# Genie Nano-CL Series™

## Camera User's Manual

### Camera Link – Monochrome & Color Area Scan

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


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**Notice**



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**About Teledyne DALSA, a business unit of Teledyne Digital Imaging Inc.**
Teledyne DALSA is an international high performance semiconductor and Electronics Company that designs, develops, manufactures, and markets digital imaging products and solutions, in addition to providing wafer foundry services.

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

# Contents

# Nano-CL Series Overview

## Description

The Genie Nano-CL Camera Link 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, monochrome NIR, or color (raw Bayer) versions.

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

## Genie Nano Overview

- Supports Power Over Camera Link (  ) or an auxiliary power input
- Optimized, rugged design with a wider operating temperature
- Available in multiple sensors/resolutions, monochrome and color
- Visual camera multicolor status LED on back plate
- 1 CC signal lines via the camera link cable
- Flexible general purpose Counter and Timer functions available for internal and external controls
- Software and hardware Events available to support imaging applications
- Defective Pixel replacement available
- User Settings to store Defective Pixel Maps
- Lens Shading Correction Maps for lens vignetting
- 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
- Camera Link v2.1, GenICam GenCP compliant
- Supports Camera link Base configuration or 80-bit configuration and Full configuration

## 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-CL 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 File Access via the CamExpert Tool). 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-CL monochrome and color models summarized in the tables below. These tables list models in increasing resolution. Nano common specifications and details for each Genie Nano model follow this section.

## Monochrome Camera Link Base Mode

| Nano-CL Model Full Resolution | Sensor Size/Model | Lens | Part Number |
|---|---|---|---|
| **M2420** 2464 x 2056 | **Sony 5.1M** (IMX264) | C-mount | **G3-CM31-M2420** |
| **M4020** 4112 x 3008 | **Sony 12M** (IMX304) | C-mount | **G3-CM31-M4020** |

## Monochrome Camera Link DECA Mode

| Nano-CL Model Full Resolution | Sensor Size/Model | Lens | Part Number |
|---|---|---|---|
| **M2450** 2448 x 2048 | **Sony 5.1M** (IMX250) | C-mount | **G3-CM30-M2450** |
| **M4060** 4112 x2176 | **Sony 8.9M** (IMX255) | C-mount | **G3-CM30-M4060** |
| **M4040** 4112 x 3008 | **Sony 12M** (IMX253) | C-mount | **G3-CM30-M4040** |
| **M4160** 4128 x 4128 | **E2V Emerald 16M** (EV2S16M) | C-mount | **G3-CM30-M4160** |
| **M4090** 4096 x 4096 | **On-Semi 16M** (Python 16K) | M42 mount | **G3-CM10-M4095** |
| **M4090-NIR** 4096 x 4096 | **On-Semi 16M** (Python 16K) | M42 mount | **G3-CM12-M4095** |
| **M5100** 5120 x 5120 | **On-Semi 25M** (Python 25K) | M42 mount | **G3-CM10-M5105** |
| **M5100-NIR** 5120 x 5120 | **On-Semi 25M** (Python 25K) | M42 mount | **G3-CM12-M5105** |

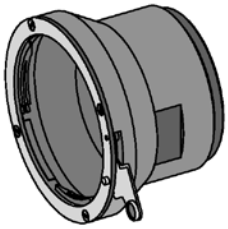
# Color Camera Link Base Mode

| Nano-CL Model<br>Full Resolution | Sensor Size/Model | Lens | Part Number |
|---|---|---|---|
| **C2420**<br>2464 x 2056 | **Sony 5.1M**<br>(IMX264) | C-mount | **G3-CC31-C2420** |
| **C4020**<br>4112 x 3008 | **Sony 12M**<br>(IMX304) | C-mount | **G3-CC31-C4020** |

# Color Camera Link DECA Mode

| Model<br>Full Resolution | Sensor Size/Model | Lens | Part Number | Notes |
|---|---|---|---|---|
| **C2450**<br>2448 x 2048 | **Sony 5.1M**<br>(IMX250) | C-mount | **G3-CC30-C2450** | |
| | | | **G3-CC30-C2450IF** | with IR Cut-off Filter |
| **C4060**<br>4112 x 2176 | **Sony 8.9M**<br>(IMX255) | C-mount | **G3-CC30-C4060** | |
| | | | **G3-CC30-C4060IF** | with IR Cut-off Filter |
| **C4040**<br>4114 x 3008 | **Sony 12M**<br>(IMX253) | C-mount | **G3-CC30-C4040** | |
| | | | **G3-CC30-C4040IF** | with IR Cut-off Filter |
| **C4160**<br>4128 x 4128 | **E2V Emerald 16M**<br>(EV2S16M color) | C-mount | **G3-CC30-C4160** | |
| **C4090**<br>4096 x 4096 | **On-Semi 16M**<br>(Python 16K) | M42 mount | **G3-CC10-C4095** | |
| **C5100**<br>5120 x 5120 | **On-Semi 25M**<br>(Python 25K) | M42 mount | **G3-CC10-C5105** | |

# Accessories

| Nano Accessories & Cables (sold separately) | | Order Number |
|---|---|---|
| Mounting Bracket Plate<br><br>(2 or 3 screw camera mount),<br>with ¼ inch external device screw mount<br>(also known as a tripod mount) |  | G3-AMNT-BRA01 |
| I/O Blunt End Cable<br><br>(1 meter Screw Retention to Flying Leads)<br><br>(2 meter Screw Retention to Flying Leads) |  | G3-AIOC-BLUNT1M<br><br>G3-AIOC-BLUNT2M |
| I/O Breakout Cable<br><br>(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 |
| Nano-CL — M42 to F-mount (Nikon) adapter<br>(same adapter as used with Genie TS)<br>*Note that there is no support for Nikon lens features such as focus and aperture motor controls.* |  | G2-AM42-MOUNT4 |

Right angle I/O cables and Ethernet cables (including combo evaluation packages) 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 systems using the Nano-CL.

# Frame Grabbers and Cabling

The Nano-CL has a Camera Link Pixel Clock of 85MHz. Teledyne DALSA Xtium series frame grabbers are recommended for error free acquisitions (contact sales for additional information).

Teledyne DALSA has also qualified 10 meter cables with the Teledyne DALSA Xtium frame grabber at 85MHz using Camera Link cables (end to end standard solutions of various lengths) from Components Express and Alysium, who also offer I/O signal solutions as described in this manual. See Cable Manufactures Contact Information for contact information.

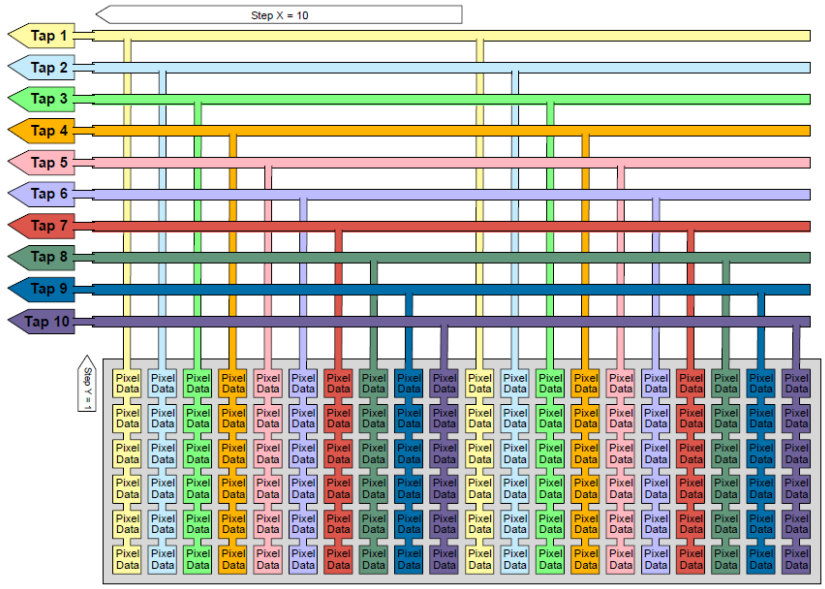
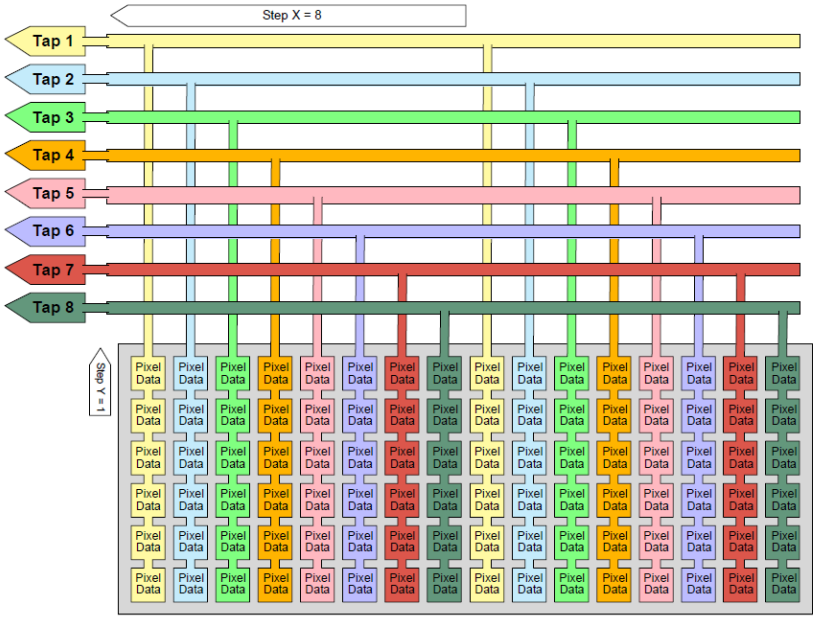
# Software Platforms

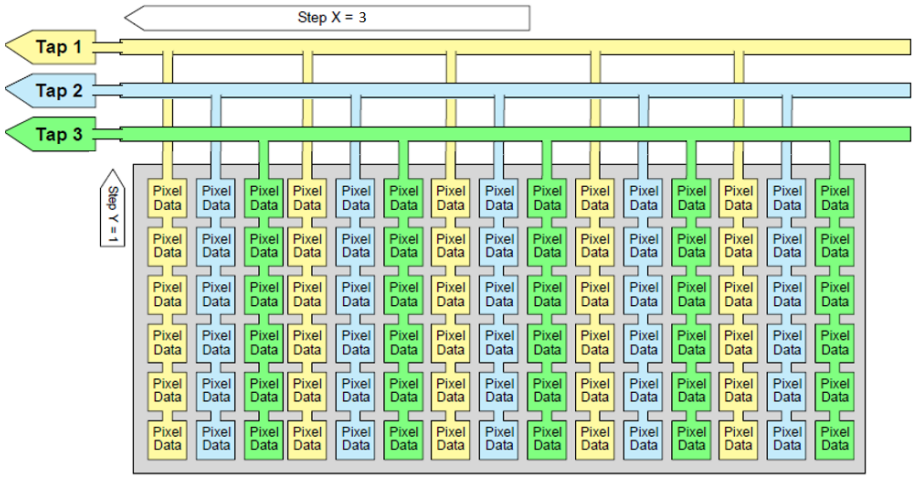
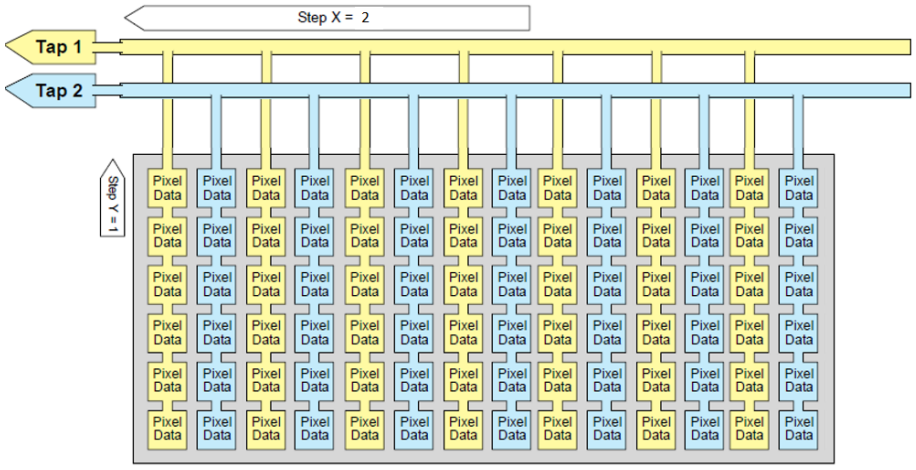
| Platform | Notes |
|---|---|
| Support of GenICam GenCP | For camera setting |
| Support of GenICam File access implementation | File access support for firmware update |
| Support of GenICam XML schema version 1.1 | |
| Support of Camera Link 1.2 | |
| GenICam™ support — XML camera description file | Embedded within Genie Nano-CL |

# Development Software for Camera Control

| **Teledyne DALSA Software Platform for Microsoft Windows** | |
|---|---|
| **Sapera LT for Windows — version 8.31 or later**<br>Includes Sapera Runtime and CamExpert.<br>Provides everything you will need to develop imaging applications<br>Sapera documentation provided in compiled HTML help,<br>and Adobe Acrobat® (PDF) | Available for download<br>http://www.teledynedalsa.com/imaging/support/ |
| **For software information for using the Nano-CL** with Teledyne DALSA Frame grabbers or third party grabbers see:<br>**G3-ANCL02-V1:** Getting Started with the Genie Nano-CL and Teledyne DALSA Frame Grabbers<br>**G3-ANCL01-V1:** Getting Started with the Genie Nano-CL and 3rd Party Frame Grabbers<br>http://www.teledynedalsa.com/en/support/documentation/app-notes/ | |
| **Third Party Software Platforms** | |
| GenICam GenCP Compliant Software And Tools | Contact your supplier |

# Camera Link Frame Grabber Requirement for the Nano-CL Family

| Camera Controls | |
|---|---|
| Trigger Input | Using CC1 line |
| Communication Protocol | GenCP over the serial port (GenICam  GenCP compliant software) |
| Camera Link Serial Baud Rate | 9600 to 921600 |
| **Camera Link Tap Geometry** | |
| **DECA Mode: 1x10_1Y**<br><br>On each cycle of the Camera Link pixel clock, the data for ten pixels is transmitted via the Camera Link interface. This is commonly referred to as a "ten tap" Camera Link configuration. |  |
| **Full Mode: 1x8_1Y**<br><br>On each cycle of the Camera Link pixel clock, the data for eight pixels is transmitted via the Camera Link interface. This is commonly referred to as an "eight tap" Camera Link configuration. |  |

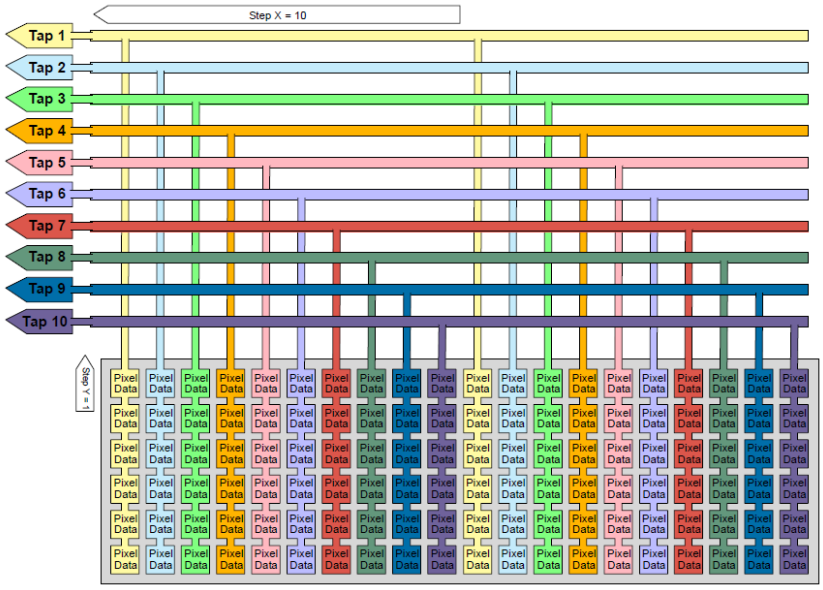
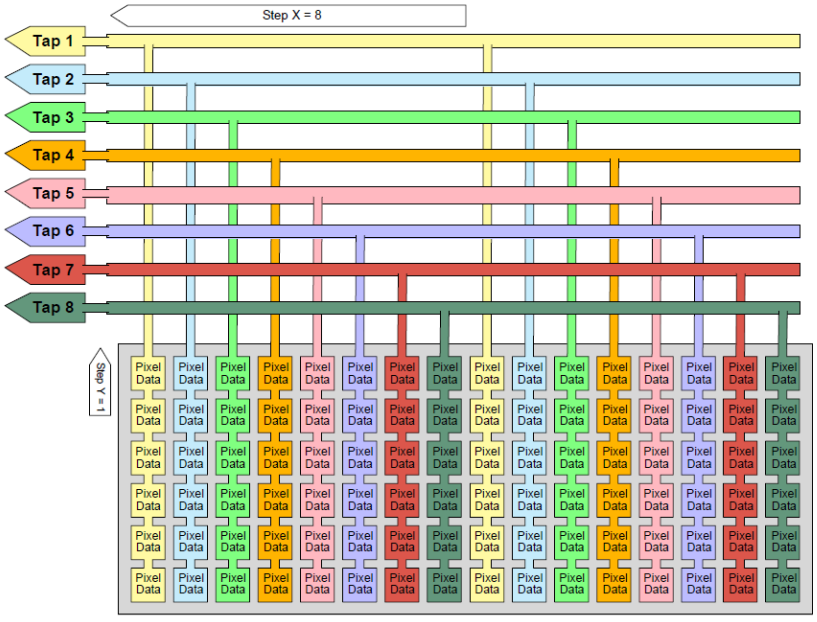
| Camera Link Tap Geometry | |
|---|---|
| **Base Mode: 1x3_1Y**<br><br>On each cycle of the Camera Link pixel clock, the data for three pixels are transmitted via the Camera Link interface. |  |
| **Base Mode: 1x2_1Y**<br><br>On each cycle of the Camera Link pixel clock, the data for three pixels are transmitted via the Camera Link interface. |  |
| **Camera Link Pixel Clock** | **85MHz** |

# Genie Nano Specifications

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

## Common Specifications

| **Camera Controls** | |
|---|---|
| Communication Protocol | GenCP over the serial port (GenICam GenCP compliant software) |
| Camera Link Serial Baud Rate | 9600 to 921600 |
| Synchronization Modes | Free running, External triggered (Using CC1 line) |
| Exposure Control | Internal – Programmable via the camera API<br>External – based on Trigger Width (using the CC1 line) |
| Exposure Time Maximum | 16 sec |
| Exposure Modes | Programmable in increments of 1µs<br>minimum time (in µs) is model specific<br>Pulse controlled via Trigger pulse width. |
| Camera Link CC Inputs | Support for CC1 (as trigger) |
| **Features** | |
| Reserved Private User Buffer | 4 kB flash memory for OEM usage (*deviceUserBuffer*) |
| Flash memory | 32 MB flash memory |
| Gain | In Sensor gain |
| Color model output | Color cameras support raw Bayer output |
| 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 |

| Camera Link Tap Geometry | |
|---|---|
| **DECA Mode:**<br>**80-bit 1x10_1Y**<br><br>Factory Default Firmware<br><br>On each cycle of the Camera Link pixel clock, the data for ten pixels is transmitted via the Camera Link interface. This is commonly referred to as a **"ten tap"** Camera Link configuration.<br><br>This configuration outputs **8-bit / pixel**. |  |
| **Full Mode 1x8_1Y**<br><br>**80-bit Mode 1x8_1Y**<br><br>Field upgradable Firmware<br><br>On each cycle of the Camera Link pixel clock, the data for eight pixels is transmitted via the Camera Link interface. This is commonly referred to as an **"eight tap"** Camera Link configuration.<br><br>This configuration outputs **8-bit or 10-bit / pixel**. |  |

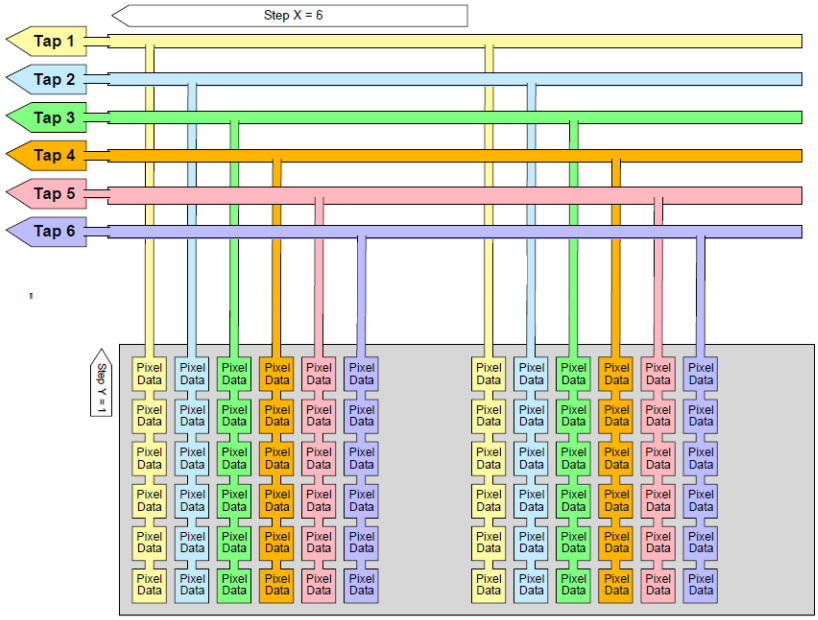
**Full Mode 1x6_1Y**

**72-bit Mode 1x6_1Y**

Field upgradable Firmware

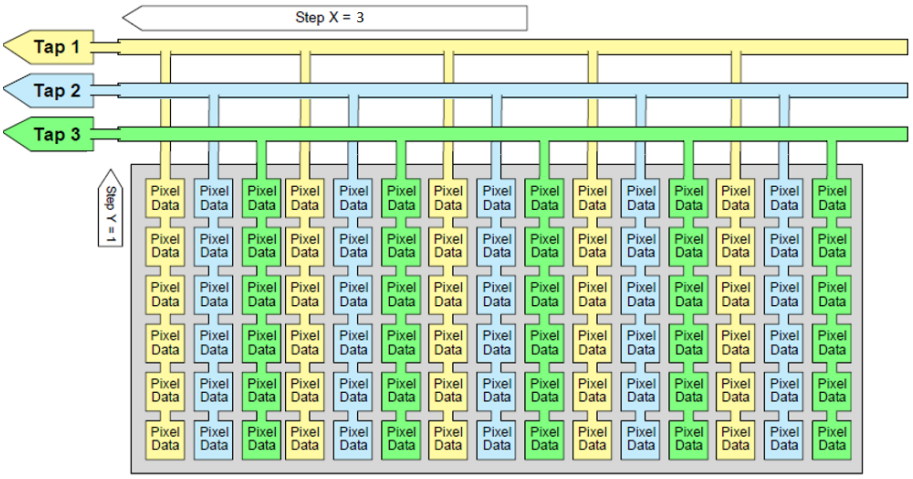
On each cycle of the Camera Link pixel clock, the data for eight pixels is transmitted via the Camera Link interface. This Camera Link configuration is available with Camera Link specification 2.1.

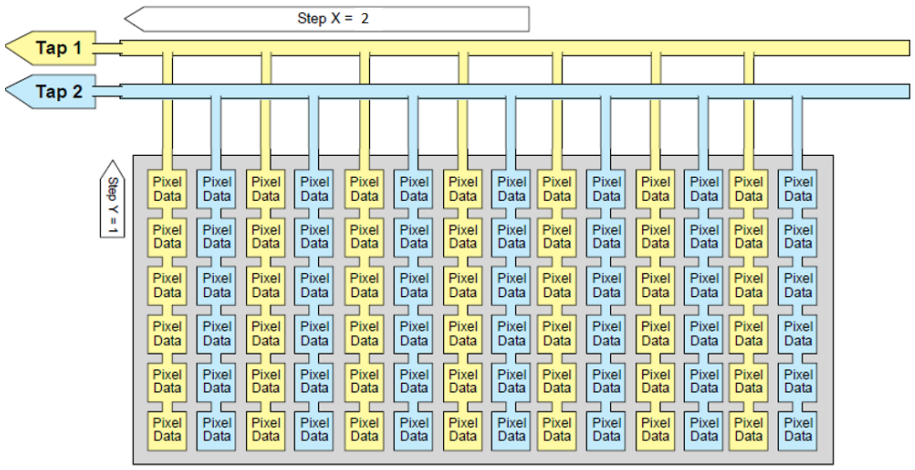
This configuration outputs **8-bit or 12-bit / pixel**.




**Base Mode: 1x3_1Y**

On each cycle of the Camera Link pixel clock, the data for three pixels are transmitted via the Camera Link interface.



| | |
|---|---|
| **Base Mode: 1x2_1Y**<br><br>On each cycle of the Camera Link pixel clock, the data for three pixels are transmitted via the Camera Link interface. |  |
| **Back Focal Distance** | |
| | 17.52 mm (C-mount with medium case models)<br>12 mm (M42 mount with XL case models) |
| **Mechanical Interface** | |
| Camera (L x H x W)<br>see Mechanical Specifications — Nano-CL : | *Medium Case*:<br>44 mm x 44 mm x 21 mm (without bar adapter and connectors)<br>44 mm x 44 mm x 39 mm (with lens adapter and connectors)<br>*XL Case*:<br>38.3 mm x 59 mm x 59 mm |
| Mass (*approximate value due to sensor variations*) | Medium Case: 72g<br>XL Case: ~ 163g |
| Camera Link Connector Type | Two SDR-26 connectors for DECA mode (80-bit)<br>For Base configurations the second SDR-26 is not used |
| Power connector | 10-pin I/O connector or via the SDR-26 Camera Link using PoCL |
| **Electrical Interface** | |
| Input Voltage | +10 to +36 Volts DC (+10%/- 10%)<br>+9 to +56 Volts DC (Absolute min/max Range) on Auxiliary connector<br>Supports the Power Over Camera Link standard (PoCL) on Models with medium casing.<br>Note: requires both CL cables when using PoCL. |
| Power Dissipation (typical) | Nano-CL: 6.5W @ 24Vdc aux. (for the XL case) |
| Data Output | Camera Link |
| **Environmental Conditions** | |
| Operating Temperature<br>(*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 | Camera Link v2.1, GenICam GenCP compliant |

# 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%<br>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 millisecond (Gain1.0) for the 16M to 25M
- For Sony
  - Max saturated values: Max Pixel format bit depth - 1DN

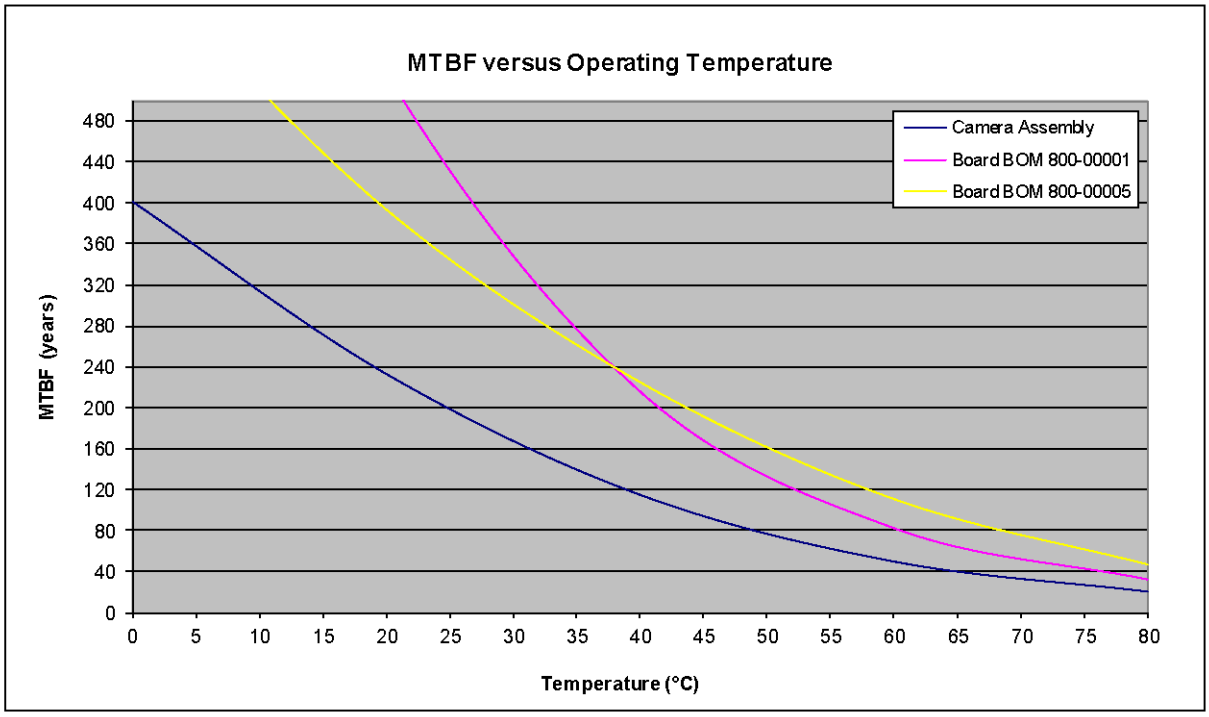
# EMI, Shock and Vibration Certifications

| Compliance Directives | Standards ID | Overview |
|---|---|---|
| CE | EN61000-4-2 : 2008 | Electrostatic discharge immunity test |
| | EN61000-4-3 : 2006 A1 : 2007 A2 : 2010 | Radiated, radio-frequency, electromagnetic field immunity test |
| | EN61000-4-4 : 2004 | Electrical fast transient/burst immunity test |
| | EN61000-4-5 : 2005 | Surge immunity |
| | EN61000-4-6 : 2008 | Immunity to conducted disturbances, induced by radio-frequency fields |
| | EN61000-4-8 : 2009 | Power frequency magnetic field immunity |
| | EN61000-4-11 : 2004 | Voltage variations immunity |
| | EN61000-6-2 : 2005 | Electromagnetic immunity |
| | EN61000-6-4: 2007 | Electromagnetic emissions |
| | CISPR 11: 2009 A1 : group 1 FCC, part 15, subpart B:2010 | Limit: class A Conducted Emissions |
| | CISPR 22 : 2008 Limit: class A | LAN port Conducted Emissions |
| **FCC** | Part 15, class A | |
| **RoHS** | Compliancy as per European directive 2011/65/EC | |
| For an image of Genie Nano certificates see “EC & FCC Declarations of Conformity” on page 104 | | |
| **Vibration & Shock Tests** | **Test Levels (while operating)** | **Test Parameters** |
| **Random vibrations** | Level 1: 2 grms 60 min.<br>Level 2: 4 grms 45 min.<br>Level 3: 6 grms 30 min. | Frequency range: 5 to 2000 Hz<br>Directions: X, Y, and Z axes |
| **Shocks** | Level 1: 20 g / 11 ms<br>Level 2: 30 g / 11 ms<br>Level 3: 40 g / 60 ms | Shape: half-sine<br>Number: 3 shocks (+) and 3 shocks (-)<br>Directions: ±X, ±Y, and ±Z axes |
| **Additional information concerning test conditions and methodologies is available on request.** | | |

# Mean Time between Failure (MTBF)

The analysis was carried out for operating temperatures varying from 0 to 80ºC. The following table presents the predicted MTBF and failure rate values.

| | Camera Assembly | | |
|---|---|---|---|
| Temperatures | MTBF (hours) | MTBF (years) | Failure Rate (Failure/$10^6$ hours) |
| 0 | 3514728 | 401.2 | 0.284517 |
| 20 | 2040096 | 232.9 | 0.490173 |
| 40 | 1005703 | 114.8 | 0.994329 |
| 60 | 434538 | 49.6 | 2.301294 |
| 80 | 177030 | 20.2 | 5.648757 |



# Nano-CL Specifications: M2420 & C2420

Model specific specifications and response graphics for the M/C2420 series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

| Supported Features | M2420 & C2420 |
|---|---|
| Resolution | 2464 x 2056 |
| Sensor | Sony IMX264 (5.1M) |
| Pixel Size | 3.45 µm x 3.45 µm |
| Shutter Type | Full frame electronic global shutter function |
| Full Well charge | 11ke (max) |
| Firmware options (field programmable) | Standard Design Bass 2-Tap Firmware |
| Maximum Frame Rate | 32.5 fps |
| Pixel Format (Mono) | Mono 8 & 12 bit |
| Pixel Format (Color) | Bayer 8 & 12 bit |
| Trigger to Exposure Minimum delay (*Synchronous Exposure*) | Less than 1µs |
| Trigger to Exposure Minimum delay (*Reset Exposure*) | 29µs |
| Trigger to Exposure Start jitter (*Synchronous Exposure*) | Up to 1 line time |
| Trigger to Exposure Start jitter *(Reset Exposure)* | 0µs |
| Exposure Time Minimum (see “exposureTimeActual” in Sensor Control) | 28.2µs |
| Horizontal Line Time: | 14.5µs |
| Min. Time from End of Exposure to Start of Next Exposure | 145µs |
| 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 251x) |
| Binning Support | No |
| Decimation Support | No |
| Defective Pixel Replacement | Yes - up to 2048 pixel position |
| Image Correction | No |
| Image Flip support | No |
| Multi-ROI Support | No |
| Output Dynamic Range (dB) | 75.4 dB (12-bit mode) |
| SNR (dB) | 39.6 dB |

# Firmware Files for Model M/C 2420

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 this model are listed below. The xx denotes the current build number.

