euresys
Empowering Computer Vision

eGrabber

Grablink Duo Handbook

1628 Grablink Duo

Contents

PART I
GETTING STARTED

1. Hardware Setup

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

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 24.03***

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
All product/firmware variants	444

> ⊘ **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

 0xfffffff0 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:
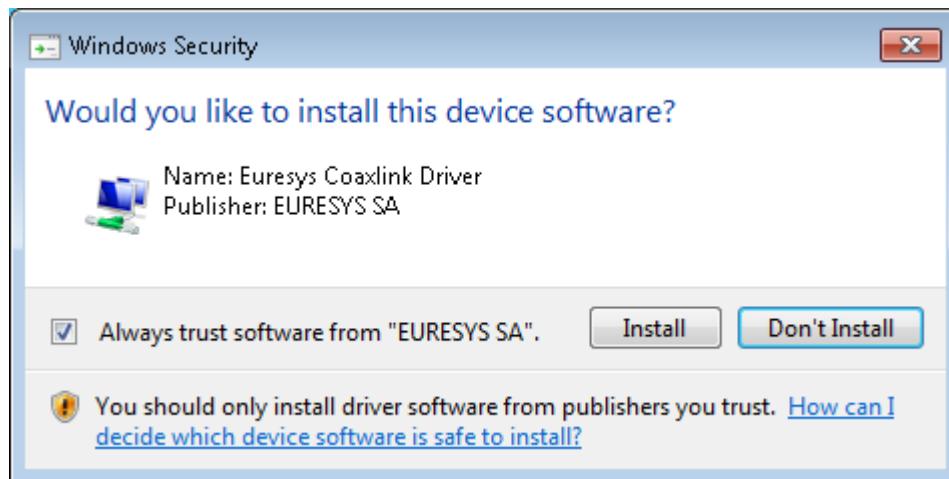
This Windows security warning message occurs when the Euresys code-signing certificate is missing from the "Trusted Publishers" Windows Certificate store. This happens, for instance, when the Euresys code-signing certificate must be renewed.

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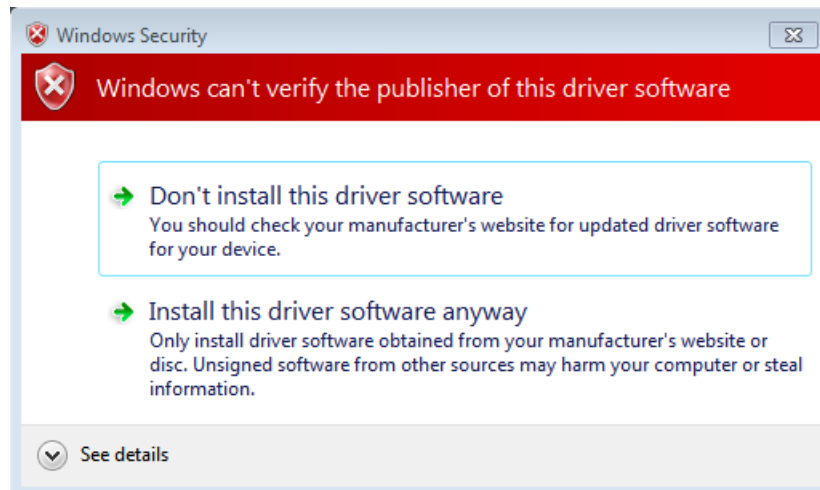
This Windows security warning occurs when the **GlobalSign Root CA - R6** certificate is missing from the Windows certificate store.

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-**24.03.2**.*.exe setup file.

- For an installation on Windows 10 or 11, select the egrabber-win10-x86_64-**24.03.2**.*.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-**24.03.2**.*.tar.gz setup file.

- For an installation on x86_64 (64-bit) processor architecture, select the egrabber-linux-x86_64-**24.03.2**.*.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-**24.03.2**.*.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-**24.03.2**.*.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-**24.03.2**.*.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?

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 s located in the firmware sub-folder 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\eGrabber\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 352 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 352 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 24.03***

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

*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 238 block gathers all the I/O ports of the card.

I/O Toolbox

The "I/O Toolbox" on page 254 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 209 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 145 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 140 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 162 block performs on-the-fly pixel processing and data formatting.

Image Data Transfer

The "Image Data Transfer" on page 196 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
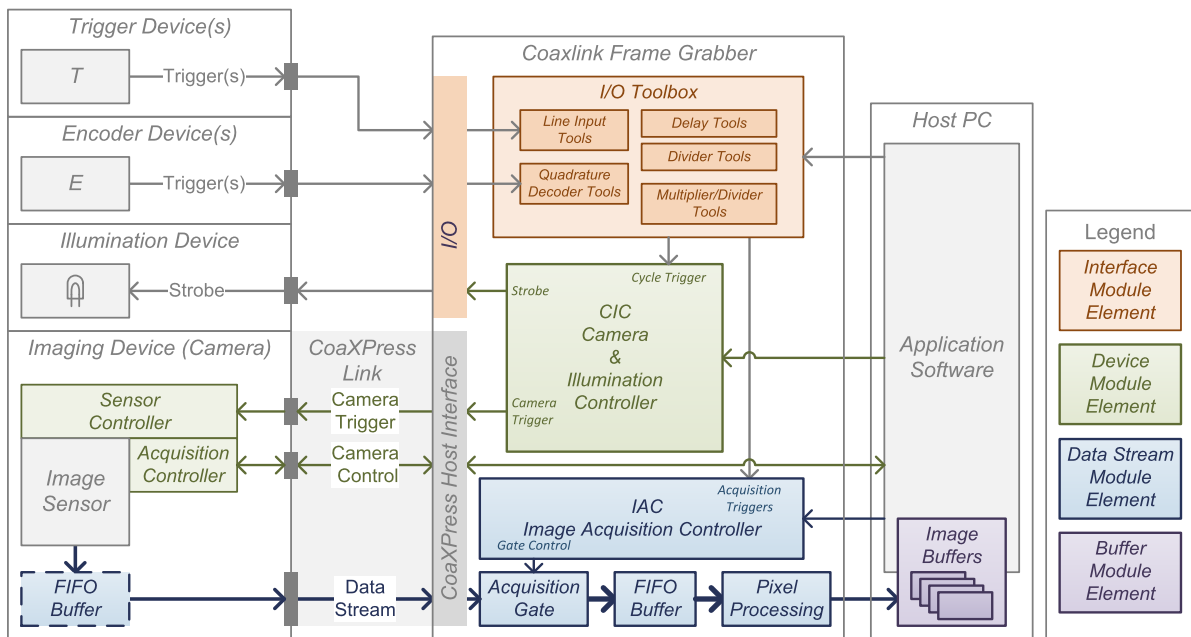
1-camera, 1-data-stream image acquisition system

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

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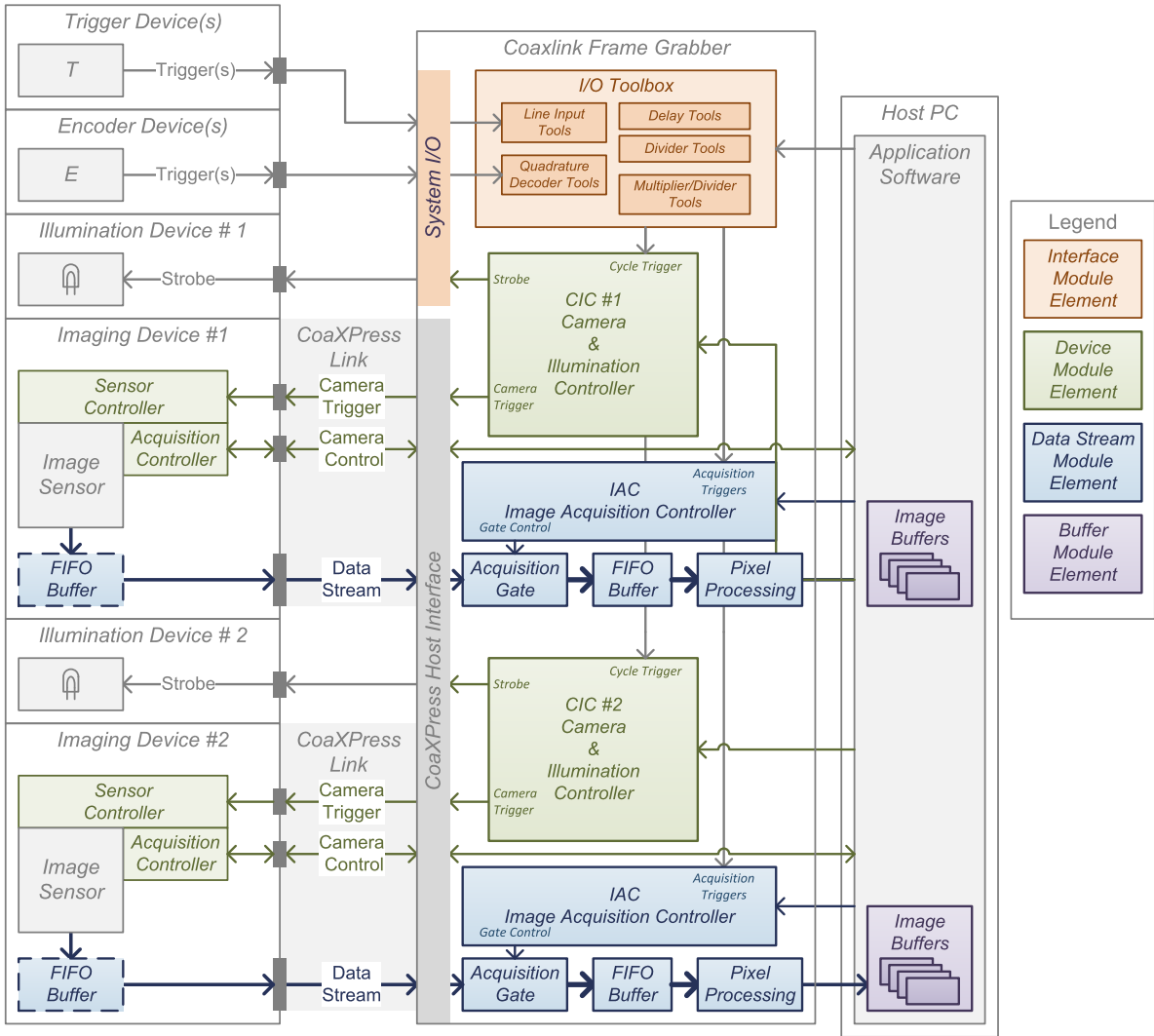
2-camera, 1-data-stream image acquisition system

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

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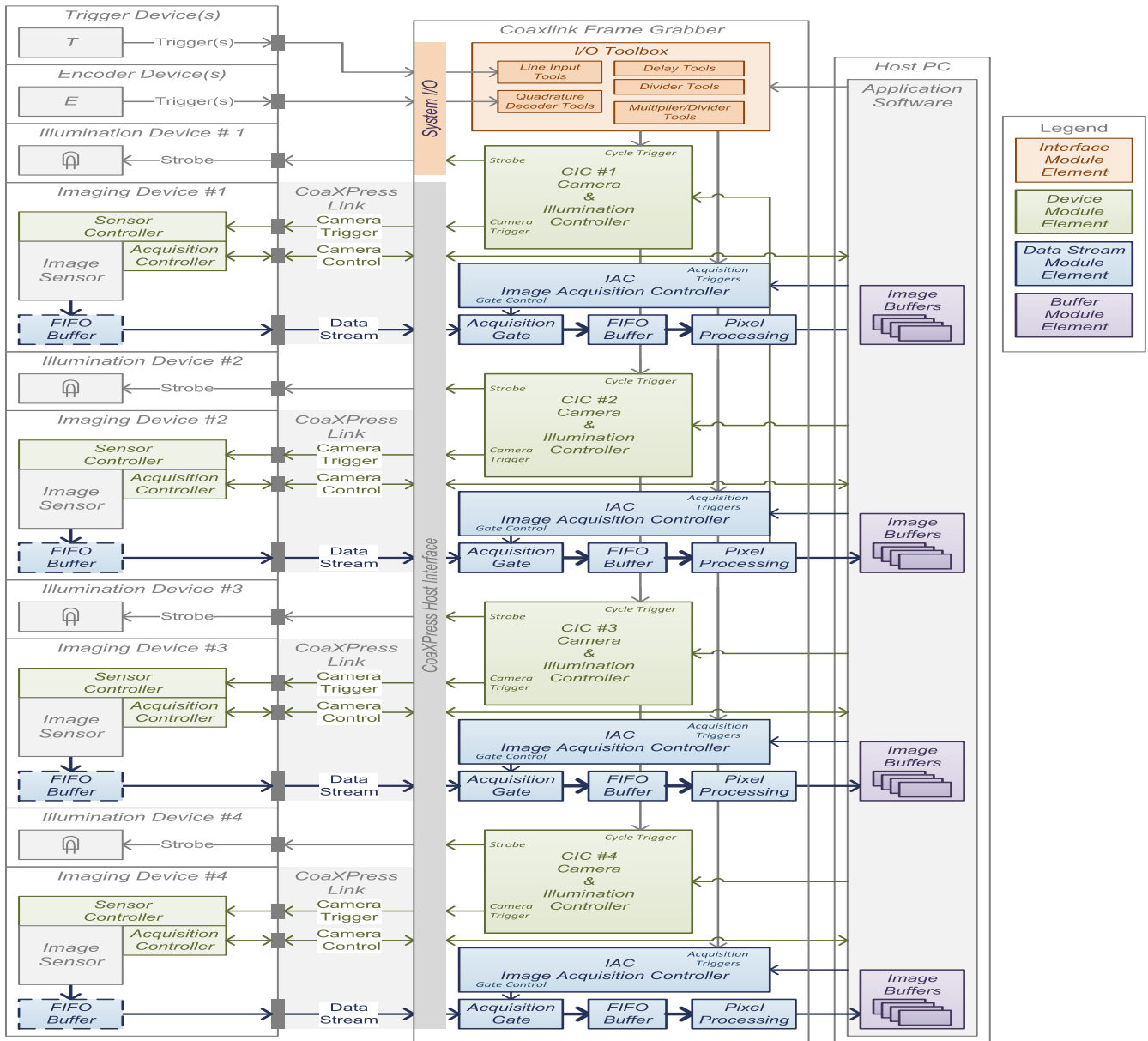
4-camera, 1-data-stream image acquisition system

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

1-camera, 4-data-stream

Trigger Device(s)

T

Trigger(s)

Encoder Device(s)

E

Trigger(s)

Illumination Device

Strobe

Coaxlink Frame Grabber

I/O Toolbox

Line Input Tools

Delay Tools

Divider Tools

Quadrature Decoder Tools

Multiplier/Divider Tools

System I/O

Cycle Trigger

Strobe

CIC
Camera
&
Illumination
Controller

Camera Trigger

Host PC

Application Software

CoaXPress Link

Camera Trigger

Camera Control

4-data-stream Imaging Device (Camera)

CoaXPress Host Interface

Data Stream

Data Stream

Data Stream

Data Stream

IAC
Image Acquisition Controller

Acquisition Triggers

Gate Control

Acquisition Gate

FIFO Buffer

Pixel Processing

IAC
Image Acquisition Controller

Acquisition Triggers

Gate Control

Acquisition Gate

FIFO Buffer

Pixel Processing

IAC
Image Acquisition Controller

Acquisition Triggers

Gate Control

Acquisition Gate

FIFO Buffer

Pixel Processing

IAC
Image Acquisition Controller

Acquisition Triggers

Gate Control

Acquisition Gate

FIFO Buffer

Pixel Processing

Image Buffers

Image Buffers

Image Buffers

Image Buffers

Legend

Interface Module Element

Device Module Element

Data Stream Module Element

Buffer Module Element

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

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 RGBI 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	*Not supported*

Supported tap configurations and geometries

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 354 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
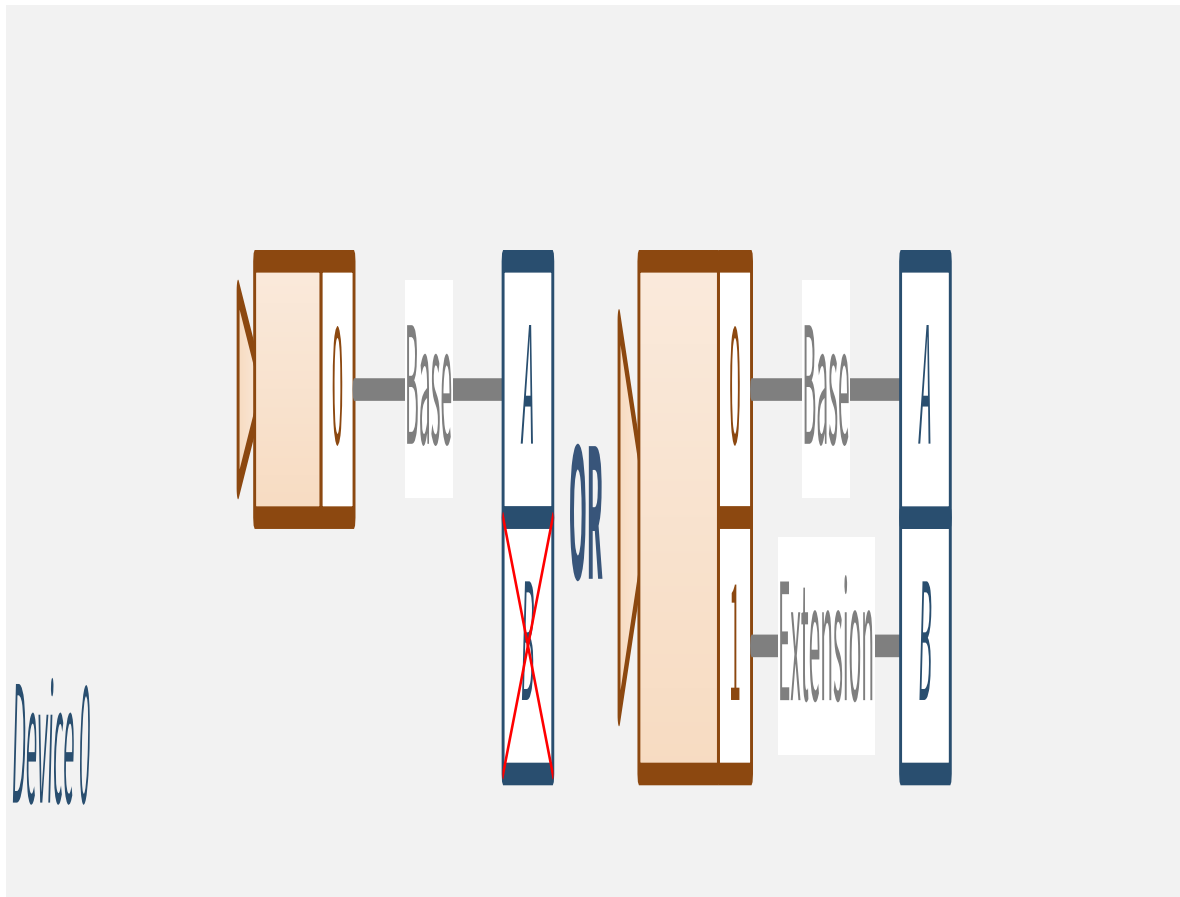
2D11 host connections map

Applies to 1628 Grablink Duo

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

One or two 1-connection devices

Device 0	▷ ▭ 0 —Base— A
Device 1	▷ ▭ 0 —Base— B
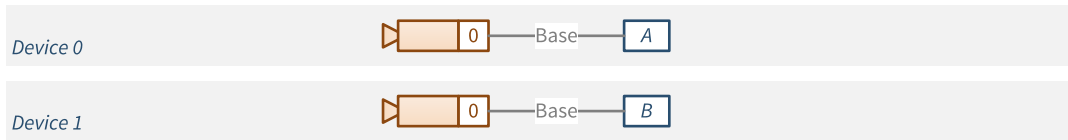
2.3. Camera Link Configurations

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**
> - [1]These frame grabbers are exclusively operated with the MultiCam driver. They are shown here for comparison purpose.
> - [2]Value 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**
> ☐ [1]These frame grabbers are exclusively operated with the MultiCam driver. They are shown here for comparison purpose.
> ☐ [2]Value 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 ClPoClAuto and ClPoClTurnOff GenApi features of the interface module.

- a PoCL status through the ClPoClStatus GenApi feature of the interface module..

- a PoCL power input status through the ClPoClPowerInputStatus 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 pource 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 363

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	kΩ
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 2.5 Ω 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 Ω/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.
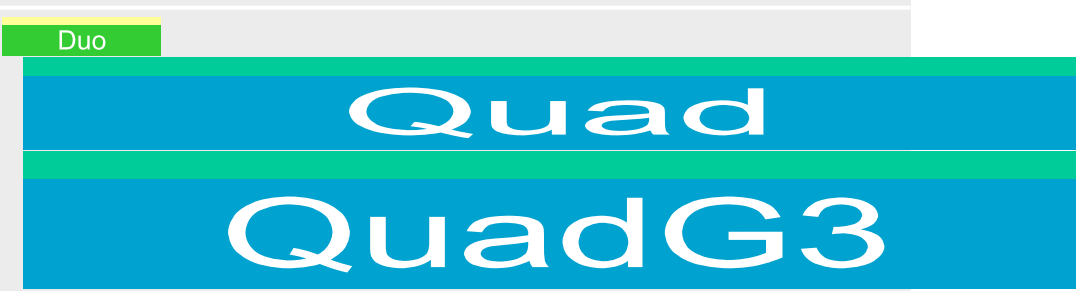
> **NOTE**
> *Tap Configuration* is a Euresys proprietary taxonomy that integrates, the channel link configuration, the number of taps and the pixel bit depth.

For each entry, it specifies:

1. **CL2.1 Name:** The name of the configuration as written in the section 4 of version 2.1 of the Camera Link standard

2. **Euresys Name:**The Euresys name of the configuration.

3. **Compatible products:** The list of Grablink products supporting that configuration. An empty cell indicates that the configuration is not supported.

8-bit Tap Configurations
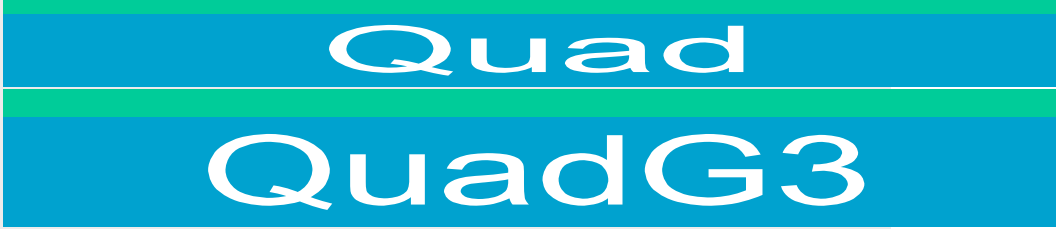
Monochrome 8-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Lite	LITE_1T8	Quad / QuadG3
Base 1 tap	BASE_1T8	Duo / Quad / QuadG3 / Full
Base 2 taps	BASE_2T8	Duo / Quad / QuadG3 / Full
Base 3 taps	BASE_3T8	Duo / Quad / QuadG3

CL2.1 Name	Euresys Name	Compatible products
		Full
Medium 4 taps	MEDIUM_4T8	Duo / Full
Medium 5 taps	MEDIUM_5T8	Duo
Medium 6 taps	MEDIUM_6T8	Duo / Full
Full 7 taps	FULL_7T8	Duo
Full 8 taps	FULL_8T8	Duo / Full

CL2.1 Name	Euresys Name	Compatible products
Full 9 taps	DECA_ 9T8	Duo ... Full
80-bit 10 taps	DECA_ 10T8	Duo ... Full

RGB 8-bit Tap Configurations
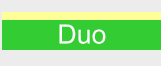
CL2.1 Name	Euresys Name	Compatible products
Base 1 tap	BASE_1T24	Duo, Quad, QuadG3, Full
Medium 2 taps	MEDIUM_2T24	Duo, Full
Full 3 taps	DECA_3T24	Duo, Full
80-bit 10 taps (3 slots)	DECA_10T24B3	Duo
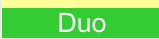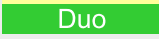
RGBI 8-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T32	Duo
Full 2 taps	FULL_2T32	Duo
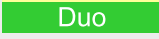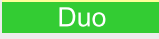
10-bit Tap Configurations

Monochrome 10-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Lite	LITE_1T10	Quad QuadG3
Base 1 tap	BASE_1T10	Duo Quad QuadG3 Full
Base 2 taps	BASE_2T10	Duo Quad QuadG3 Full
Medium 3 taps	MEDIUM_3T10	Duo Full
Medium 4	MEDIUM_4T10	Duo

CL2.1 Name	Euresys Name	Compatible products
taps		**Full** Duo
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** Duo

RGB 10-bit Tap Configurations

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

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

CL2.1 Name	Euresys Name	Compatible products

12-bit Tap Configurations

Monochrome 12-bit Tap Configurations

CL2.1 Name	Euresys Name	Compatible products
Base 1 tap	BASE_1T12	Duo / Quad / QuadG3 / Full
Base 2 taps	BASE_2T12	Duo / Quad / QuadG3 / Full
Medium 3 taps	MEDIUM_3T12	Duo / Full
Medium 4 taps	MEDIUM_4T12	Duo / Full

CL2.1 Name	Euresys Name	Compatible products		
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 2 taps	DECA_ 2T36	Duo		

Full
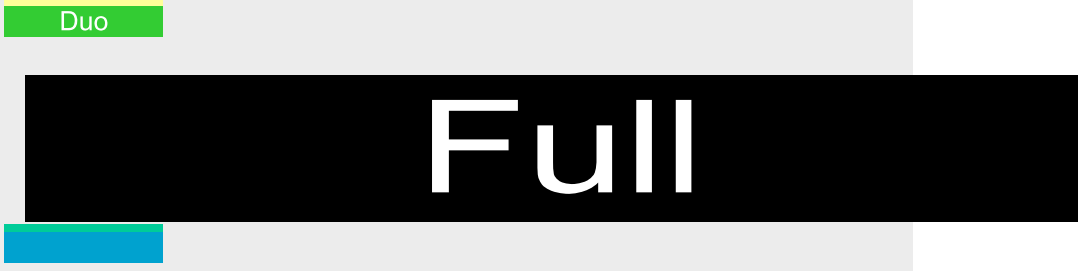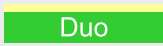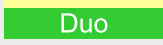
RGBI 12-bit Tap Configuration

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 · Quad · QuadG3 · Full
Medium 2 taps	MEDIUM_2T14	Duo · Full
Medium 3 taps	MEDIUM_3T14	Duo · Full
Full 4 taps	FULL_4T14	Duo
72-bit 5 taps	DECA_5T14	Duo

RGB 14-bit Tap Configurations
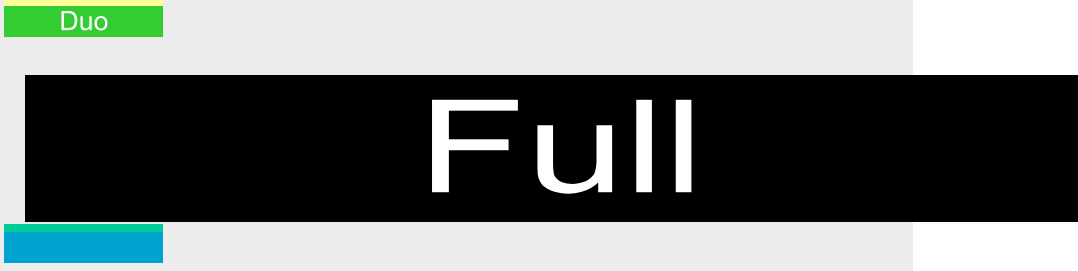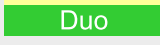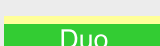
CL2.1 Name	Euresys Name	Compatible products
Medium 1 tap	MEDIUM_1T42	Duo ⬛ Full 🟦

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, Quad, QuadG3, Full
Medium 2 taps	MEDIUM_2T16	Duo, Full
Medium 3 taps	MEDIUM_3T16	Duo, Full
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

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:

$$<X\text{-}Geometry>\_<Y\text{-}Geometry>$$

<X-Geometry > and <Y-Geometry > composite fields

The <X-Geometry> composite field describes the geometrical organization of the taps along the X-direction (image row). It is composed as follows:

$$<X\text{-}Regions>X(<X\text{-}Taps>)(<X\text{-}Ext>)$$

The <Y-Geometry> composite field describes the geometrical organization of the taps along the Y-direction (image column). It is composed as follows:

$$<Y\text{-}Regions>Y(<Y\text{-}Taps>)(<Y\text{-}Ext>)$$

<X-Regions> and <Y-Regions> mandatory fields

The <X-Regions> field declares the number of regions encountered across the X-direction.

Values range: 1 to 10.

The <Y-Regions> field declares the number of regions encountered across the Y-direction .

Values range: 2 to 3. The field is omitted when <Y-Regions> = 1.

<X-Taps> and <Y-Taps> optional fields

The <X-Taps> 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 <X-Taps> = 1.

The <Y-Taps> 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 <Y-Taps> = 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	Ø

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	Ø

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

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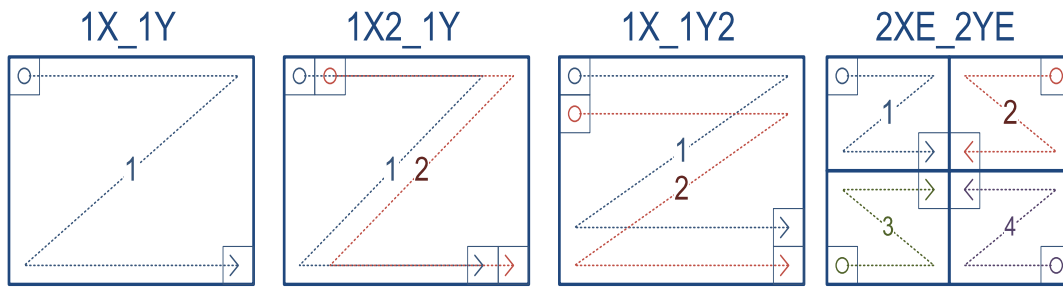
1X_1Y designates the tap geometry of a single-tap camera having 1 region across the X-direction and 1 region across the Y direction.

   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.
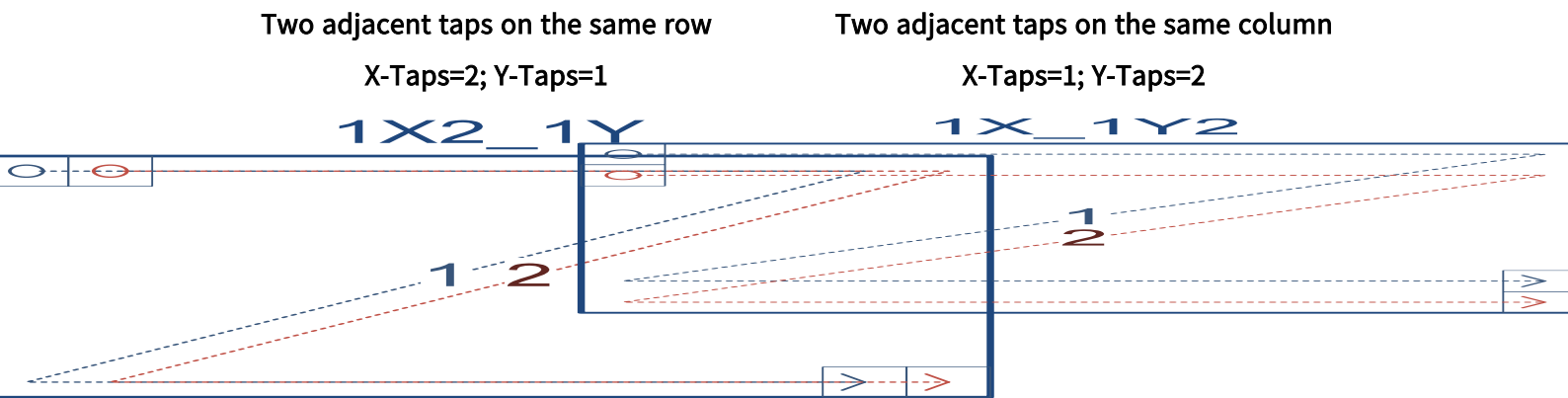
Region

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.

