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AT – Automation Technology GmbH

C6 MCS User Manual

cx4090HS

VERSION 1.0

1 Content

2 About this document

2.1 Copyrights

2.2 Disclaimer

While care has been exercised in the preparation of this document to ensure that it is fully correct and comprehensive, the owners assume no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained herein. No license is granted under any patents or patent right of AT - Automation Technology GmbH.

2.3 Trademarks

All nationally and internationally recognized trademarks and trade names are hereby acknowledged. This document is subject to change without notification. All rights reserved.

2.4 Information

This manual provides important information on how to use devices from AT-Automation Technology GmbH. It constitutes an important part of the device and should be stored in the immediate vicinity of the device. It must be accessible to all operating personnel.

Notice: These instructions must be carefully read before starting any work on the device. Observe the safety instructions and the locally applicable safety and accident prevention regulations. If anything is unclear, contact AT-Automation Technology GmbH.

2.5 Symbols

In this document, warnings, important information and tips are highlighted with symbols:

CE marking, see Declaration of Conformity

RoHS RoHS mark, the system complies with RoHS Directive 2002/95 / EG

WEEE mark, the system is registered according to the WEEE directive under the WEEE-Reg.-No. DE 13042735

Warning: Highlights safety-critical information. Non-compliance may result in situations that could lead to injury or death

Notice: Highlights important information. Non-compliance may result in damage to the device

Tip: Highlights useful tips and recommendations

3 Safety information

3.1 Usage

Intended use

3D profile sensors from AT-Automation Technology are intended to be installed as a vision image acquisition component in a machine vision system. Objects that laying in the specified range and pass under the projected laser line, will be measured. The Sensor sends the resulting data to an external processing unit for image processing.

Misuse

Any different or additional use is considered improper. AT-Automation Technology GmbH shall not be held liable for personal injury and damage to property resulting from this.

Improper use

The device does not constitute a safety component in accordance with the respective applicable safety standards for machines. The device must not be used in explosion-hazardous areas, in corrosive environments or under extreme environmental conditions. Any use of accessories not approved by AT-Automation Technology GmbH is at your own risk.

Modifications

Any modification of the device or software, in particular opening the device will void all warranty claims.

Warning: Any modification to the device can lead to unforeseeable danger.

Limitation of liability

AT - Automation Technology GmbH accepts no liability for damage caused by:

- Failing to observe the instructions in this manual
- Improper use
- Use by untrained personnel
- Unauthorized technical modifications or conversions
- Use of unauthorized spare parts or accessories

3.2 Operational safety

Warning: Electrical voltage!

- Electrical voltage can cause severe injury or death.
- Work on electrical systems must only be performed by qualified electricians.
- The power supply must be disconnected when attaching and detaching electrical connections.
- The product must only be connected to a voltage supply as set out in the requirements in these operating instructions.
- National and regional regulations must be complied with.
- Safety requirements relating to work on electrical systems must be complied with.

Warning: Dangerous equipotential bonding currents!

Improper grounding can lead to dangerous equipotential bonding currents, which may lead to dangerous voltages on metallic surfaces, such as the housing. Electrical voltage can cause severe injury or death.

- Work on electrical systems must only be performed by qualified electricians.
- Install the grounding for the product and the system in accordance with national and regional regulations.

3.3 Laser safety

AT - Automation Technology´s compact sensor series have an integrated laser (Laser = Light Amplification by the Stimulated Emission of Radiation) module, which has to incorporate additional safety features, depending on the applicable laser class.

Laser safety classification

The International Electrotechnical Commission (IEC) and the U.S. Center for Devices & Radiological Health (CDRH) enforce strict safety requirements for lasers and laser products.

The relevant standards, IEC 60825–1 (2001-08) and 21 CFR 1040.10/11 (CDRH), classify lasers into several categories. The regulations regarding the different classes applicable to the used laser are given here for the IEC 60825-1 standard.

Laser categories

The classification of a laser product is based on the laser power measured according to the methods defined by the IEC standard. The classification refers to the wavelength range between 400 nm and 700 nm. This corresponds to the maximum light power measured through a 7 mm aperture, measured in distances given in the standard. The limitations for the classification of the laser classes are the following.

Class 2M

Class II/2M lasers are visible low power lasers limited to 1 mW continuous wave or more due to the eye blink reflex for emission duration less than 0.25 seconds. Considered eye-safe with caution but may present a greater hazard if viewed using collecting optics. Focusing of this light into the eye could cause eye damage. Class II/2M laser products must bear warning and certification labels as shown in the figure below. The labels printed here are an example of an IEC classified 2M laser. For detailed specifications, refer to the label on your sensor.

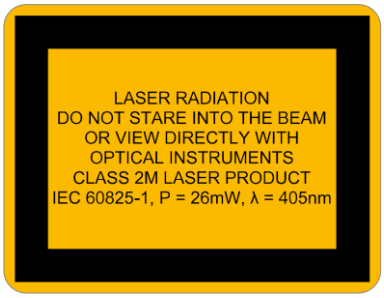


Figure 1: Class II/2M certification label

Figure 2: Laser warning label

Class 3R

Class IIIa/3R lasers emit optical power between 1 to 5 mW. The accessible emission limit is five times higher than for Class 2 visible laser light. Radiation in this class is considered low risk, but potentially hazardous. Fewer manufacturing requirements and control measures for 3R laser users apply than for 3B lasers. Class IIIa/3R laser products must bear warning and certification labels as shown in the figure below. The labels printed here are an example of an IEC classified 3R laser. For detailed specifications, refer to the label on your sensor.

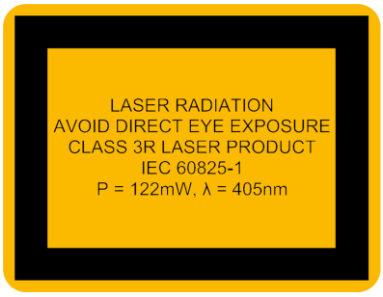


Figure 3: Class IIIa/3R certification label

Figure 4: Laser warning label

Class 3B

Class IIIb/3B lasers are medium power laser sources above 5mW up to 500 mW. Considered dangerous to your retina if exposed. Normally class IIIb/3B lasers will not produce a hazardous diffuse reflection. Viewing into the reflection should not exceed exposure duration more than 10 seconds

Class IIIb/3B laser products must bear warning and certification labels. In addition to these requirements, the certification for class IIIb/3B laser systems is only given if additional safety requirements are fulfilled and a laser safety officer is named. The labels printed here are an example of an IEC classified 3B laser. For detailed specifications, refer to the label on your sensor.

Figure 5: Class IIIb/3B certification label

Figure 6: Laser warning label

Installation considerations

When installing a compact sensor from AT - Automation Technology, the following points must be considered regarding laser safety and the corresponding laser class:

Requirement	Class 2M	Class 3R	Class 3B
System interlock A connector for connecting a remote emergency stop.	Not required	Required	Required
Warning signs Laser warning signs in conformance with the labels shown above, that are present and visible on the complete system.	Not required	Required	Required
Emission indicator Visible and/or audible indicator when the Sensor is powered on.	Not required	Not required	Required
Laser safety officer	Not required	Required	Required
Key control	Not required	Not required	Required – key removal disable laser
Eyewear protection	Not required - except in conditions where intentional long term (>0.25 seconds) direct viewing is required	Not required - except in conditions where intentional long term (>0.25 seconds) direct viewing is required	Required
Emission delay	Not required	Not required	Required
Specular reflection	Not required	Avoid unintended reflections	Avoid unintended reflections
Beam path control	Not required	Not required	Required
Beam attenuator	Not required	Not required	Required
Training	Not required	Required for operator and maintenance personnel	Required for operator and maintenance personnel

4 Installation

4.1 Transport and storage

Notice: Read and observe the following notes to avoid damage to the sensor and the components supplied

Check the delivery for completeness and for any transport damage immediately upon receipt in the goods receiving department. In the event of externally visible transport damage, do not accept the delivery or accept it only with reservations. Note the extent of the damage and complain about the delivery.

Unpacking

- Handle the sensor and the supplied components with care and protect them from mechanical damage.

Transport

To avoid damage to the product due to improper transport, we advise you:

- The sensor must be packed shockproof and moisture-proof for transport.
- Use the original packaging as it offers the best protection.
- The transport must be carried out by trained personnel.

Storage

To preserve the best possible condition of the sensor, we advise the following.

- Use the original packaging.
- Store in a dry, dust-protected place.
- Avoid mechanical shocks.
- Do not remove the protective film on the sensor glass.

4.2 Mechanical installation

Mounting

- Use the provided accessories to mount the sensor.
- For sensors with carbon spacer, it is recommended to use the provided mount. The best position of the mount is the center of gravity. It can be calculated by the formular described in chapter **Mechanical specification** corresponding to the model type.
- For models without or with a metal spacer, it is recommended to use the mounting holes on the sensor module.
- If the sensor is mounted on a static grid without shock and with little vibration, the mounting holes on the laser module can be used.

Please note, that it is absolutely recommended to use only one mounting position. The use of multiple positions may affect the accuracy of the device.

Heat dissipation

- Mount the MCS sensor to a heat conductive material with an absolute thermal resistance of at least 6 K / W.

- It is recommended to monitor the temperature of the sensor (on-board, available over GenICam).
- Keep in mind that dark current and noise performance for CMOS sensor will degrade at higher temperature.

Notice: Insufficient heat dissipation affects the lifetime of the MCS device. Especially the lifetime of the laser module.

4.3 Electrical installation

IO-Panel

The CS-IO-Panel (#202 201 402) provides a user-friendly way to connect the power, I/O, and laser supply of the compact sensor. The camera power supply includes a reverse voltage protection and features a 2A (two ampere) micro-fuse.

Fuse Specification	
Current	2A
Dimension	5 x 20mm
Characteristic	T
Operating Temperature	-50°C to +125°C

Clamp configuration

Notice: Don´t connect C5 cameras to the CS-IO-Panel. Wrong wiring can cause damage to the camera.

Warning: Due to laser safety regulations, the power supply for the laser must be provided by a separate power source if the laser protection class is greater than 2M. On the other hand, lasers with a laser class up to 2M can be powered by bridging the I/O panel connectors as shown in the drawing below.

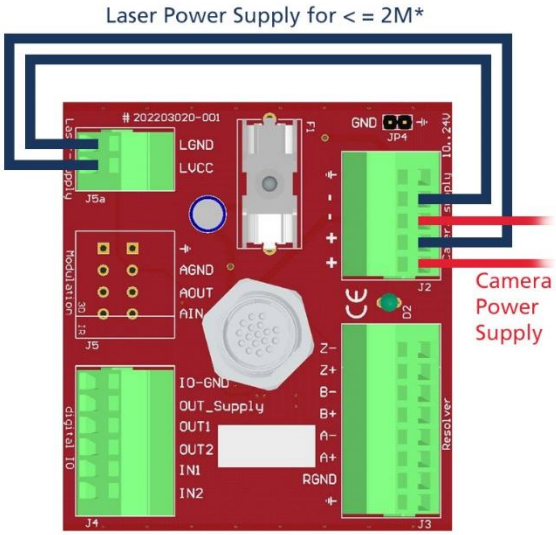


Figure 7: Wiring for 3D sensors with ≤ 2M lasers

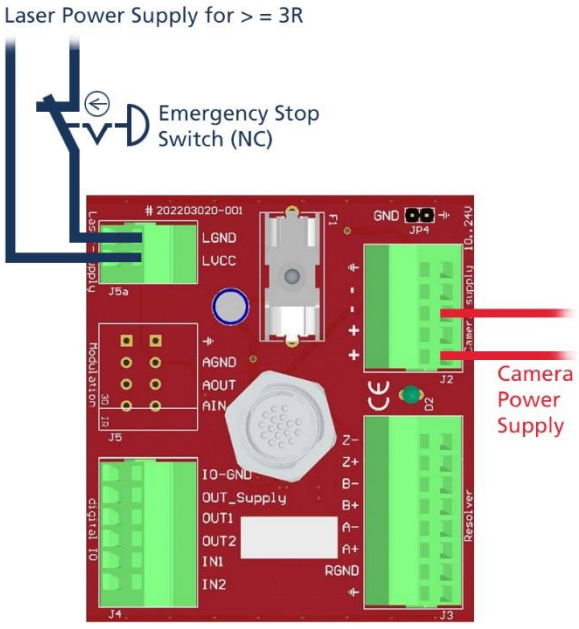
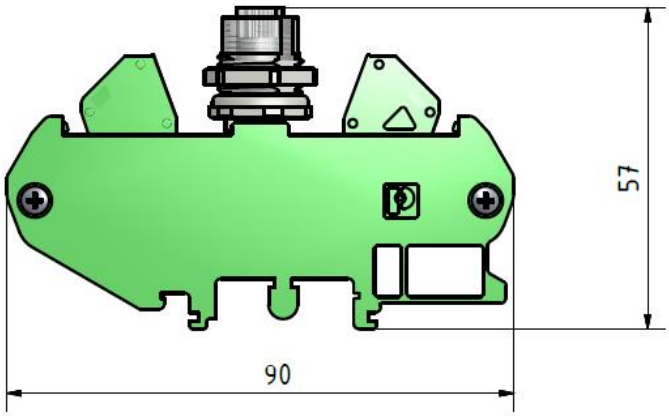


Figure 8: Wiring for 3D sensors with ≥ 3R lasers

In the following table, the clamp configuration of the IO-Panel is described. GND_EXT and LGND are connected via a coil. IO-GND and RGND are galvanic isolated. The SHIELD contacts are connected to each other.

Clamp No.	Signal Name	Description
J2/1	SHIELD	Sensor shield
J2/2	GND_EXT (-)	Sensor supply ground
J2/3	GND_EXT (-)	Sensor supply ground
J2/4	VCC_EXT (+)	Sensor supply voltage (+10 to +24V DC)
J2/5	VCC_EXT (+)	Sensor supply voltage (+10 to +24V DC)
J3/1	Z-	Differential encoder/resolver index track Z-
J3/2	Z+	Differential encoder/resolver index track Z+
J3/3	B-	Differential encoder/resolver track B-
J3/4	B+	Differential encoder/resolver track B+
J3/5	A-	Differential encoder/resolver track A-
J3/6	A+	Differential encoder/resolver track A+
J3/7	RGND	Encoder/Resolver ground
J3/8	SHIELD	Encoder/Resolver shield
J4/1	IO-GND	Reference ground for digital inputs (IN1, 2) and outputs (OUT1, 2)
J4/2	OUT_Supply	Power supply voltage of sensor isolated outputs (+5 to +24V DC)
J4/3	OUT1	Isolated output #1 (reference voltage OUT_Supply)
J4/4	OUT2	Isolated output #2 (reference voltage OUT_Supply)
J4/5	IN1	Isolated input #1 (+5 to +24V)
J4/6	IN2	Isolated input #2 (+5 to +24V)
J5a/1	LGND	Laser supply ground
J5a/2	LVCC	Laser supply voltage (+10 to +24V)

Mechanical dimension



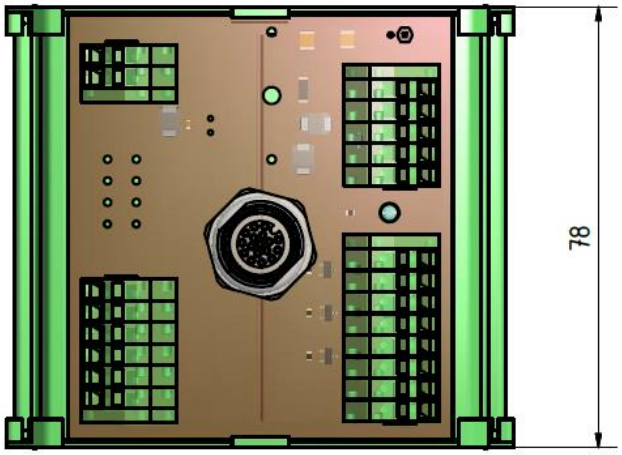


Figure 9: Mechanical drawing of CS-IO-Panel

All dimensions in mm

Mount for DIN rail assembly

Encoder

The profile acquisition can be synchronized to the motion of the scanned object by using an external encoder signal (RS422 profile trigger). The sensor features an integrated three-channel RS422 interface. Connect the encoder signal to the terminal A+, A-, B+, B-, Z+ and Z- of the I/O-Panel

AT – Automation Technology supports the following input receiver modes:

- Differential TTL (5V) -> **Standard Mode**
- Differential HTL (24V)
- Single-Ended HTL (24V)
- Single-Ended TTL (5V)

Notice: A change of the input receiver mode requires a mechanical/electrical adjustment. Please consult your contact person if this is required.

Notice: The standard encoder option is specified for TTL level. Higher voltage than 5V DC can cause damage to the device.

For technical data and a circuit diagram for the respective modes, please refer to the section **Technical specification.**

Dual/Multi MCS connection

The following schematic shows the required wiring to operate two compact sensors or one dual head sensor in a Master/Slave mode. For this purpose, the OUT2 of the master sensor is exemplary connected to the trigger input IN1 of the slave sensor. The Master/Slave mode can be realized with both inputs (IN1/IN2) and outputs (OUT1/OUT2).

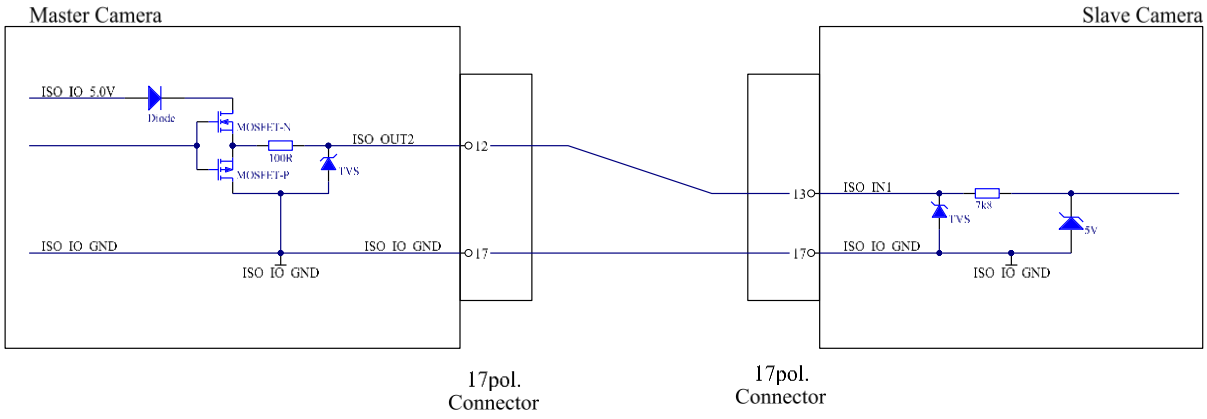


Figure 10: Wiring for multi MCS connection

4.4 Environmental conditions

Warning: Do not use the sensor in adverse environmental conditions, such as in rooms with a high concentration of flammable gases, vapors, or dust.

Temperature range

Environment temperature during operation

0°C to +40°C (+32°F to +104°F)

Storage temperature:

-20°C to +80°C (-4°F to +176°F)

Notice: The temperature affects the lifetime of the MCS device including its laser. We recommend ensuring a proper heat dissipation.

Humidity

Humidity during operation:

20 % to 80 %, relative, non-condensing

Storage humidity:

20 % to 80 %, relative, non-condensing

Vibration and shock

Vibration resistance (sinusoidal):

DIN EN 60068-2-6: 2008-10: 2g, 10-150 Hz, each axis 1 hour

Vibration resistance (random):

DIN EN 60068-2-64: 2020-09: 7g, 10-500 Hz, each axis 1 hour

Shock resistance:

DIN EN 60068-2-27: 2010-02: 3 per axis, 15g, 3ms

Notice: Vibrations during operation can negatively affect the accuracy of the device.

5 Commissioning

5.1 Network card

General recommendations

To ensure the maximum performance, the camera should always be connected to a network card that supports Gigabit Ethernet. Make sure your network card has been installed to the specifications of your network card manufacturer.

Tip: Due to the large amount of data the device delivers, it is not recommended to use a network switch between the device and network card but rather a direct connection. Using a network switch can reduce the performance or can lead to communication problems.

IP address settings

In the delivery state, the DHCP of the device is activated and the camera obtains the IP automatically. In general, the usage of static IP addresses is recommended. For this the network adapter and the device must be set to the same IP address range.

In Windows 10 the network adapter settings can be accessed by following these steps:

- Press the Windows key on your keyboard
- Search for "Control Panel"
- In the newly opened window search for "Network Status and Tasks"
- Search on the left for "Change Adapter Settings"
- After right-clicking on the relevant ethernet port, select "Properties"
- In the newly opened window search for Internet Protocol version 4 (TCP / IPv4) and open it with a double-click (see Figure 11)
- Activate the checkbox "Use the following IP address:" in the displayed window
- Enter the IP-Address, Subnet Mask in the same address range of your camera
- confirm the setting with OK.

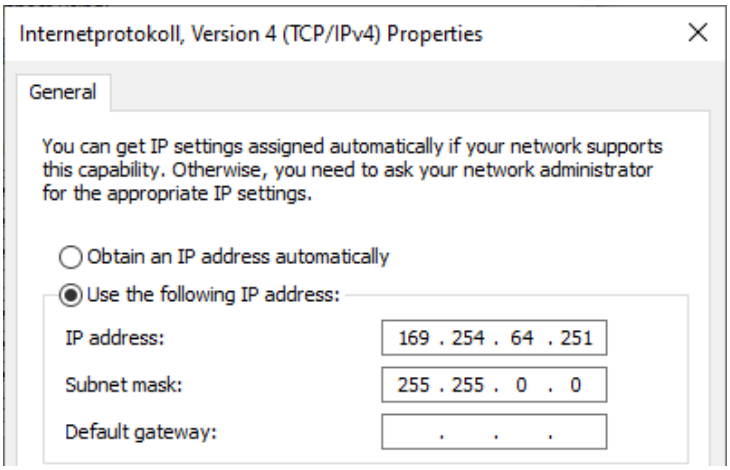


Figure 11: Settings of the network adapter (TCP/IPv4)

To assign a static IP address to the device, cxDiscover must be used. Please see section **cxDiscover** for more details.

Network adapter settings

To ensure maximum bandwidth and performance the following adapter settings must be set. The network adapter settings can be accessed by following these steps:

- In the network adapter properties, select "configure"
- Select the tab "Advanced" (see Figure 12)

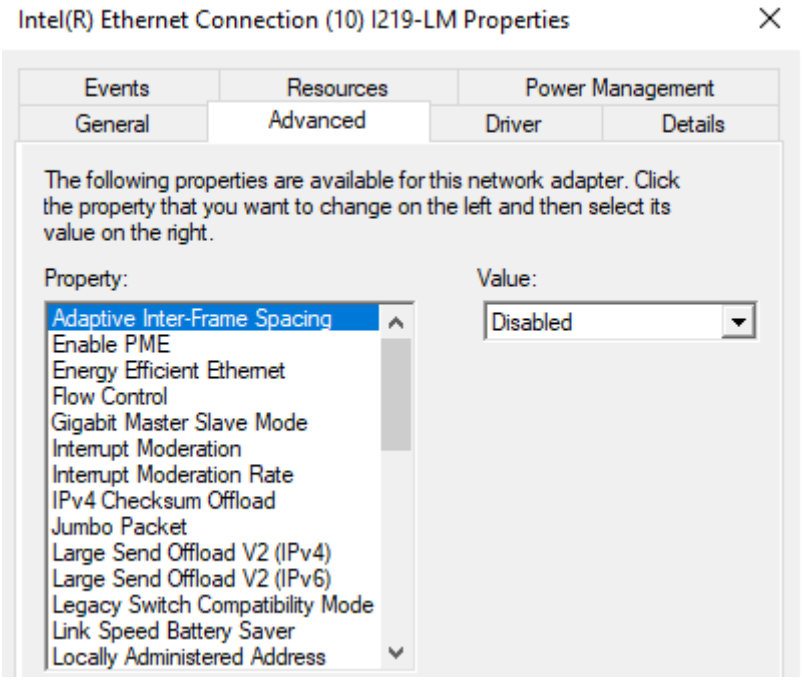


Figure 12: Ethernet adapter setting

Set the following parameters to the respective value:

- Jumbo Frames/Packets 9014 Bytes
- Receive Descriptors/Buffers 2048
- Transmit Descriptors/Buffers 2048
- Flow Control Disabled
- Interrupt Moderation Rate Extreme

The exact name of the parameters may vary between different network cards.

Tip: If the used network card does not provide these settings or the specified values cannot be set, we recommend using a different network card.

6 MCS cx4090HS Overview

6.1 Introduction

The cx4090HS is part of the MCS series, a revolutionary product family of intelligent high speed laser triangulation sensors. It is optimised for 3D profile measurement by means of laser triangulation. The device contains a laser module which projects a laser line. The 3D profile extraction is performed in the device by using high performance FPGA (Field Programmable Gate Array). The device sends the raw 3D profile data to the PC over a gigabit ethernet interface (GigE). This extreme data reduction increases the measurement speed to an unprecedented level without affecting the performance of the connected image processing unit. The device comes with a calibration file that can be used to calibrate the raw 3D data on the PC and to process it into point clouds.

MCS modules

All devices in the MCS series are configured to the needs of a specific application. It consists of standard modules that can be freely spaced. The Sensor Module contains the image sensor, electronics and optics of the device. The Laser Module contains the line laser. Depending on the configuration, it can be connected directly to the Sensor Module or mounted separately from the Sensor Module by a Link Module. The Link Module can either be a metal spacer (15 mm - 65 mm) or a carbon spacer (> 65 mm). The MCS Mount is only available for devices that come with carbon spacers.

A exampe configuration is shown below. The exact configuration may differ from the device shown here. A detailed list of all configurations and their dimensions can be found in chapter **Mechanical specification**.

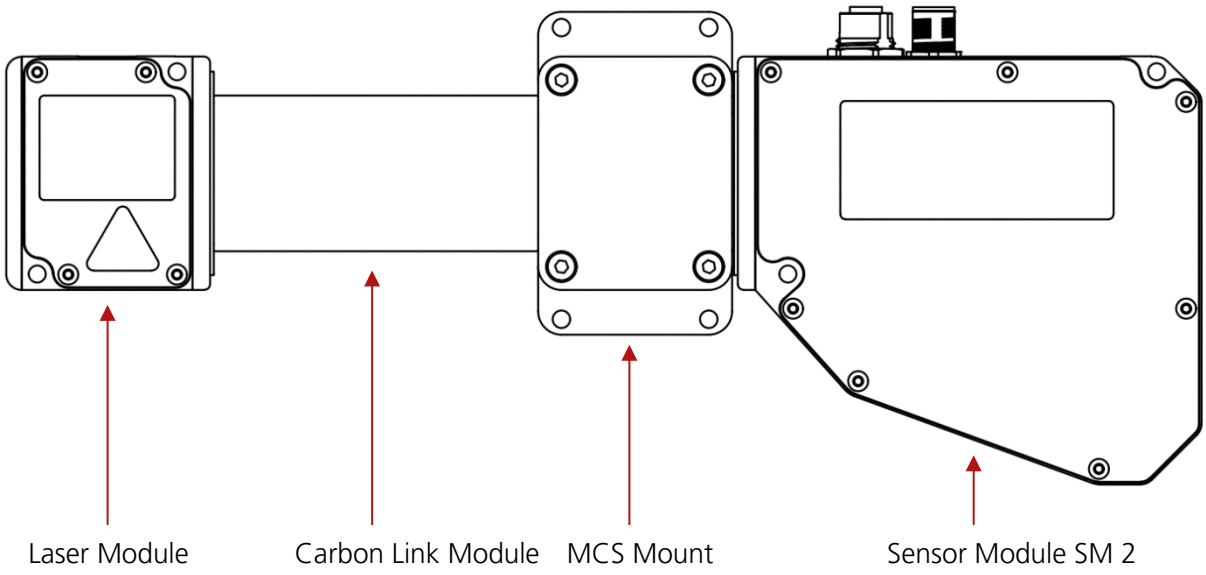


Figure 13: MCS modules

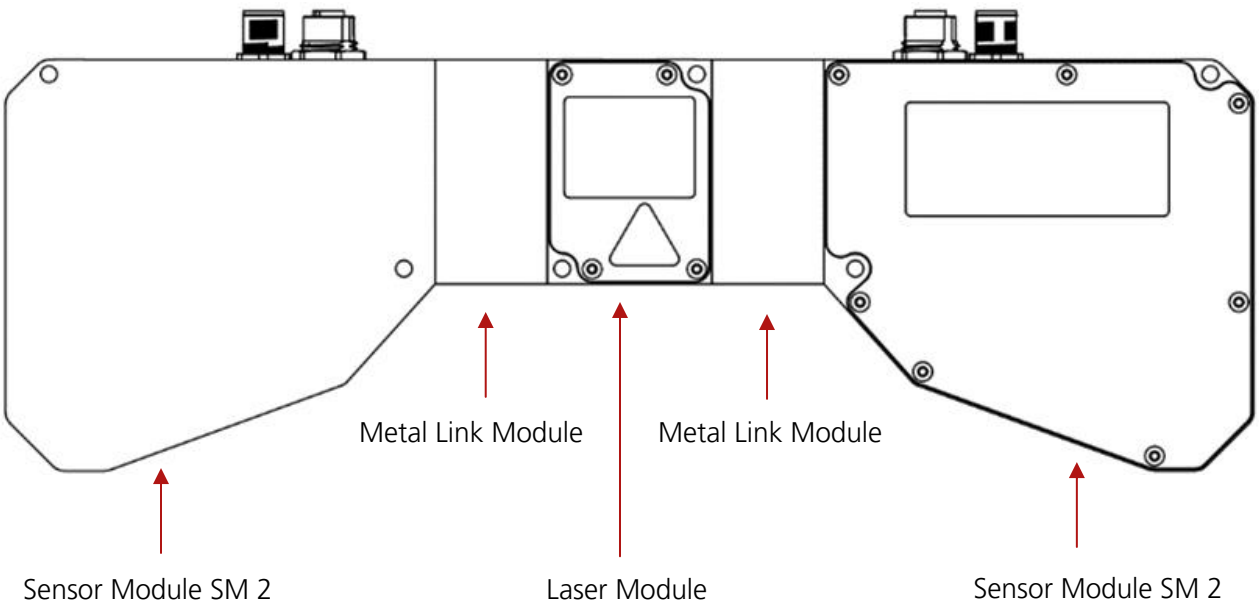


Figure 14: MCS modules in dual configuration

6.2 Measuring principle

Laser triangulation

The device acquires height profiles and height images based on the laser triangulation principle. According to this method a laser line is projected on the target object from one direction. The image sensor views the object from a different but known angle. The resulting sensor image is evaluated by the embedded processor and converted into a single height profile. By moving the target under the laser line with a certain speed, a complete height image can be acquired. The three points, laser, sensor and target and the angles and distances between them define the triangulation geometry.

Geometric dependencies

There are three major geometries on that the whole device is build and calibrated:

Field of view

The Field of view (FOV) is dependent on the built-in optics of the device and the laser fan angle of the laser. The Near FOV is defined at the upper limit of the Z-range and is narrower than the FOV. The Far FOV is defined at the lower limit of the Z-range and is wider than the FOV.

Tip: The laser line is usually wider than the FOV. This is necessary due to inaccuracies at the edges of the laser line.

Working distance

The working distance (WD) describes the nominal distance between the bottom edge of the laser module and the target surface that needs to be measured. The accuracy of the measurement will always be the best when it's performed at the working distance. However, there is a Z-range defined

in which the target surface or multiple surfaces can appear. The total Z-range is the sum of the distances from the Near FOV to the WD and the WD to the Far FOV.

Triangulation angle

The triangulation angle describes the angle between the vertically aligned laser and the tilted sensor plane.

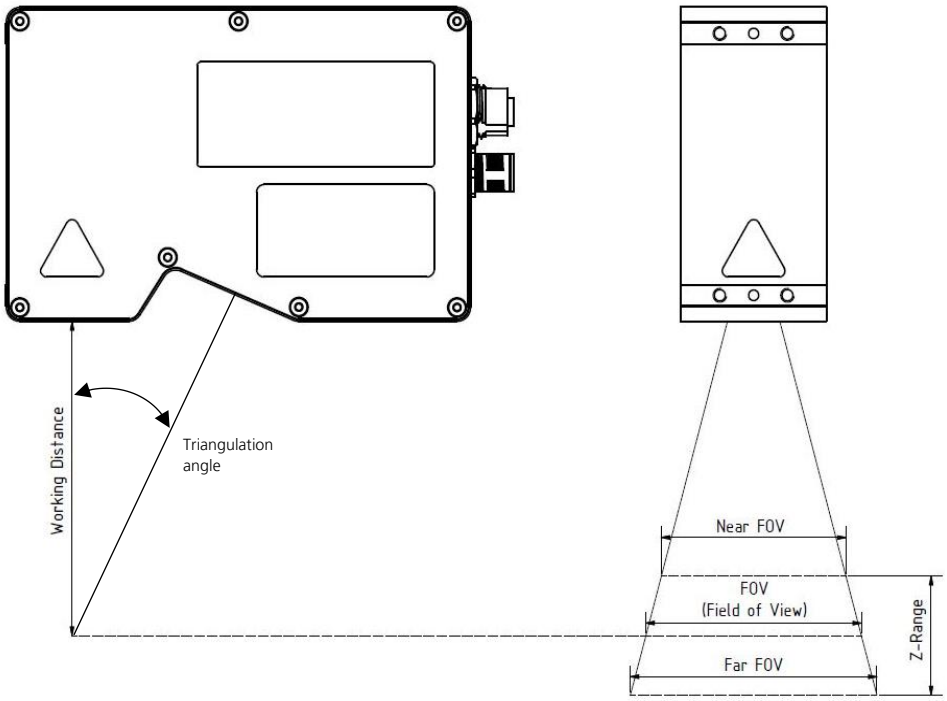


Figure 15: Geometric dependencies

Coordinate systems

The coordinate system of the device is described as followed: The X-axis describes the width of the measured area along the laser line, the Y-axis describes the transport direction and the Z-axis describes the height values along the laser plane.

