# VE Series Smart Camera

## Quick Start Guide

*Self-contained Smart Camera with User-Friendly Vision Manager Software*

This guide is designed to help you set up and install the VE Series Smart Camera. For complete information on programming, performance, troubleshooting, dimensions, and accessories, please refer to the Instruction Manual at www.bannerengineering.com. Search for p/n 191666 to view the Instruction Manual. Use of this document assumes familiarity with pertinent industry standards and practices. More details are available in the online help.

**WARNING: Not To Be Used for Personnel Protection**
**Never use this device as a sensing device for personnel protection. Doing so could lead to serious injury or death.** This device does not include the self-checking redundant circuitry necessary to allow its use in personnel safety applications. A sensor failure or malfunction can cause either an energized or de-energized sensor output condition.

**CAUTION: Electrostatic Discharge**
**Avoid the damage that electrostatic discharge (ESD) can cause to the Sensor.**
Always use a proven method for preventing electrostatic discharge when installing a lens or attaching a cable.

**CAUTION: Hot Surface**
**Use caution when handling the camera.** The surface of the camera may be hot during operation and immediately after use.

## Models

| Model [1] | Resolution | Type |
|---|---|---|
| VE200G1A | WVGA, 752 × 480 pixels grayscale | Vision |
| VE201G1A | 1.3 MP, 1280 × 1024 pixels grayscale | Vision |
| VE202G1A | 2 MP, 1600 × 1200 pixels grayscale | Vision |
| VE205G1A | 5 MP, 2592 × 2048 pixels grayscale | Vision |
| VE200G1B | WVGA, 752 × 480 pixels grayscale | ID |
| VE201G1B | 1.3 MP, 1280 × 1024 pixels grayscale | ID |
| VE202G1B | 2 MP, 1600 × 1200 pixels grayscale | ID |
| VE205G1B | 5 MP, 2592 × 2048 pixels grayscale | ID |
| VE200G1C | WVGA, 752 × 480 pixels grayscale | Vision + ID |
| VE201G1C | 1.3 MP, 1280 × 1024 pixels grayscale | Vision + ID |
| VE202G1C | 2 MP, 1600 × 1200 pixels grayscale | Vision + ID |
| VE205G1C | 5 MP, 2592 × 2048 pixels grayscale | Vision + ID |

## Features

*Figure 1. Sensor Features*




1. Display
2. Buttons
3. Pass/Fail indicator (green/red)
4. Ready/Trigger indicator (green/amber)
5. Power/Error indicator (green/red)
6. Ethernet indicator (amber), not shown
7. Ethernet connection
8. Light connection
9. Power, Discrete I/O connection

[1] Model VE202G2A, 2 MP, 1600 × 1200 grayscale with 4-pin D-code M12 Ethernet connection is also available.

## Display

*Figure 2. Display with Home Screen*




The display is a 2-line, 8-character LCD. The main screen is the Home Screen, which shows the name of the current inspection and the slot number (inspection location). Use the display to view or change several sensor settings.

## Indicators

Four LED indicators provide ongoing indication of the sensing status.

**Power/Error Indicator**
Green = Normal operation
Red = System error

**Ready/Trigger Indicator**
Green = Ready for trigger
Yellow = Trigger is active
OFF = Not ready for a trigger, triggers will be missed

**Pass/Fail Indicator**
Green = Previous inspection passed
Red = Previous inspection failed
OFF = No trigger since power up

**Ethernet Indicator**
Amber solid = Ethernet connection
Amber flashing = Ethernet activity
OFF = no connection

## Buttons

Use the sensor buttons **Down**, **Up**, **Enter**, and **Escape** to configure several sensor settings and to access sensor information. See Figure 11 on p. 9 for additional information on using the buttons.

## Vision Manager Software

Set up the VE Series Smart Camera using the free Vision Manager Software, available for download at www.bannerengineering.com.

This easy-to-use image processing software provides a variety of tools and capabilities to solve a wide range of vision applications such as item detection, part positioning, feature measurement, flaw analysis, and barcode reading. Run-time editing allows you to make changes to an inspection while the sensor is running, reducing costly downtime. Vision Manager also includes a full software emulator, allowing users to develop or troubleshoot inspections offline, without a sensor.

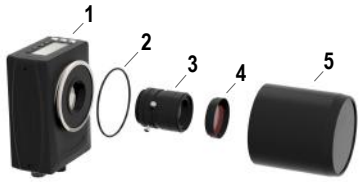
Password-protected user profiles are also available to enable different levels of access to the tools and data.

