euresys
Empowering Computer Vision

HANDBOOK

eGrabber

Coaxlink Series Handbook

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+

This documentation is provided with **eGrabber 24.04.0** (doc build **2187**).
www.euresys.com

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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

Applies to [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

For optimal data transfer performance:

- **1628 Grablink Duo**, **1630 Coaxlink Mono**, **1631 Coaxlink Duo**, **1632 Coaxlink Quad** and **1637 Coaxlink Quad 3D-LLE** must be plugged into a x4, x8 or x16 PCI Express Gen 2 or Gen 3 card connector providing at least four active lanes.
- **1633 Coaxlink Quad G3**, **1633-LH Coaxlink Quad G3 LH**, **1635 Coaxlink Quad G3 DF**, **3621 Coaxlink Mono CXP-12**, **3621-LH Coaxlink Mono CXP-12 LH**, **3622 Coaxlink Duo CXP-12** and **3622-LH Coaxlink Duo CXP-12 LH** must be plugged into a x4, x8 or x16 PCI Express Gen 3 card connector providing at least four active lanes.
- **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** and **3625 Coaxlink QSFP+** must be plugged into a x8 or x16 PCI Express Gen 3 card connector providing at least eight active lanes.

To guarantee reliable operation across the entire operating temperature range and longer lifetime, ensure an adequate cooling of the card:

- The cooling is improved by a higher air flow circulating around the board. This air flow is increased, for example, by using computer case fans.
- Avoid placing a card next to other heat dissipating boards.
- **1633-LH Coaxlink Quad G3 LH** and **3621-LH Coaxlink Mono CXP-12 LH** require a minimum of 150 LFM (Linear Feet per Minute) across the surface of the board.
- **3622-LH Coaxlink Duo CXP-12 LH** requires a minimum of 250 LFM (Linear Feet per Minute) across the surface of the board.

[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+.

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.

1.4. Low-Profile Bracket Installation

Applies to [1]

Mono12 Mono12LH Duo12 Duo12LH

3621 Coaxlink Mono CXP-12, **3621-LH Coaxlink Mono CXP-12 LH**, **3622 Coaxlink Duo CXP-12** and **3622-LH Coaxlink Duo CXP-12 LH**. boards can also be installed in a low-profile computer. Therefore:

1. Remove the original standard-profile bracket by unscrewing the screw locks
2. Install the low-profile bracket and secure it on the board with the screw locks

[1] 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

1.5. PCI Express/104 Card Stacking Requirements

Applies to [1]

Duo104EMB Not recommended for new designs

The Host PC must be equipped with one stack-DOWN connector of the following types:

- Type 2 PCIe/104 with 2 PCI Express Gen 2 x4 links providing at least four active lanes.
- Type 1 PCIe/104 with 1 PCI Express x16 link configured to operate as 2 x8 links providing at least four active lanes per link.

1.6. PCI Express/104 Module Installation Procedure

Applies to [2]

Duo104EMB Not recommended for new designs

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. Unwrap the module(s) packing, take the board and carefully hold it. Avoid any contact of the board with unnecessary items, including your clothes.
5. For each module, install a thermal drain. For instance: **3301 Thermal drain (Model 1) for Coaxlink Duo PCIe/104**.
6. Install the first module directly under the Host PC. Secure it using 4 spacers (not supplied).
7. **Optional**. Repeat the operation to install a second module under the first one.
8. For each module, attach 2 coaxial cables to the enclosure and plugs it into the CoaXPress Host A and CoaXPress Host B connectors. For instance:**3302 DIN1.0/2.3 Coaxial cable for Coaxlink Duo PCIe/104**.
9. **Optional**. For each module, attach one I/O module to the enclosure and plug the cable to the Extension connector.
10. Terminate the installation of the thermal drain. For instance:**3300 HD26F I/O module for Coaxlink Duo PCIe/104**
11. **Optional.** When the camera(s) is (are) powered through the CoaXPress cable, connect a 24 V DC power source to the Camera Power Input connector using a 4-pin 0.1-in Molex KK7478 female plug.
12. **Optional.** When synchronized acquisition is required for cameras attached to different cards, establish the card-to-card link interconnections.

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[1] 1629 Coaxlink Duo PCIe/104-EMB.

[2] 1629 Coaxlink Duo PCIe/104-EMB.

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 24.04***

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

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

WARNING

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

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

CPU Requirements

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

Image Buffer Limits

Maximum buffer size

0xfffffff0 bytes (4 GiB - 16 B) for all operating systems

Number of buffers

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

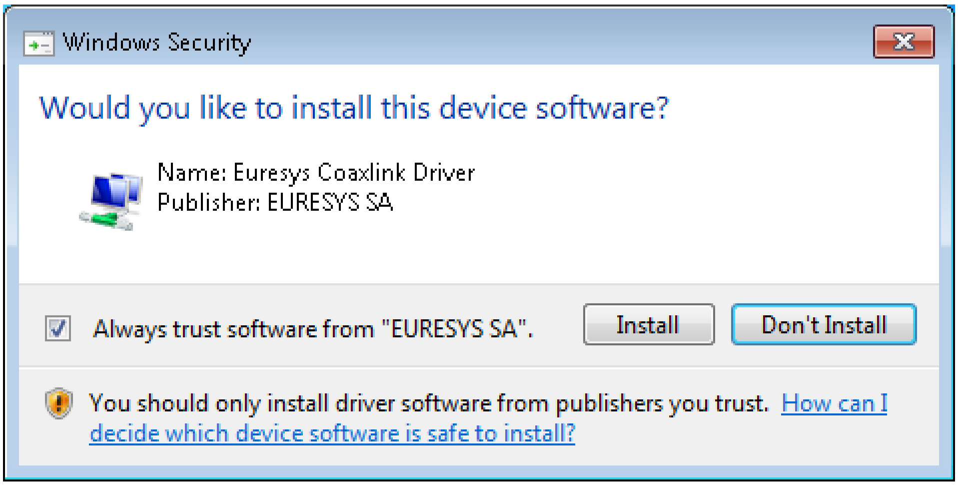
NOTE: when using very large numbers of buffers, DSAnnounceBuffer calls can take longer and longer to complete (or even fail with error code GC_ERR_CUSTOM_IOCTL_BUFFER_ANNOUNCE_FAILED). If this happens, the user should set DmaEngineOptimization=LowMemoryUsage in the data stream module.

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:

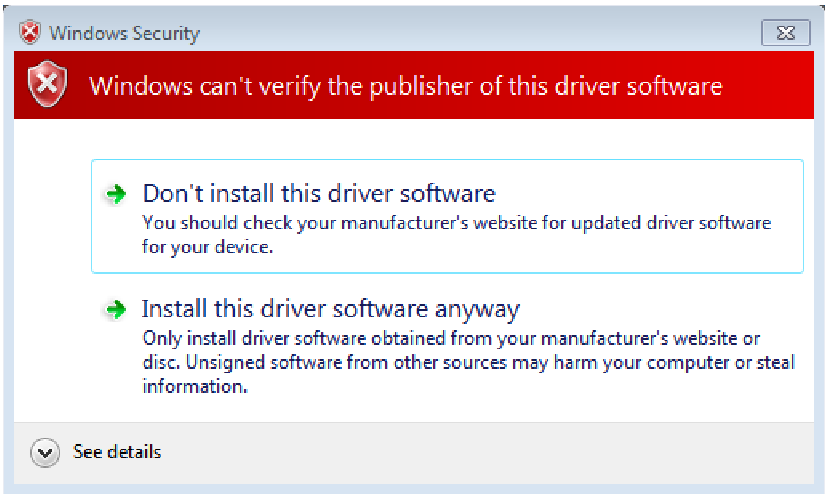


This Windows security warning message occurs when the Euresys code-signing certificate is missing from the "Trusted Publishers" Windows Certificate store. This happens, for instance, when the Euresys code-signing certificate must be renewed.

