PresencePLUS® P4

AREA

User's Manual

Features

- One-piece, self-contained vision sensor in a compact package; no external controller necessary.
- Includes a Location tool, Analysis tools, and the following Vision tools:
  - Average Gray Scale
  - BLOB Detect
- Available models are P4 AREA for fast presence/absence inspections, and P4 AREA 1.3 for presence/absence inspections of large areas.
- Easy to use, even with minimal knowledge of vision. The Sensor is quick to set up and begin running inspections.
- Easily and accurately reconfigured for new product inspection by simply performing a remote TEACH.
- Convenient, 12-pin discrete I/O for seamless integration into machine control systems.
- Separate video output for direct connection to optional real-time video display without a PC.
- Right-angle and in-line housing options with mounting brackets included for easy installation.

WARNING . . . Not To Be Used for Personnel Protection

Never use these products as sensing devices for personnel protection. Doing so could lead to serious injury or death.

These sensors do NOT include the self-checking redundant circuitry necessary to allow their use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition. Consult your current Banner Safety Products catalog for safety products which meet OSHA, ANSI and IEC standards for personnel protection.

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more sensors, more solutions
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Version Note

This User's Manual reflects GUI Software Version 2.6.0 and *Presence*Plus *P4* AREA Sensor Firmware Version 1.1.1.

1. Product Support and Maintenance

This section provides general Banner resources and specific documentation for installers and operators of the *Presence*PLUS *P4* AREA/AREA 1.3 Sensor.

1.1 Product Support

Banner provides the following resources for quickly setting up and operating the Sensor.

Documentation

The following documentation is available in PDF format on the *Presence*PLUS software CD and on the Banner website. A compatible version of Acrobat Reader is provided on the CD. *Presence*PLUS *P4* documentation is in the **Vision Product Line** list on the following Banner website page:

www.bannerengineering.com/literature_resources/product_literature

***PresencePLUS P4* QuickStart Guide P/N 118000:** An overview of setting up and using *Presence*PLUS *P4* Sensors to run inspections.

Help Files: The *Presence*PLUS *P4* AREA/AREA 1.3 Help files provide convenient access to detailed instructions for setting up and running inspections. These online Help files are included with the Sensor and can be viewed from the GUI.

Banner Website

The most current *Presence*PLUS *P4* information, documentation, and software updates are available at the following Banner website page:

www.bannerengineering.com/literature_resources/software_eds/soft_results.php

Warranty Service

The *Presence*PLUS *P4* AREA/AREA 1.3 Sensor is designed for reliability. Do not open the housing; it contains no field-replaceable components. If repair is necessary, do not attempt to repair the Sensor yourself; return the unit to the factory. Should it become necessary to return a Sensor to the factory, please do the following:

1. Contact the Banner Factory Application Engineering group at the address or numbers listed below.
   They will attempt to trouble shoot the system from your description of the problem. If they conclude that a component is defective, they will issue an RMA (Return Merchandise Authorization) number for your paperwork and give you the proper shipping address.
2. Pack the Sensor carefully. Damage which occurs during return shipping is not covered by warranty.

Factory Support

Call, e-mail, fax, or write your local Banner representative or a Banner Applications Engineer for support. Applications Engineers are available from 8:00 A.M. to 5:00 P.M. Central Time, Monday through Friday, excluding holidays.

Phone	Local: 763.544.3164 Toll free: 1.888.3.SENSOR (1.888.373.6767)
Fax	763.544.3213
E-mail	sensors@bannerengineering.com
Address	Banner Engineering Corp. 9714 10th Avenue North Minneapolis, MN 55441 USA

To help Banner better assist you, be ready to provide the following information:

- *Presence*PLUS software version (to find version number, click Help in the Main Menu toolbar and choose About)
- Operating system of your PC
- Sensor Model Number and Date Code. Model Number is on top of Sensor, Date Code is either on the bottom or the side.
- Exact wording of any messages that appeared on your screen
- A description of what you were doing and what happened
- A description of how you tried to solve the problem

1.2 Maintenance

Maintenance tasks include keeping the hardware free of dust and dirt and updating the *Presence*PLUS software as new versions become available.

Cleaning the Sensor

Regularly remove any dust or dirt from the Sensor using a soft cloth. If needed, slightly dampen the cloth with a weak solution of neutral detergent. Avoid getting dirt on the imager (the area behind the lens). If the imager is dirty, use anti-static compressed air to blow off the dust.

Cleaning the Lens

Regularly remove dust, dirt, or fingerprints from the lens. Use anti-static compressed air to blow off dust. If necessary, use a lens cloth and lens cleaner or window cleaner to wipe off remaining debris.

Do not use any other chemicals for cleaning.

Updating the *Presence*PLUS Software

The current version of *Presence*PLUS software is available for download from the Banner website. See Banner Website on page 1 for the software downloads link.

2. System Overview

2.1 Sensor Description

The *Presence*PLUS *P4* AREA/AREA 1.3 Sensor is an easy-to-use sensor with advanced inspection capabilities. With minimal knowledge of vision, a user can quickly set up the Sensor and run an inspection that tests all products and accurately rejects bad products on a production line.

Inspections are set up using a remote personal computer (PC) or by activating the Remote Teach input. The Sensor captures images, and its software analyzes images using one or more Vision tools to pass or fail the product. The PC is not required for running inspections after the inspection files have been stored in the Sensor's memory.

Inspection setup involves focusing the lens and selecting the appropriate Analysis tools or, after initial setup, by activating the Remote Teach input. The full range of inspection parameters can be established either automatically or manually. The automatic Teach function eliminates the repetitive process of determining correct parameters.

The Sensor accommodates both translational and rotational variation. Parts moving down a production line or web need not be oriented in exactly the same way.

The Sensor is self-learning and easy to operate, with both basic and advanced options. For basic options, new users can follow the guided Setup sequence. Advanced users can override automatic settings and create highly customized inspections.

2.2 Typical Application

A typical *Presence*PLUS *P4* AREA/AREA 1.3 application is shown in Figure 2-1.

Figure 2-1. Typical *Presence*PLUS *P4* AREA application

2.3 Components and Connections

For detailed information about each system component and instructions on installing the components and software, see Section 3, Installation on page 6.

TIP The trigger device can be any 10-30V dc photoelectric sensor or device with a similar output.

Components

The *Presence*PLUS *P4* system consists of the Sensor and a PC with *Presence*PLUS software and the appropriate connections. The Sensor requires lighting and a trigger device, and an optional video monitor can be connected.

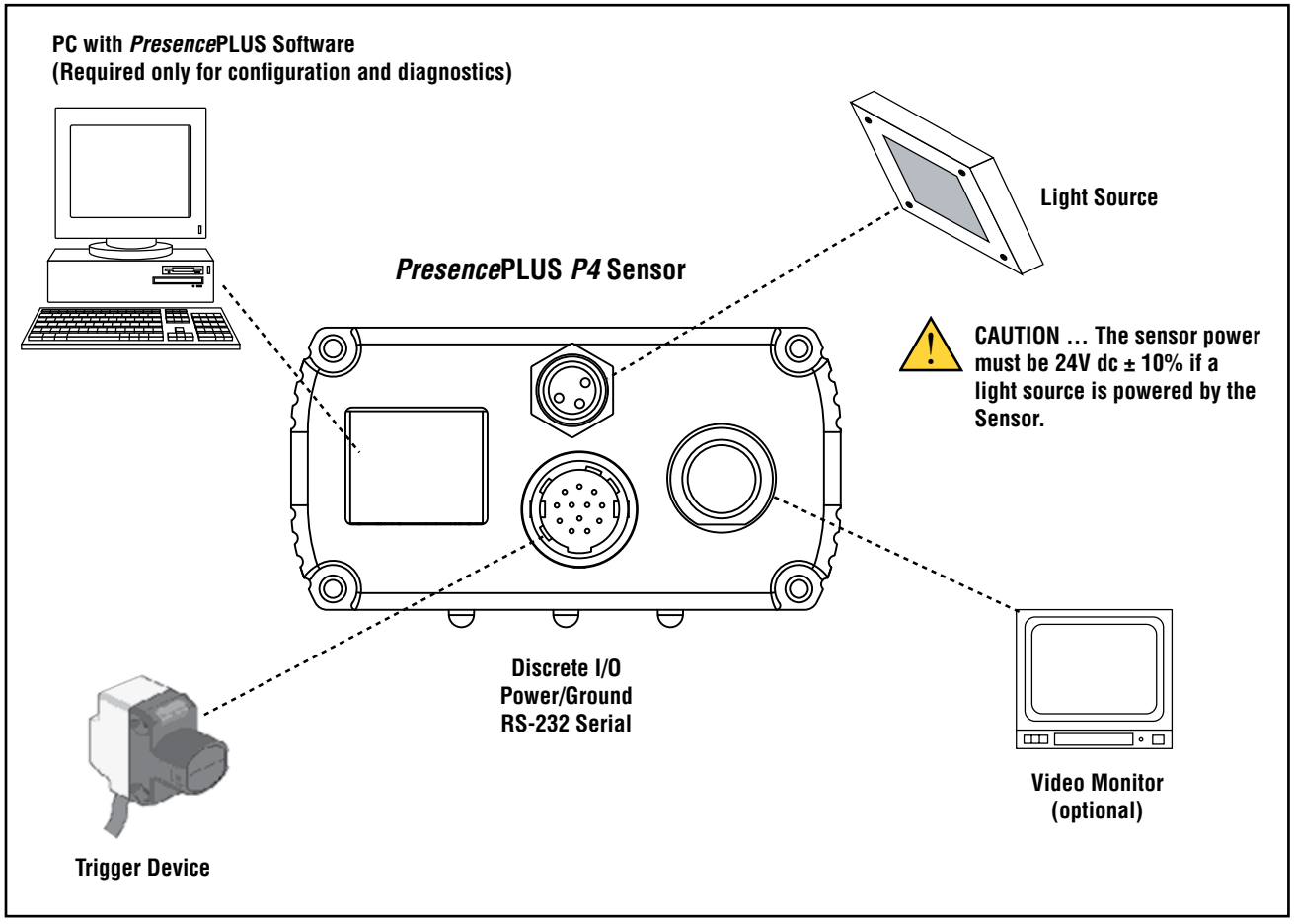
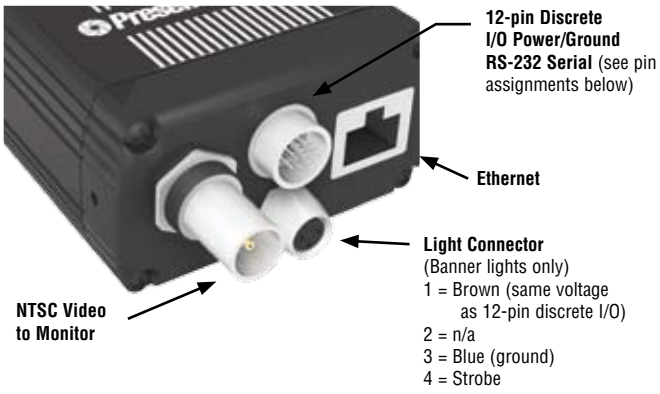


Figure 2-2. *Presence*PLUS Sensor components

Cable Connections

The PC, external light source, and optional video monitor are attached to the Sensor hookups shown in the following diagram.



CAUTION . . .

The sensor power must be 24V dc ± 10% if a light source is powered by the sensor.

Crossover Ethernet Cable (to PC Ethernet Port)*

STPX07 — 2.1 m (7')
STPX25 — 7.6 m (25')

or

Standard Ethernet Cable (to PC via Network Hub or Switch)

STP07 — 2.1 m (7')
STP25 — 7.6 m (25')

Monitor Cable (to Video Monitor, optional)

BNC06 — 2 m (6')
BNC15 — 5 m (15')
BNC30 — 9 m (30')

Serial Cable (to PC serial Port)*

DB9P06 — 2 m (6')
DB9P15 — 5 m (15')
DB9P30 — 9 m (30')

*The Sensor can be connected to the PC via a serial cable or an Ethernet network; Ethernet provides faster communication.

12-Wire Cable

Pin #	Wire Color	Description	Direction
1	Yellow	RS-232 TX**	Output
2	Gray	Remote Teach	Input
3	Orange	Product Change	Input
4	Pink	External Trigger	Input
5	Black	Discrete I/O #1	In/Out
6	Red	Discrete I/O #2	In/Out
7	White	Discrete I/O #3	In/Out
8	Light Blue	Discrete I/O #4	In/Out
9	Violet	RS-232 RX**	Input
10	Green	RS-232 Signal Ground**	Output
11	Blue	Common (Signal Ground)	Input
12	Brown	10-30V dc	Input

**Also see Figure 3-5 on page 9.

Figure 2-3. Cable connections

3. Installation

Environmental Requirements
For reliable operation, the installation location must meet the following criteria:

- Stable ambient temperature: 0° to +50° C (+32° to 122° F)
- Ambient relative humidity: 35% to 90%, non-condensing
- Stable ambient lighting: no large, quick changes in light level; no direct or reflected sunlight
- No excessive vibration or mechanical shock
- No contact with corrosive or volatile materials or atmospheres
- No liquid splash
- Minimal dust or dirt

NOTE: If sensing environment has liquid splashing or excessive dust or dirt, banner recommends using Enclosure Kit model number P4RE66-G (glass window) or P4RE66-P (polycarbonate window).

3.1 Hardware Installation Overview

Following is an overview of the procedure for connecting and powering up the basic hardware. Details are provided in the subsections that follow.

1. Check for the following essential components:
   - Lens
   - Sensor and cable
   - Communication cable (Ethernet or serial)
   - 486 microprocessor or faster personal computer running Microsoft Windows ME, NT, 2000, or XP operating system
   - Power supply with 10-30V dc and 500 mA (AREA) or 550 mA (AREA 1.3) maximum current at 24V dc
   - Light source. Every application requires a light source; however the Sensor can be used without a dedicated light source.
   - Trigger source (example: Banner WORLD-BEAM® QS18VN6D sensor)
2. Thread the lens onto the Sensor's lens mount.
3. Connect the communication cable between the PC and Sensor.
4. Connect the trigger source (see step 2 above) to the Sensor as follows:
   a. Connect brown wire to +V dc.
   b. Connect blue wire to -V dc.
   c. Connect black wire to pink wire from Sensor cable.
5. Connect the power supply to the Sensor as follows:
   a. Connect +V to brown wire of cable.
   b. Connect -V to blue wire of cable.

Caution . . . Light Source Voltage
The sensor alone will operate properly with input voltage of 10-30V dc. However, **if a light source is powered by the Sensor, input voltage must be 24V dc ± 10%.**

6. Power up the hardware and verify that the Red Error LED turns OFF. During power-up, all the Sensor LEDs turn ON for 15 to 20 seconds (see Figure 3-1).
7. Install *Presence*PLUS software on the host PC (see Section 3.4, Software Installation on page 12).
8. Start the *Presence*PLUS program and verify system connections (see Section 3.5, Startup and Troubleshooting on page 12).

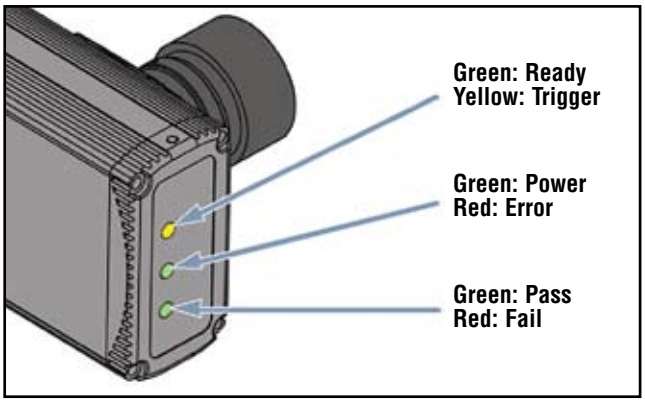


Figure 3-1. *Presence*PLUS *P4* LEDs

3.2 Hardware Installation

Mounting the Sensor
Mount the Sensor securely using the supplied mounting bracket.

Cable Bend Relief
Allow at least 75 mm (3") clearance on the cabled end of the Sensor for cable bend relief.

Mounting Hardware
The following mounting hardware is supplied with all brackets:

- Four M3 x 0.5 x 6 mm socket head cap screws
- Four medium split lock washers
- Four flat washers
- Short-arm hex key wrench

Mounting the Light Source
The light source must be securely mounted. Any movement in the light source during an inspection could affect inspection performance.

Caution . . . Light Source Voltage
The sensor alone will operate properly with input voltage of 10-30V dc. However, **if a light source is powered by the Sensor, input voltage must be 24V dc ± 10%.**

Caution . . . Electrostatic Discharge
Always use a proven method for preventing electrostatic discharge (ESD) when installing a lens or attaching a cable. Failure to take such precautions could cause damage to the Sensor circuitry.

Installing the Lens
The Sensor uses C-mount lenses.

For non-Banner lenses, follow the lens manufacturer's unpacking and installation instructions.

Installing Lens Filters
The following apply to Banner filters designed to fit Banner-supplied lenses.

Colored, infrared, and polarized lens filters can be used. The filter fits behind the lens and is held in place with a retainer ring. Use the retainer ring tool that is supplied with the filter to add or remove a filter (see Figure 3-2).

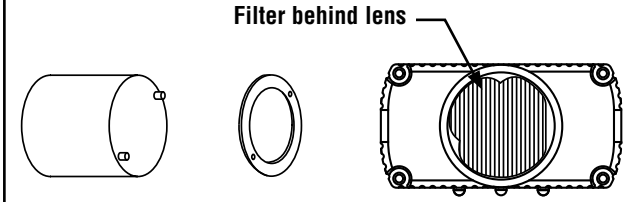


Figure 3-2. Installing a lens filter

3.3 Sensor Connections

Caution . . . Electrostatic Discharge

Always use a proven method for preventing electrostatic discharge (ESD) when installing a lens or attaching a cable. Failure to take such precautions could cause damage to the Sensor circuitry.

Warning . . . Shock Hazard

Before connecting or disconnecting any cables, be sure power supply is OFF.

Supply Voltage (Brown and Blue Wires), Pins 11 and 12

The Sensor requires a 10-30V dc power supply with 500 mA (AREA) or 550 mA (AREA 1.3) maximum current at 24V dc. If a light source is powered by the Sensor, input voltage must be 24V dc ± 10%.

Electrical Selection

The Sensor inputs (Trigger, Product Change, Remote Teach, and Discrete) and outputs can be configured for either NPN (current sourcing) or PNP (current sinking). This selection is made in the System Setup window on the InputOutput tab (see Figure 3-3).

Once NPN or PNP is selected, all inputs/outputs are either NPN or PNP.

Trigger (Pink Wire), Pin 4

- Input from an external triggering device is needed to signal the Sensor to acquire images.
- The Sensor can be set to respond to either the leading or trailing edge of the trigger pulse (see Figure 3-4).
- Trigger pulse width can be set from 1 millisecond to 8 seconds. The default is 1 millisecond.
- Trigger modes:
  - Input current sinking mode (external PNP driver)
  - Input current sourcing mode (external NPN driver)

Caution . . . Voltage Hazards

Observe the following cautions to avoid damage to the Sensor circuitry:

- Never connect the Sensor to a power source other than 10-30V dc.
- Keep components at least 250 mm (10") away from power cables
- Keep components away from high-voltage power sources and motors.

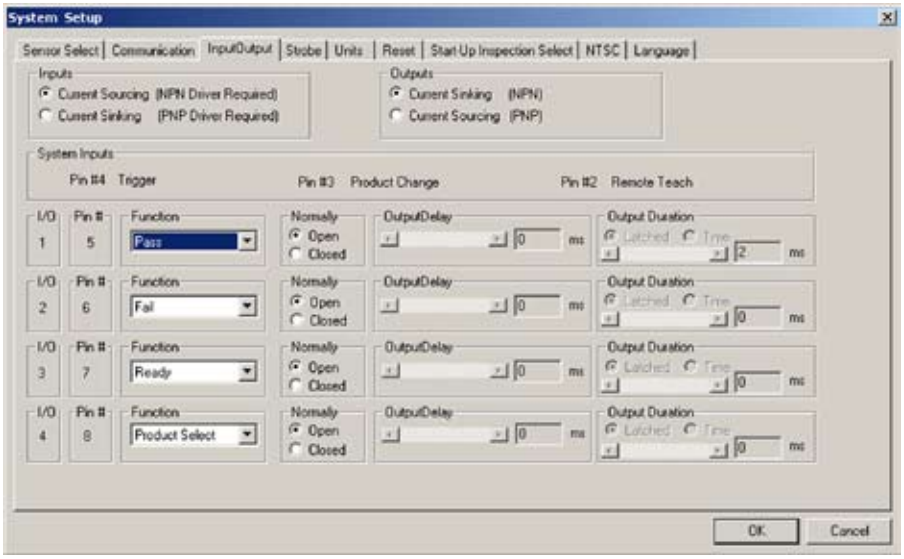


Figure 3-3. System Setup window InputOutput tab for selecting NPN or PNP

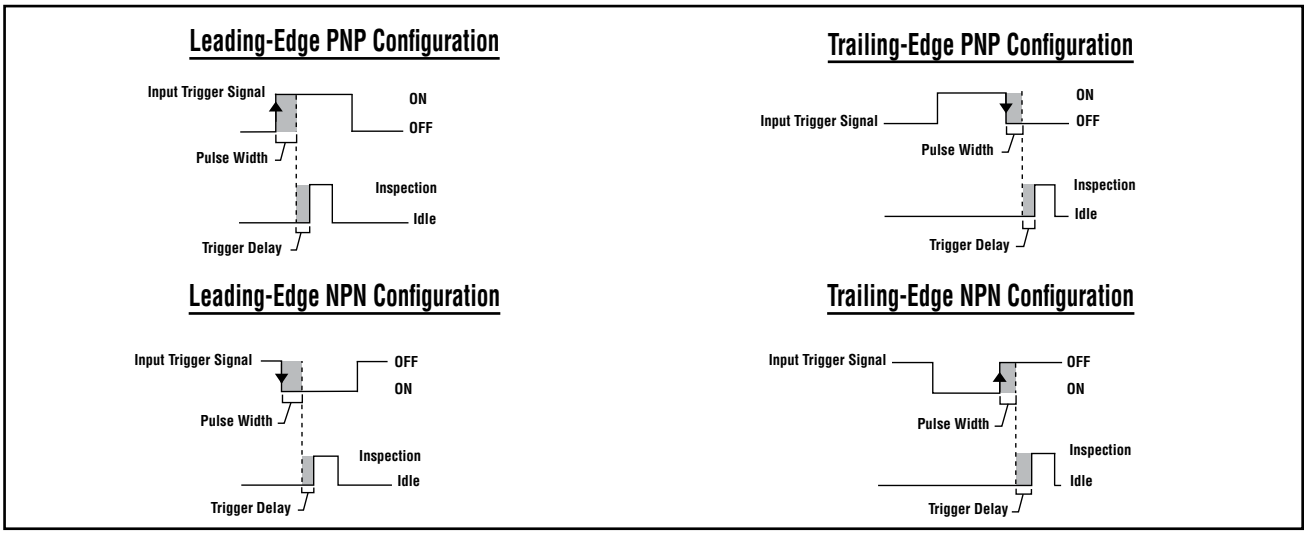


Figure 3-4. PNP and NPN Leading-Edge and Trailing-Edge trigger inputs

Strobe Out

Strobe Out is Pin 4 of the light connector. When Strobe Out is enabled, the Sensor generates a strobed output signal upon receiving a valid trigger. The signal type is configured as shown below:

Level (default: Active High)

Active High: Use if the light is enabled at 5V

Active Low: Use if the light is enabled at 0V

Strobe Width (default: Time Duration)

ON: ON continuously

OFF: OFF continuously

Exposure: Active signal during the exposure time

Time Duration: Strobe is active upon a valid trigger, with length set from 1 to 4,000 ms

Electrical Specifications of Strobe

High: 4V min. at 100 mA max.

Low: 0.5V max. at 100 microamps max.

RS-232, Pins 1, 9, and 10

The RS-232 port is used to export runtime information in ASCII format. For information on how to configure the serial connection, see Section 8, Exporting with the Communication Tool on page 47. See also Section 12, System Setup on page 59.

Figure 3-5 provides typical pin assignments for the wires from the Sensor's RS-232 port to a DB-9 serial connection.