Use Vision Manager to configure Banner vision devices including iVu Vision Sensors and VE Smart Cameras.

# Installation Instructions

## Install the Accessories

*Figure 3. Install the Accessories*




1. VE sensor
2. O-ring (used with the sealed lens cover)
3. C-mount lens (available separately)
4. Filter (optional)
5. Sealed lens cover (optional)

An external light (optional) is not shown.

**Note:** A sealed lens cover and a ring light cannot be used together.

1. If you are using a sealed lens cover: Remove the black thread protector (not shown) from the sensor (1).
2. If you are using a sealed lens cover: Fit a single o-ring (2) into the undercut area behind the sensor threads.
3. Remove the yellow temporary imager cover (not shown) from the sensor.

**CAUTION:** Do not remove the imager cover until you are ready to install the lens. Do not touch the imager. Dirt or dust on the imager can affect sensing reliability.

4. Remove any protective covers from the lens. Handle the lens carefully to avoid smudges and dirt on the optical elements.
5. Thread the lens (3) onto the sensor.
6. Make sure that the lens is focused; see Acquire a Good Image on p. 5.
7. Use the thumbscrews on the lens to lock the focus and aperture rings and to prevent movement that can occur during cleaning or accidental contact.
8. If you are using a filter: Thread the filter (4) onto the front of the C-mount lens.
9. If you are using a linear polarization filter: Rotate the outer portion of the filter mount to determine the position where glare is reduced the most, and use the locking thumbscrew to fasten the filter in position.
10. If you are using a sealed lens cover: Thread the sealed lens cover (5) onto the threaded portion of the sensor.
11. Or, if you are using an external light bracket: Attach an external light bracket to the sensor using the provided hardware kit.

**Note:** For optimal imaging, provide adequate dissipation of heat. A good heat conductor, such as aluminum, may be required.

## Mount the Sensor

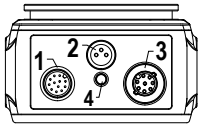
1. If a bracket is needed, mount the device onto the bracket.
2. Mount the device (or the device and the bracket) to the machine or equipment at the desired location. Do not tighten the mounting screws at this time.

**CAUTION:** This device accepts M3×0.5-h6 screws. Engaging the screws more than 3.00 mm will damage the device.

3. Check the device alignment.
4. Tighten the mounting screws to secure the device (or the device and the bracket) in the aligned position.

## Connect the Cables

*Figure 4. Cable Connections*




1. Power, Discrete I/O connection
2. Light connection
3. Ethernet connection
4. Ethernet indicator

1. Connect the Ethernet cable to the sensor (3) and to the computer or Ethernet switch.
2. Connect the power, discrete I/O cable to the sensor (1), and the leads to the appropriate locations. See Table 1 on p. 3 for the power, discrete I/O connections.
3. Connect the external light cable (optional) to the light connection (2) if the light is powered by the sensor.

**CAUTION: Use Appropriate Power**
If the light is powered by the sensor, the sensor power source must be 24 V dc. This connection is for Banner lights only.

*Table 1: Power and I/O Pinouts*

| Pin | Wire Color | Description | Direction |
|---|---|---|---|
| 1 | White | Discrete I/O #3 | Input/Output |
| 2 | Brown | 12 V dc to 30 V dc | Input |
| 3 | Green | I/O output common<br>**Important:** For PNP (sourcing) outputs connect pin 3 to +V dc, for NPN (sinking) outputs connect pin 3 to 0 V dc. The discrete I/O pins are 1, 5, 8, 10, and 11. | - |
| 4 | Yellow | RS-232 TX (transmit) | Output |
| 5 | Gray | Discrete I/O #5 | Input/Output |
| 6 | Pink | Trigger input | Input |
| 7 | Blue | Common | Input |
| 8 | Red | Discrete I/O #2 | Input/Output |
| 9 | Orange | I/O input common<br>**Important:** For PNP (sourcing) inputs connect pin 9 to 0 V dc, for NPN (sinking) inputs connect pin 9 to +V dc. The discrete I/O pins are 1, 5, 6, 8, 10, and 11. | - |
| 10 | Light Blue | Discrete I/O #4 | Input/Output |
| 11 | Black | Discrete I/O #1 | Input/Output |
| 12 | Violet | RS-232 RX (receive) | Input |
| Shield | Bare metal | Chassis ground | - |

