

# Zebra 3S



**ZEBRA**

## **Installation and Technical Reference**

2024/06/27

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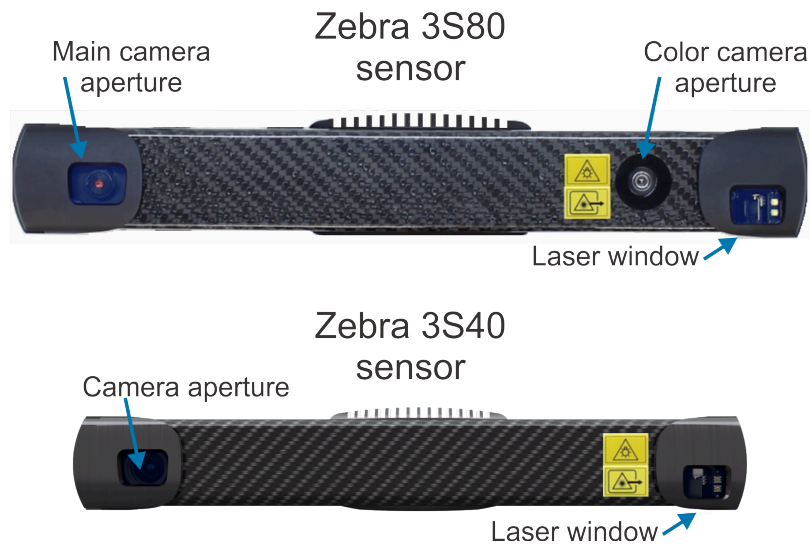
# Before you start

## Overview

Zebra 3S sensors are a family of products that provide high-resolution snapshot 3D area scanning. Zebra 3S provides two main families of 3D area scanning devices: **Zebra 3S80** and **Zebra 3S40**. Zebra 3S sensors use either Parallel Structured Light technology or sequential structured light technology to scan an entire scene. With the use of Parallel Structured Light technology, Zebra 3S80 sensors are able to scan objects that are in motion and at a faster rate (shorter exposure time), with a high degree of accuracy and resolution. Zebra 3S40 uses sequential structured light projection to scan static scenes with high resolution and quality.

All Zebra 3S sensors provide on-device laser light processing and can output the data in depth map or point cloud formats. Zebra 3S sensors can also take an image of the scene, where each pixel intensity maps to the intensity of each point in the scene; the 3S80 models can also take the image in color. Once data is processed on Zebra 3S, it is sent to a controlling computer with Aurora Design Assistant installed for further analysis. Zebra 3S sensors use a 1 Gbps Ethernet connection and can also interface with other devices using their auxiliary digital I/O lines.

**Figure 1** Locations of apertures on Zebra 3S models



## Zebra 3S features

All Zebra 3S sensors have the following features:

- **Pre-calibrated.** Zebra 3S sensors come pre-calibrated from the factory for acquiring 3D data in real world distances, making installation and integration simple and fast.
- **On-device laser light processing.** Zebra 3S sensors can process acquired structured light data and output an accurate high-density point cloud or depth map of the scene, along with its corresponding normals, confidence, and texture. The Zebra 3S80 models also provide color information.
- **Sequential structured light technology (static scenes).** Technology used to scan static scenes at a high resolution and quality. This technology is available on all Zebra 3S sensors.
- **Auxiliary I/O lines.** A total of 2 auxiliary lines (1 input line and 1 output line) are available.
- **Power-over-Ethernet (PoE+).** Zebra 3S sensors support being powered through its Ethernet cable.

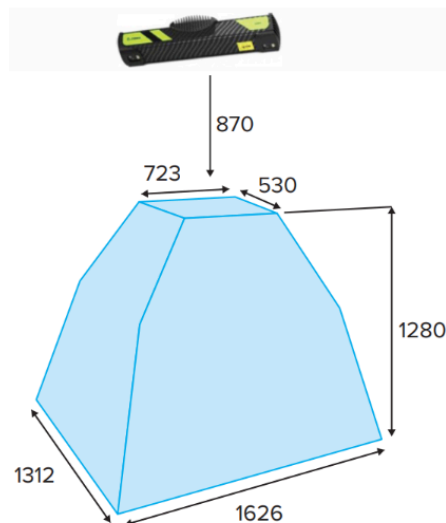
Zebra 3S80 sensors have the following additional features:

- **Parallel Structured Light technology (dynamic scenes).** Patented CMOS sensor technology that allows snapshot 3D scanning of dynamic environments, producing high resolution and quality 3D scenes. This technology is available on the Zebra 3S80-4M and 3S80-4L sensors.
- **Color camera.** Zebra 3S80 sensors come with a second camera that scans a color image, allowing you to overlay the color texture on the 3D points acquired by the grayscale (main) camera.

## Models

The FoV and specifications for each Zebra 3S model are presented below:

**Figure 2** Zebra 3S40 FoV (in mm)

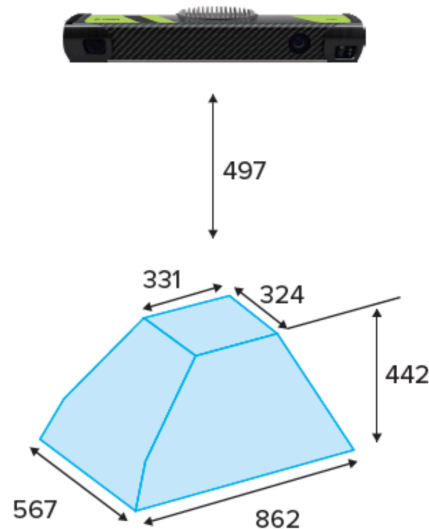


**Zebra 3S40** This model of the Zebra 3S family has a large FoV and uses sequential structured light technology, which allows the sensor to scan static objects with high accuracy and resolution.

- **Scanning range :** 34–85 in / 870–2150 mm
- **Optimal scanning distance (sweet spot) :** 49 in / 1245 mm

- **Scanning area (at sweet spot)** : 43 x 30 in / 1091 x 761 mm
- **Scanning time** : from 450 ms
- **Resolution** : 1.5 million 3D points (1440 x 1080)
- **Point-to-point distance (at sweet spot)** : 0.03 in / 0.82 mm
- **Calibration accuracy (1  $\sigma$ )** : 0.019 in / 0.5 mm
- **Temporal noise (1  $\sigma$ )** : 0.018 in / 0.45 mm
- **Maximum fps** : 2 fps

**Figure 3** Zebra 3S80-4M FoV (in mm)

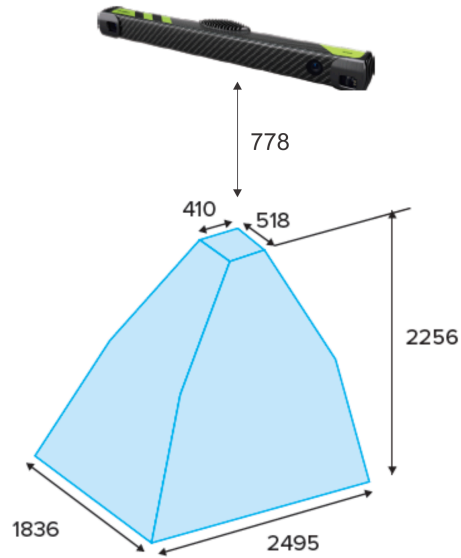


**Zebra 3S80-4M** This model of the Zebra 3S family has a medium FoV and uses Parallel Structured Light technology, which allows the sensor to scan objects in motion with high accuracy and resolution.

- **Scanning range** : 19.6–37 in / 497–939 mm
- **Optimal scanning distance (sweet spot)** : 25.7 in / 653 mm
- **Scanning area (at sweet spot)** : 23.1 x 17.5 in / 588 x 444 mm
- **Scanning time** : from 10 ms (depending on setup)
- **Resolution** : up to 2 million 3D points (1680 x 1200)
- **Color picture resolution** : 2 MP mapped on 3D data (2D data up to 8 MP)
- **Point-to-point distance (at sweet spot)** : Static: 0.015 in / 0.37 mm | Dynamic: 0.021 in / 0.55 mm at 0.9 MP and 0.015 in / 0.37 mm at 2 MP
- **Calibration accuracy (1  $\sigma$ )** : Static: 0.009 in / 0.25 mm | Dynamic: 0.02 in / 0.5 mm
- **Temporal noise (1  $\sigma$ )** : Static: 0.002 in / 0.05 mm | Dynamic: 0.003 in / 0.1 mm
- **Maximum fps** : Static: 2 fps | Dynamic: 20 fps at 0.9 MP and 5 fps at 2 MP



**Figure 4** Zebra 3S80-4L FoV (in mm)



**Zebra 3S80-4L** This model of the Zebra 3S family has a Large FoV and uses Parallel Structured Light technology, which allows the sensor to scan objects in motion with high accuracy and resolution.

- **Scanning range** : 30.6–119.4 in / 778–3034 mm
- **Optimal scanning distance (sweet spot)** : 49.3 in / 1252 mm
- **Scanning area (at sweet spot)** : 40.4 x 32.9 in / 1027 x 836 mm
- **Scanning time** : from 20 ms (depending on setup)
- **Resolution** : up to 2 million 3D points (1680 x 1200)
- **Color picture resolution** : 2 MP mapped on 3D data (2D data up to 8 MP)
- **Point-to-point distance (at sweet spot)** : Static: 0.03 in / 0.720 mm | Dynamic : .04 in / 1.05 mm at 0.9 MP and 0.03 in / 0.72 mm at 2 MP
- **Calibration accuracy (1  $\sigma$ )** : Static: 0.035 in / 0.900 mm | Dynamic: 0.05 in / 1.25 mm
- **Temporal noise (1  $\sigma$ )** : Static: 0.004 in / 0.100 mm | Dynamic: 0.006 in / 0.15 mm
- **Maximum fps** : Static: 2 fps | Dynamic: 20 fps at 0.9 MP and 5 fps at 2 MP

## Which Zebra 3S is good for you?

Zebra 3S sensor models are differentiated by their scanning technology and scanning volumes. You should select a model depending on your application.

### Movement in the scene (static or dynamic)

Zebra 3S sensors are depth sensing devices working on the principle of optical triangulation. Modulated light projected from the projection unit is reflected by the scanned object and captured by the main camera unit, from which the distance to the object is computed. Depending on which model you use, you can capture either static or dynamic scenes.

To capture scenes that are completely static during the scan, you can use Zebra 3S40 or 3S80 in sequential structured light mode (scanner mode). To capture dynamic scenes, you need to use Zebra 3S80 in Parallel Structured Light™ mode (camera mode), which allows the scene to be in arbitrary movement or vibration and is good for applications that require high accuracy and very short cycle times.

