

eGrabber

Grablink Duo Handbook

1628 Grablink Duo



This documentation is provided with **eGrabber 24.04.0** (doc build 2187).
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PART I

GETTING STARTED

1. Hardware Setup

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1.1. Precautions for Use of Board Products

Electrostatic Sensitive Device Boards may be damaged by electrostatic discharges. Follow the procedure hereby described and apply any general procedure aimed at reducing the risk associated with electrostatic discharge. Damage caused by improper handling is not covered by the manufacturer's warranty.

Electromagnetic Compatibility Euresys boards are compliant with electromagnetic compatibility regulatory requirements. To ensure this compliance, the card bracket must be secured with the relevant screw in accordance with the procedure described herein.

Risk of Electrical Shock Do not operate the computer with any enclosure cover removed. During the hardware installation, ensure the AC power cord is unplugged before touching any internal part of the computer.

Risk of Burn Do not touch an operating board. Allow board to cool before handling.

Heating Device It is normal for a board to dissipate some heat during operation. All enclosure covers, including blank brackets, must be fitted correctly to ensure that the fan cools the computer adequately.

Hot Plugging Forbidden Uncontrolled plugging and unplugging of equipment may damage a board. Always switch off the computer and any relevant system device when connecting or disconnecting a cable at the frame grabber or auxiliary board bracket. Failure to do so may damage the card and will void the warranty.

Poor Grounding Protection The computer and the camera can be located in distant areas with individual ground connections. Poor ground interconnection, ground loop or ground fault may induce unwanted voltage between equipment, causing excessive current in the interconnecting cables. This faulty situation can damage the frame grabber or the camera electrical interface. The user must follow proper equipment grounding practices at all ends of the interconnecting cables. In addition, the use of cable assemblies with overall shield solidly connected to the conductive shell of all connectors is recommended. Besides the beneficial effect of cable shielding on electromagnetic compatibility, the shield connection can increase the protection level against grounding problems by temporarily absorbing unwanted fault current.

1.2. PCI Express Card Slot Requirements

For optimal data transfer performance, **1628 Grablink Duo** must be plugged into a x4, x8 or x16 PCI Express Gen 2 or Gen 3 card connector providing at least four active lanes.

1.3. PCI Express Card Installation Procedure

1. Switch off the computer and all connected peripherals (monitor, printer...).
2. Discharge any static electricity that could be accumulated by your body. You can achieve this by touching an unpainted metal part of the enclosure of your computer with a bare hand. Make sure that the computer is linked to the AC power outlet with proper earth connection.
3. Disconnect all cables from your computer, including AC power.
4. Open the computer enclosure, according to the manufacturer instructions, to gain access to the PCI Express slots. Locate an available and adequate PCI Express slot.
5. Remove the blank bracket associated with this location. To achieve this, remove the securing screw and keep it aside for later use in the procedure. Keep the blank bracket in a known place for possible re-use.
6. Unwrap the card packing, take the board and carefully hold it. Avoid any contact of the board with unnecessary items, including your clothes.
7. Gently insert the card into the selected PCIe slot, taking care to push it down fully into the slot. If you experience some resistance, remove the board and repeat the operation. You should attempt to make a perfect board-to-slot mechanical alignment for best results. Ensure that the lower part of the bracket is inserted into the corresponding enclosure fastening.
8. Secure the board with the saved screw.
9. **Optional.** When the camera(s) is (are) powered through the CoaXPress cable or when the +12 V power output is required on any System I/O connector, connect a 12 V power source to the Auxiliary Power Input connector using a 6-pin PEG cable.
10. **Optional.** Establish the connections with the Internal GPIO connector(s) as required by the application.
11. **Optional.** When synchronized acquisition is required for cameras attached to different cards, establish the card-to-card link interconnections.
12. Close the computer enclosure according to the manufacturer instructions.

2. Software Setup

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2.1. Software Setup Procedure

Prior to use the board, it is necessary to install the driver and update or install the firmware.

- The **eGrabber** driver is available in the **Coaxlink series** section of the *download area* of the *Euresys website*: <https://www.euresys.com/Support/Download-area>.
- Detailed instructions for driver installation and firmware update are available in the *Frame Grabbers>Getting Started > Software Setup* section of the [eGrabber on-line documentation](#).

2.2. Important Notices

Important notifications to be read before installing and/or using the product on your PC!

Firmware Version Requirements

Minimum firmware version number required by **eGrabber 24.04**

The following table lists, for each product/firmware variant combination, the *minimum firmware version number* required to use this driver:

Product/Firmware Variant Combinations	Min. Firmware Version Number
3624 Coaxlink Quad CXP-12 DF (All firmware-variants)	444
Other product/firmware variants	445



WARNING

eGrabber driver checks the compatibility of the firmware installed on every frame grabber. For those having an incompatible firmware, the GenTL driver exposes 0 (zero) Device.

If the requirement is not satisfied for all the **Coaxlink and Grablink Duo frame grabbers** in your system, it is *mandatory* to apply the Firmware Upgrade procedure prior to using this version of the driver.

CPU Requirements

The image converter requires a CPU that has the Supplemental Streaming SIMD Extension 3 (SSSE3) instruction set.

Image Buffer Limits

[Maximum buffer size](#)

0xffffffff bytes (4 GiB - 16 B) for all operating systems

[Number of buffers](#)

The number of buffers is only limited by available system resources.

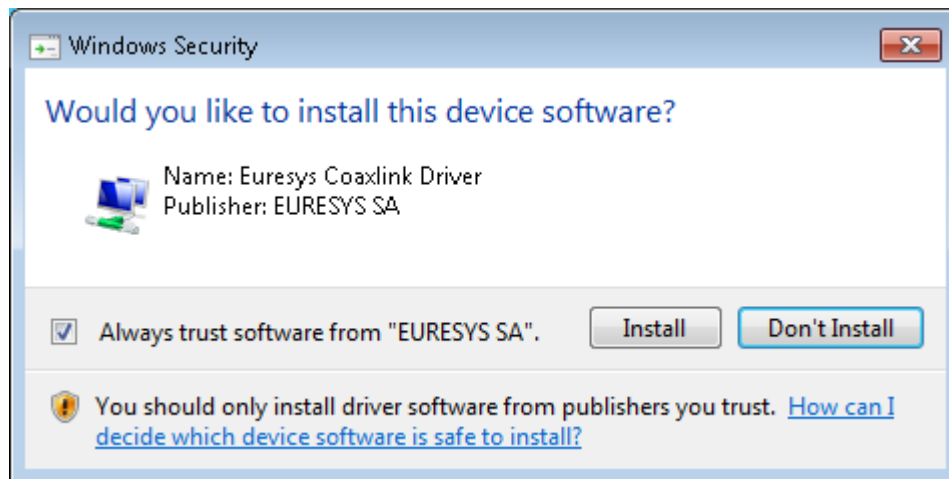
NOTE: when using very large numbers of buffers, DSAnnounceBuffer calls can take longer and longer to complete (or even fail with error code GC_ERR_CUSTOM_IOCTL_BUFFER_ANNOUNCE_FAILED). If this happens, the user should set **DmaEngineOptimization=LowMemoryUsage** in the data stream module.

Notices for Windows

Important notifications to be read before installing and/or using the product on your Windows PC

Always trust Euresys code-signing certificate on Windows 7 and 8.1

The following Windows Security warning message may occur at driver installation on Microsoft Windows 7 and 8.1:

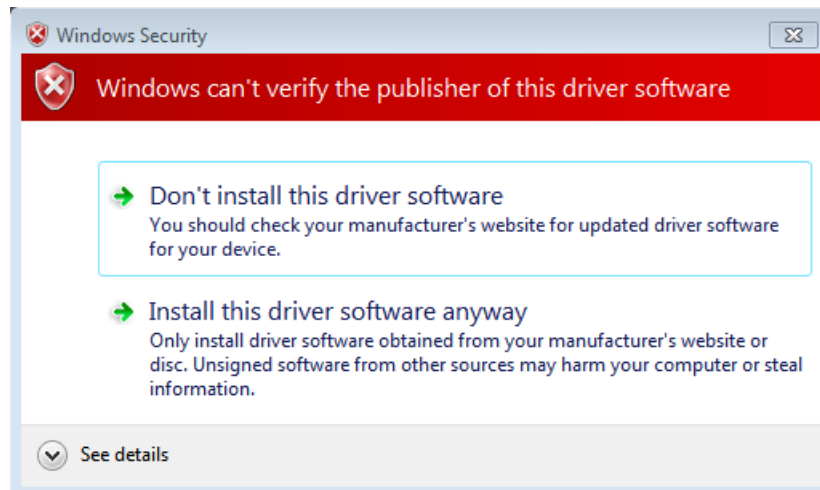


This Windows security warning message occurs when the Euresys code-signing certificate is missing from the "Trusted Publishers" Windows Certificate store. This happens, for instance, when the Euresys code-signing certificate must be renewed.

Follow the instructions to install the current Euresys code-signing certificate into the "Trusted Publishers" Windows certificate store.

Missing time-stamping certificate

The following Windows Security warning message may occur at driver installation on Microsoft Windows:



This Windows security warning occurs when the **GlobalSign Root CA - R6** certificate is missing from the Windows certificate store.

This issue can be solved by installing this missing certificate which can be downloaded [here](#) on the GlobalSign website then installed in the Trusted Root Certification Authorities (local computer) certificate store.

Notice for Linux

Important notification to be read before installing and/or using the product on your Linux PC

Memento must be installed prior to **eGrabber**.

If the **eGrabber** package is already installed, proceed as follows:

1. Uninstall **eGrabber**.
2. Install **Memento**.
3. Re-install **eGrabber**.

Notices for macOS

Important notifications to be read before installing the driver on your Mac

Driver types

Install the **Memento** package corresponding to the **eGrabber** driver type:

eGrabber driver package	Memento package
egrabber-macos-aarch64-dext-<MA.MI.RE.BU>.pkg	memento-macos-aarch64-dext-<MA.MI.RE.BU>.pkg
egrabber-macos-aarch64-kext-<MA.MI.RE.BU>.pkg	memento-macos-aarch64-kext-<MA.MI.RE.BU>.pkg
egrabber-macos-x86_64-kext-<MA.MI.RE.BU>.pkg	memento-macos-x86_64-kext-<MA.MI.RE.BU>.pkg



TIP

dext drivers operate in user-mode using the default Full Security policy level. It is not necessary to change the security setting.

Reduced Security level (only for kext drivers on Mac computers with Apple silicon)

Kernel extensions must be explicitly enabled before the installation of Euresys -aarch64-kext-packages on Mac computers with Apple silicon.

See <https://support.apple.com/fr-be/guide/security/sec8e454101b/web>

To enable kernel extensions on a Mac with Apple silicon:

1. Enter macOS recovery
2. In **Utilities > Startup Security Utility > Security Policy**
 - a. Select **Reduced Security**
 - b. Check **Allow user management of kernel extensions from identified developers**
3. Restart the system

Step 3. Approval of kernel extension (only for kext drivers on Mac computers with Apple silicon)

After installing **eGrabber** or **Memento** Euresys -aarch64-kext packages, newly installed Euresys kernel extensions must be approved by the administrator in the **Security and Privacy preferences** and the system needs to be restarted.

2.3. Installing eGrabber

Installing eGrabber on Windows

1. Read the "[Notices for Windows](#)" on page 21
2. Open the support page of the Euresys website: <https://www.euresys.com/support/> and click on the *Coaxlink series* icon to open the Coaxlink download area.
NOTE: The Euresys website download area may require user authentication. The user ID and password are not obtained, they are chosen by the user. Access is free and unrestricted.
3. Click on *eGrabber for Coaxlink and Grablink Duo* to display the file list corresponding to the latest available **eGrabber** release.
4. Select the setup file according to the processor architecture:
 - For an installation on Windows 7 or 8.1, select the egrabber-win7-x86_64-24.04.0*.exe setup file.
 - For an installation on Windows 10 or 11, select the egrabber-win10-x86_64-24.04.0*.exe setup file.
5. Launch the installer tool to install the driver files and software tools on your PC.
NOTE: If you have an existing **eGrabber** installation, the installer tool prompts you to uninstall it before being able to continue. Otherwise, it prompts you for the selection of the destination folder.

Installing eGrabber on Linux

1. Read the "[Notice for Linux](#)" on page 22
2. Open the support page of the Euresys website: <https://www.euresys.com/support/> and click on the *Coaxlink series* icon to open the Coaxlink download area.
NOTE: The Euresys website download area may require user authentication. The user ID and password are not obtained, they are chosen by the user. Access is free and unrestricted.
3. Click on *eGrabber for Coaxlink and Grablink Duo* to display the file list corresponding to the latest available **eGrabber** release.
4. Download the setup file according to the processor architecture:
 - For an installation on AArch64 (64-bit) processor architecture, select the egrabber-linux-aarch64-24.04.0*.tar.gz setup file.
 - For an installation on x86_64 (64-bit) processor architecture, select the egrabber-linux-x86_64-24.04.0*.tar.gz setup file.
5. Launch the installer tool to install the driver files and software tools on your PC.
NOTE: If you have an existing **eGrabber** installation, the installer tool prompts you to uninstall it before being able to continue. Otherwise, it prompts you for the selection of the destination folder.

Installing eGrabber on macOS

1. Read the "[Notices for macOS](#)" on page 23.
2. Open the support page of the Euresys website: <https://www.euresys.com/support/> and click on the *Coaxlink series* icon to open the Coaxlink download area.

NOTE: The Euresys website download area may require user authentication. The user ID and password are not obtained, they are chosen by the user. Access is free and unrestricted.

3. Click on *eGrabber for Coaxlink and Grablink Duo* to display the file list corresponding to the latest available **eGrabber** release.
4. Execute the installation procedure according to the processor architecture and the driver type:

Installing dext packages on Mac computers with Apple silicon

1. Download `egrabber-macos-aarch64-dext-24.04.0*.pkg`
2. After package files have been downloaded with *Safari*, the usual *double-click* to launch the installer will not let you install the package. You shall use instead *control+click* and select *Open* to launch the installer. A window will pop up, click then on *Open* to proceed.

The extension installer applications will be launched automatically and will be waiting for the administrator to approve the newly installed Euresys extensions in the [Security and Privacy preferences](#).

3. Launch the installer tool to install the driver files and software tools on your PC.

Installing kext drivers packages on Mac computers with Apple silicon

Step 1. Enable kernel extensions

Kernel extensions must be explicitly enabled before the installation of Euresys -aarch64-kext-packages on Mac computers with Apple silicon.

See <https://support.apple.com/fr-be/guide/security/sec8e454101b/web>

To enable kernel extensions on a Mac with Apple silicon:

1. Enter macOS recovery
2. In [Utilities > Startup Security Utility > Security Policy](#)
 - a. Select [Reduced Security](#)
 - b. Check [Allow user management of kernel extensions from identified developers](#)
3. Restart the system

Step 2 Launch the installer

1. Download egrabber-macos-aarch64-kext-**24.04.0**.*.pkg
2. After package files have been downloaded with *Safari*, the usual *double-click* to launch the installer will not let you install the package. You shall use instead *control+click* and select *Open* to launch the installer. A window will pop up, click then on *Open* to proceed.

Step 3. Approve kernel extension

After installing **eGrabber** or **Memento** Euresys -aarch64-kext packages, newly installed Euresys kernel extensions must be approved by the administrator in the [Security and Privacy preferences](#) and the system needs to be restarted.

Installing kext drivers packages on Mac computers with an Intel processor

1. Download egrabber-macos-x86_64-kext-**24.04.0**.*.pkg
2. After package files have been downloaded with *Safari*, the usual *double-click* to launch the installer will not let you install the package. You shall use instead *control+click* and select *Open* to launch the installer. A window will pop up, click then on *Open* to proceed.

Command-Line Installation Procedure

You may want to integrate the boards drivers and eGrabber tools installation into your own application distribution.

eGrabber setup program can be called in command-line mode with your installation options. In this mode, the **eGrabber** installation program does not prompt for user action and does not display any dialog box.

Installation

To perform a command-line installation, call the setup program with the */s* flag. The installation is launched in the silent mode, that is no window nor dialog box will appear.

There are a couple of optional flags:

- Use the */a* flag to force the installation of all components, including optional ones which are not selected by default.
- Use the */f* flag to force the removal of an already installed version before executing the setup file, even if the already installed version is newer.

Installation removal

To automatically remove installed tools, call the setup program with the */u* flag.

Use the */s* flag to launch the removal program in the silent mode. In this mode, no window nor dialog box will appear.

Reboot during Installation

A reboot may be required after driver installation but will not take place automatically. The reboot must be performed by your application. In this case, the [HKEY_LOCAL_MACHINE\SOFTWARE\Euresys\Common] "RebootNeeded" registry entry should be checked. If it exists and is set to 1, then it should be replaced by 0, and the system must be rebooted.

Error Reporting

After the command line installation, the following registry key is updated and holds the installation status: [HKEY_LOCAL_MACHINE\SOFTWARE\Euresys\Common\LastInstallError].

- The ErrorCode DWORD identifies the error:
 - 0 - There is no error.
 - Any other value - Please contact technical support.
- The Cause string gives a wording of the error.
- The Source string identifies the installer that caused the error.
- The ErrorTime string gives the time and date of the error.

3. Managing Firmware

- 3.1. What's Firmware? 29
- 3.2. Firmware Manager Tools 30
- 3.3. Updating and Installing Firmware 32
- 3.4. Special Firmware Procedures 33
- 3.5. Firmware Recovery Switch 36

3.1. What's Firmware?

Firmware

In this context, "firmware" designates the content of the FPGA (Field Programmable Gate Array) device of a card.

It defines the functionality of the card including the PCI Express end-point.

Firmware EEPROM

The FPGA used on **Coaxlink and Grablink Duo frame grabbers** is RAM-based; it needs to be loaded every power up.

Considering that a PCI Express end point must be ready within 150 milliseconds of the power-up time, the FPGA content, must be loaded quickly after having applied power to the card. Therefore, the firmware is stored into a non-volatile flash EEPROM allowing a fast start-up of the FPGA.



NOTE

This situation differs from other Euresys products, such as MultiCam cards, where the FPGA content is loaded by the MultiCam driver when it starts or at any time if a FPGA configuration change is requested during operation.



TIP

The **eGrabber** driver will never modify the content of the FPGA during operation.

Firmware modifications

Any modification of the FPGA content requires a two-step operation:

1. The new firmware is written into the Flash EEPROM of the card using a firmware management tool.
2. The new firmware is activated by cycling the system power.

3.2. Firmware Manager Tools

eGrabber is delivered with two firmware management tools:

- "Firmware Manager - GUI mode" on page 30 : A graphical user interface tool in **eGrabber Studio**,
- "Firmware Manager - Command line mode" on page 30 : A command-line tool named **Firmware Manager Console**.

Firmware Manager - GUI mode

To open the **Firmware Manager** in GUI mode, select one of the following methods:

- From the Windows Start Menu: click on Firmware Manager shortcut in the **Euresys eGrabber** folder
- From the **Welcome Screen** of **eGrabber Studio**, click on the **Firmware Manager** button.

See also: "Firmware Manager (GUI mode)" section in the eGrabber Studio User Guide for a detailed description.

Firmware Manager - Command line mode

Access

The command-line tool is named `coaxlink-firmware.exe`. It is located in the `firmware` sub-folder of the eGrabber installation folder.

On Windows, to open the **Firmware Manager** in command-line mode, select one of the following methods:

- From the Windows Start Menu: click on Firmware Manager console shortcut in the **Euresys eGrabber** folder
- Open a command prompt and open in the `C:\Program Files\Euresys\Grabber\firmware` folder

On Linux, to open the **Firmware Manager** in command-line mode:

- Open a command shell in the `/opt/euresys/egrabber/firmware` folder

On macOS, to open the **Firmware Manager** in command-line mode:

- Open a command shell in the `/usr/local/opt/euresys/egrabber/firmware` folder.

Main commands

- Executing `coaxlink-firmware --help` displays a help message describing all the command options.
- Executing `coaxlink-firmware gui` starts the **Firmware Manager (Deprecated)** graphical user interface.

- Executing `coaxlink-firmware list` lists the properties of the firmware installed on each card present in the system.
- Executing `coaxlink-firmware update` updates the firmware.
- Executing `coaxlink-firmware install` installs a new firmware variant.

Unless specified with a `--firmware=FILE` option, the tool uses the embedded library.

3.3. Updating and Installing Firmware



WARNING

Prior to executing this procedure, read the "Important Notices" section of the release notes!

The **eGrabber** driver comes with all the firmware variants for all the **Coaxlink and Grablink Duo frame grabbers**.

1. Determine the firmware variant that fulfills the functional requirements of your application: e.g. '1-camera', '1-camera, line-scan', '2-camera'. Therefore, check the *Firmware Variants per Product* section of the release notes for the firmware variants that are applicable to your card.
2. Launch a **Firmware Manager tool** to perform a firmware *update* or to *install* a specific firmware variant on your card(s) using the **Firmware Manager** tool in *GUI mode* with **eGrabber Studio** or the **Firmware Manager Console** in *command-line mode*:
 - a. In **eGrabber Studio**, open the **Firmware Manager** pane:
 - Select the card to update
 - Select the firmware variant to install
 - Proceed with the installation
 - b. In command-line mode, to *update* a variant:
coaxlink-firmware update
 - c. In command-line mode, to *install* another firmware variant:
coaxlink-firmware install '[variant-name]'
3. Wait until completion of the firmware update



WARNING

Avoid turning off your PC during the firmware update procedure!

4. Repeat the procedure on all your **Coaxlink and Grablink Duo frame grabbers**.
5. **Power off completely your PC** and restart it to activate the newly loaded firmware.

3.4. Special Firmware Procedures

In this topic:

- "GUI mode downgrade procedure" on page 33
- "Command-line mode downgrade procedure " on page 34
- "Command-line mode recovery procedure" on page 34
- "Recovery procedure with recovery switch" on page 35

Directives

- Execute either the "GUI mode downgrade procedure" on page 33 or the "Command-line mode downgrade procedure " on page 34 only when the application absolutely requires an older firmware version!
- Execute either the "Command-line mode recovery procedure" on page 34 or the "Recovery procedure with recovery switch" on page 35 only in case in case of card malfunction after installation of a new firmware!

GUI mode downgrade procedure



WARNING

For **Coaxlink and Grablink Duo frame grabbers** having a Serial Number above or equal to 10,000: this procedure must be executed on a PC with a driver version 10.0.0 or higher installed!

1. Open the **Firmware Manager** pane in **eGrabber Studio**
2. In the **Details** view, click on the **File** button to select an alternate firmware source
3. Select the coaxlink-firmware.exe file delivered with the old driver required by the application
4. In the **Cards** view:
 - a. Select the card to downgrade
 - b. Select the firmware variant to install
 - c. Proceed with the installation

Command-line mode downgrade procedure



WARNING

For **Coaxlink and Grablink Duo frame grabbers** having a Serial Number above or equal to 10,000: this procedure must be executed on a PC with a driver version 10.0.0 or higher installed!

From the **Firmware Manager Console** executes one of the following commands:

- Keeping the same firmware variant:
`coaxlink-firmware update --firmware=PATH_TO_FILE`
- Changing also the firmware variant:
`coaxlink-firmware install VARIANT_TO_INSTALL --firmware=PATH_TO_FILE`

PATH-TO_FILE is the path to the coaxlink-firmware.exe file delivered with the old Coaxlink driver required by the application.

Command-line mode recovery procedure



WARNING

For **Coaxlink and Grablink Duo frame grabbers** having a Serial Number above or equal to 10,000: this procedure has to be executed on a PC with a driver version 10.1.2 or higher installed!

1. From the **Firmware Manager Console**, execute the bank selection command:
`coaxlink-firmware bank-select --next=ALTERNATE`
The command displays a status indicating that the next firmware after boot is the other bank:
[BANK0: current firmware][BANK1: alternate/next firmware] or
[BANK0: alternate/next firmware][BANK1: current firmware]
2. Power off the PC
3. Power on the PC

Recovery procedure with recovery switch



WARNING

(*) For **Coaxlink and Grablink Duo frame grabbers** having a Serial Number above or equal to 10,000: this procedure has to be executed on a PC with a driver version 10.1.2 or higher installed!

1. Power off the PC:
 - a. Remove the card from the PC
 - b. Set the "[Firmware Recovery Switch](#)" on [page 331](#) of the card to the "Recovery" position
2. Power off a PC*
 - a. Insert the card into the PC
 - b. Power on the PC
 - c. Execute a "[Updating and Installing Firmware](#)" on [page 32](#)
 - d. Power off the PC
 - e. Remove the card
 - f. Set back the "[Firmware Recovery Switch](#)" on [page 331](#) to the "Normal" position

3.5. Firmware Recovery Switch

Switch types and location

The *firmware recovery switch* is implemented with one of the following components:

- 3-pin header and a jumper
- 2-way DIP switch

See also: Board and Bracket Layouts in the Coaxlink series Handbook or in the Grablink Duo Handbook to locate the firmware recovery switch. These drawings show its normal position.

Switch positions



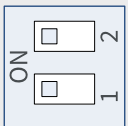
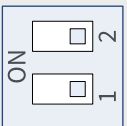
The *firmware recovery switch* has two positions:

Normal position (factory default)

At the next power ON, the latest firmware successfully written into the Flash EEPROM is used to program the FPGA. After FPGA startup completion, the card exhibits the *standard PCI ID* and the driver allows normal operation.

Recovery position

At the next power ON, the last but one firmware successfully written into the Flash EEPROM is used to program the FPGA. After FPGA startup completion, the card exhibits the *recovery PCI ID* and the driver inhibits image acquisition.

Switch type	Normal position	Recovery position
3-pin header and a jumper		
2-way DIP switch		

4. Firmware Variants per Product

List of available firmware variants per product supported by **eGrabber 24.04**

Pixel processing abbreviations

- *BIN*: Pixel binning
- *CFA-12*: Bayer CFA decoding - Methods 1 and 2
- *CFA-123*: Bayer CFA decoding - Methods 1, 2, and 3
- *CFA-125*: Bayer CFA decoding - Methods 1, 2, and 5
- *CFA-2-S0*: Bayer CFA decoding - Method 2 on Stream0
- *CFA-3*: Bayer CFA decoding - Method 3
- *CFA-35*: Bayer CFA decoding - Methods 3 and Method 5
- *CFA-35-D0*: Bayer CFA decoding - Methods 3 and 5 on Device0
- *FLIPX*: Horizontal image flipping
- *FFC*: Flat-field correction
- *JPEG-S1*: JPEG encoding on Stream1
- *LLE*: Laser line extraction
- *LUT*: Lookup table processing
- *MI*: Metadata insertion

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Firmware Variant	HCMAP	Processing	Description
1-camera	1D2_CL	LUT CFA-12	One 1- or 2-connection area-scan camera
1-camera, line-scan	1D2_CL	LUT MI	One 1- or 2-connection line-scan camera
2-camera	2D11_CL	LUT CFA-12	One or two 1-connection area-scan cameras
2-camera, line-scan	2D11_CL	LUT MI	One or two 1-connection line-scan cameras

PART II
FUNCTIONAL GUIDE

1. Architecture of Coaxlink and Grablink Duo frame grabbers

1.1. Main Elements	40
1.2. Block Diagrams	42

1.1. Main Elements

Quick overview of the main functional elements of Coaxlink and Grablink Duo frame grabbers

GenTL hierarchy

Each functional element of a frame grabber is configured and controlled by GenApi features belonging to a GenTL module.

At the top of the hierarchy, there is one *GenTL System Module* per Host PC. It binds all the *GenTL Interface Modules* of a Host PC.

There is one *GenTL Interface Module* for each frame grabber. It binds all the *GenTL Device Modules* of a frame grabber.

There is one *GenTL Device Module* for each camera (or imaging device) attached to a frame grabber. The elements belonging to the imaging device (camera) itself are referred as *Remote Device*. By opposition, the elements belonging to the frame grabber are also referred as *Local Device*.

NOTE: The maximum number of cameras that can be attached to a frame grabber is determined by the installed firmware variant.

There is one *GenTL Data Stream Module* for each data stream delivered by a camera attached to a frame grabber. It gathers the elements involved into the image build-up and transport from the imaging device to a pool of GenTL buffers.

NOTE: The maximum number of data-stream for a camera attached to a frame grabber is determined by the installed firmware variant.

There is one *GenTL Buffer Module* for each image buffer.

Main elements of the Interface Module

General purpose I/O lines

The "[General Purpose I/O](#)" on [page 218](#) block gathers all the I/O ports of the card.

I/O Toolbox

The "[I/O Toolbox](#)" on [page 235](#) block gathers a collection of tools used to build event streams from trigger and encoder devices attached to the I/O port inputs.

NOTE: These elements are common to- (or can be shared by-) all the GenTL Device Modules managed by the frame grabber.

Main elements of the Device Module

Camera and illumination controller

The "Camera and Illumination Control" on page 189 block is used to control the camera cycle and the illumination strobe. It can be configured to receive real-time (Camera) Cycle trigger events from any I/O Toolbox output stream. It produces two real-time signals: the Camera Trigger signal, sent to the camera trigger input, and the Strobe signal, sent to the illumination device associated with the camera.

NOTE: This element is common to- (or can be shared by-) all the GenTL Data Stream Modules related to that imaging device.

Main elements of the Data Stream Module

Image acquisition controller

This block controls the acquisition gate. It can be configured to receive real-time start-of-scan and end-of-scan trigger events from any I/O Toolbox output stream.

Acquisition gate

The "Acquisition Gate" on page 126 controls the data extraction and filters out the image data that doesn't need to be acquired.

On-board memory

The Image data partitions of the "On-board Memory" on page 123 temporarily stores the raw image data together with related metadata such as image size, pixel type, time-stamp...

Pixel Processing

The "Pixel Processing" on page 142 block performs on-the-fly pixel processing and data formatting.

Image Data Transfer

The "Image Data Transfer" on page 174 block transfers the image data to the destination buffer.

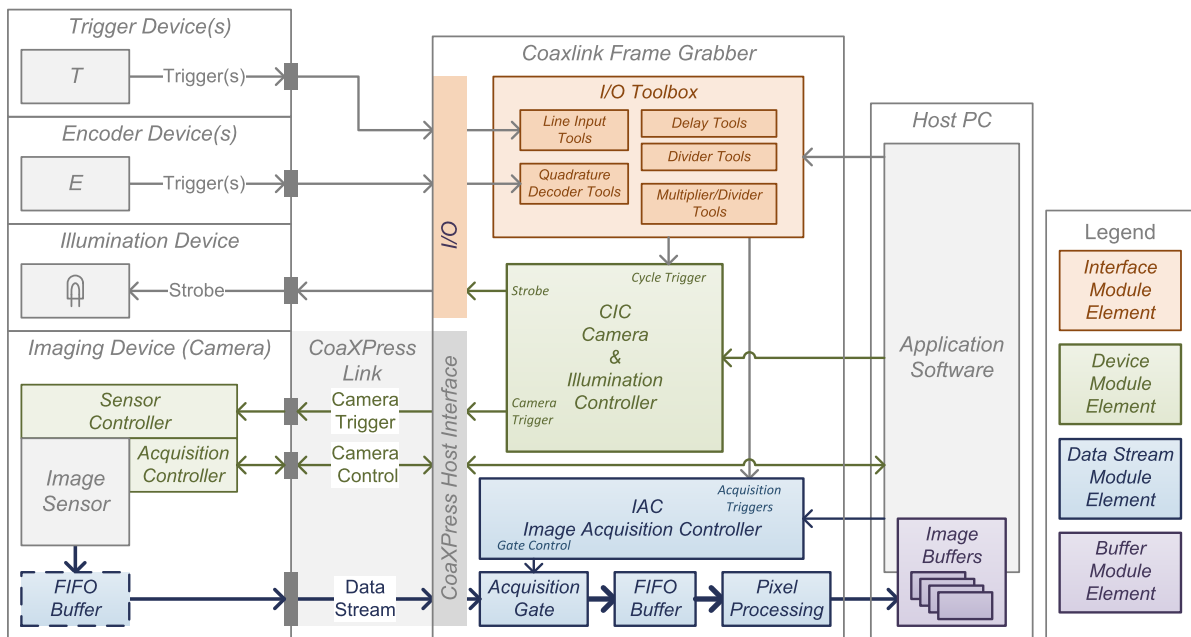
1.2. Block Diagrams



NOTE

In the diagrams hereafter, the main elements are represented by rectangles and their relations are represented by line segments with arrows indicating the direction of the signal or the data flow. The filling color of the rectangle indicates the level in the GenTL hierarchy as described in the legend.

1-camera, 1-data-stream



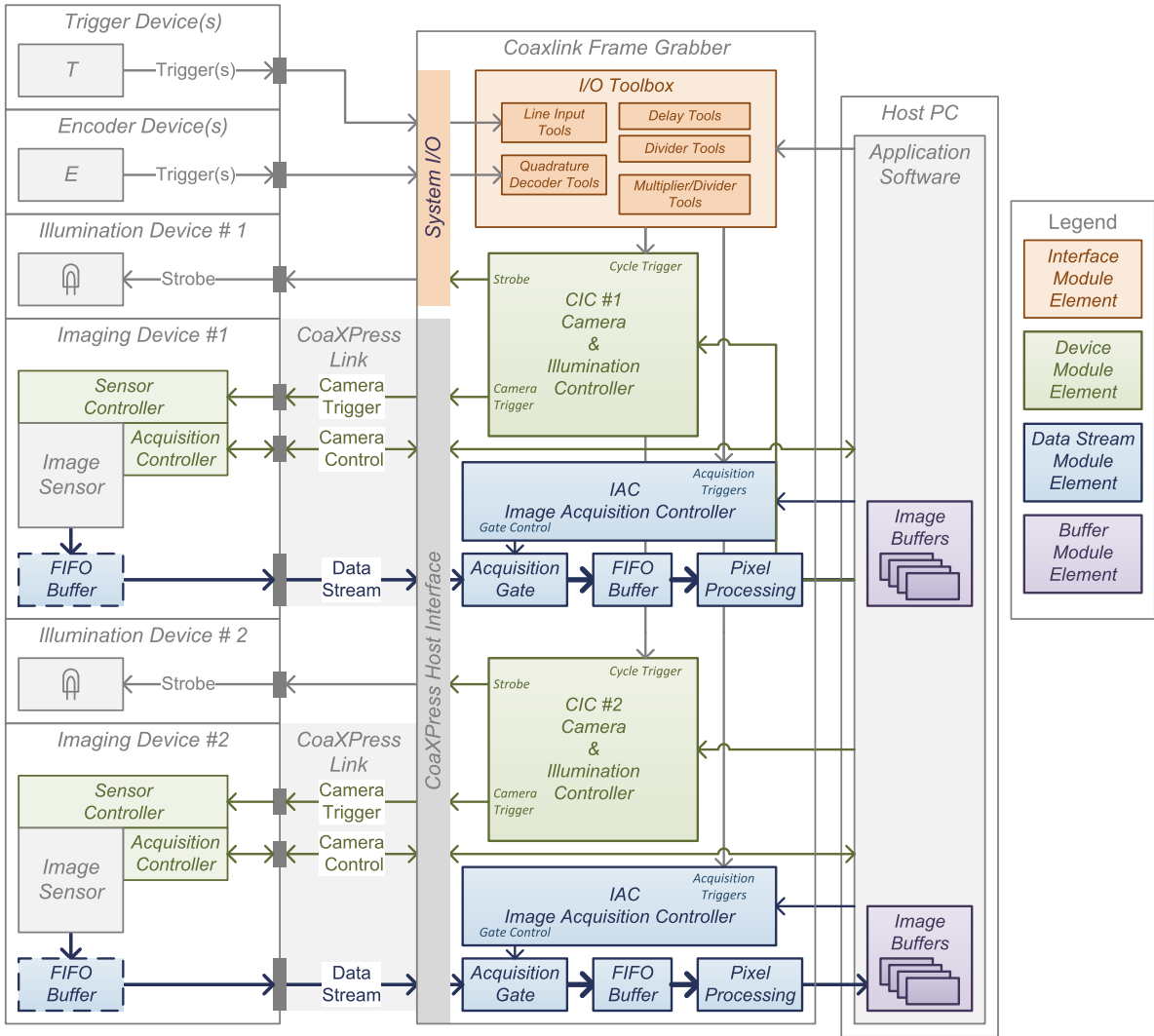
1-camera, 1-data-stream image acquisition system



NOTE

this configuration applies only when a 1-camera or a 1-camera, line-scan firmware variant is installed.

2-camera, 1-data-stream



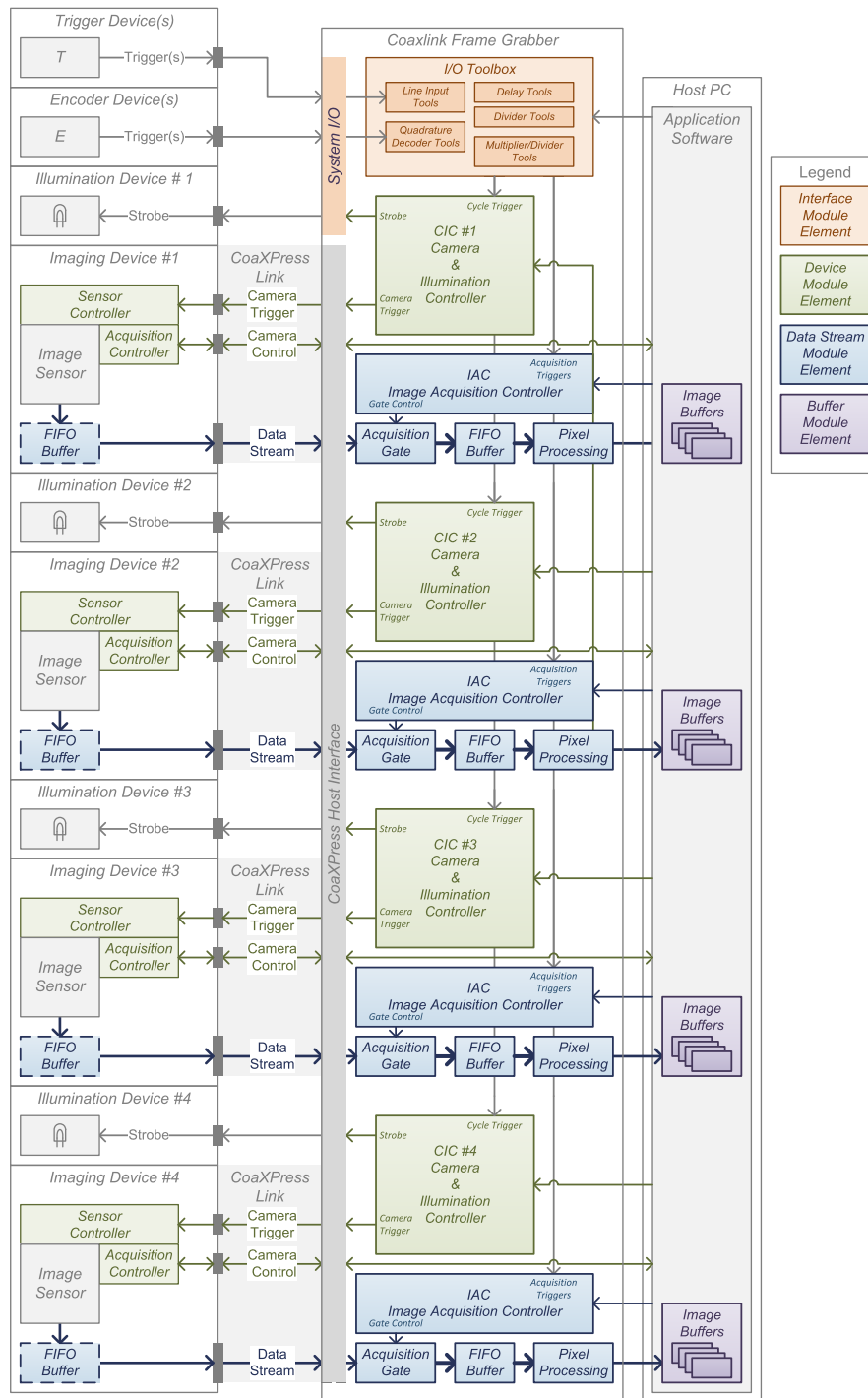
2-camera, 1-data-stream image acquisition system



NOTE

this configuration applies only when a 2-camera or a 2-camera, line-scan firmware variant is installed.

4-camera, 1-data-stream



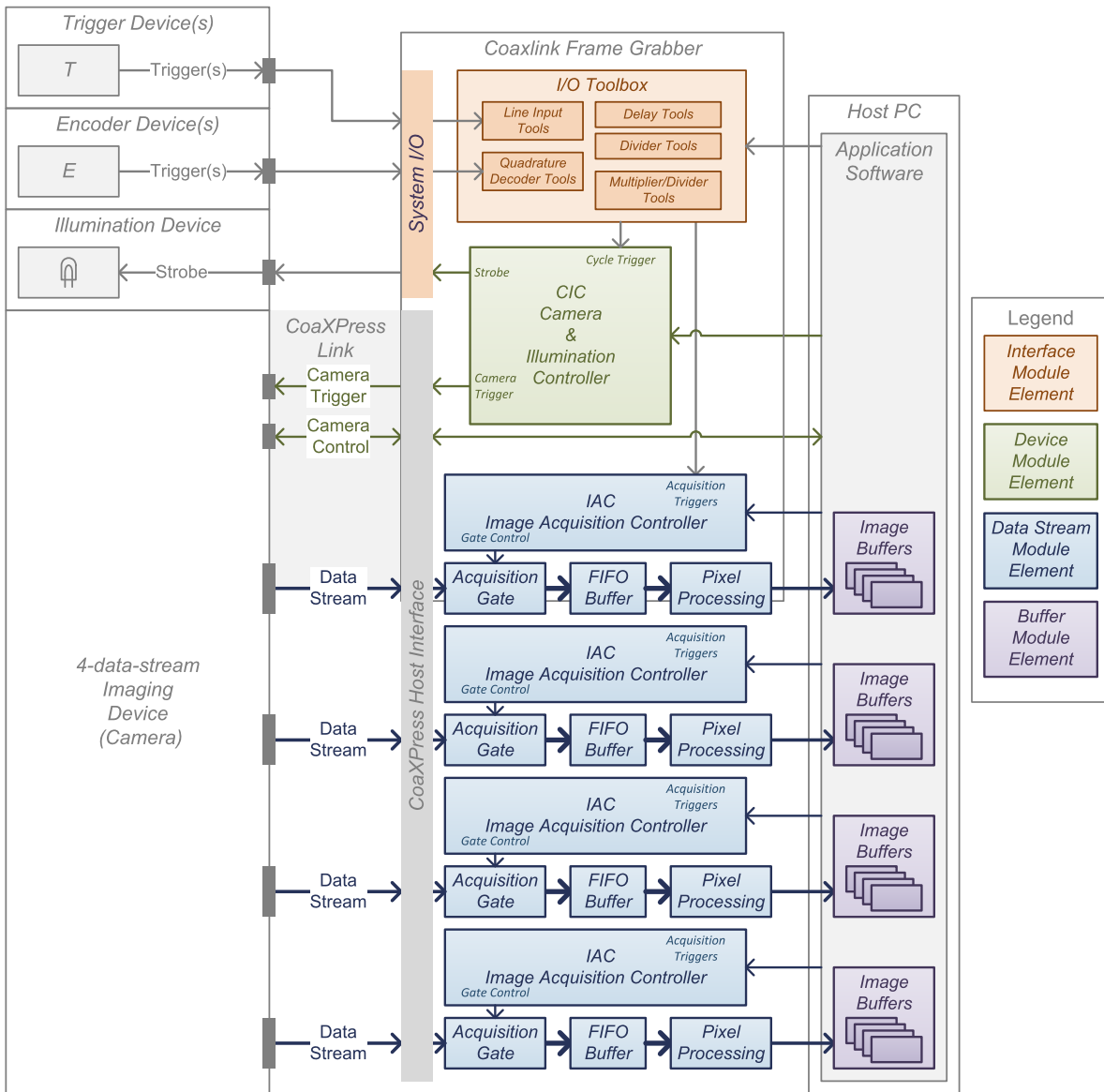
4-camera, 1-data-stream image acquisition system



NOTE

this configuration applies only when a 4-camera or a 4-camera, line-scan firmware variant is installed.

1-camera, 4-data-stream



1-camera, 4-data-stream image acquisition system



NOTE

this configuration applies only when a 1-camera,4-data-stream firmware variant is installed.

2. Camera Link Interface

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2.1. Camera Link Interface Specifications

Functional specifications summary of the Camera Link camera interface

Supported image pixel formats

Pixel Format (PFNC name)	Usage
Mono8, Mono10, Mono12, Mono14, Mono16	Monochrome cameras 8-/10-/12-/14-/16-bit per pixel
BayerGR8, BayerRG8, BayerGB8, BayerBG8 BayerGR10, BayerRG10, BayerGB10, BayerBG10 BayerGR12, BayerRG12, BayerGB12, BayerBG12 BayerGR14, BayerRG14, BayerGB14, BayerBG14 BayerGR16, BayerRG16, BayerGB16, BayerBG16	Bayer CFA color cameras 8-/10-/12-/14-/16-bit per pixel component
RGB8, RGB10, RGB12, RGB14, RGB16	Three-component RGB color cameras 8-/10-/12-/14-/16-bit per pixel component
RGBA8, RGBA10, RGBA12, RGBA14, RGBA16	Four-component RGBA color cameras 8-/10-/12-/14-/16-bit per pixel component
Raw	Undefined format

Supported image scanning methods

Image Scanning Method	
Progressive-scan - 1Y topology	✓
Progressive-scan - 1Y2 topology	✓
Progressive-scan - 2YE topology	✓
Interlaced scan	<i>Not supported</i>

Supported tap configurations and geometries

See also: "Camera Link Tap Configurations" on page 56 and "Camera Link Tap Geometries" on page 63

Devices and connections per device counts

HCMAP	#Devices	#Connectors/device	Applicable products / firmware variants
1D2_CL	1	2	Duo (1-camera), (1-camera, line-scan)
2D11_CL	2	1	Duo (2-camera), (2-camera, line-scan)

Performance

Parameter	Value
Maximum input data rate	85 MHz
Maximum pixel rate - BASE_3T8 configuration	255 Mpixels/sec
Maximum pixel rate - DECA_10T8 configuration	850 Mpixels/s

See also: "Camera Link ECCO-85 Host Interface" on page 333 in the hardware manual for electrical specifications.

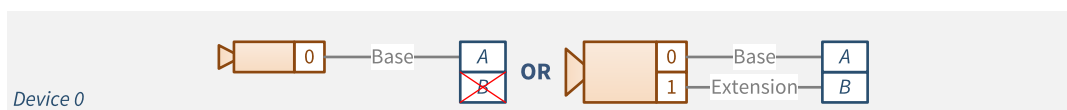
2.2. Host Connections Maps for Grablink

1D2 host connections map

Applies to **1628 Grablink Duo**

Duo (1-camera), (1-camera, line-scan)

One 1- or 2-connection device

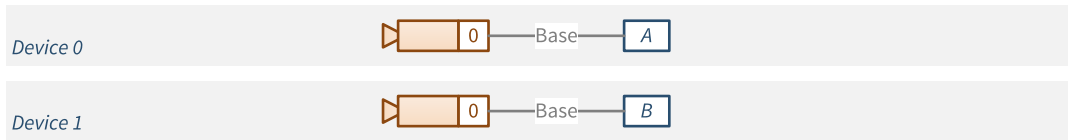


2D11 host connections map

Applies to 1628 Grablink Duo

Duo (2-camera), (2-camera, line-scan)

One or two 1-connection devices



2.3. Camera Link Configurations

Camera Link 2.1 configurations

Configuration name	Channel Link count (names)	Connectors count	Bit count	Ports count (names)
Lite	1 (X)	1	10	2 (A, B)
Base	1 (X)	1	24	3 (A, B, C)
Medium	2 (X, Y)	2	48	6 (A to F)
Full	3 (X, Y, Z)	2	64	8 (A to H)
72-bit	3 (X, Y, Z)	2	72	9 (A to I)
80-bit	3 (X, Y, Z)	2	80	10 (A to J)

Supported Camera Link configurations vs. Grablink product

Product	Firmware Variant	Camera Link configurations					
		Lite	Base	Medium	Full	72-bit	80-bit
1628 Grablink Duo	1-camera 1-camera, line-scan		✓	✓	✓	✓	✓
	2-camera, 2-camera, line-scan		✓				
1624 Grablink Base ¹	MONO ²	✓	✓				
1623 Grablink Dual Base ¹	DUO ²	✓	✓				
1622 Grablink Full ¹	MONO ²		✓	✓	✓		
	DECA ²					✓	✓
1626 Grablink Full XR ¹	MONO ²		✓	✓	✓		
	DECA ²					✓	✓



NOTE

- ¹These frame grabbers are exclusively operated with the MultiCam driver. They are shown here for comparison purpose.
- ²Value of the **BoardTopology** MultiCam parameter defining the FPGA content on MultiCam boards.

2.4. Power over Camera Link

1628 Grablink Duo is fitted with two independent Power over Camera Link (PoCL) controllers, one per Camera Link connector.

Grablink series PoCL features overview

Product	Firmware Variant	Features			
		PoCL SafePower	# 1-cable PoCL cameras	# 2-cable PoCL cameras	#PoCL controllers
1628 Grablink Duo	1-camera 1-camera, line-scan	✓	1	1	2
	2-camera, 2-camera, line-scan	✓	2		2
1624 Grablink Base ¹	MONO ²	✓	1		1
1623 Grablink Dual Base ¹	DUO ²	✓	2		2
1622 Grablink Full ¹	MONO ²				
	DECA ²				
1626 Grablink Full XR ¹	MONO ²	✓		1	2
	DECA ²	✓		1	2



NOTE

- ¹These frame grabbers are exclusively operated with the MultiCam driver. They are shown here for comparison purpose.
- ²Value of the **BoardTopology** MultiCam parameter defining the FPGA content on MultiCam boards.

PoCL controllers

The PoCL controller fulfills the requirements of the Power over Camera Link (PoCL) as specified in section 4 of the Annex E of the Camera Link Standard v2.1 for *Switchable PoCL SafePower frame grabbers*, namely;

- SafePower Switchable power output to allow the frame grabber to operate safely with PoCL and non-POCL cameras.
- Automatic detection of PoCL cameras
- Capable of supplying up to 4 W of power through each Camera Link connector
- Over-current protection (OCP)

In addition, it provides the user with:

- an AUTO/OFF control through the **CIPoCIAuto** and **CIPoCITurnOff** GenApi features of the interface module.
- a PoCL status through the **CIPoCIStatus** GenApi feature of the interface module..
- a PoCL power input status through the **CIPoCIPowerInputStatus** GenApi features of the interface module..

PoCL controller specification

Parameter	Min.	Typ.	Max.	Unit
DC input voltage requirement	11	12	13	V
DC output voltage @ON-state	11	12	13	V
PoCL power output	4			W
PoCL current rating	400			mA

PoCL power source requirements

The power originates from an external power source that has to be attached to the auxiliary power input connector.

See also: "Auxiliary Power Input" on page 342

The external power source must be a regulated 12V DC power supply capable to sustain the current required by the camera(s).



NOTE

- The voltage loss across the PoCL Controller Unit and its own power consumption are negligible.
- The power source is common for both PoCL controllers.

2-cable PoCL operation

When a *PoCL Camera Link Medium, Full, 72- or 80-bit* camera is attached, the power can be delivered through any one or both cables according to the results of the PoCL device detection performed by each PoCL controller.

Cameras that draw less than 4W may draw power from only one connector, usually the Base Camera Link connector.

Cameras that draw more than 4W must draw power from both connectors. In addition, such cameras must satisfy the following requirements:

- The camera's power supply shall be designed so that it does not draw more than 4W per cable.
- The camera's power supply shall be designed to isolate the two Camera Link connectors, i.e. power applied to one connector shall not be injected into the other one.

- The camera shall implement a voltage detection circuit that only enables the camera's power supply when power is present on both Camera Link cables.

Overcurrent protection

Each PoCL controller embeds an overcurrent protection circuit - OCP - based upon an electronic device that controls the current delivered to the load using:

- A dV/dt limiter
- A short-circuit current limiter
- An overload current limiter
- A thermal protection

The dV/dt limiter controls the output voltage rising slope. This limits the current during the charging of the load capacitor. The short circuit current limiter is effective when a short circuit event occur. It is also effective during the charging of the load capacitor since during that phase, the load is equivalent to a short circuit.

The overload current limiter is effective when during normal operation, the load current increases excessively; when the overload level is reached, the overload current limiter will automatically reduce the current to the short circuit level.

The thermal protection limits the temperature of the electronic device by opening the circuit until the device temperature reduces sufficiently.

OCP characteristics

Parameter	Min	Typ	Max	Units
Output voltage slew rate		0.15		V/ms
Short circuit current limit	0.6	1	1.8	A
Overload current limit	3.1	3.2	3.5	A

Overvoltage protection

Each PoCL controller integrates an overvoltage protection circuit - OVP - that clamps the output voltage in case of a defective external power supply.

OVP characteristics

Parameter	Min	Typ	Max	Units
Output clamping voltage	13	15	17	V

PoCL device detector

Each PoCL controller implements a PoCL device detector that measures the input impedance of the camera power input circuit at the off state and check if it is within the specified limits specified for PoCL camera Link cameras.

Therefore, a calibrated sense current is injected by the frame grabber into the power input circuit of the camera through the camera cable. After the expiration of the "sense time delay" time interval that allows the input capacitance to be charged, the detector measures repetitively the voltage during the "Sense OK time". If the voltage stays between the thresholds, the power is applied.

The camera must deliver a clock within the "initial clock turn-on delay" after the application of the power. If this is not the case, the frame grabber turns off the power immediately.

While the camera is powered, the PoCL device detector monitors continuously the Camera Link clock. If this clock is interrupted during at least "turn-off delay after clock loss" time interval, the power is immediately turned off.

PoCL device detector characteristics

Parameter	Min	Typ	Max	Units
Sense current on 10K impedance load	30	52	75	μA
Detector thresholds	0.3		1.2	V
Allowable impedance range	8	10	12	$\text{k}\Omega$
PoCL camera detector sense time delay		500		ms
PoCL camera detector sense OK time		500		ms
Initial clock turn-on delay		500		ms
Turn-off delay after clock-loss		500		ms

PoCL cable requirements

Current rating

Camera Link standard (version 2.0) requires that the power and drain wires within a cable assembly shall be capable of handling 1.0 A camera current under fault conditions. The power and drain wires shall be at least AWG 28 or larger diameter.

Conductor resistance

Camera Link standard (version 2.0) requires that the DC resistance of any power wire or drain wire shall not exceed 2.5Ω for the length of the cable assembly.



NOTE

The overall voltage drop on the loop is 1.0V ensuring at least 10V at the camera side for the minimal supply voltage of 11 V.

Considering that AWG 28 conductors have a typical resistance per unit length of $0,21 \Omega/\text{meter}$, cables using this wire gauge satisfy the above requirements for cable lengths up to 11 meters.

**NOTE**

The 10V minimal voltage requirement at the camera side can be satisfied with longer cables if the minimal supply voltage is higher than 11 V or if the camera draws less than 400 mA.

Disabling PoCL automatic activation

To avoid unexpected activation of PoCL when the camera is not powered through the Camera Link cable, execute **CLPoCLTurnOff** GenApi command.

2.5. Camera Link Tap Configurations

Tap Configuration Glossary

The *tap configuration* is a Euresys proprietary taxonomy that describes, with a standardized name, the Camera Link configuration, the tap count, the pixel bit depth and the number of time slots per pixel.

Taxonomy

<Config>_<TapCount>T<BitDepth>(B<TimeSlots>)

<Config> field

The <Config> field designates the *Camera Link configuration*:

Camera Link 2.1 name	<Config> value
Lite	LITE
Base	BASE
Medium	MEDIUM
Full	FULL
72-bit	DECA
80-bit	DECA

<TapCount> field

The <TapCount> field is the number of pixel taps. It is equal to the number of pixels delivered every Camera Link clock cycle.

Values range: 1 to 10.

<BitDepth> field

The <BitDepth> field is the total number of bits per pixel.

Possible values:

- For single-component (monochrome or Bayer CFA) cameras: 8, 10, 12, 14, 16.
- For multi-component cameras (RGB): 24, 30, 36, 42, 48.



WARNING

For multi-component pixels:

- <TapCount> is NOT the number of components!
- <BitDepth> is NOT the number of bits per component!

For instance, in case of an RGB camera delivering one pixel (with 3 8-bit color components) per clock cycle, <TapCount> must be set to 1 and <BitDepth>. must set to 24.

<TimeSlots> field (optional)

The <TimeSlots> field indicates the number of consecutive time slots required to transfer one pixel data.

Possible values: 2, 3.

NOTE: The <TimeSlots> field and the letter B are omitted when a single time slot is sufficient to deliver all the pixel data!



WARNING

For multi-slots configurations:

- <TapCount> is equal to the number of pixels delivered during <TimeSlots> Camera Link clock cycles!

Sample values

- **BASE_1T8**: Base Camera Link configuration, 1 tap, 8-bit pixel data
- **BASE_1T24**: Base Camera Link configuration, 1 tap, 24-bit pixel data (likely 3 x 8-bit RGB components)
- **DECA_8T10**: 80-bit Camera Link configuration, 8 taps, 10-bit pixel data
- **DECA_8T30B3**: 80-bit Camera Link configuration, 8 taps, 30-bit pixel data (likely 3 x 10-bit RGB), 3 time slots

Supported Tap Configurations

This topic lists all the Camera Link tap configurations (a.k.a. modes) defined in the section 4 of version 2.1 of the Camera Link standard.

The tap configurations are grouped by bit-depth then pixel type. Within a table, entries are sorted by increasing number of taps.



NOTE

Tap Configuration is a Euresys proprietary **taxonomy** that integrates, the channel link configuration, the number of taps and the pixel bit depth.

For each entry, it specifies:

- CL2.1 Name:** The name of the configuration as written in the section 4 of version 2.1 of the Camera Link standard
- Euresys Name:** The Euresys name of the configuration.
- Compatible products:** The list of Grablink products supporting that configuration. An empty cell indicates that the configuration is not supported.

8-bit Tap Configurations

Monochrome 8-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Lite	LITE_1T8	Base DualBase
Base 1 tap	BASE_1T8	Duo Base DualBase Full FullXR
Base 2 taps	BASE_2T8	Duo Base DualBase Full FullXR
Base 3 taps	BASE_3T8	Duo Base DualBase Full FullXR
Medium 4 taps	MEDIUM_4T8	Duo Full FullXR
Medium 5 taps	MEDIUM_5T8	Duo
Medium 6 taps	MEDIUM_6T8	Duo Full FullXR
Full 7 taps	FULL_7T8	Duo
Full 8 taps	FULL_8T8	Duo Full FullXR
Full 9 taps	DECA_9T8	Duo Full FullXR
80-bit 10 taps	DECA_10T8	Duo Full FullXR

RGB 8-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Base 1 tap	BASE_1T24	Duo Base DualBase Full FullXR
Medium 2 taps	MEDIUM_2T24	Duo Full FullXR
Full 3 taps	DECA_3T24	Duo Full FullXR
80-bit 10 taps (3 slots)	DECA_10T24B3	Duo

RGBI 8-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T32	Duo
Full 2 taps	FULL_2T32	Duo

10-bit Tap Configurations

Monochrome 10-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Lite	LITE_1T10	Base DualBase
Base 1 tap	BASE_1T10	Duo Base DualBase Full FullXR
Base 2 taps	BASE_2T10	Duo Base DualBase Full FullXR
Medium 3 taps	MEDIUM_3T10	Duo Full FullXR
Medium 4 taps	MEDIUM_4T10	Duo Full FullXR
Full 5 taps	FULL_5T10	Duo
Full 6 taps	FULL_6T10	Duo
80-bit 7 taps	DECA_7T10	Duo
80-bit 8 taps	DECA_8T10	Duo Full FullXR

RGB 10-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T30	Duo Full FullXR
Full 2 taps	FULL_2T30	Duo
80-bit 8 taps (3 slots)	DECA_8T30B3	Duo Full FullXR

RGBI 10-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T40	Duo
Full 2 taps	DECA_2T40	Duo Full FullXR

12-bit Tap Configurations

Monochrome 12-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Base 1 tap	BASE_1T12	Duo Base DualBase Full FullXR
Base 2 taps	BASE_2T12	Duo Base DualBase Full FullXR
Medium 3 taps	MEDIUM_3T12	Duo Full FullXR
Medium 4 taps	MEDIUM_4T12	Duo Full FullXR
Full 5 taps	FULL_5T12	Duo
Full 6 taps	DECA_6T12	Duo

RGB 12-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T36	Duo Full FullXR
Full 2 taps	DECA_2T36	Duo

RGBI 12-bit Tap Configuration

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T48	Duo

14-bit Tap Configurations

Monochrome 14-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Base 1 tap	BASE_1T14	Duo Base DualBase Full FullXR
Medium 2 taps	MEDIUM_2T14	Duo Full FullXR
Medium 3 taps	MEDIUM_3T14	Duo Full FullXR
Full 4 taps	FULL_4T14	Duo
72-bit 5 taps	DECA_5T14	Duo

RGB 14-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T42	Duo Full FullXR

RGBI 14-bit Tap Configuration

CL2.1 Name	Euresys Name	Compatible products
Full 1 tap	FULL_1T56	Duo

16-bit Tap Configurations

Monochrome 16-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Base 1 tap	BASE_1T16	Duo Base DualBase Full FullXR
Medium 2 taps	MEDIUM_2T16	Duo Full FullXR
Medium 3 taps	MEDIUM_3T16	Duo Full FullXR
Full 4 taps	FULL_4T16	Duo
72-bit 5 taps	DECA_5T16	Duo

RGB 16-bit Tap Configuration

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T48	Duo Full FullXR

RGBI 16-bit Tap Configuration

CL2.1 Name	Euresys Name	Compatible products
Full 1 tap	FULL_1T64	Duo

2.6. Camera Link Tap Geometries

Tap Geometry Glossary

The *tap geometry* is a Euresys proprietary taxonomy that describes, with a standardized name, the geometrical properties characterizing the different taps of a multi-tap camera.

Taxonomy

The *tap geometry* is built by the concatenation of two composite fields:

$$\langle X\text{-Geometry} \rangle _ \langle Y\text{-Geometry} \rangle$$

$\langle X\text{-Geometry} \rangle$ and $\langle Y\text{-Geometry} \rangle$ composite fields

The $\langle X\text{-Geometry} \rangle$ composite field describes the geometrical organization of the taps along the X-direction (image row). It is composed as follows:

$$\langle X\text{-Regions} \rangle X(\langle X\text{-Taps} \rangle)(\langle X\text{-Ext} \rangle)$$

The $\langle Y\text{-Geometry} \rangle$ composite field describes the geometrical organization of the taps along the Y-direction (image column). It is composed as follows:

$$\langle Y\text{-Regions} \rangle Y(\langle Y\text{-Taps} \rangle)(\langle Y\text{-Ext} \rangle)$$

$\langle X\text{-Regions} \rangle$ and $\langle Y\text{-Regions} \rangle$ mandatory fields

The $\langle X\text{-Regions} \rangle$ field declares the number of regions encountered across the X-direction.

Values range: 1 to 10.

The $\langle Y\text{-Regions} \rangle$ field declares the number of regions encountered across the Y-direction .

Values range: 2 to 3. The field is omitted when $\langle Y\text{-Regions} \rangle = 1$.

$\langle X\text{-Taps} \rangle$ and $\langle Y\text{-Taps} \rangle$ optional fields

The $\langle X\text{-Taps} \rangle$ field declares the number of consecutive pixels along the X-direction that are extracted simultaneously in each region.

Values range: 2 to 10. The field is omitted when $\langle X\text{-Taps} \rangle = 1$.

The $\langle Y\text{-Taps} \rangle$ field declares the number of consecutive pixels along the Y-direction that are extracted simultaneously in each region.

Values range: 2 to 3. The field is omitted when $\langle Y\text{-Taps} \rangle = 1$.

[<X-Ext> optional field](#)

The <X-Ext> field declares the relative location of the pixels extractors across one row of the image.

Possibles values:

Pixel extractors location	<X-EXT> value
At both ends of the image row	E
At the middle of the image row	M
At the right of each region	R
At the left of each region	∅

NOTE: The <X-Ext> field is omitted when all pixel extractors are at the left of each region.

[<Y-Ext> optional field](#)

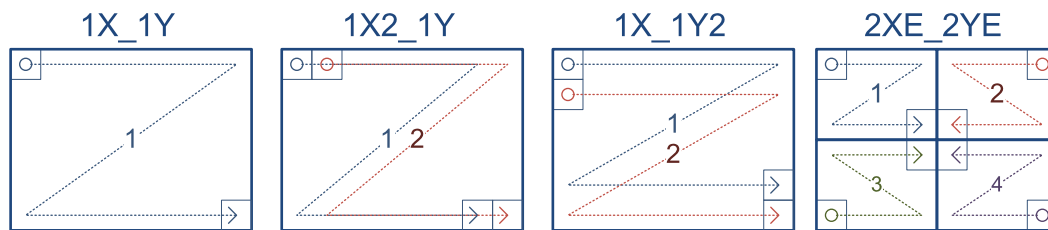
The <Y-Ext> field declares the relative location of the pixels extractors across one column of the image.

Possibles values:

Pixel extractors location	<X-EXT> value
At both ends of the image column	E
At the top of each region	∅

NOTE: The <Y-Ext> field is omitted when all pixel extractors are at the top of each region.

Examples of tap geometries



1X_1Y designates the tap geometry of a single-tap camera having 1 region across the X-direction and 1 region across the Y direction.

The pixels are delivered one at a time on a single tap beginning with the leftmost pixel of the top row, scanning progressively all the rows of the image one by one, and ending with the rightmost pixel of the bottom row.

1X2_1Y designates the tap geometry of a two-tap camera having 1 region across the X-direction and 1 region across the Y direction.

The pixels are delivered two at a time on two taps beginning with the two leftmost pixels of the top row, scanning progressively all the rows of the image one by one, and ending with the two rightmost pixels of the bottom row.

1X_1Y2 designates the tap geometry of a two-tap camera having 1 region across the X-direction and 1 region across the Y direction.

The pixels are delivered two at a time on two taps beginning with the two uppermost pixels of the first column, scanning progressively all the rows of the image two by two, and ending with the two lowermost pixels of the rightmost column.

2XE_2YE designates the tap geometry of a four-tap camera having 2 regions across the X-direction and 2 regions across the Y direction.

The pixels are delivered four at a time on four taps. Each region delivers its pixels on a single-tap using a specific scanning scheme:

- The pixels of the upper left quadrant are delivered on tap 1 starting with the upper left pixel and ending with the lower right pixel of the region.
- The pixels of the upper right quadrant are delivered on tap 2 starting with the upper rightmost pixel and ending with the lower left pixel of the region.
- The pixels of the lower left quadrant are delivered on tap 3 starting with the lower left pixel and ending with the upper right pixel of the region.
- The pixels of the lower right quadrant are delivered on tap 4 starting with the lower rightmost pixel and ending with the upper left pixel of the region.

Definitions

Tap

One pixel stream output port of the camera that delivers one pixel every clock cycle.

Adjacent taps

Two taps are adjacent when the extracted pixels are adjacent on the same row or on the same column.

X-Taps

Number of consecutive pixels along one region row that are extracted simultaneously.

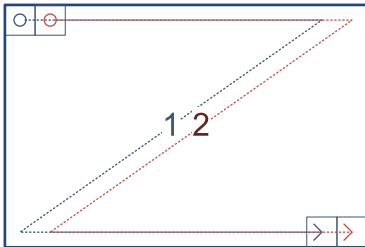
Y-Taps

Number of consecutive pixels along one region column that are extracted simultaneously.

Two adjacent taps on the same row

X-Taps=2; Y-Taps=1

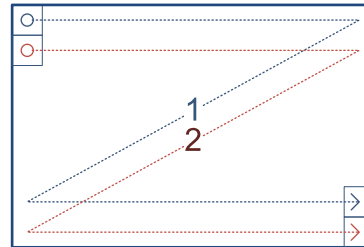
1X2_1Y



Two adjacent taps on the same column

X-Taps=1; Y-Taps=2

1X_1Y2



Region

A rectangular area of adjacent pixels that are transferred in a raster-scan order through one or multiple adjacent taps.

X-Regions

Number of regions encountered across one image row (= the X-direction or the horizontal direction). Possible values are 1, 2, 3, 4, 6, 8, and 10.

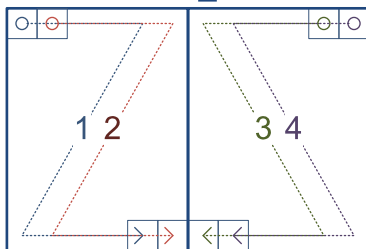
Y-Regions

Number of regions encountered across vertical direction. Possible values are 1 and 2.

Two regions on the same row

X-Regions=2; Y-Regions=1

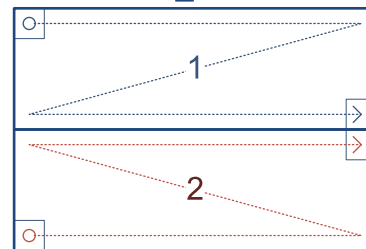
2X2E_1Y



Two regions on the same column

X-Regions=1; Y-Regions=2

1X_2YE

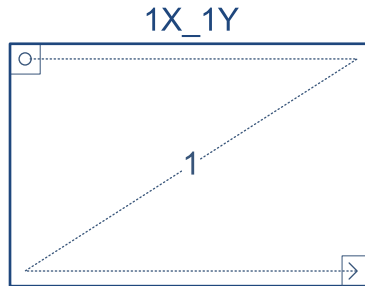


Tap geometrical properties

- X-Start: X-position of the first extracted pixel of a camera readout cycle
- X-End: X-position of the last extracted pixel of a camera readout cycle
- Y-Start: Y-position of the first extracted pixel of a camera readout cycle
- Y-End: Y-position of the last extracted pixel of a camera readout cycle
- Y-Step: the difference of Y-position between consecutive rows of pixels; it is positive when Y-position values are increasing (top to bottom); it is negative otherwise.
- X-Position: the pixel column number in the (non-flipped) image; column 1 is the leftmost column; column W is the rightmost column of an image having a width of W pixels.
- Y-Position: the pixel row number in the (non-flipped) image; row 1 is the topmost row; row H is the bottommost row of an image having a height of H pixels.

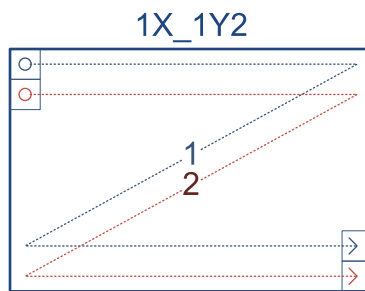
Tap Geometries Reference

1X_1Y Tap Geometry



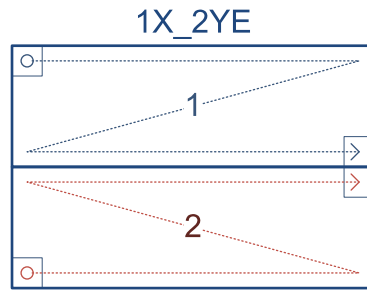
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W	1	1	H	1

1X_1Y2 Tap Geometry



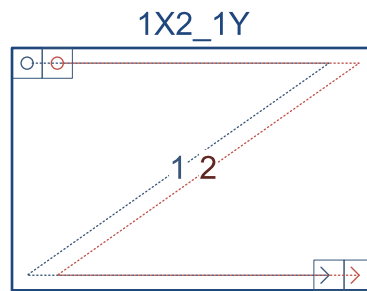
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W	1	1	H-1	2
2	1	W	1	2	H	2

1X_2YE Tap Geometry



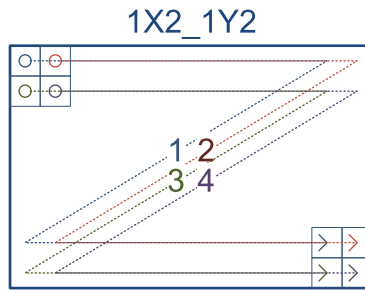
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W	1	1	H/2	1
2	1	W	1	H	H/2 + 1	-1

1X2_1Y Tap Geometry



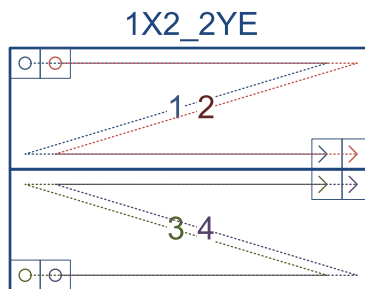
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W-1	2	1	H	1
2	2	W	2	1	H	1

1X2_1Y2 Tap Geometry



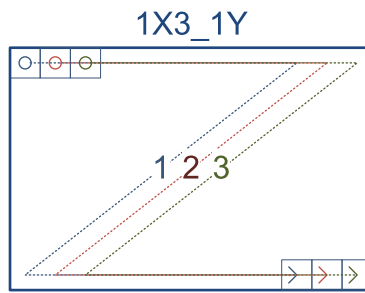
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 1	2	1	H-1	2
2	2	W	2	1	H-1	2
3	1	W - 1	2	2	H	2
4	2	W	2	2	H	2

1X2_2YE Tap Geometry



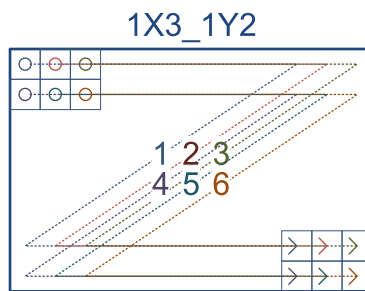
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 1	2	1	H/2	1
2	2	W	2	1	H/2	1
3	1	W - 1	2	H	H/2 + 1	-1
4	2	W	2	H	H/2 + 1	-1

1X3_1Y Tap Geometry



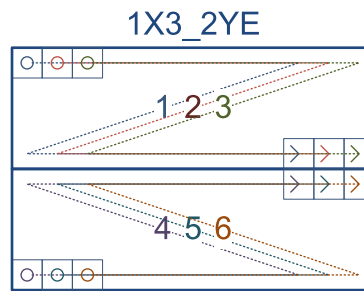
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 2	3	1	H	1
2	2	W - 1	3	1	H	1
3	3	W	3	1	H	1

1X3_1Y2 Tap Geometry



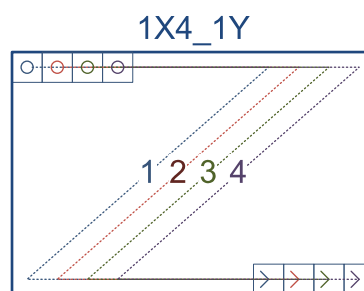
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 2	3	1	H-1	2
2	2	W - 1	3	1	H-1	2
3	3	W	3	1	H-1	2
4	1	W - 2	3	2	H	2
5	2	W - 1	3	2	H	2
6	3	W	3	2	H	2

1X3_2YE Tap Geometry



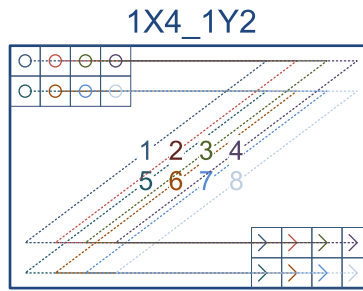
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 2	3	1	H/2	1
2	2	W - 1	3	1	H/2	1
3	3	W	3	1	H/2	1
4	1	W - 2	3	H	H/2 + 1	-1
5	2	W - 1	3	H	H/2 + 1	-1
6	3	W	3	H	H/2 + 1	-1

1X4_1Y Tap Geometry



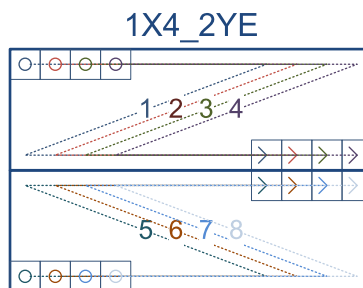
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 3	4	1	H	1
2	2	W - 2	4	1	H	1
3	3	W - 1	4	1	H	1
4	4	W	4	1	H	1

1X4_1Y2 Tap Geometry



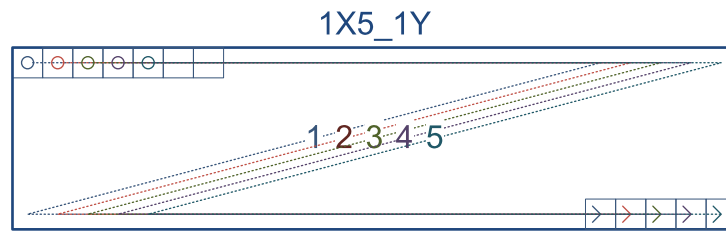
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 3	4	1	H-1	2
2	2	W - 2	4	1	H-1	2
3	3	W - 1	4	1	H-1	2
4	4	W	4	1	H-1	2
5	1	W - 3	4	2	H	2
6	2	W - 2	4	2	H	2
7	3	W - 1	4	2	H	2
8	4	W	4	2	H	2

1X4_2YE Tap Geometry



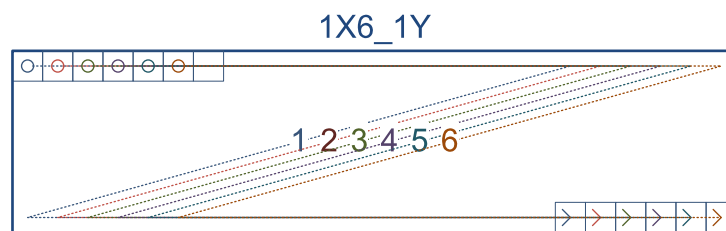
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 3	4	1	H/2	1
2	2	W - 2	4	1	H/2	1
3	3	W - 1	4	1	H/2	1
4	4	W	4	1	H/2	1
5	1	W - 3	4	H	H/2 + 1	-12
6	2	W - 2	4	H	H/2 + 1	-12
7	3	W - 1	4	H	H/2 + 1	-12
8	4	W	4	H	H/2 + 1	-12

1X5_1Y Tap Geometry



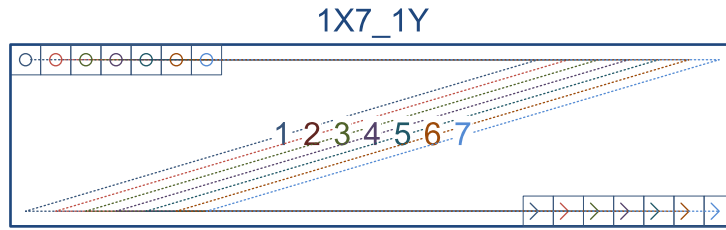
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W-4	5	1	H	1
2	2	W - 3	5	1	H	1
3	3	W - 2	5	1	H	1
4	4	W - 1	5	1	H	1
5	5	W	5	1	H	1

1X6_1Y Tap Geometry



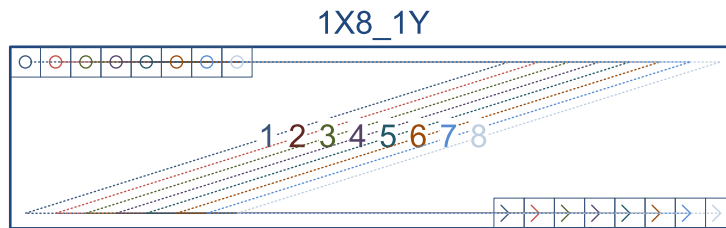
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 5	6	1	H	1
2	2	W - 4	6	1	H	1
3	3	W - 3	6	1	H	1
4	4	W - 2	6	1	H	1
5	5	W - 1	6	1	H	1
6	6	W	6	1	H	1

1X7_1Y Tap Geometry



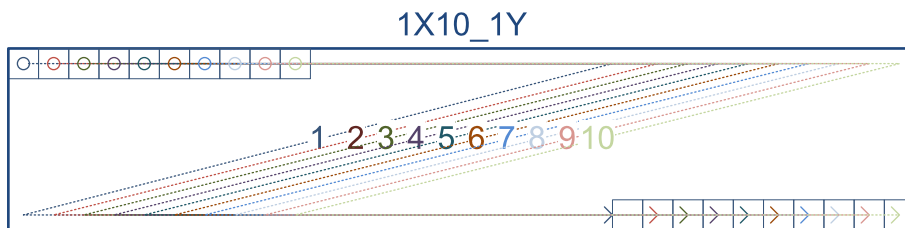
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 6	7	1	H	1
2	2	W - 5	7	1	H	1
3	3	W - 4	7	1	H	1
4	4	W - 3	7	1	H	1
5	5	W - 2	7	1	H	1
6	6	W - 1	7	1	H	1
7	7	W	7	1	H	1

1X8_1Y Tap Geometry



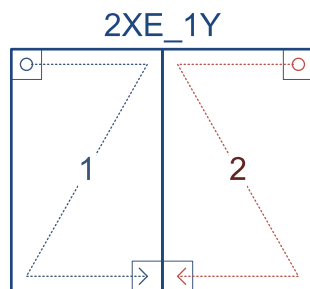
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 7	8	1	H	1
2	2	W - 6	8	1	H	1
3	3	W - 5	8	1	H	1
4	4	W - 4	8	1	H	1
5	5	W - 3	8	1	H	1
6	6	W - 2	8	1	H	1
7	7	W - 1	8	1	H	1
8	8	W	8	1	H	1

1X10_1Y Tap Geometry



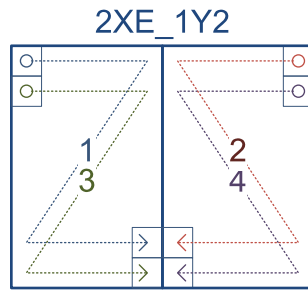
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 9	10	1	H	1
2	2	W - 8	10	1	H	1
3	3	W - 7	10	1	H	1
4	4	W - 6	10	1	H	1
5	5	W - 5	10	1	H	1
6	6	W - 4	10	1	H	1
7	7	W - 3	10	1	H	1
8	8	W - 2	10	1	H	1
9	9	W - 1	10	1	H	1
10	10	W	10	1	H	1

2XE_1Y Tap Geometry



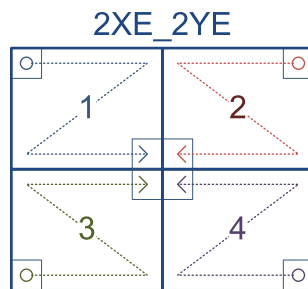
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H	1
2	W	W/2 + 1	-1	1	H	1

2XE_1Y2 Tap Geometry



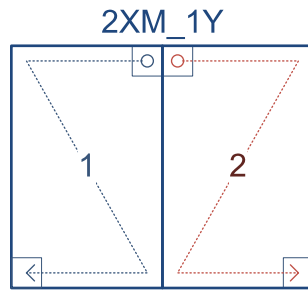
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H - 1	2
2	W	W/2 + 1	-1	1	H - 1	2
3	1	W/2	1	2	H	2
4	W	W/2 + 1	-1	2	H	2

2XE_2YE Tap Geometry



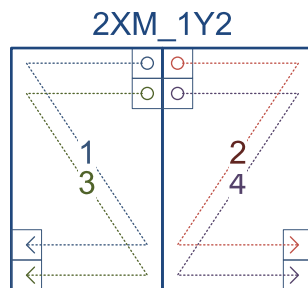
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H/2	1
2	W	W/2 + 1	-1	1	H/2	1
3	1	W/2	1	H	H/2 + 1	-1
4	W	W/2 + 1	-1	H	H/2 + 1	-1

2XM_1Y Tap Geometry



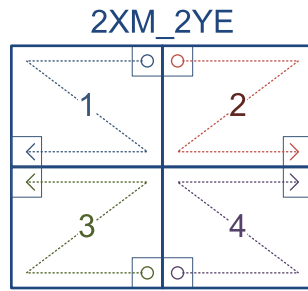
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H	1
2	W/2 + 1	W	1	1	H	1

2XM_1Y2 Tap Geometry



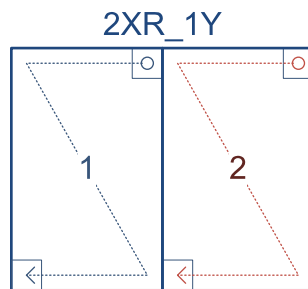
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H - 1	2
2	W/2 + 1	W	1	1	H - 1	2
3	W/2	1	-1	2	H	2
4	W/2 + 1	W	1	2	H	2

2XM_2YE Tap Geometry



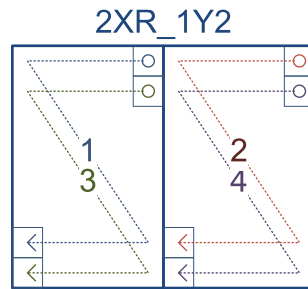
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2$	1	-1	1	$H/2$	1
2	$W/2 + 1$	W	1	1	$H/2$	1
3	$W/2$	1	-1	H	$H/2 + 1$	-1
4	$W/2 + 1$	W	1	H	$H/2 + 1$	-1

2XR_1Y Tap Geometry



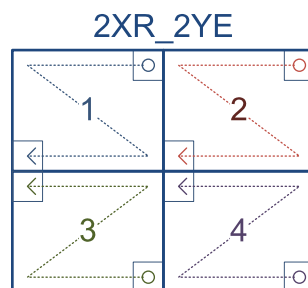
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2$	1	-1	1	H	1
2	W	$W/2 + 1$	-1	1	H	1

2XR_1Y2 Tap Geometry



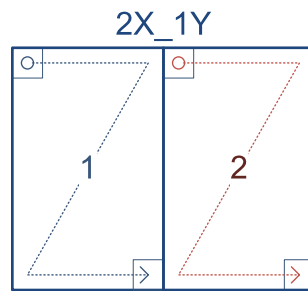
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H - 1	2
2	W	W/2 + 1	-1	1	H - 1	2
3	W/2	1	-1	2	H	2
4	W	W/2 + 1	-1	2	H	2

2XR_2YE Tap Geometry



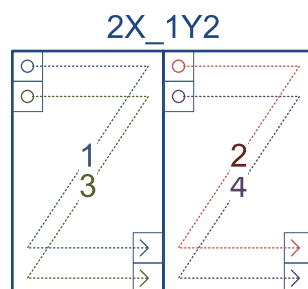
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H/2	1
2	W	W/2 + 1	-1	1	H/2	1
3	W/2	1	-1	H	H/2 + 1	-1
4	W	W/2 + 1	-1	H	H/2 + 1	-1

2X_1Y Tap Geometry



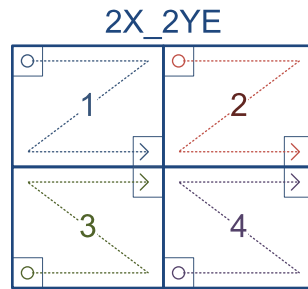
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H	1
2	W/2 + 1	W	1	1	H	1

2X_1Y2 Tap Geometry



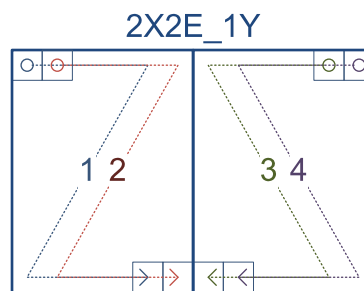
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H - 1	2
2	W/2 + 1	W	1	1	H - 1	2
3	1	W/2	1	2	H	2
4	W/2 + 1	W	1	1	H	2

2X_2YE Tap Geometry



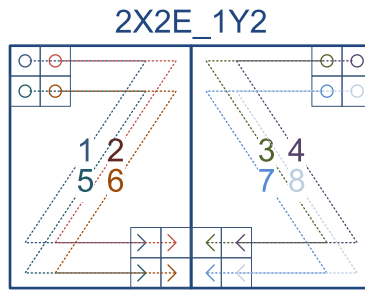
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H/2	1
2	W/2 + 1	W	1	1	H/2	1
3	1	W/2	1	H	H/2 + 1	-1
4	W/2 + 1	W	1	H	H/2 + 1	-1

2X2E_1Y Tap Geometry



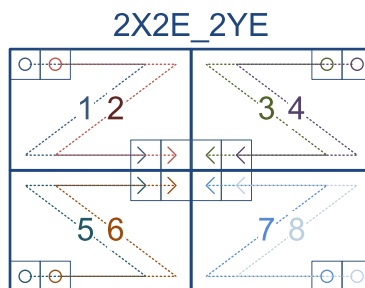
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2 - 1	2	1	H	1
2	2	W/2	2	1	H	1
3	W - 1	W/2 + 1	-2	1	H	1
4	W	W/2 + 2	-2	1	H	1

2X2E_1Y2 Tap Geometry



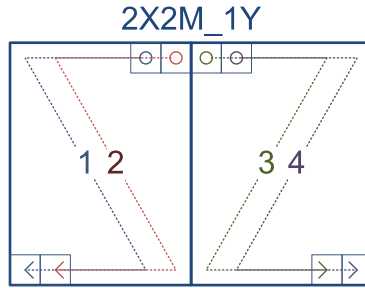
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 1$	2	1	H-1	2
2	2	$W/2$	2	1	H-1	2
3	$W - 1$	$W/2 + 1$	-2	1	H-1	2
4	W	$W/2 + 2$	-2	1	H-1	2
5	1	$W/2 - 1$	2	2	H	2
6	2	$W/2$	2	2	H	2
7	$W - 1$	$W/2 + 1$	-2	2	H	2
8	W	$W/2 + 2$	-2	2	H	2

2X2E_2YE Tap Geometry



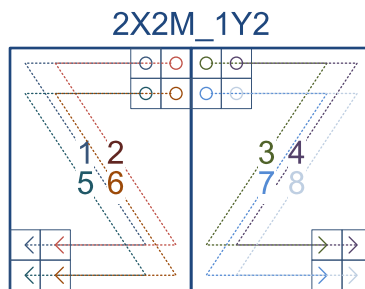
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 1$	2	1	H/2	1
2	2	$W/2$	2	1	H/2	1
3	$W - 1$	$W/2 + 1$	-2	1	H/2	1
4	W	$W/2 + 2$	-2	1	H/2	1
5	1	$W/2 - 1$	2	H	$H/2 + 1$	-1
6	2	$W/2$	2	H	$H/2 + 1$	-1
7	$W - 1$	$W/2 + 1$	-2	H	$H/2 + 1$	-1
8	W	$W/2 + 2$	-2	H	$H/2 + 1$	-1

2X2M_1Y Tap Geometry



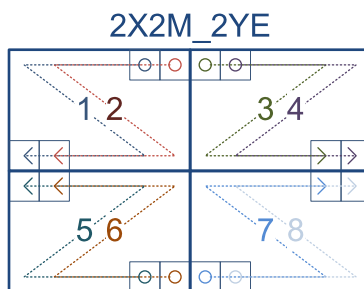
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 1$	1	-2	1	H	1
2	$W/2$	2	-2	1	H	1
3	$W/2 + 1$	$W - 1$	2	1	H	1
4	$W/2 + 2$	W	2	1	H	1

2X2M_1Y2 Tap Geometry



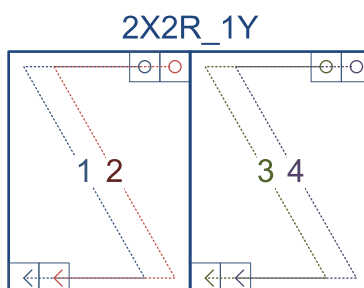
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 1$	1	-2	1	H-1	2
2	$W/2$	2	-2	1	H-1	2
3	$W/2 + 1$	$W - 1$	2	1	H-1	2
4	$W/2 + 2$	W	2	1	H-1	2
5	$W/2 - 1$	1	-2	2	H	2
6	$W/2$	2	-2	2	H	2
7	$W/2 + 1$	$W - 1$	2	2	H	2
8	$W/2 + 2$	W	2	2	H	2