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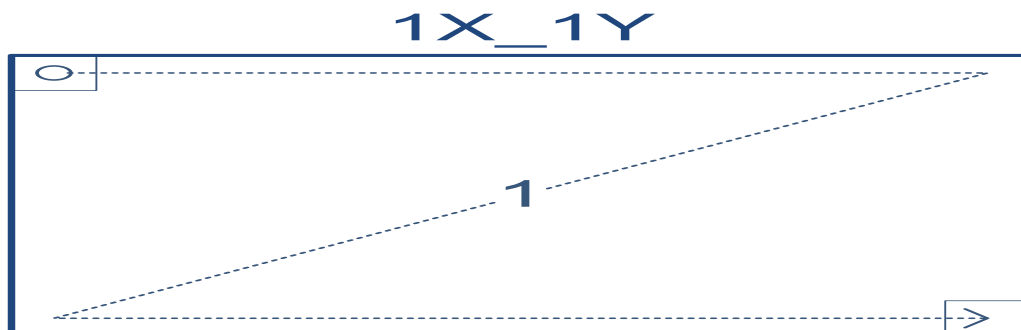
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W	1	1	H	1

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

Mono12LH

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

1X2__1Y2

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

1X2_2YE

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

QSFP+

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

1X3_1Y2

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

1X3_2YE

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

1X4_1Y

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

1X4_1Y2

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

1X4_2YE

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

1X5_1Y

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

1X6_1Y

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

1X7_1Y

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

1X8_1Y

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

1X10_1Y
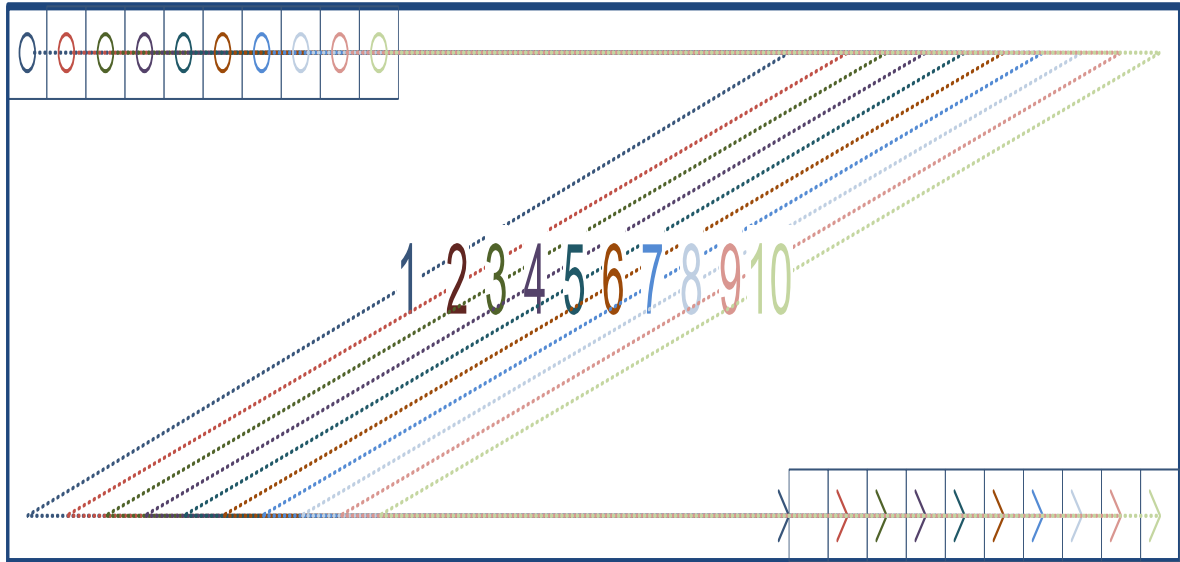
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W - 9	10	1	H	1
2	2	W - 8	10	1	H	1
3	3	W - 7	10	1	H	1
4	4	W - 6	10	1	H	1
5	5	W - 5	10	1	H	1
6	6	W - 4	10	1	H	1
7	7	W - 3	10	1	H	1
8	8	W - 2	10	1	H	1
9	9	W - 1	10	1	H	1
10	10	W	10	1	H	1

2XE_1Y Tap Geometry
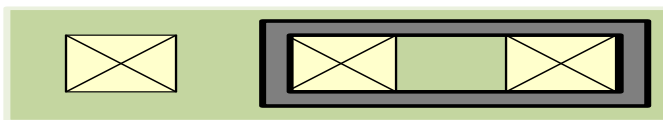
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H	1
2	W	W/2 + 1	-1	1	H	1

2XE_1Y2 Tap Geometry

2XE_1Y2
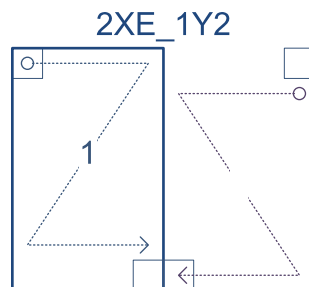
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H - 1	2
2	W	W/2 + 1	-1	1	H - 1	2
3	1	W/2	1	2	H	2
4	W	W/2 + 1	-1	2	H	2

2XE_2YE Tap Geometry

2XE_2YE

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

2XM_1Y

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

2XM_1Y2
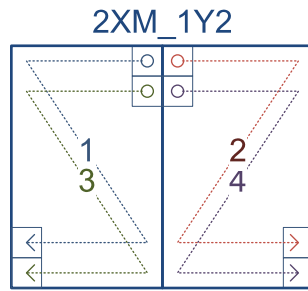
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H - 1	2
2	W/2 + 1	W	1	1	H - 1	2
3	W/2	1	-1	2	H	2
4	W/2 + 1	W	1	2	H	2

2XM_2YE Tap Geometry

2XM_2YE
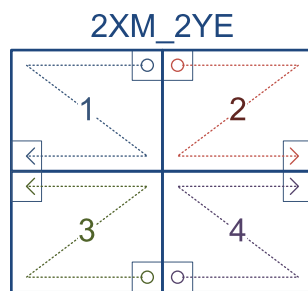
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H/2	1
2	W/2 + 1	W	1	1	H/2	1
3	W/2	1	-1	H	H/2 + 1	-1
4	W/2 + 1	W	1	H	H/2 + 1	-1

2XR_1Y Tap Geometry

2XR_1Y

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

2XR_1Y2
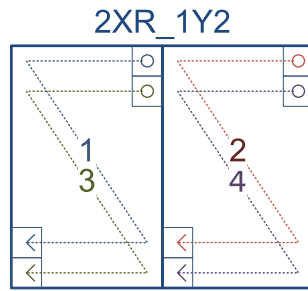
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H - 1	2
2	W	W/2 + 1	-1	1	H - 1	2
3	W/2	1	-1	2	H	2
4	W	W/2 + 1	-1	2	H	2

2XR_2YE Tap Geometry

2XR_2YE
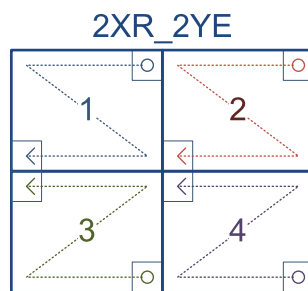
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2	1	-1	1	H/2	1
2	W	W/2 + 1	-1	1	H/2	1
3	W/2	1	-1	H	H/2 + 1	-1
4	W	W/2 + 1	-1	H	H/2 + 1	-1

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

2X_1Y2
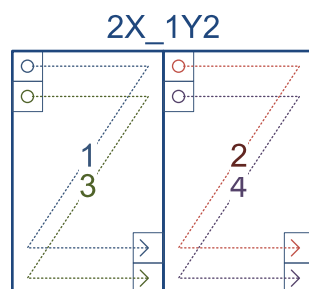
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H - 1	2
2	W/2 + 1	W	1	1	H - 1	2
3	1	W/2	1	2	H	2
4	W/2 + 1	W	1	1	H	2

2X_2YE Tap Geometry

2X_2YE
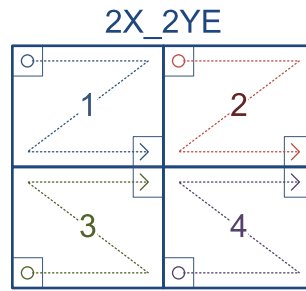
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2	1	1	H/2	1
2	W/2 + 1	W	1	1	H/2	1
3	1	W/2	1	H	H/2 + 1	-1
4	W/2 + 1	W	1	H	H/2 + 1	-1

2X2E_1Y Tap Geometry

Mono12

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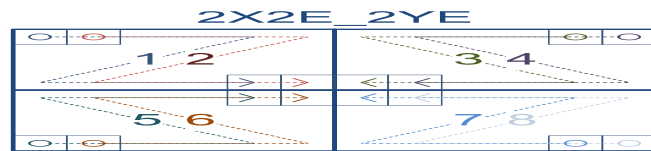
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2 - 1	2	1	H/2	1
2	2	W/2	2	1	H/2	1
3	W - 1	W/2 + 1	-2	1	H/2	1
4	W	W/2 + 2	-2	1	H/2	1
5	1	W/2 - 1	2	H	H/2 + 1	-1
6	2	W/2	2	H	H/2 + 1	-1
7	W - 1	W/2 + 1	-2	H	H/2 + 1	-1
8	W	W/2 + 2	-2	H	H/2 + 1	-1

2X2M_1Y Tap Geometry
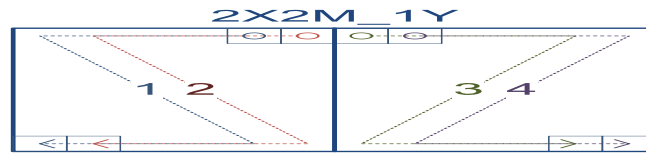
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2 - 1	1	-2	1	H	1
2	W/2	2	-2	1	H	1
3	W/2 + 1	W - 1	2	1	H	1
4	W/2 + 2	W	2	1	H	1

2X2M_1Y2 Tap Geometry
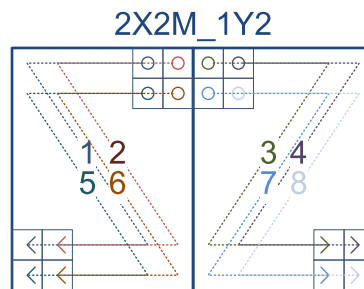
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2 - 1	1	-2	1	H-1	2
2	W/2	2	-2	1	H-1	2
3	W/2 + 1	W - 1	2	1	H-1	2
4	W/2 + 2	W	2	1	H-1	2
5	W/2 - 1	1	-2	2	H	2
6	W/2	2	-2	2	H	2
7	W/2 + 1	W - 1	2	2	H	2
8	W/2 + 2	W	2	2	H	2

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

2X2R_1Y2
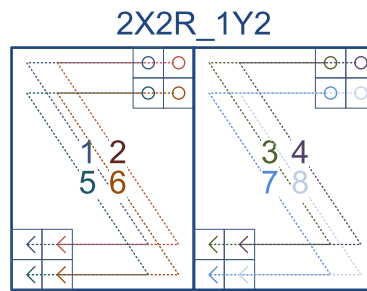
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2 - 1	1	-2	1	H-1	2
2	W/2	2	-2	1	H-1	2
3	W - 1	W/2 + 1	-2	1	H-1	2
4	W	W/2 + 2	-2	1	H-1	2
5	W/2 - 1	1	-2	2	H	2
6	W/2	2	-2	2	H	2
7	W - 1	W/2 + 1	-2	2	H	2
8	W	W/2 + 2	-2	2	H	2

2X2R_2YE Tap Geometry

2X2R_2YE
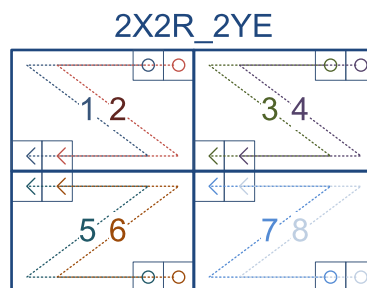
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2 - 1	1	-2	1	H/2	1
2	W/2	2	-2	1	H/2	1
3	W - 1	W/2 + 1	-2	1	H/2	1
4	W	W/2 + 2	-2	1	H/2	1
5	W/2 - 1	1	-2	H	H/2 + 1	1
6	W/2	2	-2	H	H/2 + 1	1
7	W - 1	W/2 + 1	-2	H	H/2 + 1	1
8	W	W/2 + 2	-2	H	H/2 + 1	1

2X2_1Y Tap Geometry
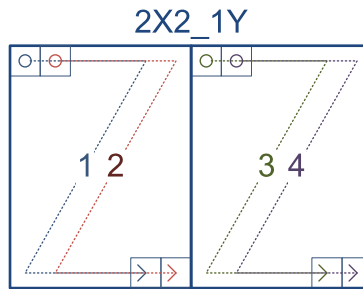
2X2_1Y

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

2X2_1Y2
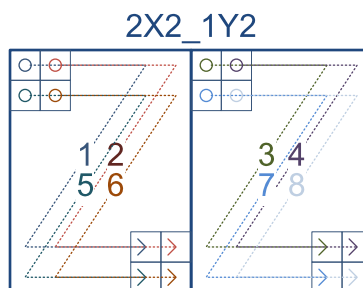
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2 - 1	2	1	H-1	2
2	2	W/2	2	1	H-1	2
3	W/2 + 1	W - 1	2	1	H-1	2
4	W/2 + 2	W	2	1	H-1	2
5	1	W/2 - 1	2	2	H	2
6	2	W/2	2	2	H	2
7	W/2 + 1	W - 1	2	2	H	2
8	W/2 + 2	W	2	2	H	2

2X2_2YE Tap Geometry

2X2_2YE
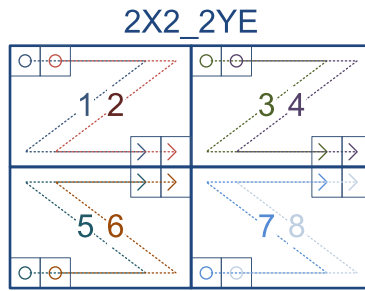
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2 - 1	2	1	H/2	1
2	2	W/2	2	1	H/2	1
3	W/2 + 1	W - 1	2	1	H/2	1
4	W/2 + 2	W	2	1	H/2	1
5	1	W/2 - 1	2	H	H/2 + 1	-1
6	2	W/2	2	H	H/2 + 1	-1
7	W/2 + 1	W - 1	2	H	H/2 + 1	-1
8	W/2 + 2	W	2	H	H/2 + 1	-1

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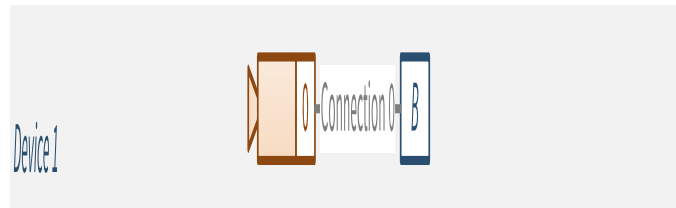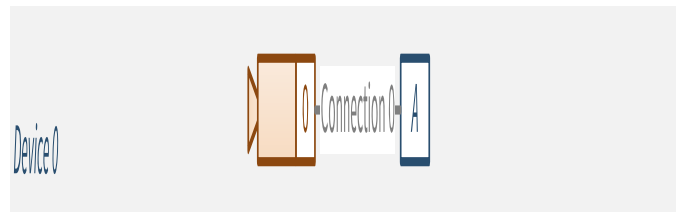
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/2 -3	4	1	H	1
2	2	W/2 - 2	4	1	H	1
3	3	W/2 - 1	4	1	H	1
4	4	W/2	4	1	H	1
5	W-3	W/2 + 1	-4	1	H	1
6	W-2	W/2 + 2	-4	1	H	1
7	W-1	W/2 + 3	-4	1	H	1
8	W	W/2 + 4	-4	1	H	1

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

2X4R_1Y
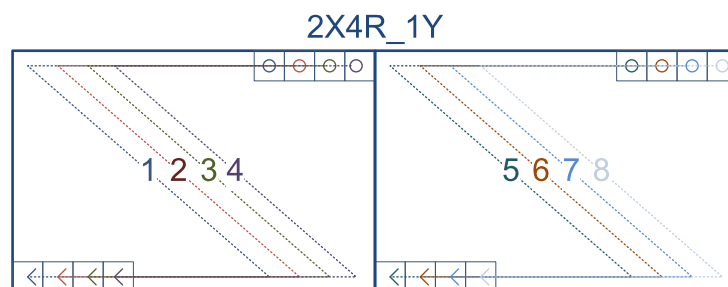
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/2 - 3	1	4	1	H	1
2	W/2 - 2	2	4	1	H	1
3	W/2 - 1	3	4	1	H	1
4	W/2	4	4	1	H	1
5	W-3	W/2 + 1	-4	1	H	1
6	W-2	W/2 + 2	-4	1	H	1
7	W-1	W/2 + 3	-4	1	H	1
8	W	W/2 + 4	-4	1	H	1

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
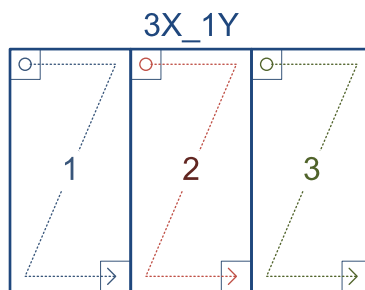
3X_1Y

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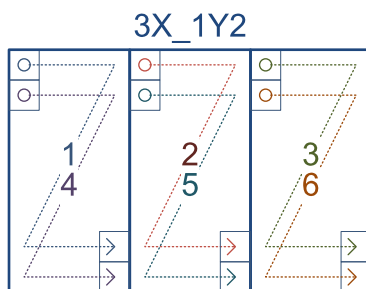
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3	1	1	H-1	2
2	W/3 + 1	2W/3	1	1	H-1	2
3	2W/3 + 1	W	1	1	H-1	2
4	1	W/3	1	2	H	2
5	W/3 + 1	2W/3	1	2	H	2
6	2W/3 + 1	W	1	2	H	2

3X_2YE Tap Geometry
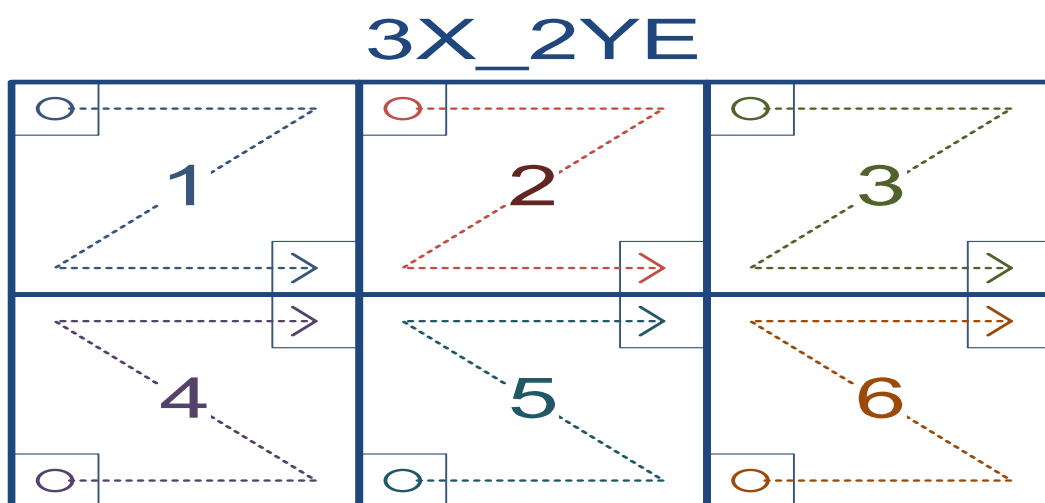
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3	1	1	H/2	1
2	W/3 + 1	2W/3	1	1	H/2	1
3	2W/3 + 1	W	1	1	H/2	1
4	1	W - 2	3	H	H/2 + 1	-1
5	Half/3 + 1	2W/3	1	H	H/2 + 1	-1
6	2W/3 + 1	W	1	H	H/2 + 1	-1

3X_1Y3 Tap Geometry
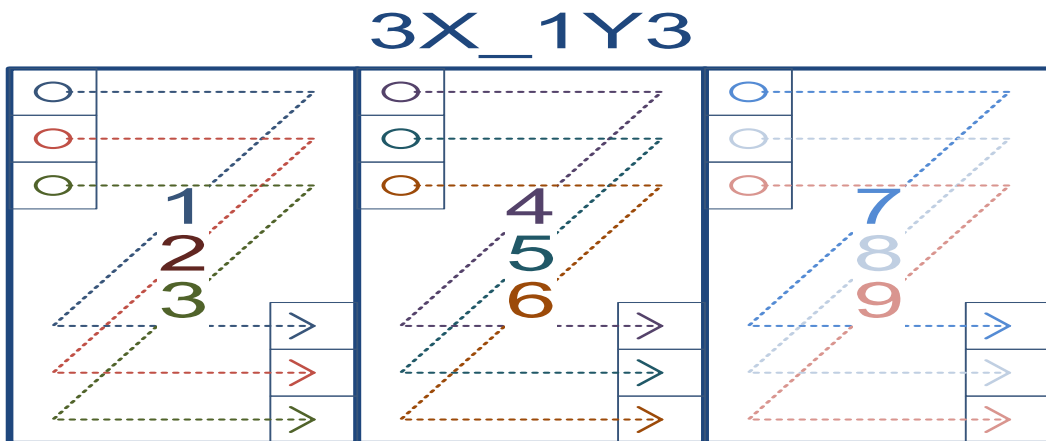
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3	1	1	H-2	3
2	1	W/3	1	2	H-1	3
3	1	W/3	1	3	H	3
4	W/3 + 1	2W/3	1	1	H-2	3
5	W/3 + 1	2W/3	1	2	H-1	3
6	W/3 + 1	2W/3	1	3	H	3
7	2W/3 + 1	W	1	1	H-2	3
8	2W/3 + 1	W	1	2	H-1	3
9	2W/3 + 1	W	1	3	H	3

3X2_1Y Tap Geometry
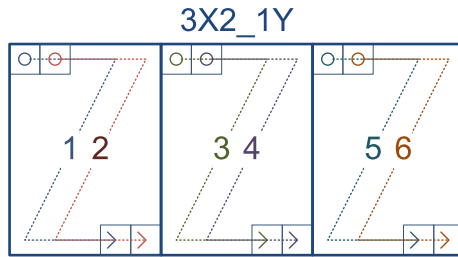
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/3 - 1	2	1	H	1
2	2	W/3	2	1	H	1
3	W/3 + 1	2W/3 - 1	2	1	H	1
4	W/3 + 2	2W/3	2	1	H	1
5	2W/3 + 1	W - 1	2	1	H	1
6	2W/3 + 2	W	2	1	H	1

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

4XE_1Y2
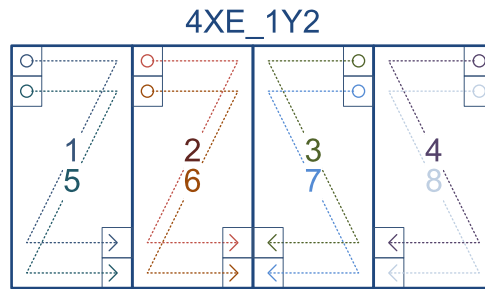
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H - 1	2
2	W/4 + 1	W/2	1	1	H - 1	2
3	3W/4	W/2 + 1	-1	1	H - 1	2
4	W	3W/4 + 1	-1	1	H - 1	2
5	1	W/4	1	2	H	2
6	W/4 + 1	W/2	1	2	H	2
7	3W/4	W/2 + 1	-1	2	H	2
8	W	3W/4 + 1	-1	2	H	2

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
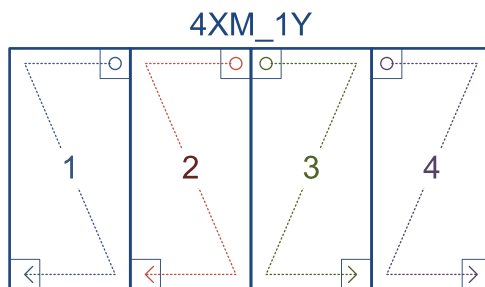
4XM_1Y

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

4XM_1Y2
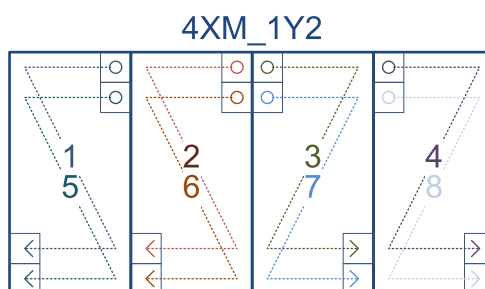
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/4	1	-1	1	H - 1	2
2	W/2	W/4 + 1	-1	1	H - 1	2
3	W/2 + 1	3W/4	1	1	H - 1	2
4	3W/4 + 1	W	1	1	H - 1	2
5	W/4	1	-1	2	H	2
6	W/2	W/4 + 1	-1	2	H	2
7	W/2 + 1	3W/4	1	2	H	2
8	3W/4 + 1	W	1	2	H	2

4XM_2YE Tap Geometry
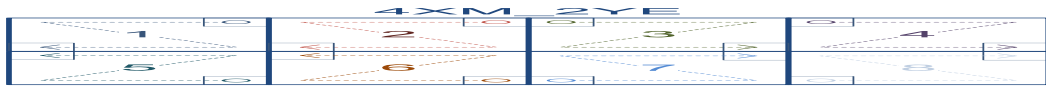
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/4	1	-1	1	H/2	1
2	W/2	W/4 + 1	-1	1	H/2	1
3	W/2 + 1	3W/4	1	1	H/2	1
4	3W/4 + 1	W	1	1	H/2	1
5	W/4	1	-1	H	H/2 + 1	-1
6	W/2	W/4 + 1	-1	H	H/2 + 1	-1
7	W/2 + 1	3W/4	1	H	H/2 + 1	-1
8	3W/4 + 1	W	1	H	H/2 + 1	-1

4XR_1Y Tap Geometry
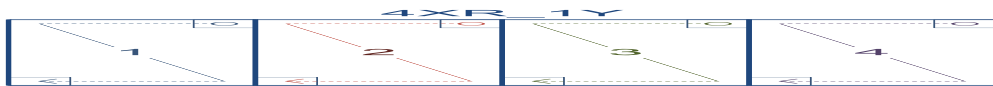
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/4	1	-1	1	H	1
2	W/2	W/4 + 1	-1	1	H	1
3	3W/4	W/2 + 1	-1	1	H	1
4	W	3W/4 + 1	-1	1	H	1

4XR_1Y2 Tap Geometry
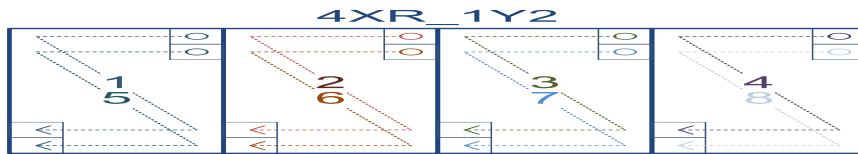
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/4	1	-1	1	H - 1	2
2	W/2	W/4 + 1	-1	1	H - 1	2
3	3W/4	W/2 + 1	-1	1	H - 1	2
4	W	3W/4 + 1	-1	1	H - 1	2
5	W/4	1	-1	2	H	2
6	W/2	W/4 + 1	-1	2	H	2
7	3W/4	W/2 + 1	-1	2	H	2
8	W	3W/4 + 1	-1	2	H	2

4XR_2YE Tap Geometry
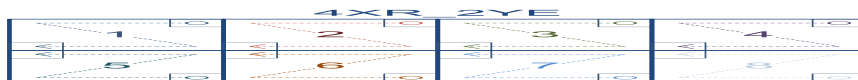
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/4	1	-1	1	H/2	1
2	W/2	W/4 + 1	-1	1	H/2	1
3	3W/4	W/2 + 1	-1	1	H/2	1
4	W	3W/4 + 1	-1	1	H/2	1
5	W/4	1	-1	H	H/2 + 1	-1
6	W/2	W/4 + 1	-1	H	H/2 + 1	-1
7	3W/4	W/2 + 1	-1	H	H/2 + 1	-1
8	W	3W/4 + 1	-1	H	H/2 + 1	-1

4X_1Y Tap Geometry
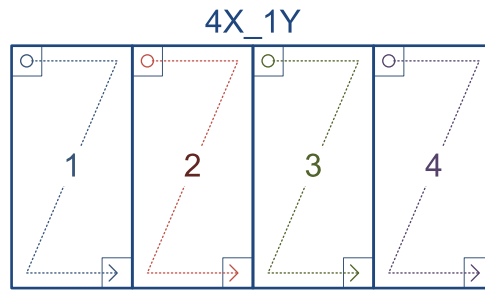
4X_1Y

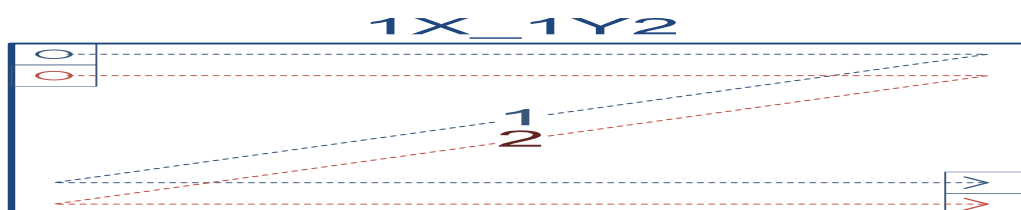| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H	1
2	W/4 + 1	W/2	1	1	H	1
3	W/2 + 1	3W/4	1	1	H	1
4	3W/4 + 1	W	1	1	H	1

4X_1Y2 Tap Geometry

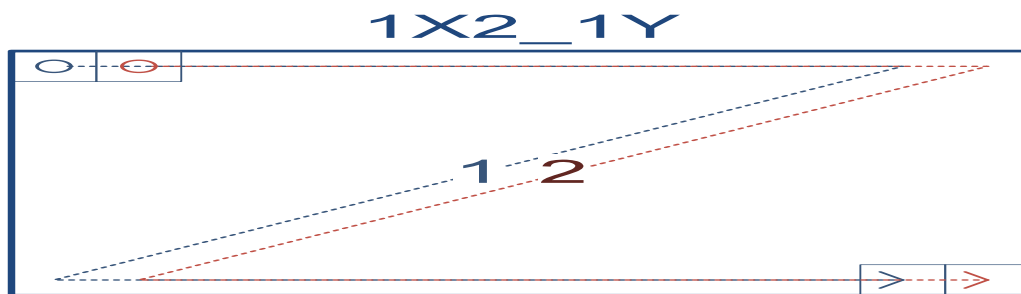| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H - 1	2
2	W/4 + 1	W/2	1	1	H - 1	2
3	W/2 + 1	3W/4	1	1	H - 1	2
4	3W/4 + 1	W	1	1	H - 1	2
5	1	W/4	1	2	H	2
6	W/4 + 1	W/2	1	2	H	2
7	W/2 + 1	3W/4	1	2	H	2
8	3W/4 + 1	W	1	2	H	2