Sensor Cable	Serial Connection
Yellow wire, transmit data	Pin 2, receive data
Violet wire, receive data	Pin 3, transmit data
Green wire, signal ground	Pin 5, signal ground

DB-9 Pinout

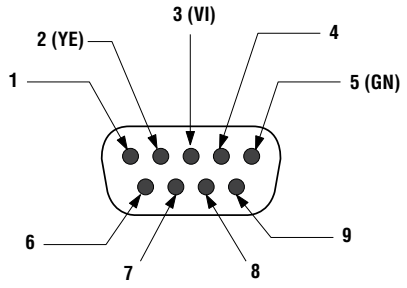


Figure 3-5. DB-9 connector RS-232 connections

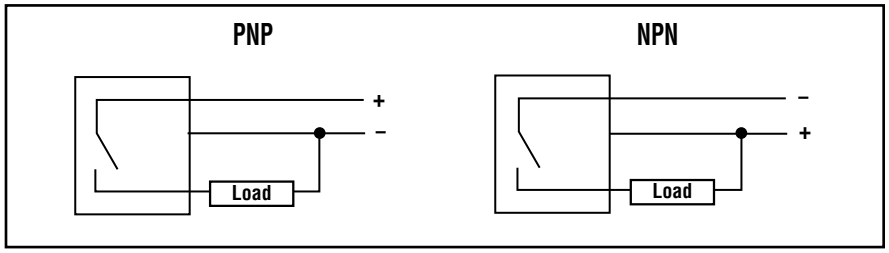
Programmable I/O, Pins 5 through 8

The Sensor provides four discrete programmable I/O connections as listed in the table below. Each I/O type can be configured as follows:

- Input current sinking mode (external PNP driver, default) or input current sourcing mode (external NPN driver), and
- Output current sinking mode (NPN) or output current sourcing mode (PNP).

Pin 5 (Black Wire)	I/O #1
Pin 6 (Red Wire)	I/O #2
Pin 7 (White Wire)	I/O #3
Pin 8 (Light Blue Wire)	I/O #4

Typical PNP and NPN connections are shown below. See also the Programmable Input and Output Specifications table below.



Programmable Input and Output Specifications

Programmable Input Specifications	NPN (Current Sinking)	PNP (Current Sourcing)
ON	< 2V at 1 mA max.	> 8V at -7.5 mA max.
OFF-State Voltage	> 10V at 4 mA max.	< 2V at -7.5 mA max.
Programmable Output Specifications (150 mA Max. each Output)	**NPN (Current Sinking)**	**PNP (Current Sourcing)**
ON	< 2V at 1 mA max.	> 8V at -7.5 mA max.
OFF-State Voltage	> 10V at 4 mA max.	< 2V at -7.5 mA max.

Product Change (Orange Wire), Pin 3

The Product Change input is used in conjunction with one of the four I/O points programmed as a Product Select/Change line. The inspection loaded will be executed upon receiving a valid trigger.

- The Product Change input responds to the leading edge transition of a pulse greater than 1 millisecond.
- The Product Select input is pulsed to correspond to a program location. For example, five pulses will load program #5.

See Product Change and Product Select Timing on this page.

Product Change Specifications

State	NPN (Current Sinking)	PNP (Current Sourcing)
ON	< 2V at 1 mA max.	> 8V at -7.5 mA max.
OFF	> 10V at 4 mA max.	< 2V at -7.5 mA max.

One of the four I/O (see Programmable I/O, Pins 5 through 8 on page 10) must be programmed as Product Select if Product Change is to be used. See Section 12.4, InputOutput Tab on page 62.

Product Select Input Specifications

State	NPN (Current Sinking)	PNP (Current Sourcing)
ON	< 2V at 1 mA max.	> 8V at -7.5 mA max.
OFF	> 10V at 4 mA max.	< 2V at -7.5 mA max.

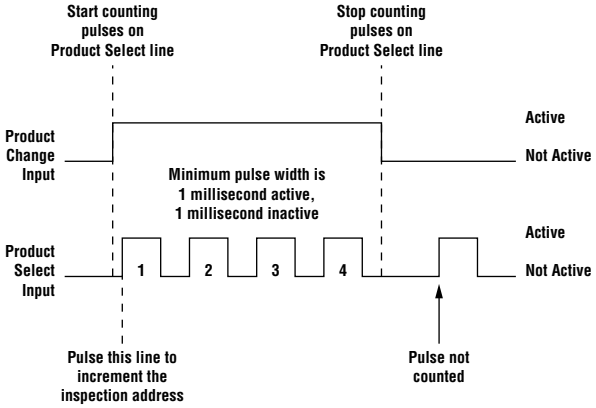
Product Change and Product Select Timing

The Product Change line signals the Sensor to stop what it is doing and begin counting pulses on the Product Select line. The number of pulses indicates to the Sensor the inspection address at which to begin executing the inspection. The only pulses counted are those that occur when the Product Change input is active. As shown in Figure 3-6, the Product Select input pulse that occurs when the Product Change input is not active is NOT counted.

If the Sensor is in Run mode, the Product Change line should be activated only when the Sensor is Ready (Green Ready LED is ON). If the Product Change line is activated when the Sensor is in Run mode but performing an inspection (not Ready), the current inspection will be aborted, and the Sensor will proceed to load the inspection at the indicated address.

If the Product Change line is activated when the Sensor is not in Run mode (Setup mode, for example), then the Sensor will go to the address indicated (address number four in this case) and begin executing.

The maximum number of pulses is limited by the number of inspections possible on the Sensor.



In this example, the Sensor will stop executing the current inspection, go to address number four (because there are four pulses), load the inspection at location four, enter Run mode, and execute the inspection on the next valid trigger.

Figure 3-6. Product Change and Product Select timing example

3.4 Software Installation

The *Presence*PLUS *P4* software CD provides the Sensor software and documentation.

Host Computer Requirements
*Presence*PLUS *P4* software requires the following host computer capabilities:

- 486 microprocessor or faster personal computer, running Microsoft Windows ME, NT, 2000, or XP operating system
- 16 MB RAM minimum, 24 MB recommended
- 15 MB available hard disk space
- 1024 x 768 or greater display screen resolution

Installing the Program
1. Close all active programs.
2. Uninstall previous installations of *Presence*PLUS (see below).
3. Insert the *Presence*PLUS CD into the CD ROM drive. The CD will auto-start.

NOTE: If the Install screen does not appear:

   a. Double-click on the **My Computer** icon.

   b. Double-click on **CD Drive** in the list that appears.

   c. Double-click on the **PresencePLUS** autorun file for your *Presence*PLUS *P4* model.

4. When the Install screen appears, click **PresencePLUS PC Software**.
5. Follow the instructions on the screen.
6. Reboot the PC.

Uninstalling the Program
1. Close the *Presence*PLUS P4 program.
2. In the task bar at the bottom of the screen, click **Start**.
3. Choose **Settings > Control Panel**.
4. Double-click **Add/Remove Programs**.
5. Select **PresencePLUS** from the list of programs.
6. Click **Add/Remove**, and follow the instructions.

3.5 Startup and Troubleshooting

This section explains how to verify connections, start the *Presence*PLUS *P4* program, and troubleshoot possible problems.

System Startup

1. Verify cable connections.

- The Sensor is connected to a PC with an Ethernet crossover cable or serial cable.
- The monitor, if used, is connected to the Sensor's video port.

2. Verify electrical connections.

- +V is connected to Pin 12, brown wire, 10-30V dc (24V dc ± 10% if a light is powered by the Sensor).
- -V is connected to Pin 11, blue wire (dc common).
- The trigger device is connected to Pin 4 (pink wire, Trigger In).
- Any additional connections are made as required.

3. Verify power.

Ensure that the Sensor is powered by 10-30V dc (24V dc ± 10% if a light is powered by the Sensor).

4. Verify PC configuration.

- **Ethernet connection:** IP address of PC is **192.168.0.2**

  NOTE: For detailed instructions on changing the IP address, see Section 4, Getting Started on page 16.

- **Serial connection:** A dial-up network has been established, and the network is a point-to-point protocol (PPP).

5. Power up the Sensor.

Verify that the Red Error LED light turns OFF (during power-up, all Sensor LEDs turn ON for 15 to 20 seconds).

After the Red Error LED turns OFF, verify that the Green Power LED is flashing.

6. Launch the software.

- Click **Start > PresencePLUS** to start the program.
- If *Presence*PLUS *P4* AREA/AREA 1.3 has a different IP address than the default address (192.168.0.1), or if it is connected through a serial connection, the following error message will appear:

  Sensor not found on specified IP address: 192.168.0.1.

  Do you want to try another IP address?

- Click Yes to access the System Setup window.
- Click on the Sensor Select tab, and change the connection setup as follows:

  Ethernet Connection:

  a. Select **Ethernet (RJ 45)** in the pull-down menu.

  b. Change the IP address to the address of the Sensor.

  c. Click **OK**.

  Serial Connection:

  a. Select **PC Serial** in the pull-down menu.

  b. Click **OK**.

  NOTE: A serial connection requires changes to the Sensor and an established dial-up network. See the *Presence*PLUS Serial Connection Procedures document (on the software CD) for instructions on setting up a dial-up network.

7. Configure the discrete I/O, create an inspection, and begin running inspections.

NOTE: Initially, all discrete I/Os are configured as inputs. If you create an inspection before configuring the discrete I/O, no outputs will be available in the Test tool. For configuration information, see Section 12.4, InputOutput Tab on page 61.

3.6 Troubleshooting Error Messages

Message	Recommended Action	
"Failed to capture a full-resolution image. Please try again."	See the Troubleshooting Table on page 15.	
"Failed to capture a full-resolution image."	See the Troubleshooting Table on page 15.	
"Sensor not found on IP 192.168.0.1. Do you want to try another IP address?	**Yes**	**No**
1. Check the power. Is the Green Power LED ON?	Go to step 2 or 3.	Check the power connection. Verify that the power source is 10-30V dc and 500 mA (AREA) or 550 mA (AREA 1.3) maximum current at 24V dc.
2. For an **Ethernet** connection:		
a. Is the yellow LED indicator integrated with the RJ-45 port ON?	Go to step b.	Verify that the cable is the correct type. Direct connection to a PC requires a crossover adapter or a crossover Ethernet cable. Connection to a network requires a straight Ethernet cable.
b. Does the error message display the IP address 192.168.0.1?	Go to step c.	Change the IP address in the software to 192.168.0.1 and retry.
c. Click the **Yes** button. If the Sensor is found on another IP address, the following message will appear: **Sensor has been found on IP = 192.168.0.xx.** **Do you want to use it?**	Click **Yes**, and start working with the software	Click **No**, and in the **IP Address** box, change the IP address to the IP address of the Sensor (default is 192.168.0.1), and click the **OK** button.
d. Does the software find the Sensor?	Start working with the software.	Go to step e.
e. Verify that the IP address of the PC is configured to work with *Presence*PLUS *P4* AREA/AREA 1.3. Is the PC configured as follows? IP address = 192.168.0.2 Subnet mask = 255.255.255.0	Contact a Banner Applications Engineer. See Factory Support on page 1.	Change the IP address and subnet mask to match the IP address and subnet mask listed at left.
3. For a **Serial** connection:		
a. Is the serial port configured for point-to-point protocol (PPP)?	Go to step b.	Use the *Presence*PLUS Serial Connection Procedures document on the software CD to guide you through the process of enabling PPP in the serial port through the boot menu.
b. Was the dial-up network running before you installed the software?	Go to step c.	Start the dial-up network session with *Presence*PLUS. Use the *Presence*PLUS Serial Connection Procedures document on the software CD to guide you through the process of creating a dial-up network.
c. Choose Serial Connection in the Sensor Select screen.		

Troubleshooting Table

This table contains solutions to the most common problems in using the *Presence*PLUS program. For further assistance, contact Banner at the numbers or address listed on the back cover.

Problem	Cause/Solution
• Green Power LED on Sensor is not ON. • Interface cannot connect to Sensor. • No image on monitor.	**Sensor not getting enough power** • Verify that the power supply is 10-30V dc with 500 mA (AREA) or 550 mA (AREA 1.3) maximum current at 24V dc. • Check the connection to the power supply.
• No image on PC or monitor. • Green Ready LED on Sensor is OFF. • The software seems to be working correctly, but the image is missing.	**Run display set to "None"** • Ensure that the Sensor is receiving trigger signals. **Sensor not receiving triggers** • If the connections are secure, call a Banner Applications Engineer.*
• Error message, "Failed to capture a full-resolution image. Please try again." • Image is frozen on PC and monitor. • Green Ready LED on Sensor is OFF.	**Software restart needed or loose connections** • Restart the *Presence*PLUS software. • If a software restart does not correct the problem and the connections are secure, call a Banner Applications Engineer.*
• Error message, "Failed to capture full-resolution image." • Image is frozen on PC, but image on monitor properly updates. • Indicator lights on RJ-45 port are OFF.	**Ethernet connection lost** • Reconnect the cable. • Check the cable for breaks, then power down and back up. • Replace the cable. • Attempt to close and reopen the *Presence*PLUS software. • If still not resolved, call a Banner Applications Engineer.*
• Focus number does not update. • QuickStart fails. • Errors when saving inspections to the Sensor.	**FTP communications blocked** • Disable TCP/IP Firewall software on the PC.
• Error code is displayed on PC.	• A list of error codes and potential causes and solutions are available under Help/About on the *Presence*PLUS software CD.*
* See Factory Support (on page 1) in Section 1.1, Product Support and Maintenance.	

The Sensor has no field-replaceable or user-serviceable components. To avoid invalidating the Banner warranty, do not disassemble or make electrical or mechanical modifications to any components.

4. Getting Started

This section presents typical approaches to setting up and running inspections.

NOTE: If the PresencePLUS software is not already installed on the PC, see Installing the Program (on page 12) in Section 3.4, Software Installation.

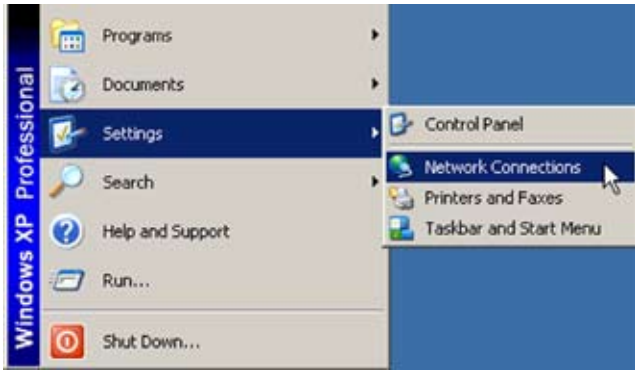
4.1 Starting Up the Software

Power up the PC, and configure the IP Address of the PC as follows:

NOTE: The following instructions and screens depict Windows XP. For instructions on earlier Windows versions, supplemental information is provided on the following Banner website page:

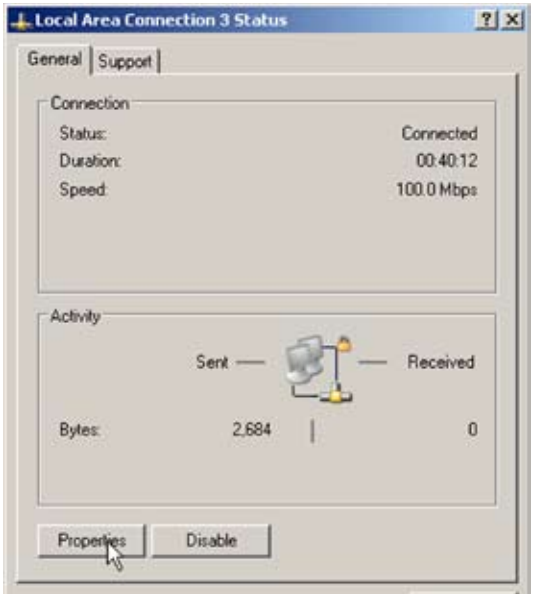
http://info.bannersalesforce.com/xpedio/groups/public/documents/trainingjobaid/vr_01_00_e.pdf.pdf

1. On the Windows desktop, select **Start > Settings > Network Connections**.



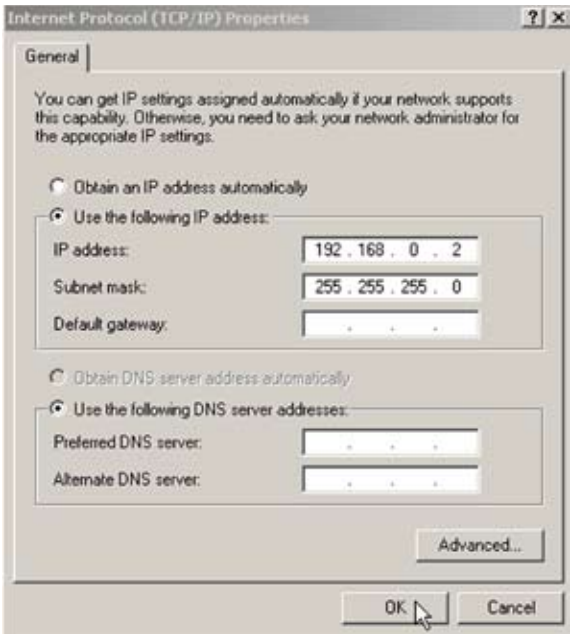
2. In the Network Connections menu, double-click on the **Local Area Connection** used by *Presence*PLUS.

3. In the Local Area Connection 3 Status window, click the **Properties** button.



4. In the Local Area Connection/Properties window, highlight **Internet Protocol (TCP/IP)**, and click the **Properties** button.

5. Write down the IP address of your PC. In the Internet Protocol (TCP/IP) Properties window, choose **Use the following IP address**, and make the following changes:
   - Change IP address to **192.168.0.2**
   - Change the Subnet mask to **255.255.255.0**
   - Click the **OK** button.



6. Start the software by double-clicking the *Presence*PLUS *P4* AREA program icon, or choosing *Presence*PLUS *P4* AREA in the Programs menu.

Upon startup, the program detects whether a Sensor is connected and displays the Setup screen (Figure 4-3 on page 19) or the Run screen (see Section 11.1 on page 54).

4.2 Setting Up Hardware Parameters

If the Sensor is being run for the first time, or if changes have been made to the hardware, then hardware parameters may need to be set or modified in the System Setup window, as described below:

1. Click the **System** button in the *Presence*PLUS *P4* AREA Main Menu toolbar.
2. Click the InputOutput tab, and configure the trigger parameter in the Inputs field according to the trigger device being used. (For example, if an NPN output sensor is the trigger device, then select NPN.)
3. Configure the four discrete inputs/outputs, and click the **OK** button.
4. If a strobed light source is being triggered by the Sensor, click the **Strobe** tab, and set the strobe options.
5. If the Product Select line is being used, configure the Product Select and Product Change lines. See Section 13, Product Change on page 68.
6. Click the **Setup** button in the Main Menu toolbar, select the **Trigger** tab, and configure the trigger parameters.

4.3 Building an Inspection

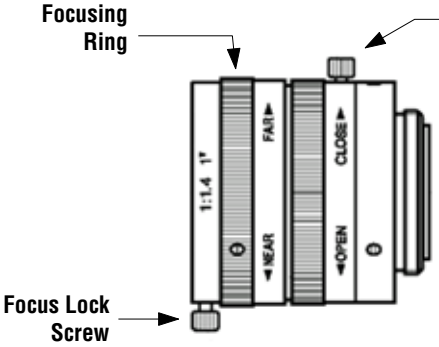
The automatic screen sequence starts with the Setup screen, which results from the first button (**Setup**) in the Main Menu toolbar. Subsequent screens are shown in Figure 4-1.

Figure 4-1. Main Menu Toolbar buttons in left-to-right task order

Click on the **Setup, Tools, Teach,** and **Run** buttons to advance to each screen.

Follow these basic steps to build and run a new inspection:

1. **Setup screen:**
   a. Set up the Sensor, lens, and lighting.
   b. Choose trigger option **Continuous** for a live image.
   c. Click **Auto Exposure** to adjust the image brightness.
   d. Focus the lens by turning the lens focusing ring (shown in Figure 4-2) until the focus value is maximized. See Focusing the Lens on page 26.
   e. When the desired image is shown, click **Next** to proceed to the Tools screen.



NOTE: If the lens has a focus lock screw, loosen the screw before focusing the lens. Some lenses also have an aperture lock screw.

Figure 4-2. Lens focusing ring and lock screws

2. **Tools screen:**

   Tools can be built from scratch or added from a previous inspection file saved on the PC or Sensor. To add a tool, click the **Tools** button. To remove a tool, click the red ✕ in the lower-left corner of the screen while that tool is selected.

   a. Add Location tool(s) to find the target and to adjust the Regions of Interest (ROI) for translational and rotational changes.

   b. **REQUIRED:** Add Vision tool(s) to inspect the part.

   c. Add Measure tool(s) to create distance measurements from points found.

   d. **REQUIRED:** Add Test tool(s) to set the Pass/Fail criteria (Vision and Measure tools are inputs to the Test tool).

   e. Click **Quick Teach** to automatically set all the selected parameters in the Test tool and to proceed to the Run screen, or click **Next** to proceed to the Teach screen and to teach a sample set of good products.

   NOTE: To keep parameters in a Test tool, skip Teach and go directly to Run.

3. **Teach screen:**

   The Teach screen automatically configures the parameters chosen in the Tools screen.

   a. Choose the sample size.

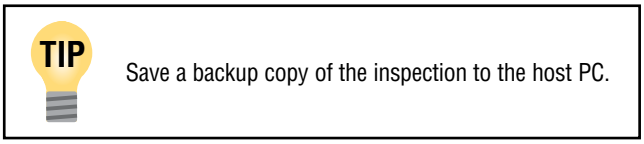
   b. Click **Start.**

   c. Trigger the Sensor with the external trigger device.

   d. Click **Stop.**

   e. Save the inspection file to one of the 10 memory locations on the Sensor.

   f. Click **Next** to proceed to the Run screen.



4. **Run screen:**

   Select an inspection to run, and review the results of the inspection.

   - To select an inspection (in the **Select** tab), enable **Software Override**, and select the inspection file from the list of stored inspections on the Sensor.
   - Alternate method: Use **Hardware Input** to select an inspection via discrete inputs to the Sensor.

5. **Begin inspection:**

   To begin inspecting, click the **Start** button in the Run screen.

4.4 Navigating the Software

The application follows typical navigational sequences (example: Setup > Tools > Teach > Run) when **Next** is clicked to finish each step. Experienced users may prefer to work in some other sequence (Setup > Tools > Run, for example) by selecting the preferred destination from the Main Menu toolbar.

To exit the software, click the Close button ✕ in the upper-right corner of the screen. If the current inspection is not saved, the software will prompt the user to do so prior to exiting. See Section 14, Saving Inspections on page 69.

4.5 Software Overview

The Setup screen, shown below, provides the Main Menu.

Image Toolbar
Allows manipulation of the Image window properties and contents.

See Figure 4-5 on page 21.

Main Menu Toolbar
Arranged from left to right, steps through the inspection creation process.

See Figure 4-4 on page 20.

Image Window
Displays Sensor image or reference image for the current inspection. This window is updated after a trigger.

See Figure 4-5 on page 21.

Navigation/Results Toolbar Buttons
Selects the Navigation/Results window display and files.

See Figure 4-7 on page 21.

Navigation/Results Window
Displays navigation buttons or inspection results information.

See Figure 4-6 on page 21 and Figure 4-8 on page 22.

Status Window
Displays feedback during Setup and Run.

See Figure 4-10 on page 23.

Configuration Window
Displays the currently selected options and Sensor settings.

See Figure 4-9 on page 22.

Figure 4-3. Setup screen

Main Menu Toolbar

Use the Main Menu toolbar to navigate between the Sensor options. Proceeding from left to right, the buttons in the Main Menu toolbar step through the process of creating and controlling an inspection. Each button is explained in the illustration below and in the table that follows.

For more information about navigating through options, see Section 4.3, Building an Inspection on page 17.

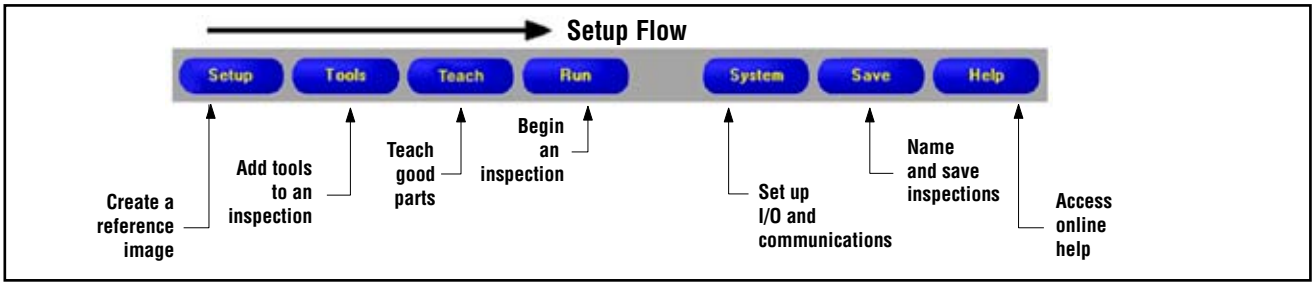


Figure 4-4. Main Menu toolbar layout

Image Window

The Image window displays images acquired from the Sensor or the reference image that is set for the current inspection. See Figure 4-5.

NOTE: The reference image is used as a template for developing an inspection; it establishes initial values. The reference image also is used by Quick Teach.

See Section 9.1, Teach Overview on page 50.

Zoom
Toggles between enabling and disabling Zoom control. When enabled, click on the Image window to zoom in, right-click to zoom out. This button is active when an image is displayed in the Image window.

Expand Image
Toggles the size of the Image window between maximum and minimum.

Selected ROI / All ROIs
Toggles between the currently selected ROI and all ( ) ROIs.

Figure 4-5. Image toolbar buttons

Navigation/Results Window

The Navigation/Results window displays tool navigation buttons or inspection results files.