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.

Flash EEPROM Change Note

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

Several **Coaxlink frame grabbers** will undergo a hardware change of the Flash EEPROM control logic.

NOTE
The Flash EEPROM is the memory that stores the contents of the on-board FPGA.

Affected products list

Product	S/N Prefix	First Serial Number of New Cards
1629 Coaxlink Duo PCIe/104-EMB	KDI	10,000
1633 Coaxlink Quad G3	KQG	10,000
1633-LH Coaxlink Quad G3 LH	KQH	10,000
1635 Coaxlink Quad G3 DF	KDF	10,000
1637 Coaxlink Quad 3D-LLE	KQE	10,000

Consequences

Existing applications using a **Coaxlink driver** prior to version 10.0.0 are required to use a new procedure to install or update the firmware on new boards.

The change has no impact for applications already using **Coaxlink driver 10.0.0** or higher.

With the exception of the firmware update, the change has strictly no impact on the product functionality, performance and specifications:

- The hardware design of these new cards, including the CoaXPress interface, PCI Express interface, the FPGA and the I/O, has not been changed.
- The functionality, performance and specification of the new cards is guaranteed to remain unchanged. Once programmed with the corresponding firmware, the new cards remain compatible with all previous versions of the **Coaxlink driver**.

TIP
For further information, read the *D207EN-Flash EEPROM Change Note* PDF document.

2.3. Installing eGrabber

Installing eGrabber on Windows

1. Read the "Notices for Windows" on page 25
2. Open the support page of the Euresys website: https://www.euresys.com/support/ and click on the *Coaxlink series* icon to open the Coaxlink download area.

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

3. Click on *eGrabber for Coaxlink and Grablink Duo* to display the file list corresponding to the latest available **eGrabber** release.
4. Select the setup file according to the processor architecture:

- For an installation on Windows 7 or 8.1, select the egrabber-win7-x86_64-**24.04.0**.*.exe setup file.
- For an installation on Windows 10 or 11, select the egrabber-win10-x86_64-**24.04.0**.*.exe setup file.

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

NOTE: If you have an existing **eGrabber** installation, the installer tool prompts you to uninstall it before being able to continue. Otherwise, it prompts you for the selection of the destination folder.

Installing eGrabber on Linux

1. Read the "Notice for Linux" on page 26
2. Open the support page of the Euresys website: https://www.euresys.com/support/ and click on the *Coaxlink series* icon to open the Coaxlink download area.

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

3. Click on *eGrabber for Coaxlink and Grablink Duo* to display the file list corresponding to the latest available **eGrabber** release.
4. Download the setup file according to the processor architecture:

- For an installation on AArch64 (64-bit) processor architecture, select the egrabber-linux-aarch64-**24.04.0**.*.tar.gz setup file.
- For an installation on x86_64 (64-bit) processor architecture, select the egrabber-linux-x86_64-**24.04.0**.*.tar.gz setup file.

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

NOTE: If you have an existing **eGrabber** installation, the installer tool prompts you to uninstall it before being able to continue. Otherwise, it prompts you for the selection of the destination folder.

Installing eGrabber on macOS

1. Read the "Notices for macOS" on page 27.
2. Open the support page of the Euresys website: https://www.euresys.com/support/ and click on the *Coaxlink series* icon to open the Coaxlink download area.

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

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

Installing dext packages on Mac computers with Apple silicon

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

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

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

Installing kext drivers packages on Mac computers with Apple silicon

Step 1. Enable kernel extensions

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

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

To enable kernel extensions on a Mac with Apple silicon:

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

Step 2 Launch the installer

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

Step 3. Approve kernel extension

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

Installing kext drivers packages on Mac computers with an Intel processor

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

Command-Line Installation Procedure

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

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

Installation

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

There are a couple of optional flags:

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

Installation removal

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

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

Reboot during Installation

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

Error Reporting

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

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

3. Managing Firmware

3.1. What's Firmware?

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 35 : A graphical user interface tool in **eGrabber Studio**,
- "Firmware Manager - Command line mode" on page 35 : 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:

Directives

- Execute either the "GUI mode downgrade procedure" on page 38 or the "Command-line mode downgrade procedure " on page 39 only when the application absolutely requires an older firmware version!
- Execute either the "Command-line mode recovery procedure" on page 39 or the "Recovery procedure with recovery switch" on page 40 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 443 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 37
   d. Power off the PC
   e. Remove the card
   f. Set back the "Firmware Recovery Switch" on page 443 to the “Normal” position

3.5. Firmware Recovery Switch

Switch types and location

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

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

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

Switch positions

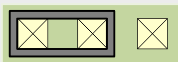
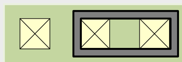
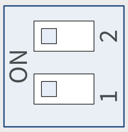
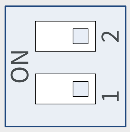
The *firmware recovery switch* has two positions:

Normal position (factory default)

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

Recovery position

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

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

4. Firmware Variants per Product

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

Pixel processing abbreviations

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

1629 Coaxlink Duo PCIe/104-EMB and 1634 Coaxlink Duo PCIe/104-MIL

Firmware Variant	HCMAP	Processing	Description
1-camera	1D2	LUT	One 1- or 2-connection area-scan camera
1-camera, line-scan	1D2	LUT	One 1- or 2-connection line-scan camera
2-camera	2D11	LUT	One or two 1-connection area-scan cameras

1630 Coaxlink Mono

Firmware Variant	HCMAP	Processing	Description
1-camera	1D1	LUT	One 1-connection area-scan camera

1631 Coaxlink Duo

Firmware Variant	HCMAP	Processing	Description
1-camera	1D2	LUT	One 1- or 2-connection area-scan camera
1-camera, line-scan	1D2	LUT	One 1- or 2-connection line-scan camera
2-camera	2D11	LUT	One or two 1-connection area-scan cameras
2-camera, line-scan	2D11	LUT	One or two 1-connection line-scan cameras

1632 Coaxlink Quad

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	LUT	One 1- or 2- or 4-connection area-scan camera
1-camera, line-scan	1D4	LUT	One 1- or 2- or 4-connection line-scan camera
2-camera	2D22	LUT	One or two 1- or 2-connection area-scan cameras

1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	FFC LUT CFA-12	One 1- or 2- or 4-connection area-scan camera
1-camera, 4-data-stream	1D4S4		One 1- or 2- or 4-connection area-scan camera, up to 4 data streams
1-camera, line-scan	1D4	FFC LUT	One 1- or 2- or 4-connection line-scan camera
1-slm-camera	1D8SLM4	LUT	Master 4-connection sub-link of an 8-connection area-scan camera
1-sls-camera	1D8SLS4	LUT	Slave 4-connection sub-link of an 8-connection area-scan camera
2-camera	2D22	LUT CFA-35-D0	One or two 1- or 2-connection area-scan cameras
2-camera, bayer	2D22	CFA-35	One or two 1- or 2-connection area-scan cameras
2-camera, line-scan	2D22	LUT	One or two 1- or 2-connection line-scan cameras
3-camera	3D211	LUT	One 1- or 2-connection and one or two 1-connection area-scan cameras
4-camera	4D1111	LUT	One or two or three or four 1-connection area-scan cameras
4-camera, line-scan	4D1111	LUT	One or two or three or four 1-connection line-scan cameras

1635 Coaxlink Quad G3 DF

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	LUT CFA-123	One 1- or 2- or 4-connection area-scan camera
1-df-camera	1DF4	LUT CFA-123	One 1- or 2- or 4-connection area-scan data-forwarded camera
1-camera, line-scan	1D4	FFC LUT	One 1- or 2- or 4-connection line-scan camera
1-df-camera, line-scan	1DF4	FFC LUT	One 1- or 2- or 4-connection line-scan data-forwarded camera

