



```
// Create an instant camera object with the first
Camera_t camera( CTIFactory::GetInstance().Creat

// Register an image event handler that accesses
camera.RegisterImageEventHandler( new CSampleImage
Ownership_TakeOwnership);

// Open the camera.
camera.Open();
```

## Quick Install Guide Line Scan

*Installation of a Basler racer 2 CXP Camera with a Basler Frame Grabber or Interface Card and Software*

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## Requirements

To use the Basler racer 2 line scan CXP camera, you need the following:

- The Basler racer 2 L or racer 2 S CXP camera and a lens
- CXP-12 data cable(s) for full speed operation
- One of the following frame grabbers or interface cards:
  - imaWorx CXP-12 Quad (for 1, 2, or 4 cameras with optional trigger extension board)
  - CXP-12 Interface Card 4C (for 1, 2, or 4 cameras)
  - CXP-12 Interface Card 2C (for 1 or 2 cameras)
- Software:
  - Framegrabber SDK 5.11.0 or higher (Windows, Linux) including driver, applets (i.e., a frame grabber FPGA program), Framegrabber SDK API, GenTL Producer, microDisplay X image viewer for line scan camera installation and calibration. The line scan applets that are required to work with a racer 2 camera are only delivered with the Framegrabber SDK 5.11.0 or higher. Therefore, you must install the Framegrabber SDK 5.11.0 or higher, if you want to use a racer 2 camera in combination with a frame grabber.
  - In addition to the Framegrabber SDK 5.11.0 (or higher), you can also use pylon 7.3.0 or higher (Windows, Linux) including pylon API and pylon Viewer to verify your settings. You must configure pylon 7.3.0 (or higher) as described in the [Installing pylon](#) section.

### Restrictions When Working with pylon 7.3.0

There are a few restrictions when configuring racer 2 cameras with pylon 7.3.0:

- No dynamic image heights: The image trigger modes **Gated**, **External Triggered** and **Gated Multi Buffer**, **External Triggered** don't work properly.
- No automatic configuration of the ROI via the pylon Viewer
- No line profile

Future versions of the Basler pylon Camera Software Suite will fully support the configuration of racer 2 cameras and Basler frame grabbers or interface cards.

Alternatively, you can calibrate your images with microDisplay X, which is included in the Framegrabber SDK.

## Additional Requirements for Single Channel Usage

In this case, you can either use one camera with the CXP-12 Interface Card 1C, or two cameras together with the CXP-12 Interface Card 2C, or four cameras together with the Interface Card 4C or the imaWorx CXP-12 Quad frame grabber. See [Possible Topologies](#) for more information.

## Additional Requirements for External Signal Sources

If you want to connect an external signal source, you need either:

- A trigger cable connected to the frame grabber (line and frame trigger) or a trigger board, or
- A trigger cable connected to the camera (line trigger only), or
- An I/O card connected to the host computer for more complex configurations.

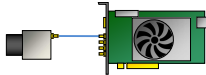
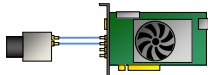
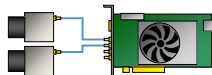
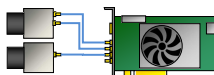
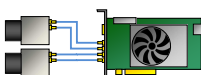
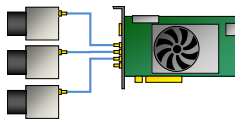
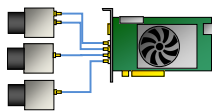
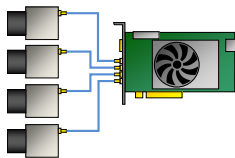
For more details, refer to the following topics of the Basler Product Documentation: [GPIO Connectors](#), [Trigger Applications](#), and [Triggered Image Acquisition](#).

You can order the following accessories for your frame grabber or interface card:

- [I/O Cable, Micro-D15 / open, 1.83 m - I/O & Power Cables](#), order number: 2200000467
- [Opto-coupled Trigger 5 - Trigger board](#), order number: 2200000371
- [TTL Trigger - Trigger board](#), order number: 2200000373

## Possible Topologies

You can operate Basler racer 2 CXP cameras with a Basler CXP frame grabber or CXP interface card as follows:

Number of Cameras	Number of Camera Channels	Topology
1	1	
1	2	
2	1	
2	2/1	
2	2	
3	1	
3	2/1	
4	1	

When connected to the computer power supply via the PCIe 6-pin connector, which always provides 12 V, the frame grabber or interface card supports Power over CXP (PoCXP).

Two cameras with reduced CXP-12 speed: Use ports 1 and 2 of the cameras and connect them to the frame grabber ports 1 and 2 or 3 and 4. The cable order between one camera and the frame grabber doesn't matter. Thus, you can swap cable 1 and 2 or 3 and 4.

The cameras can be fully powered over the CXP cable, if you connect them with two CXP cables. Also, connect the 6-pin PCIe power connector of your computer to the frame grabber or interface card during installation.

The camera can be triggered via a cable directly connected to the AUX connector of the camera or by using the CXP trigger via the frame grabber or interface card with external, internal, or software trigger sources.

See also the Basler Product Documentation for instructions for [Connecting the Frame Grabber](#) and for [Camera Installation](#).

## Software Installation

You can use the Basler racer 2 camera with pylon, the Framegrabber SDK or directly with the GenTL interface. You can also use the camera in pylon with some constraints.

The following table provides a compatibility list and guide:

Version	Compatibility
Framegrabber SDK 5.11.0 (or higher)	Yes
pylon 7.3.0 (or higher) without configuration	No
pylon 7.3.0 (or higher) together with Framegrabber SDK 5.11.0 (or higher) and configuration	Yes, with constraints, see <a href="#">Requirements</a>

## Installing the Framegrabber SDK

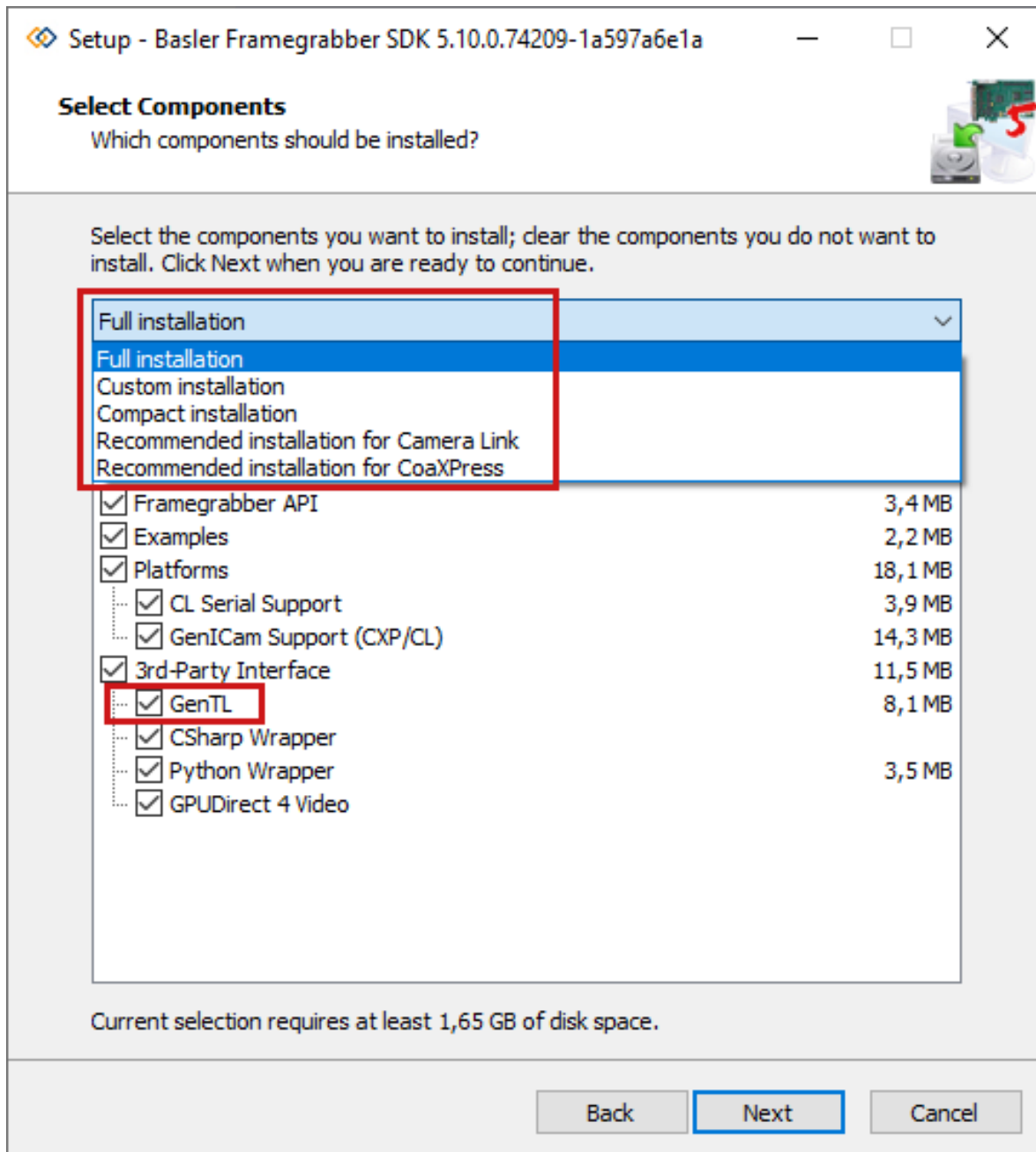
### Admin Rights Required

To install the Framegrabber SDK, you need administrator rights on your computer.

To install the Framegrabber SDK for use with the Basler racer 2 camera:

1. Download the [Framegrabber SDK Version 5.11.0 or higher](#).
2. Start the installer and follow the installation.
3. In the **Select Components** dialog, select **Full installation** and make sure that the GenTL Producer is selected in the components list.





