COGNEX

In-Sight® 2000 Series Vision Sensor

Reference Guide

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Cognex P/N INS-597-0067-01 Rev. A

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Regulations/Conformity

The vision sensor has Regulatory Model R00039 and meets or exceeds the requirements of all applicable standards organizations for safe operation. However, as with any electrical equipment, the best way to ensure safe operation is to operate them according to the agency guidelines that follow. Please read these guidelines carefully before using your device.

Regulator	Specification
USA	FCC 47 CFR Part 15 Subpart B, Class A
Canada	ICES-003
European Community	EN55022 (CISPR 22) Class A
	EN55024:1998 +A1:2001 +A2: 2003
	EN60950
Australia	C-TICK, AS/NZS CISPR 22 / EN 55022 for Class A Equipment
Japan	J55022, Class A

Note: For the most up-to-date regulations and conformity information, please refer to the Cognex online support site: http://www.cognex.com/Support.

CAUTION: IP protection is ensured only when all connectors are attached to cables or shielded by a sealing cap.

Safety and Regulatory	
European Compliance CE	The CE mark on the product indicates that the system has been tested to and conforms with the provisions noted within the 2004/108/EC Electromagnetic Compatibility Directive and the 2006/95/EC Low Voltage Directive. For further information please contact: Cognex Corporation, One Vision Drive Natick, MA 01760 USA. Cognex Corporation shall not be liable for use of our product with equipment (i.e., power supplies, personal computers, etc.) that is not CE marked and does not comply with the Low Voltage Directive.
FCC Class A Compliance Statement FC	FCC Part 15, Class AThis device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference; and (2) this device must accept any interference received, including interference that may cause undesired operation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.
KCC	MSIP-REM-CGX-IS2000
Canadian Compliance	This Class A digital apparatus complies with Canadian ICES-003. Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.
C-Tick Statement	Conforms to AS/NZS CISPR 22/ EN 55022 for Class A Equipment.
UL and cUL Statement	UL and cUL listed: UL60950-1 1st ed. and CSA C22.2 No.60950-1 1st ed. Certified to CB scheme IEC 60950-1:2001 1st ed.

For European Community Users

Cognex complies with Directive 2002/96/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 January 2003 on waste electrical and electronic equipment (WEEE).

This product has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment, if not properly disposed.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems for product disposal. Those systems will reuse or recycle most of the materials of the product you are disposing in a sound way.

 The crossed out wheeled bin symbol informs you that the product should not be disposed of along with municipal waste and invites you to use the appropriate separate take-back systems for product disposal.

If you need more information on the collection, reuse, and recycling systems, please contact your local or regional waste administration.

You may also contact your supplier for more information on the environmental performance of this product.

Precautions

Observe these precautions when installing the Cognex product, to reduce the risk of injury or equipment damage:

- This device requires the use of an LPS or NEC class 2 power supply.
- To reduce the risk of damage or malfunction due to over-voltage, line noise, electrostatic discharge (ESD), power surges, or other irregularities in the power supply, route all cables and wires away from high-voltage power sources.
- Changes or modifications not expressly approved by the party responsible for regulatory compliance could void the user's authority to operate the equipment.
- Cable shielding can be degraded or cables can be damaged or wear out more quickly if a service loop or bend radius is tighter than 10X the cable diameter. The bend radius must begin at least six inches from the connector.
- Class A Equipment (broadcasting and communication equipment for office work): Seller and user shall be notified that this equipment is suitable for electromagnetic equipment for office work (Class A) and can be used outside the home.
- This device should be used in accordance with the instructions in this manual.
- All specifications are for reference purpose only and may be changed without notice.

Symbols

The following symbols indicate safety precautions and supplemental information.

WARNING: This symbol indicates the presence of a hazard that could result in death, serious personal injury or electrical shock.

CAUTION: This symbol indicates the presence of a hazard that could result in property damage.

Note: Notes provide supplemental information about a subject.

Tip: Tips provide helpful suggestions and shortcuts that may not otherwise be apparent.

Table of Contents

Introduction

The In-Sight® 2000 vision sensor is a compact, stand-alone machine vision sensor used for automated inspection, measurement and identification applications on the factory floor. All models can be easily configured remotely over a network using an intuitive user interface.

Support

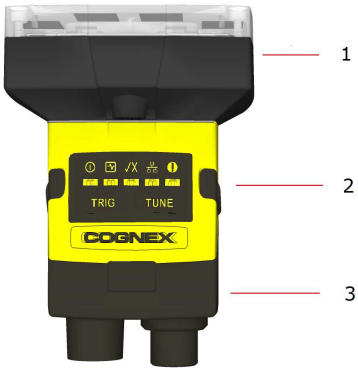
Many information resources are available to assist you in using the vision sensor:

- The *In-Sight® Explorer Help* and *EasyBuilder Help* files, provided with In-Sight Explorer software.
- On-demand training: http://www.cognex.com/on-demand-training.aspx.
- The In-Sight online support site: http://www.cognex.com/Support/InSight.

Standard Components

The vision sensor consists of three main parts:

1. Optics module, featuring high brightness white LED ring light and 8mm lens
2. Main module, including image sensor and CPU
3. I/O connector module

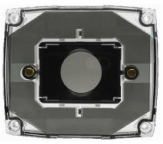


Options and Accessories

LENSES

Lens, M12, 3.6mm (LM12-03-01)	
Lens, M12, 6 mm (LM12-06-01)	
Lens, M12, 8 mm (LM12-08-01)	
Lens, M12, 12 mm (LM12-12-01)	
Lens, M12, 16 mm (LM12-16-01)	
Lens, M12, 25 mm (LM12-25-01)	
Lens Spacer, M12, 16 mm (LM12-SPACER-16-0)	
Lens Spacer, M12, 25 mm (LM12-SPACER-25-01)	

FILTERS AND LIGHT COVER

In-Sight 2000, Polarizer (IMPF-2000-POLAR)	
In-Sight 2000, Red Bandpass Filter, 635nm (IMRF-2000-BP635)	
In-Sight 2000, IR Bandpass Filter, 850nm (IMIF-2000-BP850)	
Replacement Ring Light Cover (IFS-2000-HBRING-CV)	

LIGHTS

High Brightness Red LED Ring Light (IFS-2000-HBRING-RD)	
High Brightness White LED Ring Light (IFS-2000-HBRING-WH)	
High Brightness Near Infrared LED Ring Light (IFS-2000-HBRING-IR)	

CABLES

Power and I/O Breakout Cable/5M/M12-12 to Flying Lead (CCB-PWRIO-05)	
Power and I/O Breakout Cable/10M/M12-12 to Flying Lead (CCB-PWRIO-10)	
Power and I/O Breakout Cable/15M/M12-12 to Flying Lead (CCB-PWRIO-15)	
Ethernet Cable/2M/M12-8 X-Coded to RJ-45 (CCB-84901-2001-02)	
Ethernet Cable/5M/M12-8 X-Coded to RJ-45 (CCB-84901-2001-05)	
Ethernet Cable/10M/M12-8 X-Coded to RJ-45 (CCB-84901-2001-10)	
Ethernet Cable/15M/M12-8 X-Coded to RJ-45 (CCB-84901-2001-15)	

POWER SUPPLY

Cognex 24 Volt DC Power Supply (ACC-24I)	
North America Power Cord (CBLI-24VDUS)	
Japan Power Cord (CBLI-24VDJP)	
United Kingdom Power Cord (CBLI-24VDUK)	
Europe Power Cord (CBLI-24VDEU)	

MOUNTING BRACKETS

Universal Mounting Bracket (BKT-2000-UNIV-000)	
Pivot Mounting Bracket (BKT-2000-PIVOT-00)	
Flat Surface Mounting Plate Adapter (BKT-2000-ADAPT-00)	

Installation

This section describes the connection of the vision sensor to its standard components and accessories. For a complete list of options and accessories, contact your Cognex sales representative.