2X2M_2YE Tap Geometry



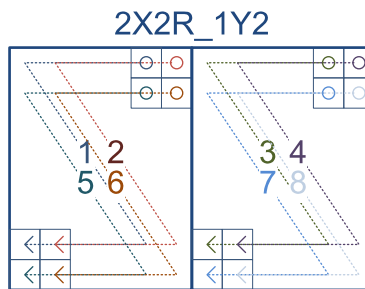
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 1$	1	-2	1	$H/2$	1
2	$W/2$	2	-2	1	$H/2$	1
3	$W/2 + 1$	$W - 1$	2	1	$H/2$	1
4	$W/2 + 2$	W	2	1	$H/2$	1
5	$W/2 - 1$	1	-2	H	$H/2 + 1$	1
6	$W/2$	2	-2	H	$H/2 + 1$	1
7	$W/2 + 1$	$W - 1$	2	H	$H/2 + 1$	1
8	$W/2 + 2$	W	2	H	$H/2 + 1$	1

2X2R_1Y Tap Geometry



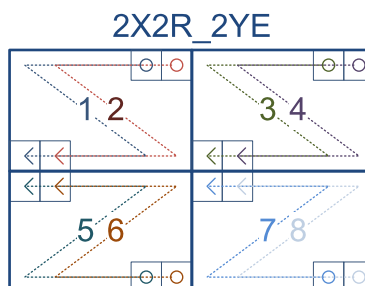
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 1$	1	-2	1	H	1
2	$W/2$	2	-2	1	H	1
3	$W - 1$	$W/2 + 1$	-2	1	H	1
4	W	$W/2 + 2$	-2	1	H	1

2X2R_1Y2 Tap Geometry



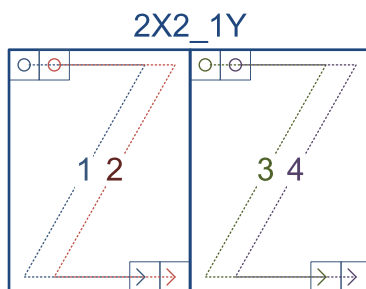
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 1$	1	-2	1	H-1	2
2	$W/2$	2	-2	1	H-1	2
3	$W - 1$	$W/2 + 1$	-2	1	H-1	2
4	W	$W/2 + 2$	-2	1	H-1	2
5	$W/2 - 1$	1	-2	2	H	2
6	$W/2$	2	-2	2	H	2
7	$W - 1$	$W/2 + 1$	-2	2	H	2
8	W	$W/2 + 2$	-2	2	H	2

2X2R_2YE Tap Geometry



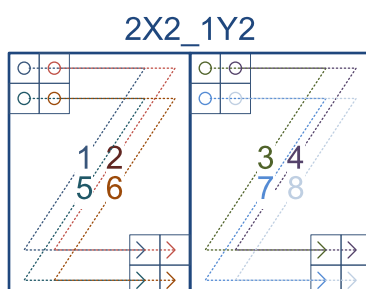
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 1$	1	-2	1	H/2	1
2	$W/2$	2	-2	1	H/2	1
3	$W - 1$	$W/2 + 1$	-2	1	H/2	1
4	W	$W/2 + 2$	-2	1	H/2	1
5	$W/2 - 1$	1	-2	H	$H/2 + 1$	1
6	$W/2$	2	-2	H	$H/2 + 1$	1
7	$W - 1$	$W/2 + 1$	-2	H	$H/2 + 1$	1
8	W	$W/2 + 2$	-2	H	$H/2 + 1$	1

2X2_1Y Tap Geometry



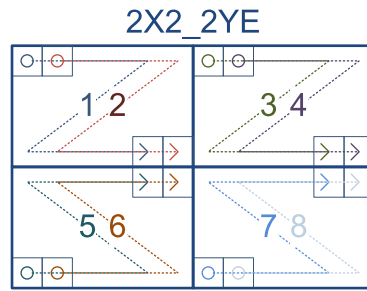
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 1$	2	1	H	1
2	2	$W/2$	2	1	H	1
3	$W/2 + 1$	$W - 1$	2	1	H	1
4	$W/2 + 2$	W	2	1	H	1

2X2_1Y2 Tap Geometry



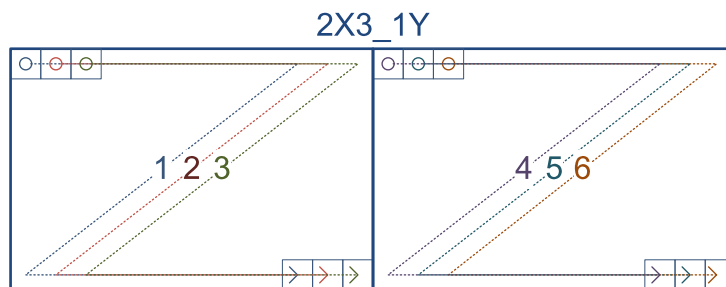
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 1$	2	1	H-1	2
2	2	$W/2$	2	1	H-1	2
3	$W/2 + 1$	$W - 1$	2	1	H-1	2
4	$W/2 + 2$	W	2	1	H-1	2
5	1	$W/2 - 1$	2	2	H	2
6	2	$W/2$	2	2	H	2
7	$W/2 + 1$	$W - 1$	2	2	H	2
8	$W/2 + 2$	W	2	2	H	2

2X2_2YE Tap Geometry



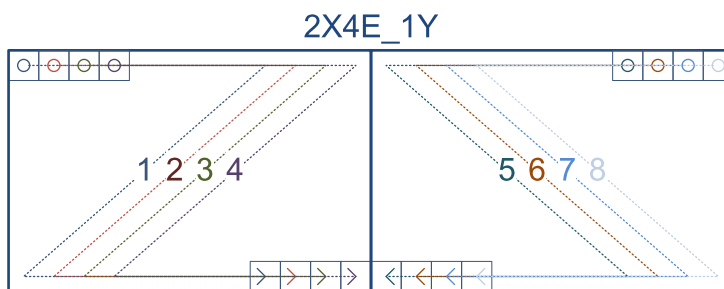
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 1$	2	1	$H/2$	1
2	2	$W/2$	2	1	$H/2$	1
3	$W/2 + 1$	$W - 1$	2	1	$H/2$	1
4	$W/2 + 2$	W	2	1	$H/2$	1
5	1	$W/2 - 1$	2	H	$H/2 + 1$	-1
6	2	$W/2$	2	H	$H/2 + 1$	-1
7	$W/2 + 1$	$W - 1$	2	H	$H/2 + 1$	-1
8	$W/2 + 2$	W	2	H	$H/2 + 1$	-1

2X3_1Y Tap Geometry



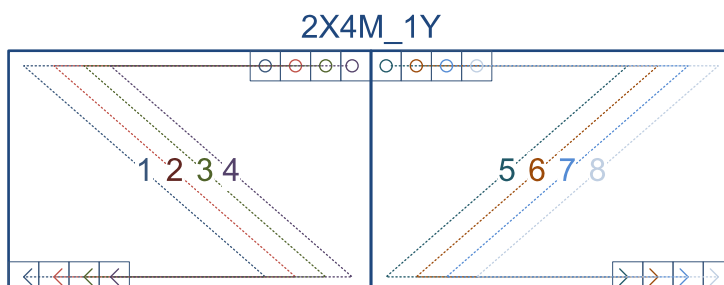
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 2$	3	1	H	1
2	2	$W/2 - 1$	3	1	H	1
3	3	$W/2$	3	1	H	1
4	$W/2 + 1$	$W - 2$	3	1	H	1
5	$W/2 + 2$	$W - 1$	3	1	H	1
6	$W/2 + 3$	W	3	1	H	1

2X4E_1Y Tap Geometry



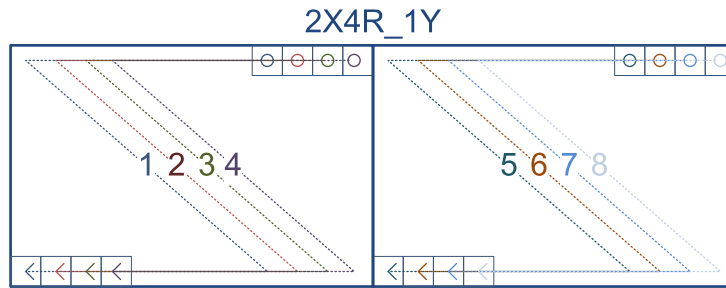
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 3$	4	1	H	1
2	2	$W/2 - 2$	4	1	H	1
3	3	$W/2 - 1$	4	1	H	1
4	4	$W/2$	4	1	H	1
5	$W-3$	$W/2 + 1$	-4	1	H	1
6	$W-2$	$W/2 + 2$	-4	1	H	1
7	$W-1$	$W/2 + 3$	-4	1	H	1
8	W	$W/2 + 4$	-4	1	H	1

2X4M_1Y Tap Geometry



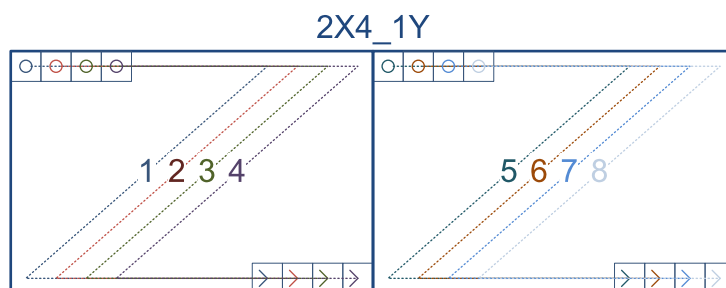
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 3$	1	4	1	H	1
2	$W/2 - 2$	2	4	1	H	1
3	$W/2 - 1$	3	4	1	H	1
4	$W/2$	4	4	1	H	1
5	$W/2 + 1$	$W - 3$	4	1	H	1
6	$W/2 + 2$	$W - 2$	4	1	H	1
7	$W/2 + 3$	$W - 1$	4	1	H	1
8	$W/2 + 4$	W	-4	1	H	1

2X4R_1Y Tap Geometry



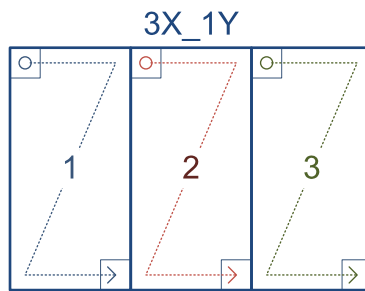
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/2 - 3$	1	4	1	H	1
2	$W/2 - 2$	2	4	1	H	1
3	$W/2 - 1$	3	4	1	H	1
4	$W/2$	4	4	1	H	1
5	$W - 3$	$W/2 + 1$	-4	1	H	1
6	$W - 2$	$W/2 + 2$	-4	1	H	1
7	$W - 1$	$W/2 + 3$	-4	1	H	1
8	W	$W/2 + 4$	-4	1	H	1

2X4_1Y Tap Geometry



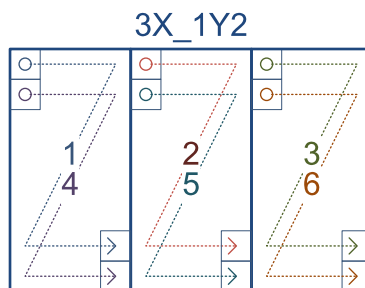
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/2 - 3$	4	1	H	1
2	2	$W/2 - 2$	4	1	H	1
3	3	$W/2 - 1$	4	1	H	1
4	4	$W/2$	4	1	H	1
5	$W/2 + 1$	$W - 3$	4	1	H	1
6	$W/2 + 2$	$W - 2$	4	1	H	1
7	$W/2 + 3$	$W - 1$	4	1	H	1
8	$W/2 + 4$	W	4	1	H	1

3X_1Y Tap Geometry



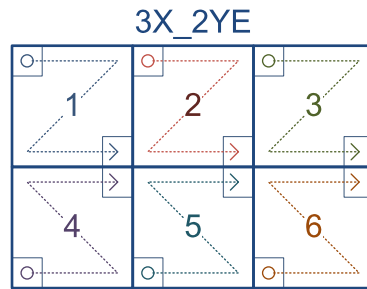
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3	1	1	H	1
2	W/3 + 1	2W/3	1	1	H	1
3	2W/3 + 1	W	1	1	H	1

3X_1Y2 Tap Geometry



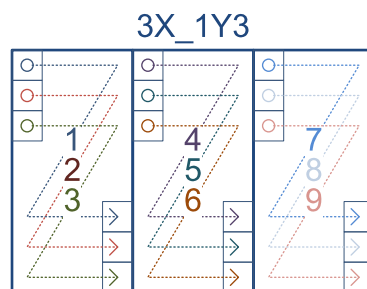
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3	1	1	H-1	2
2	W/3 + 1	2W/3	1	1	H-1	2
3	2W/3 + 1	W	1	1	H-1	2
4	1	W/3	1	2	H	2
5	W/3 + 1	2W/3	1	2	H	2
6	2W/3 + 1	W	1	2	H	2

3X_2YE Tap Geometry



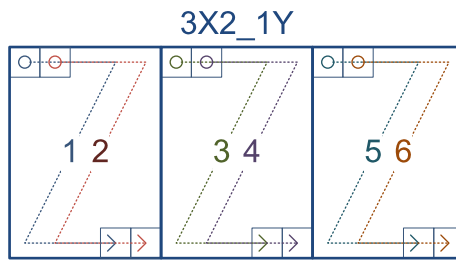
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3	1	1	H/2	1
2	W/3 + 1	2W/3	1	1	H/2	1
3	2W/3 + 1	W	1	1	H/2	1
4	1	W - 2	3	H	H/2 + 1	-1
5	W/3 + 1	2W/3	1	H	H/2 + 1	-1
6	2W/3 + 1	W	1	H	H/2 + 1	-1

3X_1Y3 Tap Geometry



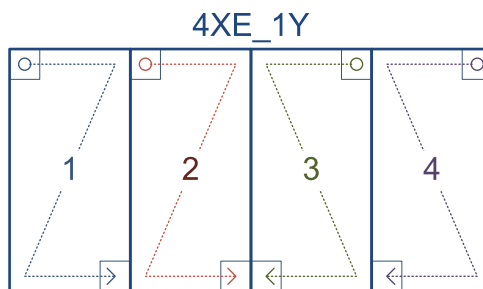
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3	1	1	H-2	3
2	1	W/3	1	2	H-1	3
3	1	W/3	1	3	H	3
4	W/3 + 1	2W/3	1	1	H-2	3
5	W/3 + 1	2W/3	1	2	H-1	3
6	W/3 + 1	2W/3	1	3	H	3
7	2W/3 + 1	W	1	1	H-2	3
8	2W/3 + 1	W	1	2	H-1	3
9	2W/3 + 1	W	1	3	H	3

3X2_1Y Tap Geometry



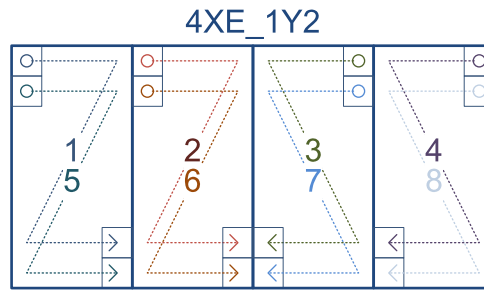
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/3 - 1$	2	1	H	1
2	2	$W/3$	2	1	H	1
3	$W/3 + 1$	$2W/3 - 1$	2	1	H	1
4	$W/3 + 2$	$2W/3$	2	1	H	1
5	$2W/3 + 1$	$W - 1$	2	1	H	1
6	$2W/3 + 2$	W	2	1	H	1

4XE_1Y Tap Geometry



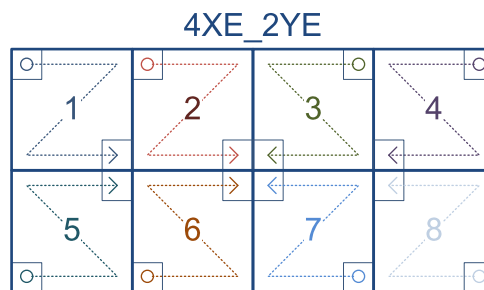
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/4$	1	1	H	1
2	$W/4 + 1$	$W/2$	1	1	H	1
3	$3W/4$	$W/2 + 1$	-1	1	H	1
4	W	$3W/4 + 1$	-1	1	H	1

4XE_1Y2 Tap Geometry



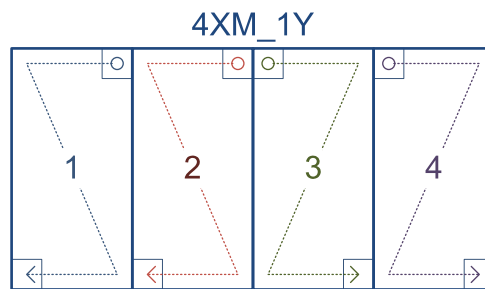
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H - 1	2
2	W/4 + 1	W/2	1	1	H - 1	2
3	3W/4	W/2 + 1	-1	1	H - 1	2
4	W	3W/4 + 1	-1	1	H - 1	2
5	1	W/4	1	2	H	2
6	W/4 + 1	W/2	1	2	H	2
7	3W/4	W/2 + 1	-1	2	H	2
8	W	3W/4 + 1	-1	2	H	2

4XE_2YE Tap Geometry



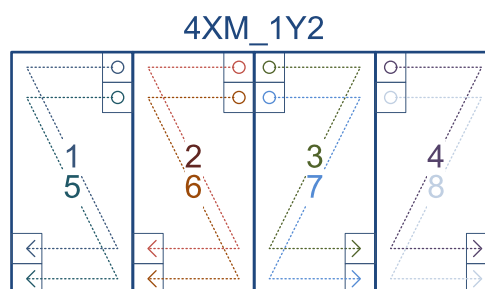
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H/2	1
2	W/4 + 1	W/2	1	1	H/2	1
3	3W/4	W/2 + 1	-1	1	H/2	1
4	W	3W/4 + 1	-1	1	H/2	1
5	1	W/4	1	H	H/2 + 1	-1
6	W/4 + 1	W/2	1	H	H/2 + 1	-1
7	3W/4	W/2 + 1	-1	H	H/2 + 1	-1
8	W	3W/4 + 1	-1	H	H/2 + 1	-1

4XM_1Y Tap Geometry



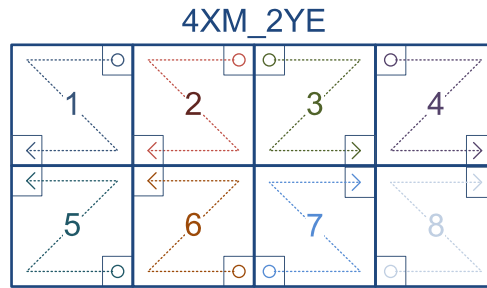
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4$	1	-1	1	H	1
2	$W/2$	$W/4 + 1$	-1	1	H	1
3	$W/2 + 1$	$3W/4$	1	1	H	1
4	$3W/4 + 1$	W	1	1	H	1

4XM_1Y2 Tap Geometry



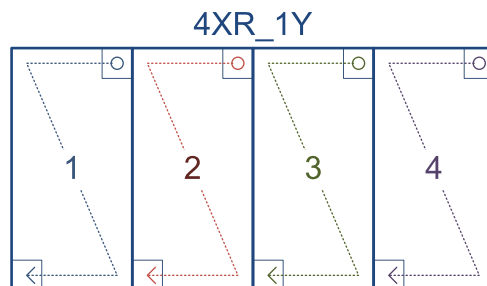
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4$	1	-1	1	H - 1	2
2	$W/2$	$W/4 + 1$	-1	1	H - 1	2
3	$W/2 + 1$	$3W/4$	1	1	H - 1	2
4	$3W/4 + 1$	W	1	1	H - 1	2
5	$W/4$	1	-1	2	H	2
6	$W/2$	$W/4 + 1$	-1	2	H	2
7	$W/2 + 1$	$3W/4$	1	2	H	2
8	$3W/4 + 1$	W	1	2	H	2

4XM_2YE Tap Geometry



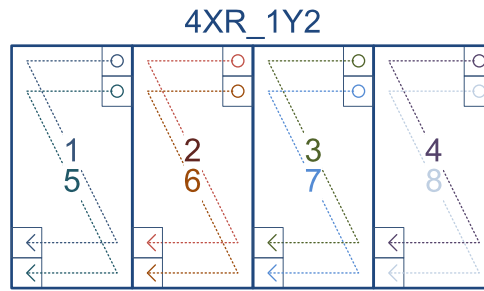
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4$	1	-1	1	$H/2$	1
2	$W/2$	$W/4 + 1$	-1	1	$H/2$	1
3	$W/2 + 1$	$3W/4$	1	1	$H/2$	1
4	$3W/4 + 1$	W	1	1	$H/2$	1
5	$W/4$	1	-1	H	$H/2 + 1$	-1
6	$W/2$	$W/4 + 1$	-1	H	$H/2 + 1$	-1
7	$W/2 + 1$	$3W/4$	1	H	$H/2 + 1$	-1
8	$3W/4 + 1$	W	1	H	$H/2 + 1$	-1

4XR_1Y Tap Geometry



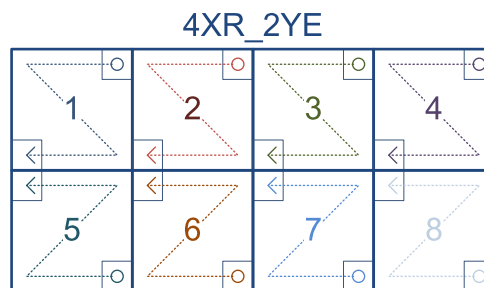
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4$	1	-1	1	H	1
2	$W/2$	$W/4 + 1$	-1	1	H	1
3	$3W/4$	$W/2 + 1$	-1	1	H	1
4	W	$3W/4 + 1$	-1	1	H	1

4XR_1Y2 Tap Geometry



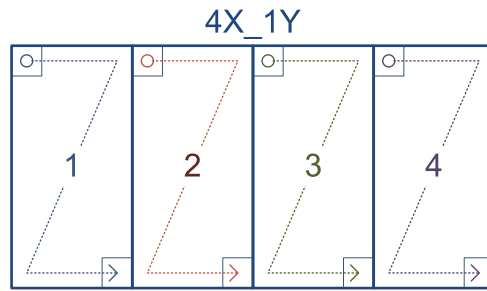
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4$	1	-1	1	$H - 1$	2
2	$W/2$	$W/4 + 1$	-1	1	$H - 1$	2
3	$3W/4$	$W/2 + 1$	-1	1	$H - 1$	2
4	W	$3W/4 + 1$	-1	1	$H - 1$	2
5	$W/4$	1	-1	2	H	2
6	$W/2$	$W/4 + 1$	-1	2	H	2
7	$3W/4$	$W/2 + 1$	-1	2	H	2
8	W	$3W/4 + 1$	-1	2	H	2

4XR_2YE Tap Geometry



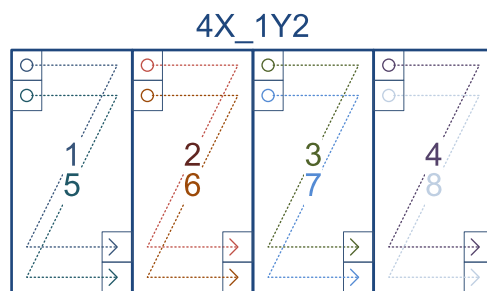
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4$	1	-1	1	$H/2$	1
2	$W/2$	$W/4 + 1$	-1	1	$H/2$	1
3	$3W/4$	$W/2 + 1$	-1	1	$H/2$	1
4	W	$3W/4 + 1$	-1	1	$H/2$	1
5	$W/4$	1	-1	H	$H/2 + 1$	-1
6	$W/2$	$W/4 + 1$	-1	H	$H/2 + 1$	-1
7	$3W/4$	$W/2 + 1$	-1	H	$H/2 + 1$	-1
8	W	$3W/4 + 1$	-1	H	$H/2 + 1$	-1

4X_1Y Tap Geometry



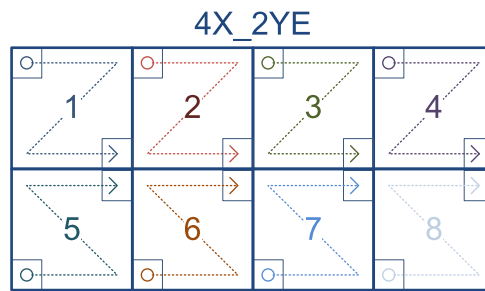
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H	1
2	W/4 + 1	W/2	1	1	H	1
3	W/2 + 1	3W/4	1	1	H	1
4	3W/4 + 1	W	1	1	H	1

4X_1Y2 Tap Geometry



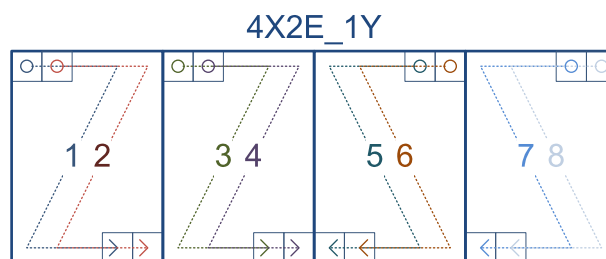
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H - 1	2
2	W/4 + 1	W/2	1	1	H - 1	2
3	W/2 + 1	3W/4	1	1	H - 1	2
4	3W/4 + 1	W	1	1	H - 1	2
5	1	W/4	1	2	H	2
6	W/4 + 1	W/2	1	2	H	2
7	W/2 + 1	3W/4	1	2	H	2
8	3W/4 + 1	W	1	2	H	2

4X_2YE Tap Geometry



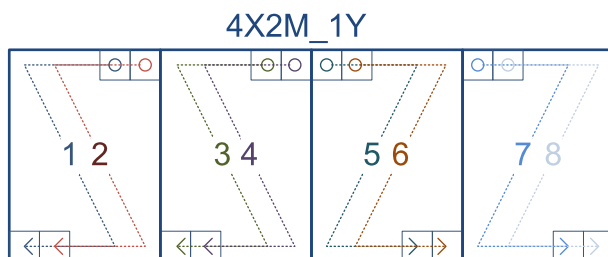
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H/2	1
2	W/4 + 1	W/2	1	1	H/2	1
3	W/2 + 1	3W/4	1	1	H/2	1
4	3W/4 + 1	W	1	1	H/2	1
5	1	W/4	1	H	H/2 + 1	-1
6	W/4 + 1	W/2	1	H	H/2 + 1	-1
7	W/2 + 1	3W/4	1	H	H/2 + 1	-1
8	3W/4 + 1	W	1	H	H/2 + 1	-1

4X2E_1Y Tap Geometry



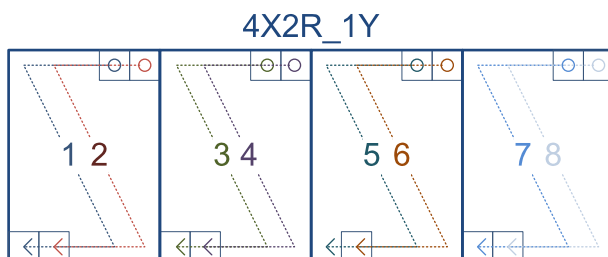
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4 - 1	2	1	H	1
2	2	W/4	2	1	H	1
3	W/4 + 1	W/2 - 1	2	1	H	1
4	W/4 + 2	W/2	2	1	H	1
5	3W/4 - 1	W/2 + 1	-2	1	H	1
6	3W/4	W/2 + 2	-2	1	H	1
7	W - 1	3W/4 + 1	-2	1	H	1
8	W	3W/4 + 2	-2	1	H	1

4X2M_1Y Tap Geometry



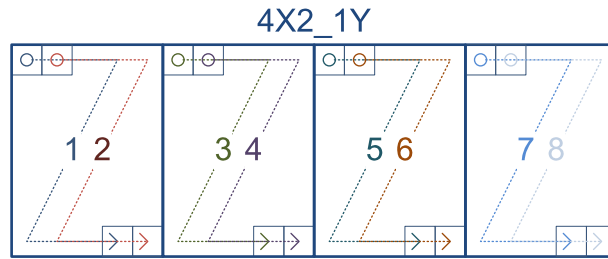
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4 - 1$	1	-2	1	H	1
2	$W/4$	2	-2	1	H	1
3	$W/2 - 1$	$W/4 + 1$	-2	1	H	1
4	$W/2$	$W/4 + 2$	-2	1	H	1
5	$W/2 + 1$	$3W/4 - 1$	2	1	H	1
6	$W/2 + 2$	$3W/4$	2	1	H	1
7	$3W/4 + 1$	$W - 1$	2	1	H	1
8	$3W/4 + 2$	W	2	1	H	1

4X2R_1Y Tap Geometry



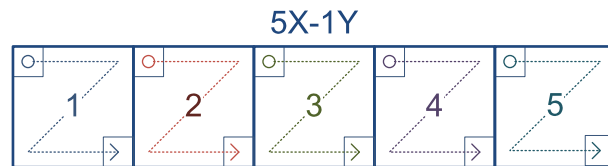
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/4 - 1$	1	-2	1	H	1
2	$W/4$	2	-2	1	H	1
3	$W/2 - 1$	$W/4 + 1$	-2	1	H	1
4	$W/2$	$W/4 + 2$	-2	1	H	1
5	$3W/4 - 1$	$W/2 + 1$	-2	1	H	1
6	$3W/4$	$W/2 + 2$	-2	1	H	1
7	$W - 1$	$3W/4 + 1$	-2	1	H	1
8	W	$3W/4 + 2$	-2	1	H	1

4X2_1Y Tap Geometry



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/4 - 1$	2	1	H	1
2	2	$W/4$	2	1	H	1
3	$W/4 + 1$	$W/2 - 1$	2	1	H	1
4	$W/4 + 2$	$W/2$	2	1	H	1
5	$W/2 + 1$	$3W/4 - 1$	2	1	H	1
6	$W/2 + 2$	$3W/4$	2	1	H	1
7	$3W/4 + 1$	$W - 1$	2	1	H	1
8	$3W/4 + 2$	W	2	1	H	1

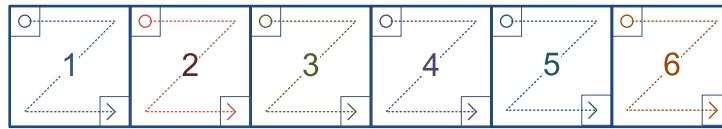
5X_1Y Tap Geometry



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/5$	1	1	H	1
2	$W/5 + 1$	$2W/5$	1	1	H	1
3	$2W/5 + 1$	$3W/5$	1	1	H	1
4	$3W/5 + 1$	$4W/5$	1	1	H	1
5	$4W/5 + 1$	W	1	1	H	1

6X_1Y Tap Geometry

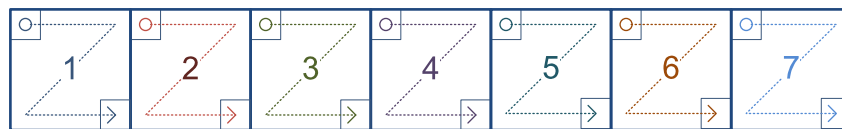
6X-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/6	1	1	H	1
2	W/6 + 1	2W/6	1	1	H	1
3	2W/6 + 1	3W/6	1	1	H	1
4	3W/6 + 1	4W/6	1	1	H	1
5	4W/6 + 1	5W/6	1	1	H	1
6	5W/6 + 1	W	1	1	H	1

7X_1Y Tap Geometry

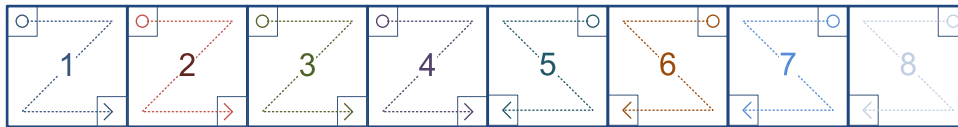
7X-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/7	1	1	H	1
2	W/7 + 1	2W/7	1	1	H	1
3	2W/7 + 1	3W/7	1	1	H	1
4	3W/7 + 1	4W/7	1	1	H	1
5	4W/7 + 1	5W/7	1	1	H	1
6	5W/7 + 1	6W/7	1	1	H	1
7	6W/7 + 1	W	1	1	H	1

8XE_1Y Tap Geometry

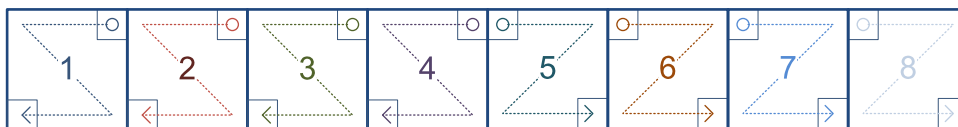
8XE-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/8	1	1	H	1
2	W/8 + 1	2W/8	1	1	H	1
3	2W/8 + 1	3W/8	1	1	H	1
4	3W/8 + 1	4W/8	1	1	H	1
5	5W/8	4W/8 + 1	-1	1	H	1
6	6W/8	5W/8 + 1	-1	1	H	1
7	7W/8	6W/8 + 1	-1	1	H	1
8	W	7W/8 + 1	-1	1	H	1

8XM_1Y Tap Geometry

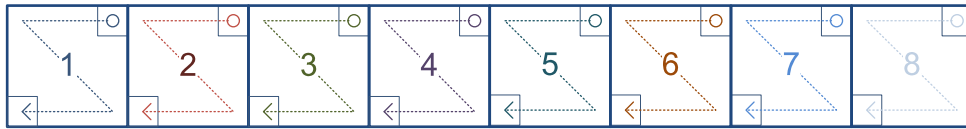
8XM-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/8	1	-1	1	H	1
2	2W/8	W/8 + 1	-1	1	H	1
3	3W/8	2W/8 + 1	-1	1	H	1
4	4W/8	3W/8 + 1	-1	1	H	1
5	4W/8 + 1	5W/8	1	1	H	1
6	5W/8 + 1	6W/8	1	1	H	1
7	6W/8 + 1	7W/8	1	1	H	1
8	7W/8 + 1	W	1	1	H	1

8XR_1Y Tap Geometry

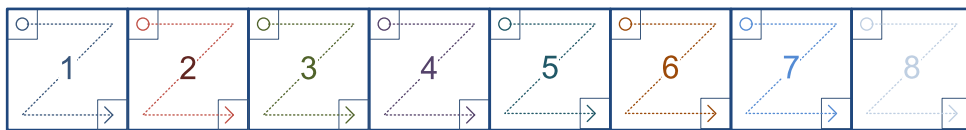
8XR-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	$W/8$	1	-1	1	H	1
2	$2W/8$	$W/8 + 1$	-1	1	H	1
3	$3W/8$	$2W/8 + 1$	-1	1	H	1
4	$4W/8$	$3W/8 + 1$	-1	1	H	1
5	$5W/8$	$4W/8 + 1$	-1	1	H	1
6	$6W/8$	$5W/8 + 1$	-1	1	H	1
7	$7W/8$	$6W/8 + 1$	-1	1	H	1
8	W	$7W/8 + 1$	-1	1	H	1

8X_1Y Tap Geometry

8X-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	$W/8$	1	1	H	1
2	$W/8 + 1$	$2W/8$	1	1	H	1
3	$2W/8 + 1$	$3W/8$	1	1	H	1
4	$3W/8 + 1$	$4W/8$	1	1	H	1
5	$4W/8 + 1$	$5W/8$	1	1	H	1
6	$5W/8 + 1$	$6W/8$	1	1	H	1
7	$6W/8 + 1$	$7W/8$	1	1	H	1
8	$7W/8 + 1$	W	1	1	H	1

10XE_1Y Tap Geometry

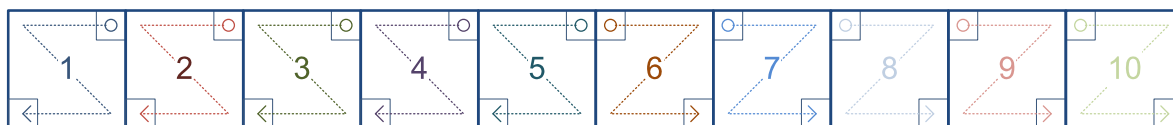
10XE-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/10	1	1	H	1
2	W/10 + 1	2W/10	1	1	H	1
3	2W/10 + 1	3W/10	1	1	H	1
4	3W/10 + 1	4W/10	1	1	H	1
5	4W/10 + 1	5W/10	1	1	H	1
6	6W/10	5W/10 + 1	-1	1	H	1
7	7W/10	6W/10 + 1	-1	1	H	1
8	8W/10	7W/10 + 1	-1	1	H	1
9	9W/10	8W/10 + 1	-1	1	H	1
10	W	9W/10 + 1	-1	1	H	1

10XM_1Y Tap Geometry

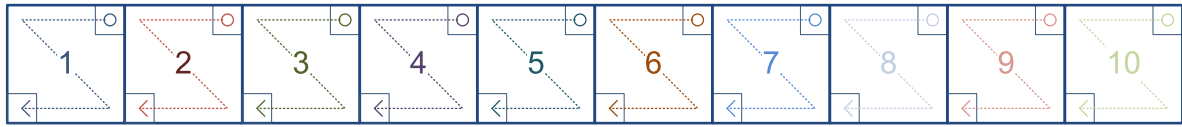
10XM-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/10	1	-1	1	H	1
2	2W/10	W/10 + 1	-1	1	H	1
3	3W/10	2W/10 + 1	-1	1	H	1
4	4W/10	3W/10 + 1	-1	1	H	1
5	5W/10	4W/10 + 1	-1	1	H	1
6	5W/10 + 1	6W/10	1	1	H	1
7	6W/10 + 1	7W/10	1	1	H	1
8	7W/10 + 1	8W/10	1	1	H	1
9	8W/10 + 1	9W/10	1	1	H	1
10	9W/10 + 1	W	1	1	H	1

10XR_1Y Tap Geometry

10XR-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/10	1	-1	1	H	1
2	2W/10	W/10 + 1	-1	1	H	1
3	3W/10	2W/10 + 1	-1	1	H	1
4	4W/10	3W/10 + 1	-1	1	H	1
5	5W/10	4W/10 + 1	-1	1	H	1
6	6W/10	5W/10 + 1	-1	1	H	1
7	7W/10	6W/10 + 1	-1	1	H	1
8	8W/10	7W/10 + 1	-1	1	H	1
9	9W/10	8W/10 + 1	-1	1	H	1
10	W	9W/10 + 1	-1	1	H	1

10X_1Y Tap Geometry

10X-1Y



Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/10	1	1	H	1
2	W/10 + 1	2W/10	1	1	H	1
3	2W/10 + 1	3W/10	1	1	H	1
4	3W/10 + 1	4W/10	1	1	H	1
5	4W/10 + 1	5W/10	1	1	H	1
6	5W/10 + 1	6W/10	1	1	H	1
7	6W/10 + 1	7W/10	1	1	H	1
8	7W/10 + 1	8W/10	1	1	H	1
9	8W/10 + 1	9W/10	1	1	H	1
10	9W/10 + 1	W	1	1	H	1

Supported Tap Geometries

2.7. Camera Link Bit Assignments

1628 Grablink Duo complies with the following bit assignment tables of section 4 of the [Camera Link 2.1 Specification](#):

- Table 4-1: 8-Bit Modes, Base/Medium/Full
- Table 4-2: 8-Bit Modes, 80-bit
- Table 4-3: 10-Bit Modes, Base/Medium/Full
- Table 4-4: 10-Bit Modes, 80-bit
- Table 4-5: 12-Bit Modes, Base/Medium/Full
- Table 4-6: 14-Bit Modes, Base/Medium/Full/72-bit
- Table 4-7: 16-Bit Modes, Base/Medium/Full
- Table 4-8: 16-Bit Mode, 80-bit

2.8. Camera Link Data Re-ordering

1628 Gralink Duo is capable to re-arrange the data in the destination buffer for a large combinations of tap configurations and tap geometries

2.9. Enable Signals

Introduction

The Camera Link standard defines four enable signals:

- ["FVAL Enable Signal" on page 112](#)
- ["LVAL Enable Signal" on page 114](#)
- ["DVAL Enable Signal" on page 116](#)
- Spare Enable Signal

The Camera Link standard requires that enable signals are provided on Channel Link chips as follows:

Camera Link Configuration	FVAL	LVAL	DVAL	Spare
Lite	X	X	-	-
Base	X	X	X	X
Medium	X and Y	X and Y	X and Y	X and Y
Full	X, Y and Z	X, Y and Z	X, Y and Z	X, Y and Z
72-bit	X, Y and Z	X, Y and Z	X, Y and Z	X, Y and Z
80-bit	X only	X, Y and Z	-	-

Enable signals usage vs. acquisition mode

On Grablinc boards, the enable signals are used differently according to the type of acquisition:

[Area-scan image acquisition](#)

When acquiring images from area-scan cameras, Grablinc frame grabbers use the Camera Link enable signals as follows:

- The rising edge of the ["FVAL Enable Signal" on page 112](#) is used as a "Start-of-Frame". The falling edge is ignored.
- The rising edge of the ["LVAL Enable Signal" on page 114](#) is used as a "Start-of-Line". The falling edge is ignored.
- The ["DVAL Enable Signal" on page 116](#) can be used as a Camera Link clock qualifier¹.
- The Spare Enable signal is unused.
- The **Width** GenApi feature of the Remote Device module specifies the image width (number of pixels per line).

¹ Active window with DVAL gating is not available yet!

- The **Height** GenApi feature of the Remote Device module specifies the image height (number of lines per frame).

Line-scan image acquisition

When acquiring images from line-scan cameras, Grablino frame grabbers use the Camera Link enable signals as follows:

- The "FVAL Enable Signal" on page 112 is ignored.
- The rising edge of the "LVAL Enable Signal" on page 114 is used as a "Start-of-Line". The falling edge is ignored.
- The "DVAL Enable Signal" on page 116 can be used as a Camera Link clock qualifier¹.
- The Spare Enable signal is ignored.
- The **Width** GenApi feature of the Remote Device module specifies the image width (number of pixels per line).

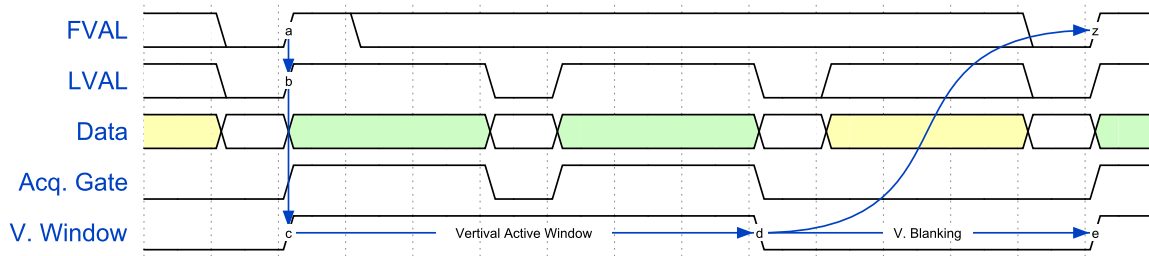
Enable signals usage as GPIO inputs

On **1628 Grablino Duo**, the Camera Link enable signals are available as source lines for the **LIN tools** of the **I/O Toolbox**.

¹ Active window with DVAL gating is not available yet!

FVAL Enable Signal

The Camera Link Frame Valid enable signal - FVAL - is only delivered by area-scan cameras.



FVAL timing diagram (Default settings)

Grablink Duo only considers the low to high transitions of FVAL. The high-to-low transitions are ignored!

Vertical Active Window - Start

The vertical active window starts with the first LVAL low-to-high transition when FVAL is 1.

On **Grablink Duo**, the FVAL low-to-high transition may occur before or simultaneously with the LVAL low-to-high transition.

Parameter	Conditions	Min	Max	Unit
FVAL rise to LVAL rise setup	-	0	N/A	Camera Link clock cycle

Vertical Active Window - Size

On **Grablink Duo**, the number of LVAL cycles defining the vertical active window is NOT defined by the duration of the FVAL high. Instead, it is established by the driver from the **Height** and the **DeviceTapGeometry** GenApi features of the Remote Device:

$$\text{Vertical Active Window [LVAL cycles]} = \text{Image height [lines]} / (\text{Y-Regions} \times \text{Y-Taps})$$

See also: "Tap Geometry Glossary" on page 63

Vertical Active Window - End

The data acquisition is immediately suspended after the last pixel data of the last Horizontal Active Window.

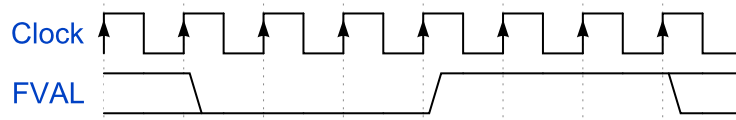
The next FVAL low-to-high transition may only occur after:

Parameter	Conditions	Min	Max	Unit
V. A. Window fall to FVAL rise setup	Default settings	3	N/A	Camera Link clock cycle
V. A. Window fall to FVAL rise setup	Filter disabled	1	N/A	Camera Link clock cycle

FVAL anti-glitch filter

To increase the robustness against degraded Camera Link transmission, the FVAL input is fitted with an *anti-glitch filter*.

The *FVAL anti-glitch filter* is enabled by default. It rejects FVAL pulses shorter than 3 Camera Link clock cycles.

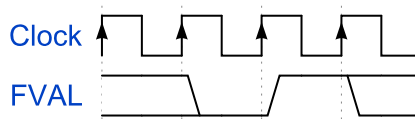


Valid FVAL rise transition - Filter enabled (Default settings)

NOTE: When the *FVAL anti-glitch filter* is enabled, the counts of glitches on Channel links X, Y and Z are reported respectively in the features **ChannelXGlitchCount**, **ChannelYGlitchCount** and **ChannelZGlitchCount**. These counters are 16-bits wide and restart to 0 when overflowed. The command **ChannelXYZGlitchCountReset** resets the counters of the 3 Channel Links.

The *FVAL anti-glitch filter* can be disabled by setting the Device module features **AntiGlitchFilterSelector** to **FVAL** and then **AntiGlitchFilterEnable** to **False**.

NOTE: This allows FVAL pulses of 1 Camera Link clock cycle to be accepted.

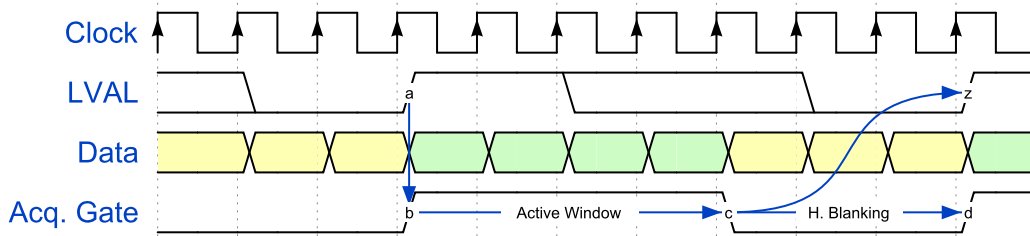


Valid FVAL rise transition - Filter disabled

Parameter	Conditions	Min	Max	Unit
FVAL pulse duration	Default settings	3	N/A	Camera Link clock cycle
FVAL pulse duration	Filter disabled	1	N/A	Camera Link clock cycle

LVAL Enable Signal

The Camera Link Line Valid enable signal - LVAL - is delivered by area-scan and line-scan cameras.



LVAL timing diagram (Default settings)

Grablink Duo only considers the low to high transitions of LVAL. The high-to-low transitions are ignored!

Horizontal Active Window - Start

The horizontal active window starts with the LVAL low-to-high transition.

Horizontal Active Window - Size

On **Grablink Duo**, the number of Camera Link clock cycles defining the horizontal active window is NOT defined by the duration of the LVAL high. Instead, it is established by the driver from the **Width** and the **DeviceTapGeometry** GenApi features of the Remote Device:

$$\text{Horizontal Active Window [Clock Cycles]} = \text{Image width [Pixels]} / (\text{X-Regions} \times \text{X-Taps})$$

See also: "Tap Geometry Glossary" on page 63

Horizontal Active Window - End

The data acquisition is immediately suspended after the last pixel data of the Active Window.

The next FVAL low-to-high transition may only occur after:

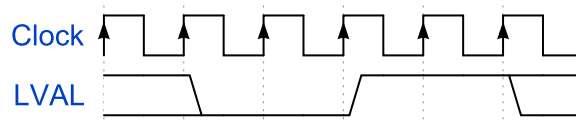
Parameter	Conditions	Min	Max	Unit
V. A. Window fall to LVAL rise setup	Default settings	2	N/A	Camera Link clock cycle
V. A. Window fall to LVAL rise setup	Filter disabled	1	N/A	Camera Link clock cycle

The next LVAL low-to-high transition may only occur after!

LVAL edge digital anti-glitch filter

To increase the robustness against degraded Camera Link transmission, the LVAL input is fitted with an *anti-glitch filter*.

The *LVAL anti-glitch filter* is enabled by default. It rejects LVAL pulses shorter than 2 Camera Link clock cycles.

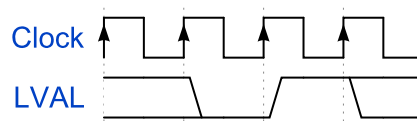


Valid LVAL rise transition - Filter enabled (Default settings)

NOTE: When the *anti-glitch filter* is enabled, the counts of glitches on Channel links X, Y and Z are reported respectively in the features `ChannelXGlitchCount`, `ChannelYGlitchCount` and `ChannelZGlitchCount`. These counters are 16-bits wide and restart to 0 when overflowed. The command `ChannelXYZGlitchCountReset` resets the counters of the 3 Channel links.

The *LVAL digital filter* can be disabled by setting the Device module features `AntiGlitchFilterSelector` to `LVAL` and then `AntiGlitchFilterEnable` to `False`.

NOTE: This allows LVAL pulses of 1 Camera Link clock cycle to be accepted.



Valid LVAL rise transition - Filter disabled

Parameter	Conditions	Min	Max	Unit
LVAL pulse duration	Default settings	2	N/A	Camera Link clock cycle
LVAL pulse duration	Filter disabled	1	N/A	Camera Link clock cycle

DVAL Enable Signal

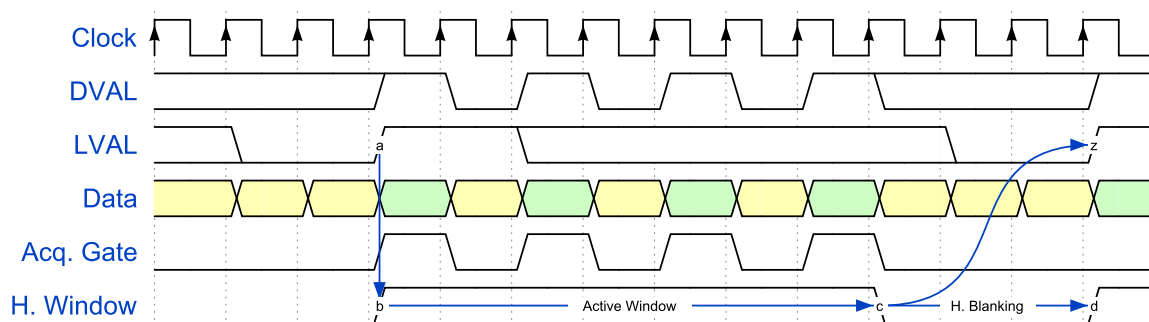
The Camera Link Data Valid enable signal - DVAL - is delivered by the camera to qualify the Camera Link clock cycles.

- A DVAL high state indicates a Camera Link clock cycle where data is transmitted.
- A DVAL low state indicates a Camera Link clock cycle where no data is transmitted.

NOTE: The DVAL signal is typically used by low-speed cameras having pixel rates below 20 MHz (the lower limit of the Camera Link clock frequency).

Horizontal Active Window with DVAL gating¹

When enabled, this feature restricts the data acquisition to Camera Link clock cycles with DVAL = 1.



LVAL timing diagram with DVAL enabled

NOTE: When DVAL gating is enabled, only Camera Link cycles with DVAL = 1 are taken into account for the size of the active window!

¹ Active window with DVAL gating is not available yet!

2.10. Upstream Control Lines

According to the Camera Link standard, four LVDS signals are reserved for general-purpose camera control by the frame grabber.

Camera manufacturers can define these signals to meet their needs for a particular product. The signals are named :

- Camera Control 1 (CC1)
- Camera Control 2 (CC2)
- Camera Control 3 (CC3)
- Camera Control 4 (CC4)

Setting up a Camera Control line

Control lines are configured using Device Module GenApi features belonging to the **CameraLink** category.

- Select a line by setting **CameraControlLineSelector** to **CC1**, **CC2**, **CC3** or **CC4**.
- Select a source by setting **CameraControlLineSource** according to the desired usage (Camera Trigger or GPIO).
- If required, change the polarity by setting **CameraControlLineInverter**.

Configuring a Camera Control line as Camera Trigger

Camera Trigger – RC camera control method

To control an asynchronous-reset camera with a Camera Trigger signal generated by the "[Camera and Illumination Controller](#)" on page 199, set **CameraControlLineSource** of the selected Camera Control line to **CameraTrigger**

A transition (either rising or falling edge) on this line resets the camera.

This action initiates either a new exposure/readout, or a readout of a frame for an area-scan camera or a line for a line-scan camera.

Camera Trigger – RG camera control method

To control an asynchronous-reset camera with a Camera Trigger signal generated by the "[Camera and Illumination Controller](#)" on page 199, set **CameraControlLineSource** of the selected Camera Control line to **CameraTrigger**

The leading edge (either rising or falling edge) on this line initiates a new exposure.

The trailing edge terminates the exposure and initiates the readout of a frame for an area-scan camera or a line for a line-scan camera.

The pulse width is actually the exposure time.

Configuring a Camera Control line as GPIO

Software driven GPIO

- Set `CameraControlLineSource` of the selected Camera Control line to `Low` or `High`

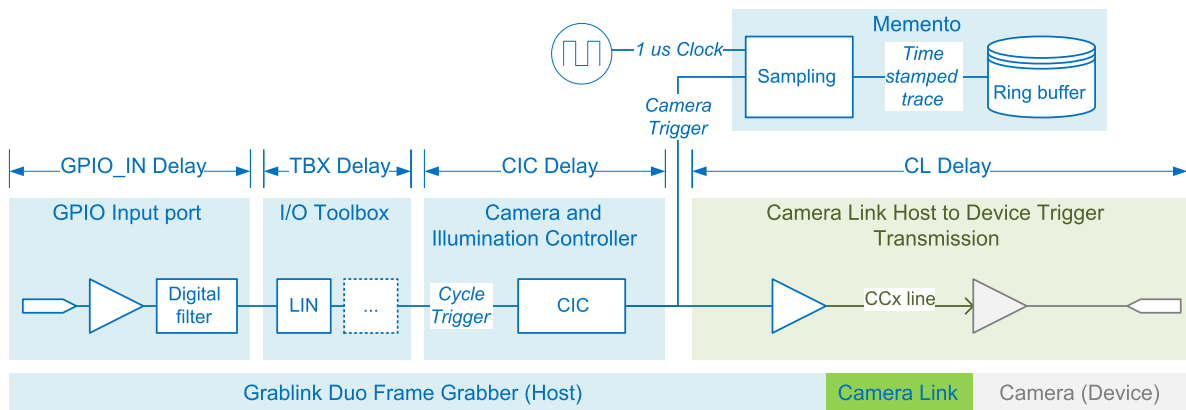
Hardware driven GPIO

- Select the GPIO line that will be used as source by configuring the `LineInputToolSource` of any `LIN tool`.
- Select the corresponding LIN tool source (`LIN1Source` ... `LIN8Source`) by configuring `CameraControlLineSource` of the selected Camera Control line.

As a result, any line source of any LIN tool can be routed to any Camera Control lines.

2.11. Trigger Delay Model

This topic describes a timing model of a trigger signal applied to any GPIO input port of a **1628 Grablink Duo** card up to the output of the Camera Link Host to Device Trigger receiver inside the camera.



Elaboration of the Camera Trigger event

Three functional blocks are involved in the elaboration of the **Camera Trigger** event:

- The GPIO Input port receiving and cleaning the electrical signal
- The I/O Toolbox tool(s) receiving the cleaned signal and delivering the cycle trigger event to the CIC
- The Camera and Illumination controller

NOTE: the **Camera Trigger** event is recorder by Memento and time-stamped with 1 MHz clock.

GPIO Input Port — GPIO_IN delay

The delay introduced by the GPIO Input port depends on:

- The electrical type
- The settings of the associated digital filter

The following table shows the typical GPIO-IN delay values with the lowest digital line filter strength:

- $\Delta t_{\text{on/high}}$ is the delay value at the low-to-high transition of the input signal or when the optocoupler turns ON.
- $\Delta t_{\text{off/low}}$ is the delay value at the high-to-low transition of the input signal or when the optocoupler turns OFF.

GPIO electrical type	$\Delta t_{\text{on/high}}$	$\Delta t_{\text{off/high}}$
"Differential Input (Version 1)" on page 346	50 ns	50 ns
"Differential Input/Output" on page 348	50 ns	50 ns
"TTL Input/Output (Version 2)" on page 351	50 ns	50 ns
"TTL Input/5 V CMOS Output" on page 354	50 ns	50 ns
"Isolated Input (Version 2)" on page 357	0.8 μs	1.35 μs

See also: "Line Filter Control" on page 229 for other settings of the digital filter.

I/O Toolbox — TBX delay

The delay introduced by the I/O toolbox depends on its configuration:

- There are no significant delay when the LIN tool is driving directly the CIC Cycle Trigger.
- A constant delay can be introduced when a DEL tool is involved in the generation of the CIC Cycle Trigger event.
- An unpredictable delay can be introduced when DIV and MDV tools are involved in the generation of the CIC Cycle Trigger event.

See also: "I/O Toolbox" on page 235 for a detailed description of the I/O Toolbox tools

Camera and Illumination Controller — CIC delay

The delay introduced by the Camera and Illumination Controller depends on its configuration:

- There are no significant delay when **StrobeDelay** is 0 or > 0 providing that the conditions to start a cycle are all satisfied.
- When **StrobeDelay** is negative, the Camera Trigger is delayed accordingly.

See also: "Camera and Illumination Control" on page 189 and "CIC Timing Diagrams" on page 208

Transmission of the Camera Trigger event- CL Delay

Two functional blocks are involved in the transmission of the Camera Trigger event:

- The CCx line driver inside the **1628 Grablink Duo** card
- The CCx line receiver of the camera
- These LVDS devices exhibit don't introduce significant delay.



NOTE

The delay introduced by the medium is usually not significant!

2.12. Serial Communication

1628 Grablink Duo supports the asynchronous full-duplex serial communication between the camera and the frame grabber.

Two differential line pairs of the first camera cable are dedicated to the serial communication, one for each direction:

- SerTFG — Downstream (camera to frame grabber) serial communication link
- SerTC — Upstream (frame grabber to camera) serial communication link

Supported baud rates : 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600 (Default), 14400, 19200, 28800, 38400, 57600, 115200 and 230400.

The application software controls the serial communication channel through:

- the standardized API defined by the Camera Link standard or ...
- the "[GenApi Serial Access Control](#)" on page 122.

2.13. GenApi Serial Access Control

The **SerialAccessControl** category in the Device module enables the asynchronous transfer of bytes to and from the camera via the Camera Link cable.

This category includes a range of useful commands such as **Open**, **Close**, **Read**, **Write**, **Flush**, and **Drain**, all of which return a status and result that are accessible through the **SerialOperationStatus** and **SerialOperationResult** features.

The possible status outcomes are **Success**, **Failure**, or **Timeout**. Only **Read** and **Write** commands are subject to a timeout. These two commands also set the **SerialOperationResult** to the number of bytes effectively read or written.

Once the Camera Link serial communication has been established, the baud rate can be configured using the **SerialBaudRate** feature. Baud rate is set to 9600 baud by default.

A read/write register buffer is available for sending and receiving bytes. Its size ranges between 4KB (default) and 16MB.

The length of these read/write operations is set via the **SerialAccessLength** feature and two read/write queues indicate the number of pending bytes left to be processed.

The **Flush** command clears any data in the reading queue, while the **Drain** command waits for any data in the writing queue to be sent.

The `egrabber://serial.js` script includes some utility functions that wrap the serial features for ease of use.

See also: [cpp/320-cl-serial-cli](#) and [cs/GrablinkSerialCommunication](#) sample programs demonstrating Camera Link serial communication through the `clseregl` library on a **Grablink Duo** board

3. On-board Memory

1628 Grablink Duo is fitted with a large on-board memory.

Product	Memory Size [MB]
1628 Grablink Duo	512

On-board memory partitions

The memory is partitioned according to the installed firmware variants:

- There is one *Image data* partition for each stream of each device.

See also: "Partition Schemes" on page 124 for a detailed description.

Image data partition

The *Image data* partition is operated as a First-In-First-Out memory to decouple the Camera Link data flow from the Pixel Processing and the PCI Express data flow.

It absorbs temporary dropouts of the PCI Express data flow ensuring a reliable Camera Link data acquisition.

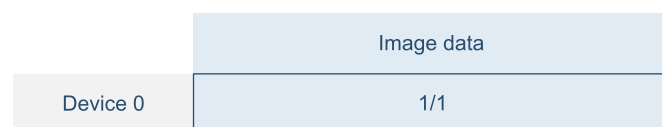
It enables burst-mode Camera Link data acquisition at the highest data rates regardless the limits of the Pixel Processor and the PCI Express interface.

3.1. Partition Schemes

One device, one 'Image data' partition

Applies to the following firmware variants of ¹

Duo	(1-camera), (1-camera, line-scan)
Duo104EMB	Duo104MIL (1-camera), (1-camera, line-scan)
Mono	(1-camera)
Duo	(1-camera), (1-camera, line-scan)
Quad	(1-camera), (1-camera, line-scan)
QuadG3	QuadG3LH (1-camera, line-scan), (1-slm-camera), (1-sls-camera)
QuadG3DF	(1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)
Quad3DLLE	(1-camera)
Octo	(1-camera), (1-camera, line-scan)
Quad12	Quad12-4 (1-camera, line-scan)
Mono12	Mono12LH (1-camera), (1-camera, line-scan)
Duo12	Duo12LH (1-camera), (1-camera, line-scan)
Value12	(1-camera, line-scan)
Quad12DF	(1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)
QSFP+	(1-camera), (1-camera, line-scan)



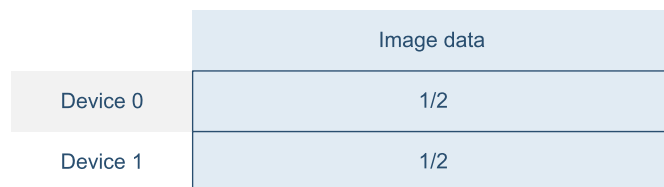
1D partition scheme

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

Two devices, one 'Image data' partition per device

Applies to the following firmware variants of ¹

- Duo** (2-camera), (2-camera, line-scan)
- Duo104EMB** **Duo104MIL** (2-camera)
- Duo** (2-camera), (2-camera, line-scan)
- Quad** (2-camera)
- QuadG3** **QuadG3LH** (2-camera), (2-camera, bayer), (2-camera, line-scan)
- Octo** (2-camera, line-scan)
- Quad12** **Quad12-4** (2-camera), (2-camera, line-scan)
- Duo12** **Duo12LH** (2-camera), (2-camera, line-scan)
- Value12** (2-camera), (2-camera, line-scan)



2D partition scheme

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH and 3623 Coaxlink Quad CXP-12 Value.

4. Acquisition Gate

The *Acquisition Gate* controls the image data extraction from the *Image data* partition of the on-board memory. It discards the image data that doesn't need to be acquired and fed to the "Pixel Processing" on page 142 chain.

Area-scan acquisition

The gate opens and closes at frame boundaries based on the application's calls of the `DSSStartAcquisition` and `DSSStopAcquisition` functions.



NOTE

The Camera and Illumination Controller indirectly controls the acquisition gating by issuing Camera Triggers using various schemes.

See also: "Area-scan Acquisition" on page 127 for more information and configuration instructions.

Line-scan acquisition

The gate opens and closes at line boundaries according to the application `DSSStartAcquisition` and `DSSStopAcquisition` function calls and, according to the settings of the Image Acquisition Controller, to the Start-of-scan and the End-of-scan triggers.

See also: "Line-scan Acquisition" on page 129 for more information and configuration instructions.

5. Area-scan Acquisition

Applies to the following firmware variants of ¹

Duo	(1-camera), (2-camera)
Duo104EMB	Duo104MIL (1-camera), (2-camera)
Mono	(1-camera)
Duo	(1-camera), (2-camera)
Quad	(1-camera), (2-camera)
QuadG3	QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, bayer), (3-camera), (4-camera)
QuadG3DF	(1-camera), (1-df-camera)
Quad3DLLE	(1-camera)
Octo	(1-camera), (1-camera, custom-logic), (2-camera), (3-camera), (4-camera), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)
Quad12	Quad12-4 (1-camera), (1-camera, custom-logic), (2-camera), (2-camera, custom-logic), (4-camera), (4-camera, custom-logic)
Quad12J	Quad12J-4 (4-camera)
Mono12	Mono12LH (1-camera)
Duo12	Duo12LH (1-camera), (2-camera)
Value12	(1-camera), (2-camera), (4-camera)
Quad12DF	(1-camera), (1-df-camera)
QSFP+	(1-camera), (1-camera, custom-logic)

5.1. Area-scan Acquisition Principles 128

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

5.1. Area-scan Acquisition Principles

Area-scan imaging

The expression “Area-scan imaging” designates machine vision applications where images are obtained from a camera delivering 1 image frame every camera cycle.

GenTL buffer filling rules – Area-scan firmware variants

In area-scan imaging, GenTL buffers are filled according to the following rules:

- The first acquired line data of a frame is, by default, stored at the beginning of a new buffer. When vertical image flipping is enabled by setting **StripeArrangement** to **Geometry_1X_1YE**, the first acquired line data of a frame is stored at the location of the last full line of a new buffer.
- When image transfer to host memory is done, the buffer, possibly partially filled, is made available to the application for processing.
- **NEW** When the remaining space of a buffer is not sufficient to store a complete frame, the remaining data is handled according to the "[Area-scan Acquisition Principles](#)" on [page 128](#).

6. Line-scan Acquisition

Applies to the following firmware variants of ¹

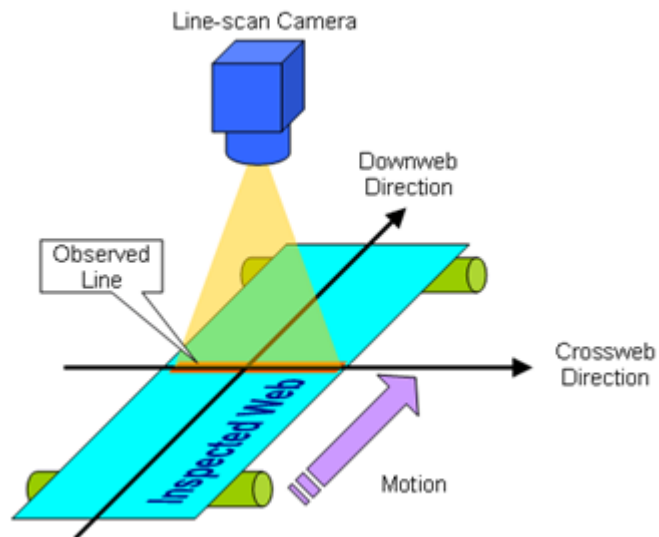
Duo	(1-camera, line-scan), (2-camera, line-scan)
Duo104EMB	Duo104MIL (1-camera, line-scan)
Duo	(1-camera, line-scan), (2-camera, line-scan)
Quad	(1-camera, line-scan)
QuadG3	QuadG3LH (1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)
QuadG3DF	(1-camera, line-scan), (1-df-camera, line-scan)
Octo	(1-camera, line-scan), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera, line-scan)
Quad12	Quad12-4 (1-camera, line-scan), (1-camera, line-scan, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)
Mono12	Mono12LH (1-camera, line-scan)
Duo12	Duo12LH (1-camera, line-scan), (2-camera, line-scan)
Value12	(1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)
Quad12DF	(1-camera, line-scan), (1-df-camera, line-scan)
QSFP+	(1-camera, line-scan)

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6.2. Line-scan Acquisition Use cases	134
6.3. Metadata Insertion	138

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

6.1. Line-scan Acquisition Principles

Line-scan imaging



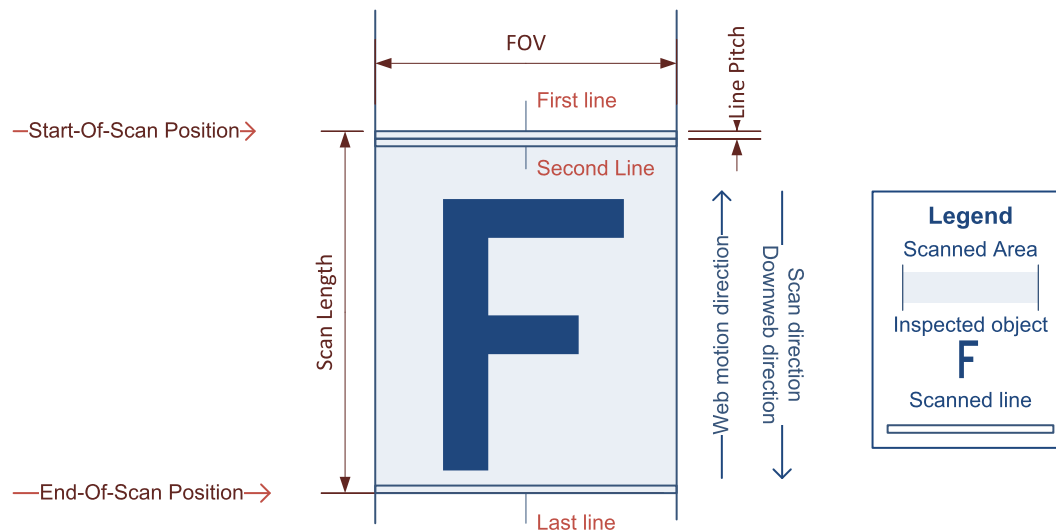
Typical line-scan imaging system

The expression “Line-scan imaging” designates machine vision applications where 2-D images are obtained by the combination of successive image lines captured from a 1-D imaging device that moves relatively to the object.

In line-scan imaging:

- The imaging device is often, but not necessarily, a line-scan camera.
- The inspected object is often a continuous web, it can also be discrete objects having fixed or variable size.
- The inspected web moves relatively to the camera. The motion speed during the acquisition can be fixed or variable.
 - The *cross-web direction* or *transverse direction* is the axis on the web plane that is observed by the camera.
 - The *down-web direction* or *axial direction* is the motion direction of the inspected web relatively to the camera.

Scanning area



Scanning area definitions

The scanning area is a 2-D area on the web having a width equal to FOV and a length equal to Scan Length.

In the cross-web direction (horizontal direction in the above drawing), the scanning area is delimited by the field of view – FOV – of the camera.

In the down-web direction (vertical direction in the above drawing), the scanning area is delimited by the start-of-scan and the end-of-scan positions. The line pitch is determined by the ratio between the web speed and the camera line rate.

The *field of view* – FOV – of a line-scan camera is determined only by the optical setup and the sensor geometrical properties.

The *start-of-scan position* is a position on the web corresponding to the scan-line boundary preceding the first acquired line.

The *end-of-scan position* is a position on the web corresponding to the scan-line boundary following the last acquired line.

Most of the line-scan cameras are delivering a single row of pixels every camera cycle. Consequently, *multiple camera cycles* are necessary to build-up the object image.

Pixel aspect ratio control

Unlike area-scan imaging, line-scan imaging allows the application to control the image pixel aspect ratio.

In the large majority of cases, the imaging application requires a constant, and preferably a 1:1 image pixel aspect ratio.

The cross-web pitch being locked by the sensor pitch and the optical magnification factor, the image pixel aspect ratio is controllable only through the line pitch control.

The following table summarizes the methods providing a constant line pitch that are applicable with **Coaxlink and Grablink Duo frame grabbers**:

Method Name	Description
VCR	<p><u>Variable Camera cycle.</u></p> <p>The <i>web speed is variable</i> and the <i>camera cycle rate is kept proportional to the web speed</i>. The frame grabber builds the object image by capturing all the successive lines delivered by the camera.</p>
CCC	<p><u>Constant Camera Cycle.</u></p> <p>The camera operates at a constant cycle rate and the frame grabber captures all the successive lines delivered by the camera.</p>

The VCR method requires:

- A *motion encoder* for measuring the web speed.
- A *real-time processing* of the motion encoder events to build a camera trigger at a rate that is *proportional* to the motion encoder events rate.

Having a proportional rate can be achieved by a *divider tool* or a *multiplier/divider tool*:

- The divider tool decimates the input rate by an integer value, it delivers 1 out of N incoming events.
- The multiplier/divider tool enables fine control of the image pixel aspect ratio by allowing any rate conversion ratio value – RCR – in the range 0.001 to 1000 with an accuracy better than 0.1% of the RCR value.

Image acquisition with line-scan imaging devices

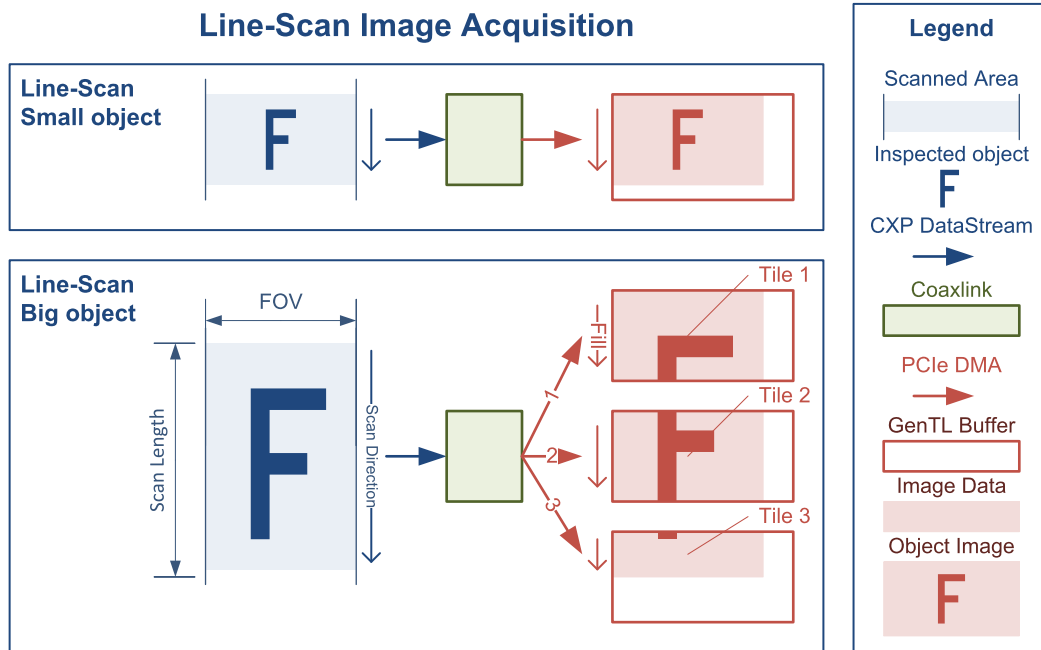


Image capture of small and large objects

For the transmission on the CoaXPress link, (most of) the line-scan cameras use *one CoaXPress Image Data Stream*.

Regarding the delivery methods of the image data, two cases are to be considered:

- For small objects, the object image data are delivered into a *single GenTL buffer*.
- For big objects, the object image data are delivered into *multiple GenTL buffers*.

In both cases, the image data are delivered through a single PCIe DMA channel and the transmission latency is low: “one image line”.

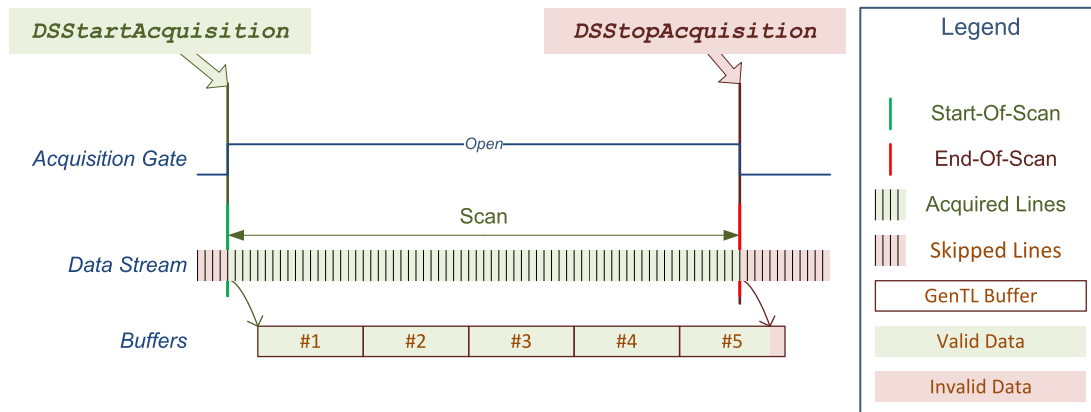
GenTL buffer filling rules – Line-scan firmware variants (Grablink Duo)

In line-scan imaging, GenTL buffers are filled according to the following rules:

- The first acquired line data of a scan is, by default, stored at the beginning of a new buffer. When vertical image flipping is enabled by setting `StripeArrangement` to `Geometry_1X_1YE`, the first acquired line data of a scan is stored at the location of the last full line of a new buffer.
- A buffer contains an integer number of image lines data.
- **NEW** When the remaining space of a buffer is not sufficient to store an image line data, the remaining data is handled according to the "[Line-scan Acquisition Principles](#)" on page 130.
- When the last line data of a scan is acquired, the last buffer, possibly partially filled, is made available to the application for processing.

6.2. Line-scan Acquisition Use cases

Scanning of continuous objects



Scanning of continuous objects

This case applies to the image scanning of **continuous objects**.

The acquisition controller is configured as follows:

- **StartOfScanTriggerSource** = **Immediate**.
- **EndOfScanTriggerSource** = **StopScan**.

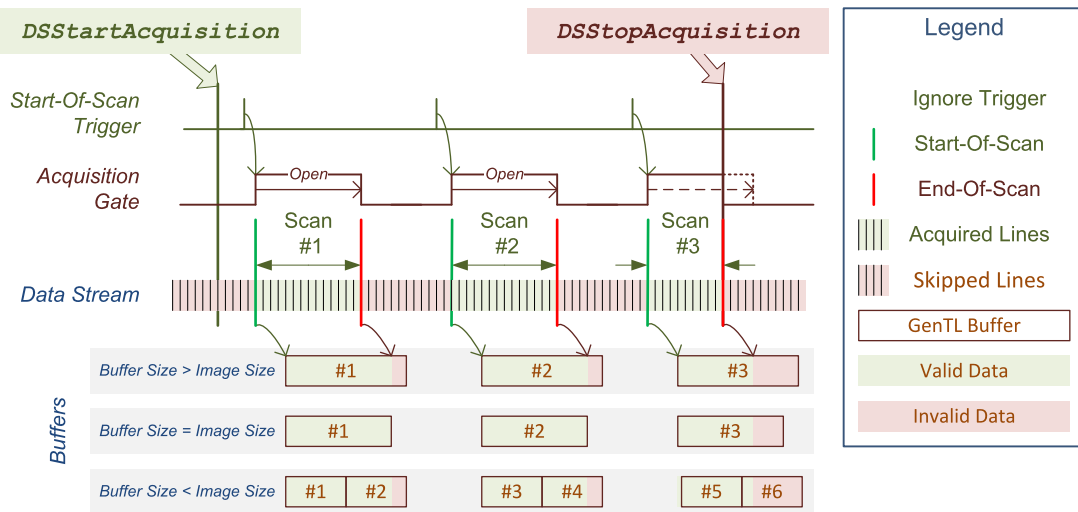
When the **DSSstartAcquisition** function is called, the scanning starts at the next line boundary.

The acquisition gate closes when the application calls the **DSSstopAcquisition** function.

Depending on the allocated buffer size and the scanning duration, the object image fits in a single buffer or requires multiple buffers.

Each buffer is delivered to the application as soon as it is filled. The last buffer, likely partially filled, is delivered as soon as the last image data are written.

Fixed-length scanning of discrete objects



Scanning of discrete objects with a common scan length

The **eGrabber** acquisition controller is configured as follows:

- **StartOfScanTriggerSource** = **StartScan** or any applicable I/O Toolbox event output, for instance: **LIN1**.
- **EndOfScanTriggerSource** = **ScanLength**.
- **ScanLength** is any positive number representing the number of lines required to capture the object image entirely.

When the **DSSStartAcquisition** function is called, the start-of-scan trigger of the acquisition controller is armed.

Then, the acquisition controller waits for the first occurrence of a valid start-of-scan trigger event.

A valid start-of-scan event can be generated:

- By the application using a **StartScan** command.
- By the selected hardware event source, if specified by **StartOfScanTriggerSource**.

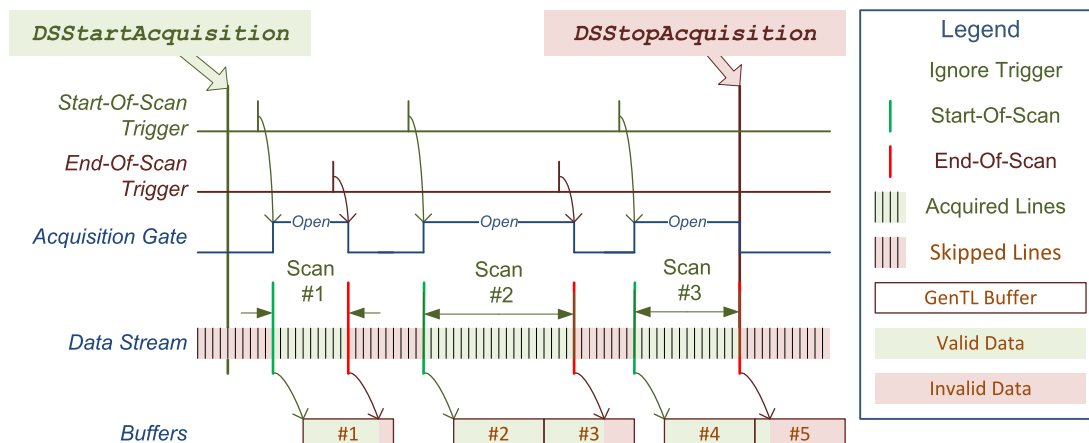
The acquisition controller ignores any Start-of-Scan trigger event while a scanning is in progress.

The acquisition gate opens at the first line boundary following a start-of-scan event.

The acquisition gate closes automatically after the specified number of lines have been acquired or anticipatively when the application calls the **DSSStopAcquisition** function.

Depending on the allocated buffer size, the object image fits in a single buffer or requires multiple buffers. Each buffer is delivered to the application as soon as it is filled. At the end-of-scan, partially filled buffers are immediately delivered. The following image acquisition always begins with a new buffer.

Variable-length scanning of discrete objects



Scanning of discrete objects requiring a variable scan length

The eGrabber acquisition controller is configured as follows:

- **StartOfScanTriggerSource** = **StartScan** or any applicable I/O Toolbox event output, for instance: **LIN1**.
- **EndOfScanTriggerSource** = **StopScan** or any applicable I/O Toolbox event output, for instance: **LIN2**.

When the **DSStartAcquisition** function is called, the start-of-scan trigger of the acquisition controller is armed.

Then, the acquisition controller waits for the first occurrence of a valid start-of-scan trigger event.

A valid start-of-scan event can be generated:

- By the application using a **StartScan** command.
- By the selected hardware event source, if specified by **StartOfScanTriggerSource**.

The acquisition controller ignores any Start-of-Scan trigger event while a scanning is in progress.

The acquisition gate opens at the first line boundary following a start-of-scan event.

The acquisition gate closes at the first line boundary following a valid end-of-scan event or immediately when the application calls the **DSStopAcquisition** function.

A valid end-of-scan event can be generated:

- By the application using a **StopScan** command.
- By the selected hardware event source, if specified by **EndOfScanTriggerSource**.

The acquisition controller ignores any End-of-Scan trigger event when no scanning is in progress.

Depending on the allocated buffer size, the object image fits in a single buffer or requires multiple buffers. Each buffer is delivered to the application as soon as it is filled. At the end-of-scan, partially filled buffers are immediately delivered. The next image acquisition always begins with a new buffer.

6.3. Metadata Insertion

Applies to the following firmware variants of ¹

Duo	(1-camera, line-scan), (2-camera, line-scan)
Octo	(1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)
Quad12	Quad12-4 (1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)
Value12	(1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)
Quad12DF	(1-camera, line-scan), (1-df-camera, line-scan)
QSFP+	(1-camera, line-scan)

Introduction

The Metadata Insertion feature allows line-scan applications to insert metadata into a buffer.

Two types of metadata can be inserted into a buffer:

- *Buffer metadata*: 4x32-bit metadata are inserted into an internal header information of the buffer;
- *Line metadata*: 4x32-bit metadata are inserted at the end of each image line within the buffer.

These two types of metadata can be inserted independently or simultaneously.

Requirements

Only available on grabber-controlled cycle-start camera control methods (RG and RC).

The metadata are sampled on the `CycleStart` events of the CIC:

- Buffer metadata are sampled on the `CycleStart` event that initiates the first line of the buffer
- Line metadata are sampled on each `CycleStart` event

Configuration

The `MetadataInsertion` category of the Data Stream module contains the features for configuring metadata insertion.

Each `MetadataInsertion` feature responsible for configuring metadata insertion must be set before starting an acquisition.

When an acquisition is started, the features are locked.

¹ 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

Activation of the metadata

- **BufferMetadataInsertionEnable**: Boolean feature to enable/disable the insertion of 4x32-bit (16 bytes) metadata for the buffer
- **LineMetadataInsertionEnable**: Boolean feature to enable/disable the insertion of 4x32-bit (16 bytes) metadata at the end of each image line

Enabling the insertion of buffer metadata does not affect the payload size of the buffer.

However, enabling the insertion of line metadata does affect the payload size of the buffer.

When **LineMetadataInsertionEnable** = **True**, the data stream feature **LineWidth** is automatically increased by 16 to count for the size of the line metadata, which in turn may increase the data stream **PayloadSize** (or consume some of the padding part of the buffer, if used).

NOTE: the size of the padding on a line, is always the difference between **LinePitch** and **LineWidth**, if **LinePitch** > **LineWidth**. When padding is added together with line metadata insertion, the padding part is located after the line metadata (image line - line metadata - padding).

See also: [Image Data Padding](#).

Contents of the metadata

The metadata can contain GPC values, QDC positions, and/or I/O line states.

The contents of the metadata are configured with the features **MetadataContent<N>**, where **N** represents the offset, from 0 to 3, of one 32-bit metadata within a chunk of 128-bit metadata.

These four features describe the contents to be reported in both the buffer and line metadata.

The features can report the following contents:

MetadataContent0

- **GPC1Value**: Value of General Purpose Counter 1
- **GPC1LatchedValue**: Latched value of General Purpose Counter 1
- **QDC1Position**: Position of Quadrature Decoder Tool 1

MetadataContent1

- **GPC2Value**: Value of General Purpose Counter 2
- **GPC2LatchedValue**: Latched value of General Purpose Counter 2
- **QDC2Position**: Position of Quadrature Decoder Tool 2 (if available)

MetadataContent2

- **GPC3Value**: Value of General Purpose Counter 3
- **GPC3LatchedValue**: Latched value of General Purpose Counter 3
- **QDC3Position**: Position of Quadrature Decoder Tool 3 (if available)
- **LineStatusAllHi**: High 32-bit part of **LineStatusAll**

MetadataContent3

- GPC4Value: Value of General Purpose Counter 4
- GPC4LatchedValue: Latched value of General Purpose Counter 4
- QDC4Position: Position of Quadrature Decoder Tool 4 (if available)
- LineStatusAll: Low 32-bit part of [LineStatusAll](#)

On `CycleStart` event, the selected contents are sampled. Their values will be inserted in the buffer and/or the line metadata.

General Purpose Counter (GPC)

Four 32-bit *General Purpose Counters* can be used in various ways, e.g., to count the number of occurrences of a particular event, to implement a differential counter between two event streams, or even to latch a counter on a particular event. The latch functionality can be useful for permanent period measurements.

The GPCs are selected through [GeneralPurposeCounterSelector](#) and enabled/disabled with [GeneralPurposeCounterEnable](#).

Up to three event sources can be set to define the behavior of a GPC:

- [GeneralPurposeCounterIncrementSource](#): selects an event stream used as trigger to increment the selected GPC
- [GeneralPurposeCounterDecrementSource](#): selects an event stream used as trigger to decrement the selected GPC
- [GeneralPurposeCounterLatchAndResetSource](#): selects an event stream used as trigger to latch and reset the selected GPC

When [GeneralPurposeCounterEnable=False](#), the selected counter is reset.

Example 1

To count the difference between `CycleStart` and `StartOfLine` with GPC1:

- Set [GeneralPurposeCounterSelector](#) to [GPC1](#).
- Set [GeneralPurposeCounterIncrementSource](#) to [CycleStart](#).
- Set [GeneralPurposeCounterDecrementSource](#) to [StartOfLine](#).
- Set [GeneralPurposeCounterLatchAndResetSource](#) to [NONE](#).
- Set [GeneralPurposeCounterEnable](#) to [True](#).

To report the value of GPC1 in the metadata:

- Set [MetadataContent0](#) to [GPC1Value](#).

NOTE: the value of this GPC in the metadata will always be greater than 0. That is because the GPC is sampled on `CycleStart`, while `StartOfLine` will always happen after `CycleStart`.

Example 2

To measure the cycle period with GPC2:

- Set [GeneralPurposeCounterSelector](#) to [GPC2](#).
- Set [GeneralPurposeCounterIncrementSource](#) to [TIME16NS](#).

- Set `GeneralPurposeCounterDecrementSource` to `NONE`.
- Set `GeneralPurposeCounterLatchAndResetSource` to `CycleStart`.
- Set `GeneralPurposeCounterEnable` to `True`.

To report the latched value of GPC2 in the metadata:

- Set `MetadataContent1` to `GPC2LatchedValue`.

Getting metadata

- To get the buffer metadata of a buffer, use the commands `BUFFER_INFO_CUSTOM_BUFFER_METADATA_<N>` from `BUFFER_INFO_CUSTOM_CMD_LIST`, where N is the offset from 0 to 3.

The commands return the 32-bit inserted buffer metadata at offset N.

If no buffer metadata was inserted in the buffer, `BUFFER_INFO_CUSTOM_BUFFER_METADATA_<N>` commands return `GC_ERR_NOT_AVAILABLE`.

- To get the line metadata of a buffer, use the command `BUFFER_INFO_CUSTOM_LINE_METADATA_BASE` from `BUFFER_INFO_CUSTOM_CMD_LIST`.

The command returns a pointer to the base address of the inserted line metadata.

If no line metadata was inserted in the buffer, `BUFFER_INFO_CUSTOM_LINE_METADATA_BASE` command returns 0.

- To get the type of content of an inserted metadata in a buffer, use the commands `BUFFER_INFO_CUSTOM_METADATA_CONTENT_<N>` from `BUFFER_INFO_CUSTOM_CMD_LIST`, where N is the offset from 0 to 3.

The commands return an integer that identify the type of content that the buffer and/or line metadata contain at offset N.

The values returned by the `BUFFER_INFO_CUSTOM_METADATA_CONTENT_<N>` commands are translated as follows:

Value	<code>BUFFER_INFO_CUSTOM_METADATA_CONTENT_0</code>	<code>BUFFER_INFO_CUSTOM_METADATA_CONTENT_1</code>	<code>BUFFER_INFO_CUSTOM_METADATA_CONTENT_2</code>	<code>BUFFER_INFO_CUSTOM_METADATA_CONTENT_3</code>
1	GPC1Value	GPC2Value	GPC3Value	GPC4Value
2	GPC1LatchedValue	GPC2LatchedValue	GPC3LatchedValue	GPC4LatchedValue
3	QDC1Position	QDC2Position	QDC3Position	QDC4Position
4			LineStatusAllHi	LineStatusAll

If neither buffer nor line metadata were inserted, `BUFFER_INFO_CUSTOM_METADATA_CONTENT_<N>` commands return `GC_ERR_NOT_AVAILABLE`.

See also: [cpp/330-metadata-insertion sample program](#)

7. Pixel Processing

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7.1. Overview

Pixel processing overview of 1628 Grablink Duo

The Image Pixel Data Processor performs the following successive operations on the image data stream:

Unpacking – UNP

This operation unpacks 10-bit, 12-bit, and 14-bit pixel components to 16-bit.

