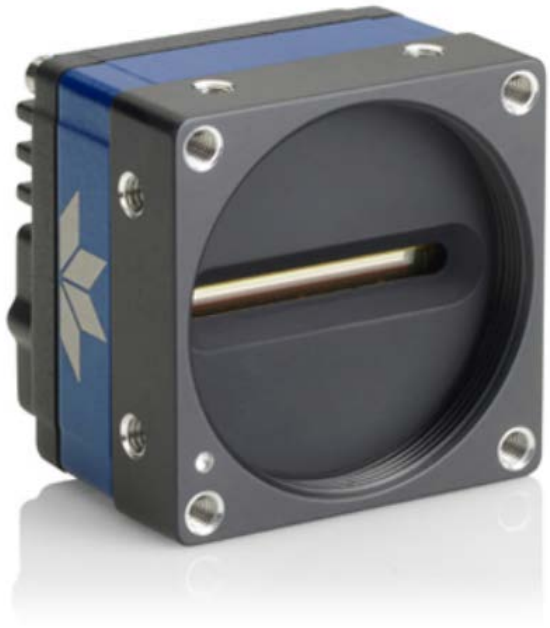
Linea Lite GigE

Camera User's Manual

2k / 4k Monochrome & Color CMOS Line Scan

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



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Notice

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About Teledyne DALSA

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

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

Contents

Linea Lite GigE Series Overview

Description

The Linea Lite™ GigE is a new affordable line scan camera delivering both speed and responsivity at a competitive price. This camera is low-powered and designed for applications such as grading and inspection, transportation safety, automated optical inspection and general purpose machine vision.

The Linea Lite GigE camera is one of a new series of affordable and easy to use digital cameras specifically engineered for industrial imaging applications requiring embedded image processing and improved network integration.

Linea Lite GigE combines standard gigabit Ethernet technology (supporting GigE Vision 1.2) with Teledyne DALSA Trigger-to-Image-Reliability it dependably captures and transfers 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 pixel line 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 µs internal timer or external events can timestamp images
- Provides 4 User Settings sets to store and recall camera configurations
- Refer to Operation Reference and Technical Specifications section 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.

Firmware updates for Linea Lite GigE are available for download from the Teledyne DALSA web site [http://www.teledynedalsa.com/imaging/support/downloads/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).

When using Sapera LT, 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 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 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	AC-LA-00115-xx-R
HD15 GPIO Breakout Cable Assembly	AC-CA-00002-xx-R
For a list of accessories go to http://www.teledynedalsa.com/imaging/products/cameras/accessories/	
Optical filters are available from https://midopt.com/	

Teledyne DALSA Software Platform	
Sapera LT version 8.50 (or higher) 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. Sapera LT includes CamExpert provides an intuitive graphical interface that allows configuring and setup of cameras. It includes live image acquisition with interactive parameter configuration capabilities.	Available for download: http://www.teledynedalsa.com/imaging/support/downloads/sdks/
GigE Vision Turbo Drive Technology Module — improved proprietary package allows the Linea Lite GigE to sustain higher data transfers to the host system. Contact Teledyne DALSA Sales for additional information.	
Sapera Processing Imaging Development Library (sold separately):	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

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 µs • minimum (in µs) is model specific • maximum is 2.5 ms Pulse controlled via Trigger pulse width
Trigger Inputs (used as Line or Frame triggers)		RS422 Debounce range from 0 to 255 µs Frame Trigger programmable delay up to 2,000,000 µs 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
Binning		Digitally based: Horizontal & Vertical (2 and 4 pixel)
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 µs 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 (see Sapera 8.60 release notes). Linea Lite color models support TurboDrive with Bayer output (Pixel Format BiColorRGBG8).
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(H) x 46(W) x 37(L) in mm For complete dimensions Refer to Mechanical Specifications section.
Mass		< 150 g (no lens)
Power Connector		via HD15 GPIO connector or RJ45 in PoE mode
Ethernet Connector		RJ45

Optical Interface	
Sensor Alignment (Relative to sides of camera)	
Flatness	50 µm
Θ y	100 µm (Parallelism vs. front plate)
x	± 300 µm (Cross-Scan Direction)
y	± 300 µm (In-Scan Direction)
z	± 300 µm (Along optical axis)
Θ z	± 0.4° (Rotation around optical axis)
Electrical Interface	
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

Environmental Specifications	Performance
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

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 µs to 2500 µs			
Internal Trigger to Start of Exposure	~0.24 µs minimum (programmable exposure mode)			
External Trigger to Start of Exposure	~0.30 µs minimum (programmable and pulse width-controlled exposure modes)			
Line Readout Time	15.6 µs			
Pixel Size	14 µm x 14 µm	7 µm x 7 µm	14 µm x 14 µm	7 µm x 7 µm
Pixel Format	User selectable 8 or 12-bit			
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^2	20 nJ / cm^2	4 nJ / cm^2	24 nJ / cm^2
NEE (@ 550nm factory calibrated)	2.6 pJ / cm^2	12 pJ / cm^2	3.1 pJ / cm^2	15 pJ / cm^2
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.

Test Conditions

- Values measured using 12-bit, 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 Model

Spectral Responsivity

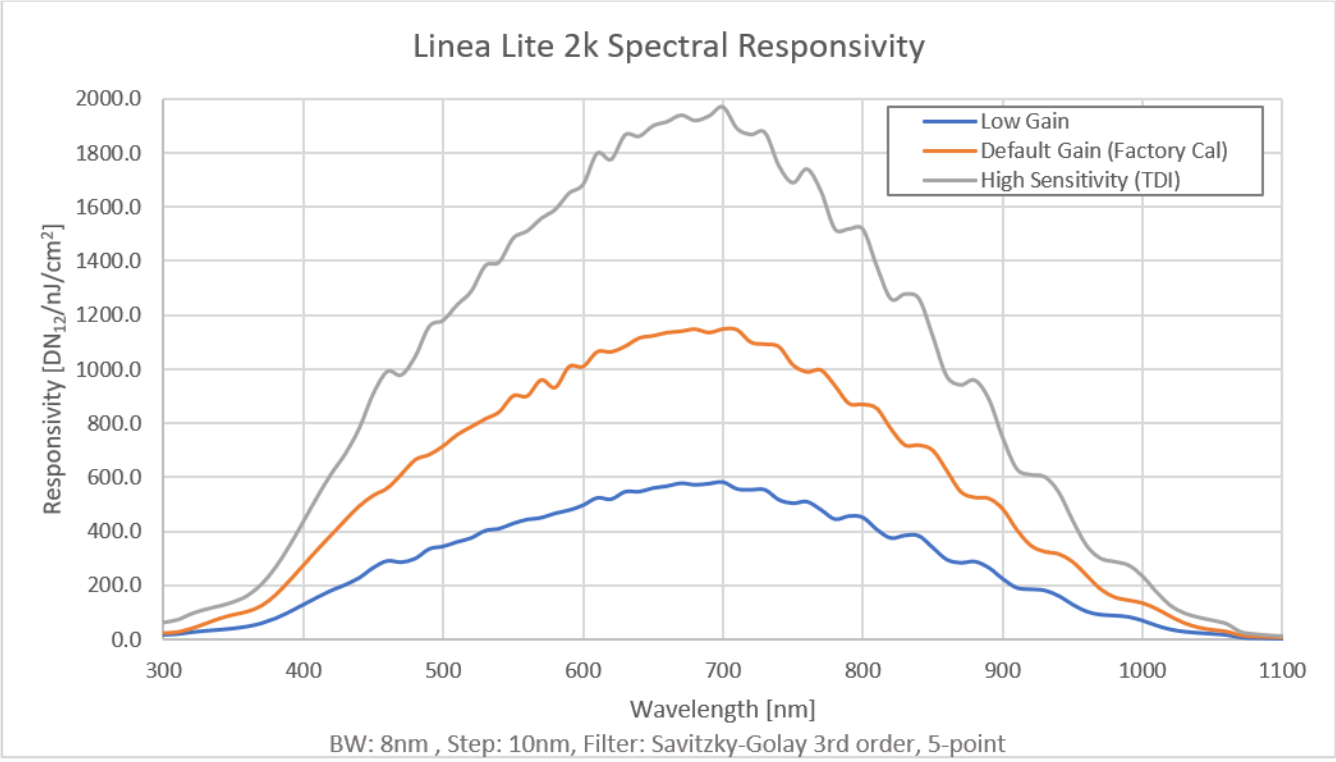


Figure 2: Linea Lite Monochrome 2k Spectral Responsivity

Effective Quantum Efficiency

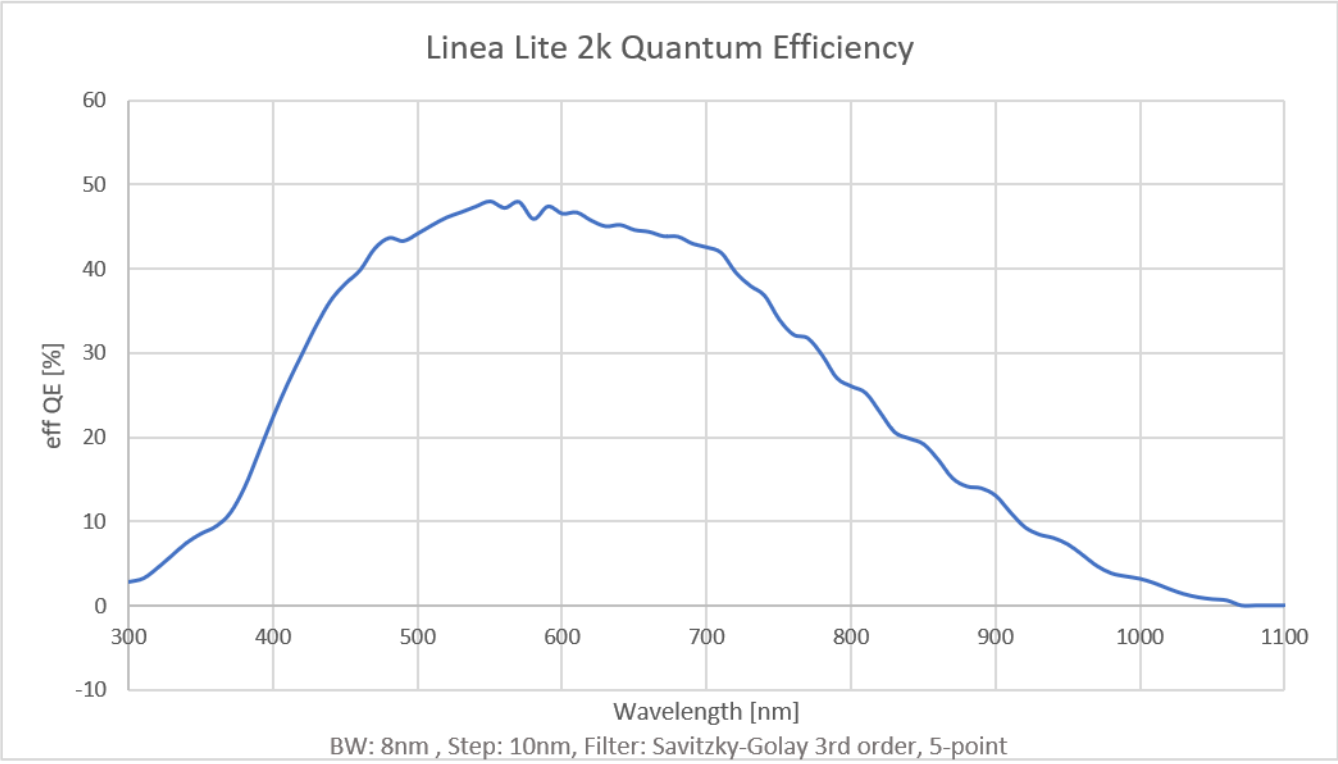


Figure 3: Linea Lite Monochrome 2k Quantum Efficiency

Linea Lite GigE Monochrome 4k Model

Spectral Responsivity

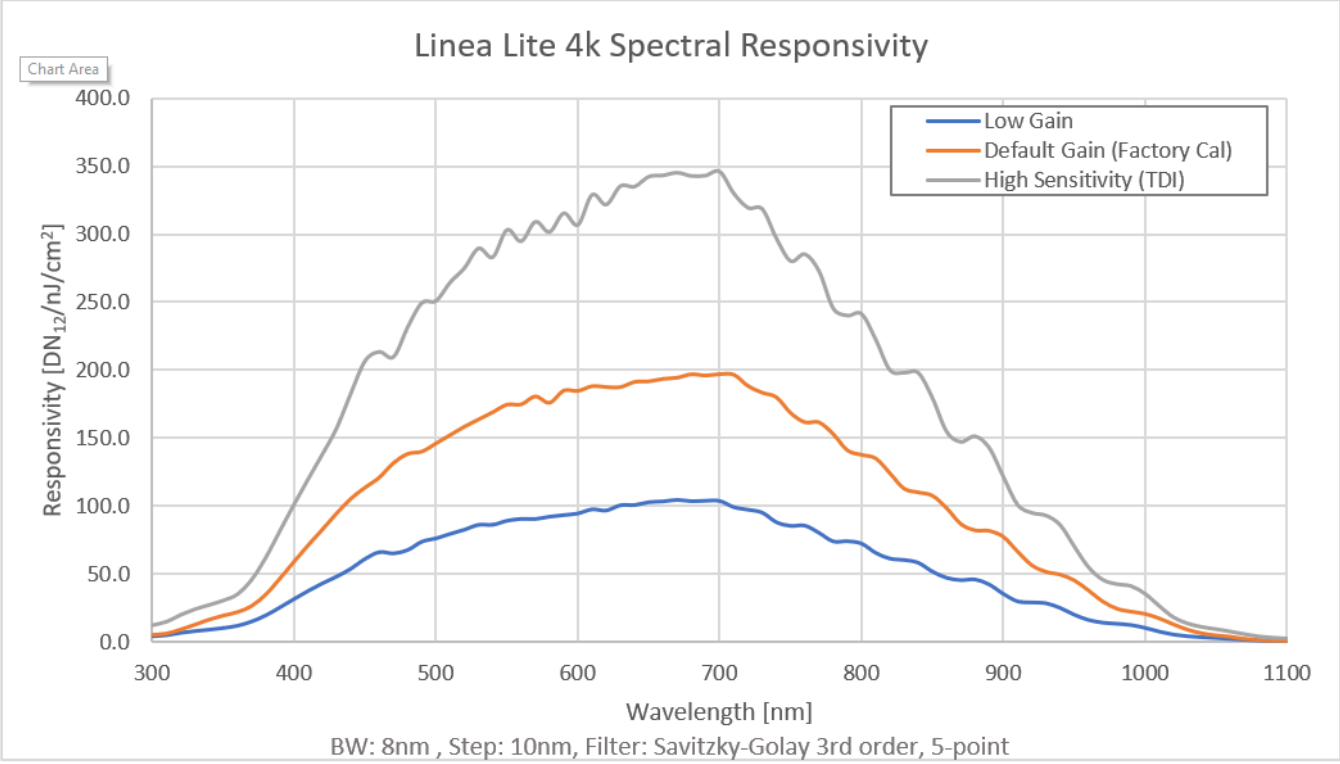


Figure 4: Linea Lite Monochrome 4k Spectral Responsivity

Effective Quantum Efficiency

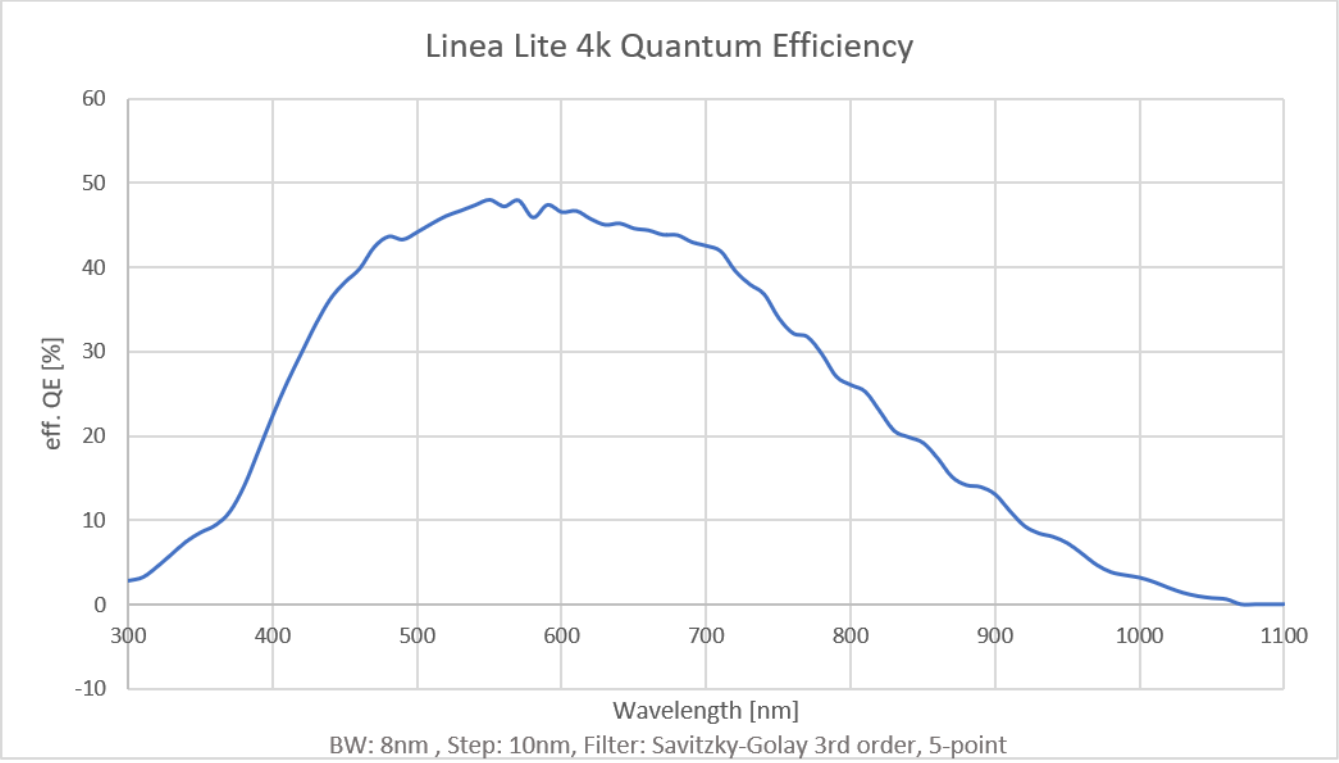


Figure 5: Linea Lite Monochrome 4k Quantum Efficiency

Linea Lite GigE Color 2k Model

Spectral Responsivity

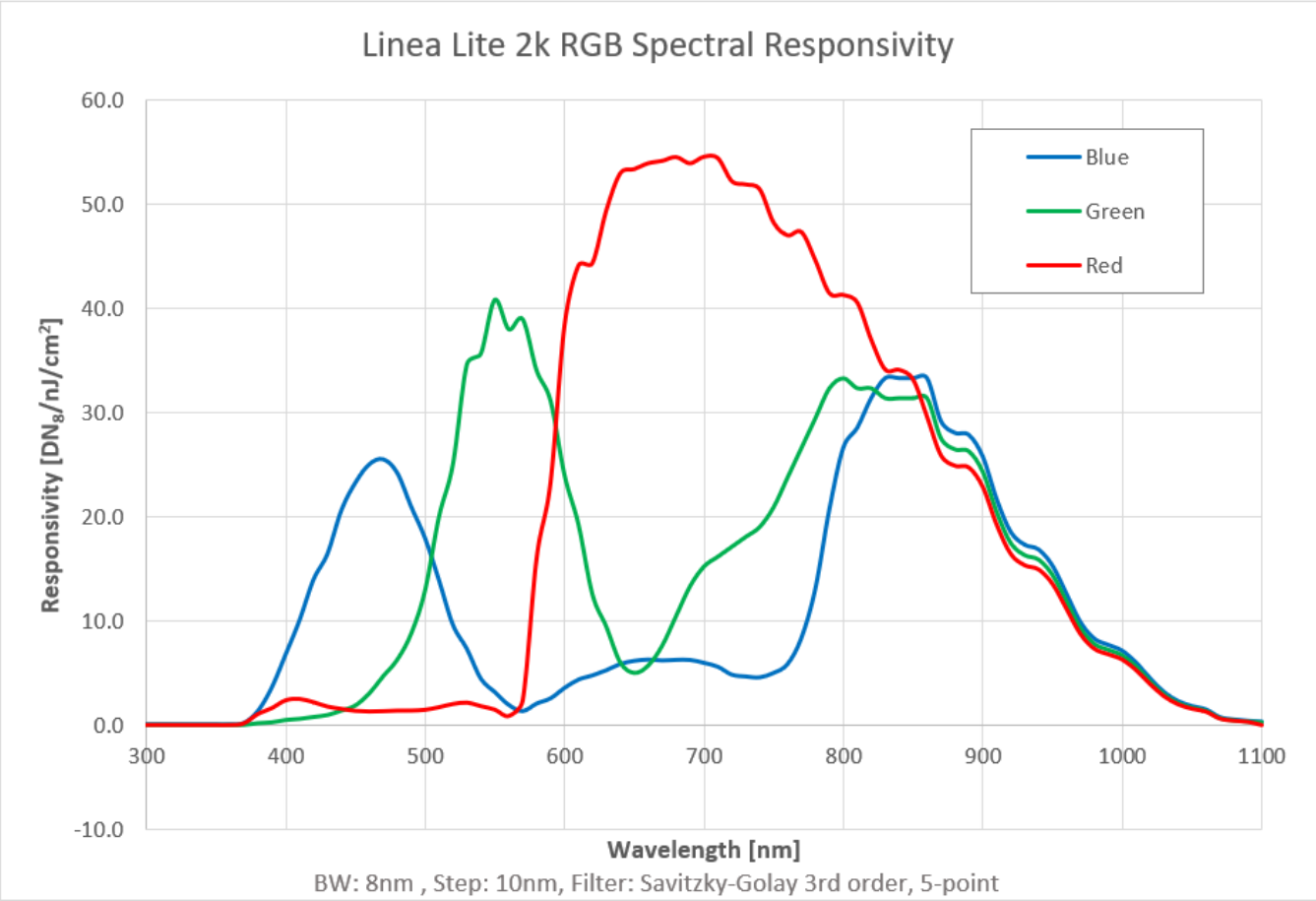


Figure 6: Linea Lite 2k RGB Spectral Responsivity

Linea Lite GigE Color 4k Model

Spectral Responsivity

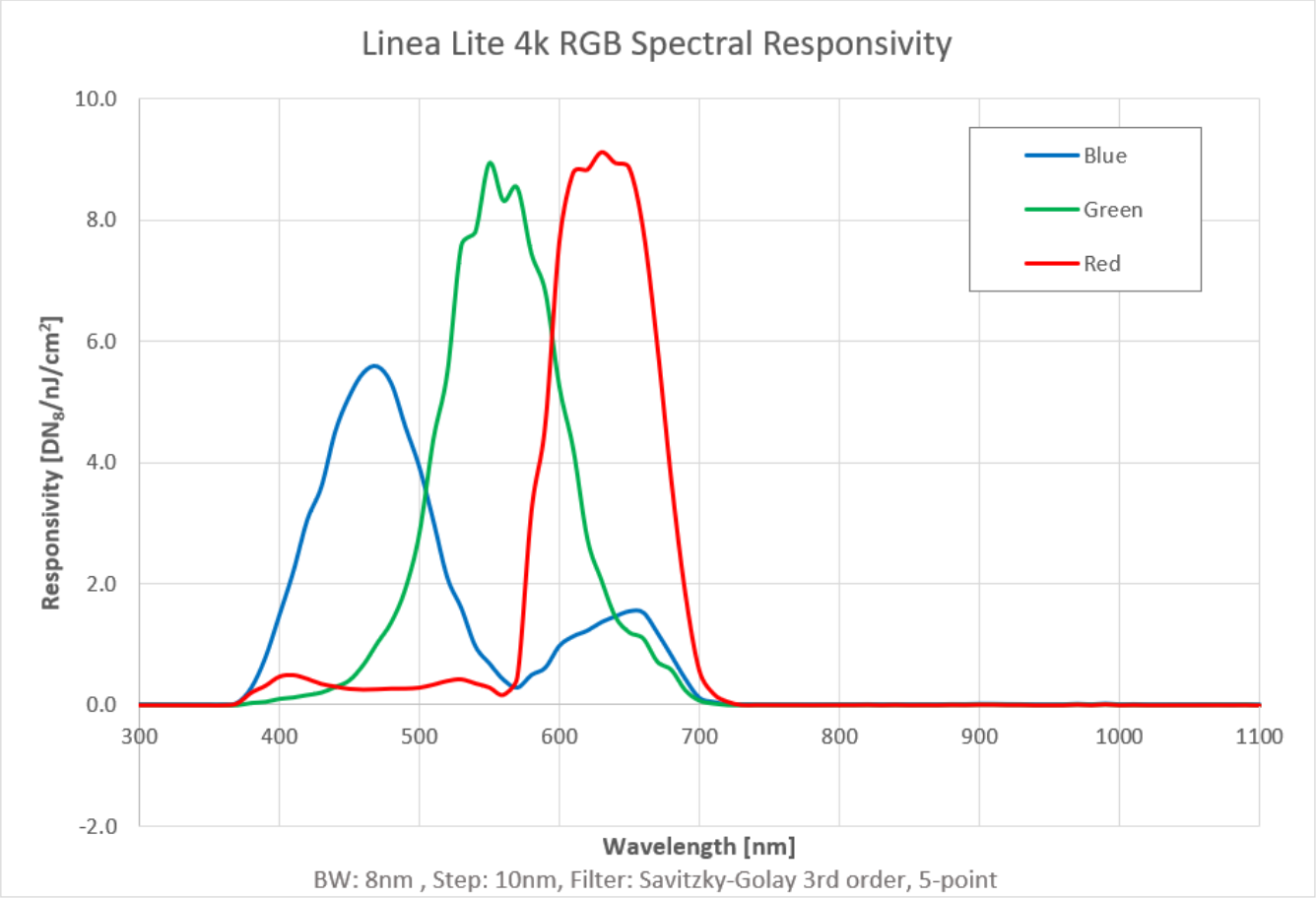


Figure 7: Linea Lite 4k RGB Spectral Responsivity

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 Sapera LT Optimization Guide, available through the Start menu under Teledyne DALSA).
- The **Windows Firewall** exceptions feature is automatically configured to allow the Sapera 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) 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 Sapera LT Optimization Guide, available through the Start menu under Teledyne DALSA, for information general networking and Sapera 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 Sapera Getting Started Manual For GigE Vision Cameras and 3D Sensors installed with the Sapera LT package, for an overview of using GigE Vison 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 µs) between packets. Dependent on the Ethernet connection, inserting a short delay (even 1 µs) 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:
http://www.teledynedalsa.com/imaging/knowledge-center/appnotes/turbodrive/

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 Sapera 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, or 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 Sapera Application Description

GiGE VISION®	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: http://www.machinevisiononline.org/public/articles/index.cfm?cat=167
GENICAM	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 www.genicam.org.

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

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

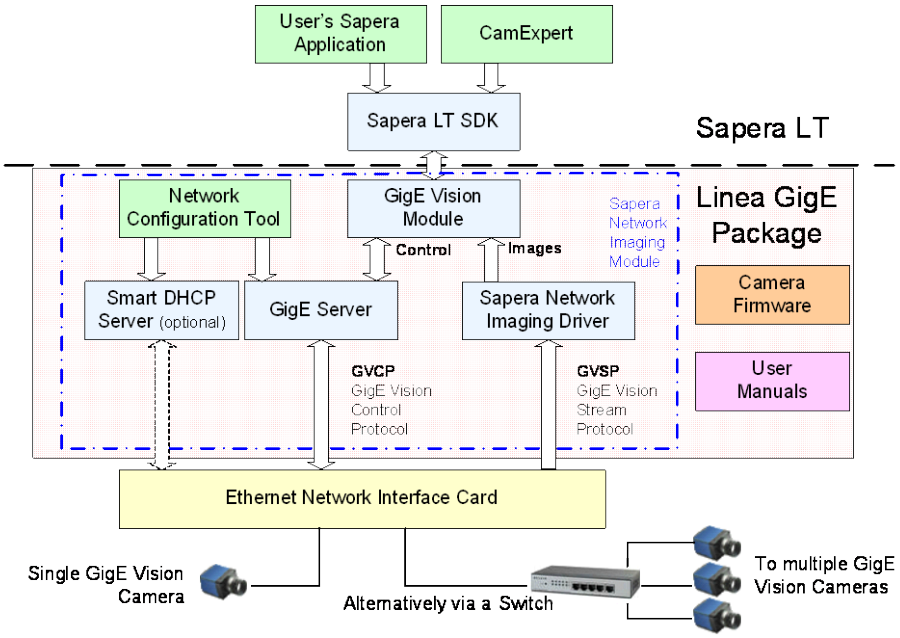


Figure 8: GigE Application Architecture

Linea Lite GigE Camera Quick Start

Sapera Software Installation

Note: Installation of Sapera LT and the GigE Vision package requires administrative privileges; logon to the workstation as an administrator or with an account that has administrator privileges.

When Linea Lite GigE is used in a **Sapera development environment** with **Sapera LT 8.0** 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.

Procedure

- Download and install Sapera LT 8.0 which automatically provides GigE Vision support. When installing, select the installation for GigE Vision support.
  http://www.teledynedalsa.com/imaging/support/downloads/sdks/

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 (8.0 or later for all firmware support) as described in the previous section.

Connecting the Linea Lite GigE Camera

Connecting a Linea Lite GigE to a network system is independent of whether the Teledyne DALSA Sapera 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.

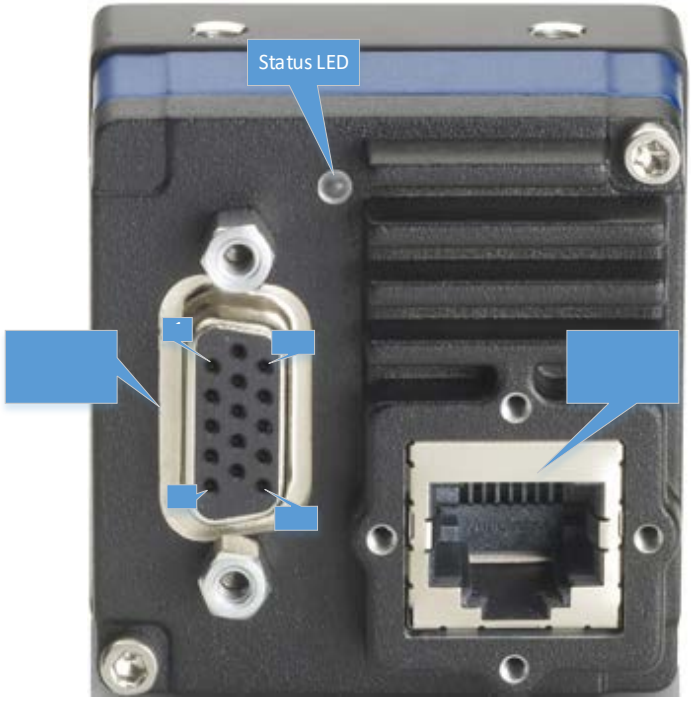


Figure 9: Linea Lite GigE Series – Rear View

Powering the Camera

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

1. Power-over-Ethernet (PoE)
2. 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
GigE Server Tray Icon:			
	The normal GigE server tray icon when the camera device is found. 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 tray icon shows a warning when a device is connected but there is some type of IP error.	A red X will remain over the GigE server tray icon when the camera device is not found. This indicates a major network issue. ***Or in the simplest case***, 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 10: GigE Server Tray Icon

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

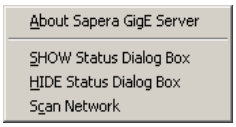


Figure 11: GigE Server Pop-up Menu

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.

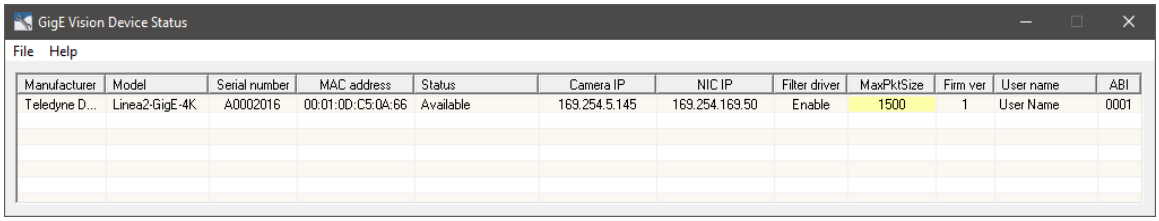


Figure 12: GigE Vision Device Status

In the event that the device is physically connected but the Sapera GigE Server icon is indicating that the connected device is not recognized click **Scan Network** to restart the discovery process.

Note: The GigE server automatically scans the network periodically 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 Troubleshooting section.

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 13: 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 Sapera CamExpert by double clicking the desktop icon created during the Sapera installation.

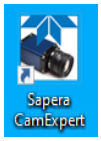


Figure 14: CamExpert Desktop Shortcut Icon

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

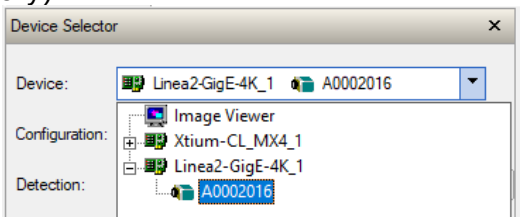


Figure 15: CamExpert Device Selector

- 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 defaults for the following features are:
  - 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.

