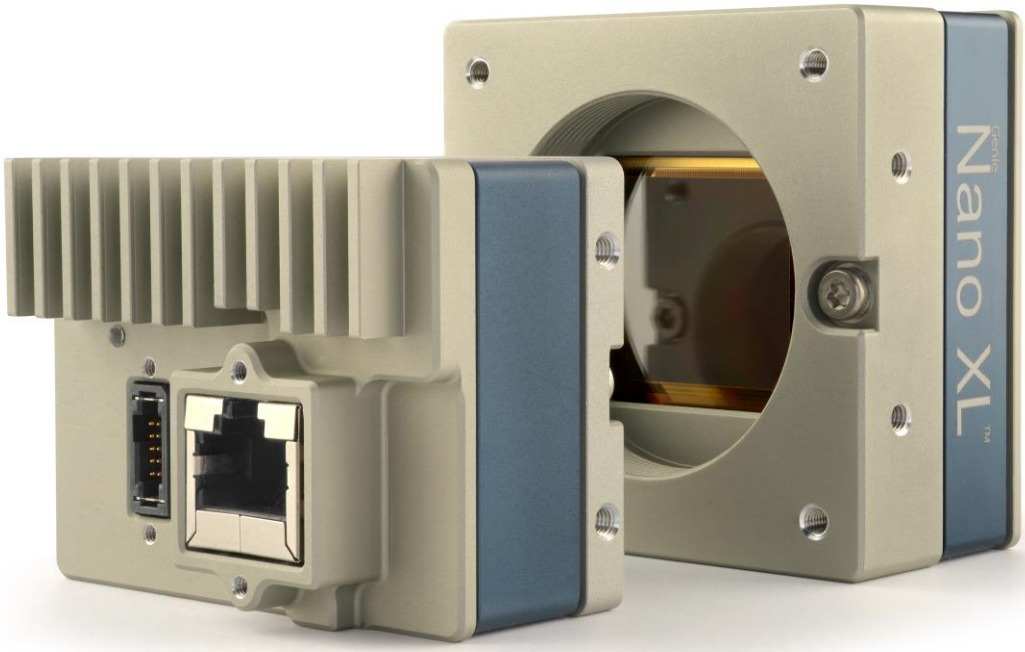
Genie Nano-5G Series™

Camera User's Manual

5 Gb GigE Vision – Monochrome & Color Area Scan

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



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Notice

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

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Genie Nano-5G Series Overview

Description

The Genie Nano-5G series, a member of the Genie camera family, provides a new series of affordable easy to use digital cameras specifically engineered for industrial imaging applications requiring improved network integration.

Genie Nano-5G cameras use the industries' latest leading sensors such as the Sony Pregius series of global shutter active pixel-type CMOS image sensors, as well as On-Semi sensors.

Genie Nano-5G cameras combine standard gigabit Ethernet technology (supporting GigE Vision 2.0) with the Teledyne DALSA Trigger-to-Image-Reliability framework to dependably capture and transfer images from the camera to the host PC. Genie Nano-5G cameras are available in a number of models implementing different sensors, image resolutions, and feature sets, either in monochrome or color versions.

GigE with TurboDrive

Genie Nano-5G cameras include TurboDrive™ technology, delivering high speed data transfers exceeding the GigE limit. TurboDrive (version 2.0) uses advanced data modeling to boost data transfers up to 2 or 3 times faster than standard GigE Vision speeds – with no loss of image quality. These breakthrough rates are achieved using a proprietary process that assembles data from the sensor to optimize throughput, simultaneously taking full advantage of both the sensor's maximum frame rate and the camera's maximum 5 GigE data transfer speed (up to 595 MB/s). Teledyne DALSA's TurboDrive increases system dependability and robustness similar to Camera Link throughput on a GigE network.

Important: Actual Transfers with TurboDrive is image content dependent but in the best case scenario, transfers over a GigE Network can reach the camera's internal acquisition limit of up to 950 MB/sec. If transfers are less than the camera maximum acquisition rate, camera memory will be used as a circular frame buffer.

Refer to TurboDrive Primer on the Teledyne DALSA web site for more details.

Note: The specification listed for Maximum Sustained Frame Rate Output (with TurboDrive v2) is limited by the Genie Nano-5G Architecture into the TurboDrive Engine to ~950MB/sec sustained using 1500 Byte Packet Size.

Genie Nano-5G Overview

- Optimized, rugged design with a wider operating temperature
- Available in multiple sensors/resolutions, monochrome and color
- Higher frame rates with Teledyne DALSA GigE Vision TurboDrive v2.0 Technology
- Visual camera multicolor status LED on back plate
- Multi-ROI support
- 2 (default models) general purpose opto-coupled inputs
- 3 (default models) general purpose opto-coupled outputs (user, counter, or timer driven for Strobe and Flash triggering)
- Flexible general purpose Counter and Timer functions available for internal and external controls
- Software and hardware Events available to support imaging applications
- Cycling mode supports 64 multiple camera setups (including Multi-Exposure)
- Auto brightness (for example, auto exposure and AGC) available on many models
- In-sensor and/or FPGA (digital) Binning available on monochrome models
- Supports Image Time-Stamp based on IEEE1588-2008 (PTP: Precise Time Protocol) or an Internal Timer
- Programmable Look-Up-Table (programmable LUT or preset Gamma) available
- Defective Pixel replacement available on some models
- Multicast and Action Command supported
- Image metadata supported
- Supports Power Over Ethernet (PoE) or auxiliary power input
- Implements 32 MB of Flash Memory
- 2 User Settings sets to store and recall camera configurations
- Supports the Gigabit Ethernet PAUSE Frame feature
- GigE Vision 2.0 compliant
- 1, 2.5 and 5 Gigabit Ethernet (GigE) interconnection to a computer via standard CAT5e or CAT6 cables
- Gigabit Ethernet (GigE) transfer speed up to 595 MB/second
- 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
- Refer to the Sapera LT 8.50 release notes for information on GigE Vision and TurboDrive Technology support.

Camera Firmware

Teledyne DALSA Genie Nano-5G 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 or downloaded directly from the Nano.

Important: Genie Nano-5G firmware updates are available for download from the Teledyne DALSA web site www.teledynedalsa.com/imaging/support/downloads. Choose Genie Nano-5G 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 easily be upgraded 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-5G monochrome and color models summarized in the two tables below. These tables list models in increasing resolution. Nano-5G common specifications and details for each Genie Nano-5G model follow these tables.

Monochrome Cameras

Model Full Resolution	Sensor Size/Model	Lens	Part Number
Nano-5G-M2050 2048 x 1536	**Sony 3.2M** (IMX252)	C-mount	**G5-GM30-M2050**
Nano-5G-M2450 2448 x 2048	**Sony 5.1M** (IMX250)	C-mount	**G5-GM30-M2450**
Nano-5G-M4060 4112 x 2176	**Sony 8.9M** (IMX255)	C-mount	**G5-GM30-M4060**
Nano-5G-M4040 4112 x 3008	**Sony 12M** (IMX253)	C-mount	**G5-GM30-M4040**
Nano-5G-M5400 5420x 5420	**On-Semi 30M** (XGS30000)	M42-mount	**G5-GM31-M5405**
Nano-5G-M8100 8192 x 5420	**On-Semi 45M** (XGS45000)	M42-mount	**G5-GM31-M8105**

Color Cameras

Model Full Resolution	Sensor Size/Model	Lens	Part Number	Notes
Nano-5G-C2050 2048 x 1536	**Sony 3.2M** (IMX252)	C-mount	**G5-GC30-C2050**	
			G5-GC30-C2050IF	With IR cut-off filter
Nano-5G-C2450 2448 x 2048	**Sony 5.1M** (IMX250)	C-mount	**G5-GC30-C2450**	
			G5-GC30-C2450IF	With IR cut-off filter
Nano-5G-C4060 4112 x 2176	**Sony 8.9M** (IMX255)	C-mount	**G5-GC30-C4060**	
			G5-GC30-C4060IF	With IR cut-off filter
Nano-5G-C4040 4114 x 3008	**Sony 12M** (IMX253)	C-mount	**G5-GC30-C4040**	
			G5-GC30-C4040IF	With IR cut-off filter
Nano-5G-C5400 5420 x 5420	**On-Semi 30M** (XGS30000)	M42-mount	**G5-GM31-C5405**	
Nano-5G-C8100 8192 x 5420	**On-Semi 45M** (XGS45000)	M42-mount	**G5-GM31-C8105**	

Optional Hardware Accessories

Nano Accessories & Cables (sold separately)		Order Number
Mounting Bracket Plate (also known as a tripod mount) Includes hole for third mounting position (¼-20 Mounting Adapter) 35 mm of length		G3-AMNT-BRA02
Heatsink compatible to Nano casing 51mm x 28mm x 15mm (screws included)		G3-AHSK-51X28
M42 x1mm to F-mount (Nikon) lens adapter		G2-AM42-MOUNT4

Optional Cable Accessories

Nano-5G Accessories & Cables (sold separately)		Order Number
I/O Blunt End Cable (1 meter Screw Retention to Flying Leads) (2 meter Screw Retention to Flying Leads)		G3-AIOC-BLUNT1M G3-AIOC-BLUNT2M
I/O Breakout Cable (2 meter Screw Retention to Euroblock connector)		G3-AIOC-BRKOUT2M
Power and Cable Evaluation Kit • Includes a Power Supply (12V), • an Ethernet Cable (RJ-45, 2 meter), • and a 2 meter I/O Breakout Cable (Euroblock)		G3-ACBL-EVALKIT

See section Components Express Right-Angle Cable Assemblies and Alysium-Tech "Extreme Rating" HiFlex Ethernet Cable for additional cabling options available directly from our preferred cable sources.

Software Requirements

Sapera LT Development Software

Teledyne DALSA Software Platform for Microsoft Windows	
Sapera LT version 8.50 or later for Windows. Includes Sapera Network Imaging Package and GigE Vision Imaging Driver, Sapera Runtime and CamExpert. Provides everything you will need to develop imaging applications Sapera documentation provided in compiled HTML help, and Adobe Acrobat® (PDF)	Available for download http://www.teledynedalsa.com/imaging/support/
Sapera Processing Imaging Development Library (available for Windows or Linux – sold separately):	Contact Teledyne DALSA Sales
Teledyne DALSA Software Platform for Linux	
GigE-V Framework Ver. 2.3 (for both X86 or Arm type processor)	Available for download http://teledynedalsa.com/imaging/products/software/linux-gige-v/

Third Party GigE Vision Development

Third Party GigE Vision Software Platform Requirements	
Support of GenICam GenApi version 2.3	General acquisition and control
Support of GenICam GenApi version 2.3	File access: firmware, configuration data, upload & download
Support of GenICam XML schema version 1.1	
GenICam™ support — XML camera description file	Embedded within Genie Nano-5G

About GigE Vision

GigE Vision®	Genie Nano-5G cameras are 100% compliant with the GigE Vision 2.0 specification which defines the communication interface protocol used by any GigE Vision device. The device description and capabilities are contained in an XML file. For more information see: https://www.visiononline.org/vision-standards-details.cfm?type=5
GENICAM	Genie Nano-5G cameras implement a superset of the GenICam™ specification which defines device capabilities. This description takes the form of an XML device description file respecting the syntax defined by the GenApi module of the GenICam™ specification. For more information see www.genicam.org.

The Teledyne DALSA GigE Vision Module provides a license free development platform for Teledyne DALSA GigE hardware or Sapera vision applications. Additionally supported are Sapera GigE Vision applications for third party hardware with the purchase of a GigE Vision Module license, or the Sapera processing SDK with a valid license.

The GigE Vision Compliant XML device description file is embedded within Genie Nano-5G firmware allowing GigE Vision Compliant applications access to Genie Nano-5G capabilities and controls immediately after connection.

Genie Nano-5G Specifications

The Nano-5G common specifications listed first are followed by model specific tables of functional features and timing details.

Common Specifications

Camera Controls	
Synchronization Modes	Free running, External triggered, Software trigger through Ethernet or IEEE 1588 Precision Time Protocol (PTP)
Exposure Control	Internal – Programmable via the camera API External (Global Shutter models) – based on Trigger Width
Exposure Time Maximum	16 sec (Global Shutter models)
Exposure Modes	Programmable in increments of 1µs (minimum (in µs) is model specific) Pulse controlled via Trigger pulse width (Global Shutter models).
Trigger Inputs	Opto-isolated, 2.4V to 24V typical, 7 mA min. Debounce range from 0 up to 255 µs Trigger Delay from 0 to 2,000,000 µs
Strobe Outputs	Output opto-isolated: Aligned to the start of exposure with a programmable delay, duration and polarity (using "start of exposure on output line source" feature)
Features	
Image Buffer	*Refer to transferQueueMemorySize feature.* ~430 MB total on-board memory for acquisitions and packet resend buffering
Reserved Private User Buffer	4 kB flash memory for OEM usage (*deviceUserBuffer*)
Gain	In Sensor gain (model dependent) and Digital gain up to 4x
Auto-Brightness	Yes , with Auto-Exposure and AGC (Sensor Gain or FPGA Gain) *Note1: Sensor Gain AGC only with Sony sensors*
Color model output	Color cameras support Bayer output firmware.
Binning (monochrome models)	Support for both Horizontal and Vertical Binning: 1x, 2x, and 4x in FPGA Models M4040, M4060 have in-sensor binning
LUT	Programmable LUT (Look-up-table) up to 12-Bit (model/firmware dependent)
Defective Pixel Replacement	Available on all models — up to 4096 entries
Automatic White Balance	Available on Color models
Counter and Timer	1 Counter, and 1 Timer. User programmable, acquisition independent, with event generation, and can control Output I/O pins
Timestamp	Timer to Timestamp images and events (1µs tics using Internal Clock, 8 nanosecond tics when using IEEE1588 (PTP: Precise time Protocol)
Metadata	Metadata Output at the end of the Images (also known as GenICam Chunk Data)
Cycling Mode	Automatic cycling between 64 camera setups
Multicast	Programming support for multicasting images (requires Multicast host support: refer to the SDK documentation – if supported)
Action Command	Programmable for up to 2 GenICam Action Commands (requires host support: refer to the SDK documentation – if supported)
Test image	Internal generator with choice of static and shifting patterns
User settings	Select factory default or either of two user saved camera configurations
TurboDrive v2.0 Technology	Supported with 8-bit buffer format (see Sapera 8.50 release notes)

Back Focal Distance	
	17.52 mm (C-mount models) 12mm (M42-mount models)
Mechanical Interface	
Camera (L x H x W) see Mechanical Specifications	Medium body size: 42.6 mm x 44 mm x 59 mm (with C-mount) 32.3 mm x 44 mm x 59 mm (without C-mount) XL body size: 41 mm x 59 mm x 59 mm
Mass (*approximate value due to sensor variations*)	~ 112g (Medium body with no lens) ~ 186g (XL body with no lens)
Power connector	via the 10-pin I/O connector, or RJ45 in PoE mode
Ethernet connector	RJ45
Electrical Interface	
Input Voltage	+12 to +36 Volts DC recommended(+10%/- 10%) +10 to +56 Volts DC (Absolute min/max Range) on Auxiliary connector Supports the Power Over Ethernet standard. (PoE Class 3 as per IEEE 802.3af)
Inputs/Outputs	Default models have 2 Inputs and 3 Outputs
Power Dissipation (typical)	24V: 9.4 to 9.6W dependent on model PoE Class 2: 10 to 10.7W dependent on model
Data Output	Gigabit Ethernet 5/2.5/1Gbps (10/100 Mbps are not supported)
Ethernet Option supported	PAUSE Frame support (as per IEEE 802.3x)
Data and Control	GigE Vision 2.0 compliant
Environmental Conditions	
Operating Temperature (*at camera front plate*)	All Models: -20°C to +65°C (-4°F to +149°F) Temperature range specification based on an auxiliary input voltage of +20 to +36Vdc or PoE. *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	CE, FCC, KC, GenICam, GigE Vision, IP30, IEEE 802.3af (PoE)

Sensor Cosmetic Specifications

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

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

- **Test conditions**
  - Nominal light = illumination at 50% of saturation
  - Temperature of camera is 45°C
  - At exposures lower than 0.1 seconds
  - At nominal sensor gain (1x)

- **Sony Sensor Limitation:**
  - Max pixel saturated values: Max Pixel format bit depth – 1DN (either 10-bit or 12-bit, as designed by Sony)

Dynamic Range & Signal to Noise Ratio Measurement Conditions

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

Dynamic Range Test Conditions

- Exposure 100µs
- 0% Full Light Level

SNR Test Conditions

- Exposure 2000µs
- 80% saturation

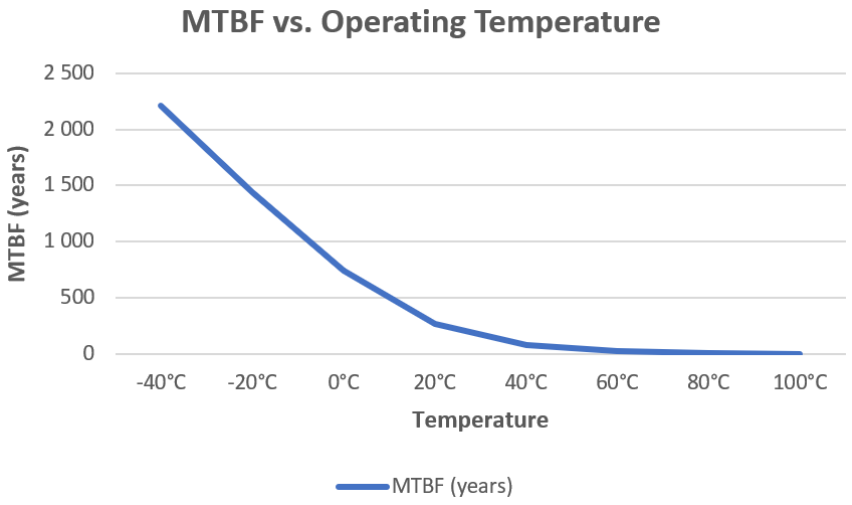
EMI, Shock and Vibration Certifications

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-5G certificates see "EMC Declarations of Conformity " on page 190		
Vibration & Shock Tests	**Test Levels (while operating)**	**Test Parameters**
Random vibrations	Level 1: 2 grms 60 min. Level 2: 4 grms 45 min. Level 3: 6 grms 30 min.	Frequency range: 5 to 2000 Hz Directions: X, Y, and Z axes
Shocks	Level 1: 20 g / 11 ms Level 2: 30 g / 11 ms Level 3: 40 g / 6 ms	Shape: half-sine Number: 3 shocks (+) and 3 shocks (-) 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 -20 to 100ºC. The following table presents the predicted MTBF and failure rate values.

Temperature °C	MTBF		Failure Rate (Failure/10^6 hours)
	Hours	Years	
-20	12642225	1443	0.0791
0	6489293	741	0.154.1
20	2345766	268	0.426.3
40	673718	77	1.484.3
60	185532	21	5.389.9
80	54118	6	18.478
100	17260	2	57.937



Heat Sink Requirements

⚠	To minimize the camera body size, the camera is designed to convey heat to the external casing and therefore must be heat-sinked to maintain the front plate temperature within operating temperature specifications.

For more information, refer to the Temperature Management section.

Network Hardware Considerations

Network devices connected to Genie Nano 5G cameras must support 5, 2.5 or 1 Gb connections.

To utilize the full 5 Gb bandwidth output of the Genie Nano 5G, all network hardware between the camera and the host computer must be capable of handling 5 Gb bandwidth.

It is recommended to test network device performance since certain devices may not achieve acceptable results in actual operation (depending on the device manufacturer's implementation). In general, it is always recommended to use the latest device drivers provided by the manufacturer.

For example, the Intel X550 network adapter achieves superior performance compared to some other manufacturer's comparable devices.

	**Note:** certain 10 Gb devices do not support 5 Gb (or 2.5 Gb) speed; connecting 5 Gb devices results in the connection speed lowered to the common supported speed of 1 Gb.

In general, to optimize performance:

- For the host computer NIC:
  - Maximize receive buffers (descriptors)
  - Adjust the Receive Side Scaling (RSS) Queue for best performance (for processing intensive applications the optimal value may not be the maximum value)
- For any switches:
  - Maximize the memory allocated to internal buffers (if available)
  - Enable PAUSE frame support (if available)
- For the host application:
  - Maximize the number of image acquisition buffers

	**Note:** it is recommended that the packet size be adjusted accordingly for optimal perfomance given the network topology (with or without a switch), in particular when using packet sizes within 1500 to 3000 and 4000 to 8000 ranges. For example, certain switches might perform better using a packet size of 4096 bytes instead of 9000 bytes. In addition, with TurboDrive a smaller to mid-size packet usually outperforms a larger packet size.

	**Note:** Some Ethernet Switches may produce more Pause Frame requests than expected when Jumbo Frames is enabled. Changing the Ethernet Packet Size may minimize Pause Requests from such a switch and improve overall transfer bandwidth.

Ethernet cable category (CAT-5e, 6, 7), manufacturer, quality and length can also affect performance.

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

Sony Sensor Models

Specifications, firmware files and responsivity for Genie Nano-5G cameras utilizing Sony sensors (monochrome and color) are described in the following sections:

<table>
<tr><th>Specifications</th><th>Spectral Respsonses</th><th>Firmware</th></tr>
<tr><td>Specifications: M2050</td><td rowspan="2">Spectral Responses (model 2050)</td><td rowspan="8">Firmware Files for All Models</td></tr>
<tr><td>Specifications: C2050</td></tr>
<tr><td>Specifications: M2450</td><td rowspan="2">Spectral Responses (model 2450)</td></tr>
<tr><td>Specifications: C2450</td></tr>
<tr><td>Specifications: M4060</td><td rowspan="4">Spectral Responses (models 4040/4060)</td></tr>
<tr><td>Specifications: C4060</td></tr>
<tr><td>Specifications: M4040</td></tr>
<tr><td>Specifications: C4040</td></tr>
</table>

For supported firmware for all models, refer to the Firmware Files for All Models section.

	**Note:** The specification listed for Maximum Sustained Frame Rate Output (with TurboDrive v2) is limited by the Genie Nano-5G Architecture into the TurboDrive Engine to ~950MB/sec sustained using 1500 Byte Packet Size.

Specifications: M2050

Supported Features	Nano-M2050
Resolution	2064 x 1544
Sensor	Sony IMX252 (3.2M)
Pixel Size	3.45 µm x 3.45 µm
Shutter type	Full frame electronic global shutter function
Firmware option (Field programmable)	Standard Design (factory) 12-bit Design
Full Well charge (firmware design dependent)	11ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate (full resolution)	187 fps (8-bit) with Standard Design 105 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	187 fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	180 fps (8-bit) with Standard Design 89 fps with 12-bit Design
Pixel Data Formats	Mono 8-bit Mono 12-bit Mono 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* *2 Line Time* + (added User value in *ExposureDelay*) *0 µs (Reset Exposure Alignment)*
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exp. Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	17 µs (increment of 3.367 µs steps) for Std Design 19.7 µs (increment of 5.98 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	13 lines– 13.73 µs
Horizontal Line Time:	3.367 µs (Standard Design) 5.980 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 23) in µs
Auto-Brightness	Yes , with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Gain (1.0x to 251x) In-FPGA Digital Gain (1x to 4x) in 0.007x steps
Binning Support	Yes In-FPGA (summing and averaging 2x2, 4x4)
Decimation Support	No
Color Correction Support	No
Defective Pixel Replacement	Yes, up to 2048 pixels
Image Correction	No
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.6 dB

Specifications: C2050

Supported Features	Nano-C2050
Resolution	2064 x 1544
Sensor	Sony IMX252 (3.2M)
Pixel Size	3.45 µm x 3.45 µm
Shutter type	Full frame electronic global shutter function
Firmware option (Field programmable)	Standard Design (factory) 12-bit Design
Full Well charge (firmware design dependent)	11ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate (full resolution)	187 fps (8-bit) with Standard Design 105 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	187 fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	180 fps (8-bit) with Standard Design 89 fps with 12-bit Design
Pixel Data Formats	Bayer 8-Bit Bayer 12-bit Bayer 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* *2 Line Time* + (added User value in *ExposureDelay*) *0 µs (Reset Exposure Alignment)*
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exposure Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	17 µs (increment of 3.367 µs steps) for Std Design 19.7 µs (increment of 5.98 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	13 lines– 13.73 µs
Horizontal Line Time:	3.367 µs (Standard Design) 5.980 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 23) in µs
Auto-Brightness	Yes , with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Gain (1.0x to 251x) In-FPGA Digital Gain (1x to 4x) in 0.007x steps
Binning Support	Yes In-FPGA (summing and averaging 2x2, 4x4)
Decimation Support	No
Color Correction Support	No
Defective Pixel Replacement	Yes, up to 2048 pixels
White Balance	Yes, up to 16x per color
Image Correction	No
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive w in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.6 dB

Specifications: M2450

Supported Features	M2450
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
Firmware option (Field programmable)	Standard Design (Factory) 12-bit Design
Full Well charge (firmware design dependent)	10.7ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate (full resolution)	141 fps (8-bit) with Standard Design 67 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	141fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	117 fps (8-bit) with Standard Design 58 fps with 12-bit Design
Pixel Data Formats	Mono 8-bit Mono 12-bit Mono 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* *2 Line Time* + (added User value in *ExposureDelay*) *0 µs (Reset Exposure Alignment)*
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exp. Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	17 µs (increment of 3.367 µs steps) for Standard Design 20 µs (increment of 7.112 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	24 lines – 13.73 µs
Horizontal Line Time:	3.367 µs (Standard Design) 5.980 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 23) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1.0x to 251x)
Binning Support	Yes In-FPGA (summing and averaging 2x2, 4x4)
Decimation Support	No
Defective Pixel Replacement	Yes, up to 2048 pixels
Image Correction	no
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.6 dB

Specifications: C2450

Supported Features	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
Firmware option (Field programmable)	Standard Design (Factory) 12-bit Design
Full Well charge (firmware design dependent)	10.7ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate (full resolution)	141 fps (8-bit) with Standard Design 67 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	141fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	117 fps (8-bit) with Standard Design 58 fps with 12-bit Design
Pixel Data Formats	Bayer 8-Bit Bayer 12-bit Bayer 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* *2 Line Time* + (added User value in *ExposureDelay*) *0 µs (Reset Exposure Alignment)*
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exp. Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	17 µs (increment of 3.367 µs steps) for Standard Design 20 µs (increment of 7.112 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	24 lines – 13.73 µs
Horizontal Line Time:	3.367 µs (Standard Design) 5.980 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 23) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1.0x to 251x)
Binning Support	Yes In-FPGA (summing and averaging 2x2, 4x4)
Decimation Support	No
Defective Pixel Replacement	Yes, up to 2048 pixels
White Balance	Yes, up to 16x per color
Image Correction	No
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.6 dB

Specifications: M4060

Supported Features	M4060
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
Firmware option (Field programmable)	Standard Design (Factory) 12-bit Design
Full Well charge (firmware design dependent)	10.7ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate Full resolution	87.5 fps (8-bit) with Standard Design 39.5 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	87.5 fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	67 fps (8-bit) with Standard Design 33 fps with 12-bit Design
Pixel Data Formats	Mono 8-bit Mono 12-bit Mono 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* 2 Horizontal Line time in µs + (added User value in *ExposureDelay*) 0 µs (*Reset Exposure Alignment*)
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exp. Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	19.4 µs (increment of 5.12 µs steps) for Std Design 25.5 µs (increment of 11.31 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	24 lines– 14.26 µs
Horizontal Line Time: Normal operation (with In-Sensor Binning enable)	5.118 µs (Standard Design) 11.314 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 28) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1.0x to 251x) In-FPGA Digital Gain (1x to 4x) in 0.007x step
Binning Support	Yes, In-sensor 2x2 (summing) Yes In-FPGA (summing and averaging, 2x2, 4x4)
Decimation Support	No
Defective Pixel Replacement	Yes , up to 2048 pixels
Image Correction	no
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.6 dB

Specifications: C4060

Supported Features	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
Firmware option (Field programmable)	Standard Design (Factory) 12-bit Design
Full Well charge (firmware design dependent)	10.7ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate Full resolution	87.5 fps (8-bit) with Standard Design 39.5 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	87.5 fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	67 fps (8-bit) with Standard Design 33 fps with 12-bit Design
Pixel Data Formats	Bayer 8-Bit Bayer 12-bit Bayer 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* 2 Horizontal Line time in µs + (added User value in *ExposureDelay*) 0 µs (*Reset Exposure Alignment*)
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exp. Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	19.4 µs (increment of 5.12 µs steps) for Std Design 25.5 µs (increment of 11.31 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	24 lines– 14.26 µs
Horizontal Line Time: Normal operation (with In-Sensor Binning enable)	5.118 µs (Standard Design) 11.314 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 28) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1.0x to 251x) In-FPGA Digital Gain (1x to 4x) in 0.007x step
Binning Support	Yes, In-sensor 2x2 (summing) Yes In-FPGA (summing and averaging, 2x2, 4x4)
Decimation Support	No
Defective Pixel Replacement	Yes , up to 2048 pixels
White Balance	Yes, up to 16x per color
Image Correction	No
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.6 dB

Specifications: M4040

Supported Features	M4040
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
Firmware option (Field programmable)	Standard Design (Factory) 12-bit Design)
Full Well charge (firmware design dependent)	10.6ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate (full resolution)	63.79 fps (8-bit) with Standard Design 28.8 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	63.79 fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	50 fps (8-bit) with Standard Design 24.5 fps with 12-bit Design
Pixel Data Formats	Mono 8-bit Mono 12-bit Mono 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* 2 Horizontal Line time in µs + (added User value in *ExposureDelay*) *Reset Exposure Alignment* 0 µs
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exp. Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	19.4 µs (increment of 5.118 µs steps) for Std Design 25.5 µs (increment of 11.314 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	*24 lines– 14.26 µs*
Horizontal Line Time: Normal operation (with In-Sensor Binning enabled)	5.118 µs (Standard Design) 11.314 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 28) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1.0x to 251x) In-FPGA Digital Gain (1x to 4x) in 0.007x step
Binning Support	Yes In-FPGA (summing and averaging, 2x2, 4x4) Yes, In-sensor 2x2 (summing)
Decimation Support	No
Defective Pixel Replacement	Yes , up to 2048 pixels
Image Correction	No
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.50 dB

Specifications: C4040

Supported Features	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
Firmware option (Field programmable)	Standard Design (Factory) 12-bit Design)
Full Well charge (firmware design dependent)	10.6ke (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate (full resolution)	63.79 fps (8-bit) with Standard Design 28.8 fps with 12-bit Design
Maximum Sustained Frame Rate Output (with TurboDrive v2)	63.79 fps (8-bit) N/A with 12-bit Design Firmware
Maximum Sustained Frame Rate Output (without TurboDrive)	50 fps (8-bit) with Standard Design 24.5 fps with 12-bit Design
Pixel Data Formats	Bayer 8-Bit Bayer 12-bit Bayer 12-bit Packed
Trigger to Exposure Minimum delay	*Synchronous Exposure Alignment* 2 Horizontal Line time in µs + (added User value in *ExposureDelay*) 0 µs (*Reset Exposure Alignment*)
Trigger to Exposure Start jitter	0 µs to 1 Line Time (*Synchronous Exp. Alignment*) 0 µs *(Reset Exposure Alignment)*
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	19.4 µs (increment of 5.118 µs steps) for Std Design 25.5 µs (increment of 11.314 µs steps) for 12-bit Design
Min. Time from End of Exposure to Start of Next Exposure	*24 lines– 14.26 µs*
Horizontal Line Time: Normal operation (with In-Sensor Binning enabled)	5.118 µs (Standard Design) 11.314 µs (12-bit Design)
Readout Time	(Horizontal Line Time) x (lines in frame + 28) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain or Sensor Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1.0x to 251x) In-FPGA Digital Gain (1x to 4x) in 0.007x step
Binning Support	Yes In-FPGA (summing and averaging, 2x2, 4x4) Yes, In-sensor 2x2 (summing)
Decimation Support	No
Defective Pixel Replacement	Yes , up to 2048 pixels
White Balance	Yes, up to 16x per color
Image Correction	No
Image Flip Support	Yes, In-Sensor, Vertical and Horizontal
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with in-sensor binning)
On-Board Image Memory	430MB
Output Dynamic Range (dB)	75.4 dB
SNR (dB)	39.50 dB

On-Semi Sensor Models

Specifications, firmware files and responsivity for Genie Nano-5G cameras utilizing On-Semi sensors (monochrome and color) are described in the following sections:

<table>
<tr><th>Specifications</th><th>Spectral Responses</th><th>Firmware</th></tr>
<tr><td>Specifications: M5400</td><td rowspan="2">Spectral Responses (models 5400)</td><td rowspan="4">Firmware Files for All Models</td></tr>
<tr><td>Specifications: C5400</td></tr>
<tr><td>Specifications: M8100</td><td rowspan="2">Spectral Responses (models 8100)</td></tr>
<tr><td>Specifications: C8100</td></tr>
</table>

For supported firmware for all models, refer to the Firmware Files for All Models section.

Specifications: M5400

Camera Models	Nano-5G-M5400
Resolution	5420 x 5420
Sensor	On-Semi XGS30000
Pixel Size	3.2 µm x 3.2 µm
Shutter type	Full frame electronic global shutter function
Firmware option (Field programmable)	Standard 8-bit Design (Factory) 12-bit Design
Full Well charge (firmware design dependent)	10k e- (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate Full resolution	19.3 fps (Standard Firmware) 13.0 fps (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (with TurboDrive v2)	19.3 fps in 8-bit (Standard Firmware) N/A on (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (without TurboDrive) (With 92% DeviceThroughputLimit)	12.5 fps in 8-bit (Standard Firmware) 8.4 fps in 12-bit packed (12-bit Firmware only) 6.3 fps in 12-bit (12-bit Firmware only)
Pixel Data Formats	Mono 8-bit Mono 12-bit Mono 12-bit Packed
Trigger to Exposure Minimum delay	52 us (Standard Firmware) 71 µs (12-bit Firmware)
Trigger to Exposure Start jitter	0-1 line (synchronous mode)
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	70 µs (Standard Sensor Exposure Mode)
Min. Time from End of Exposure to Start of Next Exposure	123 us (Standard Firmware) 176 µs (12-bit Firmware)
Horizontal Line Time: Normal operation (with In-Sensor Binning enable)	9.414 µs (Standard Firmware) 13.950 µs (12-bit Firmware)
Readout Time	(H Line Time) x (lines in frame + 1) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1x ,2x and 4x) In-sensor Digital Gain (1/32x to 2x in steps of 1/32x)
Binning Support	Yes, In-FPGA (Summing and Averaging 2x2, 4x4)
Input Look-up-Table	10-bit to 8-bit (standard Design Firmware) 12-bit (12-bit Design Firmware)
Decimation Support	No
Defective Pixel Replacement	Yes, up to 4096 pixels
Image Correction	No
Image Flip Support	Yes, In-Sensor (Vertical) and FPGA (Horizontal)
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive w binning and decimation)

Cameras synchronization	Synchronization via external trigger signal, Action Command or using PTP (IEE1588) modulo
On-Board Image Memory	430 MB
Output Dynamic Range (dB)	66.0 dB (Standard Design) 74.4 dB (12-bit Design)
SNR (dB)	39.6 dB

Specifications: C5400

Camera Models	Nano-5G-C5400
Resolution	5420 x 5420
Sensor	On-Semi XGS30000
Pixel Size	3.2 µm x 3.2 µm
Shutter type	Full frame electronic global shutter function
Firmware option (Field programmable)	Standard 8-bit Design (Factory) 12-bit Design
Full Well charge (firmware design dependent)	10k e- (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate Full resolution	19.3 fps (Standard Firmware) 13.0 fps (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (with TurboDrive)	19.3 fps in 8-bit (Standard Firmware) N/A on (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (without TurboDrive) (With 92% DeviceThroughputLimit)	12.5 fps in 8-bit (Standard Firmware) 8.4 fps in 12-bit packed (12-bit Firmware only) 6.3 fps in 12-bit (12-bit Firmware only)
Pixel Data Formats	Bayer 8-Bit Bayer 12-bit Bayer 12-bit Packed
Trigger to Exposure Minimum delay	52 us (Standard Firmware) 71 µs (12-bit Firmware)
Trigger to Exposure Start jitter	0-1 line (synchronous mode)
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	70 µs (Standard Sensor Exposure Mode)
Min. Time from End of Exposure to Start of Next Exposure	123 us (Standard Firmware) 176 µs (12-bit Firmware)
Horizontal Line Time: Normal operation (with In-Sensor Binning enable)	9.414 µs (Standard Firmware) 13.950 µs (12-bit Firmware)
Readout Time	(H Line Time) x (lines in frame + 1) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1x ,2x and 4x) In-sensor Digital Gain (0.03 to 2x)
Binning Support	No
White Balance	Yes (color models), up to 16x per color
Decimation Support	No
Defective Pixel Replacement	Yes, up to 4096 pixels
Image Correction	No
Image Flip Support	Yes, In-Sensor (Vertical) and FPGA (Horizontal)
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with binning)
Cameras synchronization	Synchronization via external trigger signal, Action Command or using PTP (IEE1588) modulo
On-Board Image Memory	430 MB

Output Dynamic Range (dB)	66.0 dB (Standard Design) 74.4 dB (12-bit Design)
SNR (dB)	39.6 dB

Specifications: M8100

Camera Models	Nano-5G-M8100
Resolution	8192 x 5420
Sensor	On-Semi XGS45000
Pixel Size	3.2 µm x 3.2 µm
Shutter type	Full frame electronic global shutter function
Firmware option (Field programmable)	Standard 8-bit Design (Factory) 12-bit Design
Full Well charge; dependent on Firmware Design Loaded	10k e- (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate Full resolution	19.3 fps (Standard Firmware) 13.0 fps (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (with TurboDrive v2)	19.3 fps in 8-bit (Standard Firmware) N/A on (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (without TurboDrive) (With 92% DeviceThroughputLimit)	12.5 fps in 8-bit (Standard Firmware) 8.4 fps in 12-bit packed (12-bit Firmware only) 6.3 fps in 12-bit (12-bit Firmware only)
Pixel Data Formats	Mono 8-bit Mono 12-bit Mono 12-bit Packed
Trigger to Exposure Minimum delay	52 us (Standard Firmware) 71 µs (12-bit Firmware)
Trigger to Exposure Start jitter	0-1 line (synchronous mode)
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	70 µs (Standard Sensor Exposure Mode)
Min. Time from End of Exposure to Start of Next Exposure	123 us (Standard Firmware) 176 µs (12-bit Firmware)
Horizontal Line Time: Normal operation (with In-Sensor Binning enable)	9.414 µs (Standard Firmware) 13.950 µs (12-bit Firmware)
Readout Time	(H Line Time) x (lines in frame + 1) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1x ,2x and 4x) In-sensor Digital Gain (1/32x to 2x in steps of 1/32x)
Binning Support	Yes, In-FPGA (Summing and Averaging 2x2, 4x4)
Input Look-up-Table	10-bit to 8-bit (standard Design Firmware) 12-bit (12-bit Design Firmware)
Decimation Support	No
Defective Pixel Replacement	Yes, up to 4096 pixels
Image Correction	No
Image Flip Support	Yes, In-Sensor (Vertical) and FPGA (Horizontal)
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with binning)

Cameras synchronization	Synchronization via external trigger signal, Action Command or using PTP (IEE1588) modulo
On-Board Image Memory	430 MB
Output Dynamic Range (dB)	66.0 dB (Standard Design) 74.4 dB (12-bit Design)
SNR (dB)	39.6 dB

Specifications: C8100

Camera Models	Nano-5G-C8100
Resolution	8192 x 5420
Sensor	On-Semi XGS45000
Pixel Size	3.2 µm x 3.2 µm
Shutter type	Full frame electronic global shutter function
Firmware option (Field programmable)	Standard 8-bit Design (Factory) 12-bit Design
Full Well charge; dependent on Firmware Design Loaded	10k e- (max)
Sensitivity to Saturation	1x
Max. Internal Frame Rate Full resolution	19.3 fps (Standard Firmware) 13.0 fps (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (with TurboDrive)	19.3 fps in 8-bit (Standard Firmware) N/A on (12-bit Design Firmware)
Maximum Sustained Frame Rate Output (without TurboDrive) (With 92% DeviceThroughputLimit)	12.5 fps in 8-bit (Standard Firmware) 8.4 fps in 12-bit packed (12-bit Firmware only) 6.3 fps in 12-bit (12-bit Firmware only)
Pixel Data Formats	Bayer 8-Bit Bayer 12-bit Bayer 12-bit Packed
Trigger to Exposure Minimum delay	52 us (Standard Firmware) 71 µs (12-bit Firmware)
Trigger to Exposure Start jitter	0-1 line (synchronous mode)
Actual Exposure Time Minimum (see "exposureTimeActual" in Sensor Control)	70 µs (Standard Sensor Exposure Mode)
Min. Time from End of Exposure to Start of Next Exposure	123 us (Standard Firmware) 176 µs (12-bit Firmware)
Horizontal Line Time: Normal operation (with In-Sensor Binning enable)	9.414 µs (Standard Firmware) 13.950 µs (12-bit Firmware)
Readout Time	(H Line Time) x (lines in frame + 1) in µs
Auto-Brightness	Yes, with Auto-Exposure and AGC (FPGA Gain)
Black offset control	Yes (in DN)
Gain Control	In-sensor Analog Gain (1x ,2x and 4x) In-sensor Digital Gain (0.03 to 2x)
Binning Support	No
White Balance	Yes (color models), up to 16x per color
Decimation Support	No
Defective Pixel Replacement	Yes, up to 4096 pixels
Image Correction	No
Image Flip Support	Yes, In-Sensor (Vertical) and FPGA (Horizontal)
Multi-ROI Support	Yes, In-Sensor, up to 16 ROI (mutually exclusive with binning and decimation)
Cameras synchronization	Synchronization via external trigger signal, Action Command or using PTP (IEE1588) modulo

On-Board Image Memory	430 MB
Output Dynamic Range (dB)	66.0 dB (Standard Design) 74.4 dB (12-bit Design)
SNR (dB)	39.6 dB

Firmware Files for All Models

The latest firmware files for all Nano-5G models are available on the Teledyne DALSA support web site: http://www.teledynedalsa.com/imaging/support/downloads/firmware/

The firmware files for mono and color models are listed below. The xx denotes the current build number.

Monochrome Camera Firmware

Model	Firmware	
	Type	Filename
M2050	Standard	Genie_Nano5G_Sony_IMX25x_3M-5M-9M-12M_STD_Firmware_1CA22.xx.cbf
M2450	Standard	
M4060	Standard	
M4040	Standard	
M8100	Standard	Genie_Nano5G_OnSemi_XGS_45M_STD_Firmware_3CA22.xx.cbf
M2050	12-bit	Genie_Nano5G_Sony_IMX25x_3M-5M-9M-12M_STD_12b_Firmware_1CA22.xx.cbf
M2450	12-bit	
M4060	12-bit	
M4040	12-bit	
M8100	12-bit	Genie_Nano5G_OnSemi_XGS_45M_STD_12b_Firmware_3CA22.xx.cbf

Color Camera Firmware

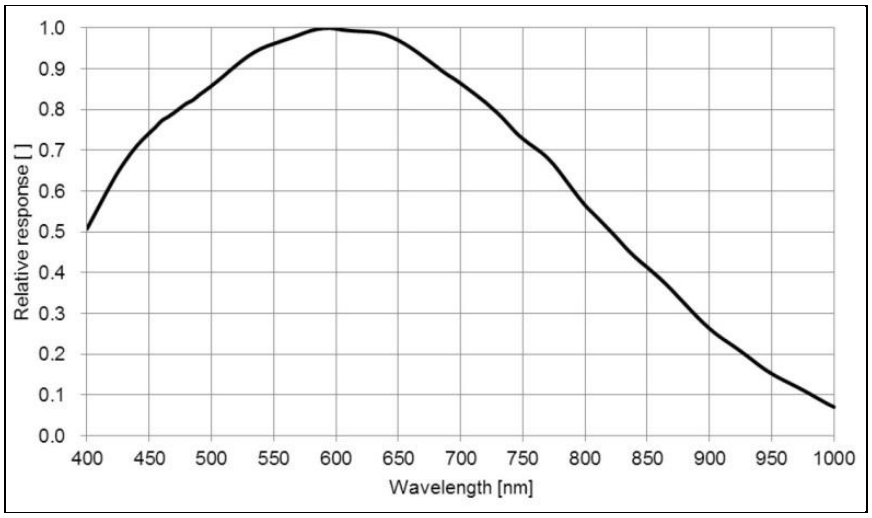
Model	Firmware	
	Type	Filename
C2050	Bayer Output	Genie_Nano5G_Sony_IMX25x_3M-5M-9M-12M_STD_Firmware_1CA22.xx.cbf
C2450	Bayer Output	
C4060	Bayer Output	
C4040	Bayer Output	
C8100	Bayer Output	Genie_Nano5G_OnSemi_XGS_45M_STD_Firmware_3CA22.xx.cbf
C2050	12-bit Bayer Output	Genie_Nano5G_Sony_IMX25x_3M-5M-9M-12M_STD_12b_Firmware_1CA22.xx.cbf
C2450	12-bit Bayer Output	
C4060	12-bit Bayer Output	
C4040	12-bit Bayer Output	
C8100	12-bit Bayer Output	Genie_Nano5G_OnSemi_XGS_45M_STD_12b_Firmware_3CA22.xx.cbf

Spectral Response Curves

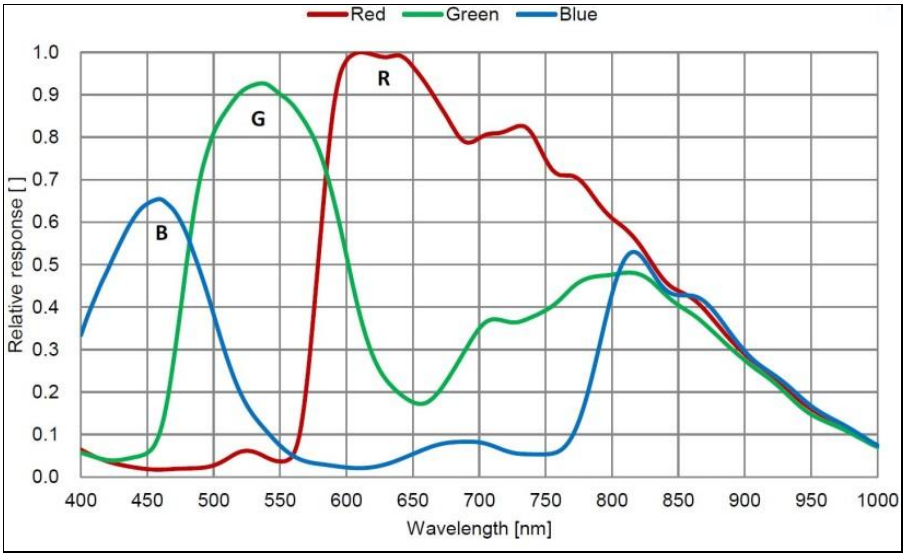
The response curves describe the sensor, excluding lens and light source characteristics.

Spectral Responses (model 2050)

Models M2050

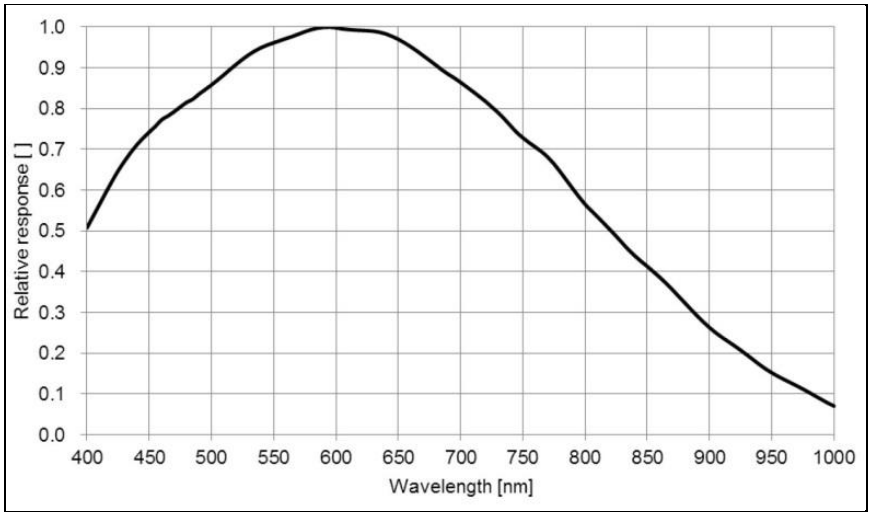


Models C2050

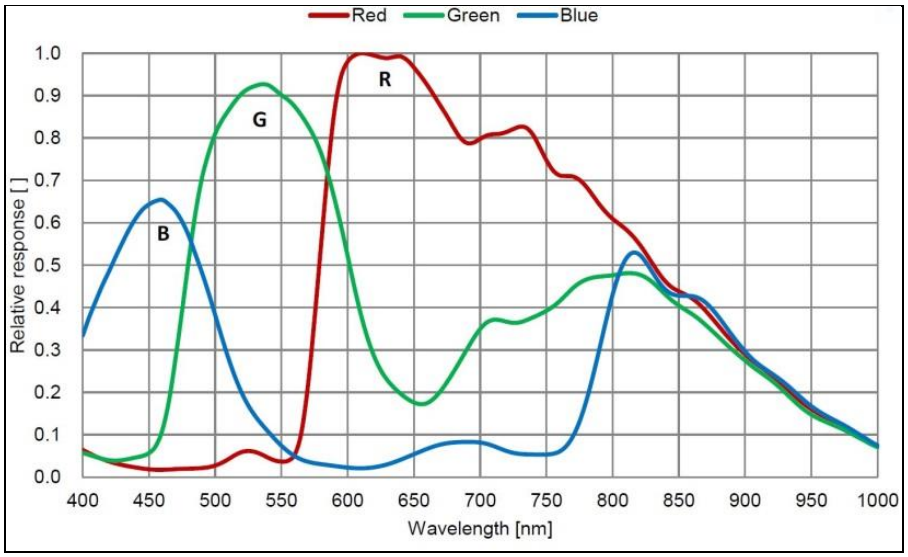


Spectral Responses (model 2450)

Models M2450

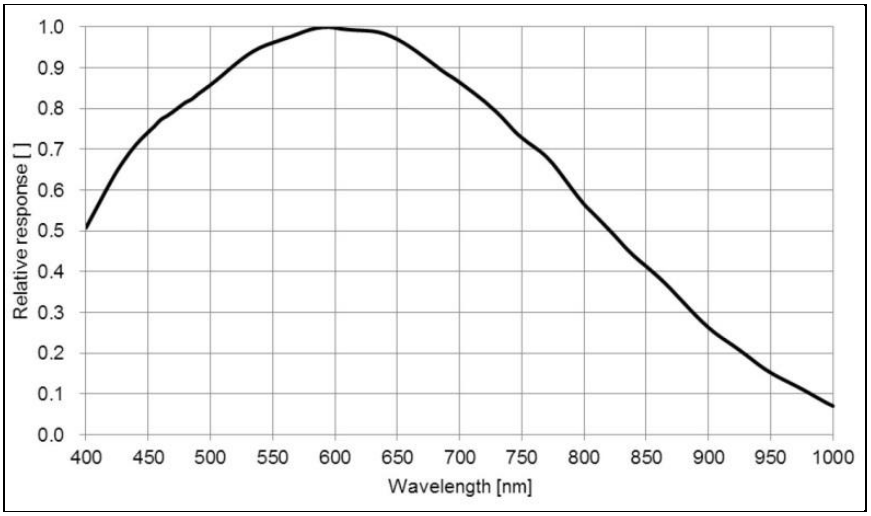


Models C2450

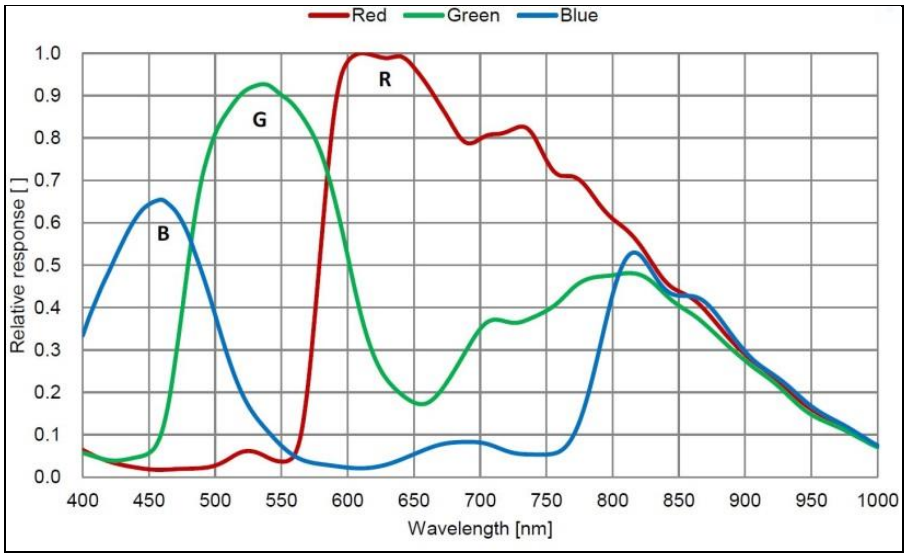


Spectral Responses (models 4040/4060)

Models M4040, M4060

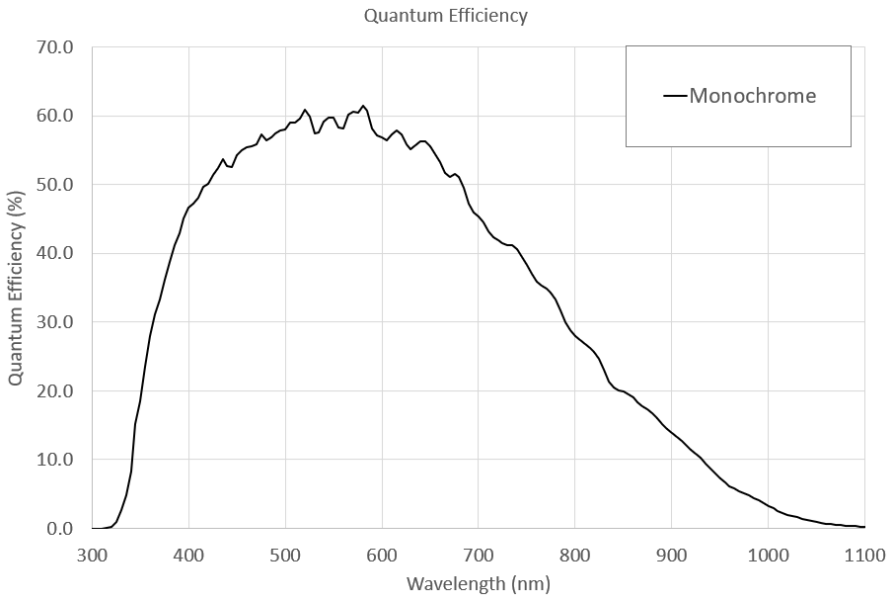


Models C4040, C4060

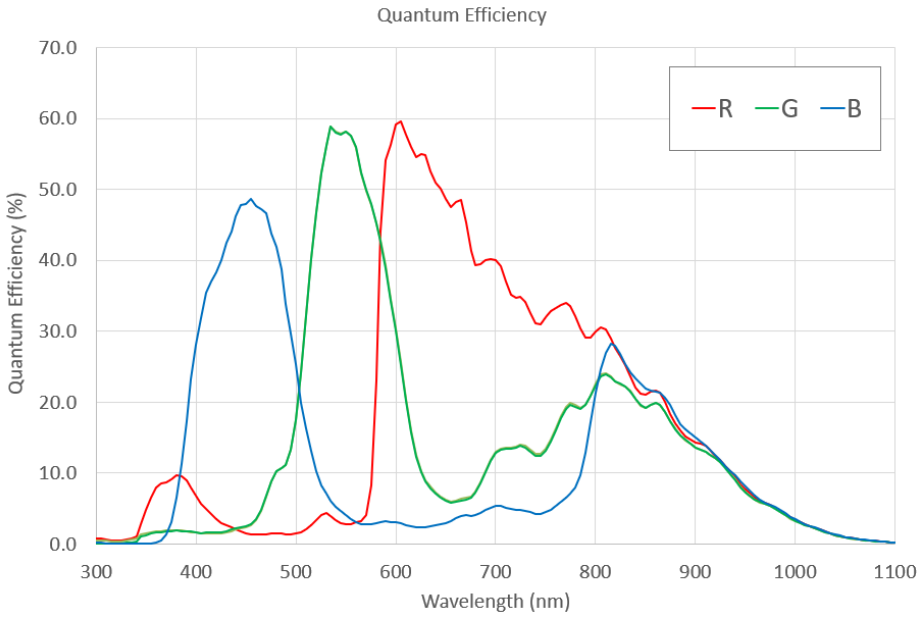


Spectral Responses (models 5400)

Models M5400

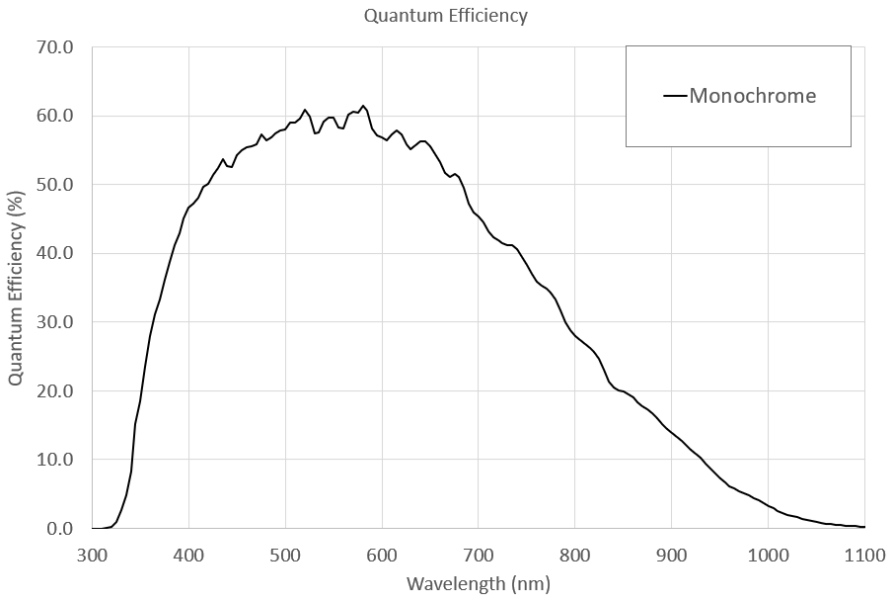


Models C5400

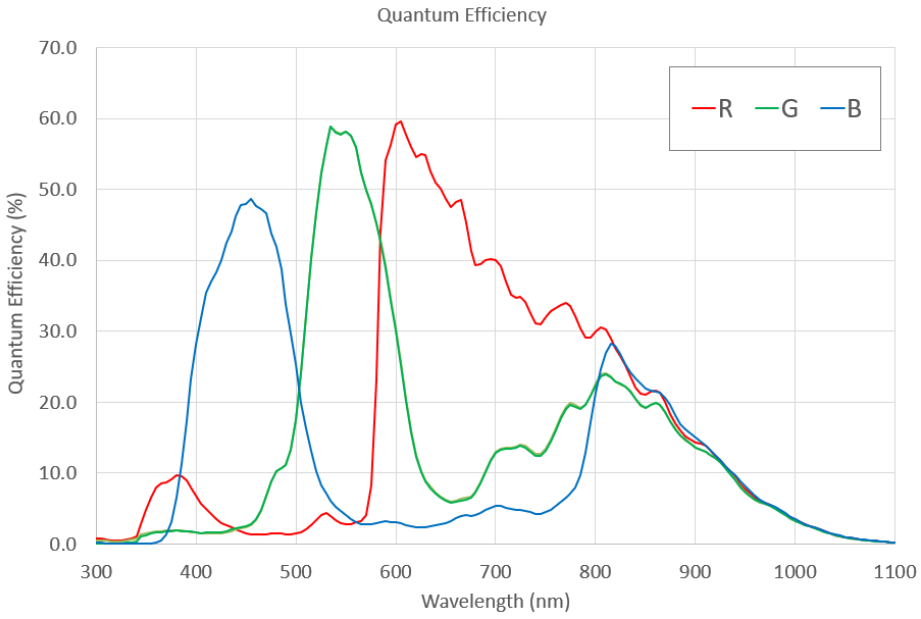


Spectral Responses (models 8100)

Models M8100



Models C8100



Nano-5G Quick Start

If you are familiar with GigE Vision cameras, follow these steps to quickly install and acquire images with Genie Nano-5G and Sapera LT in a Windows OS system. If you are not familiar with Teledyne DALSA GigE Vision cameras go to Connecting the Genie Nano-5G Camera.

