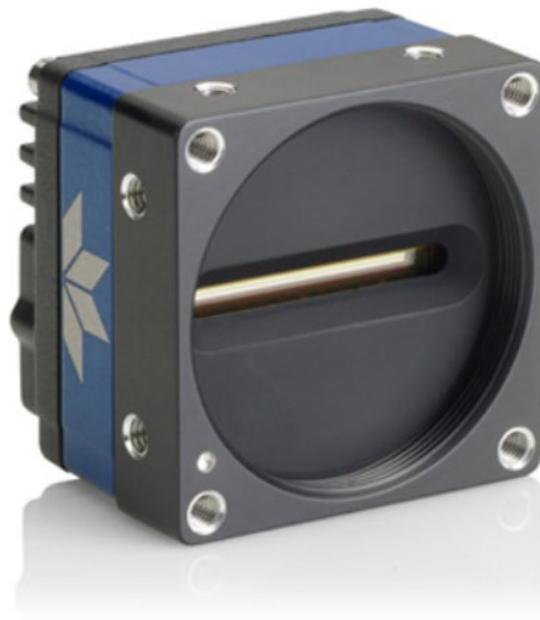


# Linea Lite GigE

## Camera User's Manual

2k / 4k Monochrome & Color, 8k Super Resolution CMOS Line Scan

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



P/N: 03-032-20294-07

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Document date: June 12, 2024

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

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# Linea Lite GigE Series Overview

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## Description

The Linea Lite™ GigE is a new affordable line scan camera delivering both speed and responsivity at a competitive price. This camera is compact, easy to use, low-powered and designed for applications requiring embedded image processing and improved network integration, such as grading and inspection, transportation safety, automated optical inspection and general purpose machine vision.

Linea Lite GigE combines standard gigabit Ethernet technology (supporting GigE Vision 1.2) with Teledyne DALSA's Trigger-to-Image-Reliability to dependably capture and transfer images between the camera to the host PC.

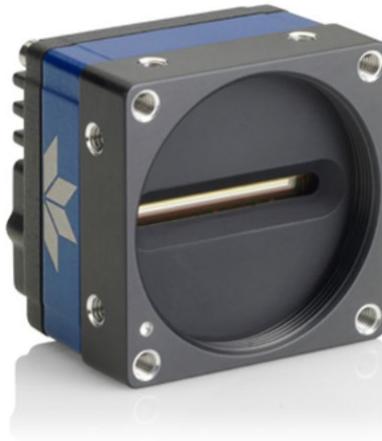


Figure 1: Linea Lite GigE Series

## GigE with TurboDrive

Linea Lite cameras include TurboDrive™ technology, delivering high speed data transfers exceeding the GigE limit. TurboDrive uses advanced data modeling to boost data transfers up to three times faster than standard GigE Vision speeds – with no loss of image quality. These transfer rates are achieved using a proprietary process that compresses sensor data to improve image transfer time. [Teledyne DALSA's TurboDrive](#) increases system dependability and robustness similar to Camera Link throughput on a GigE network.

**Important:** Transfers with TurboDrive is image content dependent. In the best-case scenario transfers over a GigE network can reach the camera's internal acquisition limit of up to 252 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.

## Linea Lite GigE Application Advantages

- Available in 2048 and 4096 pixels resolution, and in 8192 pixels super resolution
- 8 or 12-bit output
- Up to 64 kHz burst line rate
- 2 stage TDI (mono)
- Flat Field Correction
- Power over Ethernet (PoE) or Camera power via HD15 GPIO connector
- Configurable GPIO ports, timers and counters
- 2 general purpose inputs with programmable termination
- 2 general purpose outputs
- 1 general purpose programmable input / output
- Counter, Timer and Events available to support imaging applications
- Supports IEEE1588-2008 (PTP: Precise Time Protocol) for multiple camera synchronization
- Multicast and Action Command supported
- Optimized, rugged design
- GigE Vision 1.2 compliant
- Gigabit Ethernet (GigE) interconnection to a computer via standard CAT5e or CAT6 cable
- Supports connection to the host computer NIC through a GigE network switch
- Gigabit Ethernet (GigE) transfer speed up to 115 MB/second
- Native Trigger-to-Image Reliability design
- Visual status LED on camera back plate
- Supported by Sapera™ LT software libraries
- Support for end-of-frame Metadata
- Digital horizontal and vertical binning for increased sensitivity
- 1  $\mu$ s internal timer or external events can timestamp images
- Provides 4 User Settings sets to store and recall camera configurations
- Refer to Operational Reference and Technical Specifications sections of the manual for full details.

## Linea Lite GigE Firmware

Teledyne DALSA Linea Lite GigE camera firmware contains open source software provided under different open source software licenses. Information about these open source licenses can be found in the documentation that accompanies the firmware available on the Teledyne DALSA website at [www.teledynedalsa.com](http://www.teledynedalsa.com).

Firmware updates for Linea Lite GigE are available for download from the Teledyne DALSA web site [<https://www.teledynedalsa.com/en/support/downloads-center/firmware/>]. Choose Linea Lite GigE Firmware from the available download sections, then choose the zip file download specific to your camera model. Update the camera firmware using CamExpert (see File Access via the CamExpert Tool). The Camera firmware can be easily upgraded / downgraded within your application.

# Part Numbers and Software Requirements

This manual covers the Linea Lite GigE models summarized below. New models are added to this manual as they are released by Teledyne DALSA. See [Camera Specifications Overview](#) for details of each Linea Lite GigE model.

Camera	Resolution	Pixel Size	Max. Line Rate	Lens Mount (threaded)	Product Number
Linea Lite Monochrome GigE 2k	2048 x 2	14 x 14 µm	50 kHz sustained* 64 kHz burst	M42 x 1	L2-GM-02K05B-00-A
Linea Lite Monochrome GigE 4k	4096 x 2	7 x 7 µm	25 kHz sustained* 64 kHz burst	M42 x 1	L2-GM-04K02B-00-A
Linea Line Monochrome GigE 8k SR	8192 x 2	3.5 x 3.5 µm	25 kHz sustained* 32 kHz burst	M42 x 1	L2-GM-08K02S-00-A
Linea Lite Color GigE 2K	2048 x 2	14 x 14 µm	25 kHz sustained* 64 kHz burst	M42 x 1	L2-GC-02K02B-00-A
Linea Lite Color GigE 4K	4096 x 2	7 x 7 µm	12.5 kHz sustained* 32 kHz burst	M42 x 1	L2-GC-04K01B-00-A

\* Network/configuration dependent. Higher sustained line rates with Turbo mode.

Accessories	Order Number
M42 x 1 to F-mount adapter for 12 mm BFD lens, heavy duty with clip	<a href="#">AC-LA-00115-xx-R</a>
HD15 GPIO Breakout Cable Assembly	<a href="#">AC-CA-00002-xx-R</a>
For a list of accessories go to <a href="https://www.teledynedalsa.com/en/support/camera-accessories/">https://www.teledynedalsa.com/en/support/camera-accessories/</a>	
Optical filters are available from <a href="https://midopt.com/">https://midopt.com/</a>	

Teledyne DALSA Software Platform	
<p><b>Sapera LT 8.50</b> (or higher)  <b>Sapera LT 8.73</b> (or higher) for use of Super Resolution</p> <p>Sapera LT is a free image acquisition and control software development toolkit (SDK) for Teledyne DALSA's 2D/3D cameras and frame grabbers. Hardware independent in nature, Sapera LT offers a rich development ecosystem for machine vision OEMs and system integrators.</p> <p>Sapera LT includes CamExpert, which provides an intuitive graphical interface for camera configuration and setup. It includes live image acquisition with interactive parameter configuration capabilities.</p>	<p>Available for download:  <a href="https://www.teledynedalsa.com/en/products/imaging/vision-software/sapera-lt/download/">https://www.teledynedalsa.com/en/products/imaging/vision-software/sapera-lt/download/</a></p>
<p><b>GigE Vision TurboDrive™ Technology Module</b> — improved proprietary package allows the Linea Lite GigE to sustain higher data transfers to the host system.</p>	Contact Teledyne DALSA Sales for additional information.
<p><b>Sapera Processing Imaging Development Library</b> (sold separately)</p>	Contact Teledyne DALSA Sales

Third Party GigE Vision Software Platform Requirements	
Support of GenICam GenApi version 2.3	General acquisition and control. File access: firmware, FFC, configuration data, upload & download.
Support of GenICam XML schema version 1.1	
Support of GigE Vision 1.2	
GenICam™ support — XML camera description file	Embedded within Linea Lite GigE

# Camera Specifications Overview

## Common Specifications

Camera Controls	
Synchronization Modes	Free running, External triggered, Software trigger through Ethernet or IEEE 1588 Precision Time Protocol (PTP)
Exposure Modes	Programmable increments of 1 $\mu$ s <ul style="list-style-type: none"> <li>• minimum (in <math>\mu</math>s) is model specific</li> <li>• maximum is 2.5 ms</li> </ul> Pulse controlled via Trigger pulse width
Trigger Inputs (used as Line or Frame triggers)	RS422 Debounce range from 0 to 255 $\mu$ s Frame Trigger programmable delay up to 2,000,000 $\mu$ s for 128 objects maximum.
Strobe Outputs	Aligned to the start of exposure with a programmable delay, duration and polarity (using "start of exposure on output line source" feature)
Features	
Flat Field Correction	1 Factory FFC plus 4 User Defined FFC
Digital Gain	1x to 10x (global); 1x to 8x (per channel)
Sensor Analog Gain	0.6x to 1x
Counter and Timer	1 Counter and 1 Timer User programmable, acquisition independent with event generation
Timestamp	1 $\mu$ s internal timer
Test Image	Internal generator with choice of static patterns
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)
User Settings	Select factory default or one of 4 user camera configurations
TurboDrive Technology	Supported with 8-bit or 16-bit buffer format. Linea Lite color models support TurboDrive with Bayer output ( <a href="#">Pixel Format BiColorRGBG8</a> ).
Onboard Memory	
DDR	Reserved Packet Resend Buffer 6 MB default (user defined feature)
	Reserved Data Buffer 84 MB
	Total Memory 128 MB
FLASH	32 MB
Back Focal Distance	
M42 x 1 Mount	12 mm
M42 to Nikon F-bayonet adapter	46.5 mm (34.5 mm for the F mount adapter plus 12 mm for the camera body)
Mechanical Interface	
Camera Size	46.0 (H) x 46.0 (W) x 36.74 (L) mm For complete dimensions Refer to section <a href="#">Mechanical Specifications</a> .
Mass	< 150 g (no lens)
Power Connector	via HD15 GPIO connector or RJ45 in PoE mode
Ethernet Connector	RJ45

<b>Optical Interface</b>	
Sensor Alignment (Relative to sides of camera)	
Flatness	50 $\mu\text{m}$
$\Theta$ y	100 $\mu\text{m}$ (Parallelism vs. front plate)
x	$\pm 300 \mu\text{m}$ (Cross-Scan Direction)
y	$\pm 300 \mu\text{m}$ (In-Scan Direction)
z	$\pm 300 \mu\text{m}$ (Along optical axis)
$\Theta$ z	$\pm 0.4^\circ$ (Rotation around optical axis)
<b>Electrical Interface</b>	
Input Voltage	+12 to +24 Volts DC (+20% / -10%) Supports Power Over Ethernet standard (PoE Class 2 as per IEEE 802.3af)
Power Dissipation	< 5 W
Operating Temperature	0 to 60°C at front plate
Relative Humidity	5% to 90% non-condensing (operating)
Output Data Configuration	Gigabit Ethernet with PAUSE Frame support (as per IEEE 802.3x)
Data and Control	GigE Vision compliant

## Environmental Specifications

<b>Environmental Specifications</b>	<b>Performance</b>
Storage temperature range	-20°C to +80°C
Humidity (storage and operation)	15% to 85% relative, non-condensing
MTBF (mean time between failures)	> 100,000 hours, typical field operation

## Sensor Performance

The sensor description below provides a specification table and response graphics. The graph describes the sensor response to different wavelengths of light (excluding lens and light source characteristics). Visible light spans wavelengths between about 390 - 780 nm. Wavelengths below 390 nm are termed ultra-violet while those above 780 nm are termed infra-red.

## Sensor Specifications: 2k and 4k

Item / Feature	Specification			
Camera Model	L2-GM-02K05B-00-A	L2-GM-04K02B-00-A	L2-GC-02K02B-00-A	L2-GC-04K01B-00-A
Sensor Used	High speed CMOS line scan			
Minimum Line Rate (internal acquisition)	300 Hz (note 1)			
Maximum Line Rate (internal acquisition)	64 kHz Burst			32 kHz Burst
Sustained Line Rate Output (Typical, network dependent, Turbo mode disabled)	50 kHz (8-bit) 32 kHz (12-bit)	25 kHz (8-bit) 16 kHz (12-bit)	25 kHz (8-bit RGBG) 16 kHz (8 bit RGB) 16 kHz (12-bit packed RGBG)	12.5 kHz (8-bit) 8 kHz (8-bit RGB) 8 kHz (12-bit packed RGBG)
Maximum Line Rate Output	System dependent on the GigE network			
Exposure Control	5 $\mu$ s to 2500 $\mu$ s			
Internal Trigger to Start of Exposure	~0.24 $\mu$ s minimum (programmable exposure mode)			
External Trigger to Start of Exposure	~0.30 $\mu$ s minimum (programmable and pulse width-controlled exposure modes)			
Line Readout Time	15.6 $\mu$ s			
Pixel Size	14 $\mu$ m x 14 $\mu$ m	7 $\mu$ m x 7 $\mu$ m	14 $\mu$ m x 14 $\mu$ m	7 $\mu$ m x 7 $\mu$ m
Pixel Format	User selectable 8 or 12-bit			
<u>Binning</u>	Yes, horizontal and vertical (digital)			
Sensor Full Well	30 ke-			
Output Dynamic Range	64 dB (nominal gain, factory calibration) 72 dB (Minimum gain, high SNR mode)			
Random Noise	< 2.5 DN rms (nominal gain, FFC enabled)			
DC Offset	7 DN — 12-bit (FFC enabled)			
PRNU (corrected)	< 1.5% @ 50% Saturation			
FPN (corrected)	< 5 DN			
SEE (@ 550nm factory calibrated)	3.3 nJ / cm <sup>2</sup>	20 nJ / cm <sup>2</sup>	4 nJ / cm <sup>2</sup>	24 nJ / cm <sup>2</sup>
NEE (@ 550nm factory calibrated)	2.6 pJ / cm <sup>2</sup>	12 pJ / cm <sup>2</sup>	3.1 pJ / cm <sup>2</sup>	15 pJ / cm <sup>2</sup>
Anti-blooming	> 100 x Saturation			
Integral non-Linearity	< 2% DN			

*Note (1): With the external trigger, the camera will operate at slower speeds down to 0Hz. If the trigger is stopped or a timeout reached, the camera will fill the remainder of the current frame with dark lines and wait for the next trigger. Once the triggering is restarted, the camera will resume the operation.*

## Sensor Specifications: 8k SR

Item / Feature	Specification
Camera Model	L2-GM-08K02S-00-A
Sensor Used	High speed CMOS line scan
Minimum Line Rate (internal acquisition)	300 Hz (note 1)
Maximum Line Rate (internal acquisition)	32 kHz Burst
Sustained Line Rate Output (Typical, network dependent, Turbo mode disabled)	25 kHz (4k output) (8-bit) 25 kHz (8k Super Resolution output) (8-bit)
Maximum Line Rate Output	System dependent on the GigE network
Exposure Control	5 $\mu$ s to 2500 $\mu$ s
Internal Trigger to Start of Exposure	~0.24 $\mu$ s minimum (programmable exposure mode)
External Trigger to Start of Exposure	~0.30 $\mu$ s minimum (programmable and pulse width-controlled exposure modes)
Line Readout Time	15.6 $\mu$ s
Pixel Size	7.0 $\mu$ m x 7.0 $\mu$ m (physical) 3.5 $\mu$ m x 3.5 $\mu$ m (effective)
Pixel Format	8-bit in 8k SR mode 8-bit or 12-bit in 4k Single Row mode
Binning	No
Sensor Full Well	30 ke-
Output Dynamic Range	64 dB (nominal gain, factory calibration)
Random Noise	< 2.5 DN rms (12-bit nominal gain, FFC enabled)
PRNU (corrected)	< 1.5% @ 50% Saturation
FPN (corrected)	< 5 DN
SEE (@ 550nm factory calibrated)	20 nJ/cm <sup>2</sup>
NEE (@ 550nm factory calibrated)	12 pJ/cm <sup>2</sup>
Anti-blooming	> 100 x Saturation
Integral non-Linearity	< 2% DN

*Note (1): With the external trigger, the camera will operate at slower speeds down to 0 Hz. If the trigger is stopped or a timeout reached, the camera will fill the remainder of the current frame with dark lines and wait for the next trigger. Once the triggering is restarted, the camera will resume the operation.*

## Test Conditions

- Values measured using 12-bit (8-bit for 8k SR model), 1x gain
- 10 kHz line rate
- Light source: broadband, quartz halogen, 3250 K with 700 nm IR cut-off filter
- Front plate temperature: 45°C

# Spectral Responsivity & Quantum Efficiency

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

The quantum efficiency graph describes the fraction of photons at each wavelength that contribute charge to the pixel.

## Linea Lite GigE Monochrome 2k

### Spectral Responsivity

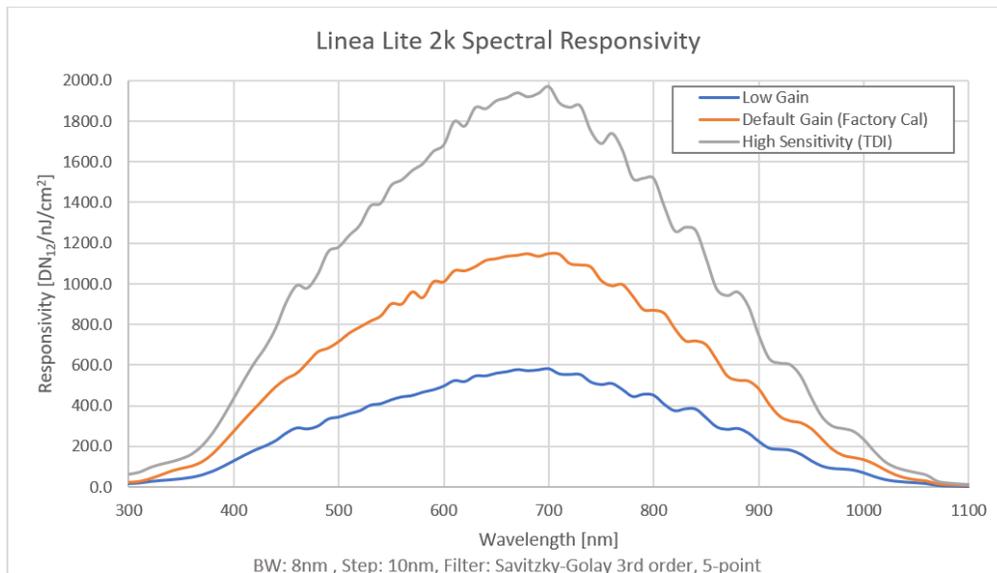


Figure 2: Linea Lite Monochrome 2k Spectral Responsivity

### Effective Quantum Efficiency

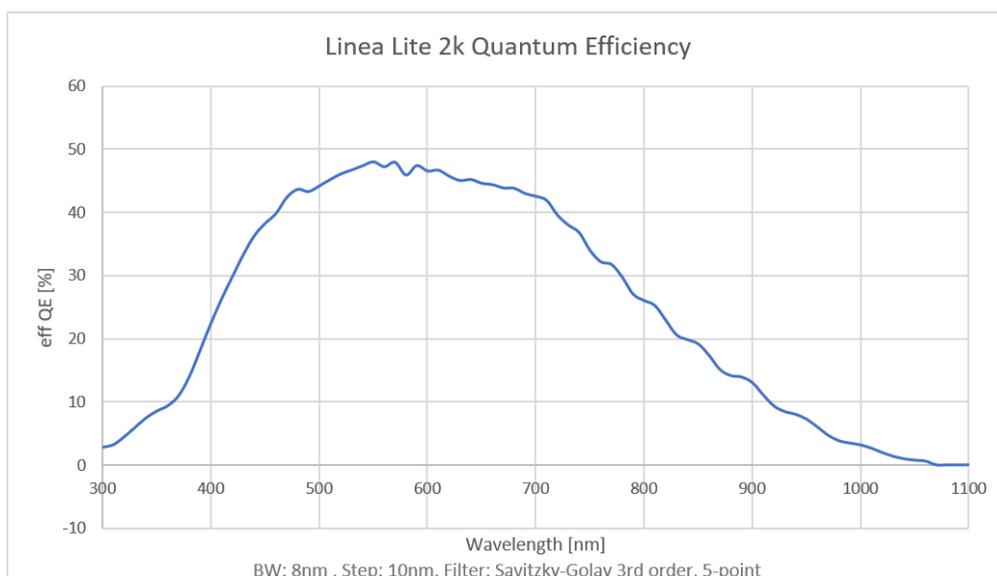


Figure 3: Linea Lite Monochrome 2k Quantum Efficiency

# Linea Lite GigE Monochrome 4k

## Spectral Responsivity

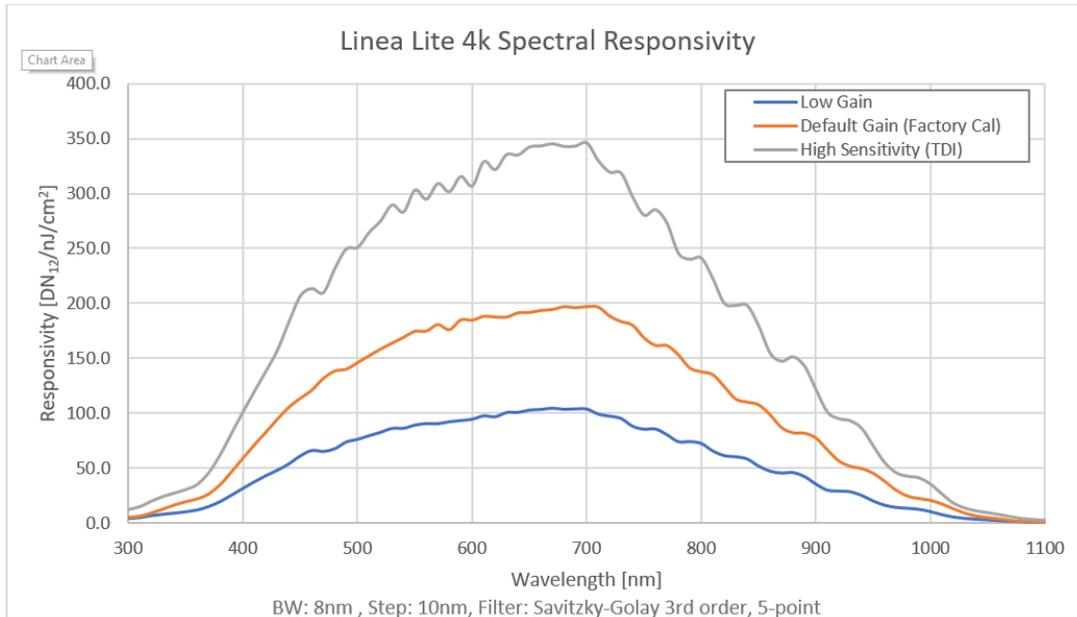


Figure 4: Linea Lite Monochrome 4k Spectral Responsivity

## Effective Quantum Efficiency

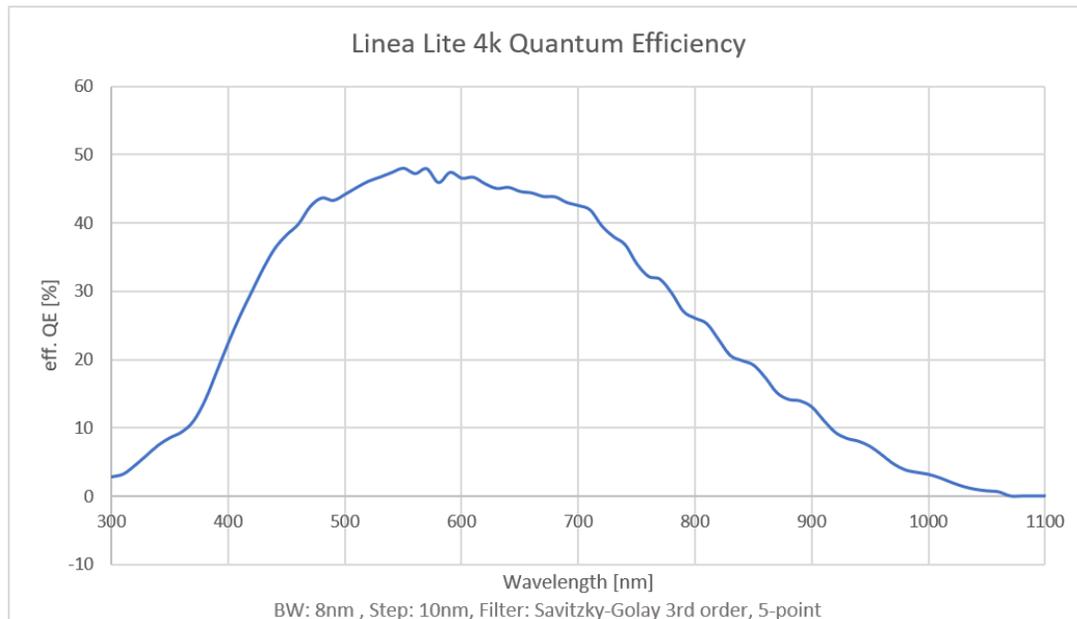
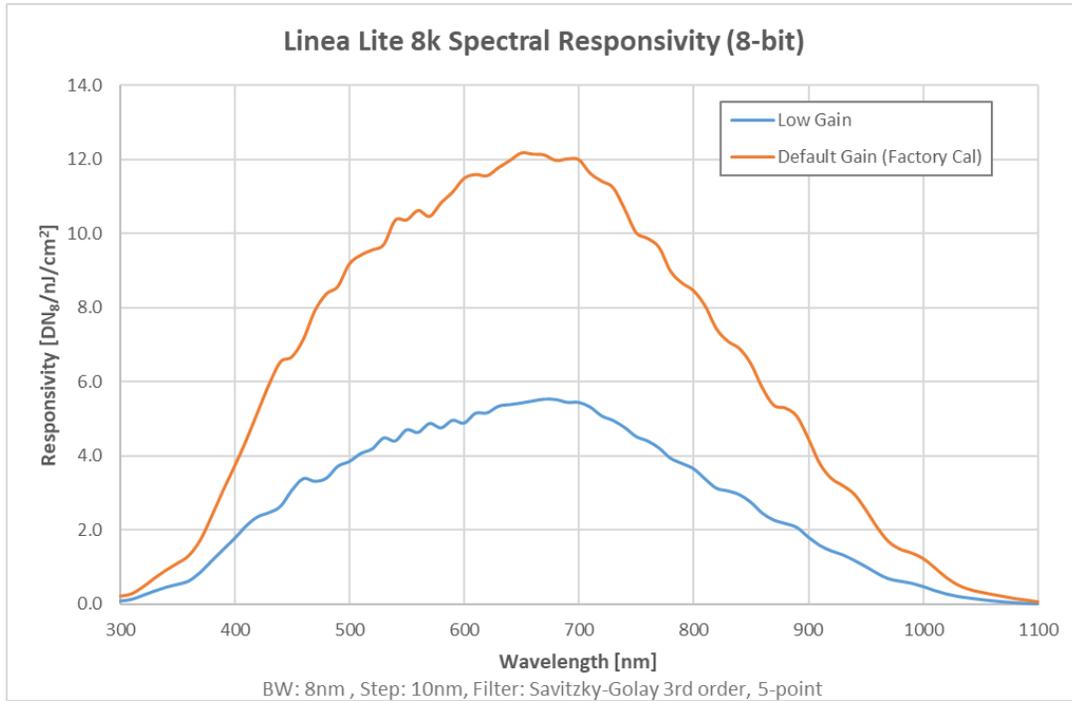


Figure 5: Linea Lite Monochrome 4k Quantum Efficiency

# Linea Lite GigE Monochrome 8k SR

## Spectral Responsivity



## Effective Quantum Efficiency

Quantum efficiency for the 8k SR is the same as for the 4k monochrome (Figure 5).

# Linea Lite GigE Color 2k

## Spectral Responsivity

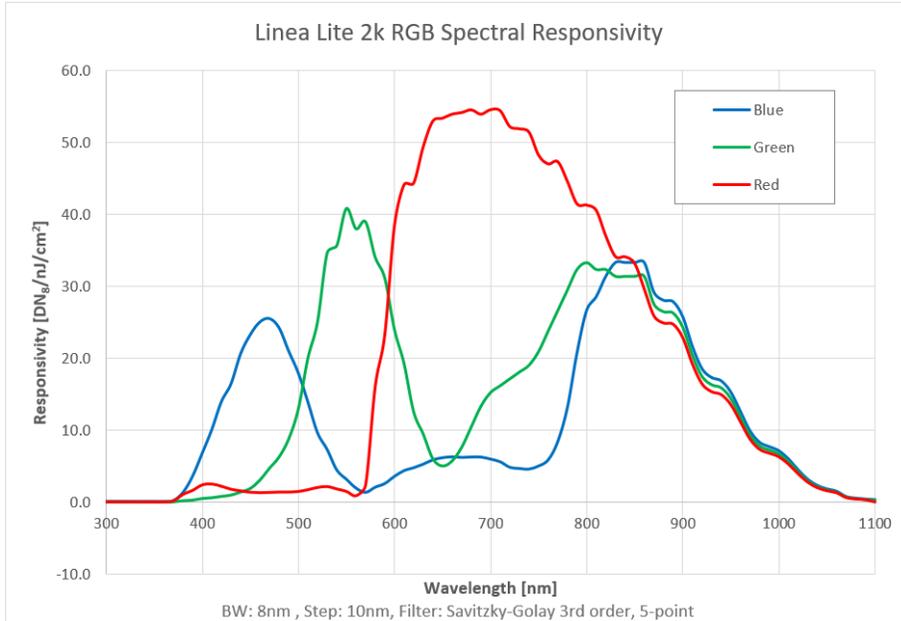


Figure 7: Linea Lite 2k RGB Spectral Responsivity

# Linea Lite GigE Color 4k

## Spectral Responsivity

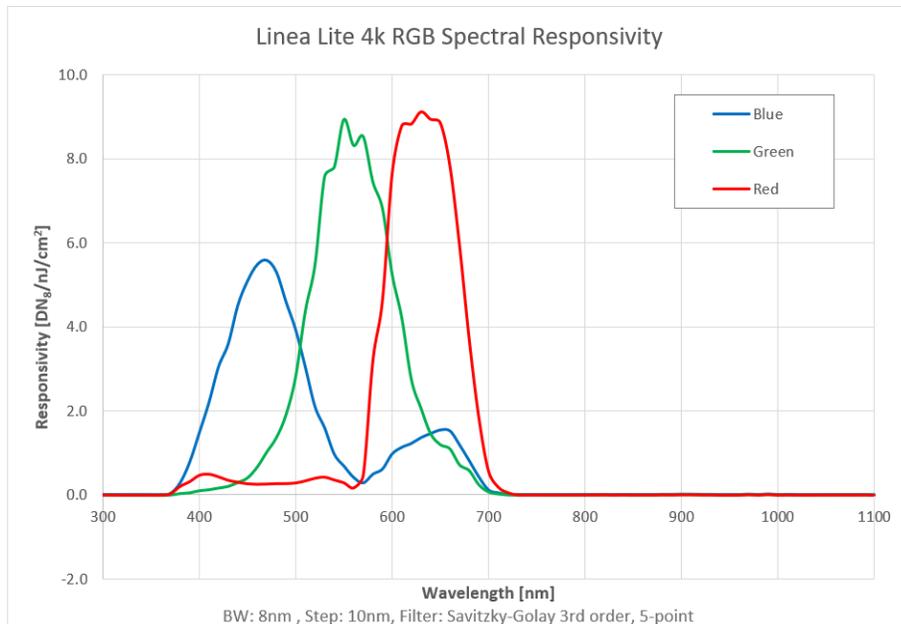


Figure 8: Linea Lite 4k RGB Spectral Responsivity

---

# Computer Requirements for Linea Lite GigE Cameras

The following information is a guide to computer and networking equipment required to support the Linea Lite GigE camera at maximum performance. The Linea Lite GigE camera series complies with the current IPv4 Internet Protocol, therefore current Gigabit Ethernet (GigE) equipment should provide trouble free performance.

## Host PC System

- Operating System: Windows 7/10 (32 or 64-bit) are supported.

## GigE Network Adapters

- GigE network adapter (either add on card or on motherboard). Typically, a system will need an Ethernet GigE adapter to supplement the single NIC on the motherboard.
- PCI Express adapters will outperform PCI adapters.
- Network adapters that support Jumbo Frames will outperform adapters with fixed packet size frames. Optimal settings will be system dependent.

If the computer to be used with the Linea Lite GigE camera does not have a Gigabit network adapter or second built in Gigabit NIC, a Gigabit Network Interface adapter card (NIC) needs to be installed.

With any high-performance Gigabit NIC adapter review the NIC documentation for any drivers required for the specific host operating system.

- **Laptop computers** with built in **GigE network adapters** may not be able to stream full line rates from Linea Lite GigE, especially when on battery power. Thorough testing is required with any laptop computer to determine the maximum frame rate possible (Refer to Teledyne DALSA Network Imaging Package for Sopera LT Optimization Guide, available through the Start menu under Teledyne DALSA).
- The **Windows Firewall** exceptions feature is automatically configured to allow the Sopera GigE Server data 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 Linea Lite GigE. Testing by the user is required.

## Ethernet Switch Requirements

If there are more than one device on the same network or a camera-to-PC separation greater than 100 meters an Ethernet switch is required. The Linea Lite GigE camera complies with the Internet Protocol, it should work with all standard Ethernet switches. However, care must be taken to choose the right switch for a particular application.

When using VLAN groups, the Linea Lite GigE and controlling computer must be in the same group (Refer to Teledyne DALSA Network Imaging Package for Sapera LT Optimization Guide, available through the Start menu under Teledyne DALSA).

### ***IEEE 802.3x Pause Frame Flow Control***

Ethernet Switches supporting Full-duplex IEEE 802.3x Pause Frame Flow Control must be used in situations where multiple cameras may be triggered simultaneously. In such a case the NIC maximum bandwidth would be exceeded if there was no mechanism to temporarily hold back data from cameras. Linea Lite GigE cameras support the IEEE 802.3x Pause Frame Flow Control protocol automatically so images from many cameras can be reliably transmitted through the switch to the NIC efficiently.

#### **IMPORTANT**

The maximum virtual frame rate possible from multiple cameras which are simultaneously triggered will depend on the camera model, frame size and network configuration. Additionally, using Pause Frame may change the Jumbo Frame value which maximizes data throughput. Each imaging system should be tested for data rate maximums.

## Ethernet to Fiber-Optic Interface Requirements

In cases of camera-to-PC separations of more than 100 meters a fiber-optic media converter can be used instead of an Ethernet switch. The FlexPoint GX from Omnitron Systems ([www.omnitron-systems.com](http://www.omnitron-systems.com)) converts GigE to fiber transmission and vice versa. It supports multimode (MM) fiber over distances of up to 220 m (720 ft.) and single-mode (SM) fiber up to 65 km (40 mi.) with SC, MT-RJ, or LC connector types.

#### **IMPORTANT**

The inclusion of GigE to fiber-optic converters does not guarantee they will meet specific application requirements or performance. The user must evaluate any supplemental Ethernet equipment.

---

# GigE Network Adapter Overview

Linea Lite 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.

Refer to Teledyne DALSA Network Imaging Package for Sopera LT Optimization Guide, available through the Start menu under Teledyne DALSA, for information general networking and Sopera LT specific configuration settings.

## Optimizing the Network Adapter used with Linea Lite

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 Linea Lite during the installation.

In addition, refer to the Sopera Getting Started Manual For GigE Vision Cameras and 3D Sensors installed with the Sopera LT package, for an overview of using GigE Vision cameras.

### *Optimizing Camera / System Performance*

Camera feature settings have a direct effect on the maximum performance possible on the imaging system network. Review the following features to optimize the system.

#### **GigE Vision Transport Layer Control**

- **Packet Size**: The default size 1500 is often more efficient than larger jumbo packets, especially when using Ethernet switches.
- **Inter-packet Delay**: Inserts a delay (in  $\mu\text{s}$ ) between packets. Dependent on the Ethernet connection, inserting a short delay (even 1  $\mu\text{s}$ ) can make the difference between transmission errors or no errors.
- **Device Link Throughput Limit**: Limits the maximum bandwidth of the data streamed by the device. This limiter is useful to allow each camera, when multiple cameras are on the same NIC and subnet, adequate time to transfer data over the network.

#### **GigE with TurboDrive**

The Linea Lite cameras include TurboDrive™ technology which enables high speed data transfers exceeding the GigE limit via a compression algorithm.

For information on TurboDrive see our technology primer:

<https://www.teledynedalsa.com/en/learn/knowledge-center/turbo-drive/>

#### **Implementing Trigger-to-Image Reliability**

Review this section to implement features to monitor the system's performance.

#### **NIC Optimization**

Refer to Teledyne DALSA Network Imaging Package for Sopera LT Optimization Guide, available through the **Start** menu under **Teledyne DALSA**, for information on optimizing network adapters for GigE Vision cameras.

## Power over Ethernet (PoE) Support

- Linea Lite requires PoE Class 0 or 2 (or greater) power source for the network if not using a separate external power source connected to pins 10 & 15 of the camera's I/O connector.
- To use PoE, the camera network setup requires a powered computer NIC supporting PoE, a PoE capable Ethernet switch, or an Ethernet power injector.

### IMPORTANT

Connect power via the I/O or PoE, **not both**. Although Linea Lite has protection, differences in ground levels may cause operational issues or electrical faults. If both supplies are connected and active, the Linea Lite will use the I/O power supply connector.

### IMPORTANT

When using PoE, the camera's I/O pin 10 (Camera Power – Ground) must not be connected to I/O pin 5 (Signals Ground).

# GigE Vision Spera Application Description

	<p>Linea Lite GigE cameras are 100% compliant with the GigE Vision 1.2 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 <a href="https://www.automate.org/vision/vision-standards/vision-standards-gige-vision">https://www.automate.org/vision/vision-standards/vision-standards-gige-vision</a></p>
	<p>Linea Lite GigE 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 <a href="https://www.emva.org/standards-technology/genicam/">https://www.emva.org/standards-technology/genicam/</a>.</p>

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

The GigE Vision Compliant XML device description file is embedded within Linea Lite GigE firmware allowing GigE Vision Compliant applications access to camera capabilities and controls immediately after connection.

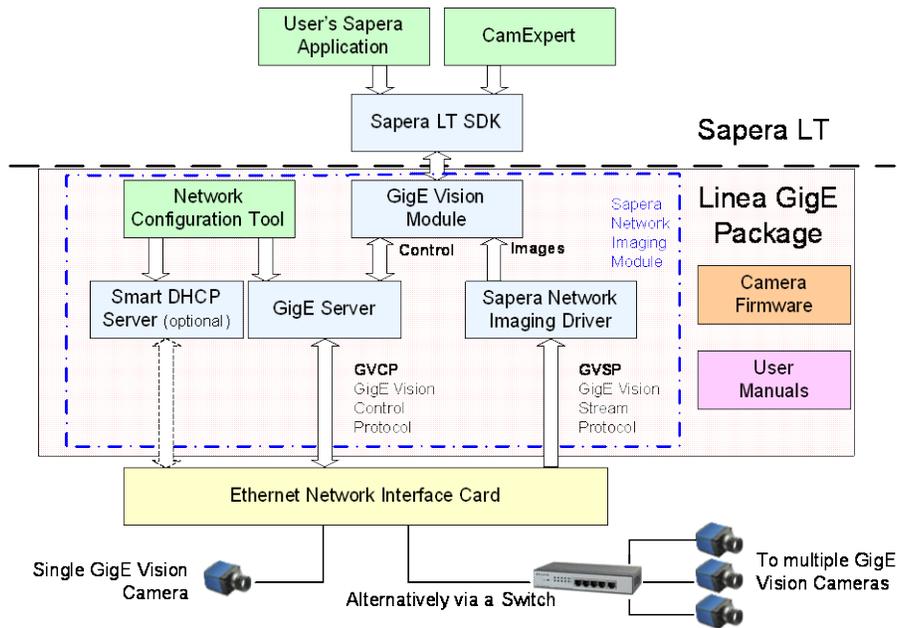


Figure 9: GigE Application Architecture

# Linea Lite GigE Camera Quick Start

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## Sapera Software Installation

### NOTE

Installation of Sapera LT and its GigE Vision package requires administrative privileges.

When Linea Lite GigE is used in a **Sapera development environment** with **Sapera LT 8.5** or later, all GigE Vision support for cameras is automatically installed.

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

If Linea Lite GigE will be used in a **third party GigE Vision Compliant environment**, Sapera or Sapera runtime is not required; follow the installation instructions of the third party package.

### NOTE

Linea Lite 8K SR model requires Sapera LT 8.73 or later.

## Procedure

- Download and install Sapera LT 8.5 or later (8.73 for 8k SR), which automatically provides GigE Vision support. When installing, select the installation of GigE Vision cameras.

<https://www.teledynedalsa.com/en/products/imaging/vision-software/sapera-lt/download/>

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 Linea Lite GigE Vision features) is installed with either the Sapera LT runtime or the Sapera LT development package. If Sapera application development is required, install Sapera LT (8.5 or later for all firmware support) as described above.

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# Connecting the Linea Lite GigE Camera

Connecting a Linea Lite GigE to a network system is independent of whether the Teledyne DALSA Sopera LT package or a third-party GigE Vision development package is used.

## Steps for Camera Startup

- Apply power to the camera: see [Connectors](#) and [Powering the Camera](#).
- Connect Linea Lite to the host computer GigE network adapter or to the Ethernet switch via a CAT5e or CAT6 Ethernet cable and wait for the [GigE Server Icon](#) in the Windows tray to show that the camera is connected. The [Linea Lite Status LED](#) will change to steady Blue.
- Once communication with the host computer is started the automatic IP configuration sequence will assign an LLA IP address as described in section [Linea Lite GigE IP Configuration Sequence](#), or a DHCP IP address if a DHCP server is present on your network. The factory defaults for Linea Lite is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification
- Check the status LED which will be initially red then switch to flashing blue while waiting for IP configuration; refer to [LED States on Power Up](#) section.

### NOTE

Cable should not be less than 1 meter (3 feet) long or more than 100 meters (328 feet) long, per GigE Vision standard.

## Connectors

The Linea Lite GigE has two connectors:

- **RJ45 Ethernet** connector for control and video data transmitted to / from the host computer Gigabit NIC. The Linea Lite supports Power over Ethernet (PoE). Refer to Ruggedized RJ45 Ethernet Cables section for information on secure cables.
- **HD15** connector for camera power, trigger, strobe and general I/O signals. Teledyne DALSA provides an optional breakout cable; see Mating GPIO Cable Assembly. Refer to HD15 Connector Details section for pinout specifications.

The following figure of the Linea Lite GigE back end shows connector and LED locations. Refer to Mechanical Specifications section for details on the connectors and camera mounting dimensions.

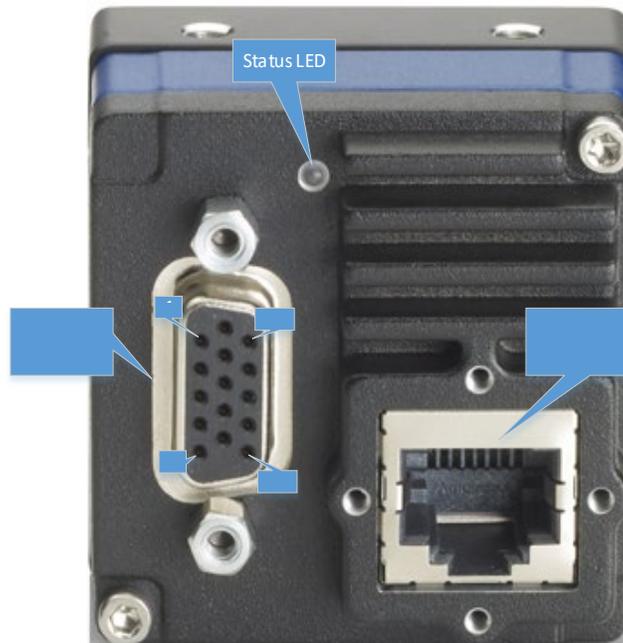


Figure 10: Linea Lite GigE Series – Rear View

## Powering the Camera

Two options are available for powering the Linea Lite GigE camera:

- Power-over-Ethernet (PoE)
- Power supply connected to the HD15 connector.

Refer to Power over Ethernet (PoE) Support section for more information.

Power supplies must meet the requirements defined in Electrical Interface section.

### IMPORTANT

Connect power via the HD15 connector or PoE, **not both**. Although Linea Lite has protection, differences in ground levels may cause operational issues or electrical faults. If both supplies are connected and active, the Linea Lite will use the I/O power supply connector.

## Preventing Operational Faults due to ESD

Linea Lite GigE 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 be solved by proper ESD management.

The Linea Lite GigE 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.

The following methods, either individually or together, will reduce or prevent ESD problems:

- **Method 1:** Use a shielded power supply. The camera case is now properly connected to earth ground and can withstand high ESD events.
- **Method 2:** Using Power over Ethernet (PoE), Teledyne DALSA strongly recommends a shielded Ethernet cable to provide a ground connection from the controlling computer / power supply to the Linea Lite. PoE requires a powered computer NIC, 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.
- **Method 4:** Avoid running the Ethernet cable close to or parallel to AC power lines.

## GigE Server Verification

After a successful Sapera GigE Vision 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 Linea Lite GigE 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
<b>GigE Server Icon</b>  It will take a few seconds for the GigE Server to refresh its state after the camera has obtained an IP address.	  The GigE server icon when a device is found. The camera has obtained an IP address and there are no network issues.	  The GigE server icon shows a warning when a device is connected but there is some type of IP error.	  The GigE server icon shows a red X when no device is found. This indicates a network issue where there is no communication with the camera, or there is no camera connected.

If you place your mouse cursor on the GigE Server icon, the GigE Server displays the number of GigE Vision devices found by your PC. Right click the icon and select status to view information about those devices. Refer to [Running the Network Configuration Tool](#) and [Troubleshooting](#) sections for more information.

## GigE Server Status

Once the Linea Lite GigE 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 device was found. The GigE Server takes a few seconds to refresh its state after the camera has obtained an IP address.



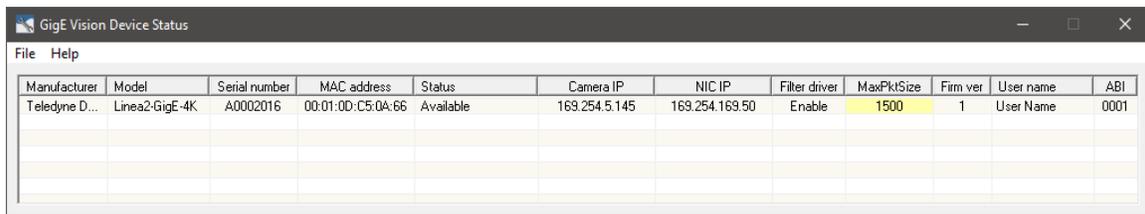
Figure 11: GigE Server Tray Icon

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



Figure 12: GigE Server Pop-up 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 Linea Lite GigE with no networking problems.

A screenshot of a window titled 'GigE Vision Device Status'. It contains a table with columns for Manufacturer, Model, Serial number, MAC address, Status, Camera IP, NIC IP, Filter driver, MaxPktSize, Firm ver, User name, and ABI. The first row shows a Teledyne D... Linea2-GigE-4K with status 'Available' and IP addresses 169.254.5.145 and 169.254.169.50.

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
Teledyne D...	Linea2-GigE-4K	A0002016	00:01:0D:C5:0A:66	Available	169.254.5.145	169.254.169.50	Enable	1500	1	User Name	0001

Figure 13: GigE Vision Device Status

If the device is physically connected but the Sopera GigE Server icon is indicating that the connected device is not recognized, click **Scan Network** to restart the discovery process.

