manual

pco.labview

excelitas.com

excelitas®

Excelitas PCO GmbH asks you to carefully read and follow the instructions in this document.
For any questions or comments, please feel free to contact us at any time.

address:	Excelitas PCO GmbH Donaupark 11 93309 Kelheim, Germany
phone:	(+49) 9441-2005-0 (+1) 866-662-6653 (+86) 0512-6763-4643
mail:	pco@excelitas.com
web:	www.excelitas.com/pco

pco.labview manual 5.6.0

Released December 2025

Contents

1 General

The **pco.labview** package is a powerful and easy-to-use high-level Software Development Kit (SDK) for working with PCO cameras under LabVIEW. It contains everything needed for camera setup, image acquisition, readout and color conversion.

The high-level class architecture makes it very easy to integrate PCO cameras into your own LabVIEW software, while still having access to the underlying **pco.sdk** and **pco.recorder** functions for a detailed control of all possible functionalities.

This version of pco.labview is suitable for LabVIEW 2019 SP1 and newer. If you need to use an older LabVIEW version, please contact us for getting suitable pco.labview packages for your version.

Note This document describes only the functions and usage of PCO's `Camera` class. All functions of the **pco.sdk** and **pco.recorder** SDK are wrapped into LabVIEW VI's inside the corresponding folders. If you need a full description of those functions, please check out the manuals of **pco.sdk** and **pco.recorder**. Although these are C libraries, the functions are nearly identical to their wrapped LabVIEW counterparts.

1.1 Installation

Download the ***pco.labview Windows*** package, unzip, and execute it. Follow the steps in the installer.

In your install directory you will find:

- a LabVIEW project containing all (sub)VI's, arranged similar to the folder structure
- an **Examples** folder containing all example VI's showing different use cases [1]
- the **pco.camera** folder containing the actual sources of this `Camera` class
- the **pco.sdk**, **pco.recorder**, **pco.convert** folders with the wrapped resources of the corresponding SDK's
- a **runtime** folder containing the required runtime Dll's
- in **errorHandling** you will find a VI to map PCO's error codes into LabVIEW error clusters (this is used in all wrapped Sub-VIs)
- **GetDLLPaths.vi** is needed to automatically load the DLL's from the correct path.

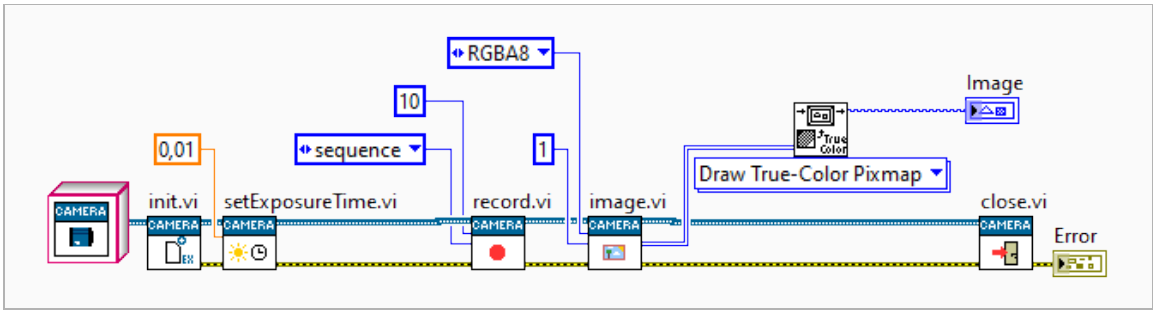
1.2 Basic Usage

This snippet shows the basic usage.

By calling **init.vi**, a camera is searched, opened and initialized. Several functions are provide to adjust the camera settings, and here we set the exposure time to 10 ms. Calling **record.vi** will start the recording. Depending on the mode it either waits until record is finished (like for sequence mode which is selected here) or directly returns (see 1.3 for the full list of available modes).

The **image.vi** returns different image data types. Regardless of the image format, the function always outputs the raw image as two-dimensional array of 16 bit values. Depending on the selected format (see 1.4 for available formats) you can also access the data either as 2d array of 8 Bit values, 2d array of 32 Bit values (RGB encoded) or 2d array of clusters (each cluster contains for values for R, G, B and A).

[1] The deprecated subfolder contains old examples showing everything without using the `Camera` class



Here we want to have the image with **index** 1 in the *RGBA8* format, so we use the U32 image output.

1.3 Recorder Modes

Depending on your workflow, you can choose between different recording modes.

Some modes are blocking, i.e. the `record` function waits until recording is finished, some are non-blocking.

Some modes store images in memory, other save images directly to file(s) on the disk and some are recording and reading directly into and from camera internal memory. However, for all modes, the recorded images can be accessed in the same way, just as they would be in memory.

Mode	Storage	Blocking	Description
`sequence`	Memory	yes	Record a sequence of images
`sequence_non_blocking`	Memory	no	Record a sequence of images, do not wait until record is finished
`ring_buffer`	Memory	no	Continuously record images in a ringbuffer, once the buffer is full, old images are overwritten
`fifo`	Memory	no	Record images in fifo mode, i.e. you will always read images sequentially and once the buffer is full, recording will pause until older images have been read
`sequence_dpcore`	Memory	yes	Same as `sequence`, but with DotPhoton preparation enabled
`sequence_non_blocking_dpcore`	Memory	no	Same as `sequence_non_blocking`, but with DotPhoton preparation enabled
`ring_buffer_dpcore`	Memory	no	Same as `ring_buffer`, but with DotPhoton preparation enabled

Continued on next page

Continued from previous page

Mode	Storage	Blocking	Description
`fifo_dpcore`	Memory	no	Same as `fifo`, but with DotPhoton preparation enabled
`tif`	File	no	Record images directly as tif files
`multitif`	File	no	Record images directly as one or more multitiff file(s)
`pcoraw`	File	no	Record images directly as one pcoraw file
`dicom`	File	no	Record images directly as dicom files
`multidicom`	File	no	Record images directly as one or more multi-dicom file(s)
`camram_segement`	Camera RAM	no	Record images to camera memory. Stops when segment is full
`camram_ring`	Camera RAM	no	Record images to camera memory. Ram segment is used as ring buffer

In the code the mode is represented as an enum type.

Note For more information on the DotPhoton preparation and image compression, please visit DotPhoton or feel free to contact us.

1.4 Image Formats

Besides the standard 16-bit raw image data, you also have the possibility to get your images in the different formats shown in the table below.

The data types have been selected so they can easily be converted to corresponding **IMAQ images** used by the NI-IMAQ module, as shown in all `*_IMAQ.vi` examples. This makes it very easy for you to integrate PCO cameras inside your NI-IMAQ applications.

The format is selected when calling the `image` / `images` / `imageAverage` functions (see 2.1.34, 2.1.35, 2.1.36) of the `Camera` class. Depending on the selected format, only one of the possible image outputs will be valid, but in all cases the functions provide the raw image data as 2d 16-bit array.

Format	Description
`Mono8`	Get image as 8-bit grayscale data, use **image(U8)** output
`Mono16`	Get the raw image as 16-bit grayscale/raw data, use **raw_image(U16)** output
`RGBA8`	Get image as 32-bit color data, use **image(U32)** output
`BGRA8`	Same as `RGBA8` but with flipped color channels (provided only for completeness, in LabVIEW typically `RGBA8` is used)
`RGBA16`	Get image as 64-bit color data, use **image(U64)** output

Continued on next page

Continued from previous page

Format	Description
BGRA16	Same as RGBA16 but with flipped color channels (provided only for completeness, in LabVIEW typically RGBA16 is used)

In the code the image format is represented as an enum type.

Note For monochrome cameras, the RGBA16/BGRA16 format is not available and the colors in the RGBA8 /BGRA8 depend on the selected lut, which is a standard grayscale mapping by default. For selecting different lut files you can use the functions setConvertControl (see 2.1.21) or loadlut (see 2.1.22) from the Camera class.

1.5 Creating Executables

If you have the LabVIEW Application Builder toolbox, you can also create standalone executables. This is described on several NI websites and is unrelated to this SDK.
An executable file can be created from all examples as well as all custom applications that were created using the pco.labview package without restrictions.

Note The paths to PCO DLL's are designed so that an application can be created without having to worry about PCO dependencies. After completion of the creation, the PCO DLL files from runtime/bin64 just have to be copied to the folder in which your created **.exe* file is located.

1.6 Error Handling

Each VI has an error in and an error out connector for a standard error cluster variable. All VI's check the incoming error before they execute their content. With this mechanism you can simply connect the VI's error connectors and be sure that possible errors are forwarded correctly. Either at the end or anywhere in between you can view the current error status, as you can see it in the example in 1.2.

We recommend to always connect the error inputs and outputs.

Additionally you can also enable the logging of the underlying SDK's. For more information on that please visit our pco.logging page.

Note In the close function the content will also be executed in case of an incoming error. This ensures that every opened camera or resource gets closed properly, even if an error occurs. Incoming errors are merged with other errors that might occur during the function execution.

2 API Documentation

The following section describes the functionality of the `Camera` class. The class can be divided into functions and controls.

2.1 Camera Functions

The following list provides a short overview of the most important functions:

- **init** open and initialize a camera with its default configuration
- **close** close the camera and clean up everything
- **defaultConfiguration()** cet default configuration to the camera
- **getConfiguration()** get current camera configuration
- **setConfiguration()** set a new configuration to the camera
- **configureHWIO_*_***()** configure the HWIO channels (1-4)
- **autoExposureOn(), autoExposureOff()** switch auto exposure on/off
- **configureAutoExposure()** set the parameters for auto exposure calculations
- **getExposureTime()** get current exposure time
- **setExposureTime()** set new exposure time to the camera
- **record()** initialize and start the recording of images
- **stop()** stop the current recording
- **waitForFirstImage()** wait until the first image has been recorded
- **waitForNewImage()** wait until a new image has been recorded
- **getConvertControl()** get current color convert settings
- **setConvertControl()** set new color convert settings
- **image()** read a recorded image
- **images()** read a series of recorded images
- **imageAverage()** read an averaged image (averaged over all recorded images)
- **hasRam()** check if camera has internal memory for recording with camram
- **switchToCamRam()** set the camram segment where the images should be written to/read from
- **getCamRamSegment()** get segment number of the active segment
- **getCamRamMaxImages()** get number of images that can be stored in the active segment
- **getCamRamNumImages()** get number of images that are available in the active segment
- **setCamRamAllocation()** set allocation distribution of camram segments.

2.1.1 init

Description

Open communication and initialize a camera. With the ”All interfaces” option, this VI will scan through all possible interfaces until it finds a connected camera.