It can be disabled for monochrome and Bayer CFA pixel formats.

See also: "Pixel Unpacking and Alignment" on page 148 for more information and configuration instructions.

Lookup Table processing – LUT

This operation applies a lookup table transformation to each individual pixel components.

See also: "Lookup Table Processing" on page 150 for more information and configuration instructions.

Alignment – ALI

This operation align 10-bit, 12-bit, and 14-bit pixel components to lsb or msb in the 16-bit container.

See also: "Pixel Unpacking and Alignment" on page 148 for more information and configuration instructions.

Bayer CFA decoding – CFA

This operation transforms the raw Bayer CFA data stream issued by the camera into an RGB color data stream.

See also: "Bayer CFA Decoding" on page 163 for more information and configuration instructions.

Image line build-up

This operation builds concatenates the components data of all pixels of an image line:

- 8-bit pixel components are aligned to byte boundaries
- 16-bit pixel components (possibly expanded by unpacking or lookup table processing) are aligned to word (2-byte) boundaries, the 2 bytes are stored according to the little-endian convention.

Line padding

This operation appends padding bits or bytes to the image line data to reach the next alignment-boundary required by the hardware implementation.

The alignment boundary requirements are product-specific.

Processing Performances

The pixel processor sustain the highest camera pixel rate. Unless specified otherwise, all the above operations are executed while transferring data to the GenTL with a negligible latency.

PCI Express Bandwidth Limitation

When acquiring pixels having a pixel bit depth larger than 8-bit, each pixel is expanded to 16-bit. In these cases, the PCI Express bandwidth limitation of the Host PC may negatively impact the achievable frame- or line-rate.

7.2. Configurations

Pixel processing configurations of 1628 Grablink Duo

This topic shows the applicable pixel data processing configurations for every class of camera pixel formats. For each class, a drawing shows the relevant pixel data processing configurations:

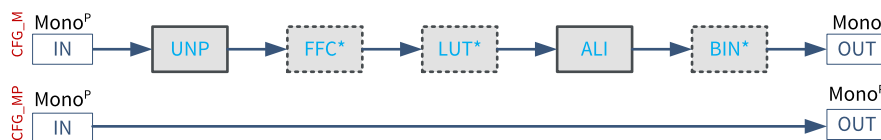
- "Configurations for monochrome cameras" on page 145
- "Configurations for Bayer CFA cameras" on page 146



WARNING

No available processing for RGB and RGBA cameras on **Grablink Duo!**

Configurations for monochrome cameras



CFG_M configuration



In the "CFG_M" configuration, the pixel processing chain transform *packed monochrome pixels* into *monochrome pixels*.

The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixels to 16-bit with alignment to lsb.
- LUT: look-up table. Applies only to 8-, 10- and 12-bit pixels!
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixels.

UNP and ALI are *mandatory processing step* that must be active and configured according to the application needs.

LUT is an optional processing step. It can be activated or not according to the application needs.



NOTE

FFC and BIN are not available!

Configurations for Bayer CFA cameras

CFG_B configuration



In the "CFG_B" configuration, the CFA and the SWAP processing steps are disabled. The pixel processing chain transform *packed Bayer CFA pixels* into *Bayer* pixels.

The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixels to 16-bit with alignment to lsb.
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixels.

UNP and ALI are *mandatory processing step* that must be active and configured according to the application needs.

LUT is an optional processing step. It can be activated or not according to the application needs.



NOTE

FFC and BIN are not available!

CFG_BC configuration



In the "CFG_BC" configuration, the CFA processing step is enabled and the SWAP processing step is disabled. The pixel processing chain transform *packed Bayer CFA pixels* into *RGB* pixels.

The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixels to 16-bit with alignment to lsb.
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixels.
- CFA: Bayer CFA decoding.

UNP and ALI are *mandatory processing step* that must be active and configured according to the application needs.



NOTE

FFC and BIN are not available!

Drawing conventions

The pixel processing configuration drawings use the following conventions:

- Solid rectangle: *mandatory processing step* that must be active and configured according to the application needs.

- Dashed rectangle: *optional processing step* that can be activated or not according to the application needs.
- Names with a *(e.g. LUT*): processing step that is only available on selected products and firmware variants
- Names without *: processing step that is always available

7.3. Pixel Unpacking and Alignment

Introduction

The pixel data processor is capable of unpacking and aligning 10-bit, 12-bit, and 14-bit pixel component data to 16-bit data containers.

The unpacking and the alignment operations are user-configurable through the **UnpackingMode** GenApi feature.

On **1628 Grablink Duo**, two options are available:

- **Lsb**: Unpacking and alignment to lsb (Default setting)
- **Msb**: Unpacking and alignment to msb

Unpacking and alignment to lsb

The significant bits of the pixel component data are aligned to the *least significant bit* of the data container. Padding '0' bits are put as necessary in the *most significant bits* to reach the next 8-bit boundary.

- 10-bit pixels: 0000 00<pp pppp pppp>
- 12-bit pixels: 0000 <pppp pppp pppp>
- 14-bit pixels: 00<pp pppp pppp pppp>

NOTE: Unpacking to lsb doesn't modify the pixel component value.

NOTE: Unpacking 10-bit, 12-bit, and 14-bit pixel components increases the amount of data by 160%, 133%, and 114% respectively!

NOTE: Unpacking 8-bit and 16-bit pixel components is a neutral operation. The size of the data container is unchanged (one byte for 8-bit pixel components; two bytes for 16-bit pixel components) and the data bits are not modified.

Unpacking and alignment to msb

The significant bits of the pixel component data are aligned to the *most significant bit* of the data container. Padding '0' bits are put as necessary in the *least significant bits* to reach the next 8-bit boundary.

- 10-bit pixels: <pppp pppp pp>00 0000
- 12-bit pixels: <pppp pppp pppp> 0000
- 14-bit pixels: <pppp pppp pppp pp>00

NOTE: Unpacking 10-bit, 12-bit, and 14-bit pixel components to msb multiplies the pixel component value by 64, 16, and 4 respectively.

NOTE: Unpacking 10-bit, 12-bit, and 14-bit pixel components increases the amount of data by 160%, 133%, and 114% respectively!

NOTE: Unpacking 8-bit and 16-bit pixel components is a neutral operation. The size of the data container is unchanged (one byte for 8-bit pixel components; two bytes for 16-bit pixel components) and the data bits are not modified.

7.4. Lookup Table Processing

Applies to the following firmware variants of ¹

Duo	(1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan)
Duo104EMB Duo104MIL	(1-camera), (1-camera, line-scan), (2-camera)
Mono	(1-camera)
Duo	(1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan)
Quad	(1-camera), (1-camera, line-scan), (2-camera)
QuadG3 QuadG3LH	(1-camera), (1-camera, line-scan), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, line-scan), (3-camera), (4-camera), (4-camera, line-scan)
QuadG3DF	(1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)
Quad3DLLE	(1-camera)
Octo	(1-camera), (1-camera, custom-logic), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (3-camera), (4-camera), (4-camera, line-scan), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)
Quad12 Quad12-4	(1-camera), (1-camera, custom-logic), (1-camera, line-scan), (1-camera, line-scan, custom-logic), (2-camera), (2-camera, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera), (4-camera, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)
Mono12 Mono12LH	(1-camera), (1-camera, line-scan)
Duo12 Duo12LH	(1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan)
Value12	(1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (4-camera), (4-camera, line-scan)
Quad12DF	(1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)
QSFP+	(1-camera), (1-camera, custom-logic), (1-camera, line-scan)

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LUT Setup Procedure	160

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

Introduction to LUT Processing

Coaxlink and Gralink Duo frame grabbers provide lookup table processing for monochrome pixel formats exclusively!

See also: ["Monochrome Lookup Table Processing"](#) on page 152 for a detailed description.

The **eGrabber** driver provides four methods to define the content of lookup tables.

See also: ["LUT Content Definition"](#) on page 153

See also: ["LUT Setup Procedure"](#) on page 160 to setup lookup tables.

Monochrome Lookup Table Processing

Configurations

The following table lists all the available lookup table configurations for monochrome pixels:

Configuration	Input Pixel Format [PFNC]	Input bits	Output bits
M_8x8	Mono8, Raw	8	8
M_10x8	Mono10	10	8
M_10x10			10
M_10x16			16
M_12x8	Mono12	12	8
M_12x12			12
M_12x16			16



NOTE

Monochrome 8-bit pixels can be transformed into monochrome 8-bit pixels, monochrome 10-bit pixels can be transformed into monochrome 8-bit, 10-bit or 16-bit pixels and, monochrome 12-bit pixels can be transformed into monochrome 8-bit, 12-bit or 16-bit pixels.

Lookup Table Data Sets

A *lookup table data set* is defined as the set of data required to configure one lookup table for each component of a pixel. In the case of monochrome pixels, a lookup table data set includes only one single lookup table content.

The number of lookup table data sets that can be uploaded depends on the lookup table configuration:

Configuration	Data Sets
M_8x8	16
M_10x8, M_10x10, M_10x16	4
M_12x8, M_12x12, M_12x16	1

LUT Content Definition

Methods

The **eGrabber** driver provides four methods to define the content of a lookup table.

Response Control

The *Response Control* method defines the transfer function of a lookup table by means of four parameters: "[Brightness](#)" on page 154, "[Contrast](#)" on page 155, "[Visibility](#)" on page 156 and "[Negative](#)" on page 157.

The **Brightness** and **Contrast** parameters provide controls similar to the brightness and contrast controls of a television monitor.

The **Visibility** parameter provides control to smoothly reshape the transfer function to cover the full input range.

The **Negative** parameter allows transforming an image into its negative image.

Emphasis

The *Emphasis* method defines the transfer function of a lookup table by means of two parameters: "[Emphasis](#)" on page 158 and "[Negative](#)" on page 157.

It allows transforming an image using a power-law expression also known as γ – Gamma – function.

The **Negative** parameter allows transforming an image into its negative image.

Threshold

The *Threshold* method defines a double threshold transformation law by means of five parameters: "[SlicingLevel](#), [SlicingBand](#), [LightResponse](#), [BandResponse](#) and [DarkResponse](#)" on page 159.

Table

The *Table* method defines the transfer function of a lookup table in a tabular form.

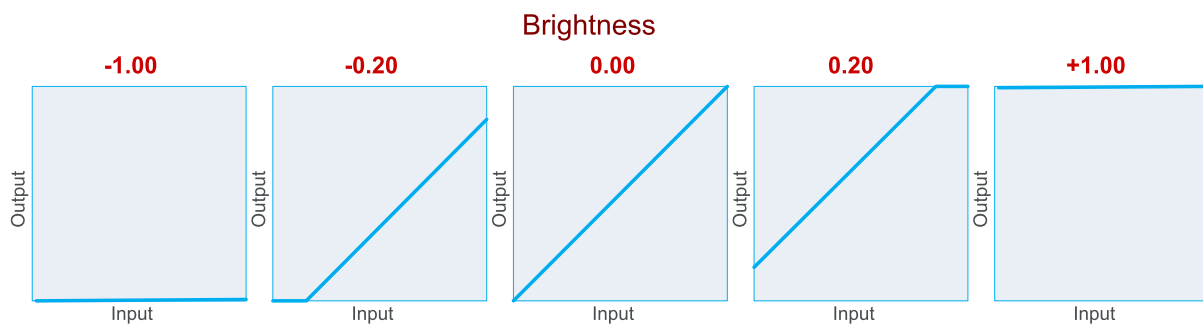
Parameters

Brightness

The **Brightness** parameter exclusively applies to the "Response Control" on page 153 lookup table definition method.

It implements a control similar to the brightness control of a television monitor.

Brightness	Note
-1.00	Minimum value. Darkest output. The whole input range data gets transformed into the full black. This rule applies for any chosen Contrast value.
0.00	Default value. Any increase in the brightness towards +1.00 results into a lighter output. Any decrease of the brightness towards -1.00 results into a darker output.
+1.00	Maximum value. Lightest output. The whole input range data gets transformed into the full white. This rule applies for any chosen Contrast value.



Effect of **Brightness** when all other controls are set to their default value:
Contrast = 1.00; Visibility = 0.00; Negative = FALSE.

Contrast

The **Contrast** parameter exclusively applies to the "Response Control" on page 153 lookup table definition method.

It implements a control similar to the contrast control of a television monitor.

The slope of the transformation law is the gain, which is non-linearly controlled from the **Contrast** parameter.

Mathematically, the relationship is:

$$\text{Gain} = 10^{2 \times (\text{Contrast} - 1)}$$

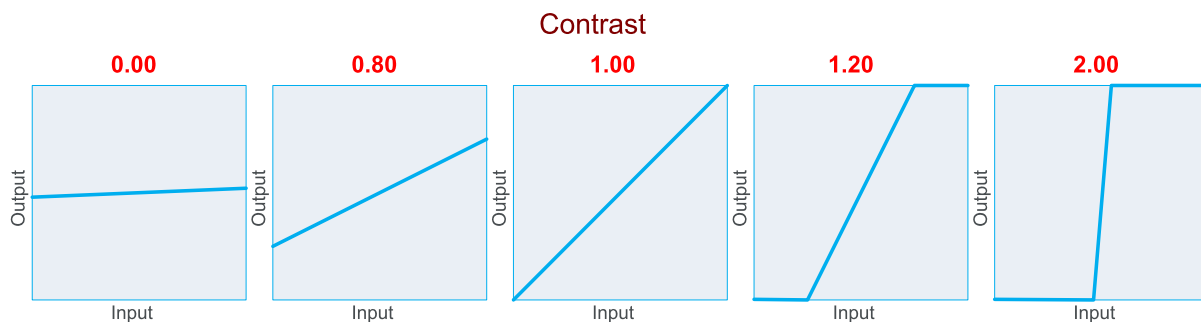
Contrast	Gain	Note
0.00	0.01	Min. Contrast value; smallest gain
1.00	1	Default Contrast value; unity gain
2.00	100	Max. Contrast value; largest gain

To achieve a required given gain, the contrast control should be set to:

$$\text{Contrast} = 1 + (\log_{10} \text{Gain})/2$$

If the required gain is expressed in decibels (dB):

$$\text{Contrast} = 1 + \text{Gain(dB)}/40$$



Effect of **Contrast** when all other controls are set to their default value:

Brightness = 0.00; Visibility = 0.00; Negative = FALSE

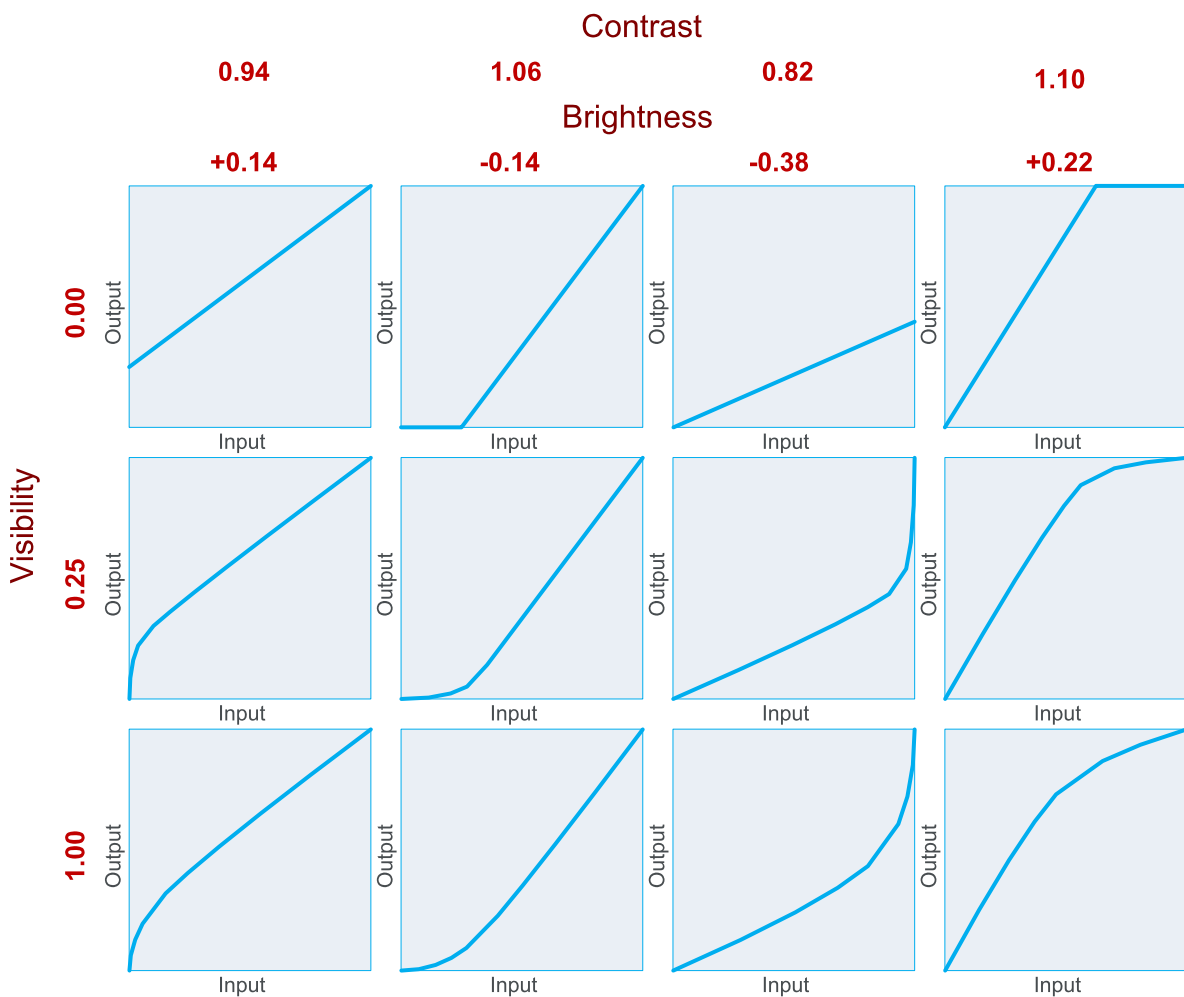
Visibility

The **Visibility** parameter exclusively applies to the "Response Control" on page 153 lookup table definition method.

The operation of **Contrast** and **Brightness** parameters occasionally removes some part of the input dynamics. Very dark regions of the image can be transformed into full black, and become invisible. This holds true for very bright regions, clipping to full white.

The **Visibility** parameter has been created to smoothly reveal these hidden parts in the image.

Visibility	Gain	Note
0.00	0.01	Minimum and default value. This generates the piecewise linear transformation curves. Choosing values closer to +1 generates smoother curves.
1.00	100	Maximum value.



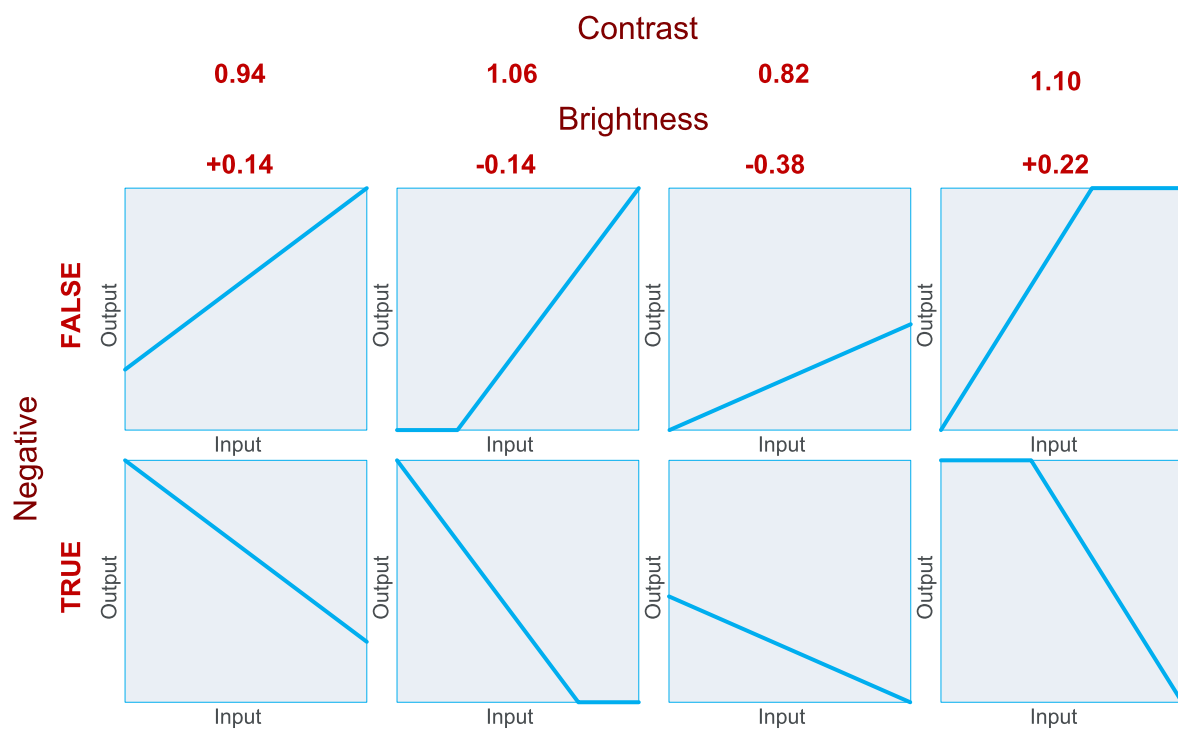
Effect of **Visibility** for typical values of **Contrast** and **Brightness** parameters assuming that **Negative = FALSE**

Negative

The **Negative** parameter applies to both the "Response Control" on page 153 and the "Emphasis" on page 153 lookup table definition methods.

This control allows transforming an image into its negative image, where the lightest areas of the image appear darkest and the darkest areas appear lightest.

Negative	Note
FALSE	Default value.
TRUE	The transformation table is mirrored around a vertical axis in the graphs. This swaps the black and white values, and gives rise to a photographic negative effect.



Effect of **Negative** for typical values of other controls

Emphasis

The **Emphasis** parameter exclusively applies to the "Emphasis" on page 153 lookup table definition method.

It allows transforming an image using a power-law expression:

$$\text{Output} = \text{Input}^\gamma$$

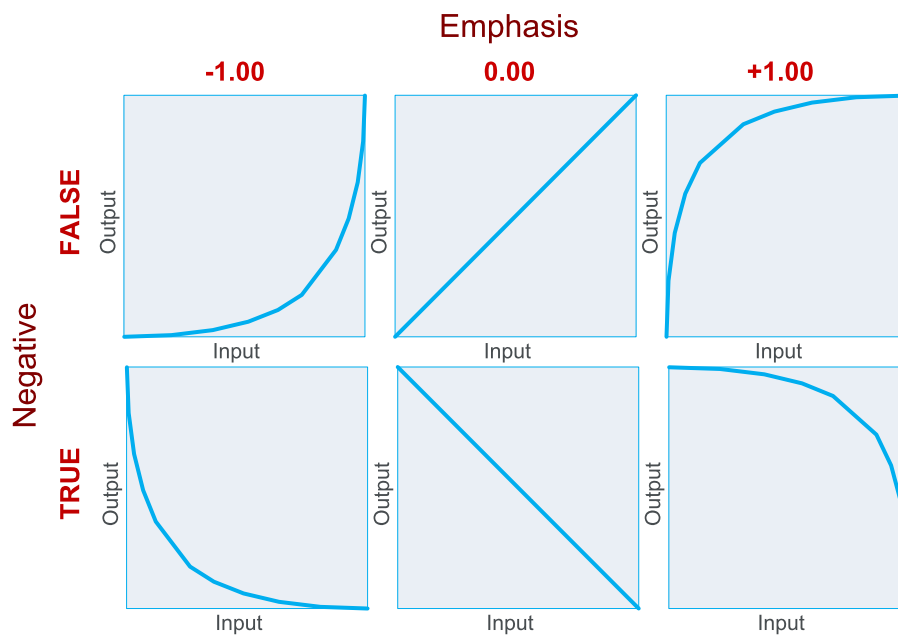
The γ - Gamma - exponent is mathematically linked to Emphasis by:

$$\gamma = 10^{-\text{Emphasis}}$$

Emphasis	Gamma	Note
1.00	0.1	Max. Emphasis value; smallest γ value
0.00	1	Default Emphasis value; linear law
-1.00	10	Min. Emphasis value; largest γ value

To achieve a required given γ , **Emphasis** should be set to:

$$\text{Emphasis} = -\log_{10}\gamma$$



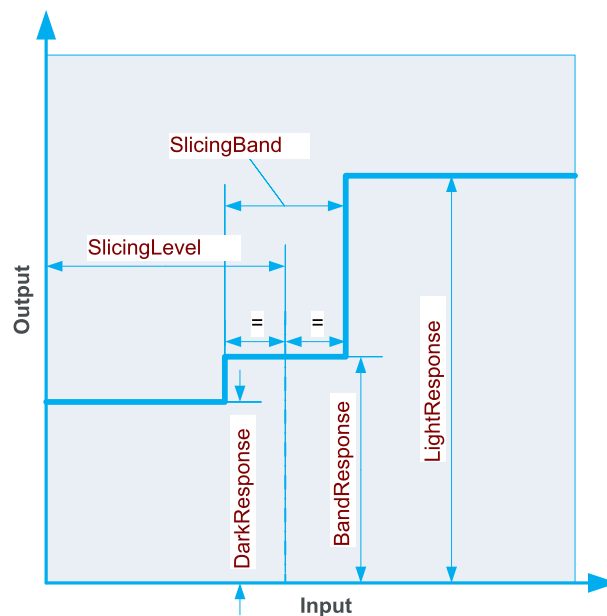
Emphasis effect for typical values of **Emphasis** and both values of **Negative**

SlicingLevel, SlicingBand, LightResponse, BandResponse and DarkResponse

SlicingLevel, SlicingBand, LightResponse, BandResponse and DarkResponse parameters exclusively apply to the "Threshold" on page 153 lookup table definition method.

As shown on the next figure, the parameters set defines a double threshold transformation law.

Parameter	Minimum Value	Default Value	Maximum Value
SlicingLevel	0.00	0.50	1.00
SlicingBand	0.00	0.50	1.00
LightResponse	0.00	0.75	1.00
BandResponse	0.00	0.50	1.00
DarkResponse	0.00	0.25	1.00



Double threshold transfer function



NOTE

SlicingLevel specifies the mean value of both thresholds in the input range.

LUT Setup Procedure

To setup the lookup table processing, proceed as follows:

1. Disable the lookup table
2. Define the lookup table configuration
3. Define the content of the lookup table
4. Upload the lookup table content into a specified lookup table data set
5. Enable the lookup table with a specified data set

Disabling the lookup table

To disable the lookup table:

- Set the **LUTEnable** feature to a **Off**.

Defining the lookup table configuration

To define the lookup table configuration, set the **LUTConfiguration** feature according to:

- The camera pixel type and bit depth
- The required output bit depth.

See also: "Monochrome Lookup Table Processing" on page 152 for configurations applicable to monochrome pixels.



NOTE

The lookup table configuration must be set prior to any other action.

Defining the lookup table content

See also: "LUT Content Definition" on page 153 for a description of the parametric and tabular methods used for defining a lookup table content.



NOTE

At least one lookup table set must be defined.

Upload a lookup table content

To upload a lookup table content in one operation:

- Select a lookup table data set to access by assigning the appropriate value to the **LUTSet** feature. For instance **Set1**.
- Set the **LUTIndex** feature to **0**.
- Write a string of **LUTLength** values to the **LUTValue** feature.

**NOTE**

The application may also selectively upload any individual lookup table entry or any block of consecutive lookup table entries.

Reading back a lookup table data set

To read back the lookup table data set in one operation:

- Select a lookup table data set to access by assigning the appropriate value to the **LUTSet** feature. For instance Set1.
- Set the **LUTIndex** feature to 0.
- Set the **LUTReadBlockLength** feature to the value returned by **LUTLength**.
- Get a string of **LUTReadBlockLength** values from the **LUTValue** feature.

**NOTE**

The application may also selectively read any lookup table entry individually or any block of consecutive entries.

Enabling the lookup table

To enable the lookup table:

- Set the **LUTEnable** feature to a value designating the lookup table data set to use.

Configuration Script Example

The following script is an example illustrating how to configure the lookup table for monochrome 8-bit to 8-bit operation and to define and upload 4 lookup table data sets using different lookup table definition methods.

```
function configure(g) {
  // Disable the lookup table
  g.StreamPort.set('LUTEnable', 'Off');
  // Configure the lookup table
  g.StreamPort.set('LUTConfiguration', 'M_8x8');

  // Build lookup table data set 1: response control
  g.StreamPort.set('LUTSet', 'Set1');
  require('coaxlink://lut/response-control')(g, { Contrast: 0.94
    , Brightness: 0.14
    , Visibility: 0.25
    , Negative: false });

  // Build lookup table data set 2: emphasis
  g.StreamPort.set('LUTSet', 'Set2');
  require('coaxlink://lut/emphasis')(g, { Emphasis: 0.5
    , Negative: true });

  // Build lookup table data set 3: threshold
  g.StreamPort.set('LUTSet', 'Set3');
  require('coaxlink://lut/threshold')(g, { SlicingLevel: 0.5
    , SlicingBand: 0.5
    , LightResponse: 0.75
    , BandResponse: 0.5
    , DarkResponse: 0.25 });

  // Build lookup table data set 4: table
  g.StreamPort.set('LUTSet', 'Set4');
  var i;
  for (i = 0; i < 256; ++i) {
    g.StreamPort.set('LUTIndex', i);
    g.StreamPort.set('LUTValue', String(255 - i));
  }
}
configure(grabbers[0]);
```

7.5. Bayer CFA Decoding

Applies to the following firmware variants of ¹

Duo	(1-camera), (2-camera)
QuadG3	QuadG3LH (1-camera), (2-camera), (2-camera, bayer)
QuadG3DF	(1-camera), (1-df-camera)
Octo	(1-camera), (2-camera)
Quad12	Quad12-4 (1-camera)
Quad12J	Quad12J-4 (4-camera)
Duo12	Duo12LH (1-camera)
Value12	(1-camera)
Quad12DF	(1-camera), (1-df-camera)
QSFP+	(1-camera)

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¹ 1628 Grablink Duo, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

Bayer CFA Decoding Methods

Various Bayer CFA decoding methods are defined to transform the raw Bayer CFA data stream issued by the camera into an RGB color data stream

CFA decoding method 1

Applies to the following firmware variants of ¹

Duo	(1-camera), (2-camera)
QuadG3	QuadG3LH (1-camera)
QuadG3DF	(1-camera), (1-df-camera)
Octo	(1-camera), (2-camera)
Quad12	Quad12-4 (1-camera)
Value12	(1-camera)
Quad12DF	(1-camera), (1-df-camera)
QSFP+	(1-camera)

The CFA decoding method 1 also known as "Legacy method" uses a 3 x 3 kernel and a linear interpolation method to compute the missing color components.

See also: ["Advanced and Legacy Methods" on page 169](#) for an extensive description

¹ 1628 Grablink Duo, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

CFA decoding method 2

Applies to the following firmware variants of ¹

Duo	(1-camera), (2-camera)
QuadG3	QuadG3LH (1-camera)
QuadG3DF	(1-camera), (1-df-camera)
Octo	(1-camera), (2-camera)
Quad12	Quad12-4 (1-camera)
Quad12J	Quad12J-4 (4-camera)
Value12	(1-camera)
Quad12DF	(1-camera), (1-df-camera)
QSFP+	(1-camera)

The CFA decoding method 2 also known as "Advanced method" uses a 3 x 3 kernel and an advanced interpolation method to compute the missing color components.

See also: ["Advanced and Legacy Methods" on page 169](#) for an extensive description



WARNING

Applies to the following firmware variants of ²

Quad12J	Quad12J-4 (4-camera)
---------	----------------------

The CFA decoding method 2 is only available for Stream0 of each device.

¹ 1628 Grablink Duo, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

² 3620 Coaxlink Quad CXP-12 JPEG and 3620-4 Coaxlink Quad CXP-12 JPEG.

Requirements and Performances

Maximum line length

The maximum line length depends on the firmware variant:

- 16384 pixels for the 1-camera firmware variant
- 8192 pixels for the 2-camera firmware variant

Peak pixel processing rate

The CFA decoding performance is limited by the PCI Express bandwidth:

- When configured to deliver RGB8 pixels, the PCI Express Interface is capable to sustain a pixel output rate of ~567 Mpixels/s.
- When configured to deliver RGB10, RGB12, RGB14 or RGB16, the PCI Express Interface is capable to sustain a pixel output rate of ~283 Mpixels/s.

For comparison purpose, the Camera Link interface sustains the following Bayer CFA pixel rates:

Configuration	Bit depth		
	8-bit	10-bit or 12-bit	14-bit or 16-bit
BASE_3T8	255 Mpixels/s		
BASE_2T10/12		170 Mpixels/s	
BASE_1T14/16			85 Mpixels/s
DECA_10T8	850 Mpixels/s		
DECA_8T10		680 Mpixels/s	
DECA_5T14/16			425 Mpixels/s

The hardware CFA decoder performs on-the-fly conversion with a negligible latency when the data throughput is NOT limited by the available PCI Express bandwidth!

Using Bayer CFA Decoder

Using the CFA decoder of 1628 Grablink Duo

Prerequisites

Frame grabber requirements

Any area-scan firmware variant:

- 1-camera
- 2-camera

Camera requirements

- Bayer CFA area-scan
- Less than "Max. line length" pixels per line

Bayer to RGB Pixel Processing Configurations

When the Bayer CFA decoder is enabled:

- the "[Pixel Unpacking and Alignment](#)" on page 148 control is inoperative, the frame grabber unpacks 10-bit, 12-bit or 14-bit pixels to lsb.
- the "[Pixel Components Swapping](#)" on page 173 feature allows to swap the Red and Blue components and deliver either BGR or RGB pixels.

Input Pixel Format	RedBlueSwap	Output Pixel Format
Bayer**8	off	RGB8
	on	BGR8
Bayer**10pmsb	off	RGB10
	on	BGR10
Bayer**12pmsb	off	RGB12
	on	BGR12
Bayer**14pmsb	off	RGB14
	on	BGR14
Bayer16	off	RGB16
	on	BGR16

Enabling the Bayer CFA Decoder

In the Data Stream module, set the `BayerMethod` feature value to `Legacy` or `Advanced` according to the desired interpolation method.

Disabling the Bayer CFA Decoder

In the Data Stream module, set the **BayerMethod** feature value to **Disable**.

Advanced and Legacy Methods

This topic describes two Bayer CFA decoding methods respectively named **Legacy** and **Advanced**.

The two methods transform the raw Bayer CFA data stream issued by the camera into an RGB color data stream using a 3x3 kernel. The missing pixel components are reconstructed from the nearest components.

The **Legacy** interpolation method computes the missing color components by applying exclusively the Mean() function.

The **Advanced** interpolation method computes the missing color components using the Mean() and the Median() functions. It eliminates the aliasing effect on the highly contrasted sharp transitions in the image.

Functions Definitions

The min() function returns the lowest integer value from a set of 2 integer values.

The max() function returns the highest integer value from a set of 2 integer values.

The mean() function returns one integer value that represents the mean value of 2 integers. It is computed as follows:

Function	Mean(a,b)
<i>Formula</i>	$(a + b + 1) \gg 1$

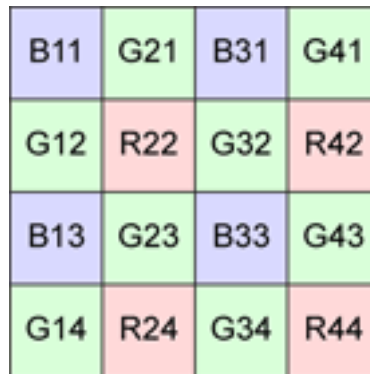
The median() function returns a set of two integer values that are the two median values of a set of four integers. It is computed as follows:

Function	Median(a,b,c,d)
<i>Value 1 formula</i>	Min [Max(a,b); Max(c,d)]
<i>Value 2 formula</i>	Max [Min(a,b); Min(c,d)]

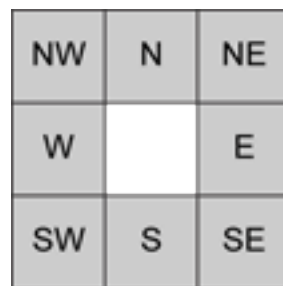
Decoder operation

For each pixel of the source image, the CFA decoder computes two missing color components from surrounding pixels.

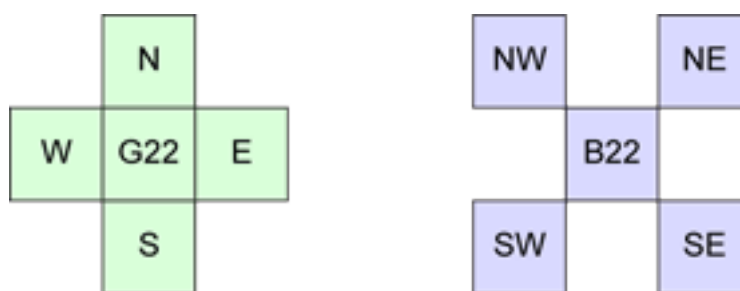
The text hereafter describes how the 4 central pixels located at positions 22, 32, 23 and 33 of a 4 x 4 Bayer CFA array are computed:



The relative positions of the surrounding pixels are identified by compass markings:

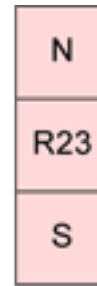
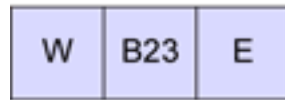


Formulas for position 22



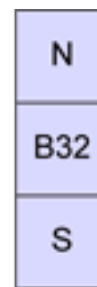
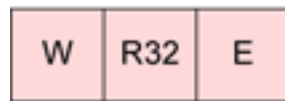
Component	Method	Formula
R22	Legacy, Advanced	R22
G22	Legacy	Mean[Mean(N,S), Mean(W,E)]
	Advanced	Mean[Median(N, S, E, W)]
B22	Legacy	Mean[Mean(NW, SW), Mean(NE, SE)]
	Advanced	Mean[Median(NW, SW, NE, SE)]

Formulas for position 23



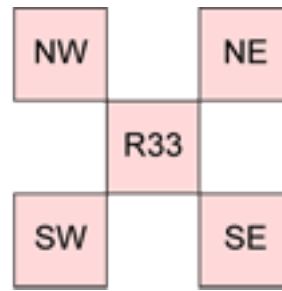
Component	Method	Formula
R23	Legacy, Advanced	Mean(N,S)
G23	Legacy, Advanced	G23
B23	Legacy, Advanced	Mean(W,E)

Formulas for position 32



Component	Method	Formula
R32	Legacy, Advanced	Mean(W,E)
G32	Legacy, Advanced	G32
B32	Legacy, Advanced	Mean(N,S)

Formulas for position 33



Component	Method	Formula
R33	Legacy	Mean[Mean(NW, SW), Mean(NE, SE)]
	Advanced	Mean[Median(NW, SW, NE, SE)]
G33	Legacy	Mean[Mean(N,S), Mean(W,E)]
	Advanced	Mean[Median(N, S, E, W)]
R33	Legacy, Advanced	B33

7.6. Pixel Components Swapping

The image data stream pixel processor can be configured to swap the first and the third component data of 3-component pixels.

The swapping is controlled through the **RedBlueSwap** boolean GenApi feature:

- When set to **False** (default settings), the original component order is preserved
- When set to **True**, the first and the third components are swapped.

The function is available for image acquisition from:

- RGB color cameras delivering 3-component pixel data,
- RGBa color cameras delivering 4-component pixel data,
- BAYER CFA color cameras providing that the BAYER CFA decoding is enabled.

8. Image Data Transfer

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8.1. Buffer Filling Rules

A DMA engine transfers the processed image data over the PCI Express bus to the allocated GenTL buffers according to rules that are different for line-scan and area-scan image acquisition.

Area-scan firmware variants

In area-scan imaging, GenTL buffers are filled according to the following rules:

- The first acquired line data of a frame is, by default, stored at the beginning of a new buffer. When vertical image flipping is enabled by setting `StripeArrangement` to `Geometry_1X_1YE`, the first acquired line data of a frame is stored at the location of the last full line of a new buffer.
- When image transfer to host memory is done, the buffer, possibly partially filled, is made available to the application for processing.
- **NEW** When the remaining space of a buffer is not sufficient to store a complete frame, the remaining data is handled according to the "[BufferFilledRule settings](#)" on page 175.

Line-scan firmware variants

In line-scan imaging, GenTL buffers are filled according to the following rules:

- The first acquired line data of a scan is, by default, stored at the beginning of a new buffer. When vertical image flipping is enabled by setting `StripeArrangement` to `Geometry_1X_1YE`, the first acquired line data of a scan is stored at the location of the last full line of a new buffer.
- A buffer contains an integer number of image lines data.
- **NEW** When the remaining space of a buffer is not sufficient to store an image line data, the remaining data is handled according to the "[BufferFilledRule settings](#)" on page 175.
- When the last line data of a scan is acquired, the last buffer, possibly partially filled, is made available to the application for processing.

BufferFilledRule settings

Discard remaining data

When `BufferFilledRule` is set to `DiscardRemainingData`, the remaining data is discarded.



NOTE

- Default settings for area-scan acquisition.
- Only available for selected line-scan firmware variants.

Applies to the following firmware variants of ¹

Duo	(1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan)
Duo104EMB	Duo104MIL (1-camera), (2-camera)
Mono	(1-camera)
Duo	(1-camera), (2-camera)
Quad	(1-camera), (2-camera)
QuadG3	QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, bayer), (3-camera), (4-camera)
QuadG3DF	(1-camera), (1-df-camera)
Quad3DLLE	(1-camera)
Octo	(1-camera), (1-camera, custom-logic), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (3-camera), (4-camera), (4-camera, line-scan), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)
Quad12	Quad12-4 (1-camera), (1-camera, custom-logic), (1-camera, line-scan), (1-camera, line-scan, custom-logic), (2-camera), (2-camera, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera), (4-camera, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)
Quad12J	Quad12J-4 (4-camera)
Mono12	Mono12LH (1-camera)
Duo12	Duo12LH (1-camera), (2-camera)
Value12	(1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (4-camera), (4-camera, line-scan)
Quad12DF	(1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)
QSFP+	(1-camera), (1-camera, custom-logic), (1-camera, line-scan)

[Continue in a next buffer \(Default settings for line-scan acquisition\)](#)

When **BufferFilledRule** is set to **ContinueInNextBuffer**, the acquisition continues into a new buffer and the filled buffer is made available to the application for processing. This setting is also available on selected area-scan firmware-variants.

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.



NOTE

- Default settings for line-scan acquisition.
- Only available for selected area-scan firmware variants.

Applies to the following firmware variants of ¹

Duo	(1-camera, line-scan), (2-camera, line-scan)
Duo104EMB	Duo104MIL (1-camera, line-scan)
Duo	(1-camera, line-scan), (2-camera, line-scan)
Quad	(1-camera, line-scan)
QuadG3	QuadG3LH (1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)
QuadG3DF	(1-camera, line-scan), (1-df-camera, line-scan)
Quad3DLLE	(1-camera)
Octo	(1-camera, line-scan), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera, line-scan)
Quad12	Quad12-4 (1-camera, line-scan), (1-camera, line-scan, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)
Mono12	Mono12LH (1-camera, line-scan)
Duo12	Duo12LH (1-camera, line-scan), (2-camera, line-scan)
Value12	(1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)
Quad12DF	(1-camera, line-scan), (1-df-camera, line-scan)
QSFP+	(1-camera, line-scan)

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

8.2. Image Limits

Image width

Condition(s)	Min	Max	Unit
(1-camera), 8-bit monochrome, 1Y-region	1024	65,536	Pixels
(1-camera), 10~16-bit monochrome, 1Y-region	1024	32,768	Pixels
(1-camera), 8-bit RGB, 1Y-region	1024	16,384	Pixels
(1-camera), 10~16-bit RGB, 1Y-region	1024	8,192	Pixels
(2-camera), 8-bit monochrome, 1Y-region	1024	32,768	Pixels
(2-camera), 10~16-bit monochrome, 1Y-region	1024	16,384	Pixels
(2-camera), 8-bit RGB, 1Y-region	1024	8,192	Pixels
(2-camera), 10~16-bit RGB, 1Y-region	1024	4,096	Pixels
(1-camera), 8-bit monochrome, 2Y-regions	1024	32,768	Pixels
(1-camera), 10~16-bit monochrome, 2Y-regions	1024	16,384	Pixels
(1-camera), 8-bit RGB, 2Y-regions	1024	8,192	Pixels
(1-camera), 10~16-bit RGB, 2Y-regions	1024	4,096	Pixels
(2-camera), 8-bit monochrome, 2Y-regions	1024	16,384	Pixels
(2-camera), 10~16-bit monochrome, 2Y-regions	1024	8,192	Pixels
(2-camera), 8-bit RGB, 2Y-regions	1024	4,096	Pixels
(2-camera), 10~16-bit RGB, 2Y-regions	1024	2,048	Pixels
(1-camera, line-scan), 8-bit monochrome	1024	65,536	Pixels
(1-camera, line-scan), 10~16-bit monochrome	1024	32,768	Pixels
(1-camera, line-scan), 8-bit RGB	1024	16,384	Pixels
(1-camera, line-scan), 10~16-bit RGB	1024	8,192	Pixels
(2-camera, line-scan), 8-bit monochrome	1024	32,768	Pixels
(2-camera, line-scan), 10~16-bit monochrome	1024	16,384	Pixels
(2-camera, line-scan), 8-bit RGB	1024	8,192	Pixels
(2-camera, line-scan), 10~16-bit RGB	1024	4,096	Pixels

Image height

Condition(s)	Min	Max	Unit
All area-scan variants	TBD	TBD	Pixels
All line-scan variants	TBD	TBD	Pixels

8.3. Image Data Padding

The DMA engine provides the capability to organize the data differently in the buffer by adding line padding or stripe padding.



NOTE

For driver versions prior to 6.2, the DMA engine was transferring the whole image data as a single 1D entity regardless the 2D structure: the lines of processed image data are concatenated into the destination buffer.

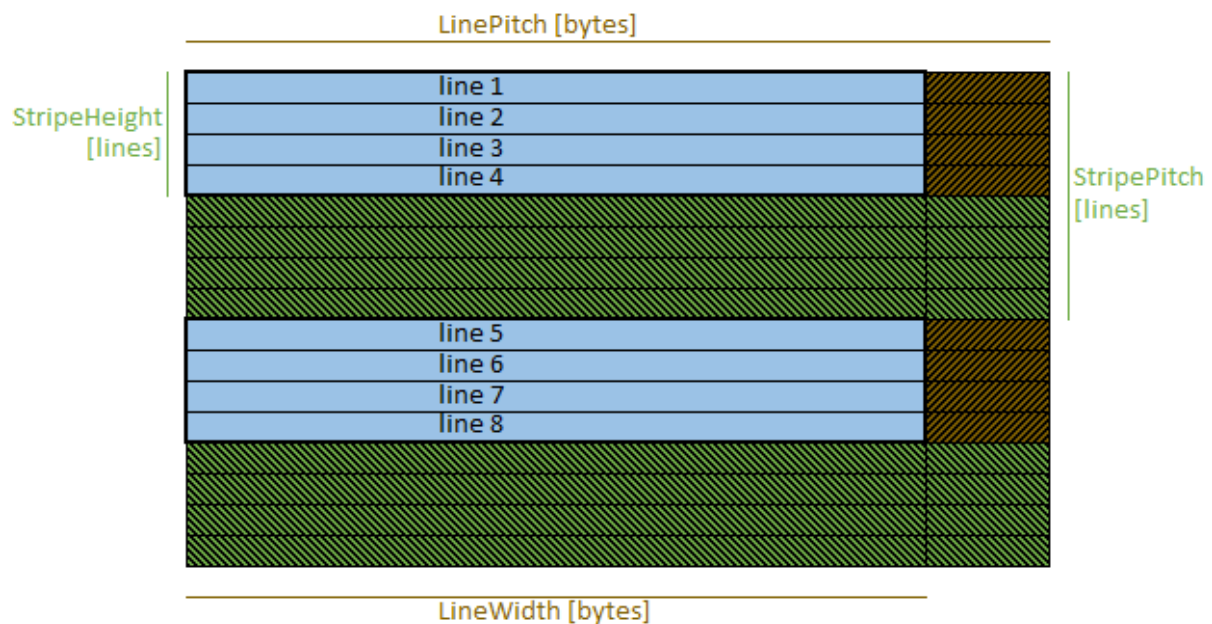


Image buffer padding model

Line Padding

The `LineWidth` and `LinePitch` features control the line padding.

When `LinePitch > LineWidth`, the line padding is enabled: the DMA engine inserts `LinePitch - LineWidth` bytes of padding at the end of each image line.

`LinePitch` can be set to `0` to disable padding after lines.

Stripe padding

Stripes are groups of adjacent lines. A stripe of height 1 is a line.

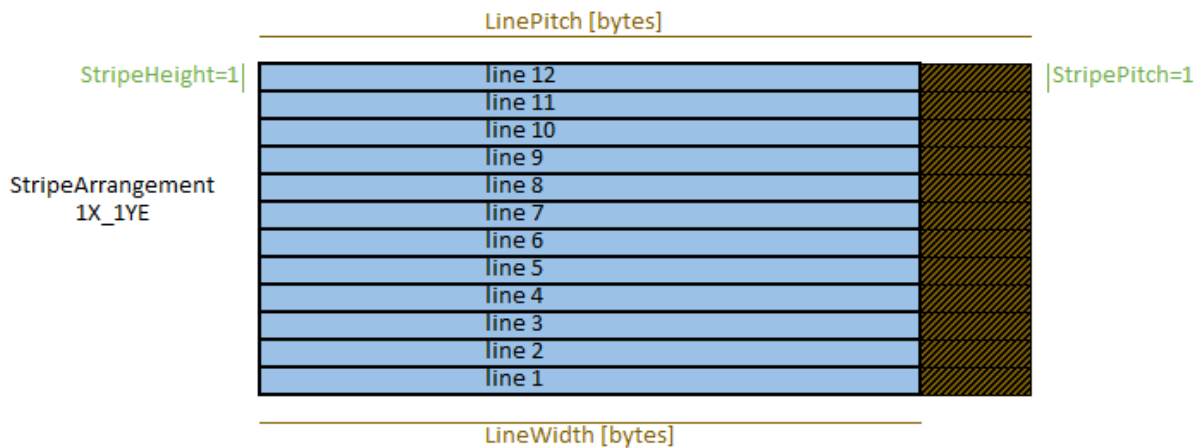
The `StripeHeight` and `StripePitch` features control the stripe padding.

When `StripePitch > StripeHeight`, the stripe padding is enabled: the DMA engine inserts `StripePitch - StripeHeight` lines of padding at the end of each stripe.

StripePitch can be set to **0** to disable padding after lines.

8.4. Vertical Image Flipping

The DMA engine provides the capability to flip the image vertically.



Flipped image data

The vertical image flip is controlled by the **StripeArrangement** feature of the data Stream module.

By default, **StripeArrangement** is set to **1X_1Y**: the vertical image flip is disabled.

When **StripeArrangement** is set to **1X_1YE**, the driver determines the position of the first image line in the buffer by using this formula:

$$\text{BufferBase} + (\text{BufferSize} + \text{LinePitch} - \text{LineWidth}) / \text{LinePitch} * \text{LinePitch} - \text{LinePitch}.$$

As a result:

- if the buffer is too small, it is the bottom part of the image (as given by the camera) that will be lost;
- lines will start at **BufferBase + n * LinePitch**;
- only complete lines are transferred;
- if the buffer size is not a multiple of **LinePitch** bytes, some bytes at the end of the buffer will be left unchanged.



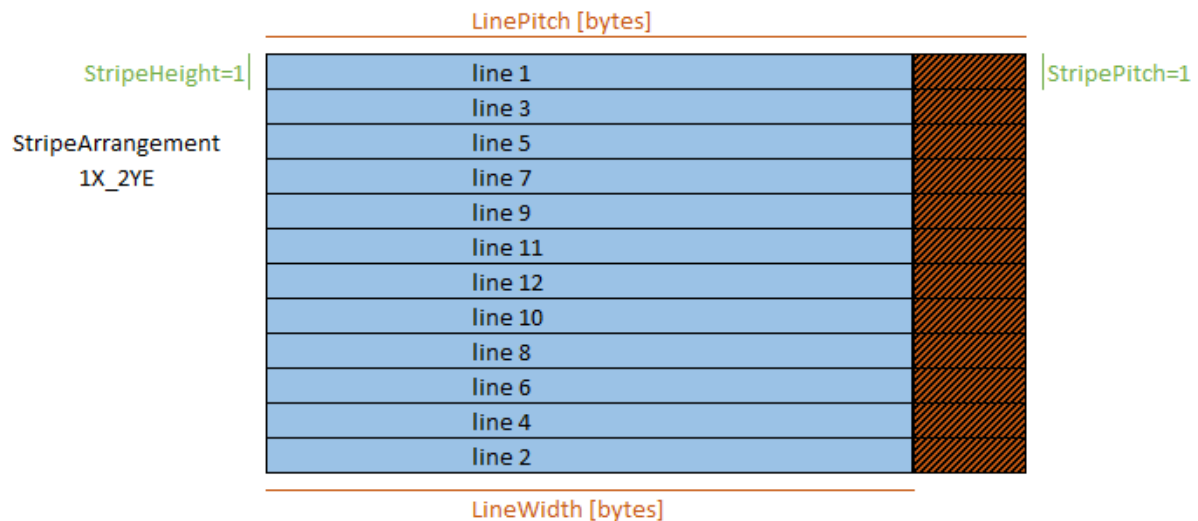
NOTE

When evaluating the above formula, if **LinePitch** is equal to **0**, **LineWidth** will be used instead. Similarly, if **StripeHeight** is **0**, **1** will be used instead.

8.5. Image Data Unscrambling

The DMA engine provides the capability to unscramble images having 1X_2YE and 1X_2YM geometries.

Unscrambling 1X_2YE images



When **StripeArrangement** is set to **Geometry_1X_2YE**, the driver determines the destination of the second line output by the camera (i.e., the position of last image line in the buffer) by using this formula:

$$\text{BufferBase} + (\text{BufferSize} + \text{LinePitch} - \text{LineWidth}) / \text{LinePitch} * \text{LinePitch} - \text{LinePitch}$$

NOTE: this is the address of the last line in the buffer large enough to receive one complete line.

As a result:

- If the buffer is too small, the last lines output by the camera (i.e., the middle part of the image) will be lost; the application is responsible for avoiding this,
- Lines will start at

$$\text{BufferBase} + n * \text{LinePitch},$$

- Only complete lines are transferred. (When evaluating the above formula, if **LinePitch** is equal to 0, **LineWidth** will be used instead. Similarly, if **StripeHeight** is 0, 1 will be used instead.)
- **StripeHeight** and **StripePitch** cannot be set to values greater than 1.

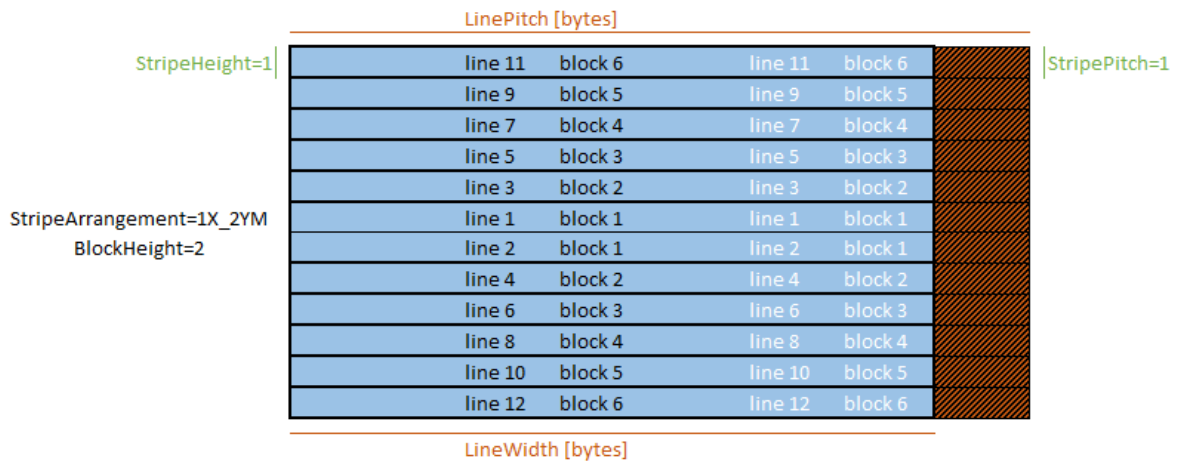
Unscrambling 1X_2YM images



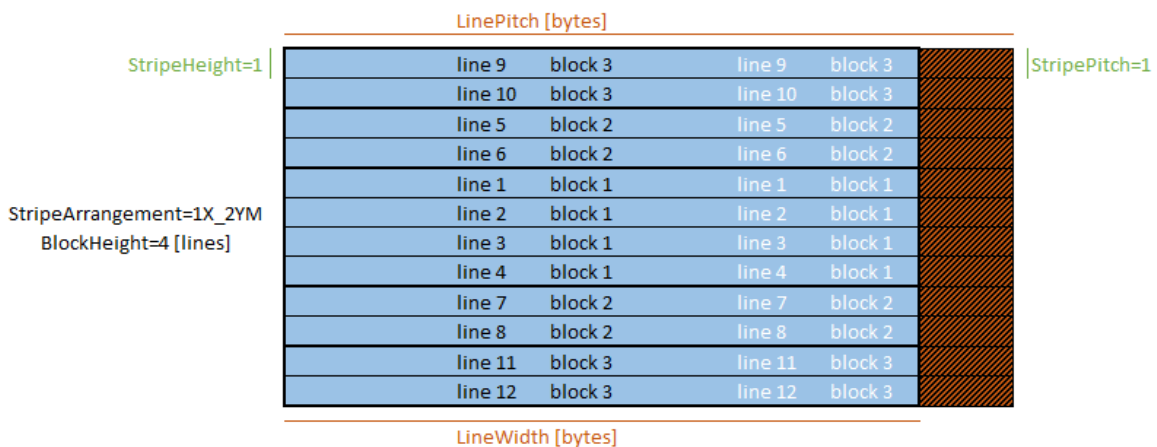
NOTE

- In the following figures, line numbers and block numbers sent by the *device* are in *white*, line numbers and block numbers received by the *host* are in *black*.
- The values of **StripePitch**, **StripeHeight** and **StripeOffset** must be multiple of **BlockHeight** value!

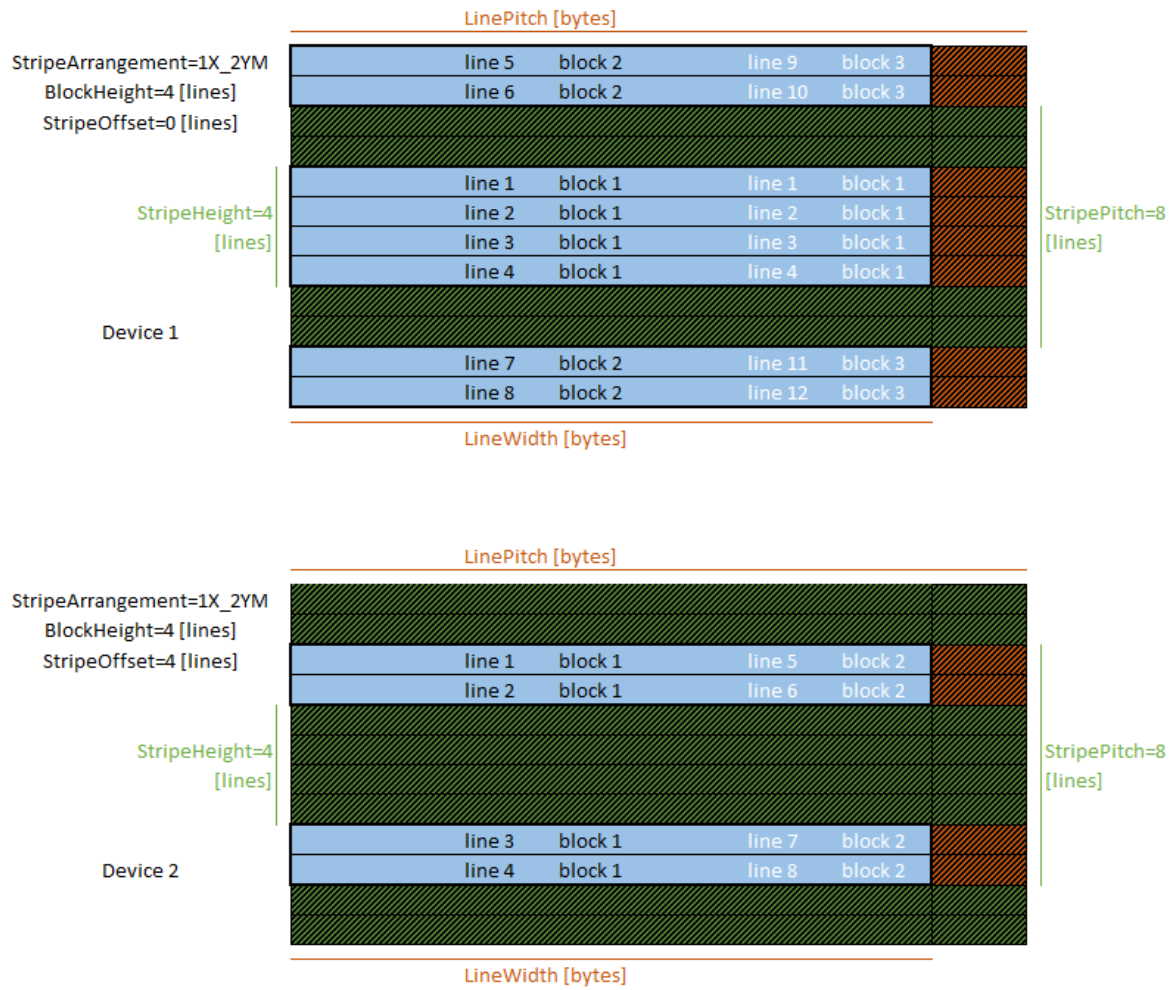
1X_2YM camera delivering lines by blocks of 2



1X_2YM camera delivering lines by blocks of 4



1X_2YM camera delivering lines by blocks of 4 to two hosts



8.6. Data Stream Statistics

The stream statistics tool monitors the image data stream at the card output and provides the application with averaged frame-, line- and data-rate.

Stream Statistics Sampling Methods

The `StatisticsSamplingSelector` determines the *averaging interval*. It can be any of the following:

- `LastSecond` or `LastTenSeconds`: The last completed *time* slot of 1 or 10 seconds.
- `Last2Buffers`, `Last10Buffers`, `Last100Buffers`, `Last1000Buffers`: The last 2, 10, 100, or 1000 *acquired buffers*
- `LastAcquisition`: The last acquisition activity period. Namely since the last `DStartAcquisition()` function call until now, if the acquisition is still active otherwise until the last `DStopAcquisition()` function call.
- `LastAcquisition`: Time interval between `StatisticsStartSampling` and `StatisticsStopSampling` commands.

The default sampling method is `LastSecond`.

Statistical Data

The statistical data is effectively computed when getting any of the following feature:

- `StatisticsFrameRate` reports the averaged frame rate expressed in frames/second (area-scan).
- `StatisticsLineRate` reports the average line rate expressed in lines/second (line-scan).
- `StatisticsDataRate` reports the average data rate expressed in megabytes/second

For every GenTL buffer filled during the averaging interval, the tool counts:

- The number of filled GenTL buffers and the corresponding number of frames (area-scan) or lines (line-scan)
- The number of transferred bytes of image data.

The related GenApi features are gathered into the Stream Statistics Category of the GenTL Data Stream Module.

8.7. Data Transfer Rate Test Program

Introduction

The *Data Transfer Rate Test Program* (DTR) can be used to measure the effective PCI Express data transfer rate in real conditions.

Host PC requirements

- The Host PC must be equipped with at least one **eGrabber**-driven frame grabber.
- Driver version 12.4 or higher must be installed on the Host PC.

Camera requirements

- The camera must be configured to deliver continuously image data.

Installation

The DTR is included in `gentl.exe`, a command-line tool that is delivered with the **eGrabber** driver. No further installation is required.

Measurement principle

The DTR measures the data transfer rate by completely filling the internal frame store and only then transferring images to the host computer:

1. All buffers are unqueued (the data stream cannot use them)
2. The data stream and remote device are started
3. When the frame store is full, the remote device is stopped
4. Current timestamp is retrieved (t_0)
5. All buffers are queued to the data stream and transfers start
6. Buffers are popped from the data stream
7. When the frame store is empty and all buffers have been retrieved, the data stream is stopped

The DTR program computes the data transfer rate as follows:

```
- byte count = sum of each buffer's BUFFER_INFO_SIZE_FILLED  
- t1 = last buffer's BUFFER_INFO_CUSTOM_EVENT_TIMESTAMP  
- duration = t1 - t0  
- data transfer rate = byte count / duration
```

gentl --help

```
GenTL Explorer

gentl [COMMAND] ... [OPTIONS]

Commands:
  info      Show detailed information about the transport layer system
  report    Generate a GenTL report archive (for Euresys tech support)
  xml       Download GenApi files (XML register descriptions)
  play      Open a data stream and acquire images (no display)
  view      Open a data stream and display images
  grab      Grab N images
  genapi    Enter the GenApi command-line interface or perform a GenApi operation
  read      Read data from a GenTL port
  write     Write data to a GenTL port
  event     Wait for events and display information about them
  script    Execute script
  run       Run an action
  dtr      Measure PCIe data transfer rate
  ber       Measure bit error rate confidence level (a.k.a. link validation tool)

Common flags:
  --cti=LIBPATH      Path to GenTL producer library.
                    Default: use EURESYS_COAXLINK_GENTL64_CTI and
                    GENICAM_GENTL64_PATH environment variables to
                    locate the library.
  -j=N               Limit the number of CPU cores to use to N (default: 2)
  -h                 --help          Display help message
  -V                 --version       Print version information
                    --numeric-version Print just the version number
  -v                 --verbose       Loud verbosity
  -q                 --quiet         Quiet verbosity
```

gentl dtr --help

```

GenTL Explorer

gentl dtr [OPTIONS]

Flags:
    --if=ID                Interface ID
    --dev=ID               Device ID
    --ds=ID                Data stream ID
    --device-access=ACCESS Access flags used to open the device (GenTL standard
access flags:
    DEVICE_ACCESS_READONLY, DEVICE_ACCESS_CONTROL,
    DEVICE_ACCESS_EXCLUSIVE;
    Coaxlink custom access flags:
    DEVICE_ACCESS_CUSTOM_READONLY_DEVICE_READONLY_
STREAM) (default:
    DEVICE_ACCESS_CONTROL)
    --ro                  Open the device as read-only (shorthand for
--device-access=DEVICE_ACCESS_READONLY)
    --buffers=INT         Buffer count (default: 4)
    --buffersize=INT      Buffer size
    --width=WIDTH         Buffer width
    --height=HEIGHT       Buffer height
    --pixelformat=ITEM    PFNC Pixel format
    --bayer=BAYERDECODINGMETHOD Bayer method (Legacy, Advanced) (default: Advanced)
    --set=SETTINGS        GenApi settings, such as Module.Feature=INT
    --setup=FILE           Path to script to execute before starting stream
    --run=FILE             Path to script to execute concurrently
    --timeout=INT         Acquisition timeout, in milliseconds (default:
infinite)
    --zero                Zero memory when queuing buffers (default: memory is
only zeroed when buffers
    are allocated)
    --remotexml=FILE      Use FILE as register description (default: register
description is read from
    remote device)
    -n --repeat[=N]       Measure data transfer rate N times (default: 1)
Common flags:
    --cti=LIBPATH         Path to GenTL producer library. Default: use
EURESYS_COAXLINK_GENTL64_CTI and
    GENICAM_GENTL64_PATH environment variables to locate
the library.
    -j=N                  Limit the number of CPU cores to use to N (default:
2)
    -h --help             Display help message
    -V --version           Print version information
    --numeric-version     Print just the version number
    -v --verbose           Loud verbosity
    -q --quiet            Quiet verbosity

```



TIP

For a better measurement accuracy, use the `gentl dtr -n` option to execute multiple measurements repeatedly. The DTR program will average the results.

9. Camera and Illumination Control

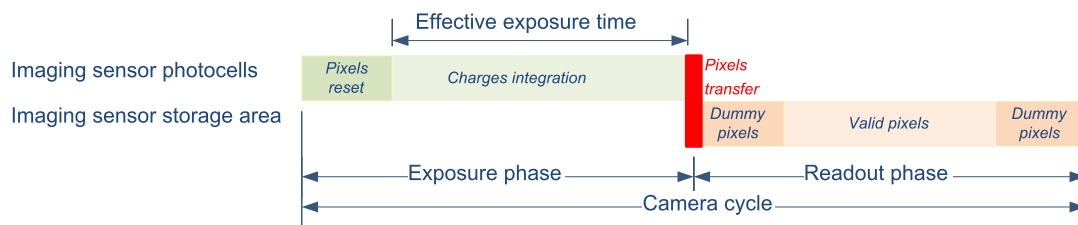
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9.1. Camera Control Principles

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Camera Cycle

A camera cycle is composed of two consecutive phases: the exposure phase and the readout phase.



Camera cycle

Exposure phase

The exposure phase is the period of time during which the photocells of the imaging sensor integrate electric charges induced by the incoming photons.

For cameras having an electronic shutter, the exposure phase begins with a pixel reset action that clears all the sensor photocells. For permanent exposure cameras, i.e. cameras having no (or not using) the electronic shutter, the exposure phase begins immediately after the completion of the previous exposure phase.

For all types of cameras, the exposure phase terminates with a “pixels transfer” action. The accumulated charges in the photocell are transferred to the storage area for further readout. This action clears the photocells and new charge integration begins immediately.

Cameras having an electronic shutter have the capability to reset the pixels asynchronously and initiate a new exposure on request. These cameras are named asynchronous reset cameras.

Having the capability of controlling the time of the start of exposure (pixel reset) and the time of the end of exposure (pixel transfer) gives full control on:

- The timing of each image capture
- The sensitivity of the imaging sensor by selecting the exposure time

Readout phase

The readout phase is the period of time during which the total amount of electrical charges accumulated by each pixel is measured and delivered to the imaging sensor output.

The readout phase is not controlled by the frame grabber:

- It is automatically initiated after each pixel transfer.
- Its duration is fixed; it is determined by the amount of pixel data to be transferred and by the readout structure of the sensor (one or more taps, tap output data rate).

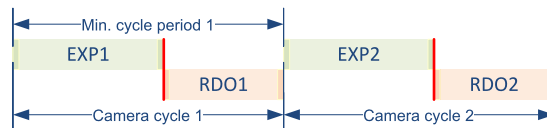
Some sensors provide the capability to select one or more region of interest (ROI) speeding up the readout since less data needs to be transferred.

Camera Cycle Concatenation Rules

This topic explains the rules that MUST be observed by the frame grabber to avoid *Camera Trigger* overrun when requesting successive camera cycles to an asynchronous reset camera.

Rule for cameras not allowing overlapping

The next camera cycle may NOT begin before the completion of the readout phase.



Shortest possible cycle period achievable by cameras NOT allowing the cycle overlapping

$$\text{Min. cycle period}_n = \text{EXP}_n + \text{RDO}_n$$

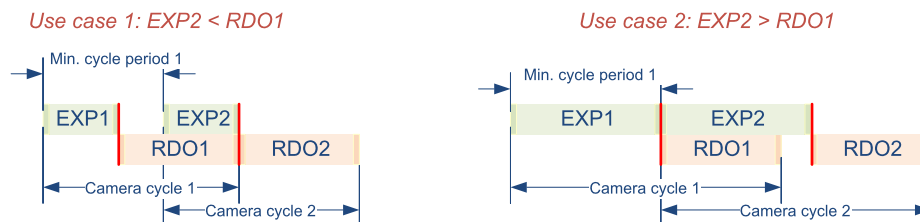


NOTE

Only a minority of industrial cameras are NOT allowing the cycle overlapping!

Rules for cameras allowing overlapping

1. The exposure phases of two consecutive camera cycles may NEVER overlap.
2. The readout phases of two consecutive camera cycles may NEVER overlap



Shortest possible cycle period achievable by cameras allowing the cycle overlapping

In the first case, the duration of the exposure phase of the second cycle is shorter than the duration of the readout phase of the first cycle. The next camera cycle may start ($EXP_{n+1} - RDO_n$) period of time after the completion of the exposure phase. The minimum cycle period is

$$Min. cycle period_n = EXP_n + RDO_n - EXP_{n+1}$$

In the second case, the duration of the exposure phase of the 2nd cycle is longer than the duration of the readout phase of the first cycle. The next camera cycle may start immediately after the completion of the exposure phase. The minimum cycle period is:

$$Min. cycle period_n = EXP_n$$



NOTE

The majority of asynchronous reset cameras used in the machine vision industry supports the overlapping of the camera cycles!

Camera Control Methods

Camera control methods of 1628 Grablink Duo

1628 Grablink Duo provides three camera control methods named **NC**, **RC** and **RG**.

NC camera control method

The **NC** camera control method targets cameras that are NOT controlled by the frame grabber. This includes

- Free-run cameras not using any external trigger signal,
- Asynchronous-reset cameras using an external trigger signal not delivered by the frame grabber,
- Asynchronous-reset cameras that are controlled by a hardware signal applied by an external controller to any GPIO input port of the grabber.

See also: "Upstream Control Lines" on page 117 to control the asynchronous-reset camera with an external trigger signal applied on any GPIO input port of the frame grabber



WARNING

The Camera and Illumination Controller (CIC) is not used!

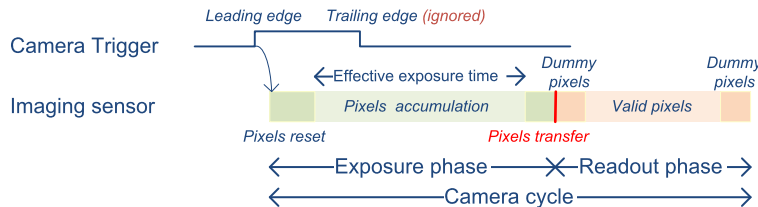
- There is no **Camera Trigger** signal produced by the CIC. The frame grabber do NOT control the camera cycles.
- There is no **Strobe** signal produced by the CIC. The frame grabber do NOT control the illumination.

The external controller is entirely responsible for the camera cycle timings!

RC camera control method

The **RC** camera control method targets asynchronous reset cameras where only the camera cycle rate is controlled by the frame grabber. The exposure duration is controlled by the camera.

The real-time control is performed through a single upstream signal named "Camera Trigger" issued by the Camera and Illumination Controller (CIC) of the frame grabber.



Grabber controlled camera cycle using the RC camera control method

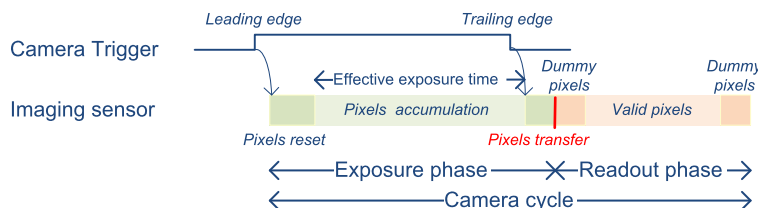
The CIC produces one single Camera Trigger pulse every camera cycle. The Camera Trigger leading edge triggers a new camera cycle and initiates a new exposure period. The Camera Trigger trailing edge is ignored by the camera.

On **1628 Grablink Duo**, the pulse width is configurable through the **CITriggerDuration** of the Device Module.

RG camera control method

The **RG** camera control method targets asynchronous reset cameras where both the camera cycle rate and the exposure duration are controlled by the frame grabber.

The real-time control is performed through a single upstream signal named Camera Trigger issued by the Camera and Illumination Controller (CIC) of the frame grabber.



Grabber controlled camera cycle using the RG camera control method

The CIC produces one single Camera Trigger pulse every camera cycle. The Camera Trigger leading edge triggers a new camera cycle and initiates a new exposure period. The Camera Trigger trailing edge terminates the exposure period and triggers the readout.

9.2. Illumination Control Principles

Illumination Devices	197
Aligning Camera and Illumination Cycles	198

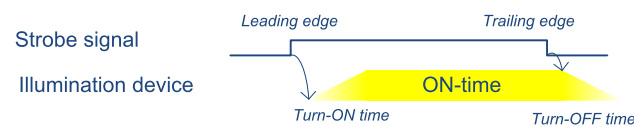
Illumination Devices

Two classes of illumination devices can be controlled by the illumination controller:

- Intermittent illumination devices
- Strobed illumination devices

Intermittent illumination devices

This illumination device class includes switched light sources where the turn-on and the turn-off time are controlled by the leading and the falling edges of the strobe signal.



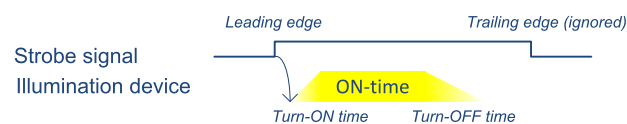
Timing diagram for intermittent illumination devices

The width of the strobe pulse determines the ON time duration of the light source

NOTE: The turn-on time and the turn-off time need to be considered when configuring the illumination controller!

Strobed illumination devices

This illumination device class includes switched light sources where only the turn-on time is controlled by the leading edge of the strobe signal.



Timing diagram for strobed illumination devices

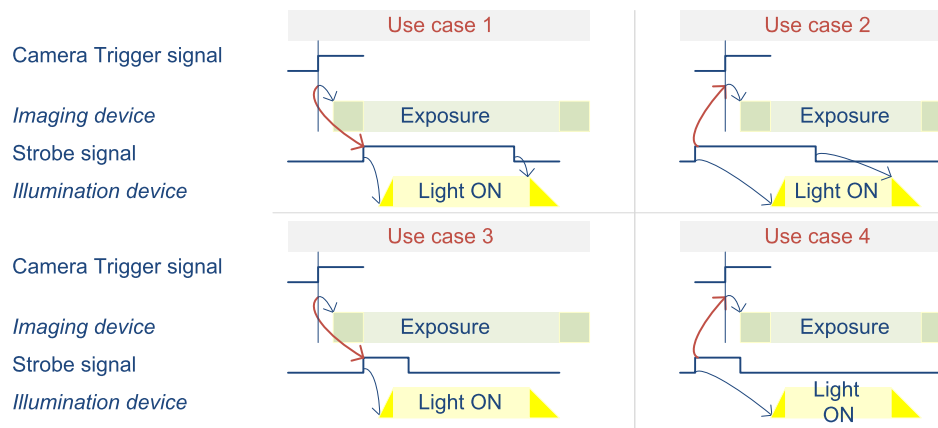
The on-time duration is either uncontrolled or controlled by the illumination device itself.

NOTE: The turn-on time and the ON time duration need to be considered when configuring the illumination controller.

Aligning Camera and Illumination Cycles

Obviously, the ON time of the light source must coincide with the exposure phase of the imaging sensor.

Therefore, the time relationship between the **Strobe** signal(s) and the **Camera Trigger** signal must be adequately controlled.



4 typical use cases of Camera Trigger vs. Strobe alignment

Intermittent light sources (Use cases 1 & 2)

The duration of the **Strobe** pulse must be adequately controlled in order to provide the right amount of light and get a correctly exposed image.

The sensor exposure should be adequately timed in order to terminate the sensor exposure after the light has turned off.

Strobed light sources (Use cases 3 & 4)

The sensor exposure should be adequately timed in order to terminate the sensor exposure after the light has turned off.

Late strobe (Use cases 1 & 3)

The leading edge (beginning) of the **Strobe** signal is delayed a little to ensure that the light is not turned on too early while the imaging device is resetting its pixels.

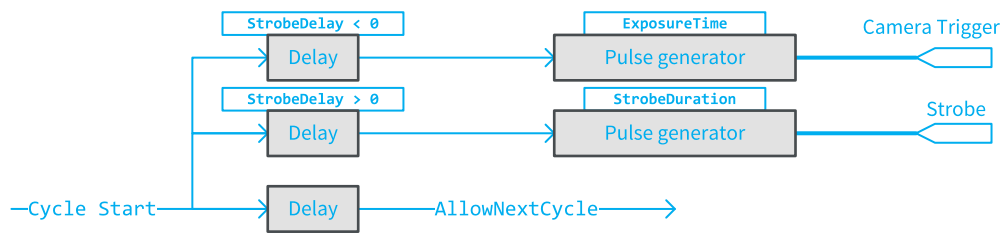
Early strobe (Use cases 2 & 4)

The leading edge of the **Camera Trigger** signal is delayed a little to ensure that the sensor exposure time is kept as short as possible and closely matches the on time.

9.3. Camera and Illumination Controller

Cycle Timing Machine	200
Cycle Manager	202
Cycle Trigger Manager	203
Sequence Manager	205
CIC Output Signals Routing	207

Cycle Timing Machine



CIC Cycle Timing Machine block diagram

The CIC timing machine is responsible for the generation of accurately timed events and signals structuring one camera and illumination controller cycle (CIC Cycle).

At every occurrence of a `Cycle Start` event, the timing machine generates:

- One single pulse on the `Camera Trigger` signal.
- One single pulse on the `Strobe` signal.
- One `AllowNextCycle` event.

Intra-cycle timing

Three GenApi features of the Device module are used to configure the timing of the output signals within a cycle:

- `ExposureTime` defines the duration of the `Camera Trigger` pulse.
- `StrobeDuration` defines the duration of the `Strobe` pulse.
- `StrobeDelay` defines the time offset from the leading edge of `Camera Trigger` up to the leading edge of `Strobe`.

See also: "Single Cycle" on page 209 for more explanations and timing diagrams

Cycle-to-cycle timing

The `AllowNextCycle` event is used by the Cycle Manager to determine when the next Cycle may start.

The position of the `AllowNextCycle` event is not directly set by the user. Instead, it is evaluated by the driver according to the following user settings:

- The `ExposureReadoutOverlap` feature of the Camera Model category defines if the camera supports or not the exposure/readout overlapping. If overlapping is allowed, the `AllowNextCycle` event is issued earlier and faster cycle rates are obtained.
- The `ExposureRecoveryTime` feature of the Camera Model category defines the minimum time gap required by the camera between two exposures. This feature is relevant when `ExposureReadoutOverlap = TRUE` and the duration of the exposure phase becomes larger than the duration of the readout phase.
- The `CycleMinimumPeriod` of the Cycle Control category defines the minimum cycle period. This value may not be smaller than the time required by the camera to perform the image readout!



NOTE

Some cameras have a data store in the image data path. This enables capturing bursts of images at a higher cycle-to-cycle rate than the camera-to-frame grabber data link can sustain. In that case, `CycleMinimumPeriod` declares the smallest cycle-to-cycle time that the image sensor can achieve!

See also: "Overlapping Cycles - Single timing" on page 211 for more explanations and timing diagrams.

Cycle Manager

The Cycle Manager is responsible for the generation of the `Cycle Start` event.

It prevents initiating a new cycle while the *cycle start conditions* listed hereafter are not satisfied:

Sequence Active Condition

The Sequence Manager must be in the ACTIVE state: the sequence has started and the sequence stop condition has not yet been reached.

This condition always applies.

Next Cycle Allowed Condition

The Cycle Timing Machine has already issued the `Allow Next Cycle` event of the previous cycle.

This condition always applies.

Free Memory Condition

There is enough free memory on board to acquire the image data of the next cycle.

This condition always applies.

Cycle Trigger Event Condition

A new Cycle Trigger event is required to initiate a new cycle.

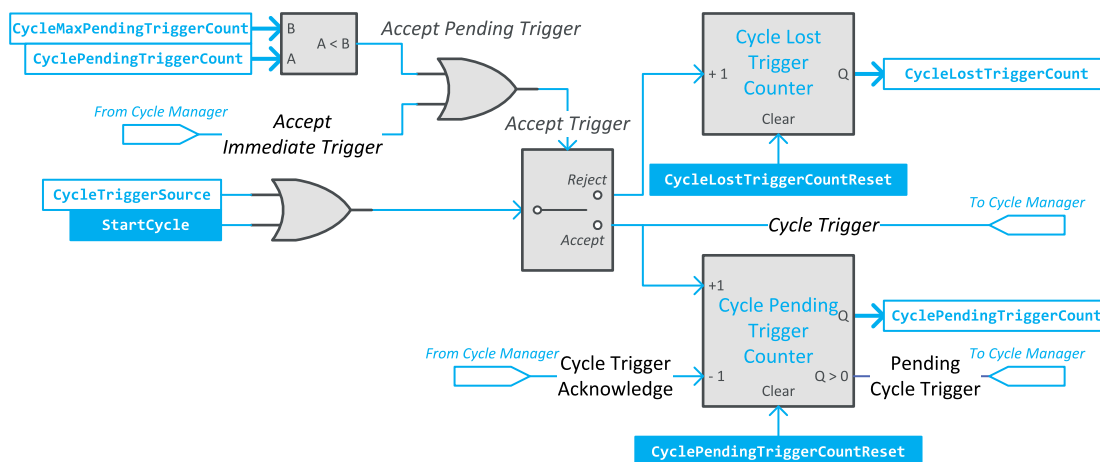
This condition applies only when `Cycle TriggerSource` \neq `Immediate` AND `CycleMaxPendingTriggerCount` = 0.

Pending Trigger Condition

There is at least one pending trigger (possibly a new one) waiting for service.

This condition applies only when `Cycle TriggerSource` \neq `Immediate` AND `CycleMaxPendingTriggerCount` > 0.

Cycle Trigger Manager



CIC Cycle Trigger Manager block diagram

The Cycle Trigger Manager is responsible, in collaboration with the Cycle Manager, to elaborate the effective *Cycle Trigger* event that initiates one cycle of the CIC timing machine.

Cycle Trigger Sources

The source of Cycle Trigger is defined by **CycleTriggerSource**.

When set to **Immediate**, the Cycle Trigger Manager is self-triggered. It generates a Cycle Trigger immediately after the start of the sequence and then repeatedly every **CycleMinimumPeriod** period.

When set to **StartCycle** or to *<any I/O toolbox event source>* the Cycle Trigger Manager doesn't start immediately after the start of the sequence, instead it waits for the execution of a **StartCycle** command or the occurrence of an event on the selected I/O toolbox event source.

A wide set of Cycle Trigger event sources is available. It includes all the I/O toolbox events, namely: LIN, QDC, MDV, DIV, DEL, EIN and User Events.

Cycle Trigger Latch Mechanism

The Cycle Manager is fitted with a trigger latch mechanism capable of latching cycle triggers that cannot be served immediately. Such triggers are named "pending triggers" since their execution is simply postponed until the corresponding CIC cycle is initiated.

The maximum number of pending triggers that can be recorded is defined by **CycleMaxPendingTriggerCount**. When **CycleMaxPendingTriggerCount = 0**, the trigger latching mechanism is disabled. This is the default value. To enable the trigger latching mechanism, set **CycleMaxPendingTriggerCount** to any integer value in range 1 to 7.

The number of pending triggers is reported by **CyclePendingTriggerCount**.

Cycle Trigger Events Sorting

When `CycleTriggerSource` is set to `StartCycle` or to *<any I/O toolbox event source>*, every Cycle Trigger event is evaluated against the *trigger acceptance criteria* and sorted according to the result.

The rejected Cycle Trigger events increment the *Cycle Lost Trigger Counter*.

The accepted Cycle Trigger events increment the *Cycle Pending Trigger Counter* if the pending trigger cannot be served immediately.

Trigger Acceptance Criteria

Cycle Trigger events are *accepted and executed immediately* when both conditions are satisfied:

- Cycle Sequence is active
- Cycle Manager is currently waiting for an immediate trigger event to start a new cycle (Accept Immediate Trigger)

Cycle Trigger events are *accepted and executed later* when following conditions are satisfied:

- Cycle Sequence is active.
- The number of pending triggers, `CycleMaxPendingTriggerCount`, is less than `CycleMaxPendingTriggerCount`.
- The Cycle Manager is not (yet) ready to initiate new cycle.

Sequence Manager

The *Sequence Manager* is the top-level manager of the CIC: It controls the Cycle Trigger Manager and the Cycle Manager.

It defines sequences of identical CIC cycles according to user-defined start sequence and stop sequence conditions.

Starting a Sequence

The conditions for starting a sequence are defined by `StartOfSequenceTriggerSource`.

When `StartOfSequenceTriggerSource` is set to `Immediate` (default setting), the Sequence Manager doesn't require any further action to allow the Cycle Manager and the Cycle Trigger Manager to proceed with the first cycle.

Depending on the `CycleTriggerSource` settings of the Cycle Manager the first cycle will be executed:

- Immediately when `CycleTriggerSource` is set to `Immediate`
- On execution of the `StartCycle` command when `CycleTriggerSource` is set to `StartCycle` or
- On execution of the `StartCycle` command or when an event occurs on the I/O toolbox event source designated by `CycleTriggerSource`.

When `StartOfSequenceTriggerSource` is set to `StartSequence`, the Sequence Manager waits for the execution of a `StartSequence` command before allowing the Cycle Manager and the Cycle Trigger Manager to proceed with the first cycle.

When `StartOfSequenceTriggerSource` is set to `<any-event-source>`, the Sequence Manager waits for the execution of a `StartSequence` command or the occurrence of an I/O toolbox event on the designated event source before allowing the Cycle Manager and the Cycle Trigger Manager to proceed with the first cycle.

Stopping a sequence

The conditions for stopping a sequence are defined by `EndOfSequenceTriggerSource`.

When `EndOfSequenceTriggerSource` is set to `StopSequence` (default setting), the Sequence Manager stops the sequence at the next cycle boundary after the execution of a `StopSequence` command.

When `EndOfSequenceTriggerSource` is set to `SequenceLength`, the Sequence Manager stops automatically the sequence after having executed a number of camera cycles specified by `SequenceLength`. The sequence can be stopped anticipatively on execution of the `StopSequence` command. The default `SequenceLength` value is 1; any value up to 16,777,215 is allowed.

When `EndOfSequenceTriggerSource` is set to `<any-event-source>`, the Sequence Manager waits for the execution of a `StopSequence` command or the occurrence of an I/O toolbox event on the designated event source before stopping the sequence at the next cycle boundary.

NOTE: Any combination of `StartOfSequenceTriggerSource` and `EndOfSequenceTriggerSource` settings is allowed.

Changing sequence length while camera is grabbing

Starting with release 10.5, if **SequenceLength** is changed between start-of-sequence and end-of-sequence events, the new value will be effective for the subsequent sequence.

NOTE: The value of **SequenceLength** is latched at the start-of-sequence event.

CIC Output Signals Routing

Camera Trigger signal

The frame grabber controls the camera cycle of an asynchronous reset camera by means of the **Camera Trigger** signal.

The signal can be transmitted from the frame grabber to the camera using one of the following media:

- The I/O channel of the CoaXPress link.
- A dedicated wiring driven by a TTL I/O

CoaXPress I/O channel

The **Camera Trigger** signal is transmitted to the camera as a high-priority Host to Device Trigger message on the CoaXPress I/O channel

TTL I/O Line

Any TTL I/O line can be configured as a **Camera Trigger** output. The polarity control of the I/O control block provides an individual polarity control for each I/O port. The mode control of the I/O control block of TTLIO lines provides an individual output driver configuration.

Strobe signal

Every output capable I/O line can be configured as an Illumination **Strobe** output. The polarity control of the I/O control block provides an individual polarity control for each I/O port. The mode control of the I/O control block of TTLIO lines provides an individual output driver configuration for each I/O port used as strobe output.