### NOTE

The GigE server periodically scans the network to refresh its state. See the [Troubleshooting](#) section for network problems.

## Camera Status LED Indicator

The camera is equipped with one multicolor LED to display the operational status of the camera. 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).

When the Linea Lite GigE is connected to a network, the Status LED turns a steady blue indicating the IP address is configured by the GigE Server or application. 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: Wait a few minutes for the camera to reboot.
Flashing Red	Initialization sequence in progress.
Steady Red + Flashing Blue	Fatal Error. If the camera 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 or FCC transfer and so forth.
Steady Blue	IP address assigned but no application is 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 100 ms for faster frame rates.

### NOTE

If the Linea Lite GigE has obtained an IP address, it might be on a different subnet than the NIC it is attached to. Therefore, if the Linea Lite GigE LED is blue but an application cannot see it, this indicates a network configuration problem; Refer to section [Troubleshooting](#).

### LED States on Power Up

The following LED sequence occurs when the Linea Lite GigE is powered up connected to a network with installed GigE Vision software.



Figure 14: LED Power-Up Sequence

---

## Quick Startup with CamExpert

If a Linea Lite GigE camera is connected to a Gigabit network adapter on a host computer, it should automatically be detected. Refer to steps below or [Using CamExpert with Linea Lite GigE Cameras](#) section for more details.

- Start Spera CamExpert by double clicking the desktop icon created during the Spera installation.



Figure 15: CamExpert Desktop Shortcut Icon

- CamExpert will search for installed Spera devices. The Device Selector list shows the connected Linea Lite GigE camera a few seconds after CamExpert completes the automatic device search (device discovery).

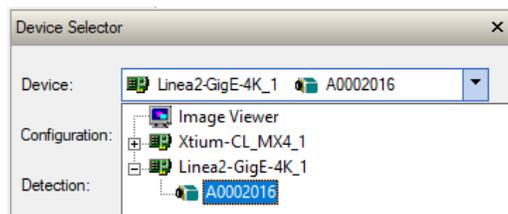


Figure 16: CamExpert Device Selector

- Select the Linea Lite GigE device by clicking on the camera icon. By default, the camera is identified by its serial number. The Linea Lite GigE status LED will turn green, indicating the CamExpert application is now connected.
- Camera default values for the following features are (model dependent):
  - AcquisitionLineRate = 20000 Hz
  - TriggerMode = Off
  - ExposureMode = Timed
  - ExposureTime = 34.4 ms
- Click the **Grab** button for live acquisition (the Linea Lite GigE factory default is Internal Trigger mode with a vertical height parameter which defines the virtual image frame). Refer to the [Operational Reference](#) for information on camera features.
- If no lens is attached, select one of the internal test patterns available using the [Test Image Selector](#) feature.

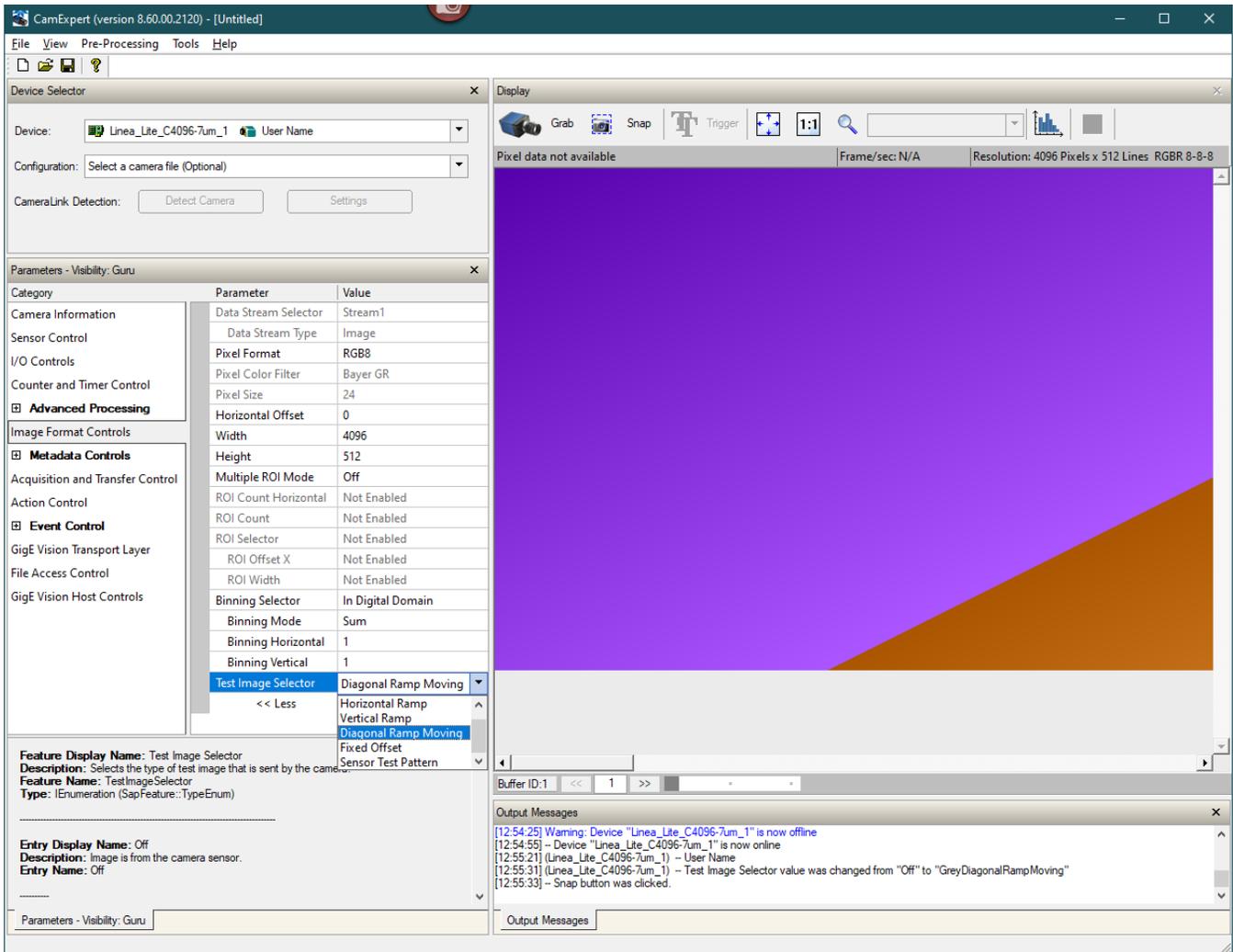


Figure 17: CamExpert Test Image

## NOTE

CamExpert cannot grab at high virtual frame rates since it generates an interrupt for each virtual video frame; the Spera Grab Demo application is better suited for high frame rates.

Firmware is uploaded using the [File Access Control](#) features in Spera CamExpert; Refer to [Camera Firmware Updates](#) section.

---

## Using CamExpert with Linea Lite GigE Cameras

The Spera CamExpert tool is the interfacing tool for GigE Vision cameras supported by the Spera library and hardware. CamExpert allows a user to test most features and operating modes. Additionally, CamExpert saves the Linea Lite GigE 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.

Click on any parameter and a short description is displayed below the Category pane. The same context sensitive help is available by clicking on the  button followed by clicking on a camera configuration parameter. Click on the  button to open the help file for more descriptive information on CamExpert.

### NOTE

The examples shown may not entirely reflect the features and parameters available from the camera model and camera mode used in your application.

# CamExpert Panes

The various areas of the CamExpert tool are described in the 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 Visibility selected (Beginner, Expert, Guru – see description below).

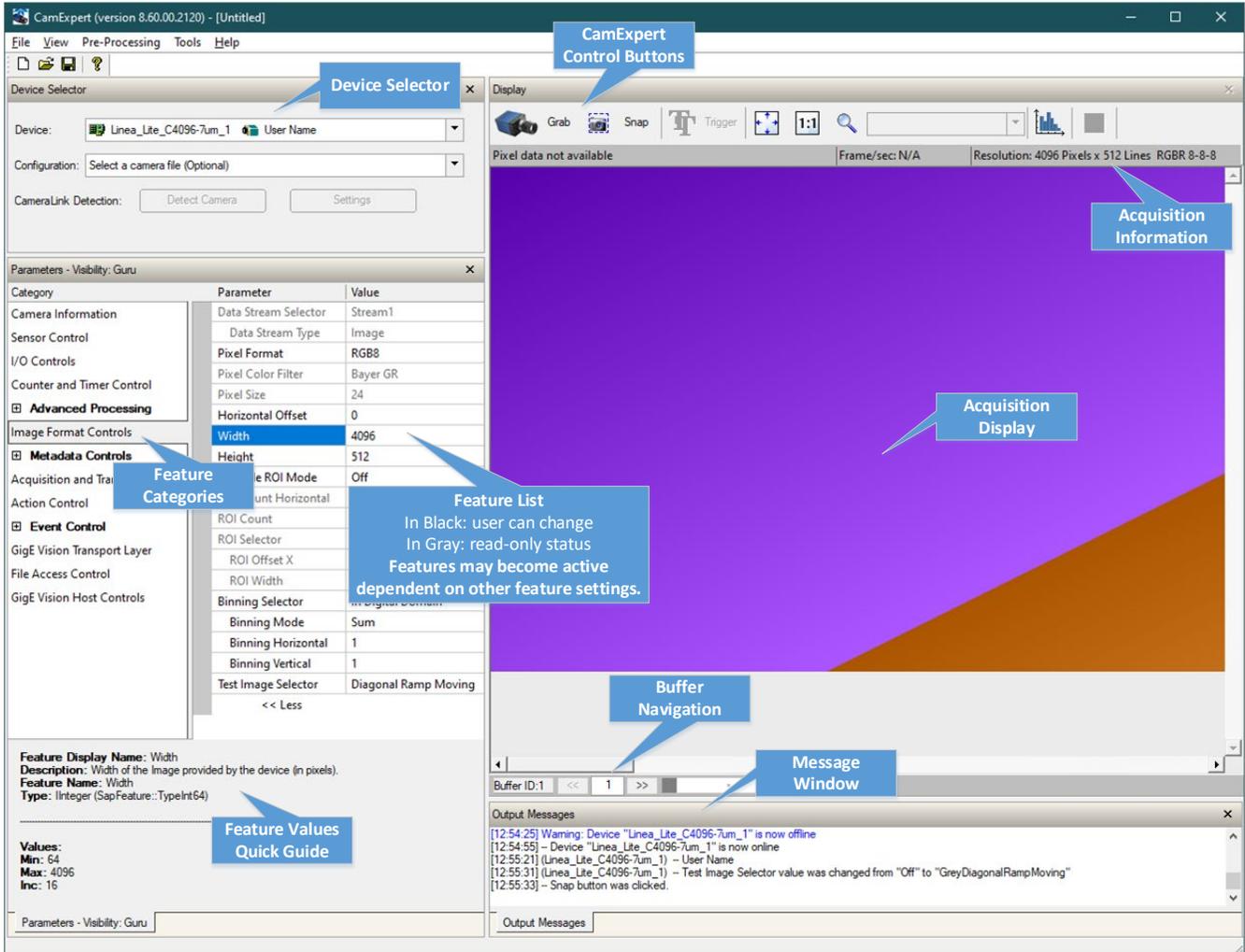


Figure 18: CamExpert Graphical User Interface (GUI)

- **Device Selector pane:** View and select from any installed GigE Vision or Spera acquisition device. After a device is selected, CamExpert will only present parameters applicable to that device. Optionally select a camera file included with the Spera installation or saved by the user.
- **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.
- **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:

 Grab  Freeze	<b>Acquisition control button:</b> Click once to start live grab, click again to stop.
 Snap	<b>Single frame grab:</b> Click to acquire one frame from device.
 Trigger	<b>Software trigger button:</b> With the I/O control parameters set to Trigger Enabled / Software Trigger type, click to send a single software trigger command.
	<b>CamExpert display controls:</b> (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. This does not affect the acquisition.
	<b>Histogram / Profile tool:</b> 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. CamExpert 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 > Visibility* menu.

### Creating a Camera Configuration File in the Host

- When using the Teledyne DALSA Sopera SDK – the CCF is created automatically via a save.
- When using a 3<sup>rd</sup> party SDK application, if that SDK supports **GenAPI 2.4**, then the process is automatic. Simply follow the 3<sup>rd</sup> party *Save Camera* method as instructed.
- If the SDK is based on **GenAPI 2.3** or lower, the user must call the command `DeviceFeaturePersistenceStart` before using the SDK *Save Camera* method and the command `DeviceFeaturePersistenceEnd` at the end of the save function.

# Camera Performance and Features

This section is intended to be an introduction to the features of the camera, including explanations of how to use them effectively.

---

## Overview of Time Delay Integration (TDI)

A basic line scan sensor is a single row of pixels, used to build up an image of a moving object. An image is created by stacking these pixel rows on top of each other.

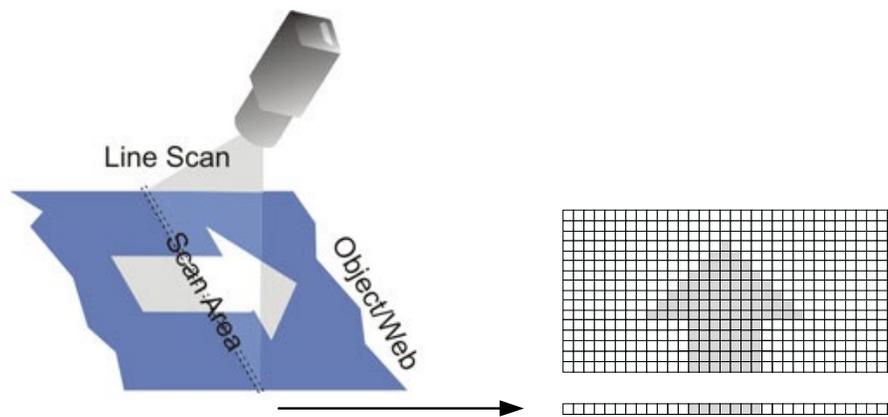


Figure 19: Line Scan Operation

Time delay integration (TDI) is based on the concept of accumulating multiple exposures of the same (moving) object, effectively increasing the integration time available to collect incident light. TDI camera sensor arrays contain multiple rows of pixels. Adding the data together essentially turns the TDI array into a line array with an effective exposure time equal to the sum of the exposure times for each line.

Using a TDI array in this manner allows line scan imaging where high-speed motion would result in too short an exposure for a single line sensor. TDI technology is most useful when signals are very weak since the multiple snapshots of the object are added together to create a stronger signal.

The object motion must be synchronized with the exposures to ensure a crisp image. By timing the transfers to occur at the same rate that the image moves across the array, each line in the array successively captures the same image segment.

The effective integration time is:

$$(1/\text{Line rate}) * \text{Number of TDI Stages (2 for Linea Lite)}$$

Light from the object is collected into the same charge packet, resulting in a higher-contrast picture. Charge motion in the TDI sensor must match object motion as closely as possible. Any discrepancy will result in blurry images (Modulation Transfer Function (MTF) degradation).

# Linea Lite Sensor Array

The Linea Lite camera TDI sensor arrays have two rows of pixels; one line is output which is the summation of both rows in the array. Alternatively, the average of both rows can also be output. Integration and digital readout may occur concurrently, however in the 4k only one row may be read out at a time.

The sensor exposure time is  $3.2 \mu\text{s}$  longer than the exposure pulse. This affects different exposure modes as follows:

- In internal or external programmable exposure modes the camera takes the additional exposure time into account and matches the Exposure Time set by the user to the actual sensor exposure time. The actual exposure time and the exposure time set by the user are the same.
- In external trigger width exposure mode, the pulse is passed to the sensor. Therefore, the actual exposure time is  $3.2 \mu\text{s}$  longer than the exposure time determined by the trigger.

The 4k and 2k dual row sensor timings are distinct:

- 2k sensor: exposure for rows one and two occur at the same time.
- 4k sensor: exposure and readouts are staggered.

## 2k Sensor

The Linea Lite 2k sensor has a  $14 \mu\text{m}$  pixel; there is no spacing between the sensor lines, so when using an external synchronization trigger signal (EXSYNC), the trigger should be fired each time the object moves  $14 \mu\text{m}$ .

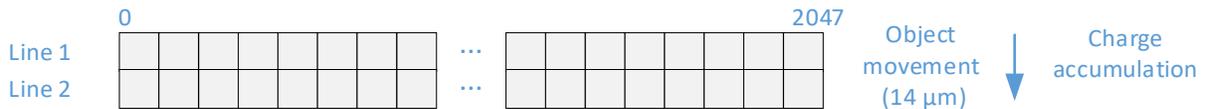


Figure 20: Object Movement & Charge Accumulation

For the 2k sensor, exposure for rows one and two occur at the same time.

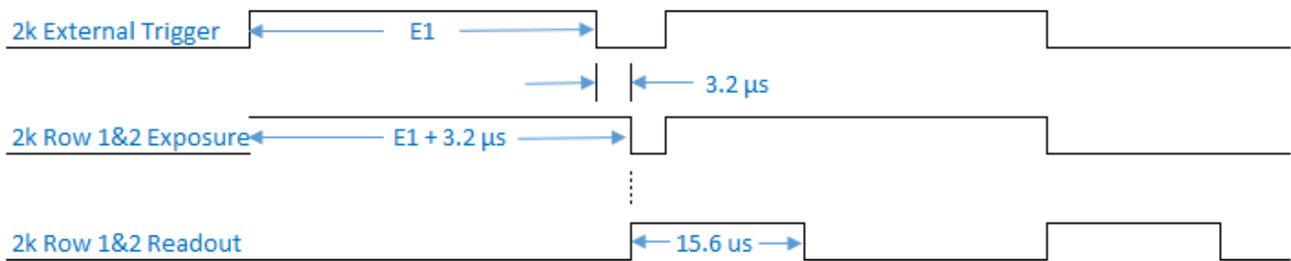


Figure 22: 2k Sensor Row Pulse Width Exposure

## 4k Sensor

The Linea Lite 4k sensor has a  $7\ \mu\text{m}$  pixel, so the trigger should be fired each time the object being imaged moves  $7\ \mu\text{m}$ , when using an external synchronization trigger signal (EXSYNC).

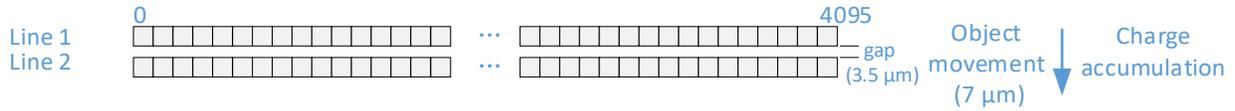


Figure 21: Object Movement & Charge Accumulation

In the 4k sensor, exposure and readouts are staggered. The default is 50% of the previous period; this matches the row spacing.

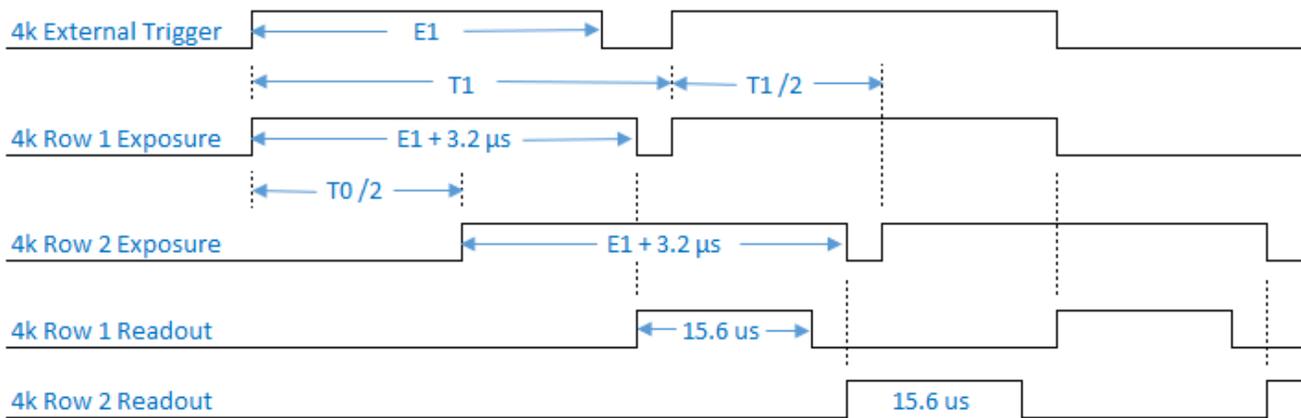


Figure 22: 4k Sensor Row Pulse Width Exposure

The exposure delay between rows can be reduced to  $15\ \mu\text{s}$  to increase the exposure overlap between the two rows using the Row Two Exposure Delay feature.

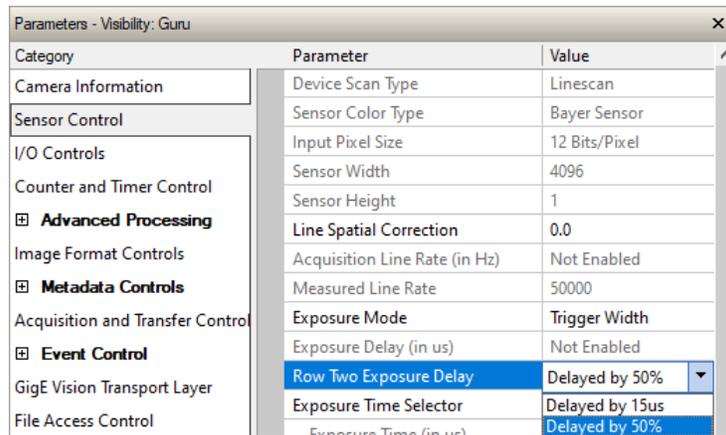


Figure 23: Row Two Exposure Delay

## 8k Super Resolution Sensor

The Linea Lite 8k sensor consists of two 4k rows of 7  $\mu\text{m}$  pixel that are shifted from one another; they are separated by 1 pixel vertically and 1/2 pixel horizontally. The trigger should be fired every time the object being imaged moves 7  $\mu\text{m}$ , when using an external synchronization trigger signal (EXSYNC).

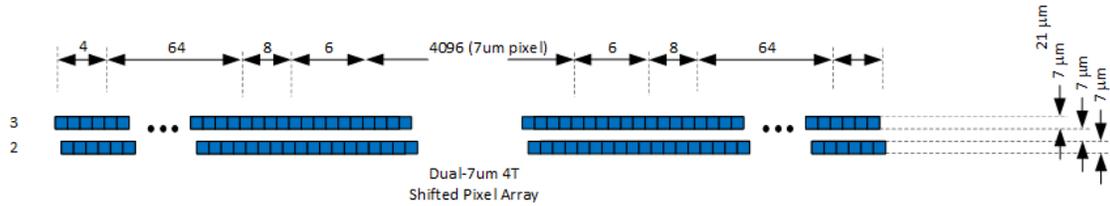


Figure 24: 8k sensor pixel arrangement. The second row is shifted 1/2 pixel horizontally and is separated by a 1 pixel gap from the first row.

# Bilinear Color and Spatial Correction

For the color 4k sensor (7 μm pixel), the Bayer filter first line sensor has red (R) and blue (B) alternating pixels, while the second line has all green (G) pixels. The G channel can be used as a monochrome output.

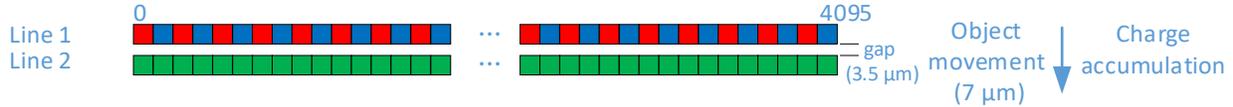


Figure 25: Color 4k Sensor Bayer Filter

The color 2k sensor has a 14 μm pixel; the sensor has a 100% fill factor with zero gap between the two lines, which minimizes any artifact due to spatial correction. The Bayer filter is the same mosaic as the 4k.

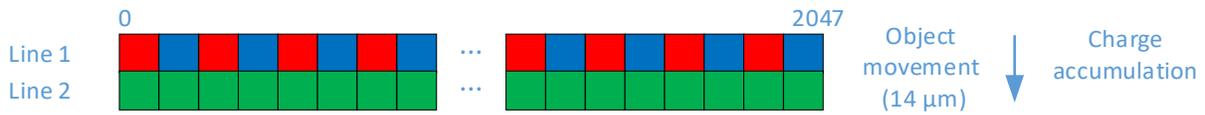


Figure 26: Color 2k Sensor Bayer Filter.

For the color 2k sensor there is no spacing between the sensor lines. When the image passes the two lines of pixels, the red/blue and green components for the same image location are captured at a different time as dictated by the line spacing. The camera automatically corrects for the line spacing to ensure that the red/blue and green components of the image pixel are all aligned when output. However, this is only correct when the object pixel size is square; that is, the distance moved by the object for one EXSYNC period is equal to the width of the object pixel. In some applications it may not be possible to achieve a ‘square’ object pixel as fine adjustment of the lens magnification and/or the distance moved for each EXSYNC period is not possible. This scenario may be especially apparent when trying to integrate the camera into an existing system.

When it is not possible to generate a square object pixel, color artifacts will occur in the scan direction and is particularly noticeable at sharp edge transitions. The size of the edge artifact is proportional to how far the pixel is from square. To correct for this, the camera has a feature, Line Spatial Correction, which allows fine adjustment of the compensation mechanism the camera uses to correct for the line spacing.

The default setting for this feature is 1, which is set for square object pixels. The setting can be adjusted from 0 to 1.5 to compensate for rectangular pixels—whether they are too long or too short.

The following examples of image artifacts show black to white image transitions and the associated corrected image after applying spatial setting.

### Example 1: Target speed adjusted for square pixels

When the target speed is adjusted for square pixels given the camera line rate, no line spatial correction is required. This is the default condition (Line Spatial Correction = 1).

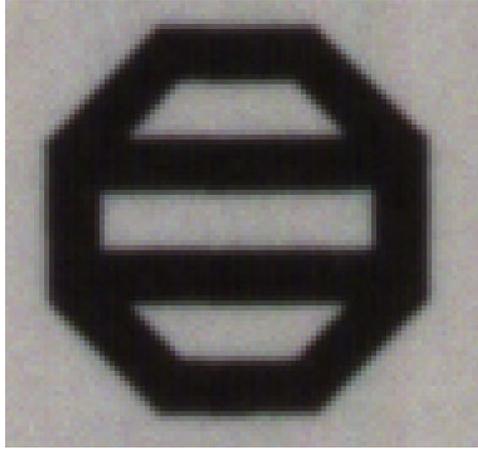


Figure 27: Default Line Spatial Correction

### Example 2. Target running slower than example 1, same EXSYNC (trigger) frequency

When the target runs slower, it appears stretched since more lines are acquired to image the target. Adjusting the Line Spatial Correction value can correct for the color artifacts that result from this stretching.

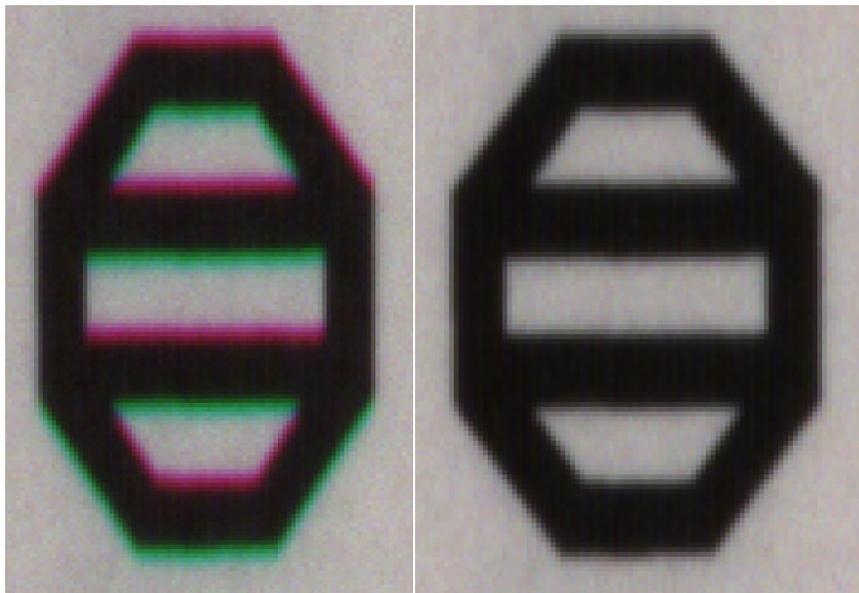
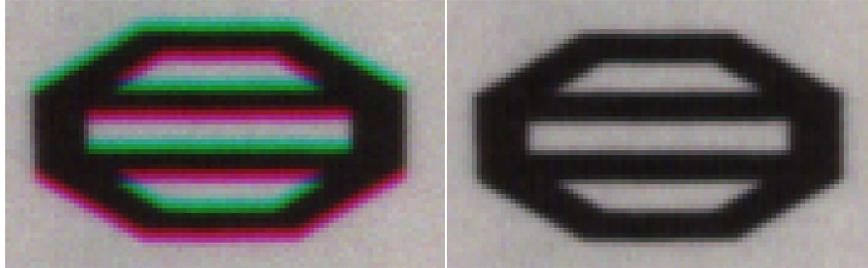


Figure 28: Line Spatial Correction – Target Too Slow

### Example 3. Target running faster than example 1, same EXSYNC (trigger) frequency

When the target runs faster, it appears compressed since fewer lines are acquired to image the target. Adjusting the Line Spatial Correction value can correct for the color artifacts that result from this compression.



*Figure 29: Line Spatial Correction – Target Too Fast*

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# Color Interpolation

When the camera output Pixel Format is RGB8, the camera performs color interpolation to generate the RGB values given the RG or BG pixels available at each horizontal pixel position. That is, the missing red or blue pixel is generated from the adjacent pixel values (except at the sensor edge where only one adjacent column of values is available).

Two Color Interpolation modes are available:

- **Basic:** The missing red or blue pixel information is generated using the neighboring red or blue pixels (left and right / 2).

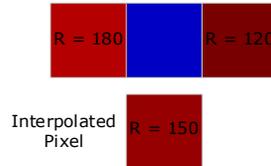


Figure 30: Basic Interpolation

- **Enhanced:** Missing red-and blue information is interpolated from green pixel variation in addition to neighboring pixels. This removes color fringing artifacts caused by edges occurring in interpolated pixels. For example, to interpolate R at BG pixels:

$$\begin{aligned} R_n &= G_n + [(R_{n-1} - G_{n-1}) + (R_{n+1} - G_{n+1})] / 2 \\ &= (R_{n-1} + R_{n+1})/2 + G_n - (G_{n-1} + G_{n+1})/2 \end{aligned}$$

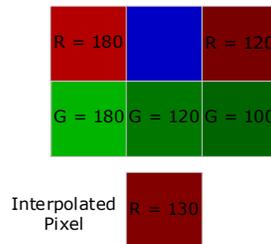


Figure 31: Enhanced Interpolation

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## TDI Mode

The TDI Mode feature, available for Linea Lite monochrome models, sets the camera's imaging mode. The 2k and 4k cameras have five different modes, the 8k SR model has two:

- Single Row
- High Sensitivity
- High SNR
- High Dynamic Range
- Multi-Row
- 4k Single Row (8k SR model only)
- 8k SR, High-BW (8k SR model only)

### Single Row Mode

Single Row mode is the default operating mode for the camera. The camera outputs one row per trigger.

### High Sensitivity Mode

In High Sensitivity mode, the TDI Stages feature is set to two, the two rows are summed together to output one row.

### High SNR Mode

In High SNR mode, the TDI Stages feature is set to two, the two rows are averaged together to output one row.

### High Dynamic Range Mode

In High Dynamic Range mode, the TDI Stages feature set to two, each row uses a different exposure time; the short and long exposures are combined as one output row to see details in both bright and dark areas.



Figure 32: High Dynamic Range Mode

### Multi-Row Mode

In Multi-Row mode, two sensor rows are synchronized and output per input line trigger. This enables processing of the synchronized image rows by the host system. The output image frame will consist of alternating sensor rows starting with row one.

## 4k Single Row Mode

(8k SR camera only). The camera outputs a single 4k pixel line per trigger.

## 8k SR, High-BW Mode

(8k SR camera only). The 8k SR High-Bandwidth mode enables the super resolution capability of the camera using a host-side driver. This mode outputs an 8k pixel line (3.5  $\mu\text{m}$  per pixel) with the responsivity of a 7  $\mu\text{m}$  pixel using host-side processing.

## Related Features

Features related to TDI Mode are part of the [Sensor Control category](#).

# Acquiring Images: Triggering the Camera

Linea Lite GigE line exposures are initiated by a trigger event. A trigger event is only generated when a grab is active; when not grabbing, no trigger events are generated. The Linea Lite can acquire images using its own internal trigger (free-running mode) or using an external trigger (EXSYNC) with several options for the trigger source.

A trigger can be:

- the camera's programmable internal clock used in free running mode
- an external input used for synchronizing exposures to external triggers
- a programmed function call message by the controlling computer.

These triggering modes are described below.

- **Trigger Mode = Off — Free running:** The Linea Lite free-running mode has programmable internal timers for line rate / exposure period. In free-running mode, the Acquisition Line Rate feature specifies the line rate, in hertz. The maximum line rate is determined by the Exposure Time feature. The Internal Acquisition FPS feature returns the internal frame rate, which is determined by the acquisition line rate and image Height features.
- **Trigger Mode = On — External trigger:** Exposures are controlled by an external or internal trigger signal where the specific input line or source is selected by the Trigger Source feature. External signal inputs have a time programmable debounce circuit.

For any exposure type, a virtual frame is specified by the number of lines per frame as set by the Height feature in the Image Format Category. A buffer contains one virtual frame.

## NOTE

In case the trigger frequency exceeds the allowable line rate, the camera will buffer one trigger.

If the Acquisition Line Rate is reduced and / or frame buffer Height is increased, the value of the Image Timeout feature (part of the GigE Vision Host Control category) may require increasing.

If error messages are shown in the Output Messages pane, try increasing the value of the Linea Lite GigE Interpacket Delay feature available from the GigE Vision Transport Layer Category group in CamExpert. An increase from default may correct errors with NIC interfaces that do not have adequate performance. For more information, refer to Teledyne DALSA Network Imaging Package for Sopera LT Optimization Guide, available through the Start menu under Teledyne DALSA.

## External Triggers

The Trigger Selector feature selects the type of external trigger to use and configure.

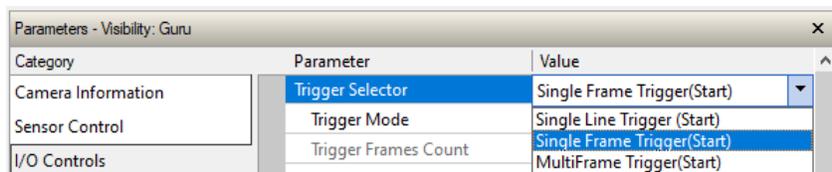


Figure 33: CamExpert – Trigger Selector

Different types of external trigger are available:

- **Single Line Trigger (Start):** Starts the acquisition of one line when the acquisition is active. While the Single Line Trigger is active image frame buffers will continuously be filled. If the trigger stops while capturing a

frame, a partial frame will be acquired and the remaining lines filled with pixel value 0. The next trigger following a pause will start a new frame.

- **Single Frame Trigger (Start):** Starts the acquisition of one frame when the acquisition is active.
- **MultiFrame Trigger (Start):** Starts the capture of several frames. No line is lost between frames. The number of frames in this mode is defined by the Trigger Frames Count feature.
- **Frame Active:** Starts the acquisition of a frame. The width of the trigger signal controls the number of lines in the frame, up to the maximum set by the Height feature.
- **Frame Burst Active:** Starts the acquisition of multiple frames. The number of lines in the frame is defined by the Height feature. The width of the trigger signal controls the number of frames.

## NOTE

The Single Frame Trigger and MultiFrame Trigger are mutually exclusive; that is, only one type of frame trigger may be used at a time. Similarly, Frame Active and Frame Burst Active are mutually exclusive.

### Single Frame Trigger

The following timing diagram shows an example of grabbing images (Height = 10) using a single frame trigger to define when an image line is stored at the beginning of the frame buffer.

In this example, the single frame trigger is configured for rising edge. The single line acquisition trigger can be generated by an external trigger, timestamp modulo event, or internal clock (free-running).

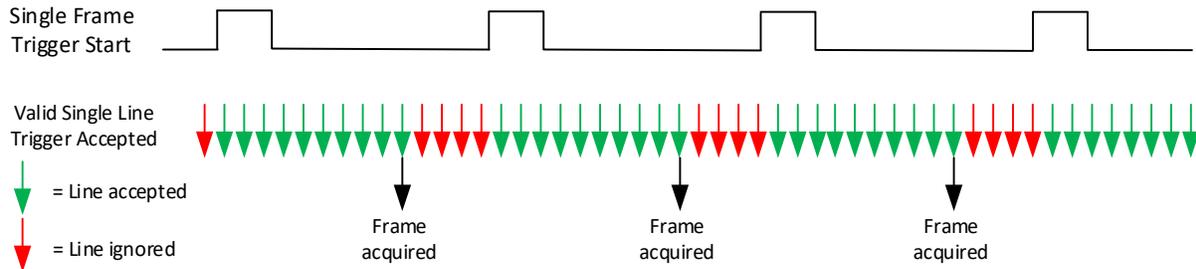


Figure 34: 10-Line Single Frame Trigger Example

## MultiFrame Trigger

The following timing diagram shows a multiframe trigger example grabbing 3 images (Height = 10, Trigger Frame Count = 3).

In this example, the multiframe trigger is configured for rising edge. The single line acquisition trigger can be generated by an external trigger, timestamp modulo event, or internal clock (free-running).

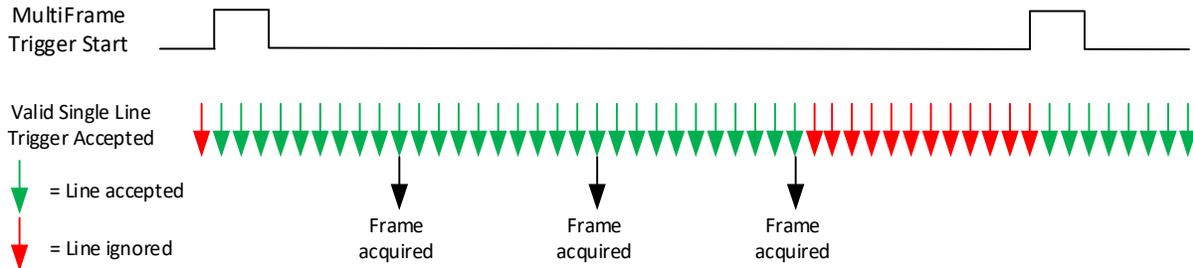


Figure 35: 10-Line Single Frame Trigger Example

### NOTE

If the acquisition of consecutive images of the specified Trigger Frame Count is interrupted before the count is reached no additional frames will be acquired for the MultiFrame trigger that initiated the acquisition.

## Frame Active

The following timing diagram shows an example of grabbing images using the duration of the frame active signal to determine the number of lines to capture. Acquisition stops when the signal drops or when the number of lines reaches the Height feature.

In this example, the frame active trigger is configured for a level high line activation. The single line acquisition trigger can be generated by an external trigger, timestamp modulo event, or internal clock (free-running).

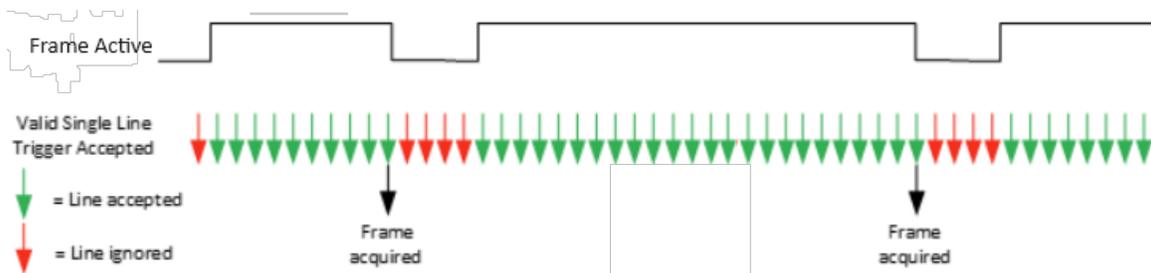


Figure 36: Frame Active Trigger Example

## Frame Burst Active

The following timing diagram shows an example of grabbing images using the width of a frame burst active signal to determine the number of frames to capture. If the signal stops while capturing a frame, the frame is completed.

In this example, the frame active trigger is configured for a level high line activation. The single line acquisition trigger can be generated by an external trigger, timestamp modulo event, or internal clock (free-running).

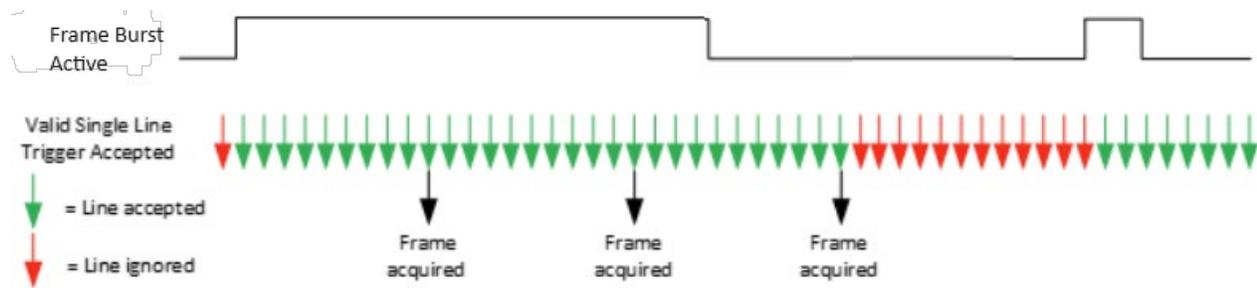


Figure 37: Frame Burst Active Trigger Example

## Trigger Source Types

- **Trigger Source = Line x:** Select the Line Input used as an external trigger. For Linea Lite, Line 1 and Line 2 are inputs; Line 3 is configurable and can be used as either an input or output. The [Trigger Input Line Activation](#) sets the edge detection for the line as rising, falling or any edge. The [Input Line Debouncing Period](#) specifies how long a signal must be active to be considered valid. When a Line Input is the trigger source, the width of the trigger signal can be used to control the exposure time by setting [Exposure Mode = Trigger Width](#) (Sensor Control category).
- **Trigger Source = Rotary Encoder:** External trigger is via one or both Rotary Encoder inputs. A number of features allow selecting encoder signal direction, scaling and other parameters, to suit the imaging application. This option is only available when Trigger Selector = *Single Line Trigger(Start)*.
- **Trigger Source = Timer1End Event or Counter1End Event:** The Timer1End Event or Counter1End Event is used as the internal trigger source. Refer to [Counter and Timer Controls](#) for information on those features.
- **Trigger Source = Counter1 Active or Timer1 Active:** The trigger is activated when Counter1 or Timer1 is running. Available when Trigger Selector = *Frame Active* or *Frame Burst Active*.
- **Trigger Source = Timestamp Modulo Event:** 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. See [Examples using Timestamp Modulo Event for Acquisitions](#).
- **Trigger Source = Action 1 or Action 2:** A GigE Vision Action Command message is used as trigger source. Action commands are broadcast by a calling program and used to trigger multiple GigE Vision devices on a network. See [GigE Vision Action Command Reference](#) for details.

## Example of Free Run Line Mode with Frame Trigger

An example setup of free run line acquisition with Frame Trigger and a configurable internal timer is used as follows:

- Set [AcquisitionLineRate](#) = 20000 Hz
- Set image [Height](#) = 100
- Select [Trigger Selector](#) = SingleFrameTrigger (Start)
- Set [Trigger Mode](#) = On
- Select [Trigger Source](#) = Timer1EndEvent
- Setup Timer1:
  - Set [Timer Start Source](#) = Timer1End
  - [Timer Duration](#) = 5000
  - [Timer Mode](#) set = Active

Then click the CamExpert **Grab** button.

## Example of Line Trigger Mode

An example setup of a Line Trigger acquisition using internal timer with a configurable internal timer is as follows:

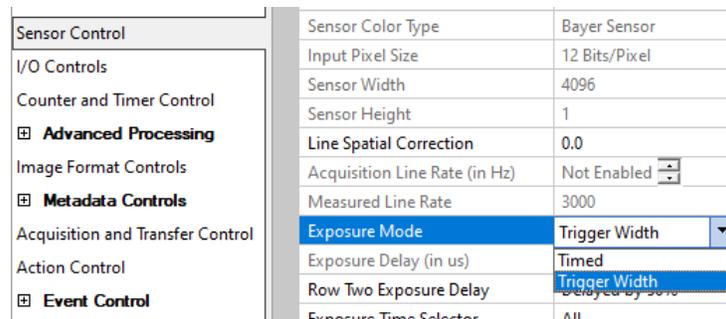
- Set image Height = 100
- Select Trigger Selector = SingleLineTrigger(Start)
- Set Trigger Mode = On
- Select Trigger Source = Timestamp Modulo Event
- Setup Timestamp Modulo Event:
  - Use Timestamp Latch Cmd to start the timestamp using the camera's internal clock
  - Timestamp Modulo Event (timeStampModulo) = 10000 (frame rate = 100 Hz)

Then click the CamExpert **Grab** button.

## Exposure Controls Details

Exposure control is defined as the start of exposure and exposure duration. This is the amount of time the sensor is exposed to incoming light before the image line data is output.

The Exposure Mode feature selects the controlling method for the exposure.



Sensor Control	Sensor Color Type	Bayer Sensor
I/O Controls	Input Pixel Size	12 Bits/Pixel
Counter and Timer Control	Sensor Width	4096
▣ <b>Advanced Processing</b>	Sensor Height	1
Image Format Controls	Line Spatial Correction	0.0
▣ <b>Metadata Controls</b>	Acquisition Line Rate (in Hz)	Not Enabled
Acquisition and Transfer Control	Measured Line Rate	3000
Action Control	<b>Exposure Mode</b>	Trigger Width
▣ <b>Event Control</b>	Exposure Delay (in us)	Timed
	Row Two Exposure Delay	Trigger Width
	Exposure Time Selector	ΔII

Figure 38: CamExpert – Exposure Mode

Possible values are:

- **Timed:** The Exposure Time feature sets the integration period. The start of exposure can be driven by an internal timer signal, an external trigger signal or a software function call.
- **Trigger Width:** The width of the trigger pulse determines the exposure time. Only available when Trigger Selector = *Single Line Trigger(Start)* and Trigger Source = *Line x*.

### NOTE

Trigger width exposure control is available for monochrome cameras when the Sensor TDI Mode is Single Row; for color cameras it is always available.

A delay between the reception of a valid line trigger (internal or external) and the start of exposure can be specified using the Exposure Delay feature.

## Pulse Width Exposure Timing

The sensor exposure time is 3.2  $\mu\text{s}$  longer than the exposure pulse. Therefore, the actual exposure time is 3.2  $\mu\text{s}$  longer than the exposure time determined by the trigger.