Tool Navigation Buttons

Clicking on the **Tools** button in the Main Menu toolbar brings up the tool navigation buttons (Figure 4-6) in the Navigation/Results window. When setting up or using tools, click on any tool navigation button to get the corresponding tab in the Configuration window.

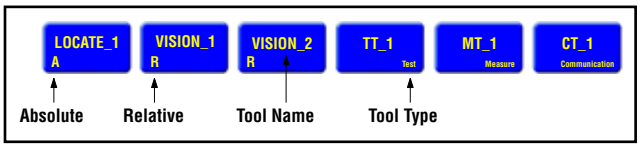


Figure 4-6. Tool navigation buttons

Absolute and Relative Tools

The Location tool tracks parts in the Image window and the Vision tools that follow are relative. If a Vision tool precedes the Location tool, it will be absolute. Rules governing whether a tool is absolute or relative are as follows:

- The first Location tool is always absolute.
- All tools following a Location tool are relative to that tool.
- For a Vision tool to be absolute, it must be placed before any Location tools.

Navigation/Results Toolbar Buttons

Using the Navigation/Results toolbar buttons, the Navigation/Results window size can be set, and tools can be deleted. See Figure 4-7.

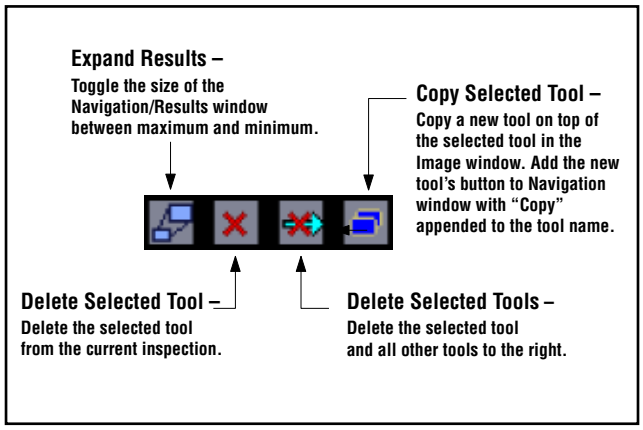


Figure 4-7. Navigation/Results toolbar buttons

Expand Button

Clicking on the **Expand** button ( ) toggles the size of the Navigation/Results window to accommodate an expanded list of inspection results files, as shown below.

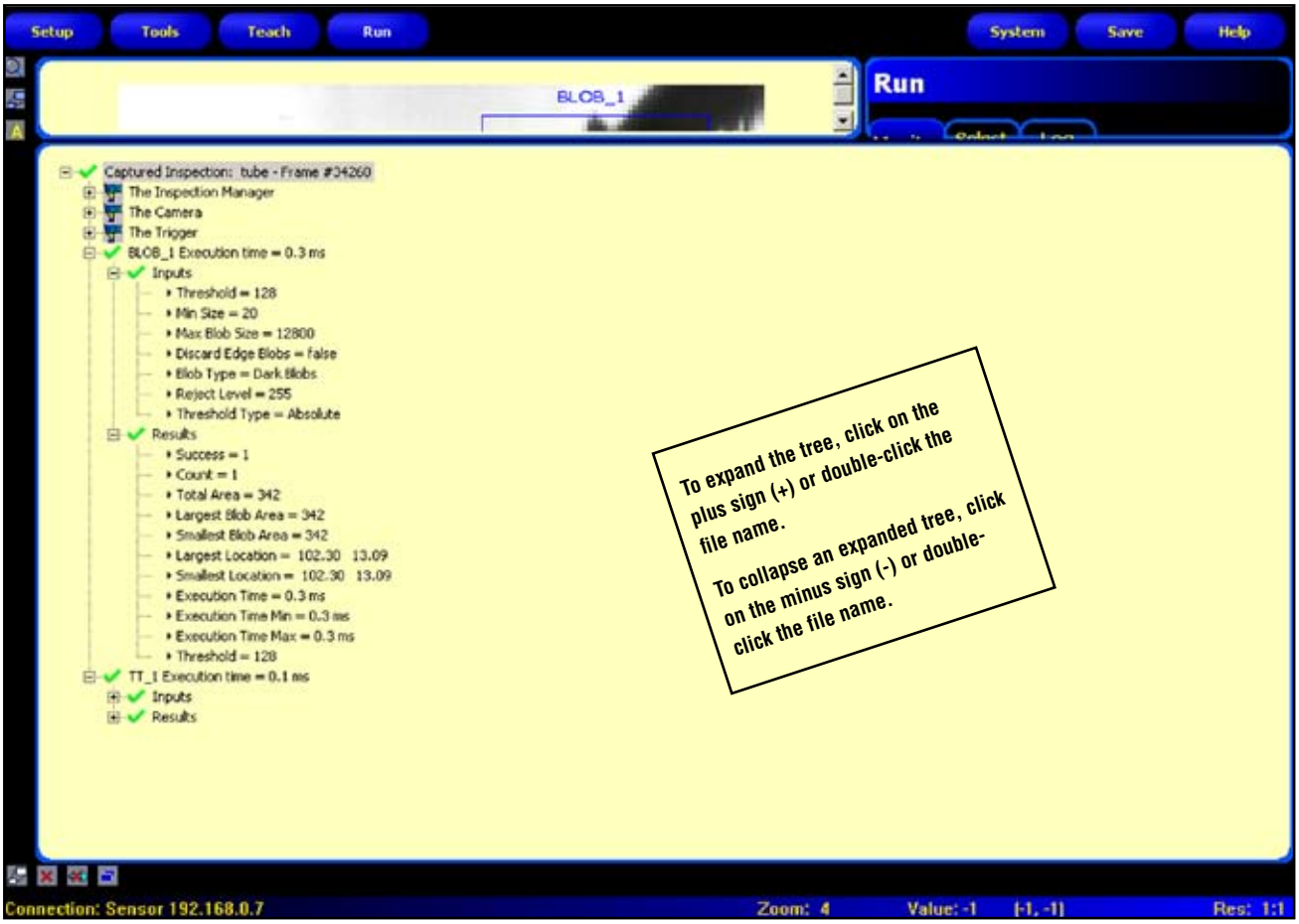


Figure 4-8. Expanded Navigation/Results window with Inspection Results files

Configuration Window

The Configuration window displays the currently selected options with multiple tabs. Clicking the **Setup**, **Tools**, **Teach**, **Run**, **System**, **Save**, or **Help** buttons on the Main Menu toolbar (see Figure 4-4 on page 20) changes the contents of the Configuration window accordingly.

Figure 4-9. Configuration window

Status Window

The Status window provides Sensor feedback as described in Figure 4-10.

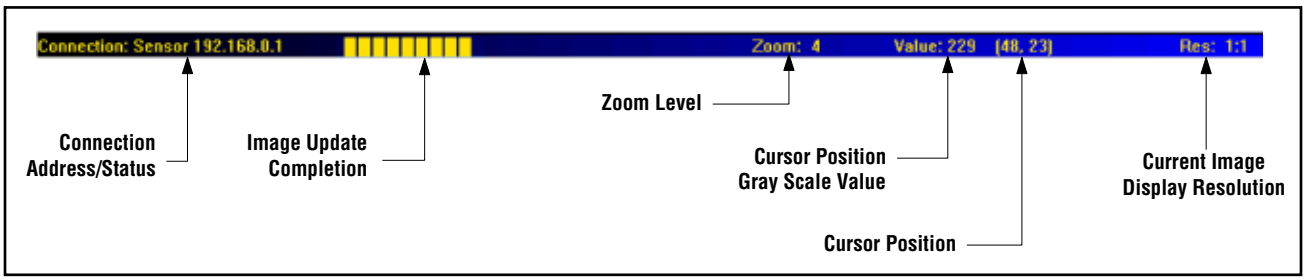


Figure 4-10. Status window layout

5. Setup

5.1 Setup Screen

On initial startup, the Sensor displays the Setup screen. This section explains how to capture a reference image and set trigger options in the Setup screen. To return to the Setup screen after passing it, click the Setup button in the Main Menu toolbar.

The reference image is used as a template for developing an inspection. The Vision tools use this image to acquire the critical information needed for the inspection.

Acquiring a quality image is crucial for a successful inspection. A quality image shows a measurable and repeatable difference between good products (which pass inspection) and bad products (which fail inspection).

5.1.1 Focus Tab

Click on the **Focus** tab in the Setup screen to bring up the trigger/exposure settings for the reference image (as shown in Figure 5-1).

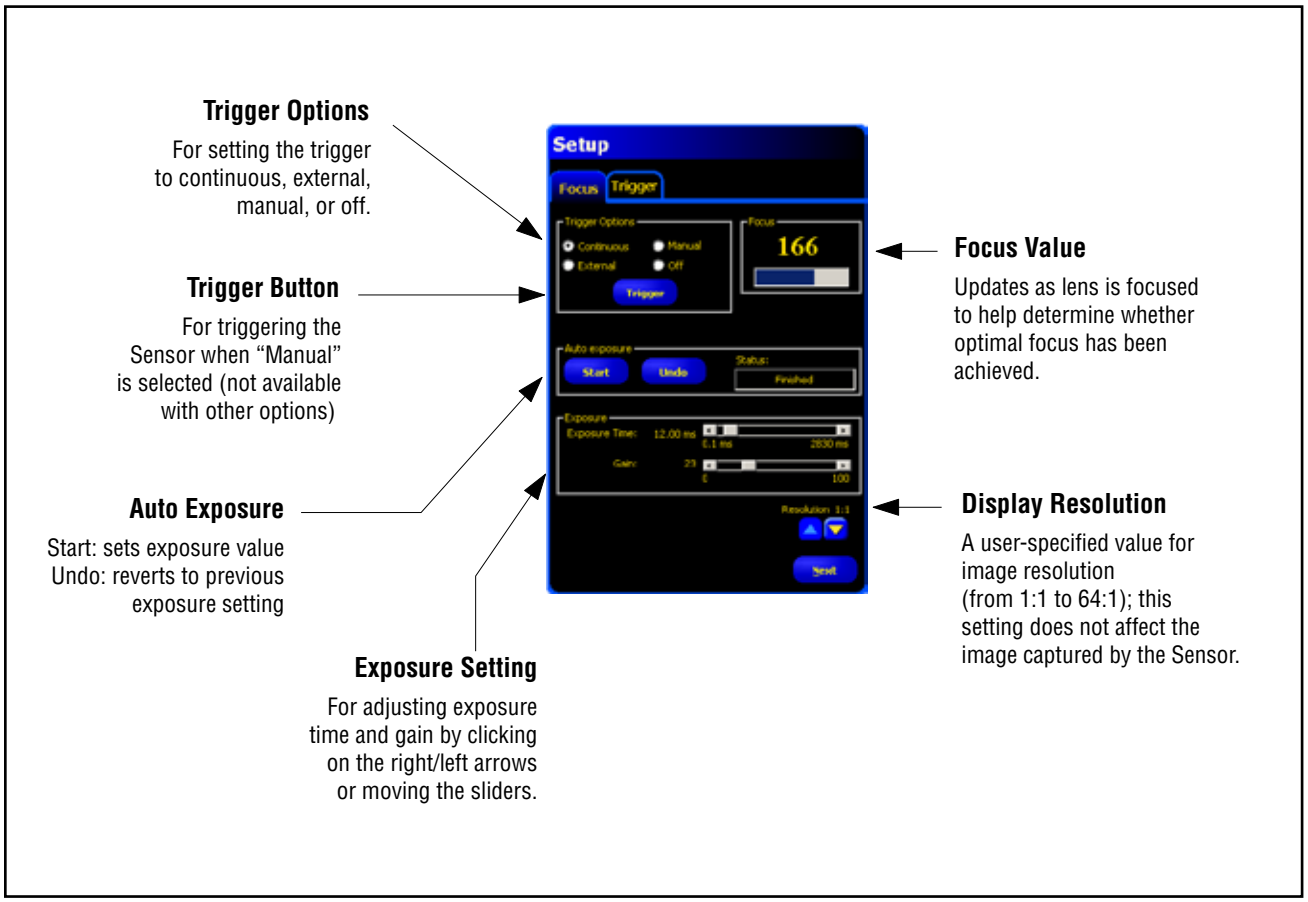


Figure 5-1. Focus tab setup options

Trigger Options

The first step in capturing an image is determining when the Sensor should capture an image. This Setup option determines how the sensor initiates an image capture.

The Sensor can be triggered to capture an image in one of four ways:

Continuous: The sensor updates continuously in Setup mode.

External: Images are acquired only in response to a signal from an external source (Pin 4 on the Sensor) as configured on the **Trigger** tab. Choose **External** if the part will be moving during the inspection. This will help capture an image with the same conditions as the inspection conditions.

NOTE: In Run mode, only the external trigger is used.

Manual: Images are acquired only when the **Trigger** button is clicked. The Trigger button is grayed out when any trigger option other than Manual is chosen.

OFF: Stop acquiring images. The last image acquired will remain on the display.

These trigger options are used only in Setup. See Section 5.1.2, Trigger Tab on page 26 for setting up inspection trigger divide, delay, width, and polarity.

Exposure Time and Gain

Exposure Time and Gain settings are used to control the brightness of an image.

- Exposure time is the amount of time the Sensor allows light to energize the image chip. Increasing the exposure time allows more light to energize the image chip, which brightens the image.
- Gain is an electronic boost to the image signal. Increasing gain increases image brightness without increasing exposure time.

NOTE: Gain brightens both the light pixels and dark pixels. High gain values will make the image appear grainy.

There are two ways to adjust exposure time and gain: use the Auto Exposure routine or adjust the settings manually.

Auto-Exposure Routine

Click **Start** to run the Auto-Exposure routine. As the Auto-Exposure routine runs, the exposure time and the gain will optimize for the current inspection, and the **Status** field will provide feedback. To halt the routine immediately, click **Stop**.

The following table explains each status in the **Status** field of the Focus tab:

Status Field Options	Explanation
Not running	Auto exposure has not been activated since entering this screen.
Running	Auto exposure is currently running.
Finished	Auto exposure has run and is complete.
Image too dark	The routine could not brighten the image enough. Add more light to the inspection.
Image too bright	The routine could not darken the image enough. Remove light from the inspection.

Manually Setting Exposure and Gain

Move the sliders in the Exposure window left or right. Move the sliders to the left to darken the image, and move them to the right to brighten the image.

To revert to previous exposure values, click the **Undo** button.

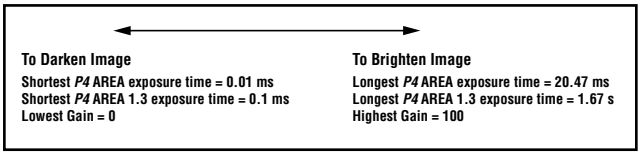


Figure 5-2. Auto-Exposure window adjustment

Exposure Time Considerations

Exposure time affects how much light is needed to illuminate the part, and how fast a part can pass by the Sensor as its image is captured. In general:

- Short exposure times require bright light sources.
- Bright light sources are less efficient and can have a shorter useful life.
- Long exposure times can blur the images of fast-moving objects. An image is blurred if the part moves a distance greater than one picture element (pixel) of the image during the exposure time.

Use the following calculation to determine the maximum exposure time without blurring:

$$\text{Max. Exposure Time (ms)} = \frac{\text{Horizontal FOV}}{\text{Part Speed x 640}} \text{ x 1000}$$

where:

Horizontal Field of View (FOV) = the width of the image in inches.

Part speed = the speed of the production line in inches per second.

To convert part speed in feet per minute to inches per second, multiply by 0.2.

Exposure Time Example:

Place a ruler in the FOV at the working distance, and observe the measurement of the FOV width in the Image window. Assume for this example that the FOV width is 5".

A part is moving along a conveyor at 25 feet per minute. What is the maximum exposure time?

25 feet per minute x 0.2 = 5" per second

Therefore:

$$\text{Max. Exposure Time (ms)} = \frac{\text{5"}}{\text{5" per second x 640}} \text{ x 1000}$$

$$= 1.56 \text{ ms}$$

Focusing the Lens

To focus the lens, place the target object so that the area to be focused appears in the center of the displayed image. Turn the lens focus ring in small increments. There are two ways to determine whether optimal focus has been achieved:

1. **View the image on the PC or video monitor.** Turn the focusing ring until the image becomes sharper and then starts to blur. Turn the focusing ring back until the focus is sharp.
2. **View the Focus value on the Focus tab.** Turn the focusing ring until the **Focus** value increases and then starts to decrease. Turn the focusing ring back until the value is at the highest possible number between 1 and 255.

NOTE: The Focus value updates at a faster rate than does the image in the Image window.

Click on the **Trigger** tab to bring up the Trigger Setup screen, or click the **Next** button to proceed to the Tools screen.

5.1.2 Trigger Tab

An external trigger is used to tell the Sensor when to capture an image. The validity and timing of the trigger may be modified through Trigger Divide, Trigger Delay, and Minimum Trigger Width. Enter the appropriate values, or set the values by using the arrows, in the **Trigger** tab of the Setup window.

NOTE: Parameters set in the **Trigger** tab are stored in the inspection file and can be different for each inspection.

Trigger Divide (range: 1-10,000 triggers)

Sets the sequence of valid triggers. If set to 1, an image is captured in response to every valid trigger; if set to 2, an image is captured in response to every second valid trigger, and so on.

Trigger Delay (range: 0-8,000 ms)

Fixed time (ms) from the instant the Sensor receives a valid trigger to the instant the Sensor captures the image (see Figure 5-3).

Minimum Trigger Width (range: 1-8,000 ms)

Eliminates unwanted triggers by accepting triggers only if they are above a specified duration.

Polarity

Choose **Leading Edge** to capture images at the leading edge of the trigger signal. Choose **Trailing Edge** to capture images at the trailing edge of the trigger signal (see Figure 5-3).

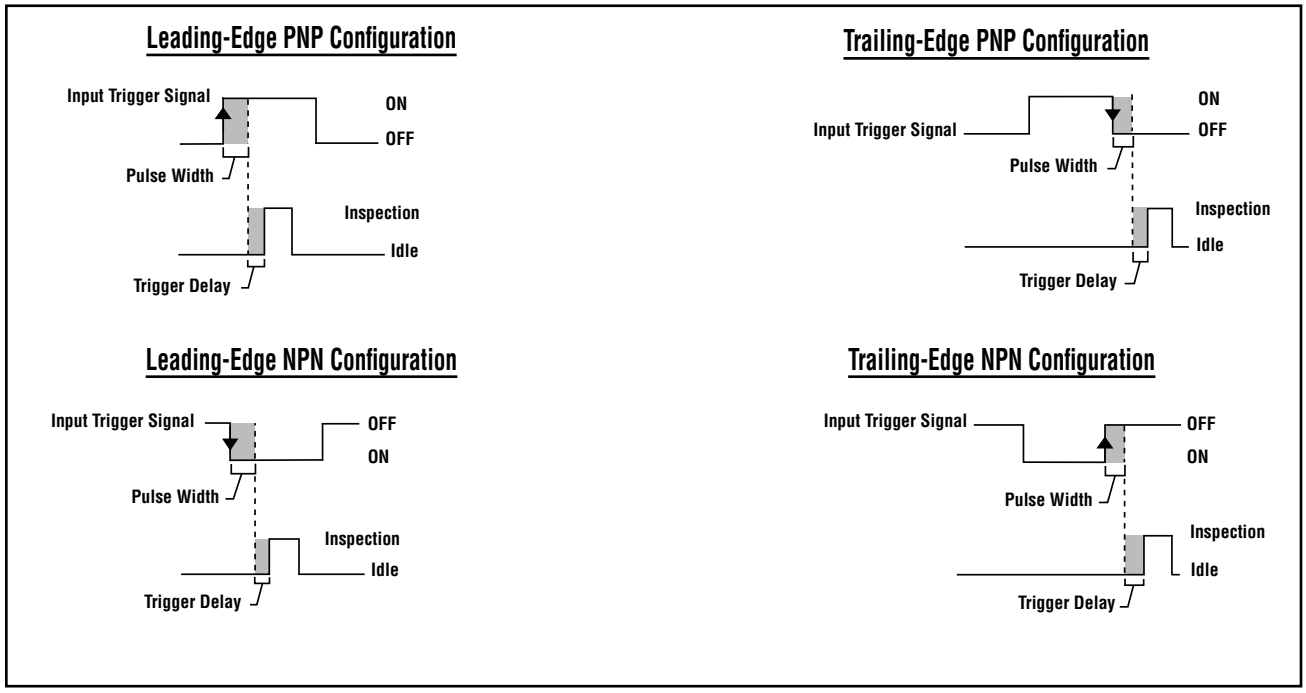


Figure 5-3. Timing Diagram: Leading-Edge and Trailing-Edge trigger inputs

6. Tools Screen

This section explains how to build, open, modify, manage, and save inspection files. Using the Tools screen, the user establishes the inspections that the Sensor will execute. The Tools screen can be viewed in the GUI by clicking the **Tools** button in the Main Menu toolbar.

Three sources of inspections are available:

Building an inspection from scratch is the typical method of establishing an inspection. The Tools screen supports this inspection organization and is designed to aid the user in building an inspection.

Existing inspections can be obtained from the Sensor (with or without the reference image) for execution or modification. This method is very useful if the user has an existing inspection on the Sensor and needs to make modifications to establish a new inspection.

Existing inspections also can be obtained from host resources using the Library. In this case, the sources of the inspections are the host's hard drive or network resources. This method provides access to an unlimited number of existing inspections for execution or modification.

6.1 Building and Modifying an Inspection

An inspection consists of both a *reference image* and an *inspection script*.

The reference image is used as a template for building the inspection.

The inspection script contains all the necessary information to run the inspection.

NOTE: A reference image must be captured or selected before building a new inspection. See Section 5.1 on page 24.

Tools Screen Build Tab

Use the **Build** tab screen to do the following:

- Choose a tool
- Add or remove tools
- Configure tools
- Set inspection parameters manually, through Teach, or through Quick Teach

To exit, click **Next** to exit the Tools screen and go to the Teach screen, or click **Quick Teach** to quickly set the tool parameters and go to the Run screen. The Sensor will add the tolerances on the inspection parameters that were selected in the Test tools.

6.2 Typical Build/Modify Procedure

The typical procedure for building or modifying an inspection is outlined below and explained in more detail later in this section.

1. Choose a tool.
2. Add a Region of Interest (ROI).
3. Set tool parameters.
4. Select **Quick Teach** or **Next** (to proceed to the Teach mode).

   NOTE: **Quick Teach** automatically sets judgment parameters by using the reference image as the target and applying the parameter tolerances selected in the Measure and Test tool(s). Once completed, Quick Teach prompts the user to save the inspection and proceeds automatically to the Run screen. Quick Teach provides the user with a very fast method of establishing candidate inspections.

   Teach automatically sets judgment parameters by running inspections on known good products. As an option, judgment parameters can be entered in the Test tool **Results** tab, and the inspection can be run without teaching.

   If Quick Teach or Teach is used, all previous manually entered parameters will be overwritten.
5. Save the inspection to the Sensor before running it. See Section 14, Saving Inspections on page 68.
6. Proceed to the Run screen to run the inspection.

Choosing a Tool

Before adding tools or removing any tools from the inspection, read all of this section to become familiar with the tools. To choose the right tools for an inspection, consider the tool's parameters and result options:

- Parameters are selected inputs for each tool (example: relative threshold).
- Results are the information returned from the tool after it has been executed.

Some tools perform evaluations, while others provide positional data for the tools that follow. Test tools evaluate, combine, or compare the results of other tools and determine a Pass-or-Fail judgment.

NOTE: Test tool must be chosen to evaluate the results of each tool or set of tools.

See Section 7, Tools on page 32 for information about how the tools analyze images.

Adding a Tool

The following steps provide an overview for setting up Vision tools in an inspection. Steps not available for some of the Location or Analysis tools are noted.

1. Click the button of the tool to be added to the inspection.
2. Rename the tool.
3. Draw the Region of Interest (ROI). This option is not applicable to Analysis tools.
4. Set Input options to indicate the expected results (see Logic Results Example on page 38). This option is not applicable for the Test tool.
5. Add a Test tool.
6. Configure the Test tool inputs and, if desired, configure the desired results (see Section 7.5, Test Tool on page 36).
7. Set the judgment parameters in one of three ways:

   -Quick Teach

   -Teach

   -Manually setting the judgment parameters

Removing a Tool

1. Choose the tool to be removed in the Navigation/Results window.
2. Click the **Delete** button () in the lower-left corner of the screen.

Renaming Tools

The default name of each tool can be edited or replaced (examples: LOCATE_1, TT_2). **Each name must be unique**.

To edit the tool name, click on the Name field (double-click to select the entire name), and type to change or replace the name.

- Enter up to 49 characters; only alphanumeric characters and underscores (no spaces) are valid.
- The button in the Navigation/Results window that appears will show the first nine characters after exiting the tool.

Region of Interest

A Region of Interest (ROI) indicates the area of the image that the tool evaluates. The area outside the ROI is ignored but remains visible in the Image window. An ROI must be drawn for all Vision tools.

ROI Types

ROI types include Area, Search, and Linear.

The following table lists the ROI type for each *Presence*PLUS *P4* AREA/AREA 1.3 tool:

Tool	ROI Type
Locate	Linear
Average Gray Scale	Area
BLOB Detect	Area

Area ROI: The Average Gray Scale and BLOB Detect tools have only a rectangular search ROI. Search ROIs evaluate the defined area.