4X_2YE Tap Geometry

4X_2YE
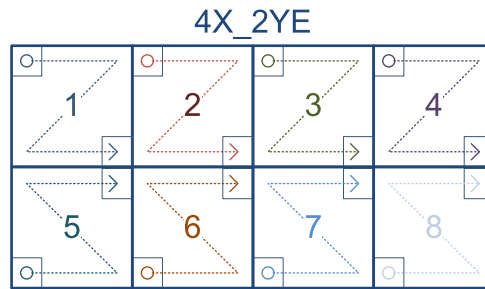
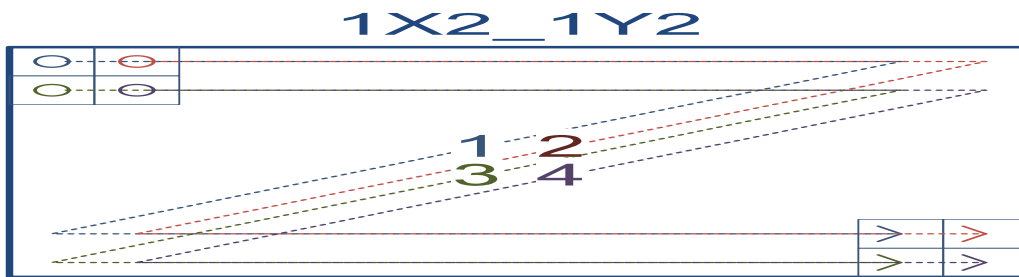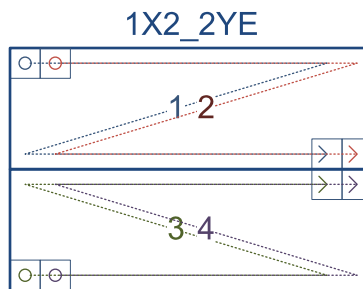| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4	1	1	H/2	1
2	W/4 + 1	W/2	1	1	H/2	1
3	W/2 + 1	3W/4	1	1	H/2	1
4	3W/4 + 1	W	1	1	H/2	1
5	1	W/4	1	H	H/2 + 1	-1
6	W/4 + 1	W/2	1	H	H/2 + 1	-1
7	W/2 + 1	3W/4	1	H	H/2 + 1	-1
8	3W/4 + 1	W	1	H	H/2 + 1	-1

4X2E_1Y Tap Geometry

4X2E_1Y
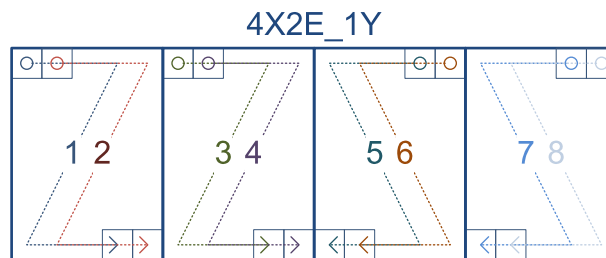
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4 - 1	2	1	H	1
2	2	W/4	2	1	H	1
3	W/4 + 1	W/2 - 1	2	1	H	1
4	W/4 + 2	W/2	2	1	H	1
5	3W/4 - 1	W/2 + 1	-2	1	H	1
6	3W/4	W/2 + 2	-2	1	H	1
7	W - 1	3W/4 + 1	-2	1	H	1
8	W	3W/4 + 2	-2	1	H	1

4X2M_1Y Tap Geometry

4X2M_1Y
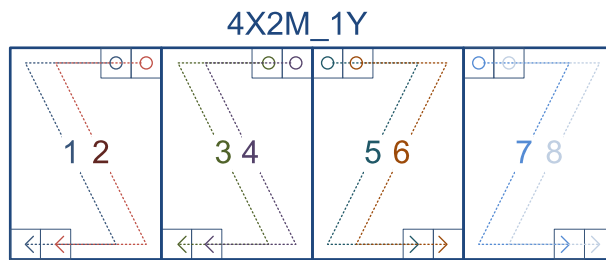
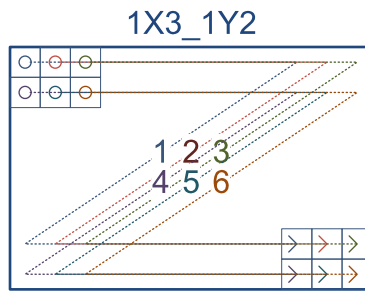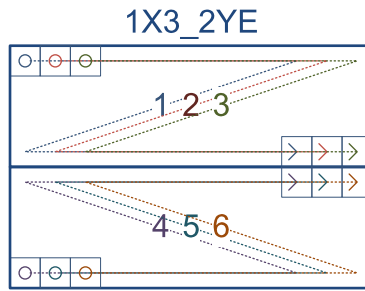| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/4 - 1	1	-2	1	H	1
2	W/4	2	-2	1	H	1
3	W/2 - 1	W/4 + 1	-2	1	H	1
4	W/2	W/4 + 2	-2	1	H	1
5	W/2 + 1	3W/4 - 1	2	1	H	1
6	W/2 + 2	3W/4	2	1	H	1
7	3W/4 + 1	W - 1	2	1	H	1
8	3W/4 + 2	W	2	1	H	1

4X2R_1Y Tap Geometry

4X2R_1Y
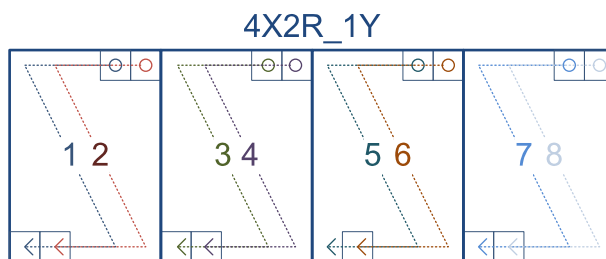
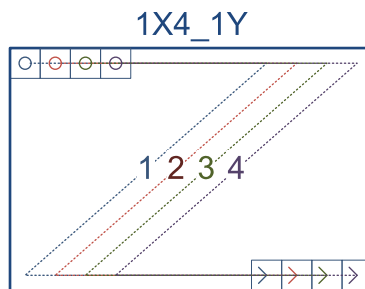| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/4 - 1	1	-2	1	H	1
2	W/4	2	-2	1	H	1
3	W/2 - 1	W/4 + 1	-2	1	H	1
4	W/2	W/4 + 2	-2	1	H	1
5	3W/4 - 1	W/2 + 1	-2	1	H	1
6	3W/4	W/2 + 2	-2	1	H	1
7	W - 1	3W/4 + 1	-2	1	H	1
8	W	3W/4 + 2	-2	1	H	1

4X2_1Y Tap Geometry

4X2_1Y
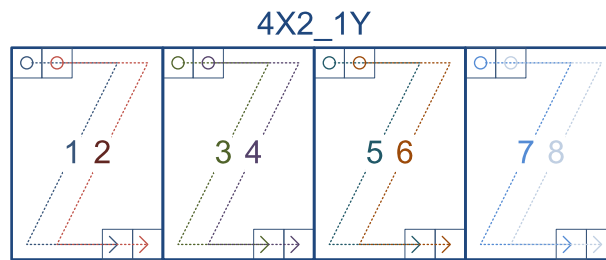
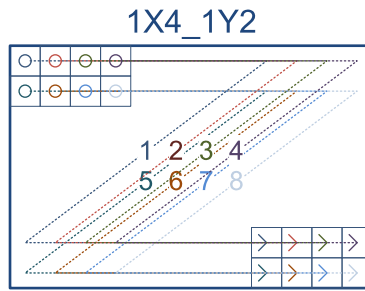| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/4 - 1	2	1	H	1
2	2	W/4	2	1	H	1
3	W/4 + 1	W/2 - 1	2	1	H	1
4	W/4 + 2	W/2	2	1	H	1
5	W/2 + 1	3W/4 - 1	2	1	H	1
6	W/2 + 2	3W/4	2	1	H	1
7	3W/4 + 1	W - 1	2	1	H	1
8	3W/4 + 2	W	2	1	H	1

5X_1Y Tap Geometry

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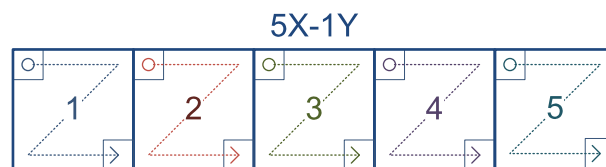
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/5	1	1	H	1
2	W/5 + 1	2W/5	1	1	H	1
3	2W/5 + 1	3W/5	1	1	H	1
4	3W/5 + 1	4W/5	1	1	H	1
5	4W/5 + 1	W	1	1	H	1

6X_1Y Tap Geometry

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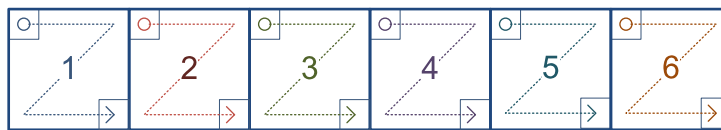
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/6	1	1	H	1
2	W/6 + 1	2W/6	1	1	H	1
3	2W/6 + 1	3W/6	1	1	H	1
4	3W/6 + 1	4W/6	1	1	H	1
5	4W/6 + 1	5W/6	1	1	H	1
6	5W/6 + 1	W	1	1	H	1

7X_1Y Tap Geometry

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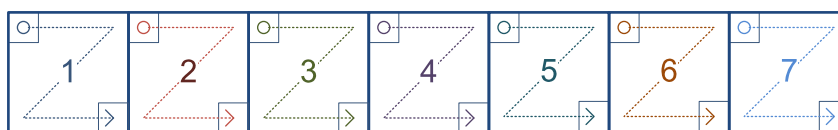
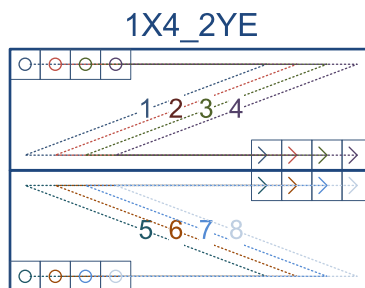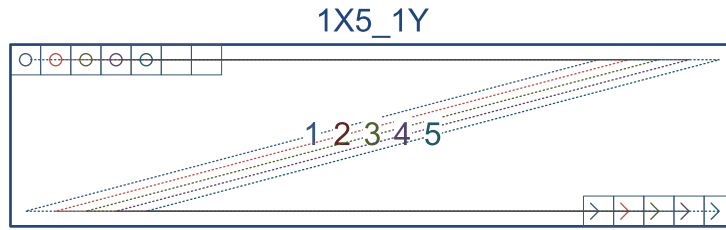| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/7	1	1	H	1
2	W/7 + 1	2W/7	1	1	H	1
3	2W/7 + 1	3W/7	1	1	H	1
4	3W/7 + 1	4W/7	1	1	H	1
5	4W/7 + 1	5W/7	1	1	H	1
6	5W/7 + 1	6W/7	1	1	H	1
7	6W/7 + 1	W	1	1	H	1

8XE_1Y Tap Geometry

8XE-1Y

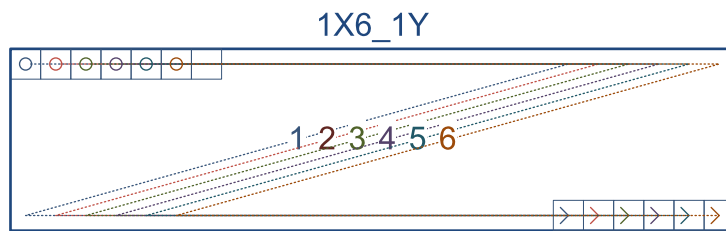| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/8	1	1	H	1
2	W/8 + 1	2W/8	1	1	H	1
3	2W/8 + 1	3W/8	1	1	H	1
4	3W/8 + 1	4W/8	1	1	H	1
5	5W/8	4W/8 + 1	-1	1	H	1
6	6W/8	5W/8 + 1	-1	1	H	1
7	7W/8	6W/8 + 1	-1	1	H	1
8	W	7W/8 + 1	-1	1	H	1

8XM_1Y Tap Geometry

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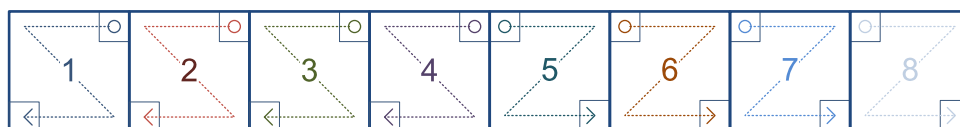
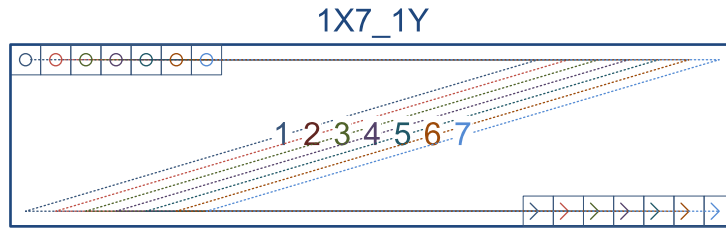| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/8	1	-1	1	H	1
2	2W/8	W/8 + 1	-1	1	H	1
3	3W/8	2W/8 + 1	-1	1	H	1
4	4W/8	3W/8 + 1	-1	1	H	1
5	4W/8 + 1	5W/8	1	1	H	1
6	5W/8 + 1	6W/8	1	1	H	1
7	6W/8 + 1	7W/8	1	1	H	1
8	7W/8 + 1	W	1	1	H	1

8XR_1Y Tap Geometry

8XR-1Y

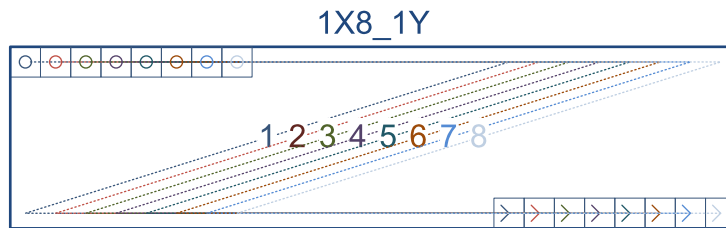| Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/8	1	-1	1	H	1
2	2W/8	W/8 + 1	-1	1	H	1
3	3W/8	2W/8 + 1	-1	1	H	1
4	4W/8	3W/8 + 1	-1	1	H	1
5	5W/8	4W/8 + 1	-1	1	H	1
6	6W/8	5W/8 + 1	-1	1	H	1
7	7W/8	6W/8 + 1	-1	1	H	1
8	W	7W/8 + 1	-1	1	H	1

8X_1Y Tap Geometry

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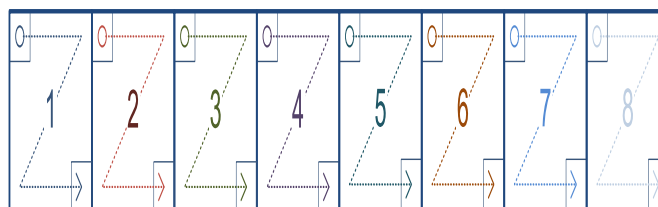
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/8	1	1	H	1
2	W/8 + 1	2W/8	1	1	H	1
3	2W/8 + 1	3W/8	1	1	H	1
4	3W/8 + 1	4W/8	1	1	H	1
5	4W/8 + 1	5W/8	1	1	H	1
6	5W/8 + 1	6W/8	1	1	H	1
7	6W/8 + 1	7W/8	1	1	H	1
8	7W/8 + 1	W	1	1	H	1

10XE_1Y Tap Geometry

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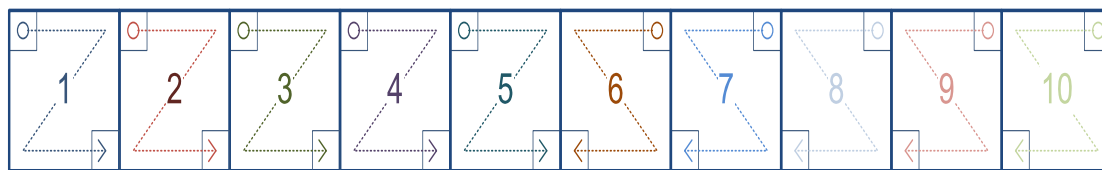
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/10	1	1	H	1
2	W/10 + 1	2W/10	1	1	H	1
3	2W/10 + 1	3W/10	1	1	H	1
4	3W/10 + 1	4W/10	1	1	H	1
5	4W/10 + 1	5W/10	1	1	H	1
6	6W/10	5W/10 + 1	-1	1	H	1
7	7W/10	6W/10 + 1	-1	1	H	1
8	8W/10	7W/10 + 1	-1	1	H	1
9	9W/10	8W/10 + 1	-1	1	H	1
10	W	9W/10 + 1	-1	1	H	1

10XM_1Y Tap Geometry

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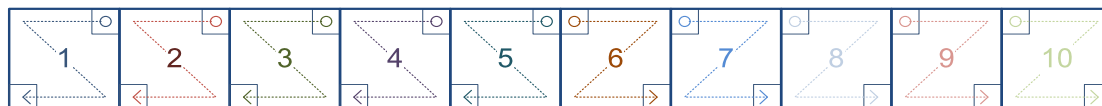
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/10	1	-1	1	H	1
2	2W/10	W/10 + 1	-1	1	H	1
3	3W/10	2W/10 + 1	-1	1	H	1
4	4W/10	3W/10 + 1	-1	1	H	1
5	5W/10	4W/10 + 1	-1	1	H	1
6	5W/10 + 1	6W/10	1	1	H	1
7	6W/10 + 1	7W/10	1	1	H	1
8	7W/10 + 1	8W/10	1	1	H	1
9	8W/10 + 1	9W/10	1	1	H	1
10	9W/10 + 1	W	1	1	H	1

10XR_1Y Tap Geometry

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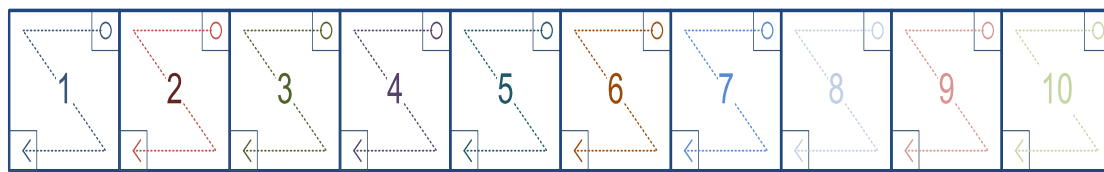
Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	W/10	1	-1	1	H	1
2	2W/10	W/10 + 1	-1	1	H	1
3	3W/10	2W/10 + 1	-1	1	H	1
4	4W/10	3W/10 + 1	-1	1	H	1
5	5W/10	4W/10 + 1	-1	1	H	1
6	6W/10	5W/10 + 1	-1	1	H	1
7	7W/10	6W/10 + 1	-1	1	H	1
8	8W/10	7W/10 + 1	-1	1	H	1
9	9W/10	8W/10 + 1	-1	1	H	1
10	W	9W/10 + 1	-1	1	H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

10X_1Y Tap Geometry

10X-1Y
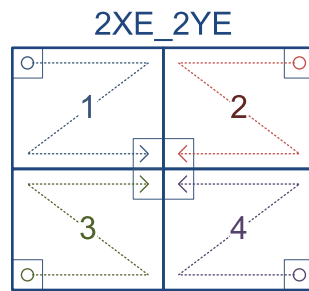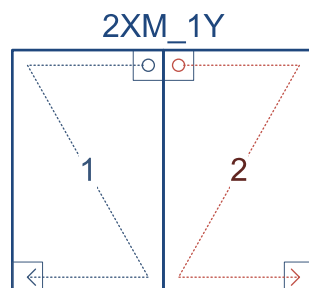

Tap#	X Start	X End	Step X	Y Start	Y End	Step Y
1	1	W/10	1	1	H	1
2	W/10 + 1	2W/10	1	1	H	1
3	2W/10 + 1	3W/10	1	1	H	1
4	3W/10 + 1	4W/10	1	1	H	1
5	4W/10 + 1	5W/10	1	1	H	1
6	5W/10 + 1	6W/10	1	1	H	1
7	6W/10 + 1	7W/10	1	1	H	1
8	7W/10 + 1	8W/10	1	1	H	1
9	8W/10 + 1	9W/10	1	1	H	1
10	9W/10 + 1	W	1	1	H	1

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 Grablink 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 128

- "LVAL Enable Signal" on page 130

- "DVAL Enable Signal" on page 133

- 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 Grablink boards, the enable signals are used differently according to the type of acquisition:

Area-scan image acquisition

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

- The rising edge of the "FVAL Enable Signal" on page 128 is used as a "Start-of-Frame". The falling edge is ignored.

- The rising edge of the "LVAL Enable Signal" on page 130 is used as a "Start-of-Line". The falling edge is ignored.

- The "DVAL Enable Signal" on page 133 can be used as a Camera Link clock qualifier[1].

- 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, Grablink frame grabbers use the Camera Link enable signals as follows:

- The "FVAL Enable Signal" on page 128 is ignored.

- The rising edge of the "LVAL Enable Signal" on page 130 is used as a "Start-of-Line". The falling edge is ignored.

- The "DVAL Enable Signal" on page 133 can be used as a Camera Link clock qualifier[1] .

- 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 Grablink 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.
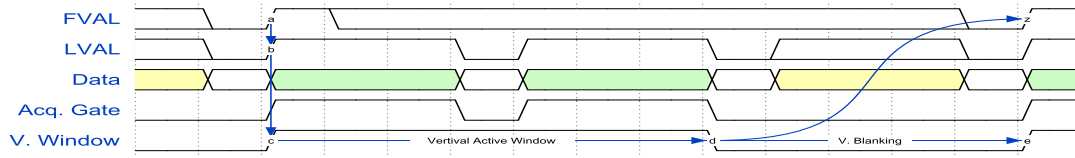
FVAL timing diagram (Default settings)

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:

Vertical Active Window [LVAL cycles] = Image height [lines]/ (Y-Regions × Y-Taps)

> **See also:** "Tap Geometry Glossary" on page 78

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.

Clock
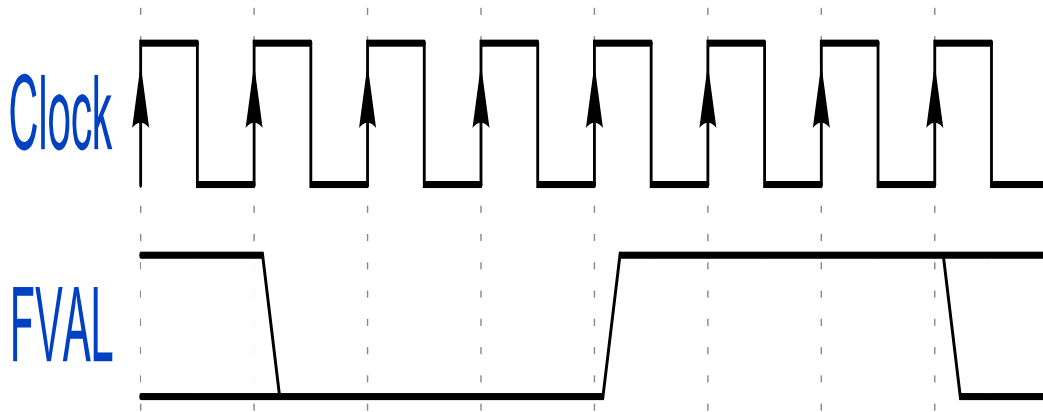
FVAL

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.
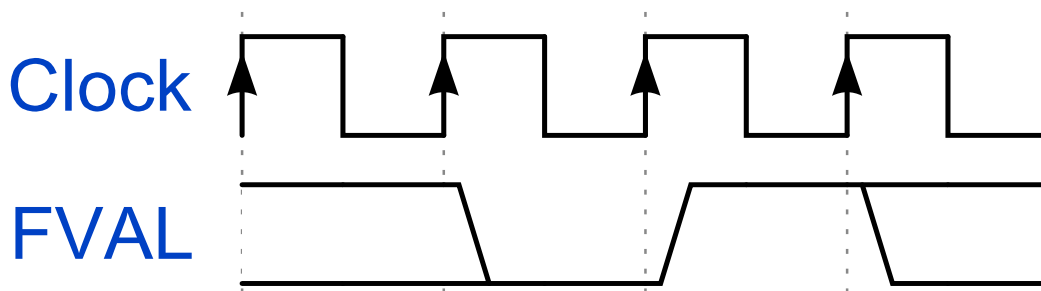
Clock

FVAL

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.
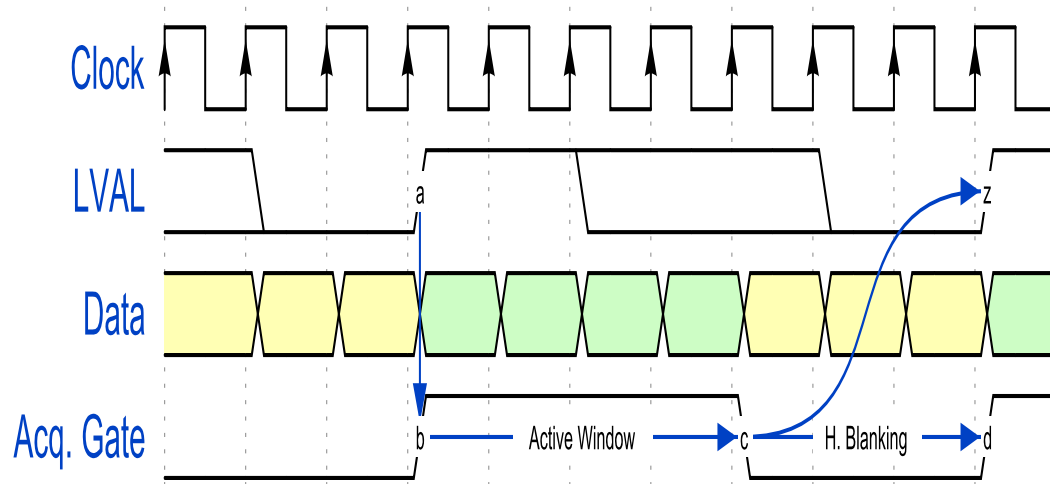
LVAL timing diagram (Default settings)

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:

Horizontal Active Window [Clock Cycles]= Image width [Pixels]/ (X-Regions × X-Taps)

> See also: "Tap Geometry Glossary" on page 78

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.
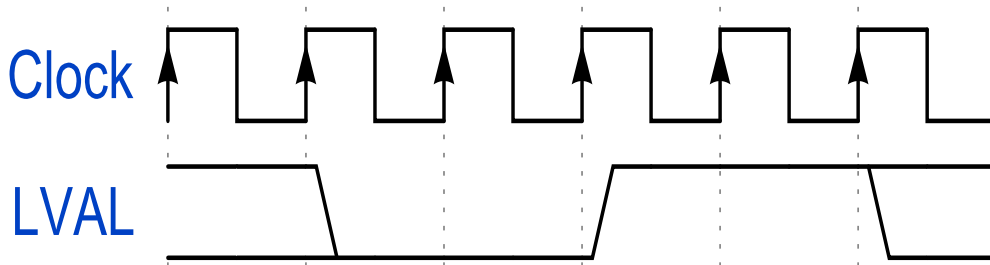
Valid LVAL rise transition - Filter enabled (Default settings)

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.
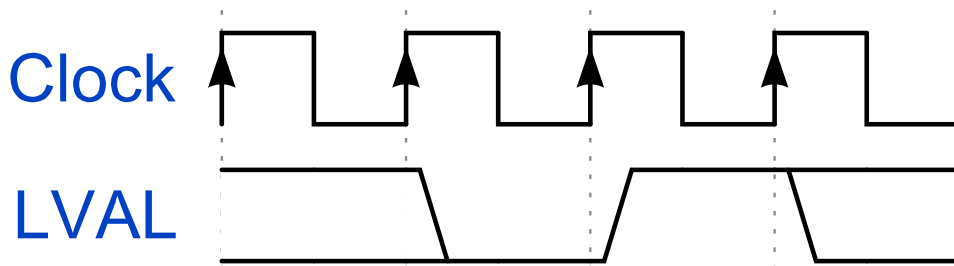
Valid LVAL rise transition - Filter disabled

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 gating[1]

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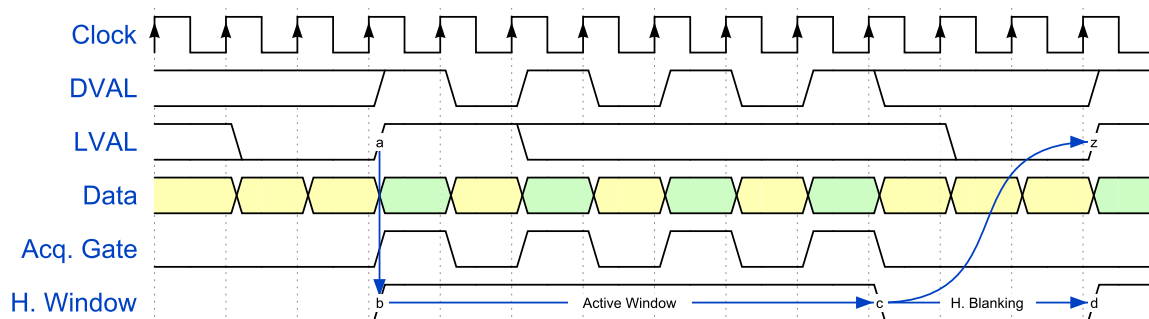
LVAL timing diagram with DVAL enabled

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 219, 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 219, 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.
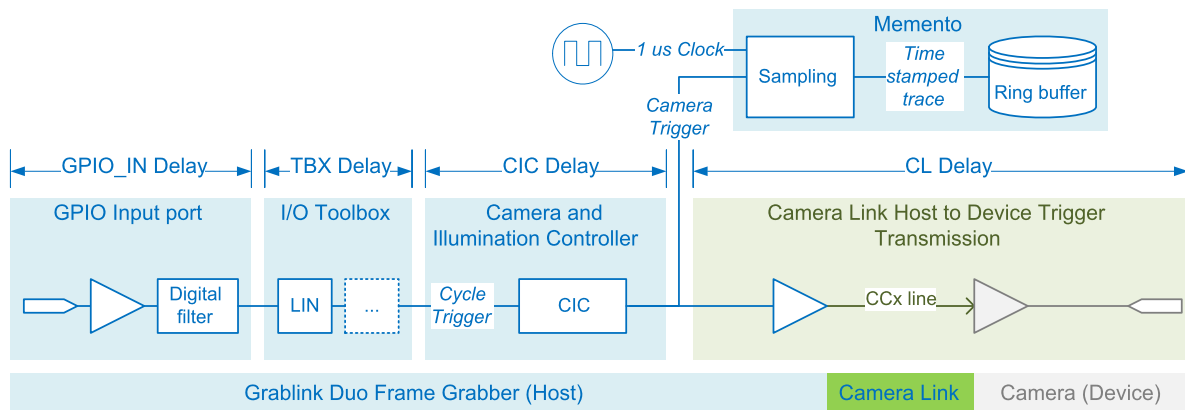
Elaboration of the Camera Trigger event

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:

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

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

GPIO electrical type	$\Delta t_{on/high}$	$\Delta t_{Off/high}$
"Differential Input (Version 1)" on page 367	50 ns	50 ns
"Differential Input/Output" on page 369	50 ns	50 ns
"TTL Input/Output (Version 2)" on page 372	50 ns	50 ns
"TTL Input/5 V CMOS Output" on page 375	50 ns	50 ns
"Isolated Input (Version 2)" on page 378	0.8 µs	1.35 µs

See also: "Line Filter Control" on page 248 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 254 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 209 and "CIC Timing Diagrams" on page 228

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 139.

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 141 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)

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

Duo12 (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)

[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+.

	Image data
Device 0	1/1

1D partition scheme

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 162 chain.

Area-scan acquisition

The gate opens and closes at frame boundaries based on the application's calls of the DSStartAcquisition and DSStopAcquisition 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 146 for more information and configuration instructions.

Line-scan acquisition

The gate opens and closes at line boundaries according to the application DSStartAcquisition and DSStopAcquisition 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 148 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-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)

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[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+.**

QSFP+ (1-camera), (1-camera, custom-logic)

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.

- When the buffer is too small to contain a complete frame, the remaining data is discarded.