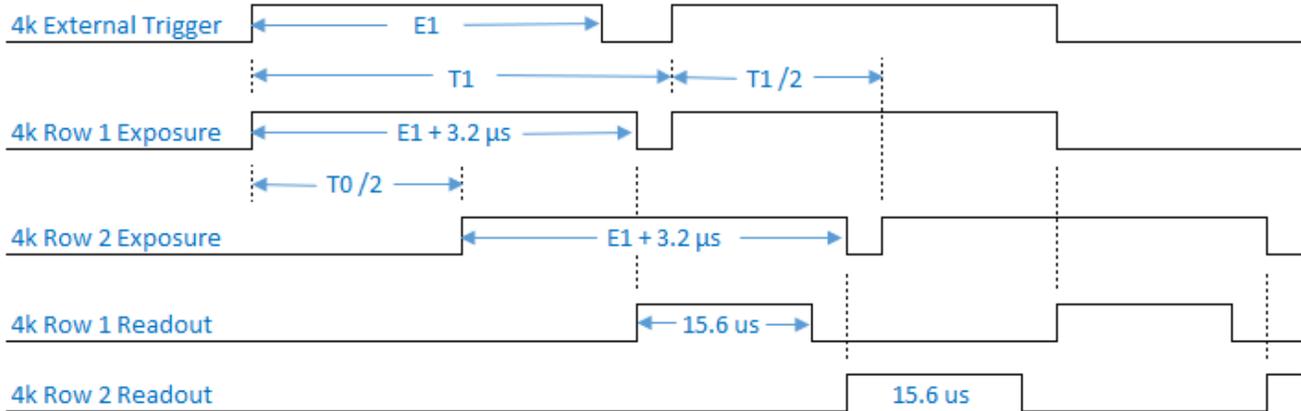


Figure 39: 4k External Trigger with Pulse Width Exposure Control

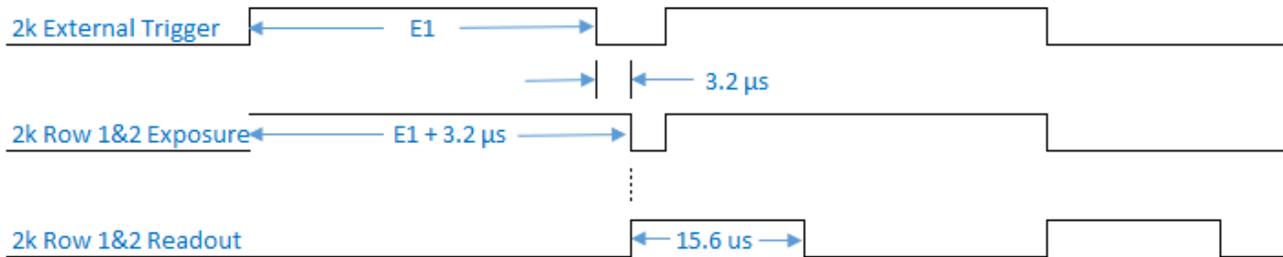


Figure 40: 2k External Trigger with Pulse Width Exposure Control

## Rotary Encoder Interface Timing

Web inspection systems with variable web speeds typically provide one or two synchronization signals from a web mounted rotary (shaft) encoder to coordinate trigger signals. When using an external trigger such as a rotary encoder, a continuous stream of encoder trigger pulses (ticks), synchronized to the object motion, establishes the line rate. The faster the object's motion is, the higher the line rate.

The Trigger Source feature specifies the trigger signal for the selected trigger type (Trigger Selector feature). The *Rotary Encoder* option is only available when Trigger Selector = *Single Line Trigger(Start)*.

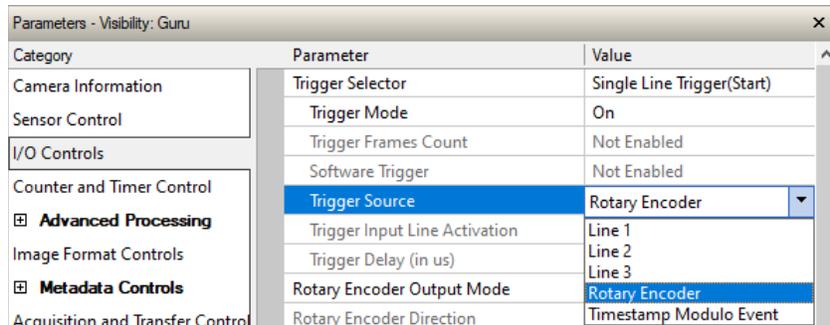


Figure 41: I/O Controls category with Trigger Selector and Trigger Source features for Rotary Encoder.

The camera can accommodate triggers up to its specified maximum frequency. If the maximum frequency is exceeded, the camera will continue to output image data at the maximum specified. The result will be that some trigger pulses will be missed and there will be an associated distortion (compression in the scan direction) of the image data. When the line rate returns to or below the maximum specified, then normal imaging will be reestablished.

The Linea Lite supports single or dual phase (also known as quadrature) rotary encoder. Dual encoder signals are typically 90 degrees out of phase relative to each other (phase A and phase B) and provide greater web motion resolution. The Linea Lite rotary encoder inputs provide additional functionality with encoder rescaler (multiplier and divider) support to adjust the encoder output timing.

## NOTE

A single encoder tick for each 7  $\mu\text{m}$  spacing will produce two lines when in 8k SR mode and one line when in 4k Single Row mode.

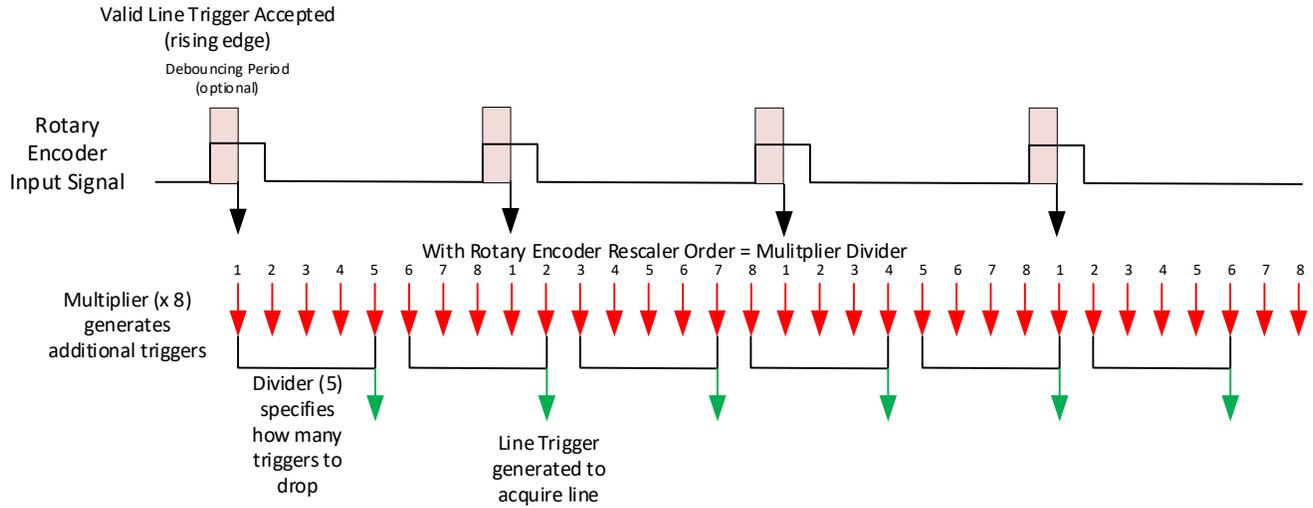
### Dual Balanced Shaft Encoder:

- Input Phase A: Phase A + and Phase A – can be assigned to Line 1 or Line 3 using the [Rotary Encoder Input A Source](#) feature.
- Input Phase B: Phase B + and Phase B – can be assigned to Line 2 or GND (not used) using the [Rotary Encoder Input B Source](#) feature.
- See [HD15 Connector Details](#) for complete connector signal details.

When enabled using the [Trigger Mode](#) feature, the triggered camera acquires one line according to the various rotary encoder feature settings:

- [Rotary Encoder Source Activation](#): Sets whether encoder ticks (triggers) are considered valid on a rising or any edge.
- [Rotary Encoder Output Mode](#): Sets whether encoder ticks are valid for any motion (forward or backward) or only in a specific direction (clockwise or counter-clockwise).
- [Rotary Encoder Rescaler Order](#): The rotary encoder pulses can also be controlled using a divider and multiplier, in either order, as specified using this feature. The [divider](#) (0-255) determines how many pulses are received before issuing the line start trigger; the [multiplier](#) ( $2^n$  up to 128) increases the number of line output pulses generated for each trigger received. The rescaling factor is the same regardless of the order. The order may be a factor when the incoming encoder trigger is very slow or fast. To avoid reaching the input trigger frequency limits or excessive jitter, very slow triggers should apply the multiplier first; very fast incoming triggers should apply the divider first.

In practice, dividers and multipliers can be used to shift the line trigger backward or forwards to adjust the rotary encoder distance per tick.



For example, if each rotary encoder tick represents 10 mm of movement, a multiplier of 8 results in each tick equaling 1.25 mm (10/8); if a divider of 5 is then applied, then each tick is 6.25 mm (1.25 x 5). Therefore, to calculate the value of each tick:

$$distance\ per\ tick \times \frac{Divider}{Multiplier}$$

This allows using a simple fraction to adjust the encoder.

For details on how to use the multiplier and divider features, see [Application Note for Multiplier & Divider](#) on the Teledyne DALSA website.

## Related Features

Feature related to triggers are part of the [I/O Controls](#) category.

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## Gain and Black Level Control Details

The Linea Lite GigE camera provides Digital Gain and Black Level adjustments. The Gain and Black Level controls can make small compensations to the acquisition in situations where lighting varies and the lens iris cannot be easily adjusted. Optimal gain and Black Level adjustments maximizes the Linea Lite GigE dynamic range for individual imaging situations. The user can evaluate Gain and Black Level by using CamExpert.

Features and limitations are described below.

- Black Level offset is expressed as a digital number (DN) providing a +/- offset from the factory setting. The factory setting optimized the black level offset for maximum dynamic range under controlled ideal dark conditions.
- Gain is expressed as a multiplication factor. Color cameras support individual red, green and blue gains.

### NOTE

Increasing digital gain does not increase the low-level resolution and increases the sensor noise proportionately.

## Related Features

Feature related to binning are part of the Sensor Control category.

# Binning

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 (factor of 2x or 4x) on Linea Lite monochrome cameras by using CamExpert.

Linea Lite monochrome cameras support horizontal and vertical binning independently. Vertical binning is performed over multiple acquisition lines within the camera; the virtual frame buffer height is automatically reduced when binning is enabled.

## NOTE

Binning is performed digitally, therefore there is no increase in acquisition line rate.

The 8k SR model does not support binning.

The following graphic illustrates binning.

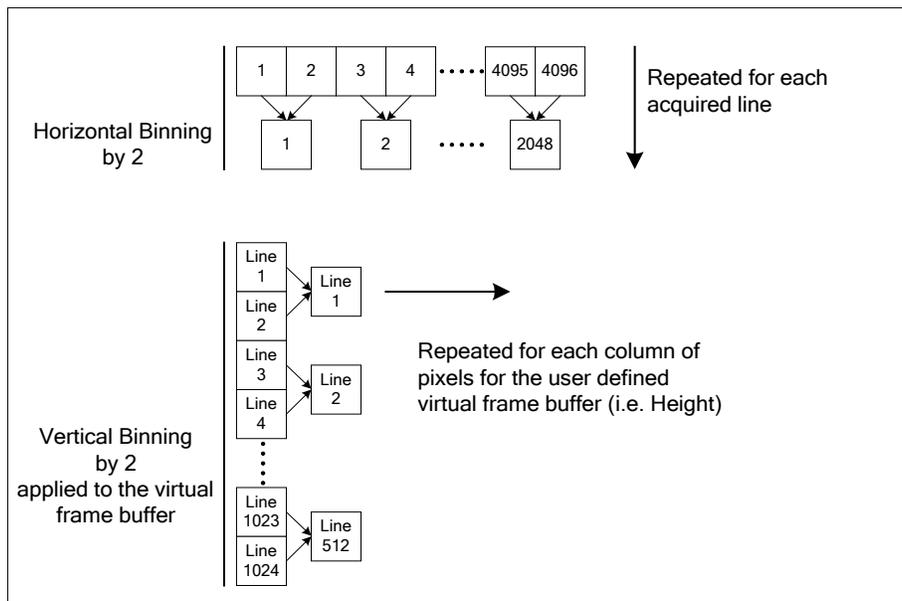


Figure 42: Horizontal & Vertical Binning

The Binning Mode feature determines whether combined pixels are averaged or summed.

## Related Features

Feature related to binning are part of the Image Format Controls category.

# Lookup Table (LUT)

The Linea Lite cameras include a user programmable LUT table as a component of its Advanced Processing features. A LUT is used for operations such as gamma adjustments or luminance adjustments, as selected by the LUT Type feature.

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

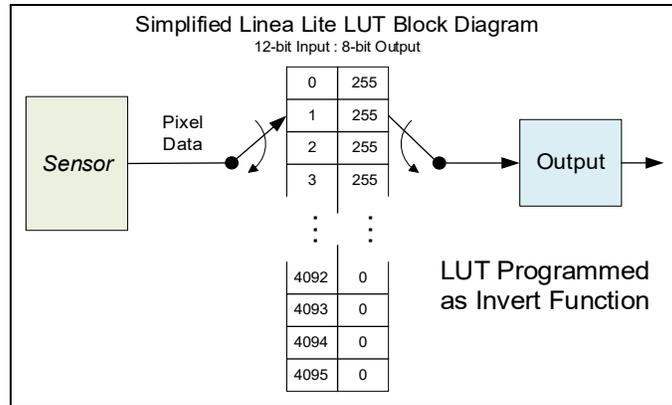


Figure 43: LUT Block Diagram

## NOTE

The 8k SR model does not support lookup tables.

## LUT Size vs. Output Pixel Format

The LUT size is the same as the camera’s sensor pixel size (current Linea Lite standard firmware LUT is 12-bit). All camera processing is performed at the 12-bit sensor pixel format of the camera, while the output pixel format is 8-bit or 12-bit.

A default neutral LUT programming is as follows:

- With **Pixel Format = 8-bit**, the default LUT data is programmed to map the 4096 sensor pixel values to 256 output values. Therefore, LUT index “0 to 15” have the value “0”, LUT index “16 to 31” have the value “1”, and so on until the last group where LUT index “4079 to 4095” 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 uploaded using the File Access controls. Refer to Sapera LT documentation (available from the Start Menu under Teledyne DALSA Sapera LT) for information about the SapLut Class.

## NOTE

The SapLut file can be uploaded to the Linea Lite 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. A 12-bit LUT is shown as an example.

- 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.

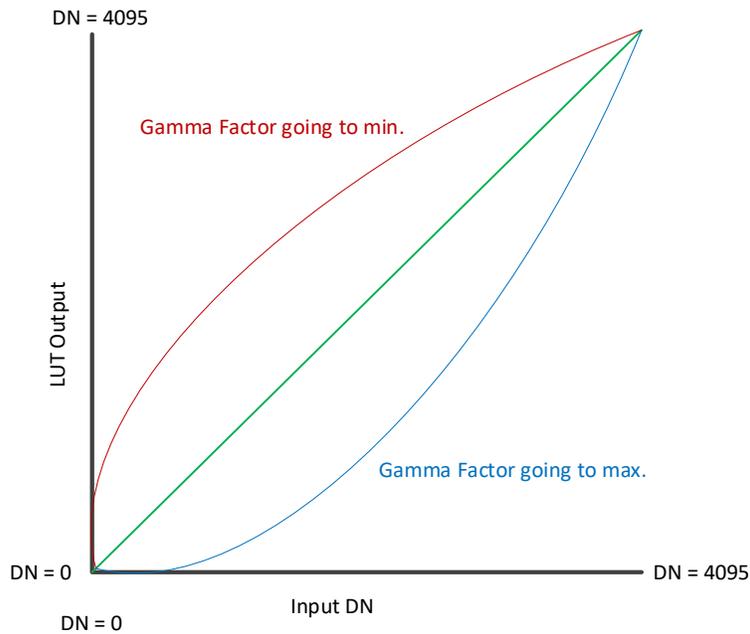


Figure 44: Gamma Correction Factor (not to scale)

## Related Features

Feature related to LUTs are part of the Advanced Processing category.

# Flat Field Correction

The Flat Field Correction function (FFC) consists of using two coefficients per pixel which correct the gain and offset of the corresponding pixel. These corrections compensate for Photo-Response Non-Uniformity (PRNU) and Fixed Pattern Noise (FPN) unique to each camera sensor.

With CMOS sensors, it is important to perform FFC calibration under the same operating conditions the camera will be used, otherwise sensor variations (over temperature and exposure) will make the FFC calibration invalid. Linea Lite GigE cameras have multiple FFC user memory spaces to store calibration data, allowing users to store FFC data for different optimized exposure setups.

The following diagram illustrates the monochrome camera's digital processing chain and associated GenICam features (color cameras also include individual red, green and blue gains).

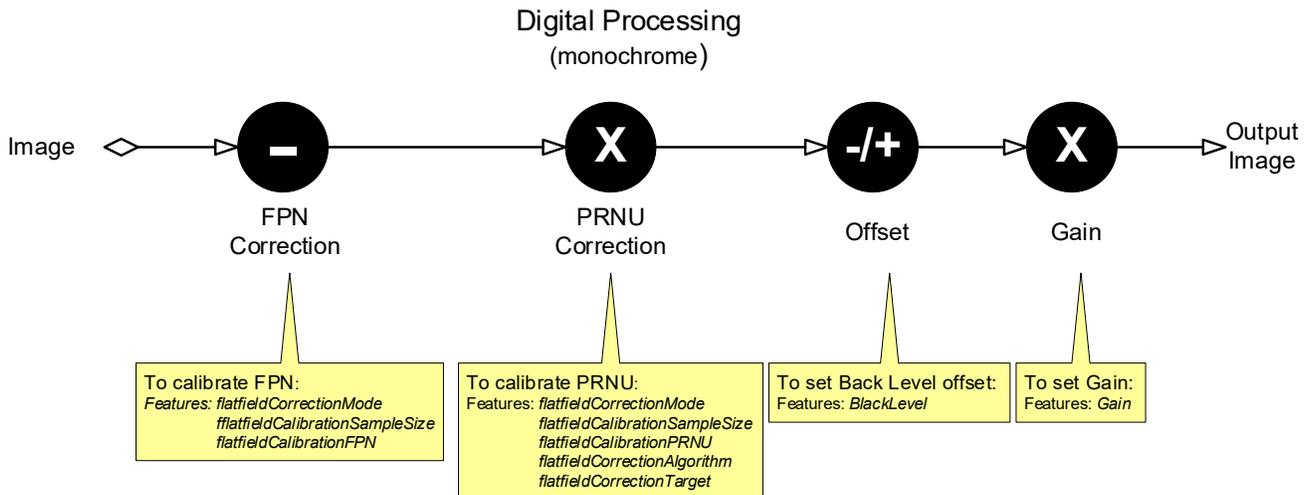


Figure 45: Digital Processing Chain

## Flat Field Correction Algorithm Description

Flat Field Correction Algorithm Method1 applies the following FFC formula for correcting pixel values.

$$newPixelValue[x] = (sensorPixelValue[x] - FFCOffset[x] \times FFCGain[x])$$

where:

- **[x]** is the Flat Field Correction Pixel coordinate.  
See the *flatfieldCorrectionPixelXCoordinate* feature.
- **newPixelValue** is the pixel value after Flat Field Correction is applied.
- **sensorPixelValue** is the pixel value before Flat Field Correction is applied.
- **FFCOffset** is the offset coefficient value to subtract from the sensorPixelValue.
- **FFCGain** is the gain coefficient value that is multiplied with the sensorPixelValue.

### NOTE

FFCOffset and FFCGain are derived factors calculated from a number of camera specific feature values (Invisible DFNC features). Reading these values directly from the Flat Field Coefficients file will be meaningless to the user.

### ***Information on the Sapera Flat Field Coefficients File***

The Flat Field Coefficients File is a standard 16-bit TIFF file for both 8-bit and 12-bit acquisition modes. If the Flat Field calibration is made while using a 12-bit buffer, the user Flat Field Calibration coefficients file is applicable to both 12-bit and 8-bit acquisitions.

A Sapera application (such as CamExpert) creates a new SapBuffer object of the same width as the sensor but with twice the number of lines. This provides the room to store both offset and gain Flat Field data. The Flat Field offset data is contained in the top half of the new buffer, while the gain buffer is in the bottom half.

A Sapera application saves the new buffer using the SapBuffer class Save function with the "-format tiff" option, which allows saving data without loss of significant bits.

### ***Important Factors about Flat Field Processing***

#### **NOTE**

Before calibration, the Linea Lite GigE should be powered on long enough to achieve its nominal temperature (a minimum of 30 minutes). A low ambient temperature may increase the time required for the camera to reach a stable internal temperature.

During calibration, no other Linea Lite GigE features should be accessed or modified.

**Calibration via CamExpert or via a User Application:** Exposure and frame rates used during a Flat Field Calibration should be similar to the exposure settings used in the camera application.

## Performing an FFC Setup via Sapera CamExpert

The Sapera LT CamExpert tool provides an easy GUI based method for a user to perform a Flat Field Calibration. The process first requires the user to plan acquisitions in dark and bright conditions, followed by the FFC process itself. These steps are detailed below.

### Set up Dark and Bright Acquisitions with the Histogram Tool

Verify the camera's acquisition with a live grab and prepare to grab a flat light gray image required for calibration. Ideally, a controlled diffused light source aimed directly at the lens should be used or a non-glossy paper with the lens slightly out of focus (or evenly lit wall). Note the lens iris position for a bright but not saturated image.

### Verify a Dark Acquisition

Close the camera lens iris and cover the lens with the lens cap.

Using CamExpert, click **Grab** and then **Statistics**.

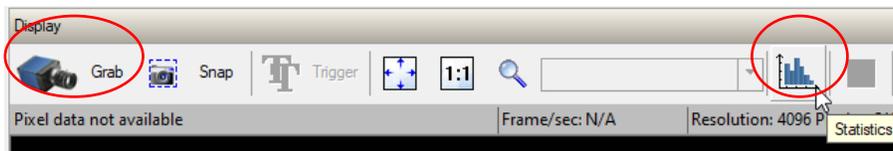


Figure 46: CamExpert – Grab & Statistics Buttons

In the Statistics dialog, use the **Selected view** drop-down list to select Histogram.



Figure 47: CamExpert Statistics Dialog – Selected View

The following figure shows a typical histogram for a camera grabbing a dark image.

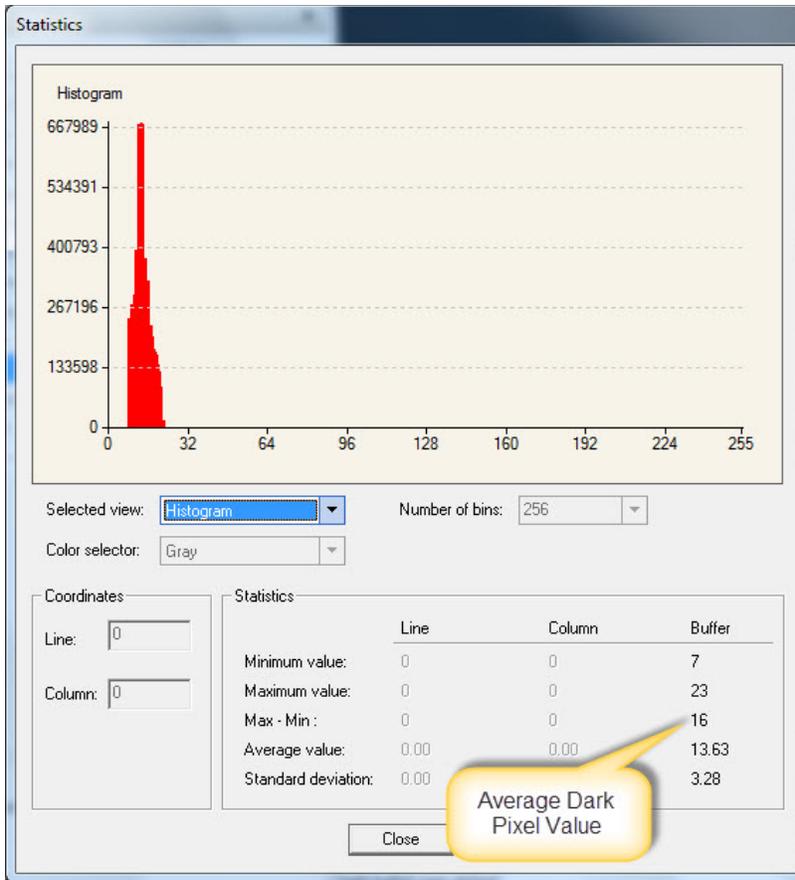


Figure 48: CamExpert Statistics Dialog – Average Dark Pixel Value

## IMPORTANT

The **average** pixel value for the frame is close to black.

Sensors might show a much higher maximum pixel value due to one or more "hot pixels".

## Verify a Bright Acquisition

Point the camera at a diffused light source or evenly lit white wall with no shadows falling on it. Click Grab, followed by Statistics. Use the lens iris to adjust for a bright gray approximately pixel value 200 (for 8-bit pixels). The following figure displays a histogram while grabbing a bright gray image.

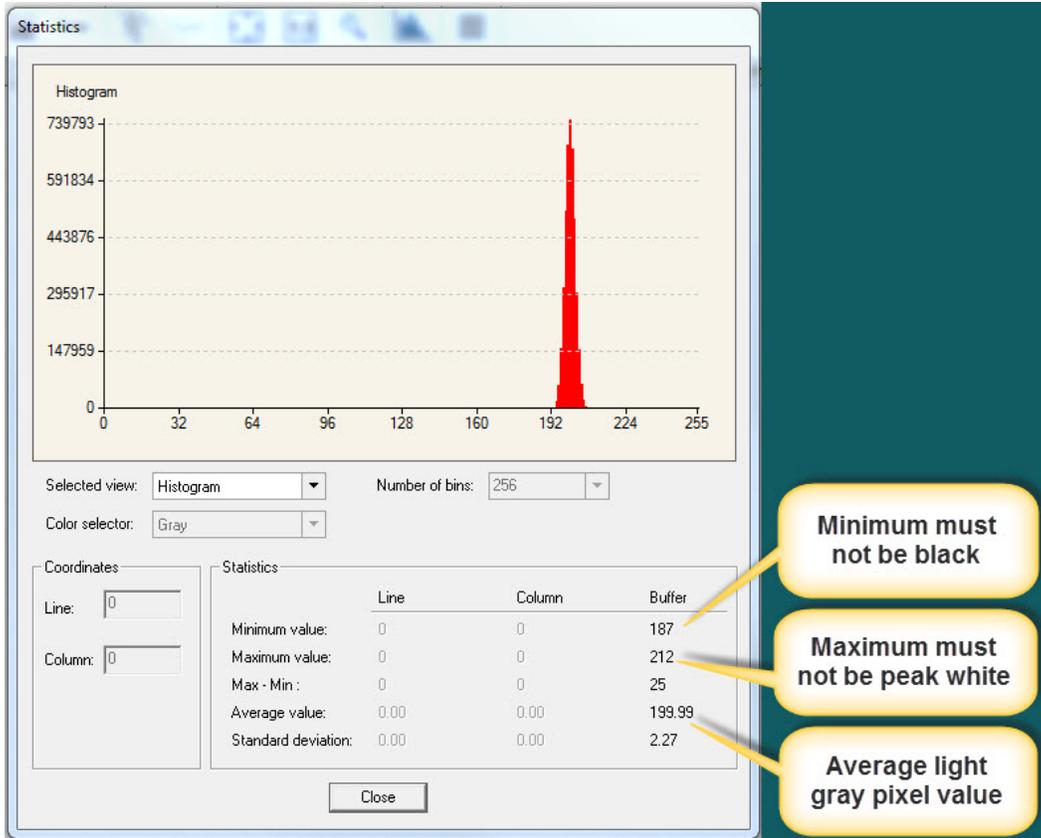


Figure 49: CamExpert Statistics Dialog – Verifying Bright Acquisition

### IMPORTANT

In this example, the **average** pixel value for the frame is bright gray.

### NOTE

Sensors may show a much higher maximum or lower minimum pixel value due to one or more "hot or dead pixels". The sensor specification accounts for a small number of hot, stuck, or dead pixels (pixels that do not react to light over the full dynamic range specified for that sensor).

When the bright gray acquisition setup is complete, note the camera and lens iris position for repeatability in the future.

## Flat Field Correction Calibration

Flat Field Correction Calibration (FFC) contains FPN (Fixed Pattern Noise) and PRNU (Photon Response non-uniformity) corrections.

### NOTE

Before performing an FFC, Teledyne DALSA recommends evaluating the “bare image” characteristics, which determine the quality of FFC, applied to the image. A bare image has no gains applied.

To obtain a bare image, disable FPN and PRNU coefficients: Choose Off from Flat Field Correction Mode:

- Set the Flat Field Correction Mode feature to Off.

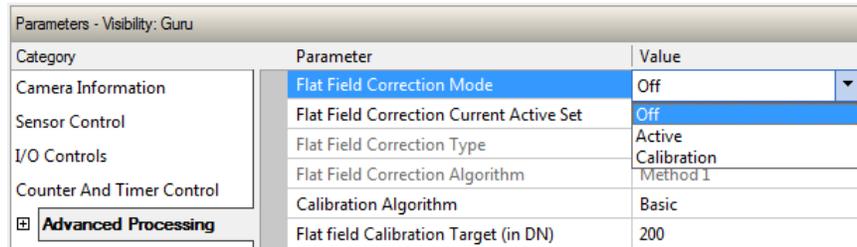


Figure 50: CamExpert – Flat Field Correction Mode

- Set the Gain to 1.0.

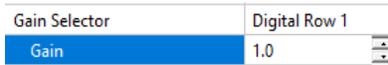


Figure 51: CamExpert – Gain

To evaluate a bare image of a uniform white target scene, use the line profile tool shown below.

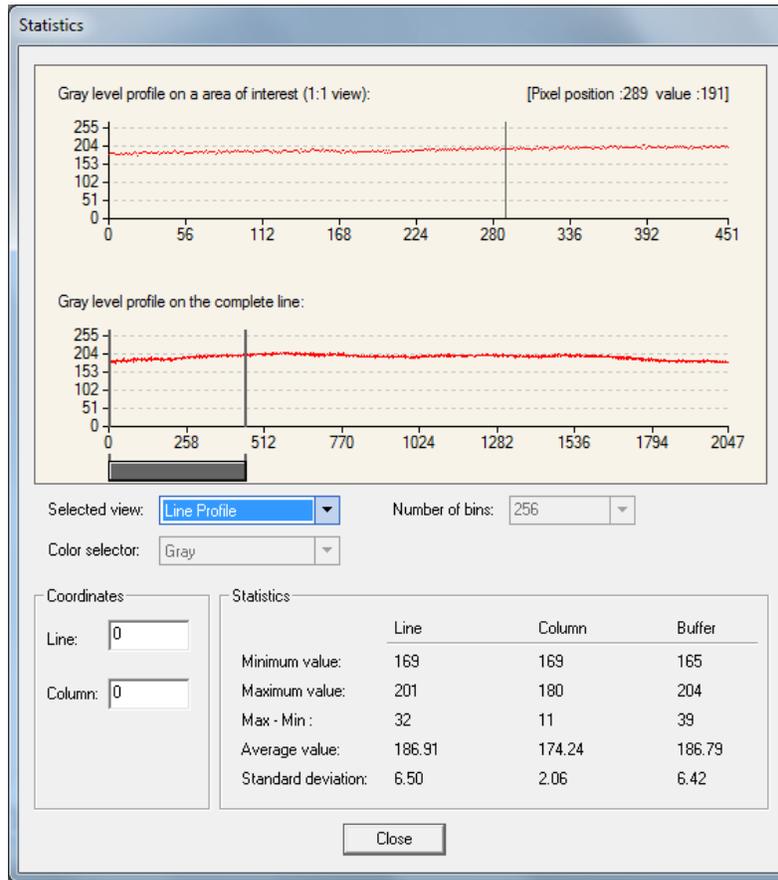


Figure 52: CamExpert Statistics Dialog – Line Profile

## A line profile is mainly determined by two factors: Flatness and Height

**1) Flatness:** The Line profile represents a Flat Field measurement. Due to lens-shading effect, light falls-off near the edges and results in lower output. This produces higher noise levels near the edge. A smaller aperture opening and longer focal length can reduce lens - shading effect. In some demanding applications, optimized low - shading lenses should be considered.

**2) Height:** An average value near your calibration target is ideal. An extremely low output compared to the target will increase noise level significantly after the PRNU is corrected. To avoid SNR and / or DNR not meeting your application requirements, the profile should reach a level near the calibration target.

### NOTE

Changes to gain do not improve image quality from a SNR perspective. Gains are analog and digital multipliers that scale up signal and noise proportionally.

Before performing a FFC follow these guidelines:

- Ensure the camera's temperature is at nominal operating condition. Power-on for minimum 30 min.
- All parameters should meet your application's specifications. If parameters change after FFC completion, the results may no longer be accurate. Perform another FFC.

## FPN Correction

In general, factory FPN correction is sufficient for most applications. However, if a new FPN correction is required a user set FPN correction can be applied.

### To perform FPN Correction

1. Cover the lens (place the sensor in dark).
2. Set the Flat Field Correction Mode to Off and check the line profile / histogram. If some, or all, of the pixels outputs are zero, then you should adjust the Black Level feature offset value to ensure that all pixel output is above zero.

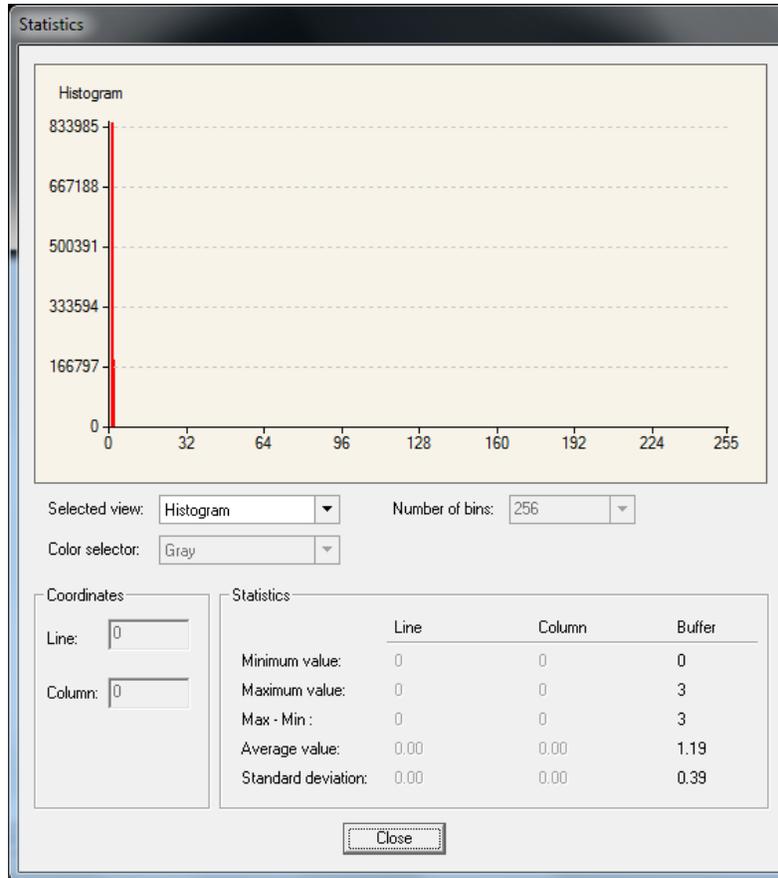


Figure 53: CamExpert Statistics Dialog – FPN Pixel Output

3. Set the Flat Field Correction Mode to Calibration and select the required user set from Flat Field Correction Current Active Set drop-down menu.

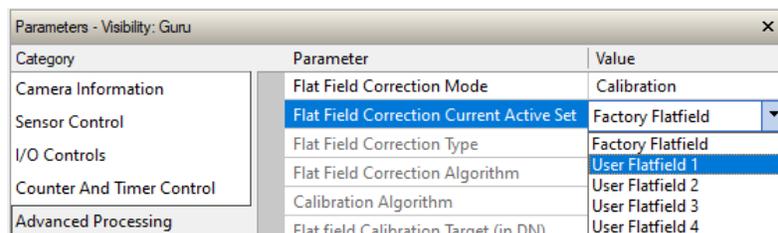


Figure 54: CamExpert – Flat Field Correction Current Active Set

4. Set the Flat Field Calibration Sample Size feature to 4096 or 2048. The 4096 option returns more accurate results whereas the 2048 option reduces calculating time. In general, the 2048 results are still satisfactory for most applications.
5. In the Calibrate FPN feature, click the *Press...* command to perform the calibration.
6. Uncover lens.

### ***PRNU Correction***

1. Apply illumination and place a white flat target in the location where the real object will be. Ideally, you would use a professional target. For convenience, you can use white paper as the target. The result of using paper may produce grain effect — where visible vertical lines show up in grabbed images.  
Two common ways to correct the grain effect are:
  - 1) Target in motion while PRNU Correction is performed.
  - 2) Defocus lens while PRNU Correction is performed.Set the Flat Field Correction Mode to *Off* and check the bare image line profile.
2. Set the Flat Field Correction Mode to Calibration and select the required user set from Flat Field Correction Current Active Set list.
3. Adjust the calibration target in the Flat Field Calibration Target (in DN) if necessary. A value of 200 DN is commonly used target in 8-bit output format.
4. Set the Flat Field Calibration Sample Size feature to 4096 or 2048.
5. In the Calibrate PRNU feature, click **Press...** to perform the calibration.
6. Select a User Flat field set from the Flat Field Correction Current Active Set. In the Save Calibration feature, click **Press...** to save the FFC results to the selected current active set. If not saved, the FFC result will be lost when the Active Set or Calibration mode is changed.
7. Set the Flat Field Correction Mode to Active to apply the calibrated FPN and PRNU parameters to. Results can be checked with the line profile.

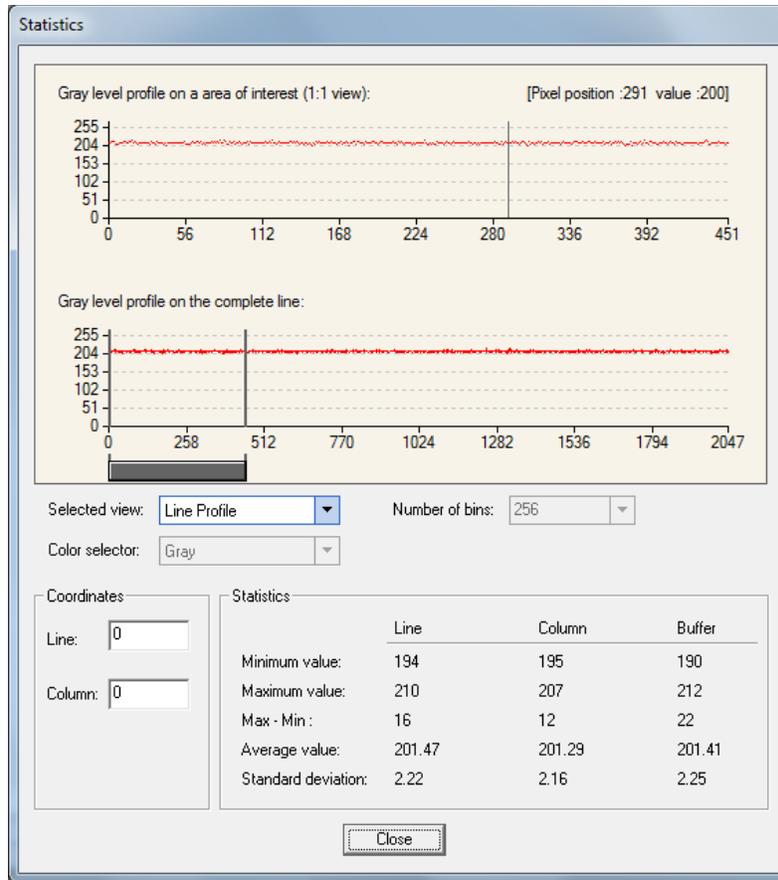


Figure 55: CamExpert Statistics Dialog – Line Profile

- To load this user set when resetting or powering on the camera, use the Power-up Configuration dialog. In Power-up Configuration feature, available in the Camera Information category, click **Setting....**

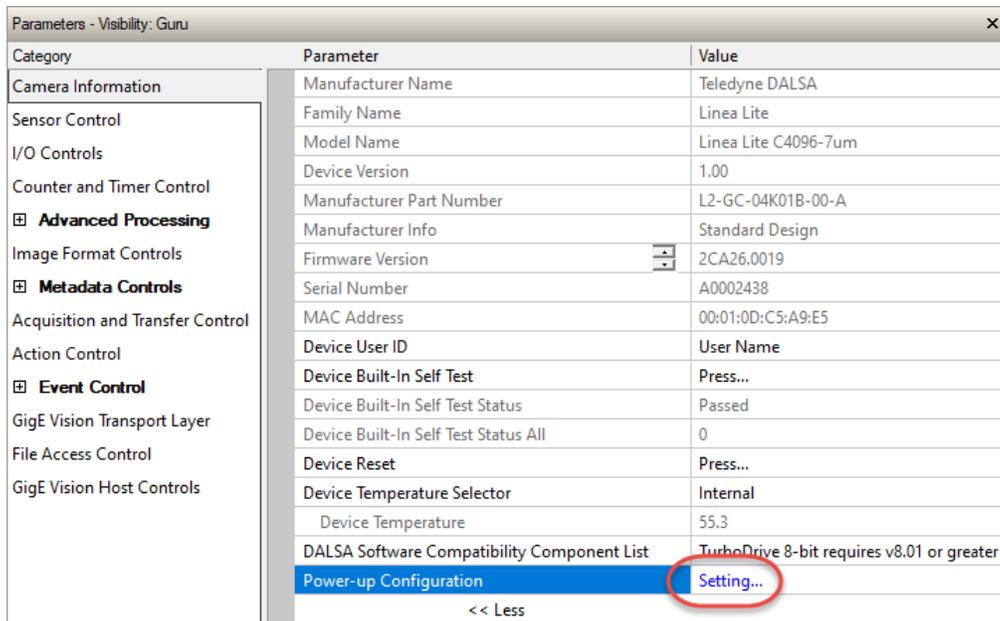


Figure 56: CamExpert – Power-up Configuration

In the Power-up Configuration dialog box select one of four [UserSets](#) for both Camera Power-up configuration and Load / Save configuration and press the [Save](#) button.

This ensures that the camera loads the saved parameters the next time the camera is turned on.

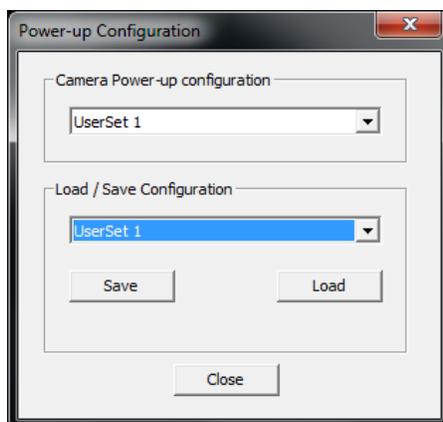


Figure 57: CamExpert – Power-up Configuration Dialog

## NOTE

User sets cannot be uploaded while the camera is acquiring images.

## Related Features

Feature related to flat field correction are part of the [Advanced Processing category](#).

# Camera Firmware Updates

In the [File Access Control](#) category, click **Setting** to open File Access Control dialog.

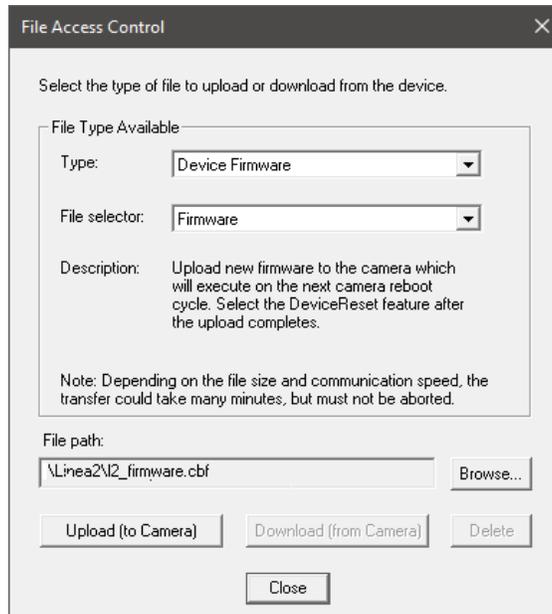


Figure 58: CamExpert – File Access Control Dialog

- **Type:** select the file type to upload to the camera.
- **File selector:** select Device Firmware.
- Click **Browse...** to open Windows Explorer.
- Select the specific file to Upload.
- Click **Upload (to Camera)** to execute the file transfer to the camera.

When firmware is successfully updated the camera must be reset to effect the change; CamExpert displays a dialog indicating that the upload was successful and prompts to reset the camera.

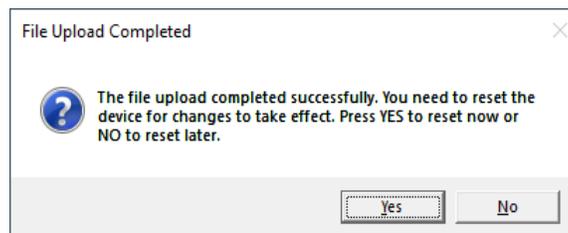


Figure 59: CamExpert – File Upload Completed Message Box

## NOTE

User sets cannot be uploaded while the camera is acquiring images. The camera must be reset for changes to take effect.

Sapera LT includes a Camera Firmware Update example that demonstrates how to perform a firmware update within an application.

# Internal Test Image Generator

The camera includes a number of internal test patterns, which confirm Ethernet connection and driver installation without the need for a camera lens or proper lighting. The patterns are subject to camera processing and Binning functions.

Use CamExpert to enable and select any test pattern from the Test Image Selector feature drop-down list while the camera is not in Acquisition Mode.

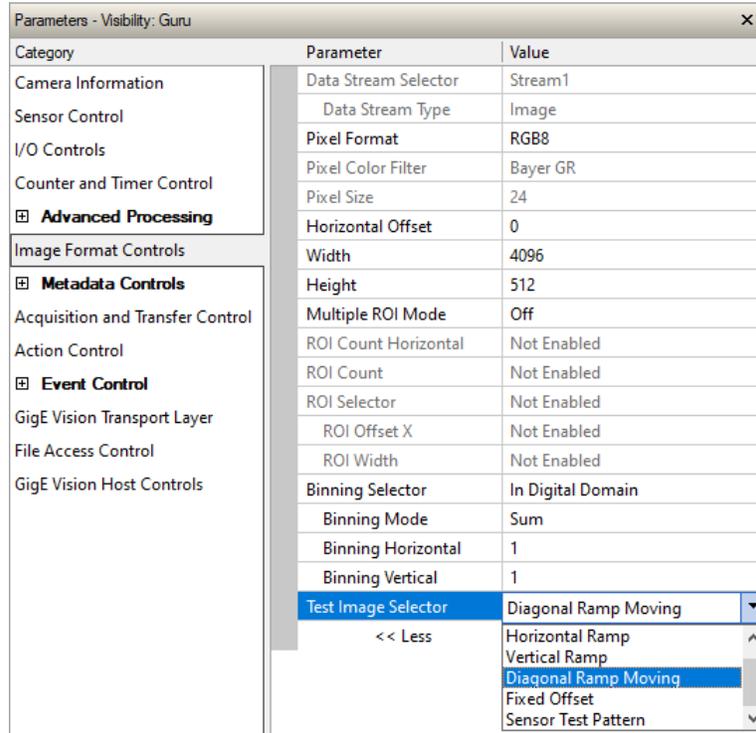


Figure 60: CamExpert – Test Image Selector

Click **Grab** to display the pattern output.

## Available Test Patterns

Available test patterns include:

### Horizontal Ramp

Display is filled with horizontally repeating image ranging from black to white.

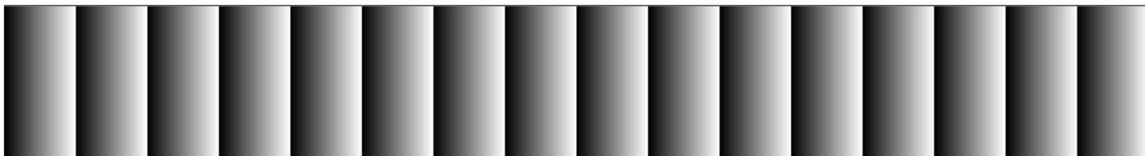


Figure 61: CamExpert Test Image – Grey Horizontal Ramp

### **Vertical Ramp**

Display is filled with vertically repeating image ranging from black to white.



*Figure 62: CamExpert Test Image – Grey Vertical Ramp*

### **Diagonal Ramp Moving**

Display is filled with a diagonally repeating image ranging from black to white. The image moves horizontally to the right in one pixel steps.



