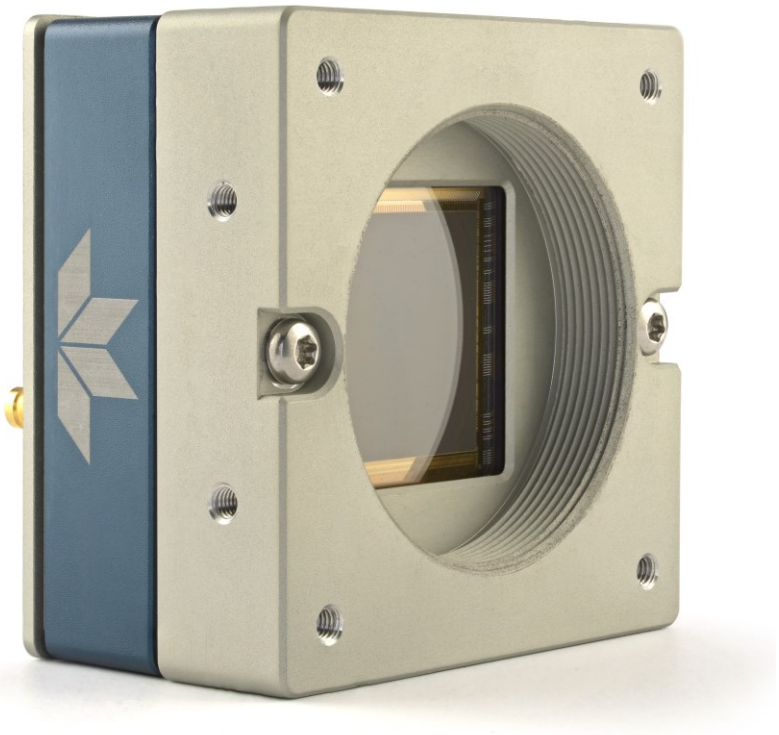
Genie Nano-CXP Series™

Camera User's Manual

CoaXPress™ Monochrome and Color Area Scan

sensors | cameras | frame grabbers | processors | software | vision solutions



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

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

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

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Contents

Nano-CXP Series Overview

Description

The Genie Nano-CXP (CoaXPress) series provides affordable easy to use digital cameras specifically engineered for industrial imaging applications by using the industries' latest leading sensors such as the On-Semi Python series of global shutter active pixel-type CMOS image sensors. Cameras are available in a number of models implementing different sensors, image resolutions and feature sets, either in monochrome or monochrome NIR.

Nano-CXP supports the Teledyne DALSA Trigger-to-Image-Reliability framework to dependably capture and transfer images from the camera to the host PC.

Genie Nano-CXP Overview

- CoaXPress 6Gbps interface
- Supports (PoCXP) Power over CoaXPress or an auxiliary power input
- Supports the CoaXPress device discovery methodology providing plug and play capability
- Implements GenICam and associated GenCP compatible with Teledyne DALSA or third party CoaXPress frame grabbers
- Optimized, rugged design with a wider operating temperature
- Available in multiple resolutions – Monochrome and Color
- Visual camera multicolor status LED on back plate
- Uses 4 x 75 ohm coax cable connections (DIN 1.0/2.3 Coaxial)
- Flexible general-purpose Counter and Timer functions available for internal and external controls
- Defective Pixel replacement & Flat Field correction available
- Lens Shading Correction Maps for lens vignetting
- Multi-ROI support (M6200, C62000, M8200 and C8200 models)
- Application development with the freely available Sapera™ LT software libraries
- Native Teledyne DALSA Trigger-to-Image Reliability design framework
- Refer to the Operation Reference and Technical Specifications section of the manual for full details
- CoaXPress is hosted by the Japan Industrial Imaging Association (JIIA)

Camera Firmware

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

Firmware updates for Genie Nano are available for download from the Teledyne DALSA web site www.teledynedalsa.com/imaging/support/downloads. Choose Genie Nano-CXP Firmware from the available download sections, then choose the zip file download specific to your camera model.

When using Sapera LT, update the camera firmware using CamExpert (see Updating Firmware via File Access in CamExpert). The Camera firmware can also be easily upgrade/downgrade within your own application via the API. The camera has a failsafe scheme which prevents unrecoverable camera errors even in the case of a power interruption.

Model Part Numbers

This manual covers the released Genie Nano-CXP monochrome and color models summarized in the table below. Nano-CXP common specifications and details follow this section.

Model numbers identify GPIO support using G3-Xx**0**x-xxxxx (yes) or G3-Xx**3**x-xxxxx (no).

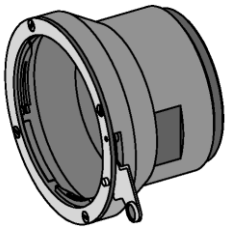
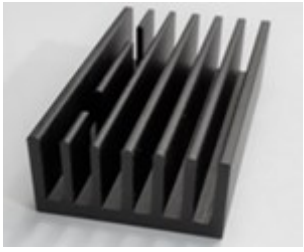
Monochrome Cameras

Nano-CXP Model Full Resolution	Sensor Size/Model	Lens	Part Number
M4090 4096 x 4096	**On-Semi 16M** (Python 16K)	M42 mount	**G3-XM30-M4095**
M4090-NIR 4096 x 4096	**On-Semi 16M** (Python 16K)	M42 mount	**G3-XM32-M4095**
M5100 5120 x 5120	**On-Semi 25M** (Python 25K)	M42 mount	**G3-XM30-M5105**
M5100-NIR 5120 x 5120	**On-Semi 25M** (Python 25K)	M42 mount	**G3-XM32-M5105**
M6200 6144 x 6144	**Teledyne E2V 37.7M Mono** (Emerald 36M)	M42 mount	**G3-XM01-M6205**
M8200 8192 x 8192	**Teledyne E2V 67M Mono** (Emerald 67M)	M42 mount	**G3-XM01-M8205**

Color Cameras

Nano-CXP Model Full Resolution	Sensor Size/Model	Lens	Part Number
C4090 4096 x 4096	**On-Semi 16M** (Python 16K)	M42 mount	**G3-XC30-C4095**
C5100 5120 x 5120	**On-Semi 25M** (Python 25K)	M42 mount	**G3-XC30-C5105**
C6200 6144 x 6144	**Teledyne E2V 37.7M Color** (Emerald 36M)	M42 mount	**G3-XM01-C6205**
C8200 8192 x 8192	**Teledyne E2V 67M Color** (Emerald 67M)	M42 mount	**G3-XM01-C8205**

Accessories

Nano Accessories & Cables (sold separately)		Order Number
Mounting Bracket Plate (2 or 3 screw camera mount), with ¼ inch external device screw mount (also known as a tripod mount)		G3-AMNT-BRA01
I/O Blunt End Cable (1 meter Screw Retention to Flying Leads) (2 meter Screw Retention to Flying Leads)		G3-AIOC-BLUNT1M G3-AIOC-BLUNT2M
I/O Breakout Cable (2 meter Screw Retention to Euroblock connector)		G3-AIOC-BRKOUT2M
Generic 12 volt power supply for Genie Nano–Aux connector (Samtec 10-Pin) – 4 Meter length		G3-APWS-S10S04M
M42 to F-mount (Nikon) adapter (same adapter as used with Genie TS) *Note that there is no support for Nikon lens features such as focus and aperture motor controls.*		G2-AM42-MOUNT4
IR Cut-off Filter M42 mount camera filter designed by Midopt to thread directly into our M42-mount camera between lens and sensor. compatible to All Nano XL casing		G3-AM42-SP644IF
Heatsink 51mm x 28mm x 15mm (screws included) compatible to All Nano XL models and Falcon4-CLHS		G3-AHSK-51X28

Cables are available directly from our preferred source:
(see Components Express Right-Angle Cable Assemblies).

Hardware and Software Environments

The following describes suggested hardware and supported software for successful imaging systems using the Nano-CXP.

Mounting

The Nano-CXP requires a mounting platform which includes camera heatsinking. Thermal management and heat dissipation is mandatory to ensure the camera remains within the stated operating temperature specification. See section Mechanical Specifications with M42 Mount: for the location of the camera mounting screw holes.

Frame Grabbers and Cabling

The Teledyne DALSA Xtium-CXP PX8 and Xtium2-CXP PX8 frame grabbers are recommended for error free acquisitions with the Nano-CXP camera (contact sales for additional information).

See Cable Manufactures Contact Information for contact information for information on CXP cable suppliers and various I/O solutions for your imaging solution.

Software Platforms

Platform	Notes
Support of GenICam GenCP	Camera settings, acquisition and other controls
Support of GenICam File access implementation	File access support for firmware update
Support of GenICam XML schema version 1.1	
Support of CoaXPress v1.1	
GenICam™ support — XML camera description file	Embedded within Genie Nano-CXP

Development Software for Camera Control

Teledyne DALSA Software Platform for Microsoft Windows	
Sapera LT for Windows — version 8.41 or later Includes Sapera Runtime and CamExpert. Provides everything you will need to develop imaging applications Sapera documentation provided in compiled HTML help, and Adobe Acrobat® (PDF)	Available for download http://www.teledynedalsa.com/imaging/support/
Third Party Software Platforms	
GenICam GenCP Compliant Software And Tools	Contact your supplier

Nano-CXP Specifications

The Nano-CXP common specifications listed first are followed by model specific tables of functional features and timing details.

Common Specifications

Camera Controls	
Communication Protocol	GenCP over CoaXPress (GenICam GenCP compliant software)
Synchronization Modes	Free running, External triggered
Exposure Control	Internal – Programmable via the camera API External – Timed Trigger or Trigger Width modes supported
Exposure Time Maximum	10 sec
Exposure Modes	Programmable in increments of 1µs minimum time (in µs) is model specific Pulse controlled via External Trigger or frame grabber CXP Trigger pulse width.
Trigger Inputs (from frame grabber CXP trigger or camera external input)	External input specification (available on models supporting GPIO (G3-Xx**0**x-xxxxx): Opto-isolated, 2.4V to 24V typical, 7 mA min. Debounce range from 0 up to 255 µs Trigger Delay from 0 to 2,000,000 µs
Strobe Outputs	Output opto-isolated (available on models supporting GPIO (G3-Xx**0**x-xxxxx): Aligned to the start of exposure with a programmable delay, duration and polarity (using "start of exposure on output line source" feature)
Features	
Reserved Private User Buffer	4 kB flash memory for OEM usage (*deviceUserBuffer*)
Flash memory	32 MB flash memory
Gain	In Sensor gain
Defective Pixel Replacement	Up to 4096 entries
Counter and Timer	1 Counter and 1 Timer. User programmable, acquisition independent, with event generation, and can control Output I/O pins
Test image	Internal generator with choice of static and shifting patterns
User settings	Select factory default or either of two user saved camera configurations
CoaXPress Link Speed	6.25 Gb/s – 4 Data Lanes M/C6200 and M/C8200 supports a user-selectable lanes configuration: 4, 2 or 1 lane(s).
Back Focal Distance	
	12 mm (M42 mount)
Mechanical Interface	
Camera (L x H x W) see Mechanical Specifications	XL Case: 38.3 mm x 59 mm x 59 mm
Mass	XL Case: ~ 163g
CoaXPress Connector Type	DIN 1.0/2.3 connector (CXP-6 maximum speed rating)

Power connector	Camera power via PoCXP or by the power pins on the 10-pin I/O connector
Electrical Interface	
Input Voltage	+24V nominal (+12 to +26 Volts DC maximum range) Supports the Power Over CXP standard (PoCXP)
Power Dissipation (typical)	12W @ 24Vdc aux. (for the XL case)
Environmental Conditions	
Operating Temperature (*at camera front plate*)	All Models: -20°C to +65°C (-4°F to +149°F) *Any metallic camera mounting provides heat-sinking therefor reducing the internal temperature.*
Operating Relative Humidity	10% to 80% non-condensing
Storage	-40°C to +80°C (-4°F to +176°F) temperature at 20% to 80% non-condensing relative humidity
Conformity	CoaXPress (JIIA), EU and REACH

Sensor Cosmetic Specifications

After Factory Calibration and/or Corrections are applied (if applicable — dependent on sensor)

Blemish Specifications	Maximum Number of Defects	Blemish Description
Hot/Dead Pixel defects	Typical 0.0025% Max 0.005%	Any pixel that deviates by ±20% from the average of neighboring pixels at 50% saturation including pixel stuck at 0 and maximum saturated value.
Spot defects	none	Grouping of more than 8 pixel defects within a sub-area of 3x3 pixels, to a maximum spot size of 7x7 pixels.
Clusters defects	none	Grouping of more than 5 single pixel defects in a 3x3 kernel.
Column defects	none	Vertical grouping of more than 10 contiguous pixel defects along a single column.
Row defects	none	Horizontal grouping of more than 10 contiguous pixel defects along a single row.

- **Test conditions**
  - Nominal light = illumination at 50% of saturation
  - Temperature of camera is 45°C
  - At exposures lower than 0.25 seconds
  - At nominal sensor gain (1x)

Dynamic Range & Signal to Noise Ratio Test Conditions

Dynamic Range Test Conditions

- Exposure 100µs
- 0% Full Light Level

SNR Test Conditions

- Exposure 2000µs
- 80% saturation

Specifications calculated according to EMVA-1288 standard, using white LED light

- For On-semi Python
  - Max saturated values: up to 10 ms (Gain1.0) for the 16M to 25M
- For Sony
  - Max saturated values: Max Pixel format bit depth - 1DN

EMI, Shock and Vibration Certifications

Refer to Declarations of Conformity section.

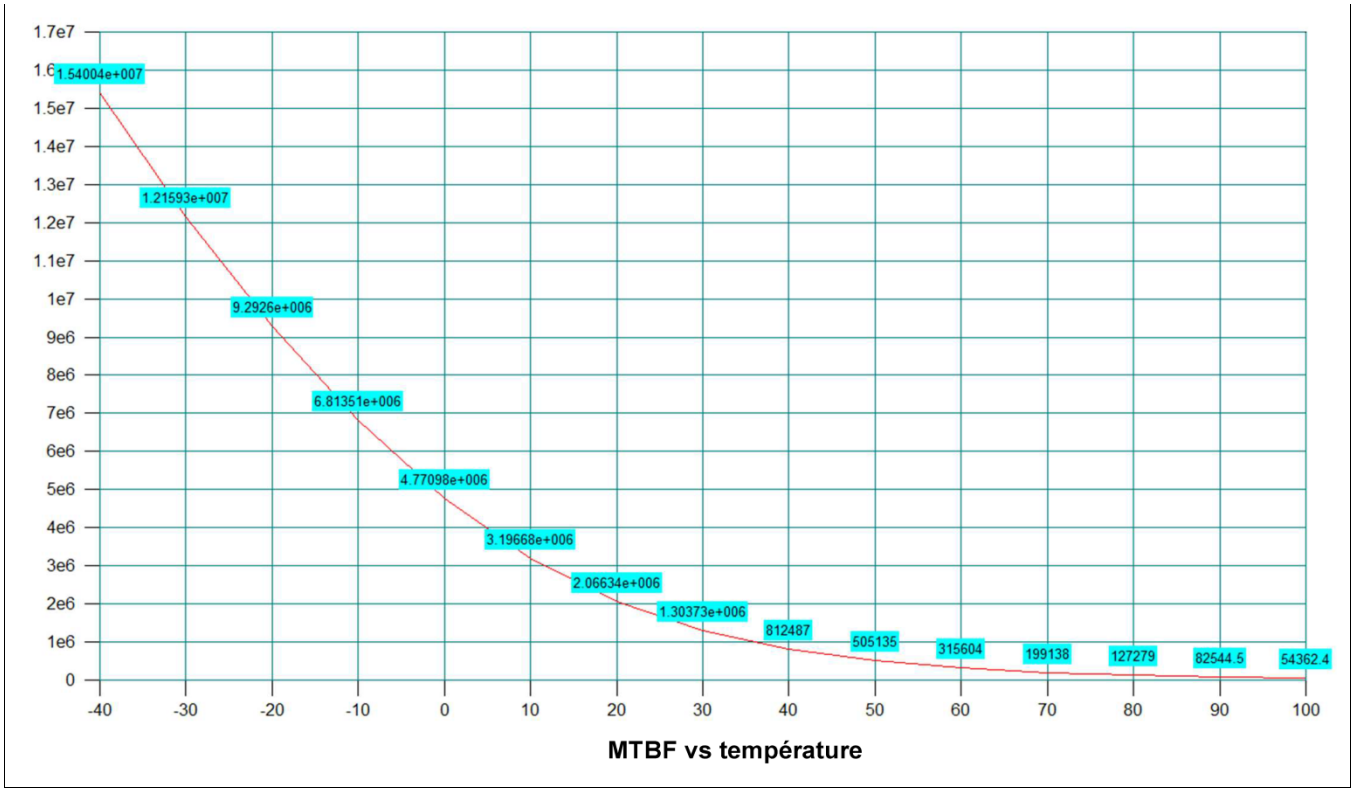
Mean Time between Failure (MTBF)

The analysis was carried out for operating temperatures varying from -40 to 100ºC. The following table presents the predicted MTBF and Failure Rate Values (**FIT**).

***FIT** calculations are based on the Bellcore/Telcordia SR-332—Method 1—Case 3 standards.

	Camera Assembly		
Temperature (°C)	**MTBF (hours)**	**MTBF (years)**	**Failure Rate (FIT) ***
-40	15,401,201	1,758	64.93
-20	9,292,817	1,061	107.61
0	4,770,992	545	209.6
20	2,066,329	236	483.95
40	812,486	93	1230.79
60	315,604	36	3168.53
80	127,279	15	7856.77
100	54,362	6	18395.1

MTBF versus temperature shown graphically

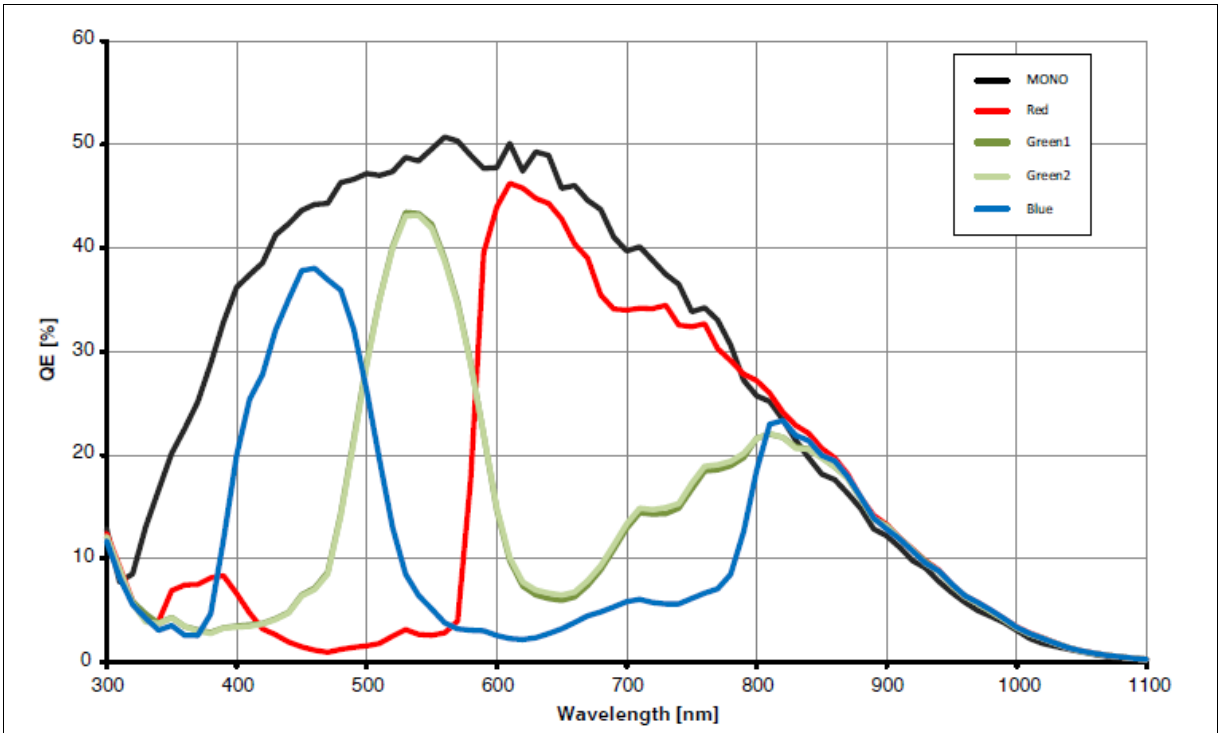


Nano-CXP Specifications: M5100, C5100, M4090, C4090

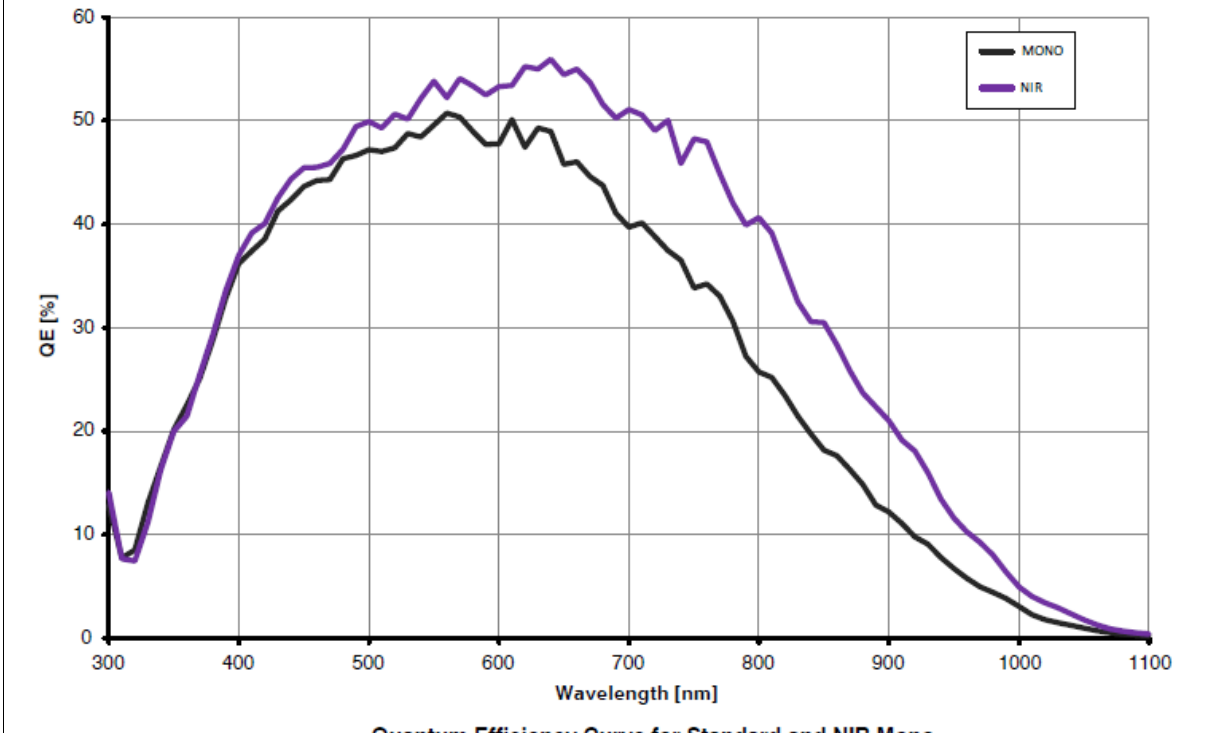
Model specific specifications and response graphics for the On-Semi Python (25K & 16K) series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

Supported Features	M5100 & C5100		M4090 & C4090	
Resolution	5120 x 5120		4096 x 4096	
Sensor	On-Semi Python25K (25M)		On-Semi Python16K (16M)	
Pixel Size	4.5 µm x 4.5 µm			
Shutter Type	Full frame electronic global shutter function			
Full Well charge	12ke (max)			
Mode Option	Normal Readout Mode	Fast Readout Mode	Normal Readout Mode	Fast Readout Mode
Maximum Frame Rate (8-bit)	46.8 fps	80.0 fps	65.4 fps	120 fps
Pixel Format (Mono)	Mono 8			
Pixel Format (Color)	Bayer 8 bit			
Trigger to Exposure Minimum delay (*Synchronous Exposure*)	9 µs			
Trigger to Exposure Minimum delay (*Reset Exposure*)	9 µs			
Trigger to Exposure Start jitter (*Synchronous Exposure*)	Up to 1 line time			
Trigger to Exposure Start jitter *(Reset Exposure)*	0 µs			
Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	34 µs			
Horizontal Line Time	4.14 µs	2.42 µs	3.70 µs	1.97 µs
Min. Time from End of Exposure to Start of Next Exposure	101 µs	68 µs	101 µs	68 µs
Readout Time	(Horizontal Line Time * NB Lines) + (2 * Horizontal Line Time at Maximum Sensor Width), in µs			
Auto-Brightness	No			
Black offset control	Yes (in DN)			
Gain Control	In-sensor Analog Gain (1.0x to 3.17x) in 4 steps (1.0x, 1.26x, 2.87x, 3.17x)			
Binning Support	No			
Decimation Support	No			
Defective Pixel Replacement	Yes, up to 2048 pixel positions			
Image Correction	Flat Line Correction (Factory and 4 User Defined entries) Lens Shading correction (Factory and 2 User Defined entry) Noise Reduction			
Image Flip support	No			
Multi-ROI Support	No			
Output Dynamic Range (dB)	55.3			
SNR (dB)	39.5			

Quantum Efficiency Curves



Quantum Efficiency Curve for Mono and Color



Quantum Efficiency Curve for Standard and NIR Mono

Defective Pixel Specification for Models 5100/4090

These defective pixel specifications in the following table are as published by the sensor manufacturer. Genie Nano cameras apply defective pixel corrections to improve the camera performance.

Defective Pixels (max: 1000)	Number of defective pixels allowed in the full window size of 5120 x 5120 (i.e. model 5100).
	For mono devices: A defective pixel is defined as a pixel which has a response that deviates 102 LSB10 in a dark image or a corrected gray image, or a saturated image, from the local median of the neighboring pixels in a 7 x 7 block.
	The defective pixels in dark, gray and saturated images are stored a in a global defect map. The limit is applied to the global defect map.
Defective Column 0 defective columns allowed	Number of defective columns in the full window size of 5120 x 5120 derived from dark, half scale and saturated image.
	For Mono devices: A bad column is defined as a column which has a response that deviates 48 LSB10 in a dark image, or a corrected gray or a saturated image, from the local median of 11 neighboring columns (+/- 5 left/right columns).
Defective Row 0 defective rows allowed	Number of defective rows in the full window size of 5120 x 5120 derived from dark, half scale and saturated image.
	For Mono devices: A bad row is defined as a row which has a response that deviates 48 LSB10 in a dark image, or a corrected gray or a saturated image, from the local median of 11 neighboring rows (+/- 5 top/bottom rows).
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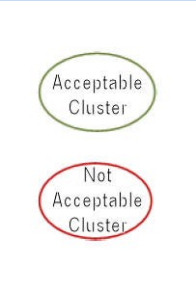
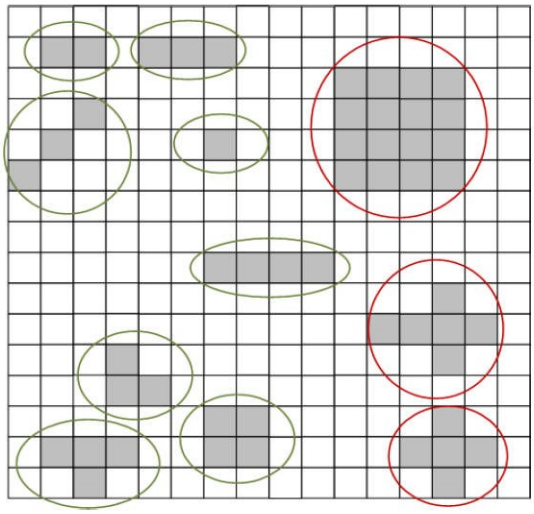
Defective Cluster Definition  	Number of clusters allowed in the full window size of 5120 X 5120. A cluster is defined as a group of neighboring defective pixels (top, Bottom side, not diagonal), derived from the global defect map. For color devices: The pixels are divided per color channels (R, G1, G2, B) and then calculated with the same methodology as mono devices. Refer to the graphic below: The number of defective pixels in one cluster is the class (F) of the cluster: F2 (max 5): 2 defective pixels in the cluster F3 (max 4): 3 defective pixels in the cluster F4 (max 3): 4 defective pixels in the cluster F5 (max 0): 5 or more defective pixels in the cluster 

Firmware Files for These Models

The latest firmware files for all Nano models are available on the Teledyne DALSA support web site: http://www.teledynedalsa.com/imaging/support/downloads/firmware/

The firmware files for currently available models are listed below. The xx variable denotes the current build number.

M4090, M5100 Monochrome CXP models – 4 Lane CoaXPress 6Gbps Interface

- Genie_Nano-CXP_OnSemi_Python_25M_HSD_Firmware_1CA23.xx.cbf

Nano-CXP Specifications: M6200, C6200

Model specific specifications and response graphics for the Teledyne E2V Emerald (37.7M) series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

Supported Features	M6200	C6200
Resolution	6144 x 6144 (37.7M pixel resolution)	
Sensor Name	Teledyne E2V Emerald 36M	
Pixel Size	2.5 µm x 2.5 µm	
Shutter Type	Full frame electronic global shutter function	
Full Well charge	5 ke (max)	
4-Lane CXP Configuration	Maximum Frame Rate	Fast readout mode (8-bit only): 40.04 fps Normal readout mode (8 or 10-bit): 26.76 fps
	Horizontal Line Time	Fast readout mode (8-bit only): 3.74 µs Normal readout mode (8 or 10-bit): 6.08 µs
2-Lane CXP Configuration	Maximum Frame Rate	Normal readout mode — 8-bit: 20.91 fps; 10-bit 15.75 fps
	Horizontal Line Time	Normal readout mode — 8-bit: 7.77 µs; 10-bit 10.32 µs
1-Lane CXP Configuration	Maximum Frame Rate	Normal readout mode — 8-bit: 10.26 fps; 10-bit 8.09 fps
	Horizontal Line Time	Normal readout mode — 8-bit: 15.83 µs; 10-bit 20.07 µs
Pixel Format	Mono 8, Mono 10	Bayer 8-bit, Bayer 10-bit
Trigger to Exposure Minimum delay (*Synchronous Exposure*)	14 µs	
Trigger to Exposure Start jitter (*Synchronous Exposure*)	Up to 1 line time	
Trigger to Exposure Start jitter *(Reset Exposure)*	0 µs	
Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	14 µs	
Min. Time from End of Exposure to Start of Next Exposure	Fast readout mode: 68 µs Normal readout mode: 101 µs	
Readout Time	(Horizontal Line Time * NB Lines) in µs	
Auto-Brightness	No	
Black offset control	Yes (in DN)	
Gain Control	In-sensor Analog Gain (1.0x to 3.0x) in 4 steps (1.0x, 1.5x, 2x, 3x)	
Binning Support	No	
Decimation Support	No	
Defective Pixel Replacement	Yes, up to 4096 positions	
Image Correction	Flat Line Correction (Factory and 4 User Defined entries) Lens Shading correction (Factory and 2 User Defined entry) Noise Reduction	

Image Flip Support	No
Multi-ROI Support	In-Sensor
Output Dynamic Range (dB)	66
SNR (dB)	37.8

Nano-CXP Specifications: M8200, C8200

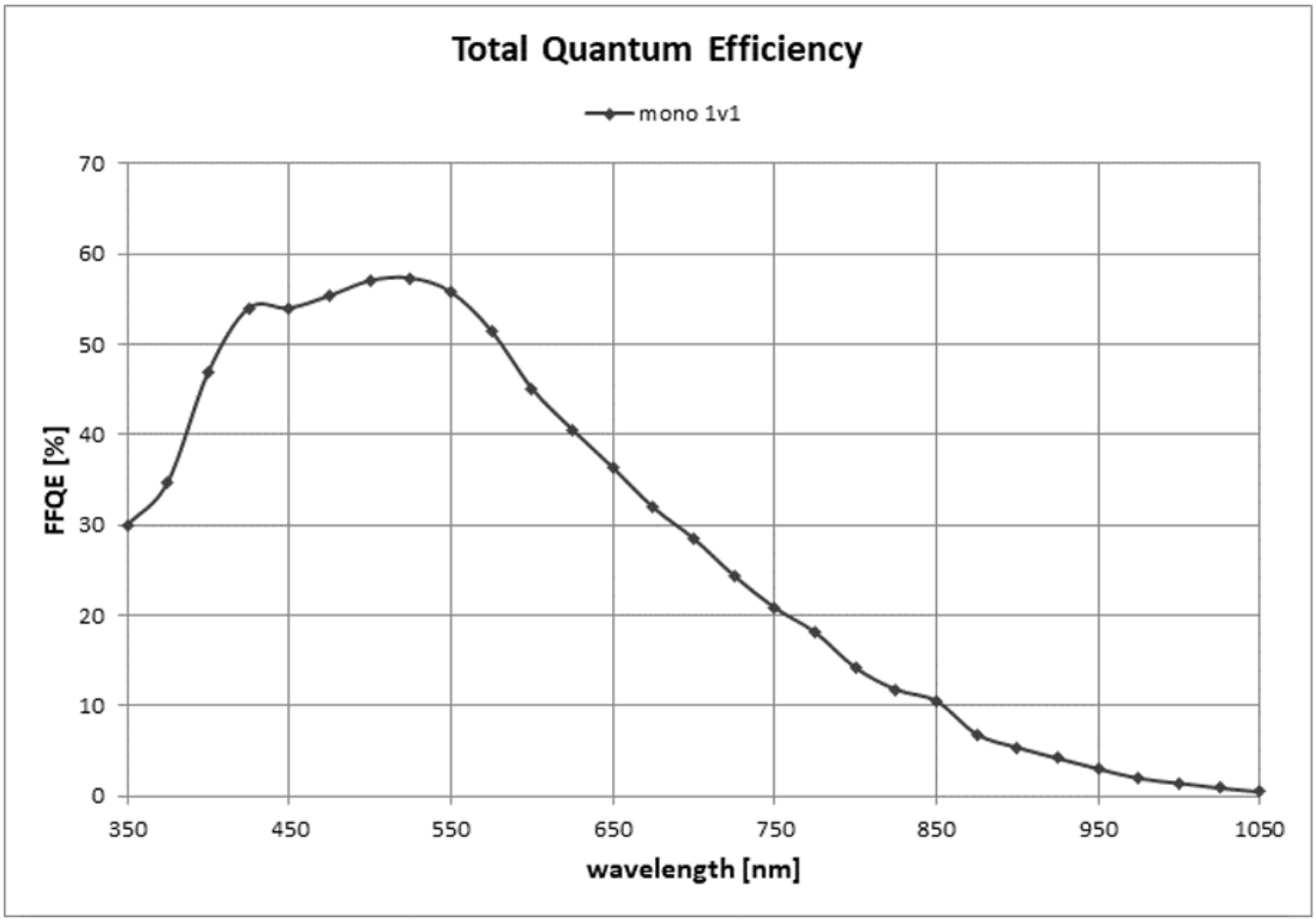
Model specific specifications and response graphics for the Teledyne E2V Emerald (67.1M) series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

Supported Features	M8200	C8200
Resolution	8192 x 8192 (67.1M pixel resolution)	
Sensor Name	Teledyne E2V Emerald 67M	
Pixel Size	2.5 µm x 2.5 µm	
Shutter Type	Full frame electronic global shutter function	
Full Well charge	5 ke (max)	
4-Lane CXP Configuration	Maximum Frame Rate	Fast readout mode (8-bit only): 30.0 fps Normal readout mode (8 or 10-bit): 20.1 fps
	Horizontal Line Time	Fast readout mode (8-bit only): 4.06 µs Normal readout mode (8 or 10-bit): 6.08 µs
2-Lane CXP Configuration	Maximum Frame Rate	Normal readout mode: 8-bit: 15.7 fps, 10-bit: 11.8 fps
	Horizontal Line Time	Normal readout mode: 8-bit: 7.78 µs, 10-bit: 10.33 µs
1-Lane CXP Configuration	Maximum Frame Rate	Normal readout mode: 8-bit: 7.70 fps, 10-bit: 6.07 fps
	Horizontal Line Time	Normal readout mode: 8-bit: 15.85 µs, 10-bit: 20.10 µs
Pixel Format	Mono 8, Mono 10	Bayer 8-bit, Bayer 10-bit
Trigger to Exposure Minimum delay (*Synchronous Exposure*)	14 µs	
Trigger to Exposure Start jitter (*Synchronous Exposure*)	Up to 1 line time	
Trigger to Exposure Start jitter *(Reset Exposure)*	0 µs	
Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	14 µs	
Min. Time from End of Exposure to Start of Next Exposure	Fast readout mode: 68 µs Normal readout mode: 101 µs	
Readout Time	(Horizontal Line Time * NB Lines) in µs	
Auto-Brightness	No	
Black offset control	Yes (in DN)	
Gain Control	In-sensor Analog Gain (1.0x to 3.0x) in 4 steps (1.0x, 1.5x, 2x, 3x)	
Binning Support	No	
Decimation Support	No	
Defective Pixel Replacement	Yes, up to 4096 positions	
Image Correction	Flat Line Correction (Factory and 4 User Defined entries) Lens Shading correction (Factory and 2 User Defined entry) Noise Reduction	
Image Flip Support	No	

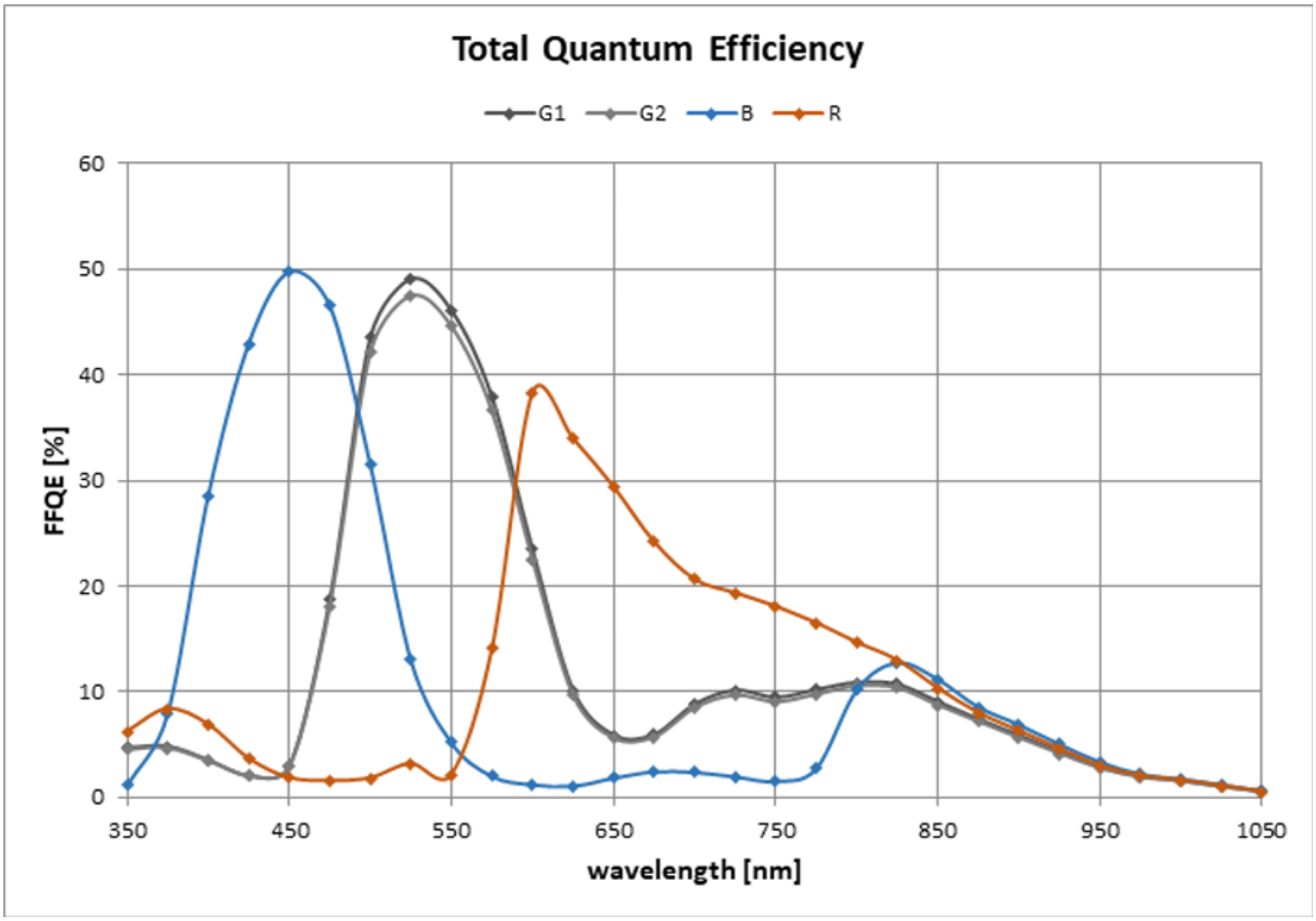
Multi-ROI Support	In-Sensor
Output Dynamic Range (dB)	66
SNR (dB)	37.8

Quantum Efficiency Curves

For monochrome Teledyne E2V Emerald 37.7M and 67M sensors.