- Your computer requires a second or unused Ethernet Gigabit network interface (NIC) that is separate from any NIC connected to any corporate or external network.
- Install Sapera 8.50 (or later) and make certain to select the installation for GigE Vision support.
- Connect the Nano-5G to the spare NIC and wait for the GigE Server Icon in the Windows tray to show that the Nano-5G is connected. The Nano-5G Status LED will change to steady Blue.

Testing Nano-5G without a Lens

- Start CamExpert. The Nano-5G Status LED will be steady Green.
- From the 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.

Testing Nano-5G with a Lens

- Start CamExpert. The Nano-5G Status LED will be steady Green.
- Click the Display Control button to show a full camera image on CamExpert display.
- Click grab.
- Adjust the lens aperture plus Focus, and/or adjust the Nano-5G Exposure Time as required.

The Camera Works — Now What

Important: Before continuing, please download the latest Nano-5G firmware file from the Teledyne DALSA web site and install it into the Nano-5G.

Consult this manual for detailed Networking and Nano-5G feature descriptions, as you write, debug, and optimize your imaging application.

Connecting the Genie Nano-5G Camera

GigE Network Adapter Overview

Genie Nano-5G connects to a computer's Gigabit Network Adapter (NIC). If the computer is already connected to a network, the computer requires a second network adapter, either onboard or an additional PCIe NIC adapter. Refer to the Teledyne DALSA Network Imaging manual for information on optimizing network adapters for GigE Vision cameras.

PAUSE Frame Support

The Genie Nano-5G supports (and monitors) the Gigabit Ethernet PAUSE Frame feature as per IEEE 802.3x. PAUSE Frame is the Ethernet flow control mechanism to manage network traffic within an Ethernet switch when multiple cameras are simultaneously used. This requires that the flow control option in the NIC property settings and the Ethernet switch settings must be enabled. The user application can monitor the Pause Frame Received Event as describe in Event Controls. Refer to the Teledyne DALSA Network Imaging manual for additional information.

Connect the Genie Nano-5G Camera

Connecting a Genie Nano-5G to a network system is similar whether using the Teledyne DALSA Sapera LT package or a third party GigE Vision development package.

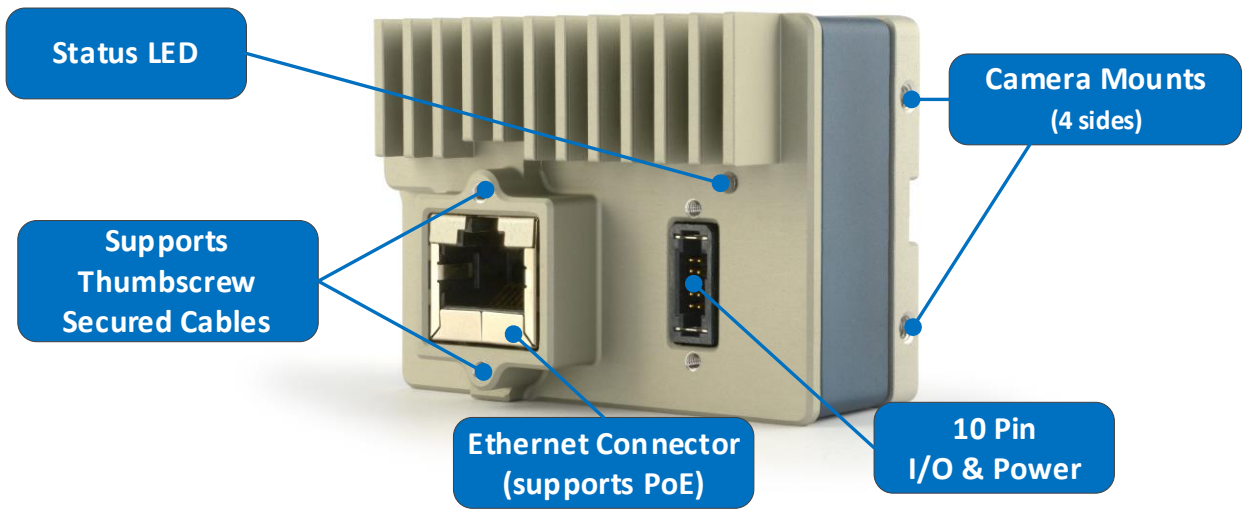
- Power supplies must meet the requirements defined in section Input Signals Electrical . Apply power to the camera.
- Connect Nano-5G to the host computer GigE network adapter or to the Ethernet switch via a CAT5e, CAT6, CAT6a or CAT7 Ethernet cable (the switch connects to the computer NIC to be used for imaging, not a corporate network).
  Note: the cable should not be more than 100 meters (328 feet) long.
- Once communication with the host computer is started the automatic IP configuration sequence will assign an LLA IP address as described in section Genie Nano-5G IP Configuration Sequence, or a DHCP IP address if a DHCP server is present on your network (such as the one installed with Sapera LT).
- Check the status LED which will be initially red then switch to flashing blue while waiting for IP configuration. See Camera Status LED for Nano-5G LED display descriptions.
- The factory defaults for Nano-5G is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification. See the next section Connectors for an overview of the Nano-5G interfaces.

Connectors

The Nano-5G has two connectors:

- A single **RJ45 Ethernet** connector for control and video data transmitted to/from the host computer Gigabit NIC. The Genie Nano-5G also supports Power over Ethernet (**PoE**). See Ruggedized RJ45 Ethernet Cables for secure cables.
- A 10 pin I/O connector for camera power, plus trigger, strobe and general I/O signals. The connector supports a retention latch, while the Nano-5G case supports thumbscrews. Teledyne DALSA provides optional cables (see Optional Hardware Accessories)
- See 10-pin I/O Connector Pinout Details for connector pin out specifications.

The following figure of the Genie Nano-5G back end shows connector and LED locations. See Mechanical Specifications for details on the connectors and camera mounting dimensions.



Genie Nano-5G – Rear View

LED Indicators

The Genie Nano-5G has one multicolor LED to provide a simple visible indication of camera state, as described below. The Nano-5G Ethernet connector does not have indicator LEDs; the user should use the LED status on the Ethernet switch or computer NIC to observe networking 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 (such as – an acquisition in progress has more priority than a valid IP address assignment).

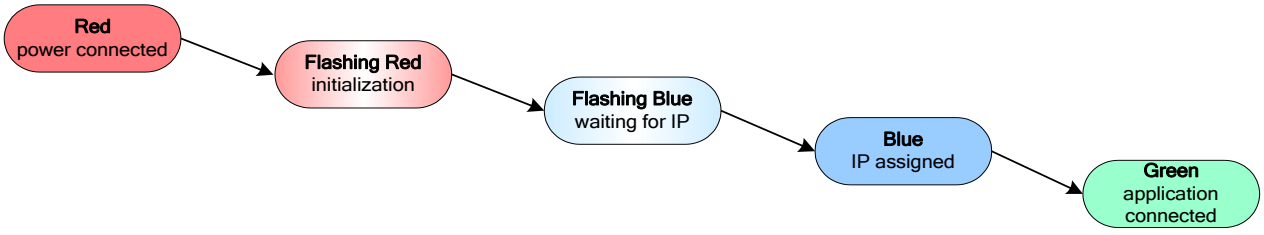
Once the Genie Nano-5G connects to a network and an IP address is assigned, the Status LED will turn to steady blue. Only at this time will it be possible by the GigE Server or any application to communicate with the camera. The following table summarizes the LED states and corresponding camera status.

LED State	Definition
LED is off	No power to the camera
Steady Red	Initial state on power up before flashing. Remains as steady Red only if there is a fatal error. Camera is not initialized **
Flashing Red **	Initialization sequence in progress Wait less than a minute for the Nano-5G to reboot itself.
Steady Red + Flashing Blue	Fatal Error. If the Genie Nano-5G does not reboot itself contact Technical Support.
Slow Flashing Blue	Ethernet cable disconnected. The camera continuously attempts to assign itself an IP address.
Fast Flashing Blue	File Access Feature is transferring data such as a firmware update, etc.
Steady Blue	IP address assigned; no application connected to the camera
Steady Green	Application connected
Flashing Green	Acquisition in progress. Flashing occurs on frame acquisition but does not exceed a rate of 100ms for faster frame rates.

Note: Even if the Nano-5G has obtained an IP address, it might be on a different subnet than the NIC it is attached to. Therefore, if the Nano-5G LED is blue but an application cannot see it, this indicates a network configuration problem. Review troubleshooting suggestions in the Network Imaging manual.

LED States on Power Up

The following LED sequence occurs when the Genie Nano-5G is powered up connected to a network.



Genie Nano-5G IP Configuration Sequence

The Genie Nano-5G IP (Internet Protocol) Configuration sequence to assign an IP address is executed automatically on camera power-up or when connected to a network. As a GigE Vision compliant device, Nano-5G attempts to assign an IP address as follows.

For any GigE Vision device, the IP configuration protocol sequence is:

- Persistent IP (if enabled)
- DHCP (if a DHCP server is present such as the Teledyne DALSA Smart DHCP server)
- Link-Local Address (always enabled as default)

The factory defaults for Nano-5G is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification.

Supported Network Configurations

The Genie Nano-5G obtains an IP address using the Link Local Address (LLA) or DHCP, by default. If required, a persistent IP address can be assigned (refer to the Network Imaging manual).

Preferably, a DHCP server is present on the network, where the Genie Nano-5G issues a DHCP request for an IP address. The DHCP server then provides the Nano-5G an IP address. The **Teledyne DALSA Network Configuration tool**, installed with the Sapera Teledyne DALSA Network Imaging Package, provides a DHCP server which is easily enabled on the NIC used with the Genie Nano-5G (refer to the Teledyne DALSA Network Imaging user's manual).

The LLA method, if used, automatically assigns the Nano-5G with a randomly chosen address on the 169.254.xxx.xxx subnet. After an address is chosen, the link-local process sends an ARP query with that IP onto the network to see if it is already in use. If there is no response, the IP is assigned to the device, otherwise another IP is selected, and the ARP is repeated. Note that the LLA mode is unable to forward packets across routers.

Preventing Operational Faults due to ESD

	Nano-5G 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. The Nano-5G camera when used with a simple power supply and Ethernet cable, is not properly connected to earth ground and therefore is susceptible to ESD caused problems. An Ethernet cable has no ground connection and a power supply's 0 volt return line is not necessarily connected to earth ground.

Teledyne DALSA has performed ESD testing on Nano-5G cameras using an 8 kilovolt ESD generator without any indication of damage to camera hardware (however the camera might reboot and reconnect to the application).

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-5G case is now properly connected to earth ground and can withstand ESD; for more information refer to EMI, Shock and Vibration Certifications.
- Method 2: When using Power over Ethernet (PoE), Teledyne DALSA strongly recommends using a shielded Ethernet cable to provide a ground connection from the controlling computer/power supply, to the Genie Nano-5G. PoE requires a powered computer NIC, or a powered Ethernet switch, or an Ethernet power injector.
- Method 3: Mount the camera on a metallic platform with a good connection to earth ground.

Using Nano-5G with Sapera API

A Genie Nano-5G camera installation with the Teledyne DALSA Sapera API generally follows the sequence described below.

Network and Computer Overview

- Nano-5G needs to connect to a computer with a **GigE network adapter**, either built in on the computer motherboard or installed as a third party PCI adapter. See the previous section Connecting the Genie Nano-5G Camera.
- **Laptop computers** with built in **GigE network adapters** may still not be able to stream full frame rates from Nano, especially when on battery power.
- Nano-5G also can connect through a **Gigabit Ethernet switch**. When using VLAN groups, the Nano-5G and controlling computer must be in the same group (refer to the Teledyne DALSA Network Imaging Package user's manual).
- If Genie Nano-5G is to be used in a **Sapera development environment**, Sapera LT 8.50 needs to be installed, which includes the **GigE Vision Module** software package with the Teledyne DALSA **GigE Vision TurboDrive Technology** module.
- If Genie Nano-5G will be used in a **third party GigE Vision Compliant environment**, Sapera or Sapera runtime is not required and you need to follow the installation instructions of the third party package.
- The **Windows Firewall** exceptions feature is automatically configured to allow the Sapera GigE Server to pass through the firewall.
- Computers with **VPN software** (virtual private network) may need to have the VPN driver disabled in the NIC properties. This would be required only on the NIC used with the Nano. Testing by the user is required.
- Once a Nano-5G is connected, look at the small camera icon added to the Windows tray (next to the clock). Ensure the Nano-5G camera has been found (right click the icon and select Status) Note that in Windows 7, the icon remains hidden until a camera is connected.
- **A new Nano-5G installation typically requires a firmware update.** The File Selector feature is used to select a firmware file. See the CamExpert procedure Updating Firmware via File Access in CamExpert for additional information.
- Use CamExpert (installed either with Sapera or Sapera runtime) to test the installation of the Nano-5G camera. Set the Nano-5G to internal test pattern. See Internal Test Pattern Generator.
- Set up the other components of the imaging system such as light sources, camera mounts, optics, encoders, trigger sources, etc. Test with CamExpert.

Installation

Note: to install Sapera LT and the GigE Vision package, logon to the workstation as an administrator or with an account that has administrator privileges.

When Genie Nano-5G is used in a **Sapera development environment**, **Sapera LT 8.50 (or later)** needs to be installed, which automatically provides all GigE Vision camera support including TurboDrive.

If no Sapera development is required. Then the Sapera LT SDK is not needed to control the Linea GigE camera. Sapera runtime with CamExpert provides everything to control the camera.

Procedure

- Download and install Sapera LT 8.50 (or later) which automatically provides GigE Vision support with Teledyne DALSA TurboDrive™ technology. Note that Nano-5G features may change when an older versions of Sapera LT is used.
- Optional: If the Teledyne DALSA Sapera LT SDK package is not used, click to install the Genie Nano-5G firmware and user manuals only. Follow the on screen prompts.
- Connect the camera to an available free Gigabit NIC that's not part of some other corporate network.

Refer to Sapera LT User's Manual concerning application development with Sapera.

Note: The Teledyne DALSA Sapera CamExpert tool (used throughout this manual to describe Genie Nano-5G features) is installed with either the Sapera LT runtime or the Sapera LT development package.

Camera Firmware Updates

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

Important: Download the latest firmware version released for any Nano-5G model from the Teledyne DALSA support web page:
http://www.teledynedalsa.com/imaging/support/downloads/firmware/

For information on performing automatic firmware updates for GigE cameras refer to the application note SAP-AN0010 GigE Vision Camera Automatic Firmware Update with Sapera LT, available for download on the Teledyne DALSA website:

https://www.teledynedalsa.com/en/support/documentation/app-notes/

Firmware via Linux or Third Party Tools

Consult your third party GigE Vision software package for file uploads to the connected device.

GigE Server Verification

After a successful Genie Nano-5G Framework package installation, the GigE Server icon is visible in the desktop taskbar tray area (note that in Windows 7 the icon remains hidden until a camera is connected). After connecting a camera (see following section), allow a few seconds for the GigE Server status to update. The Nano-5G camera must be on the same subnet as the NIC to be recognized by the GigE Server.

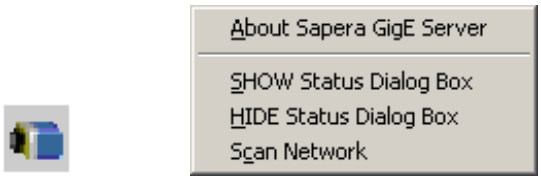
	Device Available	Device IP Error	Device Not Available
GigE Server Tray Icon:			
	The normal GigE server tray icon when the Genie device is found. It will take a few seconds for the GigE Server to refresh its state after the Genie has obtained an IP address.	The GigE server tray icon shows a warning when a device is connected but there is some type of IP error.	A red X will remain over the GigE server tray icon when the Genie device is not found. This indicates a major network issue. ***Or in the simplest case,*** the Genie is not connected.

If you place your mouse cursor on this icon, the GigE Server will display the number of GigE Vision devices found by your PC. Right click the icon and select status to view information about those devices. See Troubleshooting for more information.

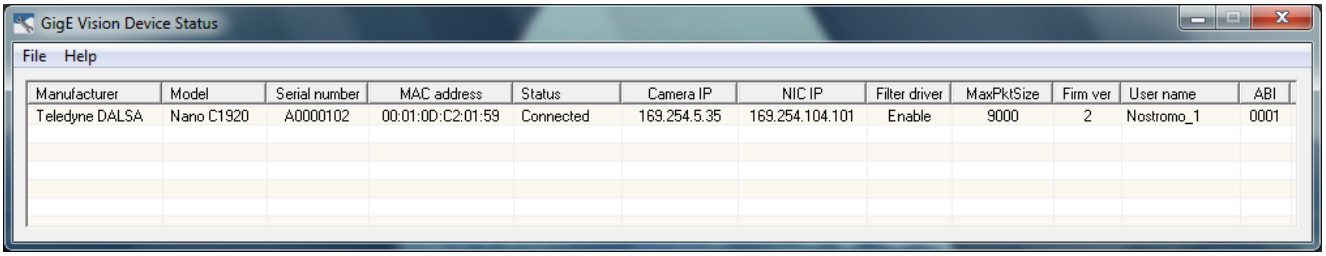
GigE Server Status

Once the Genie Nano-5G is assigned an IP address (its Status LED is steady blue) the GigE server tray icon will not have a red X through it, indicating that the Nano-5G device was found. It might take a few seconds for the GigE Server to refresh its state after the Nano-5G has obtained an IP address.

Right-click the GigE Server tray icon to open the following menu.



Click on Show Status to open a window listing all devices connected to the host system. Each GigE device is listed by name along with important information such as the assigned IP address and device MAC address. The screen shot below shows a connected Nano-5G with no networking problems.



In the event that the device is physically connected, but the Sapera GigE Server icon is indicating that the connected device is not recognized, click Scan Network to restart the discovery process. Note that the GigE server periodically scans the network automatically to refresh its state. See Troubleshooting for network problems.

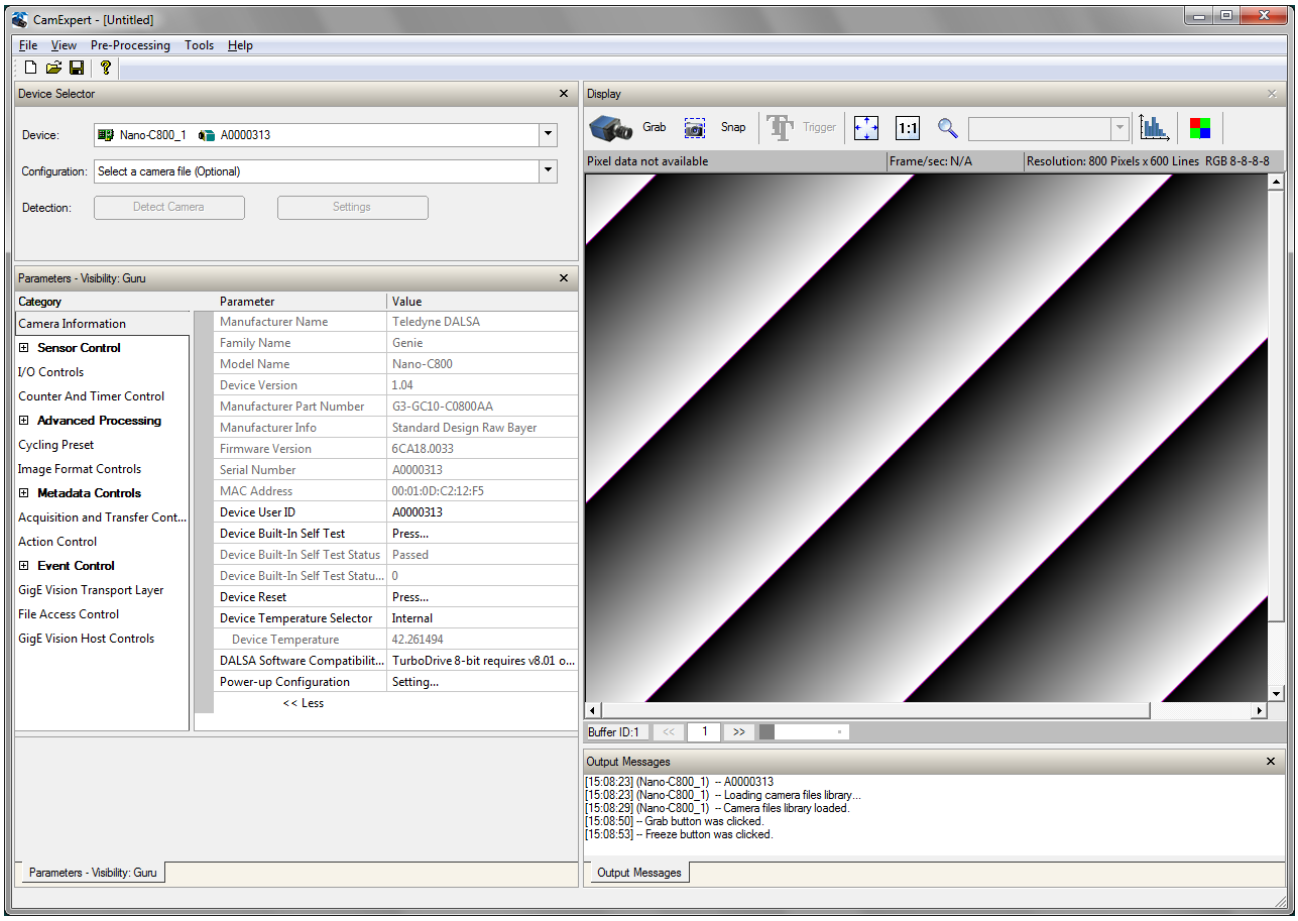
Optimizing the Network Adapter used with Nano

Most Gigabit network interface controllers (NIC) allow user modifications to parameters such as Adapter Buffers and Jumbo Frames. These should be optimized for use with the Nano-5G during the installation. Refer to the **NetworkOptimizationGuide.pdf** for optimization information (available with the Sapera LT installation [C:\Program Files\Teledyne DALSA\Network Interface]).

Quick Test with CamExpert (Windows)

When the Genie Nano-5G camera is connected to a Gigabit network adapter on a host computer, testing the installation with CamExpert is a straightforward procedure.

- Start Sapera CamExpert by double clicking the desktop icon created during the software installation.
- CamExpert will search for installed Sapera devices. In the Device list area on the left side, the connected Nano-5G camera is shown or will be listed in a few seconds after CamExpert completes the automatic device search (device discovery).
- Select the Nano-5G camera device by clicking on the camera user defined name. By default the Nano-5G camera is identified by its serial number. The Nano-5G status LED will turn green, indicating the CamExpert application is now connected.
- Click on the Grab button for live acquisition (the Nano-5G default is Free Running mode). Focus and adjust the lens iris. See Operational Reference for information on CamExpert parameters with the Nano-5G camera.
- If the Nano-5G has no lens, just select one of the internal test patterns available (*Image Format Controls – Test Image Selector*). All but one are static images to use with the Snap or Grab function of CamExpert. The single "moving" test image is a shifting diagonal ramp pattern, which is useful for testing network/computer bandwidth issues (see following image).
- Refer to the Teledyne DALSA Network Imaging package manual if error messages are shown in the Output Messages pane while grabbing.



About the Device User ID

The Nano-5G 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 set to match the camera serial number for quick initial identification. Note that the factory programmed Genie Nano-5G serial number and MAC address are not user changeable.

When using CamExpert, multiple Genie Nano-5G cameras on the network are seen as different "Nano-xxxxx" devices as an example. Non Teledyne DALSA cameras are labeled as "GigEVision Device". Click on a device user name to select it for control by CamExpert.

An imaging application uses any one of these attributes to identify a camera: its IP address, MAC address, serial number or User Name. Some important considerations are listed below.

- Do not use the camera's IP address as identification (unless it is a persistent IP) since it can change with each power cycle.
- A MAC address is unique to a single camera, therefore the control application is limited to the vision system with that unique camera if it uses the camera's MAC address.
- The User Name can be freely programmed to clearly represent the camera usage. This scheme is recommended for an application to identify cameras. In this case, the vision system can be duplicated any number of times with cameras identified by their function, not their serial numbers or MAC address.

Operational Reference

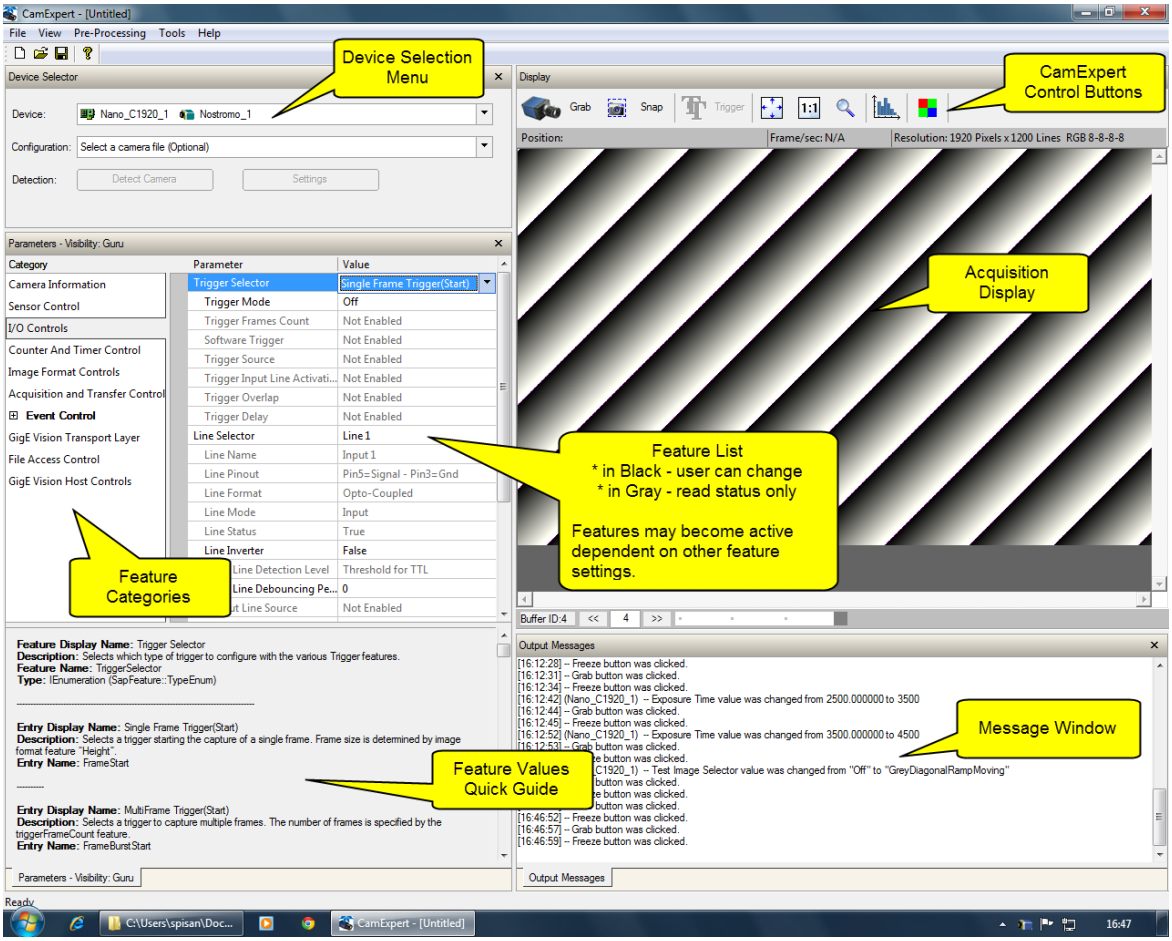
Using CamExpert with Genie Nano-5G Cameras

The Sapera CamExpert tool is the interfacing tool for GigE Vision cameras, and is supported by the Sapera library and hardware. CamExpert allows a user to test camera functions. Additionally CamExpert saves the Nano-5G user settings configuration to the camera or saves multiple configurations as individual camera parameter files on the host system (*.ccf).

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.

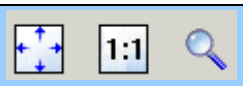
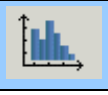
CamExpert Panes

The various areas of the CamExpert tool are described in the summary figure below. GigE Vision device Categories and Parameter features are displayed as per the device's XML description file. The number of parameters shown is dependent on the View mode selected (that is, Beginner, Expert, Guru – see description below).



- **Device pane**: View and select from any installed GigE Vision or Sapera acquisition device. 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.
- **Display pane**: Provides a live or single frame acquisition display. Frame buffer parameters are shown in an information bar above the image window.
- **Control Buttons**: The Display pane includes CamExpert control buttons. These are:

	**Acquisition control button:** Click once to start live grab, click again to stop.
	**Single frame grab:** Click to acquire one frame from device.
	**Software trigger button:** With the I/O control parameters set to Trigger Enabled / Software Trigger type, click to send a single software trigger command.

	**CamExpert display controls:** (these do not modify the frame buffer data) Stretch (or shrink) image to fit, set image display to original size, or zoom the image to any size and ratio. Note that under certain combinations of image resolution, acquisition frame rate, and host computer speed, the CamExpert screen display may not update completely due to the host CPU running at near 100%. This does not affect the acquisition.
	**Histogram / Profile tool:** Select to view a histogram or line/column profile during live acquisition.

- **Output pane**: Displays messages from CamExpert or the GigE Vision driver.

CamExpert View Parameters Option

All camera features have 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.

Camera Feature Categories

The following sections describe the available categories and their features in detail.

The description table describes parameters along with their view attribute and in which device version the feature was introduced. 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.

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).

When a Device Version number is indicated, this represents the camera software functional group, not a firmware revision number. As Genie Nano-5G capabilities evolve the device version will increase, therefore identifying the supported function package.

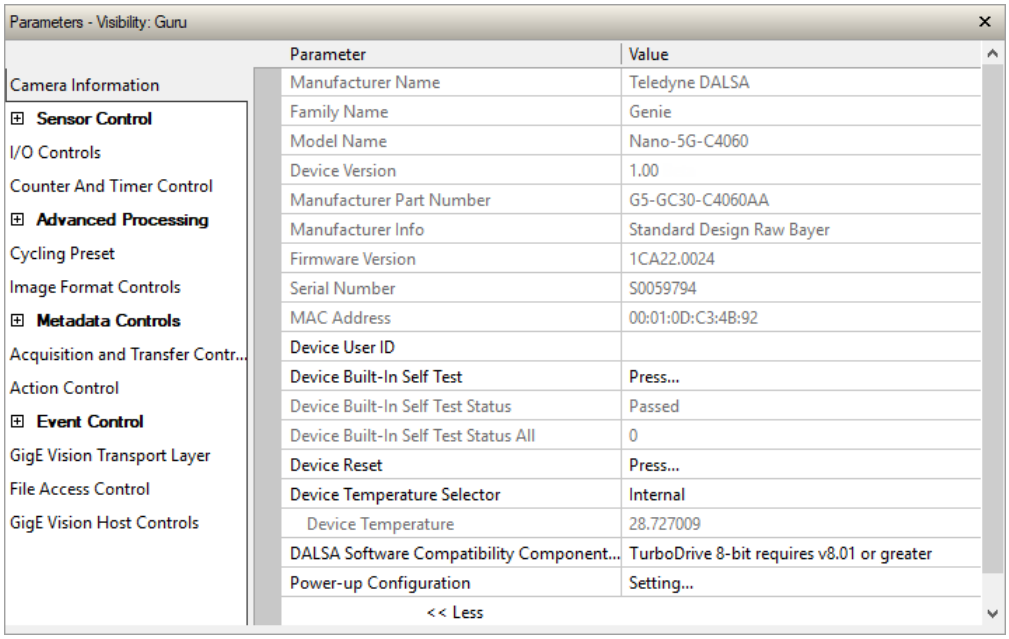
New features for a major device version release will be indicated by green text for easy identification. For each feature the device version may differ for each camera sensor available.

The **B/W & Color** column (when present) 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).

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-5G models implementing different sensors, image resolutions, and color versions; that is, a specific camera model may support the full feature set defined in a category.

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-5G device. These features are typically read-only. GigE Vision applications retrieve this information to identify the camera along with its characteristics.



Camera Information Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Manufacturer Name	DeviceVendorName	Displays the device vendor name.	1.00 Beginner
Family Name	DeviceFamilyName	Displays the device family name.	1.00 Beginner
Model Name	DeviceModelName	Displays the device model name.	1.00 Beginner
Device Version	DeviceVersion	Displays the device version. This tag will also highlight if the firmware is a beta or custom design. (RO)	1.00 Beginner
Manufacturer Part Number	deviceManufacturerPartNumber	Displays the device manufacturer part number.	1.00 DFNC Beginner
Manufacturer Info	DeviceManufacturerInfo	This feature provides extended manufacturer information about the device. Genie Nano-5G cameras show which firmware design is currently loaded.	1.00 Beginner
Firmware Version	DeviceFirmwareVersion	Displays the currently loaded firmware version number. Firmware files have a unique number and have the .cbf file extension.	1.00 Beginner
Serial Number	DeviceSerialNumber	Displays the device's factory set serial number.	1.00 Expert

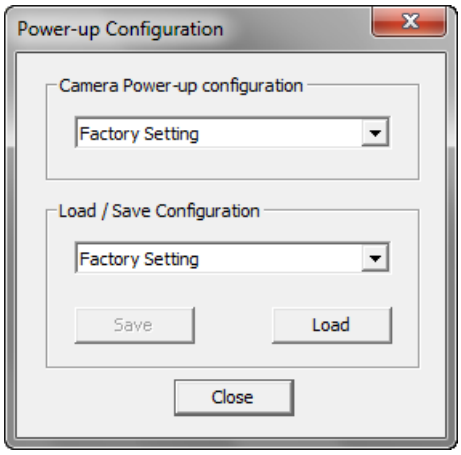
MAC Address	deviceMacAddress	Displays the unique MAC (Media Access Control) address of the Device.	1.00 DFNC Beginner
Device User ID	DeviceUserID	Feature to store a user-programmable identifier of up to 15 characters. The default factory setting is the camera serial number. (RW)	1.00 Beginner
Device Built-In Self Test	deviceBIST	Command to perform an internal test which will determine the device status. (W)	1.00 Beginner
Device Built-In Self Test Status	deviceBISTStatus	Return the status of the device Built-In Self-Test. Possible return values are device-specific.	1.00 Beginner
Passed	*Passed*	*No failure detected*	
Last firmware update failed	*FirmwareUpdateFailure*	*Last firmware update operation failed.*	
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.*	
NetworkError	*NetworkError*	*Network encountered an error during streaming.*	
Unknown Error Returned	*Unknown_Error*	*Undefined single error or multiple simultaneous errors.*	
Device Built-In Self Test Status All	deviceBISTStatusAll	Return the status of the device Built-In Self-Test as a bitfield. The meaning for each bit is device-specific. A value of 0 indicates no error. Bit-0=1:Firmware Update Failure Bit-2=1:Unexpected Error	1.00 DFNC Beginner
Device Reset	DeviceReset	Resets the device to its power up state. (W)	1.00 Beginner
Device Temperature Selector	DeviceTemperatureSelector	Select the source where the temperature is read.	1.00 Beginner
Internal	*Internal*	*Value from FPGA and or PHY temperature.*	
MaxInternal	*MaxInternal*	*Records the highest device temperature since power up. Value is reset on power off.*	
Device Temperature	DeviceTemperature	The temperature of the selected source in degrees Celsius. Maximum temperature should not exceed +70°C for reliable operation.	1.00 Beginner
DALSA Software Compatibility Component List	DALSASoftwareCompatibilityComponentList	List the optional Teledyne DALSA software functions that are supported.	1.00 Beginner
TurboDrive 8-bit requires v8.01 or greater	*Compatibility1*	*Teledyne DALSA Turbo Drive 8-bit (Monochrome or Bayer) requires Sapera-LT 8.01 or greater.*	
TurboDrive 10-bit requires v8.10 or greater	*Compatibility2*	*Teledyne DALSA Turbo Drive 10-bit (Monochrome or Bayer) requires Sapera-LT 8.10 or greater.*	
TurboDrive 12-bit requires v8.10 or greater	*Compatibility3*	*Teledyne DALSA Turbo Drive 12-bit (Monochrome or Bayer) requires Sapera-LT 8.10 or greater.*	
Multicast requires a newer version	*Compatibility4*	*Multicast feature support requires a newer version of Sapera LT than currently installed.*	

Power-up Configuration Selector	UserSetDefaultSelector	Selects the camera configuration set to load and make active on camera power-up or reset. The camera configuration sets are stored in camera non-volatile memory. (RW)	1.00 Beginner
Factory Setting	*Default*	*Load factory default feature settings.*	
UserSet1	*UserSet1*	*Select the user defined configuration UserSet 1 as the Power-up Configuration.*	
UserSet2	*UserSet2*	*Select the user defined configuration UserSet 2 as the Power-up Configuration.*	
User Set Selector	UserSetSelector	Selects the camera configuration set to load feature settings from or save current feature settings to. The Factory set contains default camera feature settings. (RW)	1.00 Beginner
Factory Setting	*Default*	*Select the default camera feature settings saved by the factory.*	
UserSet 1	*UserSet1*	*Select the User Defined Configuration space UserSet1 to save to or load from features settings previously saved by the user.*	
UserSet 2	*UserSet2*	*Select the User Defined Configuration space UserSet1 to save to or load from features settings previously saved by the user.*	
Load Configuration	UserSetLoad	Loads the camera configuration set specified by the User Set Selector feature, to the camera and makes it active. Can not be updated during a Sapera transfer. (W)	1.00 Beginner
Save Configuration	UserSetSave	Saves the current camera configuration to the user set specified by the User Set Selector feature. The user sets are located on the camera in non-volatile memory. (W)	1.00 Beginner
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 Beginner
Serial Number	DeviceID	Displays the device's factory set camera serial number.	1.00 Invisible
Factory Setting	*Default*	*Select the Factory Setting values as the Power-up Configuration.*	1.00 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 DFNC Invisible
Sensor	*Sensor*	*The device gets its data directly from a sensor.*	
Device TL Type	DeviceTLType	Transport Layer type of the device.	1.00 DFNC Invisible
GigE Vision	*GigEVision*	*GigE Vision Transport Layer*	
Device TL Version Major	DeviceTLVersionMajor	Major version of the device's Transport Layer.	1.00 Invisible
Device TL Version Minor	DeviceTLVersionMinor	Minor version of the device's Transport Layer.	

	userSetError	Error Flags for UserSetLoad & UserSetSave	1.00 Invisible
	NoError	*No Error*	
	LoadGenericError	*Unknown error*	
	LoadBusyError	*The camera is busy and cannot perform the action*	
	LoadMemoryError	*Not enough memory to load set*	
	LoadFileError	*Internal file I/O error*	
	LoadInvalidSetError	*At least one register could not be restored properly*	
	LoadResourceManagerError	*An internal error happened related to the resource manager*	
	SaveGenericError	*Unknown error*	
	SaveBusyError	*The camera is busy and cannot perform the action*	
	SaveMemoryError	*Camera ran out of memory while saving set*	
	SaveFileError	*Internal file I/O error*	
	SaveInvalidSetError	*An invalid user set was requested*	
	SaveResourceManagerError	*An internal error happened related to the resource manager*	
DFNC Major Rev	deviceDFNCVersionMajor	Major revision of Dalsa Feature Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
DFNC Minor Rev	deviceDFNCVersionMinor	Minor revision of Dalsa Feature Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
SFNC Major Rev	DeviceSFNCVersionMajor	Major Version of the Genicam Standard Features Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
SFNC Minor Rev	DeviceSFNCVersionMinor	Minor Version of the Genicam Standard Features Naming Convention which was used to create the device's XML.	1.00 DFNC Invisible
SFNC SubMinor Rev	DeviceSFNCVersionSubMinor	SubMinor Version of the Genicam Standard Features Naming Convention which was used to create the device's XML.	1.00 Invisible

Power-up Configuration Dialog

CamExpert provides a dialog box which combines the features to select the camera power-up state and for the user to save or load a Nano-5G camera state.



Camera Power-up Configuration

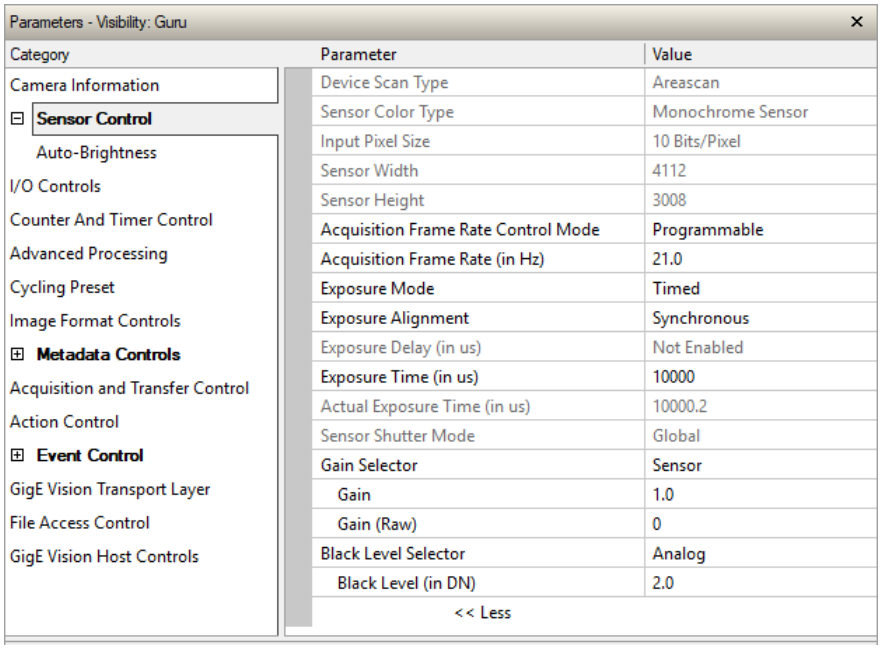
The first drop list selects the camera configuration state to load on power-up (see feature *UserSetDefaultSelector*). The user chooses from one factory data set or one of two possible user saved states.

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-5G sensor controls, as shown by CamExpert, groups sensor specific parameters. This group includes controls for frame rate, exposure time, gain, and so forth.



Sensor Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Device Scan Type *Areascan*	DeviceScanType *Areascan*	Defines the scan type of the device's sensor. Genie Nano-5G is an Areascan camera. < RO > *Device uses an Areascan sensor.*	1.00 Beginner
	Sensor Color Type *Monochrome Sensor* *Bayer Sensor*	sensorColorType *Monochrome* *CFA_Bayer*	Defines the camera sensor color type. < RO > *Sensor color type is monochrome.* *Sensor color type is Bayer Color Filter Array (CFA).*	1.00 Beginner DFNC
	Input Pixel Size *8 Bits/Pixel* *10 Bits/Pixel* *12 Bits/Pixel*	pixelSizeInput *Bpp8* *Bpp10* *Bpp12*	Size of the image input pixels, in bits per pixel. < RO > *Sensor output data path is 8 bits per pixel.* *Sensor output data path is 10 bits per pixel.* *Sensor output data path is 12 bits per pixel.*	1.00 Guru DFNC
	Sensor Width	SensorWidth	Defines the sensor width in active pixels. < RO >	1.00 Expert
	Sensor Height	SensorHeight	Defines the sensor height in active lines. < RO >	1.00 Expert
	Acquisition Frame Rate Control Mode *Programmable* *Maximum Speed*	acquisitionFrameRateControlMode *Programmable* *MaximumSpeed*	Set the frame control method used in free running mode. Note that this feature applies only to sensor acquisitions, not internal test images. The camera frame rate is controlled by the AcquisitionFrameRate feature. The camera operates at its maximum frame rate using the current exposure (time and delay) configuration.	1.00 Guru DFNC
	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 *Timed*	ExposureMode *Timed*	Sets the operation mode for the camera's exposure (or electronic shutter). *The exposure duration time is set using the Exposure Time feature and the exposure starts with a FrameStart event.*	1.00 Beginner

	Exposure Alignment *Synchronous* *Reset*	exposureAlignment *Synchronous* *Reset*	Exposure Alignment specifies how the exposure is executed in relationship to the sensor capabilities and current frame trigger. *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.* *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.*	1.00 Beginner DFNC
	Exposure Delay	exposureDelay	Specifies the delay in microseconds (µs) to apply after the FrameStart event before starting the ExposureStart event.	1.00 Beginner DFNC
	Exposure Time	ExposureTime	Sets the exposure time (in microseconds) when the Exposure Mode feature is set to Timed.	1.00 Beginner
	Actual Exposure Time	exposureTimeActual	Actual Exposure Time performed by sensor due to its design, based on the requested Exposure Time.	1.00 Beginner DFNC
	Sensor Shutter Mode *Global*	SensorShutterMode *Global*	States or selects the supported shutter mode of the device. *The shutter exposes all pixels at the same time.*	1.00 Beginner
	Gain Selector *Sensor Analog* *Sensor Digital* *Sensor Digital Red* *Sensor Digital Green* *Sensor Digital Blue*	GainSelector *SensorAnalogAll* *SensorDigitalAll* *SensorDigitalRed* *SensorDigitalGreen* *SensorDigitalBlue*	Selects which gain is controlled when adjusting gain features. *Apply an analog gain adjustment within the sensor to the entire image.* *Apply a digital gain adjustment within the sensor to the entire image.* *Apply a digital gain adjustment within the sensor to the red pixels.* *Apply a digital gain adjustment within the sensor to the green pixels.* *Apply a digital gain adjustment within the sensor to the blue pixels.*	1.00 Beginner
	Gain	Gain	Sets the selected gain as an amplification factor applied to the image. User adjusts the *Gain* feature or the *GainRaw* feature.	1.00 Beginner
	Gain (Raw)	GainRaw	Raw Gain value that is set in camera (Model Specific for range and step values).	1.00 Guru
	Black Level Selector *Digital* *Digital Red* *Digital Green* *Digital Blue*	BlackLevelSelector *DigitalAll* *DigitalRed* *DigitalGreen* *DigitalBlue*	Selects which Black Level to adjust using the Black Level features. *Sensor dark offset.* *Sensor dark offset for red pixels.* *Sensor dark offset for green pixels.* *Sensor dark offset for blue pixels.*	1.00 Beginner

	Black Level (in DN)	BlackLevel	Controls the black level as an absolute physical value. This represents a DC offset applied to the video signal, in DN (digital number) units. The Black Level Selector feature specifies the channel to adjust.	1.00 Beginner

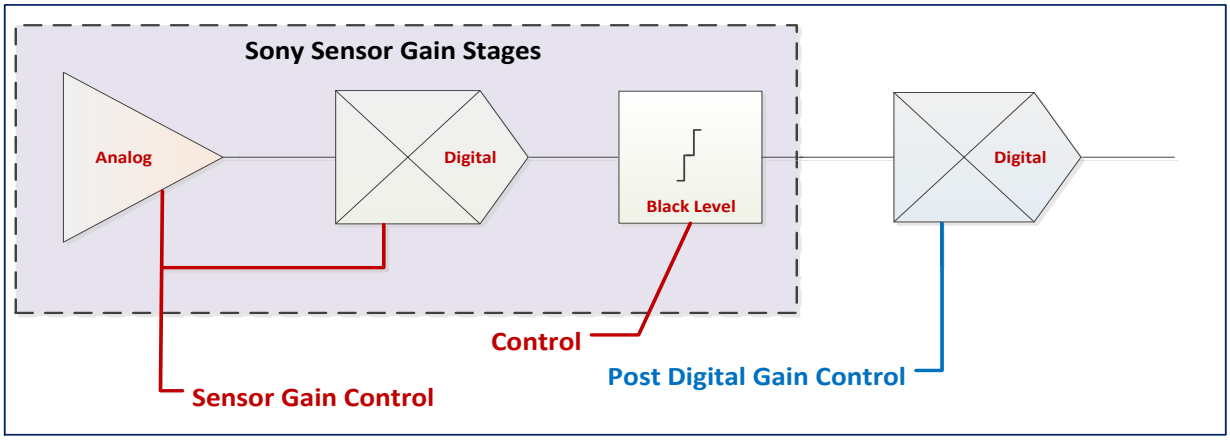
Offset/Gain Control Details (Sony sensors)

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**: The gain function is a linear multiplier control in 0.01 steps within the sensor hardware (range is "1-251", which is a +48dB maximum gain).
- **Gain**: Sensor gain is applied first by an analog amplifier (multiplier range of "1-15.85", for example, +24dB) and then continues automatically via a digital amplifier as shown in the graphic below.
- **Important**: Digital noise increases linearly and quickly with higher gain values. Users should evaluate image quality with added gain.
- **Gain (Raw)**: Provides an alternative method to control sensor gain, where values entered are in 0.1dB increments. Therefore the range is 0 to 480 which controls a 0 to 48dB gain range.
- **Gain Selector = Digital**: The gain function controls the post sensor digital amplifier (available only on some models of Nano-5G cameras). This gain factor is independent of any sensor gain set. This setting is a linear multiplying number of 1 to 4, in 0.1 steps).
- **Black Level**: This offset variable exists within the sensor. The Sony sensors allow an offset range between 0 and 511 DN. The factory settings default value for each sensor used by various Nano-5G models, is recommended as per the sensor manufacturer design specifications.

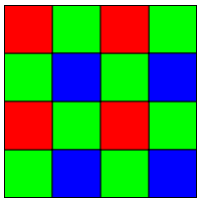
  Note: With the factory default offset, testing a camera's black output in 8-bit mode may show a 2 DN value difference across the image. Changing the Black Level value up or down will push sensor noise (present at the sensors native bits per pixel) to fall within one 8-bit value, thus the noise becomes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

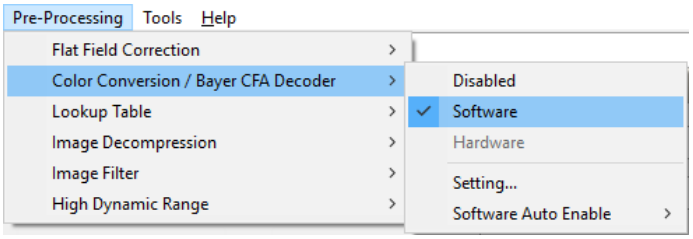
Sony Sensors Gain Stage Diagram



Bayer Mosaic Pattern

Genie Nano-5G Color cameras output raw Bayer image data using the mosaic pattern shown below. Teledyne DALSA Sapera CamExpert tool interprets the raw Bayer output when the user enables the Pre-Processing Software Bayer Decoder. CamExpert also provides an automatic white balance tool to aid RGB gain adjustments.





Bayer Mosaic Pattern and the CamExpert processing function to decode the Genie Nano-5G Color

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 Exposure Mode feature 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-5G 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.

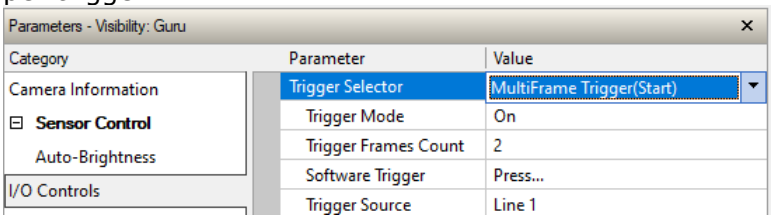
When a valid trigger is received and the Exposure Time is shorter than the readout period, the Exposure Start event is latched in the previous frame's readout. That is; the Exposure Start Event is delayed and is initiated when the actual exposure starts such that the exposure ends and readout begins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

- For Sony sensor models the exposure is synchronous to the line timing of the sensor. The frame exposure start is subject to 1 horizontal line jitter.
- Sony sensors also add an extra two line-time at the end of exposure. For short very exposures the starting jitter and ending extension will be significant.
- 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.

Sensor Exposure Timing

Nano-5G cameras have general timing characteristics using Exposure Alignment set to *Synchronous* or *Reset* mode, with and without burst mode, as described in the following sections.

For burst mode, the Trigger Selector feature is set to Multiframe Trigger(Start) (*frameBurstStart*) and the Trigger Frames Count specifies the number of frames to capture per trigger.



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

Refer to Model Part Numbers for the available Nano-5G models using Sony sensors and their timing specifications.

Sony Sensor Horizontal Line Times

Horizontal line times for Sony sensors are:

Model	Horizontal Line Time	
	Standard 8-bit Design (Factory	12-bit Design
M/C2050	3.367 µsec	5.980 µs = 1 Line (H)
M/C2450	3.367 µsec = 1 Line (H)	5.980 µs = 1 Line (H)
M/C4060	5.118 µsec = 1 Line (H)	11.314 µs = 1 Line (H)
M/C4040	5.118 µsec = 1 Line (H)	11.314 µs = 1 Line (H)

Sony Sensor Readout Times

Readout times for Sony sensors are:

Model	Readout Time
M/C2050	Lines in Frame (H) + 23H
M/C2450	Lines in Frame (H) + 23H
M/C4060	Lines in Frame (H) + 39H
M/C4040	Lines in Frame (H) + 39H

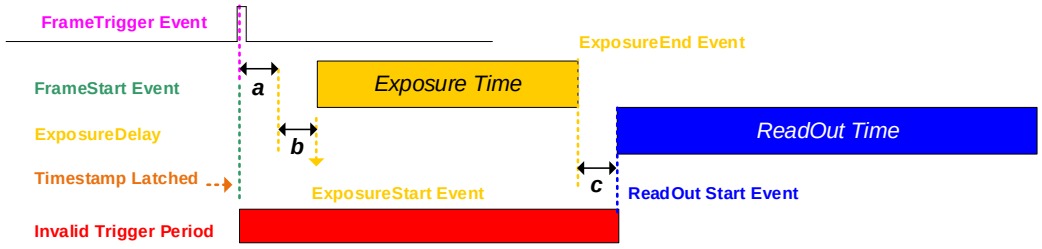
On-Semi Sensor Timings

Readout times for On-Semi sensors are:

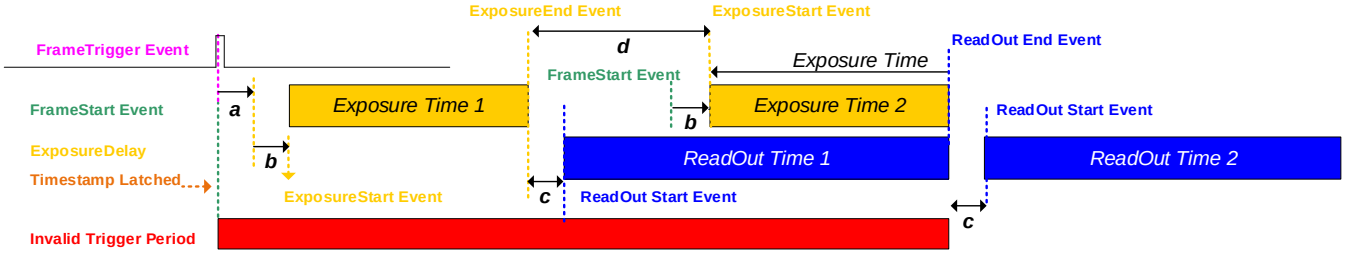
Model	Horizontal Line Time	Readout Time
M/C5400 & M/C8100 (Standard Firmware)	9.414 µsec = 1 Line (H)	Lines in Frame (H) + 1H Note: readout is interrupted for 6 line times (56.484 µsec) when a new exposure begins during readout
M/C5400 & M/C8100 (12-bitFirmware)	13.950 µsec = 1 Line (H)	Lines in Frame (H) + 1H Note: readout is interrupted for 6 line times (83.700 µsec) when a new exposure begins during readout

Trigger Characteristics: Synchronous Exposure Alignment

ExposureAlignment = Synchronous



ExposureAlignment = Synchronous
Trigger BurstMode = 2 frames



Where:

Sony Models:

a	0 µsec to 1 horizontal line time in µsec (Synchronous mode)	
b	Sony Models: 2 H x Line time in µsec + (added User value in ExposureDelay)	
c	M/C2050	19.94 µsec or ((10 H x Line time in µsec) - 13.73 µsec)
	M/C2450	19.94 µsec or ((10 H x Line time in µsec) - 13.73 µsec)
	M/C4060	88.13 µsec or ((20 H x Line time in µsec) - 14.23 µsec)
	M/C4040	88.13 µsec or ((20 H x Line time in µsec) - 14.23 µsec)
d	M/C2050	Minimum value is 30.04 µsec or ((13 x Line Time in µsec) – 13.73 µsec)
	M/C2450	Minimum value is 30.04 µsec or ((13 x Line Time in µsec) – 13.73 µsec
	M/C4060	Minimum value is 108.60 µsec or ((24 x Line Time in µsec) – 14.23 µsec)
	M/C4040	Minimum value is 108.60 µsec or ((24 x Line Time in µsec) – 14.23 µsec)

On-Semi models:

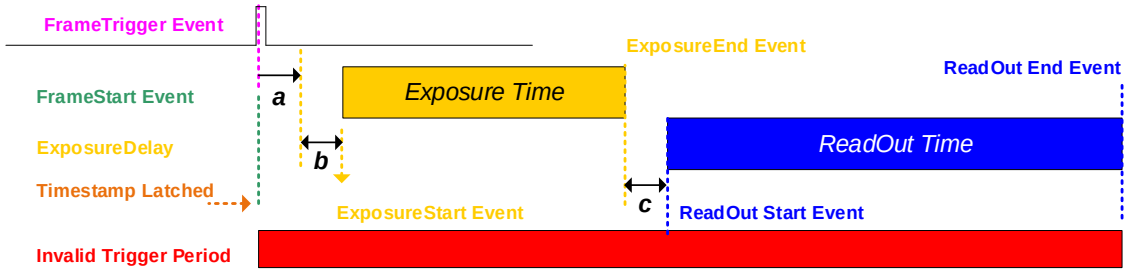
a	0 µsec	
b	Standard firmware: 52 µsec + (added User value in ExposureDelay) 12-bit firmware: 70 µsec + (added User value in ExposureDelay)	
c	M/C5400 (Standard Firmware)	63 µsec + up to 1H jitter
	M/C8100 (Standard Firmware)	63 µsec + up to 1H jitter
	M/C5400 (12-bit Firmware)	81 µsec + up to 1H jitter
	M/C8100 (12-bit Firmware)	81 µsec + up to 1H jitter
d	M/C5400 (Standard Firmware)	Minimum value is 116 µsec
	M/C8100 (Standard Firmware)	Minimum value is 116 µsec
	M/C5400 (12-bit Firmware)	Minimum value is 153 µsec
	M/C8100 (12-bit Firmware)	Minimum value is 153 µsec

Trigger Characteristics: Reset Exposure Alignment

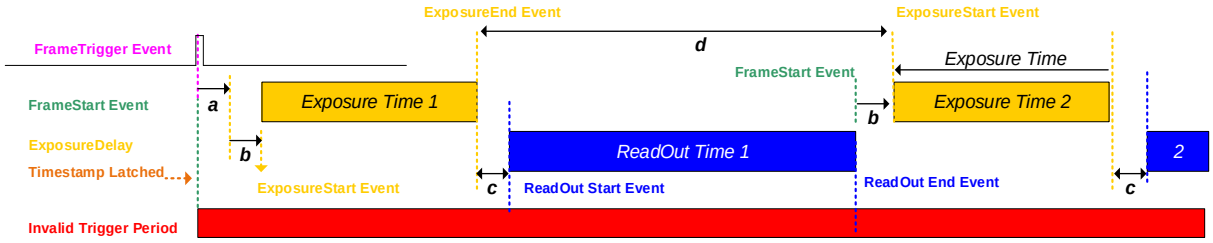
Sensor timing is reset to initiate exposure when a valid trigger is received. Readout is sequential to exposure, reducing the maximum achievable frame rates. That is, a trigger received during exposure or readout is ignored since data would be lost by performing a reset.

	Note: On-Semi sensor based models (M/C5400 and M/C8100) do not support Reset Exposure Alignment.