1637 Coaxlink Quad 3D-LLE

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	LUT LLE	One 1- or 2- or 4-connection area-scan camera

3602 Coaxlink Octo

Firmware Variant	HCMAP	Processing	Description
1-camera	1D8	LUT CFA-123	One 1- or 2- or 4- or 8-connection area-scan camera
1-camera, line-scan	1D8	LUT MI	One 1- or 2- or 4- or 8-connection line-scan camera
2-camera	2D44	FFC LUT CFA-125	One or two 1- or 2- or 4-connection area-scan cameras
2-camera, line-scan	2D44	LUT FLIPX MI	One or two 1- or 2- or 4-connection line-scan cameras
3-camera	3D422	LUT	One 1- or 2- or 4-connection and one or two 1- or 2-connection area-scan cameras
4-camera	4D2222	LUT	One or two or three or four 1- or 2-connection area-scan cameras
4-camera, line-scan	4D2222	LUT MI	One or two or three or four 1- or 2-connection line-scan cameras
5-camera	5D41111	LUT	One 1- or 2- or 4-connection and one or two or three or four 1-connection area-scan cameras
5-camera, 5D22211	5D22211	LUT	One or two or three 1- or 2-connection and one or two 1-connection area-scan cameras
8-camera	8D11111111	LUT	Up to eight 1-connection area-scan cameras

3603 Coaxlink Quad CXP-12 and 3603-4 Coaxlink Quad CXP-12

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	FFC LUT CFA-12 BIN	One 1- or 2- or 4-connection area-scan camera
1-camera, line-scan	1D4	LUT BIN MI	One 1- or 2- or 4-connection line-scan camera
2-camera	2D22	LUT	One or two 1- or 2-connection area-scan cameras
2-camera, line-scan	2D22	LUT MI	One or two 1- or 2-connection line-scan cameras
4-camera	4D1111	LUT	One or two or three or four 1-connection area-scan cameras
4-camera, line-scan	4D1111	LUT MI	One or two or three or four 1-connection line-scan cameras

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

Firmware Variant	HCMAP	Processing	Description
4-camera	4D1111	CFA-2-S0 JPEG-S1	One or two or three or four 1-connection area-scan cameras

3621 Coaxlink Mono CXP-12 and 3621-LH Coaxlink Mono CXP-12 LH

Firmware Variant	HCMAP	Processing	Description
1-camera	1D1	LUT	One 1-connection area-scan camera
1-camera, line-scan	1D1	LUT	One 1-connection line-scan camera

3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH

Firmware Variant	HCMAP	Processing	Description
1-camera	1D2	LUT CFA-3	One 1- or 2-connection area-scan camera
1-camera, line-scan	1D2	LUT	One 1- or 2-connection line-scan camera
2-camera	2D11	LUT	One or two 1-connection area-scan cameras
2-camera, line-scan	2D11	LUT	One or two 1-connection line-scan cameras

3623 Coaxlink Quad CXP-12 Value

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	FFC LUT CFA-12 BIN	One 1- or 2- or 4-connection area-scan camera
1-camera, line-scan	1D4	LUT BIN MI	One 1- or 2- or 4-connection line-scan camera
2-camera	2D22	LUT	One or two 1- or 2-connection area-scan cameras
2-camera, line-scan	2D22	LUT MI	One or two 1- or 2-connection line-scan cameras
4-camera	4D1111	LUT	One or two or three or four 1-connection area-scan cameras
4-camera, line-scan	4D1111	LUT MI	One or two or three or four 1-connection line-scan cameras

3624 Coaxlink Quad CXP-12 DF

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	FFC LUT CFA-12 BIN	One 1- or 2- or 4-connection area-scan camera
1-df-camera	1DF4	FFC LUT CFA-12 BIN	One 1- or 2- or 4-connection area-scan data-forwarded camera
1-camera, line-scan	1D4	LUT MI	One 1- or 2- or 4-connection line-scan camera
1-df-camera, line-scan	1DF4	LUT MI	One 1- or 2- or 4-connection line-scan data-forwarded camera

3625 Coaxlink QSFP+

Firmware Variant	HCMAP	Processing	Description
1-camera	1D4	LUT CFA-12	One 1- or 2- or 4-connection area-scan camera
1-camera, line-scan	1D4	LUT MI	One 1- or 2- or 4-connection line-scan camera

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 251 block gathers all the I/O ports of the card.

I/O Toolbox

The "I/O Toolbox" on page 268 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 219 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 115 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 105 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 136 block performs on-the-fly pixel processing and data formatting.

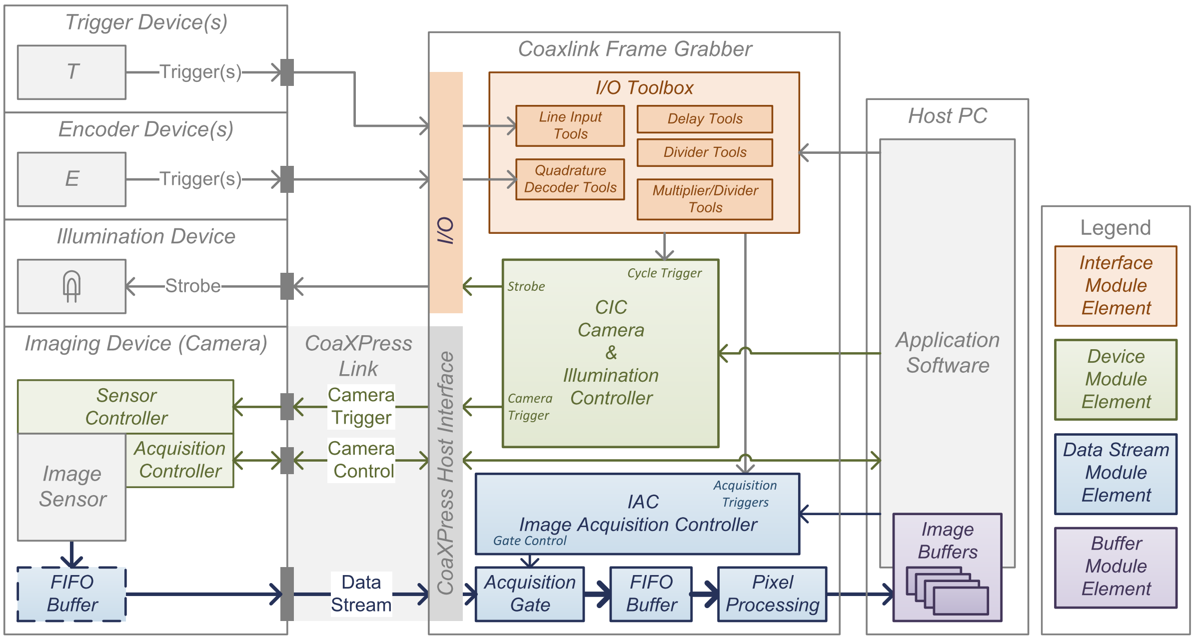
Image Data Transfer

The "Image Data Transfer" on page 199 block transfers the image data to the destination buffer.

