GigE Vision Area Scan Camera

Genie™ Monochrome Series

Camera User's Manual

Genie Framework 1.20

M640

M1024

M1400

M1600

DALSA

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About DALSA

DALSA is an international high performance semiconductor and electronics company that designs, develops, manufactures, and markets digital imaging products and solutions, in addition to providing wafer foundry services. 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.
DALSA is a public company listed on the Toronto Stock Exchange under the symbol "DSA".
Based in Waterloo, ON, Canada, the company has operations in Montreal, QC; Bromont, QC; Colorado Springs, CO; Eindhoven, NL; Munich, Germany and Tokyo, Japan.

Contents

Genie Monochrome Series Overview

Description

The Genie monochrome camera family form a series of affordable, easy to use digital cameras specifically engineered for industrial imaging applications. Genie cameras combine standard gigabit Ethernet technology with the DALSA Trigger-to-Image-Reliability framework to dependably capture and transfer images from the camera to the host PC.

All Genie cameras are supported by DALSA Sapera™ LT software libraries featuring CamExpert for simplified camera set-up and configuration. Sapera LT is field proven in thousands of robust industrial applications. Hardware independent, Sapera LT delivers the same reliable performance regardless of the image acquisition device being used. This unique feature allows OEM's to start using the Genie without re-writing applications developed for DALSA frame grabbers. In addition, Sapera LT includes powerful diagnostics and setup utilities for application development, custom camera configurations and system deployment.

Genie Application Advantages

- Compact, rugged design
- GigE Vision 1.0 compliant
- Gigabit Ethernet (GigE) interconnection to a computer via standard CAT5e or CAT6 cables
- Connection to the host computer NIC through a GigE network switch
- Available in variety of resolutions, each supporting 8-bit or 10-bit acquisitions
- Lookup table pre-processing
- Real-time shading correction (i.e. Flat Field processing)
- Horizontal Flip function
- Supports several trigger modes for image capture control
- 2 opto-isolated inputs
- 2 opto-isolated outputs
- Native Trigger-to-Image Reliability design framework
- Visual status LEDs on camera back plate
- 1μs internal timer to timestamp images and events
- Supported by Sapera™ LT software libraries

Product Part Numbers

This manual covers the five monochrome Genie models summarized below. See "Camera Performance Specifications" on page 8 for each Genie model.

Camera	Sensor Size	Resolution	Pixel size (µm)	fps (full frame)	Product Number
Genie M640-1/2	1/2 in	640 x 480	9.9 x 9.9	64	CR-GEN0-M6400
Genie M640-1/3	1/3 in	640 x 480	7.4 x 7.4	64	CR-GEN3-M6400
Genie M1024	1/3 in	1024 x 768	4.65 x 4.65	20	CR-GEN0-M1020
Genie M1400	1/2 in	1360 x 1024	4.65 x 4.65	15	CR-GEN0-M1400
Genie M1600	1/1.8 in	1600 x 1200	4.40 x 4.40	12	CR-GEN0-M1600

Software	Product Number
Genie Framework composed of the Sapera network Imaging Package, Genie Imaging Driver and latest Genie Firmware.	Included with Genie and required
Sapera Runtime including CamExpert	Included and installed if desired
GenICam™ support (XML camera description file)	Embedded within Genie
Sapera LT version 6.00 or later (sold separately): Provides everything you will need to develop imaging applications Sapera documentation in compiled HTML help, and Adobe Acrobat® (PDF) formats	OC-SL00-0000000
Sapera Processing Imaging Development Library (sold separately): Includes over 600 optimized image processing routines.	Contact Sales at DALSA

Genie Cables & Accessories (sold separately)	Product number
Genie I/O and Power breakout cable (Hirose to Euroconnector)	CA-GENC-IOP00
Tripod mount bracket (mount to Genie top or bottom—provides ¼-20 socket)	CA-GENA-BRA00
Industrial type CAT 6 cable assembly: Molded shroud with top/bottom thumbscrews on one end with standard Ethernet RJ45 clip on other. Available in various lengths. See "Ruggedized RJ45 Ethernet Cables" on page 97.	

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Camera Performance Specifications

Specifications for each available sensor are listed after the general Genie camera specifications.

Camera Controls	
Synchronization Modes	Free running and Triggered Synchronous and Reset mode Software trigger (through Ethernet)
Exposure Modes	Programmable (1μs granularity) Pulse controlled
Trigger Input	Opto-isolated, 2V to 12V typical, 2mA min. Debounce range from 1 μs up to 255 μs
Strobe Output	Output opto-isolated: Aligned to the start of exposure with a programmable delay, duration and polarity
Features	
LUT	8-bit / 10-bit
Flip	Real-time horizontal flip
Binning	Horizontal (2 pixel) and Vertical (2 line)
Timestamp	1μs internal timer to timestamp images and events
Test image	Internal pattern generator
User settings	Select factory default or one user camera configuration
Optical Interface	
Back Focal Distance—C mount	17.52 mm
Mechanical Interface	
Camera Size	29(H) x 44(W) x 67(L) in mm, (see Mechanical Specifications)
Mass	< 125g (no lens)
Power connector	12 pin male Hirose
Ethernet connector	RJ45
Electrical Interface	
Input Voltage	+11 to +13 Volts DC, (over voltage–reverse voltage protected)
Power Dissipation	< 4W
Operating Temperature	0 to 45°C
Output Data Configuration	Gigabit Ethernet (IEEE 802.3)
Data and Control	GigE Vision compliant at 1000 or 100 Mbps

Certifications

CE	EN55022, class A, Radio Disturbance Characteristics EN61000-4-2, Electrostatic discharge immunity test EN61000-4-3, Radiated, radio-frequency, electromagnetic field immunity test EN61000-4-4, Electrical fast transient/burst immunity test EN61000-4-6, Immunity to conducted disturbances, induced by radio-frequency fields
FCC	Part 15, class A
	see "EC & FCC Declaration of Conformity" on page 100
RoHS	Compliancy as per European directive 2002/95/EC (applies to camera part numbers CR-GENx-xxxxx)

Supported Industry Standards

Genie cameras are 100% compliant with the GigE Vision 1.0 specification which defines the communication interface protocol used by any GigE Vision device. For more information see: http://www.machinevisiononline.org/public/articles/index.cfm?cat=167

Genie 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.

Genie Sensor Overview

Each sensor description below provides a specification table and response graphic. 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 nanometers. Wavelengths below 390 nm are termed ultra-violet while those above 780 nm. are termed infra-red. The peak response is around 500 nanometers typical for each sensor model, corresponding to a shade of blue-green.

Genie M640-1/2 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX414AL
Resolution	640 x 480 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	64 fps
Maximum Exposure	1 / frame rate - 100μs
Pixel Size	9.9μm x 9.9μm
Pixel Format	8-bit, 10-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M640-1/2 Responsivity
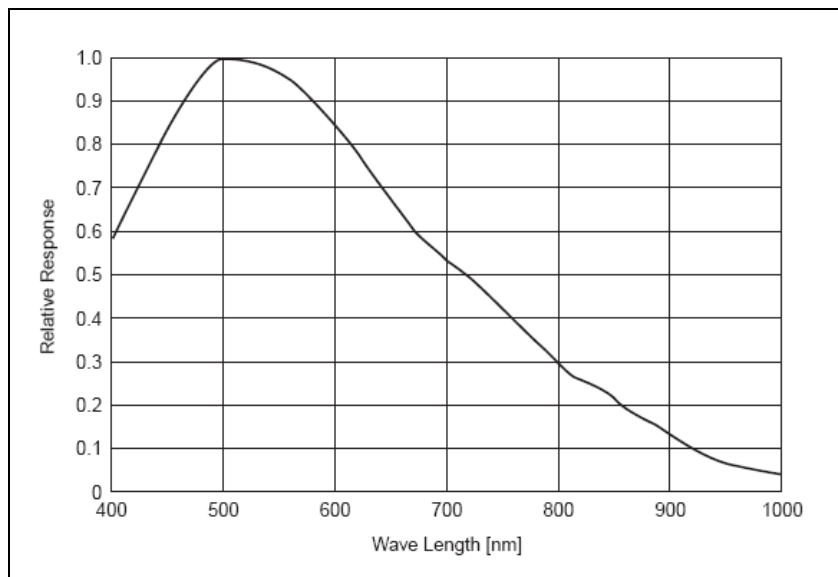
Genie M640-1/3 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX424AL
Resolution	640 x 480 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	64 fps
Maximum Exposure	1 / frame rate - 100μs
Pixel Size	7.4μm x 7.4μm
Pixel Format	8-bit, 10-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M640-1/3 Responsivity

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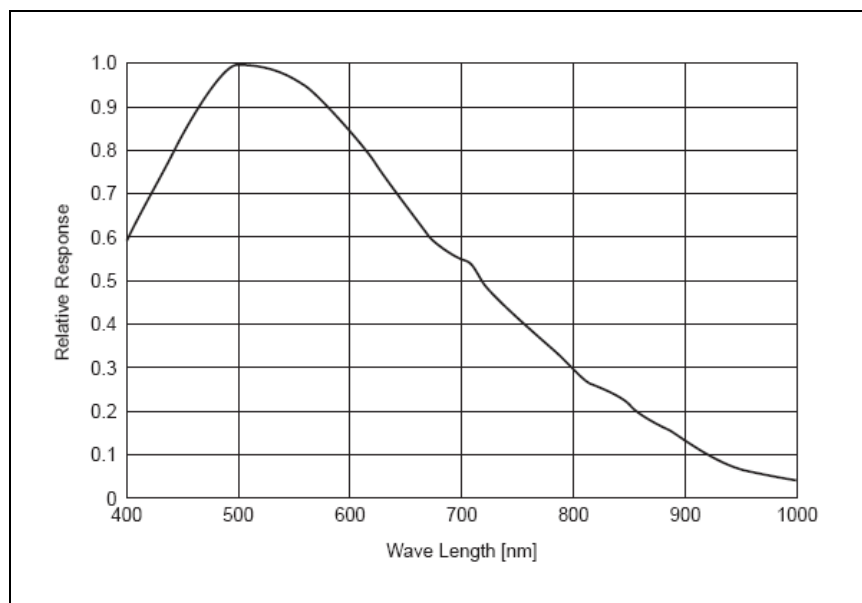
Genie M1024 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX204AL
Resolution	1024 x 768 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	20 fps
Maximum Exposure	1 / frame rate - 100μs
Pixel Size	4.65μm (H) × 4.65μm (V)
Pixel Format	8-bit, 10-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M1024 Responsivity

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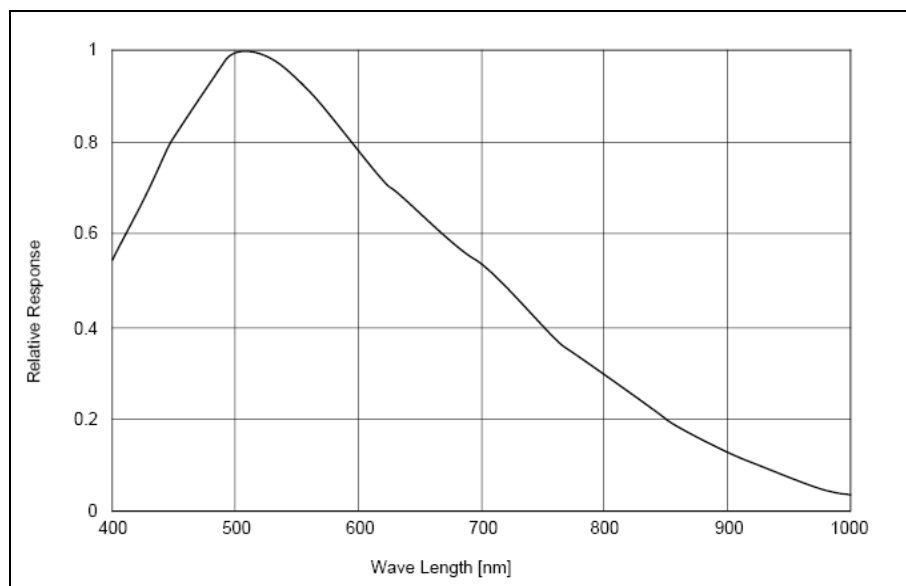
Genie M1400 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	ICX267AL
Resolution	1360 x 1024 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	15 fps
Maximum Exposure	1 / frame rate - 100μs
Pixel Size	4.65μm (H) x 4.65μm (V)
Pixel Format	8-bit, 10-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M1400 Responsivity
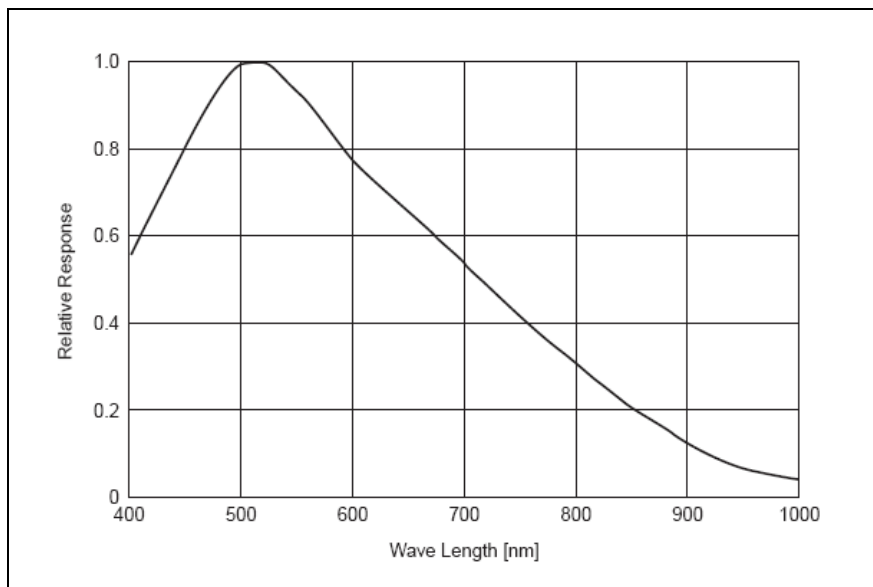
Genie M1600 Specifications

Item / Feature	Specification
Imager Format	Full frame interline CCD area scan with square pixel
Sensor	Sony ICX274AL
Resolution	1600 x 1200 pixels
Minimum Frame Rate (free-running)	0.1 fps (one frame every 10 seconds)
Maximum Frame Rate (free-running)	12 fps
Maximum Exposure	1 / frame rate - 100μs
Pixel Size	4.40μm (H) × 4.40μm (V)
Pixel Format	8-bit, 10-bit
Shutter	Full frame electronic shutter
Gain Range	-6dB to +12dB

Genie M1600 Responsivity
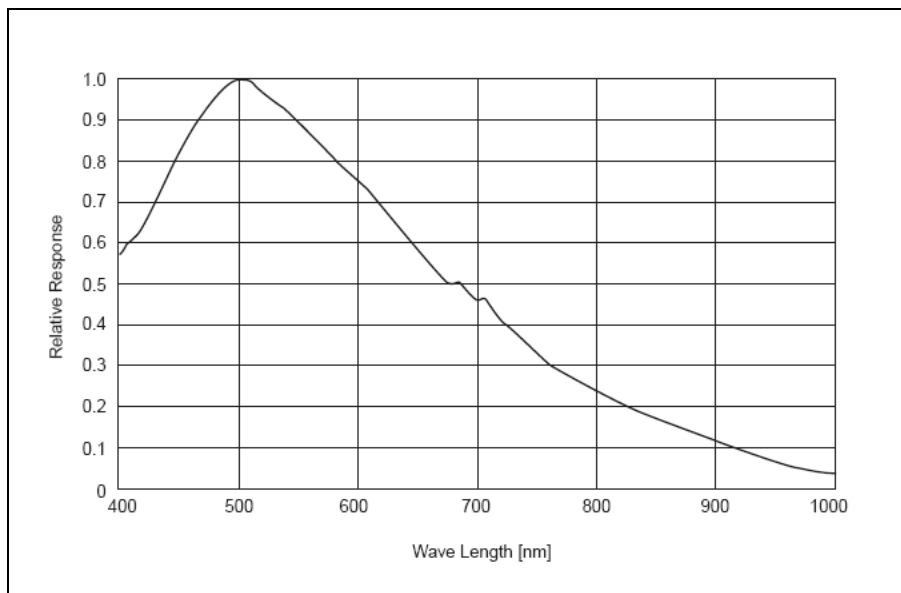
Application Development Overview

Sapera LT Library with optional Processing

Sapera LT is a powerful development library for image acquisition and control. Sapera LT provides a single API across current and future DALSA hardware. Sapera LT delivers a comprehensive feature set including program portability, versatile camera controls, flexible display functionality and management, plus easy to use application development wizards.

Sapera Processing is a comprehensive set of C++ classes for image processing and analysis. Sapera Processing offers highly optimized tools for image processing, blob analysis, search (pattern recognition), OCR and barcode decoding.

The following is a Sapera application functional block diagram.
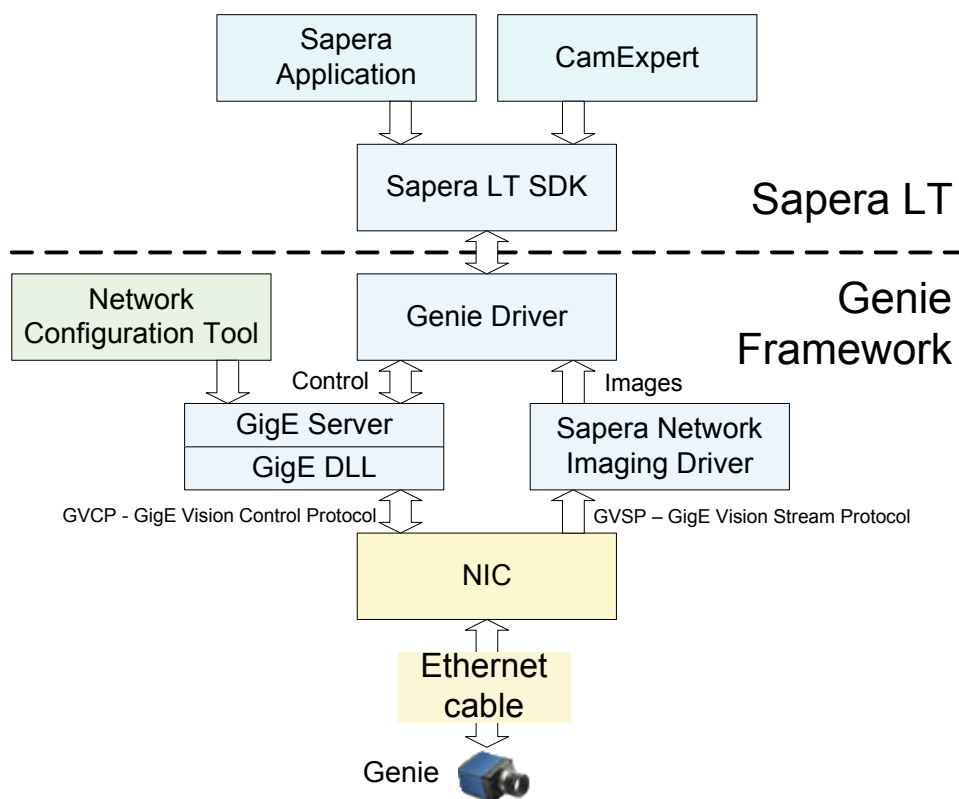
GenICam Environment

Genie cameras implement the GenICam™ specification which define the device capabilities. The GenICam XML device description file is embedded within Genie firmware allowing GenICam applications to know Genie capabilities immediately after connection. For more information about the GenApi module of the GenICam™ specification see www.genicam.org.

Installing the Genie Camera

Warning! (Grounding Instructions)

Static electricity can damage electronic components. Please discharge any static electrical charge by touching a grounded surface, such as the metal computer chassis, before performing any hardware installation.

If you do not feel comfortable performing the installation, please consult a qualified technician.

GigE Network Adapter Guideline

If the computer to be used with the Genie camera does not have a Gigabit network adapter or second built in Gigabit NIC, a PCI bus Gigabit NIC needs to be installed. Typically under Windows XP the PCI Gigabit NIC is recognized automatically when Windows boots. An example of a high performance NIC is the Intel PRO/1000 MT adapter.

Review the NIC documentation concerning any special driver required for Windows. Install the PCI bus Gigabit NIC as described by the NIC manufacture's documentation.

The Genie camera has been tested with a variety of Gigabit network adapters, both built into the system motherboard and as third party PCI adapters.

Supported Network Configurations

The Genie obtains an IP address using the Link Local Address (LLA) or DHCP, by default. If required, a persistent IP address can be assigned (see).

The LLA method automatically assigns the Genie 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.

Alternatively, if a DHCP server is present on the network, the Genie is going to issue a DHCP request asking for an IP address. The DHCP server will then provide the Genie an IP address.

Using Genie with Ethernet Switches

Examples where a Gigabit Ethernet switch would be used are:

• Multiple Genie cameras are controlled by one computer and a single NIC (running multiple instances of CamExpert as an example of the control program).
• Multiple Genie cameras are individually controlled by multiple computers, all located on the same subnet.

In these cases the Ethernet switch is a transparent device. The device discovery process finds all Genie cameras, and presents them as ready to be controlled by an application such as CamExpert.

Using Genie with a VLAN Ethernet Switch

An Ethernet switch supporting VLAN (Virtual Local Area Network) allows multiple isolated subnets to exist on the same switch.

Within each VLAN group, the Genie camera and controlling computer will behave identically as if connected to a simple Ethernet switch. But each VLAN group is isolated from each other, Therefore a Genie in one VLAN group is never seen by a computer on a different VLAN group.

VLAN Ethernet Switches support configuration as Port-based or TAG VLAN groups. Port-based groups are typically easier to configure. Review your Ethernet switch manual for information on its factory default VLAN settings and configuration method.

Installation Overview & Preparations

The Genie camera installation generally follows the sequence described below. Detailed installation instructions follow this overview.

Network and Computer Overview

- Genie needs to connect to a computer with a **GigE network adapter**, either built in on the computer motherboard or installed as a third party PCI adapter.

- **Laptop computers** with built in **GigE network adapters** may still not be able to stream full frame rates from Genie, especially when on battery power. Thorough testing is required with any laptop computer to determine the maximum frame rate possible (see "Laptop Computer Networking Issues" on page 111).

- Genie also can connect through a **Gigabit Ethernet switch**. When using VLAN groups, the Genie and controlling computer must be in the same group (see "Using Genie with a VLAN Ethernet Switch" on page 18).

- If Genie is to be used in a **Sapera development environment**, Sapera LT needs to be installed, either before or after the Genie software package. If Genie will be used in a GenICam™ environment, Sapera or Sapera runtime is not required and you need to follow the installation instructions of the third party GenICam compliant package.

- Install the **Genie Framework software package** if not using a third party GenICam compliant package. Also install **Sapera Run-time with CamExpert** to control the Genie.

- The **Windows Firewall** exceptions feature is automatically configured to allow the Sapera GigE Server to pass through the firewall.

- Computers with **VPN software** (virtual private network) may need to have the VPN driver disabled in the NIC properties. This would be required only on the NIC used with the Genie. Testing by the user is required.

Installation Overview

- Inspect all cables and connectors prior to their use. Do not use faulty cables or connectors to avoid camera damage.

- Before connecting power to the camera, test all power supplies. Power supplies must meet the requirements defined in section "Genie Signal Electrical Details" on page 91. Apply power to the camera.

- Connect Genie to the computer GigE network adapter or to the Ethernet switch via a CAT5e or CAT6 Ethernet cable. Note: cable should not be less than 1 meter (3 feet) long or more than 100 meters (328 feet) long.

- Check the diagnostic LED which will be initially red then switch to flashing blue while waiting for IP configuration. See "Status LED Codes" on page 22 for Genie LED display descriptions.

- Look at the small camera icon added to the Windows tray (next to the clock). Ensure the Genie camera has been found (right click the icon and select Status).

- A new Genie installation typically requires a firmware update. See the procedure "Updating Genie Firmware" on page 27.

- Use CamExpert (installed either with Sapera or Sapera runtime) to test the installation of the Genie camera. Set the Genie to internal test pattern. See "Sapera CamExpert Guide" on page 85.

- Set up the other components of the imaging system such as light sources, camera mounts, optics, encoders, trigger sources, etc. Test with CamExpert.

Sapera LT Library Installation

Note: to install Sapera LT and the Genie device driver, logon to the workstation as an administrator or with an account that has administrator privileges.

When Sapera application development is performed on the same computer that the Genie is connected to, the Sapera Development Library (version 6.0 or later) must be installed. Else, Sapera LT is not required to control the Genie camera.

- Insert the DALSA Sapera CD-ROM. If **AUTORUN** is enabled on your computer, the DALSA installation menu is presented.

- If **AUTORUN** is not enabled, use Windows Explorer and browse to the root directory of the CD-ROM. Execute **launch.exe** to start the DALSA installation menu and install the required Sapera components.

- The installation program will prompt you to reboot the computer.

- Continue with the Genie CD Package Installation described next.

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

Genie CD Package Installation

The Genie Framework software package and Sapera runtime provides all components required to control the Genie with the supplied CamExpert tool. Genie Framework software components include the Network Imaging driver, the Sapera GigE server, and CamExpert (if Sapera LT library is not installed).

Note: If Sapera application development is required, install Sapera (6.0 or later) as described in the previous section.

Procedure

- Insert the DALSA Genie CD-ROM. If **AUTORUN** is enabled on your computer, the Genie installation menu is presented.
- If **AUTORUN** is not enabled, use Windows Explorer and browse to the root directory of the CD-ROM. Execute **launch.exe** to start the installation menu and install the Genie software components.
- Click to install the Genie Framework Software which includes the Network Imaging driver, and the Sapera GigE server.
- The procedure will prompt for acceptance of the installation folder for the Genie files.
- If desired, click to install **Sapera LT run-time** which includes CamExpert. Follow the on screen prompts and reboot when the installation is complete.

GigE Server Verification

After a successful Genie software package installation, the GigE Server icon is visible in the desktop taskbar tray area. The Genie camera must be on the same subnet as the NIC to be recognized by the GigE Server.

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

If you place your mouse cursor on this icon, the GigE Server will display the number of GigE Vision devices found by your PC. Right click the icon and select status to view information about those devices. See "Running the Network Configuration Tool" on page 26 and "Troubleshooting" on page 101 for more information.

Connect the Genie Camera

Connect a power supply to the Genie camera and an Ethernet cable from the Genie to the host computer. Once communication with the host computer is started the automatic IP configuration sequence will assign an LLA IP address as described in section "Genie IP Configuration Sequence" on page 23, or a DHCP IP address if a DHCP server is present on your network. The factory defaults for Genie is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification. For additional information see "IP Configuration Mode Details" on page 77. See the next section "Connectors" on page 21 for an overview of the Genie interfaces.

Connectors

The Genie has only two connectors:

- A single **RJ45 Ethernet** connector for control and video data transmitted to/from the host computer Gigabit NIC. See "Ruggedized RJ45 Ethernet Cables" on page 97 for secure cables.

- A single **12-pin Hirose** male connector for camera power plus trigger, strobe and general I/O signals. The suggested female cable mating connector is Hirose model HR10A-10P-12S.

The Genie has one multicolor LED to provide a simple visible indication of camera state (see figure below and section "Status LED Codes" on page 22). Additionally the RJ45 has two LEDs for network status conditions.

The following figure of the Genie back end shows connector and LED locations. See "Mechanical Specifications" on page 89 for details on the Genie connectors and camera mounting dimensions.

LED Status		
Solid	IP Address Assigned	
Slow	Waiting for an IP Address	
Fast	Ethernet Cable Disconnected	
Solid	Application Linked to the Camera	
Slow	Trigger Acquisition in Progress	
Fast	Acquisition in Progress	
Slow	Camera Initialization Problem	
Fast	Camera Overheating	

Genie – Rear View

Status LED Codes

The camera is equipped with a 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). The following table summarizes the LED states and corresponding camera status.