9.4. CIC Timing Diagrams

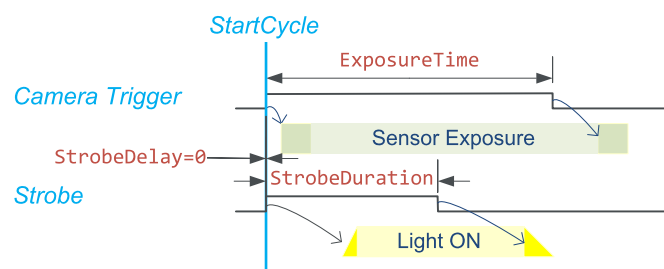
Single Cycle	209
Overlapping Cycles - Single timing	211
Cycle Sequence Timing Diagrams	216

Single Cycle

Timing diagrams of single CIC cycles

This topic shows timing diagrams of individual CIC cycles and illustrates the **ExposureTime**, **StrobeDuration** and **StrobeDelay** features for 3 use cases corresponding to positive, zero and negative values of **StrobeDelay**.

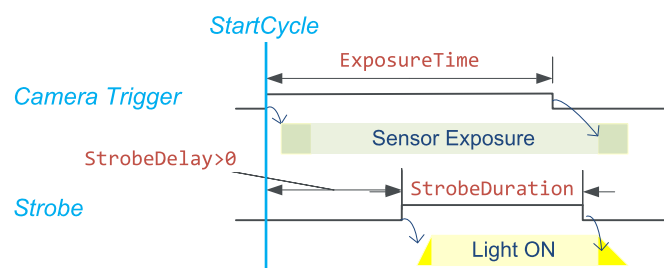
In-phase Strobe



In-phase Strobe signal

The **Camera Trigger** and the **Strobe** signals goes high immediately after the **StartCycle** event .

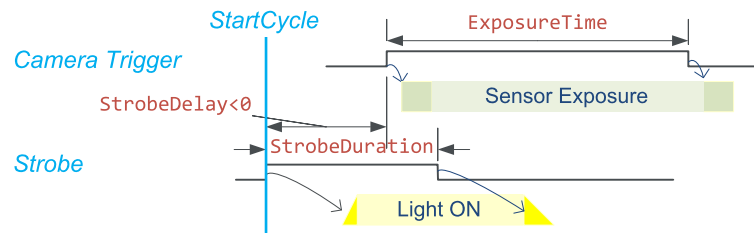
Late Strobe



Late Strobe signal

The **Camera Trigger** signal goes high immediately after the **StartCycle** event and the **Strobe** signal goes high after **StrobeDelay** microseconds.

Early Strobe



Early Strobe signal

The **Strobe** signal goes high immediately after the **StartCycle** event and the **Camera Trigger** signal goes high after a time delay equal to the opposite value of **StrobeDelay** microseconds.

Overlapping Cycles - Single timing

Timing diagrams of overlapping CIC cycles with identical cycle timing definition

This topic describes the behavior of the CIC when it is configured to generate one sequence of 4 cycles, each with identical timings settings.

In the following timing diagrams, user-defined values are shown in red:

- c is the minimum cycle period defined by `CycleMinimumPeriod`,
- d is the `Strobe` delay defined by `StrobeDelay`,
- e is the `Camera Trigger` pulse width defined by `ExposureTime`,
- r is the minimum time interval between consecutive exposure defined by `ExposureRecoveryTime`,
- s is the `Strobe` pulse width defined `StrobeDuration`.

In the following timing diagrams, values calculated by the driver are shown in blue:

- a is the CIC cycle duration,
- f is the time interval between consecutive `Camera Trigger` pulses,
 - the `Strobe` pulse width. This is the value of `StrobeDuration` set by the user.

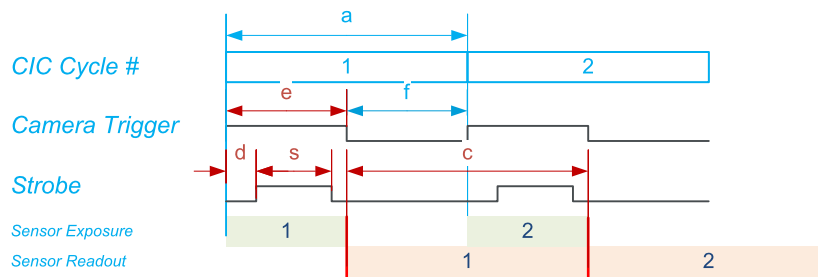
The driver calculates the duration of the CIC Cycle (a value) from the user-defined settings `ExposureTime`, `ExposureRecoveryTime` and `CycleMinimumPeriod` by searching the smallest value satisfying the following conditions:

- *Condition 1:* The time interval between consecutive `Camera Trigger` pulses (f value) must be greater than or equal to the `ExposureRecoveryTime` settings (r value). This ensures that the `Camera Trigger` properly flows through the trigger transmission link. It ensures also that a new exposure doesn't begin before the completion of the previous one.
- *Condition 2:* The CIC Cycle duration (a value) must be big enough to ensure that a new readout doesn't begin before the completion of the previous one.
- *Condition 3:* The CIC Cycle duration (a value) must be big enough to include both transitions of the `Camera Trigger` and the `Strobe` signal.

The "Readout-limited" use cases illustrate situations where the cycle period is equal to the duration of the readout phase.

The "Exposure-limited" use cases illustrate situations where the cycle period is equal to the duration of the exposure phase.

Case 1: Readout-limited - Late Strobe



The camera cycle rate is only limited by the camera readout time

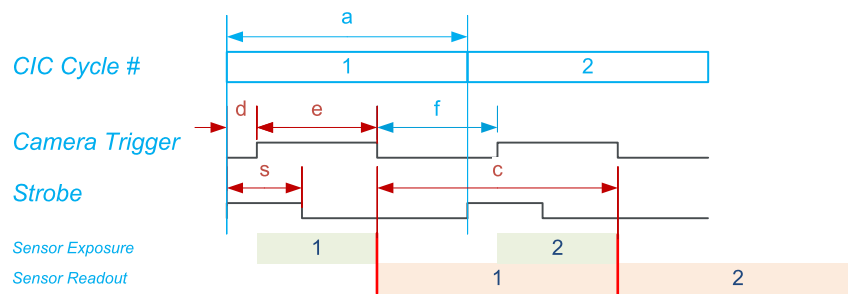
This situation occurs when the exposure time (*e* value) is significantly smaller than the readout duration (*c* value). In that situation:

- *f* is likely larger than `ExposureRecoveryTime`: *Condition 1* is fulfilled.
- The strobe pulse being "inside" the `Camera Trigger` pulse: *Condition 3* becomes irrelevant when *Condition 1* is fulfilled.
- The *Condition 2* is the only condition used by the driver to calculate the cycle duration.

The optimal duration of the CIC Cycle is equal to the effective duration of the sensor readout phase. This is obtained when the user sets `CycleMinimumPeriod` to a value corresponding to the readout duration.

NOTE: The readout duration can be derived from the maximum frame rate specification of the camera data sheet or experimentally.

Case 2: Readout-limited - Early Strobe



The camera cycle rate is only limited by the camera readout time (despite the early strobe)

This situation is similar to the case 1. It shows that despite an early strobe, it is possible to reach the maximum cycle rate of the camera.

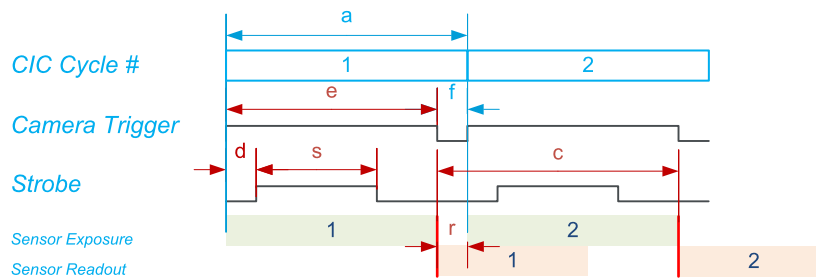
This situation occurs when the exposure time (*e* value) is significantly smaller than the readout duration (*c* value). In that situation:

- *f* is likely larger than `ExposureRecoveryTime`: *Condition 1* is fulfilled.
- The strobe pulse being terminating before the `Camera Trigger` pulse: *Condition 3* is fulfilled if *r* is greater than *d*. This is the case when $(d + e < c)$.
- The *Condition 2* is the only condition used by the driver to calculate the cycle duration.

The optimal duration of the CIC Cycle is equal to the effective duration of the sensor readout phase. This is obtained when the user sets `CycleMinimumPeriod` to a value corresponding to the readout duration.

NOTE: The readout duration can be derived from the maximum frame rate specification of the camera data sheet or experimentally.

Case 3: Exposure-limited - Late Strobe



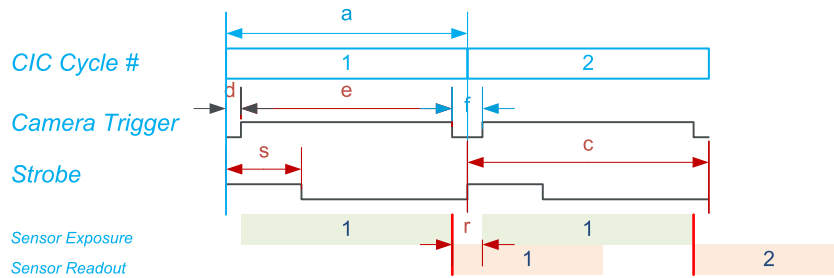
The camera cycle rate is limited by the exposure time settings

This situation occurs when the exposure time (e value) is significantly larger than the readout duration (c value). In that situation:

- All cycles being identical, having the readout duration smaller than the exposure duration, implies that *Condition 2* becomes irrelevant.
- The strobe pulse being "inside" the Camera Trigger pulse: *Condition 3* becomes irrelevant when *Condition 1* is fulfilled.
- The *Condition 1* is the only condition used by the driver to calculate the cycle duration .

The optimal duration of the Cycle is equal to the effective duration of the exposure phase. This is obtained when the user sets **ExposureRecoveryTime** to a value corresponding to the minimal time interval allowed by the camera between consecutive Camera Trigger pulses.

Case 4: Exposure-limited- Early Strobe



The camera cycle rate is limited by the exposure time settings (despite the early strobe)

This situation is similar to the case 3. It shows that despite an early strobe, it is possible to reach the same cycle rate in case of small negative **StrobeDelay** values.

This situation occurs when the exposure time (**e** value) is significantly larger than the readout duration (**c** value). In that situation:

- All cycles being identical, having the readout duration smaller than the exposure duration implies that *Condition 2* becomes irrelevant.
- The strobe pulse terminating before the **Camera Trigger** pulse: *Condition 3* becomes irrelevant when *Condition 1* is fulfilled and $d < r$.
- *Condition 3* and *Condition 1* are the only condition used by the driver to calculate the cycle duration.

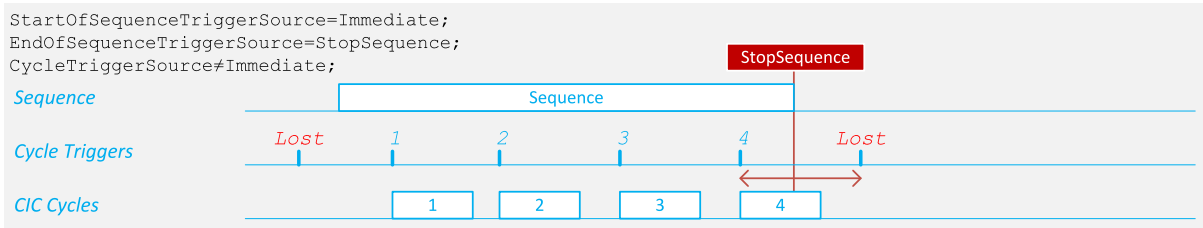
The user must set **ExposureRecoveryTime** to a value corresponding to the largest of the following two values:

- Minimal time interval allowed by the camera between consecutive **Camera Trigger** pulses.
- Opposite value of **StrobeDelay**.

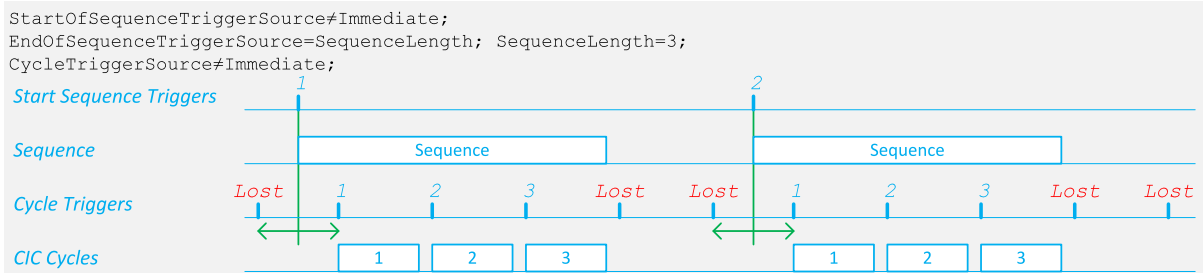
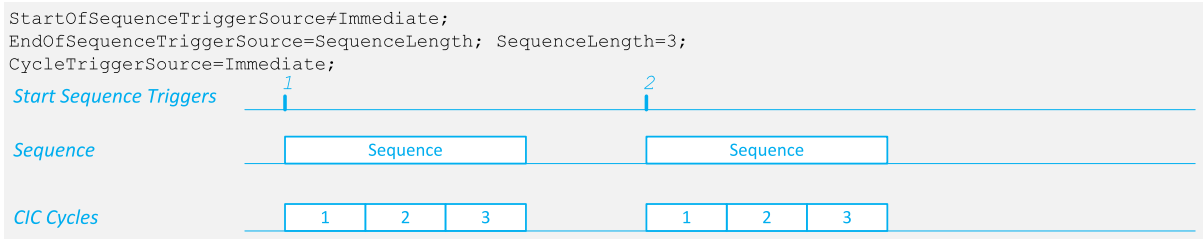
NOTE: When **CycleTriggerSource** = **Immediate**, the cycle rate can be lowered to the desired rate by assigning a greater value to **CycleMinimumPeriod**.

Cycle Sequence Timing Diagrams

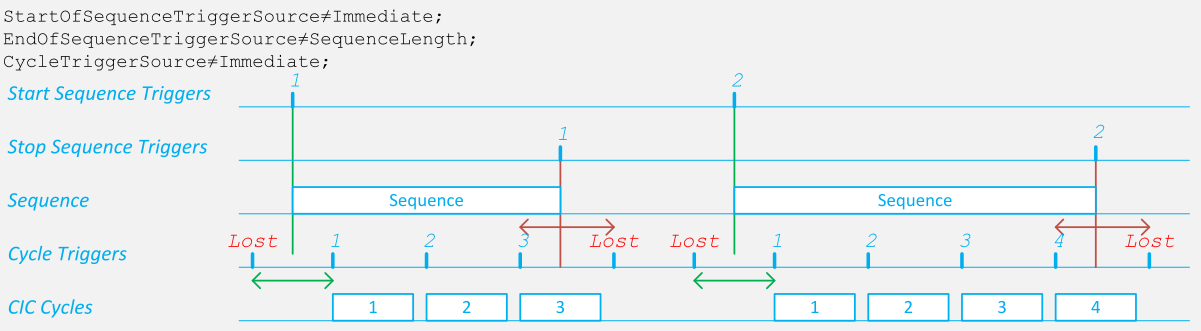
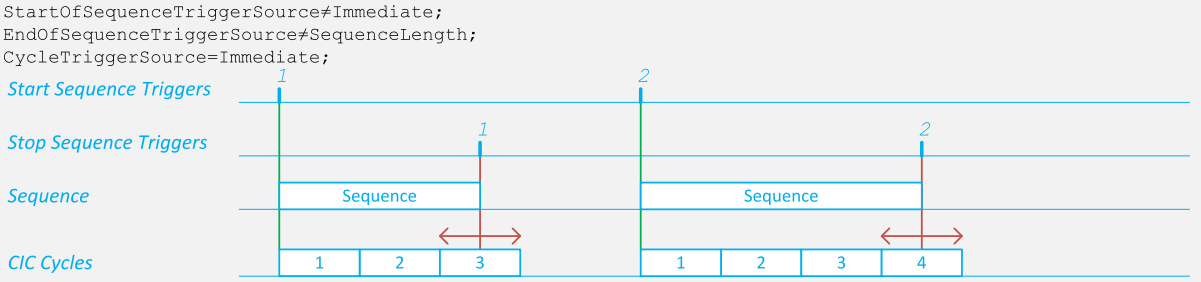
Timing diagrams of sequences of CIC cycles



Cycle sequences with immediate start



Cycle sequences with triggered start and fixed length



Cycle sequences with triggered start and triggered end

10. General Purpose I/O

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10.1. I/O Lines Overview

General Purpose I/O lines overview in Coaxlink and Grablink Duo frame grabbers

GPIO lines in GenApi

The **LineSelector** feature of the **Coaxlink and Grablink Duo frame grabbers** Interface Modules exposes:

- 2 **Standard I/O sets** of **10** I/O lines named **DIN****, **IIN****, **IOUT**** and **TTLIO****
- 1 **Module I/O set** of **40** I/O lines named **MIO****

Standard I/O set

Each *Standard I/O Set* is composed of 10 I/O lines:

I/O Line Type	I/O Line Names	Count
Isolated input	IINx1, IINx2, IINx3, IINx4	4
Isolated output	IOUTx1, IOUTx2	2
RS-422 input	DINx1, DINx2	2
TTL I/O	TTLIOx1, TTLIOx2	2
Total		10

NOTE: x is the instance number: 1 for the first instance; 2 for the second instance.

Module I/O set

I/O Line Type	I/O Line Names	Count
See note (1)	MIO1 ... MIO40	40



NOTE

(1) The mix of I/O line types is defined by the attached extension.

GPIO lines per product

The number of effectively available GPIO lines is defined by the frame grabber configuration:

- A frame grabber includes 0, 1 or 2 "**Standard I/O set**" on page 219.
- A selection of frame grabbers with less than 2 "**Standard I/O set**" on page 219 accepts one extension module with an additional Standard I/O set.
- Frame grabbers with an I/O extension connector may accept one I/O Extension module.

The following table summarizes the capabilities:

Product	Standard I/O sets		Module I/O set
	#1	#2	
1628 Grablink Duo	On-board	On-board	See note (3)
1629 Coaxlink Duo PCIe/104-EMB	See note (1)	N/A	N/A
1630 Coaxlink Mono	On-board	N/A	N/A
1631 Coaxlink Duo	On-board	On-board	N/A
1632 Coaxlink Quad	On-board	On-board	N/A
1633 Coaxlink Quad G3	On-board	On-board	N/A
1633-LH Coaxlink Quad G3 LH	On-board	On-board	N/A
1635 Coaxlink Quad G3 DF	On-board	N/A	N/A
1637 Coaxlink Quad 3D-LLE	On-board	On-board	N/A
3602 Coaxlink Octo	On-board	See note (2)	See note (3)
3603 Coaxlink Quad CXP-12	On-board	On-board	See note (3)
3603-4 Coaxlink Quad CXP-12	On-board	On-board	See note (3)
3620 Coaxlink Quad CXP-12 JPEG	On-board	On-board	See note (3)
3620-4 Coaxlink Quad CXP-12 JPEG	On-board	On-board	See note (3)
3621 Coaxlink Mono CXP-12	On-board	See note (2)	See note (3)
3621-LH Coaxlink Mono CXP-12 LH	On-board	See note (2)	See note (3)
3622 Coaxlink Duo CXP-12	On-board	See note (2)	See note (3)
3622-LH Coaxlink Duo CXP-12 LH	On-board	See note (2)	See note (3)
3623 Coaxlink Quad CXP-12 Value	On-board	On-board	See note (3)
3624 Coaxlink Quad CXP-12 DF	On-board	See note (2)	See note (3)
3625 Coaxlink QSFP+	On-board	On-board	See note (3)

1. (1) Attach a **3300 HD26F I/O module for Coaxlink Duo PCIe/104** to the Extension Connector to obtain the first "Standard I/O set" on page 219 instance.

See also: [3300/3302 Accessories for Coaxlink Duo PCIe/104](#) in the hardware manual for more information.

2. (2) Attach one of the following I/O extension modules to the [I/O extension connector](#):
 - **3614 HD26F I/O Extension Module - Standard I/O Set** to obtain the second "Standard I/O set" on page 219 instance.
 - **3618 HD26F I/O Extension Module - Fast I/O** to obtain the second "Standard I/O set" on page 219 instance with faster IIN** isolated input lines.

See also: [3618 I/O Extension Module](#) in the hardware manual for more information.

3. (3) Attach one of the following I/O extension modules to the [I/O extension connector](#):
 - **3610 HD26F I/O Extension Module - TTL-RS422** to obtain up to a configurable mix of TTL and RS422 I/O lines: the "[3610/3612 Module I/O set](#)" on page 221.
 - **3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422** to obtain up to a configurable mix of TTL/CMOS5V and RS422 I/O lines: the "[3610/3612 Module I/O set](#)" on page 221.

See also: "3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422" on page 381 in the hardware manual for more information.



WARNING

Only one module can be attached to the I/O extension connector!

GPIO lines electrical style

See also: "I/O Interfaces" on page 345 in the hardware manual for more information about the electrical styles

3610/3612 Module I/O set

Compatible with ¹

Duo	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422 provide the "3610/3612 Module" I/O set:

I/O Line Type	I/O Line Names	Count
RS-422 input	MIO1, MIO3...MIO19	0 to 10
RS-422 output	MIO1, MIO3...MIO19	0 to 10
TTL input	MIO1, MIO2...MIO20	0 to 20
TTL output (3610) CMOS output (3612)	MIO1, MIO2...MIO20	0 to 20
Total		10 RS-422 0 TTL/CMOS ... 0 RS-422 20 TTL/CMOS

¹ 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

10.2. I/O Lines Usage

Input lines

The input-capable I/O lines (DIN, TTLIO, IN, MIO) can be used as:

- General purpose input: An input signal whose state can be read or monitored by the host application.
- Motion encoder input: A pair of input signals delivered by a quadrature motion encoder and used for triggering the acquisition from the camera.
- Trigger input: An input signal used to trigger the acquisition from the camera.

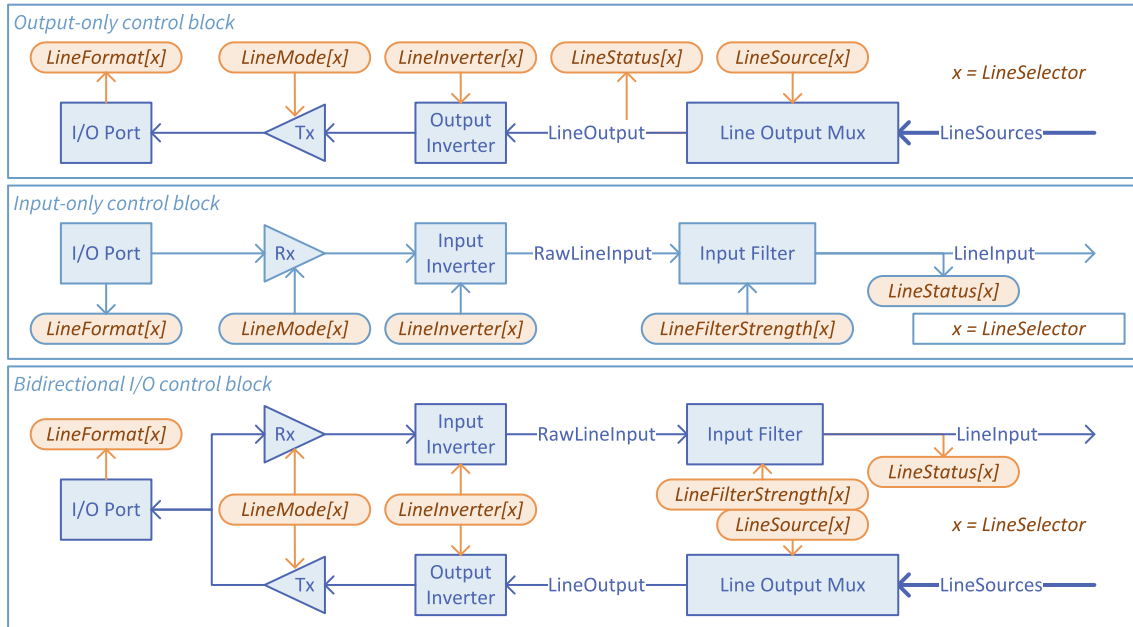
Output lines

The output-capable I/O lines (TTLIO, IOOUT, MIO) can be used as:

- General purpose output: An output signal whose state can be set by the host application.
- Strobe output: An output signal usually used to control a strobe light, in synchronization with the camera.
- Camera trigger output (only available on TTLIO): An output signal generated by the frame grabber and used to trigger the camera.

10.3. I/O Control Blocks

Every I/O line is controlled through one I/O control block. There are 3 types of control block depending on the input / output capabilities of the I/O line:



In the above figures:

- A thin blue line represents one individual electrical signal path
- A thick blue line represents a collection of electrical signal paths
- The blue arrowhead shows the propagation direction of the electrical signal(s)
- A blue shape represents a functional element of the I/O control block
- An orange (oval) shape represents a GenApi feature; the text inside being the feature name
- An [x] appended to the feature name indicates that the feature is associated with a selector feature (in this case: LineSelector)
- The orange arrowhead indicates the access-mode of the feature: read-only features having incoming arrows, writable features having an outgoing arrow.

Input path

Input-only and bidirectional I/O lines share a common input path structure including:

- The I/O port block representing the I/O pins on the I/O connector(s)
- The Rx block representing the line receiver circuit
- The Input Inverter block representing the user-configurable logic inverter
- The Input Filter block representing the user-configurable glitch-removal filter

Output path

Output-only and bidirectional I/O lines share a common output path structure including:

- The I/O port block representing the I/O pins on the I/O connector(s)
- The Tx block representing the line driver circuit
- The Output Inverter block representing the user-configurable logic inverter
- The Line Output Mux block representing the user-configurable source multiplexer

10.4. Line Format and Line Mode Controls

Introduction

The following tables summarize the details of the I/O Control blocks of each I/O line:

- The first column indicates the **LineSelector** value
- The second column indicates the bit position in the integer value reported by **LineStatusAll**
- The third column indicates the value reported by **LineFormat**
- The fourth column indicates the values that can be assigned to **LineMode**

Standard I/O sets

Standard I/O set #1

LineSelector	Bit#	LineFormat	LineMode
DIN11	0	DIFF	Input
DIN12	1	DIFF	Input
IIN11	4	ISO	Input
IIN12	5	ISO	Input
IIN13	6	ISO	Input
IIN14	7	ISO	Input
IOUT11	12	ISO	Output
IOUT12	13	ISO	Output
TTLIO11	16	TTL	Input, Output, DriveLow or DriveHigh
TTLIO12	17	TTL	Input, Output, DriveLow or DriveHigh

Standard I/O set #2

LineSelector	Bit#	LineFormat	LineMode
DIN21	1	DIFF	Input
DIN22	3	DIFF	Input
IIN21	8	ISO	Input
IIN22	9	ISO	Input
IIN23	1	ISO	Input
IIN24	11	ISO	Input
IOUT21	14	ISO	Output
IOUT22	15	ISO	Output
TTLIO21	18	TTL	Input, Output, DriveLow or DriveHigh
TTLIO22	19	TTL	Input, Output, DriveLow or DriveHigh

TTLIO ports mode control

The **LineMode** feature controls the direction and the line driver mode of each individual TTLIO port. Four modes can be selected at any time:

- **Input**: input only, totem-pole driver disabled (default power-up settings),
- **Output**: totem-pole driver capable of driving low and high,
- **DriveLow**: open-collector driver capable of driving low only,
- **Drivehigh**: open-emitter driver capable of driving high only.



NOTE

The two latest configurations allow wired-AND configurations. The line state can be read back through the input port.

I/O modules

3610/3612 I/O Extension modules

LineSelector	Bit#	LineFormat	LineMode
MIO1	20	TTL or DIFF	Input or Output
MIO2	21	TTL	Input or Output
:	:	:	:
MIO19	38	TTL or DIFF	Input or Output
MIO20	39	TTL	Input or Output

MIO format and mode controls

The **LineFormat** feature controls the electrical style of the MIO ports. Possible values:

- **TTL**: single-ended (TTL or CMOS)
- **DIFF**: differential (RS422)

The **LineMode** feature controls the direction of the MIO ports. Possible values::

- **Input**: input only,
- **Output**: totem-pole driver capable of driving low an high.



NOTE

The controls can only be changed during the module configuration .

See also: "3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422" on page 381 for an extensive description of the configuration.

10.5. Line Polarity Control

All the I/O lines are fitted with a polarity control. For bidirectional I/O lines, a single control affects equally both paths.

The line polarity is user-configurable through the **LineInverter** control.



NOTE

The user is invited to set the polarity control according to the polarity of the external signal in such a way that the *Line Input* signals of the input path and the *LineSources* signals of the output path are always using positive logic.

10.6. Line Filter Control

All the I/O input lines are fitted with a glitch-removal filter.

The filter strength is user-configurable through the `LineFilterStrength` control:

- When set to `Custom`, the filter time constant is configurable by setting `LineFilterDelay` to the desired value.
- When set to another value (`Lowest`, ... `Highest`):
 - the filter time constant is preset according to the selected strength and the I/O input line type (as shown hereafter)
 - the actual filter time constant is reported by `LineFilterDelay`

The default settings is `Lowest`.

LineFilterStrength	Differential inputs (DIN)	TTL inputs (TTLIO)	Isolated Inputs (IIN)
Lowest	50 ns	50 ns	500 ns
Low	100 ns	100 ns	1 μ s
Medium	200 ns	200 ns	2 μ s
High	500 ns	500 ns	5 μ s
Highest	1 μ s	1 μ s	10 μ s



TIP

The user is invited to set the filter strength according to the quality of the external signal. Select a filter strength such that its time constant is:

- Greater than the longest glitch duration
- Greater than the 10%~90% rise/fall time of the signal
- At least 2 times smaller than the smallest signal pulse duration



NOTE

The glitch removal filter introduces a latency into the input signal path. The latency is equal to the filter time constant when the incoming signal has clean transitions. The latency may increase significantly in case of bad quality signals.

10.7. Line Source Selection

Any output-capable I/O lines is fitted with a source signal multiplexer.

The source signal multiplexers implement a fully-populated signal routing matrix allowing a selection of internal signals to be routed to any output lines.

Selecting a line source

To select an internal signal to feed the line driver of an output capable I/O line:

1. Select an I/O line by assigning the appropriate value to the **LineSelector** feature
2. Assign the appropriate value to the **LineSource** feature:

LineSource feature value	Source signal
UserOutput<0:7>	Any bit of the User Output register
Device<0:7>Strobe	Strobe output of any device
Device<0:7>CameraTrigger	Camera trigger of any device
Device<0:7>Stream<0:7>StartOfCameraReadout	StartOfCameraReadout event* ¹ on any stream of any device
Low	Steady low
High	Steady high



NOTE

*¹ The *StartOfCameraReadout* event corresponds to a pulse of 344 ns.

10.8. Logical I/O Line State

Logical I/O line state

The (logical) state of an I/O line is the logical state of an electrical signal of the I/O control block:

- For input-capable I/O lines: the *LineInput* signal: a point in the input path of the I/O control block that is located after the Input Inverter.
- For output-only I/O lines: the *LineOutput* signal, a point in the output path of the I/O control block that is located before the Output Inverter.

Getting the state of a single I/O line

1. *Step 1:* Select an I/O line by assigning the appropriate value to the **LineSelector** feature
2. *Step 2:* Obtain directly the line status by getting the value of the **LineStatus** feature

Getting the state of all I/O lines in a single operation

Get the value of the **LineStatusAll** feature.

Each bit of the integer corresponds to an I/O line. A bit at one corresponds to a line logical state being high.

10.9. Physical I/O Line State

The physical state of the I/O line state does not only depend on the value reported when reading LineStatus but also on the following I/O block settings: LineFormat, LineMode, and LineInverter

LineFormat	LineMode	LineInverter/LineStatus	Physical I/O line state
DIFF	Input	False/False or True/True	$(VIN+ - VIN-) < VThreshold$
		False/True or True/False	$(VIN+ - VIN-) > VThreshold$ or unconnected I/O line
ISO	Input	False/False or True/True	Opto coupler is OFF. The line current is < 1 mA. <i>Line may be left unconnected or connected with the wrong polarity.</i>
		False/True or True/False	Opto coupler is ON. The line current is > 1 mA.
ISO	Output	False/False or True/True	Opto coupler is OFF
		False/True or True/False	Opto coupler is ON
TTL	Input	False/False or True/True	The line voltage is < 0.8 Volt.
		False/True or True/False	The line voltage is > 2.0 Volt.
TTL	Output	False/False or True/True	The line is driven LOW.
		False/True or True/False	The line is driven HIGH.
TTL	DriveLow	False/False or True/True	The line is driven LOW.
		False/True or True/False	The line voltage is > 2.0 Volt.
TTL	DriveHigh	False/False or True/True	The line voltage is < 0.8 Volt.
		False/True or True/False	The line is driven HIGH.

10.10. Line Driver Physical Output States

The line driver output state depends not only on the logical level of the selected Line Output signal but also on the following I/O block settings: LineFormat, LineMode, and LineInverter.

LineFormat	LineMode	LineInverter / LineOutput logical level	Line driver output state
ISO	Output	False / low or True / high	The opto-coupler switch is turned OFF.
		False / high or True / low	The opto-coupler switch is turned ON.
TTL CMOS	Output	False / low or True / high	The I/O line is driven LOW.
		False / high or True / low	The I/O line is driven HIGH.
TTL	DriveLow	False / low or True / high	The I/O line is driven LOW.
		False / high or True / low	The I/O line is not driven.
TTL	DriveHigh	False / low or True / high	The I/O line is not driven.
		False / high or True / low	The I/O line is driven HIGH.

10.11. Initial States

At power-on, the I/O lines are in the following state:

Differential Inputs

- LineInverter = **False**,
- LineFilterStrength = **Low**.

TTL Inputs/outputs

- LineMode = **Input** (The line is not driven),
- LineInverter = **False**,
- LineFilterStrength = **Low**.

Isolated Inputs

- LineInverter = **False**,
- LineFilterStrength = **Low**.

Isolated Outputs

- LineInverter = **False**,
- LineFilterStrength = **Low**,
- The opto-coupler is **OFF**.

11. I/O Toolbox

11.1. Introducing the I/O Toolbox	236
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11.6. C2C-Link Synchronization Tool	255
11.7. Delay Tool	257
11.8. Divider Tool	259
11.9. Multiplier/Divider Tool	260

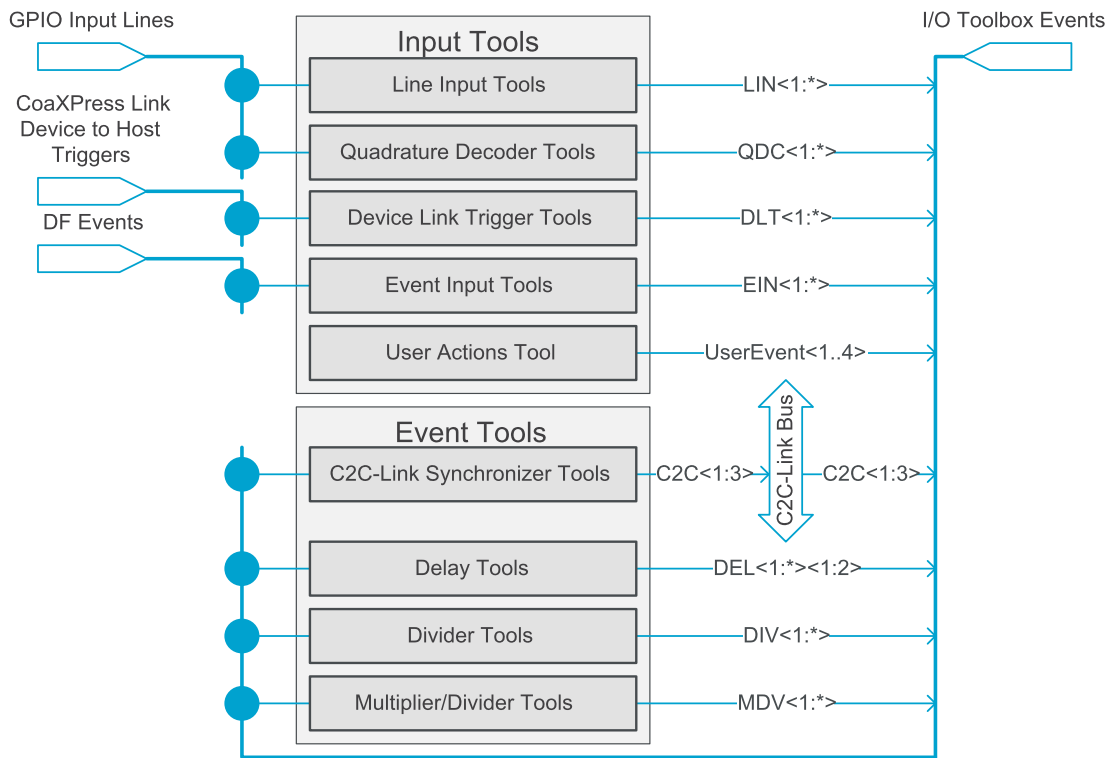
11.1. Introducing the I/O Toolbox

The *I/O Toolbox* is a configurable array of interconnected tools belonging to the GenTL Interface module.

Each tool generates one (or more) event stream. The stream name is composed of a prefix designating the tool (LIN, QDC, DLT...) followed by a 1-based index.

The *I/O Toolbox Events stream* are shared by various consumers on the card:

- The Camera and Illumination controller of any device belonging to the card for camera cycle triggering
- The Acquisition controller of any device belonging to the card for starting or stopping line-scan acquisition sequences
- Event counters



I/O Toolbox structure diagram

I/O Toolbox input tools

The *Input Tools* generate event streams from external sources.

1. The "[Line Input Tool](#)" on page 245 for use with sensors and detectors attached to a single GPIO input line.
2. The "[Quadrature Decoder Tool](#)" on page 246 for use with quadrature motion encoders attached to a pair of GPIO input lines.
3. The "[User Actions Tool](#)" on page 250 for use by the application software to generate user events.

A fully populated interconnection matrix allows:

- any *Line Input Tool* to be fed by any GPIO input line.
- any *Quadrature Decoder Tool* to be fed by a selection of GPIO input line pairs.
- any *Device Link Trigger Tool* to be fed by any CoaXPress Link Device to Host Trigger of any camera attached to the card.

I/O Toolbox event tools

The *Event Tools* process internal events generated by any *I/O Toolbox* tool

1. The "[C2C-Link Synchronization Tool](#)" on page 255 delivers one event stream to the C2C-Link Bus driver.
2. The "[Delay Tool](#)" on page 257 delays the events of one (or two) stream(s) by a configurable number of clock tick events.
3. The "[Divider Tool](#)" on page 259 divides the event rate by an integer factor D.
4. The "[Multiplier/Divider Tool](#)" on page 260 converts the event rate by a rational factor M/D.

A fully populated interconnection matrix allows any *Event Tool* to be fed by any *I/O Toolbox* event stream

I/O Toolbox tools cascading

Tools can be cascaded to form a tool chain:

- A tool chain always begins with an Input Tool.
- A tool may drive 0, 1 or several Event Tools.

11.2. I/O Toolbox Composition Tables

Introduction

Each of the following tables show the composition of the I/O toolbox for all variants of the designated product.

Column Name	Description
Input Tools	I/O Toolbox input tools: - #LIN: Number of line input tools - #QDC: Number of quadrature decoder tools - #DLT: Number of device link trigger tools - #EIN: Number of event input tools - #UAS: Number of user actions scheduler tools
Event Tools	I/O Toolbox event tools: - #DEL: Number of delay tools - #DIV: Number of divider tools - #MDV: Number of multiplier/divider tools - #C2C: Number of C2C-Link synchronization tools



NOTE

An empty cell indicates that the corresponding tool type is not available.

1628 Grablink Duo

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, line-scan	8	2			1	2	2	2	3

1629 Coaxlink Duo PCIe/104-EMB

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2

1630 Coaxlink Mono

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2

1631 Coaxlink Duo

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, line-scan	8	2			1	2	2	2	3

1632 Coaxlink Quad

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2

1633 Coaxlink Quad G3

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, 4-data-stream	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
1-slm-camera	8	1			1	2	1	1	2
1-sls-camera	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, bayer	8	1			1				
2-camera, line-scan	8	2			1	2	2	2	3
3-camera	8	2			1	2	2	2	2
4-camera	8	4			1	4	4	4	2
4-camera, line-scan	8	4			1	4	4	4	3

1633-LH Coaxlink Quad G3 LH

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, 4-data-stream	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
1-slm-camera	8	1			1	2	1	1	2
1-sls-camera	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, bayer	8	1			1				
2-camera, line-scan	8	2			1	2	2	2	3
3-camera	8	2			1	2	2	2	2
4-camera	8	4			1	4	4	4	2
4-camera, line-scan	8	4			1	4	4	4	3

1635 Coaxlink Quad G3 DF

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-df-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
1-df-camera, line-scan	8	1		2	1	2	1	1	3

1637 Coaxlink Quad 3D-LLE

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2

3602 Coaxlink Octo

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	1	4		1	2	1	1	2
2-camera, line-scan	8	2	4		2	2	1	1	3
2-camera, line-scan, custom-logic	8	2	4		1	2	2	2	3
3-camera	8	1	6		1	2	1	1	2
4-camera	8	1	8		1	2	1	1	2
4-camera, line-scan	8	1	8		1	2	1	1	3
5-camera	8	1	10		1	2	1	1	2
5-camera, 5D22211	8	1	10		1	2	1	1	2
6-camera	8	1	12		1	2	1	1	2
8-camera	8	1	16		1	2	1	1	2

3603 Coaxlink Quad CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
1-camera, line-scan, custom-logic	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, custom-logic	8	1	4		1	2	1	1	2
2-camera, line-scan	8	2	4		1	2	2	2	3
2-camera, line-scan, custom-logic	8	2	4		1	2	2	2	3
4-camera	8	4	8		1	4	4	4	2
4-camera, custom-logic	8	4	8		1	4	4	4	2
4-camera, line-scan	8	4	8		1	4	4	4	3
4-camera, line-scan, custom-logic	8	4	8		1	4	4	4	3

3603-4 Coaxlink Quad CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
1-camera, line-scan, custom-logic	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, custom-logic	8	1	4		1	2	1	1	2
2-camera, line-scan	8	2	4		1	2	2	2	3
2-camera, line-scan, custom-logic	8	2	4		1	2	2	2	3
4-camera	8	4	8		1	4	4	4	2
4-camera, custom-logic	8	4	8		1	4	4	4	2
4-camera, line-scan	8	4	8		1	4	4	4	3
4-camera, line-scan, custom-logic	8	4	8		1	4	4	4	3

3620 Coaxlink Quad CXP-12 JPEG

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
4-camera	8	4	8		1	4	4	4	2

3620-4 Coaxlink Quad CXP-12 JPEG

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
4-camera	8	4	8		1	4	4	4	2

3621 Coaxlink Mono CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3

3621-LH Coaxlink Mono CXP-12 LH

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3

3622 Coaxlink Duo CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, line-scan	8	2	4		1	2	2	2	3

3622-LH Coaxlink Duo CXP-12 LH

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, line-scan	8	2	4		1	2	2	2	3

3623 Coaxlink Quad CXP-12 Value

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, line-scan	8	2	4		1	2	2	2	3
4-camera	8	4	8		1	4	4	4	2
4-camera, line-scan	8	4	8		1	4	4	4	3

3624 Coaxlink Quad CXP-12 DF

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	3
1-df-camera	8	1	2		1	2	1	1	3
1-camera, line-scan	8	1	2		1	2	1	1	3
1-df-camera, line-scan	8	1	2	2	1	2	1	1	3

3625 Coaxlink QSFP+

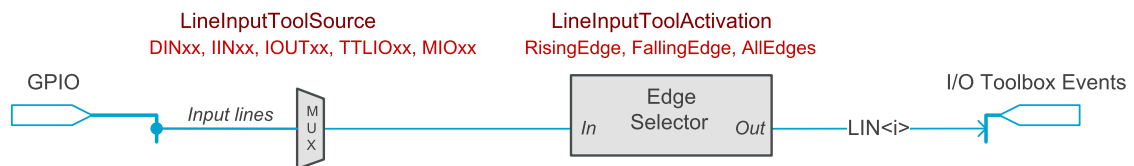
Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3

11.3. Line Input Tool

Applies to all firmware variants of **Coaxlink** and **Grablink Duo** frame grabbers

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Line Input Tool	LIN	1 GPIO input line	1 event stream: LIN<i>

Diagram



LIN tool functional and wiring diagram

Any input-capable GPIO line can be selected as the input source.

The tool feeds one I/O Toolbox event stream named LIN<i>.

Operation

The Line Input tool detects the rising or the falling edge of the `LineInput` signal delivered by the I/O Control block selected by `LineInputToolSource`.

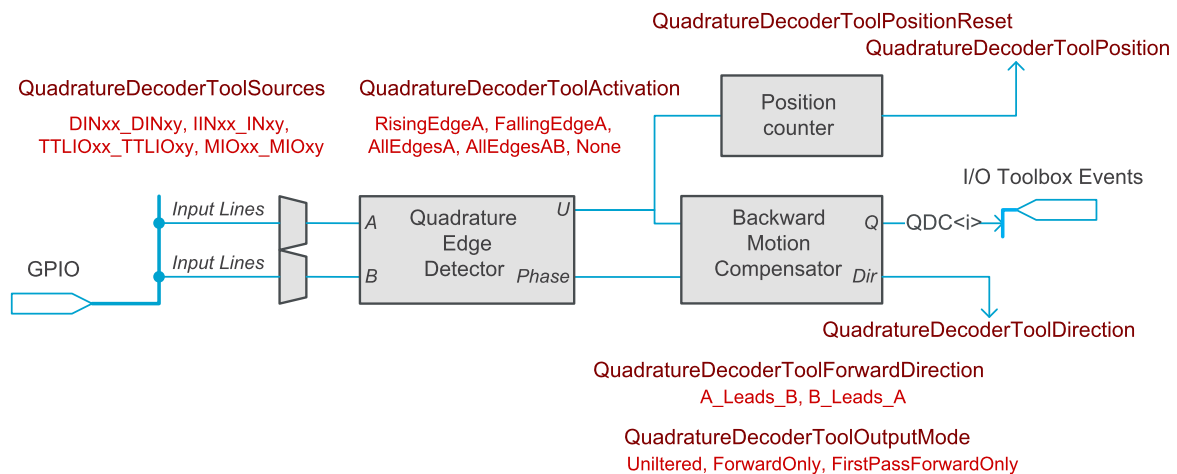
The Line Input tool delivers one event at every rising or falling edge or both according to the `LineInputToolActivation` settings.

11.4. Quadrature Decoder Tool

Applies to all firmware variants of **Coaxlink** and **Grablink Duo** frame grabbers

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Quadrature Decoder Tool	QDC	2 paired I/O input lines	1 event stream: QDC<i> 1 status bit: QDC<i>Direction 1 status word: QDC<i>Position

Diagram



QDC tool functional and wiring diagram

The quadrature edge detector is fed by a pair of signals named A and B delivered by a *phase-quadrature motion encoder* device.

The source selectors allows selected pairs of adjacent input-capable GPIO input lines to be selected as A/B input sources.

See also: "[QuadratureDecoderToolSources](#)" on page 583

The tool includes the following function blocks:

- A quadrature edge detector
- A backward motion compensator
- A position counter

The tool delivers:

- One I/O Toolbox event stream named QDC<i>.
- A *direction* status bit indicating the direction of the motion.
- A *position* status word indicating the position offset.

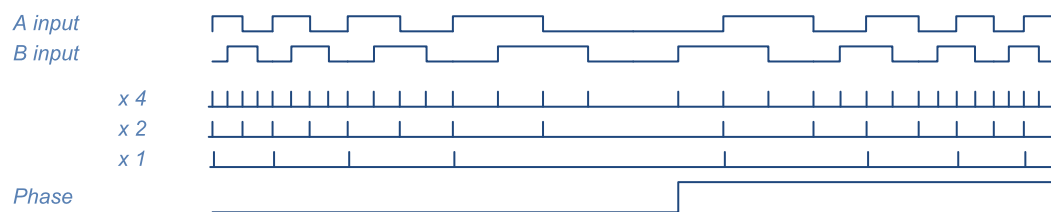
Operation

The Quadrature Decoder Tool decodes the A/B signals and delivers 1, 2, or 4 events every A/B cycle, possibly filtered by the backward motion compensator.

Quadrature edge detector

The *quadrature edge detector* analyzes the transitions on the A/B lines. It delivers:

- An event stream, named U, having 1, 2, or 4 events every A/B cycle according to the `QuadratureDecoderToolActivation` settings
- An identification of the phase between A and B (A leads B or vice-versa)



Quadrature edge detector waveforms

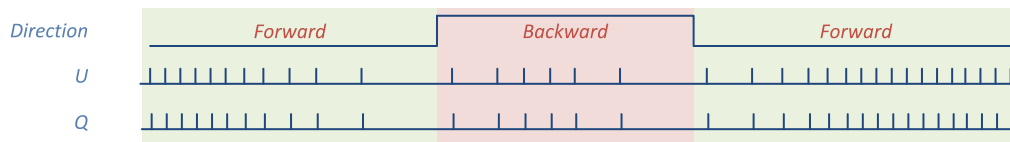
The U stream may be filtered by the backward motion compensator before being delivered to the QDC*<i>* output.

The phase indication may be inverted according to the `QuadratureDecoderToolForwardDirection` settings before being delivered to the *Direction* output.

Backward motion compensator

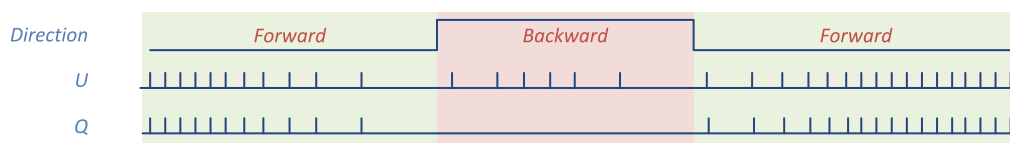
The *backward motion compensator* (BMC) filters the U stream according to the `QuadratureDecoderToolOutputMode` setting.

When set to **Unfiltered**, all the events of the U stream are delivered to the QDC<i> output:



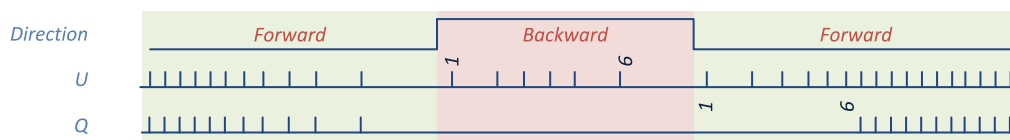
BMC waveforms - Unfiltered

When set to **ForwardOnly**, only the events corresponding to the forward direction are delivered to the QDC<i> output:



BMC waveforms - Forward Only

When set to **FirstPassForwardOnly**, only the events corresponding to the first pass in the forward direction are delivered to the QDC<i> output:



BMC waveforms - First Pass Forward Only

Position Counter

The *position counter* increments by 1 for any U event corresponding to the forward direction and decrements by 1 for the backward direction.

The counter can be reset using the `QuadratureDecoderToolPositionReset` command.

11.5. User Actions Tool

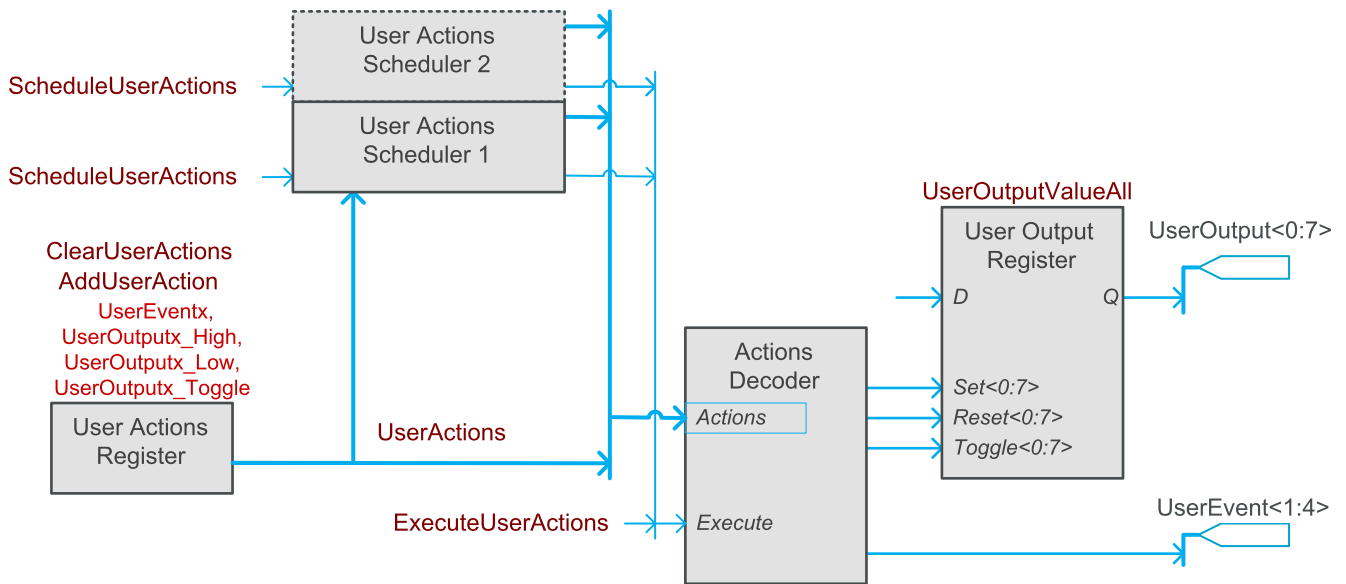
Applies to all firmware variants of **Coaxlink** and **Grablink Duo** frame grabbers

The *User Actions Tool* allow the application software to perform the following *User Actions*:

- Setting high, setting low or toggling any bit of the **UserOutputRegister**,
- Generate any one or more **UserEvent**.

To generate actions, the user application has to proceed in two steps:

1. Define a set of one or more User Actions in the **UserActionsRegister**.
2. Schedule the execution:
 - a. For an *Immediate* execution, use the **ExecuteUserActions** GenApi feature.
 - b. For a *Deferred* execution, use the **ScheduleUserActions** GenApi feature of any available **UserActionsScheduler**.



User Actions Tool functional block diagram

User output register

Coaxlink and Grablink Duo frame grabbers provide an 8-bit¹ *User Output Register* where bits are named UserOutput0 ... UserOutput7.

Any *User Output Register* bit can drive any one or more output-capable GPIO lines.

The user application has two options to define the state of the *User Output Register* bits :

- The User Actions option allows to change the state of each bit individually.
- Setting a value to the **UserOutputValueAll** to define the state of all bits.

Getting the value of **UserOutputValueAll** allows the user application to get the state of all *User Output Register* bits.

User events

Coaxlink and Grablink Duo frame grabbers provide a generator for 4 user-defined events named UserEvent1 ... UserEvent4.

User-defined events can be used by various consumers:

- To trigger a camera cycle using **CycleTriggerSource** feature
- To trigger the start or the end of an acquisition sequence using **StartOfSequenceTriggerSource** and **EndOfSequenceTriggerSource** features
- To trigger the start or the end of a line-scan acquisition using **StartOfScanTriggerSource** and **EndOfScanTriggerSource** features
- As an event source for the Divider, Multiplier/Divider and the Delay tool using **DividerToolSource**, **DelayToolSource<1:2>** and **MultiplierDividerToolSource** features
- As trigger source on the C2C-Link using the **C2CLinkSynchronizationToolSource** feature
- As notification context using **EventNotificationContext<1:3>** features

User actions register

The User Actions Register is a 32-bit register that defines a set of User Actions that will be executed simultaneously.

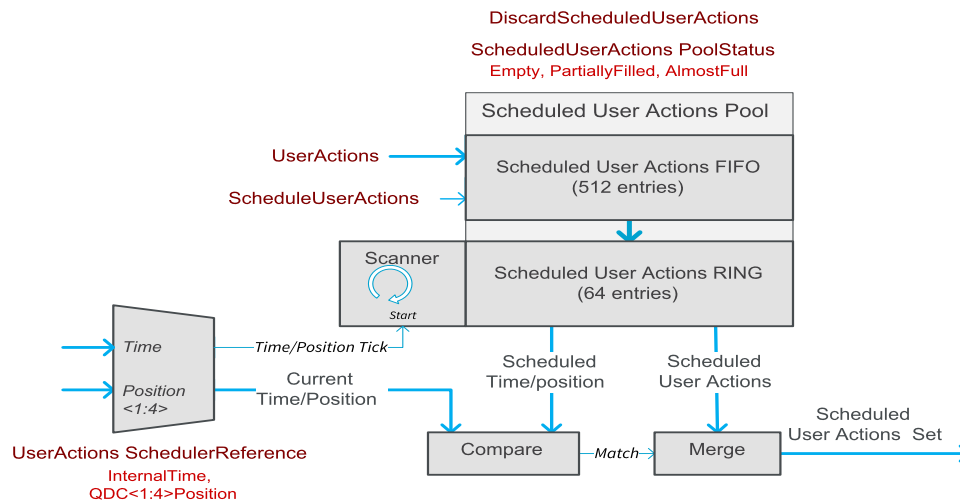
The **ClearUserActions** feature allows to clear the register.

The **AddUserActions** feature allows the application to compose the actions set one by one:

- Assert a user event using the **UserEvent<1:4>** values
- Set any user output bit high using **UserOutput<0:7>_High**
- Set any user output bit low using **UserOutput<0:7>_Low**
- Toggle user output bit high using **UserOutput<0:7>_Toggle**

¹ 1630 Coaxlink Mono implements only the 4 lowest bits!

User actions scheduler



User actions scheduler functional diagram

The *User Actions Scheduler* (UAS) function block allows an application software to postpone the execution of the actions at predefined time or position.

Prior to schedule any user actions, the user application has to setup the UAS:

1. Define the [SchedulerReference](#)
2. Initialize the [ScheduledActionsPool](#)

[Scheduler reference](#)

The scheduler reference is a 32-bit value that can be a *time* or a *position*. It is defined by setting **UserActionsSchedulerReference** as follows:

- **InternalTime** selects the *frame grabber local time*: a monotonic time base that increments by 1 every 1 microsecond and wraps around after about 71 minutes when it reaches the maximum value of 4,294,967,295.
- **QDC<1:4>Position** select the *Position Counter* of the Quadrature Decoder tools QDC<1:4> respectively. In that case,

**NOTE**

For correct operation of the UAS with a position reference:

- The position counter must increment monotonically and not faster than every microsecond.
- To ensure monotonic increments of the QDC position counter:
 - set properly `QuadratureDecoderToolForwardDirection` such that the counter increments when the object moves in the forward direction.
 - If it exists any backward motion, prevent the position counter to decrement by setting the `QuadratureDecoderToolOutputMode` to `ForwardOnly` or to `FirstPassForwardOnly`.

Scheduled user actions pool

The *Scheduled User Actions Pool* is a memory area where the *Scheduled User Actions Sets* are stored by the user application.

The pool is sub-divided into two sections:

1. A 512-locations FIFO
2. A 64-locations RING

FIFO operation

New Scheduled User Actions are first written to the FIFO before being automatically transferred to the RING when it contains at least one free location.

The first (oldest) entry is transferred first. The entries are not reordered!

The `ScheduledUserActionsPoolStatus` reports an `AlmostFull` value when the FIFO is almost full and is unable to accept a new entry.

Adding new Scheduled User Actions

To add a new Scheduled User Actions to the Pool, the user application must:

1. Ensure that there is at least one free location by getting the value of the `ScheduledUserActionsPoolStatus` GenApi feature,
2. Define a User Actions Set,
3. Determines the time/position 32-bit value when the actions are to be executed,
4. Set this value to `ScheduledUserActions` GenApi feature.

Removing Scheduled User Actions

Scheduled User Actions are removed from the pool when they are executed.

The pool can be cleared at any time by executing the `DiscardScheduledUserActions` GenICam command.

NOTE: It is not possible to remove a specific entry!

RING operation

At every increment of the 32-bit (time or position) reference counter, the Scanner reads all the locations and compares the scheduled reference time/position with the current time/position count value.

When the values are identical, the Scheduled User Actions Set is elected for execution at the end of the scan and removed from the pool.

When multiple sets are elected for execution, their actions are merged.



NOTE

Merging a set low and a set high action on the same User Output Register bit results into a toggle action.

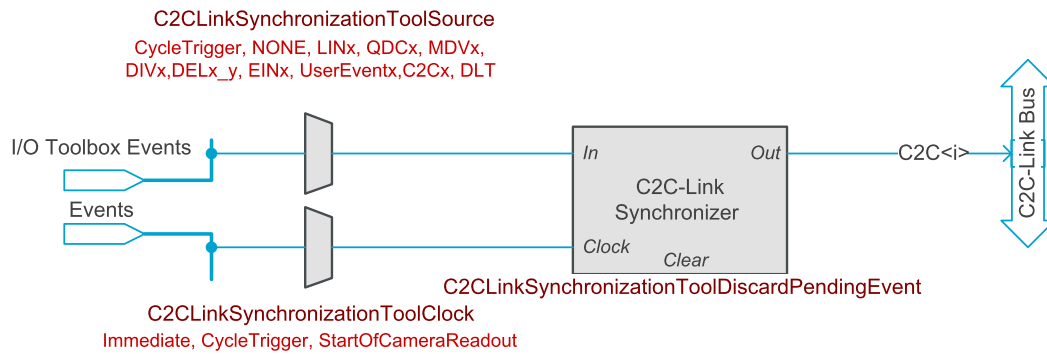
At the end of the scan, the merged elected actions are executed simultaneously. The time delay from the reference tick up to the execution of the elected actions is very small (sub-microsecond) and constant.

11.6. C2C-Link Synchronization Tool

Applies to all firmware variants of **Coaxlink** and **Grablink Duo** frame grabbers

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
C2C-Link Synchronization Tool	C2C	1 or 2 event streams	1 event stream: C2C<i>

Diagram



C2C tool functional and wiring diagram

The C2C-Link Synchronization tool (C2C) tool delivers one event stream to the C2C-Link Bus driver. It includes the following blocks:

- A source selector
- A clock source selector
- An event synchronizer with clear control

Operation

Source selector

The source selector selects the event stream applied to the tool input (In). It provides following options:

- On C2C1 instance only: `Cycle Trigger` event stream driven by the Camera and Illumination controller.
- On C2C2 and C2C3 instances only: any I/O toolbox event.

Synchronizer control

The clock source selector controls the event stream synchronization:

- When `C2CLinkSynchronizationToolClock` is set to `Immediate`, the event stream applied to the input (In) is sent immediately to the output.
- On C2C2 and C2C3 instances only: when `C2CLinkSynchronizationToolClock` is set to `CycleTrigger`, the event is latched and delayed until the following `Cycle Trigger` event.
- On C2C2 and C2C3 instances only: when `C2CLinkSynchronizationToolClock` is set to `StartOfCameraReadout`, the event is latched and delayed until the following `Start of Camera Readout` event.

The `C2CLinkSynchronizationToolDiscardPendingEvent` command discards an event that has been received but that has not been forwarded.



NOTE

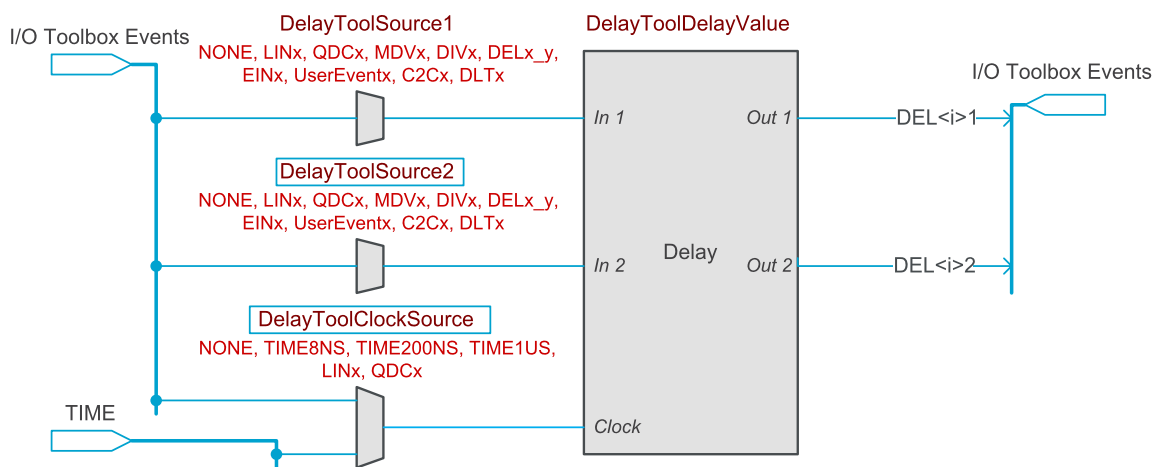
Area-scan firmware variants provide 2 instances of the C2C tool; line-scan firmware variants provide 3 instances!

11.7. Delay Tool

Applies to all firmware variants of **Coaxlink** and **Grablink Duo** frame grabbers

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Delay Tool	DEL	2 Toolbox event streams 1 clock signal	2 Toolbox event stream: DEL<i>1,&br/>DEL<i>2

Diagram



DEL tool functional and wiring diagram

Any I/O Toolbox event stream can be selected as the input 1 source.

Any I/O Toolbox event stream can be selected as the input 2 source.

The tool feeds two I/O Toolbox event streams. The outputs of the tool instance <i> are named **DEL<i>1** and **DEL<i>2**.

Operation

The event streams applied on either inputs (**In1** and **In2**) are replicated on the corresponding output (**Out1** and **Out2**) after a configurable number of clock tick events.

The sources are selected by **DelayToolSource1** and **DelayToolSource2** respectively.

The same delay applies to both channels. The common delay is defined by **DelayToolDelayValue**.

The same clock source applies to both channels. The clock source is defined by **DelayToolClockSource**. It can be a *time base*, a *Line Tool event stream*, or a *Quadrature Decoder Tool event stream*.

Selecting a *time base* implements a time delay function. The available time bases are:

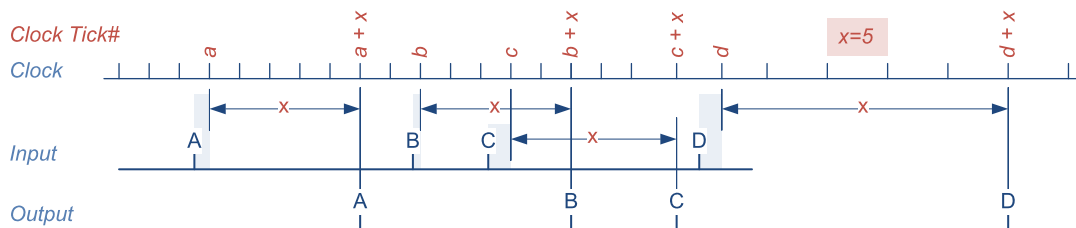
- **8NS**: A 125 MHz high accuracy regular time base allowing delays from *40 nanoseconds* up to *134 milliseconds* by steps of 8 nanoseconds
- **200NS**: A 5 MHz high accuracy regular time base allowing delays from *200 nanoseconds* up to *3.35 seconds* by steps of 200 nanoseconds
- **1US**: A 1 MHz high accuracy regular time base allowing delays from *1 microsecond* up to *16.7 seconds* by steps of 1 microsecond

Selecting a *line tool event stream* implements a position offset function when the line tool is fed by a motion encoder device. Any available Line Input tool or Quadrature Decoder tool can be used as delay clock source. The delay range is *1* up to *16,777,215 events*.



WARNING

The Delay tool operates as a delay line. The tool may accept a new event while the previous one is not yet delivered! The Delay tool is capable of recording, globally for all channels, up to 16 distinct events.



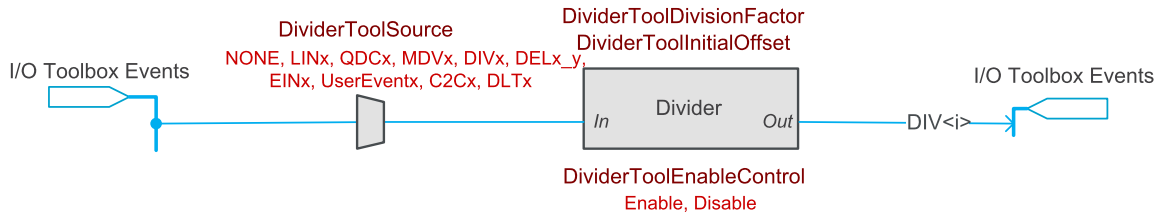
DEL tool waveforms

11.8. Divider Tool

Applies to all firmware variants of **Coaxlink** and **Grablink Duo** frame grabbers

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Divider Tool	DIV	1 Toolbox event stream	1 event stream: DIV<i>

Diagram

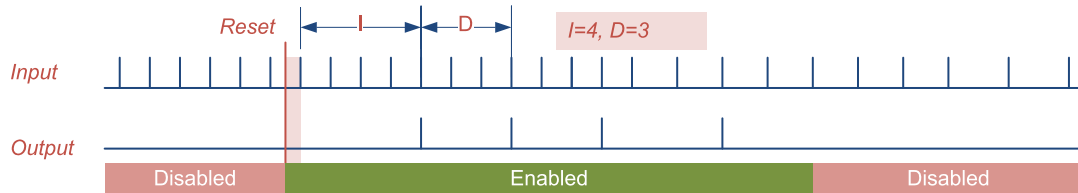


DIV tool functional and wiring diagram

Any I/O Toolbox event stream can be selected as the input source.

The tool feeds one I/O Toolbox event stream named `DIV<i>`.

Operation



DIV tool waveforms

Once enabled, the Divider tool skips the first – **I** – input events before delivering an event every **D** input events.

The division factor – **D** – is defined by `DividerToolDivisionFactor`. The default value is **2** and the value range is **1** ... **65535**.

The initial offset – **I** – is defined by `DividerToolInitialOffset`. The default value is **0** and the value range is **0** ... **65535**.

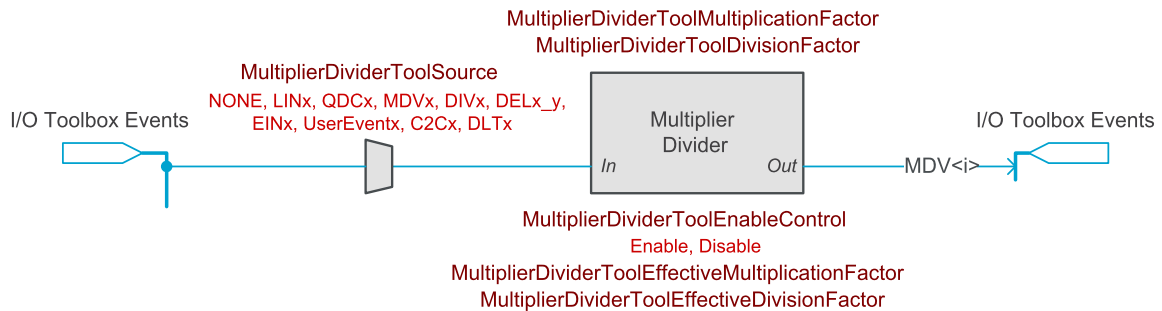
The operation state is defined by `DividerToolEnableControl`. The default value is **Disable**.

11.9. Multiplier/Divider Tool

Applies to all firmware variants of **Coaxlink** and **Grablink Duo** frame grabbers

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Multiplier/Divider Tool	MDV	1 Toolbox event stream	1 Toolbox event stream: MDV<i>

Diagram



MDV tool functional and wiring diagram

Any I/O Toolbox event stream can be selected as the input source.

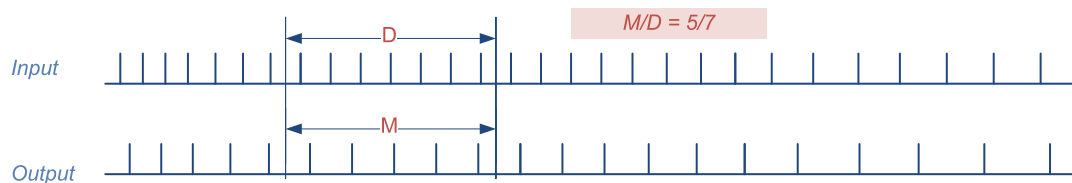
The tool feeds one I/O Toolbox event stream named MDV<i>.

Multiplier/Divider Tool Operation

The Multiplier/Divider tool multiplies and/or divides the input rate by any rate conversion ratio – RCR – value in the range 0.001 to 1000.0.

The Multiplier/Divider tool measures the time interval between every consecutive input events and adapts the output rate accordingly.

The Multiplier/Divider is *frequency accurate*. The output frequency is strictly proportional to the input frequency provided that the input frequency is stable (or varies slowly). In such conditions, the Multiplier/Divider delivers M events for every D input events.



MDV tool waveforms

The Rate Conversion Ratio is configured as the ratio of two float numbers:

- The M value is defined by `MultiplierDividerToolMultiplicationFactor`. The default value is **1.0** and the value range is **0.001** to **1000.0**.
- The D value is defined by `MultiplierDividerToolDivisionFactor`. The default value is **1.0** and the value range is **0.001** to **1000.0**.

The effective multiplication and division factors are respectively reported by `MultiplierDividerToolMultiplicationFactor` and `MultiplierDividerToolDivisionFactor`.



NOTE

The effective values may slightly differ from the specified values. However, the RCR relative error remains negligible (less than 1/1000).

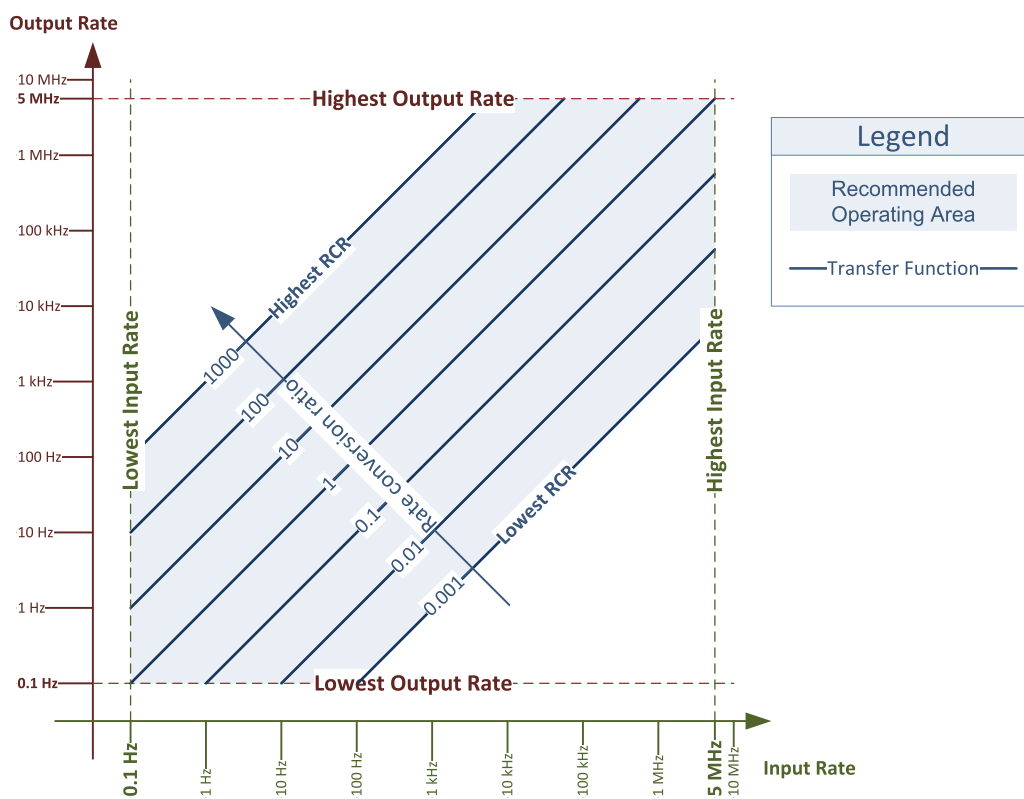


NOTE

Frequency variations of the input event stream are reported to the output event stream with a latency of 1 period of the input event stream. Such a latency induces some phase errors in the output event stream. The accumulated phase error increases when the input frequency increases. It decreases when the input frequency decreases.
The Multiplier/Divider is *not phase accurate*.

Operating Limits

Characteristic	Symbol	Min	Max
Rate Conversion Ratio	RCR	0.001	1000
Input Rate	f_{IN}	0.1 Hz	5 MHz
Output Rate	f_{OUT}	0.1 Hz	5 MHz



MDV tool operating limits diagram

12. Event Signaling And Counting

Extensive user-configurable event-reporting and event-counting mechanism

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12.1. Introduction

Short description

Coaxlink and Grablink Duo frame grabbers feature a powerful event management that allows the application to be notified of the occurrence of various events.

In addition to the GenTL `EVENT_NEW_BUFFER` and `EVENT_REMOTE_DEVICE` standard event types, the Coaxlink, Grablink and Gigelink GenTL producers provide a wide set of custom event sources.

The event sources are grouped by types according to the function block and the GenTL module they belong to.

Each custom event source is associated with a counter that counts the number of occurrences.

For each notified custom event, the following event context data is recorded and made available to the application:

- Identifier of the event source
- Time stamp (expressed in microseconds)
- 3 user-defined context data

Each individual event source is configurable:

- The event notification can be enabled or disabled.
- The content of each user-defined context data.

Event data are temporarily stored in the Event Queue Buffer. The Coaxlink GenTL producer is notified, using an interruption mechanism, of the availability of one or more event entries in the Event Queue Buffer.

The Coaxlink, Grablink and Gigelink GenTL producers implement the GenTL signaling mechanism for reporting the occurrence of asynchronous events to the application software.

The EGrabber API provides 3 callback threading models:

- *CallbackOnDemand*: This is the simplest model which gives complete control over when and how callbacks are invoked. Events are processed on demand.
- *CallbackSingleThread*: This model delivers events to callbacks in their chronological order, sequentially, in a dedicated thread context. Events are processed automatically as soon as they are available.
- *CallbackMultiThread*: This model delivers events to callbacks in separate threads (one thread per event DATA type). Events are processed automatically as soon as they are available.

Event types

GenTL identifies the events according to their Type and their relevant object Module.

Standard event types

The Coaxlink, Grablink and Gigelink GenTL producers implement the following standard event type for registration by the GenTL Consumer application:

GenTL Standard Event Type	GenTL Module	Description
EVENT_NEW_BUFFER	Data Stream	Notification on newly filled buffers.
EVENT_REMOTE_DEVICE	Device	Notification if the GenTL Producer library wants to manually set a feature in the GenICam GenApi instance using the module.

Custom event types

Beside the *standard event types*, the GenTL specification provides room for *custom event types*.

Custom event types are specific to the GenTL Producer implementation.

The Grablink GenTL producer implements the following custom event types for registration by the GenTL Consumer application:

Event Type	Module	Description
EVENT_CUSTOM_CIC	Device	Notification of Camera and Illumination Control events
EVENT_CUSTOM_DATASTREAM	Data Stream	Notification of CoaXPress data stream events
EVENT_CUSTOM_DEVICE_ERROR	Device	Notification of device error events
EVENT_CUSTOM_IO_TOOLBOX	Interface (Device)	Notification of I/O Toolbox events



NOTE

The `EVENT_CUSTOM_IO_TOOLBOX` event type can also be registered on a Device Module.



NOTE

The custom event types are generic; each one gathers multiple event sources.

See also: "Custom Event Sources" on page 267 for an exhaustive list.

Custom events counter

A 32-bit counter is associated with every custom event source.

The counter cannot be disabled. When it reaches its maximum value, 4 294 967 295 ($2^{32} - 1$), it wraps around to 0.

At any time, the user application can:

- Read the count value of a selected event source.
- Reset the counter of a selected event source.
- Reset the counters of all the event sources of the module.

The count-value can also be used as user-defined context data by any event source.

Custom events configuration

The event source is configurable.

At any time, the user application can:

- Enable or disable the notification of a selected event source.
- Enable or disable the notification of all the event sources of the module.
- Define the content of each user-defined context data of a selected event source.

Notification

By default, all notifications are disabled.

The application software must configure the event notification filter according the application needs.

The configuration of the notification filter configuration can be modified at any time without interfering with the event counting function.

Context data

The last 3 32-bit context data words of the event context data can be configured as follows:

- Event-specific data.
- State of I/O lines sampled at the event occurrence time
- Count value of any event counter.
- Count value of any Quadrature Decoder (QDC) position counter.

Some event sources provide additional options.

See also: ["Event Specific Context Data" on page 273](#)

12.2. Custom Event Sources

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EVENT_CUSTOM_DEVICE_ERROR	270
EVENT_CUSTOM_IO_TOOLBOX	271

EVENT_CUSTOM_CIC

Camera and Illumination Controller custom event sources (Device module)

Grablink GenTL Producer

Event Source	Description
_CAMERA_TRIGGER_RISING_EDGE	Rising edge of the Camera Trigger output signal (Start of Exposure in RC and RG camera control methods)
_CAMERA_TRIGGER_FALLING_EDGE	Falling edge of the Camera Trigger output signal (End of Exposure in RG camera control method)
_STROBE_RISING_EDGE	Rising edge of the Strobe output signal
_STROBE_FALLING_EDGE	Falling edge of the Strobe output signal
_ALLOW_NEXT_CYCLE	A new camera cycle is allowed to start immediately.
_DISCARDED_CIC_TRIGGER	A CIC cycle trigger is discarded.
_PENDING_CIC_TRIGGER	A CIC cycle trigger is recorded, but its execution is delayed until CIC is ready.
_TRIGGER	CIC trigger



NOTE

There is one Camera and Illumination Controller instance per GenTL Device Module. The number of GenTL Device Modules per frame grabber is defined by the firmware-variant.

EVENT_CUSTOM_DATASTREAM

Data Stream custom event sources (Data Stream Module)

Coaxlink and Grablink GenTL Producers

Event Source	Description
_START_OF_CAMERA_READOUT	The first pixel data of an image frame is written into the on-board FIFO Buffer. Applies to area-scan firmware variants only.
_END_OF_CAMERA_READOUT	The last pixel data of an image frame is written into the on-board FIFO Buffer. Applies to area-scan firmware variants only.
_START_OF_SCAN	The first pixel data of an image scan is written into the on-board FIFO Buffer. Applies to line-scan firmware variants only.
_END_OF_SCAN	The last pixel data of an image scan is written into the on-board FIFO Buffer. Applies to line-scan firmware variants only.
_REJECTED_FRAME	An image frame is rejected (On-board FIFO Buffer is full). Applies to area-scan firmware variants only.
_REJECTED_SCAN	An image scan is rejected (On-board FIFO Buffer is full) Applies to line-scan firmware variants only.
_TRIGGER_TO_CAMERA_READOUT_TIMEOUT	Trigger to camera readout timeout.
_CAMERA_READOUT_TIMEOUT	Camera readout timeout.
_BROKEN_FRAME	Broken frame due to frame store overflow. Applies to area-scan firmware variants only.

EVENT_CUSTOM_DEVICE_ERROR

Device Error custom event sources (Device Module)

Grablink GenTL Producer

Event Source	Description
_CAMERA_TRIGGER_OVERRUN	New trigger sent to remote device even though readout of previous frame has not started yet
_MIG_AXI_WRITE_ERROR	MIG AXI write error
_MIG_AXI_READ_ERROR	MIG AXI read error
_FILL_LEVEL_ABOVE_IL_SOS_REJECTED	Start of scan skipped (caused by internal exception: frame store almost full)
_FILL_LEVEL_ABOVE_AF_EARLY_EOS	End of scan (caused by internal exception: frame store almost full)
_EXTERNAL_TRIGGER_REQS_TOO_CLOSE	External trigger requests too close together

EVENT_CUSTOM_IO_TOOLBOX

[I/O Toolbox custom event sources \(Interface module\)](#)

[Coaxlink GenTL Producer](#)

Event Source	Description
_LIN1	Line Input Tool 1 – Event output
_LIN2	Line Input Tool 2 – Event output
_LIN3	Line Input Tool 3 – Event output
_LIN4	Line Input Tool 4 – Event output
_LIN5	Line Input Tool 5 – Event output
_LIN6	Line Input Tool 6 – Event output
_LIN7	Line Input Tool 7 – Event output
_LIN8	Line Input Tool 8 – Event output
_QDC1	Quadrature Decoder Tool 1 – Event output
_QDC1_DIR	Quadrature Decoder Tool 1 – Changed direction
_QDC2	Quadrature Decoder Tool 2 – Event output
_QDC2_DIR	Quadrature Decoder Tool 2 – Changed Direction
_QDC3	Quadrature Decoder Tool 3 – Event output
_QDC3_DIR	Quadrature Decoder Tool 3 – Changed direction
_QDC4	Quadrature Decoder Tool 4 – Event output
_QDC4_DIR	Quadrature Decoder Tool 4 – Changed direction
_DIV1	Divider Tool 1 – Event output
_DIV2	Divider Tool 2 – Event output
_DIV3	Divider Tool 3 – Event output
_DIV4	Divider Tool 4 – Event output
_MDV1	Multiplier/Divider Tool 1 – Event output
_MDV2	Multiplier/Divider Tool 2 – Event output
_MDV3	Multiplier/Divider Tool 3 – Event output
_MDV4	Multiplier/Divider Tool 4 – Event output
_DEL1_1	Delay Tool 1 Output 1 – Event output
_DEL1_2	Delay Tool 1 Output 2 – Event output
_DEL2_1	Delay Tool 2 Output 1 – Event output

Event Source	Description
_DEL2_2	Delay Tool 2 Output 2 – Event output
_DEL3_1	Delay Tool 3 Output 1 – Event output
_DEL3_2	Delay Tool 3 Output 2 – Event output
_DEL4_1	Delay Tool 4 Output 1 – Event output
_DEL4_2	Delay Tool 4 Output 2 – Event output
_USER_EVENT_1	User Event 1
_USER_EVENT_2	User Event 2
_USER_EVENT_3	User Event 3
_USER_EVENT_4	User Event 4
_C2C1	C2C Synchronization Tool Output 1 – Event output
_C2C2	C2C Synchronization Tool Output 2 – Event output
_C2C3	C2C Synchronization Tool Output 3 – Event output

**NOTE**

Check the "[I/O Toolbox Composition Tables](#)" on page 238 for applicable values

12.3. Event Specific Context Data

EVENT_DATA_NUMID_CIC_DISCARDED_CIC_TRIGGER

Value of *EventSpecific* for EVENT_DATA_NUMID_CIC_DISCARDED_CIC_TRIGGER is a bitfield that can be interpreted according to the following definitions:

Bit#	Description
0	Cause: frame store is full.
1	Cause: camera cycle not complete.
2	Cause: maximum number of pending triggers already reached.
3	Cause: data stream is not active

EVENT_DATA_NUMID_CIC_PENDING_CIC_TRIGGER

Value of *EventSpecific* for EVENT_DATA_NUMID_CIC_PENDING_CIC_TRIGGER is a bitfield that can be interpreted according to the following definitions:

Bit#	Description
0	Cause: frame store is full.
1	Cause: camera cycle not complete

EVENT_DATA_NUMID_DATASTREAM_START_OF_SCAN

Value of *EventSpecific* for EVENT_DATA_NUMID_DATASTREAM_START_OF_SCAN is a bitfield that can be interpreted according to the following definitions:

Bit#	Description
1	Cause: software trigger.
2	Cause: hardware trigger
3	Cause: DSStartAcquisition or end of previous scan

EVENT_DATA_NUMID_DATASTREAM_END_OF_SCAN

Value of *EventSpecific* for EVENT_DATA_NUMID_DATASTREAM_END_OF_SCAN is a bitfield that can be interpreted according to the following definitions:

Bit#	Description
1	Cause: software trigger.
2	Cause: hardware trigger
3	Cause: reached scan length
4	Cause: DSStopAcquisition
5	Cause: internal exception (frame store almost full)

EVENT_DATA_NUMID_DATASTREAM_REJECTED_FRAME

Value of *EventSpecific* for EVENT_DATA_NUMID_DATASTREAM_REJECTED_FRAME is a bitfield that can be interpreted according to the following definitions:

Bit#	Description
0	Cause: frame store is full.
1	Cause: data stream is not active
2	Cause: frame store underwent overflow

EVENT_DATA_NUMID_CXP_DEVICE_LINK_TRIGGER

Value of *EventSpecific* for GenTL::EuresysCustomGenTL::EVENT_DATA_NUMID_CXP_DEVICE_LINK_TRIGGER is a bitfield that can be interpreted according to the following definition:

Bit#	Description
7:0	LinkTriggerN (Word 2 of the CoaXPress 2.0 high speed connection trigger packet)
15:8	Delay (Word 1 of the CoaXPress 2.0 high speed connection trigger packet)
31:16	Reserved

**WARNING**

Undocumented bits must be ignored.

12.4. About GenTL Signaling

The **eGrabber** driver implements the Signaling mechanism of a GenTL Producer.

This mechanism is briefly described hereafter.

See also: section 4.2 starting on page 34 of the [GenCam GenTL Standard Version 1.4](#) for an extensive description.

Event Registration

Source: GenTL specification

Before the GenTL Consumer can be informed about an event, the event object must be registered. After a module instance has been created in the enumeration process an event object can be created with the `GCRegisterEvent()` function. This function returns a unique `EVENT_HANDLE` which identifies the registered event object. To get information about a registered event the `EventGetInfo()` function can be used.



WARNING

There must be only one event registered per module and event type!

(...)

After an `EVENT_HANDLE` is obtained the GenTL Consumer can wait for the event object to be signaled by calling the `EventGetData()` function. Upon delivery of an event, the event object carries data. This data is copied into a GenTL Consumer provided buffer when the call to `EventGetData()` was successful.

Notification and Data Retrieval

Source: GenTL specification

If the event object is signaled, data was put into the event data queue at some point in time. The `EventGetData()` function can be called to retrieve the actual data.

(...)

When data is read with this function the data is removed from the queue. Afterwards the GenTL Producer implementation checks whether the event data queue is empty or not. If there is more data available the event object stays signaled and next the call to `EventGetData()` will deliver the next queue entry. Otherwise the event object is reset to not signaled state.

(...)

The exact type of data is dependent on the event type and the GenTL Producer implementation. The data is copied into a user buffer allocated by the GenTL Consumer. The content of the event data can be queried with the `EventGetDataInfo()` function. The maximum size of the buffer to be filled is defined by the event type and can be queried using `EVENT_INFO_DATA_SIZE_MAX` after the buffer is delivered. This information can be queried using the `EventGetInfo()` function.

13. Advanced Features

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13.1. C2C-Link

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C2C-Link Interconnections

The C2C-Link is a hardware communication medium allowing a single *C2C-Link master device* to reliably share trigger events with multiple *C2C-Link slave devices*.

In area-scan applications, the C2C-Link Interconnect:

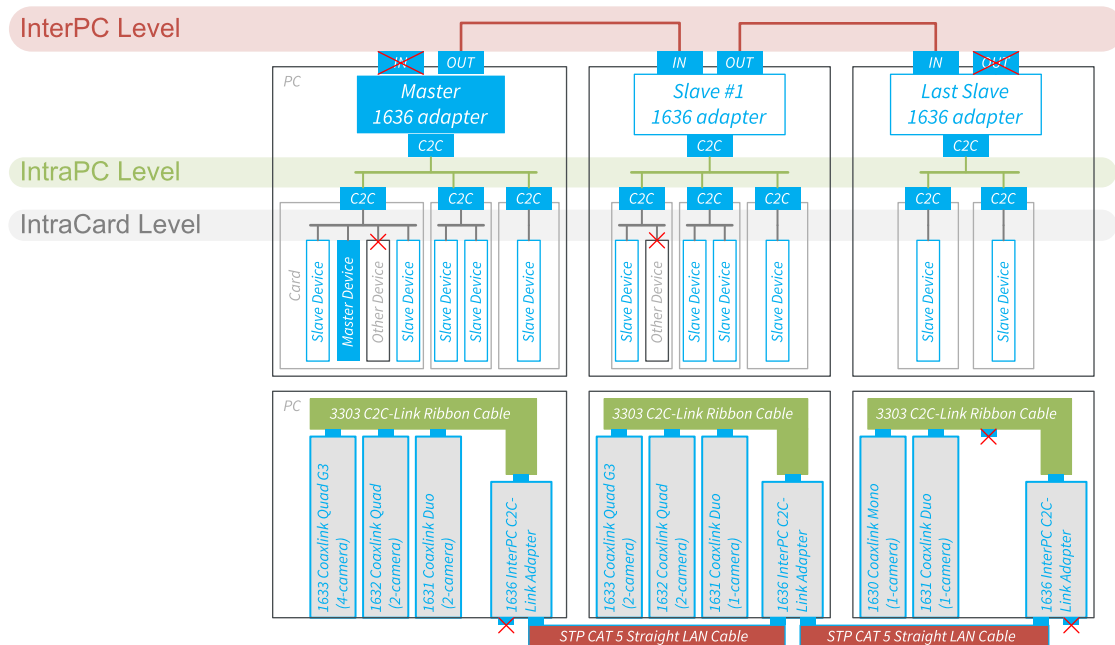
- allows to share up to 2 triggers: a CIC Cycle Trigger (mandatory) and one/I/O Toolbox event (optional).
- allows any C2C-Link device to indicate to the C2C-Link master device that it is not able to accept a trigger.

