NEWTON
RESEARCH LABS

Model 9000/9200/9400

High Performance Color & Greyscale Vision Systems

Installation and Reference Manual

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INTRODUCTION

The 9000 Series vision systems represent Newton Labs' most powerful and popular general-purpose machine vision offerings. The highlights of the 9000 Series include:

► High Resolution

► High Performance MMX Processing Power

► Abundant serial and digital I/O options

► Flexible communication via serial, Ethernet 10/100baseT and optional DeviceNet and Profibus

► Compatibility with NTSC, S-Video and Progressive scan cameras

► Rugged Nema enclosures and connectors

► High resolution

Combined with the appropriate Newton Labs Imager, cable, light source, and software components, the 9000 Series vision systems provide solutions for most machine vision applications. Some common examples are: color verification, object measurement, pattern recognition, 2D bar code reading, high speed inspection, and high resolution inspection.

Like all Newton Labs vision systems, the Model 9000 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 9000 Series 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 9000 Series.

Model 9000 Specifications

Construction

Size: 9.5" x 5 " x 9.25"
Weight: 10 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: 10/100 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
Imager: Rugged 10 Pin Connector
Imager Output: BNC connector for direct Imager output
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 8.8 billion pixel operations per second
Set up: Use with Newton Labs pre-programmed software components for easy set up

Model 9200 Specifications

Construction

Size: 9.5" x 5 " x 9.25"
Weight: 10 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: 10/100 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
Imager: 2 Rugged 10 Pin Connector
Imager Output: 2 BNC connector for direct Imager output
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 8.8 billion pixel operations per second
Set up: Use with Newton Labs pre-programmed software components for easy set up

Model 9400 Specifications

Construction

Size: 9.5" x 5 " x 9.25"
Weight: 10 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: 10/100 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
Imager: 4 Rugged 10 Pin Connector
Imager Output: 4 BNC connector for direct Imager output
Video Output: BNC connector for vision system output in video format
Illumination: DB25connector 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 8.8 billion pixel operations per second
Set up: Use with Newton Labs pre-programmed software components for easy set up

9000 Series Features

► Extremely High Performance Embedded MMX

► 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 10/100baseT (DeviceNet and Profibus optional)

► Threaded Imager connections(s) (compatible with NTSC, S-Video and Progressive scan cameras)

► BCN connectors(s) for video out

► Rugged NEMA enclosures, completely sealed against dust and contaminants

► Back plate for panel mounting

Model 9000 Description

The Model 9000 is the standard base model in this high performance series. The Model 9000 is designed to be easily integrated with an appropriate Imager and illumination source for virtually any machine vision requirement, both color and gray scale.

The Model 9000 is designed for use with a single camera, however, like the majority of Newton Labs systems, this model can be expanded to use multiple cameras with the addition of a Newton Labs multiplexer.

Model 9200 Description

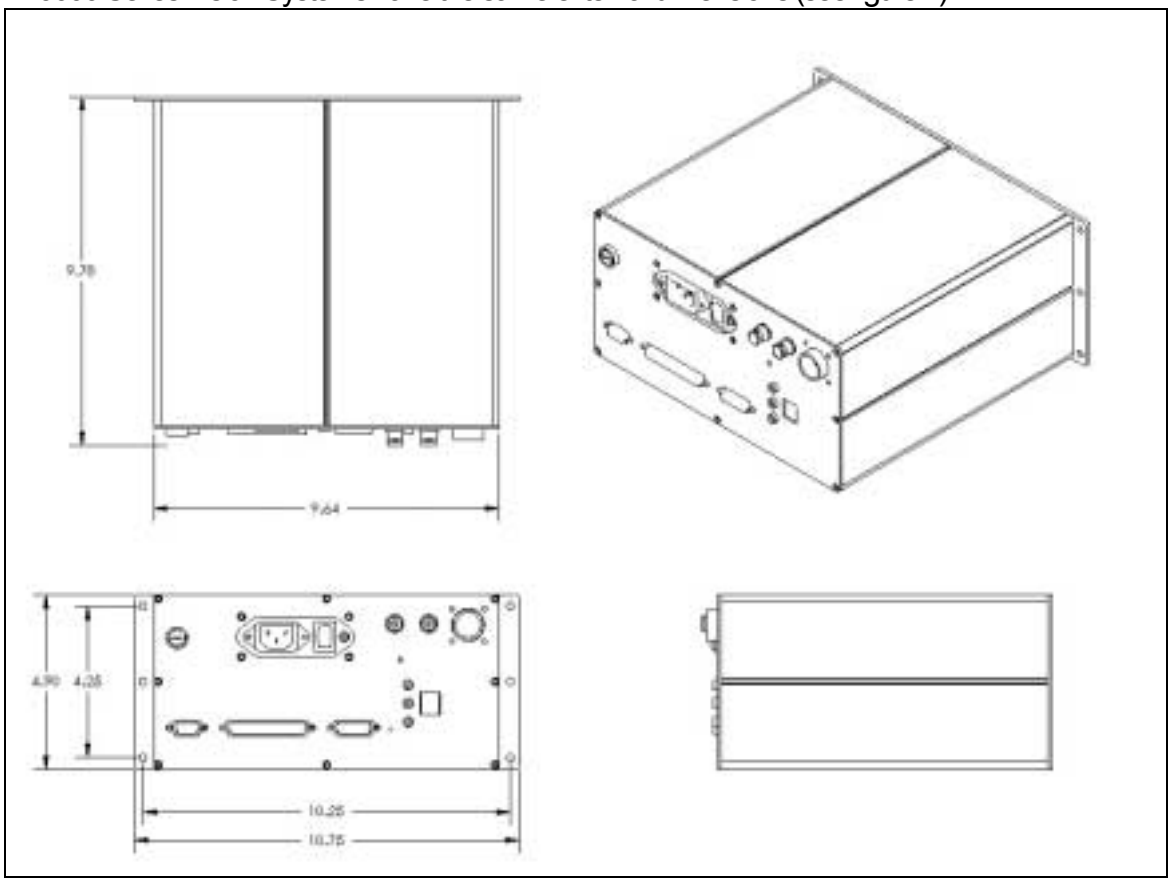
The Model 9200 concurrently processes the video from two cameras where simultaneous inspection from both cameras is required. It excels in applications such as 3D stereo tracking, applications where two sides of an object must be inspected at the same time or cases when a reference dimension must be maintained during the inspection