Linear ROI: The Locate tool has only a linear ROI. A linear ROI is used by tools that scan along a defined line in a defined direction. Data are averaged along a linear ROI wider than 1 pixel to provide accurate test results. The ROI width is in increments of 4; for example 1, 5, 9, 13, and so on. The ROI widens symmetrically.

Widening an ROI will give the user an average value/location. This will result in improved repeatability.

Linear Tool Profile Graph

The graph in the Tool screen's Input tab is shown for all linear ROIs. The graph represents the pixel values along the ROI. The vertical axis represents the gray scale or gradient level, and the horizontal axis represents the position (in pixels) along the ROI. The curve on the graph (red line on the screen) represents the edge profile, and the horizontal dashed line (green on the screen) represents the threshold level.

Drawing and Editing an ROI

To Draw an ROI: Click on the **Draw ROI** button in the tool's **Input** tab. Hold the mouse selection button, and drag the mouse to create the ROI shape in the Image window.

NOTE: To move or edit the ROI after letting go of the mouse, re-select the ROI by clicking on the tool in the Navigation window.

Use the Magnify button to the left of the Image window for a closer view of the ROI.

To Move an ROI: Select the ROI, then hover the cursor inside it. When the mouse cursor turns into a four-way arrow, drag the ROI to its new position.

To Edit an ROI: Hover the cursor over an end of the ROI. When the cursor turns into a straight or curved arrow (indicating that the ROI can be dragged or rotated), click and drag. Release the mouse button to release the ROI.

NOTE: When editing a Linear ROI, its width, length, and position can be changed. When a linear ROI is edited, the **ROI Width** field in the tool's Input tab displays the width as it changes. The width can also be entered manually.

To Delete an ROI: Select the ROI, then click Delete.

NOTE: If an ROI is selected that contains another ROI, the selected object and everything inside will be deleted.

6.3 Quick Teach

Quick Teach provides the fastest and easiest method of establishing an inspection. Quick Teach will use the reference image to establish Pass/Fail parameters of the Test tools.

For more information on Teach and Quick Teach, see Section 9.1, Teach Overview on page 49.

Quick Teach does the following:

- Executes the inspection on the reference image.
- "Learns" the results of the Vision tools.
- Applies the applicable tolerances (user-determined, but default is 10%) to the selected parameters in the Test tool (these parameters determine the Pass/Fail criteria for each Test tool within the inspection).

NOTE: Quick Teach will overwrite any previous manually entered minimum and maximum parameter values in the Test tool.

Click Quick Teach to:

- Run all the tools.
- Calculate the measurements.
- Add a percentage of tolerance around taught values.
- Save the inspection to the Sensor.
- Go to Run.

6.4 Selecting/Deleting Inspections from Sensor

Up to 10 inspection files can be stored on the Sensor. Stored inspections can be modified, run, or deleted.

To select and open an inspection from the Sensor:

1. Click the **Sensor** tab.
2. Select the desired inspection.
3. Click the **Load** button.

The tools from the selected inspection populate the Navigation/Results window, and the software returns to the Build tab. At this point, all tools in the inspection can be modified. If new tools are to be added, simply select the tool in the Tools screen. If tools are to be deleted, select the tool and click the Delete icon () in the lower-left corner of the screen.

NOTE: If the image currently displayed on the screen will be the reference image (not the image stored with the inspection), check the **Load Script without Reference Image** box.

To delete an inspection from the Sensor:

Click to select the inspection file, then click the **Delete** icon.

6.5 Selecting Inspections from Library

Inspection files may be archived into a library on the PC or on a network connected to the PC. After opening an inspection from the PC or network, modify it or save it to the Sensor.

To select and open an inspection from the Library:

1. Click the **Library** tab.
2. Select the desired inspection.
3. Click the **Load** button.

The tools from the selected inspection populate the Navigation/Results window, and the software returns to the Build tab.

To modify an inspection from the library:

See Section 6.1, Building and Modifying an Inspection on page 28.

To save an inspection:

See Section 14, Saving Inspections on page 68.

7. Tools

This section explains the capabilities of the Sensor by explaining the tools.

7.1 Locate Tool

The Locate tool is an edge-based tool that locates the absolute or relative position of a target in a Field of View (FOV). This special edge detection tool detects the first transition between bright or dark pixels. This tool is initially set up around a feature that is in a repeatable position with respect to other features being inspected.

Locate tool applications:

- Locate the position of a label on a bottle
- Locate the position of a battery plate
- Locate the edge of a box on a conveyor

Tools that follow the Locate tool do the following:

- Translate and rotate (if rotation is enabled) their ROIs relative to positional information from the Locate tool.
- Use the Locate tool as a reference for a measurement, instead of the absolute image position.
- Translate and rotate, if it follows another Location tool.

7.1.1 Input Tab

Fields in the Locate tool's **Input** tab are explained below.

Type

- **Threshold**
  Relative: Finds an edge at a relative pixel intensity.
  - Is more tolerant of light fluctuations between inspections than other transition types.
  - May find false edges.

  Absolute: Finds an edge at a specific gray scale level.
  - Is less likely to find a false edge than other transition types.
  - May miss edges if the light level changes between inspections.

  Edge Strength: Detects edges on surfaces that are not uniformly illuminated, and finds edges in low-contrast images.
  - Is more tolerant of gradual changes in light levels across the tool than other transition types.
  - Filters out weak or gradual edges.
- **Percent / Value / Edge**: Sets the threshold value (moves the dotted green line on the Edge Profile graphs).
  - **Percent** is displayed when the Threshold type is Relative.
  - **Value** is displayed when the Threshold type is Absolute.
  - **Edge** is displayed when the Threshold type is Edge Strength.
- **Polarity**
  - **Bright to Dark** finds edges that start above the threshold value and cross below the threshold value.
  - **Dark to Bright** finds edges that start below the threshold value and cross above the threshold value.
  - **Bright or Dark** finds any edge.

Filters

- **ROI Width**: Increases in increments of 4 pixels (1, 5, 9, 13, ...) up to the total FOV size.
  - Narrow ROIs execute faster but could miss the part.
  - Wide ROIs are more consistent but don't execute as fast.
  - ROI must be 13 pixels or wider to calculate the rotation of a part.
- **Smoothing**: Runs a rolling average along the ROI length.
  - Filters out small sharp changes in the edge profile.
  - A high filter number may miss the edge of a narrow line.
- **Min Width**: Filters out small spike-of-intensity changes, and narrow dark or bright bands.
  - Determines the distance (in pixels) before and after an edge that must be free from additional transitions or the end of the FOV before the edge is recognized.
  - A high filter number may miss the edge of a narrow line.
- **Sample Rate**: Determines the sub-pixel resolution, increases the resolution of the tool, and increases the inspection time.

  1: 1-pixel resolution

  2: 1/2-pixel resolution

  3: 1/3-pixel resolution

  4: 1/4-pixel resolution

Results

The **Results** field provides the position of the first edge found. The position is expressed as X,Y coordinates in pixels, with the origin (0,0) at the upper-left corner of the screen.

Select: Rotation Enable

- Activates the rotation compensation calculation.
- ROIs that follow will rotate according to the difference between the reference image and the current inspection image.
- ROI width must be 13 pixels or greater.

7.1.2 Graph Tab

When Edge Strength is selected in the Locate tool's **Input** tab, the **Graph** tab appears. Clicking on the **Graph** tab brings up separate Edge Profile and Edge Strength graphs to replace the **Input** tab's single Edge Strength graph. The graphs are separated for easier viewing.

The Edge Profile graph represents the absolute gray scale level across the Locate tool.

The Edge Strength graph represents the change in gray scale along the Locate tool. Edge Strength detects an edge when the intensity change (solid red line on the screen) crosses the selected intensity change amount (dashed green lines on the screen).

A bright-to-dark transition has a negative edge strength value, and a dark-to-bright transition has a positive edge strength value. When the Edge Strength level is adjusted, both the negative and positive lines will adjust together.

7.2 Average Gray Scale Tool

The Average Gray Scale tool calculates the average pixel intensity within the selected ROI. Each pixel has a gray scale intensity value from 0 to 255, where 0 is black and 255 is white. The Average Gray Scale tool records the gray scale value of each pixel in an ROI and then averages them. With this information, the Average Gray Scale tool can detect changes in intensity that can indicate several conditions, such as missing objects, holes, texture changes, and possible color changes.

Using the Reject Level feature, the tool can be set up to ignore pixel intensities that are not pertinent to an inspection.

Average Gray Scale Tool Applications:

- Spot-check for holes
- Check for changes in surface texture
- Check for color quality and light intensity
- Check for presence/absence of labels or other objects

Input Tab

Fields in the Average Gray Scale tool's Input tab are explained below:

Rotation

The **Rotation** field is used to rotate the ROI. Data may be manually keyed in, or the ROI can be rotated with the mouse.

Reject Level

The **Reject Level** field is for narrowing the range of pixel intensities to consider in an inspection. Leaving the defaults at 0 for low and 255 for high will result in the tool taking into consideration all gray scale levels in the ROI from 0 (black) to 255 (white).

Low Limit: Enter a gray scale value in this field, and the tool will ignore all pixels with intensities below (i.e., darker than) the number entered.

Upper Limit: Enter a gray scale value in this field, and the tool will ignore all pixels with intensities above (i.e., brighter than) the number entered.

Reject Level Example

Consider setting up an inspection for a relatively bright object that ranges from 180 to 200 in pixel intensity and takes up 15 percent of the Field of View; yet, the remaining 85 percent of the Field of View ranges from 0 to 44 in pixel intensity. Setting a Low Limit of 50 will allow the tool to "pay attention" to only the bright object being inspected. Setting an Upper Limit of 210 would reject from the average any splashes of bright pixels that are not from the object being inspected. Further, masking the too-dark and too-bright parts of the Field of View will not be necessary; the inspected object can appear in different parts of the Field of View and still comprise the only averaged pixels.

Results

The **Results** field returns the average gray scale value of the pixels in the ROI.

7.3 BLOB Tool

In imaging, a group of adjacent, like-shaded pixels is called a BLOB, short for Binary Large OBject. The BLOB tool separates selected pixels into two categories: black and white. After the pixels are separated into black and white they are grouped, and adjacent black or white pixels are called a BLOB.

BLOB Tool Applications:
- Count pills
- Measure hole size
- Verify the number of characters in a date/lot code
- Detect LCD segments
- Detect missing products during packaging

Input Tab
Fields in the BLOB tool's **Input** tab are explained below:

Rotation
The **Rotation** field is used to rotate the ROI. Data may be manually keyed in, or the ROI can be rotated with the mouse.

Threshold Type and Threshold Level
In imaging, thresholding is an image segmentation process that converts a gray scale image into a binary image by reassigning pixel gray scale intensity levels to only two values: dark or bright. Regions of the binary image are separated according to whether pixel values in the gray scale image were above or below a chosen intensity level, or threshold.

The selection made in the **Threshold type** field interacts with the limits set in the **Threshold level** field below.

Fixed Threshold: Select **Fixed** when the lighting and image content will remain unchanging for all inspections.

Adaptive Threshold: Adaptive thresholding is a technique that is used to adjust the threshold for the BLOB tool based upon image content within the ROI. The intention of adaptive thresholding is to account for lighting changes that cause the acquired image to change. It performs best if used with bi-modal images, which have a clear contrast in the ROI. Adaptive thresholding chooses the current threshold value by converging to a value based on the average value of the pixels above and below the previous threshold value; it will not move the value of the threshold above or below the upper or lower limits.

BLOB Type
Choose **Dark** if the part is darker than the background.

- Choosing **Dark** with a Fixed threshold will cause the tool to fix the threshold at the level specified in the **Threshold level** field. The tool will choose as dark BLOBs all grouped pixels below the specified threshold.
- Choosing **Dark** with an Adaptive threshold type will cause the tool to limit the threshold to the range specified in the **Threshold level** field. The tool will choose as dark BLOBs all grouped pixels below the threshold it chose.

Choose **Bright** if the part is lighter than the background.

- Choosing **Bright** with a Fixed threshold type will cause the tool to fix the threshold at the Bright level specified in the **Threshold level** field. The tool will choose as bright BLOBs all grouped pixels above the specified Bright threshold and less than or equal to the Reject level. Pixels in the ROI that are brighter than the specified Reject level will turn orange in the Image window and be ignored during inspection.
- Choosing **Bright** with an Adaptive threshold type will cause the tool to limit the threshold to the range specified in the **Threshold level** field. The tool will choose as bright BLOBs all grouped pixels above the specified Lower Limit and less than or equal to the Upper Limit. Pixels in the ROI that are brighter than the specified Reject level will turn orange in the Image window and be ignored during inspection.

Size Filter
The **Size Filter** field is used to specify a range in the **Minimum** and **Maximum** fields. BLOBs with fewer pixels than the specified Minimum and more pixels than the specified Maximum will be ignored.

Select
The **Select** field is used to indicate which BLOB (the **Largest** or the **Smallest**) to list in inspection results.

Results
The **Results** field returns the area and location of the largest or smallest BLOB (depending on **Select** field choice), total area of all found BLOBs, number of BLOBs, and the gray scale value for the threshold level used. The BLOB position is the number of pixels from the upper-left corner of the screen to the centroid (center of mass) of the BLOB.

7.4 Measure Tool

The Measure tool calculates the distance between two points. The two points are selected from the image origin (upper-left corner of FOV) or Locate Tool(s). The distance can be the vector distance, X distance, Y distance, or all of these.

Measure tool applications:
- Determine the location of a BLOB
- Determine the distance between BLOBs

7.4.1 Input Tab

Fields in the Measure tool's **Input** tab are explained below.

Type
Absolute is in respect to the origin.
Relative is in respect to the Location tool.

Tool One ...
Selectable tools in the drop-down list are Locate or BLOB tools or the origin (0,0) at the upper-left corner of the screen. Use this option to select the tool that contains the first point of the measurement.

... to Tool Two
Selectable tools in the drop-down list are Locate or BLOB tools or the origin (0,0) at the upper-left corner of the screen. Use this option to select the tool that contains the second point of the measurement.

Results
The **Results** field provides the distance from **Tool One** to **Tool Two** in total pixels, in pixels along the X axis, and in pixels along the Y axis.

7.4.2 Input Tool Tab(s)

When a tool is selected as input to the Measure tool, that tool's tab appears in the Measure tool's configuration window. Clicking on the tab brings up information from the selected tool.

7.5 Test Tool

The Test tool uses Boolean logic to combine or convert tool results. Its data can be used to evaluate the results of a single tool or multiple tools. The output of the Test tool can be used as input to another Test tool or to generate a discrete output. Additionally, a discrete input can be tied to a Test tool.

The Test tool displays the result ranges it is using as judgment criteria. Typically, these ranges are automatically set by Quick Teach or by teaching the inspection. In addition, they can be manually set or modified either before or after teaching or running the inspection, in which case Quick Teach will discard any manually entered values. The Test tool also displays the results of the last image evaluated while setting up or running the inspection.

For inspections with many Vision tools, the Test tools can be linked together.

Test tool results can be used as follows:
- Gather results from image processing tools and discrete inputs
- Establish parameters for desired inspection results
- Tie multiple results together with logic options
- Include results in the overall Pass/Fail criteria
- Activate an output based on the inspection results

7.5.1 Input Tab

Fields in the Test tool's **Input** tab are explained below:

Logic
Use logic to combine multiple inputs to the Test tool. The results at the inputs and the logic option selected will determine whether the Test tool is True or False.

See the Logic Results Example table on page 38.

Input 1 through Input 4
- Choose previous tools or external inputs that need to be evaluated to pass the Test tool.
- When a tool is chosen, another tab pops up in the Test tool window. See Section 7.5.2, Tool Tabs in the Test Tool Window on this page.

NOTE: The tool to be evaluated **must** appear before the Test tool in the Navigation window.

Select **Invert** to invert the individual input. If the input is True, Invert reverses it to False. If the input is False, Invert reverses it to True.

Enable Remote Teach
Checking the box enables the tool to be taught remotely as explained in Section 10, Remote Teach on page 53.

Output
Choose an available General Output to activate if the Test tool is True.

NOTE: If a discrete output is not available, choose **System** in the Main Menu toolbar, then click on the **InputOutput** tab. Discrete I/O set up as inputs will not show up in the Output Options box.

Pass/Fail Contribution
Check this box if the Test tool will influence the Pass/Fail status of the inspection. Do not check this box if the overall Pass/Fail status of the inspection is not dependent on the current Test tool. The Pass/Fail contribution influences the following:

- Discrete output Pass
- Discrete output Fail
- Pass/Fail results counter
- Pass (Green) and Fail (red) LEDs on the Sensor
- Freezing an image on the video monitor
- Display options on the PC

Test Tool Options

Tool	Values	Options
Locate	Not available	
Average Gray Scale	Average Gray Scale	Min/Max/Tolerance percent*
BLOB	Count	Min/Max
	Largest Area	Min/Max/Tolerance %
	Smallest Area	Min/Max/Tolerance %
	Total BLOB Area	Min/Max/Tolerance %
Measure	Distance Distance X Distance Y	Min/Max/Tolerance %*
Test	True/False value	Pass/Fail Contribution
Communication	Success/Fail	Pass/Fail
Discrete Inputs 1-6	ON/OFF	
System Error	True/False	
* See the Toleranced Value example on page 38.		

7.5.2 Tool Tabs in the Test Tool Window

Each tool chosen in the Input tab as Input 1, 2, 3, or 4 causes a new tab to appear in the Test Tool window (for example, see the **MT_1** tab on page 38).

Examples

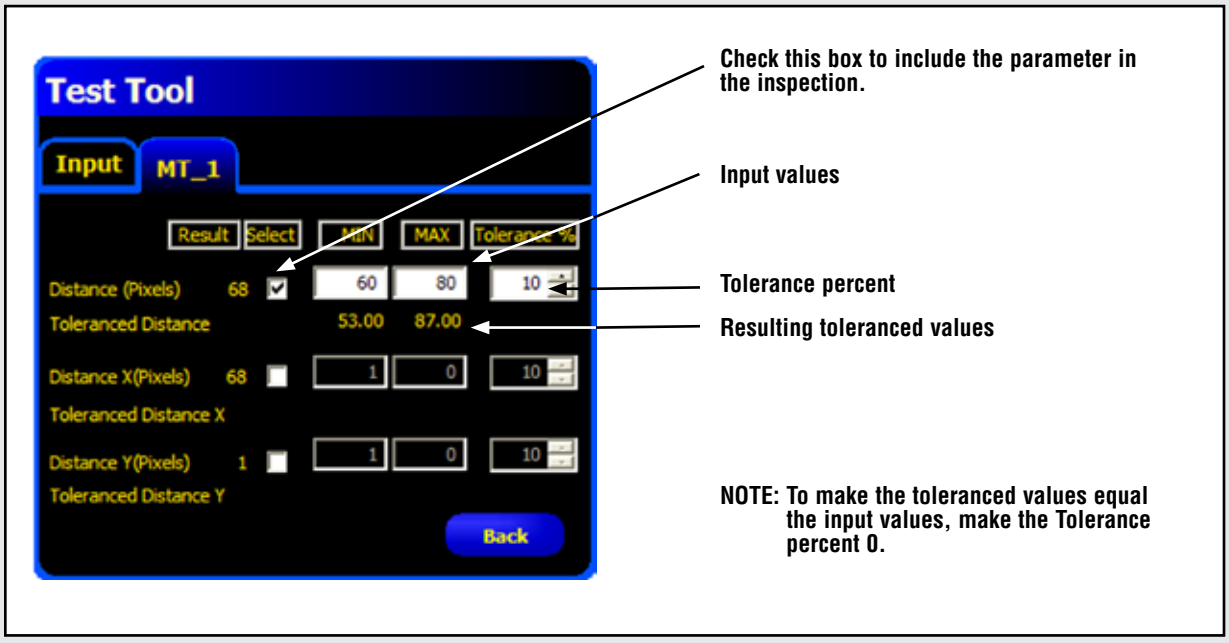
Logic Results Example

The following table shows the Test tool results for various logic functions. For each function, Input 1 and Input 2 are sampled in four different combinations.

Logic Function	Input 1	Input 2	Test Tool Result	Description
AND	False True False True	False False True True	False False False True	Test tool is True when all the inputs are True.
OR	False True False True	False False True True	False True True True	Test tool is True when any input is True.
XOR	False True False True	False False True True	False True True False	Test tool is True when one and only one input is True.

Toleranced Values Example

The Tolerance percent creates a window around the input values of the Test tool. As an example, for the default value of 10% the Sensor adds to both sides of the range a 10% buffer of the taught or manually entered range. **Adjust the Tolerance percent before teaching to customize the acceptable window.**



Tolerance Percent Formula

The software uses this formula to calculate each Toleranced Distance, shown previously.

$$\text{Toleranced Minimum} = \text{Min(R)} - \left(\frac{\text{Max(R)} + \text{Min(R)}}{2}\right) \times \frac{\text{Tolerance}}{100}$$

$$\text{Toleranced Maximum} = \text{Max(R)} + \left(\frac{\text{Max(R)} + \text{Min(R)}}{2}\right) \times \frac{\text{Tolerance}}{100}$$

Tolerance Percent Calculation

The example at right uses the formula above and the values entered for Distance X (Pixels) in the MT_1 tab shown previously.

Taught Range = 60 to 70 pixels

Taught Min(R) = 60

Taught Max(R) = 70

Tolerance = 10%

$$\text{Toleranced Minimum} = 60 - \left(\frac{80 + 60}{2}\right) \times \frac{10}{100} = 53.00$$

$$\text{Toleranced Maximum} = 80 + \left(\frac{80 + 60}{2}\right) \times \frac{10}{100} = 87.00$$

7.6 Communication Tool

The Communication tool is used to conditionally export data from the Sensor to an external device. Results from the Vision tools may be selected by the Communication tool and exported to an external device. The Sensor can export data over the Ethernet or via its serial channels. See Ethernet Communication Channel Specifications table below.

Examples of exported results:

- Execution times
- Whole-number counts
- Input and output values from Test tool
- Success from Locate and Test tools
- Reference point-to-edge and rotation distances

7.6.1 Ethernet Communication Channel Specifications

The Sensor can export data over the Ethernet. The table below provides specifications for the communications channels.

Attribute	Specification
Network Protocol	TCP/IP The Sensor places ASCII strings inside the TCP/IP packets without any additional protocols, just as if they were being transmitted over a serial line.
Communication Protocol	ASCII
Connection	RJ-45 (10 TCP sockets)
Speed	10/100 Base-T

7.6.2 Input Tab

Fields in the Communications tool's Input tab are explained below:

Select
This field provides a drop-down list from which to select tools; their results to export can be chosen from the selected tool's tab that appears in the configuration window.

Connection(s)
This field provides a drop-down list from which to select the communication connection(s) to export the data.

Format
This field provides options for formatting the ASCII string of data that will be exported.

Output Filter
This field provides a means to make specific output selections in order to avoid unwanted output information.

IMPORTANT: Add the Communication tool **after** the Vision tools that have data to be exported.

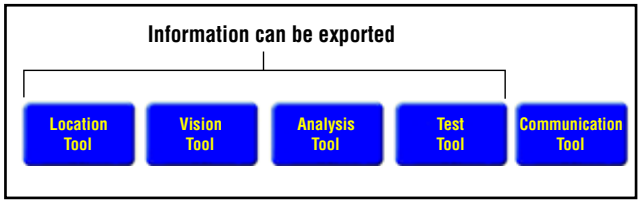


Figure 7-1. Tool navigation

Adding a Communication Tool

As shown in Figure 7-1, the Communication tool can export results data from the first Location, Vision, Analysis, and Test tools as follows:

- In the sequence that the tools are selected within the Communication tool
- In the sequence that the options are listed within the tools for export

One inspection can have more than one Communication tool.

Use one Communication tool to:

- Export data out of one port (serial or Ethernet).
- Export identical data out of multiple ports at the same time.

Use multiple Communication tools to:

- Separate the data and export separate segments to unique external devices.
- Customize the order of the exported data.
- Export data from the Vision tools at different times during the inspection.
- Customize the "Start Strings" control characters to unique external devices.

NOTE: The Test tool can have the Communication tool as one of its inputs. Therefore, if a Test tool is added after the Communication tool, a discrete output can be activated:

- If the TCP/IP connection is lost, or
- If the external device fails to acknowledge it received data.

This output could contribute to an inspection Pass/Fail if it is an input to a Test tool. A Communication tool without a Test tool will not contribute to the inspection Pass/Fail.