### Required scanning volumes, acquisition time, color, and resolution requirements

Zebra's 3S40 sensor use case:

- Static scenes with larger objects and bigger volumes.
- High resolution requirements.
- Only supports greyscale texture images.

Zebra's 3S80 sensor use case:

- Dynamic scenes with medium-sized objects and volumes (**3S80-4M**), or larger objects and bigger volumes (**3S80-4L**). The Zebra 3S80-4L can extend its scanning range up to 3 m, but its optimal scanning distance is 1.25 m, where the sensor captures high-resolution point clouds of objects within an area measuring 1027 x 836 mm.
- Highest resolution requirement with fastest scanning time.
- Supports color texture images.

### Object recommendations and pitfalls

As both Zebra 3S40 and 3S80 sensors rely on the reflection of projected light, objects most suitable for scanning are (including and not limited to):

- Rough surface objects, such as wood, rubber, paper, and plaster.
- Objects with a matte finish, such as sand-blasted aluminum and cast iron.
- Molded, un-polished plastic materials.

Some objects not suitable for scanning (including and not limited to):

- Mirrors and polished metals.
- Most liquids, such as water or oil.
- Translucent and transparent objects, such as glass and transparent plastic.

Smoke and particles dispensed in the air can negatively influence the 3D data.

## Inspecting your Zebra 3S kit

All Zebra 3S sensors come as part of a kit with either just the sensor and Aurora Imaging Design Assistant, or with the sensor and a Zebra 4Sight EV7 that has a Aurora Imaging Design Assistant license. You should check the contents of your Zebra 3S kit when you first open it. If something is missing or damaged, contact your Zebra sales representative.

### Base kit

If you have purchased a Zebra 3S sensor, your base kit will include the following:

- Selected model of the Zebra 3S sensor.
- A USB licensing dongle with a Aurora Imaging Design Assistant license.
- Desktop PoE+ injector (input: 90 - 264 Vac, output: 33.6 W, 56 V, IEEE802.3at) with power cable (1.8 m).
- Ethernet cable M12-X male - RJ45 male, 5 m, PUR.
- Regulatory guide.

### Regular vision controller kit

If you have purchased a Zebra 3S regular vision controller kit, your kit will include the following:

- Selected model of the Zebra 3S sensor.
- Aurora Imaging Design Assistant software.
- Zebra 4Sight EV7 (industrial computer).
- Desktop PoE+ injector (input: 90 - 264 VAC, output: 33.6 W, 56 V, IEEE802.3at) with power cable (1.8 m).
- Ethernet cable M12-X male - RJ45 male, 5 m, PUR.
- Regulatory guide.

### Available separately

You might have also ordered one or more of the following products:

- M12-CBL-ETH/5, a replacement cable that supports both 1000 Base-T and 2.5GBASE-T, with an M12-X 8-position (male) connector on one end and an RJ-45 registered jack on the other. This cable is meant to connect your Zebra 3S to a computer or another network device and optionally receive power through PoE + (PSE 44-57 Vdc).
- M12-CBL-PWRIO/3, a digital I/O and power cable with an M12-A 12-position (male) connector on one end and open ended wires on the other. This cable is meant to connect your Zebra 3S to power and connect with third-party digital I/O devices.

## Minimum requirements

The following lists the minimum requirements so that you can use your Zebra 3S:

- A computer running Aurora Design Assistant.
- An Ethernet M12-X 8-position to RJ-45 cable that supports Ethernet Cat5e or better, as well as installed and functioning Ethernet drivers.
- If not using PoE+, use a Zebra 3S digital I/O and power cable with a connected power supply.
- A Zebra 3S digital I/O and power cable, plus a power supply.



**NOTE:** Note that, if PoE+ is used to power your Zebra 3S, power comes over the Ethernet (M12-X 8-position to RJ-45) cable, and not over the Zebra 3S digital I/O and power cable.

## Software overview

Zebra 3S must be used with Aurora Imaging Design Assistant. Zebra software is supported under Windows.

### Aurora Design Assistant

Aurora Design Assistant is a flowchart-based, integrated development environment (IDE). It allows you to create an imaging application without writing a single line of code. Application development is a step-by-step approach, where each step is taken from an existing toolbox and is configured through a series of dialog windows. Aurora Design Assistant runs on your development computer and uses the resources of your Zebra 3S (for example, to grab an image and communicate with connected devices) to build projects. Once the project is built and deployed, it can run without the Aurora Design Assistant interface being installed.

With Aurora Design Assistant, you can:

- Create your project as a series of steps using a flowchart.
- Test your project from your computer without any additional code editors or compilers and without deploying (copying and running) your project on your Zebra 3S.
- Design and layout a web page (operator view) to receive operator input and to display your project's output.
- Run, terminate, and re-run the project on your Zebra 3S from within Aurora Design Assistant.
- Grab 3D data/images from your Zebra 3S or load them from disk.
- Analyze images and 3D data using a comprehensive set of industry-proven 2D/3D analysis and measurement tools (for example, code reader and Geometric Model Finder tools). Blob and edge analysis is also supported, along with color matching, code recognition, character recognition, bead inspection, measurement, metrology, 3D processing and analysis, classification, and a number of additional processing and analysis features.
- Perform calibration for 2D images.
- Send and receive user-defined digital I/O signals (auxiliary I/O signals).
- Write image/3D data and text files (for example, CSV) locally or on network drives.
- Send and receive information and save images across the network using OPC-UA.
- Provide HMI user input and result display through configurable, web-accessible operator views.

- Send and receive information across the network using TCP/IP, Modbus, CCLink, EtherNet/IP, and PROFINET protocols.
- Communicate with industrial robots to offer an integrated machine vision solution.

**Aurora Capture Works**

Aurora Capture Works is a utility that allows you to rapidly evaluate the performance and functionality of virtually any GenICam-compliant camera or 3D sensor (or other device). Aurora Capture Works will list all detected GigE Vision-compliant devices connected to your computer. It can start or stop capturing images/3D data, display acquired images/3D data, save the last grabbed image/3D data, send a software trigger, as well as browse and control the selected device's features. You can view network adapter information (such as, the IP address, packet size, inter-packet delay), view and change device information (such as, the user-defined name of your device), view and change acquisition properties, and view acquisition statistics. You can use it to configure the device and network adapter in static IP mode (or point-to-point connection mode) or DHCP mode (or corporate network mode). Aurora Capture Works uses the Aurora GigE Vision discovery service to automatically detect when GigE Vision-compliant devices are added to or removed from your network. Aurora Capture Works is distributed with Aurora Design Assistant.

**Warnings, laser safety, and general care**

You should be aware of the location of labels, the meaning of warnings and laser safety considerations, as well as important handling precautions and cleaning instructions. The laser class labels with additional information are located on the back of the unit and the laser aperture label is located on the front of the unit, pointing to the aperture. The laser projector aperture is located on the right side of the front panel of the device (Figure 5). Do not look directly into the laser projector while the device is in use. Laser class and laser parameters used in our devices are discussed in the [Technical Reference](#) chapter.

**Laser device**





**WARNING:** This device is a laser product. Do not deliberately look into the laser beam. This may cause injury to the retina. The use of protective eyewear is normally not necessary.

**Figure 5** Zebra 3S laser aperture location



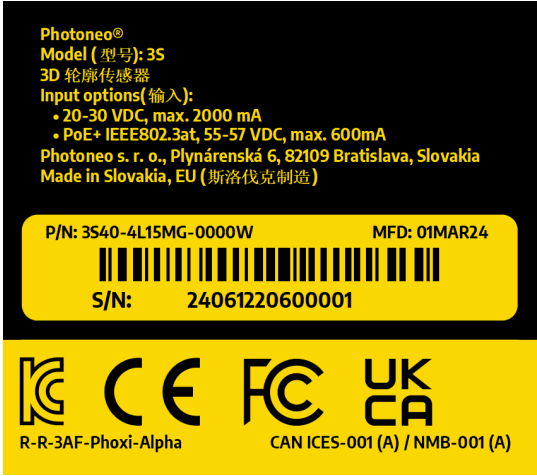

To avoid unauthorized contact with the sensor or unintentional viewing of the laser beam, it is recommended to locate the device in a restricted area and take measures to restrict laser light exposure to the surroundings. Although diffuse reflections are not harmful, users should remove mirrors, polished objects, and similar items from the vicinity of the sensor to avoid specular reflections. All components of the device, including those sourced from 3rd party suppliers, conform fully with all applicable European directives and regulations



The device uses the following warning labels.

<p><b>Figure 6</b> Warns that device emits laser radiation</p> 	<p><b>Figure 7</b> Designates where laser emits from</p> 
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## Before you start

The following information labels are attached to the Zebra 3S housing.

Laser Class 3R Zebra 3S40 device	
Labels specifying model, electrical information, wavelength, average power, pulse energy, laser class and pulse length of the laser, as well as additional compliance and warning information.	
<p><b>Figure 8</b> Label found on Zebra 3S40 model with electrical and model info</p> 	<p><b>Figure 9</b> Label found on Zebra 3S40 model with laser and compliance info</p> 

Laser Class 3R Zebra 3S80 device	
Labels specifying model, electrical information, wavelength, average power, pulse energy, laser class and pulse length of the laser, as well as additional compliance and warning information.	
<p><b>Figure 10</b> Label found on Zebra 3S80 model with electrical and model info</p> 	<p><b>Figure 11</b> Label found on Zebra 3S80 model with laser and compliance info</p> 

## Handling precautions

When performing general maintenance on Zebra 3S, ensure that Zebra 3S is powered down before beginning. When cleaning, the air must be free of oil, moisture, and other contaminants that could remain on the cleaned surface. For information on how to properly clean your Zebra 3S, see the cleaning instructions section below.