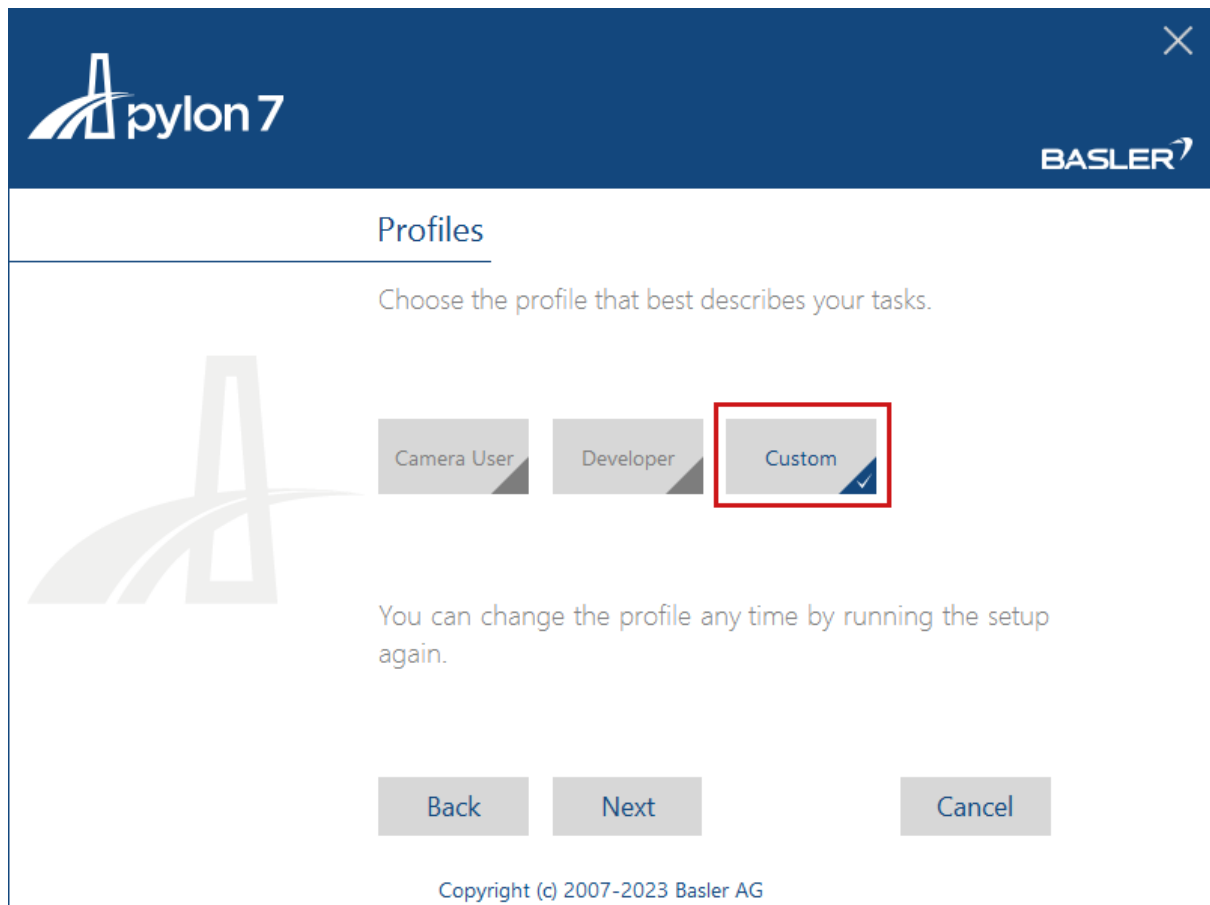
For detailed installation instructions, refer to the [Installing the Framegrabber SDK](#) topic of the Basler Product Documentation.

## Installing pylon

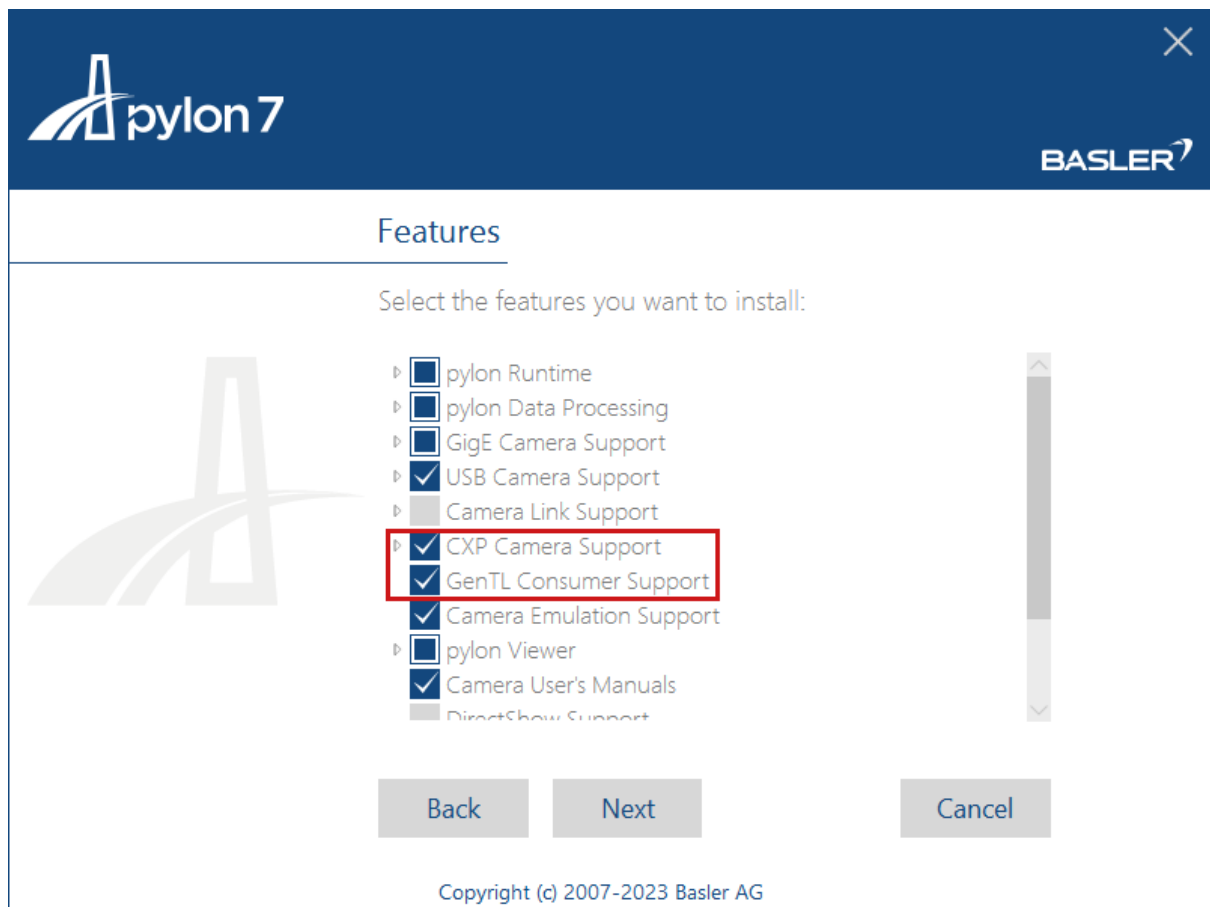
To install pylon for use with the Basler racer 2 camera:

1. Download [pylon 7.3.0 or higher](#).
2. Start the installer and follow the installation.

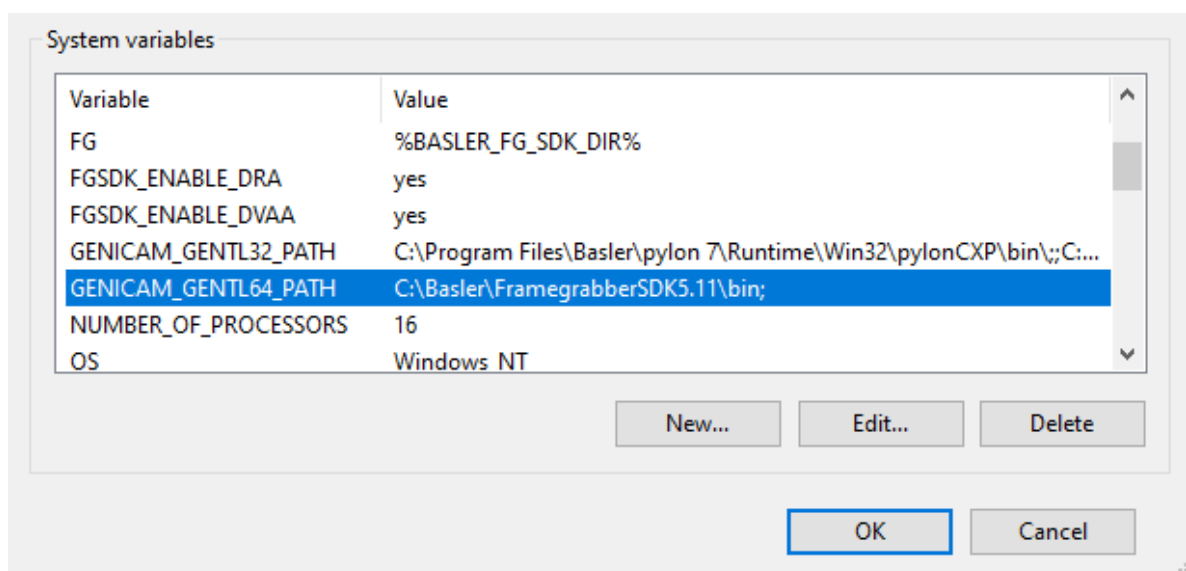
3. In the **Profiles** dialog, select **Custom** installation.