The figure below demonstrates the typical triangulation geometry.

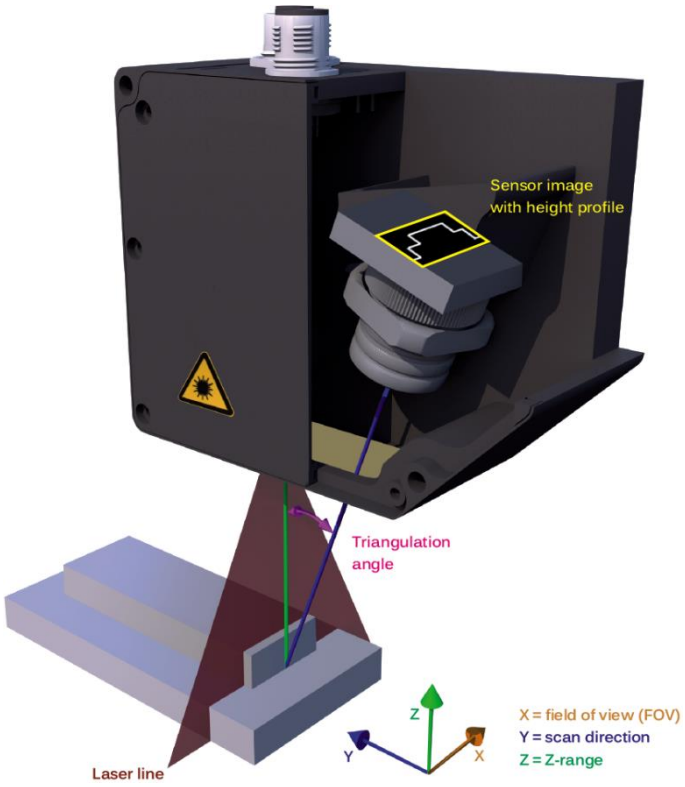


Figure 16: Coordinate system of the sensor

Resolution

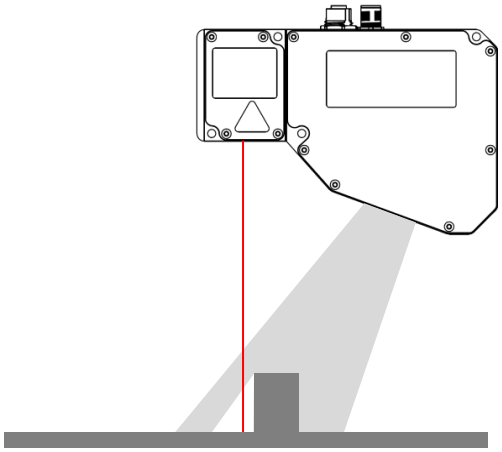
The resolution of the sensor is different in each axis:

- ΔX: Resolution along the laser line and across the target (lateral). It is the FOV width divided by the number of pixels of the imager
- ΔY: Resolution perpendicular to the laser line (longitudinal in the direction of motion). It is directly dependent on the measurement frequency and the transportation speed.
- ΔZ= Height resolution. The laser line is projected perpendicular to the object surface, while the camera views the object under the triangulation angle α. The height resolution can be approximated by:

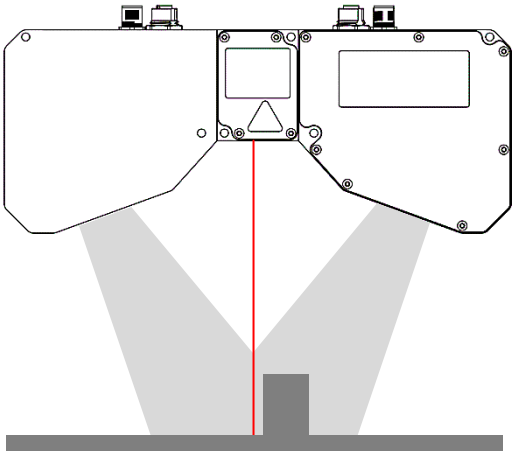
$$\Delta Z \approx \frac{\Delta X}{\sin(\alpha)}$$

Occlusion

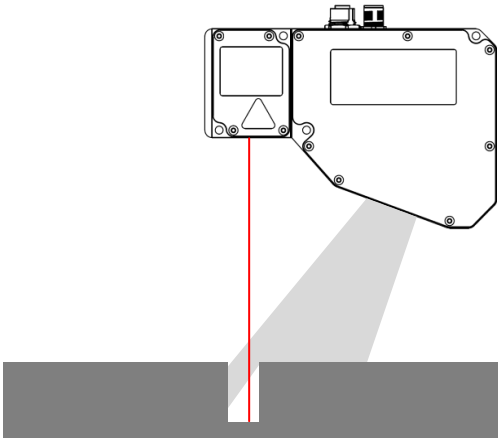
Occlusion is a major limitation of the laser triangulation method. If the laser line is not visible by the sensor, no height data can be acquired. It is necessary to analyze the target object and to plan the scan path to avoid occlusions. Using a dual-head or multi sensor configuration can be a solution. Possible examples of situations where occlusion occur are provided below.



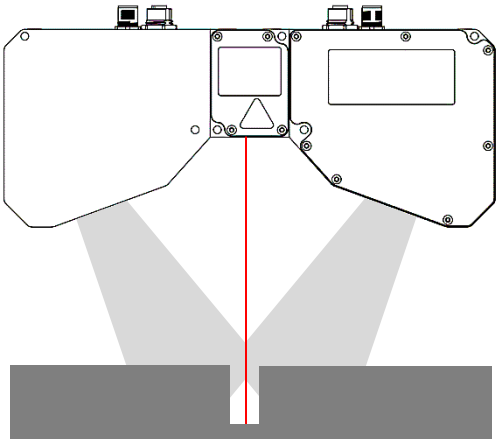
Laser line not visible



Laser line visible from one imager



Laser line not visible



Laser line not visible from both imagers

Device modes and peak detection algorithms

This chapter describes the general functionality of the implemented device modes and peak detection algorithms. This device can be operated in a 2D Areascan mode and a 3D Linescan3D mode:

Areascan

The Areascan mode is the 2D image mode in which the device is operated similar to a standard 2D camera. In this mode grey scale data of 8- to 10-bit resolution is acquired over the device interface. Furthermore, the sensor can be divided into multiple regions.

Linescan3D

The Linescan3D mode is the 3D mode, which delivers height data. Just like in the Areascan mode the sensor can be divided into multiple regions. For each region it is possible to enable a Scan3dExtraction. The Linescan3D mode can be set to different peak detection algorithms. In this mode the image sensor takes one image from which the selected algorithm extracts the laser line position column wise. All laser line positions from one image are called a profile. It represents a cross section of the target object. The device repeats this process for a defined number of profiles which are then combined into one

range image. This range image does not represent an image of the target object in a classical sense but rather a set of height profiles.

The different peak detection algorithms are:

Maximum Intensity Profile Mode (MAX)

In this mode the position of the maximum intensity of laser beam profile is calculated. The result includes the position value of the maximum (P_{MAX}) as well as the maximum intensity value (I_{MAX}).

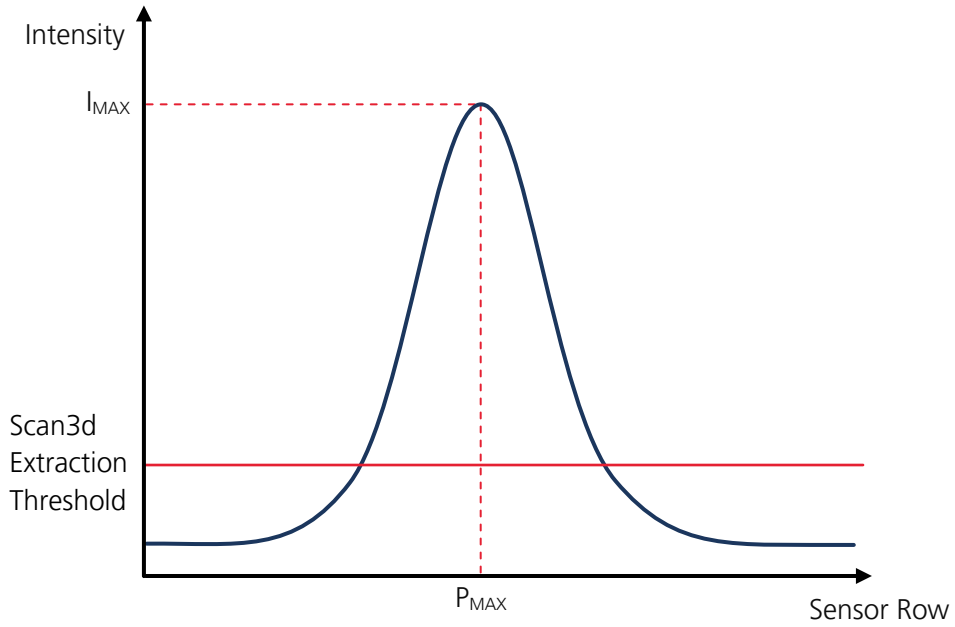


Figure 17: Extraction of the Laser Line in MAX Mode

The calculation of position value is performed with simple pixel accuracy, i.e. the evaluation of 3072 rows delivers a position range from 0 to 3071 pixels (12 bit). If there is more than one local maximum (e.g. when the intensity is saturated), the position of the first detected maximum is output. To avoid intensity saturation, it is recommended to activate the Multiple Slope Mode of the device. See chapter **Advanced features** on how to set up the Multi Slope Mode.

Threshold Mode (TRSH)

In this mode the positions of left (P_L) and right (P_R) edge of the laser beam profile are detected for a given threshold value of intensity Scan3d Extraction Threshold.

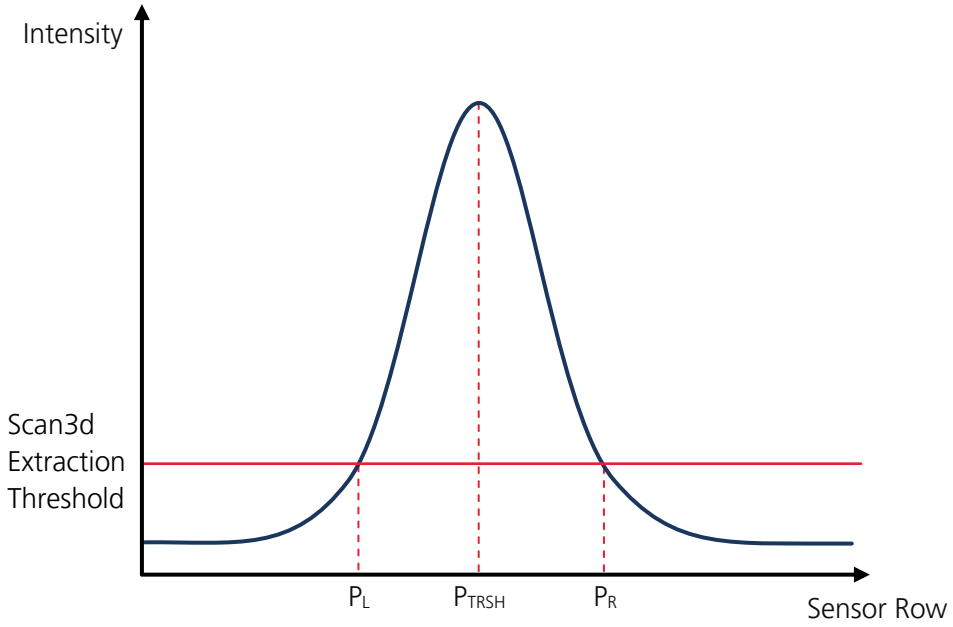


Figure 18: Extraction of the laser line in TRSH mode

The position value of the laser line is approximated: $P_{TRSH} = (P_L+P_R) / 2$. To simplify the digital representation, the division over 2 is not performed and thus an integer representation with one subpixel is implemented. The evaluation of 3072 rows delivers a position range from 0 to 3071 pixels (12 bit). In threshold mode the camera can output either the left and right threshold position separately or the subpixel position (P_L+P_R) and the line width (P_R-P_L). Moreover, the maximum intensity value can be optionally output.

Center Of Gravity Mode (COG)

In this mode the center of gravity of the laser beam profile is calculated. For this purpose, the following parameters are computed:

The position value of the left edge of laser beam profile for a given intensity threshold value P_L

The sum of intensity value $I_s = \sum I_p$,

The sum of first order moment $M_s = \sum I_p * P$.

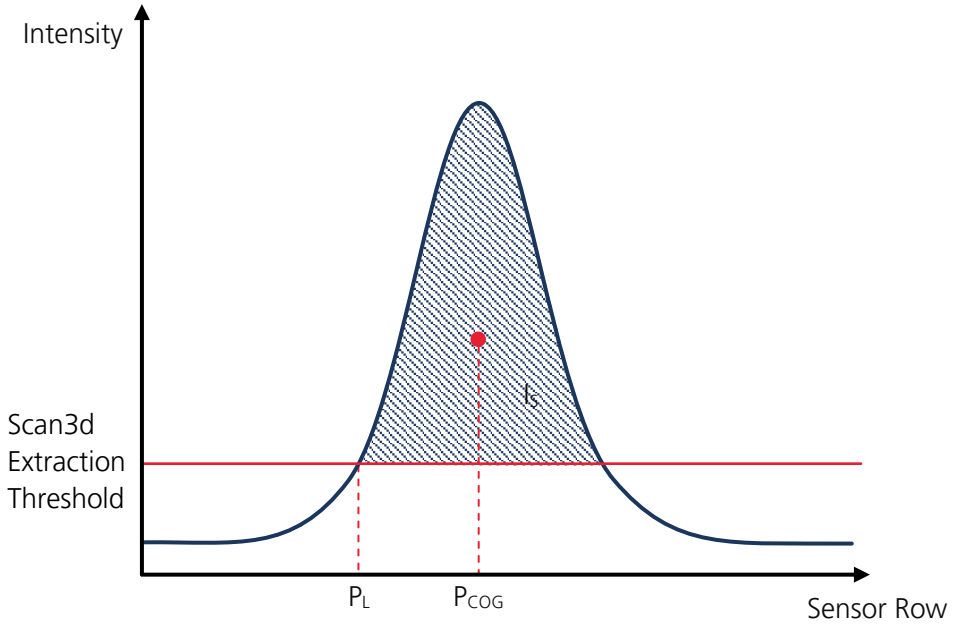


Figure 19: Extraction of the laser line in COG mode

The position value of laser line (center of gravity of beam profile) is then obtained from:

$$P_{COG} = P_L + \frac{M_s}{I_s}$$

The average intensity of the illumination profile can be calculated by normalizing the sum of intensity value I_s with the line width. With the COG algorithm high subpixel precision can be achieved.

FIR Peak Mode (FIRPeak)

In this mode the first derivative of the intensity gauss curve of laser beam profile is calculated.

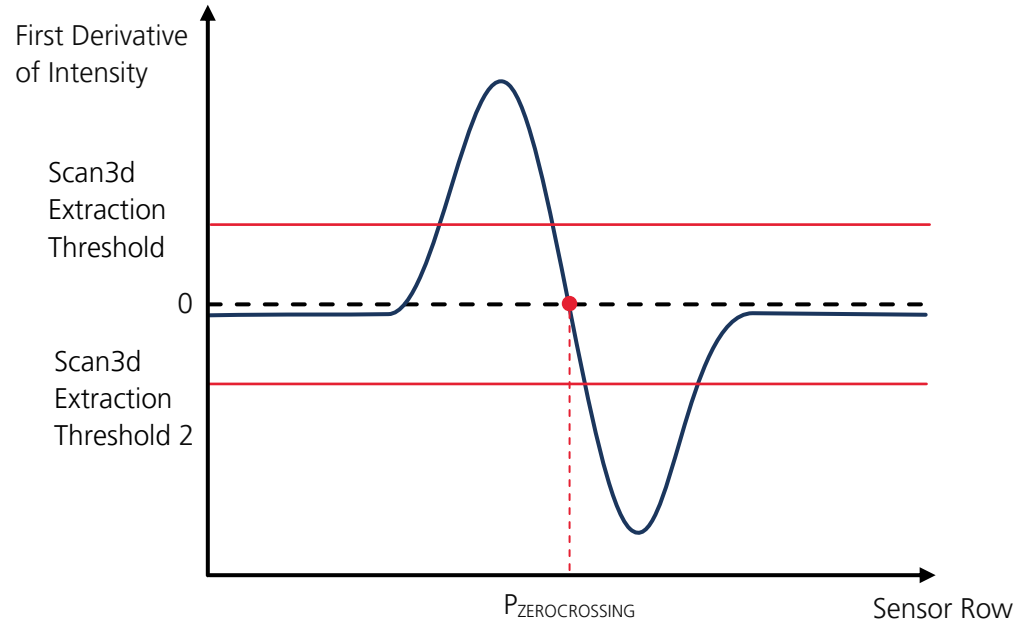


Figure 20: Extraction of the laser line in FIRPeak mode

The position of zero-crossing of first derivative is detected and output with subpixel accuracy. In this mode the Scan3d Extraction Threshold is used to detect the first rising edge of the derived intensity signal. Valid values range from 0 to 511. Scan3d Extraction Threshold 2 is used to detect the falling edge of the derived intensity signal after the zero-crossing. Valid values of Scan3d Exctraction Threshold 2 range from -511 to 0. To detect a valid peak, both thresholds need to be passed.

Tip: It is recommended to set Scan3d Extraction Threshold 2 to the negative value of Scan3d Extraction Threshold.

Scan3d Filter Mode

The Scan3d Filter Mode is a signal processing function aiming to increase the precision of laser line detection in the sensor image. It consists of a digital finite impulse response filter (FIR) and can be operated in a smoothing or differentiating mode depending on the chosen peak detection algorithm.

Tip: With enabling the Scan3d Filter Mode in MAX, TRSH and COG the accuracy of the peak detection can be improved.

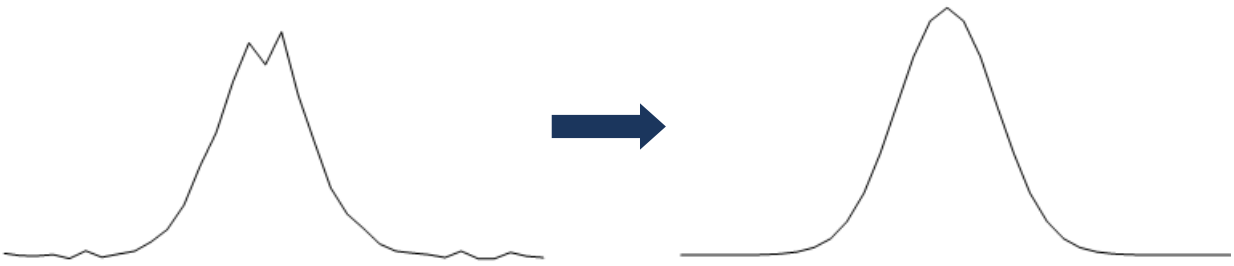


Figure 21: Smoothing mode (in combination with MAX, TRSH and COG algorithms)

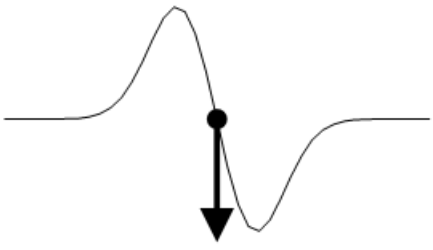


Figure 22: Derivative mode (only in combination with the FIRPeak algorithm)

6.3 Standards

All AT – Automation Technology devices comply with GenICam™ and GigE Vision® standards.

GenICam™

The GenICam™ standard provides a generic programming interface for different kinds of cameras and devices. The standard is owned by EMVA (European Machine Vision Association) and consists of multiple modules.

For further information, see https://www.emva.org/standards-technology/genicam/

GigE Vision®

GigE Vision® is a camera interface standard that is based on the Gigabit Ethernet communication protocol and allows for fast data transfer using ethernet cables. The GigE Vision® standard is owned by Association for Advancing Automation (A3).

For further information, see https://www.automate.org/vision

6.4 Technical specification

Technical data

Sensor controls	
Synchronization Modes	Free Running, Triggered, Software Triggered
Exposure Modes	Programmable, Pulse Controlled
Digital Input	2 electrical isolated inputs, +5V to +24V DC VIL, logic "0" Voltage < 1.5V VIH, logic "1" Voltage > 3.5V Max. frequency: 450kHz Min. pulse width: >2µs
Digital Output	2 electrical isolated outputs, +5V to +24V DC VOL, logic "0" Voltage < 0.5V VOH, logic "1" Voltage ≥ 3.8V IOL, logic "0" drive current max. 100mA IOH, logic "1" drive current max. 100mA
Encoder/Resolver Input[1]	A+, A-, B+, B-, Z+, Z- High-Speed Triple RS-422 Receiver Max. input voltage +5V DC (TTL level)

[1] Valid for differential TTL (standard). For HTL and single ended options see section Encoder Options.

	Max. current consumption per channel: 21mA RS-422-Mode, max. frequency: 15MHz Min. pulse width: >32ns	
Laser Supply	Reverse voltage protection Supply voltage +10V to +24V DC Laser modulation	
Electrical Interface		
Power Supply	+10V to +24V DC (max. +27V DC)	
Power Consumption	10W to 12W (depending on sensor model)	
Operating Temperature	0°C to +40°C (non-condensing)	
Output Data Interface	Gigabit Ethernet (IEEE 802.3)	
Communication Protocol	GigE Vision with GenICam	
Mechanical Interface		
Power Connector	17 pin, M12 connector	
Ethernet Connector	8 pin, A-coded M12 connector	
Mechanical Stress Specification		
Vibration (sinusoidal each axis)	2g, 20 to 500Hz	IEC 60068-2-6
Vibration (random each axis)	5g, 5 to 1000Hz	IEC 60068-2-64
Shock (each axis)	15g	IEC 60068-2-27
Enclosure rating	IP67	IEC 60529

Sensor specification

Parameters	**Sensor Specifications**
Sensor Type	CMOS
Shutter Type	Global Shutter
Resolution (Row x Column) in Pixel	4096 x 3072
Sensor ADC Resolution	10 Bit
Sensor Dynamic Range	90dB with HDR
Scan3D Extraction Methods	MAX, TRSH, COG, FIR PEAK

Parameters		**Sensor Specifications**
High Dynamic Range Imaging		Multi Slope
3D Features		Multi Peak, Multi Part
Max. Profile Rate at Max. Row Width[2]		20352 Hz
Effective Profile Rate (Hz) at Max. Row Width	Number of Rows	Effective Frame / Profile Rate (Hz)
	8	20352
	16	14925
	32	9733
	64	5740
	128	3153
	256	1658
	512	851
	1024	431
	3072	145

[2] With reduced Region height (Height[Region0] = 8)

Spectral response

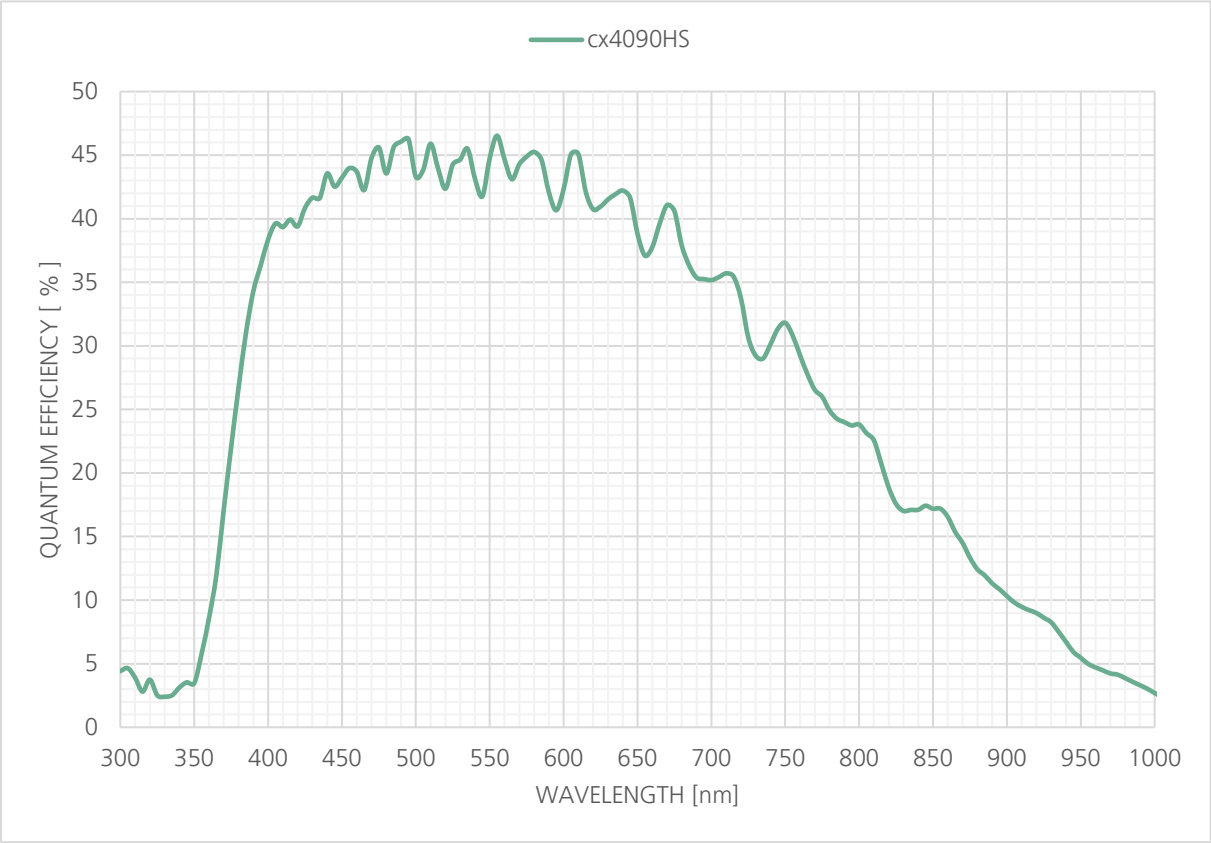


Figure 23: spectral response of the cx4090HS

Ethernet connector

M12 GigE female connector pin assignment

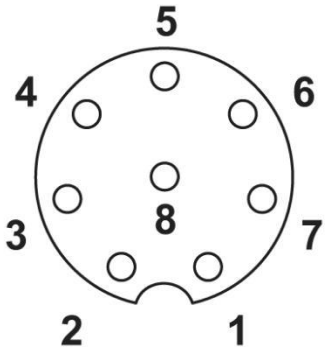


Figure 24: Pin numbering of the GigE female connector

Pin No.	GigE Signal Name
1	BI_DC-
2	BI_DD+
3	BI_DD-
4	BI_DA-
5	BI_DB+
6	BI_DA+
7	BI_DC+
8	BI_DB-
Shield	Shield

Power and IO connector

M12 I/O male connector pin assignment

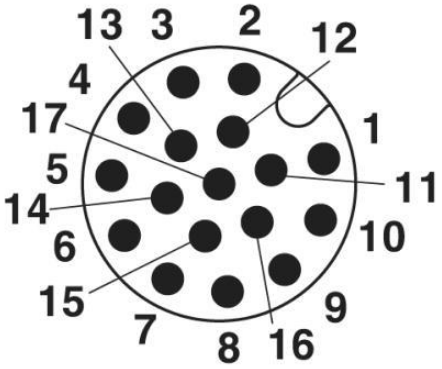


Figure 25: Pin numbering of the I/O male Connector

Pin No.	Signal Name	Description
1	ENC_Z-	Encoder/Resolver index track Z-
2	LASER_Supply	Laser supply voltage (+10 to +24V DC)
3	ENC_Z+	Encoder/Resolver index track Z+
4	ENC_B+	Encoder/Resolver Track B+
5	GND_EXT	Laser/Sensor supply GND Pin1
6	ENC_B-	Encoder/Resolver Track B -
7	ENC_A-	Encoder/Resolver Track A -
8	VCC_EXT	Sensor supply voltage (+10 to +24V DC)
9	GND_EXT2	Laser/Sensor supply GND Pin2
10	ENC_A+	Encoder/Resolver Track A+

Pin No.	Signal Name	Description
11	ENC_GND	Encoder/Resolver ground
12	OUT2	Electrically isolated digital output 2
13	IN1	Electrically isolated digital input 1 (+5 to +24V DC)
14	IN2	Electrically isolated digital input 2 (+5 to +24V DC)
15	OUT_Supply	Reference supply for digital isolated outputs (+5 to +24V DC)
16	OUT1	Electrically isolated digital output 1
17	IO_GND	Reference ground for digital inputs (IN1, 2) and outputs (OUT1, 2)
Shield	SHIELD	Is connected to sensor case

IO-Schematics

I/O and Encoder with Differential TTL-Mode for RS422 (Standard)

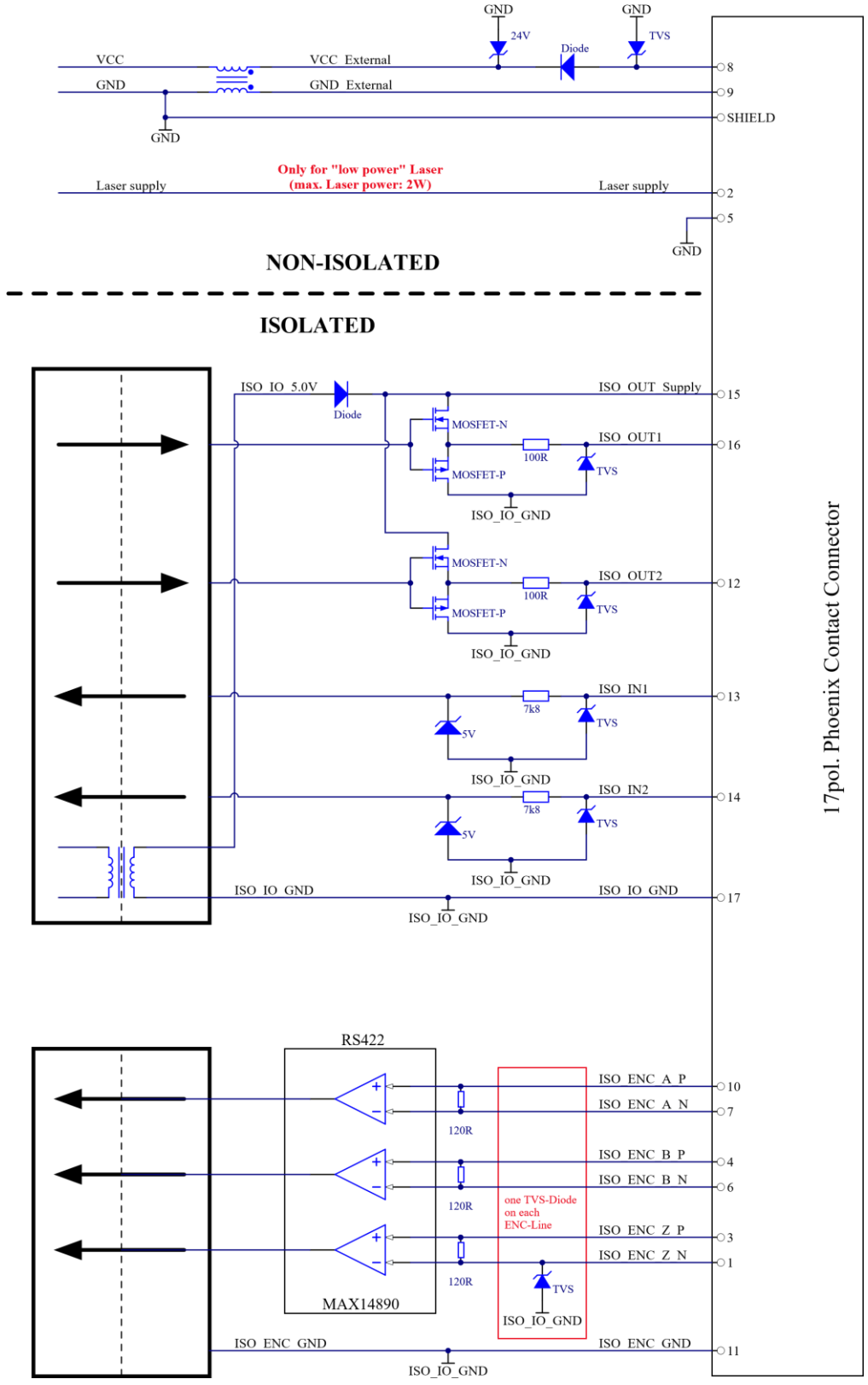


Figure 26: camera internal wiring diagram of the encoder with differential TTL-Mode

I/O and Encoder with Differential HTL-Mode for RS422 (Option)