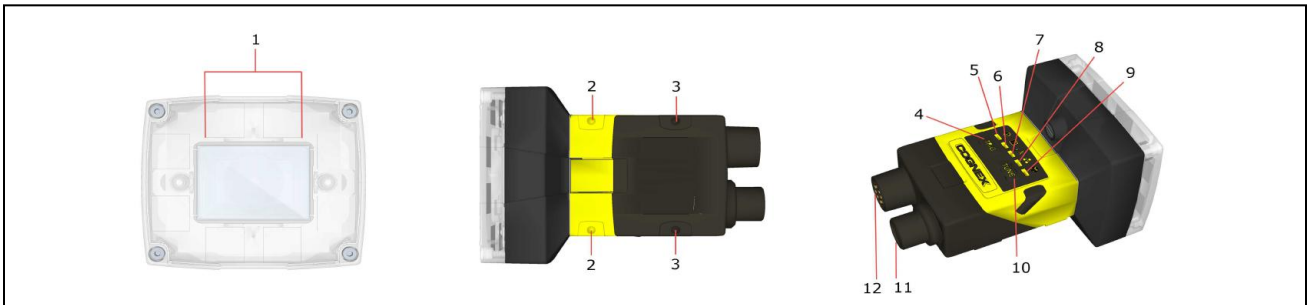
Note:

- Cables are sold separately.
- If any of the standard components appear to be missing or damaged, immediately contact your Cognex Authorized Service Provider (ASP) or Cognex Technical Support.

CAUTION: All cable connectors are “keyed” to fit the connectors on the vision sensor; do not force the connections or damage may occur.

Connectors and Indicators

The following image shows the built-in lighting system and other features of the vision sensor.



1	Illumination LEDs
2-3	Mounting holes (M3 x 3.5mm)
4	Trigger button
5	Power indicator
6	Trigger status indicator
7	Pass/Fail indicator (LED4 Green/LED4 Red)
8	Network status indicator (LED5 Yellow)
9	Error indicator
10	Tune button (unsupported)
11	Power, I/O and RS-232 connector
12	Ethernet connector

Indicator LEDs

Type	Signal	Color	Meaning
Status	Power	GREEN	Power ON
	Trigger	ORANGE (blink)	Triggering
	Error	RED	Error
Action	Pass/fail indicator	GREEN	Pass
		RED	Fail
	Network	YELLOW	Link up
		ORANGE (blink)	Data transfer

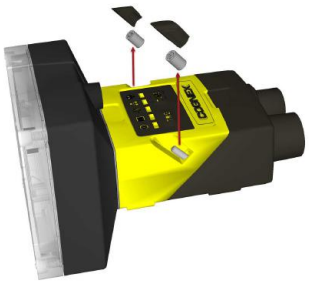
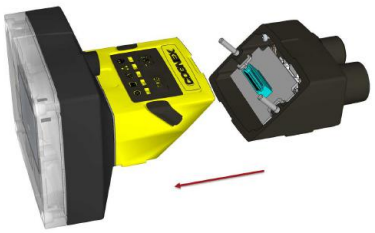
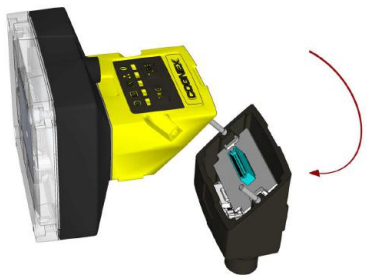
Sensor Mounting Configuration

Perform the following steps to change between in-line and right-angle configuration.

Note:

- Switching between in-line and right-angle configuration is recommended only up to 10 times in the lifetime of the vision sensor.
- Disconnect the vision sensor from power before changing the orientation.

WARNING: Make sure that no electrostatic charges are applied to the PCB. (e.g. wear ESD shoes.) If the main module is separated from the I/O connector module, take care to assemble them correctly. Otherwise, the IP rating can be compromised.

1. Carefully remove the screw covers, threaded nuts and washers.	
2. Detach the main module and the I/O connector module by firmly pulling them apart.	
3. Change the orientation. **Note**: Make sure that the gasket is properly seated on the main module.	
4. Reattach the I/O connector module to the main module.	

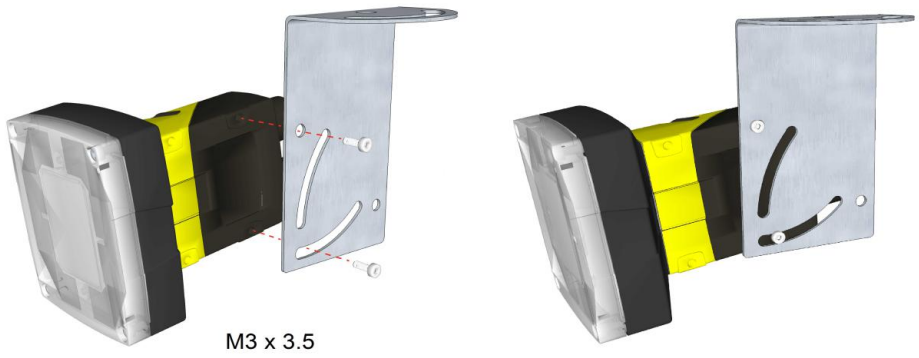
5. Reinstall the washers and loosely fasten the modules together with the two T10 cap nuts, but do not tighten.	
6. After each cap nut has been fastened, torque to 0.12 Nm (1.06 in-lb) and reinstall the screw covers. **Note**: There are unique left and right screw covers. Take care to attach them correctly.	

Mount the Vision Sensor

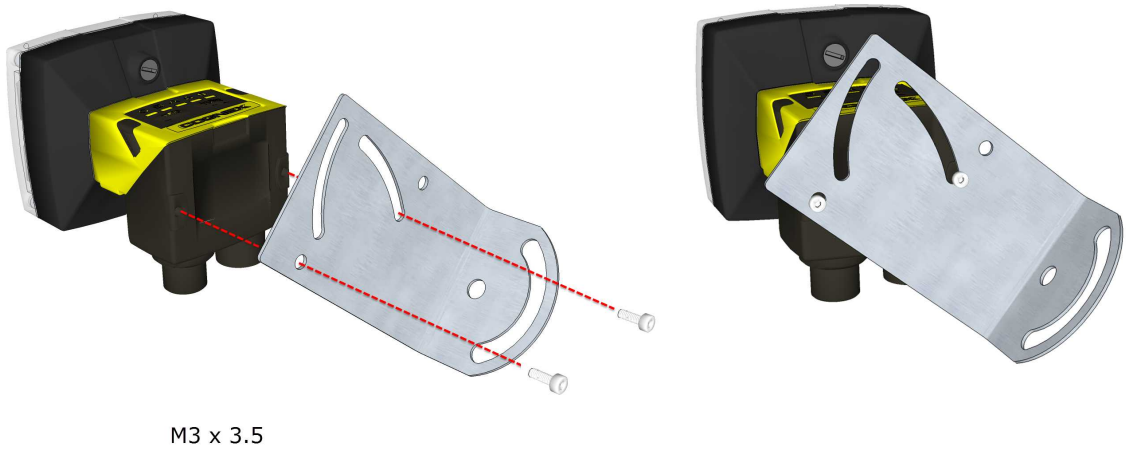
Mounting the vision sensor at a slight angle (15°) can reduce image glare and improve inspection performance.