For color Teledyne E2V Emerald 37.7M and 67M sensors.



Firmware Files for M6200, M8200, C6200, C8200 Models

The latest firmware files for all Nano models are available on the Teledyne DALSA support web site: http://www.teledynedalsa.com/imaging/support/downloads/firmware/

The firmware files for currently available models are listed below. The xx variable denotes the current build number.

M6200, M8200, C6200, C8200 CXP models – 4 Lane CoaXPress 6Gbps Interface

- Genie_Nano-CXP_E2v_Emerald_67M_HSD_Firmware_2CA23.xx.cbf

Nano-CXP Installation

If you are familiar with CoaXPress cameras and Teledyne DALSA frame grabbers, follow these steps to quickly install and acquire images with Genie Nano-CXP and the CamExpert tool provided with Sapera LT in a Windows OS system.

Quick Start (using a Teledyne DALSA Frame Grabber)

- Install Sapera 8.41 (or later). Use the Full SDK version with support for Teledyne DALSA frame grabber boards.
- Install the Teledyne DALSA CoaXPress frame grabber board along with its driver.
- Start CamExpert. The plug-and-play feature of CXP frame grabber and camera will automatically configure frame buffer, data lanes, and frame rate parameters to match the Nano-CXP model being used. At this time do not configure for an external trigger.
- Connect the Nano-CXP with 4 camera cables. The Teledyne DALSA CXP frame grabber supports PoCXP (power over CoaXPress) for a simple camera power solution.
- Enable PoCXP by its frame grabber feature. If not using PoCXP connect a power supply to the Nano-CXP via its I/O connector.
- When the Nano-CXP boots, CamExpert will read and display the camera features available with that model.
- The Nano-CXP status **LED has changed to flashing green**, indicating it is in free running acquisition mode. See LED States on Power Up for all status LED conditions.
- From the Nano-CXP Image Format Feature Category, select the *Moving Grey Diagonal Ramp* test pattern from the *Test Image Selector* Parameter.
- Click grab. You will see the moving pattern in the CamExpert display window.
- If a camera lens is attached, turn off the test pattern and grab live again. Adjust the lens aperture plus Focus, and/or adjust the Nano Exposure Time and frame rate as required.

General Installation Overview

Connecting a Nano-CXP to a frame grabber is similar whether using a Teledyne DALSA frame grabber board with Sapera LT SDK or a third-party frame grabber with its own SDK.

Camera Firmware Updates

Under Windows, the user can upload new firmware, using the File Access Control features provided by the Sapera CamExpert tool.

Download the latest firmware version released from the Teledyne DALSA support web page:
http://www.teledynedalsa.com/imaging/support/downloads/firmware/

The Camera Works — Now What

Consult this manual for detailed Nano-CXP feature descriptions, as you write, debug and optimize your imaging application. Consult the frame grabber manual for all board control features.

Nano-CXP Connectors and Status LED Overview

Connectors

The Nano-CXP has a connector for I/O and four CoaXPress data lane links:

- A **10 pin I/O** connector for camera power, plus trigger, strobe and general I/O signals. The connector supports a retention latch, while alternately the Nano-CXP case supports using an I/O cable with thumbscrews. Teledyne DALSA provides optional cables for purchase (see Ruggedized Cable Accessories). Also see 10-pin I/O Connector Details for pin out specifications.
- Four CoaXPress Link connectors are available for data output. Use a CoaXPress frame grabber with the Nano-CXP. See Components Express Contact Information for a variety of CoaXPress cables.

The following figure of the Genie Nano-CXP back shows connector and LED locations along with identification labels. See Mechanical Specifications — Nano-CXP for details on the connectors and camera mounting dimensions.

Genie Nano-CXP – Rear View

LED Indicators

The Genie Nano-CXP has one multicolor LED to provide a simple visible indication of camera state, as described below. The CoaXPress link connectors do not have any status LED indicators.

Camera Status LED Indicator

The camera is equipped with one LED to display its operational status. When more than one condition is active, the LED color indicates the condition with the highest priority. The following table summarizes the LED states.

LED State	Definition
LED is off	No power to the camera
Steady Orange	Camera initialization sequence in progress.
Steady Green	Device / Host connected, but no data being transferred.
Flashing Green	Acquisition in progress. Flashing occurs on frame acquisition. Note that flashing rate is constant – irrelevant of the frame rate.
Fast Flashing Blue	File Access Feature is transferring data such as a firmware update, etc.
Fast Flashing Red	System error (for example, internal error).

Preventing Operational Faults due to ESD

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

Teledyne DALSA has performed ESD testing on Nano cameras using an 8 kilovolt ESD generator without any indication of operational faults. The two following methods, either individually or together will prevent ESD problems.

- Method 1: Use a shielded/grounded power supply that connects ground to pin-10 of the I/O connector. The Nano case is now properly connected to earth ground and can withstand ESD of 8 kilovolts, as tested by Teledyne DALSA.
- Method 2: Mount the camera on a metallic platform with a good connection to earth ground.

Operational Reference

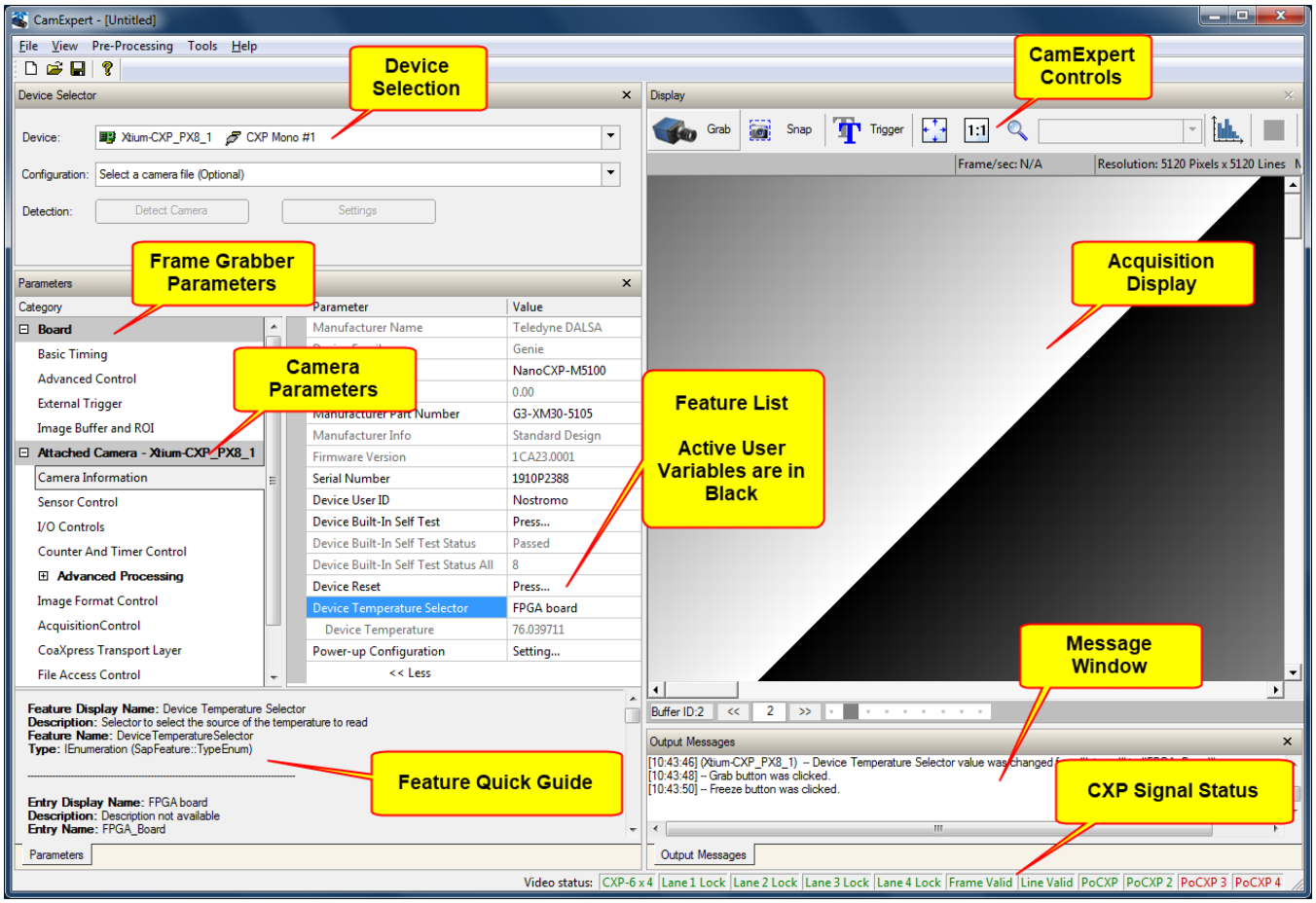
Using CamExpert with Nano-CXP Cameras

The Sapera CamExpert tool allows a user to test the camera and frame grabber combination and their functions. Additionally CamExpert saves the Teledyne DALSA frame grabber user settings as individual camera parameter files on the host system (*.ccf). The camera settings are saved within the camera as a user set.

An important component of CamExpert is its live acquisition display window which allows immediate verification of timing or control parameters without the need to run a separate acquisition program.

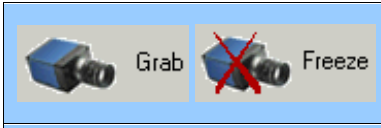
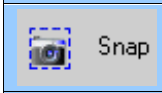
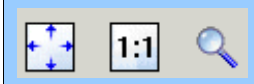
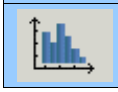
CamExpert Panes

The various areas of CamExpert are summarized in the figure below.



- **Device pane**: View and select from any installed Sapera acquisition device if more than one is installed in the computer. After a device is selected CamExpert will only present parameters applicable to that device.

- **Parameters pane**: Allows viewing or changing all acquisition parameters supported by the acquisition device or frame grabber. This avoids confusion by eliminating parameter choices when they do not apply to the hardware in use.
  When using a Teledyne DALSA frame grabber and camera, CamExpert groups all frame grabber parameters first and then follows with the supported camera features. Together the user configures the imaging system.
- **Display pane**: Provides a live or single frame acquisition display. Frame buffer parameters are shown in an information bar above the image window.
- **Control Buttons**: The Display pane includes CamExpert control buttons. These are:

	**Acquisition control button:** Click once to start the frame grabber live grab mode, click again to stop. The Nano is always in free running acquisition mode unless configured to use an external trigger.
	**Single frame grab:** Click to acquire one frame from the frame grabber device.
	**Software trigger button:** With the I/O control parameters set to Trigger Enabled / Software Trigger type, click to send a single software trigger command.
	**CamExpert display controls:** (these do not modify the frame buffer data) Stretch (or shrink) image to fit, set image display to original size, or zoom the image to any size and ratio. Note that under certain combinations of image resolution, acquisition frame rate, and host computer speed, the CamExpert screen display may not update completely due to the host CPU running at near 100%. This does not affect the acquisition.
	**Histogram / Profile tool:** Select to view a histogram or line/column profile during live acquisition.

- **Output pane**: Displays messages from CamExpert, camera or the interface driver.
- **CXP Signals**: Displays the status of CXP signals plus active PoCXP connections.

CamExpert View Parameters Option

While the **Board** section shows all frame grabber parameters, the **Attached Camera** section shows camera features filtered by a Visibility attribute which selects the targeted user. These vary from Beginner (features required for basic operation of the device) to Guru (optional features required only for complex operations).

Choose parameter visibility via the [<< Less More>>] control below each feature list. You can also choose the Visibility level from the *View – Parameters – Visibility* options menu.

Feature Descriptions

In the following feature description sections, the Device Version & View column indicates which parameter is a member of the DALSA Features Naming Convention (indicated by DFNC), versus the GenICam Standard Features Naming Convention (SFNC not shown).

When a Device Version number is indicated, this represents the camera software level, not a firmware revision number. As Genie Nano-CXP capabilities evolve the device version will increase, therefore identifying the supported function package. New features for a major device version release will be indicated by green text for easy identification. For each feature the device version may differ for each camera sensor available.

In general, feature names that start with an uppercase letter are part of the SFNC while those starting with a lowercase letter are part of the DFNC.

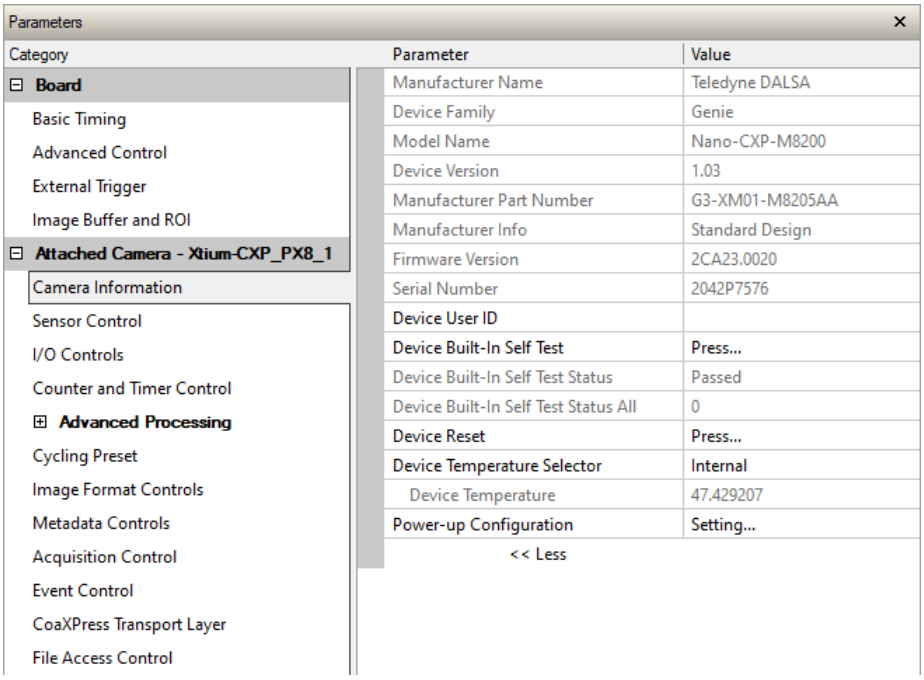
Parameters in gray are read only, either always or due to another parameter being disabled. Parameters in black are user set in CamExpert or programmable via an imaging application.

Features listed in the description table but tagged as *Invisible* are usually for Teledyne DALSA or third-party software usage—not typically needed by end user applications.

Features shown by CamExpert may change with different Genie Nano-CXP models. That is, depending on the Genie Nano-CXP model not all documented features and options are available.

Camera Information Category

Camera information can be retrieved via a controlling application. Parameters such as camera model, firmware version, etc. are read to uniquely identify the connected Nano-CXP device. These features are typically read-only.



Camera Information Feature Descriptions

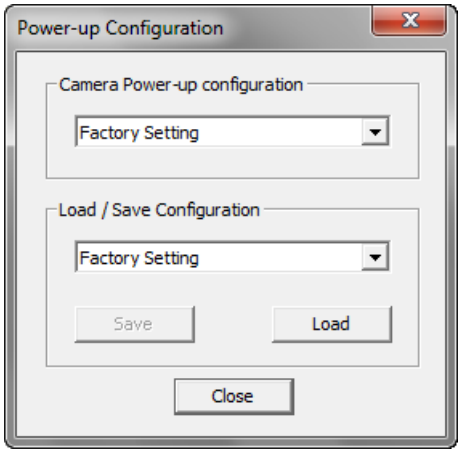
Display Name	Feature & Values	Description	Device Version & View
Manufacturer Name	DeviceVendorName	Displays the device vendor name.	1.00 Beginner
Device Family	DeviceFamilyName	Displays the device family name.	1.00 Beginner
Model Name	DeviceModelName	Displays the device model name.	1.00 Beginner
Device Version	DeviceVersion	Displays the device version. This tag will also highlight if the firmware is a beta or custom design.	1.00 Beginner
Manufacturer Part Number	deviceManufacturerPartNumber	Displays the device manufacturer part number.	1.00 DFNC Beginner
Manufacturer Info	DeviceManufacturerInfo	This feature provides extended manufacturer information about the device. Genie Nano cameras show which firmware design is currently loaded.	1.00 Beginner
Firmware Version	DeviceFirmwareVersion	Displays the currently loaded firmware version number. Firmware files have a unique number and have the .cbf file extension.	1.00 Beginner
Serial Number	DeviceSerialNumber	Displays the device's factory set serial number.	1.00 Expert

Device User ID	DeviceUserID	Feature to store a user-programmable identifier of up to 63 characters. The default factory setting is the camera serial number. (RW)	1.00 Beginner
Device Built-In Self Test	deviceBIST	Command to perform an internal test which will determine the device status. (W)	1.00 Beginner
Device Built-In Self Test Status	deviceBISTStatus	Return the status of the device Built-In Self-Test. Possible return values are device-specific.	1.00 Beginner
Passed	*Passed*	*No failure detected*	
Last firmware update failed	*FirmwareUpdateFailure*	*Last firmware update operation failed.*	
FPGA Cyclic Redundancy Check Failed	*FPGA_CRC_Failure*	*FPGA Cyclic Redundancy Check Failed*	
Unexpected Error	*Unexpected_Error*	*Switched to recovery mode due to unexpected software error.*	
Sensor Initialization Failure	*SensorFailure*	*There was an error initializing the sensor. The camera may not be able to capture images.*	
Device Built-In Self Test Status All	deviceBISTStatusAll	Return the status of the device Built-In Self-Test as a bitfield. The meaning for each bit is device-specific. A value of 0 indicates no error.	1.00 DFNC Beginner
Device Reset	DeviceReset	Resets the device to its power up state. (W)	1.00 Beginner
Device Temperature Selector	DeviceTemperatureSelector	Select the source where the temperature is read.	1.00 Beginner
Internal	*Internal*	*Value from FPGA and or PHY temperature.*	
MaxInternal	*MaxInternal*	*Records the highest device temperature since power up. Value is reset on power off.*	
Device Temperature	DeviceTemperature	The temperature of the selected source in degrees Celsius. Maximum temperature should not exceed +70°C for reliable operation.	1.00 Beginner
Power-up Configuration Selector	UserSetDefaultSelector	Selects the camera configuration set to load and make active on camera power-up or reset. The camera configuration sets are stored in camera non-volatile memory. (RW)	1.00 Beginner
Factory Setting	*Default*	Select the default camera feature settings saved by the Factory.	
UserSet1	*UserSet1*	*Select the User defined Configuration space UserSet1 to save to or load from features settings previously saved by the user.*	
UserSet2	*UserSet2*	*Select the User defined Configuration space UserSet2 to save to or load from features settings previously saved by the user.*	
User Set Selector	UserSetSelector	Selects the camera configuration set to load feature settings from or save current feature settings to. The Factory set contains default camera feature settings. (RW)	1.00 Beginner
Factory Setting	*Default*	*Select the default camera feature settings saved by the factory.*	
UserSet 1	*UserSet1*	*Select the User Defined Configuration space UserSet1 to save to or load from features settings previously saved by the user.*	
UserSet 2	*UserSet2*	*Select the User Defined Configuration space UserSet1 to save to or load from features settings previously saved by the user.*	
Load Configuration	UserSetLoad	Loads the camera configuration set specified by the User Set Selector feature, to the camera and makes it active. Cannot be updated during a Sapera transfer. (W)	1.00 Beginner

Save Configuration	UserSetSave	Saves the current camera configuration to the user set specified by the User Set Selector feature. The user sets are located on the camera in non-volatile memory. (W)	1.00 Beginner
Serial Number	DeviceID	Displays the device's factory set camera serial number.	1.00 Invisible
Calibration Date	deviceCalibrationDateRaw	Date when the camera was calibrated.	1.00 Invisible
Device Acquisition Type	deviceAcquisitionType	Displays the Device Acquisition Type of the product.	1.00 DFNC Invisible
Sensor	*Sensor*	*The device gets its data directly from a sensor.*	
Device TL Version Major	DeviceTLVersionMajor	Major version of the device's Transport Layer.	1.00 Invisible
Device TL Version Minor	DeviceTLVersionMinor	Minor version of the device's Transport Layer.	
	userSetError	Error Flags for UserSetLoad & UserSetSave	1.00 Invisible
	NoError	*No Error*	
	LoadGenericError	*Unknown error*	
	LoadBusyError	*The camera is busy and cannot perform the action*	
	LoadMemoryError	*Not enough memory to load set*	
	LoadFileError	*Internal file I/O error*	
	LoadInvalidSetError	*At least one register could not be restored properly*	
	LoadResourceManagerError	*An internal error happened related to the resource manager*	
	SaveGenericError	*Unknown error*	
	SaveBusyError	*The camera is busy and cannot perform the action*	
	SaveMemoryError	*Camera ran out of memory while saving set*	
	SaveFileError	*Internal file I/O error*	
	SaveInvalidSetError	*An invalid user set was requested*	
	SaveResourceManagerError	*An internal error happened related to the resource manager*	
DFNC Major Rev	deviceDFNCVersionMajor	Major revision of Dalsa Feature Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
DFNC Minor Rev	deviceDFNCVersionMinor	Minor revision of Dalsa Feature Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
SFNC Major Rev	DeviceSFNCVersionMajor	Major Version of the Genicam Standard Features Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
SFNC Minor Rev	DeviceSFNCVersionMinor	Minor Version of the Genicam Standard Features Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
SFNC SubMinor Rev	DeviceSFNCVersionSubMinor	SubMinor Version of the Genicam Standard Features Naming Convention which was used to create the device's XML.	1.00 Invisible

Power-up Configuration Dialog

CamExpert provides a dialog box which combines the features to select the camera power-up state and for the user to save or load a Nano camera state.



Camera Power-up Configuration

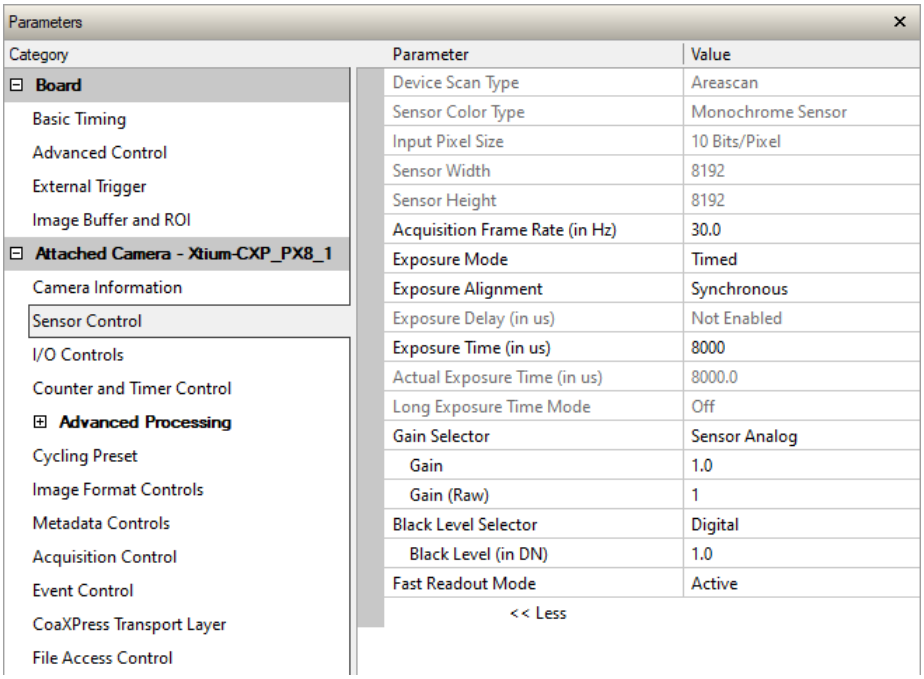
The first drop list selects the camera configuration state to load on power-up (see feature *UserSetDefaultSelector*). The user chooses from one factory data set or one of two possible user saved states.

Load / Save Configuration

The second drop list allows the user to change the camera configuration any time after a power-up (see feature *UserSetSelector*). To reset the camera to the factory configuration, select *Factory Setting* and click Load. To save a current camera configuration, select UserSet 1 or 2 and click Save. Select a saved user set and click Load to restore a saved configuration.

Sensor Control Category

The Genie Nano-CXP sensor controls, as shown by CamExpert, groups sensor specific parameters. This group includes controls for frame rate, exposure time, gain, etc.



Sensor Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Device Scan Type	DeviceScanType	Defines the scan type of the device's sensor.	1.00 Beginner
Areascan	*Areascan*	*Device uses an Areascan sensor.*	
Sensor Color Type	sensorColorType	Defines the camera sensor color type.	1.00 DFNC Beginner
Monochrome Sensor	*Monochrome*	*Sensor color type is monochrome.*	
Monochrome Sensor With Polarization Filter	*Monochrome_Polarized*	*Sensor color type is monochrome with a polarization filter.*	
Bayer Sensor	*CFA_Bayer*	*Sensor color type is Bayer Color Filter Array (CFA).*	
Bayer Sensor With Polarization Filter	*CFA_Bayer_Polarized*	*Sensor color type is Bayer Color Filter Array (CFA) with a polarization filter.*	
Input Pixel Size	pixelSizeInput	Size of the image input pixels, in bits per pixel.	1.00 DFNC Guru
8 Bits/Pixel	*Bpp8*	*Sensor output data path is 8 bits per pixel.*	
10 Bits/Pixel	*Bpp10*	*Sensor output data path is 10 bits per pixel.*	
Sensor Width	SensorWidth	Defines the sensor width in active pixels.	1.00 Expert
Sensor Height	SensorHeight	Defines the sensor height in active lines.	1.00 Expert

Acquisition Frame Rate	AcquisitionFrameRate	Specifies the camera internal frame rate, in Hz. Any user entered value is automatically adjusted to a valid camera value. Note that a change in frame rate takes effect only when the acquisition is stopped and restarted.	1.00 Beginner
Exposure Mode	ExposureMode	Sets the operation mode for the camera's exposure (or electronic shutter).	1.00 Beginner
Timed	*Timed*	*The exposure duration time is set using the Exposure Time feature and the exposure starts with a FrameStart event.*	
Trigger Width	*TriggerWidth*	*Uses the width of the trigger signal pulse to control the exposure duration. Use the Trigger Activation feature to set the polarity of the trigger.* *The Trigger Width setting is applicable with Trigger Selector = Single Frame Trigger(Start). Note that the Line Inverter feature setting may affect the polarity of the trigger signal and is only available when exposureAlignment = Reset.*	
Exposure Alignment	exposureAlignment	Exposure Alignment specifies how the exposure is executed in relationship to the sensor capabilities and current frame trigger.	1.00 DFNC Beginner
Synchronous	*Synchronous*	*Exposure is synchronous to the internal timing of the sensor. The readout is concurrent to the exposure for the fastest possible frame rate. When a valid trigger is received and the ExposureTime is shorter than the readout period, the ExposureStart event is latched in the previous frame's readout. That is; the ExposureStartEvent is delayed and is initiated when the actual exposure starts such that the exposure ends and readout begins as soon as the previous readout has completed.*	
Reset	*Reset*	*Sensor timing is reset to initiate exposure when a valid trigger is received. Readout is sequential to exposure, reducing the maximum achievable frame rates. That is, a trigger received during exposure or readout is ignored since data would be lost by performing a reset.*	
Exposure Delay (in µs)	exposureDelay	Specifies the exposure delay, in µs, to apply after the FrameStart event before starting the ExposureStart event.	1.00 Beginner
Exposure Time (in µs)	ExposureTime	Sets the exposure time (in microseconds) when the Exposure Mode feature is set to Timed.	1.00 Beginner
Actual Exposure Time (in µs)	exposureTimeActual	Actual Exposure Time performed by sensor due to its design, based on the requested Exposure Time.	1.00 Beginner
Long Exposure Time Mode	longExposureTimeMode	Selects the sensor's exposure time mode.	1.02 Beginner
Off	*Off*	For exposure times up to 50 ms.	
Active	*Active*	For exposure time above 50 ms.	
Gain Selector	GainSelector	Selects which gain is controlled when adjusting gain features.	1.00 Beginner
Sensor Analog	*SensorAnalog*	*Apply an analog gain adjustment within the sensor to the entire image.*	
Sensor Digital	*SensorDigital*	*Apply a digital gain adjustment within the sensor to the entire image.*	
Digital	*DigitalAll*	*Apply a digital gain adjustment to the entire image. This independent gain factor is applied to the image after the sensor.*	
Gain	Gain	Sets the selected gain as an amplification factor applied to the image. User adjusts the *Gain* feature or the *GainRaw* feature.	1.00 Beginner
Gain (Raw)	GainRaw	Raw Gain value that is set in camera (model-specific for range and step values).	1.00 Guru

Black Level Selector *Analog*	BlackLevelSelector *AnalogAll*	Selects which Black Level to adjust using the Black Level features. *Sensor Dark Offset*	1.00 Beginner
Black Level (in DN)	BlackLevel	Controls the black level as an absolute physical value. This represents a DC offset applied to the video signal, in DN (digital number) units. The Black Level Selector feature specifies the channel to adjust.	1.00 Beginner
Fast Readout Mode *Off* *Active*	fastReadoutMode *Off* *Active*	Selects the sensor's readout mode. *When this mode is off, the row blanking and row readout occur sequentially in the sensor.* *When this mode is active, the row blanking and row readout occur in parallel in the sensor. This helps achieve a lower total frame readout time resulting in a faster maximum frame rate. There are minor DN column artifacts, typically of no significance.*	1.00 DFNC Guru
Sensor Specific Saturation Control	sensorSpecificSaturationControl	Sensor-specific. Increasing this value can remove the black sun effect (over-saturated pixels that revert to black data) when the strobe lighting extends longer than the exposure period.	1.00 DFNC Guru
Black Level Raw	BlackLevelRaw	Controls the black level as an absolute physical value.	1.00 Invisible

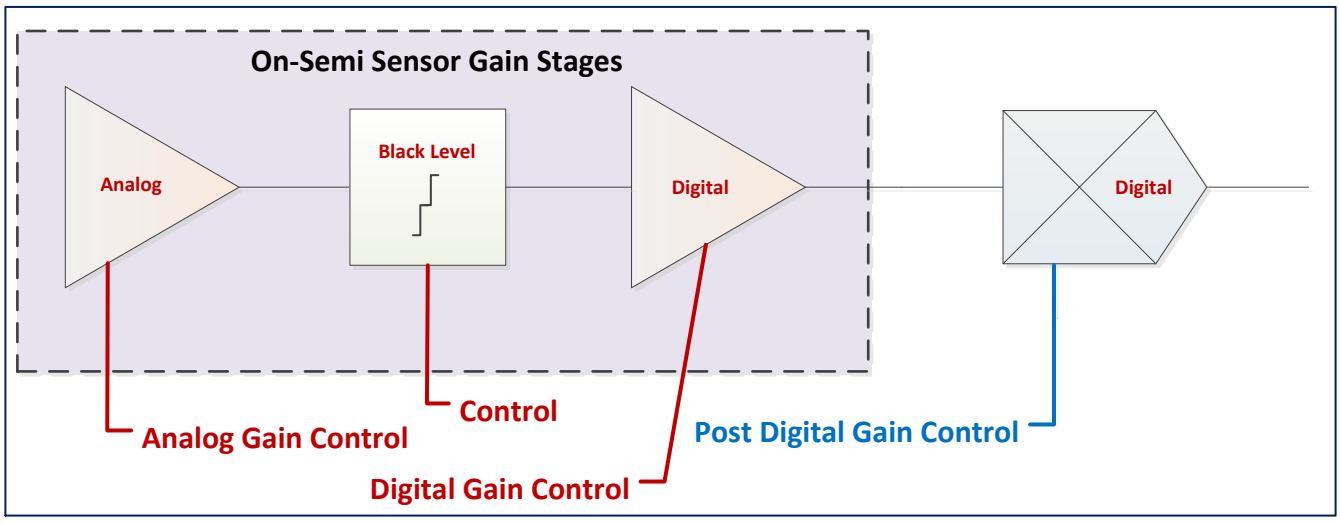
Black Level/Gain Control Details (On-Semi Python sensors)

The Gain and Black level functions are applied at the sensor and/or on the digital image values output by the sensor, as described below.

- **Gain Selector = Sensor Analog**: The gain function is a linear multiplier control in 0.01 steps within the sensor hardware.
- **Gain Selector = Sensor Digital**: The gain function is a linear multiplier control in 0.1 steps within the sensor hardware.
- **Important**: Digital noise increases linearly and quickly with higher gain values. Users should evaluate image quality with added gain.
- **Gain (Raw)**: Shows the raw sensor control for each gain stage or an alternative method to control sensor gain.
- **Black Level**: This offset variable exists within the sensor. The On-Semi sensors allow an offset range between 0 and 255 DN. The factory settings default value for each sensor used by various Nano models, is recommended as per the sensor manufacturer design specifications.

  Note: With the factory default offset, testing a camera's black output in 8-bit mode may show a 2 DN value difference across the image. Changing the Black Level value up or down will push sensor noise (present at the sensors native bits per pixel) to fall within one 8-bit value, thus the noise becomes hidden.

On-Semi Python Sensors Gain Stage Diagram



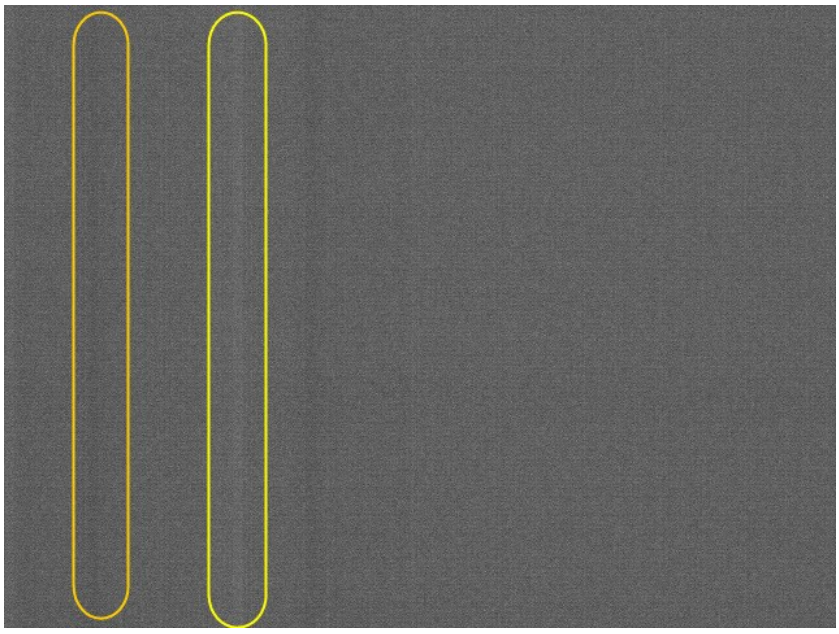
OnSemi Python Sensor Artifacts with Fast Readout Mode

	The following sections only apply to camera models using OnSemi sensors (M5100, C5100, M4090, C4090) in Fast Readout mode; camera models with Emerald E2V sensors (M6200, C6200, M8200, C8200) also support Fast Readout mode but without artifacts.

Applicable only when Flat Field Correction is purposely disabled.

When Fast Readout mode is active (cameras with OnSemi sensors), the row blanking and row readout occurs in parallel in the sensor. This reduces the total frame readout time resulting in a faster maximum frame rate. Consequently, with this mode there are minor column artifacts (of very low DN), typically of no significance and irrelevant for many imaging systems. Note that these column artifacts will become more prominent as sensor gain is increased.

The image below shows a "dark" capture with Fast Readout Mode enabled and analog gain set to maximum. The artifacts will become visible as fixed pattern DN column variations near the left edge of the video frame. There are darker columns followed by lighter columns as marked by the overlay graphics. These DN variations are not random columns, but consistent between individual OnSemi sensors operating in Fast Readout mode with high gain.



Fast Readout Mode Artifacts Correction

As noted in this section, the Fast Readout mode artifacts are automatically corrected by the factory default enabled Flat Field correction.

Alternatively, for **maximum acquisition quality**, disable Fast Readout Mode to eliminate acquisition DN variances, at a small reduction of the maximum frame rate. Also remember that high gain settings will increase overall sensor noise therefore additional gain should be used only when necessary.

Exposure Alignment: Overview

Exposure Control modes define the method and timing of controlling the sensor integration period. The integration period is the amount of time the sensor is exposed to incoming light before the video frame data is transmitted to the controlling computer.

- Exposure control is defined as the start of exposure and exposure duration.
- The feature **Exposure Mode** selects the controlling method for the exposure.
- The start of exposure is initiated by an internal timer signal, an external input trigger signal (Trigger Mode=ON), or a software function call.

- The exposure duration can be programmable (Exposure Mode = Timed, *free run or external trigger*) or controlled by the external input trigger pulse width (Exposure Mode = TriggerWidth).

Note that different Nano models will support different combinations of exposure controls.

Synchronous Exposure Alignment

Exposure is synchronous to the internal timing of the sensor. The readout is concurrent to the exposure for the fastest possible frame rate.

When a valid trigger is received and the Exposure Time is shorter than the readout period, the Exposure Start event is latched in the previous frame's readout. That is; the Exposure Start Event is delayed and is initiated when the actual exposure starts such that the exposure ends and readout begins as soon as the previous readout has completed.

- The programmable exposure duration is in 1µs steps.
- Exposure duration is from a camera sensor specific minimum (in µs) up to 10 sec.
- Any trigger received before the start of frame readout is ignored and generates an invalid frame trigger event.

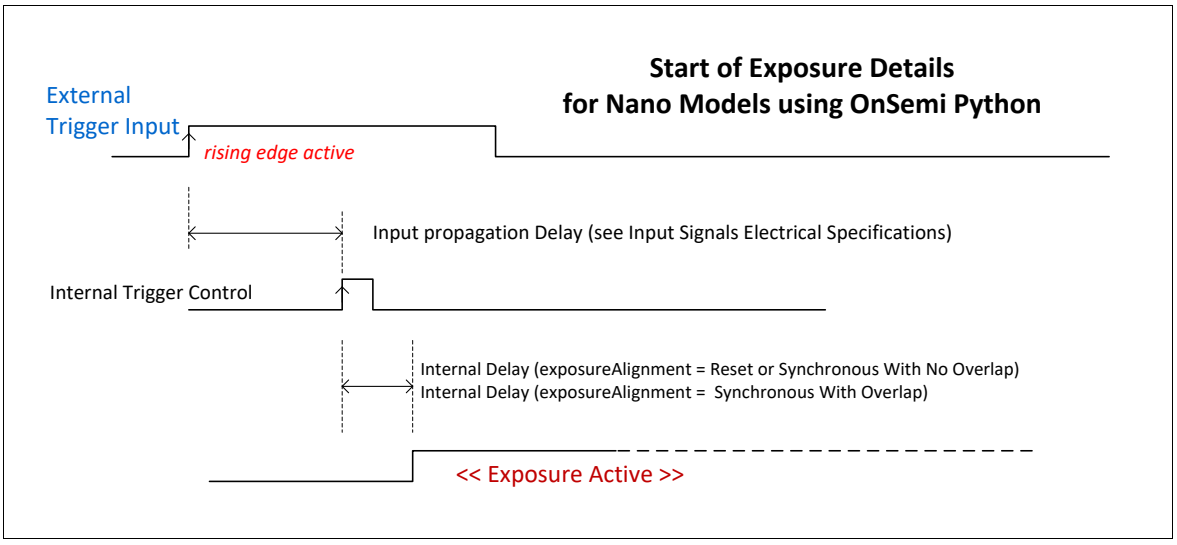
Reset Exposure Alignment

Sensor timing is reset to initiate exposure when a valid trigger is received. Readout is sequential to exposure, reducing the maximum achievable frame rates. That is, a trigger received during exposure or readout is ignored since data would be lost by performing a reset.

Sensor Exposure Timing: OnSemi Python Models

Nano cameras with OnSemi sensors have general timing characteristics as described below.

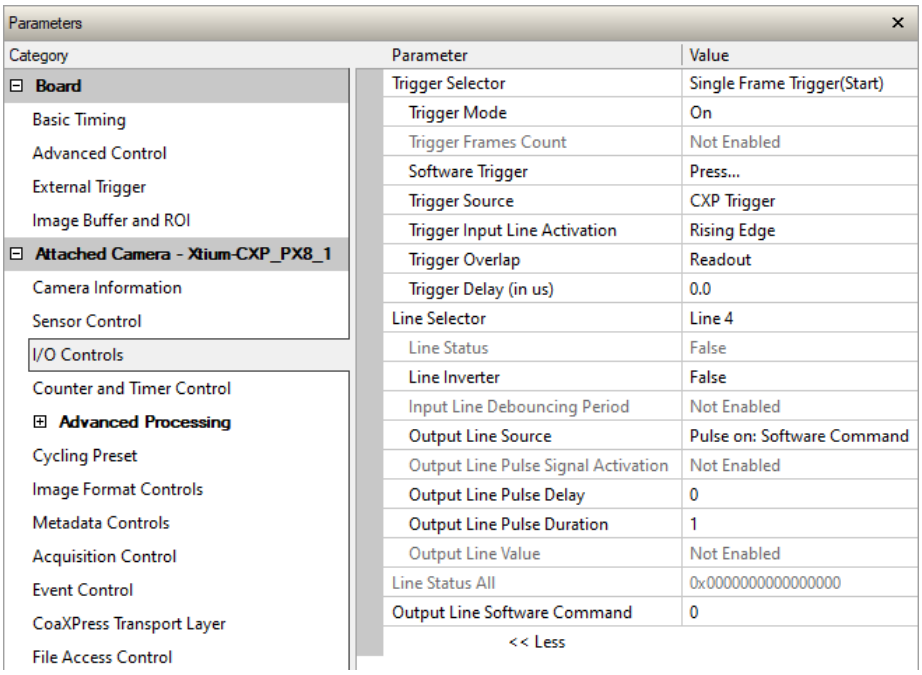
Trigger Characteristics: Start of Exposure



Additional triggered exposure mode features and timing specific to OnSemi sensors are described in the I/O Controls Category.