**M/C 2420 – Camera Link Configuration: 2 Tap**

- Genie_Nano-CL_Sony_IMX264_304_5M-12M_2Tap_Firmware_3CA21.xx.cbf

# Nano-CL Specifications: M4020 & C4020

Model specific specifications and response graphics for the M/C4020 series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

| Supported Features | M4020 & C4020 | |
|---|---|---|
| Resolution | 4112 x 3008 | |
| Sensor | Sony IMX304 (12M) | |
| Pixel Size | 3.45 µm x 3.45 µm | |
| Shutter Type | Full frame electronic global shutter function | |
| Full Well charge | 11ke (max) | |
| Firmware options (field programmable) | Standard 2-Tap Base Design | Standard 3-Tap Base Design (factory default) |
| Maximum Frame Rate | 15 fps | 20 fps |
| Pixel Format (Mono) | Mono 8 & 12 bit | Mono 8 bit |
| Pixel Format (Color) | Bayer 8 & 12 bit | Bayer 8 bit |
| Camera Link Tap Geometry | 1x2_1Y | 1x3_1Y |
| Trigger to Exposure Minimum delay (*Synchronous Exposure*) | 48µs | 32µs |
| Trigger to Exposure Minimum delay (*Reset Exposure*) | < 1µs | |
| Trigger to Exposure Start jitter (*Synchronous Exposure*) | up to 1 line time | |
| Trigger to Exposure Start jitter *(Reset Exposure)* | 0µs | |
| Exposure Time Minimum (see “exposureTimeActual” in Sensor Control) | 38.4µs | 30.4µs |
| Horizontal Line Time: | 24.2µs | 16.1µs |
| Min. Time from End of Exposure to Start of Next Exposure | 252µs | 163µs |
| 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 251x) | |
| Binning Support | No | |
| Decimation Support | No | |
| Defective Pixel Replacement | Yes, up to 2048 pixel position | |

| | |
|---|---|
| Image Correction | No |
| Image Flip support | No |
| Multi-ROI Support | No |
| Output Dynamic Range (dB) | 75.4 dB (12-bit mode) |
| SNR (dB) | 39.6 dB |

# Firmware Files: for 5.1M and 12M 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 this model are listed below. The xx denotes the current build number.

## *Standard 2-tap Design*

Encompasses all features released in previous firmware versions along with new standard features for 8 or 12-bits output in Camera Link base configuration.

**Genie Nano-CL: M2420, C2420, M4020, and C4020**

- "Genie_Nano-CL_Sony_IMX264_304_5M-12M_2-Taps_Firmware_3CA21.xx.cbf"

## *Standard 3-tap Design*

Encompasses all features released in previous firmware versions along with new standard features for 8-bits output in Camera Link base configuration.

**Genie Nano-CL: M4020, and C4020 ONLY**

- "Genie_Nano-CL_Sony_IMX304_12M_3-Taps_Base_Firmware_3CA21.xx.cbf

# Nano-CL Specifications: M2450 & C2450

Model specific specifications and response graphics for the M/C2450 series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

| Supported Features | M2450 & C2450 | |
|---|---|---|
| Resolution | 2464 x 2056 | |
| Sensor | Sony IMX250 (5.1M) | |
| Pixel Size | 3.45 µm x 3.45 µm | |
| Shutter Type | Full frame electronic global shutter function | |
| Full Well charge | 11ke (max) | |
| Sensitivity to Saturation | 1x | |
| Firmware options (field programmable) | Standard Design<br>Full 6-Taps Firmware | High Speed Design<br>80-bits-10Taps Firmware<br>(factory default) |
| Maximum Frame Rate | TBA | 141.8 fps |
| Pixel Format (Mono) | Mono 8 & 12 bit | Mono 8 bit |
| Pixel Format (Color) | Bayer 8 & 12 bit | Bayer 8 bit |
| Trigger to Exposure Minimum delay (*Synchronous Exposure*) | 2 line time = 6.74µs | |
| Trigger to Exposure Minimum delay (*Reset Exposure*) | 0.05µs | |
| Trigger to Exposure Start jitter (*Synchronous Exposure*) | 0 to 3.37µs (i.e. up to 1 line time) | |
| Trigger to Exposure Start jitter *(Reset Exposure)* | 0µs | |
| Exposure Time Minimum (see “exposureTimeActual” in Sensor Control) | 3.37 + 13.73 = 17.10µs | |
| Horizontal Line Time: | TBA | 3.37µs |
| Min. Time from End of Exposure to Start of Next Exposure | TBA | 30µs |
| Readout Time | 1 Line Time*(number of lines + 23) | |
| Auto-Brightness | No | |
| Black offset control | Yes (in DN) | |
| Gain Control | In-sensor Analog Gain (1.0x to 251x)<br>Digital Gain (1x to 4x in 0.1 steps) | |
| Binning Support | No | |
| Decimation Support | No | |
| Defective Pixel Replacement | Yes | |
| Image Correction | No | |
| Image Flip support | No | |
| Multi-ROI Support | No | |
| Output Dynamic Range (dB) | 75.4 dB (12-bit mode) | |
| SNR (dB) | 39.6 dB | |

# Firmware Files for Model M/C 2450

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 this model are listed below. The xx denotes the current build number.

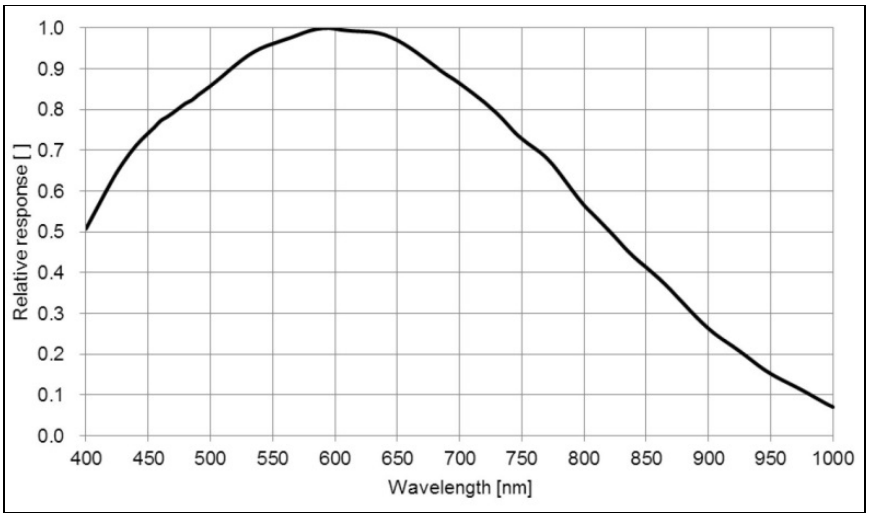
**M/C 2450 – Camera Link Configuration: 80-bit 10 Tap (factory default)**

- Genie_Nano-CL_Sony_IMX25x_5M-9M-12M_80-bits-10Tap_Firmware_2CA21.xxx.cbf

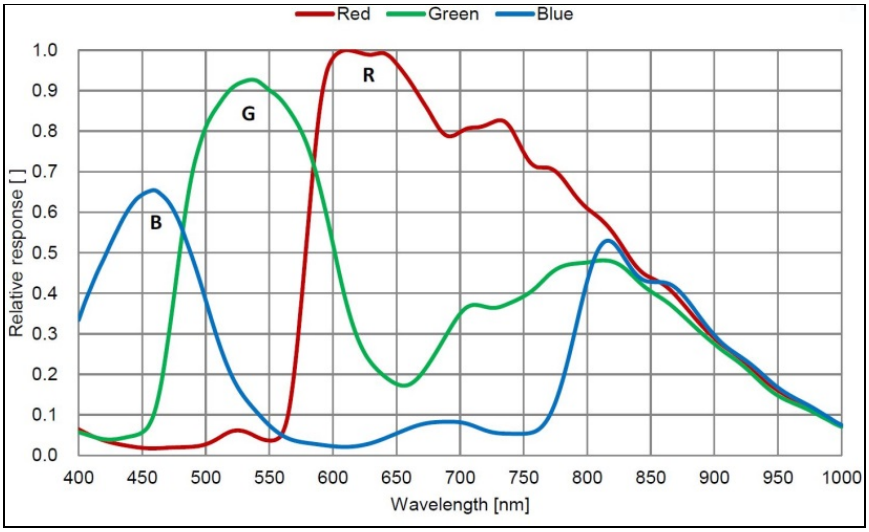
# Spectral Responses

The response curves describe the sensor, excluding lens and light source characteristics.

**Model M2450**




**Model C2450**



# Nano-CL Specifications: M4060 & C4060

Model specific specifications and response graphics for the M/C4060 series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

| Supported Features | M4060 & C4060 | |
|---|---|---|
| Resolution | 4112 x 2176 | |
| Sensor | Sony IMX255 (8.9M) | |
| Pixel Size | 3.45 µm x 3.45 µm | |
| Shutter Type | Full frame electronic global shutter function | |
| Full Well charge | 11ke (max) | |
| Sensitivity to Saturation | 4x | |
| Firmware options (field programmable) | Standard Design<br>Full 6-Taps Firmware | High Speed Design<br>80-bits-10Taps Firmware<br>(factory default) |
| Maximum Frame Rate (full frame) | TBD | 87.6 fps |
| Pixel Format (Mono) | Mono 8 & 12 bit | Mono 8 bit |
| Pixel Format (Color) | Bayer 8 & 12 bit | Bayer 8 bit |
| Trigger to Exposure Minimum delay (*Synchronous Exposure*) | 2 Line Time — 10.22µs | |
| Trigger to Exposure Minimum delay (*Reset Exposure*) | 0.05µs | |
| Trigger to Exposure Start jitter (*Synchronous Exposure*) | 0 to 5.11µs (i.e. up to 1 line time) | |
| Trigger to Exposure Start jitter *(Reset Exposure)* | 0µs | |
| Exposure Time Minimum (see “exposureTimeActual” in Sensor Control) | 5.11 + 14.26 = 19.37µs | |
| Horizontal Line Time: | 5.11µs | |
| Min. Time from End of Exposure to Start of Next Exposure | TBA | 108µs |
| Readout Time | 1 Line Time*(number of lines + 28) | |
| Auto-Brightness | No | |
| Black offset control | Yes (in DN) | |
| Gain Control | In-sensor Analog Gain (1.0x to 251x)<br>Digital Gain (1x to 4x in 0.1 steps) | |
| Binning Support | No | |
| Decimation Support | No | |
| Defective Pixel Replacement | Yes | |
| Image Correction | No | |
| Image Flip support | No | |
| Multi-ROI Support | No | |
| Output Dynamic Range (dB) | 76.4 dB (12-bit mode) | |
| SNR (dB) | 39.3 dB | |

# Firmware Files for Model M/C 4060

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 this model are listed below. The xx denotes the current build number.

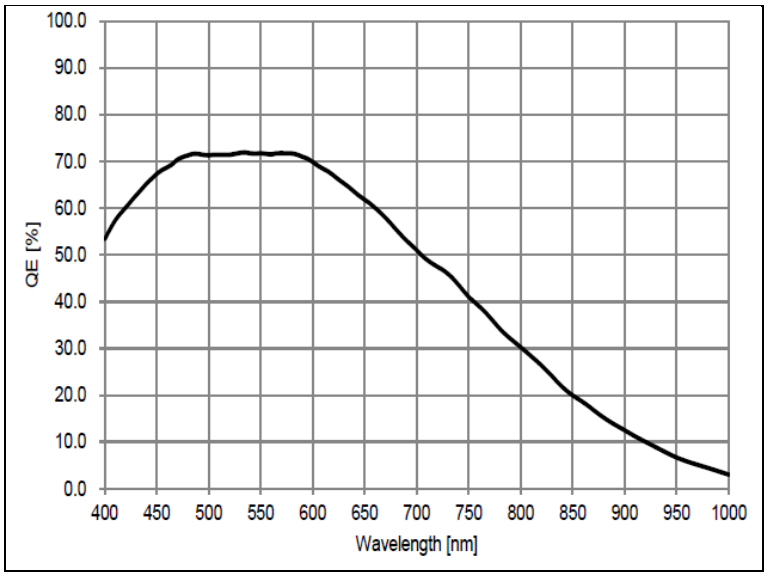
**M/C 4060 – Camera Link Configuration: 80-bit 10 Tap (factory default)**

- Genie_Nano-CL_Sony_IMX25x_5M-9M-12M_80-bits-10Tap_Firmware_2CA21.xxx.cbf

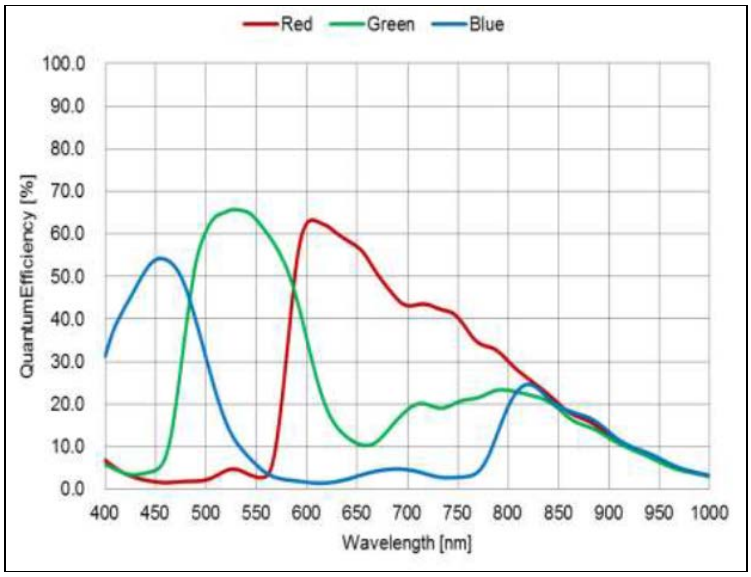
# Spectral Responses

The response curves describe the sensor, excluding lens and light source characteristics.

**Models M4060**




**Models C4060**



# Nano-CL Specifications: M4040 & C4040

Model specific specifications and response graphics for the M/C4040 series are provided here. The response curves describe the sensor, excluding lens and light source characteristics.

| Supported Features | M4040 & C4040 | |
|---|---|---|
| Resolution | 4112 x 3008 | |
| Sensor | Sony IMX253 (12M) | |
| Pixel Size | 3.45 µm x 3.45 µm | |
| Shutter Type | Full frame electronic global shutter function | |
| Full Well charge | 11ke (max) | |
| Sensitivity to Saturation | 4x | |
| Firmware options (field programmable) | Standard Design<br>Full 6-Taps Firmware | High Speed Design<br>80-bits-10Taps Firmware<br>(factory default) |
| Maximum Frame Rate (full frame) | TBA | 63.8 fps |
| Pixel Format (Mono) | Mono 8 & 12 bit | Mono 8 bit |
| Pixel Format (Color) | Bayer 8 & 12 bit | Bayer 8 bit |
| Trigger to Exposure Minimum delay (*Synchronous Exposure*) | 2 Line Time — 10.22µs | |
| Trigger to Exposure Minimum delay (*Reset Exposure*) | 0.05µs | |
| Trigger to Exposure Start jitter (*Synchronous Exposure*) | 0 to 5.11µs (i.e. up to 1 line time) | |
| Trigger to Exposure Start jitter *(Reset Exposure)* | 0 µs | |
| Exposure Time Minimum (see “exposureTimeActual” in Sensor Control) | 5.11 + 14.26 = 19.37µs | |
| Horizontal Line Time: | 5.11µs | |
| Min. Time from End of Exposure to Start of Next Exposure | TBA | 108µs |
| Readout Time | 1 Line Time*(number of lines + 28) | |
| Auto-Brightness | No | |
| Black offset control | Yes (in DN) | |
| Gain Control | In-sensor Analog Gain (1.0x to 251x)<br>Digital Gain (1x to 4x in 0.1 steps) | |
| Binning Support | No | |
| Decimation Support | No | |
| Defective Pixel Replacement | Yes | |
| Image Correction | No | |
| Image Flip support | No | |
| Multi-ROI Support | No | |
| Output Dynamic Range (dB) | 76.4 dB (12-bit mode) | |
| SNR (dB) | 39.3 dB | |

# Firmware Files for Model M/C 4040

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 this model are listed below. The xx denotes the current build number.

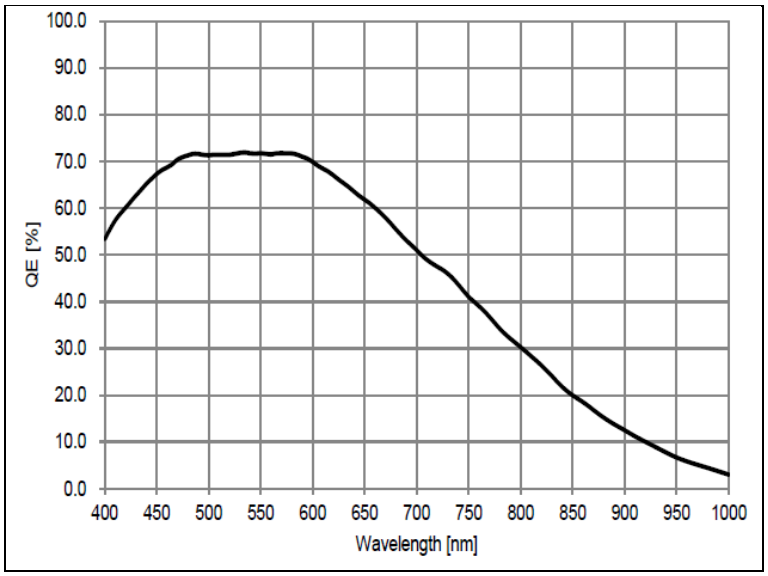
**M/C 4040 – Camera Link Configuration: 80-bit 10 Tap (factory default)**

- Genie_Nano-CL_Sony_IMX25x_5M-9M-12M_80-bits-10Tap_Firmware_2CA21.xxx.cbf

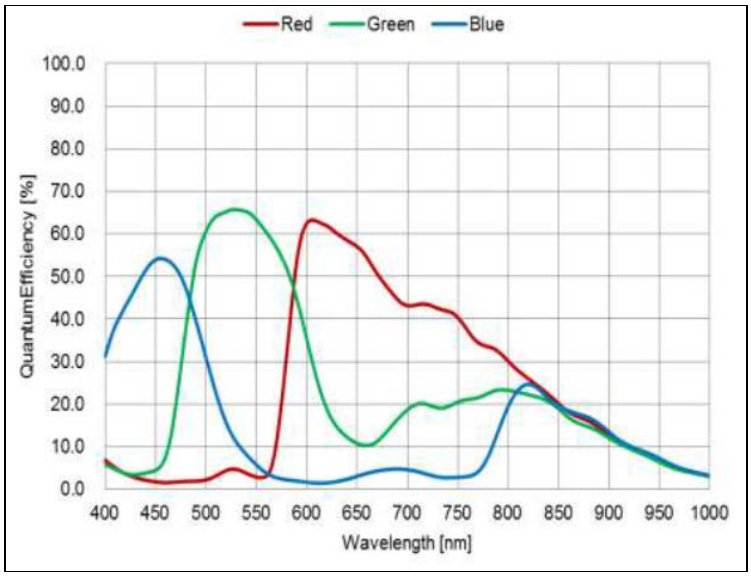
# Spectral Responses

The response curves describe the sensor, excluding lens and light source characteristics.

**Models M4040**




**Models C4040**



# Nano-CL Specifications: M4160, C4160

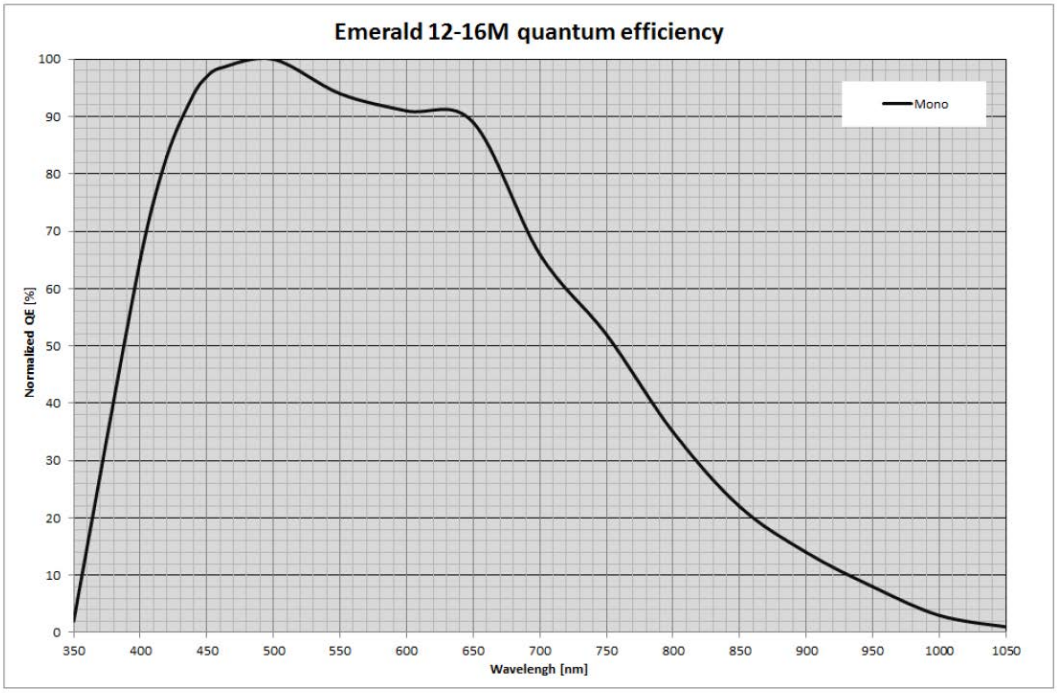
Model specific specifications and response graphics for the Teledyne E2V Emerald EV2S16M (16M) series are provided here. The response curve describes the sensor, excluding lens and light source characteristics.

| Camera Models | Nano-CL-M4160 | Nano-CL-C4160 |
|---|---|---|
| Resolution | 4128 x 4128 | |
| Sensor | Teledyne E2V Emerald EV2S16M | |
| Pixel Size | 2.8 µm x 2.8 µm | |
| Shutter | Full frame electronic global shutter function | |
| Full Well charge | 6645 e- (max) | |
| Camera Link DECA Mode 8-bit Firmware (80 bit CL configuration) | 10 Taps of 8-bit Monochrome (1X10-1Y) | |
| Max. Frame Rate | 47.3 fps | |
| Pixel Format | Mono 8-bit | Bayer 8-bit |
| Synchronization | Via external trigger signal or free run | |
| Exposure Control | Internal - Programmable via the camera API<br>External – Based on Trigger Width | |
| Trigger to Exposure Minimum delay (*Synchronous Exposure*) | 2 Line Time + 5 µs → 15.2µs (tentative) | |
| Trigger to Exposure Minimum delay (*Reset Exposure*) | N/A | |
| Trigger to Exposure Start jitter (*Synchronous Exposure*) | 0 µs | |
| Trigger to Exposure Start jitter *(Reset Exposure)* | N/A | |
| Exposure Time Minimum | 24 µsec | |
| Exposure Time Maximum | 16 sec | |
| Horizontal Line Time: | µs | |
| Min. Time from End of Exposure to Start of Next Exposure | µs | |
| Readout Time | | |
| Auto-Brightness | y / n | |
| Black offset control | y / n (in DN) | |
| Gain Control | In-sensor Analog Gain (1x, 1.5x, 2x, 3x, 4x, 6x and 8x)<br>Digital Gain (1x to 4x in 0.1 steps) | |
| Binning Support | No | |
| Decimation Support | No | |
| Defective Pixel Replacement | Yes | |
| Image Correction | Lens Shading correction (Factory and 2 User Defined entry) | |
| Image Flip support | No | |
| Multi-ROI Support | No | |
| Output Dynamic Range (dB) | 59.1 dB | |
| SNR (dB) | 37.2 (in 8-bits) | |

# Spectral Responses

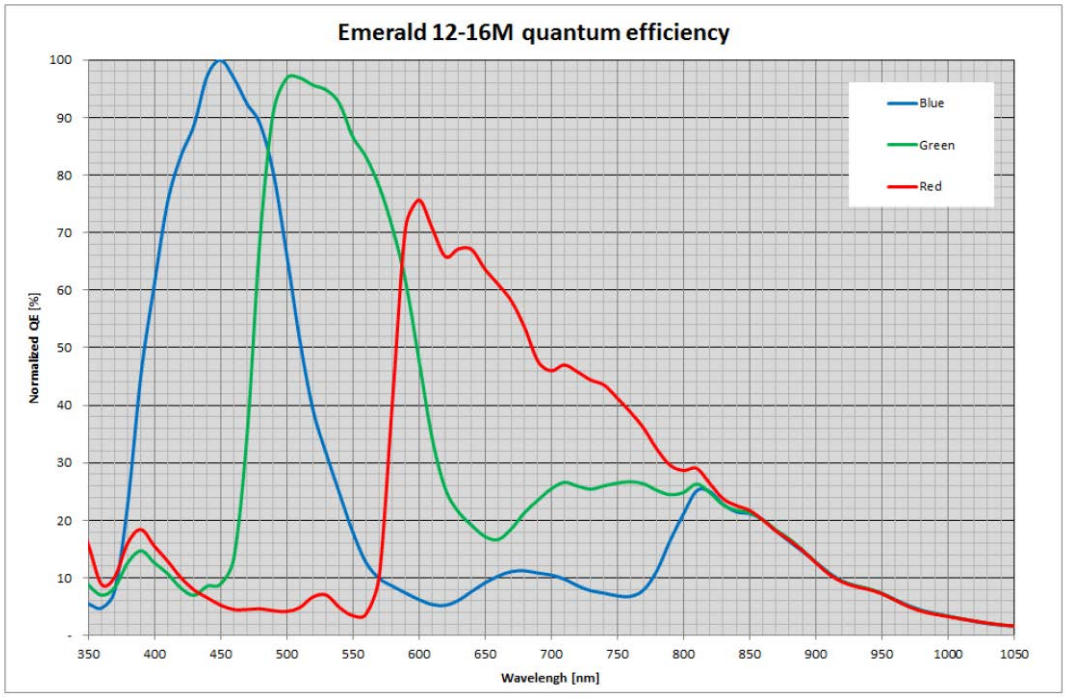
The response curve describes the sensor, excluding lens and light source characteristics.

**Monochrome Sensor:**




EV2S12M-16M Quantum Efficiency for mono version

**Bayer Color Sensor:**




EV2S12M-16M Quantum Efficiency for color version

# Nano-CL 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) | | | |
| Firmware options (field programmable) | Standard Design 80-bits-8Tap Firmware | High Speed Design 80-bits-10Tap Firmware (factory default) | Standard Design 80-bits-8Tap Firmware | High Speed Design 80-bits-10Tap Firmware (factory default) |
| Maximum Frame Rate | 25.5 fps | 32.0 fps | 36.0 fps | 46.8 fps |
| Pixel Format (Mono) | Mono 8 & 10 bit | Mono 8 bit | Mono 8 & 10 bit | Mono 8 bit |
| Pixel Format (Color) | Bayer 8 & 10 bit | Bayer 8 bit | Bayer 8 & 10 bit | Bayer 8 bit |
| Trigger to Exposure Minimum delay (*Synchronous Exposure*) | 4 µs | | | |
| Trigger to Exposure Minimum delay (*Reset Exposure*) | 4 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: Normal Mode ‡‡ | 33.1 µs | 16.55 µs | 29.55 µs | 14.78 µs |
| Horizontal Line Time: Fast Readout ‡‡ | 19.1 µs | 9.56 µs | 15.55 µs | 7.78 µs |
| Min. Time from End of Exposure to Start of Next Exposure | Normal Readout: 120 us Fast Readout: 92 us | Normal Readout: 79 us Fast Readout: 65 us | Normal Readout: 120 us Fast Readout: 92 us | Normal Readout: 79 us Fast Readout: 65 us |
| 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 | | | |
| Image Correction | Flat Line Correction (Factory and 4 User Defined entries) Lens Shading correction (Factory and 1 User Defined entry) Noise Reduction (monochrome models only) | | | |

| | | | | |
|---|---|---|---|---|
| Image Flip support | No | | | |
| Multi-ROI Support | No | | | |
| Output Dynamic Range (dB) | 55.3 | TBD | 55.3 | TBD |
| SNR (dB) | 39.4 | 39.6 | 39.4 | 39.6 |

**‡‡ Horizontal Line Time: Table Values and Formulas**

Values stated in the table are calculated for the maximum sensor widths, specifically:

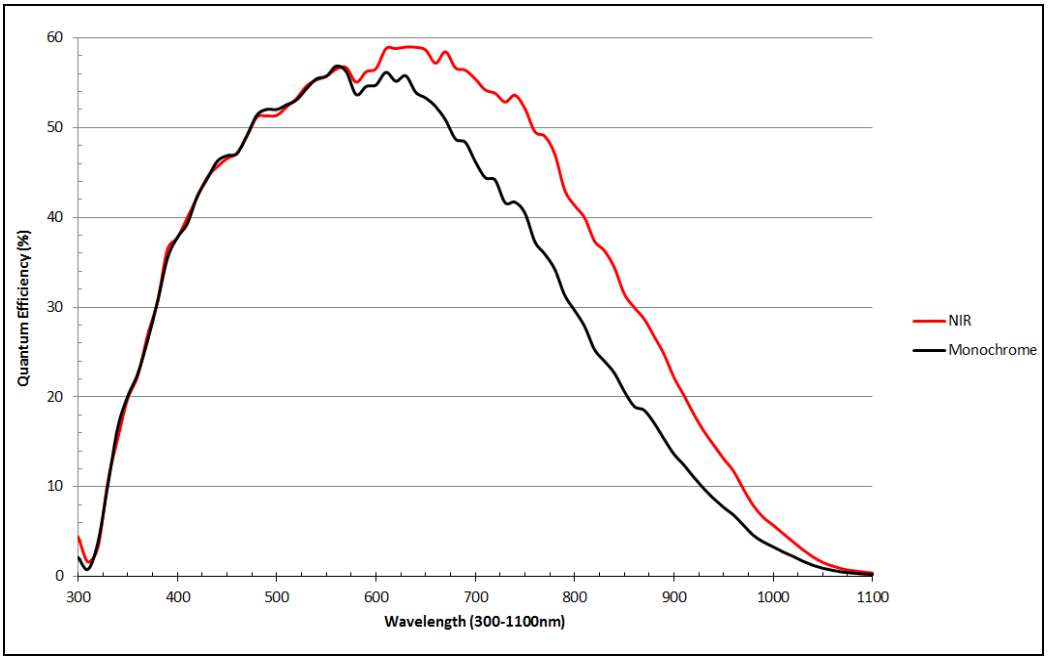
- Model M5100=5120 pixels
- Model M4090=4096 pixels

The following formulas describe **Horizontal Line Time**. Note that in "Fast Readout" mode, the line time does not reduce for widths below 4032 pixels, thus no need to calculate applicable time values for shorter lines.

