# Z-Trak™2 3D Laser Profiler Sensor

## User's Manual

sensors | cameras | frame grabbers | processors | software | vision solutions | **3D imaging**


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# Notice



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**About Teledyne DALSA, a business unit of Teledyne Digital Imaging Inc.**

Teledyne DALSA is an international high-performance semiconductor and Electronics Company that designs, develops, manufactures, and markets digital imaging products and solutions, in addition to providing wafer foundry services.

Teledyne DALSA Digital Imaging offers the widest range of machine vision components in the world. From industry-leading image sensors through powerful and sophisticated cameras, frame grabbers, vision processors and software to easy-to-use vision appliances and custom vision modules.

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# Contents

# Laser safety

Laser profilers incorporate laser emitters that are generally low power and diffused into a line pattern (versus a focused point), but which may still cause eye injuries if mishandled.


# Laser hazard classification

These devices have laser classifications of Class 2 or Class 3 as per industry standards described in the table below.

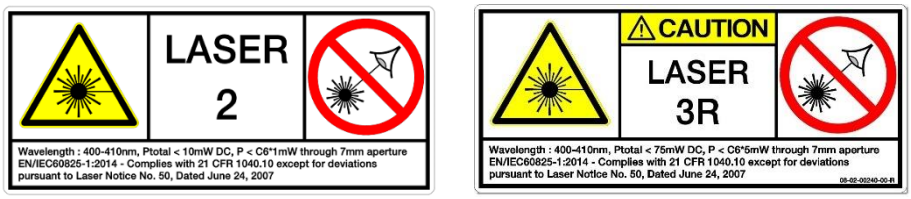
| | |
|---|---|
| **Class 2M** | **CAUTION — DO NOT STARE INTO BEAM OR EXPOSE USERS OF TELESCOPIC OPTICS**<br>Visible laser of no more than 1 mW continuous wave power through a 7 mm diameter aperture (largest pupil aperture).<br>May be hazardous if viewed with optical instruments such as binoculars or eye loupe.<br>Safe for unintentional (less than ¼ sec) unaided eye exposure. Aversion response (blink reflex) will protect workers from visible lasers unless a telescope or microscope is used.<br>Not a skin or materials burn hazard. |
| **Class 3R** | **CAUTION — AVOID DIRECT EYE EXPOSURE**<br>Visible lasers of no more than 5 mW continuous wave power through a 7 mm diameter aperture (largest pupil aperture).<br>Avoid intentional exposure to direct or reflected beam.<br>Unintentional or accidental exposure to direct or reflected beam has a low risk. Exposure to beam may cause temporary flash blindness. Aversion response (blink reflex) will protect workers from visible lasers unless a telescope or microscope is used.<br>Not a skin or materials burn hazard. |
| **Reference Source: Ontario (Canada) Ministry of Labour, etc.**<br>https://www.labour.gov.on.ca/english/hs/pubs/gl_lasers.php<br>http://www.lasersafetyfacts.com/laserclasses.html | |

It is device operator's responsibility to adhere to the warning labels.

# Warning labels

The following labels can be found on the Z-Trak2 laser profiler body.


### Z-Trak2 405 nm (blue) sensors




### Z-Trak2 660 nm (red) sensors

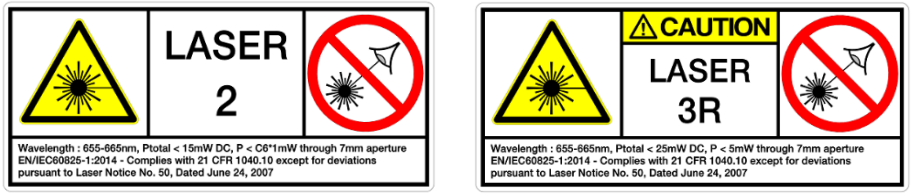



*Figure 1. Examples of labels that can be worn by the profilers.*


*Figure 2. Example of a profiler with labels.*

# Safety features – Emergency shutdown

For added safety, Z-Trak2 units come with external signal pins for an Emergency shutdown switch. Even when a Z-Trak2 unit is powered, the laser will not operate unless a normally closed emergency shutdown switch (E-STOP) is connected to the external safety pins of the sensor. A +24 VDC signal must be applied to the E-STOP. In some global jurisdictions it is possible to use Z-Trak2 equipped with a 2M or 3R class laser without an E-STOP. It is the responsibility of the device operator to ensure that the wiring of the device complies with the local regulations.

Teledyne DALSA strongly recommends to always use an external E-STOP switch with Z-Trak2 profile sensors.

See section Emergency safety switch (E-STOP) for details.

# Safety requirements

**CAUTION — DO NOT STARE INTO BEAM OR EXPOSE USERS OF TELESCOPIC OPTICS, AVOID DIRECT EYE EXPOSURE**

Proper training on laser safety should be provided, and standard operating procedures should be applied to mitigate the potential hazards associated with laser use.

# Handling precautions and cleaning instructions

Do not handle while the laser is activated or when the device is powered on.

Mount the profiler before connecting the Ethernet and I/O cables. See Installation and Technical specifications for mounting information, and subsection Connectors for cabling information.

Clean the laser and image sensor windows carefully with dry cloth lens products or lens cleaning solutions. Teledyne DALSA recommends using lint-free ESD-safe cloth wipers that do not contain particles that can scratch. The Anticon Gold 9”x 9” wiper made by Milliken is both ESD safe and suitable for class 100 environments. Another ESD acceptable wiper is the TX4025 from Texwipe.

# Z-Trak2 2K Series overview

## Description

The Z-Trak2 3D laser profiler series combines speed and performance with easy-to-use software to deliver highly accurate, real-time results for a wide variety of 3D measurements and inspection applications.

Profiler sensors are factory calibrated and offered in a variety of models to cover measurement ranges from 4 mm to 650 mm. Z-Trak2 3D sensors comply with AIA's GigE Vision 2.0 and EMVA's GenICam 3.0 (SFNC 2.3) standards, and are bundled with free, powerful software packages. All models come in IP67 rated enclosures and are ideal for applications in electronics, PCB, wafer, flat-panel, factory automation, food processing and secondary battery markets.


*Figure 3. The Z-Trak2 3D laser profiler.*

The Z-Trak2 delivers 2K points per profile with scan speeds up to 45,000 profiles per second (S-2K series) or 10,000 profiles per second (V-2K series). Its single-scan high-dynamic range (HDR) capability allows it to scan objects with surfaces displaying a mix of high and low reflectivity materials (e.g., machine aluminum or glass with rubber or matt plastic). Multiple sensors can also be combined in a variety of configurations to measure around an object, to widen the measurement surface or to eliminate occlusions.

# Key features

- Real-time, factory-calibrated measurements in real-world units (micrometers, millimeters, and thousands of an inch)
- The Z-Trak2 S-Series delivers profile rates up to 45 kHz using 5 GigE interface
- The Z-Trak2 V-Series delivers profile rates up to 10 kHz using 1 GigE interface
- Available in red (660 nm) and blue (405 nm) lasers with safety class 2M or 3R (both eye-safe)
- Variety of models cover field of view from 13 mm to 1210 mm and Z range from 4 mm to 650 mm
- Built-in, single-scan high dynamic range (HDR) capabilities, handles high and low reflective surfaces at the same time
- Multi-sensor combination and synchronization in different topologies for 360° measurements or for occlusion elimination
- Supports quadrature shaft-encoder input for external profile triggers
- External start and stop triggers for fixed and variable length scans
- GigE Vision 2.0, GeniCam 3.0 and SFNC 2.3 compliant
- Supports Windows and Linux platforms
- Free bundled software packages: Sherlock™ 8 (rapid application deployment), Sapera LT SDK 8.7 (scan and control), Sapera Processing 8.0 runtimes (1D, 2D and 3D image processing)
- Z-Expert 2.0 features intuitive graphical interface for rapid setup of multiple Z-Trak2 sensors simultaneously
- Enhanced 3D visualization of profile and surface view from one more sensor simultaneously
- Third-party software support for 3D image processing using GenICam™ 3.0 3D output formats or 16-bit monochrome output format
- Compact, integrated within a ruggedized protective housing (IP67) with tapped and through mounting holes

Refer to the Z-Trak2 features reference and Technical specifications sections of the manual for full details.

# About GigE Vision and GenICam

| | |
|---|---|
| GiGE VISION® | Z-Trak2 3D laser profiler sensors are 100% compliant with the GigE Vision® 2.0 specification, which defines the communication interface protocol used by any GigE Vision device. The device description and capabilities are contained in an XML file. For more information see: https://www.automate.org/a3-content/vision-standards-gige-vision. |
| GENICAM | Z-Trak2 3D laser profiler sensors implement a superset of the GenICam™ specification that defines device capabilities. This description takes the form of an XML device description file respecting the syntax defined by the GenApi module of the GenICam specification. For more information see www.genicam.org. |

The GigE Vision-compliant XML device description file is embedded within Z-Trak2 firmware, allowing GigE Vision-compliant applications access to Z-Trak2 capabilities and controls immediately after connection.

# Models

This manual covers the current Z-Trak2 models summarized in the tables below. See section Z-Trak2 2K Series Model specifications for model details. Contact Teledyne DALSA sales for availability.

## Z-Trak2 S-2K series

This series supports 5 GigE Ethernet.

| Model | Laser Color § (safety rating) | Measurement Range (mm) | Standoff Distance (mm) | Near FOV (mm) | Far FOV (mm) | Case Size |
|---|---|---|---|---|---|---|
| Z-TRAK2 S-2K-0015 | Blue 405 nm (2M) | 15 | 32.7 | 26.6 | 32.3 | T20 |
| Z-TRAK2 S-2K-0030 | Blue 405 nm (2M) | 30 | 43.7 | 53.2 | 72.2 | T20 |
| Z-TRAK2 S-2K-0100 | Red 660 nm (2M) | 100 | 64.5 | 96.9 | 185.3 | T20 |

§ For other laser options contact Teledyne sales

## Z-Trak2 V-2K series

This series supports 1 GigE Ethernet.

| Model | Laser Color § (safety rating) | Measurement Range (mm) | Standoff Distance (mm) | Near FOV (mm) | Far FOV (mm) | Case Size |
|---|---|---|---|---|---|---|
| Z-TRAK2 V-2K-0015 | Blue 405 nm (2M) | 15 | 32.7 | 26.6 | 32.3 | T20 |
| Z-TRAK2 V-2K-0030 | Blue 405 nm (2M) | 30 | 43.7 | 53.2 | 72.2 | T20 |
| Z-TRAK2 V-2K-0100 | Red 660 nm (2M) | 100 | 64.5 | 96.9 | 180 | T20 |

§ For other laser options contact Teledyne sales

# Cables and accessories

Mating cables and switches are available from the following suggested manufacturers (contact information provided below). Cat6 Ethernet cables are required.

If you need help, contact Teledyne DALSA for parts details.

| Part Number | Description (single device setup) | Manufacturer | Manufacturer's P/N |
|---|---|---|---|
| 3D-AC0F-M1217-5M | M12 17-pin female to flying lead (Control and I/O cable) | CEI | CC C2025-05M |
| 3D-AC00-M12X5M | M12X-R45 8-pin male X-coded to RJ45 PoE/PoE+ 5M (data cable) | CEI | MI-1-7-L0-05M |
| 3D-AP00-24V20W0 | Power supply 24 V/20 W | MEAN WELL | MDR-20-24 (*) |
| | Network smart switch with 10 Gigabit capability (optionally with PoE+) | NETGEAR | MS510TX, MS510TXPP (PoE+) |
| | Mount | Contact Teledyne | |
| | Network cable RJ45 to RJ45 (CAT6) | | |

* For single profiler setup. For multiple profilers, use Mean Well MDR-100 series, or similar.

### Manufacturers contact information

| | |
|---|---|
| Components Express, Inc. (CEI) | www.componentsexpress.com |
| Mean Well | www.meanwell.com |
| Netgear | www.netgear.com |

### Power supply requirement

Details on power supply requirements can be found in Power supply requirements (auxiliary power).

# Development software

Below are the software development tools for the Z-Trak2 sensor series.

## Teledyne software packages

| **Teledyne DALSA Software Platform for Microsoft® Windows®** | |
|---|---|
| **Sherlock™ advanced machine vision software**<br>The Sherlock™ version 8.1 or later can be used with the Z-Trak2 sensors for rapid 3D application development and deployment. See Sherlock—obtaining a license. | Available for download<br>https://www.teledynedalsa.com/en/products/imaging/vision-software/sherlock |
| **Sapera LT version 8.7 or later (for Windows)**<br>Includes Sapera Network Imaging Package and GigE Vision Driver, Sapera LT Runtime and Z-Expert<br>The Sapera LT development software provides all the tools needed for configuring and acquiring data with Z-Trak2 sensors, and for developing applications. | Available for download<br>https://www.teledynedalsa.com/en/support/downloads-center/software-development-kits/ |
| **Sapera Processing Imaging Development Library** (available for Windows or Linux – sold separately)<br>The Sapera processing Imaging Development Library provides a suite of 3D image processing functions for profiles and range maps. | Contact your Teledyne DALSA Sales Representatives |

| **Teledyne DALSA Software Platform for Linux** | |
|---|---|
| **GigE-V Framework** Ver. 2.20.01 (for X86 or Arm type processor)<br>The framework contains lightweight libraries for camera/sensor control and image acquisition. | Available for download<br>http://teledynedalsa.com/imaging/products/software/linux-gige-v/ |

## Third-party software support

The Z-Trak2 sensors comply with GigE Vision 2.0 and GenICam 3.0, SFNC 2.3 standards. Third-party software packages that comply with SFNC 2.3 can directly benefit from 3D data format supported by Z-Trak2.

In addition, the Z-Trak2 sensors support 16-bit monochrome output mode, allowing third-party software packages that do not yet support the GenICam and SFNC 2.3 standards to work with the Z-Trak2 family of 3D sensors.

| **Third-Party GigE Vision Software Platform Requirements** | |
|---|---|
| Support of GenICam™ GenApi version 3.0 (SFNC 2.3) | General acquisition and control |
| Support of GenICam™ GenApi version 3.0 | File access: firmware, configuration data, upload & download |
| Support of GenICam™—XML camera description file | Embedded within Z-Trak2 firmware |

# Z-Trak2 2K series common specifications

This chapter lists the specifications and other functional information that apply to all models.

## Common specifications

General and common specifications for all Z-Trak2 sensor models are listed below. See Z-Trak2 2K Series models for model-specific information.

| General | Description |
|---|---|
| Lasers | • Red—660 nm, class 2M or 3R<br>• Blue—405 nm, class 2M or 3R |
| Laser Activation | On (continuous) or Strobe acquisition |
| Scan types | • Profile trigger—encoder input, or internal timer/counter<br>• Fixed scan—external input, software, or internal timer/counter<br>• Variable scan—external input – level based (part in place), edge based (start/stop pulses) |
| Output formats | • Individual profile, range map and 3D point cloud<br>• Lateral (X), Depth (Z), Reflectance (R), Multipurpose (W) (typically, peak width)<br>• 3D data output formats compatible with GenICam 3.0 (SNFC 2.3) Linescan3D: RectifiedC (UniformX Z), CalibratedAC (XZ), CalibratedACRW (XZRW)<br>• Native values and world measurement units (micrometers, millimeters, inches/1000)<br>• 16-bit mono (1D line scan mode)<br>• 8-bit mono (2D area scan mode) |
| Reflectance management | • Time integration<br>• Laser power control: automatic or manual<br>• Image sensor gain control |
| Image enhancements | • Single scan HDR<br>• Filters: programmable median<br>• Unified measurement space |
| Multi-sensor sync | • Single low-cost wiring using off-the-shelf network switches<br>• Sensor grouping<br>• Configuration wizard for timing setup<br>• Master: Profile trigger – encoder, internal, counter<br>• Slave: Profile trigger – MultiSensorSync, Line3, Line4 |
| Unified measurement space | • Provides intuitive GUI for quick setup<br>• Supports multiple layouts: side-by-side, circular (ring), in-line opposite<br>• Supports combination of different color lasers<br>• Supports combination of models with different measurement ranges |

| General | Description |
|---|---|
| Status Indicators | 3 LED indicators:<br>• Status: functional and connection status<br>• Laser: when ON, laser is ready<br>• Range: TBD |
| Exposure Mode | Single<br>Programmable in increments of 1 µs (minimum 20 µs) |
| Trigger Events support | External Trigger source, Trigger Ignored count |
| Exposure Control | Internal – Programmable via the profiler API |
| Exposure Time Maximum | 16 seconds |
| Trigger Inputs | Opto-Isolated<br>Debounce range from 0 up to 255 µs with selectable edge or level active<br>Programmable Trigger Delay |
| Shaft Encoder Input | Differential input RS422 and single-ended TTL, max frequency 5 MHz |
| Laser Control | • On, Off, Strobed<br>• User-programmable laser power |
| Counter and Timer | 1 Counter and 1 Timer. User programmable, acquisition independent, with event generation and output pin control |
| User settings | 2 user sets and factory set. User selectable power-up configurations |
| **Mechanical Interface** | |
| Enclosures (L x H x W) | See details in section Mechanical specifications |
| Enclosure IP rating | Conform to IP67 Protection Level (IEC) |
| Power connection | Via I/O connector or via Ethernet cable with PoE injector |
| Connectors | I/O M12 17-pin male, Ethernet M12 X-coded 8-pin female |
| **Electrical Interface** | |
| Power input voltage | Aux. power input: +20 to +24 V DC, max = 30 V<br>PoE injector: Supports IEEE 802.3at PoE type 2 (PoE+), max voltage = 57 V DC |
| Input/outputs | 2 inputs, configurable as triggers or general-purpose input (max freq. 100 kHz)<br>2 outputs, configurable as general output |
| Power dissipation (typical) | 5 GigE:<br>24 V aux. power input: 14 W<br>PoE+: 17 W<br>1 GigE:<br>24 V aux. power input: 13.5 W<br>PoE+: 16 W |
| Data output | 5/2.5/1 GigE (S-Series), 1 GigE (V-Series) (10/100 Mbps not supported) |
| Data and control | GigE Vision 2.0 compliant, GenICam 3.0, SFNC 2.3 |
| **Environmental Conditions** | |
| Conformity | IP67, FDA, IEC, FCC & CE declarations, GenICam, GigE Vision, IEEE 802.3af (PoE) |
| Operating temperature (front plate) | 10°C to 50°C (50°F to 122°F) at up to 90% relative humidity (non-condensing)<br>Heat conducting metallic mounting used as heat-sink important for reducing device temperature |
| Storage | -40°C to 80°C (-4°F to 176°F) at 20% to 80% relative humidity (non-condensing) |

# EMI, shock, and vibration certifications

| Vibration & Shock Tests | Test Levels (while operating) | Test Standards |
|---|---|---|
| Sinusoidal Vibration | 5g, 10 Hz to 500 Hz | EN/IEC 60068-2-6 |
| Random Vibration | 5g, 10 Hz to 500 Hz | EN/IEC 60068-2-64 |
| Shock (Half-Sine) | 30g/6ms, x/y/z directions | EN/IEC 60068-2-27 |
| Additional information concerning test conditions and methodologies is available on request. | | |

# Theory of operation and definitions

## How a 3D laser profiler sensor works

There are three components to the Z-Trak2 3D laser profiler sensor:

- A laser source (blue or red depending on model) that emits a laser line projected on the object.
- A 2D sensor that captures the light reflected from the object. A narrow bandpass optical filter tuned to the laser color is placed over the 2D sensor view window to minimize ambient light interference.
- Embedded computing capability to process the captured image into height measurements at a very high rate.

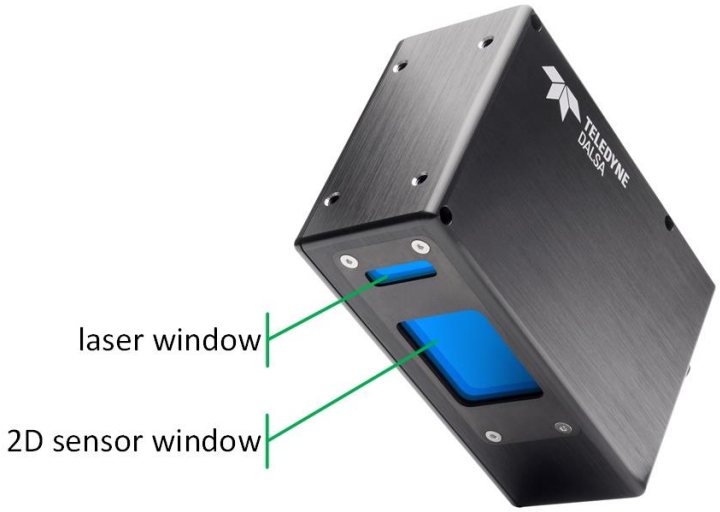



*Figure 4. Z-Trak2 3D laser profiler. Position of the laser window and 2D sensor window.*

Z-Trak2 illuminates an object with a plane of light. The light reflected by the projected line on the object is captured on the 2D sensor, which forms a profile. After determining the position of the laser line reflected on the area sensor, the profiler uses triangulation to precisely translate this information into 3D, real-world measurements. The captured data is output as a set of height values for each point of a profile.

To capture an entire surface, a sequence of profiles must be obtained by moving the object relative to the profiler. The resulting sequence of profiles is a representation of the object's surface.

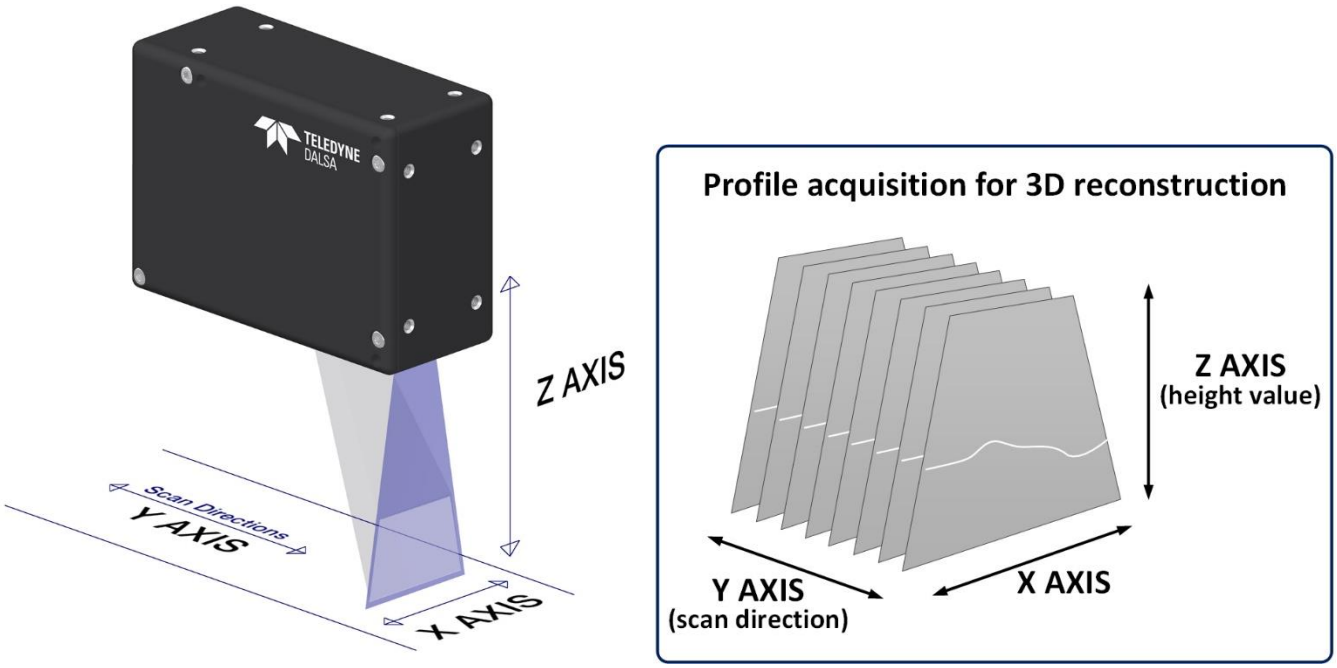



*Figure 5. (Left) X, Y and Z axes in relation to the profiler plane of light (in purple). (Right) Each captured profile, depicted as a white line in the XZ-plane, outputs Z (height) values. A scan captures a sequence of profiles; the output forms a range map.*

The Z-Trak2 data output mainly consists of the height value for every point of a scan. But other information can also be captured, such as reflectance. See section 3D Data Type output format description for details on data output formats.

# Definitions

The figure below depicts the different axes, distances, and regions; the terms used in the figure and throughout the manual are defined below.

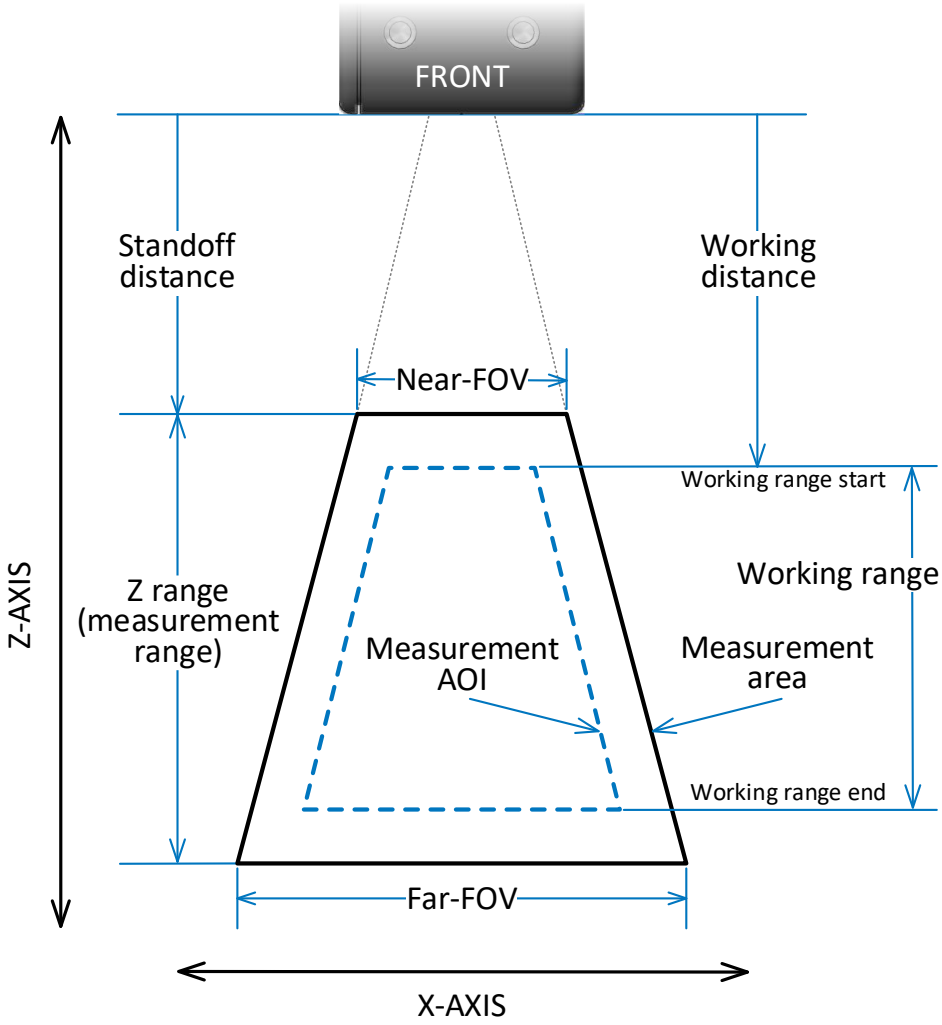



*Figure 6. The various terms used in this document (defined below) are depicted here, seen in the XZ-plane. The Y-axis is perpendicular to the page. Note that the diagram is not to scale.*

**X-Axis**

The X-axis is the lateral axis that runs along the laser line emitted by the profiler.

**Z-Axis**

The Z-axis is the vertical axis where height measurements are made. Height measurements can be made on only a portion of the Z-axis, called the Z range. The Z-axis is always perpendicular to the X-axis.

**Y-Axis**

The Y-axis is the axis of the scan or travel direction. It is perpendicular to both X and Z axes, i.e., perpendicular to the XZ-plane.

### Standoff distance

The standoff distance (also known as the clearance distance) is the minimum distance from the laser profiler exit window where measurements can be made. This distance is model dependent and cannot be changed by users. Any measured point located between the profiler and the standoff distance will return an invalid code.

### Z range (Measurement Range)

The Z range is the maximum height, in world measurement units, that the 3D laser profiler sensor can measure. The Z range, also called depth of field (DOF), is model dependent and factory calibrated, and cannot be changed by users.

The start of the Z range (the 0 value) is the farthest point from the laser exit window; the end (max Z value) is the closest to the exit window and represents the highest value that the sensor can measure. In the figure above, the Z range extends from the bottom to the top.

### Field of view (FOV), Near-FOV (NFOV), Mid-FOV(MFOV), Far-FOV (FFOV)

The field of view is the section of the X-axis where Z measurements can be made. Its size depends on the distance from the profiler; the FOV is larger at the start of the measurement range than at its end. This implies that the resolution in X varies with the distance from the profiler.

The FOV at the start of the measurement range is the far-FOV; it is the largest section where measurements can be made.

The FOV at the end of the measurement range is the near-FOV; it is the smallest measurement section, closest to the profiler.

The mid-FOV provides an indication of the size of the measurement section midway between the near-FOV and far-FOV.

Note that for the Z-Trak2 sensors, the laser line extends beyond the FOV; however, the factory calibration ensures that Z measurements can take place in the entire trapezoidal region delimited by the FOV in the XZ-plane (see measurement area definition).

### Measurement area

The measurement area is the trapezoidal region in the XZ-plane that is delimited by the FOV, from the near-FOV to the far-FOV. It is the largest region in which measurements can be made. The measurement area is determined at the time of factory calibration and cannot be changed by users. In the figure above, the measurement area is represented by the black trapezoid.

### Measurement AOI (M-AOI)

The measurement area-of-interest, called measurement AOI, is an area equal to or smaller than the measurement area, where the measurements are to be made. The measurement AOI can be changed by users: a smaller measurement AOI means that a larger number of profiles can be processed for a given amount of time, thereby increasing scanning rate. In the figure above, the measurement AOI is depicted by the blue dash trapezoid.

### Working range, Working distance

The working range is the interval between the nearest and farthest distances from the laser exit window where measurements are made. The interval corresponds to the height of the measurement AOI; the starting position of the measurement AOI is also called the working distance. The working range varies with the size and the position of the measurement AOI (see figure above).

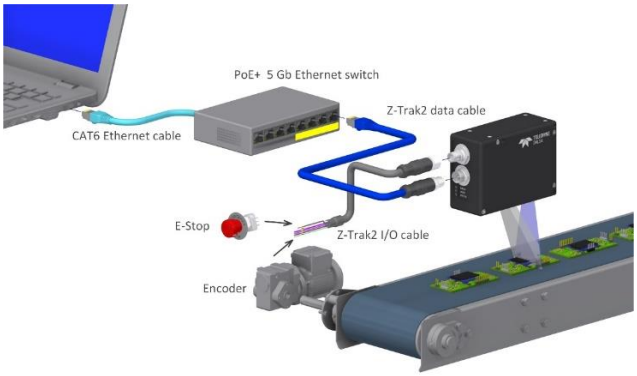
# Z-Trak2 quick start

For detailed instructions on how to set up and use a 3D laser profiler sensor, go to section Installation.

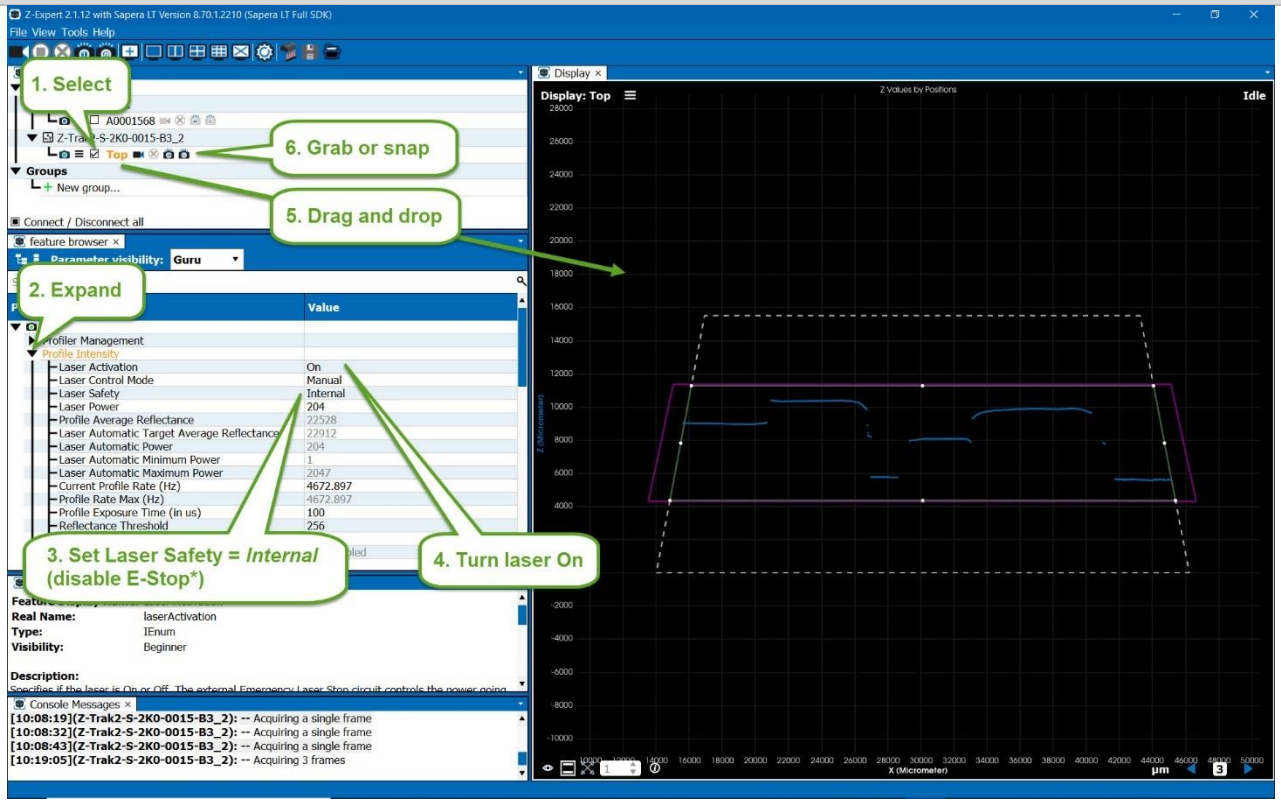
The following section provides steps for a quick setup and for acquiring 3D profiles with Z-Expert.

| **1. REQUIRED MATERIAL** | |
|---|---|
| **Material** | **Model/Part (examples)** |
| Z-Trak2 3D laser profiler sensor | Z-TRAK2 2K0-0015-B3 |
| I/O cable: M12 17-pin female to flying lead (Control and I/O cable) | 3D-AC0F-M1217-5M |
| Data cable: Ethernet M12 X-coded 8-pin male to RJ45 | 3D-AC00-M12X5M |
| Mounting Adaptor | Contact Teledyne DALSA sales |
| 5 GigE (S series) or 1 GigE (V series) Network Switch | 1 GigE with POE+ : NETGEAR GS305PP<br>1/2.5/5 GigE with PoE+: NETGEAR MS510TXPP<br>1/2.5/5 GigE : NETGEAR MS510TX |
| Power supply 24 V/20 W (if not using PoE switch) | Mean Well MDR-20-24 (for single device setup) |
| Network cable | RJ45 to RJ45 (CAT 6 required) |

| **2. DOWNLOAD** | **3. INSTALL SAPERA LT** |
|---|---|
| **Sapera LT SDK**<br>https://www.teledynedalsa.com/en/products/imaging/vision-software/sapera-lt/download/.<br>**Z-Trak2 Firmware**<br>Download Z-Trak2 firmware or contact sales. | • Double-click SaperaSDKSetup.exe. You will be asked to reboot after installation.<br>• When prompted, choose to install the **Teledyne DALSA 3D profile sensors**, which will also install Z-Expert.<br>• After installation, verify that the GigE Server tray icon appears in the notification area (show hidden icons). At this point, its status will be *No device found*.<br>  No device found |

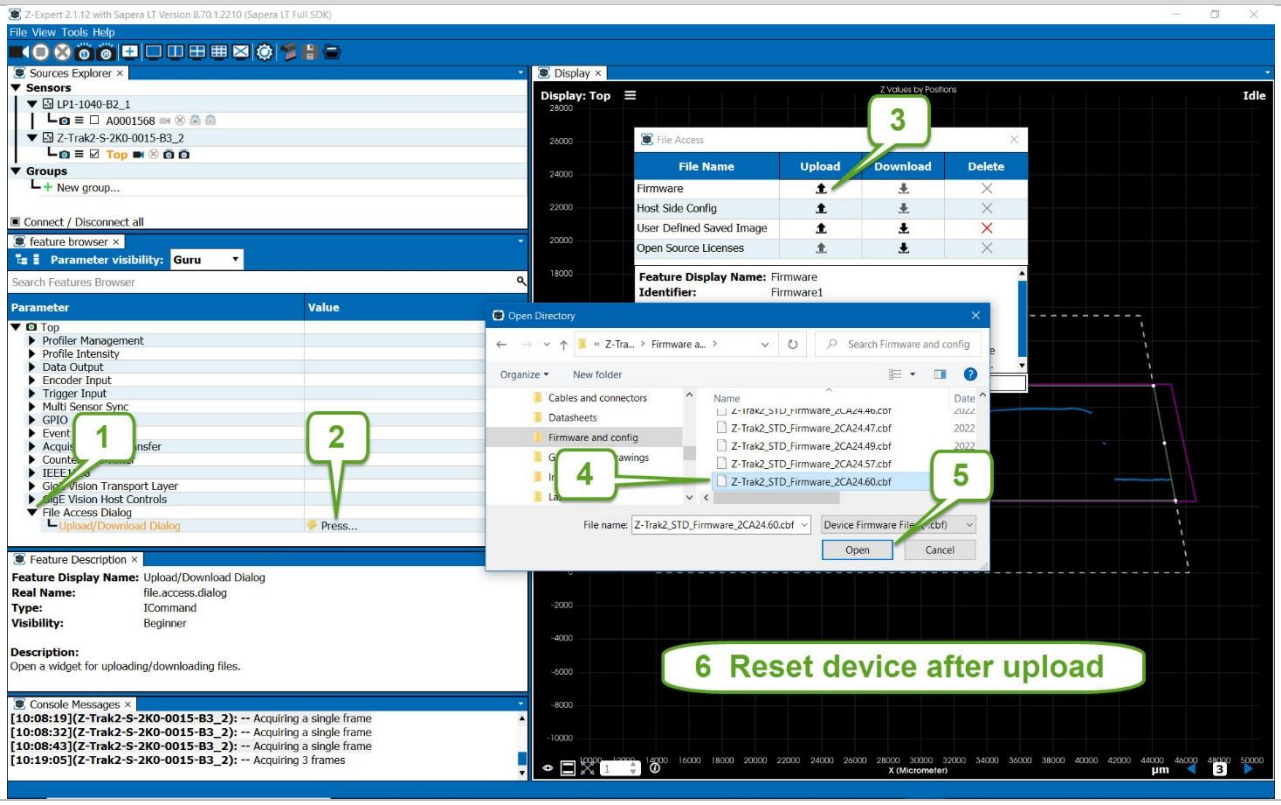
| **4. MOUNT DEVICE ON METALLIC, HEAT CONDUCTING ASSEMBLY** | **5. POWER DEVICE AND CONNECT TO HOST COMPUTER (EX. WITH POE+ SWITCH)** |
|---|---|
|  |  <br>  After a few seconds, check the notification area to verify Z-Trak2 device is available. |

## 6. START SAPERA Z-EXPERT (desktop icon or Start menu – Teledyne DALSA Sapera LT)




* If permitted by local regulations.

## 7. UPDATE Z-TRAK2 FIRMWARE



# System requirements

The following information is a guide to computer and networking equipment required to use the Z-Trak2 series of 3D laser profilers.

## Host PC system

- Microsoft® Windows® 10 (32-64 bits) compatible, with 8 GB or more system memory, 16 GB highly recommended.
- To grab at 5 GigE speed (S-Series), the minimum system requirement is an intel i7 with 8 logical cores, with 16 GB of DDR (or equivalent system).
- Dedicated display card with GPU capabilities.
- A network adapter card (NIC) supporting the desired link speed and number of ports if using multiple Z-Trak2 devices (see section Compatible GigE network adapters and switches):
  - V-2K series: 1 Gb Ethernet (1 GigE)
  - S-2K series: 5, 2.5 or 1 Gb Ethernet (5, 2.5 or 1 GigE)
- CAT 6 Ethernet cable

**10/100 Mb Ethernet is not supported** by the Z-Trak2 series. The Status LED will show that it acquired an IP address (solid Blue), but Z-Trak2 will not function at these slower connections.

## Compatible GigE network adapters and switches

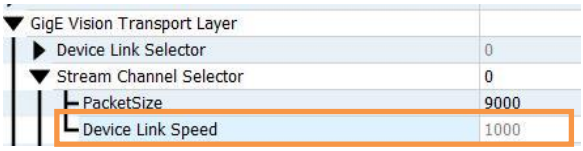
Network devices connected to Z-Trak2 S-Series 3D sensors must support 5, 2.5 or 1 GigE connections.

To utilize the full 5 GigE bandwidth output of the Z-Trak2, all network hardware between the 3D sensor and the host computer must be capable of handling 5 Gbps bandwidth.

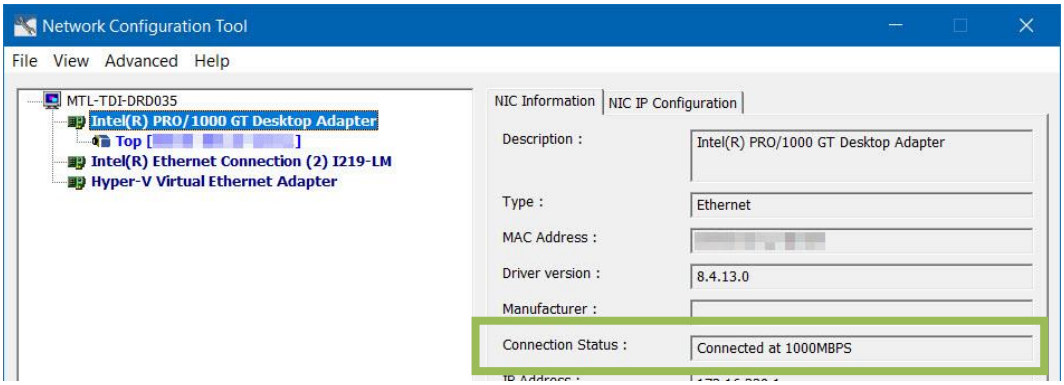
Note that when using multiple Z-Trak2 3D sensors on the same switch, the computer's network adapter and switch should support 10 Gbps.

To verify that the profiler is connected at the right speed:

- Check the profiler Link Speed feature, in the GigE Vision Transport Layer category.




- Check the network connection status of the NIC using the Network Configuration tool.




| | |
|---|---|
|  | Certain 10 Gbps devices do not support 5 Gbps (or 2.5 Gbps) speeds; connecting 5 Gbps devices results in the connection speed lowered to the common supported speed of 1 Gbps. |

# Network adapters

The Z-Trak2 3D sensor connects to a computer's gigabit network adapter (NIC). If the computer is already connected to a network, it will require a second network adapter. Multiple devices may be controlled by one host computer on a single NIC through a switch.

If multiple sensors are connected to one switch, the NIC should support 10 Gbps and be connected to the 10 Gbps port on the switch.

Two recommended 5 GigE network adapters (not exhaustive):

- **Intel X550 T2** – This network adapter achieves superior performance compared to some other manufacturer's comparable devices.
- **ASUS XG-C100C**

# Switches

Switches offer a range of functions and performance grades, so care must be taken to choose the right switch for a particular application. A switch is required if the profiler-to-PC separation is greater than 100 meters.

It is recommended to test network device performance since certain devices may not achieve acceptable results in actual operation (depending on the device manufacturer's implementation). In

general, it is always recommended to use the latest device drivers provided by the manufacturer. A 10 Gbps switch is recommended when using several 3D sensors.

Examples of suitable Ethernet switches for use with the Z-Trak2 3D sensors (not exhaustive):

- **NETGEAR MS510TX** and **MS510TXPP**

# Installation

Z-Trak2 sensors require proper setup to produce correct measurements. The Z-Trak2 installation consists of the physical setup, software setup and network connection. Please review the following sections as they include information and advice on how to install your device.

## Physical setup

The 3D laser profiler sensors are generally used with moving object, but some setups require the sensors to move instead of the object. For correct measurements, use the following setup guidelines:

- The profile sensor must be installed such that its Y-axis remains parallel to direction of travel, i.e., to the scan direction.

  To that end, the Z-Trak2 casing provides a number of screw holes and through holes (see Mounting holes specifications) for a variety of mounting options. The following figure depicts correct and incorrect installation.

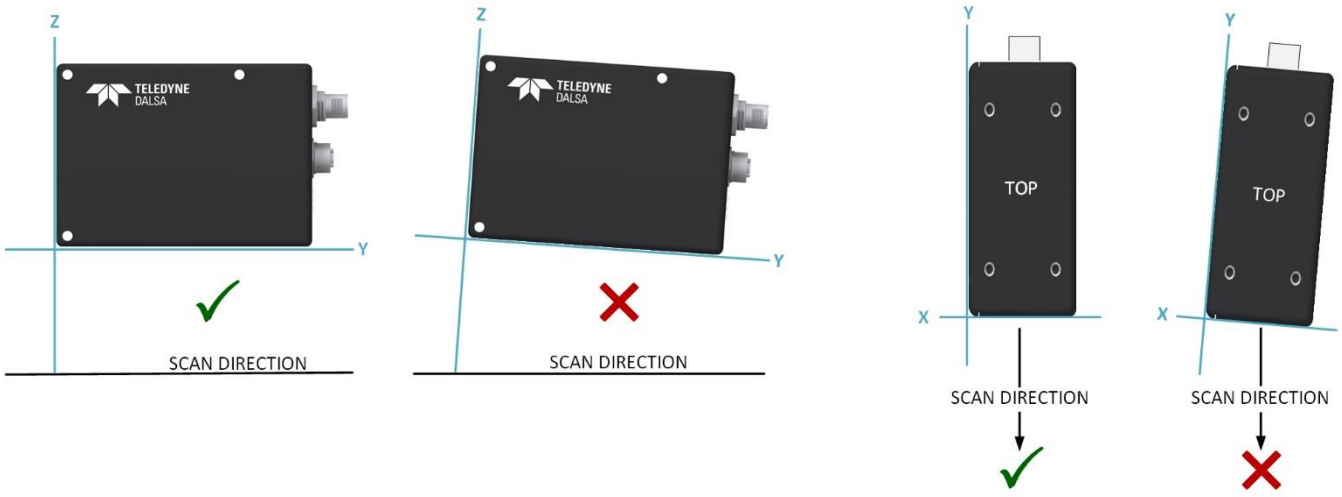



*Figure 7. The Y-axis of the sensor body must be parallel to the scan direction.*

(Note that typically, the Z-axis is vertical with respect to the scanned object. This addditional constraint is however optional. Correction may be done on the host.)

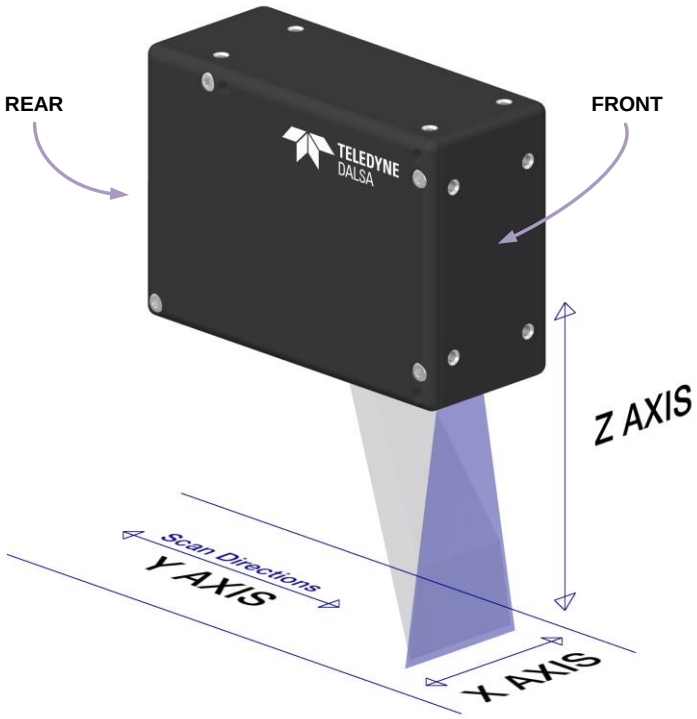



*Figure 8. The laser sheet must be perpendicular to the scan direction.*

- The target object must be in the measurement area (see Figure 6) to obtain valid measurement results.
- Z-Trak2 profiler is designed to dissipate heat through its housing. As such, ensure that it is mounted on a heat conductive metallic structure and that the entire surface of one of the sides of the housing makes full contact with the conductive surface. See section Temperature management for details.


*Figure 9. An example of mounting setup. The two metallic mounts will help dissipate heat from the sensor.*

- Power supplies must meet the requirements defined in sections PoE+ DC power requirements (PoE supply) or Power supply requirements (auxiliary power).
- Ethernet cables must be CAT6.

Note that Z-Trak2 mechanical specifications will vary for different models.

# Z-Trak2 mounting

## *Planning machine opening space*

Connector length, cable bend radius, enclosure height (height of Z-Trak2 casing), working distance, and height of the measurement area determine the minimum machine opening required for installation.

The figure below depicts the machine opening space required for an object placed within the measurement area. The height should be calculated so that the object remains within the measurement area.

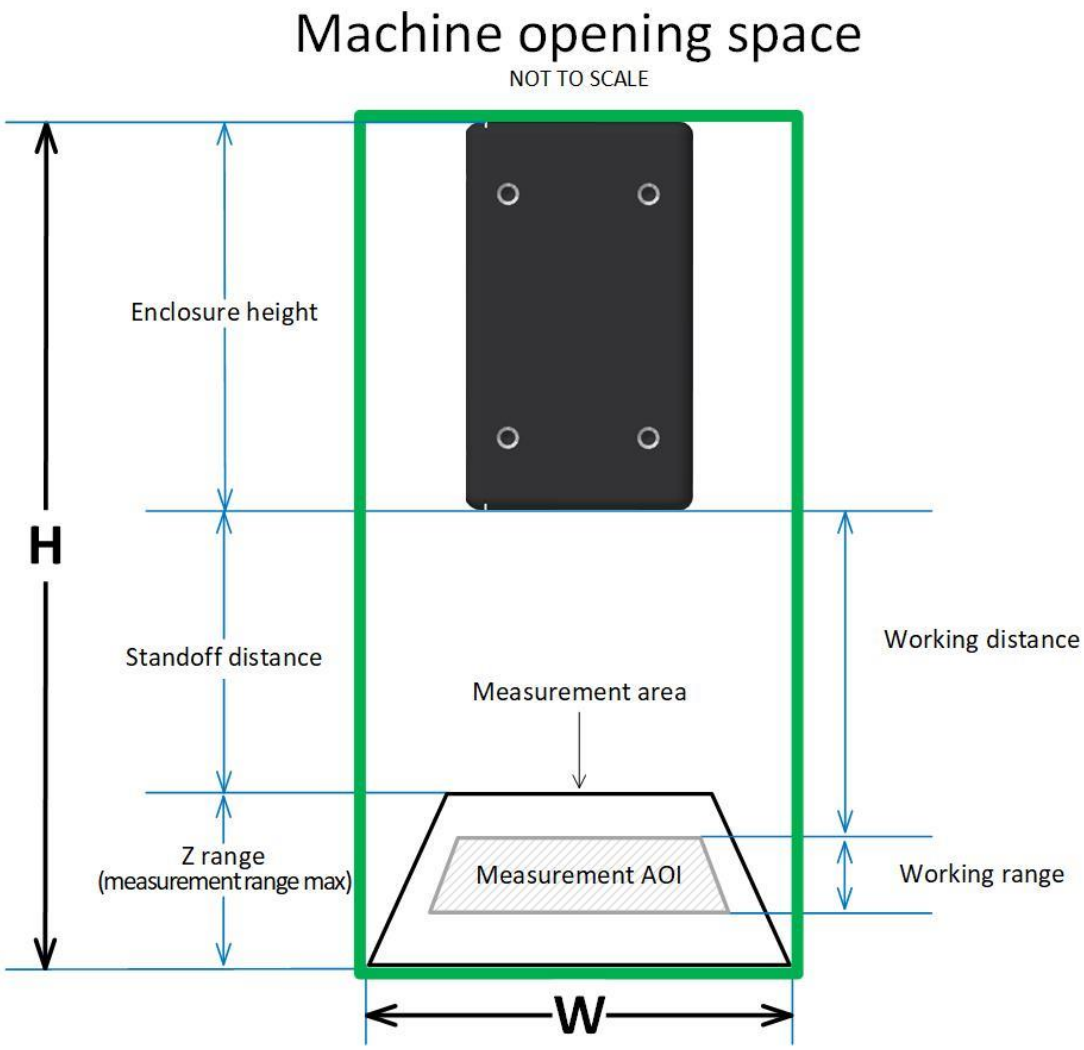



*Figure 10. Machine opening space (example). The green rectangle depicts the maximal height H of the opening space, when the target object is placed farthest from the 3D sensor, and the required width W. The object must be placed within the measurement area. The working range corresponds to the Measurement AOI Height feature, starting at the working distance.*

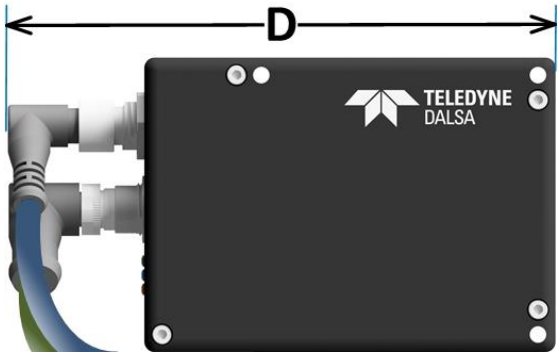



*Figure 11. Depth depends on the body (enclosure) length and connector height.*

The dimensions of the machine opening required for setup are determined as follows:

| |
|---|
| H max = enclosure height + standoff distance + Z range<br><br>W min = Far FOV width<br><br>D min = enclosure length + connector height |

The enclosure height, standoff distance, Z range, and Far FOV width are features that can be found using Z-Expert, in the Data Output category, under AOI.

For a more detailed example of AOI features, see Depiction of AOI features.

## *Planning for scan direction and profiler orientation*

There are two features that describe how the target object moves relative to the sensor: scan direction and profiler orientation.

If you look at a target object where you can identify a top and a bottom, like with text embossed as depicted below, the **scan direction** is as follows:

- **Forward**: the object crosses the laser line from top to bottom.
- **Reverse**: the object crosses the laser line from bottom to top.

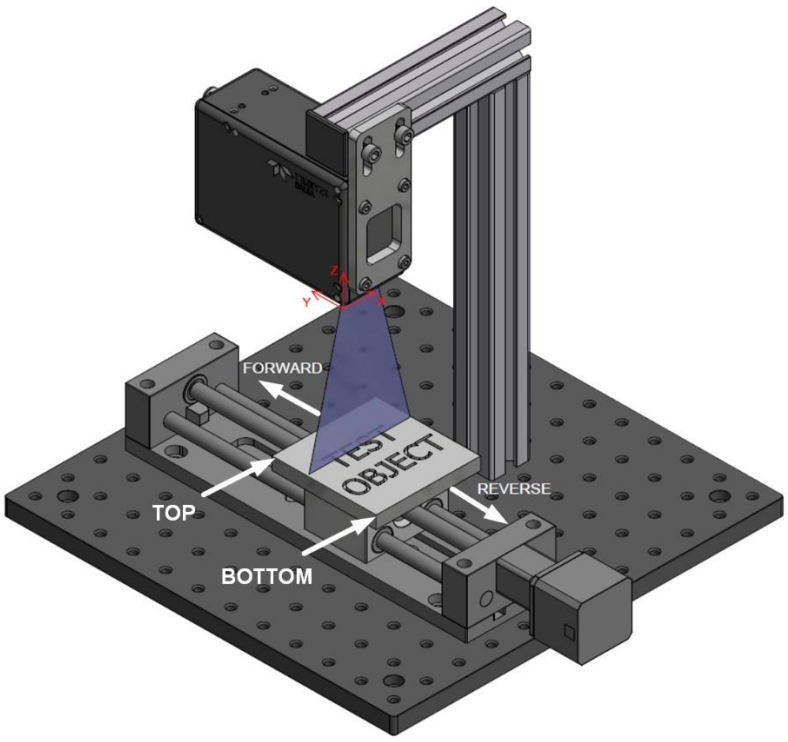



*Figure 12. Depiction of scanning direction. In the Forward scan direction, the target object crosses the laser line from top to bottom.*

**Profiler orientation**, assuming a *forward* scan direction, is as follows:

- **Normal**: the object moves from the front to the rear of the sensor body.
- **Reverse**: the object moves from the rear to the front of the sensor body.