Model 9400 Description

The Model 9400 provides inputs for four cameras. With the Model 9400, up to four cameras may be time sequenced for inspections around an object, along stations of an assembly line, or those requiring multiple fields of view. The Model 9400 offers an economical advantage where multiple cameras are necessary, but without the cost of multiple vision systems.

DIMENSION AND STANDARD MOUNTING

All 9000 Series Vision Systems have the same external dimensions (see figure 1)



Dimensions in Inches

Figure 1. Series 9000 Dimensions

Series 9000 Back Panel

The back panel on the 9000 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 9000 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.

9000 FRONT PANEL

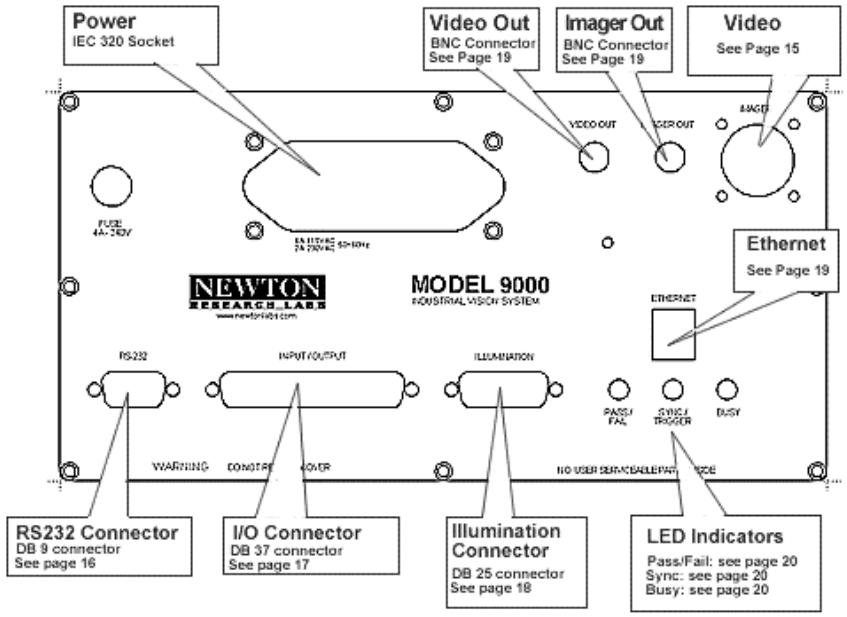


Figure 2. Model 9000 Front Panel

All the connectors and indicator on the Model 9000 are also found on the Model 9200 and the Model 9400