ExposureAlignment = Reset



ExposureAlignment = Reset
Trigger BurstMode = 2 frames

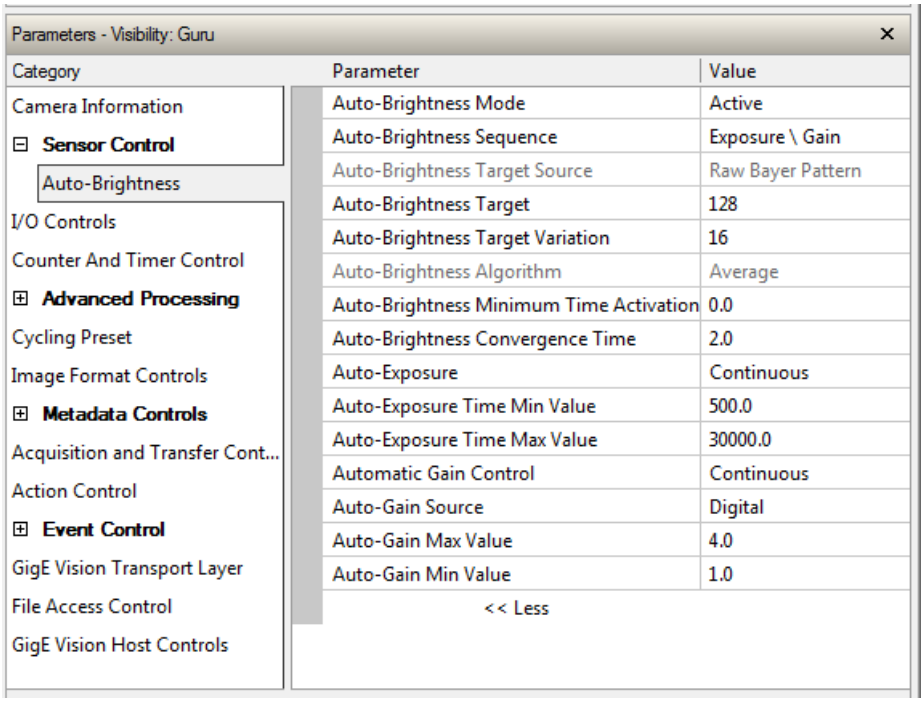


Where:

a	0 µsec for Reset mode	
b	0 µsec + (added User value in ExposureDelay)	
c	M/C2050	19.94 µsec or ((10 H x Line time in µsec) - 13.73 µsec)
	M/C2450	19.94 µsec or ((10 H x Line time in µsec) - 13.73 µsec)
	M/C4060	88.13 µsec or ((20 H x Line time in µsec) - 14.23 µsec)
	M/C4040	88.13 µsec or ((20 H x Line time in µsec) - 14.23 µsec)
d	M/C2050	Minimum value is ((Readout) +13H) x Horizontal line time in µsec) – 13.73 µsec
	M/C2450	Minimum value is ((Readout) +13H) x Horizontal line time in µsec) – 13.73 µsec
	M/C4060	Minimum value is ((Readout) +24H) x Horizontal line time in µsec) – 14.23 µsec
	M/C4040	Minimum value is ((Readout) +24H) x Horizontal line time in µsec) – 14.23 µsec

Auto-Brightness Control Category

The Genie Nano-5G Auto-Brightness controls, as shown by CamExpert as a sub group to Sensor Controls, has features used to configure the automatic gain function. Genie Nano-5G cameras are available in a number of models implementing different sensors which may support different features or none from this category.



Auto-Brightness Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Auto-Brightness Mode	autoBrightnessMode	Sets the mode for the Auto-Brightness function.	1.00 Expert DFNC
Off	*Off*	*Disable the auto-brightness mode.*	
Active	*Active*	*Activates the auto-brightness mode when the AcquisitionStart or AcquisitionArm command is received.*	
Auto-Brightness Sequence	autoBrightnessSequence	Specifies the processing order for the auto-brightness algorithm. Gain and Exposure are adjusted sequentially, in the selected order, to achieve the auto-brightness target value. If the Gain or Exposure features are not available or disabled, that feature is ignored in the processing sequence.	1.00 Expert DFNC
Exposure \ Gain	*Exposure_Gain_Iris*	*Adjust Exposure, Gain, in that order to achieve the auto-brightness target value.*	
Gain \ Exposure	*Gain_Exposure_Iris*	*Adjust Gain, Exposure, in that order, to achieve the auto-brightness target value.*	

Auto-Brightness Target Source *Luminance* *Raw Bayer Pattern*	autoBrightnessTargetSource *Luminance* *RawBayerPattern*	Specifies the source image color plane(s) used by the Auto-Brightness algorithm to determine the brightness adjustment required to obtain the auto-brightness target value. *The luminance or Y component of the image is used as the auto-brightness target source.* *The Raw Bayer Pattern of the image is used as the auto-brightness target source.*	1.00 Expert DFNC
Auto-Brightness Target	autoBrightnessTarget	Sets the target image grayscale value, in DN, for the auto-brightness algorithm. Features that use auto-brightness include ExposureAuto, and GainAuto.	1.00 Expert DFNC
Auto-Brightness Target Variation	autoBrightnessTargetRangeVariation	Sets the auto-brightness target Range Variation in (DN). An autoBrightnessTarget value within this range is considered valid and will not be compensated.	1.00 Expert DFNC
Auto-Brightness Algorithm *Average*	autoBrightnessAlgorithm *Average*	Specifies the auto-brightness algorithm used to calculate the brightness in the target image source plane(s). *The auto-brightness algorithm calculates the average luminance from the camera image and determines if the brightness should increase or decrease based on the requested target brightness.*	1.00 Expert DFNC
Auto-Brightness Minimum Time Activation (in S)	autoBrightnessAlgoMinTimeActivation	Specifies the time delay between an image brightness change from the autoBrightnessTarget and when compensation of Gain/Exposure starts. This eliminates repetitive adjustments of short term brightness variations.	1.00 Expert DFNC
Auto-Brightness Convergence Time (in S)	autoBrightnessAlgoConvergenceTime	Specifies the maximum time the autoBrightnessAlgorithm should take to compensate the image brightness as defined by the autoBrightnessTarget. Actual times typically are less but may on occasion be more.	1.00 Expert DFNC
Auto-Exposure *Off* *Continuous*	ExposureAuto *Off* *Continuous*	Sets the automatic exposure mode when the ExposureMode feature is set to Timed. *Exposure duration is manually controlled using the ExposureTime feature.* *Exposure duration is constantly adapted by the camera to meet the auto-brightness target pixel value.*	1.00 Expert
Auto-Exposure Time Min Value (in µs)	exposureAutoMinValue	Sets the minimum exposure time value allowed by the user, in microseconds, for the Auto-Exposure function.	1.00 Expert DFNC
Auto-Exposure Time Max Value (in µs)	exposureAutoMaxValue	Sets the maximum exposure time value allowed by the user, in microseconds, for the Auto-Exposure function.	1.00 Expert DFNC
Automatic Gain Control *Off* *Continuous*	GainAuto *Off* *Continuous*	Controls the state of the automatic gain control. *Gain is manually controlled using the Gain feature.* *Gain is constantly adjusted by the camera to meet the auto-brightness target pixel value. The initial starting gain can be set by setting GainAuto to Off, changing the gain value and then setting it back to Continuous.*	1.00 Expert
Auto-Gain Source *Digital* *Sensor*	gainAutoSource *DigitalAll* *SensorAll*	Selects the gain to control. *Digital* *Sensor (available in some models)*	1.00 Expert
Auto-Gain Max Value	gainAutoMaxValue	Sets the maximum gain multiplier value for the automatic gain algorithm. The automatic gain function is an amplification factor applied to the video signal to obtain the auto-brightness target value.	1.00 Expert DFNC
Auto-Gain Min Value	gainAutoMinValue	Sets the minimum gain multiplier value for the automatic gain algorithm. The automatic gain function is an amplification factor applied to the video signal to obtain the auto-brightness target value.	1.00 Expert DFNC

Auto-Brightness Algorithm Source *Local* *Ethernet*	autoBrightnessAlgoSource *Local* *Host*	Specifies the source location of the Auto-Brightness algorithm. *The auto-brightness algorithm runs in the camera.* *The auto-brightness algorithm runs on a host machine via the Ethernet connection.*	1.00 Invisible DFNC

Using Auto-Brightness

The Auto-Brightness features are designed to maintain consistent brightness (or image intensity) in situations where lighting varies. These features benefit from being optimized for each applications lighting. The information below describes making these adjustments and the feature interdependencies. All feature example settings and acquisitions examples below are made using the Sapera CamExpert tool.

Important: Setup is critical. The Auto-Brightness algorithm cannot converge unless control features are set properly (as required by the imaging situation). The following cases describe simple setups and the control feature considerations required to make them work.

General Preparation

- Before using any controls, a simple setup for experimentation is to have a reasonable free running acquisition of n-frames per second (*AcquisitionFrameRate*) and an exposure time (*ExposureTime*) that provides a viewable image.
- Take note of the frame rate and exposure time. If the frame rate is very slow due to a long exposure, add analog gain (*GainSelector* and *Gain*) and adjust the exposure time again.
- Enable all Auto-Brightness features by setting *autoBrightnessMode* to active (live acquisition must be off). This master feature only activates the auto-brightness, auto-exposure, and auto-gain controls but doesn't enable the processing.
- The features *autoBrightnessSequence*, *autoBrightnessTargetSource*, *autoBrightnessTarget*, *autoBrightnessTargetRangeVariation,* and *autoBrightnessAlgorithm* can remain at their default settings for this demo.
- Note that the *Auto-Brightness* function is not available if "*Cycling Mode"* is active.

The Auto-Brightness examples below are summarized as follows:

- Auto-Brightness by Frame Luminance Averaging
- Auto-Brightness by Adjusting a Digital Gain
- Auto-Brightness by Adjusting both Gain and Exposure

Auto-Brightness with Frame Luminance Averaging

After the preparations described above, the Auto-Exposure function is tested as follows. These setup steps are made before doing a live acquisition.

- Set the *autoBrightnessAlgoConvergenceTime* to a larger value than the default 2 seconds if more time is required to ensure adequate time for convergence.
- Set *ExposureAuto* to Continuous to activate all Auto-exposure features.
- Referring to the *ExposureTime* value used to get a viewable image during the free-running preparation stage, set *exposureAutoMaxValue* to a maximum exposure time longer than was needed. This maximum exposure limit feature may be required in imaging situations where the frame rate must not be forced below some minimum value. Also check that *exposureAutoMinValue* is low enough to allow the auto exposure a wide range to function in (but not too low else the algorithm will undershoot).

- Enable live acquisition (Grab button in CamExpert). The image exposure will adjust itself until the *autoBrightnessTarget* value is achieved. During live acquisition, the *autoBrightnessTarget* value can be changed to observe the algorithm converge to the new luminance value.
- Stop live acquisition (Freeze button in CamExpert). The feature *ExposureTime* is updated with the last exposure time used by the auto exposure algorithm. Adjust frame rate and analog gain settings as required to test again. Adjust other features mentioned as required.

Auto-Gain

An alternative method of automating exposure control is by varying the Nano-5G Digital Gain. The user needs to note that the digital gain stage is limited to a small positive multiplier and will have the side effect of increasing digital noise.

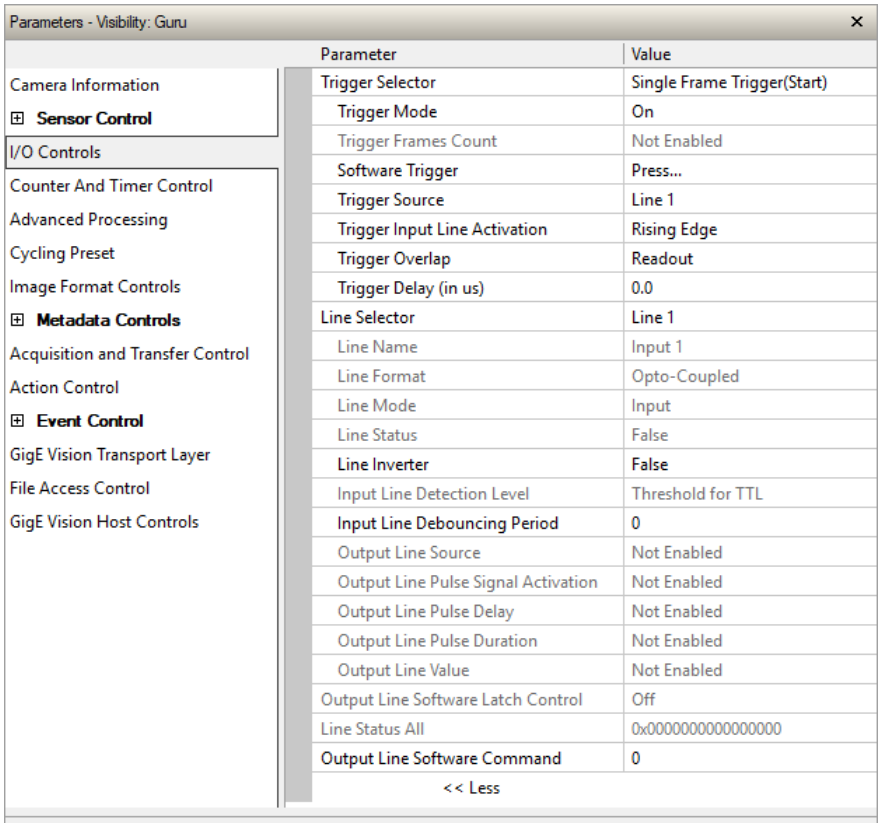
- Setup will be similar to using auto exposure alone.
- Enable automatic digital gain by setting the feature *GainAuto* to Continuous.
- Limit the total digital gain range by adjusting the values for *gainAutoMaxValue* and *gainAutoMinValue*.

Auto-Brightness by using Auto-Exposure and Auto-Gain

- Use both *ExposureAuto* and *GainAuto* together to maximize the range of the Auto-Brightness range.
- Use *autoBrightnessSequence* to select the order of automation.
- Caution: Even with both automatic functions enabled, exposure convergence to a target value requires proper setup.

I/O Control Category

The Genie Nano-5G I/O controls, as shown by CamExpert, has features used to configure external inputs and acquisition actions based on those inputs, plus camera output signals to other devices.



I/O Control Feature Descriptions

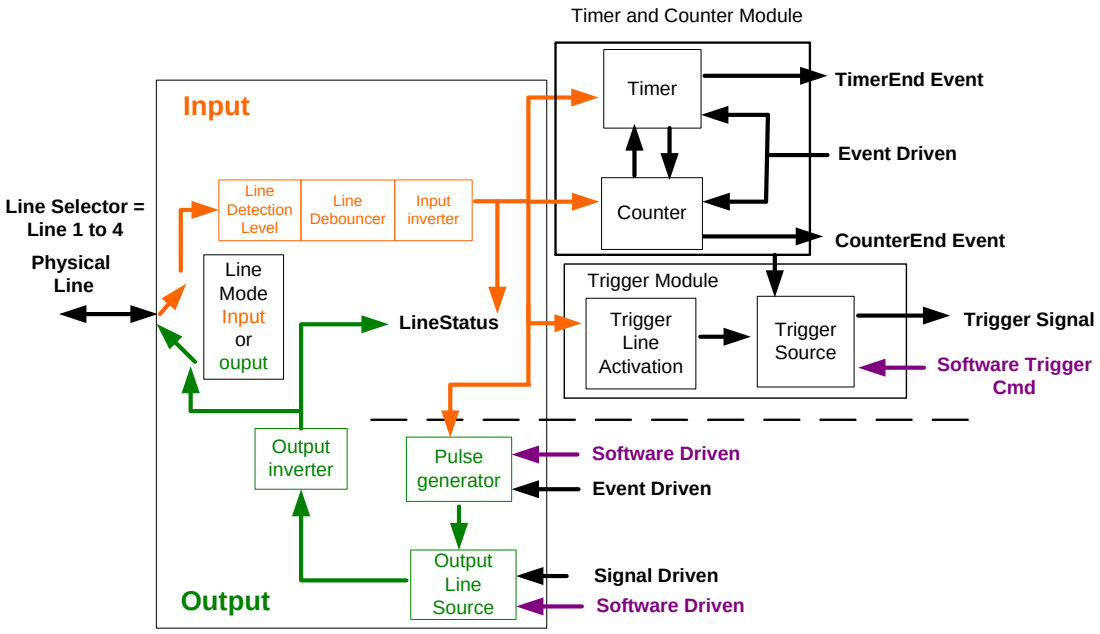
Display Name	Feature & Values	Description	Device Version & View
Trigger Selector	TriggerSelector	Selects which type of trigger to configure with the various Trigger features.	1.00 Beginner
Single Frame Trigger(Start)	*FrameStart*	*Selects a trigger starting the capture of a single frame. Frame size is determined by image format feature "Height".*	
MultiFrame Trigger(Start)	*FrameBurstStart*	*Selects a trigger to capture multiple frames. The number of frames is specified by the "triggerFrameCount" feature.*	
AcquisitionStart Trigger(Start)	*AcquisitionStart*	*Enables the selection of a trigger source that starts the Acquisition of one or many frames.*	
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. See Input Signals Electrical Specifications.	1.00 Beginner
Line 1	*Line1*	*Select Line 1 (and associated I/O control block) to use as the external trigger source. See LineSelector feature for complete list.*	
Line 2	*Line2*	*Select Line 2 (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.*	
Action 1	*Action1*	*Select the GigEVision Action Command 1 as the internal trigger source. This is a broadcast command that multiple devices can respond to simultaneously.*	
Timestamp Modulo Event	*timestampModuloEvent*	*Select the timestamp modulo event as the internal trigger source.*	
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).*	

Trigger Overlap (in µs) *Off* *ReadOut* *End Of Exposure*	TriggerOverlap *Off* *ReadOut* *EndOfExposure*	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. *No trigger overlap is permitted.* *Trigger is accepted immediately after the start of the readout.* *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.*	1.00 Guru
Trigger Delay (in µs)	TriggerDelay	Specifies the delay in microseconds to apply after receiving the trigger and before activating the triggerEvent. (min=0, max=2000000)	1.00 Beginner
Line Selector *Line 1* *Line 2* *Line 3* *Line 4* *Line 5*	LineSelector *Line1* *Line2* *Line3* *Line4* *Line5*	Selects the physical line (or pin) of the external device connector to configure. *Index of the physical line and associated I/O control block to use. Pin 5 is the Input Signal and Pin 3 is the common Ground on the I/O connector.* *Index of the physical line and associated I/O control block to use. Pin 7 is the Input Signal and Pin 3 is the common Ground on the I/O connector.* *Index of the physical line and associated I/O control block to use. Pin 6 is the Output Signal and Pin 4 is the common output power on the I/O connector.* *Index of the physical line and associated I/O control block to use. Pin 8 is the Output Signal and Pin 4 is the common output power on the I/O connector.* *Index of the physical line and associated I/O control block to use. Pin 9 is the Output Signal and Pin 4 is the common output power on the I/O connector.*	1.00 Beginner
Line Name *Input 1* *Input 2* *Output 1* *Output 2* *Output 3*	lineName *Input1* *Input2* *Output1* *Output2* *Output3*	Description of the physical Pin associated with the logical line. *Associated with the logical line Input 1* *Associated with the logical line Input 2* *Associated with the logical line Output 1* *Associated with the logical line Output 2* *Associated with the logical line Output 2*	1.00 Beginner DFNC
Line Format *Opto-Coupled*	LineFormat *OptoCoupled*	Specify the current electrical format of the selected physical input or output. (RO) *The line is opto-Coupled.*	1.00 Expert
Line Mode *Input* *Output*	LineMode *Input* *Output*	Reports if the physical Line is an Input or Output signal. (RO) See Input Signals Electrical Specifications. See Output Signals Electrical Specifications. *The line is an input line.* *The line is an output line.*	1.00 Expert
Line Status	LineStatus *False* *True*	Returns the current status of the selected input or output line. *The Line is logic LOW* *The Line is logic HIGH*	1.00 Expert
Line Inverter	LineInverter *False / True*	Control to invert the polarity of the selected input or output line signal.	1.00 Beginner

Input Line Detection Level *Threshold for TTL*	lineDetectionLevel *Threshold_for_TTL*	Specifies the voltage threshold required to recognize a signal transition on an input line. *A signal below 0.8V will be detected as a Logical LOW and a signal greater than 2.4V will be detected as a Logical HIGH on the selected input line.*	1.00 Beginner DFNC
Input Line Debouncing Period	lineDebouncingPeriod	Specifies the minimum delay before an input line voltage transition is recognizing as a signal transition.	1.00 Beginner DFNC
Output Line Source	outputLineSource	Selects which internal signal or event driven pulse or software control state to output on the selected line. Note, the LineMode feature must be set to Output. The List of supported output line sources is product-specific. The Event Control section provides details and timing diagrams for the supported trigger modes.	1.00 Beginner DFNC
Off	*Off*	*Line output is Open*	
Software Controlled	*SoftwareControlled*	*The OutputLineValue feature changes the state of the output*	
Pulse on: Start of Frame	*PulseOnStartofFrame*	*Generate a pulse on the start of the Frame Active event*	
Pulse on: Start of Exposure	*PulseOnStartofExposure*	*Generate a pulse on the ExposureStart event. This option is typically used to trigger a strobe light.*	
Pulse on: End of Exposure	*PulseOnEndofExposure*	*Generate a pulse on the ExposureEnd event. This option is typically used to trigger a strobe light.*	
Pulse on: Start of Readout	*PulseOnStartofReadout*	*Generate a pulse on the ReadoutStart event.*	
Pulse on: End of Readout	*PulseOnEndofReadout*	*Generate a pulse on the ReadoutEnd event.*	
Pulse on: Valid Frame Trigger	*PulseOnValidFrameTrigger*	*Generate a pulse on the ValidFrameTrigger event.*	
Pulse on: Rejected Frame(s) Trigger	*PulseOnInvalidFrameTrigger*	*Generate a pulse on the InvalidFrameTrigger event.*	
Pulse on: Start of Acquisition	*PulseOnStartofAcquisition*	*Generate a pulse when the AcquisiontStart event occurs.*	
Pulse on: End of Acquisition	*PulseOnEndofAcquisition*	*Generate a pulse when the AcquisiontStop event occurs.*	
Pulse on: End of Timer 1	*PulseOnEndofTimer1*	*Generate a pulse on the TimerEnd 1 event.*	
Pulse on: End of Counter 1	*PulseOnEndofCounter1*	*Generate a pulse on the CounterEnd 1 event.*	
Pulse on: Input 1 Event	*PulseOnInput1*	*Generate a pulse on the Input signal 1 event*	
Pulse on: Input 2 Event	*PulseOnInput2*	*Generate a pulse on the Input signal 2 event*	
Pulse on: Action 1	*PulseOnAction1*	*Generate a pulse on the GigEVision Action Command 1.*	
Pulse on: Action 2	*PulseOnAction2*	*Generate a pulse on the GigEVision Action Command 2.*	
Pulse on: Software Command	*PulseOnSoftwareCmd*	*Generate a pulse on the Input of a Software Command*	
Exposure Active	*ExposureActive*	*Generate a signal that is active when the Exposure is active.*	
Output Line Pulse Signal Activation	outputLinePulseActivation	Specifies the input line activation mode to trigger the OutputLine pulse.	1.00 Beginner DFNC
Rising Edge	*RisingEdge*	*Specifies that the trigger is considered valid on the rising edge of the source signal.*	
Falling Edge	*FallingEdge*	*Specifies that the trigger is considered valid on the falling edge of the source signal.*	
Any Edge	*AnyEdge*	*Specifies that the trigger is considered valid on the falling or rising edge of the source signal.*	
Output Line Pulse Delay	outputLinePulseDelay	Sets the delay (in µs) before the output line pulse signal. Applicable for the OutputLineSource feature.	1.00 Beginner DFNC
Output Line Pulse Duration	outputLinePulseDuration	Sets the width (duration) of the output line pulse in microseconds.	1.00 Beginner DFNC

Output Line Value	outputLineValue	Sets the output state of the selected Line if the outputLineSoftwareLatchControl = OFF. OutputLineSource must be SoftwareControlled. If the outputLineSoftwareLatchControl = Latch , the state of the pin will change with the outputLineSoftwareCmd command.	1.00 Beginner DFNC
Active	*Active*	*Sets the Output circuit to close*	
Inactive	*Inactive*	*Sets the Output circuit to open*	
Output Line Software Latch Control	outputLineSoftwareLatchControl	When Off, the selected output line is set with the value in Output Line Value.	1.00 Guru DFNC
Off	*Off*	*Output pin state set by outputLineValue.*	
Latch	*Latch*	*Output pin state set by outputLineSoftwareCmd.*	
Line Status All	LineStatusAll	Returns the current status of all available line signals, at time of polling, in a single bitfield. The order is Line1, Line2, Line3, ...	1.00 Expert
Output Line Software Command	outputLineSoftwareCmd	Writing a value of 1 in the bit field applies the Latch value of the outputLineSoftwareLatchControl and/or executes the PulseOnSoftwareCmd for any output line programmed for software control. The feature outputLineSoftwareCmd can take any binary value and each bit set to 1 corresponds to a Icommand for an Output. Note that Outputs are numbered from 1 to N, therefore Bit 1 of outputLineSoftwareCmd corresponds to Output1. This is applicable to OutputLineSource = Pulse On: where Software Cmd (for Pulse mode) or OutputLineSource = SoftwareControlled and OutputLineSoftwareLatchControl = Latch (for static states).	1.00 Expert DFNC
Line Pinout	linePinAssociation	Enumeration of the physical line (or pin) on the device I/O connector. (RO)	1.00 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

Genie Nano-5G 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 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-5G 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.
- **External trigger (Trigger Mode=On)**: Exposures are controlled by an external trigger signal where the specific input line is selected by the **Trigger Source** feature. External signals are isolated by an opto-coupler input with a time programmable debounce circuit.

Trigger Source Types (Trigger Mode=On)

- **Trigger Source=Software**: An exposure trigger is sent as a control command via the Ethernet network connection. Software triggers cannot be considered time accurate due to network 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 = Line 1 or 2**: An external trigger signal is opto-coupled and subject to a signal debounce, input delay, plus inversion circuits.
- **Trigger Line Polarity**: For external line signals, a rising edge signal is suggested to minimize the time it takes for the opto-coupler to change state.
- **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.

Input Line Details

The general purpose input line signals are connected to I/O lines 1 and 2, which have the following features for control or status indication.

- **Feature set:** LineSelector (RW), LineName (RO), linePinAssociation (RO), LineFormat (RO), LineMode (RO), lineDetectionLevel (RW), lineDebouncingPeriod (RW), LineInverter (RW), LineStatus (RO).
- **Connector:** See 10-pin I/O Connector Pinout Details for connector pinout and electrical information. The cable shell and shield should electrically connect the Genie Nano-5G chassis to computer chassis for maximum EMI protection.
- **Line Transition Validation:** Each input incorporates a signal debounce circuit (following the opto-couple) to eliminate short noise transitions that could be wrongly interpreted as a valid pulse. The duration is user-programmable from 0µs to 255µs with CamExpert.
- **Line Signal Propagation & Timing:** Maximum delay values are defined in Input Signals Electrical Specifications.

Trigger Overlap: Feature Details

The Trigger Overlap feature defines how the Nano-5G handles triggers that might occur more frequently than the Frame Active period (an exposure plus readout period).

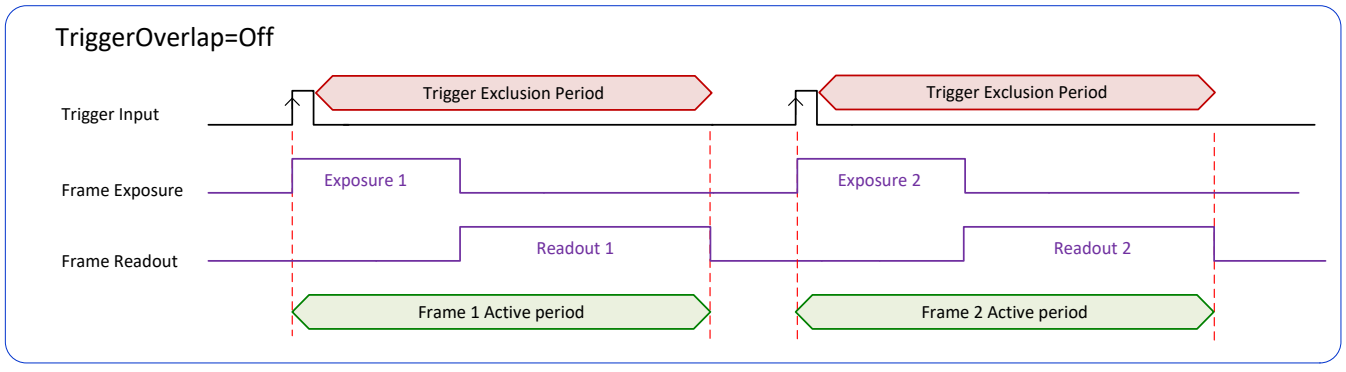
If TriggerOverlap=OFF, then triggers received before the end of the Frame Active period are ignored. Other TriggerOverlap values are dependent on the Nano-5G model and sensor used.

TriggerOverlap=Off

- No trigger overlap is permitted.

Diagram Conditions:

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

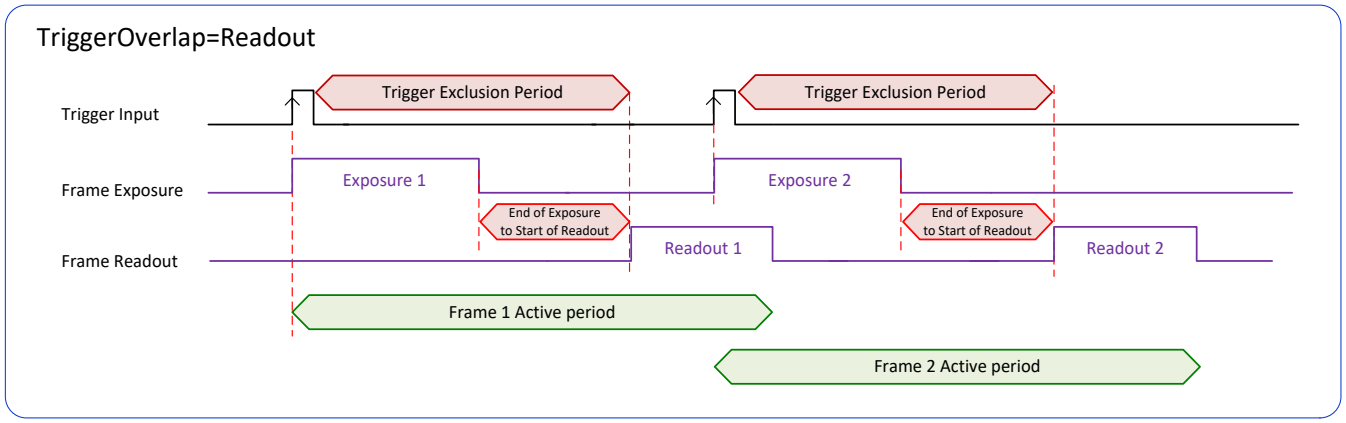


TriggerOverlap=ReadOut

- 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



TriggerOverlap=EndOfExposure

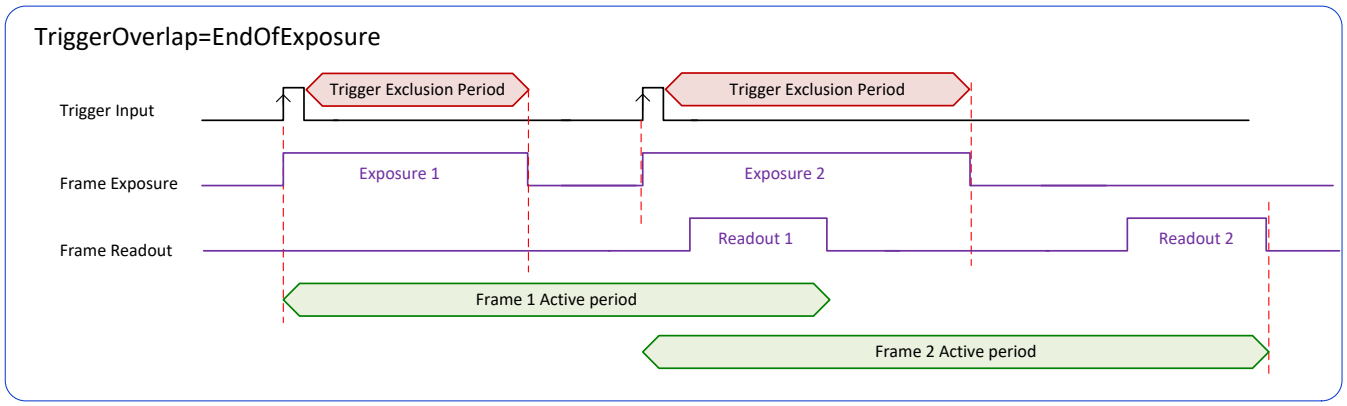
- Trigger is accepted immediately after the previous exposure period. This will latch the Trigger and delay the Exposure if the end of that exposure is shorter than the previous readout.

Diagram Conditions:

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

Applicable to current Sony sensor models

Sony sensor Nano-5G models support a maximum trigger rate by allowing a trigger signal soon after the exposure period. A trigger is accepted and buffered for a 12 line clock period (after the exclusion period) at which the next exposure starts. As shown in the diagram below, the following exposure can be active even before the frame readout of the previous exposure.



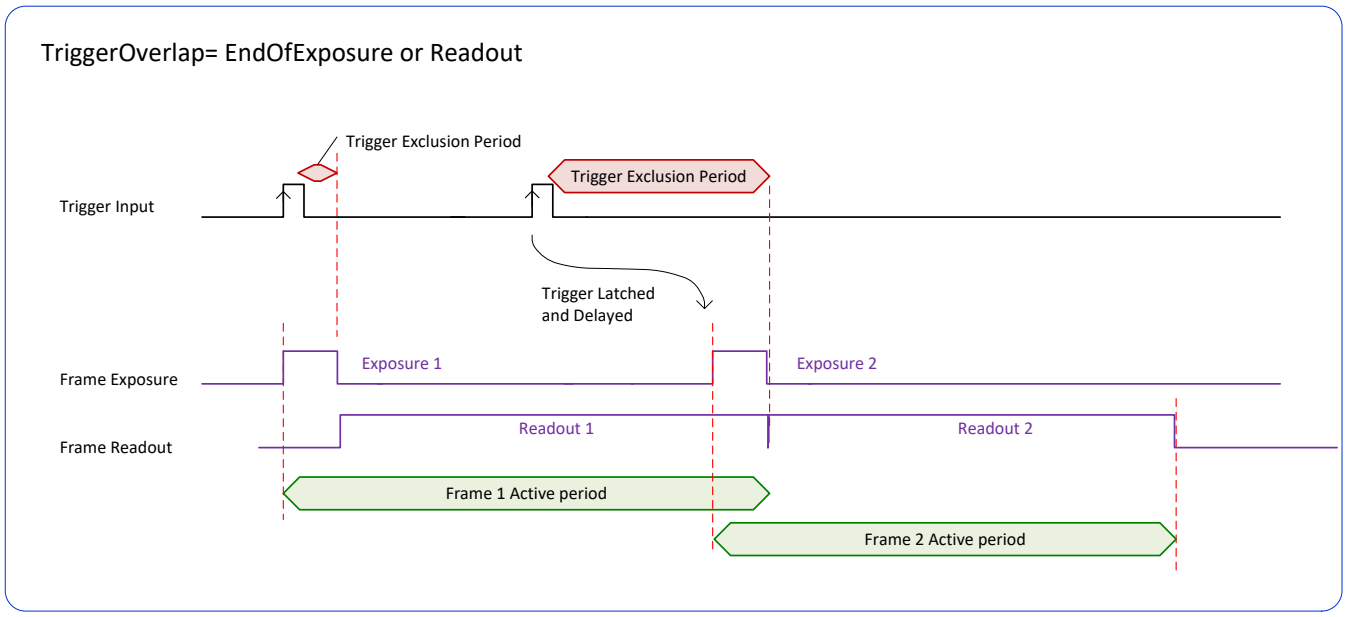
Refer to Model Part Numbers for the available Nano-5G models using Sony sensors and their timing specifications.

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

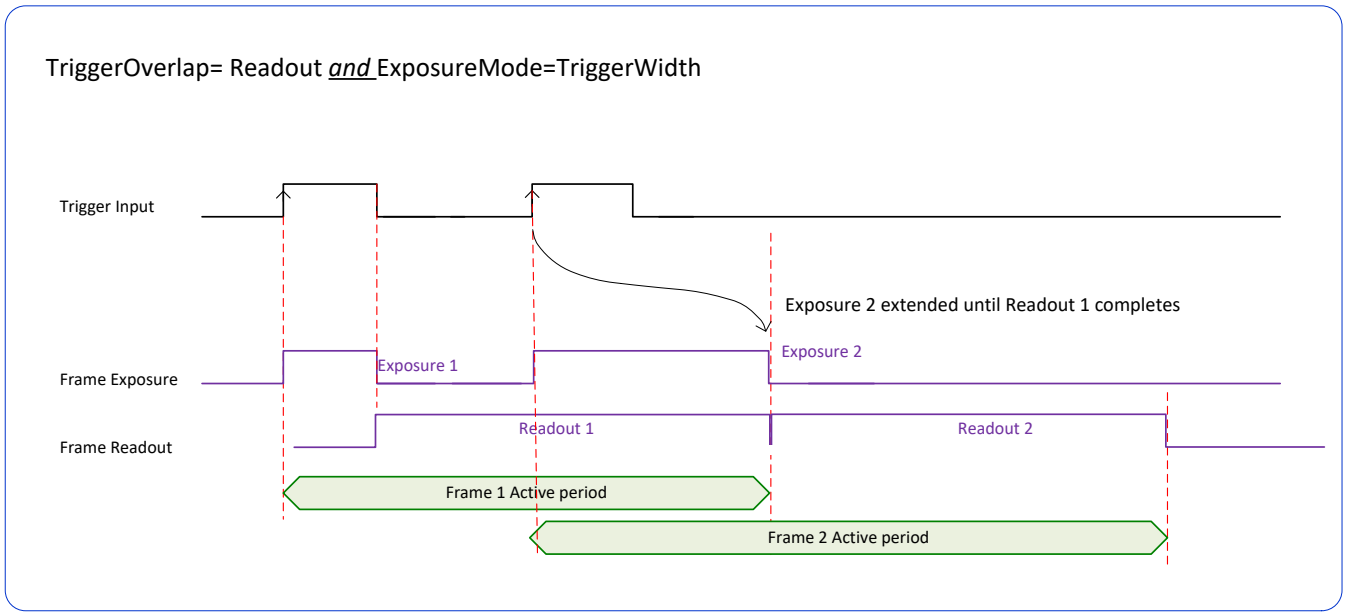


TriggerOverlap= Readout *and* ExposureMode=TriggerWidth

- 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 (Sony Sensors):

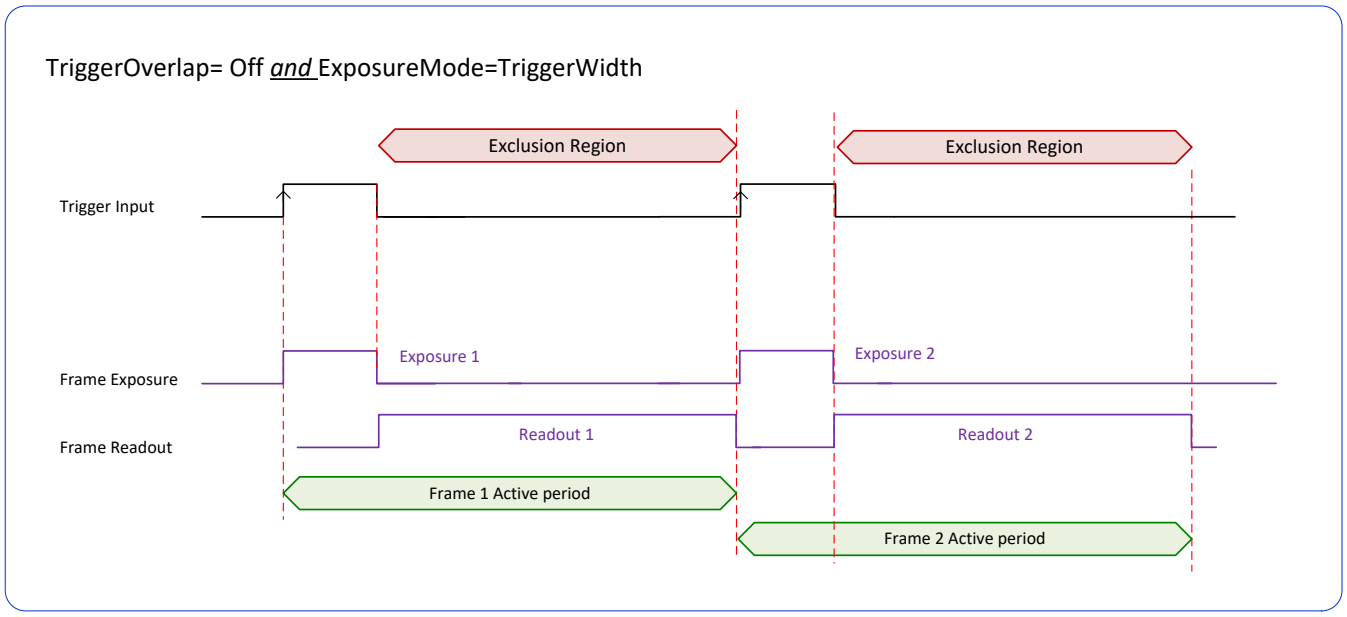
- TriggerMode=On
- ExposureMode=TriggerWidth
- TriggerActivation=RisingEdge
- TriggerDelay=0
- TriggerSelector=FrameStart
- ExposureAlignment=Synchronous



TriggerOverlap=Off *and* ExposureMode=TriggerWidth

Diagram Conditions:

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



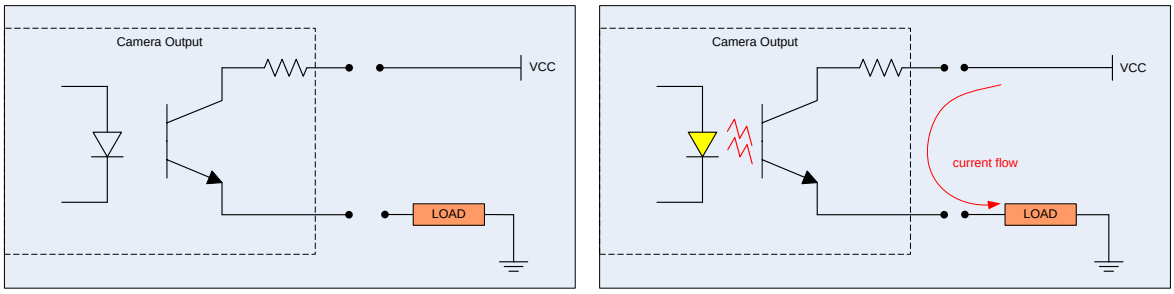
Output Line Details

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

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

Output High and Output Low Block Diagram

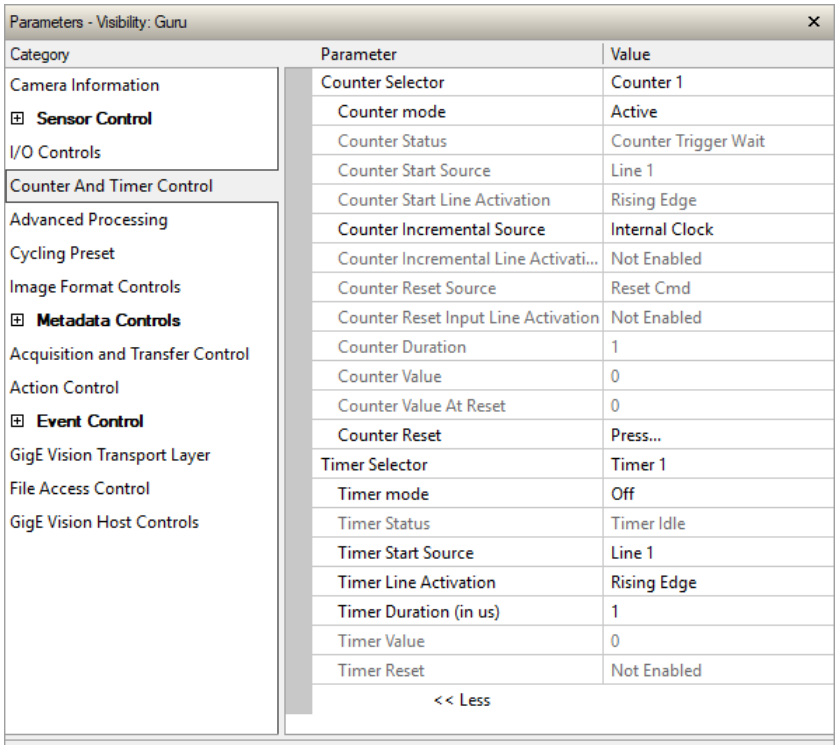
Output signal lines when either in the High or Low state are shown in the following figures with an simplified external circuit.



Examples of Logic HI and Logic LO output circuits

Counter and Timer Control Category

The Genie Nano-5G counter and timer controls, as shown by CamExpert, has parameters used to configure acquisition counters and timers for various input lines and signal edge detection.



Counter and Timer Control Feature Descriptions

The following table and block diagram, describes these parameters.

Display Name	Feature & Values	Description	Device Version & View
Counter Selector *Counter 1*	counterSelector *Counter1*	Selects the counter to configure. *Select counter 1*	1.00 Expert DFNC
Counter mode *Off* *Active*	counterMode *Off* *Active*	Selects the counter mode. The selected Counter is either Active or Disabled. When Disabled, the Counter can be configured. *The selected Counter is Disabled* *The selected Counter is Enabled*	1.00 Expert DFNC
Counter Status *Counter Idle* *Counter Trigger Wait* *Counter Active* *Counter Completed* *Counter Overflow*	counterStatus *CounterIdle* *CounterTriggerWait* *CounterActive* *CounterCompleted* *CounterOverflow*	Returns the current state of the counter. *The counter is idle.* *The counterStartSource feature is set to off.* *The counter is waiting for a start trigger.* *The counter is counting for the specified duration.* *The counter reached the CounterDuration count.* *The counter reached its maximum possible count.*	1.00 Expert DFNC

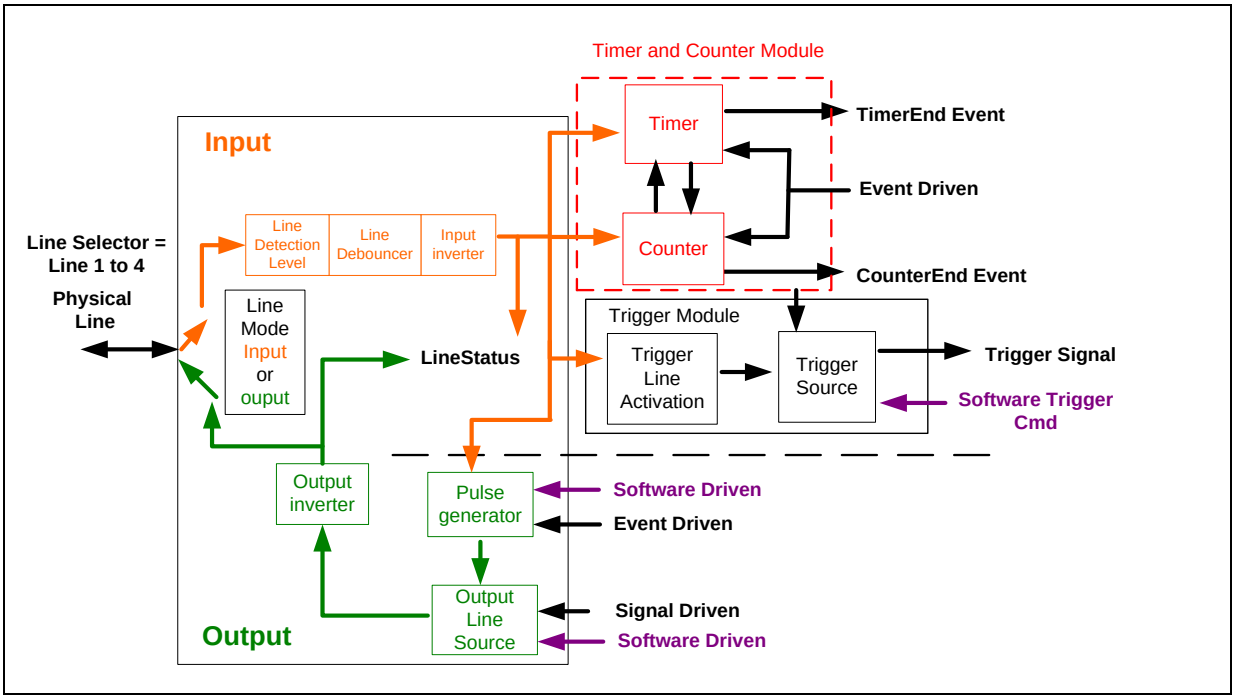
Counter Start Source	counterStartSource	Select the counter start source. Counter increments from 0 to the value of the counterDuration feature.	1.00 Expert DFNC
Off	*Off*	*Counter is stopped.*	
Acquisition Start	*AcquisitionStart*	*Counter starts on the reception of the Acquisition Start event.*	
Acquisition End	*AcquisitionEnd*	*Counter starts on the reception of the Acquisition End event.*	
Exposure Start	*ExposureStart*	*Counter starts on the reception of the Exposure Start event*	
Exposure End	*ExposureEnd*	*Counter starts on the reception of the Exposure End event.*	
Readout Start	*ReadoutStart*	*Counter starts on the reception of the Readout Start event.*	
Readout End	*ReadoutEnd*	*Counter starts on the reception of the Readout End event.*	
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.*	
Action 1	*Action1*	*GigEVision Action Command 1. This is a broadcast command that multiple devices can respond to simultaneously.*	
Action 2	*Action2*	*GigEVision Action Command 2. This is a broadcast command that multiple devices can respond to simultaneously.*	
Line 1	*Line1*	*Counter starts on the specified transitions on Line 1* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Counter starts on the specified transitions on Line 2*	
Timer 1 End	*Timer1End*	*Counter starts on the reception of the Timer 1 End event.*	
Counter 1 End	*Counter1End*	*Counter starts on the reception of the Counter 1 End event.*	
Counter Start Line Activation	counterStartLineActivation	Selects the activation mode of the input line trigger which starts the counter. This is only applicable when the counterStartSource feature selects a physical Line.	1.00 Expert DFNC
Rising Edge	*RisingEdge*	*Starts counting on rising edge of the selected Line.*	
Falling Edge	*FallingEdge*	*Starts counting on falling edge of the selected Line.*	
Any Edge	*AnyEdge*	*Starts counting on the falling or rising edge of the selected Line.*	

Counter Incremental Source	counterIncrementalSource	Select the event source which increments the counter. The Event Control section provides details and timing diagrams for the supported events.	1.00 Expert DFNC
Off	*Off*	*Counter is stopped.*	
Acquisition Start	*AcquisitionStart*	*Counts the number of Acquisition Start events.*	
Acquisition End	*AcquisitionEnd*	*Counts the number of Acquisition End events.*	
Exposure Start	*ExposureStart*	*Counts the number of Exposure Start events.*	
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.*	
MultiFrame End Trigger	*FrameBurstEnd*	*Counts the number of multi-frame end triggers*	
Line 1	*Line1*	*Counts the number of transitions on Line 1 (based on the counterIncrementalLineActivation feature setting)* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Counts the number of transitions on Line 2 (based on the counterIncrementalLineActivation feature setting)*	
Internal Clock	*InternalClock*	*The counter increments on each microsecond tick of the device internal Clock.*	
Timer 1 End	*Timer1End*	*Counts the number of Timer 1 End events.*	
Counter Incremental Line Activation	counterIncrementalLineActivation	Selects the counter signal activation mode. The counter increments on the specified signal edge or level.	1.00 Expert DFNC
Rising Edge	*RisingEdge*	*Increment the counter on the rising edge of the selected I/O Line.*	
Falling Edge	*FallingEdge*	*Increment the counter on the falling edge of the selected I/O Line.*	
Any Edge	*AnyEdge*	*Increment the counter on the falling or rising edge of the selected I/O Line.*	
Counter Reset Source	counterResetSource	Selects the signal source to reset the counter. After a reset the counter waits for the next countStartSource signal or event.	1.00 Expert DFNC
Reset Cmd	*Off*	*Reset on reception of the Reset Icommand.*	
Acquisition Start	*AcquisitionStart*	*Reset on reception of the Acquisition Start.*	
Acquisition End	*AcquisitionEnd*	*Reset on reception of the AcquisitionEnd*	
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.*	
MultiFrame End Trigger	*FrameBurstEnd*	*Reset on reception of the Frame Burst end.*	
Line 1	*Line1*	*Reset counter on the specified transition on line 1.* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Reset counter on the specified transition on line 2.*	
Timer 1 End	*Timer1End*	*Reset on reception of the Timer End.*	
Counter 1 End	*Counter1End*	*Reset on the reception of the Counter end.*	

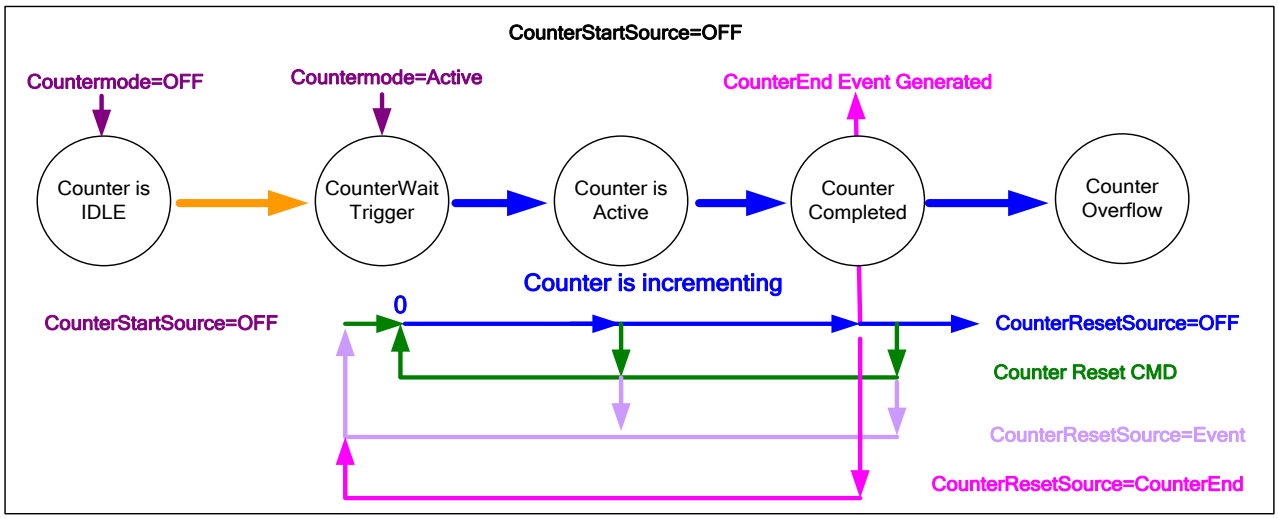
Counter Reset Input Line Activation *Rising Edge* *Falling Edge* *Any Edge*	counterResetLineActivation *RisingEdge* *FallingEdge* *AnyEdge*	Specify the edge transition on the selected line that will reset the selected counter. *Reset counter on rising edge of the selected signal.* *Reset counter on falling edge of the selected signal.* *Reset counter on the falling or rising edge of the selected signal*	1.00 Expert DFNC
Counter Duration	counterDuration	Sets the duration (or number of events) before the CounterEnd event is generated.	1.00 Expert DFNC
Counter Value	counterValue	Read the current value of the selected counter.	1.00 Expert DFNC
Counter Value At Reset	counterValueAtReset	Stores the counter value of the selected counter when it was reset by a trigger or by an explicit Counter Reset command.	1.00 Expert DFNC
Counter Reset	counterReset	Resets the selected counter to zero. The counter starts immediately after the reset. To temporarily disable the counter, set the Counter Event Source feature to Off.	1.00 Expert DFNC
Timer Selector *Timer 1*	timerSelector *Timer1*	Selects which timer to configure. *Timer 1 selected*	1.00 Expert DFNC
Timer Mode *Off* *Active*	timerMode *Off* *Active*	Select the Timer mode. The selected Timer is Active or Disabled. When Disabled, the Timer can be configured. *The selected Timer is Disabled.* *The selected Timer is Enabled.*	1.00 Expert DFNC
Timer Status *Timer Idle* *Timer Trigger Wait* *Timer Active* *Timer Completed*	timerStatus *TimerIdle* *TimerTriggerWait* *TimerActive* *TimerCompleted*	Returns the current state of the timer. *The timer is idle. The CounterStartSource feature is set to off.* *The timer is waiting for a start trigger.* *The timer is counting for the specified duration.* *The timer reached the TimerDuration count.*	1.00 Expert DFNC

Timer Start Source	timerStartSource	Select the trigger source to start the timer. The Event Control section provides details and timing diagrams for the supported events.	1.00 Expert DFNC
TimerReset Cmd	*Off*	*Starts with the reception of the TimerReset Icommand.*	
Acquisition Start	*AcquisitionStart*	*Start Timer on Acquisition Start event.*	
Acquisition End	*AcquisitionEnd*	*Start Timer on Acquisition End event*	
Exposure Start	*ExposureStart*	*Start Timer on Exposure Start event.*	
Exposure End	*ExposureEnd*	*Start Timer on Exposure End event.*	
Readout Start	*ReadoutEnd*	*Start Timer on Readout Start event.*	
Readout End	*ReadoutStart*	*Start Timer on Readout End event.*	
Frame Start	*FrameStart*	*Start Timer on Frame Start event.*	
Frame Trigger	*ValidFrameTrigger*	*Start Timer on Frame Trigger event.*	
Frame Burst End	*FrameBurstEnd*	*Start Timer on Frame Burst End event.*	
Action 1	*Action1*	*GigEVision Action Command 1. This is a broadcast command that multiple devices can respond to simultaneously.*	
Action 2	*Action2*	*GigEVision Action Command 2. This is a broadcast command that multiple devices can respond to simultaneously.*	
Line 1	*Line1*	*Start Timer on a transition of I/O Line 1 event.* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Start Timer on a transition of I/O Line 2 event.*	
Timer 1 End	*Timer1End*	*Start Timer on Timer End event.*	
Cycling Sequence Start	*CyclingSequenceStart*	*Start Timer on Frame Start event for the first frame when the current cycling active set is 1. (Ver. 1.01)*	
Counter 1 End	*Counter1End*	*Start Timer on Counter 1 End event.*	
Timer Line Activation	timerStartLineActivation	Select the trigger activation mode which starts the timer.	1.00 Expert DFNC
Rising Edge	*RisingEdge*	*Starts counter on rising edge of the selected signal.*	
Falling Edge	*FallingEdge*	*Starts counter on falling edge of the selected signal.*	
Any Edge	*AnyEdge*	*Starts counter on the falling or rising edge of the selected signal.*	
Timer Duration	timerDuration	Sets the duration (in microseconds) of the timer pulse.	1.00 Expert DFNC
Timer Value	timerValue	Reads the current value (in microseconds) of the selected timer.	1.00 Expert DFNC
Timer Reset	timerReset	Resets the timer to 0 while *timerStatus=TimerActive*. Timer then waits for the next *timerStartSource* event.	1.00 Expert DFNC

Counter and Timer Group Block Diagram

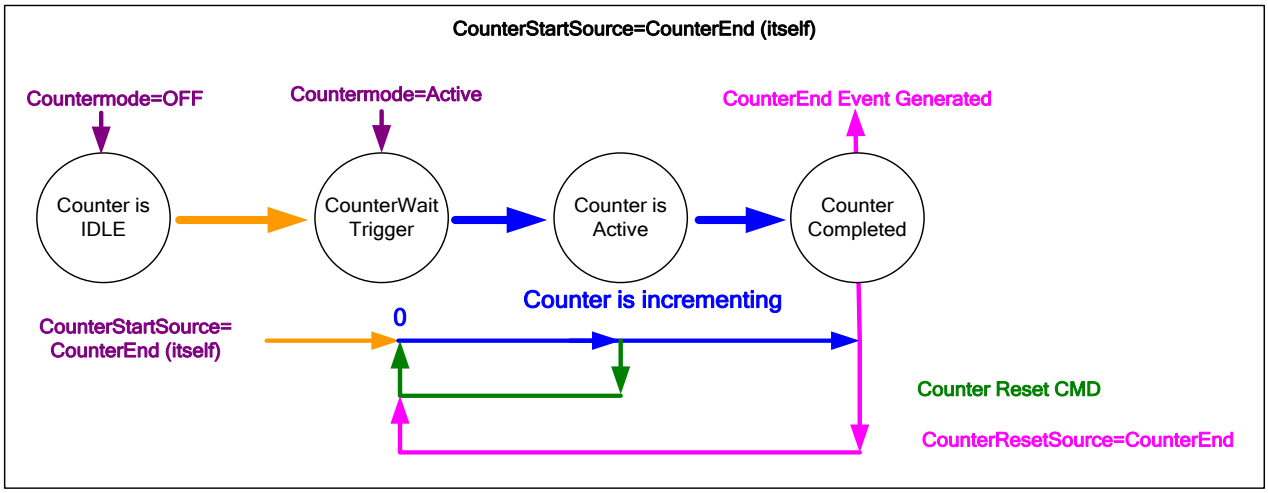


Example: Counter Start Source = OFF



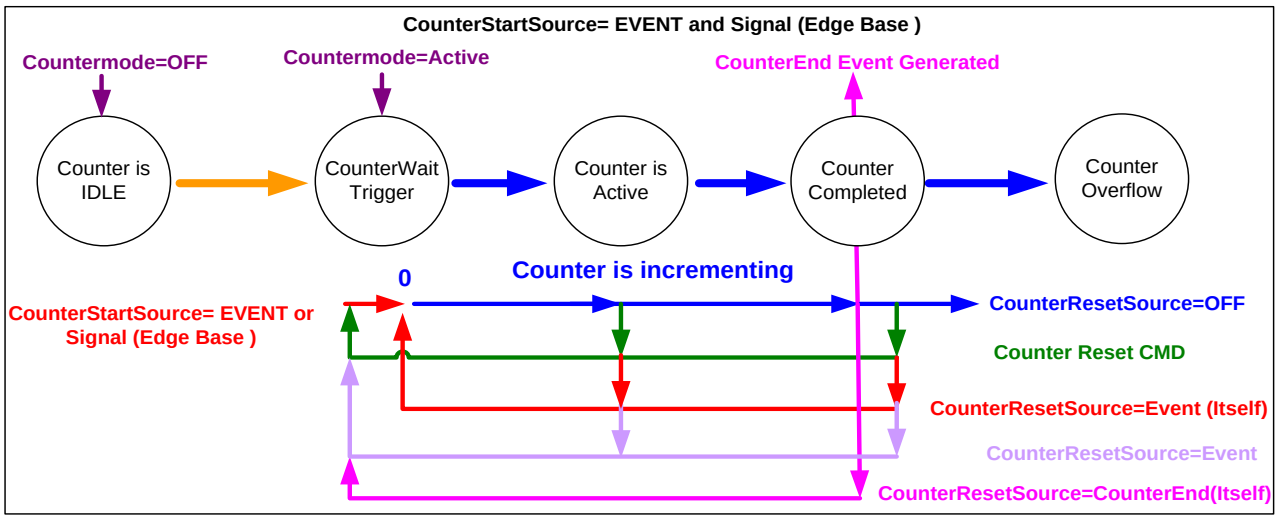
- The counter starts on the **counterReset Cmd**.
- The counter continues unless a new **counterReset Cmd** is received, which then restarts the counter at 00.
- When **Counter Reset Source= 'Event' or 'CounterEnd'** the counter is reset to 00 but does not restart counting, until the next **CounterReset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

Example: Counter Start Source = CounterEnd (itself)

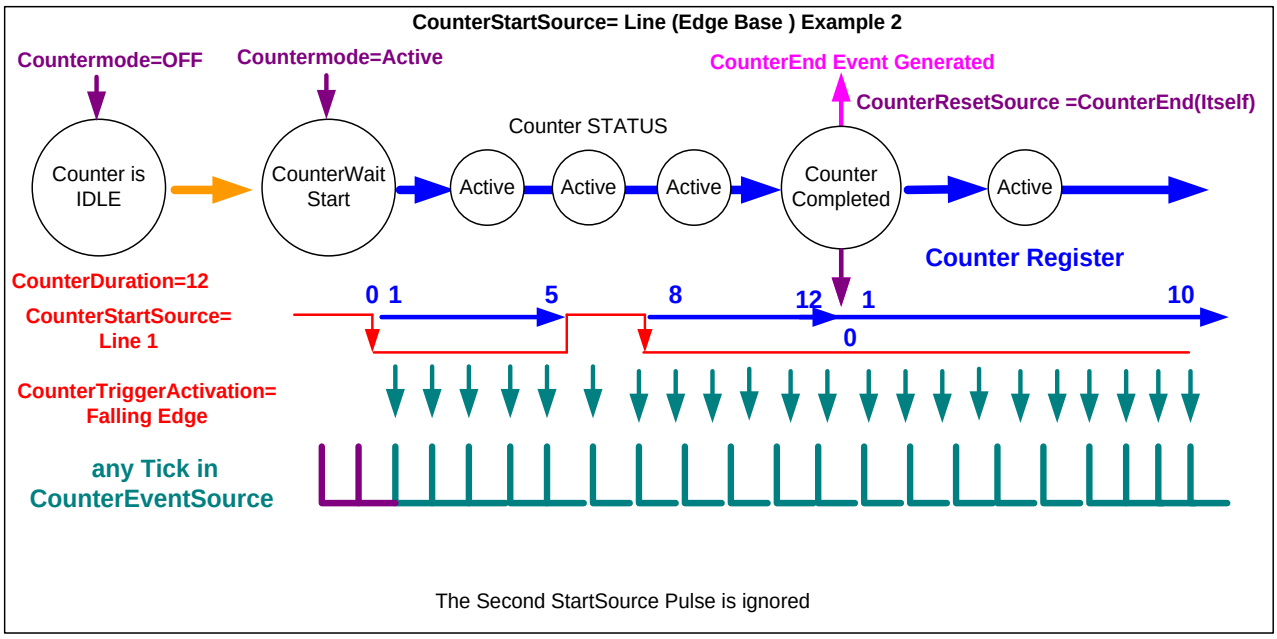


- Counter starts when Counter Mode is set to Active.
- A **Counter Reset CMD** will reset the counter to 00 and it then continues counting.
- **counterResetSource** must be set to **CounterEnd**. When the counterValue feature reaches the counterDuration value an event is generated and the counter is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

Example: CounterStartSource = EVENT and Signal (Edge Base)

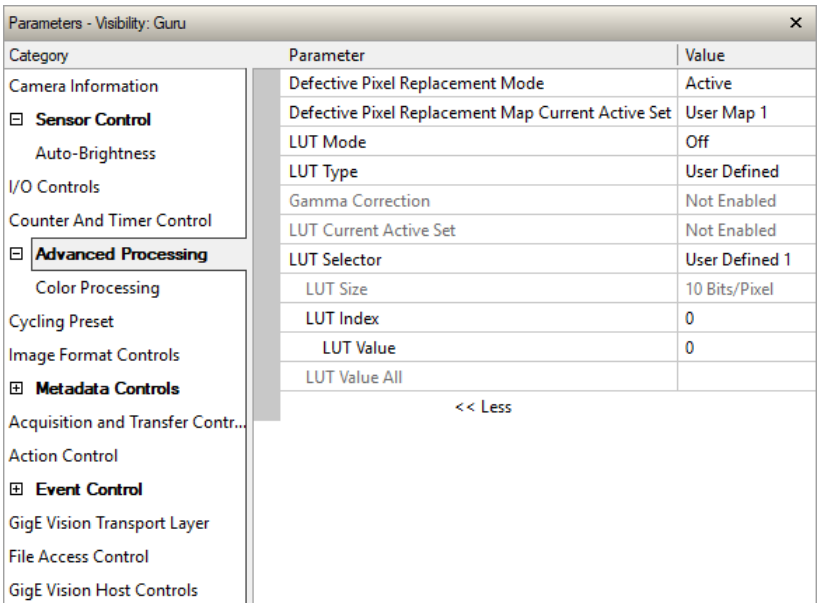


Example: CounterStartSource = Line (Edge Base) Example



Advanced Processing Control Category

The Genie Nano-5G Advanced Processing controls, as shown by CamExpert, groups parameters used to configure LUT mode controls on monochrome cameras. Genie Nano-5G 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.