In-line Configuration

Use the universal mounting bracket (BKT-2000-UNIV-000) with the mounting holes on the I/O connector module.



Right-Angle Configuration



Connect the Ethernet Cable

1. Connect the Ethernet cable's M12 connector to the vision sensor's Ethernet connector.

2. Connect the Ethernet cable's RJ-45 connector to a switch/router or PC, as applicable.

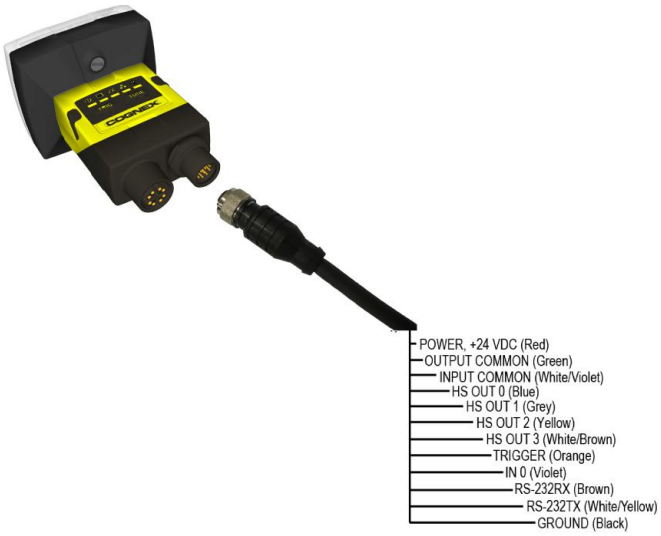
Connect the Power and I/O Breakout Cable

Note: Unused bare wires can be clipped short or tied back using a tie made of non-conductive material. Keep all bare wires separated from the +24VDC wire.

1. Verify that the 24VDC power supply being used is unplugged and not receiving power.
2. Optionally, connect the I/O or serial wires to an appropriate device (for example, a PLC or a serial device). For more information, refer to *Power and I/O Breakout Cable Specifications* on page 30.
3. Attach the Power and I/O Breakout cable's +24VDC (Red wire) and GROUND (Black wire) to the corresponding terminals on the power supply.

   CAUTION: Never connect voltages other than 24VDC. Always observe the polarity shown.

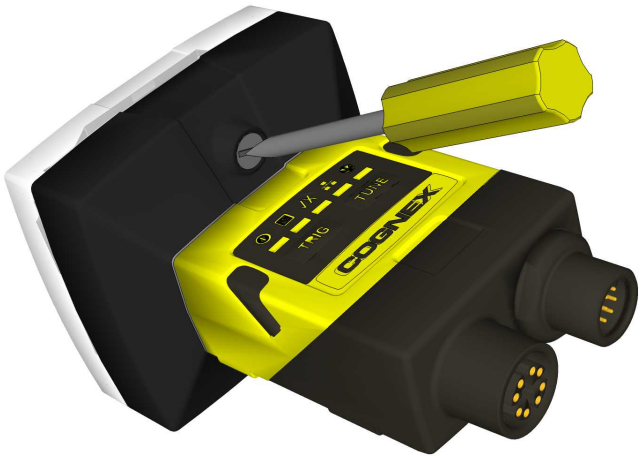
4. Attach the Power and I/O Breakout cable's M12 connector to the vision sensor's Power, I/O and RS232 connector.



5. Restore power to the 24VDC power supply and turn it on if necessary.

Set the Focus Position

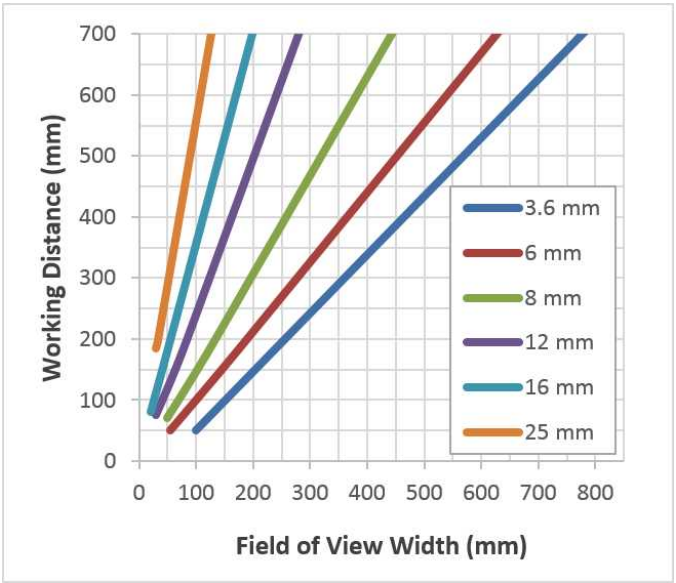
Adjust the focus on the back of the light module. Turn the screw clockwise to focus at a shorter distance, and counter-clockwise to focus at a longer distance.



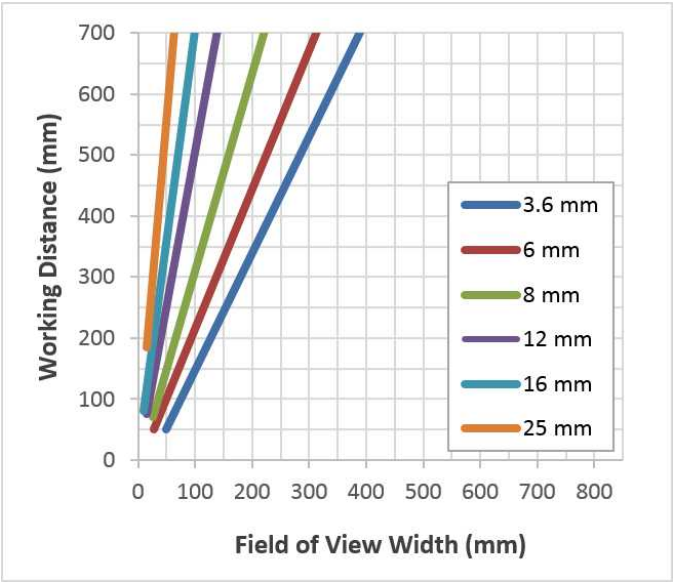
Working Distance and Field of View

The distance from the vision sensor lens to the part that needs to be inspected is the working distance. The field of view is what the vision sensor can see at that distance. As the working distance increases, so does the field of view.

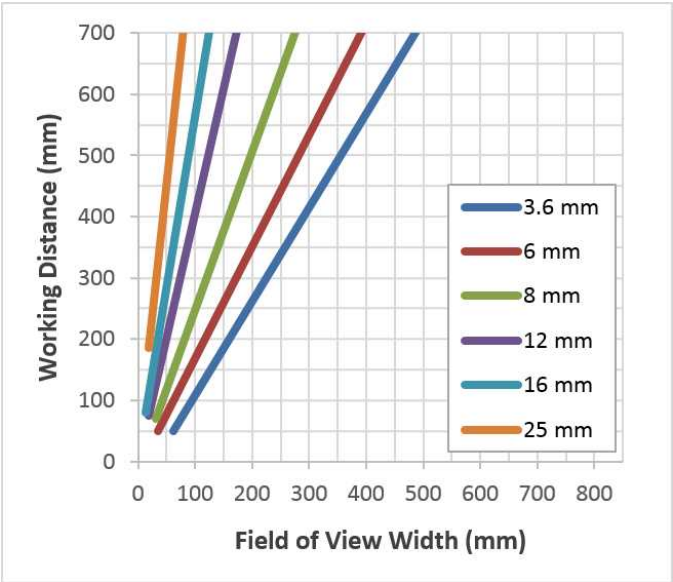
The following chart shows the horizontal field of view for **In-Sight 2000-110/120/130** model vision sensors with 640 x 480 image resolution (default).