## Cleaning instructions

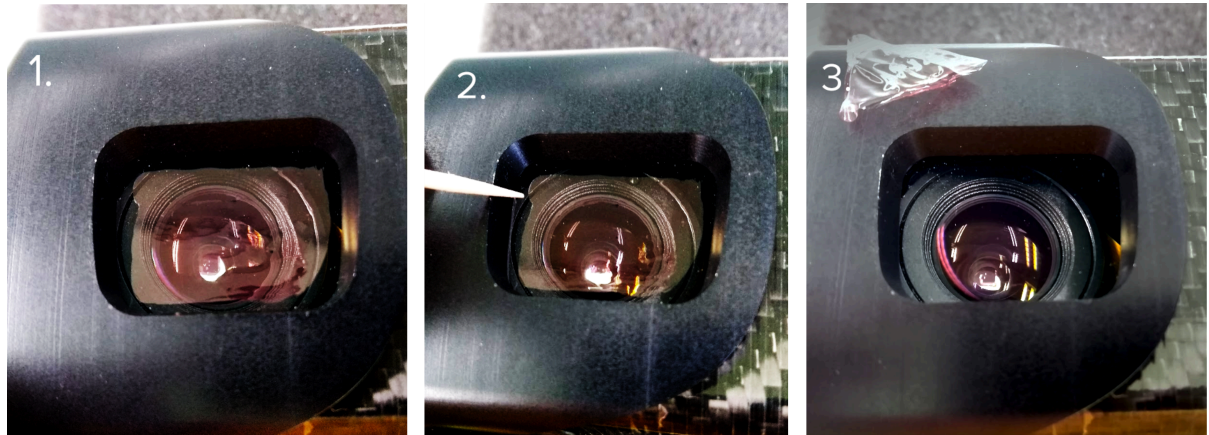
To preserve scanning performance and quality, check and maintain the 3D sensor's outer optical parts regularly. The glasses covering the camera and projection units should not be touched by bare hands to avoid staining the glass; oil from your fingers could interfere with light passing through. If the glass is touched or lightly stained by any other mechanism, wipe the glass with lint-free wipes intended for optical components.

In cases where the device is used in an environment with lots of dust, especially when the dust contains sharp or hard particles that could potentially damage the glass, clean the glasses with a specialized cleaning solution for optical components (for example, First Contact™ Cleaning Solution).

To clean the glass, perform the following steps:

1. Coat the glass with the solution using the applicator. Make sure not to spread it to the edges. The solution immediately dries and creates a film over the glass.
2. Remove the film from the glass using peel tabs with wooden or plastic tips.
3. The film removes any dirt or particles from the glass.

**Figure 12** Steps 1, 2, and 3 for how to clean the Zebra 3S glass



## Service information

If you have a problem with your equipment, contact Zebra Global Customer Support for your region.

Contact information is available at: [zebra.com/mv\\_support](http://zebra.com/mv_support). When contacting support, please have the following information available:

- Serial number of the unit.
- Model number or product name.
- Software type and version number.

Zebra responds to calls by email, telephone, or fax within the time limits set forth in support agreements.

If your problem cannot be solved by Zebra Customer Support, you may need to return your equipment for servicing and will be given specific directions. Zebra is not responsible for any damages incurred during shipment if the approved shipping container is not used. Shipping the units improperly can possibly void the warranty.

If you purchased your Zebra business product from a Zebra business partner, contact that business partner for support.



# Installation and mounting

A Zebra 3S sensor is designed for easy installation. The device can be mounted in the following ways:

- Using a mounting plate of suitable size and 4 M4 screws. This is the preferred mounting method to ensure rigid mounting of the device to avoid unwanted movement.
- Using an M8 screw.
- On a tripod using a 3/8-16 UNC screw.



**CAUTION—HOT SURFACE: Hot surface warning** The surface of the processing unit becomes hot to touch when the device is in use. Mount the device on a metal mounting plate that will act as a thermal bridge to dissipate the heat or use the carbon body to manipulate the device.

To install the device, perform the following:

1. Mount the device using any preferred method. Refer to [Dimensions and illustrations](#).
2. When mounting the 3D sensor, ensure that an appropriate scanning distance is set between the 3D sensor and the scanned object and eliminate any potential obstacles. Also, take note of the restrictions mentioned in the [Mounting restrictions](#) section.
3. Ground the device. See the [External grounding](#) section for more details.
4. Connect the device to the computer or local network and, if not using PoE+, plug it into the power. See the [Powering the device and Data connection](#) section for more details.
5. Download and install Aurora Design Assistant from the Zebra website.
6. Run Aurora Imaging Capture Works and try to make your first scan. Refer to the [Step-by-step configuration with Aurora Imaging Capture Works](#) section.

## Mounting restrictions

### Movement during scanning

In general, Zebra 3S80-4M and 3S80-4L can be mounted on moving constructions or robotic arms, since they are able to capture dynamic scenes as well as static scenes. Both the devices and the scenes can be in motion or vibrating.

It is possible to mount Zebra 3S40 sensors on moving constructions or robotic arms; however, it is necessary to stop the movement during the acquisition. Movement of the sensor during the projection of light patterns causes a loss of quality and interferes with depth calculation. Make sure the device and the scanned area are still during the acquisition. If vibrations are present, use a damping apparatus to isolate the sensor's mounting from the source of the vibrations. Acceleration and deceleration forces according

to the sensor's environment restrictions should be taken into account when designing the mount for the sensor. The maximum acceleration allowed during operation (not including the scanning process) is up to  $20 \text{ ms}^{-2}$ .

### Strong electric field

As a general rule, always isolate low-voltage, logic-type devices such as Zebra 3S sensors from devices that are high voltage and generate high electrical noise. Carefully consider the routing of the wiring for the devices in the panel as well. Avoid placing low-voltage signal wires and communication cables in the same tray with AC power wiring and high-energy, rapidly-switched DC wiring.

### Clearance for cooling

Zebra 3S sensors are designed to be cooled through natural convection cooling. To ensure adequate cooling, a clearance of at least 25 mm above and below the device must be allowed. When planning the placement of a Zebra 3S sensor, consider placing heat-generating and electronic-type devices in the cooler areas. By reducing exposure to high-temperature environments, you can extend the operating life of electronic devices considerably.



**NOTICE:** It is recommended to mount the device on a metal plate that will act as a thermal bridge and dissipate the heat produced by the processing unit away from the sensor.

### External grounding

You will need to provide a path to earth ground for your Zebra 3S sensor.

### Safety purposes

The body of the device is constructed from conductive materials: aluminum and carbon. These materials are coated with non-conductive lacquer or anodized aluminum. However, this doesn't necessarily imply that they serve as effective electrical protective layers. Therefore, relying on them for electrical protection is not assured. Equipotential bonding is made to protect operators against electric shock. It does not allow two different device chassis to have different voltages on them. Connecting these chassis with a conductive wire will bring those chassis to the same voltage potential and protect the operator against electric shock (and protect against ESD as well). Voltages of both chassis will be equal and the operator won't get hurt by touching both of those devices at the same time. The point of equipotential bonding is the ground terminal of the building. This is because the electrical network is (in TT, TN, TNC, and TNC-S cases) tied to the ground. If a dangerous voltage appears on the device chassis, the error current will flow through the ground fault circuit interrupter (GFCI) and switch off the voltage.

### EMI reduction

Even though grounding and bonding our sensor is not primarily made for EMI (Electromagnetic interference) reduction purposes, in certain cases, it can improve the EMI behavior of the device. The idea is that the conductive chassis will form a Faraday cage, which will lead the induced current by a path of the smallest impedance to the ground (it is assumed that the intrusive device is connected with the ground directly or by chassis capacity).

To achieve the smallest impedance, you should follow these rules:

- Grounding wire must be as thick and as short as possible.

- Grounding wire must be as narrow as possible.
- Grounding wire should not be tangled. If the sensor should be moving during operation, make a half loop only to relax cable bending stress.

Try to use star topology by connecting the grounding wire of our device directly to the grounding point. Avoid connecting multiple sensors in series.

Avoid ground loops (chassis ground connected to more than one point, for example, the cable shielding and the chassis ground) since they can form loop antenna and pick up unwanted noise more effectively. If so, the chassis ground should be disconnected at one point to break the loop.

Avoid long or tangled grounding wires. They have higher inductance (and therefore impedance) and are not able to ground high frequencies properly. They can even worsen the EMI.

### Required tools to ground Zebra 3S

The following are required tools to ground Zebra 3S:

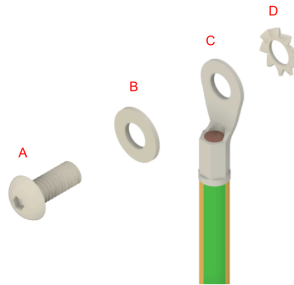
- 1x Screw M4X10mm (**A** in figure 14) - The screw must be long enough to hold the washers and lug, but not too long since the hole is blind and has limited depth.
- 1x Flat washer (4 mm hole) (**B** in figure 14) - it will make a hard support for a soft cable lug. It will improve the contact quality.
- 1x Cable lug (4 mm hole) (**C** in figure 14) - 2.5-6mm cable (according to the cable used). Lug will manage a good contact between our device and the cable. Lug cable size must be chosen properly, otherwise, the cable won't hold well and the contact will be poor.
- 1x Fan washer (4 mm hole) (**D** in figure 14) - this one will bite through aluminum anodization and make good conductive contact.
- Screwdriver which will fit the used screw-head.
- Lug/cable crimping tool.
- AWG11 Copper-stranded wire of the required size (the shorter the better). Use yellow/green stripe-colored wire since this is the color of a protective conductor according to IEC 60446 standard.

## Instructions for connecting external grounding

To ground Zebra 3S:

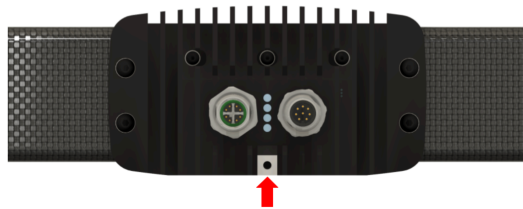
1. Crimp the lug on the cable and prepare the screw and washers according to the picture.

**Figure 13** Cable with screw and washers



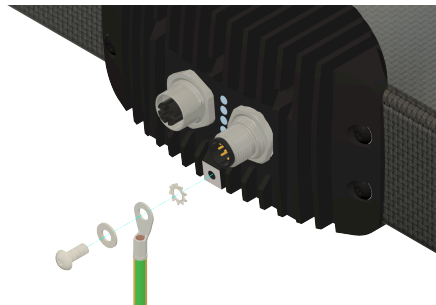
2. Locate where the grounding terminal is on the Zebra 3S.

**Figure 14** Grounding terminal found on Zebra 3S



3. Install the fan washer (D) between the body of the Zebra 3S and the crimped lug (C). Its purpose is to bite through the anodized layer and make good contact. Tighten the screw at the recommended 1.3 Nm moment. The cable lug should not be able to rotate. Do not over-tighten the bolt; otherwise, the thread in the aluminum body might get damaged.

**Figure 15** Cable connected to Zebra 3S



4. Connect the device to the grounding terminal in the building. Protective ground should be marked with the following symbol.

**Figure 16** Protective ground symbol

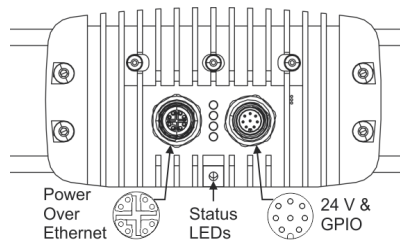


## Powering the device and data connection

There are two ways to power the device:

- Using the M12-X Ethernet connector (supports PoE+) to provide both power and data connection.
- Using the M12-A Digital I/O and power connector to power the device and the M-12X connector for data transfer.