1.2. Block Diagrams

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

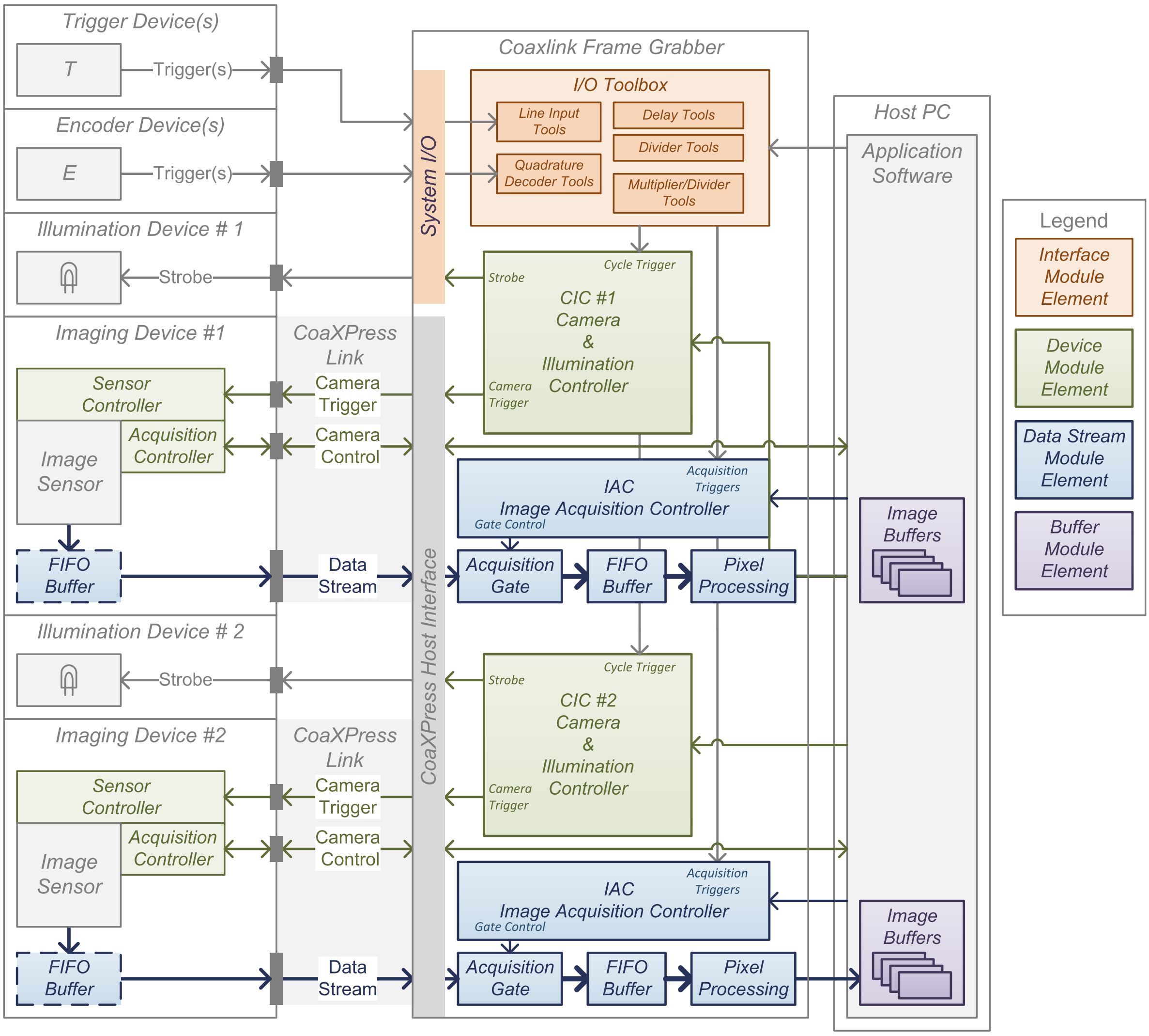
1-camera, 1-data-stream



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

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

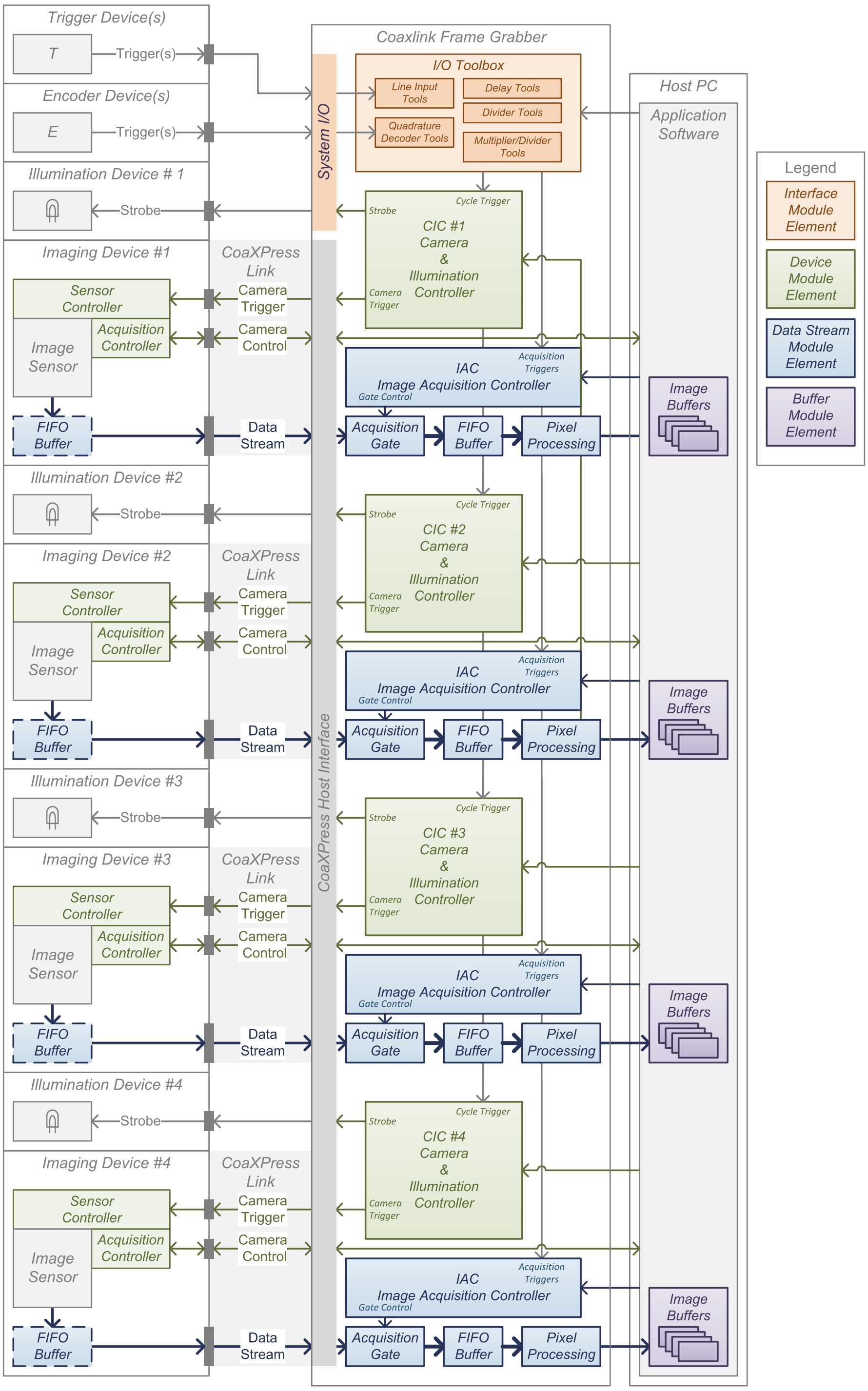
2-camera, 1-data-stream



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

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

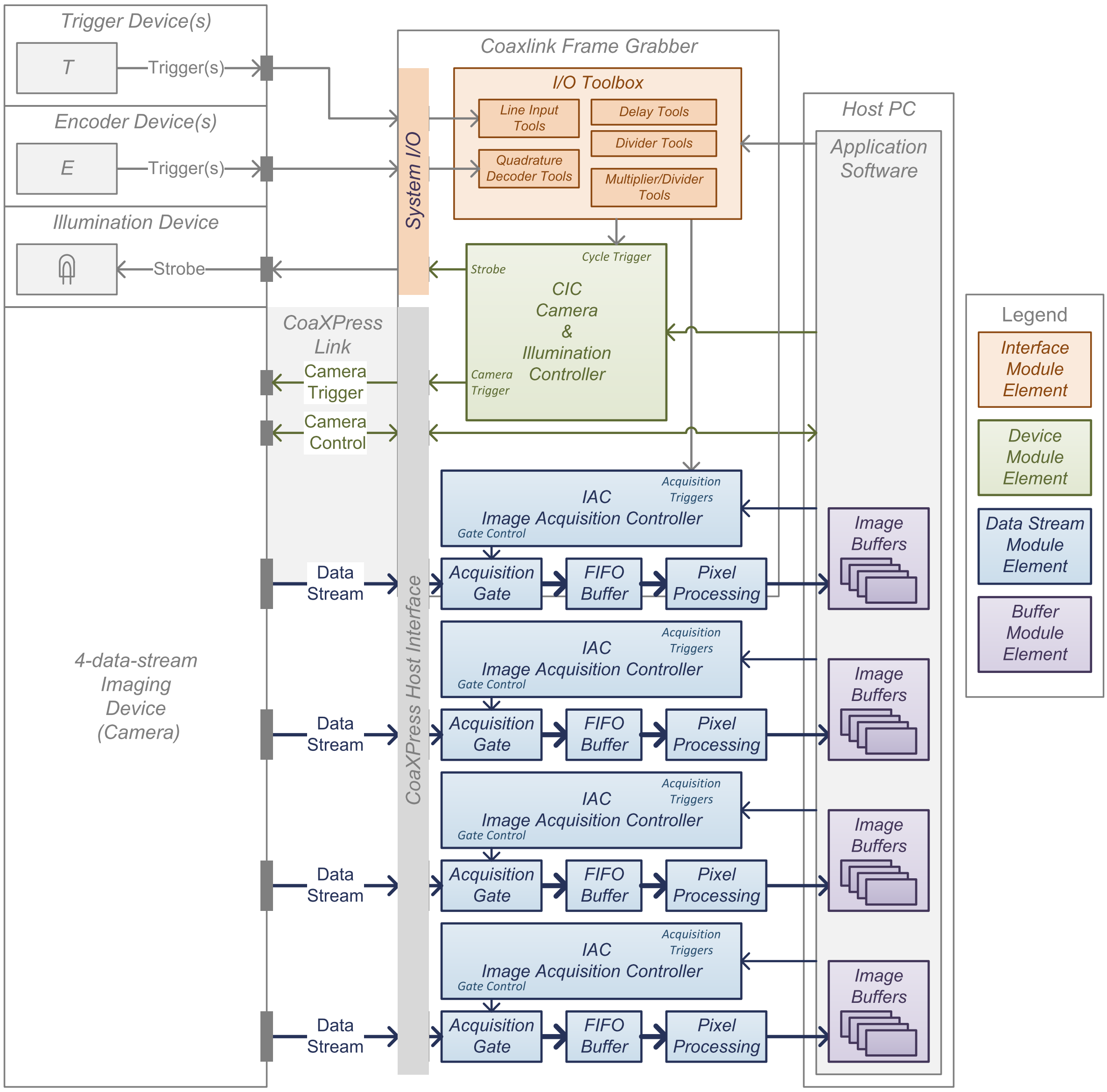
4-camera, 1-data-stream



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

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

1-camera, 4-data-stream



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

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

2. CoaXPress Host Interface

2.1. CoaXPress Interface Specifications

Functional specifications summary of the CoaXPress camera interface

See also: "Camera Interfaces" on page 450 in the hardware manual for electrical specifications.

Connectivity requirements

Physical medium and speed range

Medium Speed range	Availability
Coaxial (Copper) CXP-1 up to CXP-6	Duo104EMB (Not recommended for new designs), Mono (Not recommended for new designs), Duo (Not recommended for new designs), Quad (Not recommended for new designs), QuadG3, QuadG3LH, QuadG3DF, Quad3DLLE, Octo
Coaxial (Copper) CXP-1 up to CXP-12	Quad12, Quad12-4, Quad12J, Quad12J-4, Mono12, Mono12LH, Duo12, Duo12LH, Value12, Quad12DF
QSFP+ (Fiber) CXP-1 up to CXP-12	QSFP+

Device count, connection count

The Host Interface of **Coaxlink frame grabbers** requires a specific assignment of the Device connections to the Host connectors. Such assignment is named *Host Connections Map*.

The Host Connections Map is hard-coded in the product firmware variant.

NOTE: The Coaxlink frame grabber and the firmware variant must be selected according to the required mapping!

See also: "Host Connections Maps for Coaxlink Series" on page 61

Data stream count

Stream count	Availability
1 up to 4	QuadG3, QuadG3LH (1-camera, 4-data-stream)
1	Other firmware variants

Image format requirements

Stream packets

Packet size	Applicable products
Up to 16,384 Bytes	All products

Supported 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

Image stream format

Stream format Acquisition	Availability