The following chart shows the horizontal field of view for **In-Sight 2000-120/130** model vision sensors with 640 x 480 image resolution in 2X Image Magnification mode.

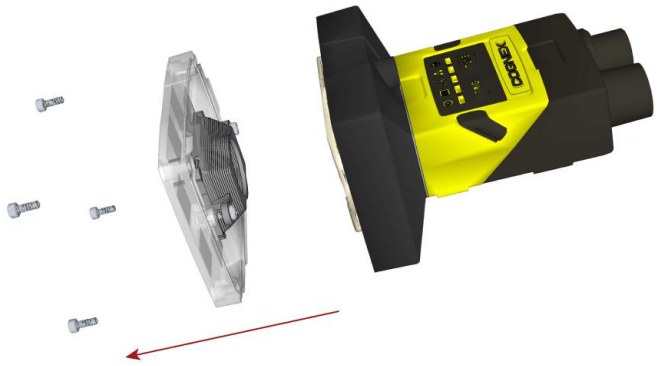


The following chart shows the horizontal field of view for **In-Sight 2000-130** vision sensor with 800 x 600 image resolution (2X Image Magnification mode).

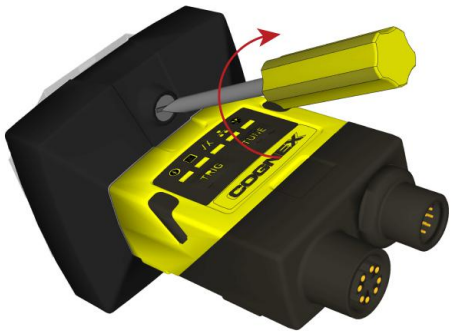


Replace the M12 Lens (Optional)

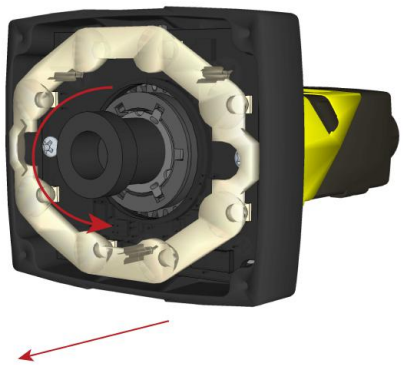
1. Verify that the 24VDC power supply being used is unplugged and not receiving power.
2. Remove the four screws and the front cover from the optics module.



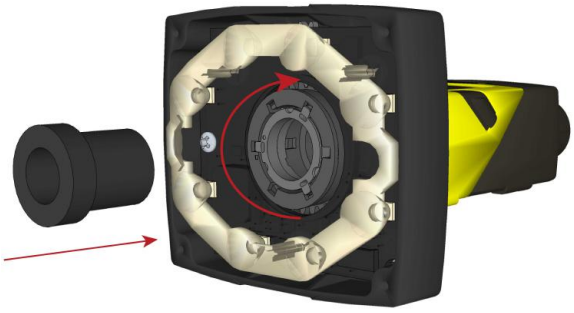
3. Move the lens to the furthest out position by turning the screw on the back of the light module clockwise.



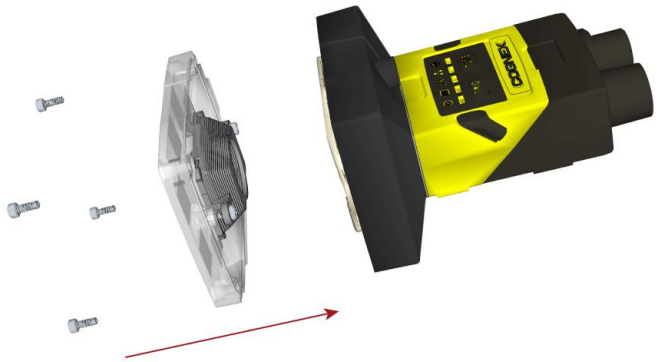
4. Using your fingers, turn the lens counter-clockwise to remove the lens.



5. Insert the new lens and using your fingers, turn it clockwise to tighten the lens.



6. Reattach the front cover. Tighten all four screws using a torque wrench; the maximum torque is 0.2 Nm (1.77 in-lb).

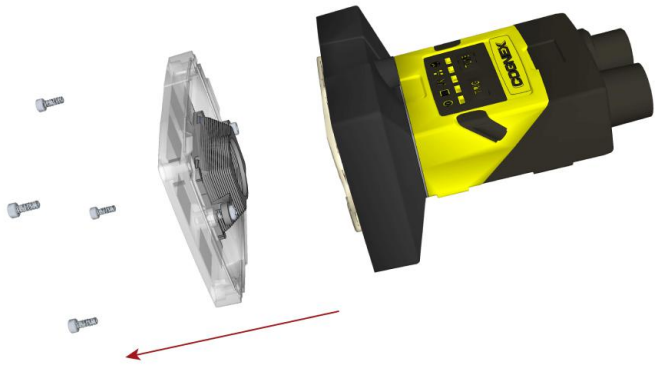


7. Restore power to the 24VDC power supply and turn it on if necessary.

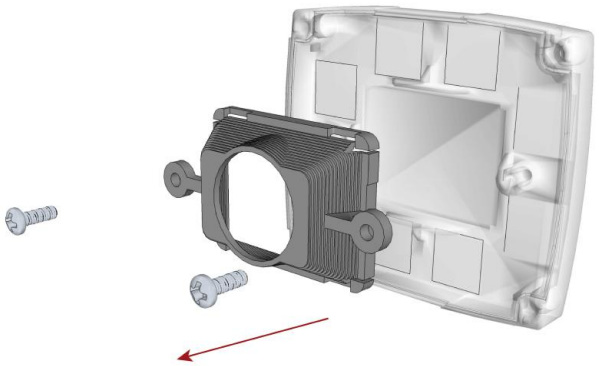
Install the Lens Filter (Optional)

Lens filters can be used to increase the contrast of images and improve the ability of the vision sensor to distinguish desired characteristics. Lens filters are available for purchase as an accessory.

1. Verify that the 24VDC power supply being used is unplugged and not receiving power.
2. Remove the four screws and the front cover from the optics module.