**Figure 17** Back panel of the Zebra 3S sensor



## Powering through the Ethernet connector that supports PoE+

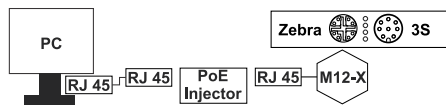
To power the device using PoE+ and connect to the network at the same time:

1. Connect a 1 Gbps capable (standardly delivered) Ethernet cable to the PoE+ injector IN (data+power) port.
2. Connect the M12-X RJ45 cable (M12-CBL-ETH/5) to the Zebra 3S sensor and to the PoE+ injector OUT (data) port.
3. Connect an RJ45-RJ45 cable (not included) between the PoE+ injector and the PC.
4. Plug in the power cable of the PoE+ injector.



**NOTICE:** It is recommended to use a PoE+ connection to power the device.

**Figure 18** Connection schematics for PoE+



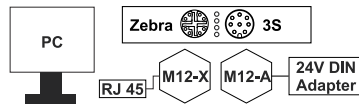
You can also connect directly to the NIC of a PC that supports PoE+.

## Powering with 24V

To power the device with an auxiliary power source and separately connect to the network:

1. Connect the Ethernet M12-X RJ45 (M12-CBL-ETH/5) cable to the device and to your computer or switch.
2. Connect the M12-A cable (M12-CBL-PWRIO/3) to the device and a 24 V power adapter; then, plug in the 24 V power adapter. Alternatively, connect the M12-A cable to the device and the open-end wires to a 24 V DIN rail adapter.

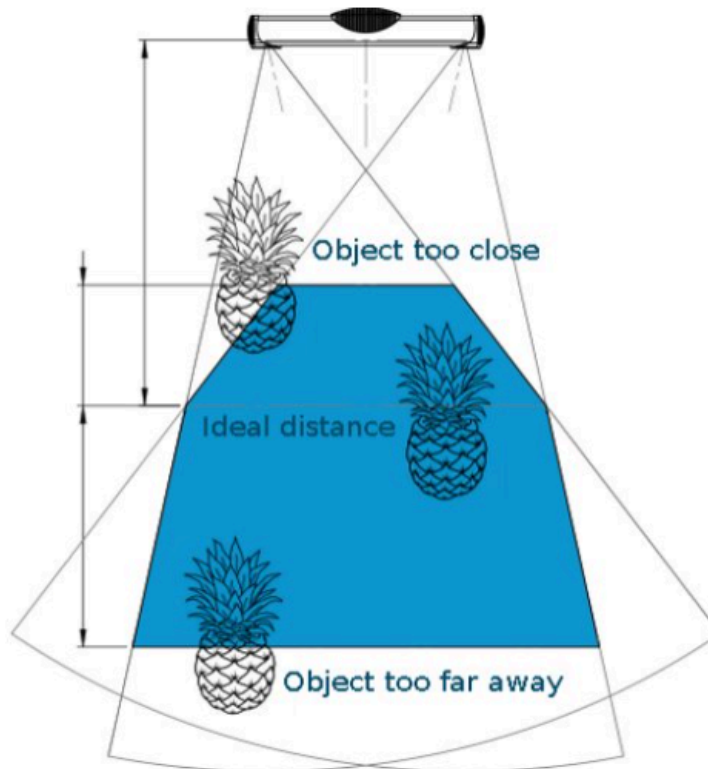
**Figure 19** Connection schematics for 24V power using DIN rail adapter



## Adjusting Zebra 3S once mounted

Once Zebra 3S has been mounted, powered, and found on your network, you should use Aurora Capture Works to ensure that the object being scanned falls within the 3D sensor's specific scanning volume. Each sensor has a specific scanning volume, and calibration accuracy can only be guaranteed inside this specific scanning volume. The ideal position within the specific scanning volume is referred to as the sweet spot, and is illustrated in the image below:

**Figure 20** Zebra 3S sensor's sweet spot



You might need to fine tune the placement of the 3D sensor relative to the object that you need to scan. For example, you might need to increase or decrease the distance between the 3D sensor and the object so that the base line and the highest points fall in the available Z-range. It is recommended to make these adjustments while Aurora Capture Works is running so that you can see the effects of the adjustment.

Ensure that you have adjusted Zebra 3S to properly account for the objects that you will scan before you begin full-time operation. Although Zebra 3S should be able to scan 3D data right out of the box with the default settings, if you find that after mounting and adjusting the 3D sensor you are still not able to see the laser line, you might need to adjust the exposure or other controls.

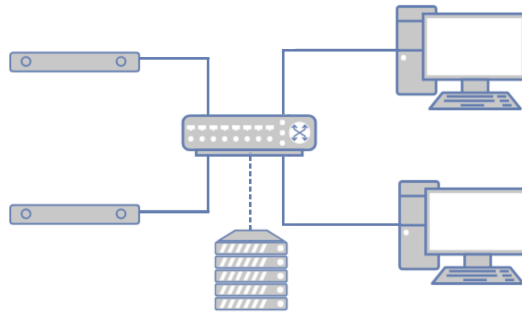
## Supported network topologies

The following network topologies are supported by Zebra 3S sensors:

- **Figure 21** Direct connection to a computer:

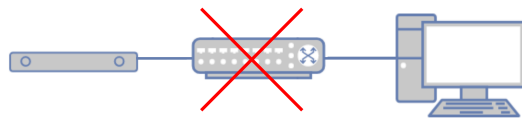


- **Figure 22** Sensor connected to a switch



The following network topology is not supported by the Zebra 3S sensor:

- **Figure 23** Connecting to a sensor through a router is not supported

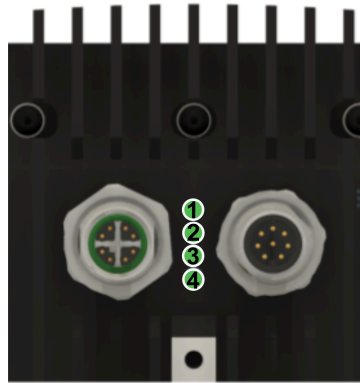


**NOTE:** If several 3D sensors are connected to a computer with several ethernet adapters, using static IP addresses on different subnets is recommended.

## Status LEDs

The LEDs on Zebra 3S sensors are found between the Ethernet connector and the Digital I/O and connector, as illustrated in the figure below.

**Figure 24** LEDs found on Zebra 3S sensor



The following table describes the LEDs found on your Zebra 3S sensor:

LED number (see Fig 25)	Name	Color	Description	Status when working correctly
1	Power	Green	Power ON and OK	Green
		Red	Power ON but power on processing unit is not OK	
		Off	No power	
2	Status	Green	Firmware ready	Green
		Red	Device occupied	
		Off	HW fault	
3	ETH 1	Flashing green	Activity on the link	Flashing green
		Green	No activity on the link	
		Off	Link is down	
4	ETH2	Green	Gigabit Ethernet connected	Green
		Off	No Gigabit Ethernet	

## Turning off the device

Before turning off the device, make sure it is not actively scanning and the device is not projecting laser patterns. Turn off the device by unplugging it from power.



**NOTICE:** It is not recommended to unplug the device from power while it is actively scanning. This is to prevent possible damage to the projection unit.



# Step-by-step configuration with Aurora Imaging Capture Works

This chapter provides steps on how to configure Zebra 3S for some common use cases, using Aurora Imaging Capture Works. When you install Aurora Design Assistant, Aurora Imaging Capture Works is automatically installed. You can then launch the utility from Aurora Imaging Control Center or by typing "Capture Works" in the Windows Start menu. The instructions provided in this chapter should be sufficient to use Aurora Imaging Capture Works with Zebra 3S.

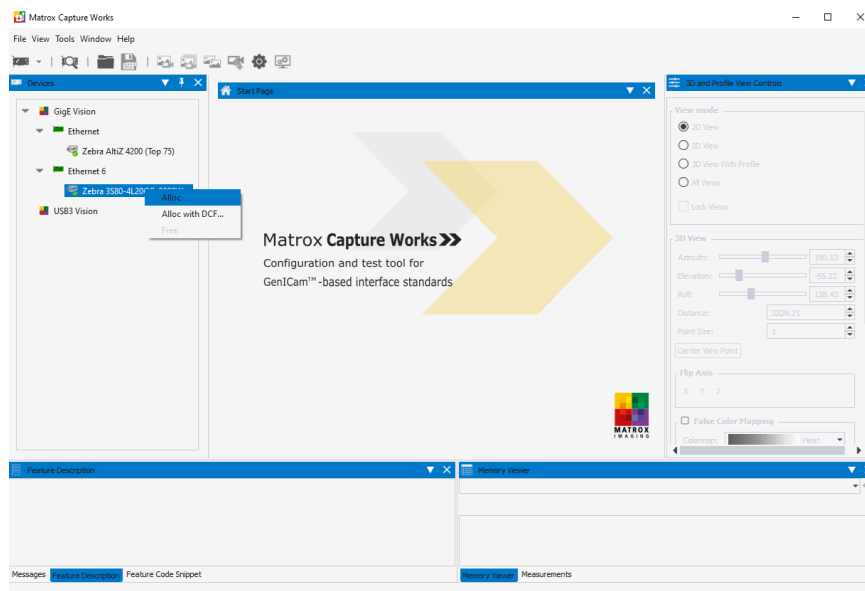
The use cases that are covered in this chapter include how to perform a 3D scan in scanner mode and in camera mode. Note that camera mode is only available for the 3S80 sensors and offers a much faster frame rate.

## Case 1: Quickly performing a continuous grab in Scanner mode

You can set Zebra 3S to perform a continuous grab in Scanner mode to scan a static scene. To do so:

1. Open Aurora Imaging Capture Works and allocate your Zebra 3S sensor.

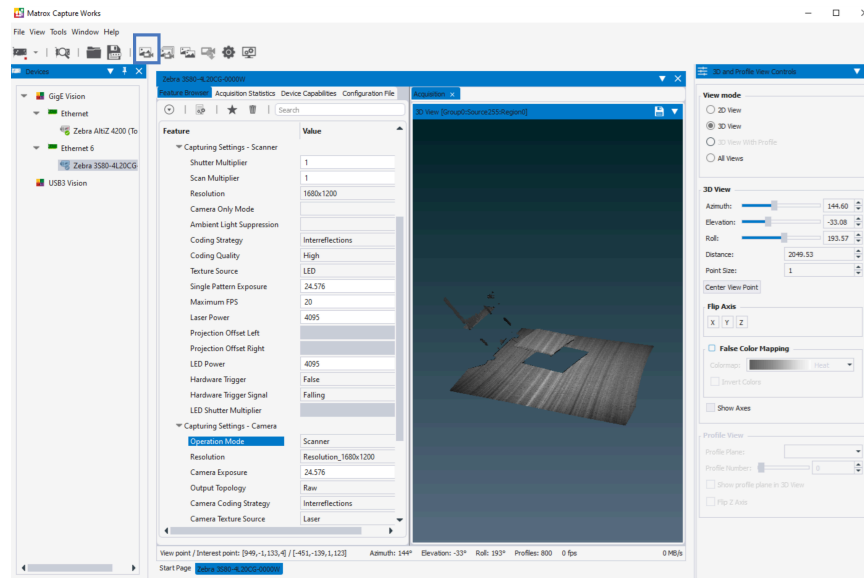
**Figure 25** Allocating Zebra 3S in Aurora Imaging Capture Works



2. Navigate to the Capture Settings - Camera category and set Operation Mode to Scanner.
3. Navigate to the Capture Settings - Scanner category and set Texture Source to Laser.

