inc.
441 SW 41st Street
Renton, WA 98055

www.newtonlabs.com

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## INTRODUCTION

The Model 1000 and Model 1200 line scan vision systems represent Newton Labs' most popular line scan machine vision offerings. The highlights of the Model 1000 Series include:

- High resolution – 2048pixels (Imager Model 4520) and 5150 pixels (Imager Model 4550)
- High speed – Up to 5000 scans per second
- High performance MMX processing power
- Dual Imagers (Model 1200)
- Abundant serial and digital I/O options
- Flexible communications via serial, Ethernet, and Rugged NEMA enclosures
- Convenient back plate for panel mounting

Combined with either a 4520 or 4550 line scan imager, Newton Labs Illuminator, and appropriate software component, Model 1000 Series line scan systems provide solutions for many web inspection, high resolution, and high speed applications. Common web inspection examples are: Textiles - pattern off trending, seam detection, defect detection; Paper - specks, tears, wrinkles, off colors; Plastics - bubbles, holes, blisters, flash, seam integrity; Metal - scratches, chip outs, machine marks, hole size and location; Wood - grain, color, knot and defect detection. Other line scan applications are commonly found in Packaging - seal adhesion integrity, glue coverage, print quality; High resolution surface inspection – scratches, dents, holes, voids, nodules, defects on small objects such as fiber optics and glass strips, OCR and OCV on small surface areas.

Like all Newton Labs vision systems, the Model 1000 series utilizes simple software user interfaces to configure the pre-programmed software modules with a laptop or PC. These software components have been specifically designed by Newton Labs to require little or no software expertise to learn or operate. Each component performs a specific vision task and may be purchased separately and combined to meet the needs of a given application. Once the component has been set up, the Model 1000 Series system will run as a stand-alone system and the laptop or PC may be removed.

This guide covers the hardware operation and installation including specifications, dimensions, connections, wiring diagrams, and pin outs. Also included are sections on typical installations, mounting, troubleshooting, and associated lights and Imagers used with the Model 1000 Series.

### POWER UP DISPLAY

When the Newton Labs Vision System is first powered up, it will perform a self-test and feature detection. When the system has completed the self-test, the **BUSY** LED on the front panel will illuminate Green.

### POWER FLUCTUATIONS

The Model 1000 series line scan vision system requires relatively stable AC power. If the system is installed in an area where the AC power is not stable and is subject to severe fluctuations and/or discontinuity, the use of an Uninterruptable Power Supply may be required. Should a rapid power fluctuation take place and the Newton Labs Vision System appears not to be operating correctly, turn off the power switch on the front panel for 5 seconds and turn back on.

# MODEL 1000 SPECIFICATIONS

## CONSTRUCTION

**Size**: 9.5" x 5 " x 9.25"

**Weight**: 10.5 lbs.

**Enclosure**: NEMA rated extruded aluminum, completely enclosed

**Mounting**: Mounting via 4 x 3/16" holes on back panel (Optional mounting brackets available)

**Processor**: High Performance embedded MMX

## CONNECTIONS

**Serial**: DB9 RS232 Configuration Connector

**Ethernet**: 10 baseT

**Input Voltage**: 85-240 VAC, 47-63 Hz, IEC 320 Connector—IEC 950 Compliant

**Input Current:** 3 A @ 115VAC, 1.5 A @ 230 VAC

**I/O**: DB37 Connector

**Inputs**: 8 Digital (1 for Trigger), Line lock/Sync and RS422 Serial Data Input

**Outputs**: 16 Digital (3 for Pass/Fail, Busy), Sync/Trigger and RS422 Serial Data Output

**Line Scan Imager**: Rugged 10 Pin Connector

**Video Output:** BNC connector for vision system output in video format

**Illumination**: DB25 connector for illumination source

**Standard Operating Temperature:** 40 to 100 degrees F, (optional high and low temperature systems available)

**Storage Temperature:** 0 to 150 degrees F

## OPERATIONS

**Speed**: Extremely high speed system, up to 10 billion pixel operations per second

**Set up**: Use with Newton Labs pre-programmed software components for easy set up

# MODEL 1200 SPECIFICATIONS

## CONSTRUCTION

**Size**: 9.5" x 5 " x 9.25"

**Weight**: 10.5 lbs.

**Enclosure**: NEMA rated extruded aluminum, completely enclosed

**Mounting**: Mounting via 4 x 3/16" holes on back panel (Optional mounting brackets available)

**Processor**: High Performance embedded MMX

## CONNECTIONS

**Serial**: DB9 RS232 Configuration Connector

**Ethernet**: 10 baseT

**Input Voltage**: 85-240 VAC, 47-63 Hz, IEC 320 Connector—IEC 950 Compliant

**Input Current:** 3 A @ 115 VAC, 1.5 A @ 230 VAC

**I/O**: DB37 Connector

**Inputs**: 8 Digital (1 for Trigger), Line lock/Sync and RS422 Serial Data Input

**Outputs**: 16 Digital (3 for Pass/Fail, Busy, Sync/Trigger) and RS422 Serial Data Output

**Line Scan Imagers**: 2 Rugged 10 Pin Connectors

**Video Output:** BNC connector for vision system output in video format

**Illumination**: DB25 connector for illumination source

**Standard Operating Temperature:** 40 to 100 degrees F, (optional high and low temperature systems available)

**Storage Temperature:** 0 to 150 degrees F

## OPERATIONS

**Speed**: Extremely high speed system, up to 10 billion pixel operations per second

**Set up**: Use with Newton Labs pre-programmed software components for easy set up

# MODEL 4520/4550 SPECIFICATIONS

## CONSTRUCTION

**Size**: 3.5" x 3.5" x 1.75" (Without Lens)

**Weight**: 1.5 lbs. (Without Lens)

**Enclosure**: NEMA rated extruded aluminum

**Mounting**: Mounting via 4 mounting/adjustment holes on front panel (Optional mounting brackets available)

**Lens Mounting:** Standard C/CS Mounting

**CCD**: **4520**-2048 pixels, **4550**-5150 pixels

**Connection:** Newton 10 pin Threaded Connector (Use with standard Newton Imager Cables)

**Standard Operating Temperature:** 40 to 100 degrees F, (optional high and low temperature models available)

**Storage Temperature:** 0 to 150 degrees F

## OPERATIONS

**Speed**: Up to 5000 Lines per Second

**Set up**: Use with Newton Labs Model 1000/1200 pre-programmed software

# 1000 Series Line Scan System Features

- Extremely High Performance Embedded MMX processor
- DB9 connector for serial configuration
- DB25 connector for illumination power and control (powers and controls up to 6 lights)
- DB37 connector for serial and digital I/O
- Ethernet 10baseT (DeviceNet and Profibus optional)
- Threaded Line Scan Imager connection(s), BNC connector for video out
- Rugged NEMA enclosures, completely sealed against dust and contaminants
- Back plate for panel mounting

## Model 1000 Description

The Model 1000 is the standard base model in this high performance line scan series. The Model 1000 is designed to be easily integrated with a Newton Labs Model 4520/4550 Line Scan Imager and illumination source for virtually any line scan machine vision requirement.

The Model 1000 is designed for use with a single Newton Labs Line Scan Camera.

## Model 1200 Description

The Model 1200 concurrently processes the video from two Newton Labs Line Scan Cameras where simultaneous inspection from both cameras is required. It is commonly used to increase the number of pixels (and thus the resolution) when the resolution from a single line scan camera is not sufficient for the application or to perform two different inspections simultaneously (such as the top and bottom of the same web).

## Model 4520 Description

The Model 4520 Line Scan Camera is specifically designed to be integrated with a Newton Labs Series 1000 Line Scan Vision System. The Model 4520 Imager supplies 2048 pixels and operates at up to 5000 Lines per Second.

## Model 4550 Description

The Model 4550 Line Scan Camera is specifically designed to be integrated with a Newton Labs Series 1000 Line Scan Vision System. The Model 4550 Imager supplies 5150 pixels and operates at up to 5000 Lines per Second.

## MODEL 1000 DIMENSIONS AND STANDARD MOUNTING

All 1000 Series Vision Systems have the same external dimensions (see Figure 1).