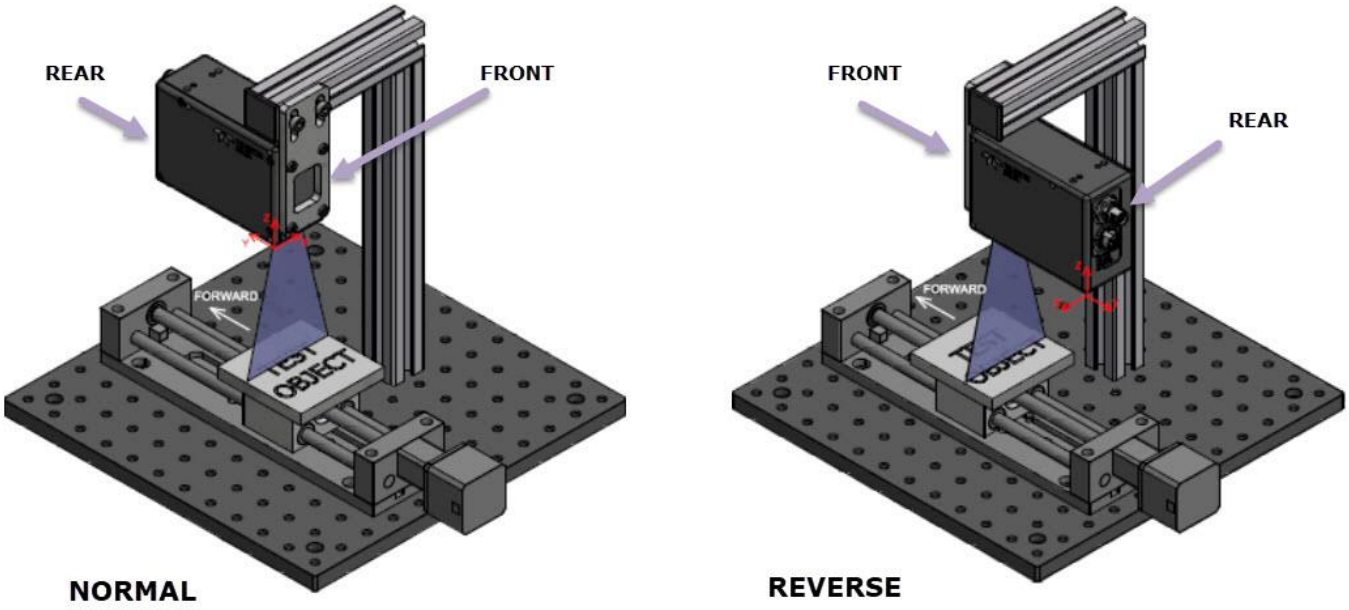



*Figure 13. Normal profiler orientation (left) and Reverse profiler orientation (right).*

| Note that scan direction and profiler orientation are independent of each other. |
|---|

Scan direction and profiler orientation features are found in the Data Output category in Z-Expert.

For further details on scan direction and profiler orientation, and for examples of different configurations, see application notes on the Teledyne DALSA web site.

## *Planning for unwanted light reflection or obstructed view*

Acquiring quality profiles entails planning for unwanted laser light reflections or acquisition blockages. The following examples depict a few potential issues to consider.

### Blocked measurement area

Consider cases where the image sensor may not have complete visibility over the required scan range, as in the figure below. In this case, the object may need to be scanned from two opposite directions to fully inspect the object, for instance by using 2 sensors head-to-head.

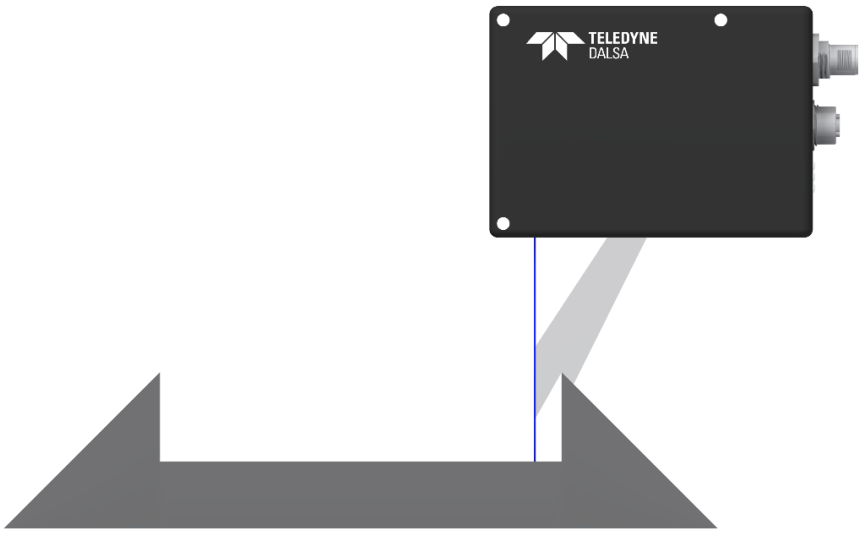



*Figure 14. The form of the object blocks the image sensor.*

### Object shape obscuring some areas

Certain objects like the spherical example below create areas where the laser is blocked. Scanning the object from two opposite directions in the Y-axis can form a more complete profile.

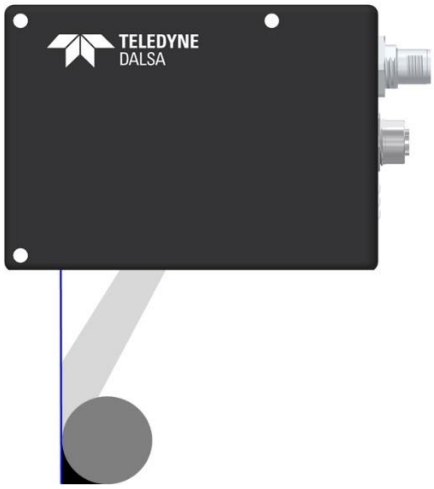



*Figure 15. The form of the object blocks the sensor from seeing the laser.*

### Objects made of reflective surfaces

Scanning reflective surfaces and oddly angled surfaces may scatter the laser light, making it difficult to obtain a clean line profile. The profiler may need to be pitched forward or backwards to change laser light reflection angles away from entering the profiler's image sensor window. Profiler positioning is dependent on the scanning situation.


*Figure 16. Reflective surfaces or objects with oddly angled surfaces may scatter the laser light back into the 2D sensor window, creating blurred profiles.*

## *Controlling ambient illumination*

Over its image sensor window, the profiler uses a narrow bandpass optical filter that is tuned to the laser wavelength (color) of the profiler model. This allows the Z-Trak2 to be used in most ambient light conditions without any measurement interference.

If the Z-Trak2 is used in a location with direct sunlight or any other type of bright full spectrum lighting, profiles may distort due to interference with the laser emission. Bright ambient light of wavelength close to that of the laser will pass through the 3D sensor filter and interfere with measurements.

Users need to control such ambient illumination conditions so that the laser line profiles are distinctly detected.

# Powering Z-Trak2 with PoE+

A PoE+ injector or a PoE+ Ethernet switch can be used to power Z-Trak2 devices. The picture below uses a PoE+ Ethernet switch. One or more Z-Trak2 units can be powered through a PoE+ switch.

For additional details see Cables and accessories.

| | |
|---|---|
|  | **Connect power via the I/O or PoE, not both**. Although Z-Trak2 has protection, differences in ground levels may cause operational issues or electrical faults. |

| | |
|---|---|
| | Heat management is a factor when using PoE+ with 5 GigE rates. See section Temperature management for details. |

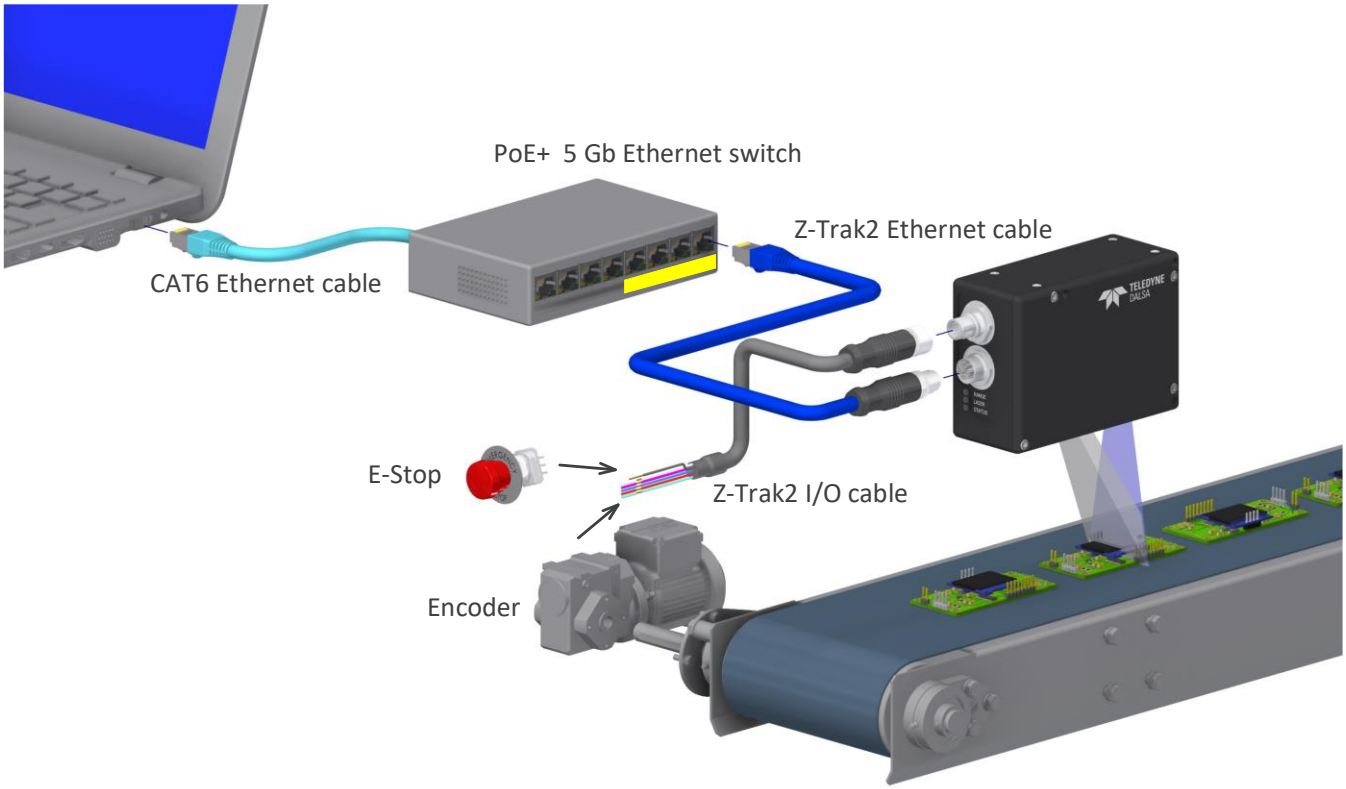



*Figure 17. General installation setup when using PoE+ to power the profiler.*

# Powering Z-Trak2 using a power supply

Z-Trak2 can be powered via its I/O connector using a 24 VDC power supply. See Power supply requirements (auxiliary power).

| | |
|---|---|
| | **Connect power via the I/O or PoE, not both**. Although Z-Trak2 has protection, differences in ground levels may cause operational issues or electrical faults. |

For additional details see Cables and accessories.

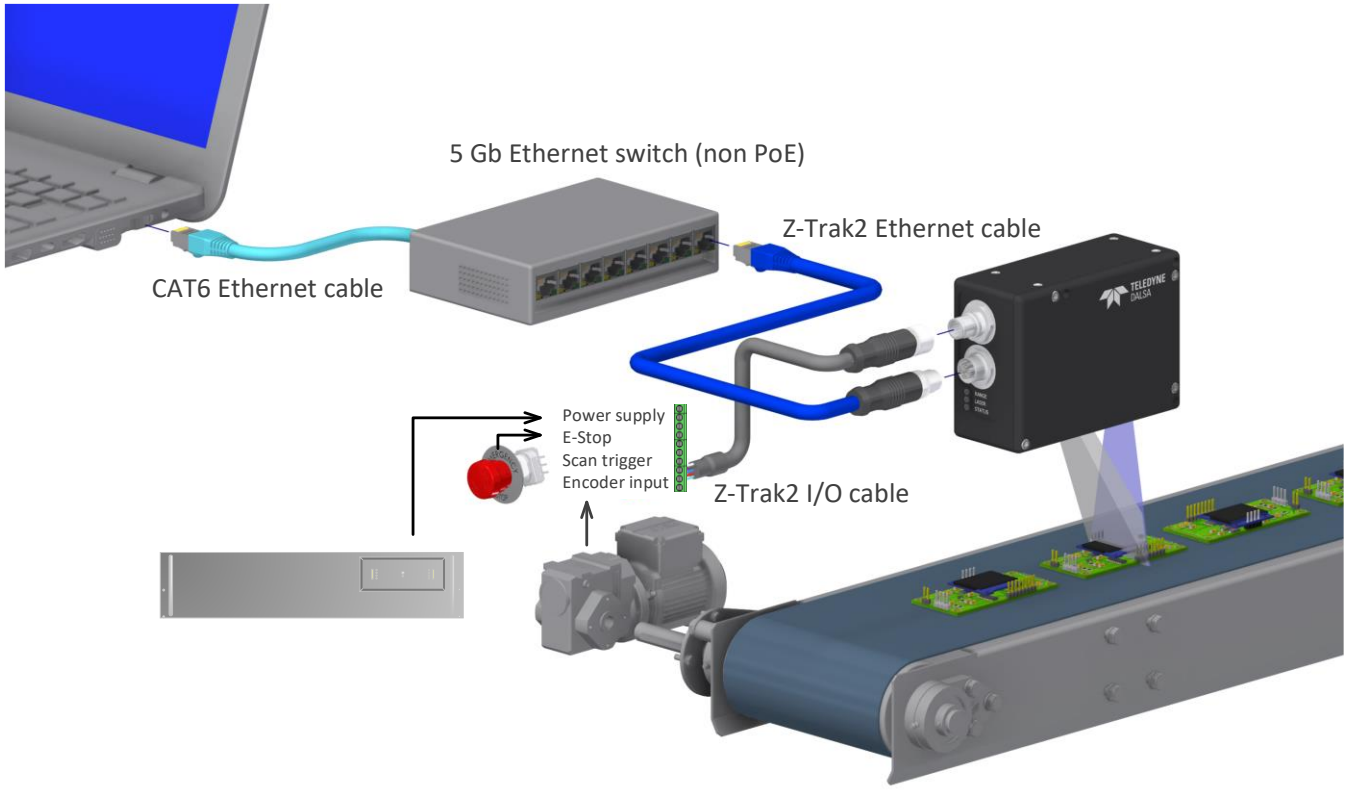



*Figure 18. General installation setup when using I/O cable to power the profiler.*

# Operating conditions

## *Temperature management*

Z-Trak2 profilers are designed to optimally transfer internal component heat to the outer metallic body. Heat management is achieved by mounting the profiler with metal screws onto a metal structure that conducts heat (which will act as a heatsink) via its mounting screw holes, and by providing the proper air flow. If the profiler is not mounted and has no means to dissipate heat, it may become very warm to the touch. Measurements are valid when the 3D sensor is used within recommended operating conditions.

**Z-Trak2 operating conditions (front plate)**

- Temperature: 10 °C to 50 °C (50 °F to 122 °F)
- Relative humidity: up to 90% (non-condensing)

**Z-Trak2 storage conditions**

- Temperature: -40 °C to 80 °C (-4 °F to 176 °F)
- Relative humidity: 20% to 80% (non-condensing)

The Z-Trak2 S-Series, when connected to a 5 GigE link, it will consume more power and therefore generate more heat.

| | |
|---|---|
|  | Z-Trak2 generates more heat when powered via PoE. Make sure the operating temperature of the unit is properly controlled. |

### *Continuous operation*

| | |
|---|---|
|  | The Z-Trak2 sensors are designed for operating 24/7 in stable ambient conditions when adequately mounted for heat management (see Temperature management). Repeated power up and power down can reduce the life span of the profiler. Except during installation or maintenance, make sure the device remains always powered up. |

### *Preventing faults due to electrostatic discharge (ESD)*

| | |
|---|---|
|  | Ensure Z-Trak2 housing is securely connected to earth ground to avoid damage to the device or intermittent failures during normal operation. |

Teledyne DALSA has performed ESD testing on profilers using a ±4 kV ESD contact generator and ±8 kV in air generator without any indication of operational faults. To prevent ESD problems, follow these guidelines:

- Mount the profiler on a metallic platform with a good connection to earth ground.
- When using Power over Ethernet Plus (PoE+), Teledyne DALSA strongly recommends using a shielded Ethernet cable to provide a ground connection from the controlling computer/power supply to the Z-Trak2 sensor. PoE+ requires a powered computer NIC, or a powered Ethernet switch, or an Ethernet power injector.
- Use a shielded/grounded power supply if not using PoE+ as stated above.

Installations that do not protect against electrostatic discharge (ESD) may exhibit operational faults. Problems such as random packet loss, random device resets, and random loss of Ethernet connections, may all be solved by proper ESD management.

# Software installation

Z-Trak and Z-Trak2 family of 3D profilers support GeniCam 3.0 and 3D data output formats as defined in SFNC 2.3. In addition, Z-Trak2 family also supports linescan 16-bit monochrome output mode; most third-party software packages like MVTec HALCON, Cognex VisionPro or NI MAX/LabVIEW, do not require any additional software components from Teledyne DALSA.

For initial setup, configuration, and profiler testing on Microsoft Windows systems, we recommend using Teledyne DALSA's Sapera LT software. Sapera LT is also required when using Teledyne DALSA's Sherlock package (see Sherlock—obtaining a license).

The Sapera LT software development kit (SDK) includes the following components: GigE Vision driver, Network Configuration tool, Z-Trak2 configuration tool called Z-Expert, as well as demos and examples with source code and documentation.

For the Linux platform, Z-Trak/Z-Trak2 are also supported by Teledyne DALSA's GigE-V Framework.

Both Sapera LT SDK and GigE-V Framework packages are available for download from Teledyne DALSA website www.teledynedalsa.com

This section discusses installation steps for Sapera LT.

# Installing Sapera LT SDK

The Sapera LT SDK version 8.7 development software provides everything you need to configure the Z-Trak2 profiler and acquire data in your applications. It includes the Sapera Network Imaging Package and GigE Vision Driver, the Sapera LT runtime and Z-Expert. Refer to the Sapera LT User Manual on how to develop applications with Sapera.

Sapera LT installs the 3D GigE Vision software and a software DHCP server for a NIC to be used with Z-Trak2.

The **Windows Firewall** exceptions feature is automatically configured by the Sapera LT installation, which allows the Sapera GigE Server to pass through the firewall.

Installing Sapera LT requires an administrator login.

**To install Sapera LT**

Before you start, make sure that the computer's hardware and video drivers are up to date. A reboot is recommended after installation.

1. Download Sapera LT SDK 8.7 or later from https://www.teledynedalsa.com/en/products/imaging/vision-software/sapera-lt/download/.
2. Double-click **SaperaSDKSetup.exe** to begin installation. Follow the instructions on screen.
3. On page *Sapera LT SDK — Installation of Sapera LT Acquisition Components*, select the **Teledyne DALSA 3D profile sensors**, which will also install the Sapera GigE Vision Driver and Z-Expert.
4. After installation, verify that the GigE Server tray icon appears in the notification area (show hidden icons). At this point, its status will be *No device found*.

# Network connection

Make sure Z-Trak2 is powered before proceeding (refer to Powering Z-Trak2 with PoE+ or Powering Z-Trak2 using a power supply.)

**To connect Z-Trak2 to the host computer**

1. Connect the Z-Trak2 unit to the host computer GigE network interface card (NIC) using the M12 X-coded to RJ45 Ethernet cable. If connecting Z-Trak2 through a network switch, connect the Z-Trak2 to the switch and then connect the switch to the NIC.
2. Check the **Status** LED, which is initially red then changes to flashing blue while waiting for an IP configuration. Once an IP is assigned, the LED will change to a steady blue. See section LED indicators for details.

## GigE server device status

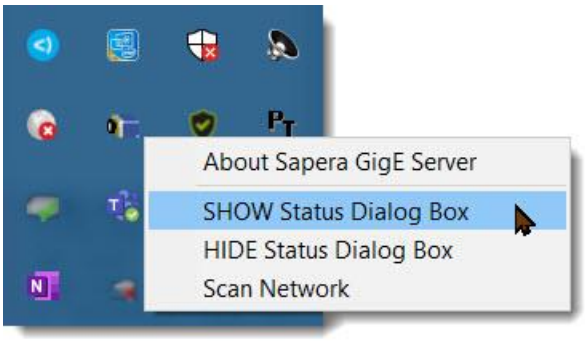
After a successful Sapera LT installation, the GigE Server icon is visible in the desktop notification area (tray).


| | Device available | Device IP error | No device found |
|---|---|---|---|
| **GigE Server notification area icon** |  The normal GigE Server icon that appears in the notification area when the device is found. It takes a few seconds for the GigE Server to refresh its state after the device has obtained an IP address. |  The GigE Server icon that appears in the notification area shows a warning when a device is connected but there is some type of IP error. |  A red X mark remains over the GigE Server icon when no device is found. This indicates that the device is not connected, or that there is a major network issue. |

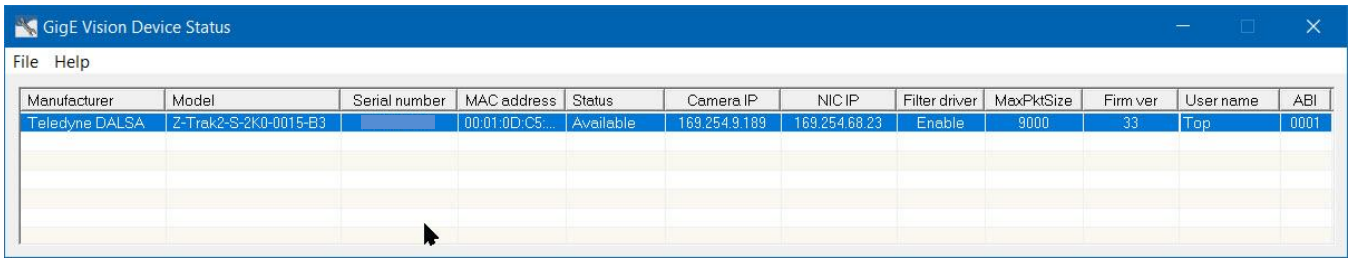
If you place your mouse cursor on this icon, the GigE Server will display the number of GigE Vision devices found by your computer.

Once the Z-Trak2 is connected and has been assigned an IP address (its Status LED is steady blue), the GigE Server icon will indicate that the device was found. It might take a few seconds for the GigE Server to refresh its state after an IP address is assigned. Note that the GigE Server periodically scans the network to refresh its state.

Right-click the GigE Server icon, then select **SHOW Status Dialog Box** to view information about the connected devices.




Each GigE device is listed by name, along with important information such as the assigned IP address. The screen capture below shows an available Z-Trak2 profiler.




- **Manufacturer, Model, Serial number, MAC address** – These properties refer to the specific Teledyne DALSA device that is connected.
- **Status** – May take the following values:
  - *Connected*. The device is connected to the host system.
  - *Available.* The device is not currently connected and is therefore available.
  - *Unavailable.* The device is already actively connected to another host system.
  - *GVSP unavailable.* The filter driver is not active on the NIC to which the device is connected.
  - *N.A*. The device status is unavailable or non-applicable.
  - ?. The device status value is invalid.
- **Firm ver** – Refers to the firmware version number that is loaded on the unit. Only the last digits are shown. The full version number can be found in the Profiler Management category.
- **User name** – Corresponds to the **Device User ID** provided by the user for the unit. This value defaults to the serial number of the device. (See Customizing the Device user ID.)
- **Camera IP, NIC IP** – Corresponds to the IP address assigned to the GigE device, and the IP address of the network adapter to which the device is attached, respectively.
- **Filter driver** – Indicates whether the Sapera GigE Vision Filter Driver is enabled, which filters incoming traffic for image packets. It must be enabled for GigE devices.
- **MaxPktSize** – Corresponds to the packet size in bytes that the device supports. Value is 0 if not connected.
- **ABI** – Application Binary Interface. Version of the interface exported by the filter driver.

## *Device IP error*

Sometimes the device is physically connected, but the Sapera GigE Server icon indicates that the connected device is not seen; this situation may arise if the device's IP address is not on the same subnet as the PC. Right-click the GigE Server icon, then select **Scan Network** to restart the discovery process, which will also include conflicting devices. After the scan, if the device is visible with the **Device IP Error** notification, then refer to section Network setup and device IP issues to determine how to recover the device.

# LED indicators

Z-Trak2 features 3 LED indicators to provide the device status of its activation, operation, and error state.


*Figure 19. The 3 LED indicators on the profiler: Status, Laser and Range.*

## *Status LED*

The Status indicator is a 3-color LED that provides information about initialization, connection, and readiness. Its various states are described in the table below.

| Status LED | Description |
|---|---|
| **LED is OFF** | No power to the profiler. |
| **Steady Red** | Initial state on power up before flashing. Remains as steady Red only if there is a fatal error. Profiler is not initialized. |
| **Flashing Red** | Initialization sequence in progress. |
| **Steady Red + Flashing Blue** | Fatal Error. If the profiler does not reboot itself, verify all connections and host computer requirements. |
| **Slow Flashing Blue** | Ethernet cable disconnected. The profiler continuously attempts to assign itself an IP address. |
| **Fast Flashing Blue** | File Access Feature is transferring data such as a firmware update, etc. |
| **Steady Blue** | IP address assigned. No application connected to the profile sensor. |
| **Steady Green** | Application connected. |
| **Flashing Green** | Acquisition in progress. |

### *Laser LED*

This amber color LED is ON when the laser is ON (laser activated and E-STOP is bypassed).

### *Range LED*

TBD.

## Z-Trak2 firmware

If a firmware update is required, Teledyne DALSA will provide the appropriate file. See section Updating firmware via File Access Dialog for details on how to install the firmware.

Z-Trak2 firmware contains open-source software provided under different open-source software licenses. More information about these open-source licenses can be found in the documentation that accompanies the firmware, which is available on the Teledyne DALSA website at www.teledynedalsa.com.

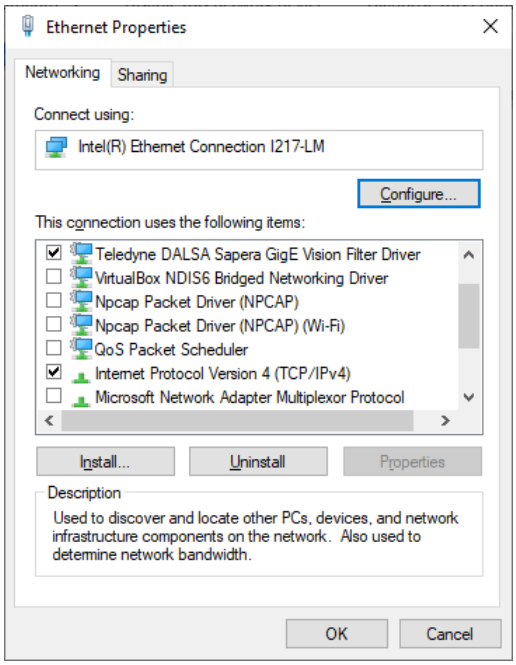
## Optimizing the network adapter used with Z-Trak2

Most gigabit network interface controllers (NICs) allow user modifications. These should be optimized for use with Z-Trak2. Use the following recommended settings (see details in section Configuring network adapter (NIC) for GigE Vision devices of the Appendix).

**For the host computer network adapter (NIC)**

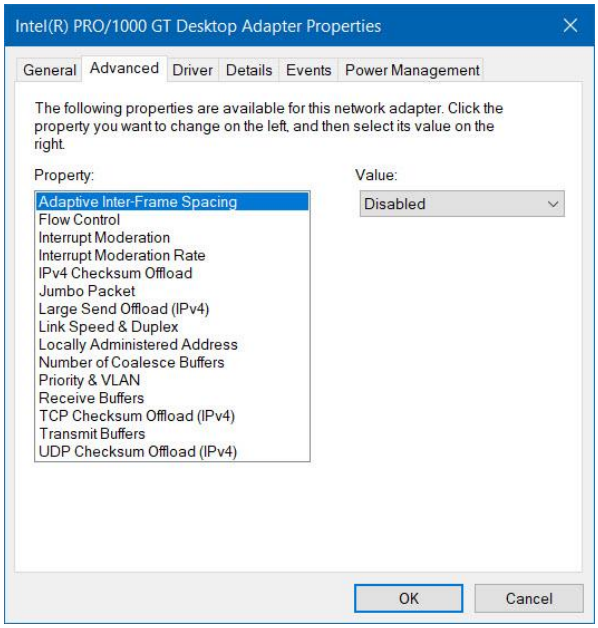
On the *Ethernet Properties* page, select only the following two items:

- **Teledyne DALSA Sapera GigE Vision Filter Driver**
- **Internet Protocol Version 4 (TCP/IPv4)**




Click **Configure** to access the *Adapter Properties* page. On the **Advanced** tab, configure the following parameters as indicated.

- Enable **Jumbo Packets** (Jumbo Frames).
- Enable **Flow Control** (choose *Rx and Tx Enabled*).
- Enable **Interrupt Moderation**.
- Choose an **Interrupt Moderation Rate** (*Extreme* or *Off*).
- Disable **Large Send Offload (IPv4)**.
- Maximize **Receive Buffers** and **Buffer Descriptors**, if available.
- Adjust the **Receive Side Scaling Queue** for best performance (for processing intensive applications the optimal value may not be the maximum value), if available.



**For the host application**

- Maximize the number of image acquisition buffers.

**For any switch**

- Maximize the memory allocated to internal buffers (if available).
- Enable PAUSE frame support (if available).

| | |
|---|---|
|  | It is recommended that the packet size be adjusted accordingly for optimal performance given the network topology (with or without a switch), when using packet sizes within the 1500 to 3000 and 4000 to 8000 ranges.<br><br>For example, certain switches might perform better using a packet size of 4096 bytes instead of 9000 bytes. |

| | |
|---|---|
|  | Some Ethernet switches may produce more Pause Frame requests than expected when Jumbo Frames is enabled. Changing the Ethernet Packet Size may minimize Pause Frame requests from such a switch and improve overall transfer bandwidth. |

Ethernet cable category (CAT6, 7), manufacturer, quality and length can also affect performance.

For additional information, refer to the *Network Imaging Package for Sapera LT Optimization Guide*, which is included with the installation of Sapera LT.

# Multiple Z-Trak2 profilers on a switch

Multiple profilers can be connected through a Gigabit Ethernet switch. When using VLAN groups, the Z-Trak2 and controlling computer must be in the same group (refer to the *Network Imaging Package for Sapera LT Optimization Guide*).

# Using Z-Trak2 with supported third-party software packages

If Z-Trak2 is used in a **third-party GigE Vision-compliant environment**, refer to the appropriate application note for the supported packages for installation details.

- 3D-L-AN0002 Using Z-Trak with MVTec HALCON HDevelop

Please contact tech support or visit website/application notes for third-party packages.

# Introduction to Z-Expert

The Sapera **Z-Expert** utility is an intuitive graphical user interface (GUI) whose purpose is to facilitate configuration and testing of the Z-Trak2 setup, and to provide live display of profiles and 3D surfaces.

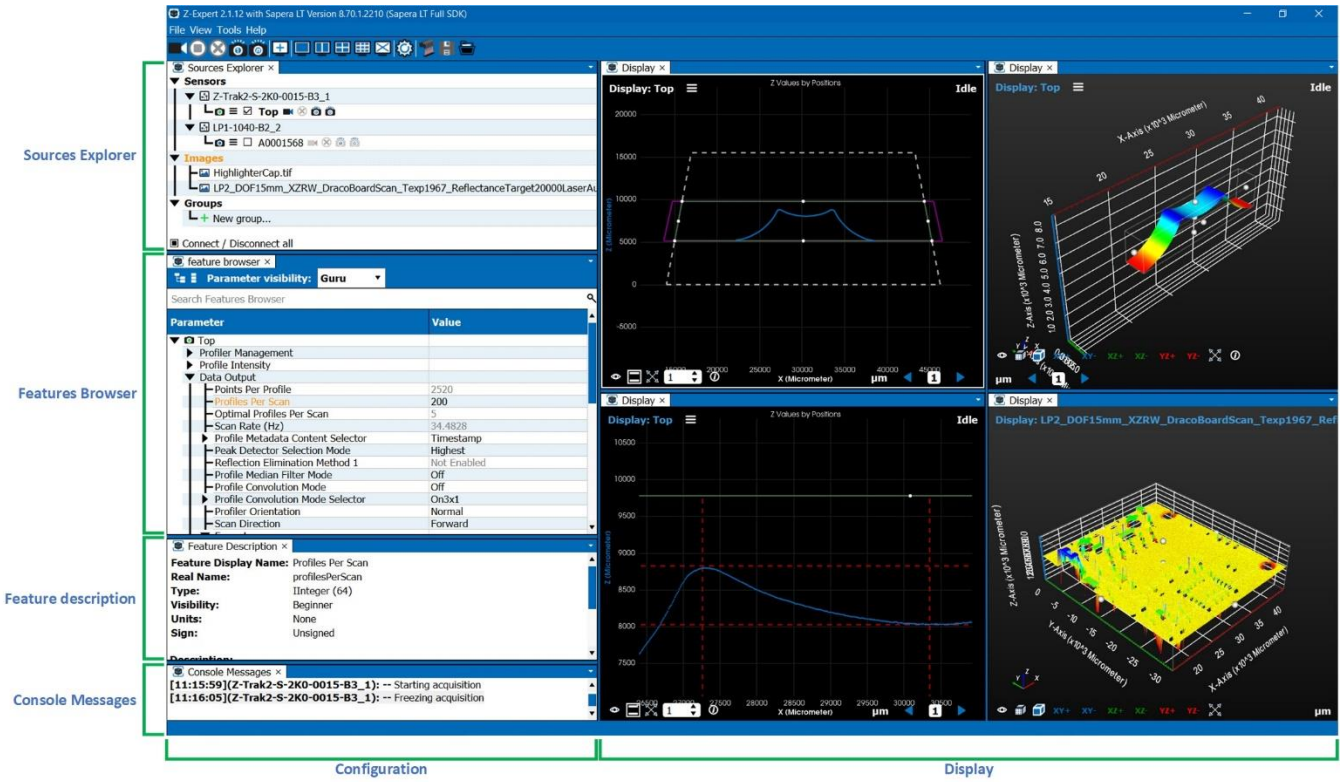
Z-Expert can save data as 3D images using industry standard point cloud formats like STL, PLY, and so forth.

When using multiple sensors, Z-Expert also provides a step-by-step process to create a unified measurement space. It can configure up to 16 sensors in a variety of topologies using user-defined alignment targets. See also chapter Multi-sensor systems.

The Z-Expert context-sensitive help (opens in a browser) is available using the F1 key from anywhere in the interface. Please refer to it for detailed information on the use of Z-Expert, as this chapter offers an overview of the application.

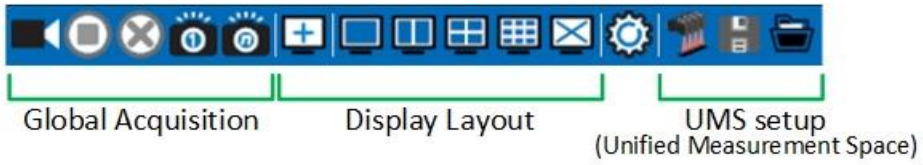
# Overview of Z-Expert GUI

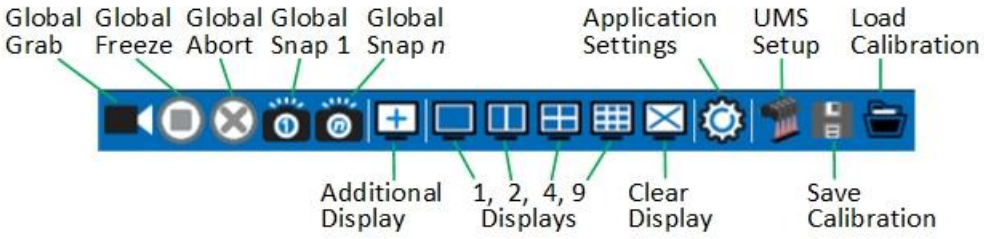
Z-Expert interface consists of a configuration section to set the features your 3D sensor(s), and a display pane to show the results of acquisitions. The different windows of the configuration section can be hidden/shown, resized, and reorganized within the interface (pane, standalone window, etc.).




# Toolbar

The toolbar provides quick access to often-used commands.



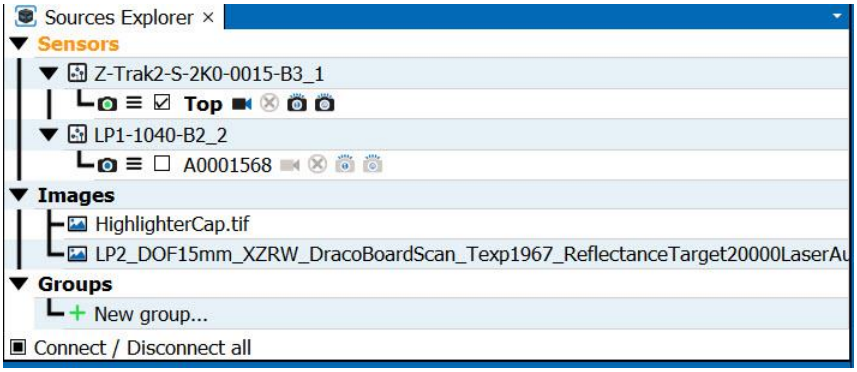



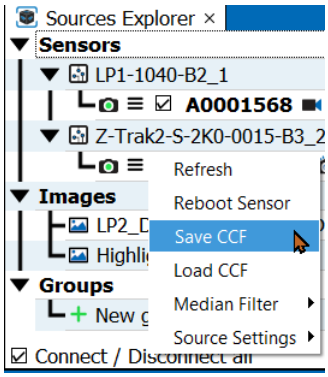
# Sources Explorer

The **Sources Explorer** pane displays all acquisition sensors available in the system (including any unsupported GigE devices) and loaded images, if any. It also includes any groups defined, which are useful for multi-sensor synchronization or UMS creation (see Multi-sensor systems), but which can be used to change features on multiple sensors in one step.

Use the **Sources Explorer** to:

- Connect or disconnect one or more profilers.
- Start or stop a continuous acquisition (grab). The result is stored in a buffer, whose content can be shown in the display pane.
- Snap one or *n* scans. The number of scans *n* is determined by the buffer count of a sensor (default is 3). A scan may consist of a single profile or of many profiles.
- Load or save the configuration settings of a device (CCF, camera configuration file).
- Manage groups of sensors.



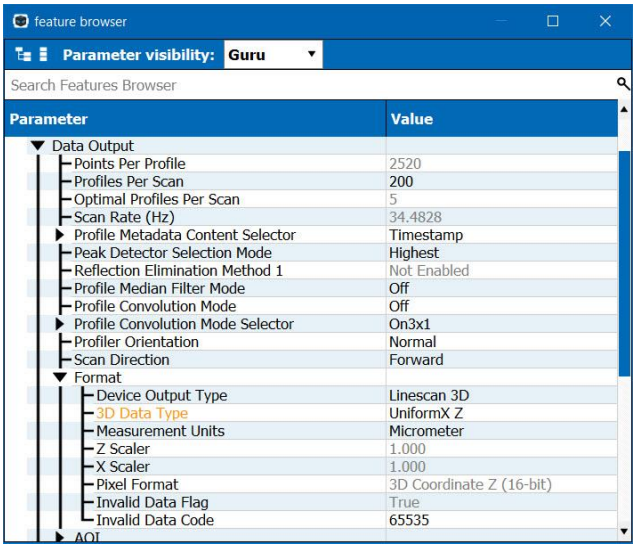

# Features Browser and Features Description

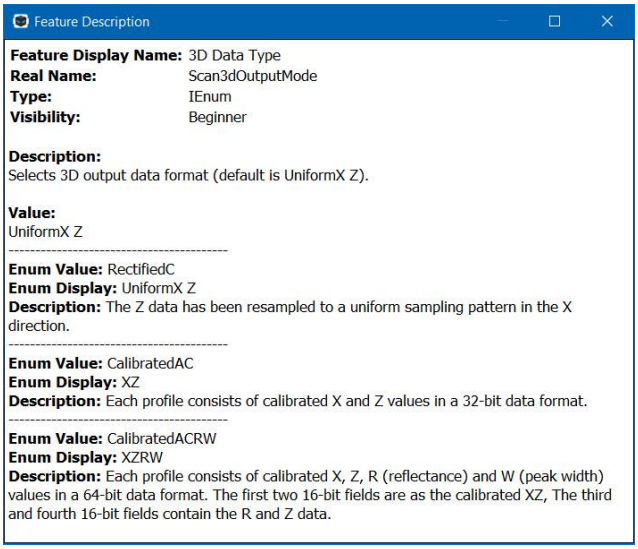
The **Features Browser** pane allows viewing or changing the features (parameters) supported by the acquisition sensor. Features are organized by categories; available categories and features are sensor dependent. Many of the features are always modifiable, some are read-only, and others may be changed depending on other settings. Several Features Browser windows can be open, for example one for each connected sensor.

The **Features Description** pane provides information on a selected feature. You can open the Features Description pane from the **View** menu.

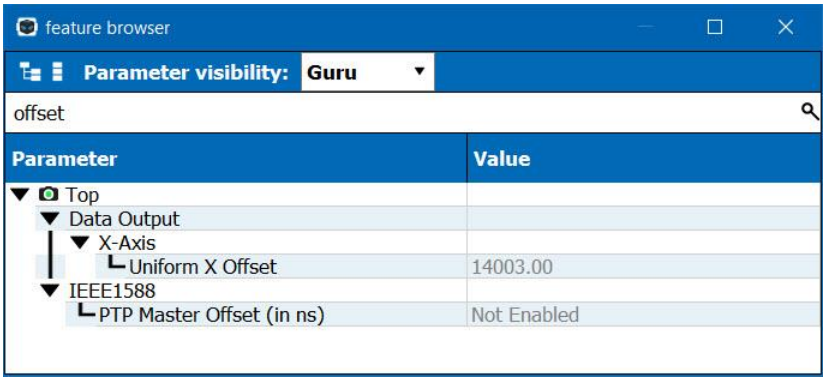
Use the **Features Browser** to:

- View or modify the current parameter settings of your sensor. See section Z-Trak2 features reference for details.
- Display information about a selected parameter, such as its description and possible values, in the Feature Description pane.



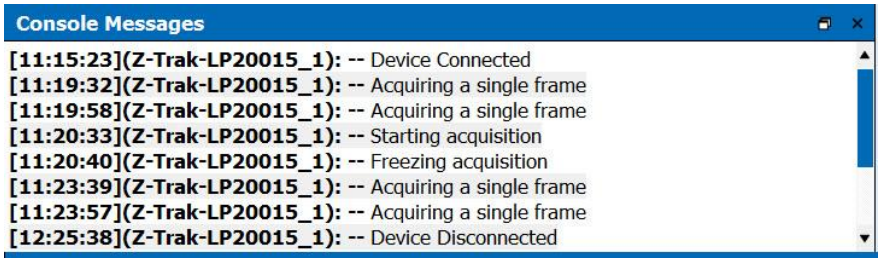

- Search for a feature with the **Search Features Browser** box. The parameters and categories that contain the search string will be shown in the parameter list.




- Choose the visible parameters according to the level required for use with the **Parameter visibility** list. You can choose among **Beginner**, **Expert**, **Guru**.
- Update the sensor firmware. See section Updating firmware via File Access Dialog.

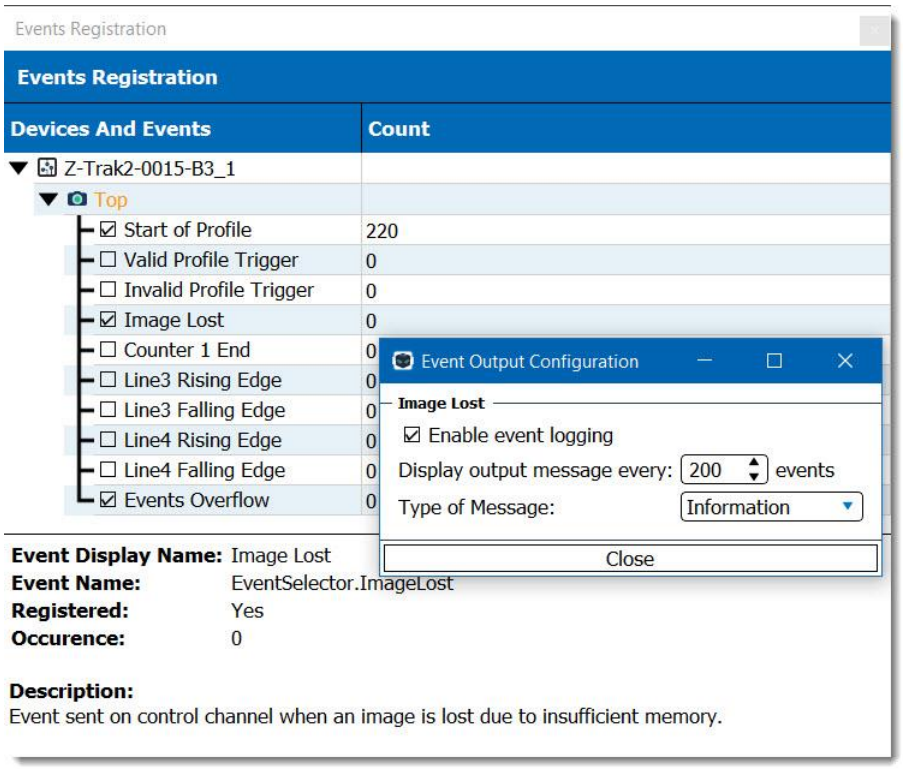
# Console Messages

The **Console Messages** pane displays displays information, warning and error messages generated by the Z-Expert application.



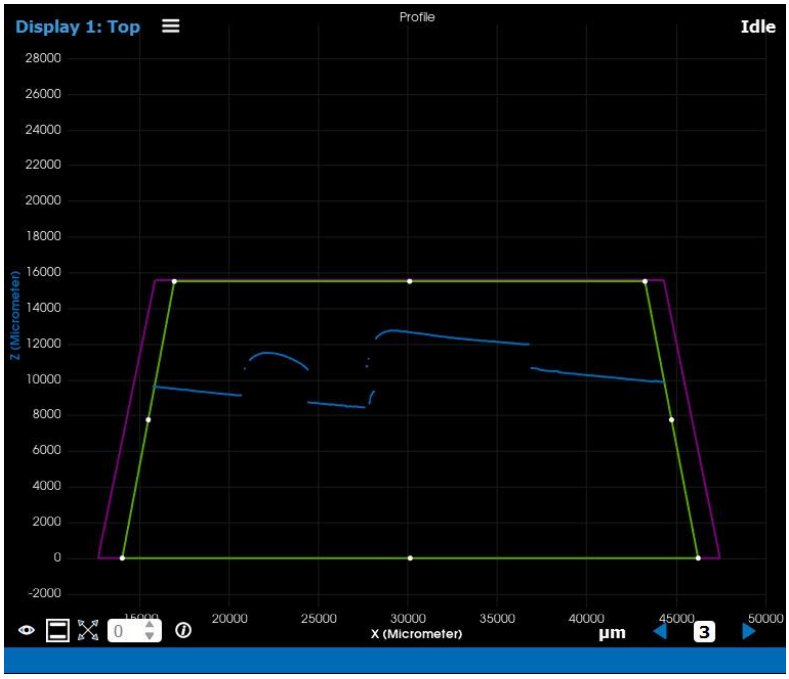
# Events Registration

The **Events Registration** pane is used to enable event monitoring and event logging. See Monitoring events.




# Display pane

The display pane renders the result of a grab or snap. The pane may display up to 9 concurrent views, and even more with standalone display windows. Select the number of views from the Z-Expert toolbar. A menu within each view can be used to change display settings.

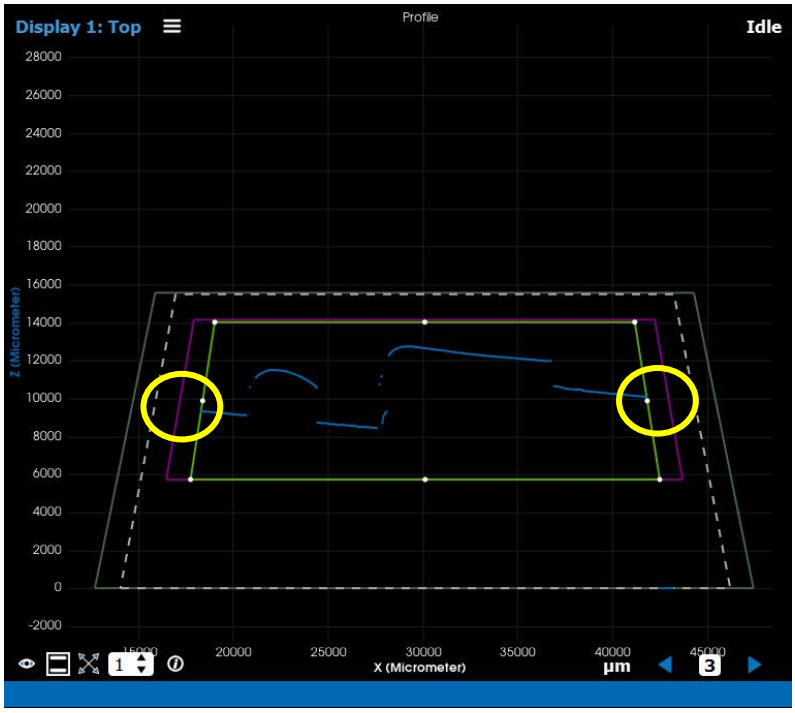



In this profile, the measurement AOI is depicted in bright green, and corresponds to the measurement area, i.e., the largest area where measurements can take place. The purple trapeze indicates the sensor area that is used. The object profile is in blue.

The X-axis coordinates appear at the bottom, and the Z-axis values on the left. The auto-hide menu at the top provides access to various display settings.

Tips:

- Put the pointer on the profile to display the X and Z values.
- Use the mouse wheel to zoom in or zoom out the profile.
- Drag the profile to change its location in the window.



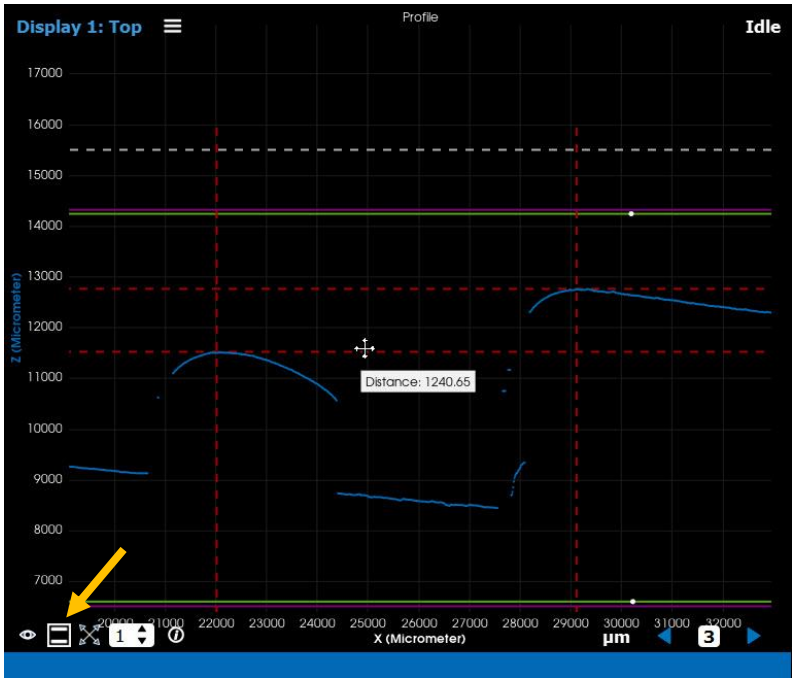

The measurement AOI from the above capture was reduced by dragging the handle points.

The area within the white dotted line represents the original size of the measurement area.

Another snap was done. Notice that the portions of the profile outside the measurement AOI were not recorded.

Tips:

- Drag the handles of the measurement AOI to change its dimensions.
- Drag the handles of the measurement AOI beyond the white dotted lines to recover the entire measurement area.

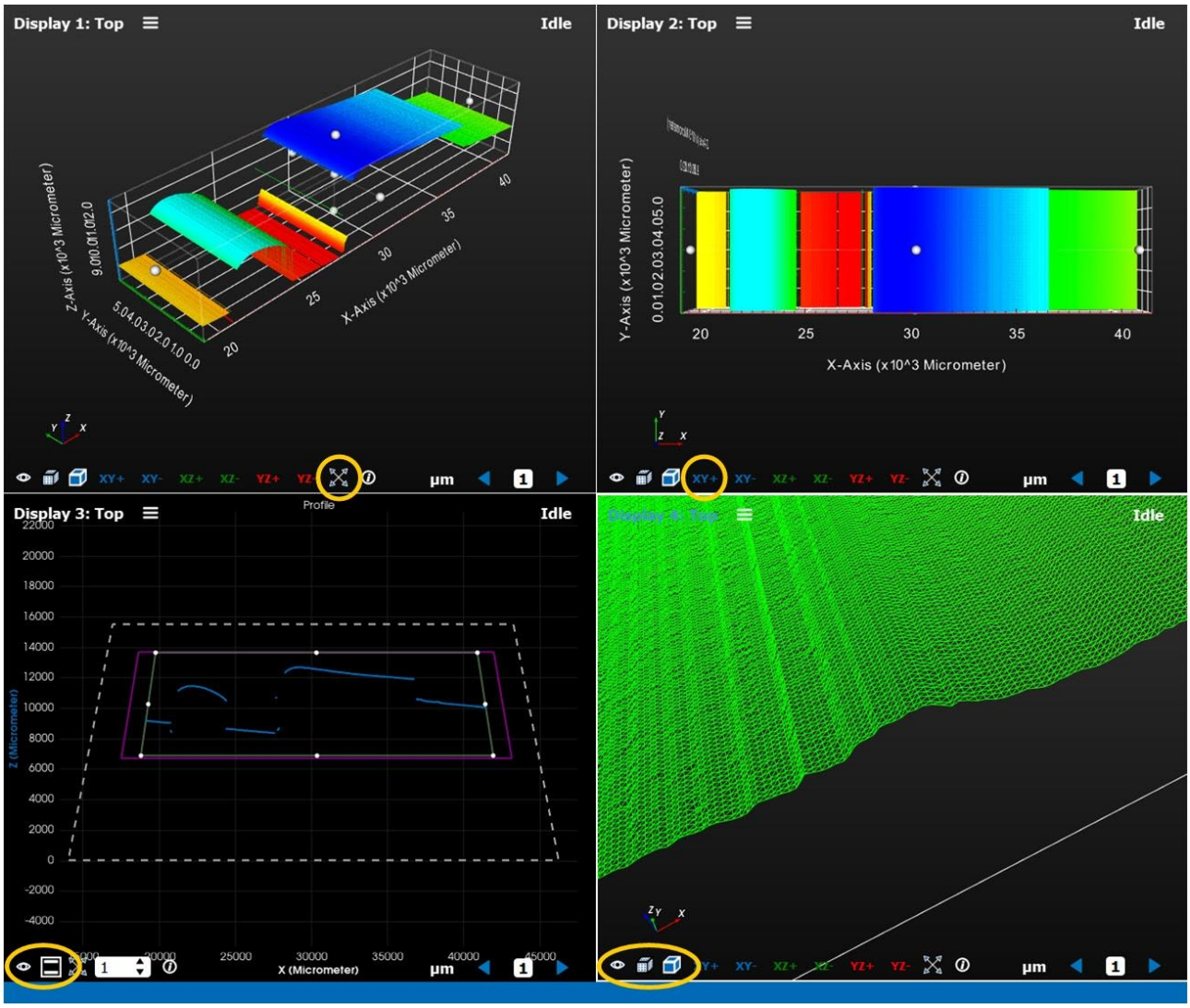



This view depicts a zoomed profile with four added distance cursors—two vertical and two horizontal, in dotted red. The color of the distance cursors can be changed from the menu for a better view.