I/O Control Category

The Nano-CXP I/O controls, as shown by CamExpert, groups' features used to configure acquisition actions based on those inputs.



Model numbers identify GPIO support:

- G3-Xx**0**x-xxxxx (yes)
- G3-Xx**3**x-xxxxx (no)

I/O Control Feature Descriptions

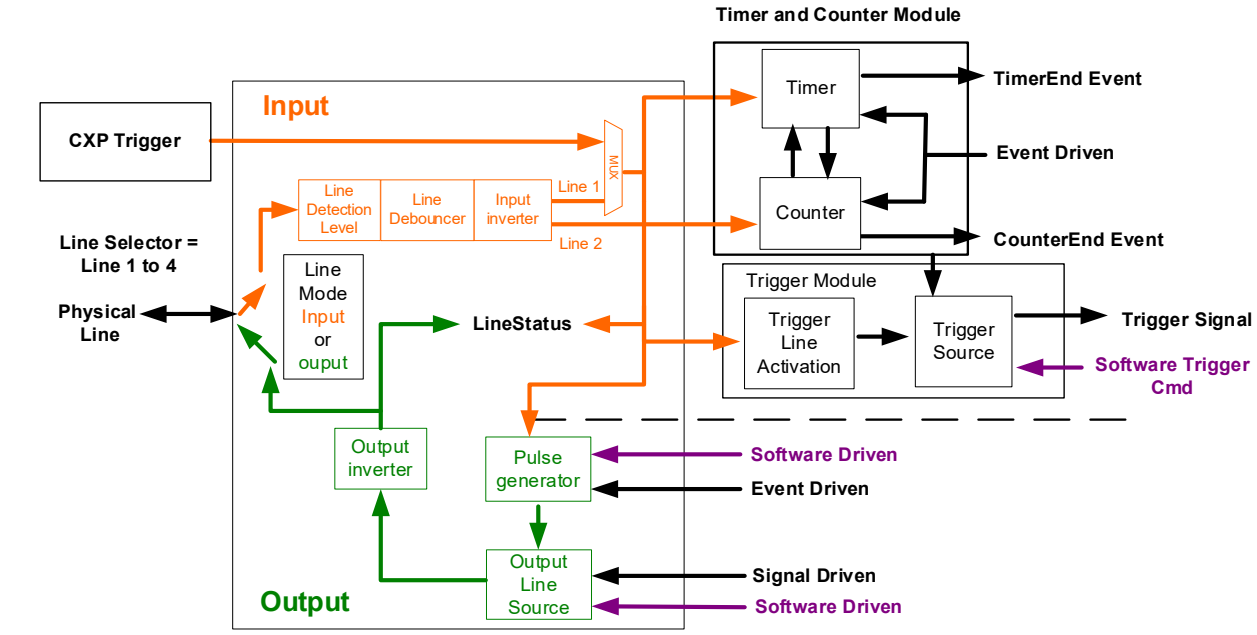
Display Name	Feature & Values	Description	Device Version & View
Trigger Selector	TriggerSelector	Selects which type of trigger to configure with the various Trigger features.	1.00 Beginner
Single Frame Trigger(Start)	*FrameStart*	*Selects a trigger starting the capture of a single frame. Frame size is determined by image format feature "Height".*	
MultiFrame Trigger(Start)	*FrameBurstStart*	*Selects a trigger to capture multiple frames. The number of frames is specified by the "triggerFrameCount" feature.*	
Trigger Mode	TriggerMode	Controls the enable state of the selected trigger.	1.00 Beginner
Off	*Off*	*The selected trigger is turned off.*	
On	*On*	*The selected trigger is turned active.*	
Trigger Frames Count	triggerFrameCount	Sets the total number of frames to acquire when a valid trigger is received. This feature is available when Trigger Selector = MultiFrame Trigger(Start).	1.00 DFNC Beginner
Software Trigger	TriggerSoftware	Generate a software command internal trigger immediately no matter what the TriggerSource feature is set to.	1.00 Beginner
Trigger Source	TriggerSource	Specifies the internal signal or physical input line to use as the trigger source. The selected trigger must have its TriggerMode set to ON.	1.00 Beginner
CXP Trigger	*CXP*	*Select CXP trigger (and associated I/O control block) to use as the external trigger source. See LineSelector feature for complete list.*	
Software	*Software*	*The trigger command source is only generated by software using the Trigger Software command.*	
Line 1	*Line1*	*Select Line 1 (and associated I/O control block) to use as the external trigger source. See LineSelector feature for complete list.*	
Line 2	*Line 2*	*Select Line 2 (and associated I/O control block) to use as the external trigger source. See LineSelector feature for complete list.*	
Timer1End Event	*Timer1End*	*Select the TimerEnd Event as the internal trigger source.*	
Counter1End Event	*Counter1End*	*Select the CounterEnd Event as the internal trigger source.*	
Trigger Input Line Activation	TriggerActivation	Select the activation mode for the selected Input Line trigger source. This is applicable only for external line inputs.	1.00 Beginner
Rising Edge	*RisingEdge*	*The trigger is considered valid on the rising edge of the line source signal (after any processing by the line inverter module).*	
Falling Edge	*FallingEdge*	*The trigger is considered valid on the falling edge of the line source signal (after any processing by the line inverter module).*	
Level High	*LevelHigh*	*The trigger is considered valid on the high level of the line source signal. (OnSemi models only)*	
Level Low	*LevelLow*	*The trigger is considered valid on the low level of the line source signal. (OnSemi models only)*	
Trigger Delay	TriggerDelay	Specifies the delay in microseconds to apply after receiving the trigger and before activating the triggerEvent.	1.00 Beginner

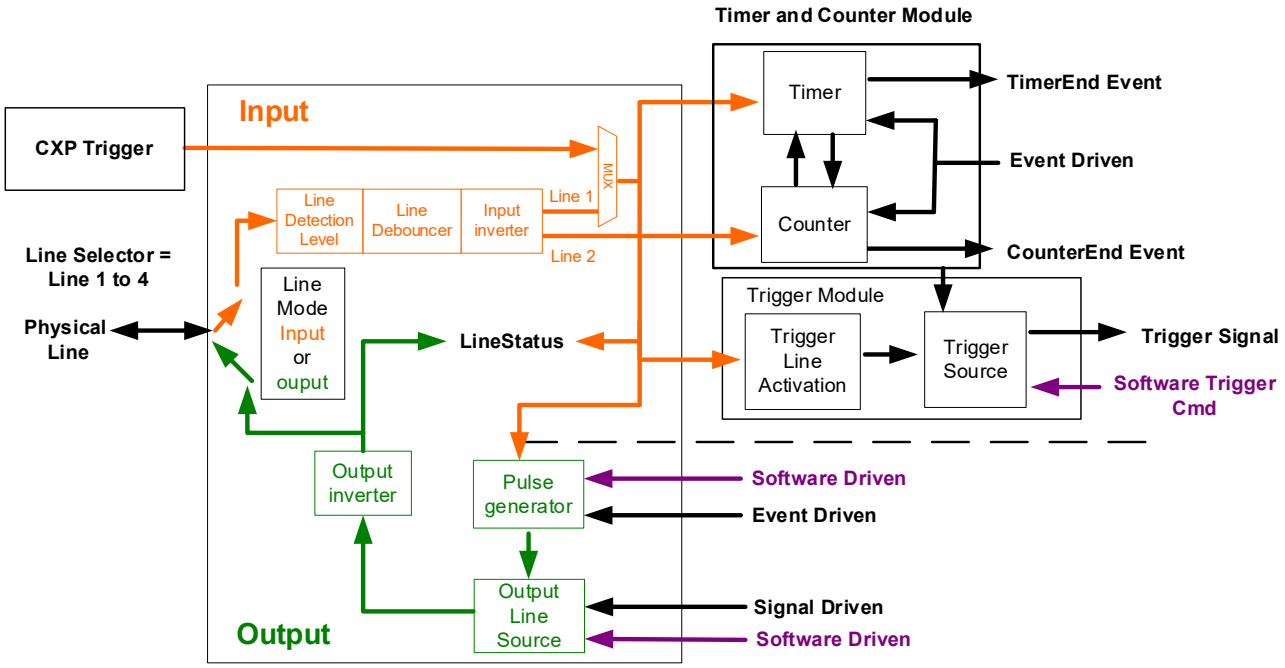
Trigger Overlap	TriggerOverlap	States if a trigger overlap is permitted with the Active Frame readout signal. This feature defines if a new valid trigger will be accepted (or latched) for a new frame.	1.00 Guru
Off	*Off*	*No trigger overlap is permitted.*	
Readout	*Readout*	*Trigger is accepted immediately after the start of the readout.*	
Line Selector	LineSelector	Selects the physical line (or pin) of the external device connector to configure.	1.00 Beginner
CXP	*CXP*	*Select the CXP trigger.*	
Line 1	*Line1*	*Index of the physical and associated I/O control block to use. Pin 5 is the Input Signal and Pine 3 is the common Ground on the I/O connector.*	
Line 2	*Line2*	*Index of the physical and associated I/O control block to use. Pin 7 is the Input Signal and Pine 3 is the common Ground on the I/O connector.*	
Line Status	LineStatus	Returns the current status of the selected input or output line.	1.00 Expert
	False	*The Line is logic LOW*	
	True	*The Line is logic HIGH*	
Line Inverter	LineInverter	Control to invert the polarity of the selected input or output line signal.	1.00 Beginner
	False / True		
Input Line Debouncing Period	lineDebouncingPeriod	Specifies the minimum delay before an input line voltage transition is recognizing as a signal transition.	1.00 Beginner DFNC
Output Line Source	outputLineSource	Selects which internal signal or event driven pulse or software control state to output on the selected line. Note, the LineMode feature must be set to Output. The List of supported output line sources is product-specific. The Event Control section provides details and timing diagrams for the supported trigger modes.	1.02 Beginner DFNC
Off	*Off*	*Line output is Open*	
Software Controlled	*SoftwareControlled*	*The OutputLineValue feature changes the state of the output*	
Pulse on: Start of Frame	*PulseOnStartofFrame*	*Generate a pulse on the start of the Frame Active event*	
Pulse on: Start of Exposure	*PulseOnStartofExposure*	*Generate a pulse on the ExposureStart event. This option is typically used to trigger a strobe light.*	
Pulse on: End of Exposure	*PulseOnEndofExposure*	*Generate a pulse on the ExposureEnd event. This option is typically used to trigger a strobe light.*	
Pulse on: Start of Readout	*PulseOnStartofReadout*	*Generate a pulse on the ReadoutStart event.*	
Pulse on: End of Readout	*PulseOnEndofReadout*	*Generate a pulse on the ReadoutEnd event.*	
Pulse on: Valid Frame Trigger	*PulseOnValidFrameTrigger*	*Generate a pulse on the ValidFrameTrigger event.*	
Pulse on: Rejected Frame(s) Trigger	*PulseOnInvalidFrameTrigger*	*Generate a pulse on the InvalidFrameTrigger event.*	
Pulse on: Start of Acquisition	*PulseOnStartofAcquisition*	*Generate a pulse when the AcquisiontStart event occurs.*	
Pulse on: End of Acquisition	*PulseOnEndofAcquisition*	*Generate a pulse when the AcquisiontStop event occurs.*	
Pulse on: End of Timer 1	*PulseOnEndofTimer1*	*Generate a pulse on the TimerEnd 1 event.*	
Pulse on: End of Counter 1	*PulseOnEndofCounter1*	*Generate a pulse on the CounterEnd 1 event.*	
Pulse on: Input 1 Event	*PulseOnInput1*	*Generate a pulse on the Input signal 1 event*	
Pulse on: Input 2 Event	*PulseOnInput2*	*Generate a pulse on the Input signal 2 event*	
Pulse on: Software Command	*PulseOnSoftwareCmd*	*Generate a pulse on the input of a Software Command.*	
Exposure Active	*ExposureActive*	*Generate a signal that is active when the Exposure is active.*	

Output Line Pulse Signal Activation *Rising Edge* *Falling Edge* *Any Edge*	outputLinePulseActivation *RisingEdge* *FallingEdge* *AnyEdge*	Specifies the input line activation mode to trigger the OutputLine pulse. *Specifies that the trigger is considered valid on the rising edge of the source signal.* *Specifies that the trigger is considered valid on the falling edge of the source signal.* *Specifies that the trigger is considered valid on the falling or rising edge of the source signal.*	1.02 Beginner DFNC
Output Line Pulse Delay	outputLinePulseDelay	Sets the delay (in µs) before the output line pulse signal. Applicable for the OutputLineSource feature.	1.02 Beginner DFNC
Output Line Pulse Duration	outputLinePulseDuration	Sets the width (duration) of the output line pulse in microseconds.	1.02 Beginner DFNC
Output Line Value *Active* *Inactive*	outputLineValue *Active* *Inactive*	Sets the output state of the selected Line if the outputLineSoftwareLatchControl = OFF. OutputLineSource must be SoftwareControlled. *Sets the Output circuit to close* *Sets the Output circuit to open*	1.02 Beginner DFNC
Line Status All	LineStatusAll	Returns the current status of all available line signals, at time of polling, in a single bitfield. The order is Line1, Line2, Line3, ...	1.00 Expert
Line Format *CXP* *Opto-Coupled*	LineFormat *CxP* *OptoCoupled*	Specify the current electrical format of the selected physical input or output. *The line accepts CXP Trigger packets.* *The line is opto-coupled.*	1.00 Invisible
Line Mode *Input* *Output*	LineMode *Input* *Output*	Reports if the physical Line is an Input or Output signal.. *The line is an input line.* *The line is an output line.*	1.00 Invisible
Input Line Detection Level *Threshold for TTL*	lineDetectionLevel *Threshold_for_TTL*	Specifies the voltage threshold required to recognize a signal transition on an input line. *A signal below 0.8V will be detected as a Logical LOW and a signal greater than 2.4V will be detected as a Logical HIGH on the selected input line.*	1.00 Invisible DFNC

I/O Module Block Diagram

Model numbers identify GPIO support:
- G3-Xx**0**x-xxxxx (yes)
- G3-Xx**3**x-xxxxx (no)





Trigger Mode Details

Nano-CXP image exposures are initiated by an event. The trigger event is either the camera's programmable internal clock used in free running mode, an external input to the controlling frame grabber used for synchronizing exposures to external triggers, or a programmed function call message by the controlling computer. These triggering modes are described below.

- **Free running (Trigger Mode=Off)**: The Nano free-running mode has programmable internal timers for frame rate and exposure period. Frame rate minimums, maximums, and increments supported are sensor specific. Maximum frame rates are dependent on the required exposure.
- **Trigger Source (Trigger Mode=On)**: Exposures are controlled by an external trigger signal where the specific input line is selected by the **Trigger Source** feature.

Trigger Source Types (Trigger Mode=On)

- **Trigger Source=CXP**: The CoaXPress trigger (controlled by the frame grabber) is used as the external trigger control.
- **Trigger Source=Software**: An exposure trigger is sent as a software command. Software triggers cannot be considered time accurate due to computer latency and sequential command jitter. But a software trigger is more responsive than calling a single-frame acquisition since the latter must validate the acquisition parameters and modify on-board buffer allocation if the buffer size has changed since the last acquisition.
- **Trigger Source=Timer1End Event**: The Timer1 End Event is used as the internal trigger source. Refer to Counter and Timer Controls for information on those features.
- **Trigger Source=Counter1End Event**: The Counter1 End Event is used as the internal trigger source.

Trigger Overlap: Feature Details

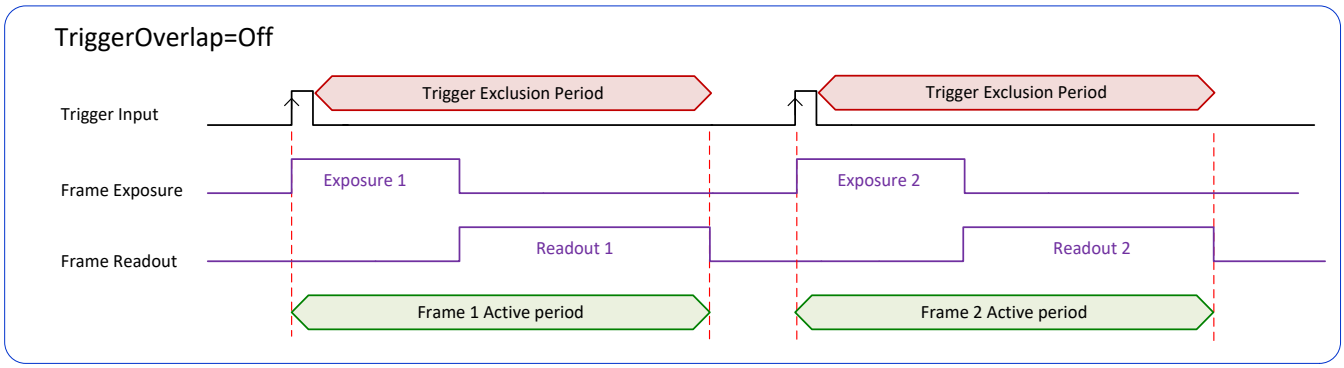
The Trigger Overlap feature defines how the Nano handles triggers that might occur more frequently than the Frame Active period (an exposure plus readout period).

If TriggerOverlap=OFF, then triggers received before the end of the Frame Active period are ignored. Other TriggerOverlap values are dependent on the Nano model and sensor used.

- **TriggerOverlap=Off**
- No trigger overlap is permitted.

Diagram Conditions:

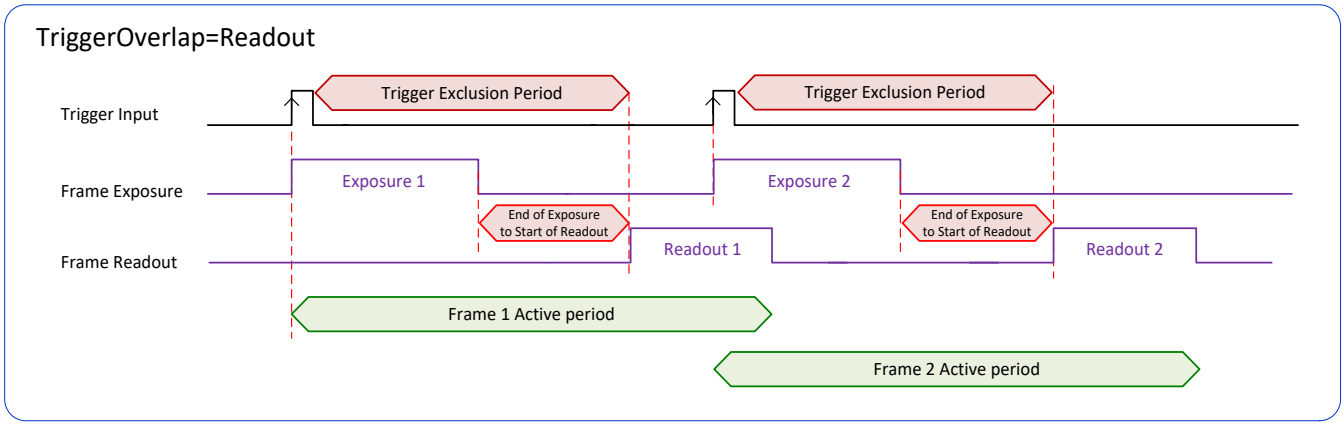
- TriggerMode=On
- ExposureMode=Timed
- TriggerActivation=RisingEdge
- TriggerDelay=0
- TriggerSelector=FrameStart
- ExposureAlignment=Synchronous
- Minimum Trigger to Exposure start delay: 3.23µs (shown as 4µs)



- **TriggerOverlap=ReadOut**
- Trigger is accepted at the beginning of the frame Readout. The "End of Exposure to Start of Readout" time is sensor dependent.

Diagram Conditions:

- TriggerMode=On
- ExposureMode=Timed
- TriggerActivation=RisingEdge
- TriggerDelay=0
- TriggerSelector=FrameStart
- ExposureAlignment=Synchronous
- Trigger to Exposure start has a delay which includes the sensor readout time plus a minimum of 62µs. An exposure always starts after the readout of the previous frame.



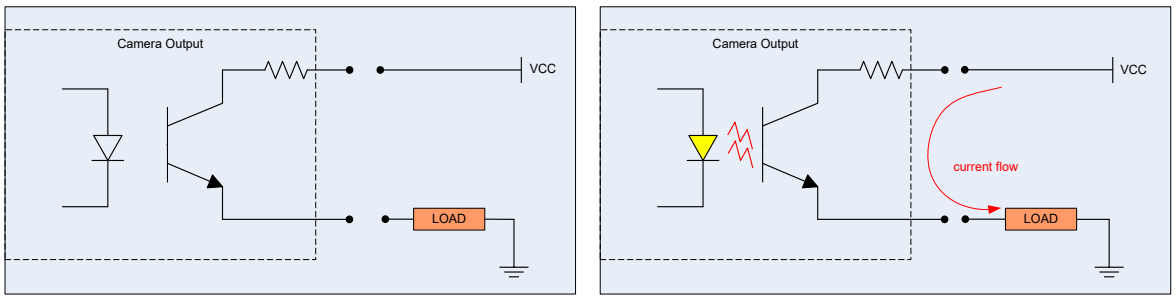
Output Line Details

The general-purpose output line signals are connected to I/O lines 3 and 4, which have the following features for control or status indication.

- **Feature set:** LineInverter (RW), outputLineSource (RW), outputLinePulseDelay (RW), outputLinePulseDuration (RW), outputLineValue (RW), outputLineSoftwareCmd (RW), LineSelector (RW), LineName (RO), linePinAssociation (RO), LineFormat (RO), LineMode (RO), LineStatus (RO). See Output Signals Electrical Specifications for more information.
- **External outputs:** Can be used as a strobe signals to control lighting or to generate programmable pulses when specific events are generated by the camera.
- **Output on Events:** Each output can be set independently to one of the available event modes defined by the 'outputLineSource' feature.

Output High and Output Low Block Diagram

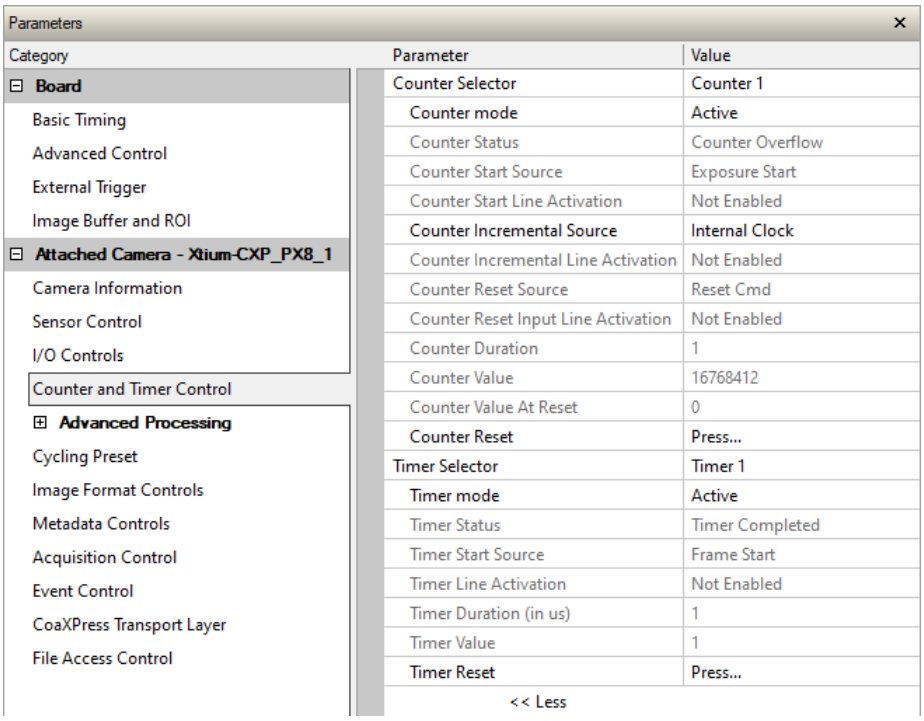
Output signal lines when either in the High or Low state are shown in the following figures with a simplified external circuit.



Examples of Logic HI and Logic LO output circuits

Counter and Timer Control Category

The Genie Nano-CXP counter and timer controls, as shown by CamExpert, groups parameters used to configure acquisition counters and timers.



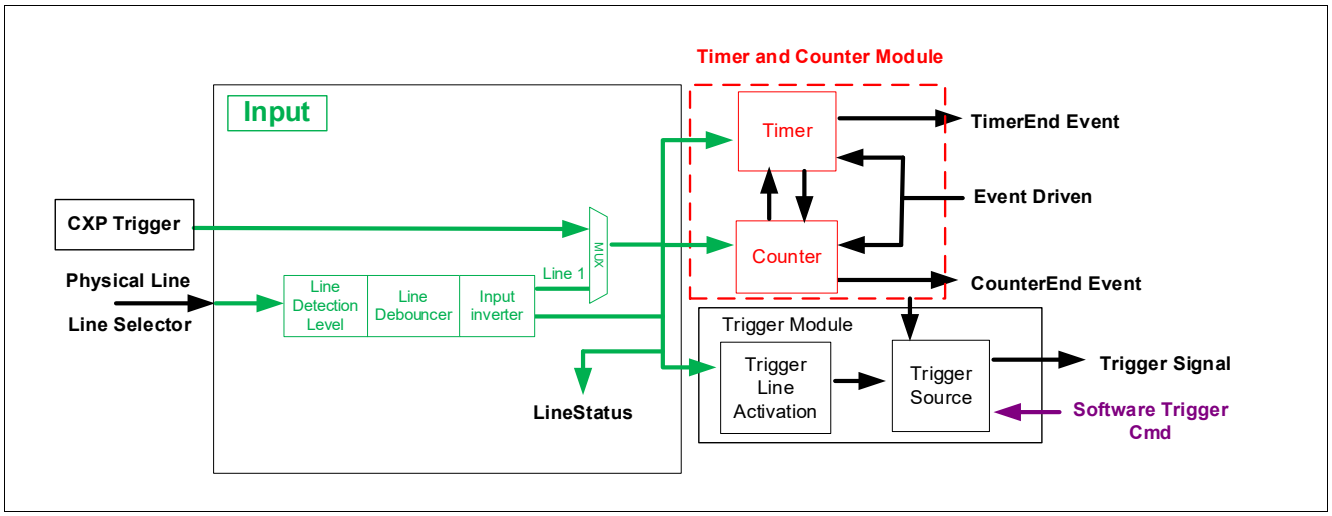
Counter and Timer Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Counter Selector	counterSelector	Selects the counter to configure.	1.00 Expert DFNC
Counter 1	*Counter1*	*Select counter 1*	
Counter mode	counterMode	Selects the counter mode. The selected Counter is either Active or Disabled. When Disabled, the Counter can be configured.	1.00 Expert DFNC
Off	*Off*	*The selected Counter is Disabled*	
Active	*Active*	*The selected Counter is Enabled*	
Counter Status	counterStatus	Returns the current state of the counter.	1.00 Expert DFNC
Counter Idle	*CounterIdle*	*The counter is idle. The counterStartSource feature is set to off.*	
Counter Trigger Wait	*CounterTriggerWait*	*The counter is waiting for a start trigger.*	
Counter Active	*CounterActive*	*The counter is counting for the specified duration.*	
Counter Completed	*CounterCompleted*	*The counter reached the CounterDuration count.*	
Counter Overflow	*CounterOverflow*	*The counter reached its maximum possible count.*	
Counter Start Source	counterStartSource	Select the counter start source. Counter increments from 0 to the value of the counterDuration feature.	1.00 Expert DFNC
Off	*Off*	*Counter is stopped.*	
Exposure Start	*ExposureStart*	*Counter starts on the reception of the Exposure Start event*	
Exposure End	*ExposureEnd*	*Counter starts on the reception of the Exposure End event.*	
Readout Start	*ReadoutStart*	*Counter starts on the reception of the Readout Start event.*	
Readout End	*ReadoutEnd*	*Counter starts on the reception of the Readout End event.*	
Frame Start	*FrameStart*	*Counter starts on the reception of the Frame Start event.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Counter starts on the reception of the Valid Frame Trigger.*	
Rejected Frame Trigger	*InvalidFrameTrigger*	*Counter starts on the reception of the Invalid Frame Trigger.*	
Line 1	*Line1*	*Counter starts on the specified transitions on CXP or Line 1 trigger.*	
Line 2	*Line2*	*Counts the number of transisitions on Line 2 (based on the counterIncrementaLineActivation feature setting).*	
Timer 1 End	*Timer1End*	*Counter starts on the reception of the Timer 1 End event.*	
Counter 1 End	*Counter1End*	*Counter starts on the reception of the Counter 1 End event.*	
Counter Start Line Activation	counterStartLineActivation	Selects the activation mode of the input line trigger which starts the counter. This is only applicable when the counterStartSource feature selects a physical Line.	1.00 Expert DFNC
Rising Edge	*RisingEdge*	*Starts counting on rising edge of the selected Line.*	
Falling Edge	*FallingEdge*	*Starts counting on falling edge of the selected Line.*	
Any Edge	*AnyEdge*	*Starts counting on the falling or rising edge of the selected Line.*	

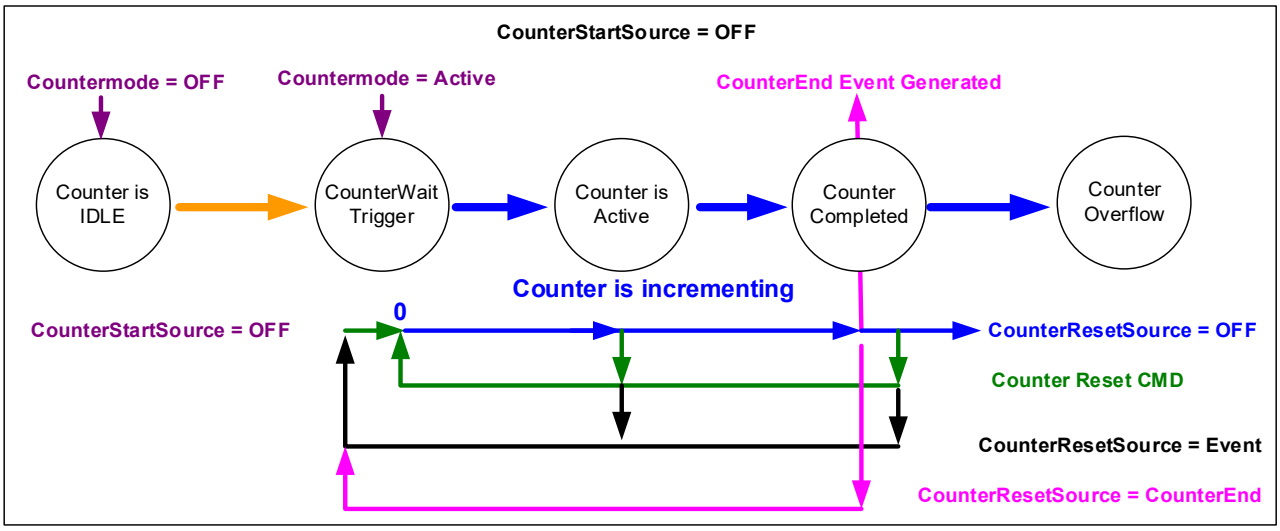
Counter Incremental Source	counterIncrementalSource	Select the event source which increments the counter. The Event Control section provides details and timing diagrams for the supported events.	1.00 Expert DFNC
Off	*Off*	*Counter is stopped.*	
Exposure Start	*ExposureStart*	*Counts the number of Exposure Start events.*	
ExposureEnd	*ExposureEnd*	*Counts the number of Exposure End events.*	
Readout Start	*ReadoutStart*	*Counts the number of Readout Start events.*	
Readout End	*ReadoutEnd*	*Counts the number of Readout End events.*	
Frame Start	*FrameStart*	*Counts the number of Frame Start events.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Counts the number of Valid Frame Triggers.*	
Rejected Frame(s) Trigger	*InvalidFrameTrigger*	*Counts the number of Rejected Frame(s) Trigger.*	
Line 1	*Line1*	*Counts the number of transitions on Line 1(based on the counterIncrementalLineActivation feature setting).*	
Line 2	*Line2*	*Counts the number of transitions on Line 2 (based on the counterIncrementalLineActivation feature setting).*	
Internal Clock	*InternalClock*	*The counter increments on each microsecond tick of the device internal Clock.*	
Timer 1 End	*Timer1End*	*Counts the number of Timer 1 End events.*	
Counter Incremental Line Activation	counterIncrementalLineActivation	Selects the counter signal activation mode. The counter increments on the specified signal edge or level.	1.00 Expert DFNC
Rising Edge	*RisingEdge*	*Increment the counter on the rising edge of the selected I/O Line.*	
Falling Edge	*FallingEdge*	*Increment the counter on the falling edge of the selected I/O Line.*	
Any Edge	*AnyEdge*	*Increment the counter on the falling or rising edge of the selected I/O Line.*	
Counter Duration	counterDuration	Sets the duration (or number of events) before the CounterEnd event is generated.	1.00 Expert DFNC
Counter Reset Source	counterResetSource	Selects the signal source to reset the counter. After a reset the counter waits for the next countStartSource signal or event.	1.00 Expert DFNC
Reset Cmd	*Off*	*Reset on reception of the Reset Icommand.*	
Exposure Start	*ExposureStart*	*Reset on reception of the Exposure Start event.*	
Exposure End	*ExposureEnd*	*Reset on reception of the Exposure End event.*	
Readout Start	*ReadoutStart*	*Reset the counter on the reception of the Readout Start event.*	
Readout End	*ReadoutEnd*	*Reset the counter on the reception of the Readout End event.*	
Frame Trigger	*FrameStart*	*Reset on reception of the Frame Trigger.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Reset on reception of the Valid Frame Trigger.*	
Rejected Frame Trigger	*InvalidFrameTrigger*	*Reset on reception of the Invalid Frame Trigger.*	
Line 1	*Line1*	*Reset the Counter on the specified transitions on Line 1.*	
Line 2	*Line2*	*Reset the Counter on the specified transitions on Line 2.*	
Timer 1 End	*Timer1End*	*Reset on reception of the Timer End.*	
Counter 1 End	*Counter1End*	*Reset on the reception of the Counter end.*	
Counter Reset Input Line Activation	counterResetLineActivation	Specify the edge transition on the selected line that will reset the selected counter.	1.00 Expert DFNC
Rising Edge	*RisingEdge*	*Reset counter on rising edge of the selected signal.*	
Falling Edge	*FallingEdge*	*Reset counter on falling edge of the selected signal.*	
Any Edge	*AnyEdge*	*Reset counter on the falling or rising edge of the selected signal*	

Counter Value	counterValue	Read the current value of the selected counter.	1.00 Expert DFNC
Counter Value At Reset	counterValueAtReset	Stores the counter value of the selected counter when it was reset by a trigger or by an explicit Counter Reset command.	1.00 Expert DFNC
Counter Reset	counterReset	Resets the selected counter to zero. The counter starts immediately after the reset. To temporarily disable the counter, set the Counter Event Source feature to Off.	1.00 Expert DFNC
Timer Selector *Timer 1*	timerSelector *Timer1*	Selects which timer to configure. *Timer 1 selected*	1.00 Expert DFNC
Timer Mode *Off* *Active*	timerMode *Off* *Active*	Select the Timer mode. The selected Timer is Active or Disabled. When Disabled, the Timer can be configured. *The selected Timer is Disabled.* *The selected Timer is Enabled.*	1.00 Expert DFNC
Timer Status *Timer Idle* *Timer Trigger Wait* *Timer Active* *Timer Completed*	timerStatus *TimerIdle* *TimerTriggerWait* *TimerActive* *TimerCompleted*	Returns the current state of the timer. *The timer is idle. The CounterStartSource feature is set to off.* *The timer is waiting for a start trigger.* *The timer is counting for the specified duration.* *The timer reached the TimerDuration count.*	1.00 Expert DFNC
Timer Start Source *TimerReset Cmd* *Exposure Start* *Exposure End* *Readout Start* *Readout End* *Frame Start* *Frame Trigger* *Line 1* *Line 2* *Timer 1 End* *Counter 1 End*	timerStartSource *Off* *ExposureStart* *ExposureEnd* *ReadoutEnd* *ReadoutStart* *FrameStart* *ValidFrameTrigger* *Line1* *Line2* *Timer1End* *Counter1End*	Select the trigger source to start the timer. The Event Control section provides details and timing diagrams for the supported events. *Starts with the reception of the TimerReset Icommand.* *Start Timer on Exposure Start event.* *Start Timer on Exposure End event.* *Start Timer on Readout Start event.* *Start Timer on Readout End event.* *Start Timer on Frame Start event.* *Start Timer on Frame Trigger event.* *Start Timer on a transition of I/O Line 1 trigger event.* *Start Timer on a transition of I/O Line 2 event.* *Start Timer on Timer 1 End event.* *Start Timer on Counter 1 End event.*	1.00 Expert DFNC
Timer Line Activation *Rising Edge* *Falling Edge* *Any Edge*	timerStartLineActivation *RisingEdge* *FallingEdge* *AnyEdge*	Select the trigger activation mode which starts the timer. *Starts counter on rising edge of the selected signal.* *Starts counter on falling edge of the selected signal.* *Starts counter on the falling or rising edge of the selected signal.*	1.00 Expert DFNC
Timer Duration	timerDuration	Sets the duration (in microseconds) of the timer pulse.	1.00 Expert DFNC
Timer Value	timerValue	Reads the current value (in microseconds) of the selected timer.	1.00 Expert DFNC
Timer Reset	timerReset	Resets the timer to 0 while *timerStatus=TimerActive*. Timer then waits for the next *timerStartSource* event.	1.00 Expert DFNC

Counter and Timer Group Block Diagram

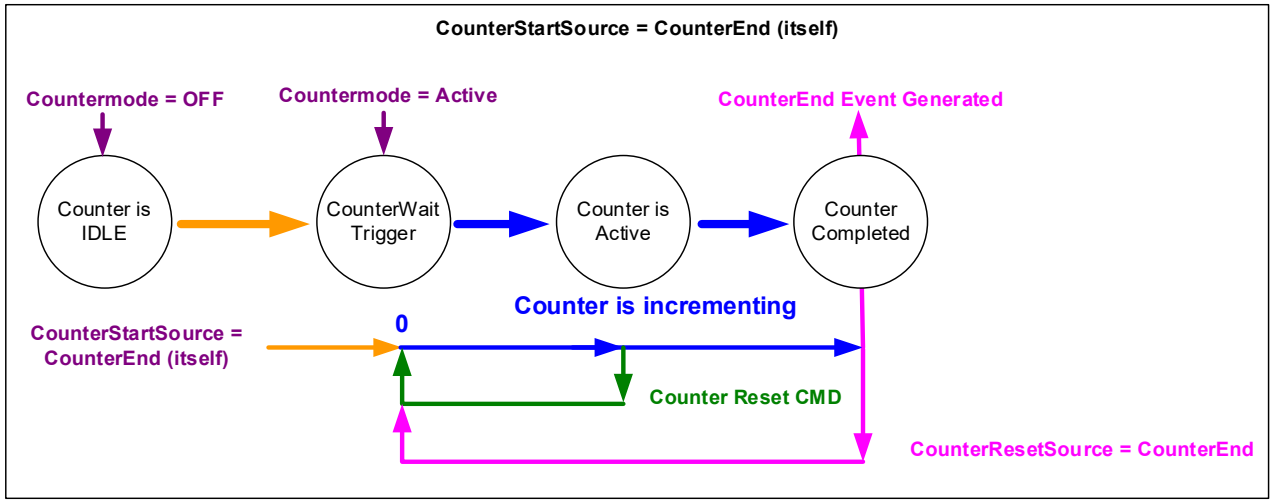


Example: Counter Start Source = OFF



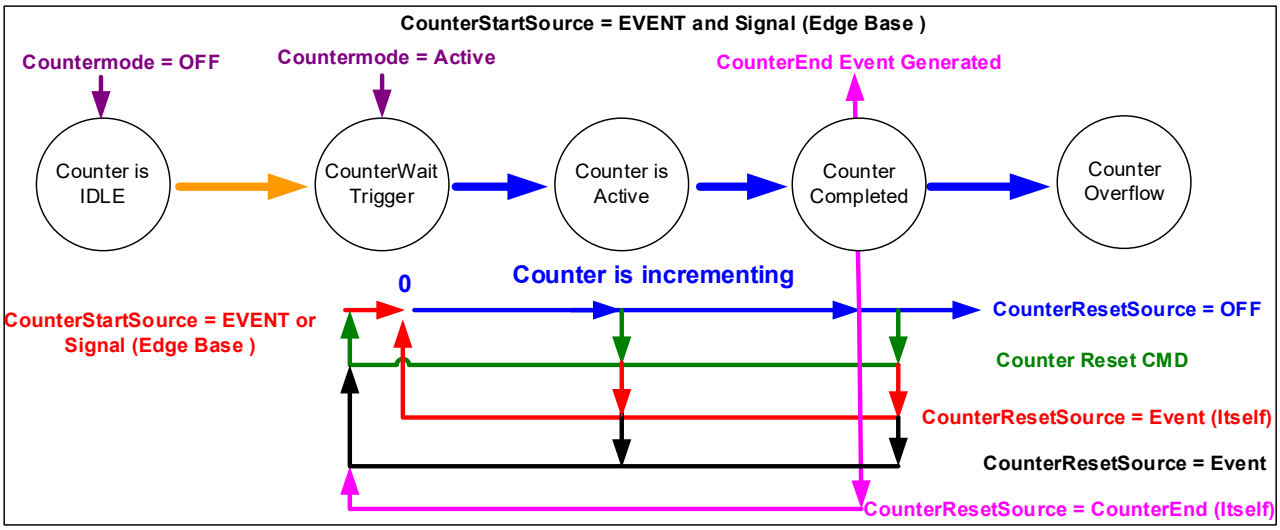
- The counter starts on the **counterReset Cmd**.
- The counter continues unless a new **counterReset Cmd** is received, which then restarts the counter at 00.
- When **Counter Reset Source= 'Event' or 'CounterEnd'** the counter is reset to 00 but does not restart counting, until the next **CounterReset Cmd**.