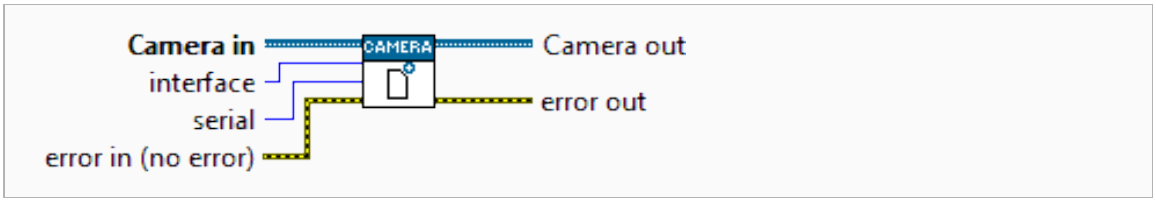
Optionally you can specify either which interface you want to look at or the serial number of the camera you want to open or both.

An error is generated if no camera is found. The camera is set to a defult configuration by this VI.

Note for windows

If you specify a serial number to be opened, we recommend to also specify the interface as this reduces the time for the function call.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initial `Camera` object, a constant can be used here
`interface`	`cU16`	Specific interface to search for cameras. If not connected, search on all interfaces.
`serial`	`cU32`	Search for the camera with this specific serial number. If not connected, search for any camera.
`error in`	`cErrClst`	Previous error state (no error if not connected)

Parameter OUT

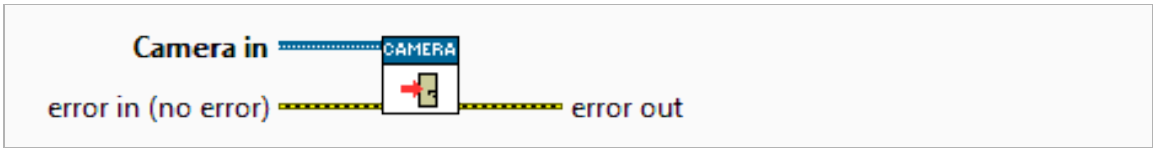
Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.2 close

Description

Close the activated camera and release the blocked resources.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

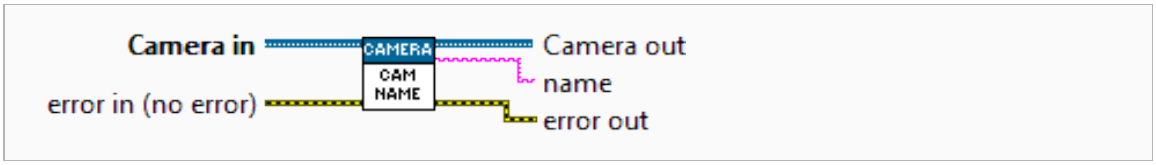
Parameter OUT

Name	Type	Description
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.3 getName

Description Get the name of the connected camera.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

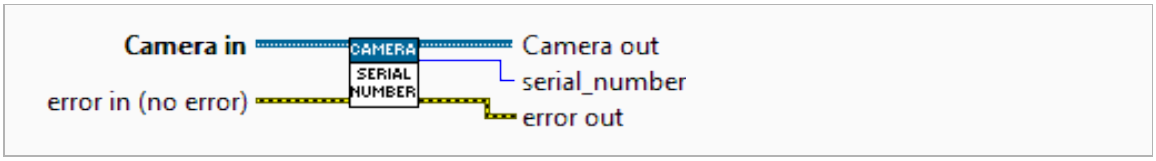
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
name	iStr	Camera name
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.4 getSerial

Description Get the serial number of the camera.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

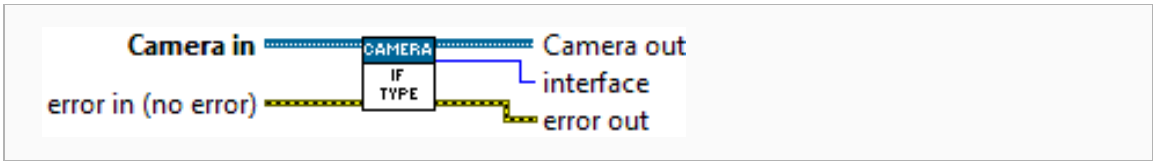
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
serial_number	iU32	Camera serial number
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.5 getInterface

Description Get the interface of the connected camera.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

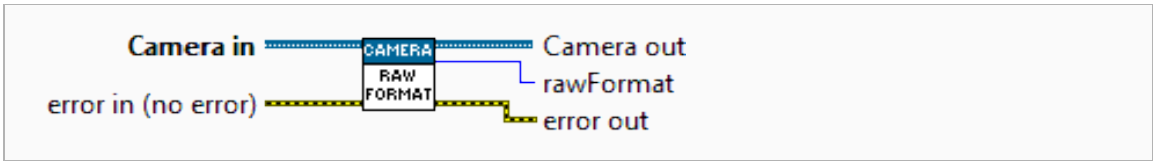
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`interface`	`iU16`	Interface of the connected camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.6 getRawFormat

Description Get the current raw pixel format.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

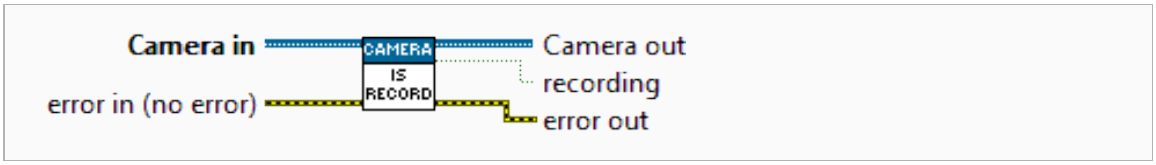
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`rawFormat`	`iEnum`	Current raw pixel format (can be `Word` or `Byte`)
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.7 isRecording

Description Determine if the camera is recording.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

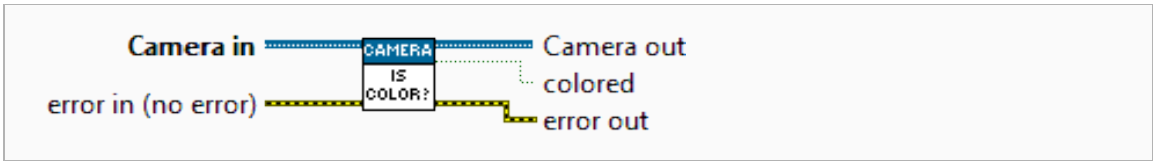
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`recording`	`iBool`	Inticates the recording state: TRUE - camera is recording FALSE - Camera is not recording
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.8 isColored

Description Determine if the camera has a color or monochrome sensor.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

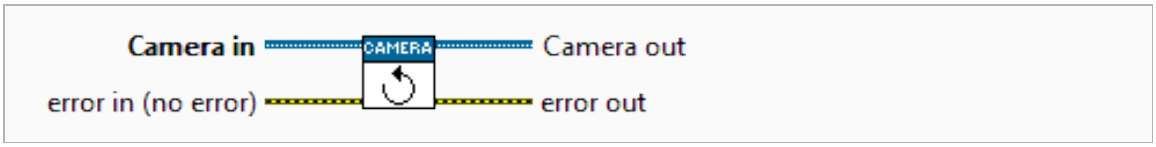
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`colored`	`iBool`	TRUE if camera has a color sensor
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.9 defaultConfiguration

Description Set the camera to it's default configuration. This function is also called during initialization inside init.vi and init_ex.vi.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

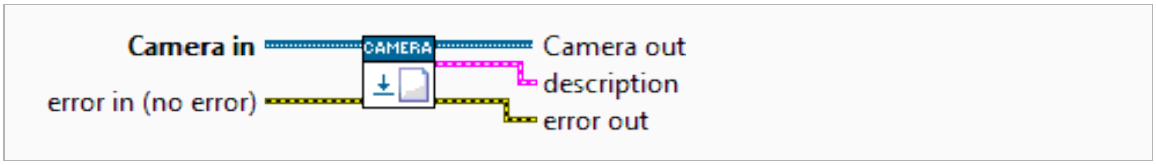
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.10 getDescription

Description Get the camera description from the camera.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

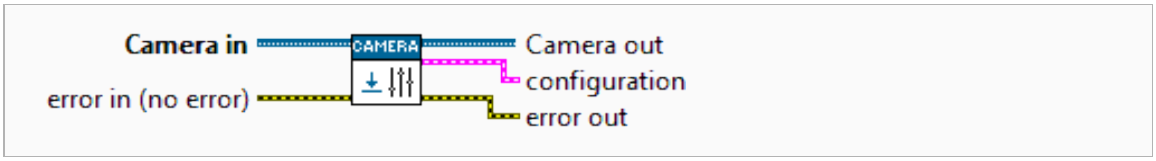
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
description	iClst	Cluster containing data on the camera properties and capabilities (see 2.2.5)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.11 getConfiguration

Description Get the current camera configuration.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

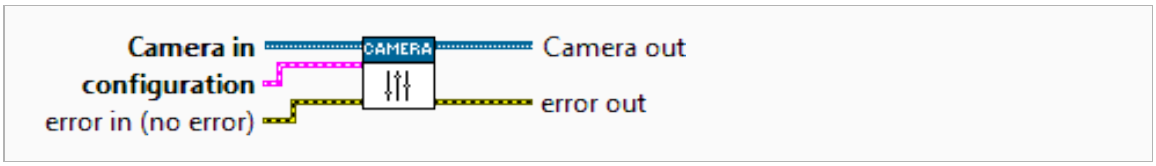
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
configuration	iClst	Cluster containing the most important camera parameters, all combined in one configuration (see 2.2.4)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.12 setConfiguration

Description Set a new coniguration to the camera.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
configuration	cClst	Cluster containing the most important camera parameters, all combined in one configuration (see 2.2.4)
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

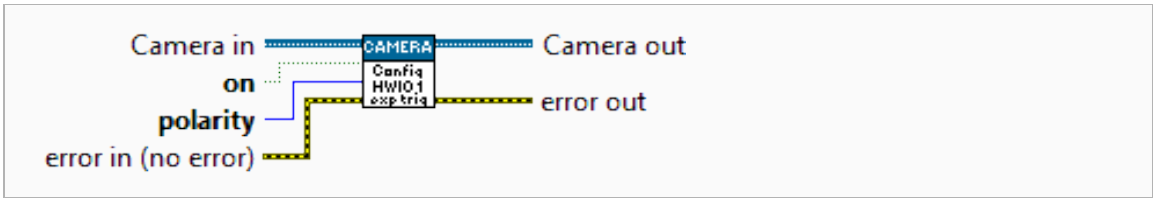
Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.13 configureHWIO_1_exposureTrigger

Description Configure the HWIO connector 1.