LED State	Definition
LED is off	No power to the camera
Steady Red	Camera not initialized
Slow Flashing Red	Camera initialization problem
Fast Flashing Red	Camera is too hot
Slow Flashing Blue	Waiting for an IP address
Fast Flashing Blue	Ethernet cable disconnected (no link)
Steady Blue	IP address assigned; no application connected to the camera
Steady Green	Application connected
Slow Flashing Green	Triggered acquisition in progress
Fast Flashing Green	Free-running acquisition in progress

Once the Genie has its RJ45 connected to a network, the Status LED will turn to steady blue when the IP address is assigned. Only at this time will it be possible by the GigE Server or any application to communicate with the camera.

Note: Even if the Genie has obtained an IP address, it might be on a different subnet than the NIC it is attached to. Therefore, if the Genie LED is blue but an application such as CamExpert can not see it, this indicates a network configuration problem.

Typical LED States on Power Up

The following LED sequence occurs when the Genie is powered up connected to a network with installed Genie Framework software.

Red power connected → **Flashing Blue** waiting for IP → **Blue** IP assigned → **Green** application connected
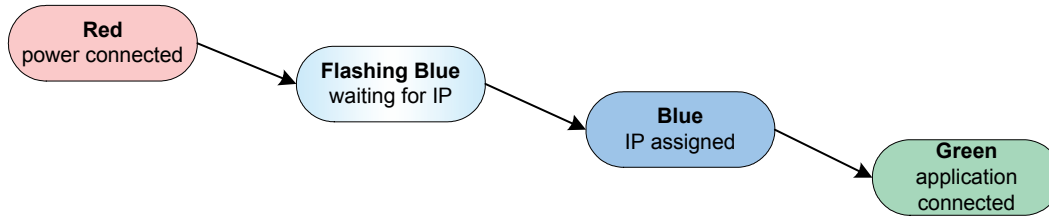
Genie IP Configuration Sequence

The Genie IP (Internet Protocol) Configuration sequence to assign an IP address is executed automatically on camera power-up or when connected to a network. As a GigE Vision compliant device, Genie 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)
- Link-Local Address (always enabled)

The factory defaults for Genie is Persistent IP disabled and DHCP enabled with LLA always enabled as per the GigE Vision specification. For additional information see "IP Configuration Mode Details" on page 77.

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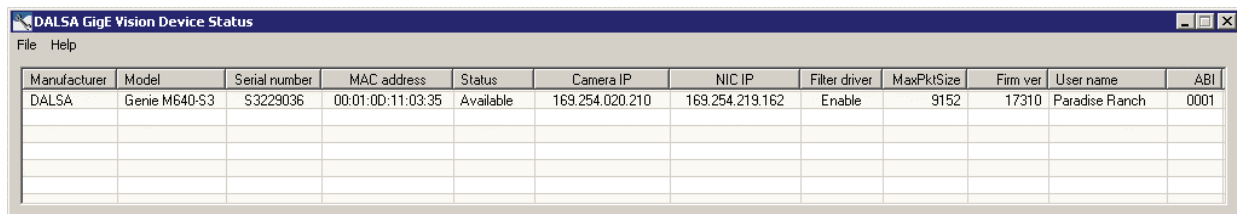
Once the Genie is assigned an IP address (its Status LED is steady blue) the GigE server tray icon will not have a red X through it, indicating that the Genie device was found. It might take a few seconds for the GigE Server to refresh its state after the Genie has obtained an IP address.

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

About Sapera GigE Server
DALSA GigE Vision Device Status
Scan Network
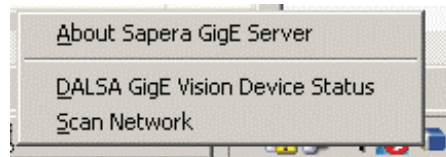
Click on **Status** to open a window listing all devices connected to the host system. Each GigE device is listed by name along with important information such as the assigned IP address and device MAC address. The screen shot below shows a connected Genie with no networking problems.

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229036	00:01:0D:11:03:35	Available	169.254.020.210	169.254.219.162	Enable	9152	17310	Paradise Ranch	0001

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

Optimizing the Network Adapter used with Genie

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 Genie during the installation.

Increasing Adapter Buffers and Jumbo Frames
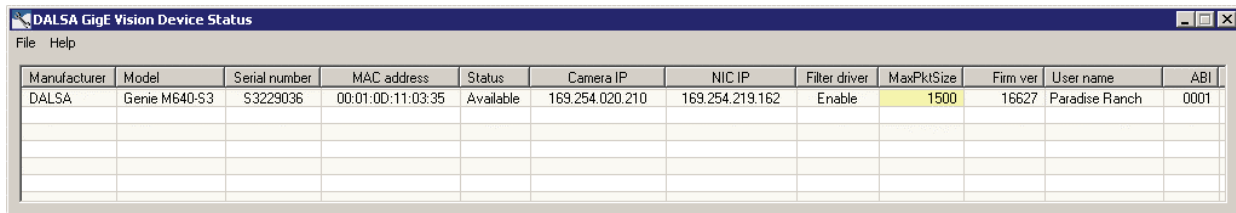
Adapter Buffers (receive descriptors): Under certain conditions the host PC system CPU may be very busy with tasks other than the imaging application. Incoming image packets remain in the PC memory allocated to store packets instead of immediately being copied into the image buffer. By increasing the NIC host buffers, more incoming image packets can be stored by the NIC before it must start discarding them. This provides more time for the PC to switch tasks and move image packets to the image buffer.

Not all network boards allow increasing their buffer count and even among those that do, such as the Intel NIC, different versions will have different maximum receive descriptor values. Refer to the NIC user documentation for details on configuring this parameter. The procedure in this section shows how to increase the number of packet buffers for one version of Intel network adapter.

Jumbo Frames: With good gigabit Ethernet connections with minimal packet resend conditions, host computer performance can be further improved by increasing the data packet size. Each streaming video packet causes an interrupt in the host computer. Therefore increasing the packet size reduces the CPU usage percentage required to handle video data from Genie.

Before the Genie is configured to use larger data packets, the NIC used with the Genie must be configured to allow Jumbo Frames. The procedure in this section describes increasing the size of Jumbo Frames for one version of Intel network adapter.

The screenshot below shows that the Genie device was found and there is no IP conflict. The Maximum Packet Size field is highlighted in yellow, indicating that Jumbo Frames are not enabled on the NIC used with the Genie or that the control application is forcing a safe packet size. Using a larger packet size improves host CPU performance, which can be critical when using multiple Genie devices. Note that the Maximum Packet Size field is updated only when an application such as CamExpert communicates with the Genie.

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229036	00:01:0D:11:03:35	Available	169.254.020.210	169.254.219.162	Enable	1500	16627	Paradise Ranch	0001

Jumbo Frames

- Select the 'Jumbo Frames' property.
- Change the value to the largest supported by the installed NIC. The Genie can then be configured to use its maximum Jumbo Frames size (currently 9000). In this example the NIC value is set to 9014.
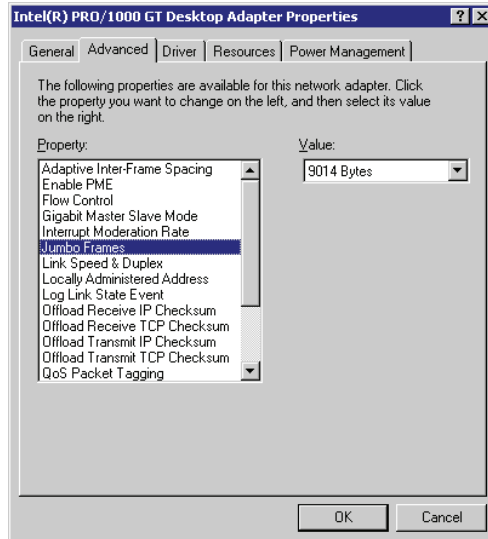
GigE NIC Jumbo Frames

Running the Network Configuration Tool

Once the GigE Server discovers a device, start the Network Configuration tool to verify and modify the network configuration of the imaging system. See "Network Configuration Tool"
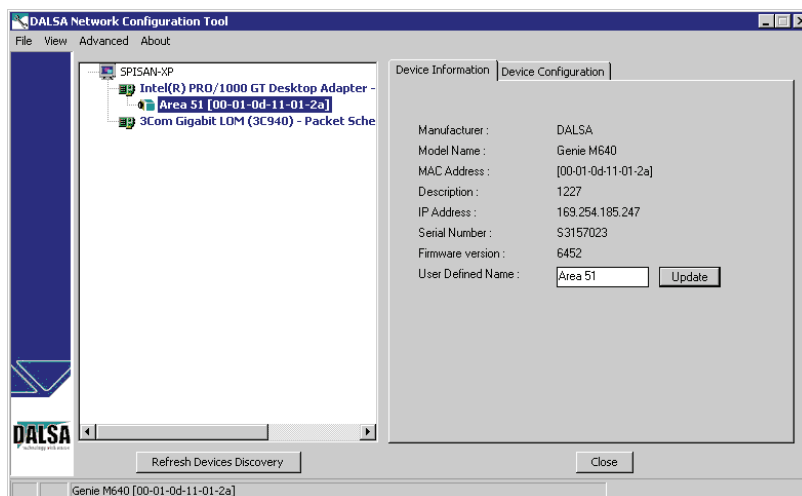
First verify the Genie camera appears as a child of the NIC card it is connected to. By default the Genie camera is identified by its serial number if no user-defined name has been assigned.

Because image transfers require considerable bandwidth through the NIC, it is recommended that a separate Gigabit Ethernet NIC for the Genie camera be used. Connections to the Internet or to a corporate network should be through a different NIC.

The Network Configuration Tools allows you to:
- Configure the Windows firewall exception list
- Activate the Network Imaging driver use for image acquisition on any NIC
- Configure the NIC and camera IP settings

Updating Genie Firmware

The Genie firmware may need to be updated to correspond with the currently used Genie software framework. After installing the new Genie software package and Genie camera, update the firmware by following this procedure.

- Start the DALSA Device Manager program from the windows start menu:
  Start•Programs•DALSA•Genie•Firmware Update.


```
DALSA Device Manager

      DALSA Device Manager
      Version: 2.65

Select " Automatic " to update with the Default Configuration
Select " Manual " to update with a Specific Configuration

Board              Serial Number   Configuration          Update
Area 51 :Genie_M640_1  S3157023    Standard               Required


          [ Automatic ]   [ Manual ]   [ Cancel ]
```
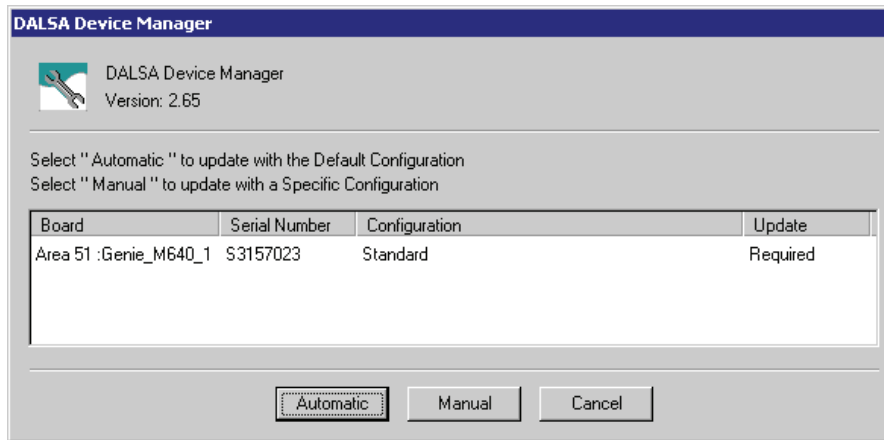
- The right hand column shows whether a firmware update is **Required** or **Not Required**.
- If an update is required, click on the Automatic button. The Update Firmware manager dialog opens and the new firmware version is written to the Genie camera.
- The manual button allows the user to select from multiple Genie firmware configuration files – if such files become available for future operational modes.
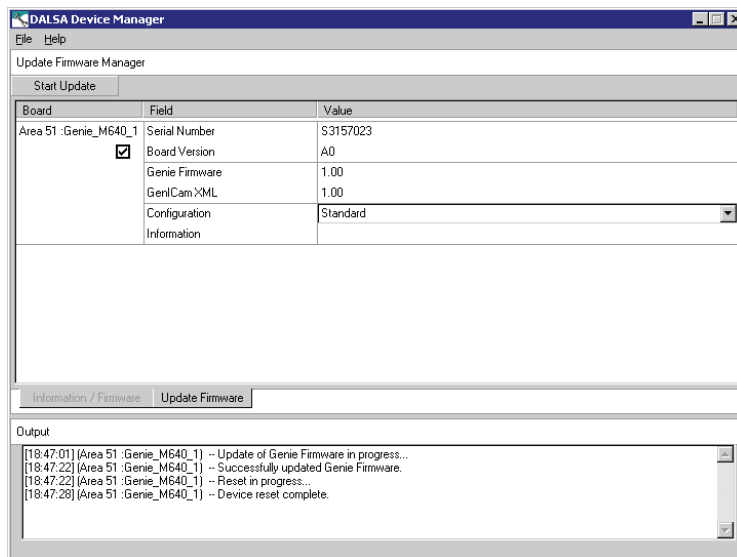
- The firmware update is complete when the lower message output area says "Device reset complete". Close the Device Manager program.
- Genie cameras manufactured in 2007 or later will display the following status LED sequence while initializing with the new firmware.
  - Status LED will flash red then go off.
  - Both LAN LEDs will flash repeatedly for a short time.
  - Status LED will flash red then go off again.
  - Both LAN LEDs will flash repeatedly for a short time again.
  - Status LED will turn blue as normally happens during power up.
- Wait for the GigE Server to find the Genie again, then run CamExpert to test the Genie operation (as described below).

Important: If the Genie power is accidentally cut off during the firmware update (such as a electrical source power failure or human error), the Genie is easily recovered. See "Power Failure During a Firmware Update–Now What?" on page 107.

Quick Test with CamExpert

When the Genie camera is directly connected to a Gigabit network adapter on a host computer or via a network switch, testing the installation with CamExpert is a straightforward procedure.

- Start Sapera CamExpert by double clicking the desktop icon created during the Genie software installation.
- CamExpert will search for installed Sapera devices. In the Device list area on the left side, the connected Genie camera is shown or will be listed in a few seconds after CamExpert completes the automatic device search (device discovery).
- Select the Genie camera device by clicking on the camera user-defined name. By default the Genie camera is identified by its serial number. The LED of the Genie will turn green, indicating the CamExpert application is now connected.
- Click on the Grab button for live acquisition (the Genie default is Free Running mode). Focus and adjust the lens iris. See "Operational Reference" on page 31 for information on CamExpert parameters with the Genie camera.
- The following figure shows CamExpert with the Genie generating a diagonal test pattern.
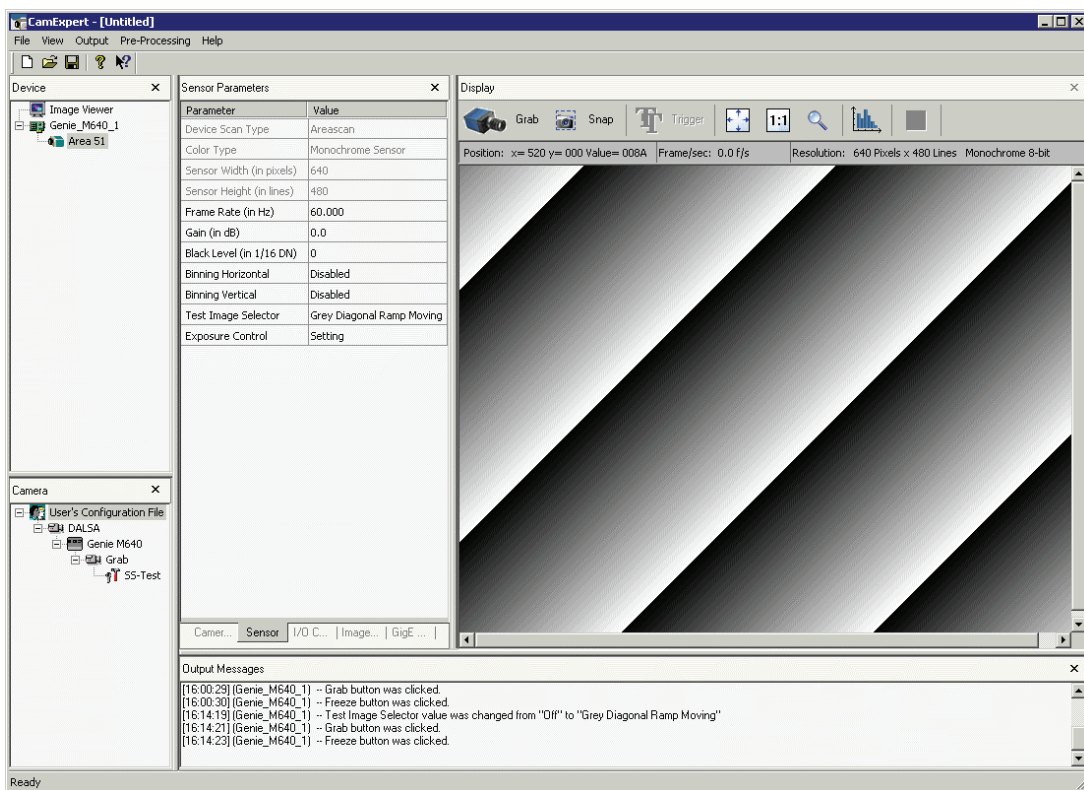
About the User-Defined Camera Name

The Genie can be programmed with a user-defined name to aid identifying multiple cameras connected to the network. For instance, on an inspection system with 4 cameras, the first camera might be labeled "top view", the second "left view", the third "right view" and the last one "bottom view". The factory default user name is set to match the camera serial number for quick initial identification. Note that the factory programmed Genie serial number and MAC address are not user changeable.

When using CamExpert, multiple Genie cameras on the network are seen as different "Genie_M640_x" devices. Click on a Genie device user name to select it for control by CamExpert.

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

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

Operational Reference

Camera and Sensor Information

Camera and sensor information can be retrieved via a controlling application. Parameters such as camera model, firmware version, sensor characteristics, etc. are read to uniquely identify the connected Genie device.

All these features, with the exception of the DeviceUserId, are read-only. Sapera LT or GenICam calls are used to retrieve this information and correctly identify the camera along with its characteristics.

Following is an overview of CamExpert displaying this information followed by tables with the feature name associated to Sapera LT and to GenICam development environments.

Access Via CamExpert

The Camera Information Parameters tab groups parameters that contain information specific to the individual Genie camera.

Camera Information Parameters	×
Parameter	**Value**
Device Vendor Name	DALSA
Device Model Name	Genie M640-S3
Device Version	1274
Firmware Version	10249
Device ID	S3229036
MAC Address	00:01:0D:11:03:35
Device User ID	Paradise Ranch
Power-up configuration	Setting…

Camera Information | Sensor | I/O Controls | Image Buffer and ROI | GigE Vision |

Read Only Parameters

Parameter	Description
Device Vendor	For the Genie Monochrome series, this is always DALSA.
Device Model Name	Displays the device model name (for example, Genie M640).
Device Version	Displays the device version.
Firmware Version	Displays the currently loaded firmware version.
Device ID	Displays the camera serial number.
MAC Address	Displays the unique MAC (Media Access Control) address of the Genie camera.

User Set Parameters

Parameter	Description
Device User ID	Specifies a user written ID, of up to 15 characters, for the Genie camera. By default, this field is set to the serial number of the camera.
Power-up Configuration	Click **Setting** to open the **Power-up configuration** dialog box which allows you to specify camera power-up configuration. For more information, see "Power-up Configuration" on page 32.

Power-up Configuration

The **Power-up configuration** dialog allows you to specify the camera configuration to load when powering-up the camera. The Genie camera flash memory contains two possible configuration settings; the Factory Default, and a user-defined Camera Configuration 1. The **Camera Power-up configuration** drop-down list box allows you to select either the Factory Default or a user specified camera configuration file. To save the current CamExpert settings to the camera user-defined (Camera Configuration) setting, click **Save**. To view in CamExpert a camera configuration file currently saved in the camera, select the configuration file in the **Load configuration from Camera** drop-down list, and click **Load**. See "Genie Power-up Configuration" on page 67 for a list of the saved parameters.

Camera Information via Sapera LT or GenICam Applications

	Genie Sapera parameters for Camera and Sensor Information:
	Interface = {GigE Vision} **DeviceVendorName** = "DALSA" **DeviceModelName** = "Genie M640" for Genie M640 **DeviceVersion** = String representing the version of the camera **FirmwareVersion** = String representing the version of the camera firmware **DeviceID** = String representing the camera serial number **MACAddress** = String representing the camera MAC address **DeviceUserID** = String representing the user-define name for the camera **DeviceMaxThroughput** = Maximum throughput of image streaming in bytes/sec. **DeviceScanType** = {Areascan} **ColorType** = {Monochrome Sensor} **SensorWidth** = Width of the sensor in pixels **SensorHeight** = Height of the sensor in lines **PixelSize** = Number of bits per pixel In CamExpert, these parameters are visible under "Camera Information" and "Sensor" tabs. See "Accessing Features with Sapera++ LT" on page 68.
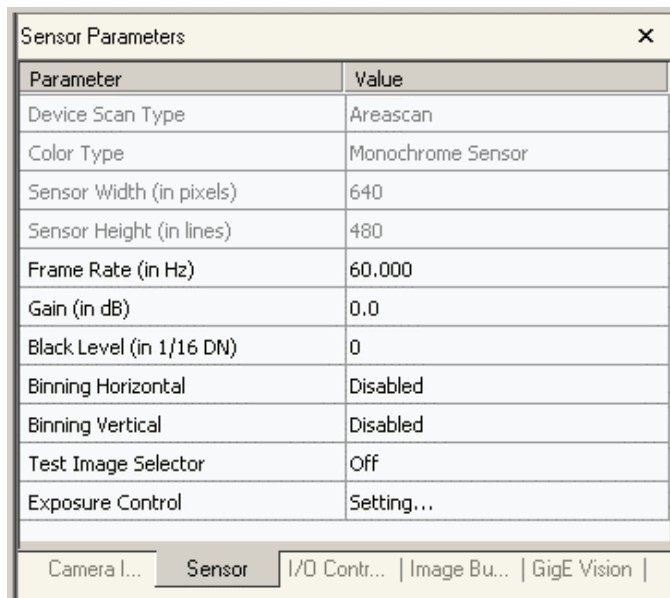
	GenICam features for Camera and Sensor Information:
	DeviceVendorName = Name of camera vendor **DeviceModelName** = Name of the camera model **DeviceVersion** = Version of the device **DeviceFirmwareVersion** = Version of camera firmware **DeviceID** = Serial number of the camera **DeviceUserID** = User-defined name the camera **DeviceScanType** = {Areascan} **DeviceMaxThroughput** = Maximum number of bytes per second device supports **DeviceRegistersStreamingStart** = Announces the start of registers streaming without immediate checking for consistency **DeviceRegistersStreamingEnd** = Announces the end of registers streaming and perform validation for registers consistency before activating them **DeviceRegistersCheck** = Performs an explicit register set validation for consistency **DeviceRegistersValid** = Informs whether the current register set is valid and consistent **SensorWidth** = Width of sensor (effective pixels) **SensorHeight** = Height of sensor (effective pixels) **WidthMax** = Maximum image width. Depends on binning and decimation **HeightMax** = Maximum image height. Depends on binning and decimation

Sensor Controls

Genie provides a number of sensor controls to optimize image acquisitions for most imaging solutions. Following is an overview of the CamExpert controls displaying this information, followed by individual control function descriptions and tables indicating the feature name associated to Sapera LT and to GenICam development environments.

Sensor Parameters: Controls Via CamExpert

The Sensor Parameters tab groups the parameters related to the camera sensor configuration for acquisition.

Sensor Parameters	✕
Parameter	**Value**
Device Scan Type	Areascan
Color Type	Monochrome Sensor
Sensor Width (in pixels)	640
Sensor Height (in lines)	480
Frame Rate (in Hz)	60.000
Gain (in dB)	0.0
Black Level (in 1/16 DN)	0
Binning Horizontal	Disabled
Binning Vertical	Disabled
Test Image Selector	Off
Exposure Control	Setting…

Camera I... | **Sensor** | I/O Contr... | Image Bu... | GigE Vision |

Read Only Parameters

Parameter	Description
Device Scan Type	Displays the device scan type. Possible values are area scan or linescan. This is always area scan for Genie.
Color Type	Displays the color type of the sensor. Possible values are Color Sensor or Monochrome Sensor.
Sensor Width (in pixels)	Displays the sensor width (in pixels).
Sensor Height (in pixels)	Displays the sensor height (in pixels).

User Set Parameters

Parameter	Description
Frame Rate (in Hz)	Specifies the internal trigger frame rate for free run mode, in Hz. Possible values range from 0.1 to 64.0 Hz for Genie M640 in full scan mode. (Note: the Sapera SDK specifies the frame rate in milliHertz). The maximum frame rate increases by using binning (see below) or partial scan (see "Partial Scan—Window ROI" on page 37).
Gain (in dB)	Specifies the sensor analog Gain factor, in dB. Possible values range from –6.0 to 12.0 dB, in 0.1 dB increments. For more information, see "Gain and Black Level Controls" on page 36.
Black level (in 1/16 DN)	Specifies the sensor black level, in 1/16 DN (digital number, which is the value assigned to a pixel in a digital image). Possible values range from -128 to 127.
Binning Horizontal	Enables or disables horizontal binning. Possible values are Disabled or 2 pixels. When set to 2 pixels, the image buffer width parameter is automatically adjusted. For more information, see "Binning" on page 41.
Binning Vertical	Enables or disables the vertical binning. Possible values are Disabled or 2 lines. When set to 2 lines, the image buffer height parameter is automatically adjusted. The maximum frame rate also increases.
Test Image Selector	Specifies the test image. Possible values are: Off Grey Horizontal Ramp Grey Vertical Ramp Grey Diagonal Ramp Moving Purity For more information, see "Internal Image Test Patterns" on page 62.
Exposure Control	Click **Setting** to open the Exposure Control dialog. For more information, see "Exposure Controls" on page 43.

Gain and Black Level Controls

The Genie series of monochrome cameras provide gain and black level adjustments for the analog signal from each CCD pixel, before the analog to digital conversion. The software gain and black level controls can make small compensations to the acquisition in situations where lighting varies and the lens iris can not be easily adjusted. The user can evaluate Gain and Black Level by using CamExpert.

Features and limitations are described below.

- Gain is expressed in decibels (dB). Range from -6dB to +12dB in 0.1dB increments. Gain is a multiplication factor to the analog signal (i.e. exposure) before digitization.
  Note that a gain of 6dB is a multiplier of 2 (doubles the level).
- Increasing gain increases the amplitude of the analog video signal but also increases the sensor analog noise proportionately, before analog to digital conversion.
- Note: Doubling gain does not necessarily double the digital data due to the Black Level Offset value as described below.
- Black level offset is applied to the sensor analog signal to shift the DC level of the video signal. Black level is an additive offset to the analog video signal before digitization.
- Black level offset increases the brightness of the video signal equally. Therefore any area of the video that is black will brighten to some gray level as offset is increased.
- Black level offset is expressed as a number ranging from -128 to 127. The offset is achieved as a change in the analog signal from the sensor where a control number change of 1 is $1/16^{th}$ of a DN (digital number) pixel change. In other words, a control change of 16 is required for each change in pixel value, therefore a maximum control value of 127 will cause a black pixel (00) to have a gray value of about 8.
- The resultant output Gain/Offset formula is

$$OutputData = (Exposure * Gain) + Offset$$
$$where: \ Gain = 20\log(multiplier)$$

Gain and Offset Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Gain and Black level: **Gain** = Amplification in dB from -6.0 to 12.0 dB **BlackLevel** = DC offset in $1/16^{th}$ of DN, range from -128 to 127 In CamExpert, these parameters are available under the "Sensor" tab. See "Accessing Features with Sapera++ LT" on page 68.