Advanced Processing Control Feature Descriptions

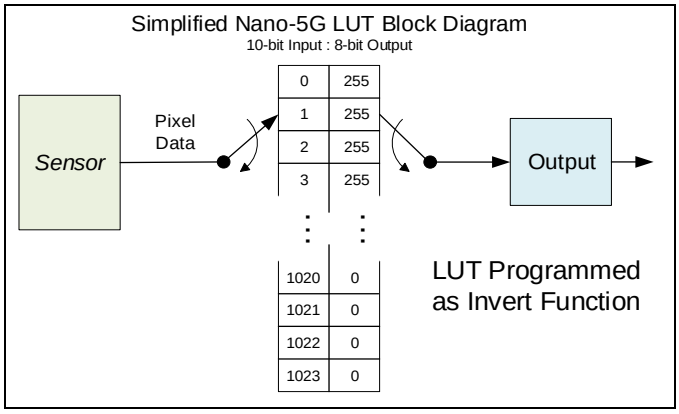
Display Name	Feature & Values	Description	Device Version & View
Defective Pixel Replacement Mode	defectivePixelReplacementMode	Sets the enable state for defective pixel replacement.	1.00 Expert DFNC
Off	*Off*	*Disable defective pixel replacement.*	
Active	*Active*	*Enable defective pixel replacement.*	
Defective Pixel Replacement Map Current Active Set	defectivePixelReplacementMapCurrentActiveSet	Specifies the defective pixel replacement set.	1.00 Expert DFNC
Off	*Off*	*Disable defective pixel replacement.*	
User Map 1	*UserMap1*	*Sets the User Map defective pixel map as active.*	
LUT Mode	lutMode	Sets the enable state of the selected LUT module (Lookup Table).	1.00 Expert DFNC
Off	*Off*	*Disables the LUT.*	
Active	*Active*	*Enables the selected LUT module.*	
LUT Type	lutType	Displays the LUT type of the currently selected Lookup Table.	1.00 Expert DFNC
User Defined	*UserDefined*	*Uses the user programmable LUT.*	
Gamma Correction	*GammaCorrection*	*Uses gamma LUT*	

Gamma Correction	gammaCorrection	Sets the gamma correction factor (i.e. inverse gamma). The gamma correction is applied as an exponent to the original pixel value. (Min: 0.001, Max: 2.0, Increment: 0.001)	1.00 Expert DFNC
LUT Current Active Set	lutCurrentActiveSet	Specifies the current LUT to use.	1.00 Expert DFNC
User Defined 1	*UserDefined1*	*Sets the current LUT as User Defined 1.*	
User Defined 2	*UserDefined2*	*Sets the current LUT as User Defined 2.*	
LUT Selector	LUTSelector	Selects which LUT to control and adjust features.	1.00 Guru
User Defined 1	*UserDefined1*	*User Defined 1 is under control*	
User Defined 2	*UserDefined2*	*User Defined 1 is under control*	
LUT Size	lutSize	Specify the LUT size of the selected LUT (Lookup Table). Available choices are model dependent.	1.00 Guru DFNC
8 Bits/Pixel	*Bpp8*	*8 bits per pixel*	
10 Bits/Pixel	*Bpp10*	*10 bits per pixel*	
12 Bits/Pixel	*Bpp12*	*12 bits per pixel*	
LUT Index	LUTIndex	Selects the index (offset) of the coefficient to access in the selected LUT.	1.00 Guru
LUT Value	LUTValue	Returns the value at specified LUT index entry of the LUT selected by the LUT Selector feature.	1.00 Guru
LUT Value All	LUTValueAll	Accesses all the LUT coefficients in a single access without using individual LUT indices. This feature accesses the LUT values in the currently active LUT table set by the LUT Current Active Set feature.	1.00 Guru

Lookup Table (LUT) Overview

The Genie Nano-5G cameras include a user programmable LUT table as a component of its embedded processing features. A LUT is used for operations such as gamma adjustments, invert and threshold processes.

The camera LUT table are dependent on the sensor (per pixel – see feature *LUT Size*) and is illustrated in the following figure (see *Processing path bits per pixel*). Pixel data from the sensor is passed through the LUT memory array, where the new programmed pixel value is then passed to the Genie Nano-5G output circuit. The LUT data table is stored along with other parameters with the user configuration function.



Simplified Example 10-bit to 8-bit LUT Block Diagram

LUT Size vs. Output Pixel Format

The LUT size will be the same as the camera's sensor pixel size; for the current Nano-5G standard firmware this is a 10-bit. All camera processing is performed at the 10-bit sensor pixel format of the camera, while the the output pixel format is 8-bit.

The Nano-5G default neutral LUT programming is as follows:

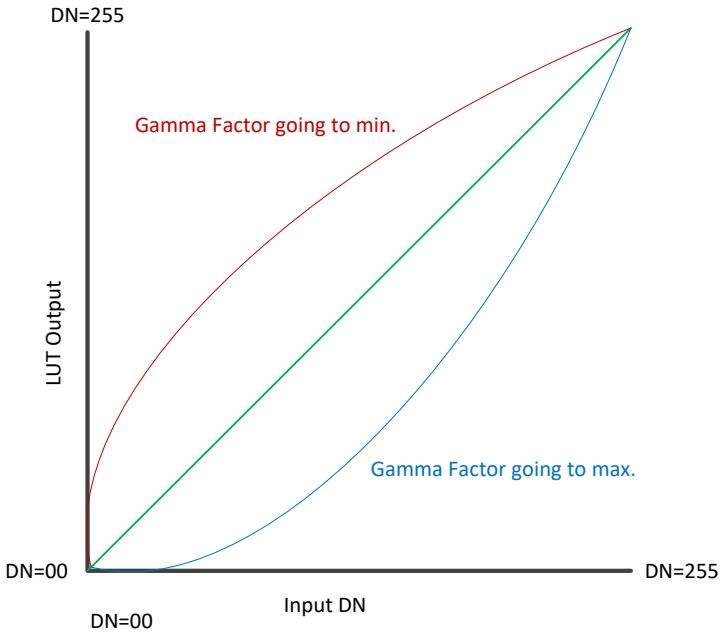
- With **Output Pixel format = 8-bit**, the default LUT data is programmed to map the 1024 sensor pixel values to 256 output values. Therefore LUT index "0 to 3" have the value "0", LUT index "4 to 7" have the value "1", and so on until the last group where LUT index "1020 to 1023" have the value "255".

LUT data is selected either as a predefined gamma correction, or is programmed with individual values for various LUT index entries, or a user LUT data file is upload using the File Access controls. Refer to the Sapera documentation for information about the SapLut Class. Note that a SapLut file can be uploaded to the Nano-5G but cannot be read back.

Gamma Correction Factor

The following graphic shows LUT output data as a function of the gamma correction factor programmed by the user. An 8-bit LUT is shown as an example and importantly the graphic is not to scale.

- As Gamma Correction is reduced in value to the minimum allowed, the nonlinear output of acquisition data through the LUT effectively boosts low value data.
- As Gamma Correction is increased in value to the maximum allowed, the nonlinear output of acquisition data through the LUT effectively reduces low value data.



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-5G model. The following XML code sample forms the template for the user to build bad pixel maps for any of their Nano-5G 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 Algorithm descriptions that follows defines the rules used by the Nano-5G firmware to replace an identified bad pixel.

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

<!--Example User Defective Pixel Map-->
<!--maximum 512 coordinates-->
<!--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 is included with the Nano-5G firmware .zip files available for

download from the Teledyne DALSA website:

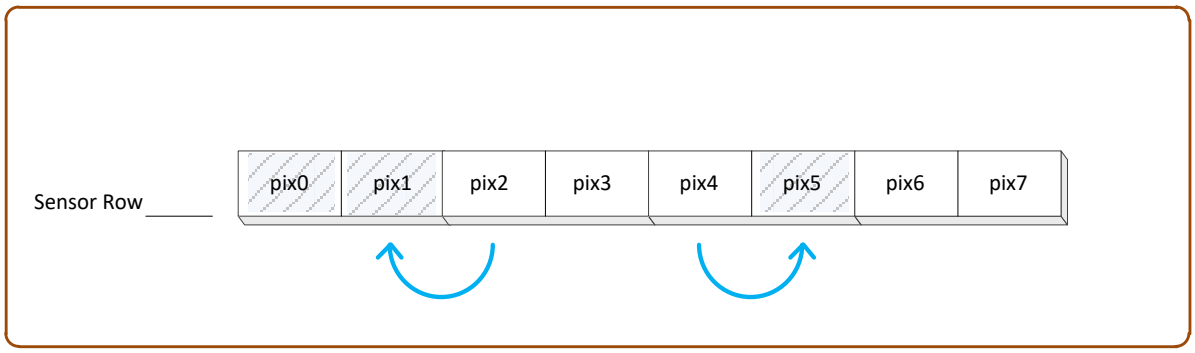
https://www.teledynedalsa.com/en/support/downloads-center/firmware/

Monochrome Defective Pixel Replacement Algorithm Description

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

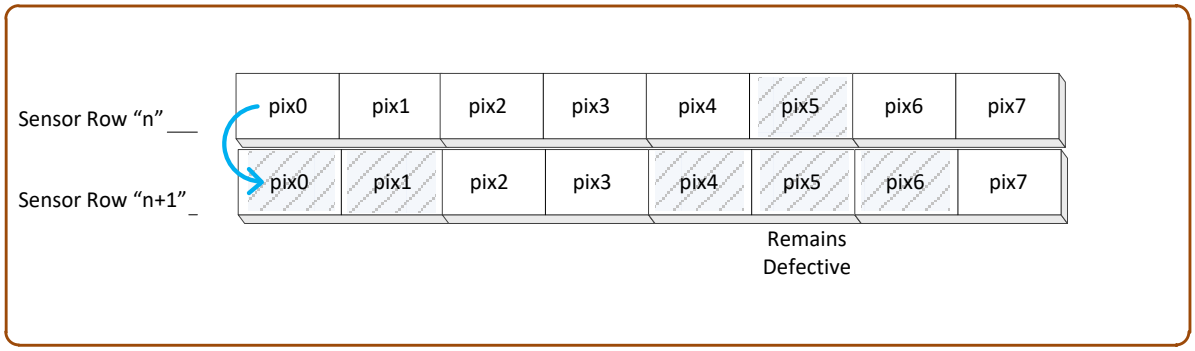
Single bad pixel in a sensor line with a good adjacent pixel

- 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.

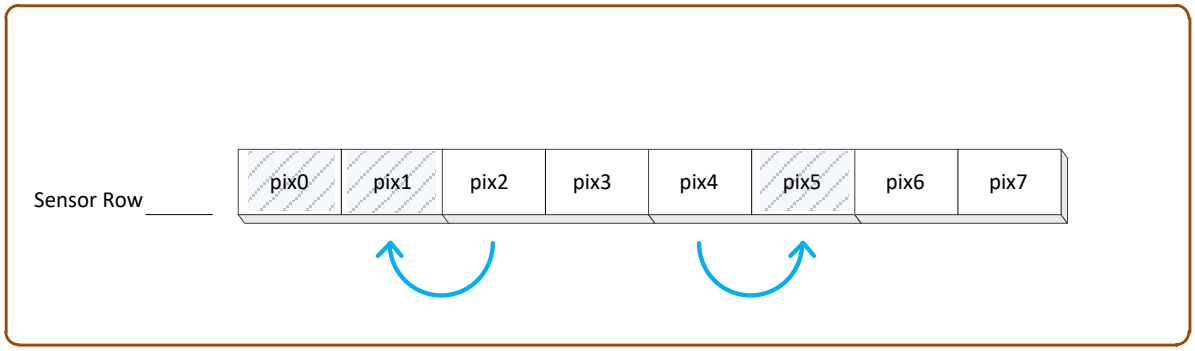


Color Defective Pixel Replacement Algorithm Description

The replacement algorithm rules for a Bayer 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.

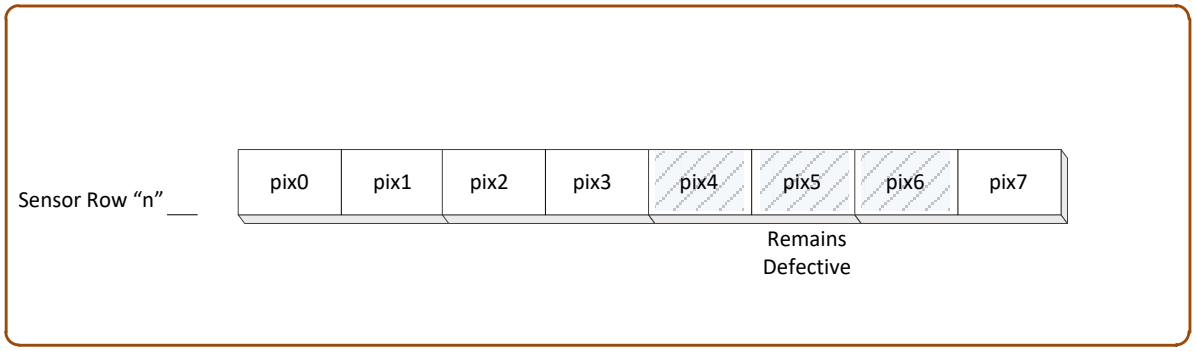
Single bad pixel in a sensor line with a good adjacent pixel

- 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.



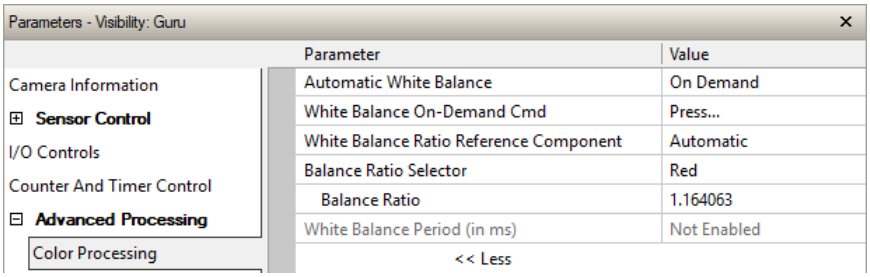
Bad pixel in a sensor line with bad adjacent pixels

- Do nothing when the neighboring pixels are also bad.



Color Processing Category

The Nano-5G Color Processing controls, as shown by CamExpert, has parameters used to configure the color camera white balance/color balance features.



Color Processing Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Automatic White Balance	BalanceWhiteAuto	Controls the mode for automatic white balancing between the color channels. The color gains are automatically adjusted.	1.00 Expert
Off	*Off*	*White balancing is manually controlled using BalanceRatio[Red], BalanceRatio[Green] and BalanceRatio[Blue].*	
On Demand	*OnDemand*	*White balancing is automatically adjusted once by the device.*	
Periodic	*Periodic*	*White balancing is periodically adjusted by the device (i.e. when the scene is known to be neutral).*	
White Balance Period	balanceWhitePeriod	White balance correction period.	1.00 Expert DFNC
White Balance On-Demand Cmd	balanceWhiteAutoOnDemandCmd	Executes the automatic white balance function. The first frame acquired is used to calculate the RGB gain adjustments, which are then applied to subsequent snaps or grabs.	1.00 Expert DFNC
White Balance Ratio Reference Component	balanceRatioReference	Selects which color component to use as the reference point for BalanceWhiteAuto.	1.00 Expert DFNC
Red	*Red*	*Red component will remain constant after the white balance adjustment.*	
Green	*Green*	*Green component will remain constant after the white balance adjustment.*	
Blue	*Blue*	*Blue component will remain constant after the white balance adjustment.*	
Automatic	*Auto*	*The reference color component is automatically selected so that the minimum component's gain becomes 1.00.*	
Balance Ratio Selector	BalanceRatioSelector	Selects which color gain is controlled with the BalanceRatio feature.	1.00 Expert
Red	*Red*	*RED gain is controlled by Balance Ratio.*	
Green	*Green*	*Green gain is controlled by Balance Ratio.*	
Blue	*Blue*	*BLUE gain is controlled by Balance Ratio.*	
Balance Ratio	BalanceRatio	Sets the digital gain of the selected color component (BalanceRatioSelector).	1.00 Expert
White Balance Period (in ms)	balanceWhitePeriod	White balance correction period in milliseconds. (RO)	1.00 Expert DFNC

Color Processing Functional Overview

Nano-5G color cameras provide White Balance controls (automatic or manual). These features are described below in more detail. Note that computer monitors have wide variations in displaying color. Users should consider using professional monitors which have factory calibrated fixed presets conforming to sRGB or AdobeRGB color spaces.

White Balance Operation

The Nano-5G white balance control allow either manual settings for the RGB gain levels, or an automatic algorithm executing periodically or on demand. Automatic mode operates under the assumption of a color neutral scene, where an IR filter installed on the Nano-5G camera is recommended for most applications.

For Manual Adjustments

- RGB values range from 1 to 4, in 0.01 increments.
- Use *BalanceRatioSelector* to select the RGB gain to adjust and use *BalanceRatio* to change the gain value.
- The user selects one color to stay fixed at a gain of 1.00 (often green).
- Adjust the gain for R & B to achieve the white balance desired.

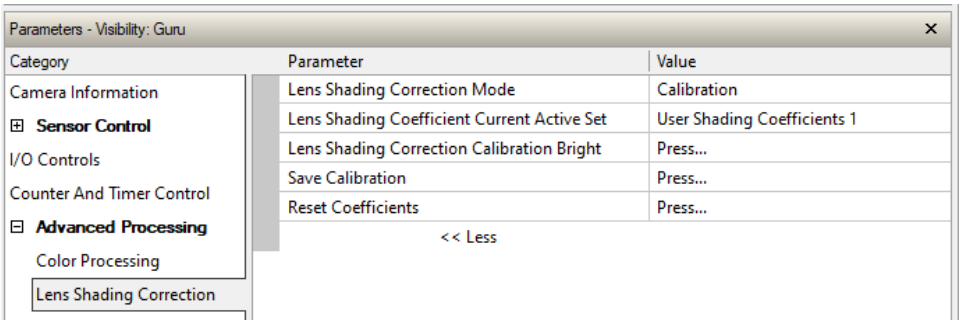
For Automatic Adjustments

With either periodic or on demand modes, the Nano-5G will determine the color to set to a gain of 1.00, and then adjust the other two color gains. The *BalanceRatio* feature will show gain settings at higher precision than user set values.

- Set BalanceWhiteAuto to Periodic or OnDemand.
- The periodic mode will recalculate every 10ms, while the on demand mode requires the execution of balanceWhiteAutoOnDemandCmd.
- The user can override the automatic choice of the color referenced to a gain of zero via the balanceRatioReference feature, but often the results look false colored.

Lens Shading Correction Category

The Nano-5G Lens Shading Correction controls, as shown by CamExpert, has parameters used to configure the lens shading correction features.



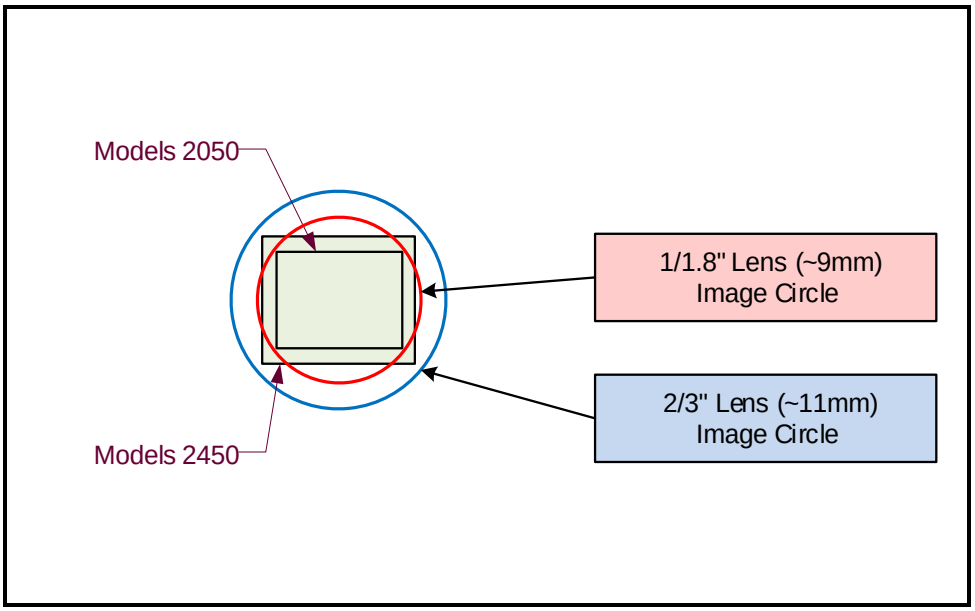
Lens Shading Correction Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Lens Shading Correction Mode	lensShadingCorrectionMode	Sets the mode for the lens shading correction.	1.01 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.	1.01 Beginner DFNC
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 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).	1.01 Expert DFNC
Save Calibration	lensShadingCorrectionCalibrationSave	Save the calibration results of the lensShadingCorrectionCalibrationBright and/or lensShadingCorrectionCalibrationDark operations to the active set.	1.01 Expert DFNC
Reset Coefficients	lensShadingResetCoefficients	Reset lens shading coefficients to pass-through.	1.01 Expert DFNC

Lens Shading Calibration

It is recommended that a "Lens Shading Calibration" procedure be done for any Nano-5G/Lens combination. Calibration eliminates 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 does not quite evenly expose the whole sensor.

The graphic below shows how a lens used on the 3.2M model could be used with a 5.1M model after shading calibration (results will vary with different lenses).

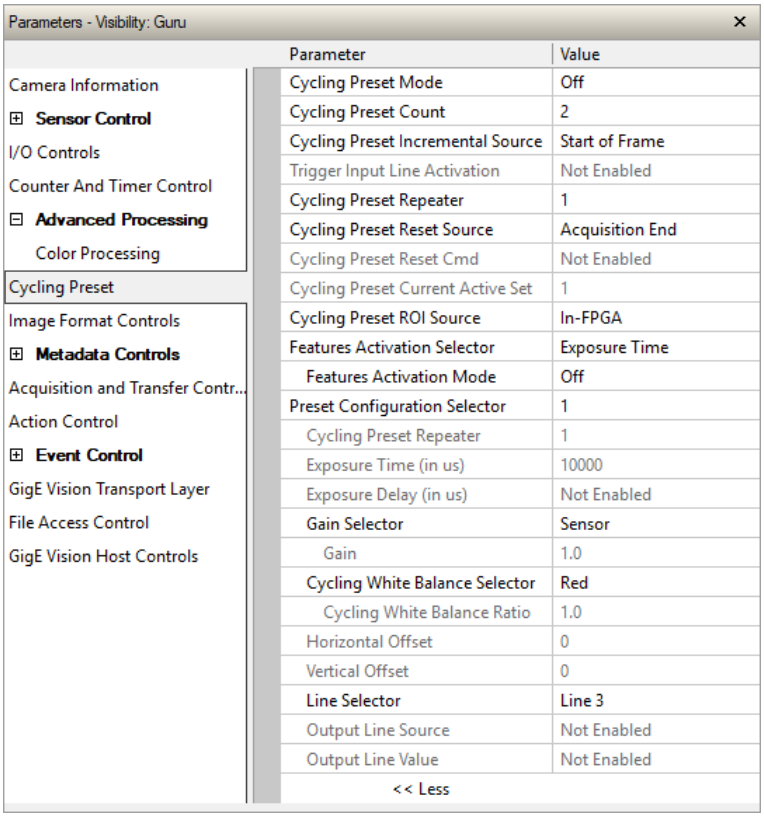


CamExpert allows quick calibration by the user. The features for the Lens Shading Correction Group can also be accessed by the user designed application. The feature descriptions are shown below and after calibration the data should be saved in a user set.

- **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).

Cycling Preset Mode Control Category

The Genie Nano-5G Cycling Preset controls, as shown by CamExpert, has parameters used to configure the camera Cycling features. Cycling controls allow the user to configure a number of camera operational states and then have the camera automatically switch between states in real-time. Only the features programmed to change are updated when switching between camera states, thus ensuring immediate camera response. A setup example follows the feature table.



Cycling Preset Mode Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Cycling Preset Mode	cyclingPresetMode	Sets the Cycling Presets module mode.	1.00 Expert DFNC
	Off	*Off*	*Disable the Cycling Preset module.*	
	Active	*Active*	*Enable the Cycling Preset module.*	
	Cycling Preset Count	cyclingPresetCount	Specifies the number of Presets to use.	1.00 Expert DFNC
	Cycling Preset Incremental Source	cyclingPresetIncrementalSource	Specifies the source that increments the currently active cycling preset.	1.00 Expert DFNC
	None	*None*	*Feature cyclingPresetCurrentActiveSet is used to select the current active set.*	
	Valid Frame Trigger	*ValidFrameTrigger*	*Increment on a Valid Frame Trigger*	
	Counter 1 End	*Counter1End*	*Increment on the end of Counter 1.*	
	Start of Frame	*StartOfFrame*	*Increment on the Start of Frame event*	
	Line2	*Line2*	*Select Line 2 (and associated I/O control block) to use as the external increment source.*	
	Trigger Input Line Activation	cyclingPresetIncrementalActivation	Select the activation mode for the selected Input Line source. This is applicable only for external line inputs.	1.00 Expert DFNC
	Rising Edge	*RisingEdge*	*The source is considered valid on the rising edge of the line source signal (after being processed by the line inverter feature).*	
	Falling Edge	*FallingEdge*	*The source is considered valid on the falling edge of the line source signal (after being processed by the line inverter feature).*	
	Any Edge	*AnyEdge*	*The source is considered valid on any edge (falling or rising) of the line source signal (after being processed by the line inverter feature).*	
	Cycling Preset Repeater	cyclingPresetRepeater	Specifies the required number of cycling preset increment events (generated by the Cycling Preset Incremental Source) to increment the index of the Cycling Preset Current Active Set.	1.00 Expert DFNC
	Cycling Preset Reset Source	cyclingPresetResetSource	Specifies the source that resets the currently active preset. On reset the current preset index is set to 1	1.00 Expert DFNC
	Valid Frame Trigger	*ValidFrameTrigger*	*Reset when a Valid Frame Triggers occurs.*	
	Counter 1 End	*Counter1End*	*Reset when counter 1 ends.*	
	Timer 1 End	*Timer1End*	*Reset when Timer 1 ends. (Ver. 1.01)*	
	Acquisition End	*EndOfAcquisition*	*Use End of Acquisition as the reset source. An End of Acquisition occurs on acquisition stop.*	
	Software	*Software*	*Use a software command as the reset source.*	
	Cycling Preset Reset Cmd	cyclingPresetResetCmd	Reset the position of the preset cycling to 1 and the count to 0.	1.00 Guru DFNC
	Cycling Preset Current Active Set	cyclingPresetCurrentActiveSet	Returns the index of the currently active cycling preset.	1.00 Guru DFNC

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Cycling Preset ROI Source *In-FPGA*	cyclingPresetRoiPositionSource *FPGA*	Specifies the source that cycles the ROI position (availability is sensor dependent). *The FPGA cycles the ROI position.*	1.00 Expert DFNC
	Features Activation Selector *Exposure Time* *Exposure Delay* *ROI Position* *Output Line3* *Output Line4* *Output Line5* *Binning Horizontal* *Binning Vertical* *Sensor Analog Gain* *White Balance Ratios* *Preset Repeater*	cP_FeaturesActivationSelector *ExposureTime* *ExposureDelay* *ROI_Position* *OutputLine3Control* *OutputLine4Control* *OutputLine5Control* *BinningHorizontal* *BinningVertical* *SensorAnalogGain* *WhiteBalanceRatio* *PresetRepeater*	Selects the feature to control by the cP_FeaturesActivationMode feature. *The cP_FeaturesActivationMode feature controls the exposure time.* *The cP_FeaturesActivationMode feature controls the exposure delay.* *The cP_FeaturesActivationMode feature will control ROI position.* *The cP_FeaturesActivationMode feature controls the output line 3.* *The cP_FeaturesActivationMode feature controls the output line 4.* *The cP_FeaturesActivationMode feature controls the output line 5.* *The cP_FeaturesActivationMode controls the horizontal binning.* *The cP_FeaturesActivationMode controls the vertical binning.* *The cP_FeaturesActivationMode controls the sensor analog gain.* *The cP_FeaturesActivationMode controls the white balance gains. (Ver. 1.01)* *The cP_FeaturesActivationMode controls the sensor preset repeater count.*	1.00 Expert DFNC
	Features Activation Mode *Off* *Active*	cP_FeaturesActivationMode *Off* *Active*	Enables the selected feature to be part of the cycling. When activating the selected feature, this will automatically set the corresponding standard camera feature to read only. < Expert, DFNC > *Exclude the selected feature from the cycling.* *Include the selected feature in the cycling.*	1.00 Expert DFNC
	Preset Configuration Selector	cP_PresetConfigurationSelector	Selects the cycling preset to configure.	1.00 Expert DFNC
	Cycling Preset Repeater	cP_PresetRepeater	Specifies the required number of cycling preset increment events (generated by the Cycling Preset Incremental Source) to increment the index of the Cycling Preset Current Active Set. The difference with *cyclingPresetRepeater* is that this feature value is specific to the current cycling set specified by *cp_PresetConfigurationSelector*.	1.00 Expert DFNC
	Exposure Time (in µs)	cP_ExposureTime	Sets the exposure time (in microseconds) for the selected set. The maximum frame rate is dependent on the longest cycling exposure time.	1.00 Expert DFNC
	Exposure Delay (in µs)	cP_ExposureDelay	Sets the exposure delay (in microseconds) for the selected set.	1.00 Expert DFNC

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Gain Selector *Sensor*	cP_GainSelector *SensorAll*	Selects which gain is controlled when adjusting cp_Gain features. *Applies to Sony sensor models: Gain is adjusted within the sensor. The first half of the gain range is applied in the analog domain and the second half is digital.*	1.00 Expert DFNC
	Cycling White Balance Selector *Red* *Green* *Blue*	cP_BalanceRatioSelector *Red* *Green* *Blue*	Selects which color gain is controlled with the *cp_BalanceRatio* feature. Note: cycling white balance gains is only available when Automatic White Balance and Auto-Brightness Mode are disabled. *Red gain.* *Green gain.* *Blue gain.*	1.01 Expert DFNC
	Cycling White Balance Ratio	cP_BalanceRatio	Sets the digital gain of the selected color component (*cp_BalanceRatioSelector*).	1.01 Expert DFNC
	Gain	cP_Gain	Sets the selected gain as an amplification factor applied to the image. This gain is applied when the current Cycling index is active.	1.00 Expert DFNC
	Horizontal Offset	cP_OffsetX	Horizontal offset from the origin to the region of interest (ROI). The value in this feature is only used when the currently selected cycling preset is active.	1.00 Expert DFNC
	Vertical Offset	cP_OffsetY	Vertical offset from the origin to the region of interest (ROI). The value in this feature is only used when the currently selected cycling preset is active.	1.00 Expert DFNC
	Binning Horizontal	cP_BinningHorizontal	Number of horizontal photo-sensitive cells to combine together. This increases the intensity of the pixels but reduces the horizontal resolution of the image.	1.00 Expert DFNC
	Binning Vertical	cP_BinningVertical	Number of vertical photo-sensitive cells to combine together. This increases the intensity of the pixels but reduces the vertical resolution of the image.	1.00 Expert DFNC
	Line Selector *Line 3* *Line 4* *Line 5*	cP_LineSelector *Line3* *Line4* *Line5*	Selects which physical line (or pin) of the external device connector to configure. *Index of the physical line and associated I/O control block to use. Pin 6 is the Output Signal and Pin 4 is the common output power on the I/O connector.* *Index of the physical line and associated I/O control block to use. Pin 8 is the Output Signal and Pin 4 is the common output power on the I/O connector.* *Index of the physical line and associated I/O control block to use. Pin 9 is the Output Signal and Pin 4 is the common output power on the I/O connector.*	1.00 Expert DFNC

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Output Line Source	cP_OutputLineSource	Selects which internal signal, or event driven pulse, or software control state to output on the selected output line.	1.00 Expert DFNC
	Off	*Off*	*Line output is Open – no output source selected.*	
	Software Controlled	*SoftwareControlled*	*The OutputLineValue feature changes the state of the output.*	
	Pulse On: Start of Exposure	*PulseOnStartofExposure*	*Generate a pulse on the ExposureStart event. This is typically used to trigger a strobe light.*	
	Exposure Active	*ExposureActive*	*Generate a signal that is active when the exposure is active.*	
	Output Line Value	cP_OutputLineValue	Sets the output state of the selected Line if the outputLineSoftwareLatchControl = OFF. OutputLineSource must be SoftwareControlled. If the outputLineSoftwareLatchControl=Latch, the state of the pin will change with the outputLineSoftwareCmd command.	1.00 Expert DFNC
	Active	*Active*	*Sets the Output circuit to closed.*	
	Inactive	*Inactive*	*Sets the Output circuit to open.*	

Using Cycling Presets—a Simple Example

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

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

Multi-Exposure Cycling Example Setup

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

Test the Example

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

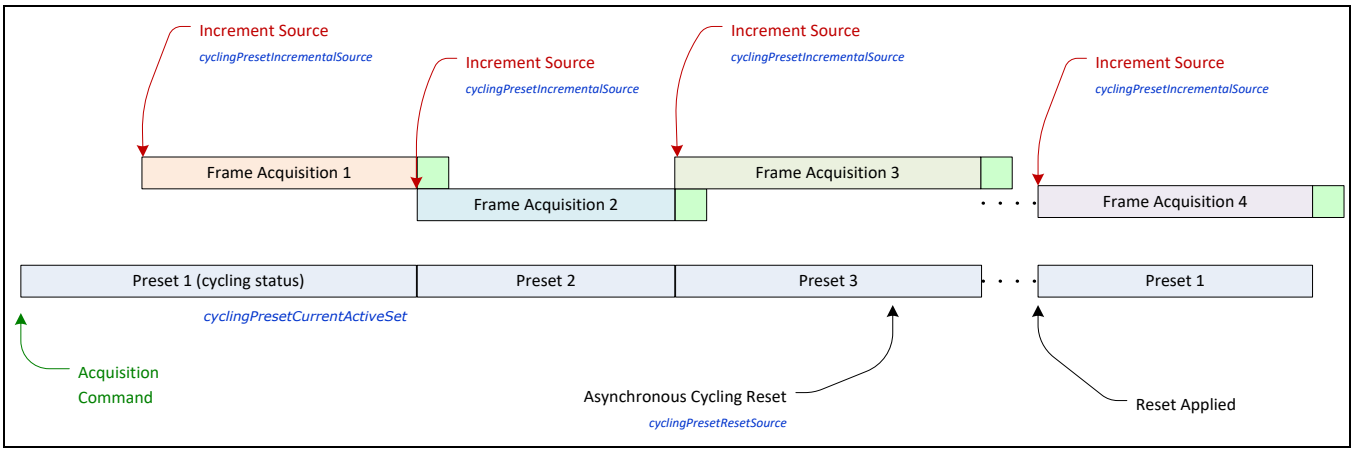
Cycling Reset Timing Details

This section describes the Nano-5G Cycling function with two cycling feature configurations. These configurations (or cases) are dependent on the cycling preset increment source as follows:

- **Internal Synchronous Increment:** Where the preset increment source is either FrameStart or ValidFrameTrigger (*cyclingPresetIncrementalSource= StartOfFrame or ValidFrameTrigger*).
- **External Asynchronous Increment:** Where the preset increment source is either Timer, Line or Software (*cyclingPresetIncrementalSource= Counter1End or Line2 or None*).

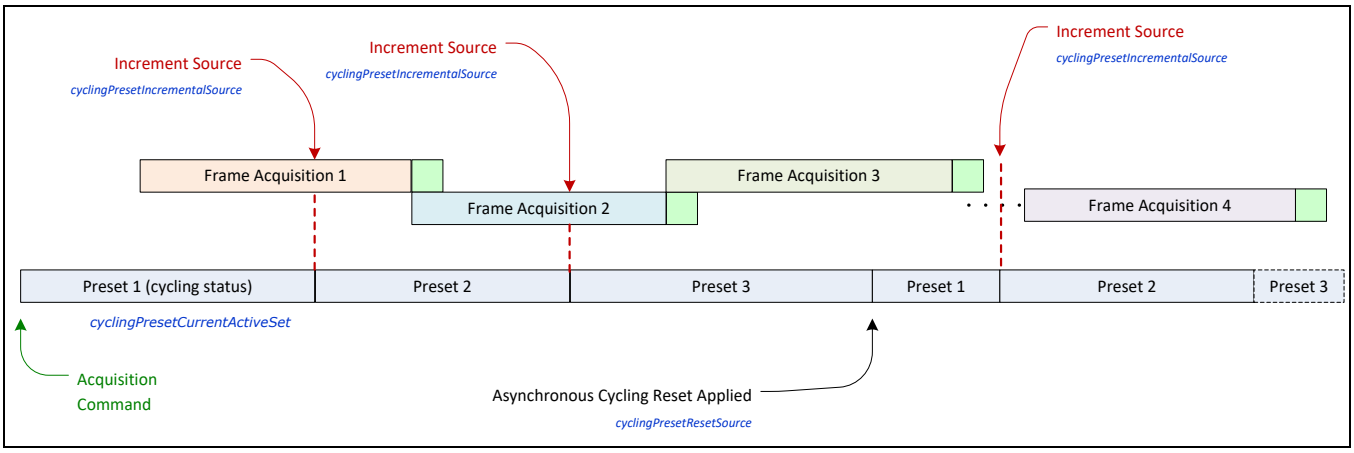
Case 1: Cycling with Internal Synchronous Increment

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



Case 2: Cycling with External Asynchronous Increment

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



Using Cycling Presets with Output Controls

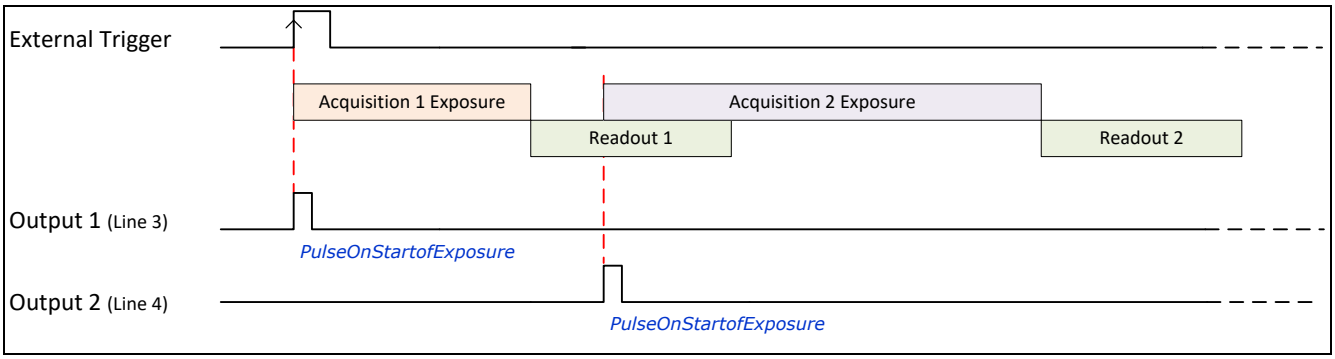
The following graphic shows a Cycling Preset function setup where a two stage setup performs exposures of different length and additionally provides an output pulse at the start of each exposure.

As an example, by using both output lines, this setup can trigger two separate light strobes of different wavelengths. This dual exposure sequence example is controlled by a single external trigger.

Feature Settings for this Example

Below are listed key features for this setup. Other Nano-5G features will be as required by the user.

- **I/O Controls:**
  - TriggerSelector = FrameBurstStart
  - TriggerMode = On
  - triggerFrameCount = 2
- **Cycling Preset**
  - cyclingPresetMode = Active
  - cyclingPresetCount = 2
  - cyclingPresetIncrementalSource = StartOfFrame
  - cP_FeaturesActivationSelector = ExposureTime
  - cP_FeaturesActivationMode = Active (plus set required exposure for each cycling preset)
  - cP_LineSelector = Line3 (for preset 1) and Line4 (for preset 2)
  - cP_OutputLineSource = PulseOnStartofExposure (line3–preset 1, line4-preset 2)



Cycling Mode Constraints with a changing ROI

The Nano-5G Cycling Mode features support a changing ROI from one cycling preset to the next. The ROI in this case refers to a single acquisition area which is a subset of the complete image frame.

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

Specifics Concerning Sony Sensor Models

Sony sensors can only use in-FPGA ROI settings, thus the complete sensor area must be readout to the processing FPGA. Then the defined ROI area is read out of the FPGA and transmitted to the host computer. This characteristic of Sony sensors does not provide any frame rate advantage when using various ROI selections with Cycling Mode acquisitions.

Image Format Control Category

The Genie Nano-5G Image Format controls, as shown by CamExpert, has parameters used to configure camera pixel format, image cropping, image flip, Binning, multiple ROI and selecting a test output image without a lens.

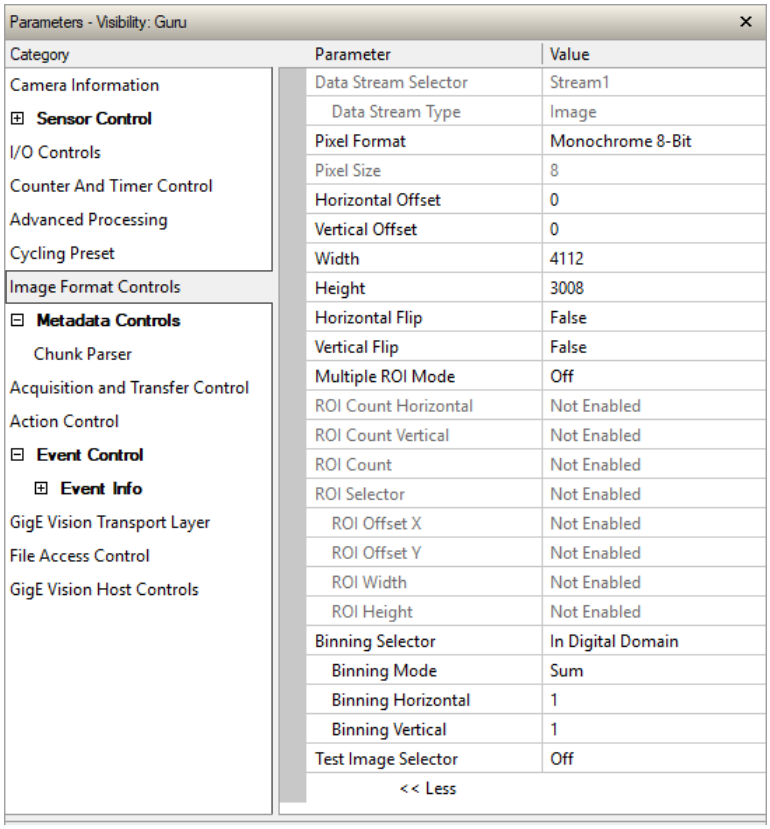


Image Format Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Data Stream Selector *Stream1*	dataStreamSelector *Stream1*	Select which data stream to control. (Default is Stream 1) *Adjust parameters for Stream1.*	1.00 Beginner DFNC
	Data Stream Type *Image*	dataStreamType *Image*	This feature is used to retrieve the transfer protocol used to stream blocks. *The Image data blocks are streamed using the payload type "Image".*	1.00 Beginner DFNC
	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 Beginner DFNC
	*Monochrome 8-Bit*	*Mono8*	*Monochrome 8-bit*	
	*Monochrome 12-Bit*	*Mono12*	*Monochrome 12-bit*	
	*Monochrome 12-Bit Packed*	*Mono12Packed*	*Monochrome 12-Bit packed*	
	*BayerGR 8-Bit*	*BayerGR8*	*Color camera: BayerGR 8-Bit*	
	*BayerRG 8-Bit*	*BayerRG8*	*Color camera: BayerRG 8-Bit*	
	*BayerGB 8-Bit*	*BayerGB8*	*Color camera: BayerGB 8-Bit*	
	*BayerBG 8-Bit*	*BayerBG8*	*Color camera: BayerBG 8-Bit*	
	*BayerGR 12-Bit*	*BayerGR8*	*Color camera: BayerGR 12-Bit*	
	*BayerRG 12-Bit*	*BayerRG12*	*Color camera: BayerRG 12-Bit*	
	*BayerGB 12-Bit*	*BayerGB12*	*Color camera: BayerGB 12-Bit*	
	*BayerBG 12-Bit*	*BayerBG12*	*Color camera: BayerBG 12-Bit*	
	*BayerGR 12-Bit*	*BayerGRPacked*	*Color camera: BayerGR 12-Bit packed*	
	*BayerRG 12-Bit*	*BayerRG12Packed*	*Color camera: BayerRG 12-Bit packed*	
	*BayerGB 12-Bit*	*BayerGB12Packed*	*Color camera: BayerGB 12-Bit packed*	
	*BayerBG 12-Bit*	*BayerBG12Packed*	*Color camera: BayerBG 12-Bit packed*	

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Pixel Size *8 Bits/Pixel* *12 Bits/Pixel*	PixelSize *Bpp8* *Bpp12*	Total size in bits of an image pixel. *8 bits per pixel* *12 bits per pixel*	1.00 Guru DFNC
	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
	Horizontal Flip	ReverseX	Horizontal image flip function (available on some models).	1.00 Expert
	Vertical Flip	ReverseY	Vertical image flip function (available on some models).	1.00 Expert
	Multiple ROI Mode *Off* *Active*	multipleROIMode *Off* *Active*	Enable the Multiple ROI (Region of Interest) per image feature. The ROI Count is set by the Multiple ROI Count feature. *Single ROI per image.* *The ROI per image feature is active.*	1.00 Guru DFNC
	ROI Count Horizontal	multipleROICountHorizontal	Specifies the number of ROI (Region of Interest) available for the X axis.	1.00 Expert DFNC
	ROI Count Vertical	multipleROICountVertical	Specifies the number of ROI (Region of Interest) available for the Y axis.	1.00 Expert DFNC
	ROI Count	multipleROICount	Specifies the number of possible ROI (Region of Interest) available in an acquired image. One is minimum, while the maximum is device specific. < RO >	1.00 Expert DFNC
	ROI Selector *ROI (x1, y1)* *ROI (x2, y1)* *ROI (x3, y1)* *ROI (x4, y1)* *ROI (x1, y2)* *ROI (x2, y2)* *ROI (x3, y2)* *ROI (x4, y2)* *ROI (x1, y3)* *ROI (x2, y3)* *ROI (x3, y3)* *ROI (x4, y3)* *ROI (x1, y4)* *ROI (x2, y4)* *ROI (x3, y4)* ROI (x4, y4)	multipleROISelector *roi1_1* *roi2_1* *roi3_1* *roi4_1* *roi1_2* *roi2_2* *roi3_2* *roi4_2* *roi1_3* *roi2_3* *roi3_3* *roi4_3* *roi1_4* *roi2_4* *roi3_4* roi4_4	Select an ROI (Region of Interest) when Multiple ROI Mode is enabled. Selector range is from 1 to the Multiple ROI Count value. *ROI (x1, y1)* *ROI (x2, y1)* *ROI (x3, y1)* *ROI (x4, y1)* *ROI (x1, y2)* *ROI (x2, y2)* *ROI (x3, y2)* *ROI (x4, y2)* *ROI (x1, y3)* *ROI (x2, y3)* *ROI (x3, y3)* *ROI (x4, y3)* *ROI (x1, y4)* *ROI (x2, y4)* *ROI (x3, y4)* ROI (x4, y4)	1.00 Expert DFNC
	ROI Offset X	multipleROIOffsetX	Horizontal offset (in pixels) from the origin to the selected ROI (Region of Interest).	1.00 Expert DFNC
	ROI Offset Y	multipleROIOffsetY	Vertical offset (in pixels) from the origin to the selected ROI (Region of Interest).	1.00 Expert DFNC
	ROI Width	multipleROIWidth	Width of the selected ROI (Region of Interest) provided by the device (in pixels).	1.00 Expert DFNC
	ROI Height	multipleROIHeight	Height of the selected ROI (Region of Interest) provided by the device (in pixels).	1.00 Expert DFNC

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Binning Selector *In Sensor* *In Digital Domain*	binningSelector *InSensor* *InDigitalDomain*	Select how the Horizontal and Vertical Binning is done. The Binning function can occur in the Digital domain of a device or at the actual sensor. *The Binning function can be done inside the Sensor itself, which often allows binning to increase the data rate from the sensor.* *The Binning function can be done inside the device but with a digital processing function. Binning does not affect the current data rate from the sensor or camera.*	1.00 Beginner DFNC
	Binning Mode *Sum* *Average*	binningMode *Sum* *Average*	Sets the mode used to combine pixels together when BinningHorizontal and/or BinningVertical is greater than 1. *The responses from the individual pixels are added together, resulting in increased sensitivity.* *The responses from the individual pixels are averaged, resulting in increased signal to noise ratio.*	1.00 Beginner DFNC
	Binning Horizontal	BinningHorizontal	Number of horizontal pixels to combine together using the method selected by binningMode. This reduces the horizontal resolution of the image.	1.00 Beginner
	Binning Vertical	BinningVertical	Number of vertical pixels to combine together using the method selected by binningMode. This reduces the vertical resolution of the image.	1.00 Beginner
	Test Image Selector *Off* *Grey Horizontal Ramp* *Grey Vertical Ramp* *Grey Diagonal Ramp Moving*	TestImageSelector *Off* *GreyHorizontalRamp* *GreyVerticalRamp* *GreyDiagonalRampMoving*	Selects the type of test image generated by the camera. *Image is from the camera sensor.* *Image is filled horizontally with an image that goes from the darkest possible value to the brightest.* *Image is filled vertically with an image that goes from the darkest possible value to the brightest.* *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.*	1.00 Beginner DFNC
	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. < RO >	1.00 Invisible DFNC
	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. < RO >	1.00 Invisible DFNC
	Pixel Coding	PixelCoding	Output image pixel coding format of the sensor. < RO >	1.00 Invisible DFNC
	*Mono*	*Mono*	*Pixel is monochrome*	
	*MonoSigned*	*MonoSigned*	*Pixel is monochrome and signed*	
	*MonoPacked*	*MonoPacked*	*Pixel is monochrome and packed*	
	*Raw Bayer*	*Raw*	*Pixel is raw Bayer*	

B/W Color	Display Name	Feature & Values	Description	Device Version & View
	Pixel Color Filter	PixelColorFilter	Indicates the type of color filter applied to the image. < RO >	1.00 Invisible DFNC
	None	*None*	*No filter applied on the sensor.*	
	*Bayer GR*	*BayerGR*	*For BayerGR, the 2x2 mosaic alignment is GR/BG.*	
	*Bayer RG*	*BayerRG*	*For BayerRG, the 2x2 mosaic alignment is RG/GB.*	
	*Bayer GB*	*BayerGB*	*For BayerGB, the 2x2 mosaic alignment is GB/RG.*	
	*Bayer BG*	*BayerBG*	*For BayerBG, the 2x2 mosaic alignment is BG/GR.*	

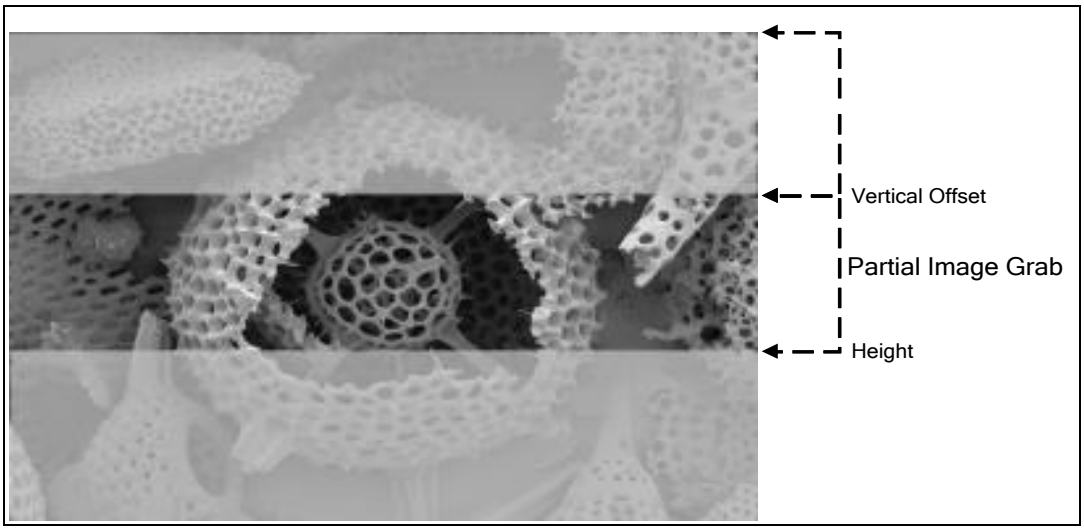
Width and Height Features for Partial Scan Control

Width and Height controls along with their respective offsets, allow the Genie Nano-5G 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 on the Gigabit Ethernet link 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-5G 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

	**Note:** In general, using short exposures at high frame rates will exceed the maximum bandwidth to host transfer speed, when the camera buffer memory is filled. The tables below (for different Genie Nano-5G models) describe frame rate maximums written to internal memory that can be sustained during continuous acquisition. Increase the exposure time, decrease the frame rate, enable TurboDrive, or acquire a limited number of frames, so as to not exceed the transfer bandwidth.

Maximum Frame Rate Examples

The following tables provide the maximum frame rates for different partial scan sizes using free-running mode (internal trigger) with the minimum exposure time.