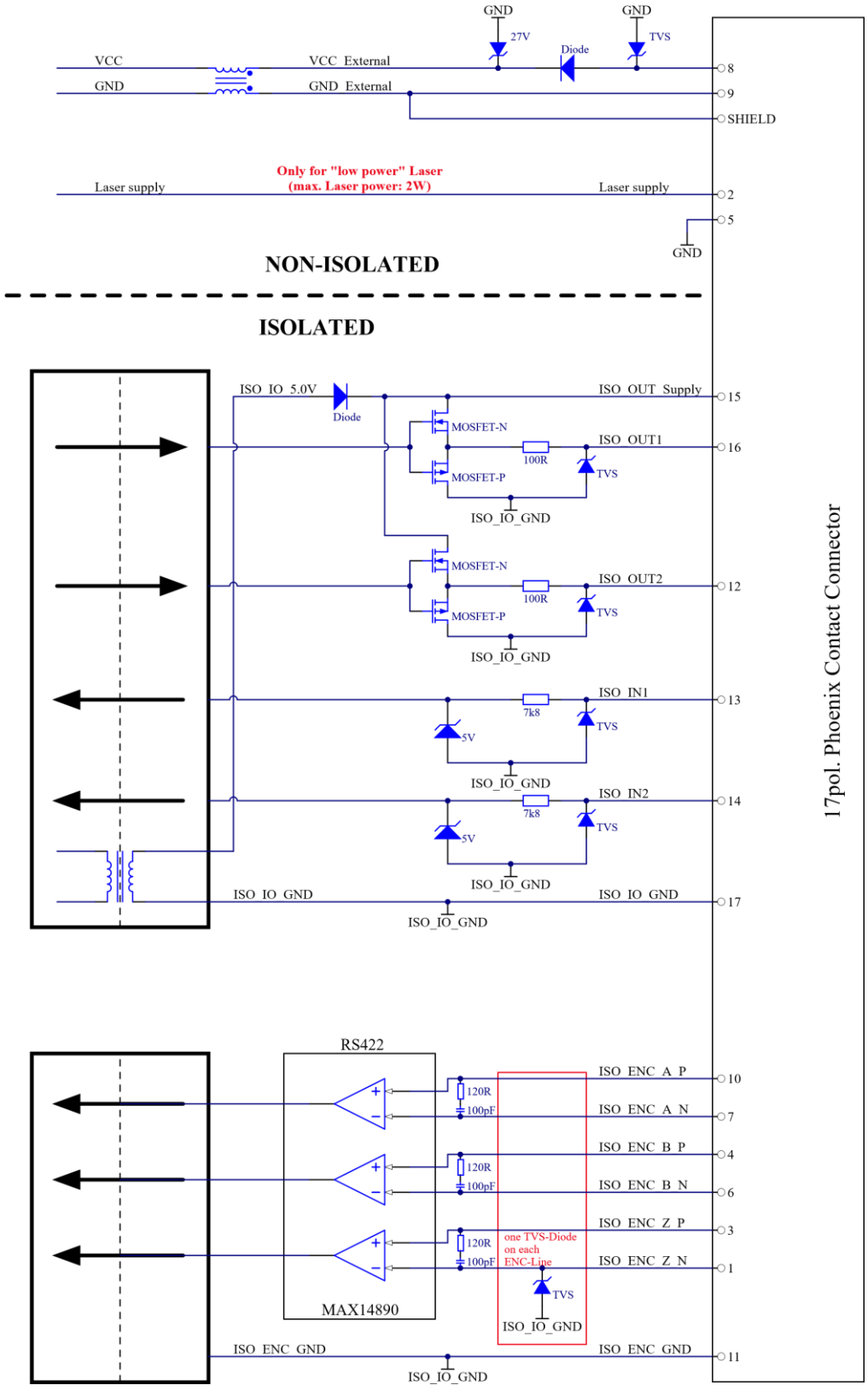


Figure 27: camera internal wiring diagram of the encoder with differential HTL-Mode

I/O and Encoder with Single Ended HTL or TTL Mode for RS422 (Option)

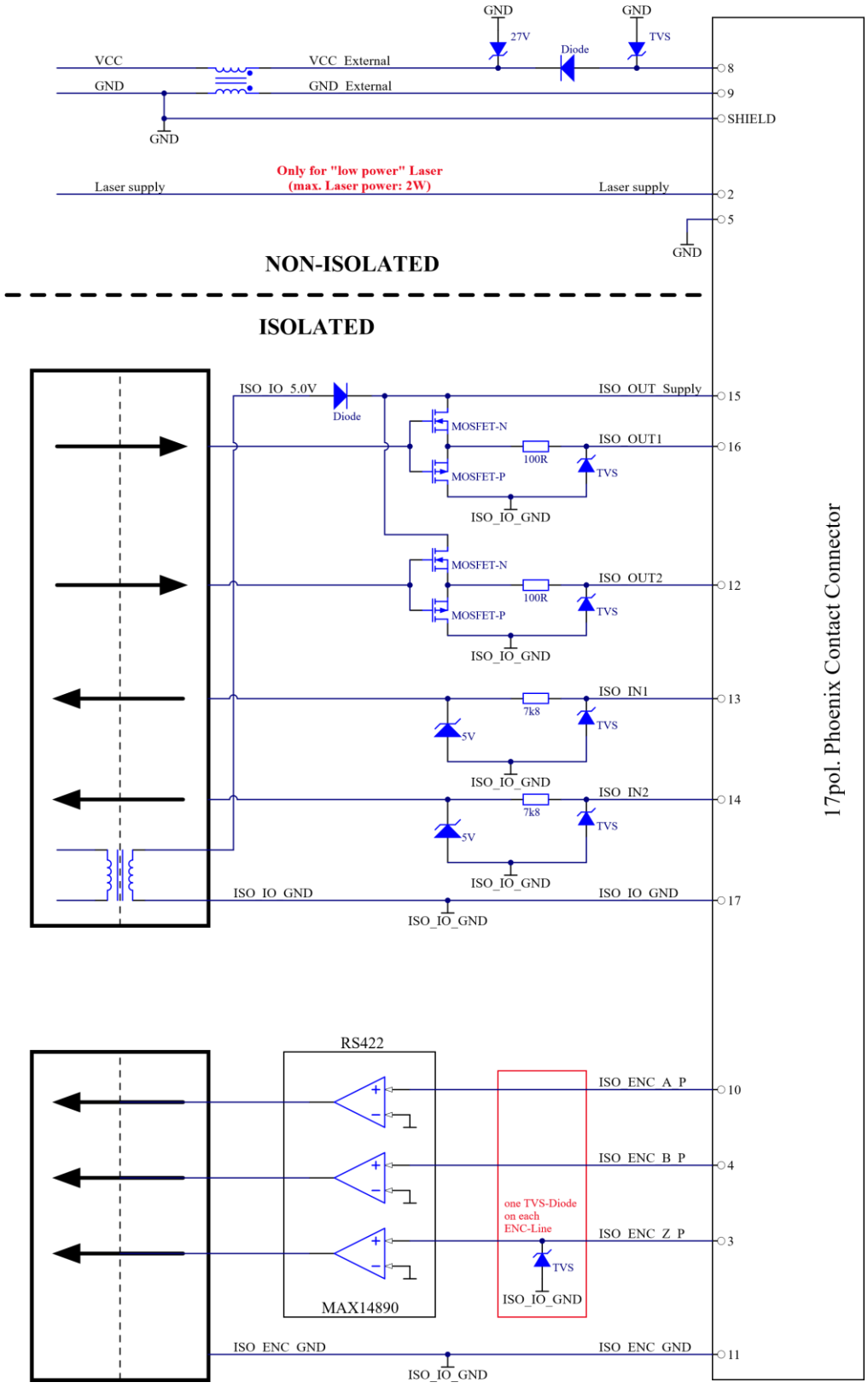


Figure 28: camera internal wiring diagram of the encoder with single ended HTL- or TTL-Mode

LED's

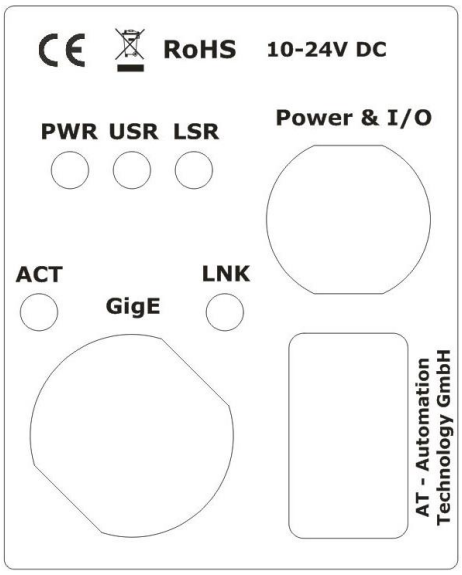


Figure 29: Connector label with LED assignment

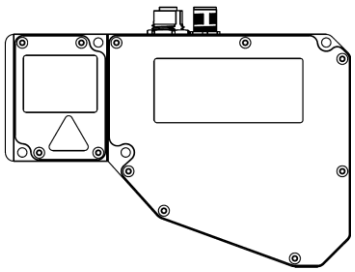
LED	Description
1 (PWR)	Green On= Power On and camera start up completed Off = Power Off or camera start up failed
2 (USR)	Amber = during start up Green On = CCP status connected Off = CCP status disconnected Red On= no network found; no network cable connected
3 (LSR)	Red On = Laser is On Off = Laser is Off
4 (ACT)	Green blink = Indication of network activity
5 (LNK)	Green On = Link speed 1 Gbit Amber On = Link speed 100 Mbit Off = Link speed 10 Mbit or wait for end of auto negotiation

6.5 Mechanical Specifications

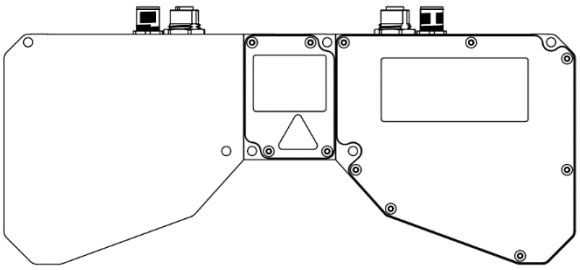
Possible Configurations and Weights

Configurations without Link Module

The weights are only approximate values. The actual weight may differ.



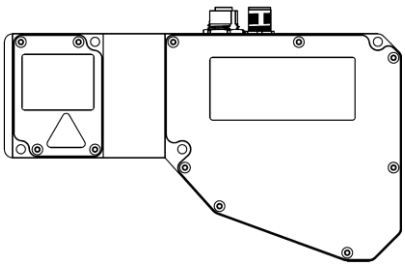
Single configuration



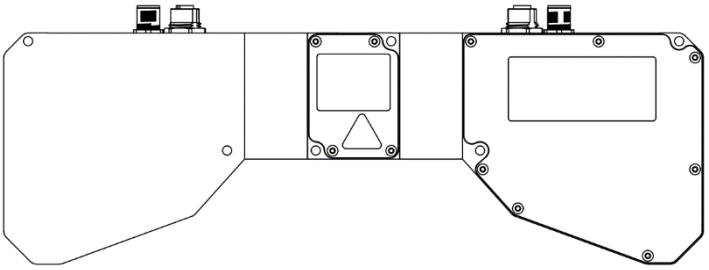
Dual configuration

Single configuration	Dual configuration
910 g	1580 g

Configurations with Metal Link Module



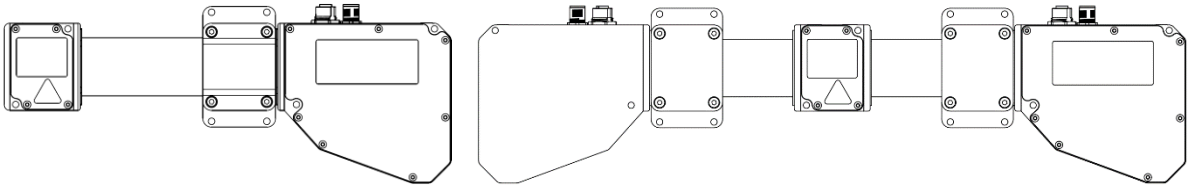
Single configuration



Dual configuration

Single configuration	Dual configuration
Link Module 15 mm: 990 g	1750 g
Link Module 30 mm: 1000 g	1760 g
Link Module 45 mm: 1020 g	1810 g
Link Module 65 mm: 1060 g	1880 g

Configurations with Carbon Link Module



Single configuration

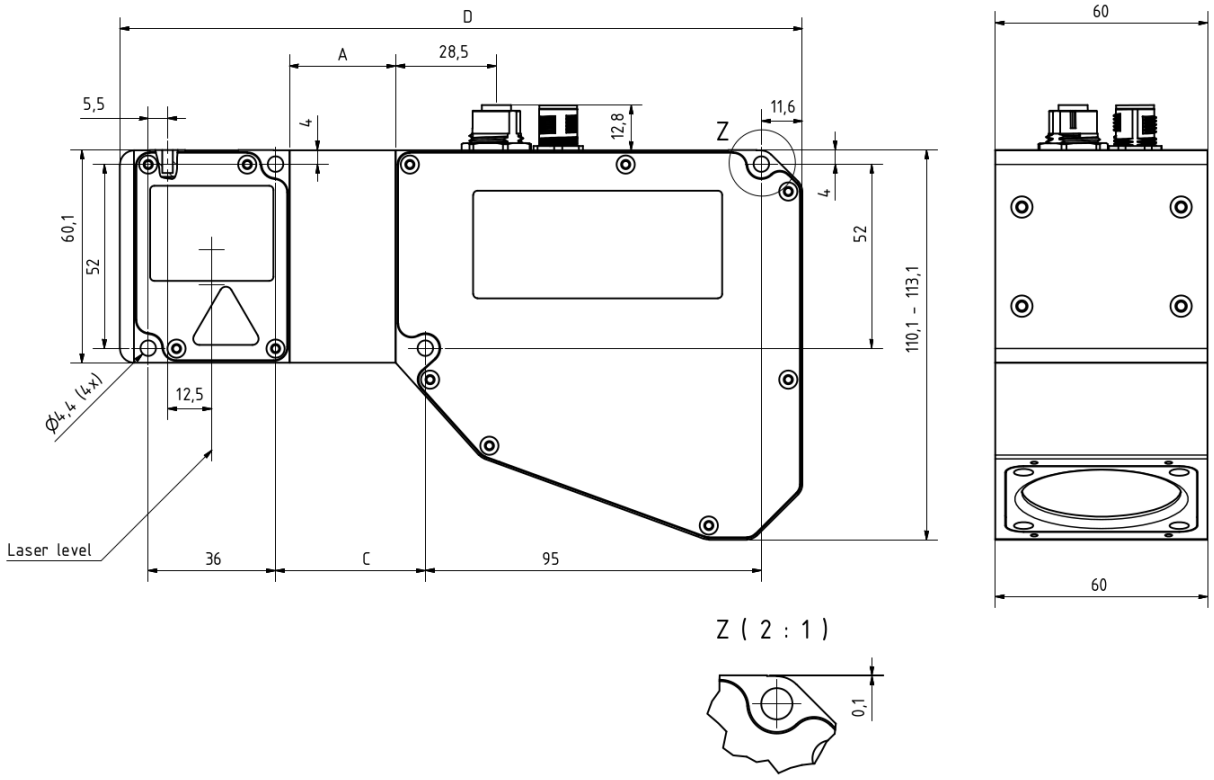
Dual configuration

$1050\ \mathrm{g} + 0{,}344\ \frac{\mathrm{g}}{\mathrm{mm}} * \mathrm{L}_{\mathrm{Link\ Module}}$	$1860\ \mathrm{g} + 0{,}688\ \frac{\mathrm{g}}{\mathrm{mm}} * \mathrm{L}_{\mathrm{Link\ Module}}$
MCS Mount: 280 g	2 x MCS Mount: 560 g

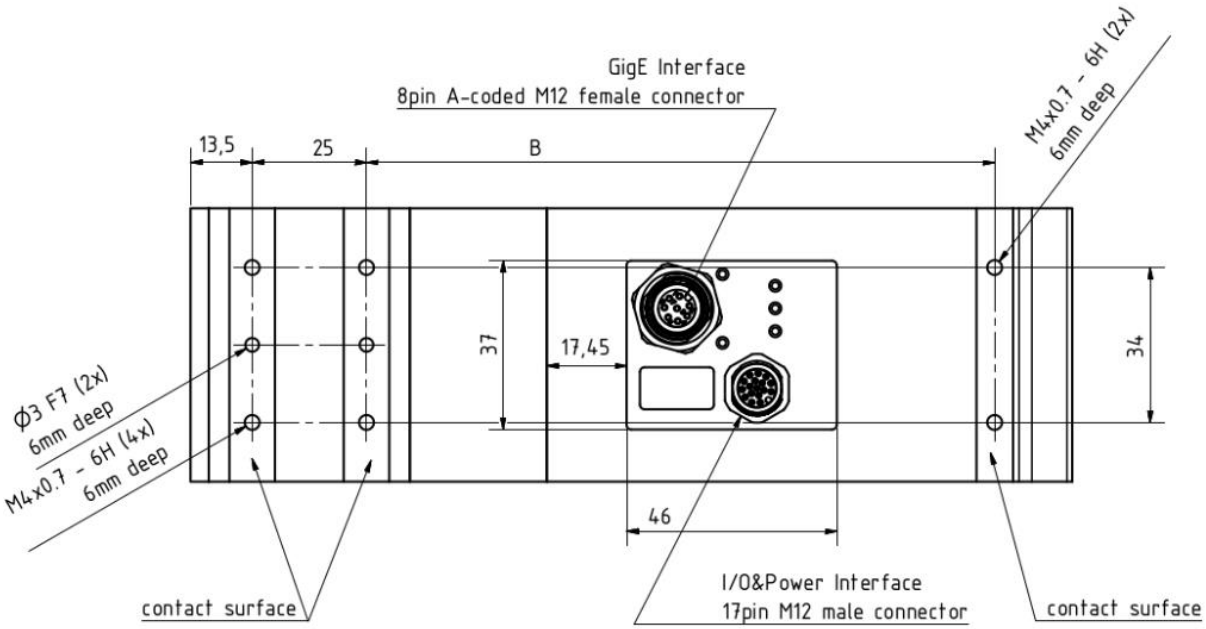
Dimensional Drawings

Configurations Without and With Metal Link Module

All dimensions in mm



Tip: Height and window position of sensor module varies depending on the triangulation angle.



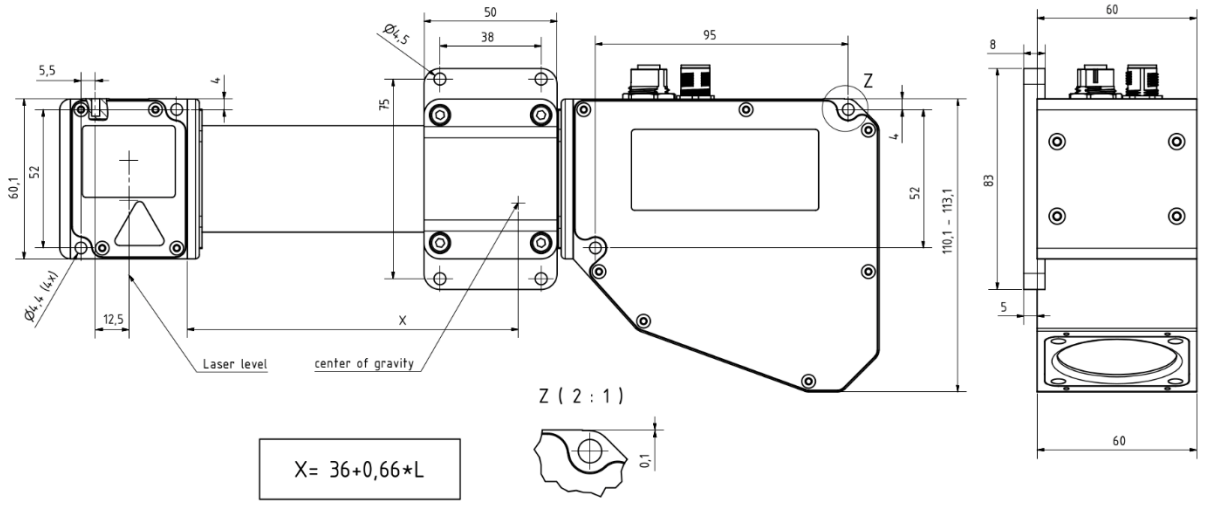
Dimension A refers to the Link Module length. Dimensions B, C and D depend on A. The respective value for these dimensions can be found in the table below.

Tabelle 1: Dimensions depending on Link Module length A

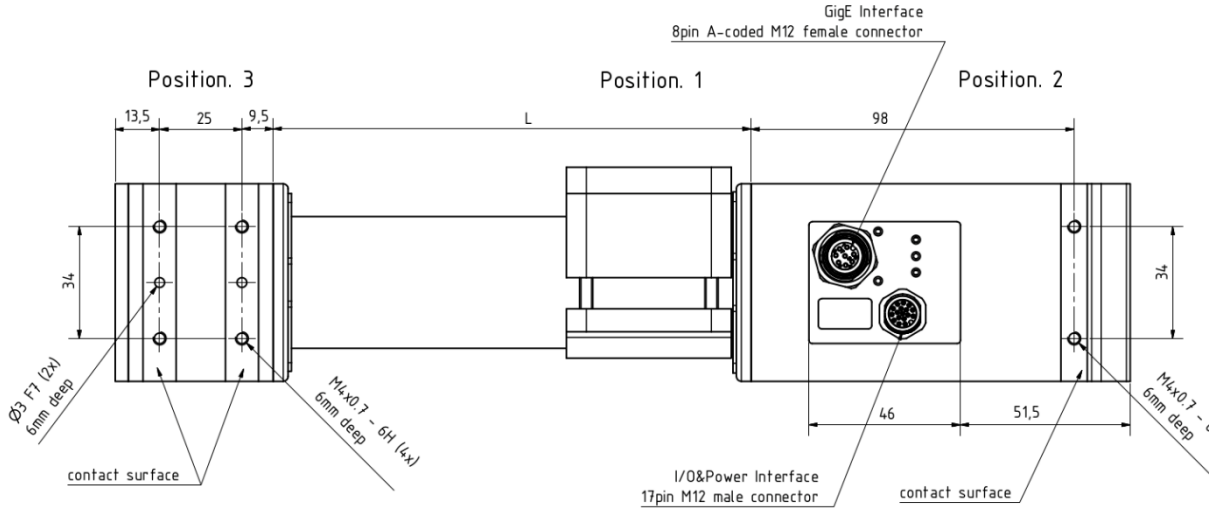
A	0	15	30	45	65
B	107,5	122,5	137,5	152,5	172,5
C	12,4	27,4	42,4	57,4	77,4
D	163	178	193	208	228

Configurations With Carbon Link Module

All dimensions in mm



Notice: The variable X refers to the center of gravity and can be calculated from the Link Module length L. The MCS Mount should always be attached to the center of gravity of the sensor.



Notice: Mounting on multiple positions is not recommended and may affect the calibration accuracy.

7 Software overview

7.1 cxSupportPackage

The cxSupportPackage assists you in the usage of AT - Automation Technology's 3D cameras and sensors. The package provides you with tools for controlling sensors, examples, documentation and an application-programming interface (API) with language wrappers for C++, Python, Matlab and Octave.

Requirements

The cxSupportPackage is available for Linux (AMD64) and Windows (64-Bit). To use the cx4090HS, the transport layer must support multi part. We recommend using the Common Vision Blox Transport Layer Version 13.04.005 or higher.

Notice: The transport layer is not part of the cxSupportPackage and must be installed separately.

Installation

Depending on the option set during cxSupportPackage installation several tools are installed. In detail a complete installed cxSupportPackage consist of following parts:

- Tools
  - cxDiscover for network discovery of AT´s cameras and sensors
  - cxShow3d a 3D data visualization tool.
  - cxExplorer a 3D acquisition tool
- cxSDK
  - cx3dLib an API for generation of 3D point clouds and Z-Maps
  - cxCamLib an API for GigE Vision based access
  - Wrapper for C++, C#, Python and Matlab/Octave
- Examples
- Documentation
  - Application notes
  - FAQ
  - SDK documentation
  - Sensor and programming manuals
  - Help pages

Notice: Because Microsoft has discontinued the support for 32 Bit Windows versions, the cxSupportPackage comes for Windows 64 Bit only.

When choosing default installation, the tools are located under C:\ProgramFiles\cxSupportPackage\tools.
All Examples are installed in Application Data folder, e.g. %PUBLIC%\Documents\cxSupportPackage.
A detailed installation instructions can be found in the cxSupportPackage in the help directory.

Help

The landing page of the cxSupportPackage can be accessed via the cxSupportPackage folder in the start menu.

In the online help of the cxSupportPackage, you can find a detailed description of the cxSDK-libraries cxCamLib and cx3dLib. Manuals, application notes and GenICam descriptions of several products can be found in the section "Documentation". In the cxTools selection there is the installation instructions mentioned above.

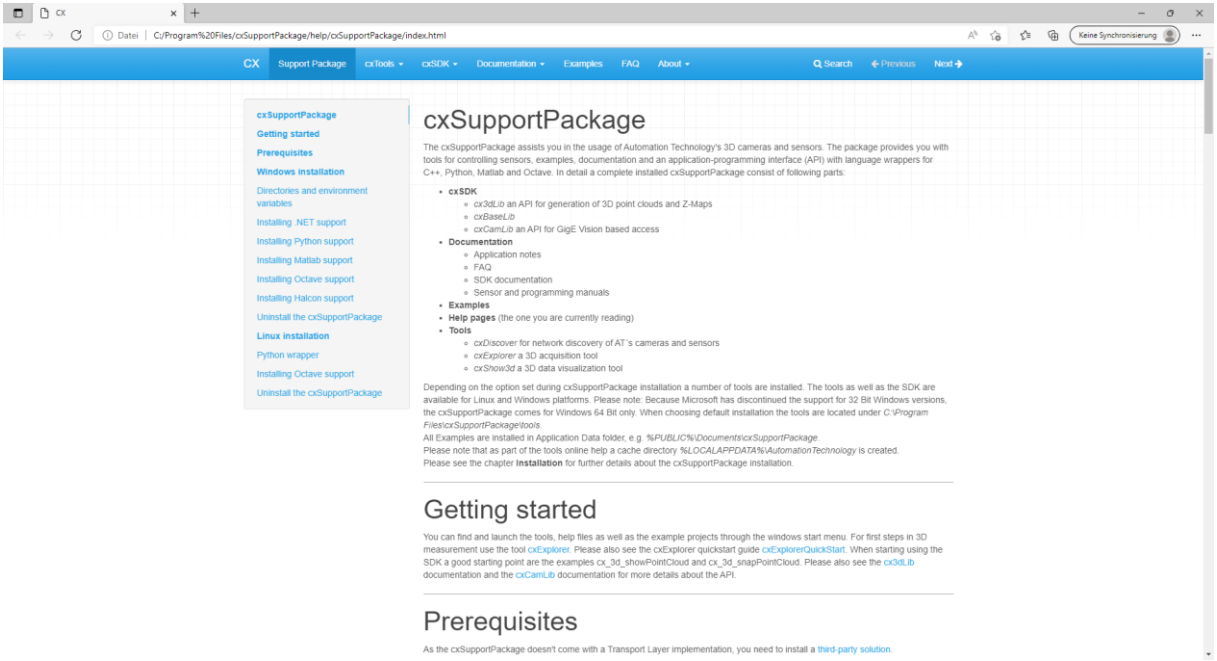


Figure 30: Help - landing page

7.2 cxDiscover

cxDiscover enumerates all available sensors connected to the PC or the connected network. It displays the available device information. The tool allows an easy configuration of the required network parameters (IP address, netmask, gateway) and to launch the device website.

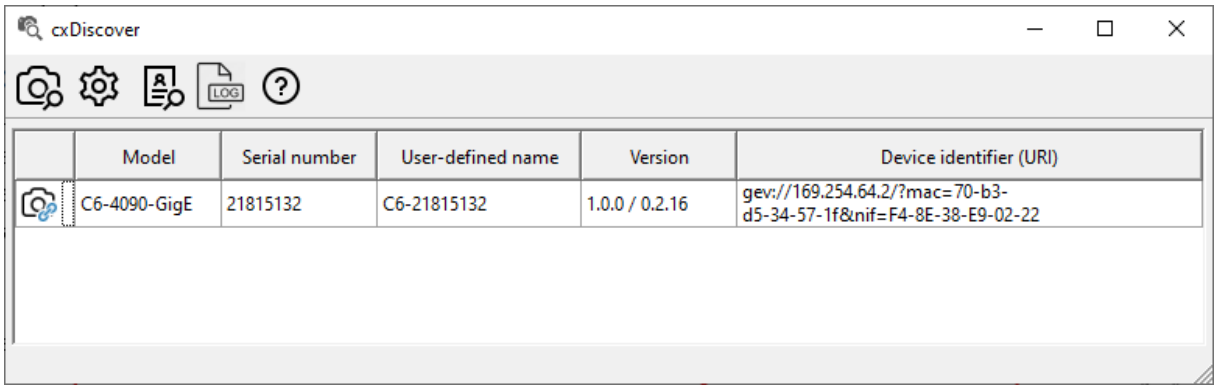


Figure 31: cxDiscover

In the menu bar are the following selections:

Discover: Device list is updates and the connected devices are displayed

Settings: A settings window opens where custom settings can be made

Available TL Licenses: Display of the transport layer license

Log: if activated, a log is displayed

Info: a help window opens

If you right-click on the selected device, the following selection window opens.

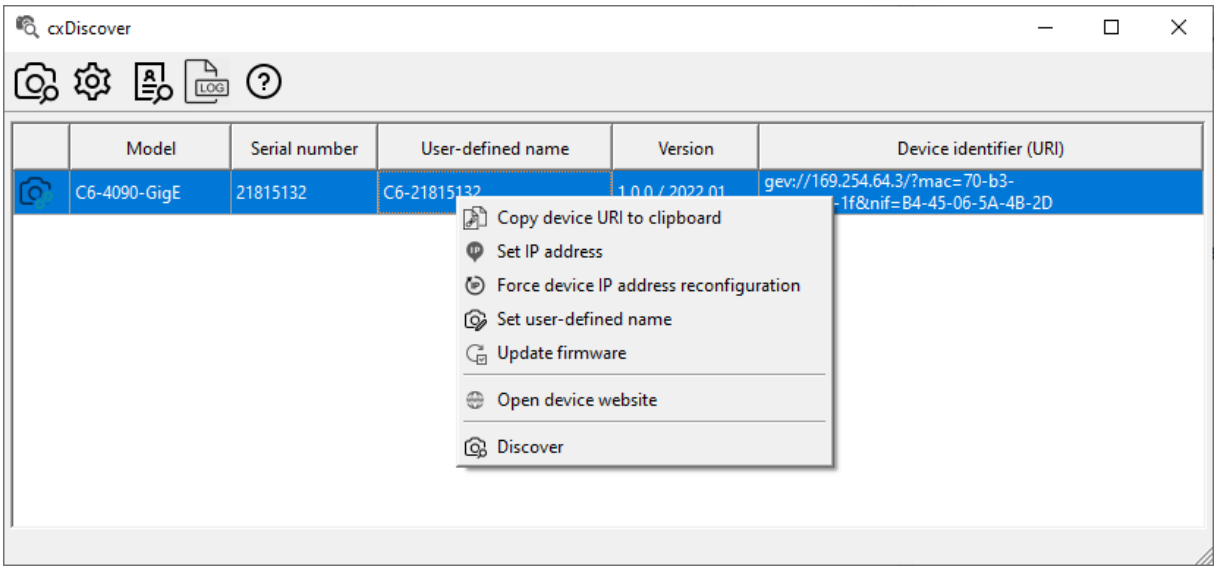


Figure 32: cxDiscover - advanced options

Here you can change the IP address and the user-defined name or access the device website. There is also the possibility to update the device list.

Notice: The firmware update must be performed via the device website. A detailed description can be found in the chapter cxWebInterface.

7.3 cxExplorer

Configuration of a compact sensor can be easily done with the cxExplorer, which is a graphical user interface provided by AT - Automation Technology. With the help of the cxExplorer a sensor can be simply adjusted to the required settings.

Tip: A detailed description of the individual functions and settings can be found in the cxExplorer-QuickStart which is accessible via the landing page of the cxSupportPackage.

After starting the tool and selecting the connected sensor, the cxExplorer opens.

Image view

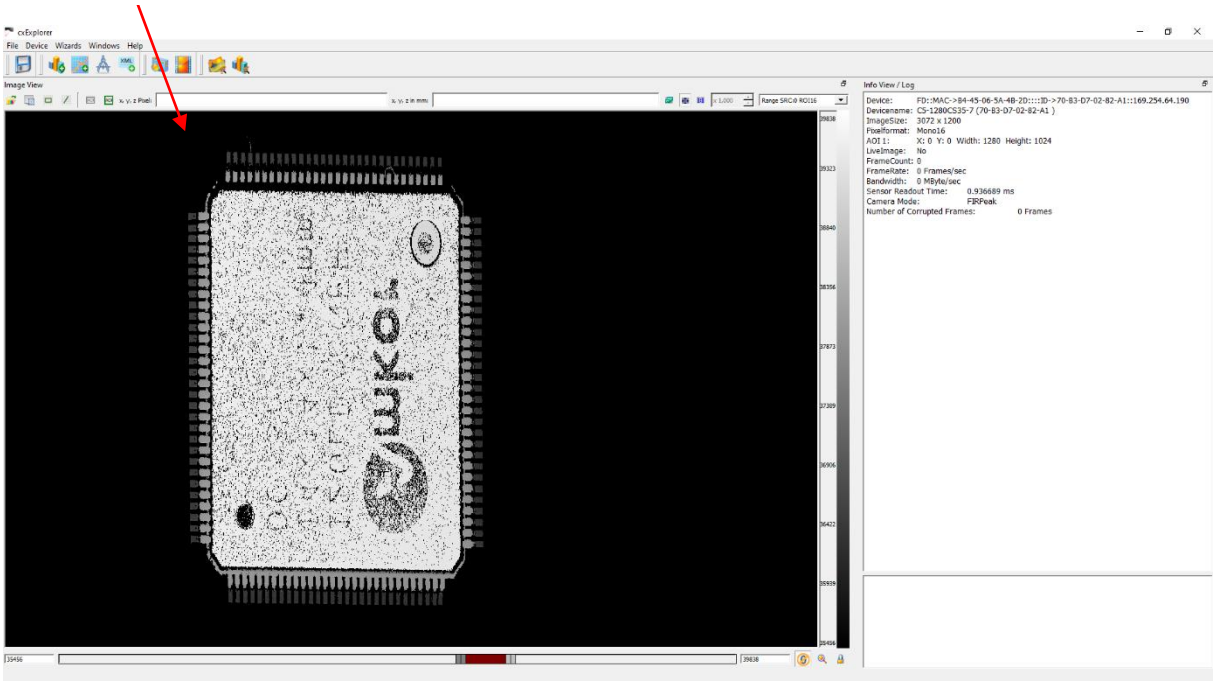


Figure 33: cxExplorer

The cxExplorer offers the possibility to display images of an Areascan (2D) or Linescan3D in the marked image view. The image above shows a range image.

