C4-1280-GigE Camera

Hardware Reference Manual

Rev 1.8

Automation Technology GmbH

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C4 Camera Series Overview

Introduction

The C4 camera series is a revolutionary product family of intelligent high speed sensors. It is optimised for 3D profile measurement by means of laser triangulation technique. The 3D profile extraction is performed in the camera by using high performance Field Programmable Gate Array processors. At the same time the 3D profile data is sent to the PC over a Gigabit Ethernet interface (GigE). This extreme data reduction boosts the measuring speed to unprecedented levels without affecting the performance of the connected image processing unit.

Measuring Principle

The C4 camera acquires height profiles and height images based on the laser triangulation principle. According to this method a laser line is projected on the object from one direction. The C4 camera views the object from another angle defining the triangulation geometry. The resulting sensor image is evaluated by the C4 camera core and converted into a single height profile. By scanning the laser line over the object a complete height image can be acquired.

The figures below demonstrate some typical triangulation geometries. The following notation is used in the approximation of height resolution:

ΔX= resolution along the laser line (lateral),

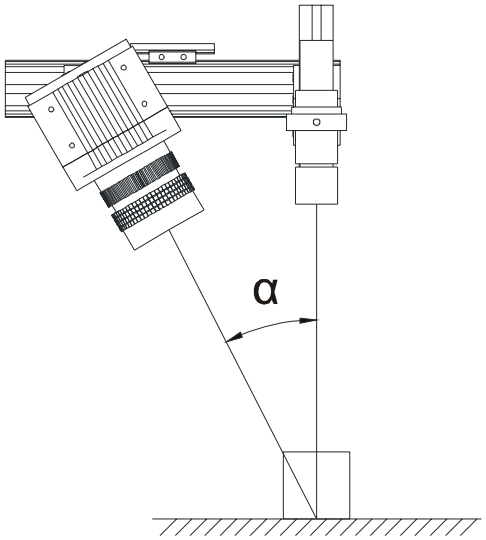
ΔY= resolution perpendicular to the laser line (longitudinal in the direction of motion),

ΔZ= height resolution.

Geometry 1

The laser line is projected perpendicular to the object surface, while the camera views the object under the triangulation angle α.

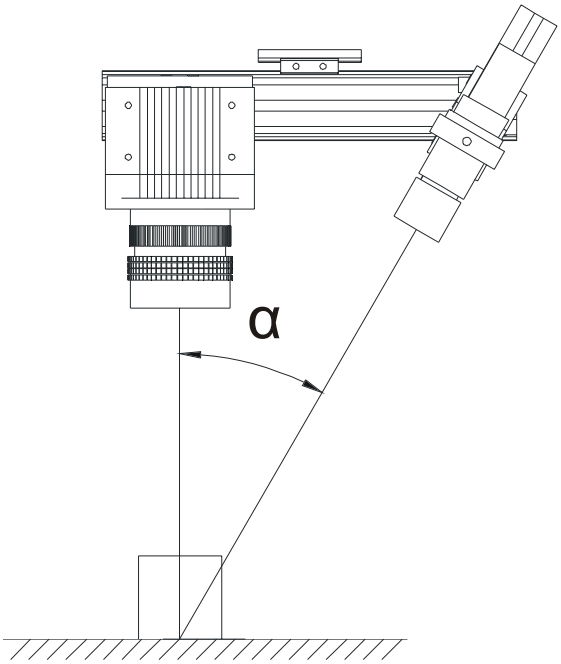
The height resolution can be approximated: $\Delta Z \approx \Delta X / \sin(\alpha)$



Geometry 2

The camera views the object perpendicularly to its surface, while the laser line is projected under the triangulation angle α.

The height resolution can be approximated: $\Delta Z \approx \Delta X / \tan(\alpha)$

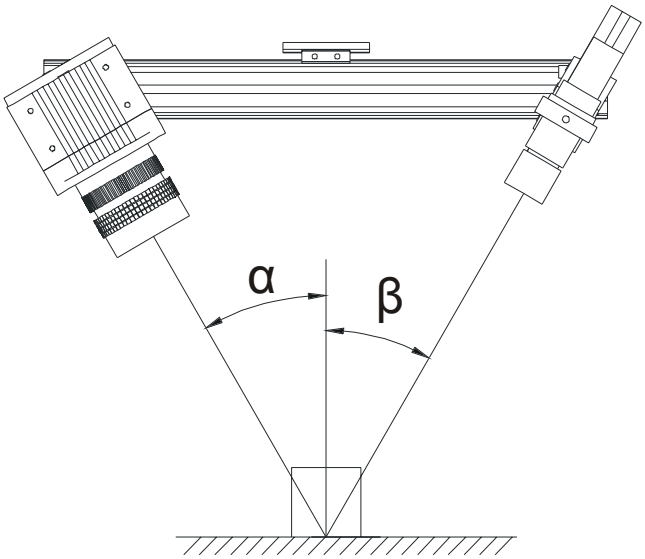


Geometry 3

The camera views the object under an angle α, while the laser line is projected under a different angle β.

The height resolution can be approximated: $\Delta Z \approx \Delta X * \cos(\beta) / \sin(\alpha + \beta)$,

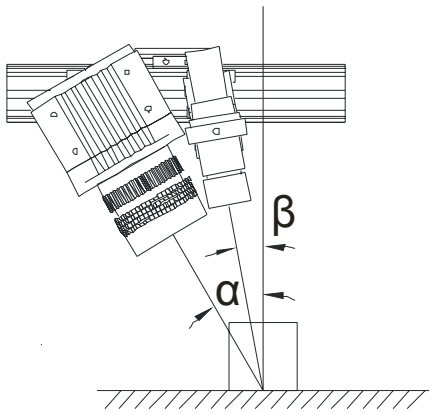
in case $\alpha = \beta$ (direct reflex) : $\Delta Z \approx \Delta X / 2 * \sin(\alpha)$



Geometry 4

The camera views the object under an angle α, while the laser line is projected under a different angle β at the camera side.

The height resolution can be approximated: $\Delta Z \approx \Delta X * \cos(\beta) / \sin(\alpha - \beta)$,



The C4-1280-GigE Camera General Specifications

Camera Controls	
Synchonization Modes	Free running, Triggered, Software Triggered
Exposure Modes	Programmable, Pulse controlled
Shutter Modes	Global Shutter
Digital Trigger Input	2 optoisolated inputs, 5V or 24V with C4-I/O-Panel
	VIL, logic ‚0' Voltage $< 2.5V$
	VIH, logic ‚1' Voltage $> 3.5V$
Encoder Trigger Input	RS422 Standard with 100 Ohm termination
Digital Output	2 optoisolated outputs
	VOL, logic ‚0' Voltage 0.5V
	VOH, logic ‚1' Voltage OC output with 4.7kOhm pull-up to VCC I/O
	IOH, logic ‚1' output current OC output with 4.7kOhm pull-up to VCC I/O
	IOL, logic ‚0' output current 8mA
Illumination Control	Power 5V DC, 200mA, Modulation 20kHz

Features	
3D-Algorithms	MAX, TRSH, COG, user specific
Smart Camera	Dedicated CPU for custom image processing, 1Gb image memory, 256 Mb processor instruction and data memory
High Speed Acquisition	Full frame: 500 fps
High Dynamic Range Imaging	Multiple Slope Curve, Non-Destructive Readout

Optical Interface	
Lens Mount	M42x1 with Back Focal Distance 6.52mm
Adapter for C-Mount lens (must be ordered separately)	Back Focal Distance 17.52mm
Adapter for F-Mount lens with Bajonett mount (must be ordered separately)	Back Focal Distance 46.50 mm

Mechanical Interface	
Camera Size	68 mm x 68 mm x 59 mm (with C-Mount adapter)
	68 mm x 68 mm x 88 mm (with F-Mount adapter)

Mechanical Interface

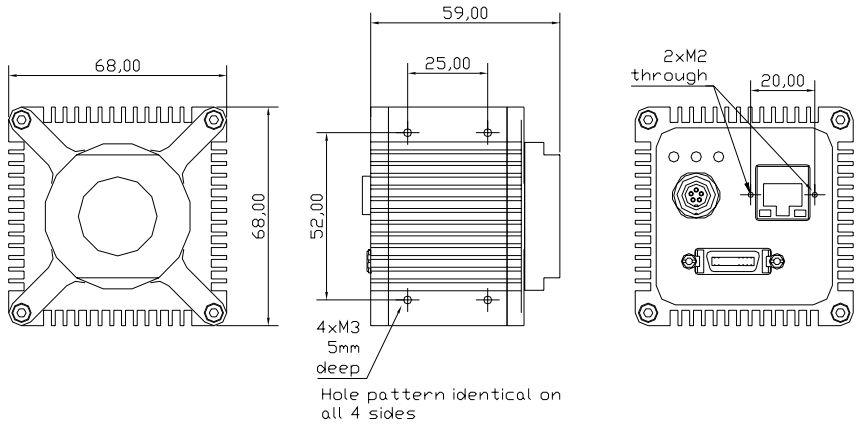
Mass (without optics)	340g (C-Mount), 410g (F-Mount)
Power connector	20-pin MDR
Ethernet connector	RJ45
Illunimation control connector	5-pin M9

Electrical Interface

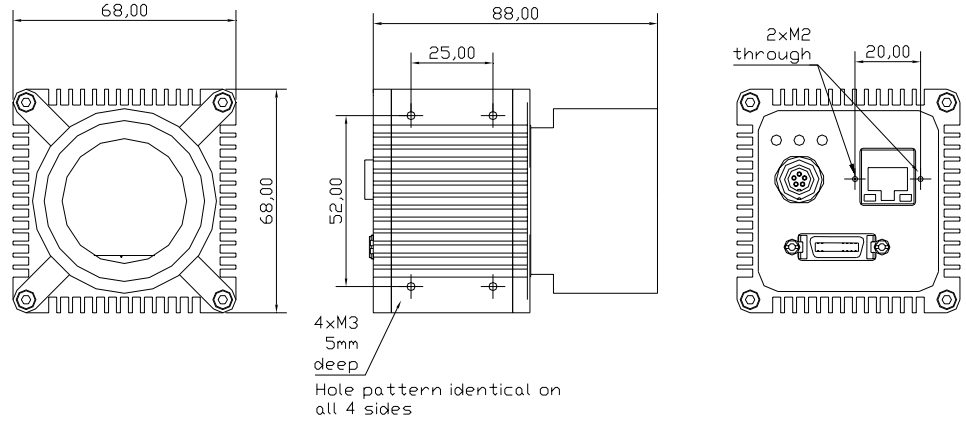
Input Voltage	10 - 24V DC
Power consumption	<10W
Operating Temperature	0°C to +50°C (non condensing)
Output Data Interface	Gigabit Ethernet (IEEE 802.3)
Communication Protocol	GigE Vision with GeniCam

Mechanical Drawings

C4-1280-GigE with C-Mount adapter:



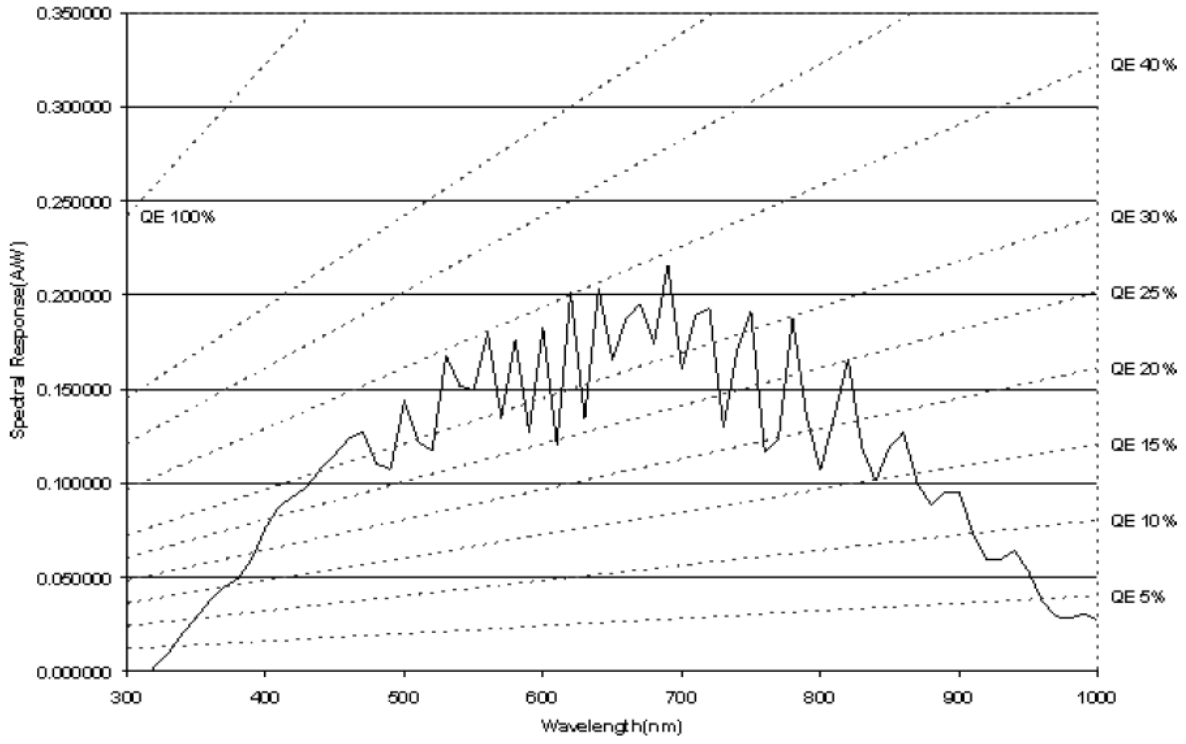
C4-1280-GigE with F-Mount adapter:



The C4-1280-GigE Camera Sensor Specifications

Parameters	Specifications	
Sensitivity at peak response	20000 LSB / μJ / cm^2 @680nm	
Resolution	1280 x 1024	
Pixel Size	14μm x 14μm	
Sensor Size	17.92mm x 14.34mm, diagonal: 22.95mm	
Optics	1″	
Sensor ADC Resolution	10 bit	
Sensor Dynamic Range	90dB	
Max. Internal Full-Frame Rate	500fps	
Max. External Full-Frame Rate	80fps	
Effective Frame / Profile Rate at Max. Row Length	Number of Rows	Effective Frame / Profile Rate (Hz)
	8	38462
	16	23810
	32	13699
	64	7353
	128	3817
	256	1949
	1024	495

Spectral sensitivity of C4-1280 sensor



C4-1280-GigE Camera Operational Reference

C4-1280-GigE Camera GenICam Features

DeviceInformation

Name	Rev.	Interface	Access	Description
DeviceVendorName	1.0	IString	R	The name of the device vendor.
DeviceModelName	1.0	IString	R	The name of the device model.
DeviceManufacturerInfo	1.0	IString	R	Additional info from manufacturer about this device.
DeviceVersion	1.0	IString	R	A string identifying the version of the device.
DeviceID	1.0	IString	R	A unique identifier of the device, e.g., a serial number or a GUID (User Data in GigE Boot register).
DeviceFirmwareVersion	1.0	IString	R	Version of firmware/software.
DeviceUserID	1.0	IString	R/W	User-programmable device identifier.
DeviceScanType	1.0	IEnumeration	R	Show the camera type: - Areascan
DeviceReset	1.0	ICommand	W	Resets and reboots the device immediately.
DeviceRegistersStreamingStart	1.2	ICommand	W	Announces the start of registers streaming without immediate checking for consistency.
DeviceRegistersStreamingEnd	1.2	ICommand	W	Announces the end of registers streaming and perform validation for registers consistency before activating them. This will also update the DeviceRegistersValid flag.
DeviceRegistersCheck	1.2	ICommand	W	Performs an explicit register set validation for consistency.
DeviceRegistersValid	1.2	IBoolean	R	Indicates whether the current register set is valid and consistent.
DeviceTemperature	AT	IFloat	R	Device temperature in degrees Celsius (°C).
DeviceMaxThroughput	1.2	IInteger	R	Maximum Bandwidth of data in Bytes/sec.

ImageFormatControls

Name	Rev.	Interface	Access	Description
PayloadSize	1.0	IInteger	R	PayloadSize provides the number of bytes transferred for each image on the stream channel
SensorWidth	1.0	IInteger	R	Width of sensor (effective pixels)
SensorHeight	1.0	IInteger	R	Height of sensor (effective pixels)
Width	1.0	IInteger	R/W	Width of Image/Area Of Interest. In Image-Mode writing this manipulates AOI[0].width.
Height	1.0	IInteger	R/W	Height of Image/Area Of Interest. In Image-Mode writing this manipulates AOI[0].height
PixelFormat	1.0	IEnumeration	R/W	Format of the image pixels. For more details, see the Pixel Format description chapter. - Mono8 - Mono16
ReverseX	1.0	IBoolean	R/W	When set to true, this parameter flips the image horizontally.

Name	Rev.	Interface	Access	Description
ReverseY	1.0	IBoolean	R/W	When set to true, this parameter flips the image vertically.
OffsetX	1.0	IInteger	R/W	X Offset of AOI
TestImageSelector	1.0	IEnumeration	R/W	Selection of the test image to be used. - Off - GreySensorColumnPattern
LinePitch	1.0	IInteger	R	Distance between consecutive lines in bytes.
PixelDynamicRangeMin	1.0	IInteger	R	Minimum pixel value sent by the camera.
PixelDynamicRangeMax	1.0	IInteger	R	Maximum pixel value sent by the camera.

AcquisitionControl

Name	Rev.	Interface	Access	Description
AcquisitionStart	1.0	ICommand	W	Issues the START command. This starts the acquisition.
AcquisitionStop	1.0	ICommand	W	Issues the STOP command. This stops the acquisition.
AcquisitionMode	1.0	IEnumeration	R/W	Defines the type of acquisition: - SingleFrame - MultiFrame - Continuous
AcquisitionAbort	1.0	ICommand	W	Issues the ABORT command. This immediately aborts the acquisition without completing the current frame.
AcquisitionFrameCount	1.0	IInteger	R/W	Number of frames to be acquired in MultiFrame acquisition mode. The minimum allowable value is 1.
AcquisitionFrameRateAbs	1.2	IFloat	R	The frame rate of the imager. Absolute units are in Hz.
AcquisitionStatusSelector	1.2	IEnumeration	R/W	Selector for AcquisitionStatus to read: - AcquisitionTriggerWait - AcquisitionActive - AcquisitionTransfer - FrameTriggerWait
AcquisitionStatus[AcquisitionStatusSelector]	1.2	IBoolean	R	Status of the selected acquisition flag

CameraControls – AOIs (Areas Of Interest)

Name	Rev.	Interface	Access	Description
MaxNumAOIs	AT	IInteger	R	Maximum number of AOIs.
NumAOIs	AT	IInteger	R/W	Number of used AOIs.
ImageModeAoiSelector	AT	IInteger	R/W	Selects the AOI to show in image mode
AoiSelector	AT	IInteger	R/W	Selects which AOI to control
AoiHeight	AT	IInteger	R/W	Number of sensor rows in AOI
AoiOffsetY	AT	IInteger	R/W	Offset distance in rows between the first row of AOI and the first row of sensor chip
AoiThreshold	AT	IInteger	R/W	Intensity threshold value for selected AOI.

CameraControls – ModeAndAlgorithmControls

Name	Rev.	Interface	Access	Description
CameraMode	AT	IEnumeration	R/W	Selects the camera mode or algorithm: - Image - CenterOfGravity - Threshold - MaximumIntensity
ProfilesPerFrame	AT	IInteger	R/W	This feature represents the number of Profiles per Frame in 3D-Mode expelled by the camera.
AbsOffsetPos	AT	IBoolean	R/W	True: Position values are referenced to the first row of sensor chip (absolute position). False: Position values are referenced to the first row of AOI.
TrshFirstFalling	AT	IBoolean	R/W	Stops the position calculation along an AOI column, as soon as the falling edge of a Gauss curve is detected.
NumCOGSP	AT	IInteger	R/W	Number of subpixel bits of COG output (0-6).
PosValidationEn	AT	IBoolean	R/W	Enable validation of position value of a Gauss curve using tolerances for width and sum of intensity. Perform validation during scan of image column and

Name	Rev.	Interface	Access	Description
				immediately after detecting a Gauss falling edge. Clear the result, if the position value is invalid.
ClearInvalidPos	AT	IBoolean	R/W	Enable validation of position value using tolerances for width and sum of intensity. Perform validation at the end of scan of image column. Invalid position values are set to zero in all DCs.
ValidationWidthMin	AT	IInteger	R/W	Minimum width of valid intensity distribution in 3D-mode.
ValidationWidthMax	AT	IInteger	R/W	Maximum width of valid intensity distribution in 3D-mode.
ValidationSumMin	AT	IInteger	R/W	Minimum sum of intensity of valid intensity distribution in 3D-mode.
ValidationSumMax	AT	IInteger	R/W	Maximum sum of intensity of valid intensity distribution in 3D-mode.

CameraControls – ModeAndAlgorithmControls - AoiTracking

Name	Rev.	Interface	Access	Description
AoiTrackingEnable	AT	IBoolean	R/W	True: AOI-Tracking mode is enabled False: AOI-Tracking mode is disabled
AoiTrackingMinNumPixel	AT	IInteger	R/W	Minimum number of required pixel (one pixel per column) to start AOI tracking algorithm
AoiTracking_P	AT	IFloat	R/W	Proportional gain of PID controller
AoiTracking_I	AT	IFloat	R/W	Integral gain of PID controller
AoiTracking_D	AT	IFloat	R/W	Derivative gain of PID controller
AoiTrackingUpdateRate	AT	IInteger	R/W	Update frequency of tracking algorithm (Hz)
AoiTrackingSensorWriteTimeout	AT	IInteger	R/W	AOI tracking senosr write timeout in microseconds (µs)

CameraControls – ModeAndAlgorithmControls - AoiSearch

Name	Rev.	Interface	Access	Description
AoiSearchEnable	AT	IBoolean	R/W	True: AOI-Search mode is activated False: AOI-Search mode is disabled
AoiSearchHeight	AT	IInteger	R/W	Height of search AOI
AoiSearchOffsetY	AT	IInteger	R/W	Vertical offset from the origin to the search AOI

CameraControls – ModeAndAlgorithmControls - ColumnEvaluationMask

Name	Rev.	Interface	Access	Description
ColRangeStart	AT	IInteger	R/W	Column start index
ColRangeEnd	AT	IInteger	R/W	Column end index
ColRangeEnableCommand	AT	ICommand	W	Enable all columns from RangeStart to RangeEnd
ColRangeDisableCommand	AT	ICommand	W	Disable all columns from RangeStart to RangeEnd
ColRangeActivate	AT	ICommand	W	Activate complete ColumnEvaluationMask and write data into flash memory

CameraControls – SensorControls

Name	Rev.	Interface	Access	Description
SensorFrameCounter	AT	IInteger	R	Sensor frame counter.
SensorReadoutTime	AT	IInteger	R	Sensor Readout Time in µs.
ExposureTimeAbs	AT	IInteger	R/W	Sensor integration time in µs.
FramePeriode	AT	IInteger	R/W	Time between two frames in µs.
FrameRate	AT	IFloat	R	Frame rate in Hz
ExposureMode	AT	IEnumeration	R	Sensor exposure mode: - Interleaved (the sensor integration and readout are performed in parallel).
MultipleSlopeMode	AT	IEnumeration	R/W	MultipleSlope Mode: - SingleSlope - DualSlope - TripleSlope
DualSlopeTime	AT	IInteger	R/W	DualSlopeTime in % of sensor integration time
TripleSlopeTime	AT	IInteger	R/W	TripleSlopeTime in % of sensor integration time
NumberOfNDRFrames	AT	IInteger	R/W	Number of NDR frames

NDRMode	AT	IEnumeration	R/W	Non Destructive Readout (NDR) Mode: - Off - On - SingleFrameMode.
NDRSingleFrameNumber	AT	IInteger	R/W	NDR single frame number.
NDRExposureTimeAbs_1	AT	IInteger	R/W	NDR exposure time 1.
NDRExposureTimeAbs_2	AT	IInteger	R/W	NDR exposure time 2.
NDRExposureTimeAbs_3	AT	IInteger	R/W	NDR exposure time 3.
NDRExposureTimeAbs_4	AT	IInteger	R/W	NDR exposure time 4.

CameraControls – SensorControls – AdvancedSensorsettings

Name	Rev.	Interface	Access	Description
FPNCorrection	AT	IEnumeration	R/W	FPN Correction: - Enable - Disable
GainAbs	1.2	IEnumeration	R/W	Gain value: - 1 - 1.5 - 2 - 2.25 - 3 - 4
AntiBlooming	AT	IFloat	R/W	Antiblooming Voltage (DAC 1)
ResetTS	AT	IFloat	R/W	Reset Voltage Triple Slope (DAC 2)
Reset	AT	IFloat	R/W	Reset Voltage (DAC 3)
ResetDS	AT	IFloat	R/W	Reset Dual Slope (DAC 4)
Precharge	AT	IFloat	R/W	Precharge Voltage (DAC5)
MemH	AT	IFloat	R/W	Pixels memory element high level (DAC6)
MemL	AT	IFloat	R/W	Pixels memory element low level (DAC7)
BlackLevelAdjust	AT	IInteger	R/W	Adjustment of black level.
Enable automatic SERDES recalibration	AT	IBoolean	R/W	Enable automatic SERDES recalibration on data channel error.