Standard Design Firmware

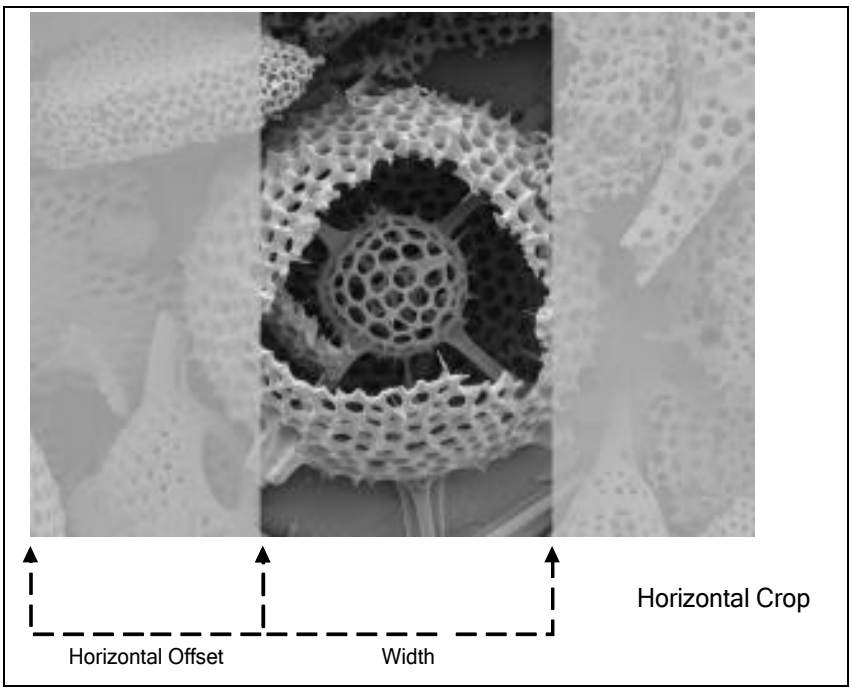
Vertical Lines Acquired	Model					
	M/C2050	M/C2450	M/C4040*	M/C4060*	M/C5400	M/C8100
5420	Not applicable	Not applicable	Not applicable	Not applicable	19	19
3008	Not applicable	Not applicable	63	Not applicable	35	35
2176	Not applicable	Not applicable	87		48	48
2056	Not applicable	87	92		51	51
1536	187		122		68	68
1024	279		181		101	101
768	368		237		133	133
512	539		344		197	197
384	702		445		258	258
256	1009		629		376	376
128	1788		1072		688	688
64	2906		1655		1177	1177
32	4237		2267		1824	1824
16	5494		2785		2512	2512
8	6451		3144		3105	3105
4	7042		3367		4545	4545

***Increased frame rates with reduced ROI available only when In-Sensor binning is not active

Horizontal Cropping (Partial Scan)

Genie Nano-5G 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 4 to define the start of the video line.
- Horizontal Width decrements from maximum in pixel counts of 8 (that is, the video width is in steps of 8 pixels).



Using the Multiple ROI Mode

Genie Nano-5G monochrome cameras implement the Multiple ROI mode (region of interest) features, which allow having 2 to 16 smaller image ROI areas versus the single ROI area possible with vertical and horizontal crop functions.

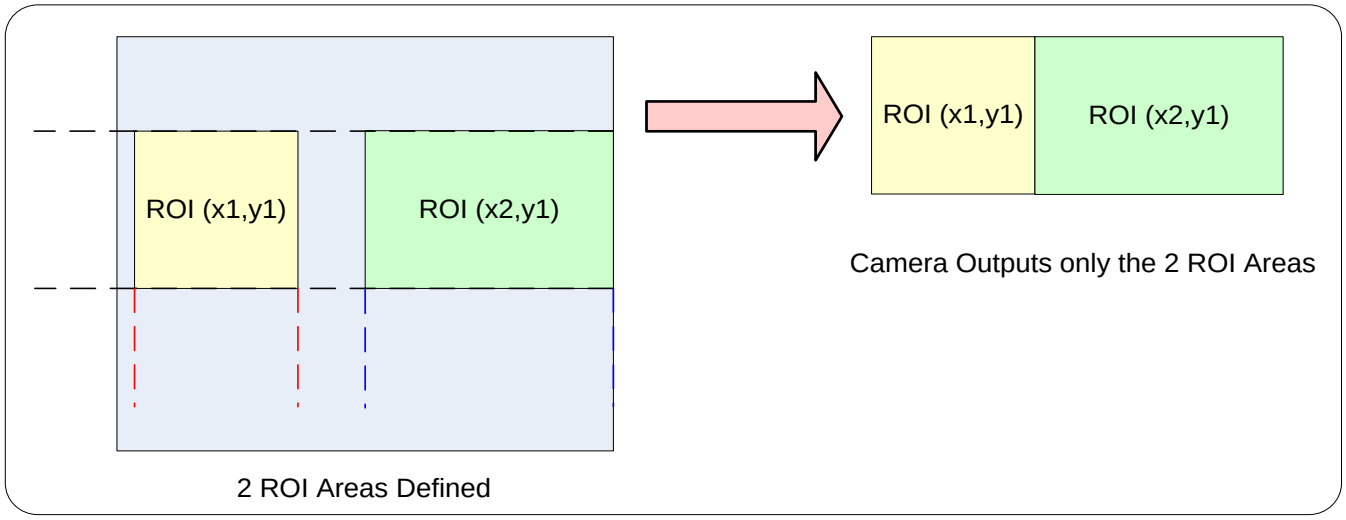
These multiple areas are combined as one output image, reducing transfer bandwidth requirements, plus with the added benefit that any reduction of the number of vertical lines output will result in a greater possible camera frame rate. This increased frame rate increase (written to internal memory) is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

Important Usage Details

- Two to 16 ROI areas are supported by the Genie Nano-5G (4x4 matrix maximum).
- For any selected ROI, the Offset X/Offset Y features define the upper left corner of the ROI.
- Offset, Width, and Height features have individual increment values (step size) to consider.
- The first ROI of any row sets the "height value" for any other ROI in that row.
- The first ROI of any column sets the "width value" of any other ROI in that column.
- Note that the Nano-5G firmware by default provides a 4x4 sample multi-ROI setup for easy verification of this function.

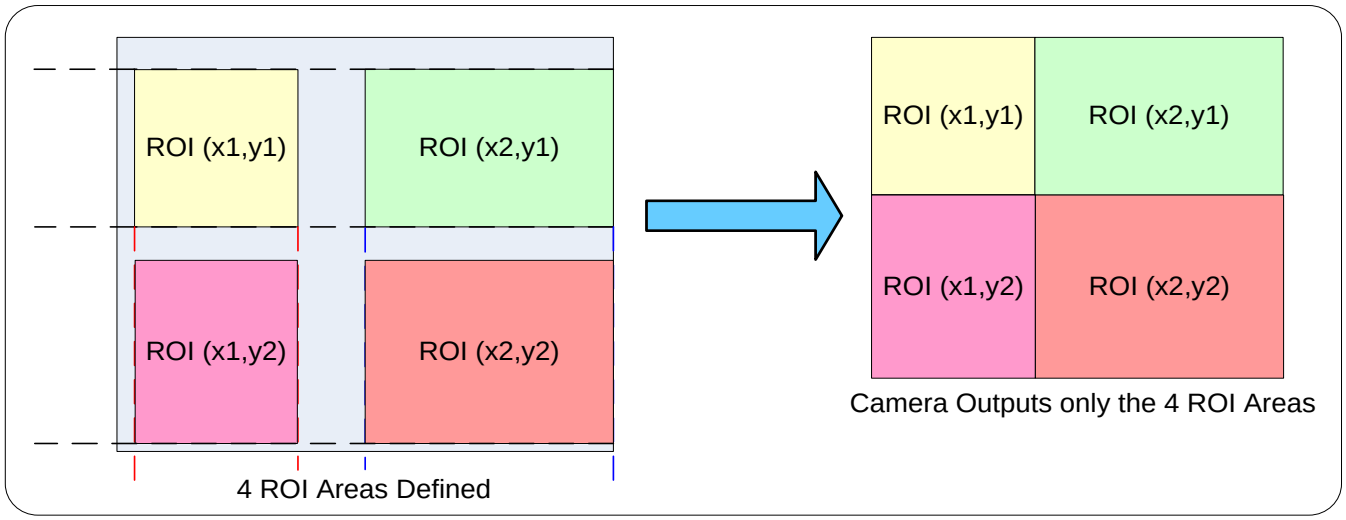
The following graphics show examples of the multi-ROI function (2x1 and 2x2 areas), the resultant camera output, and the constraints when configuring the ROI areas.

Example: Two Horizontal ROI Areas (2x1)



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

Example: Four ROI Areas (2x2)

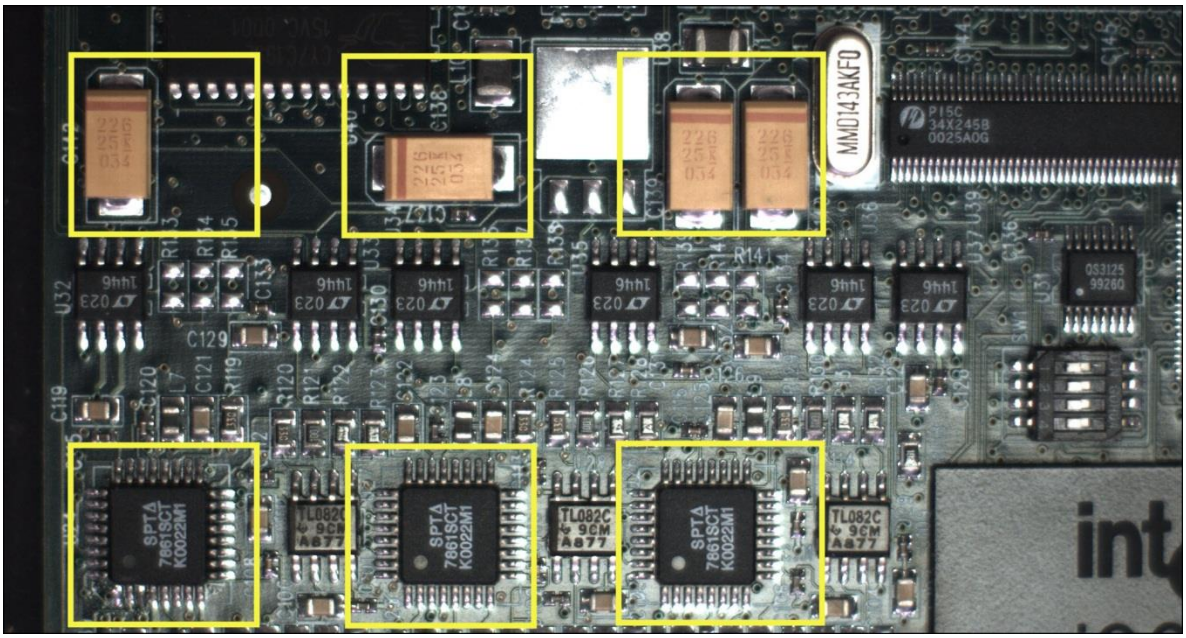


- Note that ROI(x1, y1) defines the height of any ROI in that row.
- ROI(x2, y1) can have a different width.
- ROI(x1, y2) can have a different height relative to ROI(x1,y1).
- The camera output image frame consists only of the ROI areas, in the same order as the ROI rows and columns. The user must account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

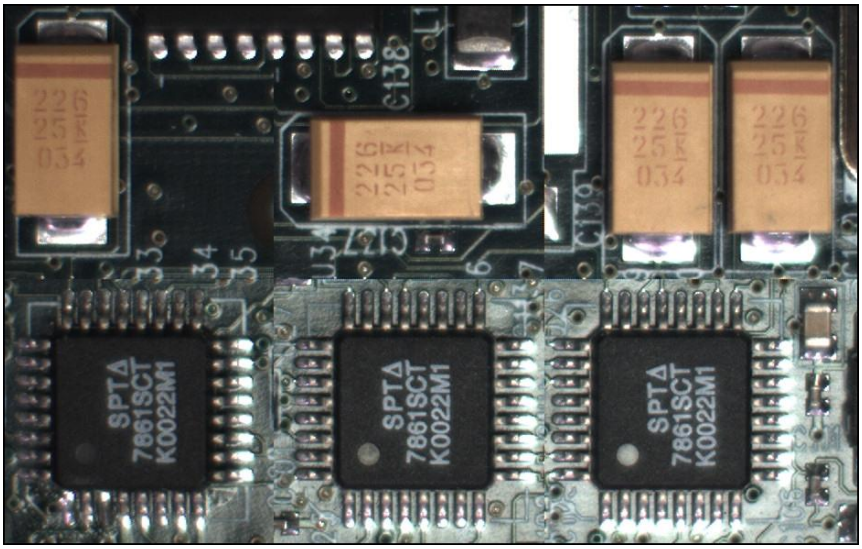
Example: Actual Sample with Six ROI Areas (3x2)

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

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



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



Horizontal and Vertical Flip

The Image Flip features activate image acquisition with horizontal and/or vertical inversion.

- Support of one or both of these functions is Genie Nano-5G model specific since it is a function of sensor data readout, not post sensor processing (thus internal test images cannot be flipped).
- When image flip is supported directly at the sensor, activation of the flip function does not reduce the maximum frame rate possible from that model of Nano.
- The Image flip functions operate both on full image acquisitions and when using multi-ROI. Both modes are described below.

Image Flip – Full Frame

With full frame acquisitions, live horizontal and/or vertical image flips function as expected.

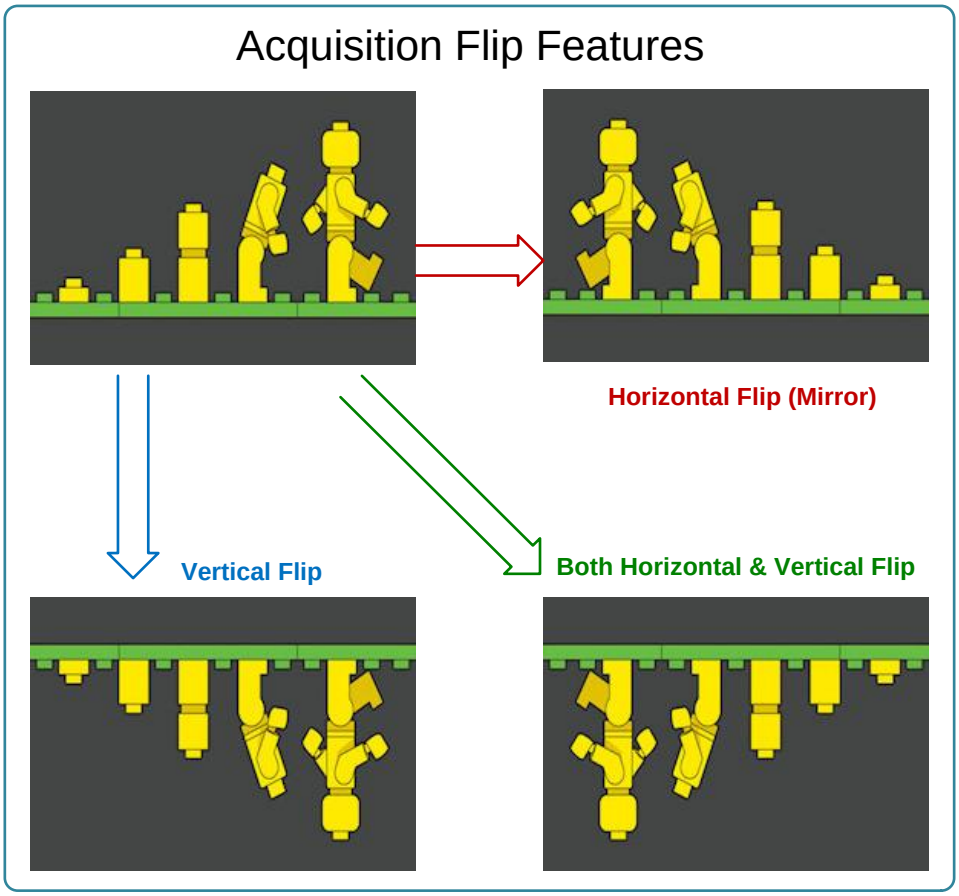
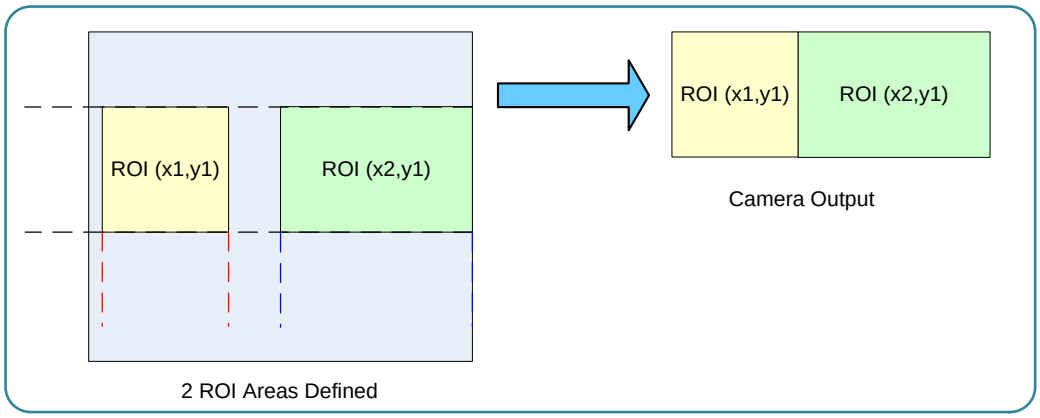


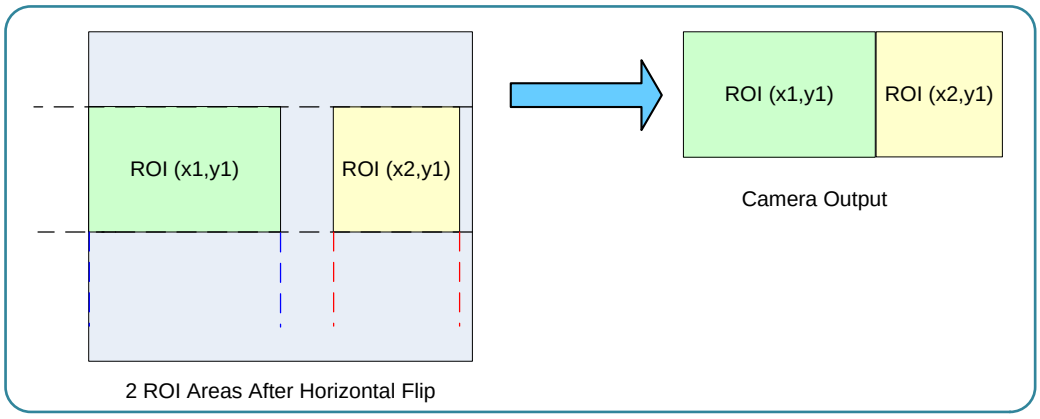
Image Flip – Multi-ROI Mode

Image acquisition flips with multi-ROI enabled is implemented as follows:

- The first graphic below shows a simple multi-ROI of two areas, where the camera output is composed of only those two areas.
- As shown in the second graphic, the multi-ROI implementation resizes the programmed ROI areas so that the same exact image areas are output by the camera but flipped as expected.
- Note that the ROI indexes do not transpose—just their size and offsets.
- All multi-ROI setup constraints remain as described in the previous section describing the Multi-ROI mode.



Horizontal Flip with Multi-ROI

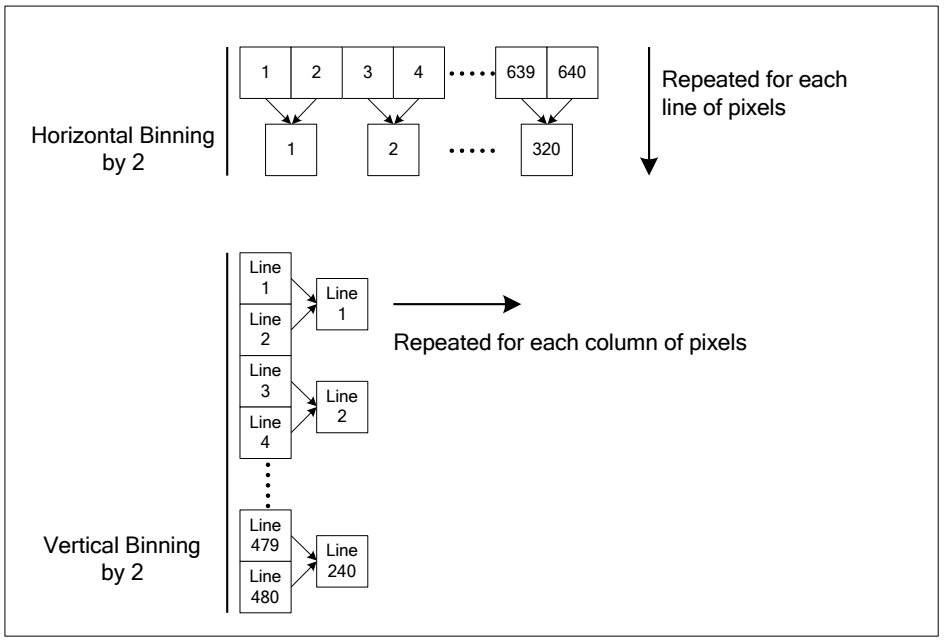


Binning Function and Limitations

Binning is the process where the charge on two (or more) adjacent pixels is combined. This results in increased light sensitivity since there is twice the sensor area to capture photons. The sensor spatial resolution is reduced but the improved low-light sensitivity plus lower signal-noise ratio may solve a difficult imaging situation. The user can evaluate the results of the binning function on the Genie Nano-5G by using CamExpert.

Horizontal and vertical binning functions are independent, by factors of 2 or 4 in each axis. Specifically if horizontal binning only is activated, a nominal 640x480 image is reduced to 320x480. If vertical binning only is activated, the image is reduced to 640x240. With both binning modes activated, the resulting image is 320x240.

Binning is performed digitally, therefore there is no increase in acquisition frame rate. The following graphic illustrates binning.



Horizontal and Vertical Binning Illustration

Horizontal Binning Constraints

- Horizontal Binning of 2 requires a minimum frame width of 128 pixels or more.
- Horizontal Binning of 4 requires a minimum frame width of 256 pixels or more.

Vertical Binning Constraints

- Vertical Binning of 4 is available if the image height before binning is a multiple of 4 lines.
- Vertical Binning of 2 is available if the image height before binning is a multiple of 2 lines.

Internal Test Pattern Generator

The Genie Nano-5G 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-5G 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.

The Nano-5G Test Patterns are:

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

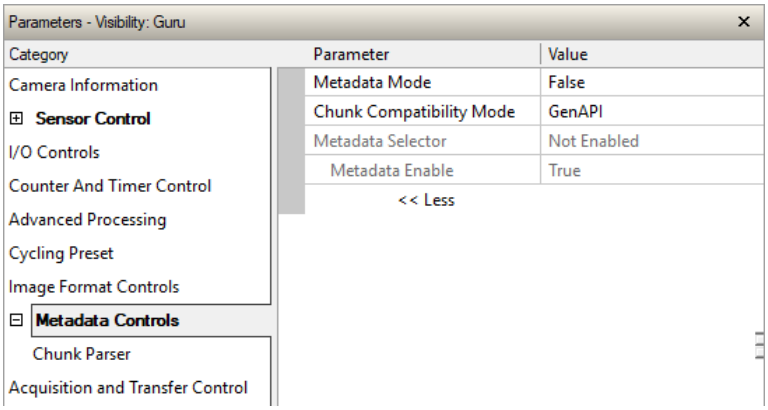
- **Grey Vertical ramp**: *Image is filled vertically with an image that goes from the darkest possible value to the brightest.*

- **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.

	**Important**: When an internal Nano-5G Test Image is selected, the Metadata feature values for Exposure Time and Exposure Delay are not valid values and must be ignored.

Metadata Control Category

The Genie Nano-5G Metadata controls as shown by CamExpert, has features to enable and select inclusion of chunk data with the image payload (as specified by the specification GigE Vision 1.2). Teledyne DALSA provides header files for developers managing Genie Nano-5G LUT data and chunk payload data as supported by GigE Vision 1.2. Refer to section following the table of metadata features.



Metadata Control Category Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Metadata Mode	ChunkModeActive	Activates the inclusion of chunk data (metadata) in the payload of the image. Note that when metadata is enabled using the ChunkModeActive feature, all available metadata is enabled; individual metadata cannot be enabled/disabled.	1.00 Expert
	False	*No chunk data.*	
	True	*Chunk data included in payload*	
Chunk Compatibility Mode	chunkCompatibilityMode	Selects the format of the chunk data (metadata) in the payload of the image.	1.00 Beginner DFNC
Gen API	*GenAPI*	*Metadata compatible with GenICam GenAPI.*	

Metadata Selector	ChunkSelector	Selects the specific metadata to control, when enabled.	1.00 Expert DFNC
	OffsetX	*Add the OffsetX value used during the image acquisition to the metadata attached to the image*	
	OffsetY	*Add the OffsetY value used during the image acquisition to the metadata attached to the image.*	
	Width	*Add the Width value used during the image acquisition to the metadata attached to the image.*	
	Height	*Add the Height value used during the image acquisition to the metadata attached to the image.*	
	PixelFormat	*Add the PixelFormat value used during the image acquisition to the metadata attached to the image.*	
	ExposureTime	*Add the ExposureTime value used during the image acquisition to the metadata attached to the image.*	
	ExposureDelay	*Add the ExposureDelay value used during the image acquisition to the metadata attached to the image. Supported only in GenAPI compatibility mode.*	
	cyclingPresetCurrentActiveSet	*Add the cyclingPresetCurrentActiveSet value used during the image acquisition to the metadata attached to the image.*	
	Timestamp	*Copies the timestampValue value at the start of frame to the metadata attached to the image.*	
	LineStatusAll	*Copies the LineStatusAll value at the start of exposure to the metadata attached to the image.*	
	Gain	*Add the Gain feature value used during the image acquisition to the metadata attached to the image.*	
	Counter1ValueAtReset	*Copies the value of the feature "*counterValueAtReset*" at the start of Frame Readout, to the Metadata attached to the image. Supported only in GenAPI compatibility mode.*	
	DeviceID	*Add the DeviceID value to the metadata attached to the image.*	
	DeviceUserID	*Add the DeviceUserID value to the metadata attached to the image.*	
	TestImageSelector	*Add the TestImageSelector value used during the image acquisition to the metadata attached to the image.*	
	BinningVertical	*Add the BinningVertical value used during the image acquisition to the metadata attached to the image. (Monochrome models only)*	
	BinningHorizontal	*Add the BinningHorizontal value used during the image acquisition to the metadata attached to the image. (Monochrome models only)*	
Metadata Enable	ChunkEnable	Gets the enable state of metadata. When enabled, metadata is included in the payload of the image. Note that when metadata is enabled using the ChunkModeActive feature, all available metadata is enabled; individual metadata cannot be enabled/disabled. <RO>	1.00 Expert
	False	*Selected metadata Disabled*	
	True	*Selected metadata Enabled*	
Chunk Binning Horizontal	ChunkBinningHorizontal	Number of horizontal pixels to combine in the payload image.	1.00 Guru
Chunk Binning Vertical	ChunkBinningVertical	Number of vertical pixels to combine in the payload image.	1.00 Guru

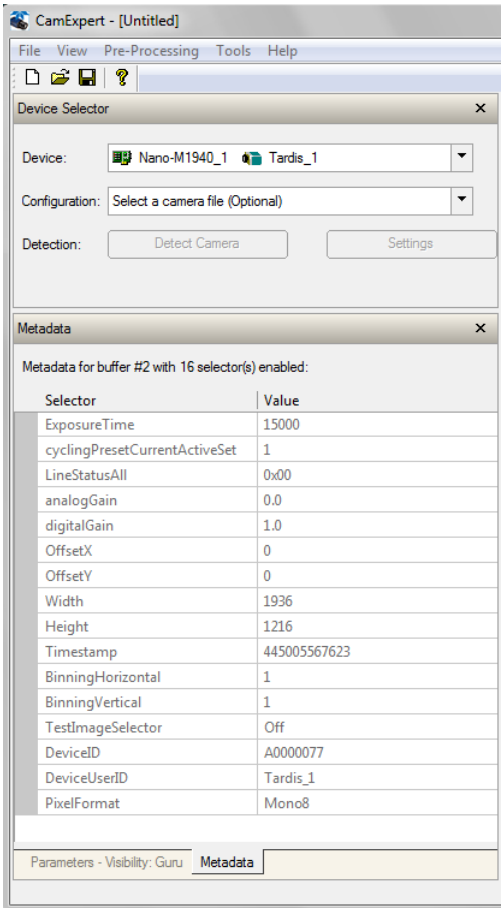
Important Metadata Notes:

- When using Metadata in conjunction with TurboDrive, the Nano-5G driver (all models) requires that the image acquisition width (horizontal crop) must be a minimum of 160 pixels in 8-bit mode or 96 pixels in 10/12-bit mode. The driver requires this minimum width to correctly apply the TurboDrive compression algorithm. When acquisitions are cropped more than the minimum widths, TurboDrive is automatically disabled while Metadata remains active.

Extracting Metadata Stored in a Sapera Buffer

For Sapera LT developers, the "SapMetadata" class is included with Sapera version 8.50.

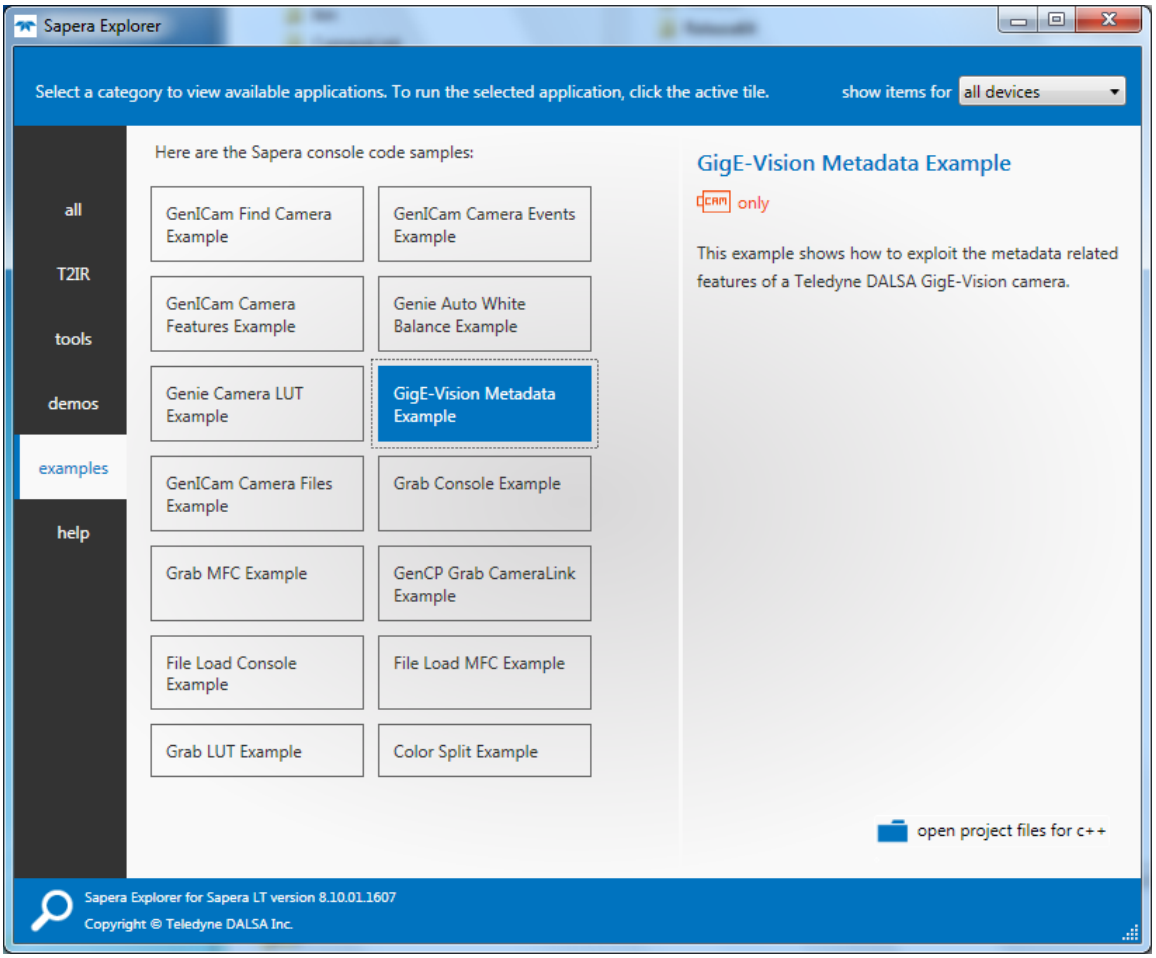
Sapera also provides two methods to view metadata. The Sapera CamExpert tool provides a tab (when the Metadata feature is enabled) to view the metadata of the last frame capture, as shown by the following image.



Alternatively, Sapera LT provides a demo program called GigEMetaDataDemo.exe which will grab a number of frames and display the metadata or save it to a file (.csv). In addition, source code and C++ project files are included for a console based executable.

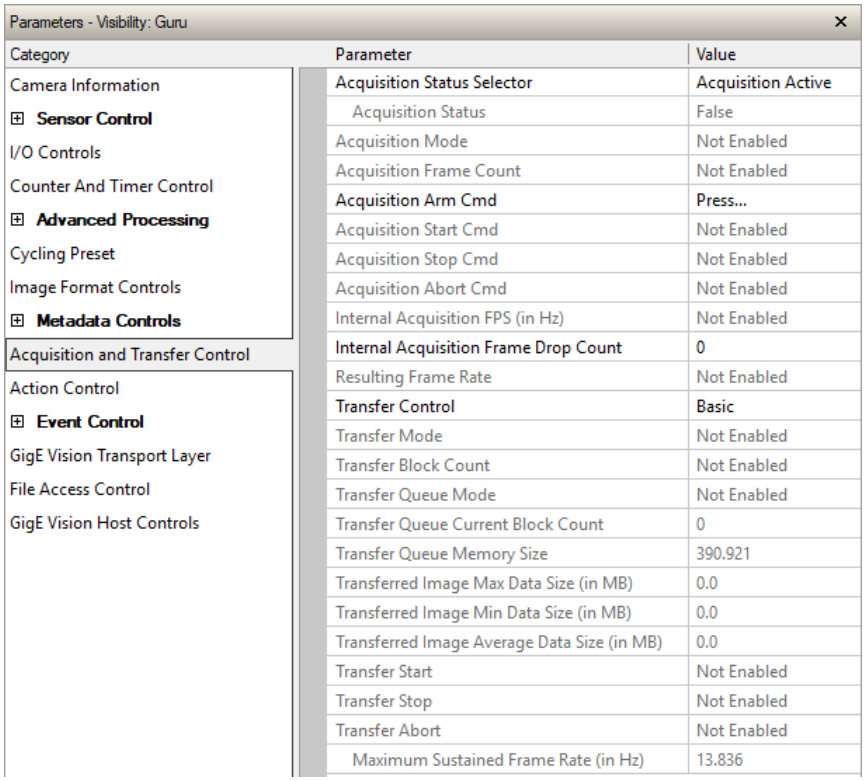
The following figure shows the Sapera Explorer tool screen with the Metadata Example highlighted.

	Important: When an internal Nano-5G Test Image is selected, the Metadata feature values for Exposure Time (*ExposureTime*) and Exposure Delay (*exposureDelay*) are not valid values and must be ignored. When in free running (not triggered) mode, the Metadata value for feature Exposure Delay (*exposureDelay*) is not a valid value and must be ignored. The value of LineStatusAll is updated on the start of exposure. For Sony sensor models, the metadata "analogGain" represents the raw gain value divided by 100.



Acquisition and Transfer Control Category

The Genie Nano-5G Acquisition and Transfer controls, as shown by CamExpert, has parameters used to configure the optional acquisition modes of the device.



Acquisition and Transfer Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Acquisition Status Selector	AcquisitionStatusSelector	Selects the internal acquisition signal to read using AcquisitionStatus.	1.00 Expert
Acquisition Active	*AcquisitionActive*	*Device is currently doing an acquisition of one or many frames.*	
Acquisition Trigger Wait	*AcquisitionTriggerWait*	*Device is currently waiting for a trigger to start the acquisition.*	
Acquisition Status	AcquisitionStatus	Reads the state of the internal acquisition signal selected using the Acquisition Status Selector feature. *(i.e. False / True)*	1.00 Expert
Acquisition Mode	AcquisitionMode	Set the acquisition mode of the device. It defines the number of frames to capture during an acquisition and the way the acquisition stops.	1.00 Beginner
Single Frame	*SingleFrame*	*One frame is captured for each AcquisitionStart Command. An AcquisitionStop occurs at the end of the Active Frame.*	
Multi-Frame	*MultiFrame*	*A sequence of frames is captured for each AcquisitionStart Command. The number of frames is specified by AcquisitionFrameCount feature. An AcquisitionStop occurs at the end of the Active Frame(s)*	
Continuous	*Continuous*	*Frames are captured continuously with AcquisitionStart until stopped with the AcquisitionStop command.*	
Acquisition Frame Count	AcquisitionFrameCount	Number of frames to be acquired in MultiFrame acquisition mode.	1.00 Beginner
Acquisition Arm Cmd	AcquisitionArm	Arms the device before an AcquisitionStart command. This optional command validates all the current features for consistency and prepares the device for a fast start of the acquisition. If not used explicitly, this command is automatically executed at the first AcquisitionStart but will not be repeated for subsequent ones unless a data transfer related feature is changed in the device.	1.00 Guru
Acquisition Start Cmd	AcquisitionStart	Start image capture using the currently selected acquisition mode. The number of frames captured is specified by AcquisitionMode feature.	1.00 Beginner
Acquisition Stop Cmd	AcquisitionStop	Stops the Acquisition of the device at the end of the current frame unless the triggerFrameCount feature is greater than 1. (WO)	1.00 Beginner
Acquisition Abort Cmd	AcquisitionAbort	Aborts the acquisition immediately. This will end the capture without completing the current Frame or aborts waiting on a trigger. If no acquisition is in progress, the command is ignored.	1.00 Beginner
Transfer Control	TransferControlMode	Sets the method used to control the transfer.	1.00 Expert
Basic	*Basic*	*Basic mode ensures maximum compatibility but does not allow for control of the transfer flow.*	
User Controlled	*UserControlled*	*Manual mode allows maximum control of the transfer flow.*	
Transfer Mode	TransferOperationMode	Sets the operation mode of the transfer	1.00 Expert
Continuous	*Continuous*	*Blocks are transferred continously until stopped with the TransferStop command.*	
Multi Block	*MultiBlock*	*The transfer terminates after the transition on the TransferBlockCount or before on a user request.*	

Transfer Queue Mode *First In First Out* *Circular When Stopped*	TransferQueueMode *FirstInFirstOut* *firstInFirstOut_CircularWhenStopped*	Specifies the operation mode of the transfer queue. *First block (images) in are transferred out first. Frames can accumulate in the queue until it is full at which point the newest new frames will be discarded.* *While the transfer module is streaming blocks (images), the first blocks in are transferred out first. Frames in the queue are not removed until they are transferred out or the transfer function is aborted. When the transfer module is stopped and the queue fills by continuing acquisitions, the oldest frames in the queue are then overwritten by new frames.*	1.00 Beginner
Transfer Queue Current Block Count	transferQueueCurrentBlockCount	Returns the current number of blocks in the transfer queue.	1.00 DFNC Expert
Transfer Queue Memory Size	transferQueueMemorySize	Indicates the amount of device memory (in MB) available for internal image frame accumulation in the transfer queue. Increasing or decreasing memory reserved by devicePacketResendBufferSize will affect total memory available here.	1.00 DFNC Expert
Transferred Image Max Data Size (in MB)	transferMaxBlockSize	Biggest image (GVE blocks) data size sent on the GigE cable. The value is displayed in MB. Use this value to calculate the frame rate transferred on the GigE cable. GigE Link speed (~595 MB) divided by Biggest Image (value) = Max fps transferred. Note: This statistic is reset when acquisitions are stopped.	1.00 DFNC Beginner
Transferred Image Min Data Size (in MB)	transferMinBlockSize	Smallest image (GVE blocks) data size sent on the GigE cable. The value is displayed in MB. Note: This statistic is reset when acquisitions are stopped.	1.00 DFNC Beginner
Transferred Image Average Data Size (in MB)	transferAverageBlockSize	Average size of the last 16 images (GVE blocks) of data sent on the GigE cable. The value is displayed in Megabytes. Use this value to calculate the sustained frame rate transferred on the GigE cable. GigE Link speed (~595 MB) divided by Average size (value) = Max fps transferred. When TurboDrive is enabled, this feature allows monitoring the average throughput.	1.00 DFNC Beginner
Transfer Start	TransferStart	Starts the streaming of data block(s) to another device.	1.00 Expert
Transfer Stop	TransferStop	Stops the streaming of data block(s) to another device.	1.00 Expert
Transfer Abort	TransferAbort	Aborts the streaming of data block(s) to another device.	1.00 Expert
Maximum Sustained Frame Rate (in Hz)	maxSustainedFrameRate	Maximum sustained frame rate that can be achieved by the camera in the current configuration (Resolution, Pixel Format and the camera's internal bandwidth limitations). When TurboDrive is enabled, this value also takes the feature transferAverageBlockSize into account.	1.00 DFNC Beginner
Device Registers Streaming Start	DeviceRegistersStreamingStart	Announces the start of registers streaming without immediate checking for consistency.	1.00 Invisible
Device Registers Streaming End	DeviceRegistersStreamingEnd	Announces end of registers streaming and performs validation for registers consistency before activating them.	1.00 Invisible
Device Feature Streaming Start	DeviceFeaturePersistenceStart	Announces the start of feature streaming without immediate checking for consistency.	1.00 Invisible
Device Feature Streaming End	DeviceFeaturePersistenceEnd	Announces end of feature streaming and performs validation for feature consistency before activating them.	1.00 Invisible
Register Check	DeviceRegistersCheck	Performs an explicit register set validation for consistency.	1.00 Invisible
Registers Valid	DeviceRegistersValid	States if the current register set is valid and consistent.	1.00 Invisible

Acquisition Buffering

All acquisitions are internally buffered and transferred as fast as possible to the host system. This internal buffer allows uninterrupted acquisitions no matter of any transfer delays that might occur (such as acquisition frame rates faster that the Gigabit Ethernet link or the IEEE Pause frame). Only when the internal buffer is consumed would an Image Lost Event be generated.

Using Transfer Queue Current Block Count with CamExpert

This feature returns the number of frames buffered within the Genie Nano-5G pending transfer to the host system. Image frames are buffered in cases where the host system is temporarily busy or cases of high network traffic with other devices through the same Ethernet switch. By buffering image frames, the Genie Nano-5G will not need to drop frames when there are temporary delays to the transfer.

When using CamExpert, right click on this field and then click on Refresh from the pop-up menu. The current frame count in the transfer buffer is displayed in the *Value* field. During live grab, if the number of frames in the transfer buffer is increasing, then there is a problem with the network or host bandwidth being exceeded. The ImageLost event occurs when all buffer space is consumed.

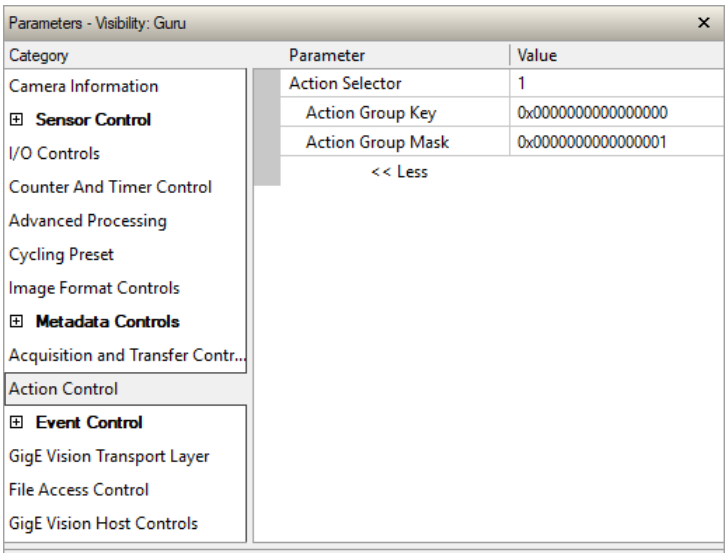
Features that cannot be changed during a Transfer

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

Feature Group	Features Locked During a Sapera Transfer
CAMERA INFORMATION	UserSetLoad
SENSOR CONTROL	*NA*
I/O CONTROL	*NA*
COUNTER AND TIMER CONTROL	*NA*
IMAGE FORMAT CONTROL	PixelFormat OffsetX (except within the Cycling Mode) OffsetY (except within the Cycling Mode) Binning (except within the Cycling Mode) Width Height Multi-ROI functions
Metadata Controls	ChunkModeActive
ACQUISITION AND TRANSFER CONTROL	DeviceRegistersStreamingStart DeviceRegistersStreamingEnd
EVENT CONTROL	*NA*
GIGE VISION TRANSPORT LAYER CONTROL	GevSCPSPacketSize
GIGE VISION HOST CONTROL	InterPacketTimeout InterPacketTimeoutRaw ImageTimeout
FILE ACCESS CONTROL	*NA*

Action Control Category

The Genie Nano-5G Action Control group, as shown by CamExpert, has features related to the control of the Action Command mechanism for the device.



Action Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Action Selector	ActionSelector	Selects the action command to configure. Certain Nano-5G features support 2 Action commands.	1.00 Beginner
Action Group Key	ActionGroupKey	*Nano-5G default=0 for all action command.* Provides the key that the device uses to validate that the action command message is part of the requested group.	1.00 Guru
Action Group Mask	ActionGroupMask	*Nano-5G default=1 for action 1, or 2 for action 2.* Provides the mask used to filter particular action command messages for the selected action.	1.00 Guru
Action Device Key	ActionDeviceKey	*This Write Only feature provides a method to uniquely target Action Commands to specific Nano-5G cameras.* *Using an application supplied by Teledyne DALSA, the user writes an ID value which cannot be read, but allows specific Nano-5G cameras to act on commands.* *Contact Sales for additional information.*	1.00 Invisible

GigE Vision Action Command Reference

An Action Command is a single Broadcast packet sent from the Host Software application to all cameras connected on the same network. How cameras act on an Action Command depends on its designed feature support. Cameras receiving the Action Command broadcast may have one or multiple functions acting on that received command.

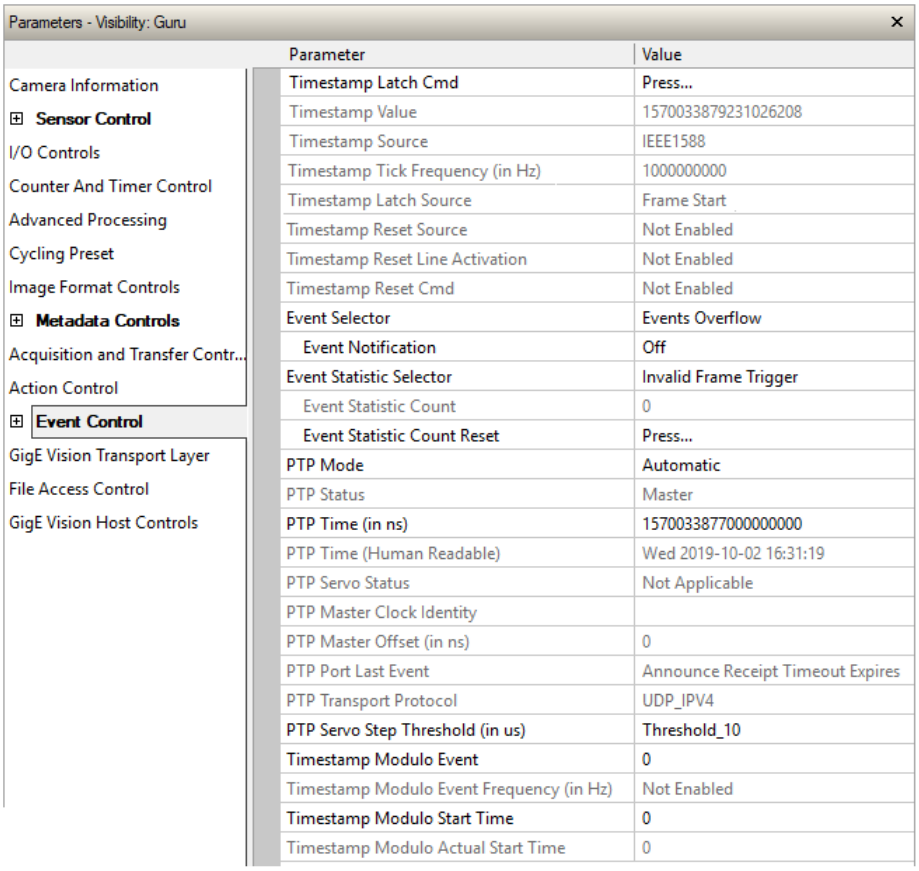
Please refer to the GigE Vision® Specification — version 2.0 RC6, for configuration and usage details. Contact Teledyne DALSA Support and request example code for Action Command usage.

Nano-5G Features Supporting Action Command

Feature Category	Feature	Enumeration
I/O Control	Trigger Selector	Single Frame Trigger (Start) MultiFrame Trigger (Start)
	Trigger Source	Action 1
	Output Line Source	Pulse On: Action 1 Pulse On: Action 2
Counter and Timer Control	Counter Start Source	Action 1 Action 2
	Timer Start Source	Action 1 Action 2
Event Control	Timer Reset Source	Action 2

Event Control Category

The Genie Nano-5G Event control, as shown by CamExpert, has parameters used to configure Camera Event related features.



Event Control Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Timestamp Latch Cmd	timestampControlLatch	Latch the current timestamp internal counter value in the timestampValue feature.	1.00 Expert DFNC
Timestamp Value	timestampValue	Returns the 64-bit value of the timestamp, which is the internal Clock timer or the PTP clock timer, depending on the Timestamp Source selection.	1.00 Expert DFNC
TimeStamp Source	timestampSource	Specifies the source used as the incrementing signal for the Timestamp register.	1.00 Expert DFNC
Internal Clock	*InternalClock*	*The timestamp source is generated by the camera internal clock. Refer to the timestampTickFrequency feature for the time base.*	
IEEE1588	*IEEE1588*	*The timestamp source is controlled by the network IEEE1588 protocol. This source is automatically selected when PTP mode is enabled.*	
Timestamp Tick Frequency	timestampTickFrequency	Indicates the number of timestamp ticks (or increments) during 1 second (frequency in Hz). This feature changes depending on the TimeStamp Source.	1.00 Expert DFNC
Timestamp Latch Source	timestampLatchSource	Specifies the internal event or signal that will latch the timestamp counter into the timestamp buffer.	1.00 Expert DFNC
Frame Start	*FrameStart*	*The timestamp is latched on frame start.*	
Timestamp Reset Cmd	timestampControlReset	Resets the timestamp counter to 0. This Feature resets both the internal Clock timer and the PTP clock timer. Note that the PTP Mode must be disabled first to reset the PTP clock timer.	1.00 Expert DFNC
Timestamp Reset Source	timestampResetSource	Specifies the internal signal or physical input line to use as the timestamp reset source.	1.01 Expert DFNC
None	*None*	*No timestamp reset source is specified. Note that the Timestamp reset command can still reset the counter.*	
Line 1	*Line1*	*Use input line 1 as the timestamp reset source.*	
Line 2	*Line2*	*Use input line 2 as the timestamp reset source.*	
Action 2	*Action2*	*Select the GigEVision Action Command 2 as the timestamp reset source. This is a broadcast command that multiple devices can respond to simultaneously.*	
Timestamp Reset Line Activation	timestampResetLineActivation	Specifies the activation mode to reset the timestamp counter on the selected line of the *TimestampResetSource* feature.	1.01 Expert DFNC
Falling Edge	*FallingEdge*	*Reset the timestamp counter on the falling edge of the source signal.*	
Rising Edge	*RisingEdge*	*Reset the timestamp counter on the rising edge of the source signal.*	
Any Edge	*AnyEdge*	*Reset the timestamp counter on the falling or rising edge of the source signal.*	

Event Selector	EventSelector	Select the Event to enable/disable with the EventNotification feature.	1.00 Expert
Start of Frame	*FrameStart*	*Event sent on control channel on an Active Frame. This occurs with the start of the exposure delay.*	
Start of Exposure	*ExposureStart*	*Event sent on control channel on start of exposure.*	
End of Exposure	*ExposureEnd*	*Event sent on control channel on end of exposure.*	
Acquisition Start Next Valid	*AcquisitionStartNextValid*	*Event sent on control channel when the AcquisitionStart command can be used again.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Event sent on control channel when a valid frame trigger is generated.*	
Invalid Frame Trigger	*InvalidFrameTrigger*	*Event sent on control channel when a frame trigger occurs in an invalid Trigger region. Therefore the trigger is rejected and no frame acquisition occurs.*	
Image Lost	*ImageLost*	*Event sent on control channel when an image is lost due to insufficient memory.*	
Counter 1 End	*Counter1End*	*Event sent when counter 1 has reached the counterDuration count.*	
Line 1 Rising Edge	*Line1RisingEdge*	*Event sent when a rising edge is detected on input line 1.*	
Line 1 Falling Edge	*Line1FallingEdge*	*Event sent when a falling edge is detected on input line 1.*	
Line 2 Rising Edge	*Line2RisingEdge*	*Event sent when a rising edge is detected on input line 2.*	
Line 2 Falling Edge	*Line2FallingEdge*	*Event sent when a falling edge is detected on input line 2.*	
Events Overflow	*eventsOverflow*	*Event sent on control channel when all previous active events have been disabled because the camera cannot send them fast enough, generating in internal message overflow. Required events must be re-enabled manually.*	
Event Notification	EventNotification	Enable Events for the event type selected by the EventSelector feature.	1.00 Expert
Off	*Off*	*The selected event is disabled.*	
On	*On*	*The selected event will generate a software event.*	
GigEVisionEvent	*GigEVisionEvent*	*The selected event will generate a software event. This entry is deprecated.* *Using "On" is recommended.*	
Event Statistic Selector	eventStatisticSelector	Selects which Event statistic to display.	1.00 Expert DFNC
Invalid Frame Trigger	*InvalidFrameTrigger*	*Counts the frame trigger occurring in an invalid Trigger region.*	
Image Lost	*ImageLost*	*Image is acquired but lost before it's been transferred.*	
Packet Resend	*PacketResend*	*Counts the number of individual packets that are resent.*	
Packet Resend Request Dropped	*PacketResendRequestDropped*	*Counts the number of packet resend requests dropped. The camera queues the packet resend requests until they are processed. There is a limit to the number of requests that can be queued by the camera. When a new request is received and the queue is full, the request is dropped but this statistic is still incremented.*	
Ethernet Pause Frame Received	*EthernetPauseFrameReceived*	*Counts the number of Ethernet Pause Frame received. Feature limited to 65536 events. See also PAUSE Frame Support for information on Ethernet Packet size.*	
Event Statistic Count	eventStatisticCount	Display the count of the selected Event.	1.00 Expert DFNC
Event Statistic Count Reset	eventStatisticCountReset	Reset the count of the selected Event.	1.00 Expert DFNC
PTP Mode	ptpMode	Specifies the PTP (IEEE-1588: Precision Time Protocol) operating mode as implemented by the Genie Nano-5G.	1.00 Expert DFNC
Off	*Off*	*PTP is disabled on the device.*	
Automatic	*Automatic*	*PTP is enabled on the device. The camera can become a Master or Slave device. The Master device is automatically determined as per IEEE-1588.*	
Slave	*Slave*	*Device will operate in PTP slave-only mode.*	

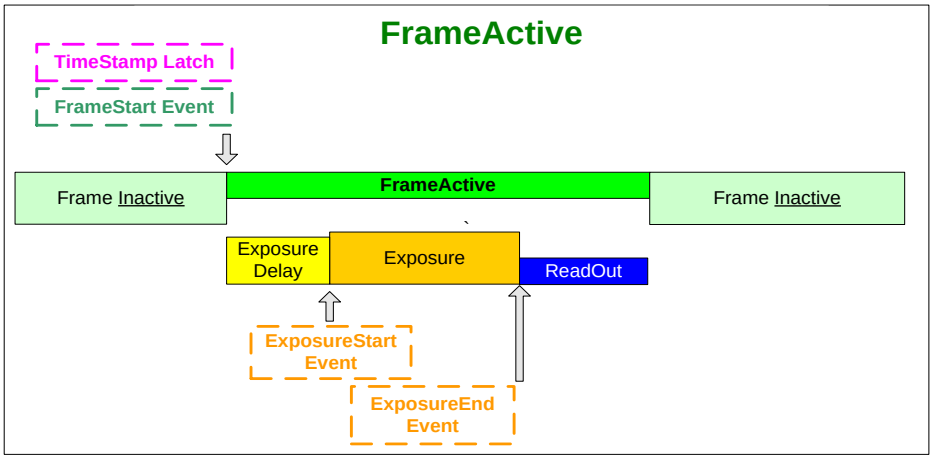
PTP Status	ptpStatus	Specifies dynamically the current PTP state of the device. (ref: IEEE Std 1588-2008)	1.00 Expert DFNC
Initializing	*Initializing*	*The port initializes its data sets, hardware, and communication facilities. No port of the clock shall place any PTP messages on its communication path. If one port of a boundary clock is in the INITIALIZING state, then all ports shall be in the INITIALIZING state.*	
Faulty	*Faulty*	*The fault state of the protocol. A port in this state shall not place any PTP messages except for management messages that are a required response to another management message on its communication path. In a boundary clock, no activity on a faulty port shall affect the other ports of the device. If fault activity on a port in this state cannot be confined to the faulty port, then all ports shall be in the FAULTY state.*	
Disabled	*Disabled*	*The port shall not place any messages on its communication path. In a boundary clock, no activity at the port shall be allowed to affect the activity at any other port of the boundary clock. A port in this state shall discard all PTP received messages except for management messages.*	
Listening	*Listening*	*The port is waiting for the announceReceiptTimeout to expire or to receive an Announce message from a master. The purpose of this state is to allow orderly addition of clocks to a domain. A port in this state shall not place any PTP messages on its communication path except for Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up, or signaling messages, or management messages that are a required response to another management message.*	
PreMaster	*PreMaster*	*The port shall behave in all respects as though it were in the MASTER state except that it shall not place any messages on its communication path except for Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up, signaling, or management messages.*	
Master	*Master*	*The port is behaving as a master port.*	
Passive	*Passive*	*The port shall not place any messages on its communication path except for Pdelay_Req, Pdelay_Resp, Pdelay_Resp_Follow_Up, or signaling messages, or management messages that are a required response to another management message.*	
Uncalibrated	*Uncalibrated*	*One or more master ports have been detected in the domain. The appropriate master port has been selected, and the local port is preparing to synchronize to the selected master port. This is a transient state to allow initialization of synchronization servos, updating of data sets when a new master port has been selected, and other implementation-specific activity.*	
Slave	*Slave*	*The port is synchronizing to the selected master port.*	
GrandMaster	*GrandMaster*	*The port is in the GrandMaster state (i.e. has the best clock). The camera can become GrandMaster only if the PTP Mode=Automatic and there's another device on the network that was Master.*	
Error	*Error*	*One or more ports have an error state.*	
PTP Time (in ns)	ptpTime	Sets the reference PTP timstamp, in nanoseconds. This used when this camera is the PTP Master. Refer to *ptpStatus* for the current PTP Master/Slave state of the camera. Note that feature write propagation delays between the host an camera clock hardware must be taken into account for real-time clock accuracy when using a UTC time reference.	1.00 Expert DFNC
PTP Time (Human Readable)	ptpTimeText	Converts PTP tim as UNIX epoch to human-readable date in UTC+00 time zone. This value gets updated when *timestampControlLatch* is executed.	1.00 Expert DFNC

PTP Servo Status	ptpServoStatus	Specifies the IEEE1588 servo status.	1.00 Expert DFNC
Unlocked	*Unlocked*	*The servo is not yet ready to track the master clock.*	
Synchronizing	*Synchronizing*	*The servo is unlocked and synchronizing to the master clock.*	
Locked	*Locked*	*The servo is adjusting (synchronizing) to the master clock.*	
Not Applicable	*NotApplicable*	*The servo state is currently not applicable.*	
PTP Master Clock Identity	ptpMasterClockId	Port identity of the current best master. The clock ID is an Extended Unique Identifier (EUI)-64 64-bit ID, converted from the 48-bit MAC address, by inserting 0xfffe at the middle of the MAC address.	1.00 Guru DFNC
PTP Master Offset (in ns)	ptpMasterOffsetNs	Dynamically returns the 64-bit value of the PTP offset with the master. This value is the input for clock corrections for the slave device clock servo algorithms.	1.00 Guru DFNC
PTP Port Last Event	ptpPortLastEvent	Logs the last PTP changed state event defining the last current status.	1.00 Expert DFNC
None	*None*	*None*	
Power up	*Powerup*	*Power up*	
Initialize	*Initialize*	*Initialize*	
Designated Enabled	*DesignatedEnabled*	*Designated Enabled*	
Designated Disabled	*DesignatedDisabled*	*Designated Disabled*	
Fault Cleared	*FaultCleared*	*Fault Cleared*	
Fault Detected	*FaultDetected*	*Fault Detected*	
State Decision Event	*StateDecisionEvent*	*State Decision Event*	
Qualification Timeout Expires	*QualificationTimeoutExpires*	*Qualification Timeout Expires*	
Announce Receipt Timeout Expires	*AnnounceReceiptTimeoutExpires*	*Announce Receipt Timeout Expires*	
Synchronization Fault	*SynchronizationFault*	*Synchronization Fault*	
Master Clock Selected	*MasterClockSelected*	*Master Clock Selected*	
Recommended State Master	*RS_Master*	*Recommended State Master*	
Recommended State Grand Master	*RS_GrandMaster*	*Recommended State Grand Master*	
Recommended State Slave	*RS_Slave*	*Recommended State Slave*	
Recommended State Passive	*RS_Passive*	*Recommended State Passive*	
PTP Transport Protocol	ptpTransportProtocol	Describes the PTP Transport Protocol used.	1.00 Expert DFNC
PTP Servo Step Threshold (in µs)	ptpServoStepThreshold	Specifies the servo step threshold (in µs). When the clock offset with the master exceeds the threshold, the servo unlocks and offset adjustment is started.	1.00 Expert DFNC
Threshold_10	*Threshold_10*	*10 µs threshold.*	
Threshold_20	*Threshold_20*	*20 µs threshold.*	
Threshold_100	*Threshold_100*	*100 µs threshold.*	
Threshold_500	*Threshold_500*	*500 µs threshold.*	
Threshold_1000	*Threshold_1000*	*1000 µs threshold.*	
Threshold_2000	*Threshold_2000*	*2000 µs threshold.*	
Timestamp Modulo Event	timestampModulo	Specifies the additional interval between the current timestamp tick and the event generated. This interval has an 80ns accuracy. Note that the value zero disables the event generator. The incremental step is 32ns.	1.00 Expert DFNC
Timestamp Modulo Event Frequency	timestampModuloFrequency	Returns the frequency of the timestamp Modulo Event (in Hz).	1.00 Expert DFNC

Timestamp Modulo Start Time	timestampModuloStartTime	Specifies the timestamp value that must be exceeded by the incrementing timestamp counter before the modulo event starts. This Feature is also used for a "Future" Frame Acquisition.	1.00 Expert DFNC
Timestamp Modulo Actual Start Time	timestampModuloActualStartTime	Displays the actual modulo event start time as used by the device. When the user specified "timestampModuloStartTime" is in the future, timestampModuloActualStartTime= timestampModuloStartTime. When the user specified "timestampModuloStartTime" has already past, the camera automatically recalculates a future value for "timestampModuloStartTime" using the user set "timestampModulo" feature value. This new start time is reported by "timestampModuloActualStartTime".	1.00 Expert DFNC
Frame Start Event ID	EventFrameStart	Event ID to identify the EventFrameStart software Event. (RO)	1.00 Guru
Exposure Start Event ID	EventExposureStart	Event ID to identify the EventExposureStart software Event. (RO)	1.00 Guru
Exposure End Event ID	EventExposureEnd	Event ID to identify the EventExposureEnd software Event. (RO)	1.00 Guru
Readout Start Event ID	EventReadoutStart	Event ID to identify the EventReadoutStart software Event. (RO)	1.00 Guru
Readout End Event ID	EventReadoutEnd	Event ID to identify the EventReadoutEnd software Event. (RO)	1.00 Guru
Valid Frame Trigger Event ID	EventInvalidFrameTrigger	Event ID to identify the EventInvalidFrameTrigger software Event. (RO)	1.00 Guru
InvalidFrameTrigger Event ID	EventInvalidFrameTrigger	Event ID to identify the EventInvalidFrameTrigger software Event. (RO)	1.00 Guru
AcquisitionStartNextValid Event ID	EventAcquisitionStartNextValid	Event ID to identify the EventAcquisitionStartNextValid software Event. (RO)	1.00 Guru
ImageLost Event ID	EventImageLost	Event ID to identify the EventImageLost software Event. (RO)	1.00 Guru
Counter 1 End ID	EventCounter1End	Event ID to identify the EventCounter1End software Event. (RO)	1.00 Guru
Line1 Rising Edge ID	EventLine1RisingEdge	Event ID to identify the EventLine1RisingEdge software Event. (RO)	1.00 Guru
Line2 Rising Edge ID	EventLine2RisingEdge	Event ID to identify the EventLine2RisingEdge software Event. (RO)	1.00 Guru
Line1 Falling Edge ID	EventLine1FallingEdge	Event ID to identify the EventLine1FallingEdge software Event. (RO)	1.00 Guru
Line2 Falling Edge ID	EventLine2FallingEdge	Event ID to identify the EventLine2FallingEdge software Event. (RO)	1.00 Guru
Events Overflow Event ID	EventeventsOverflow	Event ID to identify the EventeventsOverflow software Event. (RO)	1.00 Guru
I Timestamp Latch	GevtimestampControlLatch	Latch the current timestamp internal counter value in the timestampValue feature.	1.00 Invisible
I Timestamp Value	GevtimestampValue	Returns the 64-bit value of the timestamp counter.	1.00 Invisible
I Timestamp Tick Frequency	GevtimestampTickFrequency	Indicates the number of timestamp ticks (or increments) during 1 second (frequency in Hz).	1.00 Invisible
I Timestamp Reset	GevtimestampControlReset	Resets the timestamp counter to 0.	1.00 Invisible

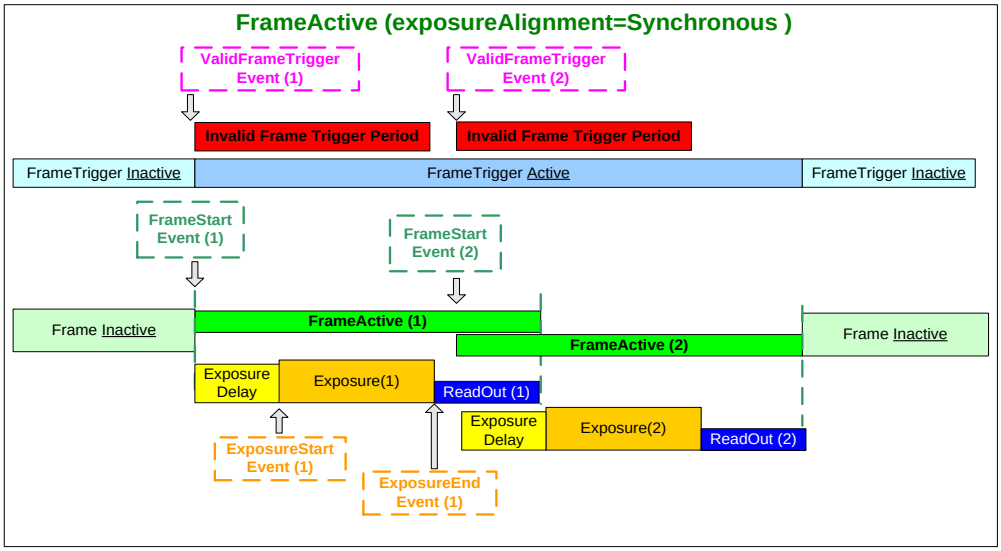
Basic Exposure Events Overview

The following timing graphic shows the primary events related to a simple acquisition.