Areascan – 2D Image Mode

The image mode enables the output of the 2D CMOS sensor images of the camera. That can be helpful i.e. to set and optimize the laser power, the region of interest or the exposure time.

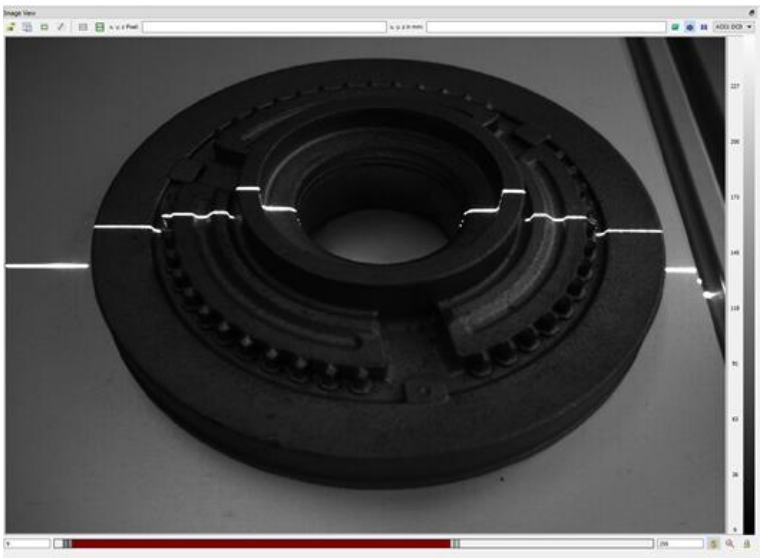


Figure 34: cxExplorer - 2D greyscale image

Linescan3D – 3D Image Mode

In the 3D mode typically a greyscale range image can be acquired and displayed in the image view using one of the four different algorithms. Furthermore, the reflectance image can also be displayed.

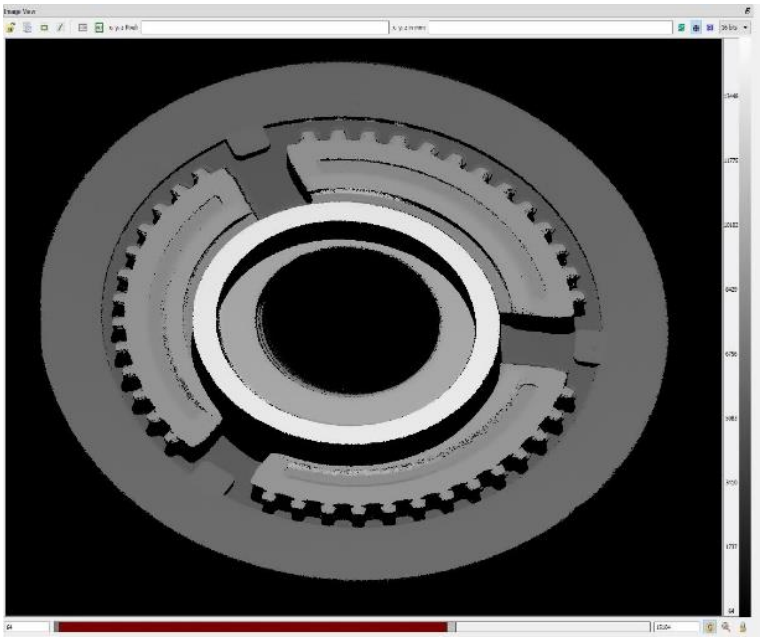


Figure 35: cxExplorer - 3D greyscale range image

Display options and settings

With the help of different tools, you can display the sensor properties and make an evaluation of the taken images. These tools can be selected and displayed via the menu bar.

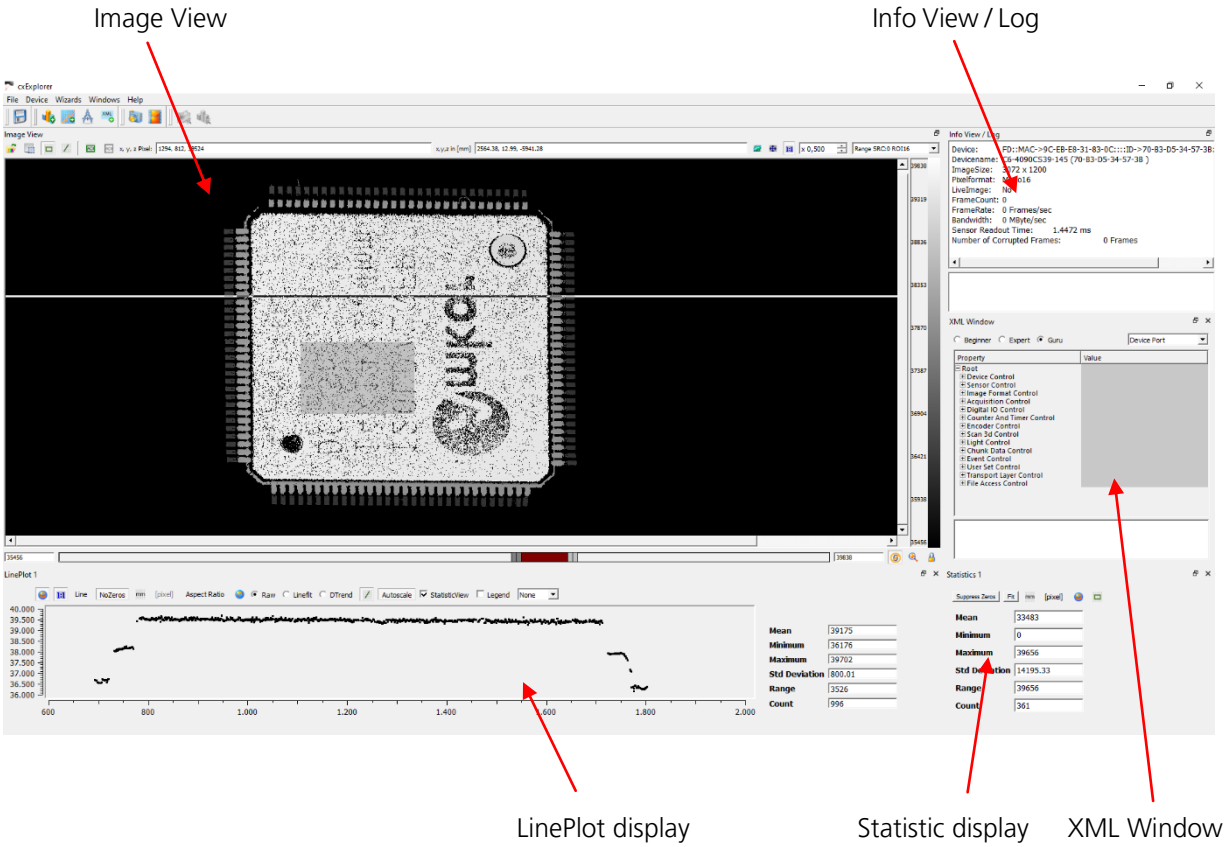


Figure 36: cxExplorer - display options

In the Image View, the last scan taken is displayed. For analysis, you can draw lines and rectangles and show image information along the line or inside the rectangle in a LinePlot display or in a Statistics display.

In the Info View, you can find general information of the device such as the current pixel format, image capture status and image size.

In the XML Window you can read and write the camera parameters. The parameter changes made here are set in the nonpersistent user set currentUserSet. Settings can also be saved permanently to the available UserSets.

Description of the cxExplorer menu bars

cxExplorer header bar

In the header bar the basic functions are displayed with buttons and are briefly explained below.

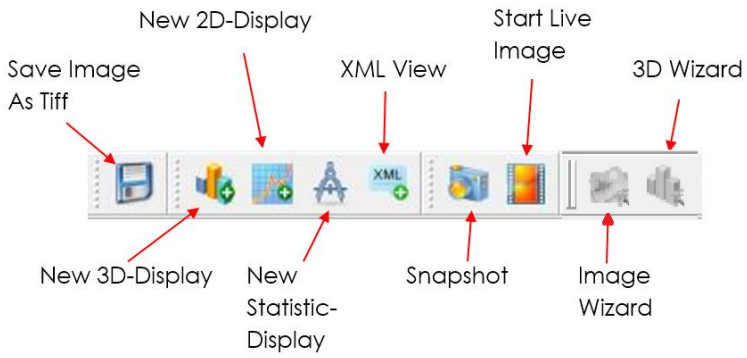


Figure 37: cxExplorer – header bar

- Save Image As Tiff: Save the current frame as a Tiff image
- New 2D-Display: Open a new LinePlot display
- New 3D-Display: Open a new 3D-Plot
- New Statistics-Display: Open a new statistic display
- XML View: Open the XML window
- Snapshot: Acquire a single frame
- Start Live Image: Start a continuous image acquisition
- Image Wizard: This point is omitted in the C6 series
- 3D Wizard: This point is omitted in the C6 series

cxExplorer Image View Toolbars

The upper Image View toolbar below the header bar contains the display settings and tools to perform analyzing the current image.

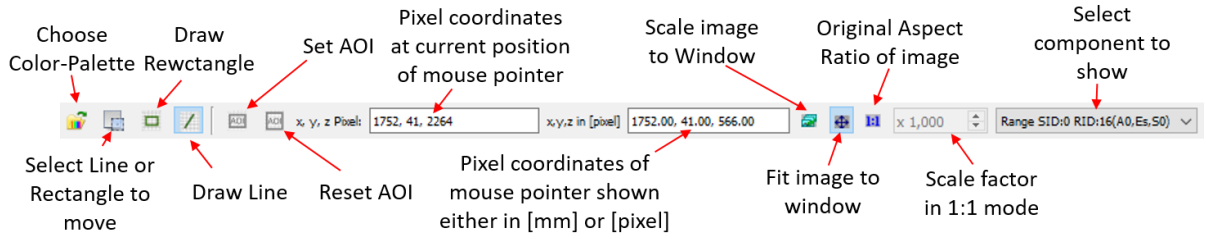


Figure 38: cxExplorer – Upper Image View Toolbar

- Choose Color-Palette: Load a color palette for false color representation
- Select Line or Rectangle to move: Select a drawn line or rectangle in the image
- Draw Rectangle: Draw a rectangle into the image
- Draw Line: Draw a line into the image
- Set AOI: Define a Region of Interest from a drawn rectangle
- Reset AOI: Set the Region to the maximum size
- Scale Image to Window: Scale the Image to fit to the Window (keep aspect Window ratio)
- Fit Image to Window: Scale the Image to fit to the Window
- Original Aspect Ratio of Image: Scales the Image to (1:1) x Scale Factor
- Scale Factor in 1:1 mode: Scale the image in 1:1 mode with this factor
- Select Component to show: Selecting the Component which will be displayed in the Image View.

In the lower Image View Toolbar, there is a scroll bar to set the data shown and some functions to edit data.

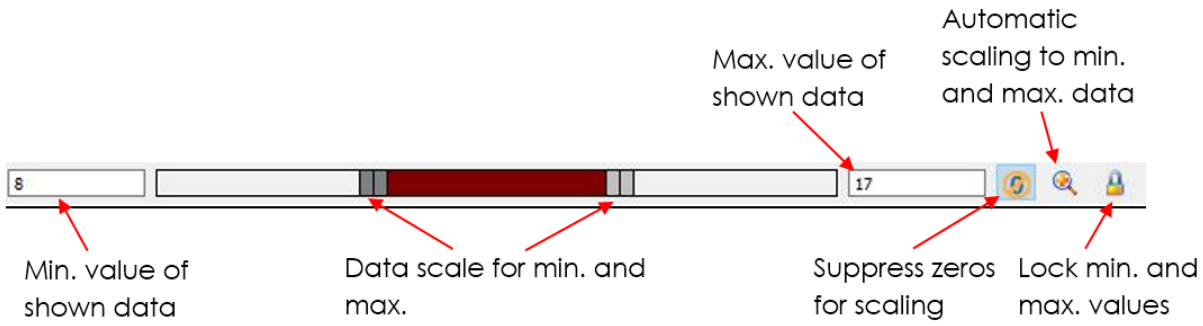


Figure 39: cxExplorer - Lower Image View Toolbar

- Min. value of shown data: Minimum value of the displayed data
- Data scale for min. and max.: Scaling the minimum and maximum values of the displayed data
- Max. value of shown data: Maximum value of the displayed data
- Suppress zeros for scaling: Suppress zero values for scaling
- Automatic scaling to min. and max. data: Scale to the minimum and maximum values of the displayed data
- Lock min. and max. values: Lock the minimum and maximum values of the displayed data

Saving Image Data

The current image can also be saved as a TIFF bitmap. It is worth mentioning that in addition to the height image (range image), a reflectance image and a scatter image can also be recorded when these components are activated. The components can be selected in the XML Window in the area Image Format Control -> Region Control -> Component Selector.

Click at the symbol  located at the cxExplorer header bar, in order to save the current image data as TIFF bitmap. A dialogue box appears. Enter the filename of the image, e.g. "TestImage". Depending on which components were enabled during the 3D image acquisition, the following files are produced:

- "*TestImage_0.tif*" contains the data of the first enabled component selector
- "*TestImage_1.tif*" contains the data of the second enabled component selector
- "*TestImage_2.tif*" contains the data of the third enabled component selector

Saving the current dataset into GenDC

The generic data container (GenDC) according to GenICam GenDC specification is a generic and self-described autonomous data container usable for representation, transmission, and reception of arbitrary data components.

Click at *File* in the menu bar and select *Save As GenDC Container …* .

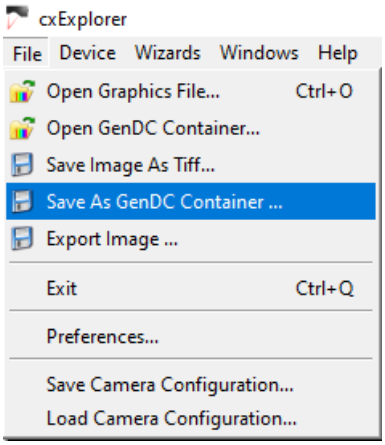


Figure 40: cxExplorer - menu bar option "Save As GenDC Container …"

The dataset stored into the GenDC consists of the current frame's data, including

- Images (depending on the enabled components)
- ChunkData
- Calibration (if it was loaded from the camera in the Load/Save Calibration Metric)
- CurrentUserSet (optional)

Stored datasets can later be loaded again by the cxExplorer or imported into the cxShow3d application.

Load/Save Calibration Metric

The device is always delivered with a factory calibration "CalibrationFactory" and a user calibration "CalibrationUser". The factory calibration is only readable and can´t be written. The CalibrationUser can be read as well as written. If changes are made, they can be saved to the CalibrationUser. In order to carry out an evaluation in the cxExplorer, it is important that the calibration of the device is loaded into the cxEplorer. Only with this a metric representation works.

A short explanation and how the calibration can be loaded and saved can be seen in the following two figures:

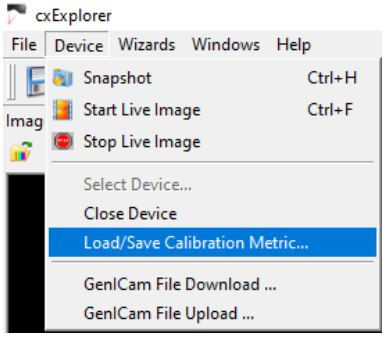


Figure 41: cxExplorer - menu bar option "Load/Save Calibration Metric …"

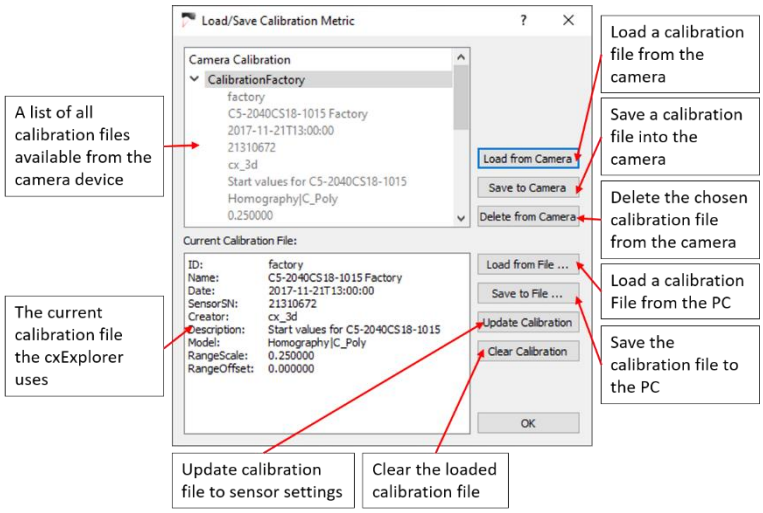


Figure 42: cxExplorer - Load/Save Calibration Metric

The calibration can also be loaded/saved from or to the device via the GenICam File Up/Download. However, care must be taken here that the calibration is loaded from the device directly. This means that if changes are made to the device configuration (e.g. the coordinatescale) in the cxExplorer, these will not be taken into account. This option can be found in the menu bar under *Device* (see figure below). Here there is also the possibility to download or upload the different UserSets.

Tip: It is recommended to use the Load/Save Calibration Metric for loading the calibration from the device.

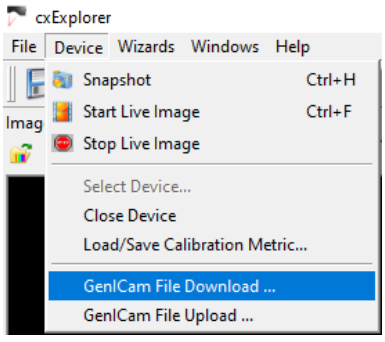


Figure 43: cxExplorer - menu bar option "GenICam File Down-/Upload"

7.4 cxShow3d

cxShow3d is a tool for the visualization of recorded 3D range maps. You can load a range map data set consisting of a range map, a calibration file and (optional) a reflectance image. Instead of loading the data set from three files, you can load a GenDC container. The mentioned dataset and the GenDC container can be generated with the previously described tool cxExplorer.

With cxShow3d PointClouds or Z-Maps can be generated with the supplied data. The created PointCloud or Z-Map can be combined with textures, different colors and visualization styles. cxShow3d allows the combination of measurements of different sensor in one visualization.

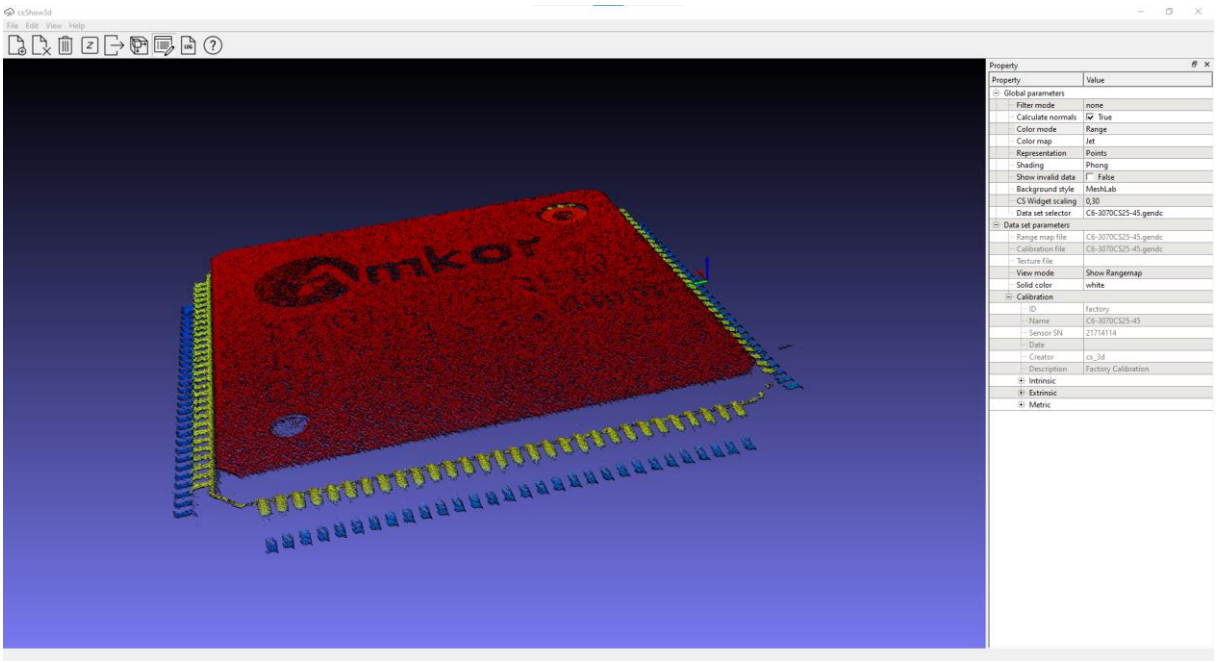


Figure 44: cxShow3D

Tip: In the cxSupportPackage (Version >= 2022.02) there is an example for a GenDC Container.

In the menu bar are the following selections:

Load range map: Load new data set consisting of range map, calibration and optional texture.

Remove current data set

Remove all data sets (empty view)

Generate Z-Map: When a point cloud is loaded, a Z-Map generator window opens. Here appropriate settings can be made and confirmed. The created Z-Map can be saved in the menu-bar under *File-> Save Z-Map*.

Save point cloud file

Reset view to fit all visible objects

Proberty: The proberty window is displayed. Here you can set various parameters such as visibility or color. Settings for calibration can be viewed here and also edited for extrinsic an metric calibration.

Log: The log is displayed

Show help

As already mentioned, GenDC containers can also be loaded. This can be done in the menu bar under *File-> Load Range Map Data Set from GenDC Container.*

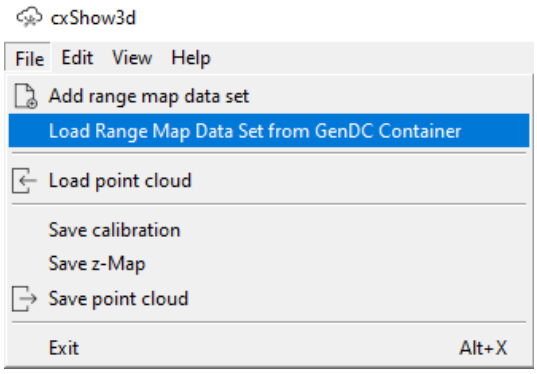


Figure 45: cxShow3D - menu bar option

7.5 cxWebInterface

Relevant data about the device can be viewed via the cxWebInterface. This includes the device information (Model Name, Serial Number, Firmware Version, …), the status of the device (Uptime, Linkspeed, …) and the memory statistics. The system log is also displayed here and can be easily exported via a button.

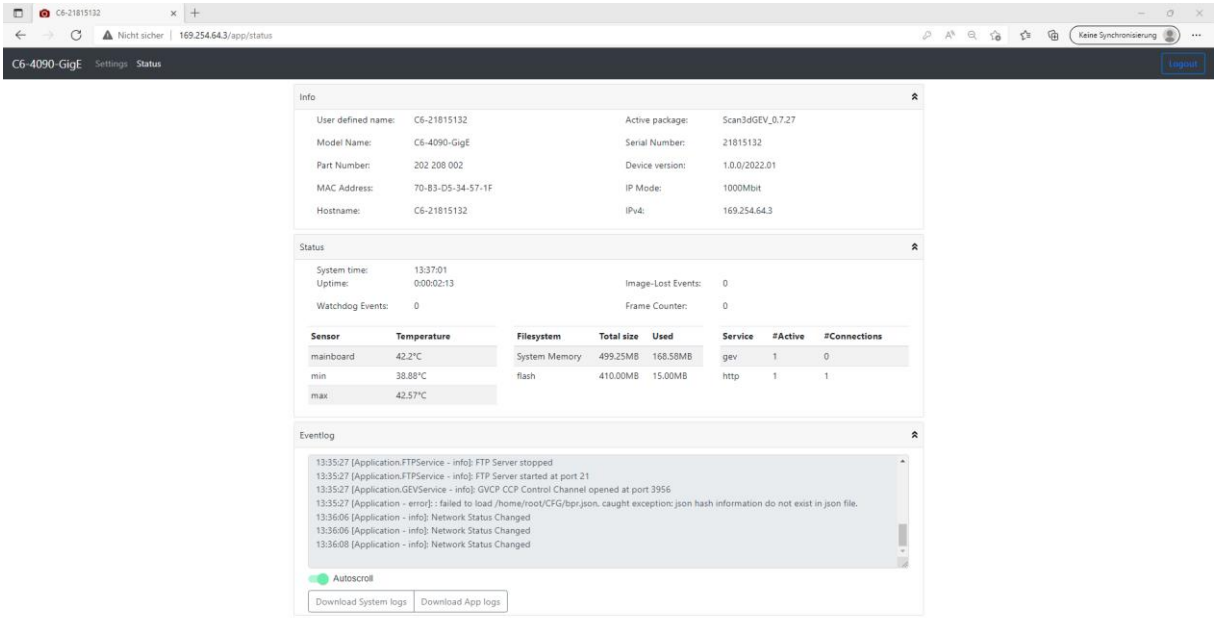


Figure 46: cxWebInterface

In the menu item settings there is the firmware manager to realize firmware updates, as well as the maintenance to make a device reboot.

The web interface can be accessed either by entering the IP address of the device in the web browser or more simply via the cxDiscover. Open the tool cxDiscover and right-click on the selected device. Select *Open Device Website* as shown in the following screenshot.

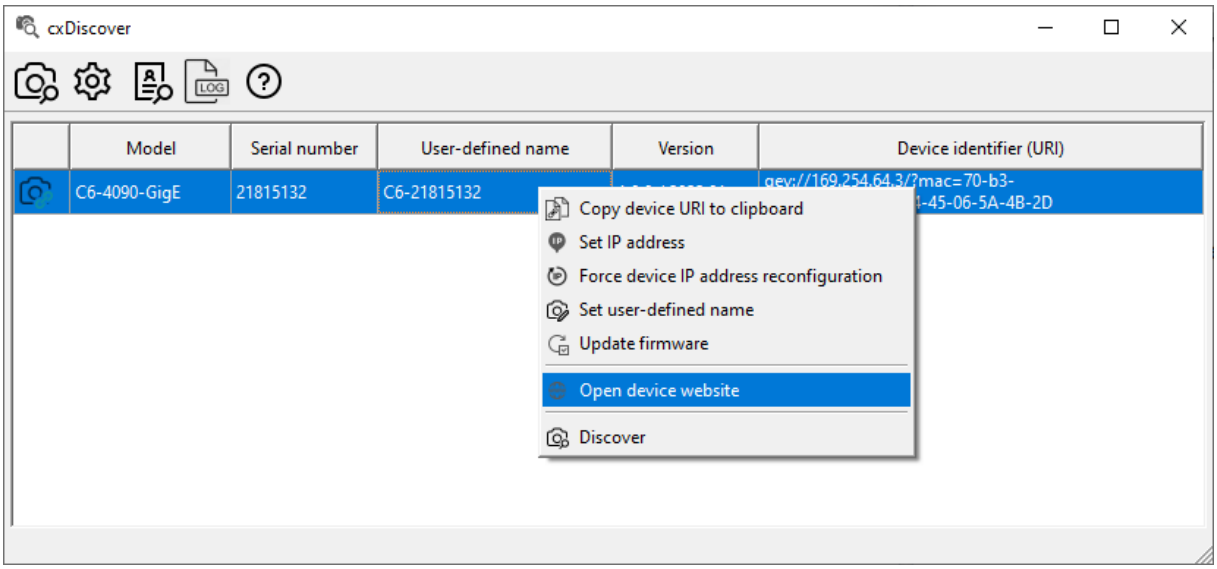


Figure 47: cxWebInterface – right click menu

Tip: After opening the device web interface a password must be entered, which is identical to the username.
Example: username=administrator password=administrator

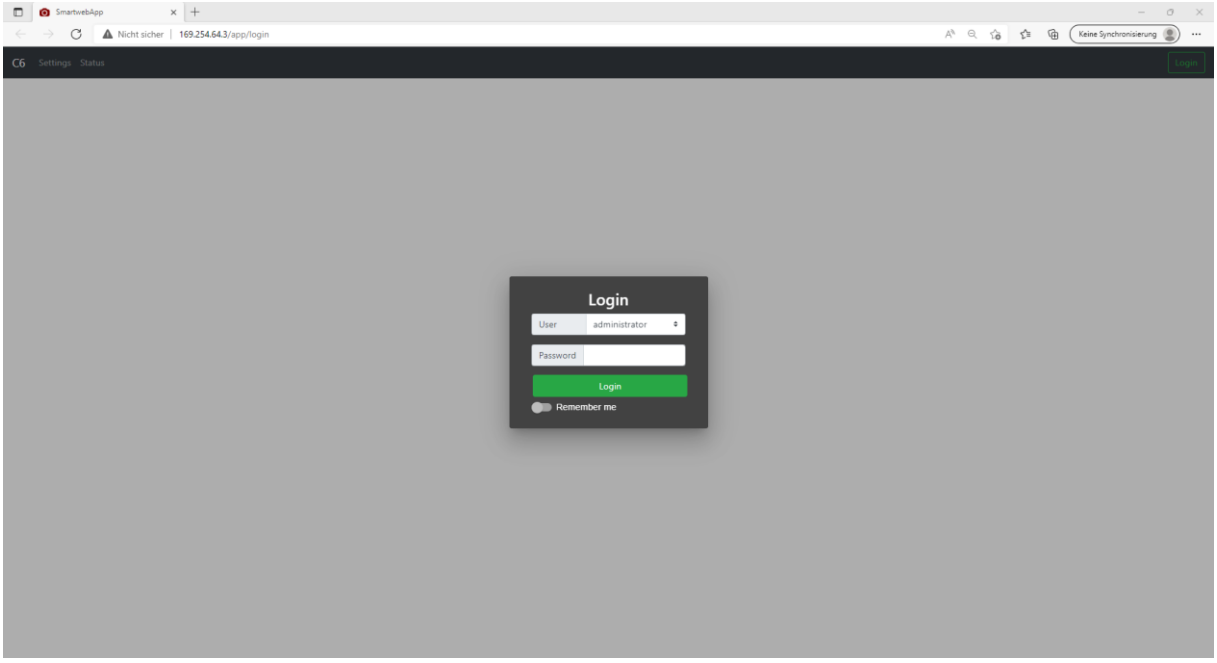


Figure 48: cxWebInterface - Login

Firmware update

A firmware update must be done via the cxWebInterface. Follow the steps below to update the device:

- Select “Settings” in the menu bar.
- In the fold-out window "Firmware-Manager" select "Upload firmware"(see picture below).
- Find and select the firmware file (.tar) and click Install

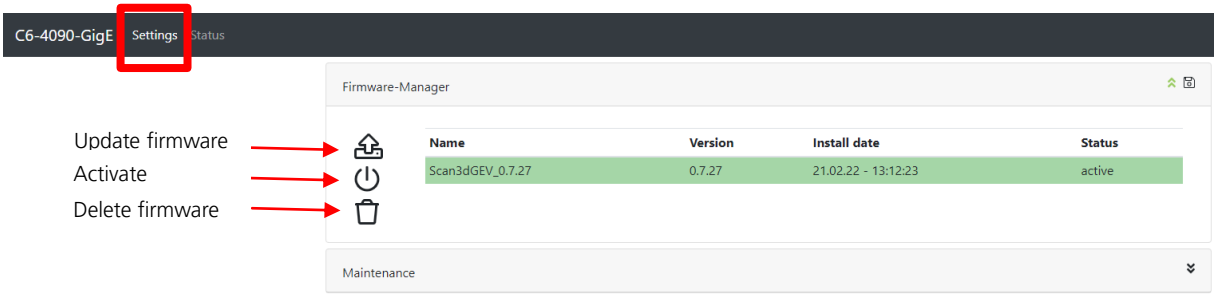


Figure 49: cxWebInterface - Firmware-Manager

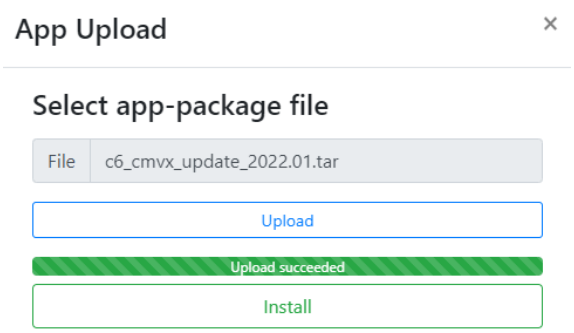


Figure 50: Firmware-Manager - App Upload

- During the installation the following window appears. If the installation was successful, this is marked with a green tick.

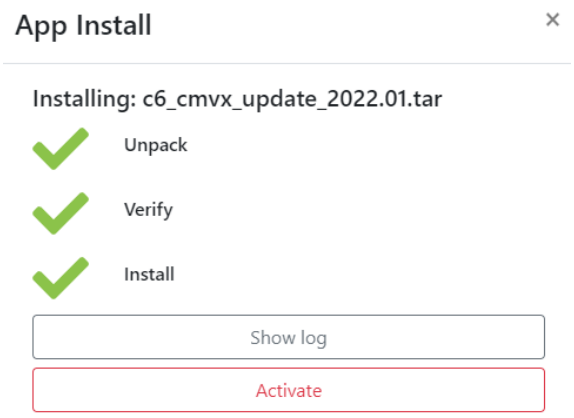


Figure 51: Firmware-Manager - App Install

- Close the “App Install” window and reboot the device. Only after reboot, the firmware update is completed successfully.