6. Line-scan Acquisition

Applies to the following firmware variants of [1]

Duo (1-camera, line-scan), (2-camera, line-scan)

Duo104EMB
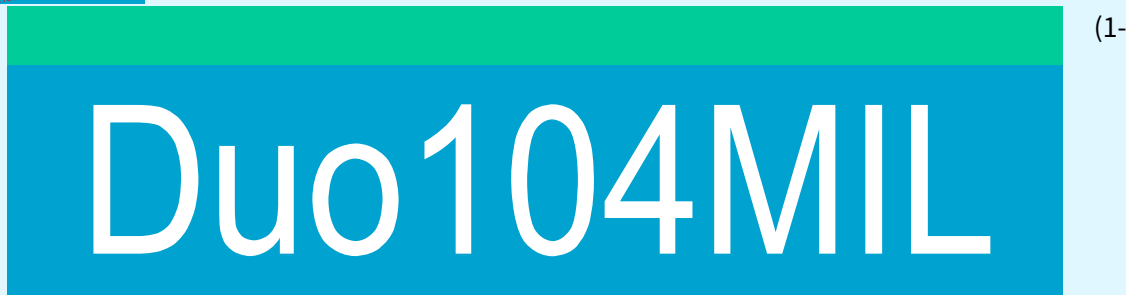
Duo104MIL (1-camera, line-scan)

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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[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
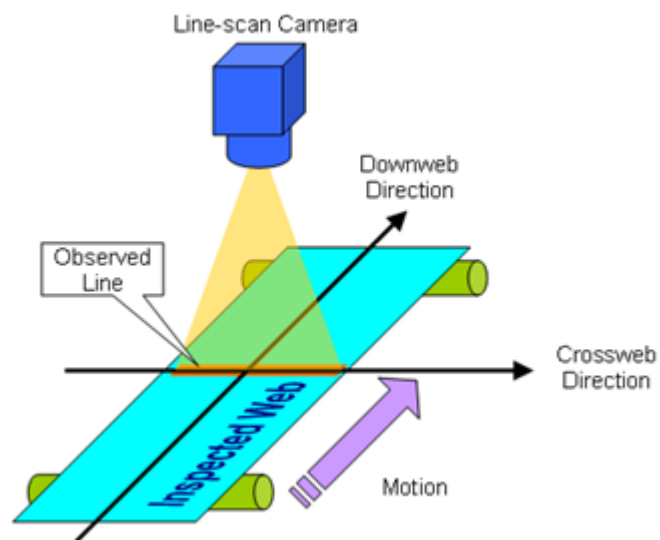
Typical line-scan imaging system

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
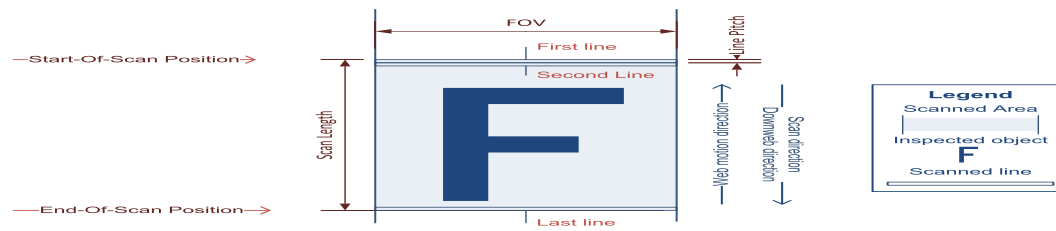
Scanning area definitions

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	**Variable Camera cycle.** The *web speed is variable* and the *camera cycle rate is kept proportional to the web speed.* The frame grabber builds the object image by capturing all the successive lines delivered by the camera.
CCC	**Constant Camera Cycle.** The camera operates at a constant cycle rate and the frame grabber captures all the successive lines delivered by the camera.

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
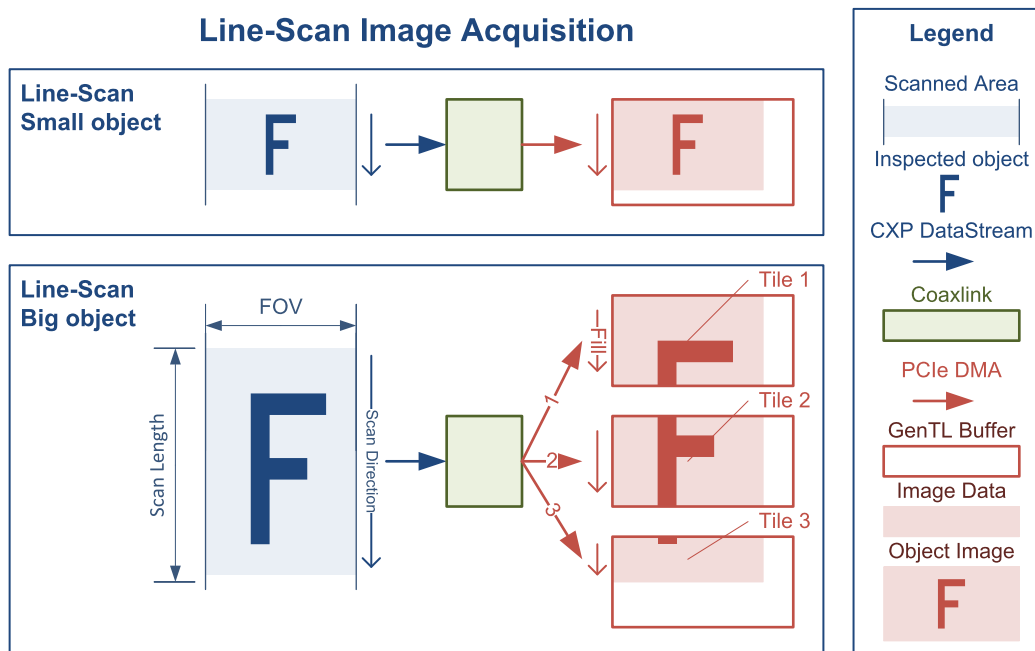
Image capture of small and large objects

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.
- 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:
  - When set to ContinueInNextBuffer, the acquisition continues into a new buffer and the filled buffer is made available to the application for processing.This is the default setting for line-scan acquisition.
  - When set to DiscardRemainingData, the remaining data is discarded.

- 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
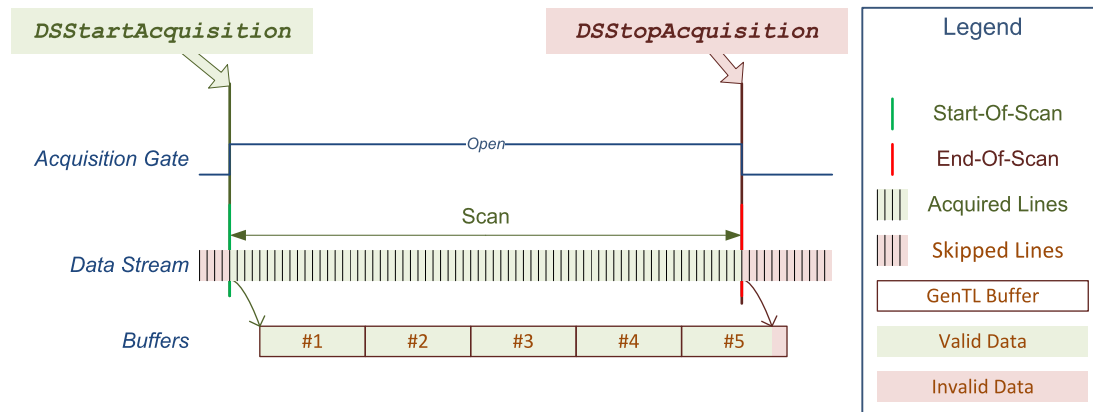
Scanning of continuous objects

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

The acquisition controller is configured as follows:

- StartOfScanTriggerSource = Immediate.
- EndOfScanTriggerSource = StopScan.

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

The acquisition gate closes when the application calls the DSStopAcquisition 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 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 automatically after the specified number of lines have been acquired or anticipatively when the application calls the DSStopAcquisition 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
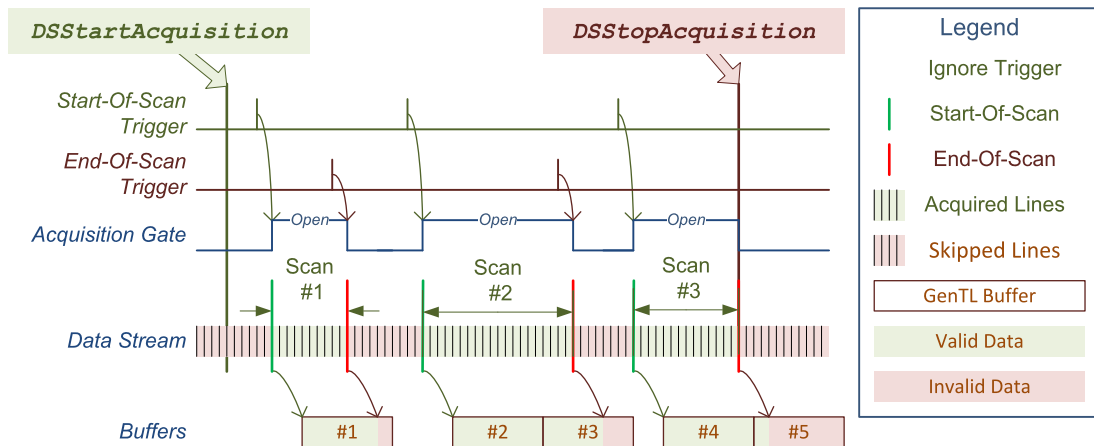
Scanning of discrete objects requiring a variable scan length

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.

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[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	BUFFER_INFO_ CUSTOM_ METADATA_ CONTENT_0	BUFFER_INFO_ CUSTOM_ METADATA_ CONTENT_1	BUFFER_INFO_ CUSTOM_ METADATA_ CONTENT_2	BUFFER_INFO_ CUSTOM_ METADATA_ CONTENT_3
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

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 168 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 170 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 168 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 185 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 165
- "Configurations for Bayer CFA cameras" on page 166

> ⚠️ **WARNING**
> No available processing for RGB and RGBa cameras on **Grablink Duo**!

Configurations for monochrome cameras
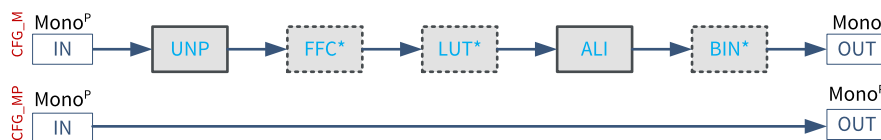
CFG_M configuration

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 (1-

Duo104MIL 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)

---

[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+.**

QSFP+   (1-camera), (1-camera, custom-logic), (1-camera, line-scan)

Introduction to LUT Processing

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

See also: "Monochrome Lookup Table Processing" on page 173 for a detailed description.

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

See also: "LUT Content Definition" on page 174

See also: "LUT Setup Procedure" on page 182 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			8
M_10x10	Mono10	10	10
M_10x16			16
M_12x8			8
M_12x12	Mono12	12	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 175, "Contrast" on page 176, "Visibility" on page 178 and "Negative" on page 179.

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 180 and "Negative" on page 179.

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 181.

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 174 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.
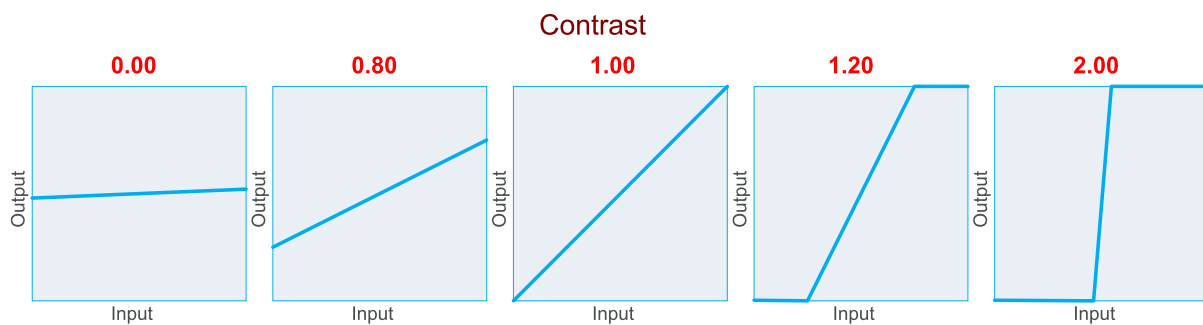
Effect of Brightness when all other controls are set to their default value:
Contrast = 1.00; Visibility = 0.00; Negative = FALSE.

Contrast

The Contrast parameter exclusively applies to the "Response Control" on page 174 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 174 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.
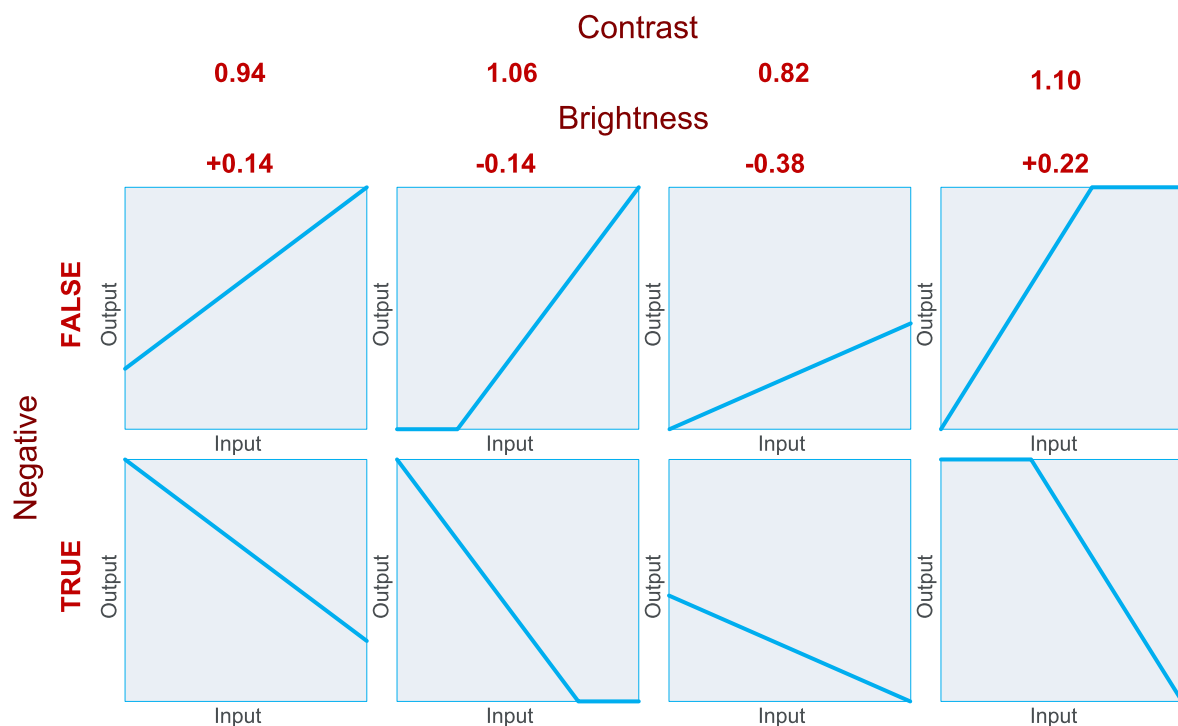
Effect of Visibility for typical values of Contrast and Brightness parameters assuming that Negative = FALSE

Negative

The Negative parameter applies to both the "Response Control" on page 174 and the "Emphasis" on page 174 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.
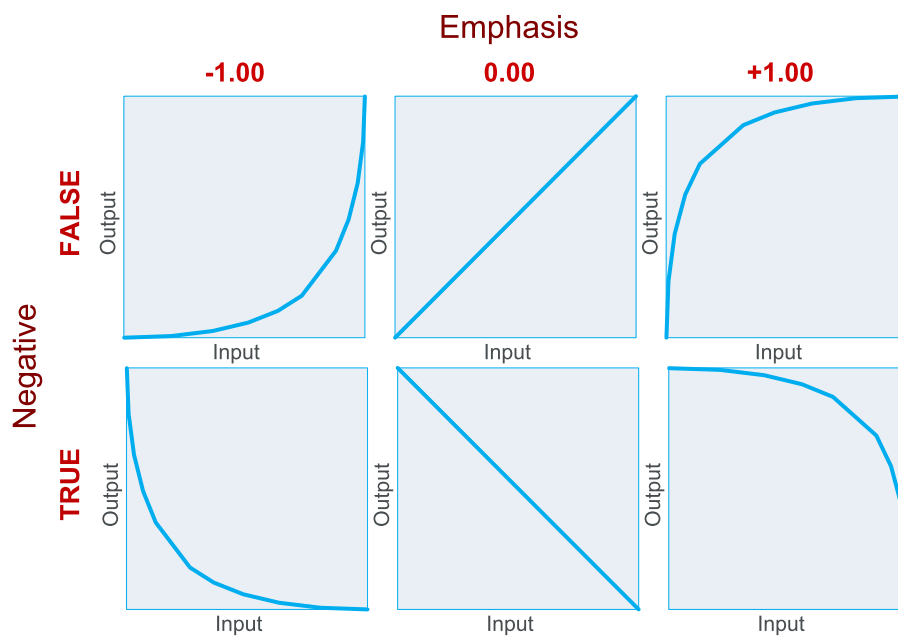
Effect of Negative for typical values of other controls

Emphasis

The Emphasis parameter exclusively applies to the "Emphasis" on page 174 lookup table definition method.

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

$$Output = Input^\gamma$$

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

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

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:

$$Emphasis = - \log_{10}\gamma$$
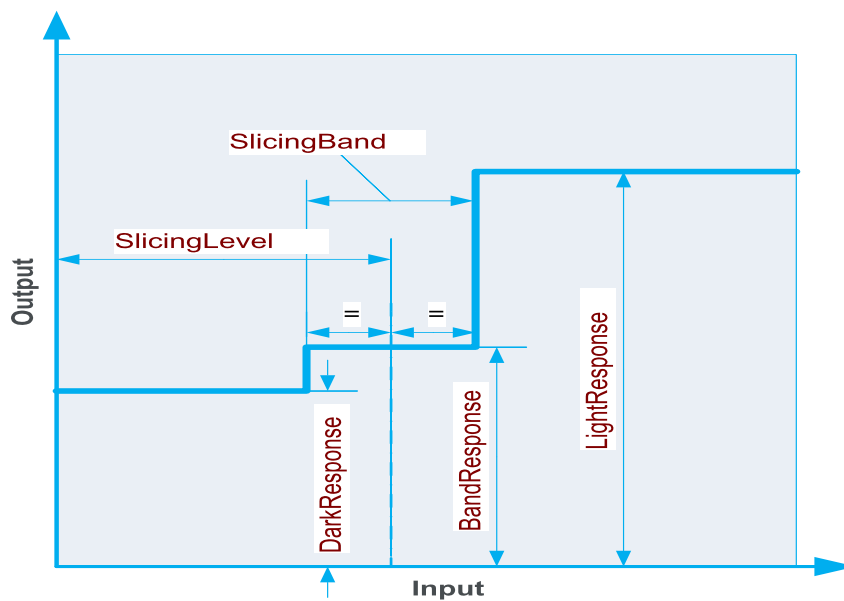
Emphasis effect for typical values of Emphasis and both values of Negative

SlicingLevel, SlicingBand, LightResponse, BandResponse and DarkResponse

SlicingLevel, SlicingBand, LightResponse, BandResponse and DarkResponse parameters exclusively apply to the "Threshold" on page 174 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
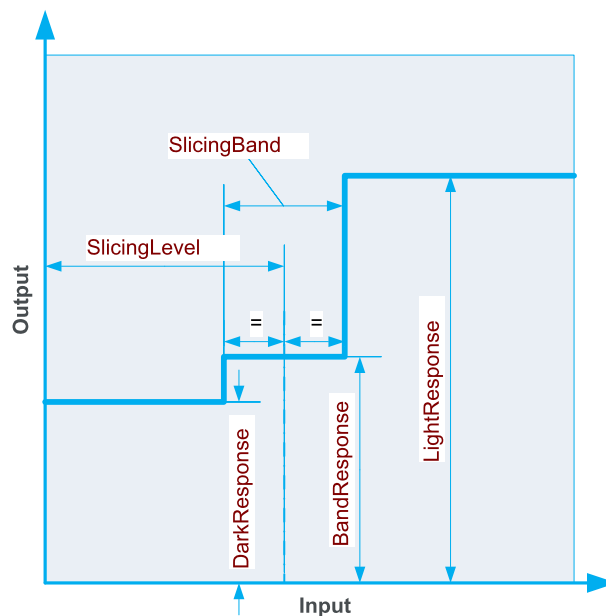
Double threshold transfer function

> **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 173 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 174 for a description of the parametric and tabular methods used for defining a lookup table content.

> NOTE
> At least one lookup table set must 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-4 | (4-camera) |

| Duo12 | Duo12LH | (1-camera) |

| Value12 | (1-camera) |

| Quad12DF | (1-camera), (1-df-camera) |

| QSFP+ | (1-camera) |

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 191 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-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 191 for an extensive description

> ⊘ **WARNING**
>
> **Applies to the following firmware variants of** [2]
>
> 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 168 control is inoperative, the frame grabber unpacks 10-bit, 12-bit or 14-bit pixels to lsb.
- the "Pixel Components Swapping" on page 195 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 transforms 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)
Formula	(a + b + 1) >> 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)
Value 1 formula	Min [Max(a,b); Max(c,d)]
Value 2 formula	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:
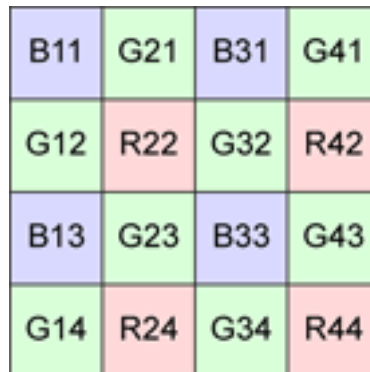
The relative positions of the surrounding pixels are identified by compass markings:
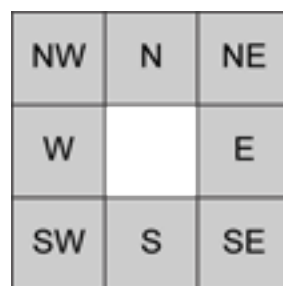
Formulas for position 22
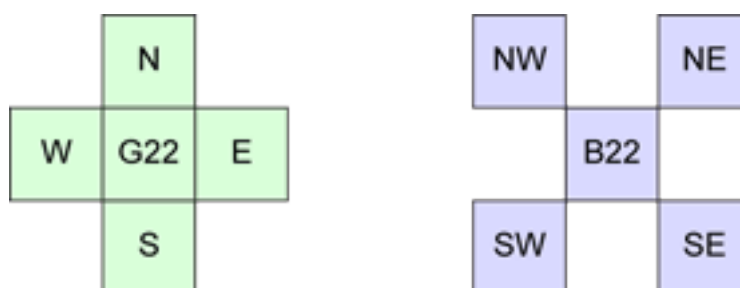
Component	Method	Formula
R22	Legacy, Advanced	R22
G22	Legacy	Mean[Mean(N,S), Mean(W,E)]
	Advanced	Mean[Median(N, S, E, W)]
B22	Legacy	Mean[Mean(NW, SW), Mean(NE, SE)]
	Advanced	Mean[Median(NW, SW, NE, SE)]

Formulas for position 23
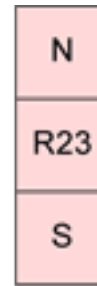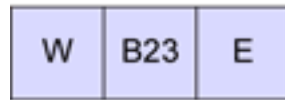
Component	Method	Formula
R23	Legacy, Advanced	Mean(N,S)
G23	Legacy, Advanced	G23
B23	Legacy, Advanced	Mean(W,E)

Formulas for position 32
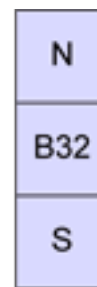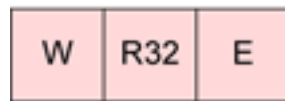
Component	Method	Formula
R32	Legacy, Advanced	Mean(W,E)
G32	Legacy, Advanced	G32
B32	Legacy, Advanced	Mean(N,S)

Formulas for position 33
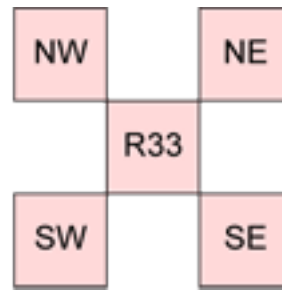
Component	Method	Formula
R33	Legacy	Mean[Mean(NW, SW), Mean(NE, SE)]
	Advanced	Mean[Median(NW, SW, NE, SE)]
G33	Legacy	Mean[Mean(N,S), Mean(W,E)]
	Advanced	Mean[Median(N, S, E, W)]
R33	Legacy, Advanced	B33

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

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.

- When the buffer is too small to contain a complete frame, the remaining data is discarded.

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.

- 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:
  - When set to ContinueInNextBuffer, the acquisition continues into a new buffer and the filled buffer is made available to the application for processing.This is the default setting for line-scan acquisition.
  - When set to DiscardRemainingData, the remaining data is discarded.

- When the last line data of a scan is acquired, the last buffer, possibly partially filled, is made available to the application for processing.

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.
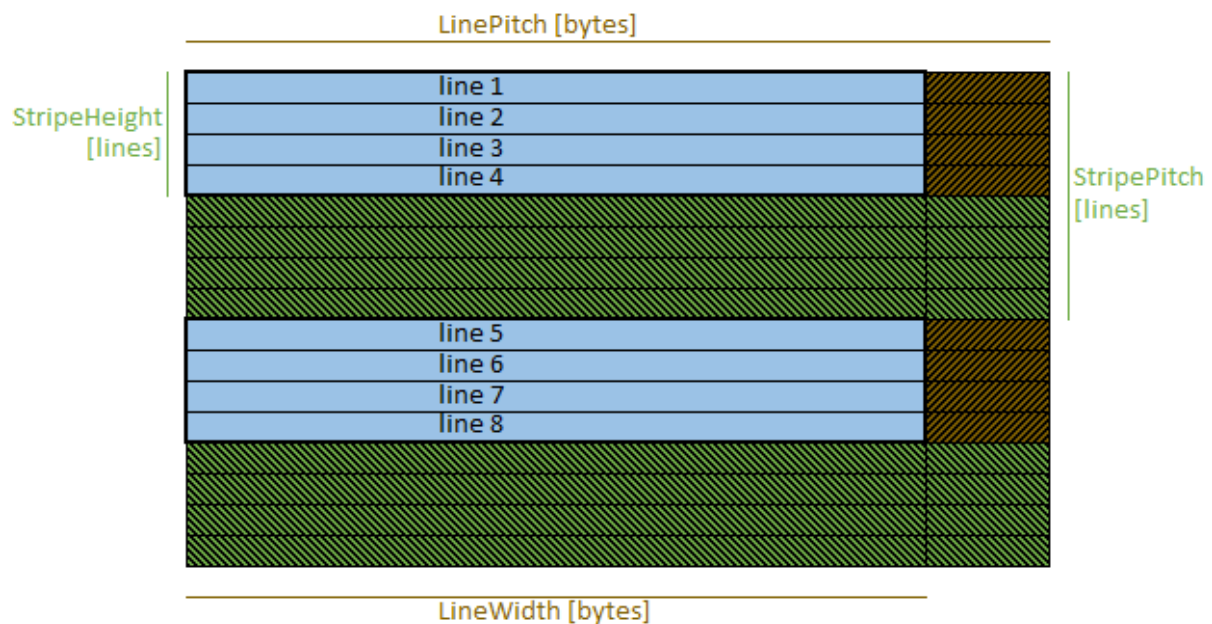
Image buffer padding model

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.
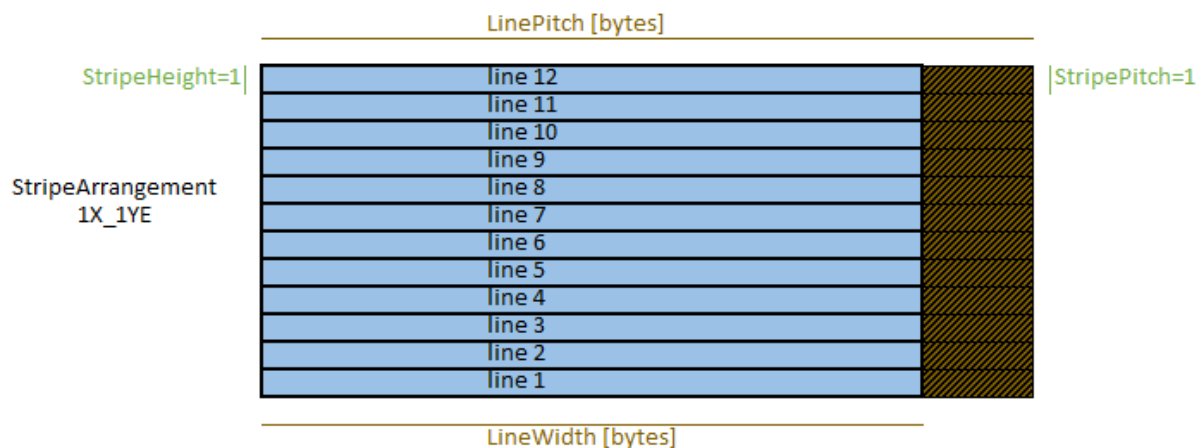
Flipped image data

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:

BufferBase + (BufferSize + LinePitch - LineWidth) / LinePitch * LinePitch - 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.