4. In the **Features** dialog, select **CXP Camera Support** and **GenTL Consumer Support**.



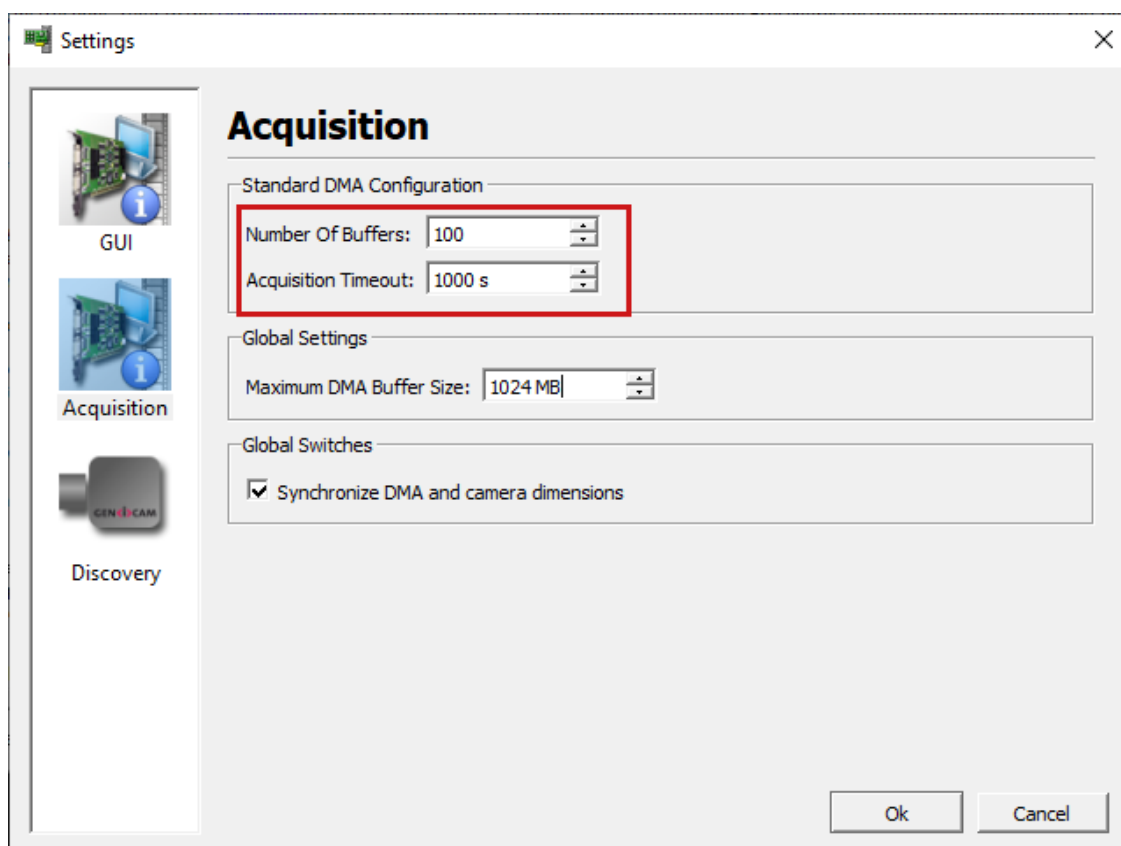
5. Set the GenTL environmental variable **%GENICAM\_GENTL64\_PATH%** to the installation path of the Framegrabber SDK:



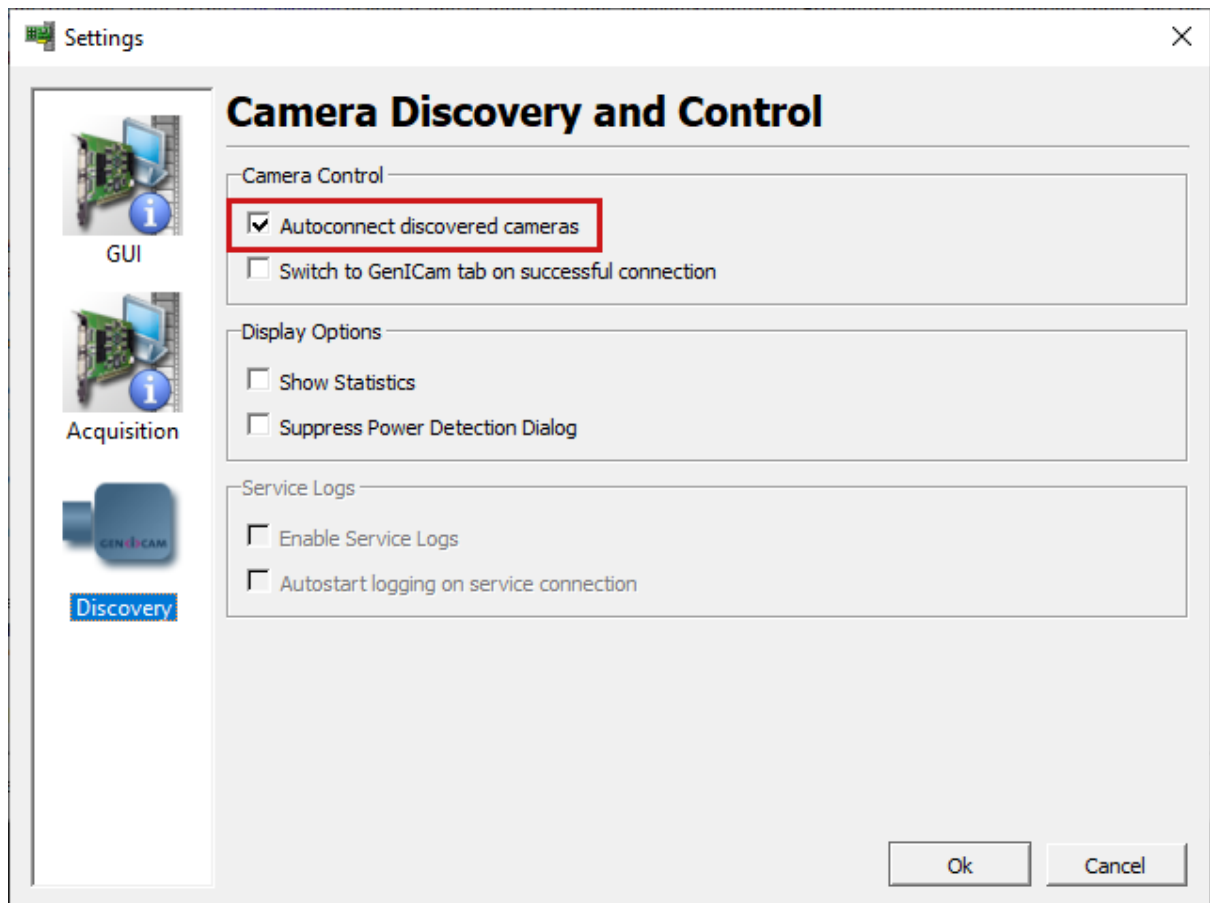
This is necessary, because the pylon installation and the Framegrabber SDK installation will interfere. Therefore, you need to use the GenTL Producer of the Framegrabber SDK as it consists of all required applets and GenTL Producer capabilities.

## Using the racer 2 Camera with the Framegrabber SDK or GenTL Producer

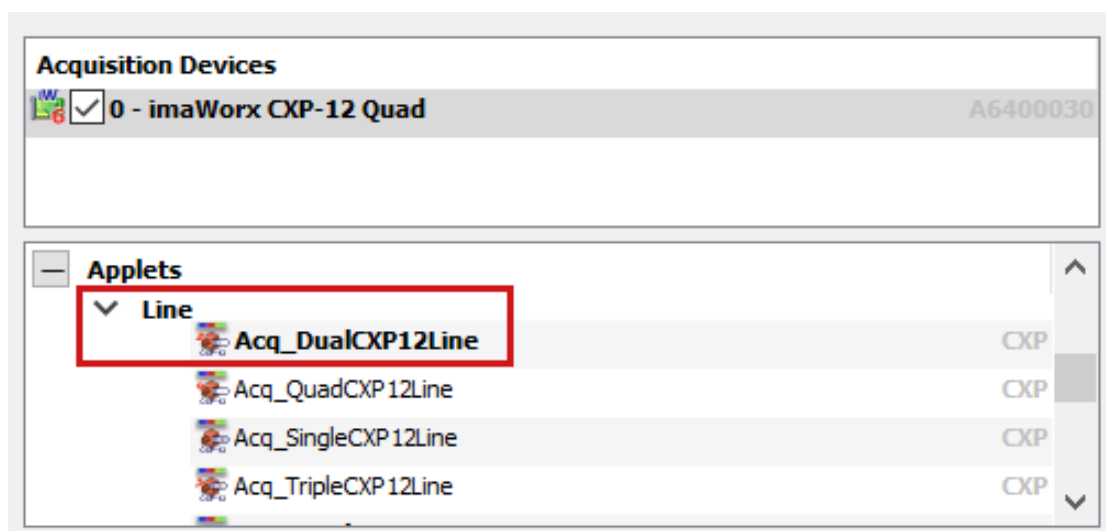
1. For a first view of the images, open microDisplay X.
2. Configure some basic settings, which simplify image acquisition with the Basler racer 2 camera:
  1. Under **Tools > Settings > Acquisition**, set the **Number of Buffers** to **100**. This enables you to browse through the acquired images, which is very useful for camera calibration.
  2. Set the **Acquisition Timeout** to a high value, e.g., **1000 s**. This is mandatory for setting up the trigger and avoids running into timeouts.



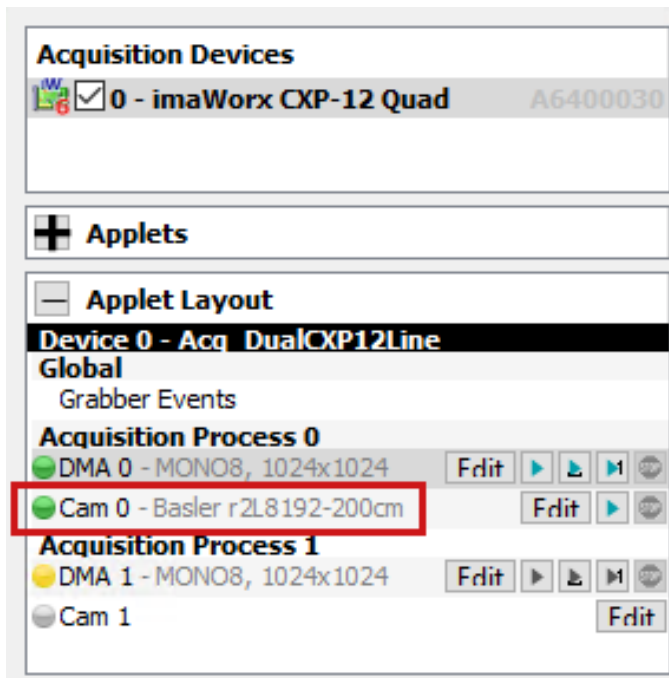
- Under **Tools > Settings > Discovery**, select the **Autoconnect discovered cameras** check box.