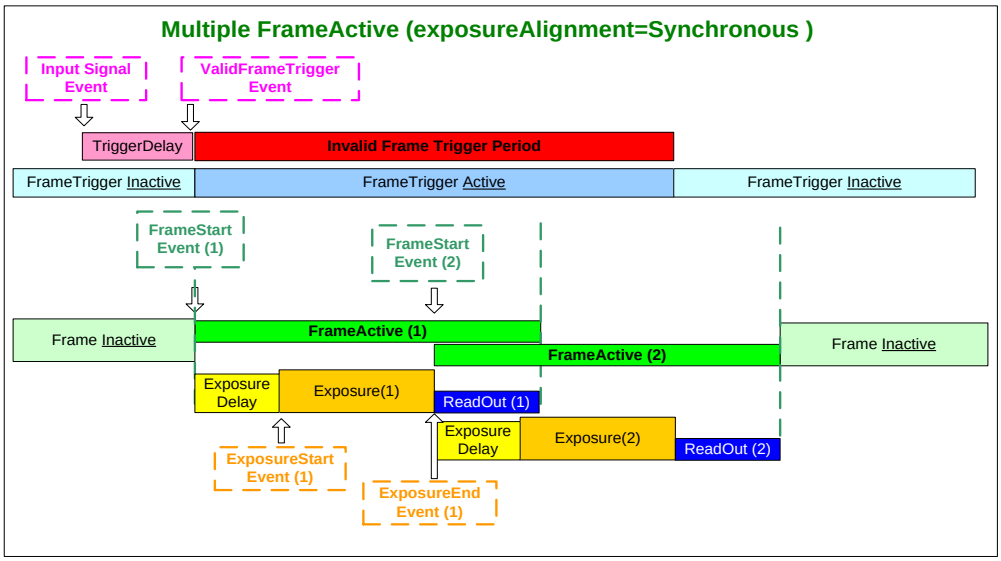
Events Associated with Triggered Synchronous Exposures

The following timing graphic shows the primary events and acquisition timing associated with a synchronous exposure of two individually triggered frames.



Events Associated with Triggered Multiple Frame Synchronous Exposures

The following timing graphic shows the primary events and acquisition timing associated with a synchronous exposure of two frames from a single trigger event.



Overview of Precision Time Protocol Mode (IEEE 1588)

PTP Mode = Precision Time Protocol

- The PTP protocol synchronizes the Timestamp clocks of multiple devices connected via a switch on the same network, where the switch supports PTP.
- For optimal clock synchronization the imaging network should use one Ethernet switch. Daisy-chaining multiple small switches will degrade camera clock syncs.
- Additionally the Ethernet switch connecting cameras to the imaging network should implement "PTP Boundary Clock" hardware.
- To use a multi-port NIC adapter or computer with multiple NIC ports instead of a switch, that multiport NIC must be capable to be configured as the common Master PTP source for all its networks. Such a configuration requires using the multi-port NIC's configuration software.
- Genie Nano-5G cameras can automatically organize themselves into a master-slave hierarchy, or the user application configures a camera master with n-number of slaves. The auto-configuration process typically happens within 2 seconds.
- The automatic organizing procedure is composed of steps (as defined by IEEE 1588) to identify the best clock source to act as master. When only Nano-5G cameras are used, since they are equal, the last selection step is to identify the Nano-5G with lowest value MAC address to be the clock master.
- The feature *TimeStamp Source* is automatically changed to *IEEE1588* when *PTP Mode* is enabled. This timestamp tick (in ns) cannot be reset by the user.
- The Genie Nano-5G cameras implement additional features designed to synchronize multiple camera acquisitions via IEEE 1588 (PTP Mode) – not via external camera trigger signals.

PTP Master Clock Identity

The clock ID of the current best master is an Extended Unique Identifier (EUI)-64 "64-bit ID", converted from the 48-bit MAC address, by inserting 0xfffe at the middle of the MAC address.

- The standard MAC address in human-friendly form is six groups of two hexadecimal digits as this example shows (excluding spaces): "0a 1b 2c 3d 4e 5f"
- The Extended Unique Identifier format is (excluding spaces): "0a 1b 2c fffe 3d 4e 5f"

An Example with two Nano-5G Cameras

The following basic steps configure two Nano-5G cameras connected to one computer via an Ethernet switch, configured with two instances of CamExpert, to grab a frame every second, controlled by a modulo event via PTP.

For each camera set features as follows:

I/O Controls — select Trigger Mode=ON, Tigger Source=Timestamp Modulo Event

Event Controls — select PTP Mode=Automatic

- Note how one Nano-5G automatically becomes Master while the other becomes Slave

Event Controls — to have a modulo event every second, set Timestamp Modulo Event=1000000000

Click Grab on each instance of CamExpert. With the two cameras aimed at the same moving object, you see that each camera grabs a frame at the same time.

IEEE 1588 Reference Resources

For additional information: http://standards.ieee.org

PTP Standard Reference: IEEE Std 1588-2008 — IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

Examples using Timestamp Modulo Event for Acquisitions

The Timestamp Modulo event is used to synchronize multiple camera acquisitions and automate repetitive acquisitions based on either the camera's internal Timestamp counter or a system wide PTP counter. The Nano-5G internal Timestamp clock has a 1µs tic, while the PTP clock has 8 nanosecond tics (PTP: IEEE1588–Precise Time Protocol).

Both Timestamp counters increment continuously but can be reset to zero with 'timestampControlReset' if 'ptpMode=Off', else only the internal camera Timestamp counter resets.

Case Examples Overview

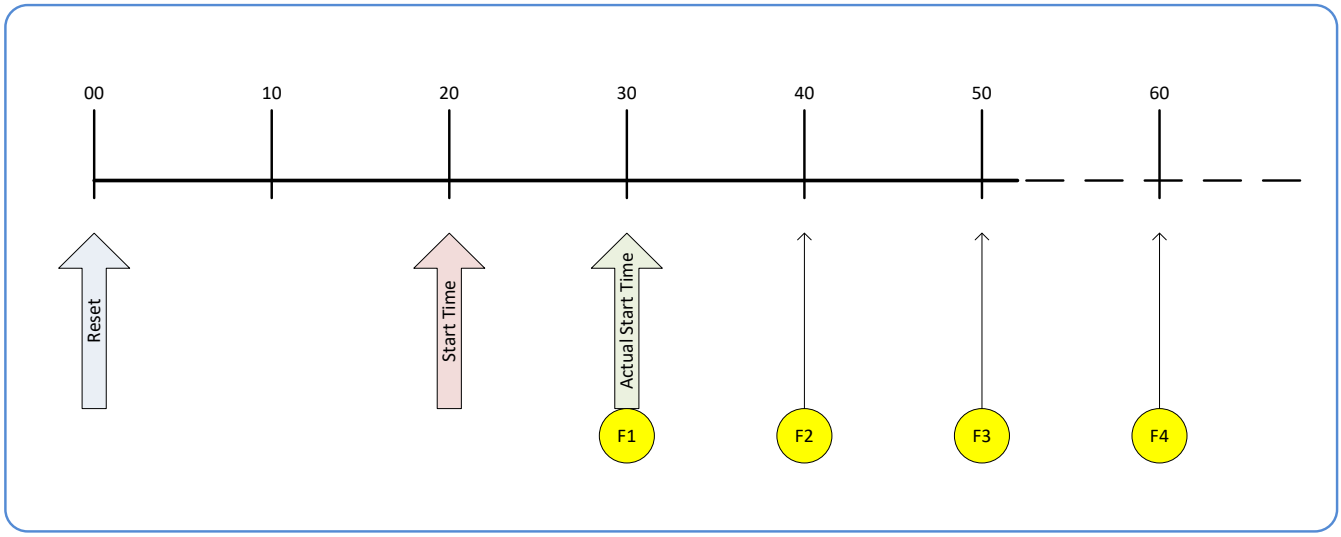
The following case examples use a simplified Timestamp timeline, which for clarity is shown with time tics from 00 to 60 without units. A timeline scale based on real time is not required to describe the usage concepts. These examples also apply equally to using an internal Timestamp clock or a system PTP clock.

Case 1: Simple Repeating Acquisitions as Upcoming Events

Conditions:

- initial timestampControlReset resets Timestamp counter
- timestampModuloStartTime at 20
- timestampModulo = 10
- timestampModuloActualStartTime = First Event generated (F1)

After the Timestamp Reset, the first acquisition is made when the Modulo reaches the +10 tick Timestamp count, following the programmed start time. Acquisitions repeat at every +10 Timestamp tick until stopped.

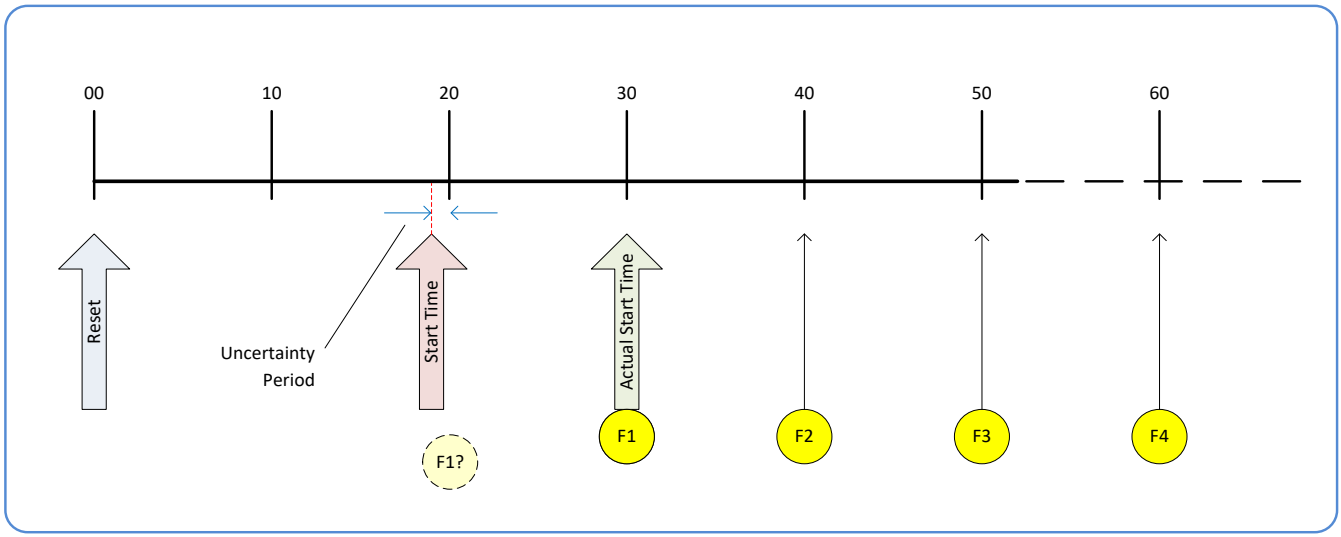


Case 2: Potential Uncertainness to the Start Time

Conditions:

- initial timestampControlReset resets Timestamp counter
- timestampModuloStartTime at < 20
- timestampModulo = 10
- timestampModuloActualStartTime = first event (F1)

Case 2 differs only from case 1 by showing that there is a period of uncertainty if the start time is too close to the first modulo count that follows. The first frame acquisition may occur at the first modulo count time or at the following. The actual value for the uncertainty period may vary with different camera and network conditions.



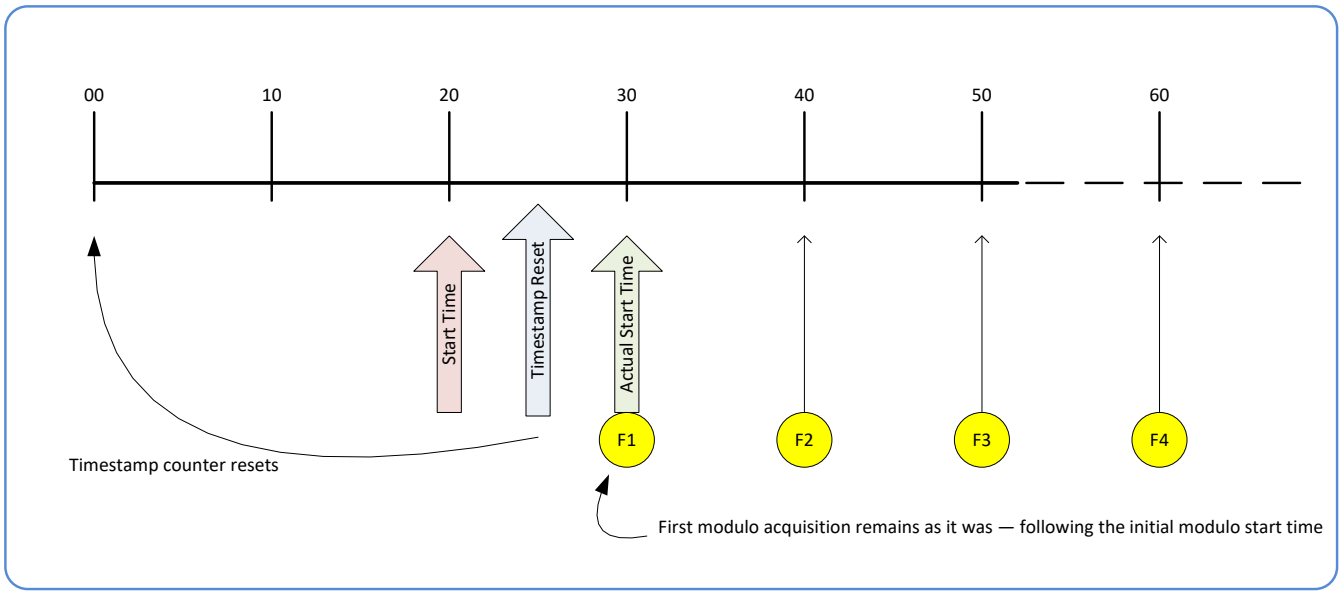
Case 3: Timer Reset before the Actual Start Time

Conditions:

- initial timestampControlReset resets Timestamp counter
- timestampModuloStartTime at 20
- timestampModulo = 10
- second timestampControlReset at count 25
- timestampModuloActualStartTime = first event (F1)

After the initial Timestamp Reset which starts the Timestamp counter, the Modulo start time is at 20. The Modulo 10 actual start time for the first acquisition is at Timestamp 30 (as described in Case 1).

Now if a new Timestamp reset happens between the Start Time and acquisition Actual Start Time, the Timestamp counter will restart from time 00, but the Start Time value has already been stored, thus the modulo Actual Start Time remains at 30. In this condition the Actual Start Time did not reset as might be expected.



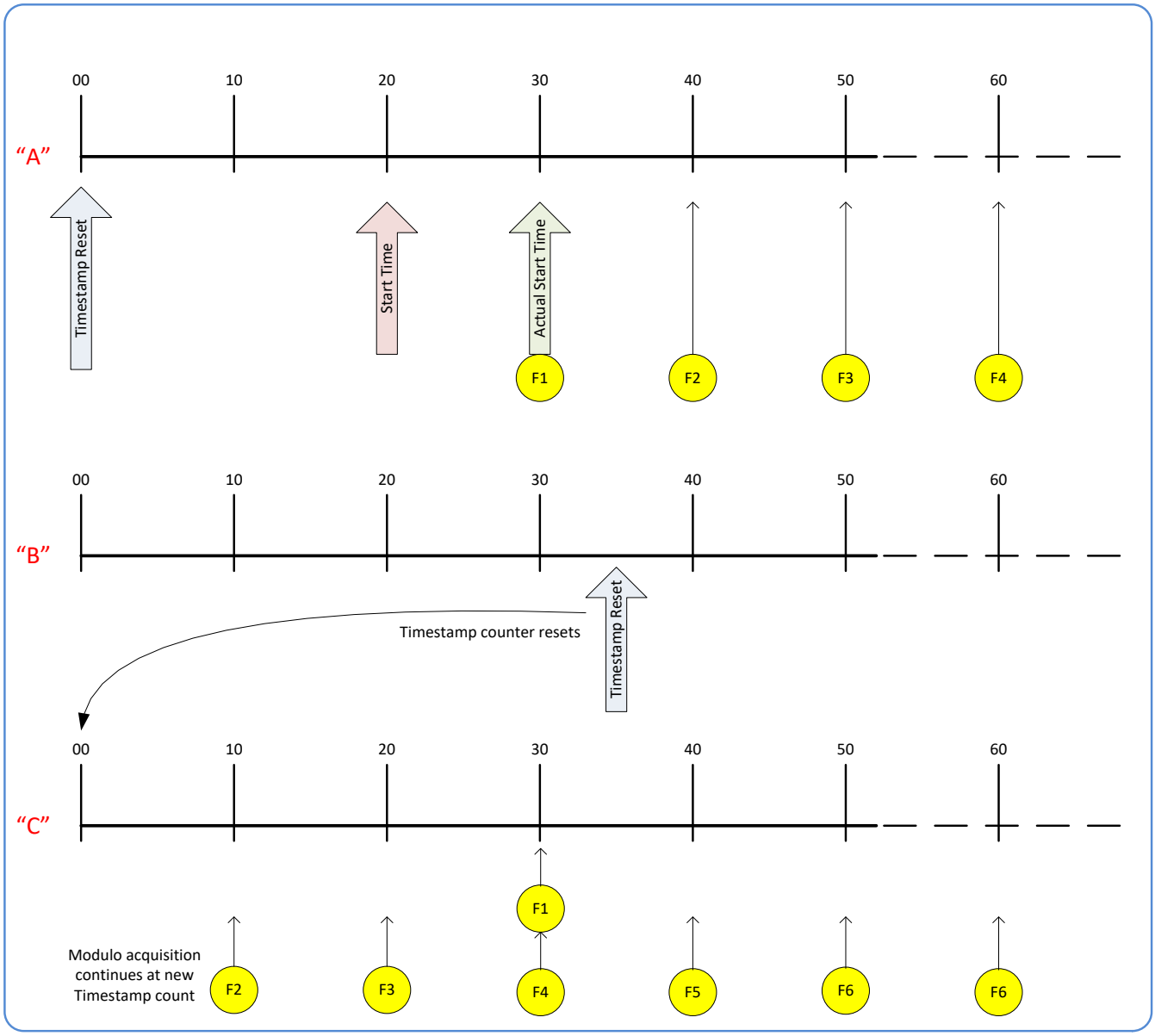
Case 4: Timer Reset after the Actual Start Time

Conditions:

- initial timestampControlReset resets Timestamp counter
- timestampModuloStartTime at 20
- timestampModulo = 10
- timestampModuloActualStartTime = first event (F1)
- second timestampControlReset at 35

This case describes the Modulo process if there is a Timestamp counter reset after a modulo controlled acquisition occurs.

- "A" shows the initial conditions with the first acquisition (F1) at the actual start time.
- "B" shows a Timestamp reset occurring after the first acquisition.
- "C" shows that acquisitions then continue at the first modulo 10 time after the reset due to acquisitions already in progress compared to the example case 3 above.

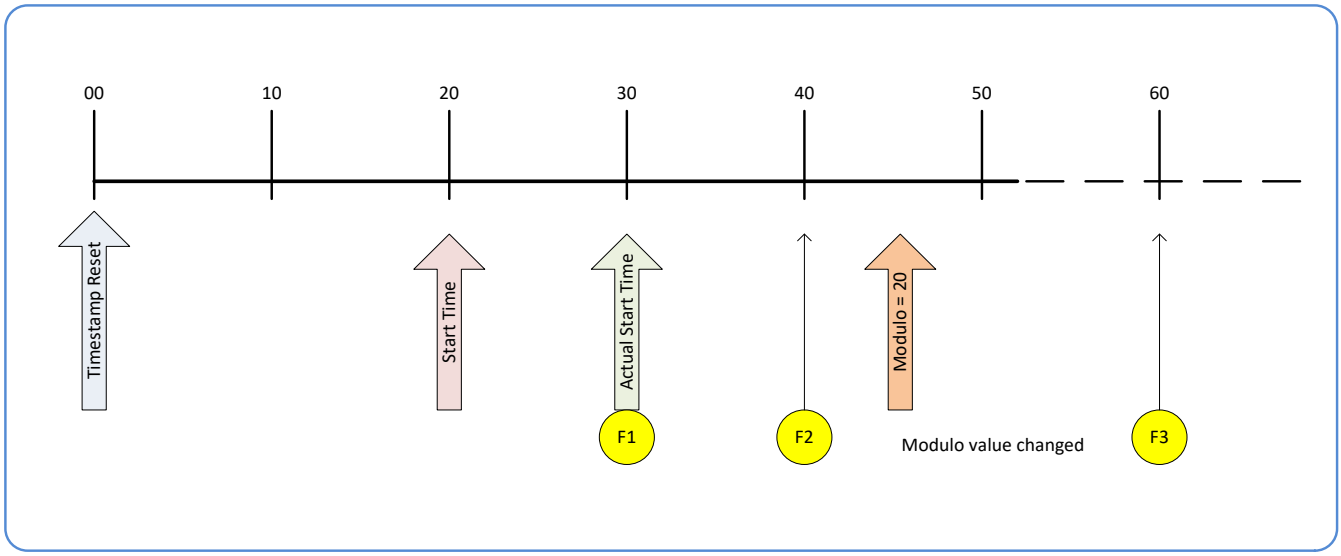


Case 5: Changing 'timestampModulo' during Acquisitions

Conditions:

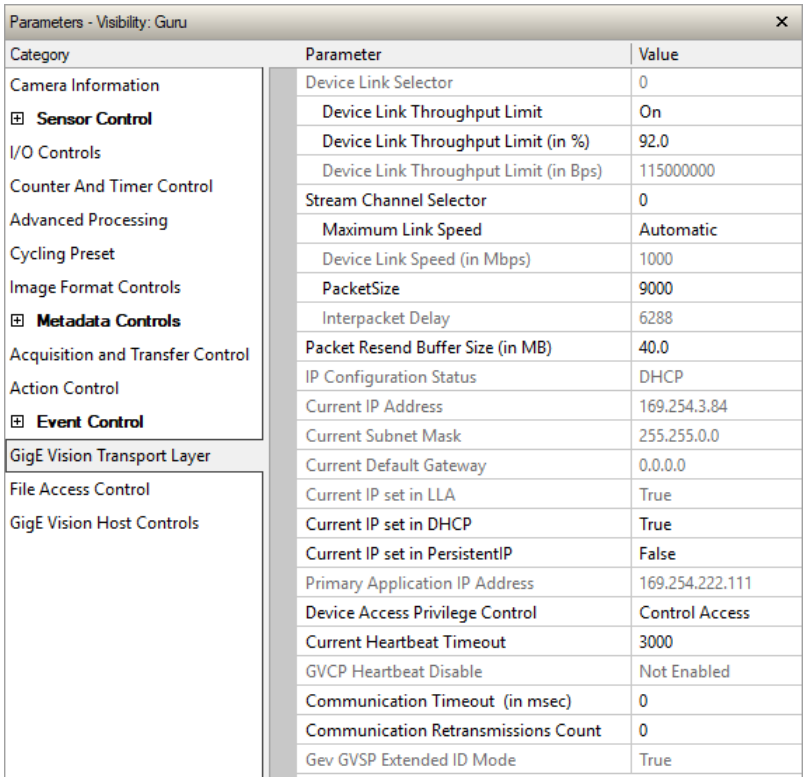
- initial timestampControlReset resets Timestamp counter
- timestampModuloStartTime at 20
- timestampModulo = 10
- timestampModuloActualStartTime = first event (F1)
- timestampModulo changes to 20

Case 5 shows that the Modulo value can be changed dynamically. Using the simple example of case 1, after the second acquisition (F2) the Modulo value is changed from 10 to 20. The third acquisition now occurs at modulo 20 time following the previous acquisition.



GigE Vision Transport Layer Control Category

The Genie Nano-5G GigE Vision Transport Layer control, as shown by CamExpert, has parameters used to configure features related to GigE Vision specification and the Ethernet Connection.



GigE Vision Transport Layer Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Device Link Selector	DeviceLinkSelector	Selects which Link of the device to control	1.00 Expert
Device Link Throughput Limit	DeviceLinkThroughputLimitMode	When disabled, lower level TL specific features are expected to control the throughput. When enabled, *DeviceLinkThroughputLimitRatio* controls the overall throughput.	1.00 Guru
Off	*Off*	*Disables the device link throughput limit feature.*	
On	*On*	*Enables the device link throughput limit feature.*	
Device Link Throughput Limit (in %)	DeviceLinkThroughputLimitRatio	Limits the maximum bandwidth of the data that will be streamed out by the device, as a percentage of the maximum bandwidth.	1.00 Guru
Device Link Throughput Limit (in Bps)	DeviceLinkThroughputLimit	Displays the maximum bandwidth of the data that will be streamed out by the device, in bytes per second.	1.00 Guru
Stream Channel Selector	GevStreamChannelSelector	Selects the stream channel to control.	1.00 Expert

Maximum Link Speed	gevLinkSpeedLimit	Maximum speed the device will advertize during auto-negotiation. Changes will take effect on the next boot.	1.00 DFNC Guru
Device Link Speed	GevLinkSpeed	Indicates the transmission speed negotiated by the given network interface.	1.00 Expert
PacketSize	GevSCPSPacketSize	Specifies the stream packet size in bytes to send on this channel.	1.00 Expert
Interpacket Delay	GevSCPD	Indicates the delay (in µs) to insert between each packet for this stream channel. Note that Interpacket delay becomes a Read-Only value when the feature "Device Link Throughput Limit" is enable.	1.00 Expert
Packet Resend Buffer Size (in MB)	devicePacketResendBufferSize	Indicates the amount of memory to reserve in MB for the packet resend buffer. Changes in reserved memory affects total memory available for acquisition buffering.	1.00 DFNC Guru
IP Configuration Status *None* *PersistentIP* *DHCP* *LLA* *ForceIP*	GevIPConfigurationStatus *None* *PersistentIP* *DHCP* *LLA* *ForceIP*	Reports the current IP configuration status. (RO) *Device IP Configuration is not defined.* *Device IP Address Configuration is set to Persistent IP (static).* *Device IP Address Configuration is set to DHCP (Dynamic Host Configuration Protocol). Network requires a DHCP server.* *Device IP Address Configuration is set to LLA (Link-Local Address). Also known as Auto-IP. Used for unmanaged networks including direct connections from a device to a dedicated NIC.* *Device IP Address Configuration is set to ForceIP. Used to force an IP address change.*	1.00 Guru
Current IP Address	GevCurrentIPAddress	Reports the IP address for the given network interface.	1.00 Beginner
Current Subnet Mask	GevCurrentSubnetMask	Reports the subnet mask of the given interface.	1.00 Beginner
Current Default Gateway	GevCurrentDefaultGateway	Reports the default gateway IP address to be used on the given network interface.	1.00 Beginner
Current IP set in LLA	GevCurrentIPConfigurationLLA	Controls whether the LLA (Link Local Address) IP configuration scheme is activated on the given network interface.	1.00 Guru
Current IP set in DHCP	GevCurrentIPConfigurationDHCP	Controls whether the DHCP IP configuration scheme (Dynamic Host Configuration Protocol) is activated on the given network interface.	1.00 Guru
Current IP set in PersistentIP	GevCurrentIPConfigurationPersistentIP	Controls whether the PersistentIP configuration scheme is activated on the given network interface.	1.00 Guru
Primary Application IP Address	GevPrimaryApplicationIPAddress	Returns the IP address of the device hosting the primary application. (RO)	1.00 Guru
Device Access Privilege Control *Exclusive Access* *Control Access*	deviceCCP *ExclusiveAccess* *ControlAccess*	Controls the device access privilege of an application. *Grants exclusive access to the device to an application. No other application can control or monitor the device.* *Grants control access to the device to an application. No other application can control the device.*	1.00 Guru DFNC
Current Heartbeat Timeout	GevHeartbeatTimeout	Indicates the current heartbeat timeout in milliseconds.	1.00 Guru
GVCP Heartbeat Disable	GevGVCPHeartbeatDisable	Disables the GVCP (GigE Vision Control Protocol) heartbeat monitor. This allows control switchover to an application on another device.	1.00 Expert
Communication Timeout (in msec)	GevMCTT	Provides the transmission timeout value in milliseconds.	1.00 Guru
Communication Retransmissions Count	GevMCRC	Indicates the number of retransmissions allowed when a message channel message times out.	1.00 Guru

GVSP Extended ID Mode	GevGVSPExtendedIDMode	Enables the extended ID mode.	1.00 Expert
Fire Test Packet	GevSCPSFireTestPacket	When this feature is set to True, the device will fire one test packet.	1.00 Invisible
Payload Size	PayloadSize	Provides the number of bytes transferred for each image or chunk on the stream channel.	1.00 Invisible
MAC Address	GevMACAddress	MAC address of the network interface.	1.00 Invisible
Current Camera IP Configuration	GevCurrentIPConfiguration	Current camera IP configuration of the selected interface.	1.00 Invisible
LLA	*LLA*	*Link-Local Address Mode*	
DHCP	*DHCP*	*Dynamic Host Configuration Protocol Mode. Network requires a DHCP server.*	
PersistentIP	*PersistentIP*	*Persistent IP Mode (static)*	
Persistent IP Address	GevPersistentIPAddress	Persistent IP address for the selected interface. This is the IP address the camera uses when booting in Persistent IP mode.	1.00 Invisible
Persistent Subnet Mask	GevPersistentSubnetMask	Persistent subnet mask for the selected interface.	1.00 Invisible
Persistent Default Gateway	GevPersistentDefaultGateway	Persistent default gateway for the selected interface.	1.00 Invisible
Primary Application Socket	GevPrimaryApplicationSocket	Returns the UDP (User Datagram Protocol) source port of the primary application.	1.00 Invisible
Device Access Privilege Control	GevCCP	Controls the device access privilege of an application.	1.00 Invisible
Open Access	*OpenAccess*	*OpenAccess*	
Exclusive Access	*ExclusiveAccess*	*Grants exclusive access to the device to an application. No other application can control or monitor the device.*	
Control Access	*ControlAccess*	*Grants control access to the device to an application. No other application can control the device.*	
Control Access Switchover Active	*ControlAccessSwitchoverActive*	*Enables another application to request control access to the device.*	
Interface Selector	GevInterfaceSelector	Selects which physical network interface to control.	1.00 Invisible
Number Of Interfaces	GevNumberOfInterfaces	Indicates the number of physical network interfaces supported by this device. (RO)	1.00 Invisible
Message Channel Count	GevMessageChannelCount	Indicates the number of message channels supported by this device. (RO)	1.00 Invisible
Stream Channel Count	GevStreamChannelCount	Indicates the number of stream channels supported by this device (0 to 512). (RO)	1.00 Invisible

I Supported Option Selector	GevSupportedOptionSelector *IPConfigurationLLA* *IPConfigurationDHCP* *IPConfigurationPersistentIP* *StreamChannelSourceSocket* *MessageChannelSourceSocket* *CommandsConcatenation* *WriteMem* *PacketResend* *Event* *EventData* *PendingAck* *Action* *PrimaryApplicationSwitchover* *ExtendedStatusCodes* *DiscoveryAckDelay* *DiscoveryAckDelayWritable* *TestData* *ManifestTable* *CCPApplicationSocket* *LinkSpeed* *HeartbeatDisable* *SerialNumber* *UserDefinedName* *StreamChannel0BigAndLittleEndian* *StreamChannel0IPReassembly* *StreamChannel0UnconditionalStreaming* *StreamChannel0ExtendedChunkData*	Selects the I option to interrogate for existing support. (RO)	1.00 Invisible
I Supported Option	GevSupportedOption	Returns TRUE if the selected I option is supported. (RO)	1.00 Invisible
LLA Supported	GevSupportedIPConfigurationLLA	Indicates if LLA (Auto-IP) is supported by the selected interface. The LLA method automatically assigns the Nano-5G with a randomly chosen address on the 169.254.xxx.xxx subnet. After an address is chosen, the link-local process sends an ARP query with that IP onto the network to see if it is already in use. If there is no response, the IP is assigned to the device, otherwise another IP is selected, and the ARP is repeated. Note that LLA is unable to forward packets across routers. LLA is the recommended scheme when only one NIC is connected to GigE cameras; ensure only one NIC is using LLA on your PC, otherwise IP conflicts will result. (RO)	1.00 Invisible
DHCP Supported	GevSupportedIPConfigurationDHCP	Indicates if DHCP is supported by the selected interface. This IP configuration mode requires a DHCP server to allocate an IP address dynamically over the range of some defined subnet. The Nano-5G must be configured to have DHCP enabled. This is the factory default settings. The DHCP server is part of a managed network. Windows itself does not provide a DHCP server function therefore a dedicated DHCP server is required. The DALSA Network Configuration Tool can be configured as a DHCP server on the NIC used for the GigE Vision network. (RO)	1.00 Invisible
Persistent IP Supported	GevSupportedIPConfigurationPersistentIP	Indicates if Persistent IP is supported by the selected interface. This protocol is only suggested if the user fully controls the assignment of IP addresses on the network and a GigE Vision camera is connected beyond routers. The GigE Vision camera is forced a static IP address. The NIC IP address must use the same subnet otherwise the camera is not accessible. If the Nano-5G camera is connected to a network with a different subnet, it cannot be accessed. (RO)	1.00 Invisible
GVCP Extended Status Codes	GevGVCPExtendedStatusCodes	Enables generation of extended status codes. (RO)	1.00 Invisible
GVCP Pending Timeout	GevGVCPPendingTimeout	Indicates the longest GVCP command execution time before a device returns a PENDING_ACK.	1.00 Invisible

I MCP HostPort	GevMCPHostPort	Indicates the port to which the device must send messages. (RO)	1.00 Invisible
I MCDA	GevMCDA	Indicates the destination IP address for the message channel. (RO)	1.00 Invisible
I MCSP	GevMCSP	This feature indicates the source port for the message channel. (RO)	1.00 Invisible
Stream Channel Interface Index	GevSCPInterfaceIndex	Index of network interface. (RO)	1.00 Invisible
I SCP HostPort	GevSCPHostPort	Indicates the port to which the device must send the data stream. (RO)	1.00 Invisible
I SCDA	GevSCDA	Indicates the destination IP address for this stream channel. (RO)	1.00 Invisible
I SCSP	GevSCSP	Indicates the source port of the stream channel. (RO)	1.00 Invisible
I First URL	GevFirstURL	Indicates the first URL to the XML device description file.	1.00 Invisible
I Second URL	GevSecondURL	Indicates the second URL to the XML device description file.	1.00 Invisible
I Major Version	GevVersionMajor	Major version of the specification.	1.00 Invisible
I Minor Version	GevVersionMinor	Minor version of the specification.	1.00 Invisible
Manifest Entry Selector	DeviceManifestEntrySelector	Selects the manifest entry to reference.	1.00 Invisible
XML Major Version	DeviceManifestXMLMajorVersion	Indicates the major version number of the XML file of the selected manifest entry.	1.00 Invisible
XML Minor Version	DeviceManifestXMLMinorVersion	Indicates the Minor version number of the XML file of the selected manifest entry.	1.00 Invisible
XML SubMinor Version	DeviceManifestXMLSubMinorVersion	Indicates the SubMinor version number of the XML file of the selected manifest entry.	1.00 Invisible
Schema Major Version	DeviceManifestSchemaMajorVersion	Indicates the major version number of the Schema file of the selected manifest entry.	1.00 Invisible
Schema Minor Version	DeviceManifestSchemaMinorVersion	Indicates the minor version number of the Schema file of the selected manifest entry.	1.00 Invisible
Manifest Primary URL	DeviceManifestPrimaryURL	Indicates the first URL to the XML device description file of the selected manifest entry.	1.00 Invisible
Manifest Secondary URL	DeviceManifestSecondaryURL	Indicates the second URL to the XML device description file of the selected manifest entry.	1.00 Invisible
Device Mode Is Big Endian	GevDeviceModeIsBigEndian	Endianess of the device registers.	1.00 Invisible
Device Mode CharacterSet	GevDeviceModeCharacterSet *reserved1* *UTF8* *reserved2*	Character set used by all the strings of the bootstrap registers.	1.00 Invisible
GevSCPSDoNotFragment	GevSCPSDoNotFragment	This feature state is copied into the "do not fragment" bit of IP header of each stream packet. (RO)	1.00 Invisible
I SCPS BigEndian	GevSCPSBigEndian	Endianess of multi-byte pixel data for this stream. (RO)	1.00 Invisible

Defaults for devicePacketResendBufferSize

The default minimum for devicePacketResendBufferSize allows at least two maximum sized buffer. Resend buffers hold the last images that have been transferred to host. More buffers allow more possible resend packets.

But it is important to remember that increasing the packet resend buffer value consumes internal memory used for image buffers waiting to transfer. This will reduce the number of frames acquired at frame rates exceeding the transfer rates possible to the host computer. Memory size is monitored with the feature "transferQueueMemorySize".

GigE Vision Host Control Category

The GigE Vision Host controls as shown by CamExpert, has parameters used to configure the host computer system GigE Vision features used for Genie Nano-5G networking management. None of these parameters are stored in any Genie Nano-5G camera.

These features allow optimizing the network configuration for maximum Nano-5G bandwidth. Settings for these parameters are highly dependent on the number of cameras connected to a NIC, the data rate of each camera and the trigger modes used.

Information on these features is found in the Teledyne DALSA Network Imaging Module User manual.

Teledyne DALSA TurboDrive

For Genie Nano-5G cameras supporting TurboDrive, ensure to set the feature "***Turbo Transfer Mode***" to ***True***.

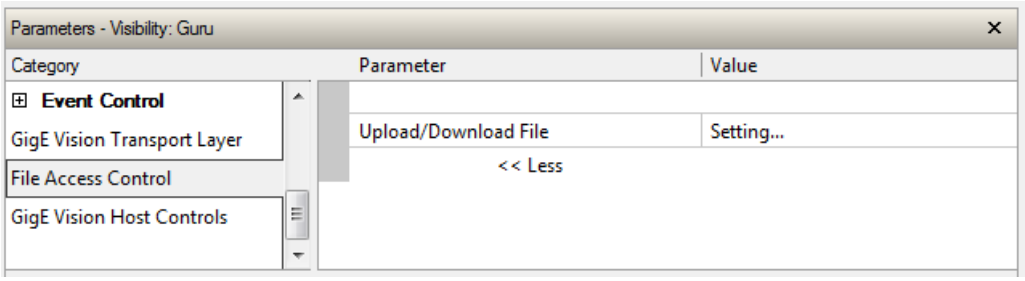
For information on TurboDrive see our technology primer:
http://www.teledynedalsa.com/imaging/knowledge-center/appnotes/turbodrive/

Plus this application note reviews Teledyne DALSA's continued development of TurboDrive:
G3-AN0004 – Genie Nano: Comparing TurboDrive v2.0 with TurboDrive v2.0 algorithm
http://www.teledynedalsa.com/imaging/knowledge-center/appnotes/

Important: When using Metadata in conjunction with TurboDrive, the Nano-5G driver (all models) requires that the image acquisition width (horizontal crop) must be a minimum of 160 pixels in 8-bit mode or 96 pixels in 10/12-bit mode. The driver requires this minimum width to correctly apply the TurboDrive compression algorithm. When acquisitions are cropped more than the minimum widths, TurboDrive is automatically disabled while Metadata remains active.

File Access Control Category

The File Access control in CamExpert allows the user to quickly upload various data files to the connected Genie Nano-5G. The supported data files are for firmware updates, and dependent on the Nano-5G model, LUT tables, Defective Pixel Maps, and other Sapera file types.



File Access Control Feature Descriptions

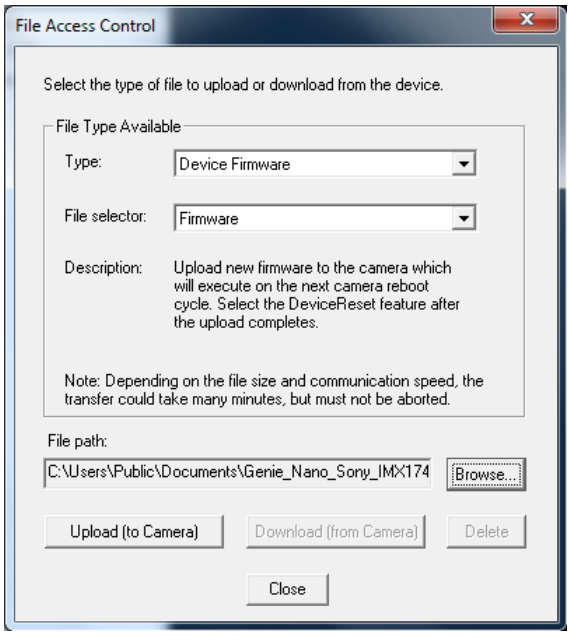
The File Access Control is implemented as a dialog therefore no View (Beginner, Expert or Guru) is used.

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. < Guru >	1.00
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.*	
LUT User Defined 1	*LutUserDefined1*	*Select to write (upload) a Look-up-Table file (Sapera .LUT file) into the camera's internal LUT User Defined 1.*	
LUT User Defined 2	*LutUserDefined2*	*Select to write (upload) a Look-up-Table file (Sapera .LUT file) into the camera's internal LUT User Defined 2*	1.00
Factory Defective Pixel Map	*BadPixelCoordinate0*	*Select the Factory Defective Pixel Map.*	1.00
User Defective Pixel Map	*BadPixelCoordinate1*	*Select the User Defective Pixel Map XML file as defined in Advanced Processing.*	1.00
User Defined Saved Image	*userDefinedSavedImage*	*Upload and download an image in the camera.*	1.00
Open Source Licenses	*SoftwareLicenses*	*Open Source Software Licenses.*	1.00
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. < Guru >	1.00
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. < Guru >	1.00
User Defined Saved Image	userDefinedSavedImage	Upload or download an image in the camera. < DFNC – Guru >	1.00

File Open Mode *Read* *Write*	FileOpenMode *Read* *Write*	Selects the access mode used to open a file on the device. < Guru > *Select READ only open mode* *Select WRITE only open mode*	1.00
File Access Buffer	FileAccessBuffer	Defines the intermediate access buffer that allows the exchange of data between the device file storage and the application. < Guru >	1.00
File Access Offset	FileAccessOffset	Controls the mapping offset between the device file storage and the file access buffer. < Guru >	1.00
File Access Length	FileAccessLength	Controls the mapping length between the device file storage and the file access buffer. < Guru >	1.00
File Operation Status *Success* *Failure* *File Unavailable* *File Invalid*	FileOperationStatus *Success* *Failure* *FileUnavailable* *FileInvalid*	Displays the file operation execution status. < Guru > *The last file operation has completed successfully.* *The last file operation has completed unsuccessfully for an unknown reason.* *The last file operation has completed unsuccessfully because the file is currently unavailable.* *The last file operation has completed unsuccessfully because the selected file in not present in this camera model.*	1.00
File Operation Result	FileOperationResult	Displays the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned. < Guru >	1.00
File Size	FileSize	Represents the size of the selected file in bytes. < Guru >	1.00
Device User Buffer	deviceUserBuffer	Unallocated memory available to the user for data storage. < Invisible >	1.00 DFNC
User Defined Saved Image Max Size	userDefinedSavedImageMax Size	Maximum size of the user Defined Saved Image in the flash memory. < Invisible >	1.00 DFNC
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. Maximum image size is 1024x768 pixels in the Nano's model maximum pixel depth (monochrome or raw Bayer). < Invisible >	1.05 DFNC

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-5G. This CamExpert tool allows quick firmware changes or updates, when available for your Genie Nano-5G model.
- From the **File Selector** drop menu, select the Genie Nano-5G 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-5G.
- Reset the Nano-5G when prompted.

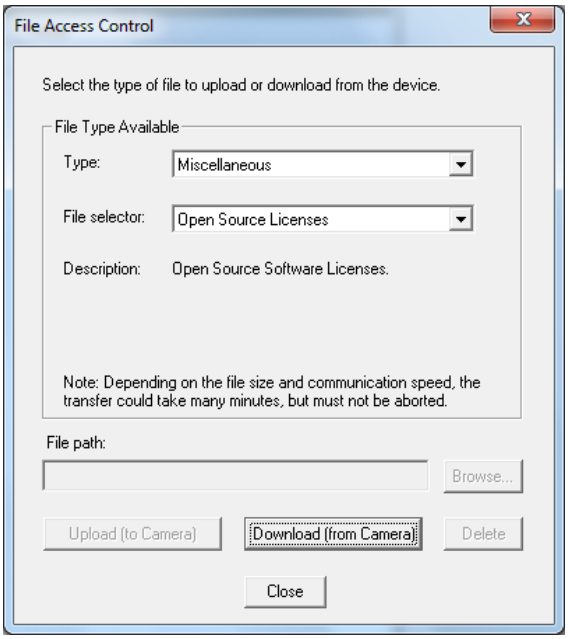
Overview of the *deviceUserBuffer* Feature

The feature *deviceUserBuffer* allows the machine vision system supplier access to 4 kB of reserved flash memory within the Genie Nano-5G. 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-5G firmware operation will overwrite this memory block thus allowing and simplifying product tracking and control.

Open Source Software Licenses

The Sapera CamExpert file access tool allows downloading the Open Source Software Licenses statement directly from the installed Nano-5G firmware.

Select *File type Miscellaneous*, *File Selector item Open Source Licenses* to download the file to your computer. Add the file extension of .TXT and open with Notepad++, or add the extension .DOC and Microsoft Word will open it as a Unicode (UTF-8). Either of these methods will format the text correctly in Windows.



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-5G

Nano-5G provides a number of features for system monitoring:

- Built-in Self-Test on power-up and reset after firmware change
- Image Buffer Accumulation – Count Status
- Image Buffer Memory Size
- Packet Resend Buffer Memory Size
- Internal Temperature Reporting
- In Camera Event Status Flags
  - Invalid External Trigger
  - Image Lost
  - Packet Resend & Related Status
  - Ethernet Pause Frame Requested

Nano-5G Features for T2IR Monitoring

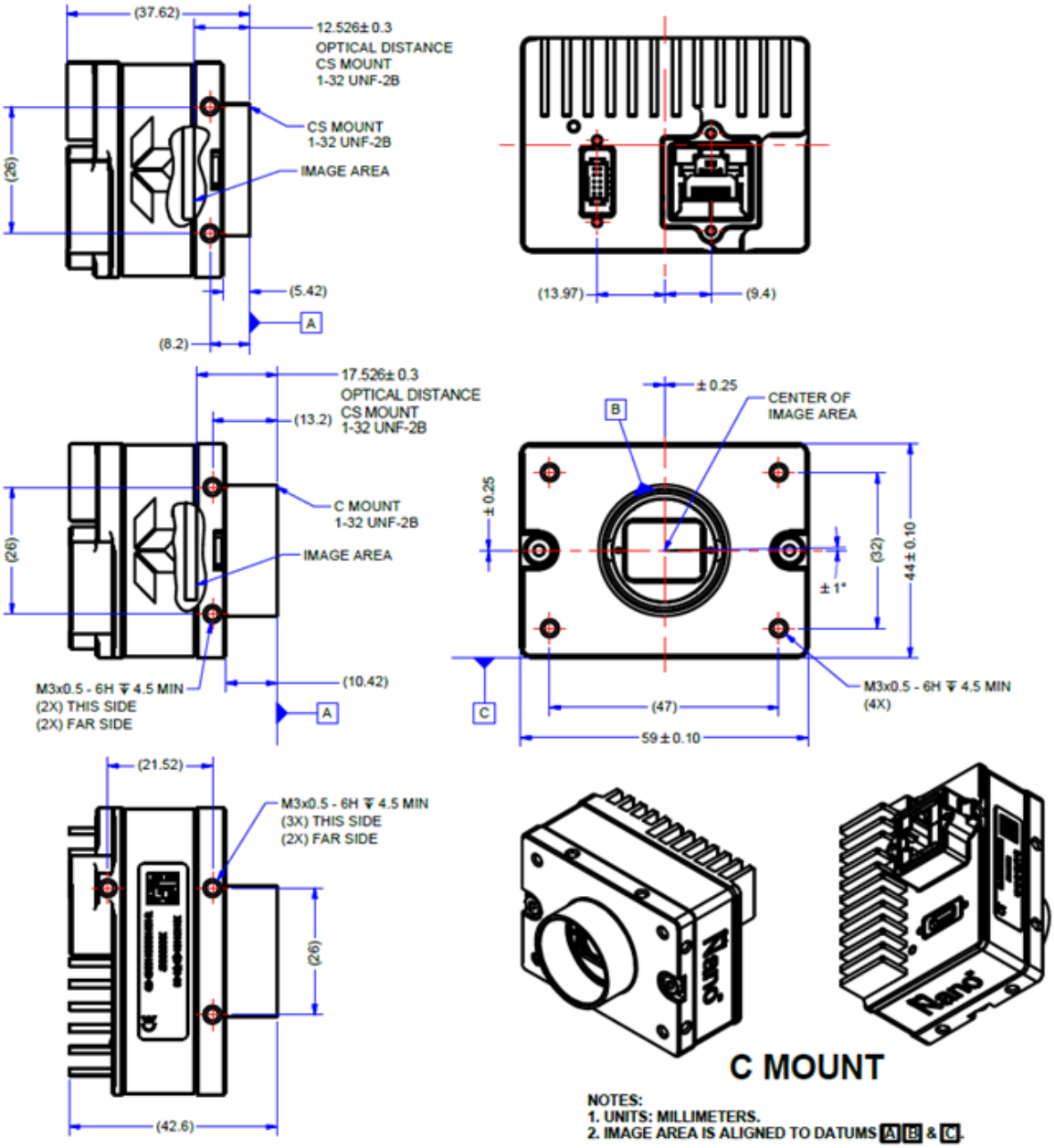
The following table presents some of the Nano-5G camera features developers can use for T2IR monitoring. The output line signals would interface to other external devices.

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
Output Lines	
Pulse on: Valid Frame Trigger	PulseOnValidFrameTrigger
Pulse on: Rejected Frame(s) Trigger	PulseOnInvalidFrameTrigger
Image Transfers	
Transfer Queue Current Block Count	transferQueueCurrentBlockCount
Transfer Queue Memory Size	transferQueueMemorySize
Transferred Image Max Data Size	transferMaxBlockSize
Transferred Image Min Data Size	transferMinBlockSize
Transferred Image Average Data Size	transferAverageBlockSize
Maximum Sustained Frame Rate	maxSustainedFrameRate
Packet Resend	PacketResend
Packet Resend Request Dropped	PacketResendRequestDropped
Ethernet Pause Frame Received	EthernetPauseFrameReceived
Precision Time Protocol (PTP)	
PTP Status	ptpStatus
PTP Servo Status	ptpServoStatus
PTP Master Clock Identity	ptpMasterClockId
PTP Master Offset	ptpMasterOffsetNs
PTP Port Last Event	ptpPortLastEvent

Technical Specifications

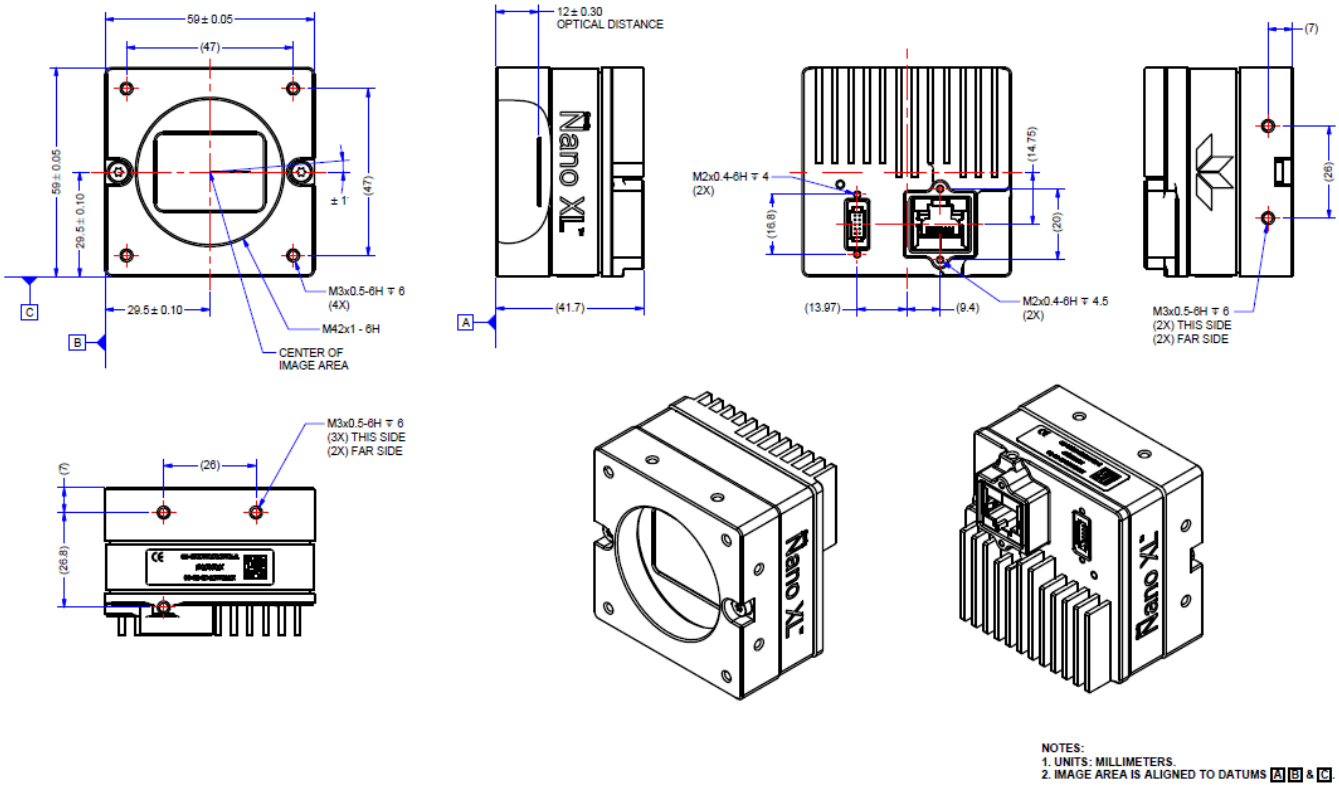
Both 2D and 3D design drawings are available for download from the Teledyne DALSA web site [http://www.teledynedalsa.com/genie-nano].