9200 FRONT PANEL

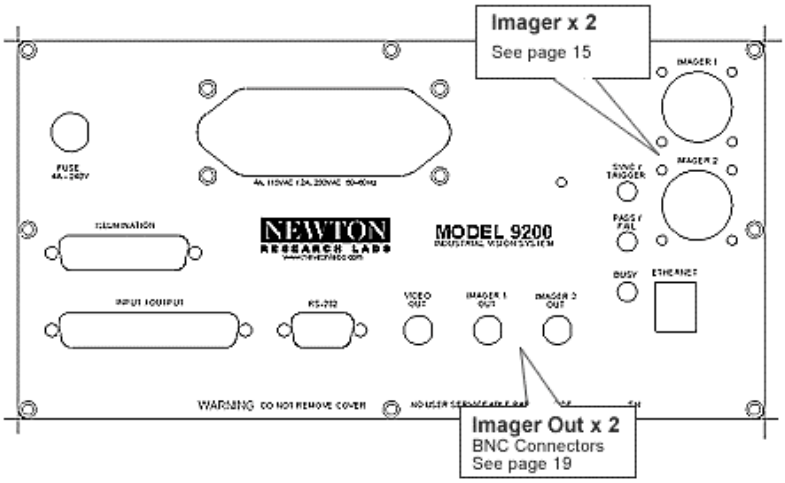


Figure 3. Model 9200 Front Panel

9400 FRONT PANEL

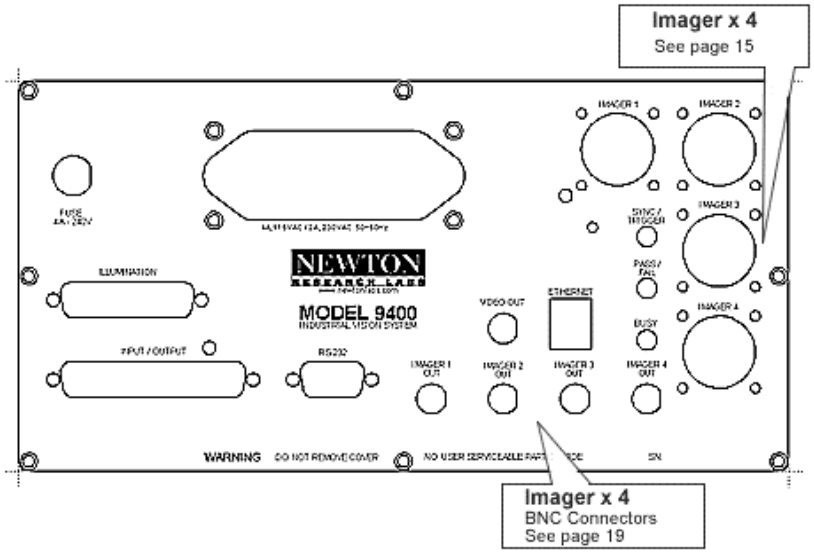


Figure 4. Model 9400 Front Panel

CONNECTIONS

OVERVIEW

9000 Series

Connection	Description/Notes	For details refer to:
RS 232	Standard serial port for config.	Page 17
Inputs/Outputs	DB37 Connector Wide range of I/O options	Page 18
Illumination	DB25 Connector Operates up to 6 Newton Lab Smart Illuminators or other lights	See Page 18
Video Out	Vision System Output in video format	See Page 20
Imager Out	Direct or raw video out from Newton Labs Imagers or other cameras	See Page 20
Network	10/100 baseT Ethernet	See Page 20
Imager	9000 has 1 Imager Connection 9200 has 2 Imager Connections 9400 has 4 Imager Connections	Connects via Newton Labs Imager Cables to Newton Labs Imagers to other cameras

DB9 RS-232 SERIAL CONFIGURTION 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	
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 9000 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 20mA Sinking Output See page 24	PCL 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 24	Ground or Supply See page 24
26	Output 14 (Busy)	OPTO_OUT_BUSY	10-27 VDC—Max 20 mA Sinking Output See Page 24	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 VCD Dual Input (Source or Sink) See Page 23	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 23	Ground or Supply See Page 23

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 Labs Smart Illuminator
8	Communication	IL_3_SER_VIS_TO_IL	Communication Signal Illuminator 3	Newton Labs Smart Illuminator
9	Communication	IL_5_SER_VIS_TO_IL	Communication Signal Illuminator 5	Newton Labs Smart Illuminator/Multiplexer
10	Communication	IL_1_SER_IL_VIS/VIS_TO_MULTI_TX+	Communication Signal Illuminator 1/Multiplexer	Newton Labs Smart Illuminator
11	Communication	IL_3_SER_IL_TO_VIS	Communication Signal Illuminator 3	Newton Labs Smart Illuminator
12	Communication	IL_5_SER_IL_TO_VIS	Communication Signal Illuminator 5	Newton Labs 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 Labs Smart Illuminator
21	Communication	IL_4_SER_VIS_TO_IL	Communication Signal Illuminator 4	Newton Labs Smart Illuminator
22	Communication	IL_6_SER_VIS_TO_IL	Communication Signal Illuminator 6	Newton Labs Smart Illuminator
23	Communication	IL_2_SER_IL_TO_VIS /VIS_TO_MULTI_TX+	Communication Signal Illuminator 2/Multiplexer	Newton Labs Smart Illuminator/Multiplexer
24	Communication	IL_4_SER_IL_TO_VIS	Communication Signal Illuminator 4	Newton Labs Smart Illuminator
25	Communication	IL_6_SER_IL_TO_VIS	Communication Signal Illuminator 6	Newton Labs Smart Illuminator