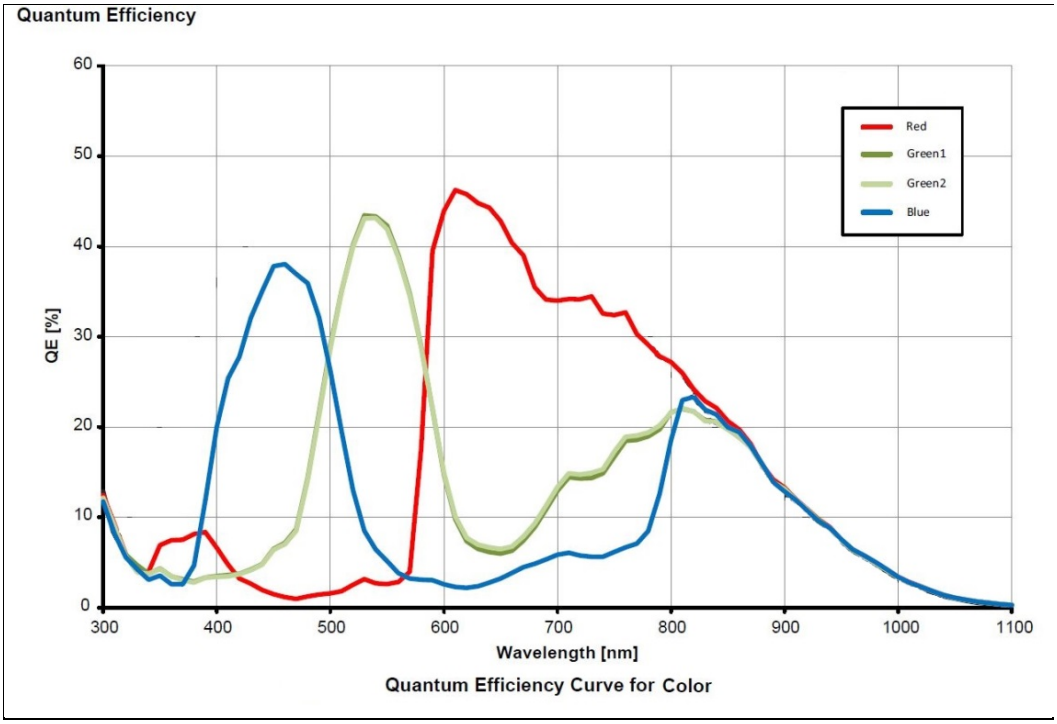
- Horizontal line time (Standard Firmware, Normal mode) = $\frac{\left(\frac{width}{4}\right)+1104}{72}$
- Horizontal line time** (Standard Firmware, Fast Readout mode) = $\frac{\left(\frac{width}{4}\right)+96}{72}$
- Horizontal line time (High Speed Firmware, Normal mode) = $\frac{\left(\frac{width}{8}\right)+552}{72}$
- Horizontal line time** (High Speed Firmware, Fast Readout mode) = $\frac{\left(\frac{width}{8}\right)+48}{72}$

# Spectral Response

### On-Semi Python Series — Monochrome and NIR



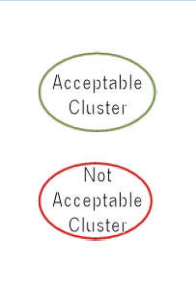
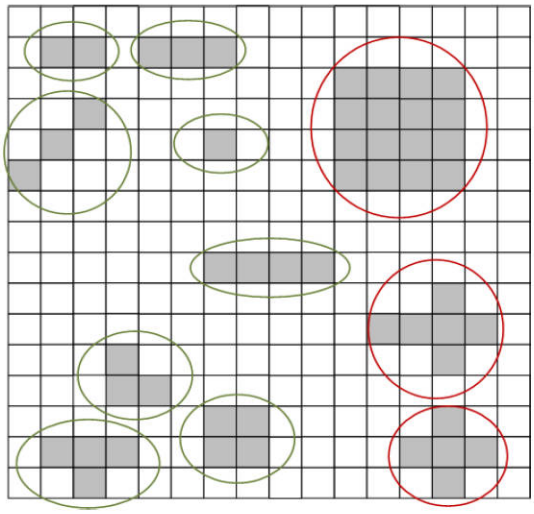

### On-Semi Python Series — Bayer Color



# 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. |
| | For color devices: The pixels are divided per color channels (R, G1, G2, B) and then calculated with the same methodology as mono devices. |
| | 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). |
| | For Color devices: The pixels are divided per color channels (R, G1, G2, B) and then calculated with the same methodology as mono devices. |
| | |
| **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). |
| | For Color devices: The pixels are divided per color channels (R, G1, G2, B) and then calculated with the same methodology as mono devices. |
| *continued next page* | |

| | |
|---|---|
| **Defective Cluster Definition**<br><br>  <br> | 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.<br>For color devices: The pixels are divided per color channels (R, G1, G2, B) and then calculated with the same methodology as mono devices.<br><br>Refer to the graphic below:<br>The number of defective pixels in one cluster is the class (F) of the cluster:<br><br>F2 (max 5): 2 defective pixels in the cluster<br>F3 (max 4): 3 defective pixels in the cluster<br>F4 (max 3): 4 defective pixels in the cluster<br>F5 (max 0): 5 or more defective pixels in the cluster<br><br>  |

# 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 these models are listed below. The xx denotes the current build number.

### M4090, C4090, M5100, C5100 – Camera Link Configuration: 80-bit 10 Tap (factory default)

- High Speed Design – 80-bit 10 Tap
  Genie_Nano-CL_OnSemi_Python_16M-25M_HSD_80-bits-10Tap_Firmware_1CA21.xx.cbf

### M4090, C4090, M5100, C5100 – Camera Link Full Configuration: 8 Tap (field optional)

- Standard Design – 8 or 10-bit x 8 Tap
  Genie_Nano-CL_OnSemi_Python_16M-25M_STD_80-bits-8Tap_Firmware_1CA21.xxcbf

# Nano-CL Installation

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

## Quick Start (using a Teledyne DALSA Frame Grabber)

- Install Sapera 8.31 (or later). Use the Full SDK version with support for Teledyne DALSA frame grabber boards.
- Install the Teledyne DALSA frame grabber board along with its driver for 10-Tap 8-bit support. This will match the default firmware loaded in the Nano-CL.
- Start CamExpert and configure frame buffer, data Taps, and frame rate parameters to match the Nano-CL model being used. Do not configure for an external trigger.
- Connect the Nano-CL with camera link cables that support PoCL. Both camera link cables connected to the frame grabber must be used for PoCL.
- Enable PoCL by its frame grabber feature. If not using PoCL connect power to the Nano-CL via its I/O connector.
- When the Nano-CL boots, CamExpert will read and display the camera features available with that model.
- Refer to the section Transport Layer Control Category to configure the camera's camera link settings.
- The Nano-CL 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-CL 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-CL 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.

Teledyne DALSA has 2 application notes which cover in detail the installation of a Genie Nano-CL. From our web site http://www.teledynedalsa.com/imaging/knowledge-center/appnotes/ download one of these getting started guides as required:

- See "*G3-ANCL02-Getting Started with Genie Nano-CL and Teledyne Frame Grabbers.pdf*"
- See "*G3-ANCL01-Getting Started with Genie Nano-CL and 3rd Party Frame Grabbers.pdf*"

## 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 for any Nano-CL model 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-CL feature descriptions, as you write, debug and optimize your imaging application. Consult the frame grabber manual for all board control features.

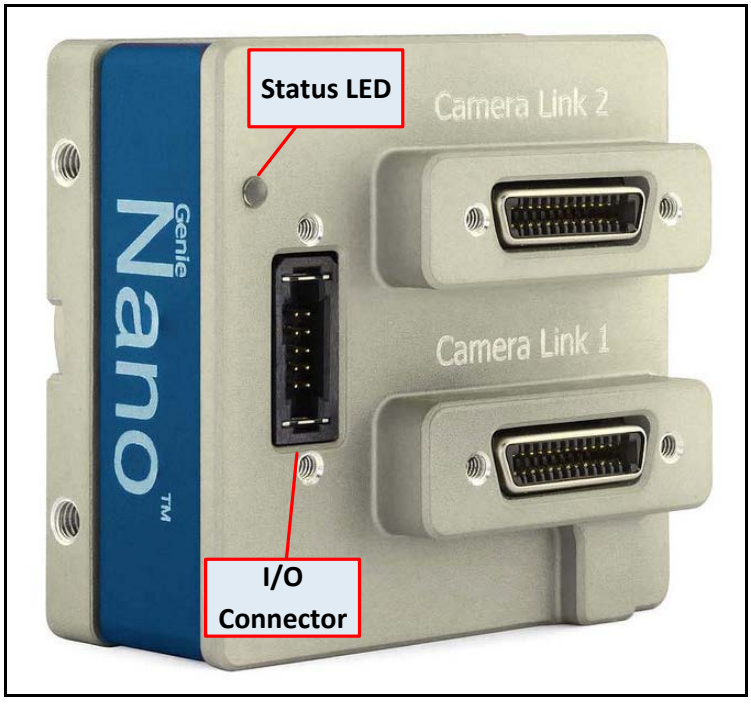
# Nano-CL Connectors and Status LED Overview

## Connectors

The Nano-CL has three connectors:

- 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-CL case supports using an I/O cable with thumbscrews. Teledyne DALSA provides optional cables for purchase (see Accessories). Also see 10-pin I/O Connector Pinout Details for pin out specifications.
- Two standard miniature SDR-26 Camera Link connectors. Use a frame grabber with SDR-26 connectors to simplify cabling. See Components Express Contact Information for a wide variety of PoCL cables.
- Note that these three connectors are identical on the two physical case sizes of the Nano-CL series.

The following figure of the Genie Nano-CL back end shows connector and LED locations. See Mechanical Specifications — Nano-CL: for details on the connectors and camera mounting dimensions.




*Genie Nano-CL (medium casing) – Rear View*

# LED Indicators

The Genie Nano-CL has one multicolor LED to provide a simple visible indication of camera state, as described below. The Nano-Cl camera link connectors do not have any indicator LEDs but the frame grabber may have LEDS for data connection status.

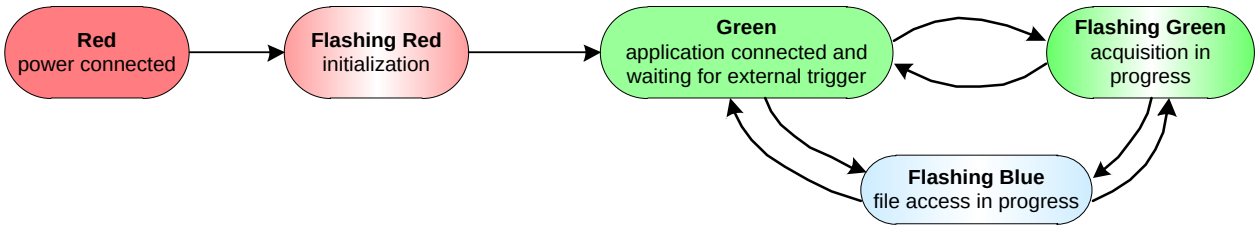
## *Camera Status LED Indicator*

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 Red** | Initial state on power up before flashing.<br>Remains as steady Red only if there is a fatal error. |
| **Flashing Red** | Initialization sequence in progress |
| **Steady Red + Flashing Blue** | Fatal Error.<br>If the Genie Nano does not reboot itself contact Technical Support. |
| **Fast Flashing Blue** | File Access Feature is transferring data such as a firmware update, etc. |
| **Steady Green** | Ready to acquire images, such as waiting on an external trigger on CC1 for an example. |
| **Flashing Green** | Acquisition in progress. Flashing occurs on frame acquisition but does not exceed a rate of 100ms, irrelevant of faster frame rates. |

## *LED States on Power Up*

The following LED sequence occurs when the Genie Nano-CL is powered up connected to a frame grabber. Initialization is followed by one of three normal operational states.



# 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

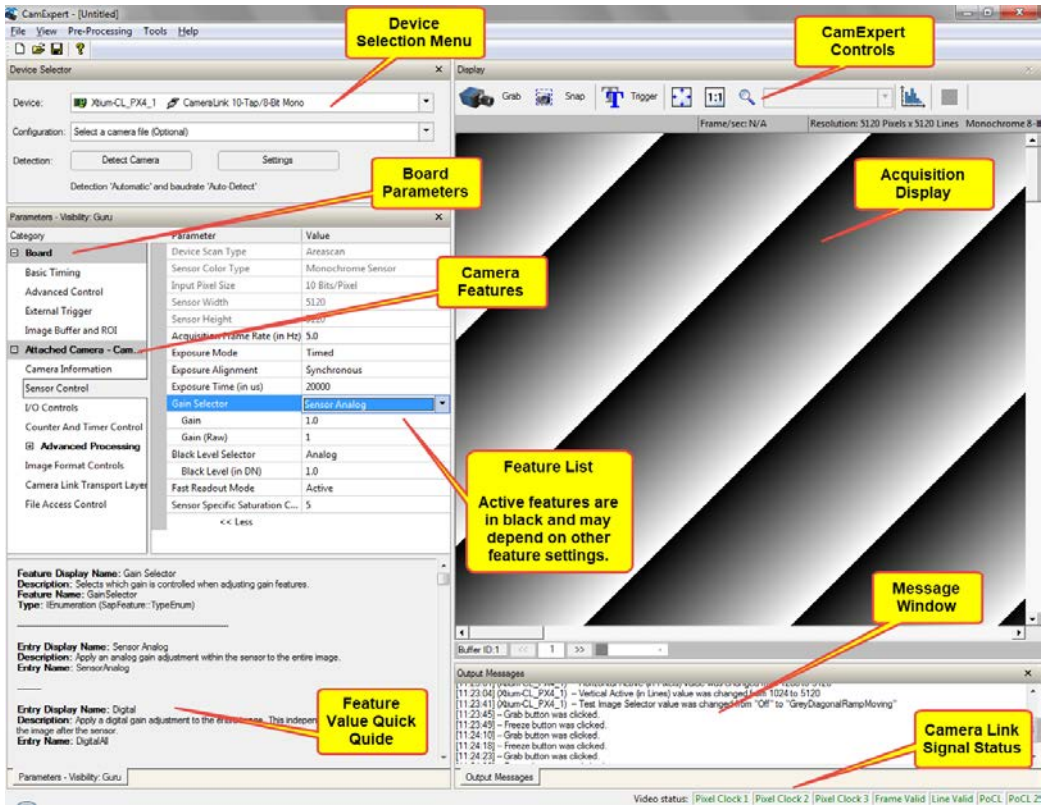
## Using CamExpert with Genie Nano Cameras

The Sapera CamExpert tool is the interfacing tool for Teledyne DALSA Camera Link cameras and Frame grabbers. CamExpert allows a user to test 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.

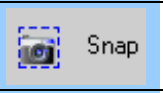
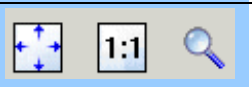
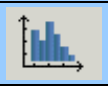
## CamExpert Panes

The various areas of the CamExpert tool are described in the summary figure below. The following screen image shows camera and board device Categories and Parameter feature groups.




- **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. CamExpert displays parameters only if those parameters are supported by the installed device. 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 link 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:**<br>Click once to start the frame grabber live grab mode, click again to stop.<br>The Nano-CL is always in free running acquisition mode unless configured to use an external trigger. |
|  | **Single frame grab:**<br>Click to acquire one frame from the frame grabber device. |
|  | **Software trigger button:**<br>With the I/O control parameters set to Trigger Enabled / Software Trigger type, click to send a single software trigger command. |
|  | **CamExpert display controls:**<br>(these do not modify the frame buffer data)<br>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:**<br>Select to view a histogram or line/column profile during live acquisition. |

- **Output pane**: Displays messages from CamExpert or the GigE Vision driver.
- **Camera Link Signals**: Displays the status of various Camera Link timing signals plus active PoCL 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 defines its requirement or complexity. The states vary from Beginner (features required for basic operation of the device) to Guru (optional features required only for complex operations).

CamExpert presents camera features based on their visibility attribute and provides quick Visibility level selection via controls below each Category Parameter list [ << Less  More>> ]. The user can also choose the Visibility level from the *View · Parameters Options* menu.

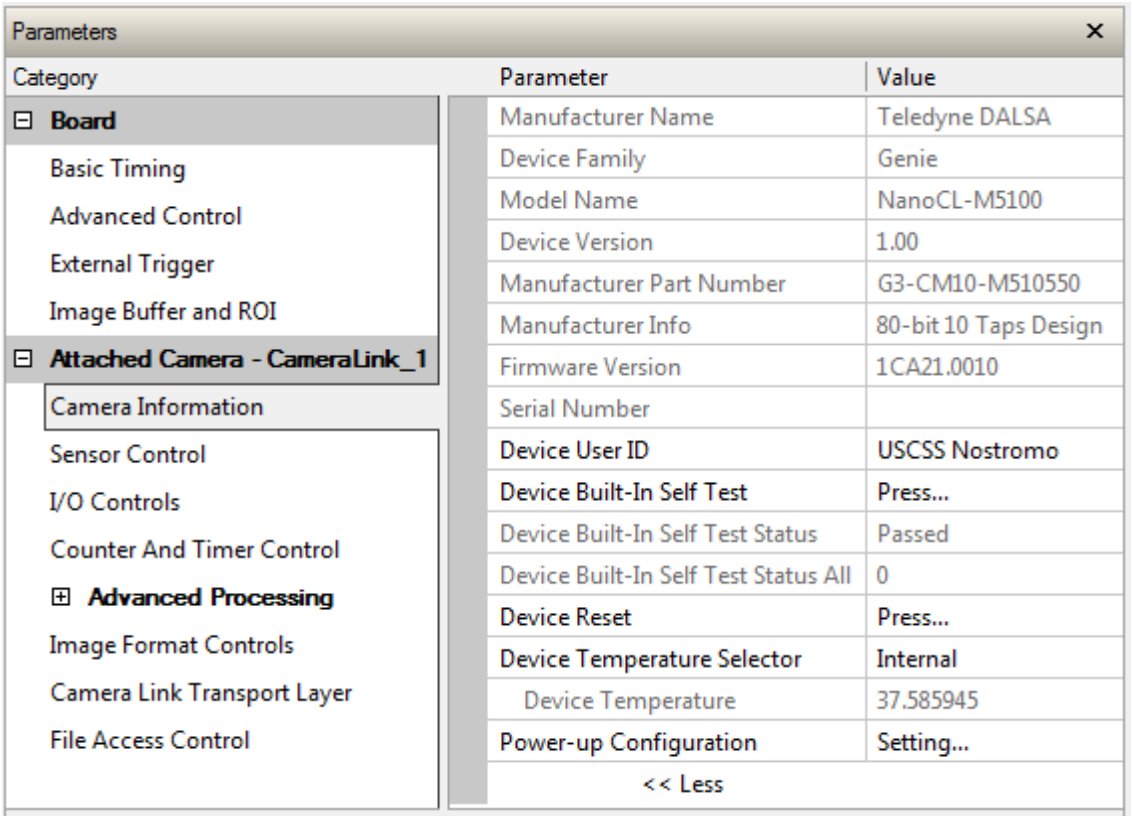
# About the Device User ID

The Nano-CL can be programmed with a user defined name to aid identifying multiple cameras connected to the network. For instance, on an inspection system with 4 cameras, the first camera might be labeled “top view”, the second “left view”, the third “right view” and the last one “bottom view”. The factory default user name is the camera serial number for quick initial identification.

# 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-CL device. These features are typically read-only.

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.




# Camera Information Feature Descriptions

The following table describes these parameters along with their view attribute and in which device version the feature was introduced. Additionally the Device Version column will indicate which parameter is a member of the DALSA Features Naming Convention (indicated by **DFNC**), versus the GenICam Standard Features Naming Convention (SFNC tag is not shown).

New features for a major device version release following release 1.00 will be indicated by green text for easy identification.

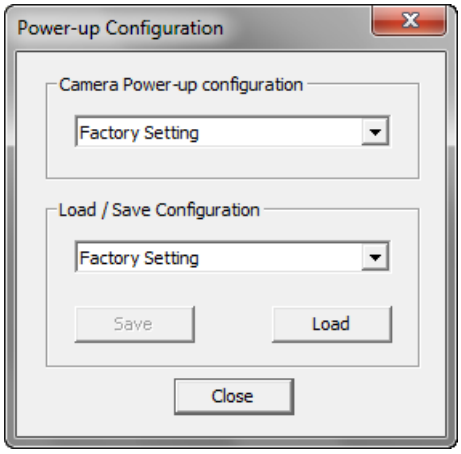
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Manufacturer Name | DeviceVendorName | Displays the device vendor name. | 1.00<br>Beginner |
| Device Family | DeviceFamilyName | Displays the device family name. | 1.00<br>Beginner |
| Model Name | DeviceModelName | Displays the device model name. | 1.00<br>Beginner |
| Device Version | DeviceVersion | Displays the device version. This tag will also highlight if the firmware is a beta or custom design. | 1.00<br>Beginner |
| Manufacturer Part Number | deviceManufacturerPartNumber | Displays the device manufacturer part number. | 1.00<br>DFNC<br>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<br>Beginner |
| Firmware Version | DeviceFirmwareVersion | Displays the currently loaded firmware version number. Firmware files have a unique number and have the .cbf file extension. | 1.00<br>Beginner |
| Serial Number | DeviceSerialNumber | Displays the device's factory set serial number. | 1.00<br>Expert |
| MAC Address | deviceMacAddress | Displays the unique MAC (Media Access Control) address of the Device. | 1.00<br>DFNC<br>Beginner |
| 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<br>Beginner |
| Device Built-In Self Test | deviceBIST | Command to perform an internal test which will determine the device status. (W) | 1.00<br>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<br>Beginner |
| *Passed* | *Passed* | *No failure detected* | |
| *Last firmware update failed* | *FirmwareUpdateFailure* | *Last firmware update operation failed.* | |
| *Unexpected Error* | *Unexpected_Error* | *Switched to recovery mode due to unexpected software error.* | |
| *Sensor Initialization Failure* | *SensorFailure* | *There was an error initializing the sensor. The 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<br>DFNC<br>Beginner |
| Device Reset | DeviceReset | Resets the device to its power up state. (W) | 1.00<br>Beginner |
| Device Temperature Selector | DeviceTemperatureSelector | Select the source where the temperature is read. | 1.00<br>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<br>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<br>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<br>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<br>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<br>Beginner |
| | | | |
| Power-up Configuration Selector | UserSetDefault | Specify 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. | 1.00<br>Beginner |
| Serial Number | DeviceID | Displays the device's factory set camera serial number. | 1.00<br>Invisible |
| *Factory Setting* | *Default* | *Select the Factory Setting values as the Power-up Configuration.* | 1.00<br>Invisible |
| *UserSet1* | *UserSet1* | *Select the user defined configuration UserSet 1 as the Power-up Configuration.* | |
| *UserSet2* | *UserSet2* | *Select the user defined configuration UserSet 2 as the Power-up Configuration.* | |
| Calibration Date | deviceCalibrationDateRaw | Date when the camera was calibrated. | |
| Device Acquisition Type | deviceAcquisitionType | Displays the Device Acquisition Type of the product. | 1.00<br>DFNC<br>Invisible |
| *Sensor* | *Sensor* | *The device gets its data directly from a sensor.* | |
| Device TL Type | DeviceTLType | Transport Layer type of the device. | 1.00<br>DFNC<br>Invisible |
| *Camera Link* | *CameraLink* | *Camera Link* | |
| Device TL Version Major | DeviceTLVersionMajor | Major version of the device's Transport Layer. | 1.00<br>Invisible |
| Device TL Version Minor | DeviceTLVersionMinor | Minor version of the device's Transport Layer. | |
| | userSetError | Error Flags for UserSetLoad & UserSetSave | 1.00<br>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<br>DFNC<br>Invisible |
| DFNC Minor Rev | deviceDFNCVersionMinor | Minor revision of Dalsa Feature Naming Convention which was used to create the device's XML. | 1.00<br>DFNC<br>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<br>DFNC<br>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<br>DFNC<br>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<br>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.

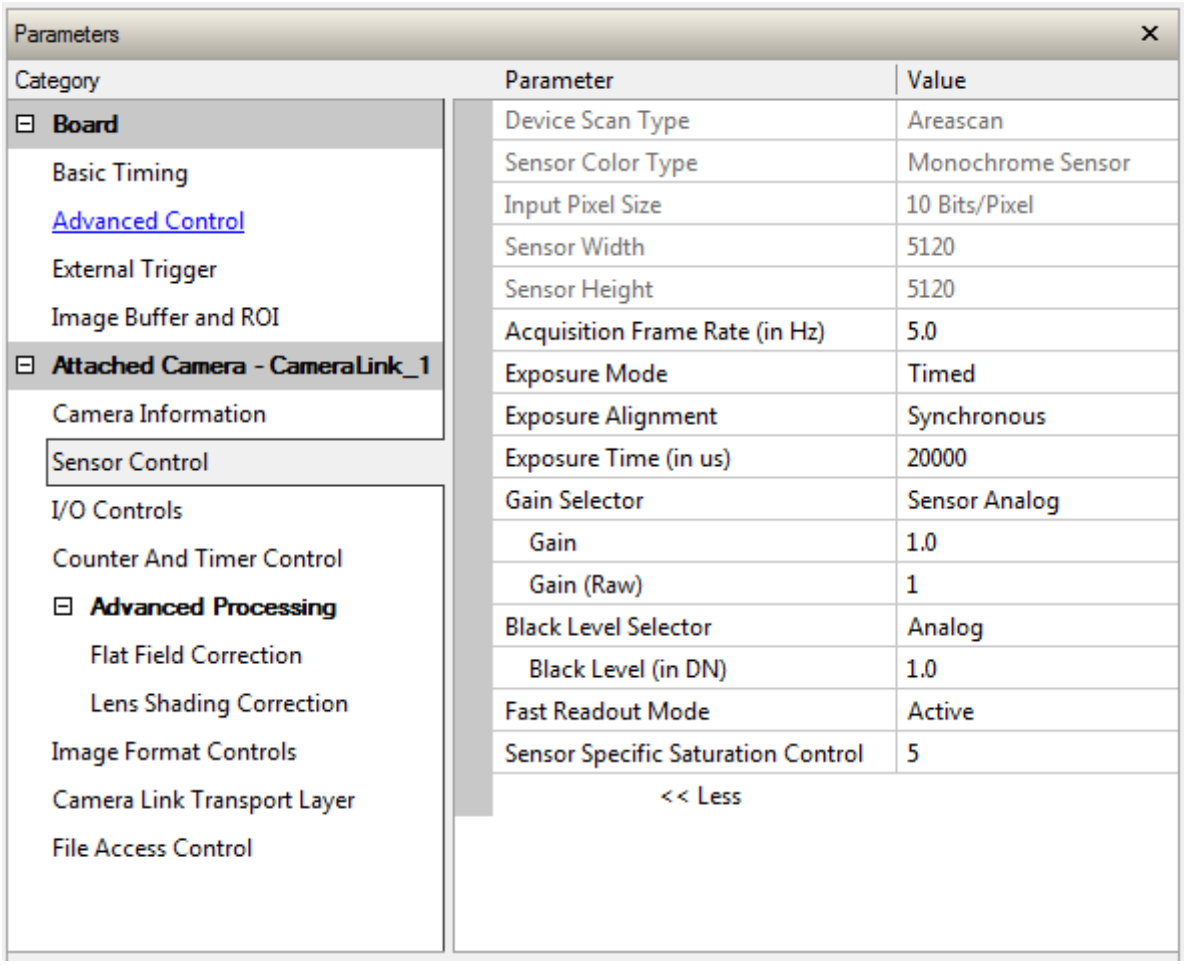
## *Load / Save Configuration*

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 User Set 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-CL sensor controls, as shown by CamExpert, groups sensor specific parameters. This group includes controls for frame rate, exposure time, gain, etc. Parameters in gray are read only, either always or due to other feature settings. Parameters in black are user set in CamExpert or programmable via an imaging application.

Features listed in the description table that are tagged as *Invisible* are usually for Teledyne DALSA or third party software usage—not typically needed by end user applications. Also important, features shown by CamExpert may change with different Genie Nano-CL models implementing different sensors, image resolutions and color versions.




# Sensor Control Feature Descriptions

The following table describes these features along with their view attribute and device version. For each feature the device version may differ for each camera sensor available.

When a Device Version number is indicated, this represents the camera software functional group, not a firmware revision number. As Genie Nano 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.

The first column indicates whether a feature applies to monochrome or color camera models via a symbol. No symbol indicates a common feature. Additionally the description column will indicate which feature is a member of the DALSA Features Naming Convention (indicated by DFNC), versus the GenICam Standard Features Naming Convention (SFNC tag is not shown).

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Device Scan Type | DeviceScanType | Defines the scan type of the device's sensor. Genie Nano-CL is an Areascan camera. | 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.* | |
| *Bayer Sensor* | *CFA_Bayer* | *Sensor color type is Bayer Color Filter Array (CFA).* | |
| 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 Time | ExposureTime | Sets the exposure time (in microseconds) when the Exposure Mode feature is set to Timed. | 1.00 Beginner |
| | | | |

| | | | |
|---|---|---|---|
| Gain Selector | GainSelector | Selects which gain is controlled when adjusting gain features. | 1.00<br>Beginner |
| *Sensor* | *SensorAll* | *Apply a gain adjustment within the sensor to the entire image. The first half of the gain range is applied in the analog domain and the second half is digital.* | |
| *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<br>Beginner |
| Gain (Raw) | GainRaw | Raw Gain value that is set in camera<br>(Model Specific for range and step values). | 1.00<br>Guru |
| Black Level Selector | BlackLevelSelector | Selects which Black Level to adjust using the Black Level features. | 1.00<br>Beginner |
| *Analog* | *AnalogAll* | *Sensor Dark Offset* | |
| Black Level | 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<br>Beginner |
| Fast Readout Mode | fastReadoutMode | Selects the sensor's readout mode. | 1.00<br>DFNC<br>Guru |
| *Off* | *Off* | *When this mode is off, the row blanking and row readout occur sequentially in the sensor.* | |
| *Active* | *Active* | *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.* | |
| Sensor Specific Saturation Control | sensorSpecificSaturationControl | Specific for this sensor. 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<br>DFNC<br>Guru |
| | | | |
| Black Level Raw | BlackLevelRaw | Controls the black level as an absolute physical value. | 1.00<br>Invisible |

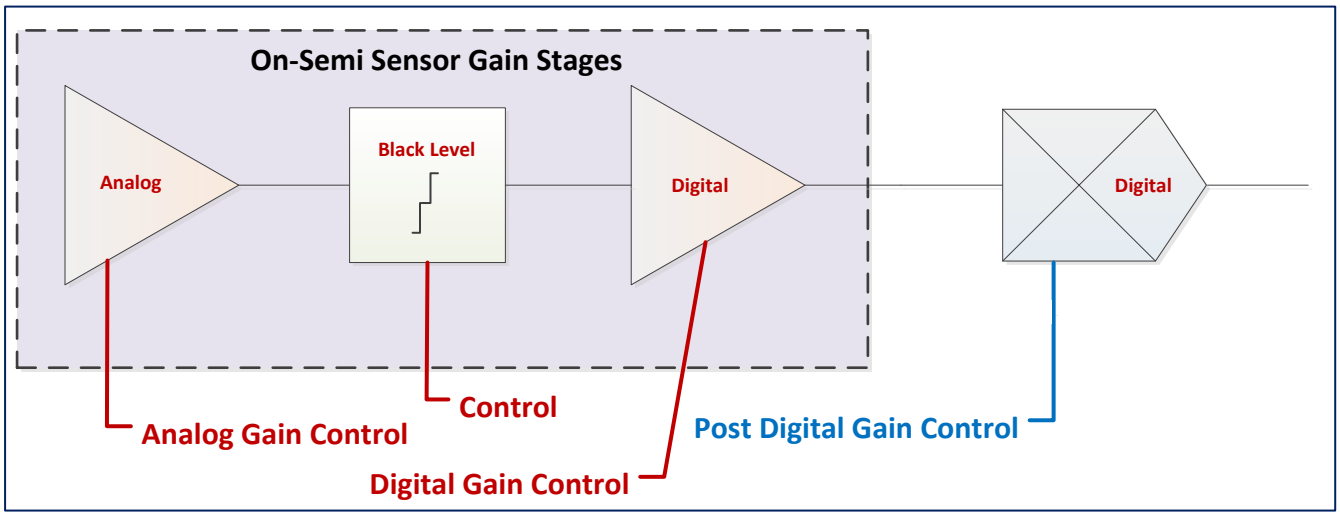
# Offset/Gain Control Details (On-Semi Python sensors)

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*

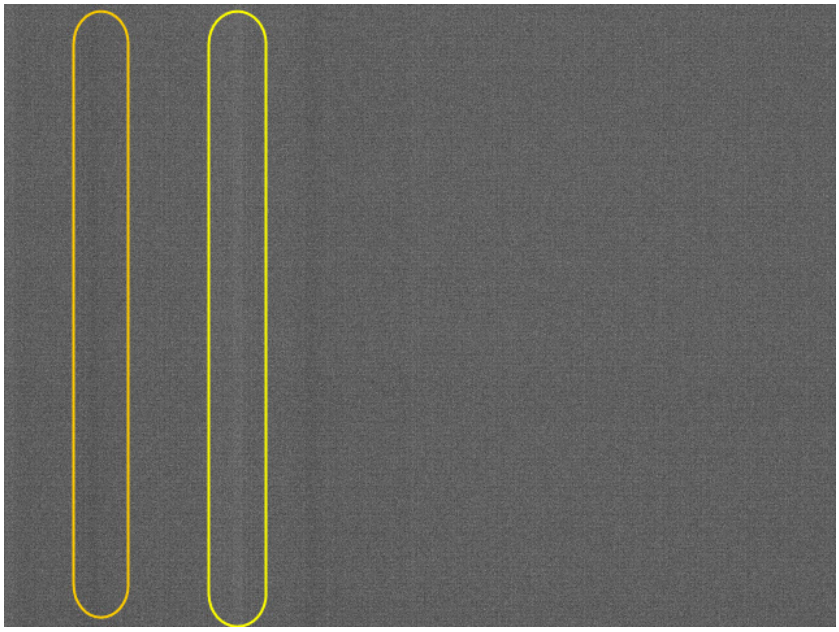



# OnSemi Sensor Artifacts with Fast Readout Mode

**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. As a consequence of 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.