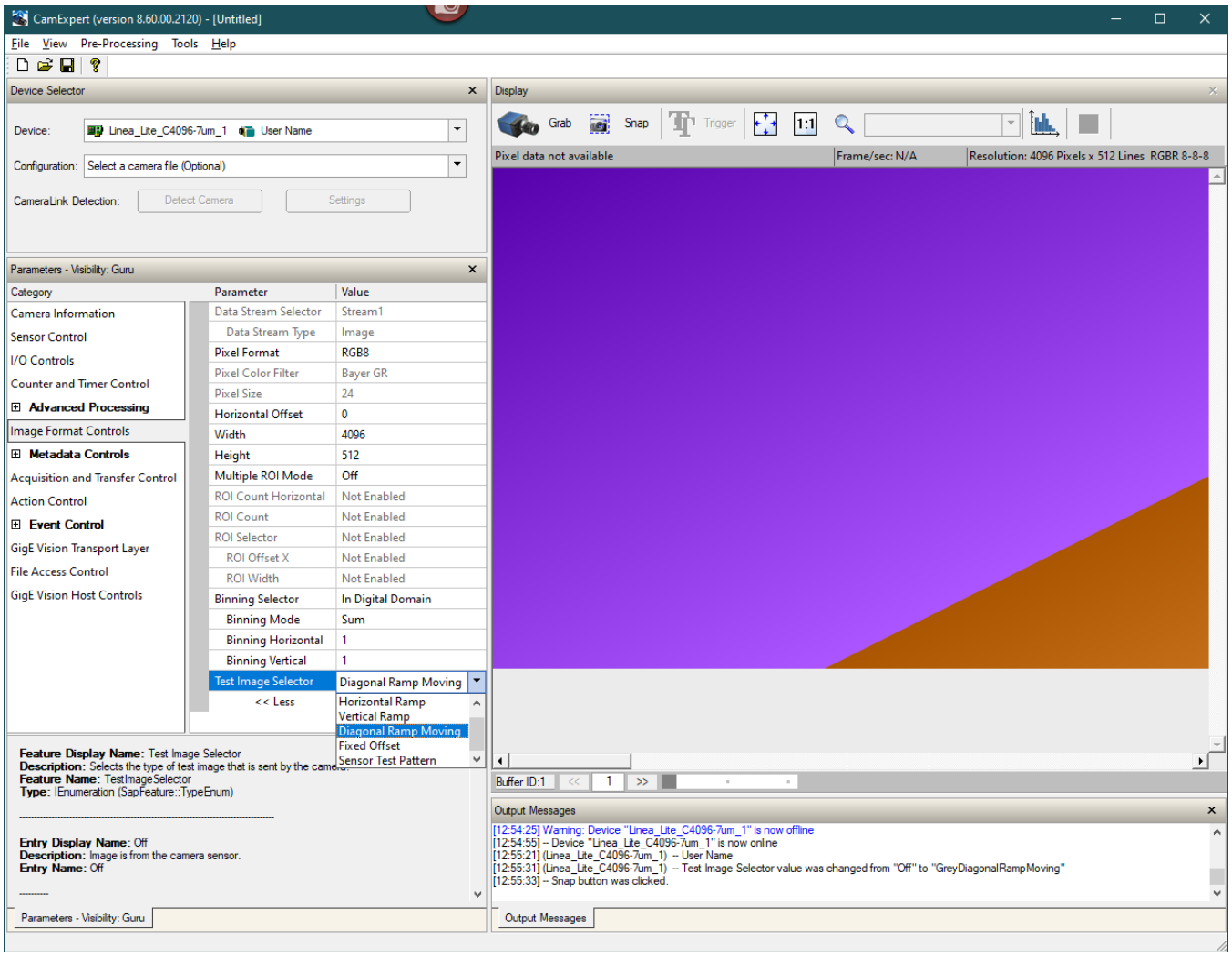


Figure 16: CamExpert Test Image

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

Firmware is uploaded using the File Access Control features in Sapera CamExpert; Refer to Camera Firmware Updates section.

Using CamExpert with Linea Lite GigE Cameras

The Sapera CamExpert tool is the interfacing tool for GigE Vision cameras supported by the Sapera 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).

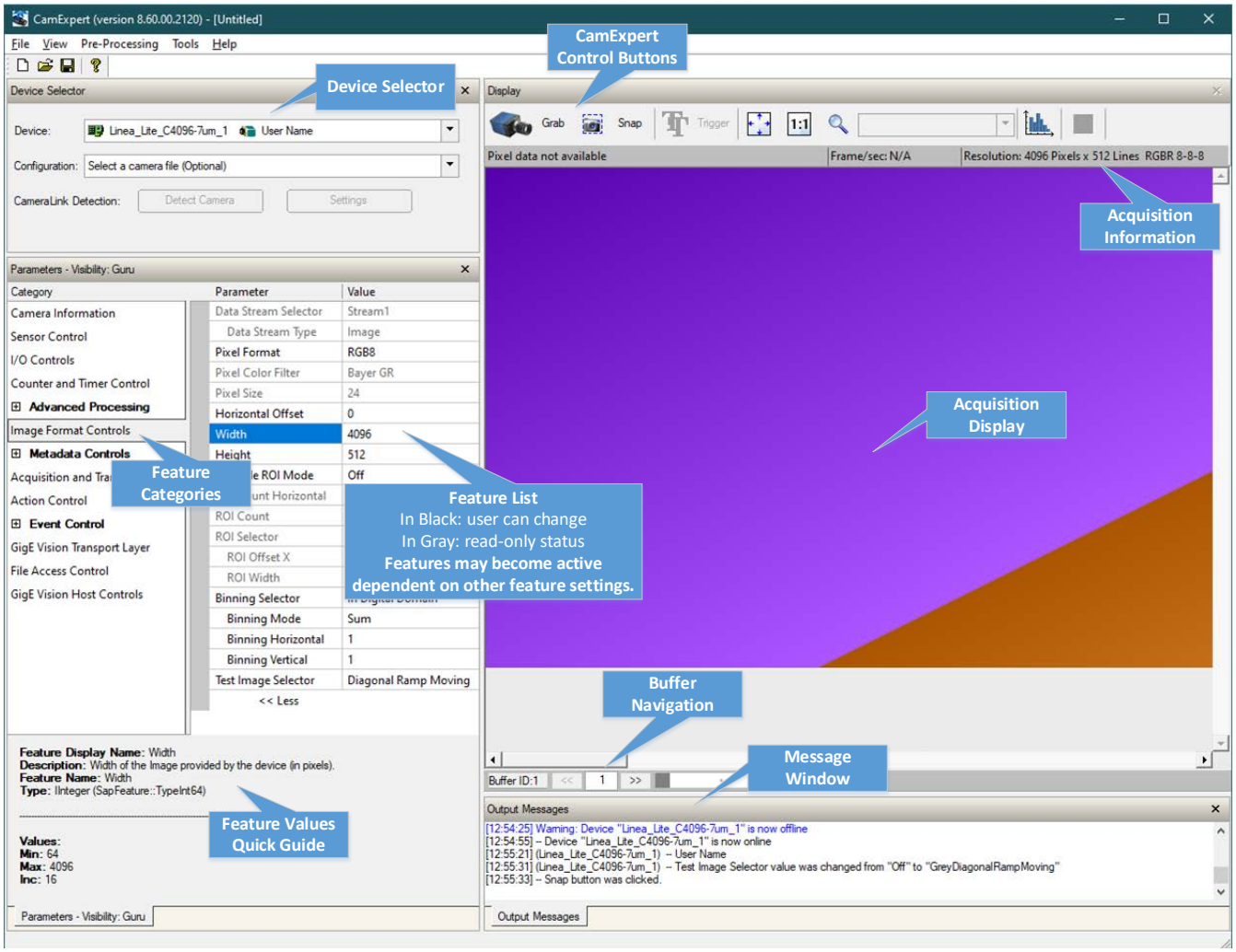
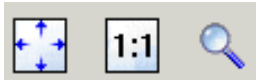
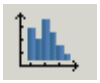


Figure 17: CamExpert Graphical User Interface (GUI)

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

	**Acquisition control button:** Click once to start live grab, click again to stop.
	**Single frame grab:** Click to acquire one frame from device.
	**Software trigger button:** With the I/O control parameters set to Trigger Enabled / Software Trigger type, click to send a single software trigger command.
	**CamExpert display controls:** (these do not modify the frame buffer data) Stretch (or shrink) image to fit, set image display to original size, or zoom the image to any size and ratio. This does not affect the acquisition.
	**Histogram / Profile tool:** Select to view a histogram or line / column profile during live acquisition.

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

CamExpert View Parameters Option

All camera features have a Visibility attribute which defines its requirement or complexity. The states vary from Beginner (features required for basic operation of the device) to Guru (optional features required only for complex operations).

CamExpert presents camera features based on their visibility attribute. 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 Sapera SDK – the CCF is created automatically via a save.
- When using a 3rd party SDK application, if that SDK supports **GenAPI 2.4**, then the process is automatic. Simply follow the 3rd 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.

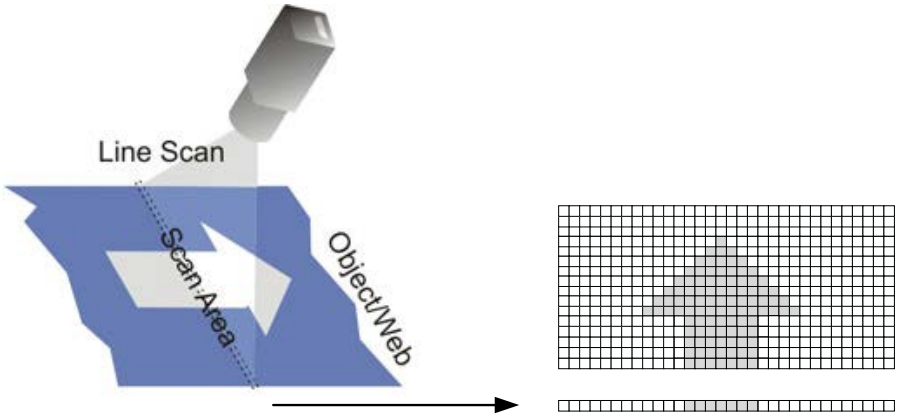


Figure 18: Line Scan Operation

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/Line rate * 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. Concurrent integration and digital readout may occur, however in the 4k only one row may be read out at a time.

The sensor exposure time is 3.2 µs 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 µs 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.

4k Sensor

The Linea Lite 4k sensor has a 7 µm pixel, so every time the object being imaged moves 7 µm, when using an external synchronization trigger signal (EXSYNC), the trigger should be fired each time the object moves 7 µm.

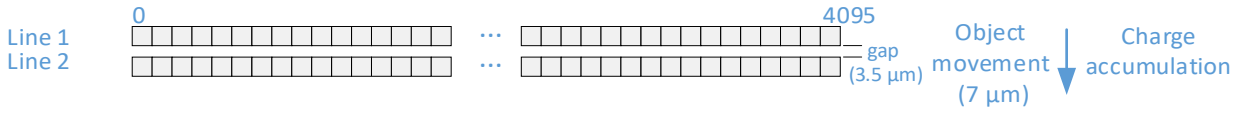


Figure 19: Object Movement & Charge Accumulation

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

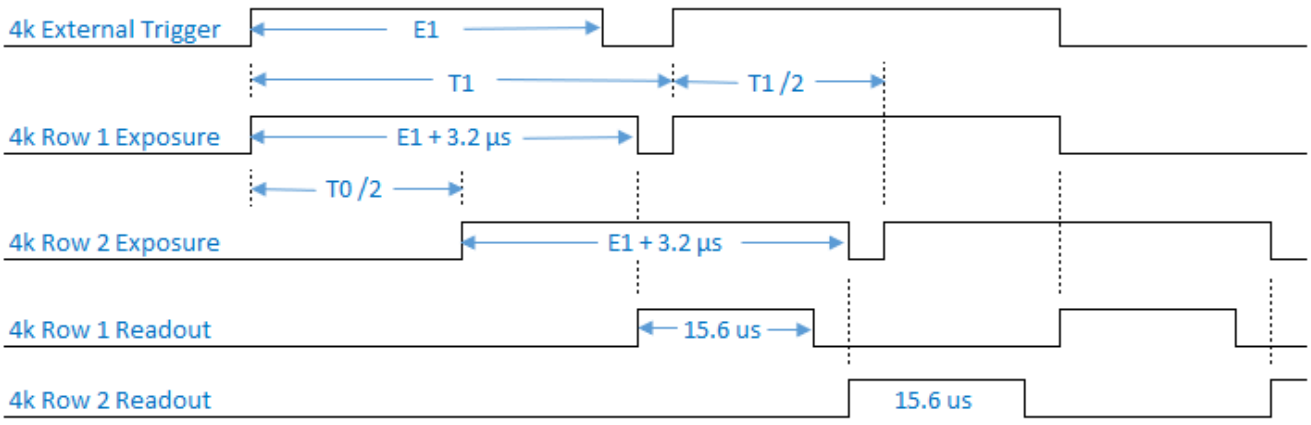


Figure 20: 4k Sensor Row Pulse Width Exposure

The exposure delay between rows can be reduced to 15 µs to increase the exposure overlap between the two rows using the Row Two Exposure Delay feature.

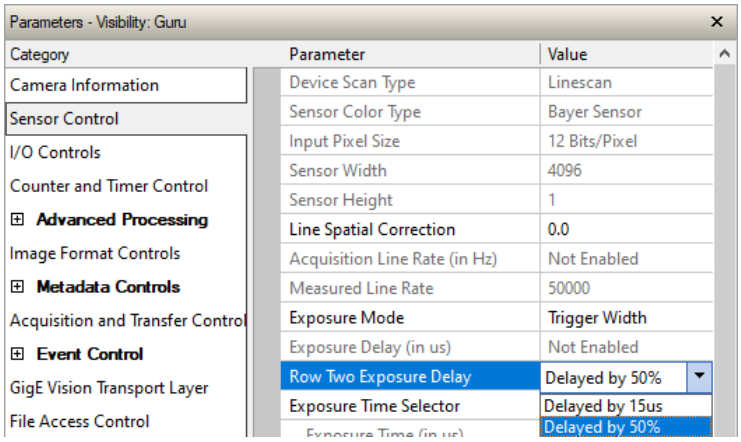


Figure 21: Row Two Exposure Delay

2k Sensor

The Linea Lite 2k sensor has a 14 µm pixel; there is no spacing between the sensor lines, so every time the object being imaged moves 14 µm, when using an external synchronization trigger signal (EXSYNC), the trigger should be fired each time the object moves 14 µm.

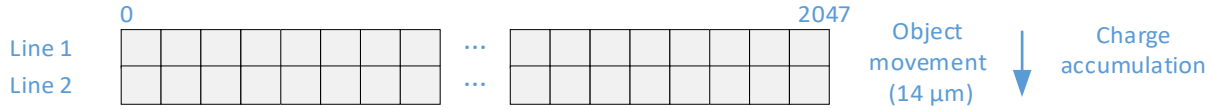


Figure 22: Object Movement & Charge Accumulation

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

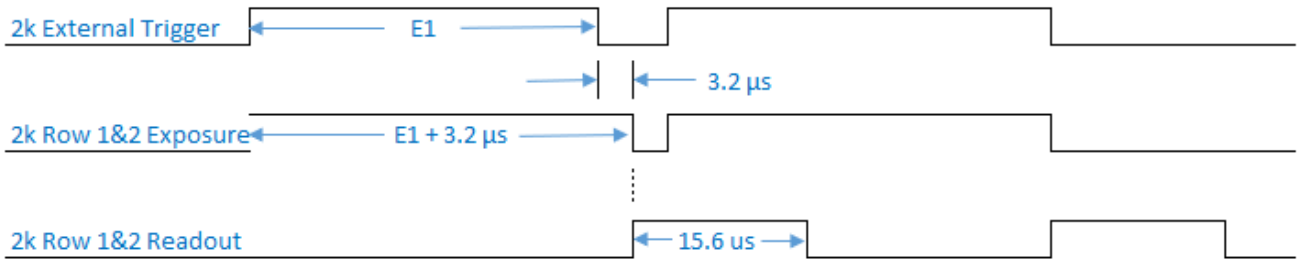


Figure 23: 2k Sensor Row Pulse Width Exposure

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.

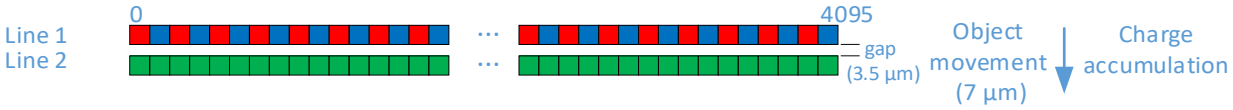


Figure 24: Color 4k Sensor Bayer Filter

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.

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).

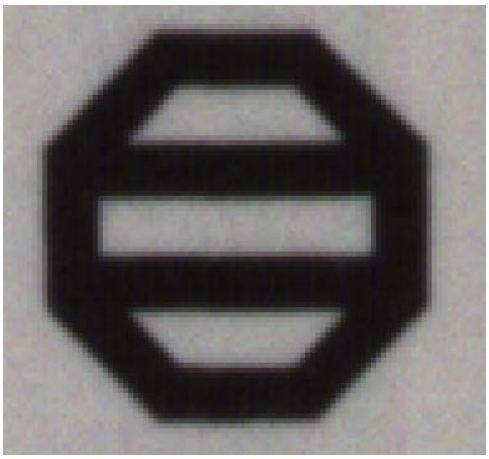


Figure 25: Default Line Spacial Correction

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.

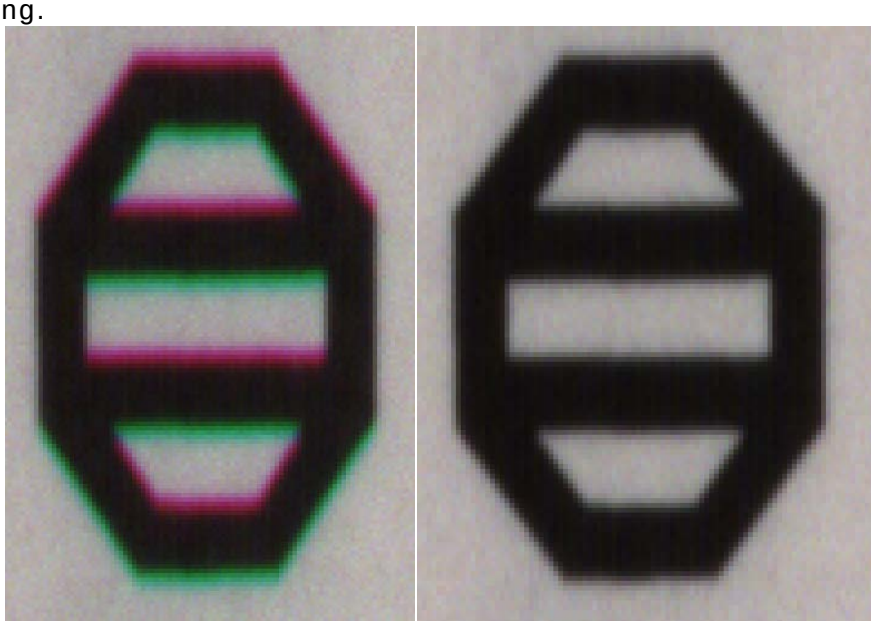


Figure 26: Line Spacial Correction – Target Too Slow

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.

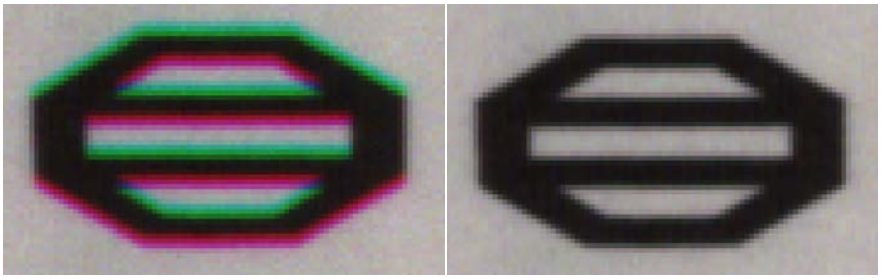


Figure 27: Line Spacial Correction – Target Too Fast

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).

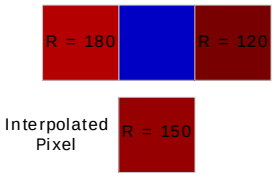


Figure 28: Basic Interpolation

- **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 occuring in interpolated pixels.

  For example, to interpolate R at BG pixels:

$$R_n = G_n + [(R_{n-1} - G_{n-1}) + (R_{n+1} - G_{n+1})] / 2;$$
$$= (R_{n-1} + R_{n+1})/2 + G_n - (G_{n-1} + G_{n+1})/2;$$

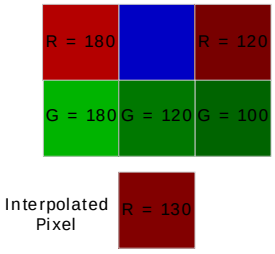


Figure 29: Enhanced Interpolation

TDI Mode

The TDI Mode feature, available for Linea Lite monochrome models, sets the camera's imaging mode. The camera has five different modes:

- Single Row
- High Sensitivity
- High SNR
- High Dynamic Range
- Multi-Row

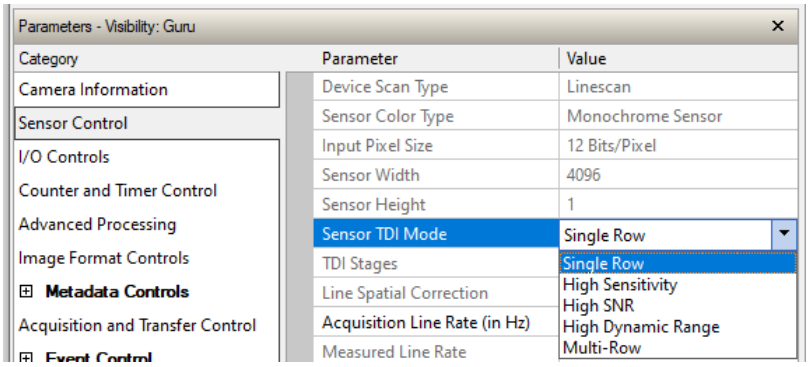


Figure 30: CamExpert – Sensor TDI Mode

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 set to two, the two rows are summed together to output one row.

High SNR Mode

In High SNR mode, the TDI Stages feature 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.

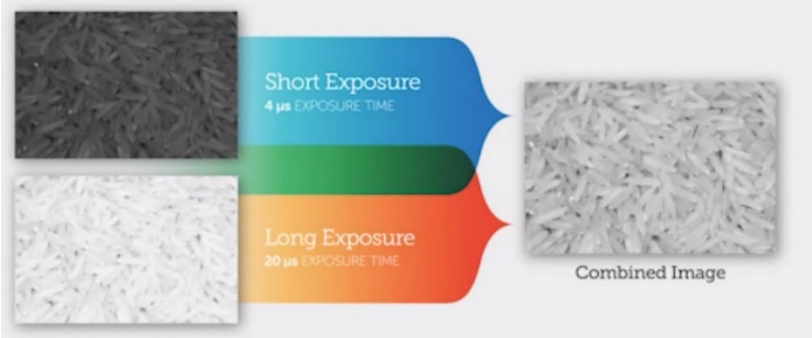


Figure 31: High Dynamic Range Mode

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.

Related GigE Vision Features

Feature related TDI Mode 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.

- **Free running —** (Trigger Mode = Off): 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 Hz. The maximum line rate is determined by the Exposure Time feature. The Internal Acquisition Frames Per Second (FPS) feature returns the FPS for the specified Frame rates are determined by the image buffer Height feature.
- **External trigger** (Trigger Mode = On): 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.
- **Virtual frames**: For any exposure type the virtual frame is the number of lines per frame as set by the Height feature, available in the Image Format Category.

The Trigger Mode feature determines if the cameras uses free-running mode (Trigger Mode = Off) or an external trigger (Trigger Mode = On).

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 Sapera 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.

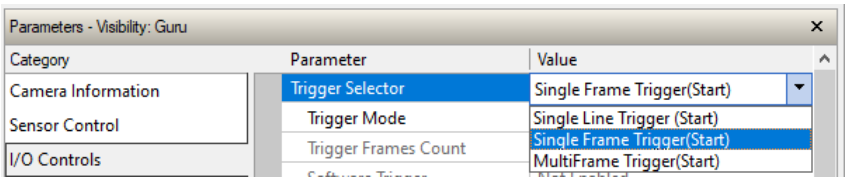


Figure 32: CamExpert – Trigger Selector

Three 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):** Burst start trigger starts the capture of a number of frames. No line is lost between frames. The number of frames in this burst mode is defined by the Trigger Frames Count feature.

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.

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 or internal clock (free-running).

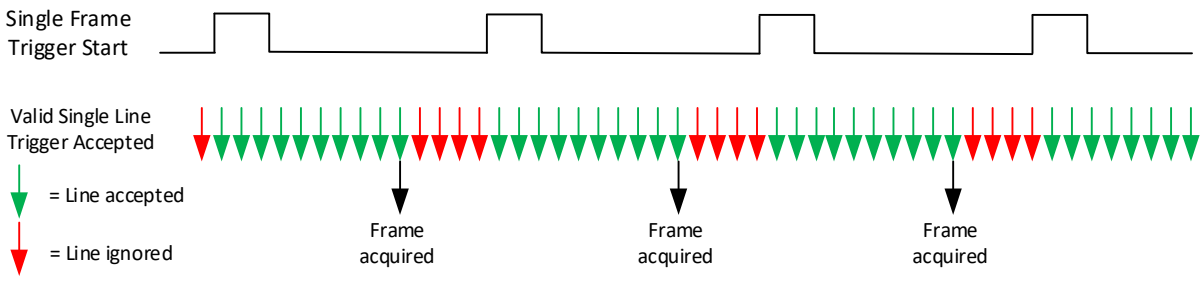


Figure 33: 10-Line Single Frame Trigger Example

MultiFrame Trigger

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

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

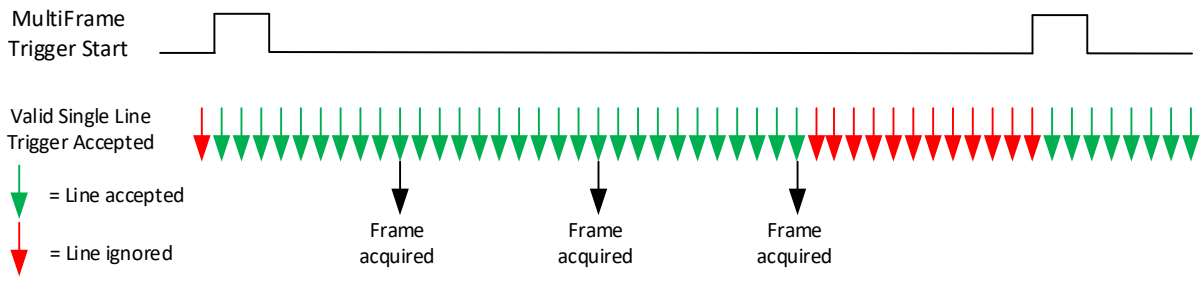


Figure 34: 10-Line Single Frame Trigger Example

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.

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.
- **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 using Single Line Trigger.
- **Trigger Source = Timer 1 End Event:** The Timer 1 End Event is used as the internal trigger source. Refer to Counter and Timer Controls for information on those features.
- **Trigger Source = Counter 1 End Event**: The Counter 1 End Event is used as the internal trigger source.
- **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
    - 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.

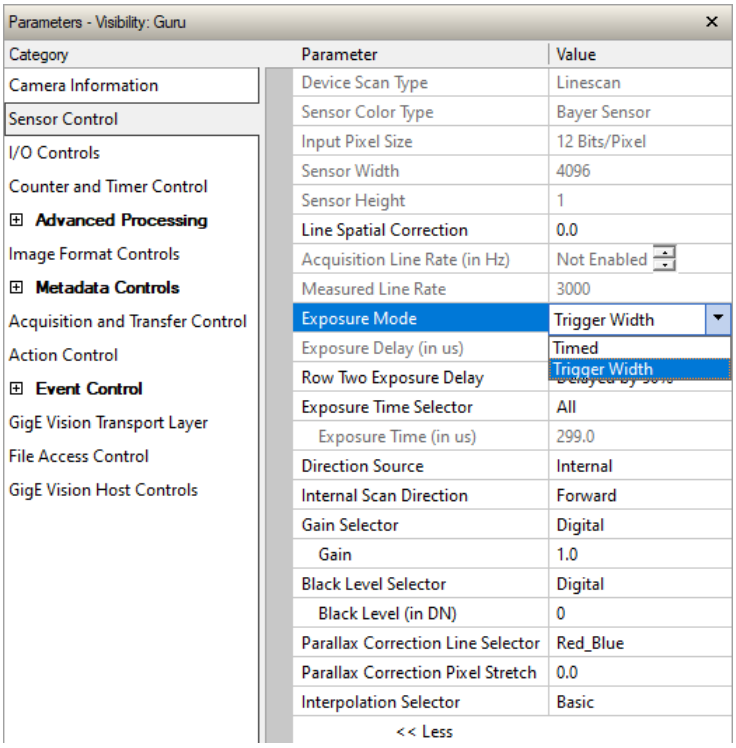


Figure 35: CamExpert – Exposure Mode

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 for Single Line Trigger.

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 µs longer than the exposure pulse. Therefore the actual exposure time is 3.2 µs longer than the exposure time determined by the trigger.

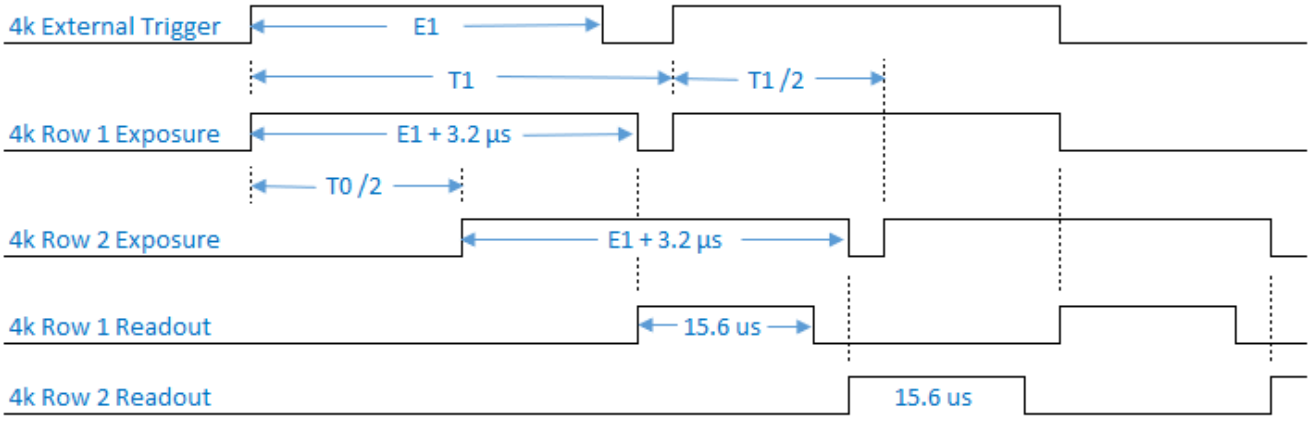


Figure 36: 4k External Trigger with Pulse Width Exposure Control

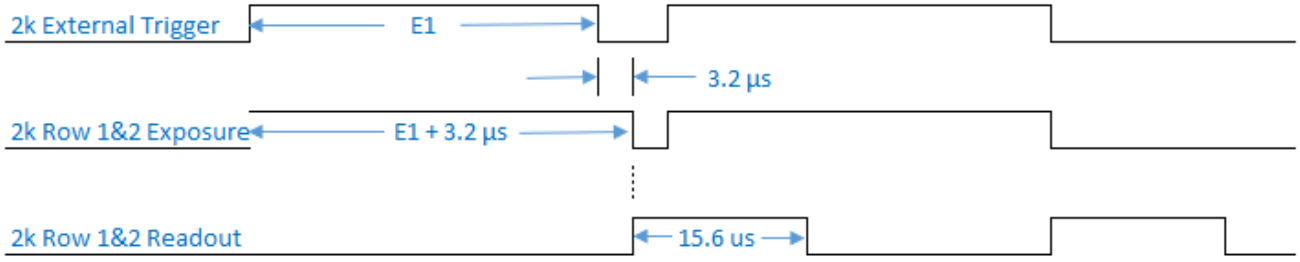
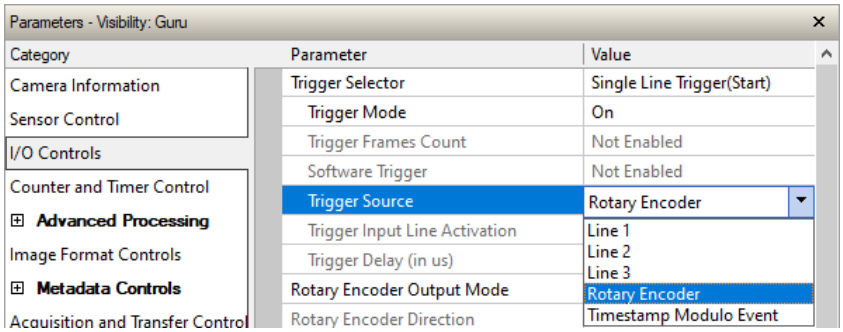


Figure 37: 2k External Trigger with Pulse Width Exposure Control

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 is only available for the Single Line Trigger.



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 Line Lite rotary encoder inputs provide additional functionality with encoder rescaler (multiplier and divider) support to adjust the encoder output timing.