Example: Counter Start Source = CounterEnd (itself)

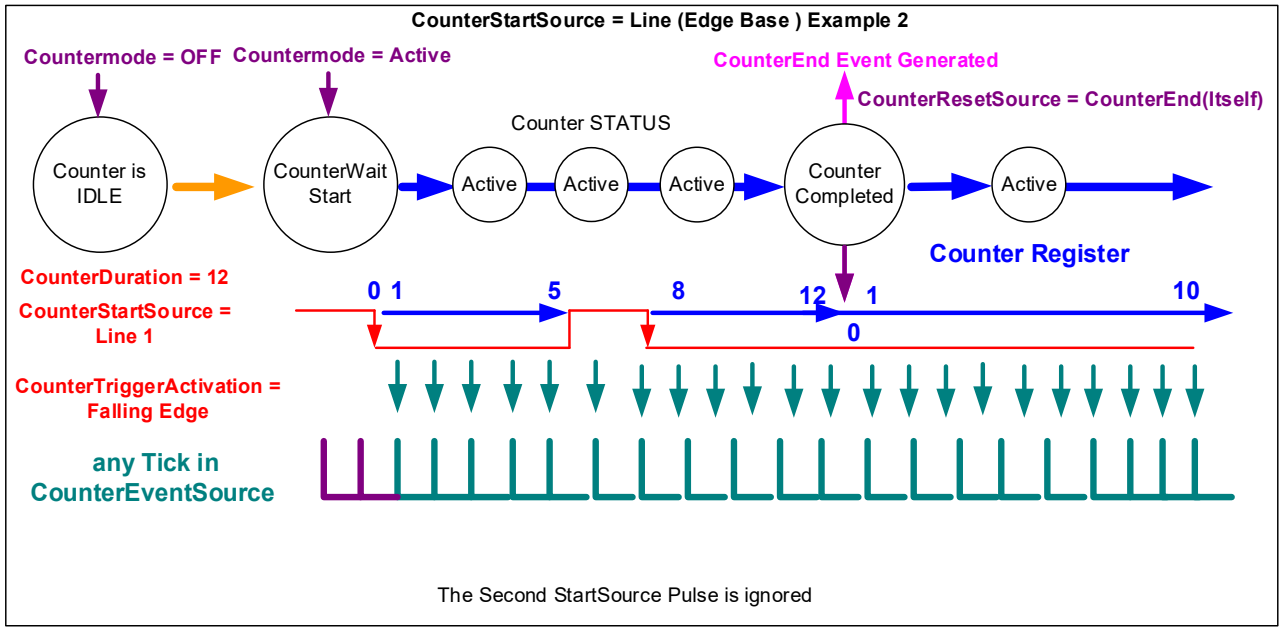


- Counter starts when Counter Mode is set to Active.
- A **Counter Reset CMD** will reset the counter to 00 and it then continues counting.
- **counterResetSource** must be set to **CounterEnd**. When the counterValue feature reaches the counterDuration value an event is generated and the counter is reset to 00, then continues.

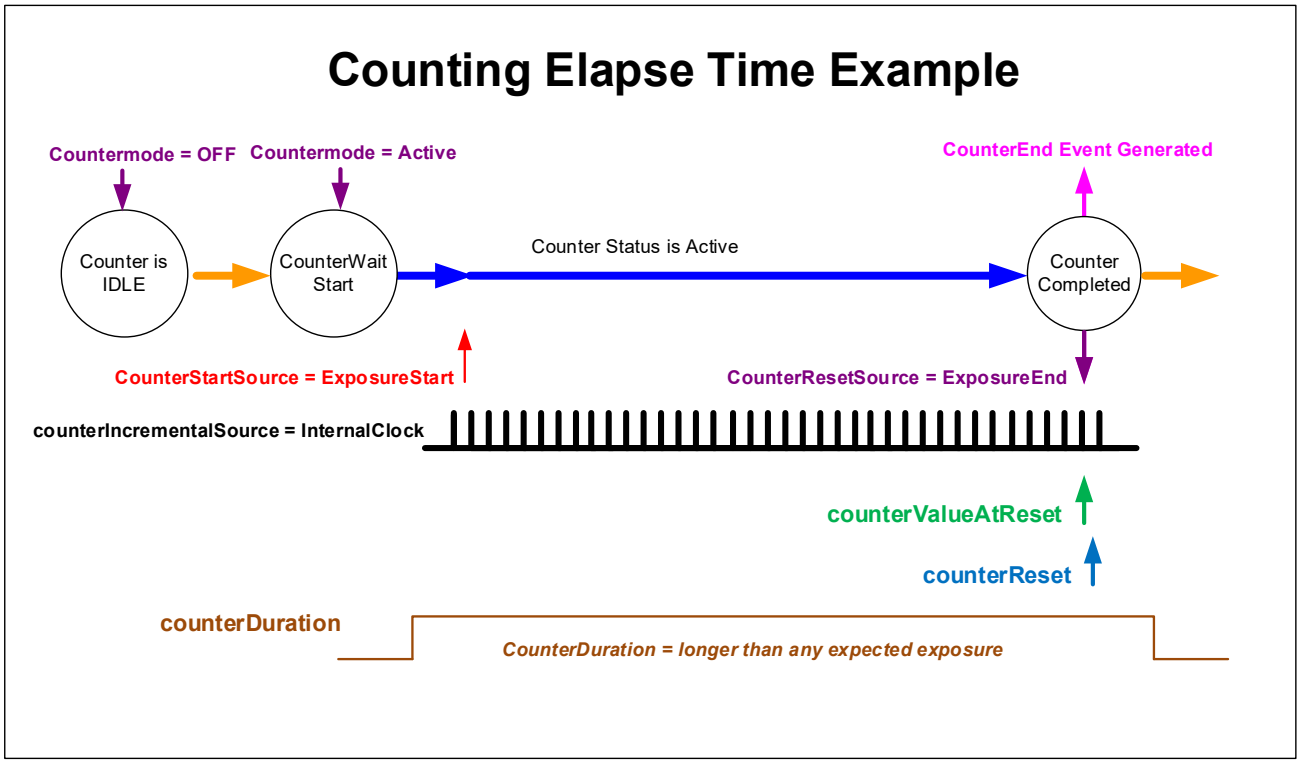
Example: CounterStartSource = EVENT or Signal (Edge Base)



Example: CounterStartSource = Line (Edge Base) Example



Example: Counting Elapse Time

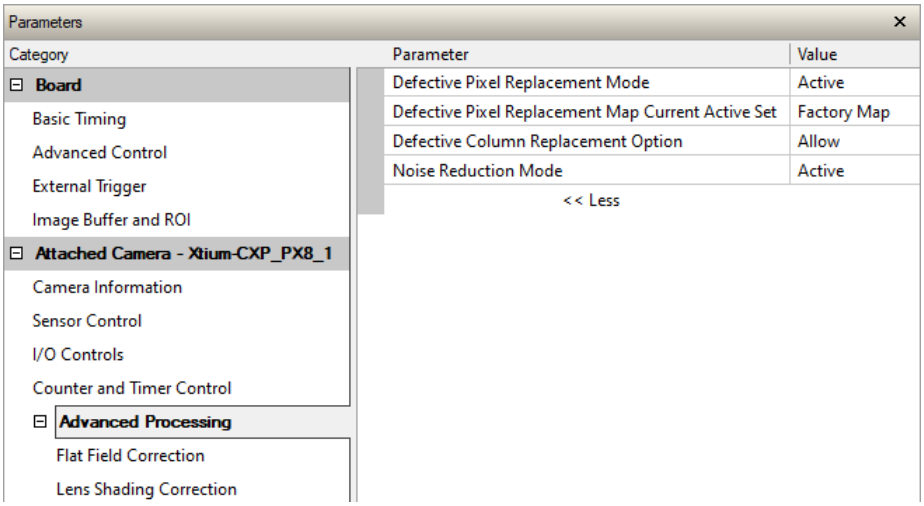


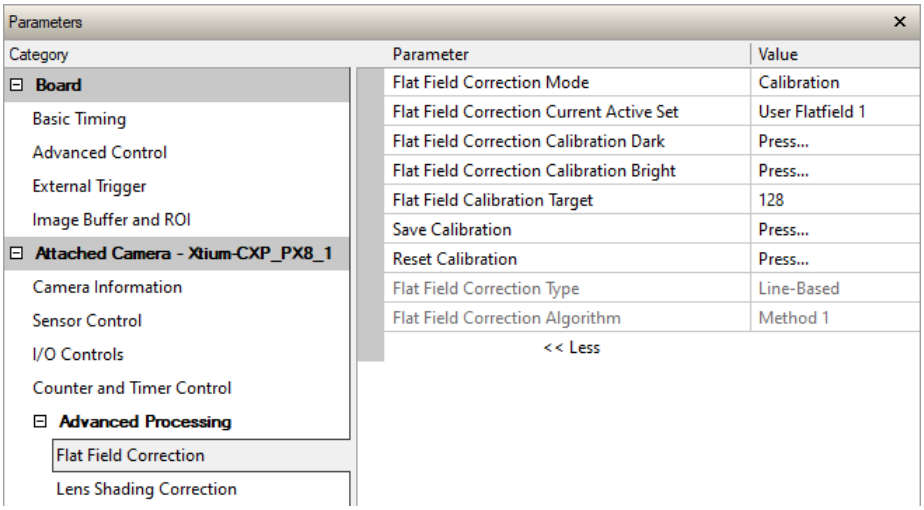
- **Countermode=Active:** Enable the counter function.
- **counterIncrementalSource=InternalClock:** Counter driven by internally generated microsecond clock tick.
- **counterDuration="a period of time longer than any expected counter active period":** In cases where the count period is not fixed by the feature "*counterDuration*", this will create a failsafe event to end the counter if the "*CounterEnd*" event fails for any reason.
- **counterStartSource= ExposureStart:** In this example – sets the counter start event.
- **counterResetSource= ExposureEnd:** In this example – sets the counter end event.
- **counterValueAtReset:** Reads the last counter value before reset. In this example the count value equals time in microseconds since the counter start event.
- **counterReset:** Force a counter value reset when required.

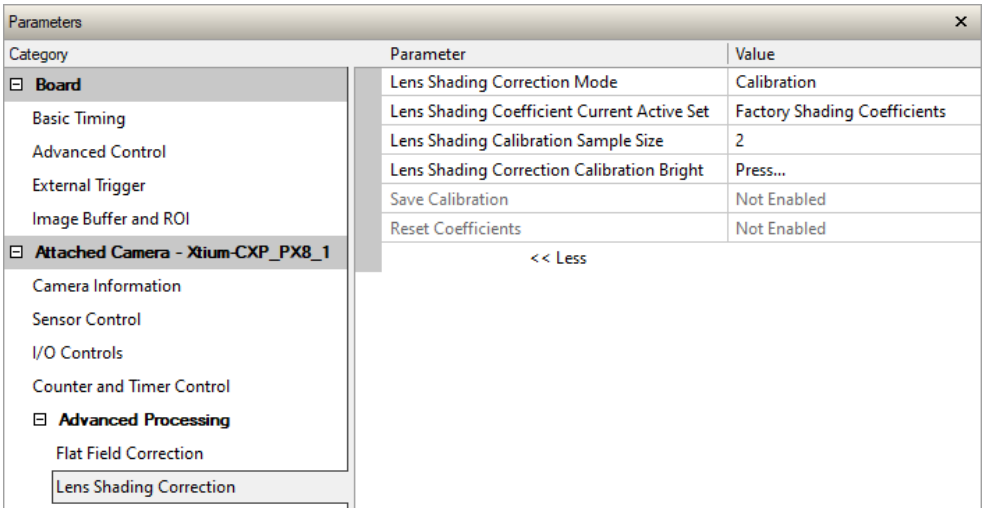
Advanced Processing Control Category

The Genie Nano-CXP Advanced Processing controls, as shown by CamExpert groups parameters used to configure pixel replacement, flat field correction (column based), and lens shading correction controls on monochrome cameras.

It is recommended that the user performs a Flat Field Calibration and save the results to the User Set if the camera is normally operated at a high temperature than the 55°C that the factory calibration was done. This eliminates the Fixed Pattern Noise (FPN) that increases at higher temperatures.

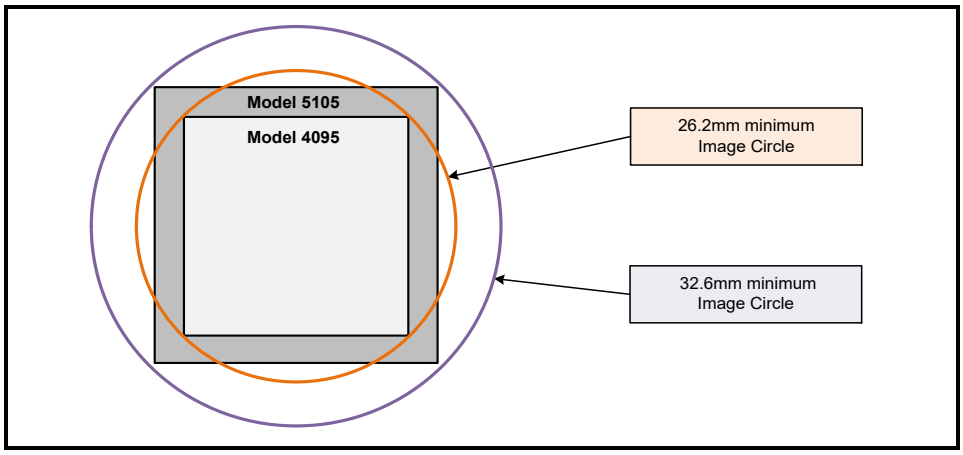






Notes about Lens Shading Calibration

Note: It is recommended that the "Lens Shading Calibration" procedure be done for every Nano-CXP/Lens combination. Calibration will eliminate any lens vignetting in the image corners or any other shading differences across the image field. Calibration will allow using a lens with a slightly smaller image circle that doesn't quite evenly expose the whole sensor. The graphic below shows how a lens used on the 16M model could be used with a 25M model after shading calibration (results will vary with different lenses).



CamExpert allows quick calibration by the user. The features for the Lens Shading Correction Group can also be accessed by the user designed application. The feature descriptions are shown below and after calibration the data should be saved in a user set.

- **Lens Shading Correction Calibration Dark:** Perform a dark calibration for lens shading correction. Typically done before the bright calibration, this calibration requires a dark acquisition (as little light on the sensor as possible).
- **Lens Shading Correction Calibration Bright:** Perform a bright calibration for lens shading correction. This calibration requires a bright featureless acquisition that is not saturated. (70% illumination is recommended).

Advanced Processing Control Feature Descriptions

Advanced Processing Group

Display Name	Feature & Values	Description	Device Version & View
Defective Pixel Replacement Mode *Off* *Active*	defectivePixelReplacementMode *Off* *Active*	Sets the mode for the defective pixel replacement. *Defective Pixel Replacement is disabled.* *Defective Pixel Replacement is enabled.*	1.00 Expert DFNC
Defective Pixel Replacement Map Current Active Set *Factory Map* *User Map 1*	defectivePixelReplacementMapCurrentActiveSet *FactoryMap* *UserMap1*	Sets the defective pixel replacement set. *Sets the factory coefficient table as active.* *Sets the User Map coefficient table as active.*	1.00 Expert DFNC
Defective Column Replacement Option *Disable* *Allow*	defectiveColumnReplacementOption *Disable* *Allow*	When defectivePixelReplacementMode is Active, this feature allows control over defective column replacement. *Defective Column Replacement is disabled.* *Defective Column Replacement is allowed.*	1.00 Guru DFNC
Noise Reduction Mode *Off* *Active*	NoiseReduction *Off* *Active*	Sets the mode for the pixel noise reduction. (monochrome only) *Noise Reduction is disabled.* *Noise Reduction is enabled.*	1.00 Expert DFNC
processingPathBpp	processingPathBpp	Processing path bits per pixel	1.00 Invisible DFNC

Flat Field Correction Group

Display Name	Feature & Values	Description	Device Version & View
Flat Field Correction Mode	flatfieldCorrectionMode	Sets the mode for the Flat Field correction. *See flatfieldCorrectionType below.*	1.00 Beginner DFNC
Off	*Off*	*Flat Field Correction is disabled.*	
Active	*Active*	*Flat Field Correction is enabled.*	
Calibration	*Calibration*	*When this mode is selected, the camera is configured for flat field correction calibration. The device may automatically adjust some of its features when calibrate mode is enabled. The features that are automatically adjusted are device specific. The device will not restore these features when the Flat Field Correction Mode feature is changed from Calibrate mode to another mode. Note: do the Dark calibration before the Bright calibration. Also the calibration steps require a few seconds to execute due to CXP communication limits.*	
Flat Field Correction Current Active Set	flatfieldCorrectionCurrentActiveSet	Specifies the current set of Flat Field coefficients to use.	1.00 Beginner DFNC
Factory Flatfield	*FactoryFlatfield*	*Sets the factory Flat Field coefficient table as the current Flat Field.*	
User Flatfield 1	*UserFlatfield1*	*Sets User Flat Field 1 coefficient table as the current Flat Field.*	
Flat Field Correction Type	flatfieldCorrectionType	Specifies the Flat Field correction type.	1.00 Guru DFNC
Line-Based	*LineBase*	*Flat field correction is based on the average of lines of gain and offset coefficients where corrections are applied to each pixel in the column. (Correcting column to column variations).*	
Flat Field Correction Algorithm	flatfieldCorrectionAlgorithm	Specifies the Flat Field correction algorithm to use.	1.00 Guru DFNC
Method 1	*Method1*	*The following formula is used to calculate the flat field corrected pixel: newPixelValue[x][y] = (sensorPixelValue[x][y] - FFCOffset[x][y]) * FFCGain[x][y]*	
Flat Field Correction Calibration Dark	flatfieldCorrectionCalibrationDark	Perform a dark calibration. This is done before the bright calibration. This calibration requires a dark acquisition (as little light on the sensor as possible).	1.00 Expert DFNC
Flat Field Correction Calibration Bright	flatfieldCorrectionCalibrationBright	Perform a bright calibration. This is done after the dark calibration. This calibration requires a bright featureless acquisition that is not saturated.	1.00 Expert DFNC
Flat Field Calibration Target	flatfieldCalibrationTarget	Sets the target pixel value for the bright calibration.	1.00 Expert DFNC
Save Calibration	flatfieldCorrectionCalibrationSave	Save the calibration results of the flatfieldCorrectionCalibrationDark and/or flatfieldCorrectionCalibrationBright operations to the current active set.	1.00 Expert DFNC
Reset Calibration	flatfieldCorrectionCalibrationResetCoefficients	Reset the current calibration coefficients to factory defaults.	1.00 Expert DFNC
Flat Field Algorithm Buffer Format	flatfieldAlgorithmBufferFormat		1.00 Invisible DFNC
Mono8	*Mono8*		

Flat Field Algorithm Buffer Width	flatfieldAlgorithmBufferWidth		1.00 Invisible DFNC
Flat Field Algorithm Buffer Height	flatfieldAlgorithmBufferHeight		1.00 Invisible DFNC
Flat Field Algorithm Gain Max	flatfieldAlgorithmGainMax		1.00 Invisible DFNC
Flat Field Algorithm Gain Min	flatfieldAlgorithmGainMin		1.00 Invisible DFNC
Flat Field Algorithm Gain Divisor	flatfieldAlgorithmGainDivisor		1.00 Invisible DFNC
Flat Field Algorithm Gain Base	flatfieldAlgorithmGainBase		1.00 Invisible DFNC
Flat Field Algorithm Offset Max	flatfieldAlgorithmOffsetMax		1.00 Invisible DFNC
Flat Field Algorithm Offset Min	flatfieldAlgorithmOffsetMin		1.00 Invisible DFNC
Flat Field Algorithm Offset Factor	flatfieldAlgorithmOffsetFactor		1.00 Invisible DFNC

Lens Shading Correction Group

Display Name	Feature & Values	Description	Device Version & View
Lens Shading Correction Mode	lensShadingCorrectionMode	Sets the mode for the lens shading correction.	1.00 Expert DFNC
Off	*Off*	*Lens Shading Correction is Disabled*	
Active	*Active*	*Lens Shading Correction is Enabled*	
Calibration	*Calibration*	*When selected, the camera is configured for Lens Shading correction calibration. Some processing will be disabled even if the associated feature is enabled. Note: do the Dark calibration before the Bright calibration. Also the calibration steps require a few seconds to execute due to CXP communication limits.*	
Lens Shading Coefficient Current Active Set	lensShadingCorrectionCurrentActiveSet	Specifies the current set of Lens Shading Coefficients to use.	1.00 Beginner DFNC
Factory Shading Coefficients	*FactoryShadingCoefficients*	*Sets the Factory Shading Coefficients as current.*	
User Shading Coefficients 1	*ShadingCoefficients1*	*Sets User Shading Coefficients set 1 as current.*	
User Shading Coefficients 2	*ShadingCoefficients2*	*Sets User Shading Coefficients set 2 as current.*	
Lens Shading Calibration Sample Size	lensShadingCorrectionCalibrationSampleSize	Number of frames to average for Lens Shading calibration	1.00 Guru DFNC
Lens Shading Correction Calibration Dark	lensShadingCorrectionCalibrationDark	Perform a dark calibration for lens shading correction. This is done before the bright calibration. This calibration requires a dark acquisition (as little light on the sensor as possible).	1.00 Expert DFNC

Lens Shading Correction Calibration Bright	lensShadingCorrectionCalibrationBright	Perform a bright calibration for lens shading correction. This is done after the dark calibration. This calibration requires a bright featureless acquisition that is not saturated. (70% illumination is recommended).	1.00 Expert DFNC
Save Calibration	lensShadingCorrectionCalibrationSave	Save the calibration results of the lensShadingCorrectionCalibrationBright and/or lensShadingCorrectionCalibrationDark operations to the active set.	1.00 Expert DFNC
Reset Coefficients	lensShadingResetCoefficients	Reset lens shading coefficients to pass-through.	1.00 Expert DFNC
Lens Shading Correction Algorithm Buffer Format *Mono8*	lensShadingCorrectionAlgorithmBufferFormat *Mono8*		1.00 Invisible DFNC
Lens Shading Correction Algorithm Buffer Width	lensShadingCorrectionAlgorithmBufferWidth		1.00 Invisible DFNC
Lens Shading Algorithm Buffer Height	lensShadingCorrectionAlgorithmBufferHeight		1.00 Invisible DFNC
Lens Shading Algorithm Gain Max	lensShadingCorrectionAlgorithmGainMax		1.00 Invisible DFNC
Lens Shading Algorithm Gain Min	lensShadingCorrectionAlgorithmGainMin		1.00 Invisible DFNC
Lens Shading Algorithm Gain Divisor	lensShadingCorrectionAlgorithmGainDivisor		1.00 Invisible DFNC
Lens Shading Algorithm Gain Base	lensShadingCorrectionAlgorithmGainBase		1.00 Invisible DFNC
Lens Shading Algorithm Offset Max	lensShadingCorrectionAlgorithmOffsetMax		1.00 Invisible DFNC
Lens Shading Algorithm Offset Min	lensShadingCorrectionAlgorithmOffsetMin		1.00 Invisible DFNC
Lens Shading Correction Algorithm Offset Factor	lensShadingCorrectionAlgorithmOffsetFactor		1.00 Invisible DFNC

Defective Pixel Replacement

The Pixel Replacement algorithm is based on a predefined bad pixel map (as an XML file), either supplied by the factory (file loaded as "Factory Map") or generated by the user (file uploaded as "User Map 1"). The number of bad pixel entries is limited and varies dependent on the Nano model. The following XML code sample forms the template for the user to build bad pixel maps for any of their Nano cameras.

Note: Identifying bad pixels is left to the user's discretion, but Teledyne DALSA technical support can provide guidance.

Example User Defective Pixel Map XML File

The following example shows the required components of the defective pixel map file. Each bad pixel position (relative to the image origin which is the upper left corner), must be identified by the XML statement:

<DefectivePixel OffsetX="***number***" OffsetY="***number***"/>

The pixel format (whether 8 or 10-bit) is handled transparently requiring no special consideration by the user.

This example XML listing has four "bad" pixels identified (maximum number of entries is model dependent). The various algorithm descriptions define the rules used by the Nano firmware to replace an identified bad pixel.

```
<?xml version="1.0" encoding="UTF-8" ?>

<!-- Example User Defective Pixel Map -->
<!-- maximum 2048 coordinates based on the camera model specific specification -->
<!-- filename: NanoExampleBadPixels.xml -->

<Coordinates>

<DefectivePixel OffsetX="100" OffsetY="0"/>
<DefectivePixel OffsetX="28" OffsetY="345"/>
<DefectivePixel OffsetX="468" OffsetY="50"/>
<DefectivePixel OffsetX="800" OffsetY="600"/>

</Coordinates>
```

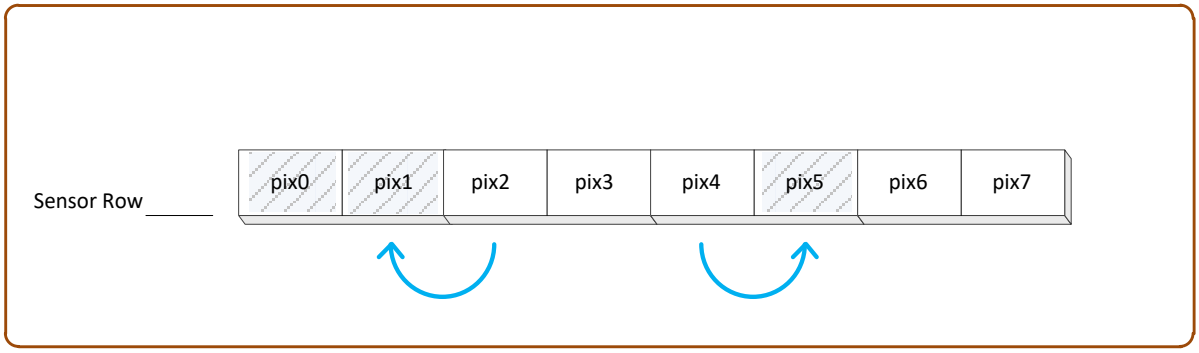
A sample editable defective pixel map replacement file will be available to download with Nano firmware files.

Monochrome Defective Pixel Replacement Algorithm Description

The replacement algorithm follows a few basic rules as defined below, which in general provides satisfactory results.

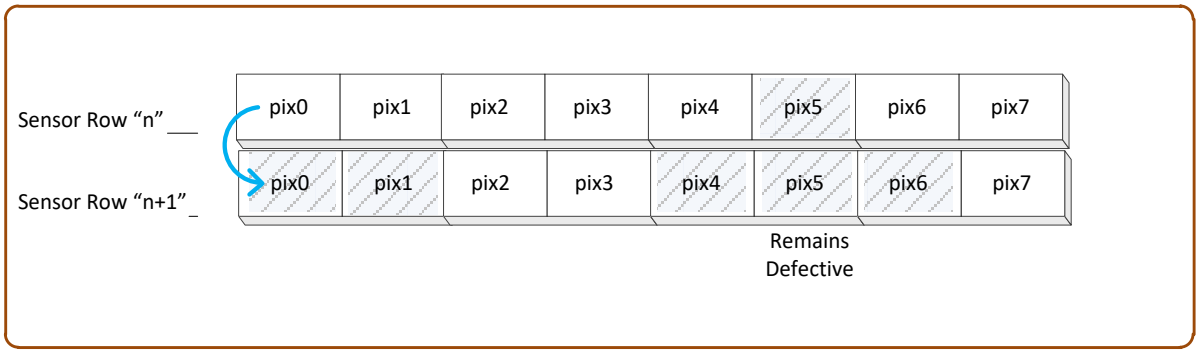
Single bad pixel in a sensor line with a good adjacent pixel

- A defective pixel is replaced by the following good pixel if previous pixel is bad or not existent.
- Or a defective pixel is replaced by the previous good pixel.



Bad pixel in a sensor line with bad adjacent pixels

- Replace bad pixel with the corresponding pixel of the previous line.
- Do nothing when the neighboring pixels are also bad.

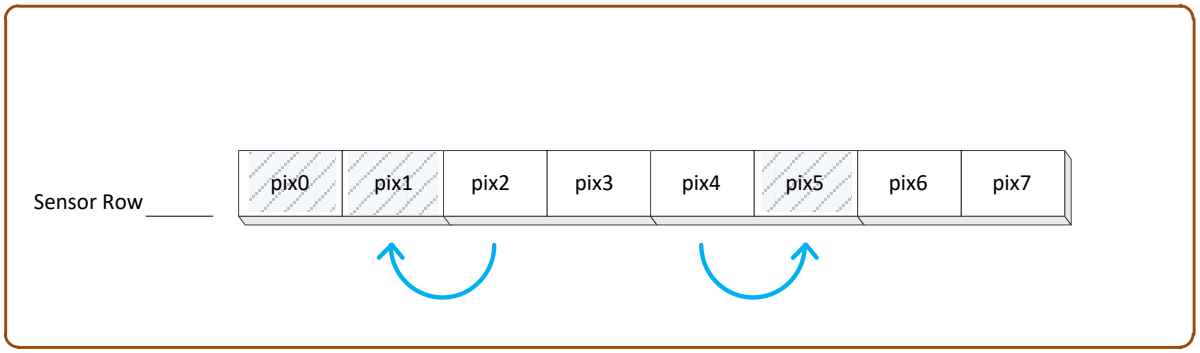


Color Defective Pixel Replacement Algorithm Description

The replacement algorithm rules for Bayer a color sensor is similar to the monochrome rules with the exception that replacement pixels of the same color as the bad are used. The two replacement cases below describe general color pixel replacements.

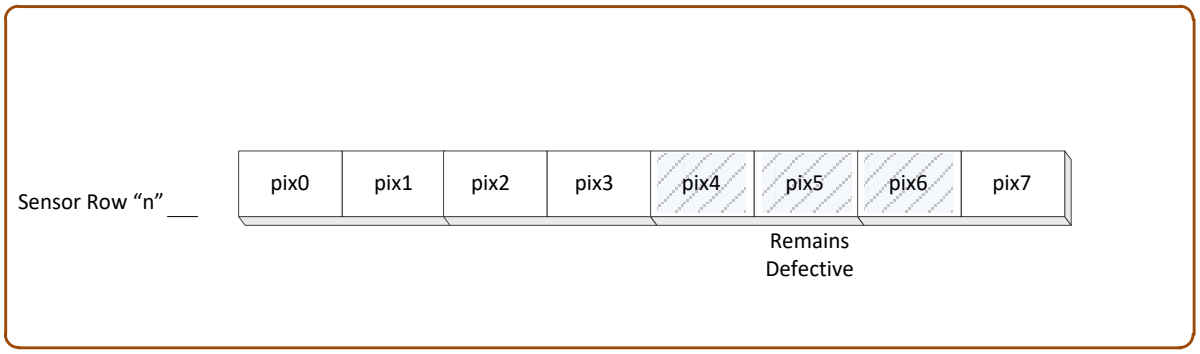
Single bad pixel in a sensor line with a good adjacent pixel

- A defective pixel is replaced by the following good pixel if previous pixel is bad or not existent.
- Or a defective pixel is replaced by the previous good pixel.



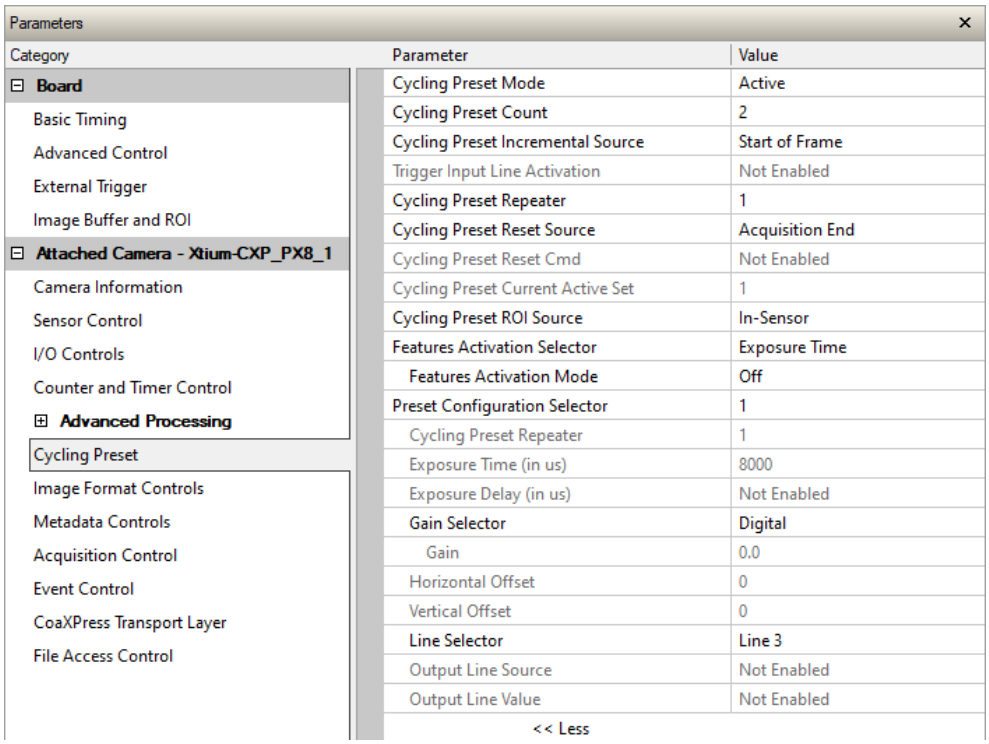
Bad pixel in a sensor line with bad adjacent pixels

- Do nothing when the neighboring pixels are also bad.



Cycling Preset Category

The Genie Nano-CXP Cycling Preset controls, as shown by CamExpert, has parameters used to configure the camera Cycling features. Cycling controls allow the user to configure a number of camera operational states and then have the camera automatically switch between states in real-time. Only the features programmed to change are updated when switching between camera states, thus ensuring immediate camera response. A setup example follows the feature table.



Cycling Preset Mode Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Cycling Preset Mode	cyclingPresetMode	Sets the Cycling Presets module mode.	1.02 Expert DFNC
Off	*Off*	*Disable the Cycling Preset module.*	
Active	*Active*	*Enable the Cycling Preset module.*	
Cycling Preset Count	cyclingPresetCount	Specifies the number of Presets to use.	1.02 Expert DFNC
Cycling Preset Incremental Source	cyclingPresetIncrementalSource	Specifies the source that increments the currently active cycling preset.	1.02 Expert DFNC
None	*None*	*Feature cyclingPresetCurrentActiveSet is used to select the current active set.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Increment on a Valid Frame Trigger*	
Counter 1 End	*Counter1End*	*Increment on the end of Counter 1.*	
Start of Frame	*StartOfFrame*	*Increment on the Start of Frame event*	
Trigger Input Line Activation	cyclingPresetIncrementalActivation	Select the activation mode for the selected Input Line source. This is applicable only for external line inputs.	1.02 Expert DFNC
Rising Edge	*RisingEdge*	*The source is considered valid on the rising edge of the line source signal (after being processed by the line inverter feature).*	
Falling Edge	*FallingEdge*	*The source is considered valid on the falling edge of the line source signal (after being processed by the line inverter feature).*	
Any Edge	*AnyEdge*	*The source is considered valid on any edge (falling or rising) of the line source signal (after being processed by the line inverter feature).*	
Cycling Preset Repeater	cyclingPresetRepeater	Specifies the required number of cycling preset increment events (generated by the Cycling Preset Incremental Source) to increment the index of the Cycling Preset Current Active Set.	1.02 Expert DFNC
Cycling Preset Reset Source	cyclingPresetResetSource	Specifies the source that resets the currently active preset. On reset the current preset index is set to 1	1.02 Expert DFNC
Valid Frame Trigger	*ValidFrameTrigger*	*Reset when a Valid Frame Triggers occurs.*	
Counter 1 End	*Counter1End*	*Reset when counter 1 ends.*	
Timer 1 End	*Timer1End*	*Reset when Timer 1 ends.*	
Acquisition End	*EndOfAcquisition*	*Use End of Acquisition as the reset source. An End of Acquisition occurs on acquisition stop.*	
Software	*Software*	*Use a software command as the reset source.*	
Cycling Preset Reset Cmd	cyclingPresetResetCmd	Reset the position of the preset cycling to 1 and the count to 0.	1.02 Guru DFNC
Cycling Preset Current Active Set	cyclingPresetCurrentActiveSet	Returns the index of the currently active cycling preset.	1.02 Guru DFNC
Cycling Preset ROI Source	cyclingPresetRoiPositionSource	Specifies the source that cycles the ROI position (availability is sensor dependent).	1.02 Expert DFNC
In-Sensor	*Sensor*	*The sensor cycles the ROI position.*	

Display Name	Feature & Values	Description	Device Version & View
Features Activation Selector	cP_FeaturesActivationSelector	Selects the feature to control by the cP_FeaturesActivationMode feature.	1.02 Expert DFNC
Exposure Time	*ExposureTime*	*The cP_FeaturesActivationMode feature controls the exposure time.*	
Exposure Delay	*ExposureDelay*	*The cP_FeaturesActivationMode feature controls the exposure delay.*	
ROI Position	*ROI_Position*	*The cP_FeaturesActivationMode feature will control ROI position.*	
Digital Gain	*DigitalGain*	*The cP_FeaturesActivationMode controls the digital gain.*	
Output Line 3	*OutputLine3Control*	*The cP_FeaturesActivationMode controls the output line 3.*	
Output Line 4	*OutputLine4Control*	*The cP_FeaturesActivationMode controls the output line 4.*	
Preset Repeater	*PresetRepeater*	*The cP_FeaturesActivationMode controls the sensor preset repeater count.*	
Features Activation Mode	cP_FeaturesActivationMode	Enables the selected feature to be part of the cycling. When activating the selected feature, this will automatically set the corresponding standard camera feature to read only. < Expert, DFNC >	1.02 Expert DFNC
Off	*Off*	*Exclude the selected feature from the cycling.*	
Active	*Active*	*Include the selected feature in the cycling.*	
Preset Configuration Selector	cP_PresetConfigurationSelector	Selects the cycling preset to configure.	1.02 Expert DFNC
Cycling Preset Repeater	cP_PresetRepeater	Specifies the required number of cycling preset increment events (generated by the Cycling Preset Incremental Source) to increment the index of the Cycling Preset Current Active Set. The difference with *cyclingPresetRepeater* is that this feature value is specific to the current cycling set specified by *cp_PresetConfigurationSelector*.	1.02 Expert DFNC
Exposure Time (in µs)	cP_ExposureTime	Sets the exposure time (in microseconds) for the selected set. The maximum frame rate is dependent on the longest cycling exposure time.	1.02 Expert DFNC
Exposure Delay (in µs)	cP_ExposureDelay	Sets the exposure delay (in microseconds) for the selected set.	1.02 Expert DFNC
Gain Selector	cP_GainSelector	Selects which gain is controlled when adjusting cp_Gain features.	1.02 Expert DFNC
Digital	*DigitalAll*	*Applies a digital gain to the entire image.The independent gain factor is apl*	
Gain	cP_Gain	Sets the selected gain as an amplification factor to the image. The gain is applied when the current Cycling index is active.	1.02 Expert DFNC
Horizontal Offset	cP_OffsetX	Horizontal offset from the origin to the region of interest (ROI). The value in this feature is only used when the currently selected cycling preset is active.	1.03 Expert DFNC
Vertical Offset	cP_OffsetY	Vertical offset from the origin to the region of interest (ROI). The value in this feature is only used when the currently selected cycling preset is active.	1.03 Expert DFNC

Display Name	Feature & Values	Description	Device Version & View
Line Selector	cP_LineSelector	Selects which physical line (or pin) of the external device connector to configure.	1.03 Expert DFNC
Line 3	*Line3*	*Index of the physical line and associated I/O control block to use. Pin 6 is the Output Signal and Pin 4 is the common output power on the I/O connector.*	
Line 4	*Line4*	*Index of the physical line and associated I/O control block to use. Pin 8 is the Output Signal and Pin 4 is the common output power on the I/O connector.*	
Output Line Source	cP_OutputLineSource	Selects which internal signal, or event driven pulse, or software control state to output on the selected output line.	1.03 Expert DFNC
Off	*Off*	*Line output is Open – no output source selected.*	
Software Controlled	*SoftwareControlled*	*The OutputLineValue feature changes the state of the output.*	
Pulse On: Start of Exposure	*PulseOnStartofExposure*	*Generate a pulse on the ExposureStart event. This is typically used to trigger a strobe light.*	
Exposure Active	*ExposureActive*	*Generate a signal that is active when the exposure is active.*	
Output Line Value	cP_OutputLineValue	Sets the output state of the selected Line if the outputLineSoftwareLatchControl = OFF. OutputLineSource must be SoftwareControlled. If the outputLineSoftwareLatchControl=Latch, the state of the pin will change with the outputLineSoftwareCmd command.	1.03 Expert DFNC
Active	*Active*	*Sets the Output circuit to closed.*	
Inactive	*Inactive*	*Sets the Output circuit to open.*	

Using Cycling Presets—a Simple Example

As presented in this category's overview, the cycling preset features allows setting up camera configurations that can change dynamically and repeatedly, with minimum overhead. The features that change along with the trigger for the feature change are preprogrammed in the camera. Additionally, a set of preset features can be updated while the camera is acquiring with a different preset. Such dynamic feature changes allow applications to perform tracking algorithms.