This connector is used for the exposure trigger signal input.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
on	cBool	Flag if the HWIO connector should be enabled or disabled
polarity	cU16	Polarity the connector should react on (HWIO_EdgePolarity, see 2.1.16.1)
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

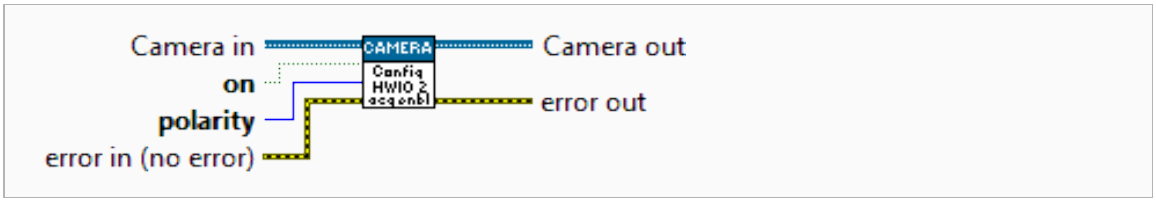
Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.14 configureHWIO_2_acquireEnable

Description Configure the HWIO connector 2.

This connector is used for the acquire enable signal input.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
on	cBool	Flag if the HWIO connector should be enabled or disabled
polarity	cU16	Polarity the connector should have (HWIO_Polarity, see 2.1.16.1)
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

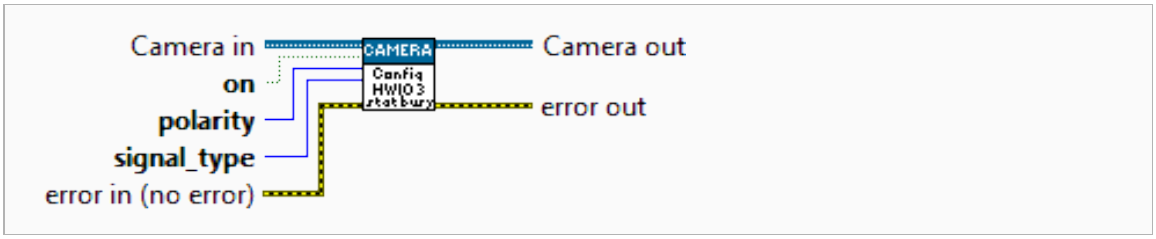
Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.15 configureHWIO_3_statusBusy

Description Configure the HWIO connector 3.

This connector is typically used for the status busy output of the camera. Depending on the camera it can also be configured to output different kind of signals, which can be selected by the `signal_type` parameter.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`on`	`cBool`	Flag if the HWIO connector should be enabled or disabled
`polarity`	`cU16`	Polarity the connector should have (`HWIO_Polarity`, see 2.1.16.1)
`signal_type`	`cU32`	Type of the signal the connector should have (`HWIO_3_SignalType`, see 2.1.16.1)
`error in`	`cErrClst`	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

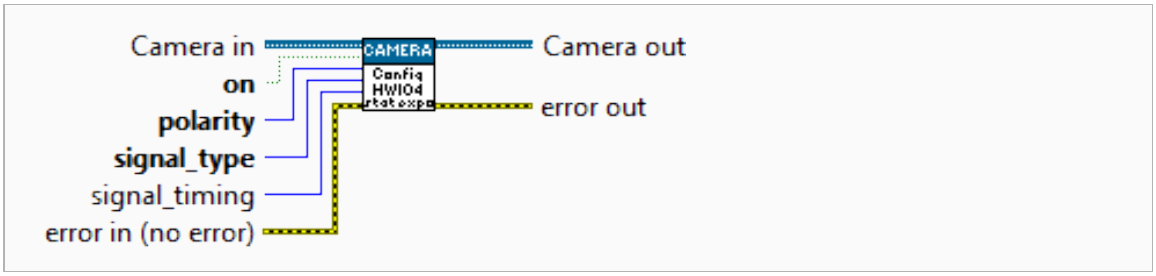
Note Even if you select a `signal_type` that is not valid, i.e. `error out` shows an error, the `on` and `polarity` parameters are set anyway.

2.1.16 configureHWIO_4_statusExpos

Description Configure the HWIO connector 4.

This connector is typically used for the status exposure output of the camera. Depending on the camera it can also be configured to output different kind of signals, selected by the `signal_type` parameter. In some cases, different timing modes for the exposure output signal can be selected by the `signal_timing` parameter.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`on`	`cBool`	Flag if the HWIO connector should be enabled or disabled
`polarity`	`cU16`	Polarity the connector should have (`HWIO_Polarity`, see 2.1.16.1)
`signal_type`	`cU32`	Type of the signal the connector should have (`HWIO_4_SignalType`, see 2.1.16.1)
`signal_timing`	`cU32`	Timing of exposure output signal (see 2.1.16.1). Only valid for Rolling Shutter cameras and `signal_type status_expos` (default is `undefined`, i.e. will not be set)
`error in`	`cErrClst`	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

Note Even if you select a `signal_type` that is not valid, i.e. `error out` shows an error, the `on` and `polarity` parameters are set anyway.

2.1.16.1 HWIO Types

For the **configureHWIO_****** functions we have the following ring enum definitions:

HWIO_Polarity This is a ring enum with the following possible items:

Item	Value	Description
high level	1	I/O signal line can be sensed for high level
low level	2	I/O signal line can be sensed for low level

HWIO_-EdgePolarity

This is a ring enum with the following possible items:

Item	Value	Description
rising edge	4	I/O signal line can be sensed for rising edges
falling edge	8	I/O signal line can be sensed for falling edges

HWIO_3_-SignalType

This is a ring enum with the following possible items:

Item	Value	Description
status busy	0	Signal is output for camera busy state
status line	2	Signal is output for the internal periodical line time of the (rolling shutter) sensor
status armed	3	Signal is output for camera arm state

HWIO_4_-SignalType

This is a ring enum with the following possible items:

Item	Value	Description
status expos	1	Signal is output for camera exposing state
status line	2	Signal is output for the internal periodical line time of the (rolling shutter) sensor
status armed	3	Signal is output for camera arm state

HWIO_-StatusExpos_-Timing

This is a ring enum with the following possible items:

Item	Value	Description
undefined	0	Ignore this parameter
first line	1	Exposure time of the first rolling shutter line ($t_{firstline}$)
global	2	Core time while all lines are exposing (t_{global})
last line	3	Exposure time of the last rolling shutter line ($t_{lastline}$)
all lines	4	Complete exposure time from the start of first until the end of the last rolling shutter line ($t_{alllines}$)

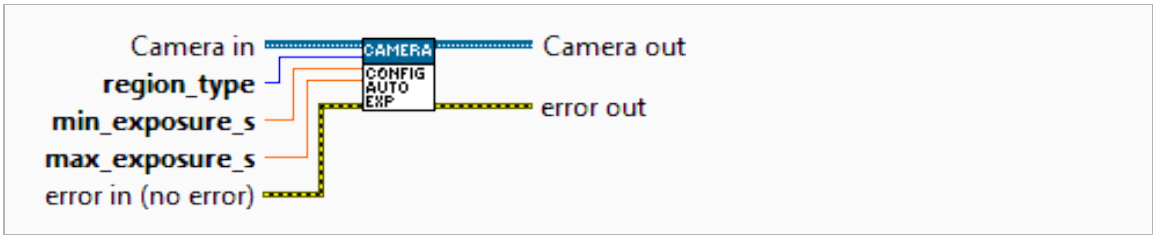
2.1.17 configureAutoExposure

Description Set the auto exposure parameters.

This does not activate or deactivate the auto exposure functionality.
For this please use `autoExposureOn.vi` and `autoExposureOff.vi`.

Note While `autoExposureOn.vi` and `autoExposureOff.vi` can be called also during record, this function can only be called when recording is off.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`region`	`cU16`	Image region type that should be used for auto exposure computation (see 2.2.1).
`min_exposure_s`	`cDbl`	Minimum exposure value that can be used for auto exposure
`max_exposure_s`	`cDbl`	Maximum exposure value that can be used for auto exposure
`error in`	`cErrClst`	Previous error state (no error if not connected)

Parameter OUT

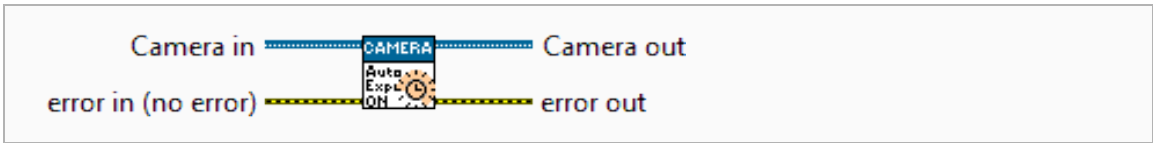
Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.18 autoExposureOn

Description Activate the auto exposure feature.

This will use the currently set configuration for auto exposure.
To set the auto exposure mode parameters please use `configureAutoExposure.vi`.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

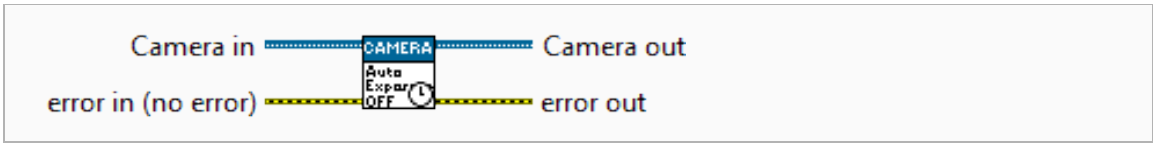
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.19 autoExposureOff

Description Deactivate the auto exposure feature.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

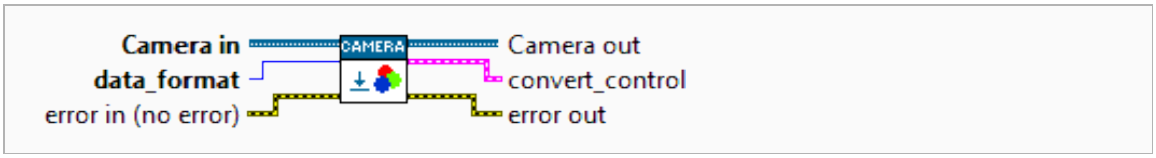
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.20 getConvertControl

Description Get the current convert control settings for the specified image format.

Prototype



Parameter IN

Name	Type	Description
Camera_in	cCamera	Initialized Camera object controlling an opened camera
data_format	cEnum	Image format for conversion of raw image
error_in	cErrClst	Previous error state (no error if not connected)

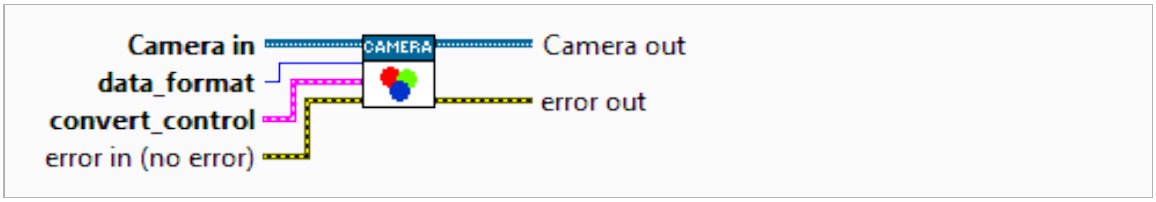
Parameter OUT

Name	Type	Description
Camera_out	iCamera	Initialized Camera object controlling an opened camera
convert_control	iClst	Cluster containing the current convert control settings (see 2.2.6)
error_out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.21 setConvertControl

Description Set the paramerters for converting raw image data to other image formats.