***Total Maximum Continuous Current Draw**

ETHERNET

Standard RJ-45 Connector 10/100 baseT Ethernet
► Model 9000 10/100 baseT
► Model 9200 10/100 baseT
► Model 9400 10/100 baseT

VIDEO OUT

BNC Connector—vision system output in video format. Standard Series 9000 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 Components Users Guide for your application for use and Configuration of this display.

IMAGER(S) OUT

BNC Connector-Raw Imager Video Output
Model 9000 – 1 Imager Connector
Model 9200 – 2 Imager Connector
Model 9400 – 4 Imager Connector
This output is used for:
► Imager Focusing
► System Setup or Debugging

The Imager out output is not available for RGB, S-Video or Progressive Scan Imagers.

STANDARD NTSC OR PAL IMAGERS FROM NEWTON LABS

Standard Series 9000 Imagers are RS170 (NTSC). Optional PAL Imagers are available on order.

OTHER CAMERA

Output may be available for other cameras. Consult your Newton Labs Authorized Distributor or the factory for details.

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 User 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 and multiple multiplexers.

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.

INPUTS AND OUTPUTS

LINE LOCK INPUT

The 9000 Series uses the Line Lock input to sync with the local power grid. This input is useful in applications where:

- ► The video input to the Series 9000 vision system needs to be synchronized with the lighting, such as fluorescent or other types of flickering lighting
- ► Multiple Series 9000 vision systems need to be time synchronized with each other and lighting
- ► Multiple cameras need to be genlocked (synchronized) with each othe.

SERIAL INPUT AND OUTPUT

The 9000 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 detail on available inputs, outputs and configuration of this port.

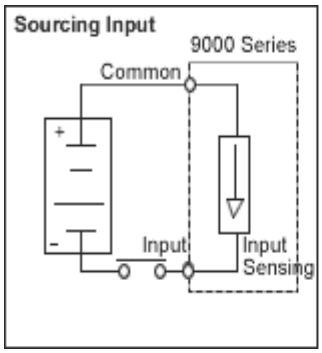
DIGITAL INPUTS AND OUTPUTS

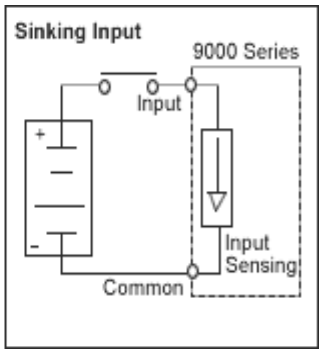
9000 SERIES DUAL DIGITAL INPUTS

The Model 9000 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	>10VDC
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) 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.

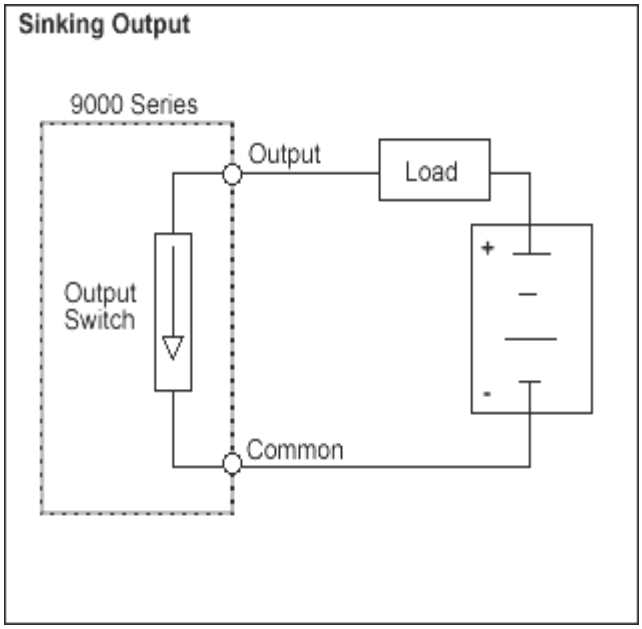
9000 SERIES DIGITAL OUTPUTS

The Model 9000 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 pin 26,27 and 28 are designated in software for special purpose usage and should not be utilized as general purpose outputs except in special cases. See Newton Labs Software Component Users Guide for full detail of the 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 setting on these outputs.