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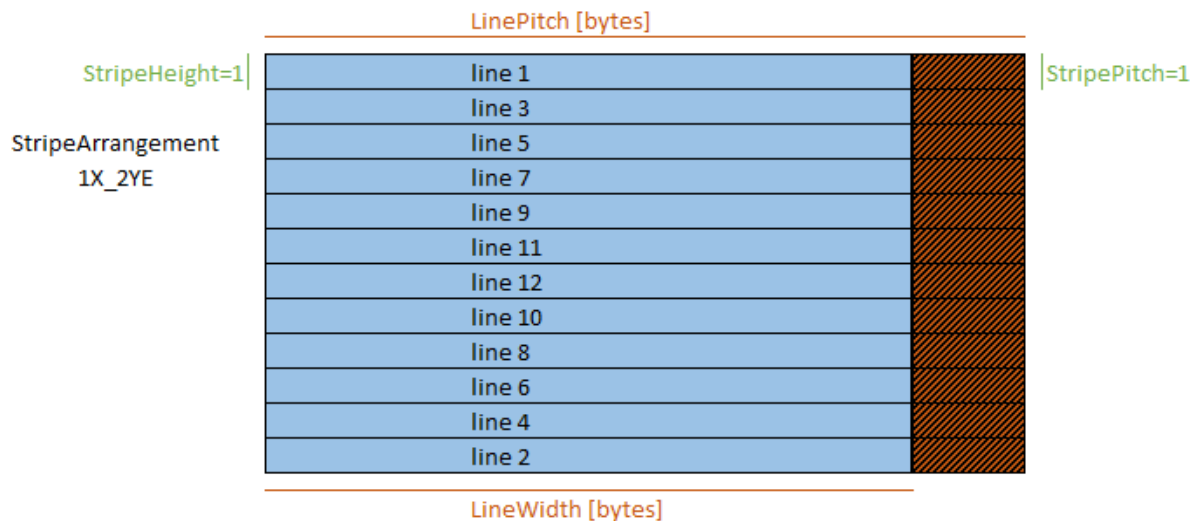
When StripeArrangement is set to Geometry_1X_2YE, the driver determines the destination of the second line output by the camera (i.e., the position of last image line in the buffer) by using this formula:

$$BufferBase + (BufferSize + LinePitch - LineWidth) / LinePitch * LinePitch - LinePitch$$

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

$$BufferBase + n * LinePitch,$$

● 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
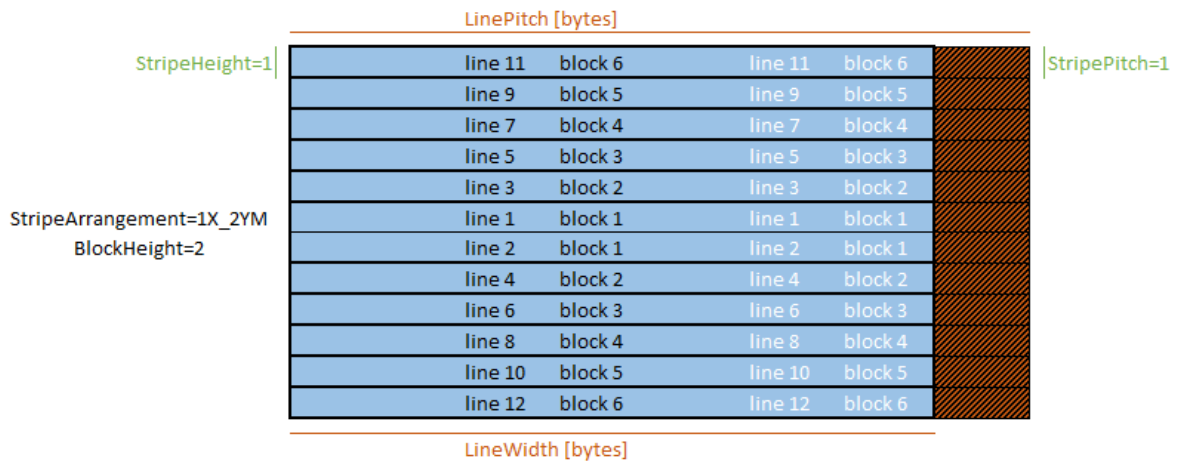
1X_2YM camera delivering lines by blocks of 4

1X_2YM camera delivering lines by blocks of 4 to two hosts
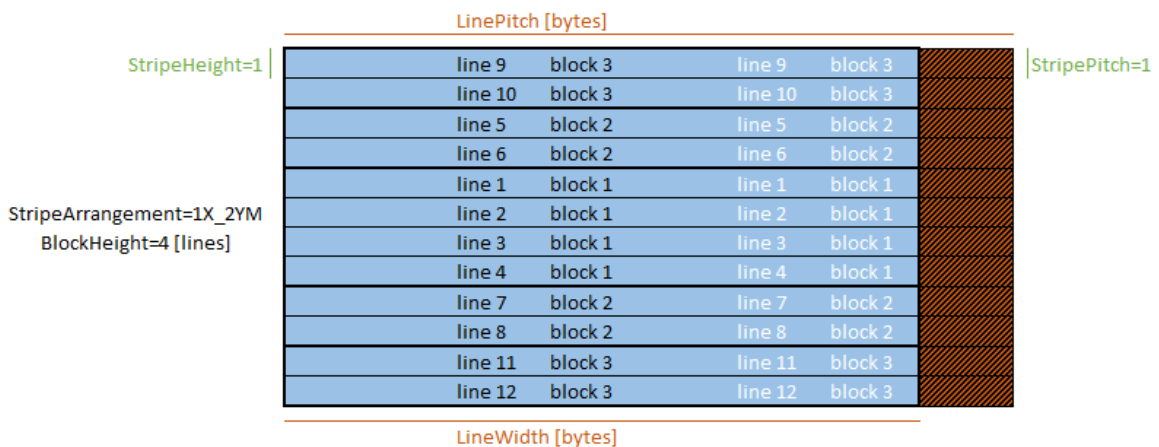
1X_2YM camera delivering lines by blocks of 4 to two hosts
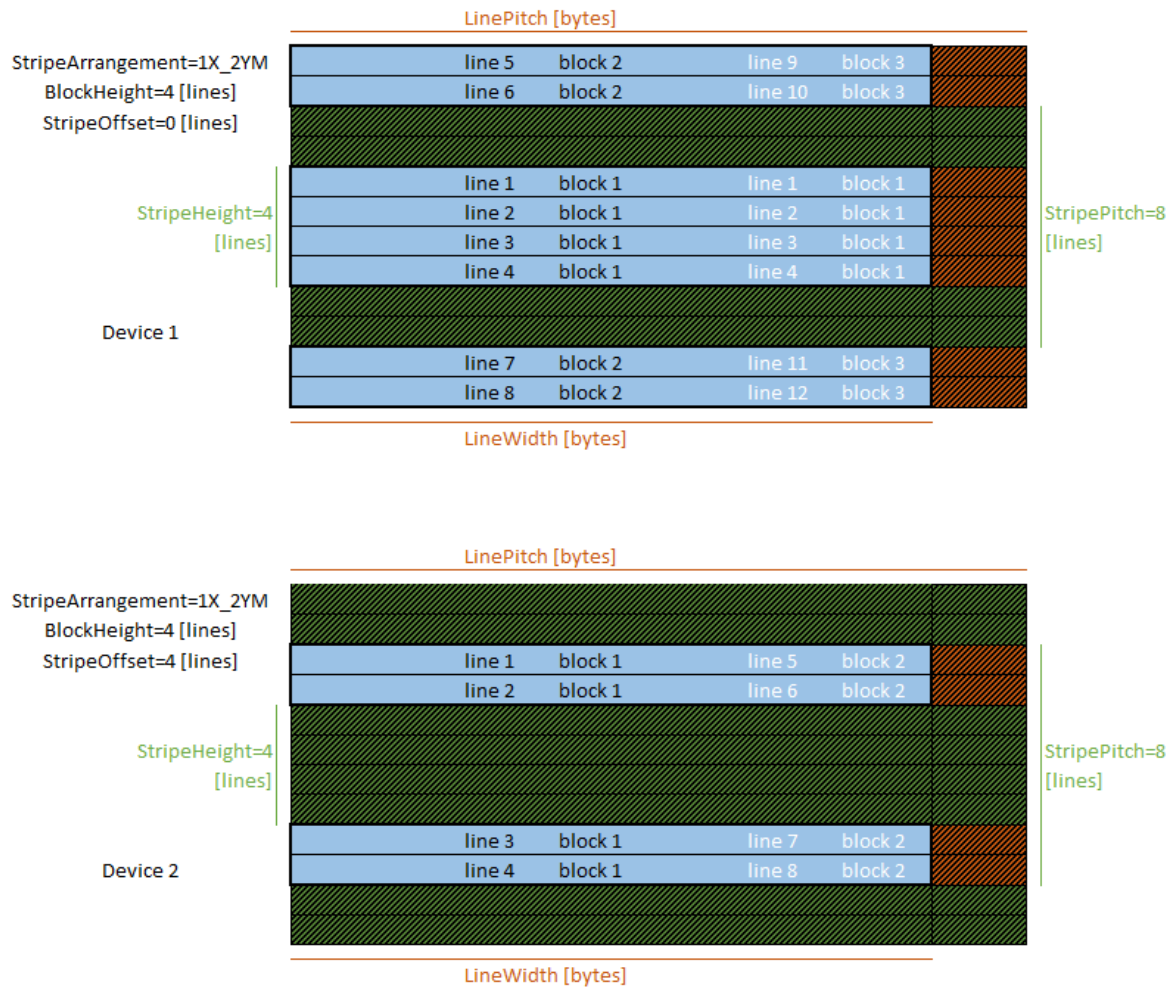
8.6. Data Stream Statistics

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 DSStartAcquisition () function call until now, if the acquisition is still active otherwise until the last DSStopAcquisition() 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 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 (t0)
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 --help

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

9.1. Camera Control Principles

Camera Cycle

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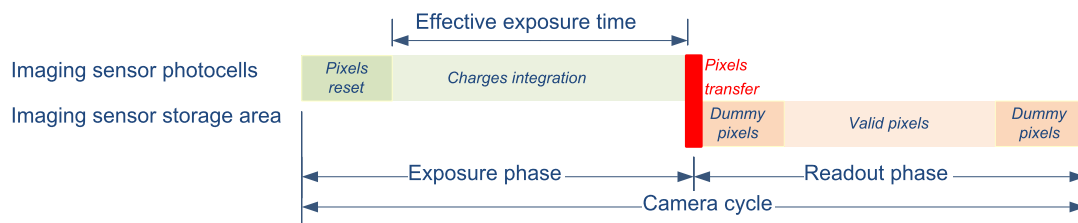
Camera cycle

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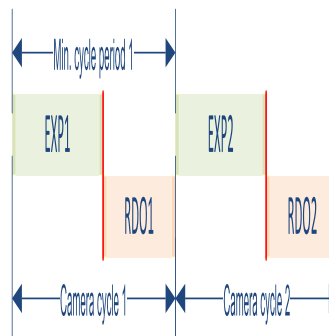
Shortest possible cycle period achievable by cameras NOT allowing the cycle overlapping

$$Min.\ cycle\ period_n = EXP_n + RDO_n$$

> **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
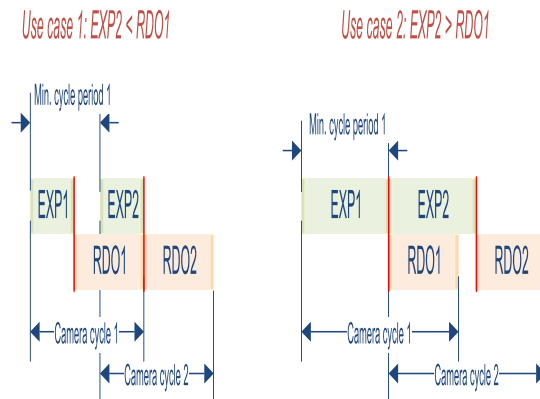
Shortest possible cycle period achievable by cameras allowing the cycle overlapping

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 134 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.
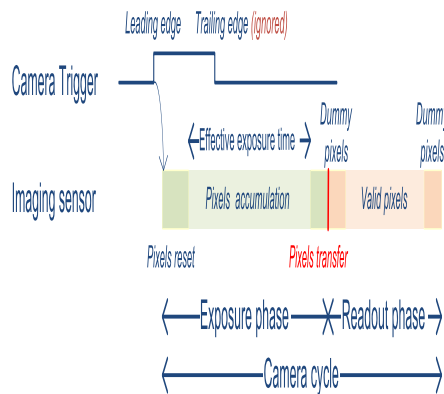
Grabber controlled camera cycle using the RC camera control method

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 ClTriggerDuration 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.
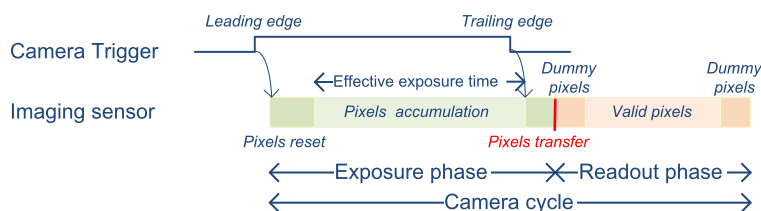
Grabber controlled camera cycle using the RG camera control method

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

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.

Strobe signal

Leading edge　　　　*Trailing edge*

Illumination device　　　　ON-time

Turn-ON time　　　*Turn-OFF time*
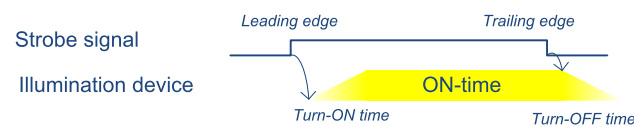
Timing diagram for intermittent illumination devices

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.

Leading edge　　　　*Trailing edge (ignored)*

Strobe signal
Illumination device　　　ON-time

Turn-ON time　　*Turn-OFF time*
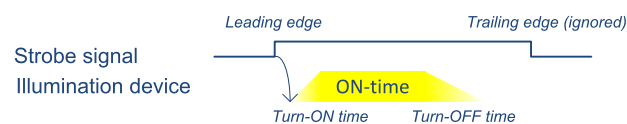
Timing diagram for strobed illumination devices

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.
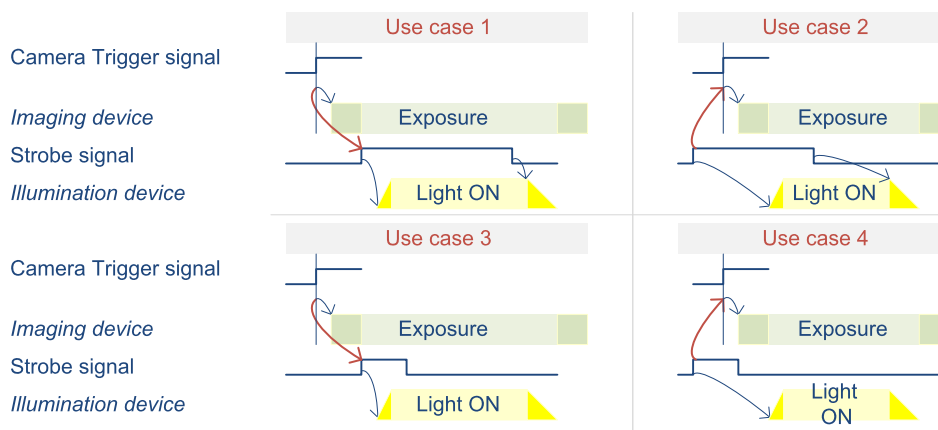
4 typical use cases of Camera Trigger vs. Strobe alignment

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
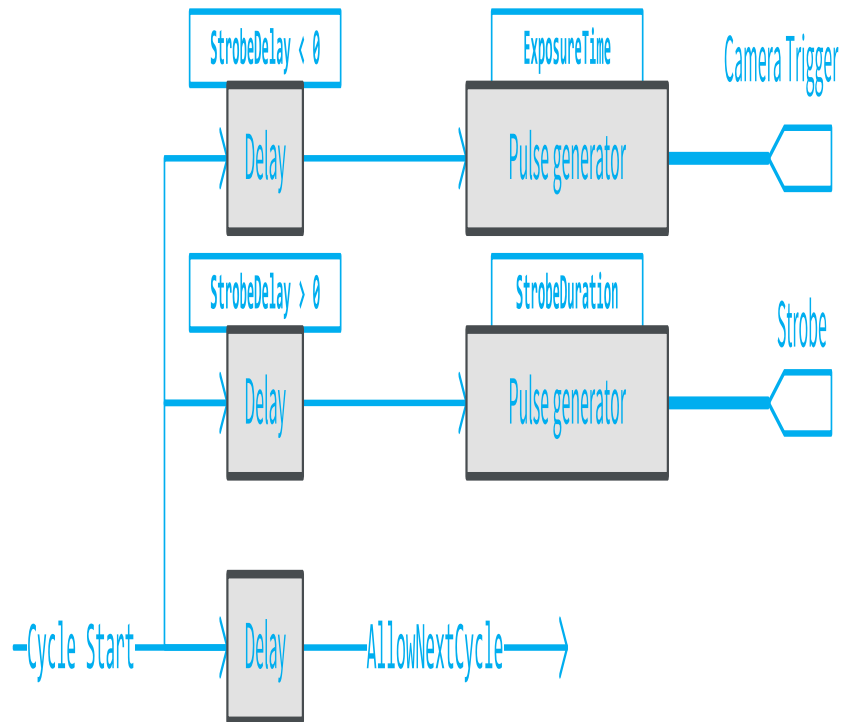
CIC Cycle Timing Machine block diagram

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.

- StobeDuration 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 229 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!

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 ≠ 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 ≠ Immediate AND CycleMaxPendingTriggerCount > 0.

Cycle Trigger Manager
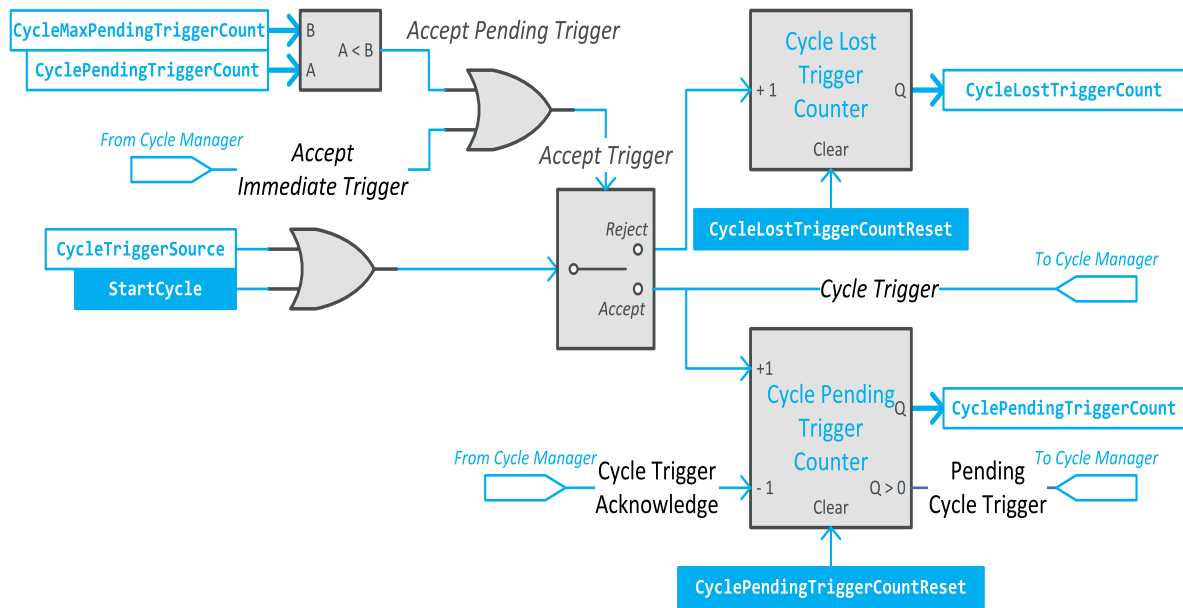
CIC Cycle Trigger Manager block diagram

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.

If 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

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
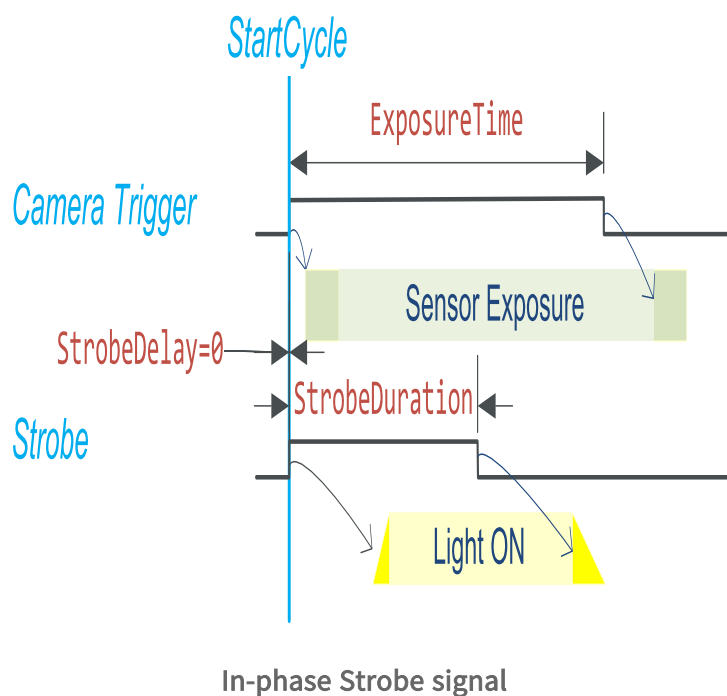
The Camera Trigger and the Strobe signals goes high immediately after the StartCycle event .

Late Strobe
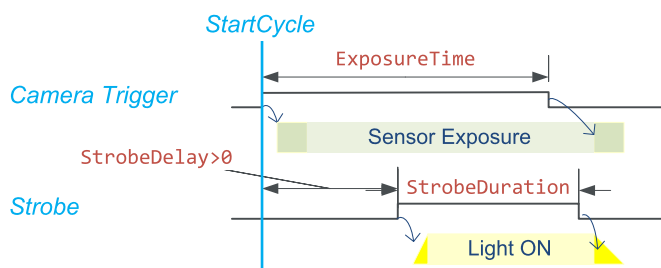
Late Strobe signal

The Camera Trigger signal goes high immediately after the StartCycle event and the Strobe signal goes high after StrobeDelay microseconds.

Early Strobe
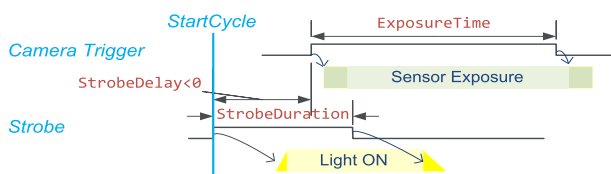
Early Strobe signal

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
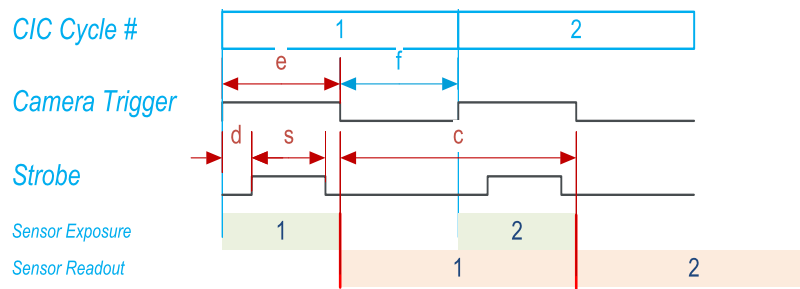
The camera cycle rate is only limited by the camera readout time

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
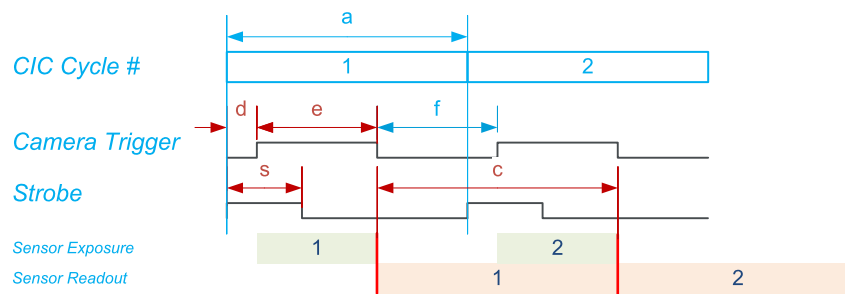
The camera cycle rate is only limited by the camera readout time (despite the early strobe)

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
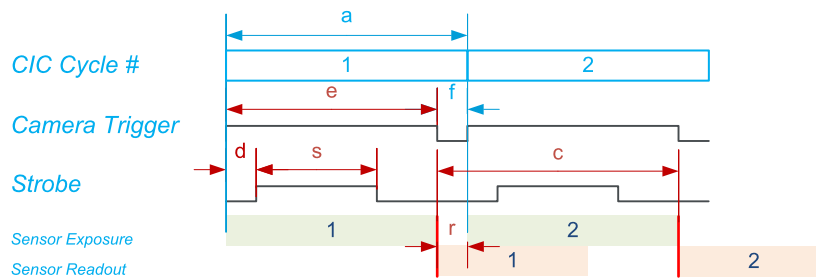
The camera cycle rate is limited by the exposure time settings

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
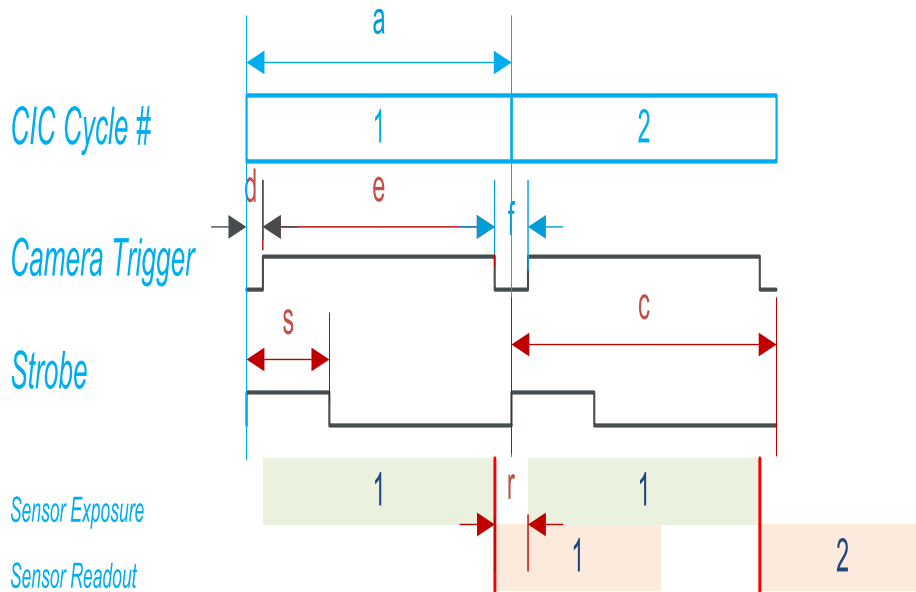
The camera cycle rate is limited by the exposure time settings (despite the early strobe)

This situation is similar to the case 3. It shows that despite an early strobe, it is possible to reach the same cycle rate win 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

```
StartOfSequenceTriggerSource=Immediate;
EndOfSequenceTriggerSource=StopSequence;
CycleTriggerSource=Immediate;
```

Cycle sequences with immediate start

```
StartOfSequenceTriggerSource=Immediate;
EndOfSequenceTriggerSource=StopSequence;
CycleTriggerSource≠Immediate;
```

Cycle sequences with immediate start

```
StartOfSequenceTriggerSource≠Immediate;
EndOfSequenceTriggerSource=SequenceLength; SequenceLength=3;
CycleTriggerSource=Immediate;
```

```
StartOfSequenceTriggerSource≠Immediate;
EndOfSequenceTriggerSource=SequenceLength; SequenceLength=3;
CycleTriggerSource≠Immediate;
```

Cycle sequences with triggered start and fixed length

```
StartOfSequenceTriggerSource≠Immediate;
EndOfSequenceTriggerSource≠SequenceLength;
CycleTriggerSource=Immediate;
```

```
StartOfSequenceTriggerSource≠Immediate;
EndOfSequenceTriggerSource≠SequenceLength;
CycleTriggerSource≠Immediate;
```
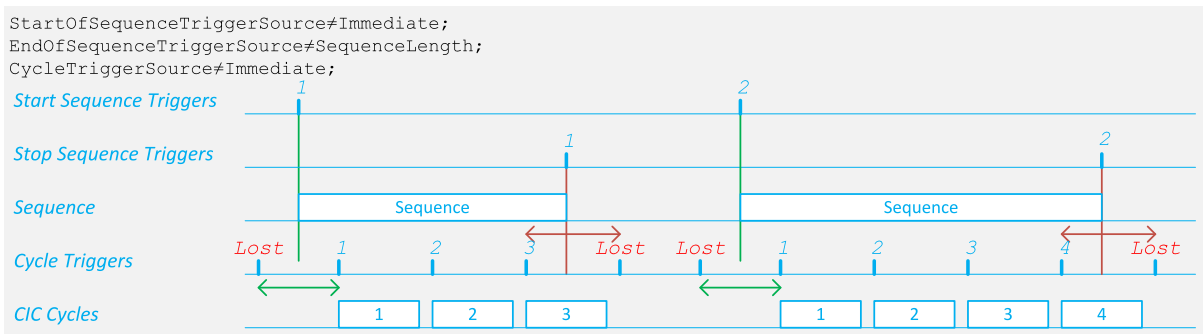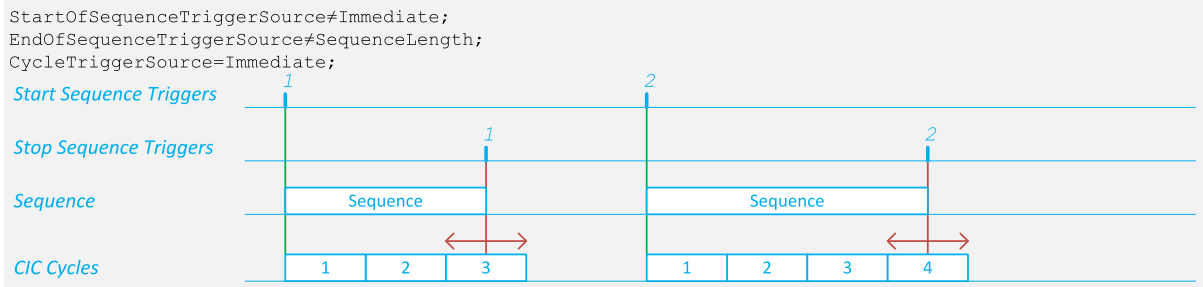
Cycle sequences with triggered start and triggered end

10. General Purpose I/O

10.1. I/O Lines Overview

*I/O lines overview of **1628 Grablink Duo***

I/O lines per product (Grablink Duo)

Product	Standard I/O sets		I/O extension
	#1	#2	
1628 Grablink Duo	On-board	On-board	✓

Standard I/O set

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**

x = 1 for first instance; x = 2 for second instance

See also: "I/O Interfaces" on page 366 in the hardware manual for more information.

3610/3612 I/O extension modules

Compatible with [1]

Duo	Octo	Quad12	Quad12-4		Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

The **3610 HD26F I/O Extension Module - TTL-RS422** and **3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422** provide a configurable mix of differential or single-ended, input or output lines:

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

> **See also:** "3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422" on page 410 in the hardware manual for more information.

---

[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, IOUT, 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 a 3 types of control block depending on the input / output capabilities of the I/O line:
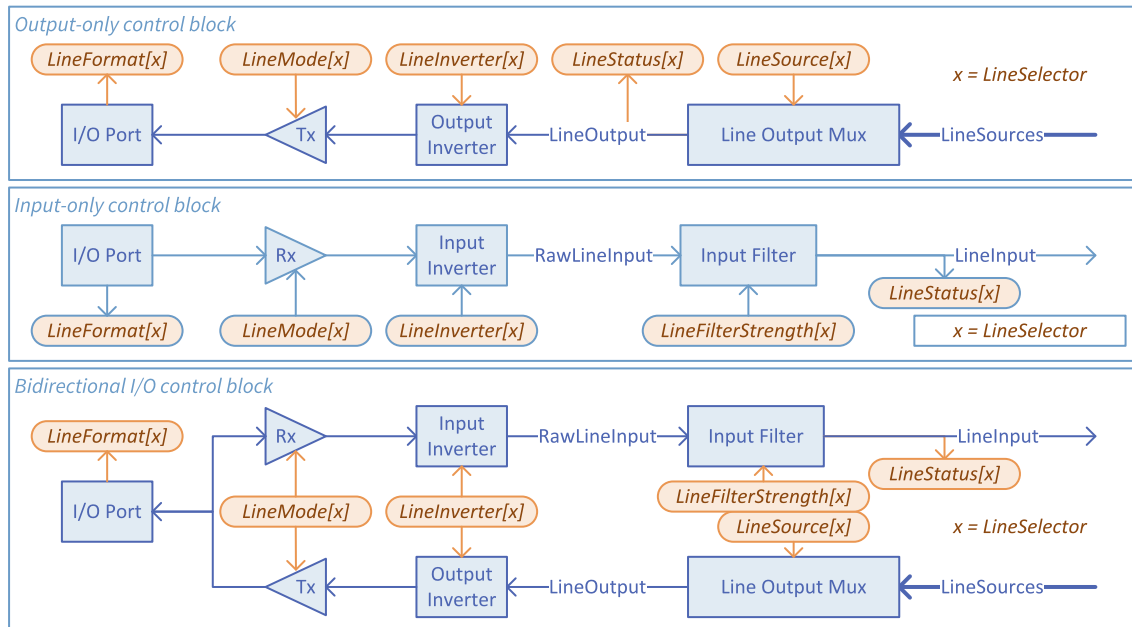
In the above figures:

- 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 (defaut power-up settings),
- □ Output: totem-pole driver capable of driving low an 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 410 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 strenght 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 µs
Medium	200 ns	200 ns	2 µs
High	500 ns	500 ns	5 µs
Highest	1 µs	1 µs	10 µs

> **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. *Line may be left unconnected or connected with the wrong polarity.*
		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

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 staring or stopping line-scan acquisition sequences
- ☐ Event counters
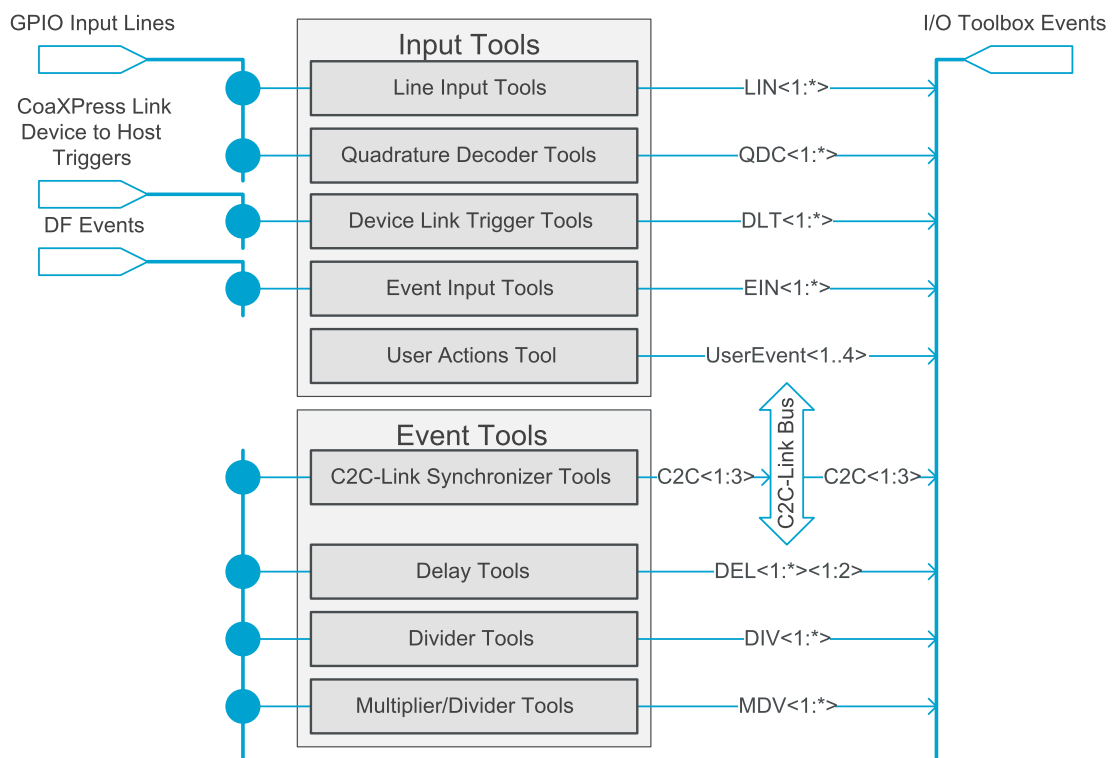
I/O Toolbox structure diagram

I/O Toolbox input tools

The *Input Tools* generate event streams from external sources.