Drag each cursor within the measurement area to points of interest. Put your pointer on a cursor line to display the distance between the two parallel lines.

Tips:

- To show the distance cursors, click the **Toggle Distance Cursor** icon at the bottom left of the view.
- Zoom in to place the cursors more precisely.




These 4 views depict a 500-profiles scan. Display 1 shows the default view. Tips:

- Use the mouse wheel to zoom in and out.
- Use the Shift key while dragging to move the entire surface.
- Drag the surface to rotate it freely around the rotation point of the surface (by default, the center handle, display 2).
- Use the Ctrl key while dragging to rotate the surface around the rotation point in the display plane.
- Use Alt-click to change the location of the rotation point.
- Use the different handles to change the proportions of the surface.
- Click the 4-arrow icon at the bottom to reset the view (display 1).
- Click **XY+**, **XY-**, **XZ+**, **XZ-**, **YZ+** or **YZ-** to display your surface in the chosen plane (display 2).
- Drag the XYZ axes at the bottom left of a view window to rotate your surface.
- Use the view icon (bottom left) to select a representation—profile, reflectance, surface (displays 3 and 4). Other settings are available depending on the chosen representation.

# Using Z-Expert

Below are some of the various tasks you can accomplish using Z-Expert for configuration and acquisition.

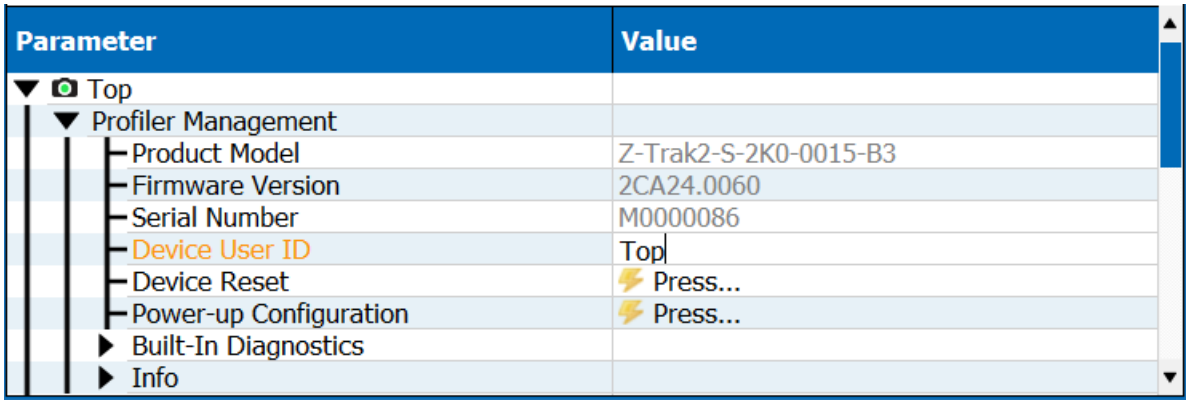
## Customizing the Device user ID

The Z-Trak2 can be programmed with a user-defined name to facilitate the identification of a profiler when several devices are connected to the network. The default value for the device user ID of a profiler is its serial number.

**To change the Device User ID feature**

- Open the **Profile Management** category and change the Device User ID value.

Tip: Use a descriptive, easy to remember name, or its location in a system, such as "Top View" and "Bottom View".



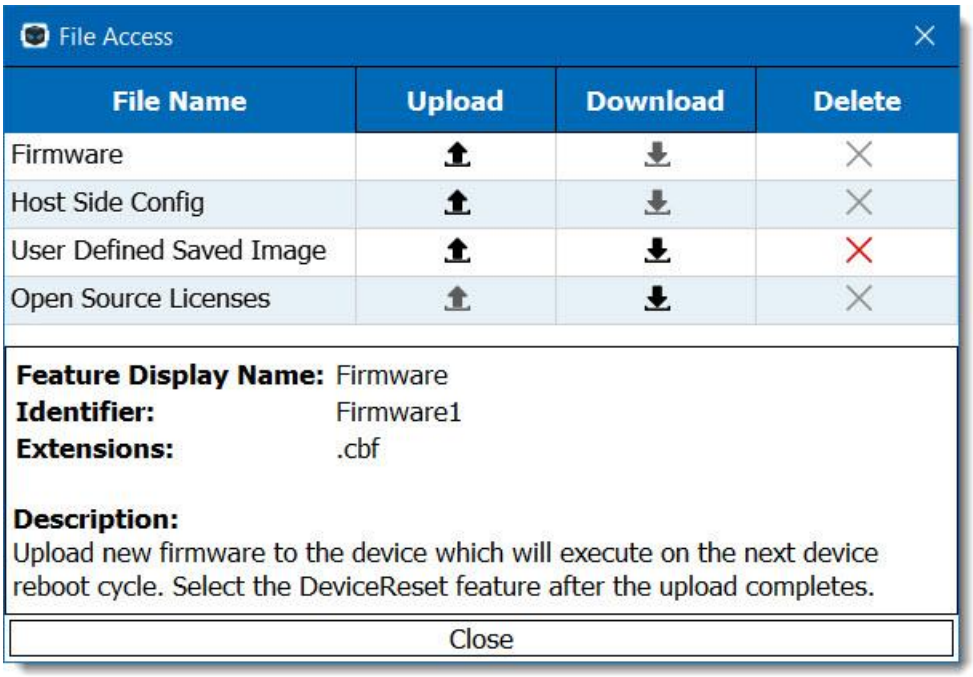

## Updating firmware via File Access Dialog

Download the latest firmware for the Z-Trak2 from the Teledyne website.

**To update the Z-Trak2 firmware**

1. Open the **File Access Dialog** category.
2. Next to the Upload/Download Dialog feature, click **Press**.

3. In the *Upload/Download Dialog* window, next to Firmware, click the **Upload** icon.




4. In the *Open Directory* window, select the new profiler firmware (.cbf extension) to upload and click **Open**.
5. After the upload completes, reset the device.

# Working with groups

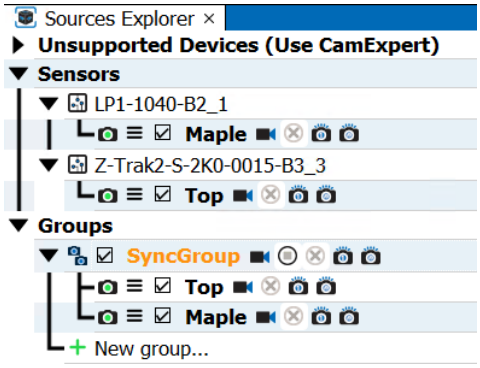
The Sources Explorer allows you to create groups of sensors whose features may be set for all members in a single location. Settings can then be coordinated, and acquisition done for the whole group.

You may create several groups for different purposes:

- To create a unified measurement space (UMS).
- To set features on several devices in a single step.
- To start/stop acquisition on several devices, whether synchronized or not.
- To perform other actions on all member devices:
  - Load a power-up configuration
  - Reset the devices
  - Upload firmware
  - Save the the group's settings in a file
  - Save device buffer metadata
  - Etc.

Note that for UMS, the devices must belong to a group.

A group appears as a device in the Feature Browser, but only a subset of all parameters is available for modification. Setting a parameter in a group changes the parameter value of all included devices; the other parameters must be set individually. The features browser also highlights the values that differ between the devices. Note that parameters do not need to be identical in all devices for acquisition to take place.




| Parameter | Value |
|---|---|
| Maple | |
| Top | |
| SyncGroup | |
| Profiler Management | |
| Device Reset | Press... |
| Power-up Configuration | Press... |
| Profile Intensity | |
| Laser Activation | Strobed |
| Laser Control Mode | Manual |
| Laser Power | 200 |
| Current Profile Rate (Hz) | Not Enabled |
| Profile Exposure Time (in us) | <Different Values> |
| Reflectance Threshold | <Different Values> |
| Data Output | |
| Profiles Per Scan | <Different Values> |
| Format | |
| Device Output Type | Linescan 3D |
| 3D Data Type | UniformX Z |
| Measurement Units | Micrometer |
| X-Axis | |
| Uniform X Step Size | 12.00 |
| Encoder Input | |
| Encoder Source B | Line 2 |
| Encoder Direction | Forward |
| Encoder Divider | 1 |
| Current Profile Rate (Hz) | Not Enabled |
| Encoder Reset | Press... |
| Displacement Between Samples Y | <Different Values> |
| Encoder Profile Trigger Mode | Any Direction |
| Trigger Input | |
| Trigger Mode Selector | Profile Trigger |
| Trigger Enable | <Different Values> |
| Software Trigger | Not Enabled |
| Trigger Start Source | Not Enabled |
| Trigger Start Input Line Activation | Not Enabled |
| Trigger Delay | Not Enabled |
| Multi Sensor Sync | |
| Sync Mode | On |
| Sync Group | 1 |
| GPIO | |
| Line Inverter | False |
| Input Line Debouncing Delay | 0 |
| IEEE1588 | |
| PTP Mode | Automatic |
| File Access Dialog | |
| Upload/Download Dialog | Press... |

*Figure 20. (Left) Sources Explorer with the SyncGroup. (Right) The Features Browser with all parameters that may be set for the group.*

Group settings may be saved in a .group file using the group's shortcut menu in the Sources Explorer, and loaded using the **File** > **Load Group** command. The devices' parameters will be set to the parameter values of the .group file.

Acquisition for all member devices may be done using the acquisition controls next to the group name.

# Loading or saving 3D sensor settings

If the current parameter settings of a device are optimal for a task, they can be saved in two ways: in a power-up feature set stored on the device, or in a camera configuration file (.ccf).

Power-up settings are used when the 3D sensor powers up or is reset. These settings are saved in non-volatile memory on the profiler itself. There are 3 feature sets; one is the default factory setting, and the other two are user settings. Users can choose a default power-up configuration among those 3 sets, load a previously saved configuration, or save their current configuration.

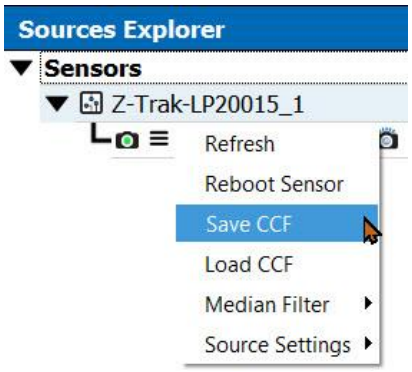
Camera configuration settings can be loaded on a connected device from a camera configuration file. They overwrite the current parameter settings of the device, but are not stored on the profiler, and as such, they need to be reloaded when the device is restarted. Any number of configuration files may be saved for different tasks.

## Using a configuration file

**To save Z-Trak2 configuration settings in a file**

1. In the **Sources Explorer**, select the device for which to save the current configuration.
2. On the device shortcut menu, choose **Save CCF**.
3. Choose a location and filename, then click **Save**.

The configuration is saved in a file with a .ccf extension.




**To load Z-Trak2 settings from a file**

- To load a saved configuration, choose **Load CCF** from the device shortcut menu and select a .ccf file.

# Using a power-up configuration

**To choose a power-up configuration**

- In the **Profiler Management** category, next to Power-up Configuration, click **Press**.

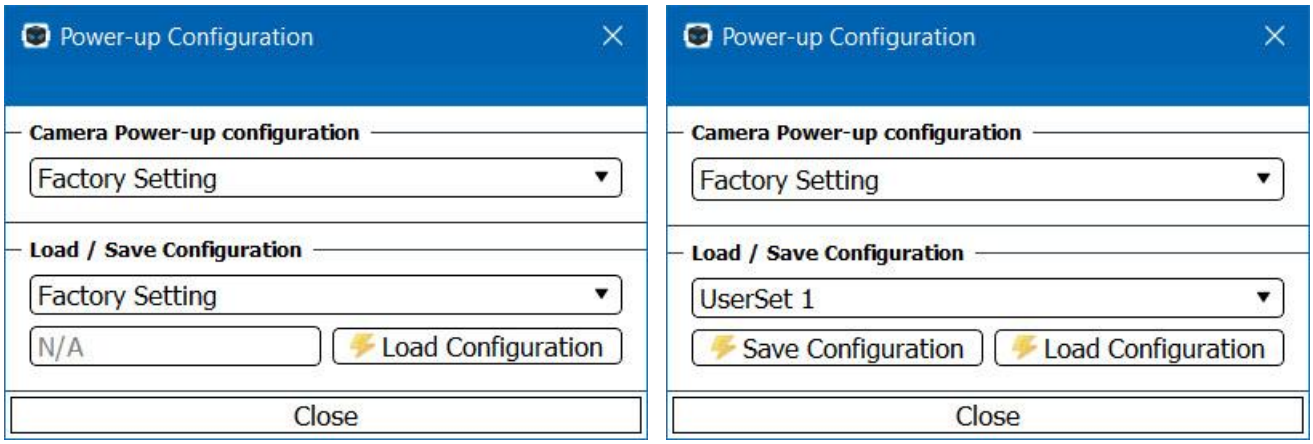



*Figure 21. Power-up dialog for choosing, loading, or saving power-up settings.*

**Camera Power-up configuration**

The **Camera Power-up configuration** list allows the user to select the default device configuration on power-up (see feature *UserSetDefaultSelector*).

- From the list, select between *Factory Setting*, *UserSet 1* or *UserSet 2*.

**Load / Save Configuration**

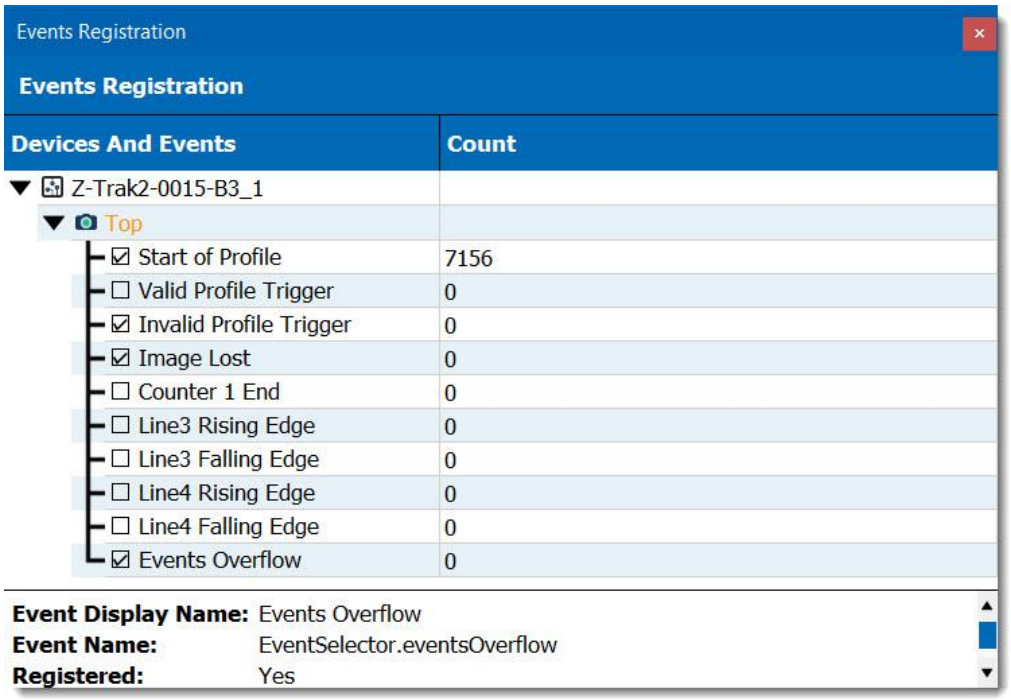
The **Load / Save Configuration** list allows the user to change the device configuration any time after power-up (see feature *UserSetSelector*).

- To reset the device to the factory configuration, select *Factory Setting* and click **Load Configuration**.
- To restore a saved configuration, select the appropriate user set and click **Load Configuration**.
- To save the current device configuration, select *UserSet 1* or *UserSet 2* and click **Save Configuration**.

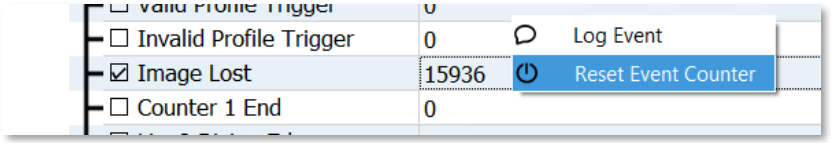
# Monitoring events

Z-Expert provides a dialog to easily monitor common events in real time.

- On the Z-Expert menu bar, select **View** > **Events Registration**.



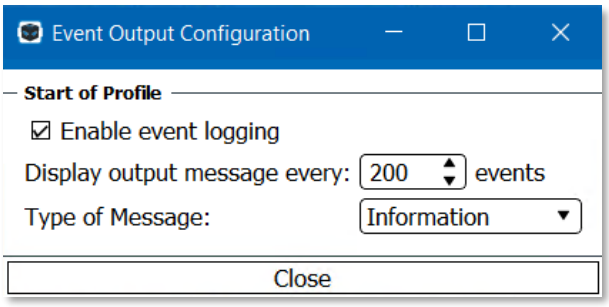

Select the events to monitor during Z-Trak2 operation. While an event remains selected, its count will continue to be updated even if the *Events Registration* window is closed. The count of an event may be reset from its shortcut menu.

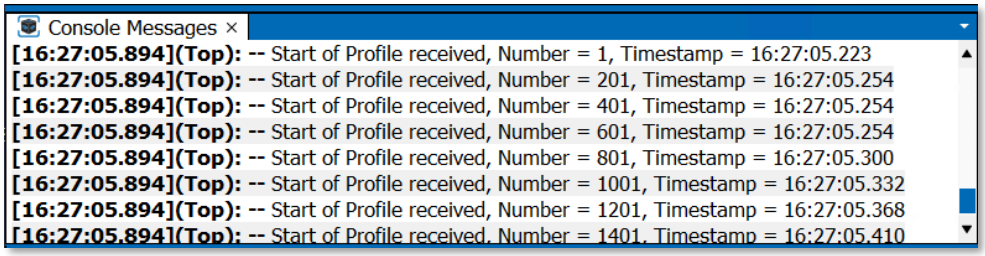



To alert users on potential issues, event occurrences can be displayed in the Console Messages pane.

**To display event occurrences on the Console Messages**

1. Open the event's shortcut menu and select **Log Event**.
2. In the *Event Output Configuration* dialog, click **Enable event logging**.
3. Modify the other settings as desired. From then on, the sensor, name of the event, count and timestamp will be displayed in the console at the specified rate. An event qualified as *Error* will be shown in red, a *Warning* in yellow.



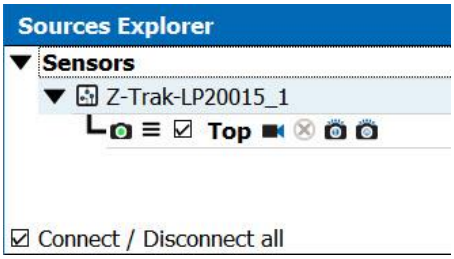

# Setting acquisition parameters

Below are examples of settings you can use to test your Z-Trak2 laser profiler with Z-Expert. Make sure the **Features Browser** is open.

## Acquiring a profile

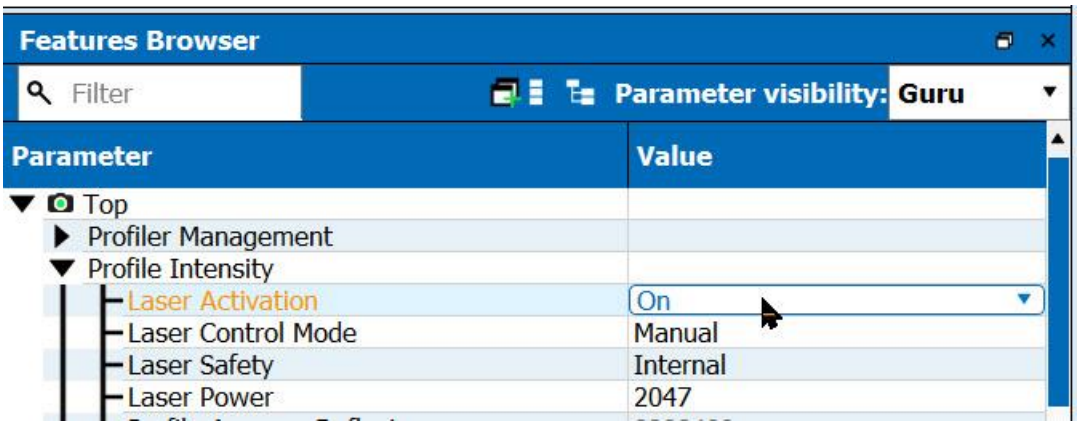
**To acquire a single profile**

1. From the Z-Expert **Sources Explorer**, select a sensor.

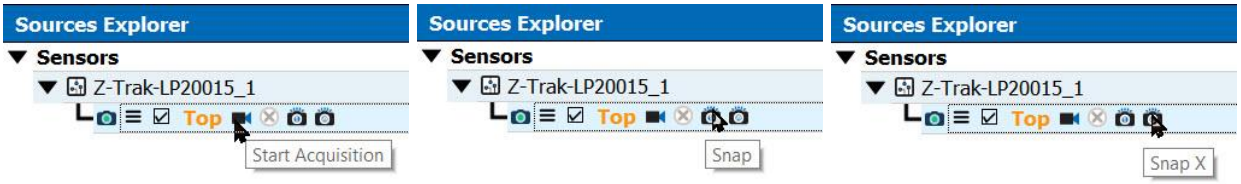



2. In the **Data Output** category of the Features Browser, set Profiles Per Scan to *1*.
3. In the **Format** subcategory, set as indicated:
   i. Device Output Type = *Linescan3D*.
   ii. 3D Data Type = *UniformX Z*.
   iii. Measurement Units = *Micrometer*.

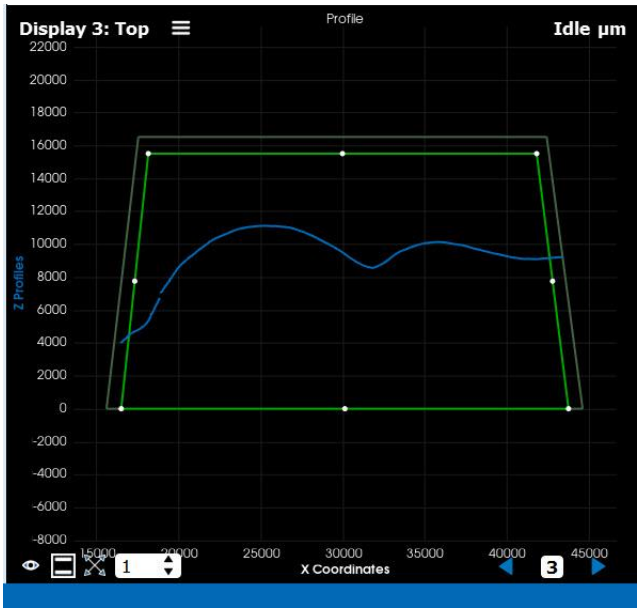
4. In the **Profile Intensity** category, set as indicated:
   i. Laser Safety = *Internal* (if permitted by local regulations).
   ii. Laser Activation = *On* (activated continuously) or *Strobed* (activated during acquisition only).




5. Click on an icon next to the sensor to start acquisition (Start/Stop Acquisition, Snap, or Snap X, which will snap as many profiles as the sensor's buffer count).




6. From the Sources Explorer, drag and drop the sensor name on the display area to view the result of the acquisition.



# Creating a 3D surface view

A 3D surface view is created by performing a scan, i.e., by acquiring multiple profiles in a single buffer.

To perform a scan, set the value of the Profiles Per Scan feature to greater than 1, for instance 200 (see Data Output features).

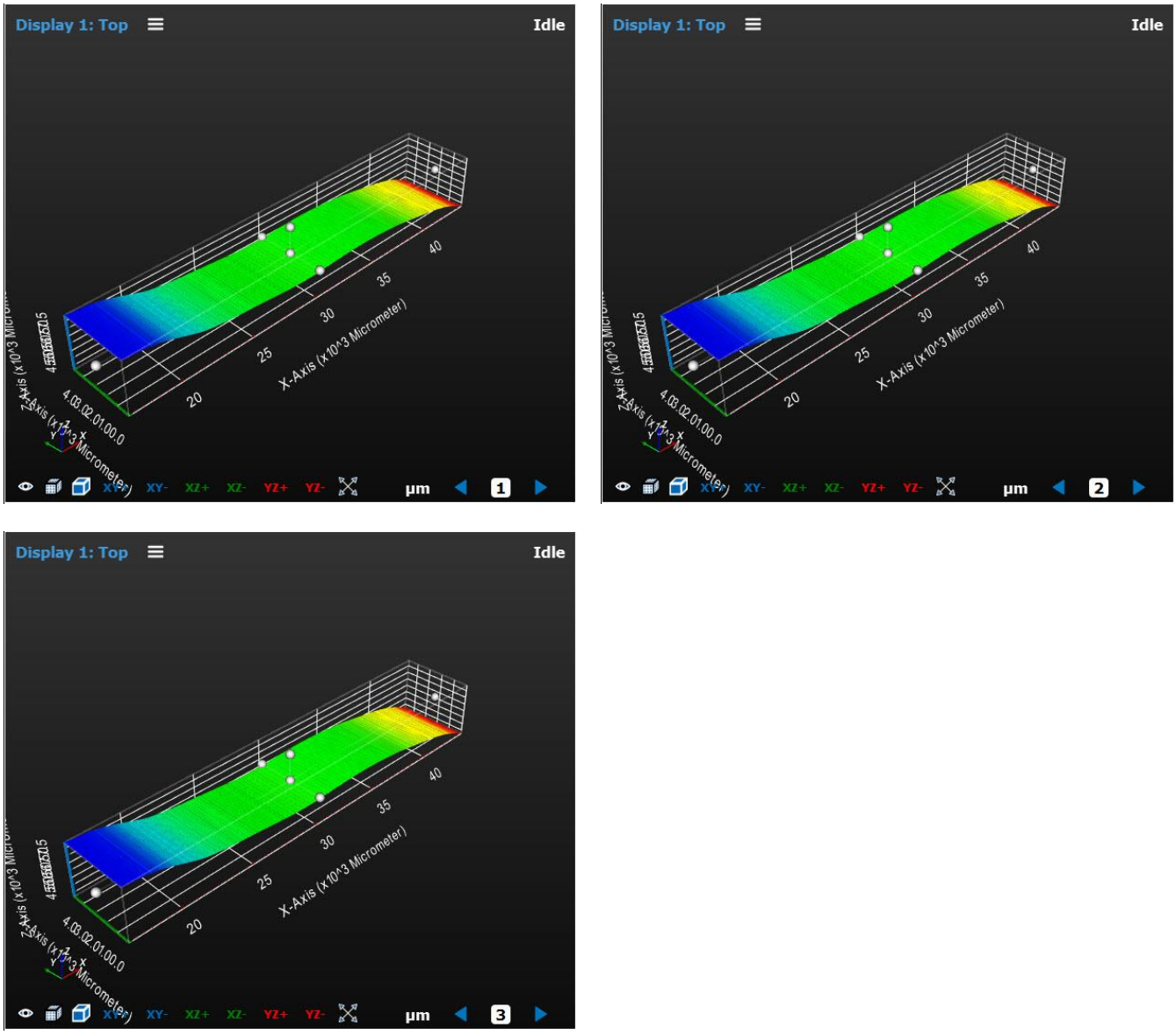



*Figure 22. Acquisition of 3 scans of a fixed object using the Snap X command (sensor buffer count = 3). Each scan contains 200 profiles. Note the buffer index in the bottom right corner of the display view.*

## *Fixed scan vs. variable scan*

The number of profiles stored in a buffer can be determined in advance (fixed) or not (variable).

- **Fixed scan**: the number of profiles is determined by the Profiles Per Scan feature. A single trigger starts acquisition.
- **Variable scan**: the number of profiles is not precisely known. A start trigger and a stop trigger (optional) are used; the number of profiles is determined by the interval between the triggers, unless the Profiles Per Scan value is reached, which will stop acquisition implicitly.

The acquisition of each profile within a scan is triggered either by a software event or more commonly by an evenly-spaced trigger such as an external quadrature shaft encoder source, a positional 3D sensor or other external signal trigger source driven by the moving platform where the object being scanned rests, or by the moving 3D sensor mount. Movement is in the scan direction (Y-axis). See Trigger Input features and Encoder Input features.

# Adjusting laser intensity for optical performance

Setting laser intensity for best measurement is the result of a balance between laser power, exposure time, gamma and HDR (high-dynamic range) settings. The goal is to produce an image with reflectance values that are not too saturated nor too dark.

1. In the **Data Output** category, set Profiles Per Scan to any valid value.
2. In the **Data Output Format** subcategory, set Device Output Type to *XZRW*.
3. Take a snap of the object. Reflectance should be shown as in figures below (if you don't see reflectance results, then on the Display menu, select **Profiles** > **View** > **Reflectance** > **Show**).
4. In the display pane, look at the distribution of the reflectance values.
5. In the **Profile Intensity** category, adjust the Laser Power and/or Profile Exposure Time values so that reflectance values over the profile are not too saturated nor too low.
6. Repeat steps 3-5 until reflectance values are satisfactory.

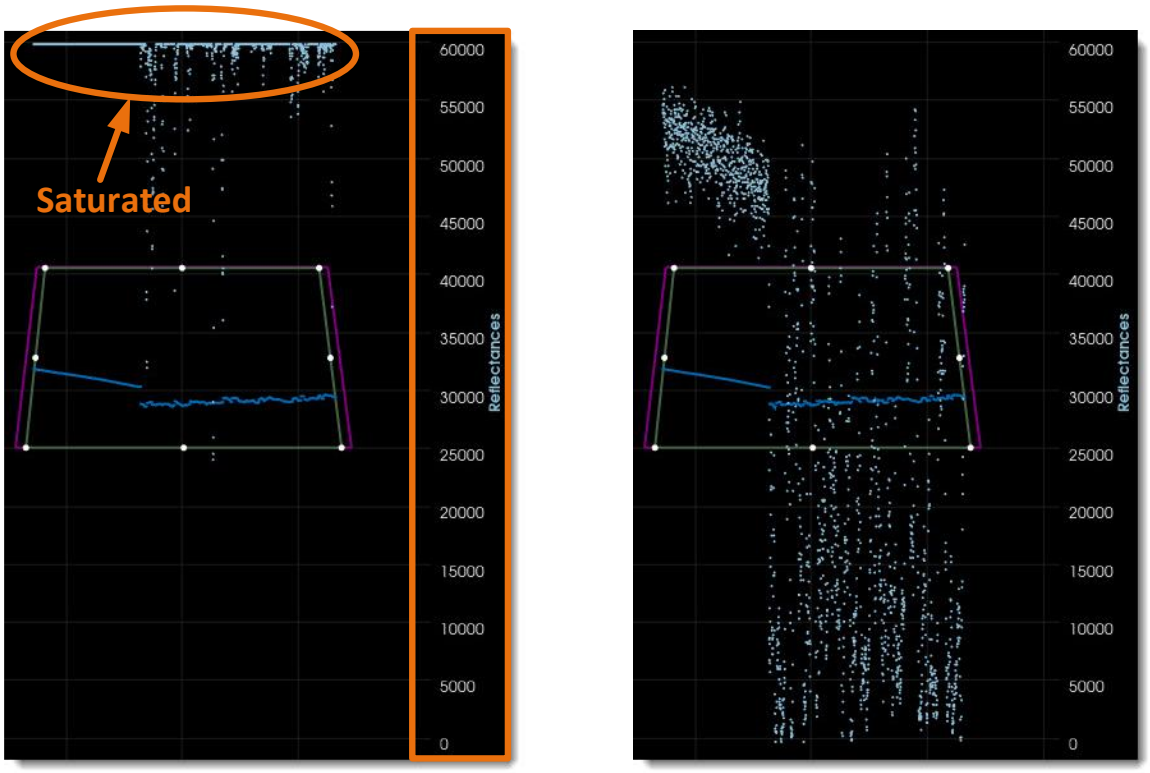



*Figure 23. (Left) Display showing a highly saturated profile. The blue dots, representing the reflectance values, are almost all at the maximum value, at the top. The reflectance scale is shown at the right of the display window. (Right) Same profile with decreased laser intensity and profile exposure time. The reflectance values are spread in the entire reflectance scale.*

# Adjusting finite impulse response (FIR)

A FIR filter is applied in the Z-Trak2 to increase the quality of the measured peak. Increasing FIR size helps improve Z-resolution. Decreasing FIR size when operating near the maximum profile rate may increase the Z-range.

# Using High Dynamic Range (HDR)

High dynamic range is useful when the object under inspection combines regions of high and low reflectivity. Increasing the exposure time to see adequately the region with low reflectivity can cause the region with high reflectivity to lose details because of saturation. Conversely, reducing the exposure time to see details in the region with high reflectivity can cause the darker region to lose details.

One solution is to take two images with two different exposure times and combine them. However, this method not only cuts the profile rate, but it also increases the processing complexity induced by the merging of two separate frames of a moving object.

Z-Trak2 achieves HDR in a single scan, simplifying the handling of objects made up of surfaces of varying reflectivity. HDR is done on-sensor and uses non-overlapping exposure/readout (a new profile cannot be grabbed until readout is complete).

The Z-Trak2 sensor provides two features to control HDR: **HDR Response Mode**, and **HDR Response Factor**.

- **HDR Response Mode**. Activates HDR and specifies the knee point, i.e., the point at which the sensitivity of the image sensor decreases, as depicted with the HDR knee point mid/high in the figure below.
- **HDR Response Factor**. Acts on the slope after the knee point to further reduce sensor sensitivity: the higher the response factor, the less sensitive the sensor.

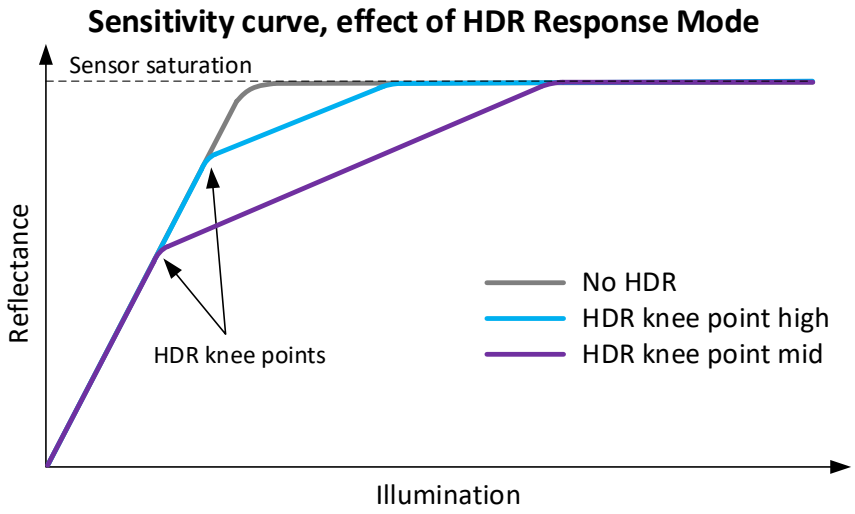



*Figure 24. Depiction of the sensitivity curve of a sensor, with and without HDR. With HDR, saturation occurs at higher illumination, as compared with no HDR.*

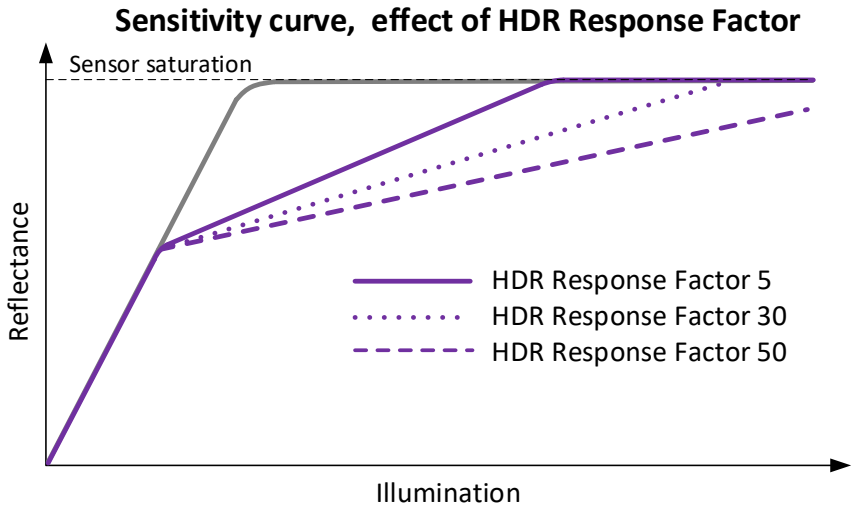



*Figure 25. Depiction of the effect of the HDR Response Factor on a sensitivity curve.*

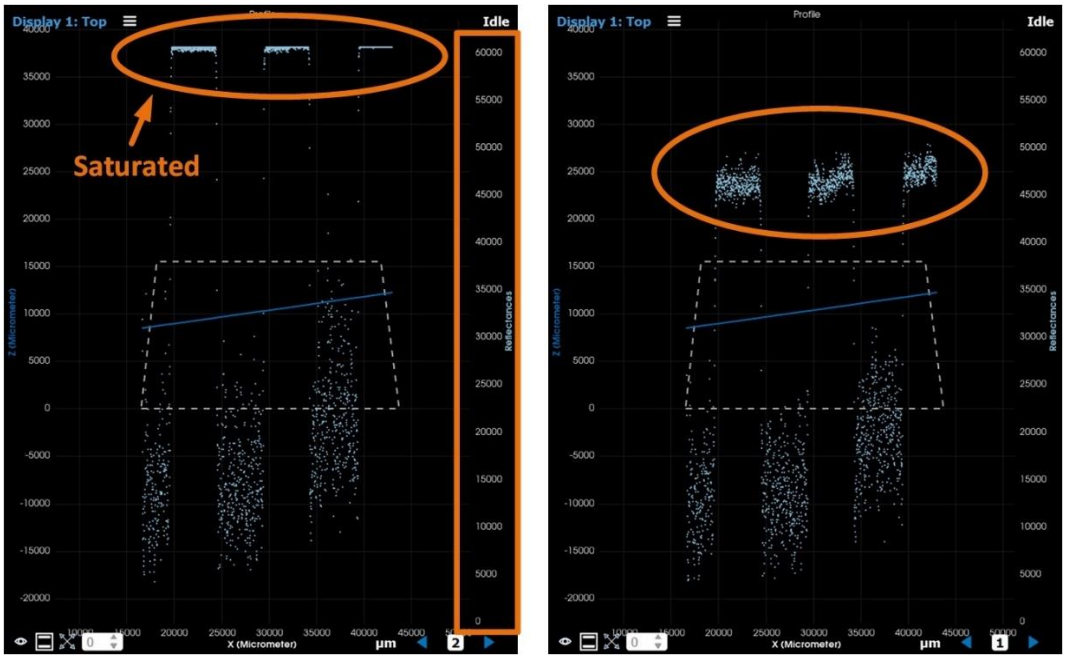



*Figure 26. Effect of HDR mode on a high contrast object. Blue dots represent reflectance values, with the reflectance scale shown at the right of the display window. (Left) HDR Off. Notice the saturated segments at the top. (Right) HDR On. High reflectance segments are not saturated any more. Note the low reflectance sections are little affected.*

# Applying a median filter

A median filter is a processing technique typically used to reduce noise from an image. Z-Trak2 provides one-dimensional median filtering of three different sizes, namely 3x1, 5x1 and 7x1.

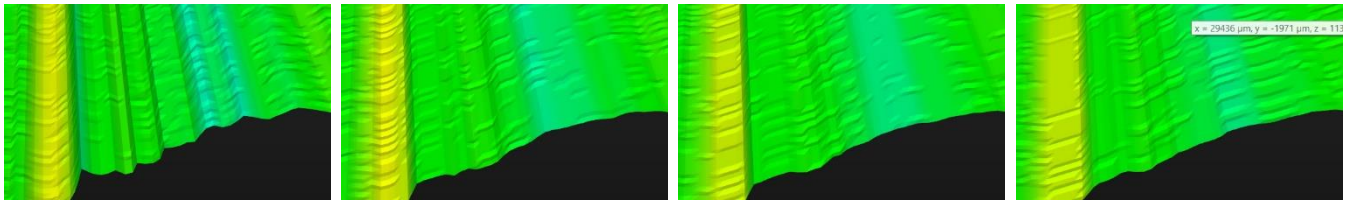


*Figure 27. Results from applying a median filter on a flat surface object. (From left to right) No median filter; 3x1 median filter; 5x1 median filter; 7x1 median filter.*

# Applying a convolution filter

Z-Trak2 proposes one-dimensional convolution filters of three different sizes, namely 3x1, 5x1 and 7x1 for smoothing profiles.

# Optimizing profile rate

Use the **Profile Intensity** > **Info-Profile Rate Optimization** subcategory to guide you on how to optimize the profile rate for the current configuration. Typical suggestions are:

- Increase the value of Profiles Per Scan feature to 5 or more.
- Reduce the Measurement AOI Height.
- Reduce Exposure Time.
- Disable Reflection Elimination Method.
- Disable HDR.

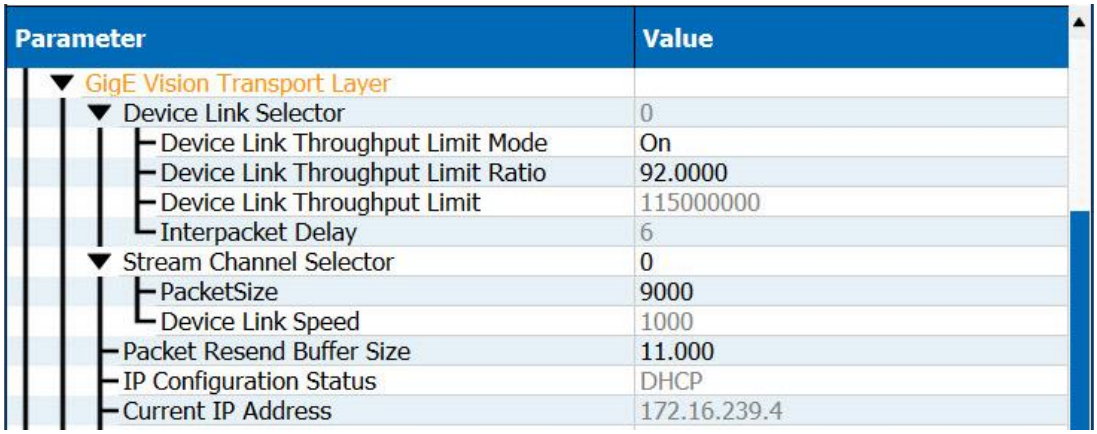
Other aspects to take into account to increase profile rate are:

- Set the 3D Data Type output format to *UniformX Z* or to *XZ*.
- In the **GigE Vision Transport Layer** category, verify that the Device Link Speed value is 1000, 2500, or 5000 Mbps or higher (according to model). This is the speed negotiated by the network interface. The value is read-only.
- Verify that the Packet Size value is above 1500 bytes, ideally 4000 or 9000 bytes, which indicates that jumbo packets are used. See Basic NIC settings on how to enable Jumbo Packets.

  If the Device Link Speed value is below 1000 Mbps, or if the Packet Size value is below 1500 bytes, first check the network equipment between your device and the host computer (see Compatible GigE network adapters and switches).

  Section Configuring network adapter (NIC) for GigE Vision devices in the Appendix provides info about how to configure the network adapter.

  Refer also to the *Network Imaging Package for Sapera LT Optimization Guide* (from the **Start** menu in the **Teledyne DALSA** folder).



# Multi-sensor systems

Several Z-Trak profiler sensors may be configured over or around an object to enlarge the measurement area, measure different areas of interest, or eliminate occlusion. In some cases, profile acquisition may be triggered synchronously or in sequence between sensors. In other cases, a larger, unified measurement space (UMS) can be created, such that all sensors report measurements within the same coordinate system.

## Connecting multiple 3D sensors

A single sensor may be connected directly to a host through a NIC, or indirectly through a switch. In multi-sensor configurations, the sensors will typically be connected to a host through a switch.

- Standalone sensors — Sensors gather and process profiles independently, on one or on different hosts. Each sensor may be connected to a switch or to a NIC.
- Synchronized sensors — Synchronization between sensors relies on Internet messages. A switch is therefore required to forward timing messages to sensors connected to it. Profiles may be processed on the same or on different hosts.
- Sensors part of a unified measurement space (UMS) — Units must be attached to the same switch, and a single host must do the acquisition and merging. The units will typically be synchronized.

## Sensor synchronization

Sensor synchronization is used to coordinate the profile acquisition of two or more sensors so that they are triggered simultaneously or sequentially. Sequential acquisition is recommended if the laser line emitted by a sensor can interfere with the laser line of another sensor when triggered simultaneously.

When synchronizing sensors, one is chosen as the master sensor, that will respond to the external signal; the others are the slave sensors. Each slave's Trigger Start Source parameter is set to Multi Sensor Sync, indicating that the slave will acquire profiles when it receives messages from the master.

Synchronization is achieved essentially by adjusting trigger delays between the sensors. Because synchronization relies on Internet messages, the master sensor must allow for a delay to forward timing messages to the slave sensors; this delay is represented by the Sync Group Delay parameter (see Sync Group Delay setting).

The following timing diagrams depict how some of the Multi Sensor Sync parameters are set. The diagrams do not include details about other synchronization settings such as exposure time or profile rate.

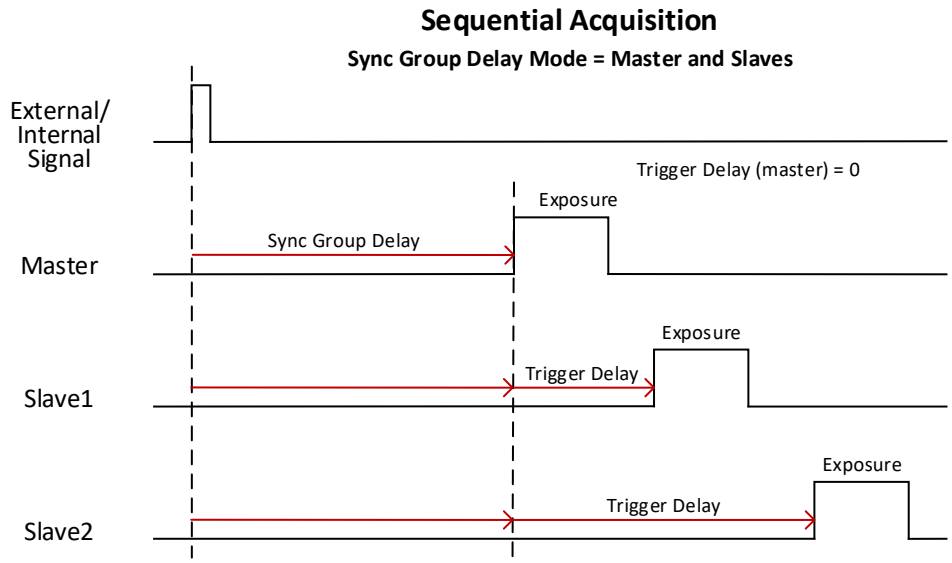



*Figure 28. The external/internal signal triggers the master sensor. The Sync Group Delay value determines the earliest time at which the sensors can start exposure. The Trigger Delay value of each sensor is different in a sequential acquisition.*

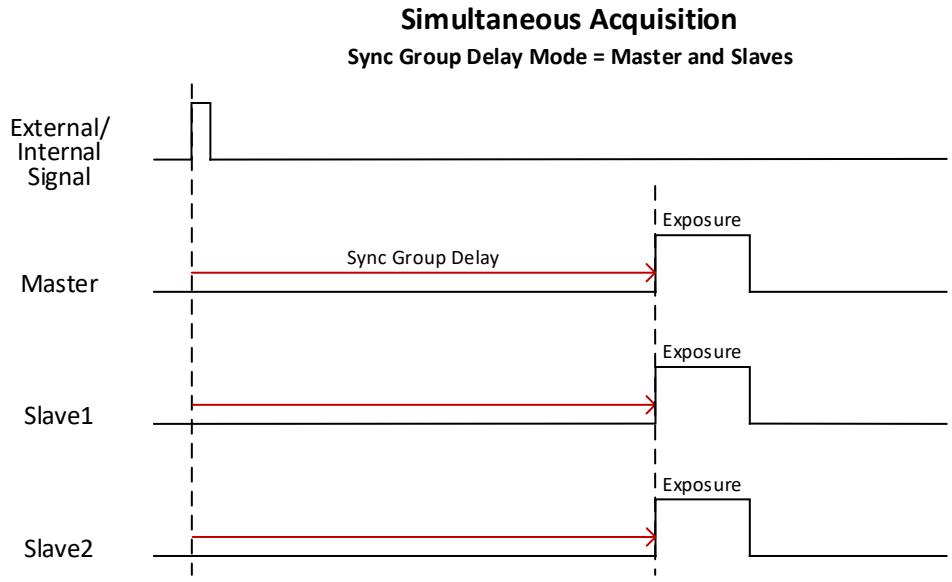



*Figure 29. The external/internal signal triggers the master sensor. The Sync Group Delay value determines the earliest time at which the sensors can start exposure. All sensors start exposure at the same time.*

# Sync Group Delay setting

To avoid missed profile triggers, the Sync Group Delay setting must not be too small. The optimal value for this feature depends mainly on network characteristics such as network link speed, packet size and number of switches.

- **Network link speed.** Sync Group Delay value needs to be longer if the master is connected on a slower link; a 1 Gbps link will require a longer delay than a 5 Gbps link.
- **Streaming packet size.** Sync Group Delay value needs to be longer if the master is using large streaming packet size because messages must wait until the current streaming packet is complete.
- **Network switch(es) between master and slaves.** Each switch between master and slave adds its own communication delay.

| Packet size (bytes) | Network speed (Gbps) | Max transmission delay (µs) |
|---|---|---|
| 9000 | 5.0 | 50 |
| 9000 | 2.5 | 70 |
| 9000 | 1.0 | 90 |

To better ascertain whether a 3D profiler is receiving messages too late and missing profile triggers, use the Event Statistic Selector (*Late MultiSensorSync*) and Event Statistic Count features found in the Event category.

# Features involved in sensor synchronization

The list shows the parameter name followed by the feature name in brackets.

- Profile Trigger Frequency (profileTriggerFrequency)
- Profile Rate (profileRate)
- Profile Exposure Time (ExposureTime)
- Laser Activation (laserActivation)
- Sync Mode (multiSensorSyncMode)
- Sync Status (multiSensorSyncStatus)
- Sync Group (multiSensorSyncGroup)
- Sync Group Delay (multiSensorSyncDelay)
- Sync Group Delay Mode (multiSensorSyncDelayMode)
- Trigger Mode Selector (TriggerSelector)
- Trigger Enable (TriggerMode)
- Trigger Start Source (TriggerSource)
- Trigger Delay (TriggerDelay)
- Line Selector (LineSelector)
- Line Inverter (LineInverter)

# Synchronization settings

The parameters must be set manually and their values can then be saved in a camera configuration file. Some features may be set indirectly, such as the Trigger Rate/Profile Trigger Frequency (which depend on the Trigger Start Source). The user is responsible for making sure of the proper timing between sensors.

Recall:

- **Slave:** device whose Trigger Start Source parameter is always set to *multi-sensor sync*.
- **Master**: device whose Trigger Start Source parameter is not set to *multi-sensor sync*. The master generates the messages that synchronize the slaves.

Note that it is not possible to acquire simultaneously if the master profile trigger is off because a profile trigger delay cannot be set.

| | Sequential | | Simultaneous | |
|---|---|---|---|---|
| **Parameters** | **Master Settings** | **Slave Settings** | **Master Settings** | **Slave Settings** |
| Laser Activation | Strobed | Strobed | Strobed | Strobed |
| Exposure Time | User defined | User defined | User defined | User defined |
| Sync Mode | On | On | On | On |
| Sync Status | Master | Slave | Master | Slave |
| Sync Group | 1 | 1 | 1 | 1 |
| Sync Group Delay | Set by user | Not Enabled | Set by user | Not Enabled |
| Sync Group Delay Mode | Set by user | Not Enabled | Set by user | Not Enabled |
| Trigger Mode Selector | Profile Trigger | Profile Trigger | Profile Trigger | Profile Trigger |
| Trigger Enable | Off (internal)<br>On (external) | On | On | On |
| Trigger Start Source | Depends on Trigger Enable parameter.<br>If Off, the internal clock is used to trigger acquisition at the specified Profile Rate.<br>If On, various sources can be used, including counter, timestamp modulo, encoder, etc. | The profile trigger is generated by the multi-sensor sync | Various sources can be used, including counter, timestamp modulo, encoder, etc. | The profile trigger is generated by the multi-sensor sync |
| Trigger Delay | Set by user (if Profile Trigger is On, otherwise not enabled) | Set by user | Set by user | Set by user |
| Profile Trigger Frequency, Current Profile Rate | Depends on Trigger Start Source | Depends on Trigger Start Source | Depends on Trigger Start Source | Depends on Trigger Start Source |
| Line Selector | Set by user | Set by user | Set by user | Set by user |
| Line inverter* | Set by user | Set by user | Set by user | Set by user |

* An external signal is detected only with a rising edge.

# Unified measurement space (UMS)

Each Z-Trak2 3D laser profiler sensor has its own measurement space; the data acquired by a unit is relative to the unit. Combining the data from several sensors in different poses can be used to

provide a more complete representation of an object. This merging of data requires a common, unified measurement space (UMS), which can be defined through a process called multi-sensor calibration.

The main requirements for creating a UMS are:

- All sensors must be part of a group.
- All sensors must use the same measurement unit.
- The laser plane of all sensors must be aligned to form a single plane.
- The calibration target object must not move during calibration.

Note that the sensors need not be identical in laser color or in range to create a UMS.

# Multi-sensor calibration

This process consists of aligning the coordinate system of each sensor of the multi-sensor system with that of the UMS. This process is done in 2 stages:

- Laser plane alignment – The sensors must be physically aligned so that their laser sheets intersect to form a single plane. To that end, an alignment plane can be used to position the sensor bodies. This stage is done by the end user. Care should be taken in this mechanical alignment because if the sensor planes are not properly aligned before the calibration process, the produced output data will be incorrect.
- Calibration – This stage creates the UMS by calculating the transform from sensor space to UMS space, using a calibration target object placed in the measurement area of the sensors. This stage is done with the help of a wizard available in Z-Expert.

Once this calibration is done, all sensors will return measurements in the UMS.

## *Multi-sensor layouts*

Two or more sensors can be calibrated in different layouts:

- Ring – Two, three, four or more profilers are positioned around an object at different angles.
- Opposite – Two profilers are aligned on opposite sides of the object.
- Side by side – Two or more profilers are positioned next to each other, forming a wide measurement area.

In all cases, the measurement area of all sensors must be in the same XZ-plane.

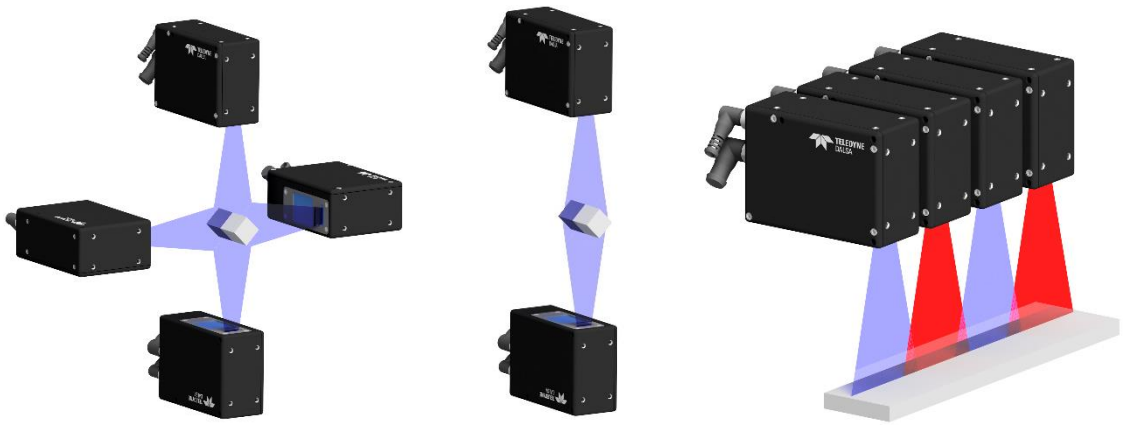


*Figure 30. Different sensor layouts: ring, opposite, side-by-side.*

# *Calibration target object*

### Ring and opposite layout

The calibration target object for ring and opposite layouts is referred to as a prism. A prism is essentially a polygon in the XZ-plane, extruded along the Y direction. Its dimensions must be precisely known: the X and Z coordinates of all vertices of the polygon in the XZ-plane are required to accurately define the prism. (These should be provided by the manufacturer.)