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)

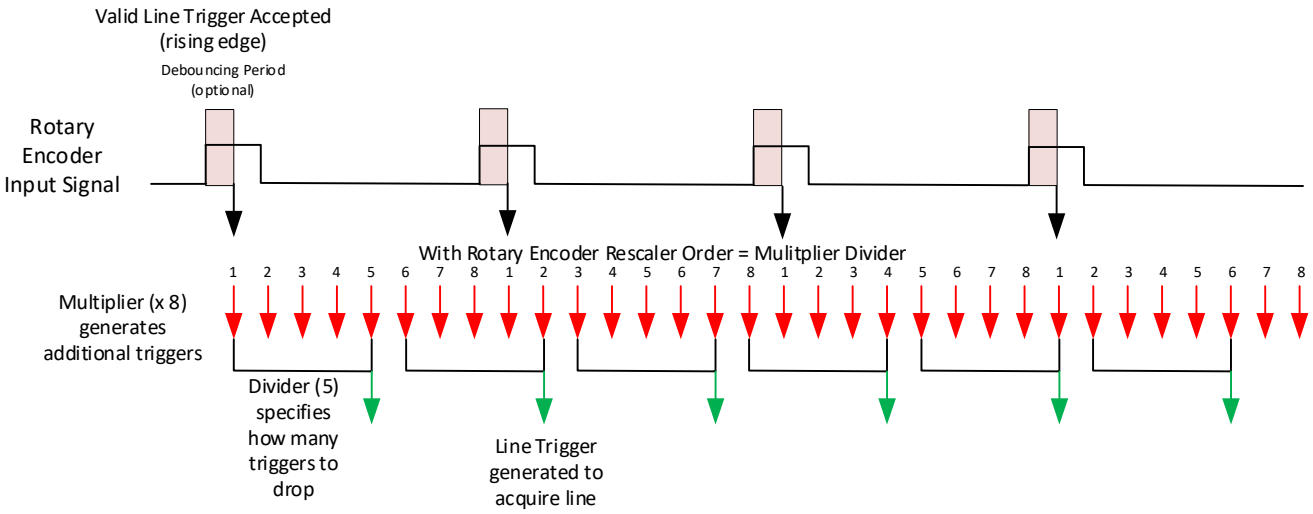
When enabled using the Trigger Mode feature, the triggered camera acquires one scan line according to the how the various rotary encoder feature settings:

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 1.125 mm (1/8); if a divider of 5 is then applied, then each tick is 6.25 mm (1.125 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

Related GigE Vision Features

Feature related to triggers are part of the I/O Controls category.

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 GigE Vision 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, therefore 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 following graphic illustrates binning.

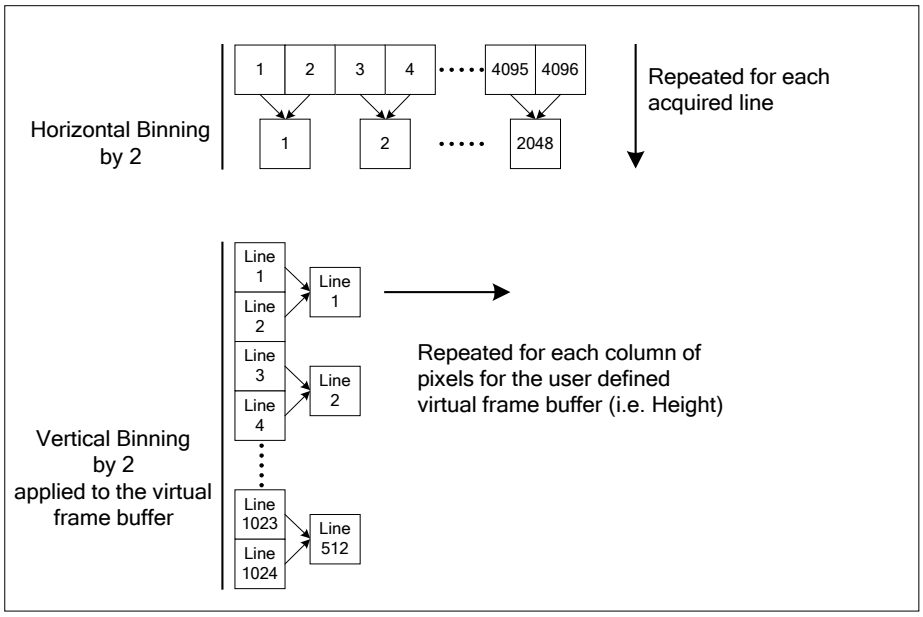


Figure 38: Horizontal & Vertical Binning

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

Related GigE Vision 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.

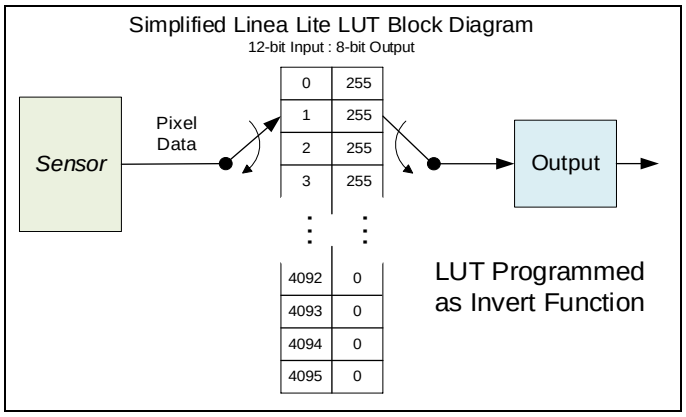


Figure 39: LUT Block Diagram

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.

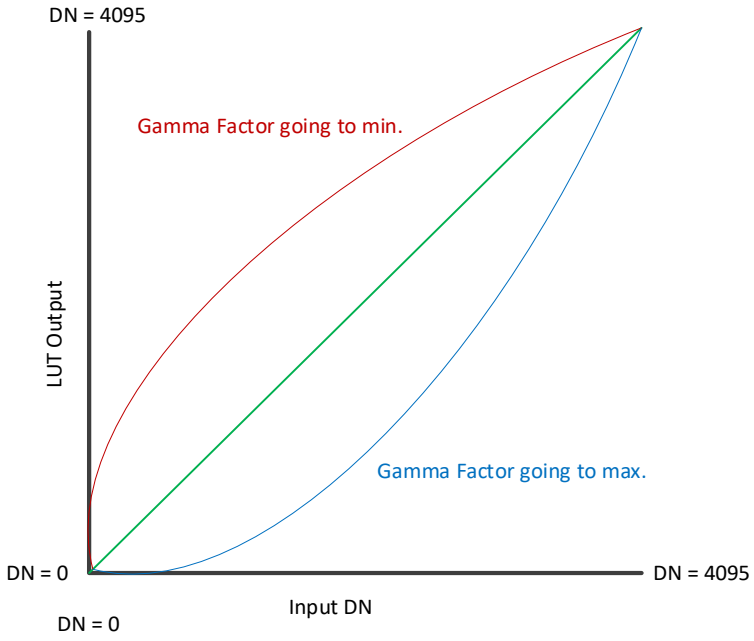


Figure 40: Gamma Correction Factor (not to scale)

Related GigE Vision 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).

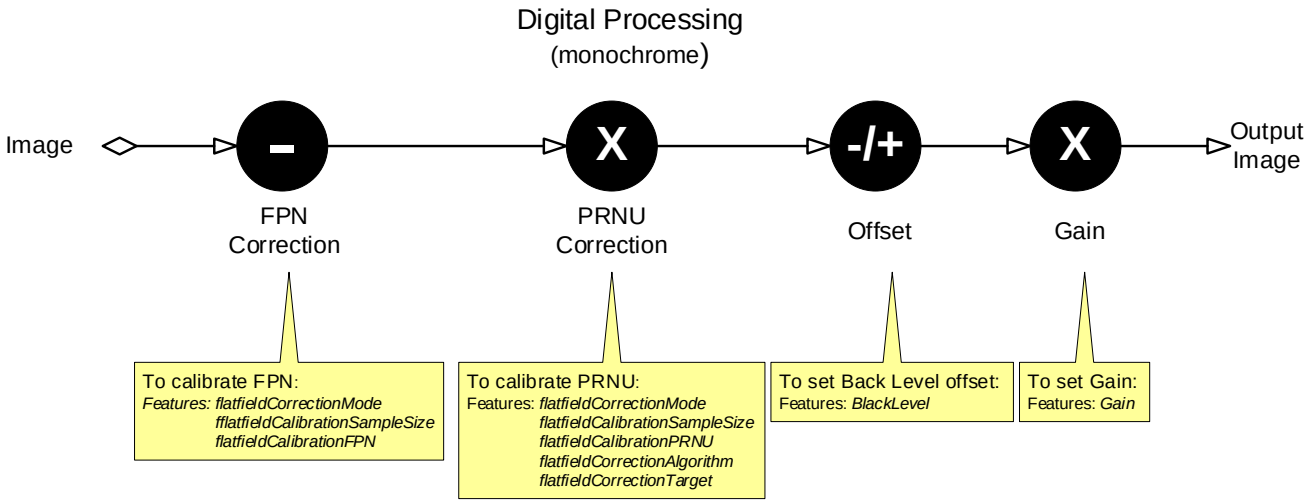


Figure 41: Digital Processing Chain

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.

Important: FFCOffset and FFCGain are derived factors calculated from a number of camera specific feature values (Invisible DFNC features).

Note: 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

Important: 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.

Important: 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**.

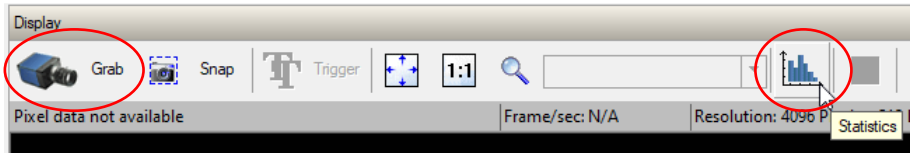


Figure 42: CamExpert – Grab & Statistics Buttons

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

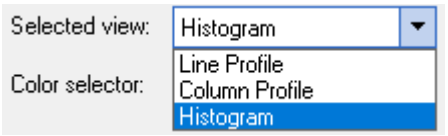


Figure 43: CamExpert Statistics Dialog – Selected View

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

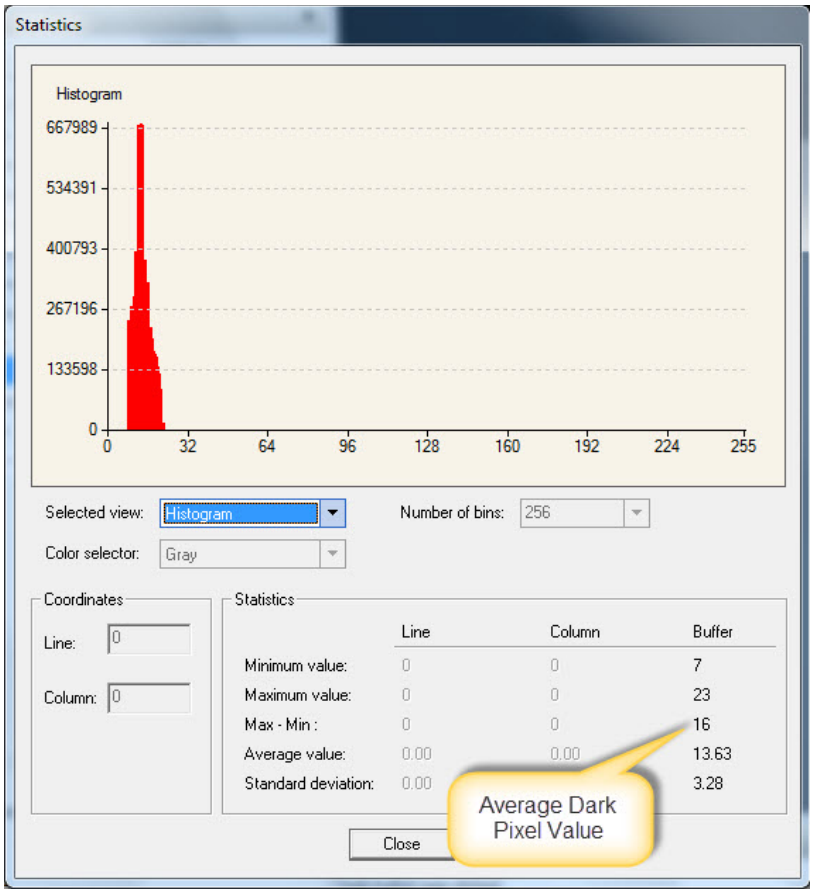


Figure 44: CamExpert Statistics Dialog – Average Dark Pixel Value

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

Note: 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.

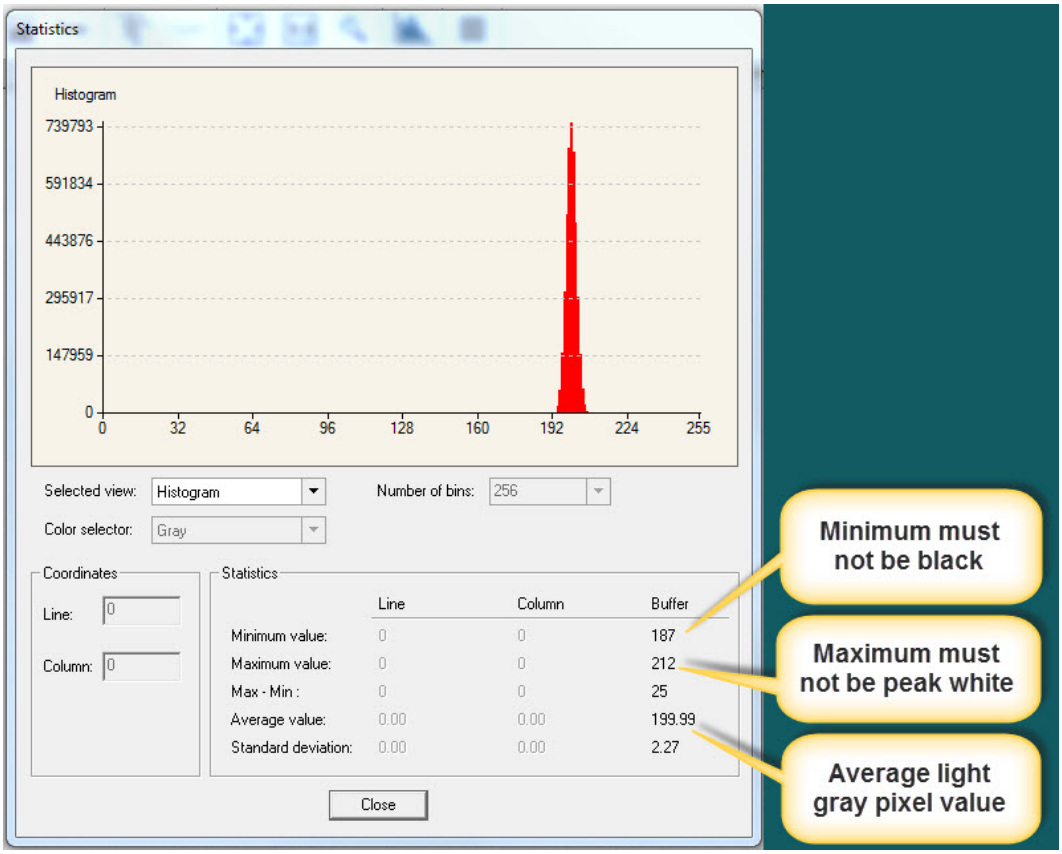


Figure 45: CamExpert Statistics Dialog – Verifying Bright Acquisition

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 a 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.

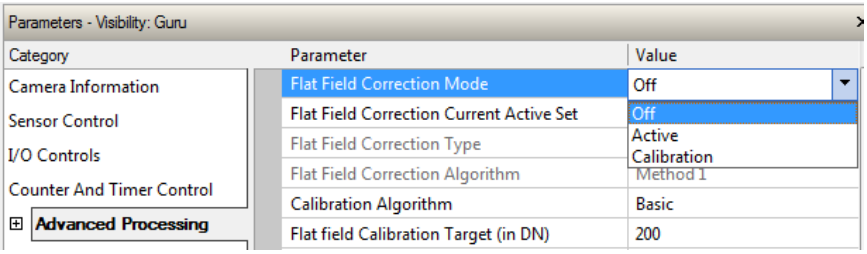


Figure 46: CamExpert – Flat Field Correction Mode

- Set the Gain to 1.0.

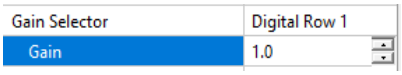


Figure 47: CamExpert – Gain

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

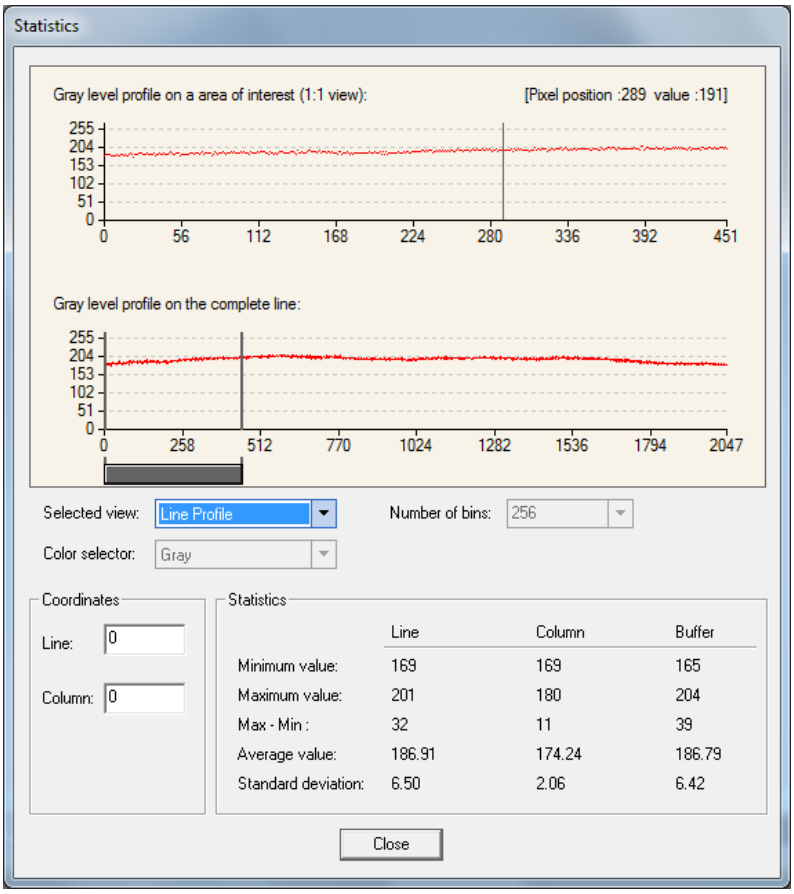


Figure 48: CamExpert Statistics Dialog – Line Profile

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:

Step 1. Cover the lens (place the sensor in dark).

Step 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.

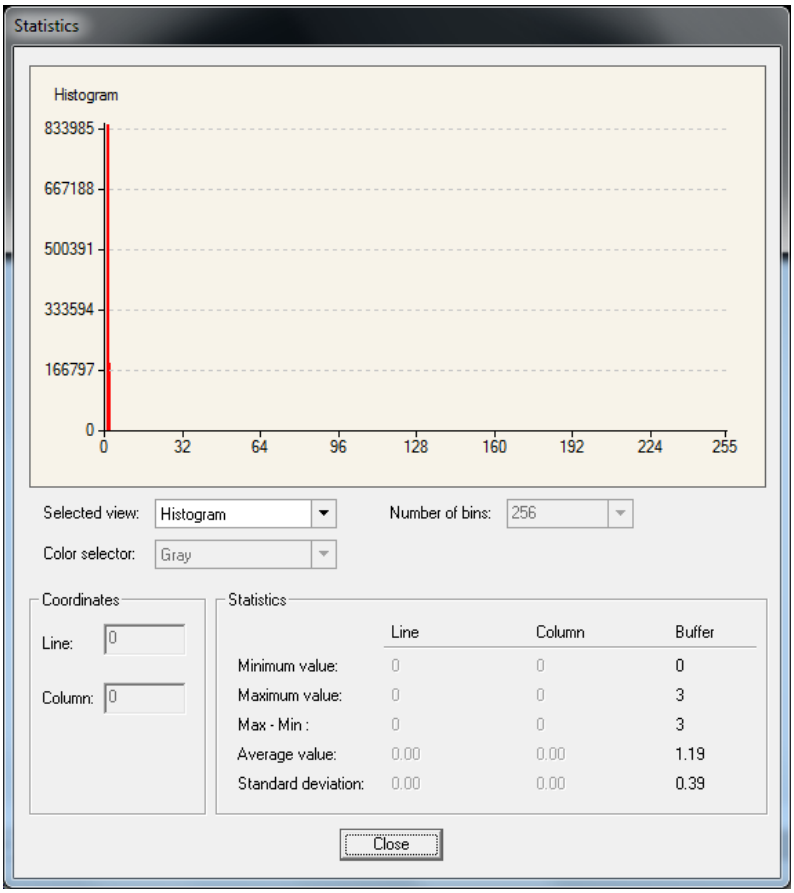


Figure 49: CamExpert Statistics Dialog – FPN Pixel Output

Step 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.

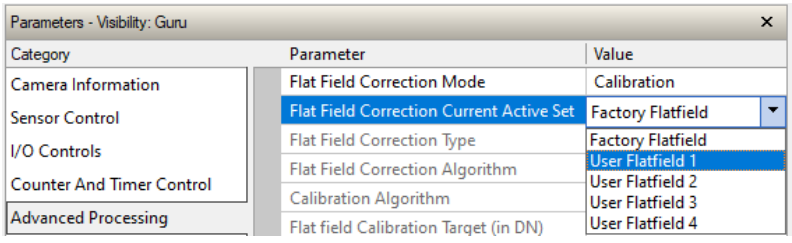


Figure 50: CamExpert – Flat Field Correction Current Active Set

Step 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.

Step 5. In the Calibrate FPN feature, click the *Press...* command to perform the calibration.

Step 6. Uncover lens.

PRNU Correction

Step 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.

Step 2. Set the Flat Field Correction Mode to Calibration and select the required user set from Flat Field Correction Current Active Set drop-down menu.

Step 3: Adjust the calibration target in the Flat Field Calibration Target (in DN) if necessary.
Note: 200 DN is commonly used target in 8-bit output format.

Step 4. Set the Flat Field Calibration Sample Size feature to 4096 or 2048.

Step 5. In the Calibrate PRNU feature, click **Press...** to perform the calibration.

Step 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.

Step 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.

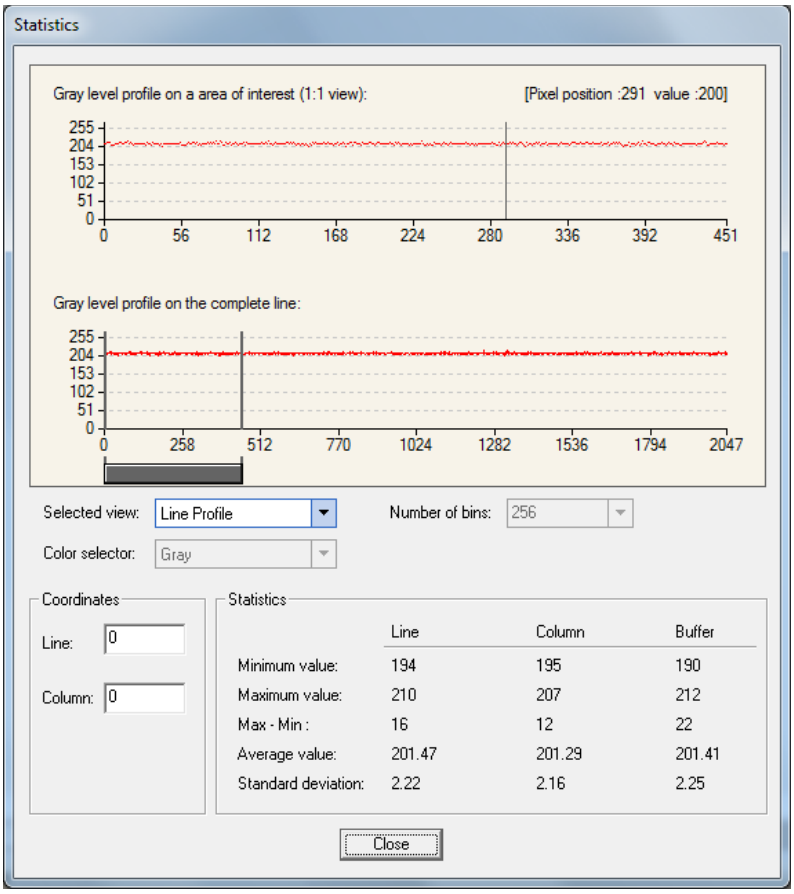


Figure 51: CamExpert Statistics Dialog – Line Profile

Step 8. 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…**.

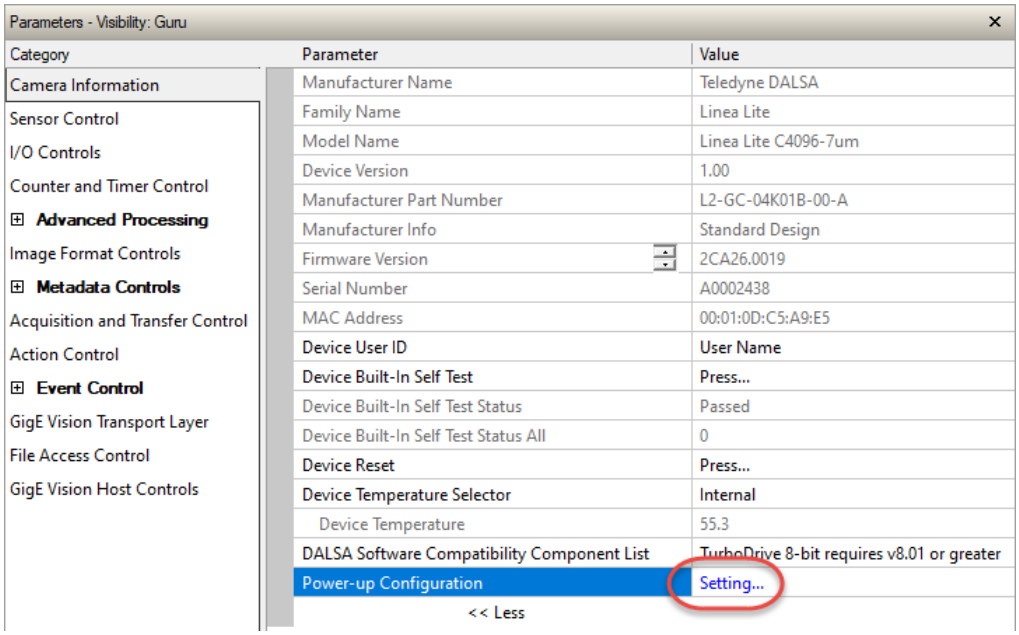


Figure 52: CamExpert – Power-up Configuration

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.

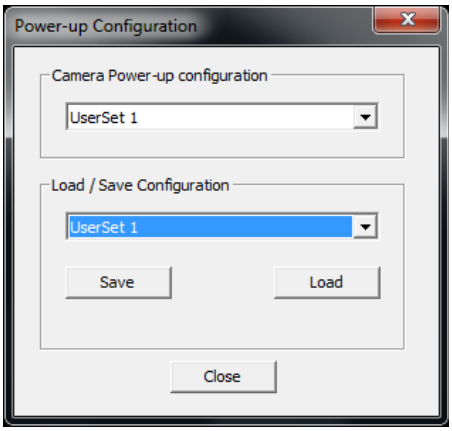


Figure 53: CamExpert – Power-up Configuration Dialog

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

Camera Firmware Updates

In the File Access Control category, click **Setting** to open File Access Control dialog.

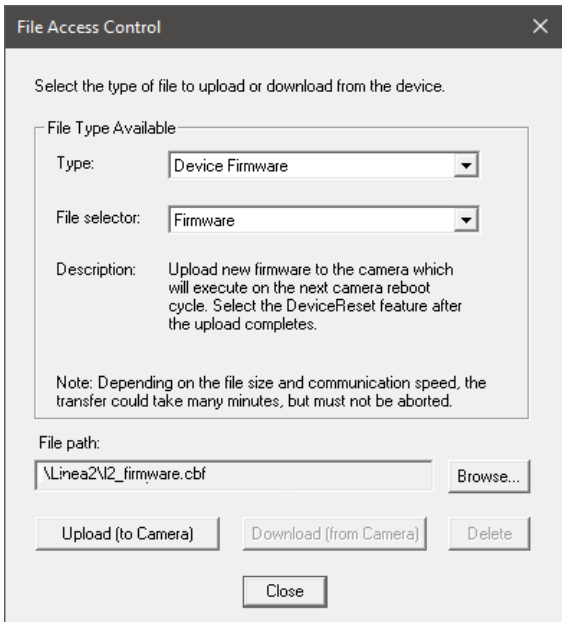


Figure 54: CamExpert – File Access Control Dialog

- **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.

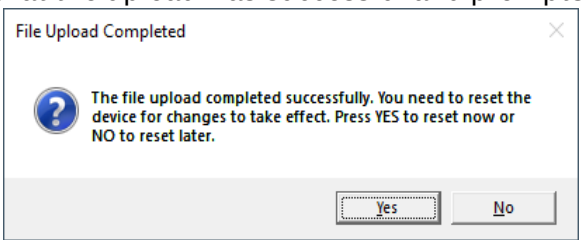


Figure 55: CamExpert – File Upload Completed Message Box

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.

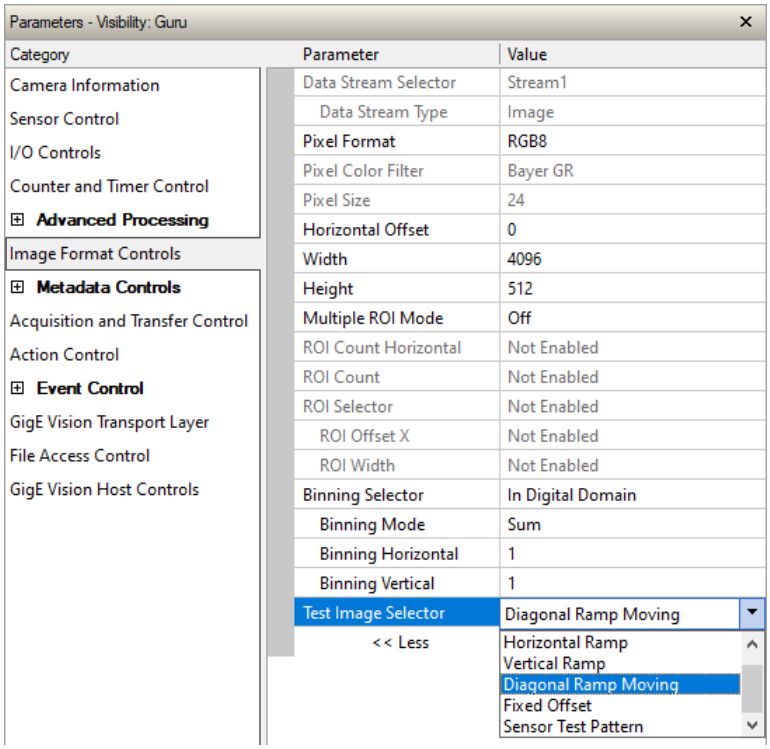


Figure 56: CamExpert – Test Image Selector

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.

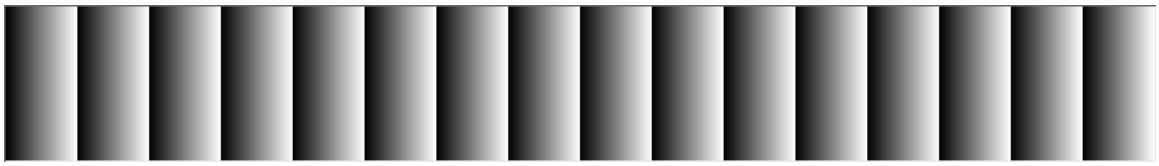


Figure 57: CamExpert Test Image – Grey Horizontal Ramp

Vertical Ramp

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

Figure 58: 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.

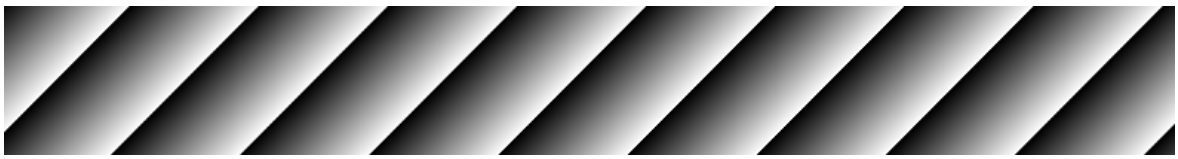


Figure 59: CamExpert Test Image – Grey Diagonal Ramp Moving

Fixed Offset

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

Figure 60: CamExpert Test Image – Fixed Offset

Sensor Test Pattern

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

Figure 61: 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.