Prototype



Parameter IN

Name	Type	Description
Camera_in	cCamera	Initialized Camera object controlling an opened camera
data_format	cEnum	Image format of the converted image.
convert_control	cClst	Cluster of controls to set the conversion parameters.
error_in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

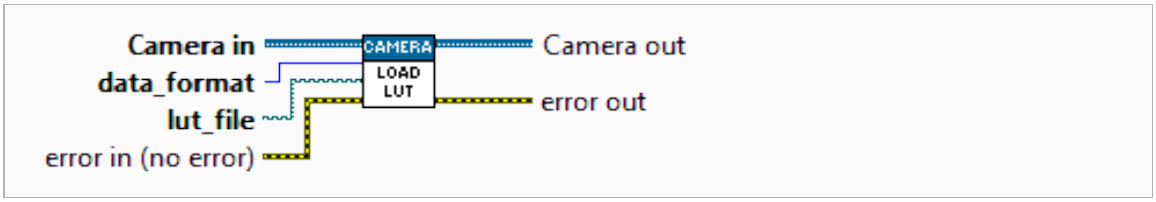
Name	Type	Description
Camera_out	iCamera	Initialized Camera object controlling an opened camera
error_out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.22 loadLut

Description

Load a Lookup Table (LUT) from a file. LUT's are used to apply pseudocolor to monochrome images. Note: the lut file could also be set using `setConvertControl` (see: 2.1.21).

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`data_format`	`cEnum`	Format of the converted image.
`lut_file`	`cPath`	Path of the LUT file to load.
`error in`	`cErrClst`	Previous error state (no error if not connected)

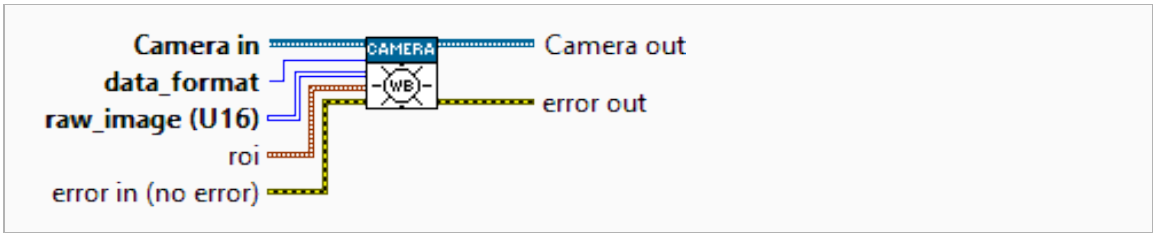
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.23 adaptWhiteBalance

Description Adjust the white balance of an image, based on the whole image or a specified region.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
data_format	cEnum	Data format for the output image
raw_image(U16)	cU16_2d	Copied 16-bit image as 2D array of pixel values
crop	cClstN	Cluster containing a region of interest. Only this region of the image is used for white balance. x0 and y0 must be >= 1 x1 and y1 must be <= width and <= height of the image, respectively
error in	cErrClst	Previous error state (no error if not connected)

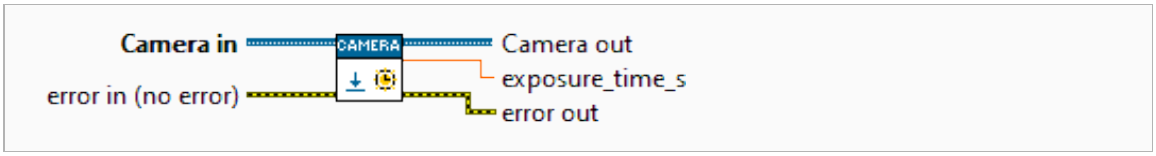
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.24 getExposureTime

Description Get the current exposure time of the camera in seconds.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

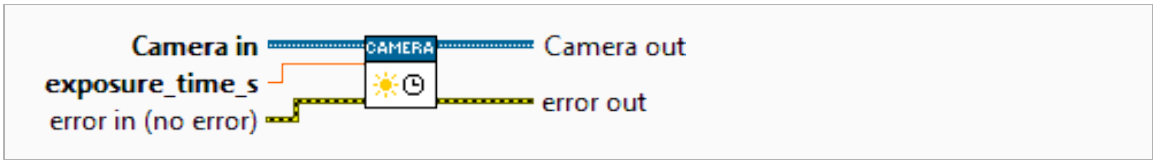
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
exposure_time_s	iDbl	Current exposure time of the camera in seconds
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.25 setExposureTime

Description Set the exposure time of the camera in seconds.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
exposure_time_s	cDbl	Exposure time in seconds to be set
error in	cErrClst	Previous error state (no error if not connected)

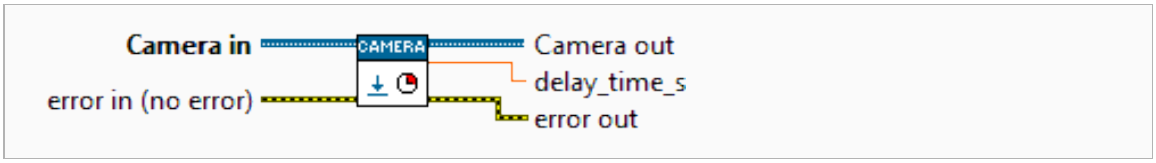
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.26 getDelayTime

Description Get the current delay time of the camera.

Prototype



Parameter IN

Name	Type	Description
Camera_in	cCamera	Initialized Camera object controlling an opened camera
error_in	cErrClst	Previous error state (no error if not connected)

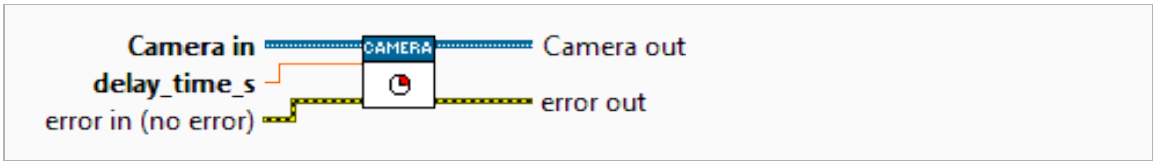
Parameter OUT

Name	Type	Description
Camera_out	iCamera	Initialized Camera object controlling an opened camera
delay_time_s	iDbl	Current delay time of the camera in seconds
error_out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.27 setDelayTime

Description Set the delay time of the camera in seconds.

Prototype



Parameter IN

Name	Type	Description
Camera_in	cCamera	Initialized Camera object controlling an opened camera
delay_time_s	cDbl	Delay time in seconds to be set
error_in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

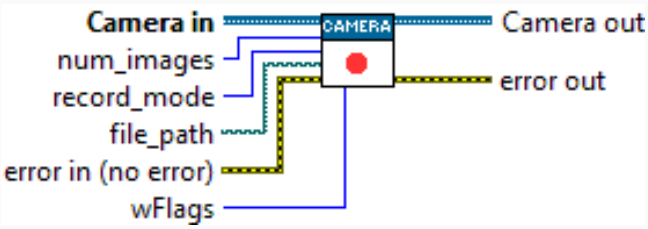
Name	Type	Description
Camera_out	iCamera	Initialized Camera object controlling an opened camera
error_out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.28 record

Description

Create, configure, and start a new recorder instance. The entire camera configuration must be set before calling record.vi. The set_exposure_time.vi is the only exception. This function has no effect on the recorder object and can be called during the recording.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
num_images	cU32	Sets the number of images allocated in the driver. The RAM, disk (of the PC) or camera RAM (depending on the mode) limits the maximum value.
record_mode	cEnum	Defines the mode for this recording (see 1.3)
file_path	cPath	Path where the image file(s) should be stored (only for modes who directly save to file, see 1.3)
file_path	wFlags	Flags to control recording formats (**??**)
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.29 Recorder flags

Description

Recorder flags are used to control the format of the output when recording to file, and to enable DotPhoton compression (dpcore) where available.

Recorder flag descriptions

Name	Value	Description
PCO_RECORDER_MODE_USE_DPCORE	0x1000	Flag to enable DotPhoton Compression (Only valid for Memory and Camram, will be ignored for file mode)
PCO_RECORDER_USE_USB3_MULTIREQUEST	0x2000	Flag for enabling the multi image request (Only for usb3 cameras and only for mode memory)

Continued on next page

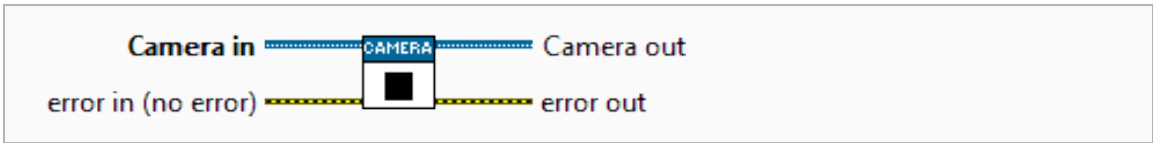
Continued from previous page

Name	Value	Description
PCO_RECORDER_DOUBLEIMG_SPLIT	0x8000	Flag to split double-shutter images (Only valid for File Mode and double image set)
PCO_RECORDER_DOUBLEIMG_SPLIT_SEQUENCE	0xC000	Flag to split double image in two sequentials streams for multi file modes 0x8000 | 0x4000

2.1.30 stop

Description Stop the current recording. In 'ring buffer' and 'fifo' mode, this function must be called by the user. In 'sequence' and 'sequence non blocking' mode, this function is automatically called when the number_of_images is reached (see 1.3).