Typically, the origin of the UMS coordinate system is considered the center of the prism. The prism can have any number of sides; it does not have to be equilateral (equal length sides), as long as each sensor sees only one corner.

Key points for the prism are:

- **Convex /\ corners**: The surfaces of the prism must define convex corners /\; concave \/ corners are not permitted due to secondary reflections.
- **Profile that fills the measurement area**: Each sensor must see a corner. The corner should be clean and centered in the measurement area, with a margin of space on each side of the X-axis. In general, the more the corner profile fills the measurement area, the more accurate the calibration.
- **Stationary target prism**: The target prism must not move.

In the calibration procedure, each sensor is presented a single corner of the prism, whose position is defined in the prism's coordinate system.

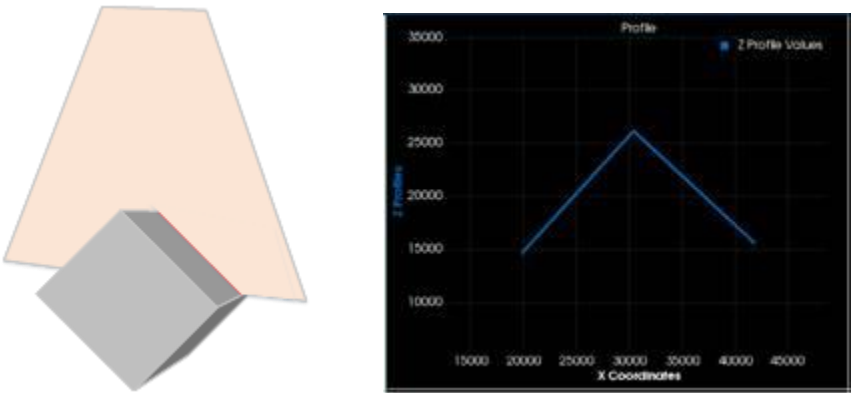



*Figure 31. (Left) Example of a prism placed within the measurement area of a sensor. A corner of the prism is presented to the sensor. (Right) The corner profile is shown in the display of Z-Expert. The more the corner profile fills the measurement area, the better the calibration.*

The user assigns a sensor to each corner. Not all corners of the prism need to have associated sensors, that is, there can be more corners than sensors depending on the prism shape and the sensors configuration. Conversely, more than one sensor can observe the same corner.

Then, given the dimensions of the prism, the calibration algorithm calculates the required transform from the sensor's measurement space to the UMS.

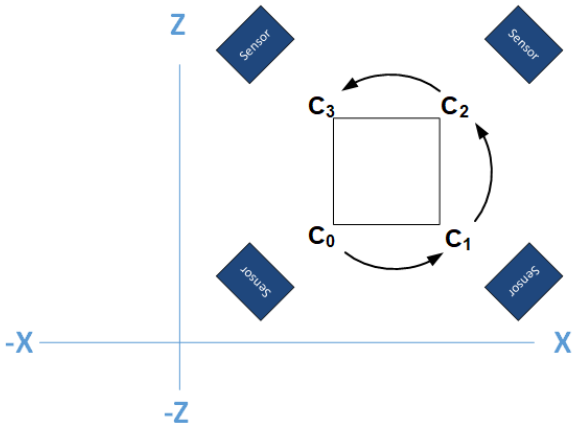



*Figure 32. This four-sensor layout is presented a square prism. Each sensor is assigned a corner in counterclockwise order.*

### Side-by-side layout

In a side-by-side layout, a straight edge (a flat, smooth, and rigid object) that spans the entire width of the combined measurement area in the XZ-plane can be used. In this case, its precise dimensions are irrelevant.

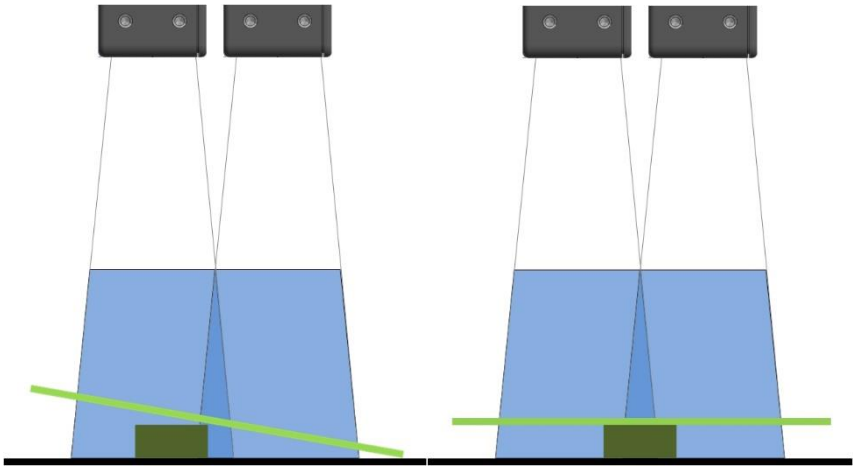


*Figure 33. Calibration of side-by-side 3D profilers. The calibration object must span the measurement area.*

The sensors should be set close enough so that their measurement areas overlap and cover the required measurement AOI[1]. When set closer, as in Figure 34 (a), the measurement areas of the sensors overlap entirely, and the measurement AOI can be chosen anywhere within the combined measurement area. To get a wider profile, the sensors can be set further apart, however the overlap is pushed back to the far-FOV region, limiting the measurement AOI height, as shown in Figure 34 (b); above it, some regions cannot be measured.

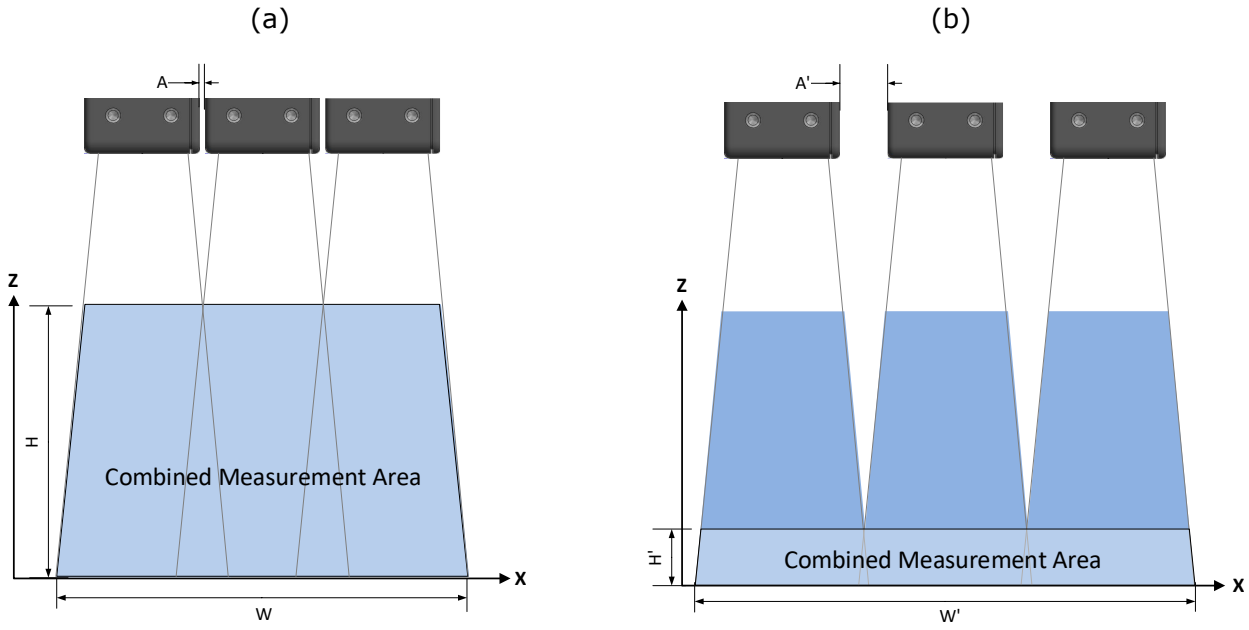



*Figure 34. The optimal width and height of the measurement AOI is limited by the overlap of the sensors' measurement areas. (a) The 3D sensors are set close enough (distance A) so that their measurement areas overlap entirely. (b) The 3D sensors are set further apart from each other (distance A' > A); the combined measurement area is wider (W' > W) but not as high (H' < H).*

[1] Note that in shorter range models, the unit width is larger than the far FOV, which means that the measurement areas cannot overlap in a side-by-side configuration.

### Other layouts

In more complex setups, it is also possible to create a custom calibration target.

# Creating a UMS

Z-Expert provides a wizard to help create the UMS for common sensor layouts, such as ring or side by side, or to define custom layouts. The profilers need to be part of a group to form a UMS.

## *UMS with predefined layout*

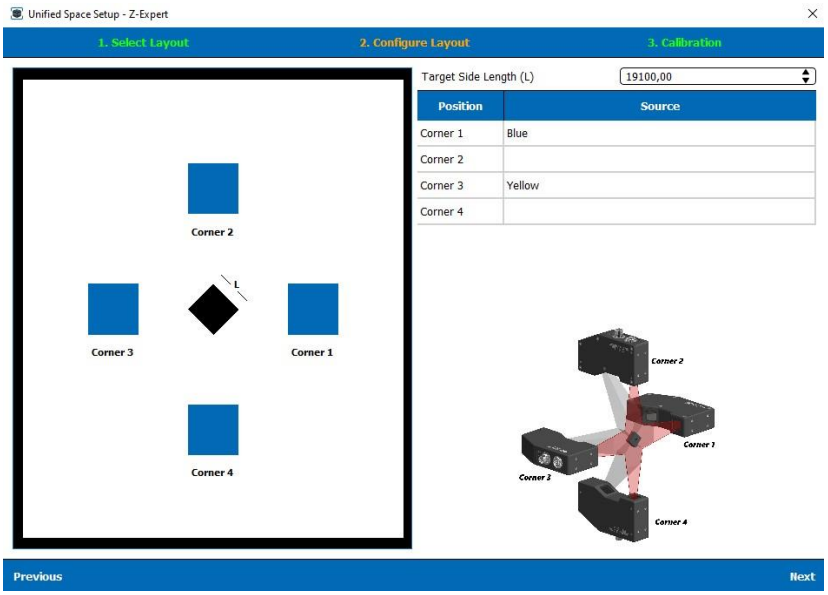
Before you begin, verify that all sensors are properly configured and, in the case of a ring layout, acquire the profile of only one corner of the target object prism. Note that two sensors can look at the same corner. To verify or change sensor feature settings, use the Features Browser.

The following procedure assumes a ring layout with 2 sensors, in an opposite configuration. For other UMS configurations, visit the Teledyne DALSA web site for application notes.

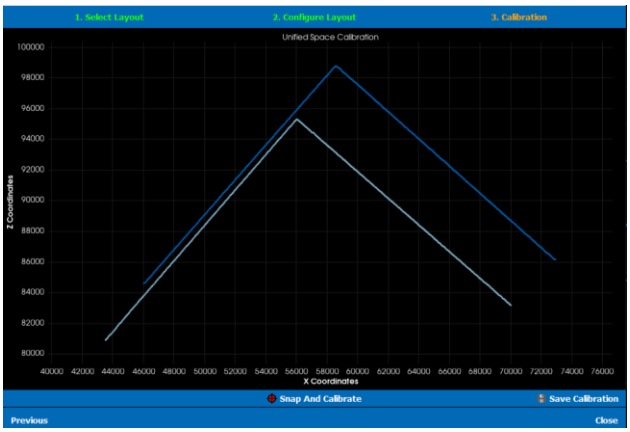
### To create a UMS with two sensors in a predefined layout

1. On the toolbar, select **Unified Space Setup** to open the *Unified Space Setup* wizard.
2. Select a group, or define one, that includes the sensors part of the UMS. Click **Next**.
3. Select the layout that corresponds most closely to your setup, in this case the four-sensor ring. Click **Next**.
4. Assign a sensor to corners 1 and 3 (or 2 and 4). Sensors are represented as squares surrounding a target prism (in black). Each corner of the prism is numbered (Corner 1-4).

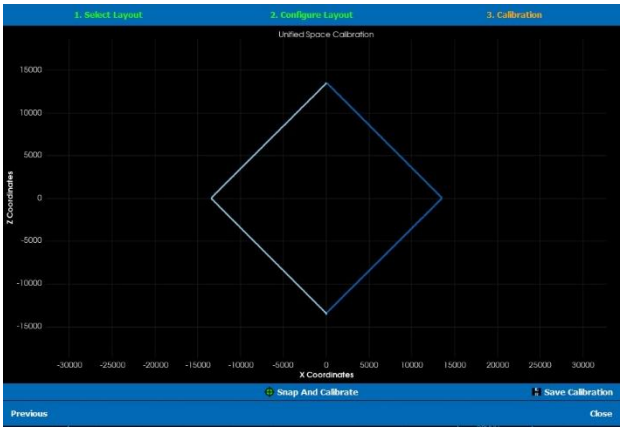
   In the ring layout depicted below, corner 1 was assigned the sensor named Blue and corner 3 the sensor named Yellow, in an "opposite" setup.



5. Specify the **Target Side Length (L)**, in the same measurement units as the sensors. Click **Next**.
6. The bottom center of the wizard window, the red icon indicates that the system is not calibrated. Click **Snap a Pose**. Uncalibrated corners will be shown in the main view. The bottom indicates the estimated number of poses (snaps) required to calibrate the sensors.




7. Click **Snap a Pose** until no more snaps are required: the icon at the bottom will turn to green. At this point, the corners will be aligned in the window, and the sensor calibration procedure is done.

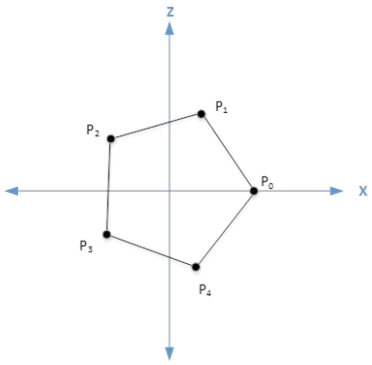



8. Click **Save** to save the UMS calibration information, then close the wizard. Multi-sensor calibration files are saved with the .mscalib file extension.

## *UMS with custom target object or layout*

Z-Expert supports custom layouts and custom target objects with any number of sides and side lengths in a custom layout. As before, only one corner of the target object should be presented to each sensor in the configuration.

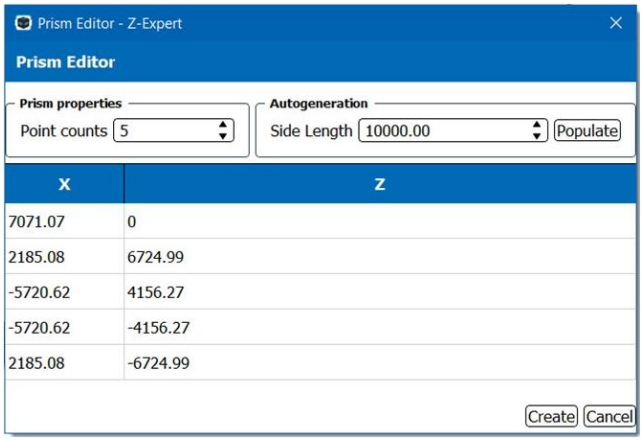
Two target objects could be used: the center of each target object must be specified within the UMS. This information will become a part of the transform from the sensors' measurement space to the UMS.



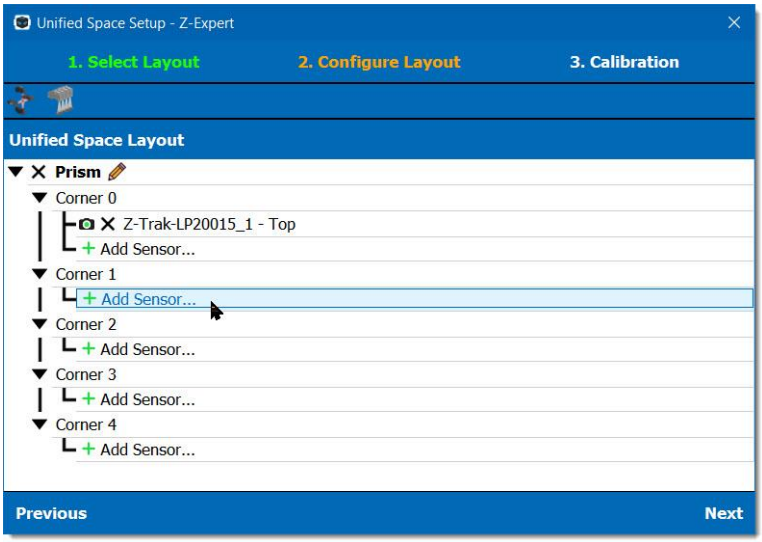

The UMS procedure will include steps to define a custom prism before proceeding with the calibration. Keep in mind that the procedure described here remains very generic. For details on calibration using custom UMS configurations, visit the Teledyne DALSA web site for application notes.

**To create a UMS with multiple sensors in a custom layout or with a custom prism**

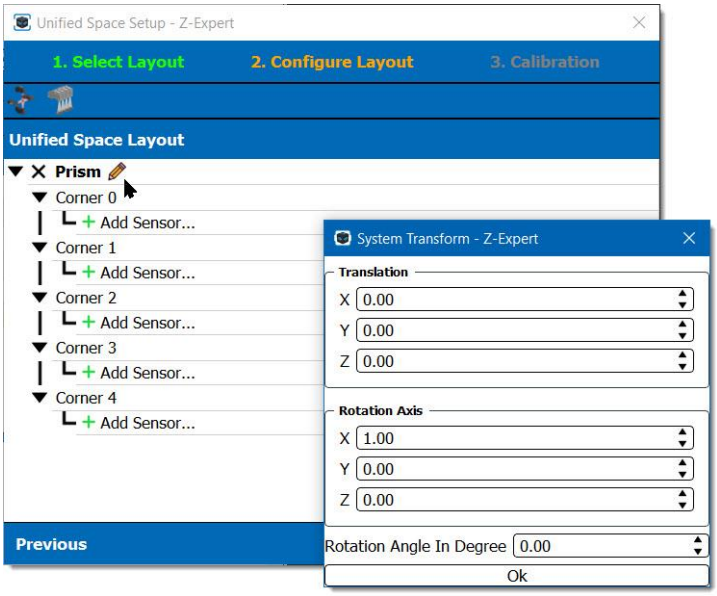
1. On the Z-Expert toolbar, select **Unified Space Setup** to open the *Unified Space Setup* wizard.
2. Select an existing group, or create a group. Click **Next**.
3. Select CUSTOM. Click **Next**.
4. On the wizard toolbar, select **Create Prism Target** (leftmost icon  ). The Prism Editor opens.




5. Under **Prism Properties**, specify the number of **Point Counts** (i.e., the number of corners) of the target object.
6. Do one:
   - If the sides are **equal in length**, enter the **Side Length** value in the sensors' measurement unit, and click **Populate** to fill up the XZ table.
   - If the sides are **not equal in length**, enter manually the X and Z values of each corner (these should be obtained from the manufacturer).
7. Click **Create**.




8. For each corner, click **Add Sensor**. Remember that corners are numbered counterclockwise from Corner 0.
9. Optional. **If you use two or more prisms**, you may change origin of a prism within the UMS. Click the **Edit** (pencil) icon to open the *System Transform* window, allowing you to translate or rotate the prism's origin.




10. Click **Next**.
11. Click **Snap a Pose** until calibration is complete.
12. Save your calibration and close the wizard.

# Z-Trak2 features reference

The Z-Trak2 feature set is divided in functional categories as specified by the profiler's XML file. In the following sections, the different categories will be described, along with their features and values.

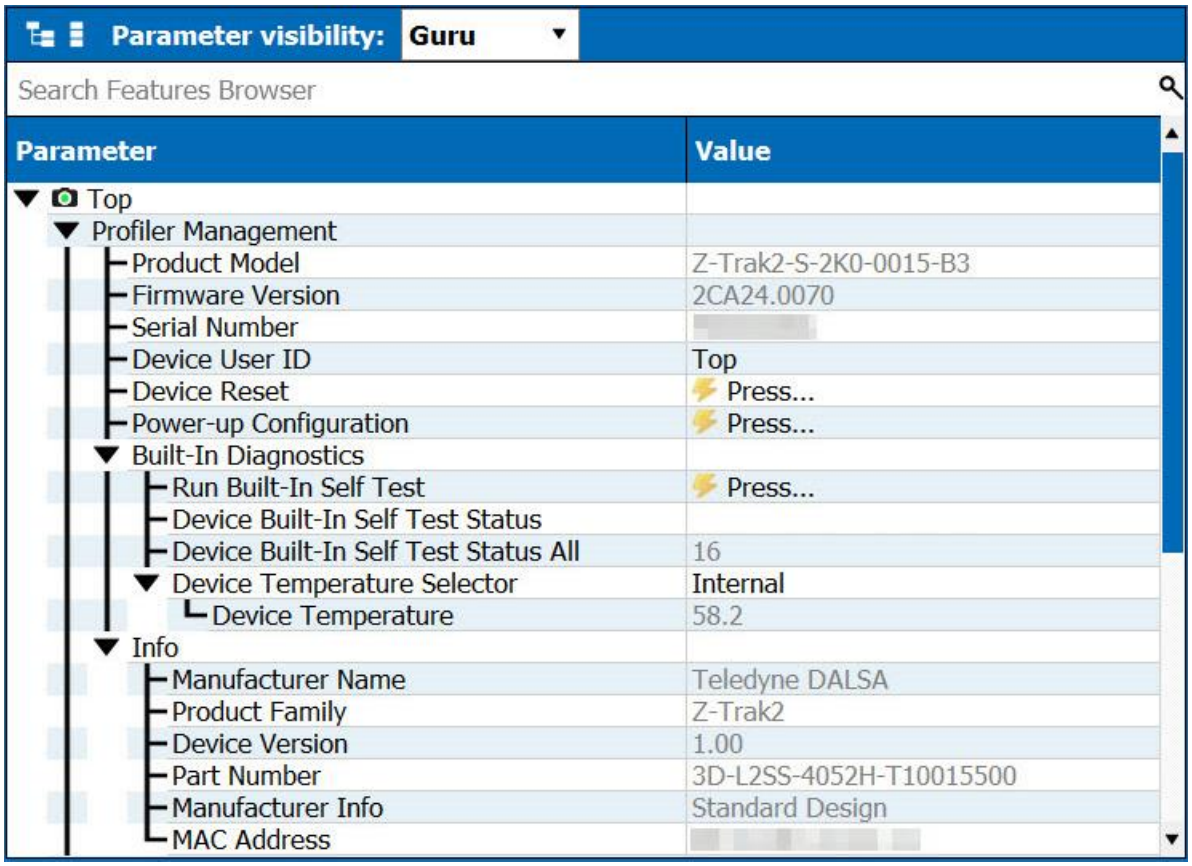
Features are listed in a table containing 4 columns:

- **Display Name** – Name of the feature as displayed in the **Parameter** column of the **Features Browser** in Z-Expert.
- **Feature Name & Values** – Name of the feature, as defined by GenICam standard or by DALSA. If the feature represents a list, each possible value is enumerated as well.
- **Description** – Description of the feature or value.
- **Device Version & View** – Indicates, for each feature:
  - the device software functional level number in which the feature was introduced (different from the firmware revision number). Features added after the initial release are in green.
  - whether the feature is a member of the GenICam Standard Features Naming Convention (SFNC, tag not shown) or of the DALSA Features Naming Convention (DFNC).
  - the visibility level in which the feature can be found (*Beginner, Expert, Guru*) in Z-Expert. Features tagged as *Invisible* are not typically needed by GUI users and therefore only available via software API (such as Teledyne DALSA or third-party).

Feature values may be changed in Z-Expert or via an imaging application according to their availability. The availability of a feature may depend on other feature values; several features are always read-only. Also note that a few features may be changed during acquisition.

# Profiler Management category

The Profiler Management category provides profiler information and diagnostics. The category contains two subcategories, Built-in Diagnostics, and Info. This information is mostly read-only; GigE Vision applications retrieve it to identify the profiler along with its characteristics.




# Profiler Management features

| Display Name | Feature Name & Values | Description | Device Version & View |
|---|---|---|---|
| Product Model | DeviceModelName | Displays the device model name. | 1.00<br>Beginner |
| Firmware Version | DeviceFirmwareVersion | Displays the currently loaded firmware version number. Firmware files have a unique number and have the .cbf file extension. | 1.00<br>Beginner |
| Serial Number | DeviceSerialNumber | Displays the factory set serial number of the device. | 1.00<br>Expert |
| Device User ID | DeviceUserID | Feature to store a user-programmable identifier of up to 15 characters. The default factory setting is the device serial number | 1.00<br>Beginner |

| Display Name | Feature Name & Values | Description | Device Version & View |
|---|---|---|---|
| Device Reset | DeviceReset | Resets the device to its power up state. | 1.00 Beginner |
| Power-up configuration | UserSetDefault | Specifies the profile sensor configuration set to load and make active on power-up or reset. The configuration sets are stored in non-volatile memory of the device. | 1.00 Beginner |
| *Factory Setting* | *Default* | *Select the Factory Setting values as the Power-up Configuration.* | |
| *UserSet1* | *UserSet1* | *Select the user defined configuration UserSet 1 as the Power-up Configuration.* | |
| *UserSet2* | *UserSet2* | *Select the user defined configuration UserSet 2 as the Power-up Configuration.* | |
| | | | |
| User Set Selector | UserSetSelector | Selects the configuration set to load feature settings from or save current feature settings to. The Factory set contains default camera feature settings. User configuration sets contain feature settings previously saved by the user. | 1.00 Beginner |
| *Factory Setting* | *Default* | *Select the default device feature settings saved by the Factory.* | |
| *UserSet 1* | *UserSet1* | *Select the User defined Configuration space UserSet1 to save to or load from features settings previously saved by the user.* | |
| *UserSet 2* | *UserSet2* | *Select the User defined Configuration space UserSet2 to save to or load from features settings previously saved by the user.* | |
| Load Configuration | UserSetLoad | Loads the configuration set, specified by the User Set Selector feature, to the device and makes it active. | 1.00 Beginner |
| Save Configuration | UserSetSave | Saves the current device configuration to the user set specified by the User Set Selector feature. The user sets are located on the device in non-volatile memory. | 1.00 Beginner |

# Built-In Diagnostics features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Run Built-In Self Test | deviceBIST | Command to perform an internal test which will determine the device status. | 1.00 DFNC Guru |
| Device Built-In Self Test Status | deviceBISTStatus | Return the status of the device Built-In Self-Test. Possible return values are device-specific. | 1.00 DFNC Guru |
| *Passed* | *Passed* | *No failure detected* | |
| *Last firmware update failed* | *FirmwareUpdateFailure* | *Last firmware update operation failed.* | |
| *Unexpected Error* | *Unexpected_Error* | *Switched to recovery mode due to unexpected software error.* | |
| *Sensor Initialization Failure* | *SensorFailure* | *There was an error initializing the sensor. The device may not be able to capture images.* | |
| *Firmware Error* | *FirmwareError* | *Firmware encountered an error during streaming.* | |

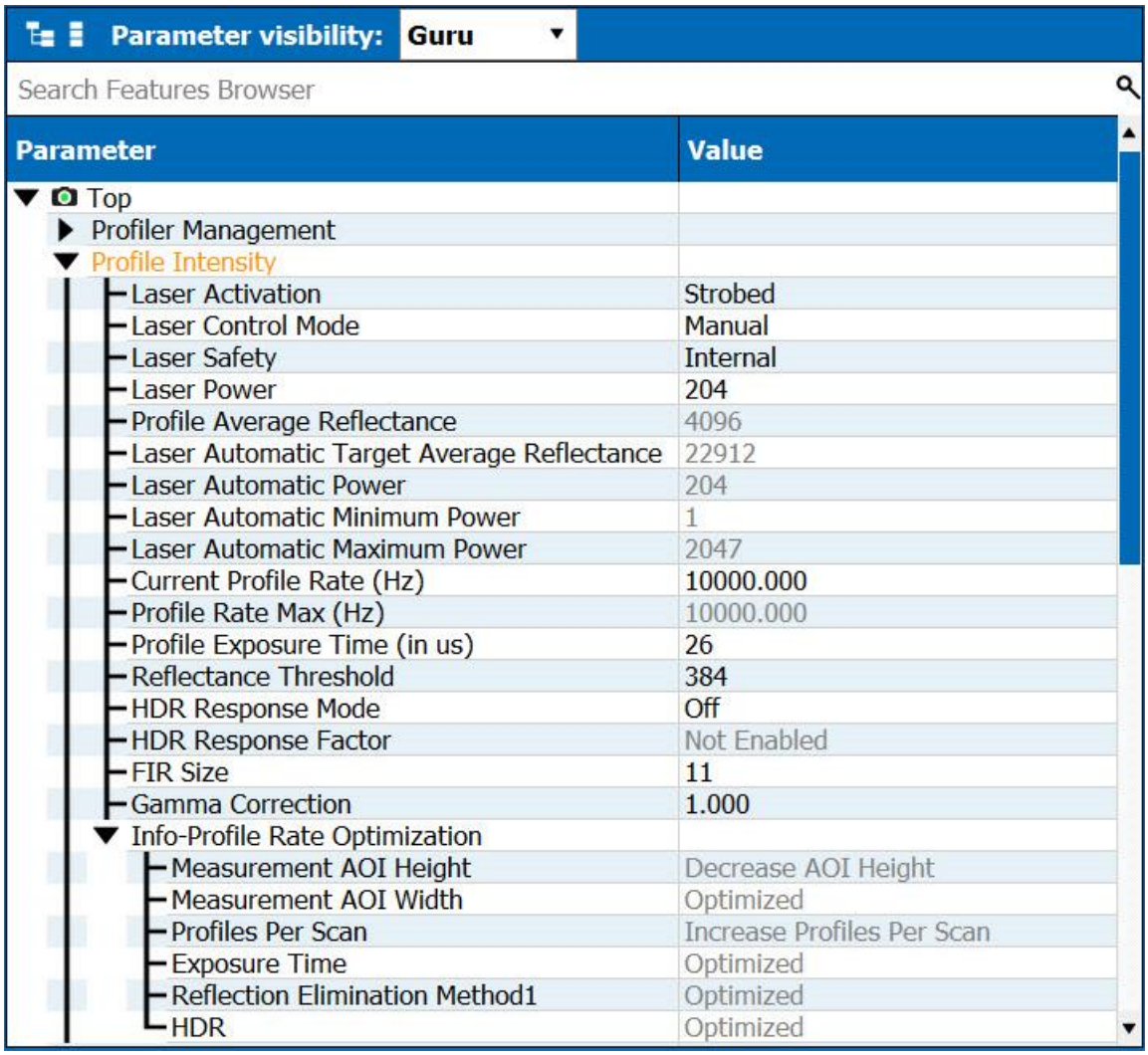
| | | | |
|---|---|---|---|
| *Unknown Error Returned* | *Unknown_Error* | *Undefined single error or multiple simultaneous errors.* | |
| Device Built-In Self Test Status All | deviceBISTStatusAll | Return the status of the device Built-In Self-Test as a bit field. The meaning for each bit is device-specific. | 1.00<br>DFNC<br>Guru |
| Device Temperature Selector | DeviceTemperatureSelector | Select the source where the temperature is read. | 1.00<br>Guru |
| *Internal* | *Internal* | *Internal temperature of the Sensor.* | |
| *MaxInternal* | *MaxInternal* | *Indicates the highest device temperature since power up. Value is reset on power off.* | |
| Device Temperature | DeviceTemperature | The temperature of the selected source in degrees Celsius. | 1.00<br>Guru |

# Info features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Manufacturer Name | DeviceVendorName | Displays the device vendor name. | 1.00<br>Beginner |
| Product Family | DeviceFamilyName | Displays the device family name. | 1.00<br>Beginner |
| Device Version | DeviceVersion | Displays the device version. This tag will also highlight if the firmware is a beta or custom design. | 1.00<br>Beginner |
| Part Number | deviceManufacturerPartNumber | Displays the device part number. | 1.00<br>DFNC<br>Beginner |
| Manufacturer Info | DeviceManufacturerInfo | This feature provides extended manufacturer information about the device. | 1.00<br>Beginner |
| MAC Address | deviceMacAddress | Displays the unique MAC (Media Access Control) address of the Device. | 1.00<br>DFNC<br>Beginner |

# Profile Intensity category

The Profile Intensity category includes parameters to manage the Z-Trak2 laser for acquisition. Subcategory Info-Profile Rate Optimization shows features to adjust to increase the profile rate.




# Profile Intensity features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Laser Activation | laserActivation | Controls the state of the laser. The external Emergency Laser Stop circuit controls the power going to the laser. If the Emergency Laser Stop is "Active" The laser will not turn on. | 1.00<br>DFNC<br>Beginner |
| *Off* | *Off* | *Turns the Laser Off.* | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *On* | *On* | *Turns the Laser On. The laser will power up only if the Emergency Stop is in the "Inactive" state.* | |
| *Strobed* | *Strobed* | *The laser will be turned on for the duration of the Profile Exposure Time. The laser will power up only if the Emergency Stop is in the "Inactive" state.* | |
| Laser Control Mode | laserControlMode | Specifies if the laser intensity will be controlled automatically or manually. | 1.00 DFNC Expert |
| *Manual* | *Manual* | *The laser intensity is controlled by Laser Power feature.* | |
| Laser Safety | laserSafety | Determines if the laser safety is applied through an external E-stop pin or bypassed internally using this feature. | 1.00 DFNC Guru |
| *External* | *External* | The laser can be turned on if power is applied to the E-Stop pin of the auxiliary connector. | |
| *Internal* | *Internal* | The laser can be turned on using the Laser Activation feature. Power does not need to be applied to the E-Stop pin. | |
| Laser Power | laserPower | User set laser power setting for when the feature laserControlMode=Manual. | 1.00 DFNC Beginner |
| Profile Average Reflectance | profileAvgReflectance | Reads the average reflectance of the last profile. | 1.00 DFNC Expert |
| Laser Automatic Target Average Reflectance | laserAutoTargetAvgReflectance | User set reflectance value used as the target for when the feature laserControlMode=Auto. | 1.00 DFNC Expert |
| Laser Automatic Power | laserAutoPower | Reads the current laser power setting when the feature laserControlMode=Auto. | 1.00 DFNC Expert |
| Laser Automatic Minimum Power | laserAutoMinPower | Laser Automatic Minimum Power. | 1.00 DFNC Expert |
| Laser Automatic Maximum Power | laserAutoMaxPower | Laser Automatic Maximum Power. | 1.00 DFNC Expert |
| Current Profile Rate (Hz) | profileRate | Specifies the profile rate of the sensor, in Hz. | 1.00 DFNC Beginner |
| Profile Rate Max (Hz) | profileRateMax | Maximum profile rate the sensor is capable of reaching using the current configuration. Refer to the Info-Profile Rate Optimization category to determine how to increase the Profile Rate Max. | 1.00 DFNC Guru |
| Profile Exposure Time (in us) | ExposureTime | Sets the exposure time (in microseconds). | 1.00 DFNC Beginner |
| Reflectance Threshold | peakDetectorReflectanceThreshold | Value which identifies the minimum reflectance a peak must have to be considered. | 1.00 DFNC Expert |
| HDR Response Mode | hdrResponseMode | Sets the state of the multislope response mechanism on the sensor. | 1.00 DFNC Expert |
| *Off* | *Off* | Disables the hdrResponseMode feature. | |
| *One Knee Point, Mid* | *OneKneeMid* | One Knee Point, Mid Position (~70%). | |
| *One Knee Point, High* | *OneKneeHigh* | One Knee Point, High Position (~90%). | |
| HDR Response Factor | hdrResponseFactor | HDR Response Factor. | 1.00 DFNC Expert |
| FIR Size | firSize | Sets the size of the FIR. | 1.00 DFNC Guru |
| *11* | *fir11* | FIR size 11. | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *9* | *fir9* | FIR size 9. | |
| *7* | *fir7* | FIR size 7. | |
| *5* | *fir5* | FIR size 5. | |
| Gamma Correction | gammaCorrection | Sets the gamma correction factor (i.e. inverse gamma). The gamma correction is applied as an exponent to the original pixel value. (Default value: 1, max value: 1, min value: 0.001, increments: 0.001) | 1.00 DFNC Expert |

# Info-Profile Rate Optimization

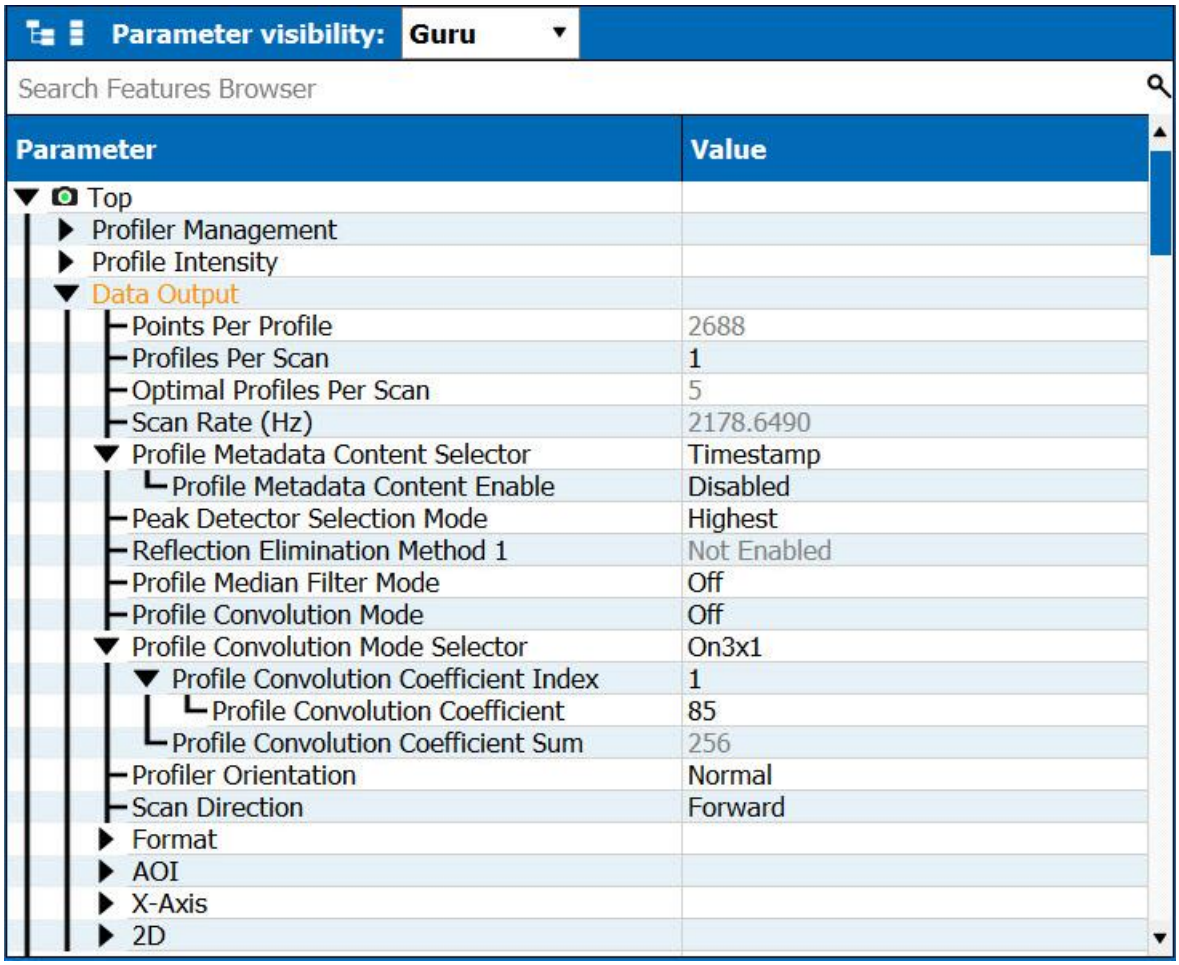
This category indicates the features that can be modified to reach the maximum profile rate (Profile Rate Max feature) achievable by the sensor given the current configuration.

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Measurement AOI Height | aoiHeightOptimization | Indicates how to modify the Measurement AOI Height feature to increase the maximum profile rate achievable by the sensor, if not optimized. | 1.00 DFNC Beginner |
| *Optimized* | *Optimized* | *Optimized.* | |
| *Decrease AOI Height* | *decreaseAOIHeight* | *Decreasing the Measurement AOI Height will increase the maximum profile rate the sensor can achieve.* | |
| Measurement AOI Width | aoiWidthOptimization | Indicates how to modify the Measurement AOI Width feature to increase the maximum profile rate achievable by the sensor, if not optimized. | 1.00 DFNC Beginner |
| *Optimized* | *Optimized* | *Optimized.* | |
| *Decrease AOI Width* | *decreaseAOIWidth* | *Decreasing the Measurement AOI Width will increase the maximum profile rate the sensor can achieve.* | |
| Profiles per Scan | profilesPerScanOptimization | Indicates how to modify the Profiles Per Scan feature to increase the maximum profile rate achievable by the sensor, if not optimized. | 1.00 DFNC Beginner |
| *Optimized* | *Optimized* | *Optimized.* | |
| *Increase Profiles Per Scan* | *increaseProfilesPerScan* | *Increasing the Profiles Per Scan will increase the maximum profile rate the sensor can achieve.* | |
| Exposure Time | exposureTimeOptimization | Indicates how to modify the the Exposure Time feature to increase the maximum profile rate achievable by the sensor, if not optimized. Only effective with use of Profile Trigger. | 1.00 DFNC Beginner |
| *Optimized* | *Optimized* | *Optimized.* | |
| *Decrease Exposure Time* | *decreaseExposureTime* | *Decreasing the ExposureTime will increase the maximum profile rate the sensor can achieve.* | |
| Reflection Elimination Method1 | reflectionEliminationMethod1Optimization | Disable or decrease the number of peaks to increase the maximum profile rate achievable by the sensor. | 1.00 DFNC Beginner |
| *Optimized* | *Optimized* | *Optimized.* | |
| *Decrease Reflection Elimination Method1* | *decreaseReflectionEliminationMethod1* | *Decreasing Reflection Elimination Method1 will increase the maximum profile rate the sensor can achieve.* | |
| HDR | hdrOptimization | Indicates how to modify the HDR feature to increase the maximum profile rate achievable by the sensor, if not optimized. | 1.00 DFNC Beginner |
| *Optimized* | *Optimized* | *Optimized.* | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *Decrease HDR Factor* | *decreaseHdrFactor* | *Disable HDR or Decrease the HDR factor to increase the maximum profile rate achievable by the sensor.* | |

# Data Output category

The Data Output category provides features to configure the profiler data output format, the measurement area of interest (measurement AOI) and other features. The category includes four subcategories: Format, AOI, X-Axis and 2D.



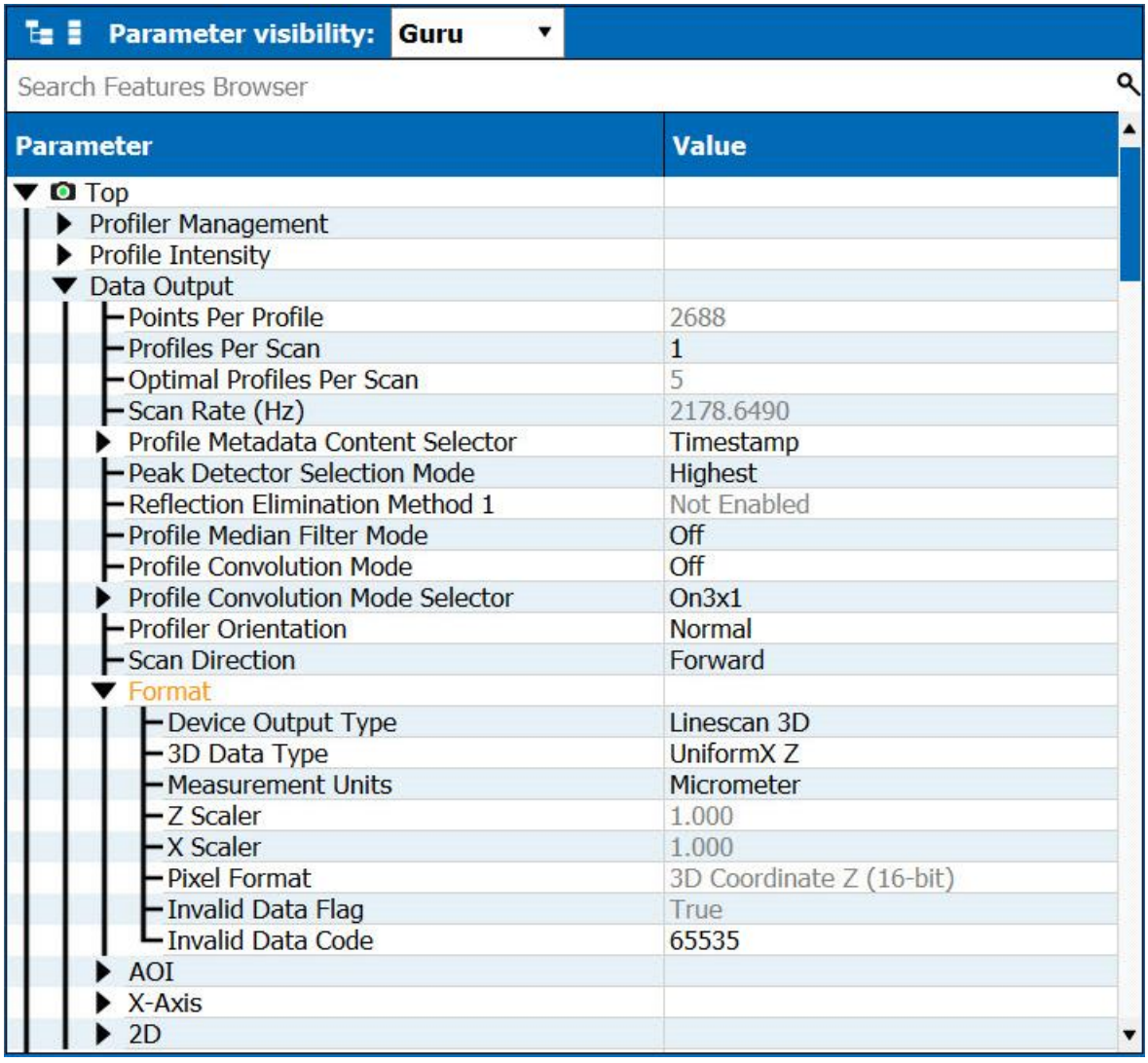

# Data Output features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Points Per Profile | pointsPerProfile | Number of points in the profile. This feature is editable when Uniform X Points Per Profile Mode is set to Manual. Otherwise this feature is read only. | 1.00 DFNC Beginner |
| Profiles Per Scan | profilesPerScan | Height of the virtual image provided by the device (in profiles). | 1.00 DFNC Beginner |
| Optimal Profiles Per Scan | optimalProfilesPerScan | Minimum number of profiles per scan to attain the highest profile rate in all cases. | 1.00 DFNC Beginner |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Scan Rate (Hz) | scanRate | Specifies the device internal frame rate, in Hz. | 1.00 DFNC Beginner |
| Profile Metadata Content Selector | profileMetadataContentSelector | Selects the Profile Metadata elements to include. Each element is 8 bytes. | 1.00 DFNC Expert |
| *Timestamp* | *Timestamp* | Includes the timestamp value in the Profile Metadata. | |
| *Encoder* | *Encoder* | Includes the encoder value in the Profile Metadata. | |
| Profile Metadata Content Enable | profileMetadataContentEnable | Indicates if the selected element is part of the Profile Metadata. | 1.00 DFNC Expert |
| *Disabled* | *Disabled* | The selected profile metadata element is not part of the Profile Metadata. | |
| *Enabled* | *Enabled* | The selected profile metadata element is part of the Profile Metadata. | |
| Peak Detector Selection Mode | peakDetectorSelectionMode | Selects which peak will be output in the profile. (Default is Highest). | 1.00 DFNC Expert |
| *Highest* | *Highest* | *The peak with the maximum reflectance will be chosen.* | |
| *First* | *First* | *The peak that is detected closest to the far field of view will be chosen.* | |
| *Last* | *Last* | *The peak that is detected closest to the near field of view will be chosen.* | |
| Reflection Elimination Method 1 | reflectionEliminationMethod1 | Selects how many peaks will be output in the profile (default is Off). | 1.00 DFNC Guru |
| *Off* | *Off* | *Not using multipeak. Default value.* | |
| *2* | *DetectionLevel2* | *The first 2 peaks are outputed.* | |
| *4* | *DetectionLevel4* | *The first 4 peaks are outputed.* | |
| *8* | *DetectionLevel8* | *The first 8 peaks are outputed.* | |
| Profile Median Filter Mode | profileMedianFilterMode | Selects the mode for the profile median filter. | 1.00 DFNC Guru |
| *Off* | *Off* | *Off.* | |
| *On3x1* | *On3x1* | *3x1 Median Filter.* | |
| *On5x1* | *On5x1* | *5x1 Median Filter.* | |
| *On7x1* | *On7x1* | *7x1 Median Filter.* | |
| Profile Convolution Mode | profileConvoMode | Selects the mode for the profile convolution filter. | 1.00 DFNC Beginner |
| *Off* | *Off* | *Off.* | |
| *On3x1* | *On3x1* | *3x1 Convolution Filter.* | |
| *On5x1* | *On5x1* | *5x1 Convolution Filter.* | |
| *On7x1* | *On7x1* | *7x1 Convolution Filter.* | |
| Profile Convolution Coefficient Index | *profileConvoCoeffIndex* | Profile convolution coefficient index. | |
| Profile Convolution Coefficient | *profileConvoCoeff* | Coefficient value of the indexed profile convolution. | |
| Profile Convolution Coefficient Sum | *profileConvoCoeffSum* | Profile Convolution Coefficient Sum. Change coefficients until the sum is 256 to have valid Z values. | |
| Profiler Orientation | profilerOrientation | *Profiler Orientation.* | 1.00 DFNC Beginner |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *Normal* | *Normal* | *Normal.* | |
| *Reverse* | *Reverse* | *Reverse.* | |
| Scan Direction | scanDirection | *Scan Direction.* | 1.00 DFNC Beginner |
| *Forward* | *Forward* | *Forward.* | |
| *Reverse* | *Reverse* | *Reverse.* | |

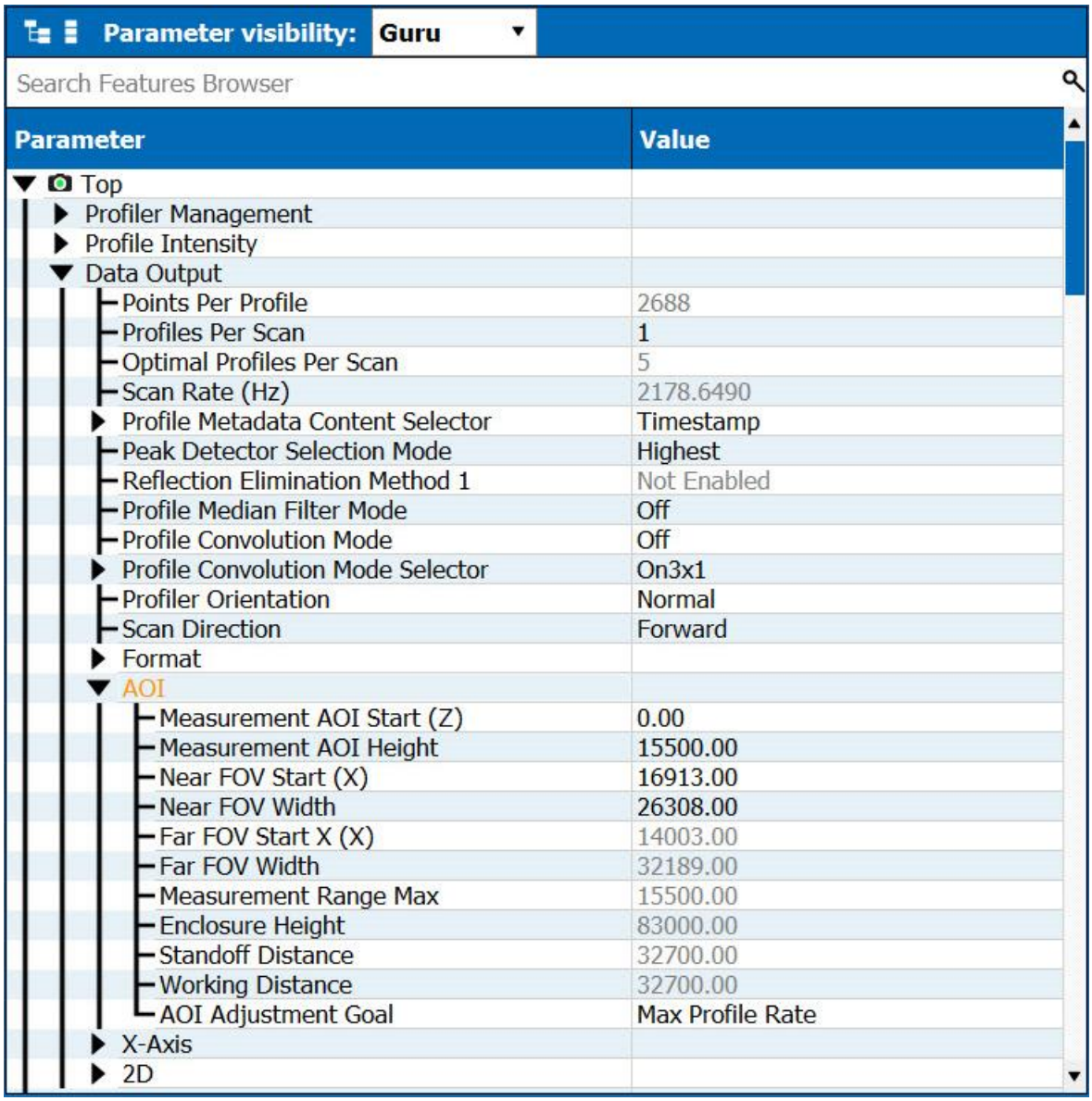
# Format features




| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Device Output Type | DeviceScanType | Selects the output type of the device. | 1.00 DFNC Beginner |
| *Linescan3D* | *Linescan3D* | *Device outputs lines of 3D profiles.* | |
| *Linescan 1D (mono 16-bit)* | *Linescan* | *Device outputs lines of 3D profiles in Mono16 format. For software packages not compliant with GeniCam 3D standard output formats.* | |
| *Areascan* | *Areascan* | *Device outputs 2D area scan images.* | |
| 3D Data Type | Scan3dOutputMode | Selects 3D output data format (default is UniformX Z). | 1.00 Beginner |
| *UniformX Z* | *RectifiedC* | *Each profile consists of calibrated Z values in a 16-bit data format. The Z values have been resampled to a uniform sampling pattern in the X direction.* | |
| *XZ* | *CalibratedAC* | *Each profile consists of calibrated X and Z values in a 32 bit data format.* | |
| *XZRW* | *CalibratedACRW* | *Each profile consists of calibrated X, Z, R (reflectance) and W (peak width) values in a 64-bit data format. The first two 16-bit fields are as the calibrated XZ. The third and fourth 16-bit fields contain the R and W data.* | |
| Measurement Units | Scan3dDistanceUnit | Sets the measurement units for the profile X and Z data (default is Micrometer). | 1.00 DFNC Beginner |
| *Micrometer* | *Micrometer* | *All X and Z values are in micrometer units.* | |
| *Millimeter* | *Millimeter* | *All X and Z values are in millimeter units.* | |
| *Inch/1000* | *Inch_1000* | *All X and Z values are in thousands of an inch (mil).* | |
| Z Scaler | heightScaler | Scaling factor to convert Z values to the units specified by Measurement Units. | 1.00 DFNC Guru |
| X Scaler | widthScaler | Scaling factor to convert X values to the units specified by Measurement Units. | 1.00 DFNC Guru |
| Pixel Format | PixelFormat | Pixel formats as defined by the GeniCam standard. | 1.00 Guru |
| *Monochrome 8-Bit* | *Mono8* | *Monochrome 8-Bit data format. Only available in Areascan mode.* | |
| *3D Coordinate Z (16-bit)* | *Coord3D_C16* | *3D Coordinate: Z position (16-Bit)* | |
| *3D Coordinate XZ (32-bit)* | *Coord3D_AC16* | *3D Coordinate: X and Z positions stored in a 32-Bit value.* | |
| *3D Coordinate XZRW (64-bit)* | *Coord3D_ACR016* | *3D Coordinate: X and Z positions, Reflectance and peak Width stored in a 64-bit value.* | |
| *Monochrome 16-Bit* | *Mono16* | *Mono16: Monochrome 16-Bit* | |
| Invalid Data Flag | Scan3dInvalidDataFlag | Enables/Disables the encoding of invalid values in the profile data. | 1.00 Guru |
| *True* | *True* | *Enables the flagging of the invalid values in the profile data.* | |
| *False* | *False* | *Disables the flagging of the invalid values in the profile data.* | |
| Invalid Data Code | Scan3dInvalidDataValue | Specifies a numerical code that indicates an invalid value in the profile data. | 1.00 Guru |

# AOI features

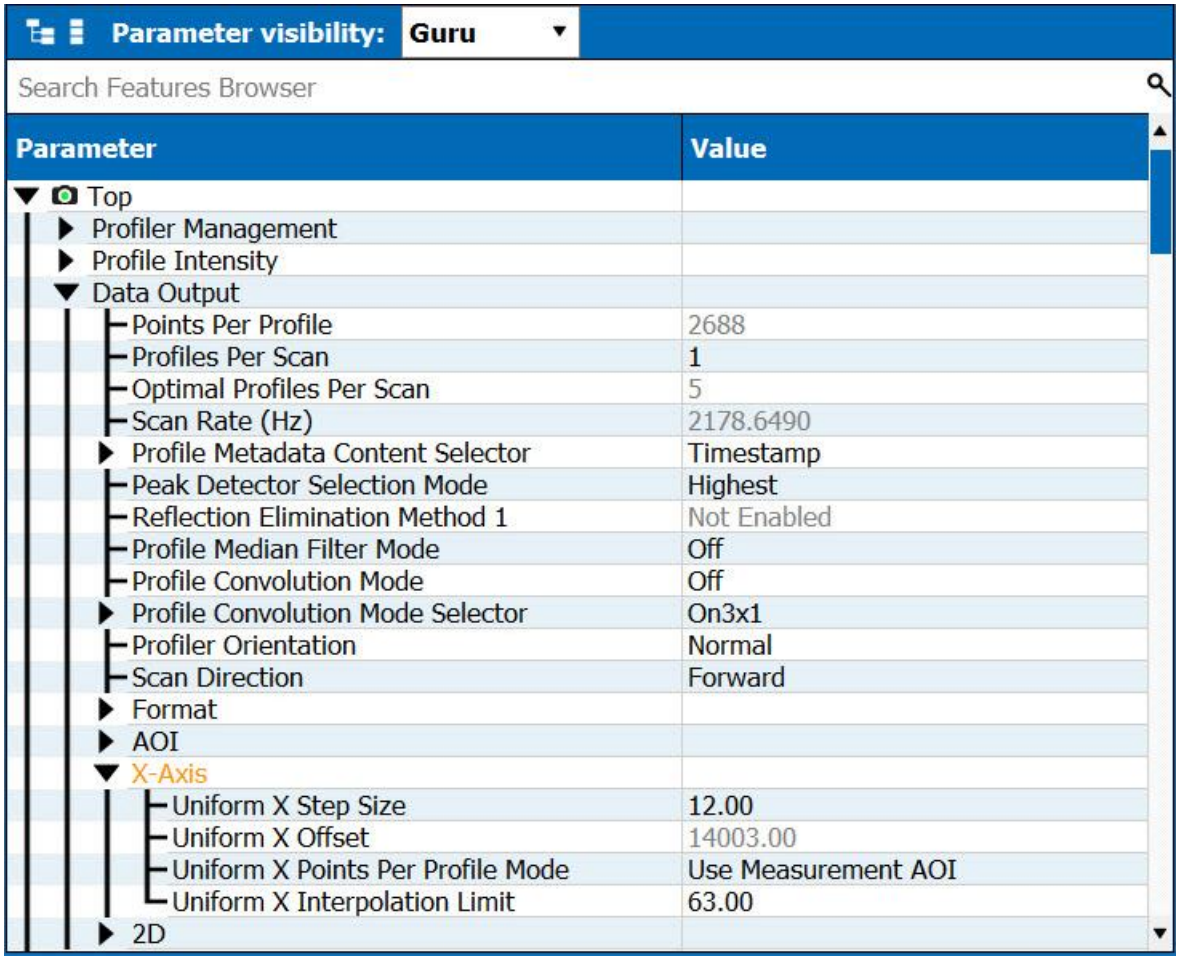



Note: Enclosure height is defined as the sensor height dimension. Refer to mechanical drawings for additional dimension information.