*Figure 63: CamExpert Test Image – Grey Diagonal Ramp Moving*

### **Fixed Offset**

Display is filled with an image with a fixed value of 64 DN.



*Figure 64: CamExpert Test Image – Fixed Offset*

### **Sensor Test Pattern**

Display is filled with an image with consecutive pixels incrementing from 0-31 DN.



*Figure 65: CamExpert Test Image –Sensor Test Pattern*

# Parallax Correction: Using the Camera at Non-Perpendicular Angles to the Object

When using a Linea Lite color camera at an angle to the objects surface, the object pixel size for the red-blue and green pixel arrays are slightly different. This is due to parallax. If the camera angle and the lens angular field of view are sufficiently large, this may cause color artifacts at the extremities of the image. The color camera includes a Parallax Correction Pixel Stretch feature that can correct these color artifacts.

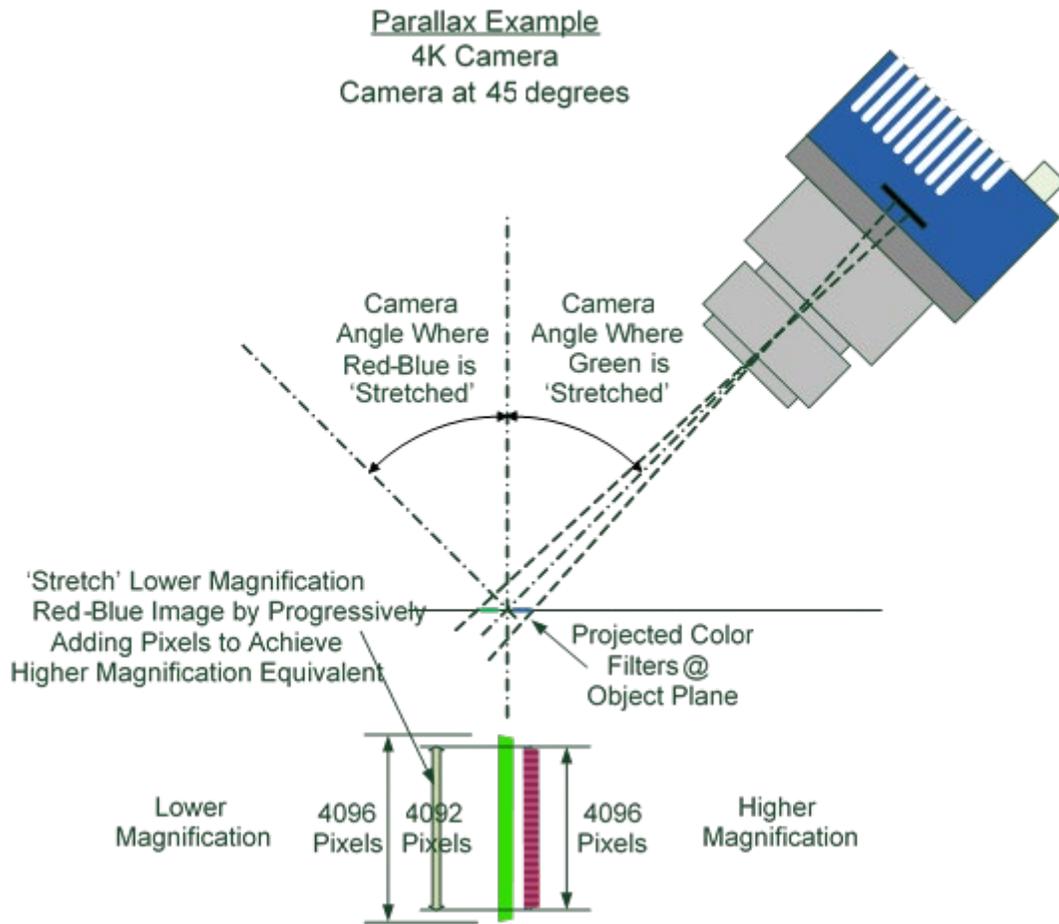


Figure 66: Camera Angle Creates Parallax

## Notes:

- This feature will be most useful when processing RGB image formats using 4K cameras with long focal length lenses.
- Parallax correction of the individual colors cannot be performed due to the row summing in the sensor. Therefore, at high angles, a degradation in MTF at the end pixels may occur.
- Selection of the color to adjust is dependent on positive or negative angle. It is not sensitive to scan direction.
- The stretch value for green is always half that of the stretch value for red-blue.

Image example of color artifact induced by parallax at the image extremity:



*Figure 67: Parallax Image Example*

# User Defined Camera Name

The Device User ID feature is a user-defined name provided for easy device identification. This is especially useful when multiple cameras are connected to the network. For example, on an inspection system with four cameras, the devices might be named Top, Left, Bottom, Right. The factory default Device User ID is the camera serial number for quick initial identification.

An imaging application can use any of the following attributes to identify a camera: its IP address, MAC address, serial number or Device User ID. Some important considerations are listed below.

- Do not use the camera's IP address as identification (unless it is a persistent IP) because it can change with each power cycle.
- A MAC address is unique to each camera; therefore the control application is limited to the vision system that uses the camera's MAC address.
- The Device User ID can be freely programmed to represent the camera usage. This method 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.

## TIP

Use the Device User ID feature to identify your devices (Camera Information category).

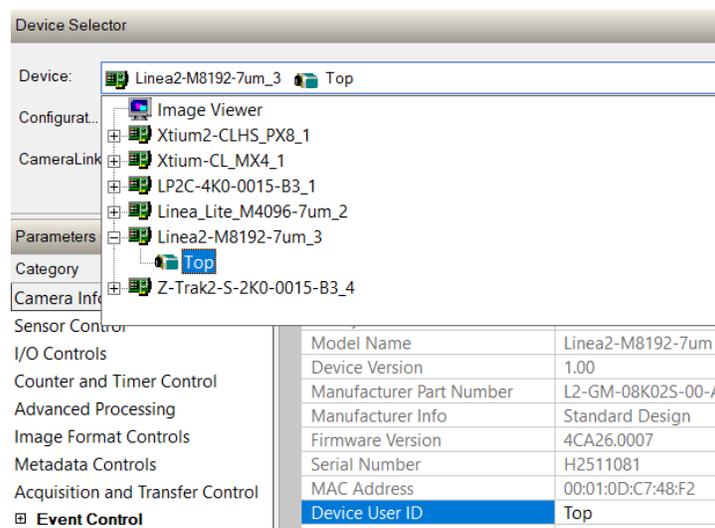


Figure 68: Device User ID

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# Saving & Restoring Camera Setup Configurations

A user system may use multiple illuminations, resolutions and responsiveness configurations in order to cover different imaging situations. The camera includes four user sets where camera setup information can be saved and restored at power up or during operation.

## NOTE

The factory settings configuration is loaded during the camera's first power-up. User sets cannot be saved while the camera is grabbing.

## Active Settings for Current Operation

Active settings are those settings used while the camera is running and include all unsaved changes made to the settings. These active settings are stored in the camera's *volatile* memory and will be lost and cannot be restored if the camera resets or loses power during operation.

The settings active during the current operation can be saved and restored when the camera is powered on using the User Set Save parameter. Once saved, the current settings become the selected user set.

## Camera Configuration Selection Dialog

CamExpert provides a dialog box which combines the features to select the camera power up configuration plus the Load / Save Configuration from Linea Lite GigE memory.

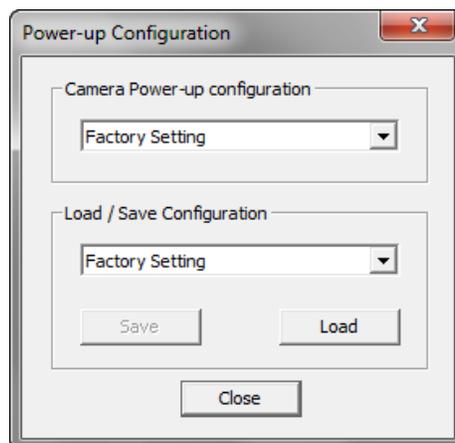


Figure 69: CamExpert – Power-up Configuration Dialog

## Camera Power-up Configuration

The Camera Power-up configuration drop down list displays the camera configuration to load during power-up (see Power-up Configuration Selector feature). The user chooses Factory Setting or one of four possible saved User Sets.

## User Set Configuration Management

The second drop-down list allows the user to change the camera configuration anytime after power-up (see UserSetSelector feature). To reset the camera to the factory configuration, select *Factory Setting* and click Load. To save a current camera configuration to non-volatile memory, select User Set 1 - 4 and click Save. Select a saved user set and click Load to restore a saved configuration. By default, the user sets are shipped with the same settings as the factory set.

# Operational Reference

Many of the features shown in CamExpert may be changed directly in CamExpert or programmatically via an imaging application. Their availability may depend on other feature settings, and while some features are read only, others may be changed even during acquisition. Note that features shown by CamExpert may change with different camera models implementing different sensors and image resolutions; that is, a specific camera model may not support the full feature set defined in a category.

The Standard & View column indicates which parameter is a member of the DALSA Features Naming Convention (indicated by DFNC), versus the GenICam Standard Features Naming Convention (SFNC, default, not shown).

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

The B/W Color column, where necessary, identifies features that are specific to monochrome, color or super resolution (SR) camera models.

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

The Camera Information category groups information specific to the individual GigE Vision camera. The features shown are identical whether the view is Beginner, Expert or Guru.

The screenshot shows a window titled "Parameters - Visibility: Guru" with a tree view on the left and a table of parameters on the right. The "Camera Information" category is selected in the tree view. The table lists various parameters and their values.

Category	Parameter	Value
Camera Information	Manufacturer Name	Teledyne DALSA
Sensor Control	Family Name	Linea Lite
I/O Controls	Model Name	Linea Lite C4096-7um
Counter and Timer Control	Device Version	1.00
<input checked="" type="checkbox"/> <b>Advanced Processing</b>	Manufacturer Part Number	L2-GC-04K01B-00-A
Image Format Controls	Manufacturer Info	Standard Design
<input checked="" type="checkbox"/> <b>Metadata Controls</b>	Firmware Version	2CA26.0019
Acquisition and Transfer Control	Serial Number	A0002438
Action Control	MAC Address	00:01:0D:C5:A9:E5
<input checked="" type="checkbox"/> <b>Event Control</b>	Device User ID	User Name
GigE Vision Transport Layer	Device Built-In Self Test	Press...
File Access Control	Device Built-In Self Test Status	Passed
GigE Vision Host Controls	Device Built-In Self Test Status All	0
	Device Reset	Press...
	Device Temperature Selector	Internal
	Device Temperature	36.8
	DALSA Software Compatibility Component List	TurboDrive 8-bit requires v8.01 or greater
	Power-up Configuration	Setting...

Figure 70: CamExpert – Camera Information Category

## Camera Information Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Manufacturer Name	DeviceVendorName	Displays the device vendor name. (RO)	Beginner
Family Name	DeviceFamilyName	Displays the device family name. (RO)	Beginner
Model Name	DeviceModelName	Displays the device model name. (RO)	Beginner
Device Version	DeviceVersion	Displays the device version. This tag will also highlight if the firmware is a beta or custom design. (RO)	Beginner
Manufacturer Part Number	deviceManufacturerPartNumber	Displays extended manufacturer part number information about the device.	Beginner DFNC
Manufacturer Info	DeviceManufacturerInfo	This feature provides extended manufacturer information about the device, such as the firmware design type. (RO)	Beginner
Firmware Version	DeviceFirmwareVersion	Displays the currently loaded firmware version number. Firmware files have a unique number and have the .cbf file extension. (RO)	Beginner
Serial Number	DeviceSerialNumber	Displays the device's factory set camera serial number. (RO)	Beginner
MAC Address	deviceMacAddress	Displays the unique MAC (Media Access Control) address of the Device. (RO)	Beginner DFNC
<u>Device User ID</u>	DeviceUserID	Feature to store a user-programmable identifier of up to 15 characters. The default factory setting is the camera serial number. (RW)	Beginner
Device Built-In Self Test	deviceBIST	Command to perform an internal test which will determine the device status. (W)	Beginner DFNC

Display Name	Feature & Values	Description	Standard & View
Device Built-In Self Test Status	deviceBISTStatus	Return the status of the device Built-In Self Test.(BIST). Possible return values are device-specific.	Beginner DFNC
<i>Passed</i>	<i>Passed</i>	<i>No failure detected</i>	
<i>Firmware update failed</i>	<i>FirmwareUpdateFailure</i>	<i>Last firmware update operation failed.</i>	
<i>Sensor Initialization Failure</i>	<i>SensorFailure</i>	<i>There was an error initializing the sensor; the camera may not be able to capture images.</i>	
<i>Firmware Error</i>	<i>FirmwareError</i>	<i>Firmware encountered an error during streaming.</i>	
<i>Unexpected Error</i>	<i>Unexpected_Error</i>	<i>Switched to recovery mode due to unexpected software error.</i>	
Device Built-In Self Test Status All	deviceBISTStatusAll	Return the status of the device Built-In Self Test (BIST) as a bit field. The meaning for each bit is device-specific.	Beginner DFNC
Device Reset	DeviceReset	Resets the device to its power up state. (W)	Beginner
Device Temperature Selector	DeviceTemperatureSelector	Select the source where the temperature is read.	Beginner
<i>Internal</i>	<i>Internal</i>	<i>Read FPGA and / or PHY temperature.</i>	
<i>MaxInternal</i>	<i>MaxInternal</i>	<i>Records the highest device temperature since power up. Value is reset on power off.</i>	
Device Temperature (in C)	DeviceTemperature	The temperature of the selected source in degrees Celsius	Beginner
DALSA Software Compatibility Component List	DALSASoftwareCompatibilityComponentList	List the optional Teledyne DALSA software functions that are supported.	Beginner
<i>TurboDrive 8-bit requires v8.01 or greater</i>	<i>Compatibility1</i>	<i>Teledyne DALSA Turbo Drive 8-bit (Monochrome or Bayer) requires Sopera-LT 8.01 or greater.</i>	
<i>TurboDrive 10-bit requires v8.10 or greater</i>	<i>Compatibility2</i>	<i>Teledyne DALSA Turbo Drive 10-bit (Monochrome or Bayer) requires Sopera-LT 8.10 or greater.</i>	
<i>TurboDrive 12-bit requires v8.10 or greater</i>	<i>Compatibility3</i>	<i>Teledyne DALSA Turbo Drive 12-bit (Monochrome or Bayer) requires Sopera-LT 8.10 or greater.</i>	
<i>Multicast requires a newer version</i>	<i>Compatibility4</i>	<i>Multicast feature support requires a newer version of Sopera LT than currently installed.</i>	
<u>Power-up Configuration Selector</u>	UserSetDefault	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)	Beginner
<i>None</i>	<i>None</i>	<i>Keep Internal configuration.</i>	
<i>Factory Setting</i>	<i>Default</i>	<i>Load factory default feature settings.</i>	
<i>UserSet1</i>	<i>UserSet1</i>	<i>Select the user defined configuration UserSet 1 as the Power-up Configuration.</i>	
<i>UserSet2</i>	<i>UserSet2</i>	<i>Select the user defined configuration UserSet 2 as the Power-up Configuration.</i>	
<i>UserSet3</i>	<i>UserSet3</i>	<i>Select the user defined configuration UserSet 3 as the Power-up Configuration.</i>	
<i>UserSet4</i>	<i>UserSet4</i>	<i>Select the user defined configuration UserSet 4 as the Power-up Configuration.</i>	
<u>User Set Selector</u>	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. User camera configuration sets contain features settings previously saved by the user. (RW)	Beginner
<i>Factory Setting</i>	<i>Default</i>	<i>Select the default camera feature settings saved by the factory.</i>	
<i>UserSet 1</i>	<i>UserSet1</i>	<i>Select the User Defined Configuration space UserSet 1 to save to or load from features settings previously saved by the user.</i>	
<i>UserSet 2</i>	<i>UserSet2</i>	<i>Select the User Defined Configuration space UserSet 2 to save to or load from features settings previously saved by the user.</i>	
<i>UserSet 3</i>	<i>UserSet3</i>	<i>Select the User Defined Configuration space UserSet 3 to save to or load from features settings previously saved by the user.</i>	
<i>UserSet 4</i>	<i>UserSet4</i>	<i>Select the User Defined Configuration space UserSet 4 to save to or load from features settings previously saved by the user.</i>	

Display Name	Feature & Values	Description	Standard & View
Load Configuration	UserSetLoad	Loads the camera configuration set specified by the User Set Selector feature, to the camera and makes it active. (W)	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)	Beginner
Device ID	DeviceID	Displays the device's factory set serial number.	Invisible
Calibration Date	deviceCalibrationDateRaw	Date when the camera was calibrated.	Invisible DFNC
Device Acquisition Type  <i>Sensor</i>	deviceAcquisitionType  <i>Sensor</i>	Displays the Device Acquisition Type of the product. (RO)  <i>The device gets its data directly from a sensor.</i>	Invisible DFNC
Device TL Type  <i>GigE Vision</i>	DeviceTLType  <i>GigEVision</i>	Transport Layer type of the device.  <i>GigE Vision Transport Layer</i>	Invisible
Device TL Version Major	DeviceTLVersionMajor	Major version of the device's Transport Layer.	Invisible
Device TL Version Minor	DeviceTLVersionMinor	Minor version of the device's Transport Layer.	Invisible
Power-up Configuration Selector  <i>None Factory Setting  UserSet1 to UserSet4</i>	UserSetDefaultSelector  <i>None Default  UserSet1 to UserSet4</i>	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)  <i>Keep Internal configuration. Select the Factory Setting values as the Power-up Configuration. Select the user defined configuration as the Power-up Configuration.</i>	Invisible
DFNC Major Rev	deviceDFNCVersionMajor	Major revision of Dalsa Feature Naming Convention which was used to create the device's XML. (RO)	Invisible DFNC
DFNC Minor Rev	deviceDFNCVersionMinor	Minor revision of Dalsa Feature Naming Convention which was used to create the device's XML. (RO)	Invisible DFNC
SFNC Major Rev	DeviceSFNCVersionMajor	Major Version of the Standard Features Naming Convention which was used to create the device's XML. (RO)	Invisible
SFNC Minor Rev	DeviceSFNCVersionMinor	Minor Version of the Standard Features Naming Convention which was used to create the device's XML. (RO)	Invisible
SFNC SubMinor Rev	DeviceSFNCVersionSubMinor	Subminor Version of the Standard Features Naming Convention which was used to create the device's XML. (RO)	Invisible

# Sensor Control Category

The Linea Lite GigE Sensor Control category groups sensor specific features. This group includes controls for line rate, exposure time, etc.

The screenshot shows a window titled "Parameters - Visibility: Guru" with a tree view on the left and a parameter list on the right. The "Sensor Control" category is selected in the tree view. The parameter list on the right contains the following data:

Parameter	Value
Device Scan Type	Linescan
Sensor Color Type	Bayer Sensor
Input Pixel Size	12 Bits/Pixel
Sensor Width	4096
Sensor Height	1
Line Spatial Correction	0.0
Acquisition Line Rate (in Hz)	3000
Measured Line Rate	3290
Exposure Mode	Timed
Exposure Delay (in us)	Not Enabled
Row Two Exposure Delay	Not Enabled
Exposure Time Selector	All
Exposure Time (in us)	299.0
Direction Source	Internal
Internal Scan Direction	Forward
Gain Selector	Digital
Gain	1.0
Black Level Selector	Digital
Black Level (in DN)	0
Parallax Correction Line Selector	Red_Blue
Parallax Correction Pixel Stretch	0.0
Color Interpolation	Enhanced

Figure 71: CamExpert – Sensor Control Category

## Sensor Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Standard & View
	Device Scan Type <i>Linescan</i>	DeviceScanType <i>Linescan</i>	Scan type of the sensor. < RO > <i>1D line scan sensor.</i>	Beginner
	Sensor Color Type <i>Monochrome Sensor</i>	sensorColorType <i>Monochrome</i>	Defines the camera sensor color type. < RO > <i>Sensor color type is monochrome.</i>	Beginner DFNC
	<i>Bayer Sensor</i>	<i>CFA_Bayer</i>	<i>Sensor color type is Bayer Color Filter Array (CFA).</i>	
	Input Pixel Size <i>12 Bits/Pixel</i>	pixelSizeInput <i>Bpp12</i>	Size of the image input pixels, in bits per pixel. < RO > <i>Sensor output data path is 12-bits per pixel.</i>	Guru DFNC
	Sensor Width	SensorWidth	Defines the sensor width in active pixels. < RO >	Expert
	Sensor Height	SensorHeight	Defines the sensor height in active lines. < RO >	Expert

B/W Color	Display Name	Feature & Values	Description	Standard & View
	<u>Sensor TDI Mode</u>	sensorTDIModeSelection	Selects how to combine the rows for processing.	Beginner DFNC
	<p>Single Row High Sensitivity</p> <p>High SNR</p> <p>High Dynamic Range</p> <p>Multi-Row</p> <p>4K Single Row 8k SR, High-BW</p>	<p>TdiOff</p> <p>TdiSum</p> <p>TdiAvg</p> <p>TdiHdr</p> <p>TdiMultiLine</p> <p>TdiOff</p> <p>TdiHSR</p>	<p>A single sensor row is output per line trigger.</p> <p>Multiple sensor rows are synchronized and summed together in the camera to increase the camera responsivity. (Not available in 8k SR model)</p> <p>Multiple sensor rows are synchronized and averaged together in the camera to increase the signal to noise ratio. (Not available in 8k SR model)</p> <p>Multiple sensor rows with independent exposure times are synchronized and combined. This mode can be used to produce a high dynamic range demonstration image with enhanced contrast in dark image regions. (Not available in 8k SR model)</p> <p>Two sensor rows are synchronized and output per input line trigger. This enables processing of the synchronized image rows by the host system. The output image frame will consist of alternating sensor rows starting with row one.</p> <p>A single sensor row is output per line trigger.</p> <p>8k Super Resolution – High Bandwidth, using a host-side driver. (8k SR model only)</p>	
	TDI Stages	sensorTDIStagesSelection	Selects the number of rows to sum / average in TDI.	Beginner DFNC
	<p>1</p> <p>2</p>	<p>Row1</p> <p>Rows2</p>	<p>Single row.</p> <p>Two rows summed/averaged together.</p>	
	Line Spatial Correction	sensorLineSpatialCorrection	<p>Sets one line of delay between two sensor lines from the sensor for Spatial Correction. Stop acquisition to change.</p> <p>On Off</p>	<p>Beginner DFNC</p> <p>On Off</p> <p>Turn on spatial correction. Turn off spatial correction.</p>
	Acquisition Line Rate	AcquisitionLineRate	Specifies the camera internal line rate, in Hz.	Beginner
	Measured Line Rate	measureLineRate	Actual sensor line rate output.	Beginner DFNC
	<u>Exposure Mode</u>	ExposureMode	<p>Sets the operation mode for the camera's exposure.</p> <p>Timed</p> <p>Trigger Width</p>	Beginner
	<p>Timed</p> <p>Trigger Width</p>	<p>Timed</p> <p>TriggerWidth</p>	<p>The exposure duration time is set using the <u>Exposure Time</u> feature and the exposure starts with a LineStart event.</p> <p>Uses the width of the trigger signal pulse to control the exposure duration. Use the Trigger Activation feature to set the polarity of the trigger. The Trigger Width setting is applicable when the LineStart trigger is enabled and a signal is selected as trigger source.</p>	
	Exposure Delay (in $\mu$ s)	exposureDelay	Specifies the delay, in $\mu$ s, to apply after the LineStart event before starting the ExposureStart event. Available when Exposure Mode is Timed.	Beginner DFNC
	Row Two Exposure Delay	rowTwoExposureDelay	<p>Sets the exposure delay for the second sensor row. This feature is available for 2k and 4k color cameras.</p> <p>Delayed by 50%</p> <p>Delayed by 15 <math>\mu</math>s</p>	Beginner DFNC
	<p>Delayed by 50%</p> <p>Delayed by 15 <math>\mu</math>s</p>	<p>Delay050</p> <p>Delay15</p>	<p>Delay by 50% of previous exposure.</p> <p>Delay exposure by ~15 <math>\mu</math>s (sensor readout).</p>	
	Exposure Time Selector	exposureTimeSelector	<p>Selects which row exposure time is accessed.</p> <p>All</p> <p>Row 1</p> <p>Row 2</p>	Beginner DFNC
	<p>All</p> <p>Row 1</p> <p>Row 2</p>	<p>All</p> <p>Row1</p> <p>Row2</p>	<p>Exposure time applied to all channels.</p> <p>Exposure time (set elsewhere) applied to the second physical row in the sensor.</p> <p>Exposure time (set elsewhere) applied to the second physical row in the sensor.</p>	
	Exposure Time (in $\mu$ s)	ExposureTime	<p>Sets the exposure time, in <math>\mu</math>s, when the Exposure Mode feature is set to Timed.</p> <p>All</p>	Beginner
	All	All	Exposure time applies to all channels.	

B/W Color	Display Name	Feature & Values	Description	Standard & View
	Direction Source  <i>Internal RotaryEncoder</i>  <i>Line 1</i> <i>Line 2</i> <i>Line 3</i>	sensorScanDirectionSource  <i>Internal Encoder</i>  <i>GPIO1</i> <i>GPIO2</i> <i>GPIO3</i>	Specifies whether scan direction is controlled by a feature or external signal.  <i>Internal Scan Direction</i> feature. <i>Rotary encoder. Channel A and B from encoder go to GPIO 1 and GPIO 2, respectively. Direction is determined from phase.</i>  <i>Available when <u>Trigger Source</u> is Encoder and <u>Rotary Encoder Output Mode</u> is Motion (see I/O Control category).</i>  <i>Pin 1 (Low: forward, high: reverse). Available when <u>Trigger Source</u> is not Rotary Encoder.</i>  <i>Pin 3 (Low: forward, high: reverse). Available when <u>Trigger Source</u> is not Rotary Encoder.</i>  <i>Pin 6 (Low: forward, high: reverse). Available when <u>Trigger Source</u> is not Rotary Encoder.</i>	Beginner DFNC
	Internal Scan Direction  <i>Forward</i> <i>Reverse</i>	sensorScanDirection  <i>Forward</i> <i>Reverse</i>	Specifies the scan direction when <u>Direction Source</u> is set to Internal,  <i>Forward scan direction.</i>  <i>Revers scan direction.</i>	Beginner DFNC
    	Gain Selector  <i>Digital</i>  <i>Sensor Analog</i>  <i>Digital Row 1</i>  <i>Digital Row 2</i>  <i>Digital Red</i>  <i>Digital Blue</i>  <i>Digital Green</i>	GainSelector  <i>DigitalAll</i>  <i>SensorAnalog</i>  <i>DigitalRow1</i>  <i>DigitalRow2</i>  <i>DigitalRed</i>  <i>DigitalBlue</i>  <i>DigitalGreen</i>	Selects which gain is controlled when adjusting gain features.  <i>Apply a digital gain adjustment to the entire image. Gain applied after row gains.</i>  <i>Final digital gain = (Row gain * Digital gain)</i>  <i>Sensor analog gain. Possible values are 0.6 -1.</i>  <i>Gain applied to first sensor row.</i>  <i>Available only when <u>Sensor TDI Mode</u> is High Dynamic Range or Multi-Row.</i>  <i>Gain applied to second sensor row.</i>  <i>Available only when <u>Sensor TDI Mode</u> is High Dynamic Range or Multi-Row.</i>  <i>Gain applied to red channel. Available for color models only.</i>  <i>Gain applied to blue channel. Available for color models only.</i>  <i>Gain applied to green channel. Available for color models only.</i>	Beginner
	<u>Gain</u>	Gain	Sets the selected gain as an amplification factor applied to the image.	Beginner
	Black Level Selector  <i>Digital</i>	BlackLevelSelector  <i>DigitalAll</i>	Selects which black level is controlled by the various Black Level features.  <i>Digital.</i>	Beginner
	<u>Black Level</u>	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.	Expert
	Parallax Correction Pixel Stretch	imageDistortionParallaxCorrection PixelStretch	Sets the parallax correction value of the selected line.	Beginner DFNC
	Parallax Correction Line Selector  <i>Red_Blue</i> <i>Green</i>	imageDistortionParallaxCorrection Selector  <i>Red_Blue</i> <i>Green</i>	Selects the line on which to apply parallax correction.  <i>Red and blue line.</i>  <i>Green line.</i>	
	Color Interpolation  <i>Basic</i>  <i>Enhanced</i>	colorInterpolation  <i>Basic</i>  <i>Enhanced</i>	Selects the color interpolation method for the red-blue row when performed in camera.  <i>Missing red and blue pixel information is copied from neighbouring pixel.</i>  <i>Red and blue pixel information is interpolated from green pixel variation in addition to neighbouring pixels. This removes color fringing artifacts caused by edges occurring in interpolated pixels.</i>	Beginner DFNC

# I/O Controls Category

The Linea Lite GigE I/O Controls category group features used to configure external inputs and acquisition actions based on those inputs, plus camera output signals to other devices. For more information on using triggers for acquisition see the [Acquiring Images: Triggering the Camera](#) section.

Category	Parameter	Value
Camera Information	Trigger Selector	Single Line Trigger(Start)
Sensor Control	Trigger Mode	On
I/O Controls	Trigger Frames Count	Not Enabled
	Software Trigger	Not Enabled
Counter and Timer Control	Trigger Source	Rotary Encoder
	Trigger Input Line Activation	Not Enabled
<input checked="" type="checkbox"/> <b>Advanced Processing</b>	Trigger Delay (in us)	Not Enabled
Image Format Controls	Rotary Encoder Output Mode	Motion
<input checked="" type="checkbox"/> <b>Metadata Controls</b>	Rotary Encoder Direction	Not Enabled
Acquisition and Transfer Control	Rotary Encoder Input A Source	Line 1
Action Control	Rotary Encoder Input B Source	Line 2
<input checked="" type="checkbox"/> <b>Event Control</b>	Rotary Encoder Source Activation	Rising Edge
GigE Vision Transport Layer	Rotary Encoder Rescaler Order	Multiplier Divider
File Access Control	Rotary Encoder Multiplier	1
GigE Vision Host Controls	Rotary Encoder Divider	1
	Rotary Encoder Position	Input A ahead B
	Line Selector	Line 4
	Line Format	RS422
	Line Mode	Output
	Line Status	False
	Line Inverter	False
	Input Line Detection Level	Not Enabled
	Input Line Debouncing Period (in us)	Not Enabled
	Line Electrical Termination	Not Enabled
	Output Line Source	Pulse on: Start of Line
	Output Line Pulse Signal Activation	Not Enabled
	Output Line Pulse Delay	0
	Output Line Pulse Duration	1
	Output Line Value	Not Enabled
	Line Status All	0x0000000000000003
	Output Line Software Command	0
	<< Less	

Figure 72: CamExpert – I/O Controls Category

# I/O Control Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Trigger Selector	TriggerSelector	Selects which type of trigger to configure with the various Trigger features.	Beginner
<i>Single Line Trigger (Start)</i>	<i>LineStart</i>	<i>Selects a trigger starting the capture of a single line.</i>	
<i>Single Frame Trigger(Start)</i>	<i>FrameStart</i>	<i>Selects a trigger starting the capture of a single frame. Frame size is determined by image format feature "Height".</i>	
<i>MultiFrame Trigger(Start)</i>	<i>FrameBurstStart</i>	<i>Selects a trigger to capture multiple frames. The number of frames is specified by the <a href="#">Trigger Frame Count</a> feature.</i>	
<i>Frame Active</i>	<i>FrameActive</i>	<i>Selects a trigger to capture an active frame.</i>	
<i>Frame Burst Active</i>	<i>FrameBurstActive</i>	<i>Selects a trigger to capture an active frame.</i>	
<u>Trigger Mode</u>	TriggerMode	Controls the enable state of the selected trigger.	Beginner
<i>Off</i>	<i>Off</i>	<i>The selected trigger is turned off.</i>	
<i>On</i>	<i>On</i>	<i>The selected trigger is active.</i>	
Trigger Frames Count	triggerFrameCount	Sets the maximum number of frames to acquire when a valid trigger is received. This feature is available when the <a href="#">Trigger Selector</a> = MultiFrame Trigger(Start).	Beginner DFNC
Software Trigger	TriggerSoftware	Only available with Single Frame Trigger(Start) or MultiFrame Trigger(Start). Generate a software command internal trigger immediately no matter what the <a href="#">Trigger Source</a> feature is set to.	Beginner
Trigger Source	TriggerSource	Specifies the internal signal or physical input line to use as the trigger source. The selected trigger must have its <a href="#">Trigger Mode</a> set to ON. Note, source availability may depend on the <a href="#">Trigger Selector</a> setting. See <a href="#">Input Signals Electrical Specifications</a> .	Beginner
<i>Line 1</i>	<i>Line1</i>	<i>Select Line 1 (and associated I/O control block) to use as the external trigger source. See <a href="#">Line Selector</a> feature for complete list.</i>	
<i>Line 2</i>	<i>Line2</i>	<i>Select Line 2 (and associated I/O control block) to use as the external trigger source. See <a href="#">Line Selector</a> feature for complete list.</i>	
<i>Line 3</i>	<i>Line3</i>	<i>Select Line 3 (and associated I/O control block) to use as the external trigger source. See <a href="#">Line Selector</a> feature for complete list.</i>	
<i>Rotary Encoder</i>	<i>rotaryEncoder1</i>	<i>Select Rotary Encoder to use as the external line trigger source. (Available for LineStart trigger.)</i>	
<i>Timer1End Event</i>	<i>Timer1End</i>	<i>Select the Timer1End Event as the internal trigger source. (Available for Single Frame and MultiFrame triggers.)</i>	
<i>Counter1End Event</i>	<i>Counter1End</i>	<i>Select the Counter1End Event as the internal trigger source. (Available for Single Frame and MultiFrame triggers.)</i>	
<i>Timer1 Active</i>	<i>Timer1Active</i>	<i>Select Timer1 as trigger source. The trigger will be activated when the timer is running.</i>	
<i>Counter1 Active</i>	<i>Counter1Active</i>	<i>Select Counter1 as trigger source. The trigger will be activated when the counter is running.</i>	
<i>Timestamp Modulo Event</i>	<i>timestampModuloEvent</i>	<i>Select the Timestamp Modulo Event as the internal trigger source.</i>	
<i>Action 1</i>	<i>Action1</i>	<i>Select the GigE Vision Action Command 1 as the internal trigger source. This is a broadcast command that multiple devices can respond to simultaneously. (Available for Single Frame and MultiFrame triggers.)</i>	
<i>Action 2</i>	<i>Action2</i>	<i>Select the GigE Vision Action Command 2 as the internal trigger source. This is a broadcast command that multiple devices can respond to simultaneously. (Available for Single Frame and MultiFrame triggers.)</i>	
Trigger Input Line Activation	TriggerActivation	Select the activation mode for the selected Input Line trigger source. This is applicable only for external line input lines.	Beginner
<i>Rising Edge</i>	<i>RisingEdge</i>	<i>The trigger is considered valid on the rising edge of the line source signal (after any processing by the line inverter module).</i>	
<i>Falling Edge</i>	<i>FallingEdge</i>	<i>The trigger is considered valid on the falling edge.</i>	
<i>Any Edge</i>	<i>AnyEdge</i>	<i>The trigger is considered valid on any edge.</i>	
Trigger Delay	TriggerDelay	Specifies the delay to apply after receiving the trigger and before activating <i>triggerEvent</i> . The delay can be set in microseconds.	Beginner

Display Name	Feature & Values	Description	Standard & View
Rotary Encoder Output Mode  <i>Position</i>  <i>Motion</i>	rotaryEncoderOutputMode  <i>Position</i>  <i>Motion</i>	Specifies the conditions for the Rotary Encoder interface to generate a valid Encoder output signal.  <i>On the camera, the "position" behaviour exists, but the number of counts is small (7-bits / 128 counts). The encoder can reverse for 256 ticks and then go forward and behave as expected for "position" style behaviour. If the user exceeds 256 ticks, the count will max out, but will not reset. When the user starts going forward again, 256 lines will be dropped / ignored and then resume output.</i>  <i>The triggers are generated for all motion increments in either direction.</i>	Expert DFNC
Rotary Encoder Direction  <i>Clockwise</i>  <i>Counter Clockwise</i>	rotaryEncoderDirection  <i>Clockwise</i>  <i>CounterClockwise</i>	Specifies the phase which defines the encoder forward direction.  <i>Inspection goes forward when the rotary encoder direction is clockwise (phase B is ahead of phase A).</i>  <i>Inspection goes forward when the rotary encoder direction is counter clockwise (phase A is ahead of phase B).</i>	Expert DFNC
Rotary Encoder Input A Source  <i>Line 1</i> <i>Line 3</i>	rotaryEncoderInputASource  <i>Line1</i> <i>Line3</i>	Selects which input line to assign to the rotary encoder input A (also known as shaft encoder). Note that the Line Mode feature must be set to Input. The list of supported input line sources is device-specific.  <i>Line 1 is assigned to the Rotary Encoder Input A.</i>  <i>Line 3 is assigned to the Rotary Encoder Input A.</i>	Expert DFNC
Rotary Encoder Input B Source  <i>GND</i> <i>Line 2</i>	rotaryEncoderInputBSource  <i>GND</i> <i>Line2</i>	Selects which input line to assign to the rotary encoder input B (also known as shaft encoder). Note that the Line Mode feature must be set to Input. The list of supported input line sources is device-specific.  <i>Rotary Encoder Input B is not used</i>  <i>Line 2 is assigned to the Rotary Encoder Input B</i>	Expert DFNC
Rotary Encoder Source Activation  <i>Rising Edge</i> <i>Any Edge</i>	rotaryEncoderSrcActivation  <i>RisingEdge</i> <i>AnyEdge</i>	Specifies the signal edge(s) use to increment the rotary encoder.  <i>The rotary encoder uses the rising edge of the source signal.</i>  <i>The rotary encoder uses either the rising edge or falling edge of the source signal.</i>	Expert DFNC
Rotary Encoder Rescaler Order  <i>Multiplier Divider</i> <i>Divider Multiplier</i>	rotaryEncoderRescalerOrder  <i>multiplierDivider</i> <i>dividerMultiplier</i>	Specifies the order that the multiplier and divider are applied.  <i>The signal is multiplied before been divided.</i>  <i>The signal is divided before been multiplied.</i>	Guru DFNC
Rotary Encoder Multiplier	rotaryEncoderMultiplier	Specifies a multiplication factor for the rotary encoder output pulse generator.	Beginner DFNC
Rotary Encoder Divider	rotaryEncoderDivider	Specifies a division factor for the rotary encoder output pulse generator.	Beginner DFNC
Rotary Encoder Position  <i>Input A ahead B</i> <i>Input B ahead A</i>	rotaryEncoderPosition  <i>SrcA</i> <i>SrcB</i>	Displays the relative positions of rotary encoder inputs A and B.  <i>Input A is ahead of Input B.</i>  <i>Input B is ahead of Input A.</i>	Guru DFNC
Line Selector  <i>Line 1</i> <i>Line 2</i> <i>Line 3</i> <i>Line 4</i> <i>Line 5</i>	LineSelector  <i>Line1</i> <i>Line2</i> <i>Line3</i> <i>Line4</i> <i>Line5</i>	Selects the physical line (or pin) of the external device connector to configure.  <i>Index of the physical line and associated I/O control block to use. Pin 1 and Pin 2 is the RS-422 Input Port 1+, 1-, respectively.</i>  <i>Index of the physical line and associated I/O control block to use. Pin 3 and Pin 4 is the RS-422 Input Port 2+ and 2-, respectively.</i>  <i>Index of the physical line and associated I/O control block to use. Pin 6 and Pin 7 is the Port 3+ and 3-, respectively.</i>  <i>Index of the physical line and associated I/O control block to use. Pin 11 and Pin 12 is Output Port 4+ and 4-, respectively.</i>  <i>Index of the physical line and associated I/O control block to use. Pin 13 and Pin 14 is the Output Port 5+ and 5-, respectively.</i>	Beginner
Line Format  <i>RS422</i> <i>Open Collector</i>	LineFormat  <i>RS422</i> <i>OpenCollector</i>	Specify the current electrical format of the selected physical input or output. Applies to all physical lines. (RO)  <i>The line accepts or sends RS422 level signals.</i>  <i>The line is an output line configured as an open collector.</i>	Expert

Display Name	Feature & Values	Description	Standard & View
Line Mode	LineMode  <i>Input</i> <i>Output</i>	Reports if the physical Line is an Input or Output signal. (RO) See <a href="#">Input Signals Electrical Specifications</a> and <a href="#">Output Signals Electrical Specifications</a> .  <i>The line is an input line.</i> <i>The line is an output line.</i>	Expert
Line Status	LineStatus  <i>False / True</i>	Returns the current status of the selected input or output line. (RO)	Expert
Line Inverter	LineInverter  <i>False / True</i>	Controls whether to invert the polarity of the selected input or output line signal.	Beginner
Input Line Detection Level	lineDetectionLevel  <i>Threshold for TTL</i>	Specifies the voltage threshold required to recognize a signal transition on an input line.  <i>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.</i>	Expert DFNC
Input Line Debouncing Period (in $\mu$ s)	lineDebouncingPeriod	Specifies the minimum delay before an input line voltage transition is recognized as a signal transition.	Beginner DFNC
Line Electrical Termination	lineElectricalTermination  <i>Disabled</i> <i>Enabled</i>	Controls if the electrical termination of both Line 1 and 2 is enabled or disabled.  <i>Line termination is disabled.</i> <i>Line termination is enabled.</i>	Expert DFNC
<u>Output Line Source</u>	outputLineSource	Selects which internal signal or event driven pulse or software control state to output on the selected line. Note, the <a href="#">Line Mode</a> feature must be set to Output. The List of supported output line sources is product-specific. The <a href="#">Event Control</a> section provides details and timing diagrams for the supported trigger modes.	Beginner DFNC
<i>Off</i>	<i>Off</i>	<i>Line output is Open</i>	
<i>Software Controlled</i>	<i>SoftwareControlled</i>	<i>The <a href="#">Output Line Value</a> feature changes the state of the output</i>	
<i>Pulse on: Start of Line</i>	<i>PulseOnStartofLine</i>	<i>Generate a pulse on the start of the Line Active</i>	
<i>Pulse on: Rejected Line Trigger</i>	<i>PulseOnInvalidLineTrigger</i>	<i>Generate a pulse on the Invalid LineTrigger event.</i>	
<i>Pulse on: Start of Acquisition</i>	<i>PulseOnStartofAcquisition</i>	<i>Generate a pulse when the AcquisitionStart event occurs.</i>	
<i>Pulse on: End of Acquisition</i>	<i>PulseOnEndofAcquisition</i>	<i>Generate a pulse when the AcquisitionStop event occurs.</i>	
<i>Pulse on: Start of Frame</i>	<i>PulseOnStartofFrame</i>	<i>Generate a pulse on the start of the Frame Active event</i>	
<i>Pulse on: Input 1 Signal</i>	<i>PulseOnInput1</i>	<i>Generate a pulse on the Input signal 1 pulse.</i>	
<i>Pulse on: Input 2 Signal</i>	<i>PulseOnInput2</i>	<i>Generate a pulse on the Input signal 2 pulse.</i>	
<i>Pulse on: Input 3 Signal</i>	<i>PulseOnInput3</i>	<i>Generate a pulse on the Input signal 3 pulse.</i>	
<i>Pulse on: Action 1</i>	<i>PulseOnAction1</i>	<i>Generate a pulse on the GigEVision Action Command 1.</i>	
<i>Pulse on: Action 2</i>	<i>PulseOnAction2</i>	<i>Generate a pulse on the GigEVision Action Command 2.</i>	
<i>Pulse on: Start of Exposure</i>	<i>PulseOnStartofExposure</i>	<i>Generate a pulse on the Exposure Start event. This option is typically used to trigger a strobe light.</i>	
<i>Pulse on: End of Exposure</i>	<i>PulseOnEndofExposure</i>	<i>Generate a pulse on the Exposure End event. This option is typically used to trigger a strobe light.</i>	
<i>Pulse on: Start of Line 1 Exposure</i>	<i>PulseOnStartofExposure</i>	<i>Generate a pulse on the Exposure Start event. This option is typically used to trigger a strobe light.</i>	
<i>Pulse on: End of Line 1 Exposure</i>	<i>PulseOnEndofExposure</i>	<i>Generate a pulse on the Exposure End event. This option is typically used to trigger a strobe light.</i>	
<i>Pulse on: Start of Line 2 Exposure</i>	<i>PulseOnStartofExposure</i>	<i>Generate a pulse on the Exposure Start event. This option is typically used to trigger a strobe light.</i>	
<i>Pulse on: End of Line 2 Exposure</i>	<i>PulseOnEndofExposure</i>	<i>Generate a pulse on the Exposure End event. This option is typically used to trigger a strobe light.</i>	
<i>Pulse on: Valid Frame Trigger</i>	<i>PulseOnValidFrameTrigger</i>	<i>Generate a pulse on the FrameTrigger event.</i>	
<i>Pulse on: Invalid Frame Trigger</i>	<i>PulseOnInvalidFrameTrigger</i>	<i>Generate a pulse on the Invalid FrameTrigger event.</i>	
<i>Pulse on: End of Timer 1</i>	<i>PulseOnTimer1End</i>	<i>Generate a pulse on the TimerEnd 1 event.</i>	
<i>Pulse on: Valid Line Trigger</i>	<i>PulseOnValidLineTrigger</i>	<i>Generate a pulse on the LineTrigger event.</i>	
<i>Pulse on: End of Counter 1</i>	<i>PulseOnCounter1End</i>	<i>Generate a pulse on the CounterEnd 1 event.</i>	
<i>Pulse on: Software Command</i>	<i>PulseOnSoftwareCmd</i>	<i>Generate a pulse on the Input of a Software Command.</i>	
<i>Exposure Active</i>	<i>ExposureActive</i>	<i>Generate a signal that is active when the Exposure is active.</i>	
<i>Line1 Exposure Active</i>	<i>Line1ExposureActive</i>	<i>Generate a signal that is active when the Line1 Exposure is active.</i>	



# I/O Module Block Diagram

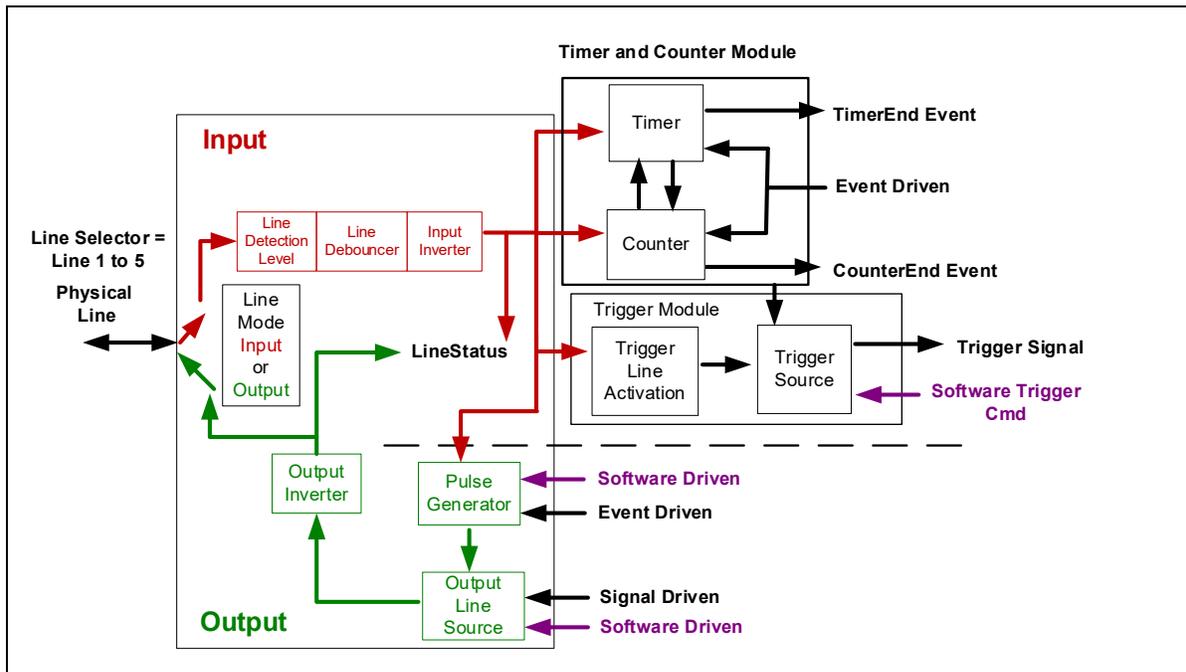


Figure 73: I/O Module Block Diagram

# Counter and Timer Control Category

The Linea Lite GigE Counter and Timer Control category groups parameters used to configure acquisition counters, timers and signal edge detection.