See also Trigger Overlap: Feature Details.

## *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 16 sec.
- Any trigger received before the start of frame readout is ignored and generates an invalid frame trigger event.

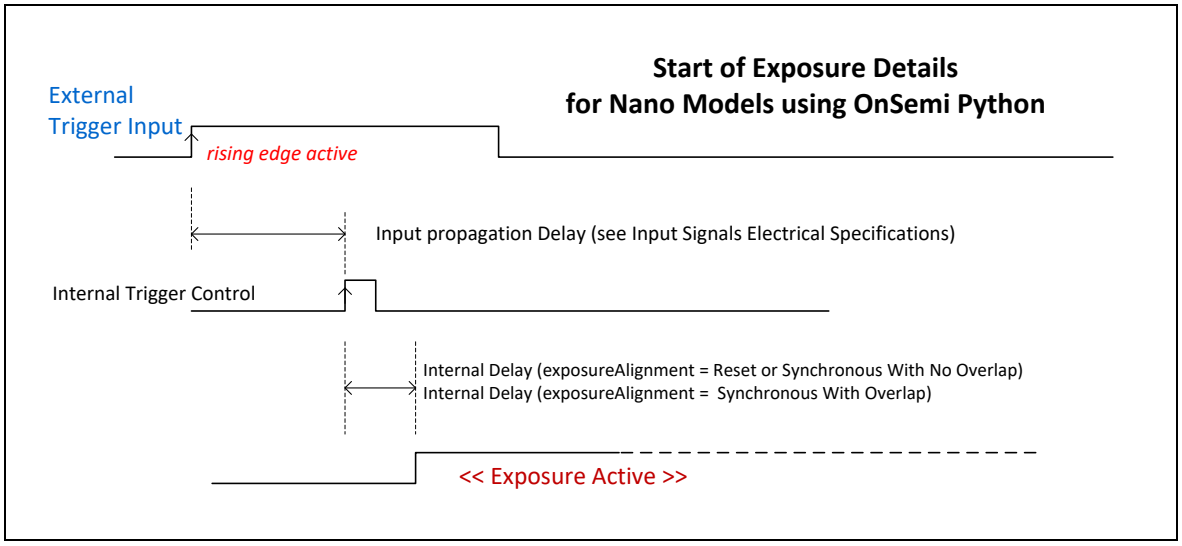
## *Reset Exposure Alignment*

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*



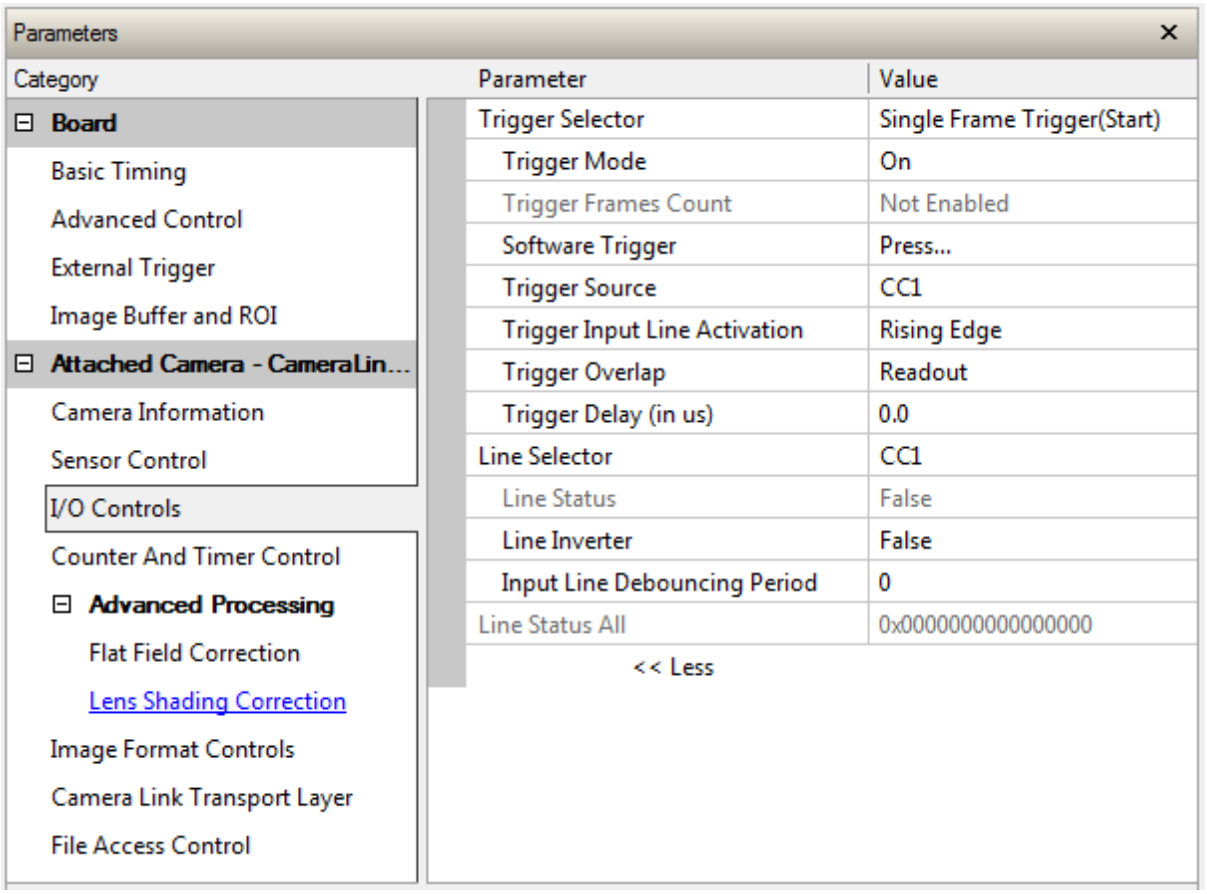

Additional triggered exposure mode features and timing specific to OnSemi sensors are described in the I/O Controls Category.

See model specific sections for explicit timing values.

# I/O Control Category

The Genie Nano I/O controls, as shown by CamExpert, groups' features used to configure acquisition actions based on those inputs. 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. Also important, Genie Nano cameras are available in a number of models implementing different sensors which may support different features within this category.



# I/O Control Feature Descriptions

The following table describes these features along with their view attribute and minimum camera firmware version required. Additionally the Device Version column will indicate which parameter is a member of the DALSA Features Naming Convention (indicated by DFNC), versus the GenICam Standard Features Naming Convention (SFNC tag is not shown).

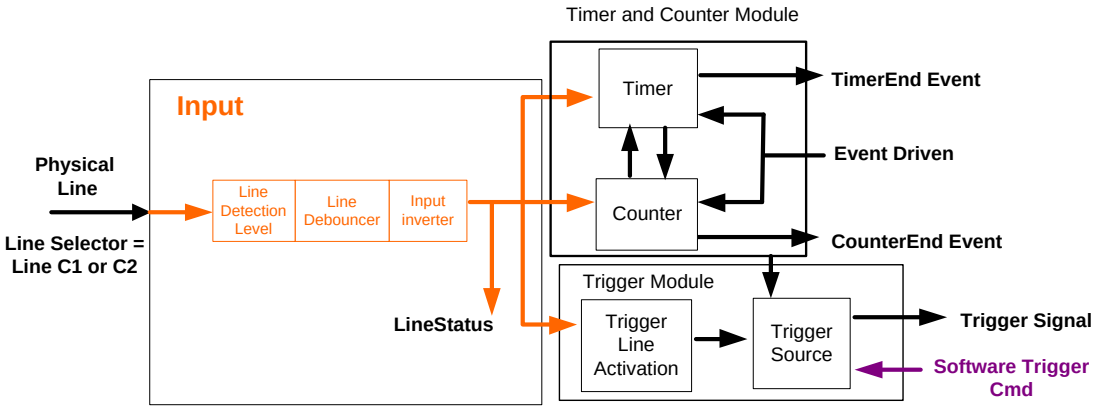
The Device Version number represents the camera software functional group, not a firmware revision number. As Genie Nano capabilities evolve the device version tag will increase, therefore identifying the supported function package. New features for a major device version release will be indicated by green text for easy identification.

| 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 |
| *CC1* | *CC1* | *Select CC1 (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.* | |
| *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).* | |
| *Any Edge* | *AnyEdge* | *The trigger is considered valid on any 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.* | |

| | | | |
|---|---|---|---|
| *Level Low* | *LevelLow* | *The trigger is considered valid on the low level of the line source signal.* | |
| Trigger Delay | TriggerDelay | Specifies the delay in microseconds to apply after receiving the trigger and before activating the triggerEvent. (min=0, max=2000000) | 1.00<br>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<br>Guru |
| *Off* | *Off* | *No trigger overlap is permitted.* | |
| *ReadOut* | *ReadOut* | *Trigger is accepted immediately after the start of the readout.* | |
| *End Of Exposure* | *EndOfExposure* | *Trigger is accepted immediately after the previous exposure period. This will latch the Trigger and delay the Exposure if the end of that exposure is shorter than the previous readout.* | |
| | | | |
| Line Selector | LineSelector | Selects the physical line (or pin) of the external device connector to configure. | 1.00<br>Beginner |
| *CC1* | *CC1* | *Select the Camera Link CC1.* | |
| *CC2* | *CC2* | *Select the Camera Link CC2.* | |
| Line Name | lineName | Description of the physical Pin associated with the logical line. | 1.00<br>Beginner<br>DFNC |
| *Camera Control 1* | *CC1* | *Camera Control 1 of the Camera Link connector* | |
| *Camera Control 2* | *CC2* | *Camera Control 2 of the Camera Link connector* | |
| Line Format | LineFormat | Specify the current electrical format of the selected physical input or output. | 1.00<br>Expert |
| *LVDS* | *LVDS* | *The line accepts LVDS level signals.* | |
| *Opto-Coupled* | *OptoCoupled* | *The line is opto-Coupled.* | |
| Line Status | LineStatus | Returns the current status of the selected input or output line. | 1.00<br>Expert |
| | *False* | *The Line is logic LOW* | |
| | *True* | *The Line is logic HIGH* | |
| 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<br>Expert |
| Line Inverter | LineInverter | Control to invert the polarity of the selected input or output line signal. | 1.00<br>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<br>Beginner<br>DFNC |
| | | | |
| Line Mode | LineMode | Reports if the physical Line is an Input or Output signal.. | 1.00<br>Invisible |
| *Input* | *Input* | *The line is an input line.* | |
| *Output* | *Output* | *The line is an output line.* | |
| Input Line Detection Level | lineDetectionLevel | Specifies the voltage threshold required to recognize a signal transition on an input line. | 1.00<br>Invisible<br>DFNC |
| *Threshold for TTL* | *Threshold_for_TTL* | *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.* | |
| Burst Frame Count | AcquisitionBurstFrameCount | Sets the maximum number of frames to acquire when a valid trigger is received. This feature is used when the Trigger Selector is set to FrameBurstStart. | 1.00<br>Invisible |
| Line Pinout | linePinAssociation | Enumeration of the physical line (or pin) on the device I/O connector. (RO) | 1.00<br>Invisible |

| | | | |
|---|---|---|---|
| *Pin5=Signal – Pin3=Gnd* | *Pin5Signal_Pin3Gnd* | *Pin 5 is the Input Signal and Pin 3 is the common input Ground on the I/O connector.* | |
| *Pin7=Signal – Pin3=Gnd* | *Pin7Signal_Pin3Gnd* | *Pin 7 is the Input Signal and Pin 3 is the common input Ground on the I/O connector.* | |
| *Pin6=Signal – Pin4=Pwr* | *Pin6Signal_Pin4Pwr* | *Pin 6 is the Output Signal and Pin 4 is the common output Power on the device connector.* | |
| *Pin8=Signal – Pin4=Pwr* | *Pin8Signal_Pin4Pwr* | *Pin 8 is the Output2 Signal and Pin 4 is the common output Power on the device connector.* | |
| | | | |

# *I/O Module Block Diagram*




# *Trigger Mode Details*

Nano-CL 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=CC1**: The Camera Link CC1 line (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*

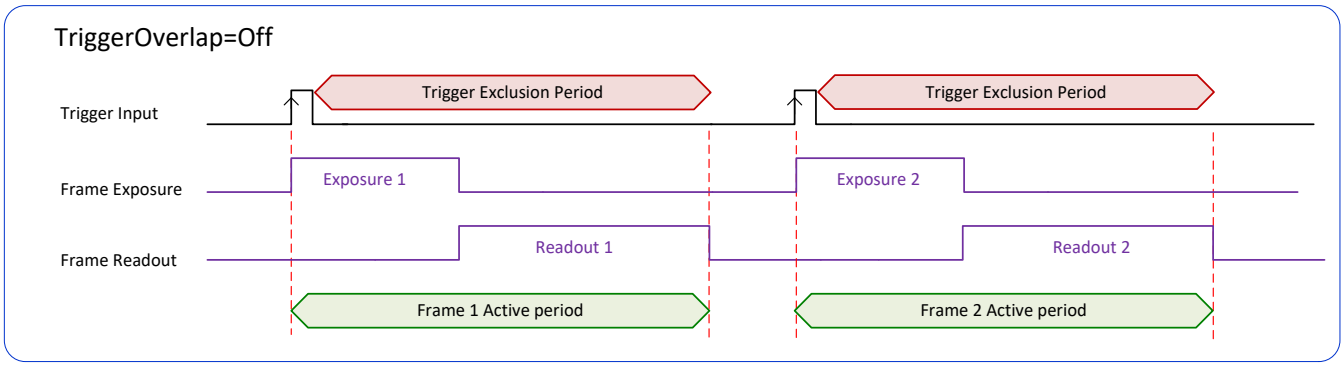
The Trigger Overlap feature defines how the Nano handles triggers that might occur more frequently than the Frame Active period (an exposure plus readout period).

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



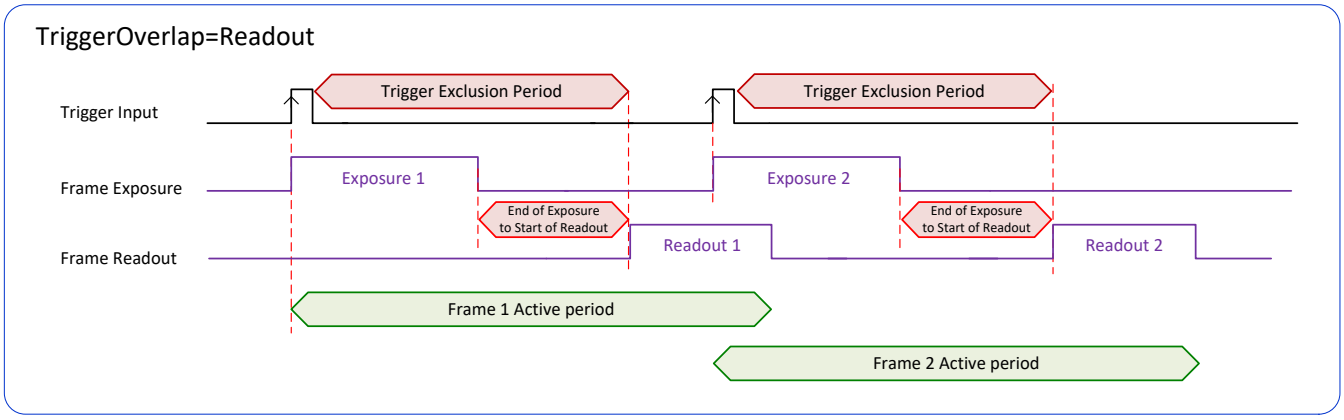

**Timing specific to OnSemi models**

- Minimum Trigger to Exposure start delay: 3.23µs (shown as 4µs)
- Readout Time:
  - M/C 5100 & M/C 4090:
    (Horizontal Line Time * NB Lines) + ( 2 * Horizontal Line Time at Maximum Sensor Width ), in µs
    see Nano-CL Specifications: M5100, C5100, M4090, C4090

- **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




**Timing specific to OnSemi models**

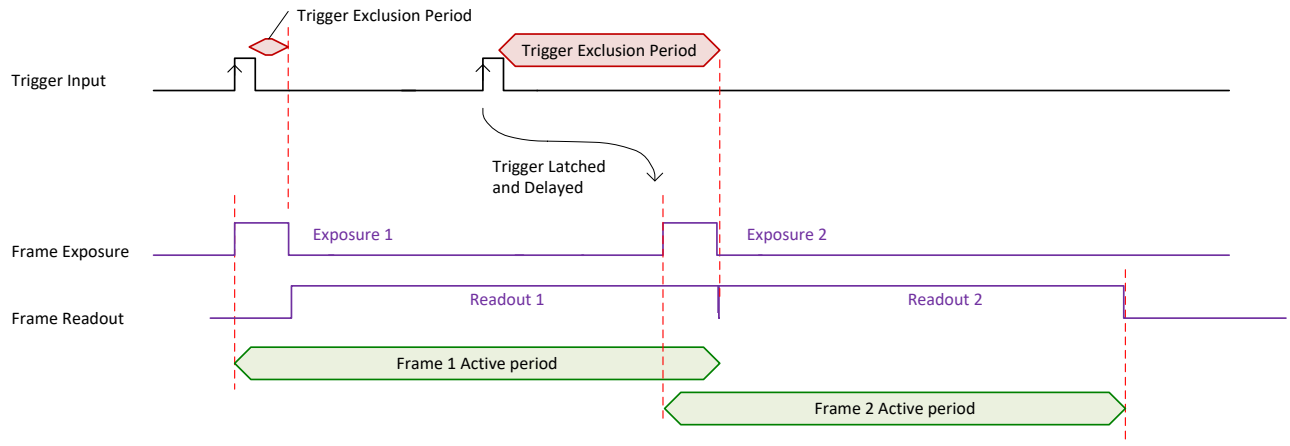
- Trigger to Exposure start has a delay which includes the sensor readout time plus a minimum of 62µs. An exposure always starts after the readout of the previous frame.
- Trigger Delay Times (min. with normal ROT):
  - M/C 5100 & M/C 4090: see Nano-CL Specifications: M5100, C5100, M4090, C4090

- **TriggerOverlap= EndOfExposure or Readout**
- This special condition describes the case of a short exposure relative to the readout period. A trigger received before the end of the frame readout is latched and delayed until such time that the following short exposure will end with the end of the previous frame readout. The second readout period will then start immediately.

Diagram Conditions:

- TriggerMode=On
- ExposureMode=Timed
- TriggerActivation=RisingEdge
- TriggerDelay=0
- TriggerSelector=FrameStart
- ExposureAlignment=Synchronous

TriggerOverlap= EndOfExposure or Readout

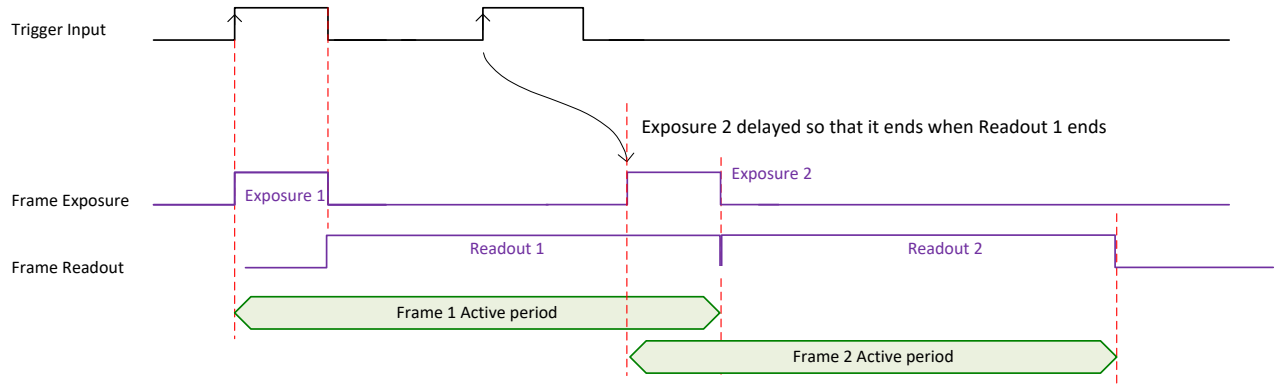


- **TriggerOverlap= Readout *and* ExposureMode=TriggerWidth**
- This special condition describes the case of a short TriggerWidth exposure relative to the readout period. If the next Trigger input signal occurs during the previous frame readout, attempting to stop the frame active period before the current readout is completed, the camera will continue the second exposure until the previous readout is completed. In this condition the actual exposure time is longer than the trigger input width.

Diagram Conditions (OnSemi Sensors):

- TriggerMode=On
- ExposureMode=TriggerWidth
- TriggerActivation=RisingEdge
- TriggerDelay=0
- TriggerSelector=FrameStart
- ExposureAlignment=Synchronous

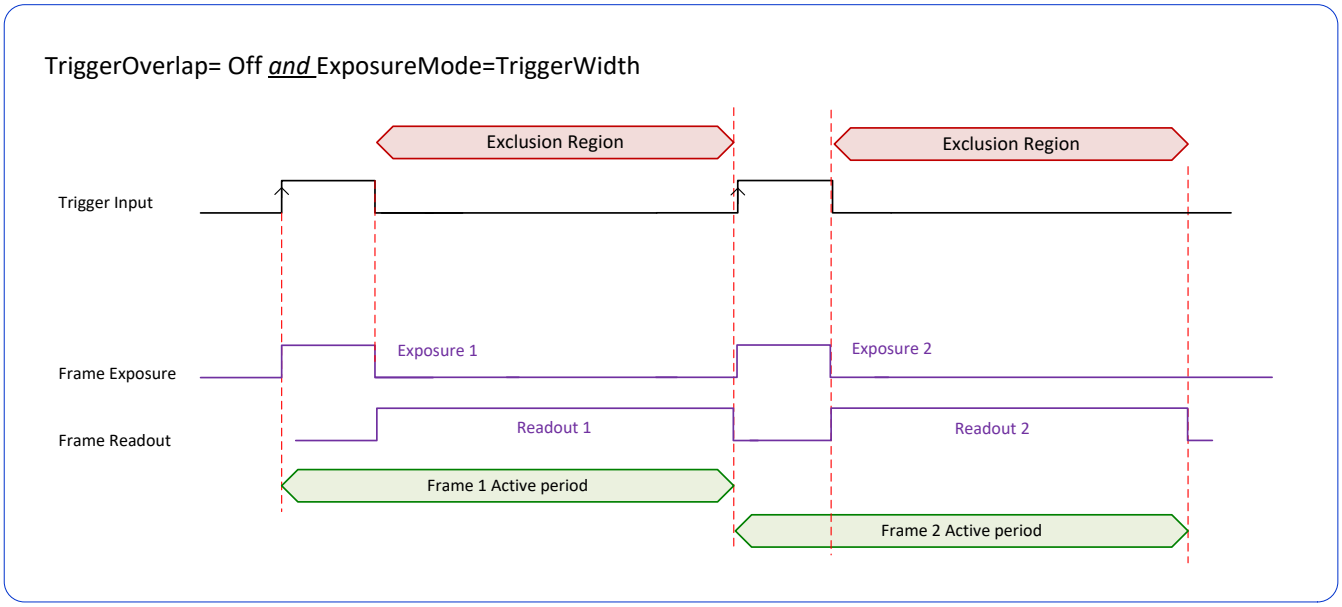
OnSemi Sensor TriggerOverlap= Readout *and* ExposureMode=TriggerWidth



- **TriggerOverlap=Off *and* ExposureMode=TriggerWidth**

Diagram Conditions:

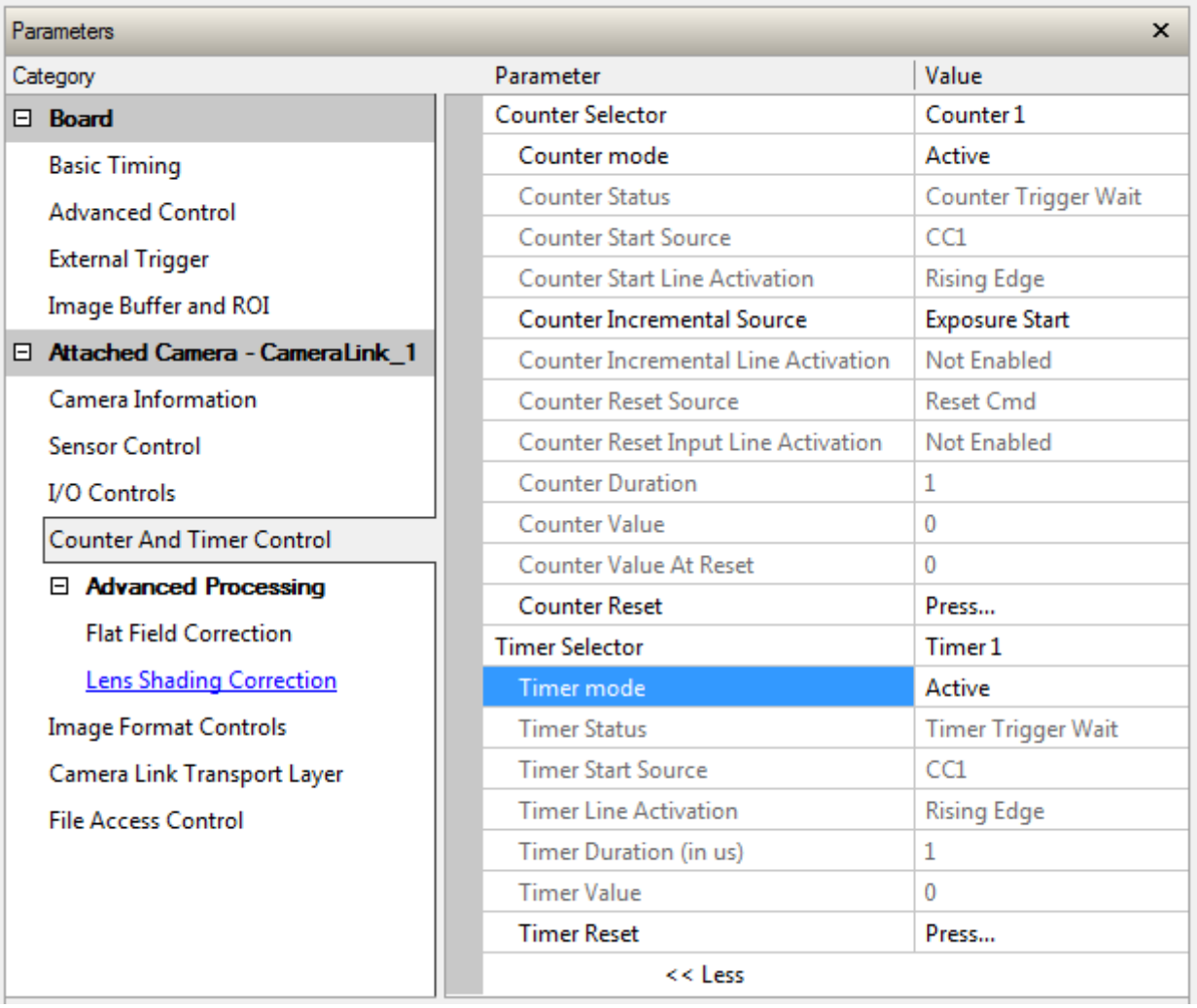
- TriggerMode=On
- ExposureMode=TriggerWidth
- TriggerActivation=RisingEdge
- TriggerDelay=0
- TriggerSelector=FrameStart
- ExposureAlignment=Synchronous



# Counter and Timer Control Category

The Genie Nano-CL counter and timer controls, as shown by CamExpert, groups parameters used to configure acquisition counters and timers. 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. Also important, Nano cameras are available in a number of models implementing different sensors and image resolutions which may not support the full feature set defined in this category.



# Counter and Timer Control Feature Description

The following table and block diagram, describes these parameters along with their view attribute and minimum camera firmware version required. Additionally the Device Version column will indicate which feature is a member of the DALSA Features Naming Convention (indicated by DFNC), versus the GenICam Standard Features Naming Convention (SFNC tag is not shown).