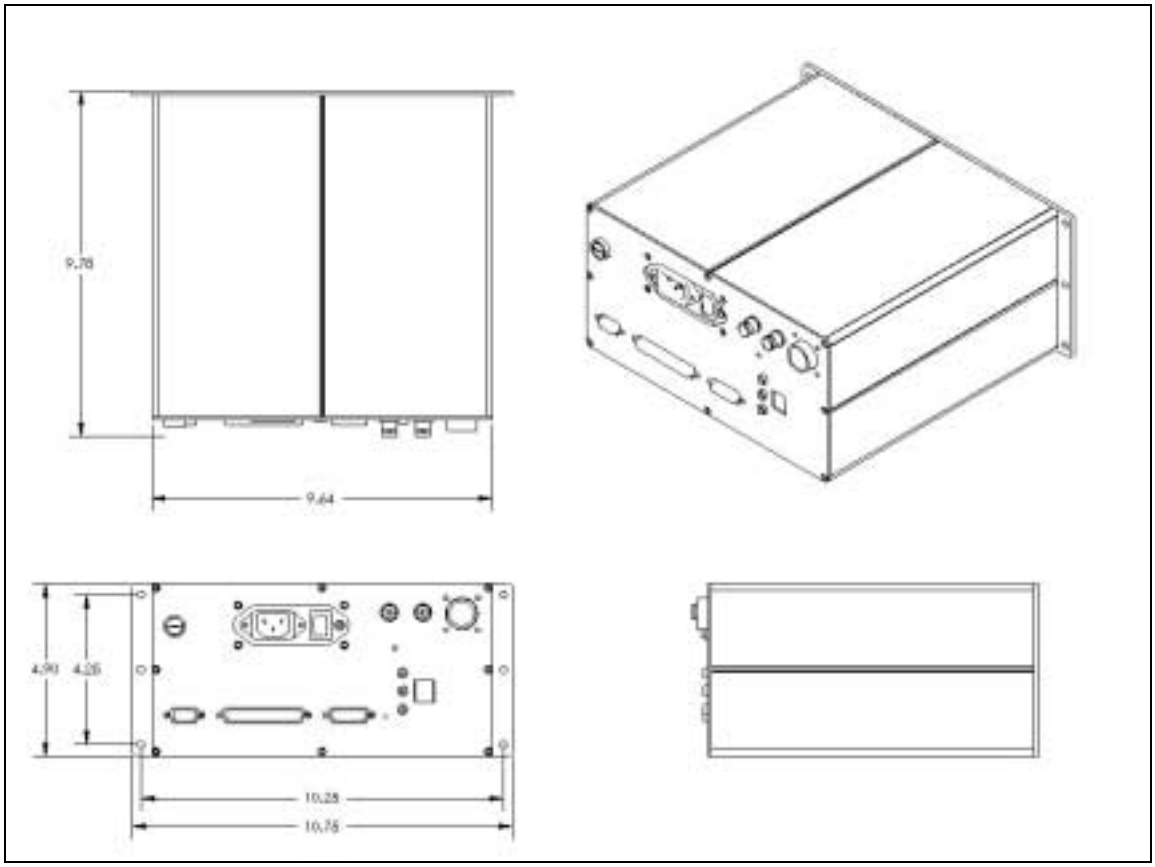



**Figure 1. Series 1000 Dimensions** **Dimensions in Inches**

### SERIES 1000 BACK PANEL

The back panel on the 1000 Series Vision Systems has the dual purpose of standard mounting plate and **heat sink**. The Vision System is designed to be easily mounted in a panel enclosure or on any flat surface. For further mounting options please consult your Newton Labs Authorized Distributor.

All Newton Labs vision systems are housed in rugged extruded aluminum enclosures. The heat generated by the internal electronics of the system is conducted out via an internal heat sink that extends to the rear panel. This heat-sinking feature allows Newton Labs vision systems to be completely sealed, without the necessity for internal fans or air intakes.

**It is extremely important that the back panel be mounted to a metal surface to conduct the heat away from the vision system. If the 1000 Series is mounted using a method that will not conduct heat away from the back panel, an external heat sink and or forced air-cooling may be required. Consult your Newton Labs Authorized Distributor for full details on heat removal requirements**.

**1000 FRONT PANEL**

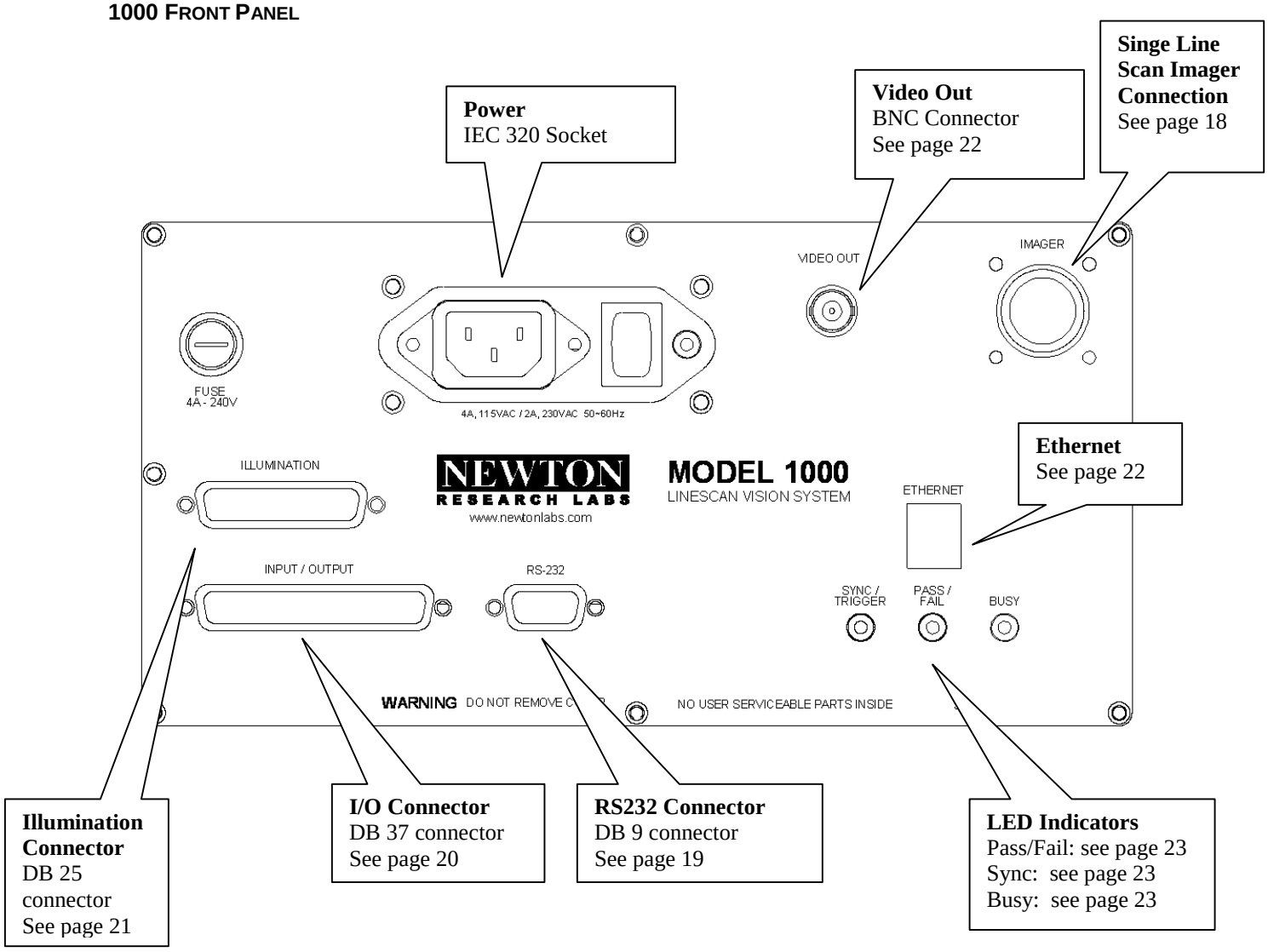



**Figure 2. Model 1000 Front Panel**

All the connectors and indicators on the Model 1000 are also found on the Model 1200.