7.6 cxSDK

AT - Automation Technology´s Software Development Kit (cxSDK) is free of charge and allows the programmatically access and control of all type of compact sensor and further the possibility of a 3D calibration.

The cxSDK provides a C-based application-programming interface (API) with language wrappers for C++, C#, Python, Matlab and Octave.

The cxSDK consists of the cxCam and cx3d library.

The cxCam library provides functions for discovering and enumerating connected devices via the GEV standard as well as the camera configuration, image acquisition and event handling.

The cx3d library provides functions for intrinsic and extrinsic calibration models to transform the height images (range maps) from the camera to 3D point cloud images or rectified images.

cx_3d_snap_point_cloud.py

```
# get image from buffer
    # the img object holds a reference to the data in the internal buffer, if you need the image data after cx_queueBu
result, img = cam.cx_getBufferImage(hBuffer, 0)
if result != base.CX_STATUS_OK:
    print("cx_getBufferImage returned error %d" % (result))

# deep co
rimg = np

# Queue b
result =
if result
    print

# stop ac
result =
if result
    print

#cleanup
result =
if result
    print

result =
if result
    print

# 6. calc
```

cx_3d_snap_point_cloud.cpp | cx_3d_show_point_cloud.cpp

cx_3d_snap_point_cloud | (Globaler Gültigkeitsbereich)

```
        // show range image in OpenCV window
        cv::Mat rangeImgMat = rangeImg;

        // save range image to file using OpenCV function
        cv::imwrite("range_image.tif", rangeImgMat);

        // normalize imgmat to Mono8 for display
        double minVal, maxVal;
        cv::minMaxLoc(rangeImgMat, &minVal, &maxVal);
        std::cout << "pixel range is: " << minVal << " - " << maxVal << std::endl;
        rangeImgMat -= minVal;
        rangeImgMat.convertTo(rangeImgMat, CV_8U, 255.0 / (maxVal - minVal));
        cv::imshow("Range Image", rangeImgMat);


        // convert range image to Point Cloud image
        cx::Image pointCloudImg;
        t1 = clock();
        cx::checkOk(cx_3d_range2calibratedABC(hCalib, rangeImg, NULL, CX_PF_COORD3D_ABC32f, pointCloudImg, CX_3D_METRIC_M
        t2 = clock();
        cout << "time elapsed for transformation to point cloud: " << double(t2 - t1) / double(CLOCKS_PER_SEC) << endl;

        // convert to OpenCV for visualization and saving
        cv::Mat normals, colors;
        cv::Mat cloud = pointCloudImg;
        cloud.convertTo(cloud, CV_32FC3);   // must be CV_32FC3 for WCloud to work
        cx::computeCloudNormals(cloud, normals);
        cx::normalizeMinMax8U(rangeImgMat, colors);

        // show point cloud
        cx::showPointCloud(viz, cloud, colors, normals);
```

Figure 52: cx3d library - example function

Tip: For more information about the handling and the integration of the cxSDK, please refer to the documentation and to various example programs contained in the cxSDK.

Wrapper/Installation

If cx3dLib and cxCamLib was installed as part of the cxSupportPackage no additional steps are necessary. The installer automatically sets the environement variable CX_SDK_ROOT. The Visual Studio project files for the cx3dLib and cxCamLib examples make use of this environement variable for include and library search path.

If you want to manually install cx3dLib and cxCamLib perform the following steps:

- unpack cx3dLib, cxCamLib and cxBaseLib into desired folder, eg. cxPackage.
- set environement variable CX_SDK_ROOT to the root folder (eg. cxPackage)

Examples

Cx3dLib

C Examples

The C examples are dependend on OpenCV for data visualization and image loading. As part of the cxSupportPackage you will find a ThirdParty folder containing a prebuild version of OpenCV 3.4.2 which is used for the C example build (CX_SDK_ROOT%\ThirdParty\opencv-3.4.2).

Tip: The "C examples" make use of the native C interfaces of the cxBaseLib, cxCamLib and cx3dLib and don't use the C++ wrapper classes. Although C++ is used in the projects for convenience, the examples could nonetheless be implemented as pure C examples.

Extrinsic Calibration

- cx_3d_calib_ext_from_points.cpp: Example of using AT 3D library for extrinsic calibration from a given set of image-points and target-points.
- cx_3d_calib_ext_from_rangemap.cpp: Example of using AT 3D library for calibration from a rangemap of a calibration target.

Intrinsic calibration

- cx_3d_calib_from_points.cpp: Example of using AT 3D library for calibration from a given set of image-points and target-points.
- cx_3d_calib_LensDistortionAndTargetTrapezoid.cpp: This example shows how to do an intrinsic calibration based on the trapeze calibration target, see also CX_3D_TARGET_TRAPEZOID.
- cx_3d_calib_SawtoothAndStraightness.cpp: This example shows how to do an intrinsic calibration in two steps based on sawtooth and planar target.
- cx_3d_calib_TargetTrapezoid.cpp: This example shows how to do an intrinsic calibration based on the single Trapez shaped calibration target (aka Linear target), see also CX_3D_TARGET_TRAPEZOID

C++ Examples

The C++ examples are dependend on OpenCV for data visualization and image loading. As part of the cxSupportPackage you will find a ThirdParty folder containing a prebuild version of OpenCV 3.4.2 which is used for the C++ example build (CX_SDK_ROOT%\ThirdParty\opencv-3.4.2).

PointCloud and Z-Map Generation

- cx_3d_show_point_cloud.cpp: Shows the conversion of range image file to point cloud and visualization using OpenCV. Also supports saving of point cloud to file (.ply, .xyz, .obj). Demonstrates the usage of C++ wrapper classes AT::cx::c3d::Calib and AT::cx::c3d::PointCloud, see Helper classes and functions for C++.
- cx_3d_create_zMap.cpp: Shows the conversion of range image file to to a rectified image in x-y Plane (Z-Map). Also shows conversion of ZMap to point cloud and their visualization. Demonstrates the usage of C++ wrapper classes AT::cx::c3d::Calib, AT::cx::c3d::ZMap and AT::cx::c3d::PointCloud.

- cx_3d_snap_point_cloud.cpp: This example shows how to snap a single range map from CX camera and convert it to a point cloud. Also visualizes point cloud using OpenCV. Demonstrates the usage of C++ wrapper classes AT::cx::Device, AT::cx::DeviceBuffer, AT::cx::c3d::Calib and AT::cx::c3d::PointCloud.

Intrinsic calibration

- cx_3d_calib_TargetFacets12.cpp: This example shows how to do an intrinsic calibration based on the Facet12 calibration target (aka Static target), see also CX_3D_TARGET_FACETS_12
- cx_3d_calib_TargetSawtooth_multiple_RangeFiles.cpp: This example shows how to do an intrinsic calibration based on a sawtooth calibration target, see also CX_3D_TARGET_SAWTOOTH
- cx_3d_calib_TargetSawtooth_single_RangeFile.cpp: This example shows how to do an intrinsic calibration based on a sawtooth calibration target, see also CX_3D_TARGET_SAWTOOTH

GEV multipart

- c6_snap_multipart_pointcloud.cpp: This example shows how to snap a single frame with gev multipart payload.

C# Examples

PointCloud and Z-Map Generation

- cx_3d_show_point_cloud.cs: Shows the conversion of range image file to point cloud and visualization using OpenCV. Also supports saving of point cloud to file (.ply, .xyz, .obj). Demonstrates the usage of C# wrapper classes. AT.cx.c3d.Calib and AT.cx.c3d.PointCloud, see Helper classes and functions for C++.
- cx_3d_create_zMap.cs: Shows the conversion of range image file to to a rectified image in x-y Plane (Z-Map). Also shows conversion of ZMap to point cloud and their visualization. Demonstrates the usage of C# wrapper classes AT.cx.c3d.Calib, AT.cx.c3d.ZMap and AT.cx.c3d.PointCloud.
- cx_3d_snap_point_cloud.cs: This example shows how to snap a single range map from CX camera and convert it to a point cloud. Also visualizes point cloud using OpenCV. Demonstrates the usage of C# wrapper classes AT.cx.Device, AT.cx.DeviceBuffer, AT.cx.c3d.Calib and AT.cx.c3d.PointCloud.

Intrinsic calibration

- cx_3d_calib_TargetFacets12.cs: This example shows how to do an intrinsic calibration based on the Facet12 calibration target (aka Static target), see also CX_3D_TARGET_FACETS_12 Demonstrates the usage of C# wrapper classes AT.cx.c3d.Calib, AT.cx.c3d.Target and AT.cx.c3d.PointCloud.

Python Examples

- cx_3d_show_point_cloud.py: Demonstrates how to use cx3d library for converting range image to point cloud.

Matlab and Octave Examples

- cx_3d_show_point_cloud.m: Demonstrates how to use cx3d library for converting range image to point cloud.

CxCamLib

C Examples

Example demonstrating device access

- cx_cam_userset_activate.cpp: This example shows how to download, upload and activate a user set.

Acquisition Example

- c5_chunk_test.cpp: Demonstrates how to read and process chunk data from a device buffer.

CX-3D-Camera Example

- c5_grab_multipart.cpp: This example shows how to snap a single multichannel frame and how to split the data into seperate images for each data channel.

C++ Examples

Examples demonstrating device access

- cx_cam_enumerate_nodemap.cpp: Demonstrates how to iterate the parameter map of a device. A file with all available parameter information is generated.
- cx_cam_nodemap_param.cpp: Demonstrates how to read and write device parameters and how to get more detailed information about a parameter.

Acquisition Examples

- cx_cam_snap_image.cpp: Demonstrates the steps necessary to snap a single image.
- cx_cam_grab_continuous.cpp: Demonstrates the steps necessary to perform continuous image acquisition.
- cx_cam_grab_event.cpp: Extending the cx_cam_grab_continuous.cpp example with additional event handling.

C# Examples

Examples demonstrating device access

- cx_cam_enumerate_nodemap.cs: Demonstrates how to iterate the parameter map of a device. A file with all available parameter information is generated.
- cx_cam_nodemap_param.cs: Demonstrates how to read and write device parameters and how to get more detailed information about a parameter.
- cx_cam_userset_activate.cs: This example shows how to download, upload and activate a user set.

Acquisition Examples

- cx_cam_snap_image.cs: Demonstrates the steps necessary to snap a single image.
- cx_cam_grab_continuous.cs: Demonstrates the steps necessary to perform continuous image acquisition.
- cx_cam_grab_event.cs: Extending the cx_cam_grab_continuous.cs example with additional event handling.
- cx_cam_chunk_test.cs: Demonstrates how to read and process chunk data from a device buffer.

CX-3D-Camera Examples

- cx_cam_grab_multipart.cs: This example shows how to snap a single multichannel frame and how to split the data into seperate images for each data channel.
- cx_cam_grab_gev_multipart.cs: This example shows how to snap a single frame with gev multipart payload.

Python Examples

- cx_cam_snap_image.py: Demonstrates the necessary steps for image acquisition.

Examples demonstrating device access

- cx_cam_enumerate_nodemap.py: Demonstrates how to iterate the parameter map of a device. A file with all available parameter information is generated.
- cx_cam_nodemap_param.py: Demonstrates how to read and write parameters and how to get more detailed information about a parameter.

Acquisition Examples

- cx_cam_chunk_test.py: Demonstrates how to read and process the chunk data from an image buffer.
- cx_cam_grab_continuous.py: Demonstrates the steps necessary to perform continuous image acquisition.
- cx_cam_grab_event.py: Demonstrates how to (un-)register event handler for different events.
- cx_cam_snap_image.py: Demonstrates the steps necessary to snap a single image.
- cx_cam_snap_sequence.py: Demonstrates the steps necessary to snap an image sequence.

Matlab and Octave Example

- cx_cam_snap_image.m: Demonstrates using cxCamLib for image acquisition.

8 Configuration and Operation

8.1 Essential features

Tip: If you are setting up the sensor for the first time, we recommend to read through this chapter thoroughly. It describes all features which are needed for a first setup. A complete list of all available features and settings can be found in the **GenICam Documentation**.

Factory configuration and User Set Control

In User Set Control the features for global control of the device settings can be found. All devices from AT – Automation Technology GmbH are shipped with a factory configuration (default), which ensures a state, where image acquisition can be started. Apart from the default User Set, up to three different User Sets can be defined.

With UserSet Selector a User Set can be choosen. UserSet Load loads the selected UserSet, UserSet Save saves the current User Set. With UserSet Default a User Set can be selected, which will be activated during startup of the device.

Tip: Loading a User Set will directly overwrite the current settings.

Areascan and Linescan3D

This device is capable to output data in two different modes. Areascan is a 2D mode, which outputs classical image data of the target object. In the LineScan3D mode the device delivers height data of the object. In the XML Window these two modes can be found and set under DeviceControl -> DeviceScanType.

In Areascan mode, the laser line is directly visible and is therefore usually used to set up the sensor for Linescan3D mode.

Image Format Control and regions

Regions of Interest (ROI or regions) are areas within the laser plane that can be freely determined according to certain rules. In the defined regions the device will search for the laser line in Linescan3D mode. By setting a region smaller than the full image sensor the frame rate can be increased. In Areascan mode the frame rate is limited by the output rate of the device (GigE). However, due to reduced data size in LineScan3D mode the frame rate is limited mainly by the output rate of the image sensor, which can be increased by reducing the region size.

The rules for setting up regions are:

- Up to four independent regions can be set
- Regions cannot intersect each other

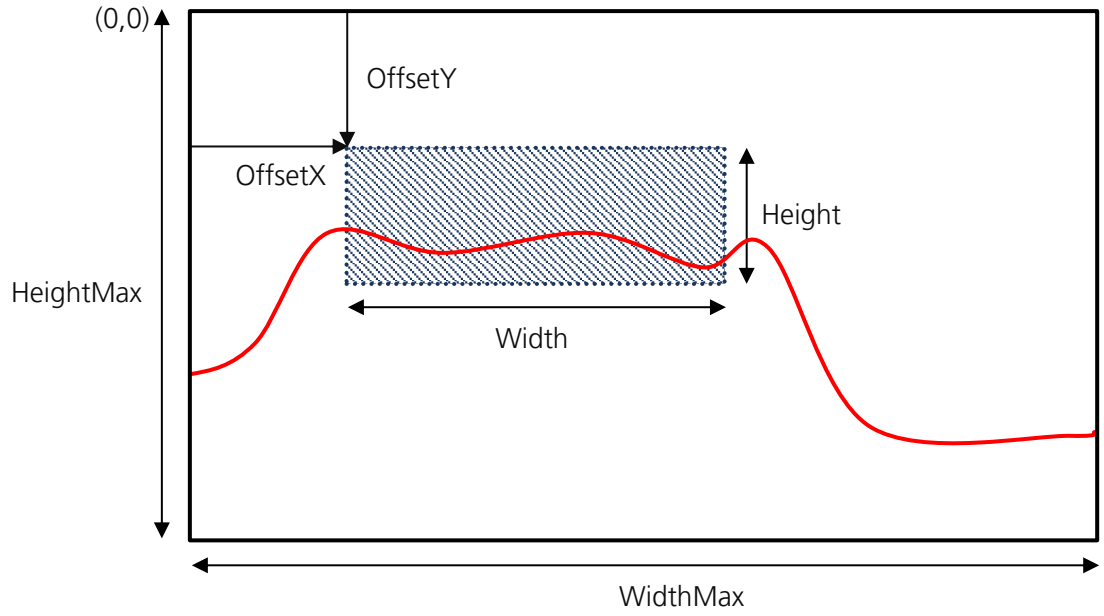


Figure 53: Settings for region size and position

The region settings can be found under Image Format Control -> Region Selector. For defining the region size and the position the parameters Height, Width, OffsetX and OffsetY are used. HeightMax and WidthMax are the fixed size of the imager.

Exposure time

In addition to the region size (Sensor Readout Time) the exposure time affects the output rate of the image sensor. The profile frequency is limited by the exposure time plus several microseconds for processing.

The exposure time can be set under Acquisition Control.

The exposure time should be chosen as short as possible but long enough, so that the laser line appears thin but clearly visible. If the exposure time is set to high the image will be saturated, which leads to reduced accuracy. In addition, the required exposure time is strongly dependent on the selected laser brightness.

Tip: The cxExplorer Line Plot Tool can be used to adjust the exposure time optimally. In Areascan the Line Plot will show the intensity distribution in the selected image row.

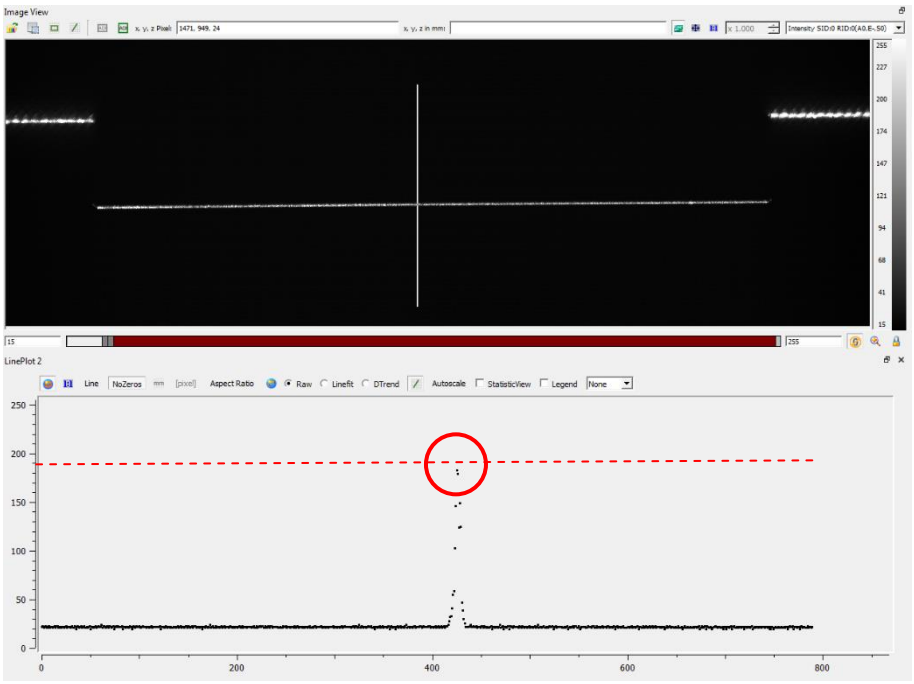


Figure 54: The exposure time is adjusted optimally. The line plot shows high intensity values but no saturation (Pixelformat: Mono8).

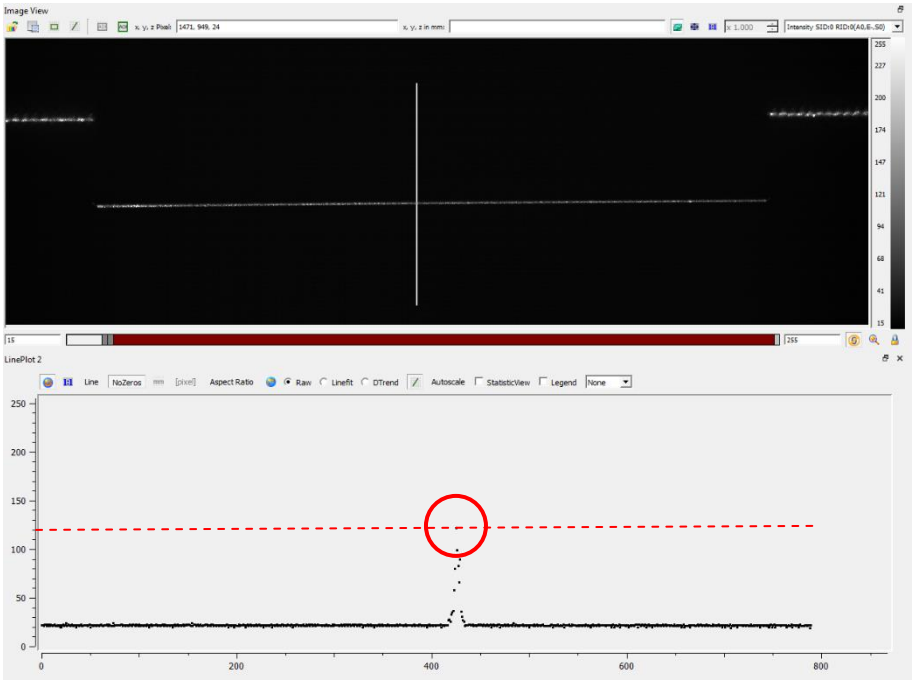


Figure 55: The exposure time is too short. The laser line appears faint (Pixelformat: Mono8).

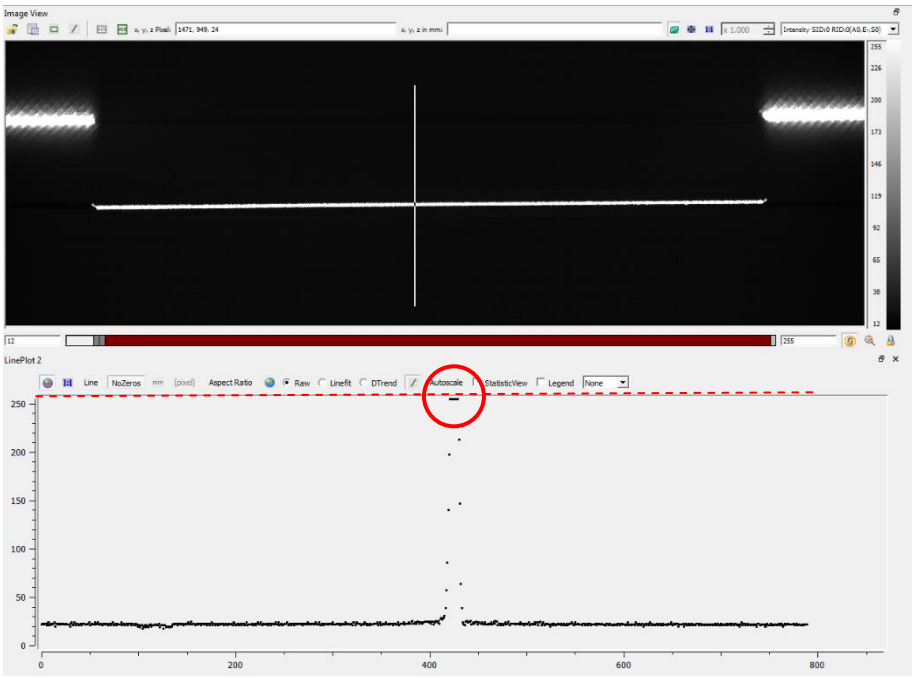


Figure 56: The exposure time is too long. Pixel saturation occurs and the laser line appears wide (Pixelformat: Mono8).

Scan3D Control and Scan3D Extractions

The Linescan3D mode comes with different algorithms for laser line detection. For further information about these algorithms, please see chapter **Measuring Principle**. For each enabled region the extraction algorithm of the corresponding Scan3D Extraction and other settings can be set independently. They can be found in the XML Window under Scan3D Control -> Scan3D Extraction Selector -> Scan3D Extraction Method

Tip: If you want to use more than one region and Scan3D Extraction, each region and Scan3D Extraction must be activated individually. Even though the Scan3D Extractions settings can be found under Scan3D Control, the Scan3D Extractions must be activated in Linescan3D mode under Image Format Control -> Region Selector.

In all extraction modes only intensity values higher than the Scan3d Extraction Threshold are processed in order to suppress weak signal noise. In case that no position value can be found, e.g. no intensity value is higher than threshold, the position value 0 is returned. This results in an extraction zone, which is limited by the region hight and the Extraction Threshold.

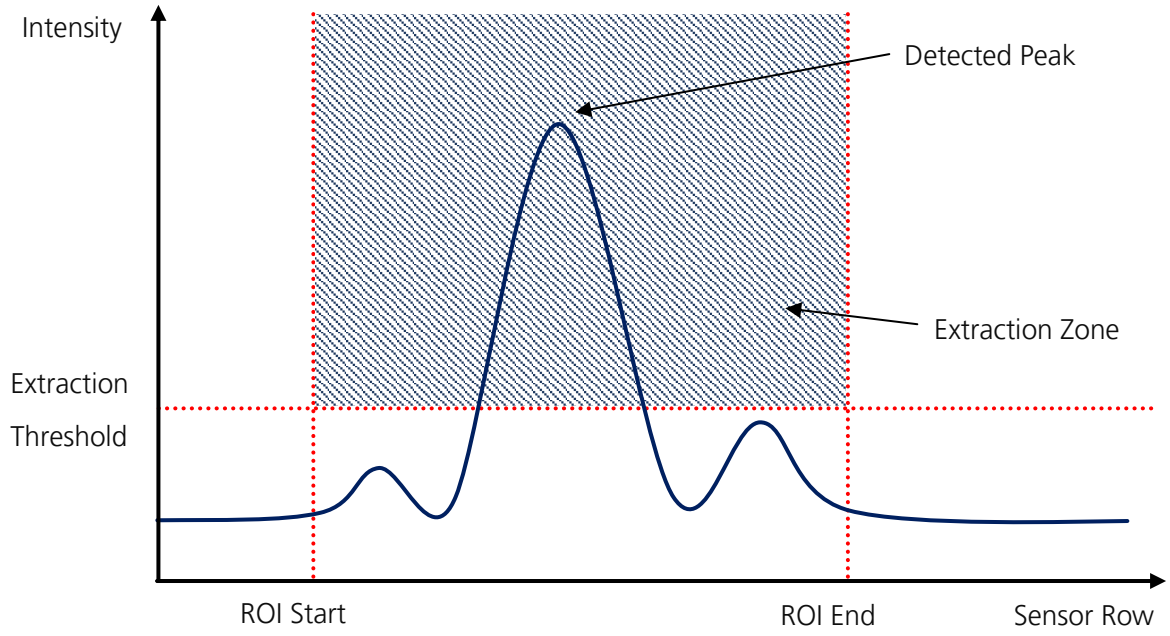


Figure 57: Zone for peak extraction

Light control

All AT – Automation Technology devices of the MCS series are equipped with an internal laser module. Under Light Control all settings regarding the laser can be found. The values for Light Controller Source are:

- Off: The laser is turned off
- On: The laser is always on
- Exposure Active: The Laser is only turned on during exposure time
- Acquisition Active: The laser is only turned on during acquisition

Warning: Before turning the integrated laser on all laser safety requirements must be met. For more information see chapter **Laser safety**.

Tip: To maximize the lifetime of the laser, it is recommended to use the pulsed modes (exposure active and acquisition active). However, the laser may appear weaker in exposure active mode.

The laser output power respectively the laser brightness can be set by setting the Light Brightness value to 0% - 100%.

Tip: Depending on the exact laser module it is possible that the laser shows no output, when set to <=50 %.

Encoder Control

Under Encoder Control all settings regarding the encoder and trigger can be found.

Encoder Source A

The signal which will be the source auf the A input of the encoder can be selected. Usually, it should be set to Line2 (Encoder-A) which can be used when the device is connected to an encoder through the IO-Panel.

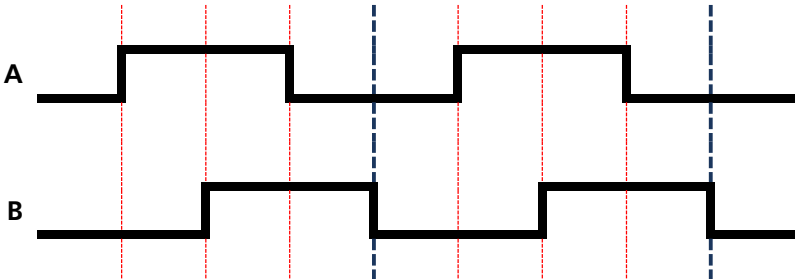
Encoder Source B

The signal which will be the source auf the B input of the encoder can be selected. Usually, it should be set to Line3 (Encoder-B) which can be used when the device is connected to an encoder through the IO-Panel.

Encoder Mode

With signals from the Encoder Source A and B there are four different states. If signal A rises, signal B is low. If signal B rises, signal A is already high and so on. In Four Phase mode all states must be cycled through in order to count one increment. This provides a certain amount of jitter filtering. In High Resolution mode each change of state counts as one increment. This provides four times the resolution, but is vulnerable to jitter.

Tip: We recommend to use the Four Phase mode, because of its robustness.



Four Phase	0	0	0	0	1	1	1	1	2
Encoder Value	0	0	0	0	1	1	1	1	2
High Resolution	1	2	3	4	5	6	7	8	9
Encoder Value	1	2	3	4	5	6	7	8	9

Encoder Divider

Sets how many Encoder increment/decrements that are needed generate an Encoder output pulse signal.

Encoder Output Mode

It is possible to trigger the device in several modes. Each mode can be operated in “Up” and “Down” direction.

Position

In Position mode only in one direction will be generated. It will result in an image as if there was only forward motion. If the direction is reversed during acquisition the triggering will continue if the position from the last forward motion is passed again.

Direction

The Direction mode is similar to Position mode, but only reversed motion will be ignored. It will continue to send pulses as soon as forward motion is detected again.

Motion

Output pulses in both directions will be generated.

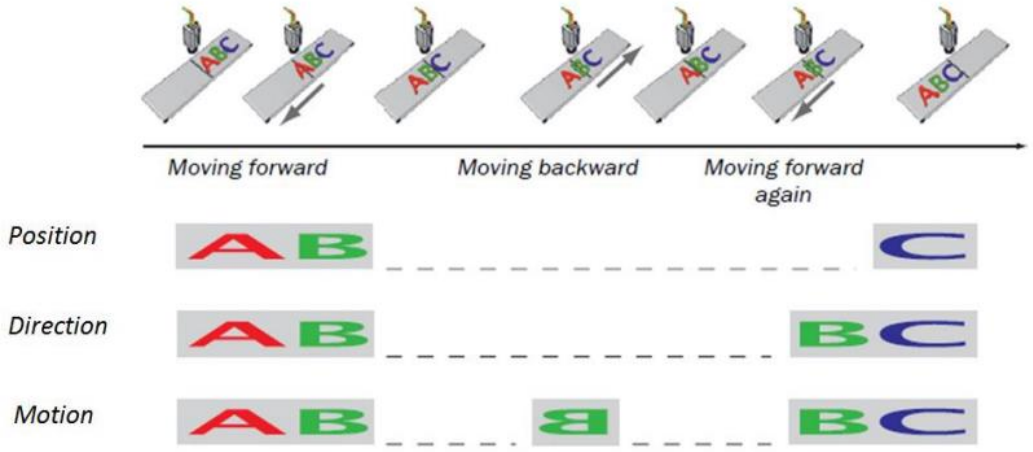


Figure 58: Encoder output modes

8.2 Advanced features

Multi Part and Components

Usually in Areascan mode the device outputs Intensity data from the enabled regions. In Linescan3D mode the device outputs range data by default from each enabled region. In this case range and intensity data are called components from their source region. In addition, our devices are able to output different components.

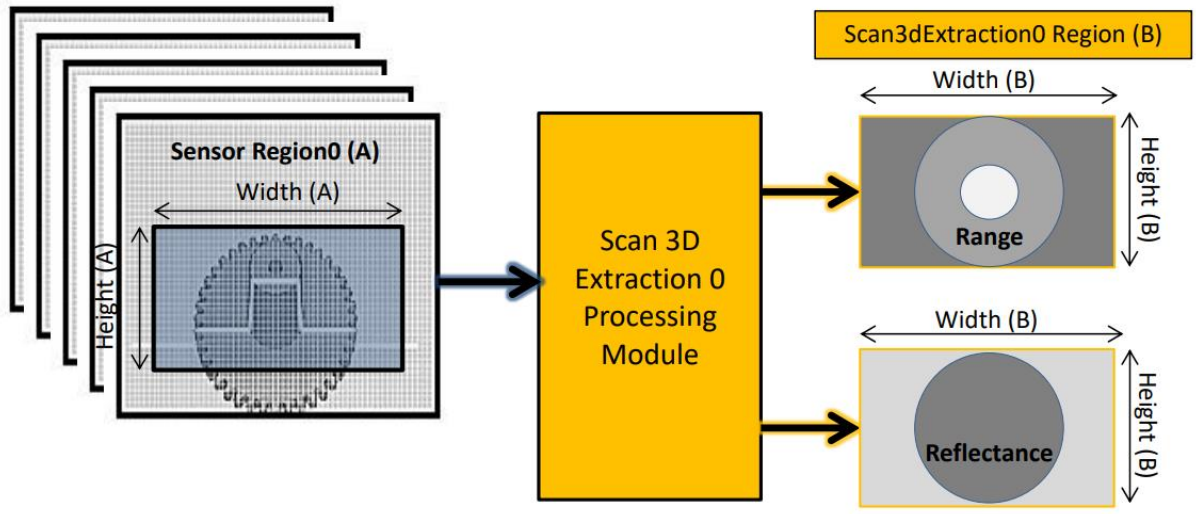


Figure 59: Component processing in the sensor

The settings for that can be found under Image Format Control -> Region Selector -> Component Selector. The Component Selector allows to enable multiple components from one source region. Our devices support the following components:

Intensity

Acquires a monochrome intensity image. In Areascan mode this component is enabled by default and is the only option. Intensity components are only available in Areascan mode.

Range

If enabled the output image will contain the range data. In Linescan3D mode the range component is enabled by default.