CameraControls – DataOutput

Name	Rev.	Interface	Access	Description
EnableDC0	AT	IBoolean	R/W	Activates the output data channel DC0.
EnableDC1	AT	IBoolean	R/W	Activates the output data channel DC1.
EnableDC2	AT	IBoolean	R/W	Activates the output data channel DC2.
EnableDC0Shift	AT	IBoolean	R/W	Right shift twice the intensity value in DC0, when PixelFormat is Mono8.
EnableDC2TrshSP	AT	IBoolean	R/W	Controls the output in channel DC2, when TRSH algorithm is selected: True: DC2 outputs the position value with 1 subpixel. False: DC2 outputs the right edge position.
EnableDC1TrshWidth	AT	IBoolean	R/W	Controls the output in channel DC1, when TRSH algorithm is selected: True: DC1 outputs the laser line width. False: DC1 outputs the left edge position.
EnableDC1Width	AT	IBoolean	R/W	Controls the output in channel DC1, when COG algorithm is selected: True: DC1 outputs the laser line width. False: DC1 outputs the left edge position.
EnableDC1Flags	AT	IBoolean	R/W	When in 16 bit mode, the bits 12-15 of output channel DC1 contain additional algorithm flags

CameraControls – Commands

Name	Rev.	Interface	Access	Description
StartPulse	AT	ICommand	W	Send Start pulse.
StopPulse	AT	ICommand	W	Send Stop pulse.
TriggerPulse	AT	ICommand	W	Send Trigger pulse.
CalibSensor	AT	ICommand	W	Start internal sensor FPN calibration.
RstFrameCnt	AT	ICommand	W	Reset frame counter to zero.
SearchAoi	AT	ICommand	W	Fit AOI to laser line position. Supports only one AOI

CameraIO

Name	Rev.	Interface	Access	Description
Input1	AT	IEnumeration	R	Lists the input signals available for IN1: - Input1_Unused. - Input1_FrameStart - Input1_EnableFrame - Input1_Trigger
Input2	AT	IEnumeration	R	Lists the input signals available for IN2: - Input2_Unused. - Input2_StopFrame - Input2_Trigger
Output1	AT	IEnumeration	RW	Selects the output signal for OUT1: - Out1_IntegrationActive - Out1_SequencerActive - Out1_IntegrationDualSlopeActive - Out1_IntegrationTripleSlopeActive - Out1_High - Out1_Low - Out1_InternalTrigger - Out1_SequencerTriggerActive
Output2	AT	IEnumeration	RW	Selects the output signal for OUT2: - Out2_IntegrationActive, - Out2_IntegrationDualSlopeActive - Out2_IntegrationTripleSlopeActive - Out2_High - Out2_Low - Out2_TriggerOverrun - Out2_ResolverCountDir - Out2_TriggerBusy
TriggerOverrun	AT	IBoolean	R	Trigger Overrun Flag.
Input1Level	AT	IEnumeration	R	The voltage level of IN1: - Input1Level_High - Input1Level_Low
Input2Level	AT	IEnumeration	R	The voltage level of IN2: - Input2Level_High - Input2Level_Low
RS422ChannelALevel	AT	IEnumeration	R	Voltage level of RS422 Channel A: - RS422ChannelALevel_High - RS422ChannelALevel_Low
RS422ChannelBLevel	AT	IEnumeration	R	Volatge level of RS422 Channel B - RS422ChannelBLevel_High - RS422ChannelBLevel_Low
LaserPower	AT	IFloat	R/W	Sets the output analog voltage of illumination control in the range 0.0-5.0 V DC (corresponds to 0...100%)
TurnLaserOn	AT	IBoolean	R/W	Laser turn on/off.
TurnLaserOnAuto	AT	IBoolean	R/W	Laser turn on automatically during sensor integration.
VoltageIn	AT	IFloat	R	Reads the input analog voltage of illumination control (range 0.0-5.0 V DC)
Output1MinPulseWidth	AT	IInteger	R/W	Output1 minimum pulse width in microseconds (µs)
Output2MinPulseWidth	AT	IInteger	R/W	Output2 minimum pulse width in microseconds (µs)
Output1Delay	AT	IInteger	R/W	Output1 delay in microseconds (µs)
Output2Delay	AT	IInteger	R/W	Output2 delay in microseconds (µs)
Output1Invert	AT	IBoolean	R/W	True: Output1 inverted False: Output1 not inverted
Output2Invert	AT	IBoolean	R/W	True: Output1 inverted False: Output1 not inverted

TriggerControls

Name	Rev.	Interface	Access	Description
SequencerMode	AT	IEnumeration	R/W	Selects the start trigger mode: - FreeRun - StartStopCameraInput12 - StartCameraInput1 - GateCameraInput1 - StartStopCameraInput12Event - AutoStart
ProfileTriggerMode	AT	IEnumeration	R/W	Selects the profile trigger mode: - FreeRun - CameraInput1 - CameraInput2

Name	Rev.	Interface	Access	Description
				- EncoderResolverInterfaceRS422.
ClearTriggerOverrun	AT	ICommand	W	Command to clear the trigger overrun flag.

TriggerControls – ResolverRS422

Name	Rev.	Interface	Access	Description
TriggerDivider	AT	IInteger	R/W	Trigger divider.
TriggerCoord	AT	IInteger	R	Resolver trigger coordinates
TriggerDirectionMode	AT	IBoolean	R/W	A sensor image is triggered when the internal pulse counter is countdown to 0. Upon start of acquisition, the initial value of pulse counter is equal to trigger divider. This parameter controls the behaviour of the pulse counter: True: The pulse counter is decreased and countdown to 0, when resolver pulses are generated from both moving directions (forwards and backwards). False: The pulse counter is decreased and countdown to 0, when resolver pulses are generated from one moving direction only (e.g. forwards). In that case, pulses corresponding to the opposite moving direction (e.g. backwards) will increase the pulse counter.
TriggerReverseDirection	AT	IBoolean	R/W	Reverse the pulse count direction.
TriggerDividerLoadAtStart	AT	IBoolean	R/W	Loads the value of trigger divider into the pulse counter, when start trigger occurs.
TriggerSingleChannelMode	AT	IBoolean	R/W	Enables trigger mode using single channel resolver.
LoadTriggerDivider	AT	ICommand	W	Command to load the value of trigger divider into the pulse counter.
ClearTriggerCoord	AT	ICommand	W	Reset trigger coordinate counter
TriggerCoordinateCountAlways	AT	IBoolean	R/W	Controls when trigger coordinates shall be counted: True: Trigger coordinates are counted always False: Trigger coordinates are counted only during image acquisition
UseAlternateResolverInputs	AT	IBoolean	R/W	True: Use IN1/IN2 instead of A/B as encoder input False: Use A/B as encoder input
UseAlternateResolverInputsInverted	AT	IBoolean	R/W	True: Invert encoder input over IN1/IN2 False: Do not invert encoder input over IN1/IN2

TriggerControls – AutoStart

Name	Rev.	Interface	Access	Description
AutoStartThreshold	AT	IInteger	R/W	Defines the position within AOI to trigger the AutoStart. Valid values are: When AbsolutePosition = FALSE : 0 - AOI-Height When AbsolutePosition = TRUE : 0 - Sensor-Height
AutoStartNumPixel	AT	IInteger	R/W	Minimum number of valid laser positions within AOI required to trigger the Autostart
AutoStartOption	AT	IEnumeration	R/W	PosLessThanAutostartThreshold: Start when laser position is less-than AutoStartThreshold PosGreaterThanAutostartThreshold: Start when laser position is greater-than AutoStartThreshold
AutoStartBufferOption	AT	IEnumeration	R/W	Defines whether the history buffer should be transmitted as first frame or not -none -HistoryBuffer

GigEVisionTransportLayer

Name	Rev.	Interface	Access	Description
GevVersionMajor	1.2	IInteger	R	This field represents the major version of the GigE Vision specification supported by this device
GevVersionMinor	1.2	IInteger	R	This field represents the minor version of the GigE Vision specification supported by this device
GevDeviceModeIsBigEndian	1.2	IBoolean	R	This represents the endianess of bootstrap registers (FALSE: Little-endian device TRUE: Big-endian device)

Name	Rev.	Interface	Access	Description
GevDeviceModeCharacterSet	1.2	IEnumeration	R	This feature represents the character set of all boot strap strings: - CharacterSet_UTF8
GevInterfaceSelector	1.2	IEnumeration	R	Indicates the index of the network interface to configure: - EnumEntry_GevInterfaceSelector_Interface_0
GevMACAddress	1.2	IInteger	R	48-bit MAC address of the selected interface
GevSupportedIPConfigurationLLA	1.2	IBoolean	R/W	Indicate if LLA (Auto-IP) is supported by the selected interface
GevSupportedIPConfigurationDHCP	1.2	IBoolean	R/W	Indicate if DHCP is supported by the selected interface
GevSupportedIPConfigurationPersistentIP	1.2	IBoolean	R/W	Indicate if Persistent IP is supported by the selected interface
GevCurrentIPConfigurationLLA	1.2	IBoolean	R	This feature indicates if Link Local Address IP configuration scheme is activated on the given network interface
GevCurrentIPConfigurationDHCP	1.2	IBoolean	R	This feature indicates if DHCP Address IP configuration scheme is activated on the given network interface
GevCurrentIPConfigurationPersistentIP	1.2	IBoolean	R	This feature indicates if PersistentIP IP configuration scheme is activated on the given network interface
GevCurrentIPAddress	1.2	IInteger	R	IP address of the selected interface
GevCurrentSubnetMask	1.2	IInteger	R	Subnet mask of the selected interface
GevCurrentDefaultGateway	1.2	IInteger	R	Default gateway of the selected interface
GevPersistentIPAddress	1.2	IInteger	R/W	Persistent IP address for the selected interface
GevPersistentSubnetMask	1.2	IInteger	R/W	Persistent subnet mask for the selected interface
GevPersistentDefaultGateway	1.2	IInteger	R/W	Persistent default gateway for the selected interface
GevLinkSpeed	1.2	IInteger	R	Link speed in Mbps.
GevFirstURL	1.2	IString	R	NULL-terminated string providing the first URL to the XML device description file
GevSecondURL	1.2	IString	R	NULL-terminated string providing the second URL to the XML device description file
GevNumberOfInterfaces	1.2	IInteger	R	Indicates the number of physical network interfaces on this device
GevMessageChannelCount	1.2	IInteger	R	Indicates the number of message channels supported by this device
GevStreamChannelCount	1.2	IInteger	R	Indicates the number of stream channels supported by this device
GevSupportedOptionalCommandsUserDefinedName	1.2	IBoolean	R	Indicates if the User-defined Name register is supported
GevSupportedOptionalCommandsSerialNumber	1.2	IBoolean	R	Indicates if the Serial Number register is supported
GevSupportedOptionalCommandsEVENTDATA	1.2	IBoolean	R	Indicates if EVENTDATA_CMD and EVENTDATA_ACK are supported
GevSupportedOptionalCommandsEVENT	1.2	IBoolean	R	Indicates if EVENT_CMD and EVENT_ACK are supported
GevSupportedOptionalCommandsPACKETRESEND	1.2	IBoolean	R	Indicates if PACKETRESEND_CMD is supported
GevSupportedOptionalCommandsWRITEMEM	1.2	IBoolean	R	Indicates if WRITEMEM_CMD and WRITEMEM_ACK are supported
GevSupportedOptionalCommandsConcatenation	1.2	IBoolean	R	Indicates if multiple operations in a single message are supported
GevHeartbeatTimeout	1.2	IInteger	R/W	Current heartbeat timeout in milliseconds
GevTimestampTickFrequency	1.2	IInteger	R	64-bit value indicating the number of timestamp clock tick in 1 second
GevTimestampControlLatch	1.2	ICommand	R	Latches the current timestamp value of the device
GevTimestampControlReset	1.2	ICommand	R	Resets the timestamp count of the device
GevTimestampValue	1.2	IInteger	R	Latched 64-bit value of the timestamp. Value must first be latched using GevTimestampControlLatch.
GevStreamChannelSelector	1.2	IInteger	R/W	Indicate which stream channel to configure
GevSCPInterfaceIndex	1.2	IInteger	R	Index of network interface
GevSCPSPacketSize	1.2	IInteger	R/W	The size of the stream packet to send on this channel
GevSCPD	1.2	IInteger	R/W	Delay (in timestamp counter unit) to insert between each packet for this stream channel

UserSets

Name	Rev.	Interface	Access	Description
UserSetSelector	1.2	IEnumeration	R/W	Selects the feature User Set to load, save or configure: - Factory - UserSet1 - UserSet2 - UserSet3
UserSetLoad[UserSetSelector]	1.2	ICommand	W	Loads the User Set specified by UserSetSelector to the device and makes it active.
UserSetSave[UserSetSelector]	1.2	ICommand	W	Saves the selected User Set specified by UserSetSelector to persistent memory.
UserSetDefaultSelector	1.2	IEnumeration	R/W	Selects the feature User set to load at power up: - Factory - UserSet1 - UserSet2 - UserSet3

ChunkDataControl

Name	Rev.	Interface	Access	Description
ChunkModeActive	1.2	IBoolean	R/W	Enables the chunk data mode.
ChunkModeSelector	1.2	IEnumeration	R/W	Selects the chunk data mode: - OneChunkPerFrame - OneChunkPerProfile

EventGeneration

Name	Rev.	Interface	Access	Description
EventSelector	1.2	IEnumeration	R/W	Selector for the Event to control: - None - AcquisitionStart - AcquisitionEnd - TransferStart - TransferEnd - AoiTrackingOn - AoiTrackingOff -AoiSearchFailed
EventNotification	1.2	IEnumeration	R/W	Notification type to issue when selected event occurs: - Off - GigEVisionEvent

FileAccessControl

Name	Rev.	Interface	Access	Description
FileSelector	1.2	IEnumeration	R/W	Selects the target file in the device.: - UserSetDefault - UserSet1 - UserSet2 - UserSet3 - UserData - ColStatisticBits
FileOperationSelector	1.2	IEnumeration	R/W	Selects the target operation for the selected file in the device. This Operation is executed when the FileOperationExecute feature is called: - Open - Close - Read - Write
FileOperationExecute	1.2	ICommand	W	Executes the operation selected by FileOperationSelector on the selected file.
FileOpenMode	1.2	IEnumeration	R/W	Selects the access mode in which a file is opened in the device. - Read - Write - ReadWrite
FileAccessOffset	1.2	IInteger	R/W	Controls the Offset of the mapping between the device file storage and the FileAccessBuffer.
FileAccessLength	1.2	IInteger	R/W	Controls the Length of the mapping between the

Name	Rev.	Interface	Access	Description
				device file storage and the FileAccessBuffer.
FileOperationStatus	1.2	IEnumeration	R	Represents the file operation execution status: - Success - Failure
FileOperationResult	1.2	IInteger	R	Represents the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned.
FileSize	1.2	IInteger	R	Represents the size of the selected file in bytes.