### 1200 FRONT PANEL

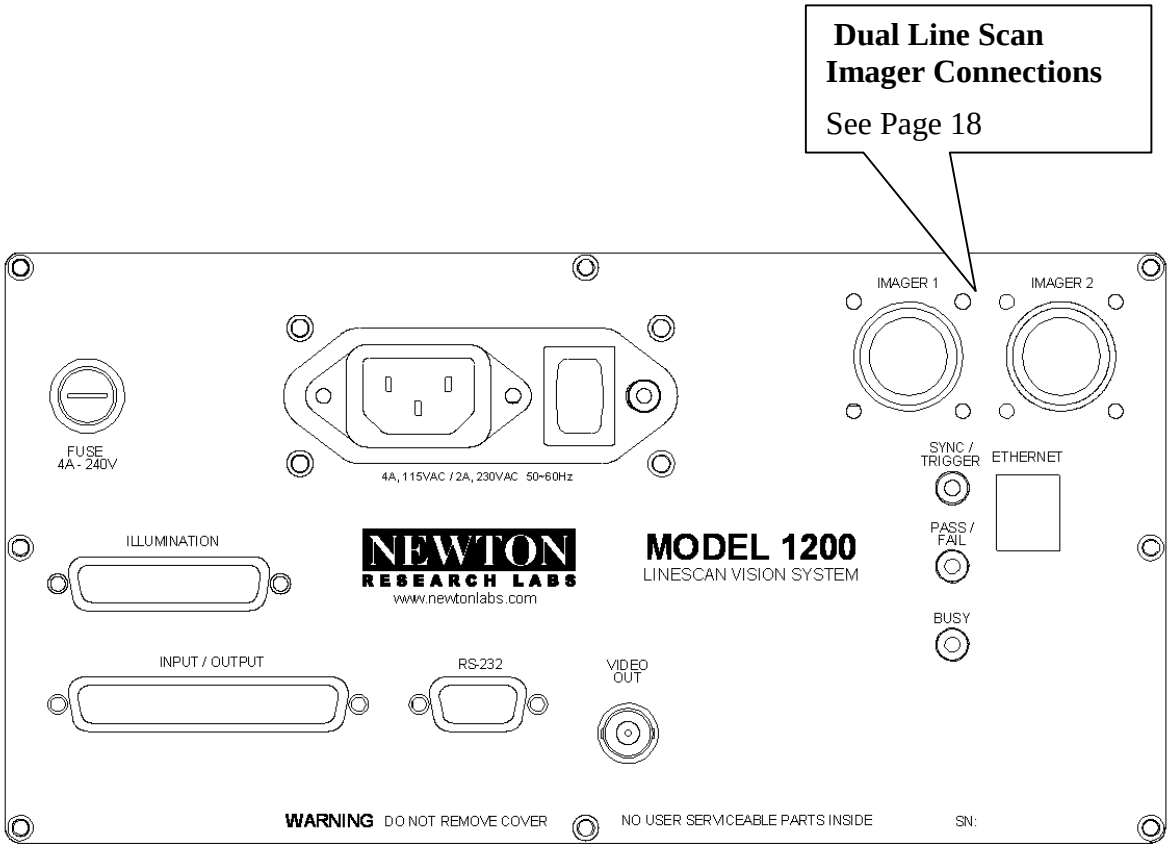



**Figure 3. Model 1200 Front Panel**

# 1000 SERIES CONNECTIONS

## OVERVIEW

1000 Series

| Connection | Description / Notes | For details and pinouts, refer to: |
|---|---|---|
| RS 232 | Standard serial port for configuration | Page 18 |
| Input / Output | DB37 Connector<br><br>Wide range of I/O Options | Page 19 |
| Illumination | DB25 Connector<br><br>Operates up to 6 Newton Smart Illuminators or other lights | See Page 20 |
| Video Out | Vision System Output in video format | See Page 21 |
| Network | 10 baseT Ethernet | See Page 21 |
| Imager | 1000 has 1 Imager connection.<br><br>1200 has 2 Imager connections. | Connects via Newton Labs Imager Cables to<br><br>Newton Labs Line Scan Imagers |

## DB9 RS-232 SERIAL CONFIGURATION CONNECTOR

| Pin Number | Function | Pin Name | Description | Typical Connection |
|---|---|---|---|---|
| 1 | NC | | | |
| 2 | TX-232 | TX_232 | Transmit | Laptop or PC |
| 3 | RX-232 | RX_232 | Receive | Laptop or PC |
| 4 | NC | | | |
| 5 | Ground | | | Laptop or PC |
| 6 | NC | | | |
| 7 | RTS | RTS_HOST | Flow control reported by host | Laptop or PC |
| 8 | CTS | CTS_VS | Flow control reported by vision system | Laptop or PC |
| 9 | NC | | | |

The RS232 Configuration Connector is designated for connection to a laptop or PC. It accepts the input from the Newton Labs Software Component user interface to configure and set up the parameters of the vision system and/or inspection. It is designed to function in either a continuously connected or setup only mode. If the setup only mode is used, the 1000 Series Vision System will operate as a stand-alone device after the removal of the laptop or PC.

## DB37 I/O CONNECTOR

| Pin Number | Function | Pin Name | Description | Typical Connection |
|---|---|---|---|---|
| 1 | TX-422+ | DATA RS422 TX+ | RS 422 Serial Port | PLC or PC |
| 2 | RX-422+ | DATA RS422 RX+ | RS 422 Serial Port | PLC or PC |
| 3 | +12V | | | |
| 4 | +12V | | | |
| 5 | nc | | | |
| 6 | nc | | | |
| 7 | Output 1 | OPTO_OUT1 | 4.5-24 VDC—Max. 20 mA Sinking Output See page 25 | PLC Input Module, LED Relay, Reject Mechanism |
| 8 | Output 2 | OPTO_OUT2 | “ | “ |
| 9 | Output 3 | OPTO_OUT3 | “ | “ |
| 10 | Output 4 | OPTO_OUT4 | “ | “ |
| 11 | Output 5 | OPTO_OUT5 | “ | “ |
| 12 | Output 6 | OPTO_OUT6 | “ | “ |
| 13 | Output 7 | OPTO_OUT7 | “ | “ |
| 14 | Output 8 | OPTO_OUT8 | “ | “ |
| 15 | Output 9 | OPTO_OUT9 | “ | “ |
| 16 | Output 10 | OPTO_OUT10 | “ | “ |
| 17 | Output 11 | OPTO_OUT11 | “ | “ |
| 18 | Output 12 | OPTO_OUT12 | “ | “ |
| 19 | Output 13 | OPTO_OUT13 | “ | “ |
| 20 | TX-422- | DATA RS422 TX- | RS 422 Serial Port | PLC or PC |
| 21 | RX-422- | DATA RS422 RX- | RS 422 Serial Port | PLC or PC |
| 22 | GND | | | |
| 23 | Line-lock In | LINELOCK_IN | 6 to 18 VAC | AC supply |
| 24 | GND | | | |
| 25 | Output Common | OPTO_OUT common | Output Common See Page 25 | Ground or Supply See Page 25 |
| 26 | Output 14 (Busy) | OPTO_OUT_BUSY | 10-27 VDC—Max. 20 mA Sinking Output See Page 25 | PLC Input Module, LED Relay, Reject Mechanism |
| 27 | Output 15 (Pass) | OPTO_OUT_PASS | “ | “ |
| 28 | Output 16 (Fail) | OPTO_OUT_FAIL | “ | “ |
| 29 | Input 1 | OPTO_IN1 | 10-27 VDC Dual Input (Source or Sink) See Page 24 | PLC Output Module, Photodiode, Proximity Switch, Relay or Manual Switch |
| 30 | Input 2 | OPTO_IN2 | “ | “ |
| 31 | Input 3 | OPTO_IN3 | “ | “ |
| 32 | Input 4 | OPTO_IN4 | “ | “ |
| 33 | Input 5 | OPTO_IN5 | “ | “ |
| 34 | Input 6 | OPTO_IN6 | “ | “ |
| 35 | Input 7 | OPTO_IN7 | “ | “ |
| 36 | Input 8 (Trigger) | OPTO_IN_TRIG | “ | “ |
| 37 | Input Common | OPTO_IN common | Input Common See Page 24 | Ground or Supply See Page 24 |

## DB25 ILLUMINATION CONNECTOR

| Pin Number | Function | Pin Name | Description | Typical Connection |
|---|---|---|---|---|
| 1 | Strobe-12V Out* ** To Illuminator 1 | IL_1_STROBE | Illuminator Strobe Signal | Newton Smart Illuminator or other light |
| 2 | Strobe-12V Out* ** To Illuminator 2 | IL_2_STROBE | Illuminator Strobe Signal | Newton Smart Illuminator or other light |
| 3 | Strobe-12V Out* ** To Illuminator 3 | IL_3_STROBE | Illuminator Strobe Signal | Newton Smart Illuminator or other light |
| 4 | Ground | GND | Ground | Case/ Earth Ground |
| 5 | Ground | GND | Ground | Case/ Earth Ground |
| 6 | Ground | GND | Ground | Case/ Earth Ground |
| 7 | Communication | IL_1_SER_VIS_TO _IL | Communication Signal Illuminator 1 | Newton Smart Illuminator |
| 8 | Communication | IL_3_SER_VIS_TO _IL | Communication Signal Illuminator 3 | Newton Smart Illuminator |
| 9 | Communication | IL_5_SER_VIS_TO _IL | Communication Signal Illuminator 5 | Newton Smart Illuminator |
| 10 | Communication | IL_1_SER_IL_TO_ VIS/VIS_TO_ MULTI_TX+ | Communication Signal Illuminator 1 | Newton Smart Illuminator |
| 11 | Communication | IL_3_SER_IL_TO_ VIS | Communication Signal Illuminator 3 | Newton Smart Illuminator |
| 12 | Communication | IL_5_SER_IL_TO_ VIS | Communication Signal Illuminator 5 | Newton Smart Illuminator |
| 13 | N/C | | | |
| 14 | Strobe-12V Out* ** To Illuminator 4 | IL_4_STROBE | Illuminator Strobe Signal | Newton Smart Illuminator or other light |
| 15 | Strobe-12V Out* ** To Illuminator 5 | IL_5_STROBE | Illuminator Strobe Signal | Newton Smart Illuminator or other light |
| 16 | Strobe-12V Out* ** To Illuminator 6 | IL_6_STROBE | Illuminator Strobe Signal | Newton Smart Illuminator or other light |
| 17 | +12V Out* | 12V_OUT_17 | +12V Out | Newton Smart Illuminator or other light |
| 18 | +12V Out* | 12V_OUT_18 | +12V Out | Newton Smart Illuminator or other light |
| 19 | +12V Out* | 12V_OUT_19 | +12V Out | Newton Smart Illuminator or other light |
| 20 | Communication | IL_2_SER_VIS_TO _IL | Communication Signal Illuminator 2 | Newton Smart Light |
| 21 | Communication | IL_4_SER_VIS_TO _IL | Communication Signal Illuminator 4 | Newton Smart Light |
| 22 | Communication | IL_6_SER_VIS_TO _IL | Communication Signal Illuminator 6 | Newton Smart Light |
| 23 | Communication | IL_2_SER_IL_TO_ VIS/VIS_TO_ MULTI_TX - | Communication Signal Illuminator 2 | Newton Smart Illuminator |
| 24 | Communication | IL_4_SER_IL_TO_ VIS | Communication Signal Illuminator 4 | Newton Smart Light |
| 25 | Communication | IL_6_SER_IL_TO_ VIS | Communication Signal Illuminator 6 | Newton Smart Light |

*** Total Combined Maximum Current Draw from all 12VDC Outputs is 3.5 Amps @ 12 VDC**

**** Total Maximum Current Draw per Strobe Output is 1 Amp @ 12VDC**

## ETHERNET

Standard RJ-45 Connector- 10 baseT Ethernet. The Ethernet IP address is marked on the front panel directly after the serial number Should you need to change the IP address, consult your Newton Labs Authorized Distributor or the factory.