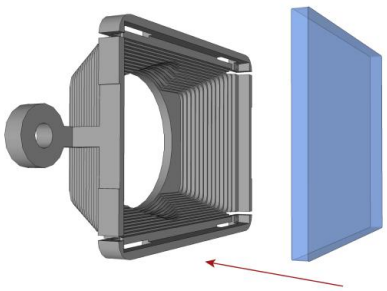


3. Unscrew the two screws on the filter holder and remove the filter holder from the front cover.

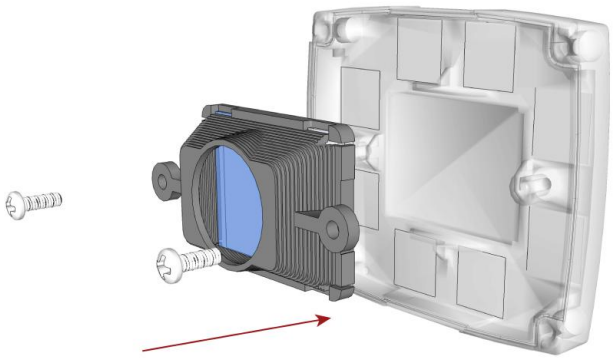


4. Hold the filter by the sides, then push the filter in until it is sitting firmly against the filter holder.

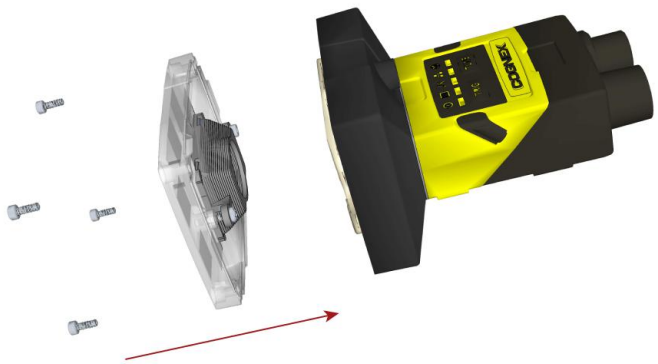
> **Note**: Make sure to only touch the sides of the filter to avoid leaving fingerprints.



5. Reinstall the filter holder back to the front cover, tightening the screws until they stop turning.



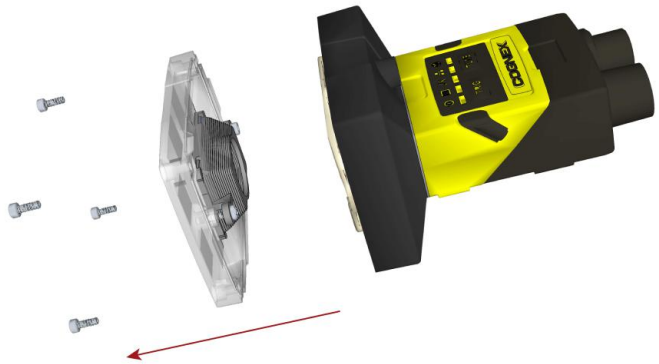
6. Reattach the front cover. Tighten all four screws using a torque wrench; the maximum torque is 0.2 Nm (1.77 in-lb).



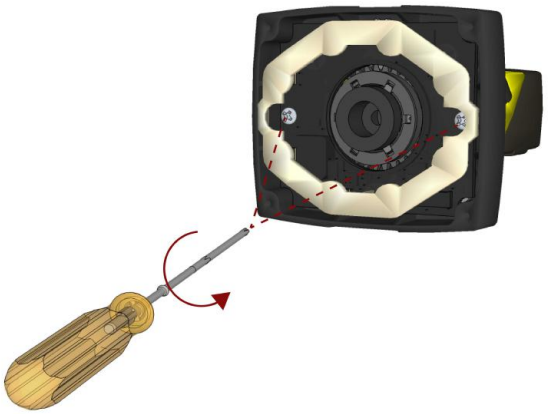
7. Restore power to the 24VDC power supply and turn it on if necessary.

Change the LED Ring Light (Optional)

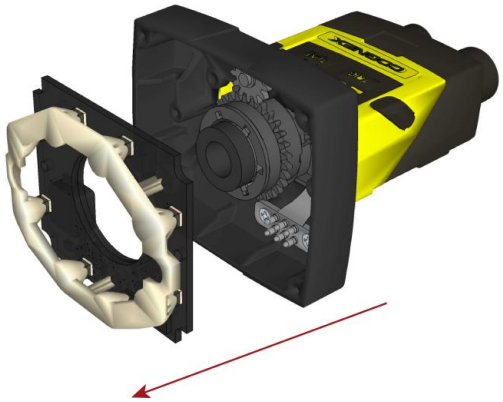
1. Verify that the 24VDC power supply being used is unplugged and not receiving power.
2. Remove the four screws and the front cover from the optics module.



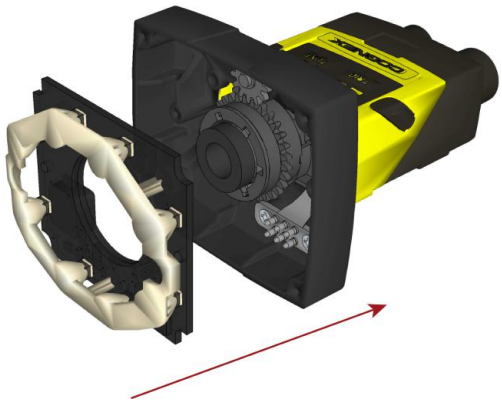
3. Using a screwdriver, loosen the two screws on the LED ring light.



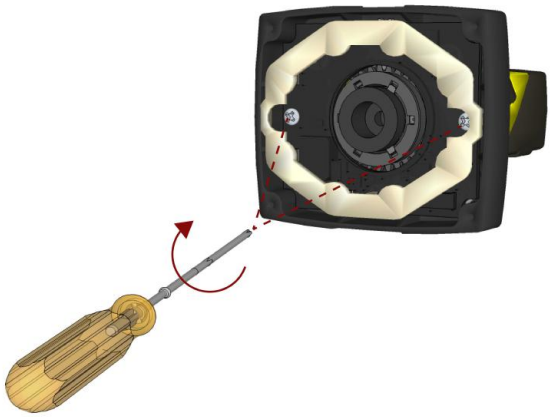
4. Remove the LED ring light.



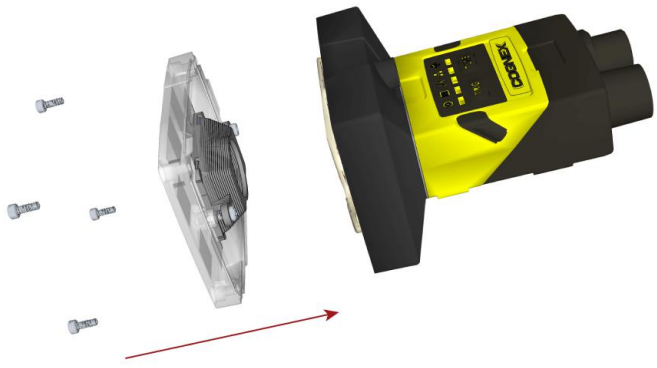
5. Carefully align the connector on the back of the new LED ring light with the pins on the vision sensor. Gently press down the LED ring light to the optics module.



6. Using a screwdriver, tighten the screws until they stop turning.



7. Reattach the front cover. Tighten all four screws using a torque wrench; the maximum torque is 0.2 Nm (1.77 in-lb).



8. Restore power to the 24VDC power supply and turn it on if necessary.

Specifications

The following sections list general specifications for the In-Sight 2000 series vision sensors.