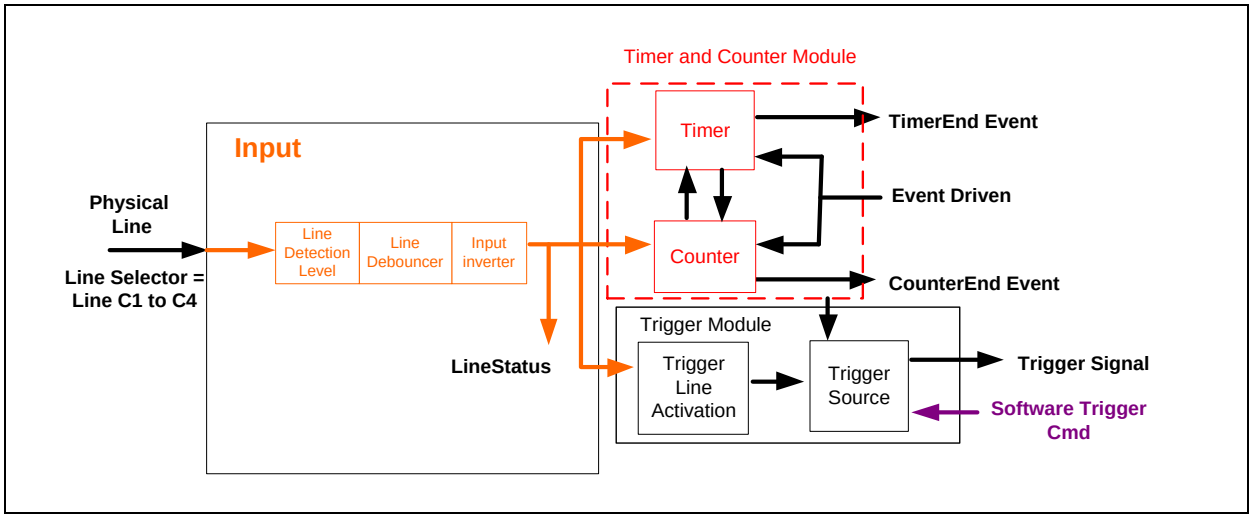
The Device Version number represents the camera software functional group, not a firmware revision number. As Nano-CL capabilities evolve the device version tag will increase, therefore identifying the supported function package. New features for a major device version release will be indicated by green text for easy identification.

| 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.*<br>*The counterStartSource feature is set to off.* | |
| *Counter Trigger Wait* | *CounterTriggerWait* | *The counter is waiting for a start trigger.* | |
| *Counter Active* | *CounterActive* | *The counter is counting for the specified duration.* | |
| *Counter Completed* | *CounterCompleted* | *The counter reached the CounterDuration count.* | |
| *Counter Overflow* | *CounterOverflow* | *The counter reached its maximum possible count.* | |
| Counter Start Source | counterStartSource | Select the counter start source. Counter increments from 0 to the value of the counterDuration feature. | 1.00 Expert DFNC |
| *Off* | *Off* | *Counter is stopped.* | |
| *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.* | |
| *CC1* | *CC1* | *Counter starts on the specified transitions on CC1.* | |
| *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 |

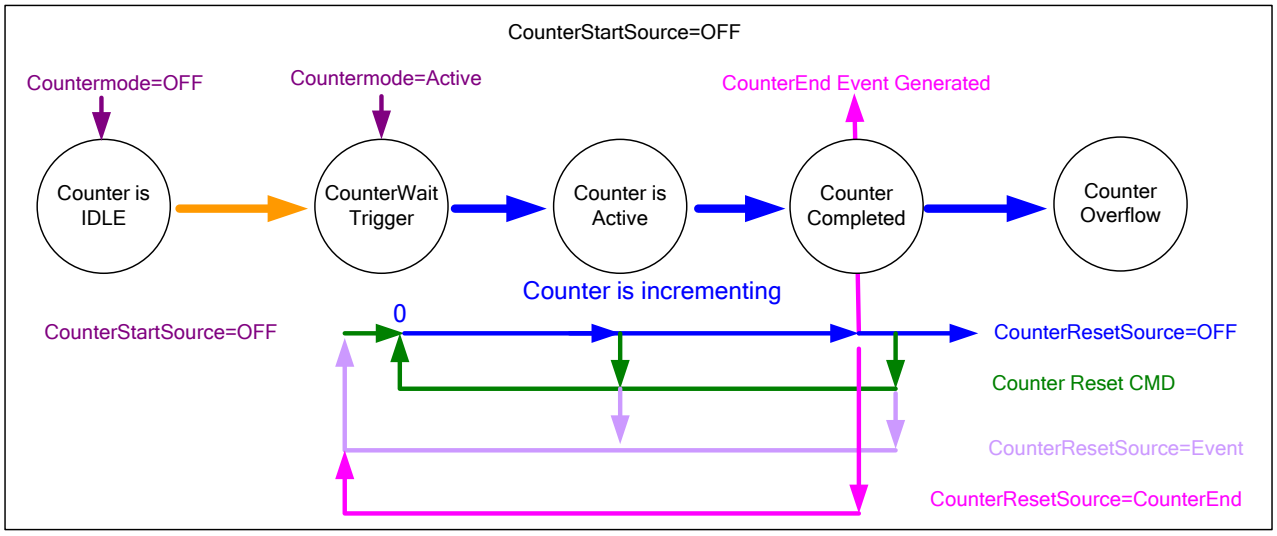
| | | | |
|---|---|---|---|
| *Rising Edge* | *RisingEdge* | *Starts counting on rising edge of the selected Line.* | |
| *Falling Edge* | *FallingEdge* | *Starts counting on falling edge of the selected Line.* | |
| *Any Edge* | *AnyEdge* | *Starts counting on the falling or rising edge of the selected 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<br>Expert<br>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.* | |
| *CC1* | *CC1* | *Counts the number of transitions on CC1 (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<br>Expert<br>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<br>Expert<br>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<br>Expert<br>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.* | |
| *CC1* | *CC1* | *Reset the Counter on the specified transitions on CC1.* | |
| *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<br>Expert<br>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<br>Expert<br>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<br>Expert<br>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<br>Expert<br>DFNC |
| | | | |
| Timer Selector | timerSelector | Selects which timer to configure. | 1.00<br>Expert<br>DFNC |
| *Timer 1* | *Timer1* | *Timer 1 selected* | |
| Timer Mode | timerMode | Select the Timer mode. The selected Timer is Active or Disabled. When Disabled, the Timer can be configured. | 1.00<br>Expert<br>DFNC |
| *Off* | *Off* | *The selected Timer is Disabled.* | |
| *Active* | *Active* | *The selected Timer is Enabled.* | |
| Timer Status | timerStatus | Returns the current state of the timer. | 1.00<br>Expert<br>DFNC |
| *Timer Idle* | *TimerIdle* | *The timer is idle. The CounterStartSource feature is set to off.* | |
| *Timer Trigger Wait* | *TimerTriggerWait* | *The timer is waiting for a start trigger.* | |
| *Timer Active* | *TimerActive* | *The timer is counting for the specified duration.* | |
| *Timer Completed* | *TimerCompleted* | *The timer reached the TimerDuration count.* | |
| Timer Start Source | timerStartSource | Select the trigger source to start the timer. The Event Control section provides details and timing diagrams for the supported events. | 1.00<br>Expert<br>DFNC |
| *TimerReset Cmd* | *Off* | *Starts with the reception of the TimerReset Icommand.* | |
| *Exposure Start* | *ExposureStart* | *Start Timer on Exposure Start event.* | |
| *Exposure End* | *ExposureEnd* | *Start Timer on Exposure End event.* | |
| *Readout Start* | *ReadoutEnd* | *Start Timer on Readout Start event.* | |
| *Readout End* | *ReadoutStart* | *Start Timer on Readout End event.* | |
| *Frame Start* | *FrameStart* | *Start Timer on Frame Start event.* | |
| *Frame Trigger* | *ValidFrameTrigger* | *Start Timer on Frame Trigger event.* | |
| *CC1* | *CC1* | *Start Timer on a transition of I/O CC1 event.* | |
| *Counter 1 End* | *Counter1End* | *Start Timer on Counter 1 End event.* | |
| Timer Line Activation | timerStartLineActivation | Select the trigger activation mode which starts the timer. | 1.00<br>Expert<br>DFNC |
| *Rising Edge* | *RisingEdge* | *Starts counter on rising edge of the selected signal.* | |
| *Falling Edge* | *FallingEdge* | *Starts counter on falling edge of the selected signal.* | |
| *Any Edge* | *AnyEdge* | *Starts counter on the falling or rising edge of the selected signal.* | |
| Timer Duration | timerDuration | Sets the duration (in microseconds) of the timer pulse. | 1.00<br>Expert<br>DFNC |
| Timer Value | timerValue | Reads the current value (in microseconds) of the selected timer. | 1.00<br>Expert<br>DFNC |
| Timer Reset | timerReset | Resets the timer to 0 while *timerStatus=TimerActive*. Timer then waits for the next *timerStartSource* event. | 1.00<br>Expert<br>DFNC |

## *Counter and Timer Group Block Diagram*

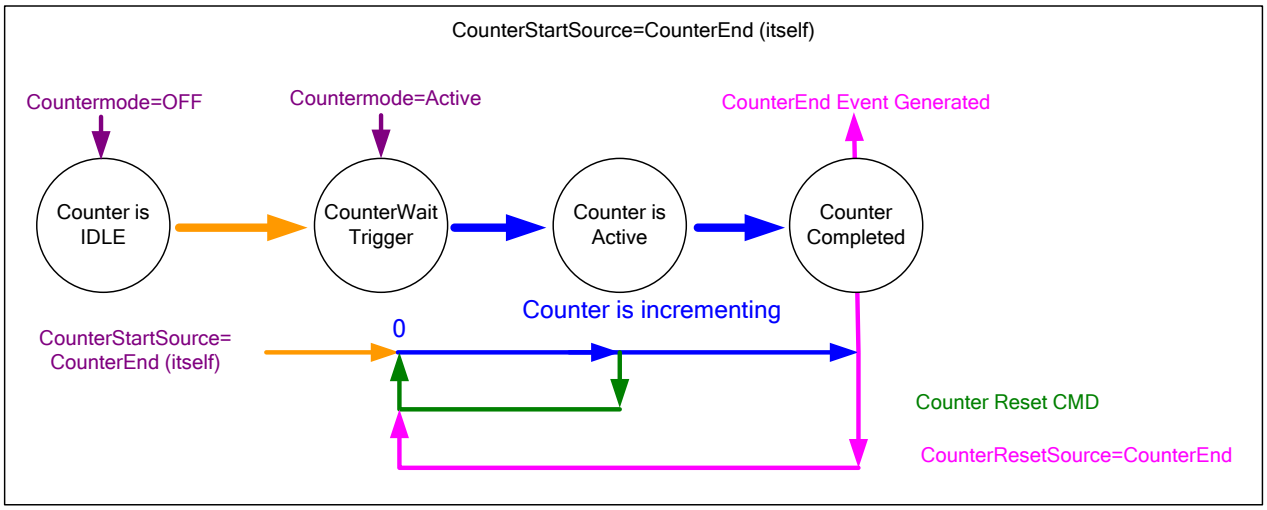



## *Example: Counter Start Source = OFF*



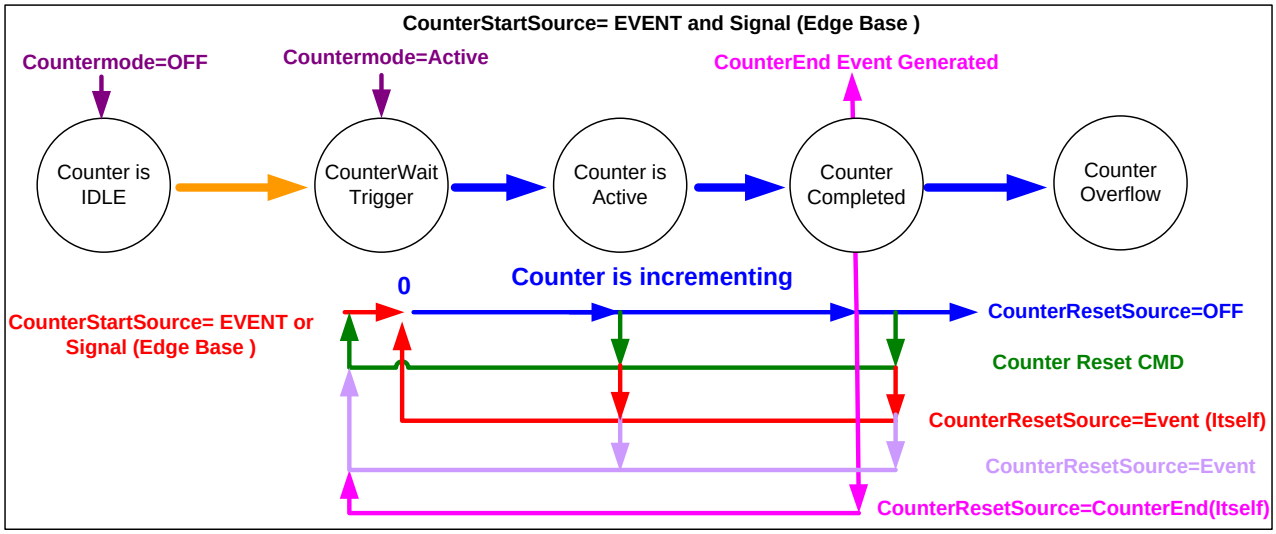

- The counter starts on the **counterReset Cmd**.
- The counter continues unless a new **counterReset Cmd** is received, which then restarts the counter at 00.
- When **Counter Reset Source= 'Event' or 'CounterEnd**' the counter is reset to 00 but does not restart counting, until the next **CounterReset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

## *Example: Counter Start Source = CounterEnd (itself)*

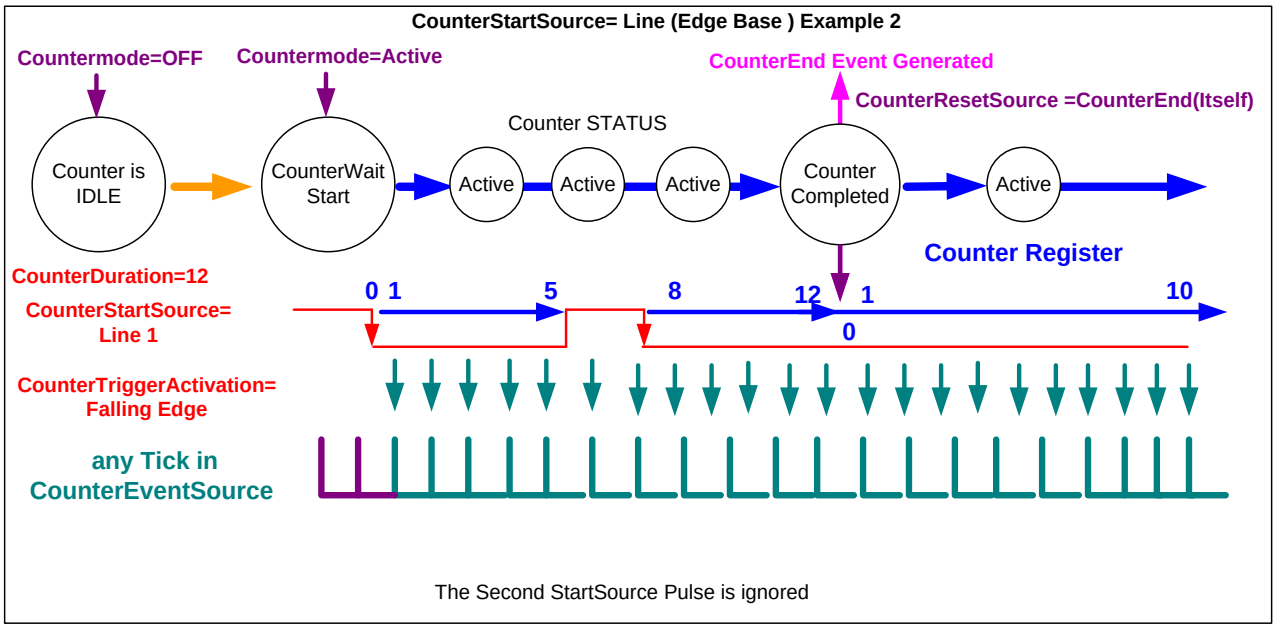



- Counter starts when Counter Mode is set to Active.
- A **Counter Reset CMD** will reset the counter to 00 and it then continues counting.
- **counterResetSource** must be set to **CounterEnd**. When the counterValue feature reaches the counterDuration value an event is generated and the counter is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

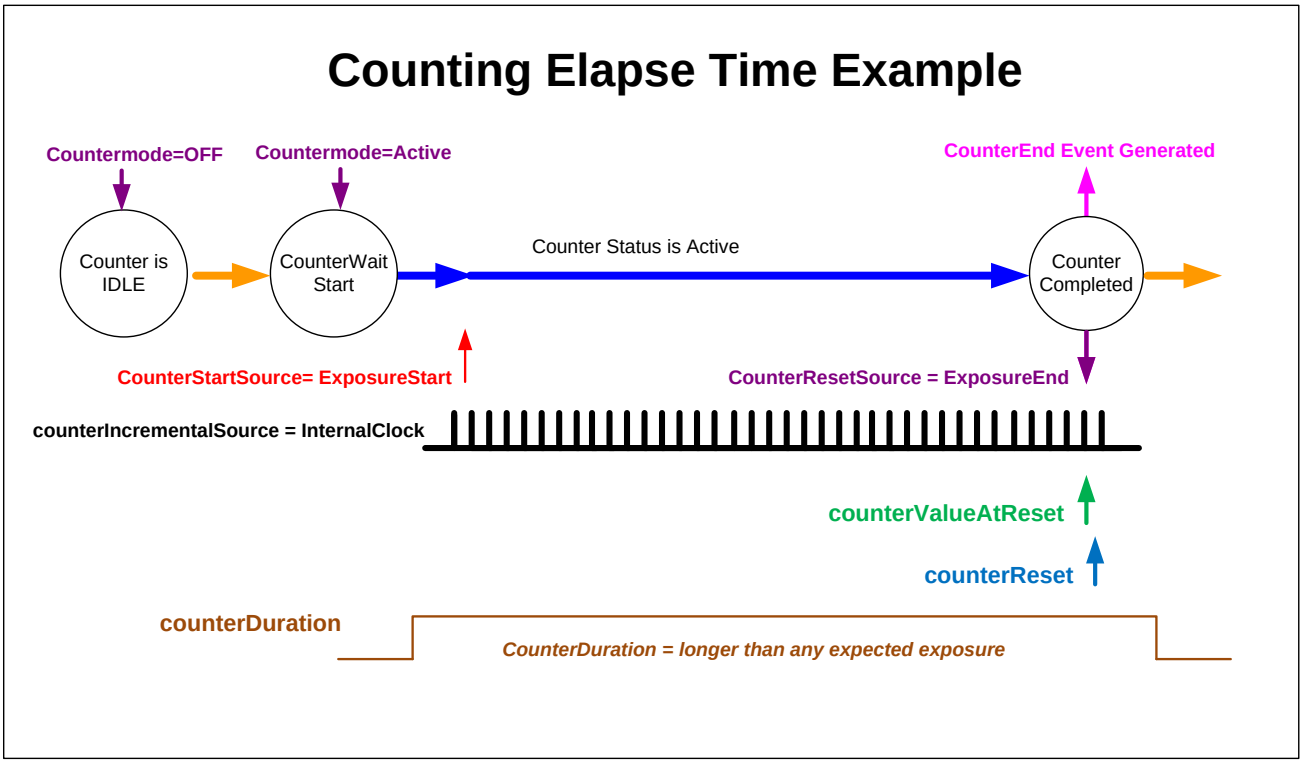
## *Example: CounterStartSource = EVENT and Signal (Edge Base)*



## *Example: CounterStartSource = Line (Edge Base) Example*



## *Example: Counting Elapse Time*



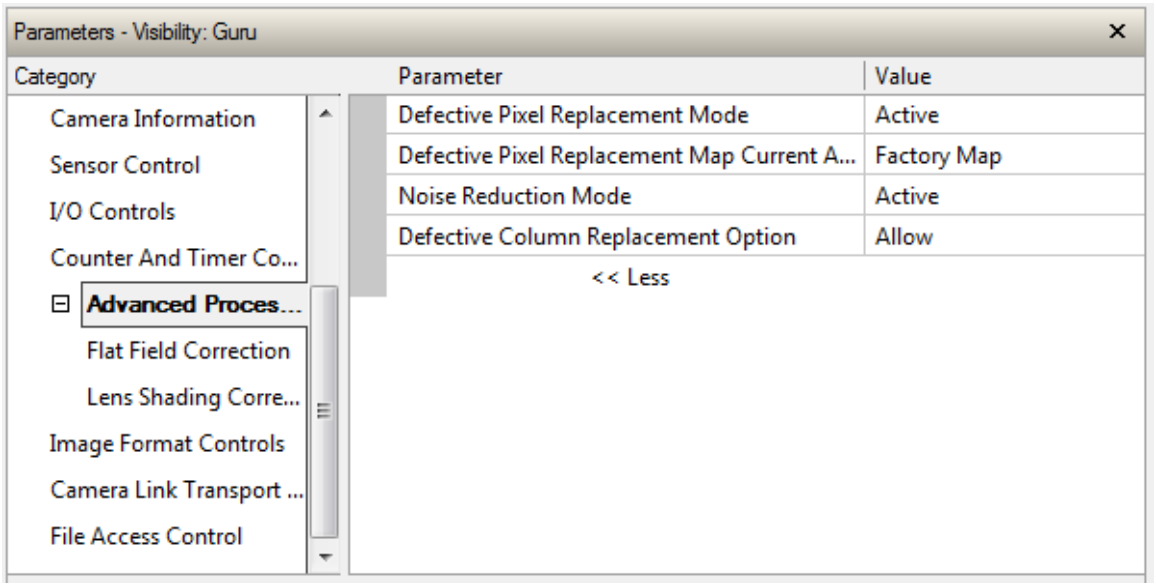

- **Countermode=Active:** Enable the counter function.
- **counterIncrementalSource=InternalClock:** Counter driven by internally generated microsecond clock tick.
- **counterDuration="a period of time longer than any expected counter active period":** In cases where the count period is not fixed by 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.

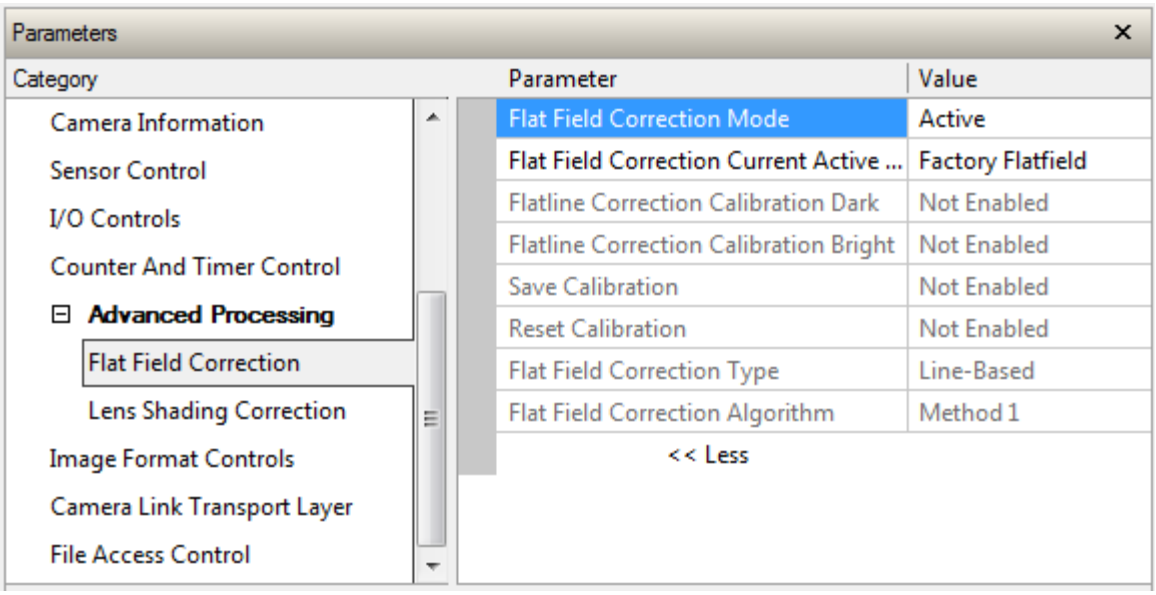
# Advanced Processing Control Category

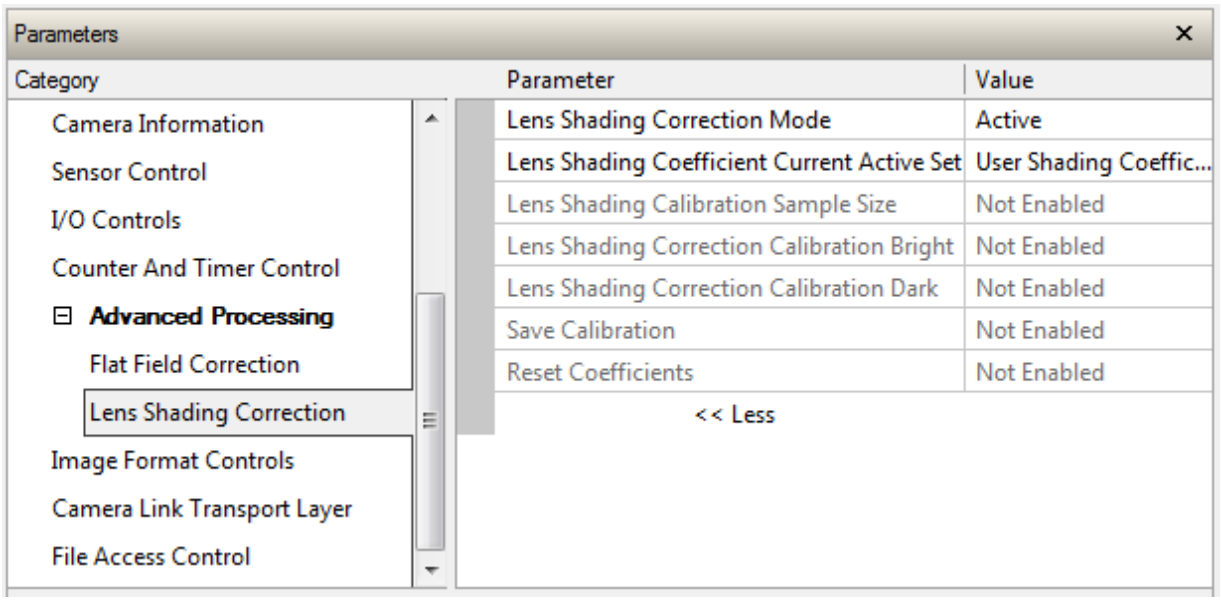
The Genie Nano-CL Advanced Processing controls, as shown by CamExpert groups parameters used to configure pixel replacement, flat field correction (column based), and lens shading correction controls on monochrome cameras. Parameters in gray are read only, either always or due to another parameter being 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.

Also important, Nano-CL cameras are available in a number of models implementing different sensors and image resolutions which may not support the full feature set defined in this category. Color cameras will have their own specific processing capabilities.

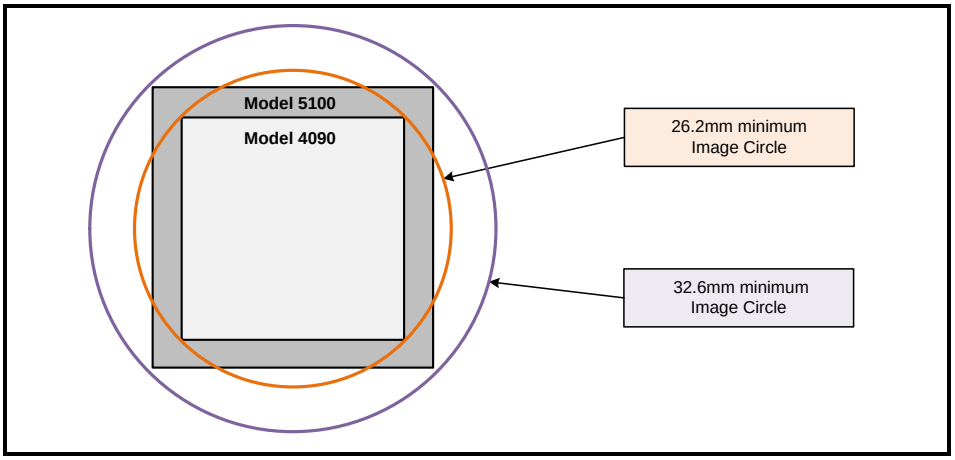





# Notes about Lens Shading Calibration

**Note:** It is recommended that a "Lens Shading Calibration" procedure be done for any Nano-CL/Lens combination. Calibration will eliminated 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

The following table describes these features along with their view attribute and device version. For each feature the device version may differ for each camera sensor available. Such feature differences will be clearly indicated.

As Nano-CL capabilities evolve the device firmware 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 that new manual release.

The description column will indicate which feature is a member of the Teledyne DALSA Features Naming Convention (indicated by DFNC), versus the GenICam Standard Features Naming Convention (SFNC not shown).

## *Advanced Processing Group*

| Display Name | Feature & Values | Description | Version |
|---|---|---|---|
| Defective Pixel Replacement Mode | defectivePixelReplacementMode | Sets the mode for the defective pixel replacement. | Ver. 1.00 Expert DFNC |
| *Off* | *Off* | *Defective Pixel Replacement is disabled.* | |
| *Active* | *Active* | *Defective Pixel Replacement is enabled.* | |
| Defective Pixel Replacement Map Current Active Set | defectivePixelReplacementMapCurrentActiveSet | Sets the defective pixel replacement set. | Ver. 1.00 Expert DFNC |
| *Factory Map* | *FactoryMap* | *Sets the factory coefficient table as active.* | |
| *User Map 1* | *UserMap1* | *Sets the User Map coefficient table as active.* | |
| Defective Pixel Replacement Algorithm | defectivePixelReplacementAlgorithm | Specifies the defective pixel replacement algorithm. | Ver. 1.00 Expert DFNC |
| *Method3: Neighboring Pixel* | *Method3* | *This algorithm replaces a defective pixel with a neighbor.* | |
| Noise Reduction Mode | noiseReduction | Sets the mode for the pixel noise reduction. | Ver. 1.00 Expert DFNC |
| *Off* | *Off* | *Noise Reduction is disabled.* | |
| *Active* | *Active* | *Noise Reduction is enabled.* | |
| Defective Column Replacement Option | defectiveColumnReplacementOption | When defectivePixelReplacementMode is Active, this feature allows control over defective column replacement. | Ver. 1.00 Expert DFNC |
| *Disable* | *Disable* | *Defective Column Replacement is disabled.* | |
| *Allow* | *Allow* | *Defective Column Replacement is allowed.* | |
| | | | |