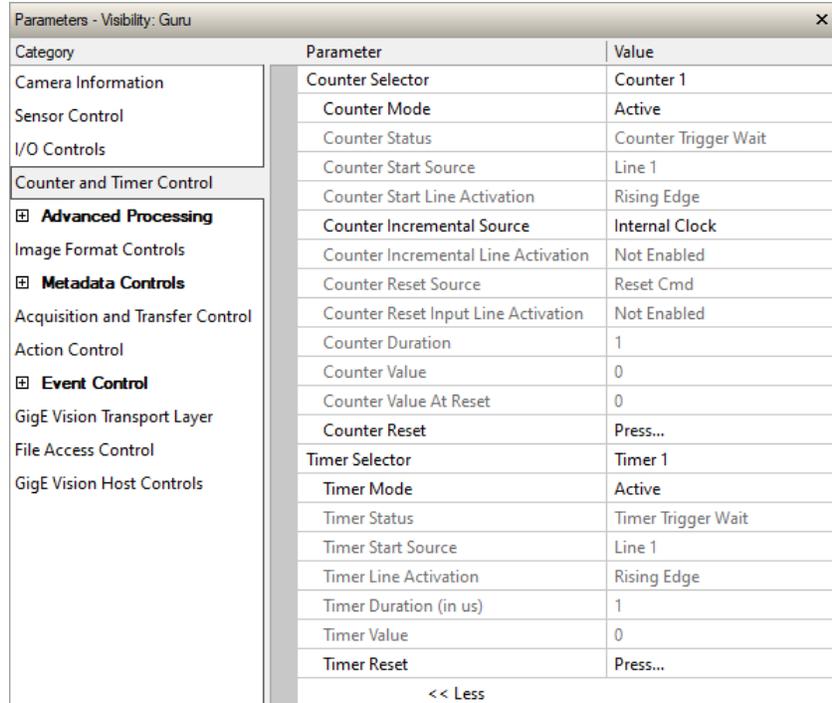


Figure 74: CamExpert – Counter and Timer Control Category

## Counter and Timer Control Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Counter Selector <i>Counter 1</i>	counterSelector <i>Counter1</i>	Selects the counter to configure. <i>Select counter 1.</i>	Expert DFNC
Counter Mode <i>Off</i> <i>Active</i>	counterMode <i>Off</i> <i>Active</i>	Selects the counter mode. The selected Counter is either Active or Disabled. When Disabled, the Counter can be configured. <i>The selected Counter is Disabled.</i> <i>The selected Counter is Enabled.</i>	Expert DFNC
Counter Status <i>Counter Idle</i> <i>Counter Trigger Wait</i> <i>Counter Active</i> <i>Counter Completed</i> <i>Counter Overflow</i>	counterStatus <i>CounterIdle</i> <i>CounterTriggerWait</i> <i>CounterActive</i> <i>CounterCompleted</i> <i>CounterOverflow</i>	Returns the current state of the counter. (RO) <i>The counter is idle.</i> <i>The CounterStartSource feature is set to off.</i> <i>The counter is waiting for a start trigger.</i> <i>The counter is counting for the specified duration.</i> <i>The counter reached the <u>Counter Duration</u> count.</i> <i>The counter reached its maximum possible count.</i>	Expert DFNC



Display Name	Feature & Values	Description	Standard & View
Counter Reset Source <i>Reset Cmd</i> <i>Acquisition Start</i> <i>Acquisition End</i> <i>Exposure Start</i> <i>Exposure End</i> <i>Frame Trigger</i> <i>Valid Frame Trigger</i> <i>Rejected Frame Trigger</i> <i>Line 1</i> <i>Line 2</i> <i>Timer 1 End</i> <i>Counter 1 End</i>	counterResetSource  <i>Off</i> <i>AcquisitionStart</i> <i>AcquisitionEnd</i> <i>ExposureStart</i> <i>ExposureEnd</i> <i>FrameStart</i> <i>ValidFrameTrigger</i> <i>InvalidFrameTrigger</i> <i>Line1</i> <i>Line2</i> <i>Timer1End</i> <i>Counter1End</i>	Selects the signal source to reset the counter then waits for the next countStartSource signal or event.  <i>Reset on reception of the Reset lcommand.</i> <i>Reset on reception of the Acquisition Start.</i> <i>Reset on reception of the Acquisition End.</i> <i>Reset on reception of the Exposure Start event.</i> <i>Reset on reception of the Exposure End event.</i> <i>Reset on reception of the Frame Trigger (valid or invalid) event.</i> <i>Reset on reception of the Valid Frame Trigger event.</i> <i>Reset on reception of the Invalid Trigger event.</i> <i>Reset counter on the specified transition on line 1. See <a href="#">Input Signals Electrical Specifications</a>.</i> <i>Reset counter on the specified transition on line 2.</i> <i>Reset on reception of the Timer 1 End.</i> <i>Reset on the reception of the Counter 1 end.</i>	Expert DFNC
Counter Reset Input Line Activation  <i>Rising Edge</i> <i>Falling Edge</i> <i>Any Edge</i>	counterResetLineActivation  <i>RisingEdge</i> <i>FallingEdge</i> <i>AnyEdge</i>	Specify the edge transition on the selected line that will reset the selected counter.  <i>Reset counter on rising edge of the selected signal.</i> <i>Reset counter on falling edge of the selected signal.</i> <i>Reset counter on the falling or rising edge of the selected signal.</i>	Expert DFNC
Counter Duration	counterDuration	Sets the duration (or number of events) before the CounterEnd event is generated.	Expert DFNC
Counter Value	counterValue	Read the current value of the selected counter. (RO)	Expert DFNC
Counter Value At Reset	counterValueAtReset	Reads the value of the selected counter when it was reset by a trigger or by an explicit Counter Reset command. (RO)	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. (WO)	Expert DFNC
Timer Selector  <i>Timer 1</i>	timerSelector  <i>Timer1</i>	Selects which timer to configure.  <i>Configure Timer 1.</i>	Expert DFNC
Timer Mode  <i>Off</i> <i>Active</i>	timerMode  <i>Off</i> <i>Active</i>	Select the timer mode. The selected Timer is Active or Disabled. When Disabled, the Timer can be configured.  <i>The selected Timer is Disabled.</i> <i>The selected Timer is Enabled.</i>	Expert DFNC
Timer Status  <i>Timer Idle</i>  <i>Timer Trigger Wait</i> <i>Timer Delaying</i> <i>Timer Active</i> <i>Timer Completed</i>	timerStatus  <i>TimerIdle</i>  <i>TimerTriggerWait</i> <i>TimerDelaying</i> <i>TimerActive</i> <i>TimerCompleted</i>	Returns the current state of the timer. (RO)  <i>The timer is idle. The CounterStartSource feature is set to off.</i> <i>The timer is waiting for a start trigger.</i> <i>The timer is counting the requested delay.</i> <i>The timer is counting for the specified duration.</i> <i>The timer reached the TimerDuration count.</i>	Expert DFNC

Display Name	Feature & Values	Description	Standard & View
Timer Start Source	timerStartSource	Select the trigger source to start the timer. The <a href="#">Event Control section</a> provides details and timing diagrams for the supported events.	Expert DFNC
<i>TimerReset Cmd</i>	<i>Off</i>	<i>Starts with the reception of the TimerReset Icommand.</i>	
<i>Acquisition Start</i>	<i>AcquisitionStart</i>	<i>Start Timer on Acquisition Start event.</i>	
<i>Acquisition End</i>	<i>AcquisitionEnd</i>	<i>Start Timer on Acquisition End event.</i>	
<i>Exposure Start</i>	<i>ExposureStart</i>	<i>Start Timer on Exposure Start event.</i>	
<i>Exposure End</i>	<i>ExposureEnd</i>	<i>Start Timer on Exposure End event.</i>	
<i>Frame Start</i>	<i>FrameStart</i>	<i>Start Timer on Frame Start event.</i>	
<i>Frame Trigger</i>	<i>ValidFrameTrigger</i>	<i>Start Timer on Valid Frame Trigger event.</i>	
<i>Invalid Trigger</i>	<i>InvalidTrigger</i>	<i>Start Timer on Invalid Trigger event.</i>	
<i>Line 1</i>	<i>Line1</i>	<i>Start Timer on a transition of I/O Line 1 event. See <a href="#">Input Signals Electrical Specifications</a>.</i>	
<i>Line 2</i>	<i>Line2</i>	<i>Start Timer on a transition of I/O Line 2 event.</i>	
<i>Line 3</i>	<i>Line3</i>	<i>Start Timer on a transition of I/O Line 3 event.</i>	
<i>Timer 1 End</i>	<i>Timer1End</i>	<i>Start Timer on Timer 1 End event.</i>	
<i>Counter 1 End</i>	<i>Counter1End</i>	<i>Start Timer on Counter 1 End event.</i>	
Timer Line Activation	timerStartLineActivation	Select the trigger activation mode which starts the timer.	Expert DFNC
<i>Rising Edge</i>	<i>RisingEdge</i>	<i>Starts counter on rising edge of the selected signal.</i>	
<i>Falling Edge</i>	<i>FallingEdge</i>	<i>Starts counter on falling edge of the selected signal.</i>	
<i>Any Edge</i>	<i>AnyEdge</i>	<i>Starts counter on the falling or rising edge of the selected signal.</i>	
Timer Duration (in $\mu$ s)	timerDuration	Sets the duration (in microseconds) of the timer pulse.	Expert DFNC
Timer Value	timerValue	Reads the current value (in microseconds) of the selected timer.	Expert DFNC
Timer Reset	timerReset	Resets the timer to 0.	Expert DFNC

## Counter and Timer Group Block Diagram

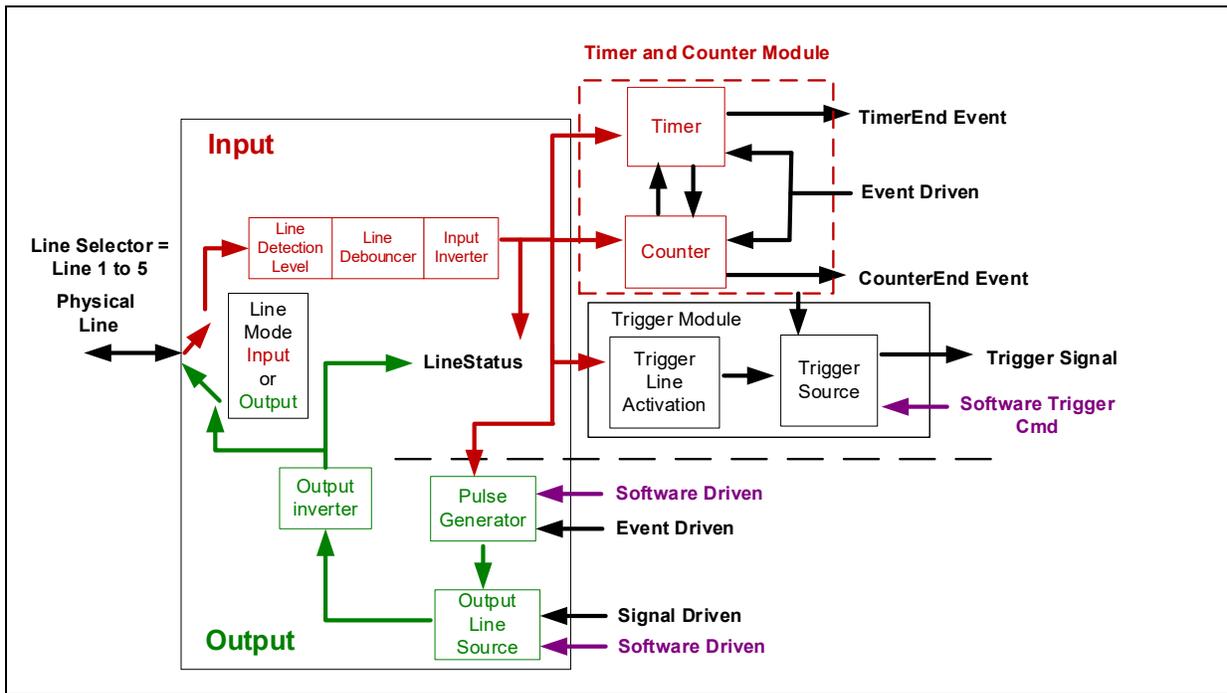


Figure 75: Counter and Timer Group Block Diagram

### Example: Counter Start Source = OFF

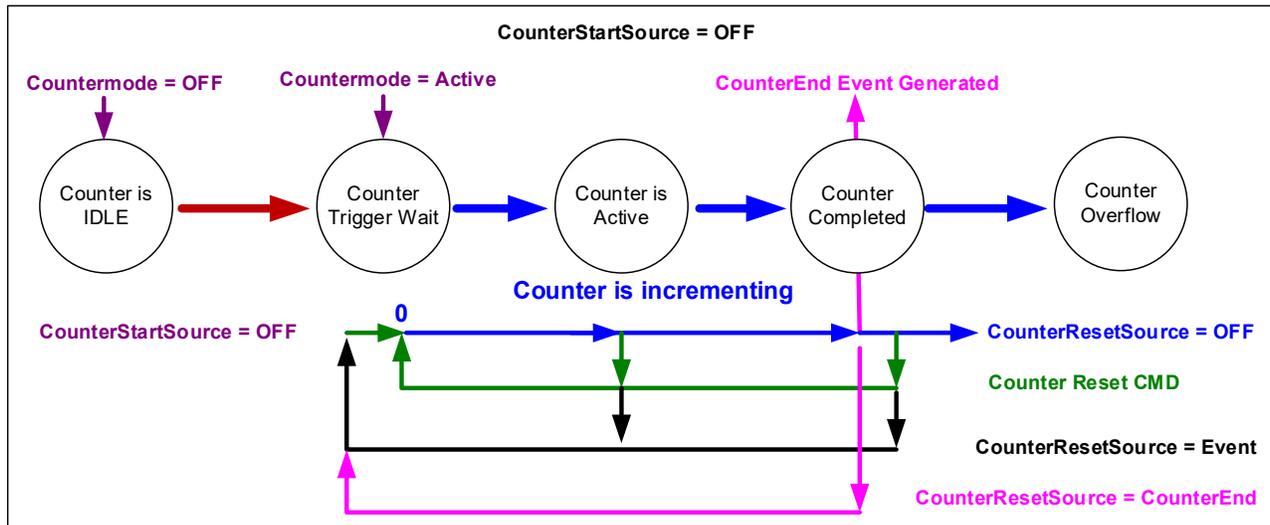


Figure 76: Example – Counter Start Source = OFF

- 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)**

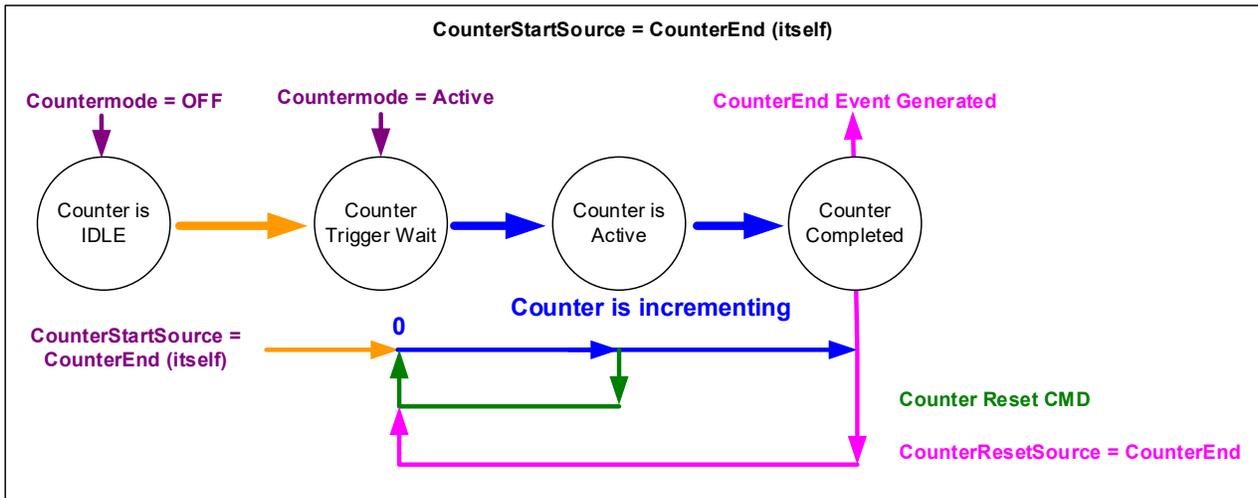


Figure 77: Example – Counter Start Source = CounterEnd

- 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)**

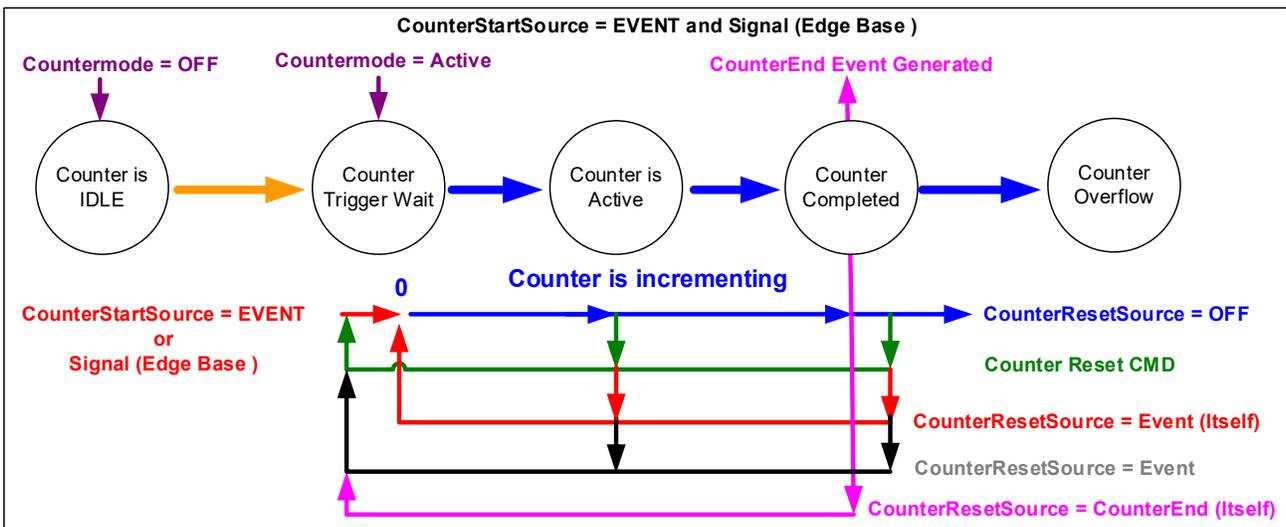


Figure 78: Example: CounterStartSource = EVENT and Signal (Edge Base)

**Example: CounterStartSource = Signal (Level Base) Example 1**

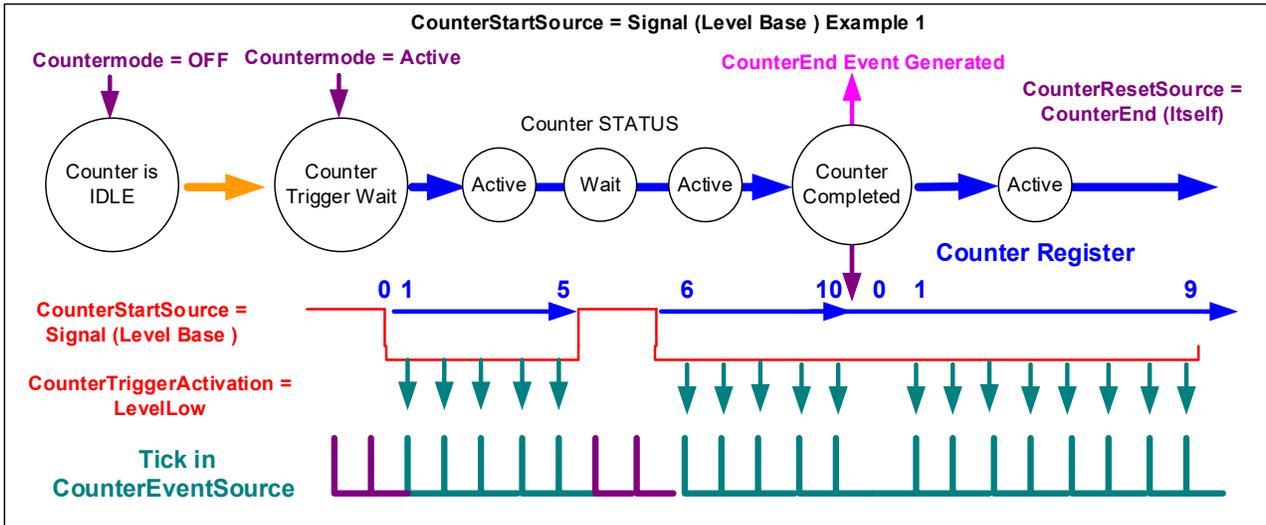


Figure 79: Example – CounterStartSource = Signal (Level Base)

**Example: CounterStartSource = Line (Edge Base) Example 2**

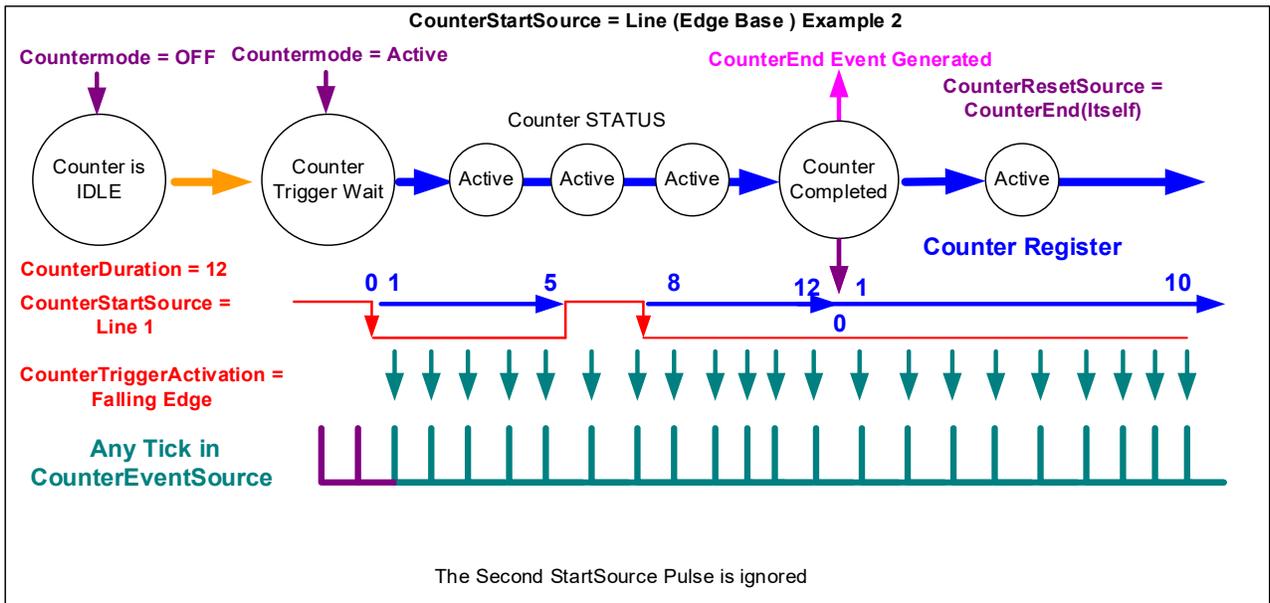


Figure 80: Example – CounterStartSource = Line (Edge Base)

# Advanced Processing Category

The Linea Lite GigE Advanced Processing category groups parameters used to configure LUTs and Flat Field calibration.

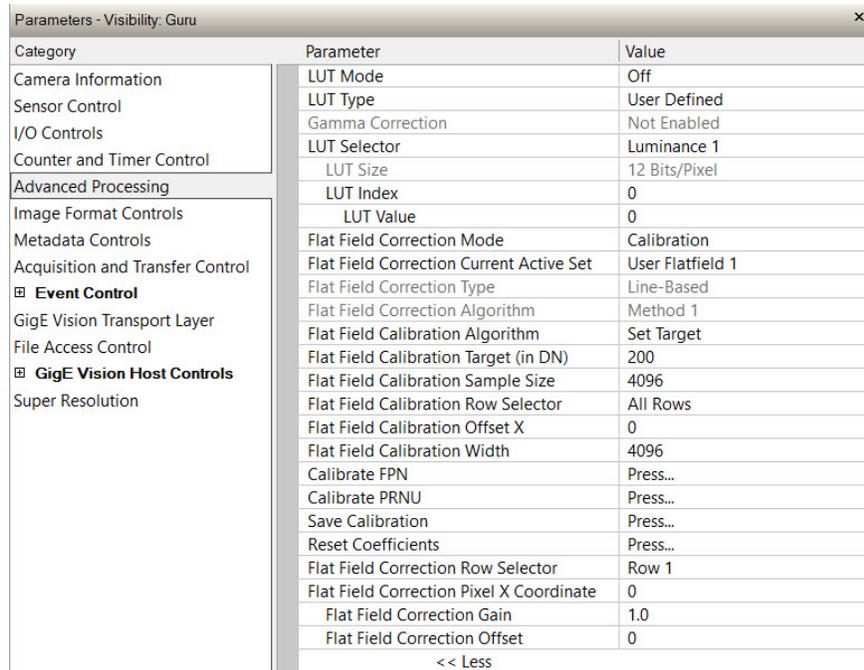
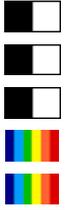


Figure 81: CamExpert – Advanced Processing Category

## Advanced Processing Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Standard & View
	LUT Mode  <i>Off</i> <i>Active</i>	lutMode  <i>Off</i> <i>Active</i>	Sets the enable state of the selected LUT module (Lookup Table).  <i>Disables the LUT.</i> <i>Enables the LUT module.</i>	Expert DFNC
	LUT Type  <i>User Defined</i> <i>Gamma Correction</i>	lutType  <i>UserDefined</i> <i>GammaCorrection</i>	Displays the LUT type of the currently selected Lookup Table.  <i>Uses the user programmable LUT.</i> <i>Uses gamma LUT</i>	Expert DFNC
				
	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.	Expert DFNC
	LUT Selector  <i>Luminance 1</i>	LUTSelector  <i>Luminance1</i>	Selects which LUT to control and adjust features.  <i>Luminance 1 is under control</i>	Guru
	LUT Size  <i>12 Bits/Pixel</i>	lutSize  <i>Bpp12</i>	Specify the LUT size of the selected LUT (Lookup Table). Available choices are model dependent.  <i>12 bits per pixel</i>	Guru DFNC
	LUT Index	LUTIndex	Selects the index (offset) of the coefficient to access in the selected LUT.	Guru
	LUT Value	LUTValue	Returns the value at specified LUT index entry of the LUT selected by the LUT Selector feature.	Guru

B/W Color	Display Name	Feature & Values	Description	Standard & View
	<u>Flat Field Correction Mode</u>  Off Active Calibration	flatfieldCorrectionMode  Off Active Calibration	Sets the mode for the Flat Field correction.  <i>Flat Field Correction is disabled.</i>  <i>Flat Field Correction is enabled.</i>  When selected, the camera is configured for flat field correction calibration. The device may automatically adjust some of its features when calibrate mode is enabled. The features that are automatically adjusted are device specific. The device will not restore these features when the Flat Field Correction Mode feature is changed from Calibrate mode to another mode.	Beginner DFNC
	Flat Field Correction Current Active Set     Factory Flatfield User Flatfield 1 User Flatfield 2 User Flatfield 3  User Flatfield 4	flatfieldCorrectionCurrentActiveSet     FactoryFlatfield UserFlatfield1 UserFlatfield2 UserFlatfield3  UserFlatfield4	Specifies the current set of Flat Field coefficients to use. User data is uploaded via the file access feature. Feature used when flatfieldCorrectionMode is Active. In Calibration, changing this feature has no effect unless you save the FFC, where this feature defines where to save the values. This feature also can be used to copy FFC sets.  Note: only 2 user sets are available for Linea Lite GigE 2k version (L2-GM-02K05B-00-A); the Linea Lite GigE 4k version (L2-GM-04K02B-00-A) supports 4 user sets.  Sets the factory Flat Field coefficient table as the current Flat Field.  Sets User Flat Field 1 coefficient table as the current Flat Field.  Sets User Flat Field 2 coefficient table as the current Flat Field.  Sets User Flat Field 3 coefficient table as the current Flat Field.  Not available for Linea Lite GigE 2k version (L2-GM-02K05B-00-A).  Sets User Flat Field 4 coefficient table as the current Flat Field.  Not available for Linea Lite GigE 2k version (L2-GM-02K05B-00-A).	Beginner DFNC
	Flat Field Correction Type Line-Based	flatfieldCorrectionType LineBase	Specifies the Flat Field correction type.  Flat field correction is based on an individual line (FlatLine).	Guru DFNC
	<u>Flat Field Correction Algorithm</u> Method 1	flatfieldCorrectionAlgorithm Method1	Specifies the Flat Field correction algorithm to use.  The following formula is used to calculate the flat field corrected pixel: $newPixelValue[x] = (sensorPixelValue[x] - FFCOffset[x]) * FFCGain[x]$	Guru DFNC
	Flat Field Calibration Algorithm Peak Set Target	flatfieldCorrectionCalibrationAlgorithm Peak SetTarget	Specifies the flatfield calibration algorithm to use.  Each pixel is gained up to the brightest.  Each pixel is gained up to the value specified in the flatfieldCalibrationTarget feature.	Guru DFNC
	Flat Field Calibration Target (in DN)	flatfieldCalibrationTarget	Sets the target pixel value for the gain (PRNU) calibration.	Expert DFNC
	Flat Field Calibration Sample Size  2048 4096	flatfieldCalibrationSampleSize  Lines_2048 Lines_4096	Set flat field calibration sample size (number of lines to sum).  2048 4096	Guru DFNC
	Flat Field Calibration Row Selector  All Rows Row 1 Row 2	flatfieldCalibrationColorSelector  All Row1 Row2	Selects which row/color is calibrated.  All rows calibrated.  Row 1 calibrated.  Row 2 calibrated.	Beginner DFNC
	Flat Field Calibration Offset X	flatfieldCalibrationROIOffsetX	Sets the ROI Offset X.	Guru DFNC
	Flat Field Calibration Width	flatfieldCalibrationROIWidth	Sets the ROI Width.	Guru DFNC

B/W Color	Display Name	Feature & Values	Description	Standard & View
	Calibrate FPN	flatfieldCalibrationFPN	Performs Fixed Pattern Noise (FPN) calibration by reducing dark pixel current to zero using a pixel offset.	Guru DFNC
	Calibrate PRNU	flatfieldCalibrationPRNU	Performs Photo Response Non-Uniformity (PRNU) calibration to a targeted, user-defined value. PRNU calibration eliminates the difference in responsivity between the most and least sensitive pixel, creating a uniform response to light.	Guru DFNC
	Save Calibration	flatfieldCalibrationSave	Save the calibration performed by flatfieldCalibrationFPN and flatfieldCalibrationPRNU to the active set.	Expert DFNC
	Reset Coefficients	flatfieldResetCoefficients	Reset all FFC coefficients to pass-through.	Expert DFNC
	Flat Field Correction Row Selector  <i>Row 1</i>  <i>Row 2</i>  <i>All rows</i>  <i>Green</i>  <i>Red/Blue</i>	flatfieldCorrectionColorSelector  <i>Row1</i>  <i>Row2</i>  <i>All</i>  <i>Green</i>  <i>RedBlue</i>	Selects the row/color for which to configure offset and gain correction.  <i>Row 1 correction.</i>  <i>Row 2 correction.</i>  <i>All rows correction.</i>  <i>Green (row 1) correction.</i>  <i>Red/Blue (row 2) correction.</i>	Beginner DFNC
	Flat Field Correction Pixel X Coordinate	flatfieldCorrectionPixelXCoordinate	Specifies the X coordinate of the flat field pixel coefficient to access.	Guru DFNC
	Flat Field Correction Gain	flatfieldCorrectionGain	Sets the gain to apply to the currently selected pixel.	Guru DFNC
	Flat Field Correction Offset	flatfieldCorrectionOffset	Sets the offset to apply to the currently selected pixel.	Guru DFNC

# Color Processing Category

The Color Processing category has parameters used to configure the Linea Lite color camera white balance / color balance features.

Category	Parameter	Value
Camera Information	Automatic White Balance	Not Enabled
Sensor Control	White Balance On-Demand Cmd	Not Enabled
I/O Controls	Color Correction Mode	Active
Counter and Timer Control	Color Correction Current Active Set	User Defined 1
Advanced Processing	Color Correction Matrix Value Selector	Offset0(R)
	Color Correction Matrix Value	10.0
Color Processing	Cross Talk Correction Coefficient For Red Pixel	Not Enabled
	Cross Talk Correction Coefficient For Blue Pixel	Not Enabled
Image Format Controls	<< Less	
Metadata Controls		
Acquisition and Transfer Control		
Action Control		
Event Control		
GigE Vision Transport Layer		
File Access Control		
GigE Vision Host Controls		

Figure 82: CamExpert – Color Processing Sub-Category

## Color Processing Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
<u>Automatic White Balance</u>  <i>Off</i>  <i>On Demand</i>	BalanceWhiteAuto  <i>Off</i>  <i>OnDemand</i>	Controls the mode for automatic white balancing between the color channels. The color gains are automatically adjusted.  <i>White balancing is manually controlled using BalanceRatio[Red], BalanceRatio[Green] and BalanceRatio[Blue].</i>  <i>White balancing is automatically adjusted once by the device.</i>	Expert
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.	Expert DFNC
Color Correction Mode  <i>Off</i> <i>Active</i>	colorCorrectionMode  <i>Off</i> <i>Active</i>	Sets the color correction feature (RGB gains) to manual or automatic.  <i>RGB gains are controlled manually using the Gain feature.</i> <i>RGB gains are specified using a color correction matrix.</i>	Expert DFNC
Color Correction Current Active Set  <i>Factory Preset</i>  <i>User Defined</i>	colorCorrectionCurrentActiveSet  <i>FactoryPreset</i>  <i>UserDefined</i>	Specifies the active set of color correction coefficients.  <i>Loads the factory color correction coefficient set as the active set.</i>  <i>Loads a user-defined color correction coefficient set as the active set.</i>	Beginner DFNC
Color Correction Matrix Value Selector	colorCorrectionMatrixValueSelector	Selects the Gain or Offset element of the color correction matrix to configure.	Guru DFNC
Color Correction Matrix Value	colorCorrectionMatrixValueSelector	Specifies the value of the selected Gain or Offset element of the color correction matrix.	Guru DFNC
Crosstalk Correction Mode  <i>Off</i> <i>Active</i>	crossTalkCorrectionEnable  <i>Off</i> <i>Active</i>	Enables or disables the crosstalk correction algorithm.  <i>Disables crosstalk correction.</i> <i>Enables crosstalk corrections.</i>	Expert DFNC
Crosstalk Correction Coefficient For Red Pixel	crosstalkCorrectionRed	Crosstalk correction coefficient for red pixel.	Beginner DFNC

Display Name	Feature & Values	Description	Standard & View
Crosstalk Correction Coefficient For Blue Pixel	crosstalkCorrectionBlue	Crosstalk correction coefficient for blue pixel.	Beginner DFNC

## Color Processing Functional Overview

Linea Lite color cameras provide White Balance controls (automatic or manual), and additionally with supported models, the optional RGB firmware provides Saturation and Luminance controls. 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 Linea Lite white balance control allows 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 Linea camera is recommended for most applications.

## Color Correction Matrix

Line Lite color models support the use of a color correction matrix for adjusting the color output of the camera.

The Sopera LT SDK includes the Sopera Color Calibration tool. This tool allows you to generate color correction coefficients that are used to adjust the camera sensor's color response for known colors at a specific illumination. This ensures that the camera outputs the correct color for a given scene.

The color correction coefficients (3 x 4 matrix) are saved as a \*.ccor file that can be uploaded to the camera to perform real-time correction using the camera's hardware (instead of performing correction on the host computer after the image transfer).

The Sopera Color Calibration tool is available from Windows Start menu:

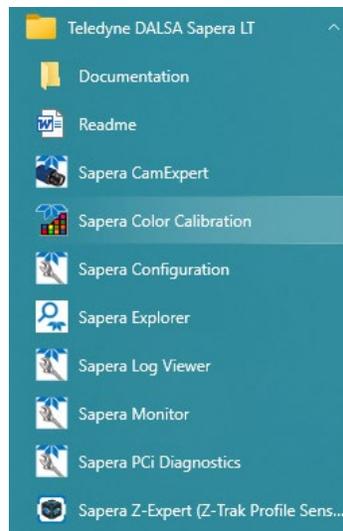


Figure 83: Sopera Color Calibration Tool Shortcut

Refer to the tool's online help for information about generating coefficients.

## Crosstalk Correction

The crosstalk correction algorithm in the camera is designed to remove the crosstalk in the green row that occurs from the neighboring red and blue pixels. This crosstalk shows up as an odd/even pattern in the green row as red and blue light affect alternating pixels.

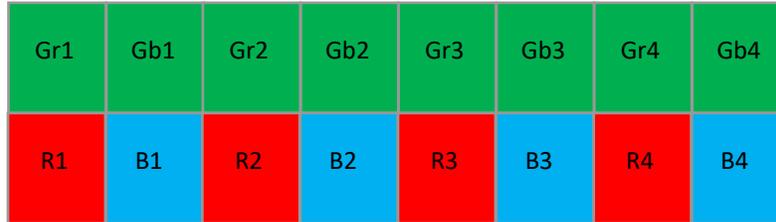


Figure 84: Sensor pixel array.

### Calibration

In most cases, the default calibration will remove most of the crosstalk. However, if the angle of incident light with respect to the sensor changes, the crosstalk correction values may need to be adjusted.

It is recommended to calibrate the crosstalk by using the following steps:

1. Configure the camera with all corrections off (crosstalk, flatfield, color correction) and with color interpolation set to basic.
2. Capture a dark image, a red image under red illumination, and a blue image under blue illumination.
3. Subtract the dark image from the red image and the blue image, then measure the average of the Gr and the average of the Gb pixels in the dark-subtracted red and blue images.
4. On the blue channel of the dark-subtracted blue image, average all even-numbered pixels and save as B (refer to Figure 84).
5. On the red channel of the dark-subtracted red image, average all odd-numbered pixels and save as R (refer to Figure 84).
6. Calculate the blue crosstalk correction value with the average of the Gr and the average of the Gb pixels in the dark-subtracted blue image:

$$\text{Blue Crosstalk correction value} = \frac{\text{abs}(\text{avgGb} - \text{avgGr})}{B} \times 100$$

7. Calculate the red crosstalk correction value with the average of the Gr and the average of the Gb pixels in the dark-subtracted red image:

$$\text{Red Crosstalk correction value} = \frac{\text{abs}(\text{avgGb} - \text{avgGr})}{R} \times 100$$

These values should be entered for features `crosstalkCorrectionBlue` and `crosstalkCorrectionRed`, and the corrections re-enabled.

# Image Format Controls Category

The Linea Lite GigE Image Format Controls category group parameters used to configure camera pixel format and image cropping. An internal test image function is used to qualify camera setup without a lens.

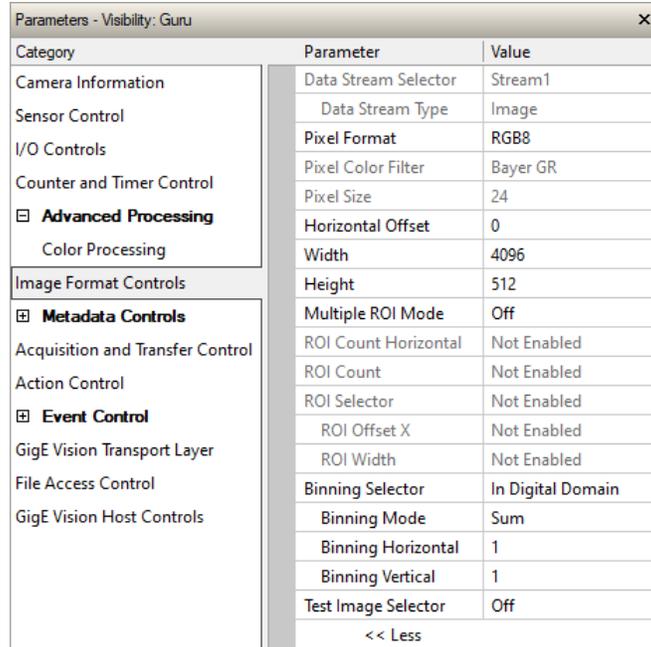
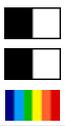


Figure 85: CamExpert – Image Format Controls Category

## Image Format Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Standard & View
	Data Stream Selector <i>Stream1</i>	dataStreamSelector <i>Stream1</i>	Select which data stream to control. (Default is Stream 1) <i>Adjust parameters for Stream1.</i>	Beginner DFNC
	Data Stream Type <i>Image</i> <i>Image_MetaData</i>	DataStreamType <i>Image</i> <i>Image_MetaData</i>	This feature is used to retrieve the transfer protocol used to stream blocks. <i>The Image data blocks are streamed using the payload type "Image".</i> <i>The Image_MetaData blocks are streamed using the payload type "Extended Chunk Data with Image".</i>	Beginner DFNC
     	Pixel Format <i>Monochrome 8-Bit</i> <i>Monochrome 12-Bit</i> <i>Green Only 8-bit</i> <i>BiColorRGBG8</i> <i>BiColorRGBG12p</i> <i>RGB8</i>	PixelFormat <i>Mono8</i> <i>Mono12</i> <i>G8</i> <i>BiColorRGBG8</i> <i>BiColorRGBG12p</i> <i>RGB8</i>	Format of the pixel provided by the device. Contains all information as provided by PixelCoding, PixelSize, PixelColorFilter, combined in one single value. <i>Monochrome 8-bit.</i> <i>Monochrome 12-bit.</i> <i>Green-only, 8-bit.</i> <i>Bicolor RGBG, 8-bit.</i> <i>Bicolor RGBG 12-bit Packed</i> <i>RGB, 8-bit.</i>	Beginner

B/W Color	Display Name	Feature & Values	Description	Standard & View
	Pixel Color Filter  <i>Bayer GR</i> <i>Bayer RG</i> <i>Bayer GB</i> <i>Bayer BG</i>	PixelColorFilter  <i>BayerGR</i> <i>BayerRG</i> <i>BayerGB</i> <i>BayerBG</i>	Indicates the type of color filter applied to the image (RO).  <i>For BayerGR, the 2x2 mosaic alignment is GR/BG.</i> <i>For BayerRG, the 2x2 mosaic alignment is RG/GB.</i> <i>For BayerGB, the 2x2 mosaic alignment is GB/RG.</i> <i>For BayerBG, the 2x2 mosaic alignment is BG/GR.</i>	Invisible
	Pixel Size  <i>8 Bits/Pixel</i> <i>12 Bits/Pixel</i> <i>24 Bits/Pixel</i>	PixelSize  <i>Bpp8</i> <i>Bpp12</i> <i>Bpp24</i>	Total size in bits of an image pixel. (RO)  <i>8-bits per pixel.</i> <i>12-bits per pixel.</i> <i>24-bits per pixel.</i>	Guru
	Horizontal Offset	OffsetX	Horizontal offset from the sensor origin (in pixels).	Beginner
	Width	Width	Width of the image provided by the device (in pixels). The minimum width is 64 pixels and can be specified in increments of 16 pixels.	Beginner
	Height	Height	Height of the image provided by the device (in lines).	Beginner
	Multiple ROI Mode  <i>Off</i> <i>Active</i>	multipleROI Mode  <i>Off</i> <i>Active</i>	Enable the Multiple ROI (Region of Interest) per image feature. The ROI Count is set by the Multiple ROI Count feature.  <i>Single ROI per image.</i> <i>The ROI per image feature is active.</i>	Expert DFNC
	ROI Count Horizontal	multipleROICountHorizontal	Specifies the number of ROIs (Regions of Interest) available for the X axis. For the Linea Lite 2k model only 2 ROIs are available.	Guru DFNC
	ROI Count	multipleROICount	Specifies the number of possible ROIs (Regions of Interest) available in an acquired image. Two is minimum; maximum is device-specific.	Guru DFNC
	ROI Selector  <i>ROI (x1, y1)</i> <i>ROI (x2, y1)</i> <i>ROI (x3, y1)</i> <i>ROI (x4, y1)</i>	multipleROISelector  <i>roi1_1</i> <i>roi2_1</i> <i>roi3_1</i> <i>roi4_1</i>	Select an ROI (Region of Interest) when Multiple ROI Mode is enabled. Selector range is from 1 to the ROI Count value.  <i>ROI (x1, y1)</i> <i>ROI (x2, y1)</i> <i>ROI (x3, y1). Not available for Linea Lite 2k model.</i> <i>ROI (x4, y1). Not available for Linea Lite 2k model.</i>	Guru DFNC
	ROI Offset X	multipleROIOffsetX	Horizontal offset (in pixels) from the origin to the selected ROI (Region of Interest).	Guru DFNC
	ROI Width	multipleROIWidth	Width of the selected ROI (Region of Interest) provided by the device (in pixels). Increment value is device dependent.	Guru DFNC
	Binning Selector  <i>In Digital Domain</i>	binningSelector  <i>InDigitalDomain</i>	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.  <i>The Binning function can be done inside the device but with a digital processing function. Binning doesn't affect the current data rate from the sensor or camera.</i>	Beginner DFNC
	Binning Mode  <i>Sum</i> <i>Average</i>	binningMode  <i>Sum</i> <i>Average</i>	Sets the mode used to combine pixels together when <b>Binning Horizontal</b> and / or <b>Binning Vertical</b> is greater than 1.  <i>The responses from the individual pixels are added together, resulting in increased sensitivity.</i> <i>The responses from the individual pixels are averaged, resulting in increased signal to noise ratio.</i>	Beginner DFNC
	Binning Horizontal	BinningHorizontal	Number of horizontal photo-sensitive cells to combine. This increases the intensity of the pixels but reduces the horizontal resolution.	Beginner
	Binning Vertical	BinningVertical	Number of vertical photo-sensitive cells to combine. This increases the intensity of the pixels but reduces the vertical resolution of the image.	Beginner

B/W Color	Display Name	Feature & Values	Description	Standard & View
	Test Image Selector <i>Off</i> <i>Horizontal Ramp</i> <i>Vertical Ramp</i> <i>Diagonal Ramp Moving</i>  <i>Fixed Offset</i> <i>Sensor Test Pattern</i>	TestImageSelector  <i>Off</i> <i>GreyHorizontalRamp</i>  <i>GreyVerticalRamp</i>  <i>GrayDiagonalRampMoving</i>   <i>FixedOffset</i> <i>SensorTestPattern</i>	Selects the type of test image output by the camera.  <i>Image is from the camera sensor.</i>  <i>Image is filled horizontally with an image that goes from the darkest possible value to the brightest.</i>  <i>Image is filled vertically with an image that goes from the darkest possible value to the brightest.</i>  <i>Image is filled horizontally and vertically with an image that goes from the darkest possible value to the brightest in increments of 1 DN per pixel and that moves horizontally from right to left at each frame by one pixel.</i>  <i>Image is a fixed value (64 DN).</i> <i>Sensor test pattern.</i>	Beginner
	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.	Invisible
	Height Max	HeightMax	The maximum image height is the dimension calculated after vertical binning, decimation or any other function changing the vertical dimension of the image.	Invisible

# Metadata Controls Category

The Metadata Controls category groups features to enable and select inclusion of chunk data with the image payload (as specified by the specification GigE Vision 1.2).