Rectangular image Area-scan	Duo (1-camera), (2-camera) Duo104EMB (Not recommended for new designs) Duo104MIL (1-camera), (2-camera) Mono (Not recommended for new designs) (1-camera) Duo (Not recommended for new designs) (1-camera), (2-camera) Quad (Not recommended for new designs) (1-camera), (2-camera) QuadG3 QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, bayer), (3-camera), (4-camera) QuadG3DF (1-camera), (1-df-camera) Quad3DLLE (1-camera) Octo (1-camera), (1-camera, custom-logic), (2-camera), (3-camera), (4-camera), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera) Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (2-camera), (2-camera, custom-logic), (4-camera), (4-camera, custom-logic) Quad12J Quad12J-4 (4-camera) Mono12 Mono12LH (1-camera) Duo12 Duo12LH (1-camera), (2-camera) Value12 (1-camera), (2-camera), (4-camera) Quad12DF (1-camera), (1-df-camera) QSFP+ (1-camera), (1-camera, custom-logic)
Rectangular image Line-scan	Duo (1-camera, line-scan), (2-camera, line-scan) Duo104EMB (Not recommended for new designs) Duo104MIL (1-camera, line-scan) Duo (Not recommended for new designs) (1-camera, line-scan), (2-camera, line-scan) Quad (Not recommended for new designs) (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)

Stream format Acquisition	Availability
	QSFP+ (1-camera, line-scan)
Arbitrary image	Not supported

Supported scanning methods

Scanning Geometry (Stream)	Availability
Progressive-scan 1X_1Y	All firmware variants
Progressive-scan 1X-2YE (Dual stream)	Quad12 Quad12-4 (1-camera) Value12 (1-camera) Quad12DF (1-camera), (1-df-camera) QSFP+ (1-camera)
Progressive-scan 1X_1Y2, 1X_2YE, 1X_2YM (Single stream)	Duo (1-camera), (2-camera) Duo104EMB (Not recommended for new designs) Duo104MIL (1-camera), (2-camera) Mono (Not recommended for new designs) (1-camera) Duo (Not recommended for new designs) (1-camera), (2-camera) Quad (Not recommended for new designs) (1-camera), (2-camera) QuadG3 QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, bayer), (3-camera), (4-camera) QuadG3DF (1-camera), (1-df-camera) Quad3DLLE (1-camera) Octo (1-camera), (1-camera, custom-logic), (2-camera), (3-camera), (4-camera), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera) Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (2-camera), (2-camera, custom-logic), (4-camera), (4-camera, custom-logic) Quad12J Quad12J-4 (4-camera) Mono12 Mono12LH (1-camera) Duo12 Duo12LH (1-camera), (2-camera) Value12 (1-camera), (2-camera), (4-camera) Quad12DF (1-camera), (1-df-camera) QSFP+ (1-camera), (1-camera, custom-logic)
Interlaced-scan	Not supported

2.2. Host Connections Maps for Coaxlink Series

The Host Interface of **Coaxlink frame grabbers** requires a specific assignment of the Device connections to the Host connectors. Such assignment is named *Host Connections Map*.