APPENDIX A: TYPICAL INSTALLATION

MODEL 9000

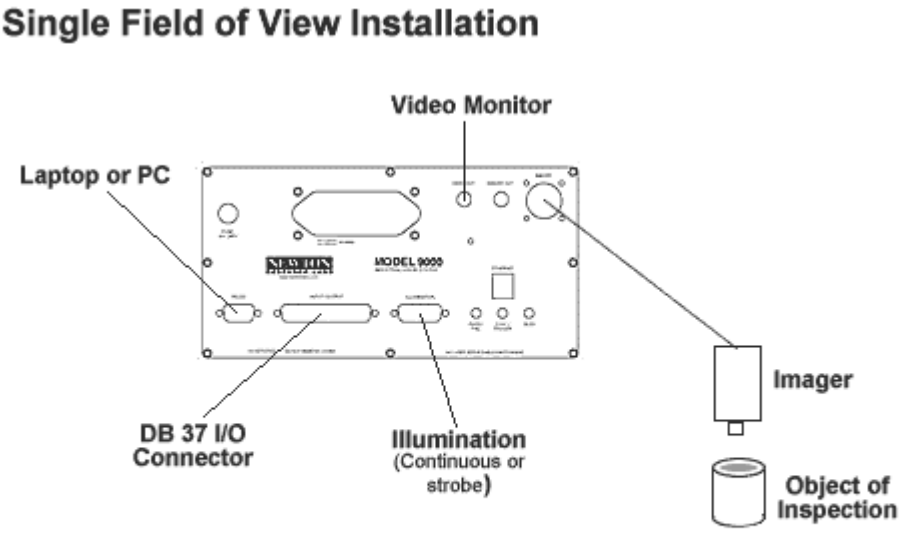


Figure 5. Model 9000 Typical Installation

The Model 9000 (8000, 7000) is typically used for inspections requiring a single field of view or only one Imager as depicted in the diagram above (one side of an object). In these cases, the associated Model 9000 Imager will be mounted in a position (fixed or robot controlled), which in relation to the installed illumination source, will provide optimum resolution, contrast and image quality for the given inspection.

MODEL 9200

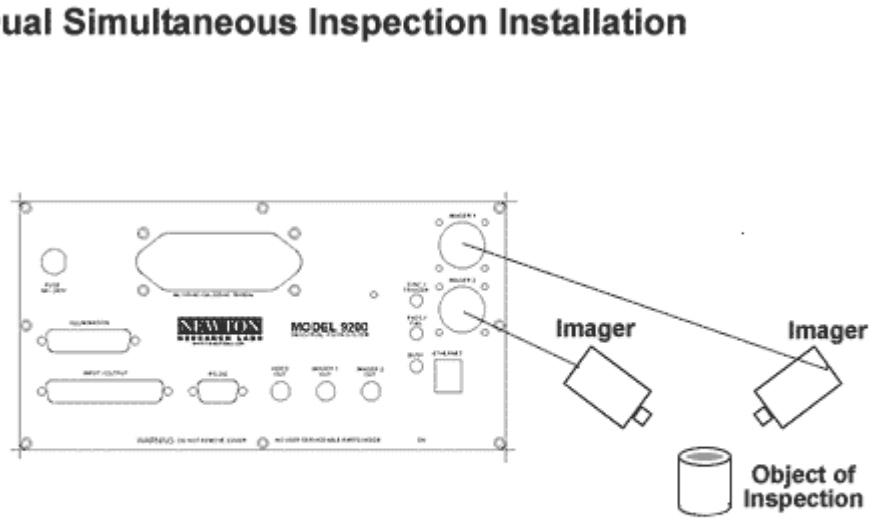


Figure 6. Model 9200 Typical Installation—3D

The Model 9200 is typically used for applications requiring two Imagers capable of simultaneous inspection from each camera. An example application is 3D stereo tracking of moving object. The resulting X and Y coordinate data from each camera can be combined (via software) and translated to the equivalent of X, Y and Z dimensional movement.