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Measurement AOI Start (Z) | aoiZStart | Specifies the vertical start of the measurement AOI. This is the minimum height value that can be measured. | 1.00 DFNC Beginner |
| Measurement AOI Height | aoiHeight | Specifies the height of the measurement AOI. | 1.00 DFNC Beginner |

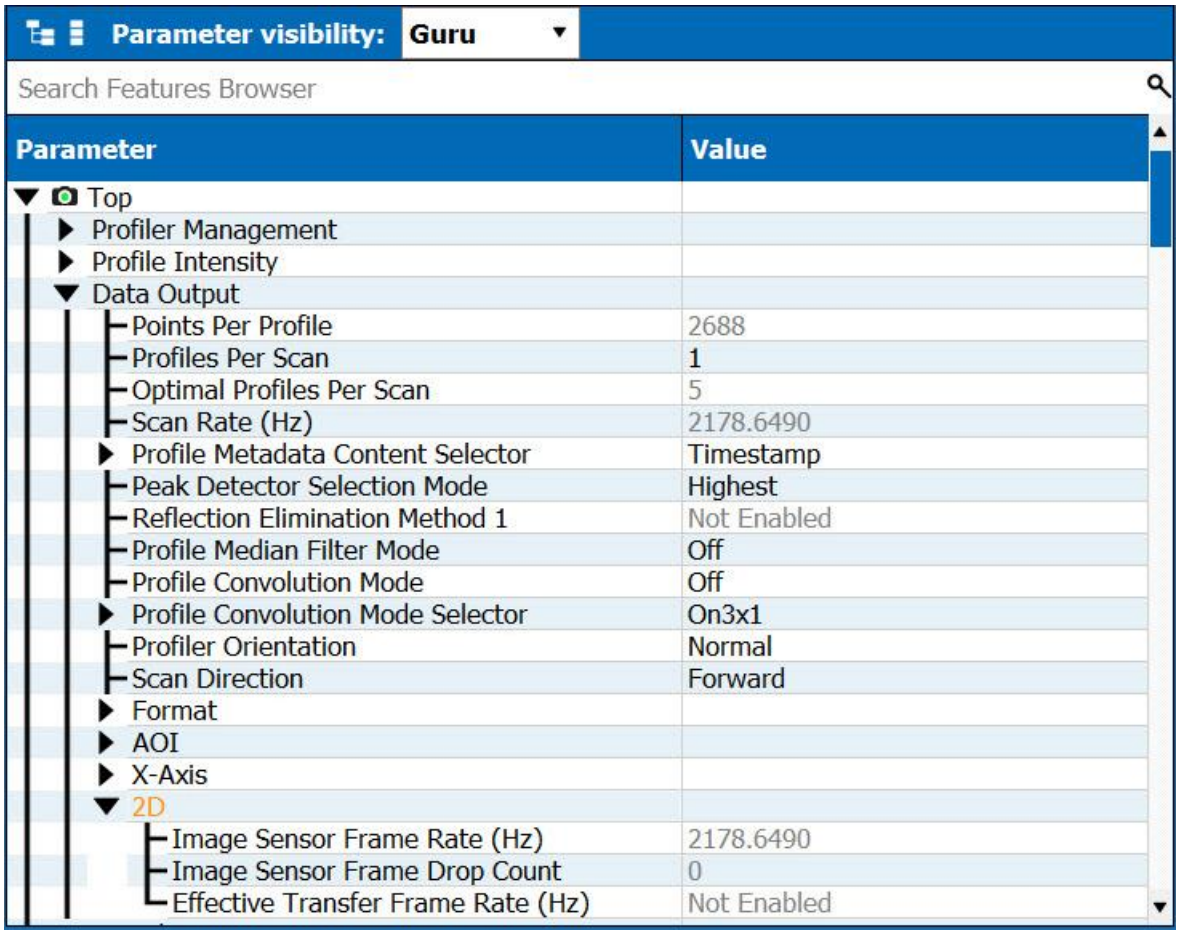
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Near FOV Start (X) | aoiNFOVStartX | Specifies the horizontal start of measurement AOI at the near FOV. | 1.00<br>DFNC<br>Beginner |
| Near FOV Width | aoiNFOVWidth | Specifies the width of the measurement AOI at the near FOV. | 1.00<br>DFNC<br>Beginner |
| Far FOV Start X (X) | aoiFFOVStartX | Indicates the horizontal start of measurement AOI at the far FOV. | 1.00<br>DFNC<br>Beginner |
| Far FOV Width | aoiFFOVWidth | Indicates the width of the measurement AOI at the far FOV. | 1.00<br>DFNC<br>Beginner |
| Measurement Range Max | measurementRangeMax | Indicates the absolute maximum measurement range of the device. | 1.00<br>DFNC<br>Expert |
| Enclosure Height | enclosureHeight | Indicates the mechanical height of the device. | 1.00<br>DFNC<br>Expert |
| Standoff Distance | standoffDistance | Standoff (Clearance) Distance indicates the distance from the laser window of the device to the top of absolute measurement AOI. | 1.00<br>DFNC<br>Expert |
| Working Distance | workingDistance | Working Distance indicates the distance from the laser window of the device to the top of resized measurement AOI. | 1.00<br>DFNC<br>Expert |
| AOI Adjustment Goal | aoiAdjustmentGoal | AOI adjustment goal. | 1.00<br>DFNC<br>Guru |
| *Max Profile Rate* | *Max* | *Max Profile Rate.* | |
| *Match Profile Rate* | *Match* | *Match Profile Rate.* | |
| *High Profile Rate* | *High* | *High Profile Rate.* | |

# X-Axis features




| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Uniform X Step Size | uniformXStepSize | Specifies the Interval between horizontal samples. This value is used only when "3D Data Type" is set to "UniformX Z". | 1.00 DFNC Beginner |
| Uniform X Offset | uniformXOffset | Horizontal offset where measurement data starts. | 1.00 DFNC Beginner |
| Uniform X Points Per Profile Mode | uniformXPointsPerProfileMode | Selects how the "Points Per Profile" will be determined. When set to "UseMeasurementAOI" the "Points Per Profile" will be calculated based on AOI settings. When set to "Manual" the user must set the "Points Per Profile" value. | 1.00 DFNC Guru |
| *Use Measurement AOI* | *UseMeasurementAOI* | *Uses the width of the MeasurementAOI to determine the number of points per profile.* | |
| *Manual* | *Manual* | *The number of Points per profile is set by the user.* | |
| Uniform X Interpolation Limit | uniformXMaxInterpolationLimit | Specifies the maximum interpolation zone along the X-axis. Only Z-values inside of this zone are used for interpolation when re-sampling for uniform spacing. | 1.00 DFNC Guru |

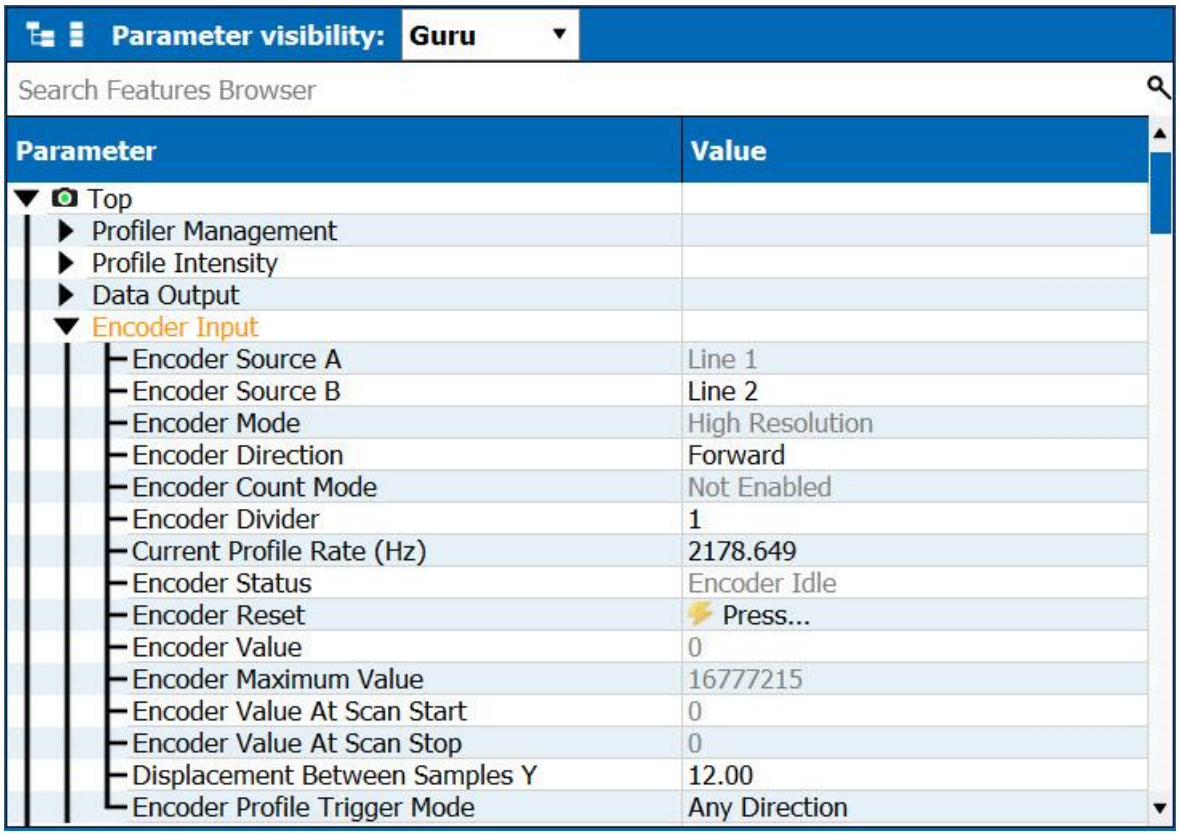
# 2D features




| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Image Sensor Frame Rate (Hz) | imageSensorFrameRate | Specifies the camera internal frame rate of the sensor, in Hz. | 1.00 DFNC Guru |
| Image Sensor Frame Drop Count | internalAcquisitionFrameDropCount | Indicates the number of 2D frames dropped from the image sensor in areascan mode to respect the maximum GigE transfer bandwidth. This preserves the image sensor settings like Exposure Time, to be the same as when in "Linescan3D". | 1.00 DFNC Guru |
| Effective Transfer Frame Rate (Hz) | resultingTransferFPS | Indicates the transfer frame rate, based on the current "Image Sensor Frame Rate" and Image "Sensor Frame Drop Count" | 1.00 DFNC Guru |

# Encoder Input Category

The Encoder Input category provides features to configure the Z-Trak2 shaft encoder inputs.




## Encoder Input features

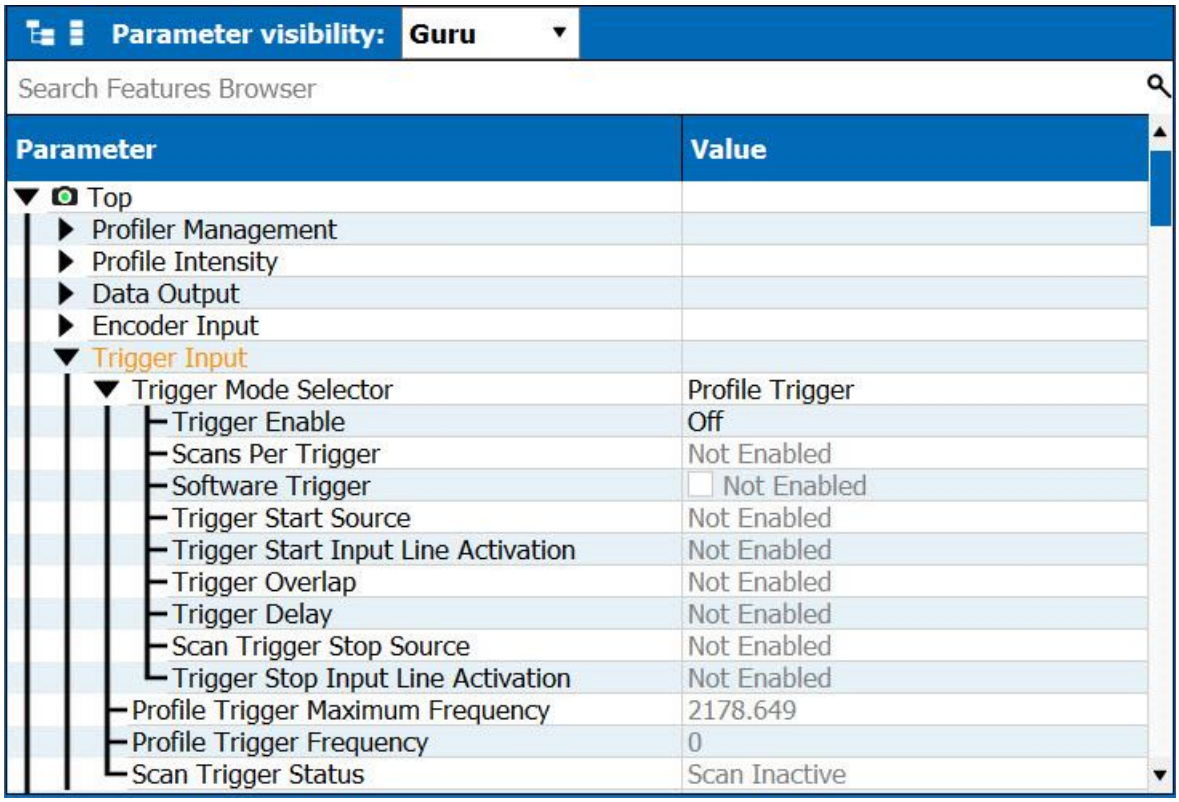
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Encoder Source A | EncoderSourceA | Select the signal source for Encoder Input A. | 1.00<br>Expert |
| *Line 1* | *Line1* | *Encoder A input is Input Line 1.* | |
| Encoder Source B | EncoderSourceB | Select the signal source for Encoder Input B. | 1.00<br>Expert |
| *Off* | *Off* | *Encoder Source B is off.* | |
| *Line 2* | *Line2* | *Encoder B is Input Line 2. Helps determine position of the encoder and direction of the motion.* | |
| Encoder Mode | EncoderMode | Indicates the Encoder modes. | 1.00<br>Expert |
| *High Resolution* | *HighResolution* | *Any change in encoder phase A or B will change the encoder value.* | |
| Encoder Count Mode | encoderCountMode | Sets if the Encoder Value increments or decrements for each encoder pulse. This feature is available when Encoder B Input (Quadrature mode) is not being used. | 1.00<br>DFNC<br>Expert |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *Increment* | *Increment* | *Encoder value increments for each encoder pulse.* | |
| *Decrement* | *Decrement* | *Encoder value decrements for each encoder pulse.* | |
| Encoder Direction | encoderDirection | When Encoder Source A and B are used, this feature sets the direction which the encoder must be moving for the profile triggers to be generated. This feature is only available when both phases of the encoder are used. | 1.00<br>DFNC<br>Expert |
| *Forward* | *Forward* | *Profile triggers are generated when the encoder is moving in the Forward direction. The forward direction of the encoder is determined by the phase A leading B.* | |
| *Reverse* | *Reverse* | *Profile triggers are generated when the encoder is moving in the Reverse direction. The reverse direction of the encoder is determined by the phase B leading A.* | |
| Encoder Divider | EncoderDivider | Selects the number of input pulses to get before generating "Profile Trigger". | 1.00<br>Expert |
| Profile Rate (Hz) | profileRate | Specifies the profile rate of the sensor, in Hz. | 1.00<br>DFNC<br>Beginner |
| Encoder Status[2] | EncoderStatus | Indicates whether the encoder is moving forward, reverse or idle. When encoder phase A and B are used, the direction is determined automatically. | 1.00<br>Expert |
| *Encoder Forward* | *EncoderUp* | *The encoder is moving in the forward direction. Phase A leads Phase B.* | |
| *Encoder Reverse* | *EncoderDown* | *The encoder is moving in the reverse direction. Phase B leads Phase A.* | |
| *Encoder Idle* | *EncoderIdle* | *The encoder is not moving.* | |
| Encoder Reset | EncoderReset | Resets the "Encoder Value" to 0. | 1.00<br>Expert |
| Encoder Value | EncoderValue | Indicates the current encoder counter value. In quadrature mode, the Encoder value automatically increments in the forward direction (phase AB) and decrements in the reverse direction (phase BA). In single phase mode, the Encoder Count Mode feature determines whether the Encoder Value will increment or decrement. | 1.00<br>Expert |
| Encoder Maximum Value | encoderMaximumValue | Indicates the maximum value of the encoder counter. When this value is reached, the counter wraps-around to 0. | 1.00<br>DFNC<br>Guru |
| Encoder Value At Scan Start | encoderValueAtScanStart | Indicates the encoder counter value at the start of every new scan. | 1.00<br>DFNC<br>Expert |
| Encoder Value At Scan Stop | encoderValueAtScanStop | Indicates the encoder counter value at the stop of every scan. | 1.00<br>DFNC<br>Expert |
| Displacement Between Samples Y | displacementY | Displacement between samples Y (um, mil, mm). | 1.00<br>DFNC<br>Expert |
| Encoder Profile Trigger Mode | EncoderOutputMode | Selects how the direction and position of the Encoder will generate profile triggers. | 1.00<br>Expert |
| *Position* | *Position* | *When the encoder moves in the opposite direction as defined by Encoder Direction, the current position is recorded. No profile triggers are generated until that position is passed again.* | |
| *Direction* | *Direction* | *In quadrature mode, The profile triggers are only generated when the motion of the encoder is in the same direction set by the Encoder Direction feature.* | |
| *Any Direction* | *AnyDirection* | *Profile triggers are generated regardless of the direction of motion.* | |

[2] The Encoder Status feature is set to *Encoder Idle* if no motion signal is detected for 65 ms from the shaft encoder inputs; it will change to either *Encoder Forward* (*EncoderUp*) or *Encoder Reverse* (*EncoderDown*) as soon as motion is detected.

# Trigger Input category

The Z-Trak2 Input features are used to configure external inputs.




# Trigger Input features

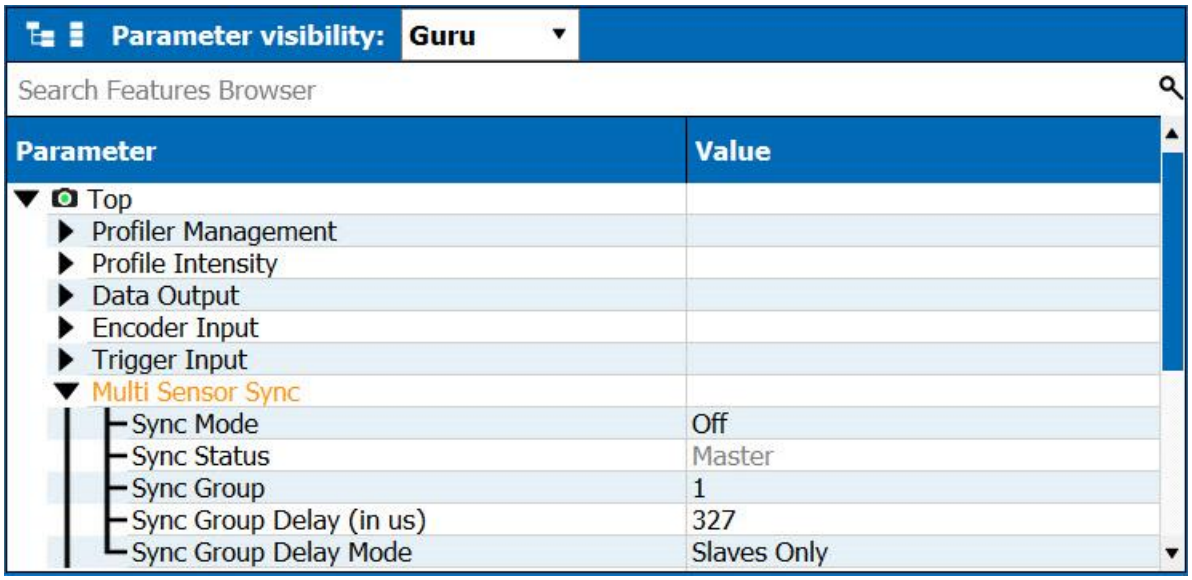
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Trigger Mode Selector | TriggerSelector | Selects the type of trigger to configure. | 1.00 Beginner |
| *Profile Trigger* | *LineStart* | *Selects the trigger that starts the capture of a profile.* | |
| *Variable Scan* | *VariableScan* | *Selects the Variable Scan trigger. Trigger Start Source and Trigger Stop Source determine the length of the scans.* | |
| *Fixed Scan* | *FixedScan* | *Selects the Fixed Scan trigger. Scan Per Trigger feature sets the number of scans to capture.* | |
| Trigger Enable | TriggerMode | Turns the selected Trigger On or Off. | 1.00 Beginner |
| *Off* | *Off* | *The selected trigger is off.* | |
| *On* | *On* | *The selected trigger is on.* | |
| Scans Per Trigger | AcquisitionBurstFrameCount | Sets the number of scans to acquire when Fixed Scan Trigger is enabled. | 1.00 Beginner |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Software Trigger | TriggerSoftware | Writing this feature generates an internal profile trigger. | 1.00 Beginner |
| Trigger Start Source | TriggerSource | Selects the start source to use for the trigger input. The source can be an internal or external signal. | 1.00 Beginner |
| *Encoder* | *Encoder1* | *The Profile trigger is generated by the Encoder.* | |
| *Line 3* | *Line3* | *The trigger is generated by the Line 3.* | |
| *Line 4* | *Line4* | *The trigger is generated by the Line 4.* | |
| *Multi Sensor Sync* | *MultiSensorSync* | *Sets the Multi Sensor Sync as the profile trigger source.* | |
| *Software* | *Software* | *The Profile trigger is generated by the Software Trigger command.* | |
| *Timer 1 End Event* | *Timer1End* | *The Profile trigger is generated by the Timer End Event.* | |
| *Counter 1 End Event* | *Counter1End* | *The Profile trigger is generated by the Counter End Event.* | |
| *Timestamp Modulo Event* | *timestampModuloEvent* | *The Profile trigger is generated by the Timestamp modulo Event.* | |
| Trigger Start Input Line Activation | TriggerActivation | Selects the activation mode for the Trigger Input. This is applicable only for external line inputs. | 1.00 Beginner |
| *Falling Edge* | *FallingEdge* | *The trigger is considered valid when the line source signal goes from high to low.* | |
| *Rising Edge* | *RisingEdge* | *The trigger is considered valid when the line source signal goes from low to high.* | |
| *Any Edge* | *AnyEdge* | *The trigger is considered valid for any transition on the line source signal.* | |
| *Level High* | *LevelHigh* | *The trigger is considered valid while the line source signal is high.* | |
| Trigger Overlap | TriggerOverlap | Selects if a new trigger will be accepted (or latched) while the previous one is still being processed. | 1.00 Guru |
| *Off* | *Off* | *No trigger overlap is permitted.* | |
| *ReadOut* | *ReadOut* | *Profile Trigger is accepted immediately after the start of the image sensor readout.* | |
| Trigger Delay | TriggerDelay | Specifies the delay before the profile integration starts or the scan starts.<br>For profile trigger mode, this value specifies the delay in µSec.<br>For scan trigger modes, this value specifies the delay in the number of profiles to skip before starting the scan. | 1.00 Beginner |
| Scan Trigger Stop Source | triggerStopSource | Variable scan stops when the trigger stop source is activated. | 1.00 DFNC Beginner |
| *Line 3* | *Line3* | *The variable scan is stopped when Line 3 is activated.* | |
| *Line 4* | *Line4* | *The variable scan is stopped when Line 4 is activated.* | |
| Trigger Stop Input Line Activation | triggerStopActivation | Select the activation mode for the "Trigger Stop Source". This is applicable only for external line inputs. | 1.00 Beginner |
| *Rising Edge* | *RisingEdge* | *The trigger is considered valid when the line source signal goes from low to high.* | |
| *Level High* | *LevelHigh* | *The trigger is considered valid while the line source signal is high.* | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Profile Trigger Maximum Frequency | profileTriggerMaxFrequency | Maximum number of profile triggers accepted per second at current exposure time. | 1.00<br>DFNC<br>Guru |
| Profile Trigger Frequency | profileTriggerFrequency | Reads the number of profile triggers sent to "TriggerSelector=Profile Trigger" per second. | 1.00<br>DFNC<br>Guru |
| Scan Trigger Status | frameBurstState | Indicates the current status of Scan Trigger signal | 1.00<br>DFNC<br>Expert |
| *Inactive* | *Inactive* | *The scan is waiting for a trigger or the grab to start.* | |
| *Active* | *Active* | *The scan is active and acquiring profiles.* | |
| *Delay Active* | *DelayActive* | *The scan trigger has been activated and is delayed by the number of profiles specified by the Trigger Delay feature.* | |

# Multi Sensor Sync category

The Multi Sensor Sync features are used to synchronize a group of devices so that profile acquisition may be simultaneous or sequential.



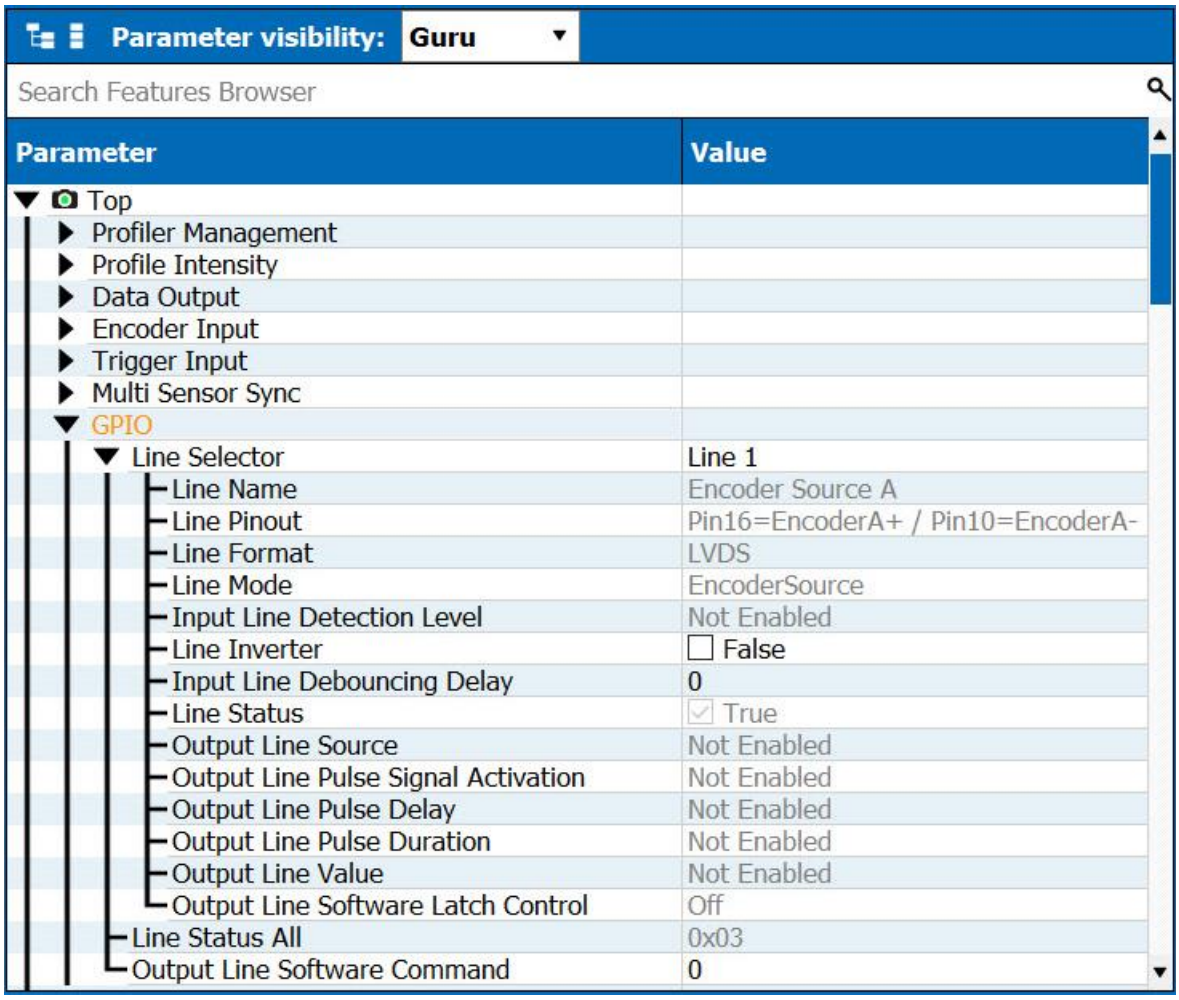

## Multi Sensor Sync features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Sync Mode | multiSensorSyncMode | Turns multi-sensor synchronization on/off.<br>The master sensor must have a trigger source set to any value other than "Multi-Sensor-Sync". All slave sensors must have their "Trigger Source" set to "Multi-Sensor-Sync". Only one master is allowed per "Multi Sensor Sync Group". | 1.00<br>DFNC<br>Expert |
| *Off* | *Off* | *Turns Off multi-sensor synchronization.* | |
| *On* | *On* | *Turns On synchronization between multiple sensors.* | |
| Sync Status | multiSensorSyncStatus | Indicates if the selected device is a multi-sync master or a slave. | 1.00<br>DFNC<br>Expert |
| *Master* | *Master* | *Indicates the device will generate synchronization signals that will be used by other devices in the network.* | |
| *Slave* | *Slave* | *Indicates the device will receive synchronization signals from the master.* | |
| Sync Group | multiSensorSyncGroup | Selects an ID for the Multi Sensor Sync group. | 1.00<br>DFNC<br>Guru |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Sync Group Delay (in us) | multiSensorSyncDelay | The Sync Group Delay represents the time (in microseconds) after which the device(s) of the group will act on the trigger input message. The Sync Group Delay Mode specifies whether this delay applies only to slave sensors or to both master and slave sensors. | 1.00<br>DFNC<br>Expert |
| Sync Group Delay Mode | multiSensorSyncDelayMode | The Sync Group Delay Mode specifies the sensors to which the Sync Group Delay applies. | 1.00<br>DFNC<br>Expert |
| *Slaves Only* | *SlaveOnly* | *Slaves only.* | |
| *Master and Slaves* | *All* | *Master and slaves.* | |

# GPIO Control category

The Z-Trak2 General Purpose Input/Output (GPIO) control has features used to configure external input and output signals.




## GPIO features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Line Selector | LineSelector | Selects the I/O line. | 1.00 Beginner |
| *Line 1* | *Line1* | *Encoder Source A+ is on Pin 16, and A– is on Pin 10 of the M12 17-pin I/O connector.* | |

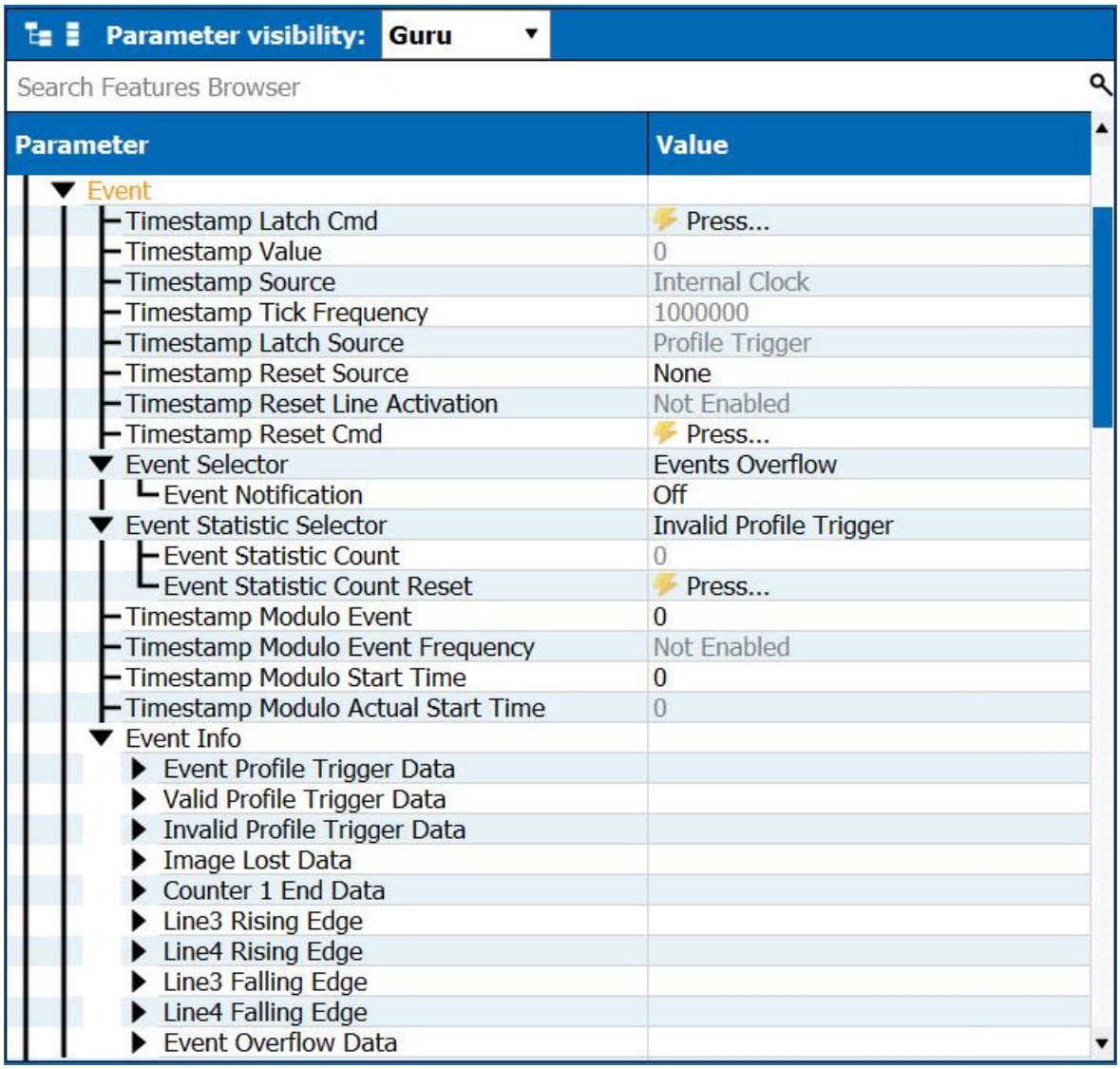
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *Line 2* | *Line2* | *Encoder Source B+ is on Pin 11, and B– is on Pin 1 of the M12 17-pin I/O connector.* | |
| *Line 3* | *Line3* | *GPI 1+ is on Pin 15 and GPI 1– is on Pin 14 of the M12 17-pin I/O connector.* | |
| *Line 4* | *Line4* | *GPI 2+ in on Pin 3 and GPI 2– is on Pin 13 of the M12 17-pin I/O connector.* | |
| *Line 5* | *Line5* | *GPO 1+ is on Pin 8 and GPO 1– is on Pin 9 of the M12 17-pin I/O connector.* | |
| *Line 6* | *Line6* | *GPO 2+ is on Pin 4 and GPO 2– is on Pin 5 of the M12 17-pin I/O connector.* | |
| Line Name | lineName | Indicates the name assigned to the selected line. | 1.00 Beginner DFNC |
| *Encoder Source A* | *EncoderSourceA* | *Associated with the logical line Encoder Source A* | |
| *Encoder Source B* | *EncoderSourceB* | *Associated with the logical line Encoder Source B* | |
| *Input 1* | *Input1* | *Associated with the logical line Input 1* | |
| *Input 2* | *Input2* | *Associated with the logical line Input 2.* | |
| *Output 1* | *Output1* | *Associated with the logical line Output 1* | |
| *Output 2* | *Output2* | *Associated with the logical line Output 2* | |
| Line Pinout | linePinAssociation | Indicates the pin numbers on the connector associated to the selected line. | 1.00 Guru DFNC |
| *Pin16=EncoderA+ / Pin10=EncoderA-* | *Pin16EncoderApos_Pin10EncoderAneg* | *Pin 16 is Encoder Source A+ and Pin 10 is the Encoder Source A– on the I/O connector.* | |
| *Pin11=EncoderB+ / Pin1=EncoderB-* | *Pin11EncoderBpos_Pin1EncoderBneg* | *Pin 11 is the Encoder Source B+ and Pin 1 is the Encoder Source B– on the I/O connector.* | |
| *Pin15=GPI1+ / Pin14=GPI1–* | *Pin15pos_Pin14neg* | *Pin 15 is the Input positive signal and Pin 14 is Input negative signal on the I/O connector.* | |
| *Pin3=GPI2+ / Pin13=GPI2–* | *Pin3pos_Pin13neg* | *Pin 3 is the Input positive signal and Pin 13 is the Input negative signal on the I/O connector.* | |
| *Pin8=GPO1+ / Pin9=GPO1–* | *Pin8pos_Pin9neg* | *Pin 8 is the Output positive signal and Pin 9 is the Output negative signal on the I/O connector.* | |
| *Pin4=GPO2+ / Pin5=GPO2–* | *Pin4pos_Pin5neg* | *Pin 4 is the Output positive signal and Pin 5 is the Output negative signal on the I/O connector.* | |
| Line Format | LineFormat | Specify the current electrical format of the selected physical input or output. | 1.00 Expert |
| *Opto-Coupled* | *OptoCoupled* | *The line is opto-Coupled.* | |
| *LVDS* | *LVDS* | *The line is LVDS.* | |
| Line Mode | LineMode | Indicates if the physical Line is an Input or Output signal. | 1.00 Expert |
| *EncoderSource* | *EncoderSource* | *The line is an encoder source.* | |
| *Input* | *Input* | *The line is an input line.* | |
| *Output* | *Output* | *The line is an output line.* | |
| Line Status | LineStatus | Indicates the current status of the selected input or output line. | 1.00 Expert |
| Line Inverter | LineInverter | Inverts the polarity of the selected line. | 1.00 Beginner |
| Input Line Detection Level | lineDetectionLevel | Specifies the voltage threshold required to recognize a signal transition on an input line. | 1.00 Beginner DFNC |
| *TTL* | *TTL* | *Valid detection range for 3.3/5.0 Volt (set point 1.6 Volt).* | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *12 Volt* | *input12V* | *Valid detection range for 12 Volt (set point 6 Volt).* | |
| *24 Volt* | *input24V* | *Valid detection range for 24 Volt (set point 12 Volt).* | |
| Input Line Debouncing Delay | lineDebouncingPeriod | Specifies the minimum delay (in microseconds) to allow the input line voltage to stabilize before determining signal transition. | 1.00 Beginner DFNC |
| | | | |
| Output Line Source | outputLineSource | Selects which internal signal to output on the selected line. | 1.00 Beginner DFNC |
| *Off* | *Off* | *Line output is Open* | |
| *Software Controlled* | *SoftwareControlled* | *The Output Line Value feature changes the state of the selected output pin.* | |
| *Pulse on: Start of Frame* | *PulseOnStartofFrame* | *Generate a pulse on the start of the Frame Active event.* | |
| *Pulse on: Start of Exposure* | *PulseOnStartofExposure* | *Generate a pulse on the ExposureStart event. This option is typically used to trigger a strobe light.* | |
| *Pulse on: End of Exposure* | *PulseOnEndofExposure* | *Generate a pulse on the ExposureEnd event. This option is typically used to trigger a strobe light.* | |
| *Pulse on: Start of Readout* | *PulseOnStartofReadout* | *Generate a pulse on the ReadoutStart event.* | |
| *Pulse on: End of Readout* | *PulseOnEndofReadout* | *Generate a pulse on the ReadoutEnd event.* | |
| *Pulse on: Valid Frame Trigger* | *PulseOnValidFrameTrigger* | *Generate a pulse on the FrameTrigger event.* | |
| *Pulse on: Rejected Frame(s) Trigger* | *PulseOnInvalidFrameTrigger* | *Generate a pulse on the Invalid FrameTrigger event.* | |
| *Pulse on: Start of Acquisition* | *PulseOnStartofAcquisition* | *Generate a pulse when the AcquisiontStart event occurs.* | |
| *Pulse on: End of Acquisition* | *PulseOnEndofAcquisition* | *Generate a pulse when the AcquisiontStop event occurs.* | |
| *Pulse on: End of Timer 1* | *PulseOnEndofTimer1* | *Generate a pulse on the TimerEnd 1 event.* | |
| *Pulse on: End of Counter 1* | *PulseOnEndofCounter1* | *Generate a pulse on the CounterEnd 1 event.* | |
| *Pulse on: Input 1 Event* | *PulseOnInput1* | *Generate a pulse on the Input signal 1 event.* | |
| *Pulse on: Input 2 Event* | *PulseOnInput2* | *Generate a pulse on the Input signal 2 event.* | |
| *Pulse on: Action 1* | *PulseOnAction1* | *Generate a pulse on the GigEVision Action Command 1.* | |
| *Pulse on: Action 2* | *PulseOnAction2* | *Generate a pulse on the GigEVision Action Command 2.* | |
| *Pulse on: Software Command* | *PulseOnSoftwareCmd* | *Generate a pulse on the Input of a Software Command.* | |
| *Exposure Active* | *ExposureActive* | *Generate a signal that is active when the Exposure is active.* | |
| Output Line Pulse Signal Activation | outputLinePulseActivation | Specifies the input line activation mode to trigger the OutputLine pulse. | 1.00 Beginner DFNC |
| *Rising Edge* | *RisingEdge* | *Specifies that the trigger is considered valid on the rising edge of the source signal.-* | |
| *Falling Edge* | *FallingEdge* | *Specifies that the trigger is considered valid on the falling edge of the source signal.-* | |
| *Any Edge* | *AnyEdge* | *Specifies that the trigger is considered valid on the falling or rising edge of the source signal.* | |
| Output Line Pulse Delay | outputLinePulseDelay | Sets the delay before the output line pulse duration signal. Applicable for the OutputLineSource feature. | 1.00 Beginner DFNC |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Output Line Pulse Duration | outputLinePulseDuration | Sets the width (duration) of the output line pulse in microseconds. | 1.00<br>Beginner<br>DFNC |
| Output Line Value | outputLineValue | Sets the output state of the selected Line. OutputLineSource must be SoftwareControlled. | 1.00<br>Beginner<br>DFNC |
| *Active* | *Active* | *Sets the output state to active.* | |
| *Inactive* | *Inactive* | *Sets the output state to inactive.* | |
| Output Line Software Latch Control | outputLineSoftwareLatchControl | When Off, the selected output line is set with the value in Output Line Value. | 1.00<br>Guru<br>DFNC |
| *Off* | *Off* | *Output pin state set by outputLineValue.* | |
| *Latch* | *Latch* | *Output pin state set by outputLineSoftwareCmd.* | |
| Line Status All | LineStatusAll | Returns the current status of all available line signals, at the time of polling, in a single bit field. The order is Line1, Line2, ... | 1.00<br>Expert |
| Output Line Software Command | outputLineSoftwareCmd | Writing a value of 1 in the bit field applies the Latch value of the outputLineSoftwareLatchControl and/or executes the PulseOnSoftwareCmd for any output line programmed for software control. The feature outputLineSoftwareCmd can take any binary value and each bit set to 1 corresponds to a Icommand for an Output. Note that Outputs are numbered from 1 to N, therefore Bit 1 of outputLineSoftwareCmd corresponds to Output1. This is applicable to OutputLineSource = Pulse On: where Software Cmd (for Pulse mode) or OutputLineSource = SoftwareControlled and OutputLineSoftwareLatchControl = Latch (for static states). | 1.00<br>Expert<br>DFNC |
| | | | |

# Event category

The Event category is used to configure the device event-related features.



# Event features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Timestamp Latch Cmd | timestampControlLatch | Latch the current timestamp internal counter value in the timestampValue feature. | 1.00 Expert DFNC |
| Timestamp Value | timestampValue | Returns the 64-bit value of the timestamp, which is the internal Clock timer or the PTP clock timer, depending on the Timestamp Source selection. | 1.00 Expert DFNC |
| Timestamp Source | timestampSource | Specifies the source used as the incrementing signal for the Timestamp register. | 1.00 Expert DFNC |
| *Internal Clock* | *InternalClock* | *The timestamp source is generated by the device internal clock. Refer to the timestampTickFrequency feature for the time base.* | |
| *IEEE1588* | *IEEE1588* | *The timestamp source is controlled by the network IEEE1588 protocol. This source is automatically selected when PTP mode is enabled.* | |
| Timestamp Tick Frequency | timestampTickFrequency | Indicates the number of timestamp ticks (or increments) during 1 second (frequency in Hz). This feature changes depending on the TimeStamp Source. | 1.00 Expert DFNC |
| Timestamp Latch Source | timestampLatchSource | Specifies the internal event or signal that will latch the timestamp counter into the timestamp buffer. | 1.00 Expert DFNC |
| *Line Start* | *LineStart* | *The timestamp is latched on profile trigger.* | |
| Timestamp Reset Source | timestampResetSource | Specifies the internal signal or physical input line to use as the timestamp reset source. | 1.00 Expert DFNC |
| *None* | *None* | *No timestamp reset source is specified. Note that the Timestamp reset command can still reset the counter.* | |
| *Line 3* | *Line3* | *Use input line 3 as the timestamp reset source.* | |
| *Line 4* | *Line4* | *Use input line 4 as the timestamp reset source.* | |
| Timestamp Reset Line Activation | timestampResetLineActivation | Specifies the activation mode to reset the timestamp counter on the selected line of the TimestampResetSource feature. | 1.00 Beginner DFNC |
| *Falling Edge* | *FallingEdge* | *Reset the timestamp counter on the falling edge of the source signal.* | |
| *Rising Edge* | *RisingEdge* | *Reset the timestamp counter on the rising edge of the source signal.* | |
| *Any Edge* | *AnyEdge* | *Reset the timestamp counter on the falling or rising edge of the source signal.* | |
| Timestamp Reset Cmd | timestampControlReset | Resets the timestamp counter to 0. This Feature resets both the internal Clock timer and the PTP clock timer. Note that the PTP Mode must be disabled first to reset the PTP clock timer. | 1.00 Expert DFNC |
| | | | |

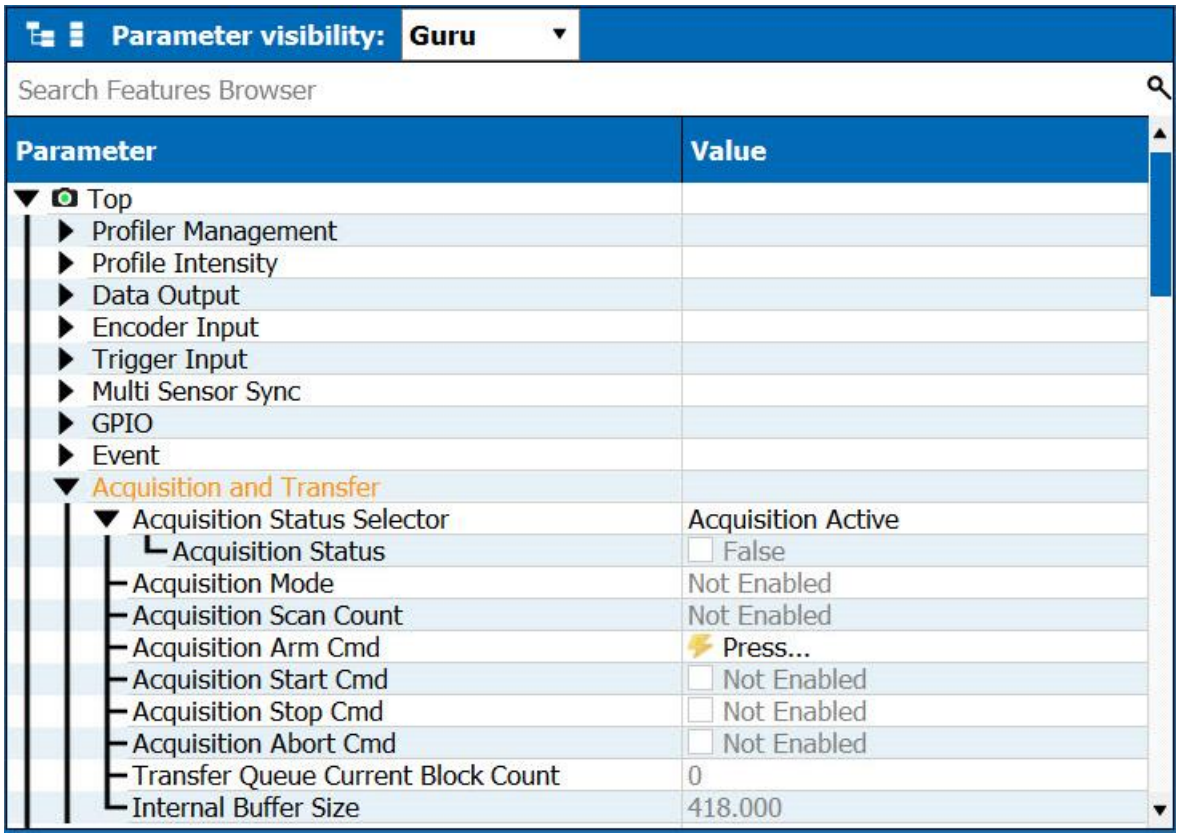
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Event Selector | EventSelector | Select the Event to enable/disable with the EventNotification feature. | 1.00 Expert |
| *Start of Profile* | *LineStart* | *Event sent on control channel on an Active Profile. This occurs with the start of the exposure delay.* | |
| *Valid Profile Trigger* | *ValidLineTrigger* | *Event sent on control channel when a valid profile trigger is generated.* | |
| *Invalid Profile Trigger* | *InvalidLineTrigger* | *Event sent on control channel when a profile trigger occurs in an invalid Trigger region. Therefore the trigger is rejected and no profile acquisition occurs.* | |
| *Image Lost* | *ImageLost* | *Event sent on control channel when an image is lost due to insufficient memory.* | |
| *Counter 1 End* | *Counter1End* | *Event sent when counter 1 has reached the counterDuration count.* | |
| *Line3 Rising Edge* | *Line3RisingEdge* | *Event generated when a Rising Edge is detected on Line 3.* | |
| *Line3 Falling Edge* | *Line3FallingEdge* | *Event generated when a Falling Edge is detected on Line 3.* | |
| *Line4 Rising Edge* | *Line4RisingEdge* | *Event generated when a Rising Edge is detected on Line 4.* | |
| *Line4 Falling Edge* | *Line4FallingEdge* | *Event generated when a Falling Edge is detected on Line 4.* | |
| *Events Overflow* | *eventsOverflow* | *Event sent on control channel when all previous active events have been disabled because the device cannot send them fast enough, generating in internal message overflow. All required events must be re-enabled manually.* | |
| Event Notification | EventNotification | Enable Events for the event type selected by the EventSelector feature. | 1.00 Expert |
| *Off* | *Off* | *The selected event is disabled.* | |
| *On* | *On* | *The selected event will generate a software event.* | |
| Event Statistic Selector | eventStatisticSelector | Selects which Event statistic to display. | 1.00 Expert DFNC |
| *Invalid Profile Trigger* | *InvalidLineTrigger* | *Counts the Profile trigger occurring in an invalid Trigger region.* | |
| *Image Lost* | *ImageLost* | *Image is acquired but lost before it's been transferred.* | |
| *Packet Resend* | *PacketResend* | *Counts the number of individual packets that are resent.* | |
| *Packet Resend Request Dropped* | *PacketResendRequestDropped* | *Counts the number of packet resend requests dropped. The device queues the packet resend requests until they are processed. There is a limit to the number of requests that can be queued by the camera. When a new request is received and the queue is full, the request is dropped but this statistic is still incremented.* | |
| *Ethernet Pause Frame Received* | *EthernetPauseFrameReceived* | *Counts the number of Ethernet Pause Frame received.* | |
| *Late MultiSensorSync* | *LateMultiSensorSync* | *MultiSensorSync was received too late.* | |
| Event Statistic Count | eventStatisticCount | Display the count of the selected Event. | 1.00 Expert DFNC |
| Event Statistic Count Reset | eventStatisticCountReset | Reset the count of the selected Event. | 1.00 Expert DFNC |
| | | | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Timestamp Modulo Event | timestampModulo | Specifies the additional interval between the current timestamp tick and the event generated. This interval has a 80ns accuracy. Note that the value zero disables the event generator. | 1.00 Expert DFNC |
| Timestamp Modulo Event Frequency | timestampModuloFrequency | Returns the frequency of the timestamp Modulo Event (in Hz). | 1.00 Expert DFNC |
| Timestamp Modulo Start Time | timestampModuloStartTime | Specifies the timestamp value that must be exceeded by the incrementing timestamp counter before the modulo event starts. This Feature is also used for a "Future" Frame Acquisition. | 1.00 Expert DFNC |
| Timestamp Modulo Actual Start Time | timestampModuloActualStartTime | Displays the actual modulo event start time as used by the device. When the user specified "timestampModuloStartTime" is in the future, timestampModuloActualStartTime = timestampModuloStartTime. When the user specified "timestampModuloStartTime" has already past, the profile sensor automatically recalculates a future value for "timestampModuloStartTime" using the user set "timestampModulo" feature value. This new start time is reported by "timestampModuloActualStartTime". | 1.00 Expert DFNC |
| | | | |
| Profile Trigger Event ID | EventLineStart | Represents the event ID to identify the Event Profile Trigger software Event. | 1.00 Guru |
| Event Profile Trigger Data | EventLineStartData | Data of the profile trigger event | 1.00 Guru |
| Profile Trigger Event Timestamp | EventLineStartTimestamp | Timestamp of the Event Profile Trigger event. | 1.00 Guru |
| Valid Profile Trigger Event ID | EventValidLineTrigger | Generate an event on valid profile trigger. | 1.00 Guru |
| Valid Profile Trigger Data | EventValidLineTriggerData | Data of the valid profile trigger event. | 1.00 Guru |
| Valid Profile Trigger Event Timestamp | EventValidLineTriggerTimestamp | Timestamp of the Valid profile trigger event. | 1.00 Guru |
| Invalid Profile Trigger Event ID | EventInvalidLineTrigger | Generate an event on invalid profile trigger. | 1.00 Guru |
| Invalid Profile Trigger Data | EventInvalidLineTriggerData | Data of the invalid profile trigger event. | 1.00 Guru |
| Invalid Profile Trigger Event Timestamp | EventInvalidLineTriggerTimestamp | Timestamp of the invalid profile trigger event. | 1.00 Guru |
| Image Lost Event ID | EventImageLost | Generate an event on image lost. | 1.00 Guru |
| Image Lost Data | EventImageLostData | Data of the image lost event. | 1.00 Guru |
| Image Lost Event Timestamp | EventImageLostTimestamp | Timestamp of the image lost event. | 1.00 Guru |
| Counter 1 End ID | EventCounter1End | Generate an event on Counter 1 End. | 1.00 Guru |
| Counter 1 End Data | EventCounter1EndData | Data of the Counter1 End event. | 1.00 Guru |
| Counter 1 End Event Timestamp | EventCounter1EndTimestamp | Timestamp of the Counter 1 End event. | 1.00 Guru |
| Line3 Rising Edge ID | EventLine3RisingEdge | Generate an event on Line3 rising edge. | 1.00 Guru |
| Line3 Rising Edge | EventLine3RisingEdgeData | Data of the Line3 rising edge event. | 1.00 Guru |
| Line3 Rising Edge Event Timestamp | EventLine3RisingEdgeTimestamp | Timestamp of the Line3 rising edge event. | 1.00 Guru |
| Line4 Rising Edge ID | EventLine4RisingEdge | Generate an event on Line4 rising edge. | 1.00 Guru |
| Line4 Rising Edge | EventLine4RisingEdgeData | Data of the Line4 rising edge event. | 1.00 Guru |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Line4 Rising Edge Event Timestamp | EventLine4RisingEdgeTimestamp | Timestamp of the Line4 rising edge event. | 1.00 Guru |
| Line3 Falling Edge ID | EventLine3FallingEdge | Generate an event on Line3 falling edge. | 1.00 Guru |
| Line3 Falling Edge | EventLine3FallingEdgeData | Data of the Line3 falling edge event. | 1.00 Guru |
| Line3 Falling Edge Event Timestamp | EventLine3FallingEdgeTimestamp | Timestamp of the Line3 falling edge event. | 1.00 Guru |
| Line4 Falling Edge ID | EventLine4FallingEdge | Generate an event on Line4 falling edge. | 1.00 Guru |
| Line4 Falling Edge | EventLine4FallingEdgeData | Data of the Line4 falling edge event. | 1.00 Guru |
| Line4 Falling Edge Event Timestamp | EventLine4FallingEdgeTimestamp | Timestamp of the Line4 falling edge event. | 1.00 Guru |
| Events Overflow Event ID | EventeventsOverflow | Represents the event ID to identify the Events Overflow Event software Event. | 1.00 Guru |
| Event Overflow Data | EventeventsOverflowData | Data of the event overflow event | 1.00 Guru |
| Events Overflow Event Timestamp | EventeventsOverflowTimestamp | Timestamp of the EventeventsOverflow event. | 1.00 Guru |
| | | | |

# Acquisition and Transfer category

The Acquisition and Transfer category features are used to configure the optional acquisition modes of the device.