The Host Connections Map is hard-coded in the product firmware variant.

NOTE: The Coaxlink frame grabber and the firmware variant must be selected according to the required mapping!

1D1 host connections map

Applies to the following firmware variants of [1]

Mono (Not recommended for new designs) (1-camera)

Mono12 Mono12LH (1-camera), (1-camera, line-scan)

One 1-connection device

1D2 host connections map

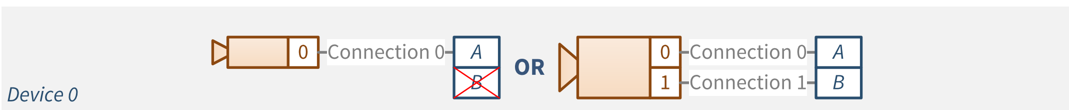
Applies to the following firmware variants of [2]

Duo104EMB (Not recommended for new designs) Duo104MIL (1-camera), (1-camera, line-scan)

Duo (Not recommended for new designs) (1-camera), (1-camera, line-scan)

Duo12 Duo12LH (1-camera), (1-camera, line-scan)

One 1- or 2-connection device



[1] 1630 Coaxlink Mono, 3621 Coaxlink Mono CXP-12 and 3621-LH Coaxlink Mono CXP-12 LH.

[2] 1629 Coaxlink Duo PCIe/104-EMB, 1631 Coaxlink Duo, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

1D4 host connections map

Applies to the following firmware variants of [1]

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

QuadG3 QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-camera, line-scan)

QuadG3DF (1-camera), (1-camera, line-scan)

Quad3DLLE (1-camera)

Octo (1-camera, custom-logic)

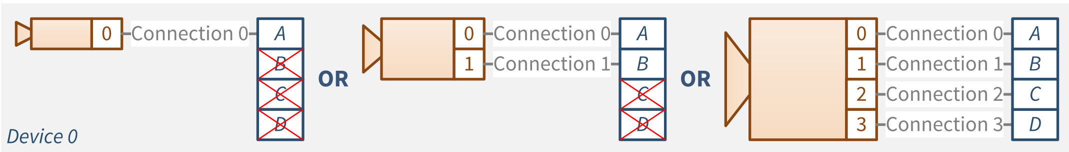
Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (1-camera, line-scan), (1-camera, line-scan, custom-logic)

Value12 (1-camera), (1-camera, line-scan)

Quad12DF (1-camera), (1-camera, line-scan)

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

One 1- or 2- or 4-connection device



[1] 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, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

1D4S4 host connections map

Applies to the following firmware variants of [1]

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

QuadG3 QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-camera, line-scan)

QuadG3DF (1-camera), (1-camera, line-scan)

Quad3DLLE (1-camera)

Octo (1-camera, custom-logic)

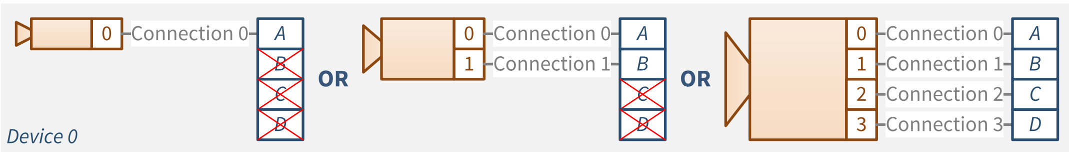
Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (1-camera, line-scan), (1-camera, line-scan, custom-logic)

Value12 (1-camera), (1-camera, line-scan)

Quad12DF (1-camera), (1-camera, line-scan)

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

One 1- or 2- or 4-connection device, up to 4 data streams



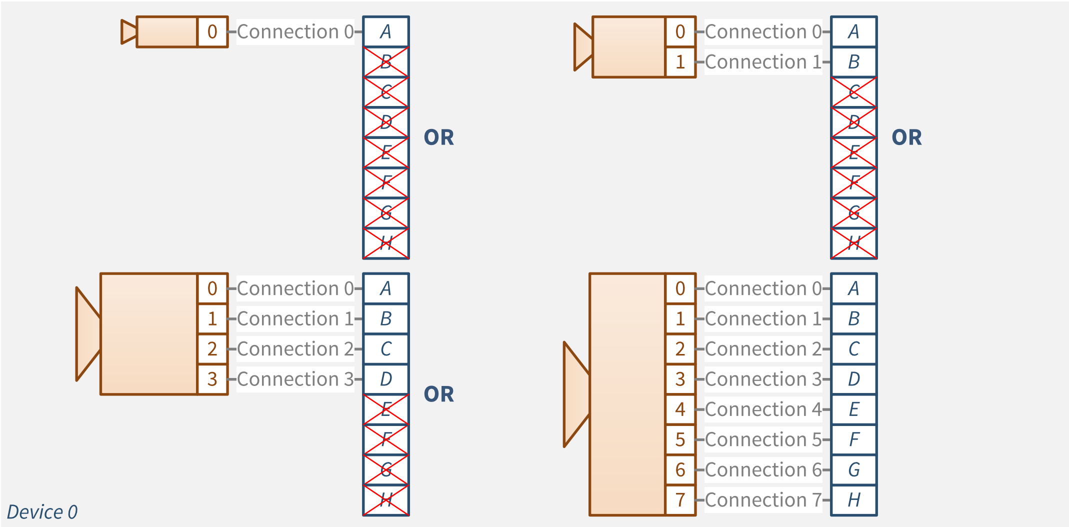
[1] 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

1D8 host connections map

Applies to the following firmware variants of [1]

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

One 1- or 2- or 4- or 8-connection device

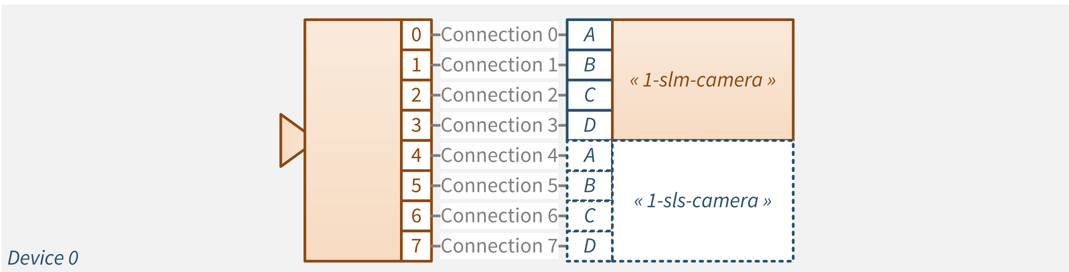


1D8SLM4 host connections map

Applies to the following firmware variants of [2]

QuadG3 QuadG3LH (1-slm-camera)

Master 4-connection sub-link of an 8-connection device



See also: "Sub-link Acquisition" on page 120 for the connection scheme of an 8-connection camera to two Coaxlink cards.

[1] 3602 Coaxlink Octo.