## VIDEO OUT

BNC Connector—vision system output in video format. Standard Series 1000 output is in RS170 (NTSC). Option PAL output is available on special order. This video output is commonly used for:

- Display of defects in real time or using stored images
- Display of current settings of inspection parameters
- Display of tabulations or defect logs
- Setup or debugging of the System

Consult the Newton Labs Software Component Users Guide for your application for use and configuration of this display.

## LINE SCAN IMAGER CONNECTION

The 1000 Series Line Scan Vision System is designed to be used with the Newton Labs 4500 Series Line Scan Cameras

# FRONT PANEL LEDS

## BUSY

The Busy LED indicates the vision system is processing an inspection.

This LED corresponds to Pin 14 (OPTO_OUT_BUSY) on the DB37 I/O connector.

For full details of the use of this LED in a specific application, consult the Newton Labs Software Component Users Guide for your application.

## PASS/FAIL

The bi-color Pass/Fail LED indicates the pass (green) or fail (red) condition of an inspection.

This LED corresponds to Pin 15 (OPTO_OUT_PASS) and Pin 16 (OPTO_OUT_FAIL) on the DB37 I/O connector.

For full details of the use of this LED in a specific application, consult the Newton Labs Software Component Users Guide for your application.

## SYNC/TRIGGER

The Sync/Trigger LED indicates the receipt of a trigger input to the vision system. It is also used for the indication of correct synchronization between multiple vision systems.

This LED corresponds to Pin 36 (OPTO_IN_TRIGGER) on the DB37 I/O connector.

For full details of the use of this LED in a specific application, consult the Newton Labs Software Component Users Guide for your application.

# SERIES 1000 INPUTS AND OUTPUTS

## LINE LOCK INPUT

The 1000 Series uses the Line Lock input to sync with the local power grid. This input is useful in applications where:

- The camera input to the Series 1000 vision system needs to be synchronized with the lighting, such as fluorescent or other types of flickering lighting.
- Multiple Series 1000 vision systems need to be time synchronized with each other and with lighting.

## SERIAL INPUT AND OUTPUT

The 1000 Series reads data in from external sources or outputs data from the vision system via a RS422 serial port found on the DB37 I/O Connector. Consult the Newton Labs Software Component user's guide for your specific application for details on available inputs, outputs and configuration of this port.

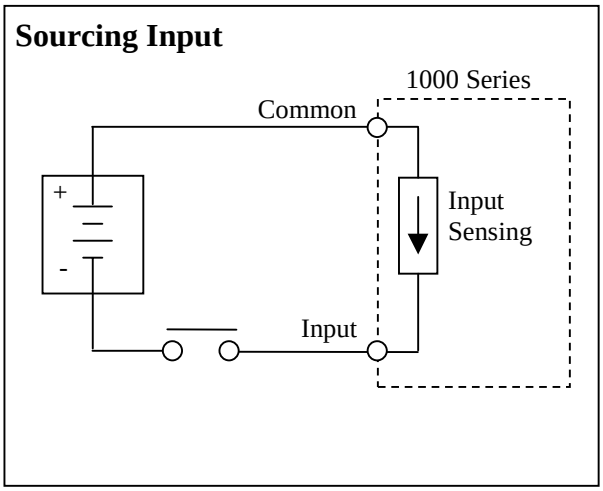
## DIGITAL INPUTS AND OUTPUTS

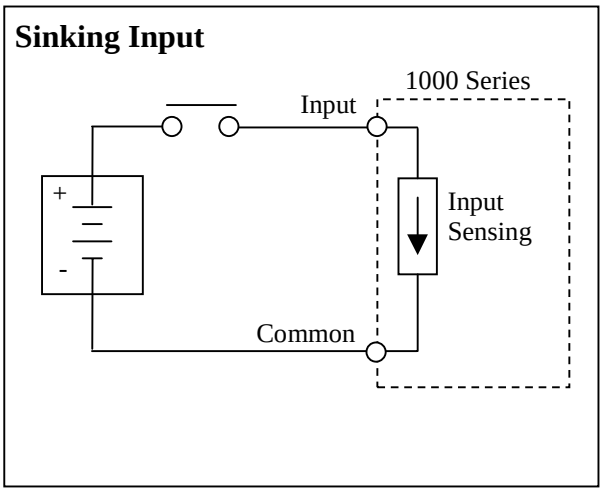
### 1000 SERIES DUAL DIGITAL INPUTS

The Model 1000 series uses dual polarity opto-isolators on all digital inputs. All inputs can be used as either sinking or sourcing inputs.

Note: as there is a single common for the entire set of inputs, all inputs must be configured as either sourcing or sinking. **It is not possible to mix the inputs between sourcing and sinking, including Trigger pin 36.**

The following diagrams illustrate the typical installation for each of the types of input:




### DC INPUT SPECIFICATIONS

| | |
|---|---|
| Minimum-Maximum Voltage Range | 10.6 – 26.8 VDC |
| Operating Voltage Range | 12 – 24 VDC |
| Peak Voltage (Non-continuous) | 30 VDC |
| Minimum Pulse Width | 0.4 mSec |
| ON Voltage Level | >10 VDC |
| OFF Voltage Level | < 2 VDC |
| Maximum. Input Current | 2mA@VDC, 4mA@VDC |
| Input Impedance | 8.2 KΩ |
| Minimum ON Current | >1mA |
| Maximum OFF Current | <0.1mA |
| OFF to ON Response | 0.2 mS Typical |
| ON to OFF Response | 0.2 mS,Typical |
| Common | Single Common all 8 Channels |

**NOTE**: Input pin 36 (Input 8) is designated in software for the special purpose usage of Trigger Input. It should not be utilized as a general purpose input except in special cases. See the Newton Labs Software Component Users Guide for full details of the settings on this input.

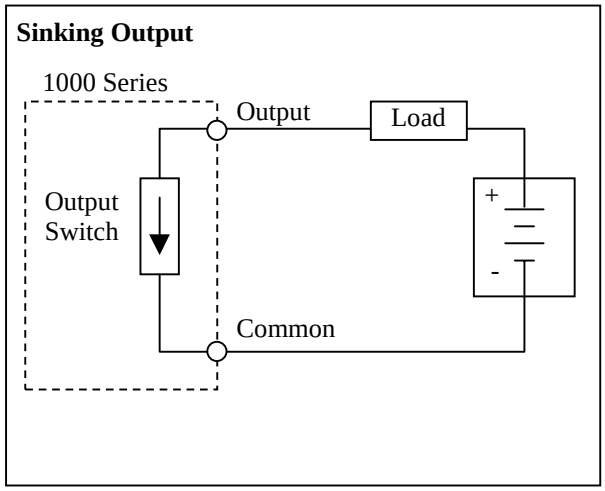
### 1000 SERIES DIGITAL OUTPUTS

The Model 1000 series uses opto-isolated sinking digital outputs. All outputs can sink up to 20 mA. There is a single common for the entire set of outputs.

Note: Output pins 26, 27, 28 are designated in software for special purpose usage and should not be utilized as general purpose outputs except in special cases. See the Newton Labs Software Component Users Guide for full details of the settings on these outputs.

| Pin Number | Use | Description |
|---|---|---|
| 26 | Busy | System processing an inspection |
| 27 | Pass | Part or inspection pass |
| 28 | Fail | Part or inspection fail |

The following diagram illustrates the typical installation for the sinking type of output:




### DC OUTPUT SPECIFICATIONS

| | |
|---|---|
| Minimum-Maximum Voltage Range | 4.0 – 26.8 VDC |
| Operating Voltage | 4.5 – 24 VDC |
| Peak Voltage | <50 VDC |
| On Voltage Drop | 1V |
| Maximum Current (resistive) | 20 mA |
| Maximum Inrush Current | 50 mA |
| OFF to ON Response | 0.2 mSec Typical |
| ON to OFF Response | 0.2 mSec Typical |
| Common | Single Common all 16 Channels |
| Fuses | None (external recommended) |

**NOTE**: Output pins 26, 27 and 28 are designated in software for the special purpose usage of Busy, Pass and Fail and should not be utilized as a general purpose outputs except in special cases. See the Newton Labs Software Component Users Guide for details of the settings on these outputs.