The following example describes a simple cycling sequence (using free running acquisitions) with exposure change steps which will repeat until stopped by the user. This example uses the Sapera tool CamExpert to set features and test the sequence.

Multi-Exposure Cycling Example Setup

- For this example, first configure a free running acquisition of 20 fps with an exposure time that's somewhat short (dark). These controls are in the Sensor Control Category group within CamExpert.
- Now select the Cycling Preset Category to setup and test the following example.
- Set *cyclingPresetMode* to *Active*. This feature enables the Cycling Preset Module.
- Set *cyclingPresetCount* to the number of presets which will be configured and used. For this example set this to 4.
- Set the feature *cyclingPresetIncrementalSource* to the event which will be used to increment the cycling presets index. For this example, set this feature to *StartOfFrame* which is a logical choice in a free-running acquisition setup.
- Set the feature *cyclingPresetRepeater* to the number of incremental source events to count before switching to the next preset. In this example we are counting *StartOfFrame* events, thus a value of 20 (with a test setup of 20 fps) will switch presets every 1 second.
- The feature *cyclingPresetResetSource* is optional for this example. This defines the event which will reset the preset index back to 1. In this example, by setting the feature to *EndOfAcquisition* we know that when Freeze is clicked in CamExpert to stop the free-running acquisition, the cycling preset index is returned to the start (1).
- Set *PresetConfigurationSelector* to index 1.
- Set *FeaturesActivationSelector* to *ExposureTime (the exposure initially set as somewhat dark).*
- Set *FeaturesActivationMode* to *Active*. This defines the camera exposure as one variable stored in this preset index 1.
- The feature *ExposureTime* shows the last exposure time used by the camera (when cycling was not enabled). This field now controls the camera exposure time. The primary exposure time field in the Sensor Control Category is in gray text indicating a read only field.
- Set *PresetConfigurationSelector* to index 2.
- Set the feature *ExposureTime* to a higher value, increasing the acquisition brightness.
- Repeat for index 3 with an exposure a bit longer again, and index 4 with an even longer exposure.

Test the Example

- With 4 different exposure times saved in four presets, click the CamExpert Grab button to start the cycling free-running acquisition.
- The CamExpert live display window will show a live grab of 20 fps, where each second shows a four step increase in exposure, which then returns to the first exposure cycling continuously until stopped by the user.

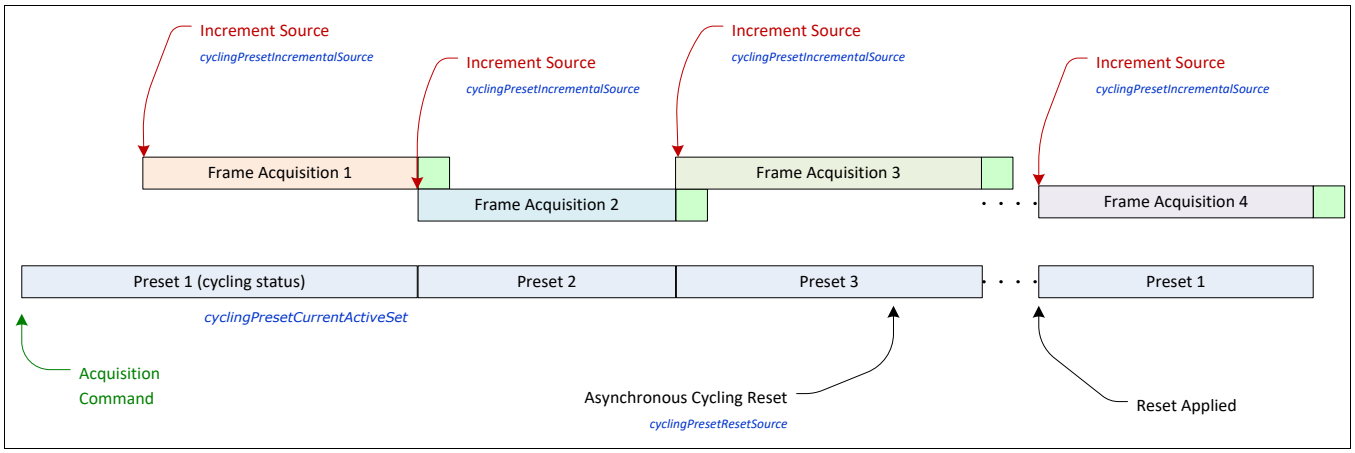
Cycling Reset Timing Details

This section describes the Nano-CXP Cycling function with two cycling feature configurations. These configurations (or cases) are dependent on the cycling preset increment source as follows:

- **Internal Synchronous Increment:** Where the preset increment source is either FrameStart or ValidFrameTrigger (*cyclingPresetIncrementalSource= StartOfFrame or ValidFrameTrigger*).
- **External Asynchronous Increment:** Where the preset increment source is Counter or Software (*cyclingPresetIncrementalSource = Counter1End* or *None*).

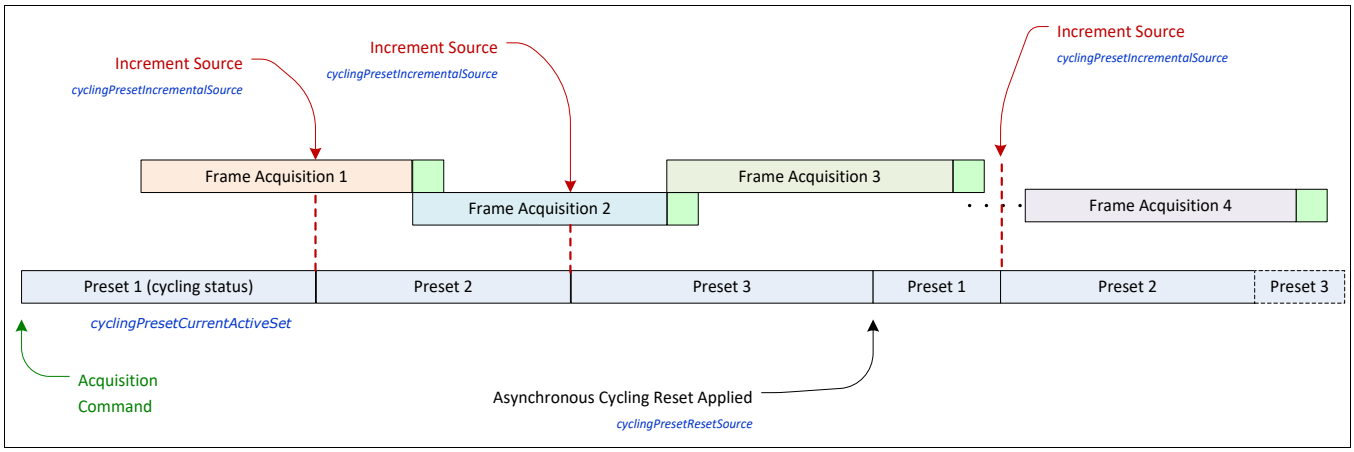
Case 1: Cycling with Internal Synchronous Increment

With an Internal Synchronous Cycling Increment, a cycling reset command will execute on the next cycling increment event.



Case 2: Cycling with External Asynchronous Increment

With an External Asynchronous Cycling Increment, a cycling reset command executes immediately and sets the cycling preset to set number 1.



Cycling Mode Constraints with a changing ROI

The Nano-CXP Cycling Mode features support a changing ROI from one cycling preset to the next. The ROI in this case refers to a single acquisition area which is a subset of the complete image frame.

The initial ROI size and position (features *Width*, *Height*, *OffsetX*, *OffsetY*) is setup via the Image Format group of features. Obviously, the defined initial ROI area would be smaller so as to allow it to be moved around via the Cycling Mode OffsetX and OffsetY features set for each Cycling Preset.

Image Format Control Category

The Nano-CXP Image Format controls, as shown by CamExpert, groups parameters used to configure camera pixel format, image cropping, etc.

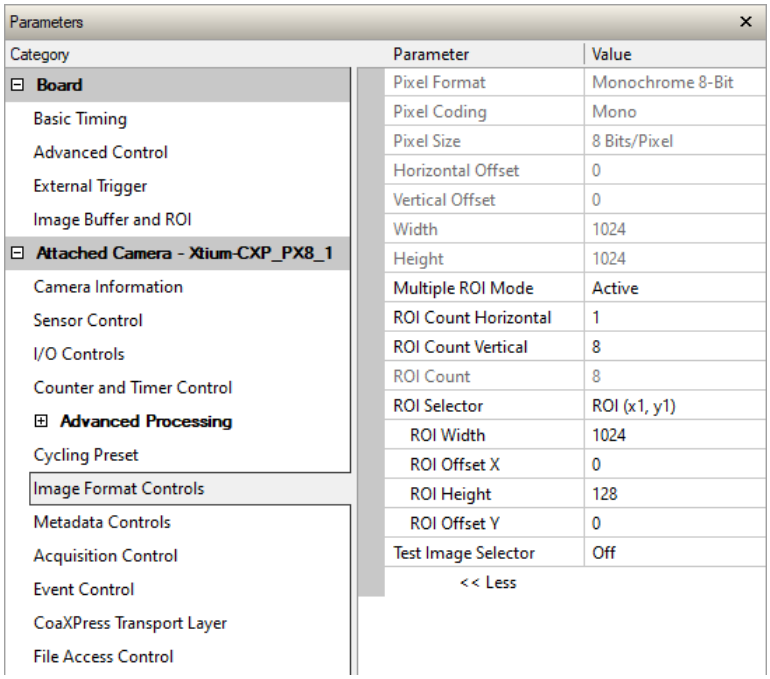


Image Format Control Feature Descriptions

Display Name	Feature & Values	Description	Version & View
Pixel Format	PixelFormat	Format of the pixel provided by the device. Contains all format information as provided by PixelCoding, PixelSize, PixelColorFilter, combined in one single value.	1.00 Beginnery
Monochrome 8-Bit	*Mono8*	*Mono8: Monochrome 8-Bit*	
Monochrome 10-Bit	*Mono10*	*Mono10: Monochrome 10-Bit*	
BayerGR 8-Bit	*BayerGR8*	*Color camera: BayerGR8*	
BayerRG 8-Bit	*BayerRG8*	*Color camera: BayerRG8t*	
BayerGB 8-Bit	*BayerGB8*	*Color camera: BayerGB8*	
BayerBG 8-Bit	*BayerBG8*	*Color camera: BayerBG8*	
BayerGR 10-Bit	*BayerGR10*	*Color camera: BayerGR10*	
BayerRG 10-Bit	*BayerRG10*	*Color camera: BayerRG10*	
BayerGB 10-Bit	*BayerGB10*	*Color camera: BayerGB10*	
BayerBG 10-Bit	*BayerBG10*	*Color camera: BayerBG10*	
Pixel Coding	PixelCoding	Output image pixel coding format of the sensor.	1.00 Guru
Mono	*Mono*	*Pixel is monochrome*	
MonoSigned	*MonoSigned*	*Pixel is monochrome and signed*	
MonoPacked	*MonoPacked*	*Pixel is monochrome and packed*	
Raw Bayer	*Raw*	*Pixel is raw Bayer*	
Pixel Size	PixelSize	Total size in bits of an image pixel.	1.00 Guru
8 Bits/Pixel	*Bpp8*	*Bpp8: 8 bits per pixel*	
10 Bits/Pixel	*Bpp10*	*Bpp10: 10 bits per pixel*	
Horizontal Offset	OffsetX	Horizontal offset from the Sensor Origin to the Region Of Interest (in pixels).	1.00 Beginner
Vertical Offset	OffsetY	Vertical offset from the Sensor Origin to the Region Of Interest (in Lines).	1.00 Beginner
Width	Width	Width of the Image provided by the device (in pixels).	1.00 Beginner
Height	Height	Height of the Image provided by the device Beginner	1.00 Beginner
Multiple ROI Mode	multipleROIMode	Enable the Multiple ROI (Region of Interest) per image feature. The ROI Count is set by the Multiple ROI Count feature.	1.03 Guru DFNC
Off	*Off*	*Single ROI per image.*	
Active	*Active*	*The ROI per image feature is active.*	
ROI Count Horizontal	multipleROICountHorizontal	Specifies the number of ROI (Region of Interest) available for the X axis.	1.03 Expert DFNC
ROI Count Vertical	multipleROICountVertical	Specifies the number of ROI (Region of Interest) available for the Y axis.	1.03 Expert DFNC
ROI Count	multipleROICount	Specifies the number of possible ROI (Region of Interest) available in an acquired image. One is minimum, while the maximum is device specific. < RO >	1.03 Expert DFNC

ROI Selector *ROI (x1, y1)* … *ROI (x4, y8)*	multipleROISelector *roi1_1* … *roi4_8*	Select an ROI (Region of Interest) when Multiple ROI Mode is enabled. Selector range is from 1 to the Multiple ROI Count value. *ROI (x1, y1)* *ROI (x4, y8)*	1.03 Expert DFNC
ROI Offset X	multipleROIOffsetX	Horizontal offset (in pixels) from the origin to the selected ROI (Region of Interest).	1.03 Expert DFNC
ROI Offset Y	multipleROIOffsetY	Vertical offset (in pixels) from the origin to the selected ROI (Region of Interest).	1.03 Expert DFNC
ROI Width	multipleROIWidth	Width of the selected ROI (Region of Interest) provided by the device (in pixels).	1.03 Expert DFNC
ROI Height	multipleROIHeight	Height of the selected ROI (Region of Interest) provided by the device (in pixels).	1.03 Expert DFNC

Width and Height Features for Partial Scan Control

Width and Height controls along with their respective offsets, allow the Nano-CXP to grab a region of interest (ROI) within the full image frame. Besides eliminating post acquisition image cropping done by software in the host computer, a windowed ROI grab reduces the bandwidth required since fewer pixels are transmitted.

Important: Any reduction of the camera's acquisition area from its maximum must be matched by the same reduction in the frame grabber's buffer dimensions. The Teledyne DALSA CXP frame grabber will generate "Buffer Incomplete" errors when the buffer dimensions do not match the Nano-CXP cropped acquisition.

Using the Multiple ROI Mode

Genie Nano-CXP color and monochrome 6200 and 8200 cameras implement the Multiple ROI mode (region of interest) features, which allow having 2 to 32 smaller image ROI areas versus the single ROI area possible with vertical and horizontal crop functions.

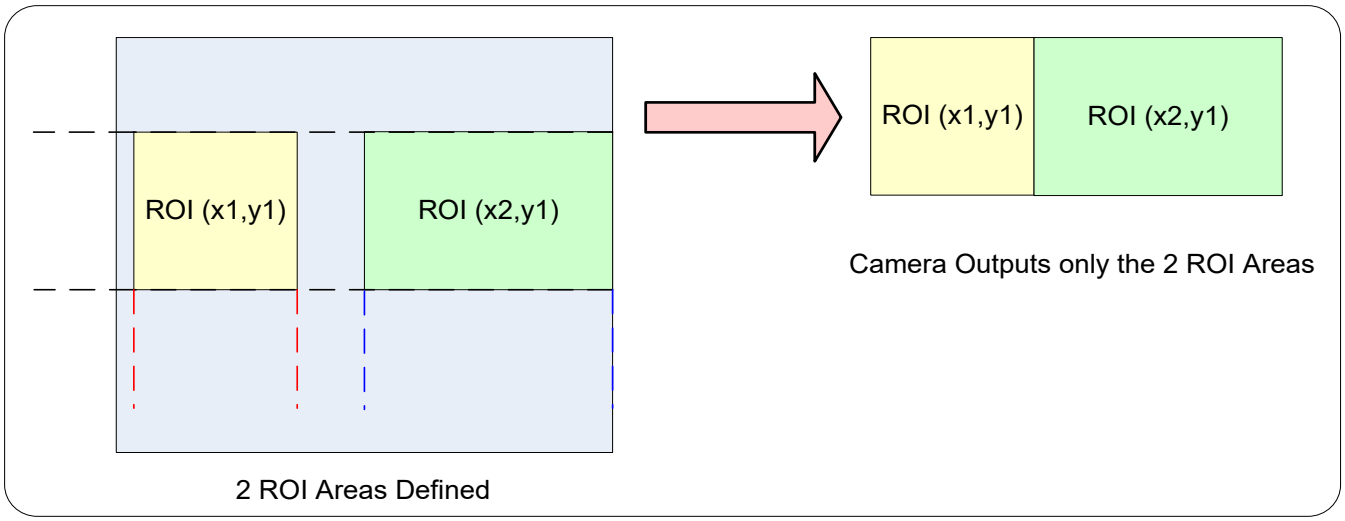
These multiple areas are combined as one output image, reducing transfer bandwidth requirements, plus with the added benefit that any reduction of the number of vertical lines output will result in a greater possible camera frame rate. This increased frame rate increase (written to internal memory) is similar to using the vertical crop feature.

Important Usage Details

- Two to 32 ROI areas are supported by the Nano-CXP (4x8 matrix maximum).
- For any selected ROI, the ROI Offset X / ROI Offset Y features define the upper left corner of the ROI.
- ROI Offset, ROI Width, and ROI Height features have individual increment values (step size) to consider.
- The first ROI of any row sets the "height value" for any other ROI in that row.
- The first ROI of any column sets the "width value" of any other ROI in that column.
- Note that the Nano-CXP firmware by default provides a 1x8 sample multi-ROI setup for easy verification of this function.

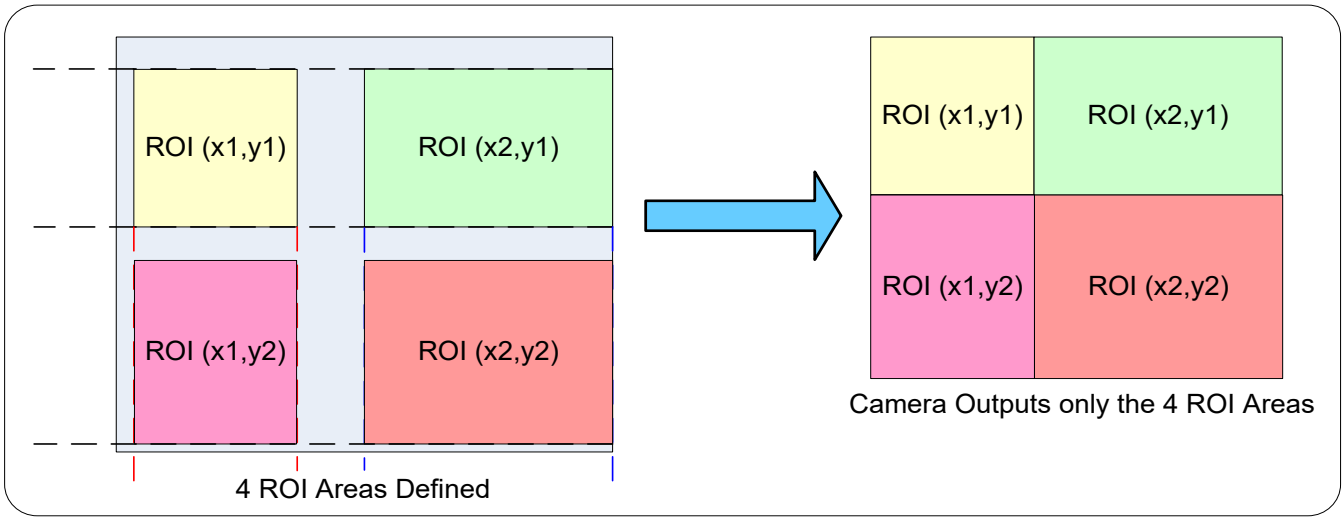
The following graphics show examples of the multi-ROI function (2x1 and 2x2 areas), the resultant camera output, and the constraints when configuring the ROI areas.

Example: Two Horizontal ROI Areas (2x1)



- Note that ROI(x1, y1) defines the height of any ROI in that row.
- ROI(x2, y1) can have a different width.
- The camera output image frame consists only of the two ROI areas. The user must account for the change between ROI data for each output image row.
- The output image being smaller, reduces the bandwidth requirements.

Example: Four ROI Areas (2x2)

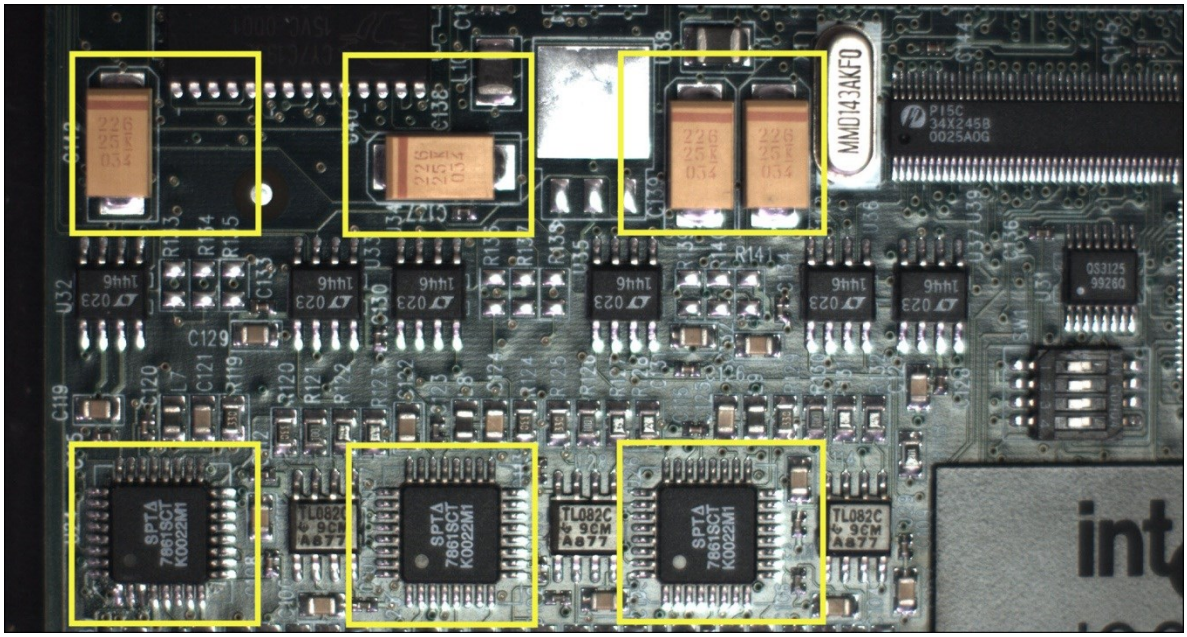


- Note that ROI(x1, y1) defines the height of any ROI in that row.
- ROI(x2, y1) can have a different width.
- ROI(x1, y2) can have a different height relative to ROI(x1,y1).
- The camera output image frame consists only of the ROI areas, in the same order as the ROI rows and columns. The user must account for the change between ROI data for each output image row.
- The output image being smaller, reduces the bandwidth requirements.

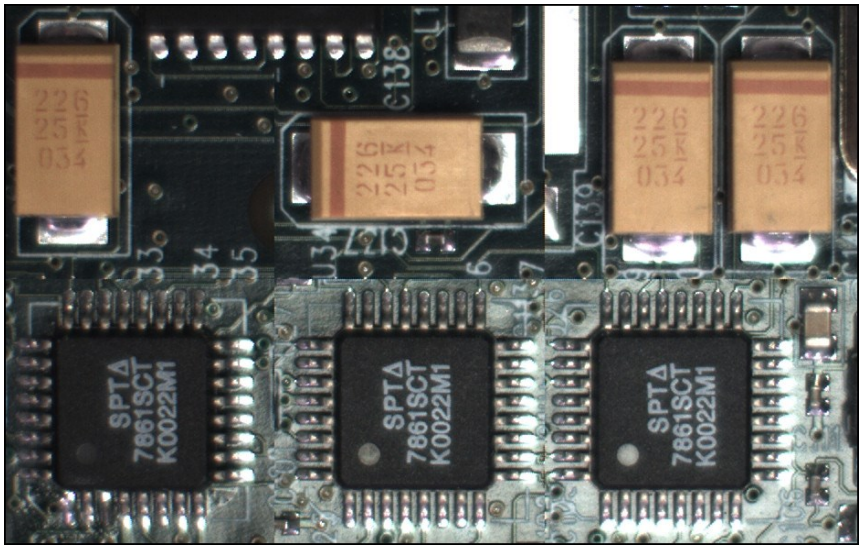
Example: Actual Sample with Six ROI Areas (3x2)

This example uses the example problem of solder inspection of certain components on a PCB. The image below of a sample PCB shows 6 ROI areas highlighted by the yellow overlay graphics (manually added to this example).

Note how the top row ROI areas may be larger than ideal due to height and width requirements of ROI areas in the second row; constraints and interdependencies as defined in the preceding ROI descriptions.



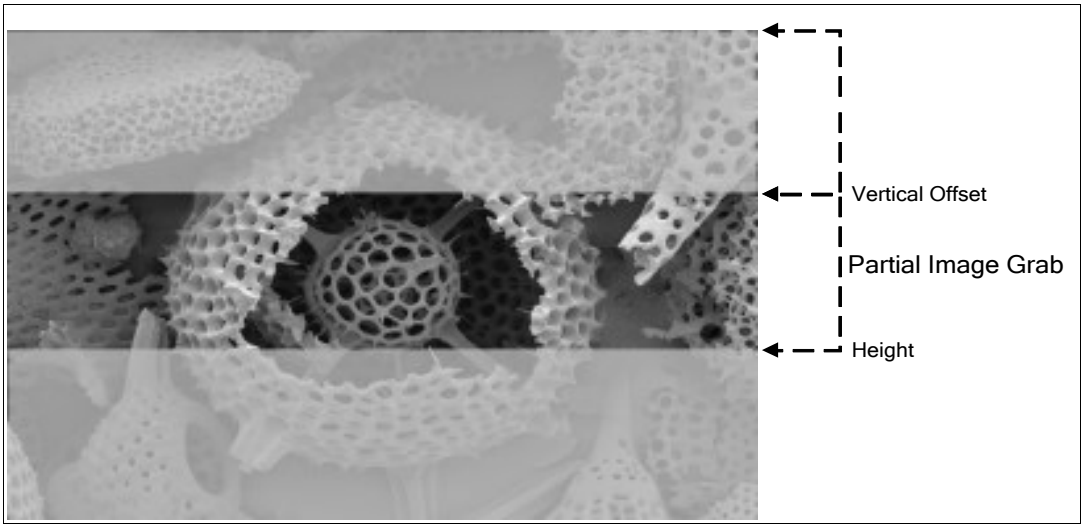
With the ROI areas defined, the camera outputs an image consisting only of data within those ROI areas, as shown below. Such data reduction improves transfer bandwidth and also reduces image processing time for the host system imaging application.



Vertical Cropping (Partial Scan)

The Height and Vertical Offset features, used for vertical cropping, reduce the number of video lines grabbed for a frame. By not scanning the full height of the sensor, the maximum possible acquisition frame rate is proportionately increased, up to the model maximum.

The following figure is an example of a partial scan acquisition using both Height and Vertical Offset controls. The Vertical Offset feature defines at what line number from the sensor origin to acquire the image. The Height feature defines the number of lines to acquire (to a maximum of the remaining frame height). Note that only the partial scan image (ROI) is transmitted to the host computer.



Partial Scan Illustration

Maximum Frame Rate Examples (Nano-CXP M/C 5100)

Note: Fast Readout Mode will have low DN Fixed Pattern column artifacts as described in the OnSemi Python Sensor Artifacts with Fast Readout Mode.

Vertical Lines Acquired (inc = 16)	Standard Readout Mode (fps)	Fast Readout Mode (fps)
5120	46.89	80.15
3840	62.45	106.6
2560	93.45	159.3
1280	185.5	315.2
640	365.8	616.5
320	711.7	1182
160	1349	2178
80	2444	3773
48	3623	5347
32	4761	6711
16	6993	9090

Maximum Frame Rate Examples (Nano-CXP M/C 4090)

Note: Fast Readout Mode will have low DN Fixed Pattern column artifacts as described in the OnSemi Python Sensor Artifacts with Fast Readout Mode.

Vertical Lines Acquired (inc = 16)	Standard Readout Mode (fps)	Fast Readout Mode (fps)
4096	65.58	122.4
3072	87.3	162.7
2048	130.5	242.6
1024	258.4	477
512	506	922
256	975	1733
128	1814	3086
64	3184	5050
32	5128	7462
16	7352	9708

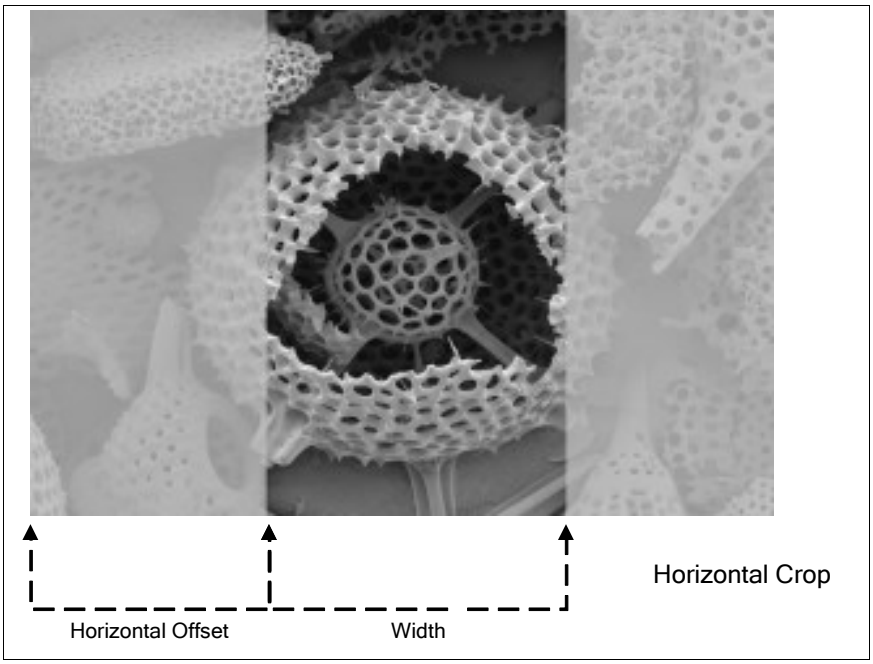
Maximum Frame Rate Examples (Nano-CXP M6200/8200)

Vertical Lines Acquired (inc = 16)	Standard Readout Mode (fps)	Fast Readout Mode (fps)
8196	20	30
6144	26	40
5120	32.1	48
4096	40.1	60
3072	53.4	79.9
2048	80	119.6
1024	159.4	238.1
512	316.4	471.2
256	622.9	923.2
128	1208.2	1774.2
64	2278.5	3290.8
32	4089.8	5746.9
16	6787.9	9168.2

Horizontal Cropping (Partial Scan)

Genie Nano supports cropping the acquisition horizontally by grabbing fewer pixels on each horizontal line. Horizontal offset defines the start of the acquired video line while horizontal width defines the number of pixels per line.

There are two Horizontal Control features. These features, horizontal offset (OffsetX) and width (Width) have three associated factors — their minimum value, maximum value and the increment (step size) value.



Internal Test Pattern Generator

The Genie Nano camera includes a number of internal test patterns which easily confirm camera installations, without the need for a camera lens or proper lighting.

Use CamExpert to easily enable and select the any of the Nano test patterns from the drop menu while the camera is not in acquisition mode. Select live grab to see the pattern output.

Note that internal test patterns are generated by the camera FPGA where the patterns are inserted immediately after the sensor output in the processing chain and are the same maximum bit depth as the sensor. The patterns are identical for monochrome or color camera models and subject to processing operations.

- Note: Processing such as Flat Field corrections and Shading corrections are not disabled automatically. Therefore the test pattern ramps will seem to be lacking various gray levels unless all processing features are off.

The Nano Test Patterns are:

- **Grey Horizontal ramp**: *Image is filled horizontally with an image that goes from the darkest possible value to the brightest.*

- **Grey Vertical ramp**: *Image is filled vertically with an image that goes from the darkest possible value to the brightest.*

- **Grey Diagonal Ramp Moving**: combination of the 2 previous schemes, but first pixel in image is incremented by 1 between successive frames. This is a good pattern to indicate motion when doing a continuous grab.

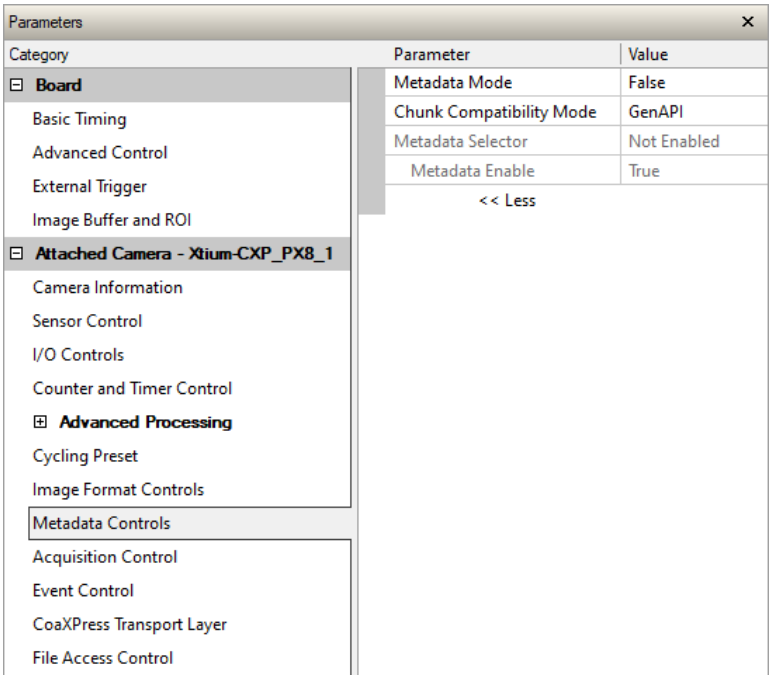
Metadata Controls Category

The Genie Nano-CXP Metadata Controls category has features to enable and select inclusion of chunk data with the image payload. Along with each image, the camera can optionally output metadata associated to that image. Metadata is appended to the image data.

Metadata is currently only supported in 8-bit acquisition with Chunk Compatibility Mode GenAPI.

To accommodate the metadata information (currently 160 bytes) the image buffer height (allocated by the host application) must be increased by at least 1 line (buffer height = image height +1). For example, if the image size is 640 x 480, the allocated buffer height is 481. However, for line lengths shorter than 160 pixels, more lines may be required.

To append metadata to the image buffer the Metadata Active feature, available in the Metadata Controls category, must be set to True (*ChunkModeActive* = True).



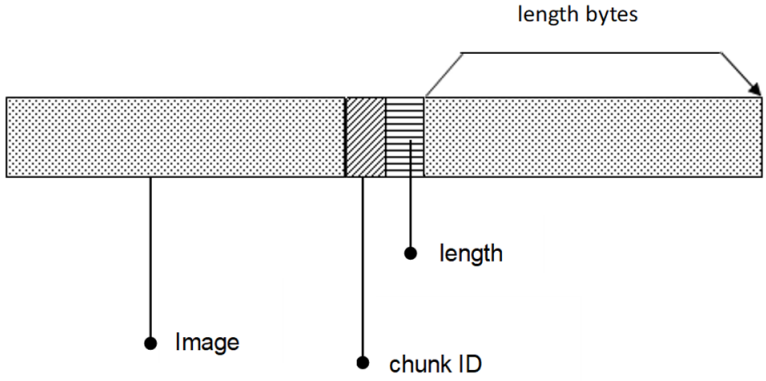
Metadata Control Category Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Metadata Mode	ChunkModeActive	Activates the inclusion of chunk data (metadata) in the payload of the image. Note that when metadata is enabled using the ChunkModeActive feature, all available metadata is enabled; individual metadata cannot be enabled/disabled.	1.02 Expert
	False	*No chunk data.*	
	True	*Chunk data included in payload*	
Chunk Compatibility Mode	chunkCompatibilityMode	Selects the format of the chunk data (metadata) in the payload of the image.	1.02 Beginner DFNC
Gen API	*GenAPI*	*Metadata compatible with GenICam GenAPI.*	
Sapera LT	*SaperaLT*	*Currently not supported.*	

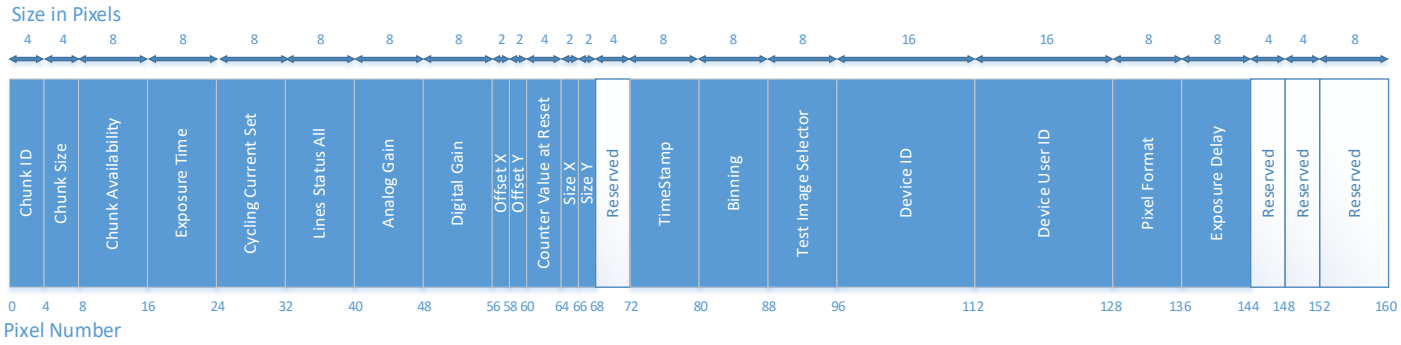
Metadata Selector	ChunkSelector	Selects the specific metadata to control, when enabled.	1.02 Expert DFNC
	OffsetX	*Add the OffsetX value used during the image acquisition to the metadata attached to the image*	
	OffsetY	*Add the OffsetY value used during the image acquisition to the metadata attached to the image.*	
	Width	*Add the Width value used during the image acquisition to the metadata attached to the image.*	
	Height	*Add the Height value used during the image acquisition to the metadata attached to the image.*	
	PixelFormat	*Add the PixelFormat value used during the image acquisition to the metadata attached to the image.*	
	ExposureTime	*Add the ExposureTime value used during the image acquisition to the metadata attached to the image.*	
	ExposureDelay	*Add the ExposureDelay value used during the image acquisition to the metadata attached to the image. Supported only in GenAPI compatibility mode.*	
	cyclingPresetCurrentActiveSet	*Add the cyclingPresetCurrentActiveSet value used during the image acquisition to the metadata attached to the image.*	
	Timestamp	*Copies the internal clock value generated by the camera at the start of frame to the metadata attached to the image. The timebase is in microseconds.*	
	LineStatusAll	*Copies the LineStatusAll value at the start of exposure to the metadata attached to the image.*	
	Gain	*Add the SensorAnalog and RawGain feature values used during the image acquisition to the metadata attached to the image.*	
	Counter1ValueAtReset	*Copies the value of the counterValueAtReset feature at the start of Frame Readout, to the metadata attached to the image. Supported only in GenAPI compatibility mode.*	
	DeviceID	*Add the DeviceID value to the metadata attached to the image.*	
	DeviceUserID	*Add the DeviceUserID value to the metadata attached to the image.*	
	TestImageSelector	*Add the TestImageSelector value used during the image acquisition to the metadata attached to the image.*	
Metadata Enable	ChunkEnable	Gets the enable state of metadata. When enabled, metadata is included in the payload of the image. Note that when metadata is enabled using the ChunkModeActive feature, all available metadata is enabled; individual metadata cannot be enabled/disabled. <RO>	1.02 Expert
	False	*Selected metadata Disabled.*	
	True	*Selected metadata Enabled.*	

Extracting Metadata Stored in a Sapera Buffer

The metadata location is always the beginning of the last line of the image.