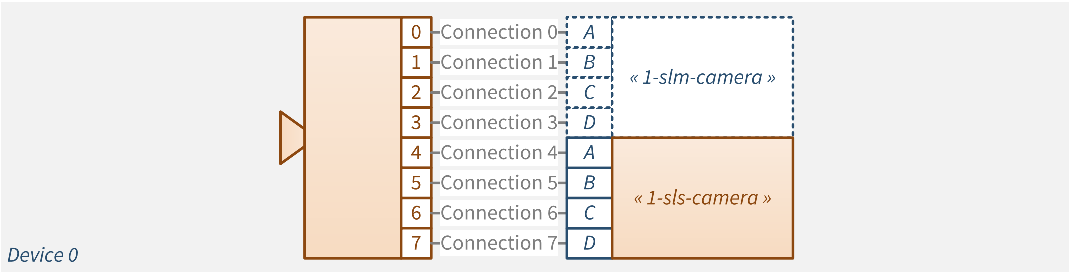
[2] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

1D8SLS4 host connections map

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (1-sls-camera)

Slave 4-connection sub-link of an 8-connection device



See also: "Sub-link Acquisition" on page 120 for the connection scheme of an 8-connection camera to two Coaxlink cards.

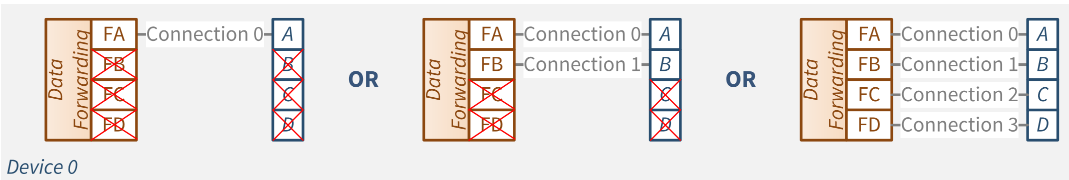
1DF4 host connections map

Applies to the following firmware variants of [2]

QuadG3DF (1-df-camera), (1-df-camera, line-scan)

Quad12DF (1-df-camera), (1-df-camera, line-scan)

One 1- or 2- or 4-connection device



See also: "CoaXPress Data Forwarding" on page 320 for the connection schemes of slave Data Forwarding devices.

[1] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

[2] 1635 Coaxlink Quad G3 DF and 3624 Coaxlink Quad CXP-12 DF.

2D11 host connections map

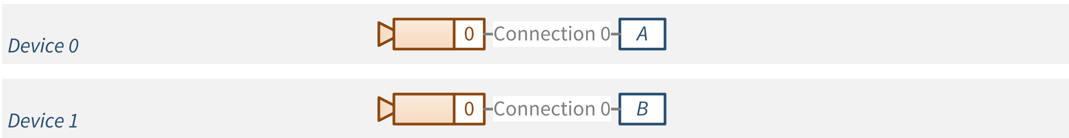
Applies to the following firmware variants of [1]

Duo104EMB Duo104MIL (2-camera)

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

Duo12 Duo12LH (2-camera), (2-camera, line-scan)

One or two 1-connection devices



2D22 host connections map

Applies to the following firmware variants of [2]

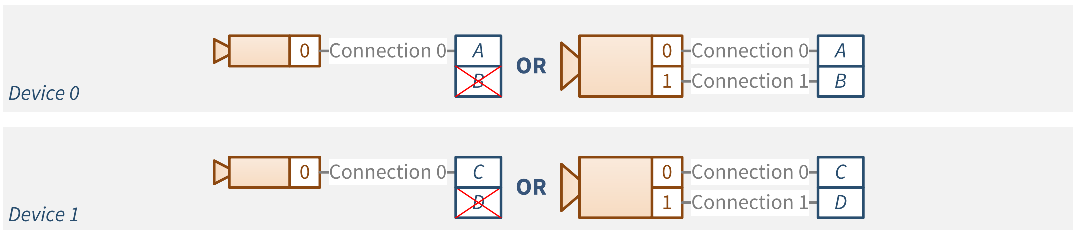
Quad (2-camera)

QuadG3 QuadG3LH (2-camera), (2-camera, bayer), (2-camera, line-scan)

Quad12 Quad12-4 (2-camera), (2-camera, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic)

Value12 (2-camera), (2-camera, line-scan)

One or two 1- or 2-connection devices



[1] 1629 Coaxlink Duo PCIe/104-EMB, 1631 Coaxlink Duo, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

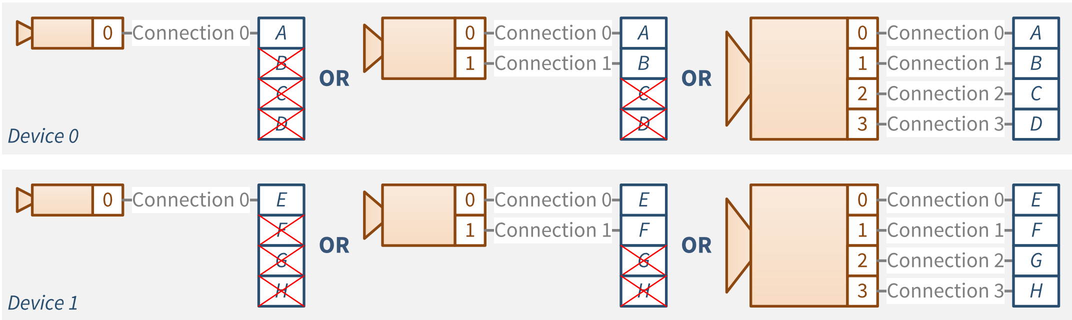
[2] 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12 and 3623 Coaxlink Quad CXP-12 Value.

2D44 host connections map

Applies to the following firmware variants of [1]

Octo (2-camera), (2-camera, line-scan), (2-camera, line-scan, custom-logic)

One or two 1- or 2- or 4-connection devices

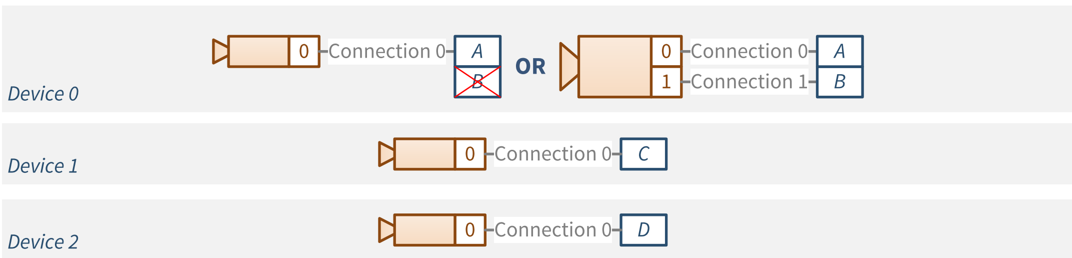


3D211 host connections map

Applies to the following firmware variants of [2]

QuadG3 QuadG3LH (3-camera)

One 1- or 2-connection and one or two 1-connection devices



[1] 3602 Coaxlink Octo.