7.6.3 Configuring the Communication Tool

There are four main steps in configuring the Communication tool:

1. **Select the Vision tools and their results to export (in the Select field).**
   - When a tool is selected, the selected tool's tab appears in the Configuration window.
   - Click on the tab to select the data to be exported.
2. **Select the communication connection(s) that will export the data (in the Connection field).**
   - If MULTIPLE is chosen from the drop-down list, then click **Edit Selections** to select more than one port.
   - Click **View Settings** to display the configuration of the connection.
   - Data can be sent through 11 different communication connections: one connector for the serial connection, and 10 sockets (1 to 10) through the Ethernet connector.
   - The 10 Ethernet sockets are comprised of the Sensor IP address and port number.
   - The table below lists the default Ethernet socket addresses:

Socket	Default IP Address	Port
1	192.168.0.1	20,000
2	192.168.0.1	20,001
3	192.168.0.1	20,002
4	192.168.0.1	20,003
5	192.168.0.1	20,004
6	192.168.0.1	20,005
7	192.168.0.1	20,006
8	192.168.0.1	20,007
9	192.168.0.1	20,008
10	192.168.0.1	20,009

   - The serial port is the RS-232 connector (Pins 1, 9, and 10) on the Sensor. The default settings for the serial port are listed in the table below.

Attribute	Default Setting
Baud Rate	115200
Data Bits	8
Parity	None
Stop Bit	1
Flow Control	None

- For more information about configuring the Ethernet and Serial connections, see Section 12.3, Communication Tab on page 60.

3. **Format the ASCII string of data (in the Format field)**.
   - Choose a Delimiter and Start and End strings.
   - Check the **Enable Labels** box to add the names for data being sent.
   - Allowable ASCII string options are given in the following table:

Option Name	Values	Description
Delimiter	Comma , Colon : Semicolon ; <cr-lf> Carriage return and then line feed <lf-cr> Line feed and then carriage return <cr> Carriage return only <lf> Line feed only	The delimiter is used to separate the individual pieces of data being sent. The delimiter will follow every individual segment of data, including the start string and end string.
Start String	User-defined ASCII characters (limit of 75 characters)	This option allows the user to add characters before the string of data.
End String	User-defined ASCII characters (limit of 75 characters)	This option allows the user to add characters after the string of data.
Enable Labels	Parameter labels	Check this box to add a label to the data before the data itself. Example: Dark Count = 3. ("Dark Count = " is the label)

4. **Set conditions for conditionally exporting the selected data (in the Output Filter field)**.
   - Select **Pass** to export the selected information on a passing Test tool.
   - Select **Fail** to export the selected information on a failing Test tool.

7.6.4 Communication Tool Results

The Communication tool will send out the data in the same sequence that the tools appear in the inspection. The transmission of data will increase the total inspection time.

The table below shows the data that will be sent out for each tool:

Result	Value	Description
Success	1 = The connection is valid, and data will be sent. 0 = The connection was lost.	Checks the connection (Ethernet only).
Execution time	Given in ms.	Processing time for the Sensor to send the data out.

The table below shows the format of the data:

Result*	Number	Format	Example
Point (X, Y)	Decimal	(0.00, 00.00)	(23.41, 156.52)
Distance	Decimal	00.00	99.00
Count	Whole	0	4

*Available data is model-dependent.

Communication Tool Exportable Results

Tool	Data Label	Value	Example	Description
Locate	Tool Name	string	LOCATE_1	User-defined name
	Success	1 or 0	1	1 = Tool executed successfully. 0 = Tool did not find a point to use as a reference.
	Execution Time	ms	1.4	Tool processing time for the current inspection.
	Execution Time Min	ms	1.4	Fastest recorded tool processing time since the start of the inspection or since power-up.
	Execution Time Max	ms	1.6	Slowest recorded tool processing time since the start of the inspection or since power-up.
	Edge Offset Point	pixels (X, Y)	(-0.11, 4.11)	Distance from the reference edge to the current edge.
	Edge Location Point	pixels (X, Y)	(140.89, 49.11)	X, Y coordinates of the current edge.
	Rotation	degrees	-16.52	Amount of rotation from the current edge to the reference edge.
	Rotation Origin	pixels (X, Y)	(140.89, 49.11)	X, Y coordinates of the point from which ROIs will rotate.
Average Gray Scale	Tool Name	string	GS_1	User-defined name
	Execution Time	ms	6	Tool processing time for the current inspection.
	Execution Time Min	ms	6	Fastest recorded tool processing time since the start of the inspection or since power-up.
	Tool Name	string	GS_1	User-defined name.
	Execution time Max	ms	6	Slowest recorded tool processing time since the start of the inspection or since power-up.
	Average Gray Scale Value	0-255	182	Average gray scale value.
BLOB	Tool Name	string	BLOB_1	User-defined name
	Execution Time	ms	48.3	Tool processing time for the current inspection.
	Execution Time Min	ms	48.3	Fastest recorded tool processing time since the start of the inspection or since power-up.
	Execution Time Max	ms	48.7	Slowest recorded tool processing time since the start of the inspection or since power-up.
	Count	whole number	8	Number of BLOBs found.
	Total Area	pixels	50315	Number of pixels when combining all BLOBs found.
	Largest BLOB Area	pixels	49933	Number of pixels in the largest BLOB.
	Largest Location	pixels (X, Y)	(334.83, 262.99)	Centroid of the largest BLOB.
	Smallest BLOB Area	pixels	28	Number of pixels in the smallest BLOB.
	Smallest Location	pixels (X, Y)	(247.70, 211.91)	Centroid of the smallest BLOB.

Communication Tool Exportable Results, continued

Tool	Data Label	Value	Example	Description
Measure	Tool Name	string	MT_1	User-defined name
	Execution Time	ms	0.1	Tool processing time for the current inspection.
	Execution Time Min	ms	0.1	Fastest recorded tool processing time since the start of the inspection or power-up.
	Execution Time Max	ms	0.2	Slowest recorded tool processing time since the start of the inspection or power-up.
	Distance	pixels	170.14	Total distance from the points selected for Tool One and Tool Two.
	Distance X	pixels	128.51	Horizontal component (X) of the total distance.
	Distance Y	pixels	111.51	Vertical component (Y) of the total distance.
	Origin Point	pixels (X, Y)	(0.00, 0.00)	X, Y coordinates of the origin point.
	Measure Location Point 1	pixels (X, Y)	(140.89, 49.11)	X, Y coordinates of the point selected for Tool One.
	Measure Location Point 2	pixels (X, Y)	(269.40, 160.62)	X, Y coordinates of the point selected for Tool Two.
Test	Tool Name	string	TT_1	User-defined name
	Success	1 or 0	1	1 = Tool overall results passed. 0 = Tool overall results failed.
	Execution Time	ms	0.1	Tool processing time for the current inspection.
	Execution Time Min	ms	0.1	Fastest recorded tool processing time since the start of the inspection or power-up.
	Execution Time Max	ms	0.1	Slowest recorded tool processing time since the start of the inspection or power-up.
	Input1	1, 0, or -1	1	1 = Input 1 results passed. 0 = Input 1 results failed. -1 = Input 1 results not defined.
	Input2	1, 0, or -1	1	1 = Input 2 results passed. 0 = Input 2 results failed. -1 = Input 2 results not defined.
	Input3	1, 0, or -1	-1	1 = Input 3 results passed. 0 = Input 3 results failed. -1 = Input 3 results not defined.
	Input4	1, 0, or -1	-1	1 = Input 4 results passed. 0 = Input 4 results failed. -1 = Input 4 results not defined.
	Output	1 or 0	1	1 = Tool overall results passed. 0 = Tool overall results failed.

8. Exporting with the Communication Tool

This section explains how the Communication tool is used to export data from the Sensor to an external device.

8.1 System Setup Window Communication Tab

Ethernet Connection

In order to establish a connection, the external device must be directed to the correct IP address and the correct TCP port. In TCP/IP protocol, a TCP port number is used with the IP address to identify a specific path or socket. The Sensor has sockets 1 to 10; therefore, it can send out unique sets of data to 10 different devices.

Establish an Ethernet connection as follows:

1. Click on the **System** button in the Main Menu toolbar to bring up the System Setup window.
2. Click on the **Communication** tab.
3. Choose a connection from the Connection drop-down list of the **Communication Tool Setup** field.

NOTE: The TCP/IP setup is automatically configured; the Ethernet Settings box is for information purposes only.

Each ethernet socket has a unique TCP port number, as shown in the following table.

Ethernet Socket	Default IP Address	TCP Port Numbers
1	192.168.0.1	20,000
2	192.168.0.1	20,001
3	192.168.0.1	20,002
4	192.168.0.1	20,003
5	192.168.0.1	20,004
6	192.168.0.1	20,005
7	192.168.0.1	20,006
8	192.168.0.1	20,007
9	192.168.0.1	20,008
10	192.168.0.1	20,009

Serial Connection

The Sensor has one serial connection that can be configured: Serial 1 is pins 1, 9, and 10. Set up the serial communication options to match the receiving device. The following table shows the configuration options:

Option	Value	Default
Baud Rate	110 to 115200 bps	115200
Data Bits	5, 6, 7, 8	8
Parity	Even, Odd, None, Mark, Space	None
Stop Bits	1, 1.5, 2	1
Flow Control	None	None

Establish a Serial connection as follows:

1. Click on the **System** button in the Main Menu toolbar to bring up the System Setup window.
2. Click on the **Communication** tab.
3. Choose **Serial 1** from the Connection drop-down list of the **Communication Tool Setup** field.

NOTE: Because there is no flow control for the serial connections, the Sensor will not detect or log a lost or broken connection.

8.2 Testing the Connection

Basic Steps for Testing the Communication Tool

1. Connect the Sensor to a PC using a crossover Ethernet cable (STPX..) or the serial pins on the Sensor cable.
2. Start an inspection that has a configured Communication tool. For details about configuring the Communication tool, see Section 7.6.3, Configuring the Communication Tool on page 41.
3. Start HyperTerminal or Telnet (see below).
4. Trigger the Sensor.
5. Look in HyperTerminal or Telnet to see if the data has updated.

Detailed Steps for Testing the Communication Tool

Various software programs can test the communication connection. Two such programs are Telnet and HyperTerminal. Telnet can test Ethernet communications and is easy to set up. HyperTerminal can test serial communications and Ethernet communications.

NOTE: HyperTerminal for Windows NT does not have an Ethernet option.

Testing Ethernet Communications with Telnet

1. Start an inspection that has a configured Communication tool.
2. Connect a PC to the Sensor using an Ethernet crossover cable.
3. From the Start menu, Click **Start > Run**.
4. Type in the dialog box

   telnet <Sensor IP address> <IP port>

   Example: telnet 192.168.0.1 20000
5. Click **OK** to open a Telnet window.
6. Trigger the Sensor.
7. View the results.

Testing Ethernet Communications with HyperTerminal

1. Start an inspection that has a configured Communication tool.
2. Connect a PC to the Sensor using an Ethernet crossover cable.
3. Start a new connection with HyperTerminal.
4. Connect using TCP/IP (Winsock).
5. Configure HyperTerminal to talk with the Sensor.

   Example:
   - Host Address = 192.168.0.1 (Sensor default)
   - Port number = 20000 (Ethernet Socket 1)
6. Trigger the Sensor.
7. View the results.

Testing Serial Communications with HyperTerminal

1. Start an inspection that has a configured Communication tool.
2. Connect a PC to the Sensor using a serial cable.
3. Start a new connection with HyperTerminal.
4. Connect using COM1 (choose a serial COM port).
5. Configure HyperTerminal to talk with the Sensor.

   Example:
   - Baud rate = 115200 bits/sec (Sensor default)
   - Data bits = 8 (Sensor default)
   - Parity = None (Sensor default)
   - Stop bits = 1 (Sensor default)
   - Flow control = None

   NOTE: The Sensor and PC settings must match exactly.
6. Trigger the Sensor.
7. View the results.

8.3 Troubleshooting Tips

Refer to the following troubleshooting tips if not receiving data from the Sensor.

Condition	Possible Causes and Corrective Action
Ethernet Connection	
Check the LEDs on the Sensor's RJ-45 connector.	
No LEDs are ON.	The cable may not be the correct type (straight or crossover), or it could be broken.
Only the yellow LED is ON.	The electrical connection is good, but the Sensor and device are not exchanging data.
Yellow LED is ON, Green LED is ON or flashing.	Data is being exchanged between the PC and the Sensor.
Verify that the Communication tool is configured correctly.	• The connection should be Ethernet socket 1-10. • Verify that the desired result data has been selected in the Tool tab.
Check the receiving device setup.	
Check the IP address.	The device IP subnet must match the Sensor IP subnet.
Check the Port number: 20000-20009 (not 2000)	See the TCP Port Numbers table on page 47.
Check all firewall or anti-virus software	Verify that software is not blocking the Sensor's Ethernet socket.
Serial Connection	
Verify the hardware.	Check for breaks in the serial connection.
Check the Communication tool to see if it is configured correctly.	Verify that the desired result data has been checked.
Check the receiving device setup.	Check that the COM port properties on the receiving device matches the system parameters in the Sensor (baud rate, data bits, parity, stop bits, flow control). See Serial Connection on page 47.

9. Teach Screen

This section explains setting judgment tolerances by teaching inspections on good product.

9.1 Teach Overview

The inspection parameters can be taught automatically by using the Teach function. There are two Teach options: Quick Teach and Teach. The **Quick Teach** button is in the Tools window, and the **Teach** button is in the Main Menu toolbar.

Quick Teach
Use Quick Teach to set the Pass/Fail parameters based on the reference image. This is a fast way to start inspecting products with minimal effort. This method works best when the reference image is a good representation of all the parts. If the good parts can vary in appearance, standard Teach is a better option.

Clicking **Quick Teach** triggers the following events:

1. The results calculated from the reference image are transferred to the minimum and maximum fields in the Test tool.
2. If a tool's **Results** field includes a tolerance (e.g., shortest distance), then the additional tolerance is calculated (default is 10%).
3. The Save window prompts the user to save the inspection on the Sensor.
4. The software proceeds to the Run screen.

CAUTION . . .

Quick Teach will overwrite all the minimum and maximum values in the Test tool. If values were entered manually, or no changes are desired, go directly to Run without clicking **Quick Teach**.

Teach
Use **Teach** to automatically set the Pass/Fail parameters based on a sample of good parts. Instead of using the reference image as the good part, Teach uses new good parts that are presented to the Sensor under running conditions.

NOTE: The Teach screen looks very similar to the Run screen. Verify that the Sensor is at the Run screen and not the Teach screen before running an inspection.

There is no limit to the sample size during the Teach process. Teach will only expand the parameter window. If the current tolerances were greater than the sample set shown during the Teach process, then the Sensor will retain the old tolerances. Use Teach when there is a large part variation between the good parts.

CAUTION . . .

Only use good parts with Teach. A taught bad part will pass the inspection.

9.2 Teach Screen

To display the Teach screen:

Click the **Teach** button on the Main Menu toolbar, or click the **Next** button on the Tools screen **Build** tab.

Use the Teach screen to automatically set judgment tolerances to accommodate all variations of good product.

After teaching the inspection, typically proceed to the Run screen to run it.

NOTE: Before entering the Run screen, a pop-up prompts the user to save the inspection. Save the inspection to one of the memory locations on the Sensor.

As an alternative to teaching, enter judgment tolerances in the **Results** tab in the Test tool, and run the inspection without teaching. See Section 7.5, Test Tool on page 36.

To exit Teach options and go to the Run screen:

Click the **Next** button on the **Teach** Tool tab. To go to another destination, click one of the options in the Main Menu toolbar.

NOTE: Teach will only widen the minimum and maximum values in the test tools. If some or all values in the test tool(s) are entered manually, then Teach will only widen these tolerances, if needed, for the taught inspection.

9.3 Teaching an Inspection

Teaching on a number of known good samples finds acceptable variations and automatically sets the judgment tolerances to accommodate the full range of acceptable results.

Several Teach parameters may be selected in the Teach tool's **Teach** tab, such as how many images to consider during a teaching session and what type of captured images to display.

To teach an inspection:
Set preferences from the various Teach options, and click the **Start** button.

The **Start** button turns into a **Stop** button after it is clicked.

Options are explained in Teach Tab below.

To stop teaching an inspection:
Click the **Stop** button.

Teach Tab
Fields in the Teach tool's Teach tab are explained below.

Sample Size
Use **All** to not limit the Teach sample size.

Use **Count t**o have the Sensor automatically stop the Teach process after a set number of samples.

Use the Count option when there is a known sample set size. Use the arrows to increase or decrease the sample size. When the sample size is reached, the Sensor will stop the Teach process, and the **Start/Stop** button will return to displaying **Start**.

Trigger – The Sensor must receive an external trigger (Pin 3) to accept a sample.

Display – Determines when information is updated on the PC.

Next Pass: Display the next passing inspection.

Next Fail: Display the next failed inspection.

Next: Display the next available inspection.

None: Do not display inspections.

Capture Control – Determines how often information is updated on the PC.

Latched: Sets the Display option to **None** after an inspection is displayed to prevent displaying additional inspections.

Continuous: Continuously updates the inspection information according to the display option.

NOTE: The display may not capture every inspection.

Image Enable – Determines if the image is included in the result information.

Checked: The inspection image and results will update upon capture.

Unchecked: Only the results will update upon capture.

NOTE: Displaying the image on the PC will add to the inspection time.

Teach Counts - Tracks the number of samples used in each Teach process. Teach ignores samples that fail. Samples fail for the following reasons:

- An Edge tool before the Test tool fails.
- A Locate tool before the Test tool fails.
- Measure tool fails to find two points.
- Time-out error.
- An ROI rotates or translates off the screen.

Click the **Reset Teach** button to clear all previously gathered data.

Resolution: Increases or decreases the resolution on the displayed image. A lower resolution will have a faster PC update. The resolution does not change the inspection. Resolution options are 1:1, 4:1, 16:1, and 64:1.

9.4 Reviewing Results

Results of the inspection are displayed in the Results window, shown in Figure 9-1 . The Results window provides such statistics as tool execution status and time, Test tool results, and any errors.

Enlarge the window to the size shown below by clicking on the **Expand** button.

To learn more about the Results window, see Section 11.2, Results Window on page 56.

Figure 9-1. Results window

10. Remote Teach

This section explains teaching inspections on good product using the Remote Teach line.

10.1 Overview

The Remote Teach function is a method of remotely updating inspection parameters in Run mode. Vision tool(s) and Test tool(s) can each be selected to be taught or not taught. To remotely teach an inspection, the Remote Teach function must be enabled on each tool to be taught.

NOTE: The Location tools, the Measure tool, and the Communication tool are **not** affected by Remote Teach.

Understanding the sequence of events in the Sensor during a Remote Teach will help the user implement successful Remote Teach applications. The sequence of events is as follows:

1. With the Sensor in Run mode (and Ready), the user pulses the Remote Teach line (Pin 2, gray wire).
2. The Sensor recognizes that the Remote Teach line is active and waits for the next valid trigger.
3. At the next valid trigger, Ready goes inactive (the Green Ready LED shuts OFF), and the Sensor acquires a new image.
4. The Sensor adjusts the ROI (if the inspection uses Location tools).
5. The Vision tool learns the new pattern and performs the analysis.
6. The Sensor adjusts the minimums and maximums in the Test tool (if the Test tool is enabled for Remote Teach).
7. The inspection will indicate **Pass** if the pattern meets the requirements of the Vision tool and (if the Test tool is enabled for Remote Teach) if the evaluation of the Test tool(s) passes with the adjusted minimums and maximums.
8. The inspection will **Fail** if the Vision tool(s) or the Test tool(s) fails. If the inspection fails, another Remote Teach sequence or user intervention is required.

10.2 Remotely Teaching a Tool

To remotely teach a tool, the user must enable Remote Teach on each tool to be taught. This can be accomplished by clicking on the Enable Remote Teach box in the tool window before running an inspection (typically performed when inspection is created).

To perform a Remote Teach, do the following:

1. Verify that the correct tools are enabled for Remote Teach.
2. Verify that the Sensor is in Run mode.
3. Verify that the Green Ready LED is ON.
4. Activate the Remote Teach input.
5. Position the target as desired.
6. Trigger the Sensor.

Following a Remote Teach, subsequent inspections will be performed with the newly learned parameters of the Vision tool(s) and the Test tool.

CAUTION . . .

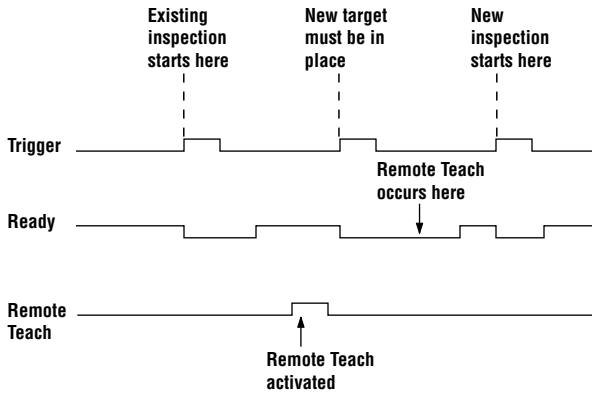
A successful Remote Teach will occur ONLY if the new target is similar in contrast to the original target. **The exposure time and gain are NOT modified during Remote Teach.**

10.3 Timing Sequence

The timing for the Remote Teach sequence is shown in Figure 10-1 (the diagram assumes Remote Teach is enabled on the tools and that all signals meet minimum times).

It is important to note that the remotely taught parameters are not saved to non-volatile memory; hence, the remotely taught inspection is good only as long as Run mode is maintained and power to the Sensor is not lost.

To record the remotely taught inspection, the logging function must be used. See Section 11.1.3, Log Tab on page 55.



Notice that the Remote Teach time is longer than the normal inspection time. This time is inspection-dependent (tool-dependent), but a safe assumption is two times the normal inspection time in most cases.

Figure 10-1. Remote Teach Timing Sequence

10.4 Remote Teach Results

Remote Teach will indicate normal Pass/Fail results. To clarify normal results, the rules are as follows:

- If Location tools were used in the inspection, then they must perform correctly; that is, the Locate tool must find an edge, and the Vision tool(s) must find a pattern. If they do not perform correctly, the Remote Teach will fail, and the inspection will indicate **Fail**.

NOTE: If the Remote Teach fails for this reason, then the new pattern will not be taught, and the previous inspection will still be valid.

- If Location tools were used and they performed correctly or if Location tools were not used, then the Remote Teach will attempt to update the Vision tool (if enabled). If the Vision tool fails, then the Remote Teach will fail, and the inspection will indicate **Fail**.

NOTE: If the Remote Teach fails for this reason, then the existing inspection is not valid. The Remote Teach inspection will continue to fail until a new inspection is taught or selected (via Product Change) or until the Sensor is taken out of Run mode.

- If the Remote Teach is successful, the inspection will indicate **Pass**, and the new inspection will perform with the new parameters.

11. Run

This section explains how to monitor and select inspections.

11.1 Run Screen

Use the Run screen to start, stop, monitor, and log an inspection.

To display the **Monitor** tab on the Run screen, click Run in the Main Menu toolbar. The **Monitor** tab is the default tab in the window.

To exit the Run screen, verify that Run is stopped, and click another destination on the Main Menu toolbar.

While running an inspection, the following can be viewed:

- Pass and Fail counts
- The status of inputs, outputs, Product Select System errors, and whether the Sensor is Ready
- Next Pass, Next Fail, Next Remote Teach, Next Remote Teach Fail, Next, None

To run an inspection, set options and preferences, and click the **Start** button. Options are explained in Monitor Tab.

11.1.1 Monitor Tab

Fields in the Run screen's **Monitor** tab are explained below.

Display
Next Pass: Display next passed inspection.
Next Fail: Display next failed inspection.
Next RT: Display next remotely taught inspection.
Next RT Fail: Display next failed, remotely taught inspection.
Next: Display all inspections. The display is updated continuously, but because of transfer speed limits, not every image will be displayed. For faster image speed, reduce resolution.
None: Display not updated.

Capture Control
Latched: The condition set in **Display** (see above) is displayed or latched until set.
Continuous: The condition set in **Display** (see above) is displayed.

Image Enable
Checked: The PC displays an image of the inspection.
Unchecked: The PC will collect the inspection information without an image.

NOTE: Capturing images slows Sensor response. For high-speed applications where the PC remains connected to the Sensor, **Image Enable** should be unchecked unless absolutely required.

Results
Pass Count: Number of passed inspections
Fail Count: Number of failed inspections
Total Count: Total number of inspections
Reset: Clears the counts for the selected inspection.

NOTE: Each of the 12 stored inspections has its own Pass/Fail registers to store the Pass/Fail counts for that particular inspection.

The legend below applies to the colored circles in the Inputs, Outputs, Product Select, and System fields on the GUI Run screen.

Gray = Inactive (not currently available)

Red = Active (not currently available)

Not Visible = Not selected as input/output

Inputs: Each numbered circle represents an input and its current state.

Outputs: Each numbered circle represents an output line and its current state.

Product Select: Displays the last latched Product Select (binary encoded).

System
E = System error
R = Ready

NOTE: The results of the discrete I/O are not displayed in real time. They update approximately 4 times per second.

Resolution
Max. = 1:1
Min. = 64:1

Click on the **Up** arrow to increase the image resolution, and click on the **Down** arrow to decrease the image resolution.

NOTE: Changing the resolution affects the display only; it does not affect the accuracy of the inspection.

11.1.2 Select Tab

Fields in the Run screen's **Select** tab are explained below.

Product Select

- The **Hardware Input** option signals the Sensor to run the option currently selected by the Product Change and Product Select line. This option allows the Product Change and Product Select input to change the inspection. When the input to the Product Change pin becomes active, the Sensor samples the Product Select pin and determines which inspection to load from the Sensor memory.
- The **Software Override** option signals the Sensor that the inspection to run will be manually selected. With this option selected, the inspection displayed next to the Override button is the inspection that runs.