Metadata is ordered as follows:



The Chunk ID, Chunk Size and Chunk Availability fields are always present in the metadata, all the other fields are optional.

Metadata Availability

The Metadata Availability field (pixels [7:15]) determines which metadata is available, as a bitfield. When a field is present, the corresponding bit is set to 1 in the availability bit field.

Note: When a field is not present (availability set to 0), it is removed from the structure.

Feature	Mask (Hex)	Available bit
Exposure Time	2	1
Cycling Current Set	4	2
FFC Current Active Set	8	3
LUT Current Active Set	10	4
Test Image User-Defined Index	20	5
Line Status All	40	6
Iris Aperature Control	80	7
Gain (Analog Gain and Digital Gain)	100	8
Black Level	200	9
Image Offset (Offset X and Offset Y)	400	10
Image Size	800	11
Timestamp	1000	12
Frame ID	2000	13
Binning	4000	14
Exposure Delay	8000	15
Counter Value at Reset	10000	16
Test Image Selector	10000000	28
Serial Number	20000000	29
Device User ID	40000000	30
Pixel Format	80000000	31

Metadata Structure

The metadata currently contains the following values, in this order:

Type	Value	Description	Available Bit
unsigned int	Chunk ID	The Chunk ID is hardcoded to 0xCD000002 when pixels are read in reverse order (3 – 0).	Always available.
unsigned int	Chunk Size	The Chunk Size is currently 136. This value is hardcoded in pixel 7.	Always available.
unsigned long long	Chunk Availability	Determines the availabilty of metadata. For bits [1:31]: 0: Metadata not available. 1: Metadata available. Refer to the Metadata Availabilty section for information on the bit field stucture.	Always available (bit 0 not used)
unsigned long long	Exposure Time	Exposure time, in µs.	1
unsigned long long	Cycling Current Set	Cycling current set.	2
unsigned long long	Line Status All	The line status for available lines is represented as a bitfield, with 0 = low and 1 = high. bit0 :Line 1 or CXP (has priority if triggering) bit1: GPI1 bit2: GPO0 bit3: GPO1	6
unsigned long long	Analog Gain	Analog gain. Values returned in units of 0.1 gain. For example, 30 = 3.0.	8
unsigned long long	Digital Gain	Digital gain, as raw gain.	
unsigned short	Offset X	Offset X, in pixels.	10
unsigned short	Offset Y	Offset Y, in pixels	
unsigned int	Counter Value at Reset	Counter1 value at reset.	16
unsigned short	Width	Image width (size X), in pixels.	11
unsigned short	Height	Image height (size Y), in pixels.	
unsigned int	Reserved	Not uses.	
unsigned long long	Timestamp	Timestamp (in microseconds) of the start of the frame's acquisition, as identified by the camera's internal Timestamp clock.	12
unsigned long long	Binning	Binning is not currently supported, but is included in the metadata (Note the availability bit is set to 0, but it is still in the structure). Binning is coded using the first byte (pixel 80): Bits [0:3]: binning horizontal Bits [4:7]: binning vertical For example, no binning is indicated by 1 in horizontal and 1 in vertical: 0001 0001 (decimal = 17)	14
unsigned long long	Test Image Selector	Test pattern image. Possible values are: 255: Off 0: GreyHorizontalRamp 1: GreyVerticalRamp 5: Purity 6: GreyDiagonalRamp 8: ColorBar 9: GreyDiagonalRampMoving 0x80: UserDefined	28
unsigned char [16]	Serial Number	ASCII codes for device serial number.	29
unsigned char [16]	Device User ID	ASCII codes for Device User ID.	30

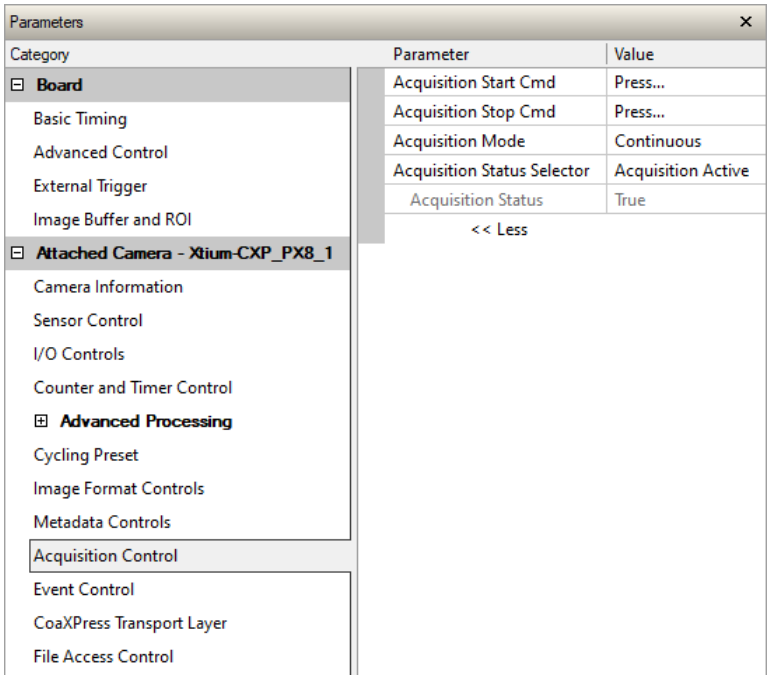
unsigned long long	Pixel Format	Pixel format. Possible values are: 0x01080001: Mono8 0x01100003: Mono10 0x01100005: Mono12 0x0108000A: BayerGB8 0x0110000E: BayerGB10 0x01100012: BayerGB12 0x02200017: BGRA8 0x82200017: BGRY8 0x0220001D: RGB10p32 0x0210001F: YUV422_8_UYVY 0x02100032: YUV422_8	31
unsigned long long	Exposure Delay	Exposure delay. If not used, the default value 10 µs is returned.	15
unsigned int	Reserved	Not used.	
unsigned int	Reserved	Not used.	
unsigned int	Reserved	Not used.	

Alternatively, this C definition can be used:

```
#pragma pack(push,1)
typedef struct
{
   unsigned int chunkID;
   unsigned int chunkSize;
   unsigned long long chunkAvailability;
   unsigned long long exposureTime;
   unsigned long long cyclingCurrentSet;
   unsigned long long lineStatusAll;
   unsigned long long analogGain;
   unsigned long long digitalGain;
   unsigned short offsetX;
   unsigned short offsetY;
   unsigned int counterValueAtReset;
   unsigned short sizeX;
   unsigned short sizeY;
   unsigned int reserved;
   unsigned long long timestamp;
   unsigned long long binning;
   unsigned long long testImageSelector;
   unsigned char deviceID[16];
   unsigned char deviceUserID[16];
   unsigned long long pixelFormat;
   unsigned long long exposureDelay;
} Metadata;
#pragma pack(pop)
```

Acquisition Control Category

The Acquisition and Transfer controls as shown by CamExpert, has parameters used to configure the optional acquisition modes of the device.



Acquisition Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Acquisition Status Selector	AcquisitionStatusSelector	Selects the internal acquisition signal to read using AcquisitionStatus.	1.00 Expert
Acquisition Active	*AcquisitionActive*	*Device is currently doing an acquisition of one or many frames.*	
Acquisition Trigger Wait	*AcquisitionTriggerWait*	*Device is currently waiting for a trigger to start the acquisition.*	
Acquisition Status	AcquisitionStatus	Reads the state of the internal acquisition signal selected using the Acquisition Status Selector feature.	1.00 Expert
Acquisition Mode	AcquisitionMode	Set the acquisition mode of the device. It defines the number of frames to capture during an acquisition and the way the acquisition stops.	1.00 Beginner
Continuous	*Continuous*	*Frames are captured continuously with AcquisitionStart until stopped with the AcquisitionStop command.*	
Acquisition Start Cmd	AcquisitionStart	Start image capture using the currently selected acquisition mode. The number of frames captured is specified by AcquisitionMode feature.	1.00 Beginner
Acquisition Stop Cmd	AcquisitionStop	Stops the Acquisition of the device at the end of the current frame unless the triggerFrameCount feature is greater than 1.	1.00 Beginner
Device Registers Streaming Start	DeviceRegistersStreamingStart	Announces the start of registers streaming without immediate checking for consistency.	1.00 Invisible
Device Registers Streaming End	DeviceRegistersStreamingEnd	Announces end of registers streaming and performs validation for registers consistency before activating them.	1.00 Invisible
Device Feature Streaming Start	DeviceFeaturePersistenceStart	Announces the start of feature streaming without immediate checking for consistency.	1.00 Invisible
Device Feature Streaming End	DeviceFeaturePersistenceEnd	Announces end of feature streaming and performs validation for feature consistency before activating them.	1.00 Invisible
Register Check	DeviceRegistersCheck	Performs an explicit register set validation for consistency.	1.00 Invisible
Registers Valid	DeviceRegistersValid	States if the current register set is valid and consistent.	1.00 Invisible

Acquisition Buffering

All acquisitions are internally buffered and transferred as fast as possible to the host system. This internal buffer allows uninterrupted acquisitions no matter of any transfer delays that might occur. Only when the internal acquisition buffer is consumed would an Image Lost Event be generated.

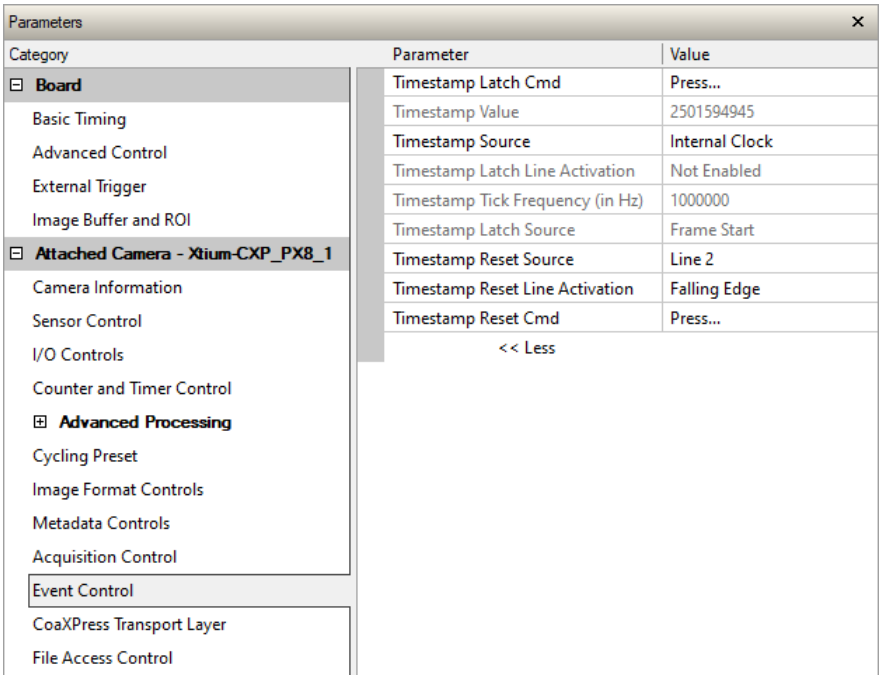
Features that cannot be changed during a Transfer

The following features cannot be changed during an acquisition or when a transfer is connected.

Feature Group	Features Locked During a Sapera Transfer
CAMERA INFORMATION	UserSetLoad, deviceBIST, DeviceReset
SENSOR CONTROL	*AcquisitionFrameRate, ExposureMode, exposureAlignment* *GainSelector, sensorSpecificSaturationControl*
I/O CONTROLS	TriggerSelector, TriggerMode, triggerFrameCount TriggerSource, TriggerDelay, TriggerOverlap-EndOfExposure
Advanced Processing	flatfieldCorrectionMode, flatfieldCorrectionAlgorithm flatfieldCorrectionType, flatfieldCorrectionCurrentActiveSet flatfieldCorrectionCalibrationDark, flatfieldCorrectionCalibrationBright flatfieldCalibrationTarget, flatfieldCorrectionCalibrationResetCoefficients defectivePixelReplacementMode, defectivePixelReplacementMapCurrentActiveSet defectiveColumnReplacementOption, noiseReduction lensShadingCorrectionMode, lensShadingCorrectionCurrentActiveSet lensShadingCorrectionCalibrationSampleSize, lensShadingCorrectionCalibrationBright, lensShadingCorrectionCalibrationDark lensShadingResetCoefficients
COUNTER AND TIMER CONTROL	*NA*
IMAGE FORMAT CONTROL	PixelFormat OffsetX (except within the Cycling Mode) OffsetY (except within the Cycling Mode) Binning (except within the Cycling Mode) Width, Height Multi-ROI functions, TestImageSelector
ACQUISITION CONTROL	DeviceRegistersStreamingStart DeviceRegistersStreamingEnd
FILE ACCESS CORNTOL	*NA*

Event Control Category

The Event Control category, as shown by CamExpert, groups parameters used to manage the Nano CXP timestamp mechanism.



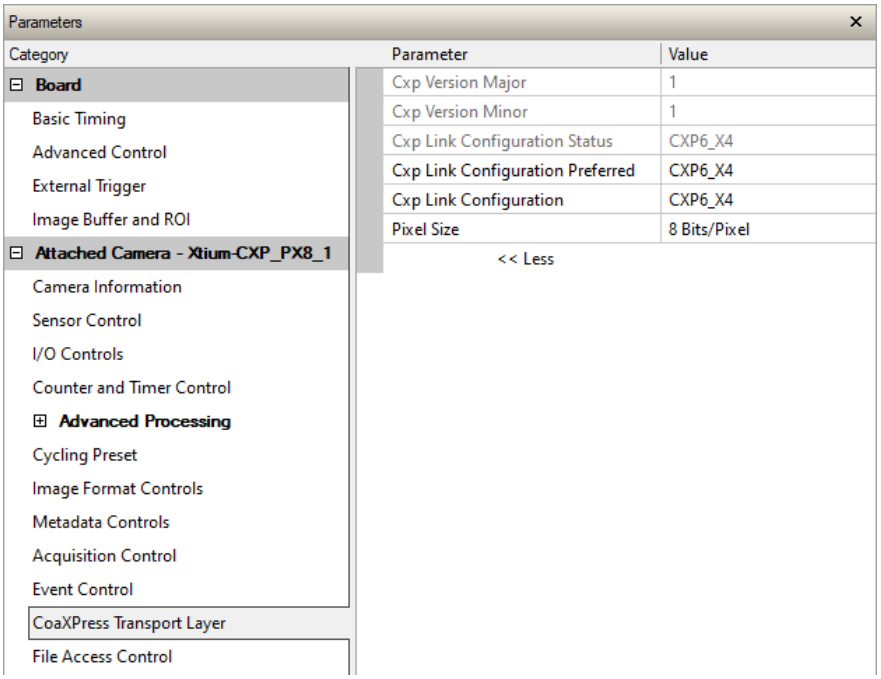
Event Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Timestamp Latch Cmd	timestampControlLatch	Latch the current timestamp internal counter value in the timestampValue feature.	1.03 Expert DFNC
Timestamp Value	timestampValue	Returns the 64-bit value of the timestamp, which is the internal Clock timer or the PTP clock timer, depending on the Timestamp Source selection.	1.03 Expert DFNC
TimeStamp Source	timestampSource	Specifies the source used as the incrementing signal for the Timestamp register.	1.03 Expert DFNC
Internal Clock	*InternalClock*	*The timestamp source is generated by the camera internal clock. Refer to the timestampTickFrequency feature for the time base.*	
Line 2	*Line2*	*The timestamp source is generated by Line 2.*	
Exposure Start	*ExposureStart*	*The timestamp source is generated by the sensor exposure start.*	
Timestamp Latch Line Activation	timestampLineActivation	Specifies the activation mode to latch the timestamp counter on the selected line of the *TimestampSource* feature.	1.03 Expert DFNC
Falling Edge	*FallingEdge*	*Latch the timestamp counter on the falling edge of the source signal.*	

Display Name	Feature & Values	Description	Device Version & View
Rising Edge	*RisingEdge*	*Latch the timestamp counter on the rising edge of the source signal.*	
Any Edge	*AnyEdge*	*Latch the timestamp counter on the falling or rising edge of the source signal.*	
Timestamp Tick Frequency	timestampTickFrequency	Indicates the number of timestamp ticks (or increments) during 1 second (frequency in Hz). This feature changes depending on the TimeStamp Source.	1.03 Expert DFNC
Timestamp Latch Source	timestampLatchSource	Specifies the internal event or signal that will latch the timestamp counter into the timestamp buffer.	1.03 Expert DFNC
Frame Start	*FrameStart*	*The timestamp is latched on frame start.*	
Timestamp Reset Cmd	timestampControlReset	Resets the timestamp counter to 0. This Feature resets both the internal Clock timer and the PTP clock timer. Note that the PTP Mode must be disabled first to reset the PTP clock timer.	1.03 Expert DFNC
Timestamp Reset Source	timestampResetSource	Specifies the internal signal or physical input line to use as the timestamp reset source.	1.03 Expert DFNC
None	*None*	*No timestamp reset source is specified. Note that the Timestamp reset command can still reset the counter.*	
Line 2	*Line2*	*Use input line 2 as the timestamp reset source.*	
Timestamp Reset Line Activation	timestampResetLineActivation	Specifies the activation mode to reset the timestamp counter on the selected line of the *TimestampResetSource* feature.	1.03 Expert DFNC
Falling Edge	*FallingEdge*	*Reset the timestamp counter on the falling edge of the source signal.*	
Rising Edge	*RisingEdge*	*Reset the timestamp counter on the rising edge of the source signal.*	
Any Edge	*AnyEdge*	*Reset the timestamp counter on the falling or rising edge of the source signal.*	

CoaXPress Transport Layer Category

The Nano-CoaXPress Transport Layer category, as shown by CamExpert, groups parameters used to manage the CXP data interface.



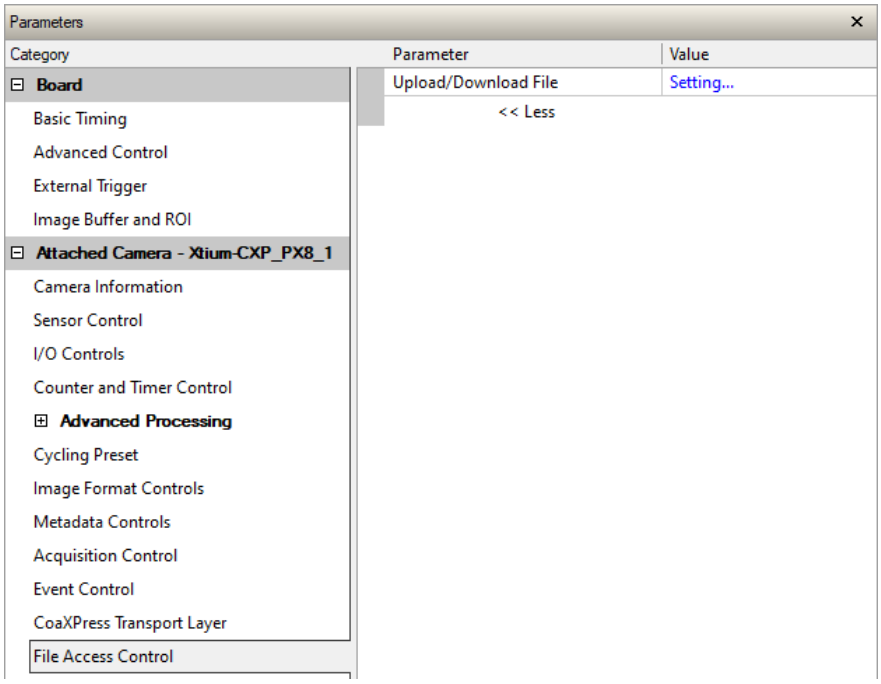
CoaXpress Transport Layer Feature Descriptions

Display Name	Feature & Values	Description	Version & View
CXP Major Version	CxpVersionMajor	This field represents the major version of the specification.	1.00 Beginner
CXP Minor Version	CxpVersionMinor	This field represents the minor version of the specification.	1.00 Beginner
Cxp Link Configuration Status	CxpLinkConfigurationStatus	CXP Link Configuration Status.	1.00 Beginner
None	None		
Pending	Pending		
Cxp6_X4	Cxp6_X4		
Cxp Link Configuration Preferred	CxpLinkConfigurationPreferred	CXP Link Configuration Preferred. The preferred CXP Link Configuration mode is used if supported by the frame grabber.	1.00 Expert
Cxp6_X4	*Cxp6_X4*	4 lane CXP link configuration preferred.	
Cxp6_X2	*Cxp6_X2*	2 lane CXP link configuration preferred.	
Cxp6_X1	*Cxp6_X1*	1 lane CXP link configuration preferred.	
Cxp Link Configuration	CxpLinkConfiguration	Current CXP Link Configuration.	1.00 Beginner
Cxp6_X4	*Cxp6_X4*	4 lane CXP link configuration.	
Cxp6_X2	*Cxp6_X2*	2 lane CXP link configuration.	
Cxp6_X1	*Cxp6_X1*	1 lane CXP link configuration.	
Auto	*Auto*	Automatically negotiates the highest CXP link configuration possible based on the frame grabber capabilities.	
CoaXPress Standard	CxpStandard	This represents the magic Number of CoaXPress.	1.00 Invisible
XML Manifest Size	CxpXmlManifestSize	This provides the number of Xml Manifests available.	1.00 Invisible
XML Manifest Selector	CxpXmlManifestSelector	Select the CXP XML Manifest to use.	1.00 Invisible
XML Major Version	CxpXmlVersionMajor	The major version of the XML file.	1.00 Invisible
XML Minor Version	CxpXmlVersionMinor	The minor version of the XML file.	1.00 Invisible
XML SubMinor Version	CxpXmlVersionSubMinor	The subminor version of the XML file.	1.00 Invisible
XML Schema Major Version	CxpXmlSchemaVersionMajor	The major version of the schema used by the XML file.	1.00 Invisible
XML Schema Minor Version	CxpXmlSchemaVersionMinor	The minor version of the schema used by the XML file.	1.00 Invisible
XML Schema Sub Minor Version	CxpXmlSchemaVersionSubMinor	The sub minor version of the schema used by the XML file.	1.00 Invisible
URL String Start Address	CxpXmlUrlAddress	The address of the start of the URL string.	1.00 Invisible
IIDC Register Start Address	CxpIidcPointer	Start address of the IIDC register space (value=0 if IIDC is not supported).	1.00 Invisible
Device Link Reset	CxpLinkReset	Execute a Device Link Reset (ConnectionReset) by writing 1 to this feature.	1.00 Invisible
Device Link ID	CxpDeviceLinkID	Provides the link ID of the current CXP link where "0" indicates the master connection.	1.00 Invisible
Master Host Link ID	CxpMasterHostLinkID	Host Link ID of the Host link connected to the Device Master connection.	1.00 Invisible
Control Packet Size	CxpControlPacketDataSize	Feature to read the control packet data size in bytes.	1.00 Invisible

Stream Packet Data Size	CxpStreamPacketDataSize	Sets the maximum stream packet size the Host can accept.	1.00 Invisible
CXP Test Mode	CxpTestMode	Starts or stops the test mode.	1.00 Invisible
Select Test Error Counter	CxpTestErrorCountSelector	Selects the test error count error register.	1.00 Invisible
CXP Test Error Count	CxpTestErrorCount	Read test error counter.	1.00 Invisible
Pixel Size 8 Bits/Pixel 10 Bits/Pixel	cxpPixelSize Bpp8 Bpp10	Total size in bits of an image pixel. Bpp8: 8 bits per pixel Bpp10: 8 bits per pixel	1.00 Invisible

File Access Control Category

The File Access control in CamExpert allows the user to quickly upload various data files to the connected Genie Nano. The supported data files are for firmware updates and other types dependent on the Nano model.



File Access Control Feature Descriptions

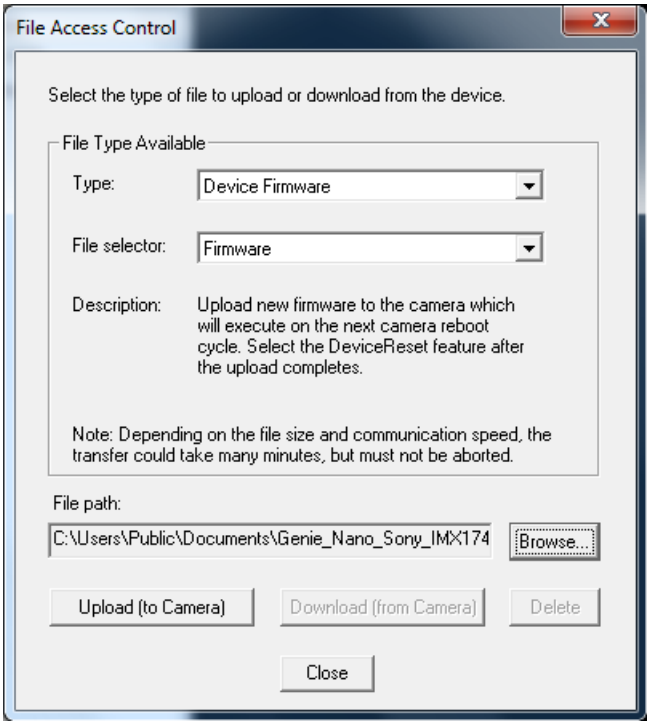
Display Name	Feature & Values	Description	Device Version & View
File Selector	FileSelector	Selects the file to access. The file types which are accessible are device-dependent.	1.00 Guru
Firmware	*Firmware1*	*Upload new firmware to the camera which will execute on the next camera reboot cycle. Select the DeviceReset feature after the upload completes.*	
Factory Defective Pixel Map	*BadPixelCoordinate0*	*Select the Factory Defective Pixel Map.*	
User Defective Pixel Map	*BadPixelCoordinate1*	*Select the User Defective Pixel Map XML file as defined in Advanced Processing.*	
Factory Flat Line coefficients 1	*FlatFieldCoefficients01*	*Select factory Flat Line coefficients 1. These are the factory values used when the camera fastReadoutMode is Off and sensor Gain is 1.0.*	
Factory Flat Line coefficients 2	*FlatFieldCoefficients02*	*Select factory Flat Line coefficients 2. These are the factory values used when the camera fastReadoutMode is Off and sensor Gain is 1.26.*	
Factory Flat Line coefficients 3	*FlatFieldCoefficients03*	*Select factory Flat Line coefficients 3. These are the factory values used when the camera fastReadoutMode is Off and sensor Gain is 1.87.*	

Factory Flat Line coefficients 4	*FlatFieldCoefficients04*	*Select factory Flat Line coefficients 4. These are the factory values used when the camera fastReadoutMode is Off and sensor Gain is 3.17.*	
Factory Flat Line coefficients 5	*FlatFieldCoefficients05*	*Select factory Flat Line coefficients 5. These are the factory values used when the camera fastReadoutMode is Active and sensor Gain is 1.0.*	
Factory Flat Line coefficients 6	*FlatFieldCoefficients06*	*Select factory Flat Line coefficients 6. These are the factory values used when the camera fastReadoutMode is Active and sensor Gain is 1.26.*	
Factory Flat Line coefficients 7	*FlatFieldCoefficients07*	*Select factory Flat Line coefficients7. These are the factory values used when the camera fastReadoutMode is Active and sensor Gain is 1.87.*	
Factory Flat Line coefficients 8	*FlatFieldCoefficients08*	*Select factory Flat Line coefficients 8. These are the factory values used when the camera fastReadoutMode is Active and sensor Gain is 3.17.*	
User Flat Line coefficients 1	*FlatFieldCoefficients1*	*Select user Flat Line coefficients1. These are the coefficient values used when the sensor analog Gain is 1.0.*	
User Flat Line coefficients 2	*FlatFieldCoefficients2*	*Select user Flat Line coefficients2. These are the coefficient values used when the sensor Gain is 1.26.*	
User Flat Line coefficients 3	*FlatFieldCoefficients3*	*Select user Flat Line coefficients3. These are the coefficient values used when the sensor Gain is 1.87.*	
User Flat Line coefficients 4	*FlatFieldCoefficients4*	*Select user Flat Line coefficients4. These are the coefficient values used when the sensor Gain is 3.17.*	
Lens Shading Correction 1	*LensShadingCorrection1*	*Lens Shading coefficients set 1*	
Lens Shading Correction 2	*LensShadingCorrection2*	*Lens Shading coefficients set 2*	
User Defined Saved Image	*userDefinedSavedImage*	*Upload and download an image in the camera.*	
Open Source Licenses	*SoftwareLicenses*	*Open Source Software Licenses.*	
File Operation Selector	FileOperationSelector	Selects the target operation for the selected file in the device. This operation is executed when the File Operation Execute feature is called.	1.00 Guru
Open	*Open*	*Select the Open operation – executed by FileOperationExecute.*	
Close	*Close*	*Select the Close operation – executed by FileOperationExecute*	
Read	*Read*	*Select the Read operation – executed by FileOperationExecute.*	
Write	*Write*	*Select the Write operation – executed by FileOperationExecute.*	
Delete	*Delete*	*Select the Delete operation – executed by FileOperationExecute.*	
File Operation Execute	FileOperationExecute	Executes the operation selected by File Operation Selector on the selected file.	1.00 Guru
File Open Mode	FileOpenMode	Selects the access mode used to open a file on the device.	1.00 Guru
Read	*Read*	*Select READ only open mode*	
Write	*Write*	*Select WRITE only open mode*	
File Access Buffer	FileAccessBuffer	Defines the intermediate access buffer that allows the exchange of data between the device file storage and the application.	1.00 Guru
File Access Offset	FileAccessOffset	Controls the mapping offset between the devices file storage and the file access buffer.	1.00 Guru
File Access Length	FileAccessLength	Controls the mapping length between the device file storage and the file access buffer.	1.00 Guru
File Operation Status	FileOperationStatus	Displays the file operation execution status.	1.00

Success	*Success*	*The last file operation has completed successfully.*	Guru
Failure	*Failure*	*The last file operation has completed unsuccessfully for an unknown reason.*	
File Unavailable	*FileUnavailable*	*The last file operation has completed unsuccessfully because the file is currently unavailable.*	
File Invalid	*FileInvalid*	*The last file operation has completed unsuccessfully because the selected file in not present in this camera model.*	
File Operation Result	FileOperationResult	Displays the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned.	1.00 Guru
File Size	FileSize	Represents the size of the selected file in bytes.	1.00 Guru
Device User Buffer	deviceUserBuffer	Unallocated memory available to the user for data storage.	1.00 DFNC Invisible
User Defined Saved Image Max Size	userDefinedSavedImageMaxSize	Maximum size of the user Defined Saved Image in the flash memory.	1.00 DFNC Invisible
Save Last Image to Flash	saveLastImageToFlash	Command that saves the last acquired image to camera flash memory. Use the file transfer feature to read the image from camera.	1.00 DFNC Invisible

Updating Firmware via File Access in CamExpert

- Click on the "Setting…" button to show the file selection menu.



- From the **File Type** drop menu, select the file **Type** that will be uploaded to the Genie Nano. This CamExpert tool allows quick firmware changes or updates, when available for your Genie Nano model.
- From the **File Selector** drop menu, select the Genie Nano memory location for the uploaded data. This menu presents only the applicable data locations for the selected file type.
- Click the Browse button to open a typical Windows Explorer window.
- Select the specific file from the system drive or from a network location.
- Click the Upload button to execute the file transfer to the Genie Nano.
- Reset the Nano when prompted.
- Important: File upload rates are fixed (as per the CXP standard) at 20Mbits/s. As an example a firmware file upload will take about 2½ minutes.

Overview of the *deviceUserBuffer* Feature

The feature *deviceUserBuffer* allows the machine vision system supplier access to 4 kB of reserved flash memory within the Genie Nano. This memory is available to store any data required, such as licensing codes, system configuration codes, etc. as per the needs of the system supplier. No Nano firmware operation will overwrite this memory block thus allowing and simplifying product tracking and control.

Implementing Trigger-to-Image Reliability

Overview

In a complex imaging system a lot can go wrong at all points – from initial acquisition, to camera processing, to data transmission. Teledyne DALSA provides features, events, and I/O signals that provide the system designer with the tools to qualify the system in real time.

The Teledyne DALSA website provides general information, FAQ, and White Paper downloads about the Trigger-to-Image Reliability (T2IR) framework in hardware and Sapera LT software SDK.
http://www.teledynedalsa.com/imaging/knowledge-center/appnotes/t2ir/

T2IR with Genie Nano

Benefits for imaging systems include:

- Makes system more predictable
- Prevents many errors before they happen
- Manage system exceptions in controlled manner
- Provides system debugging and tracing
- Reduce downtime

Nano provides a number of features for system monitoring:

- Built-in Self-Test on power-up and reset after firmware change
- Internal Temperature Reporting
- In Camera Event Status Flags
- Invalid External Trigger
- Image Lost

Nano Features for T2IR Monitoring

The following table presents some of the Nano camera features a developer can use for T2IR monitoring. The output line signals would interface to other external devices.

Camera Status Monitoring	
Device Built-In Self Test	deviceBIST
Device Built-In Self Test Status	deviceBISTStatus
Device Temperature Selector	DeviceTemperatureSelector
Device Version	DeviceVersion
Firmware Version	DeviceFirmwareVersion
Last firmware update failed	FirmwareUpdateFailure
Manufacturer Part Number	deviceManufacturerPartNumber
Manufacturer Info	DeviceManufacturerInfo
Acquisition and Triggers	
Valid Frame Trigger	ValidFrameTrigger
Invalid Frame Trigger	InvalidFrameTrigger

Technical Specifications

Both 2D and 3D design drawings are available for download from the Teledyne DALSA web site [http://www.teledynedalsa.com/genie-nano].

Notes on Genie Nano Identification and Mechanical

Identification Label

Genie Nano cameras have an identification label applied to the bottom side, with the following information:

- Model Part Number
- Serial number
- 2D Barcode
- CE and FCC logo

Additional Mechanical Notes

For information on Nano lens requirements see Choosing a Lens with the Correct Image Circle.

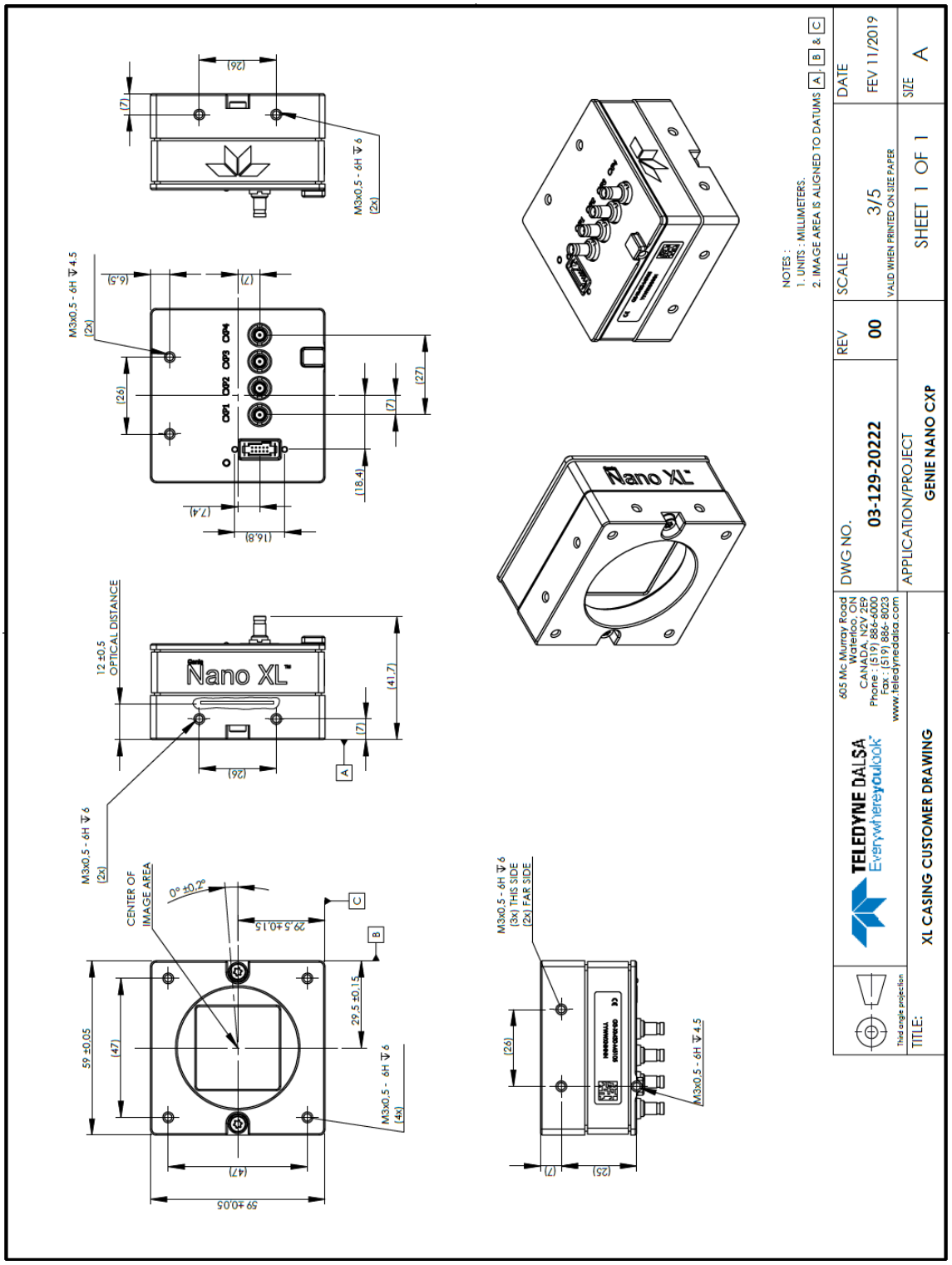
Each camera side has two mounting holes in identical locations, which provide good grounding capabilities.
Overall height or width tolerance is ± 0.05mm.

Temperature Management

Genie Nano cameras are designed to optimally transfer internal component heat to the outer metallic body. If the camera is free standing (i.e. not mounted) it will be hot to the touch.

Basic heat management is achieved by mounting the camera onto a metal structure via its mounting screw holes. Heat dissipation is improved by using thermal paste between the camera body (not the front plate) and the metal structure plus the addition of a heatsink structure.

Mechanical Specifications with M42 Mount:

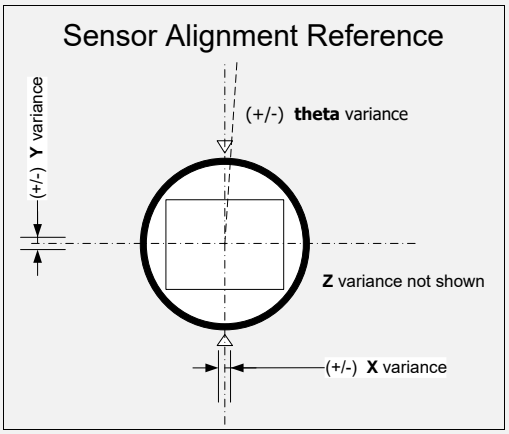


Note: Genie Nano-CXP with M42 Mount

Sensor Alignment Specification

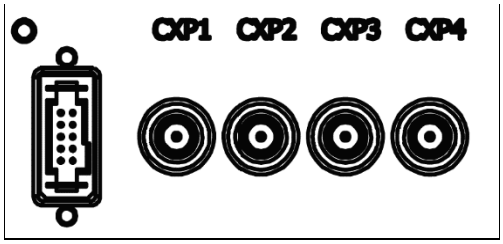
The following figure specifies sensor alignment for Genie Nano where all specifications define the absolute maximum tolerance allowed for production cameras. Dimensions "x, y, z", are in microns and referenced to the Genie Nano mechanical body or the optical focal plane (for the z-axis dimension). Theta specifies the sensor rotation relative to the sensor's center and Nano mechanical.

X variance	+/- 250 microns
Y variance	+/- 250 microns
Z variance	+/- 300 microns
Theta variance	+/- 1 degree



Connectors

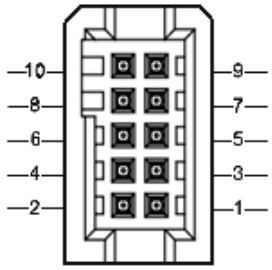
- CoaXPress: DIN 1.0/2.3 connector (CXP-6 maximum speed rating)



10-pin I/O Connector Details

- An auxiliary DC power source can be connected to the 10-pin connector (SAMTEC TFM-105-02-L-D-WT) when not using Power over CoaXPress (PoCXP). Nano supports connecting cables with retention latches or screw locks. The following figure shows the pin number assignment.
- Note: Connect power via the I/O connector or PoCXP, but never both. Although Nano has protection, differences in ground levels may cause operational issues or electrical faults.

Model numbers identify GPIO support:
- G3-Xx**0**x-xxxxx (yes)
- G3-Xx**3**x-xxxxx (no)



SAMTEC
TFM-105-02-L-D-WT

Teledyne DALSA makes available optional I/O cables as described in Ruggedized Cable Accessories. Contact Sales for availability and pricing.