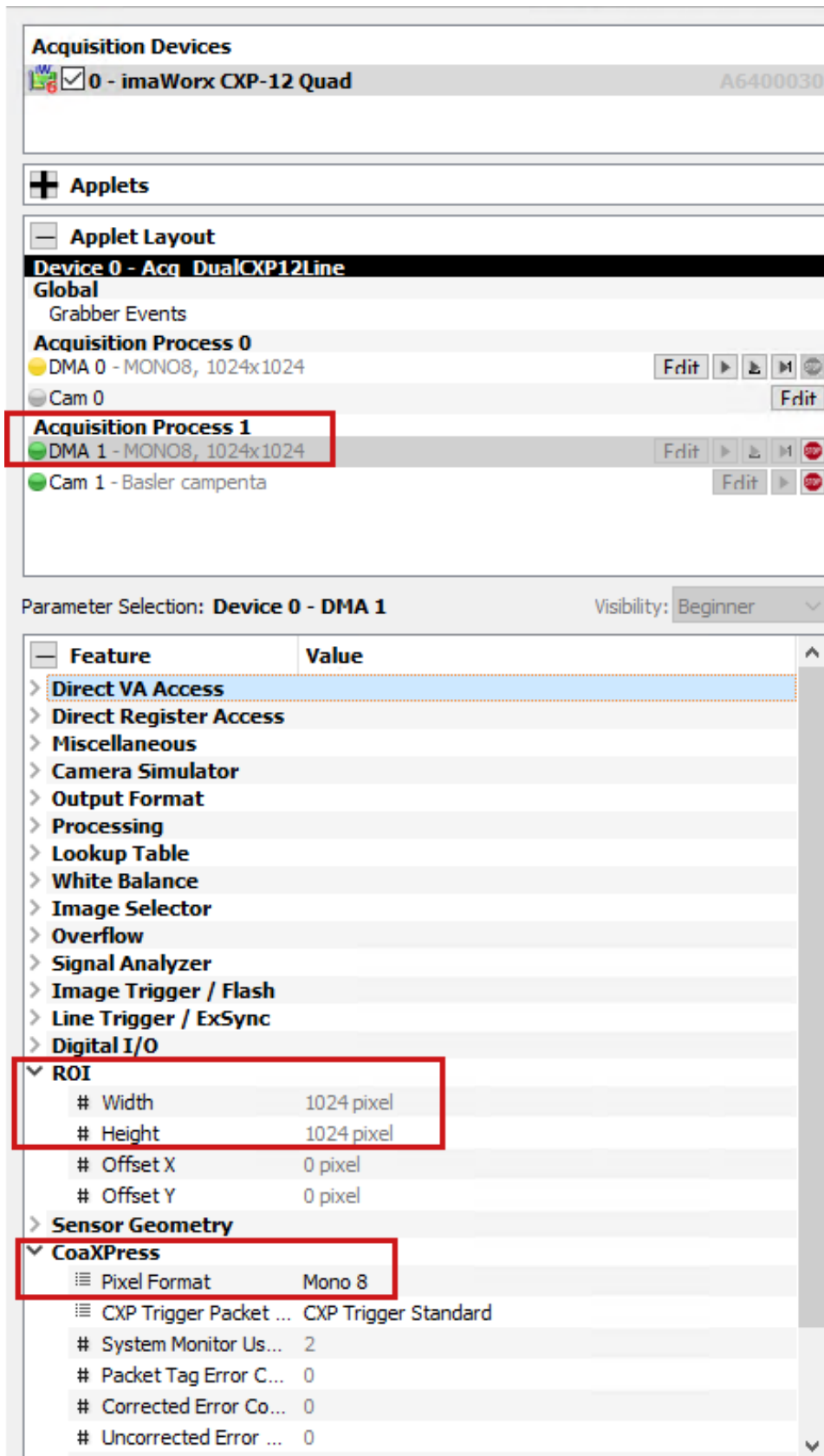
- In microDisplay X, load an applet. See [Possible Topologies](#) to find out which applet is required for your setup.




4. Double-click the applet name. The frame grabber FPGA is now configured with your applet.
5. As you have selected **Autoconnect discovered cameras**, the camera should now be connected:

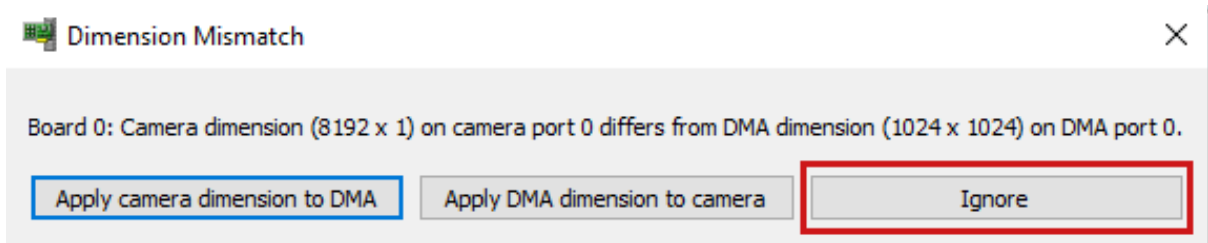


6. You can now switch between the parameters of camera and frame grabber or interface card by clicking **DMA 0** or **Cam 0** in the **Applet Layout** pane. If you have connected multiple cameras to one or multiple frame grabbers or interface cards, you can select the camera and DMA channel here.
7. Configure the camera and frame grabber or interface card as desired.
8. Important frame grabber or interface card parameters must match with the camera settings. These are:
  - **CoaXPress > Pixel Format**
  - **ROI > Width**
  - For **ROI > Height**, define your desired image height. This parameter value defines the number of camera lines of the output image.

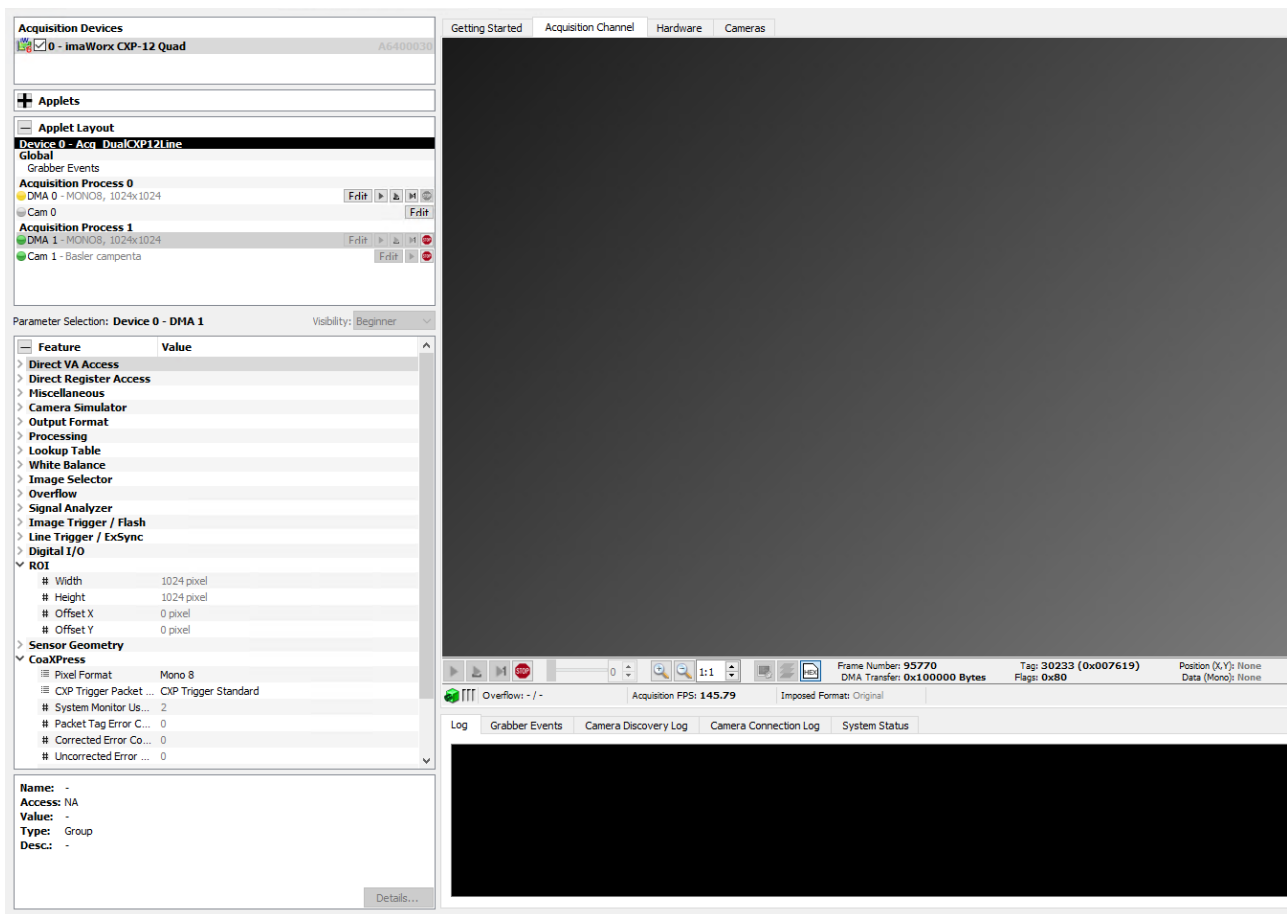


9. To start the image acquisition, switch to **Acquisition Channel** in the **Viewing** pane, and click the  **Play** button.