1. The "Line Input Tool" on page 264 for use with sensors and detectors attached to a single GPIO input line.

2. The "Quadrature Decoder Tool" on page 265 for use with quadrature motion encoders attached to a pair of GPIO input lines.

3. The "User Actions Tool" on page 269 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 274 delivers one event stream to the C2C-Link Bus driver.

2. The "Delay Tool" on page 276 delays the events of one (or two) stream(s) by a configurable number of clock tick events.

3. The "Divider Tool" on page 278 divides the event rate by an integer factor D.

4. The "Multiplier/Divider Tool" on page 279 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

LineInputToolSource   LineInputToolActivation

DINxx, IINxx, IOUTxx, TTLIOxx, MIOxx   RisingEdge, FallingEdge, AllEdges

GPIO   I/O Toolbox Events

Input lines M U X   Edge Selector In Out LIN<i>
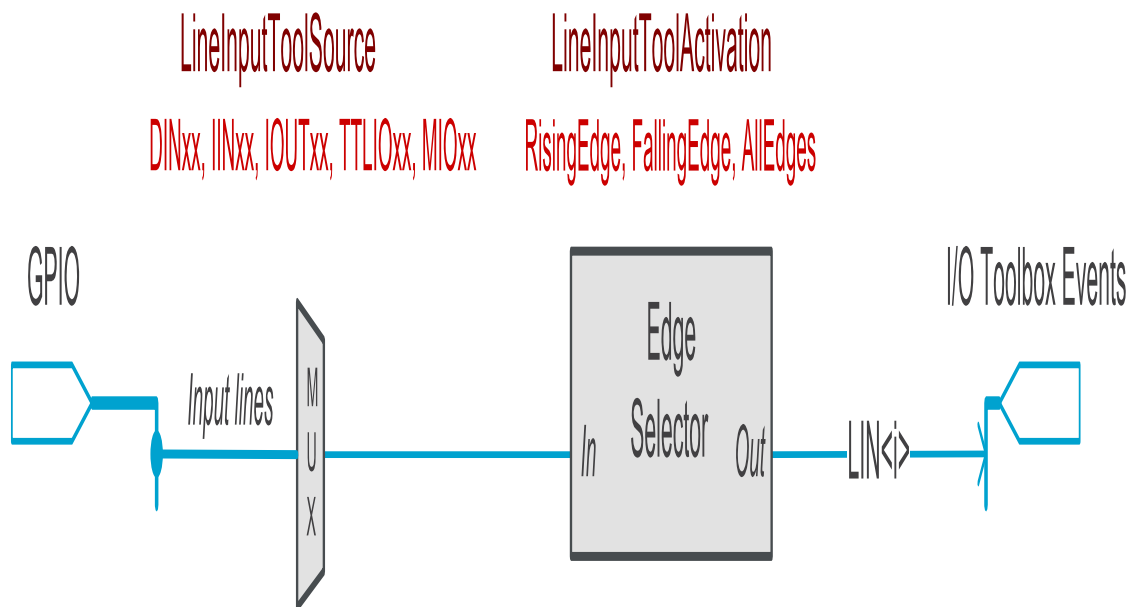
LIN tool functional and wiring diagram

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

QuadratureDecoderToolPositionReset
QuadratureDecoderToolPosition

QuadratureDecoderToolSources
DINxx_DINxy, IINxx_INxy,
TTLIOxx_TTLIOxy, MIOxx_MIOxy

QuadratureDecoderToolActivation
RisingEdgeA, FallingEdgeA,
AllEdgesA, AllEdgesAB, None

Position counter

I/O Toolbox Events

Input Lines

Input Lines

GPIO

A   Quadrature Edge Detector   U
B   Phase

Backward Motion Compensator   Q   QDC<i>
                              Dir

QuadratureDecoderToolDirection

QuadratureDecoderToolForwardDirection
A_Leads_B, B_Leads_A

QuadratureDecoderToolOutputMode
Uniltered, ForwardOnly, FirstPassForwardOnly

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 610

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 the QuadratureDecoderToolActivation settings

- An identification of the phase between A and B (A leads B or vice-versa)
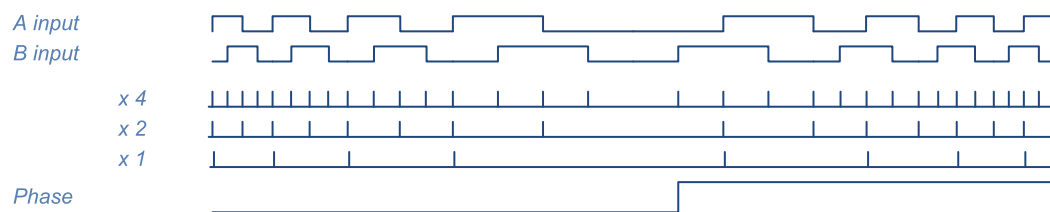
Quadrature edge detector waveforms

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:
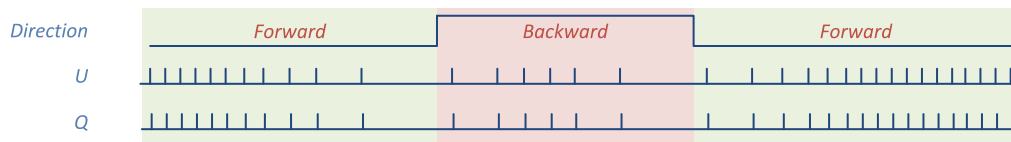
BMC waveforms - Unfiltered

When set to ForwardOnly, only the events corresponding to the forward direction are delivered to the QDC<i> output:

3614

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:
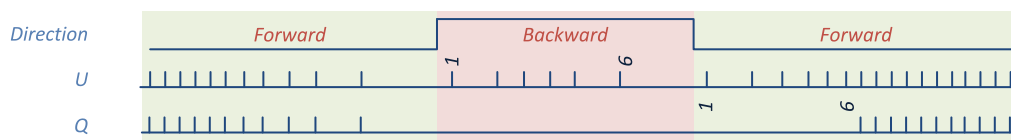
BMC waveforms - First Pass Forward Only

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.
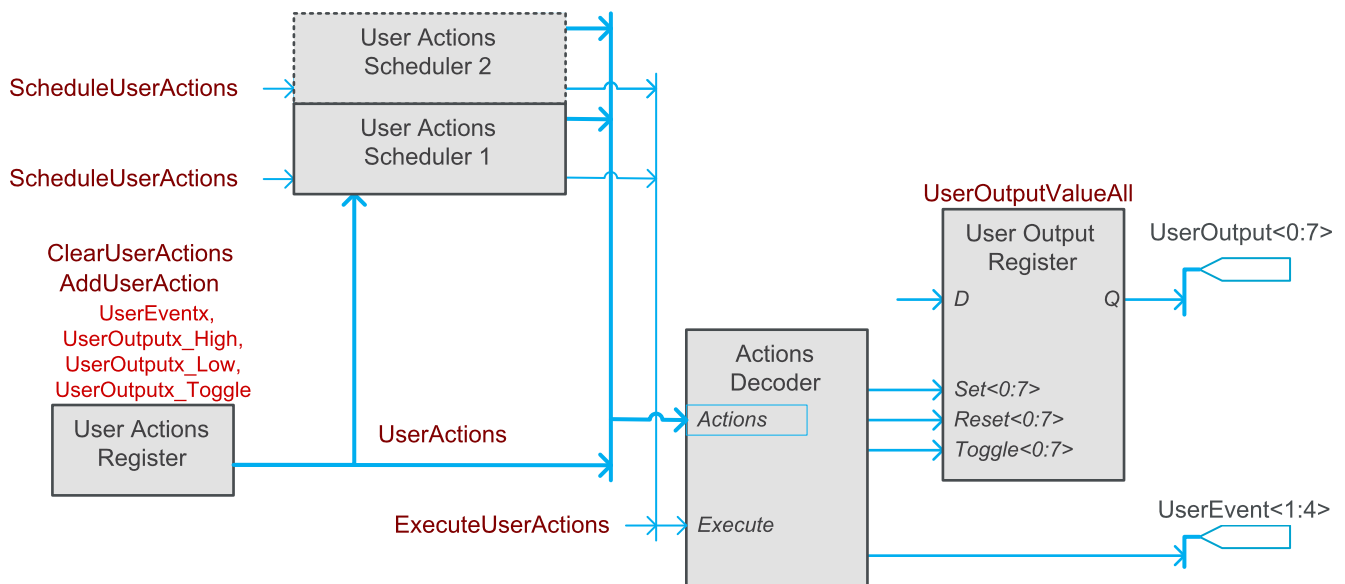
User Actions Tool functional block diagram

User output register

Coaxlink and Grablink Duo frame grabbers provide an 8-bit[1] *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
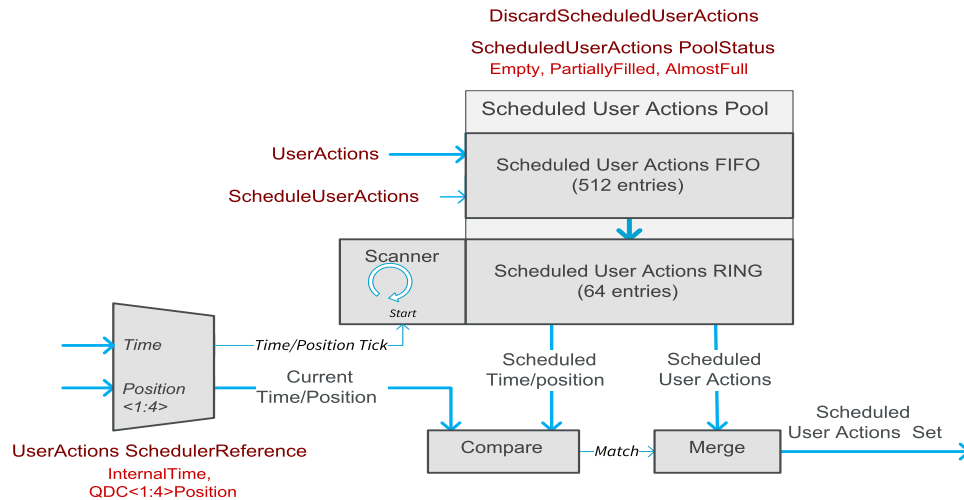
User actions scheduler functional diagram

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.

RING operation

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
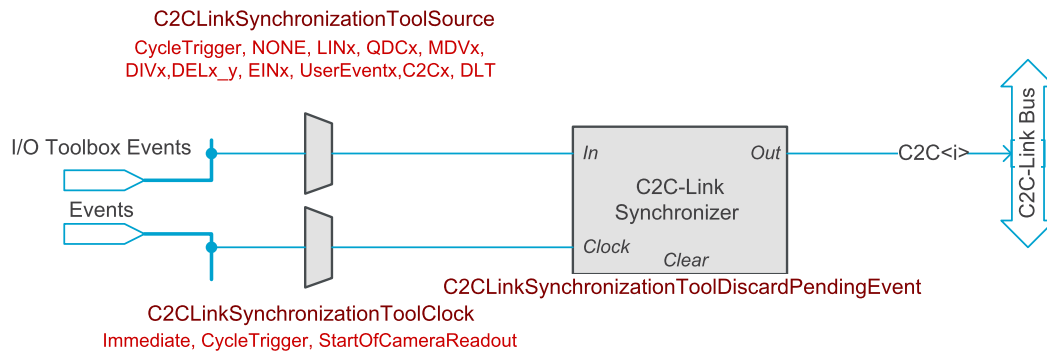
C2C tool functional and wiring diagram

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, DEL<i>2
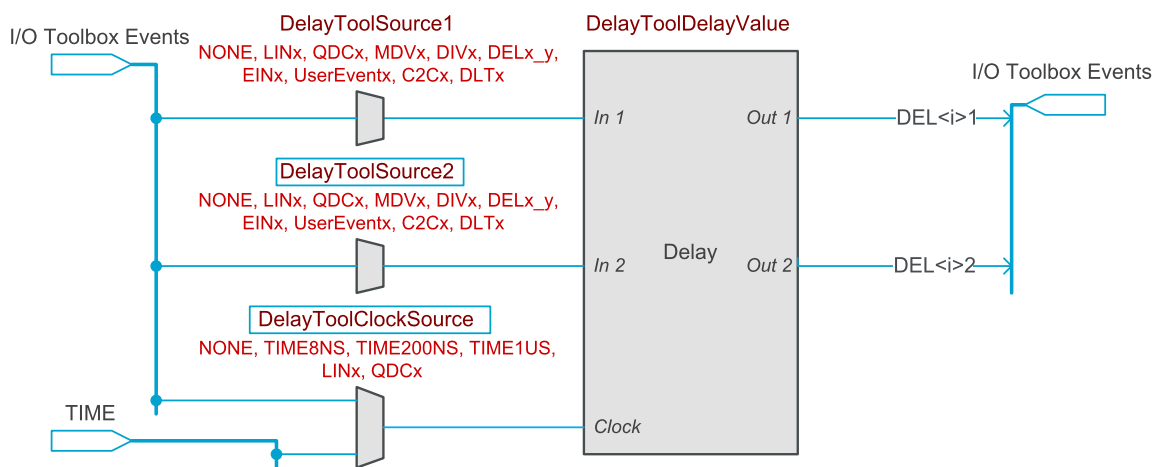
Diagram

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.
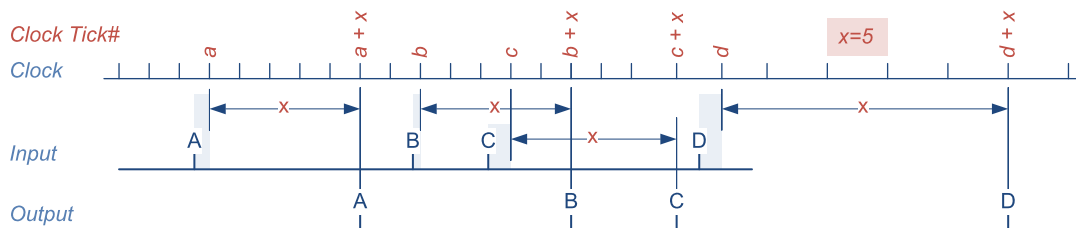
DEL tool waveforms

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
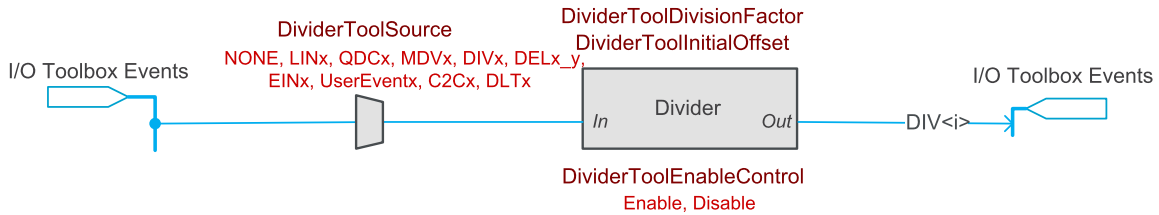
DIV tool functional and wiring diagram

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
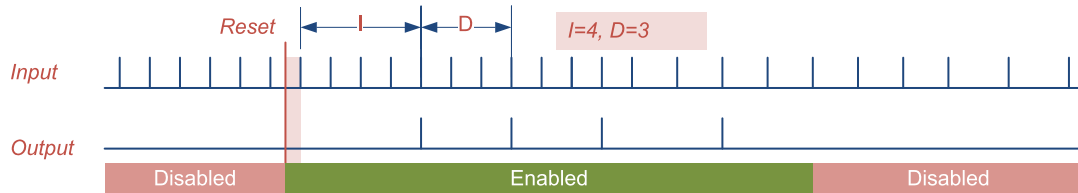
DIV tool waveforms

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.

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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

MultiplierDividerToolMultiplicationFactor
MultiplierDividerToolDivisionFactor

MultiplierDividerToolSource
NONE, LINx, QDCx, MDVx, DIVx, DELx_y,
EINx, UserEventx, C2Cx, DLTx

I/O Toolbox Events

Multiplier
Divider
In   Out

I/O Toolbox Events

MDV\<i\>

MultiplierDividerToolEnableControl
Enable, Disable
MultiplierDividerToolEffectiveMultiplicationFactor
MultiplierDividerToolEffectiveDivisionFactor

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.
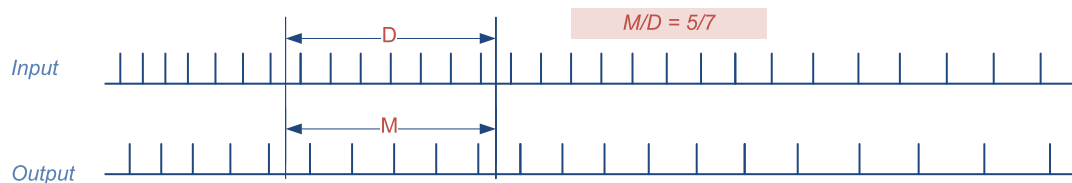
MDV tool waveforms

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
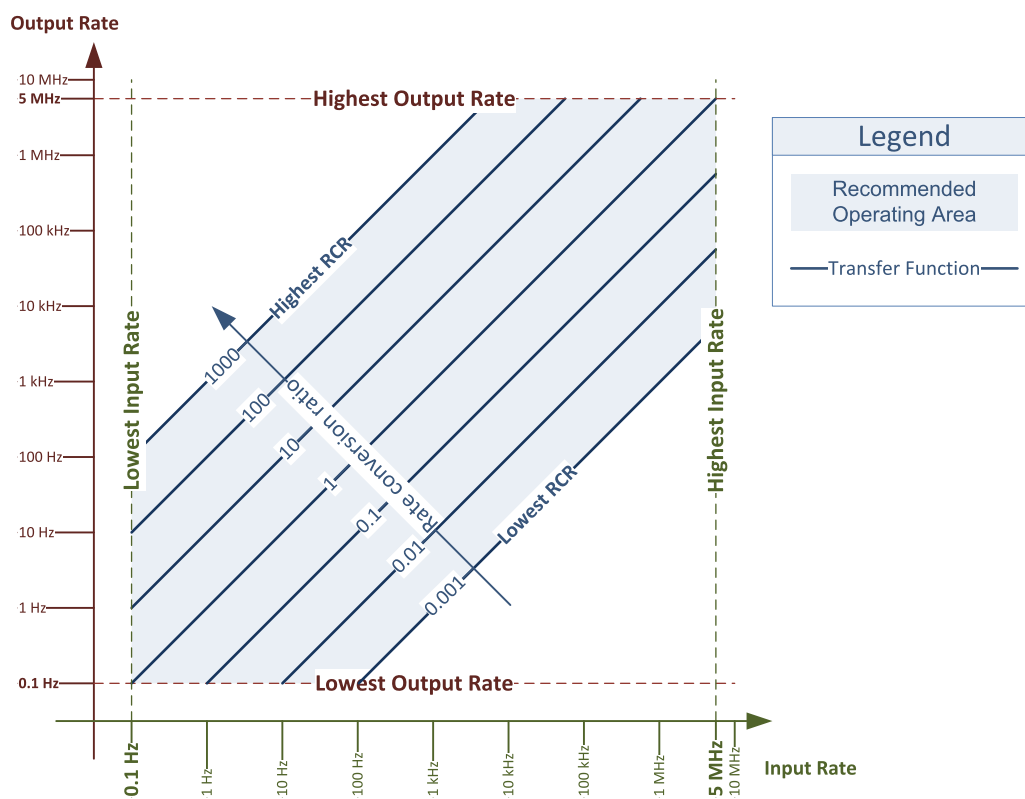
MDV tool operating limits diagram

12. Event Signaling And Counting

Extensive user-configurable event-reporting and event-counting mechanism

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 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 implements 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 286 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 292

12.2. Custom Event Sources

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 257 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 GenICam 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

13.1. C2C-Link

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 oneI/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
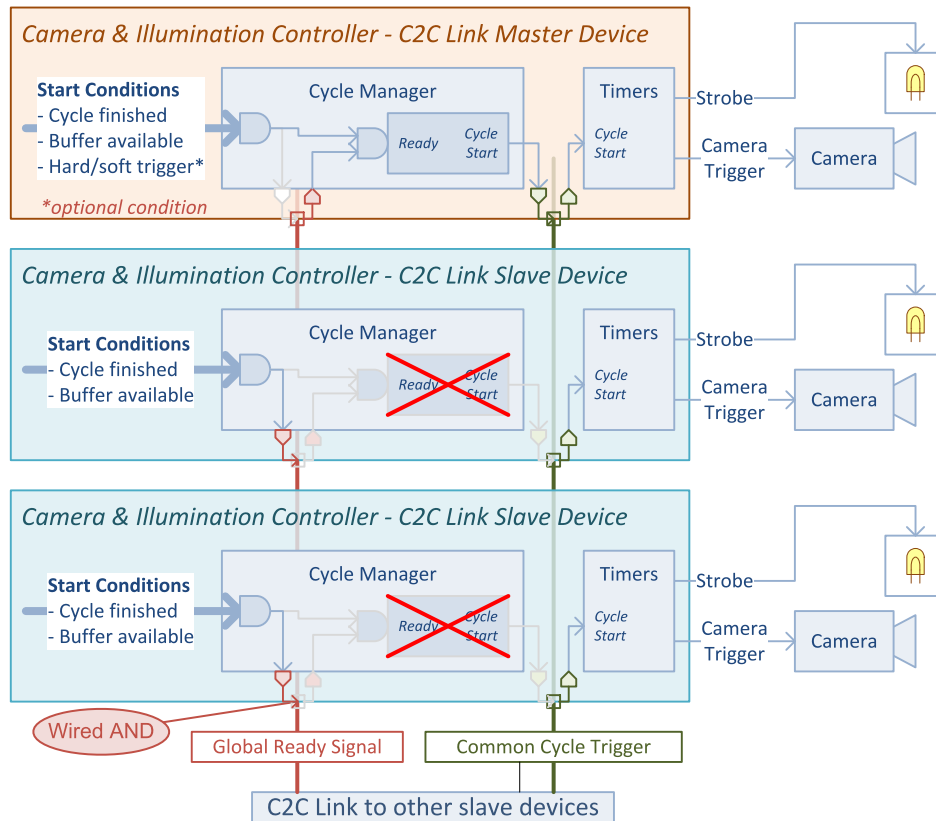
One C2C-Link master and two C2C-Link slave devices (With Global Ready)

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 274 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
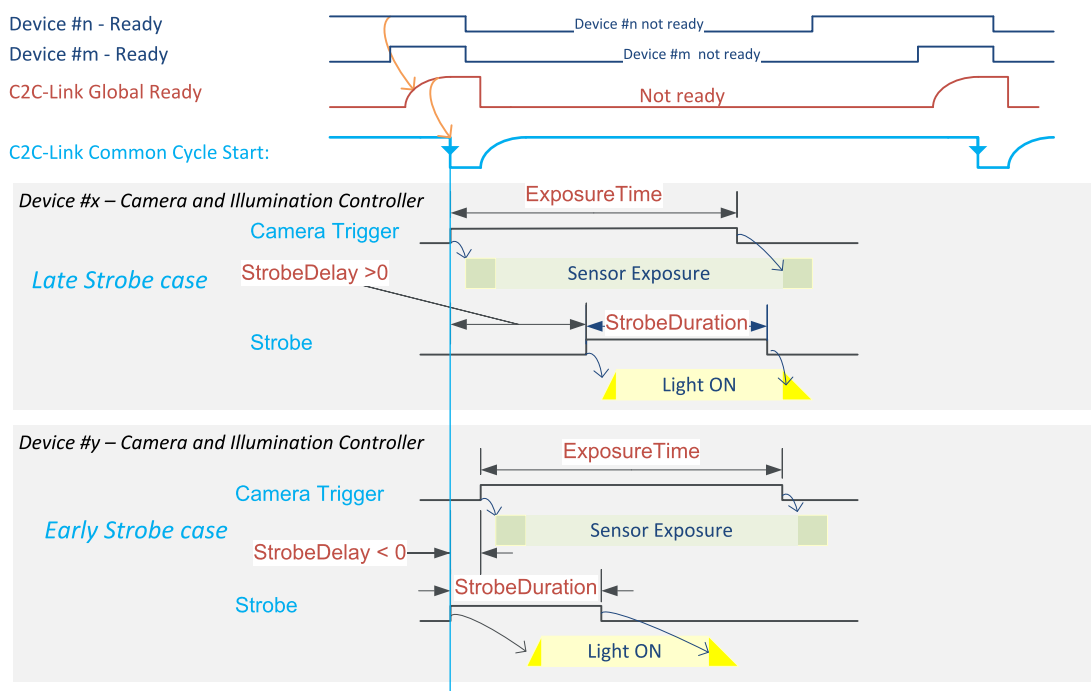
CIC Synchronization through C2C-Link timing diagram (With Global Ready)

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.
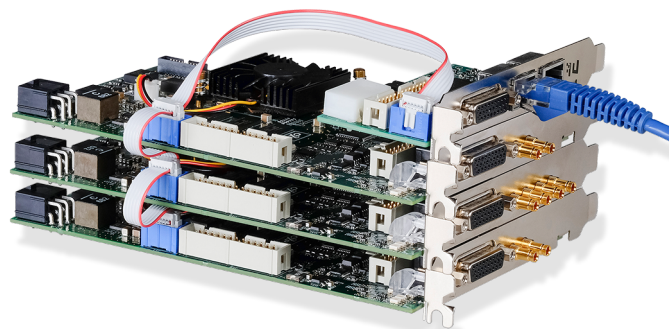
IntraPC segment of an InterPC configuration

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

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::stringencryptedKey=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.

1.1. Board and Bracket Layouts

1628 Grablink Duo
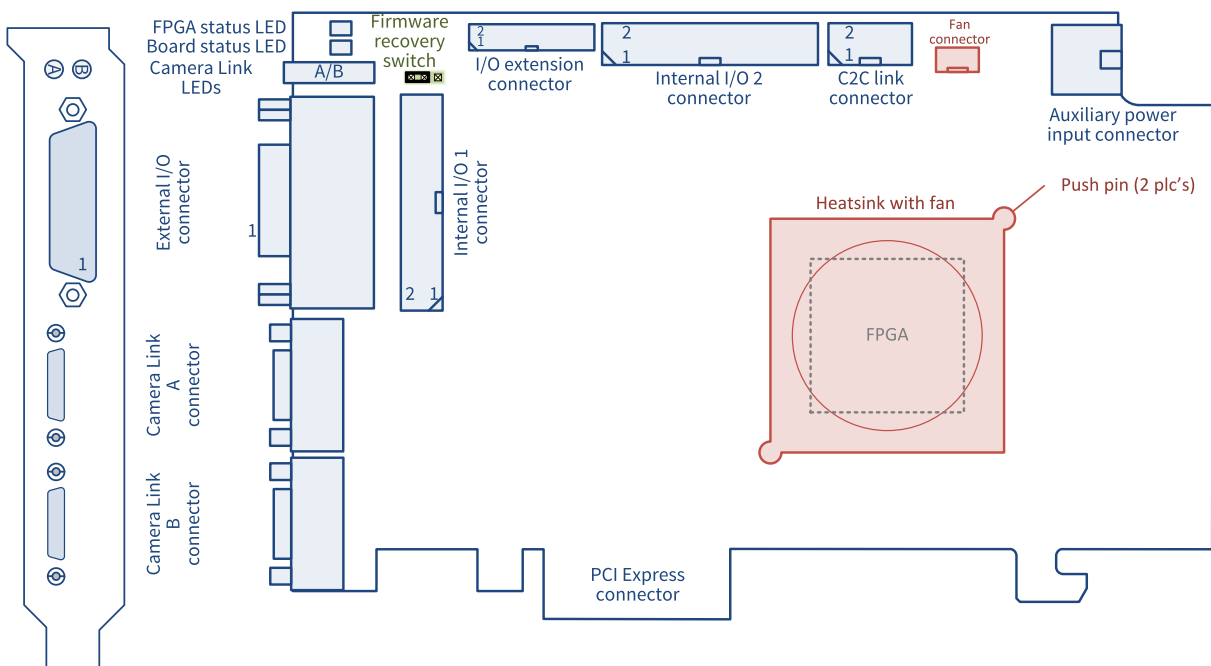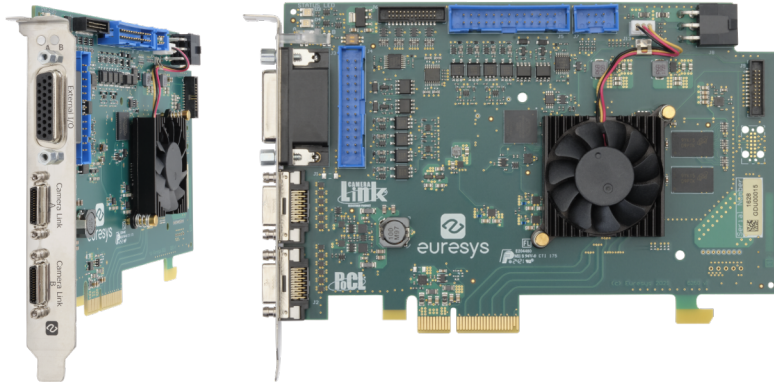
Connectors

- "Auxiliary Power Input Connector for PoCL and GPIO" on page 345
- "C2C-Link Connector" on page 343
- "Camera Link A Connector" on page 316
- "Camera Link B Connector" on page 318
- "External I/O Connector" on page 322
- "I/O Extension Connector" on page 341
- "Internal I/O 1 Connector" on page 332
- "Internal I/O 2 Connector" on page 334

Lamps and switches

- "Camera Link LED lamps" on page 347
- "Board Status LED" on page 350
- "FPGA Status LED" on page 351
- "Firmware Recovery Switch" on page 352

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

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

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

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE
Quad12	Quad12-4		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+.