## MODEL 4500 IMAGER DIMENSIONS AND STANDARD MOUNTING

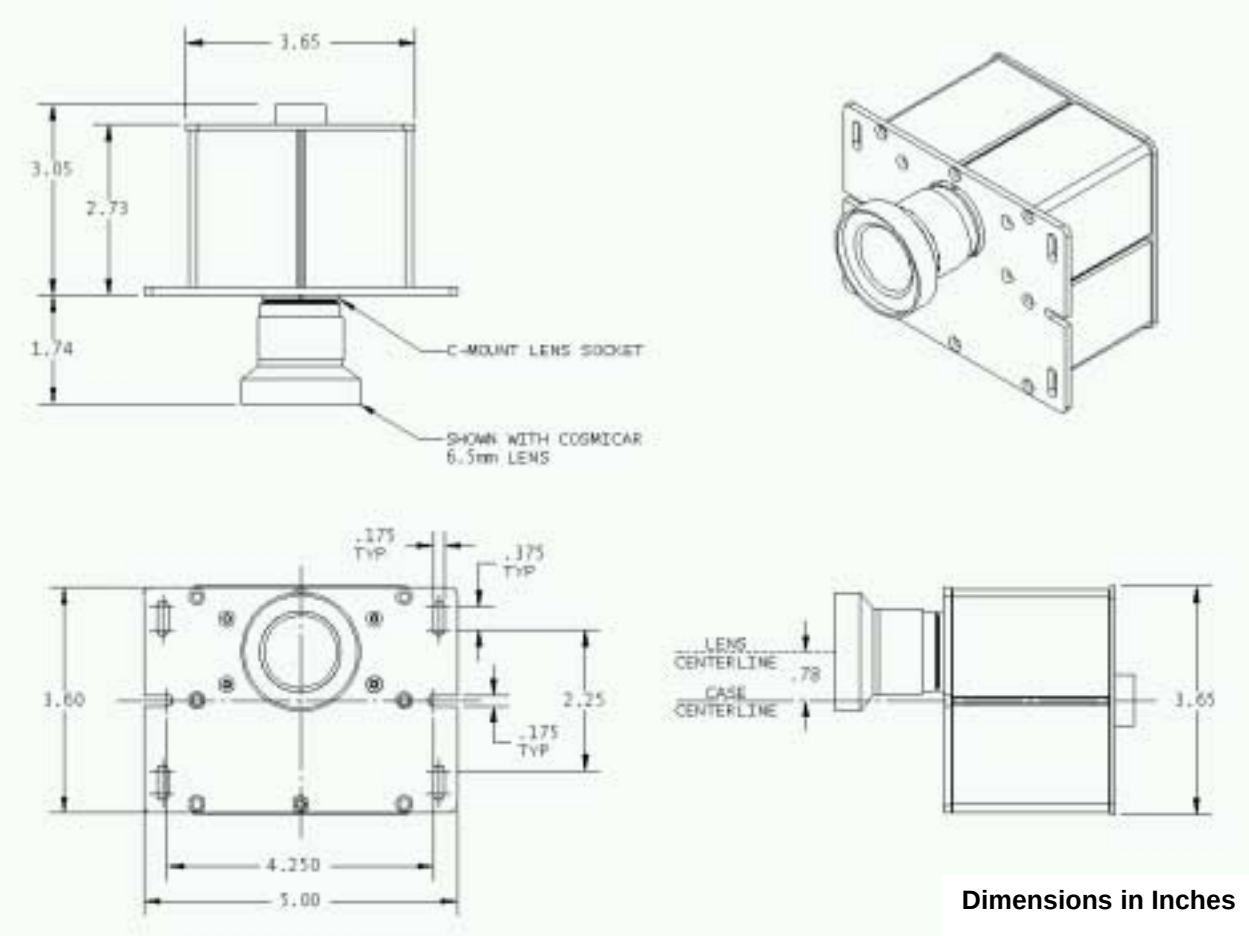



**Figure 4. Series 4500 Dimensions**

## MODEL 4500 LENS MOUNTING

Newton Labs 4500 Series Line Scan Cameras are designed to use standard C/CS mounting lenses. Line scan cameras may require special lens configurations; consult your Newton Labs Authorized distributor for the proper lens for your application.

## MODEL 4500 LENS ALIGNMENT AND FOCUSING

Since line scan cameras do not provide ordinary video output for use in camera alignment or to focus the camera, special software utilities are required for these procedures. Consult the Newton Labs software component for your application for complete directions and the necessary software utilities to perform these procedures.

# APPENDIX A: TYPICAL INSTALLATIONS

## MODEL 1000

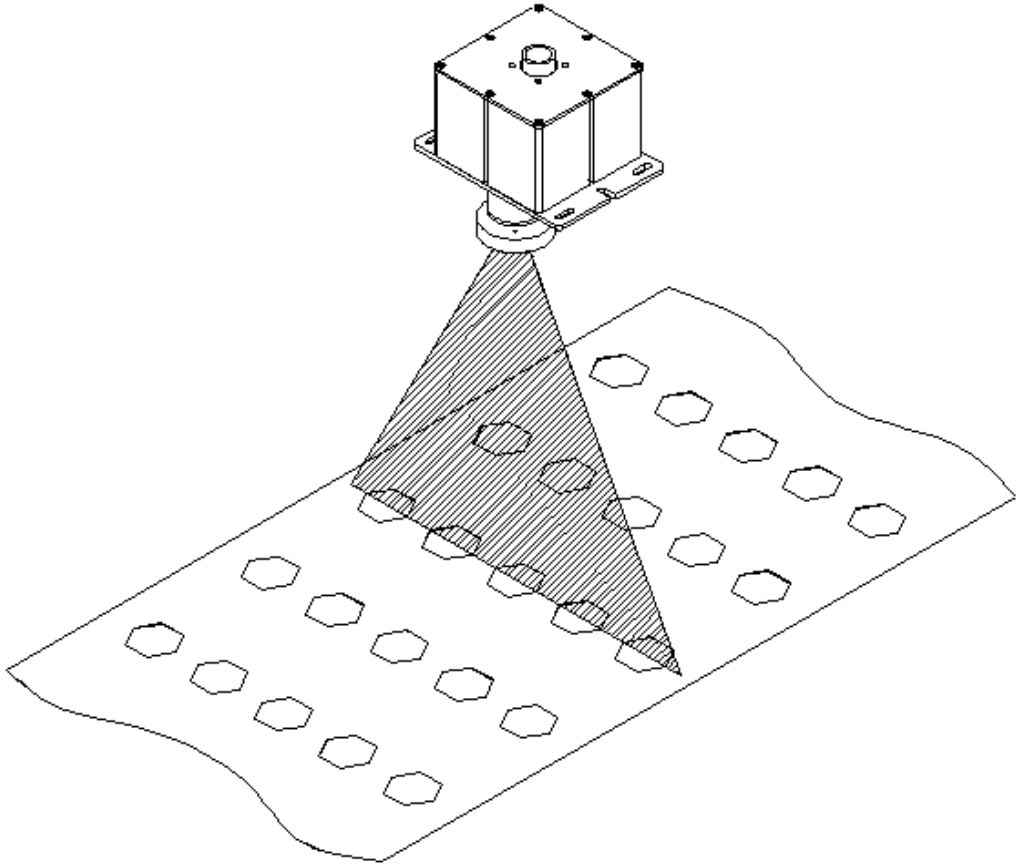


**Figure 5. Model 1000 Typical Installation-Web Inspection**

The Model 1000 is typically used for web inspections requiring a single field of view or only one Imager as depicted in the diagram above. In these cases, the associated Model 4520 or 4550 Imager will be mounted in a fixed position, which in relation to the installed illumination source, will provide optimum resolution, contrast, and image quality for the given inspection.