10. microDisplayX assists you in setting the frame grabber ROI. For line scan cameras, click **Ignore**.



You now see the camera images as long as the camera and the frame grabber or interface card are in **free run mode**.



## Using CoaXPress Line Trigger

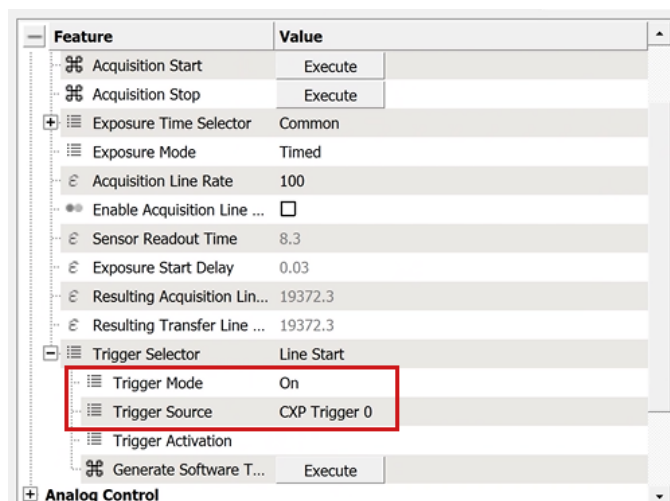
To use a CoaXPress line trigger, set the camera to CoaXPress trigger mode and configure the camera and frame grabber or interface card as follows:



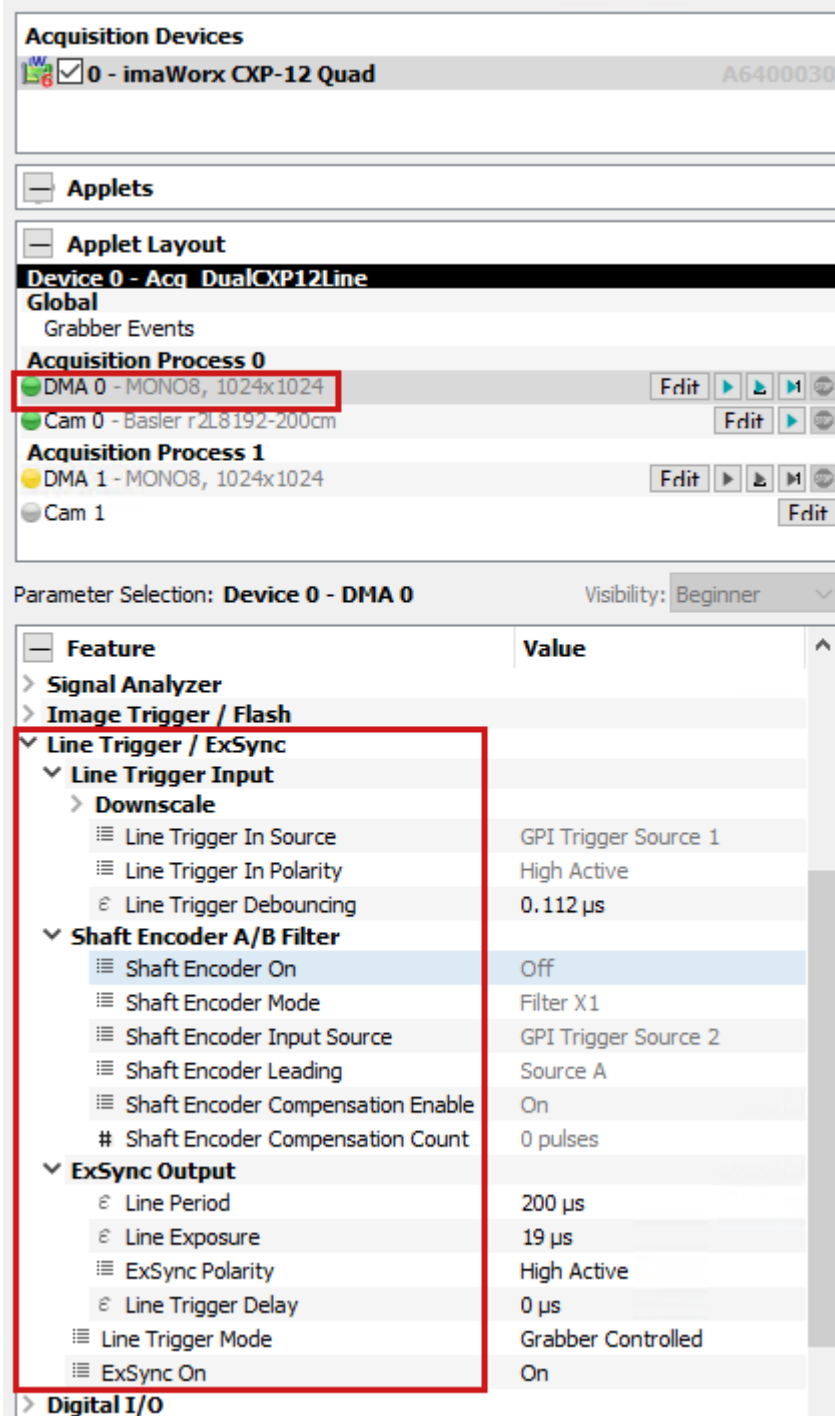
## Stop Image Acquisition Before Configuring Parameters

Before configuring any parameter settings, you must stop the image acquisition. Otherwise, some parameters can't be edited.

1. In the **Applet Layout** pane, select **Cam 0**.
2. In the **Parameter Selection** pane under **Acquisition Control**, set the following parameters:
  - Trigger Mode = On
  - Trigger Source = Cxp Trigger 0



By default, the frame grabber uses an internal generator with a period of 200  $\mu$ s. To change the source or to use the [shaft encoder](#), select **DMA 0** in the **Applet Layout** pane and configure the **Line Trigger / ExSync** parameters for your hardware setup:



For a detailed explanation of the parameters, refer to the applet documentation for [imaWorx CXP-12 Quad](#) and for the [CXP-12 Interface Cards](#).

## The Exposure Modes `Trigger Width` and `Trigger Controlled`

To control the exposure time with external signals, you can use the two exposure modes `Trigger Width` and `Trigger Controlled`.

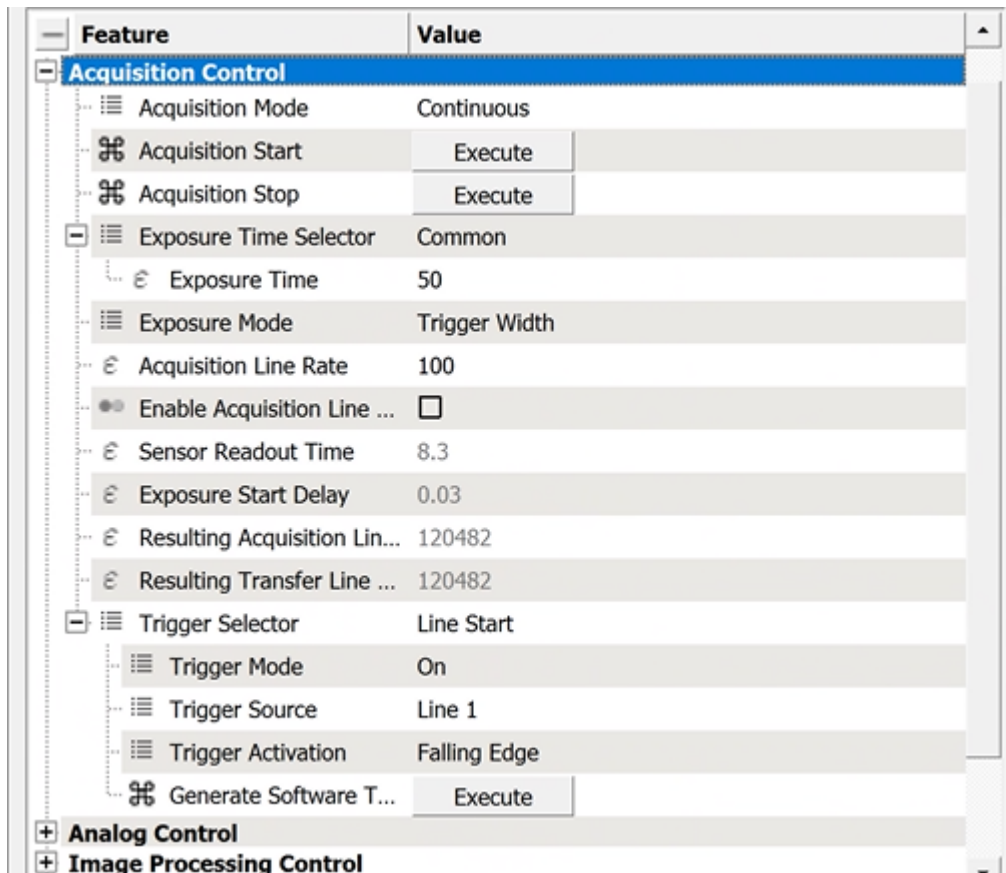
- Use `Trigger Width` if you connect your trigger signal directly to the IO of the camera.
- Use `Trigger Controlled` if CXP trigger packets are used and the triggers are coming via the camera.

### Exposure Mode `Trigger Width`

To use the exposure mode `Trigger Width`, you must set the following parameters in the camera:

1. To switch to this exposure mode, set the camera parameter `Exposure Mode` = `Trigger Width`.
2. To configure the trigger, set the following parameters:
  - `Trigger Selector` = `Line Start`
  - `Trigger Mode` = `On`
  - `Trigger Source` to the IO to which you have connected your trigger to e.g. `Line1`.
  - If you have inverted signals, you can set optionally `Trigger Activation` = `Falling Edge`.

In the exposure mode `Trigger Width`, the camera directly uses the trigger signals from the IO and not via CXP. Therefore, it isn't necessary to configure any trigger parameters for the frame grabber, if you select the exposure mode `Trigger Width`.