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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]

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
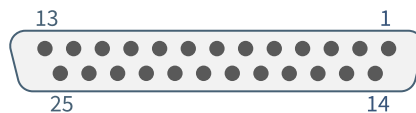
Pin assignments

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

[1] 1625 DB25F I/O Adapter Cable.

Pin	Signal	Usage
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
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

Pin	Signal	Usage
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
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

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]

3610 Not recommended for new designs   3612 Not recommended for new designs

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-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

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

Duo	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE	Quad12
Quad12-4		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

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]

3610 3612
Not recommended for new designs Not recommended for new designs

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

---

[1] **3614 HD26F I/O Extension Module - Standard I/O Set** and **3618 HD26F I/O Extension Module - Fast I/O.**

Pin	Signal	Usage
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
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

Applies to [1]

Duo	Octo	Quad12	Quad12-4		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

[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 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
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	Duo104-EMB	Mono	Duo	Quad	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4		Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+

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

[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, 3625 Coaxlink QSFP+** and **1636 InterPC C2C-Link Adapter.**

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

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
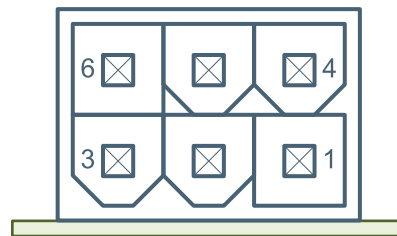
Pin assignments

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

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
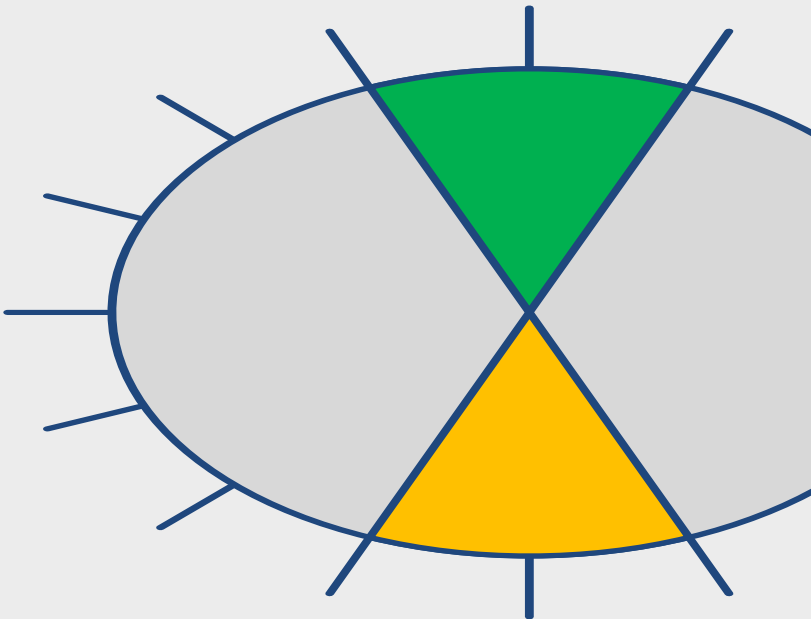
The LampMode feature of the Interface module defines the lamps operation mode:

- 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.

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[1] **1628 Grablink Duo.**
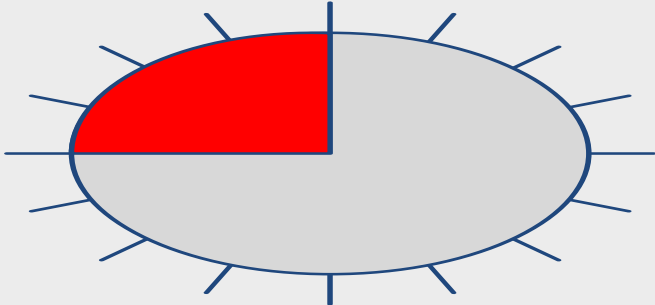
Camera Link Host Indicator LED lamps states

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

[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

Symbol	Indication, color(s)	State
	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)

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. *The normal completion time is around 100 milliseconds.*
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: ● 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. *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.*

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: • At least one FPGA clock network is not operating normally. *This might be caused by excessive jitter on external clock signals of the CoaXPress or the PCI Express interfaces.* • The DDR memory controller has not been able to successfully perform the calibration procedure.
Solid orange		**FPGA status NOK.** Possible cause: • 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

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.

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[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	

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 Shrunk 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 54 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

2.3. Power

Power requirements and specifications

2.3. Power

Power Distribution
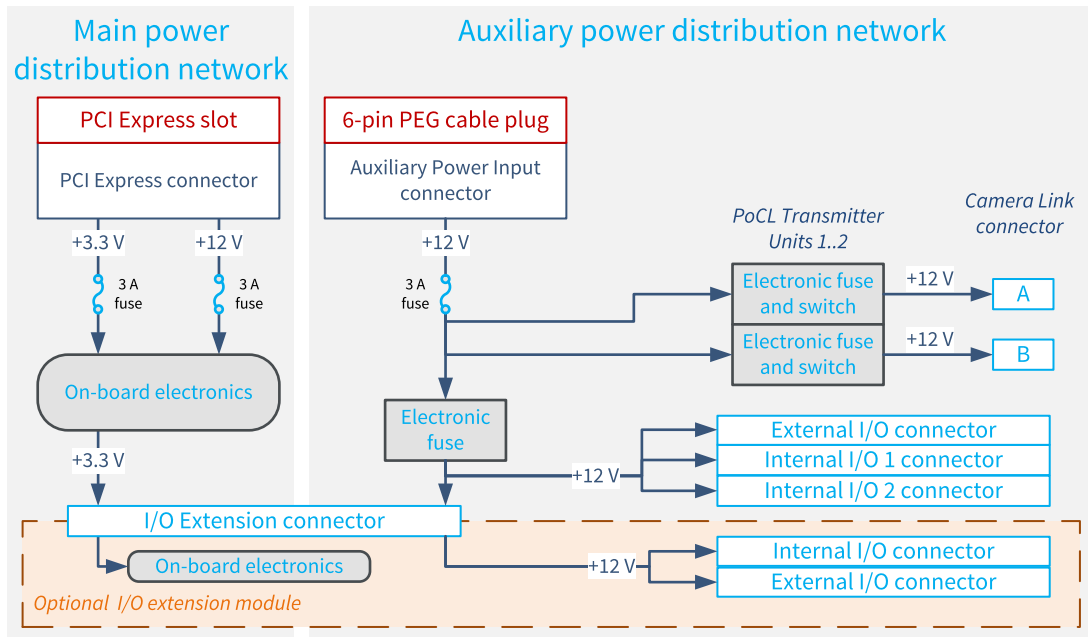
Main power distribution network

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 362

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 363, "I/O Power Output" on page 364 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 440

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-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.

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)

Applies to [1]

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4		Quad12J-4	Value12

3300 Not recommended for new designs

Quad12DF		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

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
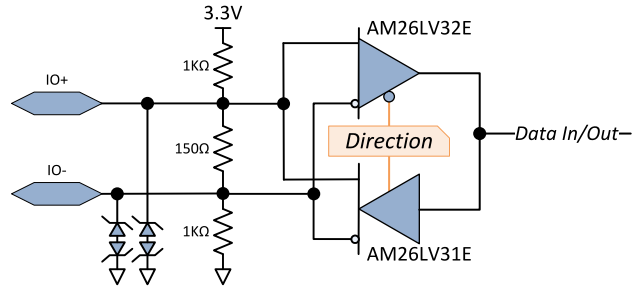
Differential Input/Output Simplified Schematic

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-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	3610

3618
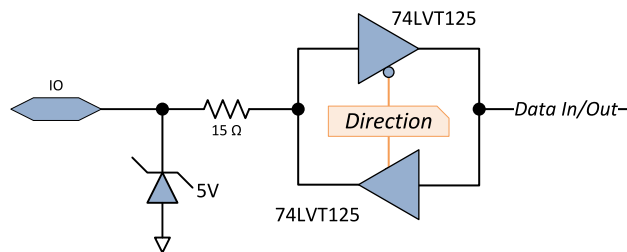
TTL Input/Output Simplified schematic

The port implements a 3.3 V LVTTL driver and a 5 V-compliant 3.3 V LVTTL 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
VIN > 2.0 V	HIGH
VIN < 0.8 V	LOW
Unconnected input port	*Undetermined*

Compatible sources

Sources with the following drivers are compatible:

- ☐ LVTTL (3.3 V low-voltage TTL)
- ☐ TTL (5 V TTL)
- ☐ CMOS (5 V CMOS)

Compatible loads

Loads with the following receivers are compatible:

- ☐ LVTTL (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
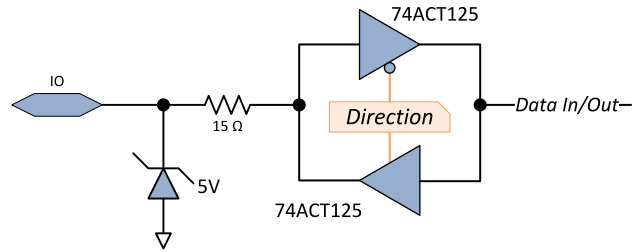
TTL Input/5 V CMOS Output Simplified schematic

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	@50µA		0.001	0.1	V
	@ 24 mA			0.81	V
High-level output current				-24	mA
High-level output voltage	@-50 µA; (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
VIN > 2.0 V	HIGH
VIN < 0.8 V	LOW
Unconnected input port	*Undetermined*

Compatible sources

Sources with the following drivers are compatible:

- LVTTL (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)

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
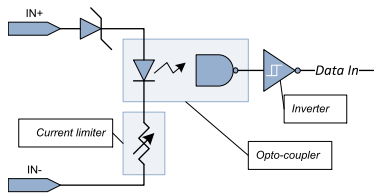
Simplified schematic
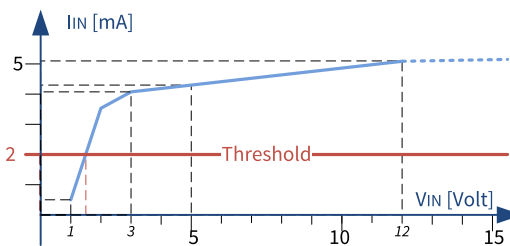
Input Current vs. Input Voltage Characteristics

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

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[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
$I_{IN} \geq 3$ mA	HIGH
$I_{IN} < 0.5$ 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

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4		Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

3300

Not recommended for new designs

3614

3618
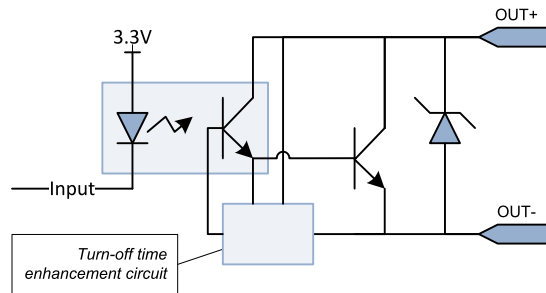
Isolated Output Simplified schematic

The output port implements an isolated contact output.

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+, 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.

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.

AC characteristics

Parameter	Min.	Typ.	Max.	Units
Pulse rate	0		100	kHz
Turn-on time			5	µs
Turn-off time			5	µs

Typical switching performance @ 25°C

Current [mA]	Turn ON time [µs]	Turn OFF time [µs]
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.

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-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

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[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+.**

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

[1] 1628 Grablink Duo.

Standard operating conditions (0°C ~ 55°C)

Applies to [1]

---

[1] 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.

1625

1636

3300
Not recommended for new designs

3301
Not recommended for new designs

3302
Not recommended for new designs

3303

3304

3610
Not recommended for new designs

3612
Not recommended for new designs

3613

3614

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.

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-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.

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[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

CE **Notice for Europe**
This product is in conformity with the Council Directive 2014/30/EU

UK CA **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.

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[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-4	Mono12	Mono12LH	Duo12
Duo12LH	Value12	Quad12DF	QSFP+			

| 3610 | 3612 | 3614 |

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.

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[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.

- 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.

EMC Compliance statement for Korea

Applies to [1]

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4		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.

4. Accessories

4.1. 1636 InterPC C2C-Link Adapter

Compatible with [1]

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4		Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	
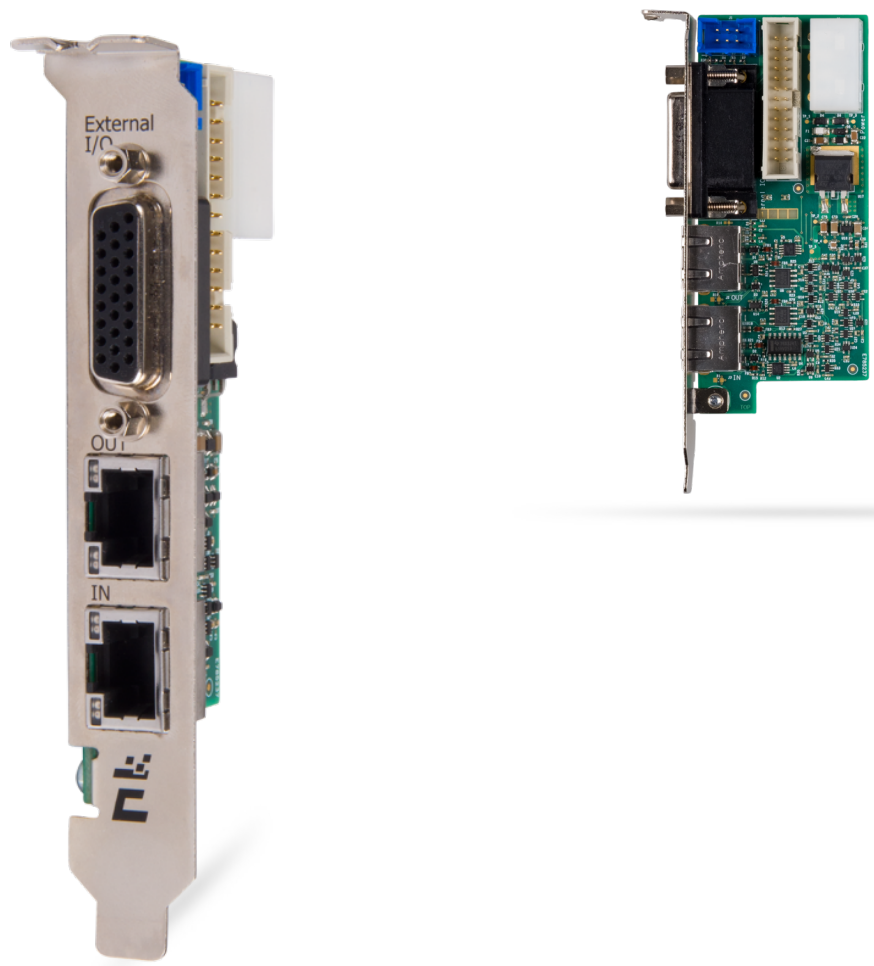
Pictures of 1636 InterPC C2C-Link Adapter

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.

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[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
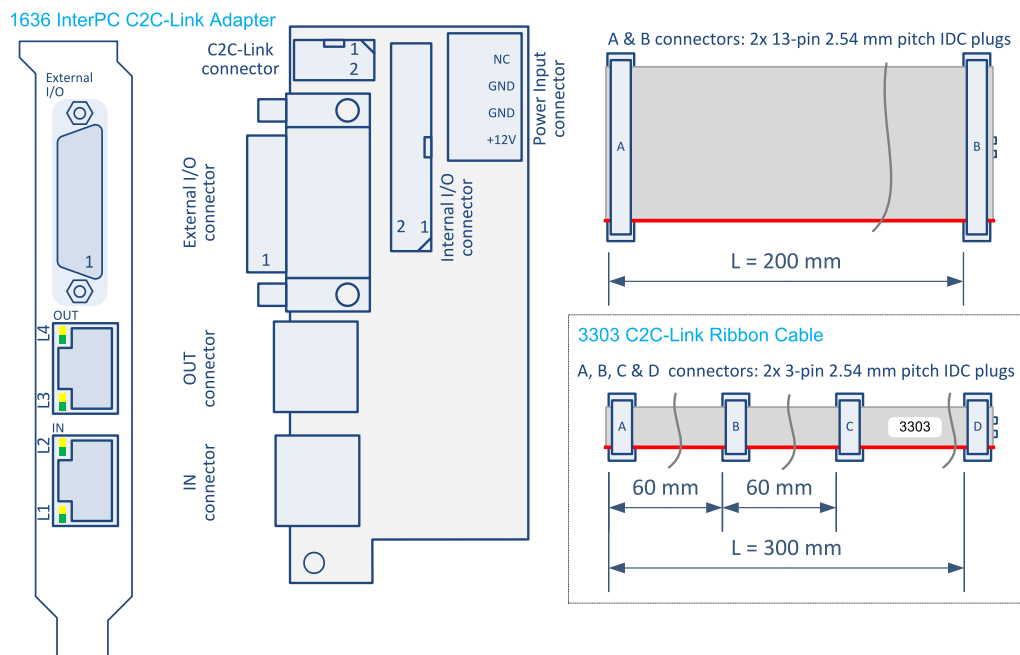
1636 InterPC C2C-Link Adapter

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 pin header with shrouding.

The **C2C-Link connector** is a 6-pin dual-row 0.1" pitch pin header with shrouding.

The **Internal I/O connector** is a 26-pin dual-row 0.1" pitch pin 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**.

402

Using 1636 as C2C-Link Extender

Compatible with [1]

Duo	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4		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
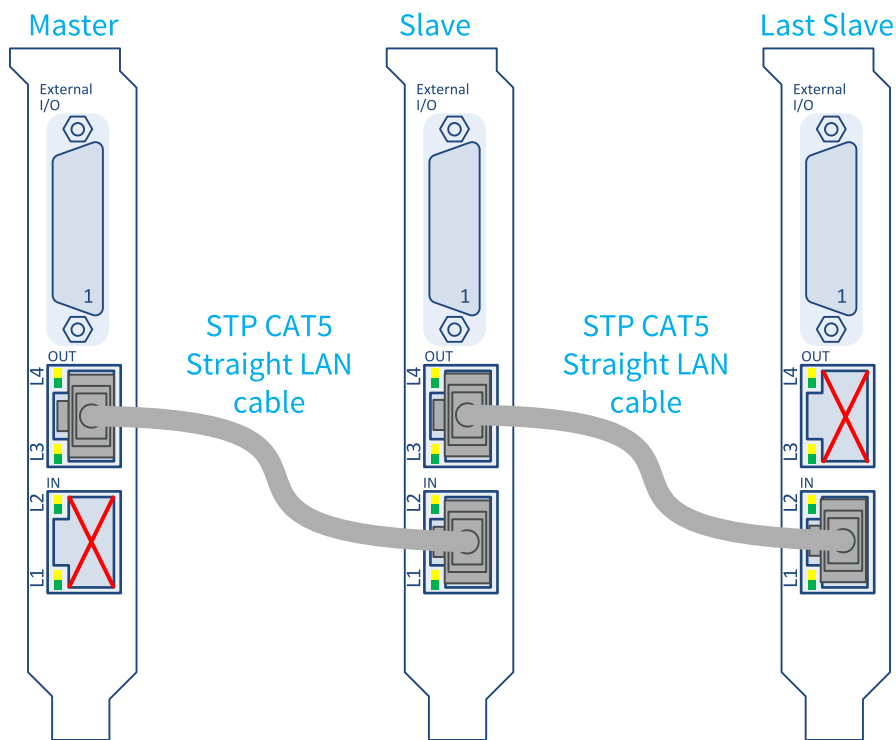
External wiring of a C2C-Link across 3 adapters.

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
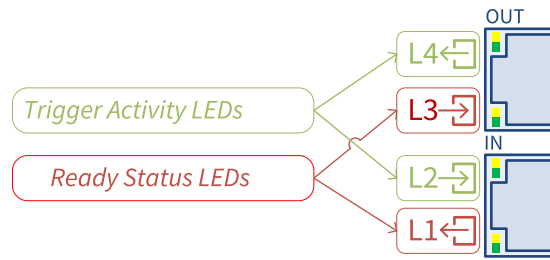
1636 InterPC C2C-Link Adapter LEDs

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. *No trigger events in the past 10 milliseconds.*
Yellow	Trigger activity. *One or more trigger events in the past 10 milliseconds.*

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. *For L1: all the C2C-Link devices attached to this adapter and the downwards adapters (if any) are ready.* *For L3: all the C2C-Link devices attached to the downwards adapters (if any) are ready.*
Yellow	Ready false. *For L1: one or more C2C-Link devices attached to this adapter and the downwards adapters (if any) are not ready.* *For L3: one or more C2C-Link devices attached to the downwards adapters (if any) are not ready.*

> **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
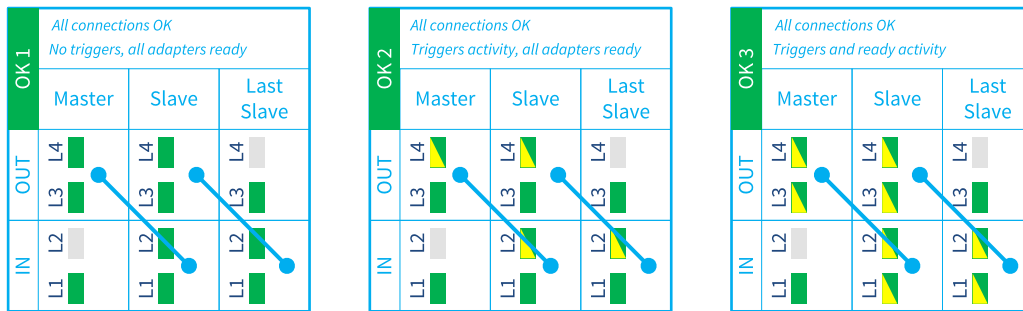
The above drawings show the LEDs states of 3 daisy-chained adapters for 3 normal situations.

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
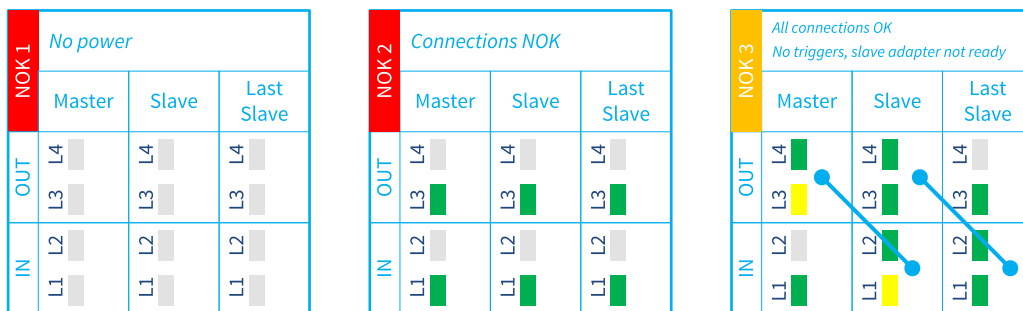
The above drawings show the LEDs states of 3 daisy-chained adapters for 3 abnormal situations.

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-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

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-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.

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[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, 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 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+.**

4.2. I/O Extension Modules

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 with [1]

Duo	Octo	Quad12	Quad12-4		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 LVTTL (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!

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[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+.**
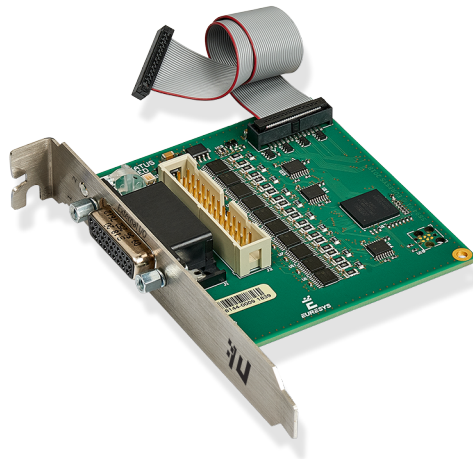
3610 HD26F I/O Extension Module - TTL-RS422
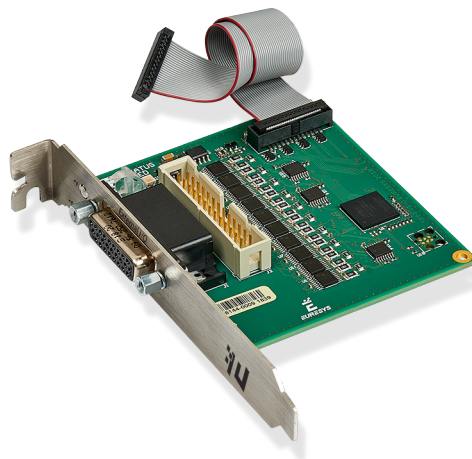
3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422

Module layout
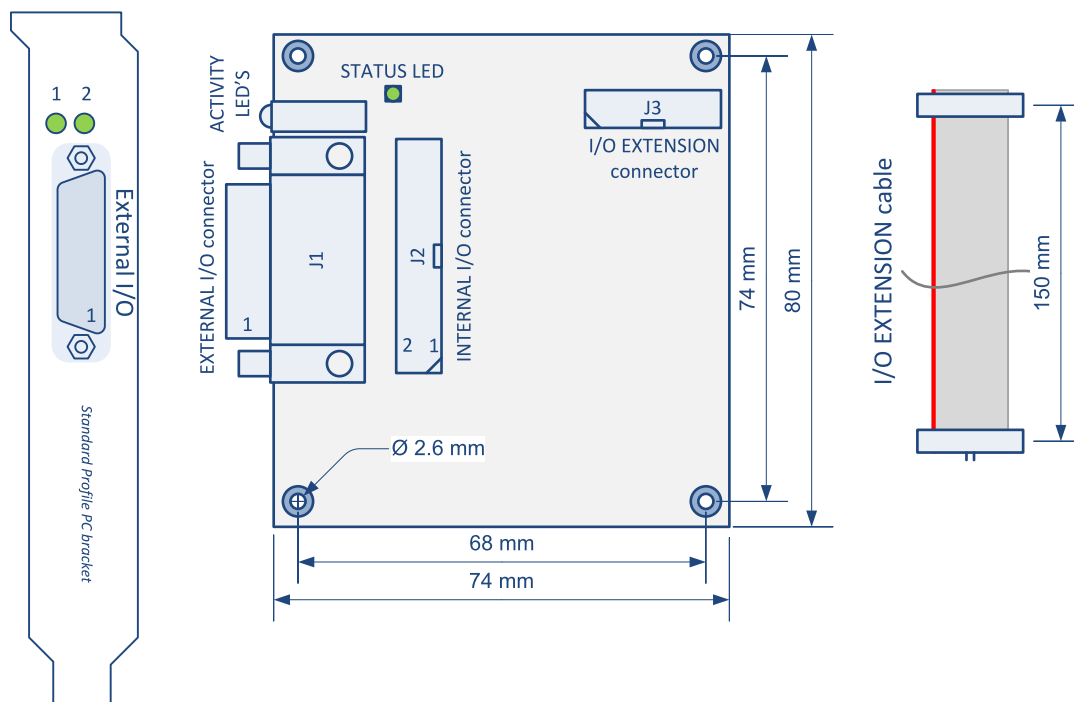
Connectors

- EXTERNAL I/O connector
    - 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 369	
Single-ended I/O	"TTL Input/Output (Version 2)" on page 372	"TTL Input/5 V CMOS Output" on page 375
Power output	"I/O Power Output" on page 364	
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 414 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

Compatible with [1]

Duo	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4		Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF	QSFP+		

1625 DB25F I/O Adapter Cable

A connector: 25-pin 2-row Sub-D female connector with UNC 4-40 Screw nuts
B connector: 2x 13-pin 2.54 mm pitch IDC plug

1625

L = 200 mm
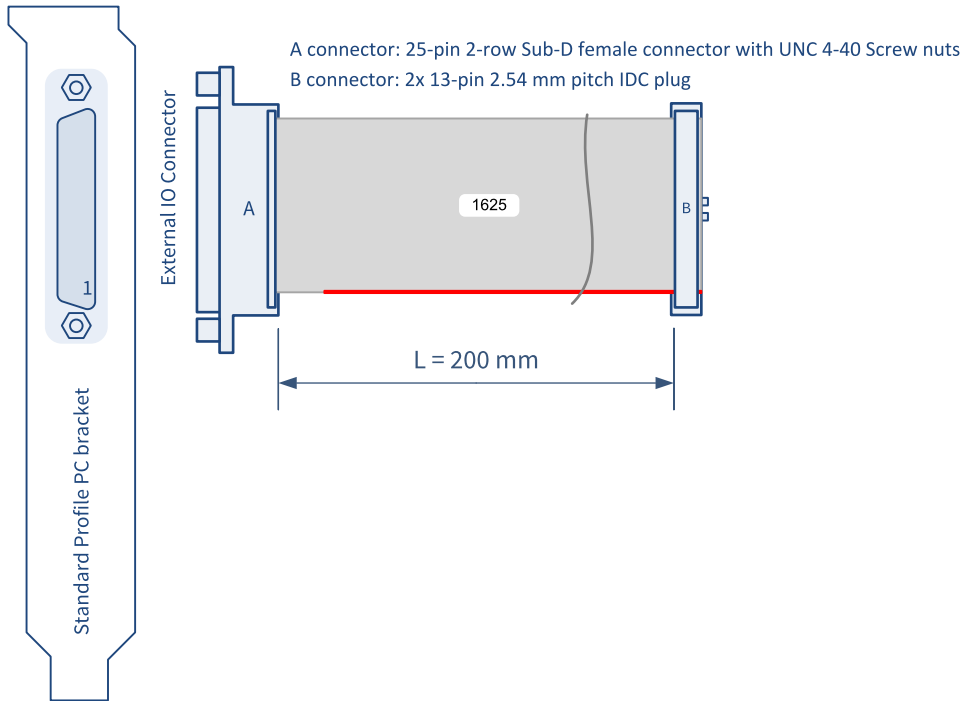
1625 DB25F I/O Adapter Cable

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.

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[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

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.

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[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+.**

3304 HD26F I/O Adapter Cable

Compatible with [1]

Duo	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4		Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF	QSFP+		

3304 HD26F I/O Adapter Cable

A connector: 26-pin 3-row high-density Sub-D female connector with UNC 4-40 Screw nuts
B connector: 2x 13-pin 2.54 mm pitch IDC plug
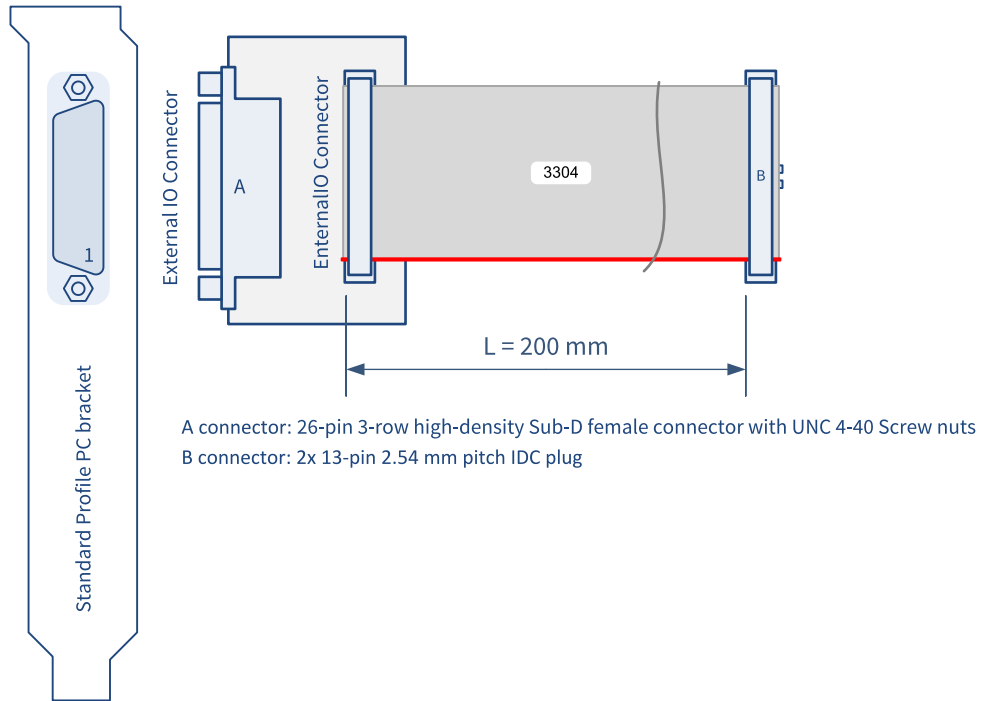
The **3304 HD26F I/O Adapter Cable** interconnects a 26-pin dual-row 0.1" pitch connector to a 26-pin 3-row female High-density SubD connector fitted into a standard-profile PC bracket.