GEN<i>CAM	GenICam features for Gain and Black level: **GainRaw** = Analog gain in tenth of dB (0.1 dB) **BlackLevelRaw** = Black level (offset) in 1/16 of DN

Partial Scan—Window ROI

Partial Scan (vertical cropping)

The Partial Scan mode, also know as vertical cropping, reduces the number of video lines grabbed for a frame. By not scanning the full vertical area of the sensor, the maximum possible acquisition frame rate is proportionately increased (as an extreme example, the M640 scanning a one line frame, exposed around 589fps).
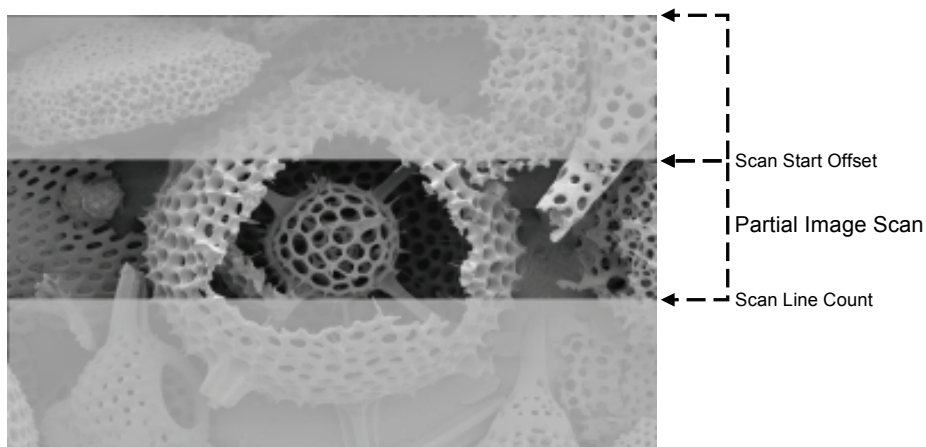
Partial Scan Illustration

Maximum Frame Rate Examples

Vertical Lines Acquired	M640 Maximum Frame Rate	M1024 Maximum Frame Rate	M1400 Maximum Frame Rate
1024	--	--	15 fps
768	--	20 fps	20 fps
512	--	28 fps	27 fps
480	64 fps	30 fps	28 fps
240	115 fps	50 fps	42 fps
120	194 fps	74 fps	55 fps
60	293 fps	99 fps	66 fps
30	394 fps	118 fps	73 fps
1	589 fps	146 fps	81 fps

Partial Scan (horizontal cropping)

Genie also can crop the acquisition horizontally by grabbing less pixels on each horizontal line. Additionally a horizontal offset value will start the grab from any pixel count, as shown in the following figure. Note that horizontal cropping does not increase the maximum frame rate due to the CCD readout architecture.

Horizontal Crop

Horizontal Scan offset   Active Horizontal Scan
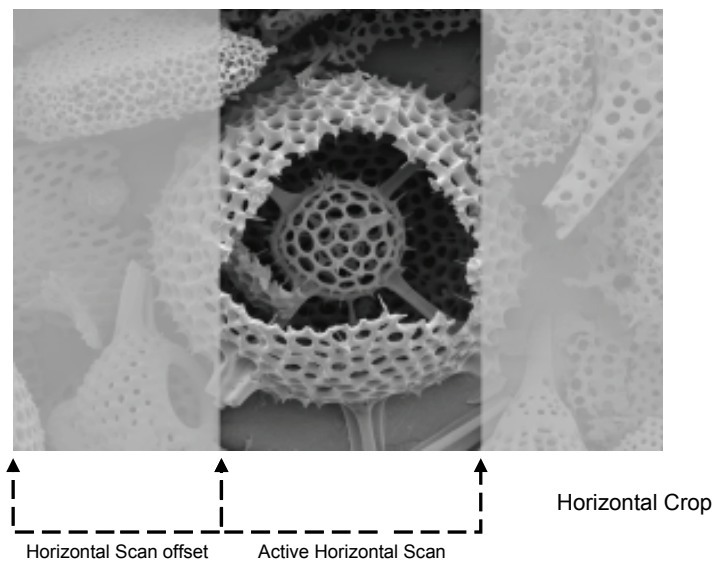
Window ROI

Vertical and Horizontal Cropping can be combined to grab only a region of interest (ROI). Besides eliminating post acquisition image cropping done by software in the host computer, a windowed ROI grab reduces the bandwidth required on the Gigabit Ethernet link since less pixels are transmitted. See "CamExpert Image Buffer and ROI Parameters" on page 40 to use CamExpert to configure image cropping.

Window ROI Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Partial Scan and Window ROI: **Width** = Buffer width in pixels **Height** = Buffer height in lines **OffsetX** = Horizontal Offset in pixels of the leftmost pixel relative to the sensor **OffsetY** = Vertical offset in lines of the uppermost pixel relative to the sensor **PixelFormat** = {Monochrome 8-bit, Monochrome 10-bit} See "Accessing Features with Sapera++ LT" on page 68.

GEN\<i\>CAM	GenICam features for Partial Scan and Window ROI: **Width** = Width of image/area of interest **Height** = Height of image/area of interest **OffsetX** = Left coordinate of area of interest **OffsetY** = Top coordinate of area of interest **LinePitch** = Distance between consecutive lines in bytes **PixelColorFilter** = Color filter convention of the image **PixelFormat** = Format of the image pixels as per GigE Vision specification **PixelDynamicRangeMin** = Minimum pixel value sent by camera **PixelDynamicRangeMax** = Maximum pixel value sent by camera

CamExpert Image Buffer and ROI Parameters

CamExpert provides controls to configure acquisitions via the Image Buffer and ROI Parameters tab. The image buffer can be easily cropped as desired. Below is the CamExpert dialog and parameter descriptions follow.

Image Buffer and ROI Parameters	✕
Parameter	**Value**
Pixel Format	Monochrome 8-bit
Width (in Pixels)	640
Height (in Lines)	480
OffsetX (in Pixels)	0
OffsetY (in Lines)	0
Image Flip	Horizontal

Camera Information | Sensor | I/O Controls | Image Buffer and ROI | GigE Vision |
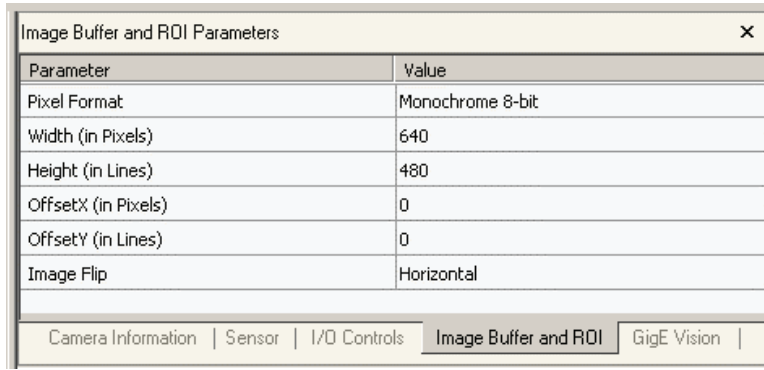
Parameter	Description
Pixel Format	For the Genie Monochrome series, the image buffer format is Monochrome 8-bit or 10-bit.
Width (in Pixels)	Displays the image buffer width (X axis), in pixels.
Height (in Pixels)	Displays the image buffer height (Y axis), in pixels.
OffsetX (in Pixels)	Specifies the offset in X, from the left of the image, when using an ROI. The image buffer width is automatically adjusted to compensate for this offset.
OffsetY (in Lines)	Specifies the offset in Y, from the top of the image, when using an ROI. The image buffer height is automatically adjusted to compensate for this offset.
Image Flip	Enables hardware based horizontal image flip.

Note: When operating in binning mode, the resolution is halved and the coordinate system is scaled accordingly. For instance, an OffsetX of 20 pixels at nominal resolution is equivalent to an OffsetX of 10 pixels with horizontal binning enabled.

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 binning by using CamExpert.

Genie supports horizontal and vertical binning independently, by a factor of 2 in each axis. Specifically if horizontal binning only is activated, a nominal 640x480 image is reduced to 320x480. If vertical binning only is activated, the image is reduced to 640x240. With both binning modes activated, the resulting image is 320x240.

Vertical binning also provides an increase in maximum acquisition frame rate. The frame rate increase depends on the camera model and amount of vertical cropping used. The following graphic illustrates binning.
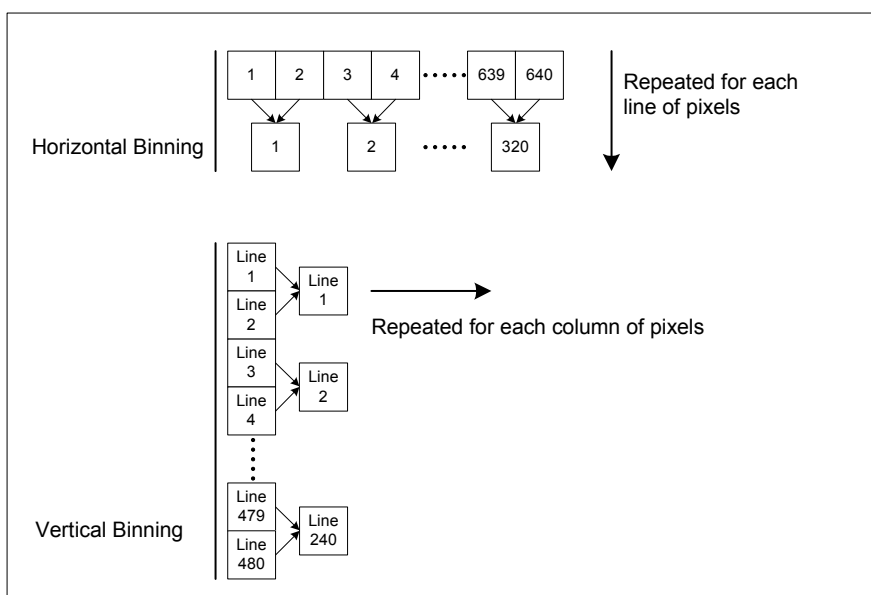
Horizontal and Vertical Binning Illustration

Binning Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Binning: **BinningHorizontal** = {Disabled = 1, 2 pixels = 2} **BinningVertical** = {Disabled = 1, 2 lines = 2} In CamExpert, these parameters are available under the "Sensor" tab. See "Accessing Features with Sapera++ LT" on page 68.

GEN⟨i⟩CAM	GenICam features for Binning: **BinningHorizontal** = Number of horizontally binned cells (1 = no binning) **BinningVertical** = Number of vertically binned cells (1 = no binning)

Trigger Modes

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

- **Free running (trigger disabled)**: The Genie free-running mode has a programmable internal timer for frame rate and a programmable exposure period. Frame rate is 0.1 fps to the maximum supported by the sensor. Exposures range from 100 μs to a maximum also dependent on the current frame rate. This always uses Synchronous mode where exposure is aligned to the sensor horizontal line timing.

- **External trigger**: Exposures are controlled by an external trigger signal. External signals are isolated by an opto-coupler input with a time programmable debounce circuit. See "General Inputs" on page 49. The following section provides information on external trigger timing.

- **Software trigger**: An exposure trigger is sent as a control command via the Ethernet network connection. Software triggers can not be considered time accurate due to network latency and sequential command jitter. But a software trigger is more responsive than calling a single-frame acquisition (Snap command) since the latter must validate the acquisition parameters and modify on-board buffer allocation if the buffer size has changed since the last acquisition.

Exposure Controls

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

- Exposure control is defined as the start of exposure and exposure duration.
- The start of exposure can be an internal timer signal (free-running mode), an external trigger signal, or a software function call trigger.
- The exposure duration can be programmable (such as the case of an internal timer) or controlled by the external trigger pulse width.
- For the Genie camera, exposure control modes are "Free-running Programmable Exposure" on page 43 (timer), "External Trigger Programmable Exposure" on page 44 (timer) and "External Trigger Level-controlled Exposure" on page 45 (trigger pulse width). Following are details for each mode.

Free-running Programmable Exposure

Genie is in a multifunctional free running mode with the following features:

- Internal trigger programmable from maximum sensor frame rate down to 0.1Hz.
- Exposure duration is user programmable (exposure maximum is dependent on the frame rate). Minimum exposure is 100μs.
- Supports vertical and horizontal binning.
- Exposure synchronization timing is "Synchronous Mode" on page 46 where the exposure is aligned with the sensor horizontal line timing and the next acquisition is triggered by an internal programmable timer.
- Image readout is simultaneous where the grabbed image frame is readout during the next frame exposure time. This allows for fastest possible frame rates. See the timing diagram below.
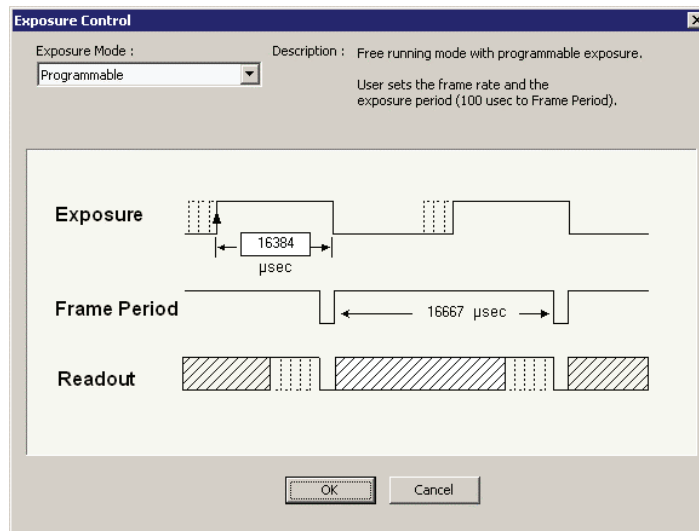
Free-running Programmable Exposure Timing

External Trigger Programmable Exposure

- Also known as "Edge Pre-select" exposure. See the timing diagram below.

- The external trigger edge initiates the exposure process. The active external trigger edge can be selected as either the low-high or high-low transition.

- The delay from active trigger edge to start of exposure is programmable from 1μs to 4 seconds (1μs steps) .

- Exposure duration is programmable from 100μs to 4 seconds (1μs steps).

- Supports "Synchronous Mode" on page 46 timing for fastest possible frame rates. Start of exposure is aligned on the next horizontal line while exposure duration granularity is 1μs. Exposure and sensor readout can be concurrent.

- Supports "Reset Mode" on page 47 timing. Exposure granularity is 1μs. Exposure and sensor readout must be sequential, limiting the maximal frame rate.

- Any external trigger received before the previous exposure is complete is ignored. An application can elect to receive messages about ignored triggers. See "Events" on page 63.
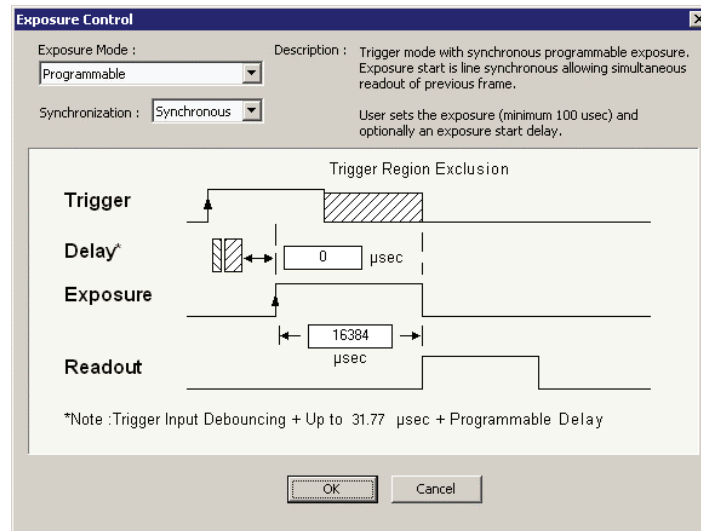
Programmable Synchronous Mode Exposure Timing
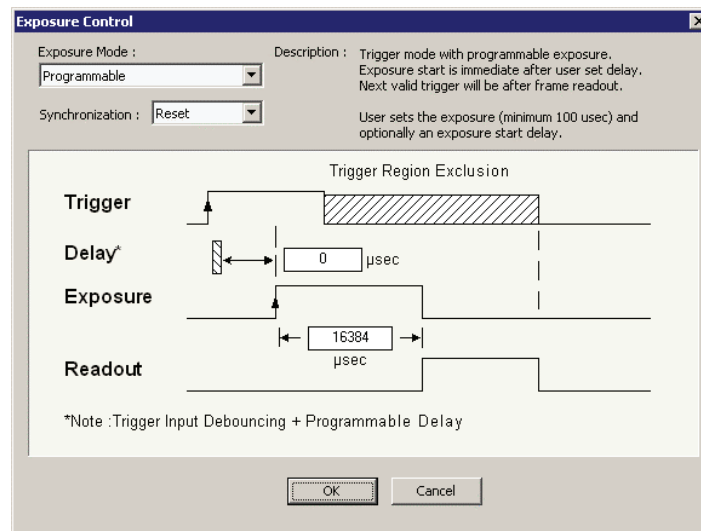
Programmable Reset Mode Exposure Timing

External Trigger Level-controlled Exposure

- Also known as "Pulse Width Control" exposure. See the timing diagram below.

- The external trigger edge initiates the exposure process. The active external trigger edge can be selected as either the low-high or high-low transition.

- No delay from active trigger edge to start of exposure.

- Exposure is stopped by the opposite edge on the trigger signal. Therefore the exposure time is defined by the trigger pulse duration.

- Supports "Reset Mode" on page 47 trigger timing only.
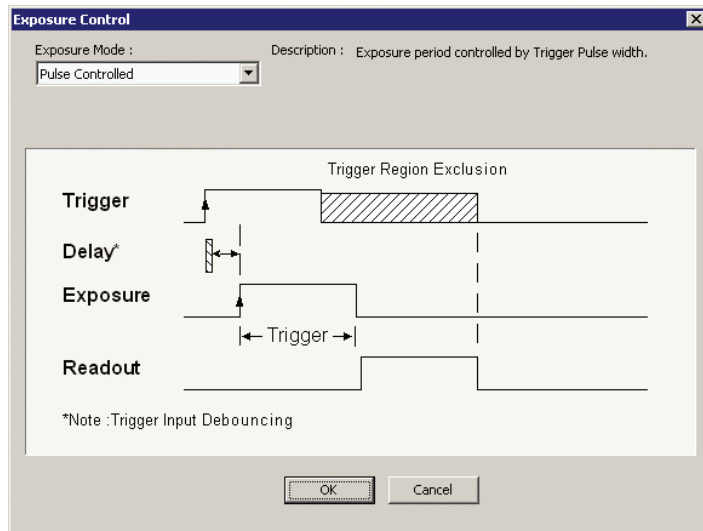
External Trigger Level-controlled Exposure Timing

Exposure Controls via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Exposure Control: **FrameRate** = 0.1 Hz up to max. frame rate supported by sensor in current mode of operation. Only available with Trigger disabled. **ExposureMode** = {Programmable = 1, Pulse Controlled = 2} **ExposureTime** = Exposure duration in µs In CamExpert, these parameters are available under "Sensor" tab. See "Accessing Features with Sapera++ LT" on page 68.

GEN<i>CAM	GenICam features for Exposure Control: **ExposureMode** = {Off = 0, Timed = 1, TriggerWidth = 2, TriggerControlled = 3, ResetContinuous = 4} **ExposureTimeRaw** = Exposure duration in µs **AcquisitionFrameRate** = Controls the desired frame rate of the camera in mHz (0.001 Hz). Only available when trigger is disabled. **AcquisitionFrameCount** = Number of frames to be acquired in MultiFrame acquisition mode **AcquisitionMode** = {Continuous = 0, SingleFrame = 1, MultiFrame = 2} **AcquisitionStart** = Start image capture using currently selected acquistion mode **AcquisitionStop** = Stop image capture **AcquisitionAbort** = Abort image capture

Synchronization Timing

Genie supports two types of sensor synchronization used to align the exposure to sensor timing:

- **Synchronous Mode**: Exposure is synchronous to the line timing of the sensor. Exposure granularity is 1µs and the readout can be concurrent to the exposure for the fastest possible frame rate.

- **Reset Mode**: Timing is reset to initiate exposure of next frame. Exposure granularity is 1µs, but readout must be sequential to exposure, reducing the maximum achievable frame rate.

Synchronous Mode

- Synchronous mode starts the exposure period aligned to the sensor horizontal line timing and the programmable duration granularity is 1µs.

- In the case of the Genie M640, a horizontal line occurs every 31.77µs.

- Exposure duration is from a minimum of 100µs up to 4 sec.

- In this mode, sensor exposure and sensor readout of the previous frame's exposure occur simultaneously. This allows operating the sensor up to its maximum frame rate.

- Any trigger received before the end of the exposure is ignored. The application can elect to receive messages about ignored triggers. See "Events" on page 63.

- Since the external trigger is asynchronous with the Genie horizontal line timing, the frame exposure start is subject to 1 horizontal line jitter.
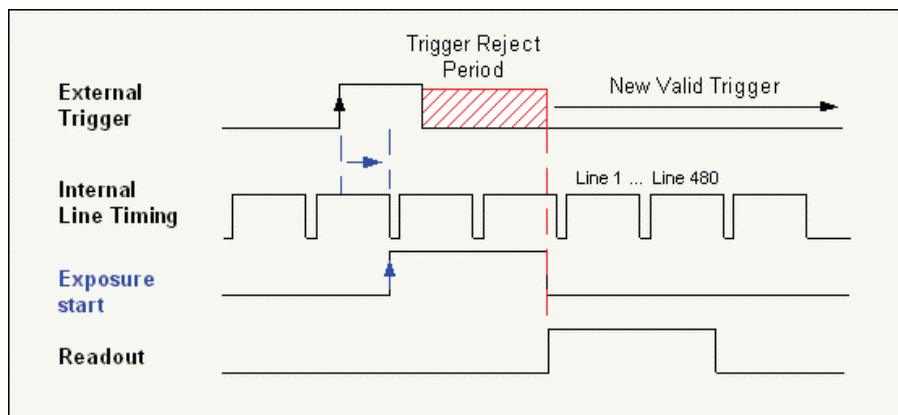
Synchronous Mode Timing example for Genie M640

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Reset Mode

- Exposure starts immediately after a valid trigger. There is no jitter on the start of exposure.

- Exposure time is programmable or controlled by the trigger pulse width.

- Minimum exposure is 100 µs – maximum is 4 seconds, with control steps of 1µs.

- Sensor readout must complete before the next exposure can start. That is, exposure and readout are sequential. Therefore, the maximum frame rate is lower than for Synchronous mode.

- Any external trigger received before the previous exposure/read out sequence is complete is ignored. An application can elect to receive messages about ignored triggers. See "Events" on page 63.
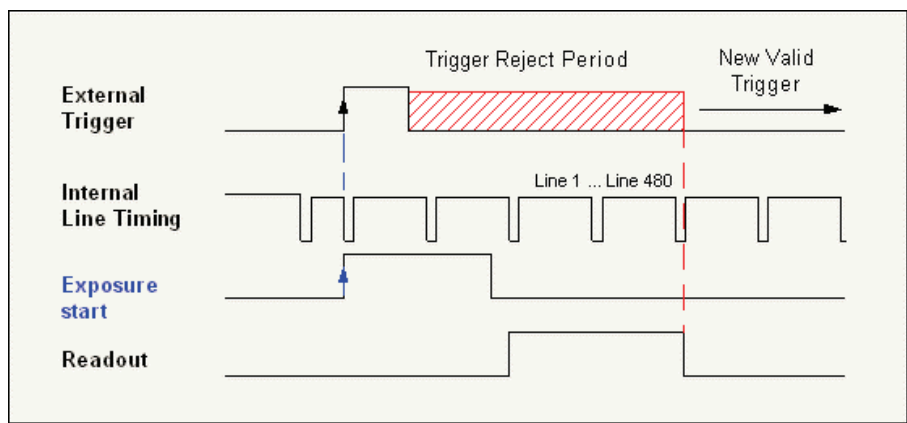
Reset Mode Timing example for Genie M640

Synchronization Mode via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Synchronization Mode: **ExposureAlignment** = {Synchronous = 0, Reset = 1} In CamExpert, these parameters are available under the "Sensor" tab in the "Exposure Control" dialog box. See "Accessing Features with Sapera++ LT" on page 68.

GEN‹i›CAM	GenICam features for Synchronization Mode: **SensorSynchronization** = {Synchronous = 0, Reset = 1}

CamExpert I/O Controls Dialog

CamExpert groups the Genie I/O Controls Parameters in one group. These parameters allow configuring the Genie inputs and outputs for type of signal and signal polarity. The screen capture below shows the CamExpert I/O parameters dialog and is followed by a descriptive overview. Detailed information on inputs and outputs follow this section.
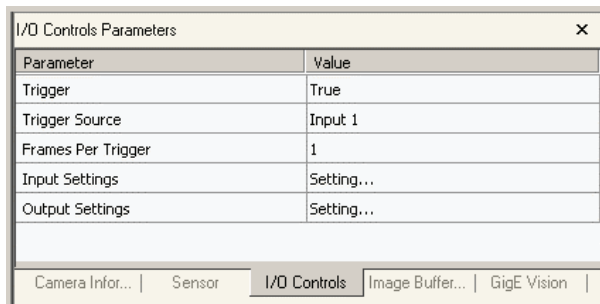
I/O Controls Dialog

Parameter	Description
Trigger	Enables or disables the Genie camera trigger.
Trigger Source	Specifies the trigger source. Possible values are Software, Input 1, or Input 2. Note that this field is only available when the Trigger parameter is True.
Frames per Trigger	Set the number of frames acquired per trigger – max. 64k (driver 1.10 limited to 1 frame).
Input Settings	Click on **Setting** to open the **Input Settings** dialog box, which allows you to specify the trigger input settings. For more information, see "General Inputs: Settings Via CamExpert" on page 49.
Output Settings	Click on **Setting** to open the **Output Settings** dialog box, which allows you to specify the trigger output settings. For more information, see "General Outputs: Settings via CamExpert" on page 51.

For more information on triggers, see "General Inputs" on page 49.

General Inputs

External Input Signal Opto-coupler & Debounce Circuit

- Genie provides two sets of opto-coupled inputs for either RS422 or TTL signals. These can be used as external trigger sources.

- See "12-Pin Hirose Connector Signal Details" on page 90 for connector pinout and electrical information. The cable shell and shield should electrically connect the Genie chassis to computer chassis for maximum EMI protection.

- For external triggers, a rising edge signal is suggested to minimize the time it takes for the opto-coupler to change state. (The opto-coupler response time is typically 10μs for rising edge compared to 50μs for falling edge).

- Each input incorporates a signal debounce circuit (following the opto-couple) to eliminate short noise transitions that could be wrongly interpreted as a valid pulse. The duration is user-programmable from 1μs to 255μs with CamExpert.

- Note, the external trigger input propagation delay is dependent on the signal used to activate the opto-coupled input. Typical delays are 3 μs for Active Open and 5 μs for Active Close.