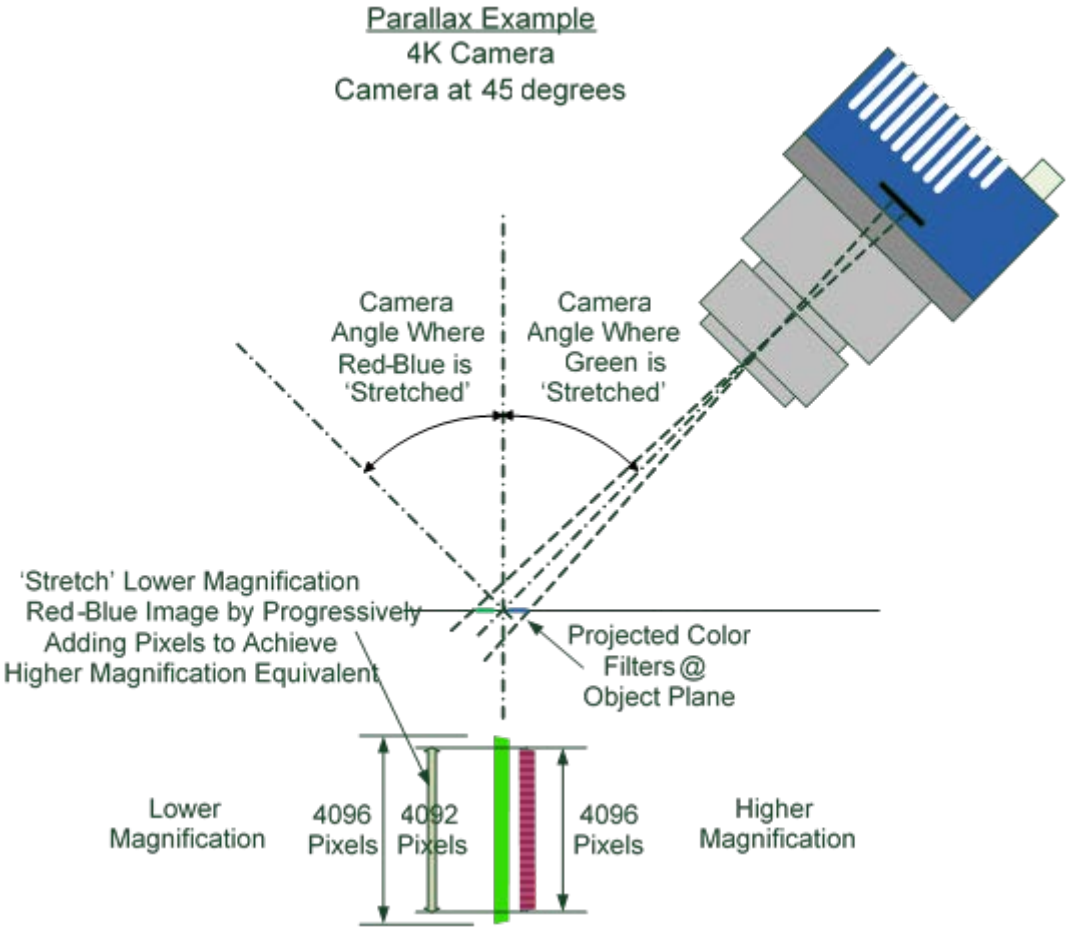


Figure 62: Camera Angle Creates Parallax

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 63:Parallax Image Example

User Defined Camera Name

The Linea Lite GigE camera can be programmed with a user-defined name, using the Device User ID feature, to identify multiple cameras connected to the network. For example, an inspection system with four cameras might label cameras “top view”, “left view”, “right view” and “bottom view”.

The Factory Default User Name is the camera serial number for quick initial identification.

Note: The factory programmed camera serial number and MAC address are not user changeable.

For example, when using CamExpert, multiple monochrome Linea Lite GigE cameras on the network are seen as different "Linea_Lite_M4096-7um_xx" 4k devices and "Linea_Lite_M2048-14um_xx" 2k devices. Non-Teledyne DALSA cameras are labeled as “GigEVision Device”. Click on a device User Name to select it for control by CamExpert.

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

- Do not use the camera's IP address as identification (unless it is a persistent IP) 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.

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.

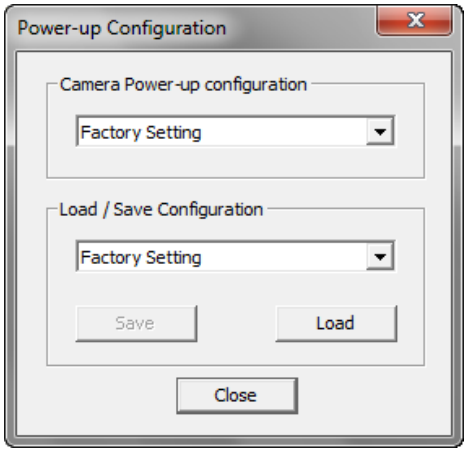


Figure 64: CamExpert – Power-up Configuration Dialog

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

Feature Descriptions

In the following feature description sections, 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 not shown). In general, feature names that start with an uppercase letter are part of the SFNC while those starting with a lowercase letter are part of the DFNC.

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

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

The B/W Color column, where necessary, identifies features that are specific to monochrome or color camera models using a symbol.

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.

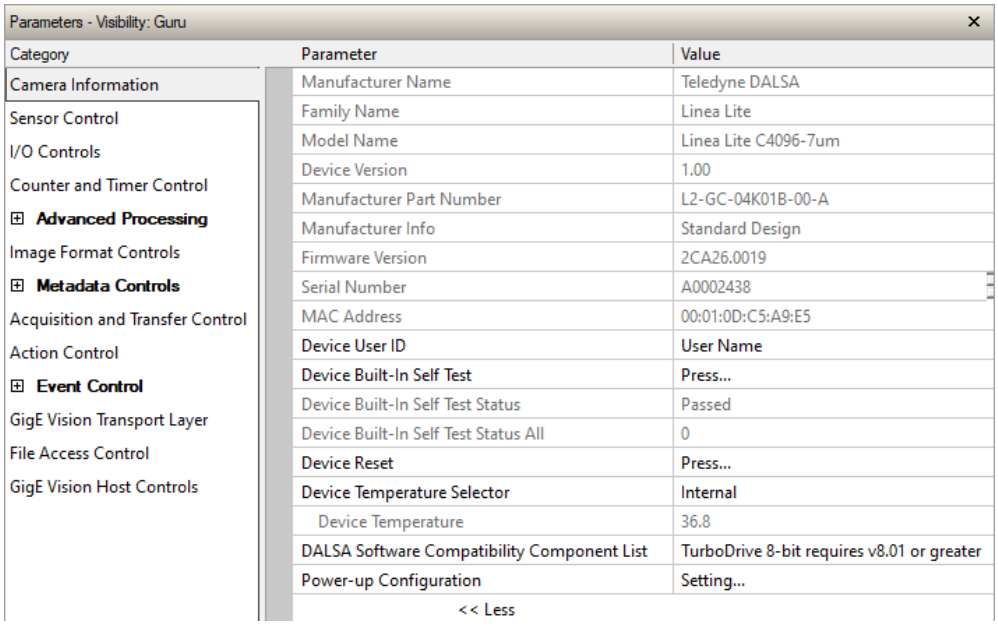


Figure 65: CamExpert – Camera Information Category

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

Device User ID	DeviceUserID	Feature to store a user-programmable identifier of up to 15 characters. The default factory setting is the camera serial number. (RW)	Beginner
Device Built-In Self Test	deviceBIST	Command to perform an internal test which will determine the device status. (W)	Beginner DFNC
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
Passed	*Passed*	*No failure detected*	
Firmware update failed	*FirmwareUpdateFailure*	*Last firmware update operation failed.*	
Sensor Initialization Failure	*SensorFailure*	*There was an error initializing the sensor; the camera may not be able to capture images.*	
Firmware Error	*FirmwareError*	*Firmware encountered an error during streaming.*	
Unexpected Error	*Unexpected_Error*	*Switched to recovery mode due to unexpected software error.*	
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
Internal	*Internal*	*Read FPGA and / or PHY temperature.*	
MaxInternal	*MaxInternal*	*Records the highest device temperature since power up. Value is reset on power off.*	
Device Temperature	DeviceTemperature	The temperature of the selected source in degrees Celsius	Beginner
DALSA Software Compatibility Component List	DALSASoftwareCompatibilityComponentList	List the optional Teledyne DALSA software functions that are supported.	Beginner
TurboDrive 8-bit requires v8.01 or greater	*Compatibility1*	*Teledyne DALSA Turbo Drive 8-bit (Monochrome or Bayer) requires Sapera-LT 8.01 or greater.*	
TurboDrive 10-bit requires v8.10 or greater	*Compatibility2*	*Teledyne DALSA Turbo Drive 10-bit (Monochrome or Bayer) requires Sapera-LT 8.10 or greater.*	
TurboDrive 12-bit requires v8.10 or greater	*Compatibility3*	*Teledyne DALSA Turbo Drive 12-bit (Monochrome or Bayer) requires Sapera-LT 8.10 or greater.*	
Multicast requires a newer version	*Compatibility4*	*Multicast feature support requires a newer version of Sapera LT than currently installed.*	
Power-up Configuration Selector	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
None	*None*	*Keep Internal configuration.*	
Factory Setting	*Default*	*Load factory default feature settings.*	
UserSet1	*UserSet1*	*Select the user defined configuration UserSet 1 as the Power-up Configuration.*	
UserSet2	*UserSet2*	*Select the user defined configuration UserSet 2 as the Power-up Configuration.*	
UserSet3	*UserSet3*	*Select the user defined configuration UserSet 3 as the Power-up Configuration.*	
UserSet4	*UserSet4*	*Select the user defined configuration UserSet 4 as the Power-up Configuration.*	

User Set Selector	UserSetSelector	Selects the camera configuration set to load feature settings from or save current feature settings to. The Factory set contains default camera feature settings. User camera configuration sets contain features settings previously saved by the user. (RW)	Beginner
Factory Setting	*Default*	*Select the default camera feature settings saved by the factory.*	
UserSet 1	*UserSet1*	*Select the User Defined Configuration space UserSet 1 to save to or load from features settings previously saved by the user.*	
UserSet 2	*UserSet2*	*Select the User Defined Configuration space UserSet 2 to save to or load from features settings previously saved by the user.*	
UserSet 3	*UserSet3*	*Select the User Defined Configuration space UserSet 3 to save to or load from features settings previously saved by the user.*	
UserSet 4	*UserSet4*	*Select the User Defined Configuration space UserSet 4 to save to or load from features settings previously saved by the user.*	
Load Configuration	UserSetLoad	Loads the camera configuration set specified by the User Set Selector feature, to the camera and makes it active. (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	deviceAcquisitionType	Displays the Device Acquisition Type of the product. (RO)	Invisible DFNC
Sensor	*Sensor*	*The device gets its data directly from a sensor.*	
Device TL Type	DeviceTLType	Transport Layer type of the device.	Invisible
GigE Vision	*GigEVision*	*GigE Vision Transport Layer*	
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	UserSetDefaultSelector	Selects the camera configuration set to load and make active on camera power-up or reset. The camera configuration sets are stored in camera non-volatile memory. (RW)	Invisible
None	*None*	*Keep Internal configuration.*	
Factory Setting	*Default*	*Select the Factory Setting values as the Power-up Configuration.*	
UserSet1 to UserSet4	*UserSet1 to UserSet4*	*Select the user defined configuration as the Power-up Configuration.*	
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

DALSA Software Compatibility Component List	DALSASoftwareCompatibilityComponentList	List the optional Teledyne DALSA software functions that are supported.	Beginner DFNC
TurboDrive 8-bit requires v8.01 or greater	*Compatibility1*	*Teledyne DALSA Turbo Drive 8-bit (Monochrome or Bayer) requires Sapera-LT 8.01 or greater.*	
TurboDrive 10-bit requires v8.10 or greater	*Compatibility2*	*Teledyne DALSA Turbo Drive 10-bit (Monochrome or Bayer) requires Sapera-LT 8.10 or greater.*	
TurboDrive 12-bit requires v8.10 or greater	*Compatibility3*	*Teledyne DALSA Turbo Drive 12-bit (Monochrome or Bayer) requires Sapera-LT 8.10 or greater.*	
Multicast requires a newer version	*Compatibility4*	*Multicast feature support requires a newer version of Sapera LT than currently installed.*	

Sensor Control Category

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

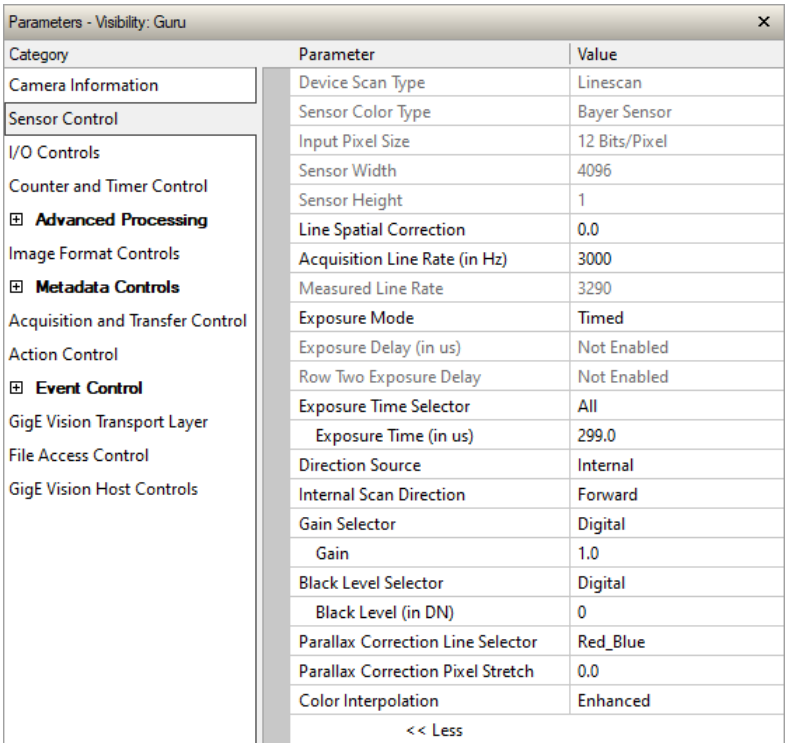


Figure 66: CamExpert – Sensor Control Category

Sensor Control Feature Descriptions

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

■□	Sensor TDI Mode	sensorTDIModeSelection	Selects how to combine the rows for processing.	Beginner DFNC
	Single Row	*TdiOff*	*A single sensor row is output per line trigger.*	
	High Sensitivity	*TdiSum*	*Multiple sensor rows are synchronized and summed together in the camera to increase the camera responsivity.*	
	High SNR	*TdiAvg*	*Multiple sensor rows are synchronized and averaged together in the camera to increase the signal to noise ratio.*	
	High Dynamic Range	*TdiHdr*	*Multiple sensor rows with independent exposure times are synchronized and combined together. This mode can be used to produce a high dynamic range demonstration image with enhanced contrast in dark image regions.*	
	Multi-Row	*TdiMultiLine*	*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.*	
■□	TDI Stages	sensorTDIStagesSelection	Selects the number of rows to sum / average in TDI.	Beginner DFNC
	1	*Row1*	*Single row.*	
	2	*Rows2*	*Two rows summed / averaged together.*	
	Line Spatial Correction	sensorLineSpatialCorrection	Sets the number of lines of delay between two sensor lines from the sensor for Spatial Correction. Stop acquisition to change. Possible values are device-dependent; for example, for certain models a numerical value is specified.	Beginner DFNC
	On	*On*	*Turn on spatial correction.*	
	Off	*Off*	*Turn off spatial correction.*	
	Acquisition Line Rate	AcquisitionLineRate	Specifies the camera internal line rate, in Hz.	Beginner
	Measured Line Rate	measureLineRate	Actual sensor line rate output.	Beginner DFNC
	Exposure Mode	ExposureMode	Sets the operation mode for the camera's exposure.	Beginner
	Timed	*Timed*	*The exposure duration time is set using the Exposure Time feature and the exposure starts with a LineStart event.*	
	Trigger Width	*TriggerWidth*	*Uses the width of the trigger signal pulse to control the exposure duration. Use the Trigger Activation feature to set the polarity of the trigger. The Trigger Width setting is applicable when the LineStart trigger is enabled and a signal is selected as trigger source.*	
	Exposure Delay (in µs)	exposureDelay	Specifies the delay, in µs, to apply after the LineStart event before starting the ExposureStart event. Available when Exposure Mode is Timed.	Beginner DFNC
	Row Two Exposure Delay	rowTwoExposureDelay	Sets the exposure delay for the second sensor row. This feature is available for 4k cameras.	Beginner DFNC
	Delayed by 50%	*Delay050*	*Delay by 50% of previous exposure.*	
	Delayed by 15 µs	*Delay15*	*Delay exposure by 15 µs.*	
	Exposure Time (in µs)	ExposureTime	Sets the exposure time , in µs, when the Exposure Mode feature is set to Timed.	Beginner
	All	*All*	*Exposure time applies to all channels.*	

	Direction Source	sensorScanDirectionSource	Direction determined by value of:	Beginner
	Internal	*Internal*	*Internal Scan Direction feature.*	
	RotaryEncoder	*Encoder*	*Rotary encoder. Channel A and B from encoder go to GPIO 1 and GPIO 2, respectively. Direction is determined from phase.* *Available when Trigger Source is Encoder and Rotary Encoder Output Mode is Motion (see I/O Control category).*	
	Line 1	*GPIO1*	*Pin 1 (Low: forward, high: reverse). Available when Trigger Source is not Rotary Encoder.*	
	Line 2	*GPIO2*	*Pin 3 (Low: forward, high: reverse). Available when Trigger Source is not Rotary Encoder.*	
	Line 3	*GPIO3*	*Pin 6 (Low: forward, high: reverse). Available when Trigger Source is not Rotary Encoder.*	
	Internal Scan Direction	sensorScanDirection	Specifies the scan direction when Direction Source is set to Internal,	Beginner DFNC
	Forward	*Forward*	*Forward scan direction.*	
	Reverse	*Reverse*	*Revers scan direction*	
	Gain Selector	GainSelector	Selects which gain is controlled when adjusting gain features.	Beginner
	Digital	*DigitalAll*	*Apply a digital gain adjustment to the entire image. Gain applied after row gains.* *Final digital gain = (Row gain * Digital gain)*	
	Sensor Analog	*SensorAnalog*	*Sensor analog gain. Possible values are 0.6 -1.*	
	*Digital Row 1*	*DigitalRow1*	*Gain applied to first sensor row.* *Available only when Sensor TDI Mode is High Dynamic Range or Multi-Row.*	
	*Digital Row 2*	*DigitalRow2*	*Gain applied to second sensor row.* *Available only when Sensor TDI Mode is High Dynamic Range or Multi-Row.*	
	*Digital Red*	*DigitalRed*	*Gain applied to red channel. Available for color models only.*	
	*Digital Blue*	*DigitalBlue*	*Gain applied to blue channel. Available for color models only.*	
	*Digital Green*	*DigitalGreen*	*Gain applied to green channel. Available for color models only.*	
	Gain	Gain	Sets the selected gain as an amplification factor applied to the image.	Beginner
	Black Level Selector	BlackLevelSelector	Selects which tap is controlled by the Black Level feature.	Beginner
	Digital	*DigitalAll*	*Digital black level offset.*	
	Black Level (in DN)	BlackLevel	Black level (offset) in DN.	Expert
	Parallax Correction Pixel Stretch	ParallaxCorrectionPixelStretch	Sets the parallax correction value of the selected line.	Beginner DFNC
	Parallax Correction Line Selector	ParallaxCorrectionLineSelector	Selects the line to adjust the parallax correction.	
	Red_Blue	*Red_Blue*	Red and blue line.	
	Green	*Green*	Green line.	

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.

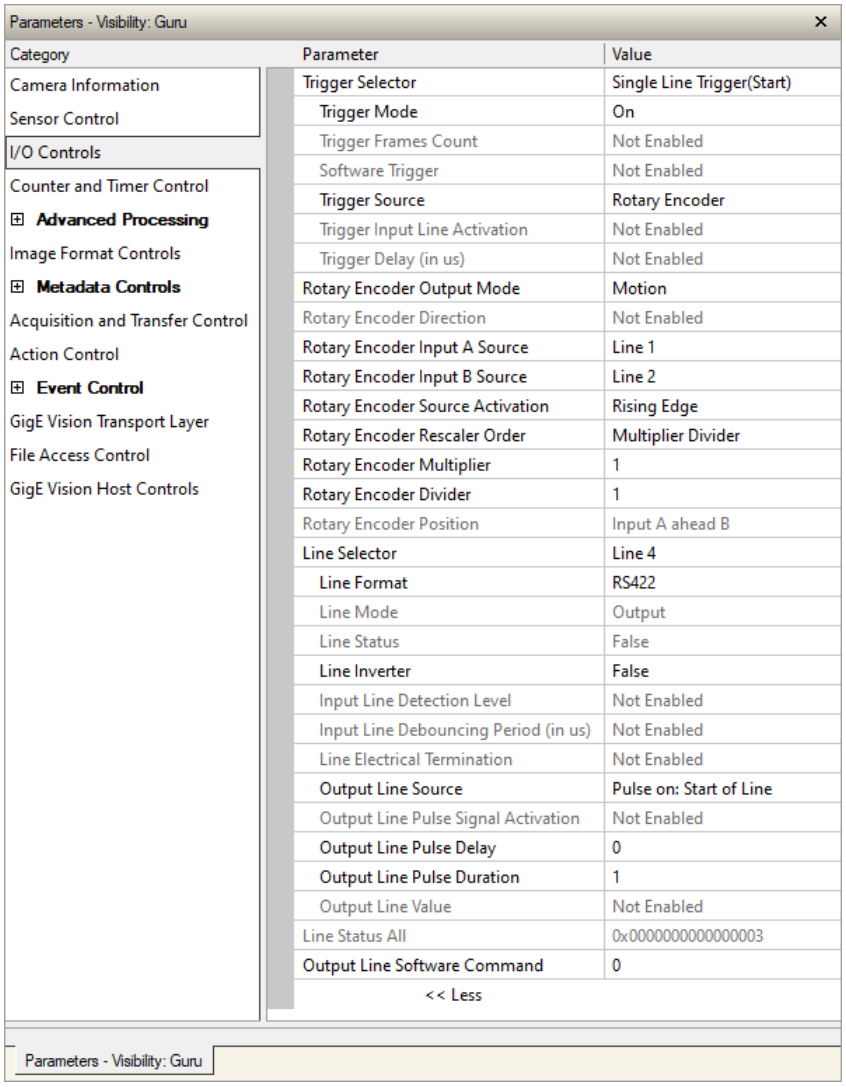


Figure 67: CamExpert – I/O Controls Category

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
Single Line Trigger (Start)	*LineStart*	*Selects a trigger starting the capture of a single line.*	
Single Frame Trigger(Start)	*FrameStart*	*Selects a trigger starting the capture of a single frame. Frame size is determined by image format feature "Height".*	
MultiFrame Trigger(Start)	*FrameBurstStart*	*Selects a trigger to capture multiple frames. The number of frames is specified by the Trigger Frame Count feature.*	
Trigger Mode	TriggerMode	Controls the enable state of the selected trigger.	Beginner
Off	*Off*	*The selected trigger is turned off.*	
On	*On*	*The selected trigger is turned active.*	
Trigger Frames Count	triggerFrameCount	Sets the number of frames to acquire when a valid trigger is received. This feature is available when the Trigger Selector is set to MultiFrames Trigger.	Beginner DFNC
Software Trigger	TriggerSoftware	Generate a software command internal trigger immediately no matter what the Trigger Source 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 Trigger Mode set to ON. Note, source availability may depend on the Trigger Selector setting. See Input Signals Electrical Specifications.	Beginner
Line 1	*Line1*	*Select Line 1 (and associated I/O control block) to use as the external trigger source. See Line Selector feature for complete list.*	
Line 2	*Line2*	*Select Line 2 (and associated I/O control block) to use as the external trigger source. See Line Selector feature for complete list.*	
Line 3	*Line3*	*Select Line 3 (and associated I/O control block) to use as the external trigger source. See Line Selector feature for complete list.*	
Rotary Encoder	*rotaryEncoder1*	*Select Rotary Encoder to use as the external line trigger source. (Available for LineStart trigger.)*	
Timer 1 End Event	*Timer1End*	*Select the Timer1End Event as the internal trigger source. (Available for Single Frame and MultiFrame triggers.)*	
Counter 1 End Event	*Counter1End*	*Select the Counter1End Event as the internal trigger source. (Available for Single Frame and MultiFrame triggers.)*	
Timestamp Modulo Event	*timestampModuleEvent*	*Select the Timestamp Modulo Event as the internal trigger source.*	
Action 1	*Action1*	*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.)*	
Action 2	*Action2*	*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.)*	
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
Rising Edge	*RisingEdge*	*The trigger is considered valid on the rising edge of the line source signal (after any processing by the line inverter module).*	
Falling Edge	*FallingEdge*	*The trigger is considered valid on the falling edge.*	
Any Edge	*AnyEdge*	*The trigger is considered valid on any edge.*	

Trigger Delay	TriggerDelay	Specifies the delay to apply after receiving the trigger and before activating *triggerEvent*. The delay can be set in microseconds.	Beginner
Rotary Encoder Output Mode	rotaryEncoderOutputMode	Specifies the conditions for the Rotary Encoder interface to generate a valid Encoder output signal.	Expert DFNC
Position	*Position*	*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.*	
Motion	*Motion*	*The triggers are generated for all motion increments in either direction.*	
Rotary Encoder Direction	rotaryEncoderDirection	Specifies the phase which defines the encoder forward direction.	Expert DFNC
Clockwise	*Clockwise*	*Inspection goes forward when the rotary encoder direction is clockwise (phase B is ahead of phase A).*	
Counter Clockwise	*CounterClockwise*	*Inspection goes forward when the rotary encoder direction is counter clockwise (phase A is ahead of phase B).*	
Rotary Encoder Input A Source	rotaryEncoderInputASource	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.	Expert DFNC
Line 1	*Line1*	*Line 1 is assigned to the Rotary Encoder Input A.*	
Line 3	*Line3*	*Line 3 is assigned to the Rotary Encoder Input A.*	
Rotary Encoder Input B Source	rotaryEncoderInputBSource	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.	Expert DFNC
GND	*GND*	*Rotary Encoder Input B is not used*	
Line 2	*Line2*	*Line 2 is assigned to the Rotary Encoder Input B*	
Rotary Encoder Source Activation	rotaryEncoderSrcActivation	Specifies the signal edge(s) use to increment the rotary encoder.	Expert DFNC
Rising Edge	*RisingEdge*	*The rotary encoder uses the rising edge of the source signal.*	
Any Edge	*AnyEdge*	*The rotary encoder uses either the rising edge or falling edge of the source signal.*	
Rotary Encoder Rescaler Order	rotaryEncoderRescalerOrder	Specifies the order that the multiplier and divider are applied.	Guru DFNC
Multiplier Divider	*multiplierDivider*	*The signal is multiplied before been divided.*	
Divider Multiplier	*dividerMultiplier*	*The signal is divided before been multiplied.*	
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	rotaryEncoderPosition	Displays the relative positions of rotary encoder inputs A and B.	Guru DFNC
Input A ahead B	*SrcA*	*Input A is ahead of Input B.*	
Input B ahead A	*SrcB*	*Input B is ahead of Input A.*	

Line Selector	LineSelector	Selects the physical line (or pin) of the external device connector to configure.	Beginner
Line 1	*Line1*	*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.*	
Line 2	*Line2*	*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.*	
Line 3	*Line3*	*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.*	
Line 4	*Line4*	*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.*	
Line 5	*Line5*	*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.*	
Line Format	LineFormat	Specify the current electrical format of the selected physical input or output. Applies to all physical lines. (RO)	Expert
RS422	*RS422*	*The line accepts or sends RS422 level signals.*	
Open Collector	*OpenCollector*	*The line is an output line configured as an open collector.*	
Line Mode	LineMode	Reports if the physical Line is an Input or Output signal. (RO) See Input Signals Electrical Specifications. See Output Signals Electrical Specifications.	Expert
Input	*Input*	*The line is an input line.*	
Output	*Output*	*The line is an output line.*	
Line Status	LineStatus	Returns the current status of the selected input or output line. (RO)	Expert
	False / True		
Line Inverter	LineInverter	Controls whether to invert the polarity of the selected input or output line signal.	Beginner
	False / True		
Input Line Detection Level	lineDetectionLevel	Specifies the voltage threshold required to recognize a signal transition on an input line.	Expert DFNC
Threshold for TTL	*Threshold_for_TTL*	*A signal below 0.8V will be detected as a Logical LOW and a signal greater than 2.4V will be detected as a Logical HIGH on the selected input line.*	
Input Line Debouncing Period (in µs)	lineDebouncingPeriod	Specifies the minimum delay before an input line voltage transition is recognized as a signal transition.	Beginner DFNC
Line Electrical Termination	lineElectricalTermination	Controls if the electrical termination of both Line 1 and 2 is enabled or disabled.	Expert DFNC
Disabled	*Disabled*	*Line termination is disabled.*	
Enabled	*Enabled*	*Line termination is enabled.*	

Output Line Source	outputLineSource	Selects which internal signal or event driven pulse or software control state to output on the selected line. Note, the Line Mode feature must be set to Output. The List of supported output line sources is product-specific. The Event Control section provides details and timing diagrams for the supported trigger modes.	Beginner DFNC
Off	*Off*	*Line output is Open*	
Software Controlled	*SoftwareControlled*	*The Output Line Value feature changes the state of the output*	
Pulse on: Start of Frame	*PulseOnStartofFrame*	*Generate a pulse on the start of the Frame Active event*	
Pulse on: Start of Line	*PulseOnStartofLine*	*Generate a pulse on the start of the Line Active*	
Pulse on: Start of Exposure	*PulseOnStartofExposure*	*Generate a pulse on the Exposure Start event. This option is typically used to trigger a strobe light.*	
Pulse on: Rejected Trigger	*PulseOnInvalidTrigger*	*Generate a pulse on the Invalid Trigger event.*	
Pulse on: End of Exposure	*PulseOnEndofExposure*	*Generate a pulse on the Exposure End event. This option is typically used to trigger a strobe light.*	
Pulse on: Valid Line Trigger	*PulseOnValidLineTrigger*	*Generate a pulse on the LineTrigger event.*	
Pulse on: Invalid Line Trigger	*PulseOnInvalidLineTrigger*	*Generate a pulse on the Invalid LineTrigger event.*	
Pulse on: End of Timer 1	*PulseOnTimer1End*	*Generate a pulse on the TimerEnd 1 event.*	
Pulse on: End of Counter 1	*PulseOnCounter1End*	*Generate a pulse on the CounterEnd 1 event.*	
Pulse on: Input 1 Signal	*PulseOnInput1*	*Generate a pulse on the Input signal 1 event*	
Pulse on: Input 2 Signal	*PulseOnInput2*	*Generate a pulse on the Input signal 2 event*	
Output Line Pulse Signal Activation	outputLinePulseActivation	Specifies the input line activation mode to trigger the Output Line pulse.	Beginner DFNC
Rising Edge	*RisingEdge*	*Specifies that the trigger is considered valid on the rising edge of the source signal.*	
Falling Edge	*FallingEdge*	*Specifies that the trigger is considered valid on the falling edge of the source signal.*	
Any Edge	*AnyEdge*	*Specifies that the trigger is considered valid on the falling or rising edge of the source signal.*	
Output Line Pulse Delay	outputLinePulseDelay	Sets the delay (in µs) before the output line pulse signal. Applicable for the Output Line Source feature. Note, the LineMode feature must be set to output.	Beginner DFNC
Output Line Pulse Duration	outputLinePulseDuration	Sets the width (duration) of the output line pulse in microseconds.	Beginner DFNC
Output Line Value	outputLineValue	Sets the output state of the selected Line if the outputLineSoftwareLatchControl = OFF. Output Line Source must be Software Controlled. If the outputLineSoftwareLatchControl = Latch , the state of the pin will change with the Output Line Software Command command.	Beginner DFNC
Active	*Active*	*Sets the Output circuit to close*	
Inactive	*Inactive*	*Sets the Output circuit to open*	
Line Status All	LineStatusAll	Returns the current status of all available line signals, at time of polling, in a single bit field. The order is Line 1, 2, 3, ... (RO)	Expert
Output Line Software Command	outputLineSoftwareCmd	Writing a value of 1 in the bit field applies the Latch value of the outputLineSoftwareLatchControl and/or executes the PulseOnSoftwareCmd for any output line programmed for software control. The feature outputLineSoftwareCmd can take any binary value and each bit set to 1 corresponds to a Icommand for an Output. Bit-0 is Line 3, Bit-1 is Line 4, Bit-2 is Line 5, Bit-3 is Line 6 This is applicable to Output Line Source = Pulse On: where Software Cmd (for Pulse mode) or OutputLineSource = Software Controlled and OutputLineSoftwareLatchControl = Latch (for static states).	Expert DFNC

I/O Module Block Diagram

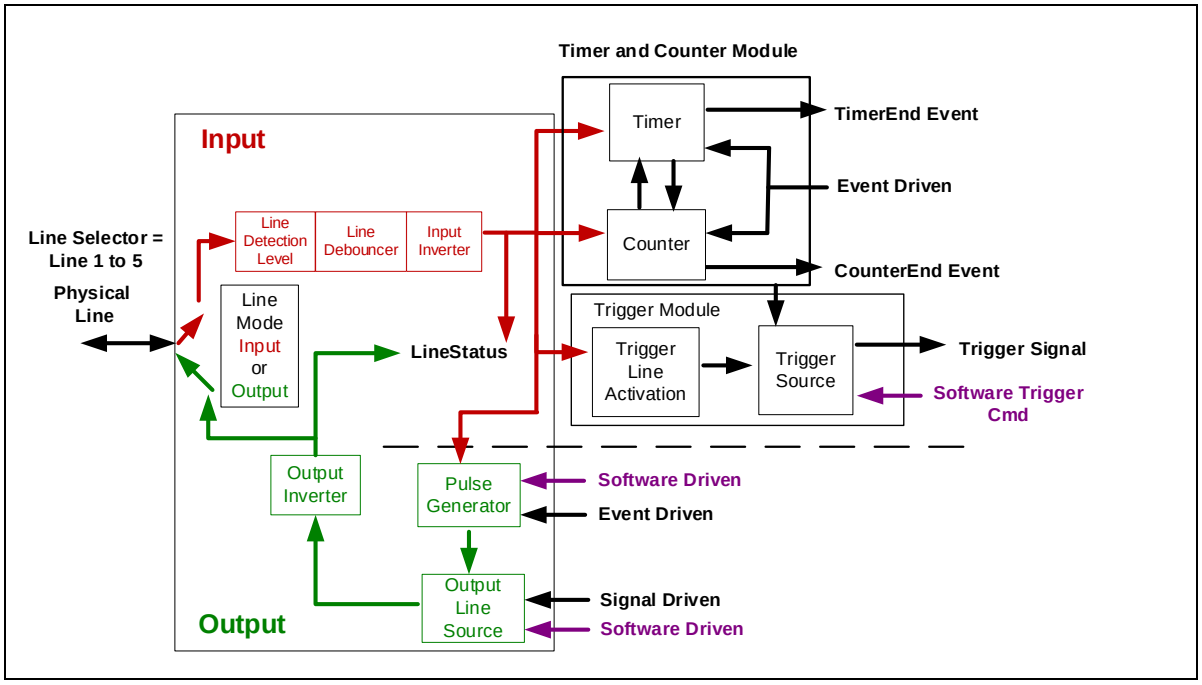


Figure 68: I/O Module Block Diagram

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.