# *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.* | |
| 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 typically 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 typically done after the dark calibration. This calibration requires a bright featureless acquisition that is not saturated. | 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.* | |
| 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 Bright | lensShadingCorrectionCalibrationBright | Perform a bright calibration for lens shading correction. This calibration requires a bright featureless acquisition that is not saturated. (70% illumination is recommended). | 1.00 Expert DFNC |
| Lens Shading Correction Calibration Dark | lensShadingCorrectionCalibrationDark | 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). | 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 | lensShadingCorrectionAlgorithmBufferFormat | | 1.00<br>Invisible<br>DFNC |
| *Mono8* | *Mono8* | | |
| Lens Shading Correction Algorithm Buffer Width | lensShadingCorrectionAlgorithmBufferWidth | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Algorithm Buffer Height | lensShadingCorrectionAlgorithmBufferHeight | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Algorithm Gain Max | lensShadingCorrectionAlgorithmGainMax | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Algorithm Gain Min | lensShadingCorrectionAlgorithmGainMin | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Algorithm Gain Divisor | lensShadingCorrectionAlgorithmGainDivisor | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Algorithm Gain Base | lensShadingCorrectionAlgorithmGainBase | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Algorithm Offset Max | lensShadingCorrectionAlgorithmOffsetMax | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Algorithm Offset Min | lensShadingCorrectionAlgorithmOffsetMin | | 1.00<br>Invisible<br>DFNC |
| Lens Shading Correction Algorithm Offset Factor | lensShadingCorrectionAlgorithmOffsetFactor | | 1.00<br>Invisible<br>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, 10, 12-bit) is handled transparently, thus requires 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 number of coordinates dependent on sensor “Defective Pixel Replacement” value -->
<!–-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>
```

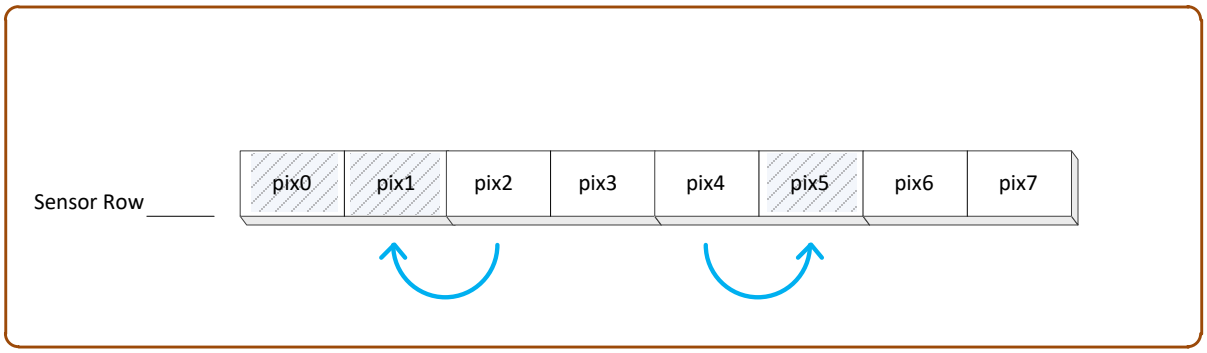
A sample editable defective pixel map replacement file will be available to download with Nano firmware files.

## *Monochrome Defective Pixel Replacement Algorithm Description*

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

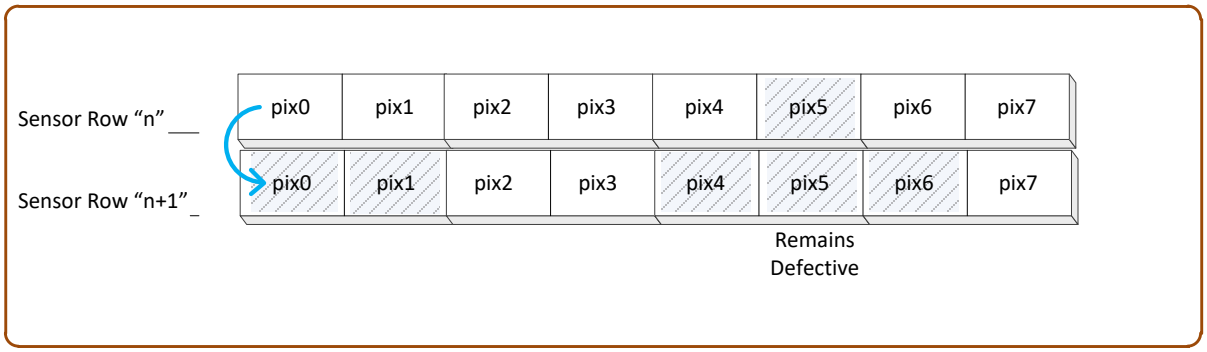
**Single bad pixel in a sensor line with a good adjacent pixel**

- 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.

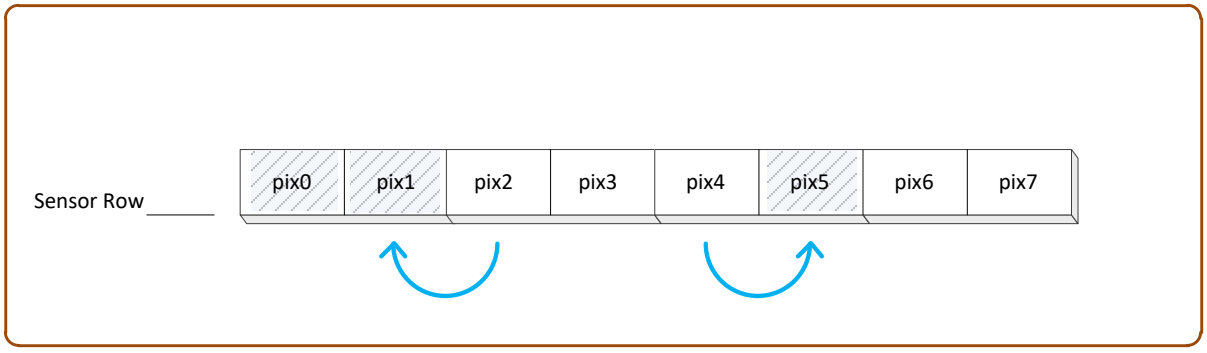


## *Color Defective Pixel Replacement Algorithm Description*

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.

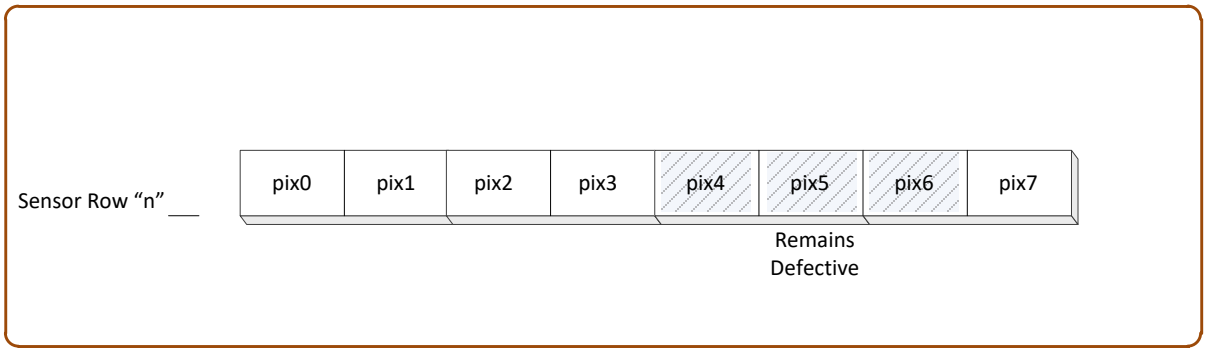
**Single bad pixel in a sensor line with a good adjacent pixel**

- 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.

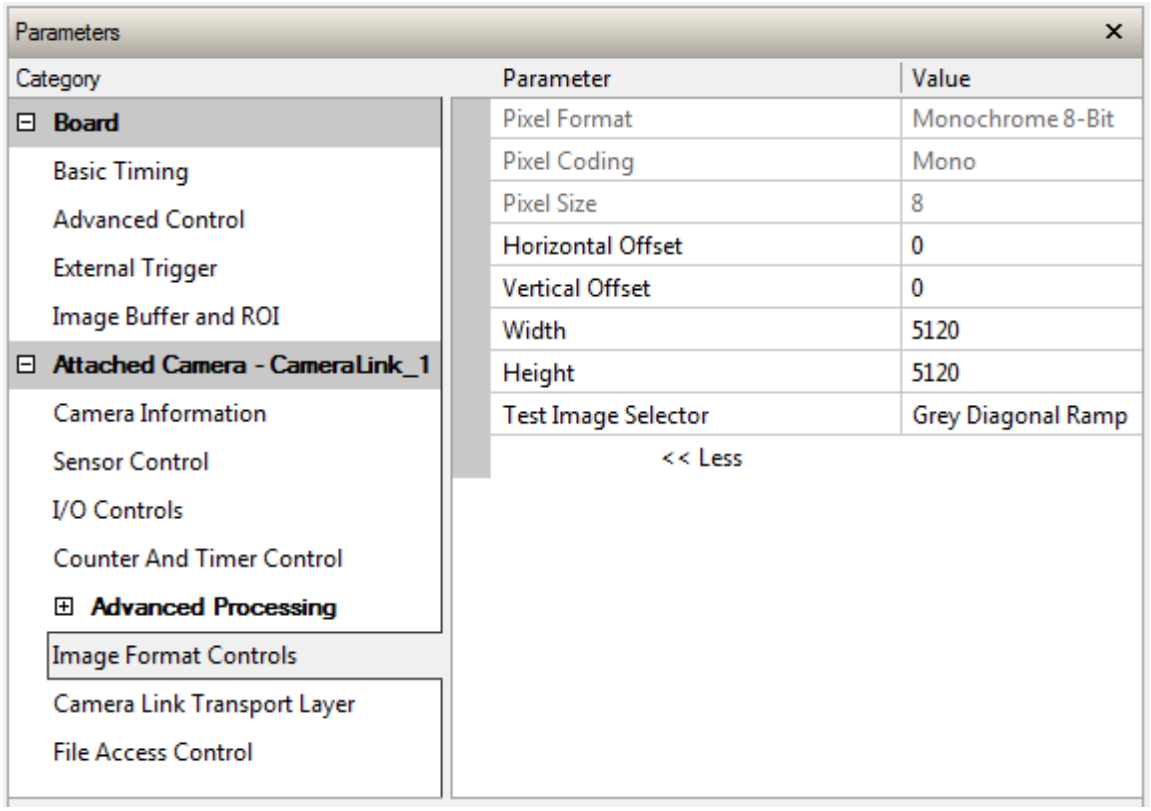


# Image Format Control Category

The Nano-CL Image Format controls, as shown by CamExpert, groups parameters used to configure camera pixel format, image cropping, and selecting a test output image without a lens.

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. Also important, Genie Nano cameras are available in a number of models implementing different sensors and image resolutions which may not support the full feature set defined in this category.




# Image Format Control Feature Description

The following table describes these features along with their view attribute and device framework version. For each feature the device version may differ for each camera sensor available. Such differences will be clearly indicated for any applicable feature.

A Revision Version number represents the camera software firmware revision. As Genie Nano capabilities evolve the 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.

The first column indicates whether a feature applies to monochrome or color camera models via a symbol. No symbol indicates a common feature. Additionally the description column will indicate

which feature is a member of the DALSA Features Naming Convention (denoted by DFNC), versus the GenICam Standard Features Naming Convention (SFNC tag is not shown).

| B/W Color | Display Name | Feature & Values | Description | Device 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<br>Beginner<br>Read Only |
|  | *Monochrome 8-Bit* | *Mono8* | *Mono8: Monochrome 8-Bit* | |
|  | *Monochrome 10-Bit* | *Mono10* | *Mono10: Monochrome 10-Bit* | |
|  | *Monochrome 12-Bit* | *Mono12* | *Mono12: 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* | |
|  | *BayerGR 10-Bit* | *BayerGR10* | *Color camera: BayerGR10* | |
|  | *BayerRG 12-Bit* | *BayerRG12* | *Color camera: BayerRG12* | |
|  | *BayerGB 12-Bit* | *BayerGB12* | *Color camera: BayerGB12* | |
|  | *BayerBG 12-Bit* | *BayerBG12* | *Color camera: BayerBG12* | |
|  | *BayerBG 12-Bit* | *BayerBG12* | *Color camera: BayerBG12* | |
| | Pixel Coding | PixelCoding | Output image pixel coding format of the sensor. See clPixelSize in the "Camera Link Transport Layer" section to change the pixel size output. | 1.00<br>Guru<br>Read Only |
|  | *Mono* | *Mono* | *Pixel is monochrome* | |
|  | *Raw Bayer* | *Raw* | *Pixel is raw Bayer* | |
| | Pixel Size | PixelSize | Total size in bits of an image pixel. | 1.00<br>Guru<br>Read Only |
| | *8 Bits/Pixel* | *Bpp8* | *Bpp8: 8 bits per pixel* | |
| | *10 Bits/Pixel* | *Bpp10* | *Bpp10: 10 bits per pixel* | |
| | *12 Bits/Pixel* | *Bpp12* | *Bpp12: 12 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 (in lines). | 1.00 Beginner |
| | | | | |
| | Test Image Selector | TestImageSelector | Selects the type of test image generated by the camera. | 1.00 Beginner |
| | *Off* | *Off* | *Image is from the camera sensor.* | |
| | *Grey Horizontal Ramp* | *GreyHorizontalRamp* | *Image is filled horizontally with an image that goes from the darkest possible value to the brightest.* | |
| | *Grey Vertical Ramp* | *GreyVerticalRamp* | *Image is filled vertically with an image that goes from the darkest possible value to the brightest.* | |
| | *Grey Diagonal Ramp Moving* | *GreyDiagonalRampMoving* | *Image is filled horizontally with an image that goes from the darkest possible value to the brightest by 1 Dn increment per pixel and that moves horizontally.* | |
| | | | | |
| | Width Max | WidthMax | The maximum image width is the dimension calculated after horizontal binning, decimation or any other function changing the horizontal dimension of the image. | 1.00 Invisible |
| | Height Max | HeightMax | The maximum image height is the dimension calculated after vertical binning, decimation or any other function changing the vertical dimension of the image. | 1.00 Invisible |

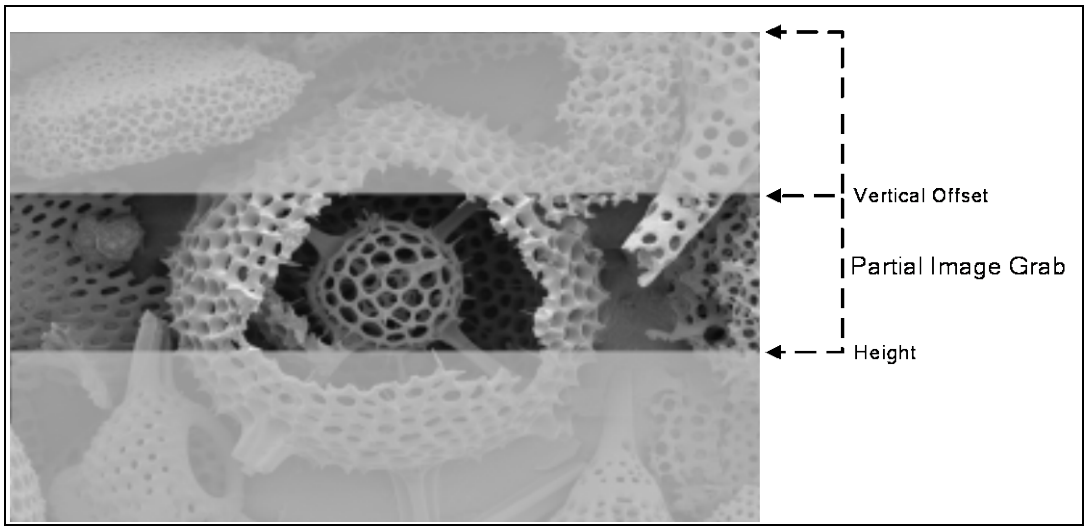
# Width and Height Features for Partial Scan Control

Width and Height controls along with their respective offsets, allow the Nano-CL 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 less pixels are transmitted.

## *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 Genie Nano 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-CL–M/C 5100)*

### Using 10-Tap 8-bit Firmware

| Vertical Lines Acquired (inc=16) | Internal Trigger / Minimum Exposure Python 25k sensor – model M5100 | Internal Trigger / Minimum Exposure Python 25k sensor – model M5100 Fast Readout Mode Enabled |
|---|---|---|
| 5120 | 23.4 fps | 32.0 fps |
| 3840 | 31.2 fps | 42.7 fps |
| 2560 | 46.8 fps | 63.9 fps |
| 1280 | 93.2 fps | 127.2 fps |
| 640 | 184.9 fps | 251.5 fps |
| 320 | 363.3 fps | 492.1 fps |
| 160 | 702.2 fps | 943.3 fps |
| 80 | 1315 fps | 1739 fps |
| 48 | 2020 fps | 2631 fps |
| 32 | 2762 fps | 3533 fps |
| 16 | 4366 fps | 5376 fps |

Note: Fast Readout Mode will have low DN Fixed Pattern column artifacts as described here OnSemi Sensor Fast Readout Mode.

### Using 8-Tap 10-bit Firmware

| Vertical Lines Acquired (inc=16) | Internal Trigger / Minimum Exposure Python 25k sensor – model M5100 | Internal Trigger / Minimum Exposure Python 25k sensor – model M5100 Fast Readout Mode Enabled |
|---|---|---|
| 5120 | 23.4 fps | 25.5 fps |
| 3840 | 31.2 fps | 34.0 fps |
| 2560 | 46.8 fps | 50.9 fps |
| 1280 | 93.3 fps | 101.4 fps |
| 640 | 185.0 fps | 201.0 fps |
| 320 | 364.0 fps | 395.0 fps |
| 160 | 704.7 fps | 762.7 fps |
| 80 | 1324 fps | 1428 fps |
| 48 | 2040 fps | 2192 fps |
| 32 | 2801 fps | 2994 fps |
| 16 | 4464 fps | 4716 fps |

## *Maximum Frame Rate Examples (Nano-CL–M/C 4090)*

### Using 10-Tap 8-bit Firmware

| Vertical Lines Acquired | Internal Trigger / Minimum Exposure Python 16k sensor –model M4090 | Internal Trigger / Minimum Exposure Python 16k sensor – model M4090 Fast Readout Mode Enabled |
|---|---|---|
| 4096 | 32.8 fps | 46.9 fps |
| 3840 | 35.0 fps | 50.0 fps |
| 2560 | 52.4 fps | 74.9 fps |
| 1280 | 104.4 fps | 148.8 fps |
| 640 | 206.7 fps | 293.7 fps |
| 320 | 405.3 fps | 572.4 fps |
| 160 | 780.0 fps | 1089 fps |
| 80 | 1450 fps | 1988 fps |
| 48 | 2212 fps | 2958 fps |
| 32 | 3003 fps | 3921 fps |
| 16 | 4651 fps | 5813 fps |

Note: Fast Readout Mode will have low DN Fixed Pattern column artifacts as described here OnSemi Sensor Fast Readout Mode.

### Using 8-Tap 10-bit Firmware

| Vertical Lines Acquired | Internal Trigger / Minimum Exposure Python 16k sensor –model M4090 | Internal Trigger / Minimum Exposure Python 16k sensor – model M4090 Fast Readout Mode Enabled |
|---|---|---|
| 4096 | 32.8 fps | 36.1 fps |
| 3840 | 35.0 fps | 38.5 fps |
| 2560 | 52.4 fps | 57.6 fps |
| 1280 | 104.4 fps | 114.7 fps |
| 640 | 206.9 fps | 227.1 fps |
| 320 | 406.1 fps | 445.2 fps |
| 160 | 783.0 fps | 856.1 fps |
| 80 | 1461 fps | 1589 fps |
| 48 | 2237 fps | 2421 fps |
| 32 | 3048 fps | 3278 fps |
| 16 | 4761 fps | 5076 fps |

## *Maximum Frame Rate Examples (Nano-CL–M/C 2450)*

| Vertical Lines Acquired | Internal Trigger – Minimum Exposure 10-Tap 8-bit |
|---|---|
| 2056 | 141.8 fps |
| 2048 | 142.4 fps |
| 1024 | 279.7 |
| 512 | 539.9 |
| 256 | 1010.1 |
| 128 | 1788.9 |
| 64 | 2906.9 |
| 32 | 4237.2 |
| 16 | 5494.5 |
| 8 | 6451.61 |
| 4 | 7042.5 |

## *Maximum Frame Rate Examples (Nano-CL–M/C 4060)*

| Vertical Lines Acquired | Internal Trigger – Minimum Exposure 10-Tap 8-bit |
|---|---|
| 2176 | 87.6 fps |
| 2048 | 92.9 fps |
| 1024 | 181.2 fps |
| 512 | 345.0 fps |
| 256 | 629.7 fps |
| 128 | 1072 fps |
| 64 | 1655 fps |
| 32 | 2267 fps |
| 16 | 2785 fps |
| 8 | 3144 fps |
| 4 | 3367 fps |

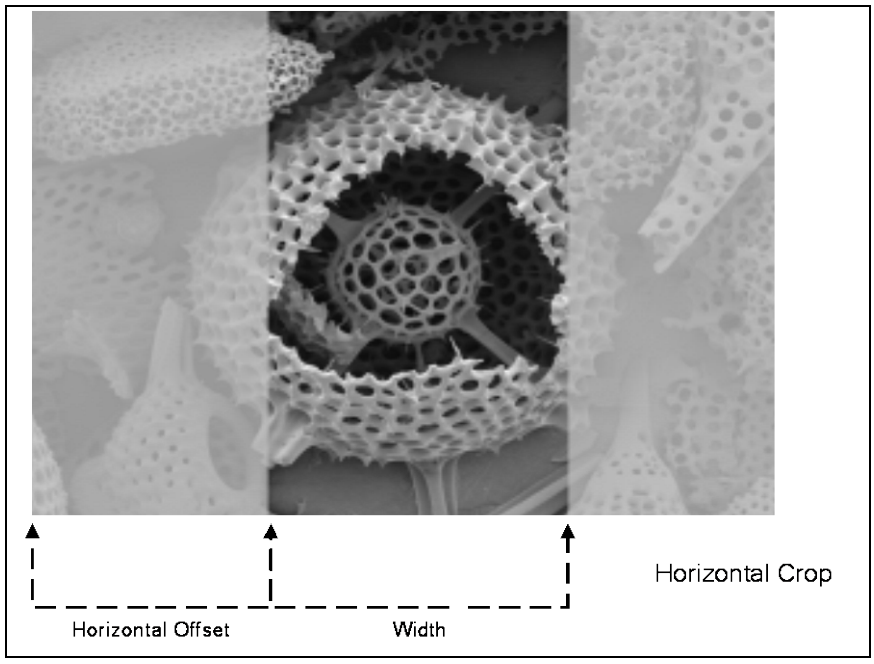
## *Maximum Frame Rate Examples (Nano-CL–M/C 4040)*

| Vertical Lines Acquired | Internal Trigger – Minimum Exposure 10-Tap 8-bit |
|---|---|
| 3008 | 63.8 fps |
| 2048 | 92.9 fps |
| 1024 | 181.2 fps |
| 512 | 345.0 fps |
| 256 | 629.7 fps |
| 128 | 1072 fps |
| 64 | 1655 fps |
| 32 | 2267 fps |
| 16 | 2785 fps |
| 8 | 3144 fps |
| 4 | 3367 fps |

## *Horizontal Cropping (Partial Scan)*

Genie Nano supports cropping the acquisition horizontally by grabbing less 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. Horizontal control features have the following independent constants:

- Horizontal Offset is limited to pixel increment values of 8, 16 or 64 to define the start of the video line.
- Horizontal Width decrements from maximum in pixel counts of 8 (i.e. the video width is in steps of 8 pixels).



# 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: Selecting the camera 8-bit output format displays the lower 8-bits of the processing path.
- 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.

# Transport Layer Control Category

The Camera Link Transport Layer Controls relate to settings and status of the Camera Link connection to the system frame grabber. 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.

# Transport Layer Control Feature Descriptions

The Device Version number represents the camera software functional group, not a firmware revision number. As Nano-CL capabilities evolve the device version tag 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.

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Serial Port Selector | DeviceSerialPortSelector | Selects which serial port of the device to control. | 1.00 Beginner |
| *Camera Link* | *CameraLink* | *Serial port associated with the Camera link connection used to communicate with the device.* | |
| Baud Rate | DeviceSerialPortBaudRate | This feature controls the baud rate used by the selected device's serial port. | 1.00 Beginner |