In line-scan applications, the C2C-Link Interconnect allows to share up to 3 triggers: a CIC Cycle Trigger (mandatory) and two I/O Toolbox events (optional).

The C2C-Link is scalable: it may interconnect devices belonging to the same frame grabber, or to different cards in the same PC or to different cards in different PCs.

A C2C-Link interconnection may combine up to three interconnection levels:

- The *IntraCard Level* interconnects 2 or more C2C-Link devices belonging to the same card using FPGA internal resources.
- The *IntraPC Level* interconnects C2C-Link devices across two or more cards of the same PC. It requires one accessory cable such as the **3303 C2C-Link Ribbon Cable** or a custom-made C2C-Link cable for each PC.
- The *InterPC Level* interconnects C2C-Link devices across two or more PCs. It requires one **1636 InterPC C2C-Link Adapter** for each PC and one RJ 45 CAT 5 STP straight LAN cable for each adapter but the last one.



C2C-Link configuration example using InterPC, IntraPC and IntraCard levels

C2C-Link Electrical Specification

Definitions

Trigger delay

Propagation delay of the trigger signal from the master device to a slave device. This delay is composed of the propagation delay inside electronic devices (FPGA, adapter...) and interconnection cables.

For cables, the delay is proportional to the cable length, typically: 5 ns/m.

Trigger delay skew

Dispersion of the trigger delay values across all the devices belonging to a C2C-Link.

Trigger delay jitter

Variation of the trigger delay depending on external factors such as temperature, signal noise...

Trigger rate

Rate of occurrence of repetitive trigger events. The reciprocal value (1/Trigger rate) is the minimum time interval required between consecutive triggers.

IntraCard C2C-Link Interconnection Level

Parameter	Min.	Typ.	Max.	Units
Trigger delay jitter			5	ns
Trigger rate	0		2.5	MHz

IntraPC C2C-Link Interconnection Level

Parameter	Min.	Typ.	Max.	Units
Cable connectors count (including 1636 adapter if any)	2		4	-
Cable length	-		0.6	m
Trigger delay jitter	5		10	ns
Trigger rate	0		2.5	MHz

InterPC C2C-Link Interconnection Level

The following specification targets applications where the *highest trigger rate* is required:

Parameter	Min.	Typ.	Max.	Units
1636 adapters count	2		10	-
Adapter-to-adapter LAN cable length	0.3		100	m
Cumulated adapter-to-adapter LAN cable length	0.3		100	m
Trigger delay jitter	10	20	40	ns
Trigger rate	0		2.5	MHz

The following specification targets applications where the *longest reachable distance* is required:

Parameter	Min.	Typ.	Max.	Units
1636 adapters count	2		32	-
Adapter-to-adapter cable length	0.3		1200	m
Cumulated adapter-to-adapter cable length	0.3		1200	m
Trigger delay jitter			1	μs
Trigger rate	0		200	kHz



NOTE

The maximum trigger rate specification can be extrapolated for intermediate distances between 100 m and 1200 m assuming that the *length x frequency* product is constant: in this case 250 [m. MHz].

Trigger Propagation Delays

The propagation delay of the Trigger signals from the master device to a slave device can be roughly estimated by adding the typical delays encountered in each segment of the signal path.

Typical Delay values per C2C-Link segment

Delay Element	Min.	Typ.	Max.	Units
(1) IntraPC interconnection (Whole IntraPC C2C-Link interconnect including FPGA I/O and IntraPC cable)	0	5	10	ns
(2) 1636 InterPC C2C-Link Adapter – IntraPC-to-InterPC delay		15		ns
(3) 1636 InterPC C2C-Link Adapter – InterPC-to-IntraPC delay		20		ns
(4) 1636 InterPC C2C-Link Adapter – InterPC-to-InterPC delay		0		ns
(5) InterPC LAN cable		5		ns/m

Example 1 – IntraPC Configuration

For an IntraPC only configuration there is only one delay element to consider: (1)

Parameter	Min.	Typ.	Max.	Units
(1) IntraPC interconnection	0	5	10	ns
Total Trigger Delay	0	5	10	ns

Example 2 – 3-adapter InterPC Configuration; 20 m+20 m LAN cable

This configuration is composed of 3 Intra-PC segments. For devices belonging to the same IntraPC segment as the Master device, there is only one element to consider.

Parameter	Min.	Typ.	Max.	Units
(1) IntraPC interconnection	0	5	10	ns
Total Trigger Delay for devices of the Master InterPC segment	0	5	10	ns

For devices belonging to the same IntraPC segment as the Slave1 adapter, there are 5 delay elements to consider:

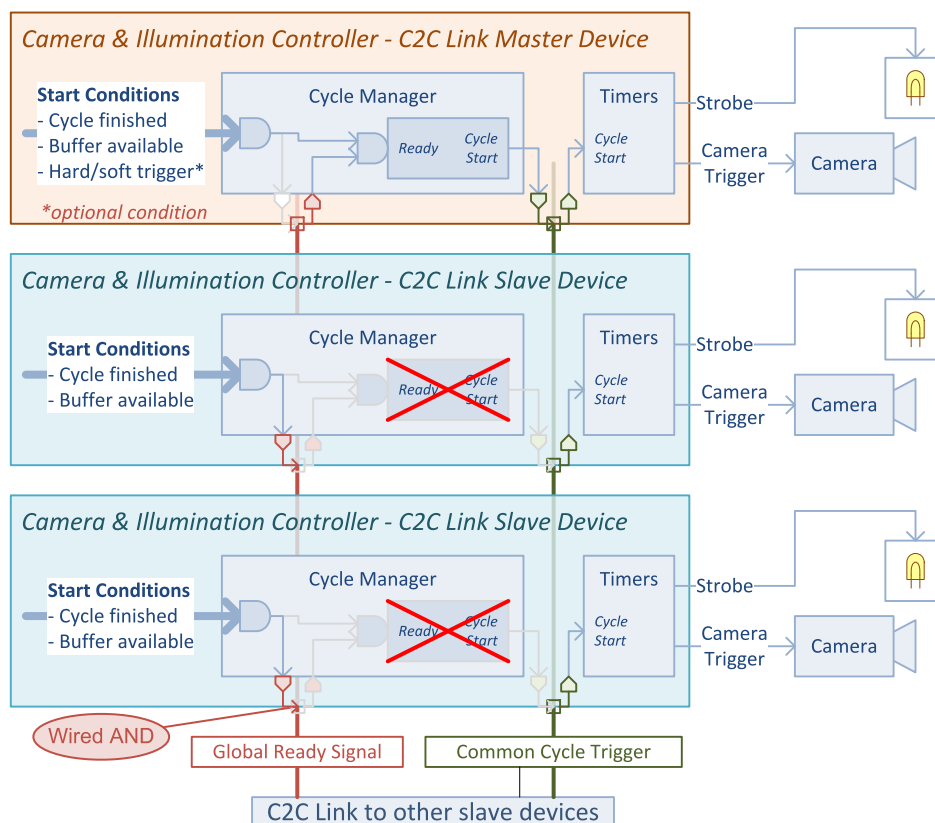
Parameter	Min.	Typ.	Max.	Units
(1) Master IntraPC interconnection	0	5	10	ns
(2) Master 1636 InterPC C2C-Link Adapter – IntraPC-to-InterPC delay		15		ns
(5) Master to slave1 InterPC LAN cable – 20 m		100		ns
(3) Slave1 1636 InterPC C2C-Link Adapter – InterPC-to-IntraPC delay		20		ns
(1) Slave1 IntraPC interconnection	0	5	10	ns
Total Trigger Delay for devices of the Slave1 InterPC segment		145		ns

For devices belonging to the same IntraPC segment as the Slave2 adapter, there are 7 delay elements to consider:

Parameter	Min.	Typ.	Max.	Units
(1) Master IntraPC interconnection	0	5	10	ns
(2) Master 1636 InterPC C2C-Link Adapter – IntraPC-to-InterPC delay		15		ns
(5) Master to slave1 InterPC LAN cable – 20 m		100		ns
(4) Slave1 1636 InterPC C2C-Link Adapter – InterPC-to-InterPC delay		0		ns
(5) Slave1 to slave2 InterPC LAN cable – 20 m		100		ns
(3) Slave2 1636 InterPC C2C-Link Adapter – InterPC-to-IntraPC delay		20		ns
(1) Slave2 IntraPC interconnection	0	5	10	ns
Total Trigger Delay for devices of the Slave2 InterPC segment		245		ns

Cycle Trigger Synchronization

Principle



One C2C-Link master and two C2C-Link slave devices (With Global Ready)

Common cycle trigger

The CIC synchronization is achieved by sharing a common **Cycle Trigger** event between all involved CIC 's using the C2C-Link interconnections. The C2C-Link interconnects two or more devices. One device is named *C2C-Link Master Device*, the others are named *C2C-Link Slave Device*.

The **Cycle Trigger** is generated by the Cycle Manager of the "*C2C-Link Master Device*" and broadcasted on the C2C-Link via the "**C2C-Link Synchronization Tool**" on page 255 of the I/O toolbox. All the participating C2C-Link devices (1 Master and one or more slaves) uses the shared C2C1 event stream as event source for the camera cycle trigger.

The CIC Cycles of all participating devices start simultaneously. However, the Cycle Timing parameters (exposure time, strobe pulse width and strobe delay) can be configured individually.

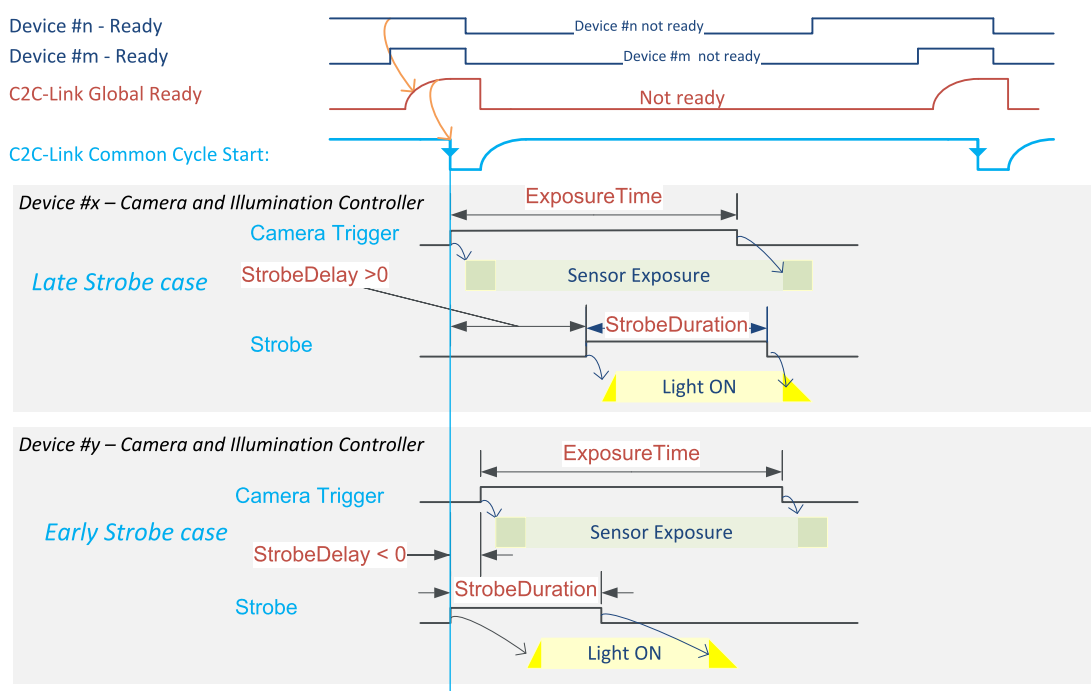
Global Ready signal

Global Ready applies only to area-scan firmware variants!

The Global Ready signal is elaborated by all C2C-Link slaves using a wired AND connection logic. A C2C-Link Slave forces the Global Ready signal to 'false' until its start conditions are all satisfied.

The C2C-Link Master device further delays the assertion a Cycle Trigger event while the Global Ready signal is false.

Timing Diagram



CIC Synchronization through C2C-Link timing diagram (With Global Ready)

The above diagram shows the timing diagram of two consecutive common `CycleTrigger` events with Global Ready :

The C2C-Link Global Ready signal is held low until the Ready of all participating devices is true preventing the C2C-Link Master to issue a start event. When released by all participating devices, it ramps up rapidly with a rise time of maximum 100 ns.

As soon as the C2C-Link Global Ready signal is confirmed to be high, the master device asserts an abrupt going low transition on the Common Cycle Start signal; this edge is propagated to all the Start inputs of the timers of all participating devices.

As soon as the cycle has started, every CIC forces the ready low as long as all the local conditions to initiate the next cycle are not satisfied.

The timers of each device issue a **Camera Trigger** and a **Strobe**, with their respective delay and duration settings. Usually, the settings are identical for all participating devices; but the application is allowed to apply different ones, if needed.

The shortest **Cycle Start** period allowed by the C2C-Link is 400 ns; allowing a theoretical frequency limit of 2.5 MHz.

C2C-Link Setup Procedure

Hardware setup

This step is specific to each C2C-Link Configuration:

[IntraCard C2C-Link configuration](#)

This configuration exclusively uses FPGA internal resources to build the C2C-Link interconnect; it doesn't require any additional hardware!

[IntraPC C2C-Link configuration](#)

This configuration requires one accessory cable such as the **3303 C2C-Link Ribbon Cable** or a custom-made C2C-Link cable for each PC.

Insert a C2C-Link female connector of the C2C-Link cable into the C2C-Link pin header connector of each participating frame grabber.

[InterPC C2C-Link configuration](#)

This configuration requires one **1636 InterPC C2C-Link Adapter** for each PC and one RJ 45 CAT 5 STP straight LAN cable for each adapter but the last one.

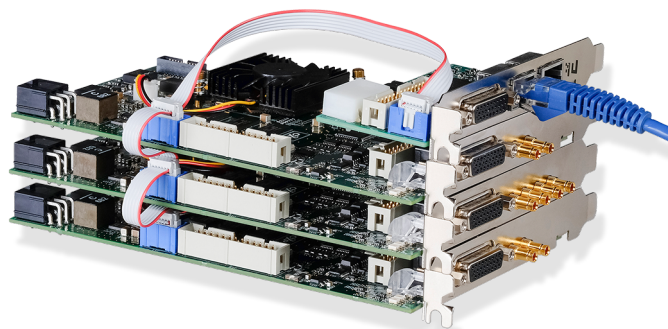
In each participating PC:

1. Install **1636 InterPC C2C-Link Adapter** into a free slot and secure the bracket.
2. Connect the adapter to a power source.

See also: "Adapter Powering" topic in the 1636 section of the hardware manual.

3. Using one **3303 C2C-Link Ribbon Cable**, bind together the C2C-Link connectors of all the participating cards together with the C2C-Link of the adapter card.
4. Using LAN Cables, interconnect the adapters.

See also: "InterPC Interconnect" topic in the 1636 section of the hardware manual.



IntraPC segment of an InterPC configuration

GenApi setup

Master C2C-Link device

- Assign value **Master** to **C2CLinkConfiguration** of the GenTL Device module
- Configure the I/O Toolbox C2C1 tool of the GenTL Interface module to share Cycle Trigger:
 - Assign value **CycleTrigger** to **C2CLinkSynchronizationToolSource**
 - Assign value **Immediate** to **C2CLinkSynchronizationToolClock**
- Optional, configure the I/O Toolbox C2C2 and C2C3 tools of the GenTL Interface module according to the application requirements

Slave C2C-Link devices

Assign value **Slave** to **C2CLinkConfiguration** of the GenTL Device module

13.2. OEM Safety Key

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Using OEMSafetyKey	290

Introducing OEM Safety Key

The OEM Safety Key capability allows the application to:

- Program an "OEM safety key" in the non-volatile memory of the frame grabber.
- Retrieve the encrypted version of the OEM safety key just programmed.
- Check a key against the programmed OEM safety key or its encrypted version.

OEM Safety Key

The OEM Safety Key is an application-defined string of characters. Any character except the null character is allowed. The string length is unlimited.

Key Programming

When the application sets the `ProgramOemSafetyKey` GenApi feature with the OEM Safety Key value, the **eGrabber** driver computes an encrypted version of the OEM Safety Key and stores it in the non-volatile memory of the frame grabber.

The encrypted value can be retrieved by getting the value of `EncryptedOemSafetyKey` immediately after having set `ProgramOemSafetyKey`.



WARNING

Only the same application process having set `ProgramOemSafetyKey` is allowed to retrieve the encrypted value. This is only allowed until any other GenApi feature is set.

Key Checking

The application has to select one `OemSafetyKeyVerification` value of the

In order to verify the OEM Safety Key of a frame grabber, the application sets a "challenge" value to the `CheckOemSafetyKey[selector]` feature.

When the [selector] argument is set to `EncryptedKey`, the set action terminates normally only when the challenge string is identical to the encrypted OEM Safety Key string.

When the [selector] argument is set to `ProgrammingKey`, the set action terminates normally only when the challenge string is identical to the programming OEM Safety Key string.

When the [selector] argument is set to `ProgrammingKeyOrEncryptedKey`, or omitted, the set action terminates normally only when the challenge string is identical to the original OEM Safety Key string or to the encrypted OEM Safety Key string.

Euresys recommends using the `EncryptedKey` selector. This improves the security level since the programming key doesn't need to appear anywhere in the end user application. Having only the encrypted key, the end user cannot retrieve the original programming key.

Using OEMSafetyKey

Programming Step – Option A

Using **GenICam Browser (Deprecated)**:

- Go to the GenApi tab of the interface module.
- Write a secret key to **ProgramOemSafetyKey**
- Copy the value of **EncryptedOemSafetyKey** and paste it somewhere appropriate.



NOTE

There is a direct relationship between the *programming key* and the *encrypted key*. A given *programming key* will always lead to the same *encrypted key*, even on different computers or with different frame grabbers. This makes it possible to read the *encrypted key* once and hard-code this value in the application that must be protected by the OEM safety key.

Programming Step – Option B

Using a custom application:

1. Program the OEM safety key of the frame grabber by writing a secret key to **ProgramOemSafetyKey**.
2. Read back the encrypted key by reading **EncryptedOemSafetyKey**. Write this value somewhere appropriate.

```
grabber.set<InterfacePort>("ProgramOemSafetyKey","plain-text key"); // 1
std::string encryptedKey=grabber.get<InterfacePort>("EncryptedOemSafetyKey"); // 2
```

Verification Step

In the application that must be protected by the OEM key:

```
InterfacePort>("CheckOemSafetyKey[EncryptedKey]", "encrypted key retrieved in the programming step");
```



NOTE

Even if the *encrypted key* is discovered and an attacker uses it to reprogram cards, the above verification will fail.

PART III
HARDWARE MANUAL

1. Mechanical Specification

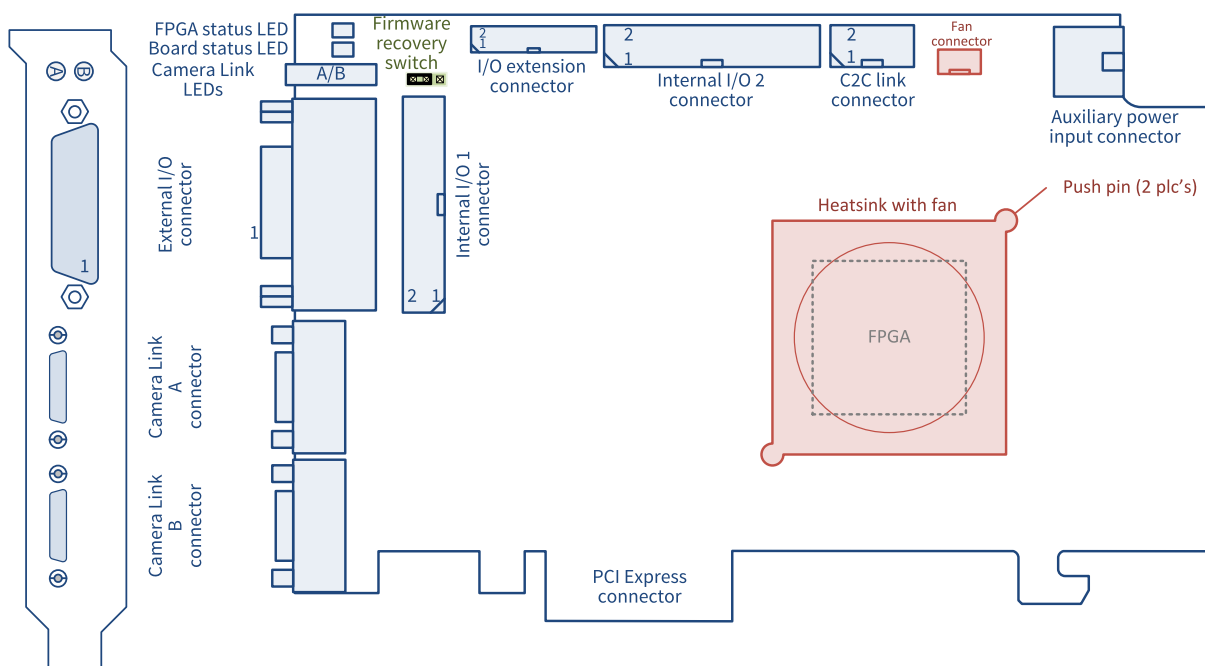
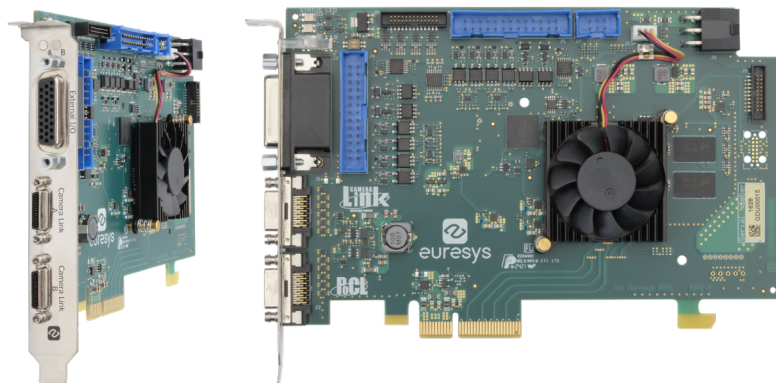
Mechanical specifications of the product(s) including: product pictures, physical dimensions, connectors description and pin assignments, LEDs description, switches description, etc.

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1.2. Camera Connectors	296
1.3. GPIO Connectors	302
1.4. Other Connectors	321
1.5. LEDs and Switches	326

1.1. Board and Bracket Layouts

1628 Grablink Duo294

1628 Grablink Duo



Connectors

- "Auxiliary Power Input Connector for PoCL and GPIO" on page 325
- "C2C-Link Connector" on page 324
- "Camera Link A Connector" on page 297
- "Camera Link B Connector" on page 299
- "External I/O Connector" on page 303
- "I/O Extension Connector" on page 322
- "Internal I/O 1 Connector" on page 313
- "Internal I/O 2 Connector" on page 315

Lamps and switches

- "Camera Link LED lamps" on page 327
- "Board Status LED" on page 329
- "FPGA Status LED" on page 330
- "Firmware Recovery Switch" on page 331

Printed circuit board dimensions and assembly weight

Product	Length	Width	Weight
1628 Grablink Duo	167.65 mm 6.6 in	111.15 mm 4.38 in	150 g 5,29 oz

1.2. Camera Connectors

Camera Link A Connector	297
Camera Link B Connector	299

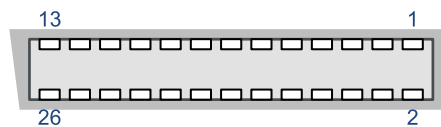
Camera Link A Connector

Applies to ¹

Duo

Connector description

Property	Value
Name, Label	Camera Link A
Type	26-position Shrunk Delta Ribbon socket with M2 jack socket screws
Location	Card bracket
Usage	Camera A input, PoCL output



Pin assignments

Base configuration

Pin	Signal	Usage
1	PoCL	PoCL +12V Power output
2	CC4-	Camera Control 4 - Negative pole
3	CC3+	Camera Control 3 - Positive pole
4	CC2-	Camera Control 2 - Negative pole
5	CC1+	Camera Control 1 - Positive pole
6	SERTFG+	Serial COM to Frame Grabber - Positive pole
7	SERTC-	Serial COM to Camera - Negative pole
8	X3+	Channel Link X - Pair 3 - Positive pole
9	XCLK+	Channel Link X - Clock - Positive pole
10	X2+	Channel Link X - Pair 2 - Positive pole
11	X1+	Channel Link X - Pair 1 - Positive pole
12	X0+	Channel Link X - Pair 0 - Positive pole

¹ 1628 Grablink Duo.

Pin	Signal	Usage
13	GND	Ground
14	GND	Ground
15	CC4+	Camera Control 4 - Positive pole
16	CC3-	Camera Control 3 - Negative pole
17	CC2+	Camera Control 2 - Positive pole
18	CC1-	Camera Control 1 - Negative pole
19	SERTFG-	Serial COM to Frame Grabber - Negative pole
20	SERTC+	Serial COM to Camera - Positive pole
21	X3-	Channel Link X - Pair 3 - Negative pole
22	XCLK-	Channel Link X - Clock - Negative pole
23	X2-	Channel Link X - Pair 2 - Negative pole
24	X1-	Channel Link X - Pair 1 - Negative pole
25	X0-	Channel Link X - Pair 0 - Negative pole
262	PoCL	PoCL +12V Power output

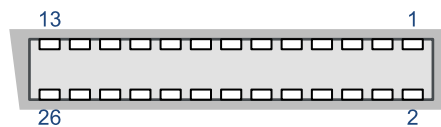
Camera Link B Connector

Applies to ¹

Duo

Connector description

Property	Value
Name, Label	Camera Link B
Type	26-position Shrunk Delta Ribbon socket with M2 jack socket screws
Location	Card bracket
Usage	Camera B input or Camera A second cable input, PoCL output



Pin assignments

Base configuration

Pin	Signal	Usage
1	PoCL	PoCL +12V Power output
2	CC4-	Camera Control 4 - Negative pole
3	CC3+	Camera Control 3 - Positive pole
4	CC2-	Camera Control 2 - Negative pole
5	CC1+	Camera Control 1 - Positive pole
6	SERTFG+	Serial COM to Frame Grabber - Positive pole
7	SERTC-	Serial COM to Camera - Negative pole
8	X3+	Channel Link X - Pair 3 - Positive pole
9	XCLK+	Channel Link X - Clock - Positive pole
10	X2+	Channel Link X - Pair 2 - Positive pole
11	X1+	Channel Link X - Pair 1 - Positive pole
12	X0+	Channel Link X - Pair 0 - Positive pole

¹ 1628 Grablink Duo.

Pin	Signal	Usage
13	GND	Ground
14	GND	Ground
15	CC4+	Camera Control 4 - Positive pole
16	CC3-	Camera Control 3 - Negative pole
17	CC2+	Camera Control 2 - Positive pole
18	CC1-	Camera Control 1 - Negative pole
19	SERTFG-	Serial COM to Frame Grabber - Negative pole
20	SERTC+	Serial COM to Camera - Positive pole
21	X3-	Channel Link X - Pair 3 - Negative pole
22	XCLK-	Channel Link X - Clock - Negative pole
23	X2-	Channel Link X - Pair 2 - Negative pole
24	X1-	Channel Link X - Pair 1 - Negative pole
25	X0-	Channel Link X - Pair 0 - Negative pole
262	PoCL	PoCL +12V Power output

Medium/72-bit/Full/80-bit configuration

Pin	Signal	Usage
1	PoCL	PoCL +12V Power output
2	Z3+	Channel Link Z - Pair 3 - Positive pole
3	ZCLK+	Channel Link Z - Clock - Positive pole
4	Z2+	Channel Link Z - Pair 2 - Positive pole
5	Z1+	Channel Link Z - Pair 1 - Positive pole
6	Z0+	Channel Link Z - Pair 0 - Positive pole
7	TERM-	Unused but terminated pair
8	Y3+	Channel Link Y - Pair 3 - Positive pole
9	YCLK+	Channel Link Y - Clock - Positive pole
10	Y2+	Channel Link Y - Pair 2 - Positive pole
11	Y1+	Channel Link Y - Pair 1 - Positive pole
12	Y0+	Channel Link Y - Pair 0 - Positive pole
13	GND	Ground
14	GND	Ground
15	Z3-	Channel Link Z - Pair 3 - Negative pole
16	ZCLK-	Channel Link Z - Clock - Negative pole

Pin	Signal	Usage
17	Z2-	Channel Link Z - Pair 2 - Negative pole
18	Z1-	Channel Link Z - Pair 1 - Negative pole
19	Z0-	Channel Link Z - Pair 0 - Negative pole
20	TERM+	Unused but terminated pair
21	Y3-	Channel Link Y - Pair 3 - Negative pole
22	YCLK-	Channel Link Y - Clock - Negative pole
23	Y2-	Channel Link Y - Pair 2 - Negative pole
24	Y1-	Channel Link Y - Pair 1 - Negative pole
25	Y0-	Channel Link Y - Pair 0 - Negative pole
262	PoCL	PoCL +12V Power output

1.3. GPIO Connectors

External I/O Connector	303
External I/O Connector - 1625	305
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External I/O Connector

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE
Quad12	Quad12-4	Quad12J	Quad12J-4	Value12	QSFP+	

Connector description

Property	Value
Name, Label	External I/O
Type	26-pin 3-row high-density female sub-D connector with UNC4-40 jack socket screws
Location	Card bracket
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	DIN12+	High-speed differential input #12 – Positive pole
3	IIN11+	Isolated input #11 – Positive pole
4	IIN13-	Isolated input #13 – Negative pole
5	IIN14-	Isolated input #14 – Negative pole
6	IOUT12-	Isolated contact output #12 – Negative pole
7	GND	Ground
8		Not connected
9	GND	Ground

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

Pin	Signal	Usage
10	GND	Ground
11	DIN12-	High-speed differential input #12 – Negative pole
12	IIN11-	Isolated input #11 – Negative pole
13	IIN12+	Isolated input #12 – Positive pole
14	IIN13+	Isolated input #13 – Positive pole
15	IIN14+	Isolated input #14 – Positive pole
16	IOUT12+	Isolated contact output #12 – Positive pole
17	TTLIO12	TTL input/output #12
18	GND	Ground
19	DIN11-	High-speed differential input #11 – Negative pole
20	DIN11+	High-speed differential input #11 – Positive pole
21	IIN12-	Isolated input #12 – Negative pole
22	IOUT11-	Isolated contact output #11 – Negative pole
23	IOUT11+	Isolated contact output #11 – Positive pole
24	GND	Ground
25	TTLIO11	TTL input/output #11
26	+12V	+12 V Power output

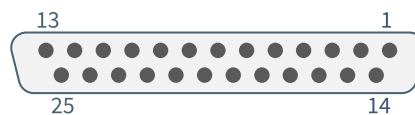
External I/O Connector - 1625

Applies to ¹

1625

Connector description

Property	Value
Name, Label	External I/O
Type	25-pin female sub-D connector with UNC4-40 jack socket screws
Location	Card bracket
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	DIN11+	High-speed differential input #11 – Positive pole
3	DIN11-	High-speed differential input #11 – Negative pole
4	DIN12+	High-speed differential input #12 – Positive pole
5	DIN12-	High-speed differential input #12 – Negative pole
6	IIN11+	Isolated input #11 – Positive pole
7	IIN11-	Isolated input #11 – Negative pole
8	IIN12+	Isolated input #12 – Positive pole
9	IIN12-	Isolated input #12 – Negative pole
10	IIN13+	Isolated input #13 – Positive pole
11	IIN13-	Isolated input #13 – Negative pole
12	IIN14+	Isolated input #14 – Positive pole
13	IIN14-	Isolated input #14 – Negative pole

¹ 1625 DB25F I/O Adapter Cable.

Pin	Signal	Usage
14	IOUT11+	Isolated contact output #11 – Positive pole
15	IOUT11-	Isolated contact output #11 – Negative pole
16	IOUT12+	Isolated contact output #12 – Positive pole
17	IOUT12-	Isolated contact output #12 – Negative pole
18	TTLIO11	TTL input/output #11
19	GND	Ground
20	TTLIO12	TTL input/output #12
21	GND	Ground
22		Not connected
23	GND	Ground
24	+12V	+12 V Power output
25	+12V_RTN	Ground

Standard I/O set #2

Pin	Signal	Usage
1	GND	Ground
2	DIN21+	High-speed differential input #21 – Positive pole
3	DIN21-	High-speed differential input #21 – Negative pole
4	DIN22+	High-speed differential input #22 – Positive pole
5	DIN22-	High-speed differential input #22 – Negative pole
6	IIN21+	Isolated input #21 – Positive pole
7	IIN21-	Isolated input #21 – Negative pole
8	IIN22+	Isolated input #22 – Positive pole
9	IIN22-	Isolated input #22 – Negative pole
10	IIN23+	Isolated input #23 – Positive pole
11	IIN23-	Isolated input #23 – Negative pole
12	IIN24+	Isolated input #24 – Positive pole
13	IIN24-	Isolated input #24 – Negative pole
14	IOUT21+	Isolated contact output #21 – Positive pole
15	IOUT21-	Isolated contact output #21 – Negative pole
16	IOUT22+	Isolated contact output #22 – Positive pole
17	IOUT22-	Isolated contact output #22 – Negative pole
18	TTLIO21	TTL input/output #21

Pin	Signal	Usage
19	GND	Ground
20	TTLIO22	TTL input/output #22
21	GND	Ground
22		Not connected
23	GND	Ground
24	+12V	+12 V Power output
25	+12V_RTN	Ground

External I/O Connector - 3304

Applies to ¹

3304

Connector description

Property	Value
Name, Label	External I/O
Type	26-pin 3-row high-density female sub-D connector with UNC4-40 jack socket screws
Location	Card bracket
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	DIN12+	High-speed differential input #12 – Positive pole
3	IIN11+	Isolated input #11 – Positive pole
4	IIN13-	Isolated input #13 – Negative pole
5	IIN14-	Isolated input #14 – Negative pole
6	IOUT12-	Isolated contact output #12 – Negative pole
7	GND	Ground
8		Not connected
9	GND	Ground
10	GND	Ground
11	DIN12-	High-speed differential input #12 – Negative pole
12	IIN11-	Isolated input #11 – Negative pole

¹ 3304 HD26F I/O Adapter Cable.

Pin	Signal	Usage
13	IIN12+	Isolated input #12 – Positive pole
14	IIN13+	Isolated input #13 – Positive pole
15	IIN14+	Isolated input #14 – Positive pole
16	IOUT12+	Isolated contact output #12 – Positive pole
17	TTLIO12	TTL input/output #12
18	GND	Ground
19	DIN11-	High-speed differential input #11 – Negative pole
20	DIN11+	High-speed differential input #11 – Positive pole
21	IIN12-	Isolated input #12 – Negative pole
22	IOUT11-	Isolated contact output #11 – Negative pole
23	IOUT11+	Isolated contact output #11 – Positive pole
24	GND	Ground
25	TTLIO11	TTL input/output #11
26	+12V	+12 V Power output

Standard I/O set #2

Pin	Signal	Usage
1	GND	Ground
2	DIN22+	High-speed differential input #22 – Positive pole
3	IIN21+	Isolated input #21 – Positive pole
4	IIN23-	Isolated input #23 – Negative pole
5	IIN24-	Isolated input #24 – Negative pole
6	IOUT22-	Isolated contact output #22 – Negative pole
7	GND	Ground
8		Not connected
9	GND	Ground
10	GND	Ground
11	DIN22-	High-speed differential input #22 – Negative pole
12	IIN21-	Isolated input #21 – Negative pole
13	IIN22+	Isolated input #22 – Positive pole
14	IIN23+	Isolated input #23 – Positive pole
15	IIN24+	Isolated input #24 – Positive pole
16	IOUT22+	Isolated contact output #22 – Positive pole

Pin	Signal	Usage
17	TTLIO22	TTL input/output #22
18	GND	Ground
19	DIN21-	High-speed differential input #21 – Negative pole
20	DIN21+	High-speed differential input #21 – Positive pole
21	IIN22-	Isolated input #22 – Negative pole
22	IOUT21-	Isolated contact output #21 – Negative pole
23	IOUT21+	Isolated contact output #21 – Positive pole
24	GND	Ground
25	TTLIO21	TTL input/output #21
26	+12V	+12 V Power output

External I/O Connector - 3610/3612

Applies to ¹



Connector description

Property	Value
Name, Label	External I/O
Type	26-pin 3-row high-density female sub-D connector with UNC4-40 jack socket screws
Location	Card bracket
Usage	General purpose I/O and power output



Pin assignments

Pin	Signal	Usage
1	GND	Ground
2	MIO03	Single-ended I/O #3 or differential I/O #3 positive pole
3	MIO05	Single-ended I/O #5 or differential I/O #5 positive pole
4	GND	Ground
5	MIO10-	Single-ended I/O #10 or differential I/O #9 negative pole
6	MIO14	Single-ended I/O #14 or differential I/O #13 negative pole
7	MIO18	Single-ended I/O #18 or differential I/O #17 negative pole
8	GND	Ground
9	MIO19	Single-ended I/O #19 or differential I/O #19 positive pole
10	GND	Ground
11	MIO04	Single-ended I/O #4 or differential I/O #3 negative pole
12	MIO06-	Single-ended I/O #6 or differential I/O #5 negative pole
13	MIO07	Single-ended I/O #7 or differential I/O #7 positive pole
14	GND	Ground

¹ 3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422.

Pin	Signal	Usage
15	MIO09	Single-ended I/O #9 or differential I/O #9 positive pole
16	MIO13	Single-ended I/O #13 or differential I/O #13 positive pole
17	MIO17	Single-ended I/O #17 or differential I/O #17 positive pole
18	MIO20	Single-ended I/O #20 or differential I/O #19 negative pole
19	MIO02	Single-ended I/O #2 or differential I/O #1 negative pole
20	MIO01	Single-ended I/O #1 or differential I/O #1 positive pole
21	MIO08	Single-ended I/O #8 or differential I/O #7 negative pole
22	MIO12	Single-ended I/O #12 or differential I/O #11 negative pole
23	MIO11	Single-ended I/O #11 or differential I/O #11 positive pole
24	MIO16	Single-ended I/O #16 or differential I/O #15 negative pole
25	MIO15	Single-ended I/O #15 or differential I/O #15 positive pole
26	+12V	+12 V Power output

Internal I/O 1 Connector

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

Connector description

Property	Value
Name, Label	Internal I/O 1
Type	26-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	GND	Ground
3	DIN11+	High-speed differential input #11 – Positive pole
4	DIN11-	High-speed differential input #11 – Negative pole
5	DIN12+	High-speed differential input #12 – Positive pole
6	DIN12-	High-speed differential input #12 – Negative pole
7	IIN11+	Isolated input #11 – Positive pole
8	IIN11-	Isolated input #11 – Negative pole
9	IIN12+	Isolated input #12 – Positive pole

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

Pin	Signal	Usage
10	IIN12-	Isolated input #12 – Negative pole
11	IIN13+	Isolated input #13 – Positive pole
12	IIN13-	Isolated input #13 – Negative pole
13	IIN14+	Isolated input #14 – Positive pole
14	IIN14-	Isolated input #14 – Negative pole
15	IOUT11+	Isolated contact output #11 – Positive pole
16	IOUT11-	Isolated contact output #11 – Negative pole
17	IOUT12+	Isolated contact output #12 – Positive pole
18	IOUT12-	Isolated contact output #12 – Negative pole
19	TTLIO11	TTL input/output #11
20	GND	Ground
21	TTLIO12	TTL input/output #12
22	GND	Ground
23		Not connected
24	GND	Ground
25	+12V	+12 V Power output
26	+12V_RTN	Ground

Internal I/O 2 Connector

Applies to ¹

Duo	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE	Quad12
Quad12-4	Quad12J	Quad12J-4	Value12	QSFP+		

Connector description

Property	Value
Name, Label	Internal I/O 2
Type	26-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #2

Pin	Signal	Usage
1	GND	Ground
2	GND	Ground
3	DIN21+	High-speed differential input #21 – Positive pole
4	DIN21-	High-speed differential input #21 – Negative pole
5	DIN22+	High-speed differential input #22 – Positive pole
6	DIN22-	High-speed differential input #22 – Negative pole
7	IIN21+	Isolated input #21 – Positive pole
8	IIN21-	Isolated input #21 – Negative pole
9	IIN22+	Isolated input #22 – Positive pole
10	IIN22-	Isolated input #22 – Negative pole
11	IIN23+	Isolated input #23 – Positive pole

¹ 1628 Grablink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

Pin	Signal	Usage
12	IIN23-	Isolated input #23 – Negative pole
13	IIN24+	Isolated input #24 – Positive pole
14	IIN24-	Isolated input #24 – Negative pole
15	IOUT21+	Isolated contact output #21 – Positive pole
16	IOUT21-	Isolated contact output #21 – Negative pole
17	IOUT22+	Isolated contact output #22 – Positive pole
18	IOUT22-	Isolated contact output #22 – Negative pole
19	TTLIO21	TTL input/output #21
20	GND	Ground
21	TTLIO22	TTL input/output #22
22	GND	Ground
23		Not connected
24	GND	Ground
25	+12V	+12 V Power output
26	+12V_RTN	Ground

Internal I/O Connector - 3610/3612

Applies to ¹



Connector description

Property	Value
Name, Label	Internal I/O
Type	26-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	General purpose I/O and power output



Pin assignments

Pin	Signal	Usage
1	GND	Ground
2	GND	Ground
3	MIO01	Single-ended I/O #1 or differential I/O #1 positive pole
4	MIO02	Single-ended I/O #2 or differential I/O #1 negative pole
5	MIO03	Single-ended I/O #3 or differential I/O #3 positive pole
6	MIO04	Single-ended I/O #4 or differential I/O #3 negative pole
7	MIO05	Single-ended I/O #5 or differential I/O #5 positive pole
8	MIO06	Single-ended I/O #6 or differential I/O #5 negative pole
9	MIO07	Single-ended I/O #7 or differential I/O #7 positive pole
10	MIO08	Single-ended I/O #8 or differential I/O #7 negative pole
11	GND	Ground
12	GND	Ground
13	MIO09	Single-ended I/O #9 or differential I/O #9 positive pole
14	MIO10	Single-ended I/O #10 or differential I/O #9 negative pole

¹ 3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422.

Pin	Signal	Usage
15	MIO11	Single-ended I/O #11 or differential I/O #11 positive pole
16	MIO12	Single-ended I/O #12 or differential I/O #11 negative pole
17	MIO13	Single-ended I/O #13 or differential I/O #13 positive pole
18	MIO14	Single-ended I/O #14 or differential I/O #13 negative pole
19	MIO15	Single-ended I/O #15 or differential I/O #15 positive pole
20	MIO16	Single-ended I/O #16 or differential I/O #15 negative pole
21	MIO17	Single-ended I/O #17 or differential I/O #17 positive pole
22	MIO18	Single-ended I/O #18 or differential I/O #17 negative pole
23	MIO19	Single-ended I/O #19 or differential I/O #19 positive pole
24	MIO20	Single-ended I/O #20 or differential I/O #19 negative pole
25	+12V	+12 V Power output
26	+12V_RTN	Ground

Internal I/O 2 Connector - 3614/3618

Applies to ¹

3614

3618

Connector description

Property	Value
Name, Label	Internal I/O 2
Type	26-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #2

Pin	Signal	Usage
1	GND	Ground
2	GND	Ground
3	DIN21+	High-speed differential input #21 – Positive pole
4	DIN21-	High-speed differential input #21 – Negative pole
5	DIN22+	High-speed differential input #22 – Positive pole
6	DIN22-	High-speed differential input #22 – Negative pole
7	IIN21+	Isolated input #21 – Positive pole
8	IIN21-	Isolated input #21 – Negative pole
9	IIN22+	Isolated input #22 – Positive pole
10	IIN22-	Isolated input #22 – Negative pole
11	IIN23+	Isolated input #23 – Positive pole
12	IIN23-	Isolated input #23 – Negative pole

¹ 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

Pin	Signal	Usage
13	IIN24+	Isolated input #24 – Positive pole
14	IIN24-	Isolated input #24 – Negative pole
15	IOUT21+	Isolated contact output #21 – Positive pole
16	IOUT21-	Isolated contact output #21 – Negative pole
17	IOUT22+	Isolated contact output #22 – Positive pole
18	IOUT22-	Isolated contact output #22 – Negative pole
19	TTLIO21	TTL input/output #21
20	GND	Ground
21	TTLIO22	TTL input/output #22
22	GND	Ground
23		Not connected
24	GND	Ground
25	+12V	+12 V Power output
26	+12V_RTN	Ground

1.4. Other Connectors

I/O Extension Connector	322
C2C-Link Connector	324
Auxiliary Power Input Connector for PoCL and GPIO	325

I/O Extension Connector

Applies to ¹

Duo	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	3610
3612	3614	3618				

Connector description

Property	Value
Name, Label	I/O Extension
Type	26-pin dual-row 0.050" pitch pin header with shrouding
Location	Printed circuit board
Usage	I/O extension cable socket



Pin assignments

Pin	Signal	Usage
1	IOEXT1WIRE	1-wire serial I/O
2	GND	Ground
3	IOEXT01	I/O Extension #1
4	+3V3	+3.3 V Power
5	IOEXT02	I/O Extension #2
6	GND	Ground
7	IOEXT03	I/O Extension #3
8	+3V3	+3.3 V Power
9	IOEXT04	I/O Extension #4
10	GND	Ground

¹ 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 3610 HD26F I/O Extension Module - TTL-RS422, 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422, 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

Pin	Signal	Usage
11	IOEXT05	I/O Extension #5
12	+3V3	+3.3 V Power
13	IOEXT06	I/O Extension #6
14	GND	Ground
15	IOEXT07	I/O Extension #7
16	+3V3	+3.3 V Power
17	IOEXT08	I/O Extension #8
18	GND	Ground
19	IOEXT09	I/O Extension #9
20	12V	12V Power
21	IOEXT10	I/O Extension #10
22	GND	Ground
23	IOEXT11	I/O Extension #11
24	12V	12V Power
25	IOEXT12	I/O Extension #12
26	GND	Ground

C2C-Link Connector

Applies to ¹

Duo	Duo104EMB	Mono	Duo	Quad	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+
1636						

Connector description

Property	Value
Name, Label	C2C-Link
Type	6-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	Card-to-card link



Pin assignments

Pin	Signal	Usage
1	GND	Ground
2	CSync1	Card-to-card synchronization bus – Signal 1
3	GND	Ground
4	CSync2	Card-to-card synchronization bus – Signal 2
5	GND	Ground
6	CSync3	Card-to-card synchronization bus – Signal 3

¹ 1628 Gralink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+ and 1636 InterPC C2C-Link Adapter.

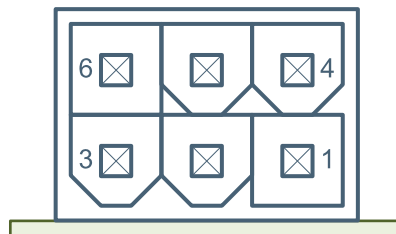
Auxiliary Power Input Connector for PoCL and GPIO

Applies to ¹

Duo

Connector description

Property	Value
Name, Label	Auxiliary Power Input
Type	6-pin PCI Express x16 Graphics 150W ATX power socket connector
Location	Printed circuit board
Usage	DC power input for PoCL and GPIO power output



Pin assignments

Pin	Signal	Usage
1	+12VIN	Auxiliary +12 V input
2	+12VIN	Auxiliary +12 V input
3	+12VIN	Auxiliary +12 V input
4	GND	Ground
5	SenseIN	Power source presence detection
6	GND	Ground

¹ 1628 Grablink Duo.

1.5. LEDs and Switches

Camera Link LED lamps	327
Board Status LED	329
FPGA Status LED	330
Firmware Recovery Switch	331

Camera Link LED lamps

Applies to ¹

Duo

Each connector of the Camera Link Host Interface is associated with a LED lamp mounted on the bracket.

LED lamps mode control










The **LampMode** feature of the Interface module defines the lamps operation mode:

- When set to **Standard** (default value), the lamps indicate the state of the Camera Link connection.
- When set to **Dark**, all lamps are turned off.
- When set to **Error**, all lamps are turned off unless error conditions are detected.
- When set to **Custom**, all lamps are controlled by **LampCustomValue**, a bitfield where each bit is mapped onto a lamp with 1 for orange and 0 for off by the **LampCustomLedA** ... **LampCustomLedH** boolean features.

¹ 1628 Grablink Duo.

Camera Link Host Indicator LED lamps states

States description

Symbol	Indication, color(s)	State
	Off	No power
	Solid, orange	System booting
	AlternateFlash_12_5, green / orange ¹	Connection detection in progress; PoCL active
	Flash_12_5, orange ²	Connection detection in progress; PoCL not in use
	Solid, green	Device / Host connected (Serdes locked), but no data being transferred
	Flash_1, orange	Device / Host connected (Serdes locked), waiting for event (e.g. trigger, exposure pulse)
	Flash_12_5, green	Device / Host (Serdes locked), data being transferred
	Flash_0_5, red	Invalid connector B configuration
	Flash_12_5, red	System error (e.g. internal error)

Flashing states timing definitions




Indication	Frequency	Duty Cycle
Flash_12_5	12.5 Hz	25% (20 milliseconds on, 60 milliseconds off)
Flash_1	1 Hz	20% (200 milliseconds on, 800 milliseconds off)
Flash_0_5	0.5 Hz	50% (1 second on, 1 second off)
AlternateFlash_12_5	12.5 Hz	25% (20 milliseconds on color 1, 60 milliseconds off, 20 milliseconds on color 2, 60 milliseconds off)

¹ Shown for a minimum of 1 second even if the connection detection is faster

² Shown for a minimum of 1 second even if the connection detection is faster




Board Status LED

Board status LED indicator states

LED state	Symbol	Meaning
Off		No power. The board is not powered or the power distribution network is not functional.
		FPGA NOK. The FPGA start-up procedure is not completed. <i>The normal completion time is around 100 milliseconds.</i>
Solid green		Board status OK. The main power distribution network is operational and the FPGA start-up procedure has successfully completed.
Solid red		Board status NOK. Possible causes are: <ul style="list-style-type: none"> • There is no power delivered on the +12 V rail of the PCI Express connector slot • At least one power converter of the main power distribution network is unable to operate properly. <i>This might be caused by excessive temperature due to inadequate board cooling, accidental short-circuits having blown one (or more) protection fuses, inappropriate supply voltages, etc.</i>

FPGA Status LED

FPGA status LED indicator states

LED state	Symbol	Meaning
Solid green		FPGA status OK. All the FPGA clock networks and the DDR memory are operating normally.
Solid red		FPGA status NOK. Possible causes: <ul style="list-style-type: none">• At least one FPGA clock network is not operating normally. <i>This might be caused by excessive jitter on external clock signals of the CoaXPress or the PCI Express interfaces.</i>• The DDR memory controller has not been able to successfully perform the calibration procedure.
Solid orange		FPGA status NOK. Possible cause: <ul style="list-style-type: none">• The DDR memory controller has not been able to successfully perform the calibration procedure.

Firmware Recovery Switch

Switch types and location

The *firmware recovery switch* is implemented with one of the following components:

- 3-pin header and a jumper
- 2-way DIP switch

See also: Board and Bracket Layouts in the Coaxlink series Handbook or in the Grablink Duo Handbook to locate the firmware recovery switch. These drawings show its normal position.

Switch positions


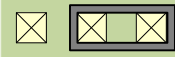
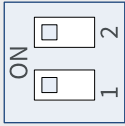
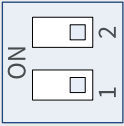
The *firmware recovery switch* has two positions:

Normal position (factory default)

At the next power ON, the latest firmware successfully written into the Flash EEPROM is used to program the FPGA. After FPGA startup completion, the card exhibits the *standard PCI ID* and the driver allows normal operation.

Recovery position

At the next power ON, the last but one firmware successfully written into the Flash EEPROM is used to program the FPGA. After FPGA startup completion, the card exhibits the *recovery PCI ID* and the driver inhibits image acquisition.

Switch type	Normal position	Recovery position
3-pin header and a jumper		
2-way DIP switch		

2. Electrical Specification

Electrical specification of the product(s) including: electrical characteristics of all the input/output ports, description of the power distribution, power requirements, etc.

2.1. Camera Link ECCO-85 Host Interface	333
2.2. 4-lane Rev 2.0 PCIe end-point	337
2.3. Power	338
Power Distribution	339
Main Power Input Requirements	341
Auxiliary Power Input	342
I/O Power Output	343
2.4. I/O Interfaces	345
Differential Input (Version 1)	346
Differential Input/Output	348
TTL Input/Output (Version 2)	351
TTL Input/5 V CMOS Output	354
Isolated Input (Version 2)	357
Isolated Output	360

2.1. Camera Link ECCO-85 Host Interface

Applies to ¹

Duo

The *Camera Link ECCO-85 Host Interface* of **1628 Grablink Duo** implements a Camera Link Host interface for 2 Base configuration cameras or 1 Medium/Full, 72-bit or 80-bit configurations camera.

FPGA emulated Channel Link receivers

The interface emulates Channel Link receivers with an FPGA according to the Camera Link 2.1 standard

Each channel link receiver is composed of:

- 5 high-performance LVDS inputs terminated with a 100 Ohm resistor: one clock and 4 serialized data inputs.
- a digital PLL for clock recovery and clock jitter cancellation
- a dynamic pair-to-pair skew compensator
- 4 7:1 data de-serializers

Extended Camera Link Cable Operation - ECCO

The FPGA emulated Channel Link exceeds the performance of original Channel Link by:

- reducing the requirements for the cable pair-to-pair skew
- allowing longer cables

See also: [ECCO \(Extended Camera Link Cable Operation\) jitter and cable skew compensation](#)

Requirements for cameras:

- Clock frequency range: 20 MHz up to 85 MHz
- The clock may not be switched off during normal operation.
- The clock jitter must be as low as possible; it is recommended to use crystal oscillators to generate the Camera Link clock. It may not exceed 1 ns or 20% of the clock period.
- The clock duty cycle must be better than 25%/75%.
- For correct operation of PoCL, it is mandatory to apply the clock as soon as possible after power on. The time-out delay is 500 milliseconds.
- The electrical signal of the 4 data lines must be conform to the Camera Link requirements.

¹ 1628 Grablink Duo.

Additional requirements for Medium/Full/72-bit/80-bit cameras

- The Camera Link standard specifies that all four enable signals (LVAL, FVAL, DVAL, SPARE) are supplied to all Channel Links. However, for the 80-bit configuration, only the LVAL signal needs to be distributed on the second and the third channel link.
- The same LVAL signal must be applied on all Channel Links
- At least one valid LVAL pulse needs to be sent to the frame grabber before it can start acquiring data.
- The skew across LVAL signals of all channel link receivers involved in the configuration may not exceed 2 ns (about 40 cm of cable). It is recommended to:
 - Use identical cables in terms of length and propagation delay characteristic for both connectors.
 - Apply the LVAL signal when power is on.

Line drivers/receivers

All output lines (Camera Control lines (CC1 to CC4) and SERTC COM line) comply with the LVDS driver specification.

All input lines (Channel Link lines and SERTFG COM line) are terminated with a 100 Ohm impedance and comply with the LVDS receiver specification.

All lines are protected against over-voltage and electrostatic discharges

Switchable configuration

The Camera Link interface of **1628 Grablink Duo** has 2 configurations. Eleven pairs of pins of the Camera Link B connector change their function according to the configuration:

Pin pairs	1-camera Medium/72-bit/Full/80-bit configuration	2-camera Base configuration	Direction Change
3, 16	ZCLK - Channel Link Z - Clock - Input	CC3 - Camera Control 3 - Output	Yes
6,19	Z0 - Channel Link Z - Data 0 - Input	SERTFG -Serial COM - Input	
5, 18	Z1 - Channel Link Z - Data 1 - Input	CC1 - Camera Control 1 - Output	Yes
4, 17	Z2 - Channel Link Z - Data 2 - Input	CC2 - Camera Control 2 - Output	Yes
2,15	Z3 - Channel Link Z - Data 3 - Input	CC4 - Camera Control 4 - Output	Yes
7, 20	TERM - Unused terminated input	SERTC - Serial COM - Output	Yes
9, 22	YCLK - Channel Link Y - Clock - Input	XCLK - Channel Link X - Clock - Input	
12, 25	Y0 - Channel Link Y - Data 0 - Input	X0 - Channel Link X - Data 0 - Input	
11, 24	Y1 - Channel Link Y - Data 1 - Input	X1 - Channel Link X - Data 1 - Input	
10, 23	Y2 - Channel Link Y - Data 2 - Input	X2 - Channel Link X - Data 2 - Input	
8, 21	Y3 - Channel Link Y - Data 3 - Input	X3 - Channel Link X - Data 3 - Input	

See also: "Camera Connectors" on page 296

As shown in the above table, five pairs of pins of the Camera Link B connector change also their direction according to the configuration: they become outputs when **1628 Grablink Duo** operates in the 2-camera Base configuration.



WARNING

To prevent short-circuits, don't connect a Medium/72-bit/Full/80-bit configuration camera to Camera Link B connector when **1628 Grablink Duo** operates in the 2-camera Base configuration.

NOTE: To prevent risk of short-circuits, **1628 Grablink Duo** are configured at factory for 1-camera Medium/72-bit/Full/80-bit configuration.

Cable Requirements

- The camera cables must be terminated with a 26-pin Shrunken Delta Ribbon - SDR - connector at the frame grabber side
- Both PoCL and non-PoCL cables can be used.



WARNING

The usage of poor quality Camera Link cables may cause malfunction. This becomes critical for systems with a high clock rate or with long cables length. Therefore, Euresys recommends using Camera Link cables that are certified by the cable manufacturer for the length vs. clock rate combination.

Power over Camera Link - PoCL

See also: Refer to "Power over Camera Link" on page 51 in the Functional Guide

2.2. 4-lane Rev 2.0 PCIe end-point

Applies to ¹

Duo

Duo104EMB

Mono

Duo

Quad

Quad3DLLE

The PCI Express Interface implements a *PCIe end-point* interface and provides *electrical power* to the on-board circuits.

The 4-lane Rev 2.0 PCIe end-point:

- complies with Revision 2.0 of the PCI Express Card Electromechanical specification,
- supports 1-lane, 2-lane, and 4-lane link width,
- supports PCIe Rev 2.0 link speed (5.0 GT/s with 8b/10b coding),
- supports PCIe Rev 1.0 link speed (2.5 GT/s with 8b/10b coding),
- supports payload size up to 512 bytes,
- offers the optimal performance when it is configured for 4-lane PCIe Rev 2.0 link speed (5 GT/s).

4-lane Rev 2.0 PCIe end-point to PC memory data transfer performance

Parameter	Conditions	Min.	Typ.	Max.	Unit
Sustainable output data rate	4-lane @ 5 GT/s (PCIe Rev 2.0)		1,700		MB/s
	4-lane @ 2.5 GT/s (PCIe Rev 1.0)		800		MB/s
	2-lane @ 5 GT/s (PCIe Rev 2.0)		800		MB/s

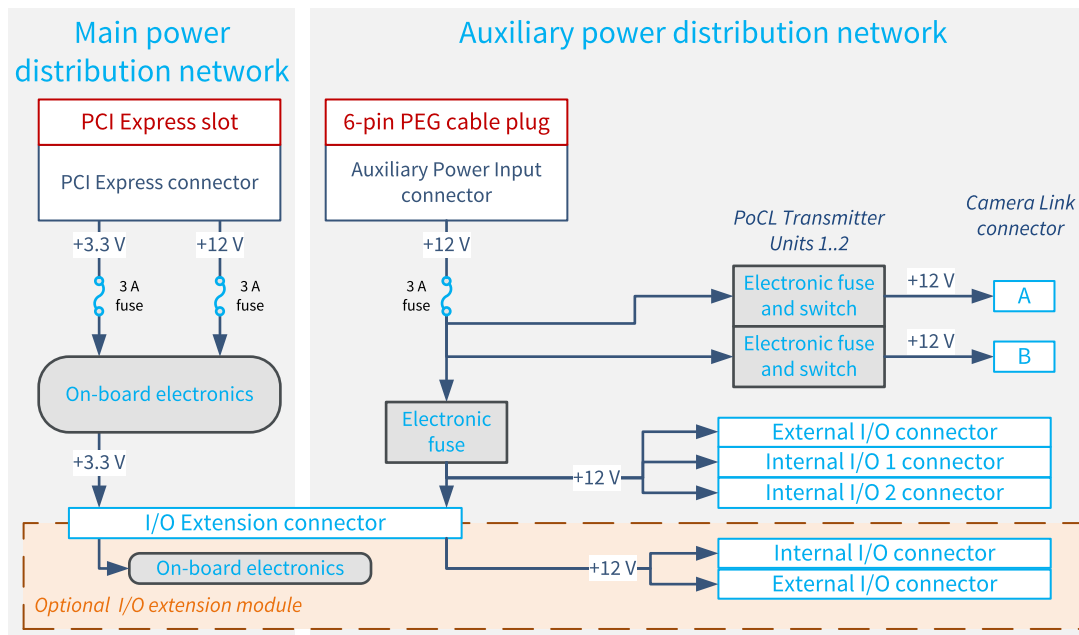
¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad and 1637 Coaxlink Quad 3D-LLE.

2.3. Power

Power requirements and specifications

Power Distribution	339
Main Power Input Requirements	341
Auxiliary Power Input	342
I/O Power Output	343

Power Distribution



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, I/O drivers and receivers.

The network is fed by the Host PC motherboard through the +3.3 V and the +12 V power rails of the PCI Express slot connector. Protection fuses inserted at the input side of each power rail prevent potential fire hazards.

The *board status LED* reflects the global status of all the power converters of the main distribution network.

See also: "Main Power Input Requirements" on page 341

Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- Camera Link cameras using the PoCL capability available on all Camera Link Host connectors
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 342, "I/O Power Output" on page 343 and

**WARNING**

- The fuses are not serviceable! When blown, the card must be returned to the factory.
- PTCs and electronic fuses are self-resettable fuses.

The card can be operated without applying power to the auxiliary power distribution network.

**TIP**

The card can be operated without applying power to the auxiliary power distribution network.

Main Power Input Requirements

Typical PCI Express power consumption

The following table provides the *typical PCI Express power consumption* for each product when it operates under the following conditions:

- Acquiring image data using all CoaXPress Host Interface connections operating at their maximum speed
- Delivering image data on the PCI Express configured for the largest link width and the highest link speed
- Operating @25°C [77 °F] ambient temperature and nominal supply voltages

Product	+12 V	+3.3 V	Total	Units
1628 Grablink Duo	4.4	2.7	7.1	W



WARNING

The above table provides typical power consumption to help the system integrator with the sizing of the Host PC power supply.

Voltage requirements

Parameter	Min.	Typ.	Max.	Units
+3.3 V voltage	3.0	3.3	3.6	V
+12 V voltage	11.0	12.0	13.0	V

Auxiliary Power Input

Auxiliary power input requirements

The following table provides the 'worst case' auxiliary power consumption for each product:

- The *I/O power* column specifies the maximum required input power dedicated to external I/O powering.
- The *Camera power* column specifies the maximum required input power dedicated to camera powering. This number takes care of the power conversion efficiency.

Product	Connector	Nominal voltage [V]	I/O power [W]	Camera power [W]	Total power [W]
1628 Grablink Duo	PEG	12	12	2 x 4	20

Requirements for PEG connector

The network is fed by a 12 V external power supply attached to the auxiliary power input connector using a power cable terminated by a 6-pin PEG plug connector. A protection fuse inserted at the input side prevents potential fire hazards.

Parameter	Min.	Typ.	Max.	Units
Voltage	11.0	12.0	13.0	V



WARNING

On the card side of the power cable, check carefully the voltage on each pin of the 6-pin PEG connector plug before insertion!

See also: "Avoid Mixing Power Supply Cables" on page 411

Monitoring the auxiliary power input

The `AuxiliaryPower12VInput` GenApi feature of the Interface module reports the status of the "12V Auxiliary Power Input" measured after the input fuse.

The `AuxiliaryPowerInput` GenApi feature of the Interface module reports the status of the auxiliary power input cable connection.



NOTE

The *SenseIN* input of the PEG connector is used for power source cable presence detection. It should be grounded at the power supply level.

I/O Power Output

I/O Power Output (Version 1)

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	QSFP+			

Description

A non-isolated +12 V power output is available on every I/O connector.

The power originates from an external 12 V power supply plugged into the Auxiliary Power Input connector. It is distributed from a common electronic fuse to all the I/O connectors.

The electronic fuse provides the following protections:

- Limits the inrush current during power on sequence
- Protects the frame grabber and the power source against overload
- Protects the frame grabber and the power source against short-circuits.

The sum of the load currents drawn from all the 12 V outputs of the I/O connectors must be lower or equal to the specified maximum output current.

Specification

Parameter	Conditions	Min.	Typ.	Max.	Units
Aggregated output current	Operating temperature range			1.0	A
Voltage drop across the electronic fuse	Max. output current			0.2	V

NOTE: The above specification applies over the whole operating temperature range of the frame grabber.

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH and 3625 Coaxlink QSFP+.

I/O Power Output (Version 2)

Applies to ¹

Value12

Quad12DF

A non-isolated +12 V power output is available on every I/O connector.

The power originates from an external 12 V power supply plugged into the Auxiliary Power Input connector. It is distributed from a common resettable fuse to all the I/O connectors.

The resettable fuse provides the following protections:

- Limits the inrush current during power on sequence
- Protects the frame grabber and the power source against overload
- Protects the frame grabber and the power source against short-circuits.
- The resettable fuse is a positive temperature coefficient device 1.85 A PTC.

The sum of the load currents drawn from all the 12 V outputs of the I/O connectors must be lower or equal to the specified maximum output current.

Specification

Parameter	Conditions	Min.	Typ.	Max.	Units
Aggregated output current	Operating temperature range			1.0	A
Voltage drop across the electronic fuse	Max. output current			0.2	V

NOTE: The above specification applies over the whole operating temperature range of the frame grabber.

¹ 3623 Coaxlink Quad CXP-12 Value and 3624 Coaxlink Quad CXP-12 DF.

2.4. I/O Interfaces

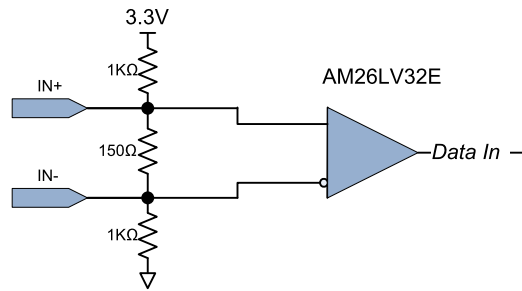
Electrical specification of the I/O interfaces

Differential Input (Version 1)	346
Differential Input/Output	348
TTL Input/Output (Version 2)	351
TTL Input/5 V CMOS Output	354
Isolated Input (Version 2)	357
Isolated Output	360

Differential Input (Version 1)

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Value12
Quad12DF	3300	3614				



Differential Input Simplified Schematic

The receiver complies with the ANSI/TIA/EIA-422B specification.

DC Characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Common mode voltage		-7		+7	V
Differential sensitivity				200	mV
Input impedance			120		Ohm
ESD protection	Human Body Model (HBM)	15			kV
	Contact discharge	8			kV
	Air gap discharge	15			kV

AC characteristics

Parameter	Min.	Typ.	Max.	Units
Pulse width	100			ns
Pulse rate	0		5	MHz
10%-90% rise/fall time			1	µs

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3300 HD26F I/O module for Coaxlink Duo PCIe/104 and 3614 HD26F I/O Extension Module - Standard I/O Set.

Logical map

The state of the port is reported as follows:

Relative V+/V- voltage	Logical State
$V+ > V-$	HIGH
$V+ < V-$	LOW
Unconnected input	HIGH

Compatible drivers

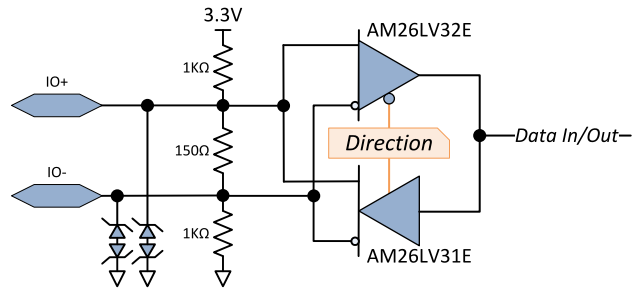
The following drivers are compatible with the high-speed differential input ports:

- RS-422/RS-485 differential line drivers
- Complementary TTL drivers

Differential Input/Output

Applies to ¹

3610 Not recommended for new designs
3612 Not recommended for new designs



Differential Input/Output Simplified Schematic

The driver and the receiver complies with the ANSI/TIA/EIA-422B specification.

¹ 3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422.

DC Characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Common mode voltage		-7		+7	V
Input impedance			120		Ohm
ESD protection	Human Body Model (HBM)	15			kV
	Contact discharge	8			kV
	Air gap discharge	15			kV

Driver

Parameter	Conditions	Min.	Typ.	Max.	Units
Low-level output current				30	mA
Low-level output voltage	20 mA		0.2	0.4	V
High-level output current				-30	mA
High-level output voltage	-20 mA	2.4	3		V
Differential output voltage	0 mA	2		4	V

Receiver

Parameter	Conditions	Min.	Typ.	Max.	Units
Differential amplitude		200			mV

AC characteristics

Driver

Parameter	Min.	Typ.	Max.	Units
Pulse width	50			ns
Pulse rate	0		10	MHz
10%-90% rise/fall time		TBD		μs

Receiver

Parameter	Min.	Typ.	Max.	Units
Pulse width	50			ns
Pulse rate	0		10	MHz
10%-90% rise/fall time		TBD		μs

Logical map

The state of the port is as follows:

Relative V+/V- voltage	Logical State
$V+ > V-$	HIGH
$V+ < V-$	LOW

Compatible sources

Sources with the following drivers are compatible:

- RS-422 differential line drivers
- Complementary TTL drivers

Compatible loads

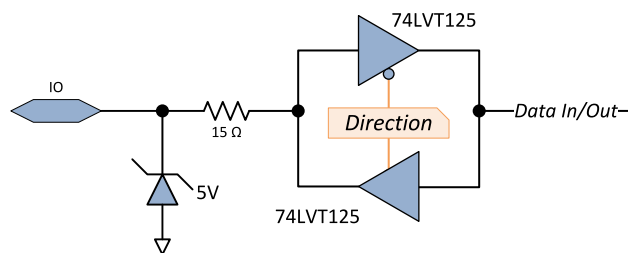
Loads with the following receivers are compatible:

- RS-422 differential line receivers

TTL Input/Output (Version 2)

Applies to ¹

Duo	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	3610 <small>Not recommended for new designs</small>
3618						



TTL Input/Output Simplified schematic

The port implements a 3.3 V LVTTTL driver and a 5 V-compliant 3.3 V LVTTTL receiver.

¹ 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 3610 HD26F I/O Extension Module - TTL-RS422 and 3618 HD26F I/O Extension Module - Fast I/O.

DC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
ESD protection	Human Body Model (HBM)	2			kV



NOTE

The I/O port includes a latch-up protection.

Driver

Parameter	Conditions	Min.	Typ.	Max.	Units
Low-level output current				64	mA
Low-level output voltage	@ 8 mA		0.34	0.36	V
	@ 16 mA		0.48	0.55	V
	@ 32 mA		0.78	0.81	V
	@ 64 mA		1.34	1.36	V
High-level output current				-32	mA
High-level output voltage	@-8 mA; (1)	2.60	3.00		V
	@-16 mA; (1)	2.20	2.70		V
	@-32 mA; (1)	1.75	2.20		V
ESD protection	Human Body Model (HBM)	2			kV

Condition (1): 300 Ohms line termination resistor to GND.

Receiver

Parameter	Conditions	Min.	Typ.	Max.	Units
Absolute maximum voltage rating		0		5	V

AC characteristics

Driver

Parameter	Conditions	Min.	Typ.	Max.	Units
Pulse width		100			ns
Pulse rate		0		5	MHz
10%-90% rise time			8		ns
10%-90% fall time			7.5		ns

Receiver

Parameter	Conditions	Min.	Typ.	Max.	Units
Pulse width		100			ns
Pulse rate		0		5	MHz

Logical Map

The state of the port is reported as follows:

Input voltage	Logical State
$V_{IN} > 2.0\text{ V}$	HIGH
$V_{IN} < 0.8\text{ V}$	LOW
Unconnected input port	<i>Undetermined</i>

Compatible sources

Sources with the following drivers are compatible:

- LVTTTL (3.3 V low-voltage TTL)
- TTL (5 V TTL)
- CMOS (5 V CMOS)

Compatible loads

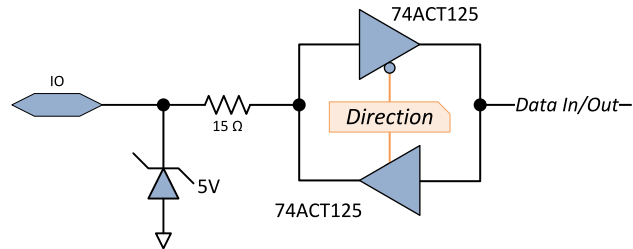
Loads with the following receivers are compatible:

- LVTTTL (3.3 V low-voltage TTL)
- TTL (5 V TTL)

TTL Input/5 V CMOS Output

Applies to ¹

3612 Not recommended for new designs



TTL Input/5 V CMOS Output Simplified schematic

The port implements a 5 V CMOS driver and a TTL-compliant receiver.

¹ 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422.

DC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
ESD protection	Human Body Model (HBM)	2			kV



NOTE

The I/O port includes a latch-up protection.

Driver

Parameter	Conditions	Min.	Typ.	Max.	Units
Absolute maximum voltage rating		0		5	V
Low-level output current				24	mA
Low-level output voltage	@50 μ A		0.001	0.1	V
	@ 24 mA			0.81	V
High-level output current				-24	mA
High-level output voltage	@-50 μ A; (1)	4.9	4.99		V
	@-24 mA; (1)	3.89			V

Condition (1): 300 Ohms line termination resistor to GND.

Receiver

Parameter	Conditions	Min.	Typ.	Max.	Units
Absolute maximum voltage rating		0		5	V

AC characteristics

Driver

Parameter	Conditions	Min.	Typ.	Max.	Units
Pulse width		500			ns
Pulse rate		0		1	MHz
10%-90% rise/fall time			TBD		ns

Receiver

Parameter	Conditions	Min.	Typ.	Max.	Units
Pulse width		500			ns
Pulse rate		0		1	MHz
10%-90% rise/fall time			TBD		ns

Logical Map

The state of the port is reported as follows:

Input voltage	Logical State
$V_{IN} > 2.0 \text{ V}$	HIGH
$V_{IN} < 0.8 \text{ V}$	LOW
Unconnected input port	<i>Undetermined</i>

Compatible sources

Sources with the following drivers are compatible:

- LVTTTL (3.3 V low-voltage TTL)
- CMOS (5 V CMOS)
- LVCMOS (3.3 V CMOS)

Compatible loads

Loads with the following receivers are compatible:

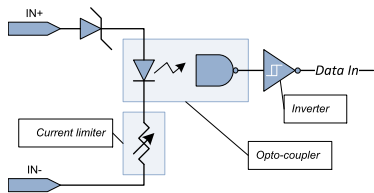
- TTL (5 V TTL)
- CMOS (5 V CMOS)

Isolated Input (Version 2)

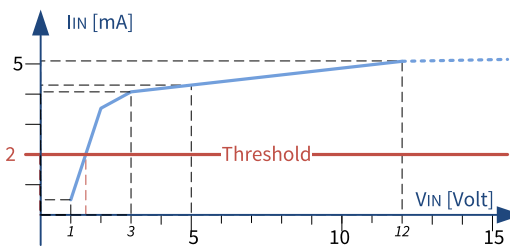
Applies to ¹

- Duo
- Value12
- Quad12DF

Isolated current-sense input with wide voltage input range up to 30V, compatible with totem-pole (push-pull) HTL drivers, 5V TTL/RS-422 differential line drivers, 5V CMOS drivers, potential free contacts, solid-state relays and opto-couplers



Simplified schematic



Input Current vs. Input Voltage Characteristics

DC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Differential voltage		-30		+30	V
Input current threshold			2	3	mA
Differential voltage	@3 mA		2.2		V
Input current	@(VIN+ - VIN-) < 1 V		0.5		mA
	@(VIN+ - VIN-) = 3 V		4.1		mA
	@(VIN+ - VIN-) = 5 V		4.4		mA
	@(VIN+ - VIN-) = 12 V		5.1		mA
	@(VIN+ - VIN-) = 30 V		6.8		mA

¹ 1628 Grablink Duo, 3623 Coaxlink Quad CXP-12 Value and 3624 Coaxlink Quad CXP-12 DF.

AC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Positive pulse width		2.5			μs
Negative pulse width		2.5			μs
Pulse rate		0		200	kHz
Turn-ON delay ¹	25 °C; 100 kHz; 5 V square signal LineFilterStrength = Lowest (LineFilterDelay = 500 ns)		800		ns
Turn-OFF delay ²			1350		ns



NOTE

1. The "Turn-ON" delay is defined as the time difference between a transition of state at the input that turns ON the opto-coupler and the subsequent transition in the FPGA.
2. The "Turn-OFF" delay is defined as the time difference between a transition of state at the input that turns OFF the opto-coupler and the subsequent transition in the FPGA.

These delays include the delay introduced by the digital line filter controlled by the **LineFilterStrength** GenApi feature!

Isolation characteristics

Parameter	Value
Isolation grade	Functional
Max. DC voltage	250 V
Max. AC voltage	170 V _{RMS}



NOTE

The functional isolation is only for the circuit technical protection. It does not provide an isolation that can protect a human being from electrical shock!

Logical map

The state of the port is reported as follows:

Input current	Logical State
$I_{IN} \geq 3 \text{ mA}$	HIGH
$I_{IN} < 0.5 \text{ mA}$	LOW
Unconnected input port	LOW

Compatible drivers

The following drivers are compatible with this version of the isolated current-sense inputs:

- Totem-pole (push-pull) HTL drivers, 5V TTL/RS-422 differential line drivers, 5 V CMOS drivers
- Potential free contact, solid-state relay, or opto-isolators
- 12 V and 24 V signaling voltages are also accepted



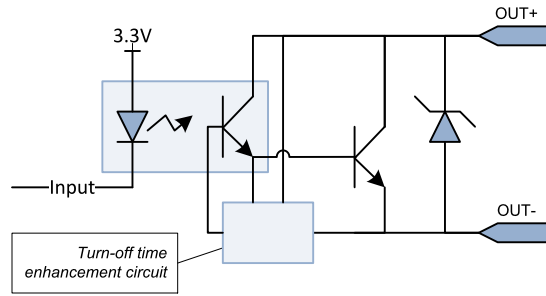
NOTE

- The +12 V power supply on the I/O connector(s) can be used for powering drivers requiring a power supply.
- No external resistors are required. However, to obtain the best noise immunity with 12 V and 24 V signaling, it is recommended to insert a series resistor in the circuit. The recommended resistor values are: 4.7k Ohms for 12 V signaling and 10k Ohms for 24 V signaling.

Isolated Output

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	3300
3614	3618					



Isolated Output Simplified schematic

The output port implements an isolated contact output.

DC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Current				100	mA
Differential voltage	Open state	-30		30	V
	Closed state @ 1 mA			0.4	V
	Closed state @ 100 mA			1.0	V



NOTE

- The output port in the closed state has no current limiter, the user circuit must be designed to avoid excessive currents that could destroy the output port.
- The output port remains in the OFF-state until it is under control of the application.

¹ 1628 Grablinc Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 3300 HD26F I/O module for Coaxlink Duo PCIe/104, 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

AC characteristics

Parameter	Min.	Typ.	Max.	Units
Pulse rate	0		100	kHz
Turn-on time			5	μ s
Turn-off time			5	μ s

Typical switching performance @ 25°C

Current [mA]	Turn ON time [μ s]	Turn OFF time [μ s]
0.5	2.0	4.8
1.0	2.0	3.9
4.0	2.2	3.3
10	2.3	2.7
40	2.3	2.7
100	2.3	2.7

Isolation characteristics

Parameter	Value
Isolation grade	Functional
Max. DC voltage	250 V
Max. AC voltage	170 V _{RMS}



NOTE

The functional isolation is only for the circuit technical protection. It does not provide an isolation that can protect a human being from electrical shock!

Logical map

The state of the output port is determined as follows:

Logical State	Output port state
HIGH	The contact switch is closed (ON)
LOW	The contact switch is open (OFF)

Compatible loads

The following loads are compatible with the isolated contact output ports:

- Any load within the 30 V / 100 mA envelope is accepted. The power originates from an external power source or alternatively from the power delivered through the 12 V and GND pins of the I/O connectors.

3. Environmental Specification

Environmental specification of the product(s) including: climatic requirements, electromagnetic standards compliance statements, safety standards compliance statements, etc.

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3.1. Storage Conditions

Standard (-20°C/+70°C) storage range

Applies to ¹

Duo	Duo104EMB	Mono	Duo	Quad	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+

Parameter	Conditions	Min	Max	Units
Ambient air temperature		-20 [-4]	70 [158]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

¹ 1628 Gralink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

3.2. Operating Conditions

Derated operating conditions (0°C ~ 50°C) — 80°C max FPGA temperature

Applies to ¹

Duo

Parameter	Conditions	Min	Max	Units
FPGA die temperature			80 [176]	°C [°F]
Ambient air temperature		0 [32]	50 [122]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

Standard operating conditions (0°C ~ 55°C)

Applies to ²

1625	1636	3300	3301	3302	3303	3304
3610	3612	3613	3614	3618		

Parameter	Conditions	Min	Max	Units
Ambient air temperature		0 [32]	55 [131]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH



WARNING

The thermal design of the host PC must ensure that, at any time, the FPGA die temperature never exceeds the recommended limit.



WARNING

Exceeding the upper limit of the FPGA die temperature can permanently damage the card.

¹ 1628 Grablink Duo.

² 1625 DB25F I/O Adapter Cable, 1636 InterPC C2C-Link Adapter, 3300 HD26F I/O module for Coaxlink Duo PCIe/104, 3301 Thermal drain (Model 1) for Coaxlink Duo PCIe/104, 3302 DIN1.0/2.3 Coaxial cable for Coaxlink Duo PCIe/104, 3303 C2C-Link Ribbon Cable, 3304 HD26F I/O Adapter Cable, 3610 HD26F I/O Extension Module - TTL-RS422, 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422, 3613 JTAG Adapter Xilinx for Coaxlink, 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

3.3. Temperature Monitor

Monitoring the FPGA temperature

Temperature sensor

All FPGA based products embed a temperature sensor located inside the FPGA, on the die.

To read the FPGA die temperature expressed in °C, the application must :

1. Set the `TemperatureSensorSelector` feature of the Interface Module to `Grabber`, and then ...
2. Get the `Temperature` feature value of the Interface Module.



WARNING

The user application is invited to check regularly the FPGA die temperature to ensure that the board operates within the specified operating limits.

Dual-threshold (80°C/85°C) temperature detection

Applies to ¹

Duo

The above listed frame grabber implements a dual-threshold excessive FPGA die temperature detection.

Warning threshold (80 °C) - Notify

When the measured FPGA die temperature reaches 82°C, the frame grabber posts a `FPGA temperature is too high` Memento message.

The message is sent repeatedly every second until the measured temperature decreases below 78°C or increases above 88°C.



WARNING

- Operation is still possible but is not recommended!
- When such event occurs, the user is invited to check and, possibly, improve the card cooling in the host PC!

¹ 1628 Grablink Duo.

Error threshold (85 °C) - Notify

When the measured FPGA die temperature reaches 88°C, the frame grabber posts a `FPGA temperature is too high; operation may stop to prevent damaging the card` Memento message.

The message is sent repeatedly every second until the measured temperature decreases below 82°C.



WARNING

- Random errors could occur in the FPGA if its core temperature becomes excessive!
- When such event occurs, the user must immediately shut down the system and revise the card cooling in the host PC before restarting!

3.4. Thermal Design Data

Main contributors

The main heat contributors of **1628 Grablink Duo** are:

- The electronic devices and power converters of the *main power distribution* network.



NOTE

There are no significant heat contributors for the *auxiliary* power distribution network:

1. The I/O powering contribution is not significant!
2. The PoCL camera powering contribution is not significant!

Generated heat power estimation and cooling method

The following table shows the estimated heat power generated by **1628 Grablink Duo**:

1. *Heat power 1*: when the card is not delivering power
1. *Heat power 2*: when the card delivers the maximum I/O and PoCL power on all camera connectors.

Product	Heat power 1	Heat power 2	Cooling method
1628 Grablink Duo	7.1 W	7.1 W	Air, heatsink with fan

Requirements for air-cooled products with fan

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Duo12
Value12	Quad12DF	QSFP+				

The heat is dissipated into the ambient air inside the Host PC. The heat exchange is facilitated by a heat sink and a fan mounted on the FPGA (the component having the largest heat source).

The thermal design must ensure sufficient air flow along both sides to keep the FPGA die temperature below the upper limit of the allowed temperature range. The application is responsible for regularly checking the temperature and for taking the appropriate action in case of excessive temperature.

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3622 Coaxlink Duo CXP-12, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

3.5. Compliance Statements

EMC compliance statements for Europe and Great Britain



Notice for Europe

This product is in conformity with the Council Directive 2014/30/EU



Notice for Great Britain

This product is in conformity with Electromagnetic Compatibility Regulations 2016

[EN55022/32 Class B emission](#) | [EN55024/35 EN61000-6-2 immunity](#)

Applies to ¹

Duo

Value12

Quad12DF

QSFP+

3614

This piece of equipment has been tested and found to comply with:

- Class B EN 55022 / CISPR 22 or EN 55032 / CISPR 32 electromagnetic emission requirements for information technology equipment
- EN 55024 / CISPR 24 or EN 55035 / CISPR 35 electromagnetic immunity requirements for information technology equipment
- EN 610006-2 Immunity standard for industrial environments

This product has been tested in typical class A and class B compliant host systems. It is assumed that this product will also achieve compliance in any class A or class B compliant unit.

To meet EC requirements, shielded cables must be used to connect a peripheral to the card.

¹ 1628 Grablink Duo, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+ and 3614 HD26F I/O Extension Module - Standard I/O Set.

EMC compliance statement for USA



Notice for USA

Compliance Information Statement (Declaration of Conformity Procedure) DoC FCC Part 15

Class B emission

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE
Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH	Duo12
Duo12LH	Value12	Quad12DF	QSFP+	1636	3610	3612
3614					Not recommended for new designs	Not recommended for new designs

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation or when the equipment is operated in a commercial environment.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 1636 InterPC C2C-Link Adapter, 3610 HD26F I/O Extension Module - TTL-RS422, 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422 and 3614 HD26F I/O Extension Module - Standard I/O Set.

EMC Compliance statement for Korea

Applies to ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLL	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	1636
3610	3612	3614	3618			



Notice for Korea

Registered products under the Clause 3, Article 58-2 of Radio Waves Act:

Product	Registration Number
1628 Grablink Duo	R-R-EUr-PC1628
1636 InterPC C2C-Link Adapter	R-R-EUr-PC1636
3610 HD26F I/O Extension Module - TTL-RS422	R-R-EUr-PC3612
3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422	R-R-EUr-PC3612
3614 HD26F I/O Extension Module - Standard I/O Set	R-R-EUr-PC3614
3618 HD26F I/O Extension Module - Fast I/O	R-R-EUr-PC3618

RoHS compliance statement



This product is in conformity with the European Union 2015/863 (ROHS3) directive, that stands for "the restriction of the use of certain hazardous substances in electrical and electronic equipment".

REACH statement



This product is in conformity with the European Union 1907/2006 (REACH) regulation.

WEEE statement



According the European Union 2012/19/EU directive, the product must be disposed of separately from normal household waste. It must be recycled according to the local regulations.

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 1636 InterPC C2C-Link Adapter, 3610 HD26F I/O Extension Module - TTL-RS422, 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422, 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

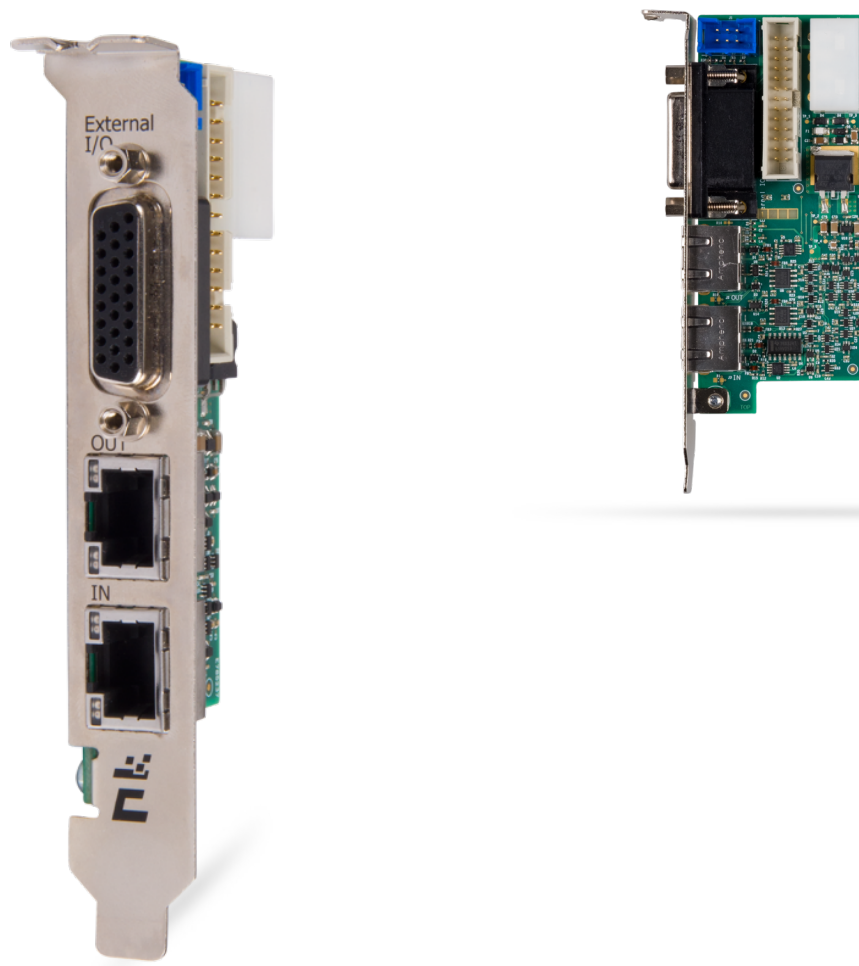
4. Accessories

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4.1. 1636 InterPC C2C-Link Adapter

Compatible with ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

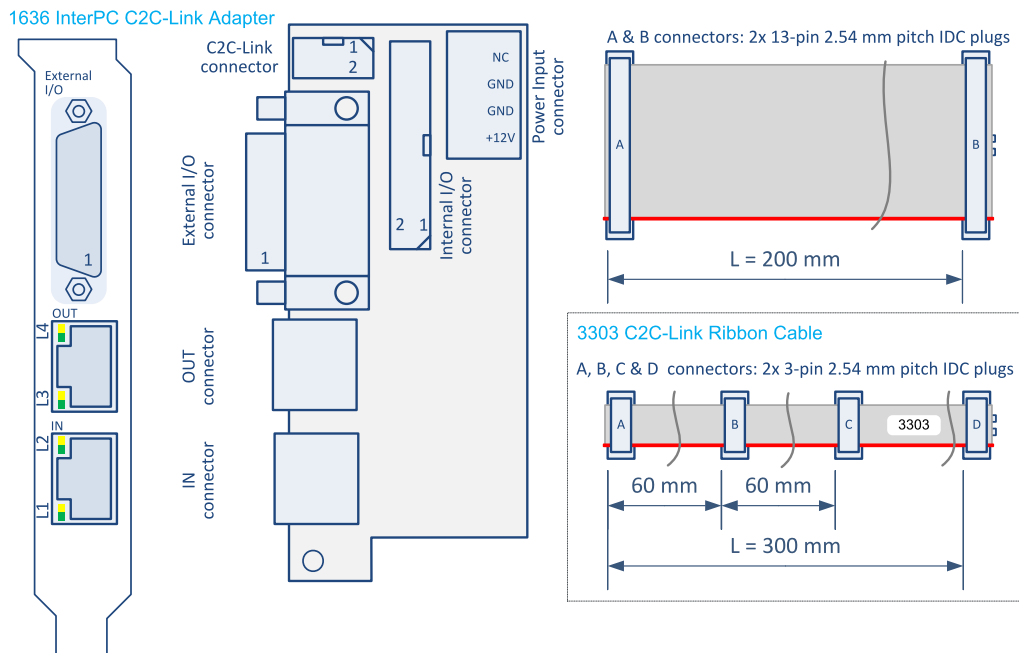


Pictures of 1636 InterPC C2C-Link Adapter

The **1636 InterPC C2C-Link Adapter** is an accessory product for use as an [InterPC C2C-Link extender](#) and/or as a [HD26F I/O adapter](#).