General Inputs: Settings Via CamExpert

CamExpert provides control of inputs via the I/O Controls Parameters tab. The **Input Settings** dialog box allows you to view the signal and status for each pin on the Hirose connector. The **Polarity** drop-down list boxes, located in the **INPUT Settings** area, allow you to specify the polarity of the Input 1 and Input 2 as either **Active High** or **Active Low**. The **Minimum duration** field for each input, allows you to specify the minimum trigger length (1-255μs) so that input transitions are debounced to prevent unwanted trigger events.
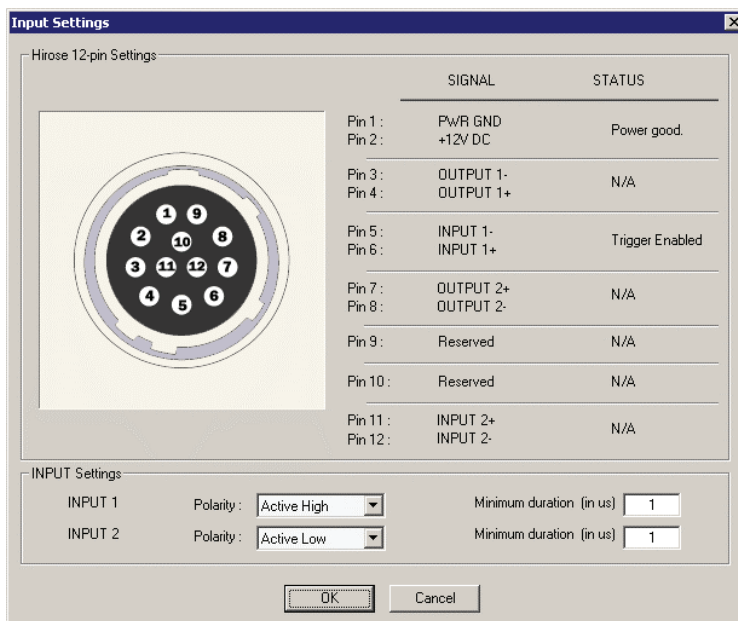
Input Settings Dialog

Input Controls via Sapera LT or GenICam Applications

	Genie Sapera parameters for Trigger Modes and General Inputs:
Sapera	**TriggerDelayToIntegration** = Delay in µs from trigger to exposure **TriggerEnable** = {FALSE, TRUE} **TriggerSource** = {Input 1 = 0, Input 2 = 1, Software = 2} **TriggerSoftware** = {FALSE, TRUE} **FramesPerTrigger** = Frame count 1 to 64k **PolarityInput_x** = {Active High = 0, Active Low = 1} **DebounceInput_x** = debouncing period in µs (from 1 to 255 µs) See "Accessing Features with Sapera++ LT" on page 68.

	GenICam features for Trigger Modes and General Inputs:
GEN⟨i⟩CAM	**TriggerMode** = {Off = 0, On = 1} **TriggerSelector** = *(not used)* **TriggerSoftware** = Generates a software trigger to start the acquisition in software trigger mode **TriggerSource** = {Line2 = 1, Software = 2} **TriggerActivation** = {LevelLow = 0, LevelHigh = 1} **TriggerDelayAbs** = Absolute delay to apply in us after reception of the trigger signal before starting exposure **InputLineSelector** = Index to general input {input1=0, input2=1} **InputLinePolarity** = {Active High = 0, Active Low = 1} **InputLineDebouncingPeriod** = debounce period in µs (from 1 to 255 µs) **InputLineValue** = Read input line state {low=0, high=1}

Strobe and General Outputs

Genie provides two sets of opto-coupled outputs (see "External Outputs" on page 92). These can be used as a strobe signal to control lighting or to generate programmable pulses when specific events are generated by the camera. They can also be set to a static state (close or open) by the application.

See "12-Pin Hirose Connector Signal Details" on page 90 for connector pinout and electrical information.

General Outputs: Settings via CamExpert

The **Output Settings** dialog box allows you to configure the event mode for both output 1 and output 2. Each output can be set independently to one of the available event modes. A typical usage of output is to control a strobe light in relation to the camera exposure. Select the output to configure by clicking on the **Output 1** or **Output 2** buttons located at the top of the dialog box. Use the **Event mode** drop-down list box to select the required event mode.

The following event modes are available:
- Open (default)
- Close
- Strobe On: Start of Exposure (used for strobe pulse)
- Pulse On: Valid Trigger
- Pulse On: Invalid Trigger
- Pulse On: Start of Readout
- Pulse On: End of Readout
- Pulse On: End of Acquisition
- Pulse On: Input 1
- Pulse On: Input 2

When an event mode is selected, its trigger output schematic or signal timing diagram is displayed, as well as any other additional parameters for the mode.

For most event modes, the trigger output signal can be set to either Active Open (that is high with the load connected to a voltage source) or Active Closed (where current is drawn through the load). The output delay can be set from 0 to 4 seconds, in increments of 1 µs. The pulse duration can be set from 100µs to 4 seconds, in increments of 1 µs.

Open and Close Output Settings

You can open and close the output circuit using software rather than hardware events, to control external devices. To control the output setting with Sapera LT see "Output Control via Sapera LT or GenICam Applications" .
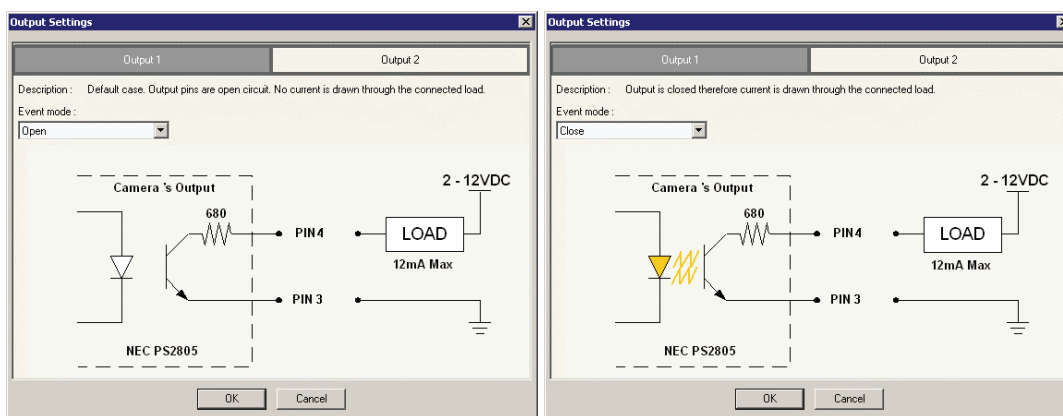
Strobe On Start of Exposure Event Mode

The Strobe On Start of Exposure event mode is used when controlling a strobe light using the Genie output pin. The exposure delay parameter is specified using the Sensor Parameters tab Exposure Control setting.

For Synchronous mode, the exposure start timing is aligned to the line period of the sensor. This can delay the start of exposure by an amount of up to 31.77µs for the Genie M640. For more information on exposure synchronous time see "Exposure Controls" .
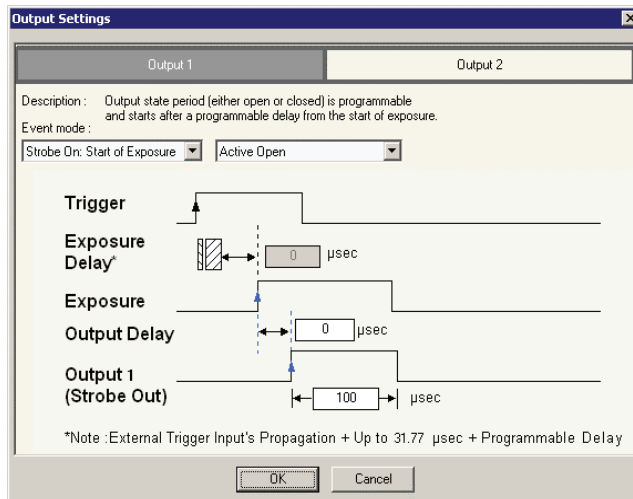
Pulse On Valid Trigger Event Mode

The Pulse On Valid Trigger event mode generates an output signal when a valid input trigger is received.
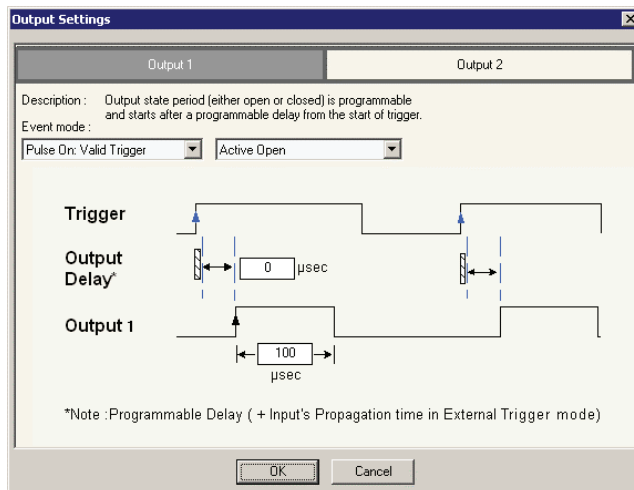
Pulse On Invalid Trigger Event Mode

This event mode generates an output signal when an invalid input trigger is received. An invalid trigger is any trigger received while the camera is engaged in frame acquisition (exposure and readout) and cannot accept trigger inputs. This is shown by the trigger exclusion region in the following diagram.
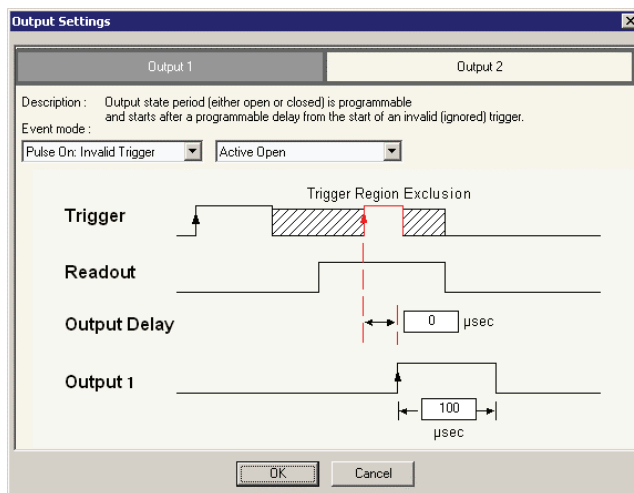
Pulse On Start of Readout Event Mode

The Pulse On Start of Readout event mode generates an output signal when the camera begins a readout operation from the sensor.
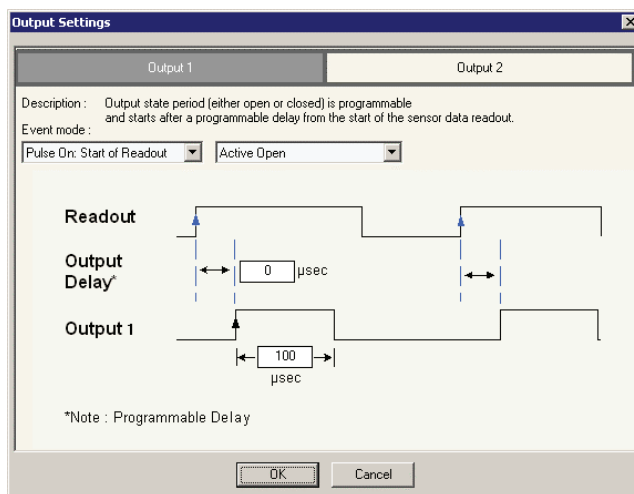
Pulse On End of Readout Event Mode

The Pulse On End of Readout event mode generates an output signal when the camera finishes a readout operation from the sensor.
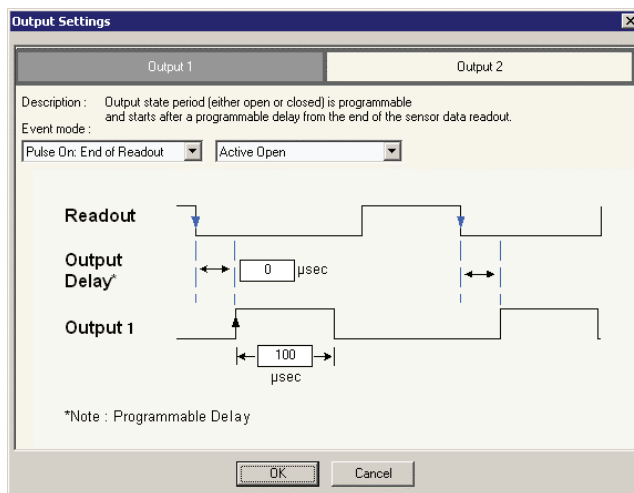
Pulse On End of Acquisition Event Mode

The Pulse On End of Acquisition event mode generates an output signal when the acquisition process is terminated using software.
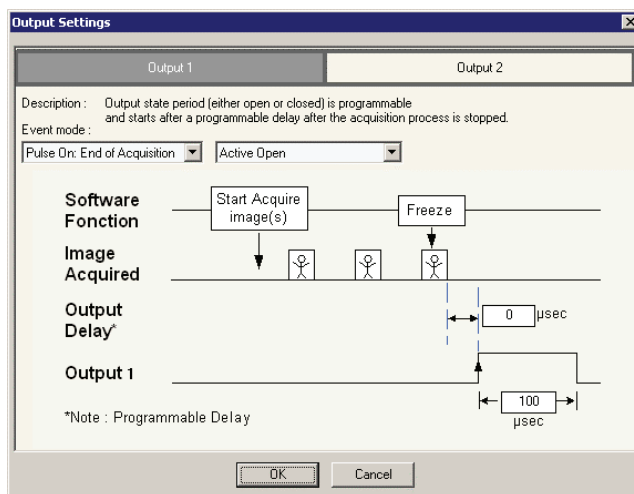
Pulse On Input 1 or Input 2 Event Modes

The Pulse On Input 1 or Input 2 event modes generate an output signal when the specified input signal is asserted.

Output Control via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Strobe and General Outputs. See "Accessing Features with Sapera++ LT" on page 68. **OutputSelectorOutput_x** = {Open = 0, Close = 1, Strobe On: Start of Exposure = 2, Pulse On: Valid Trigger = 4, Pulse On: Invalid Trigger = 5, Pulse On: Start of Readout = 6, Pulse On: End of Readout = 7, Pulse On: End of Acquisition = 8, Pulse On: Input 1 = 9, Pulse On: Input 2 = 10} **PulseDelayOutput_x** = Delay in μs to assert pulse output **PulseDurationOutput_x** = Pulse duration in μs **PolarityOutput_x** = {Active Close = 0, Active Open = 1}

GEN\<i\>CAM	GenICam features for Strobe and General Outputs: **OutputLineSelector** = Index to select output line {output 1 = 0, output 2 = 1} **OutputLineMode** = {SoftwareDriven = 0, EventDriven = 1} **OutputLineEventSource** = Event generating output line pulse {StartOfTrigger=0, StartOfExposure=1, EndOfExposure=2, StartOfReadout=3, EndOfReadout=4, EndOfAcquisition=5, EventOnInputLine1=6, EventOnInputLine2=7, OverTrigger=8, **OutputLinePulsePolarity** = State of output opto-coupler {Active Close = 0, Active Open = 1} **OutputLinePulseDelay** = Delay in μs to assert pulse output (range 0 to 64k) **OutputLinePulseDuration** = Pulse duration in μs (range 0 to 64k) **OutputLineValue** = static output state {Open = 0, Close = 1}

Genie Processing Features

The Genie monochrome series of cameras support a number of functions to enhance acquisitions or perform real time processing. Functions can be combined to solve specific imaging situations. The user can enable and evaluate each operation by using CamExpert.

Lookup Table (LUT)

The Genie camera includes a user programmable LUT as a component of its embedded processing features. The LUT is used for operations such as gamma adjustments, invert and threshold processes. CamExpert has a number of built in LUT operations for the user to explore (see "CamExpert LUT Controls" on page 87).

For monochrome sensors, the LUT table is a single 8-bit or 10-bit LUT (8/10-bit in, 8/10-bit out) as illustrated in the following figure. Pixel data when read out of the sensor is passed through the LUT memory array, where the new programmed pixel value is then passed to the Genie output circuit. The LUT data table is stored along with other parameters with the user configuration function (see "Power-up Configuration" on page 32).
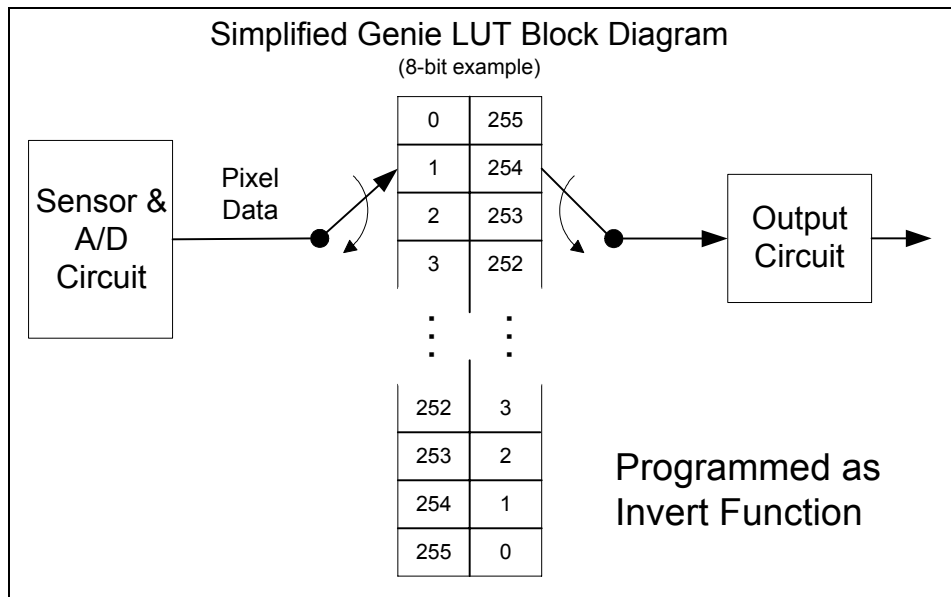
Simplified 8-bit LUT Block Diagram

LUT Control via Sapera LT or GenICam Applications

	Genie Sapera parameters for LUT:
Sapera	**LUTEnable** = {FALSE, TRUE} **LUTFormat** = {Mono 8, Mono 10 – Unsigned} **LUTNumberEntries** = Number of entries in the LUT (256 for an 8-bit LUT, 1024 for a 10-bit LUT) **LUTData** = Array of data representing the LUT content Sapera++ classes used: SapLut Class implements LUT management. SapAcquisition::GetLut to get a valid SapLut object. SapAcquisition::ApplyLut to program the SapLut object. In CamExpert, these features are available from the "Pre-Processing" menu.

	GenICam features for LUT:
GEN<i>CAM	*Not supported*

Flat Field (Image Shading) Correction

Image Shading correction, also know as Flat Field Correction is the process of eliminating small gain differences between pixels in a sensor array. That sensor when exposed to a uniformly lit field will have no gray level differences between pixels when calibrated flat field correction is applied to the image. The Genie camera stores flat field correction data until power off or in its user setting state for recall at any time (see "Power-up Configuration" on page 32). Flat field correction data is composed of 8 bit gain and 8 bit offset coefficients.

The CamExpert Flat Field Correction tool allows calibrating. saving, and loading the flat field calibration data for any Genie camera being controlled.

Before performing calibration, verify Genie acquisition with a live grab. Also at this time make preparations to grab a flat light gray level image, required for the calibration, such as a clean evenly lighted white wall or non-glossy paper. Note the lens iris position for a white but not saturated image. Additionally check that the lens iris closes well or have a lens cover to grab the dark calibration image.

Flat Field Correction Calibration Procedure

Calibration is the process of taking two reference images, one of a black field – one of a light gray field (not saturated), to generate correction data for images captured by Genie. Each sensor pixel data is modified by the correction factor generated by the calibration process, so that each pixel now has an identical response to the same illumination.

Start the Flat Field calibration tool via the CamExpert menu bar:
Pre-processing • Flat Field Correction • Calibration.

Flat Field Calibration Window

The Flat Field calibration window provides a three step process to acquire two reference images and then save the flat field correction data for the Genie used. To aid in determining if the reference images are valid, a histogram tool is provided so that the user can review the images used for the correction data.

FABER INDUSTRIAL TECHNOLOGIES
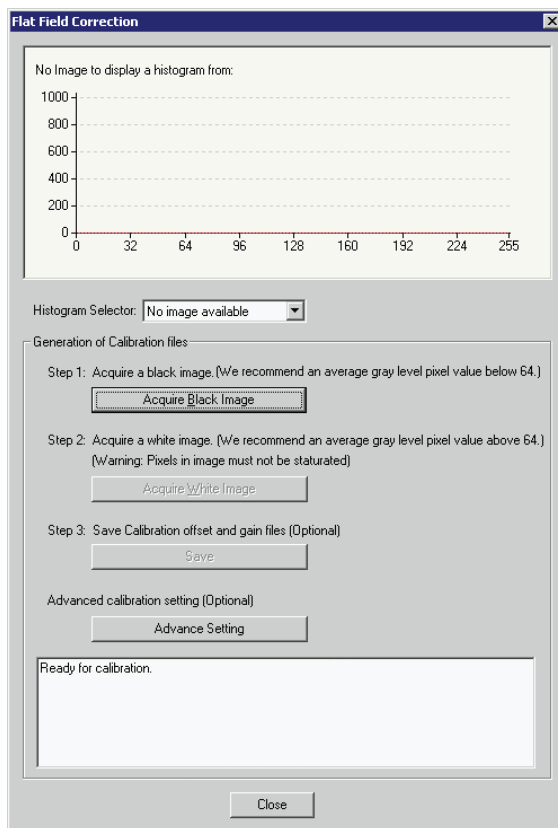
CamExpert Flat Field Calibration Menu

- Click on the **Advanced Setting** button to change the default number of frames averaged for each calibration step. The default value is 10 frames.

- Setup the camera to capture a uniform black image. Black paper with no illumination and the camera lens' iris closed to minimum can provide such a black image.

- Click on **Acquire Black Image**. The flat field calibration tool will grab video frames, analyze the pixel gray level spread, and present the statistics. The desired black reference image should have pixel values less then 20. If the results are acceptable, accept the image as the black reference.

- Setup the camera to acquire a uniform white image (but not saturated white). Even illumination on white paper can be used, with a gray level of 128 minimum. It is preferable to prepare for the white level calibration step before starting the calibration procedure.

- Click on **Acquire White Image**. The flat field demo will grab video frames, analyze the pixel gray level spread, and present the statistics. The captured gray level for all pixels should be greater than 128. If acceptable accept the image as the white reference.

- Click on **Save**. The flat field correction data is saved as a TIF image with a file name of your choice (suggestions are the camera name and its serial number).

Using Flat Field Correction

From the CamExpert menu bar enable Flat Field correction (**Pre-Processing • Flat Field Correction • Hardware**). Now when doing a live grab or snap, the incoming image is corrected by the current flat field calibration data for each pixel.

Use the menu function **Tools • Flat Field Correction • Load** to load in a flat field correction image from previously saved calibration data. CamExpert allows saving and loading calibration data for all cameras used with the imaging system.

Flat Field Correction Control via Sapera LT or GenICam Applications

	Genie Sapera parameters for Flat Field Correction: **FlatFieldEnable** = Enable Flat Field Correction {False=0, True=1} **FlatFieldFormat** = {RO: mono 8, mono 9, mono 10, RGB} **FlatFieldWidth** = read buffer width **FlatFieldHeight** = read buffer height **FlatFieldGainMin** = read minimum gain value **FlatFieldGainMax** = read maximum gain value **FlatFieldOffsetMin** = read minimum offset value **FlatFieldOffsetMax** = read maximum offset value **FlatFieldGainBuffer** = Flat Field correction gain data buffer **FlatFieldOffsetBuffer** = Flat Field correction offset data buffer Sapera++ Class constructor: SapFlatField::SapFlatField In CamExpert, these features are available from the "Pre-Processing" menu.
	GenICam features for Flat Field Correction: *Not supported*

Image Flip

Horizontal

The Genie supports a software controlled horizontal flip function as shown in the following figure. The process is done in hardware with no loss of acquisition frame rate.
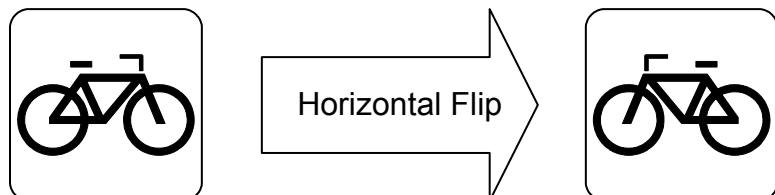
Vertical

As shown in the following figure, a vertical flip function is simply accomplished by mounting the Genie camera upside down and by programming the camera to do a horizontal flip. Genie provides identical mounting holes on both its top and bottom side to ease installations.
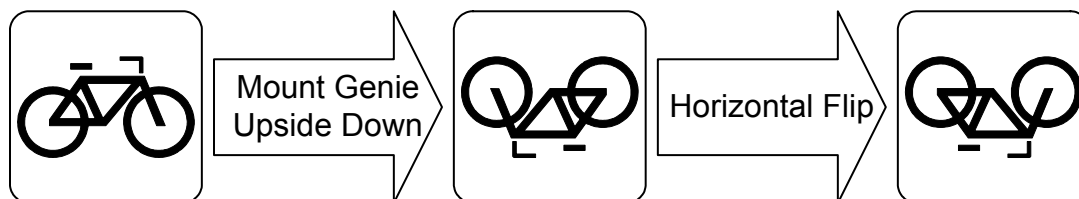
Image Flip Illustrations

	Genie Sapera parameter for Image Flip: **ImageFlip** = {disabled=0, horizontal=1} In CamExpert, this feature is available in the Image Buffer menu. See "Accessing Features with Sapera++ LT" on page 68.

	Not supported

Internal Image Test Patterns

The Genie camera includes a built in test pattern generator that can be used to confirm camera Ethernet connections or driver installations, without the need for a camera lens or proper lighting. The pattern generator inserts video just after the sensor A/D converter, therefore Genie processing such as the LUT act on the generator images or on sensor images.

CamExpert is used to easily enable and select the Genie test patterns. As shown in the following figure, select the Sensor tab, then select one of the four patterns from the drop menu. Select live grab to see the pattern output.

Parameter	Value
Device Scan Type	Areascan
Color Type	Monochrome Sensor
Sensor Width (in pixels)	640
Sensor Height (in lines)	480
Frame Rate (in Hz)	60.000
Gain (in dB)	0.0
Black Level (in 1/16 DN)	0
Binning Horizontal	Disabled
Binning Vertical	Disabled
Test Image Selector	Grey Diagonal Ramp Moving
Exposure Control	Off / Grey Horizontal Ramp / Grey Vertical Ramp / Grey Diagonal Ramp Moving / Purity

Camera Information   Sensor   I/O

Genie Test Pattern Selection – on Sensor Tab

The Genie test patterns are:

- **Horizontal ramp**: successive pixel's gray level is incremented by 1 to maximum pixel value then repeated until the end of line. The gray level is reset to 0 on the following line.

- **Vertical ramp**: similar to the horizontal ramp, successive lines are incremented by 1 gray level then repeated for the full frame.

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

- **Purity**: a purity pattern where all pixels have the same value. The gray value is incremented by one on successive frames to maximum then repeated. This also provides motion for live grabs.

Test Image Select via Sapera LT or GenICam Applications

Sapera	Genie Sapera parameters for Image Test Patterns: **TestImageSelector** = {Off = 0, Grey Horizontal Ramp = 1, Grey Vertical Ramp = 2, Grey Diagonal Ramp Moving = 3, Purity = 4} In CamExpert, these parameters are available in the "Sensor" tab. See "Accessing Features with Sapera++ LT" on page 68.

GEN⟨i⟩CAM	GenICam features for Image Test Patterns: **TestImageSelector** = {Off = 0, HorizontalWedge = 1, VerticalWedge = 2, DiagonalMovingWedge = 3}

Events

Genie supports a number of events that a control application can monitor. Events provide real time notification on various stages of the acquisition sequence and of error conditions. A Sapera application registers callbacks for those events that need monitoring.