## MODEL 1200

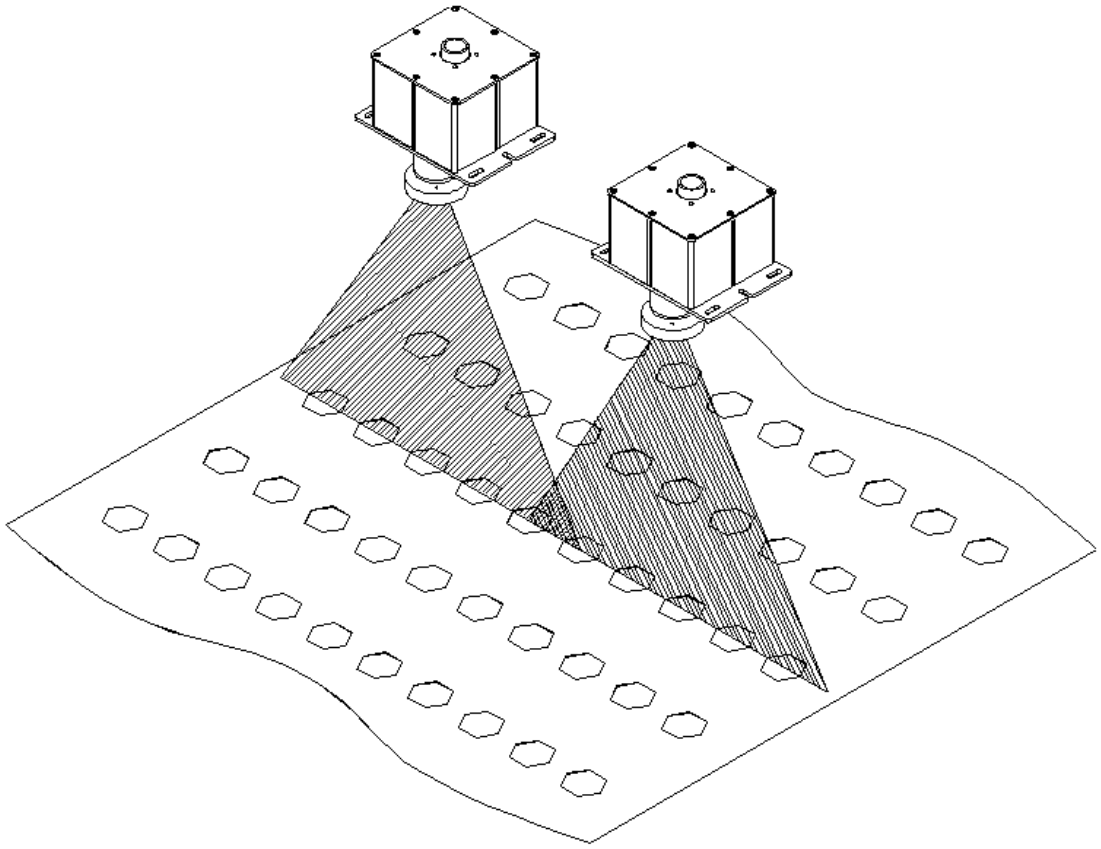


**Figure 6. Model 1200 Typical Installation- High Resolution Web Inspection**

The Model 1200 is typically used for applications requiring two Imagers capable of simultaneous inspection from each camera as depicted above. An example application is a wide web surface requiring very high resolution where very small defects must be detected, or where single camera resolution is not sufficient. In this case, the two Imagers split up the total field of view, effectively doubling the resolution.

## MODEL 1200

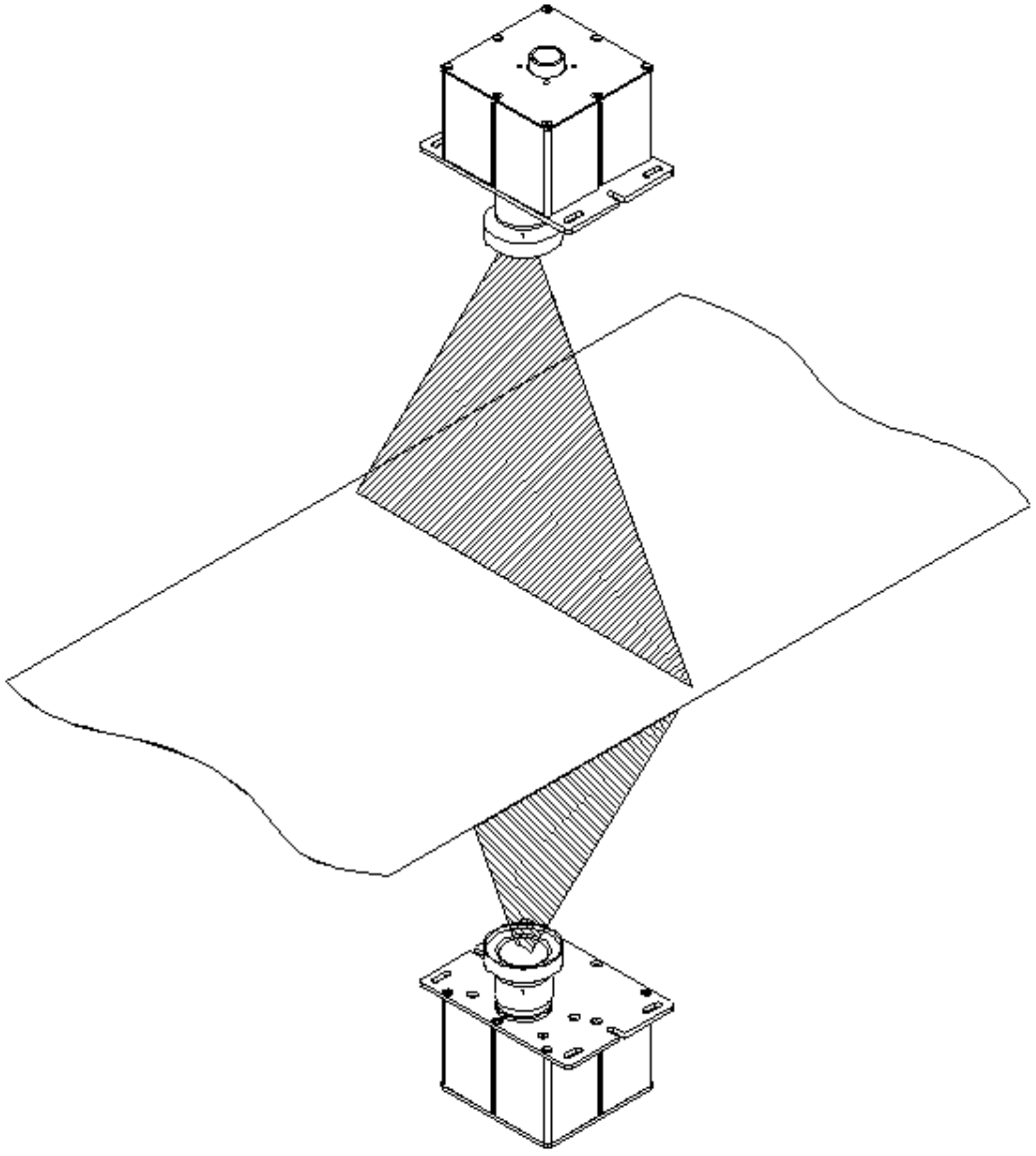


**Figure 7. Model 1200 Typical Installation—Two Side Inspection**

Another example application for dual line scan inspection from two Imagers is when two sides of an object (web) must be inspected at the same time as depicted above. In this case, the web is not transparent and cannot be back lit to highlight defects. The defects may be surface defects that require low angle front lighting in order to highlight the textured defects. The defects may be two dimensional "spots" that require diffuse front lighting in order to reduce reflection and enhance the contrast between defect and surface.

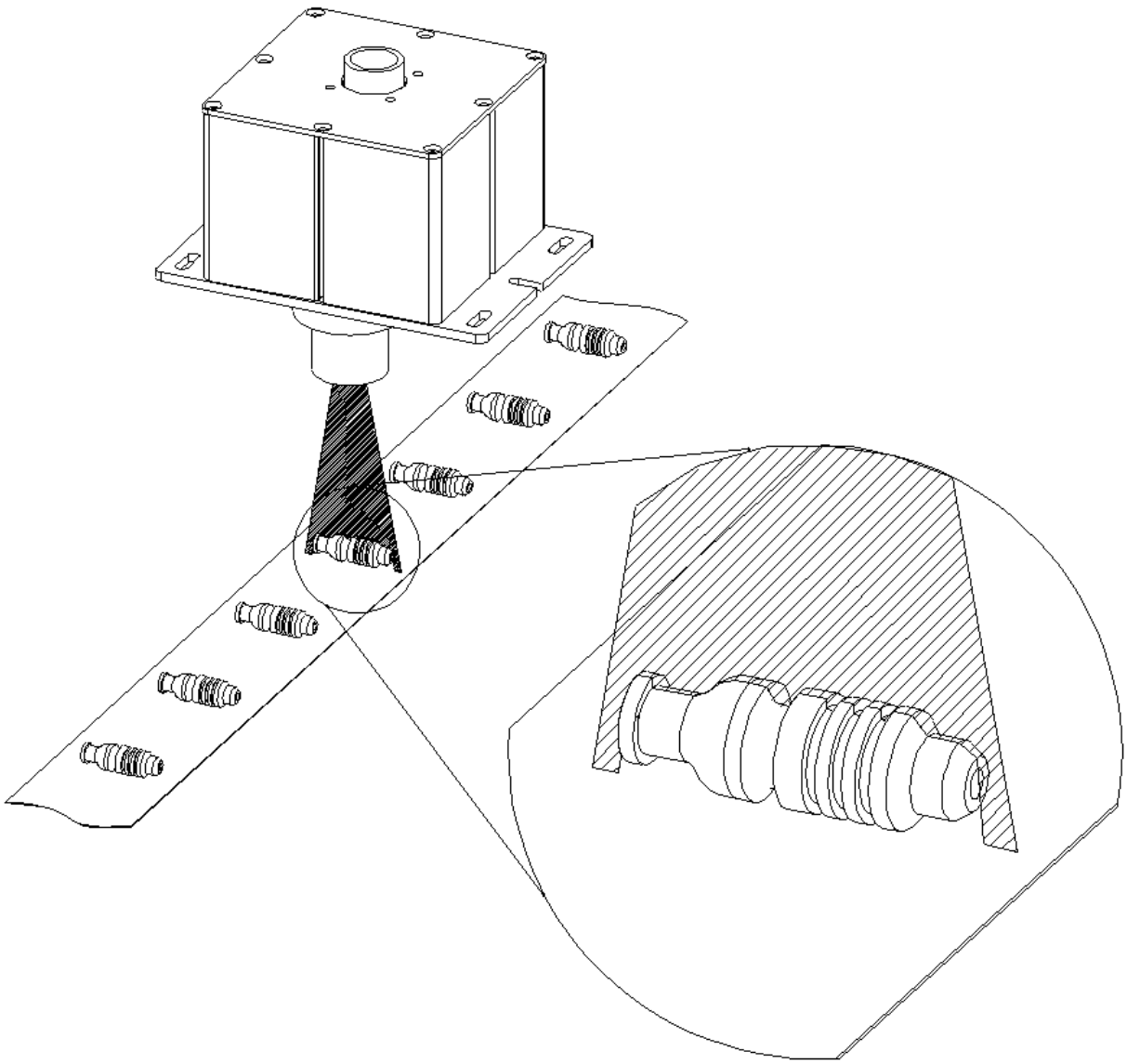


**Figure 8. Model 1000 Typical Installation-High Resolution Inspection of Small Parts**

Another example application for line scan inspection from one or two Imagers is when a very small field of view for very high resolution is required as depicted above.