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

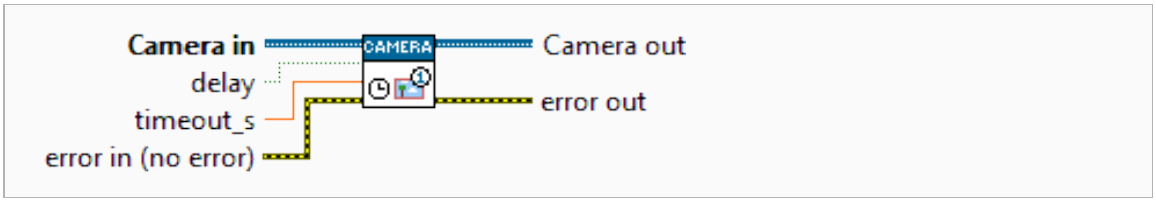
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.31 waitForFirstImage

Description Wait for the first available image in the recorder memory. In recorder mode 'sequence non blocking', 'ring buffer'. and 'fifo', the function record.vi returns immediately. Therefore, this function can be used to wait for images from the camera before calling image.vi, images.vi, or image_average.vi.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`delay`	`cBool`	Flag if a small delay should be used in the waiting loop (typically recommended to reduce cpu load)
`timeout_s`	`cDbl`	Abort waiting loop if no image is recorded during `timeout_s` seconds.
`error in`	`cErrClst`	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera

Continued on next page

Continued from previous page

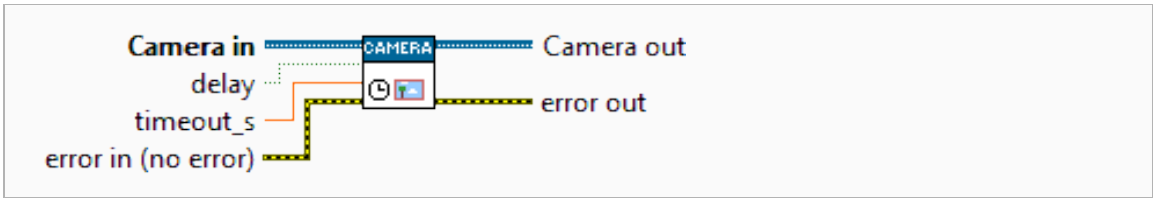
Name	Type	Description
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.32 waitForNewImage

Description

Wait for a new image to appear in the recorder memory (i.e. an image that has not been read yet). In recorder mode 'sequence non blocking', 'ring buffer'. and 'fifo', the function record.vi returns immediately. Therefore, this function can be used to wait for the next image from the camera before calling image.vi, images.vi, or image_average.vi.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`delay`	`cBool`	Flag if a small delay should be used in the waiting loop (typically recommended to reduce cpu load)
`timeout_s`	`cDbl`	Abort waiting loop if no image is recorded during `timeout_s` seconds.
`error in`	`cErrClst`	Previous error state (no error if not connected)

Parameter OUT

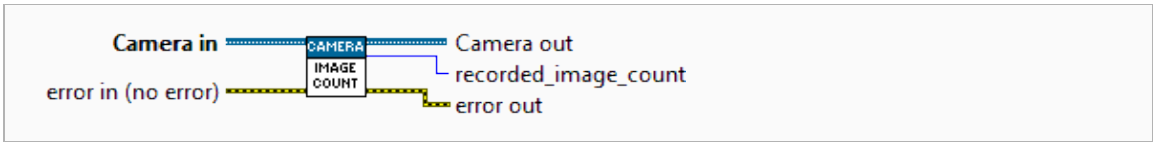
Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.33 getRecordedImageCount

Description Get the number of currently recorded images.

Note For recorder modes `fifo` and `fifo_dpcore` (see 1.3) this represents the current fill level of the fifo buffer, not the overall number of recorded images.
So in FIFO mode check for **getRecordedImageCount() > 0** to see if a new image is available.

Prototype



Parameter IN

Name	Type	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`error in`	`cErrClst`	Previous error state (no error if not connected)

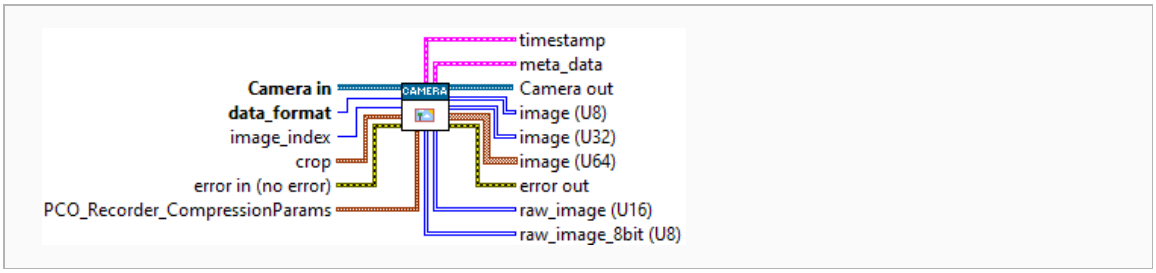
Parameter OUT

Name	Type	Description
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`recorded_image_count`	`iU32`	Number of currently recorded images
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.34 image

Description Get an image from the recorder. The type of the image is 2D array of pixel values. This array is shaped depending on the resolution and ROI of the image. The data format determines which output is valid, but the `raw_image(16)` output is always valid.

Prototype



Parameter IN

Name	Datatype	Description
`Camera in`	`cCamera`	Initialized `Camera` object controlling an opened camera
`data_format`	`cEnum`	Data format of the converted image (see 1.4)
`image_index`	`cU32`	Specifies the index of the image to be read. In 'sequence' or 'sequence non blocking' mode, the recorder index matches the image_index. If image_index is set to `0xFFFFFFFF`, the last recorded image is copied. This enables a live preview while recording. For modes `fifo`/`fifo_dpcore` always use 0 (see 1.3))
`crop`	`cClstN`	Cluster containing coordinates of the crop region. Only this region of the image is copied. (see **??** for the `crop` structure)
`error in`	`cErrClst`	Previous error state (no error if not connected)
`PCO_Recorder_CompressionParams`	`cClstN`	Struct containing the necessary noise parameters for the compression / equilibration of the specific camera, not implemented yet

Parameter OUT

Name	Type	Description
`timestamp`	`iClst`	Timestamp of the image
`meta_data`	`iClst`	Metadata of the image
`Camera out`	`iCamera`	Initialized `Camera` object controlling an opened camera
`image(U8)`	`iU8Arr_2d`	Image data as 2d 8-bit array (use this for format `Mono8`, see 1.4)

Continued on next page

Continued from previous page

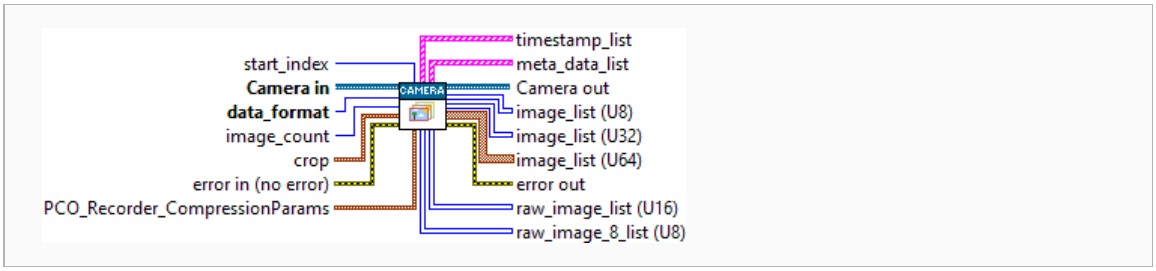
Name	Type	Description
image(U32)	iU32Arr_2d	Image data as 2d 32-bit array (use this for formats RGBA8, BGRA8, see 1.4)
image(U64)	iClstArrN_2d	Image data as 2d 64-bit (cluster of 4 times 16-bit) array (use this for formats RGBA16, BGRA16, see 1.4)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)
raw_image(U16)	iU16Arr_2d	Image data as 2d 16-bit array (use this for getting the raw image data, in format Mono16 this is the only valid image output, see 1.4)

2.1.35 images

Description

Get recorded images from the recorder as a 3D array, as specified by a start_index and an image_count. This array is shaped depending on the resolution and ROI of the image and the number of recorded images. The data is stored in the order of image, row, column. The data format determines which output is valid, but the raw_image(16) output is always valid.

Prototype



Parameter IN

Name	Type	Description
start_index	cU32	Index of the first image to copy
Camera in	cCamera	Initialized Camera object controlling an opened camera
data_format	cEnum	Data format of the output image array (see 1.4)
image_count	cU32	Number of images to copy
crop	cClstN	Cluster containing coordinates of the crop region. Only this region of the image is copied (see **??** for the crop structure)
error in	cErrClst	Previous error state (no error if not connected)
PCO_Recorder_CompressionParams	cClstN	Struct containing the necessary noise parameters for the compression / equilibration of the specific camera (not implemented yet)

Parameter OUT

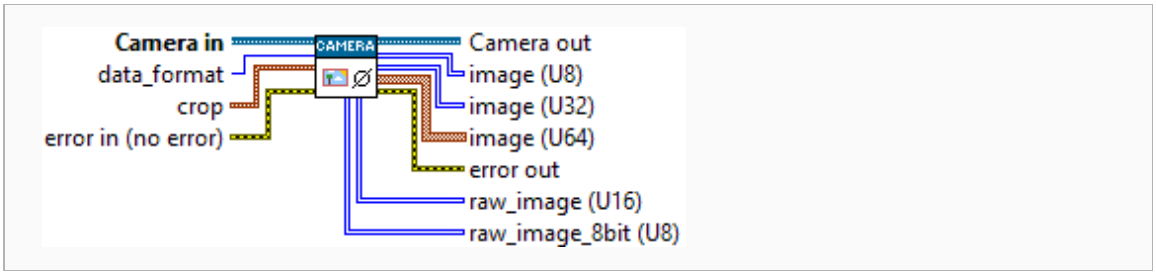
Name	Type	Description
timestamp_list	iClstArr_1d	Array of timestamps for the images
meta_data_list	iClstArr_1d	Array of metadata for the images
Camera out	iCamera	Initialized Camera object controlling an opened camera
image_list(U8)	iU8Arr_2d	List of images as 3d 8-bit array (use this for format Mono8, see 1.4)
image_list(U32)	iU32Arr_2d	List of images as 3d 32-bit array (use this for formats RGBA8, BGRA8, see 1.4)
image_list(U64)	iClstArrN_2d	List of images as 3d 64-bit (cluster of 4 times 16-bit) array (use this for formats RGBA16, BGRA16, see 1.4)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)
raw_image_list(U16)	iU16Arr_2d	List of images as 3d 16-bit array (use this for getting the raw images, in format Mono16 this is the only valid image output, see 1.4)

2.1.36 imageAverage

Description Get the averaged image as a 2D array of pixel values. The average is calculated from all recorded images in the buffer. This array is shaped depending on the resolution and ROI of the image. The data format determines which output is valid, but the raw_image(16) output is always valid.

Note We recommend that you do not use this function while recording is active, as it may give unexpected results (especially in ring_buffer mode, see 1.3.
Typically you would record the number of images you want to average as sequence, then compute the average and after all images have been recorded.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
data_format	cEnum	Data format of the averaged image (see 1.4)
crop	cClstN	Cluster containing coordinates of the crop region. Only this region of the image is copied. (see **??** for the crop structure)
error in	cErrClst	Previous error state (no error if not connected)

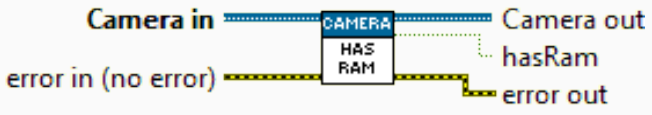
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
image(U8)	iU8Arr_2d	Averaged image as 2d 8-bit array (use this for format Mono8, see 1.4)
image(U32)	iU32Arr_2d	Averaged image as 2d 32-bit array (use this for formats RGBA8, BGRA8, see 1.4)
image(U64)	iClstArrN_2d	Averaged image as 2d 64-bit (cluster of 4 times 16-bit) array (use this for formats RGBA16, BGRA16, see 1.4)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)
raw_image(U16)	iU16Arr_2d	Averaged image as 2d 16-bit array (use this for getting the raw image data, in format Mono16 this is the only valid image output, see 1.4)

2.1.37 hasRam

Description Determine if the camera has internal memory (camera RAM).