Sapera Callbacks

Two types a callbacks can be registered for events when using the Genie:

- **Transfer events** concerning host system buffers.
  - Use the Sapera Transfer Module
  - In the Sapera C library: see CorXferRegisterCallback
  - In the Sapera++ library: see SapXferCallbackInfo class
- **Acquisition events** concerning the acquisition device, specifically the Genie camera.
  - Use the Sapera Acquisition Module
  - In the Sapera C library: see CorAcqRegisterCallback
  - In the Sapera++ library: see SapAcqDeviceCallbackInfo class

Acquisition Device Event Name (case sensitive strings)	Description
Start of Trigger	Trigger is valid based on the programmed trigger parameters
Start of Exposure	Exposure has started
End of Exposure	Exposure is complete
Feature Value Changed	Parameter value is changed
Feature Info Changed	Configuration parameter is changed
Invalid Trigger	Trigger event (software or external) was invalid
Input Event 0	External Input # 1 has received a valid signal
Input Event 1	External Input # 2 has received a valid signal
Output Event 0	External Output # 1 has changed state
Output Event 1	External Output # 2 has changed state
Transfer Event Name	**Description**
End of frame transfer	Video frame transferred to host buffer

Event Selection via GenICam Applications

GEN⟨i⟩CAM	GenICam features for Events:
	EventSelector = {AcquisitionTrigger = 2, ExposureStart = 3, ExposureEnd = 4} **EventNotification** = {Off = 0, GigEVisionEvent = 1}

Network Controls & GigE Vision Parameters
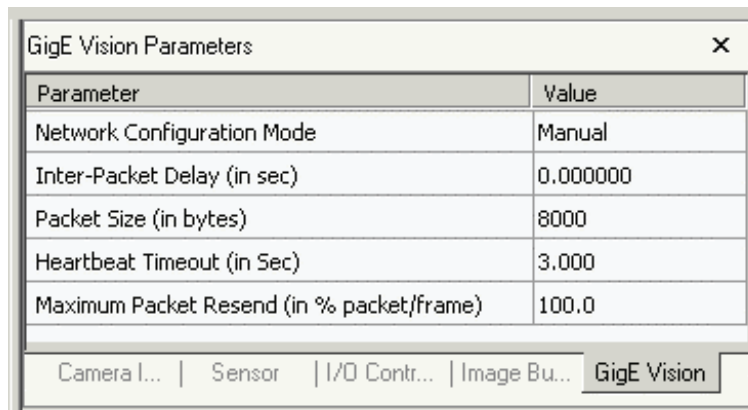
This section describes how to optimize the network configuration for maximum Genie bandwidth. Optimization of these parameters is highly dependent on the number of cameras connected to a NIC, the data rate of each camera and the trigger modes used.

[info icon] **Important**: Laptop computers may have issues even with a GigE NIC port, either built in or as a PCMCIA device. This section describes optimizations for both desktop and laptop computers, but laptops may require additional customization as described in section "Laptop Computer Networking Issues" on page 111.

CamExpert GigE Vision Parameters

The **Automatic** Network Configuration mode sets parameters to a default state. The **Optimize** mode sets the packet size to the maximum value as reported by the NIC driver. If this does not provide satisfactory performance, it is possible to optimize transfers by manually setting the network configuration parameters. The following screen shot of the GigE Vision Parameters shows the CamExpert control set to **Manual**. Descriptions for each parameter follow.

GigE Vision Parameters	
Parameter	**Value**
Network Configuration Mode	Manual
Inter-Packet Delay (in sec)	0.000000
Packet Size (in bytes)	8000
Heartbeat Timeout (in Sec)	3.000
Maximum Packet Resend (in % packet/frame)	100.0

Camera I... | Sensor | I/O Contr... | Image Bu... | **GigE Vision**

Parameter	Description
Network Configuration Mode	Specifies the Network Configuration Mode as either Automatic, Manual, or Optimize. In general use Optimize mode. Some computers, especially laptops, may require manual optimization of network parameters. The following parameters can be modified when Manual mode is selected.
Inter-Packet Delay (in sec)	Specifies the inter-packet delay, in sec. The range of permitted values is 0.000000 to 0.065535. The inter-packet delay is the minimum time interval between two successive packets. This can be increased if the NIC is unable to keep up with packet arrivals (thus dropping packets–seen as video noise).
Packet Size (in bytes)	Specifies the maximum packet size, in bytes. The range of possible values is 576 to 1500, in increments of 4 bytes when the NIC does not support jumbo packet. The maximum is currently 9000 bytes when jumbo packets are supported (see "Increasing Adapter Buffers and Jumbo Frames" on page 24 to enable jumbo packets on the NIC). In most situations, use the largest possible packet size supported by your network elements. In order to support jumbo packets, all intermediate network elements must support them, otherwise they will simply be silently discarded and no image data will reach the PC.
Heartbeat Timeout (in Sec)	Specifies the heartbeat timeout, in seconds. The range of permitted values is 0.5 to 65, in increments of 0.001 seconds. This is used by the camera to ensure the PC application is still linked. If the heartbeat timeout expires, the camera will shutdown the connection to the current application.
Maximum Packet Resend	Sets the percentage of packets that can be resent for each frame. This is used to ensure the streaming data (including resends) does not exceed the Ethernet link capacity. As an example, a system capturing at 80 MB/s can allow 25% of packet resends without exceeding 100 MB/s (about the maximum capacity of a gigabit Ethernet link).

Network Controls via Sapera LT or GenICam Applications

	Genie Sapera parameters for Network Configuration: **NetworkConfigurationMode** = {Automatic = 0, Manual = 1} **InterPacketDelay** = Minimum delay in μs between image packets **PacketSize** = Image packet size in bytes **HeartbeatTimeout** = Heartbeat period (watchdog) in ms before camera disconnect **MaximumPacketResend** = Sets percentage of packets that can be resent per frame In CamExpert, these parameters are available under the "GigE Vision" tab. See "Accessing Features with Sapera++ LT" on page 68.

	GenICam features for Network Configuration: **PayloadSize** = Size of the payload in bytes. This is the total number of bytes sent in the payload. No packet headers. Other networks parameters may be available through the 3rd party package used.

Genie Power-up Configuration

On power up the Genie camera initializes to a factory default state which sets the camera with neutral parameters and in free run mode. The default state ensures that the camera is ready for acquisition. Genie also provides storage for one user-defined state. This user state allows quick camera configuration for a known repeatable imaging system. The following table describes the camera parameters stored in the user state. See "Power-up Configuration" on page 32 for information on saving the user state with CamExpert.

Parameter	Description
ROI	Region of interest used to crop the image
Pixel Format	Defines the pixel format (MONO8)
Frame Rate	Defines the frame rate for free run mode.
Exposure mode	Defines the exposure mode (Programmable or Pulse Controlled)
Exposure duration	Defines the exposure duration for Programmable mode
Exposure synchronization	Synchronous or Reset synchronization mode
Gain	Defines the sensor analog Gain factor.
Black Level	Defines the sensor analog Black level factor.
Binning	Horizontal and vertical binning factor
Flip	Horizontal flip: Off or On
Image source	Defines the image source as the sensor or one of the stored image patterns.
Trigger enable	Free-running or triggered
Trigger source	Selects the trigger input (input pin or software)
Trigger delay	Defines the delay from input trigger to exposure start.
GPI settings	Defines the operational mode of the general input pins.
GPO settings	Defines the operational mode of the general output pins
LUT	Lookup Table function On or Off plus the LUT data.
Flat Field Correction	FFC function On or Off plus the offset/gain data.

Power-up Control via Sapera LT or GenICam Applications

	Genie Sapera parameters for Power-up Configuration:
(Sapera logo)	**Power-upConfig** = {Factory Default = 0, Camera Configuration 1 = 1} **SaveCameraConfigurationSelector** = {Camera Configuration 1 = 1} **SaveCameraConfiguration** = Write to save selected camera configuration **LoadCameraConfigurationSelector** = {Factory Default = 0, Camera Configuration 1 = 1} **LoadCameraConfiguration** = Write to load selected camera configuration In CamExpert, these parameters are available in the "Camera Information" tab, under the "Power-up Configuration" dialog box. See "Accessing Features with Sapera++ LT" on page 68.

	GenICam features for Power-up Configuration:
(GENiCAM logo)	**UserSetSelector** = {Factory = 0, UserSet1 = 1} **UserSetLoad** = Loads the User Set specified by UserSetSelector to the camera and makes it active **UserSetSave** = Saves the User Set specified by UserSetSelector to the camera **UserSetDefaultSelector** = Selects the feature User Set to load at camera reset

Sapera Supported Features List

The Genie features and its currently set values can be read by a Sapera application. The Sapera tool CamExpert is an example of an application that reads and writes Genie parameters to control its operation.

The following tables group the Genie features by their feature type—STRING, ENUM, INT32, and BOOL. Features may be read only (RO), read/write (RW), or write only (WO).

Accessing Features with Sapera++ LT

When working with Genie features, the **SapAcqDevice** class provides functions for accessing features from devices such as a GigE-Vision camera. The class also contains functions for sending commands and registering events to devices.

- **SapAcqDevice::GetFeatureInfo** returns information on a feature associated with a specified name or index.
- **SapAcqDevice::SetFeatureValue** writes a new value for a feature.
- All information about the feature is stored in a **SapFeature** class object.

Refer to the Sapera++ LT Programmer's manual (OC-SAPM-SPPP0).

Feature Type STRING

Feature Name	Access	Type	Value
Server Name	RO	STRING	Genie_M640_1 (*example*)
Number of Features	RO	STRING	(*number dependent on firmware version*)
DeviceVendorName	RO	STRING	DALSA
DeviceModelName	RO	STRING	Genie M640 (*example*)
DeviceVersion	RO	STRING	1452 (*example*)
FirmwareVersion	RO	STRING	version 7630 (*example*)
DeviceID	RO	STRING	S1234567 (*example*)
MACAddress	RO	STRING	00:01:0D:11:01:2A (*example*)
DeviceUserID	RW	STRING	Inspection-1 (*user set example*)

Feature Type ENUM

Feature Name	Access	Type	Values
Interface	RO	ENUM	GigE Vision
DeviceScanType	RO	ENUM	Area scan = 0 Linescan = 1
ColorType (*dependent on camera model*)	RO	ENUM	Monochrome Sensor = 0 CFA Bayer Sensor GR = 1 CFA Bayer Sensor RG = 2 CFA Bayer Sensor GB = 3 CFA Bayer Sensor BG = 4 RGB Sensor = 5
ExposureMode	RW	ENUM	Programmable = 1 Pulse Controlled = 2
ExposureAlignment	RW	ENUM	Synchronous = 0 Reset = 1
BinningVertical	RW	ENUM	Disabled = 1 2 lines binned = 2
BinningHorizontal	RW	ENUM	Disabled = 1 2 pixels binned = 2
FlatFieldFormat (*dependent on camera model*)	RO	ENUM	Mono 8 - Unsigned = 16844800 Mono 9 - Unsigned = 16779520 Mono 10 - Unsigned = 16779776 RGB = 1124075520
Flip	RW	ENUM	Off = 0 Horizontal = 1
TestImageSelector	RW	ENUM	Off = 0 Grey Horizontal Ramp = 1 Grey Vertical Ramp = 2 Grey Diagonal Ramp Moving = 3 Purity = 4

LUTFormat *(dependent on camera model)*	RO	ENUM	Mono 8 - Unsigned = 16844800 Mono 8 - Signed = 285280256 Mono 9 - Unsigned = 16779520 Mono 9 - Signed = 285214976 Mono 10 - Unsigned = 16779776 Mono 10 - Signed = 285215232 RGB = 1124075520
TriggerSource	RW	ENUM	Input 1 = 0 Input 2 = 1 Software = 2
OutputSelectorOutput_1	RW	ENUM	Open = 0 Close = 1 Strobe On: Start of Exposure = 2 Pulse On: Valid Trigger = 4 Pulse On: Invalid Trigger = 5 Pulse On: Start of Readout = 6 Pulse On: End of Readout = 7 Pulse On: End of Acquisition = 8 Pulse On: Input 1 = 9 Pulse On: Input 2 = 10
OutputSelectorOutput_2	RW	ENUM	Open = 0 Close = 1 Pulse On: End of Exposure = 3 Pulse On: Valid Trigger = 4 Pulse On: Invalid Trigger = 5 Pulse On: Start of Readout = 6 Pulse On: End of Readout = 7 Pulse On: End of Acquisition = 8 Pulse On: Input 1 = 9 Pulse On: Input 2 = 10
PolarityInput_1	RW	ENUM	Active High = 0 Active Low = 1
PolarityInput_2	RW	ENUM	Active High = 0 Active Low = 1
PolarityOutput_1	RW	ENUM	Active Close = 0 Active Open = 1
PolarityOutput_2	RW	ENUM	Active Close = 0 Active Open = 1
PixelFormat	RW	ENUM	Monochrome, 8-bit = 17301505 (0x1080001) 10-bit = 17825795 (0x1100003)
Power-upConfig	RW	ENUM	Factory Default = 0 Camera Configuration 1 = 1
SaveCameraConfigurationSelector	RW	ENUM	Camera Configuration 1 = 1
LoadCameraConfigurationSelector	RW	ENUM	Factory Default = 0 Camera Configuration 1 = 1
NetworkConfigurationMode	RW	ENUM	Automatic = 0 Manual = 1

Feature Type INT32

The feature list for type INT32 has an additional column 'Exponent' which defines the feature's native unit. This exponent value is used as a unit multiplier so that the feature value is expressed as an integer, not a decimal number.

- As an example from the following table, the Genie frame rate is 60000 with an exponent of 3. Therefore the frame rate native unit is mHz. The current value shown – 60000 mHz, is actually 60.000 Hz.

Feature Name	Access	Type	Exponent	Sample Value
DeviceMaxThroughput	RO	INT32	EXP10: 0	18432000
SensorWidth	RO	INT32	EXP10: 0	640
SensorHeight	RO	INT32	EXP10: 0	480
FrameRate (mHz)	RW	INT32	EXP10: 3	60000
BlackLevel	RW	INT32	EXP10: 0	0
Gain	RW	INT32	EXP10: 1	0
ExposureTime (µS)	RW	INT32	EXP10: 6	16384
TriggerDelayToIntegration (µS)	RW	INT32	EXP10: 6	0
FramesPerTrigger	RW	INT32	EXP10: 0	1
LUTNumberEntries	RO	INT32	EXP10: 0	256
DebounceInput_1 (µS)	RW	INT32	EXP10: 6	10
DebounceInput_2 (µS)	RW	INT32	EXP10: 6	10
PulseDelayOutput_1 (µS)	RW	INT32	EXP10: 6	0
PulseDurationOutput_1 (µS)	RW	INT32	EXP10: 6	0
PulseDelayOutput_2 (µS)	RW	INT32	EXP10: 6	0
PulseDurationOutput_2 (µS)	RW	INT32	EXP10: 6	0
Width	RW	INT32	EXP10: 0	640
Height	RW	INT32	EXP10: 0	480
OffsetX	RW	INT32	EXP10: 0	0
OffsetY	RW	INT32	EXP10: 0	0
SaperaBufferFormat	RO	INT32	EXP10: 0	16844800
PixelSize	RO	INT32	EXP10: 0	8
InterPacketDelay (µS)	RW	INT32	EXP10: 6	0
PacketSize	RW	INT32	EXP10: 0	1500
HeartbeatTimeout (mS)	RW	INT32	EXP10: 3	500
MaximumPacketResend	RW	INT32	EXP10: 1	10
LUTData	RW	Buffer		
FlatFieldGainBuffer	RW	Buffer		
FlatFieldOffsetBuffer	RW	Buffer		
FlatFieldGainMin	RO	INT32	EXP10: 0	*(see note 1)*
FlatFieldGainMax	RO	INT32	EXP10: 0	*(see note 1)*
FlatFieldOffsetMin	RO	INT32	EXP10: 0	*(see note 1)*
FlatFieldOffsetMax	RO	INT32	EXP10: 0	*(see note 1)*
FlatFieldWidth	RO	INT32	EXP10: 0	*(see note 1)*
FlatFieldHeight	RO	INT32	EXP10: 0	*(see note 1)*

Note 1: not displayed in CamExpert; not saved in a camera configuration file (CCF)

Feature Type BOOL

Feature Name	Access	Type	Value
LUTEnable	RW	BOOL	True/False
TriggerEnable	RW	BOOL	True/False
TriggerSoftware	RW	BOOL	True/False
FlatFieldEnable	RW	BOOL	True/False
SaveCameraConfiguration	WO	BOOL	True/False
LoadCameraConfiguration	WO	BOOL	True/False

Feature Interdependence Diagrams

The following diagrams describe operational feature availability which are dependent on user selected modes. These diagrams show what features are set to a value, and they show which feature parameters remain as user variables.

Each diagram uses the following symbol set to indicate the dependent action type.
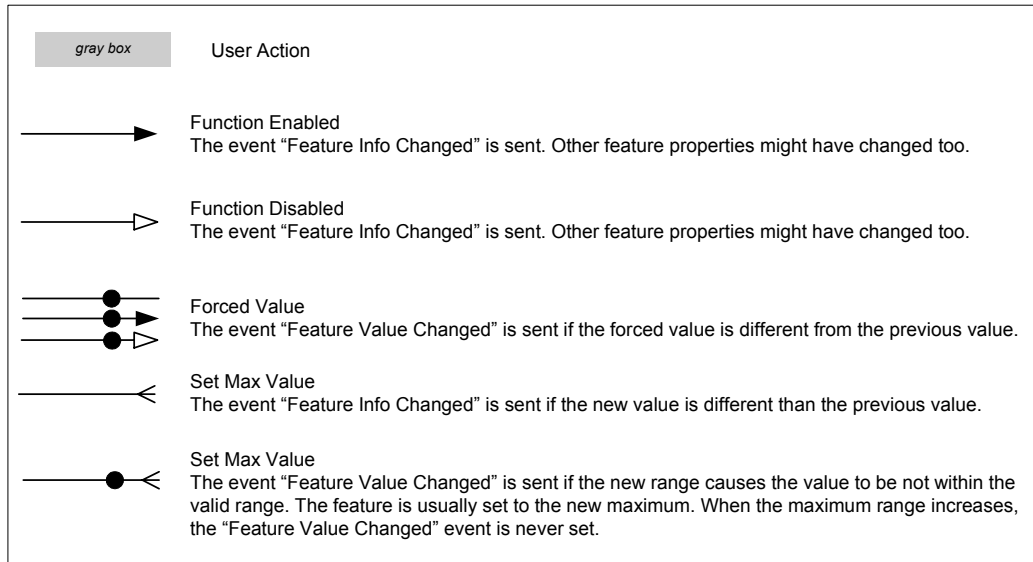
Trigger Enable - TRUE
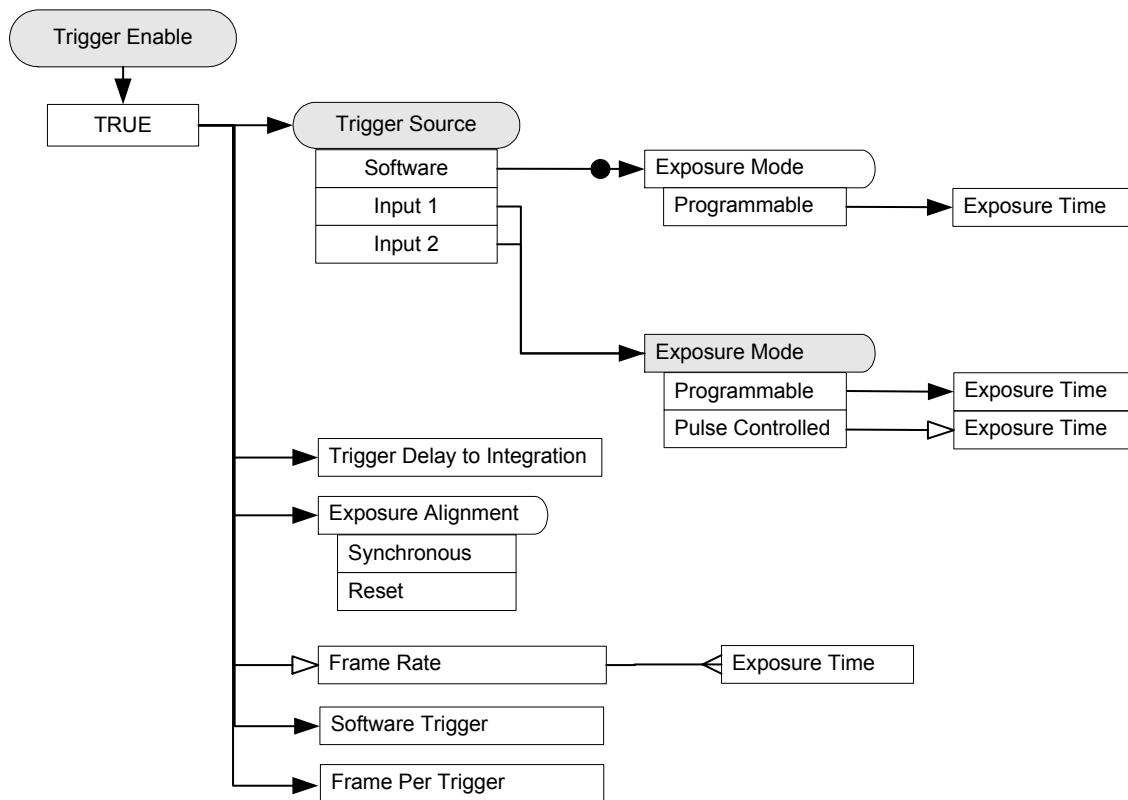
Trigger Enable - FALSE
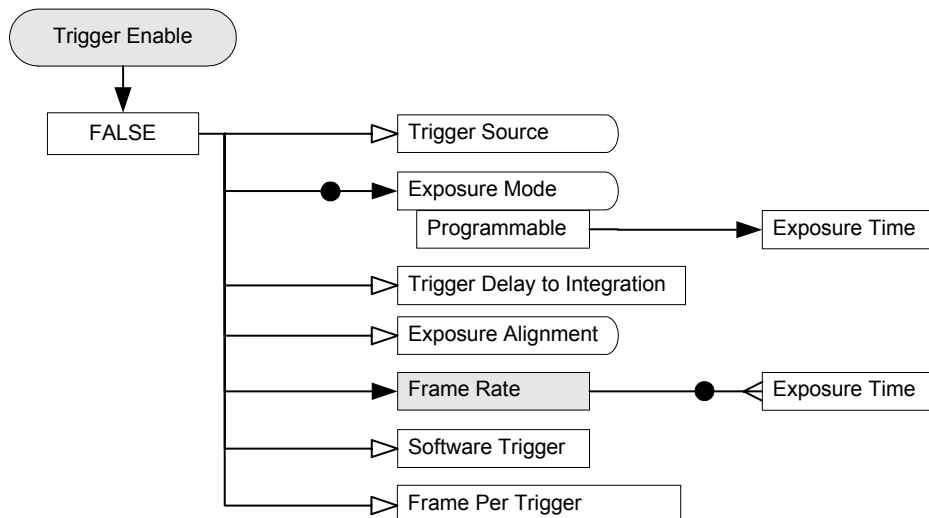
Output Selector
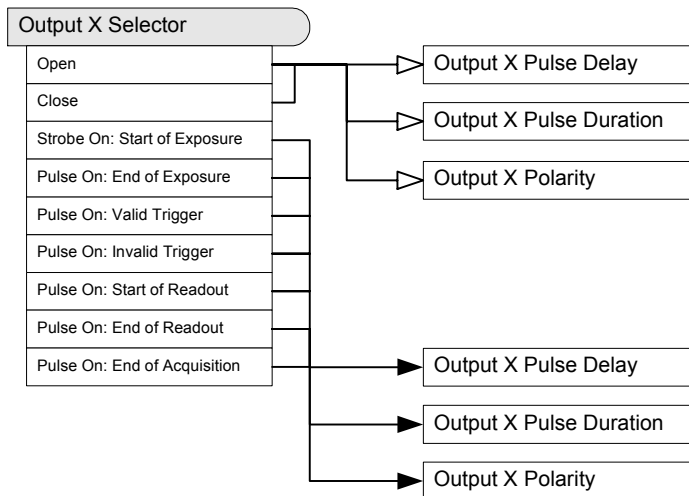
Vertical Binning
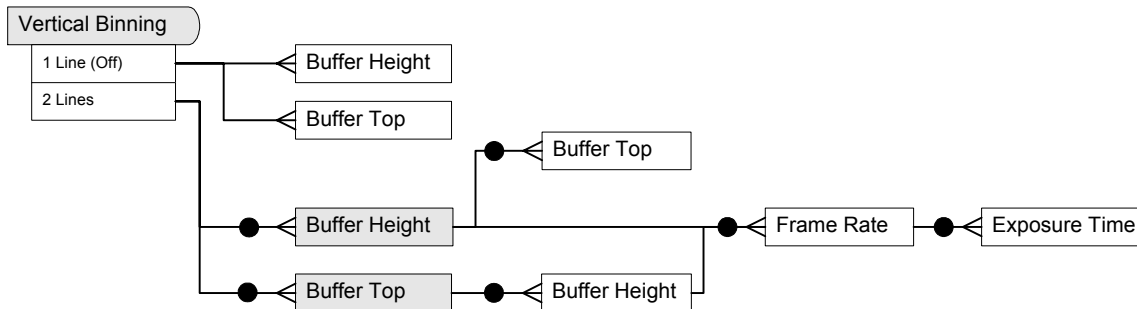
Horizontal Binning

Pixel Format

Pixel Format	
8-Bit	
10-bit	

- SaperaBufferFormat
- PixelSize
- LUTFormat
- LUTNumberEntries
- FlatFieldEnable
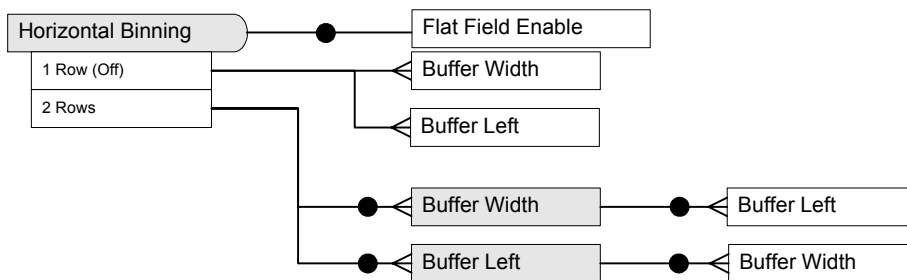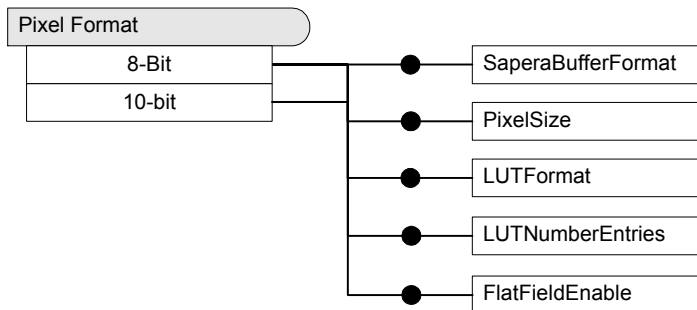
Network Configuration Mode

Network Configuration Mode	
Automatic	
Optimize	
Manual	

- Packet Size
- Heartbeat Timeout
- Inter-Packet Delay
- Max Packet Resend

- Packet Size
- Heartbeat Timeout
- Inter-Packet Delay
- Max Packet Resend
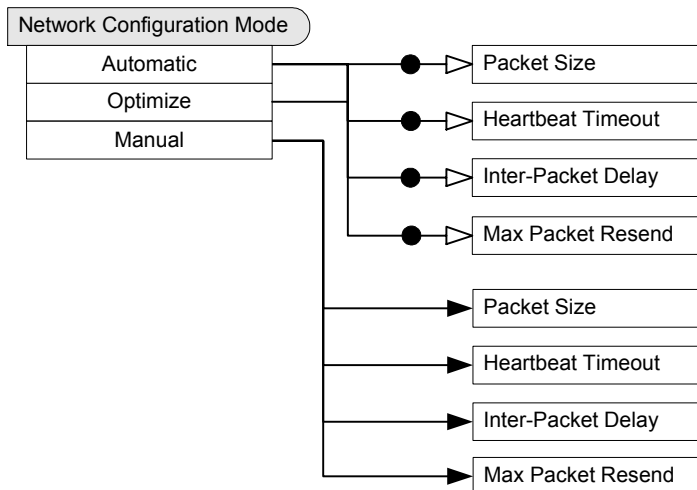
Network Tools

IP Configuration Mode Details

The following descriptions provide more information on the IP configuration modes supported by Genie. In general automatic IP configuration assignment is sufficient for most Genie installations.