MODEL 9200

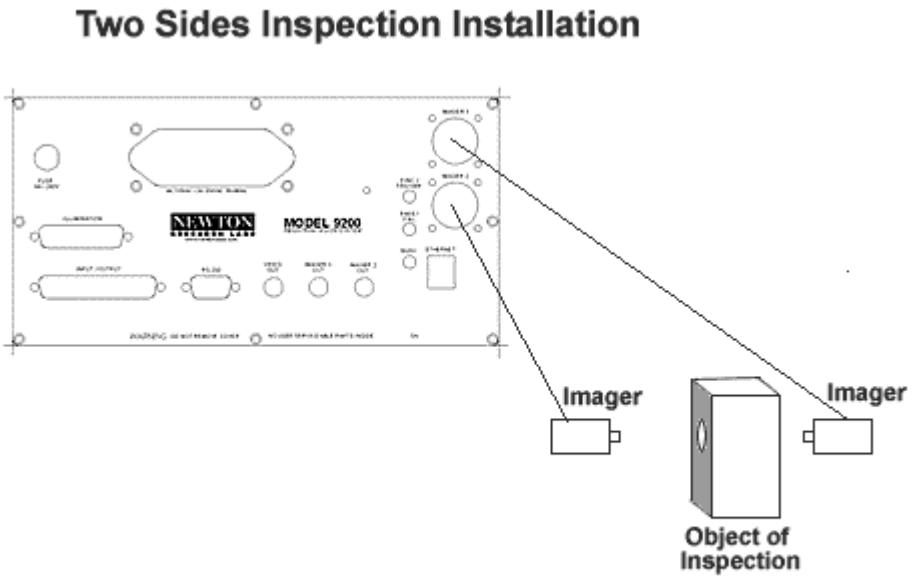


Figure 7. Model 9200 Typical Installation—Two Sides

Another example application for dual simultaneous inspection from two Imagers is when two sides of an object must be inspected at the same time as depicted in Figure 7.

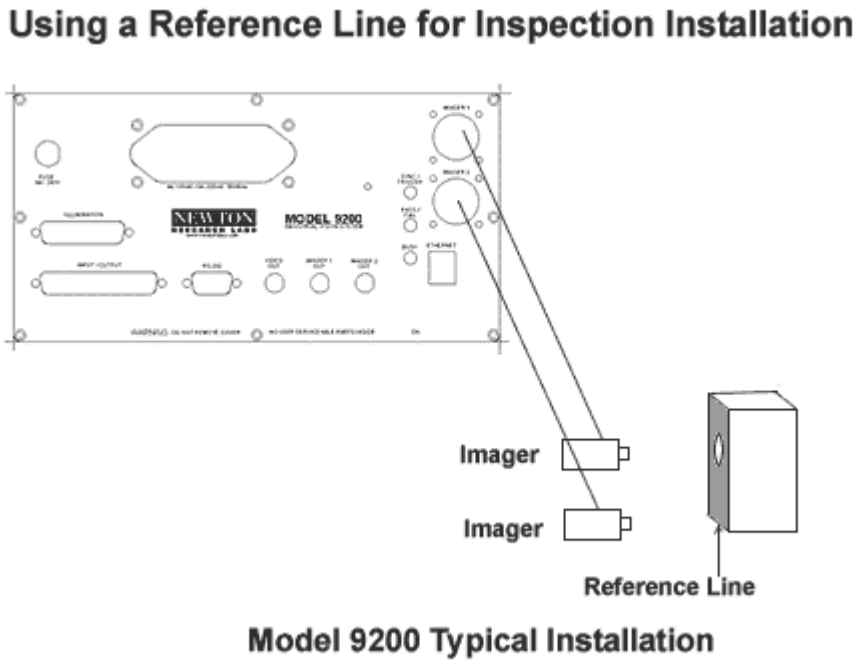


Figure 8. Model 9200 Typical Installation—Using a Reference line

Another common application for dual simultaneous inspection from two Imagers is when one Imager is used a reference for the other Imager to base its inspections. In the diagram above the bottom Imager is using the line on the “box” as a reference in which to base a “Y” location measurement of the reference line in this example, also acts as a means to account for any tilt or skewing of the object on the assembly line to assure accurate inspection results of the top Imager.