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

Layout



1636 InterPC C2C-Link Adapter

The **1636 InterPC C2C-Link Adapter** product accessory is composed of:

- A printed circuit board assembly fitted with a standard-profile PC bracket.
- A 200-mm 26-way ribbon cable.
- A **3303 C2C-Link Ribbon Cable**.

Connectors

The **External I/O connector** is a HD26F – 26-pin 3-row high-density female – Sub-D connector fitted on the bracket with UNC 4-40 screws.

The **IN connector** and the **OUT connector** are RJ-45 8-pin sockets fitted on the bracket.

The **Internal I/O connector** is a 26-pin dual-row 0.1" pitch header with shrouding.

The **C2C-Link connector** is a 6-pin dual-row 0.1" pitch header with shrouding.

The **Internal I/O connector** is a 26-pin dual-row 0.1" pitch header with shrouding.

The **Power Input connector** is a 0.2" pitch right-angled Disk Drive Power connector.

LEDs

The **IN connector** and the **OUT connector** are each equipped with 2 green/yellow LEDs named respectively **L1**, **L2**, **L3** and **L4**.

Using 1636 as C2C-Link Extender

Compatible with ¹

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

Adapter Powering



WARNING

The **1636 InterPC C2C-Link Adapter** must be powered when it is used as a C2C-Link extender.

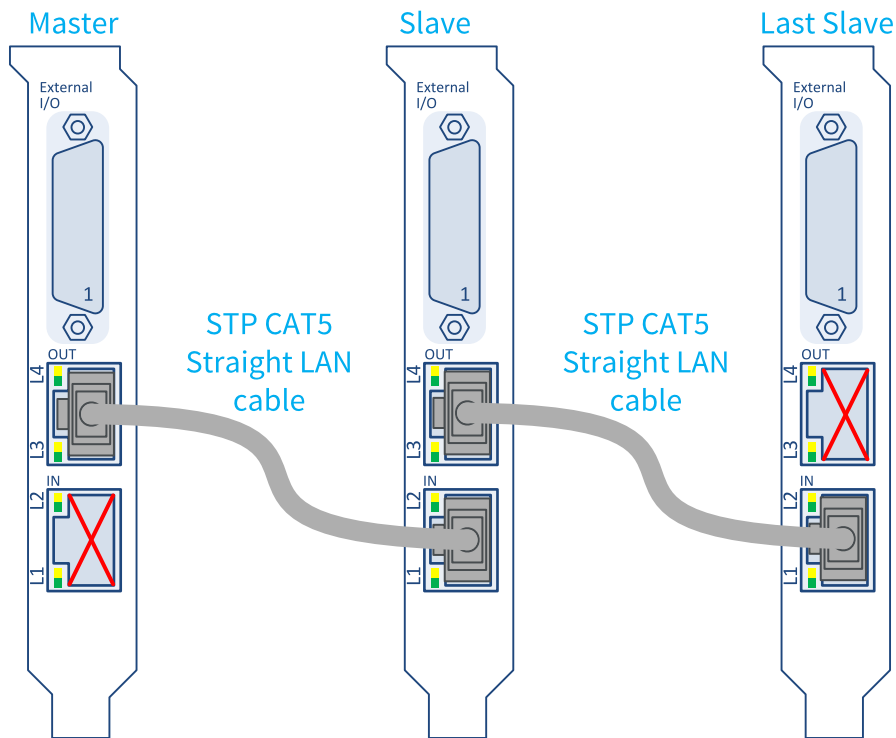
The user has two options to supply power to the adapter:

- From the compatible frame grabber +12 V power output through the 26-way ribbon cable attached to the **Internal I/O** connector.
- From the Host PC power supply through a Disk Drive Power connector cable plugged into the **Power Input** connector.

Parameter	Min.	Typ.	Max.	Units
+12 V DC Input voltage	11.0	12.0	13.0	V
+12 V Input power		1.8		W

¹ 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

InterPC Interconnect



External wiring of a C2C-Link across 3 adapters.

The external wiring of the C2C-Link is made with RJ 45 CAT 5 STP straight LAN cables. N-1 cables are required to interconnect N adapters in a daisy-chain scheme.

The daisy-chain begins on the OUT connector of the Master adapter and ends at the IN connector of the Last Slave adapter.

The IN connector of the Master adapter and the OUT connector of the Last Slave adapter are unused.



NOTE

The adapter disables the signal drivers of the IN and OUT connectors to avoid electrical damages when it detects a bad or a missing connection.

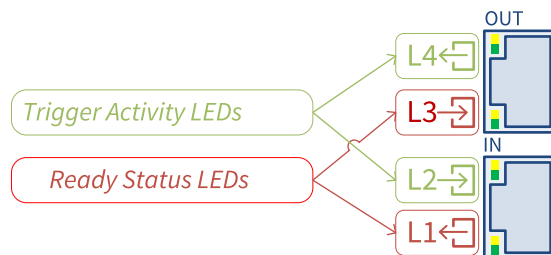
The InterPC cable drivers and receivers are not electrically isolated.



WARNING

To avoid damages, the interconnected PCs must have a common ground reference.

LEDs



1636 InterPC C2C-Link Adapter LEDs

Trigger Activity LEDs

The L2 and L4 LEDs indicate the trigger activity on the LAN cable. L2 shows the activity on the received trigger signals; L4 shows the activity on the transmitted trigger signals.

LED State	Indication
Off	The LAN cable is unplugged or the adapter is not powered.
Green	No trigger activity. <i>No trigger events in the past 10 milliseconds.</i>
Yellow	Trigger activity. <i>One or more trigger events in the past 10 milliseconds.</i>

Ready Status LEDs

The L1 and L3 LEDs indicate the state of the ready signal on the LAN cable. L1 shows the state of the transmitted ready signal; L3 shows the state of the received ready signal.

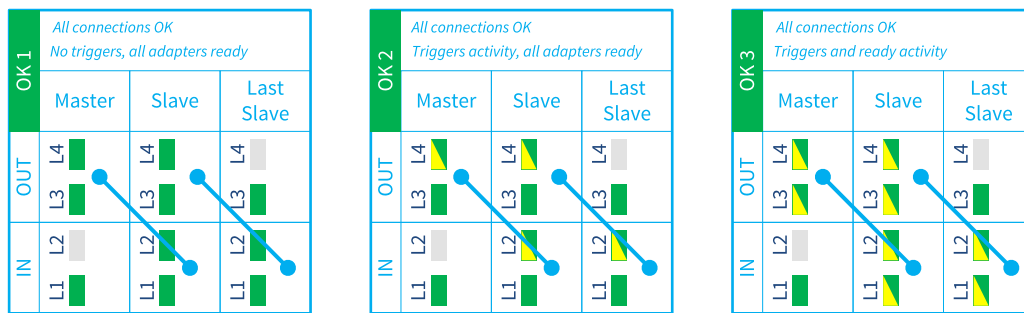
LED State	Indication
Off	The adapter is not powered.
Green	Ready true. <i>For L1: all the C2C-Link devices attached to this adapter and the downwards adapters (if any) are ready.</i> <i>For L3: all the C2C-Link devices attached to the downwards adapters (if any) are ready.</i>
Yellow	Ready false. <i>For L1: one or more C2C-Link devices attached to this adapter and the downwards adapters (if any) are not ready.</i> <i>For L3: one or more C2C-Link devices attached to the downwards adapters (if any) are not ready.</i>



NOTE

Unlike the trigger activity LEDs, the ready signals are not enlarged. Short-duration not-ready states are hardly visible!

Adapters Array LED States – Normal Situations



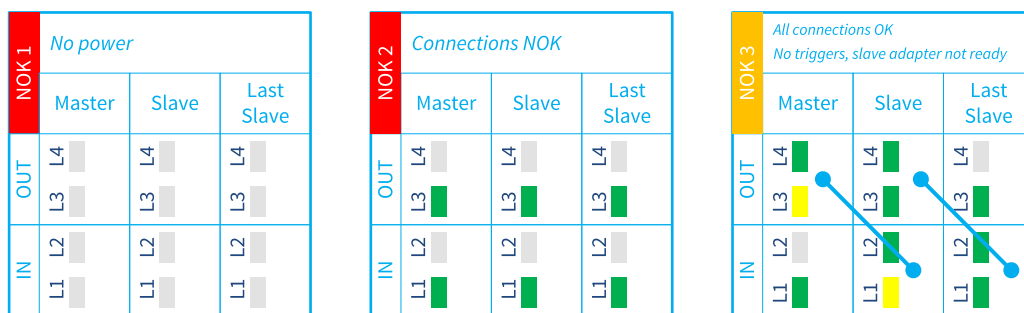
The above drawings show the LEDs states of 3 daisy-chained adapters for 3 normal situations.

In the OK 1 situation, all adapters are ready to accept triggers but no triggers are sent by the master.

In the OK 2 situation, the master adapter sends triggers and the ready signal of all adapters is permanently high. The yellow/green toggling L2 and L4 LEDs indicate the trigger activity. The steady green L1 and L3 LEDs indicate that all adapters are permanently ready to receive triggers.

In the OK 3 situation, the master adapter sends triggers and the ready signal of all adapters is cycling. The yellow/green toggling L2 and L4 LEDs indicate the trigger activity. The yellow/green toggling L1 and L3 LEDs indicate that all adapters are not ready to receive triggers for a significant duration.

Adapters Array LED States – Abnormal Situations



The above drawings show the LEDs states of 3 daisy-chained adapters for 3 abnormal situations.

In the NOK 1 situation, no adapters are powered. All LEDs are Off.

In the NOK 2 situation, all adapters are powered but all connections are missing or incorrect.

In the NOK 3 situation, all adapters are powered and all connections are OK, but the second adapter is not ready preventing the master to send new triggers. This situation is considered as abnormal when it persists.

Troubleshooting Guide

LEDs state	Indication and possible causes	Action
All LEDs Off	The adapter is not powered.	Apply power to the adapter
L2 Off L1 Green	The external connection to the IN connector is missing or incorrect.	For the master adapter, this is OK: nothing to do! For the other adapters: check and correct the connection to the OUT connector of the previous adapter in the daisy-chain.
L4 Off L3 Green	The external connection to the OUT connector is missing or incorrect.	For the last slave adapter of the daisy-chain, this is OK: nothing to do! For the other adapters: check and correct the connection to the IN connector of the next adapter in the daisy-chain.

Using 1636 as HD26F I/O Adapter

Compatible with ¹

Duo	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Value12	Quad12DF
QSFP+						

- Plug the A-connector of the supplied 200-mm 26-way ribbon cable to the **Internal I/O** connector of the **1636 InterPC C2C-Link Adapter**
- Plug the B-connector to the **Internal I/O** connector of the target card.

Target cards where the 1636 InterPC C2C-Link Adapter can be used for the standard I/O set #1

Compatible with ²

QuadG3DF	Octo	Quad12DF
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Target cards where the 1636 InterPC C2C-Link Adapter can be used for the standard I/O set #2

Compatible with ³

Duo	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE	Quad12
Quad12-4	Quad12J	Quad12J-4	Value12	QSFP+		



NOTE

No power supply connection is required when using the **1636 InterPC C2C-Link Adapter** as an HD26F I/O adapter only.

¹ 1628 Gralink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

² 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo and 3624 Coaxlink Quad CXP-12 DF.

³ 1628 Gralink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

4.2. I/O Extension Modules

3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422	381
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3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422

**WARNING**

3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422 are not recommended for new designs!

Compatible with¹

Duo	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

The **3610 HD26F I/O Extension Module - TTL-RS422** and the **3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422** accessories are *I/O extension modules* to be used with frame grabber cards having an I/O extension connector.

These modules extend the I/O capabilities of the frame grabber with a configurable mix of 4 types of I/O ports:

- single-ended 5 V compliant TTL input
- single-ended 3.3 V LVTTTL (3610 only) or 5 V CMOS (3612 only) output
- differential RS-422 input
- differential RS-422 output

**NOTE**

The 3610 and the 3612 I/O extension modules are almost identical! They differ only by the electrical specification of the single-ended outputs: low-voltage 3.3 V TTL for 3610, 5 V CMOS for 3612.

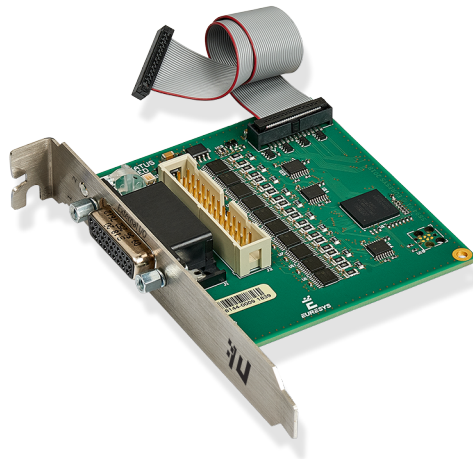
These modules:

- are powered by the frame grabber through the I/O EXTENSION cable.
- are software configurable. There are no jumpers.
- provide a persistent configuration. The last configuration is automatically restored at power-up.

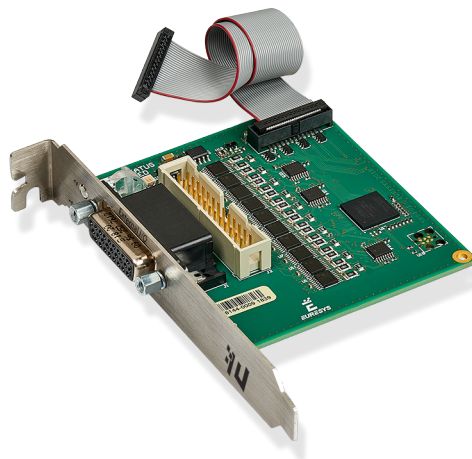
**WARNING**

Hot plugging is not allowed!

¹ 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

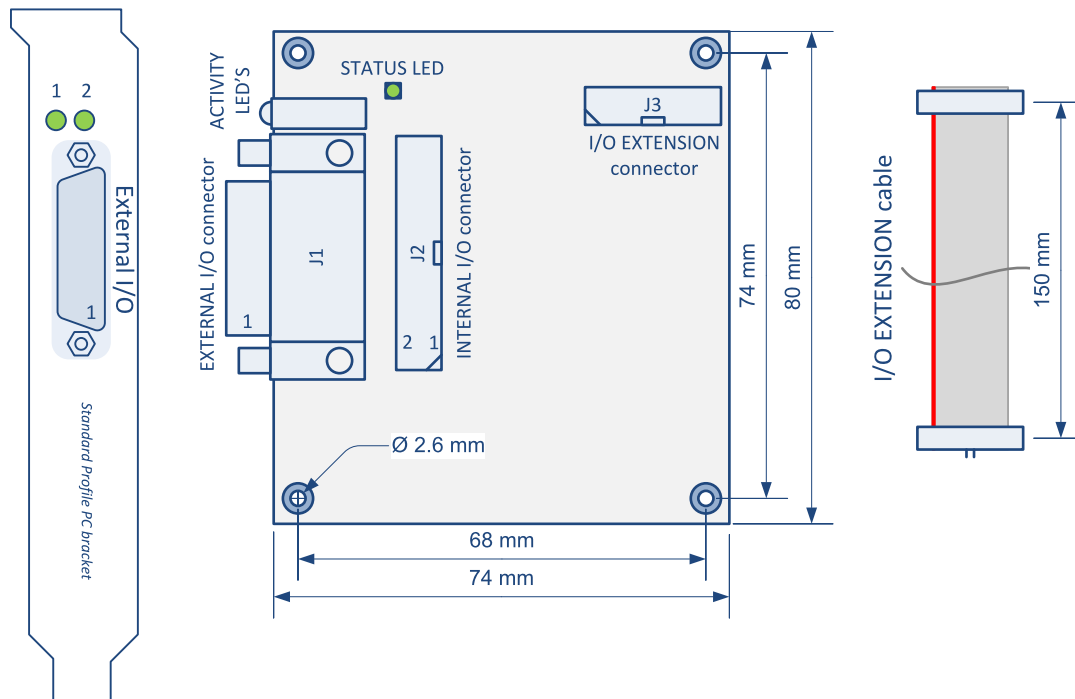


3610 HD26F I/O Extension Module - TTL-RS422



3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422

Module layout



Connectors

- "External I/O Connector - 3610/3612" on page 311
- "I/O Extension Connector" on page 322
- "Internal I/O Connector - 3610/3612" on page 317
- EXTERNAL I/O connector
 - Robust 26-pin high-density Sub-D
 - Compatible pin layout with *External I/O* connectors of **Coaxlink and Grablink Duo frame grabbers** for 12 V/GND and signals pairs
- INTERNAL I/O connector
 - Standard pitch 26-pin flat cable header
 - Compatible pin layout with *Internal I/O* connectors of **Coaxlink and Grablink Duo frame grabbers** for 12 V/GND and signals pairs
- I/O EXTENSION connector
 - Fine pitch 26-pin flat cable header fitted with the *I/O EXTENSION cable*: a 150 mm length flat cable for direct connection to the *I/O Extension* connector of compatible frame grabbers

Activity LED #1 on bracket

The ACTIVITY LED #1 is dedicated to the activity of input ports

LED State	Meaning
Green	Normal mode - Flashing indicates activity on at least one input.
Orange	Configuration mode
Red	Error - The I/O module is not (yet) controlled by the frame grabber
Off	The I/O module is not powered

Activity LED #2 on bracket

The ACTIVITY LED #2 is dedicated to the activity of output ports

LED State	Meaning
Green	Normal mode - Flashing indicates activity on at least one output.
Orange	Configuration mode
Red	Error - The I/O module is not (yet) controlled by the frame grabber
Off	The I/O module is not powered

Status LED on board

The STATUS LED is dedicated to the activity of the I/O extension bus

LED State	Meaning
Solid green	Normal mode - No activity on the bus.
Flashing green	Normal mode - Activity on the I/O extension bus.
Flashing orange	Configuration mode - Activity on the I/O extension bus.
Flashing red	Configuration mode - No activity on the I/O extension bus
Off	The I/O module is not powered

Electrical specifications

Specification Item	Product	
	3610 HD26F I/O Extension Module - TTL-RS422	3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422
Differential I/O	"Differential Input/Output" on page 348	
Single-ended I/O	"TTL Input/Output (Version 2)" on page 351	"TTL Input/5 V CMOS Output" on page 354
Power output	"I/O Power Output" on page 343	
Power consumption	< 5 W	

I/O configuration capabilities and constraints

Group	Single-ended I/O			Differential			
	I/O#	Input	Output	I/O#	Input	Output	
Group #1	MIO1	2 x TTL in	2 x TTL out	MIO1	4 x RS-422 in	4 x RS-422 out	
	MIO2						
	MIO3	2 x TTL in	2 x TTL out				MIO3
	MIO4						
	MIO5	2 x TTL in	2 x TTL out				MIO5
	MIO6						
	MIO7	2 x TTL in	2 x TTL out				MIO7
	MIO8						
Group #2	MIO9	2 x TTL in	2 x TTL out	MIO9	4 x RS-422 in	4 x RS-422 out	
	MIO10						
	MIO11	2 x TTL in	2 x TTL out				MIO11
	MIO12						
	MIO13	2 x TTL in	2 x TTL out				MIO13
	MIO14						
	MIO15	2 x TTL in	2 x TTL out				MIO15
	MIO16						
Group #3	MIO17	2 x TTL in	2 x TTL out	MIO17	4 x RS-422 in	4 x RS-422 out	
	MIO18						
	MIO19	2 x TTL in	2 x TTL out				MIO19
	MIO20						

The 20 I/O ports are configurable by group. There are 3 groups:

- The group #1 contains **8 single-ended I/O ports** named MIO1 to MIO8 *OR* **4 differential I/O ports** MIO1, MIO3, MIO5, MIO7.
- The group #2 contains **8 single-ended I/O ports** named MIO9 to MIO16 *OR* **4 differential I/O ports** MIO9, MIO11, MIO13, MIO15.
- The group #3 contains **4 single-ended I/O ports** named MIO17 to MIO20 *OR* **2 differential I/O ports** MIO17 and MIO19.

Within a group, it is allowed to set *all* the I/O ports:

- for **differential input** operation *OR* ...
- for **differential output** operation *OR* ...
- for **single-ended** operation.

When the group is set for **single-ended** operation, it is allowed to set **each pair** of single-ended I/O:

- for input operation *OR* ...
- for output operation.

**TIP**

The configuration is saved into a non-volatile memory on the I/O module.
The configuration is automatically restored after applying power.

Software configuration

The **IOExtensionModule** category of the Interface module provides a set of features to configure the 3610/3612 I/O extension modules:

- **IOExtensionModuleConfiguration** to enter/leave configuration mode
- **IOExtensionModuleLineSelector** to select a MIO to configure
- **IOExtensionModuleLineFormat**, **IOExtensionModuleLineMode** and **IOExtensionModuleLineStatus** to configure the selected MIO
- **IOExtensionModuleLineToRepair** and **IOExtensionModuleErrorCount** to help troubleshoot an invalid current configuration.

Configuration procedure

1. Select an Interface module
2. Enter the configuration mode: set **IOExtensionModuleConfiguration** to **Begin**
3. Select the I/O line to configure: set **IOExtensionModuleLineSelector** to the desired value (**MIO1** to **MIO20**)
4. Select the single-ended or differential I/O line format
 - For a single-ended I/O, set **IOExtensionModuleLineFormat** to **TTL**
 - For a differential I/O, set **IOExtensionModuleLineFormat** to **DIFF**
5. Select the input or output I/O line mode:
 - For an input, set **IOExtensionModuleLineMode** to **Input**
 - For an output, set **IOExtensionModuleLineMode** to **Output**
6. Repeat from steps 3 for all I/O's to configure
7. Verify the validity of the configuration
 - Get the value of **IOExtensionModuleErrorCount**
 - If 0, the configuration is OK, proceed to next step
 - If greater than 0, the configuration is NOK, proceed to step 10
8. Record the configuration
 - Set **IOExtensionModuleConfiguration** to **Commit**
 - The procedure is complete!
9. Repair the configuration
 - Get the value of **IOExtensionModuleLineToRepair**
 - Read "[I/O configuration capabilities and constraints](#)" on page 385 to determine why the indicated MIO doesn't satisfy the configuration constraints.
 - Adapt the configuration of one (or more) I/O's accordingly by proceeding from step 3 .

GenApi Features

The `IOExtensionModuleInformation` category of the Interface module provides information details.

- `IOExtensionModuleSerialNumber`
- `IOExtensionModulePartNumber`
- `OExtensionModuleProductCode`
- `IOExtensionModuleRevision`
- `IOExtensionModuleVariant`

4.3. Cables

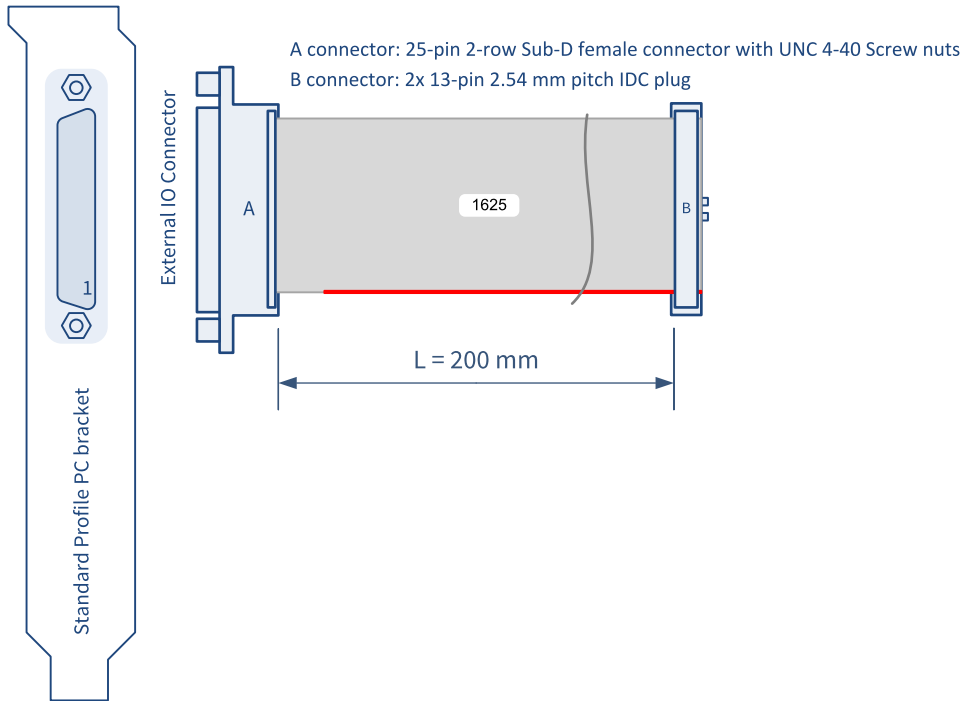
1625 DB25F I/O Adapter Cable	389
3303 C2C-Link Ribbon Cable	392
3304 HD26F I/O Adapter Cable	393
Custom C2C-Link Ribbon Cable Assembly	396

1625 DB25F I/O Adapter Cable

Compatible with ¹

Duo	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF	QSFP+		

1625 DB25F I/O Adapter Cable



1625 DB25F I/O Adapter Cable

The **1625 DB25F I/O Adapter Cable** connects all the pins (but the pin 1) 1of a 26-pin dual-row 0.1" pitch connector to a 25-pin female SubD connector fitted into a standard-profile PC bracket.

¹ 1628 Grablink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

Usage with Internal IO2 connector

The adapter brings the second set of I/O lines and the +12 V power output to a bracket-mount SubD connector. The pins are assigned as follows:

Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1		GND	Ground
2	2	1	GND	Ground
3	3	14	DIN21+	High-speed differential input #21 – Positive pole
4	4	2	DIN21-	High-speed differential input #21 – Negative pole
5	5	15	DIN22+	High-speed differential input #22 – Positive pole
6	6	3	DIN22-	High-speed differential input #22 – Negative pole
7	7	16	IIN21+	Isolated input #21 – Positive pole
8	8	4	IIN21-	Isolated input #21 – Negative pole
9	9	17	IIN22+	Isolated input #22 – Positive pole
10	10	5	IIN22-	Isolated input #22 – Negative pole
11	11	18	IIN23+	Isolated input #23 – Positive pole
12	12	6	IIN23-	Isolated input #23 – Negative pole
13	13	19	IIN24+	Isolated input #24 – Positive pole
14	14	7	IIN24-	Isolated input #24 – Negative pole
15	15	20	IOUT21+	Isolated contact output #21 – Positive pole
16	16	8	IOUT21-	Isolated contact output #21 – Negative pole
17	17	21	IOUT22+	Isolated contact output #22 – Positive pole
18	18	9	IOUT22-	Isolated contact output #22 – Negative pole
19	19	22	TTLIO21	TTL input/output #21
20	20	10	GND	Ground (TTLIO21 return)
21	21	23	TTLIO22	TTL input/output #22
22	22	11	GND	Ground (TTLIO22 return)
23	23	24	-	Not used
24	24	12	GND	Ground
25	25	25	+12V	+12 V Power output
26	26	13	GND	Ground (+12 V return)

Usage with Internal IO1 connector

The adapter brings the second set of I/O lines and the +12 V power output to a bracket-mount SubD connector. The pins are assigned as follows:

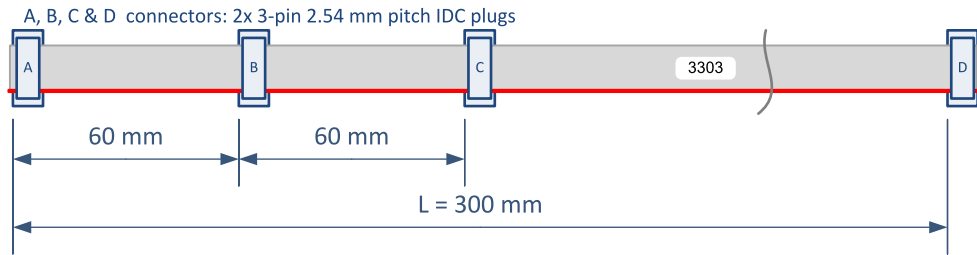
Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1		GND	Ground
2	2	1	GND	Ground
3	3	14	DIN11+	High-speed differential input #11 – Positive pole
4	4	2	DIN11-	High-speed differential input #11 – Negative pole
5	5	15	DIN12+	High-speed differential input #12 – Positive pole
6	6	3	DIN12-	High-speed differential input #12 – Negative pole
7	7	16	IIN11+	Isolated input #11 – Positive pole
8	8	4	IIN11-	Isolated input #11 – Negative pole
9	9	17	IIN12+	Isolated input #12 – Positive pole
10	10	5	IIN12-	Isolated input #12 – Negative pole
11	11	18	IIN13+	Isolated input #13 – Positive pole
12	12	6	IIN13-	Isolated input #13 – Negative pole
13	13	19	IIN14+	Isolated input #14 – Positive pole
14	14	7	IIN14-	Isolated input #14 – Negative pole
15	15	20	IOUT11+	Isolated contact output #11 – Positive pole
16	16	8	IOUT11-	Isolated contact output #11 – Negative pole
17	17	21	IOUT12+	Isolated contact output #12 – Positive pole
18	18	9	IOUT12-	Isolated contact output #12 – Negative pole
19	19	22	TTLIO11	TTL input/output #11
20	20	10	GND	Ground (TTLIO11 return)
21	21	23	TTLIO12	TTL input/output #12
22	22	11	GND	Ground (TTLIO12 return)
23	23	24	-	Not used
24	24	12	GND	Ground
25	25	25	+12V	+12 V Power output
26	26	13	GND	Ground (+12 V return)

3303 C2C-Link Ribbon Cable

Compatible with ¹

Duo	Duo104EMB	Mono	Duo	Quad	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+

3303 C2C-Link Ribbon Cable



3303 C2C-Link Ribbon Cable assembly

The **3303 C2C-Link Ribbon Cable** is a 6-conductor 0.05-in pitch ribbon fitted with 4 6-pin female ribbon cable connectors.

This cable is used for interconnecting the C2C-Link connectors of up to 4 cards located in the same PC.

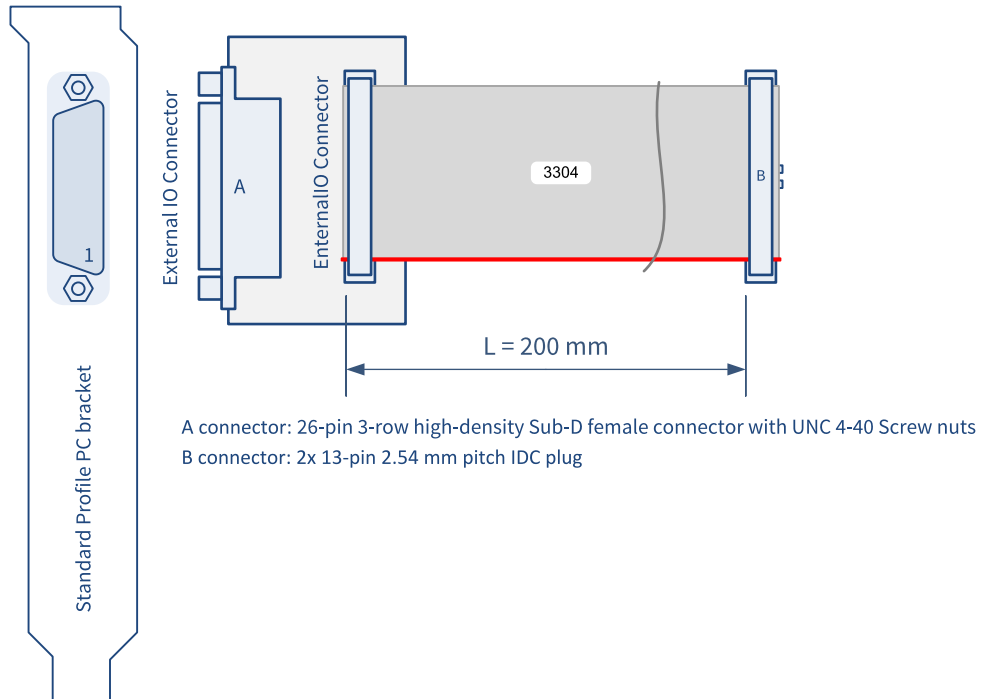
¹ 1628 Grabl原因 Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

3304 HD26F I/O Adapter Cable

Compatible with ¹

Duo	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF	QSFP+		

3304 HD26F I/O Adapter Cable



The **3304 HD26F I/O Adapter Cable** interconnects a 26-pin dual-row 0.1" pitch connector to a 26-pin 3-row female High-density SubD connector fitted into a standard-profile PC bracket.

Usage with Internal IO2 connector

Compatible with ²

Duo	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE	Quad12
Quad12-4	Quad12J	Quad12J-4	Value12	QSFP+		

¹ 1628 Grablink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

² 1628 Grablink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

The adapter brings the second set of I/O lines and the +12 V power output to a bracket-mount SubD connector. The pins are assigned as follows:

Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1	1	GND	Ground
2	2	10	GND	Ground
3	3	20	DIN21+	High-speed differential input #21 – Positive pole
4	4	19	DIN21-	High-speed differential input #21 – Negative pole
5	5	2	DIN22+	High-speed differential input #22 – Positive pole
6	6	11	DIN22-	High-speed differential input #22 – Negative pole
7	7	3	IIN21+	Isolated input #21 – Positive pole
8	8	12	IIN21-	Isolated input #21 – Negative pole
9	9	13	IIN22+	Isolated input #22 – Positive pole
10	10	21	IIN22-	Isolated input #22 – Negative pole
11	11	14	IIN23+	Isolated input #23 – Positive pole
12	12	4	IIN23-	Isolated input #23 – Negative pole
13	13	15	IIN24+	Isolated input #24 – Positive pole
14	14	5	IIN24-	Isolated input #24 – Negative pole
15	15	23	IOOUT21+	Isolated contact output #21 – Positive pole
16	16	22	IOOUT21-	Isolated contact output #21 – Negative pole
17	17	16	IOOUT22+	Isolated contact output #22 – Positive pole
18	18	6	IOOUT22-	Isolated contact output #22 – Negative pole
19	19	25	TTLIO21	TTL input/output #21
20	20	24	GND	Ground (TTLIO21 return)
21	21	17	TTLIO22	TTL input/output #22
22	22	7	GND	Ground (TTLIO22 return)
23	23	8	-	Reserved
24	24	9	GND	Ground
25	25	26	+12V	+12 V Power output
26	26	18	GND	Ground (+12 V return)

Usage with Internal IO1 connector

Compatible with ¹

QuadG3DF

Octo

Mono12

Mono12LH

Duo12

Duo12LH

Quad12DF

¹ 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH and 3624 Coaxlink Quad CXP-12 DF.

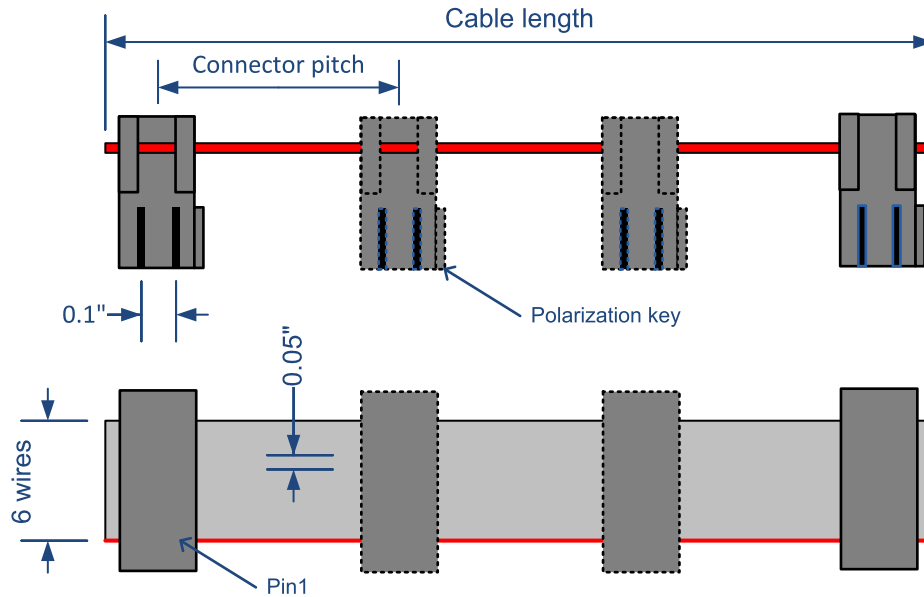
Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1	1	GND	Ground
2	2	10	GND	Ground
3	3	20	DIN11+	High-speed differential input #11 – Positive pole
4	4	19	DIN11-	High-speed differential input #11 – Negative pole
5	5	2	DIN12+	High-speed differential input #12 – Positive pole
6	6	11	DIN12-	High-speed differential input #12 – Negative pole
7	7	3	IIN11+	Isolated input #11 – Positive pole
8	8	12	IIN11-	Isolated input #11 – Negative pole
9	9	13	IIN12+	Isolated input #12 – Positive pole
10	10	21	IIN12-	Isolated input #12 – Negative pole
11	11	14	IIN13+	Isolated input #13 – Positive pole
12	12	4	IIN13-	Isolated input #13 – Negative pole
13	13	15	IIN14+	Isolated input #14 – Positive pole
14	14	5	IIN14-	Isolated input #14 – Negative pole
15	15	23	IOUT11+	Isolated contact output #11 – Positive pole
16	16	22	IOUT11-	Isolated contact output #11 – Negative pole
17	17	16	IOUT12+	Isolated contact output #12 – Positive pole
18	18	6	IOUT12-	Isolated contact output #12 – Negative pole
19	19	25	TTLIO11	TTL input/output #11
20	20	24	GND	Ground (TTLIO11 return)
21	21	17	TTLIO12	TTL input/output #12
22	22	7	GND	Ground (TTLIO12 return)
23	23	8	-	Reserved
24	24	9	GND	Ground
25	25	26	+12V	+12 V Power output
26	26	18	GND	Ground (+12 V return)

Custom C2C-Link Ribbon Cable Assembly

Compatible with ¹

Duo	Duo104EMB	Mono	Duo	Quad	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+

Assembly instructions of a custom-made IntraPC C2C-Link interconnection.



Custom C2C-Link Ribbon Cable Assembly

The cable assembly is composed with:

- A piece of a 6-conductor 0.05-in pitch ribbon cable. For instance: *Belden's (9L280XX Series)*.
- Two or more pieces of a 2 x 3-pin female ribbon cable connectors. For instance: *TE connectivity 1-1658528-1*.

The cable assembly has:

- A maximum of 4 connectors allowing up to 4 cards to share the same C2C-Link.
- A maximum length of 60 cm.

¹ 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.



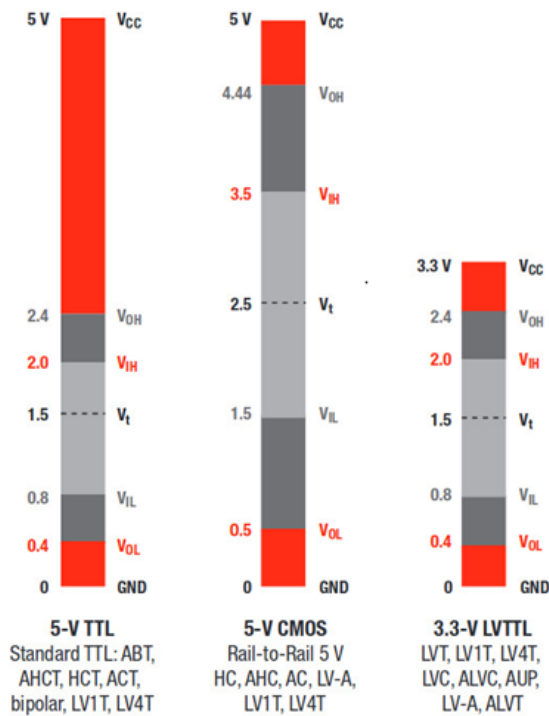
NOTE

The connector pitch(es) must be determined according to the actual card to card spacing in the Host PC.

5. Appendix

5.1. TTL, 5 V CMOS and LVTTTL Levels	399
5.2. Connecting TTL Devices to Isolated I/O Ports	400
TTL And LVTTTL Voltage Levels	401
Connecting TTL Devices to Isolated Input Ports	403
Connecting TTL Devices to Isolated Output Ports	405
5.3. Avoid Mixing Power Supply Cables	411

5.1. TTL, 5 V CMOS and LVTTTL Levels



Colors

- Dark gray: Noise margin
- Light gray: Transition range, low and high levels are unspecified

Voltage levels

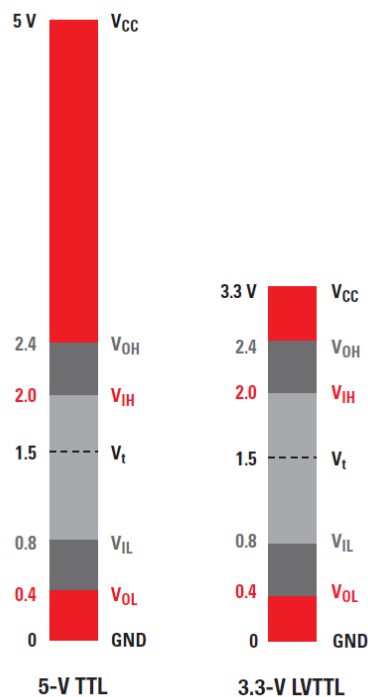
- V_{OH}: Minimum high-state voltage @driver output
- V_{IH}: Minimum high-state voltage @receiver input
- V_t: Threshold level, typically at the middle of the transition range
- V_{IL}: Maximum low-state voltage @receiver input
- V_{OL}: Maximum low-state voltage @driver output

5.2. Connecting TTL Devices to Isolated I/O Ports

This application note explains how to connect TTL devices to the isolated inputs and isolated outputs.

TTL And LVTTTL Voltage Levels	401
Connecting TTL Devices to Isolated Input Ports	403
Connecting TTL Devices to Isolated Output Ports	405

TTL And LVTTTL Voltage Levels



The figure above shows the respective voltage levels of a TTL and a LVTTTL signaling interfaces using colored bars.

Driver output

At the *low logic level*, the driver guarantees an output voltage within the *bottom red window*.

- The maximum driver output voltage, namely V_{OL} is 0.4 V for both TTL and LVTTTL.
- The minimum driver output voltage is GND

At the *high logic level*, the driver output voltage is within the *upper red window*.

- The minimum driver output voltage, namely V_{OH} is 2.4 V for both TTL and LVTTTL.
- The maximum driver output voltage is V_{CC} : 5 V for TTL and 3.3 V for LVTTTL

Receiver input

The receiver guarantees to see a *low logic level* when the input signal voltage is within the *bottom red and dark gray windows*.

- The maximum receiver input voltage, namely V_{IL} is 0.8 V for both TTL and LVTTTL.
- The minimum receiver input voltage is GND

The receiver guarantees to see a *high logic level* when the input signal voltage is within the *upper red and dark gray windows*.

- The minimum receiver input voltage, namely V_{IH} is 2.0 V for both TTL and LVTTTL.

- The maximum receiver input voltage is VCC: 5 V for TTL and 3.3 V for LVTTTL

**NOTE**

The dark gray window is a 0.4 V noise margin between the driver output and the receiver input.

**WARNING**

The light gray window is an area where the receiver cannot guarantee the logic level.

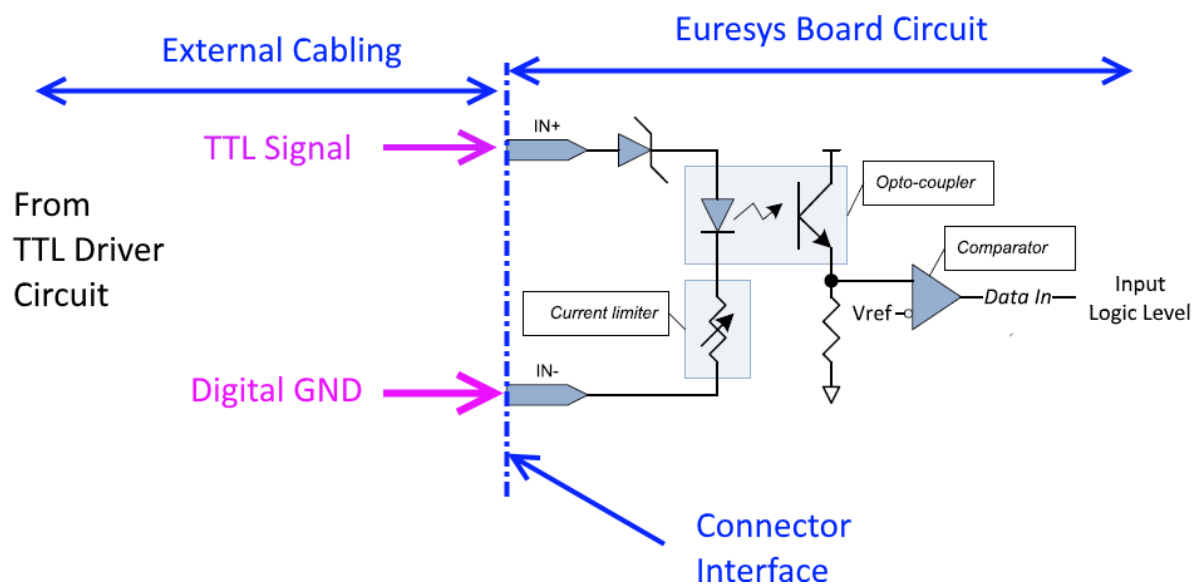
Typically the actual transition V_t between logic level low and high will occur at around 1.5 V but the actual V_t level may change a lot according to specimens or process (P) variations, actual Vcc supply voltage (V), and temperature (T). Only V_{IL} and V_{IH} are guaranteed over P,V,T variations.

Connecting TTL Devices to Isolated Input Ports

Interfacing a device with a TTL or LVTTTL output driver using an isolated input port

The isolated input ports of Coaxlink and Grablink 3G products are, by design, compatible with TTL and LVTTTL levels. No additional adapter is required to interconnect a (LV)TTL driver and an isolated input. The following section describes in detail how to connect them, what are the static voltage margins and what are the dynamic limitations.

Wiring diagram



Connecting an (LV)TTL driver to an isolated input

1. Connect TTL Signal to IN+
2. Connect TTL Circuit Ground (Digital GND) to IN-



TIP

As good practice, it is recommended to shield the whole set of wires, using a shielded cable. Shielding improve EMI protection against external interferences (immunity) and avoid unwanted EM emissions. The shield should be connected to the devices (PC, cameras, and systems components) chassis and should be separated from the digital GND line.

Static levels compatibility

(LV)TTL Driver Logic Level	(LV)TTL Driver Voltage Level	Isolated-Input Voltage Level	Voltage Margin	Isolated Input Logic Level
Low	0.4 V max	1.5 V max	1.1 V	Low
High	2.4 V min	1.9 V min	0.5 V	High

The above table shows that the voltage levels are well compatible and that they remains acceptable voltage margins for both TTL and LVTTTL applications.



NOTE

Note the circuit does not perform logic level inversion.



NOTE

The isolated input needs about 1 mA of current at high logic level. This is compatible with the current drive capabilities of (LV)TTL drivers at, as most (LV)TTL drivers provides +/-16 mA. Even old TTL technologies provides 4 mA min in any case.

Dynamic limitations

Isolated inputs requires a minimum pulse high of 10 μ s. The highest achievable pulse rate is 50 KHz.

Isolated inputs adds an extra delay of typically 5 μ s (10 μ s maximum).



NOTE

The delay can be sometimes ignored and sometimes not, according to the application.

For probably all the area-scan applications, such delay can be ignored, as is it very short compared to the camera cycle. For instance, such delay represents only 0.5 % of the cycle time of a super-fast 1,000 fps camera. For line-scan applications, the delay becomes significant since the camera cycle rate is much higher.

Connecting TTL Devices to Isolated Output Ports

Interfacing a device with a TTL or LVTTTL receiver using an isolated output port

Power must be provided to the opto-coupler transistor in order to operate the circuit.

Two cases are considered:

See also: "Using External Power" on page 405 when an external 5 V or 3.3 V power supply line is available and can be carried to the opto-coupler(s) V_{out+} pin(s).

See also: "Using Local 12 V Power" on page 408 when the power is taken from the board itself, namely through the +12 V power line connector pin.

Using External Power

The power supply voltage is not taken from the board but comes from the "external" system. A 3.3 V or also 5 V power supply can be considered, as most LVTTTL input receiver circuits support 5 V levels at their inputs. The power supply line must be carried through the cable up to the OUT+ pin of the opto-coupler.

In this case the voltage rail is called V_{CC} , as the voltage could be the same as the TTL receiver V_{CC} pin.

This circuit needs only one pull-down resistor as show in the next figure. A resistor of 180 ohm 1/8 W is suggested as best compromise but the circuit can also work within a large range of resistor values from 50 ohm 1/2 W to 10K ohm 1/16 W (1).

If an existing pull-down resistor is already available at the TTL receiver side it can be used as R resistor to operate the circuit, avoiding the need of adding an extra resistor somewhere in the cabling.

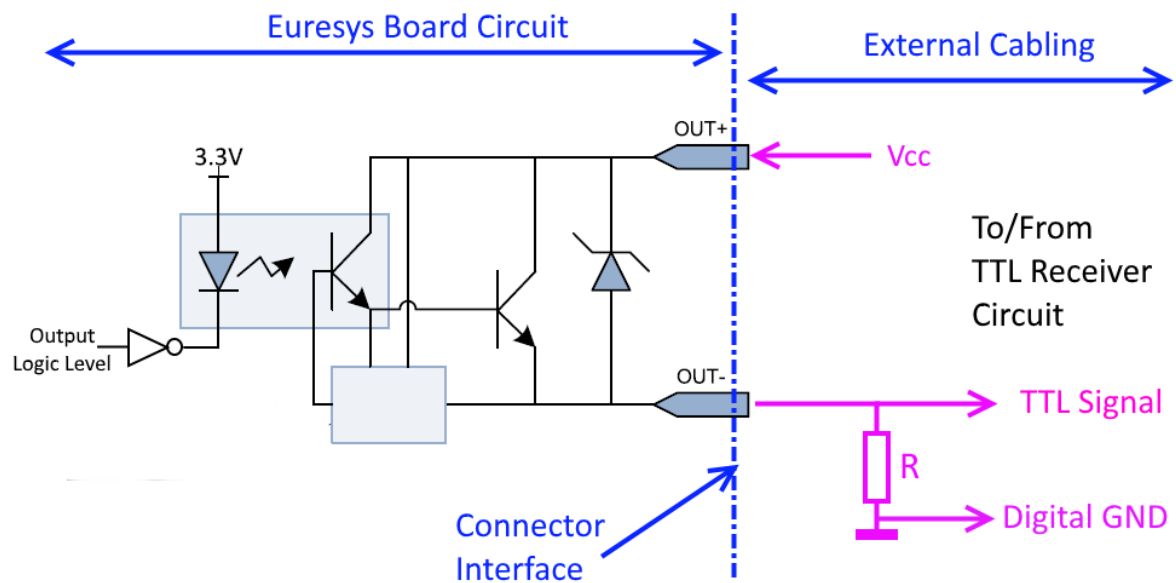
The circuit does not perform logic level inversion.



TIP

The resistor value can be also changed to match special "Static levels compatibility" on page 406 or "Dynamic limitations" on page 407 performance requirements. This topic is covered in the coming paragraphs.

Wiring diagram



Connecting an isolated output to a TTL receiver using the receiver's V_{CC} supply

See also: "GPIO Connectors" on page 302 in the hardware manual for I/O connectors pin assignments.

1. Connect OUT+ to TTL V_{CC} . Nominally, V_{CC} should be 3.3 V or 5 V.
2. Connect OUT- to the TTL input.
3. Pull-down OUT- with a resistor (R) of 180 ohm 1/8 W (or another resistor value that suits the circuit requirements).



TIP

As good practice, it is recommended to shield the whole set of wires, using a shielded cable. Shielding improve EMI protection against external interferences (immunity) and avoid unwanted EM emissions. The shield should be connected to the devices (PC, cameras, and systems components) chassis and should be separated from the digital GND line.

Static levels compatibility

The following tables show that the voltage levels are well compatible and that they remains acceptable voltage margins for both TTL and LVTTTL applications.

Voltage levels and margins in a TTL (5 V) system, R = 180 ohm

Isolated Output Logic Level	Isolated Output State	Isolated Output Voltage Level	TTL Input Voltage Level	Voltage Margin	TTL Input Logic Level
High	Close	4.1 V max ⁽²⁾	2.0 V min	2.1 V	High
Low	Open	0.36 V max ⁽¹⁾	0.8 V max	0.44 V	Low

Voltage levels and margins in a LVTTTL (3.3 V) system, R = 180 ohm

Isolated Output Logic Level	Isolated Output State	Isolated Output Voltage Level	TTL Input Voltage Level	Voltage Margin	TTL Input Logic Level
High	Close	2.4 V min ⁽²⁾	2.0 V min	0.4 V	High
Low	Open	0.36 V max ⁽¹⁾	0.8 V max	0.44 V	Low

See also: "Isolated Output" on page 360 for voltage levels of isolated outputs.



NOTE

(1) 0.36 V is obtained considering a worst-case external (pull-up) load of 2 mA (180 ohm x 2 mA = 0.36 V), which means that the circuit can support the presence of an external pull-up resistor up to a (minimum) value of 1K5 ohm (in 3.3 V) or 2K4 ohm (in 5 V). If needed, an other R value can be chosen according to the actual pull-up load within the circuit.



NOTE

(2) In any case, the voltage drop across the opto-coupler pins ($V_{OUT^+} - V_{OUT^-}$) is lower than 0.9 V. Which gives the following results: 3.3 V - 0.9 V = 2.4 V; 5 V - 0.9 V = 4.1 V.

Dynamic limitations

The maximum pulse width of isolated outputs is about 5 μ s and the maximum pulse rate is 100 KHz,

Isolated outputs add an extra delay of about 5 μ s in the signal propagation.

The resistor value of $R = 180 \text{ ohm}$ has good dynamic results for a usual capacitive loads as 1 or 2 meters of cable. As example, a 2m cable will add 100 pF of load (50pF/m) which give a rise time of about $18 \mu\text{s}$ at 180 ohm ($R \times C = 180 \text{ ohm} \times 100 \text{ pF} = 18 \mu\text{s}$). If needed, the R value can be adapted to match special requirements in terms of rise time and/or capacitive load.

If maximizing the opto-coupler switching time is a concern, it is not recommended to not increase too much the value of the resistor. The opto-coupler circuit behaves better (switching times) with a load of about 10 mA or higher. $R = 180 \text{ ohm}$ loads the opto-coupler at 13 mA (3.3 V) and 23 mA (5 V).

Using Local 12 V Power

The power supply voltage is taken from the I/O connector itself, using the power supply pin “+12V”.

This circuit needs two resistors, named R and R_{POL} .

A resistor of 180 ohm 1/8 W is suggested for R, as best compromise but the circuit can also work within a large range of resistor values from 50 ohm 1/2 W to 10K ohm 1/16 W (1).

A resistor of 560 ohm 1/4 W is suggested for R_{POL} , as best companion of $R = 180 \text{ ohm}$ but the value of R_{POL} can be adapted to match accordingly others R values.

If an existing pull-down resistor is already available at the TTL receiver side it can be used as R resistor to operate the circuit, avoiding the need of adding an extra resistor somewhere in the cabling.

The circuit does not perform logic level inversion.



TIP

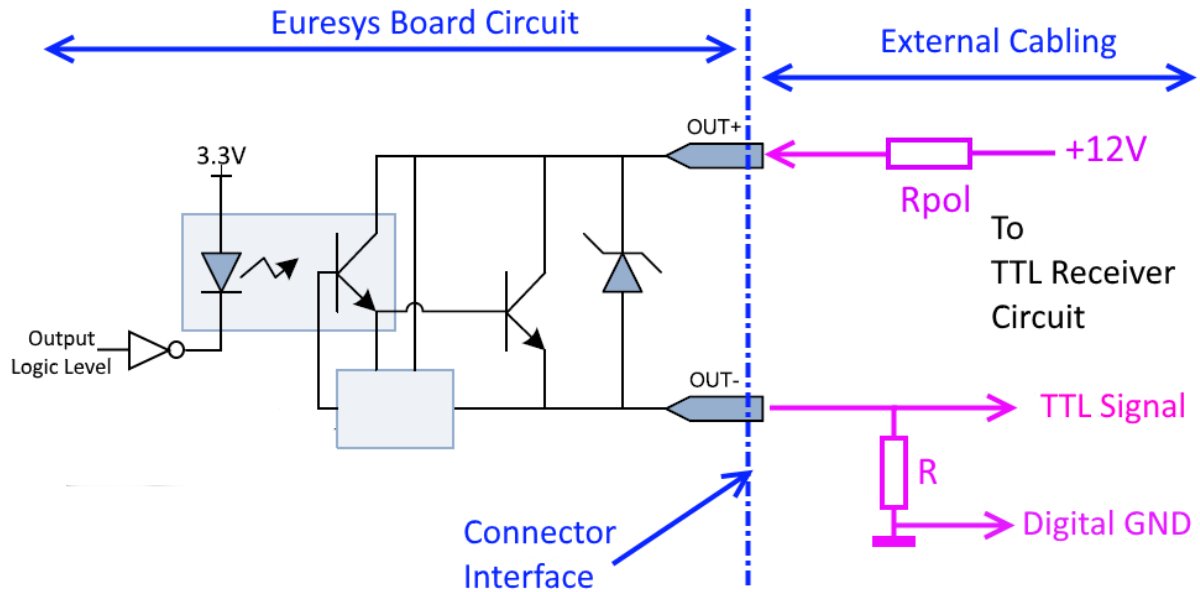
The resistor value can be also changed to match special static or dynamic performance requirements.



NOTE

The circuit does not perform logic level inversion.

Wiring diagram



See also: "GPIO Connectors" on page 302 in the hardware manual for I/O connectors pin assignments.

1. Connect "OUT+" to "+12V" through a resistor (R_{POL}) of 560 ohm 1/4 W (or another resistor value that suits the circuit requirements).
2. Connect "OUT-" to the TTL input.
3. Pull-down "OUT-" with a resistor (R) of 180 ohm 1/8 W (or another resistor value that suits the circuit requirements).

Static levels compatibility

The following table shows that the voltage levels are well compatible and that they remains acceptable voltage margins for both TTL and LVTTTL applications.

Voltage levels and margins, $R_{pol} = 560$ ohm 1/4 W, $R = 180$ ohm 1/8 W.

Isolated Output Logic Level	Isolated Output State	Isolated Output Voltage Level	TTL Input Voltage Level	Voltage Margin	TTL Input Logic Level
High	Close	2.7 V max ⁽²⁾	2.0 V min	0.7 V	High
Low	Open	0.36 V max ⁽¹⁾	0.8 V max	0.44 V	Low

See also: "Isolated Output" on page 360 for voltage levels of isolated outputs.



NOTE

(1) 0.36 V is obtained considering a worst-case external (pull-up) load of 2 mA ($180 \text{ ohm} \times 2 \text{ mA} = 0.36 \text{ V}$), which means that the circuit can support the presence of an external pull-up resistor up to a (minimum) value of 1K5 ohm (in 3.3 V) or 2K4 ohm (in 5 V). If needed, an other R value can be chosen according to the actual pull-up load within the circuit.



NOTE

(2) R_{POL} limits the Voh voltage to about 2.7 V in order to match TTL and LVTTTL levels.
2.7 V is obtained considering the R_{POL} -R 560 ohm-180 ohm divider and taking into account that the voltage drop across the opto-coupler pins ($V_{OUT}^+ - V_{OUT}^-$) is about 0.9 V.

Dynamic limitations

The maximum pulse width of isolated outputs is about 5 μs and the maximum pulse rate is 100 KHz,

Isolated outputs add an extra delay of about 5 μs in the signal propagation.

The resistor value of $R = 180 \text{ ohm}$ has good dynamic results for a usual capacitive loads as 1 or 2 meters of cable. As example, a 2m cable will add 100 pF of load (50pF/m) which give a rise time of about 18 μs at 180 ohm ($R \times C = 180 \text{ ohm} \times 100 \text{ pF} = 18 \mu\text{s}$). If needed, the R value can be adapted to match special requirements in terms of rise time and/or capacitive load.

If maximizing the opto-coupler switching time is a concern, it is not recommended to not increase too much the value of the resistor. The opto-coupler circuit behaves better (switching times) with a load of about 10 mA or higher. $R = 180 \text{ ohm}$ loads the opto-coupler at 13 mA (3.3 V) and 23 mA (5 V).

5.3. Avoid Mixing Power Supply Cables



WARNING

Don't mix PSU cables between PSU models!

Modular power supply units – PSU

Nowadays, power supply units are modular or semi-modular: all or some-of the power cables are removable for cleaner cable management. Additionally, all cables become black!



Example of a semi modular PSU and some removable cables

Power connectors pin layout

Power connectors are standardized on the device side (ATX mother board, PCIe Graphic Connector (PEG), SATA memory drives, "Molex", etc.).



WARNING

Unfortunately, power connectors are NOT standardized on the power supply unit side!

PART IV

GENAPI FEATURES

1. Grablink System Module Register Description

Categorized features list of Systemmodule version 24_04_0

1.1. Root Category	414
1.2. SystemInformation Category	417
1.3. InterfaceEnumeration Category	426

1.1. Root Category

SystemInformation	415
InterfaceEnumeration	416

SystemInformation

[Feature Info](#)

Module	Category Path	Type	Access
System	Root	Category	RW

[Category Members](#)

See also: "SystemInformation Category" on page 417

InterfaceEnumeration

[Feature Info](#)

Module	Category Path	Type	Access
System	Root	Category	RW

[Category Members](#)

See also: "InterfaceEnumeration Category" on page 426

1.2. SystemInformation Category

TLVendorName	418
TLModelName	419
TLID	420
TLVersion	421
TLPath	422
TLType	423
GenTLVersionMajor	424
GenTLVersionMinor	425

TLVendorName

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	String	Imposed: RO

[Short Description](#)

Name of the GenTL Producer vendor.

TLModelName

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	String	Imposed: RO

[Short Description](#)

Name of the GenTL Producer.

TLID

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	String	Imposed: RO

[Short Description](#)

Unique identifier of the GenTL.

TLVersion

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	String	Imposed: RO

[Short Description](#)

Vendor specific version string.

TLPath

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	String	Imposed: RO

[Short Description](#)

Full path to the GenTL Producer driver including name and extension.

TLType

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	Enumeration	Imposed: RO

[Short Description](#)

Identifies the transport layer technology of the GenTL Producer implementation.

[Enumeration Values](#)

- **CL**: This enumeration value indicates Camera Link transport layer technology.

GenTLVersionMajor

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	IntReg	RO

Register Port: TLPort

[Short Description](#)

Major version number of the GenTL specification the GenTL Producer implementation complies with.

GenTLVersionMinor

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → SystemInformation	IntReg	RO

Register Port: TLPort

[Short Description](#)

Minor version number of the GenTL specification the GenTL Producer implementation complies with.

1.3. InterfaceEnumeration Category

InterfaceUpdateList	427
InterfaceSelector	428
InterfaceID	429

InterfaceUpdateList

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → InterfaceEnumeration	Command	Imposed: WO

[Short Description](#)

Updates the internal interface list.

InterfaceSelector

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → InterfaceEnumeration	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Selector for the different GenTL Producer interfaces.

[Selected Features](#)

- "InterfaceID" on page 429

InterfaceID

[Feature Info](#)

Module	Category Path	Type	Access
System	Root → InterfaceEnumeration	String	Imposed: RO

[Short Description](#)

GenTL Producer wide unique identifier of the selected interface.

2. Grablink Interface Module Register Description

Categorized features list of Interfacemodule version 24_04_0

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2.1. Root Category

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InterfaceInformation

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "InterfaceInformation Category" on page 444

DeviceEnumeration

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "DeviceEnumeration Category" on page 454

CameraLink

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "CameraLink Category" on page 559

DigitalIOControl

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "DigitalIOControl Category" on page 461

IOExtensionModule

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "IOExtensionModule Category" on page 478

UserOutputRegister

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "UserOutputRegister Category" on page 495

IOToolbox

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "IOToolbox Category" on page 508

PCIExpress

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "PCIExpress Category" on page 515

InterfaceControl

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "InterfaceControl Category" on page 530

InterfaceDetails

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "InterfaceDetails Category" on page 547

EventControl

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "EventControl Category" on page 611

OemSafetyKey

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root	Category	RW

[Category Members](#)

See also: "OemSafetyKey Category" on page 625

2.2. InterfaceInformation Category

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InterfaceID

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	String	Imposed: RO

[Short Description](#)

GenTL Producer wide unique identifier of the selected interface.

InterfaceType

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	Enumeration	Imposed: RO

[Short Description](#)

Identifies the transport layer technology of the interface.

[Enumeration Values](#)

- **CL**: This enumeration value indicates Camera Link transport layer technology.

ProductCode

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	String	Imposed: RO

[Short Description](#)

Product Code.

SerialNumber

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	String	Imposed: RO

[Short Description](#)

Serial Number.

PartNumber

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	String	Imposed: RO

[Short Description](#)

Part Number.

FirmwareRevision

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

Firmware Revision.

FirmwareVariant

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

Firmware Variant.

FirmwareStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	Enumeration	RW

[Short Description](#)

Firmware Status.

[Enumeration Values](#)

- **OK**: OK.
- **TooRecent**: Firmware is too recent.
- **TooOld**: Firmware is too old.
- **RecoveryMode**: Firmware is in recovery mode.
- **PCleGen1NotSupported**: PCIe gen 1 not supported.
- **UpdateRequired**: Firmware update is required.

FirmwareRecoverySwitch

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceInformation	Boolean	RW

[Short Description](#)

Position of the firmware recovery switch.

2.3. DeviceEnumeration Category

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DeviceUpdateList

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DeviceEnumeration	Command	Imposed: WO

[Short Description](#)

Updates the internal device list.

DeviceSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DeviceEnumeration	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Selector for the different devices on this interface.

[Selected Features](#)

- "DeviceID" on page 457
- "DeviceVendorName" on page 458
- "DeviceModelName" on page 459
- "DeviceAccessStatus" on page 460

DeviceID

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DeviceEnumeration	String	Imposed: RO

[Short Description](#)

Interface wide unique identifier of the selected device.

DeviceVendorName

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DeviceEnumeration	String	Imposed: RO

[Short Description](#)

Name of the device vendor.

DeviceModelName

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DeviceEnumeration	String	Imposed: RO

[Short Description](#)

Name of the device model.

DeviceAccessStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DeviceEnumeration	Enumeration	Imposed: RO

[Short Description](#)

Gives the device's access status at the moment of the last execution of DeviceUpdateList.

[Enumeration Values](#)

- **Unknown**: Unknown access.
- **ReadWrite**: Available to be opened with full access.
- **ReadOnly**: Available to be opened with read-only access.
- **NoAccess**: Not reachable.
- **Busy**: Already opened by another entity.
- **OpenReadWrite**: Opened with read-write access.
- **OpenReadOnly**: Opened with read-only access.

2.4. DigitalIOControl Category

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LineSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

[Description](#)

Selects one physical GPIO line.

Default value: `DIN11`.

[Selected Features](#)

- ["LineFormat"](#) on page 465
- ["LineMode"](#) on page 466
- ["LineInverter"](#) on page 467
- ["LineFilterStrength"](#) on page 468
- ["LineFilterDelay"](#) on page 469
- ["LineStatus"](#) on page 470
- ["LineSource"](#) on page 472
- ["LineSourceInitialOffset"](#) on page 476
- ["LineSourceDivisionFactor"](#) on page 477

[Enumeration Values](#)

- `DIN11`: Differential input 1 of Internal I/O connector 1.
- `DIN12`: Differential input 2 of Internal I/O connector 1.
- `DIN21`: Differential input 1 of Internal I/O connector 2.
- `DIN22`: Differential input 2 of Internal I/O connector 2.
- `IIN11`: Isolated input 1 of Internal I/O connector 1.
- `IIN12`: Isolated input 2 of Internal I/O connector 1.
- `IIN13`: Isolated input 3 of Internal I/O connector 1.
- `IIN14`: Isolated input 4 of Internal I/O connector 1.
- `IIN21`: Isolated input 1 of Internal I/O connector 2.
- `IIN22`: Isolated input 2 of Internal I/O connector 2.
- `IIN23`: Isolated input 3 of Internal I/O connector 2.
- `IIN24`: Isolated input 4 of Internal I/O connector 2.

- **IOUT11**: Isolated output 1 of Internal I/O connector 1.
- **IOUT12**: Isolated output 2 of Internal I/O connector 1.
- **IOUT21**: Isolated output 1 of Internal I/O connector 2.
- **IOUT22**: Isolated output 2 of Internal I/O connector 2.
- **TTLIO11**: TTL input/output 1 of Internal I/O connector 1.
- **TTLIO12**: TTL input/output 2 of Internal I/O connector 1.
- **TTLIO21**: TTL input/output 1 of Internal I/O connector 2.
- **TTLIO22**: TTL input/output 2 of Internal I/O connector 2.
- **MIO1**: Input/output 1 of I/O extension module.
- **MIO2**: Input/output 2 of I/O extension module.
- **MIO3**: Input/output 3 of I/O extension module.
- **MIO4**: Input/output 4 of I/O extension module.
- **MIO5**: Input/output 5 of I/O extension module.
- **MIO6**: Input/output 6 of I/O extension module.
- **MIO7**: Input/output 7 of I/O extension module.
- **MIO8**: Input/output 8 of I/O extension module.
- **MIO9**: Input/output 9 of I/O extension module.
- **MIO10**: Input/output 10 of I/O extension module.
- **MIO11**: Input/output 11 of I/O extension module.
- **MIO12**: Input/output 12 of I/O extension module.
- **MIO13**: Input/output 13 of I/O extension module.
- **MIO14**: Input/output 14 of I/O extension module.
- **MIO15**: Input/output 15 of I/O extension module.
- **MIO16**: Input/output 16 of I/O extension module.
- **MIO17**: Input/output 17 of I/O extension module.
- **MIO18**: Input/output 18 of I/O extension module.
- **MIO19**: Input/output 19 of I/O extension module.
- **MIO20**: Input/output 20 of I/O extension module.
- **MIO21**: Input/output 21 of I/O extension module.
- **MIO22**: Input/output 22 of I/O extension module.
- **MIO23**: Input/output 23 of I/O extension module.
- **MIO24**: Input/output 24 of I/O extension module.
- **MIO25**: Input/output 25 of I/O extension module.
- **MIO26**: Input/output 26 of I/O extension module.
- **MIO27**: Input/output 27 of I/O extension module.
- **MIO28**: Input/output 28 of I/O extension module.

- **MIO29:** Input/output 29 of I/O extension module.
- **MIO30:** Input/output 30 of I/O extension module.
- **MIO31:** Input/output 31 of I/O extension module.
- **MIO32:** Input/output 32 of I/O extension module.
- **MIO33:** Input/output 33 of I/O extension module.
- **MIO34:** Input/output 34 of I/O extension module.
- **MIO35:** Input/output 35 of I/O extension module.
- **MIO36:** Input/output 36 of I/O extension module.
- **MIO37:** Input/output 37 of I/O extension module.
- **MIO38:** Input/output 38 of I/O extension module.
- **MIO39:** Input/output 39 of I/O extension module.
- **MIO40:** Input/output 40 of I/O extension module.

LineFormat

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	Imposed: RO

[Description](#)

Returns the electrical style of the selected physical GPIO line.

[Enumeration Values](#)

- **ISO**: The I/O line is opto-coupled.
- **DIFF**: The differential I/O line is RS-422 compliant.
- **TTL**: The singled-ended I/O line is TTL compliant.

LineMode

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

[Description](#)

Direction and line driver mode of the selected physical GPIO line.

Default value: **Input** for the input-capable GPIO lines; **Output** for the output-only GPIO lines.

[Enumeration Values](#)

- **Input:** Input line.
- **Output:** Output line.
- **DriveLow:** Open-collector driver capable of driving low only.
- **DriveHigh:** Open-emitter driver capable of driving high only.

LineInverter

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Boolean	RW

[Description](#)

Signal inversion of the selected input or output line.

When set to **False**, the line signal is not inverted.

When set to **True**, the line signal is inverted.



NOTE

For bidirectional GPIO lines such as the TTL input/output lines, the settings applies equally to the signal input path and the signal output path!

Default value: **False**.

LineFilterStrength

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

[Description](#)

Strength of the glitch removal filter of the selected physical GPIO line.



NOTE

This feature is only available for input-capable GPIO lines.

Default value: **Low**.

[Enumeration Values](#)

- **Lowest:** Lowest filter strength.
- **Low:** Low filter strength.
- **Medium:** Medium filter strength.
- **High:** High filter strength.
- **Highest:** Highest filter strength.
- **Custom:** Custom filter strength.

LineFilterDelay

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Float	RW

[Value Info](#)

Maximum value: 2097

Unit: us (microsecond)

[Description](#)

Returns the latency delay, expressed in microseconds, introduced by the glitch removal filter of the selected physical GPIO line.



NOTE

This feature is only available for input-capable GPIO lines.

LineStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Boolean	RW

[Description](#)

Returns the current status of the selected physical GPIO line.

When **False**, the logical state of the selected physical GPIO line is low.

When **True**, The logical state of the selected physical GPIO line is high.



NOTE

For input-capable I/O lines, the reported value is the logical state of the LineInput signal: a node in the input path of the I/O control block that is located after the Input Inverter.



NOTE

For output-only I/O lines, the reported value is the logical state of the LineOutput signal, a note in the output path of the I/O control block that is located before the Output Inverter.

LineStatusAll

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Integer	RW

[Description](#)

Returns the current state of all available GPIO line signals at time of polling in a single bit field.

Bit values:

- **0**: The logical state of the corresponding GPIO line is low.
- **1**: The logical state of the corresponding GPIO line is high.

Bit assignments:

- Bit 0: DIN11 GPIO line.
- Bit 1: DIN12 GPIO line.
- Bit 2: DIN21 GPIO line.
- Bit 3: DIN22 GPIO line.
- Bit 4: IIN11 GPIO line.
- Bit 5: IIN12 GPIO line.
- Bit 6: IIN13 GPIO line.
- Bit 7: IIN14 GPIO line.
- Bit 8: IIN21 GPIO line.
- Bit 9: IIN22 GPIO line.
- Bit 10: IIN23GPIO line.
- Bit 11: IIN24 GPIO line.
- Bit 12: IOUT11 GPIO line.
- Bit 13: IOUT12 GPIO line.
- Bit 14: IOUT21 GPIO line.
- Bit 15: IOUT22 GPIO line.
- Bit 16: TTLIO11 GPIO line.
- Bit 17: TTLIO12 GPIO line.
- Bit 18: TTLIO21 GPIO line.
- Bit 19: TTLIO22 GPIO line.
- Bit 20 ... Bit 59 : MIO1 ... MIO40 GPIO lines.

LineSource

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

Description

Select the internal signal sourcing the output of the selected physical GPIO line.



NOTE

This feature is only available for output-capable GPIO lines.

Enumeration Values

- **UserOutput0**: Bit 0 of user output register.
- **UserOutput1**: Bit 1 of user output register.
- **UserOutput2**: Bit 2 of user output register.
- **UserOutput3**: Bit 3 of user output register.
- **UserOutput4**: Bit 4 of user output register.
- **UserOutput5**: Bit 5 of user output register.
- **UserOutput6**: Bit 6 of user output register.
- **UserOutput7**: Bit 7 of user output register.
- **Device0Strobe**: Strobe output of device 0.
- **Device1Strobe**: Strobe output of device 1.
- **Device2Strobe**: Strobe output of device 2.
- **Device3Strobe**: Strobe output of device 3.
- **Device4Strobe**: Strobe output of device 4.
- **Device5Strobe**: Strobe output of device 5.
- **Device6Strobe**: Strobe output of device 6.
- **Device7Strobe**: Strobe output of device 7.
- **Device0CameraTrigger**: Camera trigger output of device 0.
- **Device1CameraTrigger**: Camera trigger output of device 1.
- **Device2CameraTrigger**: Camera trigger output of device 2.
- **Device3CameraTrigger**: Camera trigger output of device 3.
- **Device4CameraTrigger**: Camera trigger output of device 4.

- **Device5CameraTrigger**: Camera trigger output of device 5.
- **Device6CameraTrigger**: Camera trigger output of device 6.
- **Device7CameraTrigger**: Camera trigger output of device 7.
- **Device0Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 0.
- **Device0Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 0.
- **Device0Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 0.
- **Device0Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 0.
- **Device0Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 0.
- **Device0Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 0.
- **Device0Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 0.
- **Device0Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 0.
- **Device1Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 1.
- **Device1Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 1.
- **Device1Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 1.
- **Device1Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 1.
- **Device1Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 1.
- **Device1Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 1.
- **Device1Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 1.
- **Device1Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 1.
- **Device2Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 2.
- **Device2Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 2.
- **Device2Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 2.
- **Device2Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 2.
- **Device2Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 2.
- **Device2Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 2.
- **Device2Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 2.
- **Device2Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 2.
- **Device3Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 3.
- **Device3Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 3.
- **Device3Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 3.
- **Device3Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 3.
- **Device3Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 3.
- **Device3Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 3.
- **Device3Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 3.
- **Device3Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 3.
- **Device4Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 4.

- **Device4Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 4.
- **Device4Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 4.
- **Device4Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 4.
- **Device4Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 4.
- **Device4Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 4.
- **Device4Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 4.
- **Device4Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 4.
- **Device5Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 5.
- **Device5Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 5.
- **Device5Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 5.
- **Device5Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 5.
- **Device5Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 5.
- **Device5Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 5.
- **Device5Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 5.
- **Device5Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 5.
- **Device6Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 6.
- **Device6Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 6.
- **Device6Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 6.
- **Device6Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 6.
- **Device6Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 6.
- **Device6Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 6.
- **Device6Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 6.
- **Device6Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 6.
- **Device7Stream0StartOfCameraReadout**: Start of camera readout on stream 0 of device 7.
- **Device7Stream1StartOfCameraReadout**: Start of camera readout on stream 1 of device 7.
- **Device7Stream2StartOfCameraReadout**: Start of camera readout on stream 2 of device 7.
- **Device7Stream3StartOfCameraReadout**: Start of camera readout on stream 3 of device 7.
- **Device7Stream4StartOfCameraReadout**: Start of camera readout on stream 4 of device 7.
- **Device7Stream5StartOfCameraReadout**: Start of camera readout on stream 5 of device 7.
- **Device7Stream6StartOfCameraReadout**: Start of camera readout on stream 6 of device 7.
- **Device7Stream7StartOfCameraReadout**: Start of camera readout on stream 7 of device 7.
- **Device0ChannelXFval**: Camera Link FVAL signal from channel link X of device 0.
- **Device0ChannelXLval**: Camera Link LVAL signal from channel link X of device 0.
- **Device0ChannelXDval**: Camera Link DVAL signal from channel link X of device 0.
- **Device1ChannelXFval**: Camera Link FVAL signal from channel link X of device 1.
- **Device1ChannelXLval**: Camera Link LVAL signal from channel link X of device 1.

- **Device1ChannelXDval**: Camera Link DVAL signal from channel link X of device 1.
- **Low**: Low.
- **High**: high.

LineSourceInitialOffset

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 7

[Short Description](#)

Offset of the first pulse to drive the selected output line.

LineSourceDivisionFactor

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Integer	RW

[Value Info](#)

Minimum value: 1

Maximum value: 8

[Short Description](#)

Interval between each pulse sent on the selected output line. This factor should be equal to the number of output lines over which pulses are distributed.

2.5. IOExtensionModule Category

IOExtensionModuleConfiguration	479
IOExtensionModuleLineSelector	480
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IOExtensionModuleConfiguration

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	Imposed: WO

[Description](#)

This feature selects the I/O extension module configuration action.



NOTE

Committing a new configuration is only possible when no conflict is detected in the current configuration (i.e. when `IOExtensionModuleErrorCount = 0`)

[Enumeration Values](#)

- **Begin**: Enter configuration mode.
- **Commit**: Commit current configuration.
- **Abort**: Cancel current configuration.

IOExtensionModuleLineSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

[Short Description](#)

Selects an extension module I/O line to configure.

[Selected Features](#)

- ["IOExtensionModuleLineFormat" on page 482](#)
- ["IOExtensionModuleLineMode" on page 483](#)
- ["IOExtensionModuleLineStatus" on page 484](#)

[Enumeration Values](#)

- **MIO1**: Input/output 1 of I/O extension module.
- **MIO2**: Input/output 2 of I/O extension module.
- **MIO3**: Input/output 3 of I/O extension module.
- **MIO4**: Input/output 4 of I/O extension module.
- **MIO5**: Input/output 5 of I/O extension module.
- **MIO6**: Input/output 6 of I/O extension module.
- **MIO7**: Input/output 7 of I/O extension module.
- **MIO8**: Input/output 8 of I/O extension module.
- **MIO9**: Input/output 9 of I/O extension module.
- **MIO10**: Input/output 10 of I/O extension module.
- **MIO11**: Input/output 11 of I/O extension module.
- **MIO12**: Input/output 12 of I/O extension module.
- **MIO13**: Input/output 13 of I/O extension module.
- **MIO14**: Input/output 14 of I/O extension module.
- **MIO15**: Input/output 15 of I/O extension module.
- **MIO16**: Input/output 16 of I/O extension module.
- **MIO17**: Input/output 17 of I/O extension module.
- **MIO18**: Input/output 18 of I/O extension module.
- **MIO19**: Input/output 19 of I/O extension module.

- **MIO20:** Input/output 20 of I/O extension module.
- **MIO21:** Input/output 21 of I/O extension module.
- **MIO22:** Input/output 22 of I/O extension module.
- **MIO23:** Input/output 23 of I/O extension module.
- **MIO24:** Input/output 24 of I/O extension module.
- **MIO25:** Input/output 25 of I/O extension module.
- **MIO26:** Input/output 26 of I/O extension module.
- **MIO27:** Input/output 27 of I/O extension module.
- **MIO28:** Input/output 28 of I/O extension module.
- **MIO29:** Input/output 29 of I/O extension module.
- **MIO30:** Input/output 30 of I/O extension module.
- **MIO31:** Input/output 31 of I/O extension module.
- **MIO32:** Input/output 32 of I/O extension module.
- **MIO33:** Input/output 33 of I/O extension module.
- **MIO34:** Input/output 34 of I/O extension module.
- **MIO35:** Input/output 35 of I/O extension module.
- **MIO36:** Input/output 36 of I/O extension module.
- **MIO37:** Input/output 37 of I/O extension module.
- **MIO38:** Input/output 38 of I/O extension module.
- **MIO39:** Input/output 39 of I/O extension module.
- **MIO40:** Input/output 40 of I/O extension module.

IOExtensionModuleLineFormat

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

[Short Description](#)

Electrical style of the selected I/O line.

[Enumeration Values](#)

- **DIFF**: RS-422 compliant.
- **TTL**: TTL compliant.

IOExtensionModuleLineMode

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

[Short Description](#)

Direction of the selected I/O line.

[Enumeration Values](#)

- **Input:** Input line.
- **Output:** Output line.

IOExtensionModuleLineStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Boolean	RW

[Short Description](#)

Default status of the selected output line at power up (or after leaving the configuration mode).

IOExtensionModuleLineToRepair

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

[Description](#)

This feature helps the user to solve a I/O module configuration conflict by indicating the first I/O line requiring attention.



NOTE

This feature is not available unless configuration conflicts are detected in the current configuration (i.e. when `IOExtensionModuleErrorCount > 0`)

[Enumeration Values](#)

- **MIO1**: Input/output 1 of I/O extension module.
- **MIO2**: Input/output 2 of I/O extension module.
- **MIO3**: Input/output 3 of I/O extension module.
- **MIO4**: Input/output 4 of I/O extension module.
- **MIO5**: Input/output 5 of I/O extension module.
- **MIO6**: Input/output 6 of I/O extension module.
- **MIO7**: Input/output 7 of I/O extension module.
- **MIO8**: Input/output 8 of I/O extension module.
- **MIO9**: Input/output 9 of I/O extension module.
- **MIO10**: Input/output 10 of I/O extension module.
- **MIO11**: Input/output 11 of I/O extension module.
- **MIO12**: Input/output 12 of I/O extension module.
- **MIO13**: Input/output 13 of I/O extension module.
- **MIO14**: Input/output 14 of I/O extension module.
- **MIO15**: Input/output 15 of I/O extension module.
- **MIO16**: Input/output 16 of I/O extension module.
- **MIO17**: Input/output 17 of I/O extension module.
- **MIO18**: Input/output 18 of I/O extension module.
- **MIO19**: Input/output 19 of I/O extension module.
- **MIO20**: Input/output 20 of I/O extension module.

- **MIO21:** Input/output 21 of I/O extension module.
- **MIO22:** Input/output 22 of I/O extension module.
- **MIO23:** Input/output 23 of I/O extension module.
- **MIO24:** Input/output 24 of I/O extension module.
- **MIO25:** Input/output 25 of I/O extension module.
- **MIO26:** Input/output 26 of I/O extension module.
- **MIO27:** Input/output 27 of I/O extension module.
- **MIO28:** Input/output 28 of I/O extension module.
- **MIO29:** Input/output 29 of I/O extension module.
- **MIO30:** Input/output 30 of I/O extension module.
- **MIO31:** Input/output 31 of I/O extension module.
- **MIO32:** Input/output 32 of I/O extension module.
- **MIO33:** Input/output 33 of I/O extension module.
- **MIO34:** Input/output 34 of I/O extension module.
- **MIO35:** Input/output 35 of I/O extension module.
- **MIO36:** Input/output 36 of I/O extension module.
- **MIO37:** Input/output 37 of I/O extension module.
- **MIO38:** Input/output 38 of I/O extension module.
- **MIO39:** Input/output 39 of I/O extension module.
- **MIO40:** Input/output 40 of I/O extension module.

IOExtensionModuleErrorCount

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Integer	Imposed: RO

[Short Description](#)

Number of I/O line configuration errors.

IOExtensionModuleInformation

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Category	RW

[Category Members](#)

See also: "IOExtensionModuleInformation Category" on page 489

2.6. IOExtensionModuleInformation Category

IOExtensionModuleProductCode	490
IOExtensionModuleSerialNumber	491
IOExtensionModulePartNumber	492
IOExtensionModuleRevision	493
IOExtensionModuleVariant	494

IOExtensionModuleProductCode

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule → IOExtensionModuleInformation	String	Imposed: RO

[Short Description](#)

I/O Extension Module Product Code.

IOExtensionModuleSerialNumber

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule → IOExtensionModuleInformation	String	Imposed: RO

[Short Description](#)

I/O Extension Module Serial Number.

IOExtensionModulePartNumber

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule → IOExtensionModuleInformation	String	Imposed: RO

[Short Description](#)

I/O Extension Module Part Number.

IOExtensionModuleRevision

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule → IOExtensionModuleInformation	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

I/O Extension Module Revision.

IOExtensionModuleVariant

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule → IOExtensionModuleInformation	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

I/O Extension Module Variant.

2.7. UserOutputRegister Category

UserOutputValueAll	496
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AddUserAction	498
ClearUserActions	500
ExecuteUserActions	501
InternalTime	502
UserActionsSchedulerToolSelector	503
UserActionsSchedulerReference	504
ScheduledUserActionsPoolStatus	505
ScheduleUserActions	506
DiscardScheduledUserActions	507

UserOutputValueAll

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 255

[Description](#)

Value of all User Output Register bits as a bit-field in a single data word.

Bit values:

- **0:** The value of the corresponding User Output Register bit is low.
- **1:** The value of the corresponding User Output Register bit is high.

Bit assignments:

- Bit 0: Value for bit 0 of the user output register.
- Bit 1: Value for bit 1 of the user output register.
- Bit 2: Value for bit 2 of the user output register.
- Bit 3: Value for bit 3 of the user output register.
- Bit 4: Value for bit 4 of the user output register.
- Bit 5: Value for bit 5 of the user output register.
- Bit 6: Value for bit 6 of the user output register.
- Bit 7: Value for bit 7 of the user output register.

UserActions

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 2147483647

[Description](#)

Current set of user actions (built with `AddUserAction`) that can be executed immediately (c.f. `ExecuteUserActions`) or scheduled for execution at a specific time/position (c.f. `ScheduleUserActions`).

AddUserAction

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Enumeration	Imposed: WO

[Description](#)

Add an action to the current set of user actions (**UserActions**).

[Enumeration Values](#)

- **UserEvent1**: User Event 1.
- **UserEvent2**: User Event 2.
- **UserEvent3**: User Event 3.
- **UserEvent4**: User Event 4.
- **UserOutput0_High**: Set User Output Register bit 0 high.
- **UserOutput0_Low**: Set User Output Register bit 0 low.
- **UserOutput0_Toggle**: Toggle User Output Register bit 0.
- **UserOutput1_High**: Set User Output Register bit 1 high.
- **UserOutput1_Low**: Set User Output Register bit 1 low.
- **UserOutput1_Toggle**: Toggle User Output Register bit 1.
- **UserOutput2_High**: Set User Output Register bit 2 high.
- **UserOutput2_Low**: Set User Output Register bit 2 low.
- **UserOutput2_Toggle**: Toggle User Output Register bit 2.
- **UserOutput3_High**: Set User Output Register bit 3 high.
- **UserOutput3_Low**: Set User Output Register bit 3 low.
- **UserOutput3_Toggle**: Toggle User Output Register bit 3.
- **UserOutput4_High**: Set User Output Register bit 4 high.
- **UserOutput4_Low**: Set User Output Register bit 4 low.
- **UserOutput4_Toggle**: Toggle User Output Register bit 4.
- **UserOutput5_High**: Set User Output Register bit 5 high.
- **UserOutput5_Low**: Set User Output Register bit 5 low.
- **UserOutput5_Toggle**: Toggle User Output Register bit 5.
- **UserOutput6_High**: Set User Output Register bit 6 high.
- **UserOutput6_Low**: Set User Output Register bit 6 low.

- **UserOutput6_Toggle**: Toggle User Output Register bit 6.
- **UserOutput7_High**: Set User Output Register bit 7 high.
- **UserOutput7_Low**: Set User Output Register bit 7 low.
- **UserOutput7_Toggle**: Toggle User Output Register bit 7.

ClearUserActions

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Command	Imposed: WO

[Description](#)

Clear the current set of user actions (**UserActions**).

ExecuteUserActions

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Command	Imposed: WO

[Description](#)

Immediately execute the current set of user actions (**UserActions**).