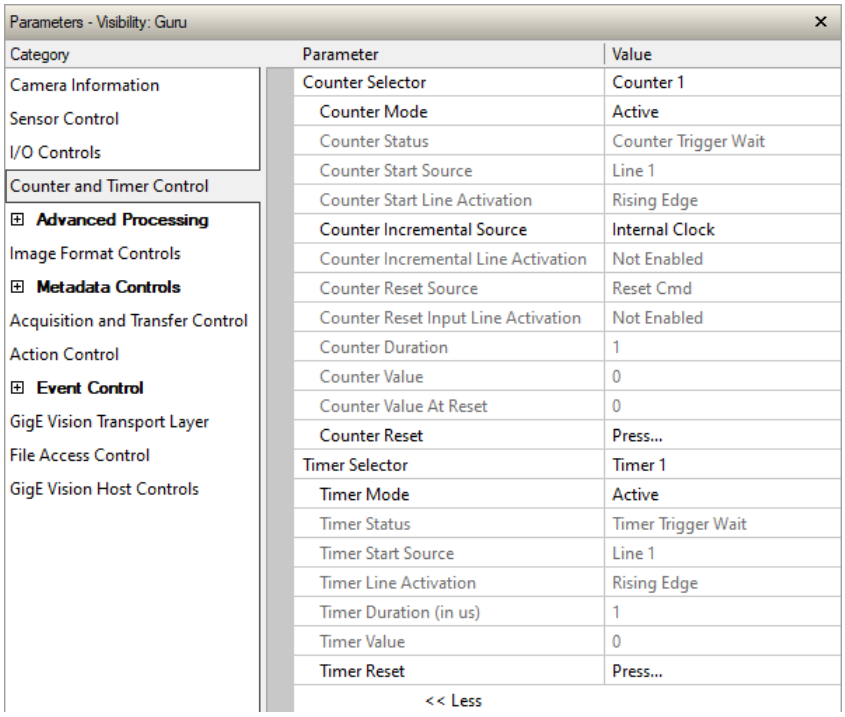


Figure 69: CamExpert – Counter and Timer Control Category

Counter and Timer Control Feature Descriptions

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

Counter Start Source	counterStartSource	Select the counter start source. Counter increments from 0 to the value of the Counter Duration feature.	Expert DFNC
Off	*Off*	*Counter is stopped.*	
Acquisition Start	*AcquisitionStart*	*Counter starts on the reception of an Acquisition Start event.*	
Acquisition End	*AcquisitionEnd*	*Counter starts on the reception of an Acquisition End event.*	
Exposure Start	*ExposureStart*	*Counter starts on the reception of an Exposure Start event.*	
Exposure End	*ExposureEnd*	*Counter starts on the reception of an Exposure End event.*	
Rejected Trigger	*InvalidTrigger*	*Counter starts on the reception of an Invalid Trigger event.*	
Frame Start	*FrameStart*	*Counter starts on the reception of a Frame Start event.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Counter starts on the reception of a Valid Frame Trigger event.*	
Line 1	*Line1*	*Counter starts on the specified transitions on Line 1.* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Counter starts on the specified transitions on Line 2.*	
Line 3	*Line3*	*Counter starts on the specified transitions on Line 3.*	
Timer 1 End	*Timer1End*	*Counter starts on the reception of the Timer 1 End event.*	
Counter 1 End	*Counter1End*	*Counter starts on the reception of the Counter 1 End event.*	
Counter Start Line Activation	counterStartLineActivation	Selects the activation mode of the input line trigger which starts the counter. This is only applicable when the counterStartSource feature selects a physical Line.	Expert DFNC
Rising Edge	*RisingEdge*	*Starts counting on rising edge of the selected Line.*	
Falling Edge	*FallingEdge*	*Starts counting on falling edge of the selected Line.*	
Any Edge	*AnyEdge*	*Starts counting on the falling or rising edge of the selected Line.*	
Counter Incremental Source	counterIncrementalSource	Select the event source which increments the counter. The Event Control section provides details and timing diagrams for the supported events.	Expert DFNC
Off	*Off*	*Counter is stopped.*	
Acquisition Start	*AcquisitionStart*	*Counts the number of Acquisition Start events.*	
Acquisition End	*AcquisitionEnd*	*Counts the number of Acquisition End events.*	
Exposure Start	*ExposureStart*	*Counts the number of Exposure Start events.*	
Exposure End	*ExposureEnd*	*Counts the number of Exposure End events.*	
Frame Start	*FrameStart*	*Counts the number of Frame Start events.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Counts the number of Valid Frame Trigger events.*	
Rejected Trigger	*InvalidTrigger*	*Counts the number of Invalid Trigger events.*	
Line 1	*Line1*	*Counts the number of transitions on Line 1 (based on the counterIncrementalLineActivation feature setting).* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Counts the number of transitions on Line 2 (based on the counterIncrementalLineActivation feature setting).*	
Line 3	*Line3*	*Counts the number of transitions on Line 3 (based on the counterIncrementalLineActivation feature setting).*	
Internal Clock	*InternalClock*	*The counter increments on each microsecond tick of the device internal Clock.*	
Timer 1 End	*Timer1End*	*Counts the number of Timer 1 End events.*	

Counter Incremental Line Activation	counterIncrementalLineActivation	Selects the counter signal activation mode for line inputs. The counter increments on the specified signal edge or level.	Expert DFNC
Rising Edge	*RisingEdge*	*Increment the counter on the rising edge of the selected I/O Line.*	
Falling Edge	*FallingEdge*	*Increment the counter on the falling edge of the selected I/O Line.*	
Any Edge	*AnyEdge*	*Increment the counter on the falling or rising edge of the selected I/O Line.*	
Counter Reset Source	counterResetSource	Selects the signal source to reset the counter then waits for the next countStartSource signal or event.	Expert DFNC
Reset Cmd	*Off*	*Reset on reception of the Reset Icommand.*	
Acquisition Start	*AcquisitionStart*	*Reset on reception of the Acquisition Start.*	
Acquisition End	*AcquisitionEnd*	*Reset on reception of the Acquisition End.*	
Exposure Start	*ExposureStart*	*Reset on reception of the Exposure Start event.*	
Exposure End	*ExposureEnd*	*Reset on reception of the Exposure End event.*	
Frame Trigger	*FrameStart*	*Reset on reception of the Frame Trigger (valid or invalid) event.*	
Valid Frame Trigger	*ValidFrameTrigger*	*Reset on reception of the Valid Frame Trigger event.*	
Rejected Frame Trigger	*InvalidFrameTrigger*	*Reset on reception of the Invalid Trigger event.*	
Line 1	*Line1*	*Reset counter on the specified transition on line 1.* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Reset counter on the specified transition on line 2.*	
Timer 1 End	*Timer1End*	*Reset on reception of the Timer 1 End.*	
Counter 1 End	*Counter1End*	*Reset on the reception of the Counter 1 end.*	
Counter Reset Input Line Activation	counterResetLineActivation	Specify the edge transition on the selected line that will reset the selected counter.	Expert DFNC
Rising Edge	*RisingEdge*	*Reset counter on rising edge of the selected signal.*	
Falling Edge	*FallingEdge*	*Reset counter on falling edge of the selected signal.*	
Any Edge	*AnyEdge*	*Reset counter on the falling or rising edge of the selected signal.*	
Counter 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	timerSelector	Selects which timer to configure.	Expert DFNC
Timer 1	*Timer1*	*Configure Timer 1.*	
Timer Mode	timerMode	Select the timer mode. The selected Timer is Active or Disabled. When Disabled, the Timer can be configured.	Expert DFNC
Off	*Off*	*The selected Timer is Disabled.*	
Active	*Active*	*The selected Timer is Enabled.*	
Timer Status	timerStatus	Returns the current state of the timer. (RO)	Expert DFNC
Timer Idle	*TimerIdle*	*The timer is idle. The CounterStartSource feature is set to off.*	
Timer Trigger Wait	*TimerTriggerWait*	*The timer is waiting for a start trigger.*	
Timer Delaying	*TimerDelaying*	*The timer is counting the requested delay.*	
Timer Active	*TimerActive*	*The timer is counting for the specified duration.*	
Timer Completed	*TimerCompleted*	*The timer reached the TimerDuration count.*	

Timer Start Source	timerStartSource	Select the trigger source to start the timer. The Event Control section provides details and timing diagrams for the supported events.	Expert DFNC
TimerReset Cmd	*Off*	*Starts with the reception of the TimerReset Icommand.*	
Acquisition Start	*AcquisitionStart*	*Start Timer on Acquisition Start event.*	
Acquisition End	*AcquisitionEnd*	*Start Timer on Acquisition End event.*	
Exposure Start	*ExposureStart*	*Start Timer on Exposure Start event.*	
Exposure End	*ExposureEnd*	*Start Timer on Exposure End event.*	
Frame Start	*FrameStart*	*Start Timer on Frame Start event.*	
Frame Trigger	*ValidFrameTrigger*	*Start Timer on Valid Frame Trigger event.*	
Invalid Trigger	*InvalidTrigger*	*Start Timer on Invalid Trigger event.*	
Line 1	*Line1*	*Start Timer on a transition of I/O Line 1 event.* See Input Signals Electrical Specifications.	
Line 2	*Line2*	*Start Timer on a transition of I/O Line 2 event.*	
Line 3	*Line3*	*Start Timer on a transition of I/O Line 3 event.*	
Timer 1 End	*Timer1End*	*Start Timer on Timer 1 End event.*	
Counter 1 End	*Counter1End*	*Start Timer on Counter 1 End event.*	
Timer Line Activation	timerStartLineActivation	Select the trigger activation mode which starts the timer.	Expert DFNC
Rising Edge	*RisingEdge*	*Starts counter on rising edge of the selected signal.*	
Falling Edge	*FallingEdge*	*Starts counter on falling edge of the selected signal.*	
Any Edge	*AnyEdge*	*Starts counter on the falling or rising edge of the selected signal.*	
Timer Duration (in µs)	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

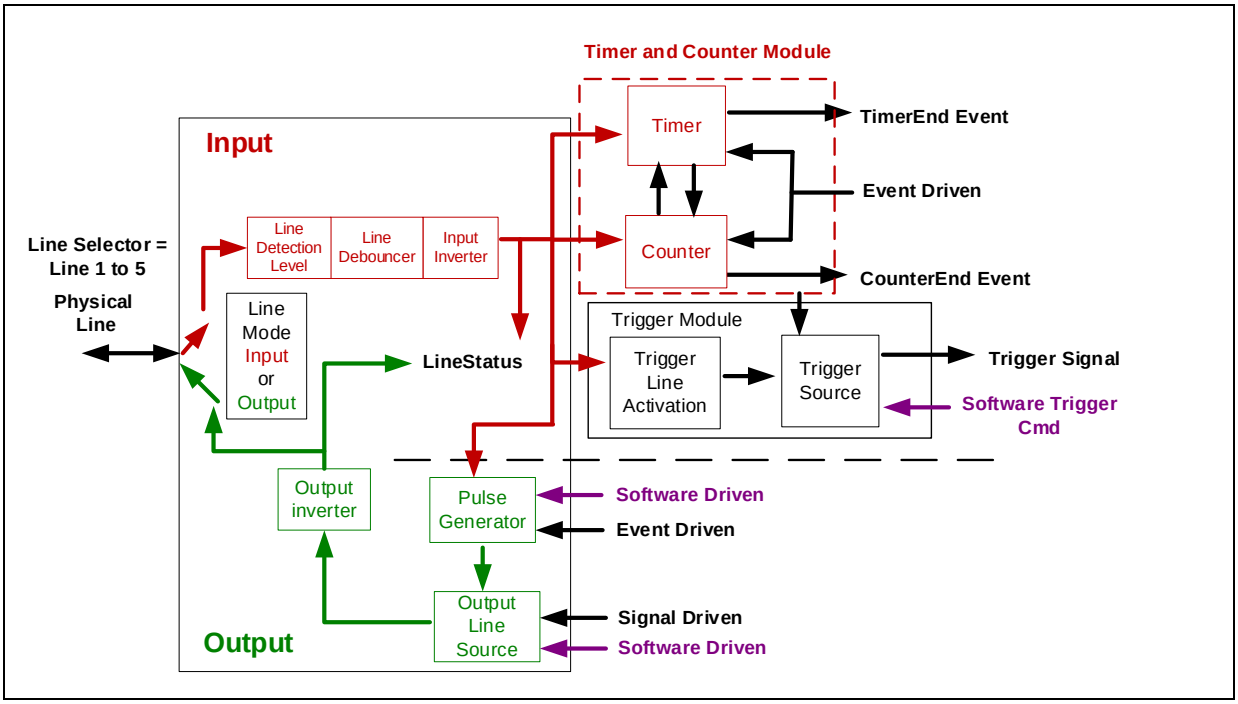


Figure 70: Counter and Timer Group Block Diagram

Example: Counter Start Source = OFF

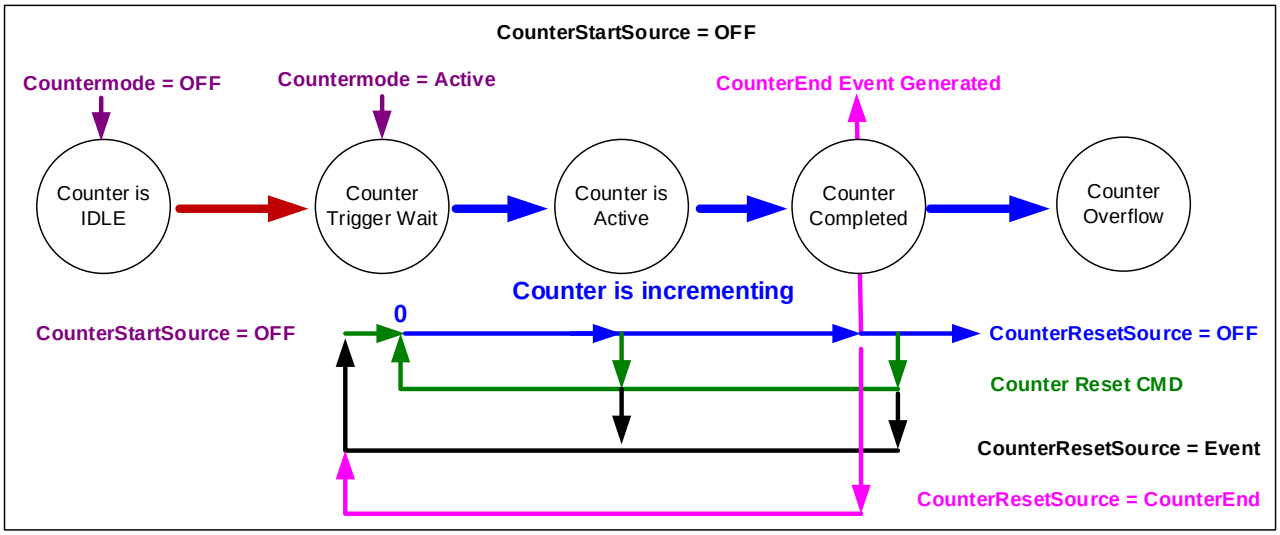


Figure 71: Example – Counter Start Source = OFF

- 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)

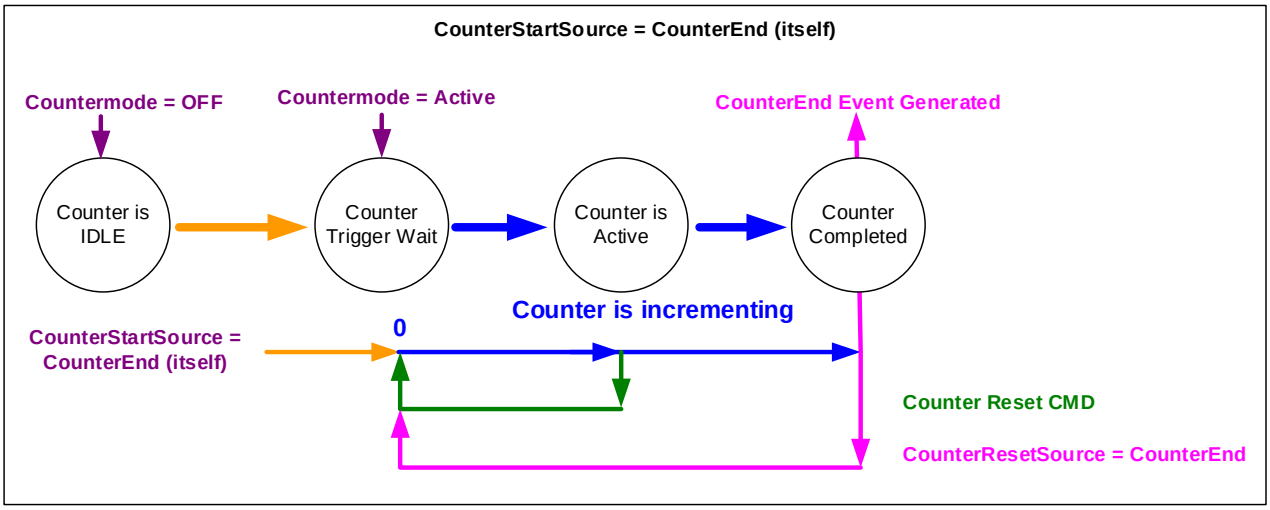


Figure 72: Example – Counter Start Source = CounterEnd

- 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)

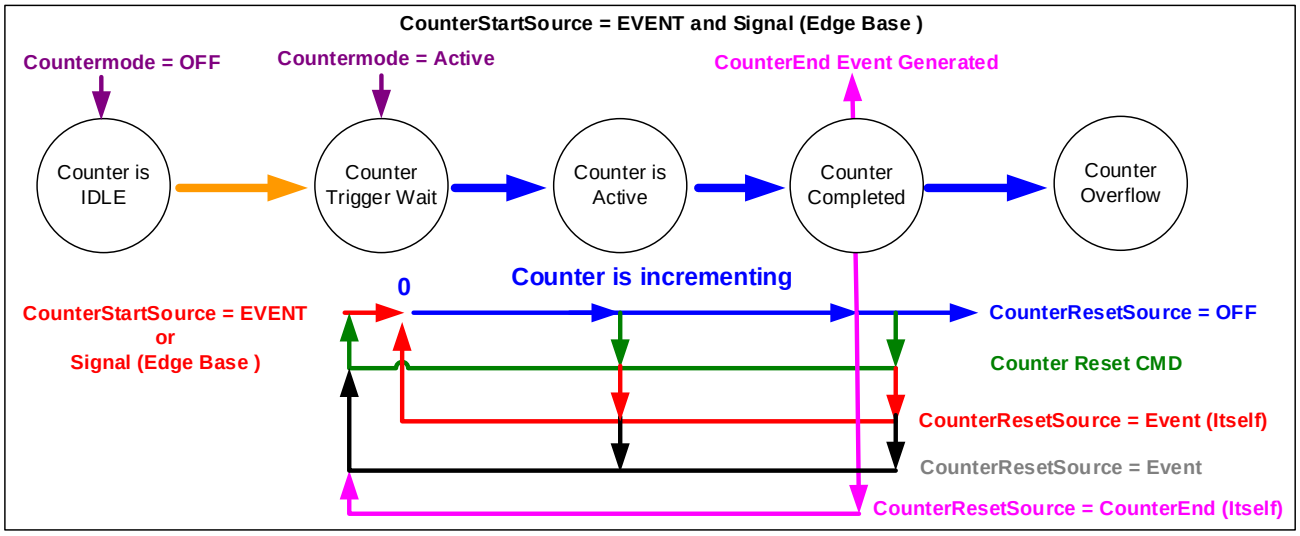


Figure 73: Example: CounterStartSource = EVENT and Signal (Edge Base)

Example: CounterStartSource = Signal (Level Base) Example 1

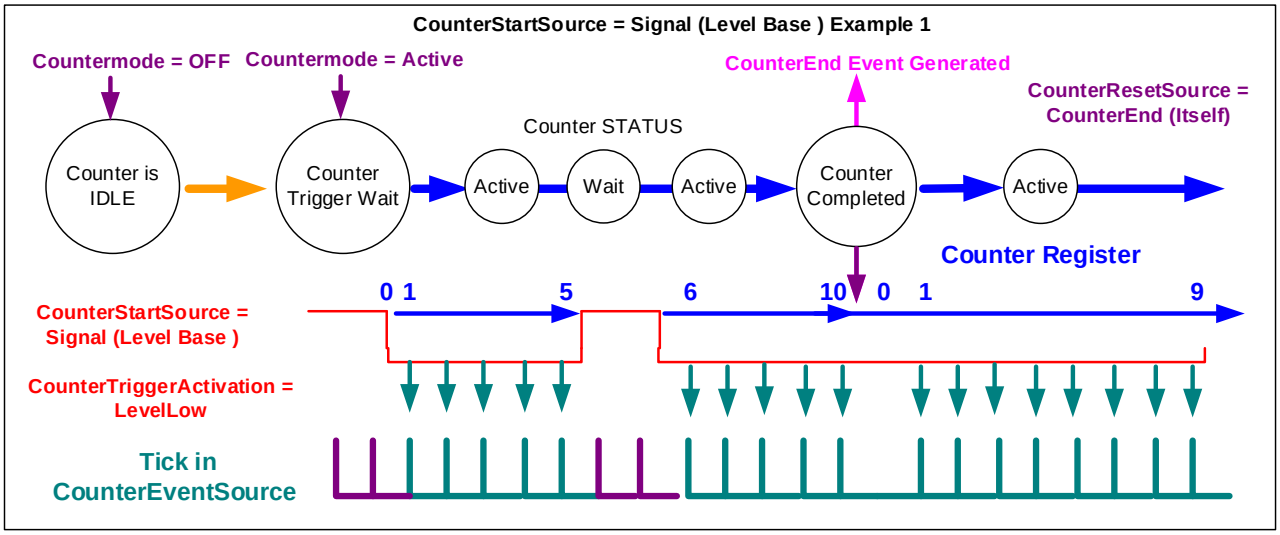


Figure 74: Example – CounterStartSource = Signal (Level Base)

Example: CounterStartSource = Line (Edge Base) Example 2

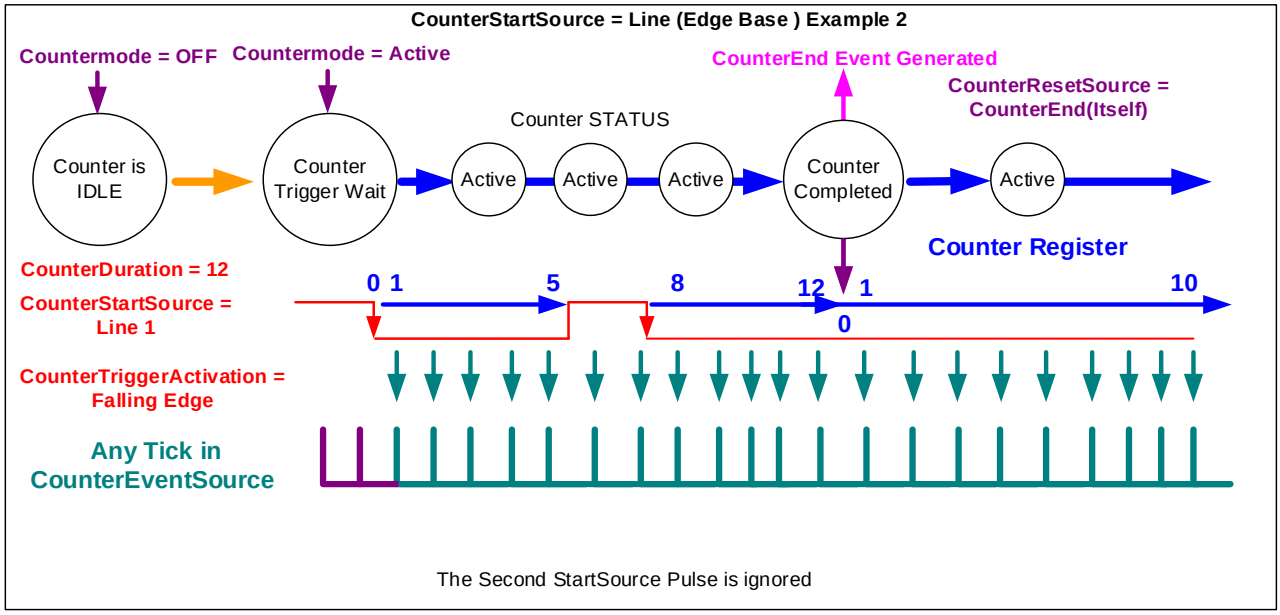


Figure 75: Example – CounterStartSource = Line (Edge Base)

Advanced Processing Category

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

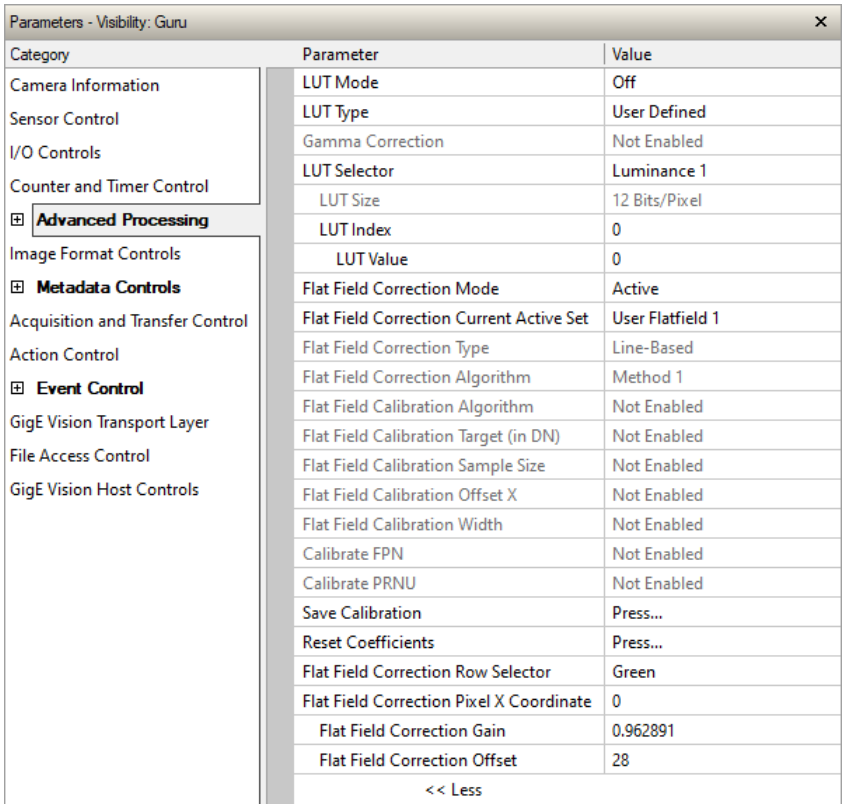


Figure 76: CamExpert – Advanced Processing Category

Advanced Processing Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Standard & View
	LUT Mode *Off* *Active*	lutMode *Off* *Active*	Sets the enable state of the selected LUT module (Lookup Table). *Disables the LUT.* *Enables the selected LUT module.*	Expert DFNC
	LUT Type *User Defined* *Gamma Correction*	lutType *UserDefined* *GammaCorrection*	Displays the LUT type of the currently selected Lookup Table. *Uses the user programmable LUT.* *Uses gamma LUT*	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. (Min: 0.001, Max: 2.0, Increment: 0.001)	Expert DFNC
	LUT Selector *Luminance 1*	LUTSelector *Luminance1*	Selects which LUT to control and adjust features. *Luminance 1 is under control*	Guru
	LUT Size *12 Bits/Pixel*	lutSize *Bpp12*	Specify the LUT size of the selected LUT (Lookup Table). Available choices are model dependent. *12 bits per pixel*	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
	Flat Field Correction Mode	flatfieldCorrectionMode	Sets the mode for the Flat Field correction.	Beginner DFNC
	Off	*Off*	*Flat Field Correction is disabled.*	
	Active	*Active*	*Flat Field Correction is enabled.*	
	Calibration	*Calibration*	*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.*	
	Flat Field Correction Current Active Set	flatfieldCorrectionCurrentActiveSet	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.	Beginner DFNC
	Factory Flatfield	*FactoryFlatfield*	*Sets the factory Flat Field coefficient table as the current Flat Field.*	
	User Flatfield 1	*UserFlatfield1*	*Sets User Flat Field 1 coefficient table as the current Flat Field.*	
	User Flatfield 2	*UserFlatfield2*	*Sets User Flat Field 2 coefficient table as the current Flat Field.*	
	User Flatfield 3	*UserFlatfield3*	*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).*	
	User Flatfield 4	*UserFlatfield4*	*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).*	
	Flat Field Correction Type	flatfieldCorrectionType	Specifies the Flat Field correction type.	Guru DFNC
	Line-Based	*LineBase*	*Flat field correction is based on an individual line (FlatLine).*	
	Flat Field Correction Algorithm	flatfieldCorrectionAlgorithm	Specifies the Flat Field correction algorithm to use.	Guru DFNC
	Method 1	*Method1*	*The following formula is used to calculate the flat field corrected pixel: newPixelValue[x] = (sensorPixelValue[x] - FFCOffset[x]) * FFCGain[x])*	
	Calibration Algorithm	flatfieldCorrectionCalibrationAlgorithm	Specifies the flatfield calibration algorithm to use.	Guru DFNC
	Peak	*Peak*	*Each pixel is gained up to the brightest.*	
	Set Target	*SetTarget*	*Each pixel is gained up to the value specified in the flatfieldCalibrationTarget feature.*	
	Flat Field Calibration Target (in DN)	flatfieldCalibrationTarget	Sets the target pixel value for the gain (PRNU) calibration.	Expert DFNC
	Flat Field Calibration Sample Size	flatfieldCalibrationSampleSize	Set flat field calibration sample size (number of lines to sum).	Guru DFNC
	2048	*Lines_2048*	*2048*	
	4096	*Lines_4096*	*4096*	

	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 sensistive pixel, creating a uniform response to light.	Guru DFNC
	Flat Field Calibration Width	flatfieldCalibrationROIWidth	Sets the ROI Width.	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	flatfieldCorrectionColorSelector	Selects the row for which to configure offset and gain correction.	Beginner DFNC
	*Row 1*	*Row1*	*Row 1 correction.*	
	*Row 2*	*Row2*	*Row 2 correction.*	
	*Green*	*Green*	*Green (row 1) correction.*	
	*Red/Blue*	*RedBlue*	*Red/Blue (row 2) correction.*	
	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.

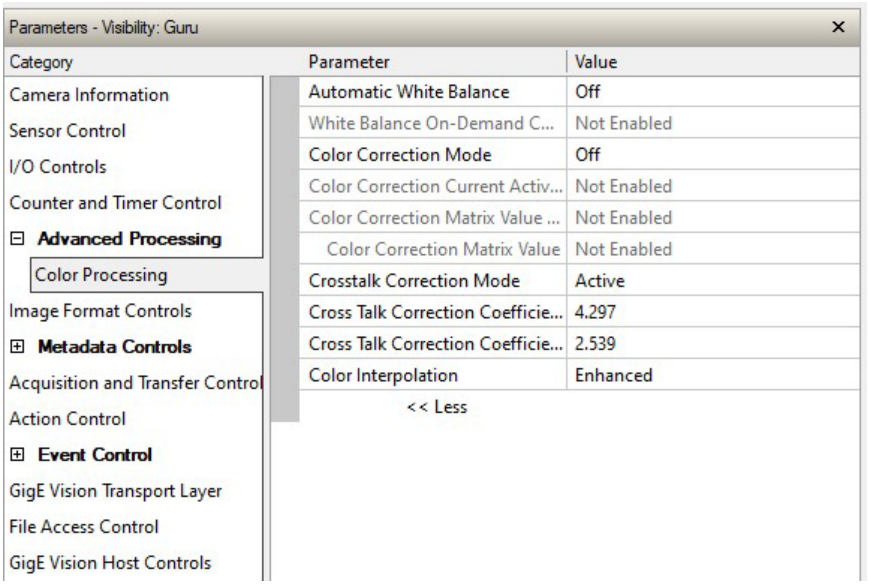


Figure 77: CamExpert – Color Processing Sub-Category

Color Processing Feature Descriptions

Display Name	Feature & Values	Description	Device Version & View
Automatic White Balance	BalanceWhiteAuto	Controls the mode for automatic white balancing between the color channels. The color gains are automatically adjusted.	Expert
Off	*Off*	*White balancing is manually controlled using BalanceRatio[Red], BalanceRatio[Green] and BalanceRatio[Blue].*	
On Demand	*OnDemand*	*White balancing is automatically adjusted once by the device.*	
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	colorCorrectionMode	Sets the color correction feature (RGB gains) to manual or automatic.	Expert DFNC
Off	*Off*	*RGB gains are controlled manually using the Gain feature.*	
Active	*Active*	*RGB gains are specified using a color correction matrix.*	
Color Correction Current Active Set	colorCorrectionCurrentActiveSet	Specifies the active set of color correction coefficients.	Expert 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	crossTalkCorrectionEnable	Enables or disables the crosstalk correction algorithm.	Expert DFNC
Off	*Off*	Disables crosstalk correction.	
Active	*Active*	Enables crosstalk corrections.	
Crosstalk Correction Red	crosstalkCorrectionRed	Crosstalk correction coefficient for red pixel.	Beginner DFNC
Crosstalk Correction Blue	crosstalkCorrectionBlue	Crosstalk correction coefficient for blue pixel.	Beginner DFNC
Color Interpolation	colorInterpolation	Selects the color interpolation method for the red-blue row when performed in-camera	Beginner DFNC
Basic	*Basic*	Missing red-and blue information is copied from neighboring pixel.	
Enhanced	*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.	