Pin Number	Genie Nano-CXP	Direction	Definition
1	PWR-GND	—	Camera Power – Ground
2	PWR-VCC	—	Camera Power – DC +10 to +36 Volts
3	GPI-Common	—	General Input/Output Common Ground
4	GPO-Power	—	General Output Common Power
5	GPI 1	In	General External Input 1
6	GPO 1	Out	General External Output 1
7	GPI 2	In	General External Input 2
8	GPO 2	Out	General External Output 2
9	Reserved	—	Not used.
10	Chassis	—	Camera Chassis (connected to CXP connector shell & pin 1)

Camera DC Power Characteristics

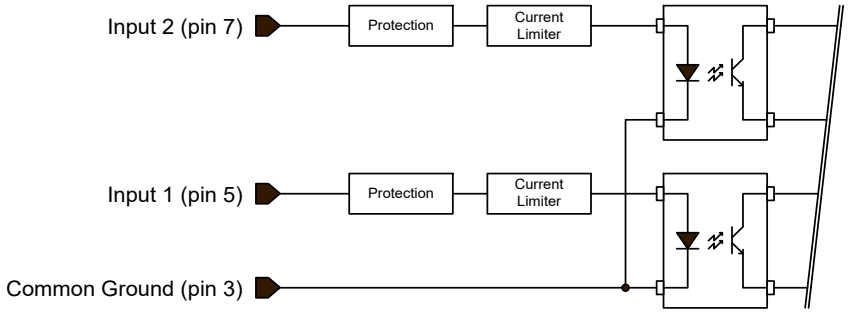
DC Operating Characteristics		
Input Voltage	+12 Volts minimum	
Input Power Consumption	@ +24 Volt Supply	12 Watts typical

Absolute Maximum DC Power Supply Range before Possible Device Failure	
Input Voltage Range	+26 Volt to –26 Volt DC

I/O Signals Electrical Specifications

Input Signals Electrical Specifications

External Inputs Block Diagram



External Input Details

- Opto-coupled with internal current limit.
- Single input trigger threshold level
  (TTL standard: <0.8V=Logical LOW, >2.4V=Logical HIGH).
- Used as trigger acquisition event, counter or timestamp event, or integration control.
- User programmable debounce time from 0 to 255µs in 1µs steps.
- Source signal requirements:
  - Single-ended driver meeting TTL, 12V, or 24V standards (see table below)
  - If using a differential signal driver, only one input can be used due to the shared input common (see details below)

External Input DC Characteristics

Operating Specification	Minimum	Maximum
Input Voltage	+3 V	+36 V
Input Current	7 mA	11.8 mA
Input logic Low		0.8 V
Input logic High	2.5 V	

Absolute Maximum Range before Possible Device Failure

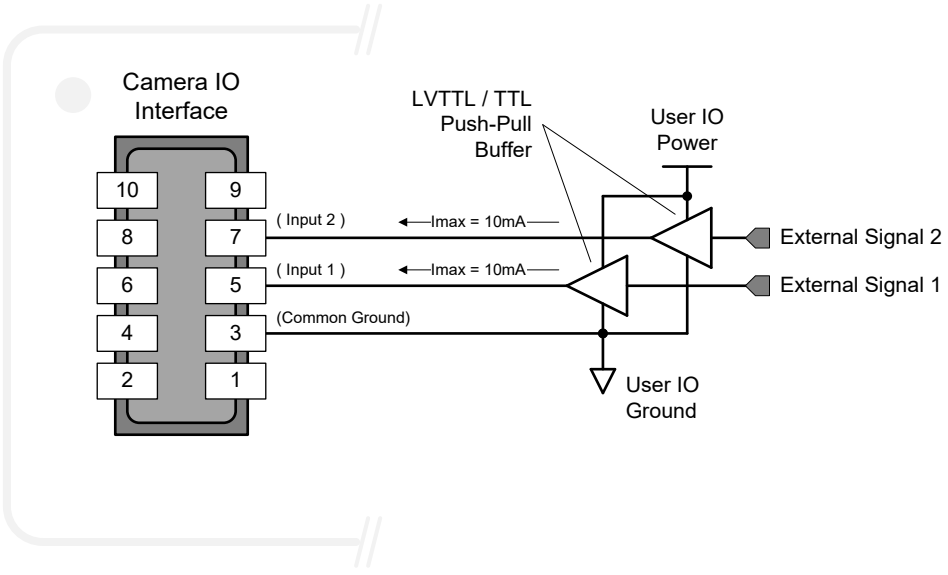
Absolute Ratings	Minimum	Maximum
Input Voltage	–26 Volts	+26 Volts

External Input AC Timing Characteristics

Conditions	Description	Min	Unit
Input Pulse 0V – 3V	Input Pulse width High	132	µs
	Input Pulse width Low	1.22	µs
	Max Frequency	392	KHz
Input Pulse 0V – 5V	Input Pulse width High	202	µs
	Input Pulse width Low	1.28	µs
	Max Frequency	392	KHz
Input Pulse 0V -12V	Input Pulse width High	345	µs
	Input Pulse width Low	1.28	µs
	Max Frequency	392	KHz
Input Pulse 0V – 24V	Input Pulse width High	132	µs
	Input Pulse width Low	1.22	µs
	Max Frequency	392	KHz

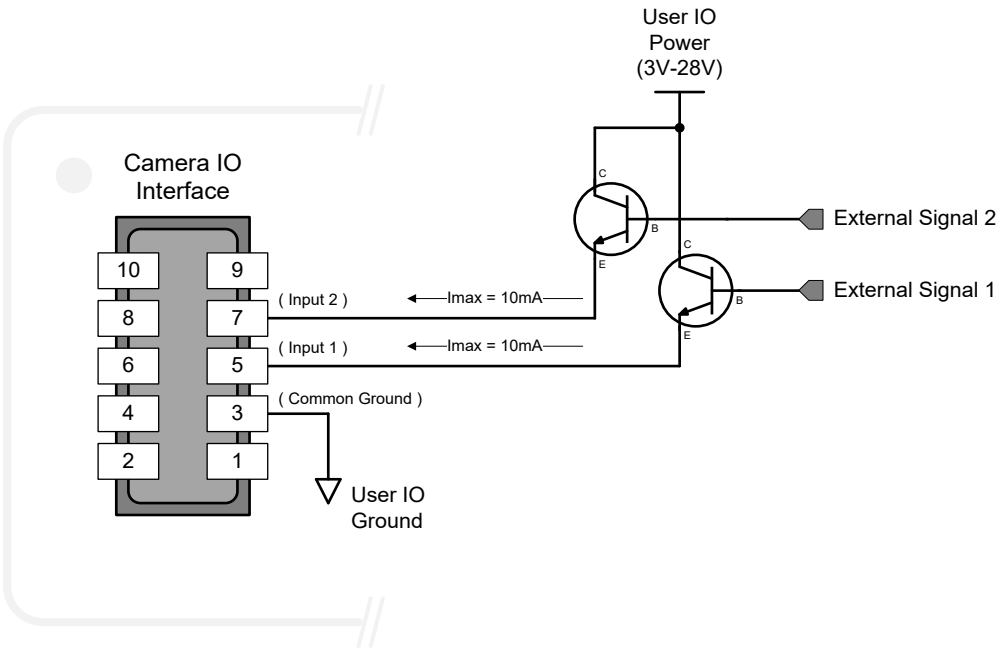
External Inputs: Using TTL/LVTTL Drivers

- External Input maximum current is limited by the Nano-CXP circuits to a maximum of 12mA.



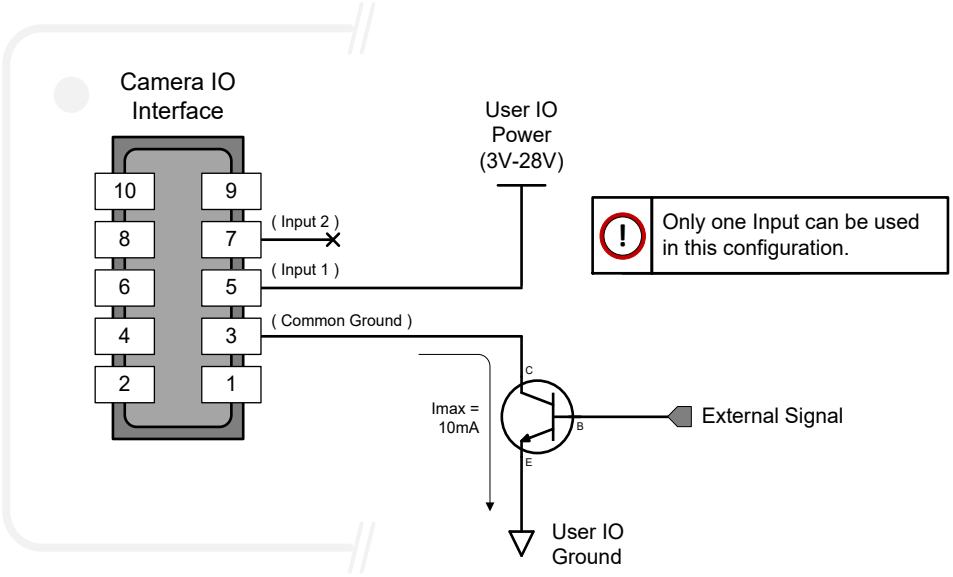
External Inputs: Using Common Collector NPN Drivers

- External Input maximum current is limited by the Nano-CXP circuits to a maximum of 12mA.



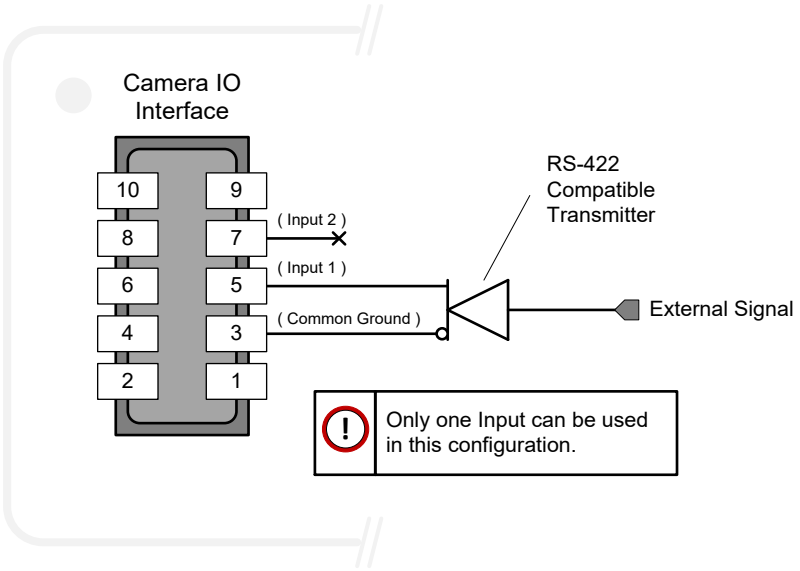
External Inputs: Using Common Emitter NPN Driver

- External Input maximum current is limited by the Nano-CXP circuits to a maximum of 12mA.
- Warning: Only one External Signal can be used (input 1 or input 2).



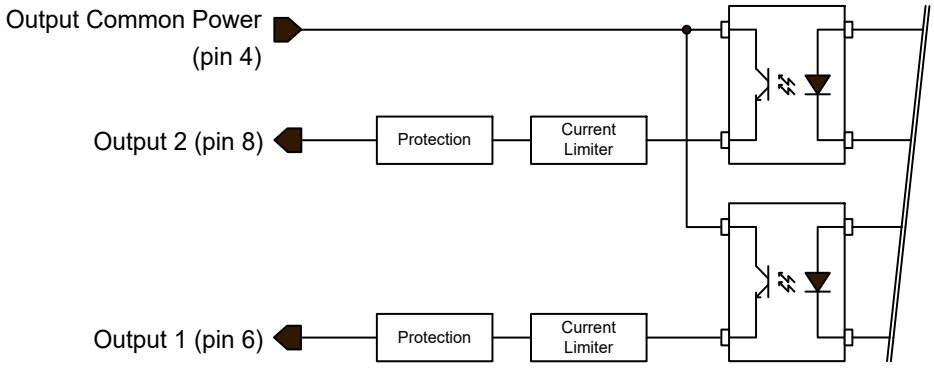
External Inputs: Using a Balanced Driver

- Warning: Only one External Signal can be used (input 1 or input 2).



Output Signals Electrical Specifications

External Outputs Block Diagram

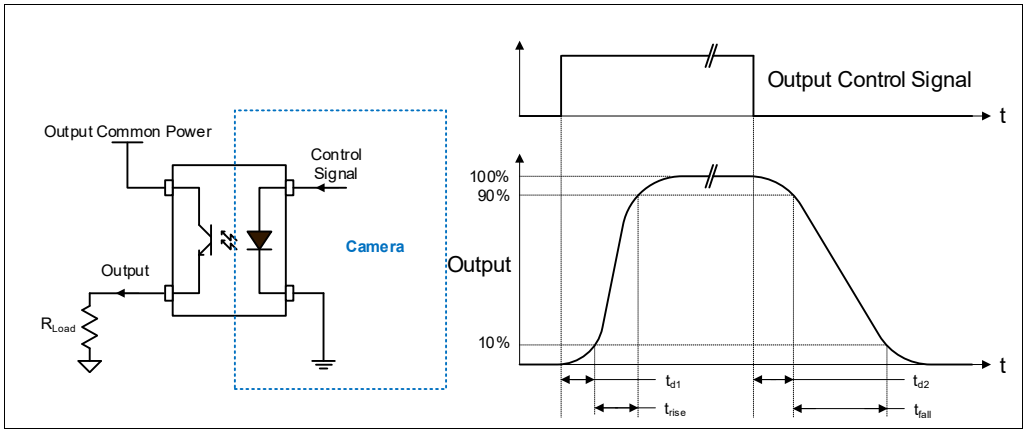


External Output Details and DC Characteristics

- Programmable output mode such as strobe, event notification, etc (see *outputLineSource* feature)
- Outputs are open on power-up with the default factory settings
- A software reset will not reset the outputs to the open state if the outputs are closed
- A user setup configured to load on boot will not reset the outputs to the open state if the outputs are closed
- No output signal glitch on power-up or polarity reversal
- **Typical** Operating Common Power Voltage Range: +3V to 24Vdc at 24mA
- **Maximum** Common Power Voltage Range : ±28Vdc
- **Maximum** Output Current: 36mA

External Output AC Timing Characteristics

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



Opto-coupled Output: AC Characteristics

Note: All measurements subject to some rounding.

The following tables describes GPO 1 and GPO 2 when the load is connected to a user-provided ground. Test conditions are with front plate temperature ~62C, FPGA ~85C.

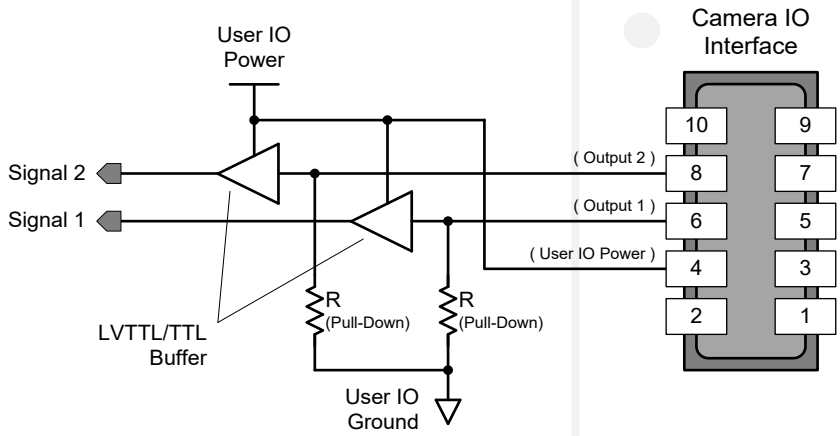
Output Common Power	Output Current	R_{load} *Test (ohm)*	t_{d1} (µs) *Leading Delay*	t_{rise} (µs) *Rise Time*	t_{d2} (µs) *Trailing Delay*	t_{fall} (µs) *Fall Time*	V_{out} (V)
3V	8 mA	240	0.459	5.03	24.07	20.41	2.17
	12ma	144	0.492	6.95	16.9	16.35	1.75
	16 mA	40	0.473	4.92	9.91	10.7	0.559
5V	8 mA	523	0.469	2.64	29.22	21.33	4.24
	16 mA	159	0.485	4.75	10.96	11.14	2.57
	24 mA	69	0.503	6.62	7.28	8.42	1.69
12V	8 mA	1400	0.496	1.65	38.37	25.64	11.23
	16 mA	595	0.514	3.03	15.13	13.86	9.61
	24 mA	360	0.531	3.76	10	9.91	8.72
24V	8 mA	2907	0.541	1.63	50.75	34.39	23.31
	16 mA	1346	0.556	2.2	21.74	18.32	21.58
	24 mA	861	0.567	2.5	14.61	12.93	20.72

General Purpose Output 3 Fast Switching

GPO 3 supports a fast switching mode with ground of the user load connected to pin 3 (General Input/Output Common Ground). Note, GPO 1 and GPO 2 do not support fast switching. Test conditions are with front plate temperature ~62C, FPGA ~85C.

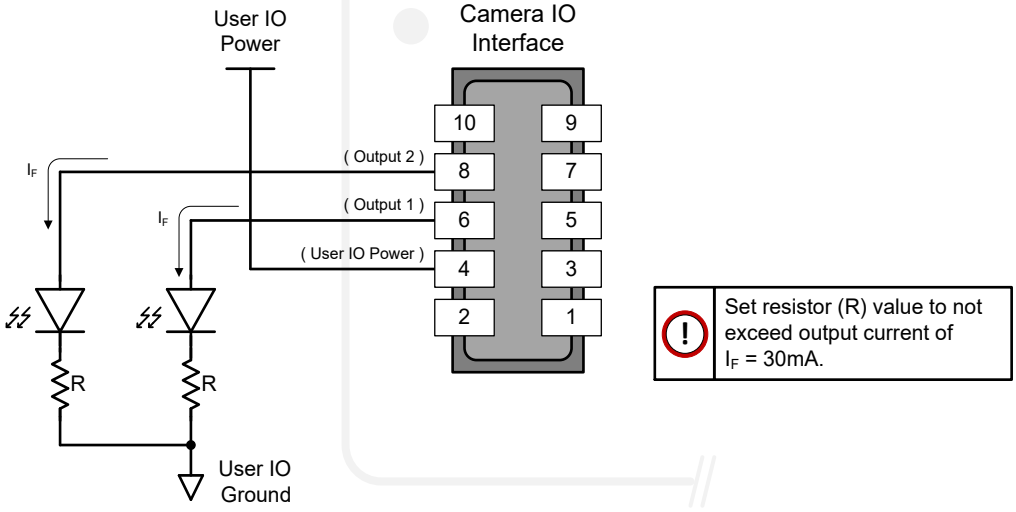
Output Common Power	Output Current	R_{load} *Test (ohm)*	t_{d1} (us) *Leading Delay*	t_{rise} (µs) *Rise Time*	t_{d2} (µs) *Trailing Delay*	t_{fall} (µs) *Fall Time*	V_{out} (V)
5V	8 mA	561	1.69	1.2144	0.897	0.811	4.53
	16 mA	277	1.883	1.6192	0.502	0.659	4.45
	24 mA	182	2.021	1.9789	0.225	0.65	4.37
12V	8 mA	1444	0.934	0.2321	2.357	0.949	11.49
	16 mA	713	0.945	0.2563	1.759	0.369	11.41
	24 mA	467	0.952	0.2739	1.481	0.224	11.33
24V	8 mA	2930	0.81	0.2079	3.542	1.639	23.57
	16 mA	1464	0.803	0.2244	2.908	0.981	23.47
	24 mA	970	0.82	0.2222	2.331	0.616	23.39

External Outputs: Using External TTL/LVTTL Drivers

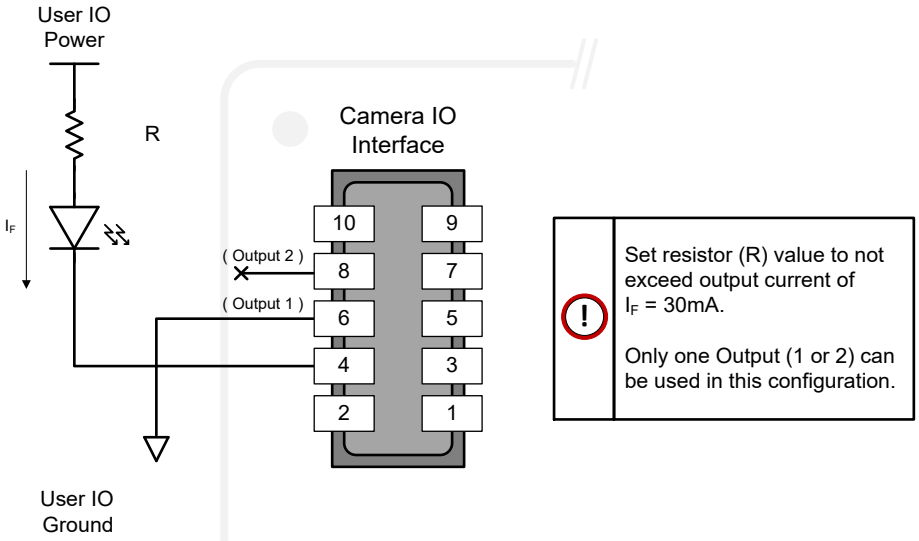


External Outputs: Using External LED Indicators

- Two external LEDs can be connected in the Common Cathode configuration.

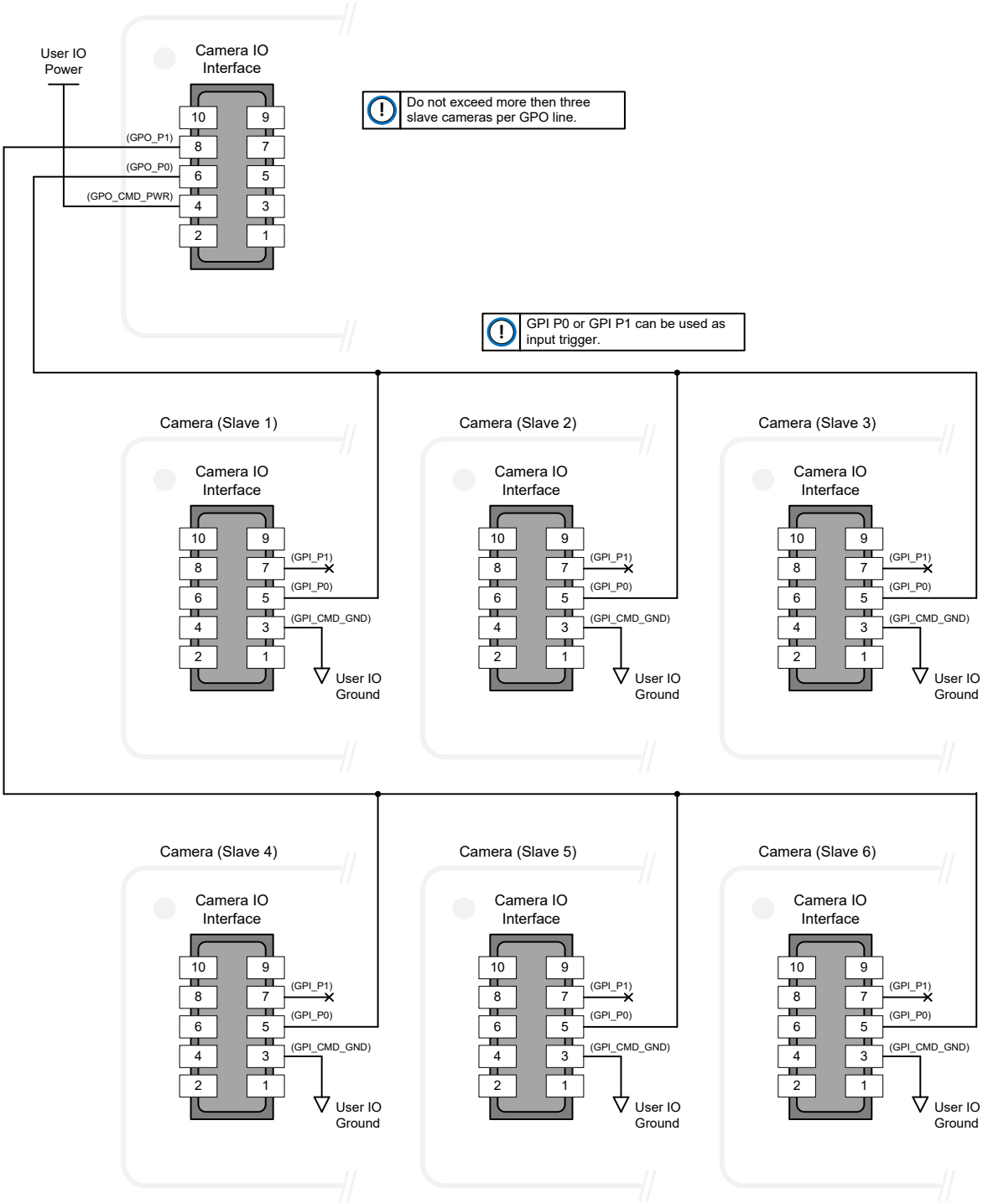


- Alternatively one external LED can be connected in the Common Anode configuration.



Using Nano-CXP Outputs to drive other Nano-CXP Inputs

- A synchronization method where one Nano-CXP camera signals other Nano-CXP cameras.
- Note: One Nano-CXP output can drive a maximum of three Nano-CXP inputs, as illustrated below.

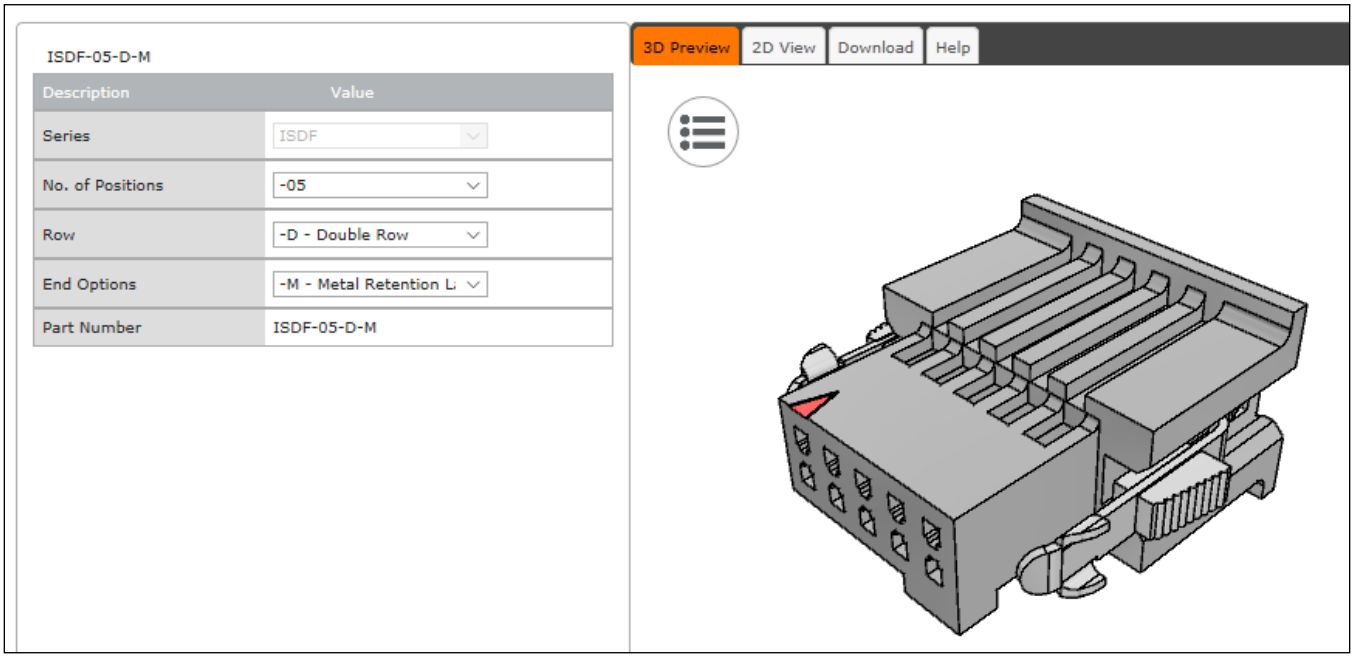


I/O Mating Connector Specifications & Sources

For users wishing to build their own custom I/O cabling, the following product information is provided to expedite your cable solutions. SAMTEC web information for the discrete connector and a cable assembly with retention clips follows the table.

MFG	Part #	Description	Data Sheet
Samtec	ISDF-05-D ISDF-05-D-M (*see image below*)	Discrete Connector *(see example below)*	https://www.samtec.com/products/isdf
Samtec	SFSD-05-[WG]-G-[AL]-DR-[E2O] *WG : Wire Gauge* *AL : Assembled Length* *E2O : End 2 Option*	Discrete Cable Assembly *(see example below)*	https://www.samtec.com/products/sfsd
ISDF-05-D-M Connector Availability On-Line			
North-America (specific country can be selected)	http://www.newark.com/samtec/isdf-05-d-m/connector-housing-receptacle-10/dp/06R6184		
Europe (specific country can be selected)	http://uk.farnell.com/samtec/isdf-05-d-m/receptacle-1-27mm-crimp-10way/dp/2308547?ost=ISDF-05-D-M		
Asia-Pacific (specific country can be selected)	http://sg.element14.com/samtec/isdf-05-d-m/receptacle-1-27mm-crimp-10way/dp/2308547?ost=ISDF-05-D-M		
Important: *Samtec ISDF-05-D-S is not compatible with Genie Nano*			

Samtec ISDF-05-D-M mating connector for customer built cables w/retention clips ".050" Tiger Eye™ Discrete Wire Socket Housing"

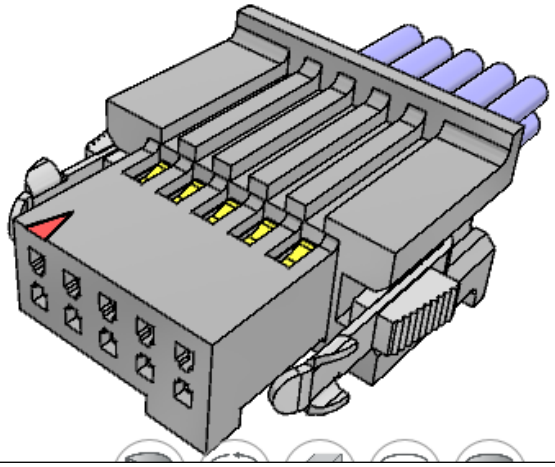


Samtec connector-cable assembly SFSD-05-28-H-03.00-SR w/retention clips ".050" Tiger Eye™ Double Row Discrete Wire Cable Assembly, Socket"

SFSD-05-28-H-03.00-SR

Description	Value
Series	SFSD
No. of Positions	-05
Wire Gauge	-28 AWG
Wire Color Code	All Black Wire
Plating Options	-H - 30µ" Heavy Gold
Assembly Length	3.00 INCH
End Option	-SR - Single Ended wit
Notch Option	Not Available
Part Number	SFSD-05-28-H-03.00-SR
Cable Type Option	PVC Cable

3D Preview | 2D View | Download | Help



Declarations of Conformity

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

FCC Statement of Conformance for Class A

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

1. The product may not cause harmful interference; and

2. The product must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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

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

EU and UKCA Declaration of Conformity

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

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

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

Additional Reference Information

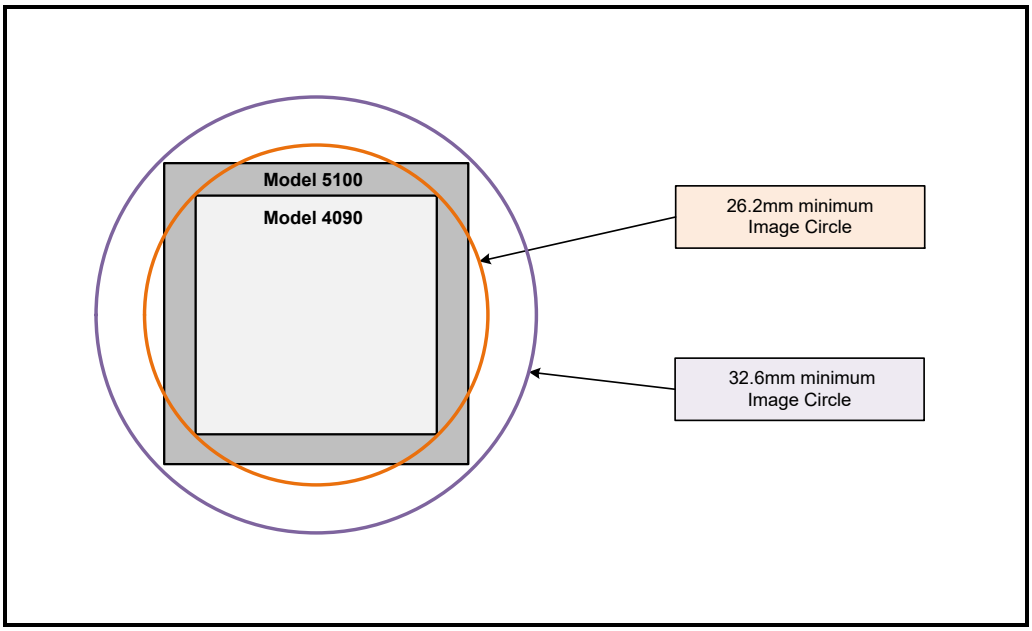
Choosing a Lens with the Correct Image Circle

Each Nano model requires a lens with an image circle specification to fully illuminate the sensor. The following section graphically shows the minimum lens image circle for each Nano model family along with alternative lens types. Brief information on other lens parameters to consider follows those sections.

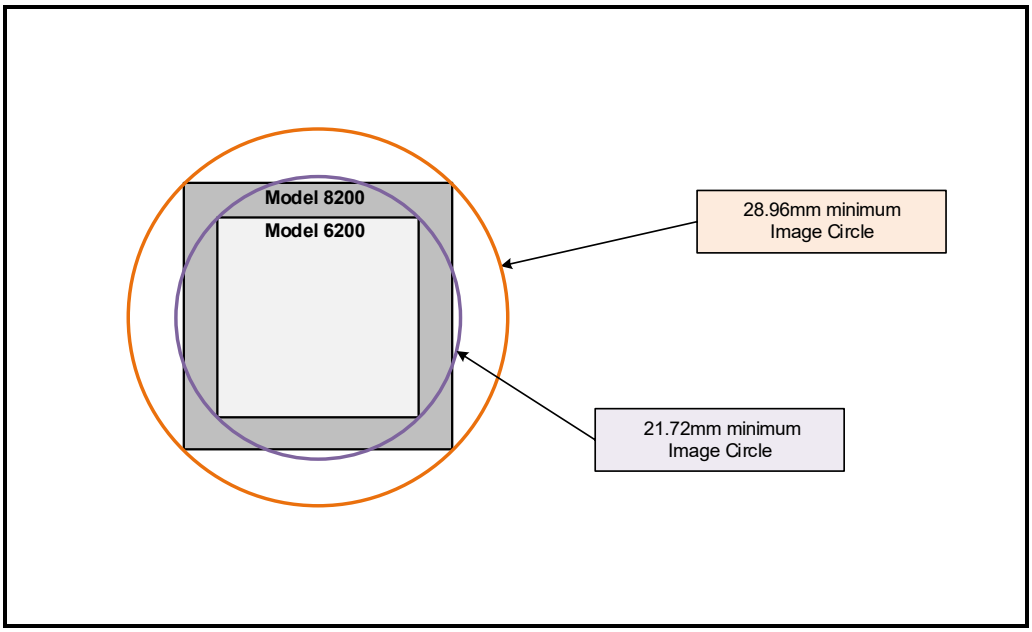
Lens Options for CXP Models with M42 Mounts

These Nano-CXP models have a M42 screw mount where M42 lens or F-mount lens (via an adapter) need to have image circles exceeding the diameter of either of these larger sensors.

The following figure shows the lens image circles relative to Genie Nano-CXP models using the OnSemi Python 25K and Python 16K sensors.



The following figure shows the lens image circles relative to Genie Nano-CXP models using the Teledyne E2V Emerald 37.7M (Four Thirds image sensor format) and 67.1M (APS-C image sensor format) sensors.



Additional Lens Parameters (application-specific)

There are other lens parameters that are chosen to meet the needs of the vision application. These parameters are independent of the Nano model (assuming that the Lens Mount and Lens Sensor Size parameters are correct, as previously covered in this section). A vision system integrator or lens specialist should be consulted when choosing lenses since there is a trade-off between the best lenses and cost. An abridged list of lens parameters follows – all of which need to be matched to the application.

- **Focal Length**: Defines the focus point of light from infinity. This parameter is related to the Nano mount (C or CS mount).
- **Field of View**: A lens is designed to image objects at some limited distance range, at some positive or negative magnification. This defines the field of view.
- **F-Number (aperture)**: The lens aperture defines the amount of light that can pass. Lenses may have fixed or variable apertures. Additionally the lens aperture affects Depth of Field which defines the distance range which is in focus when the lens is focus at some specific distance.
- **Image Resolution and Distortion**: A general definition of image quality. A lens with poor resolution seems to never be in focus when used to image fine details.
- **Aberrations (defect, chromatic, spherical)**: Aberrations are specific types of lens faults affecting resolution and distortion. Lens surface defects or glass faults distort all light or specific colors. Aberrations are typically more visible when imaging fine details.
- **Spatial Distortions**: Describes non-linear lens distortions across the field of view. Such distortion limits the accuracy of measurements made with that lens.

Optical Considerations

This section provides an overview to illumination, light sources, filters, lens modeling, and lens magnification. Each of these components contributes to the successful design of an imaging solution.

Illumination

The amount and wavelengths of light required to capture useful images depend on the particular application. Factors include the nature, speed, and spectral characteristics of objects being imaged, exposure times, light source characteristics, environmental and acquisition system specifics, and more. The Teledyne DALSA Web site provides an introduction to this potentially complicated issue. Click on Knowledge Center and then select Application Notes and Technology Primers. Review the sections of interest.

It is often more important to consider exposure than illumination. The total amount of energy (which is related to the total number of photons reaching the sensor) is more important than the rate at which it arrives. For example, $5\mu J/cm^2$ can be achieved by exposing $5mW/cm^2$ for 1ms just the same as exposing an intensity of $5W/cm^2$ for $1\mu s$.

Light Sources

Keep these guidelines in mind when selecting and setting up light source:

- LED light sources are relatively inexpensive, provide a uniform field, and longer life span compared to other light sources. However, they also require a camera with excellent sensitivity.
- Halogen light sources generally provide very little blue relative to infrared light (IR).
- Fiber-optic light distribution systems generally transmit very little blue relative to IR.
- Some light sources age such that over their life span they produce less light. This aging may not be uniform—a light source may produce progressively less light in some areas of the spectrum but not others.

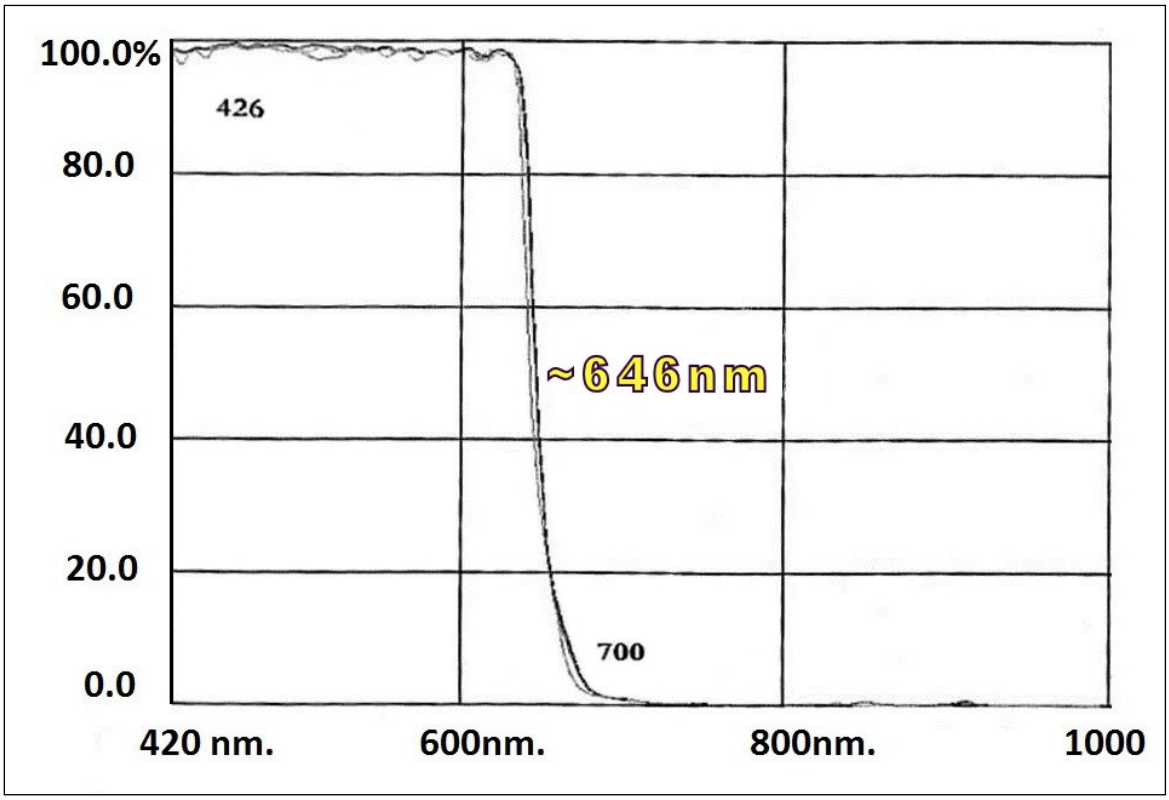
IR Cut-off Filters for Color Cameras

Genie Nano cameras are responsive to near infrared (IR) wavelengths. To prevent infrared from distorting the color balance of visible light acquisitions, use a "hot mirror" or IR cut-off filter that transmits visible wavelengths but does not transmit near infrared wavelengths and above.