InternalTime

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

Reports the Grablink card internal time.

UserActionsSchedulerToolSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Enumeration	RW

[Short Description](#)

Selects a User Action Scheduler Tool.

[Selected Features](#)

- "UserActionsSchedulerReference" on page 504
- "ScheduledUserActionsPoolStatus" on page 505
- "ScheduleUserActions" on page 506
- "DiscardScheduledUserActions" on page 507

[Enumeration Values](#)

- **UAS1**: User Action Scheduler Tool 1.
- **UAS2**: User Action Scheduler Tool 2.

UserActionsSchedulerReference

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Enumeration	RW

[Description](#)

Defines the reference used by the user action scheduler; can only be changed when `ScheduledUserActionsPoolStatus` is `Empty`.

[Enumeration Values](#)

- **InternalTime**: Grablink card internal time.
- **QDC1Position**: Quadrature Decoder Tool 1 Position.
- **QDC2Position**: Quadrature Decoder Tool 2 Position.
- **QDC3Position**: Quadrature Decoder Tool 3 Position.
- **QDC4Position**: Quadrature Decoder Tool 4 Position.

ScheduledUserActionsPoolStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Enumeration	RW

[Description](#)

Reports the status of the pool of scheduled user actions.

[Enumeration Values](#)

- **Empty**: The pool of scheduled user actions is empty.
- **PartiallyFilled**: The pool of scheduled user actions is partially filled.
- **AlmostFull**: The pool of scheduled user actions is almost full.

ScheduleUserActions

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Integer	Imposed: WO

[Value Info](#)

Minimum value: 0

Maximum value: 4294967295

[Description](#)

Schedule the current set of user actions ([UserActions](#)) for execution at given time/position.

DiscardScheduledUserActions

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Command	Imposed: WO

[Short Description](#)

Discard all scheduled user actions.

2.8. IOToolbox Category

LineInputTool	509
MultiplierDividerTool	510
QuadratureDecoderTool	511
DividerTool	512
DelayTool	513
C2CLinkSynchronizationTool	514

LineInputTool

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

[Category Members](#)

See also: "LineInputTool Category" on page 566

MultiplierDividerTool

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

[Category Members](#)

See also: "MultiplierDividerTool Category" on page 572

QuadratureDecoderTool

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

[Category Members](#)

See also: "QuadratureDecoderTool Category" on page 581

DividerTool

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

[Category Members](#)

See also: "DividerTool Category" on page 590

DelayTool

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

[Category Members](#)

See also: "DelayTool Category" on page 597

C2CLinkSynchronizationTool

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

[Category Members](#)

See also: "C2CLinkSynchronizationTool Category" on page 605

2.9. PCIExpress Category

PCIeMaxPayloadSizeSupported	516
PCIeMaxPayloadSize	517
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PCIeMaximumLinkWidth	521
PCIeNegotiatedLinkWidth	522
PCIeLinkSpeed2500MTpsSupported	523
PCIeLinkSpeed5000MTpsSupported	524
PCIeLinkSpeed8000MTpsSupported	525
PCIBus	526
PCIDevice	527
PCIFunction	528
PCISlot	529

PCleMaxPayloadSizeSupported

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIeExpress	IntReg	RO

Register Port: InterfacePort

[Description](#)

Maximum payload size of PCIe TLPs (Transaction Layer Packets) that this interface can support (cf. PCIe Capability Structure offset 04h (Device Capabilities) bits 2:0).



NOTE

PCleMaxPayloadSizeSupported is the max packet payload size supported by Coaxlink for data in the direction frame grabber to PC memory.

PCleMaxPayloadSize

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIeExpress	IntReg	RO

Register Port: InterfacePort

[Description](#)

Maximum payload size of PCIe TLPs (Transaction Layer Packets) that this interface is allowed to generate (cf. PCIe Capability Structure offset 08h (Device Control) bits 7:5).



NOTE

PCleMaxPayloadSize is the max packet payload size supported by the PC for data in the direction frame grabber to PC memory.

PCleMaxReadRequestSize

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIeExpress	IntReg	RO

Register Port: InterfacePort

[Description](#)

Maximum size of PCIe read requests that this interface is allowed to generate (cf. PCIe Capability Structure offset 08h (Device Control) bits 14:12).

PCleMaxLinkSpeed

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIeExpress	Enumeration	Imposed: RO

[Short Description](#)

Maximum PCIe transfer rate supported by this interface (cf. PCIe Capability Structure offset 0Ch (Link Capabilities) bits 3:0).

[Enumeration Values](#)

- **NotAvailable**: Not available.
- **PCleLinkSpeed2500MTps**: 2.5 GT/s (PCIe Gen 1).
- **PCleLinkSpeed5000MTps**: 5.0 GT/s (PCIe Gen 2).
- **PCleLinkSpeed8000MTps**: 8.0 GT/s (PCIe Gen 3).

PCleCurrentLinkSpeed

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIeExpress	Enumeration	Imposed: RO

[Short Description](#)

Negotiated PCIe transfer rate (cf. PCIe Capability Structure offset 12h (Link Status) bits 3:0).

[Enumeration Values](#)

- **NotAvailable**: Not available.
- **PCleLinkSpeed2500MTps**: 2.5 GT/s (PCIe Gen 1).
- **PCleLinkSpeed5000MTps**: 5.0 GT/s (PCIe Gen 2).
- **PCleLinkSpeed8000MTps**: 8.0 GT/s (PCIe Gen 3).

PCleMaximumLinkWidth

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	Enumeration	Imposed: RO

[Short Description](#)

Maximum PCIe link width supported by this interface (cf. PCIe Capability Structure offset 0Ch (Link Capabilities) bits 9:4).

[Enumeration Values](#)

- **NotAvailable**: Not available.
- **x1**: 1 Lane.
- **x2**: 2 Lanes.
- **x4**: 4 Lanes.
- **x8**: 8 Lanes.
- **x12**: 12 Lanes.
- **x16**: 16 Lanes.
- **x32**: 32 Lanes.

PCleNegotiatedLinkWidth

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	Enumeration	Imposed: RO

[Short Description](#)

Negotiated PCIe link width (cf. PCIe Capability Structure offset 12h (Link Status) bits 9:4).

[Enumeration Values](#)

- **NotAvailable**: Not available.
- **x1**: 1 Lane.
- **x2**: 2 Lanes.
- **x4**: 4 Lanes.
- **x8**: 8 Lanes.
- **x12**: 12 Lanes.
- **x16**: 16 Lanes.
- **x32**: 32 Lanes.

PCleLinkSpeed2500MTpsSupported

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	Boolean	RW

[Short Description](#)

Reports whether this interface supports PCIe Gen 1 transfer rate (2.5 GT/s).

PCleLinkSpeed5000MTpsSupported

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	Boolean	RW

[Short Description](#)

Reports whether this interface supports PCIe Gen 2 transfer rate (5.0 GT/s).

PCleLinkSpeed8000MTpsSupported

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	Boolean	RW

[Short Description](#)

Reports whether this interface supports PCIe Gen 3 transfer rate (8.0 GT/s).

PCIBus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntSwissKnife	Imposed: RO

[Short Description](#)

PCI bus number.

PCIDevice

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntSwissKnife	Imposed: RO

[Short Description](#)

PCI device number.

PCIFunction

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntSwissKnife	Imposed: RO

[Short Description](#)

PCI function number.

PCISlot

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntSwissKnife	Imposed: RO

[Short Description](#)

PCI slot identification.

2.10. InterfaceControl Category

FanStatus	531
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Temperature	533
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AuxiliaryPower12VInput	535
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LampCustomLedE	542
LampCustomLedF	543
LampCustomLedG	544
LampCustomLedH	545
InterfaceReset	546

FanStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Enumeration	Imposed: RO

[Short Description](#)

Fan Status.

[Enumeration Values](#)

- **OK**: Fan speed is OK.
- **NotOK**: Fan speed is not OK.

TemperatureSensorSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Enumeration	RW

[Short Description](#)

Temperature Sensor Selector.

[Selected Features](#)

- "Temperature" on page 533

[Enumeration Values](#)

- **Grabber**: Grabber Temperature Sensor.

Temperature

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	SwissKnife	RW

[Description](#)

Returns the temperature, expressed in °C measured by the selected temperature sensor.

AuxiliaryPowerInput

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Enumeration	Imposed: RO

[Description](#)

Auxiliary power input cable connection status.



NOTE

This status is valid only if a PEG-compliant power supply is attached to the Coaxlink auxiliary power input connector through a PEG-compliant power cable.

[Enumeration Values](#)

- **Unconnected:** There is no PEG-compliant power cable connected to the auxiliary power input.
- **Connected:** A PEG-compliant power cable is connected to the auxiliary power input.

AuxiliaryPower12VInput

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Enumeration	Imposed: RO

[Short Description](#)

Return the status of the 12 V Auxiliary Power Input.

[Enumeration Values](#)

- **NotOK:** The 12 V auxiliary power input is NOK.
- **OK:** The 12 V auxiliary power input is OK.

LampMode

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Enumeration	RW

[Short Description](#)

Selects the lamp mode.

[Enumeration Values](#)

- **Standard:** Default bracket lamps behavior.
- **Dark:** All bracket lamps are turned off.
- **Error:** All bracket lamps are turned off unless error conditions are detected.
- **Custom:** Bracket lamps are controlled by LampCustomValue (bitfield), each lamp can be individually switched on (orange) or off.

LampCustomValue

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 255

[Short Description](#)

Controls the bracket lamps with a bitfield value
(LedA=0x01,LedB=0x02,LedC=0x04,LedD=0x08,LedE=0x10,LedF=0x20,LedG=0x40,LedH=0x80).

LampCustomLedA

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led A.

LampCustomLedB

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led B.

LampCustomLedC

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led C.

LampCustomLedD

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led D.

LampCustomLedE

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led E.

LampCustomLedF

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led F.

LampCustomLedG

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led G.

LampCustomLedH

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Boolean	RW

[Short Description](#)

Lamp Custom Led H.

InterfaceReset

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Command	Imposed: WO

[Short Description](#)

Interface Reset.

2.11. InterfaceDetails Category

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PreviousBootBank	551
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CurrentBankSelect	553
CurrentBankSelectReadback	554
NextBankSelect	555
SpiBankStatus	556
PotBankStatus	557
DriverVersion	558

BoardCapabilities

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	StringReg	RO

[Short Description](#)

Board Capabilities.

FirmwareBoardID

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

Firmware Board ID.

CPLDRevision

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	Integer	RW

[Short Description](#)

CPLD Revision.

PreviousBootBank

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntSwissKnife	RW

[Short Description](#)

Flash bank used during the previous power on.

NextBootBank

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntSwissKnife	RW

[Short Description](#)

Flash bank that will be used during the next power on.

CurrentBankSelect

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntSwissKnife	RW

[Short Description](#)

Current Bank Select.

CurrentBankSelectReadback

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntSwissKnife	RW

[Short Description](#)

Current Bank Select Readback.

NextBankSelect

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntSwissKnife	RW

[Short Description](#)

Next Bank Select.

SpiBankStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

Spi Bank Status.

PotBankStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

Pot Bank Status.

DriverVersion

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	String	RW

[Short Description](#)

Driver Version.

2.12. CameraLink Category

CIPOCIHostConnectionSelector	560
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CIPOCIPowerInputStatus	565

ClPoClHostConnectionSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → CameraLink	Enumeration	RW

[Short Description](#)

Selects the Camera Link physical connection for PoCL control.

[Selected Features](#)

- ["ClPoClAuto" on page 561](#)
- ["ClPoClTurnOff" on page 562](#)
- ["ClPoClConfigurationStatus" on page 563](#)
- ["ClPoClStatus" on page 564](#)

[Enumeration Values](#)

- **All**: All Camera Link physical host connections.
- **A**: Camera Link physical host connection A.
- **B**: Camera Link physical host connection B.

ClPoClAuto

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → CameraLink	Command	Imposed: WO

[Short Description](#)

Activate automatic control of the Power over Camera Link (PoCL).

ClPoClTurnOff

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → CameraLink	Command	Imposed: WO

[Short Description](#)

Disable Power over Camera Link (PoCL).

ClPoClConfigurationStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → CameraLink	Enumeration	Imposed: RO

[Short Description](#)

Return Power over Camera Link (PoCL) configuration.

[Enumeration Values](#)

- **Off**: PoCL is forced off.
- **Auto**: Normal automatic PoCL operation.
- **Unknown**: PoCL configuration is unknown.
- **Compound**: PoCL configuration is compound.

ClPoClStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → CameraLink	Enumeration	Imposed: RO

[Short Description](#)

Return Power over Camera Link (PoCL) status.

[Enumeration Values](#)

- **NoCamera**: No camera detected.
- **PoClCamera**: PoCL camera detected.
- **ConventionalCamera**: Conventional non-PoCL camera detected.
- **Compound**: PoCL status is compound.

ClPoClPowerInputStatus

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → CameraLink	Enumeration	Imposed: RO

[Short Description](#)

Return Camera Link Power Input Status.

[Enumeration Values](#)

- **NotOK:** The 12 V Power Supply is not OK.
- **OK:** The 12 V Power Supply is OK.

2.13. LineInputTool Category

LineInputToolSelector	567
LineInputToolSource	568
LineInputToolActivation	571

LineInputToolSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → LineInputTool	Enumeration	RW

[Short Description](#)

Selects a Line Input Tool.

[Selected Features](#)

- ["LineInputToolSource" on page 568](#)
- ["LineInputToolActivation" on page 571](#)

[Enumeration Values](#)

- **LIN1**: Line Input Tool 1.
- **LIN2**: Line Input Tool 2.
- **LIN3**: Line Input Tool 3.
- **LIN4**: Line Input Tool 4.
- **LIN5**: Line Input Tool 5.
- **LIN6**: Line Input Tool 6.
- **LIN7**: Line Input Tool 7.
- **LIN8**: Line Input Tool 8.

LineInputToolSource

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → LineInputTool	Enumeration	RW

[Description](#)

Physical GPIO line used as input for the selected Line Input Tool.

Default value: **DIN11**.

[Enumeration Values](#)

- **DIN11**: Differential input 1 of Internal I/O connector 1.
- **DIN12**: Differential input 2 of Internal I/O connector 1.
- **DIN21**: Differential input 1 of Internal I/O connector 2.
- **DIN22**: Differential input 2 of Internal I/O connector 2.
- **IIN11**: Isolated input 1 of Internal I/O connector 1.
- **IIN12**: Isolated input 2 of Internal I/O connector 1.
- **IIN13**: Isolated input 3 of Internal I/O connector 1.
- **IIN14**: Isolated input 4 of Internal I/O connector 1.
- **IIN21**: Isolated input 1 of Internal I/O connector 2.
- **IIN22**: Isolated input 2 of Internal I/O connector 2.
- **IIN23**: Isolated input 3 of Internal I/O connector 2.
- **IIN24**: Isolated input 4 of Internal I/O connector 2.
- **IOUT11**: Isolated output 1 of Internal I/O connector 1.
- **IOUT12**: Isolated output 2 of Internal I/O connector 1.
- **IOUT21**: Isolated output 1 of Internal I/O connector 2.
- **IOUT22**: Isolated output 2 of Internal I/O connector 2.
- **TTLIO11**: TTL input/output 1 of Internal I/O connector 1.
- **TTLIO12**: TTL input/output 2 of Internal I/O connector 1.
- **TTLIO21**: TTL input/output 1 of Internal I/O connector 2.
- **TTLIO22**: TTL input/output 2 of Internal I/O connector 2.
- **MIO1**: Input/output 1 of I/O extension module.
- **MIO2**: Input/output 2 of I/O extension module.
- **MIO3**: Input/output 3 of I/O extension module.

- **MIO4:** Input/output 4 of I/O extension module.
- **MIO5:** Input/output 5 of I/O extension module.
- **MIO6:** Input/output 6 of I/O extension module.
- **MIO7:** Input/output 7 of I/O extension module.
- **MIO8:** Input/output 8 of I/O extension module.
- **MIO9:** Input/output 9 of I/O extension module.
- **MIO10:** Input/output 10 of I/O extension module.
- **MIO11:** Input/output 11 of I/O extension module.
- **MIO12:** Input/output 12 of I/O extension module.
- **MIO13:** Input/output 13 of I/O extension module.
- **MIO14:** Input/output 14 of I/O extension module.
- **MIO15:** Input/output 15 of I/O extension module.
- **MIO16:** Input/output 16 of I/O extension module.
- **MIO17:** Input/output 17 of I/O extension module.
- **MIO18:** Input/output 18 of I/O extension module.
- **MIO19:** Input/output 19 of I/O extension module.
- **MIO20:** Input/output 20 of I/O extension module.
- **MIO21:** Input/output 21 of I/O extension module.
- **MIO22:** Input/output 22 of I/O extension module.
- **MIO23:** Input/output 23 of I/O extension module.
- **MIO24:** Input/output 24 of I/O extension module.
- **MIO25:** Input/output 25 of I/O extension module.
- **MIO26:** Input/output 26 of I/O extension module.
- **MIO27:** Input/output 27 of I/O extension module.
- **MIO28:** Input/output 28 of I/O extension module.
- **MIO29:** Input/output 29 of I/O extension module.
- **MIO30:** Input/output 30 of I/O extension module.
- **MIO31:** Input/output 31 of I/O extension module.
- **MIO32:** Input/output 32 of I/O extension module.
- **MIO33:** Input/output 33 of I/O extension module.
- **MIO34:** Input/output 34 of I/O extension module.
- **MIO35:** Input/output 35 of I/O extension module.
- **MIO36:** Input/output 36 of I/O extension module.
- **MIO37:** Input/output 37 of I/O extension module.
- **MIO38:** Input/output 38 of I/O extension module.
- **MIO39:** Input/output 39 of I/O extension module.

- **MIO40:** Input/output 40 of I/O extension module.

LineInputToolActivation

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → LineInputTool	Enumeration	RW

[Short Description](#)

Edge activating the output of the selected Line Input Tool.

[Enumeration Values](#)

- **RisingEdge**: Activate the output on the rising edge only.
- **FallingEdge**: Activate the output on the falling edge only.
- **AllEdges**: Activate the output on all edges.

2.14. MultiplierDividerTool Category

MultiplierDividerToolSelector	573
MultiplierDividerToolSource	574
MultiplierDividerToolOutputControl	576
MultiplierDividerToolMultiplicationFactor	577
MultiplierDividerToolDivisionFactor	578
MultiplierDividerToolEffectiveMultiplicationFactor	579
MultiplierDividerToolEffectiveDivisionFactor	580

MultiplierDividerToolSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Enumeration	RW

[Short Description](#)

Selects a Multiplier/Divider Tool.

[Selected Features](#)

- "MultiplierDividerToolSource" on page 574
- "MultiplierDividerToolOutputControl" on page 576
- "MultiplierDividerToolMultiplicationFactor" on page 577
- "MultiplierDividerToolDivisionFactor" on page 578
- "MultiplierDividerToolEffectiveMultiplicationFactor" on page 579
- "MultiplierDividerToolEffectiveDivisionFactor" on page 580

[Enumeration Values](#)

- **MDV1**: Multiplier/Divider Tool 1.
- **MDV2**: Multiplier/Divider Tool 2.
- **MDV3**: Multiplier/Divider Tool 3.
- **MDV4**: Multiplier/Divider Tool 4.

MultiplierDividerToolSource

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Enumeration	RW

[Short Description](#)

I/O Toolbox event stream used as input for the selected Multiplier/Divider Tool.

[Enumeration Values](#)

- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.

- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.

MultiplierDividerToolOutputControl

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Enumeration	RW

[Short Description](#)

Output control of the selected Multiplier/Divider Tool.

[Enumeration Values](#)

- **Enable**: Output enabled.
- **Disable**: Output disabled.

MultiplierDividerToolMultiplicationFactor

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Float	RW

[Value Info](#)

Minimum value: 0.001

Maximum value: 1000

[Description](#)

Multiplication factor of the selected Multiplier/Divider Tool.

This feature is the **numerator** of the fraction defining the Rate Conversion Ratio (RCR) of the Multiplier/Divider Tool.

RCR = M/D where:

- M = MultiplierDividerToolMultiplicationFactor
- D = MultiplierDividerToolDivisionFactor

The Multiplier/Divider Tools allows defining any RCR values in the range 0.001 to 1000.0.



NOTE

The user may define RCR using any of the following methods:

- A ratio of 2 integer numbers by assigning integer values to both the numerator and the denominator.
- A single non-integer number greater or smaller than 1 assigned to the numerator leaving the denominator to the default value (1.0).
- A single non-integer number greater or smaller than 1 assigned to the denominator leaving the numerator to the default value (1.0).

Default value: 1.0.

MultiplierDividerToolDivisionFactor

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Float	RW

[Value Info](#)

Minimum value: 0.001

Maximum value: 1000

[Description](#)

Division factor of the selected Multiplier/Divider Tool.

This feature is the **denominator** of the fraction defining the Rate Conversion Ratio (RCR) of the Multiplier/Divider Tool.

RCR = M/D where:

- M = MultiplierDividerToolMultiplicationFactor
- D = MultiplierDividerToolDivisionFactor

The Multiplier/Divider Tools allows defining any RCR values in the range 0.001 to 1000.0.



NOTE

The user may define RCR using any of the following methods:

- A ratio of 2 integer numbers by assigning integer values to both the numerator and the denominator.
- A single non-integer number greater or smaller than 1 assigned to the numerator leaving the denominator to the default value (1.0).
- A single non-integer number greater or smaller than 1 assigned to the denominator leaving the numerator to the default value (1.0).

Default value: 1.0.

MultiplierDividerToolEffectiveMultiplicationFactor

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Integer	RW

[Description](#)

Effective multiplication factor of the selected Multiplier/Divider Tool.

This feature is the **numerator** of the fraction defining the Effective Rate Conversion Ratio (Effective RCR) of the Multiplier/Divider Tool.

Effective RCR = Effective M/Effective D where:

- Effective M = **MultiplierDividerToolEffectiveMultiplicationFactor**
- Effective D = **MultiplierDividerToolEffectiveDivisionFactor**

MultiplierDividerToolEffectiveDivisionFactor

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Integer	RW

[Description](#)

Effective division factor of the selected Multiplier/Divider Tool.

This feature is the **denominator** of the fraction defining the Effective Rate Conversion Ratio (Effective RCR) of the Multiplier/Divider Tool.

Effective RCR = Effective M/Effective D where:

- Effective M = **MultiplierDividerToolEffectiveMultiplicationFactor**
- Effective D = **MultiplierDividerToolEffectiveDivisionFactor**

2.15. QuadratureDecoderTool Category

QuadratureDecoderToolSelector	582
QuadratureDecoderToolSources	583
QuadratureDecoderToolActivation	584
QuadratureDecoderToolForwardDirection	585
QuadratureDecoderToolOutputMode	586
QuadratureDecoderToolPosition	587
QuadratureDecoderToolDirection	588
QuadratureDecoderToolPositionReset	589

QuadratureDecoderToolSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	Enumeration	RW

[Short Description](#)

Selects a Quadrature Decoder Tool.

[Selected Features](#)

- "QuadratureDecoderToolSources" on page 583
- "QuadratureDecoderToolActivation" on page 584
- "QuadratureDecoderToolForwardDirection" on page 585
- "QuadratureDecoderToolOutputMode" on page 586
- "QuadratureDecoderToolPosition" on page 587
- "QuadratureDecoderToolDirection" on page 588
- "QuadratureDecoderToolPositionReset" on page 589

[Enumeration Values](#)

- **QDC1**: Quadrature Decoder Tool 1.
- **QDC2**: Quadrature Decoder Tool 2.
- **QDC3**: Quadrature Decoder Tool 3.
- **QDC4**: Quadrature Decoder Tool 4.

QuadratureDecoderToolSources

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	Enumeration	RW

[Description](#)

Selects the pair of physical GPIO lines used as A/B inputs for the selected Quadrature Decoder Tool.

[Enumeration Values](#)

- **DIN11_DIN12**: Differential inputs 1 and 2 of Internal I/O connector 1.
- **DIN21_DIN22**: Differential inputs 1 and 2 of Internal I/O connector 2.
- **IIN11_IIN12**: Isolated inputs 1 and 2 of Internal I/O connector 1.
- **IIN13_IIN14**: Isolated inputs 3 and 4 of Internal I/O connector 1.
- **IIN21_IIN22**: Isolated inputs 1 and 2 of Internal I/O connector 2.
- **IIN23_IIN24**: Isolated inputs 3 and 4 of Internal I/O connector 2.
- **TTLIO11_TTLIO12**: TTL inputs 1 and 2 of Internal I/O connector 1.
- **TTLIO21_TTLIO22**: TTL inputs 1 and 2 of Internal I/O connector 2.
- **MIO1_MIO3**: Inputs 1 and 3 of I/O extension module.
- **MIO5_MIO7**: Inputs 5 and 7 of I/O extension module.
- **MIO9_MIO11**: Inputs 9 and 11 of I/O extension module.
- **MIO13_MIO15**: Inputs 13 and 15 of I/O extension module.
- **MIO17_MIO19**: Inputs 17 and 19 of I/O extension module.
- **MIO21_MIO23**: Inputs 21 and 23 of I/O extension module.
- **MIO25_MIO27**: Inputs 25 and 27 of I/O extension module.
- **MIO29_MIO31**: Inputs 29 and 31 of I/O extension module.
- **MIO33_MIO35**: Inputs 33 and 35 of I/O extension module.
- **MIO37_MIO39**: Inputs 37 and 39 of I/O extension module.

QuadratureDecoderToolActivation

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	Enumeration	RW

[Description](#)

Edge activating the output of the selected Quadrature Decoder Tool.



NOTE

The A output of the quadrature encoder device connects to the first physical GPIO line of the designated pair, e.g. DIN11.



NOTE

The B output of the quadrature encoder device connects to the second physical GPIO line of the designated pair, e.g. DIN12.

[Enumeration Values](#)

- **RisingEdgeA**: The event is activated on the rising edge of the A signal.
- **FallingEdgeA**: The event is activated on the falling edge of the A signal.
- **AllEdgesA**: The event is activated on both edges of the A signal.
- **AllEdgesAB**: The event is activated on both edges of all signals.
- **None**: The event is not activated.

QuadratureDecoderToolForwardDirection

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	Enumeration	RW

[Short Description](#)

Selects the A/B phase relationship corresponding to the forward direction.

[Enumeration Values](#)

- **A_Leads_B**: A leads B.
- **B_Leads_A**: B leads A.

QuadratureDecoderToolOutputMode

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	Enumeration	RW

[Short Description](#)

Selects the filtering mode of the backward motion compensator.

[Enumeration Values](#)

- **Unfiltered**: All the quadrature decoder events are delivered.
- **ForwardOnly**: Only the events corresponding to the forward motion are delivered.
- **FirstPassForwardOnly**: Only the events corresponding to the first pass in the forward direction are delivered.

QuadratureDecoderToolPosition

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	IntReg	RO

Register Port: InterfacePort

[Description](#)

Position counter value of the selected Quadrature Decoder Tool.

The position counter is a 32-bit up/down counter that increments by 1 for any event corresponding to the forward direction and decrements by 1 for the backward direction.

Unit: encoder events as defined by [QuadratureDecoderToolActivation](#).

Value range: from **-2,147,483,648** up to **2,147,483,647**.

QuadratureDecoderToolDirection

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	Enumeration	RW

[Short Description](#)

Current direction of the selected Quadrature Decoder Tool.

[Enumeration Values](#)

- **Forward**: Forward.
- **Backward**: Backward.

QuadratureDecoderToolPositionReset

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	Command	Imposed: WO

[Short Description](#)

Reset Position counter of the selected Quadrature Decoder Tool.

2.16. DividerTool Category

DividerToolSelector	591
DividerToolSource	592
DividerToolEnableControl	594
DividerToolDivisionFactor	595
DividerToolInitialOffset	596

DividerToolSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DividerTool	Enumeration	RW

[Short Description](#)

Selects a Divider Tool.

[Selected Features](#)

- "DividerToolSource" on page 592
- "DividerToolEnableControl" on page 594
- "DividerToolDivisionFactor" on page 595
- "DividerToolInitialOffset" on page 596

[Enumeration Values](#)

- **DIV1**: Divider Tool 1.
- **DIV2**: Divider Tool 2.
- **DIV3**: Divider Tool 3.
- **DIV4**: Divider Tool 4.

DividerToolSource

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DividerTool	Enumeration	RW

[Short Description](#)

I/O Toolbox event stream used as input for the selected Divider Tool.

[Enumeration Values](#)

- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.

- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.

DividerToolEnableControl

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DividerTool	Enumeration	RW

[Short Description](#)

Output control of the selected Divider Tool.

[Enumeration Values](#)

- **Enable**: Output enabled.
- **Disable**: Output disabled.

DividerToolDivisionFactor

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DividerTool	Integer	RW

[Value Info](#)

Minimum value: 1

Maximum value: 65535

Default value: 2

[Description](#)

Division factor of the selected Divider Tool.

This feature is the **denominator** of the fraction defining the Rate Conversion Ratio (RCR) of the Divider Tool.

RCR = 1/D where:

- D = **DividerToolDivisionFactor**

DividerToolInitialOffset

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DividerTool	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 65535

[Description](#)

Initial offset of the selected Divider Tool.

This feature defines the number of skipped input events after enabling the Divider tool.

2.17. DelayTool Category

DelayToolSelector	598
DelayToolSource1	599
DelayToolSource2	601
DelayToolClockSource	603
DelayToolDelayValue	604

DelayToolSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DelayTool	Enumeration	RW

[Short Description](#)

Selects a Delay Tool.

[Selected Features](#)

- "DelayToolSource1" on page 599
- "DelayToolSource2" on page 601
- "DelayToolClockSource" on page 603
- "DelayToolDelayValue" on page 604

[Enumeration Values](#)

- **DEL1**: Delay Tool 1.
- **DEL2**: Delay Tool 2.
- **DEL3**: Delay Tool 3.
- **DEL4**: Delay Tool 4.

DelayToolSource1

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DelayTool	Enumeration	RW

[Short Description](#)

I/O Toolbox event stream used as input 1 for the selected Delay Tool.

[Enumeration Values](#)

- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.

- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.

DelayToolSource2

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DelayTool	Enumeration	RW

[Short Description](#)

I/O Toolbox event stream used as input 2 for the selected Delay Tool.

[Enumeration Values](#)

- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.

- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.

DelayToolClockSource

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DelayTool	Enumeration	RW

[Short Description](#)

I/O Toolbox event stream used as clock.

[Enumeration Values](#)

- **NONE**: No event stream.
- **TIME8NS**: Clock input 8 nanoseconds time base.
- **TIME200NS**: Clock input 200 nanoseconds time base.
- **TIME1US**: Clock input 1 microsecond time base.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.

DelayToolDelayValue

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DelayTool	Integer	RW

[Value Info](#)

Maximum value: 16777215

[Description](#)

Delay value of the selected Delay Tool.

Minimum value:

- 5 when `DelayToolClockSource` is `TIME8NS`
- 1 in other cases

Unit: time or event according to `DelayToolClockSource`.

2.18. C2CLinkSynchronizationTool Category

C2CLinkSynchronizationToolSelector	606
C2CLinkSynchronizationToolSource	607
C2CLinkSynchronizationToolClock	609
C2CLinkSynchronizationToolDiscardPendingEvent	610

C2CLinkSynchronizationToolSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → C2CLinkSynchronizationTool	Enumeration	RW

[Short Description](#)

Selects a C2C-Link Synchronization Tool.

[Selected Features](#)

- ["C2CLinkSynchronizationToolSource" on page 607](#)
- ["C2CLinkSynchronizationToolClock" on page 609](#)
- ["C2CLinkSynchronizationToolDiscardPendingEvent" on page 610](#)

[Enumeration Values](#)

- **C2C1**: C2C-Link Synchronization Tool 1.
- **C2C2**: C2C-Link Synchronization Tool 2.
- **C2C3**: C2C-Link Synchronization Tool 3.

C2CLinkSynchronizationToolSource

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → C2CLinkSynchronizationTool	Enumeration	RW

[Short Description](#)

I/O Toolbox event stream used as input for the selected C2C-Link Synchronization Tool.

[Enumeration Values](#)

- **CycleTrigger**: C2C-Link cycle trigger.
- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.

- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.

C2CLinkSynchronizationToolClock

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → C2CLinkSynchronizationTool	Enumeration	RW

[Short Description](#)

Event used as clock for the selected C2C-Link Synchronization Tool.

[Enumeration Values](#)

- **Immediate**: Event is forwarded on the selected C2C-Link Synchronization Tool immediately.
- **CycleTrigger**: Event is forwarded on the selected C2C-Link Synchronization Tool upon the following C2C-Link cycle trigger event.
- **StartOfCameraReadout**: Event is forwarded on the selected C2C-Link Synchronization Tool upon the following start of camera readout event.

C2CLinkSynchronizationToolDiscardPendingEvent

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → IOToolbox → C2CLinkSynchronizationTool	Command	Imposed: WO

[Short Description](#)

Discard an event that has been received but that has not been forwarded yet on the selected C2C-Link Synchronization Tool. This can be useful when C2CLinkSynchronizationToolClock is not set to Immediate.

2.19. EventControl Category

EventSelector	612
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EventSelector

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Enumeration	RW

[Short Description](#)

Select an event.

[Selected Features](#)

- ["EventNotification" on page 614](#)
- ["EventNotificationContext1" on page 615](#)
- ["EventNotificationContext2" on page 617](#)
- ["EventNotificationContext3" on page 619](#)
- ["EventCount" on page 621](#)
- ["EventCountReset" on page 622](#)

[Enumeration Values](#)

- **LIN1**: Line Input Tool 1.
- **LIN2**: Line Input Tool 2.
- **LIN3**: Line Input Tool 3.
- **LIN4**: Line Input Tool 4.
- **LIN5**: Line Input Tool 5.
- **LIN6**: Line Input Tool 6.
- **LIN7**: Line Input Tool 7.
- **LIN8**: Line Input Tool 8.
- **QDC1**: Quadrature Decoder Tool 1.
- **QDC1Dir**: Quadrature Decoder Tool 1 Changed Direction.
- **QDC2**: Quadrature Decoder Tool 2.
- **QDC2Dir**: Quadrature Decoder Tool 2 Changed Direction.
- **QDC3**: Quadrature Decoder Tool 3.
- **QDC3Dir**: Quadrature Decoder Tool 3 Changed Direction.
- **QDC4**: Quadrature Decoder Tool 4.
- **QDC4Dir**: Quadrature Decoder Tool 4 Changed Direction.

- **DIV1**: Divider Tool 1.
- **DIV2**: Divider Tool 2.
- **DIV3**: Divider Tool 3.
- **DIV4**: Divider Tool 4.
- **MDV1**: Multiplier/Divider Tool 1.
- **MDV2**: Multiplier/Divider Tool 2.
- **MDV3**: Multiplier/Divider Tool 3.
- **MDV4**: Multiplier/Divider Tool 4.
- **DEL11**: Delay Tool 1 Output 1.
- **DEL12**: Delay Tool 1 Output 2.
- **DEL21**: Delay Tool 2 Output 1.
- **DEL22**: Delay Tool 2 Output 2.
- **DEL31**: Delay Tool 3 Output 1.
- **DEL32**: Delay Tool 3 Output 2.
- **DEL41**: Delay Tool 4 Output 1.
- **DEL42**: Delay Tool 4 Output 2.
- **UserEvent1**: User Event 1.
- **UserEvent2**: User Event 2.
- **UserEvent3**: User Event 3.
- **UserEvent4**: User Event 4.
- **C2C1**: C2C-Link Synchronization Tool 1.
- **C2C2**: C2C-Link Synchronization Tool 2.
- **C2C3**: C2C-Link Synchronization Tool 3.

EventNotification

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Boolean	RW

[Short Description](#)

Activate or deactivate the notification to the host application of the occurrence of the selected event.

EventNotificationContext1

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_1.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.
- **DIV1EventCount**: Number of DIV1 events.

- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.

EventNotificationContext2

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_2.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.
- **DIV1EventCount**: Number of DIV1 events.

- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.

EventNotificationContext3

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_3.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.
- **DIV1EventCount**: Number of DIV1 events.

- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.

EventCount

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	IntReg	RO

Register Port: InterfacePort

[Short Description](#)

Number of occurrences of the selected event (32-bit counter).

EventCountReset

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Command	Imposed: WO

[Short Description](#)

Reset the selected EventCount.

EventNotificationAll

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Boolean	Imposed: WO

[Short Description](#)

Activate or deactivate the notification of all events.

EventCountResetAll

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → EventControl	Command	Imposed: WO

[Short Description](#)

Reset all EventCount.

2.20. OemSafetyKey Category

OemSafetyKeyVerification	626
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OemSafetyKeyVerification

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	Enumeration	RW

[Description](#)

Defines which key can be compared with the programmed OEM safety key.

Acts as a selector for `CheckOemSafetyKey`.

Recommended value: `EncryptedKey`.

Default value: `ProgrammingKeyOrEncryptedKey`.

[Selected Features](#)

- ["CheckOemSafetyKey" on page 627](#)

[Enumeration Values](#)

- `ProgrammingKey`: Only the key written to `ProgramOemSafetyKey` can be used to verify the OEM safety key.
- `EncryptedKey`: Only the key read from `EncryptedOemSafetyKey` can be used to verify the OEM safety key (recommended).
- `ProgrammingKeyOrEncryptedKey`: Both the key written to `ProgramOemSafetyKey` and the key read from `EncryptedOemSafetyKey` can be used to verify the OEM safety key.

CheckOemSafetyKey

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	String	Imposed: WO

[Description](#)

Write-only string to use for comparing a key (the key written to **ProgramOemSafetyKey** or the key read from **EncryptedOemSafetyKey**) and the programmed OEM safety key.

ProgramOemSafetyKey

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	String	Imposed: WO

[Short Description](#)

Write-only string to use for programming the non-volatile OEM safety key.

EncryptedOemSafetyKey

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	String	Imposed: RO

[Description](#)

Read-only string that contains the encrypted version of the OEM safety key just programmed with **ProgramOemSafetyKey**.

MaximumOemKeyLength

[Feature Info](#)

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	Integer	RW

[Value Info](#)

Minimum value: 40

Maximum value: 2147483647

[Description](#)

The length of `ProgramOemSafetyKey` and `CheckOemSafetyKey` is limited by `MaximumOemKeyLength`.

Default value: 4096.

3. Grablink Device Module Register Description

Categorized features list of Devicemodule version 24_04_0

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3.1. Root Category

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DeviceInformation

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root	Category	RW

[Category Members](#)

See also: "DeviceInformation Category" on page 639

StreamEnumeration

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root	Category	RW

[Category Members](#)

See also: "StreamEnumeration Category" on page 646

CameraAndIlluminationControl

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root	Category	RW

[Description](#)

Set of features related to the Camera and Illumination Controller (CIC).

[Category Members](#)

See also: "CameraAndIlluminationControl Category" on page 663

CameraLink

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root	Category	RW

[Category Members](#)

See also: "CameraLink Category" on page 649

EventControl

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root	Category	RW

[Category Members](#)

See also: "EventControl Category" on page 718

Errors

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root	Category	RW

[Category Members](#)

See also: "Errors Category" on page 734

3.2. DeviceInformation Category

DeviceID	640
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DeviceID

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → DeviceInformation	String	Imposed: RO

[Short Description](#)

Interface wide unique identifier of this device.

DeviceVendorName

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → DeviceInformation	String	Imposed: RO

[Short Description](#)

Name of the device vendor.

DeviceModelName

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → DeviceInformation	String	Imposed: RO

[Short Description](#)

Name of the device model.

DeviceAccessStatus

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → DeviceInformation	Enumeration	Imposed: RO

[Short Description](#)

Gives the device's access status at the moment of the last execution of DeviceUpdateList.

[Enumeration Values](#)

- **Unknown**: Unknown access.
- **ReadWrite**: Available to be opened with full access.
- **ReadOnly**: Available to be opened with read-only access.
- **NoAccess**: Not reachable.
- **Busy**: Already opened by another entity.
- **OpenReadWrite**: Opened with read-write access.
- **OpenReadOnly**: Opened with read-only access.

DeviceType

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → DeviceInformation	Enumeration	Imposed: RO

[Short Description](#)

Identifies the transport layer technology of the interface.

[Enumeration Values](#)

- **CL**: This enumeration value indicates Camera Link transport layer technology.

DeviceDescription

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → DeviceInformation	String	Imposed: RO

[Short Description](#)

Description of the device.

3.3. StreamEnumeration Category

StreamSelector	647
StreamID	648

StreamSelector

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → StreamEnumeration	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Selector for the different stream channels.

[Selected Features](#)

- ["StreamID" on page 648](#)

StreamID

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → StreamEnumeration	String	Imposed: RO

[Short Description](#)

Device unique ID for the stream.

3.4. CameraLink Category

CameraControlLineSelector	650
CameraControlLineSource	651
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SerialAccessControl	655

CameraControlLineSelector

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink	Enumeration	RW

[Short Description](#)

Selects a camera control line.

[Selected Features](#)

- ["CameraControlLineSource" on page 651](#)
- ["CameraControlLineInverter" on page 652](#)

[Enumeration Values](#)

- **CC1**: Camera control output 1.
- **CC2**: Camera control output 2.
- **CC3**: Camera control output 3.
- **CC4**: Camera control output 4.

CameraControlLineSource

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink	Enumeration	RW

[Short Description](#)

Camera Control Line Source.

[Enumeration Values](#)

- **CameraTrigger**: The camera trigger pulse is sent on the selected camera control line.
- **LIN1Source**: The line source of IO Toolbox LIN1 is sent on the selected camera control line.
- **LIN2Source**: The line source of IO Toolbox LIN2 is sent on the selected camera control line.
- **LIN3Source**: The line source of IO Toolbox LIN3 is sent on the selected camera control line.
- **LIN4Source**: The line source of IO Toolbox LIN4 is sent on the selected camera control line.
- **LIN5Source**: The line source of IO Toolbox LIN5 is sent on the selected camera control line.
- **LIN6Source**: The line source of IO Toolbox LIN6 is sent on the selected camera control line.
- **LIN7Source**: The line source of IO Toolbox LIN7 is sent on the selected camera control line.
- **LIN8Source**: The line source of IO Toolbox LIN8 is sent on the selected camera control line.
- **Low**: The selected camera control line is driven to the Low state.
- **High**: The selected camera control line is driven to the High state.

CameraControlLineInverter

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink	Boolean	RW

[Short Description](#)

Inversion of the selected camera control line.

ClTriggerDuration

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink	Float	RW

[Value Info](#)

Minimum value: 0.096

Maximum value: 5.6295e+11

[Short Description](#)

Cl Trigger Duration.

AntiGlitchFilters

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink	Category	RW

[Category Members](#)

See also: "AntiGlitchFilters Category" on page 656

SerialAccessControl

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink	Category	RW

[Category Members](#)

See also: "SerialAccessControl Category" on page 706

3.5. AntiGlitchFilters Category

AntiGlitchFilterSelector	657
AntiGlitchFilterEnable	658
ChannelXGlitchCount	659
ChannelYGlitchCount	660
ChannelZGlitchCount	661
ChannelXYZGlitchCountReset	662

AntiGlitchFilterSelector

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → AntiGlitchFilters	Enumeration	RW

[Short Description](#)

Selects the Camera Link signal on which the anti-glitch filter applies.

[Selected Features](#)

- ["AntiGlitchFilterEnable" on page 658](#)
- ["ChannelXGlitchCount" on page 659](#)
- ["ChannelYGlitchCount" on page 660](#)
- ["ChannelZGlitchCount" on page 661](#)
- ["ChannelXYZGlitchCountReset" on page 662](#)

[Enumeration Values](#)

- LVAL:
- FVAL:

AntiGlitchFilterEnable

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → AntiGlitchFilters	Boolean	RW

[Short Description](#)

When enabled on LVAL, filters out LVAL high/low pulses narrower than 2 clock periods. When enabled on FVAL, filters out FVAL high/low pulses narrower than 3 clock periods.

ChannelXGlitchCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → AntiGlitchFilters	Integer	RW

[Short Description](#)

Count of glitches that have been filtered on channel link X of the selected Camera Link signal.

ChannelYGlitchCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → AntiGlitchFilters	Integer	RW

[Short Description](#)

Count of glitches that have been filtered on channel link Y of the selected Camera Link signal.

ChannelZGlitchCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → AntiGlitchFilters	Integer	RW

[Short Description](#)

Count of glitches that have been filtered on channel link Z of the selected Camera Link signal.

ChannelXYZGlitchCountReset

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → AntiGlitchFilters	Command	Imposed: WO

[Short Description](#)

Resets the glitch counters of the selected Camera Link signal.

3.6. CameraAndIlluminationControl Category

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CameraModel

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

[Description](#)

Set of features describing the behavioral model of a grabber-controlled camera.



NOTE

These features defines the operating limits of the camera and are used to configure the trigger-overrun protection mechanism of the CIC.



NOTE

An incorrectly set behavioral model may prevent reaching the highest achievable camera cycle rate or, reversely, allow the grabber to assert triggers too quickly.

[Category Members](#)

See also: "CameraModel Category" on page 670

CycleTiming

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

[Description](#)

Set of features describing the CIC Cycle timing properties.

[Category Members](#)

See also: "CycleTiming Category" on page 678

CycleControl

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

[Description](#)

Set of features describing the CIC cycle control properties.

[Category Members](#)

See also: "CycleControl Category" on page 684

SequenceControl

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

[Description](#)

Set of features describing the CIC cycle sequence control properties.

Default value: **True**.

[Category Members](#)

See also: "SequenceControl Category" on page 693

DeviceReset

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Command	Imposed: WO

[Description](#)

Reset the CIC.

CameraAndIlluminationControllerStream

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Enumeration	RW

[Short Description](#)

Defines which data stream the CIC uses to check whether a new cycle can be started.

[Enumeration Values](#)

- **Stream0**: CIC uses camera readout and frame buffer status from Stream0.
- **Stream1**: CIC uses camera readout and frame buffer status from Stream1.
- **Stream2**: CIC uses camera readout and frame buffer status from Stream2.
- **Stream3**: CIC uses camera readout and frame buffer status from Stream3.

3.7. CameraModel Category

CameraControlMethod	671
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CameraControlMethod

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Enumeration	RW

[Description](#)

Camera control method.

The **NC** camera control method is to be used with free-run or asynchronous reset cameras not controlled by the frame grabber.

The **RC** camera control method is to be used with asynchronous reset cameras having the camera cycle start controlled by the grabber CIC and the exposure time controlled by the camera.

The **RG** camera control method is to be used with asynchronous reset cameras having the camera cycle start and the exposure duration controlled by the grabber CIC.

The **EXTERNAL** camera control method is to be used with asynchronous reset cameras having the camera cycle start and the exposure duration controlled by a hardware signal applied by an external controller to any GPIO input port of the grabber.



NOTE

The NC and the EXTERNAL camera control methods doesn't use the CIC.

[Enumeration Values](#)

- **NC**: Not Controlled.
- **RC**: Grabber-controlled cycle start, Camera-controlled exposure time.
- **RG**: Grabber-controlled cycle start and exposure time.

C2CLinkConfiguration

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Enumeration	RW

[Description](#)

Sets/gets the C2C-Link configuration.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`).

Default value: `Disconnected`.

[Enumeration Values](#)

- **Disconnected:** Disconnected from the C2C-Link.
- **Master:** Connected to the C2C-Link as the C2C-Link Master Device.
- **Slave:** Connected to the C2C-Link as a C2C-Link Slave Device.

ExposureReadoutOverlap

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Boolean	RW

[Description](#)

Declares the exposure overlapping capability of the camera.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`).

When set to true, it indicates that the camera allows overlapping. The exposure phase of a new camera cycle is allowed to begin during the readout phase.

When set to false, it indicates that the camera doesn't allow overlapping. The exposure phase of a new camera cycle is not allowed to begin before the completion of the readout phase.

ExposureRecoveryTime

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

[Value Info](#)

Minimum value: 0

Maximum value: 1.71799e+07

Dimension: Time

Unit: μs

Increment: 0.008 μs (8 ns)

[Description](#)

Minimum time interval between two consecutive exposure phases.

When **CameraControlMethod** is **RG**, the CIC ensure that the time interval between two consecutive camera trigger pulses is not lower than the specified value in case of large exposure time (exposure time > readout time).

[Directive](#)

Only when **CameraControlMethod** is **RG**, set this value to the minimum time interval allowed by the camera.



WARNING

A too small value may cause missed triggers.



WARNING

An excessive value prevents reaching the highest achievable camera cycle rate.

ExposureTimeMin

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

[Value Info](#)

Dimension: Time

Unit: μs

Increment: 0.008 μs (8 ns)

[Description](#)

Minimum exposure time.

When **CameraControlMethod** is **RG**, the CIC ensure that the camera trigger pulse width is not lower than the specified value.

[Directive](#)

Only when **CameraControlMethod** is **RG**, set this value to the minimum exposure time allowed by the camera.



WARNING

A too small value may cause missed triggers.

ExposureTimeMax

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

[Value Info](#)

Maximum value: 5.6295e+11

Dimension: Time

Unit: μs

Increment: 0.008 μs (8 ns)

[Description](#)

Maximum exposure time.

When **CameraControlMethod** is **RG**, the CIC ensure that the camera trigger pulse width is not larger than the specified value.

[Directive](#)

Only when **CameraControlMethod** is **RG**, set this value to the maximum exposure time allowed by the camera.



WARNING

An excessive value may cause missed triggers.

CycleMinimumPeriod

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

Value Info

Maximum value: 5.6295e+11

Dimension: Time

Unit: μs

Increment: 0.008 μs (8 ns)

Description

Minimum camera cycle period.

When **CameraControlMethod** is **RC** or **RG**, the CIC ensure that the camera cycle period is not smaller than the specified value.



NOTE

was named **CycleTargetPeriod** in Coaxlink driver versions prior to 9.4



NOTE

was named **CyclePeriodTarget** in Coaxlink driver versions prior to 4.1

Directive

Only when **CameraControlMethod** is **RC** or **RG**, set this value to the minimum cycle period allowed by the camera.



WARNING

A too small value may cause missed triggers.

3.8. CycleTiming Category

CycleTimingSelector	679
CycleTimingCount	680
ExposureTime	681
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StrobeDuration	683

CycleTimingSelector

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleTiming	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Selector for the different cycle timings.

[Selected Features](#)

- "ExposureTime" on page 681
- "StrobeDelay" on page 682
- "StrobeDuration" on page 683

CycleTimingCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleTiming	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

A timing represents a set of values in the CycleTiming category.

ExposureTime

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleTiming	Float	RW

[Value Info](#)

Dimension: Time

Unit: μs

Increment: 0.008 μs (8 ns)

[Description](#)

Sets/gets the exposure time.

Applies only when **CameraControlMethod** is **RG**.



NOTE

Avoid using exposure time settings outside the exposure time range of the camera.



NOTE

The upper limit is very high: > 150 hours!

Default value: 1,000.0 (1 millisecond).

StrobeDelay

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleTiming	Float	RW

[Value Info](#)

Minimum value: -8.58993e+06

Maximum value: 8.58993e+06

Dimension: Time

Unit: μs

Increment: 0.008 μs (8 ns)

[Description](#)

Sets/gets the strobe pulse delay.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`).

Default value: 0.

StrobeDuration

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleTiming	Float	RW

[Value Info](#)

Minimum value: 0

Maximum value: 5.6295e+11

Dimension: Time

Unit: μs

Increment: 0.008 μs (8 ns)

[Description](#)

Sets/gets the strobe pulse duration.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`).



NOTE

The upper limit is very high: > 150 hours!

Default value: 1,000.0 (1 millisecond).

3.9. CycleControl Category

CycleTriggerSource	685
StartCycle	688
CycleMaxPendingTriggerCount	689
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CycleLostTriggerCount	691
CycleLostTriggerCountReset	692

CycleTriggerSource

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	Enumeration	RW

[Description](#)

Sets/gets the start-of-camera-cycle trigger conditions and selects a hardware or software trigger source.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`).

Default value: `Immediate`.

[Enumeration Values](#)

- **Immediate:** Immediately after the start of the sequence and then repeatedly every `CycleMinimumPeriod` period.
- **StartCycle:** On execution of the `StartCycle` command.
- **C2C:** Synchronized with the C2C-Link master device. This value is enforced when `C2CLinkConfiguration = Slave`.
- **LIN1:** When an event occurs on Line Input Tool 1 or on execution of the `StartCycle` command.
- **LIN2:** When an event occurs on Line Input Tool 2 or on execution of the `StartCycle` command.
- **LIN3:** When an event occurs on Line Input Tool 3 or on execution of the `StartCycle` command.
- **LIN4:** When an event occurs on Line Input Tool 4 or on execution of the `StartCycle` command.
- **LIN5:** When an event occurs on Line Input Tool 5 or on execution of the `StartCycle` command.
- **LIN6:** When an event occurs on Line Input Tool 6 or on execution of the `StartCycle` command.
- **LIN7:** When an event occurs on Line Input Tool 7 or on execution of the `StartCycle` command.
- **LIN8:** When an event occurs on Line Input Tool 8 or on execution of the `StartCycle` command.
- **QDC1:** When an event occurs on Quadrature Decoder Tool 1 or on execution of the `StartCycle` command.
- **QDC2:** When an event occurs on Quadrature Decoder Tool 2 or on execution of the `StartCycle` command.
- **QDC3:** When an event occurs on Quadrature Decoder Tool 3 or on execution of the `StartCycle` command.
- **QDC4:** When an event occurs on Quadrature Decoder Tool 4 or on execution of the `StartCycle` command.
- **MDV1:** When an event occurs on Multiplier/Divider Tool 1 or on execution of the `StartCycle` command.

- **MDV2**: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StartCycle command.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StartCycle command.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StartCycle command.
- **DIV1**: When an event occurs on Divider Tool 1 or on execution of the StartCycle command.
- **DIV2**: When an event occurs on Divider Tool 2 or on execution of the StartCycle command.
- **DIV3**: When an event occurs on Divider Tool 3 or on execution of the StartCycle command.
- **DIV4**: When an event occurs on Divider Tool 4 or on execution of the StartCycle command.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1 or on execution of the StartCycle command.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2 or on execution of the StartCycle command.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1 or on execution of the StartCycle command.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2 or on execution of the StartCycle command.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1 or on execution of the StartCycle command.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2 or on execution of the StartCycle command.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1 or on execution of the StartCycle command.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2 or on execution of the StartCycle command.
- **EIN1**: When an event occurs on Event Input Tool 1 or on execution of the StartCycle command.
- **EIN2**: When an event occurs on Event Input Tool 2 or on execution of the StartCycle command.
- **UserEvent1**: When an event occurs on User Event 1 or on execution of the StartCycle command.
- **UserEvent2**: When an event occurs on User Event 2 or on execution of the StartCycle command.
- **UserEvent3**: When an event occurs on User Event 3 or on execution of the StartCycle command.
- **UserEvent4**: When an event occurs on User Event 4 or on execution of the StartCycle command.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StartCycle command.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StartCycle command.

- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StartCycle command.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StartCycle command.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StartCycle command.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StartCycle command.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StartCycle command.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StartCycle command.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StartCycle command.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StartCycle command.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StartCycle command.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StartCycle command.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StartCycle command.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StartCycle command.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StartCycle command.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StartCycle command.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StartCycle command.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StartCycle command.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StartCycle command.

StartCycle

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	Command	Imposed: WO

[Description](#)

Starts a camera cycle.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`).



NOTE

was named `CycleSoftwareTrigger` in Coaxlink driver versions prior to 4.1.

CycleMaxPendingTriggerCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 7

[Description](#)

The Camera and Illumination Controller is fitted with a trigger latching mechanism capable of recording triggers that cannot be served immediately and postponing their execution.

This feature determines the capacity of the latch :

- When 0, the trigger latch mechanism is disabled. Any cycle trigger that cannot be served immediately is rejected and increments **CycleLostTriggerCount**.
- When set to any value ranging from 1 to 7, the trigger latch mechanism is enabled. Providing that **CyclePendingTriggerCount** is below **CycleMaxPendingTriggerCount**, any cycle trigger that cannot be served immediately is latched and increments **CyclePendingTriggerCount**.

Applies only when the CIC is used (i.e., when **CameraControlMethod** is **RC** or **RG**).

Default value: 0 (Disabled)

CyclePendingTriggerCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	IntReg	RO

Register Port: DevicePort

[Description](#)

Returns the count of pending CIC cycle trigger events.

Applies only when the CIC is used (i.e., when **CameraControlMethod** is **RC** or **RG**).

CycleLostTriggerCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	IntReg	RO

Register Port: DevicePort

[Description](#)

Returns the count of lost CIC cycle trigger events.

Applies only when the CIC is used (i.e., when **CameraControlMethod** is **RC** or **RG**).

Value range: from 0 up to 4,294,967,295.

CycleLostTriggerCountReset

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	Command	Imposed: WO

[Description](#)

Resets the count of lost CIC cycle trigger events.

Applies only when the CIC is used (i.e., when **CameraControlMethod** is **RC** or **RG**).

3.10. SequenceControl Category

StartOfSequenceTriggerSource	694
EndOfSequenceTriggerSource	698
SequenceLength	702
StartSequence	703
StopSequence	704
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StartOfSequenceTriggerSource

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Enumeration	RW

[Description](#)

Sets/gets the start-of-sequence trigger conditions and selects a hardware or software trigger source.

- When set to **Immediate**, the sequence starts immediately.
- When set to **StartSequence**, the sequence starts only on execution of the StartSequence command.
- When set to <any-event-source>, the sequence starts on the next occurrence of an event on the specified event source or on execution of the StartSequence command. Possible event sources include any available LIN*, QDC*, MDV*, DIV*, DEL*, EIN*, User Event* event source.

Applies only when the CIC is used (i.e., when **CameraControlMethod** is **RC** or **RG**).

[Enumeration Values](#)

- **Immediate**: Immediate.
- **StartSequence**: StartSequence command.
- **LIN1**: When an event occurs on Line Input Tool 1 or on execution of the StartSequence command.
- **LIN2**: When an event occurs on Line Input Tool 2 or on execution of the StartSequence command.
- **LIN3**: When an event occurs on Line Input Tool 3 or on execution of the StartSequence command.
- **LIN4**: When an event occurs on Line Input Tool 4 or on execution of the StartSequence command.
- **LIN5**: When an event occurs on Line Input Tool 5 or on execution of the StartSequence command.
- **LIN6**: When an event occurs on Line Input Tool 6 or on execution of the StartSequence command.
- **LIN7**: When an event occurs on Line Input Tool 7 or on execution of the StartSequence command.
- **LIN8**: When an event occurs on Line Input Tool 8 or on execution of the StartSequence command.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StartSequence command.

- **QDC2**: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StartSequence command.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StartSequence command.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StartSequence command.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StartSequence command.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StartSequence command.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StartSequence command.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StartSequence command.
- **DIV1**: When an event occurs on Divider Tool 1 or on execution of the StartSequence command.
- **DIV2**: When an event occurs on Divider Tool 2 or on execution of the StartSequence command.
- **DIV3**: When an event occurs on Divider Tool 3 or on execution of the StartSequence command.
- **DIV4**: When an event occurs on Divider Tool 4 or on execution of the StartSequence command.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1 or on execution of the StartSequence command.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2 or on execution of the StartSequence command.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1 or on execution of the StartSequence command.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2 or on execution of the StartSequence command.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1 or on execution of the StartSequence command.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2 or on execution of the StartSequence command.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1 or on execution of the StartSequence command.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2 or on execution of the StartSequence command.
- **EIN1**: When an event occurs on Event Input Tool 1 or on execution of the StartSequence command.
- **EIN2**: When an event occurs on Event Input Tool 2 or on execution of the StartSequence command.

- **UserEvent1**: When an event occurs on User Event 1 or on execution of the StartSequence command.
- **UserEvent2**: When an event occurs on User Event 2 or on execution of the StartSequence command.
- **UserEvent3**: When an event occurs on User Event 3 or on execution of the StartSequence command.
- **UserEvent4**: When an event occurs on User Event 4 or on execution of the StartSequence command.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StartSequence command.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StartSequence command.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StartSequence command.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StartSequence command.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StartSequence command.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StartSequence command.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StartSequence command.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StartSequence command.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StartSequence command.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StartSequence command.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StartSequence command.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StartSequence command.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StartSequence command.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StartSequence command.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StartSequence command.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StartSequence command.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StartSequence command.

- **DLT15:** When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StartSequence command.
- **DLT16:** When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StartSequence command.

EndOfSequenceTriggerSource

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Enumeration	RW

Description

Sets/gets the end-of-sequence trigger conditions and selects a hardware or software trigger source.

- When set to **SequenceLength**, the sequence stops automatically after having executed a number of camera cycles specified by **SequenceLength**. The sequence can be stopped anticipatively on execution of the **StopSequence** command.
- When set to **StopSequence**, the sequence stops only on execution of the **StopSequence** command.
- When set to <any-event-source>, the sequence stops on the next occurrence of an event on the specified event source or on execution of the **StopSequence** command. Possible event sources include any available LIN*, QDC*, MDV*, DIV*, DEL*, EIN*, User Event* event source.

Applies only when the CIC is used (i.e., when **CameraControlMethod** is **RC** or **RG**).

Enumeration Values

- **SequenceLength**: SequenceLength.
- **StopSequence**: StopSequence command.
- **LIN1**: When an event occurs on Line Input Tool 1 or on execution of the StopSequence command.
- **LIN2**: When an event occurs on Line Input Tool 2 or on execution of the StopSequence command.
- **LIN3**: When an event occurs on Line Input Tool 3 or on execution of the StopSequence command.
- **LIN4**: When an event occurs on Line Input Tool 4 or on execution of the StopSequence command.
- **LIN5**: When an event occurs on Line Input Tool 5 or on execution of the StopSequence command.
- **LIN6**: When an event occurs on Line Input Tool 6 or on execution of the StopSequence command.
- **LIN7**: When an event occurs on Line Input Tool 7 or on execution of the StopSequence command.
- **LIN8**: When an event occurs on Line Input Tool 8 or on execution of the StopSequence command.

- **QDC1**: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StopSequence command.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StopSequence command.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StopSequence command.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StopSequence command.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StopSequence command.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StopSequence command.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StopSequence command.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StopSequence command.
- **DIV1**: When an event occurs on Divider Tool 1 or on execution of the StopSequence command.
- **DIV2**: When an event occurs on Divider Tool 2 or on execution of the StopSequence command.
- **DIV3**: When an event occurs on Divider Tool 3 or on execution of the StopSequence command.
- **DIV4**: When an event occurs on Divider Tool 4 or on execution of the StopSequence command.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1 or on execution of the StopSequence command.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2 or on execution of the StopSequence command.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1 or on execution of the StopSequence command.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2 or on execution of the StopSequence command.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1 or on execution of the StopSequence command.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2 or on execution of the StopSequence command.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1 or on execution of the StopSequence command.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2 or on execution of the StopSequence command.
- **EIN1**: When an event occurs on Event Input Tool 1 or on execution of the StopSequence command.

- **EIN2**: When an event occurs on Event Input Tool 2 or on execution of the StopSequence command.
- **UserEvent1**: When an event occurs on User Event 1 or on execution of the StopSequence command.
- **UserEvent2**: When an event occurs on User Event 2 or on execution of the StopSequence command.
- **UserEvent3**: When an event occurs on User Event 3 or on execution of the StopSequence command.
- **UserEvent4**: When an event occurs on User Event 4 or on execution of the StopSequence command.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StopSequence command.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StopSequence command.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StopSequence command.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StopSequence command.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StopSequence command.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StopSequence command.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StopSequence command.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StopSequence command.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StopSequence command.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StopSequence command.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StopSequence command.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StopSequence command.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StopSequence command.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StopSequence command.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StopSequence command.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StopSequence command.

- **DLT14:** When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StopSequence command.
- **DLT15:** When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StopSequence command.
- **DLT16:** When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StopSequence command.

SequenceLength

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Integer	RW

[Value Info](#)

Minimum value: 1

Maximum value: 16777215

[Short Description](#)

Sequence Length.

StartSequence

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Command	Imposed: WO

[Description](#)

Starts a CIC sequence.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`) and `StartOfSequenceTriggerSource` is not set to `Immediate`.

StopSequence

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Command	Imposed: WO

[Description](#)

Stops a CIC sequence.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`).

AbortSequence

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Command	Imposed: WO

[Description](#)

Abort a CIC sequence.

Applies only when the CIC is used (i.e., when `CameraControlMethod` is `RC` or `RG`) and `StartOfSequenceTriggerSource` is not set to `Immediate`.

3.11. SerialAccessControl Category

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SerialOperationSelector

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Enumeration	RW

[Short Description](#)

Serial Operation Selector.

[Selected Features](#)

- ["SerialOperationExecute"](#) on page 708
- ["SerialOperationStatus"](#) on page 709
- ["SerialOperationResult"](#) on page 710

[Enumeration Values](#)

- **Open:**
- **Close:**
- **Read:**
- **Write:**
- **Flush:**
- **Drain:**

SerialOperationExecute

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Command	RW

[Short Description](#)

Serial Operation Execute.

SerialOperationStatus

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Enumeration	Imposed: RO

[Short Description](#)

Serial Operation Status.

[Enumeration Values](#)

- **Success:**
- **Failure:**
- **Timeout:**

SerialOperationResult

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	IntReg	RO

Register Port: DevicePort

[Short Description](#)

Serial Operation Result.

SerialAccessBuffer

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Register	RW

[Short Description](#)

Serial Access Buffer.

SerialAccessBufferLength

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Integer	RW

[Value Info](#)

Minimum value: 4096

Maximum value: 16777216

[Short Description](#)

Serial Access Buffer Length.

SerialAccessLength

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

Serial Access Length.

SerialBaudRate

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Enumeration	RW

[Short Description](#)

Serial Baud Rate.

[Enumeration Values](#)

- **Baud9600:**
- **Baud19200:**
- **Baud38400:**
- **Baud57600:**
- **Baud115200:**
- **Baud230400:**

SerialTimeout

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 10000

[Short Description](#)

Serial Timeout.

SerialReadQueueSize

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	IntReg	RO

Register Port: DevicePort

[Short Description](#)

Serial Read Queue Size.

SerialWriteQueueSize

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	IntReg	RO

Register Port: DevicePort

[Short Description](#)

Serial Write Queue Size.

3.12. EventControl Category

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EventSelector

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Enumeration	RW

[Short Description](#)

Select an event.

[Selected Features](#)

- ["EventNotification" on page 720](#)
- ["EventNotificationContext1" on page 721](#)
- ["EventNotificationContext2" on page 724](#)
- ["EventNotificationContext3" on page 727](#)
- ["EventCount" on page 730](#)
- ["EventCountReset" on page 731](#)

[Enumeration Values](#)

- **CameraTriggerRisingEdge**: Start of camera trigger.
- **CameraTriggerFallingEdge**: End of camera trigger.
- **StrobeRisingEdge**: Start of light strobe.
- **StrobeFallingEdge**: End of light strobe.
- **AllowNextCycle**: CIC is ready for next camera cycle.
- **DiscardedCicTrigger**: Ignored CIC trigger because CIC is not ready for next camera cycle.
- **PendingCicTrigger**: Delayed CIC trigger until CIC is ready for next camera cycle.
- **Trigger**: CIC trigger.
- **CameraTriggerOverrun**: New trigger sent to remote device even though readout of previous frame has not started yet.
- **MigAxiWriteError**: MIG AXI write error.
- **MigAxiReadError**: MIG AXI read error.
- **FillLevelAboveIIsosRejected**: Start of scan skipped (caused by internal exception: frame store almost full).
- **FillLevelAboveAfEarlyEos**: End of scan (caused by internal exception: frame store almost full).
- **ExternalTriggerReqsTooClose**: External trigger requests too close together.

EventNotification

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Boolean	RW

[Description](#)

Activate or deactivate the notification to the host application of the occurrence of the selected event.

When true, activate the notification.

When false, deactivate the notification.

Default value: **False**.

EventNotificationContext1

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_1.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **PendingCicTriggerCount**: Number of currently pending CIC triggers.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.

- **DIV1EventCount**: Number of DIV1 events.
- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.
- **CameraTriggerRisingEdgeEventCount**: Number of CameraTriggerRisingEdge events.
- **CameraTriggerFallingEdgeEventCount**: Number of CameraTriggerFallingEdge events.
- **StrobeRisingEdgeEventCount**: Number of StrobeRisingEdge events.
- **StrobeFallingEdgeEventCount**: Number of StrobeFallingEdge events.
- **AllowNextCycleEventCount**: Number of AllowNextCycle events.
- **DiscardedCicTriggerEventCount**: Number of DiscardedCicTrigger events.
- **PendingCicTriggerEventCount**: Number of PendingCicTrigger events.
- **TriggerEventCount**: Number of Trigger events.
- **CameraTriggerOverrunEventCount**: Number of CameraTriggerOverrun events.
- **MigAxiWriteErrorEventCount**: Number of MigAxiWriteError events.
- **MigAxiReadErrorEventCount**: Number of MigAxiReadError events.
- **FillLevelAboveIIsosRejectedEventCount**: Number of FillLevelAboveIIsosRejected events.
- **FillLevelAboveAfEarlyEosEventCount**: Number of FillLevelAboveAfEarlyEos events.

- **ExternalTriggerReqsTooCloseEventCount**: Number of ExternalTriggerReqsTooClose events.

EventNotificationContext2

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_2.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **PendingCicTriggerCount**: Number of currently pending CIC triggers.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.

- **DIV1EventCount**: Number of DIV1 events.
- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.
- **CameraTriggerRisingEdgeEventCount**: Number of CameraTriggerRisingEdge events.
- **CameraTriggerFallingEdgeEventCount**: Number of CameraTriggerFallingEdge events.
- **StrobeRisingEdgeEventCount**: Number of StrobeRisingEdge events.
- **StrobeFallingEdgeEventCount**: Number of StrobeFallingEdge events.
- **AllowNextCycleEventCount**: Number of AllowNextCycle events.
- **DiscardedCicTriggerEventCount**: Number of DiscardedCicTrigger events.
- **PendingCicTriggerEventCount**: Number of PendingCicTrigger events.
- **TriggerEventCount**: Number of Trigger events.
- **CameraTriggerOverrunEventCount**: Number of CameraTriggerOverrun events.
- **MigAxiWriteErrorEventCount**: Number of MigAxiWriteError events.
- **MigAxiReadErrorEventCount**: Number of MigAxiReadError events.
- **FillLevelAboveIIsosRejectedEventCount**: Number of FillLevelAboveIIsosRejected events.
- **FillLevelAboveAfEarlyEosEventCount**: Number of FillLevelAboveAfEarlyEos events.

- **ExternalTriggerReqsTooCloseEventCount**: Number of ExternalTriggerReqsTooClose events.

EventNotificationContext3

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_3.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **PendingCicTriggerCount**: Number of currently pending CIC triggers.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.

- **DIV1EventCount**: Number of DIV1 events.
- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.
- **CameraTriggerRisingEdgeEventCount**: Number of CameraTriggerRisingEdge events.
- **CameraTriggerFallingEdgeEventCount**: Number of CameraTriggerFallingEdge events.
- **StrobeRisingEdgeEventCount**: Number of StrobeRisingEdge events.
- **StrobeFallingEdgeEventCount**: Number of StrobeFallingEdge events.
- **AllowNextCycleEventCount**: Number of AllowNextCycle events.
- **DiscardedCicTriggerEventCount**: Number of DiscardedCicTrigger events.
- **PendingCicTriggerEventCount**: Number of PendingCicTrigger events.
- **TriggerEventCount**: Number of Trigger events.
- **CameraTriggerOverrunEventCount**: Number of CameraTriggerOverrun events.
- **MigAxiWriteErrorEventCount**: Number of MigAxiWriteError events.
- **MigAxiReadErrorEventCount**: Number of MigAxiReadError events.
- **FillLevelAboveIIsosRejectedEventCount**: Number of FillLevelAboveIIsosRejected events.
- **FillLevelAboveAfEarlyEosEventCount**: Number of FillLevelAboveAfEarlyEos events.

- **ExternalTriggerReqsTooCloseEventCount**: Number of ExternalTriggerReqsTooClose events.

EventCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	IntReg	RO

Register Port: DevicePort

[Short Description](#)

Number of occurrences of the selected event (32-bit counter).

EventCountReset

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Command	Imposed: WO

[Short Description](#)

Reset the selected EventCount.

EventNotificationAll

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Boolean	Imposed: WO

[Short Description](#)

Activate or deactivate the notification of all events.

EventCountResetAll

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → EventControl	Command	Imposed: WO

[Short Description](#)

Reset all EventCount.

3.13. Errors Category

ErrorSelector	735
ErrorCount	736
ErrorCountReset	737

ErrorSelector

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → Errors	Enumeration	RW

[Short Description](#)

Error Selector.

[Selected Features](#)

- "ErrorCount" on page 736
- "ErrorCountReset" on page 737

[Enumeration Values](#)

- **All**: All errors.
- **CameraTriggerOverrun**: New trigger sent to remote device even though readout of previous frame has not started yet.
- **MigAxiWriteError**: MIG AXI write error.
- **MigAxiReadError**: MIG AXI read error.
- **StartOfScanSkipped**: Start of scan skipped (caused by internal exception: frame store almost full).
- **PrematureEndOfScan**: End of scan (caused by internal exception: frame store almost full).
- **ExternalTriggerReqsTooClose**: Trigger requests too close together.
- **Unknown**: Unknown errors.

ErrorCount

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → Errors	IntReg	RO

Register Port: DevicePort

[Short Description](#)

Error Count.

ErrorCountReset

[Feature Info](#)

Module	Category Path	Type	Access
Device	Root → Errors	Command	Imposed: WO

[Short Description](#)

Reset the selected ErrorCount.

4. Grablink Data Stream Module Register Description

Categorized features list of Data Streammodule version 24_04_0

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4.1. Root Category

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StreamInformation

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "StreamInformation Category" on page 757

ImageFormatControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "ImageFormatControl Category" on page 762

TransportLayerControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "TransportLayerControl Category" on page 792

BufferHandlingControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "BufferHandlingControl Category" on page 794

PixelProcessing

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "PixelProcessing Category" on page 808

LineScanAcquisitionControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "LineScanAcquisitionControl Category" on page 814

StreamControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "StreamControl Category" on page 825

Errors

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "Errors Category" on page 851

LUTControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "LUTControl Category" on page 855

LinearFilter

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "LinearFilter Category" on page 864

Threshold

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "Threshold Category" on page 869

LaserLineExtractor

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "LaserLineExtractor Category" on page 872

Bayer

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "Bayer Category" on page 876

FlatFieldCorrection

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "FlatFieldCorrection Category" on page 878

MetadataInsertion

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "MetadataInsertion Category" on page 884

EventControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "EventControl Category" on page 902

StreamStatistics

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

[Category Members](#)

See also: "StreamStatistics Category" on page 918

4.2. StreamInformation Category

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StreamID

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamInformation	String	Imposed: RO

[Short Description](#)

Device unique ID for the data stream.

StreamType

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamInformation	Enumeration	Imposed: RO

[Short Description](#)

Identifies the transport layer technology of the interface.

[Enumeration Values](#)

- **CL**: This enumeration value indicates Camera Link transport layer technology.

StreamDescription

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamInformation	String	Imposed: RO

[Short Description](#)

Description of the stream.

StreamConfigurationStatus

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamInformation	Enumeration	Imposed: RO

[Short Description](#)

Stream Configuration Status.

[Enumeration Values](#)

- OK:
- UnknownError:
- BayerDecoderAndUnpackingModeMsbNotAllowed:
- BayerDecoderAndUnpackingModeOffNotAllowed:
- BinningAndFormatNotAllowed:
- BinningAndUnpackingModeNotAllowed:
- BinningConfigAndFormatDepthNotAllowed:
- LleNotImplemented:
- LleAndFormatNotAllowed:
- LutAndBayerFormatNotAllowed:
- LutAndLleNotAllowed:
- LutAndMultiComponentFormatNotAllowed:
- LutAndPackedFormatNotAllowed:
- LutAndUnpackingModeOffNotAllowed:
- LutConfigAndFormatDepthDontMatch:
- WidthNotAligned:
- CameraWidthNotAlignedToBinningWindow:
- CameraHeightNotAlignedToBinningWindow:
- UnpackingModeOffAnd16bitFormatNotAllowed:
- UnpackingModeOffAndFormatNotAllowed:
- ReverseXAndFormatNotAllowed:
- ReverseXAndUnpackingModeNotAllowed:
- CameraWidthTooLargeForReverseX:

4.3. ImageFormatControl Category

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PixelFormat

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Enumeration	Imposed: RO

[Short Description](#)

Pixel format of the image.

[Enumeration Values](#)

- **BayerBG10pmsb**: BayerBG10pmsb.
- **BayerBG12pmsb**: BayerBG12pmsb.
- **BayerBG14pmsb**: BayerBG14pmsb.
- **BayerGB10pmsb**: BayerGB10pmsb.
- **BayerGB12pmsb**: BayerGB12pmsb.
- **BayerGB14pmsb**: BayerGB14pmsb.
- **BayerGR10pmsb**: BayerGR10pmsb.
- **BayerGR12pmsb**: BayerGR12pmsb.
- **BayerGR14pmsb**: BayerGR14pmsb.
- **BayerRG10pmsb**: BayerRG10pmsb.
- **BayerRG12pmsb**: BayerRG12pmsb.
- **BayerRG14pmsb**: BayerRG14pmsb.
- **Mono10pmsb**: Mono10pmsb.
- **Mono12pmsb**: Mono12pmsb.
- **Mono14pmsb**: Mono14pmsb.
- **RGB10pmsb**: RGB10pmsb.
- **RGB12pmsb**: RGB12pmsb.
- **RGB14pmsb**: RGB14pmsb.
- **RGBa10pmsb**: RGBa10pmsb.
- **RGBa12pmsb**: RGBa12pmsb.
- **RGBa14pmsb**: RGBa14pmsb.
- **YCbCr601_10pmsb**: YCbCr601_10pmsb.
- **YCbCr601_12pmsb**: YCbCr601_12pmsb.
- **YCbCr601_14pmsb**: YCbCr601_14pmsb.

- **YCbCr601_16**: YCbCr601_16.
- **YCbCr601_411_10pmsb**: YCbCr601_411_10pmsb.
- **YCbCr601_411_12pmsb**: YCbCr601_411_12pmsb.
- **YCbCr601_411_14pmsb**: YCbCr601_411_14pmsb.
- **YCbCr601_411_16**: YCbCr601_411_16.
- **YCbCr601_411_8**: YCbCr601_411_8.
- **YCbCr601_422_10pmsb**: YCbCr601_422_10pmsb.
- **YCbCr601_422_12pmsb**: YCbCr601_422_12pmsb.
- **YCbCr601_422_14pmsb**: YCbCr601_422_14pmsb.
- **YCbCr601_422_16**: YCbCr601_422_16.
- **YCbCr601_8**: YCbCr601_8.
- **YCbCr709_10pmsb**: YCbCr709_10pmsb.
- **YCbCr709_12pmsb**: YCbCr709_12pmsb.
- **YCbCr709_14pmsb**: YCbCr709_14pmsb.
- **YCbCr709_16**: YCbCr709_16.
- **YCbCr709_411_10pmsb**: YCbCr709_411_10pmsb.
- **YCbCr709_411_12pmsb**: YCbCr709_411_12pmsb.
- **YCbCr709_411_14pmsb**: YCbCr709_411_14pmsb.
- **YCbCr709_411_16**: YCbCr709_411_16.
- **YCbCr709_411_8**: YCbCr709_411_8.
- **YCbCr709_422_10pmsb**: YCbCr709_422_10pmsb.
- **YCbCr709_422_12pmsb**: YCbCr709_422_12pmsb.
- **YCbCr709_422_14pmsb**: YCbCr709_422_14pmsb.
- **YCbCr709_422_16**: YCbCr709_422_16.
- **YCbCr709_8**: YCbCr709_8.
- **YUV10pmsb**: YUV10pmsb.
- **YUV12pmsb**: YUV12pmsb.
- **YUV14pmsb**: YUV14pmsb.
- **YUV16**: YUV16.
- **YUV411_10pmsb**: YUV411_10pmsb.
- **YUV411_12pmsb**: YUV411_12pmsb.
- **YUV411_14pmsb**: YUV411_14pmsb.
- **YUV411_16**: YUV411_16.
- **YUV411_8**: YUV411_8.
- **YUV422_10pmsb**: YUV422_10pmsb.
- **YUV422_12pmsb**: YUV422_12pmsb.

- **YUV422_14pmsb**: YUV422_14pmsb.
- **YUV422_16**: YUV422_16.
- **YUV8**: YUV8.
- **B10**: Blue 10-bit.
- **B12**: Blue 12-bit.
- **B16**: Blue 16-bit.
- **B8**: Blue 8-bit.
- **BayerBG10**: Bayer Blue-Green 10-bit unpacked.
- **BayerBG10p**: Bayer Blue-Green 10-bit packed.
- **BayerBG10Packed**: Bayer Blue-Green 10-bit packed.
- **BayerBG12**: Bayer Blue-Green 12-bit unpacked.
- **BayerBG12p**: Bayer Blue-Green 12-bit packed.
- **BayerBG12Packed**: Bayer Blue-Green 12-bit packed.
- **BayerBG14**: Bayer Blue-Green 14-bit.
- **BayerBG14p**: Bayer Blue-Green 14-bit packed.
- **BayerBG16**: Bayer Blue-Green 16-bit.
- **BayerBG4p**: Bayer Blue-Green 4-bit packed.
- **BayerBG8**: Bayer Blue-Green 8-bit.
- **BayerGB10**: Bayer Green-Blue 10-bit unpacked.
- **BayerGB10p**: Bayer Green-Blue 10-bit packed.
- **BayerGB10Packed**: Bayer Green-Blue 10-bit packed.
- **BayerGB12**: Bayer Green-Blue 12-bit unpacked.
- **BayerGB12p**: Bayer Green-Blue 12-bit packed.
- **BayerGB12Packed**: Bayer Green-Blue 12-bit packed.
- **BayerGB14**: Bayer Green-Blue 14-bit.
- **BayerGB14p**: Bayer Green-Blue 14-bit packed.
- **BayerGB16**: Bayer Green-Blue 16-bit.
- **BayerGB4p**: Bayer Green-Blue 4-bit packed.
- **BayerGB8**: Bayer Green-Blue 8-bit.
- **BayerGR10**: Bayer Green-Red 10-bit unpacked.
- **BayerGR10p**: Bayer Green-Red 10-bit packed.
- **BayerGR10Packed**: Bayer Green-Red 10-bit packed.
- **BayerGR12**: Bayer Green-Red 12-bit unpacked.
- **BayerGR12p**: Bayer Green-Red 12-bit packed.
- **BayerGR12Packed**: Bayer Green-Red 12-bit packed.
- **BayerGR14**: Bayer Green-Red 14-bit.

- **BayerGR14p**: Bayer Green-Red 14-bit packed.
- **BayerGR16**: Bayer Green-Red 16-bit.
- **BayerGR4p**: Bayer Green-Red 4-bit packed.
- **BayerGR8**: Bayer Green-Red 8-bit.
- **BayerRG10**: Bayer Red-Green 10-bit unpacked.
- **BayerRG10p**: Bayer Red-Green 10-bit packed.
- **BayerRG10Packed**: Bayer Red-Green 10-bit packed.
- **BayerRG12**: Bayer Red-Green 12-bit unpacked.
- **BayerRG12p**: Bayer Red-Green 12-bit packed.
- **BayerRG12Packed**: Bayer Red-Green 12-bit packed.
- **BayerRG14**: Bayer Red-Green 14-bit.
- **BayerRG14p**: Bayer Red-Green 14-bit packed.
- **BayerRG16**: Bayer Red-Green 16-bit.
- **BayerRG4p**: Bayer Red-Green 4-bit packed.
- **BayerRG8**: Bayer Red-Green 8-bit.
- **BGR10**: Blue-Green-Red 10-bit unpacked.
- **BGR10p**: Blue-Green-Red 10-bit packed.
- **BGR12**: Blue-Green-Red 12-bit unpacked.
- **BGR12p**: Blue-Green-Red 12-bit packed.
- **BGR14**: Blue-Green-Red 14-bit unpacked.
- **BGR16**: Blue-Green-Red 16-bit.
- **BGR565p**: Blue-Green-Red 5/6/5-bit packed.
- **BGR8**: Blue-Green-Red 8-bit.
- **BGR8a32**: BGR8a32.
- **BGRa10**: Blue-Green-Red-alpha 10-bit unpacked.
- **BGRa10p**: Blue-Green-Red-alpha 10-bit packed.
- **BGRa12**: Blue-Green-Red-alpha 12-bit unpacked.
- **BGRa12p**: Blue-Green-Red-alpha 12-bit packed.
- **BGRa14**: Blue-Green-Red-alpha 14-bit unpacked.
- **BGRa16**: Blue-Green-Red-alpha 16-bit.
- **BGRa8**: Blue-Green-Red-alpha 8-bit.
- **BiColorBGRG10**: Bi-color Blue/Green - Red/Green 10-bit unpacked.
- **BiColorBGRG10p**: Bi-color Blue/Green - Red/Green 10-bit packed.
- **BiColorBGRG12**: Bi-color Blue/Green - Red/Green 12-bit unpacked.
- **BiColorBGRG12p**: Bi-color Blue/Green - Red/Green 12-bit packed.
- **BiColorBGRG8**: Bi-color Blue/Green - Red/Green 8-bit.

- **BiColorRGBG10**: Bi-color Red/Green - Blue/Green 10-bit unpacked.
- **BiColorRGBG10p**: Bi-color Red/Green - Blue/Green 10-bit packed.
- **BiColorRGBG12**: Bi-color Red/Green - Blue/Green 12-bit unpacked.
- **BiColorRGBG12p**: Bi-color Red/Green - Blue/Green 12-bit packed.
- **BiColorRGBG8**: Bi-color Red/Green - Blue/Green 8-bit.
- **Confidence1**: Confidence 1-bit unpacked.
- **Confidence16**: Confidence 16-bit.
- **Confidence1p**: Confidence 1-bit packed.
- **Confidence32f**: Confidence 32-bit floating point.
- **Confidence8**: Confidence 8-bit.
- **Coord3D_A10p**: 3D coordinate A 10-bit packed.
- **Coord3D_A12p**: 3D coordinate A 12-bit packed.
- **Coord3D_A16**: 3D coordinate A 16-bit.
- **Coord3D_A32f**: 3D coordinate A 32-bit floating point.
- **Coord3D_A8**: 3D coordinate A 8-bit.
- **Coord3D_ABC10p**: 3D coordinate A-B-C 10-bit packed.
- **Coord3D_ABC10p_Planar**: 3D coordinate A-B-C 10-bit packed planar.
- **Coord3D_ABC12p**: 3D coordinate A-B-C 12-bit packed.
- **Coord3D_ABC12p_Planar**: 3D coordinate A-B-C 12-bit packed planar.
- **Coord3D_ABC16**: 3D coordinate A-B-C 16-bit.
- **Coord3D_ABC16_Planar**: 3D coordinate A-B-C 16-bit planar.
- **Coord3D_ABC32f**: 3D coordinate A-B-C 32-bit floating point.
- **Coord3D_ABC32f_Planar**: 3D coordinate A-B-C 32-bit floating point planar.
- **Coord3D_ABC8**: 3D coordinate A-B-C 8-bit.
- **Coord3D_ABC8_Planar**: 3D coordinate A-B-C 8-bit planar.
- **Coord3D_AC10p**: 3D coordinate A-C 10-bit packed.
- **Coord3D_AC10p_Planar**: 3D coordinate A-C 10-bit packed planar.
- **Coord3D_AC12p**: 3D coordinate A-C 12-bit packed.
- **Coord3D_AC12p_Planar**: 3D coordinate A-C 12-bit packed planar.
- **Coord3D_AC16**: 3D coordinate A-C 16-bit.
- **Coord3D_AC16_Planar**: 3D coordinate A-C 16-bit planar.
- **Coord3D_AC32f**: 3D coordinate A-C 32-bit floating point.
- **Coord3D_AC32f_Planar**: 3D coordinate A-C 32-bit floating point planar.
- **Coord3D_AC8**: 3D coordinate A-C 8-bit.
- **Coord3D_AC8_Planar**: 3D coordinate A-C 8-bit planar.
- **Coord3D_B10p**: 3D coordinate B 10-bit packed.

- **Coord3D_B12p**: 3D coordinate B 12-bit packed.
- **Coord3D_B16**: 3D coordinate B 16-bit.
- **Coord3D_B32f**: 3D coordinate B 32-bit floating point.
- **Coord3D_B8**: 3D coordinate B 8-bit.
- **Coord3D_C10p**: 3D coordinate C 10-bit packed.
- **Coord3D_C12p**: 3D coordinate C 12-bit packed.
- **Coord3D_C16**: 3D coordinate C 16-bit.
- **Coord3D_C32f**: 3D coordinate C 32-bit floating point.
- **Coord3D_C8**: 3D coordinate C 8-bit.
- **CustomBayerBG14**: CustomBayerBG14.
- **CustomBayerGB14**: CustomBayerGB14.
- **CustomBayerGR14**: CustomBayerGR14.
- **CustomBayerRG14**: CustomBayerRG14.
- **CustomJFIF**: CustomJFIF.
- **G10**: Green 10-bit.
- **G12**: Green 12-bit.
- **G16**: Green 16-bit.
- **G8**: Green 8-bit.
- **Mono10**: Monochrome 10-bit unpacked.
- **Mono10p**: Monochrome 10-bit packed.
- **Mono10Packed**: Monochrome 10-bit packed.
- **Mono12**: Monochrome 12-bit unpacked.
- **Mono12p**: Monochrome 12-bit packed.
- **Mono12Packed**: Monochrome 12-bit packed.
- **Mono14**: Monochrome 14-bit unpacked.
- **Mono14p**: Monochrome 14-bit packed.
- **Mono16**: Monochrome 16-bit.
- **Mono1p**: Monochrome 1-bit packed.
- **Mono2p**: Monochrome 2-bit packed.
- **Mono32**: Monochrome 32-bit.
- **Mono4p**: Monochrome 4-bit packed.
- **Mono8**: Monochrome 8-bit.
- **Mono8s**: Monochrome 8-bit signed.
- **R10**: Red 10-bit.
- **R12**: Red 12-bit.
- **R16**: Red 16-bit.

- **R8**: Red 8-bit.
- **RGB10**: Red-Green-Blue 10-bit unpacked.
- **RGB10_Planar**: Red-Green-Blue 10-bit unpacked planar.
- **RGB10p**: Red-Green-Blue 10-bit packed.
- **RGB10p32**: Red-Green-Blue 10-bit packed into 32-bit.
- **RGB10V1Packed**: Red-Green-Blue 10-bit packed - variant 1.
- **RGB12**: Red-Green-Blue 12-bit unpacked.
- **RGB12_Planar**: Red-Green-Blue 12-bit unpacked planar.
- **RGB12p**: Red-Green-Blue 12-bit packed.
- **RGB12V1Packed**: Red-Green-Blue 12-bit packed - variant 1.
- **RGB14**: Red-Green-Blue 14-bit unpacked.
- **RGB16**: Red-Green-Blue 16-bit.
- **RGB16_Planar**: Red-Green-Blue 16-bit planar.
- **RGB565p**: Red-Green-Blue 5/6/5-bit packed.
- **RGB8**: Red-Green-Blue 8-bit.
- **RGB8_Planar**: Red-Green-Blue 8-bit planar.
- **RGB8a32**: RGB8a32.
- **RGBa10**: Red-Green-Blue-alpha 10-bit unpacked.
- **RGBa10p**: Red-Green-Blue-alpha 10-bit packed.
- **RGBa12**: Red-Green-Blue-alpha 12-bit unpacked.
- **RGBa12p**: Red-Green-Blue-alpha 12-bit packed.
- **RGBa14**: Red-Green-Blue-alpha 14-bit unpacked.
- **RGBa16**: Red-Green-Blue-alpha 16-bit.
- **RGBa8**: Red-Green-Blue-alpha 8-bit.
- **SCF1WBWG10**: Sparse Color Filter #1 White-Blue-White-Green 10-bit unpacked.
- **SCF1WBWG10p**: Sparse Color Filter #1 White-Blue-White-Green 10-bit packed.
- **SCF1WBWG12**: Sparse Color Filter #1 White-Blue-White-Green 12-bit unpacked.
- **SCF1WBWG12p**: Sparse Color Filter #1 White-Blue-White-Green 12-bit packed.
- **SCF1WBWG14**: Sparse Color Filter #1 White-Blue-White-Green 14-bit unpacked.
- **SCF1WBWG16**: Sparse Color Filter #1 White-Blue-White-Green 16-bit unpacked.
- **SCF1WBWG8**: Sparse Color Filter #1 White-Blue-White-Green 8-bit.
- **SCF1GWGB10**: Sparse Color Filter #1 White-Green-White-Blue 10-bit unpacked.
- **SCF1GWGB10p**: Sparse Color Filter #1 White-Green-White-Blue 10-bit packed.
- **SCF1GWGB12**: Sparse Color Filter #1 White-Green-White-Blue 12-bit unpacked.
- **SCF1GWGB12p**: Sparse Color Filter #1 White-Green-White-Blue 12-bit packed.
- **SCF1GWGB14**: Sparse Color Filter #1 White-Green-White-Blue 14-bit unpacked.