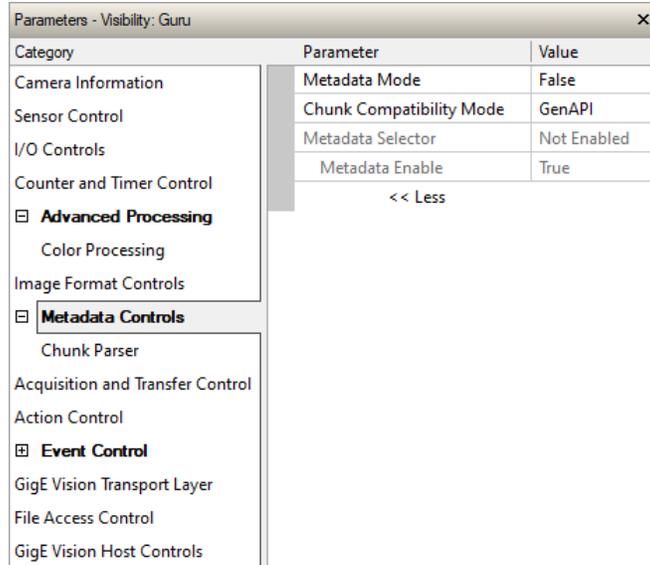


Figure 86: CamExpert – Metadata Category

## Metadata Controls Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Metadata Mode	ChunkModeActive  False True	Activates the inclusion of metadata (chunk data) in the payload of the image.  No chunk data. Chunk data included in payload.	Expert
Chunk Compatibility Mode  Sapera LT GenAPI	chunkCompatibilityMode  SaperaLT GenAPI	Selects the format of the chunk data (metadata) in the payload of the image.  Metadata compatible with Teledyne DALSA Sapera LT 8.0. Metadata compatible with GenICam GenAPI and Teledyne DALSA Sapera LT 8.1.	Expert DFNC

Display Name	Feature & Values	Description	Standard & View
Metadata Selector	ChunkSelector  <i>OffsetX</i>  <i>OffsetY</i>  <i>Width</i>  <i>Height</i>  <i>PixelFormat</i>  <i>ExposureTime</i>  <i>cyclingPresetCurrentActiveSet</i>  <i>Timestamp</i>  <i>LineStatusAll</i>  <i>Gain</i>  <i>Counter1ValueAtReset</i>  <i>DeviceID</i>  <i>DeviceUserID</i>  <i>TestImageSelector</i>  <i>BinningVertical</i>  <i>BinningHorizontal</i>  <i>ExposureDelay</i>	Selects the specific metadata to control, when enabled.  Add the <u>Horizontal Offset X</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Offset Y</u> value used during the image acquisition to the metadata attached to the image. Not available for Linea Lite.  Add the <u>Width</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Height</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Pixel Format</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Exposure Time</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Cycling Preset Current Active Set</u> value used during the image acquisition to the metadata attached to the image. Not available for Line Lite.  Copies the <u>Timestamp Value</u> at the start of exposure to the metadata attached to the image.  Copies the <u>Line Status All</u> value at the start of exposure to the metadata attached to the image.  Add the <u>Gain</u> feature value used during the image acquisition to the metadata attached to the image.  Copies the value of the <u>Counter Value At Reset</u> feature at the start of Frame Readout, to the Metadata attached to the image. Supported only in GenAPI compatibility mode.  Add the <u>Device ID</u> value to the metadata attached to the image.  Add the <u>Device User ID</u> value to the metadata attached to the image.  Add the <u>Test Image Selector</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Binning Vertical</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Binning Horizontal</u> value used during the image acquisition to the metadata attached to the image.  Add the <u>Exposure Delay</u> value used during the image acquisition to the metadata attached to the image. Supported only in GenAPI compatibility mode.	Expert
Metadata Enable	ChunkEnable  <i>False</i>  <i>True</i>	Sets the enable state of the selected metadata. When enabled, the metadata is included in the payload of the image.  Selected metadata disabled  Selected metadata enabled.	Expert
Chunk Binning Horizontal	ChunkBinningHorizontal	Number of horizontal pixels to combine in the payload image.	Guru
Chunk Binning Vertical	ChunkBinningVertical	Number of vertical pixels to combine in the payload image.	Guru

## Extracting Metadata Stored in a Sapera Buffer

For Sapera LT developers, the SapMetadata class (included with Sapera version 8.10 and higher) provides functions for manipulating image metadata. Metadata is appended to the end of virtual frame buffers; Sapera LT automatically adjusts the buffer size to accommodate the metadata.

Sapera also provides two methods to view metadata. The Sapera CamExpert tool provides a tab (when the Metadata Mode feature is enabled) to view the metadata of the last frame capture.

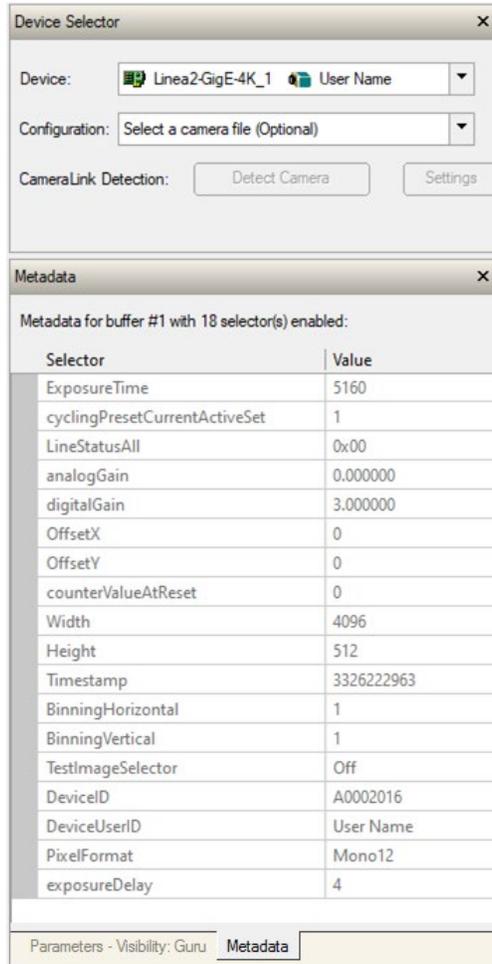


Figure 87: CamExpert – Metadata Tab

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.

### IMPORTANT

When an internal test pattern image is selected, the Metadata feature values for Exposure Time and Exposure Delay are not valid values and must be ignored.

When in free running (not triggered) mode, the Metadata value for feature Exposure Delay is not a valid value and must be ignored.

The value of Line Status All is updated on the start of exposure.

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

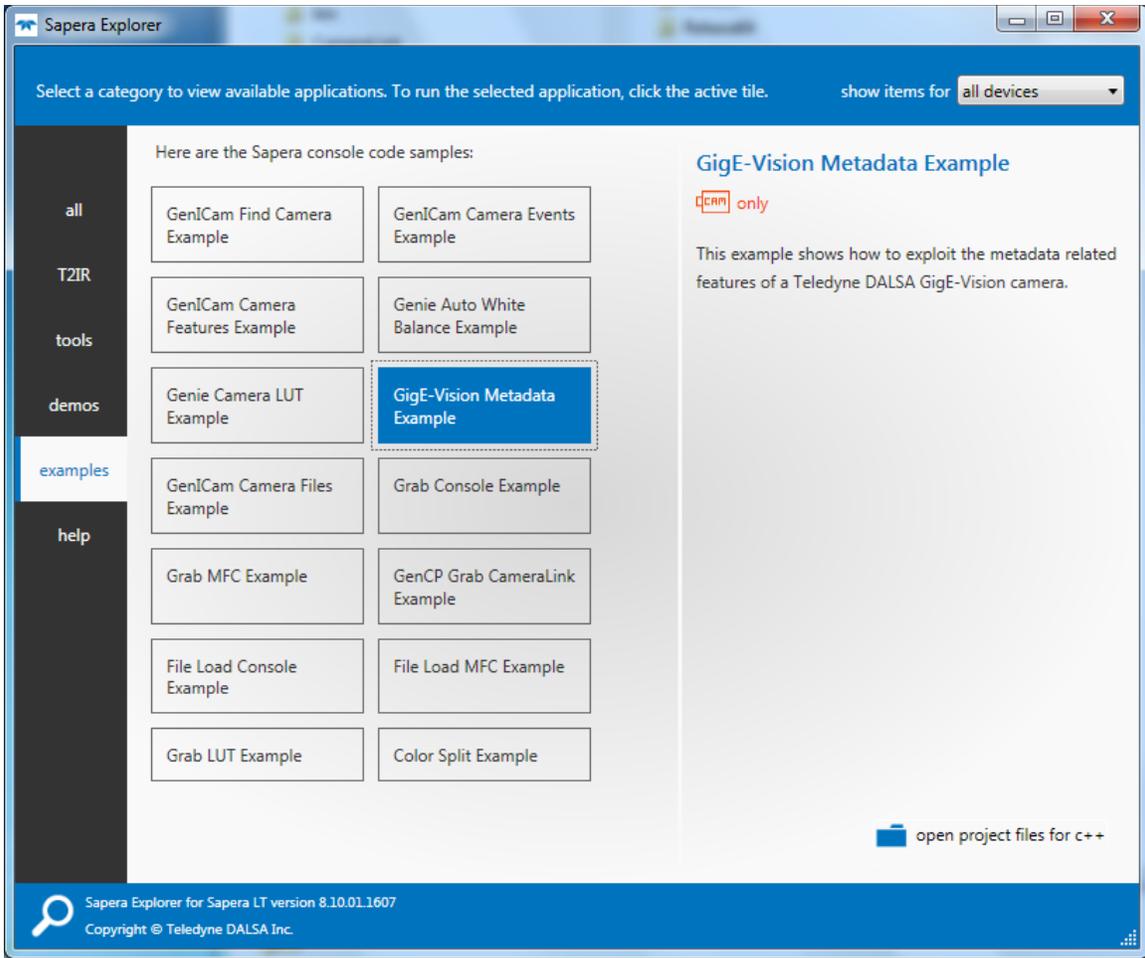


Figure 88: Sapera Explorer

# Acquisition and Transfer Control Category

The Linea Lite GigE Acquisition and Transfer Control category groups parameters used to configure the optional acquisition modes of the device. These features provide the mechanism to either have acquisitions coupled to transfers (basic mode) or to decouple acquisitions from both the camera transfer module and the host transfer module.

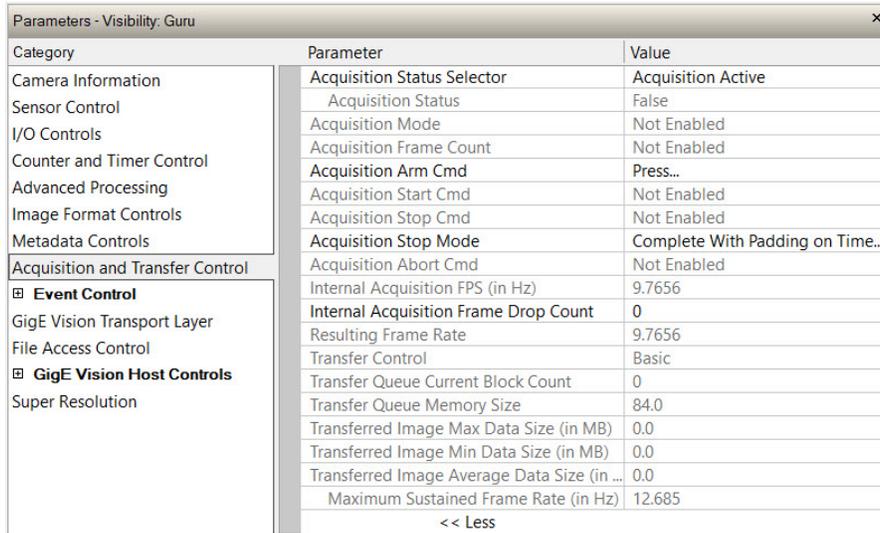


Figure 89: CamExpert – Acquisition and Transfer Control Category

## Acquisition and Transfer Control Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Acquisition Status Selector	AcquisitionStatusSelector	Selects the internal acquisition signal to read using <i>AcquisitionStatus</i> .	Expert
<i>Acquisition Trigger Wait</i>	<i>AcquisitionTriggerWait</i>	<i>Device is currently waiting for a trigger to capture one or more frames.</i>	
<i>Acquisition Active</i>	<i>AcquisitionActive</i>	<i>Device is currently doing an acquisition of one or more frames.</i>	
Acquisition Status	AcquisitionStatus	Reads the state of the internal acquisition signal selected using the <i>AcquisitionStatusSelector</i> feature.	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.	Beginner
<i>Single Frame</i>	<i>SingleFrame</i>	<i>One frame is captured for each AcquisitionStart Command. An AcquisitionStop occurs at the end of the Active Frame.</i>	
<i>Multi-Frame</i>	<i>MultiFrame</i>	<i>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).</i>	
<i>Continuous</i>	<i>Continuous</i>	<i>Frames are captured continuously with AcquisitionStart until stopped with the AcquisitionStop command.</i>	
Acquisition Frame Count	AcquisitionFrameCount	Number of frames to be acquired in MultiFrame acquisition mode.	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. (WO)	Guru

Display Name	Feature & Values	Description	Standard & View
Acquisition Start Cmd	AcquisitionStart	Start image capture using the currently selected acquisition mode. The number of frames captured is specified by AcquisitionMode feature. (WO)	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)	Beginner
Acquisition Stop Mode	AcquisitionStopMode	Controls how to end an ongoing frame when an AcquisitionStop command or an acquisition stop trigger signal is received.	Beginner
<i>Immediate With Padding</i>  <i>Complete With Padding on Timeout</i>	<i>ImmediateWithPadding</i>  <i>CompleteWithPaddingOnTimeout</i>	<i>Acquisition stops immediately even during a frame but the remaining of the frame will be padded with data to deliver a complete default height frame.</i>  <i>When stopped during a frame, the device will continue acquisition of lines until the specified height is reached or a trigger timeout occurs. In the case of a timeout, the remaining frame will be padded with data to deliver a complete default height frame.</i>	
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. (WO)	Beginner
Internal Acquisition FPS (in Hz)	internalAcquisitionFPS	Reports the camera internal frame rate, in Hz. Use the <a href="#">AcquisitionLineRate</a> and <a href="#">Height</a> features to control this value. The image <a href="#">Height</a> and <a href="#">Width</a> features determine the size of the frame.	Guru DFNC
Internal Acquisition Frame Drop Count	internalAcquisitionFrameDropCount	Number of acquired frames to drop internally between each transmitted frame.	Guru DFNC
Resulting Frame Rate	resultingTransferFPS	Reports the transfer frame rate based on the current <a href="#">internalAcquisitionFPS</a> and <a href="#">internalAcquisitionFrameDropCount</a> features. This feature does not take bandwidth limitations into account.	Guru DFNC
<u>Transfer Control</u>	TransferControlMode	Sets the method used to control the transfer.	Expert
<i>Basic</i>	<i>Basic</i>	<i>Basic mode ensures maximum compatibility but does not allow for control of the transfer flow.</i>	
Transfer Queue Current Block Count	transferQueueCurrentBlockCount	Returns the current number of blocks in the transfer queue.	Expert
Transfer Queue Memory Size	transferQueueMemorySize	Indicates the amount of device memory (in Mbytes) available for internal image frame accumulation in the transfer queue. Increasing or decreasing memory reserved by <a href="#">devicePacketResendBufferSize</a> will affect total memory available here.	
Transferred Image Max Data Size (in MB)	transferMaxBlockSize	Biggest image (GEV blocks) data size sent on the GigE cable. The value is displayed in Megabytes. Use this value to calculate the frame rate transferred on the GigE cable. GigE Link speed (~115 MB) divided by Biggest Image (value) = Max fps transferred. Note: This statistic is reset when acquisitions are stopped.	DFNC Beginner
Transferred Image Min Data Size (in MB)	transferMinBlockSize	Smallest image (GEV blocks) data size sent on the GigE cable. The value is displayed in Megabytes. Note: This statistic is reset when acquisitions are stopped.	DFNC Beginner
Transferred Image Average Data Size (in MB)	transferAverageBlockSize	Average size of the last 16 images (GEV 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 (~115 MB) divided by Average size (value) = Max fps transferred.	DFNC Beginner
Maximum Sustained Frame Rate (in Hz)	maxSustainedFrameRate	Maximum sustained frame rate that can be achieved by the camera in the current configuration (Resolution, <a href="#">Pixel Format</a> and the camera's internal bandwidth limitations).	DFNC Beginner

## ***Acquisition Buffering***

Acquisitions are internally buffered then transferred to the host system. This internal buffer allows uninterrupted acquisitions without transfer delays. When the internal buffer is full an Image Lost Event will be generated.

The camera has one block of 256 MB. A portion of the memory could be reserved for packet resends but at the loss of accumulating frames.

## ***Using Transfer Queue Current Block Count with CamExpert***

This feature returns the number of frames buffered within the camera pending transfer to the host system. Image lines / frames are buffered in cases where the host system is experiencing high network traffic with other devices through the same Ethernet switch.

### **NOTE**

By buffering image frames, the camera will not drop data when there are temporary delays to the transfer.

When using CamExpert, right-click on this parameter 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. Review the [Troubleshooting](#) section of this manual and then contact [Technical Support](#) for help in reviewing your camera setup.

### **NOTE**

The Image Lost event occurs when all buffer space is consumed.

## Overview of Transfer Control (*TransferControlMode*)

Linea Lite GigE acquisition transfers operate either in the basic coupled mode or in an independent decoupled user controlled mode, as described below.

### **TransferControlMode = Basic**

Basic Transfer Mode provides maximum compatibility with any control application running on the host computer. The host-based acquisition program commands the camera to do a frame grab and send it through the camera's frame buffer to the camera's transfer module and the host. The acquisition rate is limited by the host transfer rate.

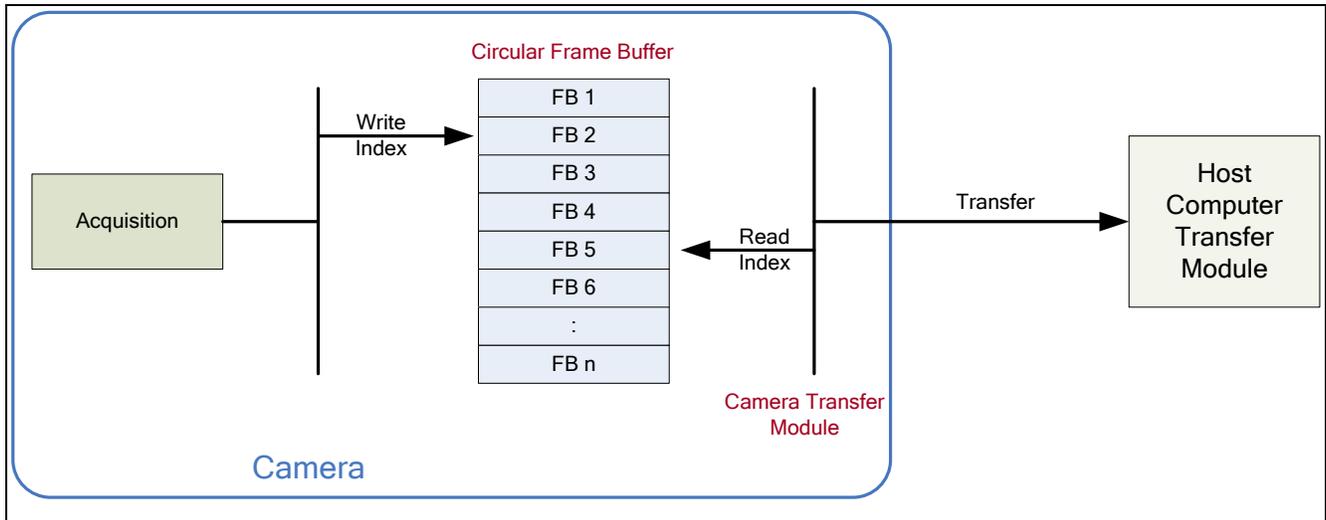


Figure 90: Transfer Control Mode

## Features Unalterable During a Sopera Transfer

The following features cannot be changed during an acquisition or Sopera transfer.

Feature Group	Features Locked During a Sopera Transfer
<u>CAMERA INFORMATION</u>	UserSetLoad
<u>SENSOR CONTROL</u>	NA
<u>I/O CONTROL</u>	NA
<u>COUNTER AND TIMER CONTROL</u>	NA
<u>ADVANCED PROCESSING CONTROL</u>	flatfieldCorrectionMode
<u>IMAGE FORMAT CONTROL</u>	PixelFormat OffsetX Width Height BinningHorizontal BinningVertical
<u>ACQUISITION AND TRANSFER CONTROL</u>	DeviceRegistersStreamingStart DeviceRegistersStreamingEnd
<u>EVENT CONTROL</u>	NA
<u>GIGE VISION TRANSPORT LAYER CONTROL</u>	GevSCPSPacketSize
<u>GIGE VISION HOST CONTROL</u>	InterPacketTimeout InterPacketTimeoutRaw ImageTimeout
<u>FILE ACCESS CONTROL</u>	NA

# Action Control Category

The Linea Lite Action Control group, as shown by CamExpert has features related to the control of the Action Command mechanism for the device.

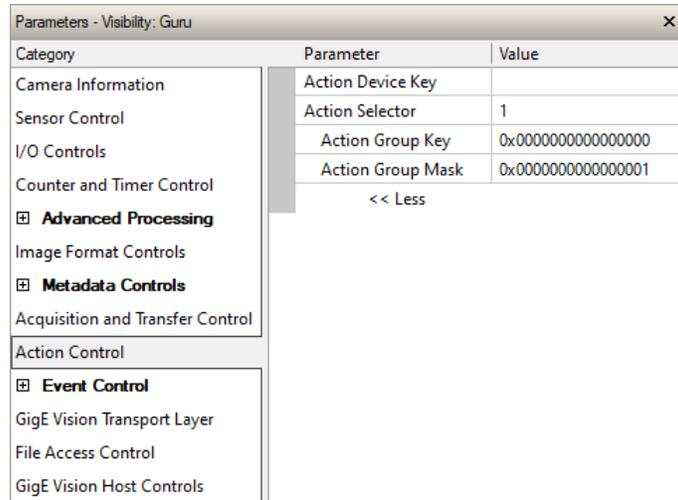


Figure 91: CamExpert – Action Control Category

## Action Control Feature Descriptions

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

## ***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.

The GigE Vision® specification defines the Action Command mechanism, which applications can use to trigger or even schedule various actions on one or more target devices. GigE Vision compliant cameras can take advantage of this mechanism and be triggered using a broadcast command over a subnetwork. 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.

### ***Features Supporting Action Command***

<b>Feature Category</b>	<b>Feature</b>	<b>Enum</b>
I/O Control	<u>Trigger Source</u>	Action 1, Action 2 – when <u>Trigger Selector</u> = <i>Single Frame Trigger (Start)</i> or <i>MultiFrame Trigger (Start)</i>
	<u>Output Line Source</u>	Pulse On: Action 1 Pulse On: Action 2

### ***Action Command Demo for GigE Vision Devices***

This demo and application note explains how to use the Action Command mechanism to trigger an action on a GigE Vision compliant device. An example program is also provided to demonstrate how to use it.

It is available for download from the Teledyne DALSA website: [Action Command Demo for GigE Vision Devices](#)

# Event Control Category

The Linea Lite GigE Event Control category groups parameters used to configure Camera Event related features.

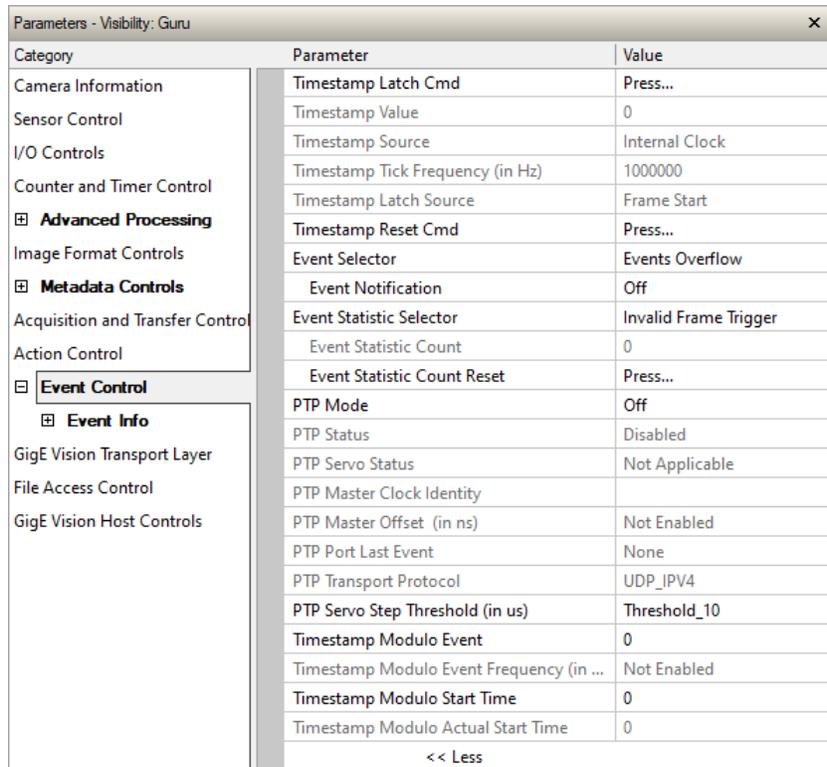


Figure 92: CamExpert – Event Control Category

## Event Control Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Timestamp Latch Cmd	timestampControlLatch	Latch the current timestamp internal counter value in the <a href="#">Timestamp Value</a> feature.	Expert DFNC
Timestamp Value	timestampValue	Returns the 64-bit value of the timestamp counter. (RO)	Expert DFNC
TimeStamp Source <i>Internal Clock</i>	timestampSource <i>InternalClock</i>	Specifies the source used as the incrementing signal for the timestamp register. <i>The timestamp source is generated by the camera internal clock. Refer to <a href="#">Timestamp Tick Frequency</a> feature for the time base.</i>	Expert DFNC
Timestamp Tick Frequency (in Hz)	timestampTickFrequency	Indicates the number of timestamp ticks (or increments) during 1 second (frequency in Hz). (RO)	Expert DFNC
Timestamp Latch Source <i>Frame Start</i>	timestampLatchSource <i>FrameStart</i>	Specifies the internal event or signal that will latch the timestamp counter into the timestamp buffer. <i>The timestamp is latched on frame start.</i>	Expert DFNC Expert DFNC
Timestamp Reset Cmd	timestampControlReset	Resets the timestamp counter to 0. (WO)	Expert DFNC

Display Name	Feature & Values	Description	Standard & View
Event Selector	EventSelector	Select the Event to enable/disable with the EventNotification feature.	Expert
<i>End of Frame</i>	<i>FrameEnd</i>	<i>Event sent on control channel on an End of Frame.</i>	
<i>Start of Frame</i>	<i>FrameStart</i>	<i>Event sent on control channel on an Active Frame. This occurs with the start of the exposure delay of the first line of the frame.</i>	
<i>Valid Frame Trigger</i>	<i>ValidFrameTrigger</i>	<i>Event sent on control channel when a valid frame trigger is generated.</i>	
<i>Rejected Frame Trigger</i>	<i>InvalidFrameTrigger</i>	<i>Event sent on control channel when a frame trigger occurs in an invalid Trigger region. The trigger is rejected and no frame acquisition occurs.</i>	
<i>Image Lost</i>	<i>ImageLost</i>	<i>Event sent on control channel when an image is lost due to insufficient memory.</i>	
<i>Rejected Line Trigger</i>	<i>InvalidLineTrigger</i>	<i>Event sent on control channel when a line trigger occurs in an invalid Trigger region. The trigger is rejected and no frame acquisition occurs.</i>	
<i>Line 1 Rising Edge</i>	<i>Line1RisingEdge</i>	<i>Event sent on control channel when a rising edge is detected on Line 1.</i>	
<i>Line 1 Falling Edge</i>	<i>Line1FallingEdge</i>	<i>Event sent on control channel when a falling edge is detected on Line 1.</i>	
<i>Line 2 Rising Edge</i>	<i>Line2RisingEdge</i>	<i>Event sent on control channel when a rising edge is detected on Line 2.</i>	
<i>Line 2 Falling Edge</i>	<i>Line2FallingEdge</i>	<i>Event sent on control channel when a falling edge is detected on Line 2.</i>	
<i>Line 3 Rising Edge</i>	<i>Line3RisingEdge</i>	<i>Event sent on control channel when a rising edge is detected on Line 3.</i>	
<i>Line 3 Falling Edge</i>	<i>Line3FallingEdge</i>	<i>Event sent on control channel when a falling edge is detected on Line 3.</i>	
<i>Start of Acquisition</i>	<i>AcquisitionStart</i>	<i>Event sent on control channel on acquisition start.</i>	
<i>End of Acquisition</i>	<i>AcquisitionEnd</i>	<i>Event sent on control channel on acquisition end.</i>	
<i>Events Overflow</i>	<i>eventsOverflow</i>	<i>Event sent on control channel when all previous active events have been disabled because the camera cannot send them fast enough, generating an internal message overflow. All required events must be re-enabled manually.</i>	
Event Notification	EventNotification	Enable Events for the event type selected by the EventSelector feature.	Expert
<i>Off</i>	<i>Off</i>	<i>The selected event is disabled.</i>	
<i>On</i>	<i>On</i>	<i>The selected event will generate a software event.</i>	
<i>GigEVisionEvent</i>	<i>GigEVisionEvent</i>	<i>The selected event will generate a software event for SFNC 1.x compatibility.</i>	
Event Statistic Selector	eventStatisticSelector	Selects which Event statistic to display.	Expert DFNC
<i>Invalid Frame Trigger</i>	<i>InvalidFrameTrigger</i>	<i>Counts the frame trigger occurring in an invalid Trigger region.</i>	
<i>Image Lost</i>	<i>ImageLost</i>	<i>Image is acquired but lost before it's been transferred.</i>	
<i>Packet Resend</i>	<i>PacketResend</i>	<i>Counts the number of individual packets that are resent.</i>	
<i>Packet Resend Request Dropped</i>	<i>PacketResendRequestDropped</i>	<i>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.</i>	
<i>Ethernet Pause Frame Received</i>	<i>EthernetPauseFrameReceived</i>	<i>Counts the number of Ethernet Pause Frame received. Feature limited to 65536 events. See also <a href="#">PAUSE Frame Support</a> for information on Ethernet Packet size.</i>	
Event Statistic Count	eventStatisticCount	Display the count of the selected Event.	Expert DFNC
Event Statistic Count Reset	eventStatisticCountReset	Reset the count of the selected Event.	Expert DFNC

Display Name	Feature & Values	Description	Standard & View
PTP Mode	ptpMode	Specifies the PTP (IEEE-1588: Precision Time Protocol) operating mode as implemented by the Linea Lite.	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)	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 Servo Status	ptpServoStatus	Specifies the IEEE1588 servo status.	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.	Guru DFNC

Display Name	Feature & Values	Description	Standard & View
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.	Guru DFNC
PTP Port Last Event	ptpPortLastEvent	Logs the last PTP changed state event defining the last current status.	Expert DFNC
None Power up Initialize Designated Enabled Designated Disabled Fault Cleared Fault Detected State Decision Event Qualification Timeout Expires Announce Receipt Timeout Expires Synchronization Fault Master Clock Selected Recommended State Master Recommended State Grand Master Recommended State Slave Recommended State Passive	None Powerup Initialize DesignatedEnabled DesignatedDisabled FaultCleared FaultDetected StateDecisionEvent QualificationTimeoutExpires AnnounceReceiptTimeoutExpires SynchronizationFault MasterClockSelected RS_Master RS_GrandMaster RS_Slave RS_Passive	None Power up Initialize Designated Enabled Designated Disabled Fault Cleared Fault Detected State Decision Event Qualification Timeout Expires Announce Receipt Timeout Expires Synchronization Fault Master Clock Selected Recommended State Master Recommended State Grand Master Recommended State Slave Recommended State Passive	
PTP Transport Protocol	ptpTransportProtocol	Describes the PTP Transport Protocol used.	Expert DFNC
PTP Servo Step Threshold (in us)	ptpServoStepThreshold	Specifies the servo step threshold (in $\mu$ s). When the clock offset with the master exceeds the threshold, the servo unlocks and offset adjustment is started.	Expert DFNC
Threshold_10 Threshold_20 Threshold_100 Threshold_500 Threshold_1000 Threshold_2000	Threshold_10 Threshold_20 Threshold_100 Threshold_500 Threshold_1000 Threshold_2000	10 $\mu$ s threshold. 20 $\mu$ s threshold. 100 $\mu$ s threshold. 500 $\mu$ s threshold. 1000 $\mu$ s threshold. 2000 $\mu$ s threshold.	
<u>Timestamp Modulo Event</u>	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.	Expert DFNC
Timestamp Modulo Event Frequency	timestampModuloFrequency	Returns the frequency of the timestamp modulo event (in Hz).	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.	Expert DFNC
Timestamp Modulo Actual Start Time	timestampModuloActualStartTime	Displays the actual modulo event start time as used by the device. When the user specified <u>Timestamp Modulo Start Time</u> is in the future, Timestamp Modulo Actual Start Time = Timestamp Modulo Start Time. When the user-specified <u>Timestamp Modulo Start Time</u> has already past, the camera automatically recalculates a future value for <u>Timestamp Modulo Start Time</u> using the user set <u>Timestamp Modulo Event</u> feature value. This new start time is reported by Timestamp Modulo Actual Start Time.	Expert DFNC
Gev Timestamp Latch	GevtimestampControlLatch	Latch the current timestamp internal counter value in the Gev Timestamp Value feature. (WO)	Invisible
Gev Timestamp Value	GevtimestampValue	Returns the 64-bit value of the timestamp counter. (RO)	Invisible
Gev Timestamp Tick Frequency	GevtimestampTickFrequency	Indicates the number of timestamp ticks (or increments) during 1 second (frequency in Hz). (RO)	Invisible
Gev Timestamp Reset	GevtimestampControlReset	Resets the timestamp counter to 0. (WO)	Invisible

## Event Info Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
FrameStart Event ID	EventFrameStart	Represents the event ID to identify the EventFrameStart software event. (RO)	Guru
FrameEnd Event ID	EventFrameEnd	Represents the event ID to identify the EventFrameEnd software event. (RO)	Guru
Exposure Start Event ID	EventExposureStart	Represents the event ID to identify the EventExposureStart software Event. (RO)	Guru
Exposure End Event ID	EventExposureEnd	Represents the event ID to identify the EventExposureEnd software Event. (RO)	Guru
Readout Start Event ID	EventReadoutStart	Represents the event ID to identify the EventReadoutStart software Event. (RO)	Guru
Readout End Event ID	EventExposureEnd	Represents the event ID to identify the EventReadoutEnd software Event. (RO)	Guru
AcquisitionStart Event ID	EventAcquisitionStart	Returns the unique identifier of the StartEnd type of event. Its value uniquely identifies the type of event that will be received.	
AcquisitionEnd Event ID	EventAcquisitionEnd	Generate an event on Acquisition End.	
ValidFrameTrigger Event ID	EventValidFrameTrigger	Represents the event ID to identify the EventValidFrameTrigger software Event. (RO)	Guru
InvalidFrameTrigger Event ID	EventInvalidFrameTrigger	Represents the event ID to identify the EventInvalidFrameTrigger software Event. (RO)	Guru
AcquisitionStartNextValid Event ID	EventAcquisitionStartNextValid	Represents the event ID to identify the EventAcquisitionStartNextValid software Event. (RO)	Guru
InvalidLineTrigger Event ID	EventInvalidLineTrigger	Generate an event on Invalid Line Trigger.	Guru
ImageLost Event ID	EventImageLost	Represents the event ID to identify the EventImageLost software Event. (RO)	Guru
Counter 1 End Event ID	EventCounter1End	Represents the event ID to identify the EventCounter1End software Event. (RO)	Guru
Line 1 Rising Edge Event ID	EventLine1RisingEdge	Represents the event ID to identify the EventLine1RisingEdge software Event. (RO)	Guru
Line 1 Falling Edge Event ID	EventLine1FallingEdge	Represents the event ID to identify the EventLine1FallingEdge software Event. (RO)	Guru
Line 2 Rising Edge Event ID	EventLine2RisingEdge	Represents the event ID to identify the EventLine2RisingEdge software Event. (RO)	Guru
Line 2 Falling Edge Event ID	EventLine2FallingEdge	Represents the event ID to identify the EventLine2FallingEdge software Event. (RO)	Guru
Line3 Rising Edge Event ID	EventLine3RisingEdge	Generate an event on Line3 rising edge. (RO)	Guru
Line3 Falling Edge Event ID	EventLine3FallingEdge	Generate an event on Line3 falling edge. (RO)	Guru
Events Overflow Event ID	EventeventsOverflow	Represents the event ID to identify the EventeventsOverflow software Event. (RO)	Guru

# Overview of Precision Time Protocol Mode (IEEE 1588)

## PTP Mode = Precision Time Protocol

- PTP 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 instead of a switch, it must be configured as the common Master PTP source for all its networks. Refer to NIC’s configuration software instructions.
- Linea Lite 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 two 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 Linea Lite cameras are used, they are equal and the Linea Lite with lowest MAC address value is set to 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.
- Linea Lite 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 0xffe 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 hyphens): “0a-1b-2c-3d-4e-5f”
- The Extended Unique Identifier is a 64-bit ID, converted from the 48-bit MAC address, by inserting 0xffe at the middle of the MAC address. The format is (excluding hyphens): “0a-1b-2c-ffe-3d-4e-5f”

## An Example with two Linea Lite Cameras

The following basic steps configure two Linea Lite cameras connected to one computer via an Ethernet switch. The configured cameras use 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

One Linea Lite is automatically set to Master while the other is set to Slave.

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

With the two cameras aimed at the same moving object, click **Grab** on each instance of CamExpert: each camera grabs frames simultaneously.

## 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 Linea Lite internal Timestamp clock has a 1  $\mu$ s tic, while the PTP clock has 8 ns 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 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 every +10 Timestamp tick until stopped.

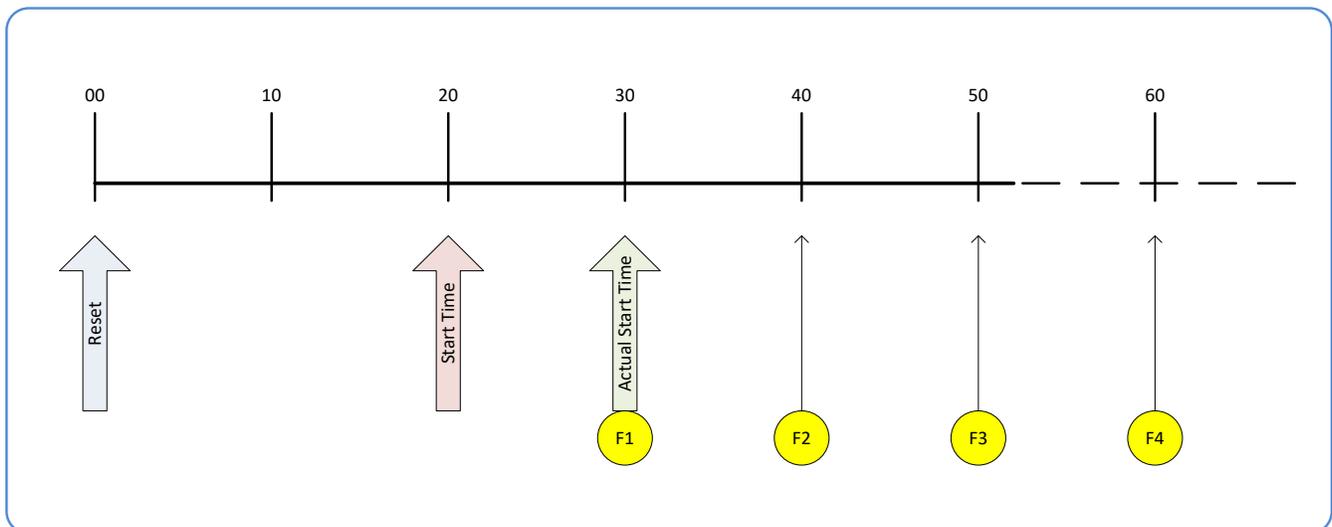


Figure 93: Case 1 - Repeating Acquisitions as Upcoming Events

## Case 2: Potential Uncertainty to the Start Time

### Conditions:

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

Case 2 differs from case 1 by showing the period of uncertainty if the start time is near 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 between cameras and network conditions.

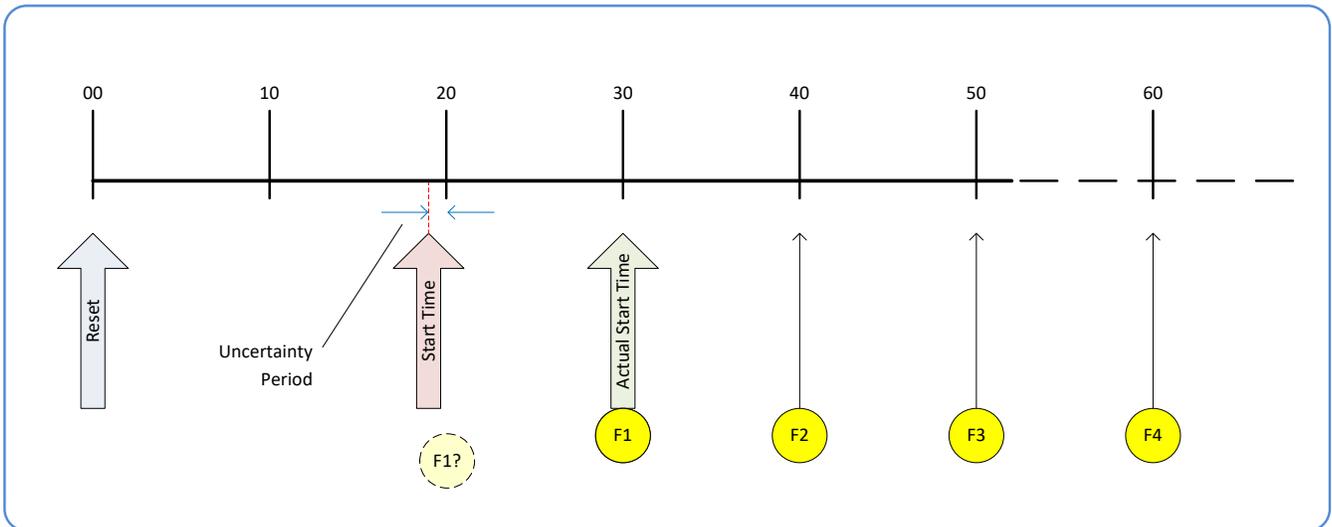


Figure 94: Case 2 – Potential Uncertainty to the Start Time

### 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).

If a new Timestamp Reset happens between the Start Time and acquisition Actual Start Time, the Timestamp counter will restart from time 00. 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.

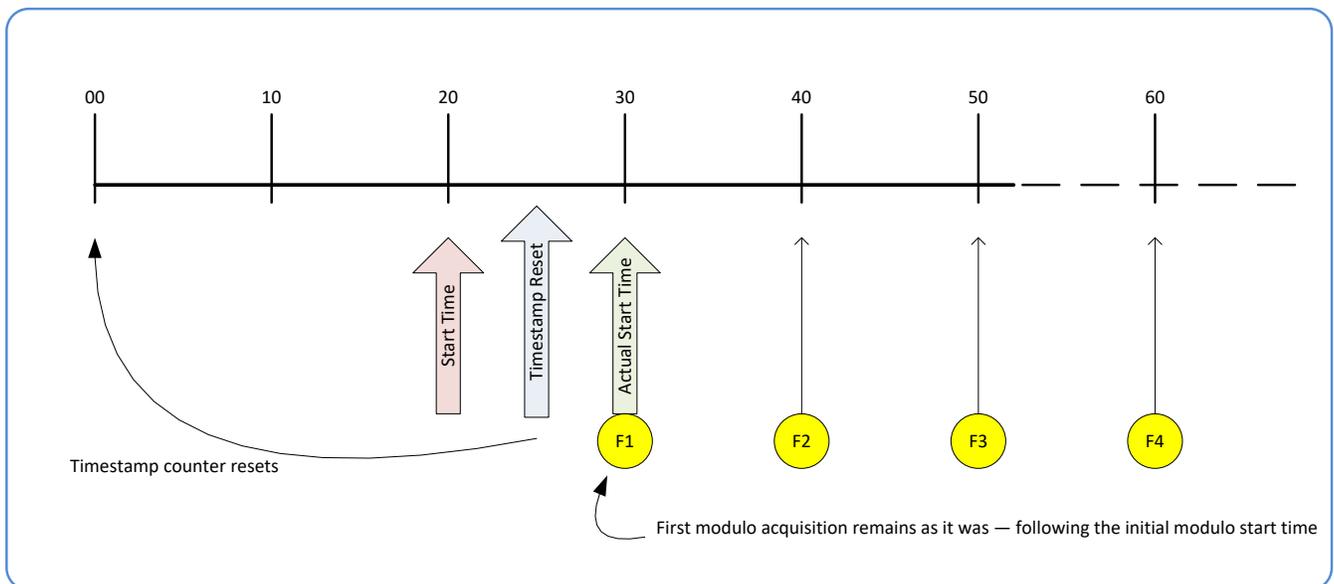


Figure 95: Case 3 – Timer Reset before the Actual Start Time

## 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.

- “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.