The GenICam Features Configuration of C4-1280-GigE

Due to dependencies of the XML nodes of C4-1280-GigE registers, it is recommended to follow a specific order, when configuring the GenICam features of the camera. The list shown below, generated as a CXC file by the CX-Explorer, demonstrates an example of the correct write order:

CameraMode CenterOfGravity
ProfileTriggerMode FreeRun
EnableDC2 1
EnableDC1 0
OffsetX 0
TestImageSelector Off
PixelFormat Mono16
ReverseY 0
ReverseX 0
Width 1280
CameraMode CenterOfGravity
ProfilesPerFrame 100
ClearInvalidPos 0
PosValidationEn 0
AbsOffsetPos 0
TrshFirstFalling 0
NumCOGSP 6
ValidationWidthMin 0
ValidationWidthMax 1023
ValidationSumMin 0
ValidationSumMax 65535
AoiTrackingEnable 0
AoiTracking_P 0.65
AoiTracking_I 0.5
AoiTracking_D 0.12
AoiTrackingUpdateRate 100
AoiTrackingSensorWriteTimeout 10000
AoiTrackingMinNumPixel 100
AoiSearchEnable 0
AoiSearchHeight 1024
AoiSearchOffsetY 0
ColRangeStart 0
ColRangeEnd 1279
NumAois 1
AoiSelector 1
AoiHeight 1024
AoiOffsetY 0
AoiThreshold 250
ExposureTimeAbs 100
FramePeriode 2007
MultipleSlopeMode SingleSlope
NDRMode Off
FPNCorrection Enable
GainAbs Gain1
AntiBlooming 0
ResetTS 1.8
Reset 3.5
ResetDS 2.5
Precharge 0.7

MemH 3.2
MemL 2.55
BlackLevelAdjust 80
EnableDC0 0
EnableDC1 0
EnableDC1TrshWidth 0
EnableDC1Width 0
EnableDC1Flags 0
EnableDC2 1
EnableDC2TrshSP 0
EnableDC0Shift 0
AcquisitionFrameCount 1
AcquisitionMode Continuous
Output1 Out1_SequencerActive
Output2 Out2_IntegrationActive
LaserPower 0
TurnLaserOn 0
TurnLaserOnAuto 0
Output1MinPulseWidth 0

The C4-1280-GigE Camera Algorithms

The C4-1280-GigE camera can be operated both in a variety of 3D profile modes and in image mode. The current operation mode can be chosen by setting the parameter Camera Controls→ ModeAndAlgorithmControls→CameraMode.

The frame rate can be increased in all camera modes by reducing the AOI size. In the image mode the frame rate is limited by the output rate of the camera interface (GigE). However, due to reduced data size in profile mode the frame rate is limited only by the sensor output rate. As a matter of principle the processing speed is independent of the chosen profile mode and is determined by the AOI size.

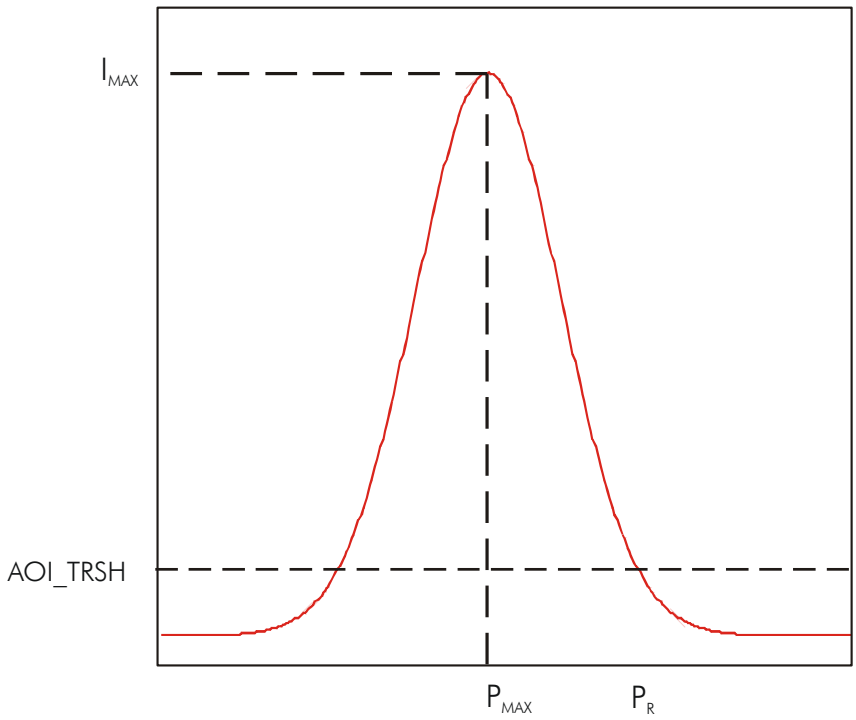
In all profile modes only intensity values higher than the AOI intensity threshold AOI_TRSH are processed in order to suppress weak signal noise. In case that no position value can be found, e.g. no intensity value is higher than threshold, the position value 0 is returned.

The Image Mode (IMG)

In the image mode the C4-1280-GigE camera is operated similar to a standard CMOS camera. In this mode grey scale data of 8 or 10 bit resolution are acquired over the camera interface. Furthermore, the sensor can be divided into multiple regions, whose data can be summarised in one output frame.

The Maximum Intensity Profile Mode (MAX)

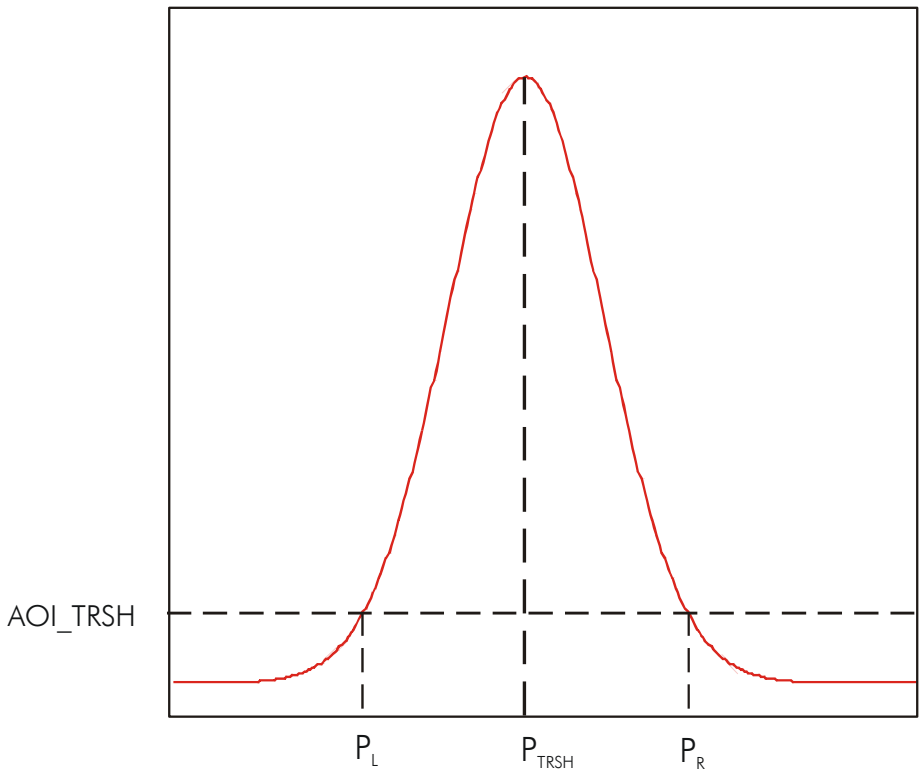
In this mode the position of the maximum intensity of laser beam profile is calculated. The result includes the position value of the maximum (P_{MAX}) as well as the maximum intensity value (I_{MAX}).



The calculation of position value is performed with simple pixel accuracy, i.e. the evaluation of 1024 rows delivers a position range from 0 to 1023 pixels (10 bit). If there is more than one local maximum, the position of the first detected maximum is output.

The Threshold Mode (TRSH)

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



The position value of the laser line is approximated: $P_{TRSH} = (P_L+P_R) / 2$. In order to simplify the digital representation the division over 2 is not performed and thus an integer representation with one subpixel is realised. The evaluation of 1024 rows delivers a position range from 0 to 2047 pixels (11 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.

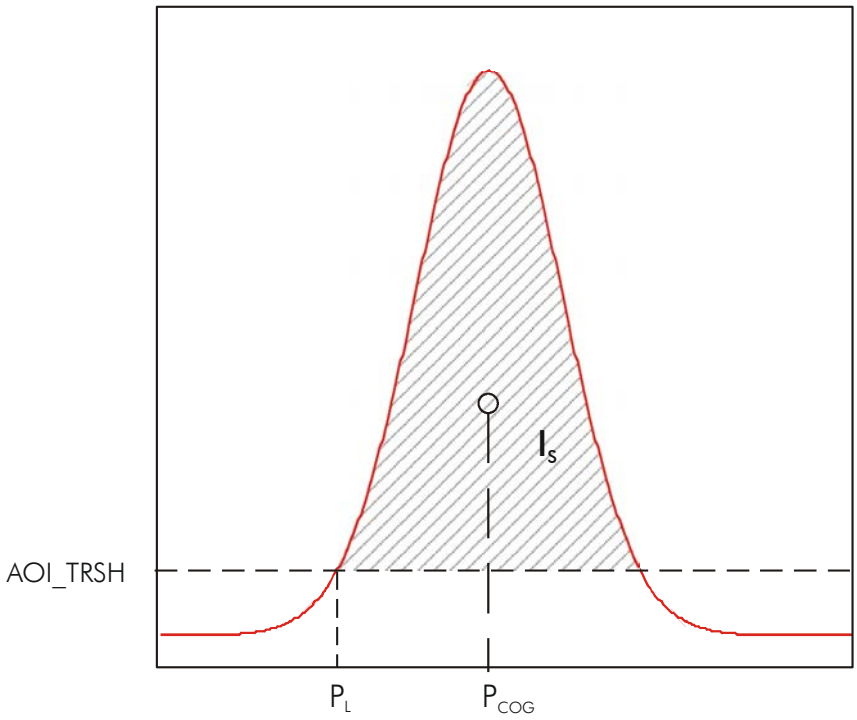
The Center Of Gravity Mode (COG)

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

Position value of the left edge of laser beam profile for a given intensity threshold value P_L ,

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

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



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

$P_{COG} = P_L + M_s / I_s$.

In addition the laser line width can be delivered over the Data Channel DC1. The average intensity of the illumination profile can be calculated by normalising the sum of intensity value I_s with the line width.

The High Dynamic Range 3D Feature (HDR-3D) of C4-1280-GigE

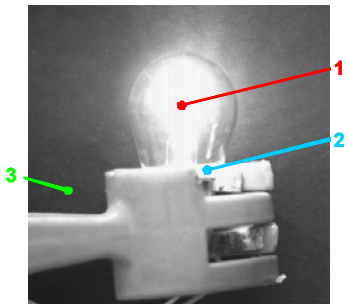
One of the most powerful features of C4-1280-GigE is the HDR-3D (High Dynamic Range) functionality, which allows to scan materials and surfaces with inhomogeneous reflection properties. Using HDR-3D the dynamic range of image intensity is extended up to 90dB, thus avoiding intensity saturation.

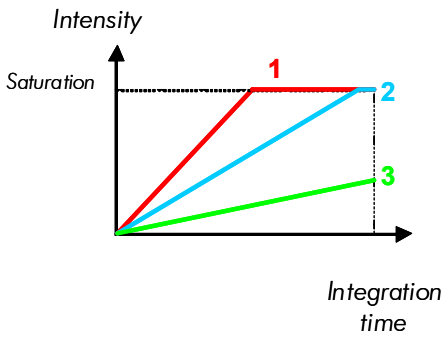
The HDR-3D comprises two independent sensor functions:

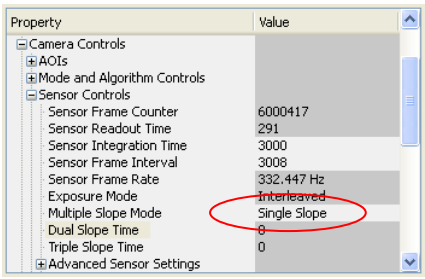
MultipleSlope Function

The aim of the MultipleSlope function is to avoid the saturation of pixels during sensor chip exposure. In order to perform this task, threshold values for the recorded light amount and produced voltage are defined. If within a predefined time the threshold is exceeded then the voltage of the pixel is reset to the threshold value and the integration continues until the exposure is completed. This mode is known as DualSlope. There is also an option of resetting the pixel voltage twice, which is called TripleSlope mode. The reset time of DualSlope and TripleSlope mode is configured as percentage of the integration time. The reset voltage levels are factory preset to a specific optimized value obtained from extensive tests and should not be modified. Advanced users can modify the reset levels by changing the XML grid visibility to "Guru".