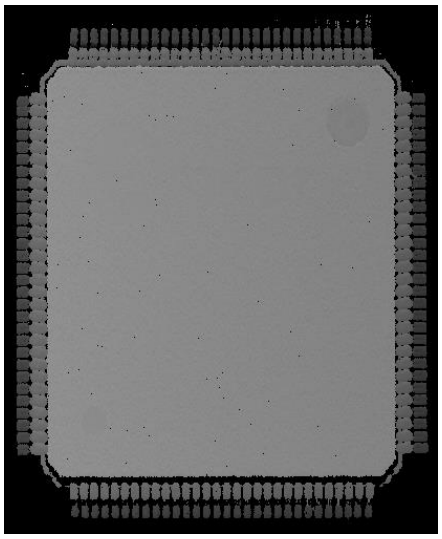


Figure 60: Typical Range image

Reflectance

Acquires the reflected intensity in Linescan3D mode. In COG mode this corresponds to the sum of intensity normalized by the width of the laser line. In MAX, TRSH and FIRPeak mode it will be the intensity at the calculated peak position. This component is useful for scans of objects with QR-Codes.

Figure 61: Typical Reflectance image

Scatter

The scatter component is defined by the width of the laser line. This component can be used to detect different surfaces.

Figure 62: Typical Scatter image

Multi Peak Mode

Tip: The Multi Peak Mode is a AT specific feature which is not documented in the GenICam reference documentation (SFNC).

Multi Peak is a feature which allows to output multiple height information when the extraction algorithm detects multiple laser line peaks in one column of the imager. By enabling the Multi Peak Mode unwanted reflections can be filtered out easily. Up to four peaks can be enabled and output. The settings for the Multi Peak Mode can be found under Scan3D Control and can be set for each Scan3d Extraction individually.

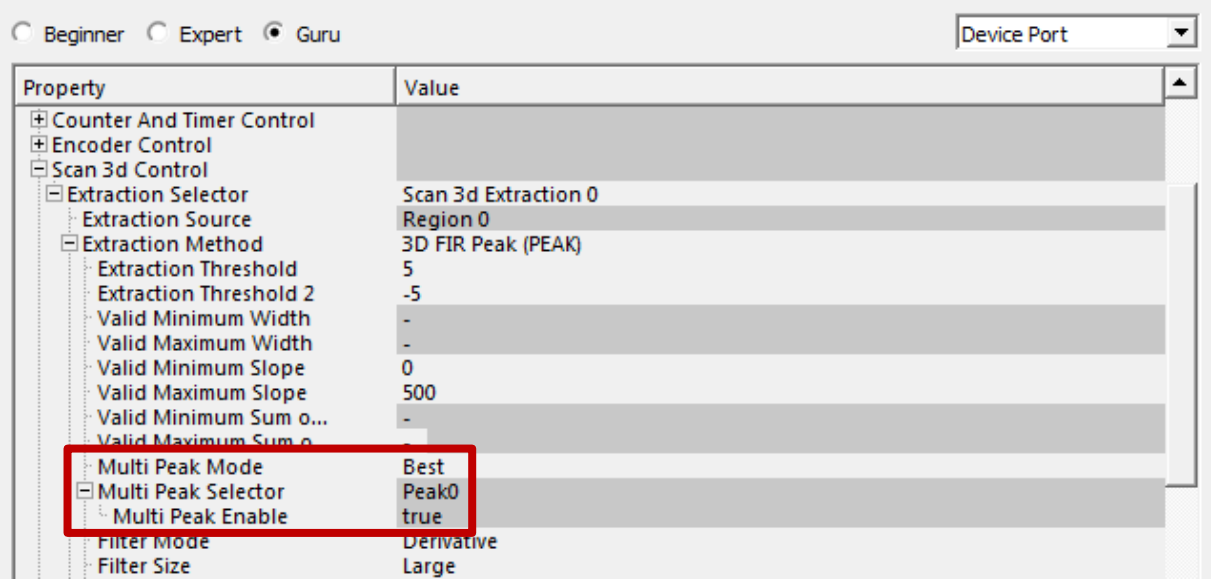


Figure 63: Multi Peak Settings in the XML Window

The MultiPeakMode can be set to four different peak modes:

First

The first detected valid peak will be output. A peak is valid, when the algorithm found a rising edge over the specified threshold and the corresponding falling edge. The peak detection will be stopped after the first found peak.

Best

This mode is only available in FIRPeak mode. The algorithm outputs the best peak, i.e. the peak with the steepest rise in the first derivative. Peaks can be overwritten when a better peak is found.

SetFirst

The first four detected peaks will be saved and can be output individually. This mode is similar to the "First" mode, but no peak will be overwritten. With Multi Peak Enable individual peaks can be enabled. Internally all four peaks will need memory space but only the selected and enabled peaks will be output.

Single

The Single mode is not available in FIRPeak mode. It will only output one Peak from the first rising edge to the last falling edge. Only one memory slot is needed and no peak detection is necessary.

Multi Peak Mode:	Available in:	Number of possible Peaks:	Default Mode in:
First	All Modes	1	-
Best	FIRPeak	1	FIRPeak
SetFirst	All Modes	4	-
Single	TRSH, MAX, COG	1	TRSH, MAX, COG

Multi Slope Mode

The Multiple Slope Mode is a function to increase the dynamic range of the sensor. It allows capturing very weak and very strong intensity signals at the same time without image saturation, thus enhancing the precision of laser line detection. The Multi Slope Mode works by limiting the pixel saturation to a

certain value for a certain portion of the exposure time. You can find all features which control the Multi Slope Mode under Acquisition Control in the cxExplorer's XML window.

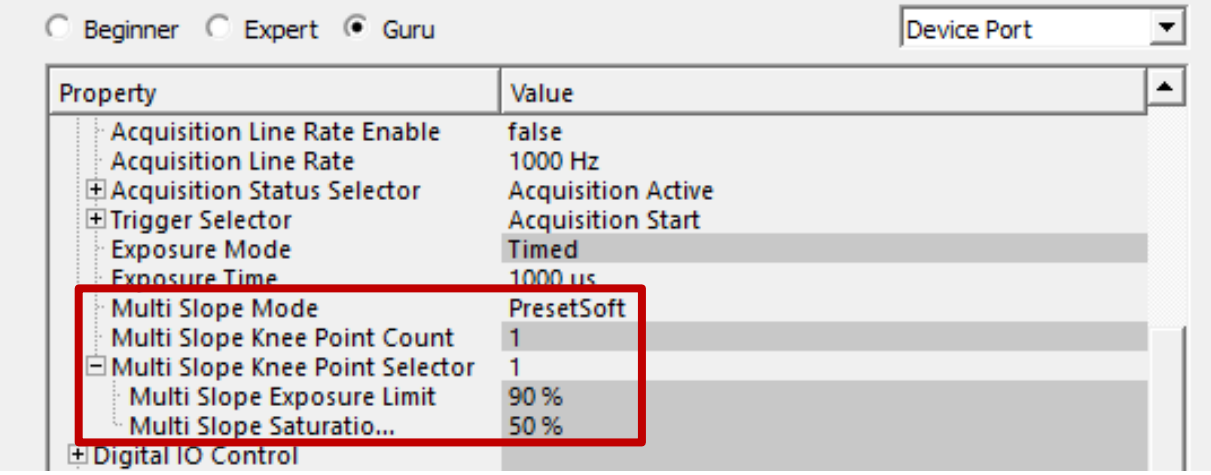


Figure 64: Multi Slope Settings in the XML Window

The Multi Slope Mode can be enabled by changing Acquisition Control -> Multi Slope Mode to manual or to one of the three pre-defined settings. These settings make it much easier to find the right setup. We strongly recommend to use the presets in your application. There are three parameters, which are controlling the behavior. The Multi Slope Knee Point Count controls how many knee points there will be. With Multi Slope Knee Point Selector you can select which Knee Point you want to adjust. The Multi Slope Exposure Limit controls to what portion of the exposure time a certain saturation level can be reached. This saturation level is called Multi Slope Saturation. You can set these values for each knee point individually.

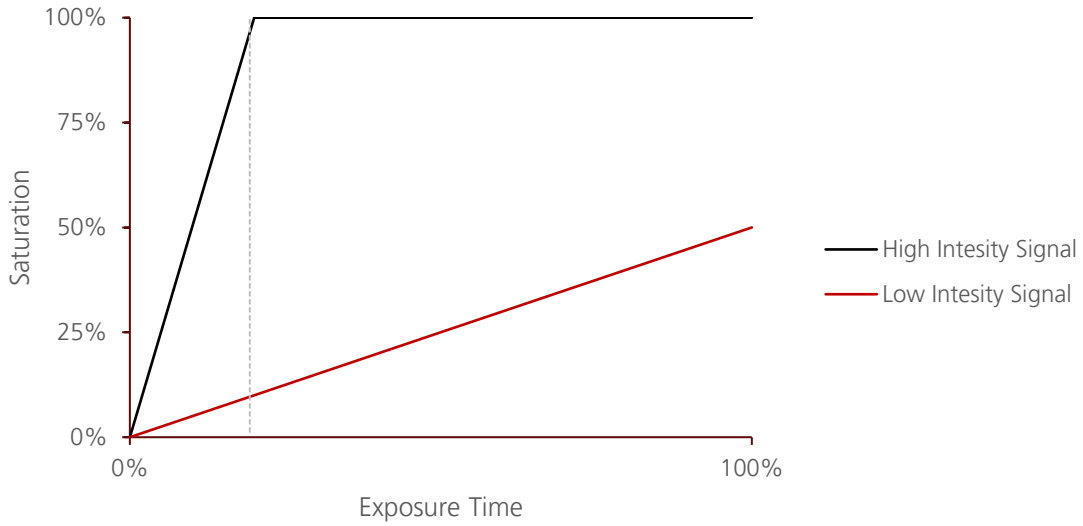


Figure 65: Single Slope Mode (Multi Slope Mode = Off)

In Default mode the high intensity signals are growing fast and leading to saturated pixels after a small portion of the exposure time. The low intensity signals on the other hand are growing very slow.

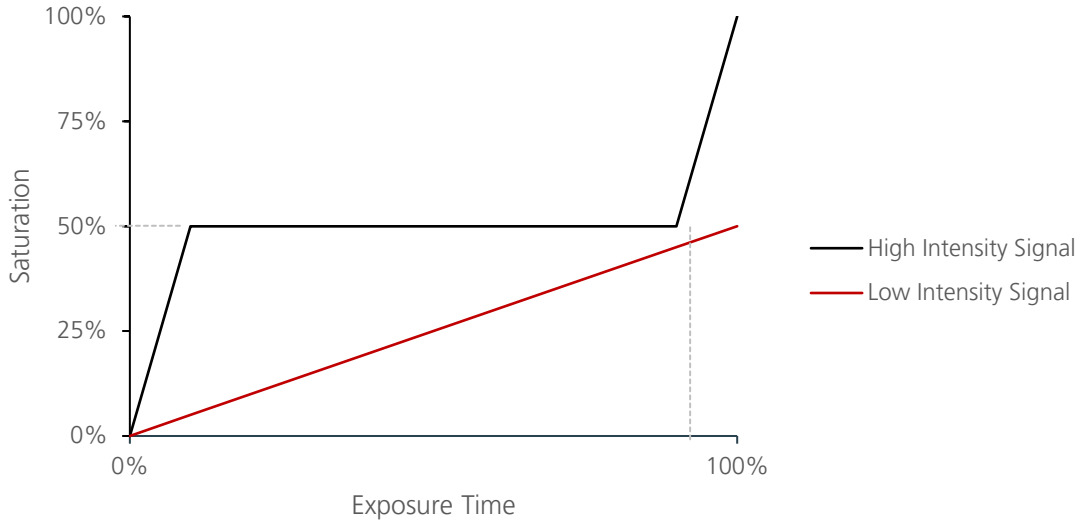


Figure 66: Dual Slope Mode (1 Knee Point)

With one enabled knee point in this example the maximum saturation level is set to 50% for 90% of the exposure time.

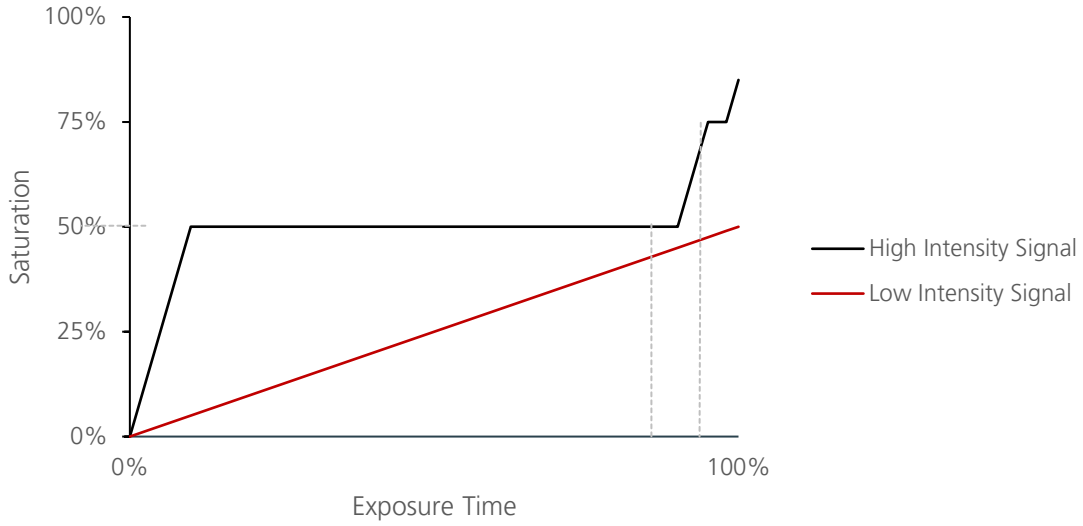


Figure 67: Triple Slope Mode (2 Knee Points)

With two enabled knee points in this example the maximum saturation level is set to 50% for 90% of the exposure time and then to 75% for 98% of the exposure time.

Tip: The values in the diagrams are for illustrative purposes and may not be accurate depending on the application.

Multi Slope Mode presets:

PresetSoft

Exposure Slope Knee Point Count = 1

Multi Slope Exposure Limit = 90%

Multi Slope Saturation = 50%

PresetMedium

Exposure Slope Knee Point Count = 1

Multi Slope Exposure Limit = 95%

Multi Slope Saturation = 40%

PresetAgressive

Exposure Slope Knee Point Count = 2

Multi Slope Exposure Limit 1 = 90 %

Multi Slope Saturation 1 = 30 %

Multi Slope Exposure Limit 2 = 99 %

Multi Slope Saturation 2 = 40 %

Tip: The presets are a quick and easy way to set up the Multi Slope Mode. In the unlikely event that the presets are not sufficient for your application, please contact our support at support@automationtechnology.de.

Coordinate Scale

The Coordinate Scale is used, when transforming a pixel from relative to world coordinates. All settings that relate to the Coordinate Scale can be found in the XML window under Scan 3d Control. The Coordinate Scale and Coordinate Mode can be set for each Scan 3d Extraction individually.

Tip: In the previous C5 device generation, the Coordinate Scale was called subpixel. subpixel and Coordinate Scale are directly related and can be converted with the following formula.

$$\text{Coordinate Scale} = \frac{1}{2^{\text{Number of Subpixels}}}$$

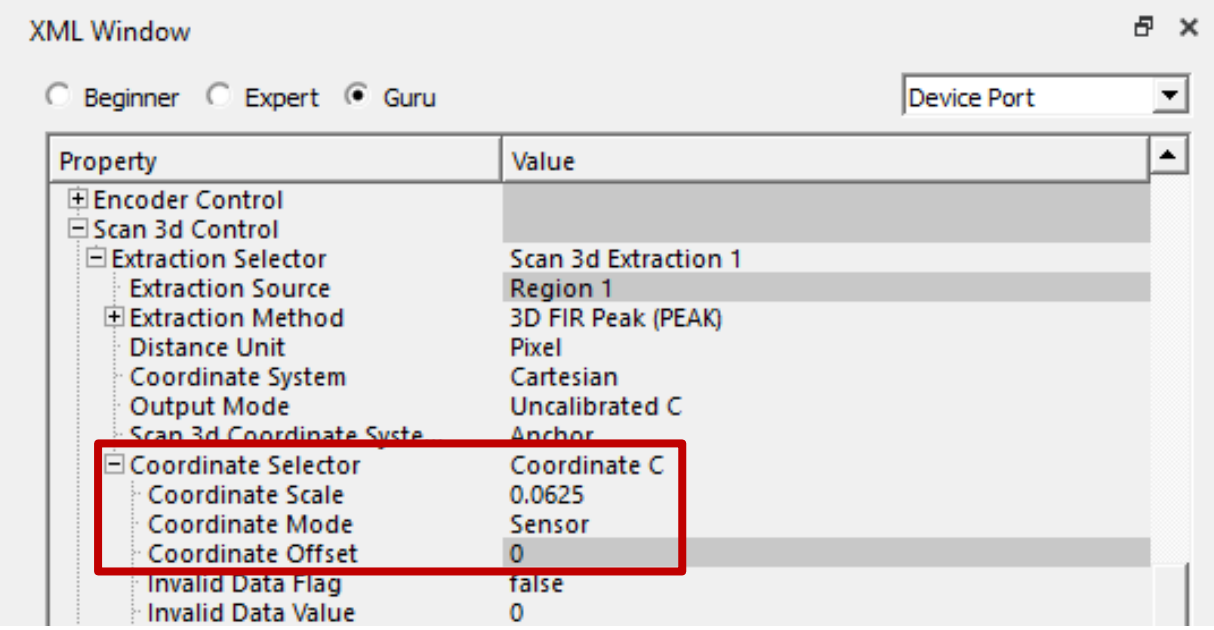


Figure 68: Coordinate Scale feature in the XML window

The possible range values of the 3D sensors in each pixel in the range image are directly limited by the used pixel format (Mono8, Mono16). In pixel format Mono16 there are possible values between 0 and 65535. Setting the Coordinate Scale to the minimum value of 0.015625 may result in a bit overflow. If the laser line appears at a sensor row higher than 1023.

$$65535*0.015625 \approx 1023$$

For example, if the Coordinate Scale is set to 0.015625 and the laser line appears at row 1500 a bit overflow occurs.

$$\frac{1500}{0.015625} = 96000$$

The tables below show the Coordinate Scale compared to the laser line appearance on the sensor and whether this combination leads to bit overflow.

CS Value / Rows	1	0.5	0.25	0.125	0.0625	0.03125	0.015625
1023	✓	✓	✓	✓	✓	✓	✓
2047	✓	✓	✓	✓	✓	✓	✗
3072	✓	✓	✓	✓	✓	✗	✗

CS Value / Rows	1	0.5	0.25	0.125	0.0625	0.03125	0.015625
3	✓	✓	✓	✓	✓	✓	✓
7	✓	✓	✓	✓	✓	✓	✗
15	✓	✓	✓	✓	✓	✗	✗
31	✓	✓	✓	✓	✗	✗	✗
63	✓	✓	✓	✗	✗	✗	✗
127	✓	✓	✗	✗	✗	✗	✗
255	✓	✗	✗	✗	✗	✗	✗

The Coordinate Scale value in the factory configuration is always set to fit the complete Z-range on the sensor chip without overflows. However, it is possible to optimise this setting and use a lower Coordinate Scale value even when the laser line appears on a sensor row >1023.

In that case the defined region for the selected Scan 3d Extraction must be smaller or even 1023/2047 rows and the Coordinate Mode must be set to region. Then the offset position with respect to the start row of the region is returned and thus the laser line can appear on sensor rows >1023.

9 Service information

9.1 Support

To process your support inquiries immediately, we always need the serial number of the camera, the firmware version, a snapshot with calibration and current User Set saved as GenDC Container in the cxExplorer and a precise problem description.

support@automationtechnology.de

9.2 RMA

Before returning a sensor for repair (warranty or non-warranty) to AT – Automation Technology GmbH, AT must provide a Return Material Authorization (RMA) number. Please get in contact with AT to receive an RMA number.

rma@automationtechnology.de

The RMA form to ask for an RMA number can be downloaded at:

www.automationtechnology.de/rma

Ship the sensor carefully packed in its original shipping box or an equivalent box back to our destination in Germany, 23843 Bad Oldesloe, Hermann-Bössow-Straße 6-8. If you purchased a camera over a distributor, please get in contact with them to start the RMA process.

9.3 Product support

The Quick start Guide, cxSupportPackage, manuals and FAQs can be accessed via our product support website at:

https://www.automationtechnology.de/cms/en/product-support/

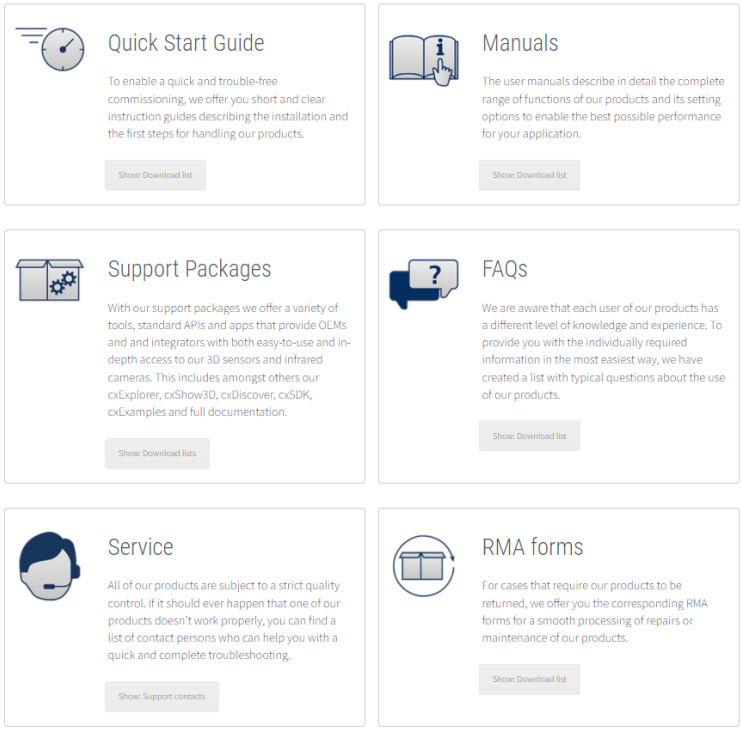


Figure 69: Product support website

10 Maintenance

10.1 Cleaning

The sensor is maintenance-free. This chapter is limited to cleaning the sensor. Use only the following items:

- Water
- Residue-free, weak detergent solution
- Soft cloth
- Lens cleaner liquid or 96% ethyl alcohol
- Lens cleaning cloths

Clean the sensor with the wetted, non-dripping cloth. Don´t expose the sensor to running liquids or immerse it.

If the protective windows are dirty, it must only be cleaned by authorized specialist personnel. Clean the windows only when absolutely necessary and within a clean environment.

Notice: Never use solvents or similar liquids to clean the housing, protective windows, cables or accessories. This may cause damage to the device.

11 Accessories/Options

11.1 Laser Options

Part Number #	Description	MTBF @25°C (h)
202 206 001	MCS Laser Module 1 405nm Class 2M	50000
202 206 002	MCS Laser Module 1 405nm Class 3R	25000
202 206 003	MCS Laser Module 1 405nm Class 3B	10000
202 206 201	MCS Laser Module 1 660nm Class 2M	160000
202 206 202	MCS Laser Module 1 660nm Class 3R	120000
202 206 203	MCS Laser Module 1 660nm Class 3B	75000

11.2 Encoder Options

Part Number for I/O and Encoder Option

Part Number #	Product Option
202 187 001	C5 Camera / CS HTL Encoder Option
202 187 002	C5 Camera / CS Single-Ended TTL Encoder Option
202 187 003	C5 Camera / CS Single-Ended HTL Encoder Option

Encoder/ Resolver Input Specification

Option	Specification
Differential HTL	Max. input voltage +24V DC Max. frequency: 1 MHz Min. pulse width: 475ns
Single-Ended TTL	Max. input voltage +5V DC (TTL level) Max. frequency: 5 MHz Min. pulse width: 80 ns
Single-Ended HTL	Max. input voltage +24V DC Max. frequency: 400 kHz Min. pulse width: 1.2µs

11.3 IO/Panel

Part Number #	Description
202 201 402	CS-IO-Panel

11.4 Cable Options

Cables for Power, I/O and Laser Control

Part Number #	Description
202 202 300	M12 17 pin cable for power, I/O and laser control, custom length and connector configuration (straight/angled), shielded, high flex
202 202 301	M12 17 pin cable for power, I/O and laser control, straight M12 female connector (IP67) to straight M12 male connector (IP67), shielded, length 0.5m, high flex
202 202 302	M12 17 pin cable for power, I/O and laser control, straight M12 female connector (IP67) to straight M12 male connector (IP67), shielded, length 3m, high flex
202 202 303	M12 17 pin cable for power, I/O and laser control, straight M12 female connector (IP67) to straight M12 male connector (IP67), shielded, length 5m, high flex
202 202 304	M12 17 pin cable for power, I/O and laser control, straight M12 female connector (IP67) to straight M12 male connector (IP67), shielded, length 10m, high flex
202 202 305	M12 17 pin cable for power, I/O and laser control, straight M12 female connector (IP67) to straight M12 male connector (IP67), shielded, length 15m, high flex

Pigtail cables:

Part Number #	Description
202 202 311	M12 17 pin pigtail cable for power, I/O and laser control, straight M12 female connector (IP67) on camera plug, shielded, length 3m, high flex
202 202 312	M12 17 pin pigtail cable for power, I/O and laser control, straight M12 female connector (IP67) on camera plug, shielded, length 5m, high flex
202 202 313	M12 17 pin pigtail cable for power, I/O and laser control, straight M12 female connector (IP67) on camera plug, shielded, length 10m, high flex
202 202 314	M12 17 pin pigtail cable for power, I/O and laser control, straight M12 female connector (IP67) on camera plug, shielded, length 15m, high flex
202 202 315	M12 17 pin pigtail cable for power, I/O and laser control, straight M12 female connector (IP67) on camera plug, shielded, length 30m, high flex

Angled adapter cables:

Part Number #	Description
202 201 501	M12 17 pin angled adapter cable for power, I/O and laser control, 90° angled M12 female connector (IP64) on camera plug to straight M12 male (IP64), angled connector configuration “TYPE #1”, length 0.2m, standard

Part Number #	Description
202 201 511	M12 17 pin angled adapter cable for power, I/O and laser control, 90° angled M12 female connector (IP64) on camera plug to straight M12 male (IP64), angled connector configuration "TYPE #2", length 0.2m, standard

Wire Assignment of M12 17 pin Pigtail Cable

Pin/Wire No.	Wire Colour	Signal Name	Description
1	Brown	ENC_Z-	Encoder/Resolver index track Z-
2	Blue	LASER_Supply	Laser supply voltage (+10 to +24V DC)
3	White	ENC_Z+	Encoder/Resolver index track Z+
4	Green	ENC_B+	Encoder/Resolver Track B+
5	Pink	GND_EXT	Laser/Sensor supply GND Pin1
6	Yellow	ENC_B-	Encoder/Resolver Track B-
7	Black	ENC_A-	Encoder/Resolver Track A-
8	Gray	VCC_EXT	Sensor supply voltage (+10 to +24V DC)
9	Red	GND_EXT2	Laser/Sensor supply GND Pin2
10	Violette	ENC_A+	Encoder/Resolver Track A+
11	Gray/Pink	ENC_GND	Encoder/Resolver ground
12	Red/Blue	OUT2	Opto-isolated digital output 2
13	White/Green	IN1	Opto-isolated digital input 1 (+5 to +24V DC)
14	Orange/Green	IN2	Opto-isolated digital input 2 (+5 to +24V DC)
15	White/Yellow	OUT_Supply	Reference supply for digital output signals (+5 to +24V DC)
16	Yellow/ Orange	OUT1	Opto-isolated digital output 1
17	White/Gray	IO_GND	Reference ground for digital inputs (IN1, 2) and outputs (OUT1, 2)

Cables for GigE Interface

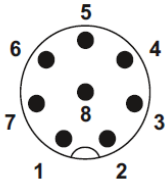
Part Number #	Description
202 201 200	M12 GigE cable with custom length and connector configuration (straight/angled)
202 201 201	M12 GigE cable, straight M12 male connector (IP67) on camera plug to RJ45 (IP20), length 0.5m, standard
202 201 202	M12 GigE cable, straight M12 male connector (IP67) on camera plug to RJ45 (IP20), length 3m, standard
202 201 203	M12 GigE cable, straight M12 male connector (IP67) on camera plug to RJ45 (IP20), length 5m, standard
202 201 204	M12 GigE cable, straight M12 male connector (IP67) on camera plug to RJ45 (IP20), length 10m, standard

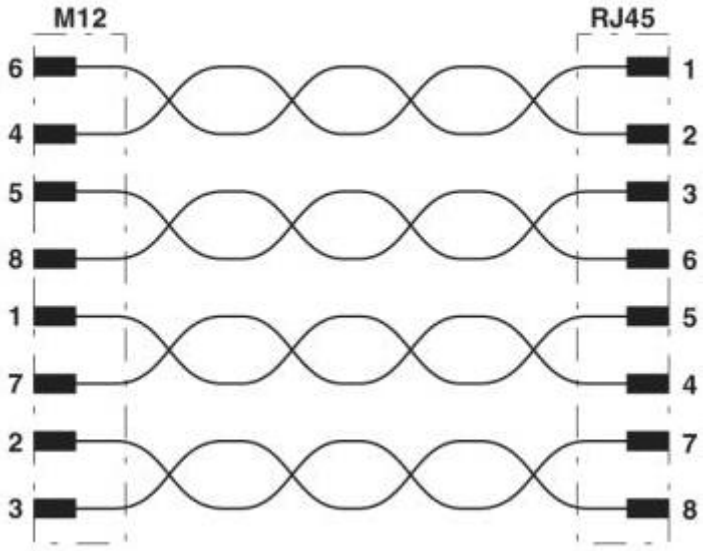
Part Number #	Description
202 201 205	M12 GigE cable, straight M12 male connector (IP67) on camera plug to RJ45 (IP20), length 15m, standard
202 201 206	M12 GigE cable, straight M12 male connector (IP67) on camera plug to RJ45 (IP20), length 30m, standard

Angled adapter cables:

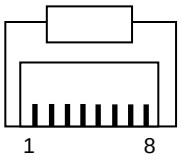
Part Number #	Description
202 201 502	M12 GigE angled adapter cable for GigE, 90° angled M12 male connector (IP64) on camera plug to straight M12 female (IP64), angled connector configuration "TYPE #1", length 0.2m, standard
202 201 512	M12 GigE angled adapter cable for GigE, 90° angled M12 male connector (IP64) on camera plug to straight M12 female (IP64), angled connector configuration "TYPE #2", length 0.2m, standard

M12
Male Plug





RJ45
Male Plug



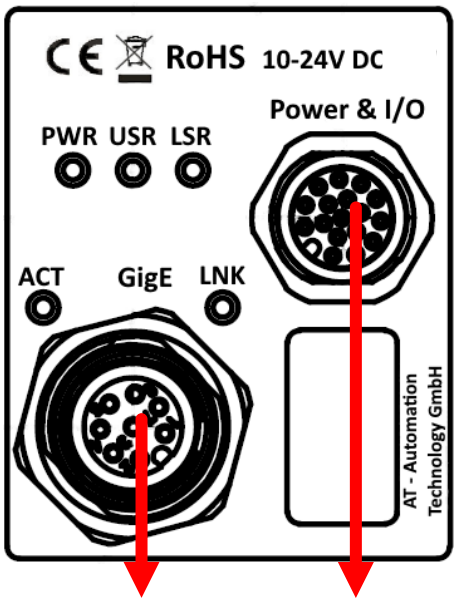
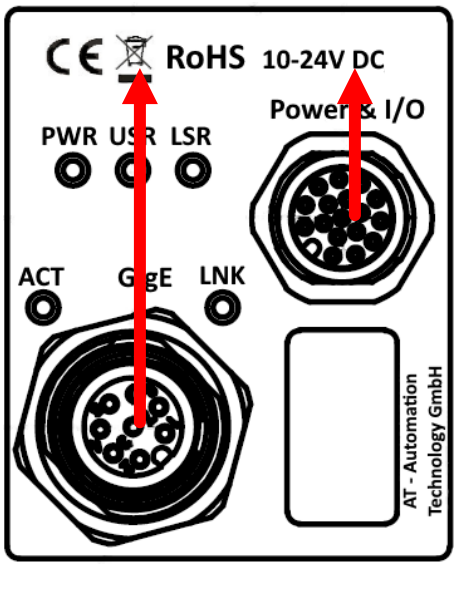
GigE Signal Name	Pin No. M12	Pin No. RJ45
BI_DC-	1	5
BI_DD+	2	7
BI_DD-	3	8
BI_DA-	4	2
BI_DB+	5	3
BI_DA+	6	1
BI_DC+	7	4

GigE Signal Name	Pin No. M12	Pin No. RJ45
BI_DB-	8	6
Shield	Shield	Shield

Orientation of Angles Adapter Cable

Depending on the angled adapter cable the option "TYPE #1" or "TYPE #2" will change the outlet direction of the angled cables.

Part Number #	Description
202 201 501	Power & I/O "TYPE #1"
202 201 502	GigE "TYPE #1"
202 201 511	Power & I/O "TYPE #2"
202 201 512	GigE "TYPE #2"

TYPE #1	TYPE #2
	

12 GenICam documentation

12.1 DeviceControl

Category for Device information and control.