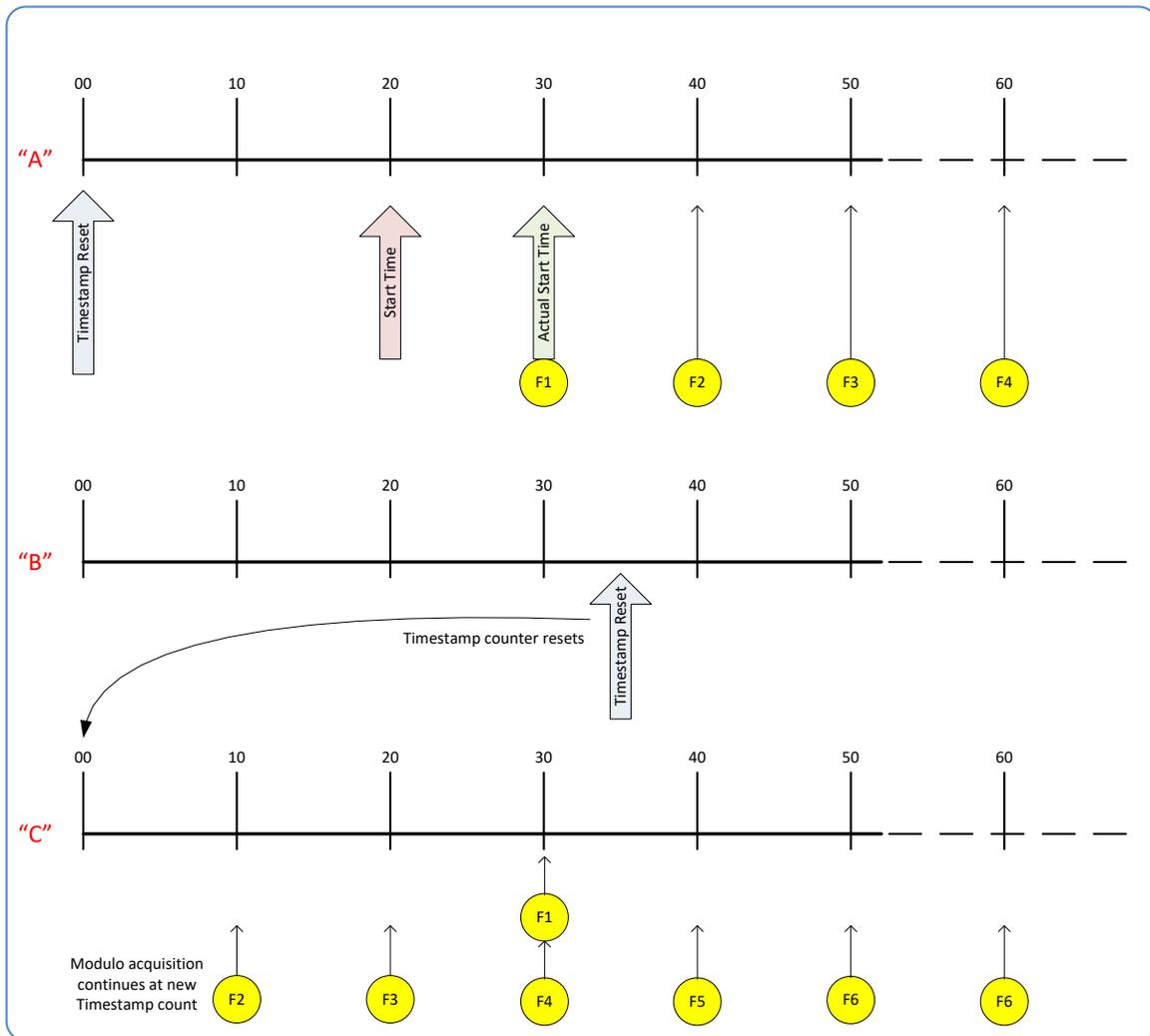


Figure 96: Case 4 – Timer Reset after the Actual Start Time

## 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 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.

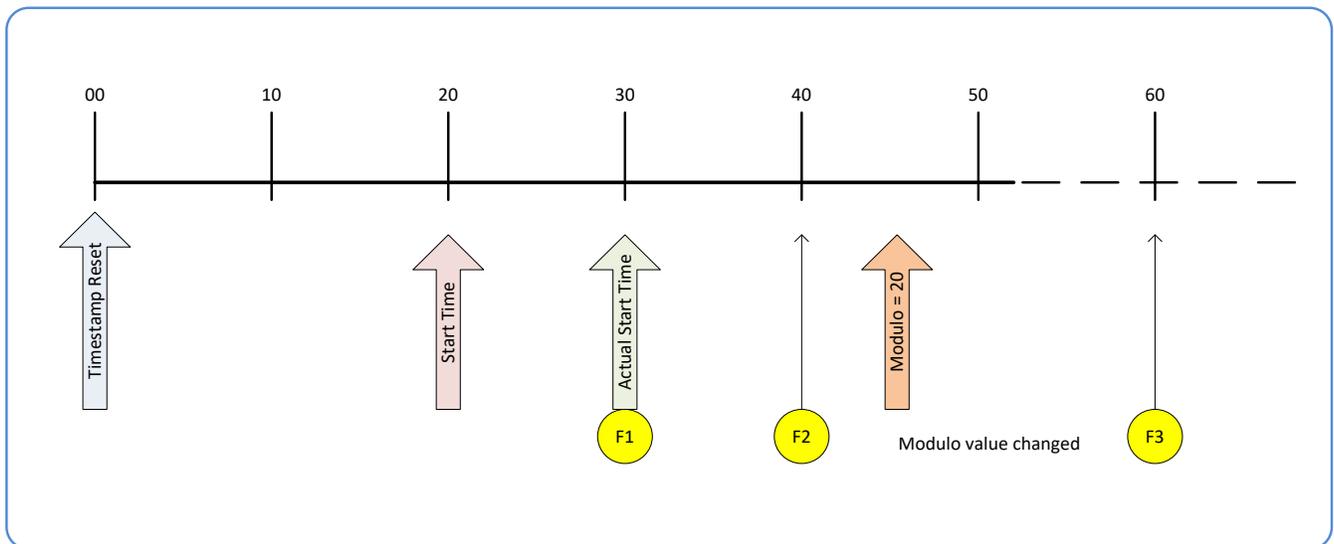


Figure 97: Case 5 – Changing 'timestampModulo' during Acquisitions

# GigE Vision Transport Layer Control Category

The Linea Lite GigE Vision Transport Layer Control category groups parameters used to configure features related to GigE Vision specification and the Ethernet Connection.

Category	Parameter	Value
Camera Information	Device Link Selector	0
Sensor Control	Device Link Throughput Limit	On
I/O Controls	Device Link Throughput Limit (in Bps)	115000000
Counter and Timer Control	Stream Channel Selector	0
<input checked="" type="checkbox"/> <b>Advanced Processing</b>	Device Link Speed (in Mbps)	1000
Image Format Controls	PacketSize	1500
<input checked="" type="checkbox"/> <b>Metadata Controls</b>	Interpacket Delay	2
Acquisition and Transfer Control	Packet Resend Buffer Size (in MB)	6.0
Action Control	IP Configuration Status	DHCP
<input checked="" type="checkbox"/> <b>Event Control</b>	Current IP Address	169.254.10.136
GigE Vision Transport Layer	Current Subnet Mask	255.255.0.0
File Access Control	Current Default Gateway	0.0.0.0
GigE Vision Host Controls	Current IP set in LLA	True
	Current IP set in DHCP	True
	Current IP set in PersistentIP	False
	Primary Application IP Address	169.254.211.19
	Device Access Privilege Control	Exclusive Access
	Current Heartbeat Timeout	3000
	GVCP Heartbeat Disable	Not Enabled
	Communication Timeout (in msec)	0
	Communication Retransmissions Count	0

Figure 98: CamExpert – GigE Vision Transport Layer Category

## GigE Vision Transport Layer Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Device Link Selector	DeviceLinkSelector	Selects which Link of the device to control.	Expert
Device Link Throughput Limit	DeviceLinkThroughputLimitMode	When disabled, lower level TL specific features are expected to control the throughput. When enabled, DeviceLinkThroughputLimit controls the overall throughput.	
	<i>Off</i>	<i>Disables the DeviceLinkThroughputLimit feature.</i>	
	<i>On</i>	<i>Enables the DeviceLinkThroughputLimit feature.</i>	
Device Link Throughput Limit (in Bps)	DeviceLinkThroughputLimit	Limits the maximum bandwidth of the data that will be streamed out by the device.	Guru
Stream Channel Selector	GevStreamChannelSelector	Selects the stream channel to control.	Expert
Device Link Speed (in Mbps)	GevLinkSpeed	Indicates the transmission speed negotiated by the given network interface. (in Mbps) (RO)	Expert
Packet Size	GevSCPSPacketSize	Specifies the stream packet size in bytes to send on this channel.	Expert
Interpacket Delay	GevSCPD	Indicates the delay (in $\mu$ s) to insert between each packet for this stream channel.	Expert
Packet Resend Buffer Size (in MB)	devicePacketResendBufferSize	Indicates the amount of memory to reserve in MBytes for the packet resend buffer.	DFNC Guru

Display Name	Feature & Values	Description	Standard & View
IP Configuration Status	GevIPConfigurationStatus	Reports the current IP configuration status. (RO)	Guru
None	None	Device IP Configuration is not defined.	
PersistentIP	PersistentIP	Device IP Address Configuration is set to Persistent IP (static).	
DHCP	DHCP	Device IP Address Configuration is set to DHCP (Dynamic Host Configuration Protocol). Network requires a DHCP server.	
LLA	LLA	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.	
ForceIP	ForceIP	Device IP Address Configuration is set to ForceIP. Used to force an IP address change.	
Current IP Address	GevCurrentIPAddress	Reports the IP address for the given network interface. (RO)	Beginner
Current Subnet Mask	GevCurrentSubnetMask	Reports the subnet mask of the given interface. (RO)	Beginner
Current Default Gateway	GevCurrentDefaultGateway	Reports the default gateway IP address to be used on the given network interface. (RO)	Beginner
Current IP set in LLA	GevCurrentIPConfigurationLLA	Controls whether the LLA (Link Local Address) IP configuration scheme is activated on the given network interface. (RO)	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.	Guru
Current IP set in Persistent IP	GevCurrentIPConfigurationPersistentIP	Controls whether the PersistentIP configuration scheme is activated on the given network interface.	Guru
Primary Application IP Address	GevPrimaryApplicationIPAddress	Returns the IP address of the device hosting the primary application. (RO)	Guru
Device Access Privilege Control	deviceCCP	Controls the device access privilege of an application.	Guru DFNC
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.	
Current Heartbeat Timeout	GevHeartbeatTimeout	Indicates the current heartbeat timeout in milliseconds.	Guru
GVCP Heartbeat Disable	GevGVCPHeartbeatDisable	Disables the GVCP (GigE Vision Control Protocol) heartbeat monitor. This allows control switchover to an application on another device.	Expert
Communication Timeout (in msec)	GevMCTT	Provides the transmission timeout value in milliseconds.	Guru
Communication Retransmissions Count	GevMCRC	Indicates the number of retransmissions allowed when a message channel message times out.	Guru
Fire Test Packet	GevSCPSFireTestPacket	When this feature is set to True, the device will fire one test packet.	Invisible
MAC Address	GevMACAddress	MAC address of the network interface. (RO)	Invisible
Current Camera IP Configuration	GevCurrentIPConfiguration	Current camera IP configuration of the selected interface. (RO)	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.	Invisible
Persistent Subnet Mask	GevPersistentSubnetMask	Persistent subnet mask for the selected interface.	Invisible
Persistent Default Gateway	GevPersistentDefaultGateway	Persistent default gateway for the selected interface.	Invisible
Primary Application Socket	GevPrimaryApplicationSocket	Returns the UDP (User Datagram Protocol) source port of the primary application. (RO)	Invisible

Display Name	Feature & Values	Description	Standard & View
Device Access Privilege Control	GevCCP  <i>Open Access</i> <i>Exclusive Access</i>  <i>Control Access</i>	Controls the device access privilege of an application.  <i>OpenAccess</i> <i>OpenAccess</i> <i>Grants exclusive access to the device to an application. No other application can control or monitor the device.</i> <i>ControlAccess</i> <i>Grants control access to the device to an application. No other application can control the device.</i>	Invisible
Interface Selector	GevInterfaceSelector	Selects which physical network interface to control.	Invisible
Number of Interfaces	GevNumberOfInterfaces	Indicates the number of physical network interfaces supported by this device. (RO)	Invisible
Message Channel Count	GevMessageChannelCount	Indicates the number of message channels supported by this device. (RO)	Invisible
Stream Channel Count	GevStreamChannelCount	Indicates the number of stream channels supported by this device (0 to 512). (RO)	Invisible
Gev Supported Option Selector	GevSupportedOptionSelector	Selects the GEV option to interrogate for existing support. (RO)	Invisible
	<i>IPConfigurationLLA</i> <i>IPConfigurationDHCP</i> <i>IPConfigurationPersistentIP</i> <i>StreamChannelSourceSocket</i> <i>MessageChannelSourceSocket</i> <i>CommandsConcatenation</i> <i>WriteMem</i> <i>PacketResend</i> <i>Event</i> <i>EventData</i> <i>PendingAck</i> <i>Action</i> <i>PrimaryApplicationSwitchover</i> <i>ExtendedStatusCodes</i> <i>DiscoveryAckDelay</i> <i>DiscoveryAckDelayWritable</i> <i>TestData</i> <i>ManifestTable</i> <i>CCPApplicationSocket</i> <i>LinkSpeed</i> <i>HeartbeatDisable</i> <i>SerialNumber</i> <i>UserDefinedName</i> <i>StreamChannel0BigAndLittleEndian</i> <i>StreamChannel0IPReassembly</i> <i>StreamChannel0UnconditionalStreaming</i> <i>StreamChannel0ExtendedChunkData</i>		
Gev Supported Option	GevSupportedOption	Returns TRUE if the selected GEV option is supported. (RO)	Invisible
LLA Supported	GevSupportedIPConfigurationLLA	Indicates if LLA (Auto-IP) is supported by the selected interface. The LLA method automatically assigns the camera 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)	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 camera 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)	Invisible

Display Name	Feature & Values	Description	Standard & View
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 camera is connected to a network with a different subnet, it cannot be accessed. (RO)	Invisible
GVCP Extended Status Codes	GevGVCPExtendedStatusCodes	Enables generation of extended status codes. (RO)	Invisible
Gev MCP HostPort	GevMCPHostPort	Indicates the port to which the device must send messages. (RO)	Invisible
Gev MCDA	GevMCDA	Indicates the destination IP address for the message channel. (RO)	Invisible
Gev MCSP	GevMCSP	This feature indicates the source port for the message channel. (RO)	Invisible
Stream Channel Interface Index	GevSCPInterfaceIndex	Index of network interface. (RO)	Invisible
Gev SCP HostPort	GevSCPHostPort	Indicates the port to which the device must send the data stream. (RO)	Invisible
Gev SCDA	GevSCDA	Indicates the destination IP address for this stream channel. (RO)	Invisible
Gev SCSP	GevSCSP	Indicates the source port of the stream channel. (RO)	Invisible
Gev First URL	GevFirstURL	Indicates the first URL to the XML device description file. (RO)	Invisible
Gev Second URL	GevSecondURL	Indicates the second URL to the XML device description file. (RO)	Invisible
Gev Major Version	GevVersionMajor	Major version of the specification. (RO)	Invisible
Gev Minor Version	GevVersionMinor	Minor version of the specification. (RO)	Invisible
Manifest Entry Selector	DeviceManifestEntrySelector	Selects the manifest entry to reference.	Invisible
XML Major Version	DeviceManifestXMLMajorVersion	Indicates the major version number of the XML file of the selected manifest entry. (RO)	Invisible
XML Minor Version	DeviceManifestXMLMinorVersion	Indicates the Minor version number of the XML file of the selected manifest entry. (RO)	Invisible
XML SubMinor Version	DeviceManifestXMLSubMinorVersion	Indicates the SubMinor version number of the XML file of the selected manifest entry. (RO)	Invisible
Schema Major Version	DeviceManifestSchemaMajorVersion	Indicates the major version number of the Schema file of the selected manifest entry. (RO)	Invisible
Schema Minor Version	DeviceManifestSchemaMinorVersion	Indicates the minor version number of the Schema file of the selected manifest entry. (RO)	Invisible
Manifest Primary URL	DeviceManifestPrimaryURL	Indicates the first URL to the XML device description file of the selected manifest entry. (RO)	Invisible
Manifest Secondary URL	DeviceManifestSecondaryURL	Indicates the second URL to the XML device description file of the selected manifest entry. (RO)	Invisible
Device Mode Is Big Endian	GevDeviceModelsBigEndian	Endianess of the device registers. (RO)	Invisible
Device Mode CharacterSet	GevDeviceModeCharacterSet	Character set used by all the strings of the bootstrap registers. (RO)	Invisible
	<i>reserved1</i> <i>UTF8</i> <i>reserved2</i>		
GevSCPSDoNotFragment	GevSCPSDoNotFragment	This feature state is copied into the "do not fragment" bit of IP header of each stream packet. (RO)	Invisible
Gev SCPS BigEndian	GevSCPSBigEndian	Endianess of multi-byte pixel data for this stream. (RO)	Invisible
TLParamsLocked	TLParamsLocked	Flag to indicate if features are locked during acquisition.	Invisible

# File Access Control Category

The File Access control in CamExpert allows the user to quickly upload various data files to the connected Linea Lite GigE. The supported data files are for Linea Lite GigE firmware updates and Flat Field coefficients.

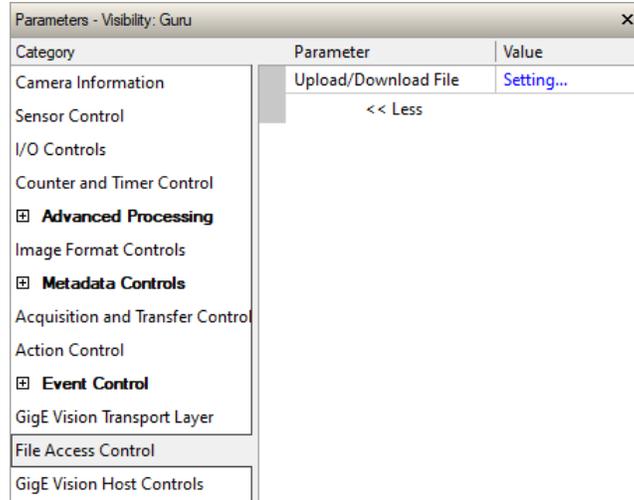


Figure 99: CamExpert – File Access Control Category

## NOTE

In CamExpert the File Access Control features are not exposed directly but are accessed through the File Access Control dialog for easier operation.

## File Access Control Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
File Selector	FileSelector	Selects the file to access. The file types which are accessible are device-dependent.	Guru
<i>Firmware</i>	<i>Firmware1</i>	<i>Upload new firmware to the camera which will execute on the next camera reboot cycle. Select the DeviceReset feature after the upload completes.</i>	
<i>Factory Flat Line Coefficients 1</i>	<i>FlatFieldCoefficients01</i>	<i>Select factory flatfield coefficients1. These are the factory values when the camera sensor Gain is 1.0.</i>	
<i>User Flat Line Coefficients 1</i>	<i>FlatFieldCoefficients1</i>	<i>Select to read (download), write (upload) or delete the User flatfield coefficients 1.</i>	
<i>User Flat Line Coefficients 2</i>	<i>FlatFieldCoefficients2</i>	<i>Select to read (download), write (upload) or delete the User flatfield coefficients 2.</i>	
<i>User Flat Line Coefficients 3</i>	<i>FlatFieldCoefficients3</i>	<i>Select to read (download), write (upload) or delete the User flatfield coefficients 3.</i>	
<i>User Flat Line Coefficients 4</i>	<i>FlatFieldCoefficients4</i>	<i>Select to read (download), write (upload) or delete the User flatfield coefficients 4.</i>	
<i>LUT Luminance 1</i>	<i>LutLuminance1</i>	<i>Select to write (upload) a Look-up-Table file (Sapera .LUT file) into the camera's internal LUT Luminance 1.</i>	
<i>User Defined Saved Image</i>	<i>userDefinedSavedImage</i>	<i>Upload and download an image in the camera.</i>	
<i>Open Source Licenses</i>	<i>SoftwareLicenses</i>	<i>Open Source Software Licenses.</i>	

Display Name	Feature & Values	Description	Standard & View
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
<i>Open</i>	<i>Open</i>	<i>Select the Open operation - executed by FileOperationExecute.</i>	
<i>Close</i>	<i>Close</i>	<i>Select the Close operation - executed by FileOperationExecute.</i>	
<i>Read</i>	<i>Read</i>	<i>Select the Read operation - executed by FileOperationExecute.</i>	
<i>Write</i>	<i>Write</i>	<i>Select the Write operation - executed by FileOperationExecute.</i>	
<i>Delete</i>	<i>Delete</i>	<i>Select the Delete operation - executed by FileOperationExecute.</i>	
File Operation Execute	FileOperationExecute	Executes the operation selected by File Operation Selector on the selected file.	Guru
File Open Mode	FileOpenMode	Selects the access mode used to open a file on the device.	Guru
<i>Read</i>	<i>Read</i>	<i>Select READ only open mode.</i>	
<i>Write</i>	<i>Write</i>	<i>Select WRITE only open mode.</i>	
File Access Buffer	FileAccessBuffer	Defines the intermediate access buffer that allows the exchange of data between the device file storage and the application.	Guru
File Access Offset (in B)	FileAccessOffset	Controls the mapping offset between the device file storage and the file access buffer.	Guru
File Access Length (in B)	FileAccessLength	Controls the mapping length between the device file storage and the file access buffer.	Guru
File Operation Status	FileOperationStatus	Displays the file operation execution status. (RO)	Guru
<i>Success</i>	<i>Success</i>	<i>The last file operation has completed successfully.</i>	
<i>Failure</i>	<i>Failure</i>	<i>The last file operation has completed unsuccessfully for an unknown reason.</i>	
<i>File Unavailable</i>	<i>FileUnavailable</i>	<i>The last file operation has completed unsuccessfully because the file is currently unavailable.</i>	
<i>File Invalid</i>	<i>FileInvalid</i>	<i>The last file operation has completed unsuccessfully because the selected file is not present in this camera model.</i>	
File Operation Result	FileOperationResult	Displays the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned. (RO)	Guru
File Size (in B)	FileSize	Represents the size of the selected file in bytes.	Guru
Device User Buffer	deviceUserBuffer	Unallocated memory available to the user for data storage.	DFNC Invisible
FTP File Access	ftpFileAccessSupported	Shows whether File Access is supported over FTP.	DFNC Invisible

## File Access via the CamExpert Tool

- Click **Setting** to open the File Access Control dialog.

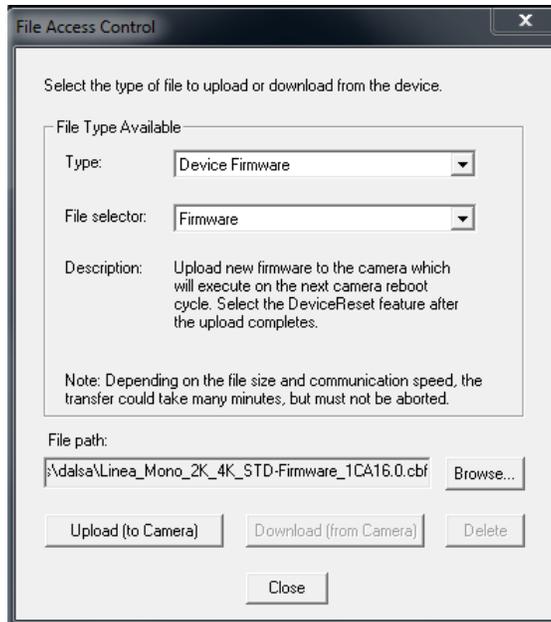


Figure 100: CamExpert – File Access Control Dialog

- **Type:** select the file type to upload to camera.
- **File Selector:** select the required file; different options may be available depending on the Type selected.
- Click **Browse** to open Windows Explorer and select the specific file to upload.
- Click **Upload (to Camera)** to execute the file transfer to the Linea Lite GigE.

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## GigE Vision Host Control Category

The GigE Vision Host Controls category group parameters used to configure the host computer system GigE Vision features used for Linea Lite GigE networking management. **None of these parameters are stored in any Linea Lite GigE camera.**

These features allow optimizing the network configuration for maximum 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 Getting Started Manual for GigE Vision Cameras & 3D Sensors.

# Super Resolution

Features related to operating the camera in super resolution mode. Available for model 8k SR only. Sopera LT 8.73 required.

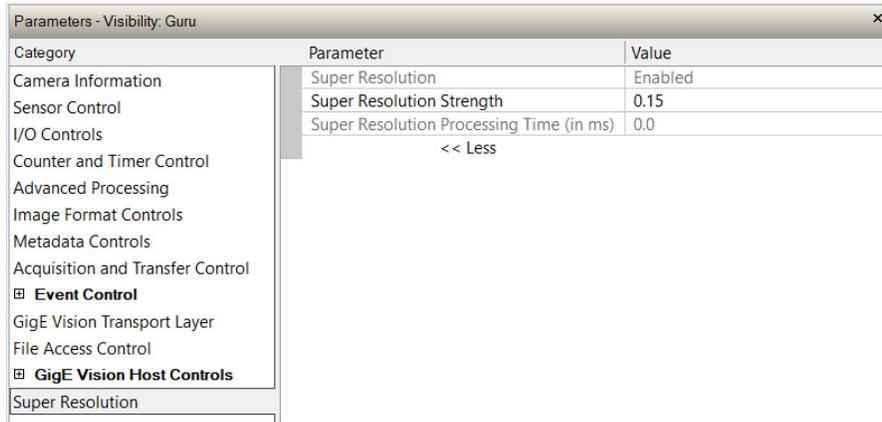


Figure 101: CamExpert – Super Resolution Category

## Super Resolution Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Super Resolution	superResolution	Indicates whether the super resolution mode is enabled. (RO) To enable, select <u>Sensor TDI Mode</u> option <i>8K SR, High-BW</i> (Sensor Control category).	Beginner DFNC
Super Resolution Strength	srStrength	Strength of the edge reconstruction of the Super Resolution algorithm. A higher number will improve image contrast but may increase noise.	Beginner DFNC
Super Resolution Processing Time (in ms)	srProcessingTime	Reports the time used to generate one super resolution frame from the data sent by the camera, in milliseconds. (RO)	Beginner DFNC

---

# Device Streaming Registers

## Start – End Command Requirements

### IMPORTANT

Every start command must have a corresponding end command. If not, the camera can be in an unpredictable state. This pertains to *DeviceRegistersStreamingStart*, *DeviceRegistersStreamingEnd*, *DeviceFeaturePersistenceStart*, and *DeviceFeaturePersistenceEnd*.

Device Registers Streaming Start	DeviceRegistersStreamingStart	Announces the start of registers streaming without immediate checking for consistency.	Invisible
Device Registers Streaming End	DeviceRegistersStreamingEnd	Announces end of registers streaming and performs validation for registers consistency before activating them.	Invisible
Device Feature Streaming Start	DeviceFeaturePersistenceStart	Announces the start of feature streaming without immediate checking for consistency.	Invisible
Device Feature Streaming End	DeviceFeaturePersistenceEnd	Announces end of feature streaming and performs validation for feature consistency before activating them.	Invisible
Register Check	DeviceRegistersCheck	Performs an explicit register set validation for consistency.	Invisible
Registers Valid	DeviceRegistersValid	States if the current register set is valid and consistent.	Invisible

# Implementing Trigger-to-Image Reliability

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## Overview

In a complex imaging system, many points of possible failure exist – from acquisition to processing and transmission. Teledyne DALSA provides features, events and I/O signals that provide the system designer with tools to qualify the system in real-time.

Teledyne DALSA's website provides general information, FAQ and White Papers about the Trigger-to-Image Reliability (T2IR) framework in hardware and Sopera LT SDK. See <https://www.teledynedalsa.com/en/learn/knowledge-center/trigger-to-image-reliability-t2ir/>.

## T2IR with Linea Lite

Linea Lite 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

# Linea Lite Features for T2IR Monitoring

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

Camera Status Monitoring	
Device Built-In Self-Test	deviceBIST
Device Built-In Self-Test Status	deviceBISTStatus
Device Temperature Selector	DeviceTemperatureSelector
Device Version	DeviceVersion
Firmware Version	DeviceFirmwareVersion
Last firmware Update Failed	FirmwareUpdateFailure
Manufacturer Part Number	deviceManufacturerPartNumber
Manufacturer Info	DeviceManufacturerInfo
Events	
Event Selector	EventSelector
Event Notification	EventNotification
Event Statistic Selector	eventStatisticSelector
Event Statistic Count	eventStatisticCount
Events Overflow	eventsOverflow
Event Statistic Count Reset	eventStatisticCountReset
Acquisition and Triggers	
Valid Frame Trigger	ValidFrameTrigger
Invalid Frame Trigger	InvalidFrameTrigger
Image Lost	ImageLost
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

# Network Overview & Tools

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## Linea Lite GigE IP Configuration Sequence

The IP (Internet Protocol) Configuration sequence to assign an IP address is executed automatically on camera power-up or when a connection is established to a network. As a GigE Vision compliant device, Linea Lite GigE 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)

The factory defaults for Linea Lite GigE is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification.

## Supported Network Configurations

The Linea Lite GigE obtains an IP address using the Link Local Address (LLA) or DHCP, by default. A LLA IP address is obtained typically in a few seconds with Microsoft Windows 7/8/10. If required, a persistent IP address can be assigned (see the [Running the Network Configuration Tool](#) section).

Preferably, a DHCP server is present on the network, where the Linea Lite GigE issues a DHCP request for an IP address. The DHCP server then provides the IP address. The Teledyne DALSA Network Configuration tool, installed with the Teledyne DALSA Network Imaging Package, provides a DHCP server which is easily enabled on the NIC used with the Linea Lite GigE (Refer to Teledyne DALSA's Sapera LT Getting Started Manual for GigE Vision Cameras).

The LLA method, if used, automatically assigns the camera with a randomly chosen address on the 169.254.xxx.xxx subnet. After an address is chosen, the LLA process sends an Address Resolution Protocol (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.

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## IP Configuration Mode Details

The following descriptions provide more information on the IP configuration modes supported by Linea Lite GigE. In general, automatic IP configuration assignment (LLA/DHCP) is sufficient for most Linea Lite installations.

Refer to **Teledyne DALSA's Network Imaging Package for Sapera LT Optimization Guide** for information on the Teledyne DALSA Network Configuration tool and network optimization for GigE Vision cameras and devices.

Refer to **Sapera LT Getting Started Manual for GigE Vision Cameras** for information on using GigE Vision cameras.

### Link-Local Address (LLA)

- LLA is also known as Auto-IP. It is used for unmanaged networks including direct connections from a GigE Vision device to a dedicated NIC.
- A subnet configured with LLA cannot send packets across routers but only via Ethernet switches.
- LLA is the recommended scheme when only one NIC is connected to GigE cameras. LLA is fully automatic requiring no user input.

#### NOTE

Ensure only one NIC is using LLA on your PC, otherwise IP conflicts will occur.

- The NIC will automatically assign a random IP address within the 169.254.x.x subnet. The LLA protocol ensures there are no conflicts with other devices through an arbitration scheme.
- The Windows NIC configuration must be set to DHCP (the typical default case) and no DHCP server must be present on the network. Otherwise, an IP address gets assigned by the DHCP server. Windows will turn to LLA when no DHCP server answers requests coming from the NIC.
- Windows and Linea Lite GigE are still running the DHCP process in the background. If a DHCP server becomes available on the network, the NIC will get a DHCP assigned IP address for the connected device but connections on the LLA IP address will be lost. The Teledyne DALSA Network Configuration Tool can enable the Teledyne DALSA DHCP server on the NIC used for the GigE Vision network.

#### IMPORTANT

If the host system has multiple NIC devices configured with LLA, then the communication stack cannot accurately resolve which NIC to forward an IP packet on the 169.254 segment. Limit the number of NIC configured using LLA to one interface. It is preferable that the Teledyne DALSA DHCP server is used instead of LLA mode (see next section).

- Use Teledyne DALSA's Network Configuration Tool to change the Linea Lite GigE from the default DHCP / LLA mode to Persistent IP mode when required, such as when there are multiple NIC devices with Linea Lite GigE connected to each.

#### NOTE

Teledyne DALSA recommends DHCP / LLA as the mode of operation where a switch is used to connect multiple devices.

## DHCP (Dynamic Host Configuration Protocol)

- This IP configuration mode requires a DHCP server to allocate an IP address dynamically over the range of some defined subnet. The Linea Lite GigE camera must be configured to have DHCP enabled. This is the factory default setting.
- 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 Teledyne DALSA's Network Configuration Tool can configure the Teledyne DALSA DHCP server on the NIC used for the GigE Vision network.
- Teledyne DALSA DHCP server is recommended where there are multiple NIC ports with multiple GigE Vision devices attached. Each NIC port must use a different subnet to avoid IP address conflicts. Persistent IP assignment is required if there is no DHCP server for any additional subnet.
- Windows configures a NIC in DHCP mode by default. If no DHCP server is present on the subnet, Windows reverts to LLA mode.
- Ensure a different subnet is assigned to each NIC on the network. This will automatically be managed when the Teledyne DALSA DHCP server is enabled on one or all subnets used for GigE Vision devices. The graphic below illustrates a system with one NIC having the Teledyne DALSA DHCP server enabled.

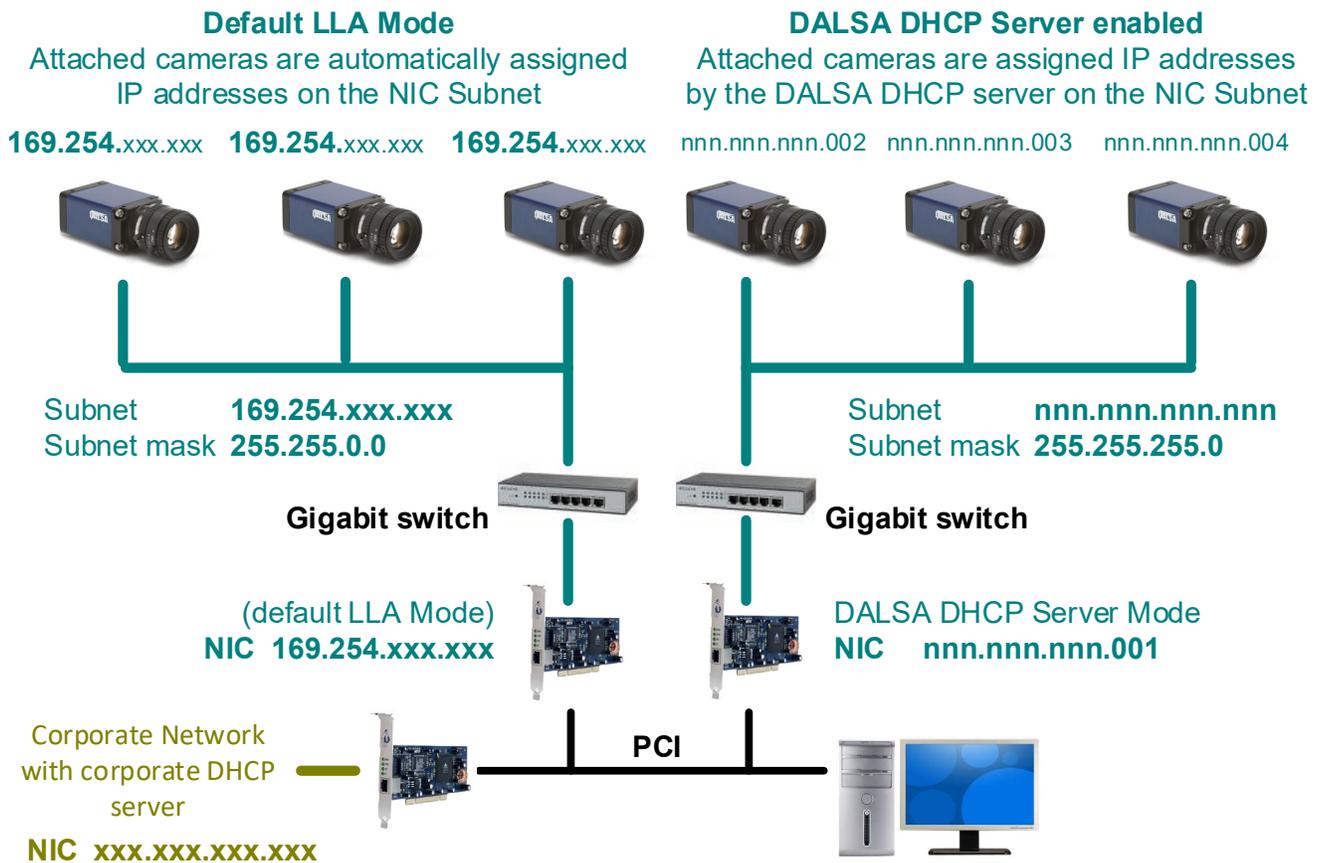


Figure 102: DHCP Configuration Overview

## Persistent IP

- Allows the user full control of IP address assignment on the network.
- The camera is forced a static IP address. The NIC IP address must be the same to access the camera.
- If the camera is connected to a network with a different subnet, it cannot be accessed.
- Use Teledyne DALSA's Network Configuration Tool to set a persistent IP address. Refer to Teledyne DALSA's Network Imaging manual.
- Example of a Persistent IP address assignment on a class B network:
  - NIC Subnet = 192.168.1.1
  - Subnet Mask = 255.255.0.0
  - Persistent IP = 192.168.1.2
  - Default Gateway = 0.0.0.0

### WARNING

An incorrect IP address assignment may block connecting to the camera. Use Teledyne DALSA's Network Configuration tool to recover a camera with an unknown persistent IP. It will reset the camera's factory default mode, DHCP / LLA. The camera's MAC address displayed on the exterior camera is required to perform this function.

- For GigE Vision applications, the FORCEIP command is used to force a new persistent IP or to change the IP configuration protocol. The camera's MAC address must be known to use the FORCEIP command.
- The following illustration shows a functional computer setup with three NIC ports but no DHCP server. Two NIC ports are used for private GigE Vision networks. The first uses the default LLA mode for IP addresses, the second NIC and cameras connected to it are configured with persistent IP addresses. An application on the computer can control each camera, on each subnet, without conflict.

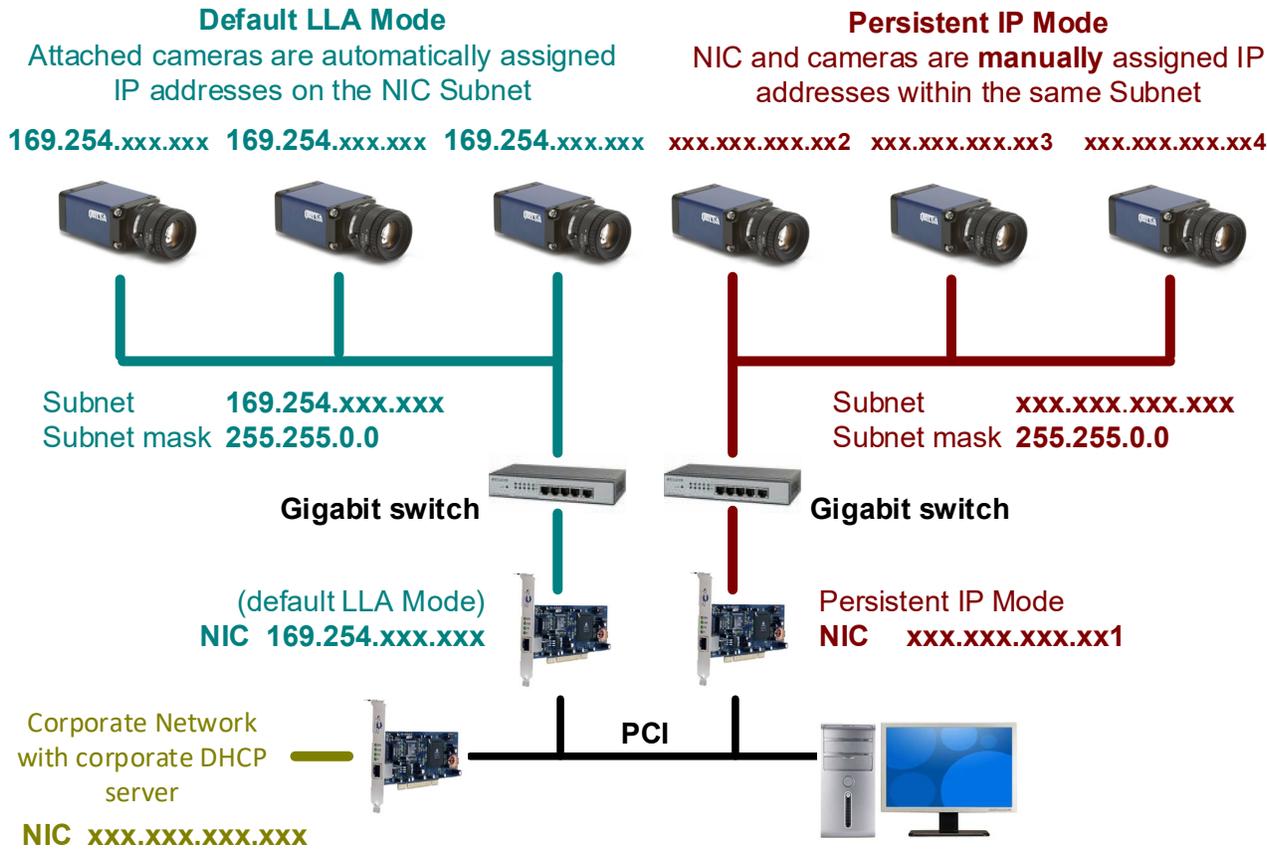


Figure 103: Persistent IP Configuration Overview

# Optimizing the Network Adapter used with Linea Lite GigE

Most Gigabit network interface controllers (NIC) allow user modifications to parameters such as Adapter Buffers and Jumbo Frames. The optimal settings will be system dependent. These should be optimized for use with the Linea Lite GigE during installation; refer to Teledyne DALSA's Network Imaging Package for Sapera LT Optimization Guide for more information.

## Running the Network Configuration Tool

The Network Configuration tool provides access to NIC and connected GigE Vision camera parameters without use of any Windows Control Panel application.

This tool allows you to:

- Activate the Network Imaging driver use for image acquisition on any NIC or disable the imaging driver for any NIC not used with a GigE Vision camera.
- Configure the NIC as a DHCP server for connected GigE Vision camera.
- Change the Auto Discovery Interval from the default of 15 seconds.
- Configure the NIC and camera IP settings.
- Assign a User Defined name to a connected camera.
- Assign a Persistent IP address to a camera instead of the default DHCP / LLA assigned address.

### CAUTION

Changes made with this tool may update Linea Lite GigE parameters stored in flash memory. Do not remove power from the camera for a minimum 10 seconds.

Refer to Teledyne DALSA's **Sapera LT Getting Started Manual for GigE Vision Cameras** for more detailed information on using this tool. The Network Configuration tool can quickly verify and modify certain network configuration items of the imaging system.

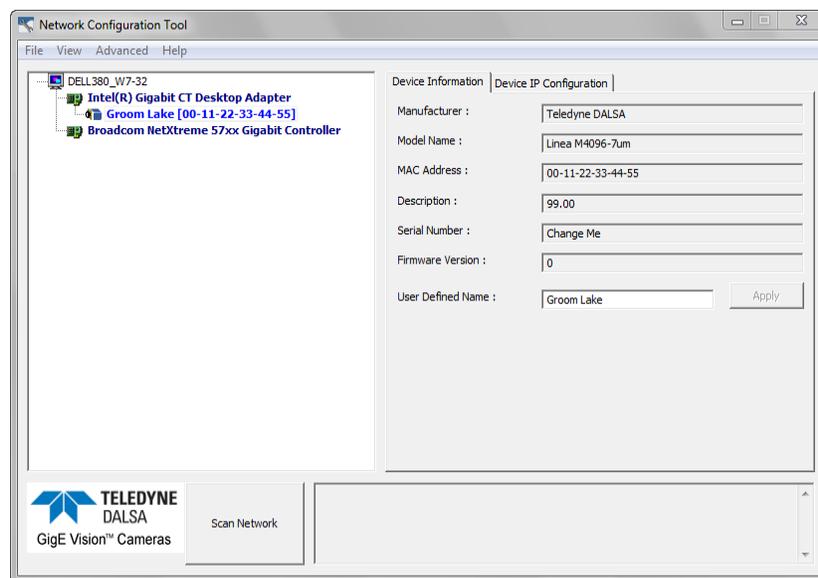


Figure 104: Network Configuration Tool

## To open the Network Configuration Tool

From the **Start** menu select **Teledyne DALSA > Network Configuration Tool**.



Figure 105: Windows Start Menu Network Configuration Tool Shortcut

Verify the camera appears as a child of the NIC card it is connected to. By default, the camera is identified by its serial number if no user defined name has been assigned.

## PAUSE Frame Support

The Linea Lite GigE supports the Gigabit Ethernet PAUSE Frame feature as per IEEE 802.3x. PAUSE Frame is the Ethernet flow control mechanism that temporarily stops data transmission on the network. The PAUSE Frame feature can help a NIC that does not have enough buffering to handle full-speed reception. This requires that the flow control option in the NIC property settings and the Ethernet switch settings must be enabled.

### NOTE

this problem is not as common with advances in computer bus speeds and memory sizes. PAUSE Frame support is typically required to manage network traffic within an Ethernet switch when multiple cameras are simultaneously used. Using PAUSE Frame will require the user to test various values of Jumbo Frames, to determine the best data throughput. The downside to managed network traffic is that the Pause Frame control will reduce the absolute maximum transfer bandwidth possible on the network.

# Technical Specifications

## Mechanical Specifications

### Linea Lite GigE 2k / 4k / 8k SR

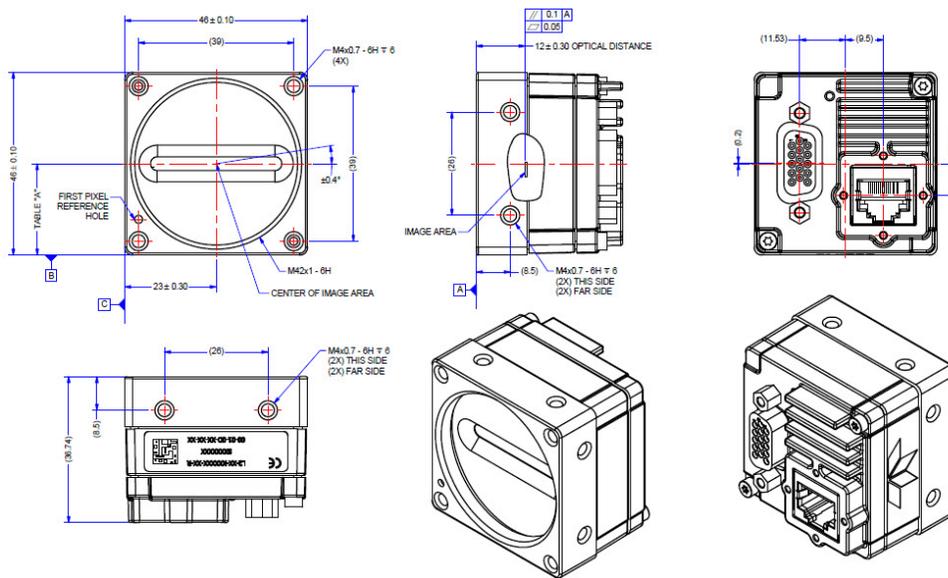


TABLE A	
CAMERA P/N	DIMENSION
L2-XX-02KXXX-	23.2 ± 0.30
L2-XX-04KXXX-	23.0 ± 0.30
L2-XX-08KXXX-	22.96 ± 0.30

NOTES:  
 1. UNITS: MILLIMETERS.  
 2. IMAGE AREA IS ALIGNED TO DATUMS [A], [B], & [C].

Figure 106: Linea Lite GigE 2k / 4k / 8k with M42x1 Lens Mount

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# Additional Notes on Linea Lite GigE Identification and Mechanical

## Identification Label

Linea Lite GigE cameras have an identification label applied to its side, with the following information:

- Model Part number
- Serial number
- MAC Address
- 2D Barcode

## Additional Mechanical Notes

- Linea Lite GigE supports a screw lock Ethernet cable (see [Ruggedized RJ45 Ethernet Cables](#)).
- For information on lens requirements see [Lens Selection Overview](#) and [Optical Considerations](#).
- Each camera side has two mounting holes in identical locations to provide grounding capabilities.
- Overall height or width tolerance is  $\pm 0.10$  mm.

# Sensor Alignment Specification

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

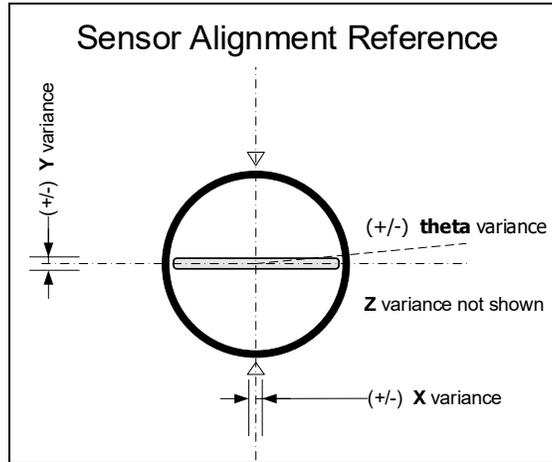


Figure 107: Sensor Alignment Reference

<b>X variance</b>	$\pm 300 \mu\text{m}$
<b>Y variance</b>	$\pm 300 \mu\text{m}$
<b>Z variance</b>	$\pm 300 \mu\text{m}$
<b>Theta variance</b>	$\pm 0.4^\circ$

# Connectors

- **RJ45 Ethernet** connector for control and video data to the host Gigabit NIC. For industrial environments, Linea GigE supports the use of screw lock Ethernet cables (see [Ruggedized RJ45 Ethernet Cables](#)).
- A single **HD15 female** connector for all I/O and DC power source.