4. Press the continuous grab toolbar button at the top of the window and a point cloud of your captured scene will appear in the Acquisition window.

**Figure 26** Grab in Scanner mode



5. At this point, if necessary, adjust the exposure of the main camera using the Single Pattern Exposure feature in the Capture Settings - Scanner category. Adjust it such that you minimize the number of missing points given your lighting environment. When doing a continuous grab, you will see the changes to your exposure in the live acquisition and can update this value accordingly.



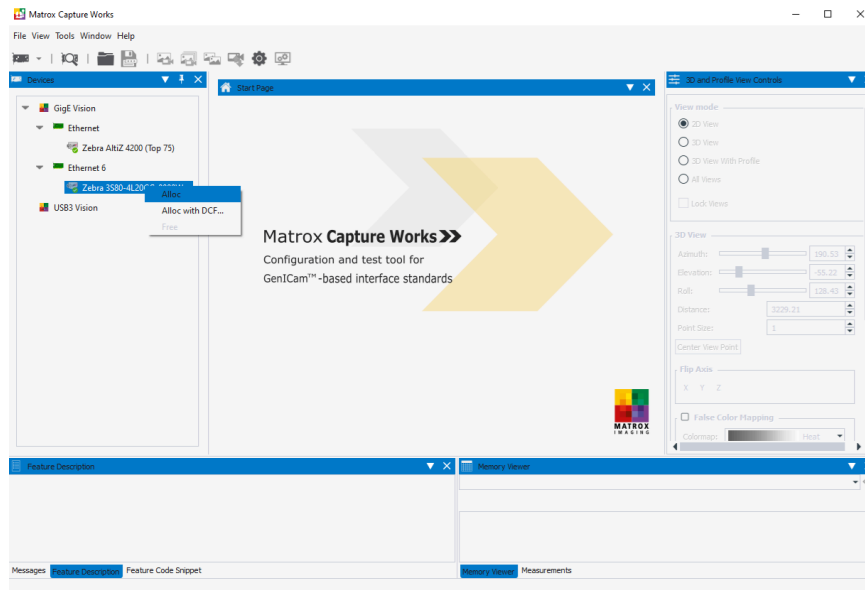
**NOTE:** Note that you can also set the exposure of the main camera using the Exposure Time feature in the Acquisition Control category. The value will match the exposure feature corresponding to the current operation mode (Scanner or Camera mode).

## Case 2: Quickly performing a continuous grab in Camera mode and increasing acquisition speed

You can set Zebra 3S80 to perform a continuous grab in Camera mode to scan a dynamic scene. To do so:

1. Open Aurora Imaging Capture Works and allocate your Zebra 3S80 sensor.

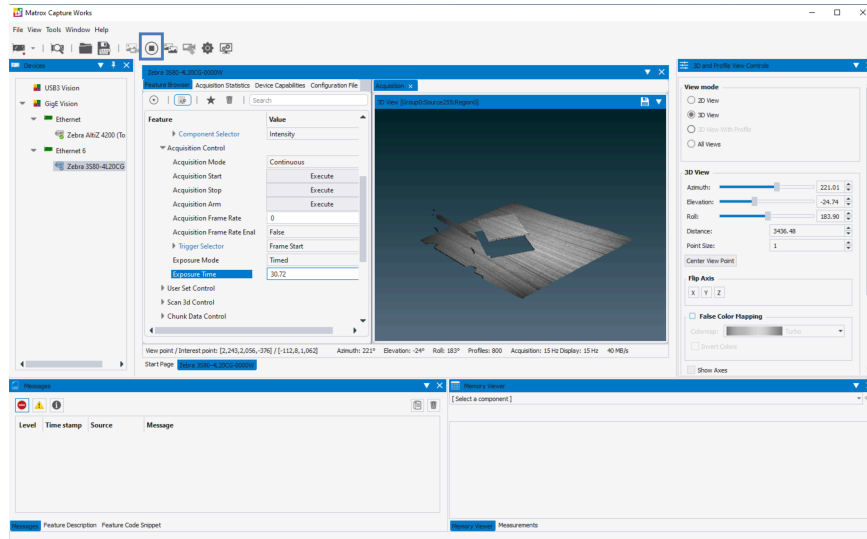
**Figure 27** Allocating Zebra 3S in Aurora Imaging Capture Works



2. Navigate to the Capture Settings - Camera category and set Operation Mode to Camera.
3. In the same category, set Camera Texture Source to Laser (for a computed texture when in Camera mode) or Color (for a color texture).

4. Press the continuous grab button at the top of the window and a point cloud of your captured scene will appear in the Acquisition window.

**Figure 28** Grab in Camera mode



5. At this point, if necessary, adjust the exposure of the main camera using the Camera Exposure feature in the Capture Settings - Camera category. Adjust it such that you minimize the number of missing points given your lighting environment. When doing a continuous grab, you will see the changes to your exposure in the live acquisition and can update this value accordingly. Be aware that the lower the exposure time, the faster the acquisition speed. In our example above, the exposure time is set to 30.72, which results in an acquisition speed of 15 Hz. If you require a faster acquisition speed, you will need to reduce your exposure.



**NOTE:** Note that you can also set the exposure of the main camera using the Exposure Time feature in the Acquisition Control category. The value will match the exposure feature corresponding to the current mode (Scanner or Camera mode).

To further reduce acquisition speed, you can also disable components that you do not need. For example, navigate to Component Selector, found under Image Format Control, and select Intensity. Next expand Component Selector, and set Component Enable to False. This will disable the Intensity component on the device (which stores the texture information) and prevent this component from being transmitted, saving time and reducing transmission size.

# Zebra 3S GenICam feature reference

This chapter lists both custom and standard GenICam features of Zebra 3S. For more information about the GenICam standard, refer to the GenICam Standard Feature Naming Convention, available on the GenICam website at: <http://www.emva.org/standards-technology/genicam>. Note that this chapter lists the features in the order that they appear in Aurora Imaging Capture Works.

## As per the GenICam Standard

In situations where multiple instances of a feature exists, a selector feature is used to index the instance to access/modify. A selector feature is a separate feature whose name ends with Selector and is typically an IEnumeration or an Integer. A selector feature selects the target features for subsequent changes. In this document, if a feature is dependent on a selector, the selector is listed in square brackets below the feature name.



In some cases, a feature might appear in multiple categories. This is only for clarity or convenience when accessed through a GUI (such as, Aurora Imaging Capture Works). If a feature has the same name, it is the same feature. This is also true for selector features.

Note that all features that are settable can also be inquired. This only applies to features that are settable and not to features that are commands.

## Image Format Control

The Image Format Control category groups GenICam features that control the components and format of the transmitted data. This includes which components are transmitted and their format.

Feature Name	Description	
	Feature Value	Description
ComponentSelector		Sets which component to control. You should only enable required components because transmitting additional components reduces the maximum frame rate. Some of these components might not be available with certain settings.
	Intensity	Specifies the intensity component. This stores a 2D representation of the scene. There is a one-to-one correspondence with the 3D points, and provides texture for the point cloud. The color of the points is based on TextureSource (for example, Color, Focus, and LED). When TextureSource is set to Color, it is a transformed version of the image taken with the color camera, such that it aligns with the 3D points.

Feature Name	Description	
	Feature Value	Description
	Range	<p>Specifies the range component. This component stores 3D distance or position information. If Scan3dOutputMode is set to ProjectedC, the range component is stored in Coord3D_C16 pixel format, and the 3D sensor is said to output its 3D data in depth map format. If Scan3dOutputMode is set to CalibratedABC_Grid, the range component is stored in Coord3D_ABC32f_Planar pixel format, and the 3D sensor is said to output its 3D data in point cloud format.</p>
	Confidence	<p>Specifies the confidence component. Each pixel of the confidence component indicates how accurate the value at the corresponding position in the range component is. If the value is 0, the point is not valid and if it is above 0, the point is considered valid. Areas with higher confidence are brighter and invalid points are black.</p>
	CoordinateMapA	<p>Specifies the A coordinate map component. This component represents the A coordinates map (for example X) necessary to calculate the true X-coordinate of the corresponding range value, for depth maps output from the 3D sensor (Scan3dOutputMode is set to ProjectedC). The component must use a Coord3D_Axx pixel format.</p> <p> <b>NOTE:</b> Note that typically, you should not enable this component. The Zebra GigE Vision driver downloads the A and B coordinate maps when required (when not grabbing) and stores them in a cache associated with the Camera step. When grabbing, the GigE Vision driver will add the maps to the grab container (along with grabbed data such as range, intensity, and confidence) so that the depth map can be converted more accurately to a point cloud if necessary. This approach saves Ethernet bandwidth and increases the frame rate.</p>
	CoordinateMapB	<p>Specifies the B coordinate map component. This component represents the B coordinates map (for example Y) necessary to calculate the true Y-coordinate of the corresponding range value, for depth maps output from the 3D sensor (Scan3dOutputMode is set to ProjectedC). The component must use a Coord3D_Bxx pixel format.</p> <p> <b>NOTE:</b> Note that typically, you should not enable this component. See above.</p>

Feature Name	Description	
	Feature Value	Description
	Normal	Specifies the normals component. This indicated the orientation of the scanned surface with respect to the device. Each pixel of the normals component indicates the normal of the corresponding position in the range component. Note that this component cannot be visualized in Aurora Imaging Capture Works.
	ColorCamera	Specifies the color camera component. This stores the raw color image taken from the color camera.
ComponentEnable [ComponentSelector]	Sets if the selected component is active.	
	False	Specifies that the selected component is active.
	True	Specifies that the selected component is not active.

## Scan 3D Control

The Scan 3D Control category groups GenICam features specifically related to the acquisition of 3D data.