Name	Type	Access	Visibility	Description
DeviceVendorName	String	RO	Beginner	Name of the manufacturer of the device.
DeviceModelName	String	RO	Beginner	Model of the device.
DeviceFamilyName	String	RO	Beginner	Family Name of the device.
DeviceManufacturerInfo	String	RO	Beginner	Manufacturer information about the device.
DeviceVersion	String	RO	Beginner	Version of the device.
DeviceFirmwareVersion	String	RO	Beginner	Version of camera firmware
DeviceSerialNumber	String	RO	Beginner	Serial number of the camera
DeviceUserID	String	RW	Beginner	User-programmable device identifier.
DeviceScanType	Enumeration	RW	Expert	Scan type of the sensor. - *Areascan* (Value=0) - *Linescan3D* (Value=3)
DeviceTemperatureSelector	Enumeration	RW	Expert	Selects the location within the device, where the temperature will be measured. - *Mainboard* (Value=0) - *IO* (Value=1) - *Sensor* (Value=2) - *Housing* (Value=3)
DeviceTemperature *[DeviceTemperatureSelector]*	Float	RO	Expert	Device temperature in degrees Celsius (C). Min: -40 Max: 200
CVBLicense	Integer	RO	Guru	License feature for camera locked CVB license.
DeviceAccessCode	Integer	RW	Guru	Device Access Code

Name	Type	Access	Visibility	Description
DeviceAccessMode	Enumeration	RO	Guru	Device Access Mode - *Operator* (Value=1) - *Administrator* (Value=2) - *Integrator* (Value=3) - *Factory* (Value=4)
DeviceStatusAll	Integer	RO	Expert	Returns the current status of all available device status signals at time of polling in a single bitfield.
DeviceReset	Command	RW	Expert	Resets the device to its power up state. After reset, the device must be rediscovered.
DeviceLinkHeartbeatTimeout	Integer	RW	Guru	Controls the current heartbeat timeout of the specific Link in milliseconds. Min: 500
TimestampLatch	Command	WO	Expert	Latches the current timestamp value of the device
TimestampLatchValue	Integer	RO	Expert	Returns the latched 64-bit value of the timestamp counter in ns. Inc: 1

12.2 SensorControl

Features relating to sensor control

Name	Type	Access	Visibility	Description
SensorType	Enumeration	RO	Guru	Sensor Type - *None* (Value=0) - *cx4090* (Value=1) - *cx3070* (Value=2)
SensorReadoutMode	Enumeration	RW	Expert	Readout of the Sensor. - *Standard* (Value=0): Standard readout mode, each snapshoot. - *Rolling* (Value=1): Readout as rolling shutter with several lines from each snapshoot.
SensorSpeedMode	Enumeration	RW	Expert	Mode of the sensor. - *Standard* (Value=0) - *Warp1* (Value=1): Warp 1: slowest - HighSpeed mode.

Name	Type	Access	Visibility	Description
				- *Warp2* (Value=2): Warp 2: medium - HighSpeed mode. - *Warp3* (Value=3): Warp 3: fastest - HighSpeed mode.
SensorStatusAll	Integer	RO	Expert	Returns the current status of all available sensor status signals at time of polling in a single bitfield.
SensorFrameRateMax	Float	RO	Beginner	Maximum possible Sensor frame rate in Hz
SensorReadoutTime	Float	RO	Beginner	Current Sensor Readout Time in microseconds (us)
SensorGain	Enumeration	RW	Expert	Gain value applied to the sensor. - *gain_0_5* (Value=0): Gain 0.5 available for cx3070 - *gain_0_6* (Value=1): Gain 0.6 available for cx4090 - *gain_1_0* (Value=2): Gain 1.0 available for cx3070 and cx4090 (default) - *gain_1_5* (Value=3): Gain 1.5 available for cx3070 - *gain_1_6* (Value=4): Gain 1.6 available for cx4090 - *gain_2_0* (Value=5): Gain 2.0 available for cx3070 (default) and cx4090 - *gain_2_5* (Value=6): Gain 2.5 available for cx3070 - *gain_2_6* (Value=7): Gain 2.6 available for cx4090 - *gain_3_0* (Value=8): Gain 3.0 available for cx3070 and cx4090 - *gain_4_0* (Value=9): Gain 4.0 available for cx3070 and cx4090 - *gain_8_0* (Value=10): Gain 8.0 available for cx3070 and cx4090
Gain	Float	RO	Expert	Gain value applied to the sensor.
BlackLevel	Float	RW	Expert	Dark level offset of the sensor.

12.3 ImageFormatControl

Category for Image Format Control features.

Name	Type	Access	Visibility	Description
SensorWidth	Integer	RO	Expert	Effective width of the sensor (in pixels).
SensorHeight	Integer	RO	Expert	Effective height of the sensor (in pixels).
SensorPixelWidth	Float	RO	Guru	Physical size (pitch) in the x direction of a photo sensitive pixel unit.
SensorPixelHeight	Float	RO	Guru	Physical size (pitch) in the y direction of a photo sensitive pixel unit.

Name	Type	Access	Visibility	Description
WidthMax	Integer	RO	Expert	Maximum width of the image (in pixels). The dimension is calculated after horizontal binning, decimation or any other function changing the horizontal dimension of the image.
HeightMax	Integer	RO	Expert	Maximum height of the image (in pixels). This dimension is calculated after vertical binning, decimation or any other function changing the vertical dimension of the image.
RegionReverseY	Boolean	RW	Expert	Flip vertically the image of each Region.
AlternateReverseY	Boolean	RW	Guru	Alternate readout direction every frame (i.e. ReverseY on and off).
RegionSelector	Enumeration	RW	Beginner	Selects the Region of interest to control. The RegionSelector feature allows devices that are able to extract multiple regions out of an image, to configure the features of those individual regions independently. - *Region0* (Value=0): Selected feature will control the region 0. - *Region1* (Value=1): Selected feature will control the region 1. - *Region2* (Value=2): Selected feature will control the region 2. - *Region3* (Value=3): Selected feature will control the region 3. - *Scan3dExtraction0* (Value=16): Selected feature will control the Scan3dExtraction0 output from Region0. - *Scan3dExtraction1* (Value=17): Selected feature will control the Scan3dExtraction1 output from Region1. - *Scan3dExtraction2* (Value=18): Selected feature will control the Scan3dExtraction2 output from Region2. - *Scan3dExtraction3* (Value=19): Selected feature will control the Scan3dExtraction3 output from Region3.
RegionIDValue *[RegionSelector]*	Integer	RO	Expert	Returns a unique Identifier value that corresponds to the selected Region.
RegionMode *[RegionSelector]*	Enumeration	RW	Beginner	Controls if the selected Region of interest is active and streaming. - *Off* (Value=0): Disable the usage of the Region. - *On* (Value=1): Enable the usage of the Region.
OffsetX *[RegionSelector]*	Integer	RW	Beginner	Horizontal offset from the origin to the AOI (in pixels). Min: 0 Max: SensorWidth Inc: 32

Name	Type	Access	Visibility	Description
OffsetY *[RegionSelector]*	Integer	RW	Beginner	Vertical offset from the origin to the AOI (in pixels). Min: 0 Max: SensorHeight Inc: IncOffsetY
Width *[RegionSelector]*	Integer	RW	Beginner	Width of the Image provided by the device (in pixels). Min: 64 Max: SensorWidth Inc: 32
Height *[RegionSelector]*	Integer	RW	Beginner	Height of the image provided by the device (in pixels). Min: MinHeight Max: MaxHeight Inc: IncHeight
ComponentSelector	Enumeration	RW	Beginner	Selects a component to activate/deactivate its data streaming. - *Intensity* (Value=1): The acquisition of intensity (monochrome or color) of the visible reflected light is controlled. - *Range* (Value=4): The acquisition of range (distance) data is controlled. The data produced may be only range (2.5D) or a point cloud giving the 3D coordinates depending on the Scan3dControl features. - *Reflectance* (Value=5): The reflected intensity acquired together with Range in a Linescan3D sensor acquiring a single linescan profile for each exposure of the sensor. - *Scatter* (Value=7): The acquisition of data measuring how much light is scattered around the reflected light. In processing this is used as an additional intensity image, often together with the standard intensity or reflectance.
ComponentEnable *[RegionSelector]* *[ComponentSelector]*	Boolean	RW	Beginner	Controls if the selected component streaming is active.
ComponentIDValue *[ComponentSelector]*	Integer	RO	Expert	Returns a unique Identifier value that corresponds to type of the component selected by ComponentSelector.
PixelFormat *[ComponentSelector]*	Enumeration	RW	Beginner	Format of the pixel to use for acquisition. It represents all the informations provided by PixelCoding, PixelSize, PixelColorFilter but combined in one single value. - *Mono8* (Value=0x01080001): 8 bit per pixel linear memory.

Name	Type	Access	Visibility	Description
				- *Mono10* (Value=0x01100003): Monochrome 10-bit unpacked - *Mono12p* (Value=0x010C0047): 12 bit (packed) per pixel linear memory. - *Mono16* (Value=0x01100007): 16 bit per pixel linear memory.
PixelSize *[ComponentSelector]*	Enumeration	RO	Expert	Total size in bits of a pixel of the image. - *Bpp8* (Value=8) - *Bpp10* (Value=10) - *Bpp12* (Value=12) - *Bpp14* (Value=14) - *Bpp16* (Value=16)
PixelDynamicRangeMin *[ComponentSelector]*	Integer	RW	Expert	Minimum value that can be returned during the digitization process. This corresponds to the darkest value of the camera. For color camera, this returns the smallest value that each color component can take.
PixelDynamicRangeMax *[ComponentSelector]*	Integer	RW	Expert	Maximum value that will be returned during the digitization process. This corresponds to the brightest value of the camera. For color camera, this returns the biggest value that each color component can take.
RegionTracking	Category	—	—	Features relating to the Region-Tracking mode
RegionSearch	Category	—	—	Features relating to the Region-Search mode
TestPatternGeneratorSelector	Enumeration	RW	Beginner	Selects which test pattern generator is controlled by the TestPattern feature. - *Sensor* (Value=0): TestPattern feature will control the sensor's test pattern generator. - *Generator* (Value=1): TestPattern feature will control the internal test pattern generator.
TestPattern *[TestPatternGeneratorSelector]*	Enumeration	RW	Beginner	Selects the type of test pattern that is generated by the device as image source. - *Off* (Value=0): Image is coming from the sensor. - *Grey* (Value=1): From Sensor: Homogeneous Image. - *Pattern* (Value=2): From Sensor: Pattern. - *Ramp* (Value=3): Testpattern ramp generated by internal processing. - *FrameCounter* (Value=4): From Generator: framecounter as pixel intesity. - *HorizontalLineStaticBlack* (Value=5): From Generator: Horizontal line, static, on black background. - *HorizontalLineMovingBlack* (Value=6): From Generator: Horizontal line, moving, on black background. - *HorizontalLineStaticOverlay* (Value=7): From Generator: Horizontal line, static, superimposed

Name	Type	Access	Visibility	Description
				on the live image. - *HorizontalLineMovingOverlay* (Value=8): From Generator: Horizontal line, moving, superimposed on the live image. - *DiagonalLineStaticBlack* (Value=9): From Generator: Diagonal line, static, on black background. - *DiagonalLineMovingBlack* (Value=10): From Generator: Diagonal line, moving, on black background. - *DiagonalLineStaticOverlay* (Value=11): From Generator: Diagonal line, static, superimposed on the live image. - *DiagonalLineMovingOverlay* (Value=12): From Generator: Diagonal line, moving, superimposed on the live image.
TestPatternValue *[TestPatternGeneratorSelector]*	Integer	RW	Expert	Value of the selected TestPattern.

ImageFormatControl::RegionTracking

Features relating to the Region-Tracking mode

Name	Type	Access	Visibility	Description
RegionTrackingMode	Enumeration	RO	Guru	RegionTrackingMode - *Off* (Value=0): Region Tracking is off. - *OffsetY* (Value=1): Region Tracking Algorithm 1.
RegionTrackingLostMode	Enumeration	RO	Guru	RegionTrackingLostMode - *stay* (Value=0): stay at current position. - *default* (Value=1): Go to default position. - *search* (Value=2): Run a Region search.
RegionTrackingStatus	Enumeration	RO	Guru	RegionTrackingStatus. - *NonActive* (Value=0): NonActive. - *Running* (Value=1): Running. - *Lost* (Value=2): Lost.
RegionTrackingAlgorithm	Enumeration	RO	Guru	Algorithm. - *Range* (Value=0)

Name	Type	Access	Visibility	Description
				- *Min* (Value=1) - *Max* (Value=2) - *Mean* (Value=3)
RegionTrackingAlgorithmOffsetY	Integer	RO	Expert	RegionTrackingValidPixel
RegionTrackingAlgorithmMinY	Integer	RO	Expert	RegionTrackingAlgorithmMinY Min: 16 Max: Width Inc: 1
RegionTrackingAlgorithmMaxY	Integer	RO	Expert	RegionTrackingAlgorithmMaxY
RegionTrackingTriggerStart	Enumeration	RW	Guru	Selects the type of trigger to start the tracking. - *Off* (Value=0): Off - *UserOutput0* (Value=2): User Output 0 - *UserOutput1* (Value=3): User Output 1 - *Counter0Start* (Value=4): Counter 0 Start - *Counter0End* (Value=5): Counter 0 End - *SoftwareSignal0* (Value=6): Software Signal 0 - *SoftwareSignal1* (Value=7): Software Signal 1 - *Line0* (Value=8): Internal Line0 (IN1) - *Line1* (Value=9): Internal Line1 (IN2) - *Line2* (Value=10): Internal Line2 (Encoder-A) - *Line3* (Value=11): Internal Line3 (Encoder-B) - *Line4* (Value=12): Internal Line4 (Encoder-Z) - *FrameTrigger* (Value=17): FrameTrigger - *AcquisitionActive* (Value=18): AcquisitionActive - *FrameBurstActive* (Value=19): FrameBurstActive - *FrameActive* (Value=20): FrameActive - *LineActive* (Value=21): LineActive - *ExposureActive* (Value=27): ExposureActive
RegionTrackingTriggerEnd	Enumeration	RW	Guru	Selects the type of trigger to end the tracking. - *Off* (Value=0): Off - *UserOutput0* (Value=2): User Output 0 - *UserOutput1* (Value=3): User Output 1

Name	Type	Access	Visibility	Description
				- *Counter0Start* (Value=4): Counter 0 Start - *Counter0End* (Value=5): Counter 0 End - *SoftwareSignal0* (Value=6): Software Signal 0 - *SoftwareSignal1* (Value=7): Software Signal 1 - *Line0* (Value=8): Internal Line0 (IN1) - *Line1* (Value=9): Internal Line1 (IN2) - *Line2* (Value=10): Internal Line2 (Encoder-A) - *Line3* (Value=11): Internal Line3 (Encoder-B) - *Line4* (Value=12): Internal Line4 (Encoder-Z) - *FrameTrigger* (Value=17): FrameTrigger - *AcquisitionActive* (Value=18): AcquisitionActive - *FrameBurstActive* (Value=19): FrameBurstActive - *FrameActive* (Value=20): FrameActive - *LineActive* (Value=21): LineActive - *ExposureActive* (Value=27): ExposureActive
RegionTrackingValidPixel	Integer	RO	Expert	RegionTrackingValidPixel
RegionTrackingP	Float	RO	Expert	RegionTrackingP Min: 0.0 Max: 1.0
RegionTrackingI	Float	RO	Expert	RegionTrackingI Min: 0.0 Max: 1.0
RegionTrackingD	Float	RO	Expert	RegionTrackingD Min: 0.0 Max: 1.0
RegionTrackingUpdateRate	Integer	RO	Expert	RegionTrackingUpdateRate Min: 1 Max: 1000 Inc: 1

ImageFormatControl::RegionSearch

Features relating to the Region-Search mode

Name	Type	Access	Visibility	Description
RegionSearchMode	Enumeration	RO	Guru	RegionSearchMode - *Off* (Value=0): Region Search is off. - *OffsetY* (Value=1): Region Search Algorithm 1.
RegionSearchStatus	Enumeration	RO	Guru	RegionSearchStatus. - *Failed* (Value=0): Failed. - *Success* (Value=1): Success.
RegionSearchEndEvent	Enumeration	RO	Guru	RegionSearchEndEvent. - *LineStatus* (Value=0): Failed.
RegionSearchValidPixel	Integer	RO	Expert	RegionSearchValidPixel
RegionSearchHeight	Integer	RO	Expert	RegionSearchHeight
RegionSearchOffsetY	Integer	RO	Expert	RegionSearchOffsetY
RegionSearchAlgorithm	Enumeration	RO	Guru	RegionSearchAlgorithm. - *Algorithm_1* (Value=0): Algorithm_1
RegionSearchAlgorithmOffset	Integer	RO	Expert	RegionSearchAlgorithmOffset

12.4 AcquisitionControl

Category for the acquisition and trigger control features.

Name	Type	Access	Visibility	Description
AcquisitionMode	Enumeration	RW	Beginner	Sets the acquisition mode of the device. It defines mainly the number of frames to capture during an acquisition and the way the acquisition stops. - *SingleFrame* (Value=0): This enumeration value sets the camera's acquisition mode to single frame - *Continuous* (Value=1): This enumeration value sets the camera's acquisition mode to continuous.

Name	Type	Access	Visibility	Description
				- *MultiFrame* (Value=2): This enumeration value sets the camera's acquisition mode to multi frame.
AcquisitionStopMode	Enumeration	RW	Expert	Controls how the AcquistionStop command and the acquisition stopped using a trigger (e.g. AcquisitionActive, FrameBurstActive, FrameActive or FrameEnd trigger), ends an ongoing frame. This feature is mainly used in Linescan devices where each line in a frame is acquired sequencially. - *Complete* (Value=0): When stopped during a frame, the device will continue acquisition of lines until the specified Height is reached to deliver a complete default size frame. Note that if each line is triggered from an external source and this line trigger stops no frame is delivered, and an AcquisitionAbort is needed. - *ImmediateWithPadding* (Value=2): Acquisition stops immediately even during a frame but the remaining of the frame will be padded with data to deliver a complete default Height frame.
AcquisitionStart	Command	WO	Beginner	Starts the Acquisition of the device. The number of frames captured is specified by AcquisitionMode.
AcquisitionStop	Command	WO	Beginner	Stops the Acquisition of the device at the end of the current Frame. It is mainly used when AcquisitionMode is Continuous but can be used in any acquisition mode.
AcquisitionStatusSelector	Enumeration	RW	Expert	Selects the internal acquisition signal to read using AcquisitionStatus. - *AcquisitionActive* (Value=0): Device is currently doing an acquisition of one or many frames. - *FrameBurstActive* (Value=1): Device is currently doing the capture of a burst frame. - *FrameActive* (Value=2): Device is currently doing the capture of a frame. - *LineActive* (Value=3): Device is doing the exposure of a line.
AcquisitionStatus *[AcquisitionStatusSelector]*	Boolean	RO	Expert	Reads the state of the internal acquisition signal selected using AcquisitionStatusSelector.
AcquisitionFrameCount	Integer	RW	Beginner	This value sets the number of frames acquired in the multiframe acquisition mode Min: 1 Max: 65535 Inc: 1
AcquisitionBurstFrameCount	Integer	RW	Beginner	This value sets the number of frames acquired in the Continuous acquisition mode Min: 1

Name	Type	Access	Visibility	Description
				Max: 65535 Inc: 1
AcquisitionDroppedFrameCount	Integer	RO	Guru	The number of internal dropped Frames.
AcquisitionFrameRateEnable	Boolean	RW	Beginner	Controls if the AcquisitionFrameRate feature is writable and used to control the acquisition rate. Otherwise, the acquisition rate is implicitly controlled by the combination of other features like ExposureTime
AcquisitionFrameRate	Float	RW	Beginner	Controls the acquisition rate (in Hertz) at which the frames are captured. Min: 0 Max: SensorFrameRateMax
AcquisitionLineRateEnable	Boolean	RW	Beginner	Controls if the AcquisitionFrameRate feature is writable and used to control the acquisition rate. Otherwise, the acquisition rate is implicitly controlled by the combination of other features like ExposureTime
AcquisitionLineRate	Float	RW	Beginner	Controls the rate (in Hertz) at which the Lines in a Frame are captured Min: 0.0 Max: SensorFrameRateMax
TriggerSelector	Enumeration	RW	Beginner	Selects the type of trigger to configure. - *AcquisitionStart* (Value=0): Selects a trigger that starts the Acquisition of one or many frames according to AcquisitionMode. - *AcquisitionEnd* (Value=1): Selects a trigger that ends the Acquisition of one or many frames according to AcquisitionMode. - *FrameBurstStart* (Value=2): Selects a trigger starting the capture of the bursts of frames in an acquisition. AcquisitionBurstFrameCount controls the length of each burst unless a FrameBurstEnd trigger is active. The total number of frames captured is also conditioned by AcquisitionFrameCount if AcquisitionMode is MultiFrame. - *FrameBurstEnd* (Value=3): Selects a trigger ending the capture of the bursts of frames in an acquisition. - *FrameStart* (Value=4): Selects a trigger starting the capture of one frame. - *FrameEnd* (Value=5): Selects a trigger ending the capture of one frame (mainly used in line scan mode). - *LineStart* (Value=6): Selects a trigger starting the capture of one Line of a Frame (mainly used in line scan mode).

Name	Type	Access	Visibility	Description
TriggerMode *[TriggerSelector]*	Enumeration	RW	Beginner	Controls if the selected trigger is active. - *Off* (Value=0): Disables the selected trigger. - *On* (Value=1): Enable the selected trigger.
TriggerSoftware *[TriggerSelector]*	Command	RW	Beginner	Generates an internal trigger. TriggerSource must be set to Software.
TriggerSource *[TriggerSelector]*	Enumeration	RW	Beginner	Specifies the internal signal or physical input Line to use as the trigger source. The selected trigger must have its TriggerMode set to On. - *Software* (Value=0) - *UserOutput0* (Value=2) - *UserOutput1* (Value=3) - *Counter0Start* (Value=4) - *Counter0End* (Value=5) - *SoftwareSignal0* (Value=6) - *SoftwareSignal1* (Value=7) - *Line0* (Value=8) - *Line1* (Value=9) - *Line2* (Value=10) - *Line3* (Value=11) - *Line4* (Value=12) - *Encoder0* (Value=16)
TriggerActivation *[TriggerSelector]*	Enumeration	RW	Beginner	Specifies the activation mode of the trigger. - *RisingEdge* (Value=1): Specifies that the trigger is considered valid on the rising edge of the source signal. - *FallingEdge* (Value=2): Specifies that the trigger is considered valid on the falling edge of the source signal. - *AnyEdge* (Value=3): Specifies that the trigger is considered valid on the falling or rising edge of the source signal.
ExposureTime	Float	RW	Beginner	Sets the Exposure time. This controls the duration the photosensitive cells are exposed to light. Min: 0.01 Max: ExposureTimeMaxReg Inc: 0.01

Name	Type	Access	Visibility	Description
MultiSlopeMode	Enumeration	RW	Beginner	Controls multi-slope exposure state - *Off* (Value=0): Off - *Manual* (Value=1): Manual - *PresetSoft* (Value=2): PresetSoft - *PresetMedium* (Value=3): PresetMedium - *PresetAggressive* (Value=4): PresetAggressive
MultiSlopeKneePointCount	Integer	RW	Beginner	The number of knee-points as well as the number of additional exposure slopes used for multi-slope exposure Min: 0 Max: 2 Inc: 1
MultiSlopeKneePointSelector	Integer	RW	Beginner	Selects the parameters for controlling a kneepoint during multi-slope exposure Min: 1 Max: 2 Inc: 1
MultiSlopeExposureLimit *[MultiSlopeKneePointSelector]*	Float	RW	Beginner	Percent of the ExposureTime at a certain knee-point of multi-slope exposure Min: 0.0 Max: 100.0
MultiSlopeSaturationThreshold *[MultiSlopeKneePointSelector]*	Float	RW	Beginner	The percentage of the full saturation that is applied at a certain knee-point of a multi-slope exposure. The limits are sensor-specific and might not span the whole range of 0..100%. In principle, setting this value to 100% would effectively disable this knee-point, while setting this value to 0% would effectively start exposure at this knee-point. Min: 0.0 Max: 100.0

12.5 DigitalIOControl

Category that contains the digital input and output control features.

Name	Type	Access	Visibility	Description
LineSelector	Enumeration	RW	Expert	Selects the physical line (or pin) of the external device connector or the virtual line of the Transport Layer to configure. - *Line0* (Value=0): IN1 - *Line1* (Value=1): IN2 - *Line2* (Value=2): Encoder-A - *Line3* (Value=3): Encoder-B - *Line4* (Value=4): Encoder-Z - *Line5* (Value=128): OUT1 - *Line6* (Value=129): OUT2
LineMode *[LineSelector]*	Enumeration	RO	Expert	Controls if the physical Line is used to Input or Output a signal. - *Input* (Value=1): The selected physical line is used to Input an electrical signal. - *Output* (Value=0): The selected physical line is used to Output an electrical signal.
LineStatus *[LineSelector]*	Boolean	RO	Beginner	Returns the current status of the selected input or output Line.
LineInverter *[LineSelector]*	Boolean	RW	Expert	Controls the inversion of the signal of the selected input or output Line.
LineGlitchEnable *[LineSelector]*	Boolean	RW	Expert	Indicates if the glitch filter is enabled.
LineGlitchValue *[LineSelector]*	Integer	RW	Expert	Sets the value (in ns) which is applied to the line glitch filter. Min: 10 Max: 100000000 Inc: 10
LineStretchEnable *[LineSelector]*	Boolean	RW	Expert	Indicates if the stretcher is enabled.
LineStretchValue *[LineSelector]*	Integer	RW	Expert	Sets the value (in ns) which is applied to the stretcher. Min: 10 Max: 100000000 Inc: 10
LineSource *[LineSelector]*	Enumeration	RW	Expert	Controls the signal to Output on selected line. - *Off* (Value=0): Off - *UserOutput0* (Value=2): User Output 0

Name	Type	Access	Visibility	Description
				- *UserOutput1* (Value=3): User Output 1 - *Counter0Start* (Value=4): Counter 0 Start - *Counter0End* (Value=5): Counter 0 End - *SoftwareSignal0* (Value=6): Software Signal 0 - *SoftwareSignal1* (Value=7): Software Signal 1 - *Line0* (Value=8): Internal Line0 (IN1) - *Line1* (Value=9): Internal Line1 (IN2) - *Line2* (Value=10): Internal Line2 (Encoder-A) - *Line3* (Value=11): Internal Line3 (Encoder-B) - *Line4* (Value=12): Internal Line4 (Encoder-Z) - *Encoder0* (Value=16): Encoder0 - *FrameTrigger* (Value=17): FrameTrigger - *AcquisitionActive* (Value=18): AcquisitionActive - *FrameBurstActive* (Value=19): FrameBurstActive - *FrameActive* (Value=20): FrameActive - *LineActive* (Value=21): LineActive - *ExposureActive* (Value=27): ExposureActive
LineFormat *[LineSelector]*	Enumeration	RO	Expert	Controls the current electrial format of the selected physical input or output Line. - *RS422* (Value=4): The Line is currently accepting or sending RS422 level signals. - *OptoCoupled* (Value=5): The Line is opto-coupled.
LineStatusAll	Integer	RO	Expert	Returns the current status of all available Line signals at time of polling in a single bitfield.
UserOutputSelector	Enumeration	RW	Expert	Select which bit of the User Output register will be set by User Output Value. - *UserOutput0* (Value=0): Selects User Output 0 register. - *UserOutput1* (Value=1): Selects User Output 1 register.
UserOutputValue *[UserOutputSelector]*	Boolean	RW	Expert	Sets the value of the bit selected by UserOutputSelector.
UserOutputValueAll	Integer	RW	Expert	Sets the value of all the bits of the User Output register.

12.6 CounterAndTimerControl

Category that contains the Counter and Timer control features.

Name	Type	Access	Visibility	Description
CounterSelector	Enumeration	RW	Expert	Selects which Counter to configure. - *Counter0* (Value=0): Selects the counter 0.
CounterTriggerSource *[CounterSelector]*	Enumeration	RW	Expert	Selects the source to start the Counter. - *Off* (Value=0) - *UserOutput0* (Value=2) - *UserOutput1* (Value=3) - *Counter0Start* (Value=4) - *Counter0End* (Value=5) - *SoftwareSignal0* (Value=6) - *SoftwareSignal1* (Value=7) - *Line0* (Value=8) - *Line1* (Value=9) - *Line2* (Value=10) - *Line3* (Value=11) - *Line4* (Value=12) - *Encoder0* (Value=16) - *Trigger0* (Value=17) - *AcquisitionStart* (Value=18) - *FrameBurstStart* (Value=19) - *FrameStart* (Value=20) - *LineTriggerMissed* (Value=24) - *FrameTriggerMissed* (Value=25)
CounterTriggerActivation *[CounterSelector]*	Enumeration	RW	Expert	Selects the Activation mode Event Source signal. - *LevelLow* (Value=0): Resets the counter as long as the selected signal level is Low. - *RisingEdge* (Value=1): Resets the counter on the Rising Edge of the signal. - *FallingEdge* (Value=2): Resets the counter on the Falling Edge of the signal. - *AnyEdge* (Value=3): Resets the counter on the Falling or rising Edge of the selected signal. - *LevelHigh* (Value=4): Resets the counter as long as the selected signal level is High.
CounterEventSource *[CounterSelector]*	Enumeration	RW	Expert	Select the events that will be the source to increment the Counter. - *Off* (Value=0) - *UserOutput0* (Value=2) - *UserOutput1* (Value=3)

Name	Type	Access	Visibility	Description
				- *Counter0Start* (Value=4) - *Counter0End* (Value=5) - *SoftwareSignal0* (Value=6) - *SoftwareSignal1* (Value=7) - *Line0* (Value=8) - *Line1* (Value=9) - *Line2* (Value=10) - *Line3* (Value=11) - *Line4* (Value=12) - *Encoder0* (Value=16) - *Trigger0* (Value=17) - *AcquisitionStart* (Value=18) - *FrameBurstStart* (Value=19) - *FrameStart* (Value=20) - *LineTriggerMissed* (Value=24) - *FrameTriggerMissed* (Value=25)
CounterEventActivation *[CounterSelector]*	Enumeration	RW	Expert	Selects the Activation mode Event Source signal. - *RisingEdge* (Value=1): Counts on the Rising Edge of the signal. - *FallingEdge* (Value=2): Counts on the Falling Edge of the signal. - *AnyEdge* (Value=3): Counts on the Falling or rising Edge of the selected signal.
CounterResetSource *[CounterSelector]*	Enumeration	RW	Expert	Selects the signals that will be the source to reset the Counter. - *Off* (Value=0): CounterReset disabled. - *UserOutput0* (Value=2) - *UserOutput1* (Value=3) - *Counter0Start* (Value=4) - *Counter0End* (Value=5) - *SoftwareSignal0* (Value=6) - *SoftwareSignal1* (Value=7) - *Line0* (Value=8) - *Line1* (Value=9) - *Line2* (Value=10) - *Line3* (Value=11) - *Line4* (Value=12)

Name	Type	Access	Visibility	Description
				- *Encoder0* (Value=16) - *Trigger0* (Value=17) - *AcquisitionStart* (Value=18) - *FrameBurstStart* (Value=19) - *FrameStart* (Value=20) - *LineTriggerMissed* (Value=24) - *FrameTriggerMissed* (Value=25)
CounterResetActivation *[CounterSelector]*	Enumeration	RW	Expert	Selects the Activation mode of the Counter Reset Source signal. - *LevelLow* (Value=0): Resets the counter as long as the selected signal level is Low. - *RisingEdge* (Value=1): Resets the counter on the Rising Edge of the signal. - *FallingEdge* (Value=2): Resets the counter on the Falling Edge of the signal. - *AnyEdge* (Value=3): Resets the counter on the Falling or rising Edge of the selected signal. - *LevelHigh* (Value=4): Resets the counter as long as the selected signal level is High.
CounterReset *[CounterSelector]*	Command	RW	Expert	Does a software reset of the selected Counter and starts it. The counter starts counting events immediately after the reset unless a Counter trigger is active. CounterReset can be used to reset the Counter independently from the CounterResetSource. To disable the counter temporarily, set CounterEventSource to Off.
CounterValue *[CounterSelector]*	Integer	RO	Expert	Reads or writes the current value of the selected Counter. Min: 0 Max: 65535
CounterValueAtReset *[CounterSelector]*	Integer	RO	Expert	Reads the value of the selected Counter when it was reset by a trigger or by an explicit CounterReset command. Min: 0 Max: 65535
CounterDuration *[CounterSelector]*	Integer	RW	Expert	Sets the duration (or number of events) before the CounterEnd event is generated.
CounterStatus *[CounterSelector]*	Enumeration	RO	Expert	Returns the current status of the Counter. - *CounterIdle* (Value=0): The counter is idle. - *CounterTriggerWait* (Value=1): The counter is waiting for a start trigger. - *CounterActive* (Value=2): The counter is counting for the specified duration.

Name	Type	Access	Visibility	Description
				- *CounterCompleted* (Value=3): The counter reached the CounterDuration count. - *CounterOverflow* (Value=4): The counter reached its maximum possible count.

12.7 EncoderControl

Category that contains the quadrature Encoder Control features.