See also Product Change and Product Select Timing (on page 11) in Section 3.3, Sensor Connections.

Image Hold
Failed Image Hold: How long (in seconds) failed images should be displayed on the optional NTSC video monitor.

Trigger Delay Adjust: How long (in ms) to delay the Sensor before it takes a picture after receiving a valid trigger.

11.1.3 Log Tab

The Product Change and Product Select line is used to swap between inspections. Select any of the (up to 10) stored inspections to be the next inspection to run. A time delay, typically less than 1 second, is required to change the inspections.

Fields in the Run screen's **Log** tab are explained below.

Mode (default: None)
Pass: Log only passed inspections based on Strategy.
Fail: Log only failed inspections based on Strategy.
RT: Log remotely-taught inspections based on Strategy.

Using the Trigger Delay when a part is triggered too early may be easier than moving the Sensor.

RT Fail: Log failed, remotely-taught inspections based on Strategy.
Any: Log all inspections based on Strategy.
None: Log not updated.

Strategy (default: First Ten)
First Ten: Store the first 10 inspections that meet the mode criteria.
Last Ten: Store the previous 10 inspections that meet the mode criteria.
First and Last Five: Store the first 5 and last 5 inspections that meet the mode criteria.

Image Enable
Checked: The PC displays an image of the inspection
Unchecked: The PC will collect the inspection information without an image.

NOTE: Capturing images impacts the Sensor response speed. For high-speed applications where the PC remains connected to the Sensor, Image Enable should be unchecked unless absolutely required.

Camera
Shows the number of stored inspections currently in the Sensor's memory. **Obtain** moves the stored inspection data from the Sensor's memory to the GUI's memory. **Flush** deletes all stored inspections from the Sensor's memory.

PC
Saved Selected allows writing of the current log file from the GUI's memory to a hard drive or other storage device. **Load** allows a saved file to be loaded from the computer's hard drive or other storage device into the GUI to be viewed.

Result View
Clear Selected deletes the currently selected inspection from the GUI's memory. **Clear All** deletes all inspections from the GUI's memory.

11.2 Results Window

In the Run screen, the Results/Navigation window at the bottom of the display defaults to the Results window shown below. The Results window provides information about the last displayed inspection.

Each tool in the list can be expanded to show its results. Each result shown indicates the tolerance assigned to the parameter and its current value.

- If the current value falls within the Test tool's set tolerance or if the tool executed properly, then a green checkmark symbol is shown beside that parameter (see **Passed tool** in Figure 11-1).
- If the current value falls outside the Test tool's set tolerance or if the tool failed to execute properly, then a red failed symbol is shown beside that parameter (see **Failed tool** in Figure 11-1).

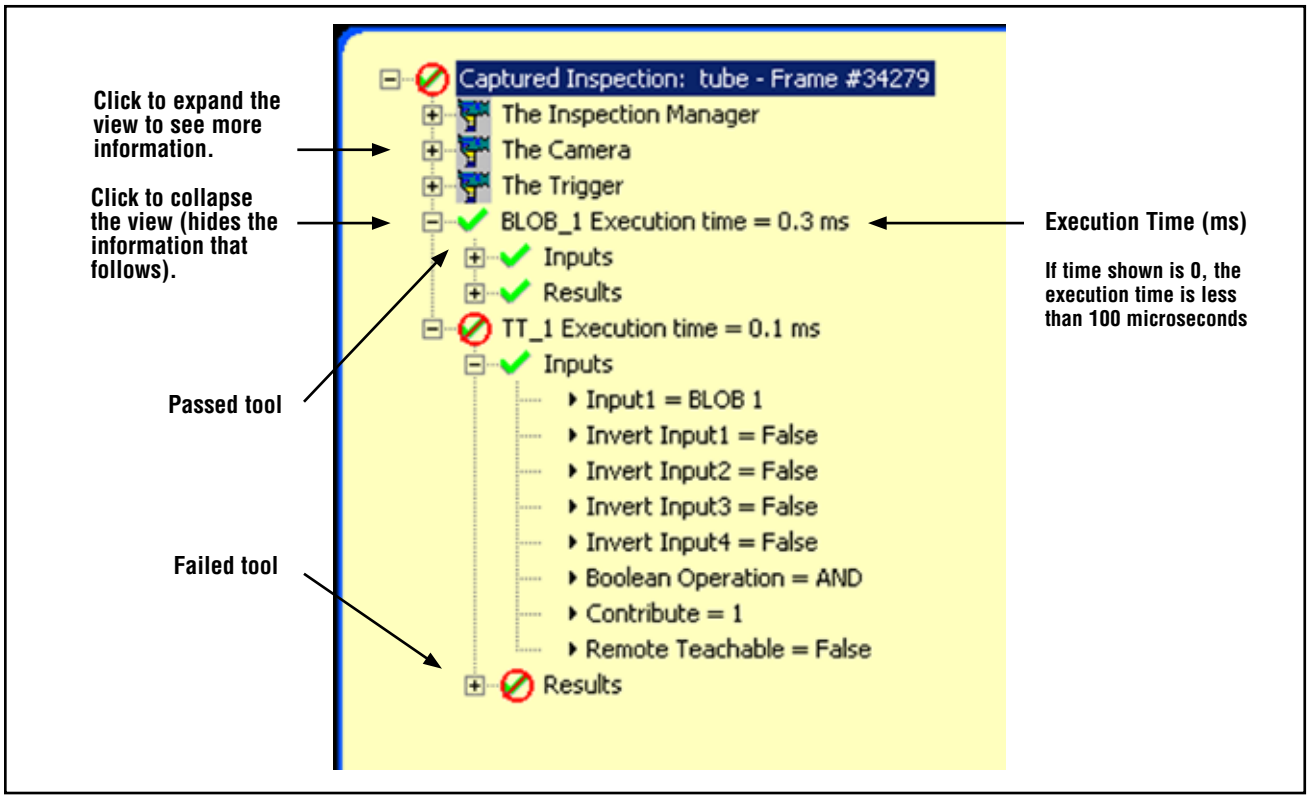


Figure 11-1. Results window

11.3 Run Results

Name	Level	Parent Level	Description
Current Inspection	First	None	Name of current running inspection.
The Camera	Second	Inspection Name	Sensor Information: -Gain -Exposure time (ms)
The Trigger	Second	Inspection Name	Trigger Input Information: -Divide -Delay -Width -Polarity
The Inspection Manager	Second	Inspection Name	General inspection information: - Fail hold time (ms): how long a failed image is displayed on the monitor - Power-up time: time since last shutdown (resolution = second) - Pass count - Fail count - Missed trigger count: total number of triggers missed because Sensor was not Ready - Lifetime: how long the Sensor has been turned on (resolution = 1 hour) - Total inspection time minimum (ms): minimum inspection time recorded (resolution = 0.1 ms) - Total inspection time maximum (ms): maximum inspection time recorded (resolution = 0.1 ms) - Total inspection time (ms)*: inspection time from trigger until end of processing time for last inspection (resolution = 0.1 ms) (does not include inspection capture to PC*) - Config timestamp: when inspection was created *Capturing an image on the PC adds to the inspection time. Set display settings to None to decrease the inspection time to a minimum.
Tools (tool name)	Second	Inspection Name	Information about current tool: -Execution time (resolution = 0.1 ms) -Inputs (parameters set for the current tool) -Results (results of the current tool)
System Log	First	None	Not used

12. System Setup

12.1 System Setup Window

This section explains how to configure the Sensor and diagnose system errors in the System Setup window.

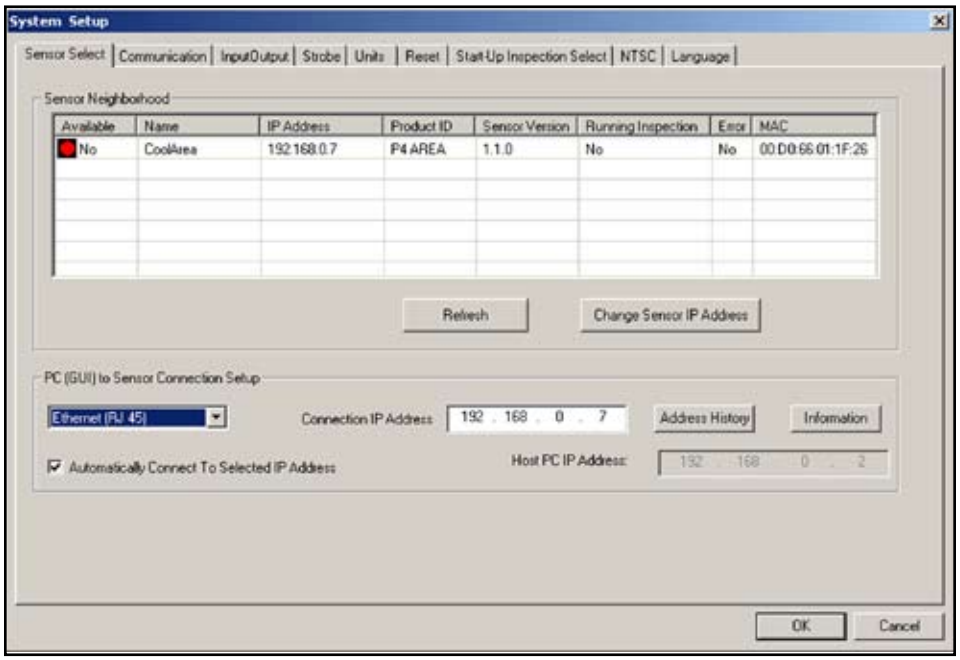


Figure 12-1. System Setup window

To call up the System Setup window, click the **System** button in the Main Menu toolbar. Use the tabs in the System Setup window to configure the Sensor and diagnose system errors.

To clear changes, click **Cancel.**

To save changes and exit the System Setup window, click **OK**.

To exit the System Setup window without changes, click the .

NOTE: To make changes to the Sensor selections, an inspection must not be running. To stop a running inspection, click the **Stop** button in the **Run** tab. To save changes, click **OK** before exiting the tab or closing the window.

12.2 Sensor Select Tab

Use the **Sensor Select** tab (Figure 12-1) to establish the Sensor connection with the PC.

NOTE: An option box to open the **Sensor Select** tab is automatically displayed if the Sensor either is not connected or is connected but with the wrong location selected.

PC (GUI) to Sensor Connection Setup
Use this field to select whether the Sensor will communicate via the Ethernet port or a serial connection. Choose to use an IP address if the Ethernet port will be used.

Ethernet (RJ 45)
- Shows the IP address the software is looking for.
- Change the IP address to 192.168.0.1 (default IP address of the Sensor).
- Not applicable if **Serial** is chosen.

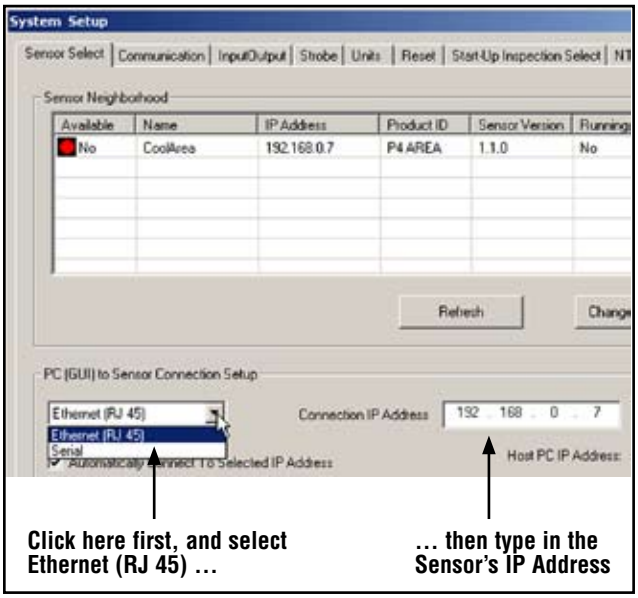


Figure 12-2. PC-to-Sensor connection setup fields

IP Address History: Use this button to view previous IP Addresses and Subnet Masks.

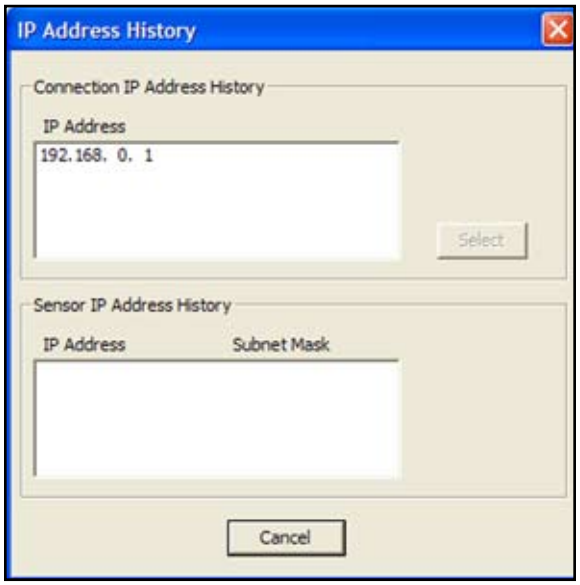


Figure 12-3. IP Address History window

12.3 Communication Tab

Use the **Communication** tab to modify the IP address and subnet of the Sensor connected to the PC.

NOTE: An option box to open the **Communication** tab is automatically displayed if the Sensor either is not connected or is connected but with the wrong location selected.

Modify Sensor IP Address

To change the Sensor IP Address:

1. Enter the new IP address and click **OK**.
2. Change the IP address in the **Communication** tab to the new address.

NOTE: **Performing a system reset in Step 3 may result in lost communication if communicating via an Ethernet connection.**

3. Reboot the Sensor. Perform a system reset if desired.
4. Restart the software.
5. Change the IP address to the new address in the **Communication** tab.

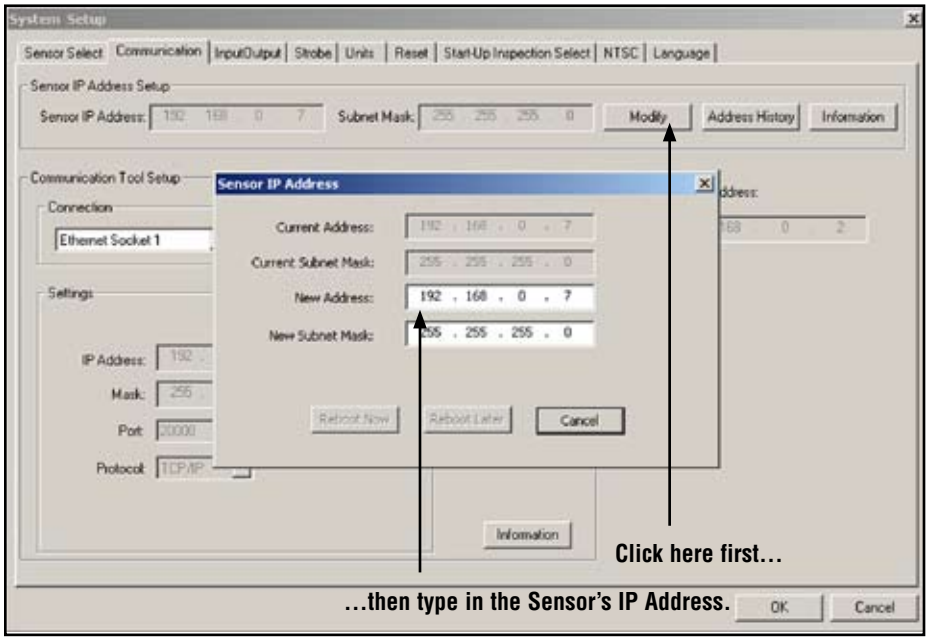


Figure 12-4. Communication Tab in the Sensor IP Address window

Serial Communication

Choosing the Serial 1 option in the **Connections** field allows the serial channel to be configured. The Baud Rate, Data Bits, Parity, and Stop Bits may be configured. Currently flow control is NOT selectable.

See Serial Connection in Section 8, Exporting with the Communication Tool on page 46.

12.4 InputOutput Tab

Use this screen to set the functionality of the four programmable I/O connections. Defaults are shown.

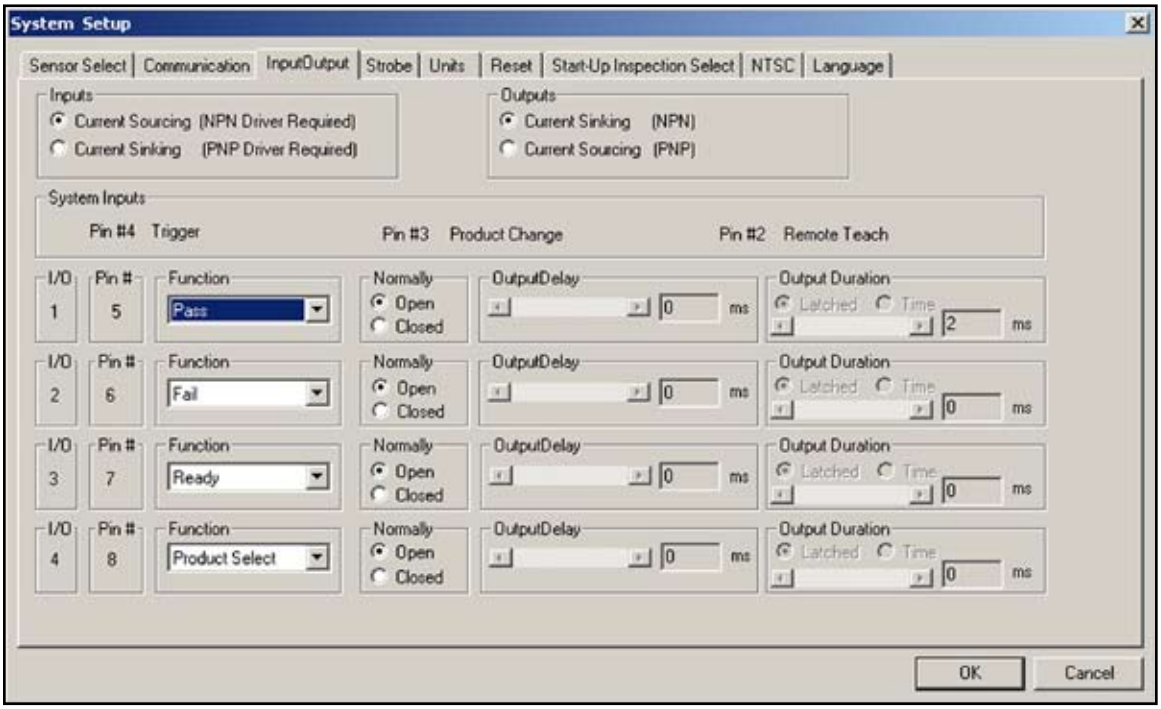


Figure 12-5. System Setup window InputOutput tab

Fields in the System Setup window's InputOutput tab are explained below.

Inputs and Outputs

Trigger, Product Change, Remote Teach, and Discrete inputs and outputs can be selected as either NPN (current sourcing) or PNP (current sinking). Once NPN or PNP is selected, all inputs/outputs are either NPN or PNP.

I/O, Pin #, Function

I/O 1 through 4 in the **I/O** column correspond to Pins 5 through 8 in the **Pin #** column.

Options from the Function pull-down lists are explained below:

General Input: Input to the Sensor
General Output: Output from the Sensor that can be selected in a Test tool
Pass: Active when the entire inspection passes
Fail: Active when the inspection fails
System Error: Active when a system error occurs
Ready: Active when the Sensor is ready to accept another trigger.
Product Select: Used in conjunction with Product Change to select inspection locations at which to begin execution. See Section 13, Product Change on page 68.

Normally Open/Closed

Select the state (open or closed) that the output will take when not active.
Normally Open: The output becomes active when the logic condition controlling the output becomes True.
Normally Closed: The output becomes inactive when the logic condition controlling the output becomes True.

Output Delay

Output Delay is the time from a trigger to start an inspection until the Sensor output turns ON. It is available only for general outputs.

NOTE: If processing time is longer than the output delay, the output will become active immediately after the processing is finished.

Output Duration

This option is available only for the general outputs; the other outputs (Pass, Fail, System Error, and Ready) are latched only.

Latched: Active until the condition changes.
Time: Active for a specific length of time.

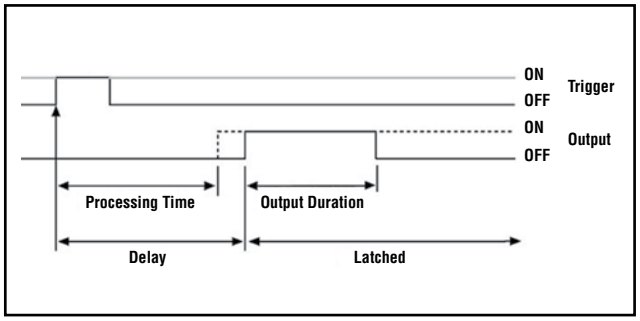


Figure 12-6. Output Delay and Output Duration

12.5 Strobe Tab

The Strobe option in the System Setup window is shown below. Use the **Strobe** tab to set the strobe signal (Pin 4 on the external light connector) for a strobed light source. The strobe signal is a +5V dc TTL signal.

Fields in the System Setup window's Strobe tab are explained below.

Strobe Width

OFF: The strobe output never becomes active.
ON: The strobe output remains active.
Exposure Duration: The strobe output is active only while the Sensor is acquiring an image.
Time Duration: Sets the duration for active strobe output from the initial valid trigger (minimum pulse width has been satisfied) to the end of the duration. The range is from 0 to 4,000 ms.

Level

Active High: An active output produces a +5V dc signal.
Active Low: An active output produces a 0V dc signal.

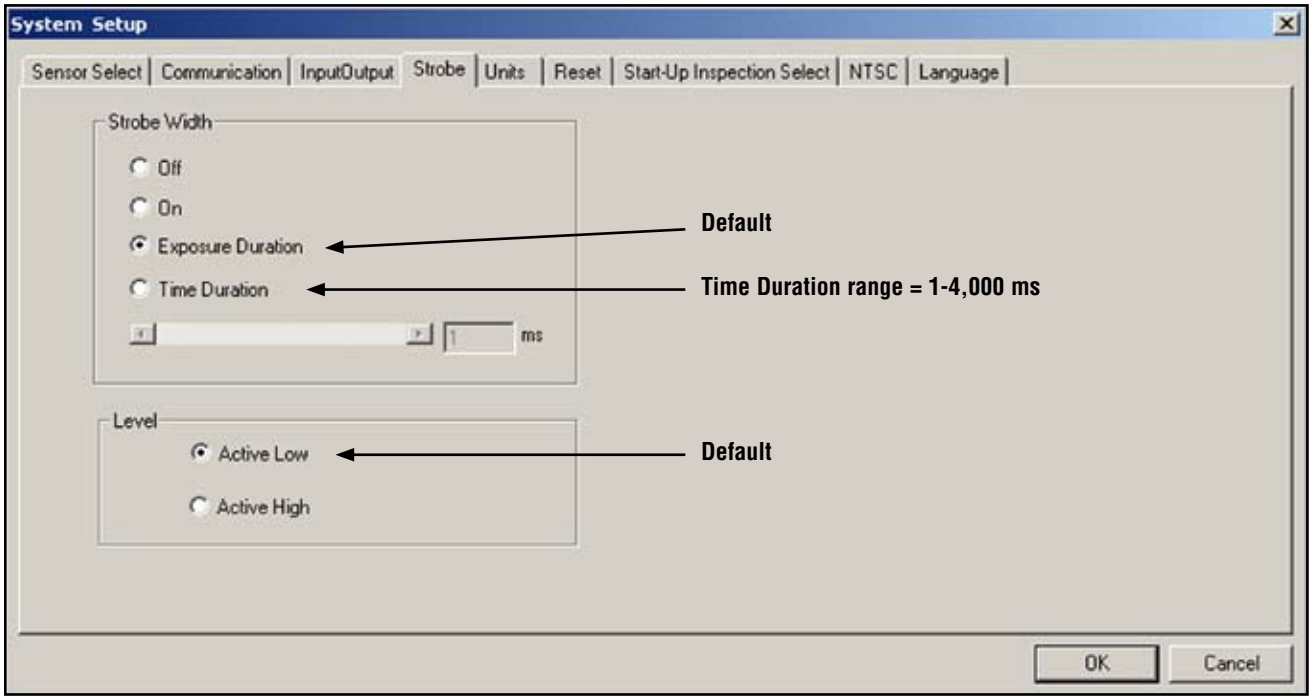


Figure 12-7. System Setup window Strobe tab

12.6 Units Tab

Use the **Units** tab to scale pixels to Engineering units (inches, millimeters, etc.). Follow the instructions on the screen.