Mechanical Specifications — C Mount:



Note: Genie Nano-5G with C Mount

Mechanical Specifications — M42 Mount:



Note: Genie Nano-5G with M42 Mount

Additional Notes on Genie Nano-5G Identification and Mechanical

Identification Label

	Genie Nano-5G cameras have an identification label applied to the bottom side, with the following information: Model Part Number Serial number MAC ID 2D Barcode CE and FCC logo

Additional Mechanical Notes

	Nano-5G supports a screw lock Ethernet cable as described in Ruggedized RJ45 Ethernet Cables. For information on Nano-5G 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-5G cameras are designed that optimally transfer internal component heat to the outer metallic body. Due to the small form factor of the camera body, heat-sinking is required to dissipate thermal energy.

	The camera is free standing (that is, not mounted or heat-sinked) it will be hot to the touch.

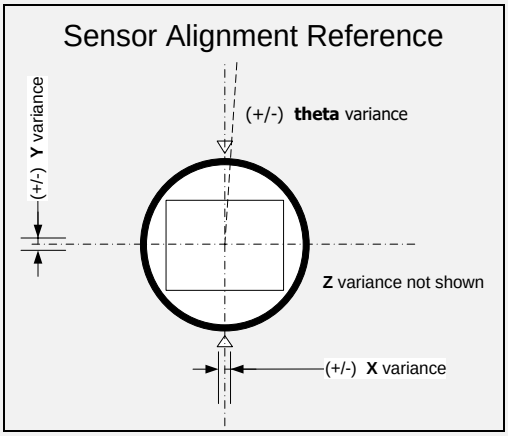
Basic heat management is achieved by mounting the camera onto a metal structure via its mounting screw holes. Heat dissipation is improved by using thermal paste between the camera body (not the front plate) and the metal structure.

Other heat sink methods include dissipation through the lens and air flow.

Sensor Alignment Specification

The following figure specifies sensor alignment for Genie Nano-5G 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-5G 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-5G mechanical.

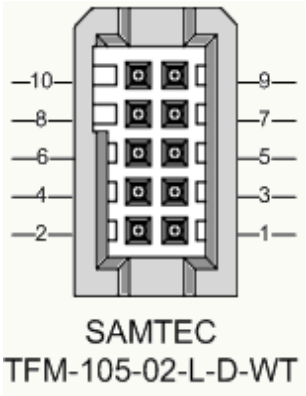
X variance	+/- 250 microns
Y variance	+/- 250 microns
Z variance	+/- 300 microns
Theta variance	+/- 1 degree



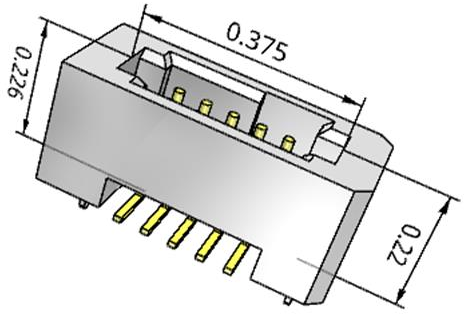
Connectors

- A single **RJ45 Ethernet** connector for control and video data to the host Gigabit NIC. Additionally for PoE, the Genie Nano-5G requires an appropriate PoE Class 0 or Class 3 (or greater) power source device (such as a powered computer NIC, or a powered Ethernet switch, or an Ethernet power injector). For industrial environments, Nano-5G supports the use of screw lock Ethernet cables (see Ruggedized RJ45 Ethernet Cables). Note that for PoE installations, a shielded Ethernet cable is required to provide a camera ground connection to the controlling computer.
- Note: Connect power via the I/O or PoE, **not both**. Although Nano-5G has protection, differences in ground levels may cause operational issues or electrical faults.
- The Nano-5G has a single 10-pin connector (SAMTEC connector TFM-105-02-L-D-WT) for all I/O signals and for an auxiliary DC power source. Nano-5G supports connecting cables with retention clips or screw locks.
- See I/O Mating Connector Sources for information about the mating connector or complete cable solutions with retention clips. The following figure shows the pinout number assignment (external view of the camera body connector).

Face View of the Nano-5G Back



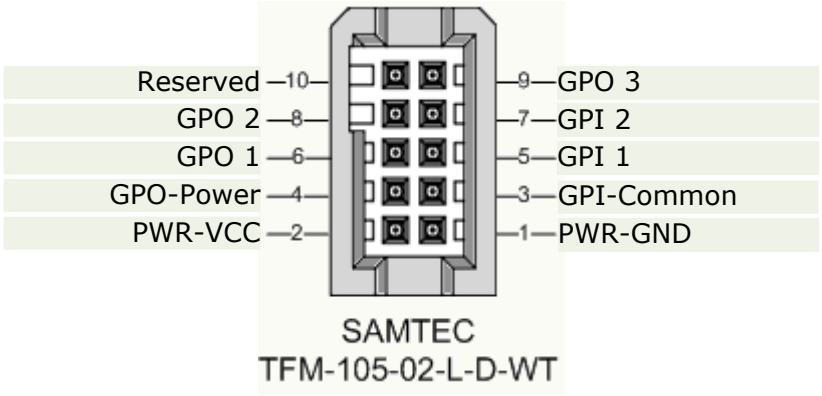
3D View of the camera's connector TFM-105-02-L-D-WT



10-pin I/O Connector Pinout Details (Standard Models)

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

Pin Number	Genie Nano-5G	Direction	Definition
1	PWR-GND	—	Camera Power – Ground
2	PWR-VCC	—	Camera Power – DC +10 to +36 Volts
3	GPI-Common	—	General Input/Output Common Ground
4	GPO-Power	—	General Output Common Power
5	GPI 1	In	General External Input 1
6	GPO 1	Out	General External Output 1
7	GPI 2	In	General External Input 2
8	GPO 2	Out	General External Output 2
9	GPO 3	Out	General External Output 3 / Fast Switching Output
10	Reserved		Do not use.
			Note: Differs from previous Genie Nano models; if upgrading verify cable connections.



Camera DC Power Characteristics

DC Operating Characteristics		
Input Voltage	+10 Volts minimum	
Input Power Consumption	@ +12 Volt Supply	10.02 Watts typical
Input Power Consumption	@ +24 Volt Supply	9.6 Watts typical
Input Power Consumption (POE)	@ +56 Volts	10.76 Watts typical

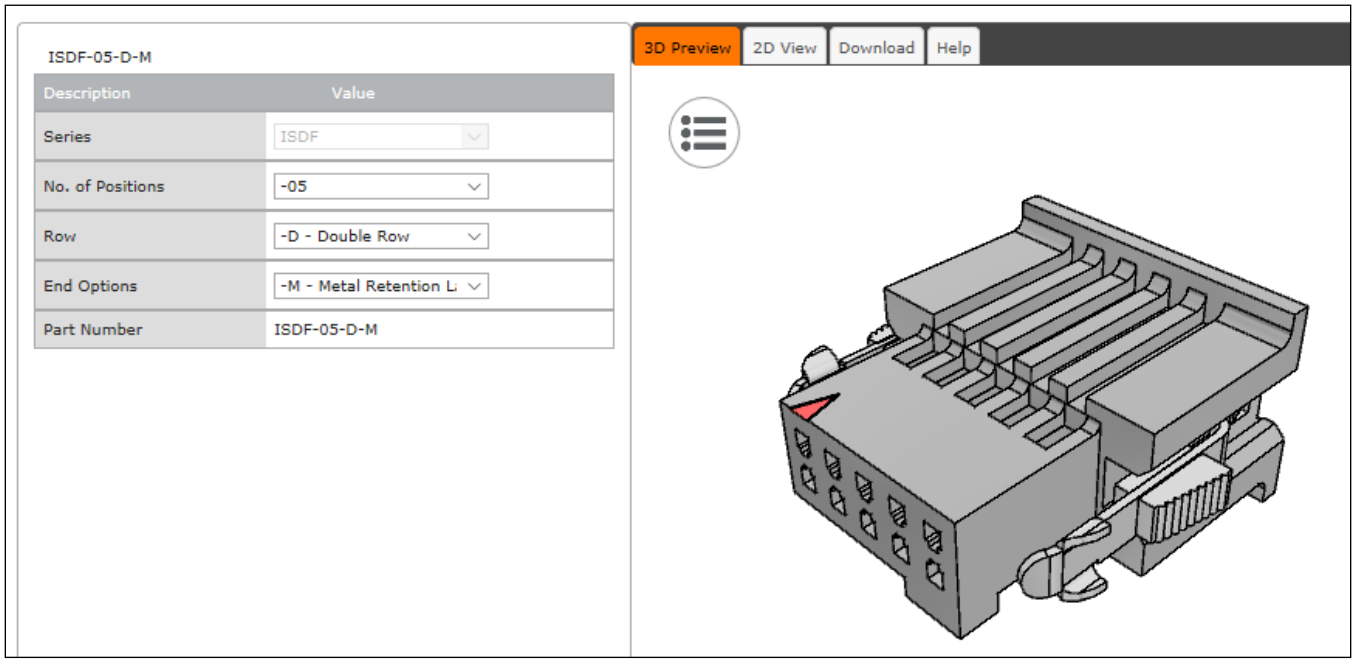
Absolute Maximum DC Power Supply Range before Possible Device Failure		
Input Voltage	−58 Volt DC	+58 Volts DC

I/O Mating Connector Specifications & Sources

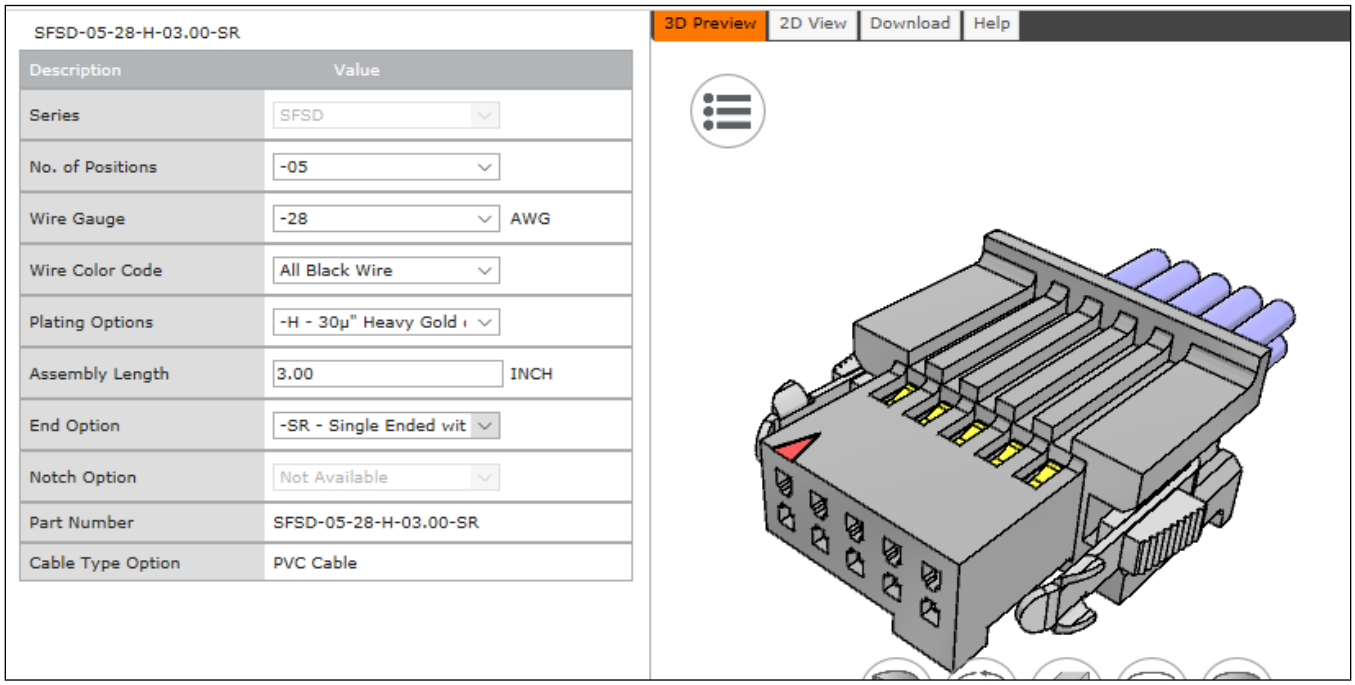
For users wishing to build their own custom I/O cabling, the following product information is provided to expedite your cable solutions. Samtec web information for the discrete connector and a cable assembly with retention clips follows the table.

MFG	Part #	Description	Data Sheet
Samtec	ISDF-05-D ISDF-05-D-M (*see image below*)	Discrete Connector *(see example below)*	https://www.samtec.com/products/isdf
Samtec	SFSD-05-[WG]-G-[AL]-DR-[E2O] *WG : Wire Gauge* *AL : Assembled Length* *E2O : End 2 Option*	Discrete Cable Assembly *(see example below)*	https://www.samtec.com/products/sfsd
ISDF-05-D-M Connector Availability On-Line			
North-America (specific country can be selected)		http://www.newark.com/samtec/isdf-05-d-m/connector-housing-receptacle-10/dp/06R6184	
Europe (specific country can be selected)		http://uk.farnell.com/samtec/isdf-05-d-m/receptacle-1-27mm-crimp-10way/dp/2308547?ost=ISDF-05-D-M	
Asia-Pacific (specific country can be selected)		http://sg.element14.com/samtec/isdf-05-d-m/receptacle-1-27mm-crimp-10way/dp/2308547?ost=ISDF-05-D-M	
Important: *Samtec ISDF-05-D-S is not compatible with Genie Nano-5G*			

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"



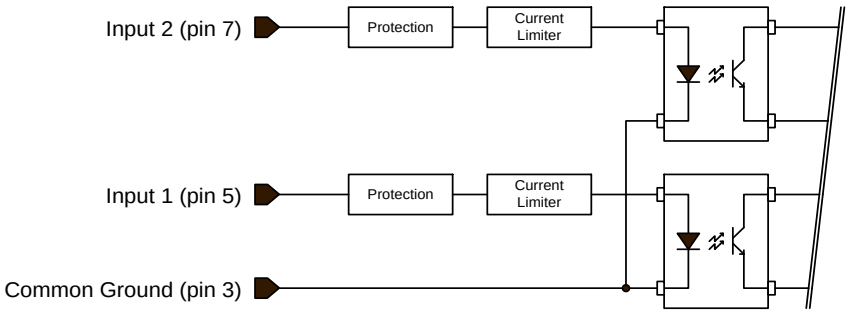
Power over Ethernet (PoE) Support

- The Genie Nano-5G requires a PoE Class 0 or Class 2 (or greater) power source for the network if not using a separate external power source connected to pins 1 & 2 of the camera's I/O Connector.
- To use PoE, the camera network setup requires a powered computer NIC supporting PoE, or a PoE capable Ethernet switch, or an Ethernet power injector.
- **Important:** Connect power via the I/O connector or PoE, but not both. Although Nano-5G has protection, differences in ground levels may cause operational issues or electrical faults.
- If both supplies are connected and active, the Nano-5G will use the I/O power supply connector. But as stated, ground differences may cause camera faults or failure.
- **Important:** When using PoE, the camera's I/O pin 1 (Camera Power – Ground) must not be connected to I/O pin 3 (General Input/Output Common Ground).

	**Note**: Power-over-Ethernet (PoE) is not available with models that include a UART RS-232 serial port (part numbers G5-Gx4x-xxxxx).

Input Signals Electrical Specifications

External Inputs Block Diagram



External Input Details

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

External Input DC Characteristics

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

Absolute Maximum Range before Possible Device Failure

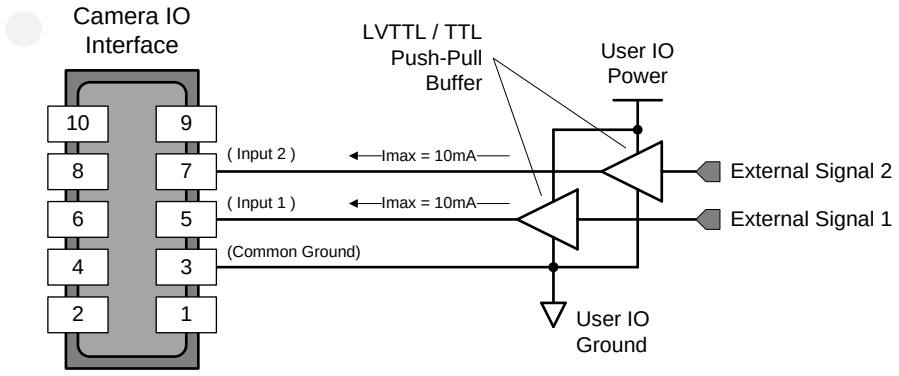
Absolute Ratings	Minimum	Maximum
Input Voltage	–36 Volts	+36 Volts

External Input AC Timing Characteristics

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

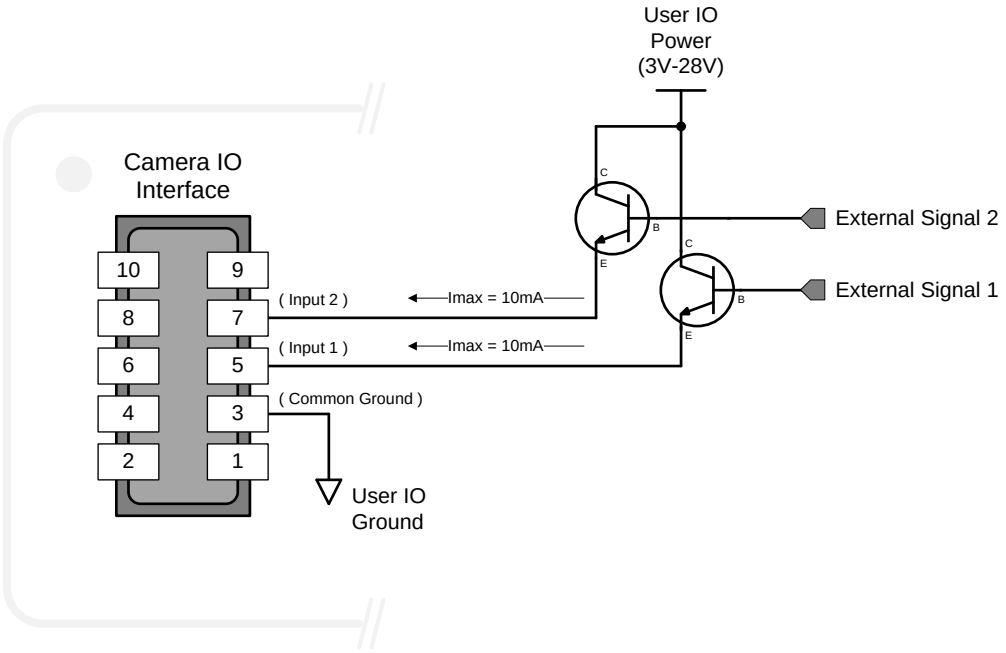
External Inputs: Using TTL/LVTTL Drivers

- External Input maximum current is limited by the Nano-5G circuits to a maximum of 12mA.



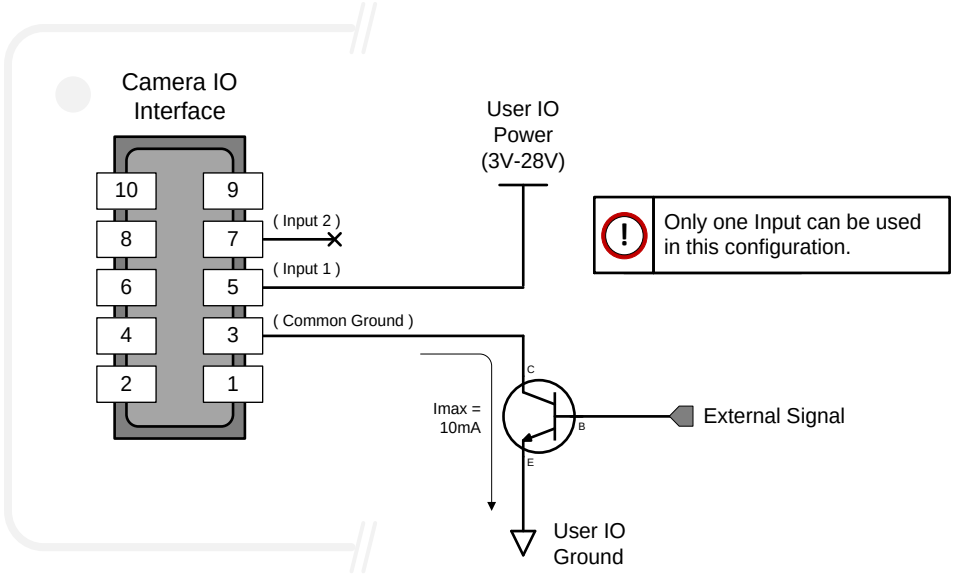
External Inputs: Using Common Collector NPN Drivers

- External Input maximum current is limited by the Nano-5G circuits to a maximum of 12mA.



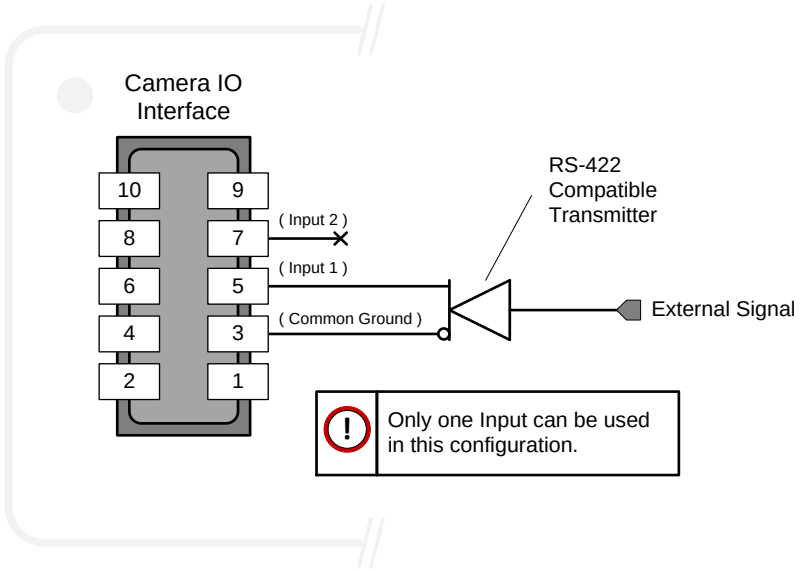
External Inputs: Using Common Emitter NPN Driver

- External Input maximum current is limited by the Nano-5G circuits to a maximum of 12mA.
- Warning: Only one External Signal can be used (input 1 or input 2).



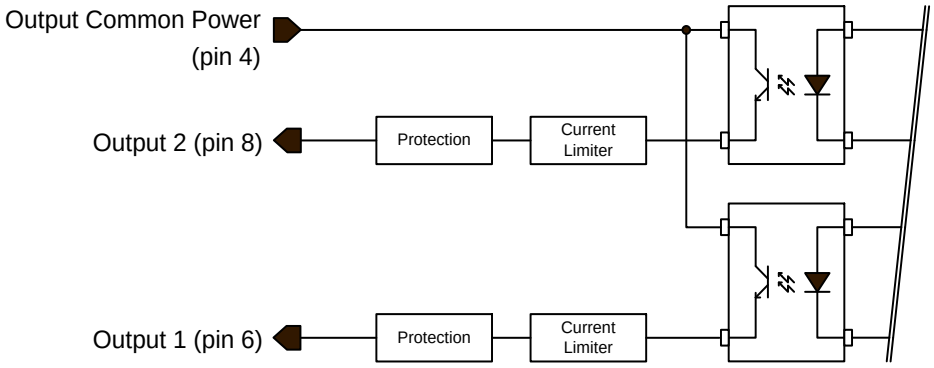
External Inputs: Using a Balanced Driver

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



Output Signals Electrical Specifications

External Outputs Block Diagram

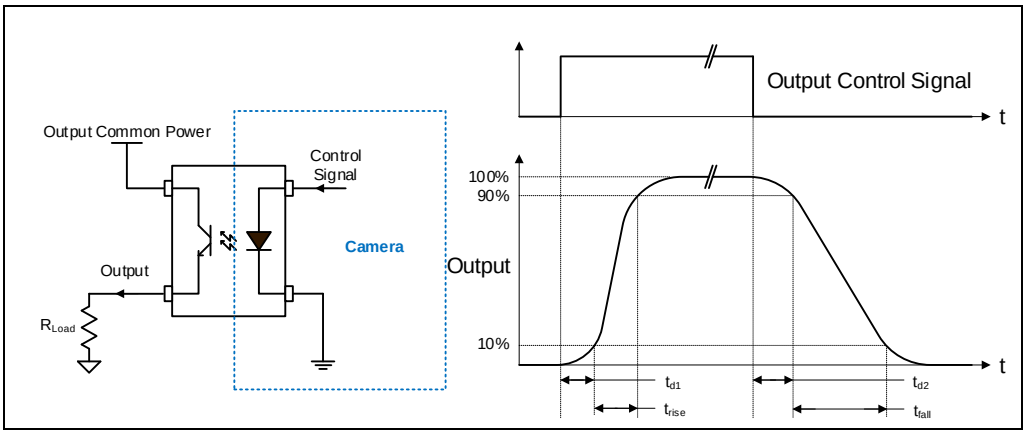


External Output Details and DC Characteristics

- Programmable output mode such as strobe, event notification, etc (see *outputLineSource* feature)
- Outputs are open on power-up with the default factory settings
- A software reset will not reset the outputs to the open state if the outputs are closed
- A user setup configured to load on boot will not reset the outputs to the open state if the outputs are closed
- No output signal glitch on power-up or polarity reversal
- **Typical** Operating Common Power Voltage Range: +3V to 28Vdc at 24mA
- **Maximum** Common Power Voltage Range : ±30Vdc
- **Maximum** Output Current: 36mA

External Output AC Timing Characteristics

The graphic below defines the test conditions used to measure the Nano-5G external output AC characteristics, as detailed in the table that follows.



Opto-coupled Output: AC Characteristics

Note: All measurements subject to some rounding.

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

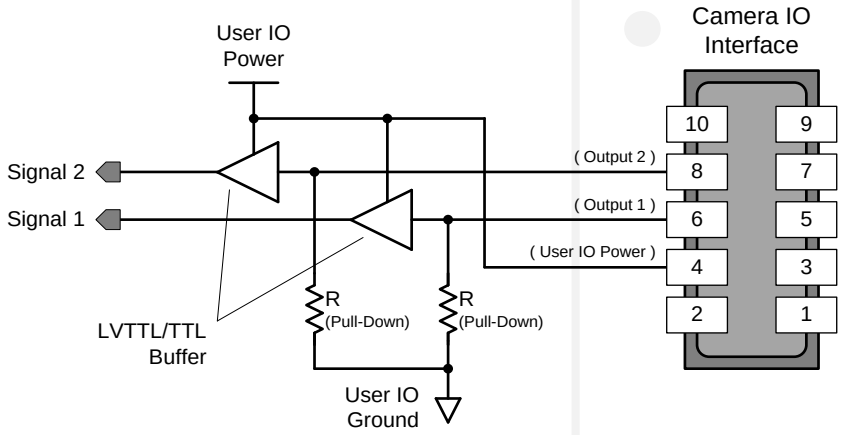
Output Common Power	Output Current	R_{load} *Test (ohm)*	t_{d1} (µs) *Leading Delay*	t_{rise} (µs) *Rise Time*	t_{d2} (µs) *Trailing Delay*	t_{fall} (µs) *Fall Time*	V_{out} (V)
3V	8 mA	240	0.459	5.03	24.07	20.41	2.17
	12ma	144	0.492	6.95	16.9	16.35	1.75
	16 mA	40	0.473	4.92	9.91	10.7	0.559
5V	8 mA	523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

General Purpose Output 3 Fast Switching

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

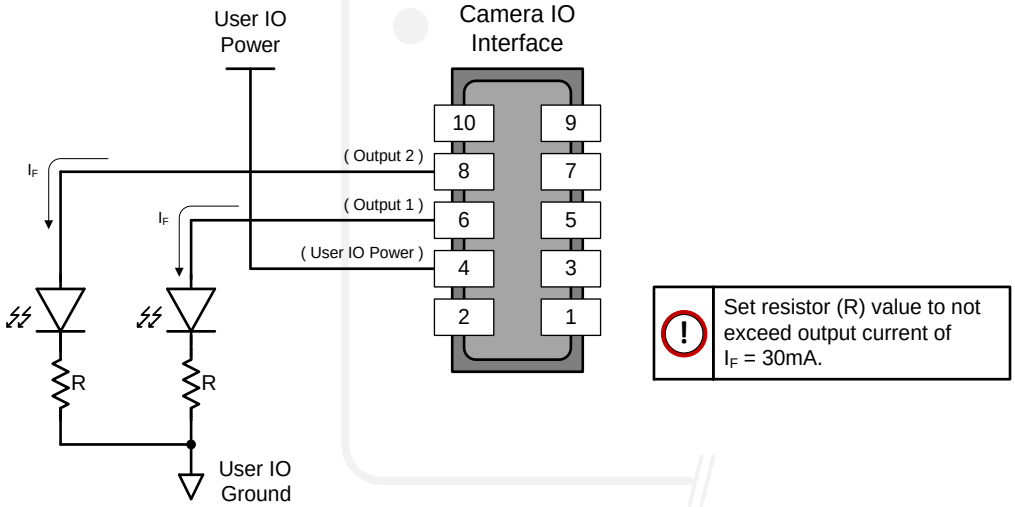
Output Common Power	Output Current	R_{load} *Test (ohm)*	t_{d1} (us) *Leading Delay*	t_{rise} (µs) *Rise Time*	t_{d2} (µs) *Trailing Delay*	t_{fall} (µs) *Fall Time*	V_{out} (V)
5V	8 mA	561	1.69	1.2144	0.897	0.811	4.53
	16 mA	277	1.883	1.6192	0.502	0.659	4.45
	24 mA	182	2.021	1.9789	0.225	0.65	4.37
12V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

External Outputs: Using External TTL/LVTTL Drivers

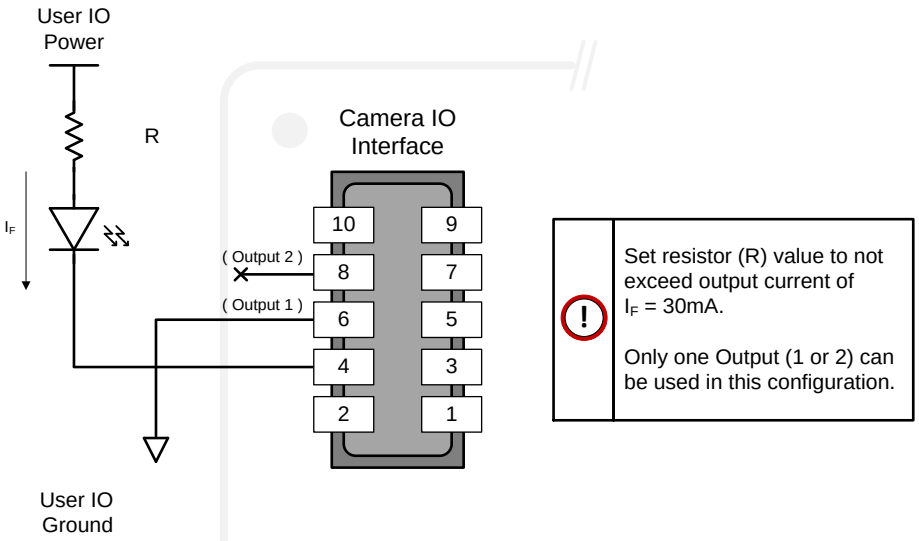


External Outputs: Using External LED Indicators

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

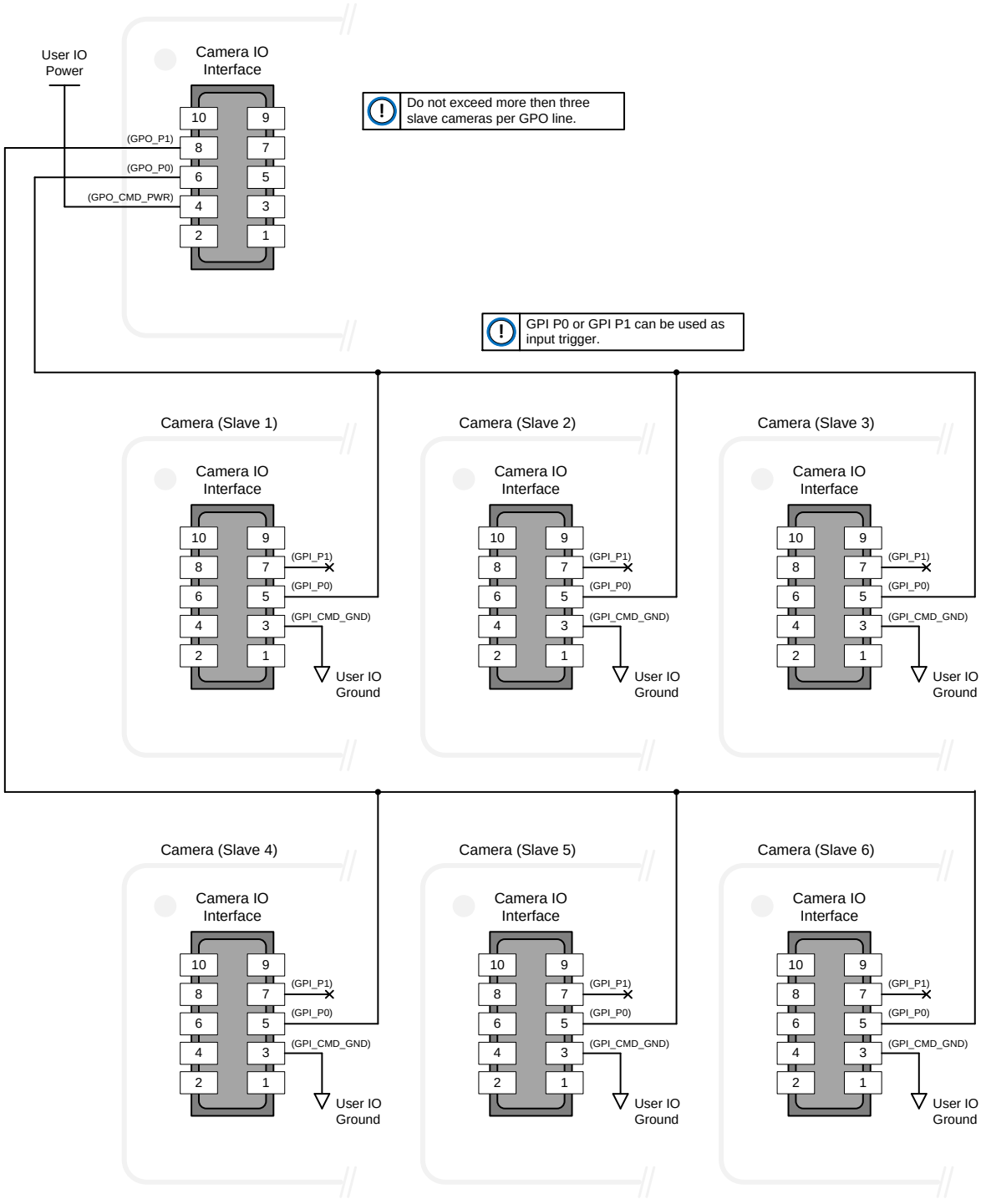


- Alternatively one external LED can be connected in the Common Anode configuration.



Using Nano-5G Outputs to drive other Nano-5G Inputs

- A synchronization method where one Nano-5G camera signals other Nano-5G cameras.
- Note: One Nano-5G output can drive a maximum of three Nano-5G inputs, as illustrated below.



Computer Requirements for Nano-5G Cameras

The following information is a guide to computer and networking equipment required to support the Nano-5G camera at maximum performance. The Nano-5G camera series complies with the current Ipv4 Internet Protocol, therefore current Gigabit Ethernet (GigE) equipment should provide trouble free performance.

Host PC System

- Refer to your GigE-Vision compliant SDK for computer requirements.

Network Adapters

- To support 5G, the network connection to the camera must support the 5G link speed (network adapter and/or switches), otherwise speed will auto-negotiate to the maximum speed supported by the network hardware (this speed can be validated using the GevLinkSpeed feature). For more information, refer to the Network Hardware Considerations section.
- **Important:** 10/100 Mb Ethernet is not supported by the Genie Nano-5G series of cameras. The Genie Nano-5G Status LED will show that it acquired an IP address (solid Blue) but the Nano-5G will not respond or function at these slower connections.

EMC Declarations of Conformity

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

FCC Statement of Conformance

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

1. The product may not cause harmful interference; and

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

FCC Class A Product

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

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

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

CE Declaration of Conformity

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

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

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

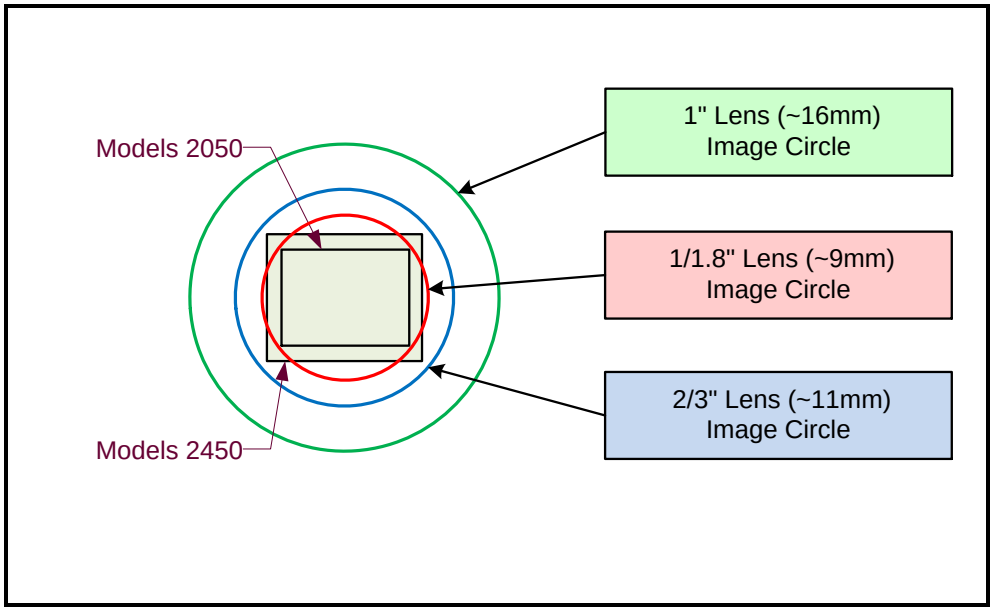
Additional Reference Information

Choosing a Lens with the Correct Image Circle

Each Nano-5G 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-5G model family along with alternative lens types. Brief information on other lens parameters to consider follows those sections.

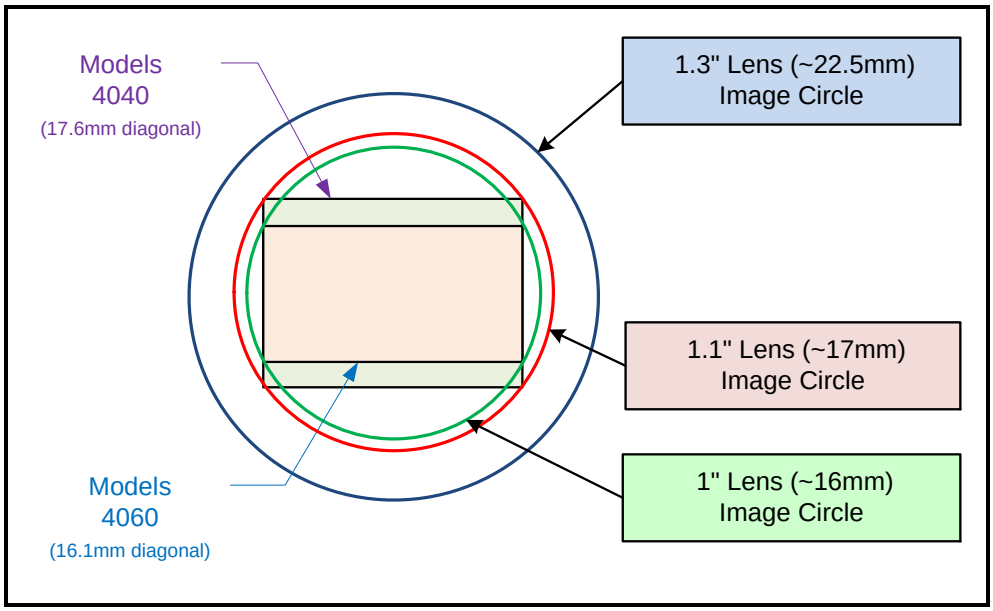
Lens Options for Models '2450' & '2050'

- The following figure shows the lens image circles relative to Genie Nano-5G models using the Sony IMX250/264 and IMX252/265 sensors, in color or monochrome versions.
- A typical 2/3" lens will fully illuminate these sensors. A smaller 1/1.8" lens could be used with Model 2050.



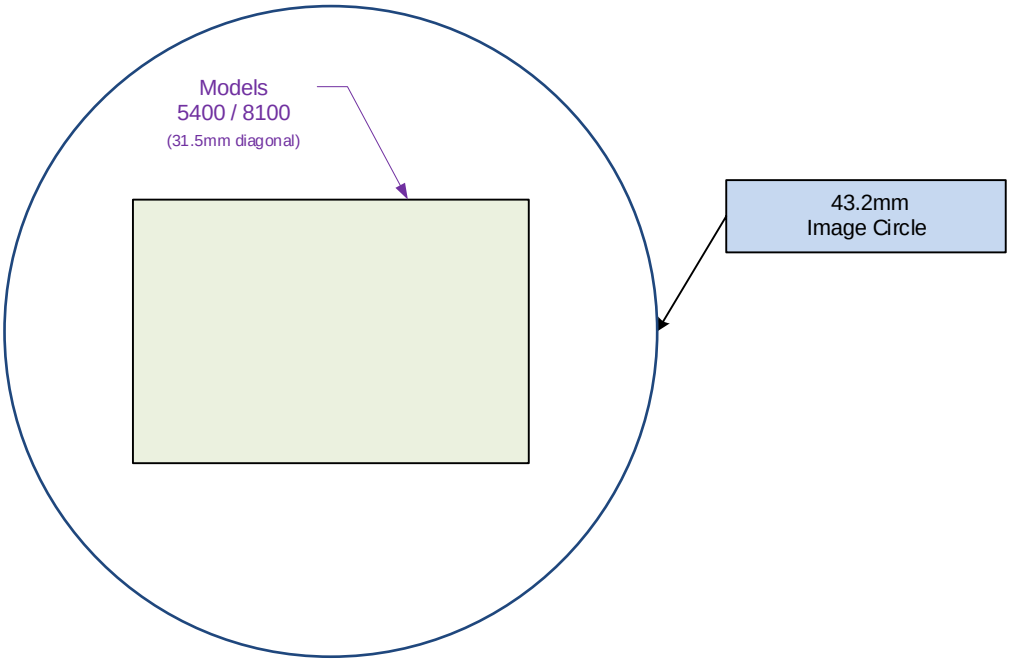
Lens Options for Models '4040 /4060'

- The following figure shows the lens image circles relative to Genie Nano-5G models using the Sony IMX253 (models 4040) and MX255 (models 4060) sensors.
- A typical 1.1" lens will illuminate both sensors models while the 1" lens should only be used with models 4060 to avoid image vignetting.



Lens Options for Models '5400 /8100'

- The following figure shows a 43.2mm lens image circle relative to Genie Nano-5G models using the On-Semi XGS30000 (models 5400) and OnSemi XGS45000 (models 8100) sensors.



Examples of Available Lenses for High Resolution Models

Lenses for the Genie Nano-5G models using the On-Semi XGS30000 (models 5400) and OnSemi XGS45000 (models 8100) are available from Schneider Kreuznach.

Lens Version	Code no.
Xenon-Emerald 4.0/60	F mount 1085115
Xenon-Emerald 4.0/80	F mount 1085723
Xenon-Emerald 2.8/100 S	F mount 1064881
Xenon-Emerald 2,9/100 L	F mount 1070506

Useable Lenses

Lens Version	Code no.	Remark
Xenon-Emerald 2.8/28 S	F mount 1071609	Resolution may not be sufficient
Xenon-Emerald 2.8/28 L	F mount 1071606	Resolution may not be sufficient
Xenon-Emerald 2.2/50	F mount 1062672	Resolution may not be sufficient

Special Lenses with large image circle like Makro-Symmar, Macro Varon, Xenon-Sapphire, Xenon-Diamond and Xenon-Zirconia can be also used for special applications.

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-5G 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-5G mount (C mount). See Genie Nano-5G 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, 5μJ/cm^2 can be achieved by exposing 5mW/cm^2 for 1ms just the same as exposing an intensity of 5W/cm^2 for 1μs.

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.

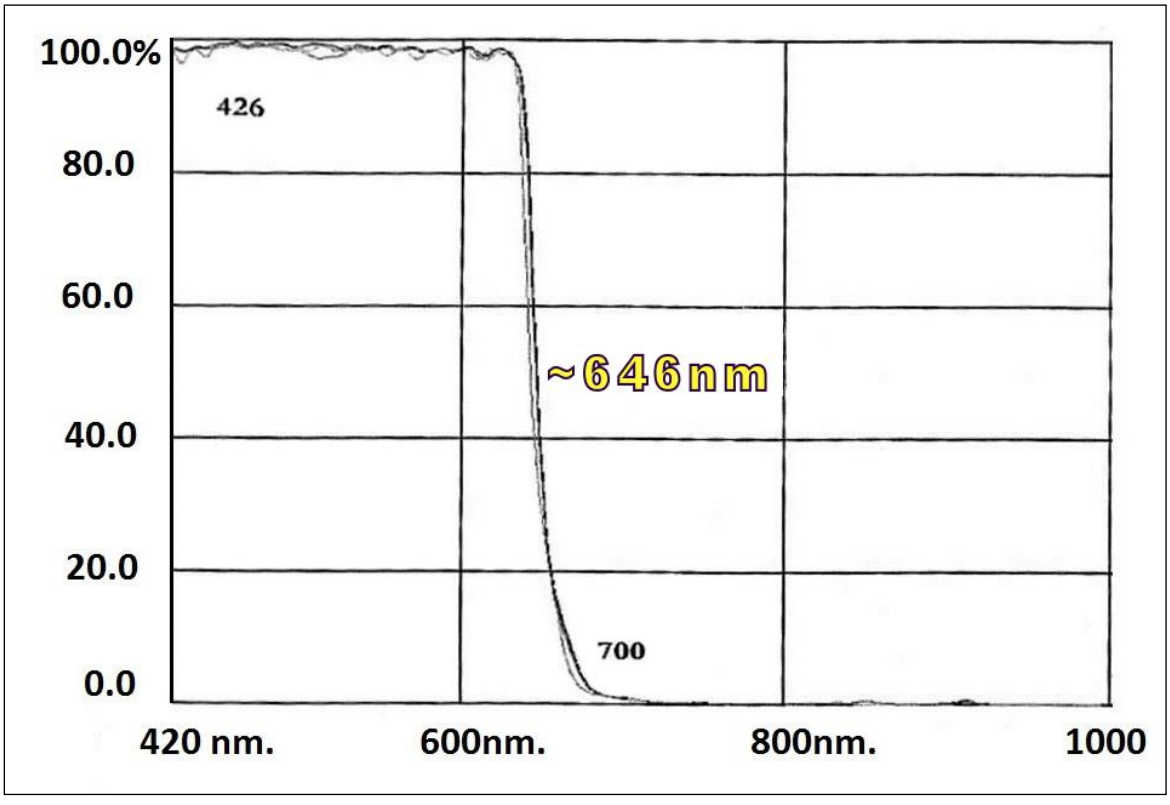
IR Cut-off Filters

Genie Nano-5G 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-5G 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.

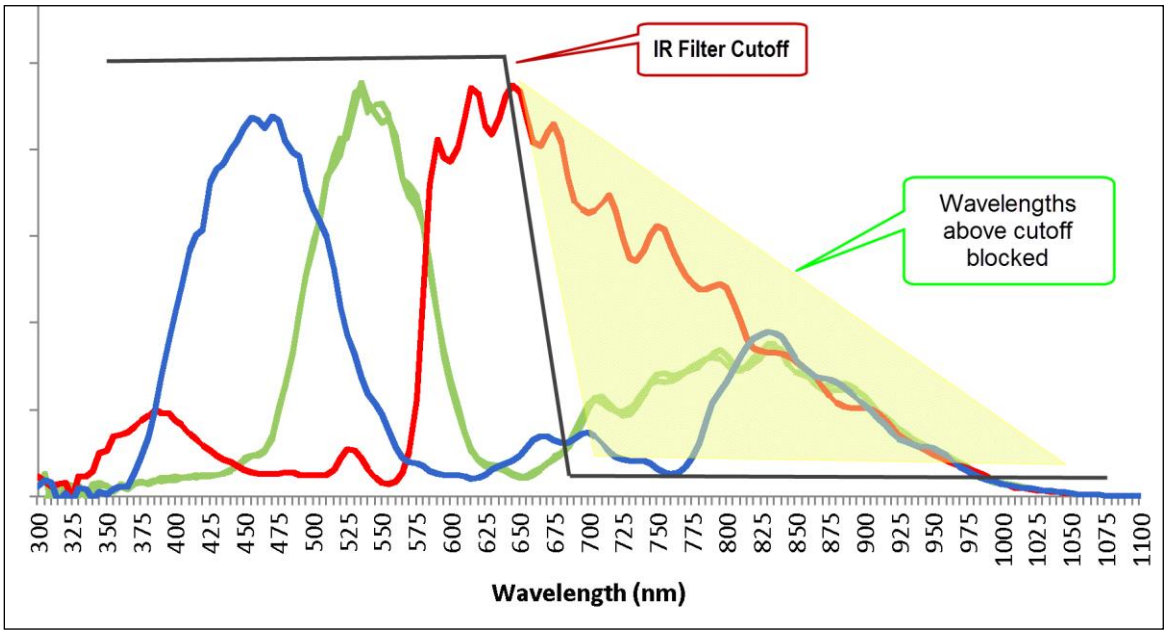
Nano-5G C-Mount Models with Built-in IR Cut-off Filters

Choose Nano-5G 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-5G color cameras.



For larger sensor Nano-5GigE models with M42 mount contact Midwest Optical for available IR cut filter fitting the m42 x 1mm thread (example part: M42x1C)

Midwest Optical Systems, Inc.
Office: 847-359-3550
Fax: 847-359-3567
http://www.midopt.com

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.

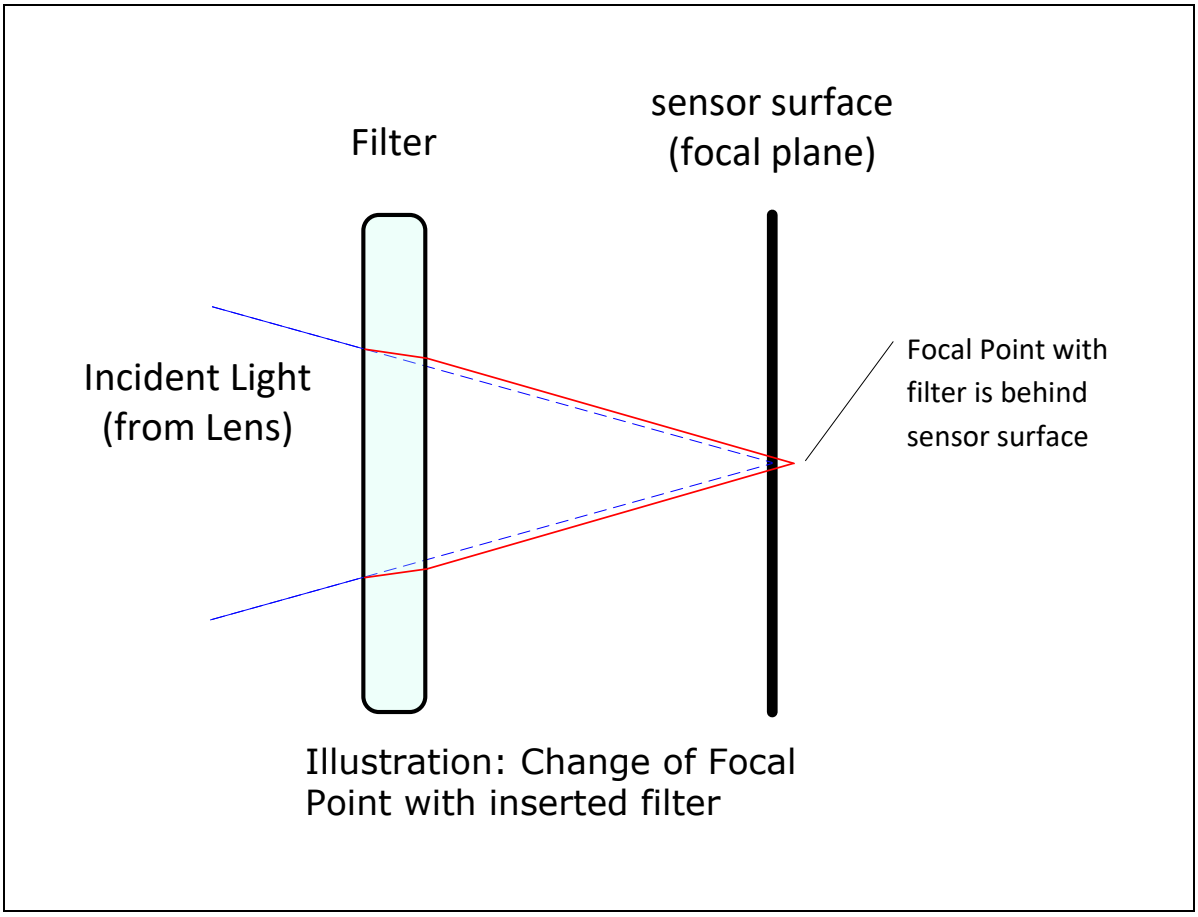


Illustration: Change of Focal Point with inserted filter

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-5G filters are specified as 1mm thick.

Genie Nano-5G 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-5G 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.

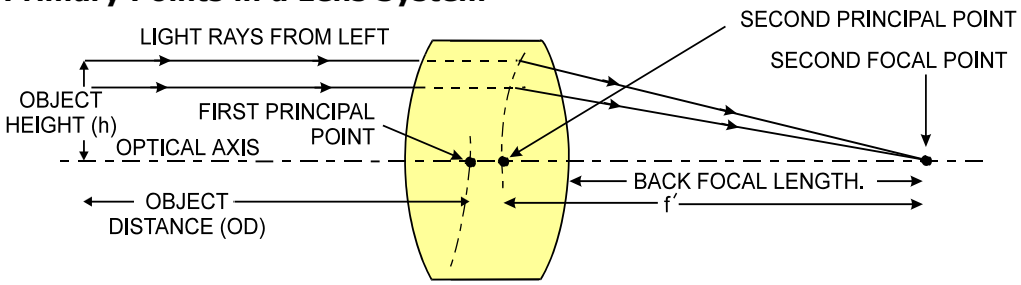
For users interested in installing their own choice of filters, please refer to application note:
G3-AN0001 – Installing Custom Filters into Genie Nano.pdf
available here http://www.teledynedalsa.com/imaging/knowledge-center/appnotes/

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).

$\frac{10\mu m}{100\mu m} = \frac{45mm}{OD}$	$OD = 450mm(0.450m)$

Sensor Handling Instructions

This section reviews proper procedures for handling, cleaning, or storing the Genie Nano-5G camera. Specifically the Genie Nano-5G 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-5G 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-5G. Users wishing to build their I/O cabling by starting from available cable packages should consider these popular assemblies described below. Contact Sales for pricing and delivery.

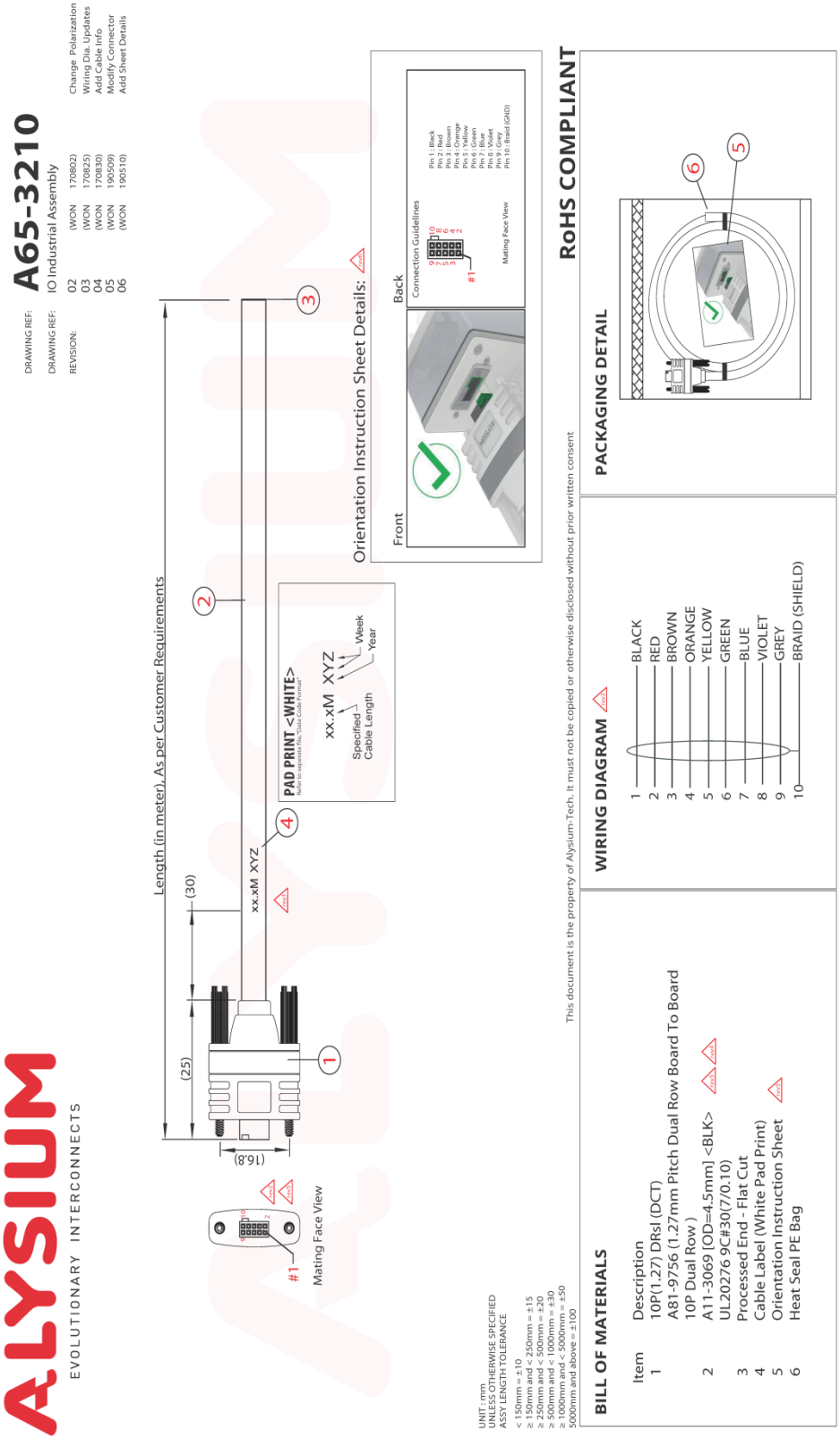
Users also may order cable assembly quantities directly from Alysium-Tech or Components Express. In such cases use the manufacturer’s part number shown on the cable assembly engineering drawing.