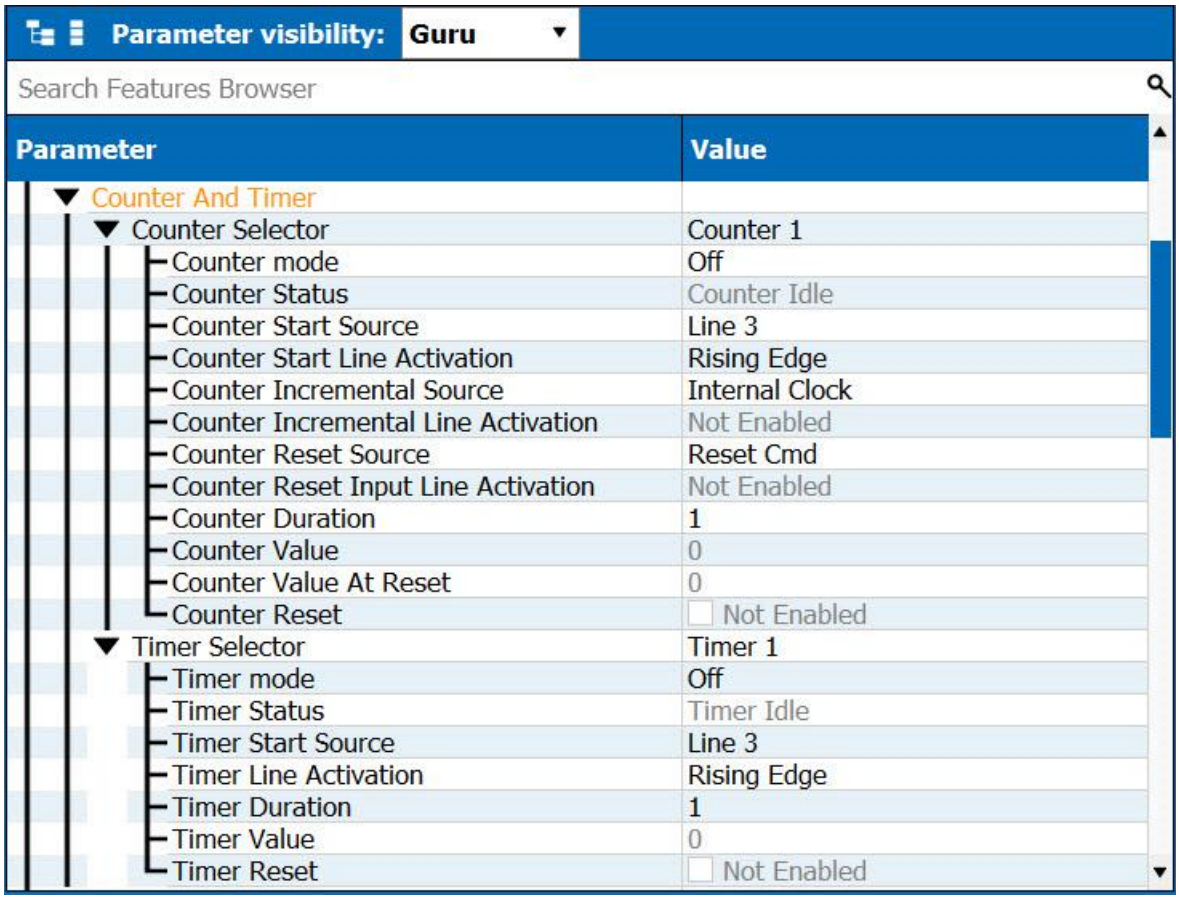

## Acquisition and Transfer features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Acquisition Status Selector | AcquisitionStatusSelector | Selects what status "Acquisition Status" to monitor. | 1.00 Expert |
| *Acquisition Active* | *AcquisitionActive* | *Device is currently doing an acquisition of one or many profiles.* | |
| Acquisition Status | AcquisitionStatus | Reads the state of the internal acquisition signal selected using the "Acquisition Status Selector" feature. | 1.00 Expert |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Acquisition Mode | AcquisitionMode | Set the acquisition mode of the device. It defines the number of frames to capture during an acquisition and the way the acquisition stops. | 1.00 Beginner |
| *Single Scan* | *SingleFrame* | *One scan is captured for each AcquisitionStart Command. An AcquisitionStop occurs at the end of the Active Scan.* | |
| *Multi-Scan* | *MultiFrame* | *A sequence of scans is captured for each AcquisitionStart Command. The number of scans is specified by AcquisitionFrameCount feature. An AcquisitionStop occurs at the end of the Active Scan(s)* | |
| *Continuous* | *Continuous* | *Scans are captured continuously with AcquisitionStart until stopped with the AcquisitionStop command.* | |
| Acquisition Scan Count | AcquisitionFrameCount | Number of scans to be acquired in Multiscan acquisition mode. | 1.00 Beginner |
| Acquisition Arm Cmd | AcquisitionArm | Arms the device before an AcquisitionStart command. This optional command validates all the current features for consistency and prepares the device for a fast start of the acquisition. If not used explicitly, this command is automatically executed at the first AcquisitionStart but will not be repeated for subsequent ones unless a data transfer related feature is changed in the device. | 1.00 Guru |
| Acquisition Start Cmd | AcquisitionStart | Start scan capture using the currently selected acquisition mode. The number of scans captured is specified by AcquisitionMode feature. | 1.00 Beginner |
| Acquisition Stop Cmd | AcquisitionStop | Stops the Acquisition of the device at the end of the current profile. | 1.00 Beginner |
| Acquisition Abort Cmd | AcquisitionAbort | Aborts the acquisition immediately. This will end the capture without completing the current scan or aborts waiting on a trigger. If no acquisition is in progress, the command is ignored. | 1.00 Beginner |
| Transfer Queue Current Block Count | transferQueueCurrentBlockCount | Returns the current number of blocks in the transfer queue. | 1.00 DFNC Expert |
| Internal Buffer Size | transferQueueMemorySize | Indicates the amount of device memory (in MBytes) available for internal image frame accumulation in the transfer queue. Increasing or decreasing memory reserved by devicePacketResendBufferSize will affect total memory available here. | 1.00 DFNC Guru |

# Counter and Timer category

The Counter and Timer category features are used to configure acquisition counters and timers for various inputs.




## Counter and Timer features

| Display Name | Feature & Values | Description | Version & View |
|---|---|---|---|
| Counter Selector | counterSelector | Selects the counter to configure. | 1.00 Expert DFNC |
| *Counter 1* | *Counter1* | *Select counter 1* | |
| Counter mode | counterMode | Selects the counter mode. The selected Counter is either Active or Disabled. When Disabled, the Counter can be configured. | 1.00 Expert DFNC |
| *Off* | *Off* | *The selected Counter is Disabled* | |
| *Active* | *Active* | *The selected Counter is Enabled* | |

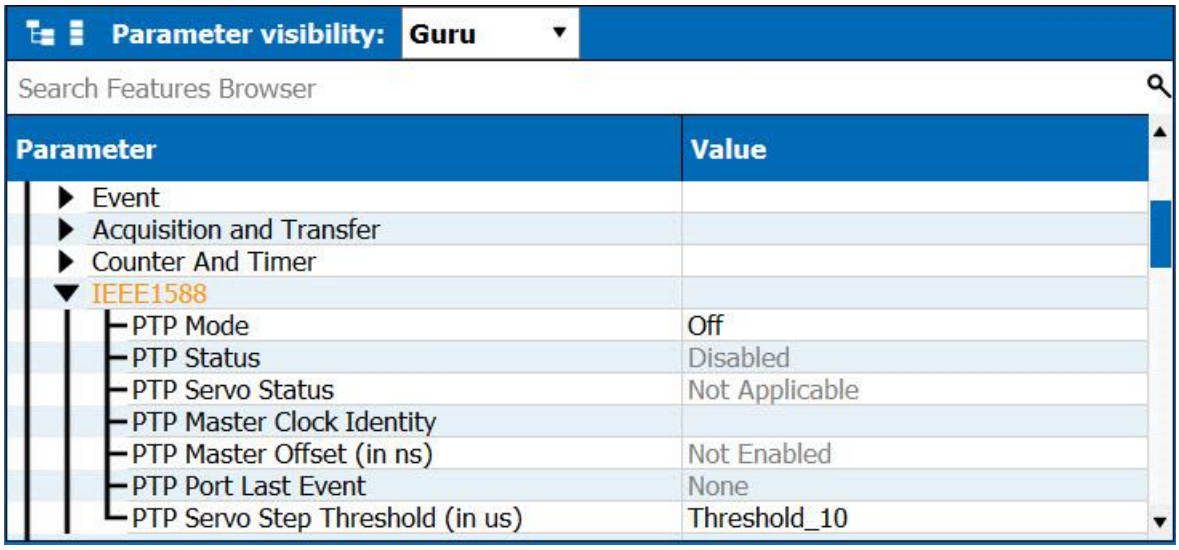
| Display Name | Feature & Values | Description | Version & View |
|---|---|---|---|
| Counter Status | counterStatus | Returns the current state of the counter. | 1.00 Expert DFNC |
| *Counter Idle* | *CounterIdle* | *The counter is idle.*<br>*The counterStartSource feature is set to off.* | |
| *Counter Trigger Wait* | *CounterTriggerWait* | *The counter is waiting for a start trigger.* | |
| *Counter Active* | *CounterActive* | *The counter is counting for the specified duration.* | |
| *Counter Completed* | *CounterCompleted* | *The counter reached the CounterDuration count.* | |
| *Counter Overflow* | *CounterOverflow* | *The counter reached its maximum possible count.* | |
| Counter Start Source | counterStartSource | Select the counter start source. Counter increments from 0 to the value of the counterDuration feature. | 1.00 Expert DFNC |
| *Off* | *Off* | *Counter is stopped.* | |
| *Acquisition Start* | *AcquisitionStart* | *Counter starts on the reception of the Acquisition Start event.* | |
| *Acquisition End* | *AcquisitionEnd* | *Counter starts on the reception of the Acquisition End event.* | |
| *Exposure Start* | *ExposureStart* | *Counter starts on the reception of the Exposure Start event* | |
| *Exposure End* | *ExposureEnd* | *Counter starts on the reception of the Exposure End event.* | |
| *Readout Start* | *ReadoutStart* | *Counter starts on the reception of the Readout Start event.* | |
| *Readout End* | *ReadoutEnd* | *Counter starts on the reception of the Readout End event.* | |
| *Profile Start* | *LineStart* | *Counter starts on the reception of the Profile Trigger event.* | |
| *Valid Profile Trigger* | *ValidLineTrigger* | *Counter starts on the reception of the Valid Profile Trigger.* | |
| *Rejected Profile Trigger* | *InvalidLineTrigger* | *Counter starts on the reception of the Invalid Profile Trigger.* | |
| *Multi Sensor Sync* | *MultiSensorSync* | *The Multi Sensor Sync signal will start the counter.* | |
| *Line 3* | *Line3* | *Counter starts on the specified transitions on Line 3* | |
| *Line 4* | *Line4* | *Counter starts on the specified transitions on Line 4* | |
| *Timer 1 End* | *Timer1End* | *Counter starts on the reception of the Timer 1 End event.* | |
| *Counter 1 End* | *Counter1End* | *Counter starts on the reception of the Counter 1 End event.* | |
| Counter Start Line Activation | counterStartLineActivation | Selects the activation mode of the input line trigger which starts the counter. This is only applicable when the counterStartSource feature selects a physical Line. | 1.00 Expert DFNC |
| *Rising Edge* | *RisingEdge* | *Starts counting on rising edge of the selected Line.* | |
| *Falling Edge* | *FallingEdge* | *Starts counting on falling edge of the selected Line.* | |
| *Any Edge* | *AnyEdge* | *Starts counting on the falling or rising edge of the selected Line.* | |
| Counter Incremental Source | counterIncrementalSource | Select the event source which increments the counter. | 1.00 Expert DFNC |
| *Off* | *Off* | *Counter is stopped.* | |
| *Acquisition Start* | *AcquisitionStart* | *Counts the number of Acquisition Start events.* | |
| *Acquisition End* | *AcquisitionEnd* | *Counts the number of Acquisition End events.* | |
| *Exposure Start* | *ExposureStart* | *Counts the number of Exposure Start events.* | |
| *Exposure End* | *ExposureEnd* | *Counts the number of Exposure End events.* | |
| *Readout Start* | *ReadoutStart* | *Counts the number of Readout Start events.* | |
| *Readout End* | *ReadoutEnd* | *Counts the number of Readout End events.* | |

| Display Name | Feature & Values | Description | Version & View |
|---|---|---|---|
| *Profile Trigger* | *LineStart* | *Counts the number of Profile Trigger events.* | |
| *Valid Profile Trigger* | *ValidLineTrigger* | *Counts the number of Valid Profile Triggers.* | |
| *Rejected Profile(s) Trigger* | *InvalidLineTrigger* | *Counts the number of Rejected Profile(s) Trigger.* | |
| *Line 3* | *Line3* | *Counts the number of transitions on Line 3 (based on the counterIncrementalLineActivation feature setting)* | |
| *Line 4* | *Line4* | *Counts the number of transitions on Line 4 (based on the counterIncrementalLineActivation feature setting)* | |
| *Internal Clock* | *InternalClock* | *The internal clock increments the counter value.* | |
| *Timer 1 End* | *Timer1End* | *Counts the number of Timer 1 End events.* | |
| Counter Incremental Line Activation | counterIncrementalLineActivation | Selects the counter signal activation mode. The counter increments on the specified signal edge or level. | 1.00 Expert DFNC |
| *Rising Edge* | *RisingEdge* | *Increment the counter on the rising edge of the selected I/O Line.* | |
| *Falling Edge* | *FallingEdge* | *Increment the counter on the falling edge of the selected I/O Line.* | |
| *Any Edge* | *AnyEdge* | *Increment the counter on the falling or rising edge of the selected I/O Line.* | |
| Counter Reset Source | counterResetSource | Selects the signal source to reset the counter. After a reset the counter waits for the next countStartSource signal or event. | 1.00 Expert DFNC |
| *Reset Cmd* | *Off* | *Reset on reception of the Reset Icommand.* | |
| *Acquisition Start* | *AcquisitionStart* | *Reset on reception of the Acquisition Start.* | |
| *Acquisition End* | *AcquisitionEnd* | *Reset on reception of the Acquisition End* | |
| *Exposure Start* | *ExposureStart* | *Reset on reception of the Exposure Start event.* | |
| *Exposure End* | *ExposureEnd* | *Reset on reception of the Exposure End event.* | |
| *Readout Start* | *ReadoutStart* | *Reset the counter on the reception of the Readout Start event.* | |
| *Readout End* | *ReadoutEnd* | *Reset the counter on the reception of the Readout End event.* | |
| *Profile Trigger* | *LineStart* | *Reset on reception of the Profile Trigger.* | |
| *Valid Profile Trigger* | *ValidLineTrigger* | *Reset on reception of the Valid Profile Trigger.* | |
| *Rejected Profile Trigger* | *InvalidLineTrigger* | *Reset on reception of the Invalid Profile Trigger.* | |
| *Line 3* | *Line3* | *Reset counter on the specified transition on line 3.* | |
| *Line 4* | *Line4* | *Reset counter on the specified transition on line 4.* | |
| *Timer 1 End* | *Timer1End* | *Reset on reception of the Timer End.* | |
| *Counter 1 End* | *Counter1End* | *Reset on the reception of the Counter 1 end.* | |
| Counter Reset Input Line Activation | counterResetLineActivation | Specify the edge transition on the selected line that will reset the selected counter. | 1.00 Expert DFNC |
| *Rising Edge* | *RisingEdge* | *Reset counter on rising edge of the selected signal.* | |
| *Falling Edge* | *FallingEdge* | *Reset counter on falling edge of the selected signal.* | |
| *Any Edge* | *AnyEdge* | *Reset counter on the falling or rising edge of the selected signal* | |
| Counter Duration | counterDuration | Sets the terminal value of the counter; when the "Counter Value" reaches this value a CounterEnd event is generated. | 1.00 Expert DFNC |
| Counter Value | counterValue | Reads the current value of the selected counter. | 1.00 Expert DFNC |
| Counter Value At Reset | counterValueAtReset | Reads the counter value of the selected counter when it was reset by a trigger or by an explicit Counter Reset command. | 1.00 Expert DFNC |
| Counter Reset | counterReset | Resets the selected counter to zero. The counter starts immediately after the reset. To temporarily disable the counter, set the Counter Event Source feature to Off. | 1.00 Expert DFNC |

| Display Name | Feature & Values | Description | Version & View |
|---|---|---|---|
| | | | |
| Timer Selector | timerSelector | Selects which timer to configure. | 1.00 Expert DFNC |
| *Timer 1* | *Timer1* | *Timer 1 selected* | |
| Timer Mode | timerMode | Select the Timer mode. The selected Timer is Active or Disabled. When Disabled, the Timer can be configured. | 1.00 Expert DFNC |
| *Off* | *Off* | *The selected Timer is Disabled.* | |
| *Active* | *Active* | *The selected Timer is Enabled.* | |
| Timer Status | timerStatus | Returns the current state of the timer. | 1.00 Expert DFNC |
| *Timer Idle* | *TimerIdle* | *The timer is idle. The counterStartSource feature is set to off.* | |
| *Timer Trigger Wait* | *TimerTriggerWait* | *The timer is waiting for a start trigger.* | |
| *Timer Active* | *TimerActive* | *The timer is counting for the specified duration.* | |
| *Timer Completed* | *TimerCompleted* | *The timer reached the timerDuration count.* | |
| Timer Start Source | timerStartSource | Select the trigger source to start the timer. | 1.00 Expert DFNC |
| *TimerReset Cmd* | *Off* | *Starts with the reception of the TimerReset Icommand.* | |
| *Acquisition Start* | *AcquisitionStart* | *Start Timer on Acquisition Start event.* | |
| *Acquisition End* | *AcquisitionEnd* | *Start Timer on Acquisition End event* | |
| *Exposure Start* | *ExposureStart* | *Start Timer on Exposure Start event.* | |
| *Exposure End* | *ExposureEnd* | *Start Timer on Exposure End event.* | |
| *Readout Start* | *ReadoutEnd* | *Start Timer on Readout Start event.* | |
| *Readout End* | *ReadoutStart* | *Start Timer on Readout End event.* | |
| *Profile Trigger* | *LineStart* | *Start Timer on Profile Trigger event.* | |
| *Valid Profile Trigger* | *ValidLineTrigger* | *Start Timer on Valid Profile Trigger event.* | |
| *Multi Sensor Sync* | *MultiSensorSync* | *Multi Sensor Sync* | |
| *Line 3* | *Line3* | *Start Timer on a transition of I/O Line 3 event.* | |
| *Line 4* | *Line4* | *Start Timer on a transition of I/O Line 4 event.* | |
| *Timer 1 End* | *Timer1End* | *Start Timer on Timer End event.* | |
| *Counter 1 End* | *Counter1End* | *Start Timer on Counter 1 End event.* | |
| Timer Line Activation | timerStartLineActivation | Select the trigger activation mode which starts the timer. | 1.00 Expert DFNC |
| *Rising Edge* | *RisingEdge* | *Starts counter on rising edge of the selected signal.* | |
| *Falling Edge* | *FallingEdge* | *Starts counter on falling edge of the selected signal.* | |
| *Any Edge* | *AnyEdge* | *Starts counter on the falling or rising edge of the selected signal.* | |
| Timer Duration | timerDuration | Sets the duration (in microseconds) of the timer pulse. | 1.00 Expert DFNC |
| Timer Value | timerValue | Reads the current value (in microseconds) of the selected timer. | 1.00 Expert DFNC |
| Timer Reset | timerReset | Resets the timer to 0. | 1.00 Expert DFNC |

# IEEE1588 category

The IEEE1588 controls as shown by Z-Expert, has parameters used to configure the Precision Time Protocol function.




# IEEE1588 features

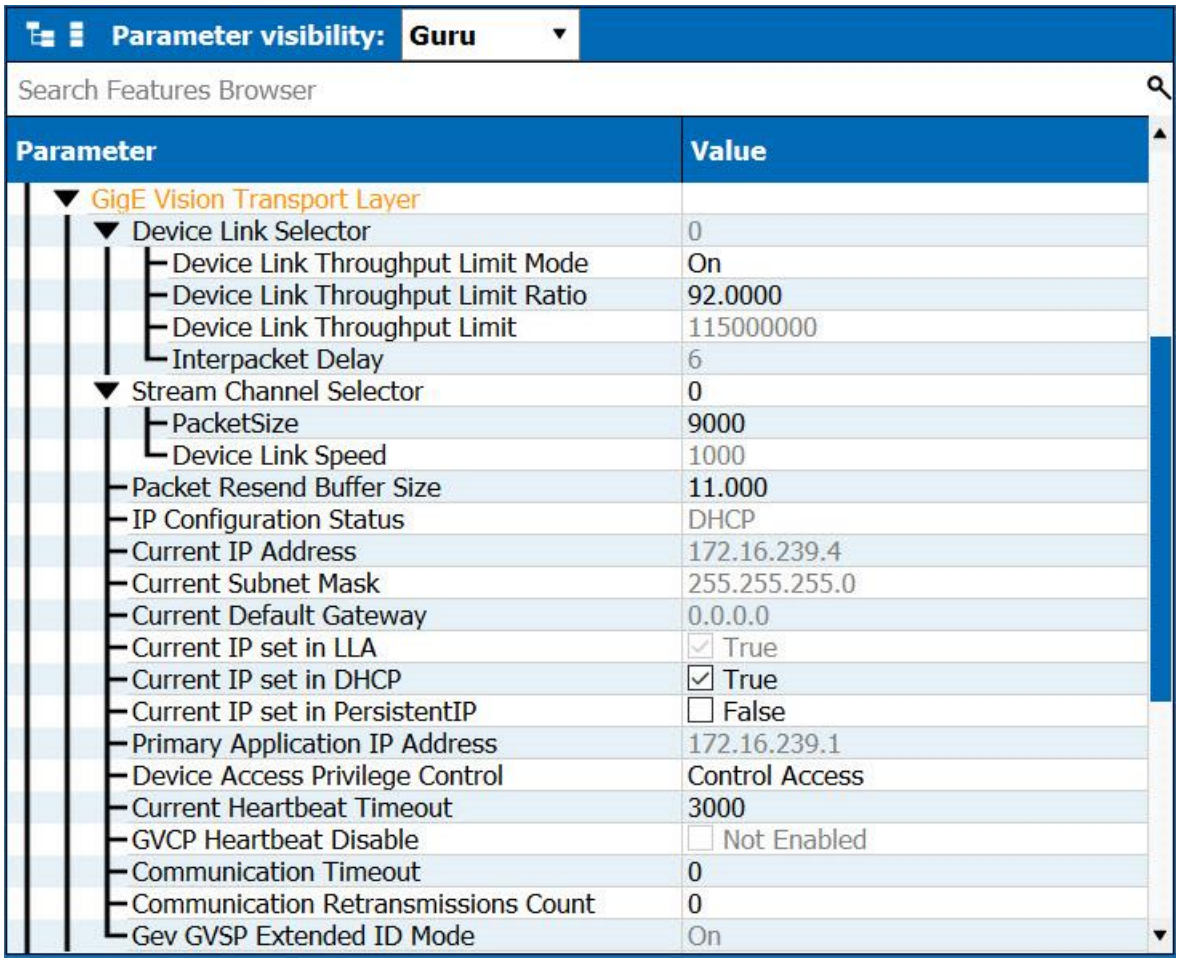
| Display Name | Feature & Values | Description | Version & View |
|---|---|---|---|
| PTP Mode | ptpMode | Specifies the PTP (IEEE-1588: Precision Time Protocol) operating mode implemented. If multiSensorSyncMode is not Off, ptpMode cannot be put to Off. | 1.00<br>Expert<br>DFNC |
| *Off* | *Off* | *PTP is disabled on the device.* | |
| *Automatic* | *Automatic* | *PTP is enabled on the device. The camera can become a Master or Slave device. The Master device is automatically determined as per IEEE-1588.* | |
| *Slave* | *Slave* | *Device will operate in PTP slave-only mode.* | |

| Display Name | Feature & Values | Description | Version & View |
|---|---|---|---|
| PTP Status | ptpStatus | Specifies dynamically the current PTP state of the device. (ref: IEEE Std 1588-2008) | 1.00 Expert DFNC |
| *Initializing* | *Initializing* | *The port initializes its data sets, hardware and communication facilities. No port of the clock shall place any PTP messages on its communication path. If one port of a boundary clock is in the INITIALIZING state, then all ports shall be in the INITIALIZING state.* | |
| *Faulty* | *Faulty* | *The fault state of the protocol. A port in this state shall not place any PTP messages except for management messages that are a required response to another management message on its communication path. In a boundary clock, no activity on a faulty port shall affect the other ports of the device. If fault activity on a port in this state cannot be confined to the faulty port, then all ports shall be in the FAULTY state.* | |
| *Disabled* | *Disabled* | *The port shall not place any messages on its communication path. In a boundary clock, no activity at the port shall be allowed to affect the activity at any other port of the boundary clock. A port in this state shall discard all PTP received messages except for management messages.* | |
| *Listening* | *Listening* | *The port is waiting for the announceReceiptTimeout to expire or to receive an Announce message from a master. The purpose of this state is to allow orderly addition of clocks to a domain. A port in this state shall not place any PTP messages on its communication path except for Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up, or signaling messages, or management messages that are a required response to another management message.* | |
| *PreMaster* | *PreMaster* | *The port shall behave in all respects as though it were in the MASTER state except that it shall not place any messages on its communication path except for Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up, signaling, or management messages.* | |
| *Master* | *Master* | *The port is behaving as a master port.* | |
| *Passive* | *Passive* | *The port shall not place any messages on its communication path except for Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up, or signaling messages, or management messages that are a required response to another management message.* | |
| *Uncalibrated* | *Uncalibrated* | *One or more master ports have been detected in the domain. The appropriate master port has been selected, and the local port is preparing to synchronize to the selected master port. This is a transient state to allow initialization of synchronization servos, updating of data sets when a new master port has been selected, and other implementation-specific activity.* | |
| *Slave* | *Slave* | *The port is synchronizing to the selected master port.* | |
| *GrandMaster* | *GrandMaster* | *The port is in the Grand Master state (i.e. has the best clock). The device can become GrandMaster only if the PTP Mode=Automatic and there's another device on the network that was Master.* | |
| *Error* | *Error* | *One or more ports have an error state.* | |

| Display Name | Feature & Values | Description | Version & View |
|---|---|---|---|
| PTP Servo Status | ptpServoStatus | Specifies the IEEE1588 servo status. | 1.00 Expert DFNC |
| *Unlocked* | *Unlocked* | *The servo is not yet ready to track the master clock.* | |
| *Synchronizing* | *Synchronizing* | *The servo is unlocked and synchronizing to the master clock.* | |
| *Locked* | *Locked* | *The servo is adjusting (syntonizing) to the master clock.* | |
| *Not Applicable* | *NotApplicable* | *The servo state is currently not applicable.* | |
| PTP Master Clock Identity | ptpMasterClockId | Port identity of the current best master. The clock ID is an Extended Unique Identifier (EUI)-64 64-bit ID, converted from the 48-bit MAC address, by inserting 0xfffe at the middle of the MAC address. | 1.00 Guru DFNC |
| PTP Master Offset (in ns) | ptpMasterOffsetNs | Dynamically returns the 64-bit value of the PTP offset with the master. This value is the input for clock corrections for the slave device clock servo algorithms. | 1.00 Guru DFNC |
| PTP Port Last Event | ptpPortLastEvent | Logs the last PTP changed state event defining the last current status. | 1.00 Guru DFNC |
| *None* | *None* | *None* | |
| *Power up* | *Powerup* | *Power up* | |
| *Initialize* | *Initialize* | *Initialize* | |
| *Designated Enabled* | *DesignatedEnabled* | *Designated Enabled* | |
| *Designated Disabled* | *DesignatedDisabled* | *Designated Disabled* | |
| *Fault Cleared* | *FaultCleared* | *Fault Cleared* | |
| *Fault Detected* | *FaultDetected* | *Fault Detected* | |
| *State Decision Event* | *StateDecisionEvent* | *State Decision Event* | |
| *Qualification Timeout Expires* | *QualificationTimeoutExpires* | *Qualification Timeout Expires* | |
| *Announce Receipt Timeout Expires* | *AnnounceReceiptTimeoutExpires* | *Announce Receipt Timeout Expires* | |
| *Synchronization Fault* | *SynchronizationFault* | *Synchronization Fault* | |
| *Master Clock Selected* | *MasterClockSelected* | *Master Clock Selected* | |
| *Recommended State Master* | *RS_Master* | *Recommended State Master* | |
| *Recommended State Grand Master* | *RS_GrandMaster* | *Recommended State Grand Master* | |
| *Recommended State Slave* | *RS_Slave* | *Recommended State Slave* | |
| *Recommended State Passive* | *RS_Passive* | *Recommended State Passive* | |
| PTP Servo Step Threshold (in us) | ptpServoStepThreshold | Specifies the servo step threshold (in us). When the clock offset with the master exceeds the threshold, the servo unlocks and offset adjustment is started. | 1.00 Guru DFNC |
| *Threshold_10* | *Threshold_10* | | |
| *Threshold_20* | *Threshold_20* | | |
| *Threshold_100* | *Threshold_100* | | |
| *Threshold_500* | *Threshold_500* | | |
| *Threshold_1000* | *Threshold_1000* | | |
| *Threshold_2000* | *Threshold_2000* | | |

# GigE Vision Transport Layer category

The GigE Vision Transport Layer features are used to configure settings related to the GigE Vision specification and the Ethernet Connection.




## GigE Vision Transport Layer features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Device Link Selector | DeviceLinkSelector | Selects which Link of the device to control | 1.00<br>Expert |
| Device Link Throughput Limit Mode | DeviceLinkThroughputLimitMode | When disabled, lower level TL specific features are expected to control the throughput. When enabled, DeviceLinkThroughputLimit controls the overall throughput. | 1.00<br>Guru |
| *Off* | *Off* | *Disables the DeviceLinkThroughputLimit feature.* | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *On* | *On* | *Enables the DeviceLinkThroughputLimit feature.* | |
| Device Link Throughput Limit Ratio | deviceLinkThroughputLimitRatio | Limits the maximum bandwidth of the data that will be streamed out by the device. This value is set as a percentage of the maximum link speed detected by the Camera. | 1.00 Beginner DFNC |
| Device Link Throughput Limit | DeviceLinkThroughputLimit | Limits the maximum bandwidth of the data that will be streamed out by the device. | 1.00 Guru |
| Stream Channel Selector | GevStreamChannelSelector | Selects the stream channel to control. | 1.00 Expert |
| Device Link Speed | GevLinkSpeed | Indicates the transmission speed negotiated by the given network interface. | 1.00 Expert |
| PacketSize | GevSCPSPacketSize | Specifies the stream packet size in bytes to send on this channel. | 1.00 Expert |
| Interpacket Delay | GevSCPD | Indicates the delay (in µs) to insert between each packet for this stream channel. Note that Interpacket delay becomes a Read-Only value when the feature "Device Link Throughput Limit" is enabled. | 1.00 Expert |
| Packet Resend Buffer Size | devicePacketResendBufferSize | Indicates the amount of memory to reserve in Mbytes for the packet resend buffer. Increasing or decreasing this value affects the value returned by transferQueueMemorySize | 1.00 DFNC Guru |
| IP Configuration Status | GevIPConfigurationStatus | Reports the current IP configuration status. | 1.00 Guru |
| *None* | *None* | *Device IP Configuration is not defined.* | |
| *PersistentIP* | *PersistentIP* | *Device IP Address Configuration is set to Persistent IP (static).* | |
| *DHCP* | *DHCP* | *Device IP Address Configuration is set to DHCP (Dynamic Host Configuration Protocol). Network requires a DHCP server.* | |
| *LLA* | *LLA* | *Device IP Address Configuration is set to LLA (Link-Local Address). Also known as Auto-IP. Used for unmanaged networks including direct connections from a device to a dedicated NIC.* | |
| *ForceIP* | *ForceIP* | *Device IP Address Configuration is set to ForceIP. Used to force an IP address change.* | |
| Current IP Address | GevCurrentIPAddress | Reports the IP address for the given network interface. | 1.00 Beginner |
| Current Subnet Mask | GevCurrentSubnetMask | Reports the subnet mask of the given interface. | 1.00 Beginner |
| Current Default Gateway | GevCurrentDefaultGateway | Reports the default gateway IP address to be used on the given network interface. | 1.00 Beginner |
| Current IP set in LLA | GevCurrentIPConfigurationLLA | Controls whether the LLA (Link Local Address) IP configuration scheme is activated on the given network interface. | 1.00 Guru |
| Current IP set in DHCP | GevCurrentIPConfigurationDHCP | Controls whether the DHCP IP configuration scheme (Dynamic Host Configuration Protocol) is activated on the given network interface. | 1.00 Guru |
| Current IP set in PersistentIP | GevCurrentIPConfigurationPersistentIP | Controls whether the PersistentIP configuration scheme is activated on the given network interface. | 1.00 Guru |
| Primary Application IP Address | GevPrimaryApplicationIPAddress | Returns the IP address of the device hosting the primary application. | 1.00 Guru |

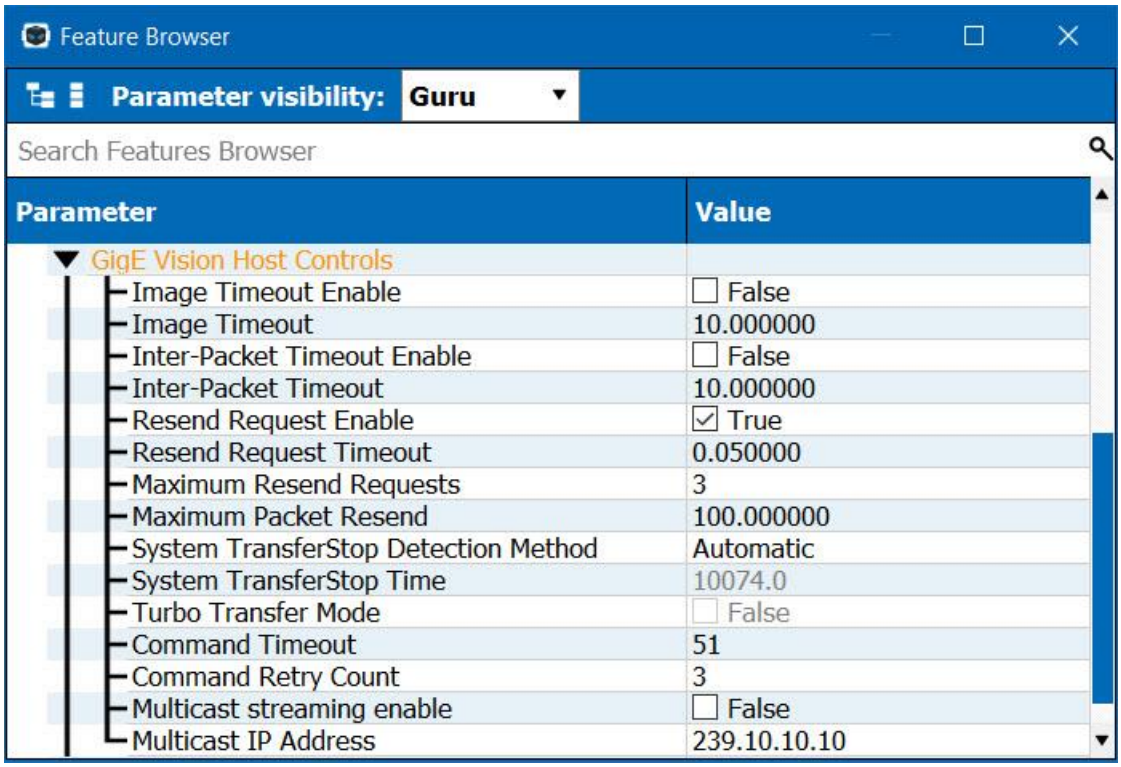
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Device Access Privilege Control | deviceCCP | Controls the device access privilege of an application. | 1.00<br>Guru<br>DFNC |
| *Exclusive Access* | *ExclusiveAccess* | *Grants exclusive access to the device to an application. No other application can control or monitor the device.* | |
| *Control Access* | *ControlAccess* | *Grants control access to the device to an application. No other application can control the device.* | |
| *Control Access Switchover Active* | *ControlAccessSwitchoverActive* | *Enables another application to request control access to the device.* | |
| Current Heartbeat Timeout | GevHeartbeatTimeout | Indicates the current heartbeat timeout in milliseconds. | 1.00<br>Guru |
| GVCP Heartbeat Disable | GevGVCPHeartbeatDisable | Disables the GVCP (GigE Vision Control Protocol) heartbeat monitor. This allows control switchover to an application on another device. | 1.00<br>Expert |
| Communication Timeout | GevMCTT | Provides the transmission timeout value in milliseconds. | 1.00<br>Guru |
| Communication Retransmissions Count | GevMCRC | Indicates the number of retransmissions allowed when a message channel message times out. | 1.00<br>Guru |
| Gev GVSP Extended ID Mode | GevGVSPExtendedIDMode | Enables the extended ID mode. | 1.00<br>Expert |
| *Off* | *Off* | *Disables the extended ID mode.* | |
| *On* | *On* | *Enables the extended ID mode.* | |
| | | | |

# GigE Vision Host Controls category

The GigE Vision Host Controls features are used to configure the host computer system GigE Vision features used for networking management. None of these parameters are stored in the profiler device.

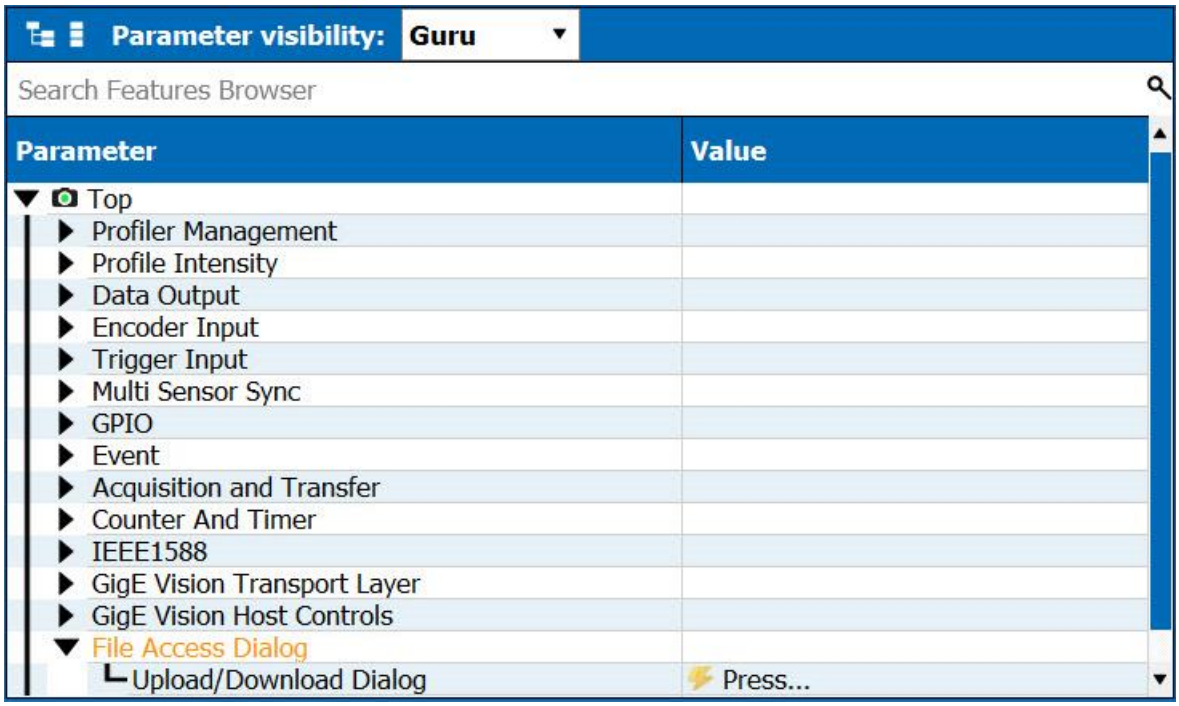
These features allow optimizing the network configuration for maximum data bandwidth. Settings for these parameters are highly dependent on the number of profilers connected to a NIC, the data rate of each and the trigger modes used.

**Information on these features is found in the Teledyne DALSA Sapera LT Getting Started Manual for GigE Vision Cameras & 3D Sensors.**



# File Access Dialog category

The File Access Dialog category allows the user to quickly upload firmware files to the Z-Trak2 device.




# File Access Dialog features

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| File Selector | FileSelector | Selects the file to access. The file types which are accessible are device-dependent. | 1.00 Guru |
| *Firmware* | *Firmware1* | *Upload new firmware to the device which will execute on the next device reboot cycle. Select the DeviceReset feature after the upload completes.* | |
| *User Defined Saved Image* | *userDefinedSavedImage* | *Upload and download an image in the device.* | |
| *Open Source Licenses* | *SoftwareLicenses* | *Open Source Software Licenses.* | |
| File Operation Selector | FileOperationSelector | Selects the target operation for the selected file in the device. This operation is executed when the File Operation Execute feature is called. | 1.00 Guru |
| *Open* | *Open* | *Select the Open operation – executed by FileOperationExecute.* | |
| *Close* | *Close* | *Select the Close operation – executed by FileOperationExecute* | |
| *Read* | *Read* | *Select the Read operation – executed by FileOperationExecute.* | |

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| *Write* | *Write* | *Select the Write operation – executed by FileOperationExecute.* | |
| *Delete* | *Delete* | *Select the Delete operation – executed by FileOperationExecute.* | |
| File Operation Execute | FileOperationExecute | Executes the operation selected by File Operation Selector on the selected file. | 1.00 Guru |
| File Open Mode | FileOpenMode | Selects the access mode used to open a file on the device. | 1.00 Guru |
| *Read* | *Read* | *Select READ only open mode* | |
| *Write* | *Write* | *Select WRITE only open mode* | |
| File Access Buffer | FileAccessBuffer | Defines the intermediate access buffer that allows the exchange of data between the device file storage and the application. | 1.00 Guru |
| File Access Offset | FileAccessOffset | Controls the mapping offset between the device file storage and the file access buffer. | 1.00 Guru |
| File Access Length | FileAccessLength | Controls the mapping length between the device file storage and the file access buffer. | 1.00 Guru |
| File Operation Status | FileOperationStatus | Displays the file operation execution status. | 1.00 Guru |
| *Success* | *Success* | *The last file operation has completed successfully.* | |
| *Failure* | *Failure* | *The last file operation has completed unsuccessfully for an unknown reason.* | |
| *File Unavailable* | *FileUnavailable* | *The last file operation has completed unsuccessfully because the file is currently unavailable.* | |
| *File Invalid* | *FileInvalid* | *The last file operation has completed unsuccessfully because the selected file in not present in this device model.* | |
| File Operation Result | FileOperationResult | Displays the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned. | 1.00 Guru |
| File Size | FileSize | Represents the size of the selected file in bytes. | 1.00 Guru |
| | | | |

# Technical specifications

## Identification label

Z-Trak2 profilers have an identification label with the following information:

- Model Part Number
- MAC ID
- Serial number
- Revision number
- 2D Barcode
- CE

Note that the 2D Barcode lists all information above.

## Mechanical specifications

The distance between the laser line and the image sensor plane determines the maximum height Z-Trak2 can measure. For this reason, the length of Z-Trak2 housing varies with its measurement range. The case type refers to the overall length of the Z-Trak2 model.

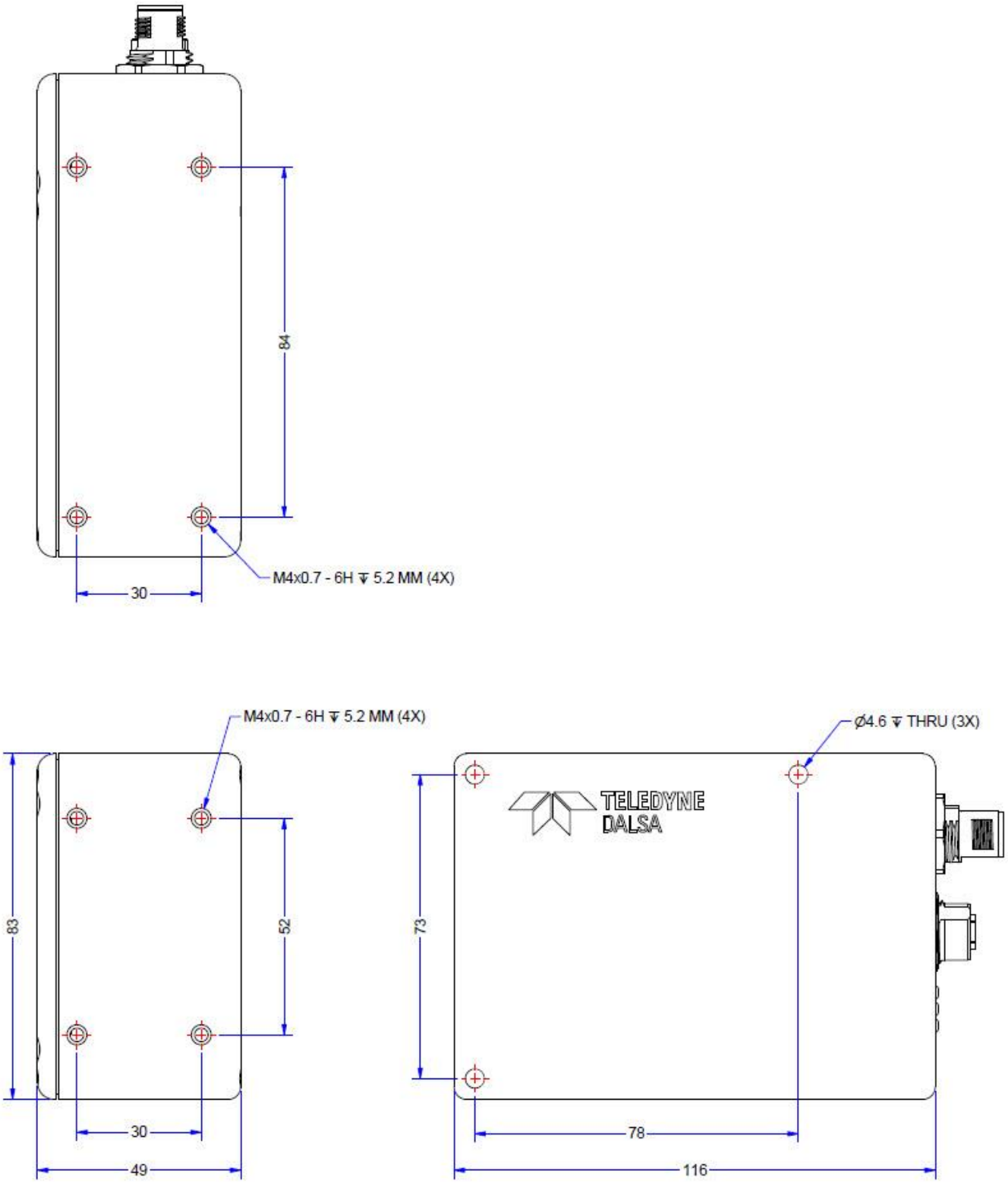



*Figure 35. Mechanical specifications for T20 casing models.*

# Mounting holes specifications

Mounting points are threaded for metric M4 screws (0.7 thread pitch) with depths of 5.2 mm; 4.6 mm through holes are also present, as indicated in the drawing of section Mechanical specifications.

# Enclosure IP rating

The Z-Trak2 enclosure conforms to **IP67 Protection** level (IEC), which is defined as follows:

| IP__ | Meaning | Definition |
|---|---|---|
| **6x** | Dry: Dust Tight | No ingress of dust; complete protection against contact. |
| **x7** | Wet: Immersion up to 1 meter deep for a maximum of 30 minutes. | Ingress of water in harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time (up to 1 m of submersion for 30 minutes).<br>The profiler must function correctly once removed from the water. |

**The Laser Profiler does not make valid measurements submersed in liquid at any depth.**

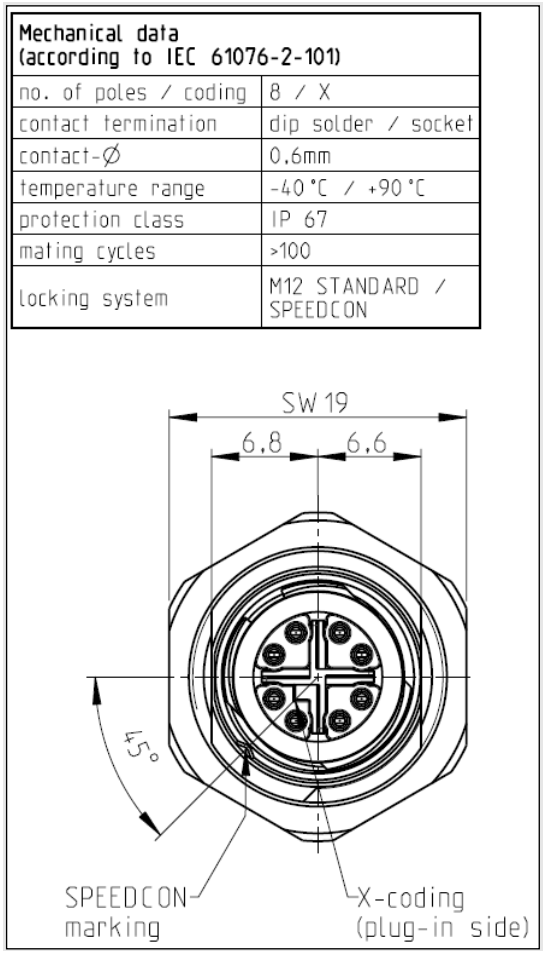
# Connectors

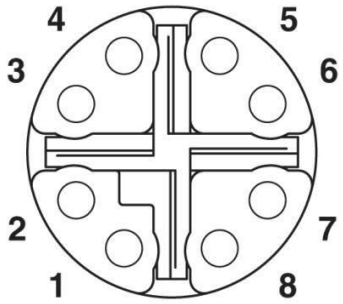
Z-Trak2 has two connectors that maintain the profiler IP67 protection level rating when used with IP67 certified cables.

Mating cables are available from Teledyne DALSA or directly from suggested manufacturers (see Cables and accessories).