Name	Type	Access	Visibility	Description
EncoderSourceA	Enumeration	RW	Expert	Selects the signal which will be the source of the A input of the Encoder. - *Off* (Value=0) - *UserOutput0* (Value=2) - *UserOutput1* (Value=3) - *Counter0Start* (Value=4) - *Counter0End* (Value=5) - *SoftwareSignal0* (Value=6) - *SoftwareSignal1* (Value=7) - *Line0* (Value=8) - *Line1* (Value=9) - *Line2* (Value=10) - *Line3* (Value=11) - *Line4* (Value=12)
EncoderSourceB	Enumeration	RW	Expert	Selects the signal which will be the source of the B input of the Encoder. - *Off* (Value=0) - *UserOutput0* (Value=2) - *UserOutput1* (Value=3) - *Counter0Start* (Value=4) - *Counter0End* (Value=5) - *SoftwareSignal0* (Value=6) - *SoftwareSignal1* (Value=7) - *Line0* (Value=8) - *Line1* (Value=9) - *Line2* (Value=10)

Name	Type	Access	Visibility	Description
				- *Line3* (Value=11) - *Line4* (Value=12)
EncoderMode	Enumeration	RW	Expert	Selects if the count of encoder uses FourPhase mode with jitter filtering or the HighResolution mode without jitter filtering. - *HighResolution* (Value=0): The counter increments or decrements every quadrature phase for high resolution counting, but without jitter filtering. - *FourPhase* (Value=1): The counter increments or decrements 1 for every full quadrature cycle with jitter filtering.
EncoderDivider	Integer	RW	Expert	Sets how many Encoder increment/decrements that are needed generate an Encoder output pulse signal.
EncoderOutputMode	Enumeration	RW	Expert	Selects the conditions for the Encoder interface to generate a valid Encoder output signal. - *Off* (Value=0): No output pulse are generated. - *PositionUp* (Value=1): Output pulses are generated at all new positions in the positive direction. If the encoder reverses no output pulse are generated until it has again passed the position where the reversal started. - *PositionDown* (Value=2): Output pulses are generated at all new positions in the negative direction. If the encoder reverses no output pulse are generated until it has again passed the position where the reversal started. - *DirectionUp* (Value=3): Output pulses are generated at all position increments in the positive direction while ignoring negative direction motion. - *DirectionDown* (Value=4): Output pulses are generated at all position increments in the negative direction while ignoring positive direction motion. - *Motion* (Value=5): Output pulses are generated at all motion increments in both directions.
EncoderResetSource	Enumeration	RW	Expert	Selects the signals that will be the source to reset the Encoder. - *Off* (Value=0): EncoderReset disabled. - *UserOutput0* (Value=2) - *UserOutput1* (Value=3) - *Counter0Start* (Value=4) - *Counter0End* (Value=5) - *SoftwareSignal0* (Value=6) - *SoftwareSignal1* (Value=7) - *Line0* (Value=8)

Name	Type	Access	Visibility	Description
				- *Line1* (Value=9) - *Line2* (Value=10) - *Line3* (Value=11) - *Line4* (Value=12) - *AcquisitionStart* (Value=18)
EncoderResetActivation	Enumeration	RW	Expert	Selects the Activation mode of the Encoder Reset Source signal. - *LevelLow* (Value=0): Resets the Encoder as long as the selected signal level is Low. - *RisingEdge* (Value=1): Resets the Encoder on the Rising Edge of the signal. - *FallingEdge* (Value=2): Resets the Encoder on the Falling Edge of the signal. - *AnyEdge* (Value=3): Resets the Encoder on the Falling or rising Edge of the selected signal. - *LevelHigh* (Value=4): Resets the Encoder as long as the selected signal level is High.
EncoderReset	Command	RW	Expert	Does a software reset of the selected Encoder and starts it. The Encoder starts counting events immediately after the reset. EncoderReset can be used to reset the Encoder independently from the EncoderResetSource.
EncoderValue	Integer	RW	Expert	Reads or writes the current value of the position counter of the selected Encoder.
EncoderValueAtReset	Integer	RO	Expert	Reads the value of the of the position counter of the selected Encoder when it was reset by a signal or by an explicit EncoderReset command.

12.8 Scan3dControl

Category for control of 3D camera specific features.

Name	Type	Access	Visibility	Description
Scan3dExtractionSelector	Enumeration	RW	Expert	Selects the 3DExtraction processing module to control (if multiple ones are present). - *Scan3dExtraction0* (Value=16): Selects Scan3d Extraction module 0. - *Scan3dExtraction1* (Value=17): Selects Scan3d Extraction module 1. - *Scan3dExtraction2* (Value=18): Selects Scan3d Extraction module 2. - *Scan3dExtraction3* (Value=19): Selects Scan3d Extraction module 3.
Scan3dExtractionSource *[Scan3dExtractionSelector]*	Enumeration	RO	Expert	Selects the sensor's data source region for 3D Extraction module. - *Region0* (Value=0): Data come from Sensor's Region0. - *Region1* (Value=1): Data come from Sensor's Region1.

Name	Type	Access	Visibility	Description
				- *Region2* (Value=2): Data come from Sensor's Region2. - *Region3* (Value=3): Data come from Sensor's Region3.
Scan3dExtractionMethod	Enumeration	RW	Expert	Selects the method for extracting 3D from the input sensor data. - *Threshold* (Value=0) - *MaximumIntensity* (Value=1) - *CenterOfGravity* (Value=2) - *FIRPeak* (Value=3)
Scan3dExtractionThreshold *[Scan3dExtractionSelector]* *[Scan3dExtractionMethod]*	Integer	RW	Expert	Extraction threshold value for selected region Min: 0 Max: Scan3dExtractionThresholdMax
Scan3dExtractionThreshold2 *[Scan3dExtractionMethod]*	Integer	RW	Guru	Extraction Threshold 2 bottom value for selected region Min: -511 Max: 0
Scan3dMultiPeakMode *[Scan3dExtractionMethod]*	Enumeration	RW	Expert	Multi Peak mode - *First* (Value=0) - *Best* (Value=1) - *Single* (Value=3) - *SetFirst* (Value=4)
Scan3dMultiPeakSelector	Enumeration	RW	Beginner	Selects a peak to activate/deactivate its data streaming. - *Peak0* (Value=0) - *Peak1* (Value=1) - *Peak2* (Value=2) - *Peak3* (Value=3)
Scan3dMultiPeakEnable *[Scan3dExtractionMethod]* *[Scan3dMultiPeakSelector]*	Boolean	RW	Beginner	Controls if the selected peak streaming is active.
Scan3dValidationWidthMin *[Scan3dExtractionMethod]*	Integer	RW	Beginner	Minimum width of valid intensity distribution in 3D mode Min: 0 Max: hMaxValidationWidthMin Inc: 1

Name	Type	Access	Visibility	Description
Scan3dValidationWidthMax *[Scan3dExtractionMethod]*	Integer	RW	Beginner	Maxiumum width of valid intensity distribution in 3D mode Min: 0 Max: SensorHeight Inc: 1
Scan3dValidationSlopeMin *[Scan3dExtractionMethod]*	Integer	RW	Beginner	Minimum slope of valid intensity distribution in 3D mode Min: 0 Max: hMaxValidationSlopeMin Inc: 1
Scan3dValidationSlopeMax *[Scan3dExtractionMethod]*	Integer	RW	Beginner	Maxiumum slope of valid intensity distribution in 3D mode Min: 0 Max: SensorHeight Inc: 1
Scan3dValidationSumMin *[Scan3dExtractionMethod]*	Integer	RW	Beginner	Minimum sum of intensity of valid intensity distribution in 3D mode Min: 0 Max: 65535 Inc: 1
Scan3dValidationSumMax *[Scan3dExtractionMethod]*	Integer	RW	Beginner	Maximal sum of intensity of valid intensity distribution in 3D mode Min: 0 Max: 65535 Inc: 1
Scan3dFilterMode *[Scan3dExtractionMethod]*	Enumeration	RW	Expert	Scan3dFilterMode - *Off* (Value=0) - *Smoothing* (Value=1) - *Derivative* (Value=2) - *Manual* (Value=3)
Scan3dFilterSize *[Scan3dExtractionMethod]*	Integer	RW	Guru	Filter Size Peak Fitting. Adapt to laser peak width on sensor. Small: Peak width 5 pixels, Normal:Peak width 7 pixels, Large: Peak width 9 pixels. Min: 5

Name	Type	Access	Visibility	Description
				Max: Scan3dFilterSizeMax Inc: 2
Scan3dFilterCoefficientSelector	Enumeration	RW	Expert	Scan3dFilterCoefficientSelector - *C0* (Value=0) - *C1* (Value=1) - *C2* (Value=2) - *C3* (Value=3) - *C4* (Value=4)
Scan3dFilterCoefficientValue *[Scan3dExtractionMethod]* *[Scan3dFilterCoefficientSelector]*	Float	RW	Expert	Filter Coefficient Value Min: -1.0 Max: 1.0
Scan3dDistanceUnit *[Scan3dExtractionSelector]*	Enumeration	RO	Expert	Specifies the unit used when delivering (calibrated) distance data. - *Pixel* (Value=3): Distance values are given as a multiple of the size of a pixel.
Scan3dCoordinateSystem *[Scan3dExtractionSelector]*	Enumeration	RO	Expert	Specifies the Coordinate system to use for the device. - *Cartesian* (Value=0): Default value. 3-axis orthogonal, right-hand X-Y-Z.
Scan3dOutputMode *[Scan3dExtractionSelector]*	Enumeration	RO	Expert	Controls the Calibration and data organization of the device and the coordinates transmitted. - *UncalibratedC* (Value=0): Uncalibrated 2.5D Depth map. The distance data does not represent a physical unit and may be non-linear. The data is a 2.5D range map only.
Scan3dCoordinateSystemReference *[Scan3dExtractionSelector]*	Enumeration	RO	Expert	Defines coordinate system reference location. - *Anchor* (Value=0): Default value. Original fixed reference. The coordinate system fixed relative the camera reference point marker is used.
Scan3dCoordinateSelector	Enumeration	RW	Expert	Selects the individual coordinates in the vectors for 3D information/transformation. - *CoordinateC* (Value=2): The third (Z or Rho) coordinate.
Scan3dCoordinateScale *[Scan3dExtractionSelector]* *[Scan3dCoordinateSelector]*	Float	RW	Expert	Scale factor when transforming a pixel from relative coordinates to world coordinates.
Scan3dCoordinateMode *[Scan3dCoordinateSelector]*	Enumeration	RW	Expert	Selects the coordinate mode. - *Sensor* (Value=0): Sensor

Name	Type	Access	Visibility	Description
				- *Region* (Value=1): Region - *Manual* (Value=2): Manual
Scan3dCoordinateOffset *[Scan3dCoordinateSelector]*	Float	RW	Expert	Offset when transforming a pixel from relative coordinates to world coordinates.
Scan3dInvalidDataFlag *[Scan3dCoordinateSelector]*	Boolean	RW	Expert	Enables the definition of a non-valid flag value in the data stream. Using a Scan3dInvalidDataValue may give processing penalties due to special handling.
Scan3dInvalidDataValue *[Scan3dCoordinateSelector]*	Float	RW	Expert	Value which identifies a non-valid pixel if Scan3dInvalidDataFlag is enabled.
Scan3dAxisMin *[Scan3dCoordinateSelector]*	Float	RO	Expert	Minimum valid transmitted coordinate value of the selected Axis.
Scan3dAxisMax *[Scan3dCoordinateSelector]*	Float	RO	Expert	Maximum valid transmitted coordinate value of the selected Axis.

12.9 LightControl

Category containing the Lighting control features.

Name	Type	Access	Visibility	Description
LightControllerSelector	Enumeration	RO	Beginner	Selects the Light Controller to configure. - *LightController0* (Value=0)
LightControllerType *[LightControllerSelector]*	Enumeration	RW	Beginner	Selects the Type of the Light Controller. - *Generic* (Value=1) - *GenericInverse* (Value=2) - *ATZ_I2C* (Value=34) - *ATO_I2C* (Value=49) - *ZLaserZQ1* (Value=101) - *ZLaserZQ2* (Value=102) - *OselaILS2* (Value=103) - *OselaSL* (Value=104) - *OselaCL* (Value=105)

Name	Type	Access	Visibility	Description
LightControllerSource *[LightControllerSelector]*	Enumeration	RW	Beginner	Selects the input source signal of the Light Controller. - *Off* (Value=0): Light source is disabled - *On* (Value=1): Light source is always active - *AcquisitionActive* (Value=2): Device is currently doing an acquisition of one or many Frames. - *ExposureActive* (Value=3): Device is doing the exposure of a Frame (or Line).
LightBrightness *[LightControllerSelector]*	Float	RW	Beginner	Controls laser power from 0 to 100 percentage (%) Min: 0.0 Max: 100.0 Inc: 0.1
LightModulationVoltage *[LightControllerSelector]*	Float	RO	Expert	Controls the analog modulation of the laser power in volt (V) Min: 0.0 Max: 5.0
LightMonitorVoltage *[LightControllerSelector]*	Float	RO	Expert	Former VoltageIn (AI) Min: 0.0 Max: 5.0
LightConnectionStatus *[LightControllerSelector]*	Enumeration	RO	Beginner	Return the selected Light status - *NoConnect* (Value=0): No connection - *Sensing* (Value=1): Sensing - *Ready* (Value=2): Ready - *Error* (Value=3): Error - *Warning* (Value=4): Warning
LightModelName *[LightControllerSelector]*	String	RO	Expert	Returns the Light model name as string
LightSerialNumber *[LightControllerSelector]*	String	RO	Expert	Returns the Light serial number.
LightFirmwareVersion *[LightControllerSelector]*	String	RO	Expert	Returns the Light firmware version as string
LightHardwareVersion *[LightControllerSelector]*	String	RO	Expert	Returns the Light hardware version as string

Name	Type	Access	Visibility	Description
LightOperatingTime *[LightControllerSelector]*	Float	RO	Expert	Returns the laser diodes accumulated operating hours Min: 0.0 Max: 876000.0
LightOperatingCurrent *[LightControllerSelector]*	Float	RO	Expert	Returns the Light device operating current in mA Min: 0.0 Max: 2000.0
LightOperatingPower *[LightControllerSelector]*	Float	RO	Expert	Returns the Light device operating power in mW Min: 0.0 Max: 10000.0
LightTemperatureSelector	Enumeration	RW	Expert	Selects the device specific temperature source - *Diode* (Value=0) - *Housing* (Value=1) - *DiodeLowLimit* (Value=2) - *DiodeHighLimit* (Value=3)
LightTemperature *[LightControllerSelector]* *[LightTemperatureSelector]*	Float	RO	Expert	Light temperature in degrees Celsius (C) Min: -100.0 Max: 200.0

12.10ChunkDataControl

Features relating to chunk data control

Name	Type	Access	Visibility	Description
ChunkModeActive	Boolean	RW	Expert	Activate chunk mode
ChunkModeSelector	Enumeration	RO	Expert	Configure chunk mode - *OneChunkPerFrame* (Value=0) - *OneChunkPerProfile* (Value=1)
ChunkSelector	Enumeration	None	Expert	This enumeration selects chunks for enabling. - *Timestamp* (Value=8): This enumeration value selects the time stamp chunk for enabling. - *Framecounter* (Value=10): This enumeration value selects the frame counter chunk for enabling. - *EncoderValue* (Value=12): This enumeration value selects the encoder value chunk for enabling.

Name	Type	Access	Visibility	Description
				- *LineStatusAll* (Value=9): This enumeration value selects the line status all chunk for enabling. - *AO0* (Value=6): This enumeration value selects the AO0 chunk for enabling. - *AI0* (Value=7): This enumeration value selects the AI0 chunk for enabling. - *OffsetX* (Value=1): This enumeration value selects the X offset chunk for enabling. - *OffsetY* (Value=2): This enumeration value selects the Y offset chunk for enabling. - *Height* (Value=4): This enumeration value selects the height chunk for enabling. - *Width* (Value=5): This enumeration value selects the width chunk for enabling. - *TimestampTrigger* (Value=11): This enumeration value selects the trigger time stamp chunk for enabling. - *EncoderValueTrigger* (Value=13): This enumeration value selects the trigger encoder value chunk for enabling. - *LineMax* (Value=14): This enumeration value selects the line max chunk for enabling. - *LineMin* (Value=15): This enumeration value selects the line min chunk for enabling. - *LineSum* (Value=16): This enumeration value selects the line sum chunk for enabling.
ChunkEnable *[ChunkSelector]*	Boolean	RO	Expert	This boolean value enables the inclusion of the selected chunk in the payload data.
ChunkScanLineSelector	Integer	None	Expert	Index for vector representation of one chunk value per line in an image. Min: 0 Max: 5000 Inc: 1
ChunkTimestamp *[ChunkScanLineSelector]*	Integer	RO	Expert	This integer indicates the value of the timestamp when the image was acquired.
ChunkFrameID *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the unique Identifier of the frame (or image) included in the payload.
ChunkEncoderValue *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the counter's value of the selected Encoder at the time of the FrameStart in area scan mode or the counter's value at the time of the LineStart selected by ChunkScanLineSelector in Linescan mode.
ChunkLineStatusAll *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the status of all the I/O lines at the time of the FrameStart internal event.
ChunkAO0 *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the DAC value

Name	Type	Access	Visibility	Description
ChunkAI0 *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the ADC value
ChunkOffsetY *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the OffsetY of the image or profile included in the payload.
ChunkHeight *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the Height of the image or profile region of interest included in the payload.
ChunkOffsetX *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the OffsetX of the image or profile included in the payload.
ChunkWidth *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the Width of the image or profile region of interest included in the payload.
ChunkTimestampTrigger *[ChunkScanLineSelector]*	Integer	RO	Expert	This integer indicates the value of the timestamp latch at trigger.
ChunkEncoderValueTrigger *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the counter's value of the selected Encoder latch at trigger.
ChunkLineMax *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the line max value
ChunkLineMin *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the line min value
ChunkLineSum *[ChunkScanLineSelector]*	Integer	RO	Expert	Returns the line sum value

12.11EventControl

Category that contains Event control features.

Name	Type	Access	Visibility	Description
EventSelector	Enumeration	RW	Expert	Selector for the event to control - *AcquisitionStart* (Value=0x9012) - *AcquisitionEnd* (Value=0x9013) - *AcquisitionTransferStart* (Value=0x9014)

Name	Type	Access	Visibility	Description
				- *AcquisitionTransferEnd* (Value=0x9015) - *FrameStart* (Value=0x9016) - *FrameEnd* (Value=0x9017) - *FrameBurstStart* (Value=0x9018) - *FrameBurstEnd* (Value=0x9019) - *FrameMissed* (Value=0x901C) - *LineMissed* (Value=0x901D) - *LogMessage* (Value=0x9020)
EventNotification *[EventSelector]*	Enumeration	RW	Expert	Activate or deactivate the notification to the host application of the occurrence of the selected Event. - *Off* (Value=0): The selected Event notification is disabled. - *On* (Value=1): The selected Event notification is enabled.
EventAcquisitionStartData	Category	—	—	Category that contains all the data features related to the Acquisition Start Event.
EventAcquisitionEndData	Category	—	—	Category that contains all the data features related to the Acquisition End Event.
EventAcquisitionTransferStartData	Category	—	—	Category that contains all the data features related to the Acquisition Transfer Start Event.
EventAcquisitionTransferEndData	Category	—	—	Category that contains all the data features related to the Acquisition Transfer End Event.

EventControl::EventAcquisitionStartData

Category that contains all the data features related to the Acquisition Start Event.

Name	Type	Access	Visibility	Description
EventAcquisitionStart	Integer	RO	Expert	Returns the unique Identifier of the Acquisition Start type of Event.
EventAcquisitionStartTimestamp	Integer	RO	Expert	Returns the Timestamp of the Acquisition Start Event.

EventControl::EventAcquisitionEndData

Category that contains all the data features related to the Acquisition End Event.

Name	Type	Access	Visibility	Description
EventAcquisitionEnd	Integer	RO	Expert	Returns the unique Identifier of the Acquisition End type of Event.

Name	Type	Access	Visibility	Description
EventAcquisitionEndTimestamp	Integer	RO	Expert	Returns the Timestamp of the Acquisition End Event.

EventControl::EventAcquisitionTransferStartData

Category that contains all the data features related to the Acquisition Transfer Start Event.

Name	Type	Access	Visibility	Description
EventAcquisitionTransferStart	Integer	RO	Expert	Returns the unique Identifier of the Acquisition Transfer Start type of Event.
EventAcquisitionTransferStartTimestamp	Integer	RO	Expert	Returns the Timestamp of the Acquisition Transfer Start Event.

EventControl::EventAcquisitionTransferEndData

Category that contains all the data features related to the Acquisition Transfer End Event.

Name	Type	Access	Visibility	Description
EventAcquisitionTransferEnd	Integer	RO	Expert	Returns the unique Identifier of the Acquisition Transfer End type of Event.
EventAcquisitionTransferEndTimestamp	Integer	RO	Expert	Returns the Timestamp of the Acquisition Transfer End Event.

12.12UserSetControl

Category that contains the User Set control features.

Name	Type	Access	Visibility	Description
UserSetSelector	Enumeration	RW	Beginner	Selects the feature user set to load, save or configure. - *Default* (Value=0) - *UserSet0* (Value=1) - *UserSet1* (Value=2) - *UserSet2* (Value=3)
UserSetLoad *[UserSetSelector]*	Command	WO	Beginner	Loads the user set specified by UserSetSelector to the device and makes it active.

Name	Type	Access	Visibility	Description
UserSetSave *[UserSetSelector]*	Command	WO	Beginner	Save the user set specified by UserSetSelector to the non-volatile memory of the device.
UserSetDefault	Enumeration	RW	Beginner	Selects the feature user set to load and make active by default when the device is reset. - *Default* (Value=0) - *UserSet0* (Value=1) - *UserSet1* (Value=2) - *UserSet2* (Value=3)

12.13TransportLayerControl

Category that contains the transport Layer control features.

Name	Type	Access	Visibility	Description
PayloadSize	Integer	RO	Expert	Provides the number of bytes transferred for each image or chunk on the stream channel. This includes any end-of-line, end-of-frame statistics or other stamp data. This is the total size of data payload for a data block.
CurrentThroughput	Float	RO	Expert	Provides the number of bytes transferred for each second.
GigEVision	Category	—	—	Category that contains the features pertaining to the GigE Vision transport layer of the device.

TransportLayerControl::GigEVision

Category that contains the features pertaining to the GigE Vision transport layer of the device.

Name	Type	Access	Visibility	Description
GevVersionMajor	Integer	RO	Expert	Major version of the specification.
GevVersionMinor	Integer	RO	Expert	Minor version of the specification.
GevDeviceModeIsBigEndian	Boolean	RO	Guru	Endianess of the device registers.
GevDeviceModeCharacterSet	Enumeration	RO	Guru	Character set used by all the strings of the bootstrap registers. - *UTF8* (Value=1)
GevInterfaceSelector	Integer	RW	Beginner	Selects which physical network interface to control.

Name	Type	Access	Visibility	Description
GevMACAddress *[GevInterfaceSelector]*	Integer	RO	Beginner	MAC address of the network interface.
GevSupportedOptionSelector	Enumeration	None	Expert	Selects the GEV option to interrogate for existing support. - *UserDefinedName* (Value=0): Indicates if the Userdefined name register is supported - *SerialNumber* (Value=1): Indicates if the Serial number register is supported - *HeartbeatDisable* (Value=2): Indicates if the Heartbeat can be disabled - *LinkSpeed* (Value=3): Indicates if the Link Speed registers are supported - *CCPApplicationSocket* (Value=4): Indicates if the CCP Application Port and IP address registers are supported. - *DiscoveryAckDelay* (Value=7): When Discovery ACK Delay register is supported, this bit indicates that the application can write it. If this bit is 0, the register is read-only - *DiscoveryAckDelayWritable* (Value=8): Indicates if the Discovery ACK Delay register is supported - *ExtendedStatusCodes* (Value=9): It indicates if the generation of extended status codes is supported. - *PrimaryApplicationSwitchover* (Value=10): It indicates if the authenticate primary application switchover requests are supported. - *Action* (Value=25): It indicates if ACTION_CMD and ACTION_ACK are supported. - *PendingAck* (Value=26): It indicates if the generation of PENDING_ACK is supported. - *EventData* (Value=27): It indicates if the EVENTDATA_CMD and EVENTDATA_ACK are supported. - *Event* (Value=28): It indicates if the EVENT_CMD and EVENT_ACK are supported. - *PacketResend* (Value=29): It indicates if the PACKETRESEND_CMD is supported. - *WriteMem* (Value=30): It indicates if the WRITEMEM_CMD and WRITEMEM_ACK are supported. - *CommandsConcatenation* (Value=31): It indicates if the Multiple operations in a single message are supported. - *IPConfigurationLLA* (Value=61): It indicates if Link Local Address IP configuration scheme is supported - *IPConfigurationDHCP* (Value=62): It indicates if DHCP IP configuration scheme is supported - *IPConfigurationPersistentIP* (Value=63): It indicates if PersistentIP configuration scheme is supported

Name	Type	Access	Visibility	Description
				- *StreamChannelSourceSocket* (Value=64): Indicates the SCSP register (stream channel source port) is available - *MessageChannelSourceSocket* (Value=96): Indicates the MCSP register (message channel source port) is available\
GevSupportedOption *[GevSupportedOptionSelector]*	Boolean	RO	Expert	Returns if the selected GEV option is supported.
GevCurrentIPConfigurationLLA *[GevInterfaceSelector]*	Boolean	RW	Beginner	Indicates if Link Local Address IP configuration scheme is activated on the given network interface.
GevCurrentIPConfigurationDHCP *[GevInterfaceSelector]*	Boolean	RW	Beginner	Indicates if DHCP IP configuration scheme is activated on the given network interface.
GevCurrentIPConfigurationPersistentIP *[GevInterfaceSelector]*	Boolean	RW	Beginner	Indicates if PersistentIP configuration scheme is activated on the given network interface.
GevCurrentIPAddress *[GevInterfaceSelector]*	Integer	RO	Beginner	Reports the IP address for the given network interface.
GevCurrentSubnetMask *[GevInterfaceSelector]*	Integer	RO	Beginner	Provides the subnet mask of the given interface.
GevCurrentDefaultGateway *[GevInterfaceSelector]*	Integer	RO	Beginner	Indicates the default gateway IP address to be used on the given network interface.
GevFirstURL	String	RO	Guru	Indicates the first URL to the XML device description file. The First URL is used as the first choice by the application to retrieve the XML device description file.
GevSecondURL	String	RO	Guru	Indicates the second URL to the XML device description file. This URL is an alternative if the application was unsuccessful to retrieve the device description file using the first URL.
GevNumberOfInterfaces	Integer	RO	Expert	Indicates the number of physical network interfaces supported by this device.
GevPersistentIPAddress *[GevInterfaceSelector]*	Integer	RW	Beginner	Indicates the Persistent IP address for this network interface. It is only used when the device boots with the Persistent IP configuration scheme.
GevPersistentSubnetMask *[GevInterfaceSelector]*	Integer	RW	Beginner	Indicates the Persistent subnet mask associated with the Persistent IP address on this network interface. It is only used when the device boots with the Persistent IP configuration scheme.

Name	Type	Access	Visibility	Description
GevPersistentDefaultGateway *[GevInterfaceSelector]*	Integer	RW	Beginner	Indicates the persistent default gateway for this network interface. It is only used when the device boots with the Persistent IP configuration scheme.
GevCCP	Enumeration	RW	Guru	Controls the device access privilege of an application. - *OpenAccess* (Value=0) - *ExclusiveAccess* (Value=1) - *ControlAccess* (Value=2)
GevMCPHostPort	Integer	RW	Guru	Indicates the port to which the device must send messages. Setting this value to 0 closes the message channel.
GevMCDA	Integer	RW	Guru	Indicates the destination IP address for the message channel.
GevMCTT	Integer	RW	Guru	Provides the transmission timeout value in milliseconds.
GevMCRC	Integer	RW	Guru	Indicates the number of retransmissions allowed when a message channel message times out.
GevStreamChannelSelector	Integer	RW	Expert	Selects the stream channel to control.
GevSCPInterfaceIndex *[GevStreamChannelSelector]*	Integer	RW	Guru	Index of network interface to use (from 0 to 3).
GevSCPHostPort *[GevStreamChannelSelector]*	Integer	RW	Guru	Indicates the port to which the device must send data stream. Setting this value to 0 closes the stream channel.
GevSCPSFireTestPacket *[GevStreamChannelSelector]*	Boolean	RW	Guru	Sends a test packet. When this feature is set, the device will fire one test packet.
GevSCPSDoNotFragment *[GevStreamChannelSelector]*	Boolean	RW	Guru	The state of this feature is copied into the “do not fragment” bit of IP header of each stream packet. It can be used by the application to prevent IP fragmentation of packets on the stream channel.
GevSCPSBigEndian *[GevStreamChannelSelector]*	Boolean	RW	Guru	Endianess of multi-byte pixel data for this stream.
GevSCPSPacketSize *[GevStreamChannelSelector]*	Integer	RW	Expert	Specifies the stream packet size in bytes to send on this channel. Min: 86 Max: GevSCPSMaxPacketSize

Name	Type	Access	Visibility	Description
GevSCPD *[GevStreamChannelSelector]*	Integer	RW	Expert	Indicates the delay (in timestamp counter unit) to insert between each packet for this stream channel. This can be used as a crude flow-control mechanism if the application or the network infrastructure cannot keep up with the packets coming from the device.
GevSCDA *[GevStreamChannelSelector]*	Integer	RW	Guru	Indicates the destination IP address for this stream channel.
GevSCCFGMultiPart *[GevStreamChannelSelector]*	Boolean	RW	Guru	Stream Channel Multi-part configuration
GevSCCFGGenDC *[GevStreamChannelSelector]*	Boolean	RW	Guru	Stream Channel GenDC configuration
GevSCCFGLargeLeaderTrailer *[GevStreamChannelSelector]*	Boolean	RW	Guru	Stream Channel Large Leader configuration
GevGVSPExtendedIDMode	Boolean	RW	Guru	Use Extended ID stream transfers

12.14FileAccessControl

Category that contains the File Access control features.

Name	Type	Access	Visibility	Description
FileSelector	Enumeration	RW	Guru	Selects the target file in the device. - *UserSetDefault* (Value=0): The default (factory) user set of the device. - *UserSet0* (Value=1): The first user set of the device. - *UserSet1* (Value=2): The second user set of the device. - *UserSet2* (Value=3): The third user set of the device. - *UserSetCurrent* (Value=14): The current user set of the device. - *BPRData* (Value=4): The Bad Pixel Replacement configuration of the device. - *CalibrationFactory* (Value=5): The Factory Calibration of the device. - *CalibrationUser* (Value=10): The User Calibration of the device. - *InfoDump* (Value=11): The internal sensor and register dump of the device.
FileOperationSelector	Enumeration	RW	Guru	Selects the target operation for the selected file in the device. This Operation is executed when the FileOperationExecute feature is called. - *Open* (Value=0): Opens the file selected by FileSelector in the device. The access mode in which the file

Name	Type	Access	Visibility	Description
				is opened is selected by FileOpenMode. - *Close* (Value=1): Closes the file selected by FileSelector in the device. - *Read* (Value=2): Reads FileAccessLength bytes from the device storage at the file relative offset FileAccessOffset into FileAccessBuffer. - *Write* (Value=3): Writes FileAccessLength bytes taken from the FileAccessBuffer into the device storage at the file relative offset FileAccessOffset. - *Delete* (Value=4): Deletes the file selected by FileSelector in the device. Note that deleting a device file should not remove the associated FileSelector entry to allow future operation on this file.
FileOperationExecute *[FileSelector]* *[FileOperationSelector]*	Command	WO	Guru	Executes the operation selected by FileOperationSelector on the selected file.
FileAccessLength *[FileOperationSelector]*	Integer	RW	Guru	Controls the length of the mapping between the device file storage and the FileAccessBuffer Min: 0 Max: 4096 Inc: 1
FileAccessOffset *[FileOperationSelector]*	Integer	RW	Guru	Controls the offset of the mapping between the device file storage and the FileAccessBuffer Min: 0 Max: FileAccessOffsetMax Inc: 1
FileOperationStatus *[FileOperationSelector]*	Enumeration	RO	Guru	Represents the file operation execution status. - *Success* (Value=0): File Operation was successful. - *Failure* (Value=1): File Operation failed.
FileOperationResult *[FileOperationSelector]*	Integer	RO	Guru	Represents the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned.
FileOpenMode *[FileSelector]*	Enumeration	RW	Guru	Selects the access mode in which a file is opened in the device. - *Read* (Value=0): This mode selects read-only open mode. - *Write* (Value=1): This mode selects write-only open mode. - *ReadWrite* (Value=2): This mode selects read and write open mode.
FileSize *[FileSelector]*	Integer	RO	Guru	Represents the size of the selected file in bytes.

12.15EventFrameStartData

Category that contains all the data features related to the Frame Start Event.

Name	Type	Access	Visibility	Description
EventFrameStart	Integer	RO	Expert	Returns the unique Identifier of the Frame Start type of Event.
EventFrameStartTimestamp	Integer	RO	Expert	Returns the Timestamp of the Frame Start Event.

12.16EventFrameEndData

Category that contains all the data features related to the Frame End Event.

Name	Type	Access	Visibility	Description
EventFrameEnd	Integer	RO	Expert	Returns the unique Identifier of the Frame End type of Event.
EventFrameEndTimestamp	Integer	RO	Expert	Returns the Timestamp of the Frame End Event.

12.17EventFrameBurstStartData

Category that contains all the data features related to the FrameBurst Start Event.

Name	Type	Access	Visibility	Description
EventFrameBurstStart	Integer	RO	Expert	Returns the unique Identifier of the FrameBurst Start type of Event.
EventFrameBurstStartTimestamp	Integer	RO	Expert	Returns the Timestamp of the FrameBurst Start Event.

12.18EventFrameBurstEndData

Category that contains all the data features related to the FrameBurst End Event.

Name	Type	Access	Visibility	Description
EventFrameBurstEnd	Integer	RO	Expert	Returns the unique Identifier of the FrameBurst End type of Event.
EventFrameBurstEndTimestamp	Integer	RO	Expert	Returns the Timestamp of the FrameBurst End Event.

12.19EventFrameMissedData

Category that contains all the data features related to the Acquisition Start Event.

Name	Type	Access	Visibility	Description
EventFrameMissed	Integer	RO	Expert	Returns the unique Identifier of the Acquisition Start type of Event.
EventFrameMissedTimestamp	Integer	RO	Expert	Returns the Timestamp of the Acquisition Start Event.

12.20EventLineMissedData

Category that contains all the data features related to the Acquisition End Event.

Name	Type	Access	Visibility	Description
EventLineMissed	Integer	RO	Expert	Returns the unique Identifier of the Acquisition End type of Event.
EventLineMissedTimestamp	Integer	RO	Expert	Returns the Timestamp of the Acquisition End Event.