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

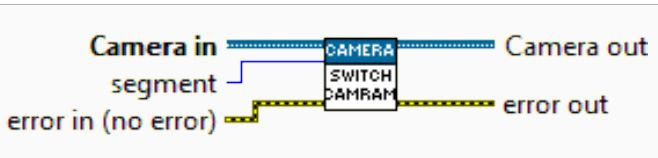
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
hasRam	iBool	Boolean indicating whether cam ram is available. Set if camera has internal memory
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.38 switchToCamRam

Description Select the active RAM segment in cameras with internal memory (CAMRAM).

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
segment	cU16	RAM segment to use for recording and image readout.
error in	cErrClst	Previous error state (no error if not connected)

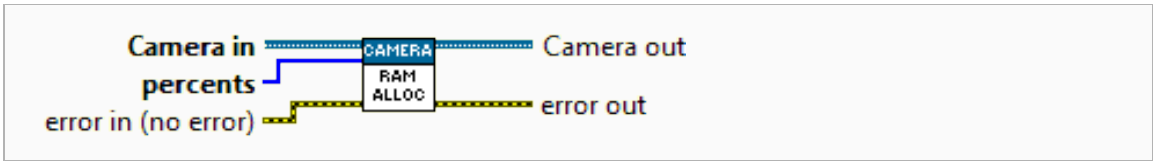
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.39 setCamRamAllocation

Description For cameras with internal memory (CAMRAM) this VI can be used to set the number of images allocated to each of the four segments. Allocation is specified as a percentage of the total, so the sum of the allocation elements cannot exceed 100. The total can be less than 100, i.e. not all memory is allocated.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
percents	cU32Arr_1d	Array of four elements corresponding to the four memory segments, specifying the percentage of the total RAM in each segment. Note: Segments are index starting at 1, so element 0 here is segment 1, element 1 is segment 2, etc
error in	cErrClst	Previous error state (no error if not connected)

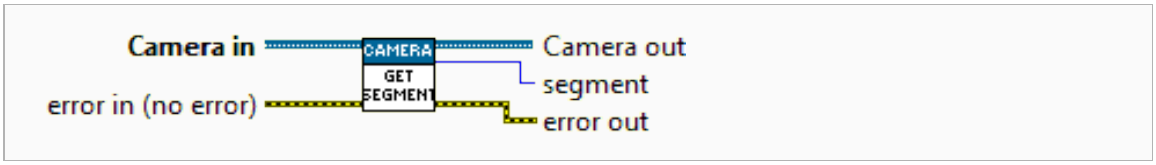
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.40 getCamRamSegment

Description Get the number of the current RAM segment. Returns an error if camera does not have internal memory.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
segment	iU16	Number of active camram segment

Continued on next page

Continued from previous page

Name	Type	Description
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.41 setCamRamSegment

Description Set the number of the current CAMRAM segment. Subsequent recordings will use this segment, and images will be read from this segment. For cameras with internal memory only.

Prototype

Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
segment	iU16	Specifies the segement to use for recording or reading images.
error in	cErrClst	Previous error state (no error if not connected)

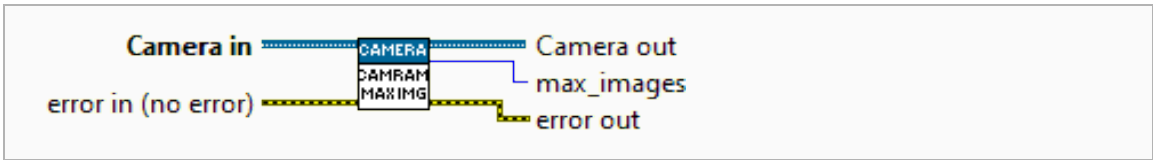
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.42 getCamRamMaxImages

Description Determine the maximum number of images that can be stored in the camera RAM. For cameras with internal memory only. Returns an error if camera does not have internal memory.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

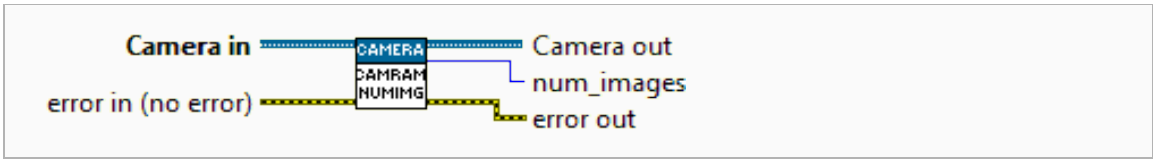
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
max_images	iU32	Maximum number of images that can be stored in the camera RAM. For cameras with internal memory only
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.43 getCamRamNumImages

Description Return the number of images stored in the current camera RAM segment. For cameras with internal memory only. Returns an error if camera does not have internal memory.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

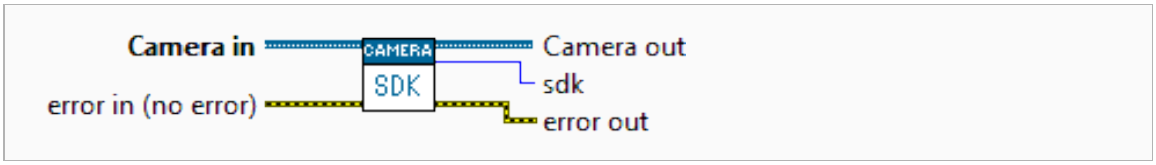
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
num_images	iU32	Number of images stored in the current camera RAM segment
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.44 sdk

Description Retrieve the sdk handle. This handle allows direct access to all underlying functions of the pco.sdk.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

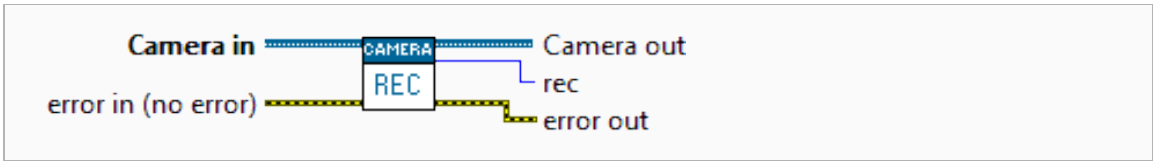
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
sdk	iU64	Handle to the pco.sdk library functions
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.45 rec

Description Retrieve the recorder handle. This handle allows direct access to all underlying functions of the pco.recorder.

Prototype



Parameter IN

Name	Type	Description
Camera in	cCamera	Initialized Camera object controlling an opened camera
error in	cErrClst	Previous error state (no error if not connected)

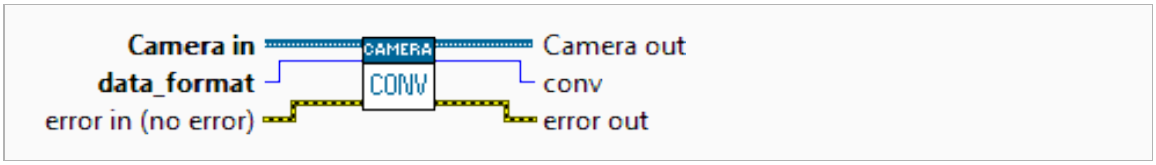
Parameter OUT

Name	Type	Description
Camera out	iCamera	Initialized Camera object controlling an opened camera
rec	iU64	Handle to the pco.recorder library functions
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.1.46 conv

Description Retrieve the conv handle. This handle allows direct access to all underlying functions of the color conversion library pco.convert.

Prototype



Parameter IN

Name	Type	Description
Camera_in	cCamera	Initialized Camera object controlling an opened camera
data_format	cEnum	Image data format for the convert functions
error_in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
Camera_out	iCamera	Initialized Camera object controlling an opened camera
conv	iU64	Handle to the pco.convert library functions
error_out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.2 Controls

In the following sections you will find all controls used in the `Camera` class.

Here we omit the ”c” and ”i” in the datatype description because control elements can be used as controls and indicators.

2.2.1 auto_exposure

Description Structure holding the auto exposure information.

Name	Type	Description
`region`	`U16`	Region type that should be used for auto exposure calculation (see below for explanation)
`min_exposure_s`	`Dbl`	Minimum exposure value that can be used for auto exposure
`max_exposure_s`	`Dbl`	Maximum exposure value that can be used for auto exposure

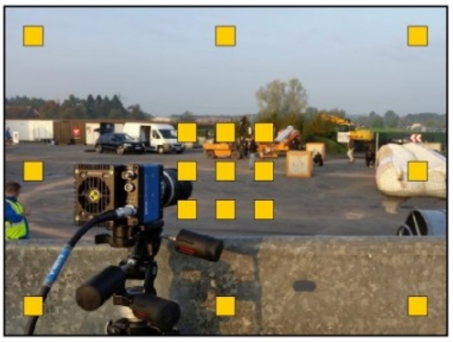
Note `region` is a ring enum with the following possible items:

Item	Value
balanced	0
center_based	1
corner_based	2
full	3

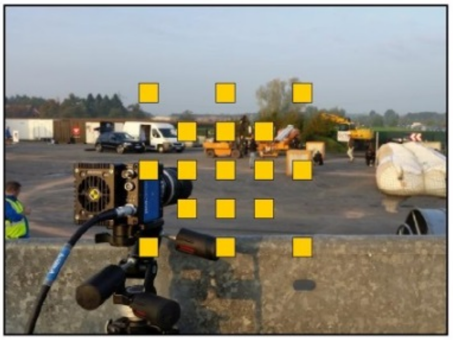
The size of the pixel clusters is fixed, but depends on the overall image size and is treated seperately for width and height:

- for width/height >= 1300 the cluster size is 100
- for 1300 > width/height >= 650 the cluster size is 50
- for 650 > width/height >= 325 the cluster size is 25
- for width/height < 325 the cluster size equal to width/height.

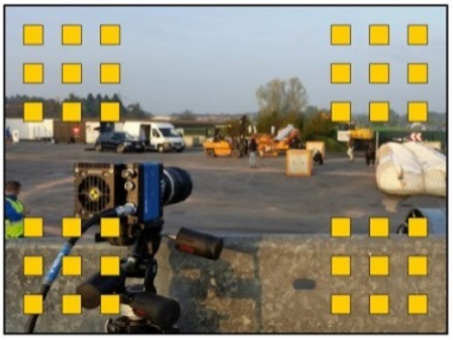
balanced Measurement fields positioned centrally and in all corners



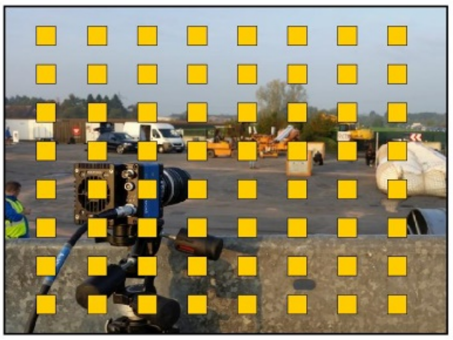
center_based Measurement fields positioned centrally.



corner_based Measurement fields positioned in all four corners.



full Measurement fields across the image.