Genie Nano color cameras have a spectral response that extends into near IR wavelengths (as defined for each sensor model in the sensor specification descriptions). Images captured will have washed out color if the sensor response is not limited to the visible light band.

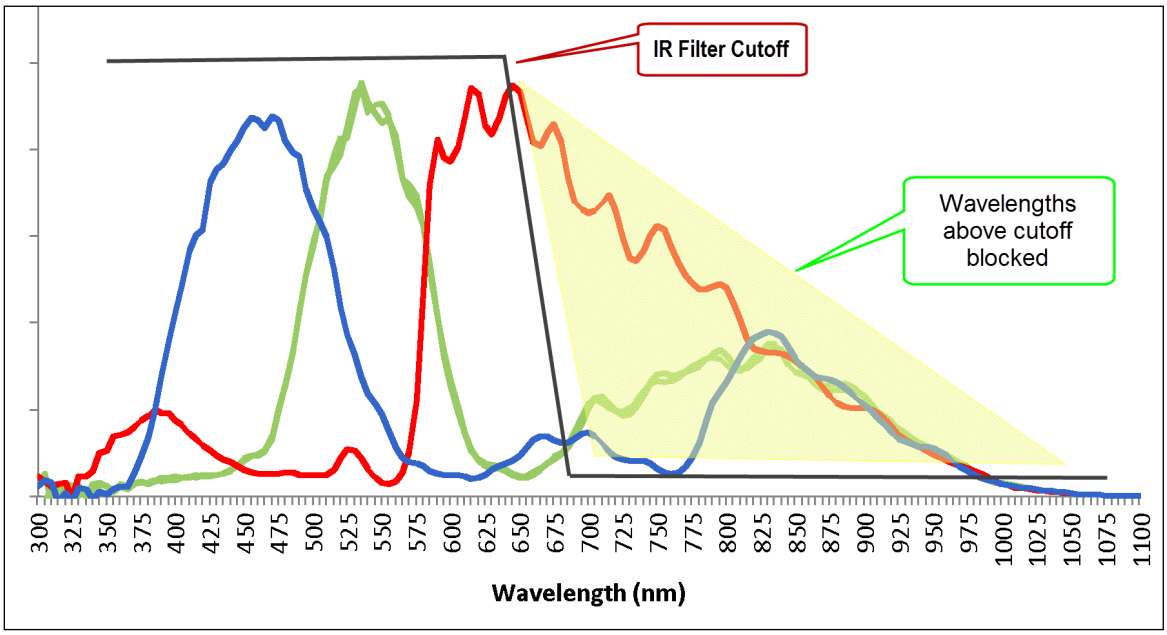
Nano Models with Built-in IR Cut-off Filters

Choose Nano color cameras with built-in IR Cut-off Filters for a simple generalized solution. The following graphic shows these models having an IR filter with a specified cut-off of about 646nm.



Guidelines for Choosing IR Cut-off Filters

The following graphic, using a color sensor response spectrum, shows the transmission response of typical filters designed for CMOS sensor cameras. When selecting an IR cut-off filter, choose a near infrared blocking specification of ~650nm. Filters that block at 700nm or longer wavelengths, designed for CCD cameras, are not recommended for Genie Nano color cameras.



Back Focal Variance when using any Filter

Inserting a filter between a lens and sensor changes the back focal point of the lens used. A variable focus lens simply needs to be adjusted, but in the case of a fixed focus lens, the changed focal point needs correction.

The following simplified illustration describes this but omits any discussion of the Optics, Physics, and the math behind the refraction of light through glass filter media.

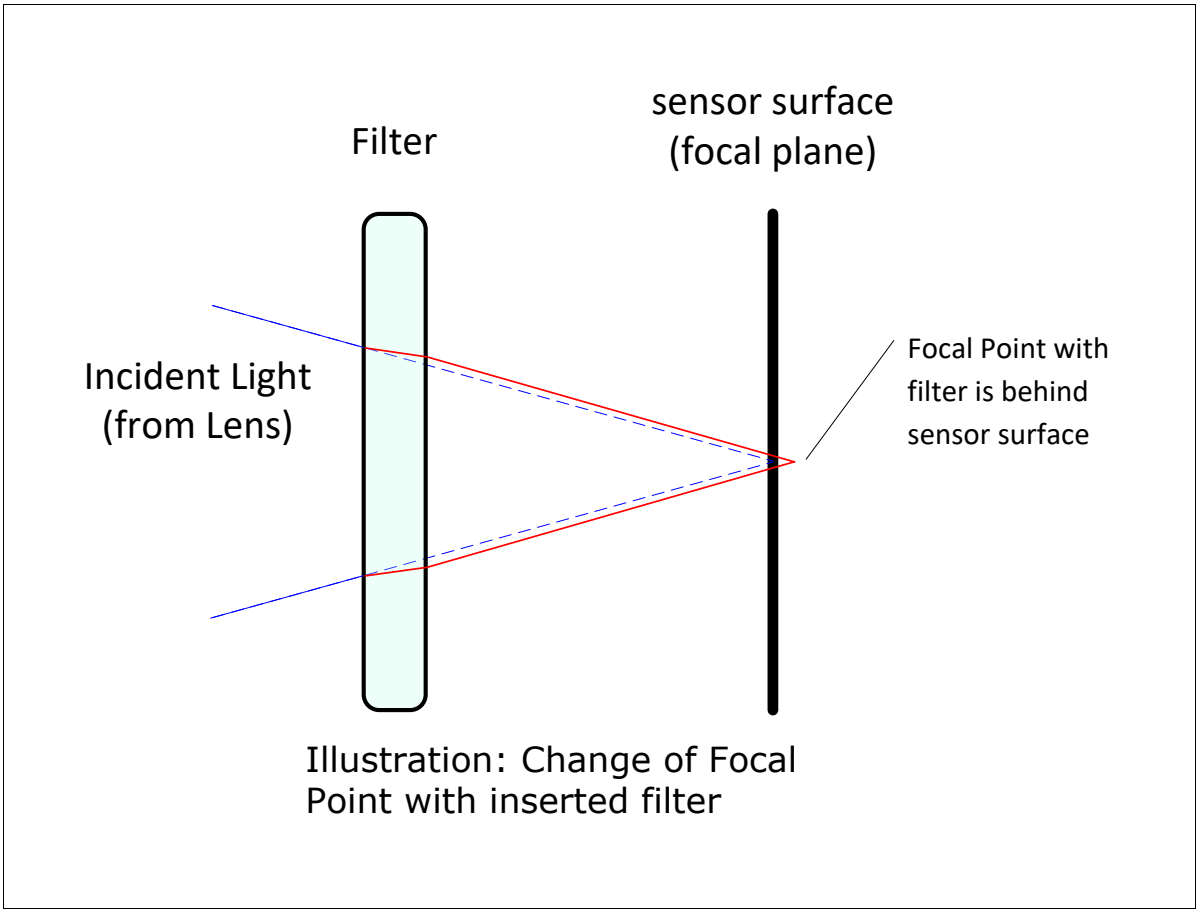


Illustration: Change of Focal Point with inserted filter

In this example when a glass filter is inserted between the lens and the camera sensor, the focal point is now about 1/3 of the filter thickness behind the sensor plane. Genie Nano filters are specified as 1mm thick.

Genie Nano models with factory installed filters automatically compensate for the focal point variance by having the sensor PCB mounted deeper within the camera body.

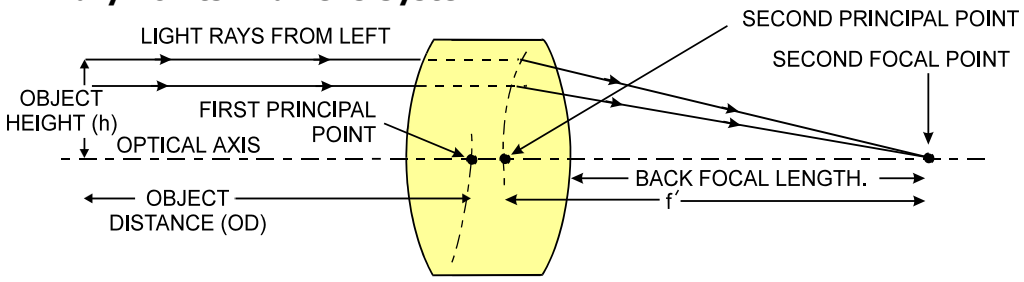
For Nano models normally shipped without filters, when a filter is installed a fixed focus lens requires a 1/3mm C-mount shim (spacer) added to move the lens focal point back to the sensor surface. Such shims are available from filter and lens suppliers. Alternatively, use a variable focus lens and secure its focus ring after adjustment.

Lens Modeling

Any lens surrounded by air can be modeled for camera purposes using three primary points: the first and second principal points and the second focal point. The primary points for a lens should be available from the lens data sheet or from the lens manufacturer. Primed quantities denote characteristics of the image side of the lens. That is, h is the object height and h′ is the image height.

The focal point is the point at which the image of an infinitely distant object is brought to focus. The effective focal length (f′) is the distance from the second principal point to the second focal point. The back focal length (BFL) is the distance from the image side of the lens surface to the second focal point. The object distance (OD) is the distance from the first principal point to the object.

Primary Points in a Lens System



Magnification and Resolution

The magnification of a lens is the ratio of the image size to the object size:

$m = \frac{h'}{h}$	Where m is the magnification, h′ is the image height (pixel size) and h is the object height (desired object resolution size).

By similar triangles, the magnification is alternatively given by:

$m = \frac{f'}{OD}$

These equations can be combined to give their most useful form:

$\frac{h'}{h} = \frac{f'}{OD}$	This is the governing equation for many object and image plane parameters.

Example: An acquisition system has a 512 x 512 element, 10μm pixel pitch area scan camera, a lens with an effective focal length of 45mm, and requires that 100μm in the object space correspond to each pixel in the image sensor. Using the preceding equation, the object distance must be 450mm (0.450m).

$\frac{10\,\mu m}{100\,\mu m} = \frac{45\,mm}{OD}$	$OD = 450\text{mm}$

Sensor Handling Instructions

This section reviews proper procedures for handling, cleaning, or storing the Genie Nano camera. Specifically the Genie Nano sensor needs to be kept clean and away from static discharge to maintain design performance.

Electrostatic Discharge and the Sensor

Cameras sensors containing integrated electronics are susceptible to damage from electrostatic discharge (ESD).

Electrostatic charge introduced to the sensor window surface can induce charge buildup on the underside of the window that cannot be readily dissipated by the dry nitrogen gas in the sensor package cavity. With charge buildup, problems such as higher image lag or a highly non-uniform response may occur. The charge normally dissipates within 24 hours and the sensor returns to normal operation.

Important: Charge buildup will affect the camera's flat-field correction calibration. To avoid an erroneous calibration, ensure that you perform flat-field correction only after a charge buildup has dissipated over 24 hours.

Protecting Against Dust, Oil and Scratches

The sensor window is part of the optical path and should be handled like other optical components, with extreme care.

Dust can obscure pixels, producing dark patches on the sensor response. Dust is most visible when the illumination is collimated. The dark patches shift position as the angle of illumination changes. Dust is normally not visible when the sensor is positioned at the exit port of an integrating sphere, where the illumination is diffuse.

Dust can normally be removed by blowing the window surface using a compressed air blower, unless the dust particles are being held by an electrostatic charge, in which case either an ionized air blower or wet cleaning is necessary.

Oil is usually introduced during handling. Touching the surface of the window barehanded will leave oily residues. Using rubber finger cots and rubber gloves can prevent oil contamination. However, the friction between the rubber and the window may produce electrostatic charge that may damage the sensor.

Scratches can be caused by improper handling, cleaning or storage of the camera. When handling or storing the Nano camera without a lens, always install the C-mount protective cap. Scratches diffract incident illumination. When exposed to uniform illumination, a sensor with a scratched window will normally have brighter pixels adjacent to darker pixels. The location of these pixels changes with the angle of illumination.

Cleaning the Sensor Window

Even with careful handling, the sensor window may need cleaning. The following steps describe various cleaning techniques to clean minor dust particles to accidental finger touches.

- Use compressed air to blow off loose particles. This step alone is usually sufficient to clean the sensor window. Avoid moving or shaking the compressed air container and use short bursts of air while moving the camera in the air stream. Agitating the container will cause condensation to form in the air stream. Long air bursts will chill the sensor window causing more condensation. Condensation, even when left to dry naturally, will deposit more particles on the sensor.
- When compressed air cannot clean the sensor, Teledyne DALSA recommends using lint-free ESD-safe cloth wipers that do not contain particles that can scratch the window. The Anticon Gold 9”x 9” wiper made by Milliken is both ESD safe and suitable for class 100 environments. Another ESD acceptable wiper is the TX4025 from Texwipe.
- An alternative to ESD-safe cloth wipers is Transplex swabs that have desirable ESD properties. There are several varieties available from Texwipe. Do not use regular cotton swabs, since these can introduce static charge to the window surface.
- Wipe the window carefully and slowly when using these products.

Ruggedized I/O Cable Accessories

Teledyne DALSA provides optional I/O cable assemblies for Genie Nano. Users wishing to build their I/O cabling by starting from available cable packages should consider these popular assemblies described below. Contact Sales for pricing and delivery.

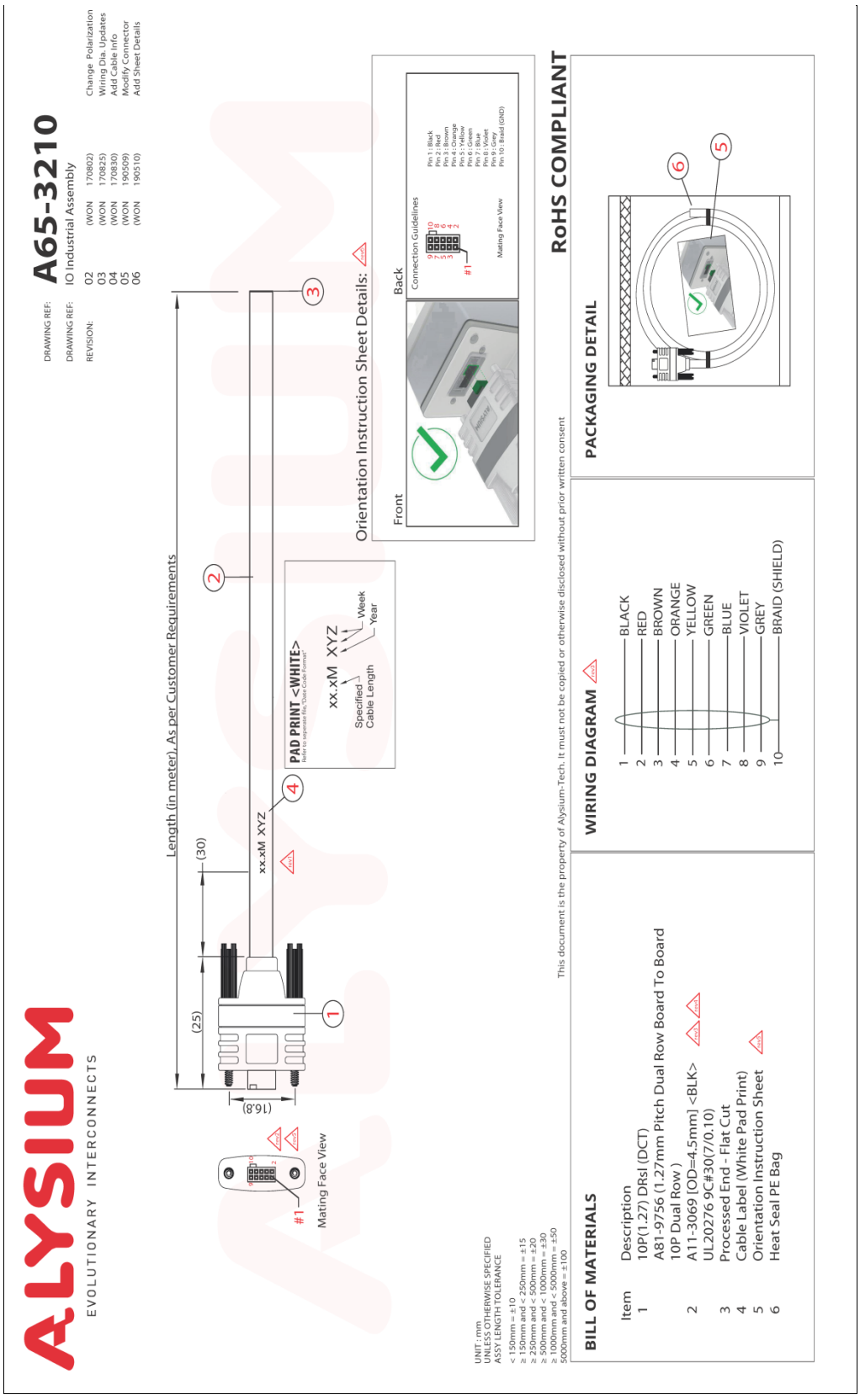
Users also may order cable assembly quantities directly from Alysium-Tech or Components Express. In such cases use the manufacturer’s part number shown on the cable assembly engineering drawing.

Cable Manufactures Contact Information

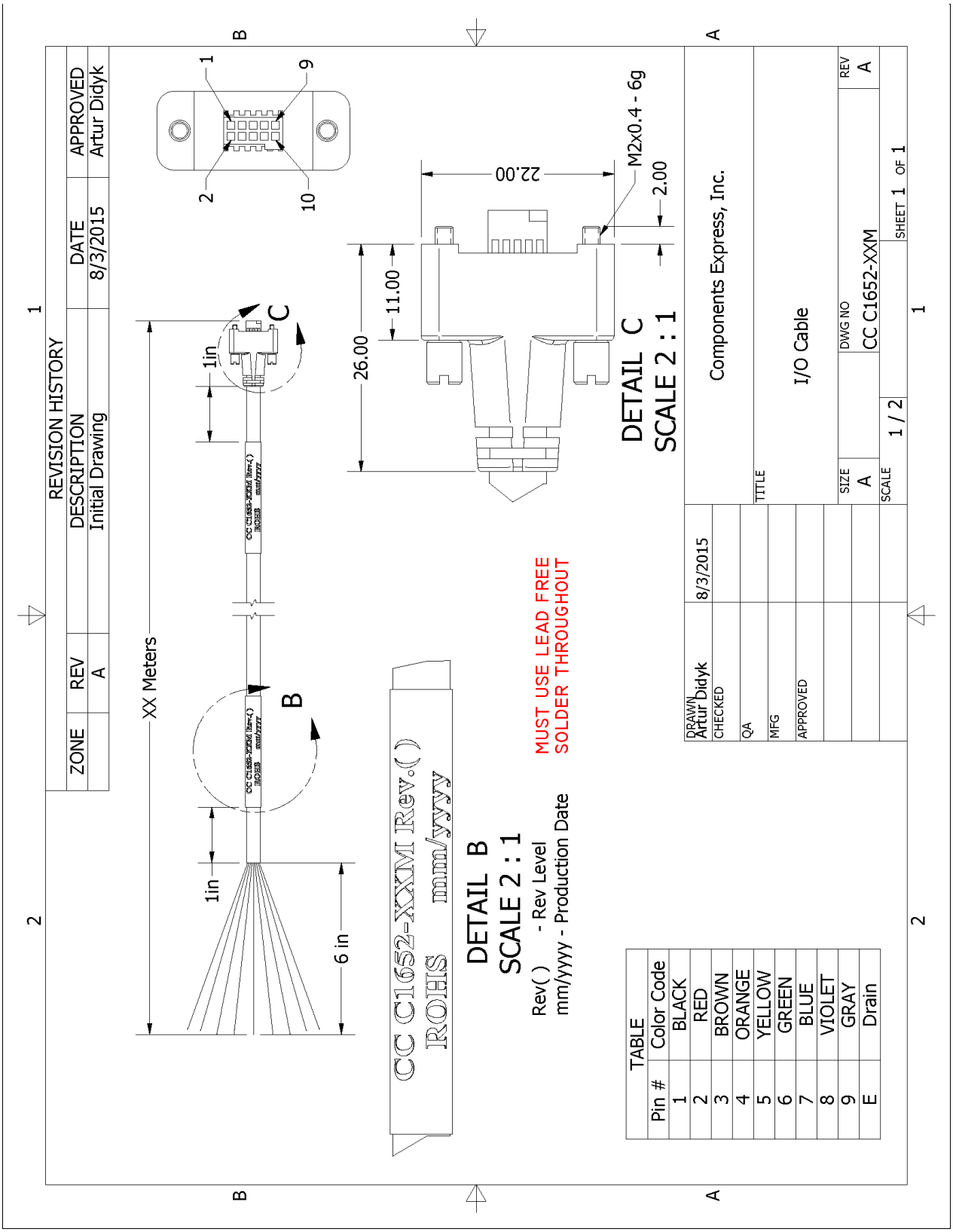
For Information contact: *(see their web site for worldwide offices)*	Alysium-Tech 101 Montgomery Street, Suite 2050 San Francisco, CA 94104 Phone: 415 248 7807 Fax: 415 248 7800 https://www.alysium.com/

For Information contact: *(see their web site for worldwide offices)*	Components Express, Inc. (CEI) 10330 Argonne Woods Drive, Suite 100 Woodridge, IL 60517-4995 Phone: 630-257-0605 / 800.578.6695 (outside Illinois) Fax: 630-257-0603 http://www.componentsexpress.com/

Cable Assembly G3-AIOC-BLUNT1M

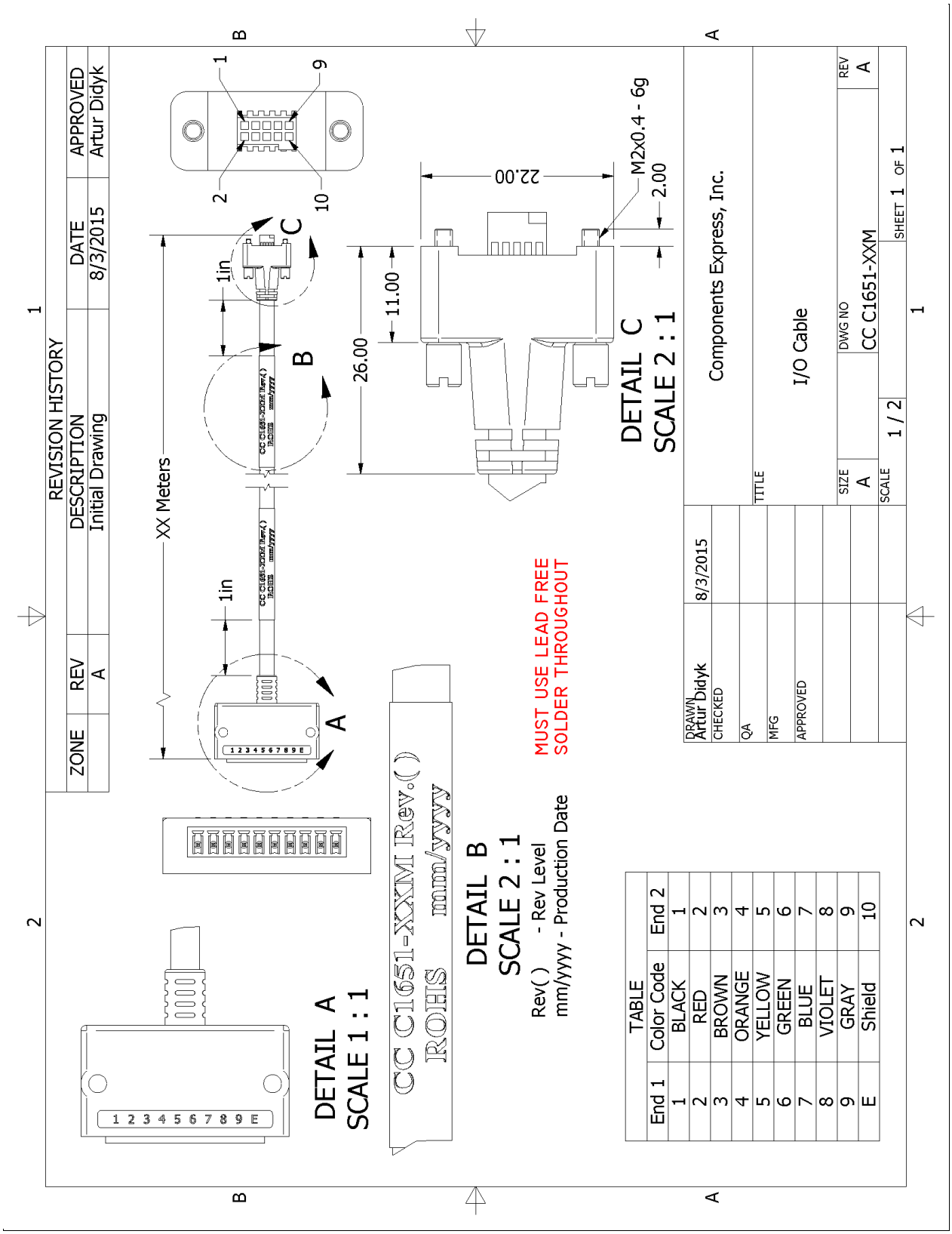


Cable Assembly G3-AIOC-BLUNT2M




ROHS
08/2015

Cable Assembly G3-AIOC-BRKOUT2M




1 2 3 4 5 6 7 8 9 E
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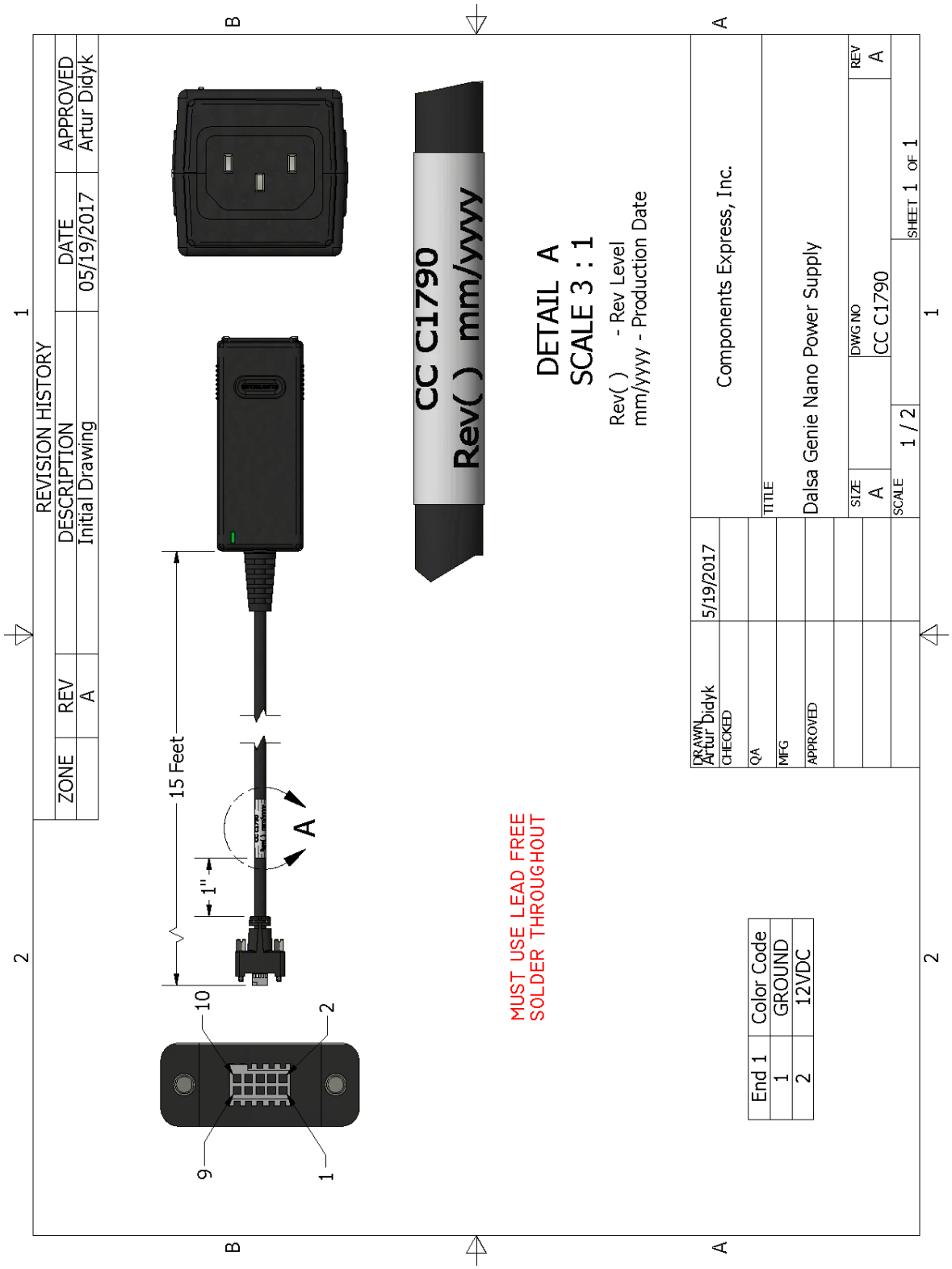
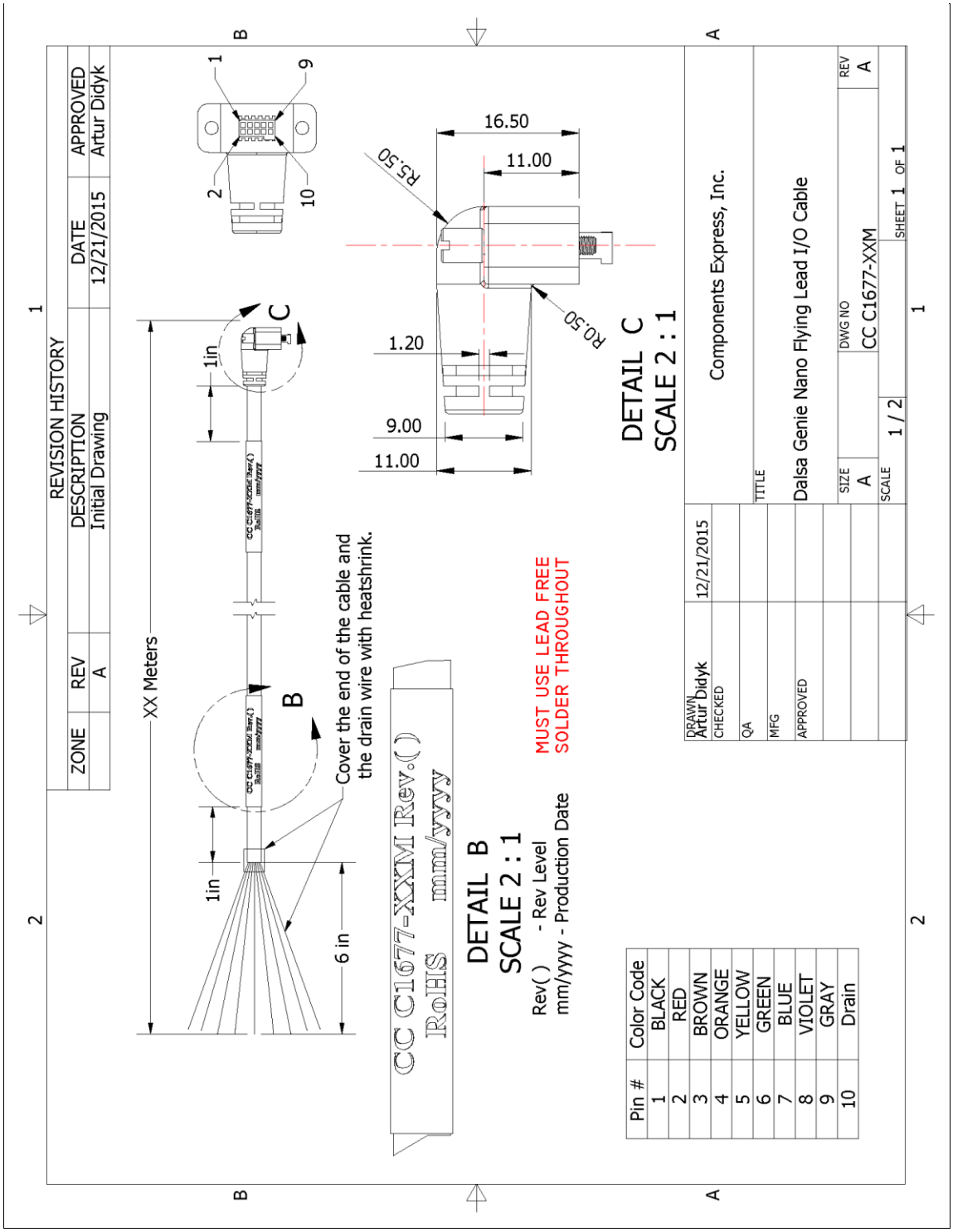
Nano Generic Power Supply with no I/O



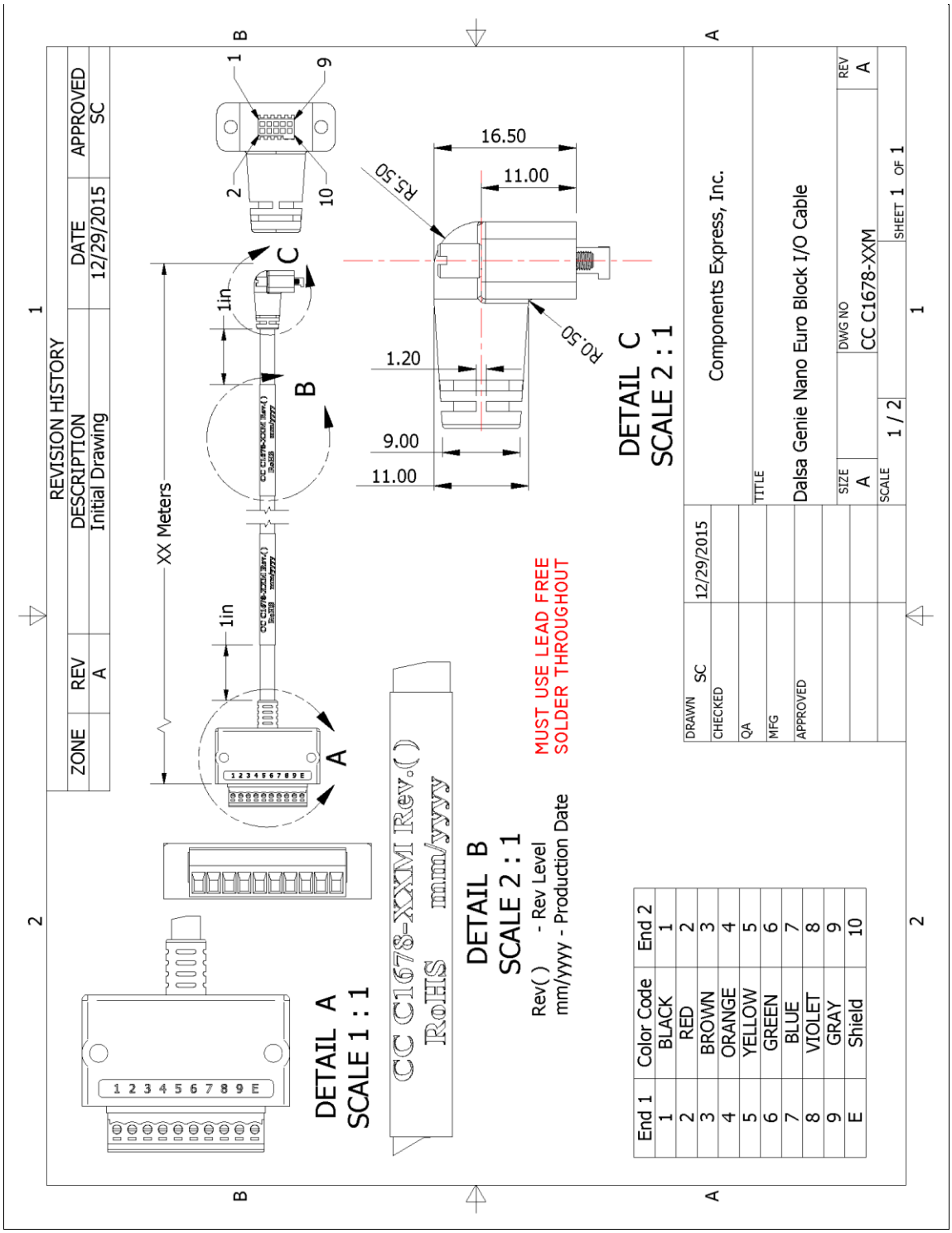
Components Express Right-Angle Cable Assemblies

These cable assemblies can be acquired directly from our partner Components Express. In such cases use the manufacturer's part number shown on the cable assembly engineering drawing.

Cable Assembly: Right-Angle I/O Bunt End



Cable Assembly: Right-Angle I/O to Euro Block



Troubleshooting

Overview

In rare cases an installation may fail or there are problems in controlling and using the Nano camera. This section highlights issues or conditions which may cause installation problems. Emphasis is on the user to perform diagnostics with the tools provided plus methods are described to correct the problem.

Problem Type Summary

Nano-CXP problems are either installation issues due to cabling or power, or setup errors with the frame grabber configuration.

Before Contacting Technical Support

Carefully review the issues described in this Troubleshooting section. To aid Teledyne DALSA personnel when support is required, the following should be included with the request for support.

- From the Start menu, go to **Programs ● Dalsa ● Sapera LT ● Tools** and run the **Log Viewer** program. From its File menu click on **Save Messages** to generate a log text file.
- Report the version of Genie Nano Firmware and Sapera version used.
- Report the frame grabber brand and model used. Provide specifications for any third part frame grabber used.

Device Available with Operational Issues

This section considers issues with frame grabbers, cabling, multiple cameras and camera exposure.

Firmware Updates

As a general rule any Nano installation must include the firmware update procedure to ensure having the latest build (see Updating Firmware via File Access in CamExpert).

Note:

- A Nano-CXP that had a fault with a firmware update will automatically recover by booting with the previous firmware version.

Important: New Nano-CXP cameras installed in previously deployed systems are fully backward compatible with the older vision application.

Power Failure during a Firmware Update–Now What?

Don't panic! There is far greater chance that the host computer OS is damaged during a power failure than any permanent problems with the Nano. When electrical power returns and the host computer system has restarted follow this procedure.

- Connect power to the Nano-CXP. The Nano processor knows that the firmware update failed.
- The Nano-CXP will boot with the previous version of firmware and will operate normally.
- The Nano Self Status (deviceBISTStatus) will return that the last firmware update failed.
- Perform the firmware update procedure again.

Cabling and Communication Issues

With only 4 CXP coax cables and possibly an external power supply (if not using PoCXP), possible cabling issues are limited.

Power supply problems:

- If using PoCXP power, verify that the frame grabber used has activated its PoCXP source function. Note that the frame grabber typically requires direct PC power connected to it, as directed by the grabber's user manual.
- If using DC supply power via the I/O camera connector, verify the power supply voltage and I/O cable wiring.

Communication Problems:

- Use quality DIN 1.0/2.3 coax cables along with quality shielded I/O cables. This can eliminate issues in a high EMI environment. Purchase CXP cables from certified sources.
- Use the Log Viewer tool (see point below) for error conditions.
- Run the Sapera Log Viewer: **Start●Programs●Teledyne DALSA●Sapera LT●Tools●Log Viewer**. Start the Nano-CXP acquisition program, such as CamExpert. Review the log output for error messages.

Camera is functional, frame rate is as expected, but image is black

- Using CamExpert set the Nano-CXP to output its Internal Pattern Generator (with external trigger Off). This step is typically done for any camera installation to quickly verify the Nano and its software package.
- If using an external trigger exposure (via the frame grabber), verify the trigger source rate and pulse width coming from the grabber parameters.
- Verify that the lens iris is open.
- Aim the Nano-CXP at a bright light source.
- Check that the programmed exposure duration is not too short or set it to maximum.

Revision History

Revision	Date	Major Change Description
R: 0.2	August 29, 2019	Preliminary version made available
R: 0001	October 4, 2019	Initial release
R: 0002	February 14, 2020	Various updates
R: 0002	March 3, 2020	Additional updates
R: 0003	September 10, 2020	Minor error corrections
R: 0004	April 7, 2022	Added new models

Contact Information

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Technical Support

Submit any support question or request via our web site:

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