## Wiring Diagrams

*Figure 5. PNP Output*

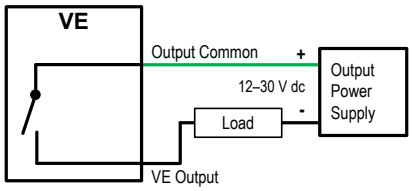



*Figure 6. NPN Output*

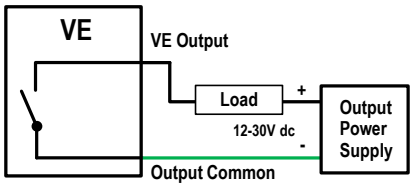



*Figure 7. PNP Input*

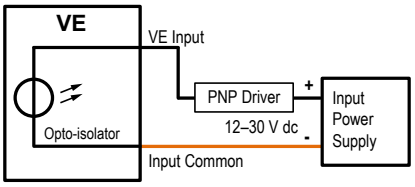
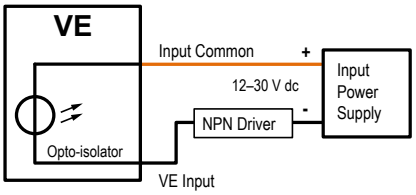



*Figure 8. NPN Input*




## Install the Software

### PC Requirements

**Operating System**
Microsoft® Windows® operating system version 7, 8, or 10 [2]

**System Type**
32-bit, 64-bit

**Hard Drive Space**
80 MB (plus up to 280 MB for Microsoft .NET 4.5, if not already installed)

**Memory (RAM)**
512 MB minimum, 1 GB+ recommended

**Processor**
1 GHz minimum, 2 GHz+ recommended

**Screen Resolution**
1024 × 768 full color minimum, 1650 × 1050 full color recommended

**Third-Party Software**
Microsoft .NET 4.5, PDF Viewer (such as Adobe Acrobat)

**USB Port**
USB 3.0, recommended if a USB to Ethernet adapter used to communicate with the sensor

**Important:** Administrative rights are required to install the Vision Manager software.

1. Download the latest version of the software from www.bannerengineering.com.
2. Navigate to and open the downloaded file.
3. Click **Next** to begin the installation process.
4. Confirm the software destination and availability for users and click **Next**.
5. Click **Install** to install the software.
6. Depending on your system settings, a popup window may appear prompting to allow Vision Manager to make changes to your computer. Click **Yes**.
7. Click **Close** to exit the installer.

## Getting Started

Power up the sensor, and verify that the power/error LED is ON green and that the Ethernet indicator is ON amber to verify the Ethernet connection.

## Connect to the Sensor

These instructions use Windows® operating system version 7, 8, or 10. [3]

1. Confirm the network connections.
   a) Click the **Start** button, then on the **Start** menu, click **Control Panel**.
   b) In **Control Panel**, click **Network and Internet**, then click **Network and Sharing Center**, and then click **Change adapter settings**.
   c) Right-click on the connection that you want to change, then click **Properties**.
   If you are prompted for an administrator password or confirmation, enter the password or provide confirmation.
   d) In the connection properties, click **Internet Protocol Version 4 (TCP/IPv4)**, and then click **Properties**.
   e) In the **Internet Protocol (TCP/IPv4) Properties**, select **Use the following IP address**.
   f) Make sure that the IP address is 192.168.0.2, and the subnet mask is 255.255.255.0.
2. Open Vision Manager from the desktop or the **Start** menu.
   The **Sensor Neighborhood** tab displays and lists the available sensors.

[2] Microsoft and Windows are registered trademarks of Microsoft Corporation in the United States and/or other countries.
[3] Windows is a registered trademark of Microsoft Corporation in the United States and/or other countries.