## Exposure Mode `Trigger Controlled`

To use the exposure mode `Trigger Controlled`, you must set the following parameters in the camera:

1. To switch to this exposure mode, set the camera parameter `Exposure Mode` = `Trigger Controlled`.
2. To configure the trigger, set the following parameters. This starts and ends the exposure by a CoaXPress trigger:
  - `Trigger Selector` = `Exposure Start`
  - `Trigger Mode` = `On`
  - `Trigger Source` = `Cxp Trigger 0`.
  - `Trigger Selector` = `Exposure End`
  - `Trigger Mode` = `On`
  - `Trigger Source` = `Cxp Trigger 1`.

Parameter Selection: **Device 0 - Cam 0**

Feature	Value
> <b>Image Format Control</b>	
▼ <b>Acquisition Control</b>	
≡ Acquisition Mode	Continuous
⌘ Acquisition Start	<input type="button" value="Execute"/>
⌘ Acquisition Stop	<input type="button" value="Execute"/>
⌘ Exposure Time	50
≡ Exposure Mode	Trigger Controlled
⌘ Acquisition Frame Rate	100
•• Enable Acquisition Frame Rate	<input type="checkbox"/>
⌘ Sensor Readout Time	0
⌘ Exposure Start Delay	0
⌘ Resulting Acquisition Frame Rate	200000
⌘ Resulting Transfer Frame Rate	200000
▼ <b>Trigger Selector</b>	Exposure Start
≡ Trigger Mode	On
≡ Trigger Source	CXP Trigger 0
≡ Trigger Activation	Rising Edge
⌘ Generate Software Trigger	<input type="button" value="Execute"/>
≡ Acquisition Burst Mode	Standard
> <b>Analog Control</b>	
> <b>Software Signal Control</b>	
> <b>User Set Control</b>	
> <b>Device Control</b>	
> <b>Transport Layer Control</b>	

Parameter Selection: **Device 0 - Cam 0**

Feature	Value
> <b>Image Format Control</b>	
▼ <b>Acquisition Control</b>	
≡ Acquisition Mode	Continuous
⌘ Acquisition Start	<input type="button" value="Execute"/>
⌘ Acquisition Stop	<input type="button" value="Execute"/>
⌘ Exposure Time	50
≡ Exposure Mode	Trigger Controlled
⌘ Acquisition Frame Rate	100
⌘ Enable Acquisition Frame Rate	<input type="checkbox"/>
⌘ Sensor Readout Time	0
⌘ Exposure Start Delay	0
⌘ Resulting Acquisition Frame Rate	200000
⌘ Resulting Transfer Frame Rate	200000
▼ ≡ Trigger Selector	Exposure End
≡ Trigger Mode	On
≡ Trigger Source	CXP Trigger 1
≡ Trigger Activation	Rising Edge
⌘ Generate Software Trigger	<input type="button" value="Execute"/>
≡ Acquisition Burst Mode	Standard
> <b>Analog Control</b>	
> <b>Software Signal Control</b>	
> <b>User Set Control</b>	
> <b>Device Control</b>	
> <b>Transport Layer Control</b>	

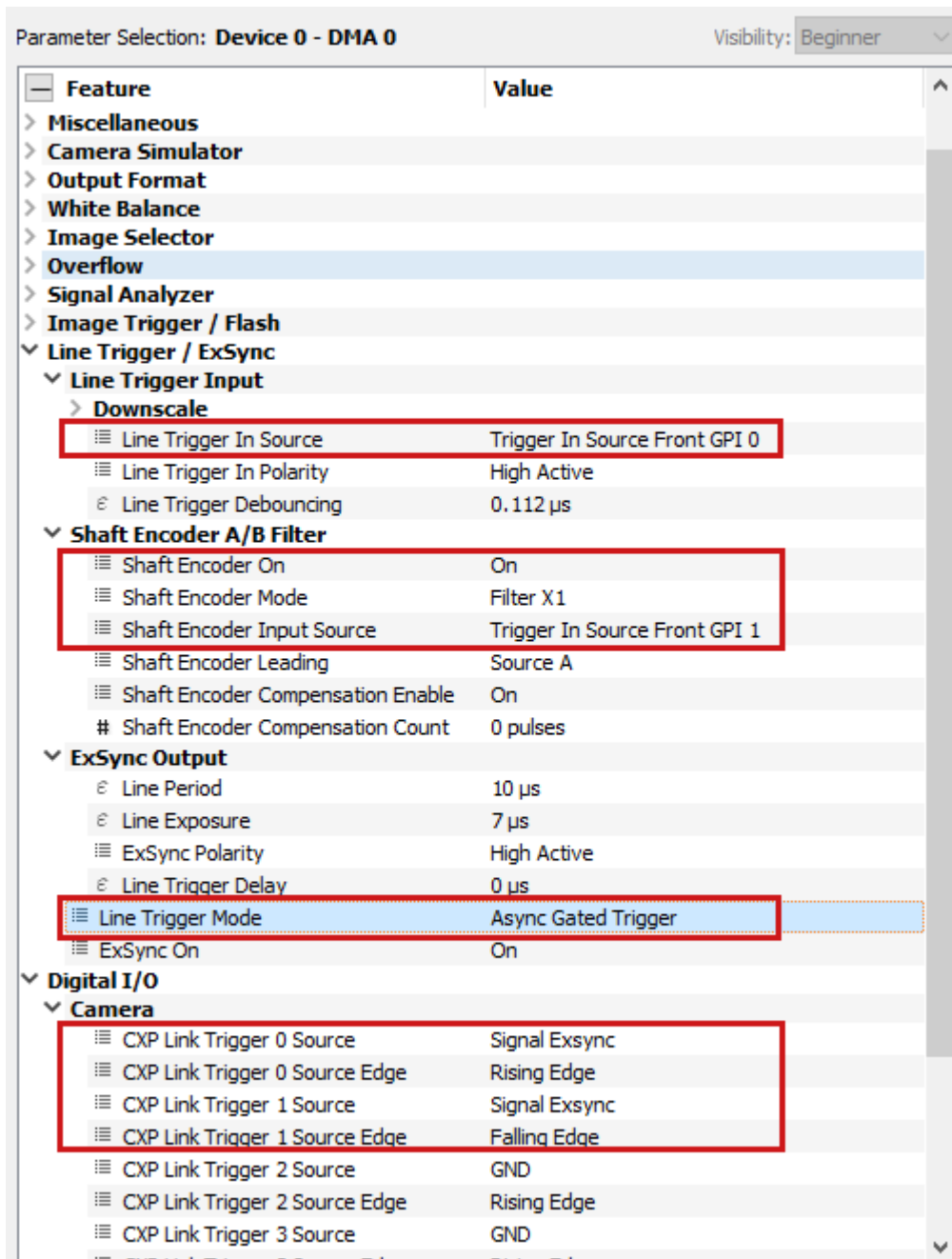
Now, you must configure the frame grabber to generate Cxp Trigger 0 and Cxp Trigger 1 trigger packets. You have the following three options:

- By default, an internal generator is used:

Parameter Selection: **Device 0 - DMA 0** Visibility: **Beginner**

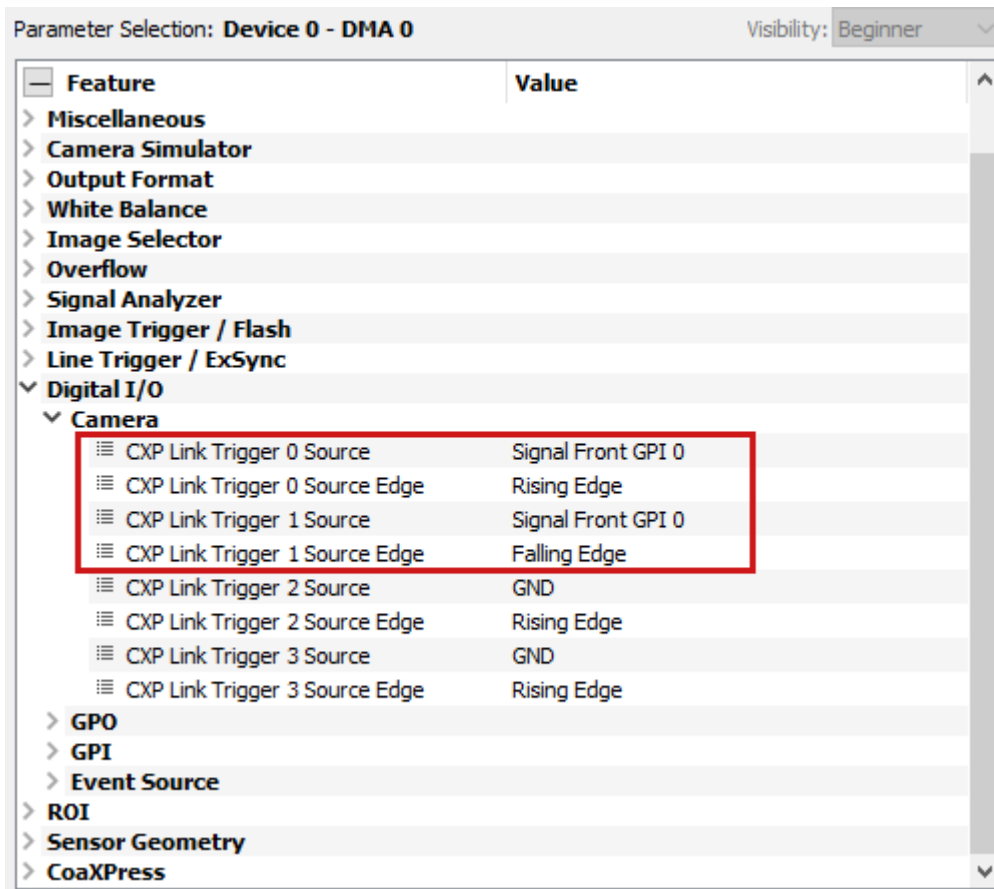
Feature	Value
> Miscellaneous	
> Camera Simulator	
> Output Format	
> White Balance	
> Image Selector	
> Overflow	
> Signal Analyzer	
> Image Trigger / Flash	
▼ Line Trigger / ExSync	
> Line Trigger Input	
> Shaft Encoder A/B Filter	
▼ ExSync Output	
⌵ Line Period	10 $\mu$ s
⌵ Line Exposure	7 $\mu$ s
≡ ExSync Polarity	High Active
⌵ Line Trigger Delay	0 $\mu$ s
≡ Line Trigger Mode	Grabber Controlled
≡ ExSync On	On
▼ Digital I/O	
▼ Camera	
≡ CXP Link Trigger 0 Source	Signal Exsync
≡ CXP Link Trigger 0 Source Edge	Rising Edge
≡ CXP Link Trigger 1 Source	Signal Exsync
≡ CXP Link Trigger 1 Source Edge	Falling Edge
≡ CXP Link Trigger 2 Source	GND
≡ CXP Link Trigger 2 Source Edge	Rising Edge
≡ CXP Link Trigger 3 Source	GND
≡ CXP Link Trigger 3 Source Edge	Rising Edge
> GPO	