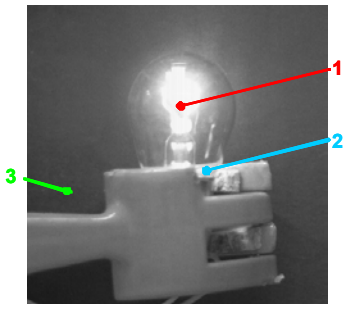
SingleSlope-Modus (default mode)

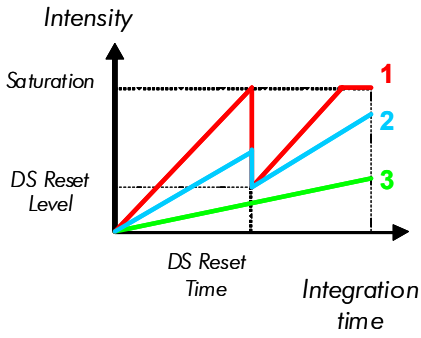


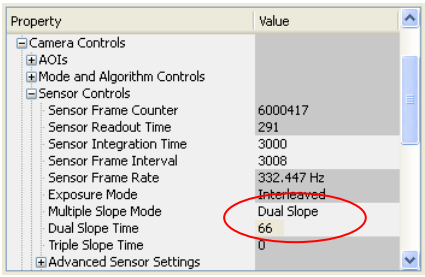




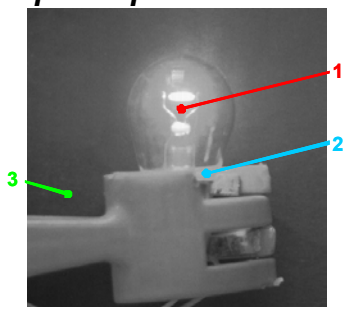
DualSlope mode

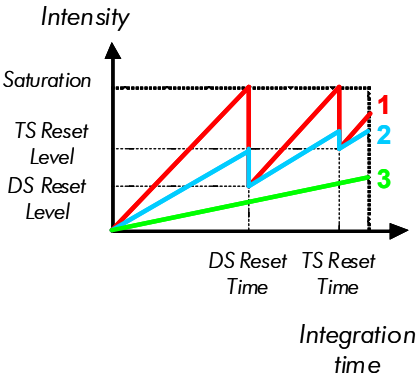


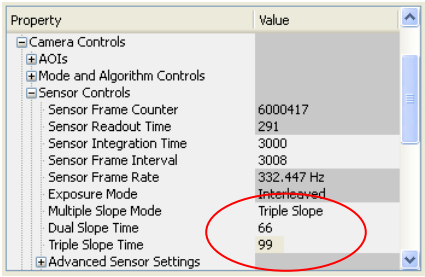




TripleSlope mode

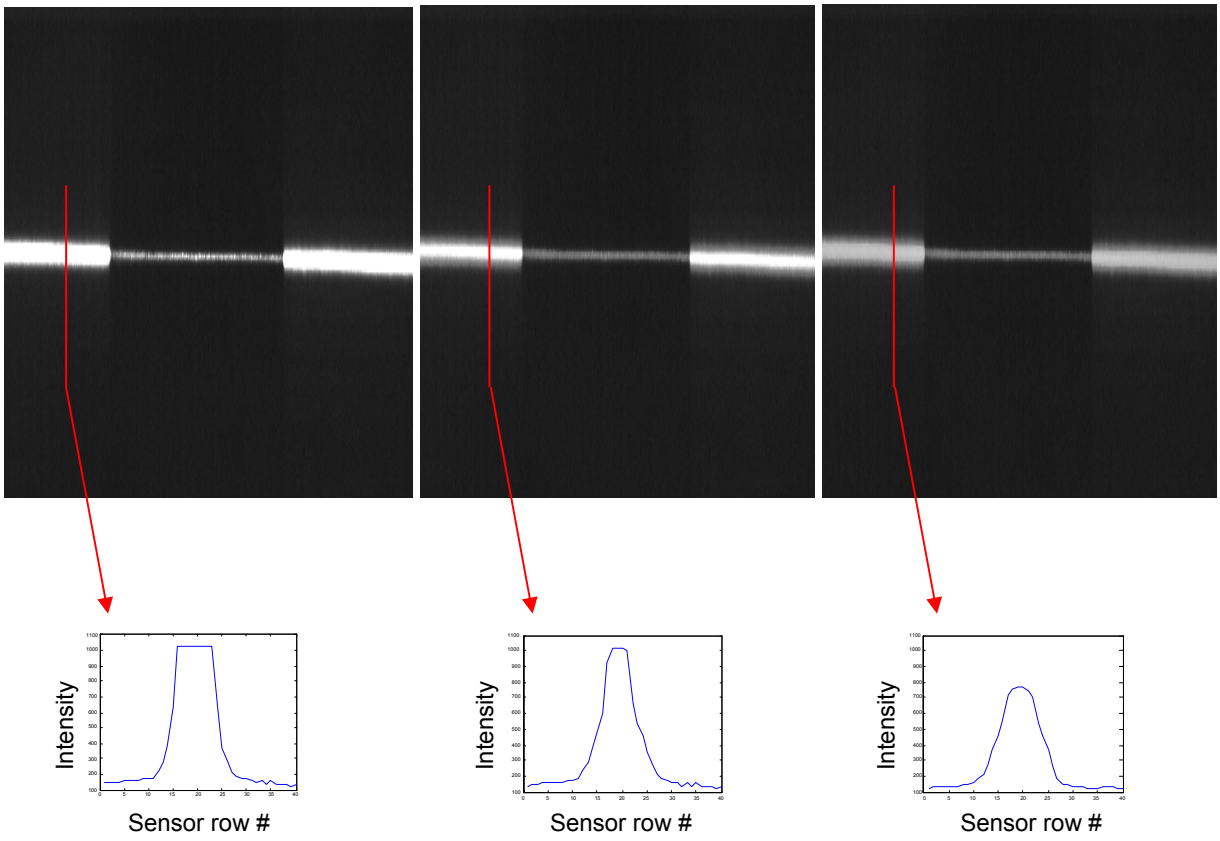






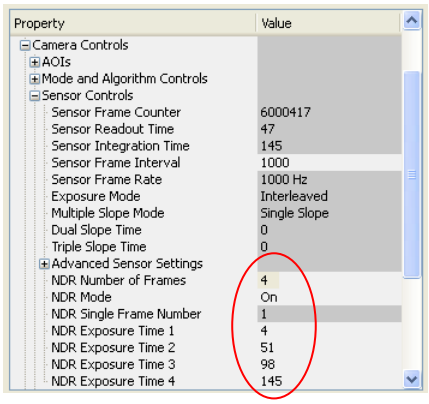
Application of MultipleSlope function in the image of a laser line projected on a surface with non-homogeneous reflectivity (black & white pattern)

SingleSlope DualSlope TripleSlope

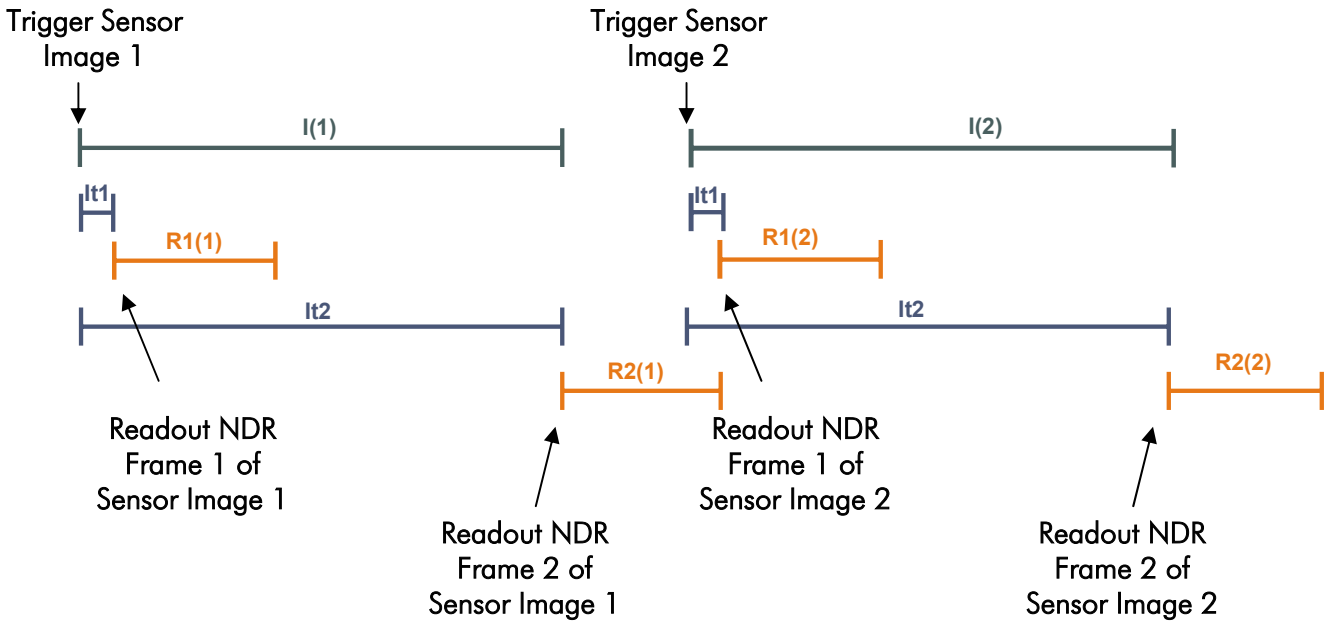


Non-Destructive Readout (NDR) Mode

With the NDR mode it is possible to readout of up to 4 images at different integration levels during one exposure period. The principle is comparable to multiple scans with different integration times with the advantage of taking all data during one single integration period. It allows the combination of profile data from different integration levels and it ensures accurate profile data even for difficult surfaces with strong changes in reflectance.



The following timing diagram shows the function of NDR with 2 frames, when subsequent sensor images are acquired. The exposure times for NDR frame 1 and 2 are depicted with It1 and It2 respectively. Please note that the readout of the second frame R2 can not begin unless the first frame R1 has been readout. The same applies also between two subsequent sensor images, i.e. the first NDR frame of sensor image 2 can not be readout unless the last NDR frame of sensor image 1 has been readout.



The Data Output Format of C4-1280-GigE

The image and 3D data output is performed by selecting the data channel DC0-DC2 (node Camera Controls→DataOutput). Depending on the algorithm the data can be acquired by enabling the corresponding output Data Channel (DC). Every DC is saved in a new image row. The bit depth of output data depends on the selected algorithm. In 3D mode the camera outputs data with 16 bit. In Image mode the camera can output 8 or 16 bit data. When in 8 bit Image mode, the DC0 delivers the 8 most significant bits of the 10 bit intensity data.