2.2.2 binning

Description Structure holding the binning information.

Name	Type	Description
vert	U16	Vertical binning
horz	U16	Horizontal binning
mode	U16	Binning mode (default is 0 which means sum)

Note mode is a ring enum with the following possible items:

Item	Value	Description
sum	0	Sum up the pixel
average	1	Average over the pixel

2.2.3 roi

Description The roi.ctl element contains the region of interest parameters.

Name	Type	Description
x0	U64	Left position of ROI (starting from 1)
y0	U64	Top position of ROI (starting from 1)
x1	U64	Right position of ROI (up to full width)
y1	U64	Bottom position of ROI (up to full height)

roi vs crop roi is the hardware ROI. What the camera records and sends to the memory/computer. If it is changed new images have to be recorded to be applied. crop is the software ROI. The crop can never be greater than the roi and can be changed without recording new images.

2.2.4 configuration

Description Cluster containing the most important camera parameters, all combined in one configuration.

Name	Type	Description
exposure_time_s	Dbl	Exposure time of the camera in seconds
delay_time_s	Dbl	Delay time of the camera in seconds
roi	ClstN	Cluster containing the region of interest of the camera (see 2.2.3)
timestamp_mode	U16	Timestamp mode
pixelrate	U32	Pixelrate
trigger_mode	U16	Trigger mode
acquire_mode	U16	Acquire mode
acquire_sequence_number	U32	Number of images to acquire in sequence mode
metadata_mode	U16	Metadata mode

Continued on next page

Continued from previous page

Name	Type	Description
noisefilter_mode	U16	Noise filter mode
binning	ClstN	Cluster of three U16 elements containing the binning setting of the camera(see 2.2.2)
auto_exposure	ClstN	Auto Exposure structure (see 2.2.1)

2.2.5 description

Description Cluster of indicators containing the camera description. The camera description lists important camera properties, such as resolution, exposure time range, clock rates, etc.

Name	Type	Description
serial	U32	Serial number of the camera
type	U16	Sensor type used in the camera
sub_type	U16	Sub-type of the camera sensor
interface_type	U16	Interface used to connect the camera to the PC
bit_resolution	U16	Number of bits used in the conversion to digital
min_exposure_time_s	Dbl	Minimum exposure time in seconds
max_exposure_time_s	Dbl	Maximum exposure time in seconds
min_exposure_step_s	Dbl	Smallest increment of exposure time in seconds
min_delay_time_s	Dbl	Minimum delay time in seconds
max_delay_time_s	Dbl	Maximum delay time in seconds
min_delay_step_s	Dbl	Minimum increment for setting delay time, in seconds
min_width	U64	Minimum image width in pixels (hardware ROI)
min_height	U64	Minimum image height in pixels (hardware ROI)
max_width	U64	Maximum image width in pixels (hardware ROI)
max_height	U64	Maximum image height in pixels (hardware ROI)
roi_step_horz	U64	Minimum increment for setting horizontal ROI (hardware ROI)
roi_step_vert	U64	Minimum increment for setting vertical ROI (hardware ROI)
roi_symmetric_horz	Bool	Flag if hardware ROI has to be horizontally symmetric (i.e. if x0 is increased, x1 has to be decreased by the same value)

Continued on next page

Continued from previous page

Name	Type	Description
roi_symmetric_vert	Bool	Flag if hardware ROI has to be vertically symmetric (i.e. if y0 is increased, y1 has to be decreased by the same value)
has_timestamp_mode	Bool	Flag if camera supports the timestamp setting
has_timestamp_mode_ascii_only	Bool	Flag if camera supports setting the timestamp to ascii-only
pixelrate_vec	U32Arr_1d	Array containing all possible values of the pixel clock, in Hz. Index 0 is default value (index 0 is default)
has_trigger_mode_extexpctrl	Bool	Flag if camera supports trigger mode external exposure control
has_acquire_mode	Bool	Flag if camera supports the acquire mode setting
has_ext_acquire_mode	Bool	Flag if camera supports the external acquire setting
has_metadata_mode	Bool	Flag if metadata can be activated for the camera
has_ram	Bool	Flag if camera has internal memory (CAMRAM)
binning_horz_vec	U16Arr_1d	Array containing all possible horizontal binning values
binning_vert_vec	U16Arr_1d	Array containing all possible vertical binning values
has_average_binning	Bool	Flag if camera supports average binning

2.2.6 convert_control

Description Cluster of controls for the conversion of raw images to other image formats.

Name	Type	Description
sharpen	Bool	Set if the image should be sharpened
adaptive_sharpen	Bool	Set to enable adaptive sharpening
flip_vertical	Bool	Set to flip output image vertically with respect to input image
auto_minmax	Bool	Set to enable auto scaling
add_conv_flags	U16	Variable to set additional flags for image/color conversion (default is 0)
min_limit	U16	Minimum scaling value (will be ignored if auto scale is enabled)
max_limit	U16	Maximum scaling value (will be ignored if auto scale is enabled)
gamma	Dbl	Gamma of the image (default is 1.0)

Continued on next page

Continued from previous page

Name	Type	Description
contrast	I32	Contrast of the image (default is 0)
pco_debayer_algorithm	Bool	Set to enable PCO debayering
color_temperature	I32	Color temperature for image conversion
color_saturation	I32	Color saturation for image conversion
color_vibrance	I32	Color vibrance for image conversion
color_tint	I32	Color tint for image conversion
lut_file	Path	Path to the lut file for converting mono images

2.3 XCite

The following sections describe the XCite class to control X-Cite® devices within LabVIEW.

With this class you can easily create and control a system with PCO cameras and Excelitas X-Cite® light sources.

2.3.1 init

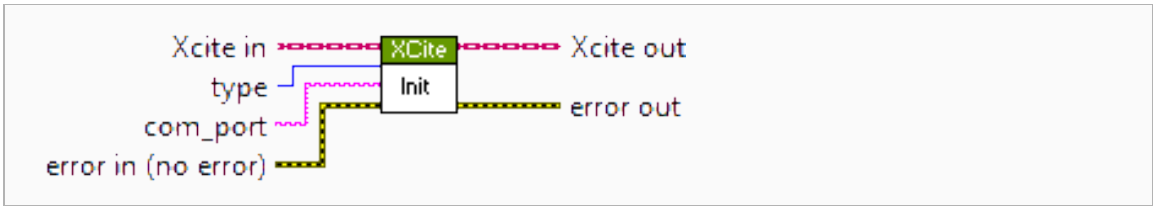
Description

Initialize the connection to an X-Cite® light source. With the ”All interfaces” option, this VI will scan through all possible interfaces until it finds a connected X-Cite® light source.

Optionally one can specify either the device or the com port.

An error is generated if no X-Cite® is found.

Prototype



Parameter IN

Name	Type	Description
`Xcite in`	`cXcite`	Initialized `XCite` object controlling an opened X-Cite® light source
`type`	`cI32`	X-Cite® device type (see 2.3.13.3)
`com_port`	`cStr`	Com port string
`error in`	`cErrClst`	Previous error state (no error if not connected)

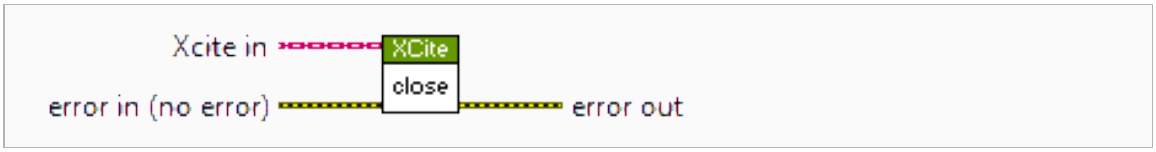
Parameter OUT

Name	Type	Description
`Xcite out`	`iXCite`	Initialized `XCite` object controlling an opened X-Cite® light source
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.2 close

Description Close the activated connection and release the blocked resources.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

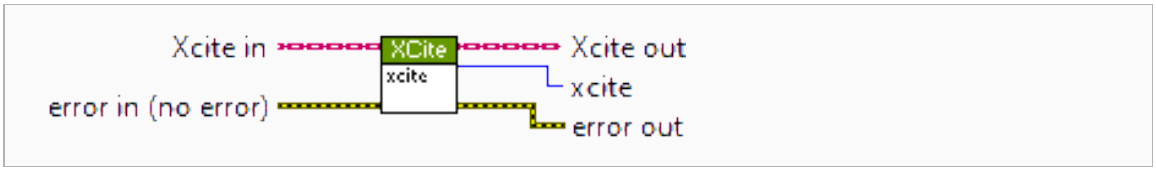
Parameter OUT

Name	Type	Description
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.3 xcite

Description Return the handler for the xcite connection for the xcite library.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

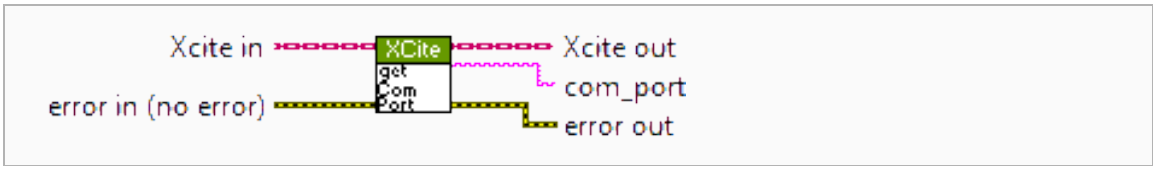
Parameter OUT

Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
xcite	iU64	HANDLE for the current xcite connection
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.4 getComPort

Description Return the Com Port of the current connection.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

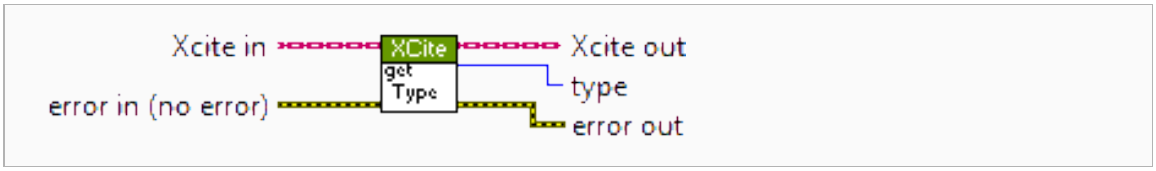
Parameter OUT

Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
com_port	iStr	Com port of the opened light source
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.5 getType

Description Return the X-Cite® device type.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

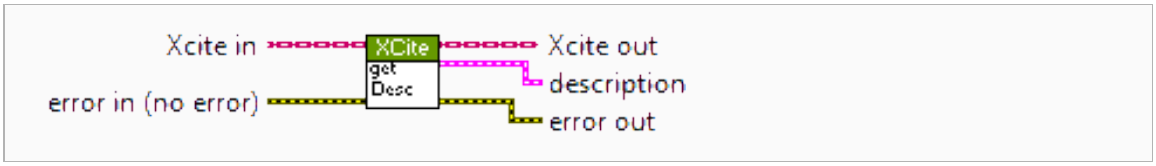
Parameter OUT

Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
type	iI32	X-Cite® device type (see 2.3.13.3)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.6 getDescription

Description Return the description parameters of the X-Cite® device.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

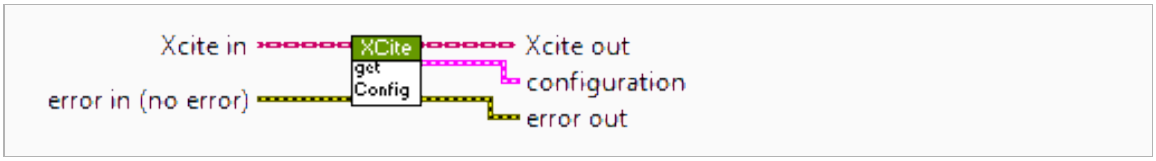
Parameter OUT

Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
description	iClst	Description structure of the X-Cite® device (see 2.3.13.2)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.7 getConfiguration

Description Return the configuration parameters of the X-Cite® device.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
configuration	iClst	Configuration structure of the X-Cite® device (see 2.3.13.1)
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.8 setConfiguration

Description Write a configuration to the X-Cite® device.