| *9600* | *Baud_9600* | *Baud_9600* | |
| *19200* | *Baud_19200* | *Baud_19200* | |
| *38400* | *Baud_38400* | *Baud_38400* | |
| *57600* | *Baud_57600* | *Baud_57600* | |
| *115200* | *Baud_115200* | *Baud_115200* | |
| *230400* | *Baud_230400* | *Baud_230400* | |
| *460800* | *Baud_460800* | *Baud_460800* | |
| *921600* | *Baud_921600* | *Baud_921600* | |
| Heartbeat Mode | DeviceLinkHeartbeatMode | Activate or deactivate the control channel heartbeat. | 1.00 Expert |
| *On* | *On* | *Enables the heartbeat* | |
| *Off* | *Off* | *Disables the heartbeat* | |
| Heartbeat Timeout | DeviceLinkHeartbeatTimeout | Controls the GenCP heartbeat timeout | 1.00 Expert |
| Camera Link Configuration | ClConfiguration | Describes the camera's current Camera Link configuration. | 1.00 Beginner |
| *Base* | *Base* | *Camera Link Full Configuration allows up to a 24-bit data path or up to 3-tap x 8-bit.* | |
| *Full* | *Full* | *Camera Link Full Configuration allows up to a 64-bit data path or up to 8-tap x 8-bit.* | |
| *Eighty Bit* | *EightyBit* | *Camera Link 80-bit Configuration allows up to an 80-bit data path or up to 10-tap x 8-bit.* | |
| Camera Link TimeSlots | ClTimeSlotsCount | Displays the number of consecutive time slots required for one complete data transfer of all camera taps. For example, when sending 4 taps over a 2 tap configuration, the required number of timeslots is 2. | 1.00 Beginner |

| | | | |
|---|---|---|---|
| *One Time Slot* | *TimeSlots1* | *One time slot is required for one complete data transfer of all camera taps.* | |
| Camera Link Taps | deviceTapsCount | Number of Camera Link taps in the current configuration. | 1.00 Beginner |
| *8* | *Eight* | *The data path in this mode uses eight Camera Link Taps per timeslot.* | |
| *10* | *Ten* | *The data path in this mode uses ten Camera Link Taps per timeslot.* | |
| *12* | *Twelve* | *The data path in this mode uses twelve Camera Link Taps per timeslot.* | |
| Pixel Size | clPixelSize | Total size in bits of an image pixel.<br>Important: Use this feature to change the camera's output pixel format – if multiple pixel formats are supported. | 1.00 Beginner |
| *8 Bits/Pixel* | *Bpp8* | *Bpp8: 8 bits per pixel* | |
| *10 Bits/Pixel* | *Bpp10* | *Bpp10: 10 bits per pixel* | |
| *12 Bits/Pixel* | *Bpp12* | *Bpp12: 12 bits per pixel* | |
| Camera Link Pixel Clock Frequency | clDeviceClockFrequency | Returns the frequency, in Hz, of the Camera clock. | 1.00 Beginner |
| Camera Tap Geometry | DeviceTapGeometry | The tap geometry describes the geometrical properties characterizing the different taps of a multi-tap camera. | 1.00 Beginner |
| *Geometry 1X2 Y1* | *Geometry_1X2_Y1* | *2 tap area scan, with 1 zone in X with 2 alternating taps and 1 zone in Y. Tap 1 starts with pixel coordinate (1,1), extending to the image width -1 and height, using a step of 2 (that is x = 1, 3, 5,...). Tap 2 starts with pixel coordinate (2, 1), extending to the image width and height, using a step of 2 (that is, x = 2,4,6, ...).* | |
| *Geometry 1X3 Y1* | *Geometry_1X3_Y1* | *3 tap area scan, with 1 zone in X with 3 alternating taps and 1 zone in Y. Tap 1 starts with pixel coordinate (1,1), extending to the image width -1 and height, using a step of 3 (that is x = 1, 4, 7,...). Tap 2 starts with pixel coordinate (2, 1), extending to the image width and height, using a step of 3 (that is, x = 2, 5, 8, ...).*<br>*Firmware available on demand only.* | |
| *Geometry 1X8 Y1* | *Geometry_1X8_Y1* | *8 tap area scan, with 1 zone in X with 8 alternating taps and 1 zone in Y. Tap 1 starts with pixel coordinate (1,1), extending to the image width -1 and height, using a step of 8 (that is x = 1, 9, 17,...). Tap 2 starts with pixel coordinate (2, 1), extending to the image width and height, using a step of 8 (that is, x = 2, 10, 18, ...)* | |
| *Geometry 1X10 Y1* | *Geometry_1X10_Y1* | *10 tap area scan, with 1 zone in X with 10 alternating taps and 1 zone in Y. Tap 1 starts with pixel coordinate (1,1), extending to the image width -1 and height, using a step of 10 (that is x = 1, 11, 21,...). Tap 2 starts with pixel coordinate (2, 1), extending to the image width and height, using a step of 10 (that is, x = 2, 12, 22, ...).* | |
| | | | |
| Camera Link Data Valid Mode | clDataValidMode | The Data Valid mode describes if the Data Valid signal from the camera is available to the frame grabber. | 1.00 Invisible |
| *Off* | *Off* | *The Data Valid signal is not valid and should not be used by the framegrabber for image acquisition.* | |
| *Active* | *Active* | *The Data Valid signal is valid and should be used by the framegrabber for image acquisition.* | |

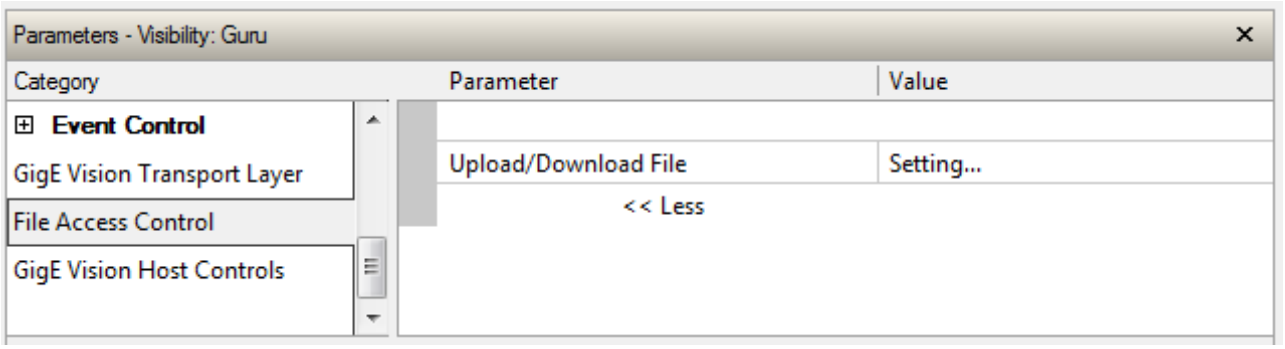
| | | | |
|---|---|---|---|
| Payload Size | PayloadSize | Provides the number of bytes transferred for each image or chunk on the stream channel. | 1.00<br>Invisible |

# 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 dependent on the Nano model, LUT tables, Defective Pixel Maps, and other Sapera file types.

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.

Also important, Genie Nano cameras are available in a number of models implementing different sensors and image resolutions which may not support the full feature set defined in this category.




# File Access Control Feature Descriptions

The Device Version number represents the camera software functional group, not a firmware revision number. As Genie Nano capabilities evolve the device version tag 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.

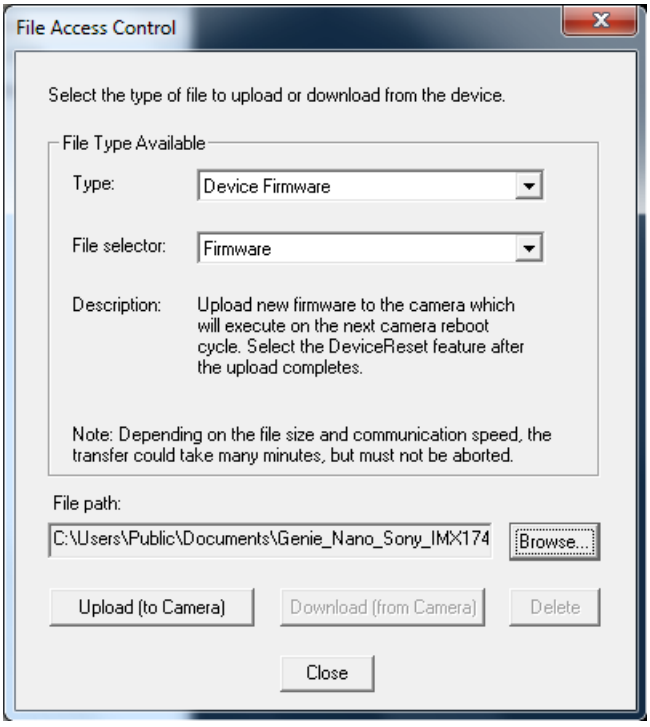
| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| File Selector | FileSelector | Selects the file to access. The file types which are accessible are device-dependent. | 1.00<br>Guru |
| *Firmware* | *Firmware1* | *Upload new firmware to the camera which will 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.* | |
| 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<br>Guru |
| File Access Length | FileAccessLength | Controls the mapping length between the device file storage and the file access buffer. | 1.00<br>Guru |
| File Operation Status | FileOperationStatus | Displays the file operation execution status. | 1.00<br>Guru |
| *Success* | *Success* | *The last file operation has completed successfully.* | |
| *Failure* | *Failure* | *The last file operation has completed unsuccessfully for an unknown reason.* | |
| *File Unavailable* | *FileUnavailable* | *The last file operation has completed unsuccessfully because the file is currently unavailable.* | |
| *File Invalid* | *FileInvalid* | *The last file operation has completed unsuccessfully because the selected file in not present in this 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<br>Guru |
| File Size | FileSize | Represents the size of the selected file in bytes. | 1.00<br>Guru |
| | | | |
| Device User Buffer | deviceUserBuffer | Unallocated memory available to the user for data storage. | 1.00<br>DFNC<br>Invisible |
| User Defined Saved Image Max Size | userDefinedSavedImageMaxSize | Maximum size of the user Defined Saved Image in the flash memory. | 1.00<br>DFNC<br>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<br>DFNC<br>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.

# 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.

# Transfer Control Category

The Transfer control features are all invisible. These features are usually for Teledyne DALSA or third party software usage—not typically needed by end user applications.

# Transfer Control Feature Descriptions

The Device Version number represents the camera software functional group, not a firmware revision number. As Nano-CL capabilities evolve the device version tag 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.

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

# GenICamAccess Control Feature

| Display Name | Feature & Values | Description | Device Version & View |
|---|---|---|---|
| Features Locked Flag | TLParamsLocked | Flag to indicate if features are locked during acquisition. | 1.00 Invisible |

# 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 download 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

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 |
| **Events** | |
| Event Selector | EventSelector |
| Event Notification | EventNotification |
| Event Statistic Selector | eventStatisticSelector |
| Event Statistic Count | eventStatisticCount |
| Events Overflow | eventsOverflow |
| Event Statistic Count Reset | eventStatisticCountReset |
| **Acquisition and Triggers** | |
| Valid Frame Trigger | ValidFrameTrigger |
| Invalid Frame Trigger | InvalidFrameTrigger |
| Image Lost | ImageLost |

# 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

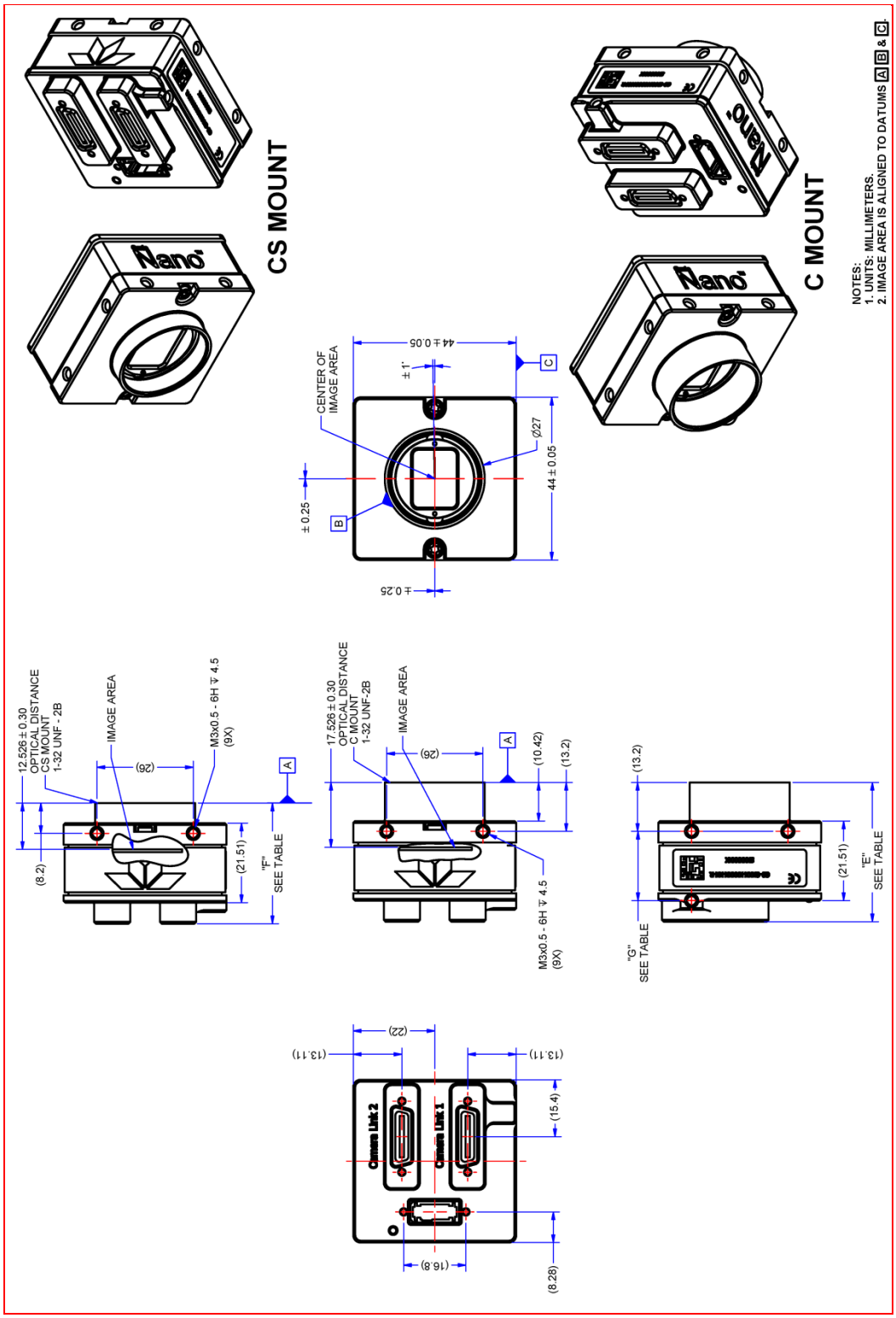
For information on Nano lens requirements see Optical Considerations.
Each camera side has two mounting holes in identical locations, which provide good grounding capabilities.
Overall height or width tolerance is ± 0.05mm.

## 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 very warm to the touch.

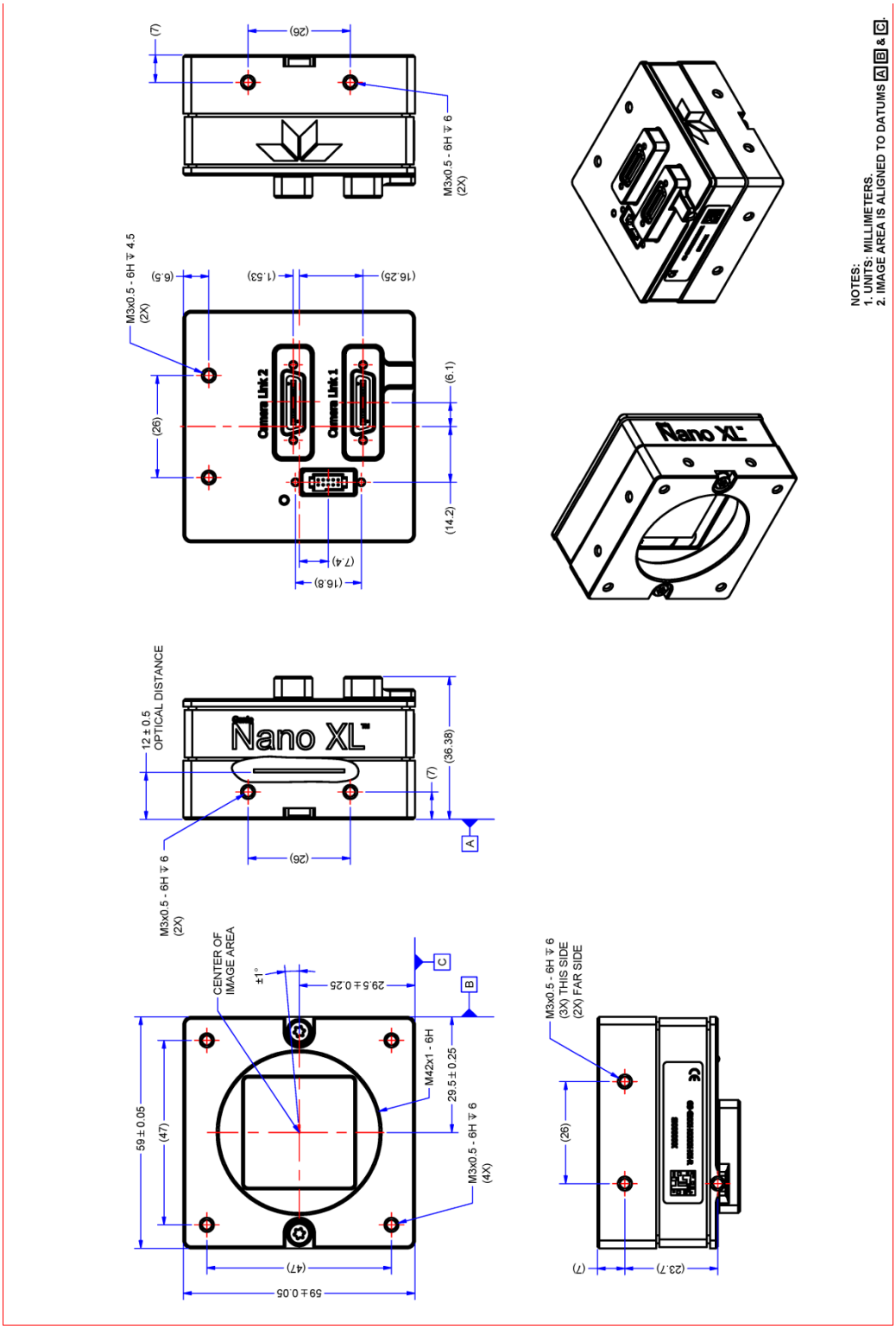
Basic heat management is achieved by mounting the camera onto a metal structure via its mounting screw holes. Heat dissipation is improved by using thermal paste between the camera body (not the front plate) and the metal structure.

# Mechanical Specifications — Nano-CL Medium Case:




*Note: Genie Nano-CL with C or CS Mount*

# Mechanical Specifications — Nano-CL XL Case:

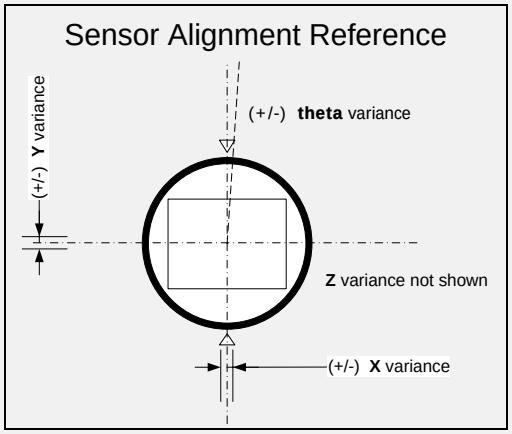



*Note: Genie Nano-CL with M42 Mount*

# Sensor Alignment Specification

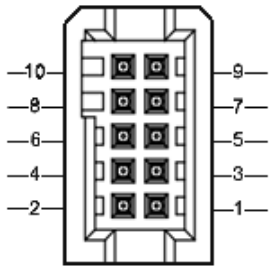
The following figure specifies sensor alignment for Genie Nano where all specifications define the absolute maximum tolerance allowed for production cameras. Dimensions “x, y, z”, are in microns and referenced to the Genie Nano mechanical body or the optical focal plane (for the z-axis dimension). Theta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



# I/O Connector and Pinout

- An auxiliary DC power source can be connected to the 10-pin connector (SAMTEC TFM-105-02-L-D-WT) when not using a PoCL power source. 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 or PoCL, but never both. Although Nano has protection, differences in ground levels may cause operational issues or electrical faults.




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

# 10-pin I/O Connector Pinout Details

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

| Pin Number | Genie Nano | Direction | Definition |
|---|---|---|---|
| 1 | PWR-GND | — | Camera Power Ground (common with chassis pin10) |
| 2 | PWR-VCC | — | Camera Power – DC +10 to +36 Volts |
| 3 - 9 | N/A | — | Reserved |
| 10 | Chassis | — | Camera Chassis<br>(connected to camera link connector shell & pin-1) |

## *Camera DC Power Characteristics*

| DC Operating Characteristics | | |
|---|---|---|
| Input Voltage | +10 Volts minimum | |
| Input Power Consumption | @ +24 Volt Supply | 7 Watts typical (using 10-Taps) |

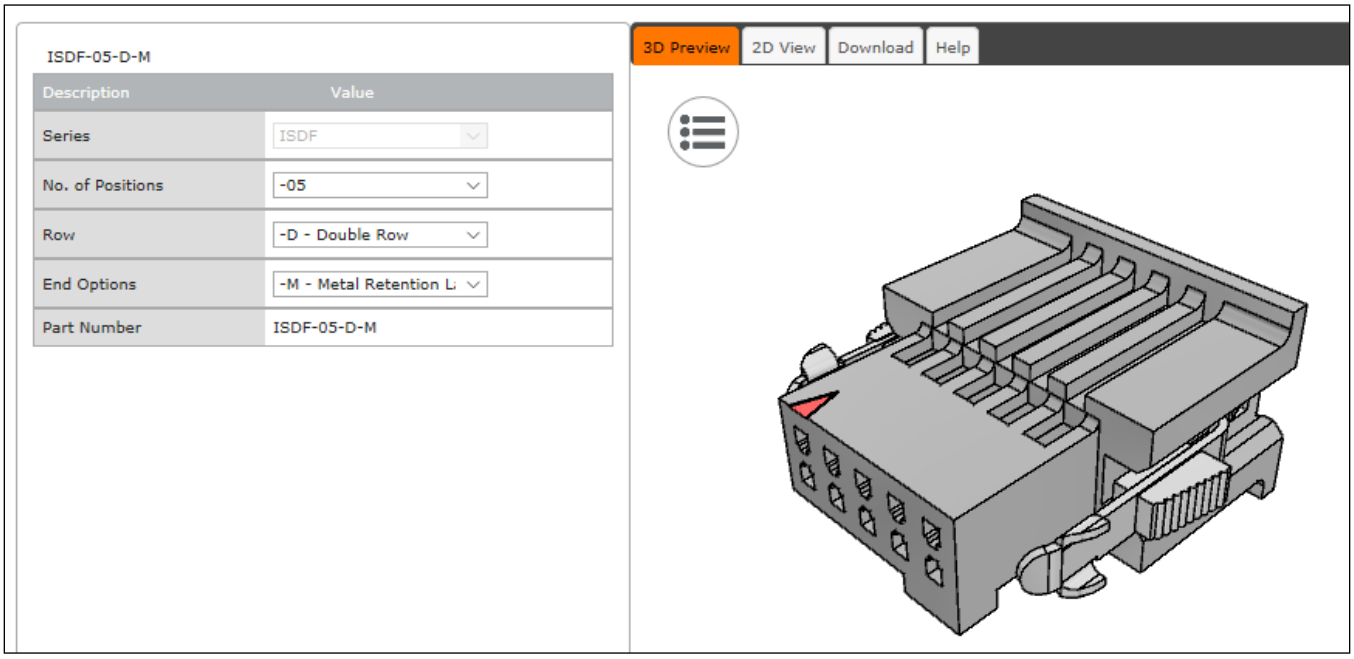
| Absolute Maximum DC Power Supply Range before Possible Device Failure | | |
|---|---|---|
| Input Voltage | –58 Volt DC | +58 Volts DC |

# *I/O Mating Connector Specifications & Sources*

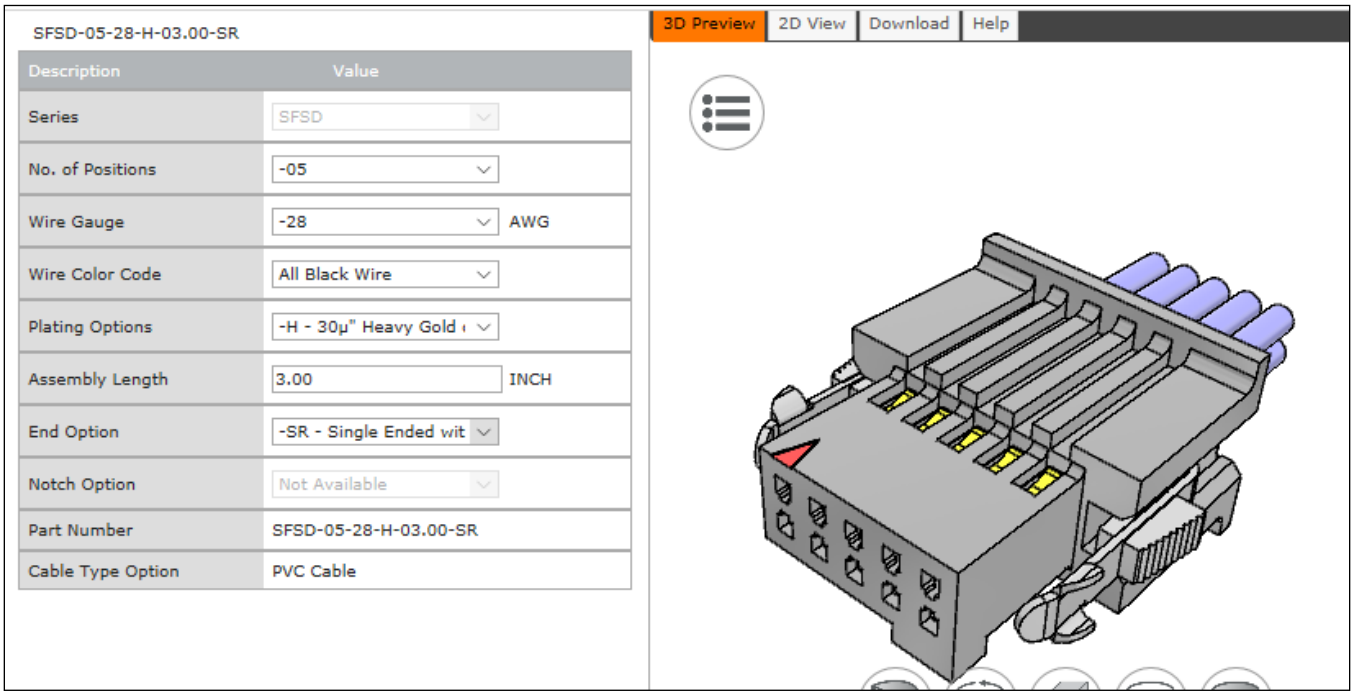
For users wishing to build their own custom I/O cabling, the following product information is provided to expedite your cable solutions. SAMTEC web information for the discrete connector and a cable assembly with retention clips follows the table.

| MFG | Part # | Description | Data Sheet |
|---|---|---|---|
| Samtec | ISDF-05-D<br>ISDF-05-D-M (*see image below*) | Discrete Connector<br>*(see example below)* | https://www.samtec.com/products/isdf |
| Samtec | SFSD-05-[WG]-G-[AL]-DR-[E2O]<br>*WG : Wire Gauge*<br>*AL : Assembled Length*<br>*E2O : End 2 Option* | Discrete Cable Assembly<br>*(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"**




# Power over Camera Link (PoCL) Support

- The Nano-CL supports PoCL electrical power delivered from a PoCL capable frame grabber if not using a separate external power source connected to pins 1 & 2 of the camera's I/O Connector.
- When using PoCL, ensure the camera link cables are certified for PoCL usage.
- PoCL requires that the camera be connected with both cables to the frame grabber.
- **Important:** Connect power via the I/O connector or PoCL, but not both. Although Nano-CL has protection, differences in ground levels may cause operational issues or electrical faults.