Usage with Internal IO2 connector

Compatible with [2]

Duo	Duo	Quad	QuadG3	QuadG3LH	Quad3DLLE	Quad12
Quad12-4		Quad12J-4	Value12	QSFP+		

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[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	IOUT21+	Isolated contact output #21 – Positive pole
16	16	22	IOUT21-	Isolated contact output #21 – Negative pole
17	17	16	IOUT22+	Isolated contact output #22 – Positive pole
18	18	6	IOUT22-	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-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+

Assembly instructions of a custom-made IntraPC C2C-Link interconnection.
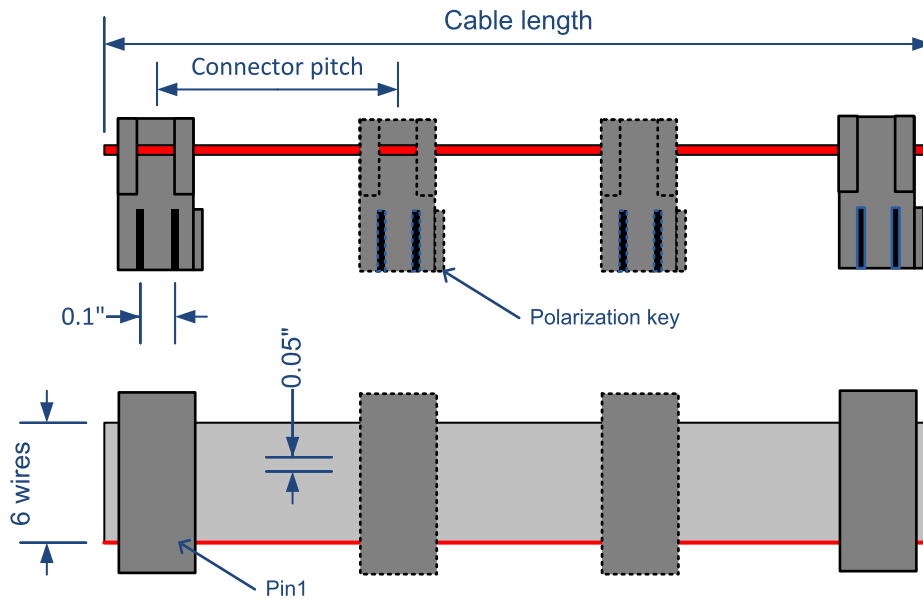
Custom C2C-Link Ribbon Cable Assembly

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.

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[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 LVTTL Levels

5-V TTL
Standard TTL: ABT,
AHCT, HCT, ACT,
bipolar, LV1T, LV4T

5-V CMOS
Rail-to-Rail 5 V
HC, AHC, AC, LV-A,
LV1T, LV4T

3.3-V LVTTL
LVT, LV1T, LV4T,
LVC, ALVC, AUP,
LV-A, ALVT

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 LVTTL Voltage Levels

The figure above shows the respective voltage levels of a TTLand a LVTTL 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 LVTTL.

- 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 LVTTL.

- The maximum driver output voltage is VCC: 5 V for TTL and 3.3 V for LVTTL

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 LVTTL.

- 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 LVTTL.

- The maximum receiver input voltage is VCC: 5 V for TTL and 3.3 V for LVTTL

> **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 LVTTL output driver using an isolated input port

The isolated input ports of Coaxlink and Grablink 3G products are, by design, compatible with TTL and LVTTL 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
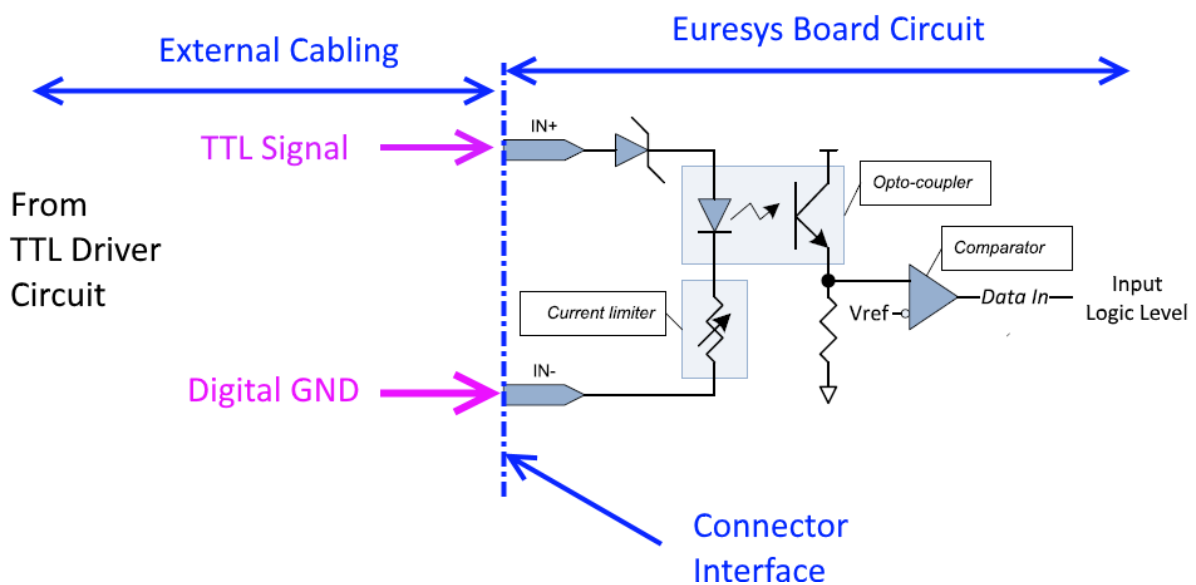
Connecting an (LV)TTL driver to an isolated input

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 LVTTL 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 µs. The highest achievable pulse rate is 50 KHz.

Isolated inputs adds an extra delay of typically 5 µs (10 µs 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 LVTTL 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 434 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 437 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 LVTTL 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 435or "Dynamic limitations " on page 436performance requirements. This topic is covered in the coming paragraphs.

Wiring diagram
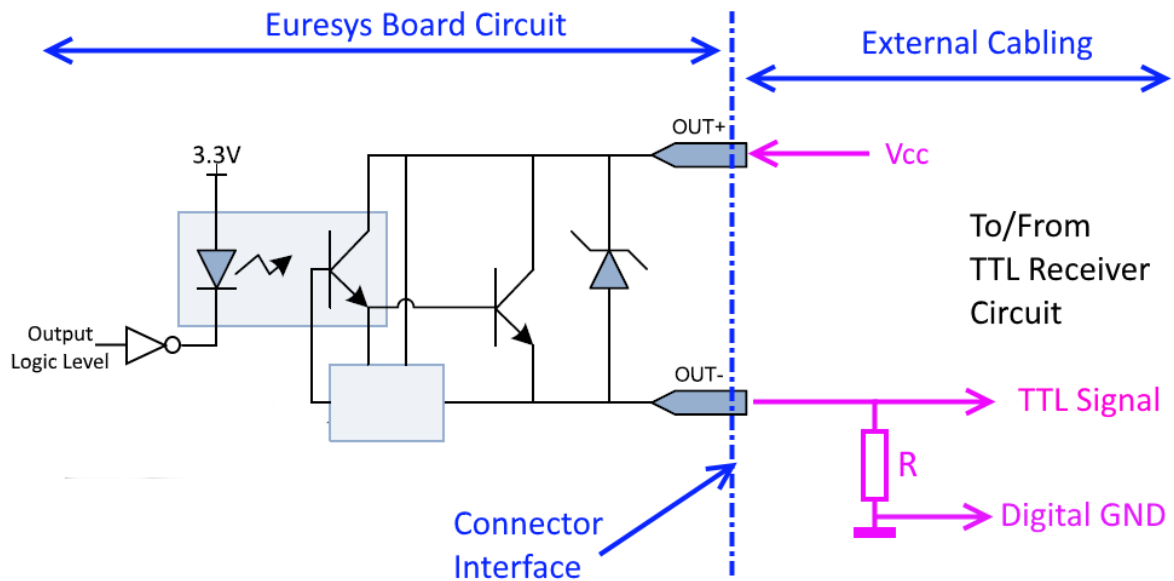
Connecting an isolated output to a TTL receiver using the receiver's V_{CC} supply

> **See also:** "GPIO Connectors" on page 321 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 LVTTL 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 LVTTL (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 381 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}^{+} - $V_{OUT}t^{-}$) 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 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 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 x C = 180 ohm x 100 pF = 18 μs) . 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 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 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
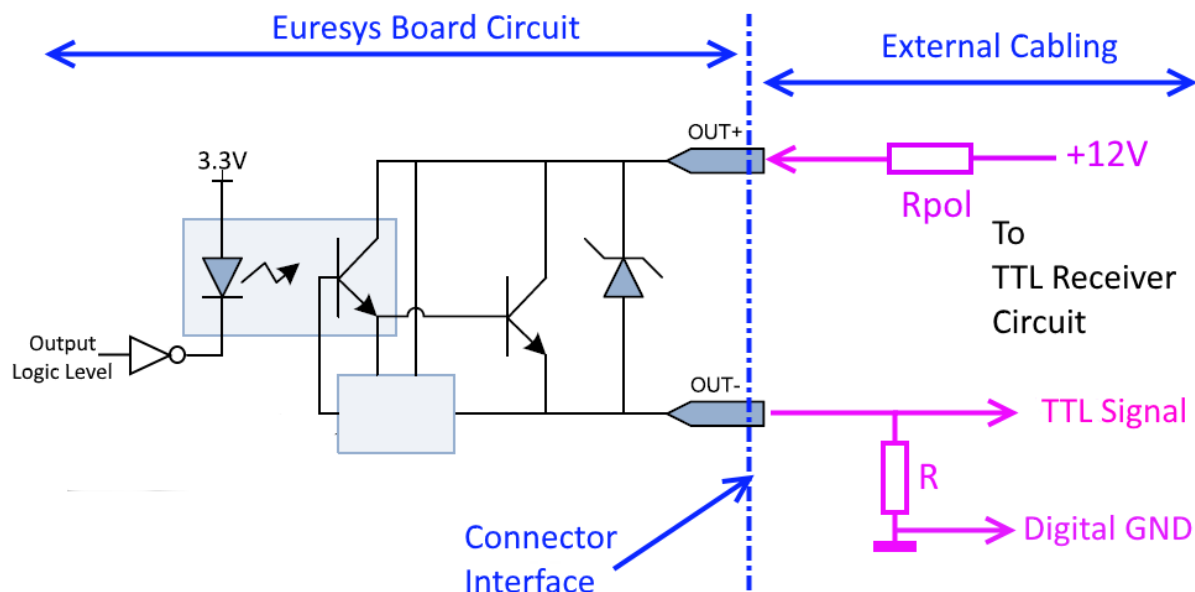
> **See also:** "GPIO Connectors" on page 321 in the hardware manual for I/O connectors pin assignments.

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 LVTTL applications.

Voltage levels and margins, Rpol = 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 381 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) R_{POL} limits the Voh voltage to about 2.7 V in order to match TTL and LVTTL 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}^{+} - $V_{OUT}t^{-}$) 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 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 x C = 180 ohm x 100 pF = 18 µs) . 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 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_03_2

1.1. Root Category

SystemInformation

Feature Info

Module	Category Path	Type	Access
System	Root	Category	RW

Category Members

See also: "SystemInformation Category" on page 446

InterfaceEnumeration

Feature Info

Module	Category Path	Type	Access
System	Root	Category	RW

Category Members

See also: "InterfaceEnumeration Category" on page 455

1.2. SystemInformation Category

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

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 458

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_03_2

2.1. Root Category

InterfaceInformation

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "InterfaceInformation Category" on page 473

DeviceEnumeration

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

> See also: "DeviceEnumeration Category" on page 483

CameraLink

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

> **See also:** "CameraLink Category" on page 587

DigitalIOControl

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "DigitalIOControl Category" on page 490

DigitalIOControl

IOExtensionModule

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "IOExtensionModule Category" on page 506

UserOutputRegister

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "UserOutputRegister Category" on page 523

IOToolbox

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "IOToolbox Category" on page 536

PCIExpress

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "PCIExpress Category" on page 543

InterfaceControl

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

> **See also:** "InterfaceControl Category" on page 558

InterfaceDetails

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "InterfaceDetails Category" on page 575

EventControl

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "EventControl Category" on page 638

EventControl

OemSafetyKey

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "OemSafetyKey Category" on page 652

2.2. InterfaceInformation Category

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.
- **PCIeGen1NotSupported**: 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

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 486
- "DeviceVendorName" on page 487
- "DeviceModelName" on page 488
- "DeviceAccessStatus" on page 489

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

LineSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

Short Description

Selects a physical I/O line.

Selected Features

- "LineFormat" on page 494
- "LineMode" on page 495
- "LineInverter" on page 496
- "LineFilterStrength" on page 497
- "LineFilterDelay" on page 498
- "LineStatus" on page 499
- "LineSource" on page 501
- "LineSourceInitialOffset" on page 504
- "LineSourceDivisionFactor" on page 505

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

Short Description

Electrical style of the selected I/O 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

Short Description

Direction and line driver of the selected I/O line.

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

Short Description

Inversion of the selected I/O line.

LineFilterStrength

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

Short Description

Strength of the glitch removal filter of the selected I/O line.

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)

Short Description

Delay introduced by the glitch removal filter of the selected I/O line.

LineStatus

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Boolean	RW

Short Description

Current status of the selected I/O line.

LineStatusAll

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Integer	RW

Short Description

Current state of all available line signals at time of polling in a single bit field.

LineSource

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

Short Description

Internal signal sourcing the output of the selected I/O line.

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

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	Imposed: WO

Short Description

Selects the I/O extension module configuration action.

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 510
- "IOExtensionModuleLineMode" on page 511
- "IOExtensionModuleLineStatus" on page 512

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

Short Description

I/O line that needs attention.

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 517

2.6. IOExtensionModuleInformation Category

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

Feature Info

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Integer	RW

Value Info

Minimum value: 0

Maximum value: 255

Short Description

Value of all User Output Register bits.

UserActions

Feature Info

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Integer	RW

Value Info

Minimum value: 0

Maximum value: 2147483647

Short 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

Short 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

Short Description

Clear the current set of user actions (UserActions).

ExecuteUserActions

Feature Info

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Command	Imposed: WO

Short 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 532
- "ScheduledUserActionsPoolStatus" on page 533
- "ScheduleUserActions" on page 534
- "DiscardScheduledUserActions" on page 535

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

Short 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

Short 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

Short 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

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "LineInputTool Category" on page 594

LineInputTool

MultiplierDividerTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "MultiplierDividerTool Category" on page 599

QuadratureDecoderTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "QuadratureDecoderTool Category" on page 608

DividerTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "DividerTool Category" on page 617

DelayTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

> See also: "DelayTool Category" on page 624

C2CLinkSynchronizationTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "C2CLinkSynchronizationTool Category" on page 632

C2CLinkSynchronizationTool

2.9. PCIExpress Category

PCIeMaxPayloadSizeSupported

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntReg	RO

Register Port: InterfacePort

Short 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).

PCIeMaxPayloadSize

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntReg	RO

Register Port: InterfacePort

Short 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).

PCIeMaxReadRequestSize

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntReg	RO

Register Port: InterfacePort

Short 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).

PCIeMaxLinkSpeed

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	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.
- **PCIeLinkSpeed2500MTps**: 2.5 GT/s (PCIe Gen 1).
- **PCIeLinkSpeed5000MTps**: 5.0 GT/s (PCIe Gen 2).
- **PCIeLinkSpeed8000MTps**: 8.0 GT/s (PCIe Gen 3).

PCIeCurrentLinkSpeed

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	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.
- **PCIeLinkSpeed2500MTps**: 2.5 GT/s (PCIe Gen 1).
- **PCIeLinkSpeed5000MTps**: 5.0 GT/s (PCIe Gen 2).
- **PCIeLinkSpeed8000MTps**: 8.0 GT/s (PCIe Gen 3).

PCIeMaximumLinkWidth

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.

PCIeNegotiatedLinkWidth

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.

PCIeLinkSpeed2500MTpsSupported

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).

PCIeLinkSpeed5000MTpsSupported

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).

PCIeLinkSpeed8000MTpsSupported

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

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 561

Enumeration Values

- Grabber: Grabber Temperature Sensor.

Temperature

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	SwissKnife	RW

Short Description

Temperature.

AuxiliaryPowerInput

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Enumeration	Imposed: RO

Short Description

Auxiliary Power Input.

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

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.

NextBankSelect

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.

PotBankStatus

DriverVersion

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	String	RW

Short Description

Driver Version.

2.12. CameraLink Category

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 589
- "ClPoClTurnOff" on page 590
- "ClPoClConfigurationStatus" on page 591
- "ClPoClStatus" on page 592

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

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 596
- "LineInputToolActivation" on page 598

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

Short Description

Physical I/O line used as input for the selected Line Input Tool.

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 PARION 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

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 601
- "MultiplierDividerToolOutputControl" on page 603
- "MultiplierDividerToolMultiplicationFactor" on page 604
- "MultiplierDividerToolDivisionFactor" on page 605
- "MultiplierDividerToolEffectiveMultiplicationFactor" on page 606
- "MultiplierDividerToolEffectiveDivisionFactor" on page 607

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

Short Description

Multiplication factor of the selected Multiplier/Divider Tool.

MultiplierDividerToolDivisionFactor

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Float	RW

Value Info

Minimum value: 0.001

Maximum value: 1000

Short Description

Division factor of the selected Multiplier/Divider Tool.

MultiplierDividerToolEffectiveMultiplicationFactor

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Integer	RW

Short Description

Effective multiplication factor of the selected Multiplier/Divider Tool.

MultiplierDividerToolEffectiveDivisionFactor

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox → MultiplierDividerTool	Integer	RW

Short Description

Effective division factor of the selected Multiplier/Divider Tool.

2.15. QuadratureDecoderTool Category

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 610
- "QuadratureDecoderToolActivation" on page 611
- "QuadratureDecoderToolForwardDirection" on page 612
- "QuadratureDecoderToolOutputMode" on page 613
- "QuadratureDecoderToolPosition" on page 614
- "QuadratureDecoderToolDirection" on page 615
- "QuadratureDecoderToolPositionReset" on page 616

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

Short Description

Selects the line input pair to use as A/B line input.

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

Short Description

Edge activating the output of the selected Quadrature Decoder Tool.

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

Short Description

Position counter value of the selected Quadrature Decoder Tool.

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

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DividerTool	Enumeration	RW

Short Description

Selects a Divider Tool.

Selected Features

- "DividerToolSource" on page 619
- "DividerToolEnableControl" on page 621
- "DividerToolDivisionFactor" on page 622
- "DividerToolInitialOffset" on page 623

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

Short Description

Divider value of the selected Divider Tool.

DividerToolInitialOffset

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox → DividerTool	Integer	RW

Value Info

Minimum value: 0

Maximum value: 65535

Short Description

Initial value of the selected Divider Tool.

2.17. DelayTool Category

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 626
- "DelayToolSource2" on page 628
- "DelayToolClockSource" on page 630
- "DelayToolDelayValue" on page 631

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

Short Description

Delay value of the selected Delay Tool.

2.18. C2CLinkSynchronizationTool Category

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 634
- "C2CLinkSynchronizationToolClock" on page 636
- "C2CLinkSynchronizationToolDiscardPendingEvent" on page 637

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

Feature Info

Module	Category Path	Type	Access
Interface	Root → EventControl	Enumeration	RW

Short Description

Select an event.

Selected Features

- "EventNotification" on page 641
- "EventNotificationContext1" on page 642
- "EventNotificationContext2" on page 644
- "EventNotificationContext3" on page 646
- "EventCount" on page 648
- "EventCountReset" on page 649

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

Feature Info

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	Enumeration	RW

Short Description

Defines which key can be compared with the programmed OEM safety key.

Selected Features

- "CheckOemSafetyKey" on page 654

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

Short Description

Write-only string to use for comparing a key (c.f. OemSafetyKeyVerification) 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

Short 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

Short Description

Maximum length of strings that can be set to ProgramOemSafetyKey and CheckOemSafetyKey.

3. Grablink Device Module Register Description

Categorized features list of Devicemodule version 24_03_2

3.1. Root Category

DeviceInformation

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "DeviceInformation Category" on page 666

StreamEnumeration

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "StreamEnumeration Category" on page 673

CameraAndIlluminationControl

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "CameraAndIlluminationControl Category" on page 690

CameraLink

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "CameraLink Category" on page 676

EventControl

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "EventControl Category" on page 743

EventControl

Errors

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

> **See also:** "Errors Category" on page 759

3.2. DeviceInformation Category

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

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 675

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

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraLink	Enumeration	RW

Short Description

Selects a camera control line.

Selected Features

- "CameraControlLineSource" on page 678
- "CameraControlLineInverter" on page 679

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 683

SerialAccessControl

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraLink	Category	RW

Category Members

> **See also:** "SerialAccessControl Category" on page 731

3.5. AntiGlitchFilters Category

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 685
- "ChannelXGlitchCount" on page 686
- "ChannelYGlitchCount" on page 687
- "ChannelZGlitchCount" on page 688
- "ChannelXYZGlitchCountReset" on page 689

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

CameraModel

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Category Members

> See also: "CameraModel Category" on page 697

CycleTiming

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Category Members

See also: "CycleTiming Category" on page 705

CycleControl

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Category Members

See also: "CycleControl Category" on page 711

SequenceControl

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Category Members

See also: "SequenceControl Category" on page 720

SequenceControl

DeviceReset

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Command	Imposed: WO

Short Description

Device Reset.

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

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Enumeration	RW

Short Description

Camera Control Method.

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

Short Description

C2C-Link Configuration.

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

Short Description

Exposure Readout Overlapping Capability.

ExposureReadoutOverlap

ExposureRecoveryTime

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

Value Info

Minimum value: 0

Maximum value: 1.71799e+07

Short Description

Exposure Recovery Time.

ExposureTimeMin

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

Short Description

Exposure Time Min.

ExposureTimeMax

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

Value Info

Maximum value: 5.6295e+11

Short Description

Exposure Time Max.

CycleMinimumPeriod

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CameraModel	Float	RW

Value Info

Maximum value: 5.6295e+11

Short Description

Cycle Minimum Period.

3.8. CycleTiming Category

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 708
- "StrobeDelay" on page 709
- "StrobeDuration" on page 710

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

Short Description

Exposure Time.

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

Short Description

Strobe Delay.

StrobeDuration

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleTiming	Float	RW

Value Info

Minimum value: 0

Maximum value: 5.6295e+11

Short Description

Strobe Duration.

3.9. CycleControl Category

CycleTriggerSource

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	Enumeration	RW

Short Description

Cycle Trigger Source.

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

Short Description

Start Cycle.

CycleMaxPendingTriggerCount

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	Integer	RW

Value Info

Minimum value: 0

Maximum value: 7

Short Description

Maximum number of CIC cycle triggers that can be delayed when they cannot be served immediately.

CyclePendingTriggerCount

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	IntReg	RO

Register Port: DevicePort

Short Description

Gets the count of pending CIC cycle trigger events.

CycleLostTriggerCount

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	IntReg	RO

Register Port: DevicePort

Short Description

Gets the count of lost CIC cycle trigger events.

CycleLostTriggerCountReset

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → CycleControl	Command	Imposed: WO

Short Description

Resets the count of lost CIC cycle trigger events.

3.10. SequenceControl Category

StartOfSequenceTriggerSource

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Enumeration	RW

Short Description

Start Of Sequence Trigger Source.

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

Short Description

End Of Sequence Trigger Source.

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

Short Description

Start Sequence.

StopSequence

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Command	Imposed: WO

Short Description

Stop Sequence.

AbortSequence

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl → SequenceControl	Command	Imposed: WO

Short Description

Abort Sequence.

3.11. SerialAccessControl Category

SerialOperationSelector

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraLink → SerialAccessControl	Enumeration	RW

Short Description

Serial Operation Selector.

Selected Features

- "SerialOperationExecute" on page 733
- "SerialOperationStatus" on page 734
- "SerialOperationResult" on page 735

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

3.12. EventControl Category

EventSelector

Feature Info

Module	Category Path	Type	Access
Device	Root → EventControl	Enumeration	RW

Short Description

Select an event.

Selected Features

- "EventNotification" on page 745
- "EventNotificationContext1" on page 746
- "EventNotificationContext2" on page 749
- "EventNotificationContext3" on page 752
- "EventCount" on page 755
- "EventCountReset" on page 756

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.
- FillLevelAboveIlSosRejected: 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

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
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.
- **FillLevelAboveIlSosRejectedEventCount**: Number of FillLevelAboveIlSosRejected 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.

- FillLevelAboveIlSosRejectedEventCount: Number of FillLevelAboveIlSosRejected 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.
- **FillLevelAboveIlSosRejectedEventCount**: Number of FillLevelAboveIlSosRejected 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

Feature Info

Module	Category Path	Type	Access
Device	Root → Errors	Enumeration	RW

Short Description

Error Selector.

Selected Features

- "ErrorCount" on page 761
- "ErrorCountReset" on page 762

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_03_2

4.1. Root Category

StreamInformation

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "StreamInformation Category" on page 782

ImageFormatControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "ImageFormatControl Category" on page 787

ImageFormatControl

TransportLayerControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "TransportLayerControl Category" on page 817

BufferHandlingControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "BufferHandlingControl Category" on page 819

BufferHandlingControl

PixelProcessing

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "PixelProcessing Category" on page 833

LineScanAcquisitionControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "LineScanAcquisitionControl Category" on page 839

LineScanAcquisitionControl

StreamControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "StreamControl Category" on page 850

Errors

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "Errors Category" on page 876

Errors

LUTControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

> **See also:** "LUTControl Category" on page 880

LinearFilter

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

> **See also:** "LinearFilter Category" on page 889

Threshold

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "Threshold Category" on page 894

LaserLineExtractor

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "LaserLineExtractor Category" on page 897

Bayer

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

> **See also:** "Bayer Category" on page 901

FlatFieldCorrection

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "FlatFieldCorrection Category" on page 903

MetadataInsertion

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

> **See also:** "MetadataInsertion Category" on page 909

EventControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

> **See also:** "EventControl Category" on page 927

StreamStatistics

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

> **See also:** "StreamStatistics Category" on page 943

4.2. StreamInformation Category

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

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.
- **SCF1WGWB10**: Sparse Color Filter #1 White-Green-White-Blue 10-bit unpacked.
- **SCF1WGWB10p**: Sparse Color Filter #1 White-Green-White-Blue 10-bit packed.
- **SCF1WGWB12**: Sparse Color Filter #1 White-Green-White-Blue 12-bit unpacked.
- **SCF1WGWB12p**: Sparse Color Filter #1 White-Green-White-Blue 12-bit packed.
- **SCF1WGWB14**: Sparse Color Filter #1 White-Green-White-Blue 14-bit unpacked.

- **SCF1WGWB16**: Sparse Color Filter #1 White-Green-White-Blue 16-bit.

- **SCF1WGWB8**: 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.

- **SCF1WGWR8**: 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_CbYYCrYY**: 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_CbYYCrYY**: 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_UYYVYY**: 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.
- **SCF1WGWB10**: Sparse Color Filter #1 White-Green-White-Blue 10-bit unpacked.
- **SCF1WGWB10p**: Sparse Color Filter #1 White-Green-White-Blue 10-bit packed.
- **SCF1WGWB12**: Sparse Color Filter #1 White-Green-White-Blue 12-bit unpacked.
- **SCF1WGWB12p**: Sparse Color Filter #1 White-Green-White-Blue 12-bit packed.
- **SCF1WGWB14**: Sparse Color Filter #1 White-Green-White-Blue 14-bit unpacked.

- **SCF1WGWB16**: Sparse Color Filter #1 White-Green-White-Blue 16-bit.

- **SCF1WGWB8**: 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.

- **SCF1WGWR8**: 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_CbYYCrYY**: 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 BAT.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_CbYYCrYY**: 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_UYYVYY**: 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-actived when the data-stream is inactive.

4.4. TransportLayerControl Category

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

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

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → PixelProcessing	Enumeration	RW

Short Description

Unpacking Mode of multi-byte pixel components.

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

Short Description

Red-Blue component swapping.

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-actived 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

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Enumeration	RW

Short Description

Start Of Scan Trigger Source.

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

Short Description

End Of Scan Trigger Source.

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

Short Description

Scan Length.

ScanLength

BufferHeight

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Integer	RW

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.

StartScan

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

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-actived 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

SyncMarker

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → StreamControl	Category	RW

Category Members

See also: "SyncMarker Category" on page 872

SyncMarker

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

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

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

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → Errors	Enumeration	RW

Short Description

Error Selector.

Selected Features

- "ErrorCount" on page 878
- "ErrorCountReset" on page 879

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

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-actived 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.

LUTLength

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 886

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 886

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-actived 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-actived 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

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-actived 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

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-actived 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

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-actived 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

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-actived 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

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-actived 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

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-actived 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-actived 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-actived 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-actived 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-actived 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-actived 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 917

GeneralPurposeCounter

4.19. GeneralPurposeCounter Category

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 919
- "GeneralPurposeCounterIncrementSource" on page 920
- "GeneralPurposeCounterDecrementSource" on page 923
- "GeneralPurposeCounterLatchAndResetSource" on page 925

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-actived when the data-stream is inactive.

GeneralPurposeCounterEnable

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-actived 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:

- 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-actived 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-actived 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

EventSelector

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Enumeration	RW

Short Description

Select an event.

Selected Features

- "EventNotification" on page 929
- "EventNotificationContext1" on page 930
- "EventNotificationContext2" on page 933
- "EventNotificationContext3" on page 936
- "EventCount" on page 939
- "EventCountReset" on page 940

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

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
Data Stream	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.
- 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.

EventCountResetAll

4.21. StreamStatistics Category

StatisticsSamplingSelector

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	Enumeration	RW

Short Description

Selects the stream statistics sampling method.

Selected Features

- "StatisticsFrameRate" on page 945
- "StatisticsLineRate" on page 946
- "StatisticsDataRate" on page 947

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 DSStartAcquisition() function call until now, if the acquisition is still active otherwise until the last DSStopAcquisition() 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)

Short Description

Get the average image frames acquisition rate using the selected sampling method.

StatisticsLineRate

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	FloatReg	RO

Register Port: StreamPort

Value Info

Unit: Lps (Lines per second)

Short Description

Get the average image lines acquisition rate using the selected sampling method.

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_03_2

5.1. Root Category

DeviceControl

Feature Info

Module	Category Path	Type	Access
	Root	Category	RW

Category Members

> **See also:** "DeviceControl Category" on page 973

DeviceEnumeration

Feature Info

Module	Category Path	Type	Access
	Root	Category	RW

Category Members

See also: "DeviceEnumeration Category" on page 957

ImageFormatControl

Feature Info

Module	Category Path	Type	Access
	Root	Category	RW

Category Members

See also: "ImageFormatControl Category" on page 960

TransportLayerControl

Feature Info

Module	Category Path	Type	Access
	Root	Category	RW

Category Members

> **See also:** "TransportLayerControl Category" on page 966

AcquisitionControl

Feature Info

Module	Category Path	Type	Access
	Root	Category	RW

Category Members

See also: "AcquisitionControl Category" on page 969

5.2. DeviceEnumeration Category

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

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.

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

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

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

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.