*Figure 36. View of the back of the profiler. On top is the M12 17-pin male connector. The bottom connector is an M12 X-coded 8-pin female connector.*

# Data connector: Ethernet M12 X-coded 8-pin female connector




| Pin | Label | Description |
|---|---|---|
| 1 | TP0+ | Transmit Data 0 + |
| 2 | TP0– | Transmit Data 0 – |
| 3 | TP1+ | Transmit Data 1 + |
| 4 | TP1– | Transmit Data 1 – |
| 5 | TP3+ | Transmit Data 3 + |
| 6 | TP3– | Transmit Data 3 – |
| 7 | TP2+ | Transmit Data 2 + |
| 8 | TP2– | Transmit Data 2 – |

*Figure 37. Details of the M12 X-coded 8-pin connector.*

# I/O connector: M12 17-pin male connector

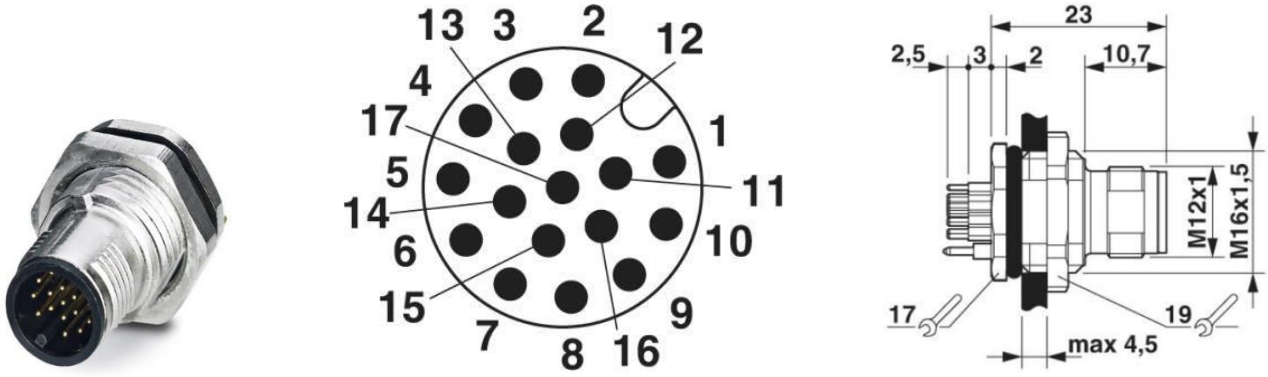



*Figure 38. Details of the M12 17-pin connector.*

| Pin | Signal | Direction | Description |
|---|---|---|---|
| 1 | SHAFT ENCODER B– | IN | RS-422 Shaft encoder input B– |
| 2 | E-STOP GND | GND | Emergency stop ground |
| 3 | GPI 2+ | IN | General Purpose Input 2+ |
| 4 | GPO 2+ | OUT | General Purpose Output 2+ |
| 5 | GPO 2– | OUT | General Purpose Output 2– |
| 6 | AUX GND | GND | Auxiliary power ground |
| 7 | AUX PWR | PWR IN | Auxiliary power input |
| 8 | GPO 1+ | OUT | General Purpose Output 1+ |
| 9 | GPO 1– | OUT | General Purpose Output 1– |
| 10 | SHAFT ENCODER A– | IN | RS-422 Shaft encoder input A– |
| 11 | SHAFT ENCODER B+ | IN | RS-422 Shaft encoder input B+ |
| 12 | E-STOP PWR | IN | Emergency stop power input |
| 13 | GPI 2– | IN | General Purpose Input 2– |
| 14 | GPI 1– | IN | General Purpose Input 1– |
| 15 | GPI 1+ | IN | General Purpose Input 1+ |
| 16 | SHAFT ENCODER A+ | IN | RS-422 Shaft encoder input A+ |
| 17 | ISO GND | GND | Isolated ground |

## *Power supply requirements (auxiliary power)*

To power a single sensor over the control and I/O cable, the power supply should meet the following requirements (requirements increase for multiple sensor setups).

| | |
|---|---|
| **Voltage** | 24 ± 4 VDC power supply |
| **Current** | 0.8 A or higher |
| **Power** | 20 W or higher |

## *Emergency safety switch (E-STOP)*

The laser will not operate unless the +24 V DC emergency stop power and ground signals are connected as shown below. Laser is ON if power is applied to pin 12, OFF if power is not applied.

An external **emergency safety switch** (E-STOP), which is normally closed, should be included in the image system.

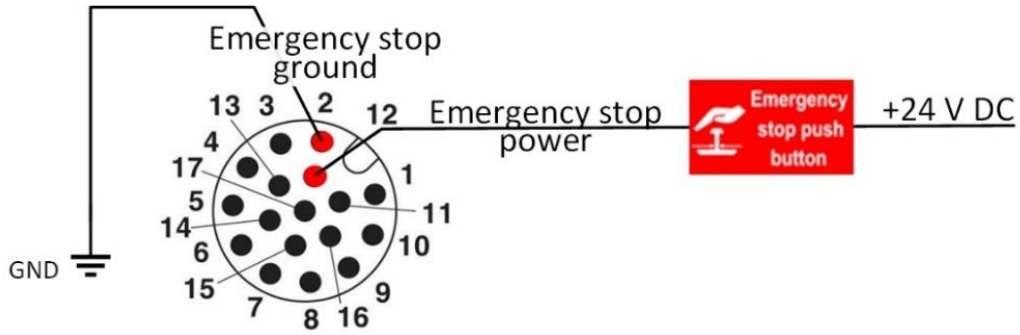



*Figure 39. Pinout details for the emergency safety switch.*

| | |
|---|---|
|  | The E-STOP safety feature is enabled by default. However, IF PERMITTED BY LOCAL REGULATIONS, it can be disabled in the Z-Trak2 configuration. |

# Power over Ethernet (PoE+) support

The Z-Trak2 profiler requires an IEEE 802.3at PoE type 2 (PoE+)—or better—power source when using a PoE Ethernet switch or injector, else a separate external power source connected to the I/O connector is required.

To use PoE, the network setup requires a powered computer NIC supporting PoE, a PoE capable Ethernet switch, or an Ethernet power injector. Using PoE in the context of 5 GigE bandwidth (S-Series) generates heat. See Temperature management.

| | |
|---|---|
|  | **Connect power via the I/O connector or PoE, but not both.** |

Even though Z-Trak2 has protection, differences in ground levels may cause operational issues or electrical faults.

| | |
|---|---|
|  | When using PoE, the Z-Trak2 I/O pins 7/6 (profiler power/ground) must not be connected to I/O pin 17 (input signal common ground). |

## *PoE+ DC power requirements (PoE supply)*

| PoE DC Operating Characteristics | |
|---|---|
| **PoE Injector Voltage** | **Current Consumed (typical)** |
| PoE = 57 V DC | 300 mA |

# Power consumption summary

The table below summarizes the typical power consumption according to power input source and profiler output.

| Ethernet transmission rate | Power consumption auxiliary (24 V) | Power consumption with PoE+ |
|---|---|---|
| 1 GigE | 13.5 W | 16 W |
| 5 GigE | 14 W | 17 W |

# General-purpose input signals electrical specifications

Each of the two general inputs are opto-coupled and able to connect to differential or single-ended source signals. They can also act as external trigger inputs.

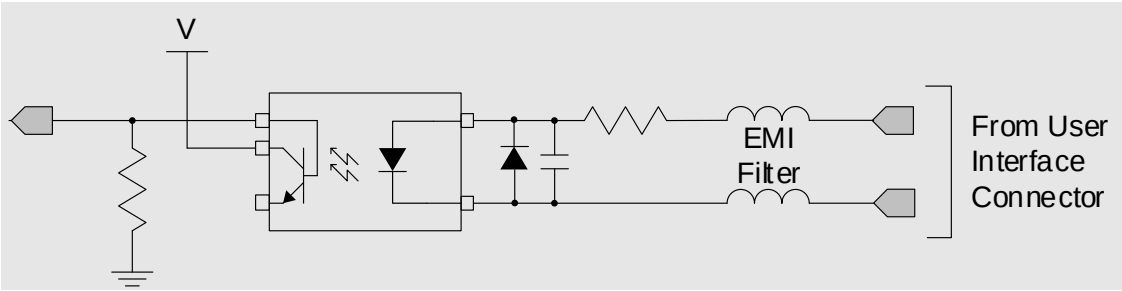



*Figure 40. General-purpose inputs block diagram.*

## *General-purpose input characteristics*

- Two inputs, configurable as trigger acquisition events or as general-purpose inputs.
- User-programmable debounce time from 0 to 255 µs in 1 µs steps.
- Maximum input voltage is 26 V.
- Maximum input signal frequency is 100 kHz.
- Each input has a 750 ohm series resistor on the opto-coupler input.
- The 0.001 µF capacitor provides high-frequency noise filtering.
- Minimum current is dependent on input voltage applied: I*optoin*(min) = (V*optoin* - 0.5)/750 Ω
- The switch point is software programmable to support differential RS-422, single-ended TTL, 12 V, or 24 V input signals.

# *External trigger usage*

Input signal is debounced to ensure that no voltage glitch is detected as a valid transition. This debounce circuit time constant can be programmed from 1 μs to 255 μs. Any pulse smaller than the programmed value is blocked and therefore not seen by the board. If no debounce value is specified (value of 0 μs), the minimum value of 1 μs will be used.

### Trigger signal total delay

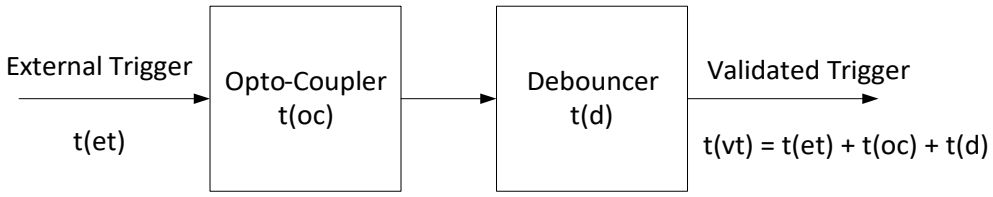



*Figure 41: External trigger input validation and delay*

| | |
|---|---|
| where | t(et) = time of external trigger in μs<br>t(oc) = time opto-coupler takes to change state (also called propagation delay) (note: time varies with input voltage)<br>t(d) = user set debounce duration from 1 to 255 μs<br>t(vt) = time of validated trigger in μs |

If t(et) > t(oc) + t(d), then a valid acquisition trigger is detected.

### Input switching points and propagation delay

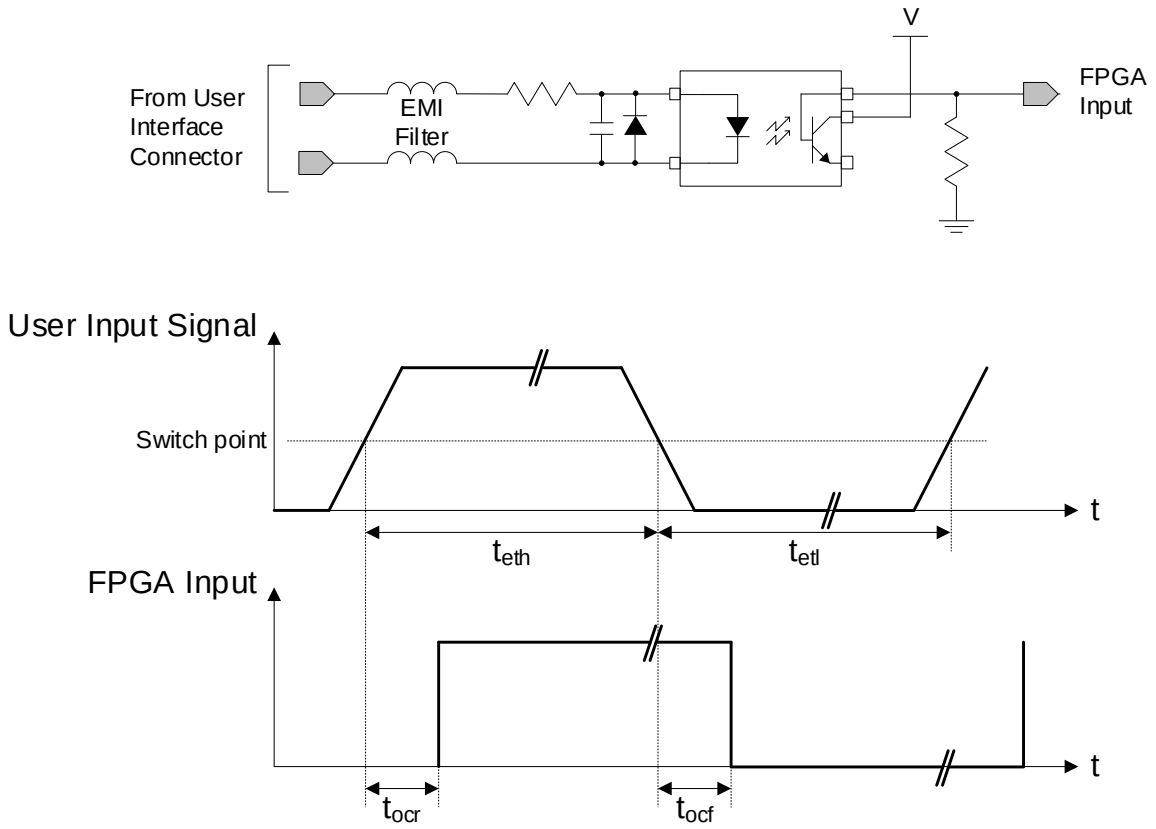



*Figure 42. Input switching points and propagation delay diagram. $t_{ocr}$: opto-coupler propagation delay on rising edge; $t_{eth}$: time external trigger high (min pulse width high); $t_{ocf}$: opto-coupler propagation delay on falling edge; $t_{etl}$: time external trigger low (min pulse width low).*

| Trigger Level | Switch Point | $t_{ocr}$ (µs) propagation delay on rising edge | $t_{eth}$ (µs) min pulse width high | $t_{ocf}$ (µs) propagation delay on falling edge | $t_{etl}$ (µs) min pulse width low |
|---|---|---|---|---|---|
| **RS-422** | 1.6 V | 3 | 4 | 2 | 2 |
| **TTL** | 1.6 V | 3 | 4 | 3 | 3 |
| **12V** | 6 V | 3 | 3 | 2 | 3 |
| **24V** | 12 V | 2 | 2 | 4 | 4 |

# General-purpose output signals electrical specifications

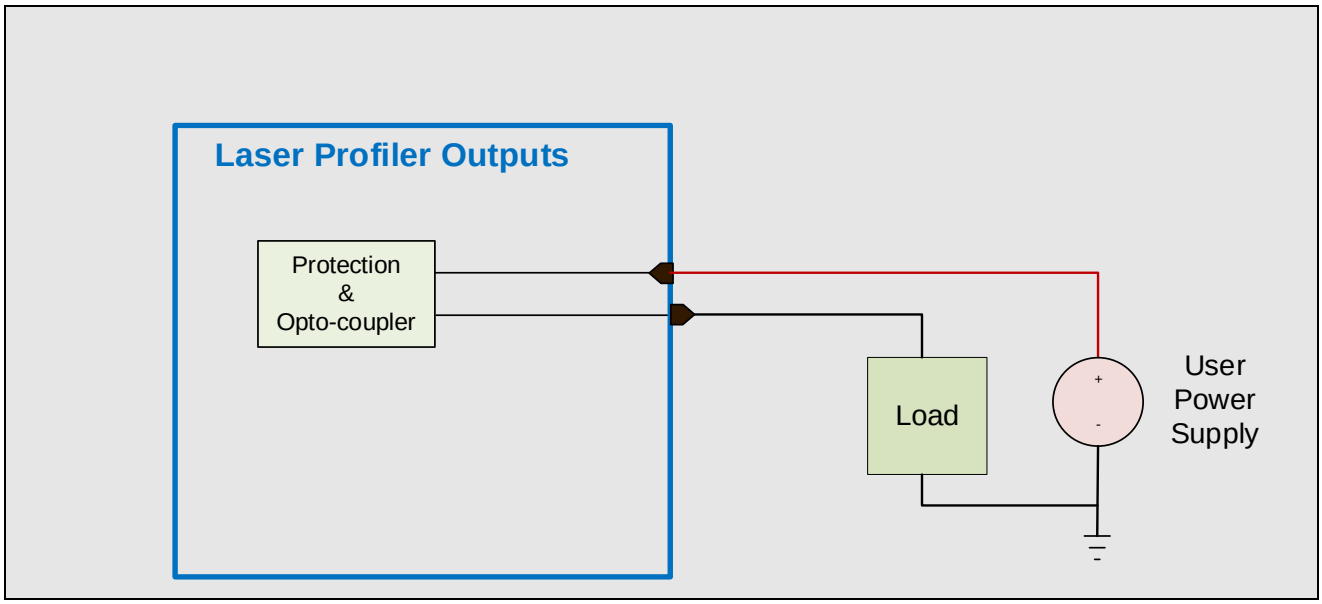



*Figure 43. General-purpose outputs block diagram.*

## *General-purpose output characteristics*

- Programmable output mode (see *Output Line Source* in GPIO features).
- Outputs are open on power-up with the default factory settings.
- A software reset will reset the outputs to the open state if the outputs are closed.

| **Typical operating voltage range: -28 V DC to +28 V DC @ 24 mA** |
|---|

| Voltage | Max output current |
|---|---|
| 28 V | 100 mA |
| 3 V | 20 mA |

The graphic below defines the test conditions used to measure the Z-Trak2 external output AC characteristics, as detailed in the table that follows.

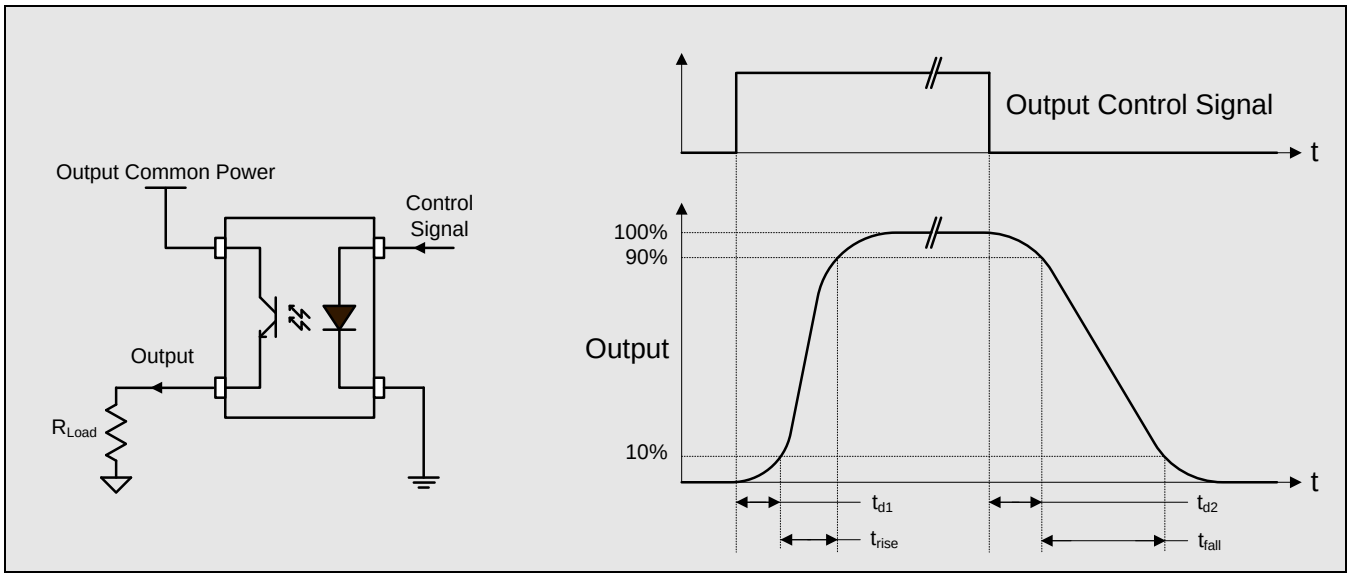



*Figure 44. Test conditions for Z-Trak2 external output AC timing characteristics.*

*Note: All measurements subject to some rounding.*

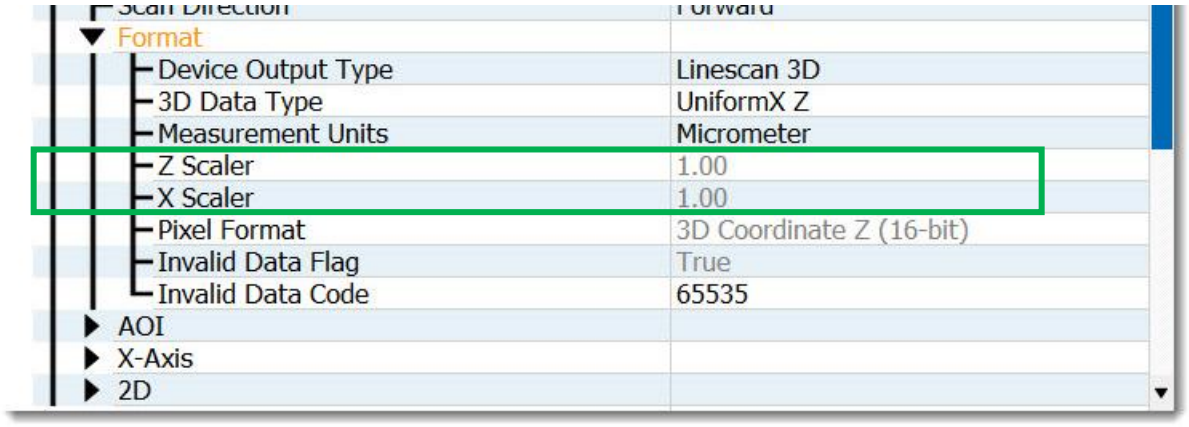
| Output Common Power | Output Current (mA) | $t_{d1}$ (µs) Leading Delay | $t_{rise}$ (µs) Rise Time | $t_{d2}$ (µs) Trailing Delay | $t_{fall}$ (µs) Fall Time | Output Voltage (V) |
|---|---|---|---|---|---|---|
| 12 V | 8 | 0.43 | 0.84 | 14 | 17 | 10.7 |
| | 12 | 0.43 | 0.62 | 10 | 12 | 10.4 |
| | 24 | 0.43 | 1.05 | 5 | 5 | 10.0 |
| 24 V | 8 | 0.43 | 0.62 | 18 | 23 | 22.7 |
| | 12 | 0.43 | 0.65 | 13 | 17 | 22.4 |
| | 24 | 0.44 | 0.70 | 8 | 10 | 22.0 |

# 3D Data Type output format description

The **Linescan 3D** output type allows for different 3D data type output formats: UniformX Z (RectifiedC), XZ (CalibratedAC) and XZRW (CalibratedACRW).

**Things to know about 3D output data**

- Because of optical system considerations and because the measurement area forms a trapeze, the resolution varies in the X and Z directions, namely, the intervals between points in the X and Z axes vary. So, any raw value in X and in Z must be compensated for this variation; this process is done automatically, and the result is called "calibrated" data.
- Profiler values are also scaled down and require multiplication to represent full scale values. The Z Scaler and X Scaler values serve two purposes: to restore full scale values and to convert them to the chosen measurement units. The scaling factor is a model-dependent, read-only value. Therefore, **the end user application must apply the scaling factor to the output data to obtain the real-world measurement**. See Calculating real-world values.




# Choosing a 3D Data Type output format

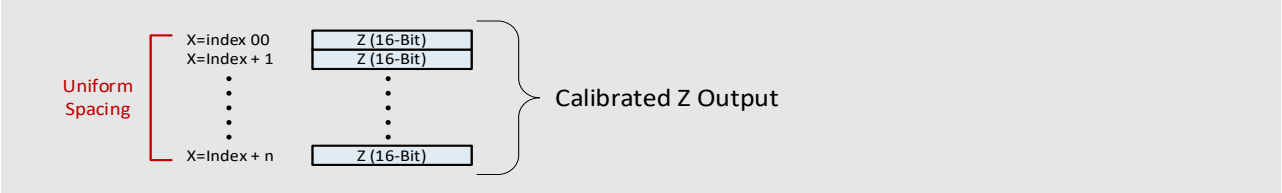
The following are the data types available when using Linescan 3D device output type:

- **UniformX Z**: The output consists of Z values alone (16 bits). This format is easier to represent and to handle by image processing applications.
- **XZ**: The output consists of calibrated X and Z values (16 bits each).
- **XZRW**: The output consists of calibrated X and Z values, along with reflectance R (16 bits) and multipurpose W (16 bits).

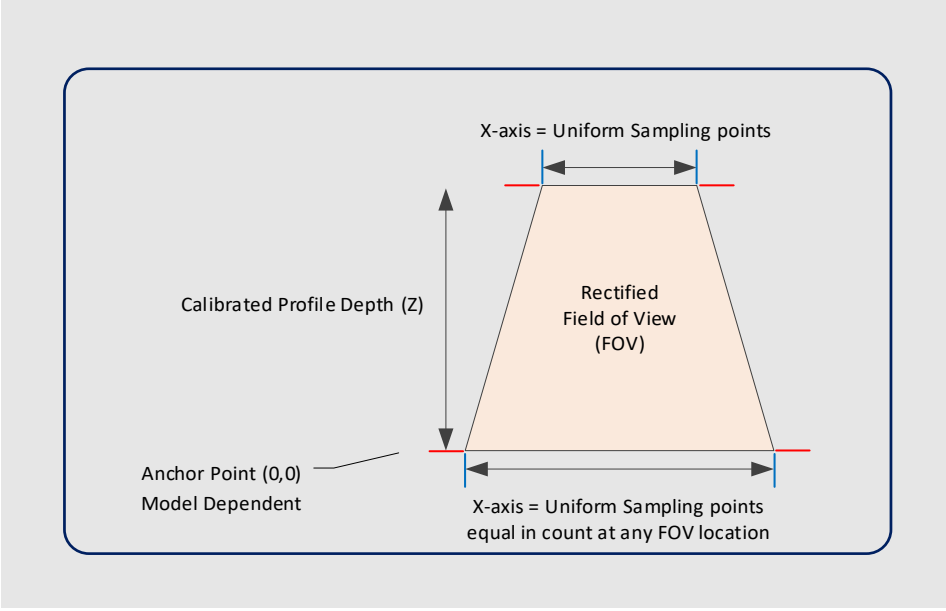
# UniformX Z (RectifiedC)

As mentioned above, the sampling interval between points varies in both X and Z in the measurement area. The UniformX Z format intends to make the sampling interval uniform in the X direction; each profile only consists of 16-bit Z values, the interval in X-axis (called step size) is implicit. This is achieved through resampling, as depicted below. The data is therefore "rectified" to a uniform sampling pattern.

- Output is 16-bit calibrated Z data.



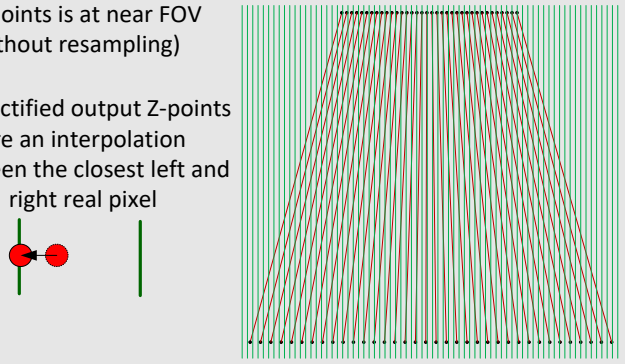

- The raw X data are resampled, providing a uniform scale for the Z data in any location of the measurement area. The step size is a feature of the X-Axis category in Z-Expert.
- The calibrated Z data (16-bit) must be multiplied by the Z scale factor to obtain the real-world Z value in the specified measurement unit.
- Z data above the Near-FOV (i.e., Z value > max Z) or below the Far-FOV (i.e., Z value < 0) will return as invalid.
- Z-Expert graphs the Z output data in the selected measurement unit at each X index point; floating the mouse over the profile will show the calculated real-world X measurement relative to the left edge of the measurement area. Use the view settings to change the X-axis labels to these transformed X values.



## Resampling Points in X Details

Maximum resolution between real points is at near FOV (without resampling)

The rectified output Z-points are an interpolation between the closest left and right real pixel





Near FOV

Far FOV

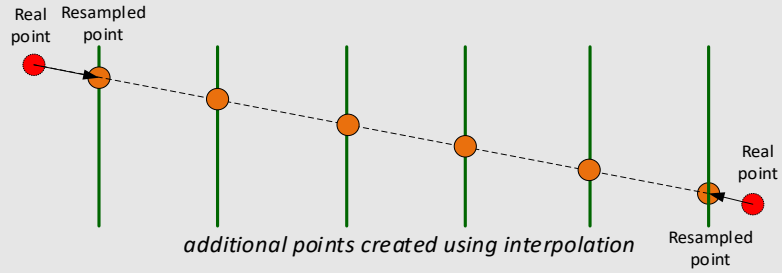
Distance between real points is larger at the far FOV (without resampling)

uniform spacing in X

## Additional interpolated X points are dependent on the step size

Since FOV width is fixed, the X step size determines:
- *distance between output points in microns*
- *number of output points*

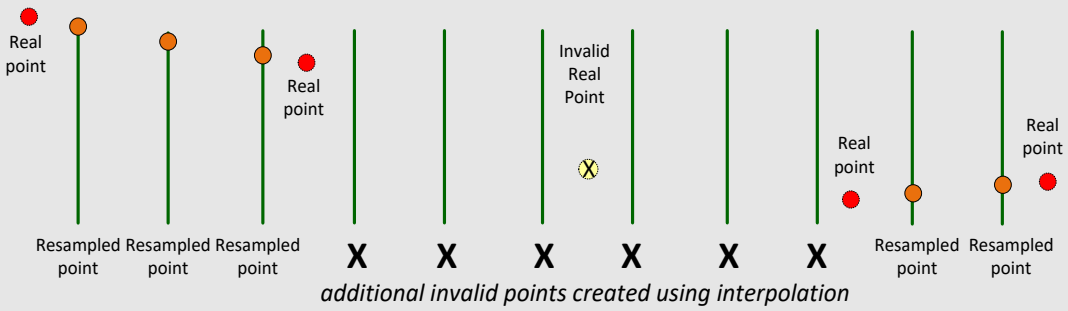
If the number of output points (set by Z-Trak2, not by the user) is greater than the number of real points (dependent on the step size), those new points are created by interpolation between real points.




Resampled Z-points are calculated based on adjacent real points.

## Possibility of Invalid Interpolated Points

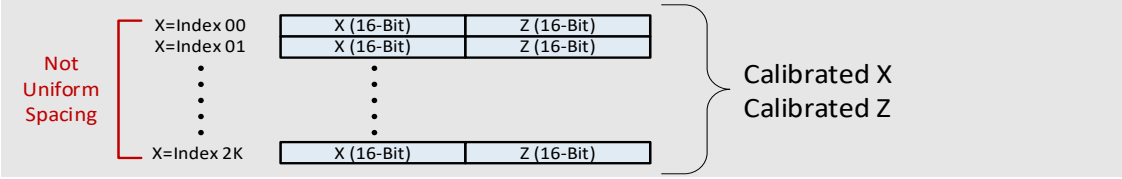
If there is an invalid point between valid real points, all interpolated points created between the two valid real points are also invalid.



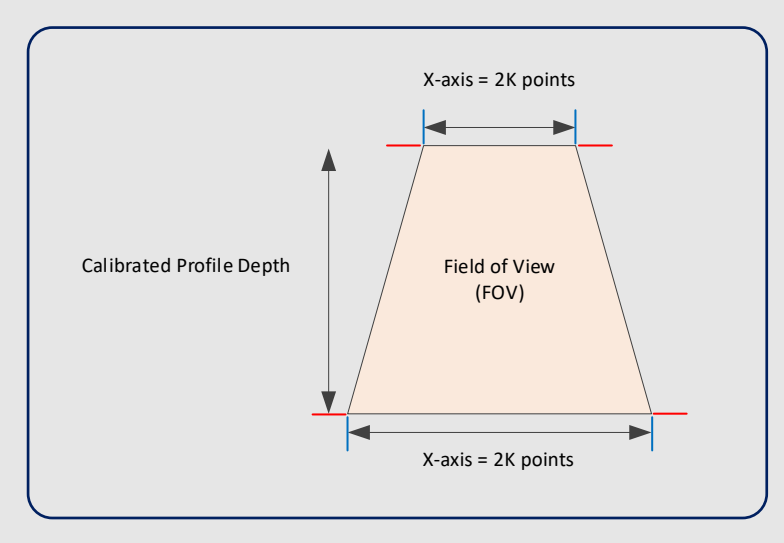
# XZ (CalibratedAC)

This output format takes into account that the resolution varies in the X and Z directions. So, any raw value in X and in Z is "compensated" for this variation; this process is done automatically in the sensor, which outputs "calibrated" data. The calibrated data must be multiplied by a scaling factor to obtain the real-world Z value in the specified measurement unit. Each profile therefore consists of X and Z values.

- Output is 32 bits, consisting of calibrated X data (16-bit) and calibrated Z data (16-bit). There are about 2K 32-bit output data words indexed by the 2K X-axis points.



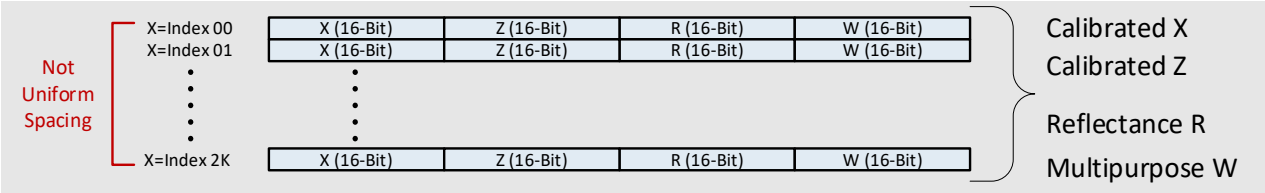

- The calibrated Z data (16-bit) must be multiplied by the Z scale factor to obtain the real-world Z value in the specified measurement unit.
- The calibrated X data (16-bit) must be multiplied by the X scale factor to obtain the real-world X value in the specified measurement unit.
- Z data above the Near-FOV (i.e., Z value > max Z) or below the Far-FOV (i.e., Z value < 0) will return as invalid.
- Z-Expert graphs the Z output data in the selected measurement unit at each X point; floating the mouse over the profile will show the calculated real-world X measurement relative to the left edge of the measurement area.



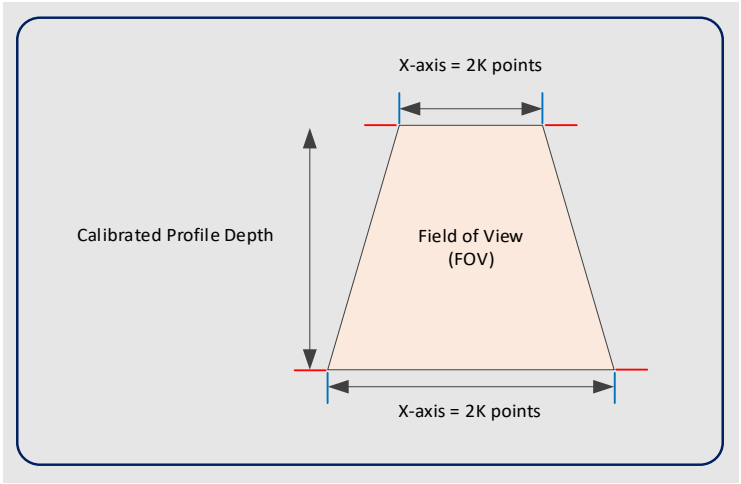

# XZRW (CalibratedACRW)

Each profile consists of calibrated X and Z data (as in the XZ format), reflectance R, and multipurpose W (typically peak width) values, in a 64-bit data format.

- Output is 64 bits, consisting of calibrated X data, calibrated Z data, reflectance, and W (multipurpose) data.




- The calibrated Z data (16-bit) must be multiplied by the Z scale factor to obtain the real-world Z value in the specified measurement unit.
- The calibrated X data (16-bit) must be multiplied by the X scale factor to obtain the real-world X value in the specified measurement unit.
- Z data above the Near-FOV (i.e., Z value > max Z) or below the Far-FOV (i.e., Z value < 0) will return as invalid.
- Z-Expert graphs the Z output data in the selected measurement unit at each X point; floating the mouse over the profile will show the calculated real-world X measurement relative to the left edge of the measurement area.
- The raw reflectance value is a 16-bit number representing the object's reflectance at reflected point (peak). This R data is not scaled to any real-world unit such as lumens.
- The current implementation of the multipurpose W value represents the width of the reflected point (peak width) in pixels, and uses only the low-order 8 bits. The high-order bits are reserved.




# Calculating real-world values

Real-world measurement data is calculated from the data acquired by the profiler with the formulas shown below. It is important to note that the profiler capture data buffer has scaled down values

and requires multiplication to represent full scale values and conversion to the chosen measurement unit.

| 3D Data Type format | Real World Formulas |
|---|---|
| RectifiedC | $\mathbf{Z}_{\text{measurement unit}} = \mathbf{Z} \bullet \mathbf{Z\_Scaler}$<br>$\mathbf{X}_{\text{measurement unit}} = \mathbf{(index} \bullet \mathbf{UniformX\_Step\_Size)} + \mathbf{UniformX\_Offset}$ |
| CalibratedAC | $\mathbf{Z}_{\text{measurement unit}} = \mathbf{Z} \bullet \mathbf{Z\_Scaler}$<br>$\mathbf{X}_{\text{measurement unit}} = \mathbf{X} \bullet \mathbf{X\_Scaler}$ |
| CalibratedACRW | $\mathbf{Z}_{\text{measurement unit}} = \mathbf{Z} \bullet \mathbf{Z\_Scaler}$<br>$\mathbf{X}_{\text{measurement unit}} = \mathbf{X} \bullet \mathbf{X\_Scaler}$ |

Where:

| Variables | Description |
|---|---|
| X | Calibrated X output value |
| X_Scaler | Scale factor used to transform the calibrated X value into the real-world value in the selected measurement unit. The X_Scaler value is found in the Data Output > Format category (read only) |
| Z | Calibrated Z output value |
| Z_Scaler | Scale factor used to transform the calibrated Z value into the real-world value in the selected measurement unit. The Z_Scaler value is found in the Data Output > Format category (read only) |
| index | Index of the profiler capture data buffer in the X direction |
| UniformX_Step_Size | Resampled distance between each coordinate of the X-axis. The UniformX_Step_Size value is found in the Data Output > X-Axis category, and already takes into account the unit and scale (can be used as is) |
| UniformX_Offset | Offset between index 0 of the X-axis and the anchor point. The UniformX_Offset value is found in the Data Output > X-Axis category (read only), and already takes into account the unit and scale (can be used as is). |

# Troubleshooting

## Before contacting technical support

Review this Troubleshooting section. To aid Teledyne DALSA personnel when support is required, the following should be included with the request for support.

- From the **Start** menu, open the **Teledyne Dalsa Sapera LT** folder, and run the **Sapera Log Viewer** program. On the **File** menu, click **Save Messages** to generate a log text file.
- Report the version of the Z-Trak2 driver and the version of Sapera LT used (must be version 8.7 or later).

## Network setup and device IP issues

In rare cases, an installation may fail, or problems may occur in controlling and using the profiler. The Sapera GigE Server status icons found in the notification area (tray) provides visual information on possible problems. The three states are shown in the following table. Note that even an installation with no networking issue may still require optimization to perform to specification.

| | No Device Found | Device IP Error | Device Available |
|---|---|---|---|
| **GigE Server Tray Icon:** |  |  |  |
| **Note—**It will take a few seconds for the GigE Server to refresh its state after any change. | A red X will remain over the GigE Server tray icon when the device is not found. This indicates a network issue where there is no communication, ***or in the simplest case,*** the Z-Trak2 is device not connected. | The GigE Server tray icon shows a warning when a device is connected but there is some type of network or IP error. | This GigE Server tray icon indicates that the device is found. The Z-Trak2 device has obtained an IP address and there are no network issues. |

**Recall**—10/100 Mb Ethernet is **not** supported by the Z-Trak2 series profilers. The Status LED will show that it acquired an IP address (solid blue) but the device will not function at these slower connections.

# No Device Found

The red X over the GigE server icon indicates that the Z-Trak2 device is not found. This indicates either a major device fault or condition such as disconnected power, or a network issue where there is no communication.

- Review sections Software installation and System requirements to verify the installation steps.
- Refer to the Teledyne DALSA *Network Imaging Package for Sapera LT Optimization Guide* to review networking details. This document is supplied with Sapera LT.
- In multiple NIC systems where the NIC for the Z-Trak2 is using LLA mode, ensure that no other NIC is in LLA mode. Preferably, enable the Sapera DHCP server on the NIC used with Z-Trak2.
- Verify that your NIC is running the latest driver available from the manufacturer.

# Device IP Error

The GigE server tray icon shows a warning with IP errors.

This situation may arise if a device's IP address is not on the same subnet as the host computer NIC. See section Recovering a device with invalid IP.

**Multiple Profiler Issues**

- When using multiple profilers with a computer with multiple NIC ports, confirm that each device has been assigned an IP address by checking the GigE server.
- LLA mode can only be used on one NIC. For other NICs, use a DHCP server or persistent IP.
- When using multiple profilers connected to a VLAN Ethernet switch, confirm that all cameras are **on the same subnet setup** on that switch.
- Verify that your NIC is running the latest driver available from the manufacturer.

Section Sapera LT Network Configuration tool may provide some help with IP configuration.

# Device Available but with Operational Issues

A properly installed profiler with no network issues may still not perform optimally. Operational issues may still arise related to cabling, Ethernet switches, multiple devices, etc. Common issues are described in the following sections. Also look at section Preventing faults due to electrostatic discharge (ESD) to avoid random packet loss, random device resets, and random loss of Ethernet connections.

Please refer to the Teledyne DALSA *Network Imaging Package for Sapera LT Optimization Guide* for information on network optimization for GigE Vision devices.

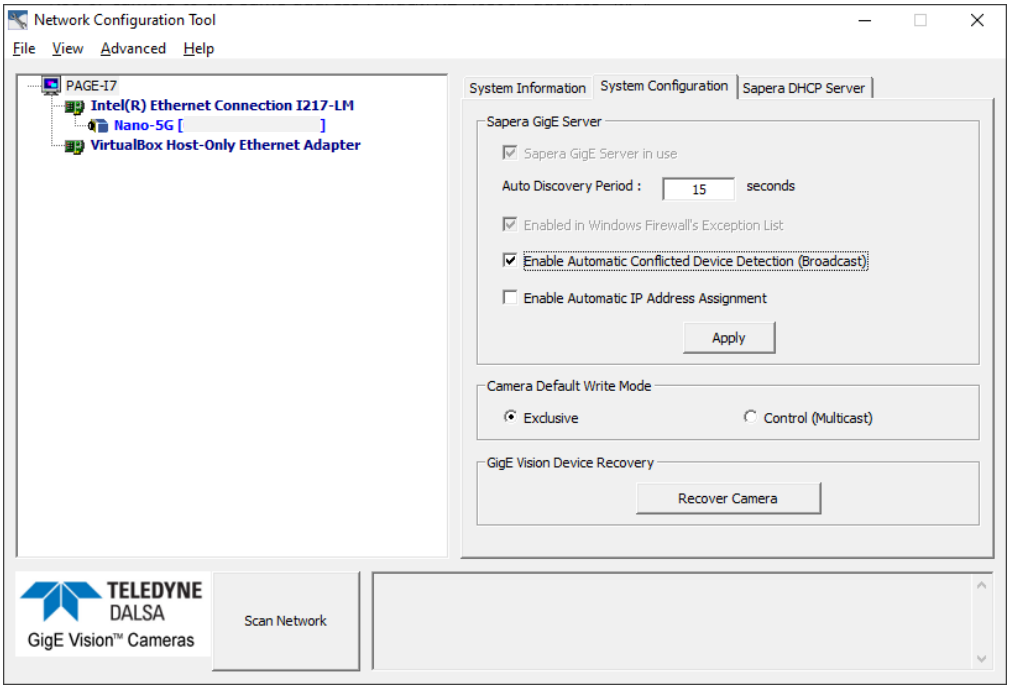
Please refer to the Teledyne DALSA *Sapera LT Getting Started Manual for GigE Vision Cameras & 3D Sensors* for information on the Teledyne DALSA Network Configuration tool.

# Recovering a device with invalid IP

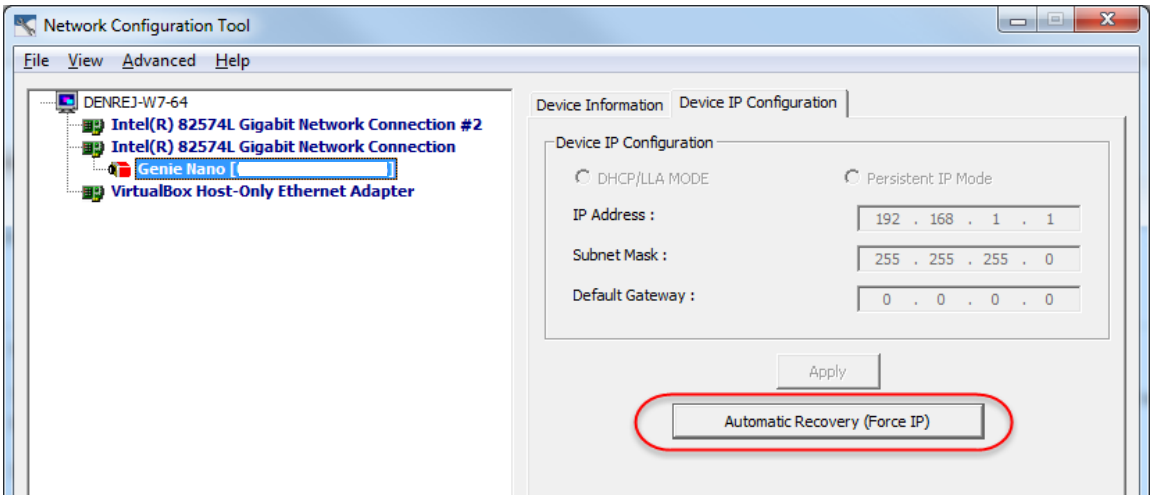
Sometimes a device is physically connected, but the Sapera GigE Server icon indicates that the connected device is not seen; this situation may arise if the device's IP address is not on the same subnet as the PC. Right-click the GigE Server icon, then select **Scan Network** to restart the discovery process, which will also include conflicting devices. After the scan, if the device is visible with the **Device IP Error** notification you may recover it using the Teledyne DALSA **Network Configuration** tool (details in Sapera LT Network Configuration tool).

**To recover a GigE camera**

1. Start the **Network Configuration** tool from the **Start** menu, under **Teledyne DALSA**.
2. On the **System Configuration** tab, check **Enable Automatic Conflicted Device Detection (Broadcast)**.




3. Click **Scan Network** (at the bottom). The conflicted devices appear in red in the left pane. (If no camera is found, you can use the Recover Camera tool. See the Getting Started manual referred to below.)
4. Select the device to recover.
5. Click **Automatic Recovery (Force IP)**.




The Force IP address will remain valid until the device is powered off.

See the *Sapera LT Getting Started Manual for GigE Vision Cameras & 3D Sensors* for details on using the **Network Configuration** tool.

# Power failure during a firmware update

As a general rule, any Z-Trak2 installation must include the firmware update procedure (see Updating firmware via File Access Dialog).

If a power failure occurs during a firmware update, it is unlikely to result in any permanent problems with the Z-Trak2. When electrical power returns and the host computer system has rebooted, follow this procedure.

1. Connect power to the profiler.

   The profiler knows that the firmware update failed. The profiler will boot with the previous version of firmware and operate normally.

   The **Self Status** feature (deviceBISTStatus) will report that the last firmware update failed.

2. Restart the firmware update procedure.

# Cabling and communication issues

With only two cables connected the Z-Trak2, cabling issues are limited.

**Power supply problems**

- If the profiler status LED is off, the DC supply power is not connected or faulty. Verify the power supply voltage.

**Communication Problems**

- If using the I/O cable to connect a power supply, use a shielded cable where the connector shell electrically connects the Z-Trak2 to the power supply earth ground. This can eliminate trigger issues in a high EMI environment.
- Check that the Ethernet cable is clipped to the sensor on one end, and to the NIC or switch on the other end.
- Verify that all Ethernet cables are CAT6 and in good condition. This is very important with long cable lengths. Poor cables will cause connections to auto-configure at lower speeds.
- Check the Ethernet status LEDs on the NIC used with the device. The Link Status indicator is on and the activity LED should flash with network messages.
- When using very long cables, up to the maximum specified length of 100 m for gigabit Ethernet, different NIC hardware and EMI conditions can affect the quality of transmission.
- Minimum recommended Ethernet cable length is 3 feet (1 meter).
- Use the **Sapera Log Viewer** tool to check on packet resend conditions. There should be no *packet resend* messages, else this indicates a control or video transmission problem due to poor connections or extremely high EMI environments. The Log Viewer tool can be found on the Windows **Start** menu, under **Teledyne DALSA Sapera LT**.

# Low connection speed after camera reset with Intel X550 T2 NIC

When connected directly to the Intel X550 T2 NIC (not through a switch), following a camera reset and subsequent link speed negotiation, the GigE link speed is set to 1 GigE instead of higher speeds (5 GigE or 2.5 GigE).

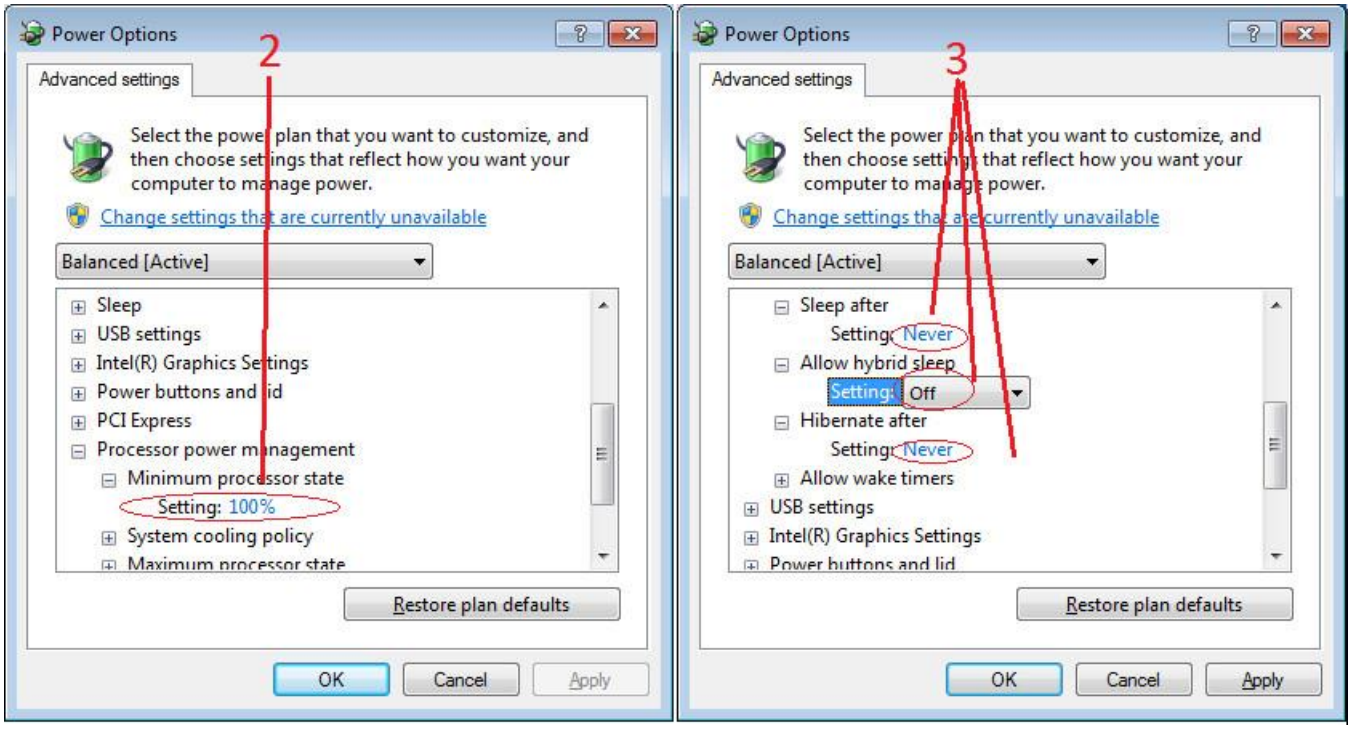
To correct the problem, connect to the Intel X550 T2 through a 5G capable switch, or replace the NIC with a different model, such as the ASUS XG-C100C, which does not exhibit this behavior.

# Preventing dropped packets by adjusting power options

Computers using new generation CPU chips such as Intel Skylake require adjustments to the default *Power Options* to avoid possible dropped packets or frames.

- Open **Control Panel** – *Power Options* and select advanced settings, as shown below.

- Scroll down to the *Processor power management* control and change the Minimum processor state to 100%.
- Disable the *Sleep* and *Hibernate* options to ensure continuous system operation.




# Random invalid trigger events

Do not change the exposure time while grabbing, else an Invalid Trigger event may be generated. This applies to any exposure mode or trigger source. The only indicates the loss of a video frame. Stopping acquisitions before changing exposure will avoid this error.

# Issues with uninstalling Cognex VisionPro with Sapera LT

When the Cognex VisionPro package is uninstalled, the Z-Trak2 becomes unavailable within Z-Expert due to the Cognex uninstaller removing GigE Vision components. This forces a Z-Trak2 user to reinstall the Network Imaging package (or execute a repair within Sapera LT).

Cognex VisionPro remains a useable third-party product except for their uninstaller fault. Z-Trak2 users just need to account for this issue until resolved by Cognex.

# Appendix

## Z-Trak2 2K Series models

Below are the specifications for the S-2K series and for the V-2K series models.

### Z-Trak2 S-2K series

FOV: field of view

* : model in development, specification values subject to change.

| Specifications | S-2K-0015 | S-2K-0030 | S-2K-0100 |
|---|---|---|---|
| Scanning rate (#profiles/sec) | Up to 45,000 | Up to 45,000 | Up to 45,000 |
| Z range (mm) | 15 | 30 | 100 |
| Standoff distance (mm) | 32.7 | 43.7 | 64.5 |
| Near FOV—Far FOV (mm) | 26.6—32.3 | 53.2—72.2 | 96.9—185.3 |
| X-resolution, Near FOV—Far FOV (µm) | 13.7—16.6 | 27.3—37.1 | 49.8—95.2 |
| Z-resolution (µm) | 2 | 3 | 12 |
| Repeatability, Near FOV—Far FOV (± µm) | 0.3—0.4 | 0.6—0.8 | 1.5—2.0 |
| Linearity (± ) % of full scale | < 0.03 % | < 0.02 % | < 0.02 % |
| Laser color (nm) — classification | Blue405—2M | Blue405—2M | Red660—2M |
| Laser options, color (nm) — classification | Red660—3R | Red660—3R | Blue405—3R |
| Interface | 5/2.5/1 GigE | 5/2.5/1 GigE | 5/2.5/1 GigE |
| Case size | T20 | T20 | T20 |

# Z-Trak2 V-2K series

FOV: field of view

* : model in development, specification values subject to change.

| Specifications | V-2K-0015 | V-2K-0030 | V-2K-0100 |
|---|---|---|---|
| Scanning rate (#profiles/sec) | Up to 10,000 | Up to 10,000 | Up to 10,000 |
| Z range (mm) | 15 | 30 | 100 |
| Standoff distance (mm) | 32.7 | 43.7 | 64.5 |
| Near FOV—Far FOV (mm) | 26.6—32.3 | 53.2—72.2 | 96.9—185.3 |
| X-resolution, Near FOV—Far FOV (µm) | 13.7—16.6 | 27.3—37.1 | 49.8—95.2 |
| Z-resolution (µm) | 2 | 3 | 12 |
| Repeatability, Near FOV—Far FOV (± µm) | 0.3—0.4 | 0.6—0.8 | 1.5—2.0 |
| Linearity (± ) % of full scale | < 0.03 % | < 0.02 % | < 0.02 % |
| Laser color (nm) — classification | Blue405—2M | Blue405—2M | Red660—2M |
| Laser options, color (nm) — classification | Red660—3R | Red660—3R | Blue405—3R |
| Interface | 1 GigE | 1 GigE | 1 GigE |
| Case size | T20 | T20 | T20 |

# Reference point, anchor point and offsets

Profiles are the result of the laser line reflected by the object surface and imaged by the 2D sensor. Depending on where the line is located on the 2D image, height calculations can be made using triangulation.

For each profiler model, reference points are defined: The profiler reference point and the anchor point.

The profiler reference point is located at the bottom right corner of the front side of the profiler body (the left side when looking at the front), as depicted below. This corner is on the lowest mechanical edge of the profiler. It is the reference point relative to the unit itself.