3. From **Sensor Neighborhood**, click to connect to the desired sensor.
   The status changes from **Available** to **Connected** and the **Sensor** screen displays. Click to disconnect from the sensor.
4. If the desired sensor is not listed, verify that:
   - The network adapter connected to the sensor has the same subnet mask as the sensor (for example, 192.168.0.xxx); view the subnet mask in the Network Adapters list at **Home** > **Sensor Neighborhood** > **Network Adapters**
   - The Ethernet cable is the correct type
   - The TCP/IPv4 settings are correct

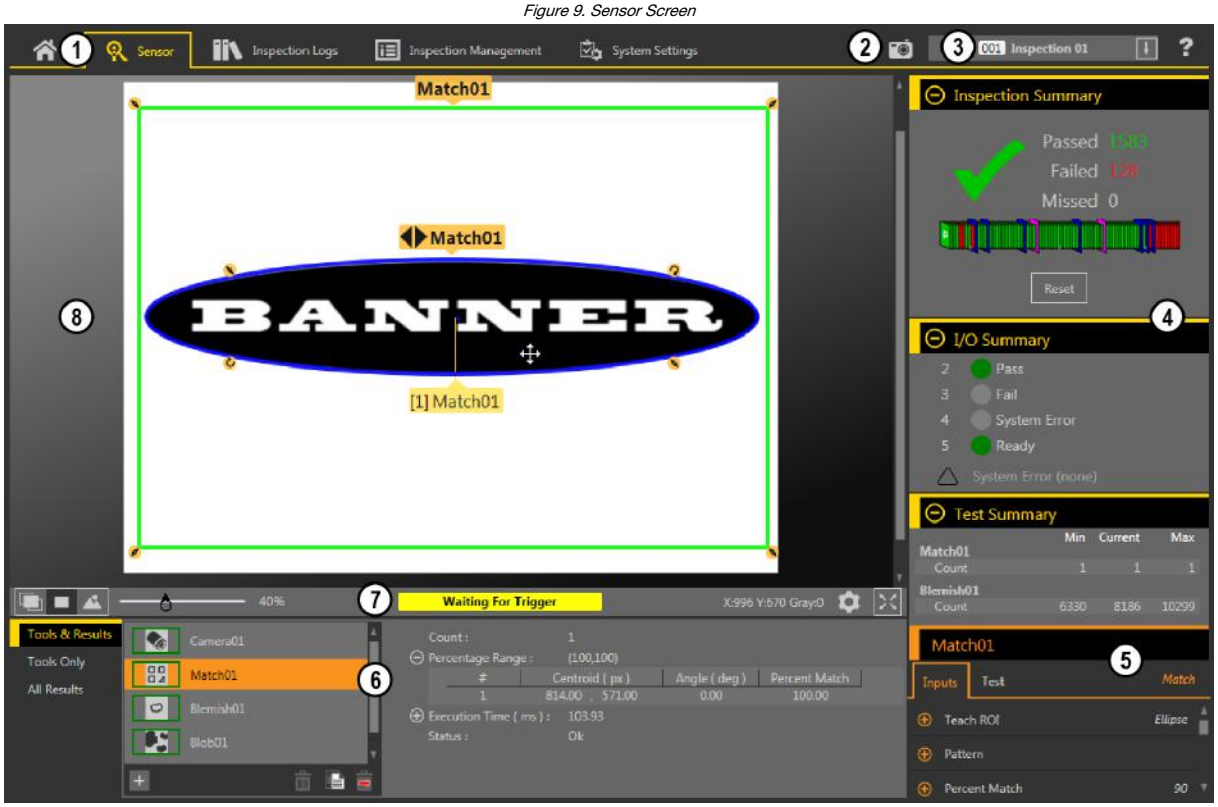
   Or, manually enter the sensor's IP address.

**Note:** The sensor's IP address and subnet mask are also available from the sensor display.

## Sensor Screen

The **Sensor** screen displays the information needed to create or modify an inspection.

*Figure 9. Sensor Screen*




1. Screens—**Home**, **Sensor**, **Inspection Logs**, **Inspection Management**, **System Settings**
2. **Manual Trigger** button—Click to manually trigger the sensor
3. **Inspection** list—Select the desired inspection to start, and to view or modify the inspection
4. **Summary** pane—Includes the Inspection Summary, the I/O Summary, and the Test Summary
5. **Parameters** pane—Includes user-adjustable Inputs parameters or Test parameters for the tools in an inspection, depending on what is selected in the **Tools and Results** pane
6. **Tools and Results** pane—Includes **Tools and Results**, **Tools Only**, and **All Results**, which display the camera tool, the tools that are included in the current inspection, and the results of the inspection
7. **Image Pane Parameters** panel—Includes ROI view buttons, zoom, x and y coordinates, grayscale value, settings button, and full image display button, as well as sensor messages
8. **Image** pane—Displays the current image captured by the sensor; this includes the region of interest (ROI) for the tool for the selected inspection

## Acquire a Good Image

The sensor needs to capture a good image of each part to ensure that it correctly passes good parts and fails bad parts.