## MODEL 1000

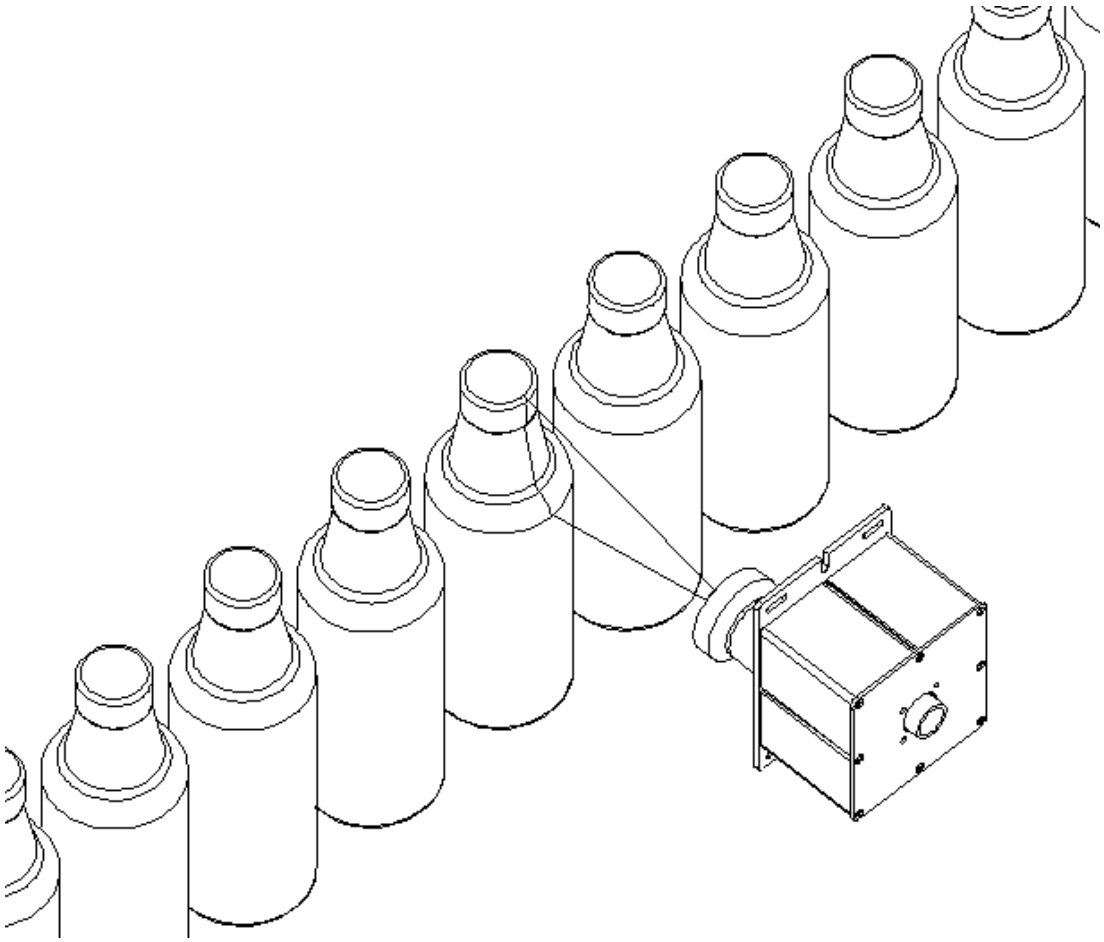


**Figure 9. Model 1000 Typical Installation-High Speed Inspection**

Another example application for line scan inspection from one or two Imagers is when the inspection of very high-speed lines is required as depicted above.

# APPENDIX B: LIGHTING

## NEWTON LABS SMART ILLUMINATORS

While the 1000 Series of Line Scan Vision Systems can be used with virtually any type of lighting, Newton Labs provides a wide range of Smart Illuminators specifically designed to enhance the performance and robustness of industrial vision applications. These Smart Illuminators are available in many different sizes, colors, and styles. Consult your Authorized Newton Labs Distributor for the full listing of available Smart Illuminators.

Smart Illuminators contain microprocessors to enable them to be used for continuous, strobe and pattern lighting. They are designed to match with 1000 Series line scan vision systems without the use of external control units. In addition, they can be used without external power supplies up to the current limit of the specific Newton Labs Model in the system. (See Page 20-DB25 Illumination Connector for the illuminator current limit of the Model you are using.) In that case, the only requirement is the use of a Newton Labs Smart Illuminator Cable, greatly simplifying installation.

## GENERAL LIGHTING CONSIDERATIONS

In general there are four main considerations when choosing a light source which will result in more consistent inspection results: ambient light, part presentation, choosing the appropriate light source, and budget.

### AMBIENT LIGHT

Ambient light refers to any outside light such as sunlight coming through windows or overhead room light. Ambient light seldom lends itself to suitable illumination for vision applications, as it tends to be inconsistent and causes inaccurate inspection results. It is therefore critical to control any and all ambient light within the immediate area of the vision installation. Sometimes this means building a shroud over or around the area of installation to completely block all ambient light. In other cases this could mean flooding the inspection area with enough dedicated stable light so as to supersede any ambient light.

### PART PRESENTATION

In general the more accurately and consistent the objects of inspection can be presented before the camera, the more accurate and consistent the lighting effect on the objects will be, and the more accurate and consistent the inspection results will be. It is therefore important to optimize part presentation.

### CHOOSING THE APPROPRIATE LIGHT SOURCE

Choose the right tool for the right job. Listed below are brief descriptions of the most common types of lighting. Please contact your Newton Labs Authorized Distributor for further information, pricing, and availability.

- Back lighting: commonly used for finding holes and taking dimensional measurements of objects (webs). Bright back lighting can penetrate opaque webs thus highlighting specs and blemishes within the web as dark spots.
- Front lighting: commonly used for applications where features on the surface of the object (web) are to be inspected. It is a simple concept where the lights illuminate the object from the front. Typically the lights are angled at 45 degrees shining down from the side with the camera looking straight down at the object. This technique is best used on surfaces that are not too reflective.
- Diffuse Lighting: commonly used for inspecting very reflective and curved surfaces and for detecting the presence of features on polished components. Polarizing filters also allow unwanted reflections to be dramatically reduced in intensity.
- Structured Light: commonly used to illuminate objects in order to extract depth information where other methods are impractical. Typically this involves a laser light source emitting a line or lines of light which, when projected on the three dimensional part, leaves a profile of it from which to gain data.
- Ring Lighting: commonly used when inspecting circular objects, small objects, or small areas of large objects. This technique provides very even illumination around the object.
- Fiber Optic Lighting: commonly used for small space constraint and small object illumination.
- Low Angle Lighting: commonly used for highlighting small surface features and textures where the features will appear bright against a dark background. In this technique, the light source shines from the side at a very low angle where the light glances off the object. It is important in this scenario to maintain a constant angle from light source to object for consistent and accurate results.

#### BUDGET

Lighting can become (relatively) expensive, but it is always worth the cost for accurate and consistent inspection results.

The least expensive are the low-voltage and fluorescent lights. They provide bright and consistent illumination, but have a limited life span (weeks/months) and will reduce in intensity with age. Newton Research Labs recommends replacing these types of lights half way through their rated life.

LED illumination is more expensive, but will last years before replacement. LED life span is generally rated at 100,000 hours. The illumination is very even and flicker-free. LEDs come in bright white, red, green, blue, yellow, orange, and infrared.

Also on the more expensive end are fiber optic lights, which are very suitable for small working space and/or small object illumination requirements. Whether using LED, fluorescent, or fiber optic lighting, each type comes in different shapes to suit different applications: bar lights, flat panel back lights, ring lights, dome lights, co-axial lights, flood lights, etc.

# APPENDIX C: CAMERAS

## LINE SCAN IMAGERS (CAMERAS)

Line Scan cameras operate quite differently than area scan cameras. In an area scan camera, a CCD matrix (usually rectangular in form) of pixels provides a view of an object that contains both length and width. With a line scan camera, the CCD contains only a single row of pixels. This almost one-dimensional image usually requires that the object be moved and that a series of pictures be taken to provide useful data for an inspection. Line scan cameras typically provide for very fast scanning of the pixels so that many pictures may be taken over a short period of time as the object moves in the field of view of the camera. These pictures are then combined in a Newton Labs line scan machine vision system, allowing normal machine vision algorithms to be used to analyze the picture and perform the inspection. In addition, once the pictures are combined in a Newton Labs line scan vision system, human viewable displays of the object that contain both length and width can be provided if desired for the application.