Vision Sensor Specifications

Specifications	2000-110	2000-120	2000-130
Minimum Firmware Requirement	In-Sight version 5.2.1		
Job/Program Memory	32MB non-volatile flash memory; unlimited storage via remote network device		
Image Processing Memory	128MB SDRAM		
Imager Type	1/3-inch CMOS		
Imager Properties	4.80 mm x 3.60 mm (W x H), 3.75 µm sq. pixels		
Maximum Image Resolution (pixels)	640 x 480		640 x 480[1] 800 x 600
Electronic Shutter Speed	0 to 1000 ms		
Bit Depth	256 grey levels (8 bits/pixel).		
Frames Per Second	20 full frames per second	40 full frames per second	
Lens Type	M12, 8 mm lens		
Trigger	1 opto-isolated, acquisition trigger input. Remote software commands via Ethernet. Supports DHCP (factory default), static and link-local IP address configuration.		
Discrete Inputs	1 opto-isolated general-purpose input line		
Discrete Outputs	4 opto-isolated high-speed general-purpose output lines		
Status LEDs	Power, Trigger Status, Pass/Fail Status, Network and Error		
Network Communication	Ethernet port, 10/100 BaseT with auto MDI/MDIX. IEEE 802.3 TCP/IP protocol		
RS-232	RxD, TxD according to TIA/EIA-232-F		
Discrete I/O Operating Limits	HS Output 0, 1, 2, 3 I_{MAX} 50 mA R_{MAX} @ 12 VDC 240 Ω @ 24 VDC 480 Ω Trigger Input 0 V_{IH} 15 — 24 V V_{IL} 0 — 5 V I_{TYP} @ 12 VDC 3.6 mA @ 24 VDC 7.5 mA		
Power Consumption	24VDC ±10%, 48W (2.0A) maximum when the illumination is on		
Material	Aluminum housing		
Finish	Painted		
Mounting	Four M3 threaded mounting holes		
Dimensions	98mm (3.86in) x 68mm (2.68in) x 45mm (1.77in)		
Weight	200 g (7.05 oz.)		
Operating Temperature	0°C to 40°C (32°F to 104°F)		
Storage Temperature	-10°C to 60°C (-14°F to 140°F)		

[1] The default resolution for the In-Sight 2000-130 vision sensor is 640 x 480 pixels. The vision sensor's resolution can be configured as 800 x 600 pixels within the In-Sight Explorer software. Refer to the *In-Sight® Explorer Help* file for more information.

Specifications	2000-110	2000-120	2000-130
Maximum Humidity	< 95%, non-condensing		
Protection	IP65 when all connectors are attached to cables or shielded by a sealing cap		
Shock (Shipping and Storage)	IEC 60068-2-27: 1000 shocks, semi-sinusoidal, 11g, 10ms		
Vibration (Shipping and Storage)	IEC 60068-2-6: vibration test in each of the three main axis for 2 hours @ 10 Gs (10 to 500 Hz at 100m/s2 /15mm)		

I/O Specifications

Cable and connector specifications and connection examples for acquisition trigger input and high-speed outputs are provided in the following sections.

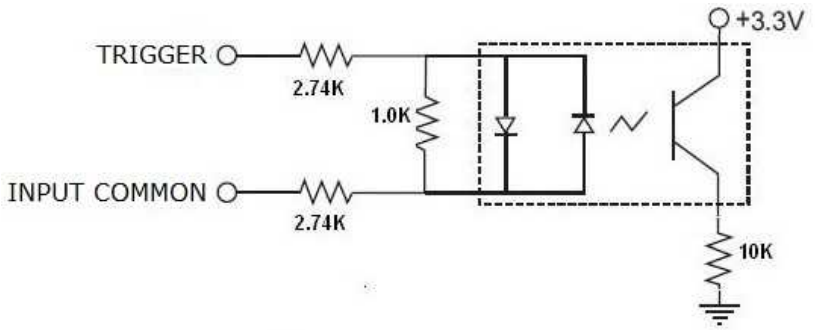
Acquisition Trigger Input

The vision sensor features one acquisition trigger input that is opto-isolated. The acquisition trigger input can be configured to trigger from either an NPN (current sinking) or PNP (current sourcing) device.

Specification	Description
Voltage	ON: 15 to 24VDC (24VDC nominal) OFF: 0 to 5VDC (0VDC nominal)
Current	3.6 mA @ 12VDC, 7.5 mA @ 24VDC Resistance: ~5.48 kOhms
Delay	1.45ms maximum latency between leading edge of trigger and start of acquisition. Input pulse should be a minimum of 1ms wide.

To trigger from an NPN (pull-down) type photo-detector or PLC output, connect TRIGGER to +24VDC and connect INPUT COMMON to the output of the detector. When the output turns on, it pulls INPUT COMMON down to 0VDC, turning the opto-coupler on. For more information, refer to *Power and I/O Breakout Cable Specifications* on page 30.

To trigger from a PNP (pull-up) photo-detector or PLC output, connect TRIGGER to the output of the detector and connect INPUT COMMON to 0VDC. When the output turns on, it pulls TRIGGER up to 24VDC, turning the opto-coupler ON. For more information, refer to *Power and I/O Breakout Cable Specifications* on page 30.



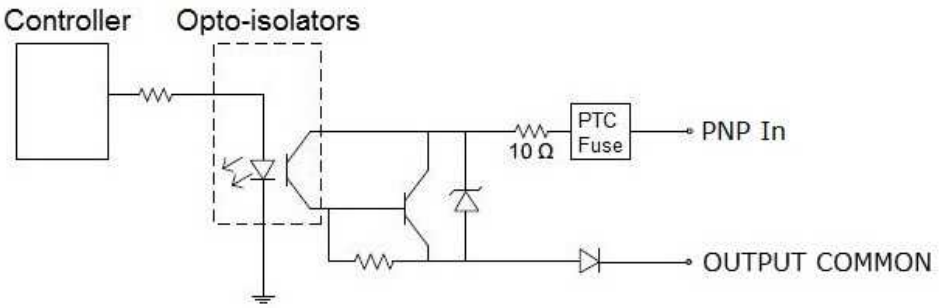
28V Max. Across input pins - Transition approx. 12V (Min).

High-Speed Outputs

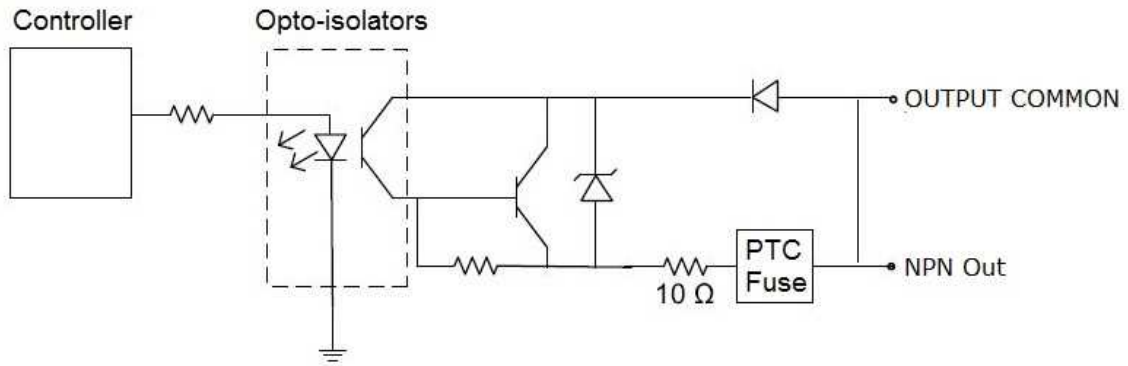
The high-speed outputs can be used as either NPN (pull-down) or PNP (pull-up) lines.

Specification	Description
Voltage	28VDC maximum through external load
Current	50mA maximum sink current OFF state leakage current 100µA External load resistance 240 Ohms to 10K Ohms Each line rated at a maximum 50mA, protected against over-current, short circuits and transients from switching inductive loads. High current inductive loads require external protection diode.