1. Make sure that the lighting is appropriate for your target. Use supplementary lighting, such as a ring light, if necessary.
2. Click the **Sensor** screen.
3. Click the camera tool on **Tools and Results**.
   The **Inputs** parameters display.
4. Set the trigger.
   a) Expand the **Trigger** parameters.

b) In the **Trigger Mode** list, click **Internal** (continuous images).

5. Run Auto Exposure.
   a) Expand the **Imager** parameters.
   b) Expand the **Auto Exposure** parameters, and click **Start** to run.
6. Check the lighting on the part.
   - Make sure that the lighting is constant and consistent (unchanging over time, no shadows or hot spots)
   - Capture the shape and form of the target object with lighting that optimizes its contrast and separates the feature of interest from the background. Depending on the target, consider other Banner lights
   - Adjust the mounting angle to provide the clearest image of the part features you are inspecting
7. After checking and adjusting the lighting, run **Auto Exposure** a second time or adjust the exposure manually by expanding the **Exposure** parameters and moving the slider or entering a specific exposure time.
8. Adjust the focus.
   a) Place the part so that the area to be focused appears in the center of the **Image** pane.
   b) Expand the **Focus Info** parameters.
   c) Make sure that the **Focus Info** checkbox is selected.
   d) Adjust the focus of the lens while monitoring the focus number.
   The focus number is a number between 1 and 255. Use the **Image** pane to determine when the image is sharp enough, or use the focus number as a guide. Turn the focus ring on the lens until the focus number is at the highest possible number between 1 and 255. The focus number is also available on the sensor display.

   **Note:** There is no optimal value for this number, but it can be used as a guide if you are setting up more than one sensor that are focused on the same target.

   e) Tighten the locking thumbscrews to secure the lens at the desired focus.

## Set Up an Inspection

Vision Manager allows you to set up or make changes to an inspection while the sensor is running. Changes are automatically saved as they are made.

1. From the **Sensor** screen, click in the upper right corner to view the inspection list.
2. Click **Add New Inspection**.
   A new inspection is added to the list, the **Image** pane updates, and the **Tools & Results** tab shows only the camera tool.
3. Add tools and adjust them as needed for the inspection.

### Add a Tool

1. Click on the **Tools & Results** tab.
   The **Add Tool** window opens.
2. Click the desired tool.

**Note:** Not all tools are available for all VE models, with the exception of Vision + ID models.

| Tool Name | Description | Available on: | |
|---|---|---|---|
| | | Vision Models | ID Models |
| Average Gray | Evaluates pixel brightness within an ROI and computes the average grayscale value. | x | |
| Bead | Inspects parts for uniformity of adhesive or sealant material, or for uniformity of a gap. | x | |
| Barcode | Finds and reads 1D and 2D barcodes. | | x |
| Blemish | Determines whether flaws are present on a part, or detects whether a feature exists on a part. | x | |
| Blob | Detects and counts/locates groups of connected light or dark pixels within the ROI and designates them as blobs (Binary Large Objects). After blobs are found, they can be characterized by size and shape. | x | |
| Circle Detect | Detects a single circle or piece of a circle (arc). | x | |
| Edge | Detects and counts transitions between bright and dark pixels (edges). Counts the total number of edges, and determines the position of each edge. | x | |
| Line Detect | Locates a single, straight line segment by finding edge points along bright or dark pixel transitions and fitting a line to those points. | x | |
| Locate | Finds the first edge on a part and compensates for translation and rotation of downstream tools (if selected). | x | x |
| Match | Verifies that a pattern, shape, or part in any orientation matches a reference pattern. Can also compensate for translation and rotation of downstream tools (if selected). | x | |
| Object | Detects the edges of dark and bright segments and locates their midpoints. Counts dark and bright segments, and measures the width of each dark and bright segment. | x | |
| Math | Performs mathematical operations using tool data or user-supplied constants. Includes basic arithmetic, inequality expressions, and statistical information. | x | x |

| Tool Name | Description | Available on: | |
|---|---|---|---|
| | | Vision Models | ID Models |
| Measure | Measures distance, calculates angles, and creates points and lines for use as inputs to other tools. | x | |
| Logic | Uses Boolean logic to combine or convert tool results, or to drive discrete outputs from tool results. Logic tool data can be used to evaluate the results of a single tool or multiple tools. | x | x |

The tool is added to **Tools & Results** and the region of interest (ROI) appears on the **Image** pane.