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 Sapera LT SDK includes the Sapera 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 Sapera Color Calibration tool is available from Windows Start menu:

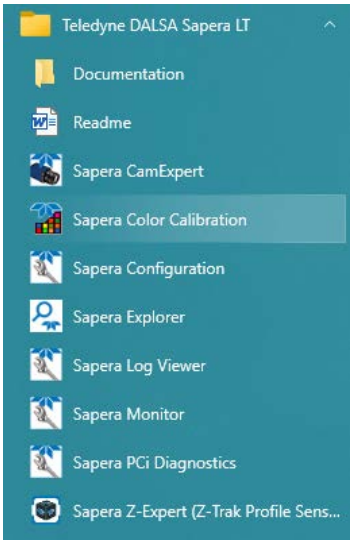


Figure 78: Sapera Color Calibration Tool Shortcut

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.

Gr1	Gb1	Gr2	Gb2	Gr3	Gb3	Gr4	Gb4
R1	B1	R2	B2	R3	B3	R4	B4

Figure 79: 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 79).

5. On the red channel of the dark-subtracted red image, average all odd-numbered pixels and save as R (refer to Figure 79).
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:

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

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:

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

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.

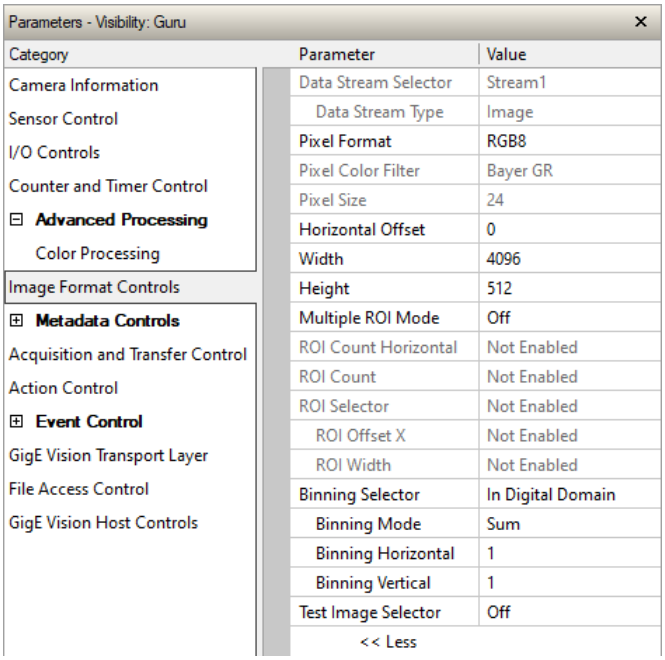


Figure 80: CamExpert – Image Format Controls Category

Image Format Control Feature Descriptions

B/W Color	Display Name	Feature & Values	Description	Standard & View
	Data Stream Selector *Stream1*	dataStreamSelector *Stream1*	Select which data stream to control. (Default is Stream 1) *Adjust parameters for Stream1.*	Beginner DFNC
	Data Stream Type *Image* *Image_MetaData*	DataStreamType *Image* *Image_MetaData*	This feature is used to retrieve the transfer protocol used to stream blocks. *The Image data blocks are streamed using the payload type "Image".* *The Image_MetaData blocks are streamed using the payload type "Extended Chunk Data with Image".*	Beginner DFNC
	Pixel Format	PixelFormat	Format of the pixel provided by the device.	Beginner
	Monochrome 8-Bit	*Mono8*	*Monochrome 8-bit.*	
	Monochrome 12-Bit	*Mono12*	*Monochrome 12-bit.*	
	Green Only 8-bit	*G8*	*Green-only, 8-bit.*	
	BicolorRGB8	*BicolorRGB8*	*Bicolor RGB, 8-bit.*	
	RGB8	*RGB8*	*RGB, 8-bit.*	

	Pixel Color Filter	PixelColorFilter	Indicates the type of color filter applied to the image (RO).	Beginner
	Bayer GR	*BayerGR*	*For BayerGR, the 2x2 mosaic alignment is GR/BG.*	
	Bayer RG	*BayerRG*	*For BayerRG, the 2x2 mosaic alignment is RG/GB.*	
	Bayer GB	*BayerGB*	*For BayerGB, the 2x2 mosaic alignment is GB/RG.*	
	Bayer BG	*BayerBG*	*For BayerBG, the 2x2 mosaic alignment is BG/GR.*	
	Pixel Size	PixelSize	Total size in bits of an image pixel.	Guru
	8	*Bpp8*	*8-bits per pixel.*	
	12	*Bpp12*	*12-bits per pixel.*	
	24	*Bpp24*	*24-bits per pixel.*	
	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	multipleROIMode	Enable the Multiple ROI (Region of Interest) per image feature. The ROI Count is set by the Multiple ROI Count feature.	Expert DFNC
	Off	*Off*	*Single ROI per image.*	
	Active	*Active*	*The ROI per image feature is active.*	
	ROI Count Horizontal	multipleROICountHorizontal	Specifies the number of ROI (Region of Interest) available for the X axis. For the Linea Lite 2k model only 2 ROIs are available.	Expert DFNC
	ROI Count	multipleROICount	Specifies the number of possible ROI (Region of Interest) available in an acquired image. Two is minimum; maximum is device-specific.	Expert DFNC
	ROI Selector	multipleROISelector	Select an ROI (Region of Interest) when Multiple ROI Mode is enabled. Selector range is from 1 to the ROI Count value.	Expert DFNC
	ROI (x1, y1)	*roi1_1*	*ROI (x1, y1)*	
	ROI (x2, y1)	*roi2_1*	*ROI (x2, y1)*	
	ROI (x3, y1)	*roi3_1*	*ROI (x3, y1). Not available for Linea Lite 2k model.*	
	ROI (x4, y1)	*roi4_1*	*ROI (x4, y1). Not available for Linea Lite 2k model.*	
	ROI Offset X	multipleROIOffsetX	Horizontal offset (in pixels) from the origin to the selected ROI (Region of Interest).	Expert DFNC
	ROI Width	multipleROIWidth	Width of the selected ROI (Region of Interest) provided by the device (in pixels). Increment value is device dependent.	Expert DFNC
	Binning Selector	binningSelector	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.	Beginner DFNC
	In Digital Domain	*InDigitalDomain*	*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.*	
	Binning Mode	binningMode	Sets the mode used to combine pixels together when Binning Horizontal and / or Binning Vertical is greater than 1.	Beginner DFNC
	Sum	*Sum*	*The responses from the individual pixels are added together, resulting in increased sensitivity.*	
	Average	*Average*	*The responses from the individual pixels are averaged, resulting in increased signal to noise ratio.*	
	Binning Horizontal	BinningHorizontal	Number of horizontal photo-sensitive cells to combine together. This increases the intensity of the pixels but reduces the horizontal resolution.	Beginner
	Binning Vertical	BinningVertical	Number of vertical photo-sensitive cells to combine together. This increases the intensity of the pixels but reduces the vertical resolution of the image.	Beginner

	Test Image Selector	TestImageSelector	Selects the type of test image output by the camera.	Beginner
	Off	*Off*	*Image is from the camera sensor.*	
	Horizontal Ramp	*GreyHorizontalRamp*	*Image is filled horizontally with an image that goes from the darkest possible value to the brightest.*	
	Vertical Ramp	*GreyVerticalRamp*	*Image is filled vertically with an image that goes from the darkest possible value to the brightest.*	
	Diagonal Ramp Moving	*GrayDiagonalRampMoving*	*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.*	
	Fixed Offset	*FixedOffset*	*Image is a fixed value of 64 DN.*	
	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).

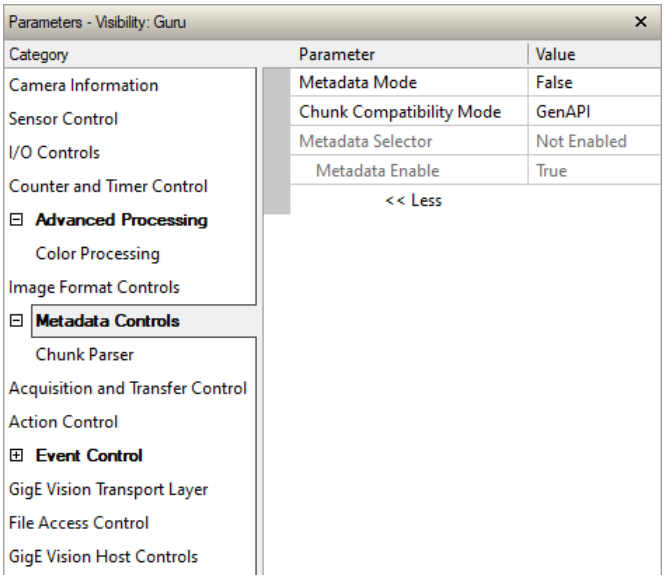


Figure 81: CamExpert – Metadata Category

Metadata Controls Feature Descriptions

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

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

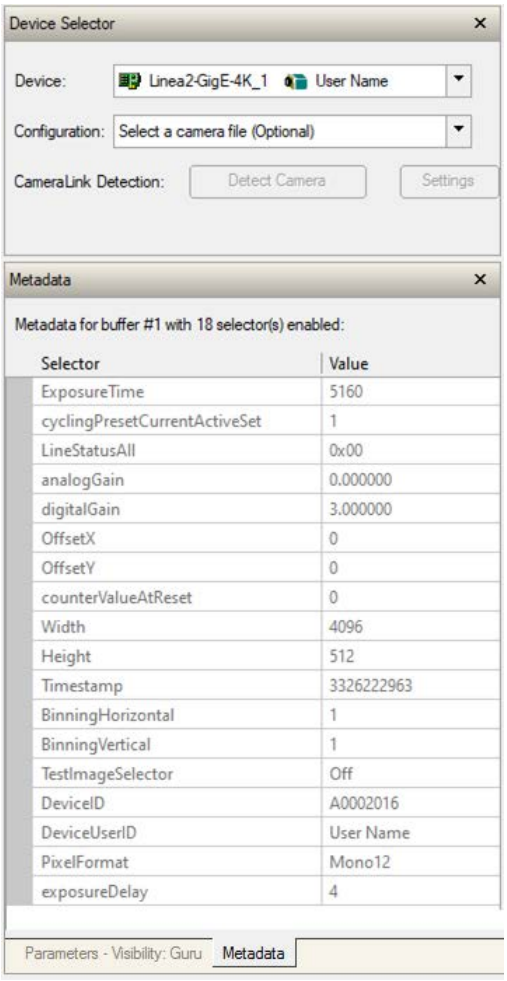


Figure 82: CamExpert – Metadata Tab

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.

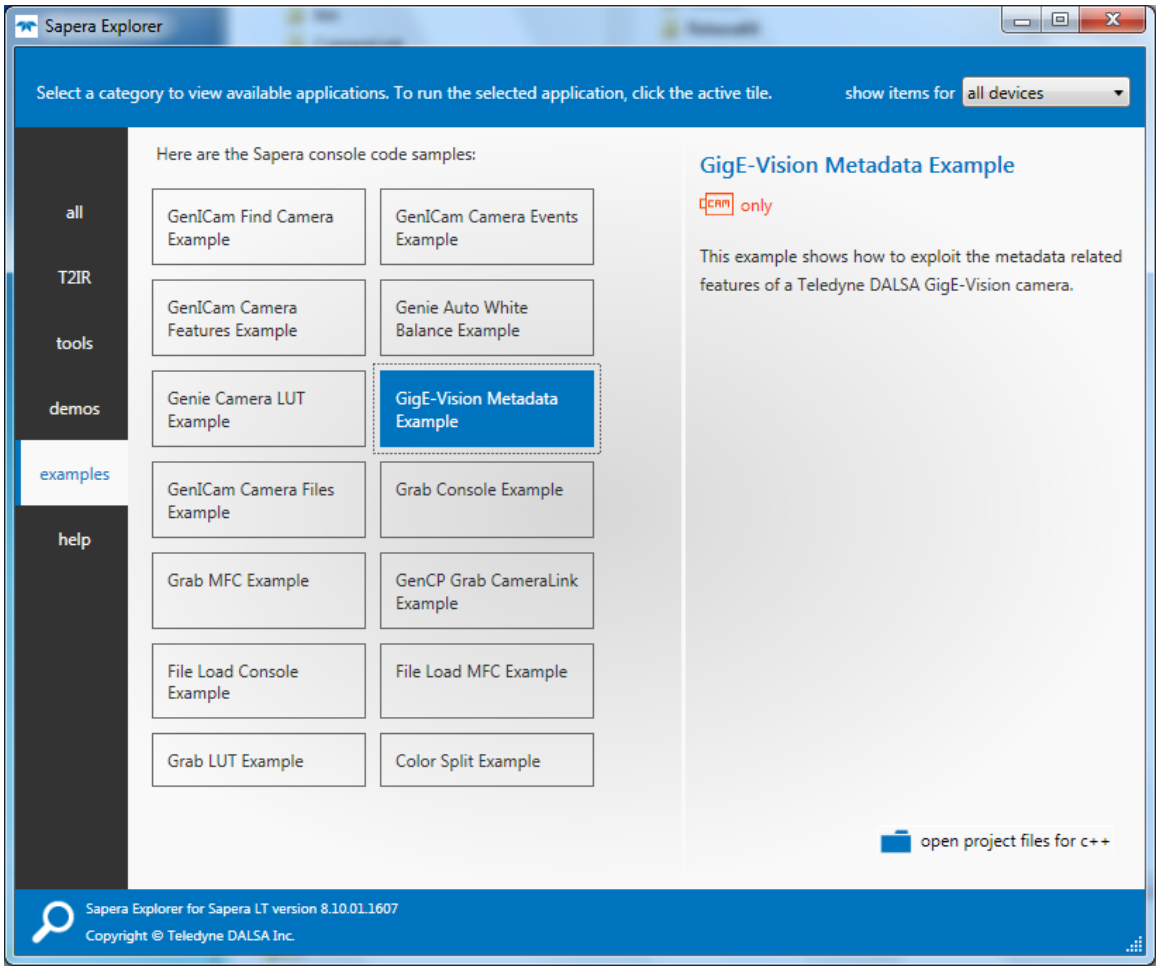


Figure 83: Sapera Explorer

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.

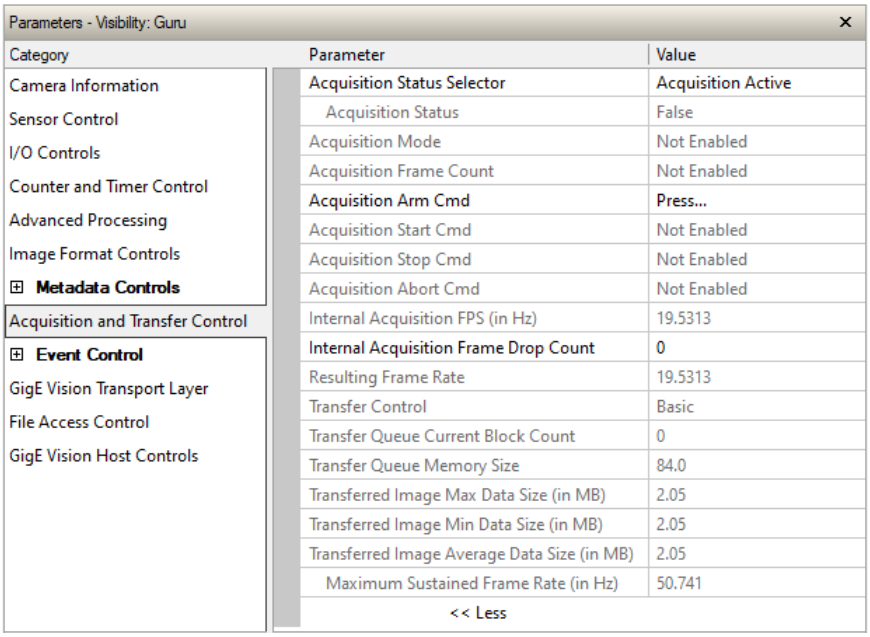


Figure 84: CamExpert – Acquisition and Transfer Control Category

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 *AcquisitionStatus*.	Expert
Acquisition Trigger Wait	*AcquisitionTriggerWait*	*Device is currently waiting for a trigger to capture one or more frames.*	
Acquisition Active	*AcquisitionActive*	*Device is currently doing an acquisition of one or more frames.*	
Acquisition Status	AcquisitionStatus	Reads the state of the internal acquisition signal selected using the *AcquisitionStatusSelector* 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
Single Frame	*SingleFrame*	*One frame is captured for each AcquisitionStart Command. An AcquisitionStop occurs at the end of the Active Frame.*	
Multi-Frame	*MultiFrame*	*A sequence of frames is captured for each AcquisitionStart Command. The number of frames is specified by AcquisitionFrameCount feature. An AcquisitionStop occurs at the end of the Active Frame(s).*	
Continuous	*Continuous*	*Frames are captured continuously with AcquisitionStart until stopped with the AcquisitionStop command.*	

Acquisition Frame Count	AcquisitionFrameCount	Number of frames to be acquired in MultiFrame acquisition mode.	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
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 then 1. (WO)	Beginner
Acquisition Abort Cmd	AcquisitionAbort	Aborts the acquisition immediately. This will end the capture without completing the current Frame or aborts waiting on a trigger. If no acquisition is in progress, the command is ignored. (WO)	Beginner
Internal Acquisition FPS (in Hz)	internalAcquisitionFPS	Reports the camera internal frame rate, in Hz. Use the AcquisitionFrameRate feature to control this value. The image Height and Width 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 *AcquisitionFrameRate* and *internalAcquisitionFrameDropCount*. This feature does not take bandwidth limitations into account.	Guru DFNC
Transfer Control *Basic*	TransferControlMode *Basic*	Sets the method used to control the transfer. *Basic mode ensures maximum compatibility but does not allow for control of the transfer flow.*	Expert
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 devicePacketResendBufferSize will affect total memory available here.	
Transferred Image Max Data Size	transferMaxBlockSize	Biggest image (GVE 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	transferMinBlockSize	Smallest image (GVE 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	transferAverageBlockSize	Average size of the last 16 images (GVE blocks) of data sent on the GigE cable. The value is displayed in Megabytes. Use this value to calculate the sustained frame rate transferred on the GigE cable. GigE Link speed (~115 MB) divided by Average size (value) = Max fps transferred.	DFNC Beginner
Maximum Sustained Frame Rate	maxSustainedFrameRate	Maximum sustained frame rate that can be achieved by the camera in the current configuration (Resolution, Pixel Format and the camera's internal bandwidth limitations).	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.

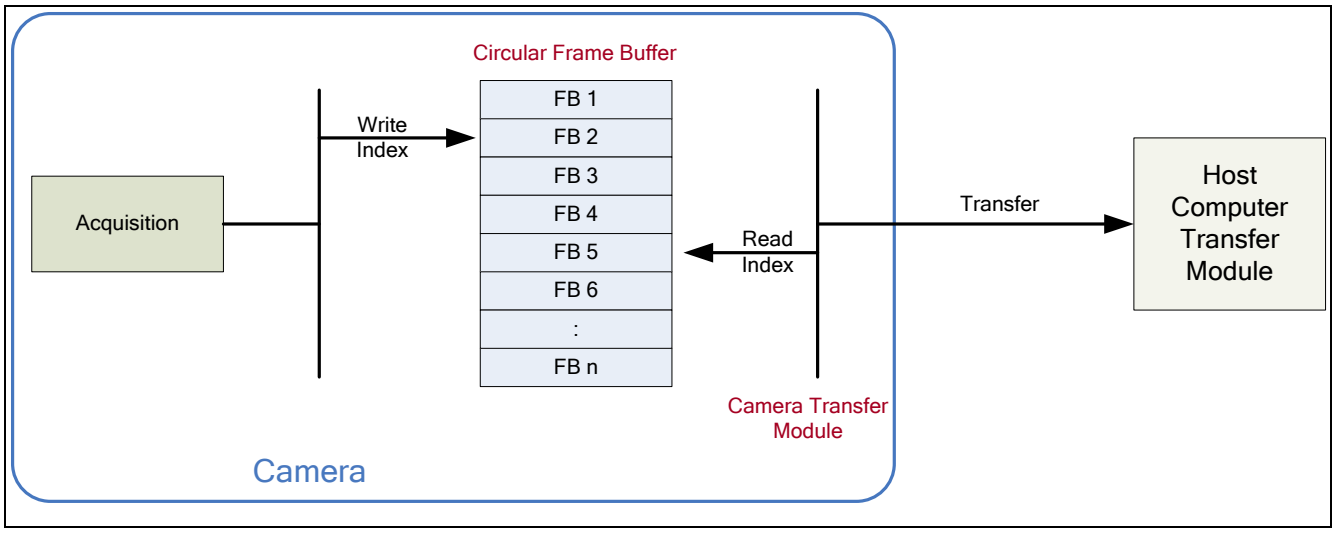


Figure 85: Transfer Control Mode

Features Unalterable During a Sapera Transfer

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

Feature Group	Features Locked During a Sapera Transfer
CAMERA_INFORMATION	UserSetLoad
SENSOR_CONTROL	*NA*
I/O_CONTROL	*NA*
COUNTER_AND_TIMER_CONTROL	*NA*
ADVANCED_PROCESSING_CONTROL	flatfieldCorrectionMode
IMAGE_FORMAT_CONTROL	PixelFormat OffsetX Width Height BinningHorizontal BinningVertical
ACQUISITION_AND_TRANSFER_CONTROL	DeviceRegistersStreamingStart DeviceRegistersStreamingEnd
EVENT_CONTROL	*NA*
GIGE_VISION_TRANSPORT_LAYER_CONTROL	GevSCPSPacketSize
GIGE_VISION_HOST_CONTROL	InterPacketTimeout InterPacketTimeoutRaw ImageTimeout
FILE_ACCESS_CONTROL	*NA*

Action Control Category

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

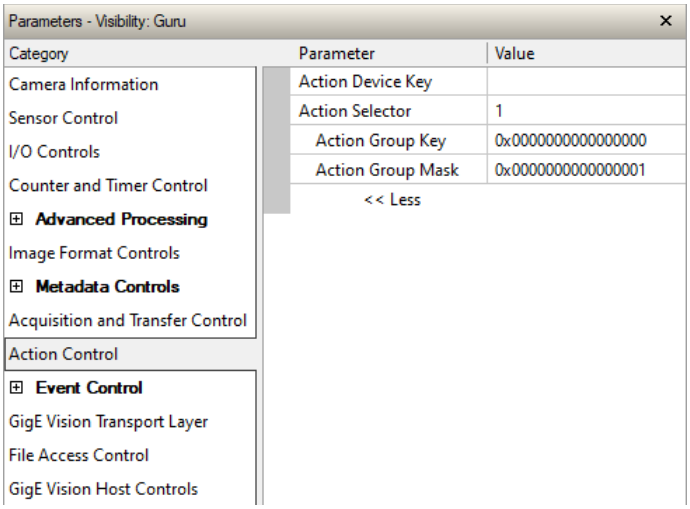


Figure 86: CamExpert – Action Control Category

Action Control Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Action Device Key	ActionDeviceKey	*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	*Linea Lite default = 0 for all action command.* Provides the key that the device uses to validate that the action command message is part of the requested group.	Guru
Action Group Mask	ActionGroupMask	*Linea Lite default = 1 for action 1, or 2 for action 2.* Provides the mask used to filter particular action command messages for the selected action.	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

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

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.

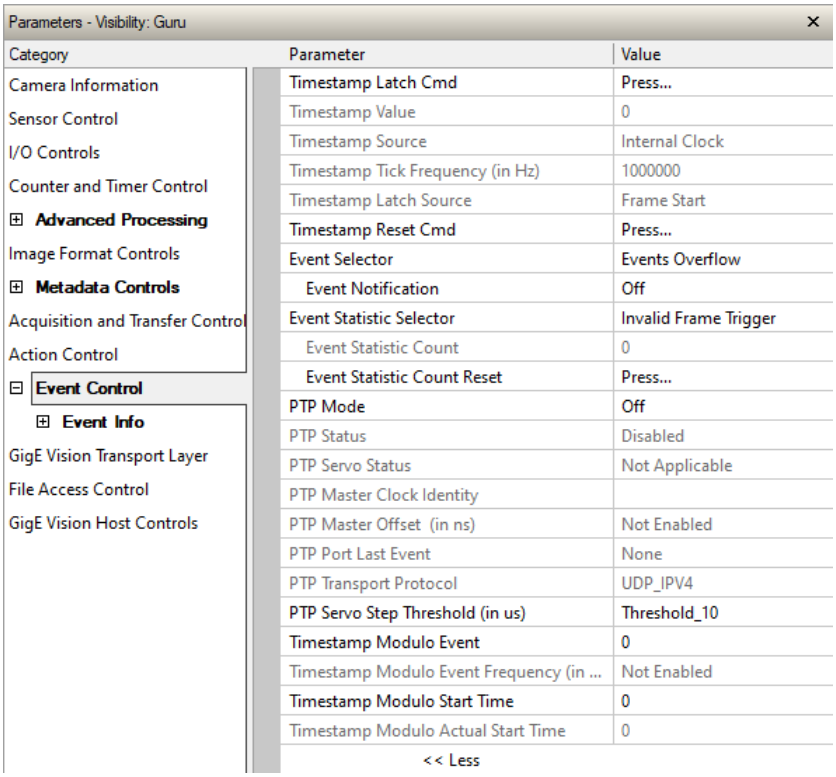


Figure 87: CamExpert – Event Control Category

Event Control Feature Descriptions

Display Name	Feature & Values	Description	Standard & View
Timestamp Latch Cmd	timestampControlLatch	Latch the current timestamp internal counter value in the Timestamp Value feature.	Expert DFNC
Timestamp Value	timestampValue	Returns the 64-bit value of the timestamp counter. (RO)	Expert DFNC
TimeStamp Source *Internal Clock*	timestampSource *InternalClock*	Specifies the source used as the incrementing signal for the timestamp register. *The timestamp source is generated by the camera internal clock. Refer to Timestamp Tick Frequency feature for the time base.*	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	timestampLatchSource	Specifies the internal event or signal that will latch the timestamp counter into the timestamp buffer.	Expert DFNC
Frame Start	*FrameStart*	*The timestamp is latched on frame start.*	Expert DFNC
Timestamp Reset Cmd	timestampControlReset	Resets the timestamp counter to 0. (WO)	Expert DFNC
Event Selector *End of Frame* *Start of Frame* *Valid Frame Trigger* *Rejected Frame Trigger* *Image Lost* *Rejected Line Trigger* *Line 1 Rising Edge* *Line 1 Falling Edge* *Line 2 Rising Edge* *Line 2 Falling Edge* *Line 3 Rising Edge* *Line 3 Falling Edge* *Start of Acquisition* *End of Acquisition* *Events Overflow*	EventSelector *FrameEnd* *FrameStart* *ValidFrameTrigger* *InvalidFrameTrigger* *ImageLost* *InvalidLineTrigger* *Line1RisingEdge* *Line1FallingEdge* *Line2RisingEdge* *Line2FallingEdge* *Line3RisingEdge* *Line3FallingEdge* *AcquisitionStart* *AcquisitionEnd* *eventsOverflow*	Select the Event to enable/disable with the EventNotification feature. *Event sent on control channel on an End of Frame.* *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.* *Event sent on control channel when a valid frame trigger is generated.* *Event sent on control channel when a frame trigger occurs in an invalid Trigger region. The trigger is rejected and no frame acquisition occurs.* *Event sent on control channel when an image is lost due to insufficient memory.* *Event sent on control channel when a line trigger occurs in an invalid Trigger region. The trigger is rejected and no frame acquisition occurs.* *Event sent on control channel when a rising edge is detected on Line 1.* *Event sent on control channel when a falling edge is detected on Line 1.* *Event sent on control channel when a rising edge is detected on Line 2.* *Event sent on control channel when a falling edge is detected on Line 2.* *Event sent on control channel when a rising edge is detected on Line 3.* *Event sent on control channel when a falling edge is detected on Line 3.* *Event sent on control channel on acquisition start.* *Event sent on control channel on acquisition end.* *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.*	Expert

Event Notification *Off* *On* *GigEVisionEvent*	EventNotification *Off* *On* *GigEVisionEvent*	Enable Events for the event type selected by the EventSelector feature. *The selected event is disabled.* *The selected event will generate a software event.* *The selected event will generate a software event for SFNC 1.x compatibility.*	Expert
Event Statistic Selector *Invalid Frame Trigger* *Image Lost* *Packet Resend* *Packet Resend Request Dropped* *Ethernet Pause Frame Received*	eventStatisticSelector *InvalidFrameTrigger* *ImageLost* *PacketResend* *PacketResendRequestDropped* *EthernetPauseFrameReceived*	Selects which Event statistic to display. *Counts the frame trigger occurring in an invalid Trigger region.* *Image is acquired but lost before it's been transferred.* *Counts the number of individual packets that are resent.* *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.* *Counts the number of Ethernet Pause Frame received. Feature limited to 65536 events. See also PAUSE Frame Support for information on Ethernet Packet size.*	Expert DFNC
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
PTP Mode *Off* *Automatic* *Slave*	ptpMode *Off* *Automatic* *Slave*	Specifies the PTP (IEEE-1588: Precision Time Protocol) operating mode as implemented by the Linea Lite. *PTP is disabled on the device.* *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.* *Device will operate in PTP slave-only mode.*	Expert DFNC

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
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	*None*	*None*	
Power up	*Powerup*	*Power up*	
Initialize	*Initialize*	*Initialize*	
Designated Enabled	*DesignatedEnabled*	*Designated Enabled*	
Designated Disabled	*DesignatedDisabled*	*Designated Disabled*	
Fault Cleared	*FaultCleared*	*Fault Cleared*	
Fault Detected	*FaultDetected*	*Fault Detected*	
State Decision Event	*StateDecisionEvent*	*State Decision Event*	
Qualification Timeout Expires	*QualificationTimeoutExpires*	*Qualification Timeout Expires*	
Announce Receipt Timeout Expires	*AnnounceReceiptTimeoutExpires*	*Announce Receipt Timeout Expires*	
Synchronization Fault	*SynchronizationFault*	*Synchronization Fault*	
Master Clock Selected	*MasterClockSelected*	*Master Clock Selected*	
Recommended State Master	*RS_Master*	*Recommended State Master*	
Recommended State Grand Master	*RS_GrandMaster*	*Recommended State Grand Master*	
Recommended State Slave	*RS_Slave*	*Recommended State Slave*	
Recommended State Passive	*RS_Passive*	*Recommended State Passive*	
PTP Transport Protocol	ptpTransportProtocol	Describes the PTP Transport Protocol used.	Expert DFNC
PTP Servo Step Threshold (in us)	ptpServoStepThreshold	Specifies the servo step threshold (in µs). When the clock offset with the master exceeds the threshold, the servo unlocks and offset adjustment is started.	Expert DFNC
Threshold_10	*Threshold_10*	10 µs threshold.	
Threshold_20	*Threshold_20*	20 µs threshold.	
Threshold_100	*Threshold_100*	100 µs threshold.	
Threshold_500	*Threshold_500*	500 µs threshold.	
Threshold_1000	*Threshold_1000*	1000 µs threshold.	
Threshold_2000	*Threshold_2000*	2000 µs threshold.	
Timestamp Modulo Event	timestampModulo	Specifies the additional interval between the current timestamp tick and the event generated. This interval has an 80ns accuracy. Note that the value zero disables the event generator.	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 Timestamp Modulo Start Time is in the future, Timestamp Modulo Actual Start Time = Timestamp Modulo Start Time. When the user-specified Timestamp Modulo Start Time has already past, the camera automatically recalculates a future value for Timestamp Modulo Start Time using the user set Timestamp Modulo Event 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
Frame Start Event ID	EventFrameStart	Represents the event ID to identify the EventFrameStart 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
Valid Frame Trigger Event ID	EventValidFrameTrigger	Represents the event ID to identify the EventValidFrameTrigger software Event. (RO)	Guru
Invalid Frame Trigger Event ID	EventInvalidFrameTrigger	Represents the event ID to identify the EventInvalidFrameTrigger software Event. (RO)	Guru
Acquisition Start Next Valid End Data Event ID	EventAcquisitionStartNextValid	Represents the event ID to identify the EventAcquisitionStartNextValid software Event. (RO)	Guru
Image Lost Data 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
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 0xfffe at the middle of the MAC address.

- The standard MAC address in human-friendly form is six groups of two hexadecimal digits as this example shows (excluding 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 0xfffe at the middle of the MAC address. The format is (excluding hyphens): "0a-1b-2c-fffe-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 µs 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.

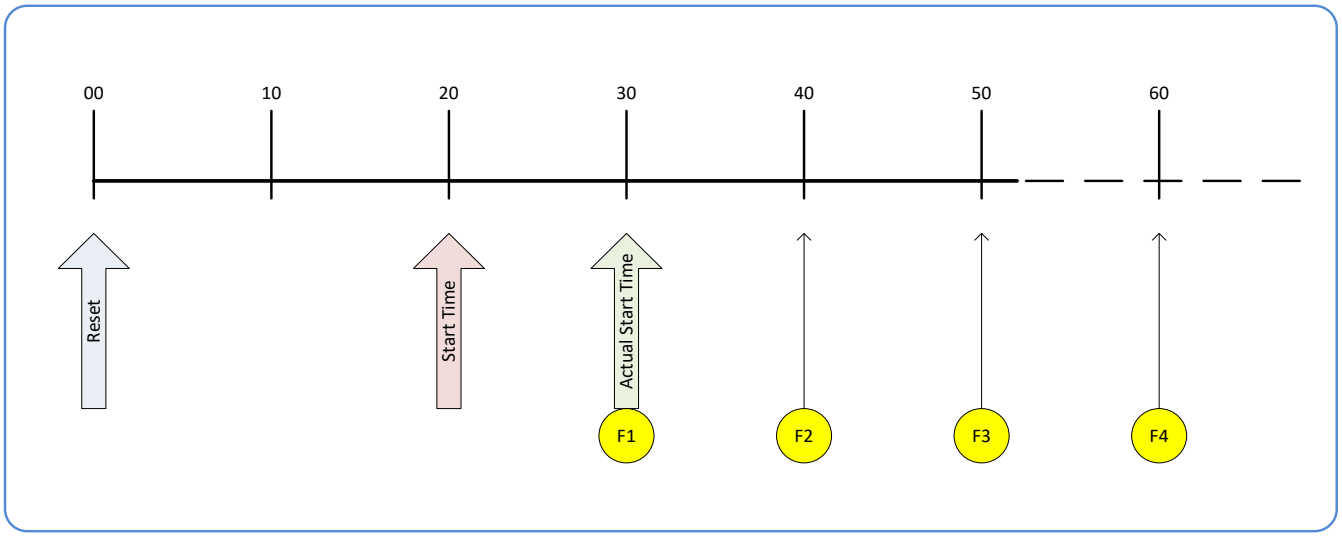


Figure 88: Case 1 - Repeating Acquisitions as Upcoming Events

Case 2: Potential Uncertainness to the Start Time

Conditions:

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

Case 2 differs 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.