- If both supplies are connected and active, the Nano-CL will use the I/O power supply connector. But as stated, ground differences may cause camera faults or failure.

# EC & FCC Declarations of Conformity

# Models M/C2420, M/C4020, M/C2450, M/C4040, M/C4060

TELEDYNE DALSA
Everywhereyoulook™
Part of the Teledyne Imaging Group

**EMC DECLARATION OF CONFORMITY**

We :
Teledyne DALSA, a business unit of Teledyne Digital Imaging, Inc.
880 Rue McCaffrey
St-Laurent, Quebec, Canada
H4T 2C7

Declare under sole legal responsibility that the following products conform to the protection requirements of council directive 2014/30/EU on the approximation of the laws of member states relating to electromagnetic compatibility and are CE-marked accordingly:

Genie Nano-CL M2420, C2420, M4020, C4020,
M2450, C2450, M4040, C4040, M4060 & C4060

The products to which this declaration relates are in conformity with the following relevant harmonized standards, the reference numbers of which have been published in the Official Journal of the European Communities:

| | |
|---|---|
| EN55032 (2015) | Electromagnetic compatibility of multimedia equipment — Emission requirements |
| EN55011 (2016) with A1(2017) | Industrial, scientific and medical equipment — Radio-frequency disturbance characteristics — Limits and methods of measurement |
| EN 61326-1 (2013) | Electrical equipment for measurement, control and laboratory use — EMC requirements — Part 1: General requirements |
| EN 55024 (2010) | Information technology equipment — Immunity characteristics — Limits and methods of measurement |
| EN 55035 (2017) | Electromagnetic compatibility of multimedia equipment – Immunity requirements |

Further declare under our sole legal responsibility that the product listed also conforms to the following international standards:

| | |
|---|---|
| CFR 47 | part 15 (2008), subpart B, for a class A product. Limits for digital devices |
| ICES-003 | Information Technology Equipment (ITE) — Limits and Methods of Measurement |
| CISPR 11(2015) with A1 (2016) | Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement |
| CISPR 32 (2015) | Electromagnetic compatibility of multimedia equipment - Emission requirements |
| CISPR 35 (2016) | Electromagnetic compatibility of multimedia equipment - Immunity requirements |

Note: this product is intended to be a component of a larger industrial system. It is not intended for use in a residential system.

Waterloo, Canada — Location
2019-07-24 — Date

Cheewee Tng, P. Eng
Director, Quality Assurance

# Models M/C5100, M/C4090

TELEDYNE DALSA
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Part of the Teledyne Imaging Group

**EMC DECLARATION OF CONFORMITY**

We:
Teledyne DALSA, a business unit of Teledyne Digital Imaging, Inc.
880 Rue McCaffrey
St-Laurent, Quebec, Canada
H4T 2C7

Declare under sole legal responsibility that the following products conform to the protection requirements of council directive 2014/30/EU on the approximation of the laws of member states relating to electromagnetic compatibility and are CE-marked accordingly:

Genie Nano-CL M5100, M4090
Genie Nano-CL C5100, C4090

The products to which this declaration relates are in conformity with the following relevant harmonized standards, the reference numbers of which have been published in the Official Journal of the European Communities:

| | |
|---|---|
| EN55032 (2015) | Electromagnetic compatibility of multimedia equipment — Emission requirements |
| EN55011 (2016) with A1(2017) | Industrial, scientific and medical equipment — Radio-frequency disturbance characteristics — Limits and methods of measurement |
| EN 61326-1 (2013) | Electrical equipment for measurement, control and laboratory use — EMC requirements — Part 1: General requirements |
| EN 55024 (2010) | Information technology equipment — Immunity characteristics — Limits and methods of measurement |
| EN 55035 (2017) | Electromagnetic compatibility of multimedia equipment – Immunity requirements |

Further declare under our sole legal responsibility that the product listed also conforms to the following international standards:

| | |
|---|---|
| CFR 47 | part 15 (2008), subpart B, for a class A product. Limits for digital devices |
| ICES-003 | Information Technology Equipment (ITE) — Limits and Methods of Measurement |
| CISPR 11(2015) with A1 (2016) | Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement |
| CISPR 32 (2015) | Electromagnetic compatibility of multimedia equipment - Emission requirements |
| CISPR 35 (2016) | Electromagnetic compatibility of multimedia equipment - Immunity requirements |

Note: this product is intended to be a component of a larger industrial system. It is not intended for use in a residential system.

Waterloo, Canada — Location
2019-04-24 — Date

Cheewee Tng, P. Eng
Director, Quality Assurance

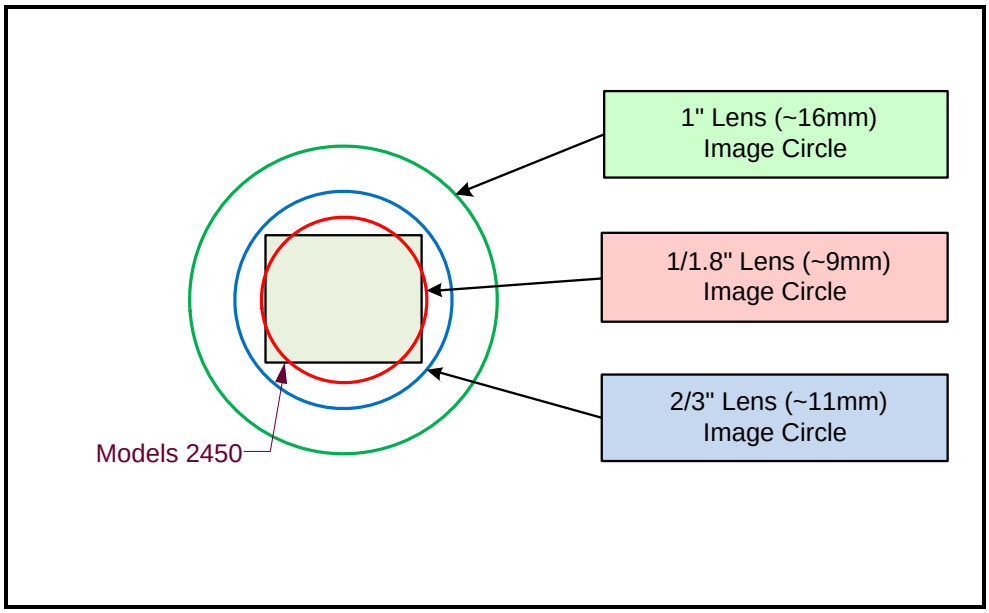
# Additional Reference Information

## 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.

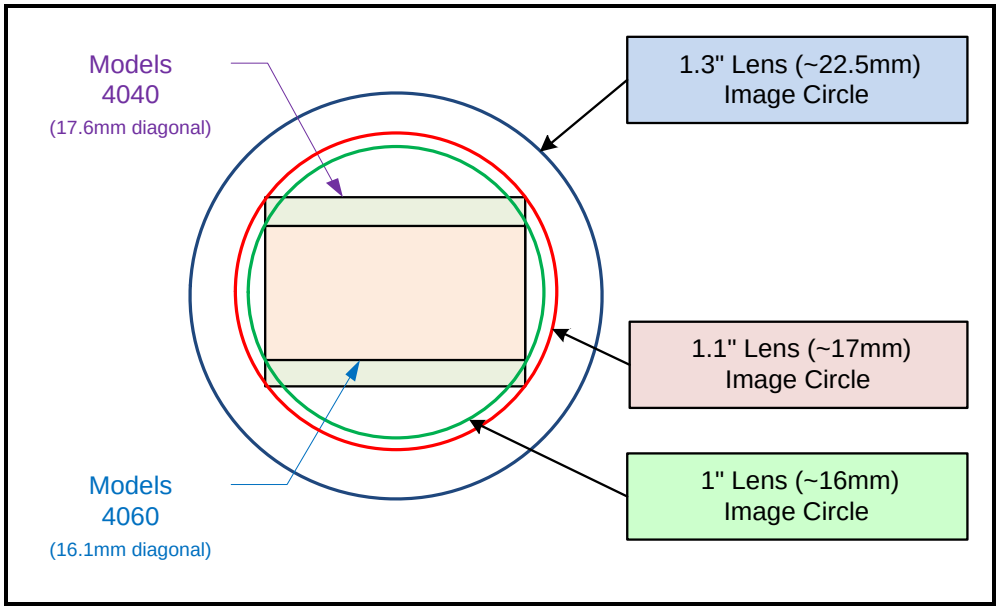
## Lens Options for Models '2450'

- The following figure shows the lens image circles relative to Genie Nano models using the Sony IMX250 sensor, in color or monochrome versions.
- A typical 2/3" lens will fully illuminate this sensor.



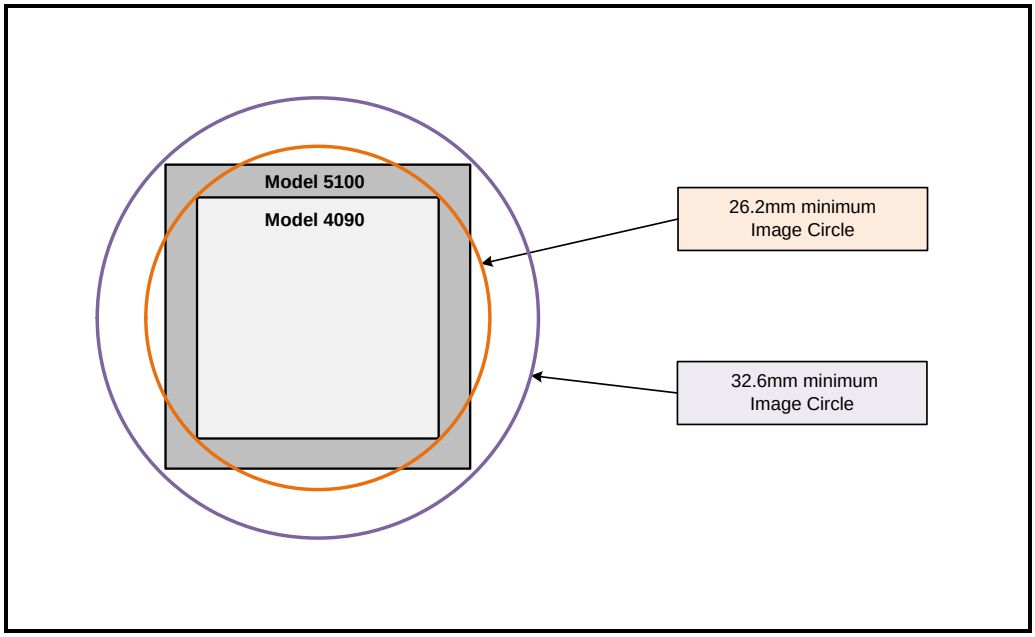
# Lens Options for Models ‘4060/4040’

- The following figure shows the lens image circles relative to Genie Nano models using the Sony IMX255 (models 4060), IMX253 (models 4040) sensors.
- A typical 1.1” lens will illuminate the model 4040 sensors models while the 1” lens should only be used with models 4060 to avoid image vignetting.




# Lens Options for CL Models ‘M/C 5100’ and ‘M/C 4090

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



## 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). See Genie Nano Specifications — Back Focal Distance.
- **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 contribute 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, http://mv.dalsa.com/, 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.

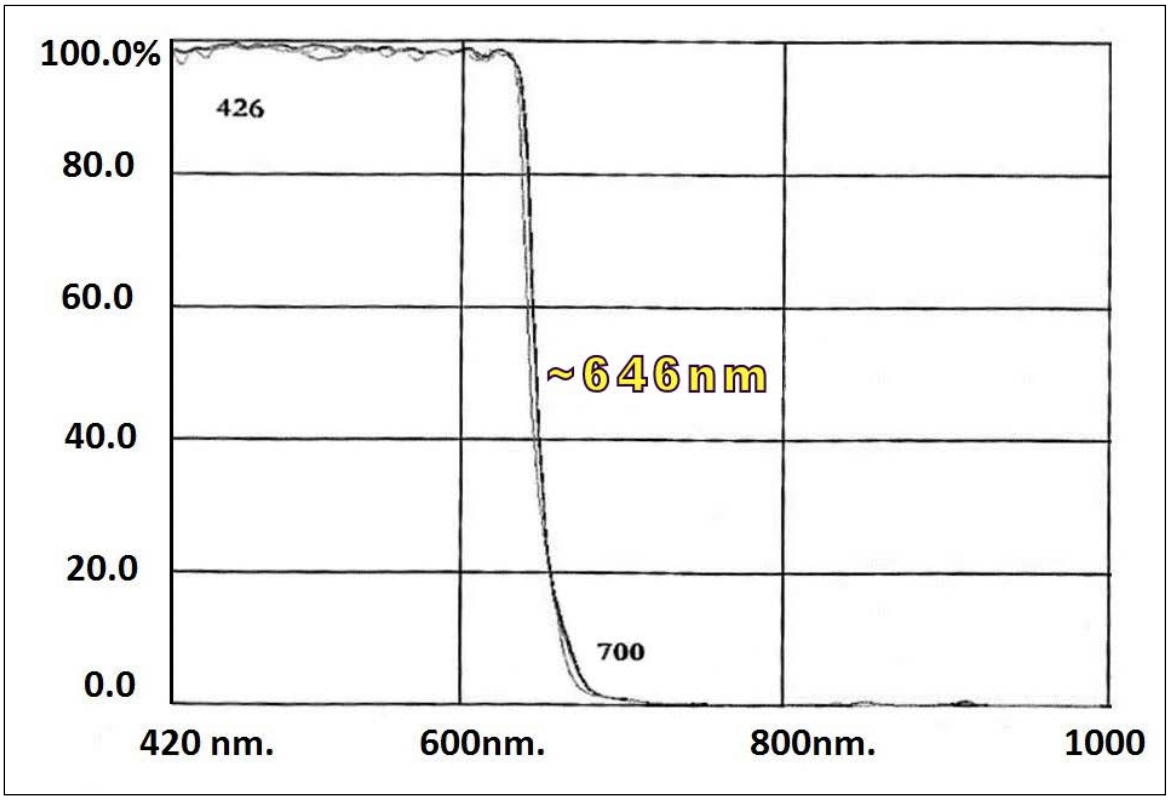
# IR Cut-off Filters

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.

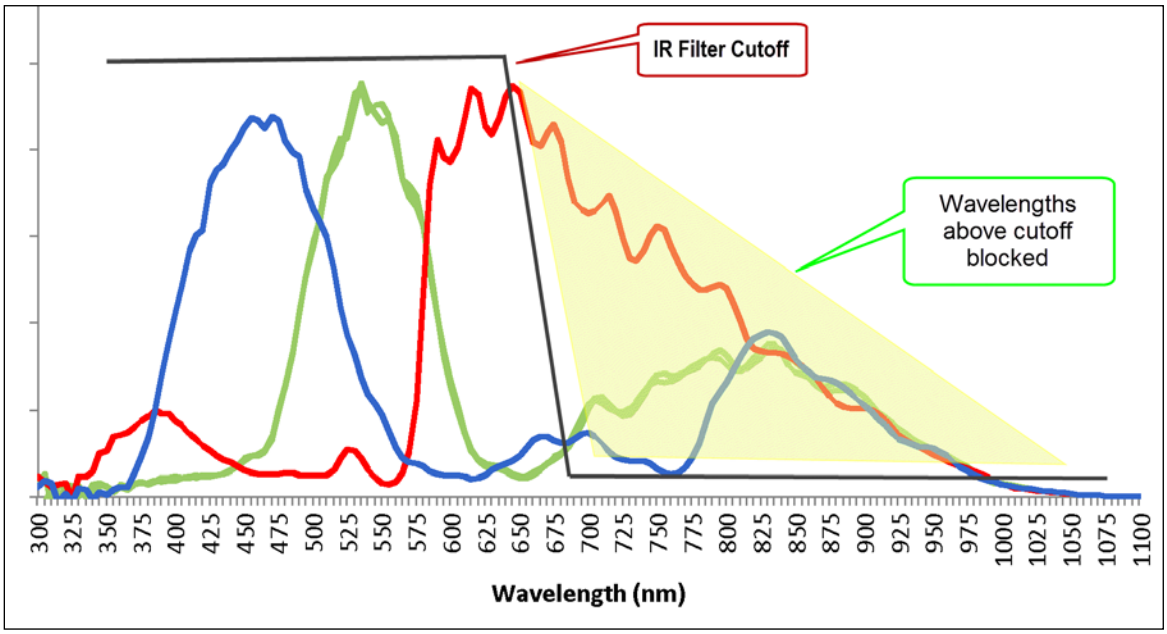
## *Nano Models with Built-in IR Cut-off Filters*

Choose Nano color cameras with built-in IR Cut-off Filters for an optimized 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.

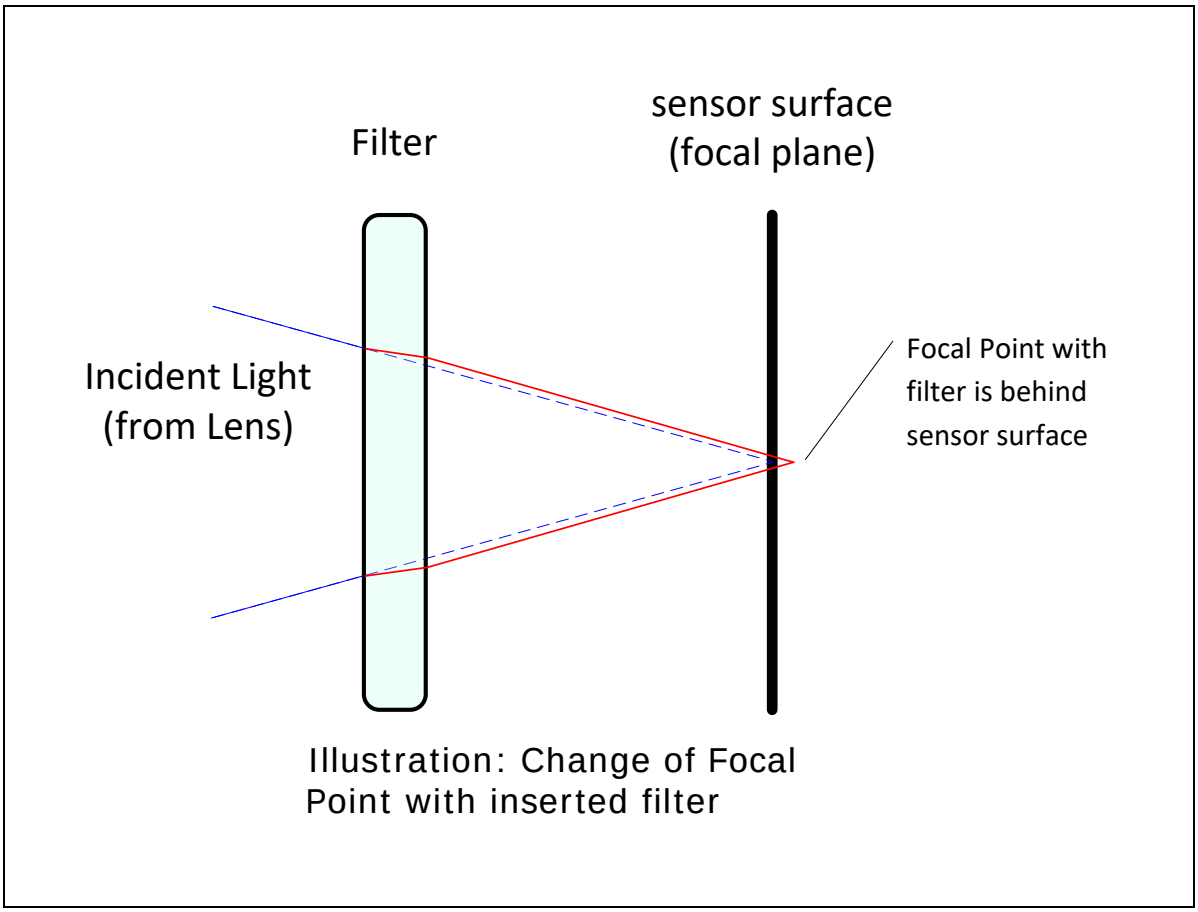



Illustration: Change of Focal Point with inserted filter

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.

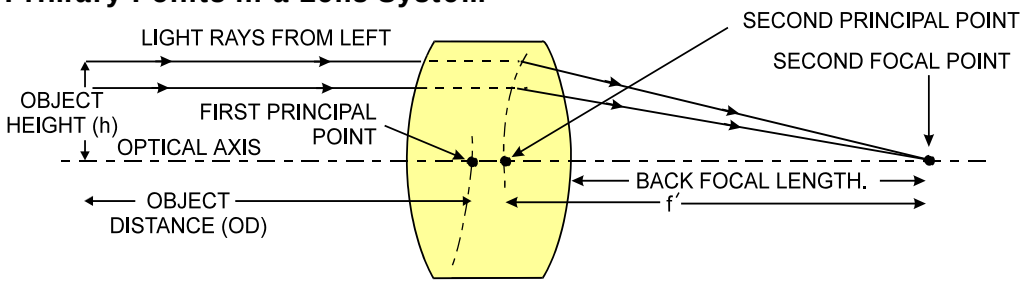
For Nano models normally shipped without filters, when a filter is installed a fixed focus lens requires a 1/3mm C-mount shim (spacer) added to move the lens focal point back to the sensor surface. Such shims are available from filter and lens suppliers. Alternatively use a variable focus lens and secure 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, 10□m 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).

| | |
|---|---|
| $\frac{10\mu m}{100\mu m} = \frac{45mm}{OD}$ | OD = 450mm |

# 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 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.

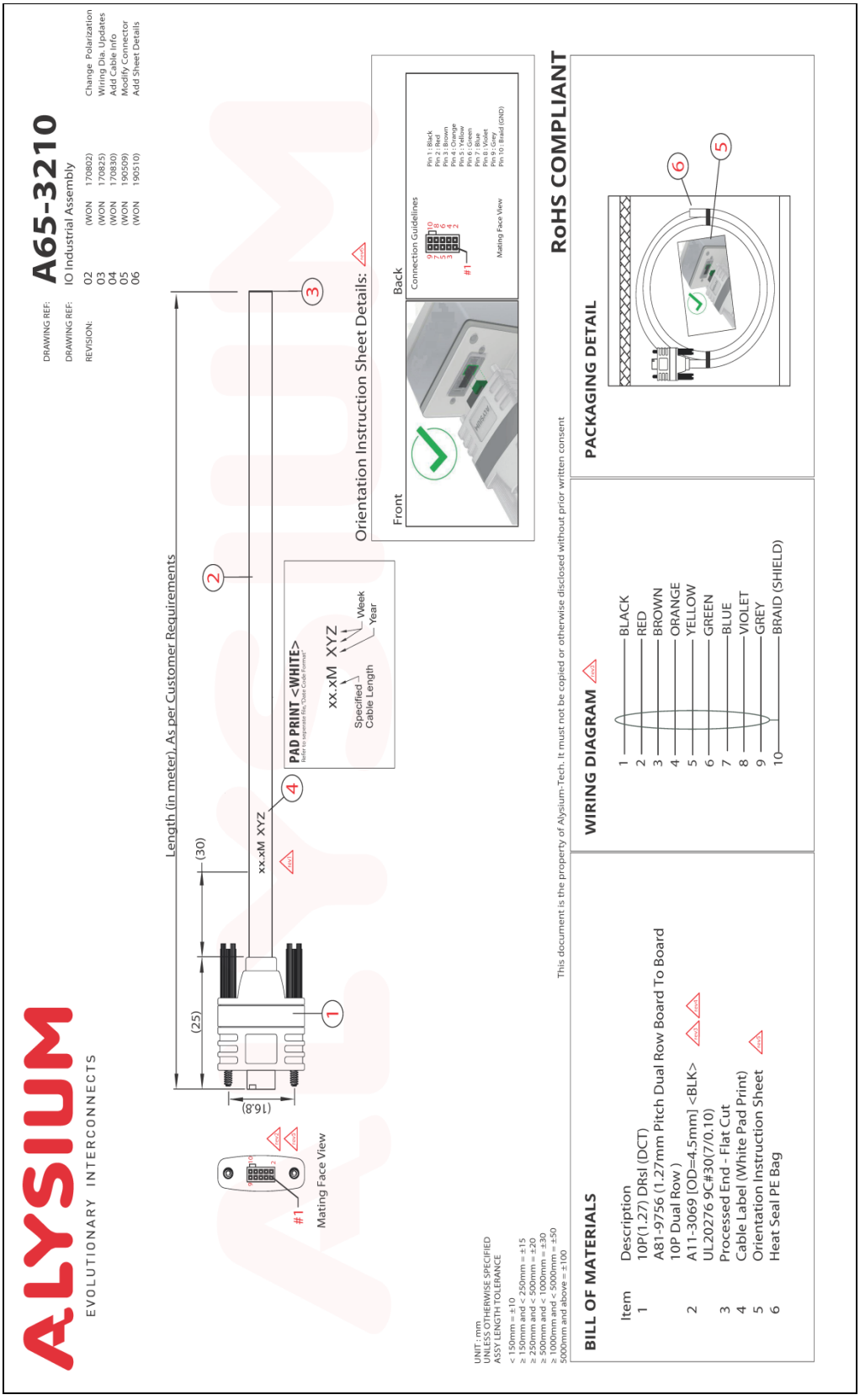
Users also may order cable assembly quantities directly from Alysium-Tech or Components Express. In such cases use the manufacturer’s part number shown on the cable assembly engineering drawing.

## Cable Manufactures Contact Information

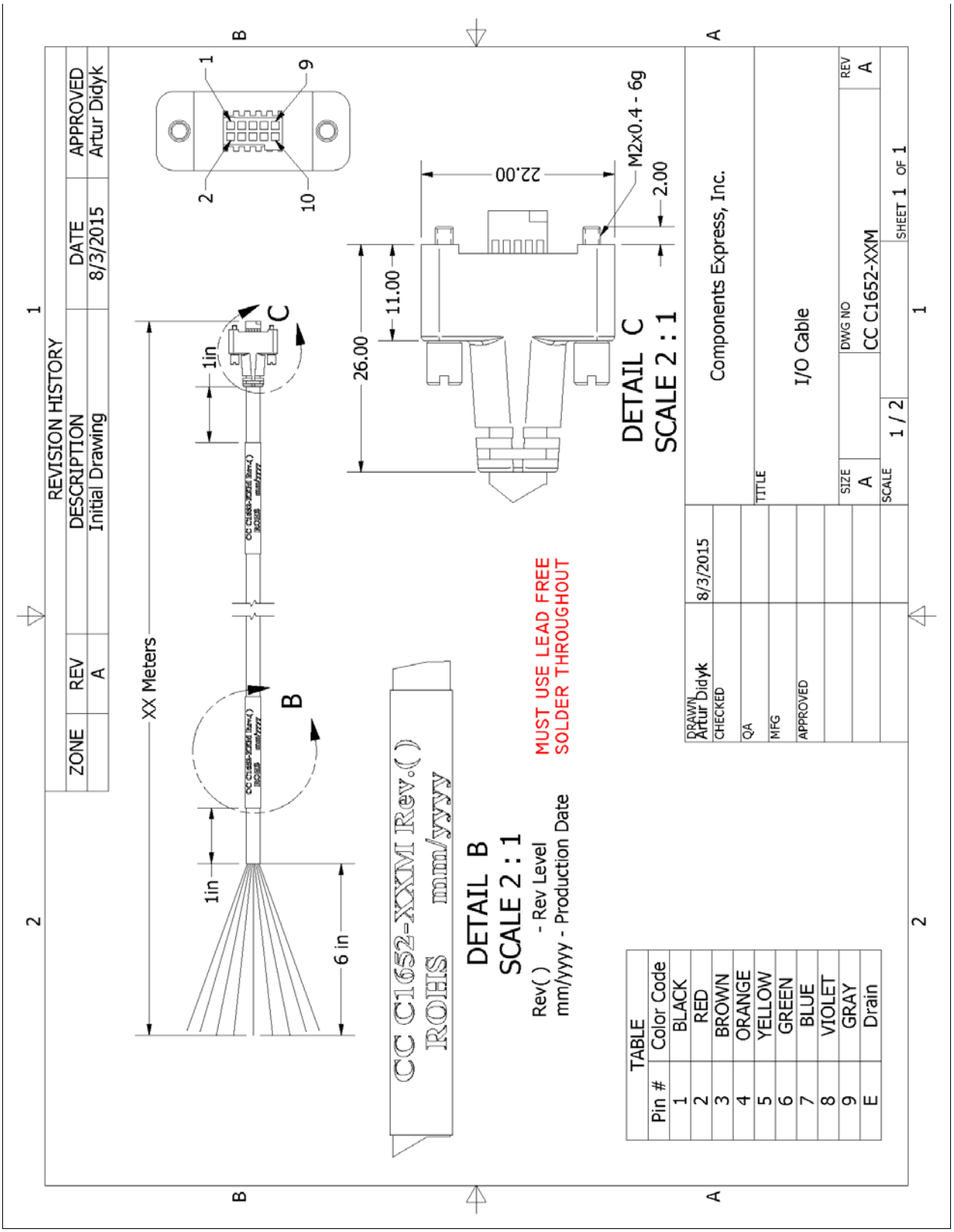
| | |
|---|---|
| **For Information contact:** *(see their web site for worldwide offices)* | Alysium-Tech<br>101 Montgomery Street, Suite 2050<br>San Francisco, CA 94104<br>Phone: 415 248 7807<br>Fax: 415 248 7800<br>https://www.alysium.com/ |

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

# Cable Assembly G3-AIOC-BLUNT1M

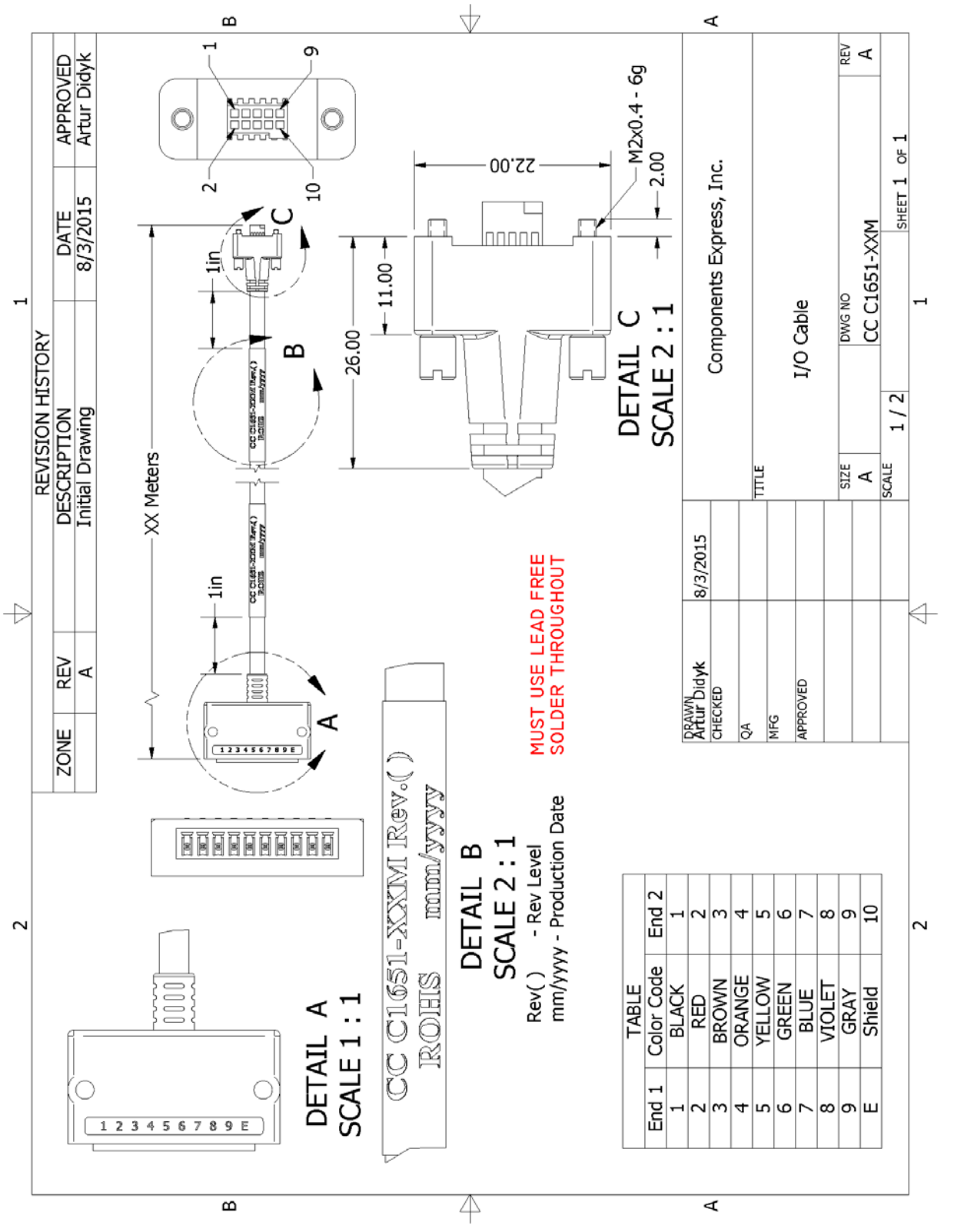


# Cable Assembly G3-AIOC-BLUNT2M



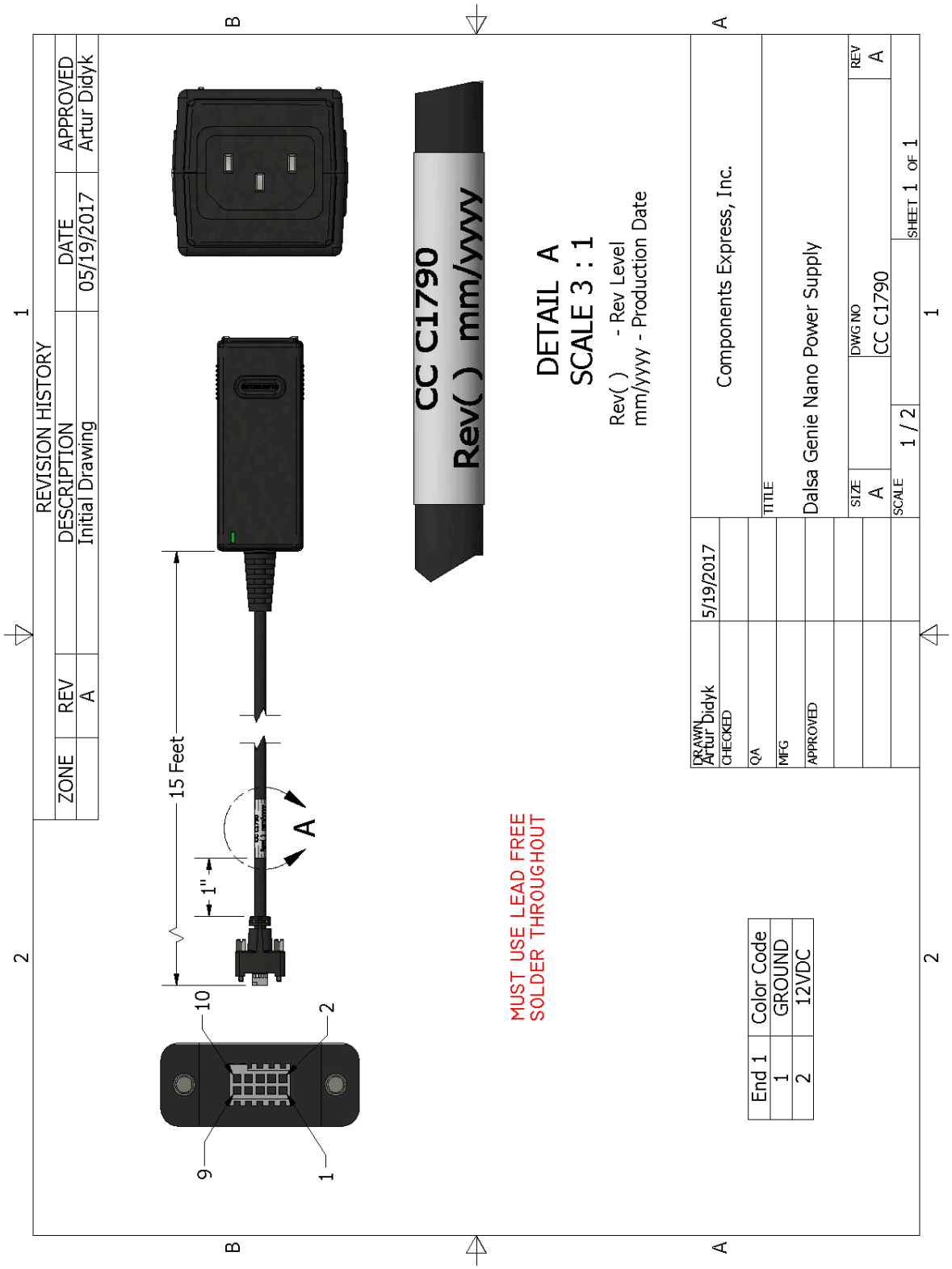

ROHS
08/2015

# Cable Assembly G3-AIOC-BRKOUT2M




1 2 3 4 5 6 7 8 9 E
CC C1661-02M REV. A
ROHS 05.12.2016

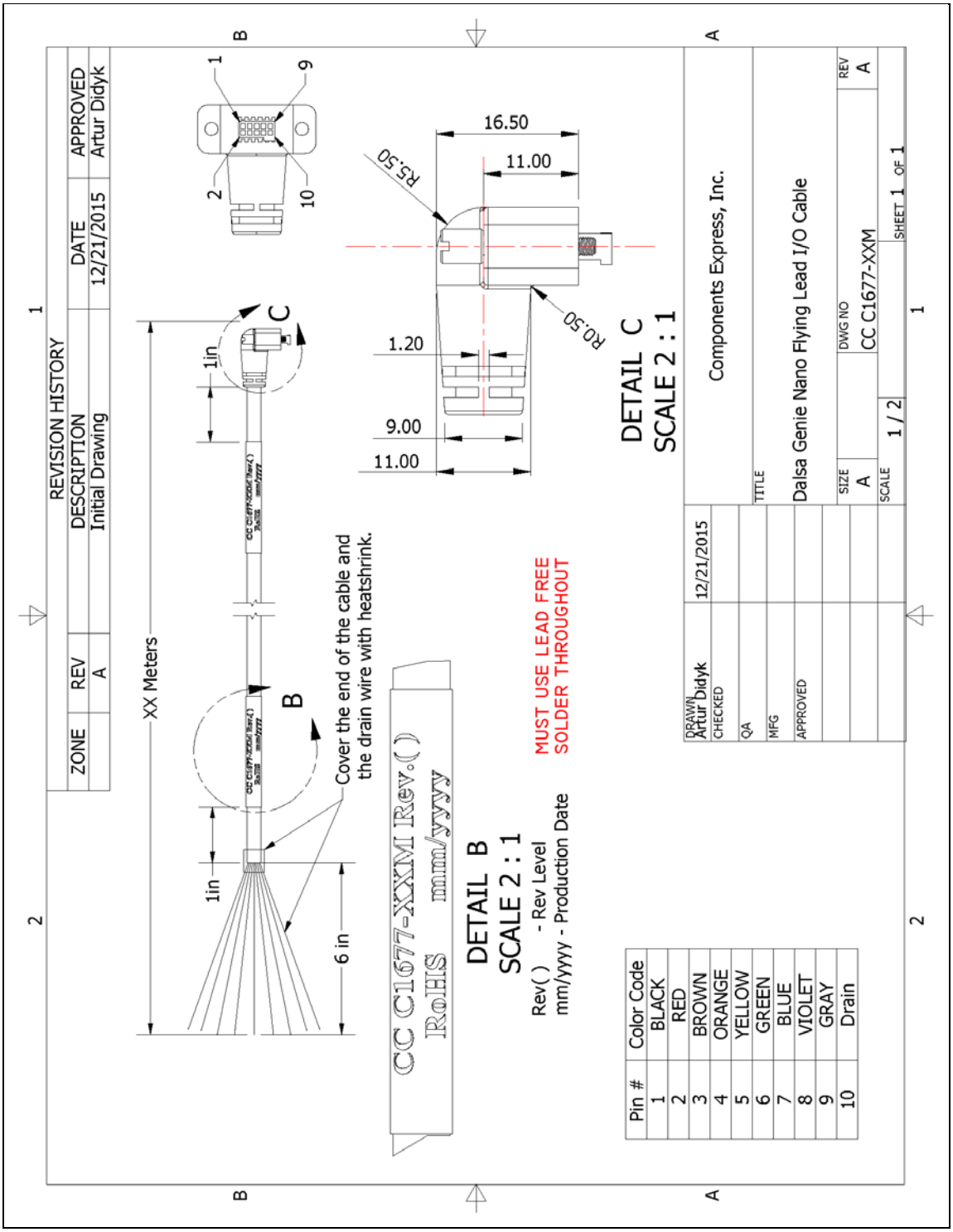
# Nano Generic Power Supply with no I/O



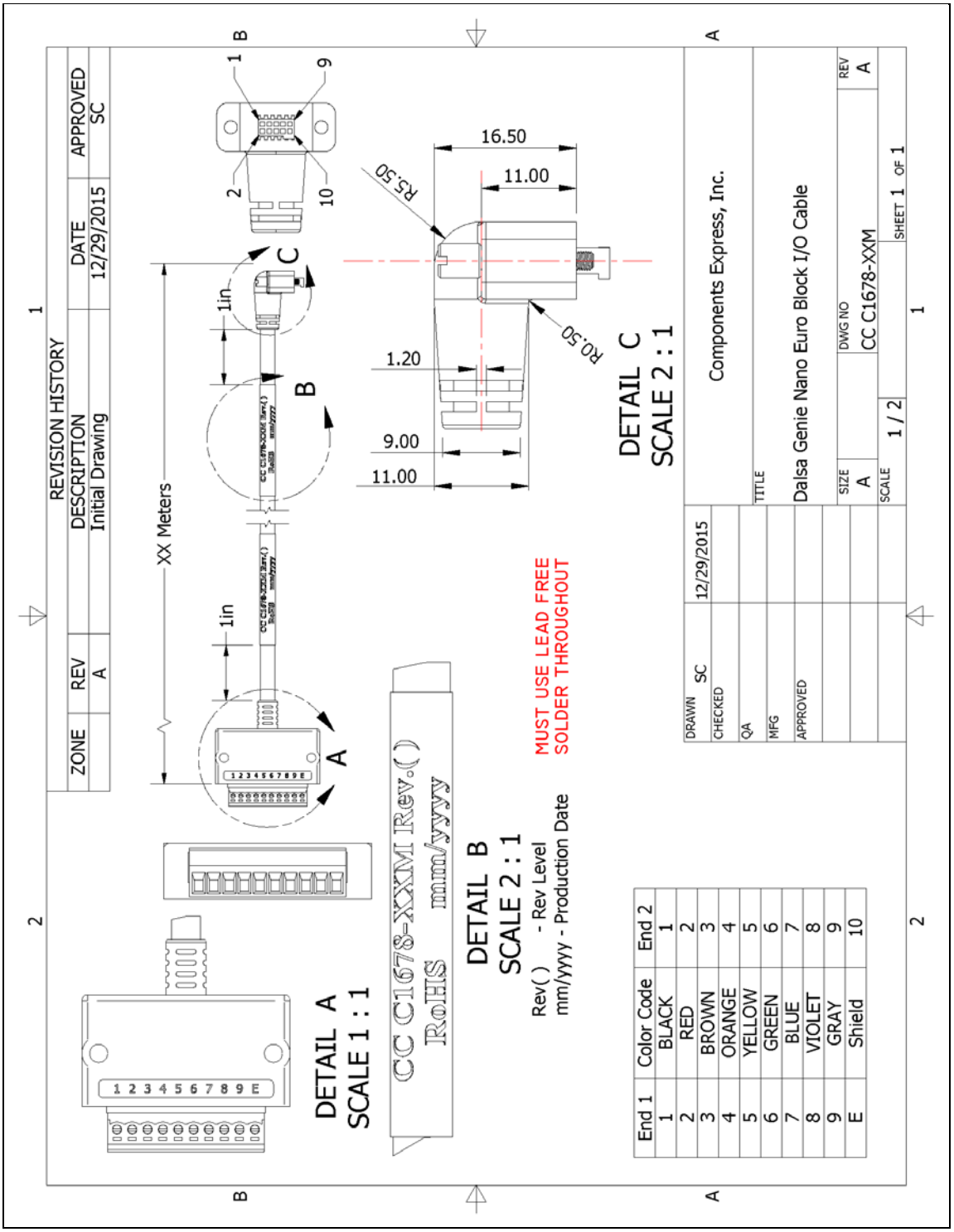
# Components Express Right-Angle Cable Assemblies

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 and methods are described to correct the problem.

## Problem Type Summary

Nano 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 File Access Control Category).

Note:

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

| | |
|---|---|
|  | **Important**: New Nano-CL 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-CL. The Nano processor knows that the firmware update failed.
- The Nano-CL 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 (see File Access Control Category) again.

# Cabling and Communication Issues

With only camera link cables and possibly an external power supply connected to Nano-CL, possible cabling issues are limited.

**Power supply problems:**

- If the Nano status LED is off, the DC supply power is not connected or faulty. Verify the power supply voltage.
- If using PoCL power, use both camera link cables connected to the frame grabber and verify that the frame grabber used has activated its PoCL source.

**Communication Problems:**

- Use shielded cables where the connector shell electrically connects the Nano chassis to the power supply earth ground. This can eliminate trigger issues in a high EMI environment. Purchase camera link cables from quality 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-CL acquisition program, such as CamExpert. Review the log output for error messages.

# Recommended Hardware

The Nano-CL has a Camera Link Pixel Clock of 85MHz. Teledyne DALSA Xtium series frame grabbers are recommended for error free acquisitions (contact sales for additional information).

## *Cable Length Considerations*

- The camera outputs data at 85MHz on the Camera Link cable.
- The high data rate on the Camera Link cable can cause compatibility issues based on cable quality, cable length and Frame Grabber used.
- Teledyne DALSA has qualified the Xtium frame grabber with 10 meter cables at 85MHz (10-tap configuration). Camera Link cables (end to end standard solutions of various lengths) are recommended from Components Express and Alysium, who also offer I/O signal solutions as described in this manual. See Cable Manufactures Contact Information for contact information.
- The Teledyne DALSA Xcelera frame grabber (10-tap configuration) has been qualified using up to 4 meter cables with the Nano-CL.
- Use of third party frame grabbers and other cables requires thorough testing by the user.

### *Nano-CL — Minimum horizontal Sync*

- The camera requires a frame grabber that supports a LVAL signal of 4 clock cycles when operating in Fast Readout mode (applicable to OnSemi sensor cameras).
- Older generation frame grabbers (such as the Teledyne DALSA Xcelera PX8) can show compatibility issues resulting in corrupted images. To be compatible with older frame grabbers, the camera should be operated in Normal Readout mode. See feature *fastReadoutMode* in the Sensor Control Feature Descriptions.

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

- 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-CL at a bright light source.
- Check that the programmed exposure duration is not too short or set it to maximum. See Sensor Control Category.
- Using CamExpert set the Nano-CL to output its Internal Pattern Generator. This step is typically done for any camera installation to quickly verify the Nano and its software package. See Internal Test Pattern Generator for information on using CamExpert to select internal patterns from Nano.

## Other Problems or Issues

This section describes problems that do not fit any of the categories above. Typically these are issues found in the field under specific or unusual conditions.

# Revision History

| Revision | Date | Major Change Description |
|---|---|---|
| R:0001 | May 28, 2018 | Initial release |
| R:0002 | March 7, 2019 | Various manual improvements and technical corrections |
| R:0003 | October 15, 2019 | Various manual improvements and technical corrections.<br>Addition of models 4160 using Teledyne E2V Emerald EV2S16M sensors. |

# Contact Information

## Sales Information

| | |
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| **Email:** | mailto:info@teledynedalsa.com |

| **Canadian Sales** | |
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## Technical Support

Submit any support question or request via our web site:

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