3. Configure the tool as needed for your application.
   a) Resize and rotate the ROI around the feature to be analyzed.
   b) Define or view parameters for the tool on the **Input** tab, such as ROI shape, threshold, or view the histogram.
   c) Define pass or fail criteria on the **Test** tab, such as the count, size, or match.

## Save an Inspection to a Computer, Network Drive, or Storage Device

Vision Manager automatically saves inspections to the VE as they are created and modified. Save a copy of the inspection to your computer or another network location if you want to be able to go back to previous settings.

Use the following procedure to save a copy of an inspection to your computer or a network location.

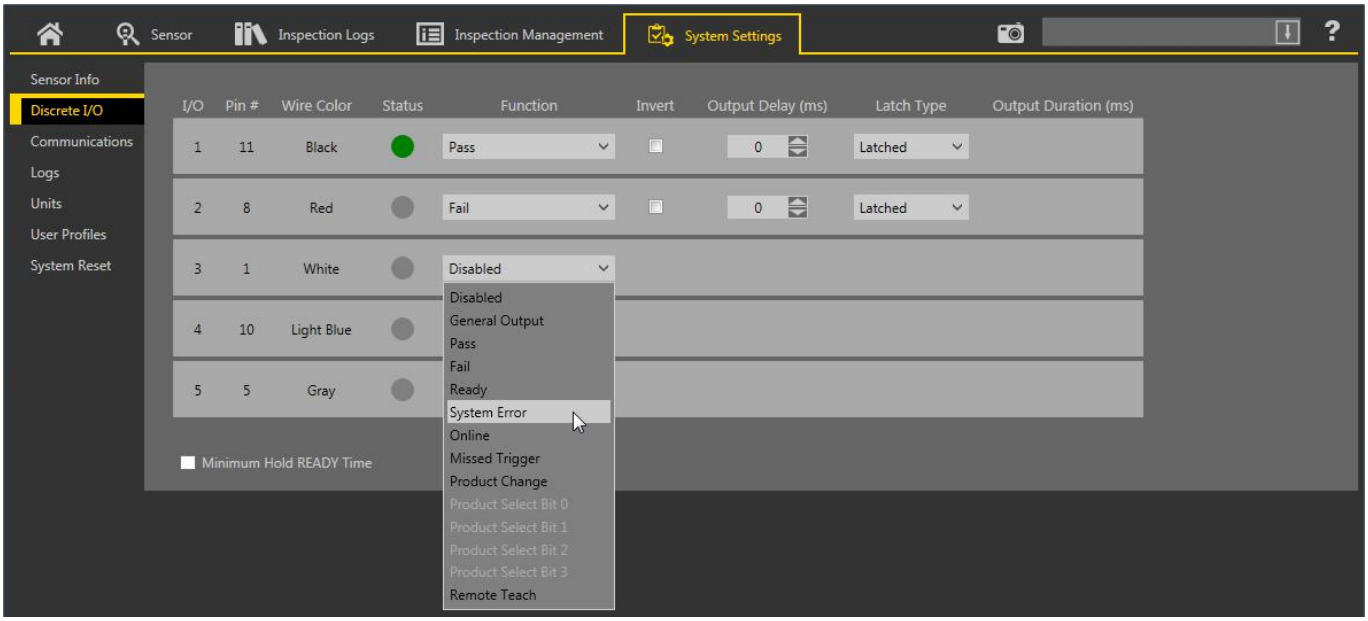
1. On the **Inspection Management** screen, click **Transfer**.
2. Change the destination folder, if desired.
   a) Click above the right column.
   An explorer window opens.
   b) Navigate to the desired location, network location, or storage device.
   c) Click **Select Folder**.
   The folder is selected and the window closes.

   The path to the location displays above the right column.
3. Select the desired inspection from the inspection list in the left column.
4. Click .
   *Inspection name.idb* displays in the right column and the inspection is transferred (saved) to the selected location.

## Configure the Discrete I/O

From the **System Settings** screen, select **Discrete I/O** to change the discrete I/O settings.

*Figure 10. Discrete I/O*




For more details, see the Instruction Manual.

## Sensor Display

The LCD display on the top of the sensor provides access to view or change several settings without using Vision Manager. The display provides limited programming options:

- **ETHER**—Ethernet settings
- **PCHANGE**—Product change
- **IO**—Input/Output settings

- **IMAGE**—Image settings
- **INFO**—Sensor information
- **SYSERROR**—System errors, if present
- **DISPLAY**—Display settings
- **REBOOT**—Reboot

Access the sensor menu by pressing **Enter** from the Home Screen on the sensor display.