Line scan cameras can not be focused or aligned with the use of a standard video monitor. Special software utilities are provided with your Newton Labs Software Component for performing these processes. Consult your Newton Labs Software Component manual for exact procedures.

## NEWTON RESEARCH LABS IMAGERS

For maximum performance, use Newton Research Labs Line Scan Imagers. Newton Labs extensively researches and manufactures the latest camera technology for suitability in machine vision applications. The results of these findings, combined with Newton Labs' proprietary techniques, optimize Newton Labs Line Scan Imagers for machine vision use with Newton Labs Line Scan vision systems.

## OTHER CAMERAS

Other line scan cameras (color or monochrome) can be used with Newton Labs 1000 Series Vision Systems. Please contact your Newton Labs Authorized Distributor for connection details and further information.

# APPENDIX D: TROUBLESHOOTING

This section provides fundamental hardware troubleshooting for the Model 1000 Series Line Scan systems. For problems that are not covered in this section, contact your local Newton Labs Authorized Distributor.

## TIPS FOR GETTING A GOOD IMAGE

- Assure that the lens is focused properly. Refer to the lens focusing instructions in the "Blurry Image" section.
- Make sure that the light is consistently illuminated across the inspection area.
- Use lenses with longer focal lengths to produce more accurate images. Check with your Newton Labs Authorized Distributor regarding availability of lenses for the 9000 Series.

| PROBLEMS COMMUNICATING WITH THE 1000 LINE SCAN SERIES | |
|---|---|
| ♦ The user interface will not connect with the 1000 Series | Try the following first:<br>♦ Wait 30 seconds and try reconnecting.<br>♦ Check all connections.<br>♦ Make sure only one copy of the software component is running on the laptop or PC.<br>♦ Try to connect using another COM port.<br>♦ Turn off the computer, restart, and try again.<br>If the above suggestions do not provide results, follow the procedures below to further troubleshoot communications:<br>STEP 1: Establish communications via a communications terminal program.<br>HyperTerminal can be used to debug system communications. You can use the HyperTerminal program as follows:<br>Start HyperTerminal: Click the Start button, choose Run, type in Hypertrm.exe and click OK. A dialog box will appear with the words "Connection Description" in the title bar. Type NRL1000 (or 1200) in the name field. Under "Connect Using", click "Direct to Com ..." and choose the COM port you are using to connect to the 1000 Series. Try using COM 1, if you are using a PS-2 mouse. If you have a serial mouse, try COM 2. If you are not sure which COM port to use, repeat until you determine the right one.<br>Select the appropriate communications port. |

| PROBLEMS COMMUNICATING WITH THE 1000 SERIES (CONTINUED) | |
|---|---|
| ♦ The user interface will not connect with the 1000 Series (continued) | A dialog box will appear listing the properties for the com port selected. Set the com port properties to 115,200, 1 stop bit, Flow Control-Hardware<br><br>The HyperTerminal program will display a white box. Press the space key (several times). An "OK" will appear each time you press enter as long as the PC is communicating with the 1000 Series through HyperTerminal. If successful communications with the 1000 Series have been established, skip to Step 4.<br><br>STEP 2: Check the wiring<br><br>There may be a problem with the RS-232 cable or the laptop/PC. Make sure the wiring is correct.<br><br>STEP 3: Make sure the computer is working properly<br><br>If you are not able to obtain control over a COM port on the PC, check with your system administrator for help. If you are able to get control over a COM port, and you have checked all wiring and connections, go to Step 4.<br><br>STEP 4: Power down the 1000 Series and power up again normally.<br><br>STEP 5: Establish communications with the 1000 Series using the software component.<br><br>Disconnect from the terminal mode in the program you are using. Use the software component to try to connect to the 1000 Series. If you still cannot establish communications using the terminal mode and/or the software component after reloading the software and establishing that there are no problems with the wiring or PC, go to Step 6.<br><br>STEP 6: Call your Newton Labs Authorized Distributor<br><br>Arrange with your local distributor to substitute a working 1000 Series and laptop to determine where the problem exists. |

| **IMAGING PROBLEMS** | |
|---|---|
| ♦ The Image Is Entirely White | ♦ Make sure the Imager cable is connected properly to the Imager and to the system unit.<br>♦ Put your hand or a dark piece of paper over the Imager lens. If the image shown in the User Interface does not darken, then contact your Newton Labs Authorized Distributor. |
| ♦ The Image Is Black | ♦ Make sure the Imager cable is properly connected to the system unit and to the Imager.<br>♦ Point the Imager at a bright light. If the image shown in the User Interface is entirely black, then contact your Newton Labs Authorized Distributor. |
| ♦ Random Pixels Appear In The Image | This is commonly caused by electrical noise generated by motors and controllers connected to or near the 1000 Series, the Imager or Imager Cables. This random image noise can adversely affect inspections and should be minimized.<br>Use the following guide to try to isolate the cause of the noise:<br>STEP 1: The idea in this step is to determine what a normal image looks like for comparison. Try to electrically isolate the 1000 Series to determine a known or normal visual pattern in the User Interface of your Newton Labs Software Component. If it is not possible to electrically isolate the 1000 Series at it's normal mounting position, take the 1000 Series away from the area where inspections are being performed and connect it to an imager. Determine the normal image.<br>STEP 2: Determine the noise.<br>Reconnect the 1000 Series normally (or move it back on to the line if you had to remove it).<br>Block the lens to produce a dark image so that you can see the electrically induced noise. |

| IMAGING PROBLEMS (CONTINUED) | |
|---|---|
| ♦ Random Pixels Appear In The Image (continued) | Remove the unit from its current mounting- repeat Step 2.<br>Change the power source-repeat Step 2.<br>Change the ground connections-repeat Step 2.<br>Disconnect controllers and drives one at a time from the control panel-repeat Step 2.<br>Physically move the 1000 Series (or imager cables) away from the machine-repeat Step 2.<br>Continue with these suggestions until the source of the noise is discovered.<br>**Note: A common solution is to isolate the ground from the grounds of heavy machinery.** |
| ♦ The Image Is Too Dark | ♦ Increase the overall light by moving the illumination source closer to the inspection area, or by increasing the number of illumination sources.<br>♦ Adjust Exposure Time. The exposure time refers to the amount of time that the light is allowed into the CCD in the Imager. As the exposure time is increased, more light enters the CCD, and the image becomes brighter. Increasing exposure time may increase image blur when inspections are moving. The Software Component controls the exposure time. Consult the Newton Labs Software Component user's guide for details on increasing or decreasing exposure time and if it is available with your Software Component.<br>♦ It may be helpful to increase the gain rather than increasing exposure time. This is useful when you wish to increase the contrast or brightness in the image. Note: higher gains increase the CCD's sensitivity to light, producing lower quality images, and may adversely affect the inspection. For details on increasing or decreasing Imager gain and if it is available with your Software Component, consult the Newton Labs Software Component user's guide.<br>♦ If you have an adjustable lens, open the aperture to let in more light |

| IMAGING PROBLEMS (CONTINUED) | |
|---|---|
| ♦ The Image Is Too Bright | ♦ If you have an adjustable lens, close the aperture to let in less light.<br>♦ Decrease the illumination source.<br>♦ Decrease the Exposure Time, if it is available with your Software Component.<br>♦ If you previously increased the gain, you may wish to decrease it. |
| ♦ White Streaks Appear In The Image | Decrease the illumination source and test |
| ♦ The Image Is Blurry | You may need to:<br>♦ Re-focus the lens.<br>On most lenses, a small screw locks the focus ring in place.<br>Position the 4500 Series Imager so that it is acquiring an image of an object. The distance from the 4500 Series to the object should be the same as the distance from 4500 Series to the actual inspection object.<br>Adjust the lens focus by rotating it.<br>♦ Clean the lens.<br>A clean lens ensures that the images acquired by the 1000 Series Imagers are accurate. This is important to the inspection performance. The lens can be cleaned with a commercial glass cleaner and a lint-free cloth.<br>You may need to clean the lens daily in dusty environments.<br>♦ Adjust the exposure time.<br>Images acquired on moving assembly lines can become blurry if the exposure time is too long.<br>Adjust the exposure time to the optimal time calculated above. See “If the Image Is Too Dark” in this section for more information on adjusting the exposure time.<br>If the image is too dark, either increase the Imager gain, or increase the illumination. See “If the Image is Too Dark” for more information. |

## ALL INSPECTIONS ARE FAILING

If a working application suddenly returns failed inspections for all or most of the inspections, the 4500 Series Imager has probably been bumped, or something has obscured the field of view. A change in lighting conditions is another possible problem area. Observe the inspection results to help determine causes of failure.

| | |
|---|---|
| ♦ Check the lighting conditions | A light source that dims over time or a light source that has gone out completely can affect the inspection. Make sure that your light sources are strong and positioned correctly. Good lighting is essential to getting a good image and to inspection performance. |
| ♦ Check to see if the 4500 Series Imager is out of position | Put the 4500 Series Imager to its original position. If you are unsure, reposition it as close to the original location as possible.<br><br>If you cannot reposition the 4500 Series Imager properly, connect the 1000 Series to a PC and redo the inspection setup in the software component. |

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