Feature Name	Description	
	Feature Value	Description
Scan3dOutputMode	Sets in which mode to output 3D data.	
	CalibratedABC_Grid	Specifies to output 3D data in a point cloud format. This will convert the selected peaks to explicit real-world XYZ-coordinates, whereby the X, Y, and Z coordinates are stored in separate bands of the range component as 32-bit floating point (32F) values.
	ProjectedC	Specifies to output 3D data in projective depth map format. This will convert the selected peaks to real world depth; the range component only stores the Z-coordinates value, in 32-bit floating point. X and Y-coordinates are computed from the Z value and the pixel positions using projective geometry model.

## Capturing Settings - Scanner

The Capturing Settings - Scanner category groups GenICam features generally related to the acquisition of 3D data when using Scanner mode.

Feature Name	Description	
	Feature Value	Description
TextureSource	Sets which texture information to output for the point cloud when using Scanner mode. The options will only apply when you are in Scanner mode.	

Feature Name	Description	
	Feature Value	Description
	LED	Specifies to use an LED texture on your point cloud. An additional image is taken with an LED flash from the projection unit. This provides a speckle free 2D grayscale image.
	Computed	Specifies to use a computed texture on your point cloud. This texture is computed from structured light patterns and does not require any additional images to be taken. This is useful for investigating the light conditions of the scene. Some speckle might be visible from the laser noise.
	Laser	Specifies to use the laser texture on your point cloud. This will capture an additional image that is illuminated only with a laser diode flash. This is useful for investigating contrast and lighting conditions of the scene.
	Focus	Specifies to use the focus texture. This will use a single structured light pattern as the texture and is useful for evaluating the contrast. This feature is only available in Scanner mode.
	Color	Specifies to use the color texture on your point cloud. This will capture an additional image that is illuminated with a white LED flash. The RGB intensity that is captured from this image is then mapped onto each point in the range component to display a speckle-free 2D color (RGB) texture. This is only available on the 3S80 models.
SinglePatternExposure	Sets the duration of projection for one pattern in $\mu$ sec.	
LaserPower	Sets the power of the laser that is projected from the unit.	

## Capturing Settings - Camera

The Capturing Settings - Camera category groups GenICam features generally relate to the acquisition of 3D data when using Camera mode.

Feature Name	Description	
	Feature Value	Description
OperationMode	Sets which operation mode to use. Be aware that whether you are using Camera or Scanner mode, you will need to use this feature to set the mode.	
	Camera	Specifies to use Camera mode. This mode captures dynamic scenes and moving objects in high resolution. This feature value is only available on the Zebra 3S80 models.
	Scanner	Specifies to use Scanner mode. This mode captures static scenes in high resolution.



Feature Name	Description	
	Feature Value	Description
	2D	Specifies to use 2D mode. This mode captures textures only.
CameraExposure	Sets the duration of the main camera exposure in $\mu$ sec.	
OutputTopology	Sets the structure of the points of the output 3D point cloud.	
	Raw	Specifies to output point cloud points using raw organization. Points are organized into a checkerboard grid. This is the fastest output topology.
	Regular Grid	Specifies to output point cloud points using regular grid organization. All 3D points of this topology are properly estimated without the use of interpolation.
	Full Grid	Computes 3D points on the native sensor resolution (2 MP), as in the Scanner mode. Transfer and computation time are impacted. Acquisition is identical to using other Output Topologies in the Camera mode, which makes it suitable for scenes in motion.
CameraTextureSource	Sets which texture information to use on the point cloud when using camera mode. The options will only apply when you are in Camera mode.	
	Laser	Specifies to use the computed texture on your point cloud. This texture is computed from structured light patterns and does not require any additional images to be taken. This is useful for investigating the light conditions of the scene. Some speckle might be visible from the laser noise. Note that this option is the same as Scanner mode's Computed texture.
	LED	Specifies to use an LED texture on your point cloud. An additional image is taken with an LED flash from the projection unit. This provides a speckle free 2D greyscale image.
	Color	Specifies to use the color texture on your point cloud. This will capture an additional image that is illuminated with a white LED flash. The RGB intensity that is captured from this image is then mapped onto each point in the range component to display a speckle-free 2D color (RGB) texture. This is only available on the 3S80 models.

## Color Camera Settings

The Color Camera Settings category groups GenICam features specifically related to the acquisition of color image data.

Feature Name	Description	
	Feature Value	Description
ColorSettings_ISO	Sets the ISO value for images acquired in color.	
ColorSettings_Exposure	Sets the exposure (in ms) for images acquired by the color camera.	
ColorSettings_Resolution	Sets the resolution for images acquired in color.	
	3864 x 2192	Specifies to use a resolution of 3864 x 2192.
	1932 x 1096	Specifies to use a resolution of 1932 x 1096.
	1288 x 730	Specifies to use a resolution of 1288 x 730.
ColorSettings_ResolutionWidth	Returns the width of the acquired image in pixels.	
ColorSettings_ResolutionHeight	Returns the height of the acquired image in pixels.	
ColorSettings_Gamma	Sets the gamma value for images acquired in color.	
ColorSettings_WhiteBalanceEnabled	Set whether to enable white balance for images acquired in color.	
	True	Specifies to enable white balancing.
	False	Specifies to disable white balancing.
ColorSettings_WhiteBalancePreset	Sets the white balance preset to use when white balancing images acquired in color.	
	Custom	Specifies to use a custom white balance preset.
ColorSettings_WhiteBalanceR	Sets the white balance value for the red channel. This value can be a floating-point value ranging from 0 to 1.	
ColorSettings_WhiteBalanceG	Sets the white balance value for the blue channel. This value can be a floating-point value ranging from 0 to 1.	
ColorSettings_WhiteBalanceB	Sets the white balance value for the green channel. This value can be a floating-point value ranging from 0 to 1.	
ColorSettings_ComputeCustomWhiteBalance	Sets whether to compute a custom white balance, based on the values set for ColorSettings_WhiteBalanceR, ColorSettings_WhiteBalanceG, and ColorSettings_WhiteBalanceB.	
	True	Specifies to calculate a custom white balance value based on previously defined values for R, G, and B channels.
	False	Specifies not to calculate a custom white balance.
ColorSettings_SupportedISOs	Returns supported ISO values for color images. To see the values, click on the Register editor field next to the feature name in the feature browser.	
ColorSettings_SupportedExposure	Returns supported exposure values for color images. To see the values, click on the Register editor field next to the feature name in the feature browser	

Feature Name	Description	
	Feature Value	Description
ColorSettings_SupportedCapturingModes	Returns supported capturing modes for color images. To see the values, click on the Register editor field next to the feature name in the feature browser	
ColorSettings_SupportedColorWhiteBalancePresets	Returns supported white balance presets for color images. To see the values, click on the Register editor field next to the feature name in the feature browser	
ColorSettings_RemoveFalseColors	Sets whether to remove false colors from the acquired image. False colors can be caused by occlusions and lighting differences in the perspective of the color camera, resulting in falsely colored points.	
	True	Specifies to remove false colors from the acquired image.
	False	Specifies not to remove false colors from the acquired image.

# Glossary

This chapter defines scanning concepts and descriptions that are used by Zebra 3S sensors.

## 3D sensing technology

The technology used to establish the 3D data. Zebra 3S sensors either use sequential structured light technology or patented Parallel Structured Light technology.

## Baseline

Distance between the main camera and the projection unit.

## Calibration accuracy (1 $\sigma$ )

The accuracy of point measurement as the result of device calibration (can also be understood as space deformation). Every 3D point is determined with a certain measurement error. This measurement error is different for each point across the whole measured volume. Calibration accuracy is the standard deviation ( $\sigma$ ) of measurement errors of all 3D points.

## FPS

Frames per second. FPS is used to measure frame rate – the number of consecutive full-screen images that are displayed each second.

## Operation mode (Camera or Scanner)

Mode in which to acquire the 3D data. The modes available depend on the 3D sensing technologies supported by the device. Zebra 3S80-4M and 3S80-4L devices are able to switch between a Camera (Dynamic) mode and a Scanner (Static) mode. In the Camera mode, the device is able to capture objects in motion or the device itself can be moving without causing any motion blur. In Scanner mode, the device and the scene must be static during scanning. Zebra 3S40 only supports scanner mode.

All devices also support a 2D mode that outputs only 2D texture data.

## Optimal scanning distance (sweet spot)

The focus distance of the main 2D camera at which theoretically the best scanning results can be obtained.

## Output data

Depending on the device used for scanning, the following components can be transmitted.

- **3D points (xyz):** Floating numbers depicting the position of a 3D point in a given coordinate frame. The default coordinate frame has its origin in the 2D camera with the Z axis towards the scene, the X-axis continuing to the right along the length of the body of the device, and the Y-axis pointing away from the mounting plate. The range component can either store the coordinates of the 3D points or the depth of the points.
- **Normals (xyz):** The normal vector for each 3D point can also be calculated. The normal vector is perpendicular to the area surrounding the point.
- **Projective depth Map (z):** The “depth” of a point is the absolute 3D distance from the image sensor to the measured point (the ray of light that hits the surface of the object). The depth map is, therefore, always in the camera coordinate system and corresponds to the Z-coordinate value in the point cloud. The X and Y-coordinate are computed using a projective geometric model.
- **Color Image (RGB):** A 2D RGB texture is available on the Zebra 3S80-4M and 3S80-4L sensors when using Scanner or Camera mode, which can be output at different resolutions.
- **Texture (grayscale intensity):** A 2D grayscale texture (LED, laser, computed).
- **Confidence (Confidence8):** Each pixel of the confidence component indicates whether the value at the corresponding position in the range component was established based on the image sensor seeing and extracting a valid peak. If the value is 0 the point is not valid and if it is above 0 the point is considered valid. This value is based on a heuristic method that considers the light conditions for each pixel.
- **Event map:** Contains the time information of when each 3D point was acquired, which is based on the timing of the laser line sweep.

## Point-to-point distance (at the sweet spot)

The average distance between two neighboring points in the point cloud of a plane located in the focus distance of the camera. Alternatively, the square of the point size is the average surface sampled by a single 3D point on the plane scanned in the focus distance of the camera.

The point size linearly decreases with the distance. Therefore, it is possible to calculate the approximate point size using the optimal scanning distance (sweet spot) and the point-to-point distance (at the sweet spot) values, which can be found in the datasheet. If the point size ( $P_s$ ) is at the optimal scanning distance ( $D_o$ ), then we can calculate the approximate point size ( $P$ ) at the desired distance ( $D_d$ ) as follows:

$$P = (P_s / D_o) \times D_d$$

## Resolution

Resolution describes the number of points per distance. Resolution can also be expressed as the distance between points. A higher resolution is one where the quality is better and the distance between points is smaller. When expressing resolution as points per distance, a higher number means better resolution and quality; when expressing resolution as distance between points, a lower number means better resolution and quality.