MODEL 9400

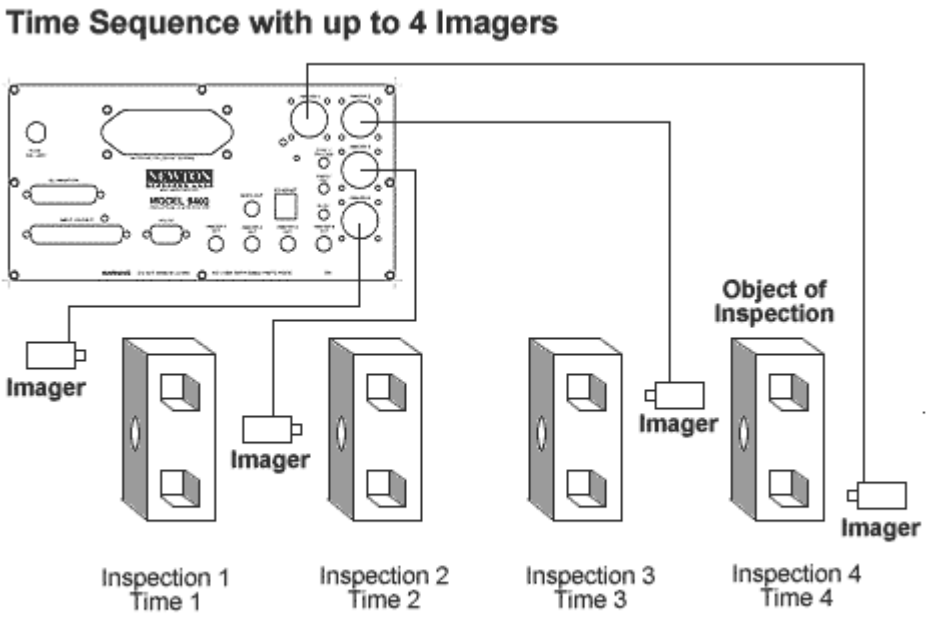


Figure 9. Model 9400 Typical Installation—Time Sequence

The Model 9400, 8400 and 7400 are typically used for applications requiring up to four Imagers. The Model 9400 is time sequence with approximately 17 mS between each Imager providing a very efficient way to perform inspection around an object as shown above in Figure 9.

MODEL 9400

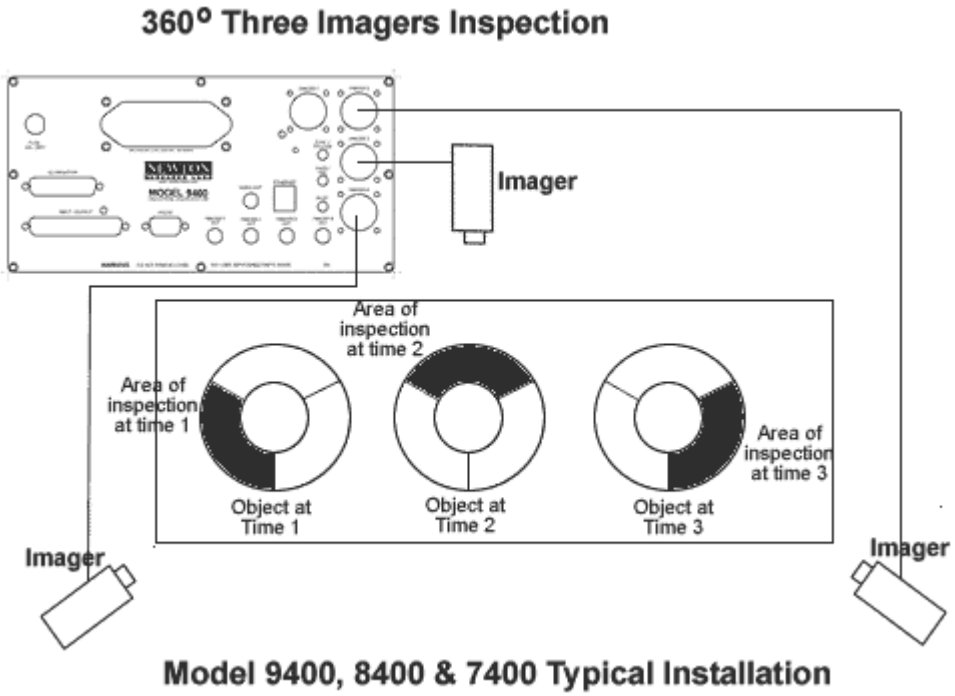


Figure 10. Model 9400 Typical Installation--360° Inspection

The above diagram depicts the Model 9400 in use with three Imagers to create a 360-degree view around an object. In this example, each of the three Imagers accounts for a 120-degree view of the object. The three Imagers are time sequenced, but can still accommodate fast moving objects (bottling line speeds) as they pass by the Imagers. The Imagers are mounted slightly offset to account for the movement of the objects between the inspections. The Model 9400 can time sequence at speeds up to 17 mS per Image.

APPENDIX B: LIGHING

NEWTON LABS SMART ILLUMINATORS

While the 9000 Series of 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 9000 Series 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 18 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 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 in objects and taking dimensional measurements of objects where only the silhouette of the object is required. It is a very effective and simple to set up technique where the

camera views the profile of the object. As this technique requires access to both sides of the object, it may not be suitable in all cases.

- Front lighting: commonly used for applications where features on the surface of the object 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. Dome lights are very effective diffuse light sources where the camera looks through a hole in the top of a hemispherical dome shaped light. The dome typically houses LED lights inside it, which shine on the inside dome surface causing diffuse light to reflect onto the object of interest. Polarizing filters also allow unwanted reflections to be dramatically reduced in intensity.

- Co-Axial Lighting: commonly used to properly illuminate the insides of holes for inspection. In short, this technique allows both the cameras to look straight onto the object and the light source to shine directly onto the object at the same time. The co-axial light is a box with a 45 degree angled mirror (one sided) in it allowing the camera to look through both it and the mirror and onto the object. Meanwhile, the light source shines from the side onto the other side of the mirror reflecting the light directly onto the object. Trying to illuminate the bottoms of holes any other way will result in unwanted shadows and a difficult vision task.