Note that when User Profiles are enabled, the sensor display is available as read-only. No editing can be done directly from the sensor until User Profiles are disabled for that sensor.

See the Instruction Manual, p/n 191666, for more information.

## Sensor Display Interface

**Down and Up Buttons**

Press **Down** and **Up** to:

- Navigate the menu systems
- Change programming settings

When navigating the menu systems, the menu items loop.

**Enter Button**

Press **Enter** to:

- Access the Sensor Menu
- Access the submenus
- Save changes

In the Sensor Menu, a check mark in the lower right corner of the display indicates that pressing **Enter** accesses a submenu.

**Escape Button**

Press **Escape** to:

- Leave the current menu and return to the parent menu
- Leave the current menu and return to the Home Screen from any menu

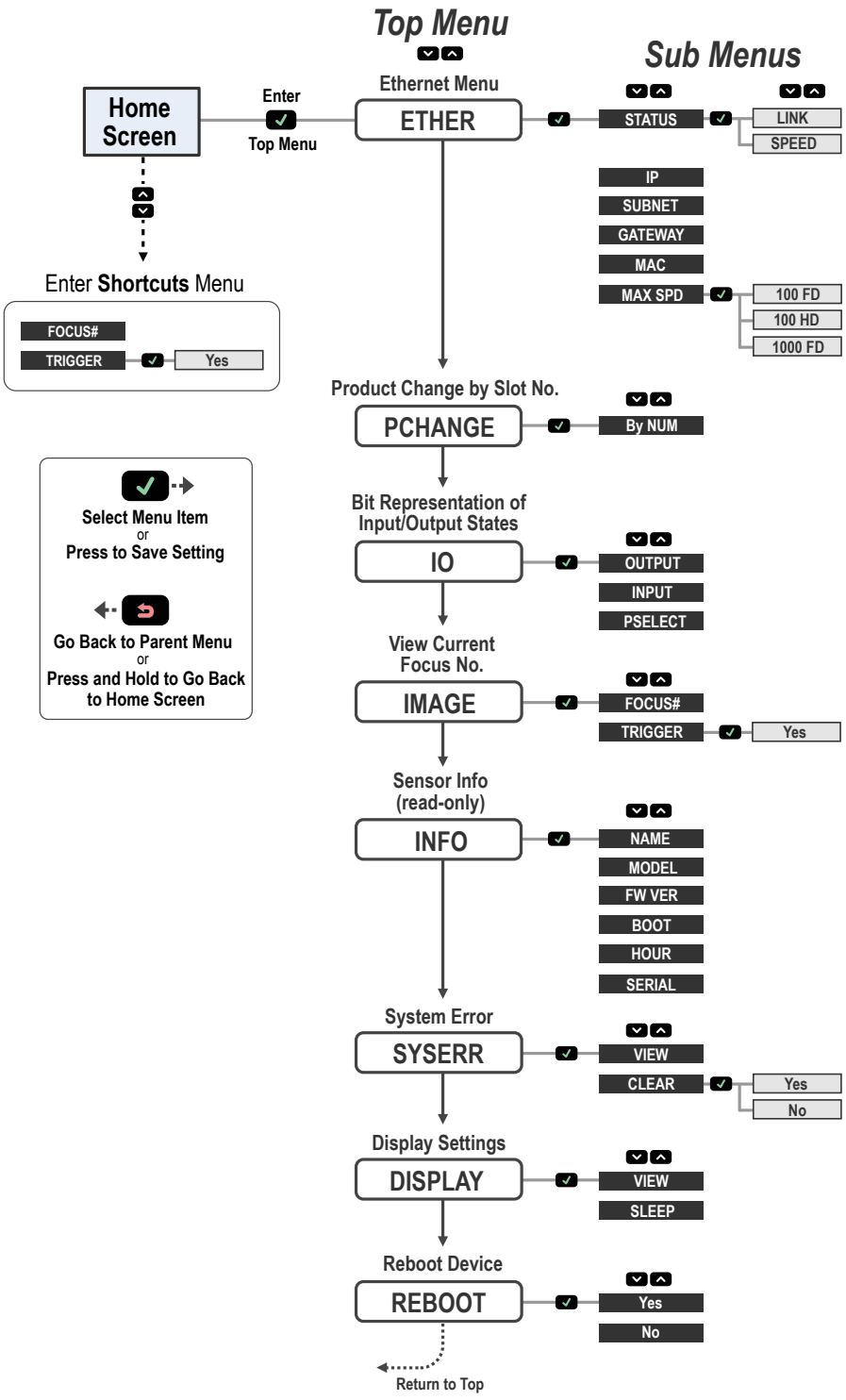
**Important:** Pressing **Escape** discards any unsaved changes.