## Scanning area (at sweet spot)

Size of the area that is covered at the optimal scanning distance (sweet spot).

## Scanning range

The scanning range consists of 2 values which represent the minimal and maximal distance of the scanned object from the device to perform the 3D reconstruction. The volume bounded by intersecting planes at these distances is called a calibration volume, and it is determined by the model of the Zebra 3S sensor.

## Temporal noise (1 $\sigma$ )

The standard deviation of noise (measured on a diffuse surface with 80 percent albedo). The noise level describes the ability of the sensor to capture local surface details. The noise distribution of our sensor is similar to the Gaussian distribution.

Equivalently, temporal noise can also be defined as the average distance of the 3D points from the average Z-value of the 3D points.

## Temperature working range

Range of temperatures at which the device is designed to work. Zebra 3S sensors are designed to work within the full temperature working range; however, to achieve the stated accuracy, it is advised to keep the ambient temperatures in the optimal temperature working range.

# Technical reference

This chapter summarizes the hardware elements of Zebra 3S. In addition, this chapter provides pinout descriptions for the external connectors of your Zebra 3S.

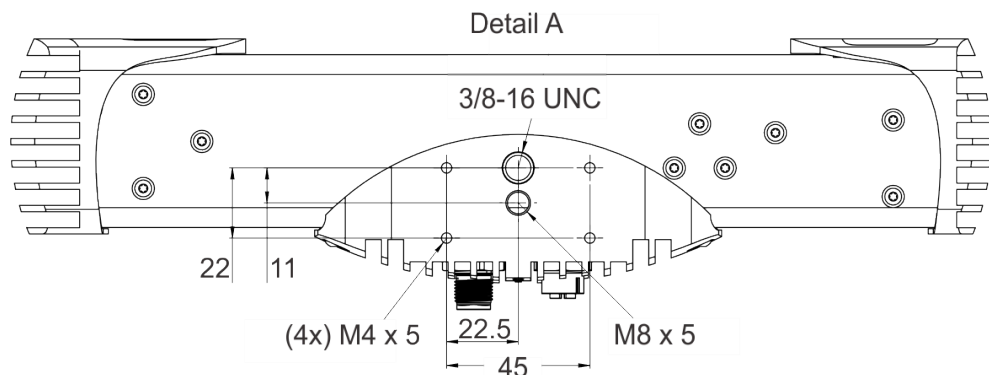
## Projection unit properties

Model	Zebra 3S40, Zebra 3S80-4M, and Zebra 3S80-4L
Light source and laser class	Visible red light (laser) with class LC3R
Wavelength	640nm
Average power	4.32 mW
Pulse energy	300 $\mu$ J
Pulse length	5.3 ms
Beam divergence	36°
Repetition rate	9.4 Hz

## Dimensions and illustrations

The lengths are given in mm for both the illustration and table. The baseline (distance between camera and projection unit) for all Zebra 3S models is 350 mm.

**Figure 29** Zebra 3S mounting plate dimensions (in mm)



The width and depth of all Zebra 3S devices are equal.

**Figure 30** Zebra 3S back dimensions with mounting plate

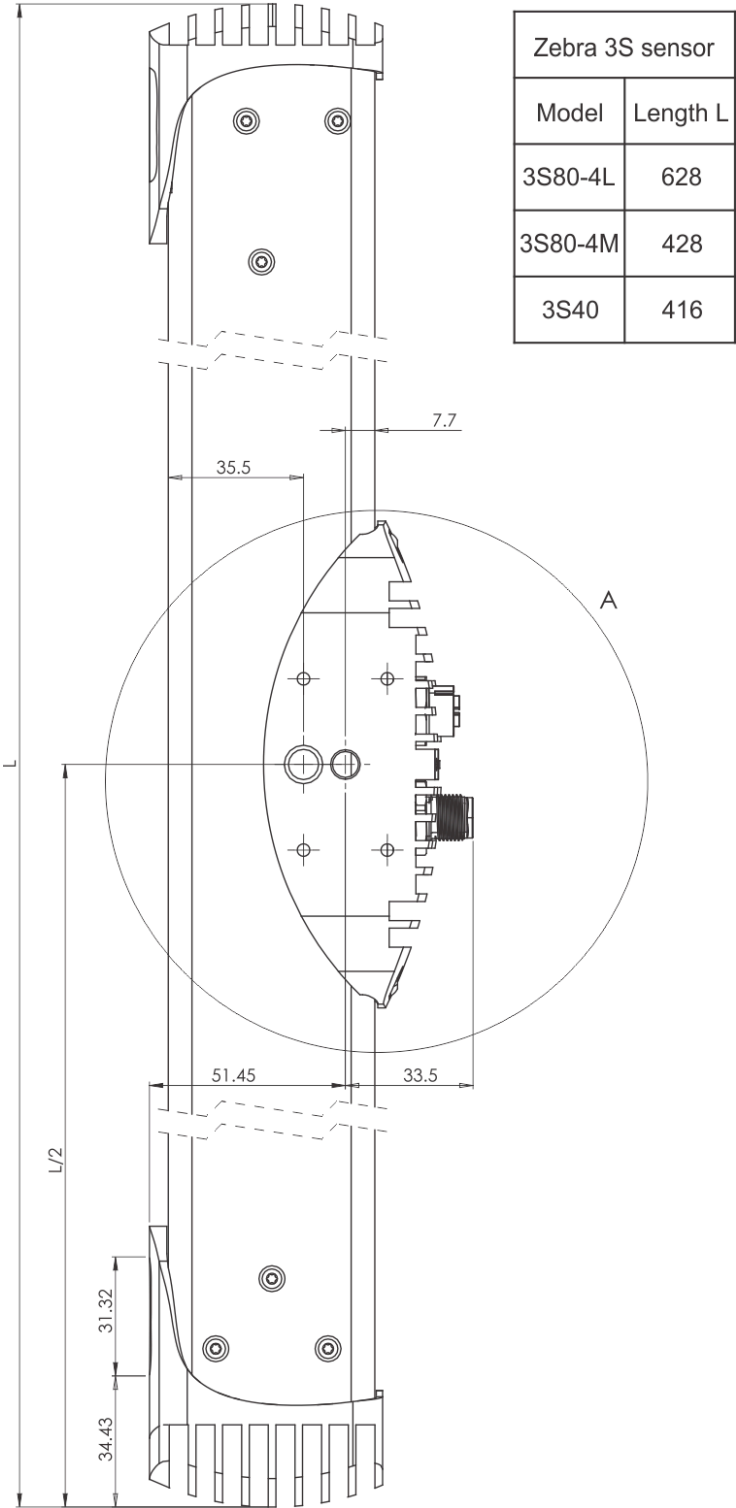
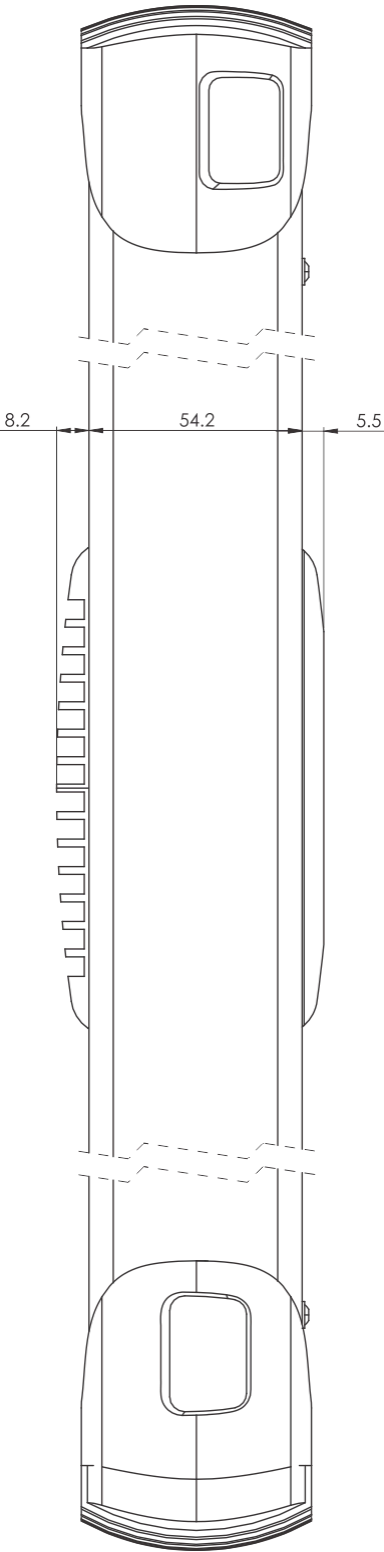




Figure 31 Zebra 3S bottom dimensions



## Environmental Conditions

### Transport conditions

Ambient temperature	From -20 °C to 50 °C (max gradient 10 °C/hour)
Humidity	From 0 % to 95 % non-condensing
Atmospheric pressure	From 1080 hPa to 660 hPa (corresponding to an altitude of -1000 m to 3500 m)



**CAUTION:** Ensure that the device is always transported in its original casing or that it is properly cushioned for transport.

### Operating conditions

Operating temperature for optimal scanning performance	From 22 °C to 25 °C
Overall operating temperature	From 0 °C to 40 °C
Humidity	From 0 % to 95 % non-condensing
Atmospheric pressure	From 1080 hPa to 660 hPa (corresponding to an altitude of -550 m to 3500 m)
Maximum acceleration	20 ms <sup>2</sup>

For the correct performance of the device, make sure it has reached its operating temperature. The operating temperature is reached approximately after 45 minutes of the device being powered up or after 10 minutes of continuous scanning in the free run mode followed by 2 - 5 minutes of cool down to stabilize the temperature.

## Hardware trigger characteristics

Hardware triggers provide a means of triggering devices by external device. These triggers provide synchronization with external events, such as:

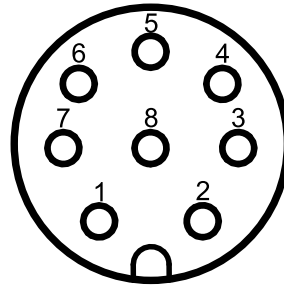
- Objects arriving inside the field of view of Zebra 3S sensor (that is, triggered by an optical gate).
- Other devices, such as 2D cameras, and PLCs.
- Multiple Zebra 3S sensors.

Hardware triggers are activated by feeding a logical signal to the specified pin of the M12-A connector. Hardware signals can also inform you that the Zebra 3S is currently acquiring → this signal can be read from the output pin on the M12-A connector.