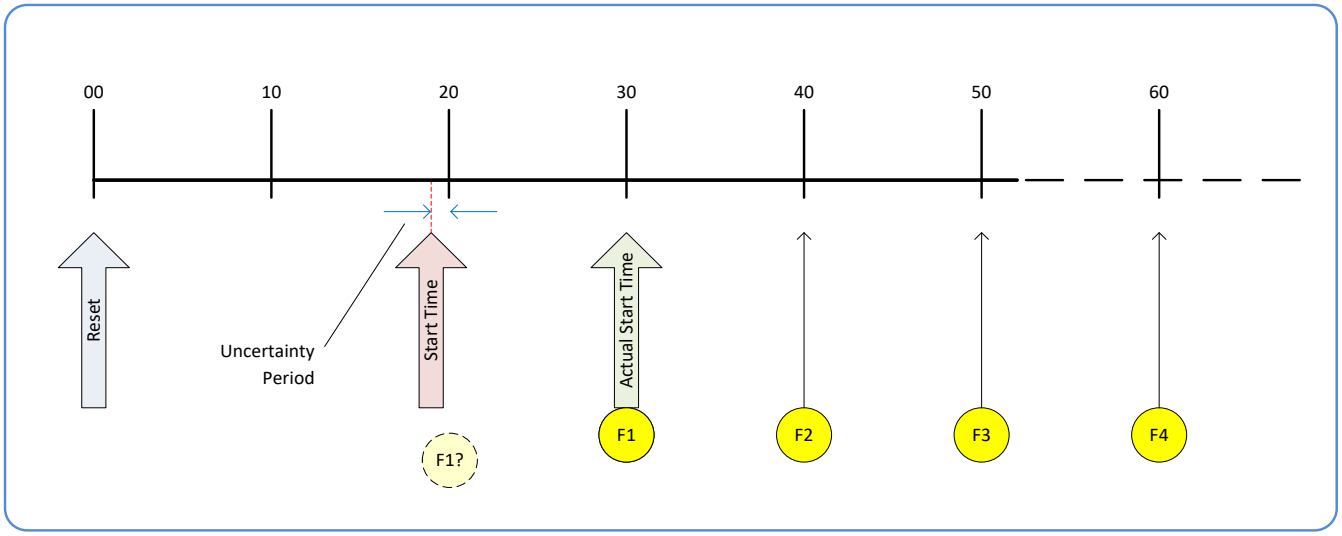


Figure 89: Case 2 – Potential Uncertainness to the Start Time

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.

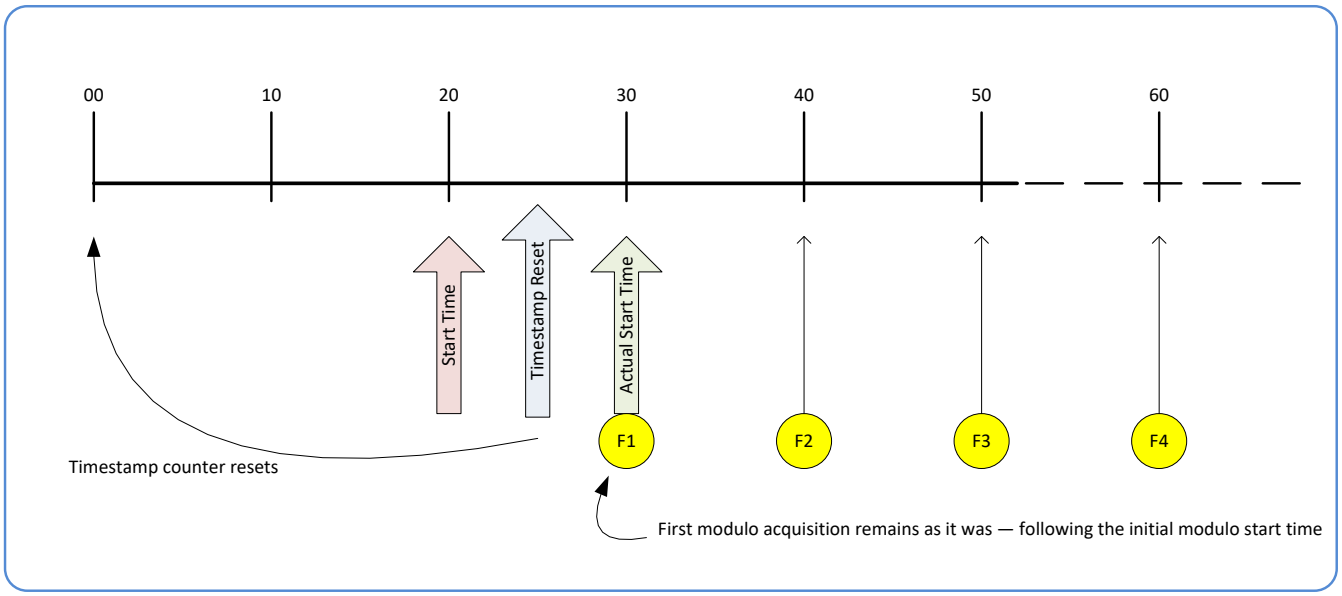


Figure 90: Case 3 – Timer Reset before the Actual Start Time

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.

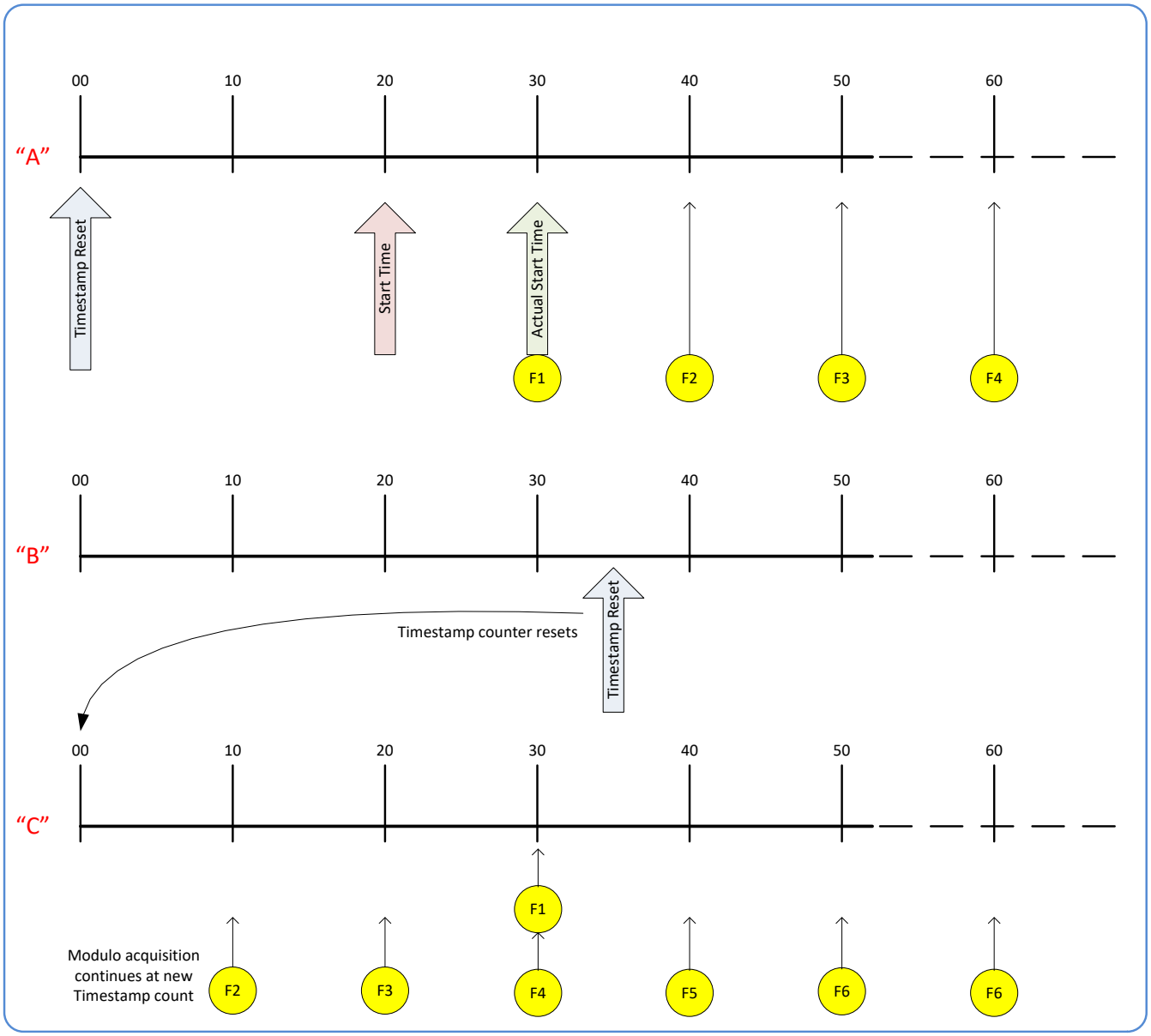


Figure 91: Case 4 – Timer Reset after the Actual Start Time

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.

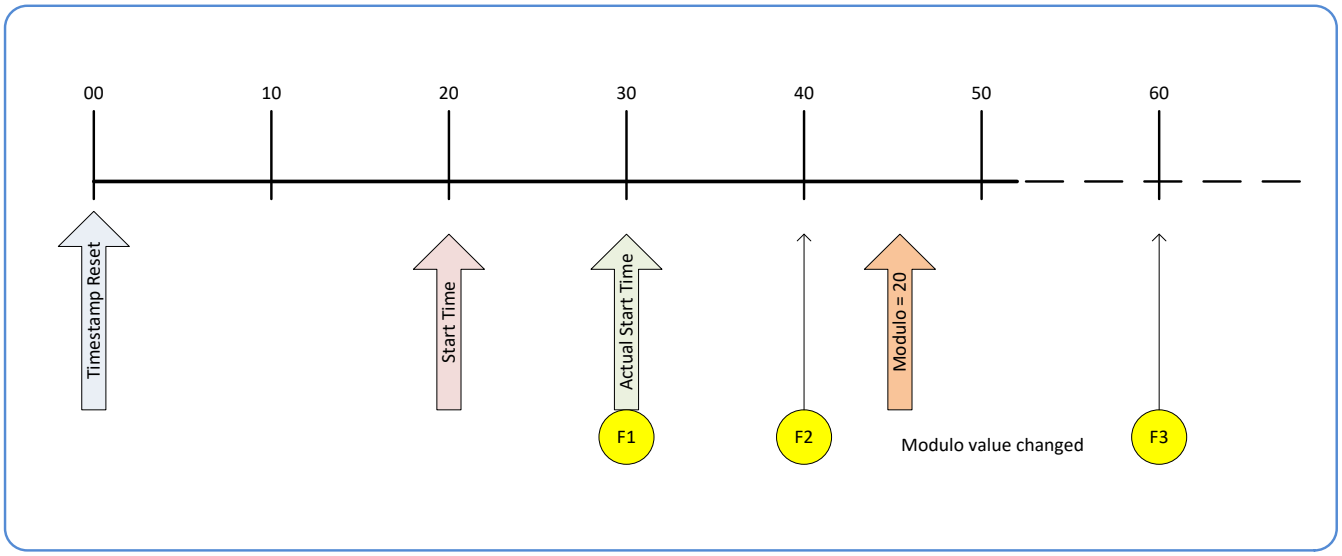


Figure 92: Case 5 – Changing 'timestampModulo' during Acquisitions

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.

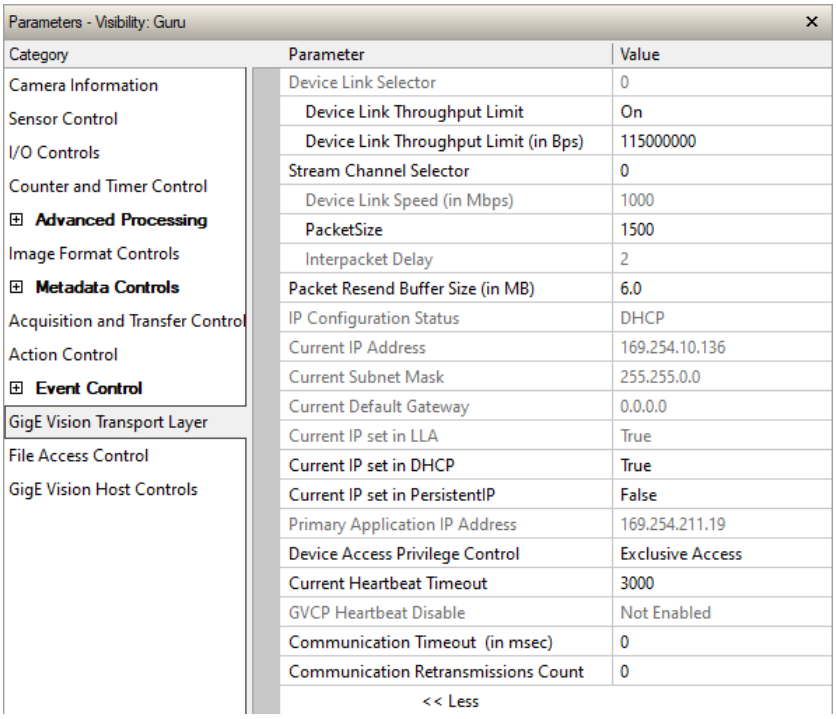


Figure 93: CamExpert – GigE Vision Transport Layer Category

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.	
Off	*Off*	*Disables the DeviceLinkThroughputLimit feature.*	
On	*On*	*Enables the DeviceLinkThroughputLimit feature.*	
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 µs) 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

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
Device Access Privilege Control	GevCCP	Controls the device access privilege of an application.	Invisible
Open Access	*OpenAccess*	*OpenAccess*	
Exclusive Access	*ExclusiveAccess*	*Grants exclusive access to the device to an application. No other application can control or monitor the device.*	
Control Access	*ControlAccess*	*Grants control access to the device to an application. No other application can control the device.*	
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 *IPConfigurationLLA* *IPConfigurationDHCP* *IPConfigurationPersistentIP* *StreamChannelSourceSocket* *MessageChannelSourceSocket* *CommandsConcatenation* *WriteMem* *PacketResend* *Event* *EventData* *PendingAck* *Action* *PrimaryApplicationSwitchover* *ExtendedStatusCodes* *DiscoveryAckDelay* *DiscoveryAckDelayWritable* *TestData* *ManifestTable* *CCPApplicationSocket* *LinkSpeed* *HeartbeatDisable* *SerialNumber* *UserDefinedName* *StreamChannel0BigAndLittleEndian* *StreamChannel0IPReassembly* *StreamChannel0UnconditionalStreaming* *StreamChannel0ExtendedChunkData*	Selects the GEV option to interrogate for existing support. (RO)	Invisible
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
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	GevDeviceModeIsBigEndian	Endianess of the device registers. (RO)	Invisible
Device Mode CharacterSet	GevDeviceModeCharacterSet *reserved1* *UTF8* *reserved2*	Character set used by all the strings of the bootstrap registers. (RO)	Invisible
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

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.

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.

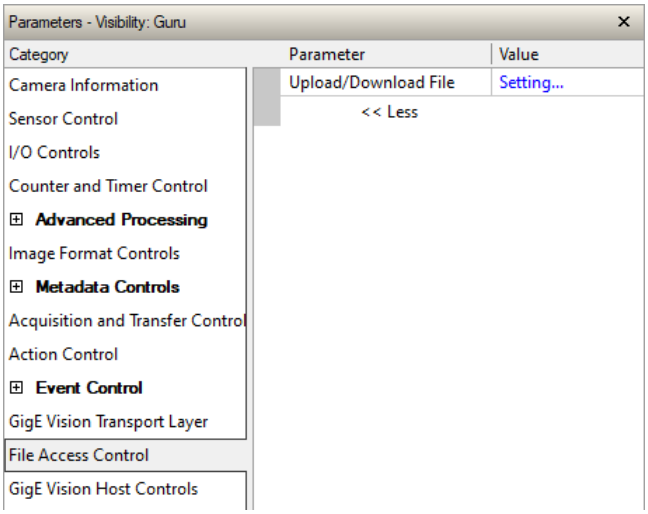


Figure 94: CamExpert – File Access Control Category

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
Firmware	*Firmware1*	*Upload new firmware to the camera which will execute on the next camera reboot cycle. Select the DeviceReset feature after the upload completes.*	
Factory Flat Line Coefficients 1	*FlatFieldCoefficients01*	*Select factory flatfield coefficients1. These are the factory values when the camera sensor Gain is 1.0.*	
User Flat Line Coefficients 1	*FlatFieldCoefficients1*	*Select to read (download), write (upload) or delete the User flatfield coefficients 1.*	
User Flat Line Coefficients 2	*FlatFieldCoefficients2*	*Select to read (download), write (upload) or delete the User flatfield coefficients 2.*	
User Flat Line Coefficients 3	*FlatFieldCoefficients3*	*Select to read (download), write (upload) or delete the User flatfield coefficients 3.*	
User Flat Line Coefficients 4	*FlatFieldCoefficients4*	*Select to read (download), write (upload) or delete the User flatfield coefficients 4.*	
LUT Luminance 1	*LutLuminance1*	*Select to write (upload) a Look-up-Table file (Sapera .LUT file) into the camera's internal LUT Luminance 1.*	
User Defined Saved Image	*userDefinedSavedImage*	*Upload and download an image in the camera.*	
Open Source Licenses	*SoftwareLicenses*	*Open Source Software Licenses*	
File Operation Selector	FileOperationSelector	Selects the target operation for the selected file in the device. This operation is executed when the File Operation Execute feature is called.	Guru
Open	*Open*	*Select the Open operation - executed by FileOperationExecute.*	
Close	*Close*	*Select the Close operation - executed by FileOperationExecute.*	
Read	*Read*	*Select the Read operation - executed by FileOperationExecute.*	
Write	*Write*	*Select the Write operation - executed by FileOperationExecute.*	
Delete	*Delete*	*Select the Delete operation - executed by FileOperationExecute.*	
File Operation Execute	FileOperationExecute	Executes the operation selected by File Operation Selector on the selected file.	Guru
File Open Mode	FileOpenMode	Selects the access mode used to open a file on the device.	Guru
Read	*Read*	*Select READ only open mode.*	
Write	*Write*	*Select WRITE only open mode.*	
File Access Buffer	FileAccessBuffer	Defines the intermediate access buffer that allows the exchange of data between the device file storage and the application.	Guru
File Access Offset	FileAccessOffset	Controls the mapping offset between the device file storage and the file access buffer.	Guru
File Access Length	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
Success	*Success*	*The last file operation has completed successfully.*	
Failure	*Failure*	*The last file operation has completed unsuccessfully for an unknown reason.*	
File Unavailable	*FileUnavailable*	*The last file operation has completed unsuccessfully because the file is currently unavailable.*	
File Invalid	*FileInvalid*	*The last file operation has completed unsuccessfully because the selected file in not present in this camera model.*	
File Operation Result	FileOperationResult	Displays the file operation result. For Read or Write operations, the number of successfully read/written bytes is returned. (RO)	Guru

File Size	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.

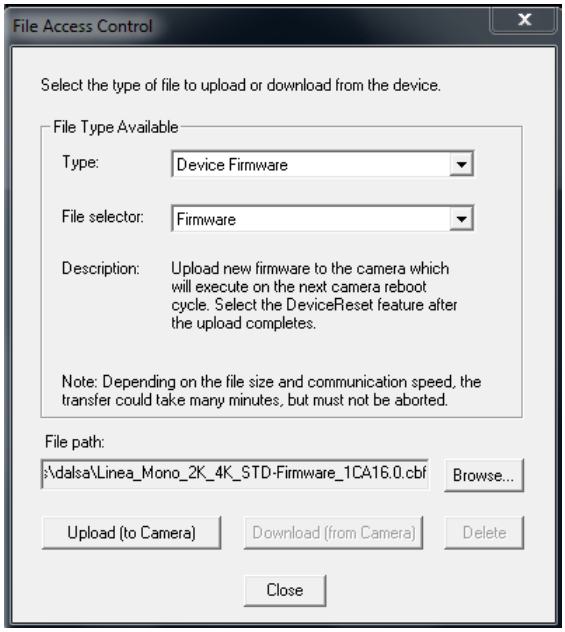


Figure 95: CamExpert – File Access Control Dialog

- **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.

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

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 Sapera LT SDK.
http://www.teledynedalsa.com/imaging/knowledge-center/appnotes/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

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.

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.

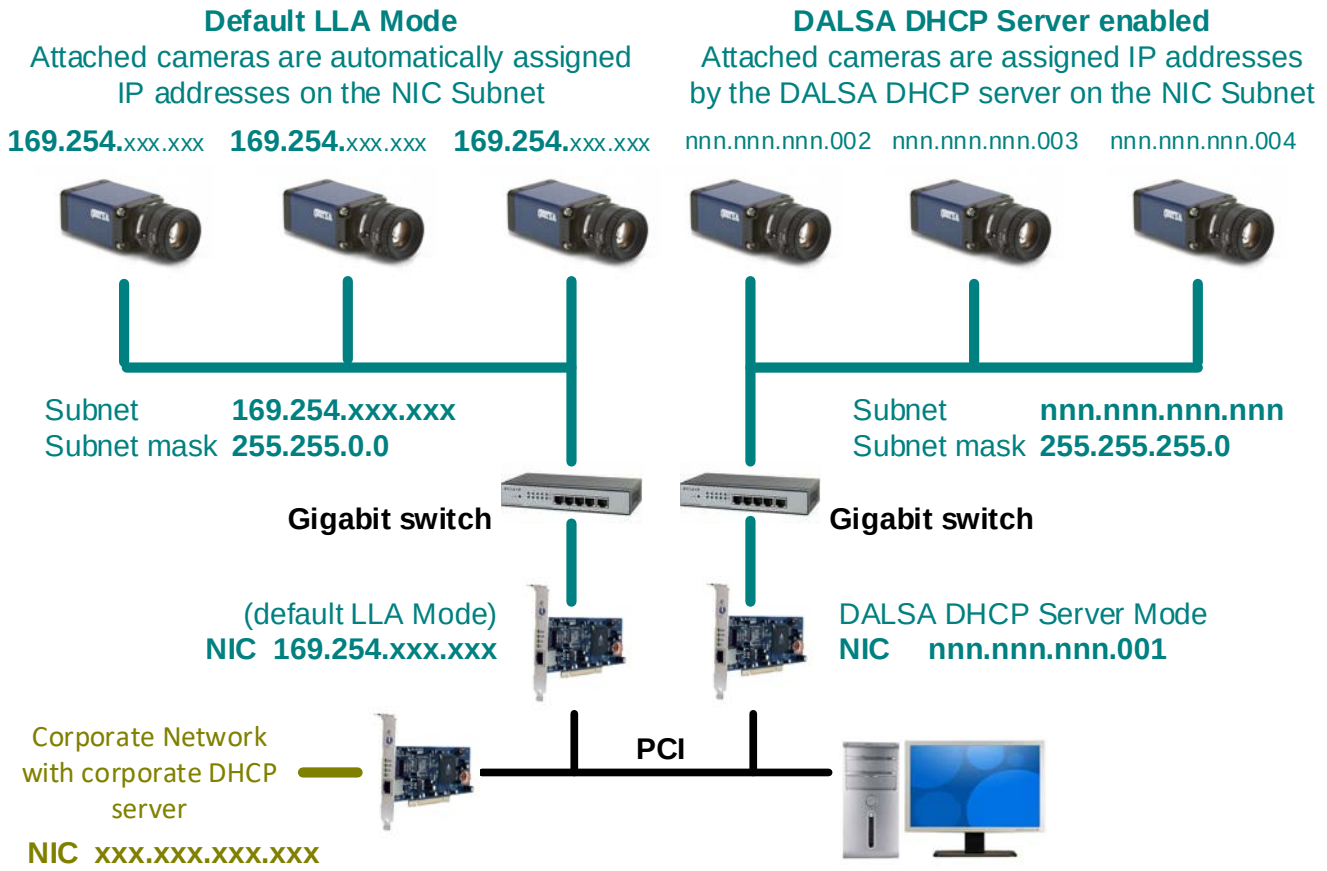


Figure 96: DHCP Configuration Overview

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.

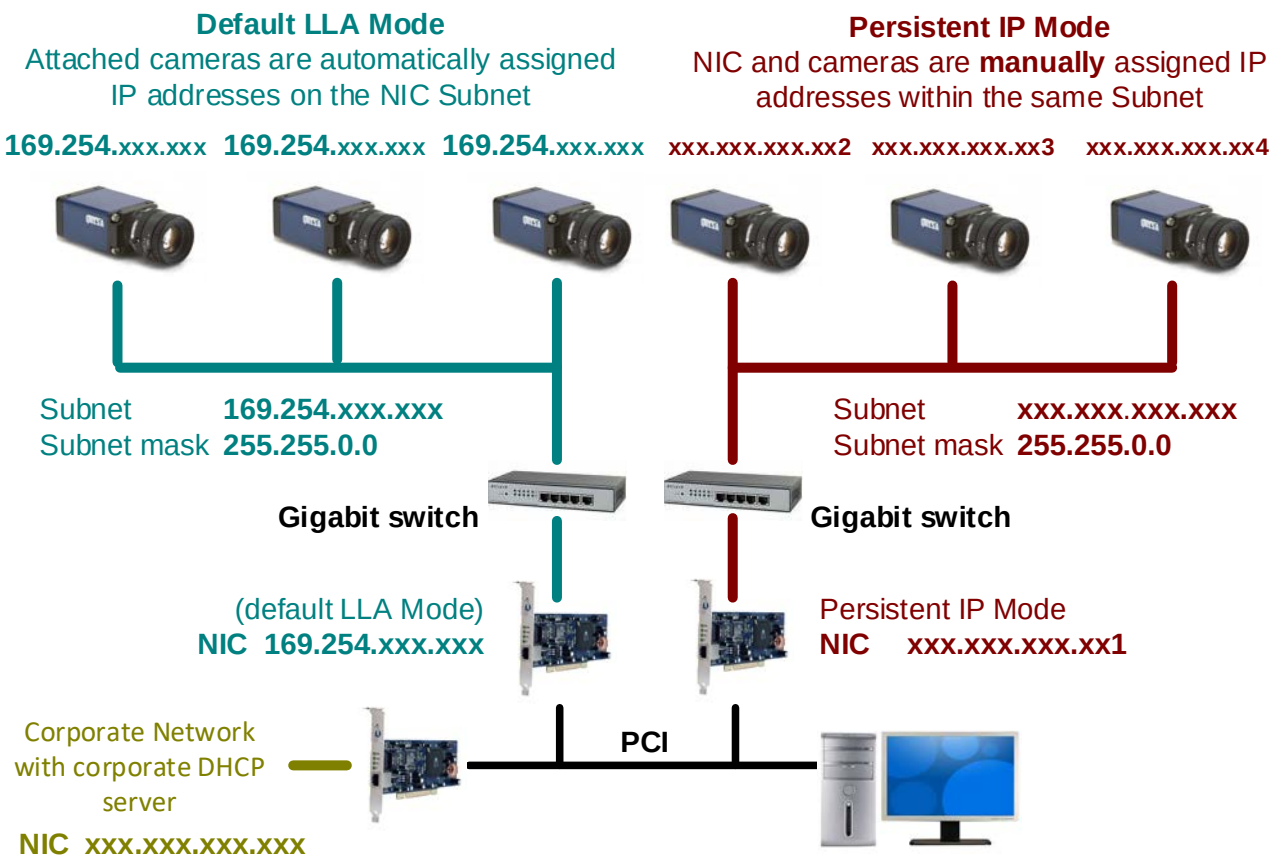


Figure 97: Persistent IP Configuration Overview

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.

Important: 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.

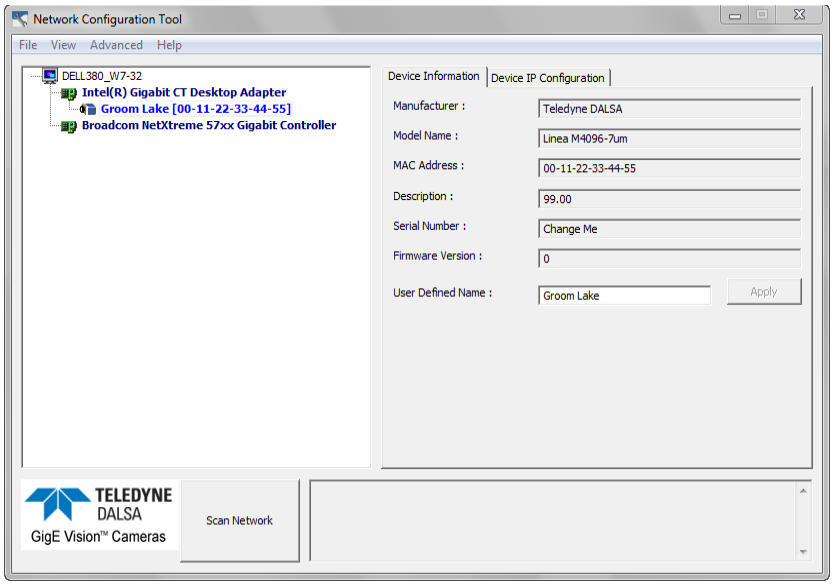


Figure 98: Network Configuration Tool

Run the tool from the Windows Start menu:

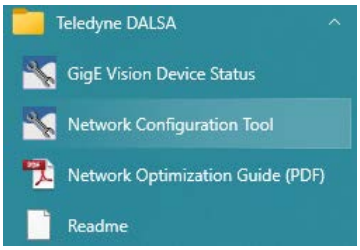


Figure 99: Windows Start Menu Network Configuration Tool Shortcut

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 Monochrome and Color

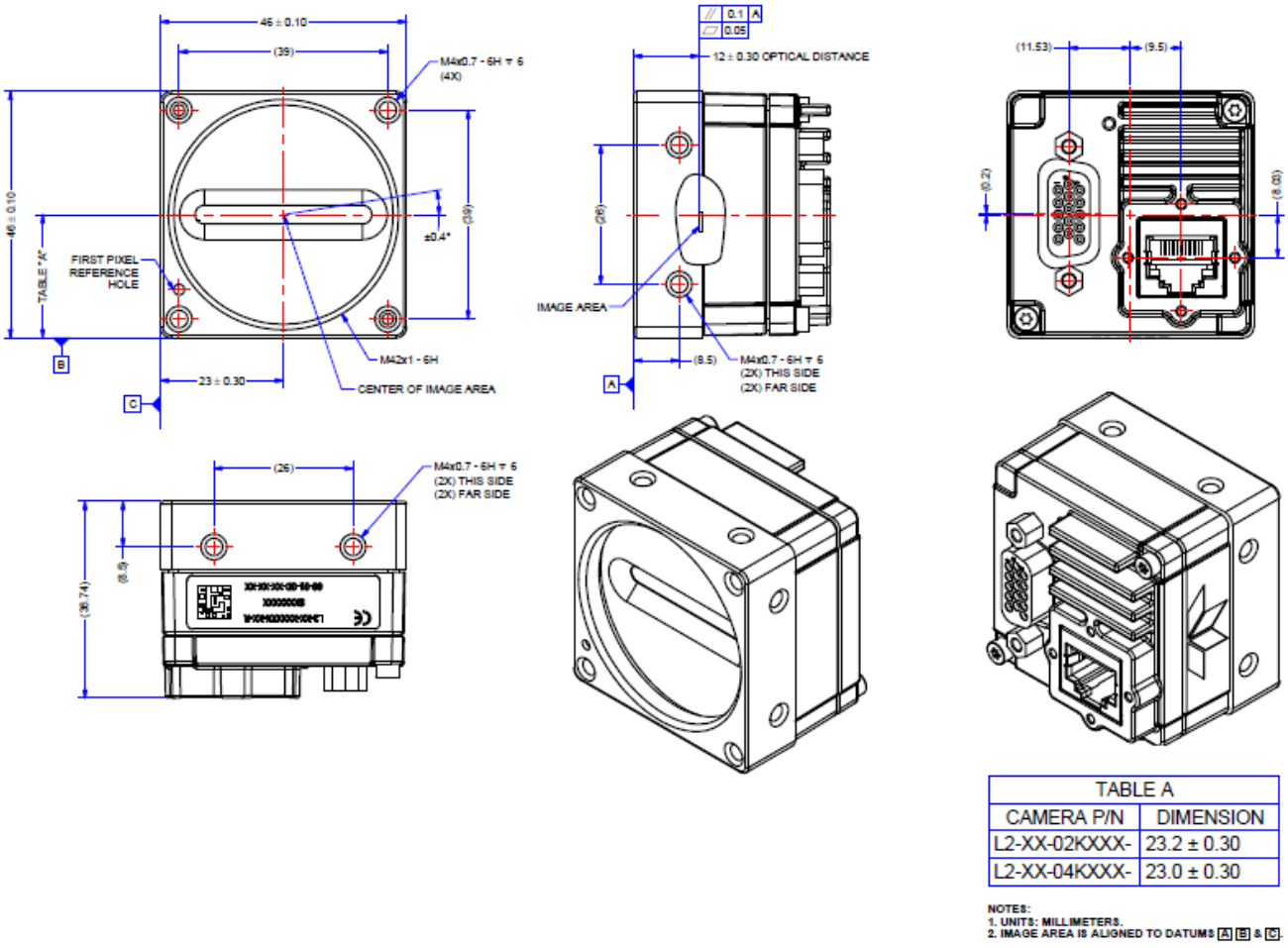


TABLE A	
CAMERA P/N	DIMENSION
L2-XX-02KXXX-	23.2 ± 0.30
L2-XX-04KXXX-	23.0 ± 0.30

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

Figure 100: Linea Lite GigE 2k / 4k with M42x1 Lens Mount

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 ±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.