The Data Channel Assignment DC0-DC2

Alg.	DC0	DC1	DC2
IMG	Grey scale values	Not used	Not used
TRSH	Maximum intensity	Left edge of laser line (PosL) or line width (PosR-PosL)	Right edge of laser line (PosR) or line position with 1/2 pixel accuracy (PosL+PosR)
MAX	Maximum intensity	Left edge of laser line (PosL)	Position of maximum intensity (PosM)
COG	Sum of intensity values I_s	Left edge of laser line (PosL) or laser line width (PosR-PosL)	Line position with 1/X pixel resolution, where X=1,2,4,8,16,32,64

Alg. Flags – Output over DC1 (16 bit mode):

Bit14 = LEFT_TRSH_FOUND_FLAG: indicates that the left edge of laser line was found
Bit15 = RIGHT_TRSH_FOUND_FLAG: indicates that the right edge of laser line was found

The Output Frame Structure

Depending on configuration, the C4-1280-GigE writes data to the output frame according to following scheme:

1) NDR mode disabled (NDRMode="Off")

```
for (profile_idx=1; profile_idx <=ProfilesPerFrame; profile_idx ++)
{
      for(AOI_idx=1; AOI_idx<=NumAOIs; AOI_idx++)
      {
            if(EnableDC0==true)
                  write_data_of_DC0 (AOI_idx);
            if(EnableDC1==true)
                  write_data_of_DC1 (AOI_idx);
            if(EnableDC2==true)
                  write_data_of_DC2 (AOI_idx);
      }
}
```

2) NDR mode enabled (NDRMode="On")

```
for (profile_idx=1; profile_idx <=ProfilesPerFrame/2; profile_idx ++)
{
      for(AOI_idx=1; AOI_idx<=NumAOIs; AOI_idx++)
      {
            for(NDR_idx=1: NDR_idx <= NumberOfNDRFrames; NDR_idx ++)
            {
                  if(EnableDC0==true)
                        write_data_of_DC0 (AOI_idx,NDR_idx);
                  if(EnableDC1==true)
                        write_data_of_DC1 (AOI_idx,NDR_idx);
                  if(EnableDC2==true)
                        write_data_of_DC2 (AOI_idx,NDR_idx);
            }
      }
}
```

Index Definition

Index #	Range	Description
Profile_idx	1-16384	Index of Profile
AOI_idx	1-4	Index of sensor AOI
NDR_idx	1-4	Index of NDR frame

Examples of Output Frame Structure

1) Configuration with single AOI, single DC, disabled NDR mode and output of 6 profiles resulting to a frame height of 6 rows:

ProfilesPerFrame=10

NumAOIs=1

EmableDC0= false,

EnableDC1=false

EnableDC2=true

NDRMode="Off"

Row #	Description	Profile #
1	Data of DC2 readout from AOI1	1
2	Data of DC2 readout from AOI1	2
3	Data of DC2 readout from AOI1	3
4	Data of DC2 readout from AOI1	4
5	Data of DC2 readout from AOI1	5
6	Data of DC2 readout from AOI1	6

2) Configuration with two AOIs, two DCs, disabled NDR mode and output of 5 profiles resulting to frame height of 20 rows:

ProfilesPerFrame=5

NumAOIs=2

EmableDC0= true,

EnableDC1=false

EnableDC2=true

NDRMode="Off"

Row #	Description	Profile #
1	Data of DC0 readout from AOI1	1
2	Data of DC2 readout from AOI1	
3	Data of DC0 readout from AOI2	
4	Data of DC2 readout from AOI2	
5	Data of DC0 readout from AOI1	2
6	Data of DC2 readout from AOI1	
7	Data of DC0 readout from AOI2	
8	Data of DC2 readout from AOI2	
9	Data of DC0 readout from AOI1	3
10	Data of DC2 readout from AOI1	
11	Data of DC0 readout from AOI2	
12	Data of DC2 readout from AOI2	
13	Data of DC0 readout from AOI1	4
14	Data of DC2 readout from AOI1	
15	Data of DC0 readout from AOI2	
16	Data of DC2 readout from AOI2	
17	Data of DC0 readout from AOI1	5
18	Data of DC2 readout from AOI1	
19	Data of DC0 readout from AOI2	
20	Data of DC2 readout from AOI2	

3) Configuration with single AOI, single DC, NDR mode with two NDR frames and output of 3 profiles resulting to a frame height of 6 rows:

ProfilesPerFrame=6

NumAOIs=1

EmableDC0= false,

EnableDC1=false

EnableDC2=true

NDRMode="On"

NumberOfNDRFrames=2

Row #	Description	Profile #
1	Data of DC2 extracted from NDR1, readout from AOI1	1
2	Data of DC2 extracted from NDR2, readout from AOI1	
3	Data of DC2 extracted from NDR1, readout from AOI1	2
4	Data of DC2 extracted from NDR2, readout from AOI1	
5	Data of DC2 extracted from NDR1, readout from AOI1	3
6	Data of DC2 extracted from NDR2, readout from AOI1	

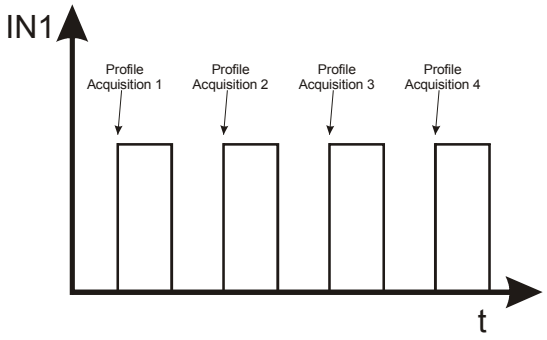
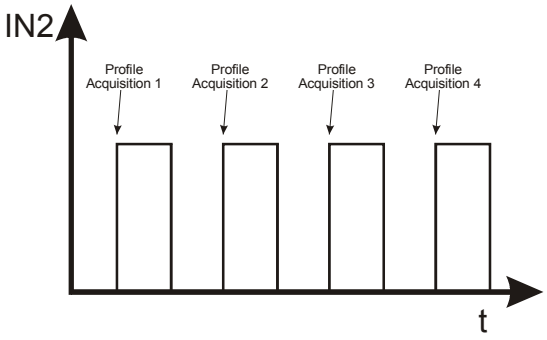
Advanced AOI Functions

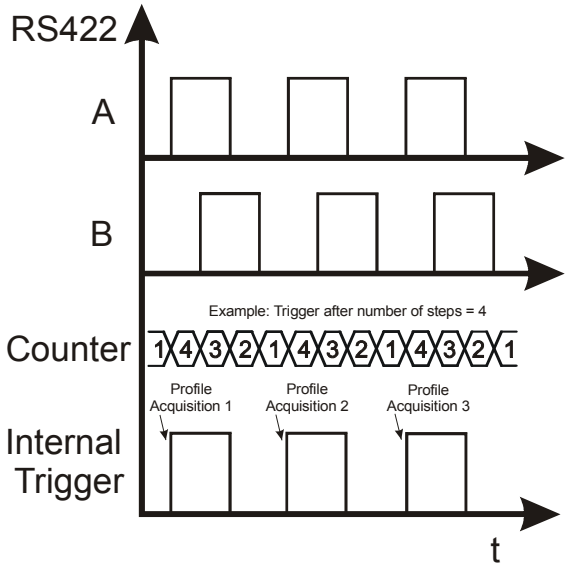
The C4 camera features an area CMOS sensor, whose frame rate depends on the number of pixels to readout. By defining a sensor Area of Interest (AOI) the frame rate and hence the profile speed will be significantly increased due to the smaller number of pixels to readout.

In some cases the AOI position may not be constant and it should follow the image of laser line on the camera sensor. The C4-1280-GigE features functions for performing an automatic AOI positioning (AOI-Search) as well as line tracking (AOI-Tracking). A detailed description of these functions can be found in a separate application note.

C4-1280-GigE Camera Triggering

Description of Profile Trigger Modes

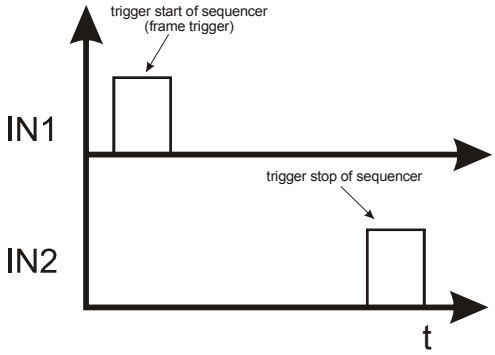
No.	Profile Trigger Mode (PTM)
0	Free-run (PTM0)
1	Camera input 1 (PTM1) 
2	Camera input 2 (PTM2) 

No.	Profile Trigger Mode (PTM)
3	Encoder/Resolver Interface (PTM3) 

Description of Modes for Triggering of Sequencer/Frame and Profile Acquisition

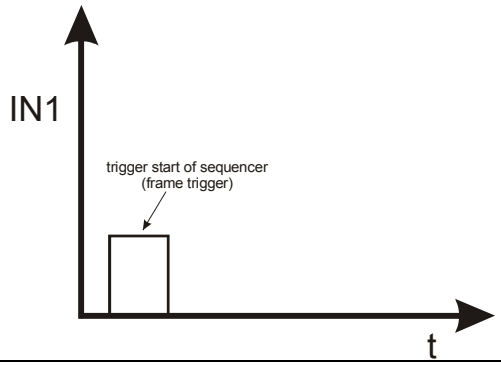
<table>
<tr><th>No.</th><th>Sequencer/Frame Trigger Mode</th><th>Profile Trigger Mode (PTM)</th></tr>
<tr><td rowspan="4">0</td><td rowspan="4">Free-run</td><td>PTM0 (free-run)</td></tr>
<tr><td>PTM1(IN1)</td></tr>
<tr><td>PTM2 (IN2)</td></tr>
<tr><td>PTM3 (RS422)</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Start/stop over camera input 1 / 2

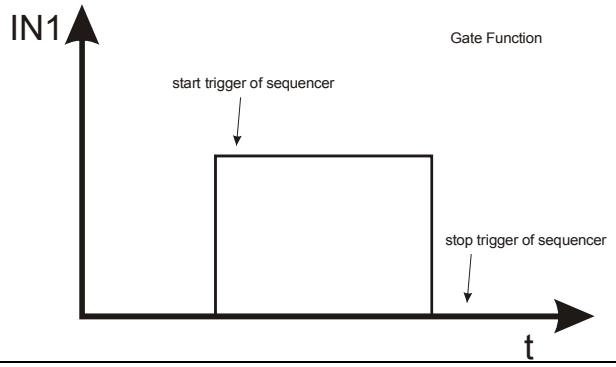
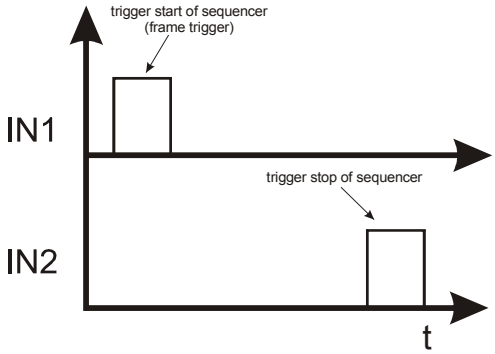
Continuous frame acquisition is started with the rising edge of camera input 1 (IN1) and stopped with rising edge of camera input 2 (IN2)

When “stop” occurs, the frame is not transmitted immediately over the GigE interface but the camera continues to acquire profile data, until the predefined frame height is reached.</td><td>PTM0 (free-run)</td></tr>
<tr><td>PTM3 (RS422)</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Start over camera input 1

Single frame acquisition is triggered over the rising edge of camera input 1 (IN1)

 
</td><td>PTM0 (free-run)</td></tr>
<tr><td>PTM2 (IN2)</td></tr>
<tr><td>PTM3 (RS422)</td></tr>
</table>

No.	Sequencer/Frame Trigger Mode	Profile Trigger Mode (PTM)
3	Gate over camera input 1 Continuous frame acquisition is performed as long as the camera input 1 is on high state 	PTM0 (free-run) PTM2 (IN2) PTM3 (RS422)
4	Start/stop with instant transmission over camera input 1 / 2 Continuous frame acquisition is started with rising edge of camera input 1 (IN1) and stopped with rising edge of camera input 2 (IN2)  When "stop" occurs, the frame is transmitted immediately over the GigE interface. Using the Chunk Data mode of C4 camera, it is possible to determine how many rows of the frame contain valid data (see ChunkImageInfo for details).	PTM0 (free-run) PTM3 (RS422)
5	AutoStart (no external signal is required)	PTM0 (free-run) PTM1(IN1) PTM2 (IN2) PTM3 (RS422)

Remarks:

The above table (except AutoStart) applies also to acquisition in image mode. In this case the camera delivers a gray scale sensor image for every profile trigger.

A detailed description of the AutoStart function can be found in a separate application note.

The Chunk Data Mode of C4-1280-GigE

General Description

The C4-1280-GigE features a Chunk Data mode for providing additional information to the acquired image data. The implementation of XML nodes is performed according to SFNC 1.4:

- Category ChunkDataControl
- ChunkModeActive
- ChunkModeSelector (OneChunkPerFrame, OneChunkPerProfile)

The ChunkData generated by the camera have the following format:

- ChunkImage
- 1…N x ChunkAcqInfo
- ChunkImageInfo

Depending on camera mode (image or 3D) the ChunkData block („ChunkAcqInfo“) can be sent as follows:

- in image mode, the camera can send only one ChunkAcqInfo block per image frame.
- in 3D mode, the camera can send one ChunkAcqInfo block either per 3D frame (“OneChunkPerFrame”) or per 3D profile (“OneChunkPerProfile”).

The „ChunkImageInfo“ is the last ChunkData sent by the camera and contains following data:

- number of valid rows in ChunkImage
- number of valid ChunkAcqInfo blocks
- flags identifing the current frame as „Start“ or „Stop“

The ChunkAcqInfo block consists of totally 32 bytes containing following data

- 64 bit timestamp
- 32 bit frame counter
- 32 bit trigger coordinate
- Trigger status
- I/O Status
- reserved

The data of timestamp, frame counter, trigger coordinate, trigger status and I/O status are assigned at the start of every image integration.

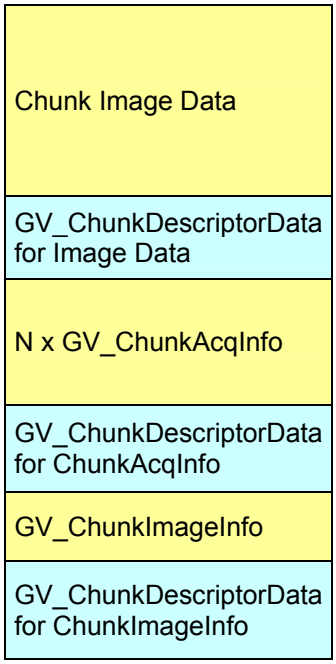
When ChunkMode is disabled, the camera uses the “regular“ GEV image protocol, in which the optional transfer of frames with variable height and payload is supported.

Furthermore, when ChunkMode is enabled, the camera sends the full payload, even if the ChunkImage or ChunkAqInfo blocks contain partially valid data. The number of valid ChunkImage rows and ChunkAqInfo blocks can be read from ChunkImageInfo.