For NPN lines, the external load should be connected between the output and the positive supply voltage (<28VDC). The outputs pull down to less than 3VDC when ON, which causes current to flow through the load. When the outputs are OFF, no current flows through the load. For more information, refer to *Power and I/O Breakout Cable Specifications* on page 30.



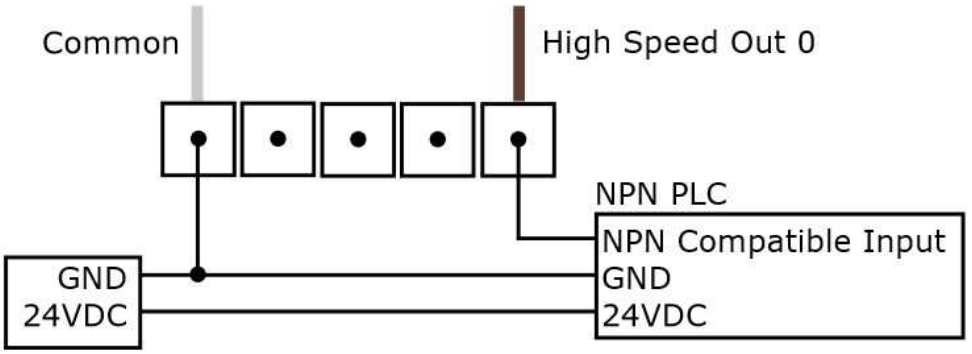
For PNP lines, the external load should be connected between the output and the negative supply voltage (0VDC). When connected to a 24VDC power supply, the outputs pull up greater than 21VDC when ON, and current flows through the load. When the outputs are OFF, no current flows through the load. For more information, refer to *Power and I/O Breakout Cable Specifications* on page 30.



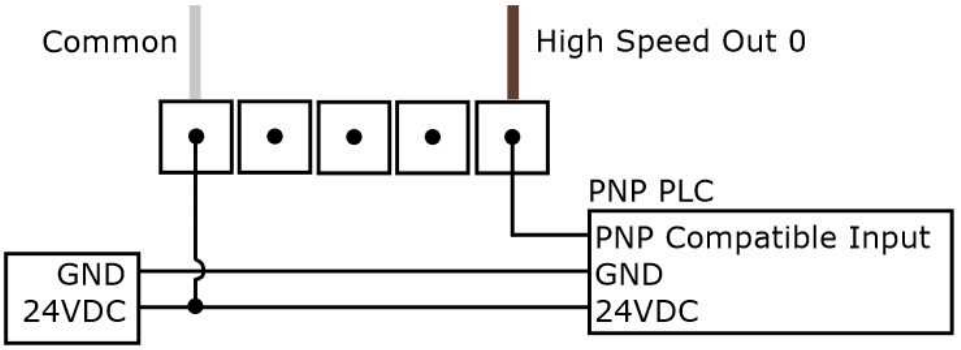
High-Speed Output Wiring

Note: For more information, refer to *Power and I/O Breakout Cable Specifications* on page 30.

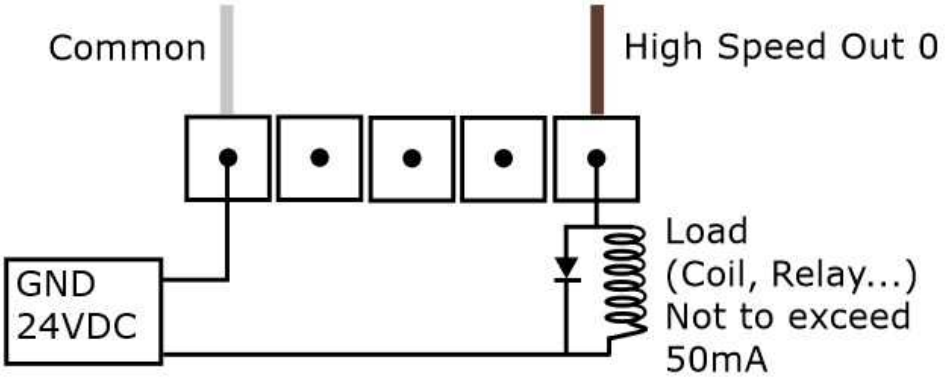
To connect to an NPN-compatible PLC input, connect any of the high-speed outputs directly to the PLC input. When enabled, the output pulls the PLC input down to less than 3VDC.



To connect to a PNP-compatible PLC input, connect any of the high-speed outputs directly to the PLC input. When enabled, the output pulls the PLC input up to greater than 21VDC.

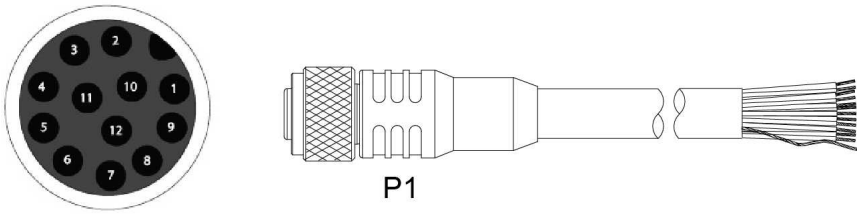


To connect the high-speed outputs to a relay, LED or similar load, connect the negative side of the load to the output and the positive side to +24VDC. When the output switches on, the negative side of the load is pulled down to less than 3VDC, and 24VDC appears across the load. Use a protection diode for a large inductive load, with the anode connected to the output and the cathode connected to +24VDC.



Power and I/O Breakout Cable Specifications

The Power and I/O Breakout cable provides connections to an external power supply, the acquisition trigger input, a general-purpose input, high-speed outputs, and RS-232 serial communications.



Pin#	Signal Name	Wire Color
1	HS OUT 2	Yellow
2	RS-232 Tx	White/Yellow
3	RS-232 Rx	Brown
4	HS OUT 3	White/Brown
5	IN 0	Violet
6	INPUT COMMON	White/Violet
7	+24VDC	Red
8	GND	Black
9	OUTPUT COMMON	Green
10	TRIGGER	Orange
11	HS OUT 0	Blue
12	HS OUT 1	Grey

Note:

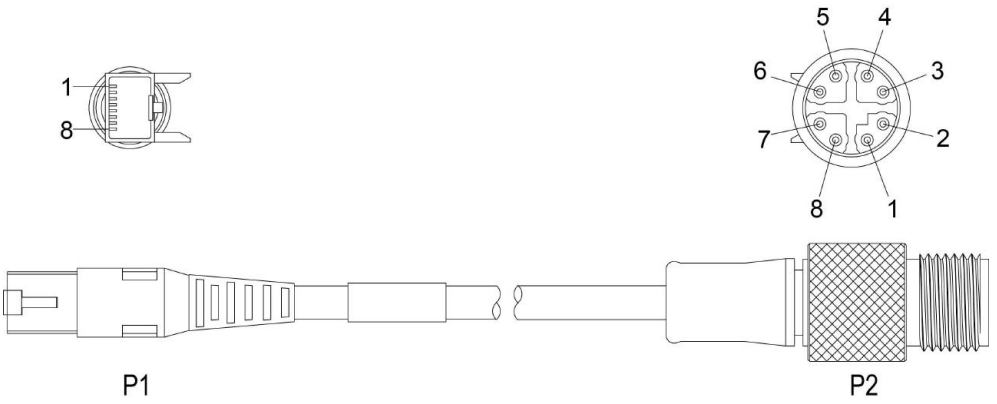
- For RS-232, use the Power Supply return path for ground.
- Cables are sold separately.
- Unused bare wires can be clipped short or tied back using a tie made of non-conductive material. Keep all bare wires separated from the +24VDC wire.