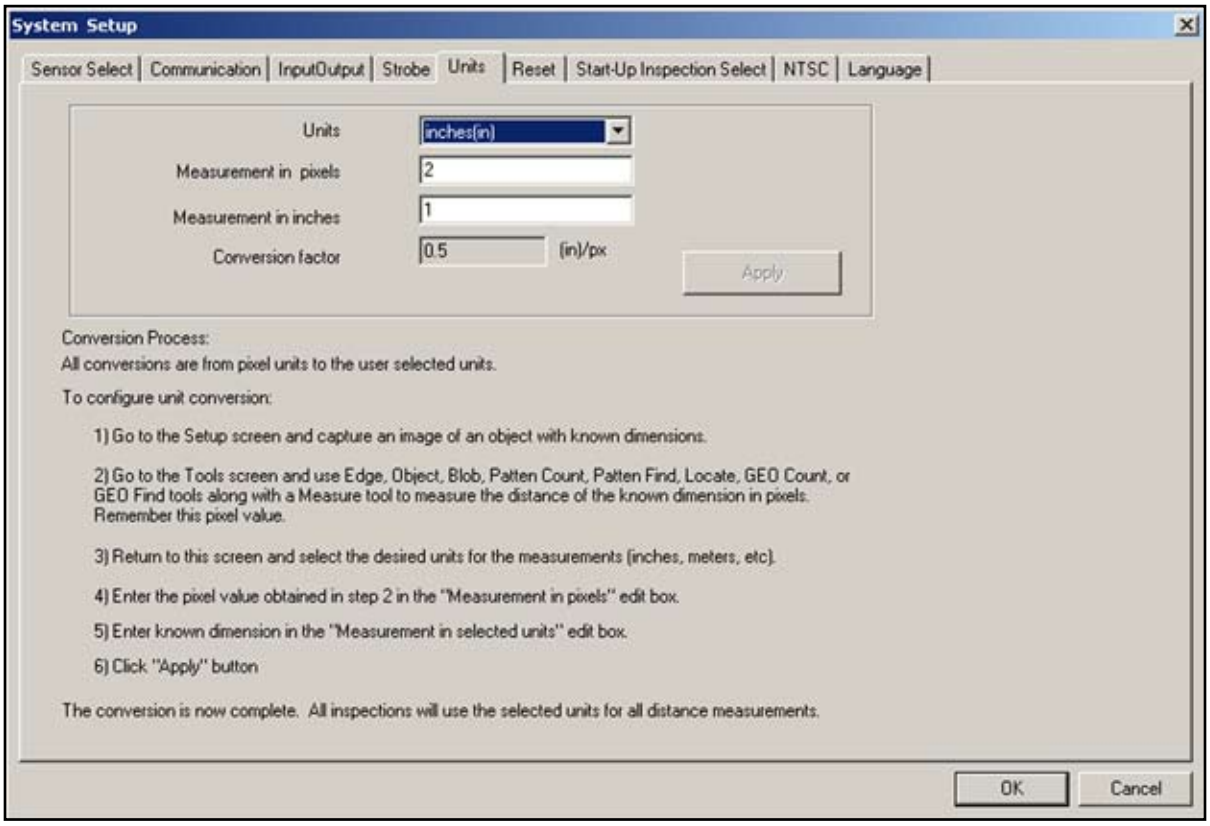


Figure 12-8. System Setup window Units tab

12.7 Reset Tab

Use the **Reset** tab to clear system errors and reestablish Sensor communications.

Fields in the System Setup window's Reset tab are explained below.
Reset Error Flag: Click to clear the Sensor's Red Error LED.
Reset Error Log: Click to clear the error log.
System Reset: Click to reboot the Sensor. (This is a system reboot and will take several seconds).
Get Error Log: Click to display the System Log icon in the Navigation/Results window. The System Log records information about all system failures (such as communication errors between the PC and the Sensor).

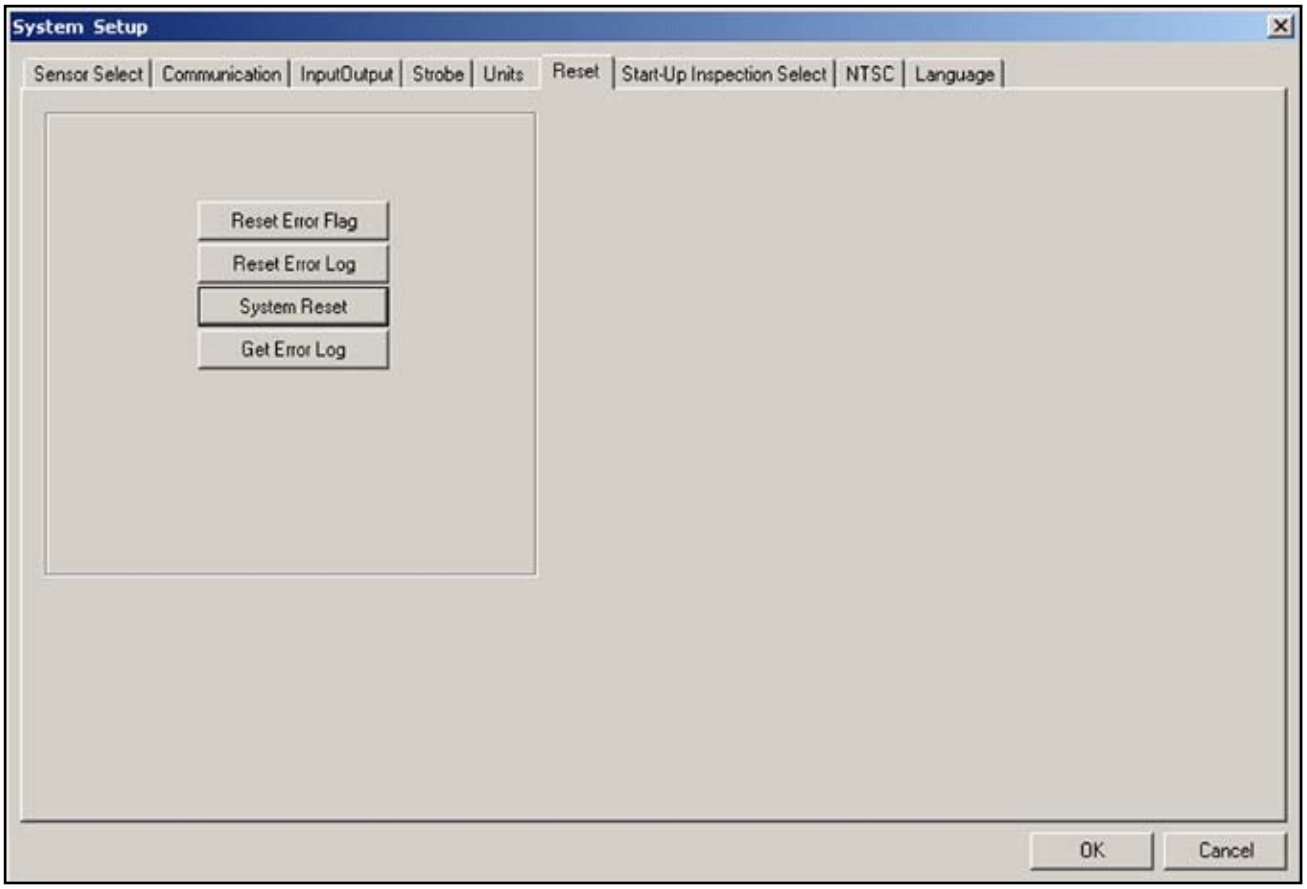


Figure 12-9. System Setup window Reset tab

12.8 Start-Up Inspection Select Tab

Click on the **down** arrow for a drop-down list of up to 10 inspections saved on the Sensor.

If Hardware Select is the inspection selection, then the inspection chosen in this window is the one that will start if the Sensor is powered down while running an inspection.

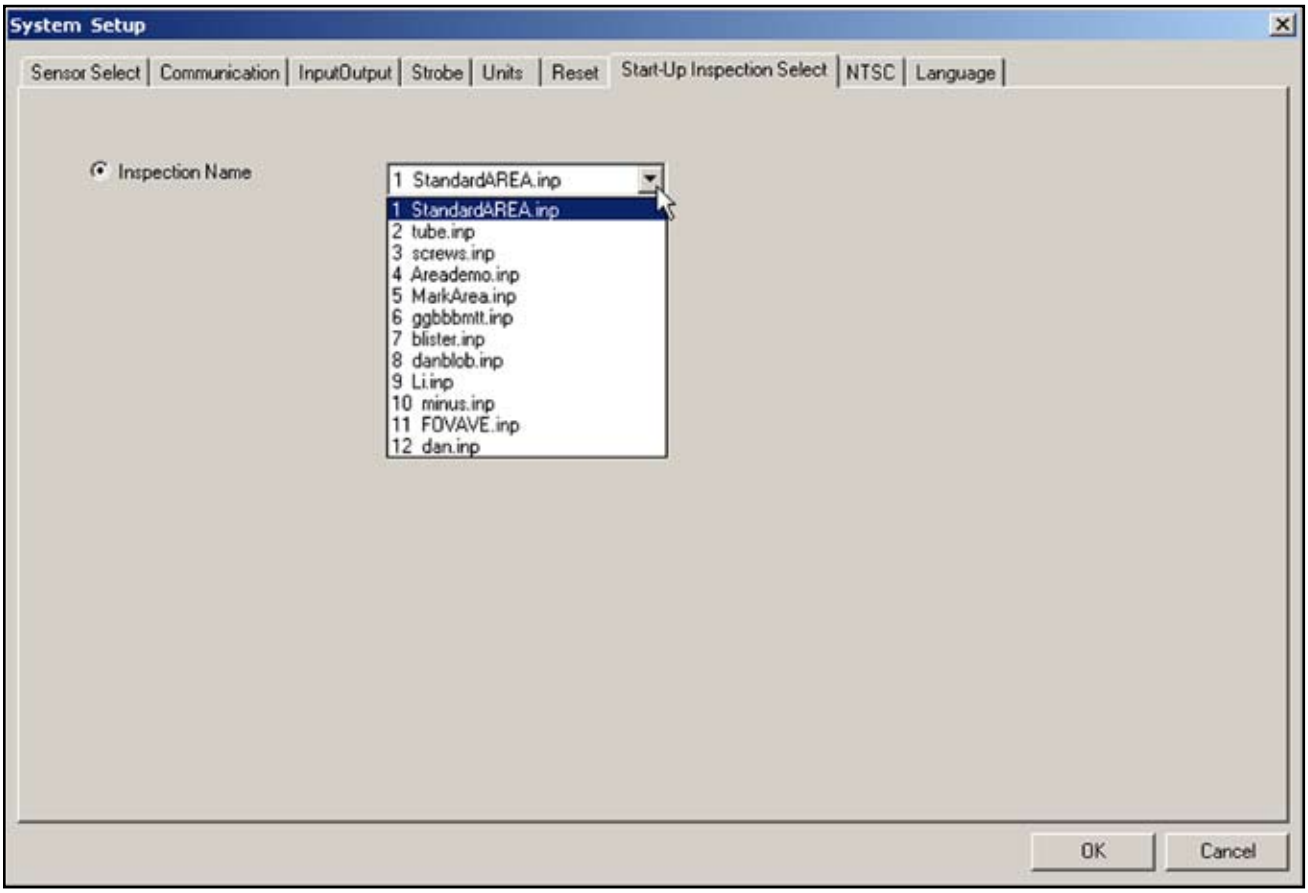


Figure 12-10. System Setup window Start-Up Inspection Select tab

12.9 NTSC Tab

Choose the desired zoom level of the image window as it will appear on the optional NTSC video monitor. The default **Zoom Level** is 4:1.

NOTE: This tab is available for *P4* AREA only; it does not appear in the System Setup window for *P4* AREA 1.3.

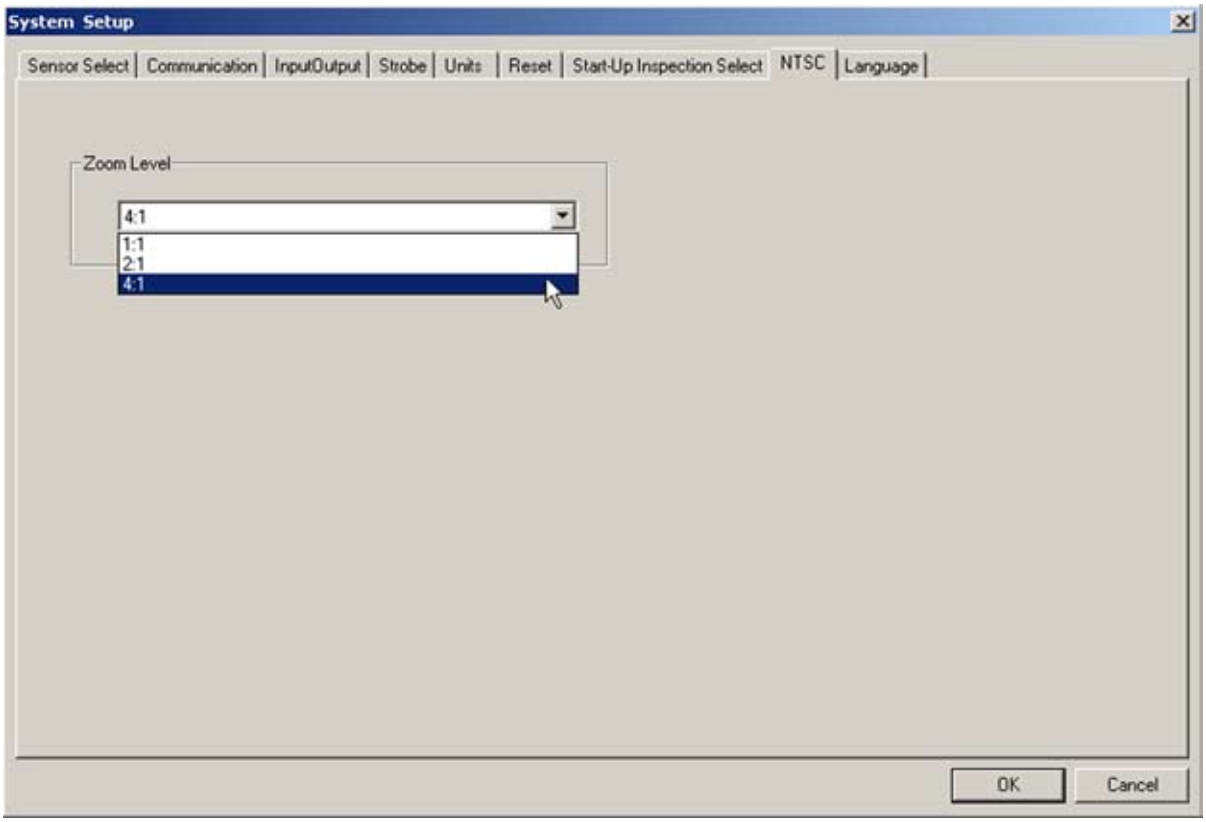


Figure 12-11. System Setup window NTSC tab

12.10 Language Tab

Click on the **down** arrow for a drop-down list of the languages installed from the *Presence*PLUS software CD. Click on the desired language, then click **Apply**. At the next start-up, the *Presence*PLUS software will use the selected language.

To save changes and exit the System Setup window, click **OK**. To exit the System Setup window without making any changes, click the .

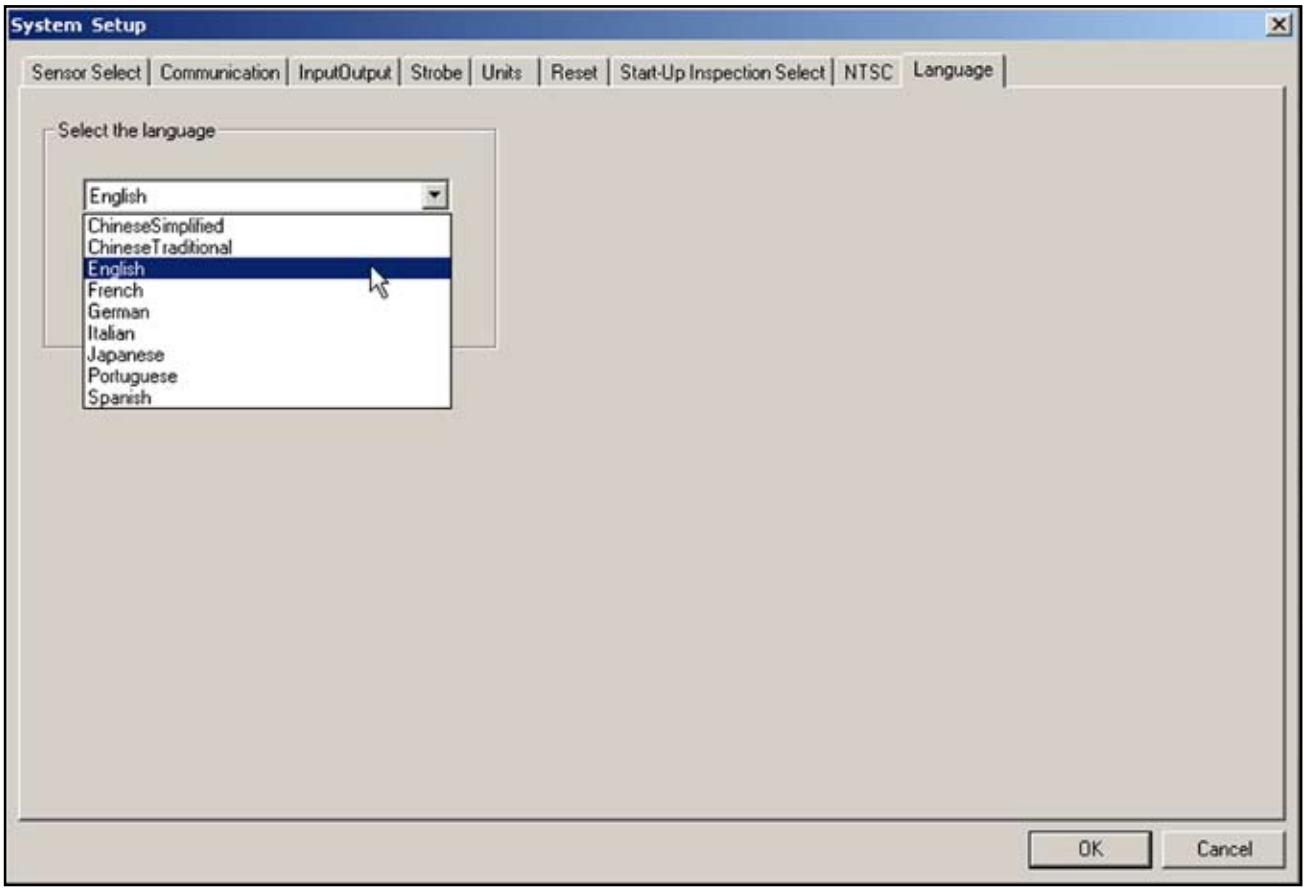


Figure 12-12. System Setup window Language tab

13. Product Change

This section explains the Product Change (Pin 3) input.

13.1 Product Change, Pin 3

The Product Change input is used in conjunction with one of the four I/O points programmed as a Product Select line. The inspection loaded will be executed following a valid trigger.

- The Product Change input responds to the leading edge transition of a pulse greater than 1 millisecond.
- The Product Select input is pulsed to correspond to a program location. For example, five pulses will load program #5.

See Section 13.2 on this page.

Product Change Specifications

State	Current Sinking (NPN)	Current Sourcing (PNP)
ON	< 2V at 1 mA max.	> 8V at -7.5 mA max.
OFF	> 10V at 4 mA max.	< 2V at -7.5 mA max.

One of the four I/O (see Programmable I/O, Pins 5 through 8 on page 10) must be programmed for Product Select if Product Change is to be used. See Section 12.4, InputOutput Tab on page 61.

Product Select Input Specifications

State	Current Sinking (NPN)	Current Sourcing (PNP)
ON	< 2V at 1 mA max.	> 8V at -7.5 mA max.
OFF	> 10V at 4 mA max.	< 2V at -7.5 mA max.

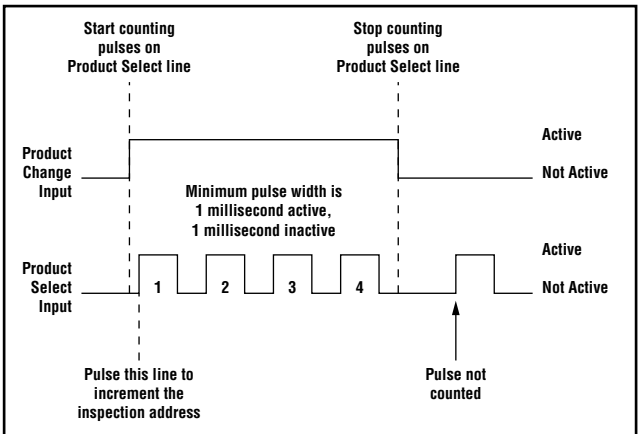
13.2 Product Change and Product Select Timing

The Product Change line signals the Sensor to stop what it is doing and begin counting pulses on the Product Select line. The number of pulses indicates to the Sensor the inspection address at which to begin executing the inspection. The only pulses counted are those that occur when the Product Change input is active. As shown in the diagram below, a Product Select input pulse that occurs when the Product Change input is not active is NOT counted.

If the Sensor is in Run mode, the Product Change line should be activated only when the Sensor Green Ready LED is ON. If the Product Change line is activated when the Sensor is in Run mode but performing an inspection (not Ready), the current inspection will be aborted, and the Sensor will proceed to load the inspection at the indicated address.

If the Product Change line is activated when the Sensor is not in Run mode (Setup mode, for example), then the Sensor will go to the address indicated (address number four in this case) and begin executing.

The maximum number of pulses is limited by the number of inspections possible on the Sensor.



In this example, the Sensor will stop executing the inspection it is currently running, go to address number four (because there are four pulses), load the inspection at location four, enter Run mode, and execute the inspection on the next valid trigger.

Figure 13-1. Product Change and Product Select timing diagram

14. Saving Inspections

This section explains how to store inspection files on the Sensor or PC.

14.1 Save Window

Use the Save window to save an inspection to the Sensor or to the Inspections folder on the PC.

The Save window is also displayed whenever the Sensor prompts the user to save something.

To display the Save window:
Click the **Save** button in the Menu toolbar.

Save Window Options

Option	Description
Save in Sensor	The Sensor will prompt the selection of one of 10 Sensor locations.
Save in Inspections Folder	• If an occupied location is selected, the selected filename appears in the **Filename** field. The file being saved overwrites the selected file. • To clear a location, delete the file on the **Sensor** tab. See Section 6.4, Selecting/ Deleting Inspections from Sensor on page 31. • Save the file in any folder on the PC, or create new subfolders.
Save as an .inp	Saving as an **.inp** saves the entire inspection.
Save as a .bmp	Saving as a **.bmp** saves only the current image. This is available only when saving to the PC.

14.2 Inspection (.inp) Files

Inspection files can be saved either to the Sensor or to the PC. Inspections must be saved to the Sensor in order to be run.

A copy of the inspection may also be saved to the PC to serve as a backup.

An inspection (.inp) file contains the reference image, image parameters, and inspection parameters:

- The reference image is the image selected in the Setup screen.
- Image parameters are the programmed values that were used by the Sensor to acquire the inspection image. These values include gain, exposure time, and trigger setup.
- Inspection parameters include Location tools, Vision tools, and Analysis tools and their associated parameters.