For example, when in Start/Stop mode with instant frame transmission, the camera stops the frame acquisition as soon as the stop trigger occurs and transfers the complete contents of internal image buffer. Using the ChunkImageInfo data block, it is possible to detect how many image rows and ChunkAqInfo blocks are valid in the payload buffer.

The tag of ChunkData has big endian byte order. The data of ChunkData has little endian byte order. An endian converter for ChunkData is not supported.

Payload Layout in Chunk Data Mode



XML Descriptors and Id's

ChunkImageInfo

```
<Port Name="FrameInfoPort">
<ChunkID>11119999</ChunkID>
</Port>
```

ChunkAcqInfo

```
<Port Name="CameraChunkPort">
<ChunkID>66669999</ChunkID>
</Port>
```

ChunkImage

```
<Port Name="ImageInfoPort">
<ChunkID>A5A5A5A5</ChunkID>
</Port>
```

Chunk Data Structure

```
#pragma pack(push)
#pragma pack(1)

typedef struct _GV_ChunkAcqInfo
{
          unsigned int                timeStamp64L;    // 0..3
          unsigned int                timeStamp64H;    // 4..7
          unsigned int                frameCnt; // 8..11
          signed int                  triggerCoord;    // 12..15
          unsigned char               triggerStatus;   // 16
          unsigned short              DAC;// 17..18
          unsigned short              ADC;// 19..20
          unsigned char               INT_idx;   // 21
          unsigned char               AOI_idx;   // 22
          unsigned short              AOI_ys;    // 23..24
          unsigned short              AOI_dy;    // 25..26
          unsigned short              AOI_xs;    // 27..28
          unsigned short              AOI_trsh; // 29..30
          unsigned char               AOI_alg;   // 31
} GV_ChunkAcqInfo;

#define CHUNKACQINFO_TRIGGERSTATUS_BIT_TRIGGER_OVERRUN 0x01
#define CHUNKACQINFO_TRIGGERSTATUS_BIT_RESOLVER_CNT_UP 0x02

#define CHUNKACQINFO_TRIGGERSTATUS_BIT_IN0  0x10
#define CHUNKACQINFO_TRIGGERSTATUS_BIT_IN1  0x20
#define CHUNKACQINFO_TRIGGERSTATUS_BIT_OUT0 0x40
#define CHUNKACQINFO_TRIGGERSTATUS_BIT_OUT1 0x80


typedef struct _GV_ChunkImageInfo
{
      unsigned int mSizeYReal;
      unsigned int numChunkAcqInfo;
      unsigned int flag;
}     GV_ChunkImageInfo;

#define CHUNKIMAGEINFO_FLAG_BIT_START_FRAME 0x00000001
#define CHUNKIMAGEINFO_FLAG_BIT_STOP_FRAME  0x00000002

typedef struct _GV_ChunkDescriptor
{
      unsigned int descriptor;
      unsigned int length;
} GV_ChunkDescriptorData;

#pragma pack(pop)
```

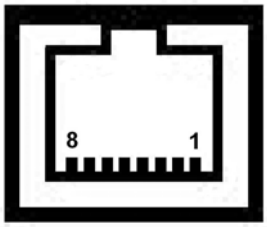
The GigE-Vision Events of C4-1280-GigE

The C4-1280-GigE supports a number of events that can be monitored by a software application by means of a callback function. Events provide real time notification on various stages of the acquisition sequence and data transfer.

Event Name	Event ID	Description
AcquisitionStart	36882	Frame Acquisition is started
AcquisitionEnd	36883	Frame Acquisition is terminated
TrasnferStart	36884	Frame transfer is started from the camera
TransferEnd	36885	Frame transfer is terminated
AoiTrackingOn	36886	The AOI tracking process is started and the laser line image is valid for AOI alignment
AoiTrackingOff	36887	The AOI tracking process is stopped and the AOI position is not updated anymore
AoiSearchFailed	36888	AOI-Search failed to detect the laser line

C4-1280-GigE Camera Interface

The GigE Interface



Pin Nr.	GigE Signal Name
1	MX0+
2	MX0-
3	MX1+
4	MX1-
5	MX2+
6	MX2-
7	MX3+
8	MX3-
Shield	Shield

The I/O & Power Interface

Pin Nr.	Signal Name	Description
1	GND_EXT	main camera ground
2	VCC_EXT	camera supply voltage (10-24V DC)
3	RS232_RX	reserved
4	RS232_GND	reserved
5	ENC_A-	encoder Track1 RS422 reversible input (A-)
6	ENC_B-	encoder Track2 RS422 reversible input (B-)
7	OUT1	optoisolated Output1
8	OUT2	optoisolated Output2
9	IN1	optoisolated Input1
10	IN2	optoisolated Input2
11	GND_EXT	main camera ground
12	VCC_EXT	camera supply voltage (10-24V DC)
13	RS232_TX	reserved
14	ENC_GND	Encoder ground
15	ENC_A+	encoder Track1 RS422 none reversible input (A+)
16	ENC_B+	encoder Track2 RS422 none reversible input (B+)

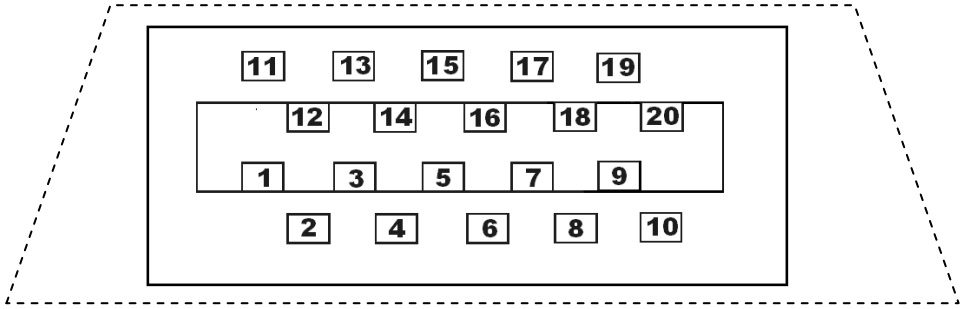
Pin Nr.	Signal Name	Description
17	VCC_OUT	Power supply voltage of camera optoisolated outputs (5V/24V DC)
18	GND_OUT	Ground of camera optoisolated outputs
19	GND_IN1	GND for optoisolated Input1
20	GND_IN2	GND for optoisolated Input2
Shield	SHIELD	is connected to camera case

Part Numbers for I/O Connector MDR 20

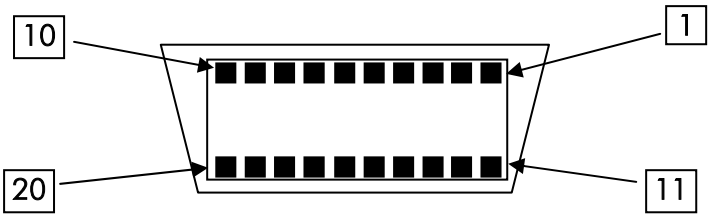
Description	Part Number 3M
20-pin Connector	10120
lockable connector case	10320

MDR20 I/O Connector Pin Assignment

Cable Plug: View from solder side:

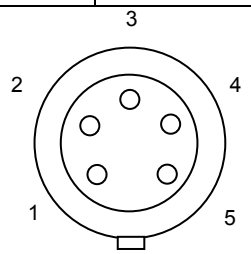


Camera Receptable: View from rear side of camera:



The Illumination Control

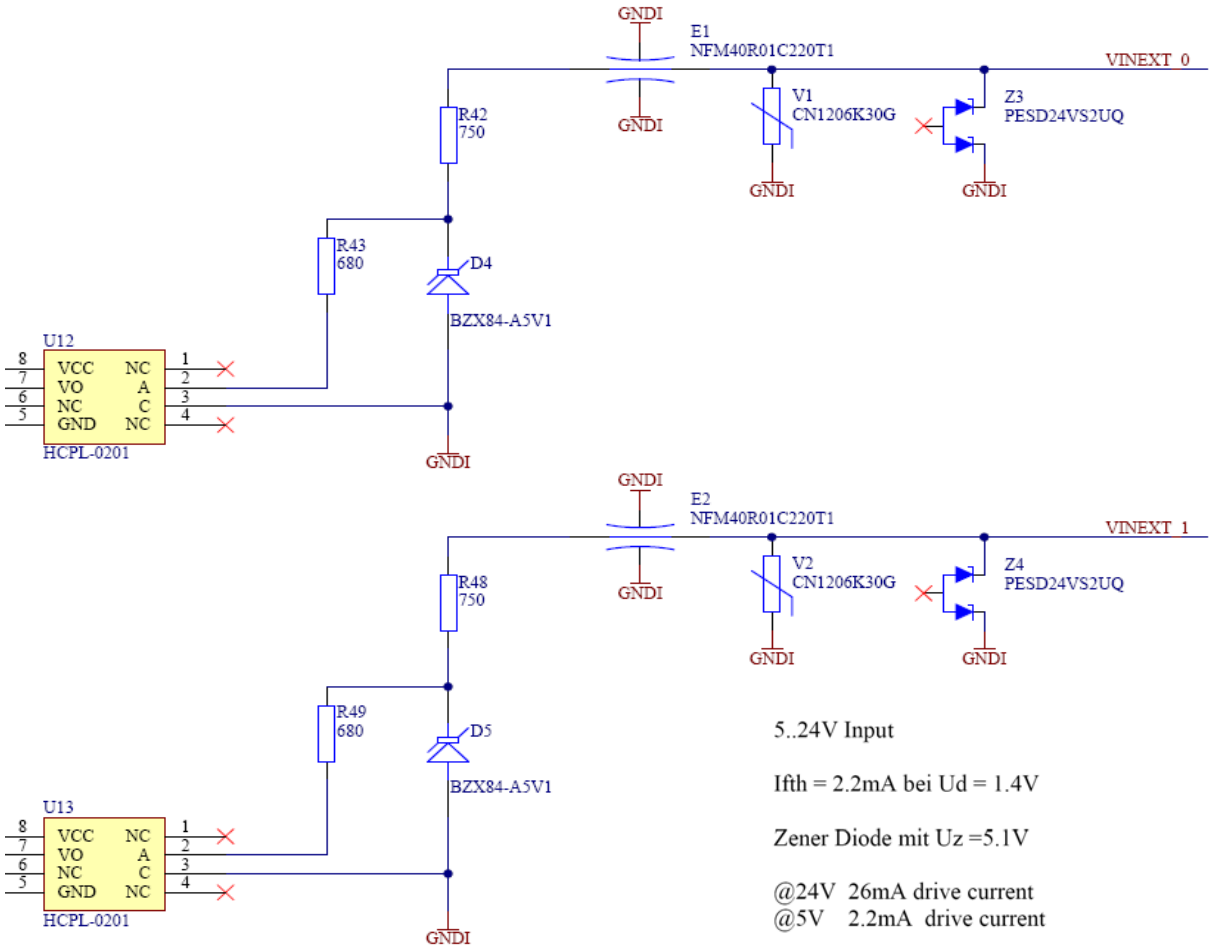
Pin Nr.	Signal Name	Description
1	VCC_LASER	Output to power the illumination device (5V, max. 200mA, fused)
2	GND_LASER	Ground for illumination device
3	LASER_DOUT	Output for digital modulation of illumination device (TTL signal)
4	LASER_AOUT	Output for analog modulation of illumination device (0-5V DC)
5	LASER_AIN	Input for monitoring specific functions of illumination device (0-5V DC)



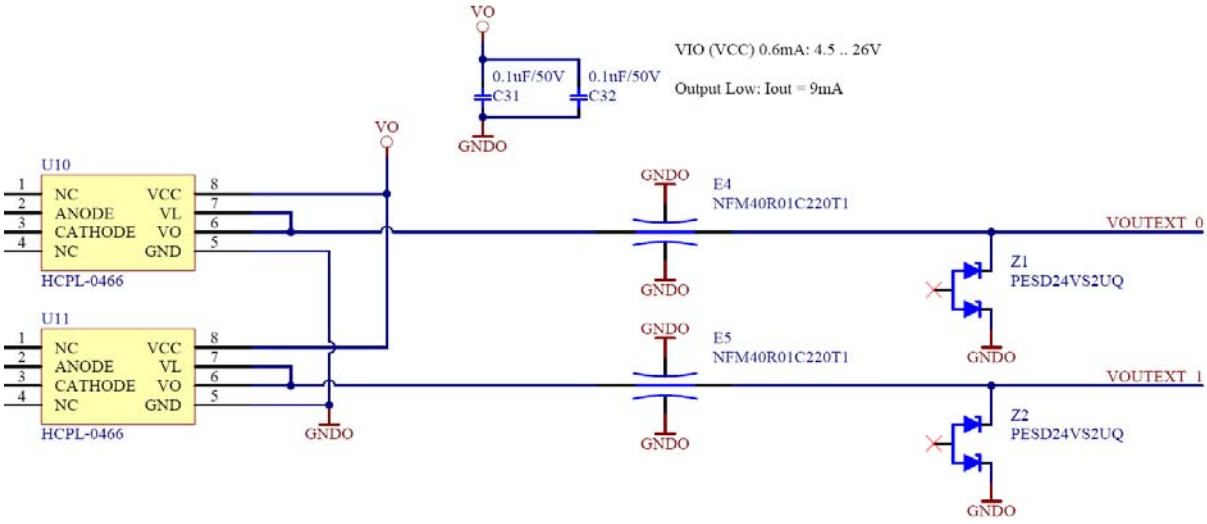
Part Number for Illumination Control Connector