- 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

NEWTON RESEARCH LABS IMAGERS

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

OTHER CAMERAS

Other cameras (color or monochrome) can be used with Newton Labs 9000 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 9000 Series. 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.

PROBLEM COMMUNICATING WITH THE 9000 SERIES	
► The user interface will not connect with the 9000 series	Try the following first: ► Wait 30 seconds and try reconnecting. ► Check all connections. ► Make sure only one of the software component is running on the Laptop or PC. ► Try to connect using another COM port. ► Turn off the computer, restart and try again. If the above suggestions do not provide results, follow the procedures below to further troubleshoot communications: STEP1: Establish communications via a communication terminal program. HyperTerminal can be used to debug system communications. You can use the HyperTerminal program as follows: 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 NRL9000 in the name field. Under "Connect Using", click "Direct to Com ..." and choose the COM port you are using to connect to the 9000 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.

PROBLEMS COMMUNICATING WITH THE 9000 SERIES (CONTINUED)	
► The user interface will not connect with the 9000 Series (continued)	Select the appropriate communications port. 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 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 9000 Series through HyperTerminal. If successful communications with the 9000 Series have been established, skip to Step 4. STEP 2: Check the wiring There may be a problem with the RS-232 cable or the laptop/PC. Make sure the wiring is correct. STEP 3: Make sure the computer is working properly 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. STEP 4: Power down the 9000 Series and power up again normally. STEP 5: Establish communications with the 9000 Series using the software component. Disconnect from the terminal mode in the program you are using. Use the software component to try to connect to the 9000 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. STEP 6: Call your Newton Labs Authorized Distributor Arrange with your local distributor to substitute a working 9000 Series and laptop to determine where the problem exists.

IMAGING PROBLEMS

To assist in troubleshooting, connect the 9000 Series to any NTSC color monitor. Use a BNC cable and adapters to connect from the monitor to the appropriate Imager Out terminal on the front panel of the 9000 Series unit. This will allow you see what the Imager is seeing in terms of bright spots, reflections, and other illumination related problems.

► The Image Is Entirely White	► Make sure the Imager cable is connected properly to the Imager and to the system unit. ► Put your hand or a dark piece of paper over the Imager lens. If the live image 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. ► Point the Imager at a bright light. If the live image 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 9000 Series, the Imager or Imager Cables. This random image noise can adversely affect inspections and should be minimized. Use the following guide to try to isolate the cause of the noise: STEP 1: The idea in this step is to determine what a normal image looks like for comparison. Try to electrically isolate the 9000 Series to determine a known or normal visual pattern on the video monitor. If it is not possible to electrically isolate the 9000 Series at it's normal mounting position, take the 9000 Series away from the area where inspections are being performed and connect it to an imager. Determine the normal image. STEP 2: Determine the noise. Reconnect the 9000 Series normally (or move it back on to the line if you had to remove it). Block the lens to produce a dark image so that you can see the electrically induced noise.

*Note: It may be difficult to see with the human eye the raw video output from an IR Imager. Ensure that the light you are using contains sufficient IR signal to produce an output on the video monitor.

IMAGING PROBLEMS (CONTINUED)	
► Random Pixels Appear In The Image (continued)	Remove the unit from its current mounting- repeat Step 2. Change the power source-repeat Step 2. Change the ground connections-repeat Step 2. Disconnect controllers and drives one at a time from the control panel-repeat Step 2. Physically move the 9000 Series (or imager cables) away from the machine-repeat Step 2. Continue with these suggestions until the source of the noise is discovered. **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. ► 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. ► 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. ► 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. ► Decrease the illumination source. ► Decrease the Exposure Time, if it is available with your Software Component. ► 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: ► Re-focus the lens. On most lenses, a small screw locks the focus ring in place. Position the 9000 Series Imager so that it is acquiring an image of an object. The distance from the 9000 Series to the object should be the same as the distance from 9000 Series to the actual inspection object. Adjust the lens focus by rotating it. Observe the focus in the video monitor. The clearer the object becomes, the better the lens is focused. ► Clean the lens. A clean lens ensures that the images acquired by the 9000 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. You may need to clean the lens daily in dusty environments. ► Adjust the exposure time. Images acquired on moving assembly lines can become blurry if the exposure time is too long. 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. 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 9000 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. To see the effect of the lighting, connect a video monitor to the appropriate Imager Out connector and monitor the live image.
► Check to see if the 9000 Series Imager is out of position	Put the 9000 Series Imager to its original position. If you are unsure, reposition it as close to the original location as possible. If you cannot reposition the 9000 Series properly, connect the 9000 Series to a PC and redo the inspection setup in the software component.

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