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

- 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 takes up to 1 minute to obtain an LLA IP address. With Windows XP, with no DHCP server involved, the network adapter icon in the system tray (in Windows XP) typically shows "limited or no

  connectivity".
  This is normal (see Microsoft KB article #892896) and indicates that the network does not have connectivity beyond routers.

- Windows and Genie 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.

- 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. See "GigE Server Warning Example 1a: IP error with multiple NICs" on page 103 for additional information.

- Use the DALSA Network tool to change the Genie from the default DHCP/LLA mode to Persistent IP mode when required, such as when there are multiple NIC devices with Genie connected to each. Note that DALSA recommends DHCP/LLA as the mode of operation where a switch is used to connect multiple Genie devices.

DHCP (Dynamic Host Configuration Protocol)

- This Genie IP configuration mode requires a DHCP server to allocate an IP address dynamically. The Genie must be configured to have DHCP enabled. This is the factory default settings.

- The DHCP server is part of a managed network. Windows XP itself does not provide a DHCP server function. A dedicated DHCP server is required. Open-source DHCP server software can be found on the Internet, but they might not provide the same level of functionality as commercial-grade DHCP servers.

- A DHCP server is recommended where there are multiple NIC ports with multiple GigE Vision devices attached. Each NIC ports must use a different subnet to avoid IP address conflicts (see "GigE Server Warning Example 1a: IP error with multiple NICs" on page 103).

- Under Windows, a NIC is configured in DHCP mode by default. If no DHCP server is present on a given subnet, Windows will revert to LLA as explained in the section above.

- Ensure that a different subnet is assigned to each NIC on the network. Typical ranges are 192.200.x.x or 10.10.x.x for internal networks.

Persistent IP

- 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 Genie camera is connected to a network with a different subnet, it cannot be accessed.

- The DALSA network configuration tool is used to set a persistent IP address.

- An example of a Persistent IP address assignment:
  - Persistent IP = 192.200.1.1
  - Subnet Mask = 255.255.0.0
  - Default Gateway = 0.0.0.0

- Warning: an incorrect IP address assignment might make it impossible to connect to the camera. In such a case the DALSA network configuration tool includes a function to recover a Genie camera with an unknown persistent IP and set the Genie to the factory default setting, i.e. DHCP/LLA mode. The Genie MAC address must be known to use this function. See "Recovering a Camera with an Unknown Persistent IP" on page 82 and "GigE Server Warning Example 2: Subnet Mask or IP error" on page 105.

- For GigE Vision applications the FORCEIP command is used to force a new persistent IP or to change the IP configuration protocol. The Genie MAC address must be known to use the FORCEIP command.
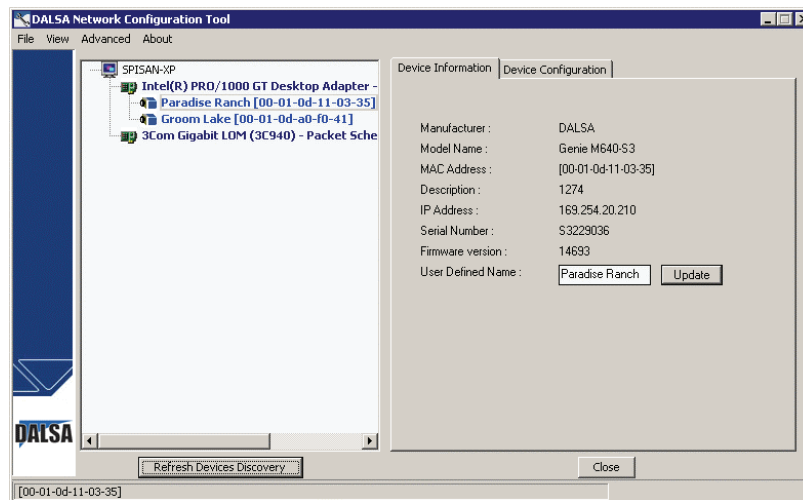
Network Configuration Tool

The Network Configuration tool provides information on all network adapters installed in the system and any connected GigE Vision devices. For the Genie, the tool allows a simple method to assign a User-Defined name and also to set a Persistent IP address instead of the default DHCP/LLA assigned IP address. Using this tool, Genie network configurations can be easily made without having to use any Windows Control Panel application.

Important: Any changes made with this tool will update the Genie flash memory. Do not remove power from the Genie camera for a minimum 10 seconds. Then cycle the Genie power to load the new flash settings.

Quick Genie Network Configuration

- Start the Network Configuration program from the windows start menu: **Start•Programs•DALSA•Sapera Network Imaging Package•DALSA Network Configuration Tool**.
- The left display window will show all installed network adapters and any connected Genie camera.
- Click on a Genie camera to see information such as MAC address, current IP address, serial and firmware numbers.
- Click in the User Defined Name edit box and change the Genie name as required. Click on the Update button to write into the Genie memory.

Genie Network Information

- Select the **Device Configuration tab** to switch from the default IP configuration mode DHCP/LLA to Persistent IP mode (only if required).
- With Persistent IP mode selected enter the desired IP address, subnet mask, and default gateway.
  Important: do not forget the persistent IP address you assign, else the camera can not be controlled.
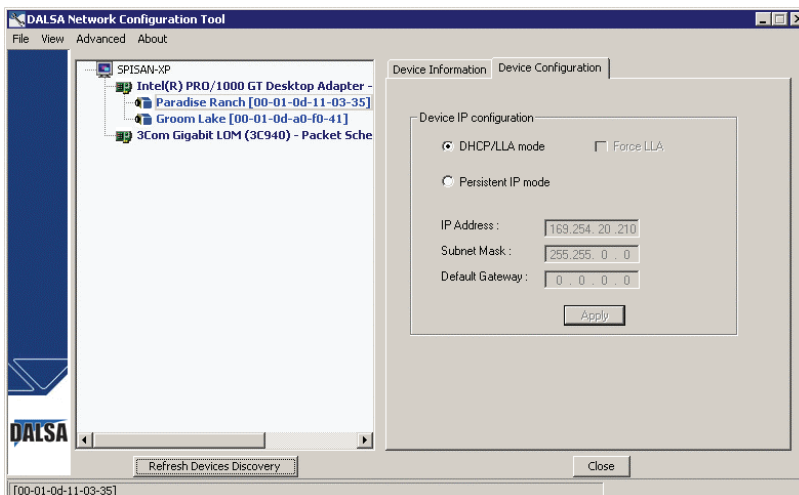
Genie IP Configuration

System Information and Configuration

Select the system icon (the computer symbol) in the left pane to display current system information which may be required when documenting Genie installations. There are no user changeable fields in the System Information tab.

In the right hand pane click on the **System Configuration tab**. By default the Sapera GigE Server is added to the Windows Firewall exception list. This function is performed automatically when the Genie software package is installed. This ensures the Windows Firewall remains active (if it was enabled) without having to individually put each Genie application program in the exception list.
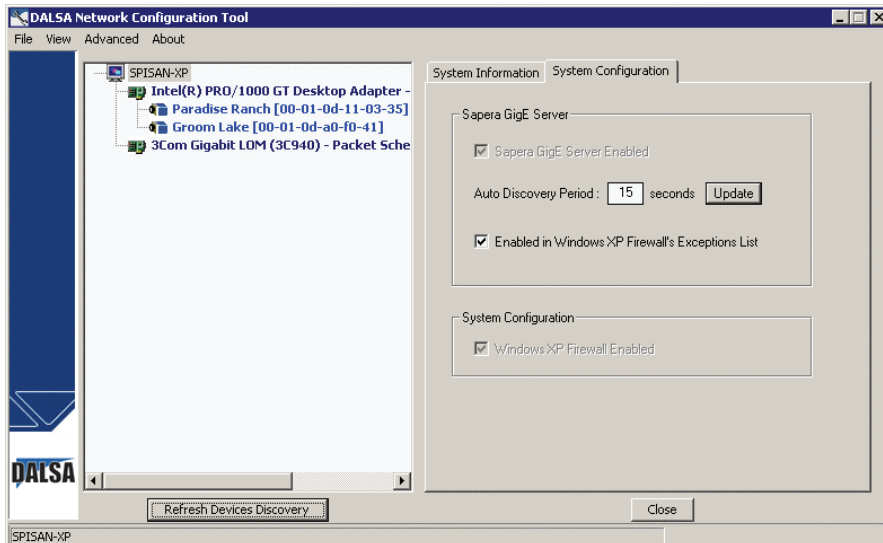
System Firewall Configuration

If the computer is using a different firewall software package, refer to that firewall's software manual to allow the Sapera GigE Server to have access through it.

Alternatively, it is possible to exclude a specified NIC from using the firewall. The NIC dedicated to the Genie camera does not need Windows firewall. See "Disabling Windows Firewall" on page 107 for details on excluding a NIC from firewall settings.

Network Card Information and Configuration

Select a network card icon in the left pane to see the NIC configuration parameters. The Network Configuration tool ensures that no two NIC devices installed in the computer are on the same subnet, since that would create a conflict. A warning message is displayed in such a case, indicating that a settings change is required for one of the NIC.
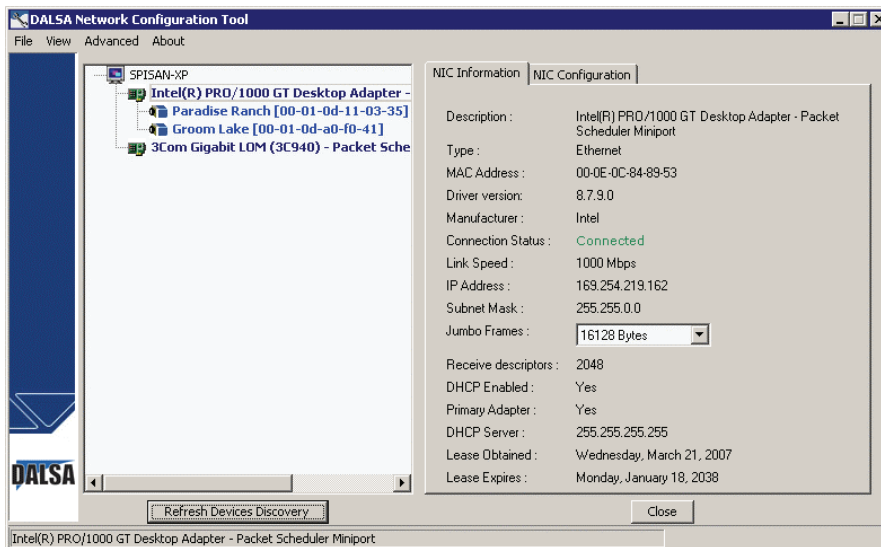
NIC Information

NIC IP and Network Imaging Driver Assignment

For each NIC, it is possible to configure the IP configuration mode (either DHCP/LLA or Persistent IP) if required via the NIC Configuration tab.

Warning: Changing the NIC IP address may put it on a different subnet than the Genie. Changing the NIC IP configuration first might cause the case where the camera becomes inaccessible from the NIC.
The proper sequence is to first change the camera IP configuration then change the NIC IP.
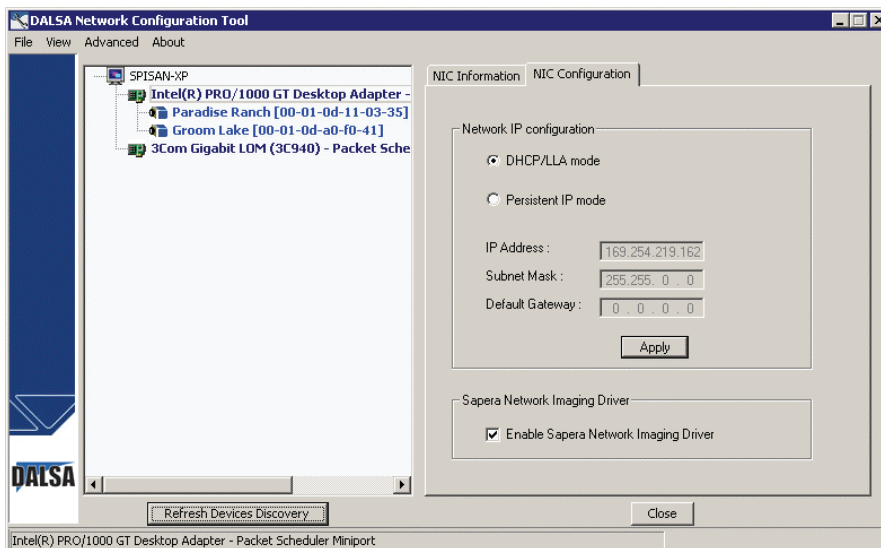
After installation, all system NIC devices have the Sapera Network Imaging driver enabled. Only the NIC connected to a Genie camera requires the Network Imaging driver enabled to capture images from Genie. The Network Imaging driver streams image data efficiently to image buffers.

Select other NIC devices in the system and disable the Network Imaging Driver if they are not used with a Genie camera.

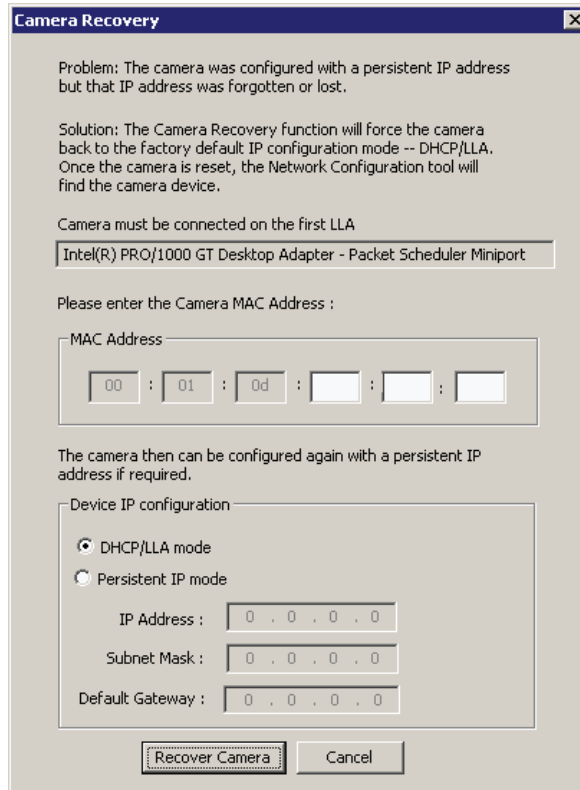## Recovering a Camera with an Unknown Persistent IP

When a Genie camera has been configured with a persistent IP address, that camera can not be controlled if its IP address has been lost or forgotten. The DALSA Network Configuration tool provides a function to recover cameras and reset them back to the DHCP/LLA mode. The camera can also be set to a new persistent IP address immediately if required.

Important: To recover a Genie camera, the camera MAC address must be known. DALSA ships all Genie cameras with a label stating its serial number and MAC address. Additionally the NIC connected to the Genie must be configured for LLA mode.

To recover a Genie:

- Start the Network Configuration program from the windows start menu: **Start•Programs•DALSA•Network Interface•DALSA Network Configuration Tool**.
- From the menu bar click on **Advanced** and then on **Recover Camera**.
- On the dialog enter the camera MAC address and click the Recover Camera button.

Camera Recovery Dialog

INDUSTRIAL
TECHNOLOGIES

- If the camera requires a persistent IP address, select the bullet to assign a persistent IP immediately with recovery. Enter the new IP address and click on Recover Camera.
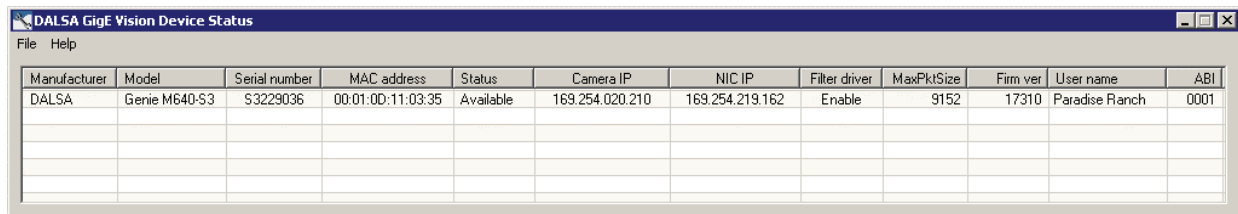
Important: Any changes made with this tool will update the Genie flash memory. Do not remove power from the Genie camera for a minimum 10 seconds.

Sapera GigE Server Details

This section provides additional details on the GigE Server not covered in the Genie installation section of this manual. Generally the Genie automatic installation requires no user intervention.

- The Sapera GigE Server implements the GigE Vision Control Protocol (GVCP). This provides the interface to generate GVCP messages to control and configure a GigE Vision device.
- GigE Server handles the heartbeat messages, allowing an application in development, to be single-stepped while in debug mode, without loss of the camera connection.
- GigE Server is a single application going through the firewall. This simplifies firewall settings as only this application needs to be listed in the firewall exceptions.
- The GigE Server periodically rescans the network to discover any new camera that might have been added to the network. This will also identify devices removed.
- When required, it is possible to disabled the GigE server. A Sapera application will then directly be linked to the library responsible for GigE Vision control channel communications. This can be used to minimize inter-process communications.
- The GigE Server Status window provides valuable information about the GigE Vision devices present on your system (see "Troubleshooting" on page 101).

DALSA GigE Vision Device Status

File   Help

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229036	00:01:0D:11:03:35	Available	169.254.020.210	169.254.219.162	Enable	9152	17310	Paradise Ranch	0001

Status Window Description

User Name	User assigned identification
Manufacturer	Manufacturer for this device
Model	GigE Vision device model
Serial Number	Device serial number
Firm Ver	Device firmware revision number
MAC adddress	Device MAC address
Camera IP	Device current IP address
NIC IP	NIC IP associated with the GigE server
Filter driver	Network driver status
MaxPktSize	Largest packet size that should be used for image streaming. This is found using the Test Packet mechanism of GigE Vision.
ABI	Sapera Application Binary Interface to communicate with the device
Status	General device status
	Note that the user can resize columns or drag any column header to reorder the displayed information. Column order is automatically saved in an .ini file when the Genie Framework is uninstalled and reinstalled.

Creating a Status Report

Before contacting DALSA technical support, the user should review the Troubleshooting section of this manual (see "Troubleshooting" on page 101). Most installation, configuration, and imaging issues are documented along with their solutions.

To aid technical support, the tool can save a network configuration report. From the *File* menu select "*Save current status*". You will be prompted for a filename for the report text file. This file should always be sent with any request for technical support.

Sapera CamExpert Guide

Using CamExpert with Genie Monochrome Cameras

CamExpert is the camera interfacing tool supported by the Sapera library. When used with a Genie camera, CamExpert allows a user to test all Genie operating modes. Additionally CamExpert saves the Genie 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.

For context sensitive help, click on the [image] button then click on a camera configuration parameter. A short description of the configuration parameter will be shown in a popup. Click on the [image] button to open the help file for more descriptive information on CamExpert.

The central section of CamExpert provides access to the Genie parameters. Five tabs group Genie parameters depending on their type as described in the summary below. Each Genie configuration parameter is described in detail following the summary.

Camera Information	Displays Genie firmware details such as camera model, version, serial number and MAC address. Users can set the User ID and set the power-up configuration mode.
Sensor Parameters	Displays both static and variable sensor parameters that are Genie model specific. Variable parameters control Genie exposure, binning, gain and exposure controls. The internal test image is selected here.
I/O Controls	Provides controls for trigger source and I/O pin configuration.
Image Buffer and ROI	Provides controls for buffer pixel depth, image size and cropping.
GigE Vision	Provides advance controls to optimize the network connection.

CamExpert Panes
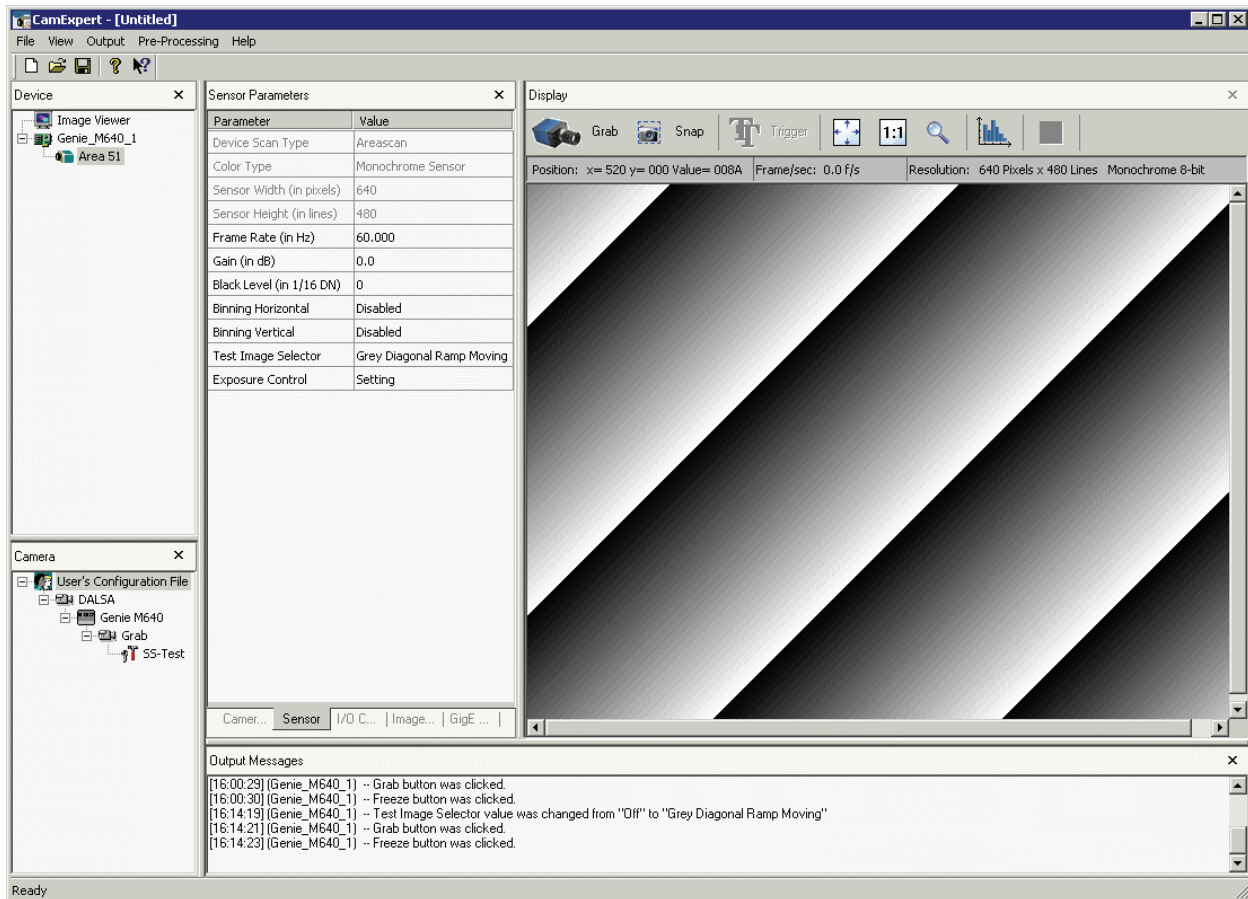
The CamExpert application uses 5 windows to simplify choosing and configuring camera files or acquisition parameters for the installed device.

- **Device pane**: View and select from any installed Sapera acquisition device. Once a device is selected CamExpert will only present acquisition parameters applicable to that device.

- **Parameters pane**: Allows viewing or changing all acquisition parameters supported by the acquisition device. CamExpert displays parameters only if those parameters are supported by the installed device. This avoids confusion by eliminating parameter choices when they do not apply to the hardware in use.

- **Display pane**: Provides a live or single frame acquisition display. Frame buffer parameters are shown in an information bar above the image window.

- **Control Buttons**: The Display pane includes CamExpert control buttons. These are:

Grab / Freeze	**Acquisition control button:** Click once to start live grab, click again to stop.
Snap	**Single frame grab:** Click to acquire one frame from device.
Trigger	**Software trigger button:** With the I/O control parameters set to Trigger Enabled / Software Trigger type, click to send a single software trigger command.
1:1	**CamExpert display controls:** (these do not modify the frame buffer data) Stretch image to fit, set image display to original size, or zoom the image to any size and ratio.
	Histogram / Profile tool: Select to view a histogram or line/column profile during live acquisition.

- **Camera pane**: Allows selecting any camera file that is included with the Sapera installation. Only camera files supported by the selected acquisition device. When there is more then one acquisition server, such as monochrome and RGB, selecting an inappropriate camera file will produce a message prompting you to select the correct acquisition server.
- **Output pane**: Displays messages from CamExpert or the device driver.
- **Video Status bar**: Located on the lower right of the CamExpert window, color coded camera signal status information is displayed. Green for valid signals detected, red for missing or incorrect signals. Video status items may differ with different devices.

Most of these panes can be hidden via the menu bar view command. Typically after selecting an acquisition device and loading a camera file, the Device and Camera windows can be closed.

CamExpert LUT Controls

The Lookup Table dialog allows you to configure the LUT if it is available on the device. Genie monochrome cameras support an 8-bit or 10-bit LUT. To open this dialog, use the Pre-Processing > Lookup Table > Setting menu command. Note that you must first enable the Lookup Table, otherwise the Setting command will be grayed-out.
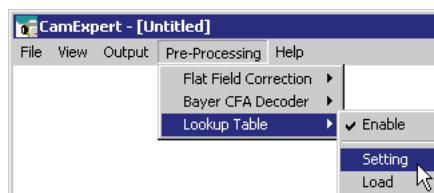
To select the type of LUT to use, click the LUT Mode Value field; a drop-down list box displays the available modes. The Lookup Table dialog displays a graph of the input and output values for the selected LUT. These are CamExpert common examples for LUT operations. A Sapera application can program the Genie LUT for any required LUT operation. See "Lookup Table (LUT)" on page 56 for Genie LUT support.
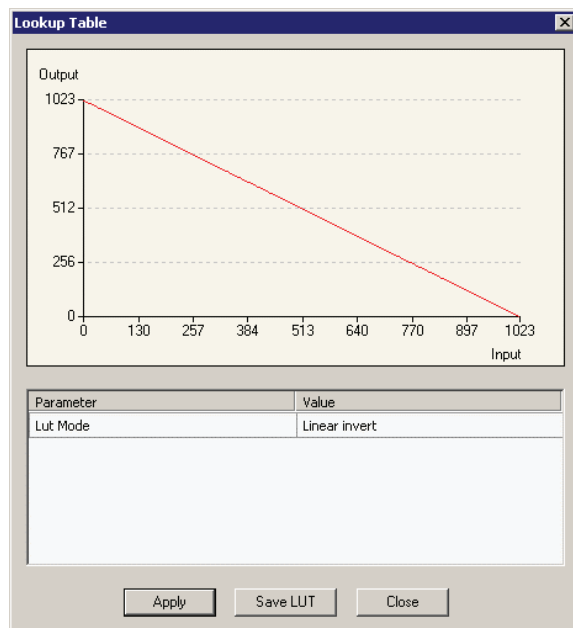
10-bit Invert LUT

CamExpert available LUT examples are briefly described below. The LUT function graphic simplifies understanding the operation especially when user settings modify the LUT function.