Description	Part Number Binder Series 712
M9 5-pin male connector, EMV protected	99-0413-10-05
M9 5-pin male connector 90° angled, EMV protected	99-0413-75-05

Schematic of C4-1280-GigE digital inputs



Schematic of C4-1280-GigE digital outputs



Description of LEDs

LED	Description
1 (PWR)	During boot: Green On = FPGA configuration done Red On = Loader Stop. Boot failed. No valid Image could be loaded. After boot: Green On= Boot completed
2 (USR)	During boot: Green fast blink = boot procedure takes places Green blink = Configuration Error, FPGA configuration failure. Boot procedure is repeated up to 3 times, after which the Factory-Image is loaded. Green On = camera start up completed, FPGA configuration success Off = FPGA configuration successful after error recovery Red On = a boot error has occurred After boot: Red On= no network found Off = network found Green On=CCP status connected
3 (LSR)	On = Laser is ON Off = Laser is OFF
4 (GigE_left)	Green blink = Indication of network activity
5 (GigE_right)	Green On = Linkspeed 1 Gbit Yellow On = Linkspeed 100 Mbit Off = Linkspeed 10 Mbit or wait for end of autonegotiation

Integrated RS232 serial interface and Camera Boot Log

During boot procedure, the camera outputs a log via the integrated RS232 serial interface. The external C4-I/O-Panel provides a D-sub 9-pin male socket for monitoring the boot log. A null-modem cable (crosslinked) must be used to connect the C4-I/O-Panel to a host PC. The parameters of the serial communication are listed as follows:

Baudrate	115200
Data bits	8
Parity	None
Stopbits	1
Handshake	None

Sample camera boot log

```
**************************************
MCB InitDone. (WaitClks 75203(84466))
Bootloader(build Mar  6 2012, 08:25:53)

Executing program starting at address: 0x50000000
**************************************
00004700 ms: Camera start.
------------------------------------------
Start HardwareInit.
Reset sensor to defaults.
Reset sensor.
PLL sensor.
Wait PLL locked. Locked.
StreamAlignLupa done(0x032A).
Current stream delay values.
-24 37 -30 -31 -30 31 -28 29 32 30 -31 -33 -23
------------------------------------------
Ready to start GEV.
00004743 ms: Start system monitoring.
Stack info: Current Stack position changed to 0x00001F98.
00004752 ms: Load Bootstrap registers.
00004755 ms: ************************************
00004759 ms: Camera type: 1280
00004762 ms: Model: C4_1280_GigE
00004765 ms: MAC: 0-50-C2-8E-D0-74
```

00004768 ms: Serial Number: 20502217

00004772 ms: Device Version: 2.0.0

00004775 ms: Firmware Version: 1.4.1

00004778 ms: Application build: Development 1.4.0.2374 - Fri Mar 16 09:07:23 2012

00004786 ms: LwIP build: Patched Lwlp 1.30 Mar 16 2012, 08:55:33

00004791 ms: Installed Modules:

00004794 ms: File: C4_1280_GigE_1.3.4.zip, Rev.: 1030400, Device: 1, Length: 2274949

00004808 ms: File: Bitstreamfb.bin, Rev.: 1000000, Device: 1, Length: 2453092

00004815 ms: File: 1280S6.srec, Rev.: 1040000, Device: 1, Length: 742770

00004821 ms: File: 1280S6.srec, Rev.: 1000000, Device: 1, Length: 697386

00004828 ms: GEV Version 1.1

00004830 ms: XML-URL1: Local:C4_1280_GigE_1.3.4.zip;8C400904;58DD

00004836 ms: XML-URL2: http://www.automationtechnology.de/genicam/C4_1280_GigE_1.3.4.zip

00004844 ms: IP config mode:

00004846 ms: Persistent IP

00004849 ms: IP: 169.254.64.2

00004851 ms: Netmask: 255.255.0.0

00004854 ms: Gateway: 0.0.0.0

00004857 ms: LLA always ON.

00004860 ms: **********

auto-negotiated link speed: 1000

00004896 ms: Wait for end of IP configuration...

00004899 ms: Start IP configuration with persistent IP

00004904 ms: Enable hw InterPacketDelay.

00004908 ms: Network interface is up, speed: 1000 Mbps

00004913 ms: IP: 169.254. 64. 2

00004916 ms: Netmask: 255.255. 0. 0

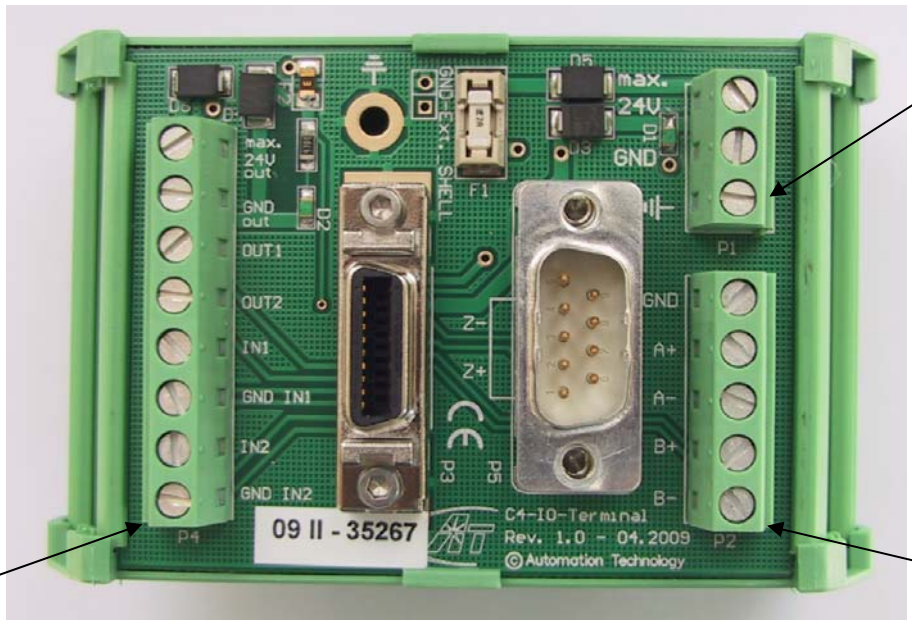
00004919 ms: Gateway: 0. 0. 0. 0

00004923 ms: Assigned from static address

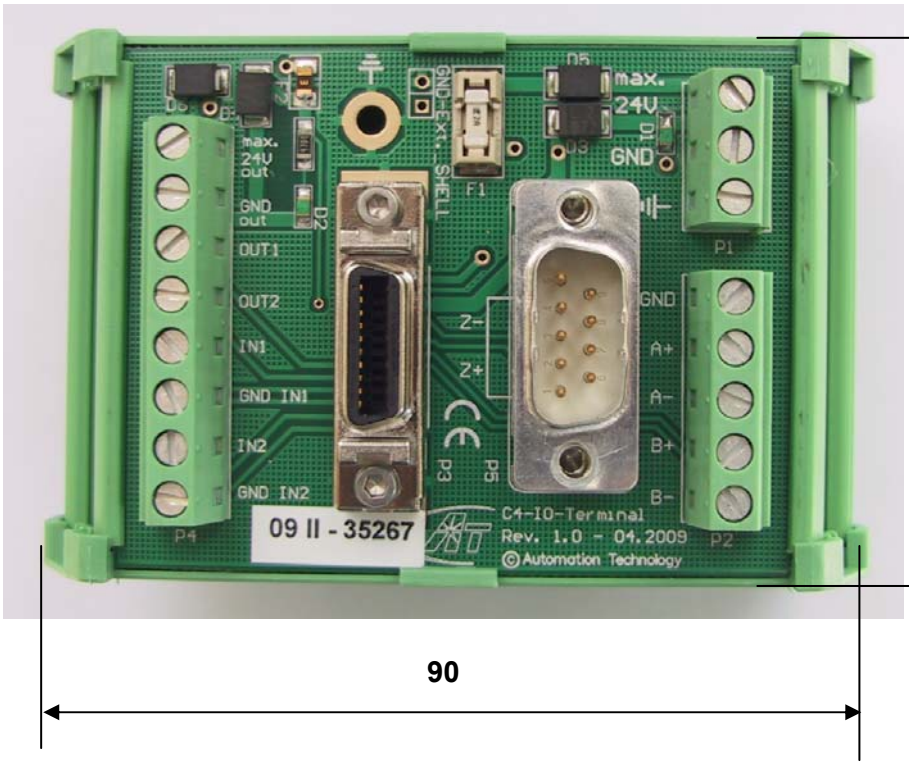
The External C4 I/O Panel

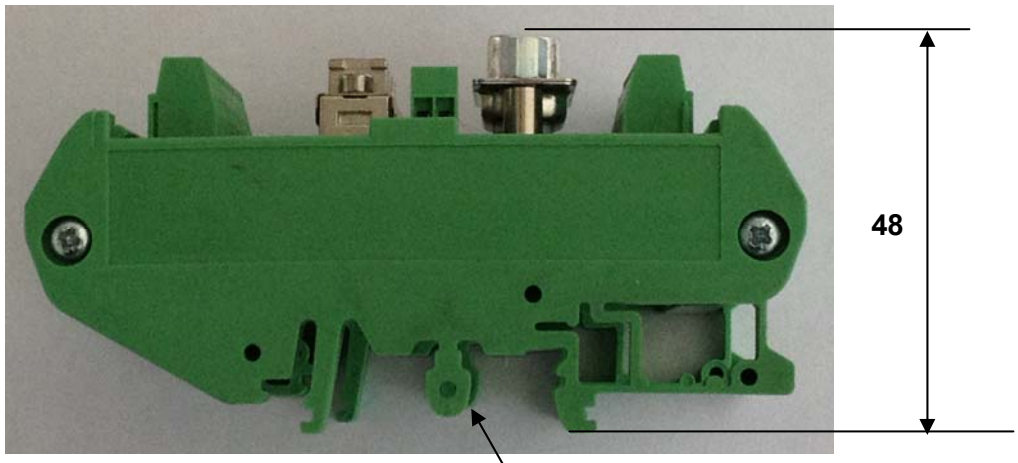
Clamp Pin Nr.	Signal Name	Description
P1 / 1	SCHIELD	camera shield
P1 / 2	GND_EXT	camera ground
P1 / 3	VCC_EXT	camera supply voltage (7-24V DC)
P2 / 1	ENC_B-	encoder Track2 RS422 reversible input (B-)
P2 / 2	ENC_B+	encoder Track2 RS422 none reversible input (B+)
P2 / 3	ENC_A-	encoder Track1 RS422 reversible input (A-)
P2 / 4	ENC_A+	encoder Track1 RS422 none reversible input (A+)
P2 / 5	ENC_GND	encoder ground is connected to camera ground
P4 / 1	GND_IN2	GND for optoisolated Input2
P4 / 2	IN2	optoisolated Input2
P4 / 3	GND_IN1	GND for optoisolated Input1
P4 / 4	IN1	optoisolated Input1
P4 / 5	OUT1	optoisolated Output1
P4 / 6	OUT2	optoisolated Output2
P4 / 7	GND_OUT	Ground of camera optoisolated outputs
P4 / 8	VCC_OUT	Power supply voltage of camera optoisolated outputs (5V/24V DC)

- the optoisolated inputs of the C4 I/O panel can be operated with 5V or 24 V DC
- the panel features a 2A fuse for camera protection
- in order to avoid signal noise, do not connect the main ground GND_EXT to other GND signals



Mechanical Dimensions (mm)





Weight of C4-I/O-Panel: 50 g

Service Information

Document Revision

Rev. Nr.	Date	Modification
1.0	05.01.2009	First version
1.1	13.05.2009	Added mechanical drawings, information about I/O panel, I/O cable. Updated GenICam file description.
1.2	27.05.2009	Update I/O panel image
1.3	03.12.2009	Update GenICam Features
1.4	12.02.2010	Update GenICam Features, Trigger Modes, Specification
1.5	05.10.2010	Update GenICam Features, Trigger Modes, Chunk Data Mode
1.6	05.03.2011	Minor corrections, added I/O schematics
1.7	05.01.2012	Update CXC file, GEV Events, Dataout structure
1.8	13.08.2012	New XML registers, GEV Events, dimensions C4-I/O-Panel, minor additions and corrections

Product Information and Updates

Updates

www.AutomationTechnology.de

Service and Support

service@AutomationTechnology.de

In order to process your support inquiries immediately, we always need the serial number of the camera, a dump of configuration EEPROMs, a snapshot and a precise problem description.

Product Inquiries and Price Quotations

info@AutomationTechnology.de

Warranty Conditions

Only the manufacturer can recognize the conditions of warranty. Should other parties than the manufacturer be responsible for the malfunctioning, we consider the right of warranty as void. This is the case if the unit is modified electrically or mechanically, particularly in its wiring/soldering, or if the unit is used for purposes not intended by the manufacturer, or if the unit's external wiring is faulty, or if the unit is used under conditions outside those stated in its manual.