Prototype

Parameter IN

Name	Type	Description
`Xcite in`	`cXcite`	Initialized `XCite` object controlling an opened X-Cite® light source
`configuration`	`cClst`	Configuration structure for the X-Cite® device (see 2.3.13.1)
`error in`	`cErrClst`	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
`Xcite out`	`iXCite`	Initialized `XCite` object controlling an opened X-Cite® light source
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.9 defaultConfiguration

Description Reset the configuration of the X-Cite® device to the default values, turns all lights off.

Prototype

Parameter IN

Name	Type	Description
`Xcite in`	`cXcite`	Initialized `XCite` object controlling an opened X-Cite® light source
`error in`	`cErrClst`	Previous error state (no error if not connected)

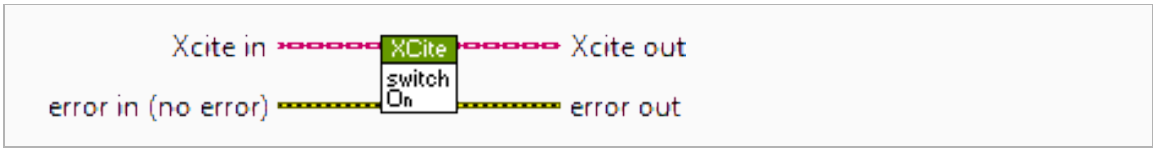
Parameter OUT

Name	Type	Description
`Xcite out`	`iXCite`	Initialized `XCite` object controlling an opened X-Cite® light source
`error out`	`iErrClst`	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.10 switchOn

Description Switch the configured lights on.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

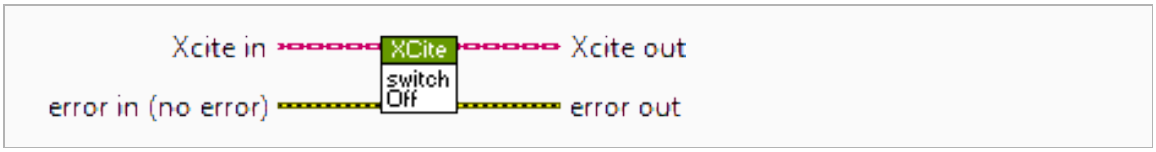
Parameter OUT

Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.11 switchOff

Description Switch all lights off.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

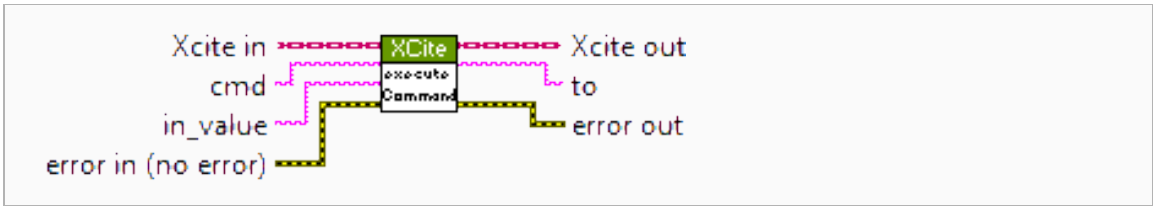
Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.12 executeCommand

Description

The command list for X-Cite® is available by request. To obtain the latest update, please contact Excelitas Technologies support.

Prototype



Parameter IN

Name	Type	Description
Xcite in	cXcite	Initialized XCite object controlling an opened X-Cite® light source
cmd	cStr	Command string to be sent to the X-Cite® device
in_value	cStr	Parameter string if necessary for the command
error in	cErrClst	Previous error state (no error if not connected)

Parameter OUT

Name	Type	Description
Xcite out	iXCite	Initialized XCite object controlling an opened X-Cite® light source
to	iStr	Response string
error out	iErrClst	Error state after VI: Error state of the function (if no error was passed in) Error state of error in parameter (if error was passed in)

2.3.13 Controls

In the following sections you will find all structures and enums used in the `XCite` class.

2.3.13.1 XCITE_Configuration

Description Structure holding an X-Cite® configuration.

Name	Type	Description
`intensities`	`U32Arr_1d`	Array of available intensities
`on_states`	`U8Arr_1d`	Array of which lights are on

2.3.13.2 XCITE_Description

Description Structure holding the X-Cite® description information.

Name	Type	Description
`serial`	`U32`	Serial number
`type`	`U16`	XCite type (see 2.3.13.3)
`name`	`Str`	Name of the X-Cite® device
`wavelengths_vec`	`U32Arr_1d`	Array of available wavelengths
`exclusivity_vec`	`U32Arr_1d`	Array of values indicating which wavelengths can be set exclusively (matching wheel number). Wheel number 0: independent activation possible
`intensity_max_vec`	`U32Arr_1d`	Array of available maximum intensities
`intensity_min_vec`	`U32Arr_1d`	Array of available minimum intensities

2.3.13.3 XCiteType

Description This is a ring enum with the following possible items:

Item	Value	Light Source Name
XC_120PC	0	120PC
XC_exacte	1	exacte
XC_120LED	2	120LED
XC_110LED	3	110LED
XC_mini	4	mini
XC_XYLIS	5	XYLIS
XC_XR210	6	XR210
XC_XLED1	7	XLED1
XC_XT600	8	XT600
XC_XT900	9	XT900
Any	65535	

3 Type Definitions

The following table shows the correlation of data type names used in this manual and the corresponding **LabVIEW** data type symbols.

All controls start with `c`, all indicators start with `i`.

Name	Type	Description
cCamera		`Camera` class object control
iCamera		`Camera` class object indicator
cXcite		`XCite` class object control
iXcite		`XCite` class object indicator
cBool		Boolean variable control
iBool		Boolean variable indicator
cClst		Cluster variable (mixed data types) control
iClst		Cluster variable (mixed data types) indicator
cDbl		Double precision variable control
iDbl		Double precision variable indicator
cEnum		Enum variable control
iEnum		Enum variable indicator
cErrClst		LV error code cluster control
iErrClst		LV error code cluster indicator
iI16		Signed 16 bit variable indicator
cI32		Signed 32 bit variable control
iI32		Signed 32 bit variable indicator
cClstN		Cluster variable (numeric data types) control
iClstN		Cluster variable (numeric data types) indicator
cPath		(File) Path variable control
iPath		(File) Path variable indicator
cStr		String variable control
iStr		String variable indicator
cU8		Unsigned 8-bit variable control
iU8		Unsigned 8-bit variable indicator
cU16		Unsigned 16-bit variable control
iU16		Unsigned 16-bit variable indicator
cU32		Unsigned 32-bit variable control
iU32		Unsigned 32-bit variable indicator
cU64		Unsigned 64-bit variable control
iU64		Unsigned 64-bit variable indicator
iTS		LV timestamp variable indicator
iClstArr_1d		one-dimensional array of clusters (mixed data types) indicator
iDblArr_1d		one-dimensional array of double precision values indicator
cU8Arr_1d		one-dimensional array of unsigned 8-bit values control

Continued on next page

Continued from previous page

Name	Type	Description
iU16Arr_1d		one-dimensional array of unsigned 16-bit values indicator
cU32Arr_1d		one-dimensional array of unsigned 32-bit values control
iU32Arr_1d		one-dimensional array of unsigned 32-bit values indicator
iClstArrN_2d		two-dimensional array of clusters (numeric data types) indicator
iU8Arr_2d		two-dimensional array of unsigned 8-bit values indicator
cU16_2d		two-dimensional array of unsigned 16-bit values control
iU16Arr_2d		two-dimensional array of unsigned 16-bit values indicator
iU32Arr_2d		two-dimensional array of unsigned 32-bit values indicator
iClstArrN_3d		three-dimensional array of clusters (numeric data types) indicator
iU8Arr_3d		three-dimensional array of unsigned 8-bit values indicator
iU16Arr_3d		three-dimensional array of unsigned 16-bit values indicator
iU32Arr_3d		three-dimensional array of unsigned 32-bit values indicator

4 About Excelitas PCO

Pioneering in Cameras and Optoelectronics (PCO) has been our shared philosophy since our establishment in 1987. Starting with image-intensified cameras, followed by the co-invention of the groundbreaking sCMOS sensor technology, PCO greatly surpassed the imaging performance standards of the day. Acquired by Excelitas in 2021, our PCO camera portfolio continues to forge ahead as a leader in digital imaging innovation across diverse applications such as scientific and industrial research, automotive testing, quality control, and metrology.

With sophisticated mechanical design, extensive software support, and a broad range of accessories, we deliver adaptable solutions for all demands. This adaptability extends to tailor-made firmware and custom image sensors, which allow us to develop highly specialized solutions for all our customers. PCO represents a world-renowned brand of high-performance camera systems that complement Excelitas' expansive range of illumination, optical, and sensor technologies and extend the bounds of our end-to-end photonic solutions capabilities.

Our comprehensive camera portfolio covers the entire spectrum - from deep ultraviolet (DUV) to shortwave infrared (SWIR), from long exposure to high-speed, from line scan to high-resolution area scan. Our camera systems are controlled and processed through an intuitive and powerful software suite addressing an extensive range of platforms and architectures.

pco.®

address:	Excelitas PCO GmbH Donaupark 11 93309 Kelheim, Germany
phone:	(+49) 9441-2005-0 (+1) 866-662-6653 (+86) 0512-6763-4643
mail:	pco@excelitas.com
web:	www.excelitas.com/pco

excelitas®

excelitas.com