- If you change the `LineTriggerMode` parameter to `Async Gated Trigger`, you can use IO signals to control the exposure time:





- Alternatively, you can bypass an IO signal directly to CXP Link Trigger 0 and CXP Link Trigger 1 to control the start and end of the exposure:



## Examining Images

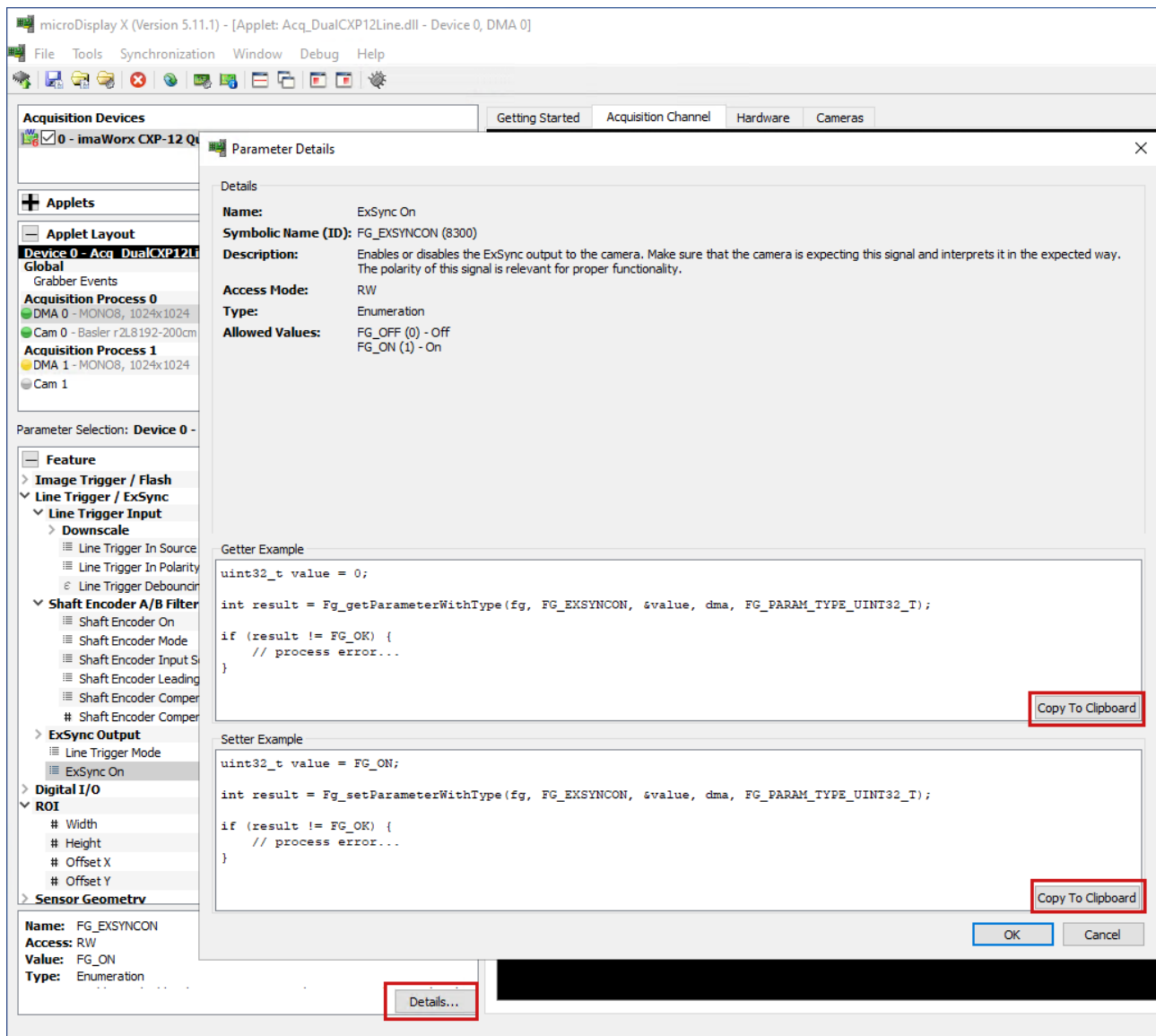
microDisplay X offers several ways to examine the acquired images. The following items are helpful when you want to calibrate your camera:

- The **Line Histogram** view
- The **Line Profile** view
- Flipping through the acquired image sequence
- Getting the pixel values or zooming in for each pixel
- Saving the current image or an image sequence

For detailed information, refer to the [Examining Images](#) topic of the Basler Product Documentation.

## Copying the SDK Code

To copy the configuration into your SDK program, select **Details** of any parameter and copy the SDK code.



Alternatively, you can save a configuration file in microDisplay X and load it in your SDK program. For detailed information, refer to the [Saving Applet Configuration](#) topic of the Basler Product Documentation.

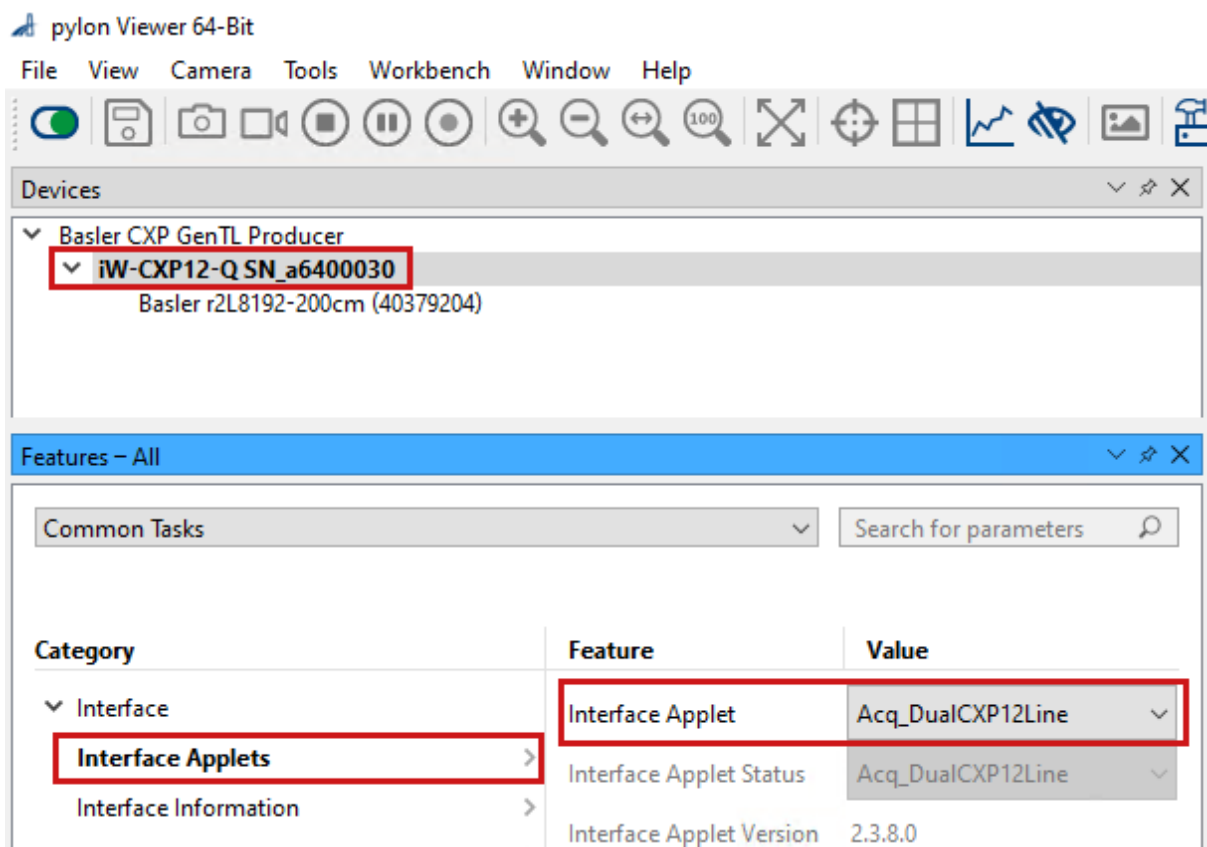
For GenTL usage, follow the same parameter configuration. You find the GenTL Producer in the %GENICAM\_GENTL64\_PATH% directory.

## Using the racer 2 Camera with pylon

Using the racer 2 camera with pylon is possible in combination with the Framegrabber SDK 5.11.0 or higher. It's important that the environment variables of the GenTL Producer are set to the Framegrabber SDK.

For a first view of the images in the pylon Viewer:

1. Start pylon.
2. Load the required applet:
  1. Double-click the interface, i.e., the frame grabber or interface card.
  2. Select **Interface Applet** from the **Category** view and select your required applet. To choose the correct applet for your board and configuration, see [Possible Topologies](#).