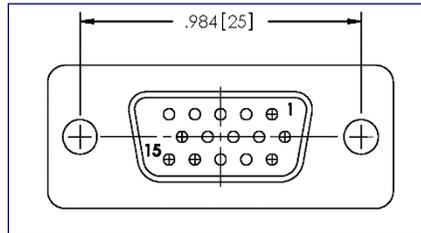


Figure 108: HD15 Female Connector

## HD15 Connector Details

Pin Number	Linea Lite GigE	Direction	Definition
1	Line 1+	In	RS-422 <sub>[1]</sub> Input Port 1+
2	Line 1-	In	RS-422 <sub>[1]</sub> Input Port 1-
3	Line 2+	In	RS-422 <sub>[1]</sub> Input Port 2+
4	Line 2-	In	RS-422 <sub>[1]</sub> Input Port 2-
5	Signals Ground		Signals Ground
6	Line 3+	In/Out	Configurable <sub>[2]</sub> IO Port 3+
7	Line 3 -	In/Out	Configurable <sub>[2]</sub> IO Port 3-
8	Input Trigger Level	Out	
9	Input Trigger Level	Out	
10	PWR-GND		Camera Power Ground
11	Line 4+	Out	Configurable <sub>[3]</sub> Output Port 4+
12	Line 4-	Out	Configurable <sub>[3]</sub> Output Port 4-
13	Line 5+	Out	Configurable <sub>[3]</sub> Output Port 5+
14	Line 5-	Out	Configurable <sub>[3]</sub> Output Port 5-
15	PWR-VCC		Camera Power – DC +12 to +24 Vdc

[1]: Programmable RS422 termination

[2]: Line 3 is programmable as:

- Single ended input with programmable threshold

0-24 V in (0-60 V tolerant)

0-11 V threshold voltage

- RS422 In (external termination required)
- RS422 Out
- 3.3 V single ended output

[3]: Line 4 and 5 are programmable as:

- RS422
- Single ended 3.3 V open collector output

## ***Input Line Details***

The input line signals have the following features for control or status indication.

- **Feature Set:**
  - [Line Selector](#) (RW)
  - [Line Format](#) (RW)
  - [Line Mode](#) (RW)
  - [Input Line Debouncing Period](#) (RW)
  - [Line Inverter](#) (RW)
  - [Line Status](#) (RO)
  - [Input Line Detection Level](#) (RO).
- **Connector:** See [HD15 Connector Details](#) for connector pinout and electrical information. The cable shell and shield should electrically connect the Linea Lite chassis to computer chassis for maximum EMI protection.
- **Input Line Debouncing Period:** Each input incorporates a signal debounce circuit to eliminate short noise transitions that could be wrongly interpreted as a valid pulse. The duration is user-programmable from 0  $\mu$ s to 255  $\mu$ s.
- **Line Input Signal Characteristics:** See [Input Signals Electrical Specifications](#).

## ***Output Line Details***

The general purpose output line signals either dedicated or shared with inputs. For more information, see [HD15 Connector Details](#) for connector pinout and [Output Signals Electrical Specifications](#).

- **Feature Set:**
  - [Line Inverter](#) (RW)
  - [Output Line Source](#) (RW)
  - [Output Line Pulse Delay](#) (RW)
  - [Output Line Pulse Duration](#) (RW)
  - [Output Line Value](#) (RW)
  - [Output Line Software Command](#) (RW)
  - [Line Selector](#) (RW)
  - [Line Format](#) (RW)
  - [Line Mode](#) (RW)
  - [Line Status](#) (RO).
- **External Outputs:** Can be used as a strobe signal 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 the available event modes defined by the [Output Line Source](#) feature. The output delay can be set from 0 to 16 seconds in increments of 1  $\mu$ s. The pulse duration can be set from 0 to 16 seconds in increments of 1  $\mu$ s.

## Mating GPIO Cable Assembly

Teledyne DALSA optionally provides for purchase a GPIO breakout cable (HD15 Male to 26-Pos Euro Block) as shown in the following drawing. Use accessory number #AC-CA-00002-00-R when placing your order.

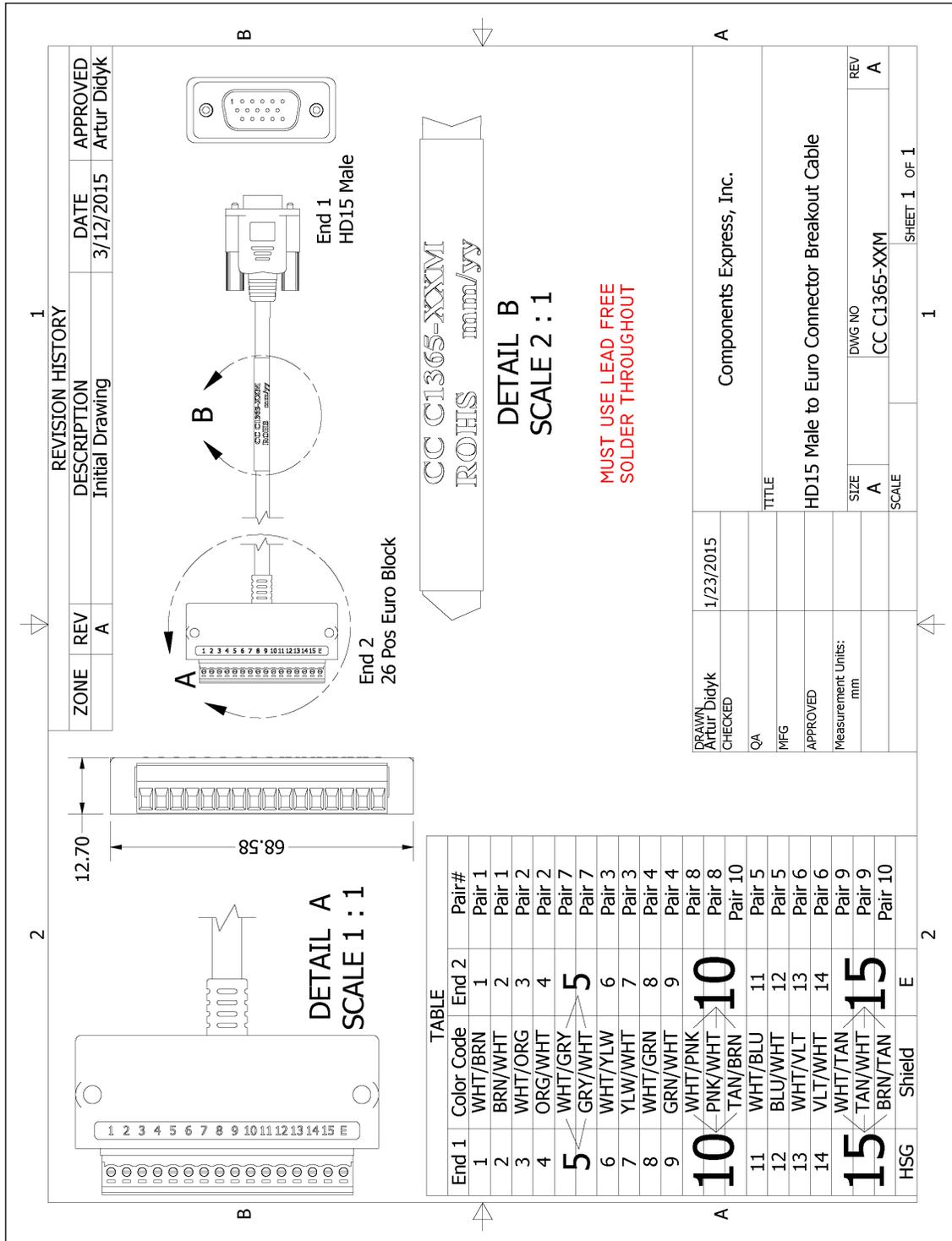


Figure 109: Mating GPIO Cable Assembly

# Input Signals Electrical Specifications

## External Inputs Block Diagrams

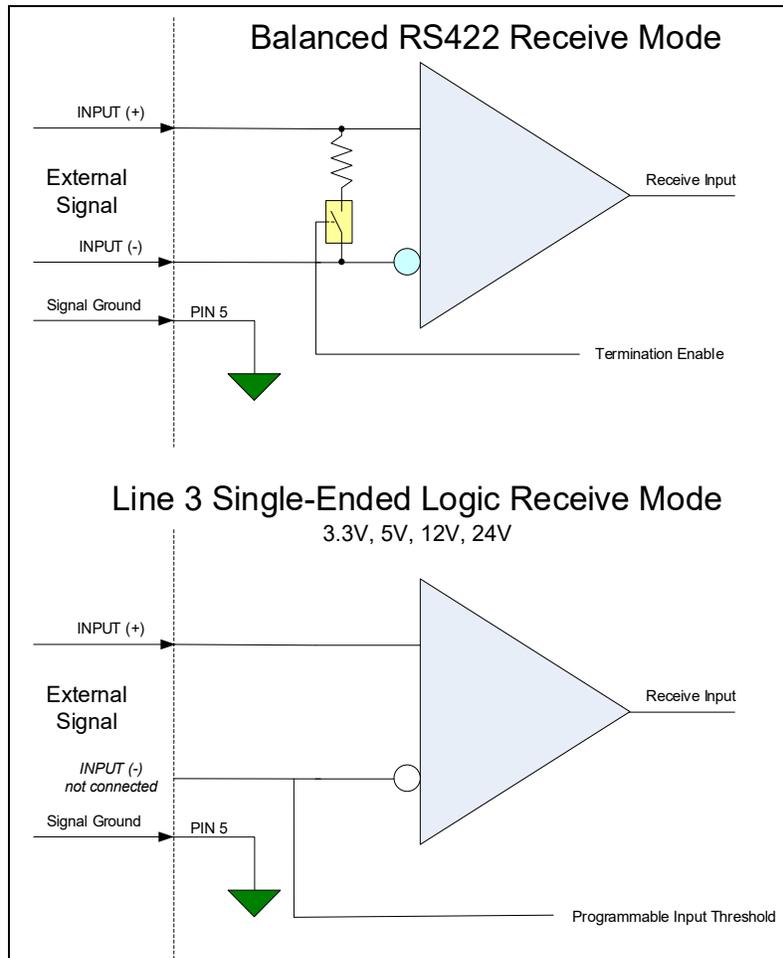


Figure 110: External Inputs Block Diagram

### External Input Overview

- The input signals can be used as trigger acquisition event, counter or timestamp event, or integration control.
- The input signal can be improved by user programmable Input Line Debouncing Period from 0 to 255  $\mu$ s, in 1  $\mu$ s steps.

### CAUTION

It is important to correctly configure external inputs before connecting external signals. Connecting higher voltage signals to inputs configured as RS422 may damage the inputs.

## External Input Electrical Characteristics

RS422 Inputs	
Common Mode Input Voltage ( $V_{cm}$ )	-25 V min. – 25 V max.
Differential Input Signal Threshold	200 mV
Differential Input Signal Hysteresis	150 mV ( $V_{cm} = 0$ V)

Single-Ended Inputs (Applies to Line 3 only)		
	Switching Voltage	
	Low to High	High to Low
3.3 V TTL	1.5 V	1.5 V
5.0 V TTL	2.5 V	2.5 V
12 V	6 V	6 V
24 V	11 V	11 V

## External Input Timing Reference

Input Level Standard	Maximum Input Frequency	Minimum Pulse Width	Source Current Requirements	Maximum Signal Propagation Delay at 60°C	
				<i>Input Signal Direction</i>	
LVTTTL (3.3 V)	20 MHz	25 ns		0 to 3.3 V	<100 ns
				3.3 V to 0	<100 ns
TTL (5.0 V)	20 MHz	25 ns		0 to 5 V	<100 ns
				5 V to 0	<100 ns
12 V	20 MHz	25 ns		0 to 12 V	<100 ns
				12 V to 0	<100 ns
24 V	20 MHz	25 ns		0 to 24 V	<100 ns
				24 V to 0	<100 ns

# Output Signals Electrical Specifications

## External Outputs Block Diagrams

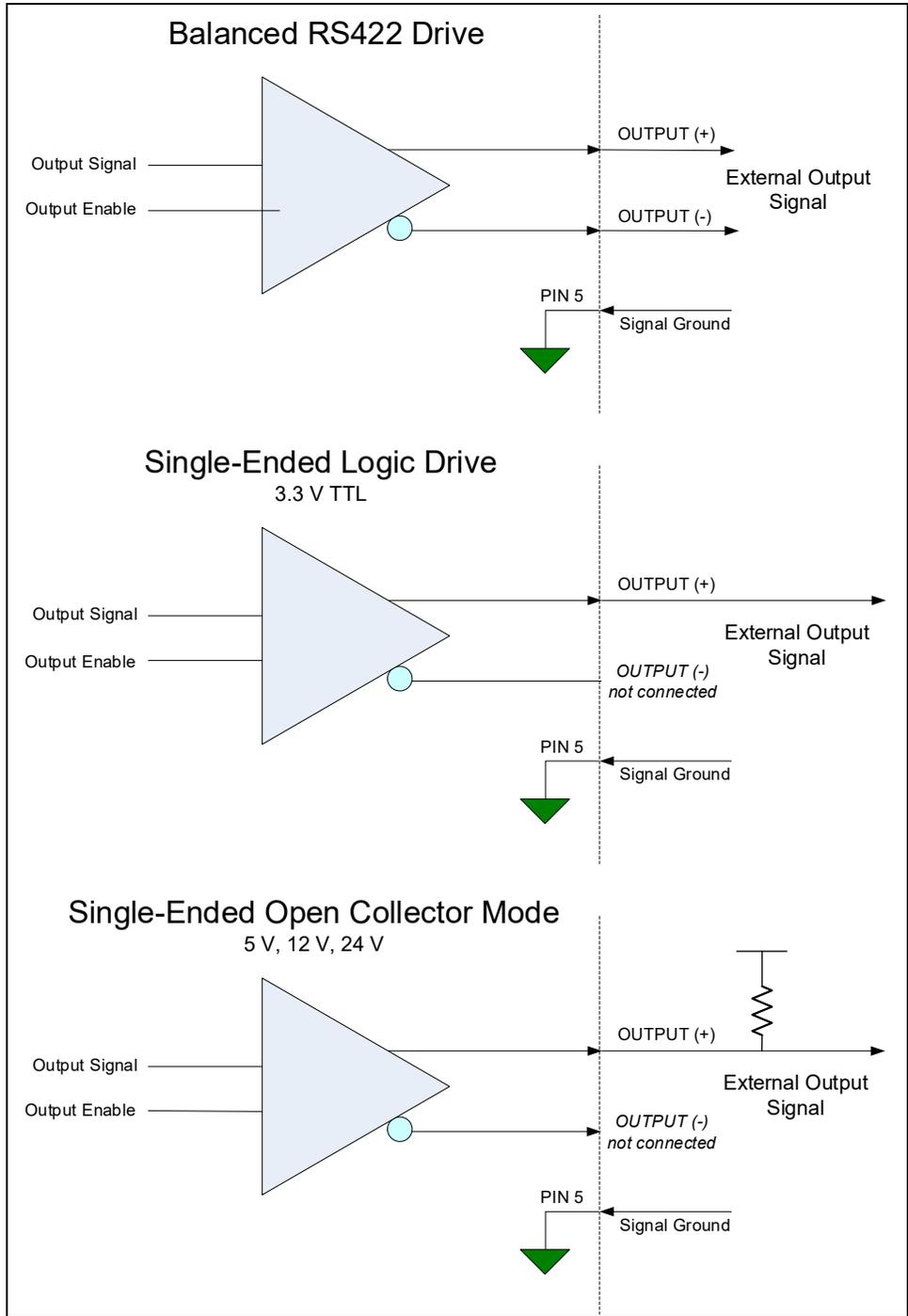


Figure 111: External Outputs Block Diagram

## External Output Details

- The output signals can be used in programmable output mode such as strobe, event notification, etc. (See [Output Line Source](#) feature).
- For the Single-Ended Open Collector outputs, the user supplied pull-up resistor value should be between 1 k $\Omega$  and 10 k $\Omega$  depending on supply rail. Resistor wattage should be calculated accordingly.
- Outputs are open (disabled) on power-up with the default factory settings.
- A software reset will not reset the outputs to the open state if the outputs are active.
- A user setup configured to load on boot will not reset the outputs to the open state if the outputs are active.
- The output signals are designed to prevent an output signal glitch on power-up or polarity reversal.
- Protection Circuit – DC Ratings:
  - Output protected against shorts to ground or other voltages
  - Output maximum voltage of 26 V at 10 mA (at 60°C)

# Declarations of Conformity

Copies of the Declarations of Conformity documents (for example, EU, FCC & ICES Supplier and Material Composition Product Declaration) 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 and UKCA Declaration of Conformity**

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

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

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

# Additional Reference Information

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## Lens Selection Overview

This section provides a general overview to selecting a lens for the Linea Lite GigE. Mechanical drawings and Teledyne DALSA part numbers for available lens adapters are provided.

The first two lens parameters, Lens Mount and Lens Image Circle, are based on correctly matching the lens to the sensor. Brief information on other lens parameters to consider follows those sections.

## Lens Mount Types

Linea Lite GigE 2k/4k/8k SR cameras use a M42x1 lens screw mount and have an optional adapter for F-mount (AC-LA-00115-xx-R) lenses, as described below.

**M42x1 to Nikon F Bayonet Adapter (AC LA 00115 xx-R)**

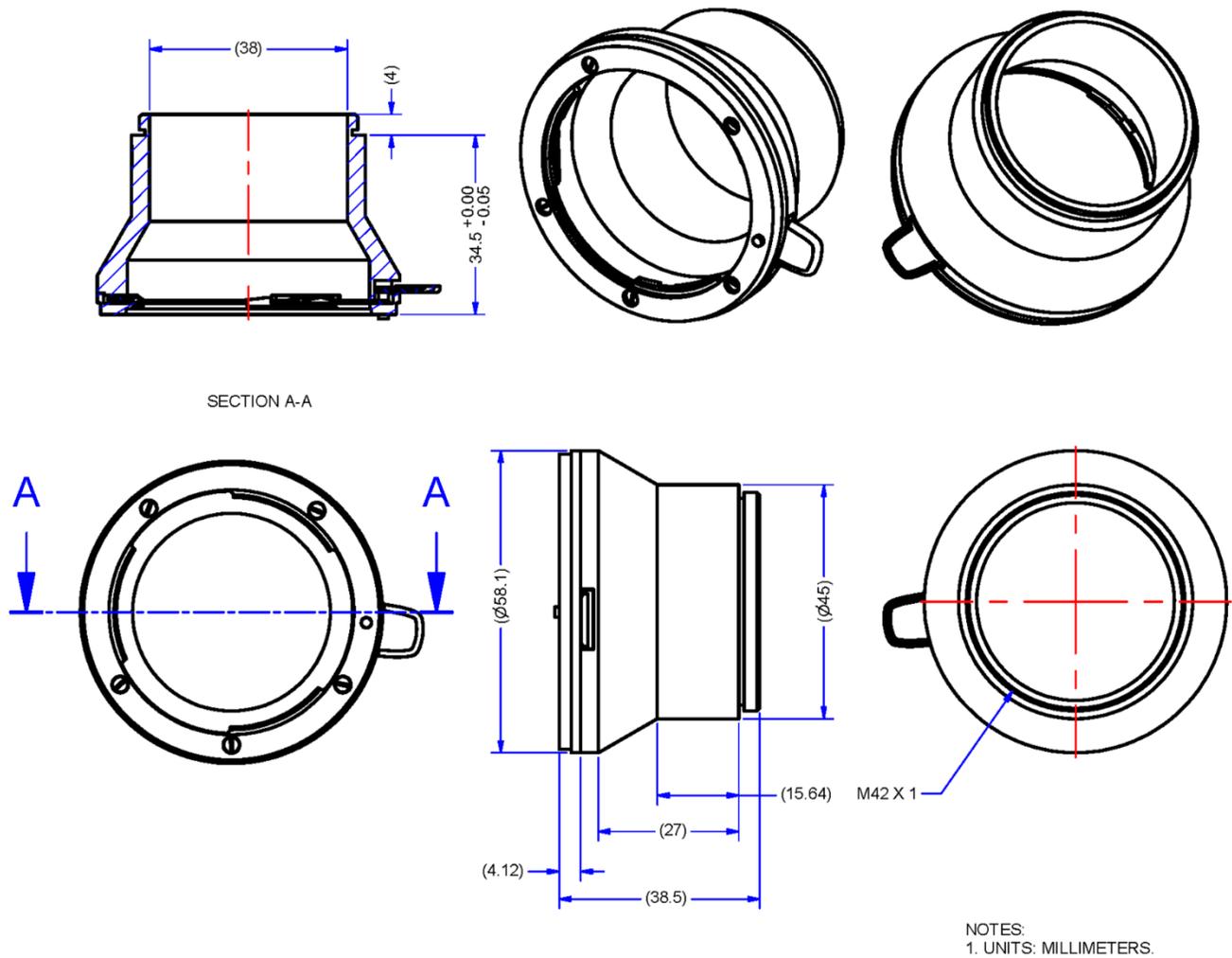


Figure 112: Nikon F Bayonet to M42x1 Adapter, 12mm BFD, HEAVY DUTY w/clip

## Lens Image Circle Illustration

The graphic below illustrates the Linea Lite GigE 2k/4k/8k SR active sensor relative to the lens image circle of a Nikon FDX lens (using the optional F-mount adapter).

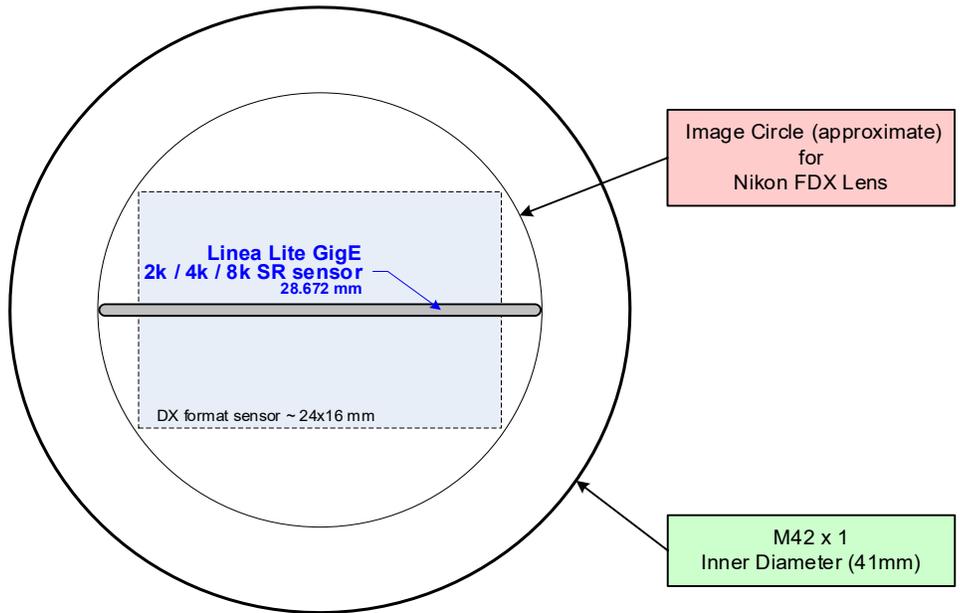


Figure 113: Lens Circle

## 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 Linea Lite GigE (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 tradeoff 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. See Camera 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 appears out of 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 wavelengths and intensity of light required to capture useful images vary per application. The image will be affected by speed, spectral characteristics, exposure time, light source characteristics, environmental and acquisition system specifics, etc. Teledyne DALSA's Web Site introduces this potentially complicated issue. Click on Knowledge Center and select Application Notes and Technology Primers.

Exposure settings have more effect 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.

**Example:**  $5 \mu\text{J}/\text{cm}^2$  can be achieved by exposing  $5 \text{ mW}/\text{cm}^2$  for 1 ms or exposing  $5 \text{ W}/\text{cm}^2$  for 1  $\mu\text{s}$ .

### Light Sources

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

- LED light sources are inexpensive and provide a uniform field with a longer life span compared to other light sources.
- Halogen and fiber-optic light sources provide very little blue relative to IR.
- Some light sources age and produce less illumination in some areas of the spectrum.

## 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

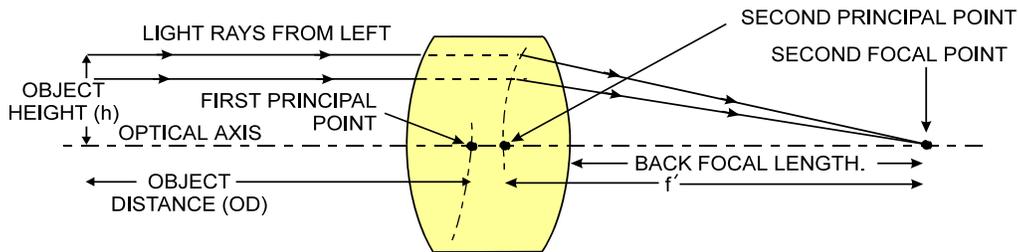


Figure 114: Primary Points in a Lens System

## 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:

$m = \frac{f'}{OD}$	Where $f'$ is the focal length and $OD$ is the target object distance.
---------------------	------------------------------------------------------------------------

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  $\mu\text{m}$  pixel pitch, a lens with an effective focal length of 45 mm. For each pixel in the image sensor to correspond to 100  $\mu\text{m}$  in the object space, using the preceding equation, the object distance must be 450 mm (0.450 m).

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

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# Sensor Handling Instructions

This section reviews procedures for handling, cleaning or storing the camera. The sensor must be kept clean and away from static discharge to maintain design performance.

## Electrostatic Discharge and the Sensor

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

Electrostatic charge introduced to the sensor window can induce charge buildup on the underside of the window. The dry nitrogen gas in the sensor package cavity cannot readily dissipate the ESD. Problems such as higher image lag or non-uniform response may occur.

### NOTE

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 must be handled with extreme care.

Dust can obscure pixels producing dark patches on the sensor image. 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 illumination is diffused.

Blowing compressed air on the window will remove dust particles unless they are held by an electrostatic charge. In this case, either an ionized air blower or a wet cleaning is necessary.

Touching the surface of the window will leave oily residues. Using rubber finger cots and rubber gloves can prevent oil contamination. Avoid friction between the rubber and window or electrostatic charge build up may damage the sensor.

When handling or storing the camera without a lens always install the protective cap.

### NOTE

When exposed to uniform illumination a scratched window will normally have brighter pixels adjacent to darker pixels. The location of these pixels will change with the angle of illumination.

## Cleaning the Sensor Window

The following steps describe various cleaning techniques to clean minor dust particles and accidental fingerprints.

### IMPORTANT

Avoid using canned air as it contains particulates that can increase the contamination of the sensor window.

- DALSA recommends the use of an ionized air gun and compressor to blow off the sensor.
- 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.

### NOTE

Extended airbursts will chill the sensor window causing more condensation. Condensation when left to dry naturally will deposit particles on the sensor.

- Use lint-free ESD-safe cloth wipers. 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.
- Wipe the window carefully and slowly when using these products.

### NOTE

Do not use regular cotton swabs since they can introduce static charge to the window surface.

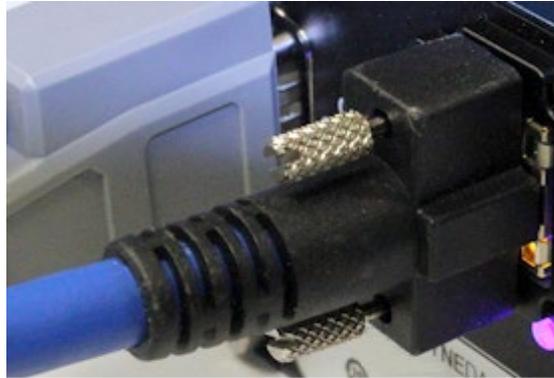
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# Ruggedized RJ45 Ethernet Cables

Components Express Inc. supplies an industrial RJ45 CAT6 cable. One end has a molded shroud assembly with top / bottom thumbscrews while the other end has a standard RJ45.

## NOTE

Ruggedized RJ45 cable is recommended in a high vibration environment.



*Figure 115: Ruggedized RJ45 Ethernet Cable*

**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)

**For Information contact:**

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/>

# Troubleshooting

## Overview

If an installation fails or experiences problems controlling and using the Linea SWIR GigE camera, the user may perform diagnostics with the methods and tools provided to correct the problem.

The GigE Server status provides visual information on possible camera problems. The three states are displayed in the following table with descriptions of possible conditions.

### NOTE

An installation with no networking issue may still require optimization to perform to specification.

	Device Available	Device IP Error	Device Not Available
<b>GigE Server Icon</b>			
It will take a few seconds for the GigE Server to refresh its state after the camera has obtained an IP address.	The GigE server icon when a device is found. The camera has obtained an IP address and there are no network issues.	The GigE server icon shows a warning when a device is connected but there is some type of IP error.	The GigE server icon shows a red X when no device is found. This indicates a network issue where there is no communication with the camera, or there is no camera connected.

## Problem Type Summary

Camera problems are either installation or setup related where the camera is found but not controllable. Additionally, the camera may be properly installed but network optimization is required for maximum performance.

### Device Not Available



A red X over the GigE server tray icon indicates that the camera 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 Connecting the Linea Lite GigE Camera to verify installation steps.
- Refer to Teledyne DALSA Network Imaging manual to review networking details.
- The Linea Lite GigE camera cannot acquire a DHCP.
- In multiple NIC systems where the NIC for the Linea Lite GigE is using LLA mode, ensure 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 camera instead of using LLA mode, which prevents errors associated with multiple NIC ports.
- Verify 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.

Refer to Teledyne DALSA's Network Imaging Package for Sopera LT Optimization Guide for information on Teledyne DALSA's Network Configuration tool and network optimization for GigE Vision cameras and devices.

## Multiple Camera Issues

- When using multiple cameras with a computer with multiple NIC ports, confirm each Linea Lite GigE 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 Teledyne DALSA's Network Imaging Package for Sopera LT Optimization Guide.
- When using multiple cameras connected to a VLAN Ethernet switch, confirm that all cameras are on the same subnet setup on that switch. Refer to Teledyne DALSA's Network Imaging Package for Sopera LT Optimization Guide for more information.
- If a Linea Lite GigE 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 NIC properties and Teledyne DALSA's Sopera Network Imaging Driver does not install. Verify this issue by uninstalling the third party driver and installing the Linea Lite GigE package again.
- Verify NIC is running the latest driver available from the manufacturer.



## Device Available but with Operational Issues

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

### Always Important

- Camera firmware updated. Refer to [File Access via the CamExpert Tool](#).
- [Power Failure During a Firmware Update—Now What?](#).
- [Cabling and Communication Issues](#).
- [Preventing Operational Faults due to ESD](#).

### No Timeout messages

- CamExpert grabs (with no error message) but there is no image (display window stays black). Refer to [Acquisition Error without Timeout Messages](#).
- CamExpert grabs (with no error message) but the frame rate is lower than expected. Refer to [Camera acquisition is good but frame rate is lower than expected](#).
- No image and the line rate is lower than expected. Refer to [Camera acquisition is good but frame rate is lower than expected](#).
- No image but the frame rate is as expected. Refer to [Camera is functional, line rate is as expected, but image is black](#).

### Other problems

- Buffer Incomplete message. See [Buffer Incomplete Error Message](#).

## Verifying Network Parameters

Teledyne DALSA provides a Network Configuration tool to verify and configure network devices and the Linea Lite GigE network parameters. If there were any problems with the automatic Linea Lite GigE software installation refer to Network Configuration Tool section of Teledyne DALSA's Network Imaging manual.

## 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, select **Programs > Teledyne DALSA Sopera LT > Sopera Log Viewer** program. From its **File** menu, select **Save Messages** to generate a log text file.
- Report the version of GigE Vision software and Sopera version used.

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## Installation Issues and Functional Problems

This section covers issues that are apparent after installation or are indicated by the GigE server tray icon showing a warning symbol.

---

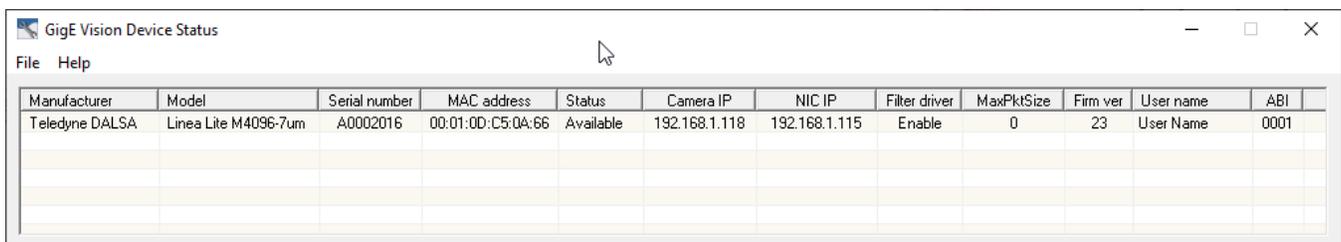
### Camera Fails to Establish Connection with Host PC

If 'No device found' is displayed a manual IP address assignment must be made. Left click Show Hidden Icons. (Located bottom right task bar)



Figure 116: Windows Task Bar - Show Hidden Icons

Right-click the GigE server tray icon . Select **Scan Network** to update the GigE Vision Device Status and Camera IP.



Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
Teledyne DALSA	Linea Lite M4096-7um	A0002016	00:01:00:C5:0A:66	Available	192.168.1.118	192.168.1.115	Enable	0	23	User Name	0001

Figure 117: GigE Vision Device Status



The camera is connected but a NIC IP is not assigned. The GigE server tray icon is displaying a warning.

Use the Teledyne DALSA Network Configuration Tool. From the **Start** menu, select **Teledyne DALSA > Network Configuration Tool**.

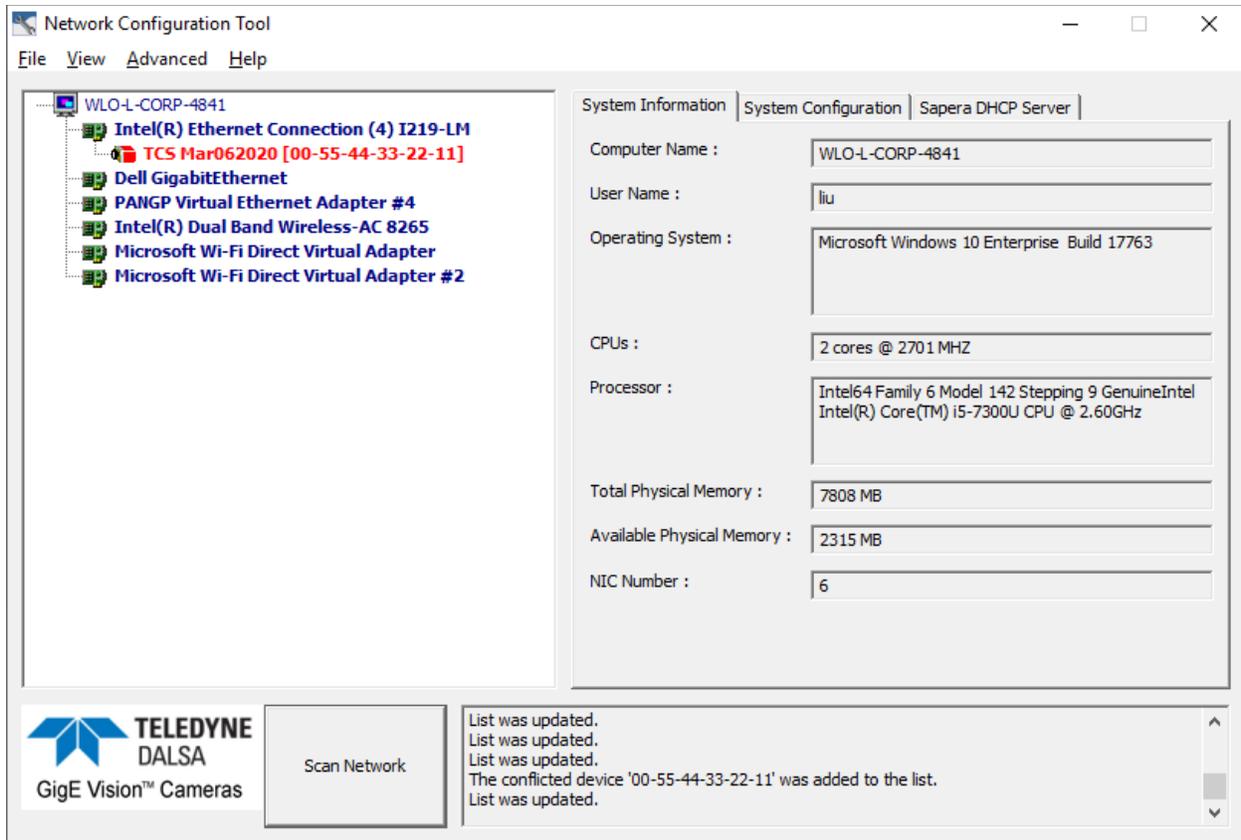


Figure 118: The Network Configuration Tool.

Cameras displayed in red require a NIC IP. Select the camera name and open the **Device IP Configuration** tab.

#### NOTE

The network tool provides a **Scan Network** button if no cameras are displayed.

Click **Automatic Recovery (Force IP)**.

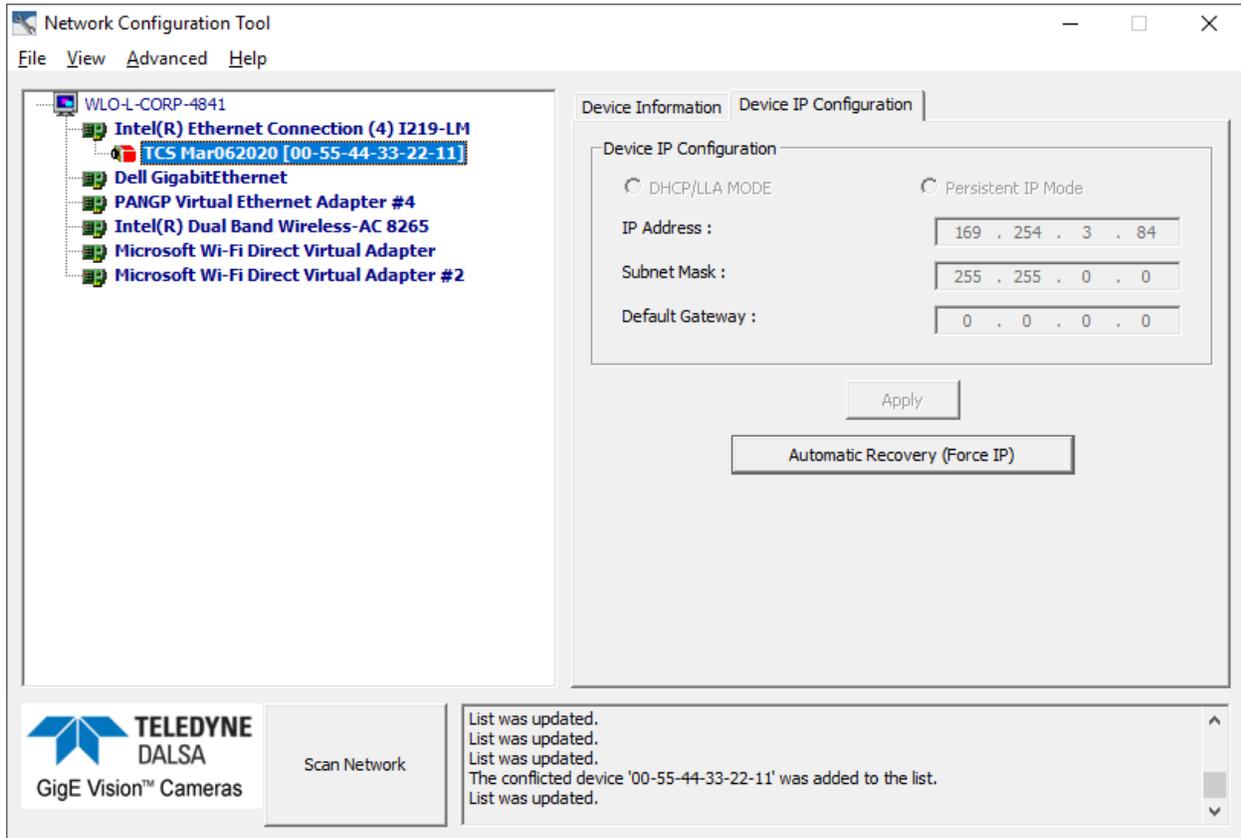


Figure 119: Network Configuration Tool – Automatic Recovery (Force IP)

Cameras displayed in blue have a proper NIC IP assigned.

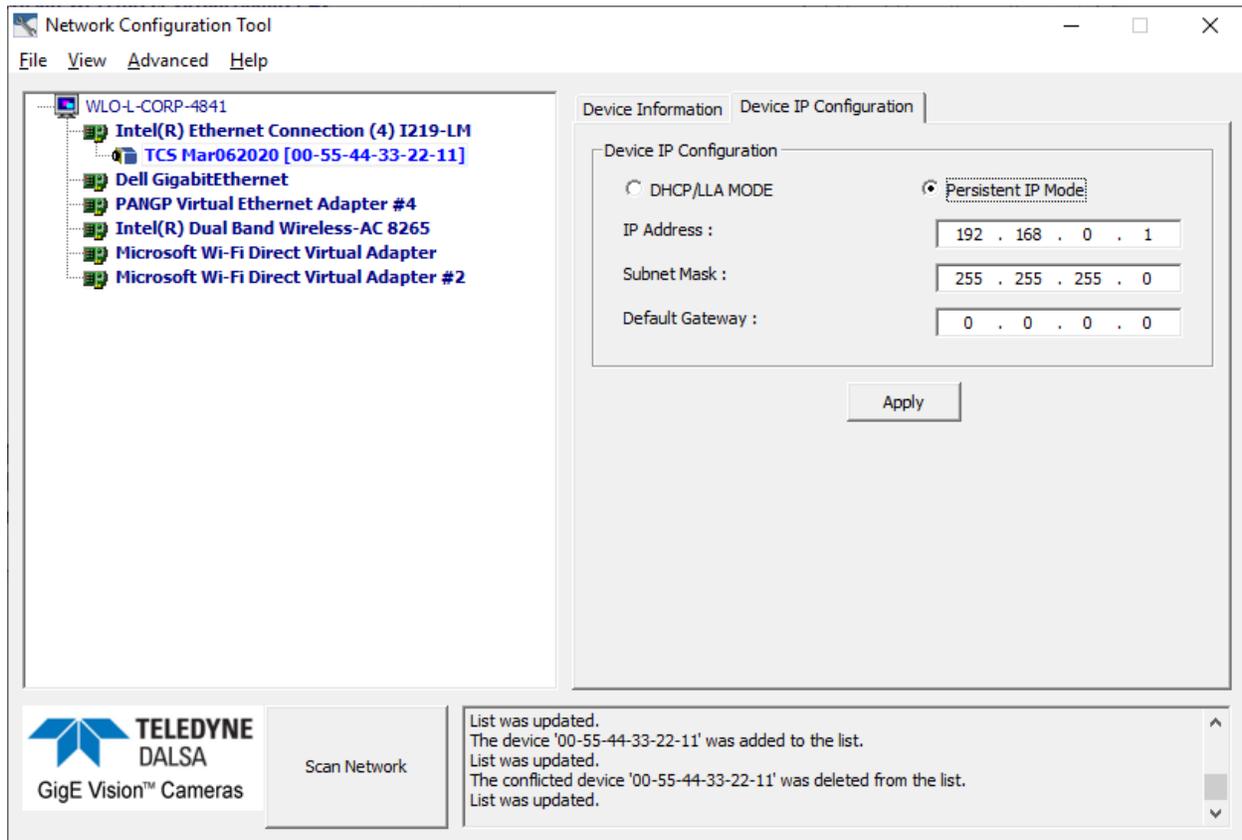


Figure 120: Network Configuration Tool – Proper IP Assigned

## NOTE

The Network Configuration Tool assigns a dynamic IP address, which is lost on power down. To avoid this issue, assign a persistent IP address to the camera.

Select **Persistent IP Mode** (shown above), then **Apply** to assign the IP address. It will automatically connect to the host PC if the IP address does not conflict with other network IP addresses. Refer to section [Persistent IP](#) for more information.

## NOTE

Assigning two devices with the same IP Address will cause conflicts.

---

## Device Available with Operational Issues

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

### Firmware Updates

As a general rule any Linea Lite GigE installation must include the [firmware update procedure](#) (Refer to File Access Control Category section for feature descriptions). Linea Lite GigE camera firmware that does not match a newer version of installed GigE Vision software is likely to have unpredictable behavior.

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

#### NOTE

New cameras installed in previously deployed systems are fully backward compatible with the older vision application.

### Power Failure During a Firmware Update

Do not panic! There is far greater chance that the host computer OS is damaged during a power failure than any permanent problems with the Linea Lite GigE. When power returns and the host computer system has started, follow this procedure.

- Connect power to the Linea Lite GigE. The camera processor knows that the firmware update failed.
- The Linea Lite GigE will boot with the previous version of firmware and will operate normally.
- Perform the [firmware update procedure](#) again.

### Cabling and Communication Issues

With only two cables connected to Linea Lite GigE possible cabling issues are limited.

#### Power supply problems

- If the Linea Lite GigE 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 Linea Lite GigE 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 camera 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 Linea Lite GigE is in a high vibration environment. Refer to [Ruggedized RJ45 Ethernet Cables](#) section.

- Check the Ethernet status LEDs on the Linea Lite GigE RJ45 connector. The Link Status indicator should be on, and the activity LED should flash with network messages.
- Verify the Ethernet cable is CAT5e or CAT6. This is very important with long cables.
- When using long cables up to the maximum specified length of 100 m 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 Sopera Log Viewer: from the **Start** menu, select **Teledyne DALSA Sopera LT > Sopera Log Viewer**. Start the camera 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 GigE Vision cameras in various computers and setups. Refer to Teledyne DALSA's Network Imaging Optimization Guide for information on network optimization.

### ***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 factory default from the Power-up Configuration in CamExpert. This will reset the camera to its nominal acquisition rate.

### ***Camera is functional but frame rate is lower than expected***

- Verify Ethernet link speed. If the LAN connection is limited to 100 Mbps, the line rate maximum will be limited once the internal buffers are filled. Refer to Teledyne DALSA's Network Imaging manual for information on network optimization.
- If using an external trigger, verify the trigger source rate and camera parameters such as trigger to exposure delay.

### ***Camera acquisition is good but frame rate is lower than expected***

- While running CamExpert and grabbing in free-run mode at the maximum frame rate, start the **Sopera Monitor** tool from the Sopera Tools installed with Sopera.
- Make sure the **Memory Overflow** event monitor is enabled.
- Continue grabbing at maximum frame rate. If any memory overflow events are counted, the internal buffer could not be transmitted on time and was discarded. Such a condition may occur at high frame rate cameras.

#### NOTE

Sopera CamExpert tool limits the maximum frame rate possible due to CamExpert generating an interrupt for each acquired frame. The Sopera Grab Demo may be better suited for testing at higher frame rates.

- Verify network parameters are optimal as described in Teledyne DALSA's Network Imaging Package for Sopera LT Optimization Guide. Ensure the host computer is not executing other network intensive tasks. Try a different Gigabit NIC.

#### NOTE

Changed acquisition frame rate requires the acquisition to be stopped; when acquisition is restarted the new frame rate is applied.

### ***Camera is functional, line rate is as expected, but image is black***

- Verify that the lens iris is open.
- Aim the Linea Lite GigE at a bright light source.
- Check the programmed exposure duration is not too short or set it to maximum. Refer to [Sensor Control Category](#) for relevant features.

Using CamExpert set the Linea Lite GigE to output its Internal Pattern Generator. This step is typically done for any camera installation to quickly verify the Linea Lite GigE and its software package. Refer to [Internal Test Image Generator](#) section for information on using CamExpert to select internal patterns.

## **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.

### ***Buffer Incomplete Error Message***

Error Messages are generated when the logical acquisition frame buffer takes longer to fill (line rate x frame buffer height) than the time set for the GigE Vision Host Control. Increase the "Image Timeout" value as required.

### ***Issues with Cognex VisionPro***

When the Cognex VisionPro package is uninstalled, the Linea Lite GigE becomes unavailable within CamExpert due to the Cognex uninstaller removing GigE Vision components. This forces the user to reinstall the camera package.

Cognex VisionPro remains a useable third party product except for their uninstaller fault. Users need to account for this issue until resolved by Cognex.

# Revision History

Number	Change	Date
00	Initial release of preliminary version to support early consignment cameras.	30 July 2020
01	Alpha version.	19 Nov 2020
02	Introduction of 2k model.	4 June 2021
03	Introduction of 4k color model.	12 Nov 2021
04	Introduction of 2k color model.	20 April 2022
05	New Crosstalk Correction section. Minor updates.	17 November 2022
06	Introduction of 8k SR model. New Trigger Selector options: Frame Active, Frame Burst Active. New Trigger Source options: Counter1 Active and Timer1 Active. Minor updates.	3 May 2024
07	Turbo Drive support for 8k SR model.	5 June 2024

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