Cable Manufactures Contact Information

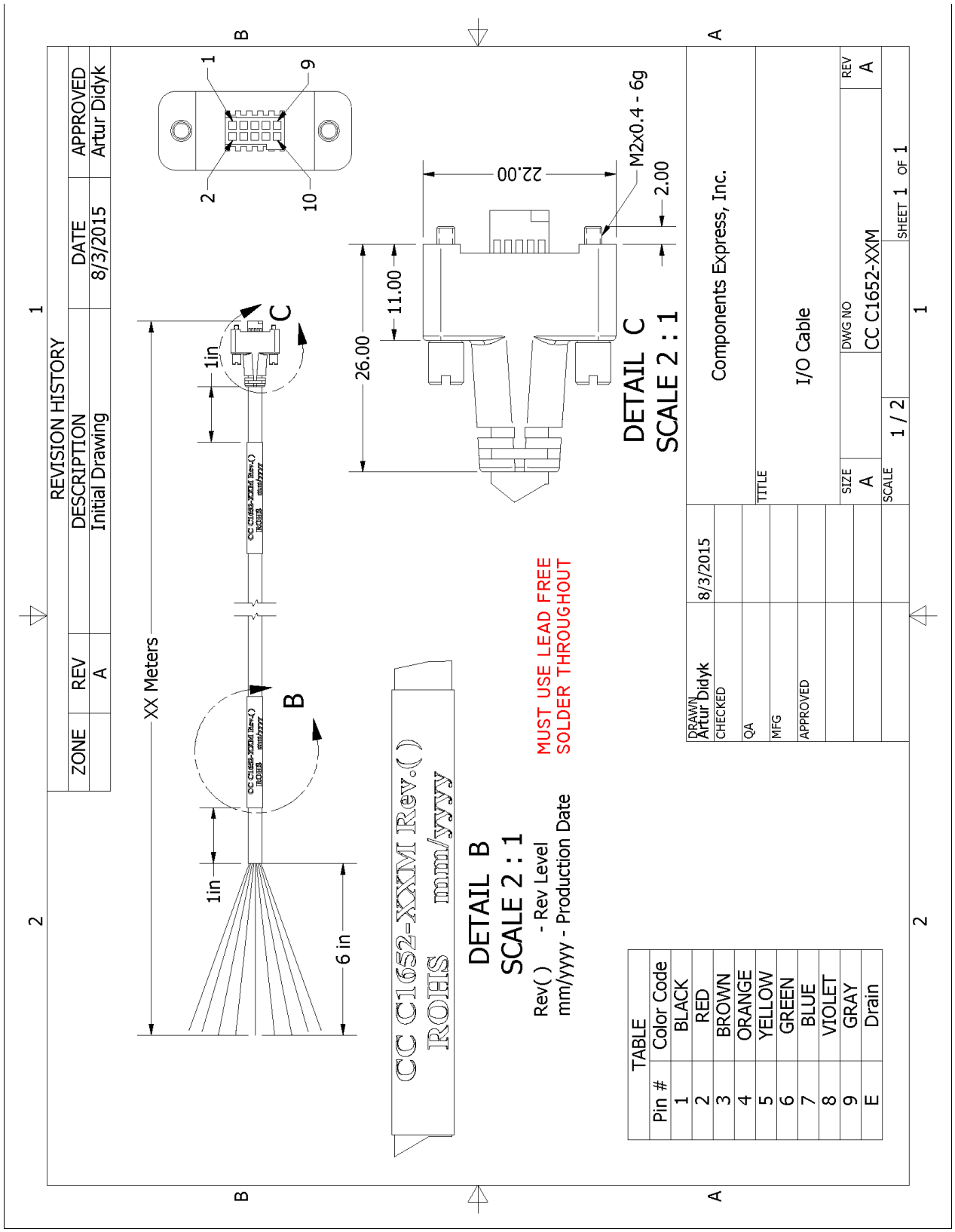
For Information contact: *(see their web site for worldwide offices)*	Alysium-Tech 101 Montgomery Street, Suite 2050 San Francisco, CA 94104 Phone: 415 248 7807 Fax: 415 248 7800 https://www.alysium.com/

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

Cable Assembly G3-AIOC-BLUNT1M

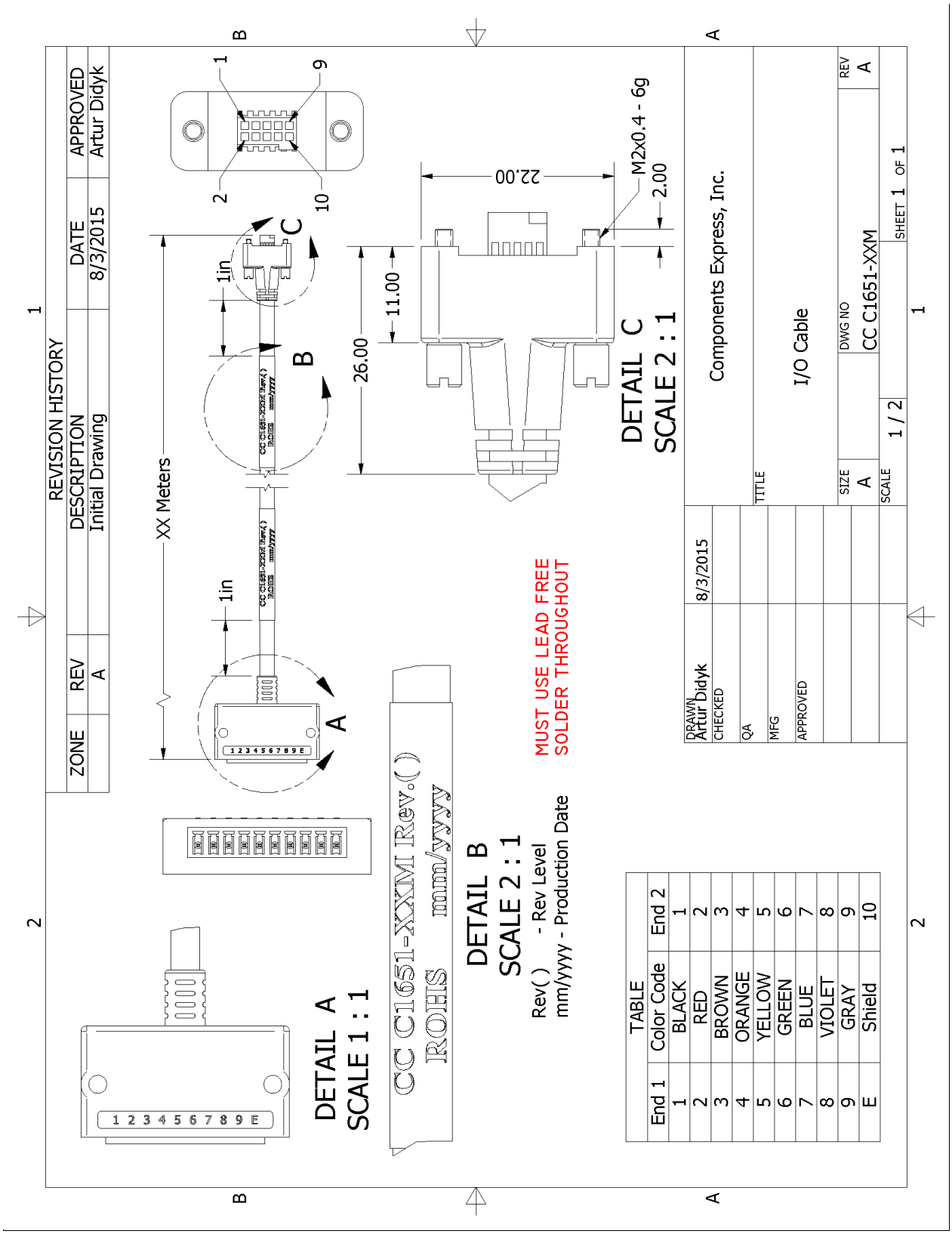


Cable Assembly G3-AIOC-BLUNT2M



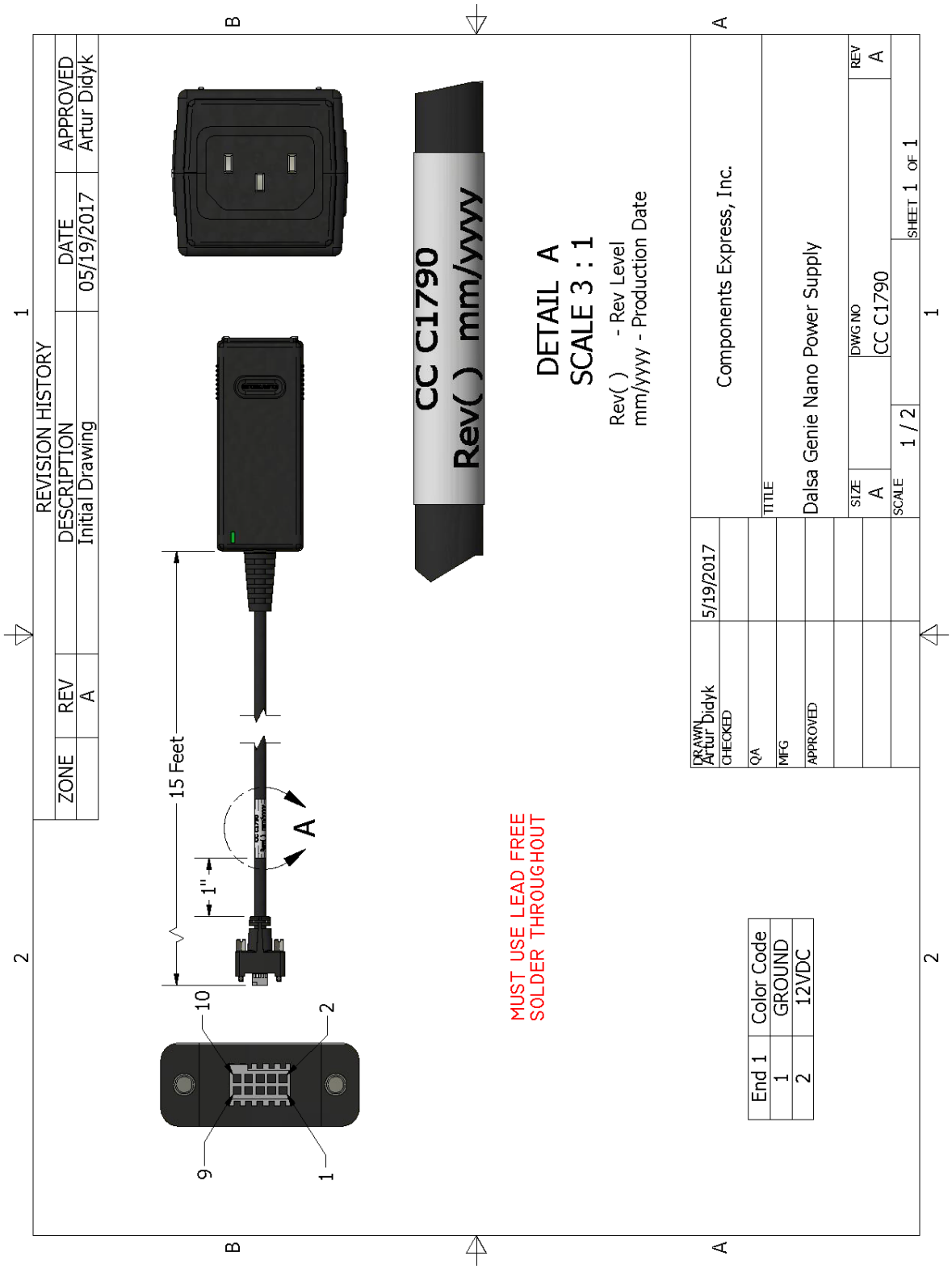

ROHS
08/2015

Cable Assembly G3-AIOC-BRKOUT2M




1 2 3 4 5 6 7 8 9 E
CC C1661-22M REV. A
ROHS 05.12016

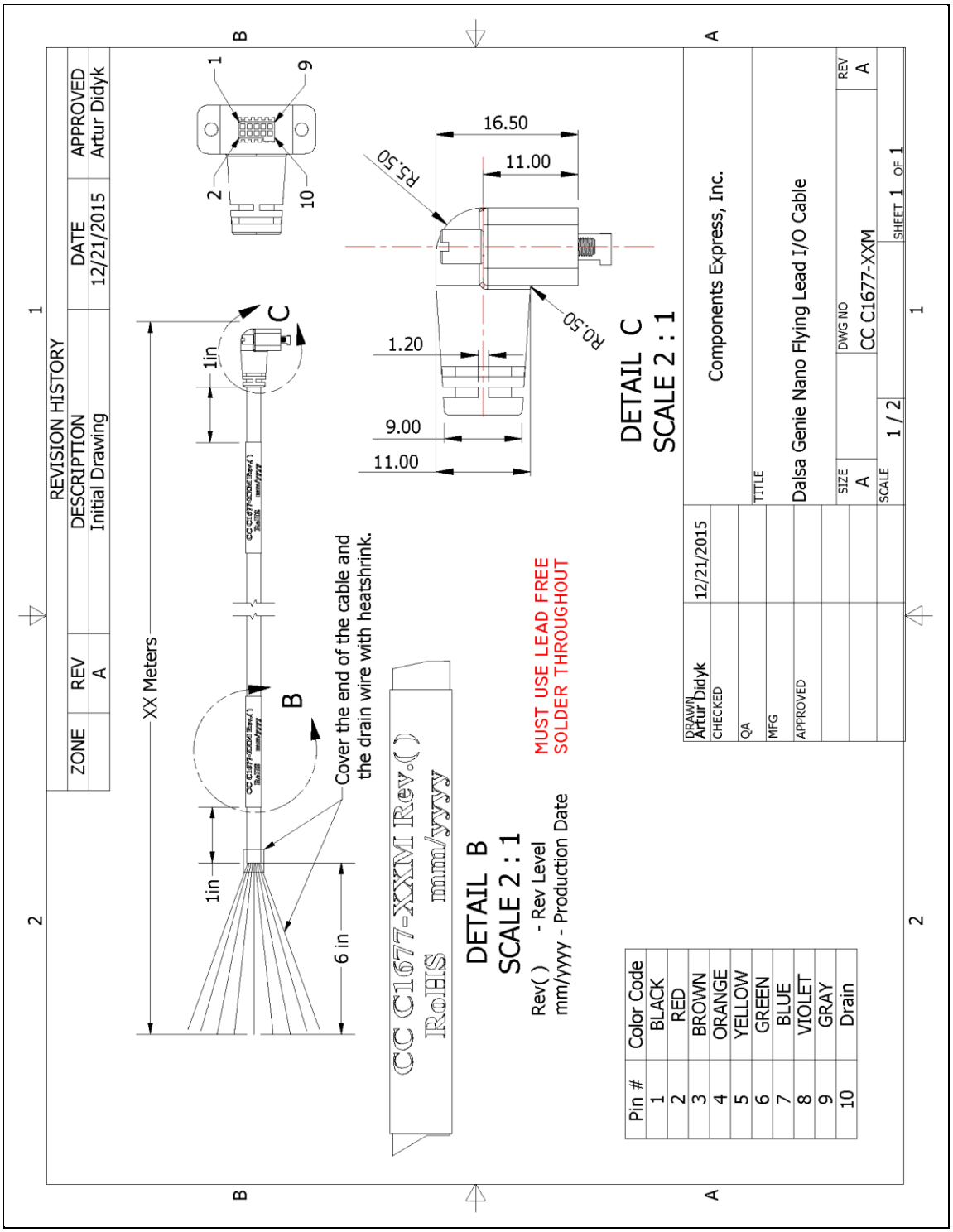
Nano-5G Generic Power Supply with no I/O



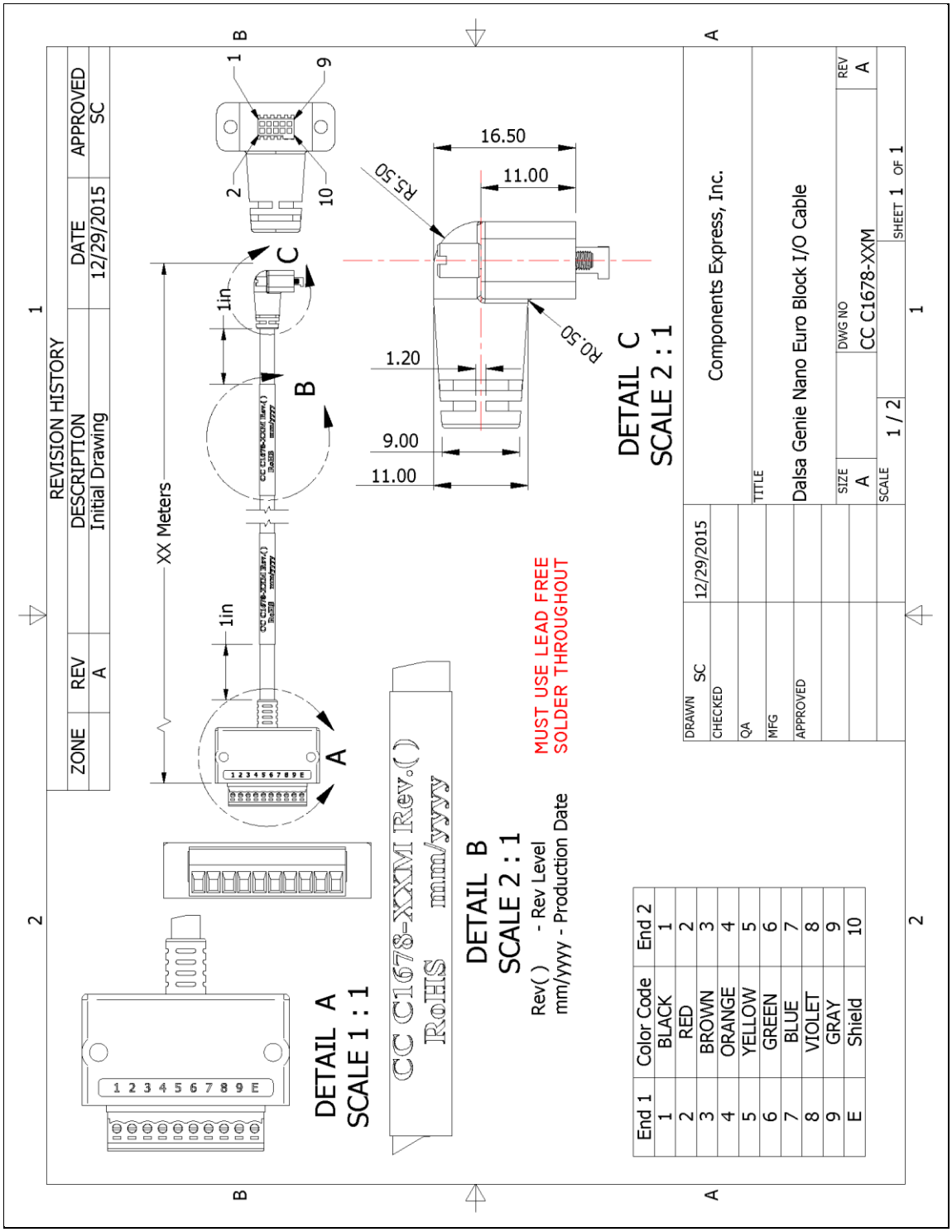
Components Express Right-Angle Cable Assemblies

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



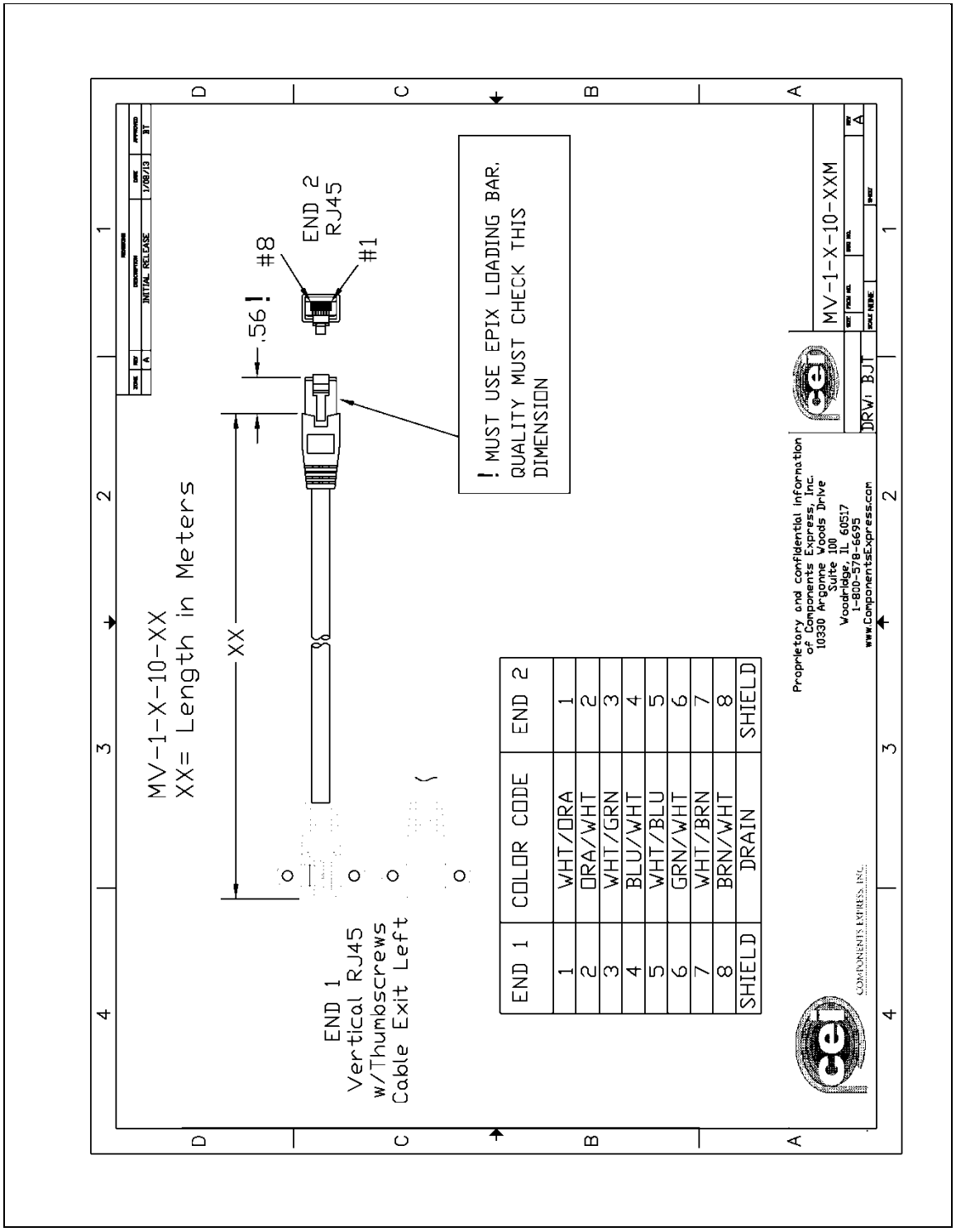
Ruggedized RJ45 Ethernet Cables

Components Express Inc. has available industrial RJ45 CAT6 cables that on one end have a molded shroud assembly with top/bottom thumbscrews, while the other end is a standard RJ45 (one example shown below). These cables are recommended when Nano-5G is installed in a high vibration environment. All Nano-5G versions support this secure Ethernet cable. Review their catalog for all available versions of vertical thumbscrew RJ45 cable sets.

RJ45 Vertical
w/Thumbscrews

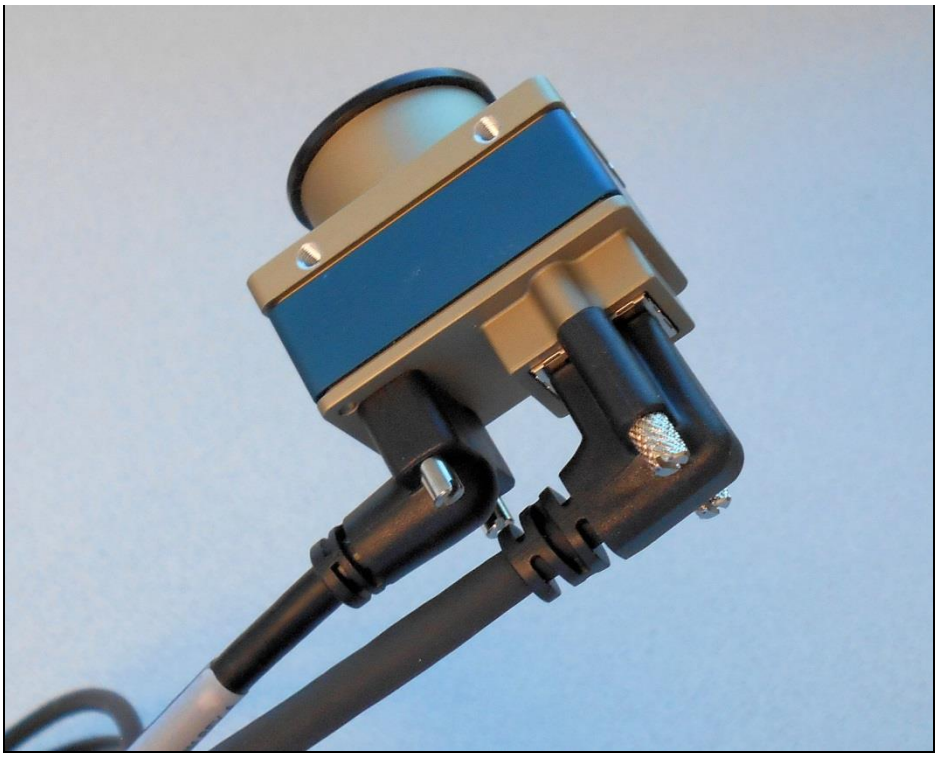
All cables made in U.S.A. – all cables RoHS compliant.	CAT6 certified (tested for near end / far end crosstalk and return loss). IGE-3M (3meters) IGE-10M (10meters) IGE-25M (25meters) IGE-50M (50meters) IGE-100M (100meters)

Cable Assembly: Right-Angle Ethernet



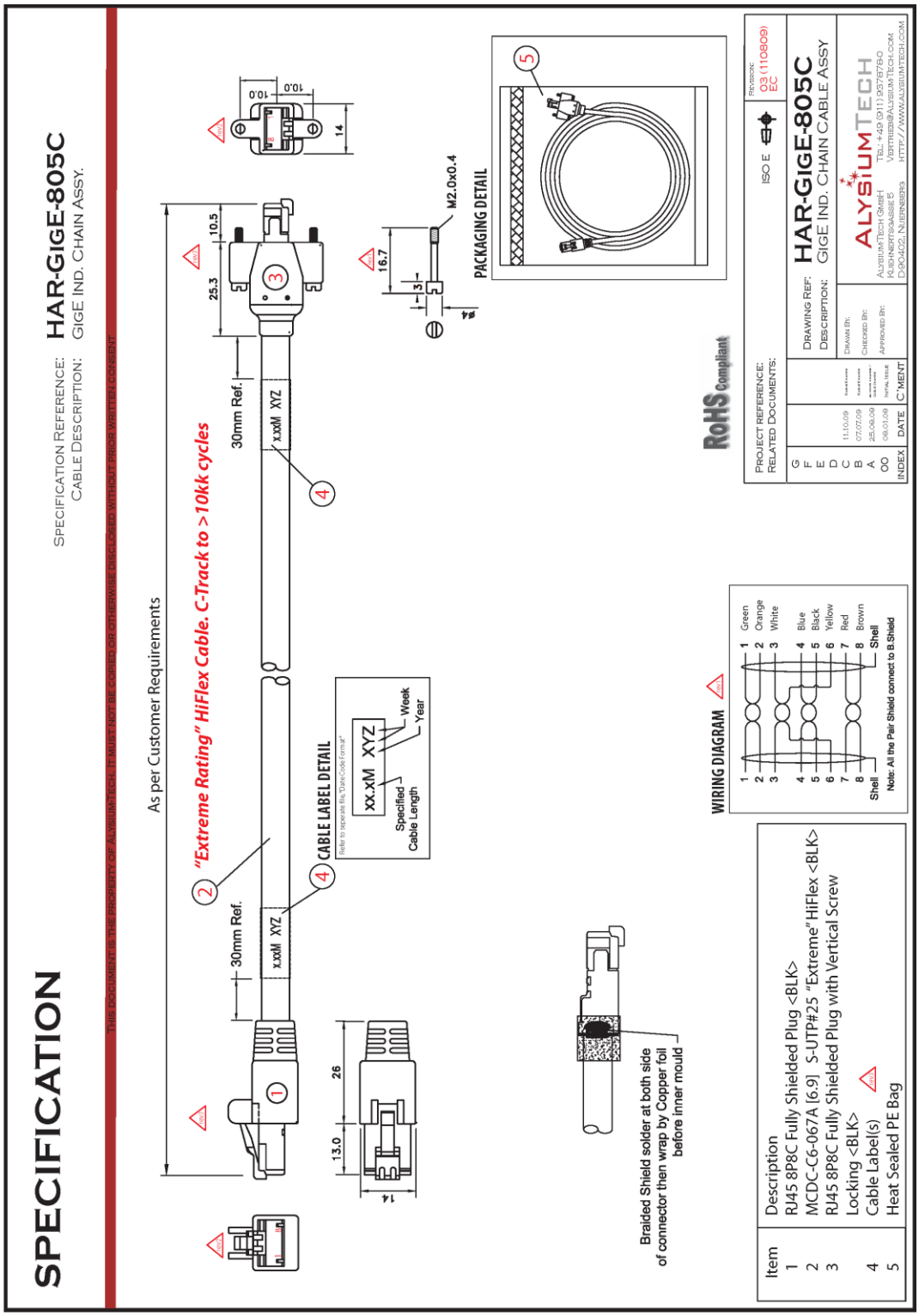
Right-Angle Cable-Set (Mounted)

Photos show the Components Express Right-Angle combo package (**CC C1679-xxM**) consisting of a Right-Angle Ethernet cable, Right-Angle I/O to Euro Block, and power supply (not shown).



Alysium-Tech “Extreme Rating” HiFlex Ethernet Cable

Alysium-Tech has a cable series for constant movement applications such as cameras mounted on robotic arms or other locations where reliable interconnects are required. [Contact Alysium-Tech](#) directly for pricing.



IP67 Enclosure Products

Component Express has designed IP67 enclosures for Nano 5G cameras. Contact them directly for complete information.

IP67 Protection Enclosure Designed for Nano 5G

Shown below is page one of the Component Express data sheet for this enclosure.

COMPONENTS EXPRESS, INC.
INDUSTRY LEADING PERFORMANCE
10330 Argonne Woods Drive, Suite 100 • Woodridge, IL 60517
Tel 630-257-0605 / 800-578-6695 (outside Illinois) Fax 630-257-0603

CEI Machine Vision Camera Enclosure IP67 88mm Series Round

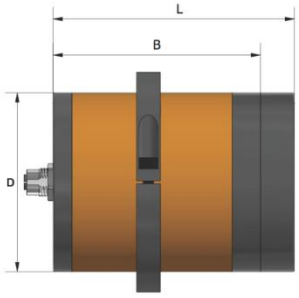
As a leading innovator in the Machine Vision Industry, CEI is proud to introduce our new line of Machine Vision Camera Enclosures, Cables, and Accessories for demanding vision applications.

IP67 88mm Series Camera Round Enclosure Key Features

- **CEI Integrated Connector Design (no cord grips)**
- **IP67 protection**
- **Universal design for camera models with up to 60mm^2 body**
- **Also supports Dalsa Genie Nano XL, Nano 5G, Sony Block**
- **Excellent heat dissipation**
- **Enclosure tailored for specific Camera & Optics**
- **Adjustable Mount with 4 tapped holes included**
- **High quality (easy to replace) windows by Midwest Optical**
- **Lightweight low-profile design**
- **Type 2 anodizing**
- **Options: Mounts, Windows & Filters, Cables**
- **Options: Custom Sizes, lengths, and focusing solutions.**
- **Options: Complete Solutions (Camera, Enclosure, Cabling)**
- **Competitive pricing**
- **Made in USA, Patent Pending**

Enclosure Specs (*See Appendix "A" for part numbers*)

Camera Size: up to 60mm square machine vision
Optics: Supports a wide range optics
Window: Midwest Optical 2mm– AR coated
Borofloat glass
Lens Covers: Available in 79mm and 103mm Diameters
Lengths in 10mm increments
Interface Connectors: M12 X-Code Ethernet Female
Optional Interface: M12 A-Code I/O Male
Mounting: Qty. 2, M6 and Qty. 2 ¼-20 UNC tapped holes with 19.05mm (¾") hole spacing
Adjustable ring mount
Sealing: IP67
Material: 6061 Aluminum
Coating: Type 2 anodized
Overall Length (L): Varies, See Appendix "A"
Body Length (B): Varies, See Appendix "A"
Height / Width (D): 95 mm OD round (body)
Mount diameter: 120 mm
Weight: ~1000g (typical weight fully assembled W/ Camera)



Contact CEI for Application and Configuration Details.

Call Components Express, Inc. at 630-257-0605 for Ordering Information.

IP67_88mm Round – Rev A

Troubleshooting

Overview

In rare cases an installation may fail or there are problems in controlling and using the Nano-5G camera. This section highlights issues or conditions which may cause installation problems and additionally provides information on computers and network adapters which have caused problems with Nano. Emphasis is on the user to perform diagnostics with the tools provided and methods are described to correct the problem.

The GigE Server status provides visual information on possible Nano-5G problems. The three states are shown in the following table. Descriptions of possible conditions causing an installation or operational problem follow. Note that even a Nano-5G installation with no networking issue may still require optimization to perform to specification.

	Device Not Available	Device IP Error	Device Available
GigE Server Tray Icon:			
Note: It will take a few seconds for the GigE Server to refresh its state after any change.	A red X will remain over the GigE server tray icon when the Nano-5G device is not found. This indicates a network issue where there is no communication with Nano. ***Or in the simplest case,*** the Nano-5G is not connected.	The GigE server tray icon shows a warning when a device is connected but there is some type of IP error.	The GigE server tray icon when the Nano-5G device is found. The Nano-5G has obtained an IP address and there are no network issues. Optimization may still be required to maximize performance.

Important: 10/100 Mb Ethernet is not supported by the Genie Nano-5G series of cameras. The Genie Nano-5G status LED will show that it acquired an IP address (solid Blue) but the Nano-5G will not respond or function at these slower connections.

Problem Type Summary

Nano-5G problems are either installation types where the Nano-5G is not found on the network or setup errors where the Nano-5G device is found but not controllable. Additionally a Nano-5G may be properly installed but network optimization is required for maximum performance. The following links jump to various topics in this troubleshooting section.

Device Not Available

A red X over the GigE server tray icon indicates that the Nano-5G device is not found. This indicates either a major camera fault or condition such as disconnected power, or a network issue where there is no communication.

- Review the section Using Nano-5G to verify required installation steps.
- Refer to the Teledyne DALSA Network Imaging manual to review networking details.
- In multiple NIC systems where the NIC for the Nano-5G is using LLA mode, ensure that no other NIC is in or switches to LLA mode. It is preferable that the Teledyne DALSA DHCP server is enabled on the NIC used with the Nano-5G instead of using LLA mode, which prevents errors associated with multiple NIC ports.
- Verify that your NIC is running the latest driver available from the manufacturer.

Device IP Error

The GigE server tray icon shows a warning with IP errors. Review the following topics on network IP problems to identify and correct the condition.

Please refer to the Teledyne DALSA Network Imaging Package manual for information on the Teledyne DALSA Network Configuration tool and network optimization foe GigE Vision cameras and devices.

Multiple Camera Issues

- When using multiple cameras with a computer with multiple NIC ports, confirm each Nano-5G has been assigned an IP address by checking the GigE server.
- To reduce network traffic in configured problem free systems, use the Network Configuration tool to stop camera discovery broadcasts. Refer to the Teledyne DALSA Network Imaging manual.
- When using multiple cameras connected to an VLAN Ethernet switch, confirm that all cameras are on the same subnet setup on that switch. See the Teledyne DALSA Network Imaging package manual for more information. .
- If a Nano-5G camera installed with other GigE Vision cameras cannot connect properly with the NIC or has acquisition timeout errors, there may be a conflict with the third party camera's filter driver. In some cases third party filter drivers modify the NIC properties such that the Teledyne DALSA Sapera Network Imaging Driver does not install. Verify such a case by uninstalling the third party driver and installing the Nano-5G package again.
- Verify that your NIC is running the latest driver available from the manufacturer.

Device Available but with Operational Issues

A properly installed Nano-5G with no network issues may still not perform optimally. Operational issues concerning cabling, Ethernet switches, multiple cameras, and camera exposure are discussed in the following sections:

Always Important

- Why should Nano-5G firmware be updated? See Firmware Updates.
- Power Failure during a Firmware Update–Now What?
- Cabling and Communication Issues
- See Preventing Operational Faults due to ESD to avoid random packet loss, random camera resets, and random loss of Ethernet connections.

No Timeout messages

- I can use CamExpert to grab but the image is corrupted with bad data. See Grab has Random Bad Data or Noise.
- I can use CamExpert to grab (with no error message) but there is no image (display window stays black). See Acquisition Error without Timeout Messages.
- I can use CamExpert to grab (with no error message) but the frame rate is lower than expected. See Camera acquisition is good but frame rate is lower than expected.
- There is no image but the frame rate is as expected.
  See Camera is functional, frame rate is as expected, but image is black.

Other problems

- Unexpected or missing 'Trigger Events'. See Random Invalid Trigger Events.
- Dropped packets or lost frames when using newer CPU system. See Preventing Dropped Packets by adjusting Power Options.

Verifying Network Parameters

Teledyne DALSA provides the Network Configuration tool to verify and configure network devices and the Nano-5G network parameters. See section Network Configuration Tool of the Teledyne DALSA Network Imaging manual, if there were any problems with the automatic Nano-5G software installation.

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-5G Framework and Sapera version used.

Device Available with Operational Issues

This section considers issues with cabling, Ethernet switches, multiple cameras, and camera exposure. All information concerning the Teledyne DALSA Network Configuration Tool and other networking considerations, is available in the **Teledyne DALSA Network Imaging manual**.

Firmware Updates

As a general rule any Nano-5G installation must include the firmware update procedure (see File Access Control Category). Nano-5G camera firmware that does not match a newer version of installed Nano-5G Framework software is likely to have unpredictable behavior.

Problems might be:

- Nano-5G is not found by the device discovery process.
- Nano-5G is found by the Sapera GigE Server but an application such as CamExpert does not see the camera.
- A Nano-5G that had a fault with a firmware update will automatically recover by booting with the previous firmware version.

Important: New Nano-5G 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 started, follow this procedure.

- Connect power to the Nano. The Nano-5G processor knows that the firmware update failed.
- The Genie Nano-5G will boot with the previous version of firmware and will operate normally.
- The Nano-5G 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 two cables connected to Nano, possible cabling issues are limited.

Power supply problems:

- If the Nano-5G status LED is off, the DC supply power is not connected or faulty. Verify the power supply voltage.

Communication Problems:

- Use a shielded cable where the connector shell electrically connects the Nano-5G chassis to the power supply earth ground. This can eliminate trigger issues in a high EMI environment.
- Check that the Ethernet cable is clipped both to the Nano-5G and the NIC or switch on the other end.
- Verify the Ethernet cabling. Poor cables will cause connections to auto-configure at lower speeds.
- Use a secured Ethernet cable when the Nano-5G is in a high vibration environment. See Ruggedized RJ45 Ethernet Cables.
- Check the Ethernet status LEDs on the NIC used with the camera. The Link Status indicator is on and the activity LED should flash with network messages.
- Verify that the Ethernet cable is CAT5e or CAT6. This is very important with long cable lengths.
- When using very long cables, up to the maximum specified length of 100m for gigabit Ethernet, different NIC hardware and EMI conditions can affect the quality of transmission.
- Minimum recommended Ethernet cable length is 3 feet (1 meter).
- Use the Log Viewer tool (see point below) to check on packet resend conditions.
- Run the Sapera Log Viewer: **Start•Programs•Teledyne DALSA•Sapera LT•Tools•Log Viewer**. Start the Nano-5G acquisition program, such as CamExpert. There should not be any "packet resend" messages, else this indicates a control or video transmission problem due to poor connections or extremely high EMI environments.

Acquisition Error without Timeout Messages

Streaming video problems range from total loss of image data to occasional loss of random video data packets. The following section describes conditions identified by Teledyne DALSA engineering while working with Nano-5G in various computers and setups. See the Teledyne DALSA Network Imaging manual for information on network optimizations.

Grab has Random Bad Data or Noise

The problem is seen as random noise and missing sections of video data from the acquisition. All configuration parameters seem correct and the Ethernet cable is secure. The following image shows an example of this type of bad acquisition while testing a Genie installation with CamExpert.

- This problem has been seen with network adapters that do not support jumbo frames but still report a false maximum packet frame size.
- Test for a good acquisition by reducing the camera packet size used. Set the value to the default value of 1500 to verify acquisition before trying a higher value.
- Other marginal NIC boards or ports can cause problems with packet transfers. Try alternative NIC adapters.

Review other reasons for such acquisition errors as described in the **Teledyne DALSA Network Imaging Module for Sapera LT** manual.

No camera exposure when expected

- Verify by using the camera in free-running mode. Do not use external trigger mode when testing a camera setup.
- If using free-running mode, verify that the exposure period is set to the maximum possible for the set frame rate.
- Load the factory default from the Power-up Configuration in CamExpert. This will reset the camera to its nominal acquisition rate.

Camera acquisition is good but frame rate is lower than expected

- While running CamExpert and grabbing in free run mode, check the GigE Vision Transport Layer Control to verify and possibly increase the Interpacket Delay. In multi-camera setups using a Gigabit Ethernet switch, the Device Link Throughput may need to be reduced so that each camera can equally share the available bandwidth.
- While running CamExpert and grabbing in free-run mode at the maximum frame rate, start the **Sapera Monitor** tool from the Sapera Tools installed with Sapera.
- Make sure the **Memory Overflow** event monitor is enabled.
- Continue grabbing from the Nano-5G at maximum frame rate. If any memory overflow events are counted, then the Nano-5G internal buffer could not be transmitted on time and was discarded. Such a condition may occur with large frame color or high frame rate Nano-5G cameras.
- Note that the Sapera CamExpert tool has limits to the maximum frame rate possible due to CamExpert generating an interrupt for each acquired frame. The Sapera Grab Demo may be better suited for testing at higher frame rates.
- Verify that network parameters are optimal as described in the Teledyne DALSA Network Imaging Module manual. Ensure the host computer is not executing other network intensive tasks. Try a different Gigabit NIC.
- Note that a changed acquisition frame rate becomes active only when the acquisition is stopped and then restarted.
- If using an external trigger, verify the trigger source rate and Nano-5G parameters such as trigger to exposure delay.
- USB to Ethernet adapters are not recommended nor guaranteed. Even in cases where the camera seems to be connected and transferring images, reports of random disconnections are common. If the user wishes to try such an interface, limit this to just one high quality unit, never more. Multiple units have not worked in a machine vision environment.

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

- Verify that the lens iris is open.
- Aim the Nano-5G 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-5G to output its Internal Pattern Generator. This step is typically done for any camera installation to quickly verify the Nano-5G and its software package. See Internal Test Pattern Generator for information on using CamExpert to select internal patterns from Nano.

Intel X550 T2 NIC: Low Connection Speed After Camera Reset

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

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

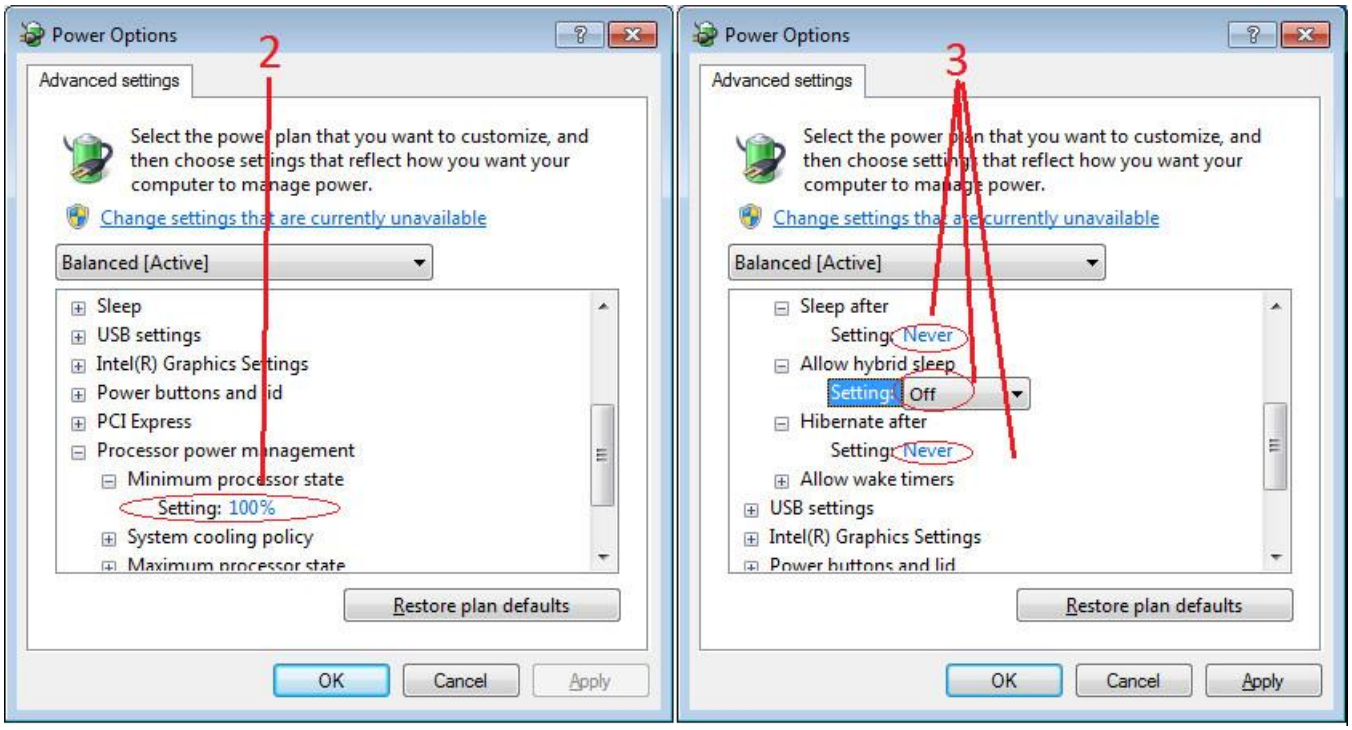
Other Problems or Issues

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.

Preventing Dropped Packets by adjusting Power Options

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

- Open Control Panel – Power Options and select advanced settings, as shown below.
- Scroll down to the Processor Power Management control and change the Minimum Processor State to 100%.
- Disable the Sleep and Hibernate options to ensure continuous system operation.



Random Invalid Trigger Events

- Do not change the exposure time while grabbing, else an Invalid Trigger Event may be generated. This applies to any exposure mode or trigger source. The Invalid Trigger Event is not catastrophic and only indicates the loss of a video frame. Stopping acquisitions first will avoid this error.
- Version 1.00 firmware may not correctly generate Invalid Trigger Events when triggers are received early (i.e. within the trigger exclusion period). All trigger management issues will be resolved with firmware 1.01.

Minimum Sapera Version Required

Save User Configuration Failed: An unusual error that occurred with no other Nano-5G control problem. The solution is to verify the minimum Sapera version used with the Nano-5G Framework. The Genie Nano-5G requires Sapera version 8.50 or later.

Issues with uninstalling Cognex VisionPro with Sapera LT CamExpert

When the Cognex VisionPro package is uninstalled, the Genie Nano-5G becomes not available within CamExpert due to the Cognex uninstaller removing GigE Vision components. This forces a Genie Nano-5G user to reinstall the Network Imaging package (or execute a repair within Sapera LT).

Cognex VisionPro remains a useable third party product except for their uninstaller fault. Genie Nano-5G users just need to account for this issue until resolved by Cognex.

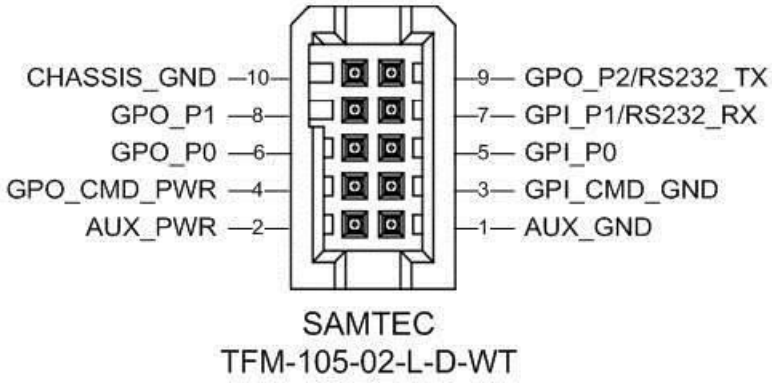
Addendums

This section provides supplemental information about alternative Nano-5G specifications pertaining to various models or legacy firmware revisions. For purchasing information and lead times of optional Nano-5G models that are not part of the typical production cycle, contact Teledyne DALSA Sales.

10-pin I/O Connector Pinout Details (Special Order)

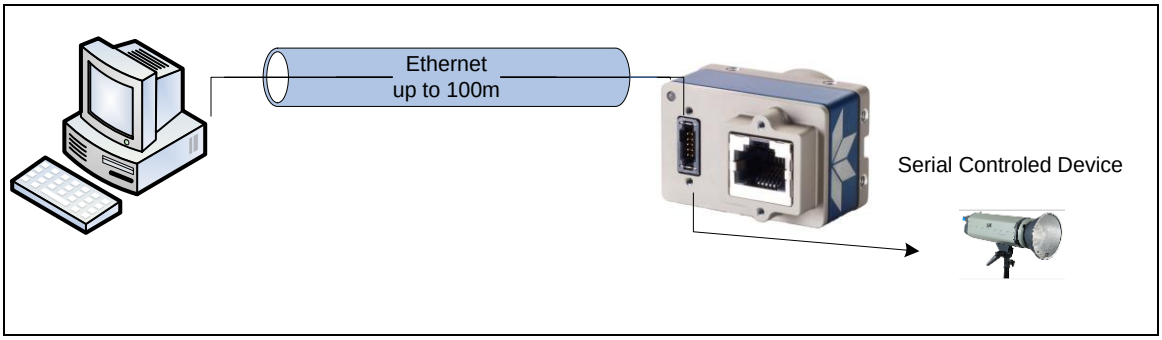
Pin Number	Genie Nano-5G	Direction	Definition
1	PWR-GND	—	Camera Power – Ground
2	PWR-VCC	—	Camera Power – DC +10 to +36 Volts
3	GPI0-Common	—	General Input/Output Common Ground
4	GPO-Power	—	General Output Common Power
5	GPI 1	In	General External Input 1
6	GPO 1	Out	General External Output 1
7	RS232_RX	In	*RS-232 Serial Port Input for G5-Gx**4** models*
	GPI_2	In	General External Input 2 *with G5-Gx**3** models*
8	GPO 2	Out	General External Output 2
9	RS232_TX	Out	*RS-232 Serial Port Output for G5-Gx**4** models*
	GPO 3	Out	*General External Output 3 with G5-Gx**3** models*
10	Chassis		Camera Chassis

Nano: "G5-GM**4**… or G5-GC**4**…" part numbers denote optional Serial Port special order models.



Using the Special Order Serial Port

The Nano-5G provides a UART RS-232 serial port for general use where the Nano-5G functions as an Ethernet to serial port bridge only, because the Nano-5G itself does not respond to any serial port commands. An external serial controlled device can be connected to the camera serial port to benefit from the extended control distance provided by the camera Ethernet connection. Examples of such devices might include lighting, motors, remote switching, various sensors, etc. The following figure shows an example of such a setup.

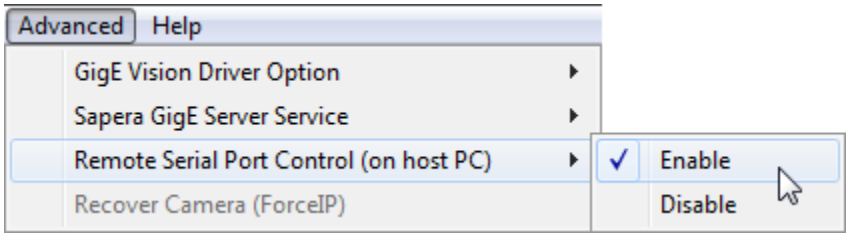


	Special order RS-232 serial port Nano-5G models do not support power-over-ethernet (PoE) due to grounding issuesa.

Enable the Virtual Serial Port Driver

The Virtual Serial Port Driver is automatically installed with the Nano-5G Framework. Even if the Nano-5G is used only with third part GigE Vision applications, usage of the serial port requires that the Nano-5G Framework is installed and enabled by using the **Teledyne DALSA Network Configuration tool**.

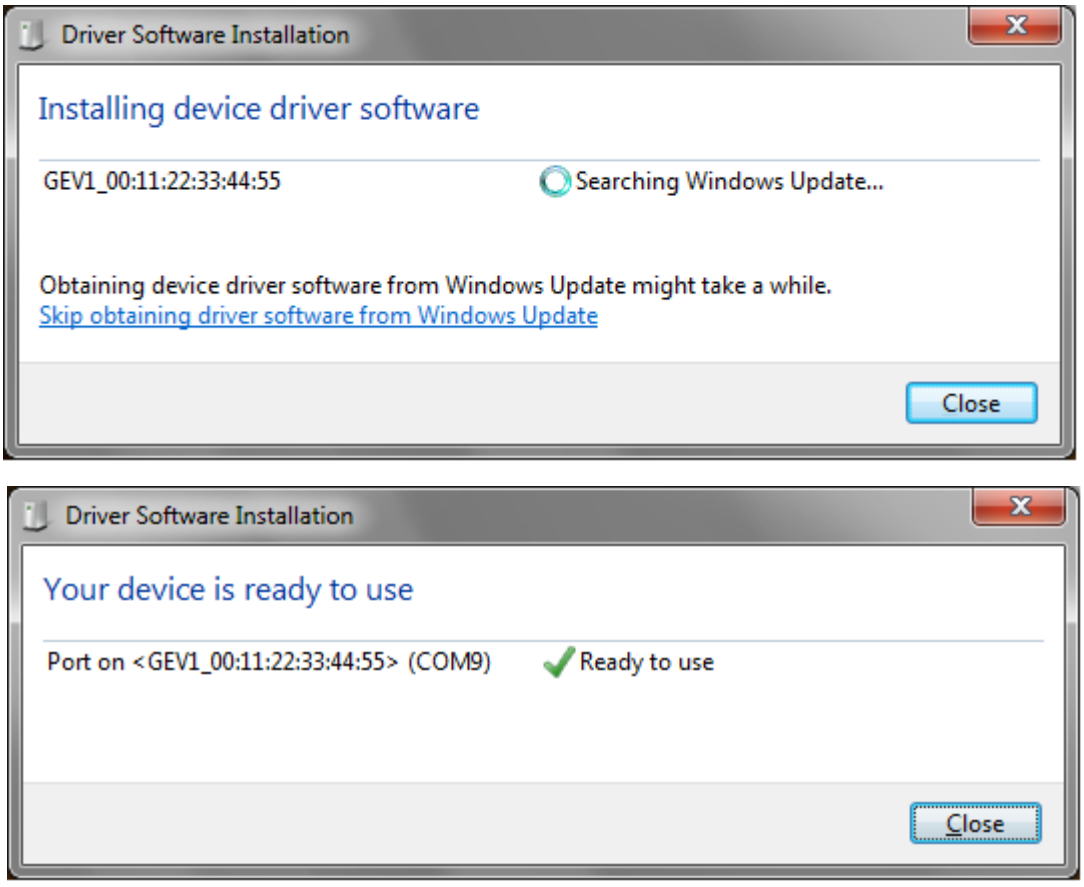
To enable the serial port driver:



- Run the Teledyne DALSA Network Configuration tool.
- Click on the Advanced menu button.
- Click on Enable for the Remote Serial Port Control menu item.

Automatic Windows Driver Installation

The first time the remote serial port control is enabled on a system, an automatic Windows driver update executes as shown in the following screen captures.



This update procedure will not repeat on an update of the framework unless the serial port control is first disabled and then follow by an un-install of the Nano-5G driver.

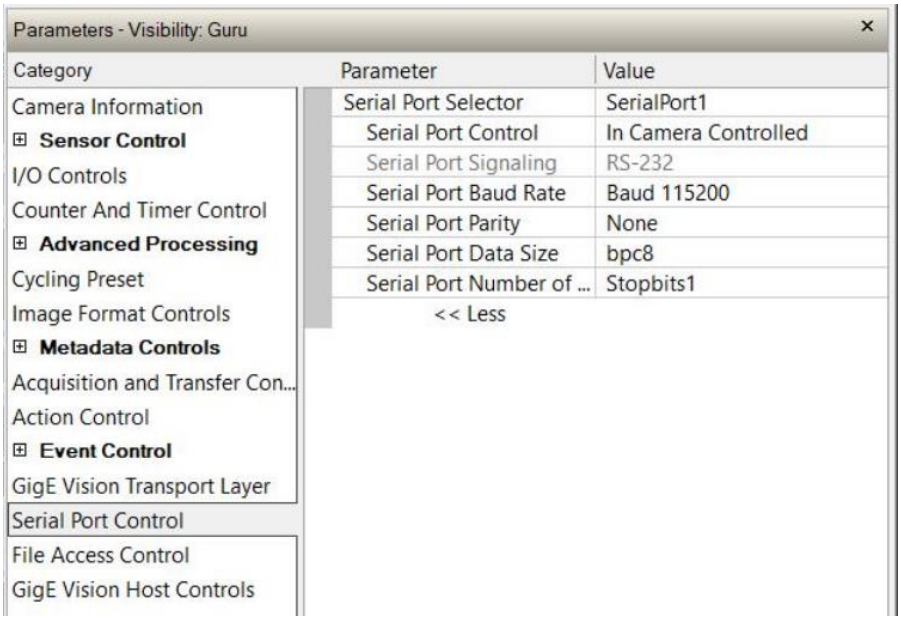
Selecting Serial Port Parameters

The Sapera CamExpert tool allows selecting a camera serial port and viewing its current configuration.

- With the Port Control set to *RemoteHostControlled* use any third party serial communication program to configure the serial ports and control connected devices. Note that currently, only the Baud rate is variable (within the software control's capabilities).
- With the Port Control set to *InCameraControlled* port parameters are set by Genie Nano-5G features.

Serial Port Control Category

The Serial Port Control category groups the features related to the optional RS-232 UART serial port.



GigE Vision Transport Layer Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Serial Port Selector	DeviceSerialPortSelector	Selects the serial port to control.	1.00 Expert
Serial Port Control	deviceSerialPortControlMode	Specifies whether the device serial port is controlled by the device itself or remotely controlled by the host computer.	1.00 Expert DFNC
Remote Host Controlled	*RemoteHostControlled*	*Local serial port is controlled by the host computer.*	
In Camera Controlled	*InCameraControlled*	*Local serial port is controlled by the camera itself.*	
Serial Port Signaling	deviceSerialPortSignaling	Displays the current serial port signaling protocol in use by the device. This feature selects the protocol if multiple types are supported.	1.00 Expert DFNC
Serial Port Baud Rate	DeviceSerialPortBaudRate	Sets the baud rate used by the selected device's serial port. Available baud rates are device-specific.	1.00 Expert
Serial Port Parity	deviceSerialPortParity	Sets the parity checking type on the selected serial port.	1.00 Expert DFNC
Even	*Even*	Use Even parity checking.	
Odd	*Odd*	Use Odd parity checking.	
None	*None*	Parity checking is disabled.	
Serial Port Data Size	deviceSerialPortDataSize	Sets the bits per character (bpc) to use.	1.00 Expert DFNC
bpc8	*bpc8*	Use 8 bits per character	
bpc7	*bpc7*	Use 7 bits per character	
Serial Port Number of Stop Bits	deviceSerialPortNumberOfStopBits	Sets the number of stop bits to use.	1.00 Expert DFNC
Stopbits0	*Stopbits0*	Use no stop bits.	
Stopbits1	*Stopbits1*	Use 1 stop bit.	
Stopbits2	*Stopbits2*	Use 2 stop bits.	

Revision History

Revision	Date	Major Change Description
R:0001	November 22, 2019	Initial release
R:0002	December 19, 2019	Added GPO electrical specifications
R:0003	April 22, 2020	White Balance cycling and other features
R:0004	September 10, 2020	12-bit firmware

Contact Information

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