- Normal (default): modifies all LUT entries using a linear mapping such that a gray level input is equal to the output
- Arithmetic operation: modifies all LUT entries using an arithmetic operation
- Binary pattern: modifies some LUT entries based on a binary pattern
- Boolean operation: modifies all LUT entries using a Boolean operation
- Gamma correction: modifies all LUT entries using Gamma correction function
- Linear invert: modifies all LUT entries using a linear mapping with a negative slope
- Position shift: modifies LUT entries with a zero position offset
- Bit shift: modifies LUT entries with a binary bit shift
- Slope within range: modifies part of a LUT with a linear mapping
- Single Threshold: modifies all LUT entries using a threshold operation
- Double Threshold: modifies all LUT entries using a dual level threshold operation

Technical Specifications

Mechanical Specifications

The figure below defines the Genie family mechanical specifications. Additional notes follow.
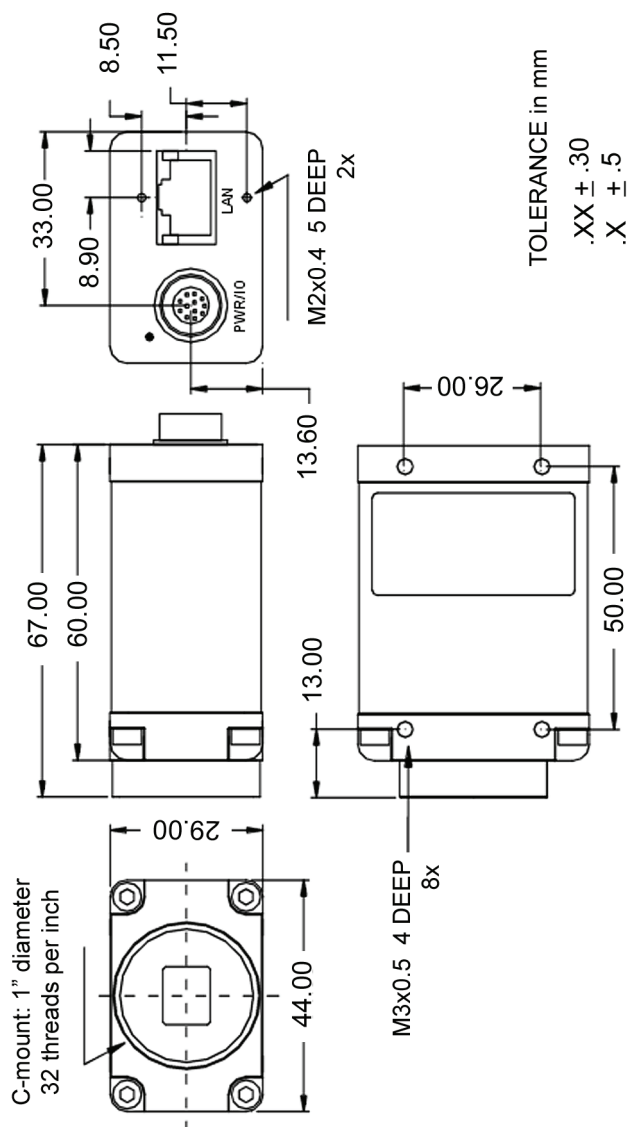
Notes:
Genie supports a screw lock Ethernet cable (see "Ruggedized RJ45 Ethernet Cables" on page 97).
For information on Genie lens requirements see "Optical Considerations" on page 93.
Lens flange focal distance = 17.52 mm.
The camera top also has four mounting holes in identical locations.

Connectors

- A single **RJ45 Ethernet** connector for control and video data to the host Gigabit NIC. Genie is available with an industrial case supporting a screw lock Ethernet cable (see "Ruggedized RJ45 Ethernet Cables" on page 97).

- A single **12-pin Hirose** male connector for power, trigger and strobe signals. The suggested female cable mating connector is Hirose model HR10A-10P-12S.

12-Pin Hirose Connector Signal Details

The following figure shows the pinout identification when looking at the Genie camera 12-pin male Hirose connector. The table below the figure lists the Genie I/O signal specifications.

Pin	Direction	Genie Signal (see details below)	Notes
1	-	Power GND	
2	-	+12V DC power supply	10% tolerance
3	Out	Output 1 -	
4	Out	Output 1 +	
5	In	Input 1 -	RS422- or TTL GND
6	In	Input 1 +	RS422+ or TTL
7	Out	Output 2 + / Strobe +	
8	Out	Output 2 - / Strobe -	
9	-	Reserved	
10	-	Reserved	
11	In	Input 2 +	RS422+ or TTL
12	In	Input 2 -	RS422- or TTL GND
shell / shield	via cable shield	Genie chassis connects to supply earth ground	improves EMI shielding

Genie Signal Electrical Details

- **Power Supply (pin 2)**: +12V DC nominal.
  Operating tolerance +10% to –10%.
  Over voltage and reverse voltage protection circuit built in. The protection circuit is reset by shutting down or disconnecting the power supply.

- The **12-pin Hirose** male connector shell and cable shield should connect to the supply earth ground to improve EMI shielding.

External Inputs

- Opto-coupled (2V to 12V, 2mA minimum) with internal current limit.
- RS422 or TTL signal type.
- Used as trigger or integration control.
- External signal polarity selected via configuration parameter.
- User programmable debounce time from 1 to 255µs.
- See "Input Controls via Sapera LT or GenICam Applications" on page 50.
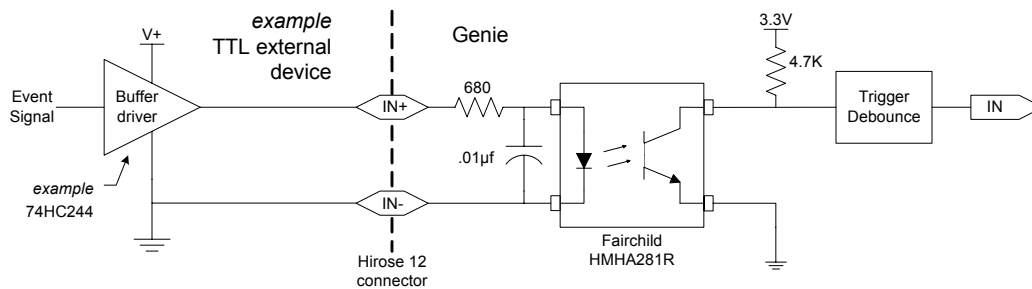
External Input Detail with an Example Signal Driver

The opto-coupler is typically a Fairchild HMHA281 with the following characteristics.

Input Electrical Parameter Description	Value
Voltage threshold to turn OFF	0.8 V
Voltage threshold to turn ON	2 V
Minimum input current to turn ON	2 mA
Maximum input current	50 mA
Minimum input pulse width to turn ON	30 us
Maximum input voltage	13 V

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External Outputs

- Programmable output mode such as strobe, event notification, etc. (see "Output Control via Sapera LT or GenICam Applications" on page 56).
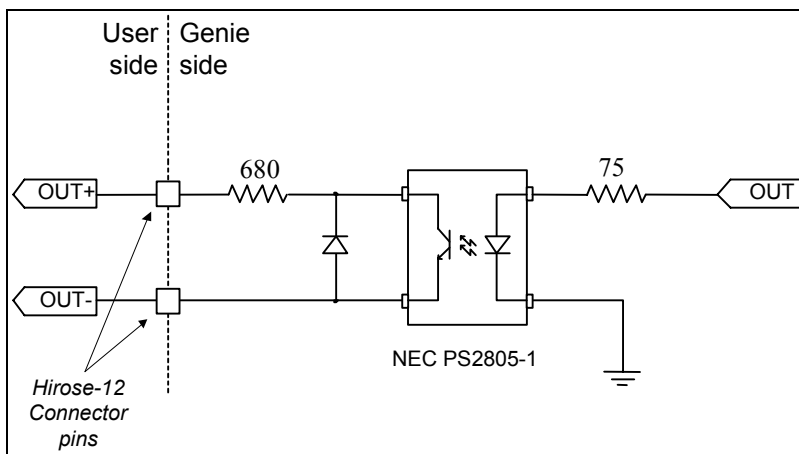
The opto-coupler is typically a NEC PS2805-1 with the following characteristics.

Output Electrical Parameter Description	Value
Maximum voltage difference	13 V
Maximum current through opto-coupler	12mA
Minimum output pulse width	100 us
Maximum switch closure transition time	12 µs
Maximum switch open transition time	40 µs

RJ45 LAN Ethernet Connector Details

The RJ45 LAN connector has two LEDs for network status conditions.

The LED color codes are as follows.

Network Connection		Network Activity	
Green	100Mbps	Off	no network activity
Orange	1000Mbps	Yellow	typically blinking – active

Network Connection ⎯ [RJ45] ⎯ Network Activity
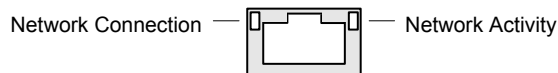
The Genie LAN connector is a standard Ethernet socket. Use CAT5e or CAT6 certified Ethernet cables. CAT5e cable is rated for 100 MHz spectral bandwidth but CAT6 cable is rated for a 200 MHz spectral bandwidth with less signal attenuation, therefore strongly recommended for long connection lengths.

The interconnection Ethernet cable can be either Straight Through or Crossover cable type. The Gigabit Ethernet standard for devices defines that they will auto-negotiate send and receive channels, eliminating the need for users to use a specific Ethernet cable type.

Camera Status LED

The Genie has one multicolor LED to provide a simple visible indication of the operational status of the camera. When more than one condition is active, the LED color indicates the condition with the highest priority. The following table summarizes the LED states and corresponding camera status.

LED State	Definition
LED is off	No power to the camera
Steady Red	Camera not initialized
Slow Flashing Red	Camera initialization problem
Fast Flashing Red	Camera is too hot
Slow Flashing Blue	Waiting for an IP address
Fast Flashing Blue	Ethernet cable disconnected (no link)
Steady Blue	IP address assigned; no application connected to the camera
Steady Green	Application connected
Slow Flashing Green	Triggered acquisition in progress
Fast Flashing Green	Free running acquisition in progress

Optical Considerations

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

Illumination

The amount and wavelengths of light required to capture useful images depend on the particular application. Factors include the nature, speed, and spectral characteristics of objects being imaged, exposure times, light source characteristics, environmental and acquisition system specifics, and more. The DALSA Web site, http://vfm.dalsa.com/, provides an introduction to this potentially complicated issue. Click on the **Application Support** link and then select the **CCD Technology Primer**. Review "Radiometry and Photo Responsivity" along with other sections of interest.

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

Light Sources

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

- LED light sources are relatively inexpensive, provide a uniform field, and longer life span compared to other light sources. However, they also require a camera with excellent sensitivity.
- Halogen light sources generally provide very little blue relative to infrared light (IR).
- Fiber-optic light distribution systems generally transmit very little blue relative to IR.

- Some light sources age such that over their life span they produce less light. This aging may not be uniform—a light source may produce progressively less light in some areas of the spectrum but not others.

Filters

CCD cameras are extremely responsive to infrared (IR) wavelengths of light. To prevent infrared from distorting the images you scan, use a "hot mirror" or IR cutoff filter that transmits visible wavelengths but does not transmit wavelengths over 750nm. Examples are the Schneider Optics™ B+W 489, which includes a mounting ring, the CORION™ LS-750, which does not include a mounting ring, and the CORION™ HR-750 series hot mirror.

Lens Modeling

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

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

Primary Points in a Lens System
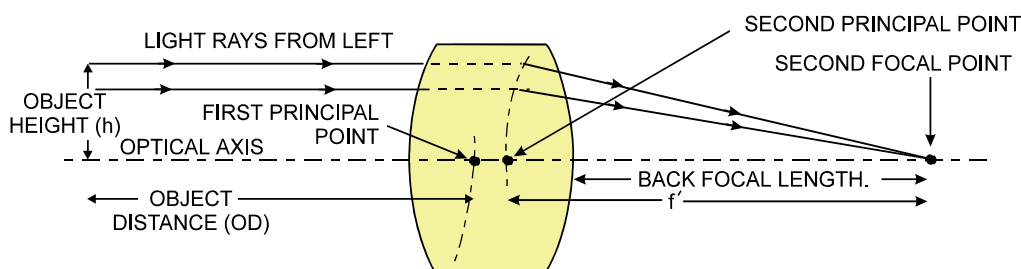
Magnification and Resolution

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

$m = \dfrac{h'}{h}$	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:

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

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

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

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

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

Sensor Handling Instructions

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

Electrostatic Discharge and the CCD Sensor

Cameras contain charge-coupled device (CCD) image sensors, which are metal oxide semiconductor (MOS) devices and are susceptible to damage from electrostatic discharge (ESD).

Electrostatic charge introduced to the sensor window surface can induce charge buildup on the underside of the window that cannot be readily dissipated by the dry nitrogen gas in the sensor package cavity. When charge buildup occurs, surface-gated photodiodes (SGPDs) may exhibit higher image lag or a highly non-uniform response, with some pixels displaying a much higher response when the sensor is exposed to uniform illumination. 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 CCD window is part of the optical path and should be handled like other optical components, with extreme care.

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

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

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

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

Cleaning the Sensor Window

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

- Use compressed air to blow off loose particles. This step alone is usually sufficient to clean the sensor window. Avoid moving or shaking the compressed air container and use short bursts of air while moving the camera in the air stream. Agitating the container will cause condensation to form in the air stream. Long air bursts will chill the sensor window causing more condensation. Condensation, even when left to dry naturally, will deposit more particles on the sensor.

- When compressed air cannot clean the sensor, Dalsa recommends using lint-free ESD-safe cloth wipers that do not contain particles that can scratch the window. The Anticon Gold 9"x 9" wiper made by Milliken is both ESD safe and suitable for class 100 environments. Another ESD acceptable wiper is the TX4025 from Texwipe.

- An alternative to ESD-safe cloth wipers is Transplex swabs that have desirable ESD properties. There are several varieties available from Texwipe. Do not use regular cotton swabs, since these can introduce static charge to the window surface.

- Wipe the window carefully and slowly when using these products.

Environment

Ambient Temperature:	0° to 45° C (operation) 0° to 70° C (storage)
Relative Humidity:	5% to 90% non-condensing (operating) 0% to 95% (storage)

Ruggedized RJ45 Ethernet Cables

Components Express Inc. has available an industrial RJ45 CAT6 cable that on one end has a molded shroud assembly with top/bottom thumbscrews, while the other end has a standard RJ45. This cable is recommended when Genie is installed in a high vibration environment.

Contact sales at DALSA for availability of Genie with female mounts for this secure Ethernet cable.

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/

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)

Computer Requirements for Genie Cameras

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

Host PC System

- Pentium 4 system (or AMD equivalent) with 512 MB system memory.
- System motherboard without an embedded graphic card. Avoid using onboard video cards as they may compete with other components for shared memory.
- High performance video card as either an AGP bus or PCI Express bus.
- Operating System: Windows 2000 SP1 and Windows XP are supported.

Network Adapters

- GigE network adapter (either add on card or on motherboard). The Intel PRO/1000 MT adapter is an example of a high performance NIC. 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.

Laptop Information

- Laptop computers with built in **GigE network adapters** may still not be able to stream full frame rates from Genie. Thorough testing is required with any laptop computer to determine the maximum frame rate possible (see "Laptop Computer Networking Issues" on page 111).

Ethernet Switch Requirements

When there is more than one device on the same network or a camera-to-PC separation greater than 100 meters, an Ethernet switch is required. Since the Genie GigE camera complies with the Internet Protocol, it should work with all standard Ethernet switches. However, switches offer a range of functions and performance grades, so care must be taken to choose the right switch for a particular application. The following switches are expected to work with the camera but manufacturers may change specifications and features at anytime:

- SMC (http://www.smc.com/) TigerSwitch 86xxT family
  Features Layer 2 with IGMP v2.0 that supports jumbo frames and multicast.
  SMC EZ Switch (SMCGS8): low cost switch supporting jumbo frames.
- 3COM (http://www.3com.com/) 3C1740x (3800 Family):
  Features Layer 2 with IGMP v2.0 that supports multicast.
  3COM 3C1770x (4900 Family):
  Features Layer 2 non-blocking switch that converts multicast into a broadcast.
- Dlink (http://www.dlink.com/) DGS-10xxTx 10/100/1000 family:
  Features Layer 2 unmanaged switch that converts multicast into a broadcast.
  DGS-3308FG & DGS-3308-TG
  Features Layer 3 non-blocking switch that supports multicast.
- Cisco (http://www.cisco.com/) WS-C3750G-12S-S:
  Features: Layer 3 switch that supports multicast.

Ethernet to Fiber-Optic Interface Requirements

In cases of camera-to-PC separations of more than 100 meters but an Ethernet switch is not desired, a fiber-optic media converter can be used. The FlexPoint GX from Omnitron Systems (http://www.omnitron-systems.com/) converts GigE to fiber transmission and vice versa. It supports multimode (MM) fiber over distances of up to 220 m (720 ft.) and single-mode (SM) fiber up to 65 km (40 mi.) with SC, MT-RJ, or LC connector types.

Important: The inclusion in this manual 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.

EC & FCC Declaration of Conformity

DALSA

EC & FCC DECLARATION OF CONFORMITY

We :   DALSA Montreal Inc.
                         7075 Place Robert-Joncas, Suite 142,
                         St. Laurent, Quebec, Canada H4M 2Z2

Declare under sole legal responsibility that the following products conform to the
protection requirements of council directive 89/336 EEC on the approximation of the
laws of member states relating to electromagnetic compatibility, as amended by directive
93/68/EEC:

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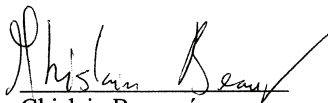
The products to which this declaration relates are in conformity with the following
relevant harmonized standards, the reference numbers of which have been published in
the Official Journal of the European Communities:

EN55022:1998- Residential, Commercial and Light Industry
EN61000-4 (-2, -3, -4, -6, -11): 1998, 2001

Further declare under our sole legal responsibility that the product listed conforms to the
code of federal regulations CFR 47 part 15 for a class A product.

St. Laurent, Canada	January 04, 2007	Ghislain Beaupré
Location	Date	Vice-President,
		Research & Development

Troubleshooting

Overview

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

The GigE Server status provides visual information on possible Genie problems. The three states are shown in the following table. Descriptions of possible conditions causing an installation or operational problem follow. Note that even a Genie 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 Genie device is not found. This indicates a network issue where there is no communication with Genie.	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 Genie device is found. The Genie has obtained an IP address and there are no network issues. Optimization may still be required to maximize performance.

Problem Type Summary

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

Device Not Available

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

- Review the section "Installation Overview & Preparations" on page 18 to verify required installation steps.
- See "Verifying Network Parameters" on page 115 to review networking details.
- See "VPN Driver Interference" on page 115 if using Genie Framework previous to release 1.20.

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.

- "GigE Server Warning Example 1a: IP error with multiple NICs" on page 103
- "GigE Server Warning Example 1b: IP error with multiple NICs" on page 104
- "GigE Server Warning Example 2: Subnet Mask or IP error" on page 105
- "GigE Server Warning Example 3: Filter Driver (CorSnid) Disabled" on page 105

Device Available but with Operational Issues

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

- "Firmware Updates" on page 106
- "Power Failure During a Firmware Update–Now What?" on page 107
- "Streaming Error" on page 107
- "Test a Genie Using Internal Test Patterns" on page 109
- "Cabling and IP Configuration Issues" on page 109
- "Grab has Random Bad Data or Noise" on page 110
- "Laptop Computer Networking Issues" on page 111
- "Ethernet Switch Issues" on page 113
- "Multiple Camera Issues" on page 113
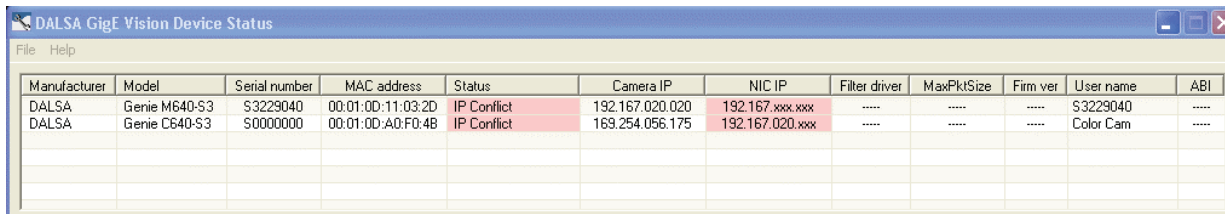- "Camera Exposure Issues" on page 114

Installation Issues and Functional Problems

This section covers issues indicated by the GigE server tray icon shows a warning symbol.

GigE Server Warning Example 1a: IP error with multiple NICs

The screenshot below shows an IP conflict error due to two (or more) NICs that are all set to LLA mode. In this case both NICs are assigned the same IP address preventing communication with any connected Genie.

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229040	00:01:0D:11:03:2D	IP Conflict	192.167.020.020	192.167.xxx.xxx	-----	-----	-----	S3229040	-----
DALSA	Genie C640-S3	S0000000	00:01:0D:A0:F0:4B	IP Conflict	169.254.056.175	192.167.020.xxx	-----	-----	-----	Color Cam	-----
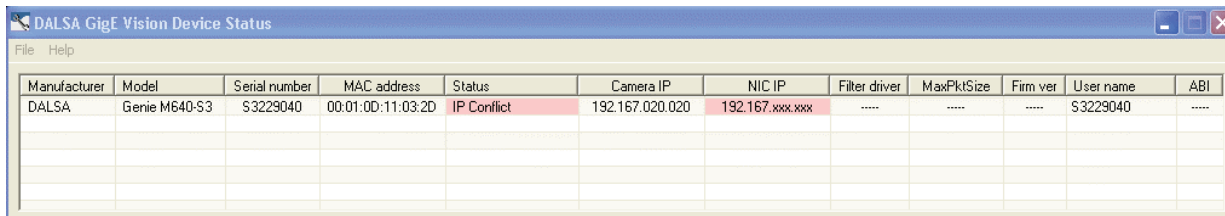
- When multiple NICs are used, only one can be set to LLA mode. A second NIC connected to Genie must use the persistent IP mode or must have a DHCP server on that subnet. The following illustration shows such a setup.
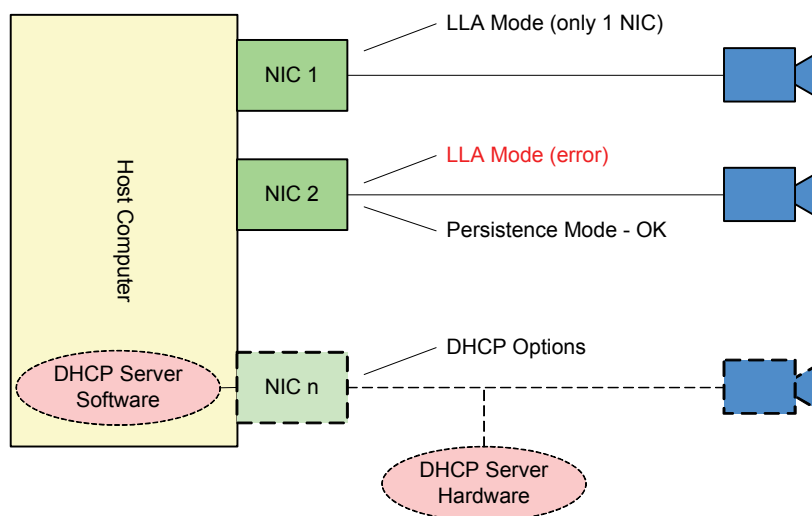
- For more information see "Multiple Camera Issues" on page 113, "Using Genie with Ethernet Switches" on page 17, and "IP Configuration Mode Details" on page 77.

GigE Server Warning Example 1b: IP error with multiple NICs

As a second example, the screenshot below shows an IP conflict error similar to the example above but the second NIC has no camera connected (or only an Ethernet switch).

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229040	00:01:0D:11:03:2D	IP Conflict	192.167.020.020	192.167.xxx.xxx	-----	-----	-----	S3229040	-----
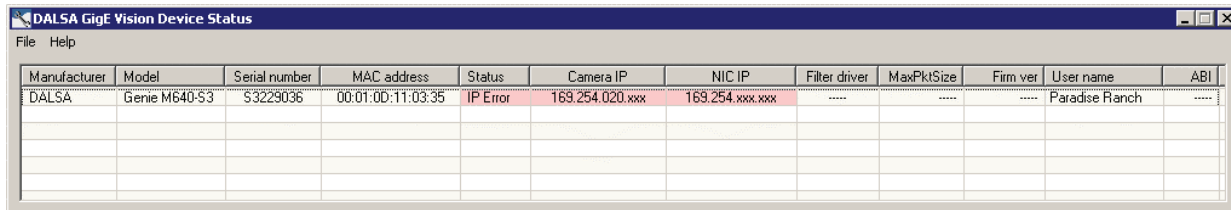
- The following illustration shows an example of this fault condition. The second NIC has not Genie connected ether directly or via a switch.
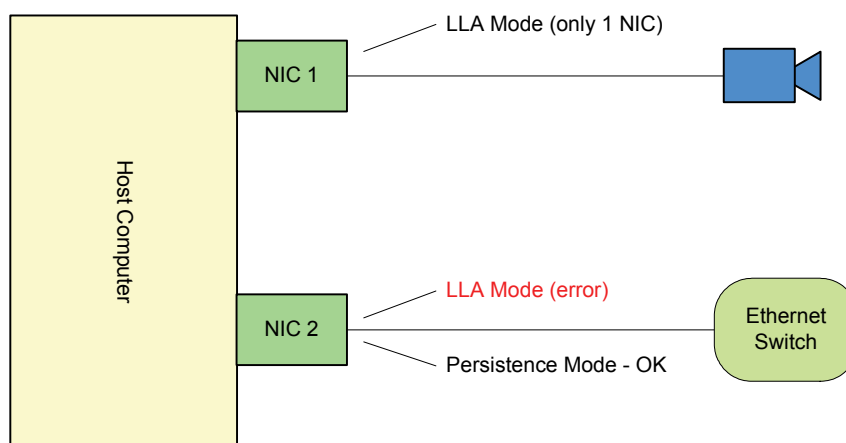
- The solution again is that the second NIC must use the persistent IP mode or must have a DHCP server on that subnet.

- For more information see "Multiple Camera Issues" on page 113, "Using Genie with Ethernet Switches" on page 17, and "IP Configuration Mode Details" on page 77.

GigE Server Warning Example 2: Subnet Mask or IP error

The screenshot below shows that the Genie device is not accessible. This IP error is an example of the Genie being assigned a persistent IP address with an incorrect subnet mask.
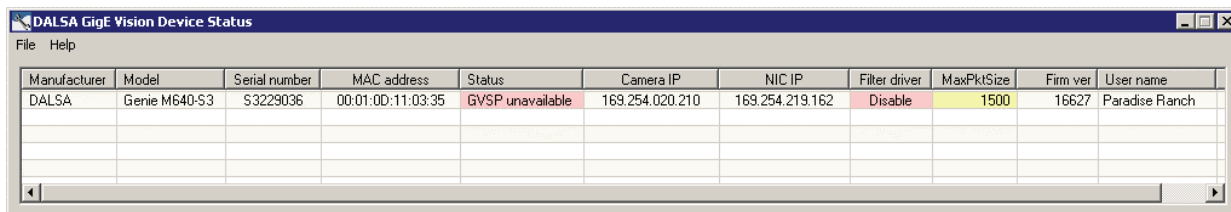
Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name	ABI
DALSA	Genie M640-S3	S3229036	00:01:0D:11:03:35	IP Error	169.254.020.xxx	169.254.xxx.xxx	-----	-----	-----	Paradise Ranch	-----

- This example error was made using the DALSA Network Configuration tool, where the Genie was set to Persistent IP mode with an incorrect subnet mask.