The allowed input signal voltage range is 5 - 24 V, depending on the user requirements. The output signal needs to be read through a pull-up resistor.

To correctly connect/wire the devices together, adhere to the following schematics for trigger input and trigger output.

**Figure 32** M12-A view of the port on the Zebra 3S sensor



Pin	Hardware trigger
4	HW trigger input signal 5-24V
5	HW trigger input ground
6	HW trigger output signal 5-24V
7	HW trigger output ground

## Trigger input

### Input circuit characteristics

Both wiring schematics below are valid. It is recommended to:

- Use  $R = 0 \Omega$  if your  $VCC = 5 - 12V$
- Use  $R = 4K7 \Omega$  if your  $VCC = 24V$

The trigger input can be done as a common cathode or common anode. Refer to the diagrams below.

### Input signal characteristics

The trigger input signal is what causes the device to start the acquisition. The trigger input signal is a transition between logic zero and logic one, therefore the signals are:

- Falling edge → change from logic 1 to logic 0
- Rising edge → change from logic 0 to logic 1

The choice of the signal depends on the specifics of the setup. For example, one setup for a falling edge is:

- The input pin is kept at 24 V and it's lowered to 0 V to produce the falling edge
- The input pin is kept at 0 V and it's elevated to 24 V for a short period of time. Letting it fall back down produces a falling edge that triggers the device

Whether the device is triggered by a falling edge, rising edge, or both is controlled by a parameter called Hardware Trigger Signal.

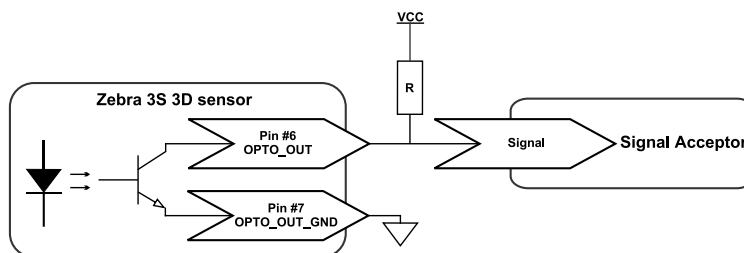
## Trigger output

### Output circuit characteristics

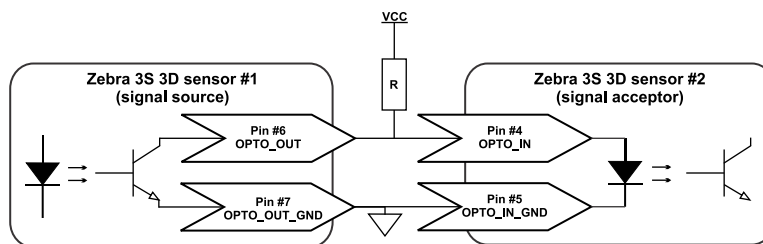
The trigger output is read through the VCC pull-up. Refer to the diagram below. It is recommended to:

- Use an  $R=10K \Omega$  resistor to read the signal (for example using a PLC).
- Use an  $R=1K6 \Omega$  resistor when Zebra 3S is daisy-chained with another Zebra 3S and your  $VCC = 5 - 12V$ .
- Use an  $R=4K7 \Omega$  resistor when Zebra 3S is daisy-chained with another Zebra 3S and your  $VCC = 24V$ .

**Figure 33** Trigger output when connected to a 3rd party signal acceptor



**Figure 34** Trigger output when connected to a second Zebra 3S



### Output signal characteristics

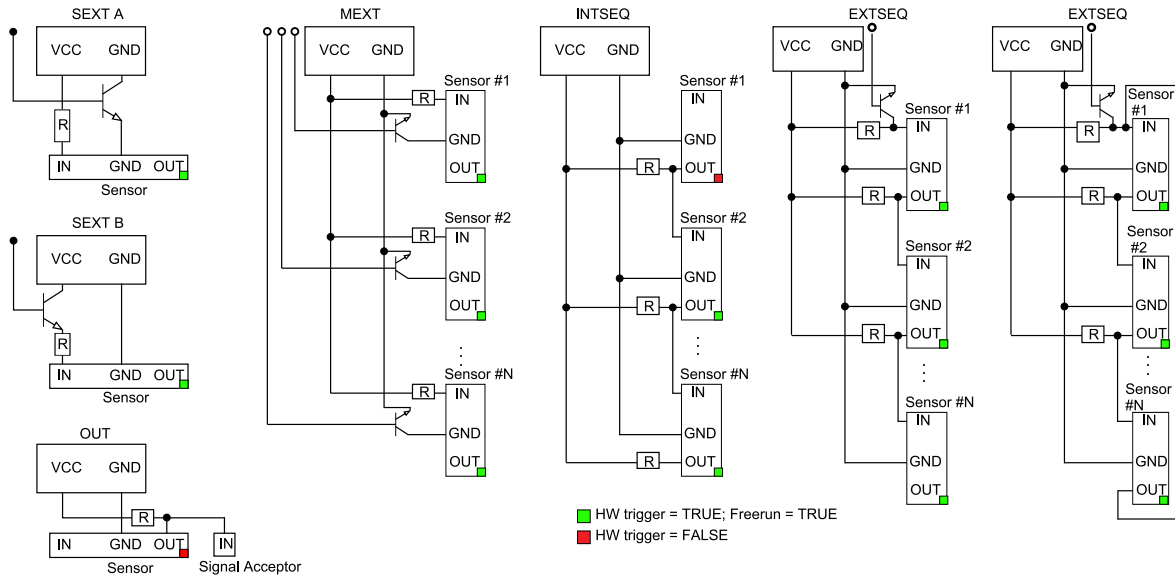
Trigger output signal is used to mark the time during which the device is in acquisition. Once the acquisition starts, the signal changes from logic 0 to logic 1. After it finishes it changes from logic 1 to logic 0.

The acquisition is defined as follows:

- In camera mode → the time during which the laser sweeps the scene and the 3D data are gathered.
- In scanner mode → the time it takes to project all necessary patterns as well as LED texture.

## Simplified wiring schemes

**Figure 35** Different wiring configurations for the Zebra 3S



SEXT (A/B)	Single device triggered by HW trigger
OUT	Zebra 3S sensor output signal to PLC or another device
MEXT	Multiple devices triggered by HW trigger independently from each other
EXTSEQ/INTSEQ	Two or more devices triggered sequentially in a daisy chain
EXTDCL	Two or more devices triggered sequentially in a loop - daisy chain in a loop

## Ethernet connector (supports PoE+)

Connector type: M12 X coded, 1404741

Figure 36 Ethernet connector pinout, view from the mating side

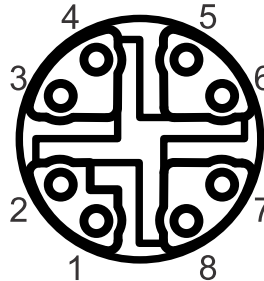
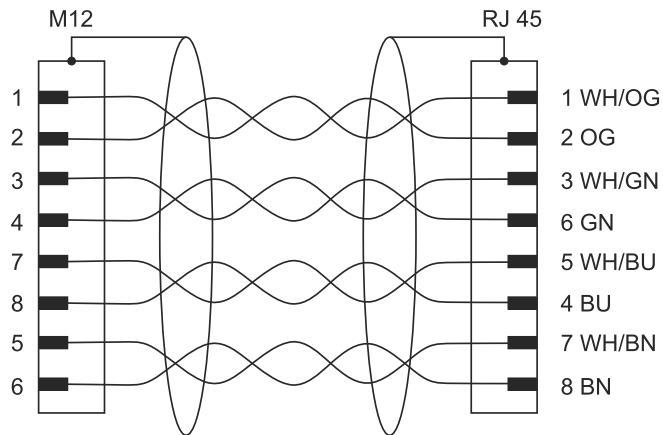


Figure 37 Contact assignments of the M12 and RJ45 plug



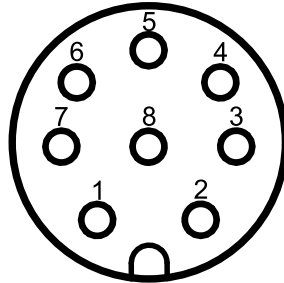
## PoE+ powering requirements

PoE Standard	IEEE802.3.at (PoE+)
Operating voltage $U_{eDC}$	min. 55V
Residual ripple maximum (% of $U_e$ )	0.5%
Rated operating current $I_e$ ( $I_{max}$ )	0.360A (0.6A)
Minimum power	33 W
Shielding	Fully Shielded RJ45
Transfer data rate	1 Gbit
Maximum recommended cable length	20 M

## Digital I/O and power connector

Connector type: **M12 A coded, M12A-08PMMP-SF8001**

**Figure 38** 24 V Power & GPIO pinout, view from the mating side (the port on the Zebra 3S)



Pin	Cable Color	Pinout	Function
1	White	DC_IN	+24V
2	Brown	N/A	N/A
3	Green	GND	ground
4	Yellow	OPTO_IN1	hardware trigger input signal (5-24V)
5	Grey	OPTO_IN1_GND	hardware trigger input ground
6	Pink	OPTO_OUT	hardware trigger output signal (5-24V)
7	Blue	OPTO_OUT_GND	hardware trigger output ground
8	N/A	N/A	N/A

### 24 V powering requirements

Operating DC voltage $U_e$ ( $U_{min}$ - $U_{max}$ )	24 V (20 - 30 V)
Residual ripple maximum (% of $U_e$ )	2%
Rated operating current $I_e$ ( $I_{max}$ )	1 A (2 A)
Minimum power	60 W
Maximum recommended cable length	20 m

# Compliance with standards

Zebra 3S sensors conform to the following standards and test specifications. Note that the certification status might change without notification. Consult your local Zebra representative if you need additional information related to the latest listing of exact approvals.

## CE

Zebra 3S sensors satisfy requirements and safety-related objectives according to the EC directives listed below. This CE mark is supported by tests conducted by the manufacturer.

## Laser classification

The Laser class of the sensor is determined according to EN 60825-1:2014 Equipment Classification and requirements standard. The laser class was tested by an independent certification body.

Zebra 3S sensors are Laser Class 3R devices. All devices are labeled according to their respective class following rules given by the harmonized standard.

Details about the laser device used can be found in the Projection unit properties section of the [Technical Reference](#) chapter.

If necessary, contact Zebra for a written Declaration of Laser Class for your specific device.

## GenICam interface

The Generic Interface for Cameras (GenICam) standard is the base for plug-and-play handling of cameras and devices. It was developed by the European Machine Vision Association (EMVA). Zebra 3S sensors are GenICam compliant.

## GigE Vision

GigE Vision is a high-speed communication protocol and interface standard that is designed for transmitting data over Ethernet networks.