Ethernet Cable Specifications

The Ethernet cable provides Ethernet connection for network communications. The Ethernet cable can be connected to a single device or provide connections to multiple devices via a network switch or router.

Note: Cables are sold separately. The wiring for this cable follows standard industrial Ethernet M12 specifications. This differs from the 568B standard.

M12 X-coded to RJ-45 Cable

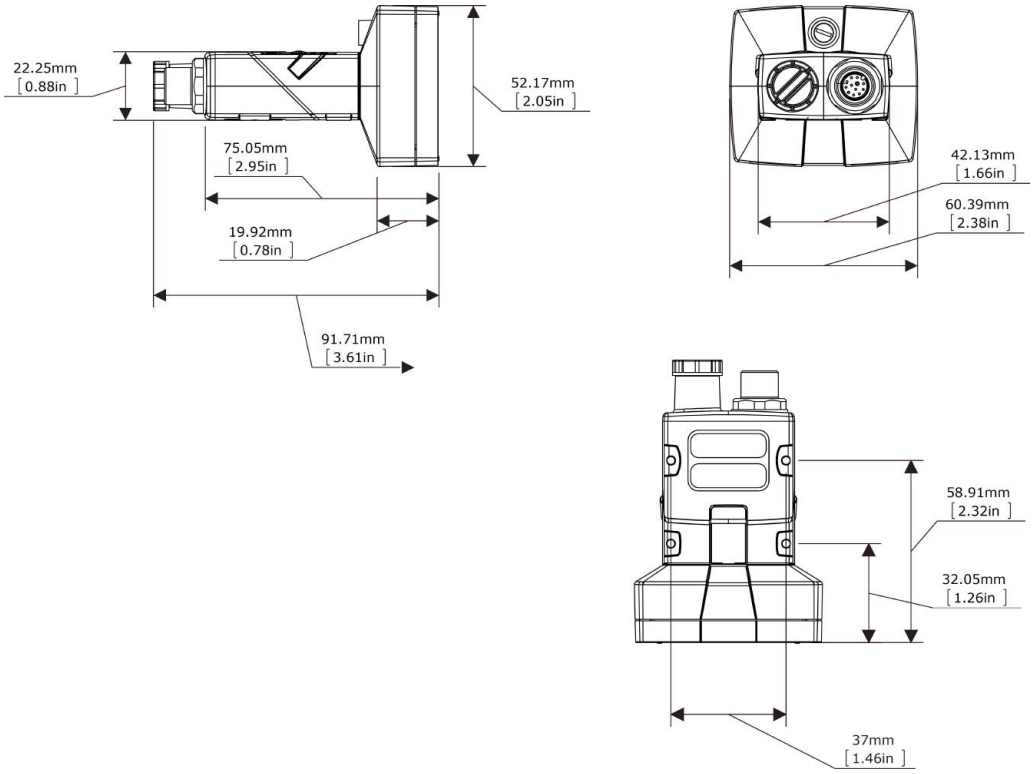


P1 Pin Number	Wire Color	Signal Name	P2 Pin Number
1	White/Orange	TxRx A +	1
2	Orange	TxRx A -	2
3	White/Green	TxRx B +	3
4	Blue	TxRx C +	8
5	White/Blue	TxRx C -	7
6	Green	TxRx B -	4
7	White/Brown	TxRx D +	5
8	Brown	TxRx D -	6

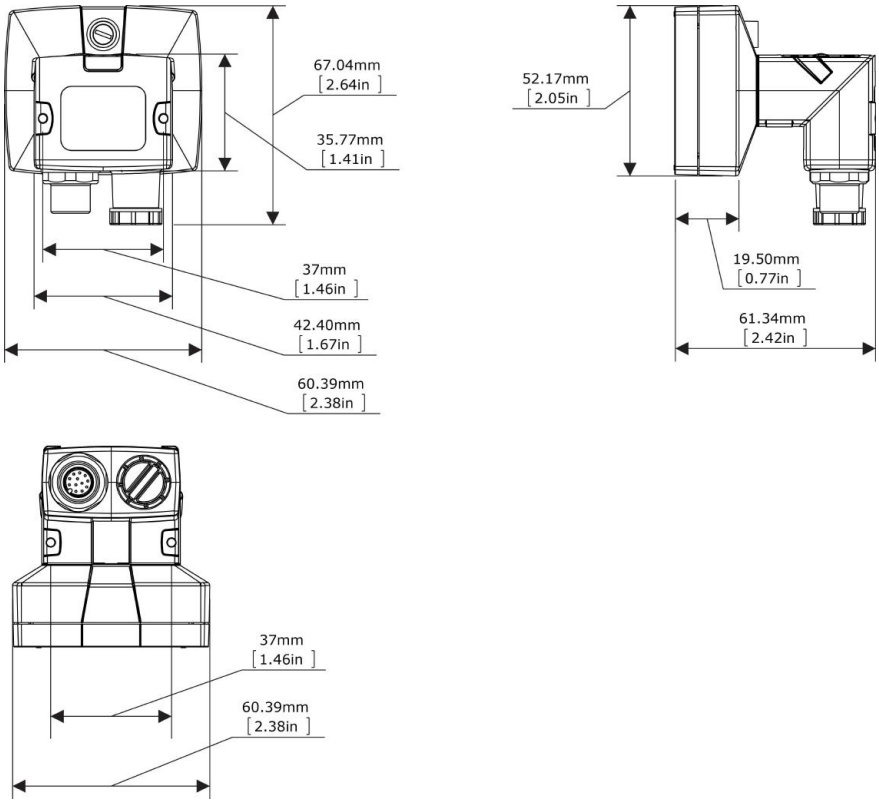
Note: Cable shielding can be degraded or cables can be damaged or wear out more quickly if a service loop or bend radius is tighter than 10X the cable diameter. The bend radius must begin at least six inches from the connector.

Dimensional Drawings

The size of the vision sensor in the straight configuration is shown in the following figure:



The size of the vision sensor in the angled configuration is shown in the following figure:



Cleaning/Maintenance

Clean the Vision Sensor Housing

To clean the outside of the vision sensor housing, use a small amount of mild detergent cleaner or isopropyl alcohol on a cleaning cloth. Do not pour the cleaner directly onto the vision sensor housing.

⚠ **CAUTION**: Do not attempt to clean any In-Sight product with harsh or corrosive solvents, including lye, methyl ethyl ketone (MEK) or gasoline.

Clean the Vision Sensor Image Sensor Window

To remove dust from the outside of the image sensor window, use a pressurized air duster. The air must be free of oil, moisture or other contaminants that could remain on the glass and possibly degrade the image. Do not touch the glass window. If oil/smudges still remain, clean the window with a cotton bud using alcohol (ethyl, methyl or isopropyl). Do not pour the alcohol directly on the window.

Clean the Vision Sensor Lens Cover

To remove dust from the lens cover, use a pressurized air duster. The air must be free of oil, moisture or other contaminants that could remain on the lens cover. To clean the plastic window of the lens cover, use a small amount of isopropyl alcohol on a cleaning cloth. Do not scratch the plastic window. Do not pour the alcohol directly on the plastic window.

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