3. The frame grabber's FPGA is now configured with your applet. pylon automatically detects the camera. Double-click your camera. The device tree opens showing parameters for camera and frame grabber configuration:

Devices

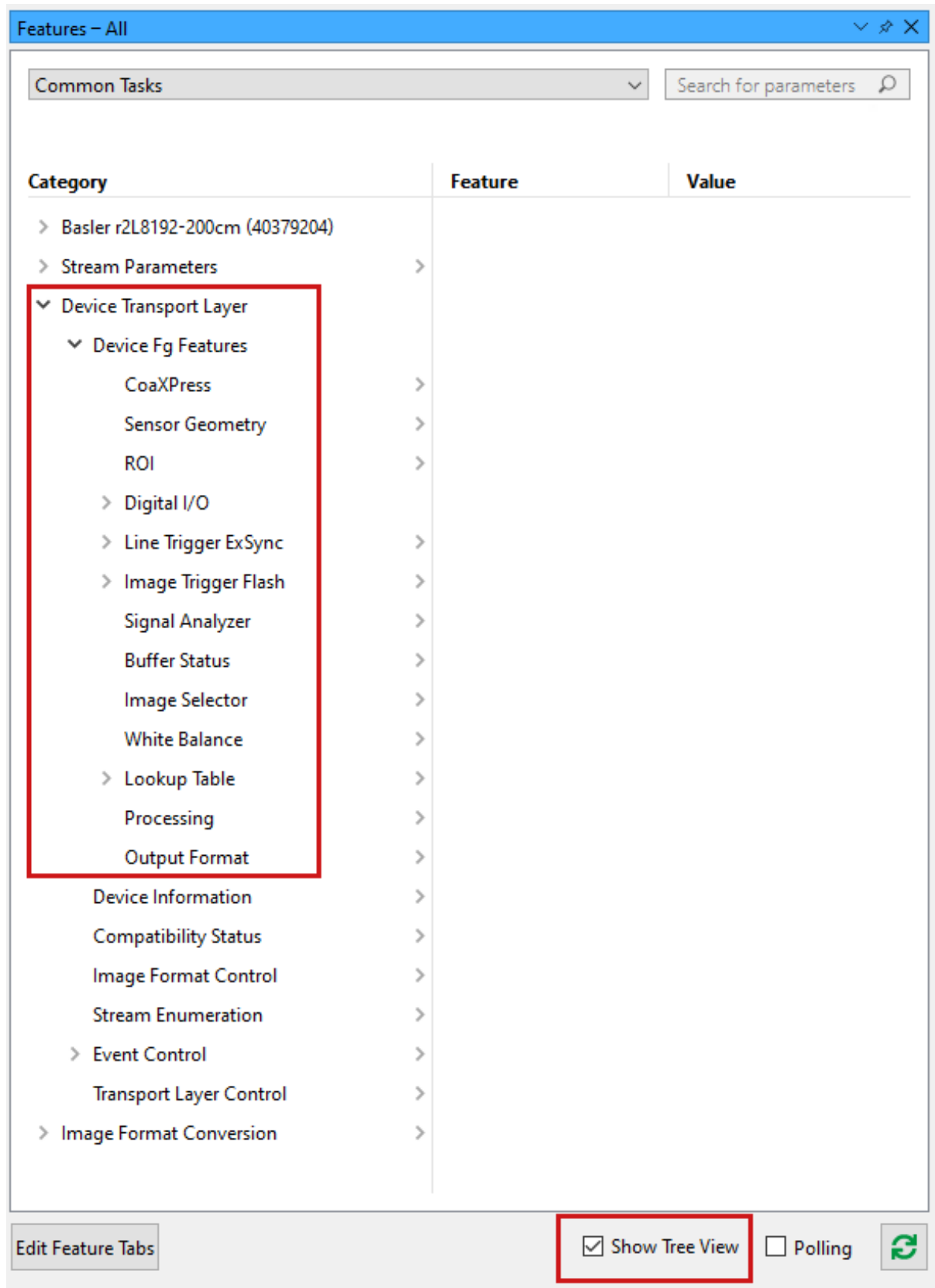
- Basler CXP GenTL Producer
  - iW-CXP12-Q SN a6400030
    - Basler r2L8192-200cm (40379204)

Features – All

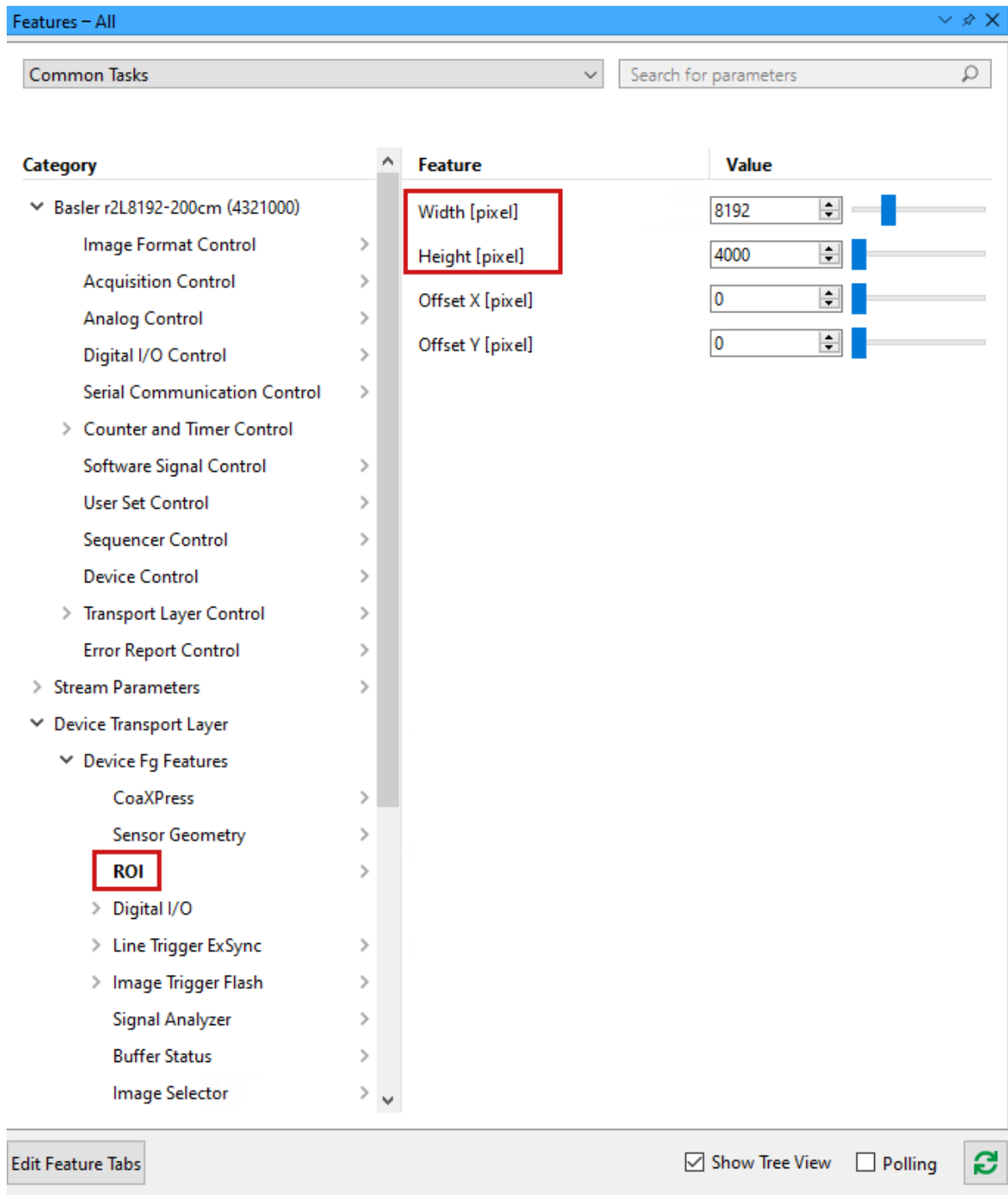
Common Tasks ▼ Search for parameters

Category	Feature	Value
Basler r2L8192-200cm (40379204)		
Image Format Control	>	
Acquisition Control	>	
Analog Control	>	
Digital I/O Control	>	
Serial Communication Control	>	
Counter and Timer Control	>	
Software Signal Control	>	
User Set Control	>	
Sequencer Control	>	
Device Control	>	
Transport Layer Control	>	
Error Report Control	>	
> Stream Parameters	>	
> Device Transport Layer		
> Image Format Conversion	>	


4. To configure the parameters, enable the **Tree View**. Otherwise, the parameters are all listed in the same category.

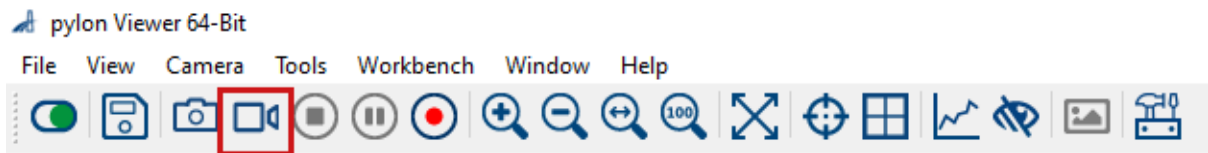


5. Select **ROI** from the **Category** view and configure the ROI **Width** and **Height** to your requirements. Note that the height is a defined number of camera lines merged into one output frame. See also descriptions for [Using the racer 2 Camera with the Framegrabber SDK or GenTL Producer](#).



6. You can now acquire frames using the **Continuous Shot** acquisition mode.

The **Single Shot** acquisition mode  doesn't work.



7. Configure the camera and frame grabber or interface card with your custom settings as desired.
8. For information about trigger modes, see [Using CoaXPress Line Trigger](#) and [Using an Image Trigger](#). The **Gated Trigger** modes don't work in pylon 7.3.0.

## Revision History

Document Number	Date	Changes
AW00183501000	1 Aug 2023	Initial version of this document.
AW00183502000	29 Feb 2024	Added section “The Exposure Modes TriggerWidth and TriggerControlled”, which replaces section “Using an Image Trigger”.
AW00183503000	5 Jul 2024	Extended this document for the racer 2 S, changed product name “racer 2 L” to “racer 2”.