- **SCF1WGW16**: Sparse Color Filter #1 White-Green-White-Blue 16-bit.
- **SCF1WGW8**: Sparse Color Filter #1 White-Green-White-Blue 8-bit.
- **SCF1WGWR10**: Sparse Color Filter #1 White-Green-White-Red 10-bit unpacked.
- **SCF1WGWR10p**: Sparse Color Filter #1 White-Green-White-Red 10-bit packed.
- **SCF1WGWR12**: Sparse Color Filter #1 White-Green-White-Red 12-bit unpacked.
- **SCF1WGWR12p**: Sparse Color Filter #1 White-Green-White-Red 12-bit packed.
- **SCF1WGWR14**: Sparse Color Filter #1 White-Green-White-Red 14-bit unpacked.
- **SCF1WGWR16**: Sparse Color Filter #1 White-Green-White-Red 16-bit.
- **SCF1WGW8**: Sparse Color Filter #1 White-Green-White-Red 8-bit.
- **SCF1WRWG10**: Sparse Color Filter #1 White-Red-White-Green 10-bit unpacked.
- **SCF1WRWG10p**: Sparse Color Filter #1 White-Red-White-Green 10-bit packed.
- **SCF1WRWG12**: Sparse Color Filter #1 White-Red-White-Green 12-bit unpacked.
- **SCF1WRWG12p**: Sparse Color Filter #1 White-Red-White-Green 12-bit packed.
- **SCF1WRWG14**: Sparse Color Filter #1 White-Red-White-Green 14-bit unpacked.
- **SCF1WRWG16**: Sparse Color Filter #1 White-Red-White-Green 16-bit.
- **SCF1WRWG8**: Sparse Color Filter #1 White-Red-White-Green 8-bit.
- **YCbCr10_CbYCr**: YCbCr 4:4:4 10-bit unpacked.
- **YCbCr10p_CbYCr**: YCbCr 4:4:4 10-bit packed.
- **YCbCr12_CbYCr**: YCbCr 4:4:4 12-bit unpacked.
- **YCbCr12p_CbYCr**: YCbCr 4:4:4 12-bit packed.
- **YCbCr2020_10_CbYCr**: YCbCr 4:4:4 10-bit unpacked BT.2020.
- **YCbCr2020_10p_CbYCr**: YCbCr 4:4:4 10-bit packed BT.2020.
- **YCbCr2020_12_CbYCr**: YCbCr 4:4:4 12-bit unpacked BT.2020.
- **YCbCr2020_12p_CbYCr**: YCbCr 4:4:4 12-bit packed BT.2020.
- **YCbCr2020_411_8_CbYCrYY**: YCbCr 4:1:1 8-bit BT.2020.
- **YCbCr2020_422_10**: YCbCr 4:2:2 10-bit unpacked BT.2020.
- **YCbCr2020_422_10_CbYCrY**: YCbCr 4:2:2 10-bit unpacked BT.2020.
- **YCbCr2020_422_10p**: YCbCr 4:2:2 10-bit packed BT.2020.
- **YCbCr2020_422_10p_CbYCrY**: YCbCr 4:2:2 10-bit packed BT.2020.
- **YCbCr2020_422_12**: YCbCr 4:2:2 12-bit unpacked BT.2020.
- **YCbCr2020_422_12_CbYCrY**: YCbCr 4:2:2 12-bit unpacked BT.2020.
- **YCbCr2020_422_12p**: YCbCr 4:2:2 12-bit packed BT.2020.
- **YCbCr2020_422_12p_CbYCrY**: YCbCr 4:2:2 12-bit packed BT.2020.
- **YCbCr2020_422_8**: YCbCr 4:2:2 8-bit BT.2020.
- **YCbCr2020_422_8_CbYCrY**: YCbCr 4:2:2 8-bit BT.2020.
- **YCbCr2020_8_CbYCr**: YCbCr 4:4:4 8-bit BT.2020.

- **YCbCr411_8**: YCbCr 4:1:1 8-bit.
- **YCbCr411_8_CbYYCrYY**: YCbCr 4:1:1 8-bit.
- **YCbCr420_8_YY_CbCr_Semiplanar**: YCbCr 4:2:0 8-bit YY/CbCr Semiplanar.
- **YCbCr420_8_YY_CrCb_Semiplanar**: YCbCr 4:2:0 8-bit YY/CrCb Semiplanar.
- **YCbCr422_10**: YCbCr 4:2:2 10-bit unpacked.
- **YCbCr422_10_CbYCrY**: YCbCr 4:2:2 10-bit unpacked.
- **YCbCr422_10p**: YCbCr 4:2:2 10-bit packed.
- **YCbCr422_10p_CbYCrY**: YCbCr 4:2:2 10-bit packed.
- **YCbCr422_12**: YCbCr 4:2:2 12-bit unpacked.
- **YCbCr422_12_CbYCrY**: YCbCr 4:2:2 12-bit unpacked.
- **YCbCr422_12p**: YCbCr 4:2:2 12-bit packed.
- **YCbCr422_12p_CbYCrY**: YCbCr 4:2:2 12-bit packed.
- **YCbCr422_8**: YCbCr 4:2:2 8-bit.
- **YCbCr422_8_CbYCrY**: YCbCr 4:2:2 8-bit.
- **YCbCr422_8_YY_CbCr_Semiplanar**: YCbCr 4:2:2 8-bit YY/CbCr Semiplanar.
- **YCbCr422_8_YY_CrCb_Semiplanar**: YCbCr 4:2:2 8-bit YY/CrCb Semiplanar.
- **YCbCr601_10_CbYCr**: YCbCr 4:4:4 10-bit unpacked BT.601.
- **YCbCr601_10p_CbYCr**: YCbCr 4:4:4 10-bit packed BT.601.
- **YCbCr601_12_CbYCr**: YCbCr 4:4:4 12-bit unpacked BT.601.
- **YCbCr601_12p_CbYCr**: YCbCr 4:4:4 12-bit packed BT.601.
- **YCbCr601_411_8_CbYYCrYY**: YCbCr 4:1:1 8-bit BT.601.
- **YCbCr601_422_10**: YCbCr 4:2:2 10-bit unpacked BT.601.
- **YCbCr601_422_10_CbYCrY**: YCbCr 4:2:2 10-bit unpacked BT.601.
- **YCbCr601_422_10p**: YCbCr 4:2:2 10-bit packed BT.601.
- **YCbCr601_422_10p_CbYCrY**: YCbCr 4:2:2 10-bit packed BT.601.
- **YCbCr601_422_12**: YCbCr 4:2:2 12-bit unpacked BT.601.
- **YCbCr601_422_12_CbYCrY**: YCbCr 4:2:2 12-bit unpacked BT.601.
- **YCbCr601_422_12p**: YCbCr 4:2:2 12-bit packed BT.601.
- **YCbCr601_422_12p_CbYCrY**: YCbCr 4:2:2 12-bit packed BT.601.
- **YCbCr601_422_8**: YCbCr 4:2:2 8-bit BT.601.
- **YCbCr601_422_8_CbYCrY**: YCbCr 4:2:2 8-bit BT.601.
- **YCbCr601_8_CbYCr**: YCbCr 4:4:4 8-bit BT.601.
- **YCbCr709_10_CbYCr**: YCbCr 4:4:4 10-bit unpacked BT.709.
- **YCbCr709_10p_CbYCr**: YCbCr 4:4:4 10-bit packed BT.709.
- **YCbCr709_12_CbYCr**: YCbCr 4:4:4 12-bit unpacked BT.709.
- **YCbCr709_12p_CbYCr**: YCbCr 4:4:4 12-bit packed BT.709.

- `YCbCr709_411_8_CbYCrY`: YCbCr 4:1:1 8-bit BT.709.
- `YCbCr709_422_10`: YCbCr 4:2:2 10-bit unpacked BT.709.
- `YCbCr709_422_10_CbYCrY`: YCbCr 4:2:2 10-bit unpacked BT.709.
- `YCbCr709_422_10p`: YCbCr 4:2:2 10-bit packed BT.709.
- `YCbCr709_422_10p_CbYCrY`: YCbCr 4:2:2 10-bit packed BT.709.
- `YCbCr709_422_12`: YCbCr 4:2:2 12-bit unpacked BT.709.
- `YCbCr709_422_12_CbYCrY`: YCbCr 4:2:2 12-bit unpacked BT.709.
- `YCbCr709_422_12p`: YCbCr 4:2:2 12-bit packed BT.709.
- `YCbCr709_422_12p_CbYCrY`: YCbCr 4:2:2 12-bit packed BT.709.
- `YCbCr709_422_8`: YCbCr 4:2:2 8-bit BT.709.
- `YCbCr709_422_8_CbYCrY`: YCbCr 4:2:2 8-bit BT.709.
- `YCbCr709_8_CbYCr`: YCbCr 4:4:4 8-bit BT.709.
- `YCbCr8`: YCbCr 4:4:4 8-bit.
- `YCbCr8_CbYCr`: YCbCr 4:4:4 8-bit.
- `YUV411_8_UYVYY`: YUV 4:1:1 8-bit.
- `YUV422_8`: YUV 4:2:2 8-bit.
- `YUV422_8_UYVY`: YUV 4:2:2 8-bit.
- `YUV422Packed`: YUV422Packed.
- `YUV8_UYV`: YUV 4:4:4 8-bit.

PixelFormatNamespace

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Enumeration	Imposed: RO

[Short Description](#)

Namespace of the pixel format.

[Enumeration Values](#)

- **Unknown**: Unknown.
- **GEV**: GEV.
- **IIDC**: IIDC.
- **PFNC_16BIT**: PFNC 16-bit.
- **PFNC_32BIT**: PFNC 32-bit.

PixelSize

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	IntReg	RO

Register Port: StreamPort

[Short Description](#)

Pixel size in bits.

PixelComponentCount

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	IntReg	RO

Register Port: StreamPort

[Short Description](#)

Number of components per pixel.

Width

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Integer	Imposed: RO

[Short Description](#)

Width of the image.

Height

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Integer	Imposed: RO

[Short Description](#)

Height of the image.

ImageFormatSource

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Enumeration	RW

[Short Description](#)

Source of remote device image format.

[Enumeration Values](#)

- **RemoteDevice**: Remote device (PixelFormat, Width, Height).
- **DataStream**: Data stream (RemotePixelFormat, RemoteWidth, RemoteHeight).

RemotePixelFormat

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Enumeration	RW

[Short Description](#)

Pixel format of the remote device image.

[Enumeration Values](#)

- **BayerBG10pmsb**: BayerBG10pmsb.
- **BayerBG12pmsb**: BayerBG12pmsb.
- **BayerBG14pmsb**: BayerBG14pmsb.
- **BayerGB10pmsb**: BayerGB10pmsb.
- **BayerGB12pmsb**: BayerGB12pmsb.
- **BayerGB14pmsb**: BayerGB14pmsb.
- **BayerGR10pmsb**: BayerGR10pmsb.
- **BayerGR12pmsb**: BayerGR12pmsb.
- **BayerGR14pmsb**: BayerGR14pmsb.
- **BayerRG10pmsb**: BayerRG10pmsb.
- **BayerRG12pmsb**: BayerRG12pmsb.
- **BayerRG14pmsb**: BayerRG14pmsb.
- **Mono10pmsb**: Mono10pmsb.
- **Mono12pmsb**: Mono12pmsb.
- **Mono14pmsb**: Mono14pmsb.
- **RGB10pmsb**: RGB10pmsb.
- **RGB12pmsb**: RGB12pmsb.
- **RGB14pmsb**: RGB14pmsb.
- **RGBa10pmsb**: RGBa10pmsb.
- **RGBa12pmsb**: RGBa12pmsb.
- **RGBa14pmsb**: RGBa14pmsb.
- **YCbCr601_10pmsb**: YCbCr601_10pmsb.
- **YCbCr601_12pmsb**: YCbCr601_12pmsb.
- **YCbCr601_14pmsb**: YCbCr601_14pmsb.

- **YCbCr601_16**: YCbCr601_16.
- **YCbCr601_411_10pmsb**: YCbCr601_411_10pmsb.
- **YCbCr601_411_12pmsb**: YCbCr601_411_12pmsb.
- **YCbCr601_411_14pmsb**: YCbCr601_411_14pmsb.
- **YCbCr601_411_16**: YCbCr601_411_16.
- **YCbCr601_411_8**: YCbCr601_411_8.
- **YCbCr601_422_10pmsb**: YCbCr601_422_10pmsb.
- **YCbCr601_422_12pmsb**: YCbCr601_422_12pmsb.
- **YCbCr601_422_14pmsb**: YCbCr601_422_14pmsb.
- **YCbCr601_422_16**: YCbCr601_422_16.
- **YCbCr601_8**: YCbCr601_8.
- **YCbCr709_10pmsb**: YCbCr709_10pmsb.
- **YCbCr709_12pmsb**: YCbCr709_12pmsb.
- **YCbCr709_14pmsb**: YCbCr709_14pmsb.
- **YCbCr709_16**: YCbCr709_16.
- **YCbCr709_411_10pmsb**: YCbCr709_411_10pmsb.
- **YCbCr709_411_12pmsb**: YCbCr709_411_12pmsb.
- **YCbCr709_411_14pmsb**: YCbCr709_411_14pmsb.
- **YCbCr709_411_16**: YCbCr709_411_16.
- **YCbCr709_411_8**: YCbCr709_411_8.
- **YCbCr709_422_10pmsb**: YCbCr709_422_10pmsb.
- **YCbCr709_422_12pmsb**: YCbCr709_422_12pmsb.
- **YCbCr709_422_14pmsb**: YCbCr709_422_14pmsb.
- **YCbCr709_422_16**: YCbCr709_422_16.
- **YCbCr709_8**: YCbCr709_8.
- **YUV10pmsb**: YUV10pmsb.
- **YUV12pmsb**: YUV12pmsb.
- **YUV14pmsb**: YUV14pmsb.
- **YUV16**: YUV16.
- **YUV411_10pmsb**: YUV411_10pmsb.
- **YUV411_12pmsb**: YUV411_12pmsb.
- **YUV411_14pmsb**: YUV411_14pmsb.
- **YUV411_16**: YUV411_16.
- **YUV411_8**: YUV411_8.
- **YUV422_10pmsb**: YUV422_10pmsb.
- **YUV422_12pmsb**: YUV422_12pmsb.

- **YUV422_14pmsb**: YUV422_14pmsb.
- **YUV422_16**: YUV422_16.
- **YUV8**: YUV8.
- **B10**: Blue 10-bit.
- **B12**: Blue 12-bit.
- **B16**: Blue 16-bit.
- **B8**: Blue 8-bit.
- **BayerBG10**: Bayer Blue-Green 10-bit unpacked.
- **BayerBG10p**: Bayer Blue-Green 10-bit packed.
- **BayerBG10Packed**: Bayer Blue-Green 10-bit packed.
- **BayerBG12**: Bayer Blue-Green 12-bit unpacked.
- **BayerBG12p**: Bayer Blue-Green 12-bit packed.
- **BayerBG12Packed**: Bayer Blue-Green 12-bit packed.
- **BayerBG14**: Bayer Blue-Green 14-bit.
- **BayerBG14p**: Bayer Blue-Green 14-bit packed.
- **BayerBG16**: Bayer Blue-Green 16-bit.
- **BayerBG4p**: Bayer Blue-Green 4-bit packed.
- **BayerBG8**: Bayer Blue-Green 8-bit.
- **BayerGB10**: Bayer Green-Blue 10-bit unpacked.
- **BayerGB10p**: Bayer Green-Blue 10-bit packed.
- **BayerGB10Packed**: Bayer Green-Blue 10-bit packed.
- **BayerGB12**: Bayer Green-Blue 12-bit unpacked.
- **BayerGB12p**: Bayer Green-Blue 12-bit packed.
- **BayerGB12Packed**: Bayer Green-Blue 12-bit packed.
- **BayerGB14**: Bayer Green-Blue 14-bit.
- **BayerGB14p**: Bayer Green-Blue 14-bit packed.
- **BayerGB16**: Bayer Green-Blue 16-bit.
- **BayerGB4p**: Bayer Green-Blue 4-bit packed.
- **BayerGB8**: Bayer Green-Blue 8-bit.
- **BayerGR10**: Bayer Green-Red 10-bit unpacked.
- **BayerGR10p**: Bayer Green-Red 10-bit packed.
- **BayerGR10Packed**: Bayer Green-Red 10-bit packed.
- **BayerGR12**: Bayer Green-Red 12-bit unpacked.
- **BayerGR12p**: Bayer Green-Red 12-bit packed.
- **BayerGR12Packed**: Bayer Green-Red 12-bit packed.
- **BayerGR14**: Bayer Green-Red 14-bit.

- **BayerGR14p**: Bayer Green-Red 14-bit packed.
- **BayerGR16**: Bayer Green-Red 16-bit.
- **BayerGR4p**: Bayer Green-Red 4-bit packed.
- **BayerGR8**: Bayer Green-Red 8-bit.
- **BayerRG10**: Bayer Red-Green 10-bit unpacked.
- **BayerRG10p**: Bayer Red-Green 10-bit packed.
- **BayerRG10Packed**: Bayer Red-Green 10-bit packed.
- **BayerRG12**: Bayer Red-Green 12-bit unpacked.
- **BayerRG12p**: Bayer Red-Green 12-bit packed.
- **BayerRG12Packed**: Bayer Red-Green 12-bit packed.
- **BayerRG14**: Bayer Red-Green 14-bit.
- **BayerRG14p**: Bayer Red-Green 14-bit packed.
- **BayerRG16**: Bayer Red-Green 16-bit.
- **BayerRG4p**: Bayer Red-Green 4-bit packed.
- **BayerRG8**: Bayer Red-Green 8-bit.
- **BGR10**: Blue-Green-Red 10-bit unpacked.
- **BGR10p**: Blue-Green-Red 10-bit packed.
- **BGR12**: Blue-Green-Red 12-bit unpacked.
- **BGR12p**: Blue-Green-Red 12-bit packed.
- **BGR14**: Blue-Green-Red 14-bit unpacked.
- **BGR16**: Blue-Green-Red 16-bit.
- **BGR565p**: Blue-Green-Red 5/6/5-bit packed.
- **BGR8**: Blue-Green-Red 8-bit.
- **BGR8a32**: BGR8a32.
- **BGRa10**: Blue-Green-Red-alpha 10-bit unpacked.
- **BGRa10p**: Blue-Green-Red-alpha 10-bit packed.
- **BGRa12**: Blue-Green-Red-alpha 12-bit unpacked.
- **BGRa12p**: Blue-Green-Red-alpha 12-bit packed.
- **BGRa14**: Blue-Green-Red-alpha 14-bit unpacked.
- **BGRa16**: Blue-Green-Red-alpha 16-bit.
- **BGRa8**: Blue-Green-Red-alpha 8-bit.
- **BiColorBGRG10**: Bi-color Blue/Green - Red/Green 10-bit unpacked.
- **BiColorBGRG10p**: Bi-color Blue/Green - Red/Green 10-bit packed.
- **BiColorBGRG12**: Bi-color Blue/Green - Red/Green 12-bit unpacked.
- **BiColorBGRG12p**: Bi-color Blue/Green - Red/Green 12-bit packed.
- **BiColorBGRG8**: Bi-color Blue/Green - Red/Green 8-bit.

- **BiColorRGBG10**: Bi-color Red/Green - Blue/Green 10-bit unpacked.
- **BiColorRGBG10p**: Bi-color Red/Green - Blue/Green 10-bit packed.
- **BiColorRGBG12**: Bi-color Red/Green - Blue/Green 12-bit unpacked.
- **BiColorRGBG12p**: Bi-color Red/Green - Blue/Green 12-bit packed.
- **BiColorRGBG8**: Bi-color Red/Green - Blue/Green 8-bit.
- **Confidence1**: Confidence 1-bit unpacked.
- **Confidence16**: Confidence 16-bit.
- **Confidence1p**: Confidence 1-bit packed.
- **Confidence32f**: Confidence 32-bit floating point.
- **Confidence8**: Confidence 8-bit.
- **Coord3D_A10p**: 3D coordinate A 10-bit packed.
- **Coord3D_A12p**: 3D coordinate A 12-bit packed.
- **Coord3D_A16**: 3D coordinate A 16-bit.
- **Coord3D_A32f**: 3D coordinate A 32-bit floating point.
- **Coord3D_A8**: 3D coordinate A 8-bit.
- **Coord3D_ABC10p**: 3D coordinate A-B-C 10-bit packed.
- **Coord3D_ABC10p_Planar**: 3D coordinate A-B-C 10-bit packed planar.
- **Coord3D_ABC12p**: 3D coordinate A-B-C 12-bit packed.
- **Coord3D_ABC12p_Planar**: 3D coordinate A-B-C 12-bit packed planar.
- **Coord3D_ABC16**: 3D coordinate A-B-C 16-bit.
- **Coord3D_ABC16_Planar**: 3D coordinate A-B-C 16-bit planar.
- **Coord3D_ABC32f**: 3D coordinate A-B-C 32-bit floating point.
- **Coord3D_ABC32f_Planar**: 3D coordinate A-B-C 32-bit floating point planar.
- **Coord3D_ABC8**: 3D coordinate A-B-C 8-bit.
- **Coord3D_ABC8_Planar**: 3D coordinate A-B-C 8-bit planar.
- **Coord3D_AC10p**: 3D coordinate A-C 10-bit packed.
- **Coord3D_AC10p_Planar**: 3D coordinate A-C 10-bit packed planar.
- **Coord3D_AC12p**: 3D coordinate A-C 12-bit packed.
- **Coord3D_AC12p_Planar**: 3D coordinate A-C 12-bit packed planar.
- **Coord3D_AC16**: 3D coordinate A-C 16-bit.
- **Coord3D_AC16_Planar**: 3D coordinate A-C 16-bit planar.
- **Coord3D_AC32f**: 3D coordinate A-C 32-bit floating point.
- **Coord3D_AC32f_Planar**: 3D coordinate A-C 32-bit floating point planar.
- **Coord3D_AC8**: 3D coordinate A-C 8-bit.
- **Coord3D_AC8_Planar**: 3D coordinate A-C 8-bit planar.
- **Coord3D_B10p**: 3D coordinate B 10-bit packed.

- **Coord3D_B12p**: 3D coordinate B 12-bit packed.
- **Coord3D_B16**: 3D coordinate B 16-bit.
- **Coord3D_B32f**: 3D coordinate B 32-bit floating point.
- **Coord3D_B8**: 3D coordinate B 8-bit.
- **Coord3D_C10p**: 3D coordinate C 10-bit packed.
- **Coord3D_C12p**: 3D coordinate C 12-bit packed.
- **Coord3D_C16**: 3D coordinate C 16-bit.
- **Coord3D_C32f**: 3D coordinate C 32-bit floating point.
- **Coord3D_C8**: 3D coordinate C 8-bit.
- **CustomBayerBG14**: CustomBayerBG14.
- **CustomBayerGB14**: CustomBayerGB14.
- **CustomBayerGR14**: CustomBayerGR14.
- **CustomBayerRG14**: CustomBayerRG14.
- **CustomJFIF**: CustomJFIF.
- **G10**: Green 10-bit.
- **G12**: Green 12-bit.
- **G16**: Green 16-bit.
- **G8**: Green 8-bit.
- **Mono10**: Monochrome 10-bit unpacked.
- **Mono10p**: Monochrome 10-bit packed.
- **Mono10Packed**: Monochrome 10-bit packed.
- **Mono12**: Monochrome 12-bit unpacked.
- **Mono12p**: Monochrome 12-bit packed.
- **Mono12Packed**: Monochrome 12-bit packed.
- **Mono14**: Monochrome 14-bit unpacked.
- **Mono14p**: Monochrome 14-bit packed.
- **Mono16**: Monochrome 16-bit.
- **Mono1p**: Monochrome 1-bit packed.
- **Mono2p**: Monochrome 2-bit packed.
- **Mono32**: Monochrome 32-bit.
- **Mono4p**: Monochrome 4-bit packed.
- **Mono8**: Monochrome 8-bit.
- **Mono8s**: Monochrome 8-bit signed.
- **R10**: Red 10-bit.
- **R12**: Red 12-bit.
- **R16**: Red 16-bit.

- **R8**: Red 8-bit.
- **RGB10**: Red-Green-Blue 10-bit unpacked.
- **RGB10_Planar**: Red-Green-Blue 10-bit unpacked planar.
- **RGB10p**: Red-Green-Blue 10-bit packed.
- **RGB10p32**: Red-Green-Blue 10-bit packed into 32-bit.
- **RGB10V1Packed**: Red-Green-Blue 10-bit packed - variant 1.
- **RGB12**: Red-Green-Blue 12-bit unpacked.
- **RGB12_Planar**: Red-Green-Blue 12-bit unpacked planar.
- **RGB12p**: Red-Green-Blue 12-bit packed.
- **RGB12V1Packed**: Red-Green-Blue 12-bit packed - variant 1.
- **RGB14**: Red-Green-Blue 14-bit unpacked.
- **RGB16**: Red-Green-Blue 16-bit.
- **RGB16_Planar**: Red-Green-Blue 16-bit planar.
- **RGB565p**: Red-Green-Blue 5/6/5-bit packed.
- **RGB8**: Red-Green-Blue 8-bit.
- **RGB8_Planar**: Red-Green-Blue 8-bit planar.
- **RGB8a32**: RGB8a32.
- **RGBa10**: Red-Green-Blue-alpha 10-bit unpacked.
- **RGBa10p**: Red-Green-Blue-alpha 10-bit packed.
- **RGBa12**: Red-Green-Blue-alpha 12-bit unpacked.
- **RGBa12p**: Red-Green-Blue-alpha 12-bit packed.
- **RGBa14**: Red-Green-Blue-alpha 14-bit unpacked.
- **RGBa16**: Red-Green-Blue-alpha 16-bit.
- **RGBa8**: Red-Green-Blue-alpha 8-bit.
- **SCF1WBWG10**: Sparse Color Filter #1 White-Blue-White-Green 10-bit unpacked.
- **SCF1WBWG10p**: Sparse Color Filter #1 White-Blue-White-Green 10-bit packed.
- **SCF1WBWG12**: Sparse Color Filter #1 White-Blue-White-Green 12-bit unpacked.
- **SCF1WBWG12p**: Sparse Color Filter #1 White-Blue-White-Green 12-bit packed.
- **SCF1WBWG14**: Sparse Color Filter #1 White-Blue-White-Green 14-bit unpacked.
- **SCF1WBWG16**: Sparse Color Filter #1 White-Blue-White-Green 16-bit unpacked.
- **SCF1WBWG8**: Sparse Color Filter #1 White-Blue-White-Green 8-bit.
- **SCF1GWGB10**: Sparse Color Filter #1 White-Green-White-Blue 10-bit unpacked.
- **SCF1GWGB10p**: Sparse Color Filter #1 White-Green-White-Blue 10-bit packed.
- **SCF1GWGB12**: Sparse Color Filter #1 White-Green-White-Blue 12-bit unpacked.
- **SCF1GWGB12p**: Sparse Color Filter #1 White-Green-White-Blue 12-bit packed.
- **SCF1GWGB14**: Sparse Color Filter #1 White-Green-White-Blue 14-bit unpacked.

- **SCF1WGW16**: Sparse Color Filter #1 White-Green-White-Blue 16-bit.
- **SCF1WGW8**: Sparse Color Filter #1 White-Green-White-Blue 8-bit.
- **SCF1WGWR10**: Sparse Color Filter #1 White-Green-White-Red 10-bit unpacked.
- **SCF1WGWR10p**: Sparse Color Filter #1 White-Green-White-Red 10-bit packed.
- **SCF1WGWR12**: Sparse Color Filter #1 White-Green-White-Red 12-bit unpacked.
- **SCF1WGWR12p**: Sparse Color Filter #1 White-Green-White-Red 12-bit packed.
- **SCF1WGWR14**: Sparse Color Filter #1 White-Green-White-Red 14-bit unpacked.
- **SCF1WGWR16**: Sparse Color Filter #1 White-Green-White-Red 16-bit.
- **SCF1WGW8**: Sparse Color Filter #1 White-Green-White-Red 8-bit.
- **SCF1WRWG10**: Sparse Color Filter #1 White-Red-White-Green 10-bit unpacked.
- **SCF1WRWG10p**: Sparse Color Filter #1 White-Red-White-Green 10-bit packed.
- **SCF1WRWG12**: Sparse Color Filter #1 White-Red-White-Green 12-bit unpacked.
- **SCF1WRWG12p**: Sparse Color Filter #1 White-Red-White-Green 12-bit packed.
- **SCF1WRWG14**: Sparse Color Filter #1 White-Red-White-Green 14-bit unpacked.
- **SCF1WRWG16**: Sparse Color Filter #1 White-Red-White-Green 16-bit.
- **SCF1WRWG8**: Sparse Color Filter #1 White-Red-White-Green 8-bit.
- **YCbCr10_CbYCr**: YCbCr 4:4:4 10-bit unpacked.
- **YCbCr10p_CbYCr**: YCbCr 4:4:4 10-bit packed.
- **YCbCr12_CbYCr**: YCbCr 4:4:4 12-bit unpacked.
- **YCbCr12p_CbYCr**: YCbCr 4:4:4 12-bit packed.
- **YCbCr2020_10_CbYCr**: YCbCr 4:4:4 10-bit unpacked BT.2020.
- **YCbCr2020_10p_CbYCr**: YCbCr 4:4:4 10-bit packed BT.2020.
- **YCbCr2020_12_CbYCr**: YCbCr 4:4:4 12-bit unpacked BT.2020.
- **YCbCr2020_12p_CbYCr**: YCbCr 4:4:4 12-bit packed BT.2020.
- **YCbCr2020_411_8_CbYCrYY**: YCbCr 4:1:1 8-bit BT.2020.
- **YCbCr2020_422_10**: YCbCr 4:2:2 10-bit unpacked BT.2020.
- **YCbCr2020_422_10_CbYCrY**: YCbCr 4:2:2 10-bit unpacked BT.2020.
- **YCbCr2020_422_10p**: YCbCr 4:2:2 10-bit packed BT.2020.
- **YCbCr2020_422_10p_CbYCrY**: YCbCr 4:2:2 10-bit packed BT.2020.
- **YCbCr2020_422_12**: YCbCr 4:2:2 12-bit unpacked BT.2020.
- **YCbCr2020_422_12_CbYCrY**: YCbCr 4:2:2 12-bit unpacked BT.2020.
- **YCbCr2020_422_12p**: YCbCr 4:2:2 12-bit packed BT.2020.
- **YCbCr2020_422_12p_CbYCrY**: YCbCr 4:2:2 12-bit packed BT.2020.
- **YCbCr2020_422_8**: YCbCr 4:2:2 8-bit BT.2020.
- **YCbCr2020_422_8_CbYCrY**: YCbCr 4:2:2 8-bit BT.2020.
- **YCbCr2020_8_CbYCr**: YCbCr 4:4:4 8-bit BT.2020.

- **YCbCr411_8**: YCbCr 4:1:1 8-bit.
- **YCbCr411_8_CbYYCrYY**: YCbCr 4:1:1 8-bit.
- **YCbCr420_8_YY_CbCr_Semiplanar**: YCbCr 4:2:0 8-bit YY/CbCr Semiplanar.
- **YCbCr420_8_YY_CrCb_Semiplanar**: YCbCr 4:2:0 8-bit YY/CrCb Semiplanar.
- **YCbCr422_10**: YCbCr 4:2:2 10-bit unpacked.
- **YCbCr422_10_CbYCrY**: YCbCr 4:2:2 10-bit unpacked.
- **YCbCr422_10p**: YCbCr 4:2:2 10-bit packed.
- **YCbCr422_10p_CbYCrY**: YCbCr 4:2:2 10-bit packed.
- **YCbCr422_12**: YCbCr 4:2:2 12-bit unpacked.
- **YCbCr422_12_CbYCrY**: YCbCr 4:2:2 12-bit unpacked.
- **YCbCr422_12p**: YCbCr 4:2:2 12-bit packed.
- **YCbCr422_12p_CbYCrY**: YCbCr 4:2:2 12-bit packed.
- **YCbCr422_8**: YCbCr 4:2:2 8-bit.
- **YCbCr422_8_CbYCrY**: YCbCr 4:2:2 8-bit.
- **YCbCr422_8_YY_CbCr_Semiplanar**: YCbCr 4:2:2 8-bit YY/CbCr Semiplanar.
- **YCbCr422_8_YY_CrCb_Semiplanar**: YCbCr 4:2:2 8-bit YY/CrCb Semiplanar.
- **YCbCr601_10_CbYCr**: YCbCr 4:4:4 10-bit unpacked BT.601.
- **YCbCr601_10p_CbYCr**: YCbCr 4:4:4 10-bit packed BT.601.
- **YCbCr601_12_CbYCr**: YCbCr 4:4:4 12-bit unpacked BT.601.
- **YCbCr601_12p_CbYCr**: YCbCr 4:4:4 12-bit packed BT.601.
- **YCbCr601_411_8_CbYYCrYY**: YCbCr 4:1:1 8-bit BT.601.
- **YCbCr601_422_10**: YCbCr 4:2:2 10-bit unpacked BT.601.
- **YCbCr601_422_10_CbYCrY**: YCbCr 4:2:2 10-bit unpacked BT.601.
- **YCbCr601_422_10p**: YCbCr 4:2:2 10-bit packed BT.601.
- **YCbCr601_422_10p_CbYCrY**: YCbCr 4:2:2 10-bit packed BT.601.
- **YCbCr601_422_12**: YCbCr 4:2:2 12-bit unpacked BT.601.
- **YCbCr601_422_12_CbYCrY**: YCbCr 4:2:2 12-bit unpacked BT.601.
- **YCbCr601_422_12p**: YCbCr 4:2:2 12-bit packed BT.601.
- **YCbCr601_422_12p_CbYCrY**: YCbCr 4:2:2 12-bit packed BT.601.
- **YCbCr601_422_8**: YCbCr 4:2:2 8-bit BT.601.
- **YCbCr601_422_8_CbYCrY**: YCbCr 4:2:2 8-bit BT.601.
- **YCbCr601_8_CbYCr**: YCbCr 4:4:4 8-bit BT.601.
- **YCbCr709_10_CbYCr**: YCbCr 4:4:4 10-bit unpacked BT.709.
- **YCbCr709_10p_CbYCr**: YCbCr 4:4:4 10-bit packed BT.709.
- **YCbCr709_12_CbYCr**: YCbCr 4:4:4 12-bit unpacked BT.709.
- **YCbCr709_12p_CbYCr**: YCbCr 4:4:4 12-bit packed BT.709.

- `YCbCr709_411_8_CbYCrY`: YCbCr 4:1:1 8-bit BT.709.
- `YCbCr709_422_10`: YCbCr 4:2:2 10-bit unpacked BT.709.
- `YCbCr709_422_10_CbYCrY`: YCbCr 4:2:2 10-bit unpacked BT.709.
- `YCbCr709_422_10p`: YCbCr 4:2:2 10-bit packed BT.709.
- `YCbCr709_422_10p_CbYCrY`: YCbCr 4:2:2 10-bit packed BT.709.
- `YCbCr709_422_12`: YCbCr 4:2:2 12-bit unpacked BT.709.
- `YCbCr709_422_12_CbYCrY`: YCbCr 4:2:2 12-bit unpacked BT.709.
- `YCbCr709_422_12p`: YCbCr 4:2:2 12-bit packed BT.709.
- `YCbCr709_422_12p_CbYCrY`: YCbCr 4:2:2 12-bit packed BT.709.
- `YCbCr709_422_8`: YCbCr 4:2:2 8-bit BT.709.
- `YCbCr709_422_8_CbYCrY`: YCbCr 4:2:2 8-bit BT.709.
- `YCbCr709_8_CbYCr`: YCbCr 4:4:4 8-bit BT.709.
- `YCbCr8`: YCbCr 4:4:4 8-bit.
- `YCbCr8_CbYCr`: YCbCr 4:4:4 8-bit.
- `YUV411_8_UYVYY`: YUV 4:1:1 8-bit.
- `YUV422_8`: YUV 4:2:2 8-bit.
- `YUV422_8_UYVY`: YUV 4:2:2 8-bit.
- `YUV422Packed`: YUV422Packed.
- `YUV8_UYV`: YUV 4:4:4 8-bit.

RemoteWidth

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

Width of the remote device image.

RemoteHeight

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

Height of the remote device image.

ReverseX

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → ImageFormatControl	Boolean	RW

[Short Description](#)

Flip horizontally the image sent by the device.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

4.4. TransportLayerControl Category

PayloadSize	793
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PayloadSize

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → TransportLayerControl	Integer	Imposed: RO

[Short Description](#)

Expected size of buffers for the data stream. This depends on the camera resolution, onboard pixel processing (e.g., UnpackingMode, BayerMethod), padding (LinePitch, StripePitch). Also depends on BufferPartCount (area-scan firmware variants) and BufferHeight (line-scan firmware variants).

4.5. BufferHandlingControl Category

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StreamAnnouncedBufferCount

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Integer	Imposed: RO

[Short Description](#)

Number of announced buffers on the stream.

StreamBufferHandlingMode

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Enumeration	RW

[Short Description](#)

Available buffer handling modes of this Stream.

[Enumeration Values](#)

- **Default:** Default Buffer Handling Mode.

StreamAnnounceBufferMinimum

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Integer	Imposed: RO

[Short Description](#)

Minimal number of buffers to announce to enable selected buffer handling mode.

StreamAcquisitionModeSelector

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Enumeration	RW

[Short Description](#)

Available buffer handling modes of this Stream. Deprecated.

[Enumeration Values](#)

- **Default:** Default Buffer Handling Mode.

BufferAllocationAlignmentControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Enumeration	RW

[Short Description](#)

Buffer Allocation Alignment Control.

[Enumeration Values](#)

- **Disable**: Disable aligned buffer allocation.
- **Enable**: Enable aligned buffer allocation.

BufferAllocationAlignment

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

Alignment of buffers allocated by DSAllocAndAnnounceBuffer, should be a power of 2.

BufferFilledRule

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Enumeration	RW

[Short Description](#)

Rule for handling remaining data when a buffer is full.

[Enumeration Values](#)

- **DiscardRemainingData**: Discard remaining acquired data.
- **ContinueInNextBuffer**: Continue acquisition in next buffer.

BufferInfoSource

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Enumeration	RW

[Short Description](#)

Source of buffer info.

[Enumeration Values](#)

- **ImageHeader**: Remote device image header (PixelFormat, Width, Height).
- **DataStream**: Data stream (BufferInfoPixelFormat, BufferInfoWidth, BufferInfoHeight).

BufferInfoWidth

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

Imposed width.

BufferInfoHeight

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Imposed height.

BufferInfoPixelFormat

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → BufferHandlingControl	Enumeration	RW

[Short Description](#)

Imposed pixel format.

[Enumeration Values](#)

- **BayerBG10pmsb**: BayerBG10pmsb.
- **BayerBG12pmsb**: BayerBG12pmsb.
- **BayerBG14pmsb**: BayerBG14pmsb.
- **BayerBG16**: BayerBG16.
- **BayerBG8**: BayerBG8.
- **BayerGB10pmsb**: BayerGB10pmsb.
- **BayerGB12pmsb**: BayerGB12pmsb.
- **BayerGB14pmsb**: BayerGB14pmsb.
- **BayerGB16**: BayerGB16.
- **BayerGB8**: BayerGB8.
- **BayerGR10pmsb**: BayerGR10pmsb.
- **BayerGR12pmsb**: BayerGR12pmsb.
- **BayerGR14pmsb**: BayerGR14pmsb.
- **BayerGR16**: BayerGR16.
- **BayerGR8**: BayerGR8.
- **BayerRG10pmsb**: BayerRG10pmsb.
- **BayerRG12pmsb**: BayerRG12pmsb.
- **BayerRG14pmsb**: BayerRG14pmsb.
- **BayerRG16**: BayerRG16.
- **BayerRG8**: BayerRG8.
- **Mono10pmsb**: Mono10pmsb.
- **Mono12pmsb**: Mono12pmsb.
- **Mono14pmsb**: Mono14pmsb.
- **Mono16**: Mono16.

- **Mono8**: Mono8.
- **RGB10pmsb**: RGB10pmsb.
- **RGB12pmsb**: RGB12pmsb.
- **RGB14pmsb**: RGB14pmsb.
- **RGB16**: RGB16.
- **RGB8**: RGB8.
- **RGBa10pmsb**: RGBa10pmsb.
- **RGBa12pmsb**: RGBa12pmsb.
- **RGBa14pmsb**: RGBa14pmsb.
- **RGBa16**: RGBa16.
- **RGBa8**: RGBa8.
- **YCbCr601_10pmsb**: YCbCr601_10pmsb.
- **YCbCr601_12pmsb**: YCbCr601_12pmsb.
- **YCbCr601_14pmsb**: YCbCr601_14pmsb.
- **YCbCr601_16**: YCbCr601_16.
- **YCbCr601_411_10pmsb**: YCbCr601_411_10pmsb.
- **YCbCr601_411_12pmsb**: YCbCr601_411_12pmsb.
- **YCbCr601_411_14pmsb**: YCbCr601_411_14pmsb.
- **YCbCr601_411_16**: YCbCr601_411_16.
- **YCbCr601_411_8**: YCbCr601_411_8.
- **YCbCr601_422_10pmsb**: YCbCr601_422_10pmsb.
- **YCbCr601_422_12pmsb**: YCbCr601_422_12pmsb.
- **YCbCr601_422_14pmsb**: YCbCr601_422_14pmsb.
- **YCbCr601_422_16**: YCbCr601_422_16.
- **YCbCr601_422_8**: YCbCr601_422_8.
- **YCbCr601_8**: YCbCr601_8.
- **YCbCr709_10pmsb**: YCbCr709_10pmsb.
- **YCbCr709_12pmsb**: YCbCr709_12pmsb.
- **YCbCr709_14pmsb**: YCbCr709_14pmsb.
- **YCbCr709_16**: YCbCr709_16.
- **YCbCr709_411_10pmsb**: YCbCr709_411_10pmsb.
- **YCbCr709_411_12pmsb**: YCbCr709_411_12pmsb.
- **YCbCr709_411_14pmsb**: YCbCr709_411_14pmsb.
- **YCbCr709_411_16**: YCbCr709_411_16.
- **YCbCr709_411_8**: YCbCr709_411_8.
- **YCbCr709_422_10pmsb**: YCbCr709_422_10pmsb.

- **YCbCr709_422_12pmsb**: YCbCr709_422_12pmsb.
- **YCbCr709_422_14pmsb**: YCbCr709_422_14pmsb.
- **YCbCr709_422_16**: YCbCr709_422_16.
- **YCbCr709_422_8**: YCbCr709_422_8.
- **YCbCr709_8**: YCbCr709_8.
- **YUV10pmsb**: YUV10pmsb.
- **YUV12pmsb**: YUV12pmsb.
- **YUV14pmsb**: YUV14pmsb.
- **YUV16**: YUV16.
- **YUV411_10pmsb**: YUV411_10pmsb.
- **YUV411_12pmsb**: YUV411_12pmsb.
- **YUV411_14pmsb**: YUV411_14pmsb.
- **YUV411_16**: YUV411_16.
- **YUV411_8**: YUV411_8.
- **YUV422_10pmsb**: YUV422_10pmsb.
- **YUV422_12pmsb**: YUV422_12pmsb.
- **YUV422_14pmsb**: YUV422_14pmsb.
- **YUV422_16**: YUV422_16.
- **YUV422_8**: YUV422_8.
- **YUV8**: YUV8.

4.6. PixelProcessing Category

UnpackingMode	809
RedBlueSwap	810
ImageScaling	811
JpegQuality	812
BinningMethod	813

UnpackingMode

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → PixelProcessing	Enumeration	RW

[Description](#)

Unpacking Mode of multi-byte pixel components.

When set to **Lsb**, each pixel component is unpacked to the least significant bit. Padding '0' bits are put as necessary in the most significant bits to reach the next 8-bit boundary. 16-bit data are delivered using the little-endian convention.

When set to **Msb**, each pixel component is unpacked to the most significant bit. Padding '0' bits are put as necessary in the least significant bits to reach the next 8-bit boundary. 16-bit data are delivered using the little-endian convention.

When set to **Off**, the pixel components are not unpacked. The pixel data stream is left unchanged.

Default value: **Lsb**.



NOTE

The default value was **Msb** for Coaxlink driver versions prior to 4.3.

[Enumeration Values](#)

- **Lsb**: Unpacking to lsb.
- **Msb**: Unpacking to msb.
- **Off**: No unpacking.

RedBlueSwap

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → PixelProcessing	Boolean	RW

[Description](#)

Red-Blue component swapping.

When true, the first (Red) and the last (Blue) color components of an RGB packed pixel are swapped before being delivered.

When false, the pixel component order remains unchanged.

Default value: **False**.

ImageScaling

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → PixelProcessing	Enumeration	RW

[Short Description](#)

Image scaling.

[Enumeration Values](#)

- **Off**: No image scaling.
- **Scaling_1_8**: 1:8 image down-scaling.

JpegQuality

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → PixelProcessing	Integer	RW

[Value Info](#)

Minimum value: 1

Maximum value: 100

[Short Description](#)

JPEG quality.

BinningMethod

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → PixelProcessing	Enumeration	RW

[Short Description](#)

Binning method and window.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **Disable**: Disable.
- **Sum_2x2**: Binning 2x2 Sum.
- **Mean_2x2**: Binning 2x2 Mean.
- **Sum_4x4**: Binning 4x4 Sum.
- **Mean_4x4**: Binning 4x4 Mean.

4.7. LineScanAcquisitionControl Category

StartOfScanTriggerSource	815
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BufferHeight	822
StartScan	823
StopScan	824

StartOfScanTriggerSource

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Enumeration	RW

[Description](#)

Start-of-scan trigger conditions and trigger source.

Default value: **Immediate**.

[Enumeration Values](#)

- **Immediate:** Immediate.
- **StartScan:** StartScan command.
- **LIN1:** When an event occurs on Line Input Tool 1 or on execution of the StartScan command.
- **LIN2:** When an event occurs on Line Input Tool 2 or on execution of the StartScan command.
- **LIN3:** When an event occurs on Line Input Tool 3 or on execution of the StartScan command.
- **LIN4:** When an event occurs on Line Input Tool 4 or on execution of the StartScan command.
- **LIN5:** When an event occurs on Line Input Tool 5 or on execution of the StartScan command.
- **LIN6:** When an event occurs on Line Input Tool 6 or on execution of the StartScan command.
- **LIN7:** When an event occurs on Line Input Tool 7 or on execution of the StartScan command.
- **LIN8:** When an event occurs on Line Input Tool 8 or on execution of the StartScan command.
- **QDC1:** When an event occurs on Quadrature Decoder Tool 1 or on execution of the StartScan command.
- **QDC2:** When an event occurs on Quadrature Decoder Tool 2 or on execution of the StartScan command.
- **QDC3:** When an event occurs on Quadrature Decoder Tool 3 or on execution of the StartScan command.
- **QDC4:** When an event occurs on Quadrature Decoder Tool 4 or on execution of the StartScan command.
- **MDV1:** When an event occurs on Multiplier/Divider Tool 1 or on execution of the StartScan command.
- **MDV2:** When an event occurs on Multiplier/Divider Tool 2 or on execution of the StartScan command.
- **MDV3:** When an event occurs on Multiplier/Divider Tool 3 or on execution of the StartScan command.

- **MDV4**: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StartScan command.
- **DIV1**: When an event occurs on Divider Tool 1 or on execution of the StartScan command.
- **DIV2**: When an event occurs on Divider Tool 2 or on execution of the StartScan command.
- **DIV3**: When an event occurs on Divider Tool 3 or on execution of the StartScan command.
- **DIV4**: When an event occurs on Divider Tool 4 or on execution of the StartScan command.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1 or on execution of the StartScan command.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2 or on execution of the StartScan command.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1 or on execution of the StartScan command.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2 or on execution of the StartScan command.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1 or on execution of the StartScan command.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2 or on execution of the StartScan command.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1 or on execution of the StartScan command.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2 or on execution of the StartScan command.
- **EIN1**: When an event occurs on Event Input Tool 1 or on execution of the StartScan command.
- **EIN2**: When an event occurs on Event Input Tool 2 or on execution of the StartScan command.
- **UserEvent1**: When an event occurs on User Event 1 or on execution of the StartScan command.
- **UserEvent2**: When an event occurs on User Event 2 or on execution of the StartScan command.
- **UserEvent3**: When an event occurs on User Event 3 or on execution of the StartScan command.
- **UserEvent4**: When an event occurs on User Event 4 or on execution of the StartScan command.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StartScan command.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StartScan command.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StartScan command.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StartScan command.

- **DLT2:** When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StartScan command.
- **DLT3:** When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StartScan command.
- **DLT4:** When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StartScan command.
- **DLT5:** When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StartScan command.
- **DLT6:** When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StartScan command.
- **DLT7:** When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StartScan command.
- **DLT8:** When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StartScan command.
- **DLT9:** When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StartScan command.
- **DLT10:** When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StartScan command.
- **DLT11:** When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StartScan command.
- **DLT12:** When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StartScan command.
- **DLT13:** When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StartScan command.
- **DLT14:** When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StartScan command.
- **DLT15:** When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StartScan command.
- **DLT16:** When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StartScan command.

EndOfScanTriggerSource

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Enumeration	RW

[Description](#)

End-of-scan trigger conditions and trigger source.

Default value: `ScanLength`.

[Enumeration Values](#)

- `ScanLength`: ScanLength.
- `StopScan`: StopScan command.
- `LIN1`: When an event occurs on Line Input Tool 1 or on execution of the StopScan command.
- `LIN2`: When an event occurs on Line Input Tool 2 or on execution of the StopScan command.
- `LIN3`: When an event occurs on Line Input Tool 3 or on execution of the StopScan command.
- `LIN4`: When an event occurs on Line Input Tool 4 or on execution of the StopScan command.
- `LIN5`: When an event occurs on Line Input Tool 5 or on execution of the StopScan command.
- `LIN6`: When an event occurs on Line Input Tool 6 or on execution of the StopScan command.
- `LIN7`: When an event occurs on Line Input Tool 7 or on execution of the StopScan command.
- `LIN8`: When an event occurs on Line Input Tool 8 or on execution of the StopScan command.
- `QDC1`: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StopScan command.
- `QDC2`: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StopScan command.
- `QDC3`: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StopScan command.
- `QDC4`: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StopScan command.
- `MDV1`: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StopScan command.
- `MDV2`: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StopScan command.
- `MDV3`: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StopScan command.

- **MDV4**: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StopScan command.
- **DIV1**: When an event occurs on Divider Tool 1 or on execution of the StopScan command.
- **DIV2**: When an event occurs on Divider Tool 2 or on execution of the StopScan command.
- **DIV3**: When an event occurs on Divider Tool 3 or on execution of the StopScan command.
- **DIV4**: When an event occurs on Divider Tool 4 or on execution of the StopScan command.
- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1 or on execution of the StopScan command.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2 or on execution of the StopScan command.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1 or on execution of the StopScan command.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2 or on execution of the StopScan command.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1 or on execution of the StopScan command.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2 or on execution of the StopScan command.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1 or on execution of the StopScan command.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2 or on execution of the StopScan command.
- **EIN1**: When an event occurs on Event Input Tool 1 or on execution of the StopScan command.
- **EIN2**: When an event occurs on Event Input Tool 2 or on execution of the StopScan command.
- **UserEvent1**: When an event occurs on User Event 1 or on execution of the StopScan command.
- **UserEvent2**: When an event occurs on User Event 2 or on execution of the StopScan command.
- **UserEvent3**: When an event occurs on User Event 3 or on execution of the StopScan command.
- **UserEvent4**: When an event occurs on User Event 4 or on execution of the StopScan command.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StopScan command.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StopScan command.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StopScan command.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StopScan command.

- **DLT2:** When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StopScan command.
- **DLT3:** When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StopScan command.
- **DLT4:** When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StopScan command.
- **DLT5:** When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StopScan command.
- **DLT6:** When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StopScan command.
- **DLT7:** When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StopScan command.
- **DLT8:** When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StopScan command.
- **DLT9:** When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StopScan command.
- **DLT10:** When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StopScan command.
- **DLT11:** When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StopScan command.
- **DLT12:** When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StopScan command.
- **DLT13:** When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StopScan command.
- **DLT14:** When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StopScan command.
- **DLT15:** When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StopScan command.
- **DLT16:** When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StopScan command.

ScanLength

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Integer	RW

[Value Info](#)

Minimum value: 1

Maximum value: 16777215

Unit: lines

Default value: 512

[Description](#)

Sets/gets the number of captured lines before stopping the scanning.



NOTE

Applies only when `EndOfScanTriggerSource = ScanLength`.

BufferHeight

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Integer	RW

[Value Info](#)

Unit: lines

[Short Description](#)

Height of the image in line-scan mode. This feature is only used in line-scan acquisition scenarios to compute PayloadSize

StartScan

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Command	Imposed: WO

[Short Description](#)

Starts a scan.

StopScan

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Command	Imposed: WO

[Short Description](#)

Stops a scan.

4.8. StreamControl Category

StreamReset	826
DmaEngineOptimization	827
DmaEngineMaxQueueSize	828
TriggerToCameraReadoutTimeout	829
CameraReadoutTimeout	830
LineWidth	831
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StreamReset

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Command	Imposed: WO

[Short Description](#)

Stream Reset.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

DmaEngineOptimization

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Enumeration	RW

[Short Description](#)

Dma Engine Optimization.

[Enumeration Values](#)

- **Default:** DMA operations are optimized for low latency and maximum PCIe throughput.
- **LowMemoryUsage:** DMA operations are optimized for low memory usage; this may lead to higher latency and reduced PCIe throughput.

DmaEngineMaxQueueSize

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 1

Maximum value: 10000

[Short Description](#)

Maximum number of pending buffers (i.e., buffers queued for DMA operations). Pending buffers are removed from the input queue and placed in an internal pending buffer queue. When a pending buffer is filled, it is removed from the pending buffer queue and placed in the output buffer queue. Higher values of DmaEngineMaxQueueSize lead to lower latency and higher PCIe throughput. DmaEngineMaxQueueSize is ignored when DmaEngineOptimization is set to LowMemoryUsage.

TriggerToCameraReadoutTimeout

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 134217728

[Short Description](#)

Trigger To Camera Readout Timeout.

CameraReadoutTimeout

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 134217728

[Short Description](#)

Camera Readout Timeout.

LineWidth

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Line width in bytes.

LinePitch

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Line pitch in bytes.

StripeHeight

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Stripe height in lines.

StripePitch

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Stripe pitch in lines.

BlockHeight

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Block height in lines.

StripeOffset

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Stripe offset in lines.

StripeArrangement

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Enumeration	RW

[Short Description](#)

The stripe arrangement defines how image data is arranged in user buffers.

[Enumeration Values](#)

- **Geometry_1X_1Y**: Regular (top-down) image.
- **Geometry_1X_1YE**: Vertically flipped (bottom-up) image.
- **Geometry_1X_2YE**: 2 taps arranged top-down and bottom-up.
- **Geometry_1X_2YM**: 2 taps arranged middle-up and middle-down.

BufferPartCount

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

Number of images to put in one buffer (default: 1). Using larger values is recommended for high frame rate applications. Note that the value of BufferPartCount is only used when the buffer is announced.

MultiTapControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Category	RW

[Category Members](#)

See also: "MultiTapControl Category" on page 843

SyncMarker

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Category	RW

[Category Members](#)

See also: "SyncMarker Category" on page 847

ActivateCic

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Command	Imposed: WO

[Short Description](#)

Activate the Camera and Illumination Controller if the data stream was started with ACQ_START_FLAGS_CUSTOM_DO_NOT_ACTIVATE_SEQUENCER.

DeactivateCic

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Command	Imposed: WO

[Short Description](#)

Deactivate the Camera and Illumination Controller.

4.9. MultiTapControl Category

DeviceTapGeometry	844
Image1StreamID	845
Image2StreamID	846

DeviceTapGeometry

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl → MultiTapControl	Enumeration	RW

[Short Description](#)

Device Tap Geometry.

[Enumeration Values](#)

- **Geometry_1X_1Y:**
- **Geometry_1X_1Y2:**
- **Geometry_1X_2YE:**

Image1StreamID

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl → MultiTapControl	Integer	RW

[Short Description](#)

Stream ID of first tap (ignored when DeviceTapGeometry is Geometry_1X_1Y).

Image2StreamID

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl → MultiTapControl	Integer	RW

[Short Description](#)

Stream ID of second tap (ignored when DeviceTapGeometry is Geometry_1X_1Y).

4.10. SyncMarker Category

SyncMarkerBusAddress	848
SyncMarkerValue	849
SyncMarkerValueIncrement	850

SyncMarkerBusAddress

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl → SyncMarker	Integer	RW

[Short Description](#)

When a buffer is announced (with one of DSAnnounceBuffer, DSAllocAndAnnounceBuffer, or EuresysDSAnnounceBusBuffer), if SyncMarkerBusAddress is non-zero, the driver will setup DMA operations so that a 4-byte synchronization marker (value SyncMarkerValue) is written to PCIe address SyncMarkerBusAddress as soon as the DMA transfer is complete. Note that the value of SyncMarkerBusAddress is only used when the buffer is announced, while the value of SyncMarkerValue is used (and adjusted by SyncMarkerValueIncrement) each time the buffer is queued.

SyncMarkerValue

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl → SyncMarker	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 4294967295

[Short Description](#)

32-bit value of sync marker that will be written upon DMA transfer completion.

SyncMarkerValueIncrement

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamControl → SyncMarker	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 4294967295

[Short Description](#)

32-bit value that will be added to SyncMarkerValue each time a buffer is queued.

4.11. Errors Category

ErrorSelector	852
ErrorCount	853
ErrorCountReset	854

ErrorSelector

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → Errors	Enumeration	RW

[Short Description](#)

Error Selector.

[Selected Features](#)

- "ErrorCount" on page 853
- "ErrorCountReset" on page 854

[Enumeration Values](#)

- **All**: All errors.
- **CameraTriggerOverrun**: New trigger sent to remote device even though readout of previous frame has not started yet.
- **MigAxiWriteError**: MIG AXI write error.
- **MigAxiReadError**: MIG AXI read error.
- **StartOfScanSkipped**: Start of scan skipped (caused by internal exception: frame store almost full).
- **PrematureEndOfScan**: End of scan (caused by internal exception: frame store almost full).
- **ExternalTriggerReqsTooClose**: Trigger requests too close together.
- **Unknown**: Unknown errors.

ErrorCount

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → Errors	IntReg	RO

Register Port: StreamPort

[Short Description](#)

Error Count.

ErrorCountReset

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → Errors	Command	Imposed: WO

[Short Description](#)

Reset the selected ErrorCount.

4.12. LUTControl Category

LUTConfiguration	856
LUTLength	857
LUTMaxValue	858
LUTSet	859
LUTIndex	860
LUTValue	861
LUTReadBlockLength	862
LUTEnable	863

LUTConfiguration

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	Enumeration	RW

[Short Description](#)

Configuration of the LUT processor.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **M_8x8**: Monochrome 8-bit to 8-bit.
- **M_10x8**: Monochrome 10-bit to 8-bit.
- **M_10x10**: Monochrome 10-bit to 10-bit.
- **M_10x16**: Monochrome 10-bit to 16-bit.
- **M_12x8**: Monochrome 12-bit to 8-bit.
- **M_12x12**: Monochrome 12-bit to 12-bit.
- **M_12x16**: Monochrome 12-bit to 16-bit.

LUTLength

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	IntReg	RO

Register Port: StreamPort

[Short Description](#)

Number of table entries in a LUT device.

LUTMaxValue

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	IntReg	RO

Register Port: StreamPort

[Short Description](#)

Highest value of a table entry.

LUTSet

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	Enumeration	RW

[Short Description](#)

LUT set to access.

[Selected Features](#)

- ["LUTValue" on page 861](#)

[Enumeration Values](#)

- **Set1**: Select LUT set 1 for access.
- **Set2**: Select LUT set 2 for access.
- **Set3**: Select LUT set 3 for access.
- **Set4**: Select LUT set 4 for access.
- **Set5**: Select LUT set 5 for access.
- **Set6**: Select LUT set 6 for access.
- **Set7**: Select LUT set 7 for access.
- **Set8**: Select LUT set 8 for access.
- **Set9**: Select LUT set 9 for access.
- **Set10**: Select LUT set 10 for access.
- **Set11**: Select LUT set 11 for access.
- **Set12**: Select LUT set 12 for access.
- **Set13**: Select LUT set 13 for access.
- **Set14**: Select LUT set 14 for access.
- **Set15**: Select LUT set 15 for access.
- **Set16**: Select LUT set 16 for access.

LUTIndex

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	Integer	RW

[Value Info](#)

Minimum value: 0

[Short Description](#)

Index of the first entry to access.

[Selected Features](#)

- ["LUTValue" on page 861](#)

LUTValue

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	StringReg	RW

[Short Description](#)

String of value(s) to read from- or to write to- the accessed LUT at location LUTIndex.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

LUTReadBlockLength

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	Integer	RW

[Value Info](#)

Minimum value: 1

[Short Description](#)

Number of consecutive table entries to read.

LUTEnable

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LUTControl	Enumeration	RW

[Short Description](#)

Enables the LUT processor with a specific LUT set..



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- Off:
- **Set1**: Enables the LUT processor with LUT set 1.
- **Set2**: Enables the LUT processor with LUT set 2.
- **Set3**: Enables the LUT processor with LUT set 3.
- **Set4**: Enables the LUT processor with LUT set 4.
- **Set5**: Enables the LUT processor with LUT set 5.
- **Set6**: Enables the LUT processor with LUT set 6.
- **Set7**: Enables the LUT processor with LUT set 7.
- **Set8**: Enables the LUT processor with LUT set 8.
- **Set9**: Enables the LUT processor with LUT set 9.
- **Set10**: Enables the LUT processor with LUT set 10.
- **Set11**: Enables the LUT processor with LUT set 11.
- **Set12**: Enables the LUT processor with LUT set 12.
- **Set13**: Enables the LUT processor with LUT set 13.
- **Set14**: Enables the LUT processor with LUT set 14.
- **Set15**: Enables the LUT processor with LUT set 15.
- **Set16**: Enables the LUT processor with LUT set 16.

4.13. LinearFilter Category

LinearFilterControl	865
LinearFilterCoefficientA	866
LinearFilterCoefficientB	867
LinearFilterCoefficientC	868

LinearFilterControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LinearFilter	Enumeration	RW

[Short Description](#)

Linear Filter Control.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **Disable**: Disable.
- **Enable**: Enable.

LinearFilterCoefficientA

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LinearFilter	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 512

[Short Description](#)

Linear filter coefficient A.

LinearFilterCoefficientB

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LinearFilter	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 512

[Short Description](#)

Linear filter coefficient B.

LinearFilterCoefficientC

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LinearFilter	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 512

[Short Description](#)

Linear filter coefficient C.

4.14. Threshold Category

ThresholdControl	870
ThresholdLevel	871

ThresholdControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → Threshold	Enumeration	RW

[Short Description](#)

Threshold Control.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **Disable**: Disable.
- **Enable**: Enable.

ThresholdLevel

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → Threshold	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 255

[Short Description](#)

Threshold level.

4.15. LaserLineExtractor Category

Scan3dExtractionMethod	873
Scan3dOutputMode	874
Scan3dSecondLineROIOffsetY	875

Scan3dExtractionMethod

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LaserLineExtractor	Enumeration	RW

[Short Description](#)

Scan3d Extraction Method.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **Disable**: Disable extraction.
- **MaxDetection_8**: Maximum detection, 8-bit integer coordinates.
- **MaxDetection_16**: Maximum detection, 16-bit integer coordinates.
- **PeakDetection_11_5**: Peak detection, UQ11.5 fixed-point coordinates (fx11.16).
- **PeakDetection_8_8**: Peak detection, UQ8.8 fixed-point coordinates (fx8.16).
- **CenterOfGravity_11_5**: Center of gravity, UQ11.5 fixed-point coordinates (fx11.16).
- **CenterOfGravity_8_8**: Center of gravity, UQ8.8 fixed-point coordinates (fx8.16).

Scan3dOutputMode

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LaserLineExtractor	Enumeration	RW

[Short Description](#)

Scan3d Output Mode.

[Enumeration Values](#)

- **UncalibratedC**: Uncalibrated 2.5D Depth map.

Scan3dSecondLineROIOffsetY

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → LaserLineExtractor	Integer	RW

[Value Info](#)

Minimum value: 0

Maximum value: 65535

[Short Description](#)

Scan3d Second Line ROI Offset Y.

4.16. Bayer Category

BayerMethod	877
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BayerMethod

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → Bayer	Enumeration	RW

[Short Description](#)

Bayer Decoder method.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **Disable**: Disable.
- **Legacy**: 3x3 interpolation, a.k.a. method 1.
- **Advanced**: 3x3 median-based interpolation, a.k.a. method 2.
- **Method3**: 5x5 gradient-based interpolation.
- **Method5**: 2x2 average-based interpolation.

4.17. FlatFieldCorrection Category

FfcCoefficientPartitionBase	879
FfcCoefficientPartitionSize	880
FfcControl	881
FfcBypass	882
FfcCoefficientsValid	883

FfcCoefficientPartitionBase

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → FlatFieldCorrection	Integer	Imposed: RO

[Short Description](#)

Base address of the flat field correction coefficient partition.

FfcCoefficientPartitionSize

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → FlatFieldCorrection	IntReg	RO

Register Port: StreamPort

[Short Description](#)

Flat field correction coefficient partition size in bytes.

FfcControl

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → FlatFieldCorrection	Enumeration	RW

[Short Description](#)

Ffc Control.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **Disable**: Disable.
- **Enable**: Enable.

FfcBypass

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → FlatFieldCorrection	Enumeration	RW

[Short Description](#)

Ffc Bypass.

[Enumeration Values](#)

- **Disable**: Disable.
- **Enable**: Enable.

FfcCoefficientsValid

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → FlatFieldCorrection	Boolean	Imposed: RO

[Short Description](#)

Flat field correction coefficients are valid.

4.18. MetadataInsertion Category

BufferMetadataInsertionEnable	885
LineMetadataInsertionEnable	886
MetadataContent0	887
MetadataContent1	888
MetadataContent2	889
MetadataContent3	890
GeneralPurposeCounter	891

BufferMetadataInsertionEnable

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion	Boolean	RW

[Short Description](#)

The buffer metadata are sampled on the first CycleStart. The buffer metadata can be retrieved with the info commands `BUFFER_INFO_CUSTOM_BUFFER_METADATA_<N>`.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

LineMetadataInsertionEnable

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion	Boolean	RW

[Short Description](#)

The line metadata are sampled on each CycleStart. The base address of the line metadata can be retrieved with the info command `BUFFER_INFO_CUSTOM_LINE_METADATA_BASE`.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

MetadataContent0

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion	Enumeration	RW

[Short Description](#)

Content of the 32-bit metadata at offset 0.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **GPC1Value**: Value of General Purpose Counter 1.
- **GPC1LatchedValue**: Latched value of General Purpose Counter 1.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.

MetadataContent1

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion	Enumeration	RW

[Short Description](#)

Content of the 32-bit metadata at offset 1.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **GPC2Value**: Value of General Purpose Counter 2.
- **GPC2LatchedValue**: Latched value of General Purpose Counter 2.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.

MetadataContent2

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion	Enumeration	RW

[Short Description](#)

Content of the 32-bit metadata at offset 2.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **GPC3Value**: Value of General Purpose Counter 3.
- **GPC3LatchedValue**: Latched value of General Purpose Counter 3.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.

MetadataContent3

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion	Enumeration	RW

[Short Description](#)

Content of the 32-bit metadata at offset 3.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **GPC4Value**: Value of General Purpose Counter 4.
- **GPC4LatchedValue**: Latched value of General Purpose Counter 4.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.

GeneralPurposeCounter

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion	Category	RW

[Category Members](#)

See also: "GeneralPurposeCounter Category" on page 892

4.19. GeneralPurposeCounter Category

GeneralPurposeCounterSelector	893
GeneralPurposeCounterEnable	894
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GeneralPurposeCounterLatchAndResetSource	900

GeneralPurposeCounterSelector

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion → GeneralPurposeCounter	Enumeration	RW

[Short Description](#)

Select a General Purpose Counter.

[Selected Features](#)

- ["GeneralPurposeCounterEnable" on page 894](#)
- ["GeneralPurposeCounterIncrementSource" on page 895](#)
- ["GeneralPurposeCounterDecrementSource" on page 898](#)
- ["GeneralPurposeCounterLatchAndResetSource" on page 900](#)

[Enumeration Values](#)

- **GPC1:** General Purpose Counter 1.
- **GPC2:** General Purpose Counter 2.
- **GPC3:** General Purpose Counter 3.
- **GPC4:** General Purpose Counter 4.

GeneralPurposeCounterEnable

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion → GeneralPurposeCounter	Boolean	RW

[Short Description](#)

The selected General Purpose Counter is reset when disabled.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

GeneralPurposeCounterIncrementSource

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion → GeneralPurposeCounter	Enumeration	RW

[Short Description](#)

Event stream used as trigger to increment the selected General Purpose Counter.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.

- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.
- **CycleStart**:
- **StartOfLine**:
- **TIME16NS**: Clock input 16 nanoseconds time base.

- `CycleLostTrigger`:

GeneralPurposeCounterDecrementSource

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion → GeneralPurposeCounter	Enumeration	RW

[Short Description](#)

Event stream used as trigger to decrement the selected General Purpose Counter.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

[Enumeration Values](#)

- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.

- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.
- **CycleStart**:
- **StartOfLine**:
- **TIME16NS**: Clock input 16 nanoseconds time base.

GeneralPurposeCounterLatchAndResetSource

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → MetadataInsertion → GeneralPurposeCounter	Enumeration	RW

Short Description

Event stream used as trigger to latch and reset the selected General Purpose Counter.



WARNING

This feature can only be activated or de-activated when the data-stream is inactive.

Enumeration Values

- **NONE**: No event stream.
- **LIN1**: When an event occurs on Line Input Tool 1.
- **LIN2**: When an event occurs on Line Input Tool 2.
- **LIN3**: When an event occurs on Line Input Tool 3.
- **LIN4**: When an event occurs on Line Input Tool 4.
- **LIN5**: When an event occurs on Line Input Tool 5.
- **LIN6**: When an event occurs on Line Input Tool 6.
- **LIN7**: When an event occurs on Line Input Tool 7.
- **LIN8**: When an event occurs on Line Input Tool 8.
- **QDC1**: When an event occurs on Quadrature Decoder Tool 1.
- **QDC2**: When an event occurs on Quadrature Decoder Tool 2.
- **QDC3**: When an event occurs on Quadrature Decoder Tool 3.
- **QDC4**: When an event occurs on Quadrature Decoder Tool 4.
- **MDV1**: When an event occurs on Multiplier/Divider Tool 1.
- **MDV2**: When an event occurs on Multiplier/Divider Tool 2.
- **MDV3**: When an event occurs on Multiplier/Divider Tool 3.
- **MDV4**: When an event occurs on Multiplier/Divider Tool 4.
- **DIV1**: When an event occurs on Divider Tool 1.
- **DIV2**: When an event occurs on Divider Tool 2.
- **DIV3**: When an event occurs on Divider Tool 3.
- **DIV4**: When an event occurs on Divider Tool 4.

- **DEL1_1**: When an event occurs on Delay Tool 1 Output 1.
- **DEL1_2**: When an event occurs on Delay Tool 1 Output 2.
- **DEL2_1**: When an event occurs on Delay Tool 2 Output 1.
- **DEL2_2**: When an event occurs on Delay Tool 2 Output 2.
- **DEL3_1**: When an event occurs on Delay Tool 3 Output 1.
- **DEL3_2**: When an event occurs on Delay Tool 3 Output 2.
- **DEL4_1**: When an event occurs on Delay Tool 4 Output 1.
- **DEL4_2**: When an event occurs on Delay Tool 4 Output 2.
- **EIN1**: When an event occurs on Event Input Tool 1.
- **EIN2**: When an event occurs on Event Input Tool 2.
- **UserEvent1**: When an event occurs on User Event 1.
- **UserEvent2**: When an event occurs on User Event 2.
- **UserEvent3**: When an event occurs on User Event 3.
- **UserEvent4**: When an event occurs on User Event 4.
- **C2C1**: When an event occurs on C2C-Link Synchronization Tool 1.
- **C2C2**: When an event occurs on C2C-Link Synchronization Tool 2.
- **C2C3**: When an event occurs on C2C-Link Synchronization Tool 3.
- **DLT1**: When an event occurs on DeviceLinkTrigger Tool 1.
- **DLT2**: When an event occurs on DeviceLinkTrigger Tool 2.
- **DLT3**: When an event occurs on DeviceLinkTrigger Tool 3.
- **DLT4**: When an event occurs on DeviceLinkTrigger Tool 4.
- **DLT5**: When an event occurs on DeviceLinkTrigger Tool 5.
- **DLT6**: When an event occurs on DeviceLinkTrigger Tool 6.
- **DLT7**: When an event occurs on DeviceLinkTrigger Tool 7.
- **DLT8**: When an event occurs on DeviceLinkTrigger Tool 8.
- **DLT9**: When an event occurs on DeviceLinkTrigger Tool 9.
- **DLT10**: When an event occurs on DeviceLinkTrigger Tool 10.
- **DLT11**: When an event occurs on DeviceLinkTrigger Tool 11.
- **DLT12**: When an event occurs on DeviceLinkTrigger Tool 12.
- **DLT13**: When an event occurs on DeviceLinkTrigger Tool 13.
- **DLT14**: When an event occurs on DeviceLinkTrigger Tool 14.
- **DLT15**: When an event occurs on DeviceLinkTrigger Tool 15.
- **DLT16**: When an event occurs on DeviceLinkTrigger Tool 16.
- **CycleStart**:
- **StartOfLine**:

4.20. EventControl Category

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EventSelector

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Enumeration	RW

[Short Description](#)

Select an event.

[Selected Features](#)

- ["EventNotification" on page 904](#)
- ["EventNotificationContext1" on page 905](#)
- ["EventNotificationContext2" on page 908](#)
- ["EventNotificationContext3" on page 911](#)
- ["EventCount" on page 914](#)
- ["EventCountReset" on page 915](#)

[Enumeration Values](#)

- **StartOfCameraReadout**: Starts acquiring data of a new image frame (area-scan only).
- **EndOfCameraReadout**: Stops acquiring data of an image frame (area-scan only).
- **StartOfScan**: Starts acquiring data of a new image scan (line-scan only).
- **EndOfScan**: Stops acquiring data of an image scan (line-scan only).
- **RejectedFrame**: Dropped image frame data (area-scan only).
- **RejectedScan**: Dropped image scan data (line-scan only).
- **TriggerToCameraReadoutTimeout**: Trigger to camera readout timeout.
- **CameraReadoutTimeout**: Camera readout timeout.
- **BrokenFrame**: Broken frame due to frame store overflow (area-scan only).

EventNotification

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Boolean	RW

[Description](#)

Activate or deactivate the notification to the host application of the occurrence of the selected event.

Default value: **True**.

EventNotificationContext1

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Enumeration	RW

[Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_1 (context information value is latched when the event occurs).

Default value: **EventSpecific**.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **PendingCicTriggerCount**: Number of currently pending CIC triggers.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.

- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.
- **DIV1EventCount**: Number of DIV1 events.
- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.
- **CameraTriggerRisingEdgeEventCount**: Number of CameraTriggerRisingEdge events.
- **CameraTriggerFallingEdgeEventCount**: Number of CameraTriggerFallingEdge events.
- **StrobeRisingEdgeEventCount**: Number of StrobeRisingEdge events.
- **StrobeFallingEdgeEventCount**: Number of StrobeFallingEdge events.
- **AllowNextCycleEventCount**: Number of AllowNextCycle events.
- **DiscardedCicTriggerEventCount**: Number of DiscardedCicTrigger events.
- **PendingCicTriggerEventCount**: Number of PendingCicTrigger events.
- **TriggerEventCount**: Number of Trigger events.
- **StartOfCameraReadoutEventCount**: Number of StartOfCameraReadout events.
- **EndOfCameraReadoutEventCount**: Number of EndOfCameraReadout events.
- **StartOfScanEventCount**: Number of StartOfScan events.

- **EndOfScanEventCount**: Number of EndOfScan events.
- **RejectedFrameEventCount**: Number of RejectedFrame events.
- **RejectedScanEventCount**: Number of RejectedScan events.
- **TriggerToCameraReadoutTimeoutEventCount**: Number of TriggerToCameraReadoutTimeout events.
- **CameraReadoutTimeoutEventCount**: Number of CameraReadoutTimeout events.
- **BrokenFrameEventCount**: Number of BrokenFrame events.

EventNotificationContext2

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_2.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **PendingCicTriggerCount**: Number of currently pending CIC triggers.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.

- **DIV1EventCount**: Number of DIV1 events.
- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.
- **CameraTriggerRisingEdgeEventCount**: Number of CameraTriggerRisingEdge events.
- **CameraTriggerFallingEdgeEventCount**: Number of CameraTriggerFallingEdge events.
- **StrobeRisingEdgeEventCount**: Number of StrobeRisingEdge events.
- **StrobeFallingEdgeEventCount**: Number of StrobeFallingEdge events.
- **AllowNextCycleEventCount**: Number of AllowNextCycle events.
- **DiscardedCicTriggerEventCount**: Number of DiscardedCicTrigger events.
- **PendingCicTriggerEventCount**: Number of PendingCicTrigger events.
- **TriggerEventCount**: Number of Trigger events.
- **StartOfCameraReadoutEventCount**: Number of StartOfCameraReadout events.
- **EndOfCameraReadoutEventCount**: Number of EndOfCameraReadout events.
- **StartOfScanEventCount**: Number of StartOfScan events.
- **EndOfScanEventCount**: Number of EndOfScan events.
- **RejectedFrameEventCount**: Number of RejectedFrame events.

- **RejectedScanEventCount**: Number of RejectedScan events.
- **TriggerToCameraReadoutTimeoutEventCount**: Number of TriggerToCameraReadoutTimeout events.
- **CameraReadoutTimeoutEventCount**: Number of CameraReadoutTimeout events.
- **BrokenFrameEventCount**: Number of BrokenFrame events.

EventNotificationContext3

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Enumeration	RW

[Short Description](#)

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_3.

[Enumeration Values](#)

- **EventSpecific**: Event-specific context information.
- **LineStatusAll**: Low 32-bit part of LineStatusAll.
- **LineStatusAllHi**: High 32-bit part of LineStatusAll.
- **QDC1Position**: Position of Quadrature Decoder Tool 1.
- **QDC2Position**: Position of Quadrature Decoder Tool 2.
- **QDC3Position**: Position of Quadrature Decoder Tool 3.
- **QDC4Position**: Position of Quadrature Decoder Tool 4.
- **PendingCicTriggerCount**: Number of currently pending CIC triggers.
- **LIN1EventCount**: Number of LIN1 events.
- **LIN2EventCount**: Number of LIN2 events.
- **LIN3EventCount**: Number of LIN3 events.
- **LIN4EventCount**: Number of LIN4 events.
- **LIN5EventCount**: Number of LIN5 events.
- **LIN6EventCount**: Number of LIN6 events.
- **LIN7EventCount**: Number of LIN7 events.
- **LIN8EventCount**: Number of LIN8 events.
- **QDC1EventCount**: Number of QDC1 events.
- **QDC1DirEventCount**: Number of QDC1Dir events.
- **QDC2EventCount**: Number of QDC2 events.
- **QDC2DirEventCount**: Number of QDC2Dir events.
- **QDC3EventCount**: Number of QDC3 events.
- **QDC3DirEventCount**: Number of QDC3Dir events.
- **QDC4EventCount**: Number of QDC4 events.
- **QDC4DirEventCount**: Number of QDC4Dir events.

- **DIV1EventCount**: Number of DIV1 events.
- **DIV2EventCount**: Number of DIV2 events.
- **DIV3EventCount**: Number of DIV3 events.
- **DIV4EventCount**: Number of DIV4 events.
- **MDV1EventCount**: Number of MDV1 events.
- **MDV2EventCount**: Number of MDV2 events.
- **MDV3EventCount**: Number of MDV3 events.
- **MDV4EventCount**: Number of MDV4 events.
- **DEL11EventCount**: Number of DEL11 events.
- **DEL12EventCount**: Number of DEL12 events.
- **DEL21EventCount**: Number of DEL21 events.
- **DEL22EventCount**: Number of DEL22 events.
- **DEL31EventCount**: Number of DEL31 events.
- **DEL32EventCount**: Number of DEL32 events.
- **DEL41EventCount**: Number of DEL41 events.
- **DEL42EventCount**: Number of DEL42 events.
- **UserEvent1EventCount**: Number of UserEvent1 events.
- **UserEvent2EventCount**: Number of UserEvent2 events.
- **UserEvent3EventCount**: Number of UserEvent3 events.
- **UserEvent4EventCount**: Number of UserEvent4 events.
- **C2C1EventCount**: Number of C2C1 events.
- **C2C2EventCount**: Number of C2C2 events.
- **C2C3EventCount**: Number of C2C3 events.
- **CameraTriggerRisingEdgeEventCount**: Number of CameraTriggerRisingEdge events.
- **CameraTriggerFallingEdgeEventCount**: Number of CameraTriggerFallingEdge events.
- **StrobeRisingEdgeEventCount**: Number of StrobeRisingEdge events.
- **StrobeFallingEdgeEventCount**: Number of StrobeFallingEdge events.
- **AllowNextCycleEventCount**: Number of AllowNextCycle events.
- **DiscardedCicTriggerEventCount**: Number of DiscardedCicTrigger events.
- **PendingCicTriggerEventCount**: Number of PendingCicTrigger events.
- **TriggerEventCount**: Number of Trigger events.
- **StartOfCameraReadoutEventCount**: Number of StartOfCameraReadout events.
- **EndOfCameraReadoutEventCount**: Number of EndOfCameraReadout events.
- **StartOfScanEventCount**: Number of StartOfScan events.
- **EndOfScanEventCount**: Number of EndOfScan events.
- **RejectedFrameEventCount**: Number of RejectedFrame events.

- **RejectedScanEventCount**: Number of RejectedScan events.
- **TriggerToCameraReadoutTimeoutEventCount**: Number of TriggerToCameraReadoutTimeout events.
- **CameraReadoutTimeoutEventCount**: Number of CameraReadoutTimeout events.
- **BrokenFrameEventCount**: Number of BrokenFrame events.

EventCount

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	IntReg	RO

Register Port: StreamPort

[Short Description](#)

Number of occurrences of the selected event (32-bit counter).

EventCountReset

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Command	Imposed: WO

[Short Description](#)

Reset the selected EventCount.

EventNotificationAll

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Boolean	Imposed: WO

[Short Description](#)

Activate or deactivate the notification of all events.

EventCountResetAll

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Command	Imposed: WO

[Short Description](#)

Reset all EventCount.

4.21. StreamStatistics Category

StatisticsSamplingSelector	919
StatisticsFrameRate	920
StatisticsLineRate	921
StatisticsDataRate	922
StatisticsStartSampling	923
StatisticsStopSampling	924

StatisticsSamplingSelector

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	Enumeration	RW

[Description](#)

Selects the stream statistics sampling method.

Default value: `LastSecond`.

[Selected Features](#)

- `"StatisticsFrameRate"` on page 920
- `"StatisticsLineRate"` on page 921
- `"StatisticsDataRate"` on page 922

[Enumeration Values](#)

- `LastSecond`: During the last second.
- `LastTenSeconds`: During the last 10 seconds.
- `Last2Buffers`: For the last 2 buffers.
- `Last10Buffers`: For the last 10 buffers.
- `Last100Buffers`: For the last 100 buffers.
- `Last1000Buffers`: For the last 1000 buffers.
- `LastAcquisition`: During the last acquisition activity period. Namely since the last `DSSstartAcquisition()` function call until now, if the acquisition is still active otherwise until the last `DSSstopAcquisition()` function call.
- `Custom`: Custom sampling using `StatisticsStartSampling` and `StatisticsStopSampling` commands.

StatisticsFrameRate

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	FloatReg	RO

Register Port: StreamPort

[Value Info](#)

Unit: Fps (Frames per second)

[Description](#)

Average frame delivery rate using the selected sampling method.



NOTE

This feature is only available for area-scan firmware variants.



NOTE

The statistics measures the frame rate at the level of the PCI Express interface, NOT at the level of the CoaXPress interface!

StatisticsLineRate

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	FloatReg	RO

Register Port: StreamPort

[Value Info](#)

Unit: Lps (Lines per second)

[Description](#)

Average line delivery rate using the selected sampling method.



NOTE

This feature is only available for line-scan firmware variants.



NOTE

The statistics measures the line rate at the level of the PCI Express interface, NOT at the level of the CoaXPress interface!

StatisticsDataRate

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	FloatReg	RO

Register Port: StreamPort

[Value Info](#)

Unit: MBps (Megabytes per second)

[Short Description](#)

Get the average PCI data delivery rate using the selected sampling method.

StatisticsStartSampling

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	Command	Imposed: WO

[Short Description](#)

Start sampling the stream data. Applies only when StatisticsSamplingSelector = Custom.

StatisticsStopSampling

[Feature Info](#)

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	Command	Imposed: WO

[Short Description](#)

Stop sampling the stream data. Applies only when StatisticsSamplingSelector = Custom.

5. Grablink Fake Camera Link Device Register Description

Categorized features list of module version 24_04_0

5.1. Root Category	926
5.2. DeviceEnumeration Category	932
5.3. ImageFormatControl Category	935
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5.6. DeviceControl Category	948

5.1. Root Category

DeviceControl	927
DeviceEnumeration	928
ImageFormatControl	929
TransportLayerControl	930
AcquisitionControl	931

DeviceControl

[Feature Info](#)

Module	Category Path	Type	Access
	Root	Category	RW

[Category Members](#)

See also: "DeviceControl Category" on page 948

DeviceEnumeration

[Feature Info](#)

Module	Category Path	Type	Access
	Root	Category	RW

[Category Members](#)

See also: "DeviceEnumeration Category" on page 932

ImageFormatControl

[Feature Info](#)

Module	Category Path	Type	Access
	Root	Category	RW

[Category Members](#)

See also: "ImageFormatControl Category" on page 935

TransportLayerControl

[Feature Info](#)

Module	Category Path	Type	Access
	Root	Category	RW

[Category Members](#)

See also: "TransportLayerControl Category" on page 941

AcquisitionControl

[Feature Info](#)

Module	Category Path	Type	Access
	Root	Category	RW

[Category Members](#)

See also: "AcquisitionControl Category" on page 944

5.2. DeviceEnumeration Category

DeviceVendorName	933
DeviceModelName	934

DeviceVendorName

[Feature Info](#)

Module	Category Path	Type	Access
	Root → DeviceEnumeration	StringReg	RO

[Short Description](#)

Device Vendor Name.

DeviceModelName

[Feature Info](#)

Module	Category Path	Type	Access
	Root → DeviceEnumeration	StringReg	RO

[Short Description](#)

Device Model Name.

5.3. ImageFormatControl Category

Width	936
Height	937
PixelFormat	938
PixelFormat	938
PixelFormat	938
PixelSize	940

Width

[Feature Info](#)

Module	Category Path	Type	Access
	Root → ImageFormatControl	Integer	RW

[Short Description](#)

Width.

Height

[Feature Info](#)

Module	Category Path	Type	Access
	Root → ImageFormatControl	Integer	RW

[Short Description](#)

Height.

PixelFormat

[Feature Info](#)

Module	Category Path	Type	Access
	Root → ImageFormatControl	Enumeration	RW

[Short Description](#)

Pixel Format.

[Enumeration Values](#)

- Mono8:
- Mono10:
- Mono12:
- Mono14:
- Mono16:
- RGB8:
- BayerBG8:
- BayerBG10:
- BayerBG12:
- BayerBG14:
- BayerBG16:
- BayerGB8:
- BayerGB10:
- BayerGB12:
- BayerGB14:
- BayerGB16:
- BayerRG8:
- BayerRG10:
- BayerRG12:
- BayerRG14:
- BayerRG16:
- BayerGR8:
- BayerGR10:
- BayerGR12:

- BayerGR14:
- BayerGR16:

PixelSize

[Feature Info](#)

Module	Category Path	Type	Access
	Root → ImageFormatControl	Integer	RW

[Short Description](#)

Pixel Size.

5.4. TransportLayerControl Category

PayloadSize	942
DeviceTapGeometry	943

PayloadSize

[Feature Info](#)

Module	Category Path	Type	Access
	Root → TransportLayerControl	IntSwissKnife	RW

[Short Description](#)

Payload Size.

DeviceTapGeometry

[Feature Info](#)

Module	Category Path	Type	Access
	Root → TransportLayerControl	Enumeration	RW

[Short Description](#)

Device Tap Geometry.

[Enumeration Values](#)

- [Geometry_1X_1Y:](#)
- [Geometry_1X2_1Y:](#)
- [Geometry_1X3_1Y:](#)
- [Geometry_1X4_1Y:](#)
- [Geometry_1X8_1Y:](#)
- [Geometry_1X10_1Y:](#)
- [Geometry_2X_1Y:](#)
- [Geometry_2XE_1Y:](#)
- [Geometry_2XM_1Y:](#)
- [Geometry_2XR_1Y:](#)
- [Geometry_2X2_1Y:](#)
- [Geometry_2X2E_1Y:](#)
- [Geometry_2X2M_1Y:](#)
- [Geometry_2X4_1Y:](#)
- [Geometry_3X_1Y:](#)
- [Geometry_4X_1Y:](#)
- [Geometry_4XE_1Y:](#)
- [Geometry_4XR_1Y:](#)
- [Geometry_4X2_1Y:](#)
- [Geometry_4X2E_1Y:](#)
- [Geometry_8X_1Y:](#)
- [Geometry_8XR_1Y:](#)
- [Geometry_10X_1Y:](#)

5.5. AcquisitionControl Category

AcquisitionMode	945
AcquisitionStart	946
AcquisitionStop	947

AcquisitionMode

[Feature Info](#)

Module	Category Path	Type	Access
	Root → AcquisitionControl	Enumeration	RW

[Short Description](#)

Acquisition Mode.

[Enumeration Values](#)

- **Continuous:**

AcquisitionStart

[Feature Info](#)

Module	Category Path	Type	Access
	Root → AcquisitionControl	Command	Imposed: WO

[Short Description](#)

Acquisition Start.

AcquisitionStop

[Feature Info](#)

Module	Category Path	Type	Access
	Root → AcquisitionControl	Command	Imposed: WO

[Short Description](#)

Acquisition Stop.

5.6. DeviceControl Category

DeviceClockSelector	949
DeviceClockFrequency	950

DeviceClockSelector

[Feature Info](#)

Module	Category Path	Type	Access
	Root → DeviceControl	Enumeration	RW

[Short Description](#)

Device Clock Selector.

[Enumeration Values](#)

- **CameraLink:**

DeviceClockFrequency

[Feature Info](#)

Module	Category Path	Type	Access
	Root → DeviceControl	Integer	RW

[Short Description](#)

Device Clock Frequency.