15. Dimensions, Specifications, and Parts

15.1 Dimensions

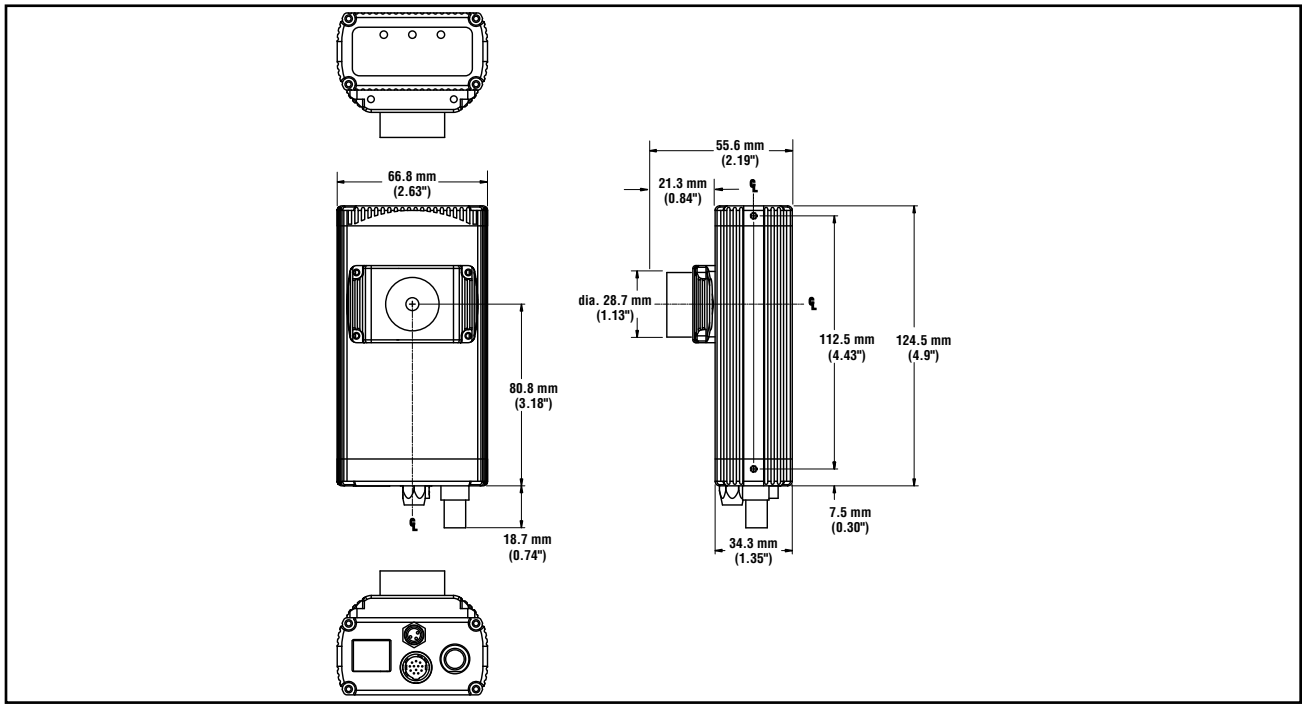


Figure 15-1. Right-Angle Sensor dimensions

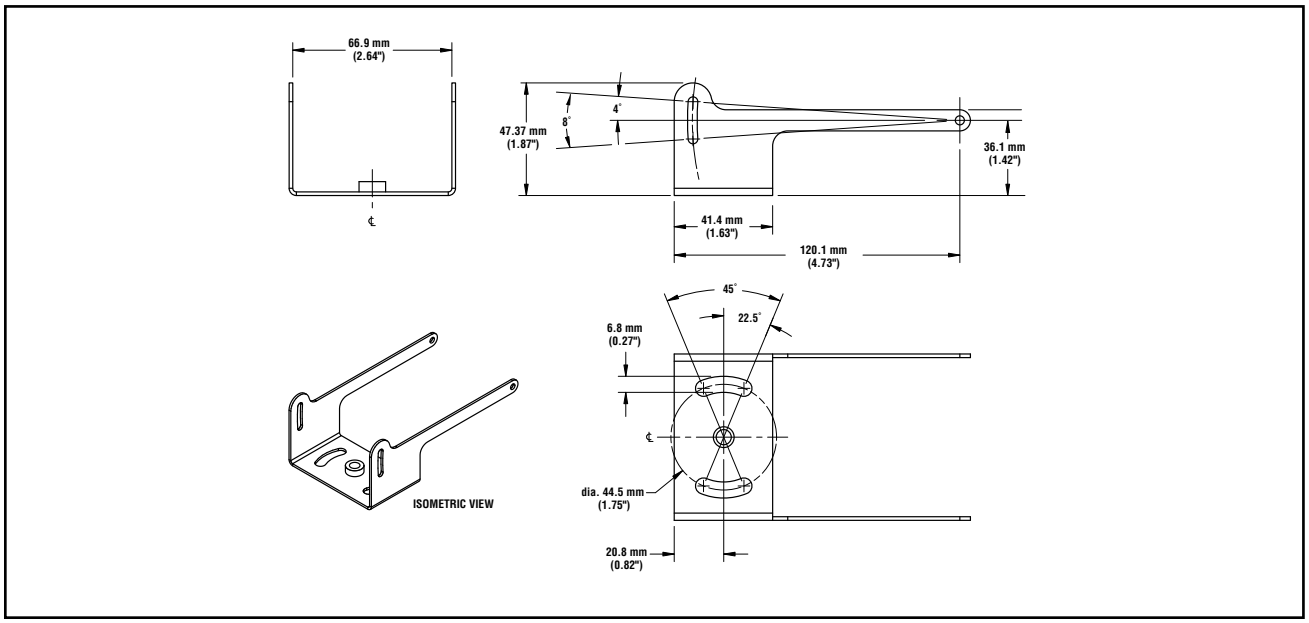


Figure 15-2. Right-Angle Sensor mounting bracket dimensions

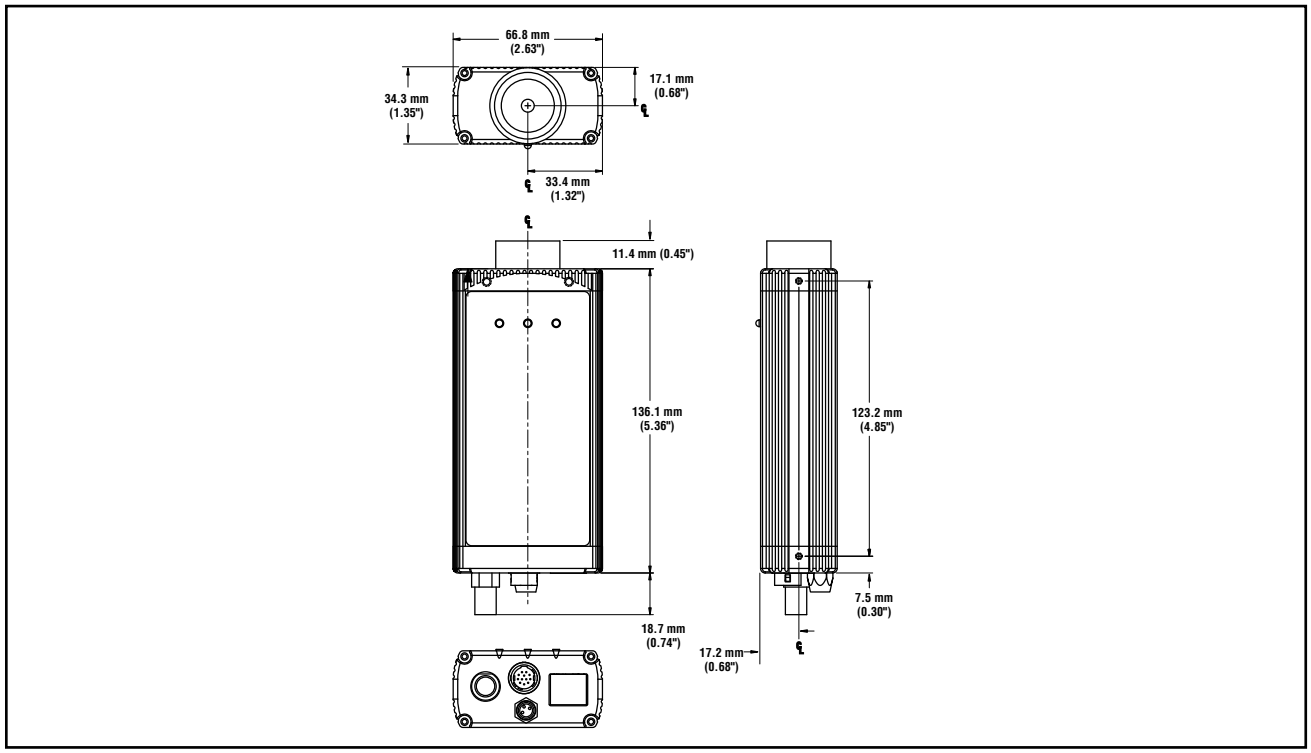


Figure 15-3. In-Line Sensor dimensions

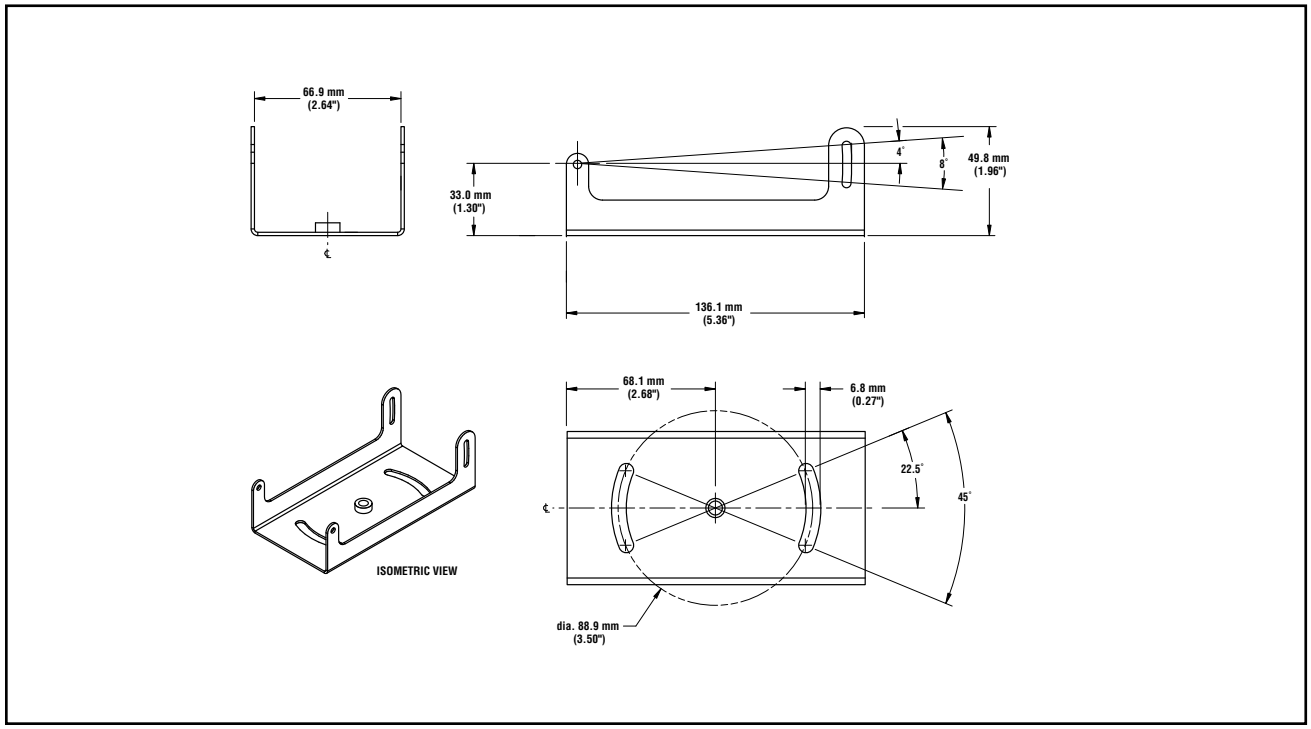


Figure 15-4. In-Line Sensor mounting bracket dimensions

15.2 Sensor Specifications

Model Numbers	***Presence*PLUS *P4* AREA Right-Angle Sensor:** P4AR **P4 AREA In-Line Sensor:** P4AI ***Presence*PLUS *P4* AREA 1.3 Right-Angle Sensor:** P4A1.3R **P4 AREA 1.3 In-Line Sensor:** P4A1.3I
Power	**Voltage:** 10-30V dc (24V dc ± 10% if a light source is powered by the Sensor) **Current: *P4* AREA:** 500 mA maximum (exclusive of I/O load and lights) ***P4* AREA 1.3:** 550 mA maximum (exclusive of I/O load and lights)
Discrete I/O	1 Trigger IN 1 Strobe OUT 4 Programmable I/O 1 Product Change 1 Remote Teach
Input/Output Configuration	NPN or PNP software selectable
Output Rating	150 mA **ON-State Saturation Voltage:** <1V at 150 mA max. NPN; >V ± 2V **OFF-State Leakage Current:** <100 microamps NPN or PNP
Communication	1 RJ-45 Ethernet RS-232 flying leads
Display Options	PC or NTSC video; 9 m (30') max. cable length
Memory	Stores 12 inspection files
Acquisition	**Frames Per Second: *P4* AREA:** 500 frames per second ***P4* AREA 1.3:** 26.8 frames per second **Image Size: *P4* AREA:** 128 x 100 pixels ***P4* AREA 1.3:** 1280 x 1024 pixels **Levels of Gray Scale:** 256
Exposure Time	***P4* AREA:** 0.01 to 20.47 ms ***P4* AREA 1.3:** 0.1 ms to 1.67 seconds
Imager	***P4* AREA:** 2.52 x 1.96 mm (0.10" x 0.08"), 3.19 mm (0.13") diagonal CMOS Pixel size: 20 x 20 micrometers ***P4* AREA 1.3:** 8.60 x 6.90 mm (0.34" x 0.27"), 11.03 mm (0.43") diagonal CMOS Pixel size: 6.7 x 6.7 micrometers
Lens Mount	C-mount
Dimensions	See Figure 15-1 (on page 70) and Figure 15-3 (on page 71).
Construction	Black anodized aluminum Sensor housing, glass lens **Weight:** Approximately 0.29 kg (0.642 lb.)
Environmental Rating	IEC IP20; NEMA 1
Operating Conditions	**Stable Ambient Temperature:** 0° to +50° C (+32° to +122° F) **Stable Ambient Lighting:** No large, quick changes in light level; no direct or reflected sunlight **Relative Humidity:** 35-90%, non-condensing
Certifications	Approvals are in process

15.3 Monitor Specifications - 9" CRT

Model Number	PPM9
Construction	Metal case, glass screen **Dimensions:** 220 x 240 x 267 mm (8.66" x 9.45" x 10.51") **Weight:** 6 kg (13.2 lb.)
Operating Conditions	**Operating Temperature:** -10° to +55° C (+14° to 130° F) **Maximum Relative Humidity:** 95%, non-condensing
Electrical	**System:** NTSC compatible **Picture Tube:** 9" measured diagonally **Horizontal Resolution:** > 1000 TV lines (center), > 800 TV lines (corners) **Power Requirement:** 110-240V ac, 50/60 Hz **Power Consumption:** 0.5A
Certifications	Listed TV/Video Product 8K37, E133441
Controls/Connectors	Horizontal Hold (rotary knob) Brightness (rotary knob) Video IN-OUT (BNC) Vertical Hold (rotary knob) Contrast (rotary knob) Impedance High/Low switch (75 Ohms)

15.4 Monitor Specifications - 7" LCD

Model Number	PPM7
Construction	Black plastic case, glass screen **Dimensions:** 189 x 117 x 30.3 mm (7.46" x 4.6" x 1.2") **Weight:** 450 grams (15.8 ounces)
Operating Conditions	**Operating Temperature:** 0° to +50° C (+32° to 122° F) **Maximum Relative Humidity:** 95%, non-condensing
Electrical	**System:** NTSC/PAL autoswitching **Display:** 7" measured diagonally TFT LCD Wide Screen **Resolution:** 1440 x 234 pixels **Viewing Angle:** left 55° / right 55° / top 15° / bottom 35° **Power Requirement:** 10-30V dc **Power Consumption:** 1A max
Certifications	CE
Controls/Connectors	**Buttons on panel and on remote control:** - Brightness - Contrast - Color - Tint - Up/down reverse - 4:3 Full/zoom/center/right/left - 16:9 Wide - Video (BNC)

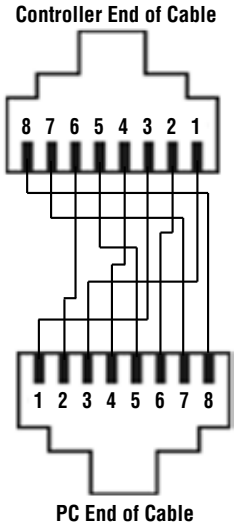
15.5 Serial Port Communication Specifications

Baud Rate	115K
Data Bits	Eight
Stop Bits	One
Parity	Odd
Flow Control	None
Connector	See pin descriptions in Figure 2-3, Cable Connections on page 5.

15.6 Ethernet Communication Specifications

Use a crossover Ethernet cable for communicating directly with a PC. Use a straight Ethernet cable for communicating with a network device, such as an Ethernet hub or switch.

Protocol	TCP/IP
Data Transfer Rate	10/100 Mbps
Max. Cable Length	120 m (393')
Recommended PC IP Address	192.168.0.2
PC Subnet Mask	255.255.255.0
Factory Default Sensor IP Address	192.168.0.1
Connector	RJ-45
Connector Pinout	Use an RJ45 network crossover cable for direct connection to a PC.



Pin	Name
Pin 1	TXD+
Pin 2	TXD-
Pin 3	RXD+
Pin 4	Not used
Pin 5	Not used
Pin 6	RXD-
Pin 7	Not used
Pin 8	Not used

15.7 Parts

Description	Model
Standard C-Mount Lenses	
4 mm	**LCF04**
8 mm	**LCF08**
12 mm, focus locking	**LCF12**
16 mm, focus locking	**LCF16**
25 mm, adjustable aperture	**LCF25R**
25 mm, focus and adjustable aperture locking	**LCF25LR**
50 mm, focus and adjustable aperture locking, plastic	**LCF50L1R**
50 mm, focus and adjustable aperture locking, metal	**LCF50L2R**
75 mm, focus and adjustable aperture locking	**LCF75LR**
High-Performance C-Mount Lenses	
6.5 mm, focus and adjustable aperture locking	**LCF06LT**
8 mm, focus and adjustable aperture locking	**LCF08LT**
12 mm, focus and adjustable aperture locking	**LCF12LT**
16 mm, focus and adjustable aperture locking	**LCF16LT**
25 mm, focus and adjustable aperture locking	**LCF25LT**
50 mm, focus and adjustable aperture locking	**LCF50LT**
75 mm, focus and adjustable aperture locking	**LCF75LT**
10 mm to 40 mm zoom, focus and adjustable aperture locking	**LCF1040LT**
Protective lens cover, UV filter, clear (for all high-performance lenses except 6.5 mm lens)	**FLTUV**
Megapixel C-Mount Lenses	
8 mm, focus and adjustable aperture locking	**LCF08LMP**
12 mm, focus and adjustable aperture locking	**LCF12LMP**
16 mm, focus and adjustable aperture locking	**LCF16LMP**
25 mm, focus and adjustable aperture locking	**LCF25LMP**
35 mm, focus and adjustable aperture locking	**LCF35LMP**
50 mm, focus and adjustable aperture locking	**LCF50LMP**
Lens Extensions	
Lens extensions kit: 0.5 mm, 1 mm, 5 mm, 10 mm, 20 mm, and 40 mm lens extensions	**LEK**
Lens extension shims kit: 0.25 mm and 0.50 mm lens extension shims	**LEKS**

Description	Model
LED Ring Lights and Kits	
LED ring light, white, male pigtail, 80 mm x 80 mm	**LEDWR80X80M**
LED ring light, green, male pigtail, 80 mm x 80 mm	**LEDGR80X80M**
LED ring light, blue, male pigtail, 80 mm x 80 mm	**LEDBR80X80M**
LED ring light, visible red, male pigtail, 80 mm x 80 mm	**LEDRR80X80M**
LED ring light, infrared, male pigtail, 80 mm x 80 mm	**LEDIR80X80M**
Ring light polarizing kit, 80 mm x 80 mm	**LEDRRPFK**
LED ring light, white, male pigtail, 62 mm x 62 mm	**LEDWR62X62M**
LED ring light, green, male pigtail, 62 mm x 62 mm	**LEDGR62X62M**
LED ring light, blue, male pigtail, 62 mm x 62 mm	**LEDBR62X62M**
LED ring light, visible red, male pigtail, 62 mm x 62 mm	**LEDRR62X62M**
LED ring light, infrared, male pigtail, 62 mm x 62 mm	**LEDIR62X62M**
Ring light polarizing kit, 62 mm x 62 mm	**LEDRRPFKS**
Area Lights and Kits	
LED area light, white, male pigtail, 80 mm x 80 mm	**LEDWA80X80M**
LED area light, green, male pigtail, 80 mm x 80 mm	**LEDGA80X80M**
LED area light, blue, male pigtail, 80 mm x 80 mm	**LEDBA80X80M**
LED area light, visible red, male pigtail, 80 mm x 80 mm	**LEDRA80X80M**
LED area light, infrared, male pigtail, 80 mm x 80 mm	**LEDIA80X80M**
Area light polarizing kit, 80 mm x 80 mm	**LEDAPFK**
LED area light, white, male pigtail, 62 mm x 62 mm	**LEDWA62X62M**
LED area light, green, male pigtail, 62 mm x 62 mm	**LEDGA62X62M**
LED area light, blue, male pigtail, 62 mm x 62 mm	**LEDBA62X62M**
LED area light, visible red, male pigtail, 62 mm x 62 mm	**LEDRA62X62M**
LED area light, infrared, male pigtail, 62 mm x 62 mm	**LEDIA62X62M**
Area light polarizing kit, 62 mm x 62 mm	**LEDAPFKS**
Specialty Lights and Kits Color and strobe lights also available. Contact your Banner sales representative.	
On-Axis Lights	
12.5 mm (0.5") Field of View (FOV)	**LEDRO25N**
25 mm (1") FOV	**LEDRO50N**
38 mm (1.5") FOV	**LEDRO75N**

Description	Model
Low-Angle Ring Lights	
50 mm (2") FOV	**LEDRI100N**
75 mm (3") FOV	**LEDRI150N**
38 mm (1.5") FOV	**LEDRI150N-3**
Dome Lights	
50 mm (2") FOV, red, classic dome	**LEDRD150N**
50 mm (2") FOV, red, cloudy day illumination	**LEDRC150N**
Power Supply for NER Specialty Lights	
Regulated Power Supply **Input:** 100-250V ac, 50/60 Hz **Output:** 12V dc ± 5%, 3.5A max	**PSA-12**
High-Frequency Fluorescent Lights and Brackets	
203 mm (8") light, 24V dc	**HFFW8DC**
203 mm (8") light, 110V ac, 60 Hz	**HFFW8AC110**
203 mm (8") light, 120V ac, 50/60 Hz, remote ballast	**HFFW8ACR**
203 mm (8") light, 230V ac, 50 Hz	**HFFW8AC230**
305 mm (12") light, 24V dc	**HFFW12DC**
305 mm (12") light, 110-230V ac, 50/60 Hz	**HFFW12AC**
305 mm (12") light, 120V ac, 50/60 Hz, remote ballast	**HFFW12ACR**
356 mm (14") light, 24V dc	**HFFW14DC**
381 mm (15") light, 110V ac, 50/60 Hz	**HFFW15AC110**
381 mm (15") light, 120V ac, 50/60 Hz, remote ballast	**HFFW15ACR**
381 mm (15") light, 230V ac, 50 Hz	**HFFW15AC230**
610 mm (24") light, 110-230V ac, 50/60 Hz	**HFFW24AC**
610 mm (24") light, 120V ac, 50/60 Hz, remote ballast	**HFFW24ACR**
915 mm (36") light, 110-230V ac, 50/60 Hz	**HFFW36AC**
915 mm (36") light, 120V ac, 50/60 Hz, remote ballast	**HFFW36ACR**
1220 mm (48") light, 110-230V ac, 50/60 Hz	**HFFW48AC**
1220 mm (48") light, 120V ac, 50/60 Hz, remote ballast	**HFFW48ACR**
Single straight light bracket	**SMBWFTLS**
Single right-angle light bracket	**SMBWFTLR**
Replacement bulbs and enclosure tubes are available. Contact your Banner sales representative.	

Description	Model
Laser Emitters (Light Sources)	
Small spot laser beam	**QS186LE**
Vertical line laser beam	**QS186LE11**
Horizontal line laser beam	**QS186LE12**
Cross-shaped laser beam	**QS186LE14**
Ethernet Cables	
Cat5e Ethernet cable, straight, 2.1 m (7')	**STP07**
Cat5e Ethernet cable, straight, 7.6 m (25')	**STP25**
Cat5e Ethernet cable, crossover, 2.1 m (7')	**STPX07**
Cat5e Ethernet cable, crossover, 7.6 m (25')	**STPX25**
P4 Cables	
Cable, 2 m (6')	**P4C06**
Cable, 7 m (23')	**P4C23**
Cable, 10 m (32')	**P4C32**
Cable, 16 m (50')	**P4C50**
Sensor Mounting Columns	
Mounting knuckle assembly kit, with 76 mm (3") extension (contains a, b, and c below)	**SMBPPK3**
Mounting knuckle assembly kit, with 152 mm (6") extension (contains a, b, and d below)	**SMBPPK6**
a. Column bracket knuckle	**SMBPPK**
b. Column bracket base	**SMBPPKB**
c. Column bracket 76 mm (3") extension	**SMBPPKE3**
d. Column bracket 152 mm (6") extension	**SMBPPKE6**
Enclosure Kits	
Right-Angle P4 sensor enclosure kit, glass window	**P4RE67-G**
Right-Angle P4 sensor enclosure kit, polycarbonate window	**P4RE67-P**
Monitors and Video Cables	
9" NTSC video monitor	**PPM9**
7" LCD Monitor	**PPM7**
Video cable, 2 m (6')	**BNC06**
Video cable, 5 m (15')	**BNC15**
Video cable, 9 m (30')	**BNC30**

Description	Model
Lens Filters	
Red filter kit	**FLTR**
Infrared filter kit	**FLTI**
Green filter kit	**FLTG**
Blue filter kit	**FLTB**
Software and Documentation	
*Presence*PLUS Software CD	**PPCD**
*Presence*PLUS *P4* AREA/AREA 1.3 User's Manual (printed)	**P/N 125439**
*Presence*PLUS *P4* QuickStart Guide (printed)	**P/N 118000**
*Presence*PLUS Lens Selection Guide (printed)	**P/N 69950**
*Presence*PLUS Lighting Guide (printed)	**P/N 69951**

WARRANTY: Banner Engineering Corp. warrants its products to be free from defects for one year. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture found to be defective at the time it is returned to the factory during the warranty period. This warranty does not cover damage or liability for the improper application of Banner products. This warranty is in lieu of any other warranty either expressed or implied.

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