In the Sensor Menu, a return arrow in the upper left corner of the display indicates that pressing **Escape** returns to the parent menu.

Press and hold **Escape** for 2 seconds to return to the Home Screen from any menu.

## Sensor Menu

*Figure 11. Menu Map*







*VE Series User Interface*

# Specifications

**Power**
12 V dc to 30 V dc (24 V dc ± 10% if a Banner light source is powered by the sensor)
**Current:** 400 mA maximum (exclusive of load and lights)
Use only with a suitable Class 2 power supply, or current limiting power supply rated 12 V DC to 30 V DC, 1 A

**Supply Protection Circuitry**
Protected against reverse polarity and transient overvoltages

**Discrete I/O**
1 Trigger IN
5 Programmable I/O

**Output Configuration**
Optically isolated

**Output Rating**
**Output Resistance:** < 2 Ω
**Strobe Output Resistance:** < 13 Ω
**Programmable Output:** 100 mA
**External Strobe Output:** 100 mA
**Off-State Leakage Current:** < 100 µA

**External Light Maximum Current Draw**
350 mA

**Exposure Time**
0.01 ms to 500 ms

**Imager**
**VE200G1x:** 6.9 mm × 5.5 mm, 8.7 mm diagonal (1/1.8-inch CMOS)
**VE201G1x:** 6.9 mm × 5.5 mm, 8.7 mm diagonal (1/1.8-inch CMOS)
**VE202Gxx:** 7.2 mm × 5.4 mm, 9.0 mm diagonal (1/1.8-inch CMOS)
**VE205G1x:** 12.4 mm × 9.8 mm, 15.9 mm diagonal (1-inch CMOS)

**Lens**
C-mount

**Pixel Size**
**VE200G1x:** 5.3 µm
**VE201G1x:** 5.3 µm
**VE202Gxx:** 4.5 µm
**VE205G1x:** 4.8 µm

**Communication**
10/100/1000 [5] Mbps Ethernet

**Communication Protocols**
Ethernet/IP™, Modbus/TCP, PCCC, PROFINET®, TCP/IP, FTP, and RS-232

**Memory**
**Device Settings and Inspection Storage Memory:** 500 MB
**Number of inspection files:** 999

**Acquisition**
256 grayscale levels

| Model | Frames Per Second [4] | Image Size |
|---|---|---|
| VE200G1x | 60 fps, maximum | 752 × 480 px |
| VE201G1x | 60 fps, maximum | 1280 × 1024 px |
| VE202Gxx | 50 fps, maximum | 1600 × 1200 px |
| VE205G1x | 22 fps, maximum | 2592 × 2048 px |

**Torque—Tapped Holes for Mounting Screws**
8 lbf·in (0.9 N·m) maximum torque

**Construction**
**Housing:** Aluminum
**Display Label:** Polyester

**Connections**
**Ethernet:** M12, 8-pin A-code or 4-pin D-code Euro-style female
**Light Connector:** M8, 3-pin Pico-style female
**Power, Discrete I/O:** M12, 12-pin Euro-style male

**Environmental Rating**
IEC IP67 with an optional sealed lens cover properly installed

**Operating Conditions**
**Operating Temperature:** 0 °C to +50 °C (+32 °F to +122 °F)
95% maximum relative humidity (non-condensing)
**Stable Ambient Lighting:** No large, quick changes in light level; no direct or reflected sunlight
**Storage Temperature:** –30 °C to +70 °C (–22 °F to +158 °F)

**Vibration and Mechanical Shock**
Meets EN 60947-5-2: IEC 60068-2-27 (Shock: 30G); IEC 60068-2-6 (Vibration: 10 Hz to 60 Hz, 1 mm amplitude)

**Certifications**

c UL us Information Technology Equipment E365235

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[4] This value can vary based on inspection settings.
[5] 1000 Mbps communication speed not available on 4-pin Ethernet models

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