- Once the incorrect setting was applied, the Genie was not accessible to the Network Configuration tool or any application.

- The DALSA Network Configuration tool provides a device recovery function to force the Genie back to LLA mode. See "Recovering a Camera with an Unknown Persistent IP" on page 82.

- An alternative solution is to change IP address of the NIC to match the camera subnet. This might be preferable if a DHCP server is running on this segment (as the Recovery process requires the NIC to be in LLA mode).

GigE Server Warning Example 3: Filter Driver (CorSnid) Disabled

The screenshot below shows that the Genie device was found but there is an issue with the filter driver (CorSnid). Such problems occur because the filter driver has become disabled or never installed correctly.

Manufacturer	Model	Serial number	MAC address	Status	Camera IP	NIC IP	Filter driver	MaxPktSize	Firm ver	User name
DALSA	Genie M640-S3	S3229036	00:01:0D:11:03:35	GVSP unavailable	169.254.020.210	169.254.219.162	Disable	1500	16627	Paradise Ranch

- Verify that the Filter driver is enabled in the properties for the NIC used with Genie. The screenshot below shows a typical installation.
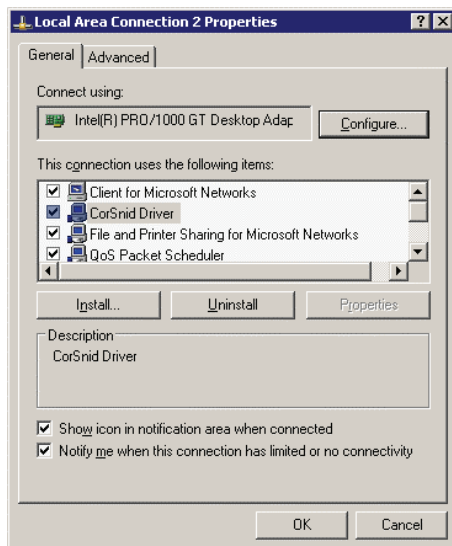
- Information about the CorSnid driver is also available from Network Configuration tool.

Device Available with Operational Issues

This section considers issues with cabling, Ethernet switches, multiple cameras, and camera exposure.

Firmware Updates

As a general rule any Genie installation must include the firmware update procedure (see "Updating Genie Firmware" on page 27). Genie camera firmware that does not match a newer version of installed Genie Framework software is likely to have unpredictable behavior. Problems might be:

- Genie is not found by the device discovery process.
- Genie is found by the Sapera GigE Server but an application such as CamExpert does not see the camera.

Important: New Genie cameras installed in previously deployed systems are fully backward compatible with the older vision application. New Genie cameras must not be programmed with older firmware.

Power Failure During a Firmware Update–Now What?

Don't panic! There is far greater chance that the host computer OS is damaged during a power failure than any permanent problems with the Genie. When electrical power returns and the host computer system has started, the Genie firmware reprogramming sequence is as follows.

- Connect power to the Genie. The Genie processor knows that the operating firmware is corrupt.

- The Genie status LED is slow flashing red. This will continue for about 2 minutes (pre-2007 Genie cameras may take up to 5 minutes and has no led status).

- During this period, the Genie is loading embedded write-protected firmware. When the status LED goes blue the Genie is initialized with a minimal safe boot firmware.

- The Genie is now operating normally as a network device but will not function as a camera.

- Perform the firmware update procedure (see "Updating Genie Firmware") again. The Genie is now be ready for use.

Streaming Error: No Acquisition with a Timeout Message

A streaming error is typical with a firewall not allowing the filter driver through. As an example, CamExpert will run (but start slowly due to initialization timeouts), the Genie is visible in the device pane, but no parameters are shown to control the camera.

- If the host computer is using a firewall, either add the GigE Server in the firewall exception list or disable the firewall completely on the NIC used only with the Genie. Review the following information on disabling Windows Firewall on the NIC used with Genie.

- Run the Sapera log viewer program. A firewall block is identified as a timeout event as shown in the following screen capture (the Genie identifier will match the Genie in use).
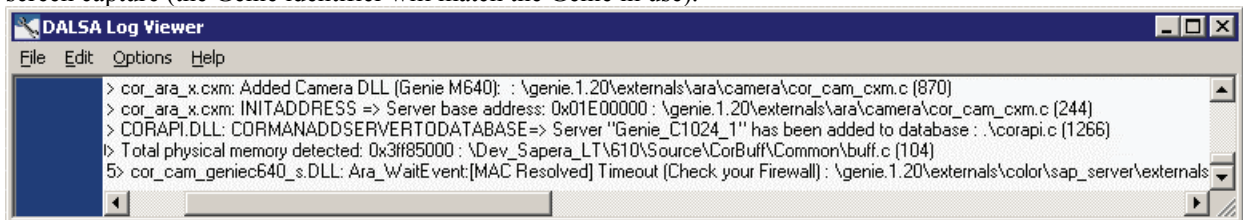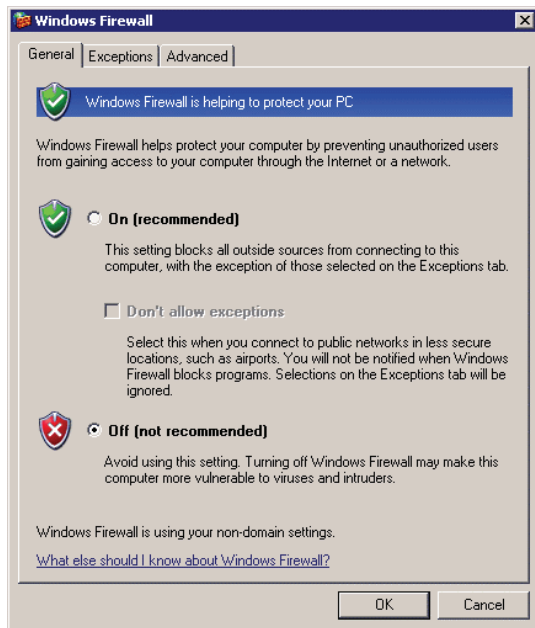

Disabling Windows Firewall

Connecting the Genie camera to a system running a firewall would require careful planning of the camera IP and the ports used by the streaming video and messaging. In general, the Genie camera is installed in a private network or within a corporate network with an external firewall. In both these cases, the host system that the Genie connects to does not need to run a firewall, therefore eliminating installation issues.

The Network Configuration tool automatically adds the Sapera GigE Server in the list of Exceptions of the Windows firewall. Therefore, in most situations, you don't have to take any special precaution to have the Genie run through the firewall.

The following figure shows how to turn off the Windows XP firewall when the computer is behind a corporate network firewall. Run the Windows firewall application from the start menu **Start ● Settings ● Control Panel ● Windows Firewall**. If the host computer is running a firewall from a third party, review the program's documentation to disable its execution.

Turning Windows Firewall Off

With a computer that is not behind a corporate firewall an alternative is to disable Windows firewall only for the network adapter dedicated for the Genie camera. Such a computer would have two or more network adapters where one NIC only connects to the Genie—never the Internet.

The following figures show an example of the Windows firewall On but disabled for the network adapter used by Genie.
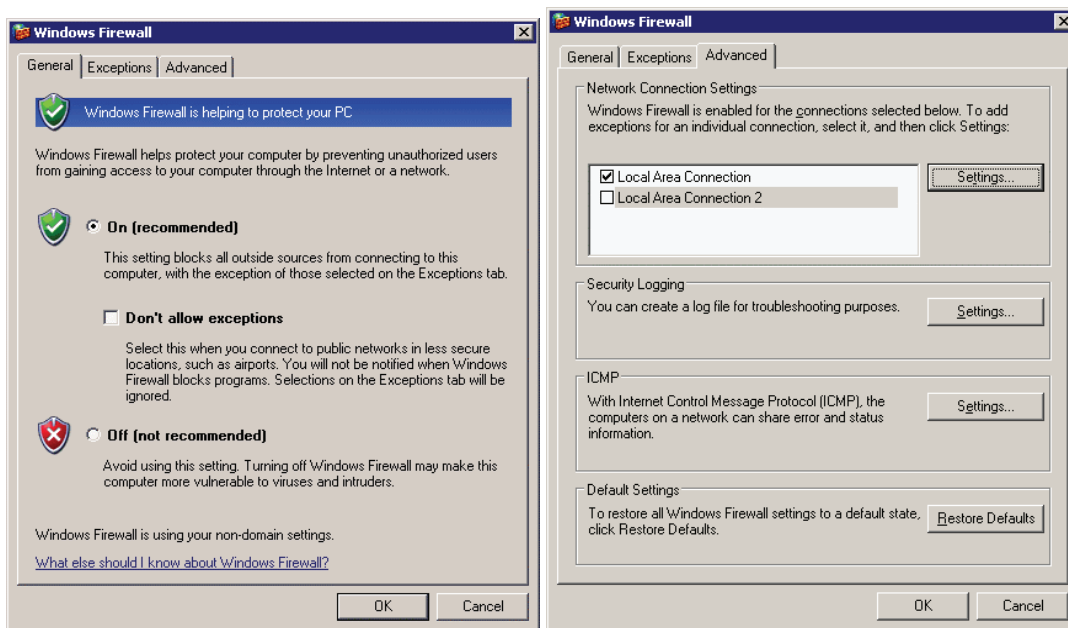
Windows Firewall Off for Genie Only

Test a Genie Using Internal Test Patterns

The Genie test pattern mode allows quick verification of an installation without the need for correct lighting or lens. Troubleshooting physical connection issues or communication problems is made easier knowing that the camera can output a known video signal at selectable frame rates. See "Internal Image Test Patterns" on page 62 for information on using CamExpert to select internal patterns from Genie.

Cabling and IP Configuration Issues

With only two cables connected to Genie, possible cabling issues are limited.

Power supply problems:

- If the Genie status LED is off, the DC supply power is not connected or faulty. Verify the power supply voltage at the Hirose connector. See "12-Pin Hirose Connector Signal Details" on page 90 for pinout information.

Communication problems:

- Use a shielded cable where the Hirose connector shell electrically connects the Genie 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 Genie 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 the Genie Ethernet status LED to confirm a gigabit connection. Note that a gigabit connection may still have many packet resends, rendering the connection useless. This condition has been seen with different NIC products.
- Use a secured Ethernet cable when the Genie is in a high vibration environment. See "Ruggedized RJ45 Ethernet Cables" on page 97.
- Check the Ethernet status LEDs on the Genie RJ45 connector. The network speed indicator should show the expect connection speed and the activity LED should flash with network messages.
- Verify that the Ethernet cable is CAT5e or CAT6. This is very important with long cable lengths.
- When using very long cables, up to the maximum specified length of 100m for gigabit Ethernet, different NIC hardware and EMI conditions can affect the quality of transmission.
- Minimum recommended Ethernet cable length is 3 feet (1 meter).
- Use the Log Viewer tool (see point below) to check on packet resend conditions.
- See "RJ45 LAN Ethernet Connector Details" on page 92 RJ45 LAN Ethernet Connector Details for more information on the Ethernet connection status LEDs.
- The Genie camera status LED, when connected and assigned an IP address will light steady blue. See "Camera Status LED" on page 93 for details on all camera states indicated by the LED.
- When using a VLAN Ethernet switch, the Genie and controlling computer must be on the same subnet setup on that VLAN switch. See "Using Genie with a VLAN Ethernet Switch" on page 18.
- Run the Sapera Log Viewer: **Start•Programs•DALSA•Sapera LT•Tools•Log Viewer**. Start the Genie 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.

Streaming Video (grab) Issues

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 DALSA engineering while working with Genie in various computers and setups.

Grab Remains Black

While using CamExpert to test a Genie installation, there are no obvious installation problems. But when Grab is clicked in CamExpert, a grab failure occurs. The grab remains black and an Abort message is displayed.

- Typically this problem occurs when the video stream is blocked by a third-party firewall program. Configure the firewall to pass GigE Vision applications.

- Confirm that the problem is the firewall settings and not the Genie sensor by configuring Genie to output its internal test pattern (see "Internal Image Test Patterns" on page 62).

- Computers with **VPN software** installed most likely need to have the VPN driver disabled in the NIC properties. This would be required only on the NIC used with the Genie.

Grab has Random Bad Data or Noise

The problem is seen as random noise and missing sections of video data from the acquisition. All configuration parameters seem correct and the Ethernet cable is secure. The following image shows an example of this type of bad acquisition while testing a Genie installation with CamExpert (with the Genie set to generate its internal test pattern).
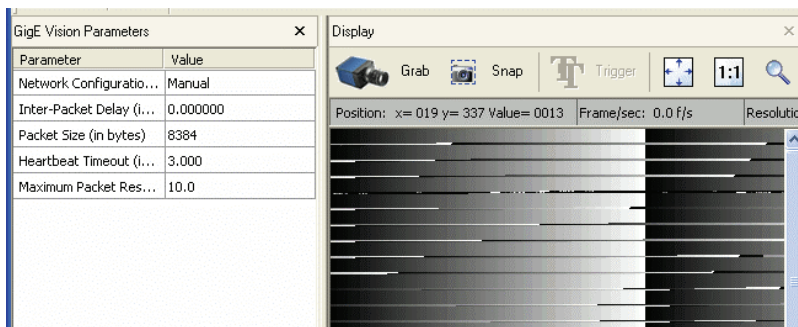
Following are various examples of this data transmission problem. The solutions vary but commonly involve reducing the maximum packet size claimed by the NIC used.

Grab has Random Bad Data or Noise – Case 1

- This problem has been seen on some computers where the NIC used does not fully support passing the maximum jumbo frame possible from the Genie.

- In the NIC configuration, keep the jumbo frame size set to the maximum allowed. See "Increasing Adapter Buffers and Jumbo Frames" on page 24.

- Using CamExpert, test for a good acquisition by reducing the Genie packet size used. See "CamExpert GigE Vision Parameters" on page 65. Also check for packet resend messages with the Sapera tool "Log Viewer".

Grab has Random Bad Data or Noise – Case 2

- This problem has been seen with network adapters using the Realtek RTL8169 chip and associated low-level driver. In this case the NIC reports a false maximum jumbo frame size.

- In the NIC configuration, set the jumbo frame size set to less than the maximum allowed. In this example the NIC reports supporting a maximum jumbo frame size of 8384 but good acquisitions are possible only when the size is reduced to 7k. See "Increasing Adapter Buffers and Jumbo Frames" on page 24. and the image below.
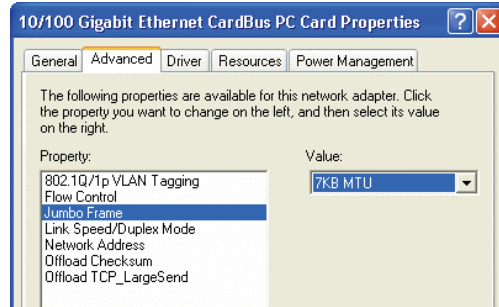
- Using CamExpert, test for a good acquisition by reducing the Genie packet size used. Set the value to the new reduced size set in the NIC configuration. See "CamExpert GigE Vision Parameters" on page 65.

- Verify there are no packet resend messages with the Sapera tool "Log Viewer".

Grab has Random Bad Data or Noise – Case 3

- This problem has also been seen with network adapters that do not support jumbo frames but still report a false maximum packet frame size.

- When using CamExpert, if the Network Configuration Mode is left as Automatic (default), CamExpert uses the value the NIC reports as its maximum. This maximum value is actually not supported.

- Test for a good acquisition by reducing the Genie packet size used. Set the value to a starting value of 1500 to verify acquisition before trying a higher value. See "CamExpert GigE Vision Parameters" on page 65.

Laptop Computer Networking Issues

Laptop computers with built in GigE network adapters may still not be able to stream full frame rates from Genie. Laptops with gigabit Ethernet PCMCIA boards may not be able to stream video at all unless network parameters are modified. Thorough testing is required with any laptop computer.

Streaming video problems may change depending on the computer chipset and NIC combinations. Laptops running on battery power may exhibit more bandwidth issues due to the inherent power saving characteristics of laptops.

This section describes a few configuration items to modify for best performance. Verify the Genie at the frame rates required or to determine the maximum frame rate possible with the laptop used.

Configuration Recommendations with Laptops

- In the NIC configuration, keep the jumbo frame size set to the maximum allowed. See "Increasing Adapter Buffers and Jumbo Frames" on page 24.

- If **VPN software** is installed, most likely the VPN driver must be disabled in the NIC properties (open via Control Panel). This would be required only on the NIC used with the Genie.

- Run the Sapera Log Viewer: **Start•Programs•DALSA•Sapera LT•Tools•Log Viewer**. Start the Genie acquisition program, such as CamExpert. There should not be any "packet resend" messages, else this indicates problem due to poor connections or extremely high EMI conditions.

- Packet resends might also be eliminated by adjusting the GigE parameter *Inter-Packet Delay*. Using CamExpert (see "CamExpert GigE Vision Parameters" on page 65), increase the inter-packet delay value from 0 to 0.000050 (50µs) and test again.

Problems when Changing the Laptop NIC

If a laptop has had a Genie installed on it and a new NIC is later installed on the laptop, a Genie connected to the new NIC will not be found. A quick solution is to deselect/reselect the CorSnid driver on that NIC as follows.

- Open the NIC properties (the one connected to Genie) via Control Panel.
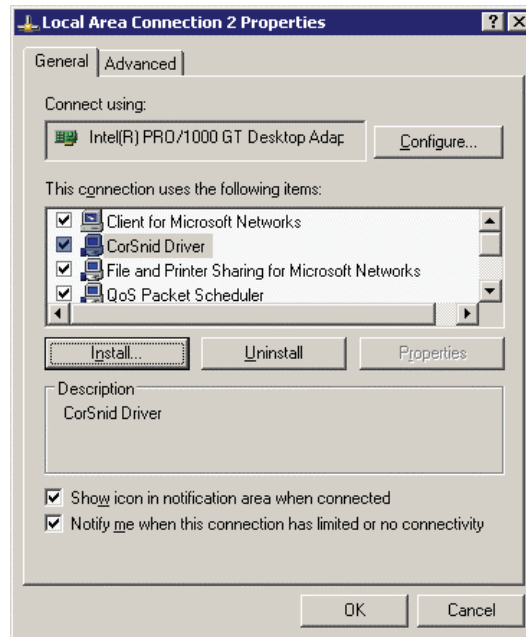
CorSnid Driver Selection

- Deselect the CorSnid driver and click the OK button.
- Open the NIC properties again and reselect the CorSnid driver.
- The Genie will now be found via the automatic device discovery process. This will take a few seconds.

Problems with Disconnecting NICs

Genie cameras installed in environments with physical motion, vibrations, or high EMI may be disconnected by the NIC. The following items need to be reviewed to solve the problem.

- Motion or vibrations may cause data loss because the Ethernet cable connection is not secure. Use a locking Ethernet cable (see "Ruggedized RJ45 Ethernet Cables" on page 97).

- High EMI may cause the NIC to drop data or to disconnect and reconnect at a lower data rate. Such situations do not have simple solutions and may require an expert consultant.

- Some NIC products may not tolerate any data disruptions. Any condition causing the NIC to drop the connection may make it unrecoverable. Communication with the Genie can not be reestablished without power cycling. In this case, trying a variety of NIC products is suggested.

Ethernet Switch Issues

An Ethernet switch usually works transparently and presents no problems. Review the following list when troubleshooting switch issues.

- Is the Ethernet switch powered on.
- Are all ports used configured as active; not disabled.
- Are all ports running at gigabit speeds–not low speed (i.e. not 10 or 100 Mbps).
- Is the switch configured to use Jumbo Frames.
- Verify the Ethernet cabling. Poor cables will cause connections to auto-configure at lower speeds.
- When using a VLAN Ethernet switch, confirm that the Genie and controlling computer are on the same VLAN group setup on that switch.
- When using a chain of switches, ensure that inter-switch connection speeds are the same (1000 Mbps).

Multiple Camera Issues

- When using multiple cameras with a computer with multiple NIC ports, confirm each Genie has been assigned an IP address by checking the GigE server (see "Sapera GigE Server Details" on page 83).

- Do not use multiple NIC port configured in LLA. In this case use a DHCP server or persistent IP.

- When using multiple cameras connected to an VLAN Ethernet switch, confirm that all cameras are on the same subnet setup on that switch. See "Using Genie with a VLAN Ethernet Switch" on page 18.

Camera Exposure Issues

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 monochrome Genie frame rate maximum will be around 30 fps for a 640x480 exposure. Higher resolution Genie models would have even lower frame rates without a Gigabit Ethernet connection.
- If using an external trigger, verify the trigger source rate and Genie parameters such as trigger to exposure delay.
- Verify the exposure mode type is Synchronous, not Reset mode. (See "Synchronization Timing" on page 46).

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

- Verify that the lens iris is open.
- Aim the Genie at a bright light source.
- Check that the programmed exposure duration is not too short or set it to maximum. See "Exposure Controls" on page 43.
- Using CamExpert set the Genie to output its internal pattern generator. This step is typically done for any camera installation to quickly verify the Genie and its software package.

Verifying Network Parameters

DALSA provides the Network Configuration tool to verify and configure network devices and the Genie network parameters. See section "Network Configuration Tool" on page 79 if there were any problems with the automatic Genie software installation.

VPN Driver Interference

VPN (virtual private network) software using a driver component called "Deterministic Network Enhancement" has been identified as interfering with the Genie operation when using Framework versions previous to 1.20. At the time to solution was to disable this VPN driver by deselecting the component from the NIC properties (see following figure).

With Genie Framework version 1.20 or later, there is no need to disable this VPN component.

FABER INDUSTRIAL TECHNOLOGIES
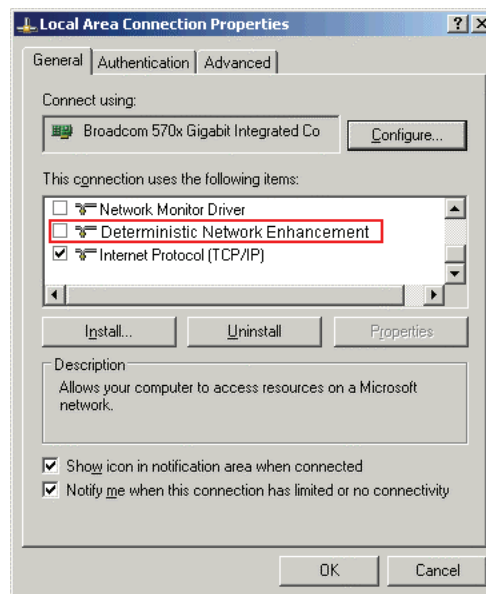
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Any support question or request can be submitted via our web site:

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

Glossary of Terms

ARP

Address Resolution Protocol provides a way to retrieve the MAC address associated to an IP address.

Bandwidth

Describes the measure of data transfer capacity.

CAT5e Ethernet cable

Category 5e was designed for transmission speeds of up to 1 gigabit per second (Gigabit Ethernet).

CAT6 Ethernet cable

Same as Category 5e, except that it is made to a higher standard. Supports transmission speeds greater than Gigabit Ethernet with less signal attenuation over a given length of cable.

CCD – Charge-Coupled Device

A type of image sensor converting light into electrical charges.

Contiguous Memory

A block of physical memory occupying consecutive addresses.

DHCP (Dynamic Host Configuration Protocol)

Protocol which provides a mechanism for allocating IP addresses dynamically by a DHCP server on a network. Typically dedicated DHCP servers are a component of corporate networks. Used for managed networks.

Driver

Also called a device driver, a program routine that links a peripheral device to the operating system. a device driver is required for its frame grabber capabilities.

DSNU

Dark Signal Non-Uniformity (equivalent to FPN).

Ethernet Switch

A network device performing bridging at full wire-speed based on MAC addresses. Packet collisions are eliminated when using a full duplex switch. An Ethernet Switch operates at Layer 2 of the seven-layer OSI model.

FPN

Fixed Pattern Noise (equivalent to DSNU). FPN is the peak to peak difference between the minimum and maximum measured values for all active valid pixels sensor in darkness. Fixed Pattern Noise does not include a Random Noise component.

Frame

One complete image data set or its equivalent storage space.

Frame buffer

An area of memory used to hold a frame of image data. A frame buffer may exist on the acquisition hardware or be allocated by the acquisition hardware device driver in host system memory.

GigE Vision specification

Specification of the Automated Imaging Association (AIA, www.machinevisiononline.org). Defines the communication interface protocol used by any GigE Vision device.

GenICam specification

Specification of the European Machine Vision Association (EMVA, www.emva.org). Defines the capabilities of any GigE Vision device.

Grab

Acquiring an image frame.

Grayscale

In image processing, the range of available brightness levels, displayed in shades of gray. In an 8-bit system, the gray scale contains values from 0 to 255. A 10-bit system has a range of 0-1023.

GVCP – GigE Vision Control Protocol

One of the core protocols of the GigE Vision specification used to control camera. GVCP uses UDP port 3956 on the camera.

GVSP – GigE Vision Stream Protocol

One of the core protocols of the GigE Vision specification used to stream images.

Host

Refers to the computer system that supports the installed frame grabber.

IP – Internet Protocol

The Internet Protocol is the method by which data is sent from one computer to another on a network or across the Internet. Each device must have an IP address to identify that device on the network or on the Internet.

LLA

Link-Local Address is a protocol providing a scheme for devices to automatically assign themselves an IP address and check for IP conflict. Used in unmanaged networks.

NIC

Network Interface Card/Controller. For the Genie products the NIC must be a Gigabit Ethernet interface to provide sufficient bandwidth.

Pixel

A contraction of "picture element". The number of pixels describes the number of digital samples taken of the analog video signal. The number of pixels per video line by the number of active video lines describes the acquisition image resolution. The binary size of each pixel (e.g., 8-bits, 16-bits, 24-bits) defines the number of gray levels or colors possible for each pixel.

PRNU

Photo-Response Non-Uniformity. For a given even illumination the difference between the minimum and maximum measured pixel values is the PRNU.

Progressive Scan Camera

The progressive scan format outputs data from the camera (the signal) in sequential order as it is scanned. The scan format produces a full frame of video in a continuous stream, rather than half the image per output sequence in standard interlaced cameras.

Random Noise

Random noise is defined as the difference in peak to peak value for any single pixel repetitively sampled, with the sensor in darkness. For digital cameras the measurement is based on at least 512 samples from any pixel.

Router

A Router device forwards packets across networks. It operates at Layer 3 of the seven-layer OSI model. Note that broadcast packets (such as GigE Vision Device Discovery message) do not cross routers.

SAT

Saturation Output Amplitude. SAT is the average maximum output level for a specified light input.

Scatter Gather

Host system memory allocated for frame buffers is virtually contiguous but physically scattered throughout all available memory.

SNR

Signal to Noise Ratio. SNR measures the ratio between random noise and an arbitrary reference signal on the transmission path or within a device.

Subnet

The subnet is identified by performing the logical AND of the IP address with its subnet mask.

TCP

Connection-oriented transport protocol providing robustness and reliability. Used by many Internet application, such as HTML.

Trigger

A mechanism that initiates an action when an event occurs such as synchronizing an image acquisition to an external event. A trigger generally causes a program routine to be executed such as the resetting of camera exposure and/or the firing of a strobe light.

UDP

User Datagram Protocol is a connectionless transport protocol providing no guaranty of delivery or reliability. GigE Vision Control Protocol and GigE Vision Stream Protocol are based on UDP.

VLAN

A Virtual Local Area Network is a flexible arrangement where computers connected via a VLAN Ethernet switch are not necessarily on the same LAN broadcast domain. Refer to the VLAN Ethernet switch documentation for implementation and configuration details.

VPN

A virtual private network is a private data network that makes use of the public telecommunication infrastructure, maintaining privacy through the use of a tunneling protocol and security procedures. The idea of the VPN is to give the company the same capabilities at much lower cost by using the shared public infrastructure rather than a private one. (source: www.netunlimited.com/glossary.html)

Index