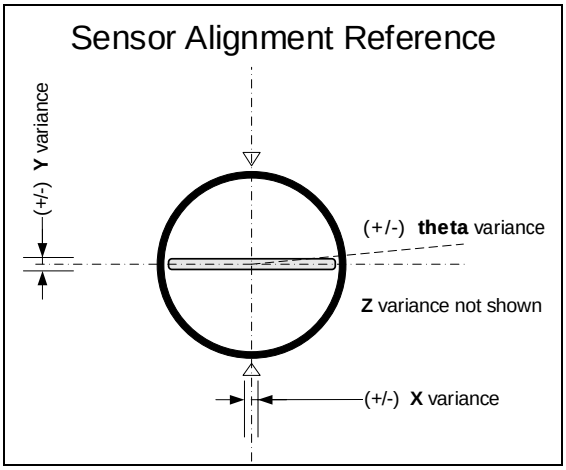


Figure 101: Sensor Alignment Reference

	Linea Lite GigE
X variance	± 300 µm
Y variance	± 300 µm
Z variance	± 300 µm
Theta variance	± 0.4°

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.

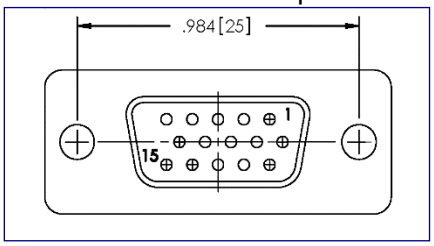


Figure 102: HD15 Female Connector

HD15 Connector Details

Pin Number	Linea Lite GigE	Direction	Definition
1	Line 1+	In	RS-422[1] Input Port 1+
2	Line 1-	In	RS-422[1] Input Port 1-
3	Line 2+	In	RS-422[1] Input Port 2+
4	Line 2-	In	RS-422[1] Input Port 2-
5	Signals Ground		Signals Ground
6	Line 3+	In/Out	Configurable[2] IO Port 3+
7	Line 3 -	In/Out	Configurable[2] IO Port 3-
8	Input Trigger Level	Out	
9	Input Trigger Level	Out	
10	PWR-GND		Camera Power Ground
11	Line 4+	Out	Configurable[3] Output Port 4+
12	Line 4-	Out	Configurable[3] Output Port 4-
13	Line 5+	Out	Configurable[3] Output Port 5+
14	Line 5-	Out	Configurable[3] 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 µs to 255 µs.
- **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 µs. The pulse duration can be set from 0 to 16 seconds in increments of 1 µs.

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.

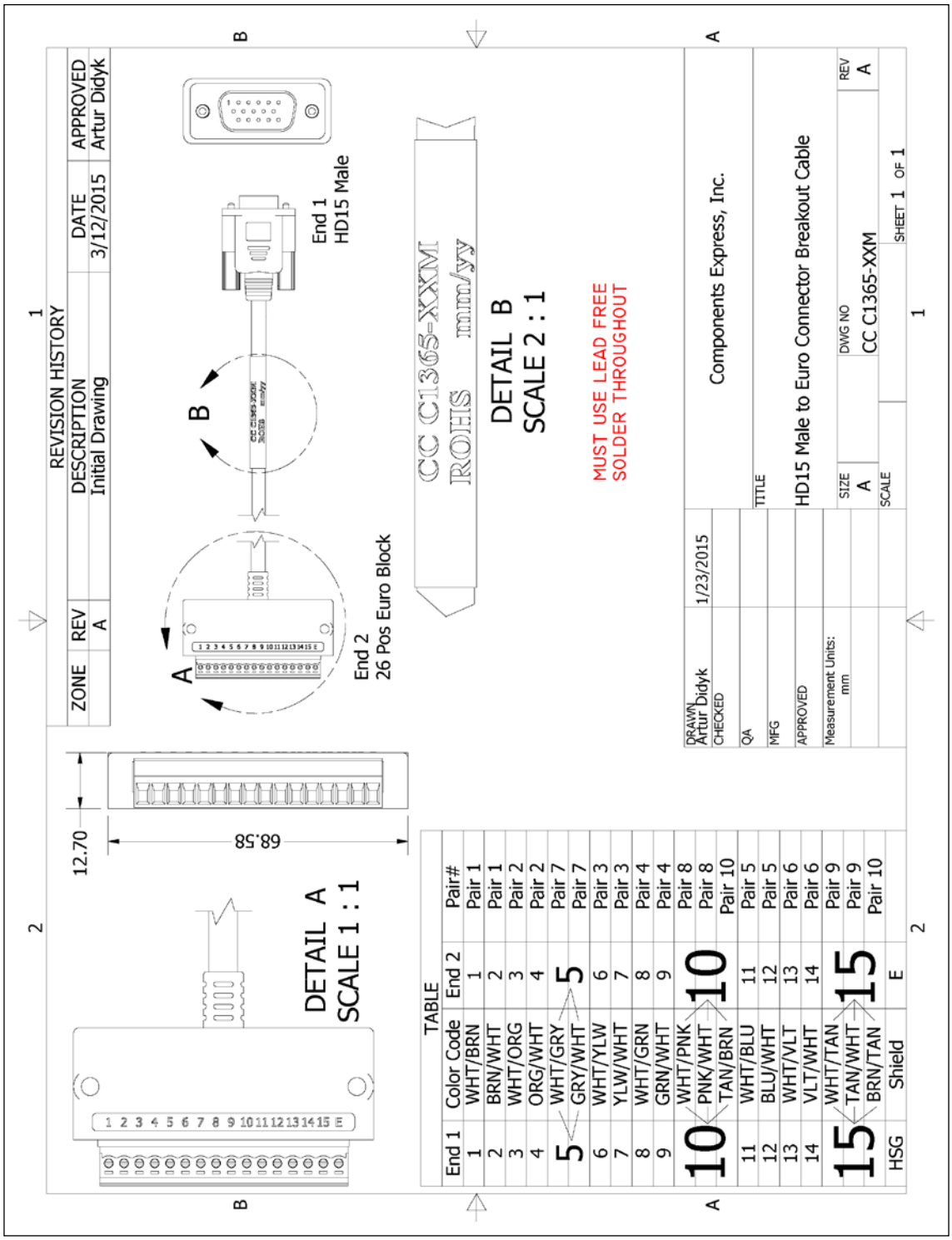


Figure 103: Mating GPIO Cable Assembly

Input Signals Electrical Specifications

External Inputs Block Diagrams

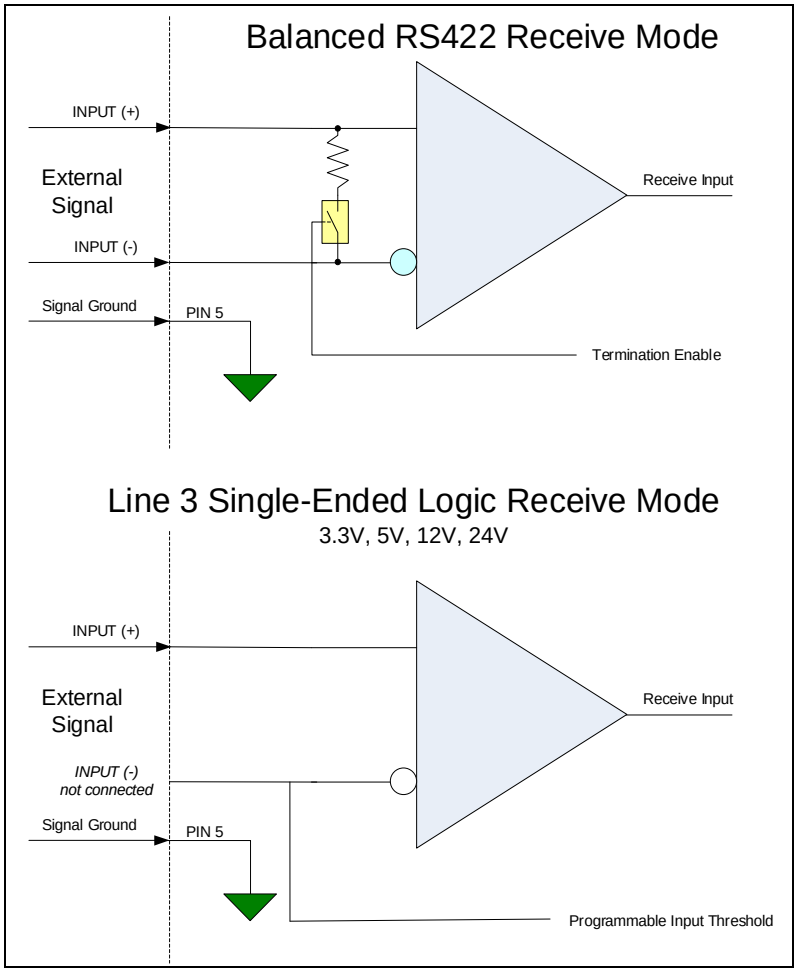


Figure 104: External Inputs Block Diagram

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 µs, in 1 µs 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 *Input Signal Direction*	
LVTTL (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

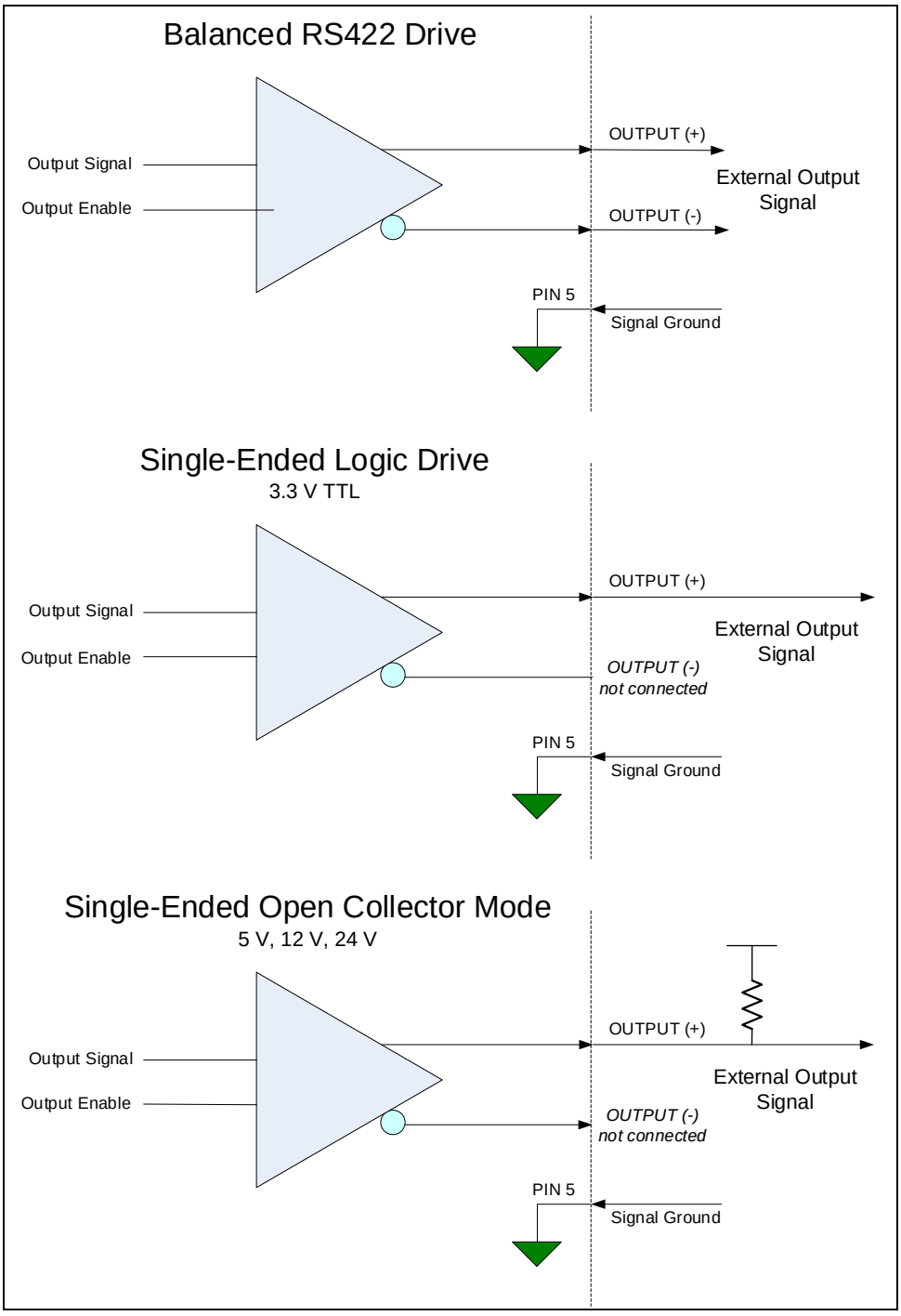


Figure 105: External Outputs Block Diagram

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 kΩ and 10 kΩ 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.

EU and UKCA Declaration of Conformity

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

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

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

Additional Reference Information

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 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)

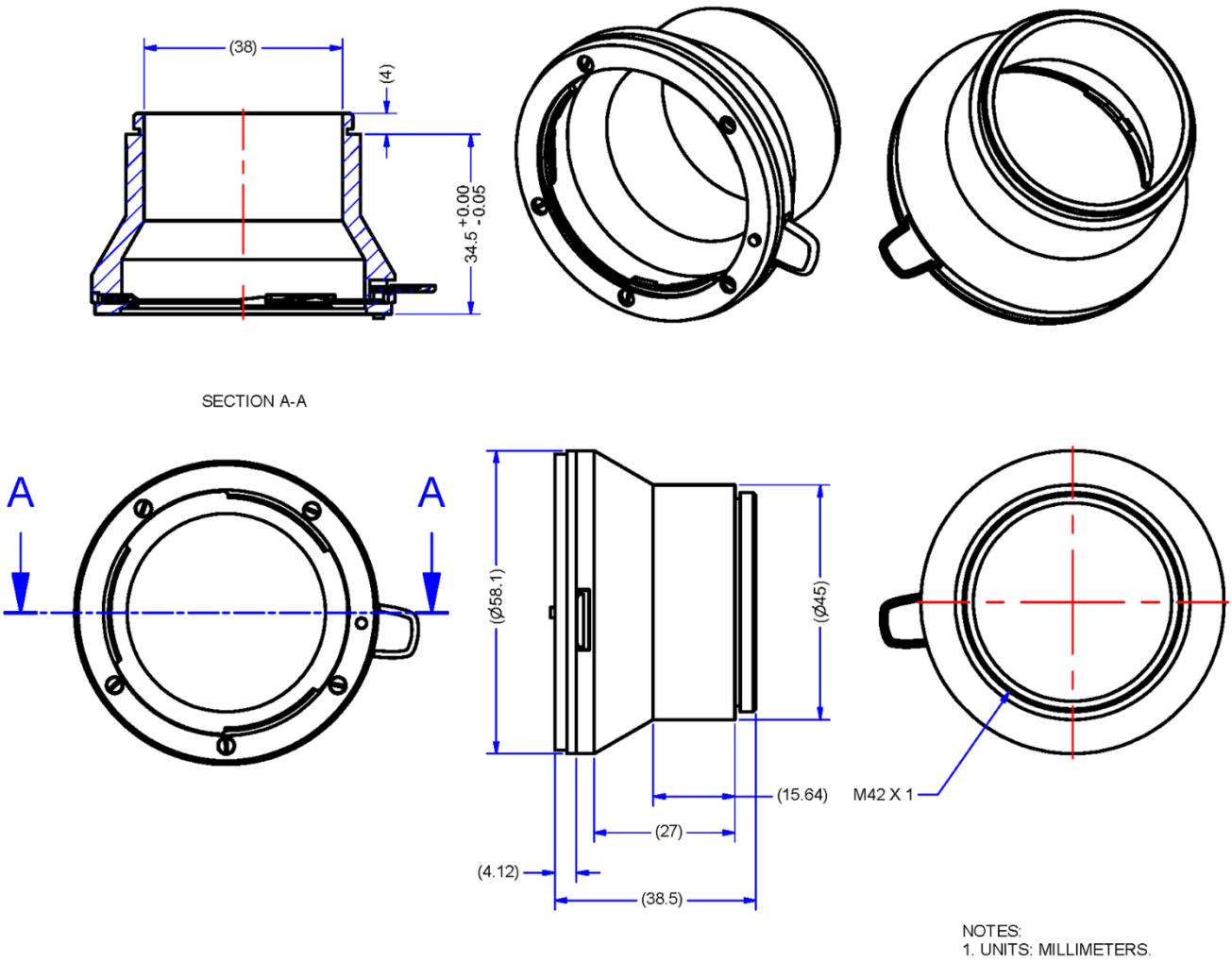


Figure 106: Nikon F Bayonet to M42x1 Adapter, 12mm BFD, HEAVY DUTY w/clip

Lens Image Circle Illustration

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

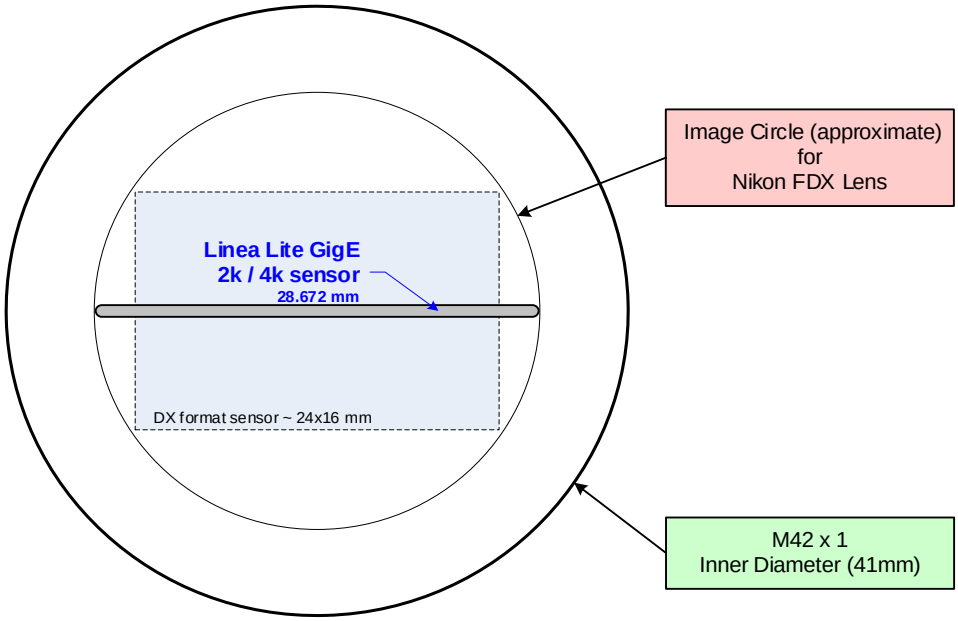


Figure 107: Lens Circle

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 $\mu J/cm^2$ can be achieved by exposing 5 mW/cm^2 for 1 ms has the same effect as exposing an intensity of 5 W/cm^2 for 1 μs.

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

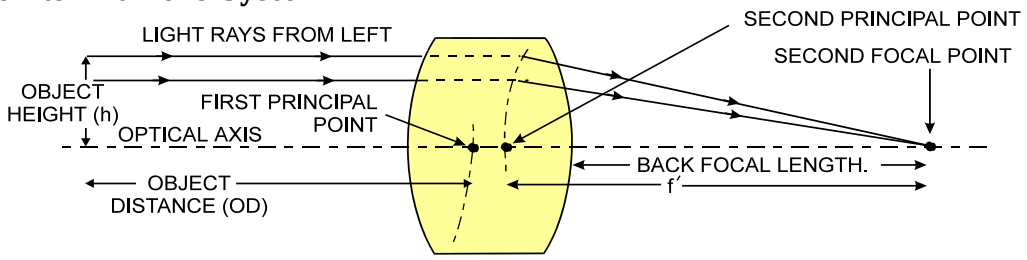


Figure 108: Primary Points in a Lens System

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

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

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 these can introduce static charge to the window surface.

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

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 Sapera 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 Sapera 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 Sapera 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 Sapera 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, go to **Programs • Dalsa • Sapera LT • Tools** and run the **Log Viewer** program. From its File menu click on **Save Messages** to generate a log text file.
- Report the version of GigE Vision software and Sapera version used.

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)*

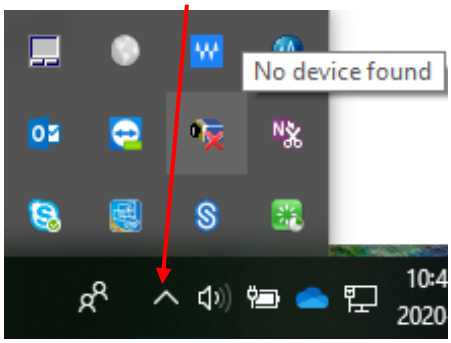


Figure 110: Windows Task Bar - Show Hidden Icons

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

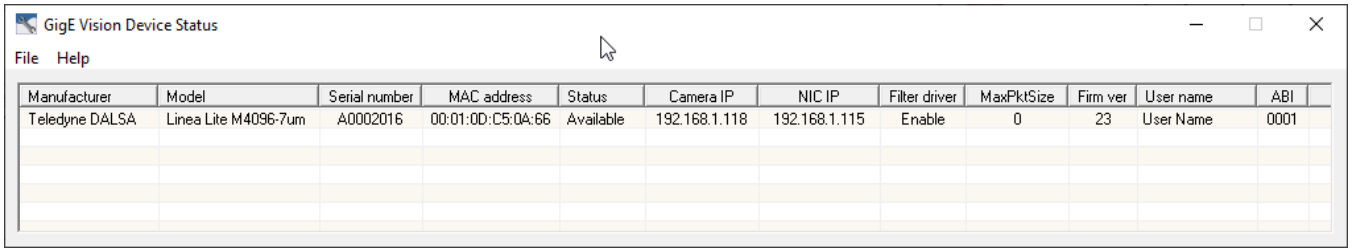
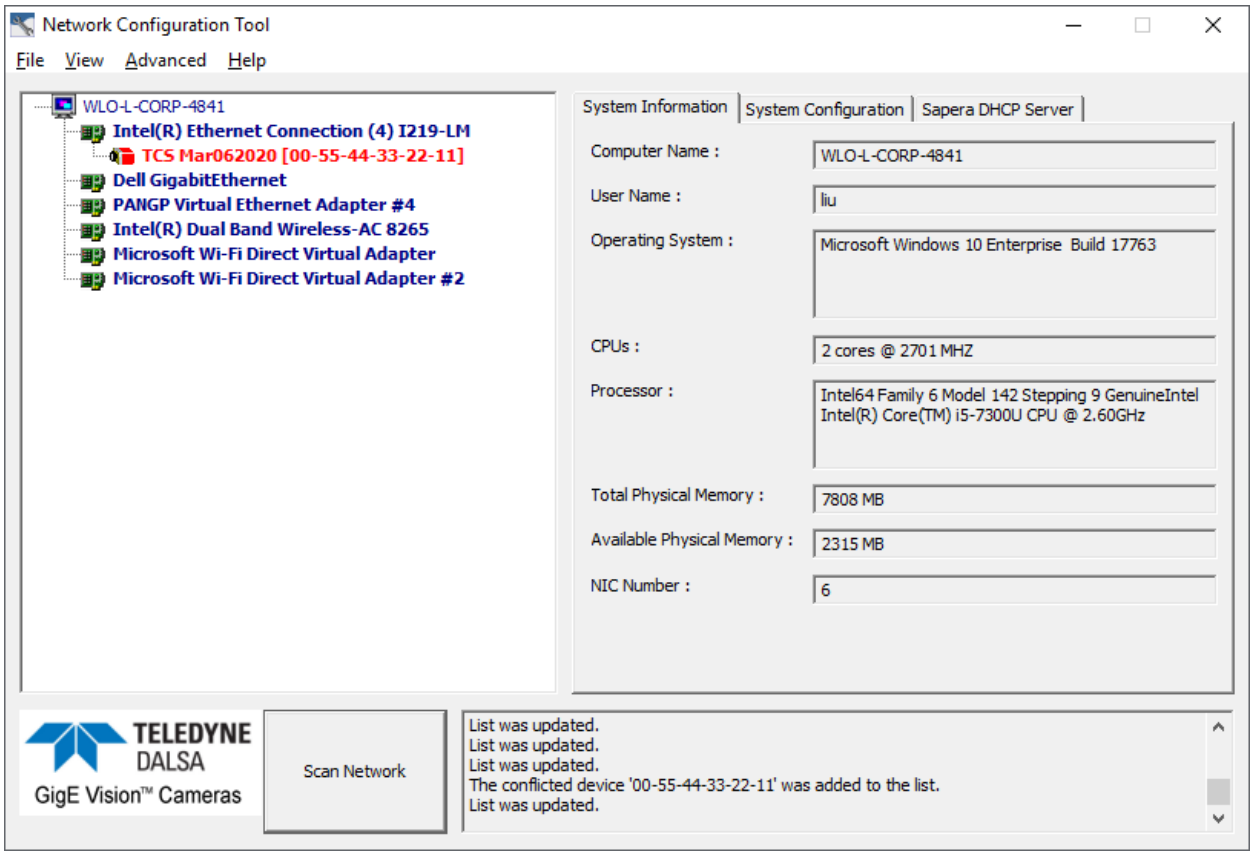


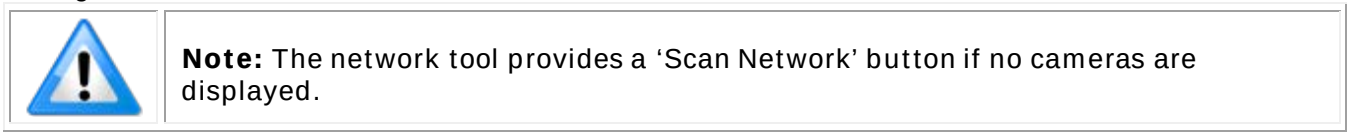
Figure 111: GigE Vision Device Status

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

Open Teledyne DALSA's Network Configuration Tool from Window's Start Menu.



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



Note: The network tool provides a 'Scan Network' button if no cameras are displayed.

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

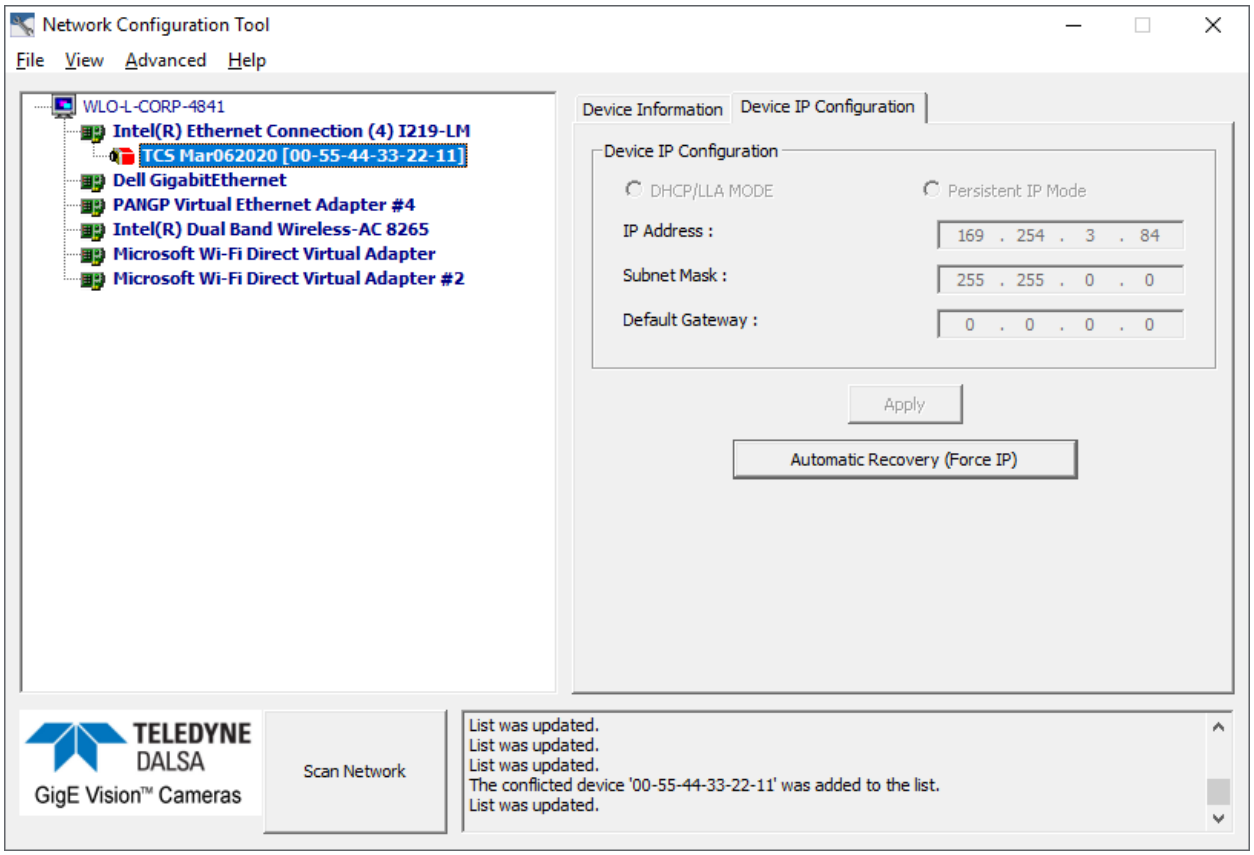


Figure 112: Network Configuration Tool – Automatic Recovery (Force IP)

Cameras displayed in blue have a proper NIC IP assigned.

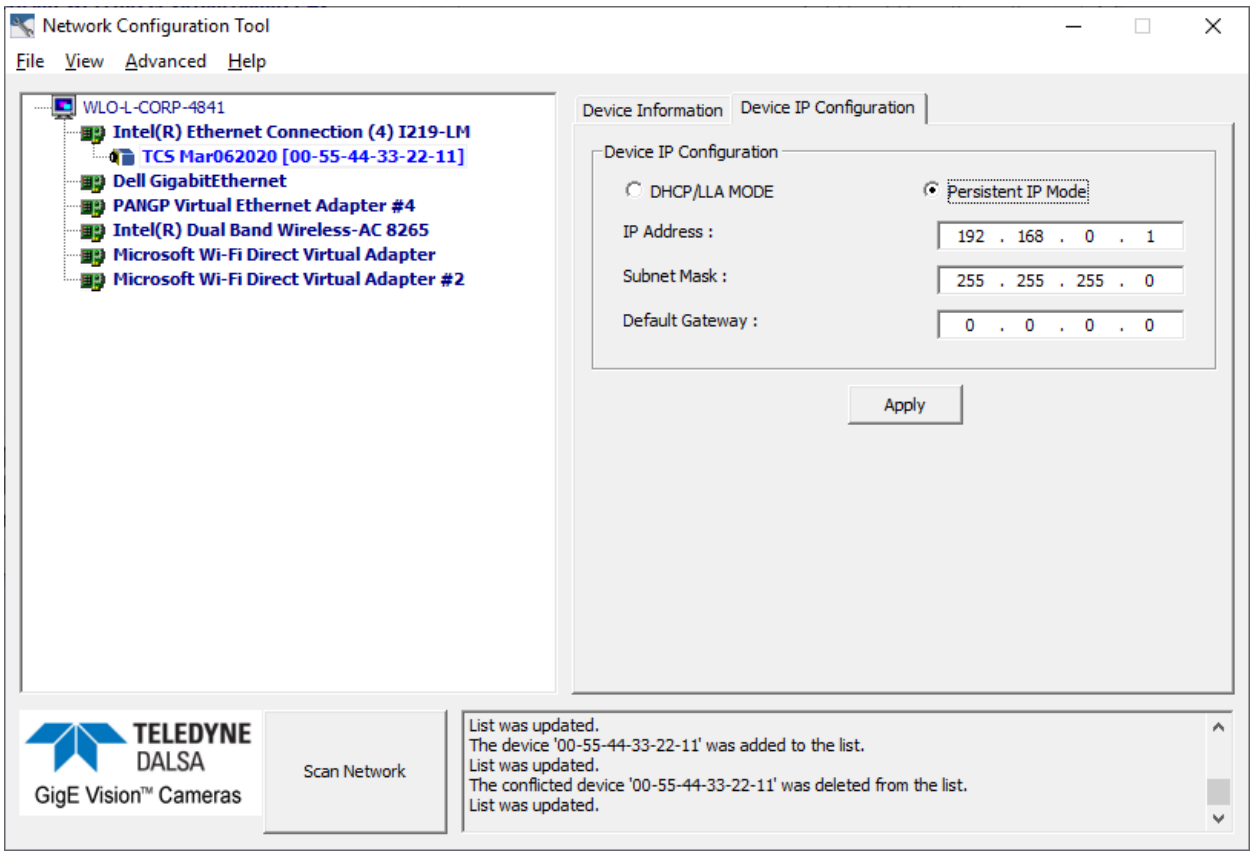


Figure 113: Network Configuration Tool – Proper IP Assigned

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.

Click the 'Persistent IP Mode' (shown above) and press the Apply button 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 Persistent IP section for more information.

Note: Assigning two devices 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 Sapera 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.

Important: 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 Sapera Log Viewer: **Start • Programs • Teledyne DALSA • Sapera LT • Tools • 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 **Sapera Monitor** tool from the Sapera Tools installed with Sapera.
- 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: Sapera CamExpert tool limits the maximum frame rate possible due to CamExpert generating an interrupt for each acquired frame. The Sapera Grab Demo may be better suited for testing at higher frame rates.

- Verify network parameters are optimal as described in Teledyne DALSA's Network Imaging Package for Sapera 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

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