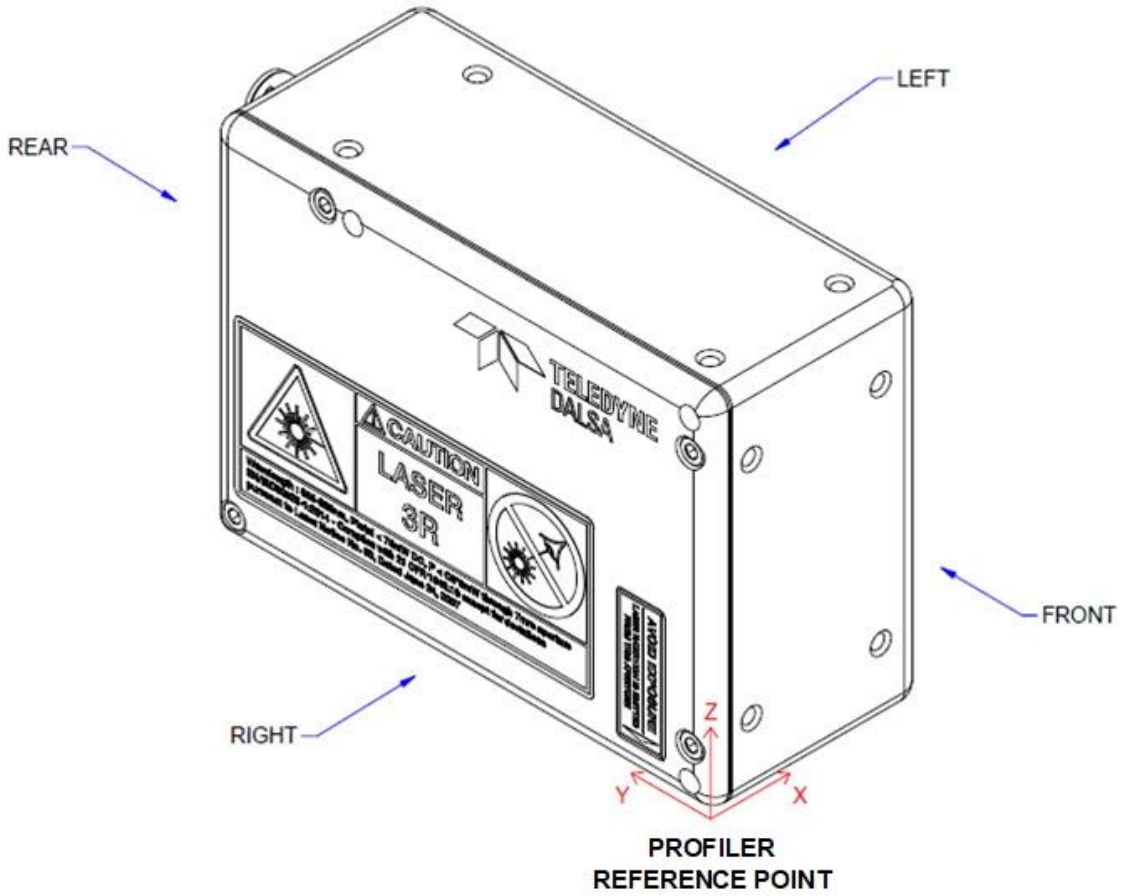



*Figure 45. The profiler reference point is located on the bottom right corner of the body, on the front side. Looking AT the front, it will be on the left.*

The anchor point is the origin (0, 0) of the 2D sensor image (DN range map); it is the reference point for real-world measurements. Using these reference points, various X and Z real-world offsets are calculated at calibration, which enable real-world measurements (see Figure 46-Figure 48). Each model has its own set of offsets, as depicted in the diagrams and tables below. Notice the relative location of the X Ref offset relative to the X1 and X2 offsets in the three diagrams.

The following legend applies to the diagrams:

| | |
|---|---|
| Z Range | Z range (DOF, or measurement range) of the model |
| FOV | Field of View |
| X REF | X value (from the anchor point) where the rightmost edge of the profiler is located |
| X1 | X value at the start of the FFOV (Far-FOV) |
| X2 | X value at the start of the NFOV (Near-FOV) |
| XC | X value in the middle of the FOV |
| X3 | X value at the end of the NFOV |
| X4 | X value at the end of the FFOV |
| Z1 | Z value at the FFOV |
| Z2 | Z value at the NFOV. |
| ZREF | Z value at the profiler reference point. |

Note: all values are in micrometers and are typical values. Diagrams not to scale.

**Model 15 mm range**

- Note that the X Ref point is located to the left of the X1 offset.
- The FFOV (Far-FOV) is smaller than the enclosure width. Consequently, the FOVs of multiple profilers cannot overlap when used in a side-by-side configuration (see section Multi-sensor layouts).

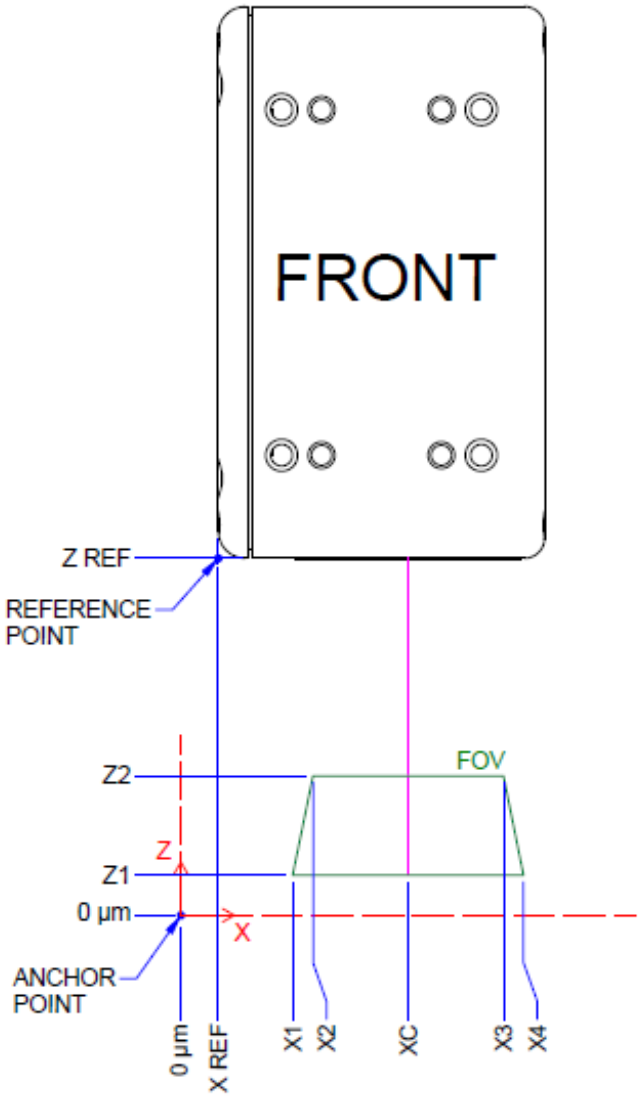



*Figure 46. Depiction of the anchor point and offsets for the 15 mm range model. Positive Y-axis into the page.*

| Z Range | X1 | X2 | X3 | X4 | XC | X REF | Z1 | Z2 | Z REF |
|---|---|---|---|---|---|---|---|---|---|
| | all values in micrometers | | | | | | | | |
| **15 mm** | 13850 | 16700 | 43300 | 46150 | 30000 | 1500 | 250 | 15500 | 47950 |

Z Range = Z2 – Z1  FFOV = X4 – X1  NFOV = X3 – X2

**Model 30 mm measurement range**

- Note that the X Ref point is located between the X1 and X2 offsets.

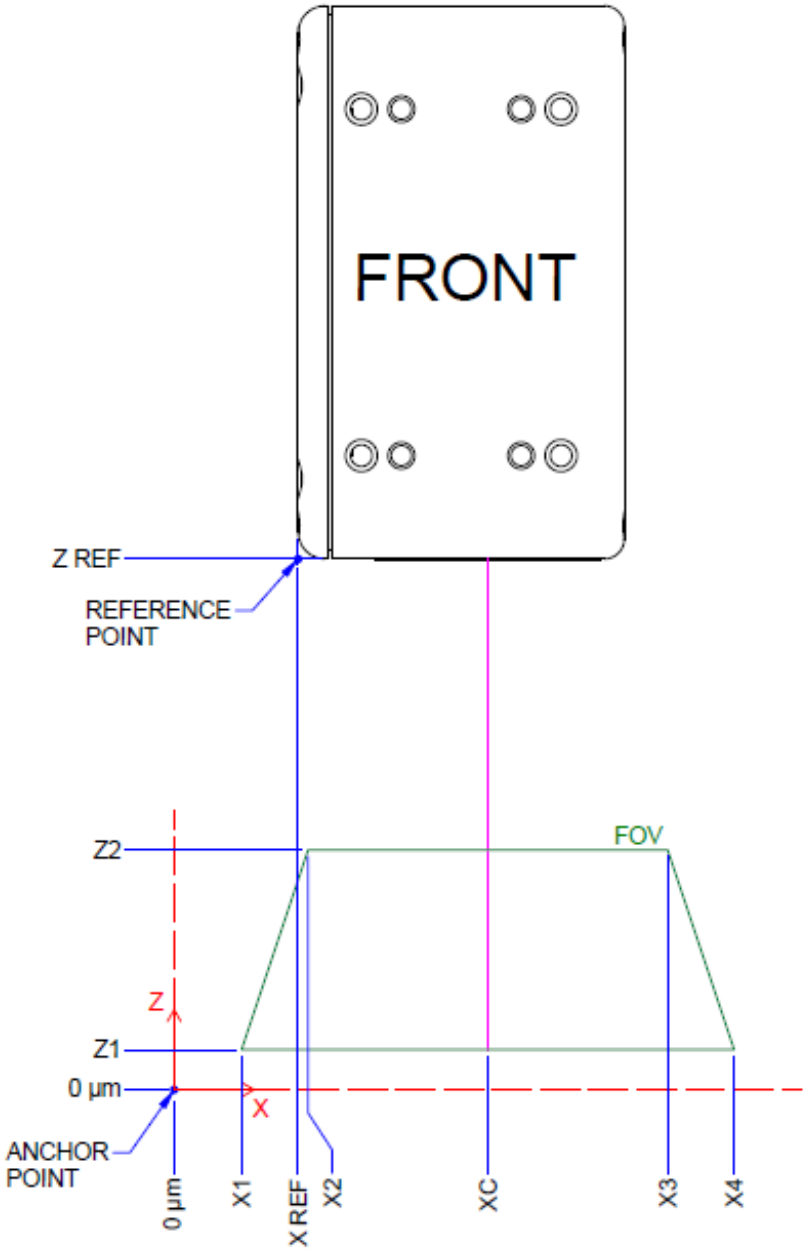



*Figure 47. Depiction of the anchor point and offsets for the 30 mm range model. Positive Y-axis into the page.*

| Z Range | X1 | X2 | X3 | X4 | XC | X REF | Z1 | Z2 | Z REF |
|---|---|---|---|---|---|---|---|---|---|
| | all values in micrometers | | | | | | | | |
| **30 mm** | 23900 | 33400 | 86600 | 96100 | 60000 | 31500 | 500 | 31000 | 74200 |

Z Range = Z2 – Z1  FFOV = X4 – X1  NFOV = X3 – X2

**Model 100 mm measurement range**

- Note that the X Ref point is located beyond the X2 offset.

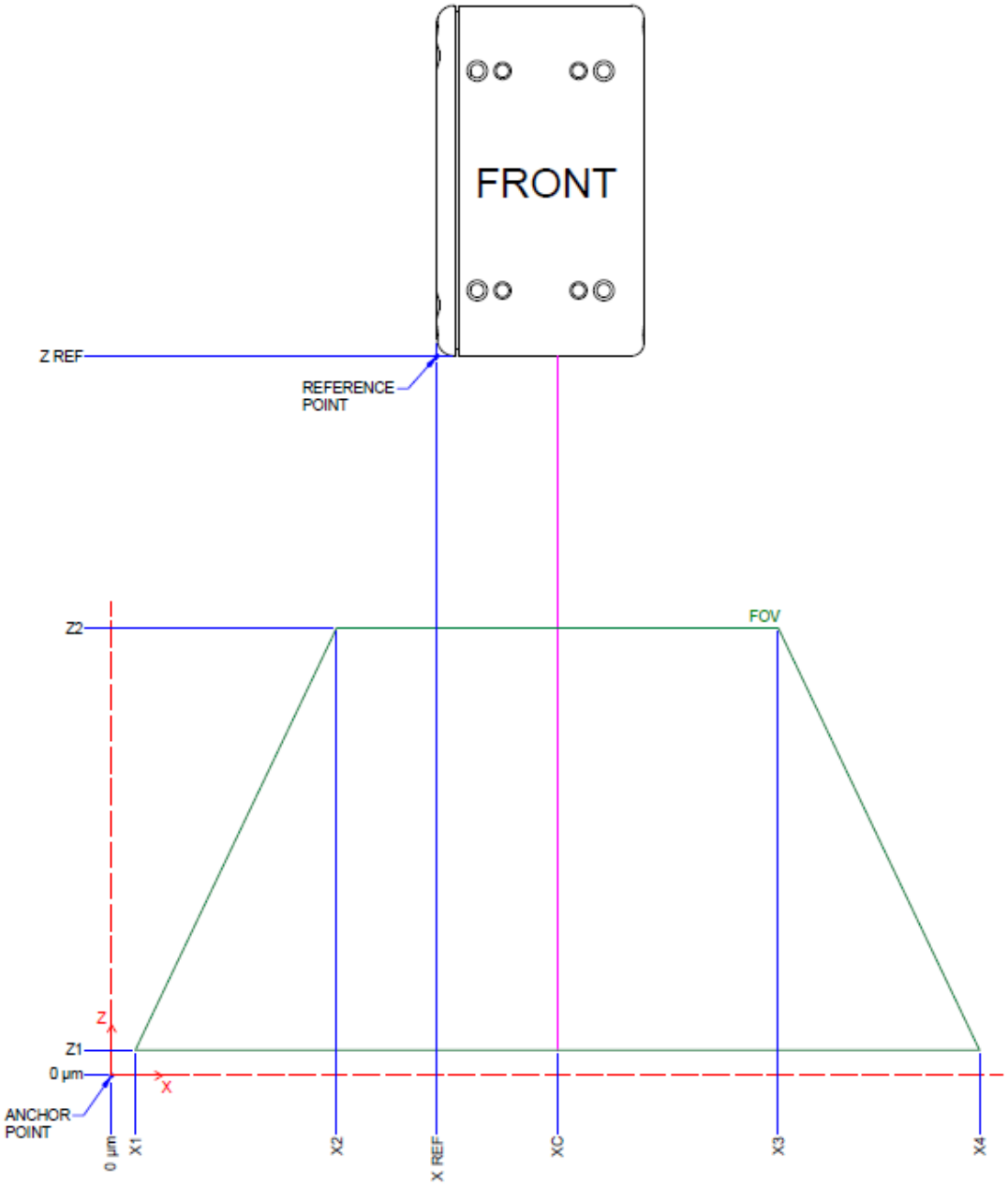



*Figure 48. Depiction of the anchor point and offsets for the 100 mm range model. Positive Y-axis into the page.*

| Z Range | X1 | X2 | X3 | X4 | XC | X REF | Z1 | Z2 | Z REF |
|---|---|---|---|---|---|---|---|---|---|
| | all values in micrometers | | | | | | | | |
| **100 mm** | 27350 | 71550 | 168450 | 212650 | 120000 | 91500 | 1000 | 102000 | 165500 |

Z Range = Z2 – Z1  FFOV = X4 – X1  NFOV = X3 – X2

# Depiction of AOI features

Here is an example of the AOI feature values that correspond to the AOI shown in the display (Figure 49). The same features are depicted with their names (Figure 50) and their values (Figure 51).

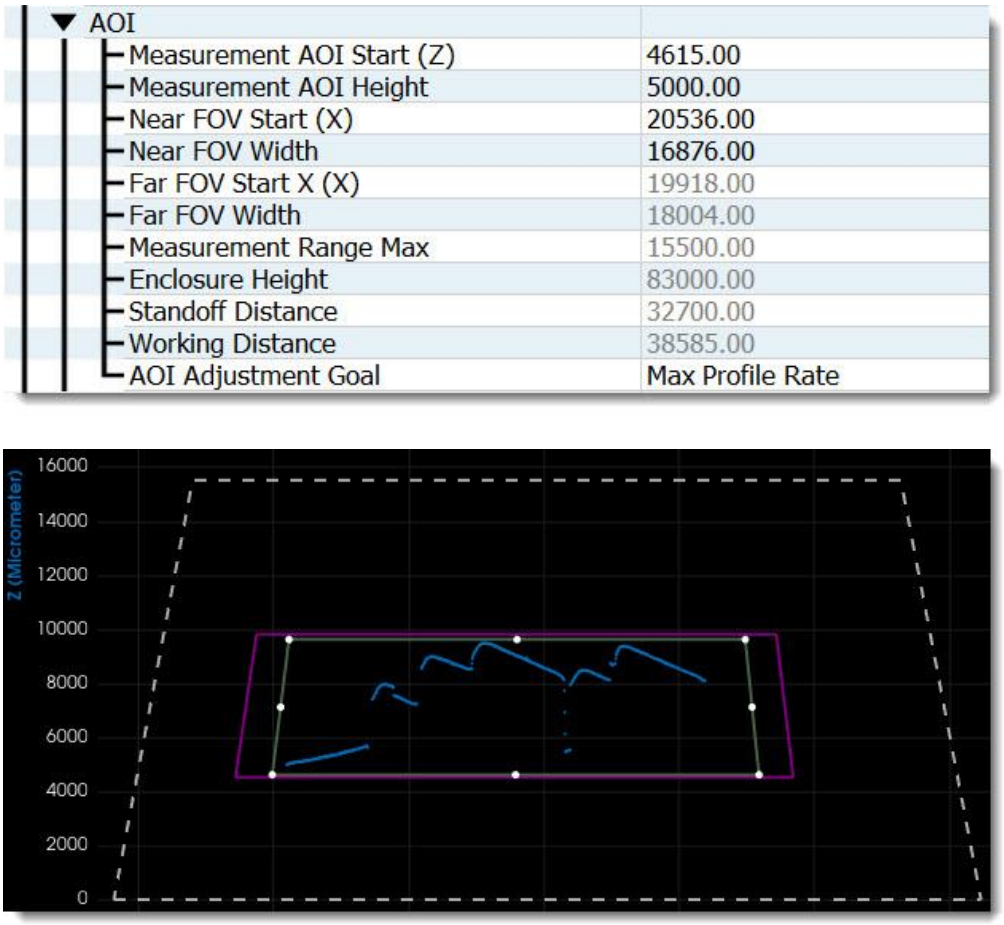



*Figure 49. Example of AOI feature values (top) and a display of the measurement AOI (bottom).*

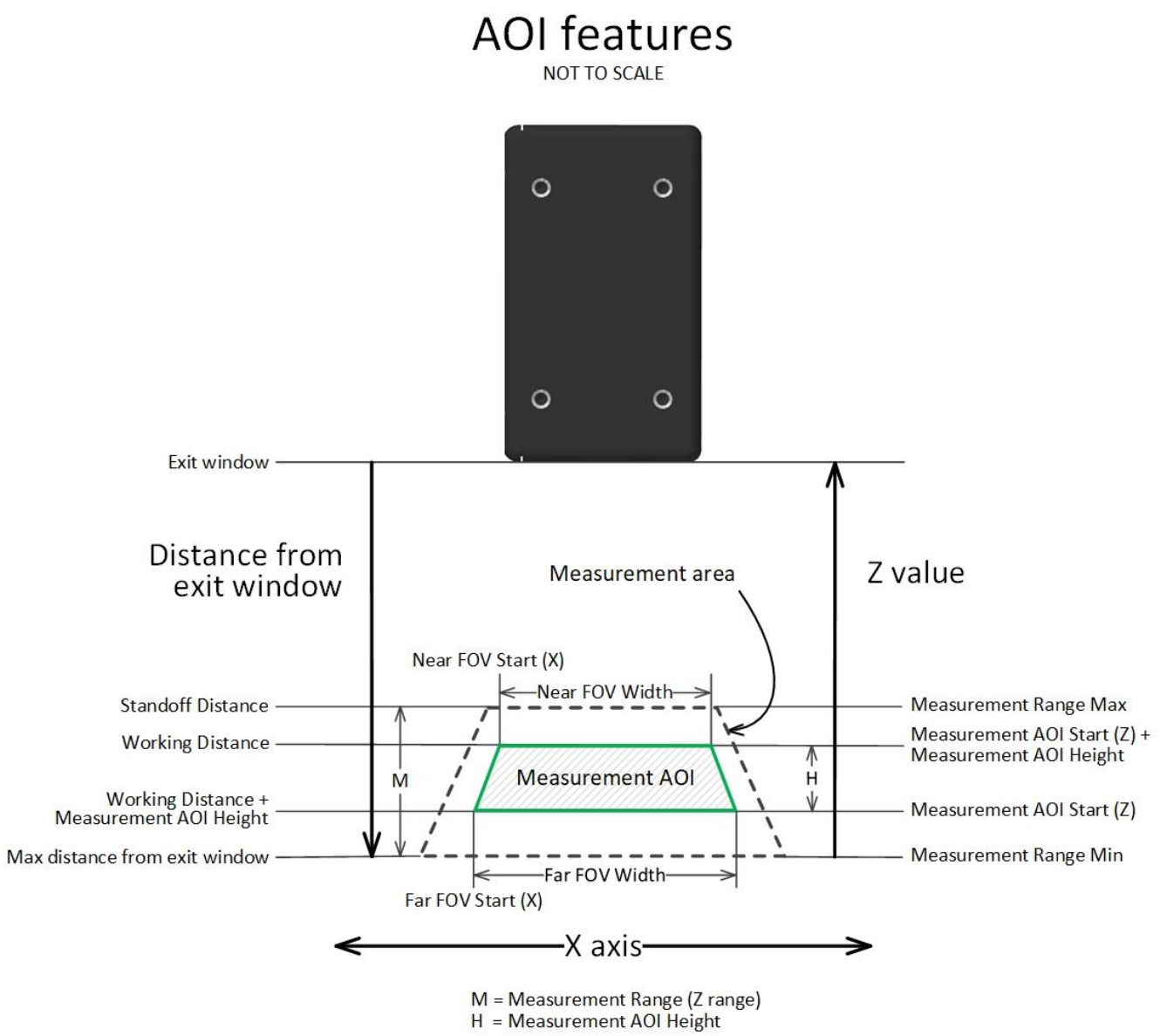



*Figure 50. The various AOI features are depicted. Note that the standoff distance and working distance start from the sensor exit window, while the Z measurements start from the measurement area's Far FOV. M is the Measurement Range Max; H is the Measurement AOI Height starting at Measurement AOI Start (Z).*

Below is depicted the same information, with the corresponding values.

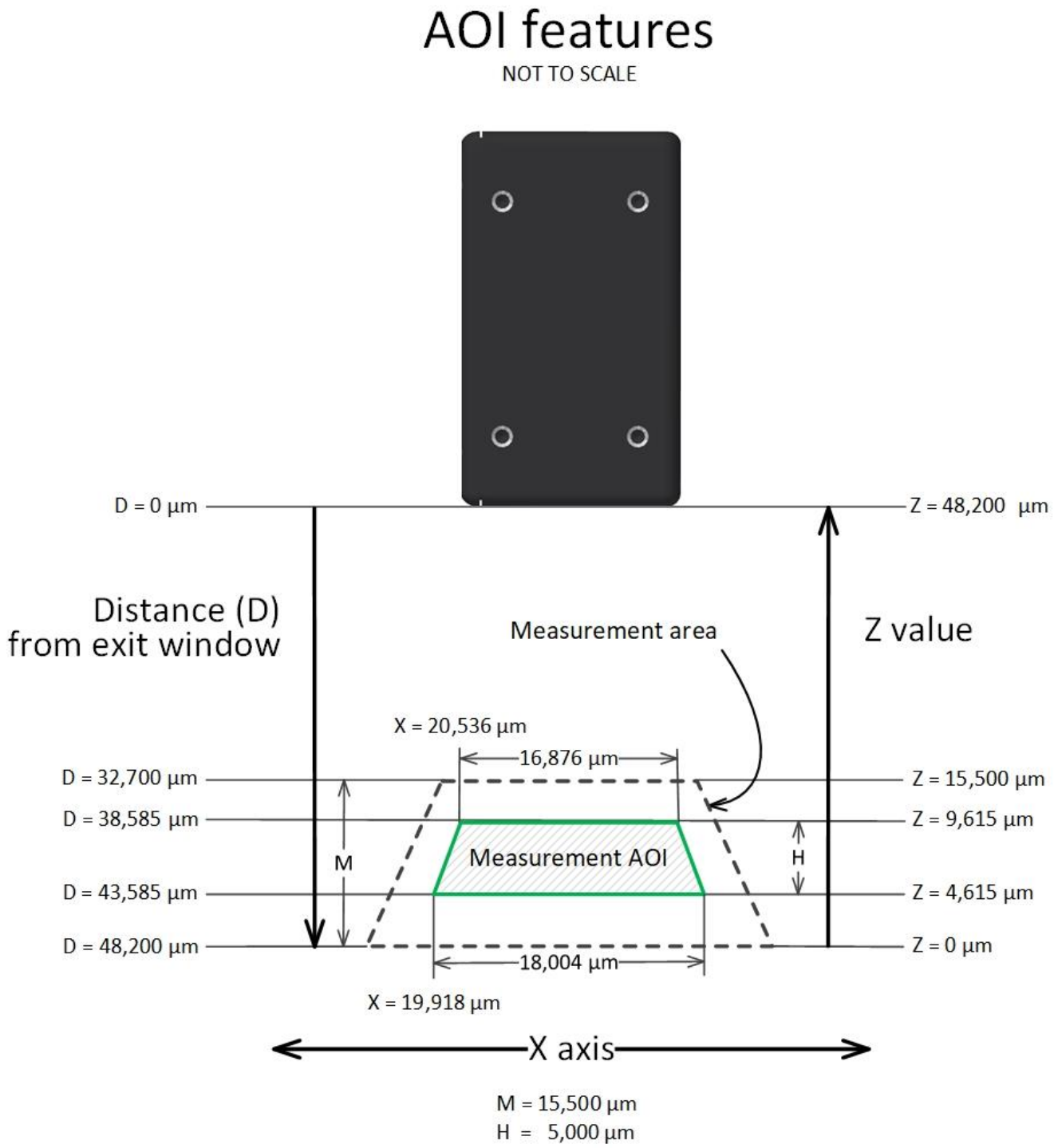



*Figure 51. The different values, in micrometers, corresponding to the feature values and calculations found in the AOI features of Z-Expert. Note that the Z values increase from Far FOV to the sensor's laser exit window, while the distance from exit window values (D) increase from the exit window down.*

# Features saved in a configuration file

The table below presents features saved in a .ccf file (subject to changes, not exhaustive). Note that features in GigE Vision Host Controls and GigE Vision Transport Layer are not saved in a configuration file.

**Features in Device Version 1.00.**

| Features saved in .ccf |
|---|
| laserActivation |
| laserControlMode |
| laserSafety |
| laserAutoTargetAvgReflectance |
| laserPower |
| peakDetectorReflectanceThreshold |
| peakDetectorSelectionMode |
| profileRate |
| AcquisitionLineRate |
| ExposureTime |
| Scan3dOutputMode |
| PixelFormat |
| uniformXMaxInterpolationLimit |
| uniformXPointsPerProfileMode |
| pointsPerProfile |
| profilesPerScan |
| uniformXStepSize |
| Scan3dInvalidDataValue |
| aoiZStart |
| aoiHeight |
| aoiNFOVStartX |
| aoiNFOVWidth |
| aoiFFOVStartX |
| aoiFFOVWidth |
| rectifiedZNumberOfSamplesManual |
| EncoderSourceB |
| EncoderMode |
| encoderDirection |
| encoderCountMode |
| encoderDividerMode |
| displacementUnitsY |
| displacementSpeedY |
| displacementY |

| Features saved in .ccf |
|---|
| encoderSpeedMax |
| encoderTicksPerRevolution |
| EncoderDivider |
| EncoderOutputMode |
| EncoderValue |
| encoderMaximumValue |
| internalAcquisitionFrameDropCount |
| TriggerSelector |
| TriggerMode |
| AcquisitionBurstFrameCount |
| TriggerSource |
| TriggerActivation |
| TriggerDelay |
| triggerStopSource |
| triggerStopActivation |
| multiSensorSyncMode |
| multiSensorSyncGroup |
| multiSensorSyncDelay |
| Width |
| OffsetX |
| Height |
| OffsetY |
| LineSelector |
| LineInverter |
| lineDebouncingPeriod |
| outputLineSource |
| outputLineValue |
| outputLinePulseDelay |
| outputLinePulseDuration |
| outputLinePulseActivation |
| timestampResetSource |
| timestampResetLineActivation |
| timestampLatchSource |

| Features saved in .ccf |
|---|
| timestampModulo |
| timestampModuloStartTime |
| TransferControlMode |
| counterMode |
| counterStartSource |
| counterStartLineActivation |
| counterIncrementalSource |
| counterIncrementalLineActivation |
| counterDuration |
| counterResetSource |
| counterResetLineActivation |
| timerSelector |
| timerMode |
| timerStartSource |
| timerStartLineActivation |
| timerDuration |
| Gain |
| ptpMode |
| devicePacketResendBufferSize |
| DeviceLinkThroughputLimitMode |
| deviceLinkThroughputLimitRatio |
| GevSCPSPacketSize |
| GevSCPD |
| SensorShutterMode |
| deviceReserved102 |
| ImageTimeoutRaw |
| InterPacketTimeoutRaw |
| CommandAcknowledgeTimeout |
| CommandRetryCount |
| multiCastStreamingEnable |
| multiCastStreamingIPAddress |

# Sherlock—obtaining a license

Sherlock is a software tool that helps develop machine vision applications easily, using an intuitive visual interface, and most importantly without any coding required. The generated applications can be tested and then easily deployed.

Sherlock can be used with various devices that support the GenICam standard. When bundled with Z-Trak2, Sherlock can be unlocked for use with the unit: The license is keyed to the serial number of the profiler and stored in a register on the profiler. The license is "portable" and moves with the device. Z-Trak2 requires the Sapera LT Runtime software to read the registers.

Sherlock is available for download from the Teledyne DALSA website. To obtain a license for a Z-Trak2, use the software registration page as indicated in the procedure below.

**To obtain a license for Sherlock**

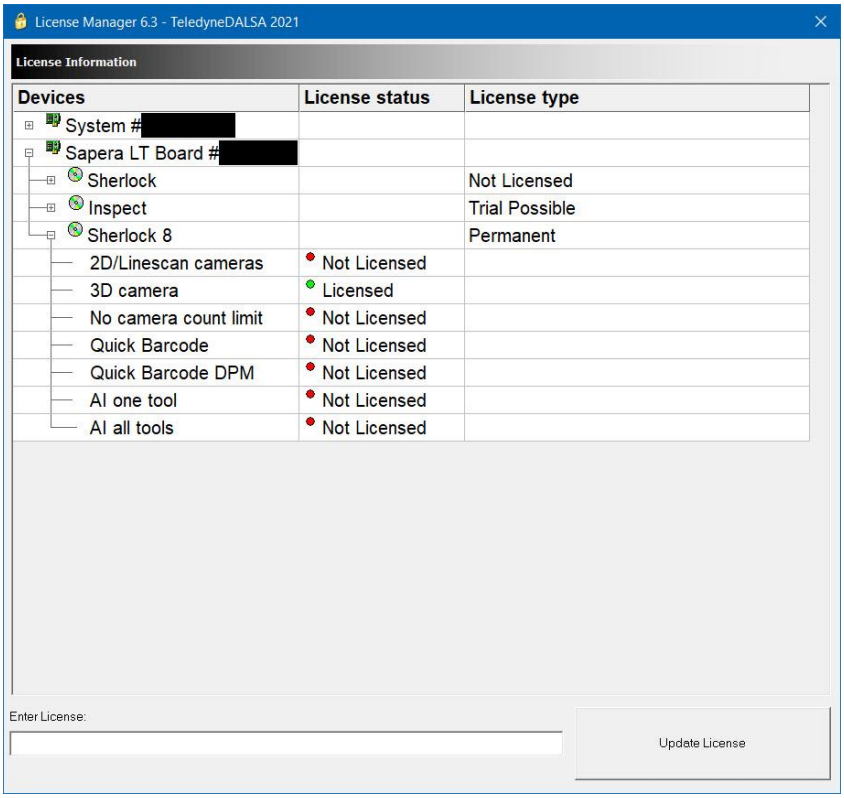
You will need your Z-Trak2 serial number at hand, which you can find through Z-Expert in the **Profiler Management** category.

1. Download Sherlock through the Teledyne DALSA website.
2. On the Teledyne's Software Registration page, register your copy by selecting *Sherlock 3D for Z-Trak* and entering your Z-Trak2 serial number.
3. Click **Generate Software Key**. A software license key for your device will be shown on screen; it will also be sent to you by email.

**To install and unlock Sherlock**

You must have administrator rights for installation.

1. Install Sherlock on your computer.
2. Power your Z-Trak2 device and connect it to the host computer NIC. Wait for it to be found by the Sapera GigE Server in the notification area (see GigE server device status). It takes a few seconds for the GigE Server to refresh its state after a device has obtained an IP address.
3. On the **Start** menu, open the Teledyne DALSA Sherlock 8 folder, and select **License Manager**. Verify that you can see the Z-Trak2 Profiler, which should be listed as **Sapera LT Board** followed by a 7-digit serial number (you may need to scroll down the list). Note: You may need to open Z-Expert and connect to your Z-Trak2 device.
4. Enter (or copy and paste) the software license key in the **Enter License** text box, then click **Update License**.
5. Verify that the license status for the **3D camera** option indicates *Licensed*.


License Manager 6.3 - TeledyneDALSA 2021
License Information
Devices
License status
License type
System #[redacted]
Sapera LT Board #[redacted]
Sherlock
Not Licensed
Inspect
Trial Possible
Sherlock 8
Permanent
2D/Linescan cameras
Not Licensed
3D camera
Licensed
No camera count limit
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# Configuring network adapter (NIC) for GigE Vision devices

## Reference documents

The following documents may contain helpful information for network settings.

**Sapera LT Getting Started Manual for GigE Vision Cameras and 3D Sensors**

- On the **Start** menu, open **Teledyne DALSA Sapera LT**, select **Documentation**, then open **SaperaGettingStarted_Cameras.pdf**.

**Network Imaging Package for Sapera LT Optimization Guide**

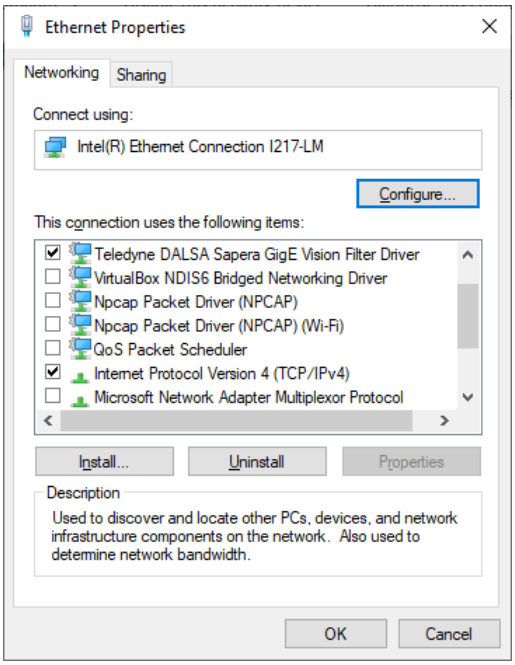
- On the **Start** menu, open **Teledyne Dalsa**, then select **Network Optimization Guide (PDF)**.

## GigE connection Ethernet Properties

The Ethernet configuration of a NIC is done through the GigE Connection Ethernet Properties dialog box.

**To open the Ethernet Properties dialog of the NIC**

1. On the **Start** menu, open **Settings** and select **Network and Internet**.
2. On the left pane, select **Ethernet**, then click **Change adapter options**.
3. On the shortcut menu of the GigE connection to configure, select **Properties**.




**Networking tab**

For NICs with GigE Vision cameras/sensors connected, only the two following options should be enabled:

- Teledyne DALSA Sapera GigE Vision Filter Driver
- Internet Protocol Version 4 (TCP/IPv4)

# Basic NIC settings

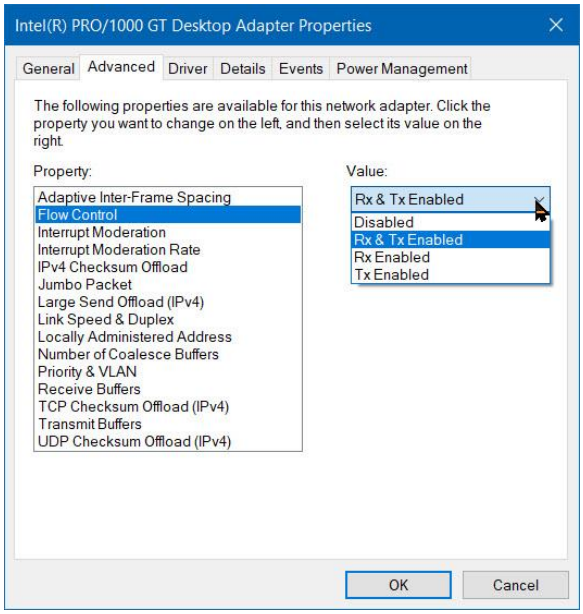
The following describe the recommended settings for a NIC used with GigE Vision devices.

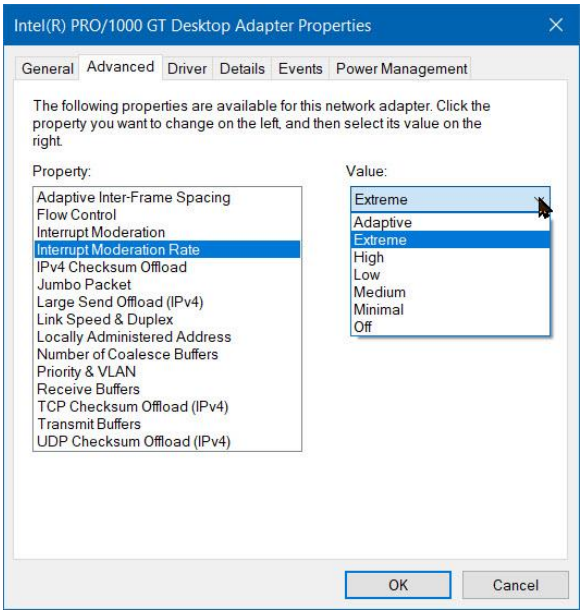
**To configure the NIC**

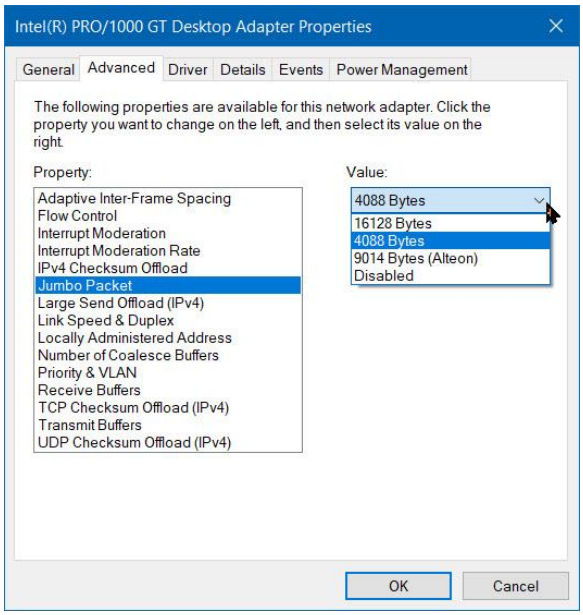
1. Click **Configure**.
2. Click the **Advanced** tab.

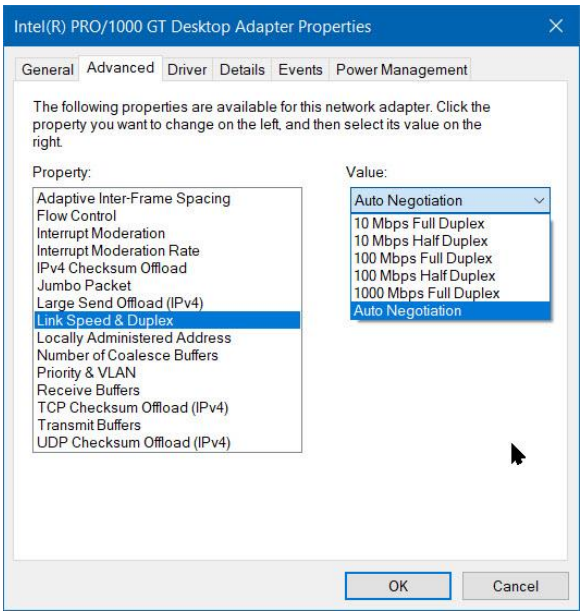
Several parameters are listed, which may differ according to the adapter. Recommended values for GigE connections are provided below.

For detailed description of the configuration parameters of the GigE connection, please refer to the *Network Imaging Package for Sapera LT Optimization Guide*.




- **Adaptive Inter-Frame Spacing**. Disabled by default, it should remain disabled.
- **Flow Control**. Should be enabled. The chosen value may depend on the network switch used. Choose *Rx & Tx Enabled*.
- **Interrupt Moderation**. Should be enabled.
- **Interrupt Moderation Rate**. Choose any value except *Adaptative*. To maximize real-time performance, choose *Off*. To minimize CPU usage, choose *Extreme*.
- **Jumbo Packets (Jumbo Frames)**. Should be enabled, e.g., choose *9014*.
- **Large Send Offload (IPv4)**. Should be disabled.

- **Receive Buffers**. Increase the number of Receive Buffers if you notice a significant decrease in the performance of received traffic. If receive performance is not an issue, use the default setting.
- **Receive Descriptors**. If available, set to the largest value supported by the NIC.
- **Receive Side Scaling Queues**. If supported, enable. Use 2 queues when good throughput and low CPU are required.
- **Wait for Link**. If available, select *Auto Detect*.

# NIC optimizations

The *Network Imaging Package for Sapera LT Optimization Guide* also proposes some configuration values for different optimization goals, such as quick response and low latency, high throughput, system robustness, or lower CPU utilization.

For instance, for optimizing throughput, recommended settings are:

- Enable **Jumbo Packets**. A value between 1500 and 9000 bytes might increase max throughput in certain systems.
- Disable **Flow Control** in Ethernet switches.
- Increase **Receive Descriptors**.
- Enable/increase **Receive Side Scaling Queue**.
- Set **Interrupt Moderation Rate** to *Extreme* or *Off*.

Please refer to the *Network Imaging Package for Sapera LT Optimization Guide* for details.

# Sapera LT Network Configuration tool

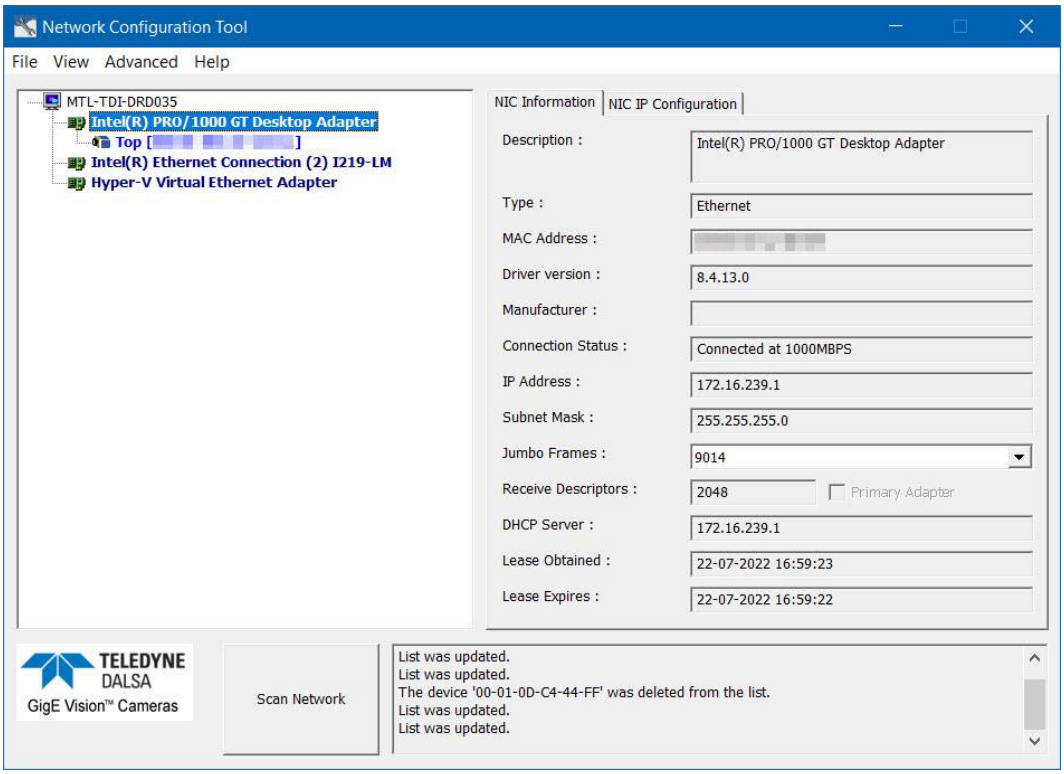
The Network Configuration tool provides information on all network adapters installed in the system and on any connected GigE Vision devices. Configuration of GigE Vision network can be easily made without having to use any Windows Control Panel application.

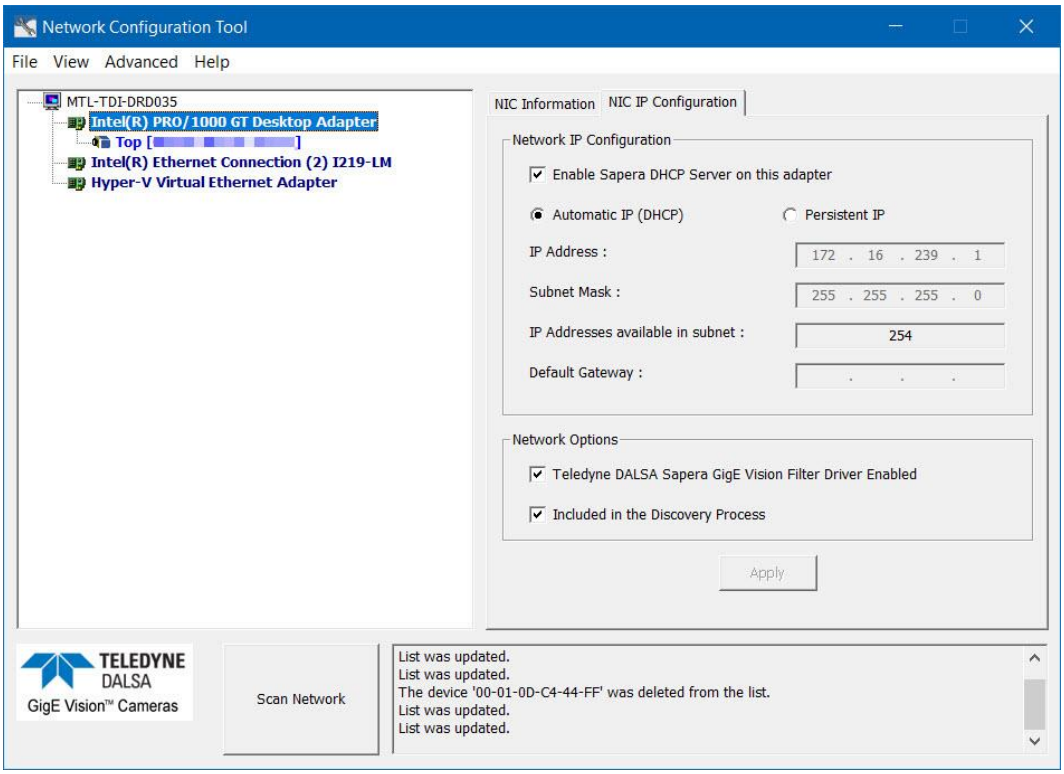
For details on this tool and on the different configuration options, please refer to the document *Sapera LT Getting Started Manual for GigE Vision Cameras and 3D Sensors*.

**To start the Network Configuration tool**

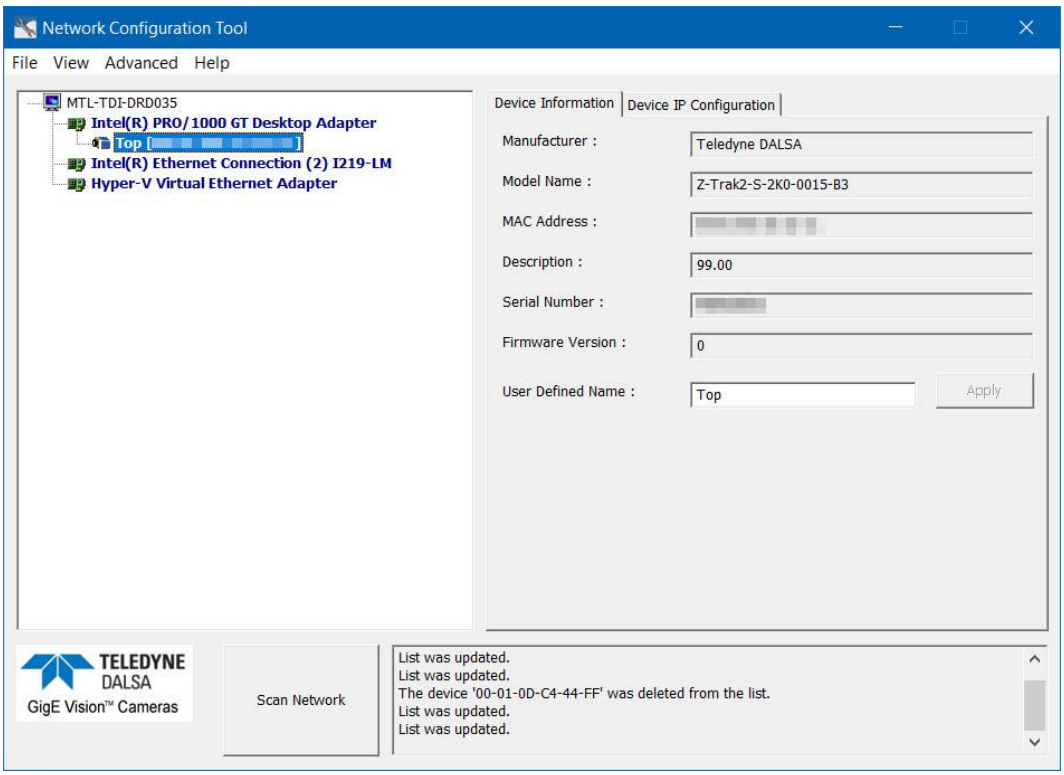
On the **Start** menu, open the **Teledyne DALSA** folder and select **Network Configuration Tool**.

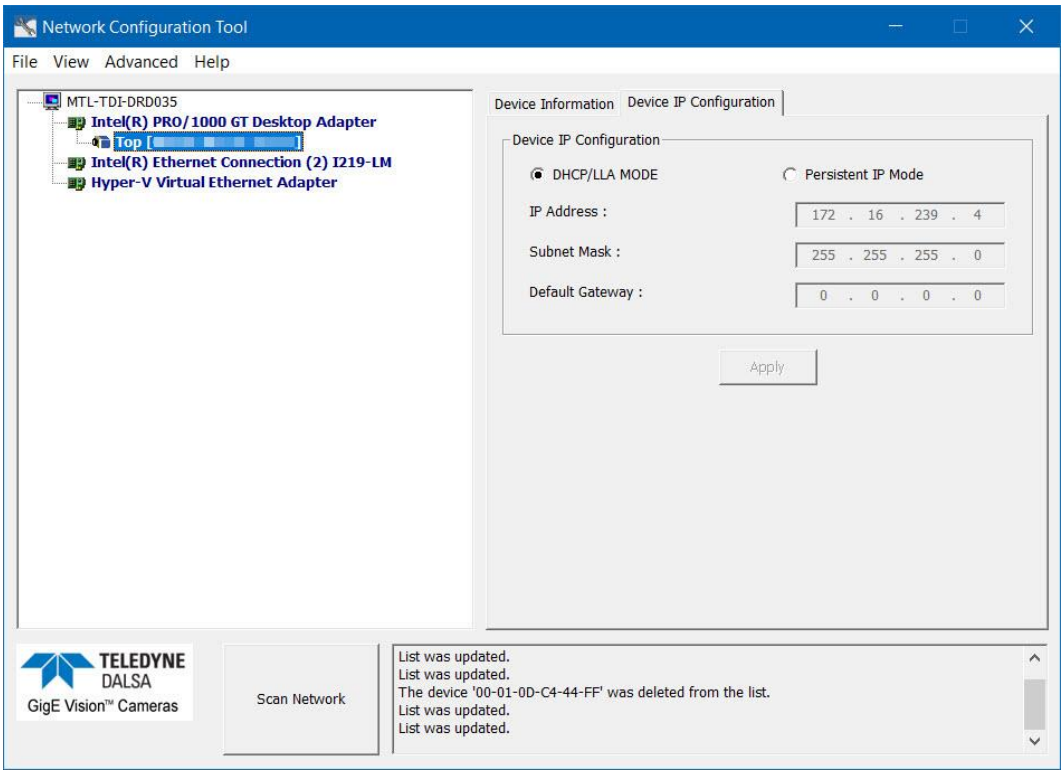
- Select a network adapter (NIC) in the left pane to preview information about the NIC, or to change its configuration.






- Select a GigE device in the left pane to preview information on the device and change the **User Defined Name** (corresponds to the **Device User ID**), or to change its IP configuration mode.






- Select a host computer on the left pane to preview system information, change its configuration or change the default Sapera DHCP server configuration. Refer to the *Sapera LT Getting Started Manual for GigE Vision Cameras & 3D Sensors* for configuration details.

# Configuring the IP assignment mode

**DHCP/LLA Mode** is the preferred automatic IP assignment mode on a NIC used with GigE devices such as Z-Trak2; it is enabled in the Sapera LT installation (see Sapera LT Network Configuration tool). For configurations involving multiple NICs with multiple GigE Vision devices, enable the Sapera DHCP server to seamlessly manage IP address assignment.

Alternately, choosing **Persistent IP Mode**, IP addresses are not automatically assigned; the user must explicitly provide IP address and subnet mask.

# How IP is assigned

Once communication with the host computer is established, an IP address is assigned to the device using one of three methods, according to the following sequence:

- Persistent IP (if enabled)
- DHCP (if a DHCP server is enabled, such as the Sapera DHCP server)
- LLA (always enabled as default)

The factory default for Z-Trak2 is *DHCP* enabled, with *LLA* always enabled as per the GigE Vision specification (**GigE Vision Transport Layer category**).

By default, automatic IP assignment is enabled through DHCP on the host computer NIC. If a DHCP server is enabled on the NIC subnet, it will assign IP addresses to the cameras/sensors attached to that subnet. Using a DHCP server is recommended when there are multiple NICs with multiple devices attached.

If no DHCP server is enabled on a NIC, then the LLA (Link-Local Address) method is used, which automatically assigns the device a randomly chosen address on the 169.254.xxx.xxx subnet. Note that the LLA mode is unable to forward packets across routers.

Persistent IP should be used only when the user fully controls the assignment of IP addresses on the network. The GigE device is assigned a static IP address that must use the same subnet as the NIC.

For additional information on IP configuration modes, see the *Sapera LT Getting Started Manual for GigE Vision Cameras & 3D Sensors*.

# Ethernet to fiber-optic interface requirements

In cases where the profiler-to-PC separation is greater than 100 meters, but an Ethernet switch is not desired, a fiber-optic media converter can be used. The FlexPoint GX from Omnitron Systems (www.omnitron-systems.com) converts GigE to fiber transmission and vice versa. It supports multimode (MM) fiber over distances of up to 220 m (720 ft.) and single-mode (SM) fiber up to 65 km (40 mi.) with SC, MT-RJ, or LC connector types.

| | |
|---|---|
|  | The inclusion in this manual of GigE to fiber-optic converters does not guarantee they will meet specific application requirements or performance.<br><br>The user must evaluate any supplemental Ethernet equipment. |

# FCC & CE declarations

Copies of the Declarations of Conformity documents are available on the product page on the Teledyne DALSA website or by request.

## FCC Statement of Conformance

This equipment complies with Part 15 of the FCC rules. Operation is subject to the following conditions:

1. The product may not cause harmful interference; and
2. The product must accept any interference received, including interference that may cause undesired operation.

### *FCC Class A Product*

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. 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 his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment is intended to be a component of a larger industrial system.

## CE Declaration of Conformity

Teledyne DALSA declares that this product complies with applicable standards and regulations.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This product is intended to be a component of a larger system and must be installed as per instructions to ensure compliance.

# Revision history

| Revision | Date | Major Change Description |
|---|---|---|
| R:0001 | April 2021 | Preliminary release |
| R:0002 | June 1, 2021 | Preliminary release |
| R:0003 | July 8, 2021 | Preliminary release |
| R:0004 | September 6, 2021 | Preliminary release |
| R:0005 | September 15, 2021 | Preliminary release |
| R:0006 | October 27, 2021 | Preliminary release |
| R:0007 | December 22, 2021 | Preliminary release |
| R:0008 | February 8, 2022 | Preliminary release |
| R:0009 | August 1, 2022 | Preliminary release |
| R:0010 | August 5, 2022 | Manual Initial Release |

# Contact information

## Sales information

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|---|---|
| **Visit our web site:** | www.teledynedalsa.com/en/contact/contact-sales/ |
| **Email:** | info@teledynedalsa.com |

| **Canadian Sales** | |
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## Technical support

Submit any support question or request via our web site:

| | |
|---|---|
| Technical support form via our web page:<br>Support requests for imaging product installations,<br>Support requests for imaging applications<br><br>Camera/sensor support information<br><br>Product literature and driver updates | www.teledynedalsa.com/mv/support |