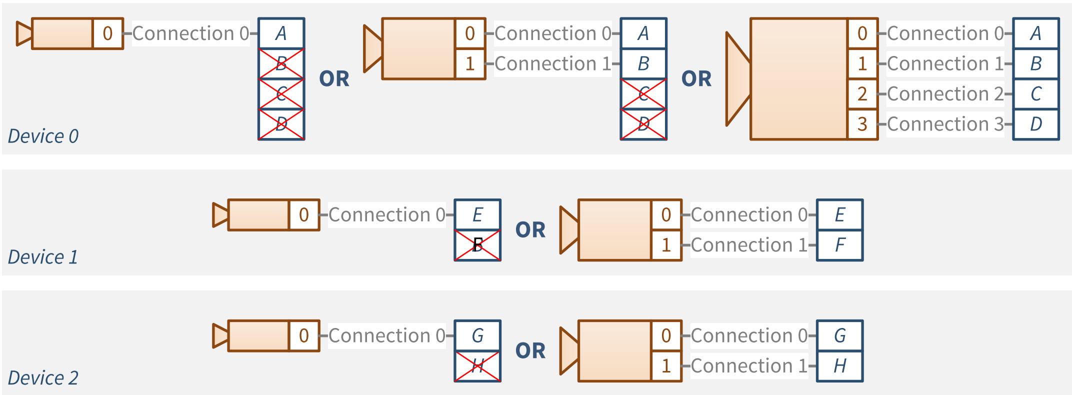
[2] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

3D422 host connections map

Applies to the following firmware variants of [1]

Octo (3-camera)

One 1- or 2- or 4-connection and one or two 1- or 2-connection devices



4D1111 host connections map

Applies to the following firmware variants of [2]

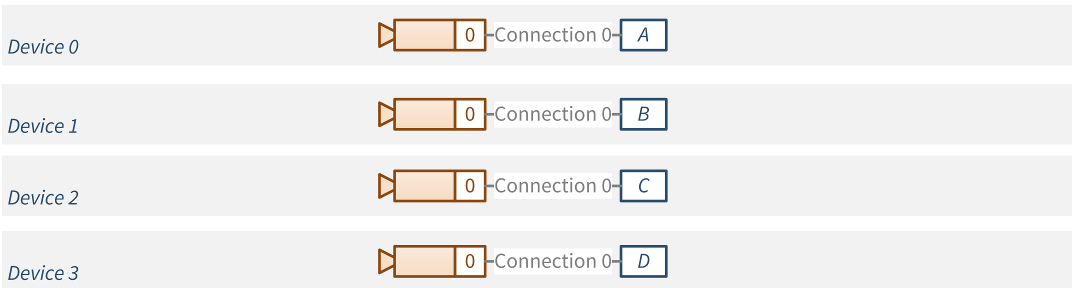
QuadG3 QuadG3LH (4-camera), (4-camera, line-scan)

Quad12 Quad12-4 (4-camera), (4-camera, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)

Quad12J Quad12J-4 (4-camera)

Value12 (4-camera), (4-camera, line-scan)

One or two or three or four 1-connection devices



[1] 3602 Coaxlink Octo.

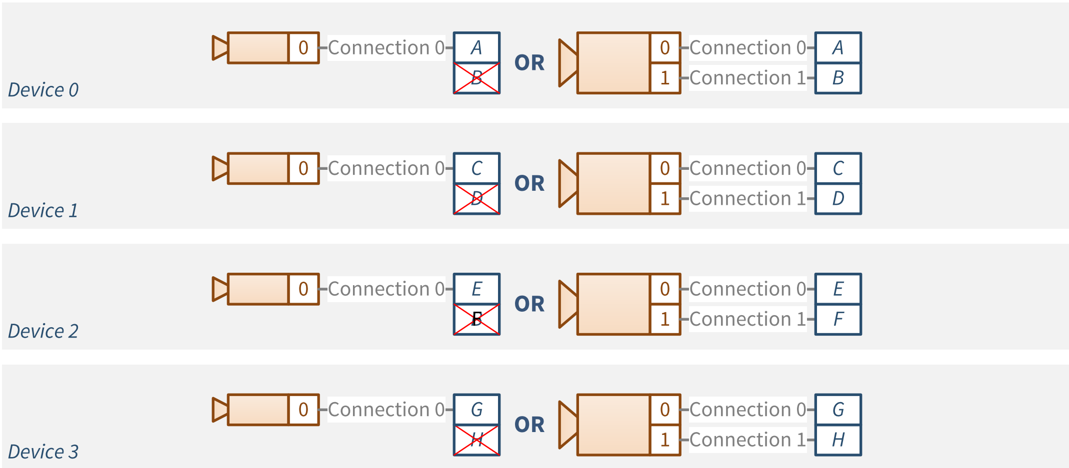
[2] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG and 3623 Coaxlink Quad CXP-12 Value.

4D2222 host connections map

Applies to the following firmware variants of [1]

Octo (4-camera), (4-camera, line-scan)

One or two or three or four 1- or 2-connection devices

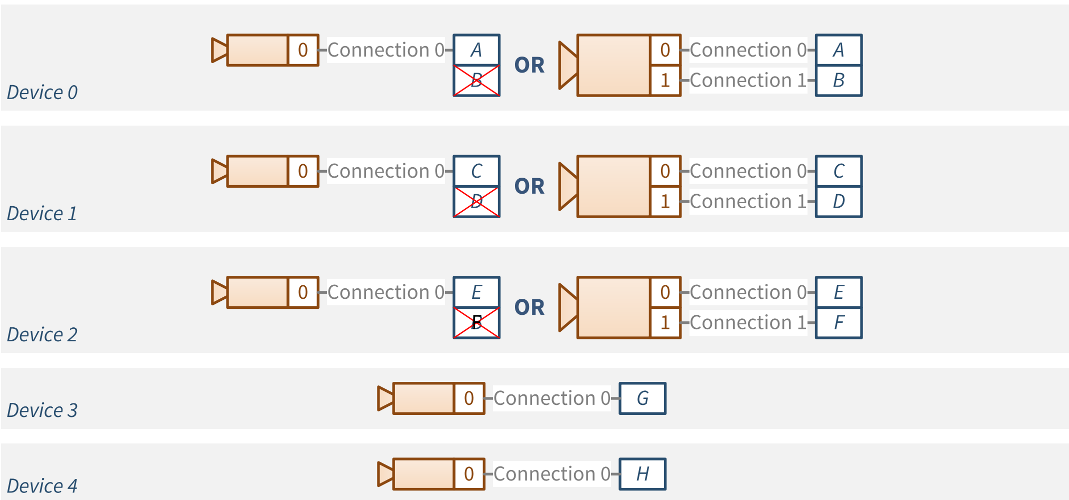


5D22211 host connections map

Applies to the following firmware variants of [2]

Octo (5-camera, 5D22211)

One or two or three 1- or 2-connection and one or two 1-connection devices



[1] 3602 Coaxlink Octo.

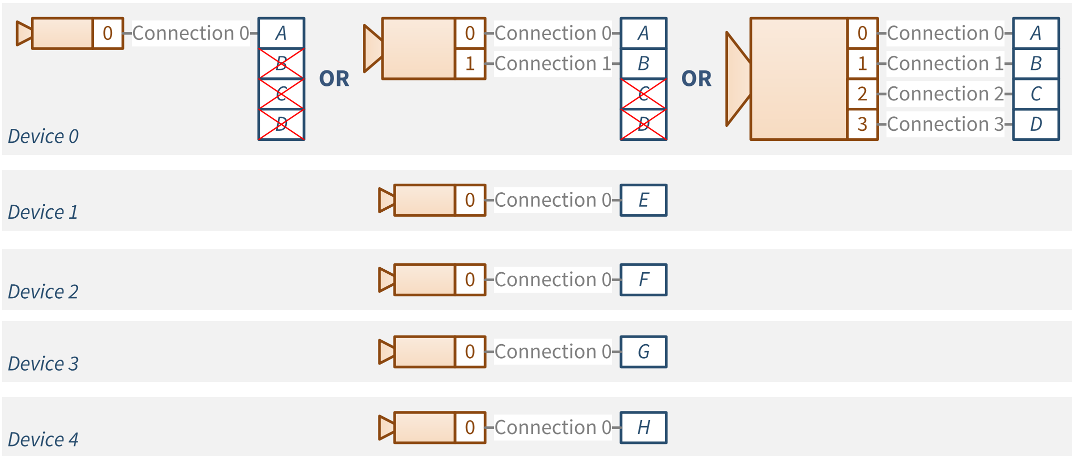
[2] 3602 Coaxlink Octo.

5D41111 host connections map

Applies to the following firmware variants of [1]

Octo (5-camera)

One 1- or 2- or 4-connection and one or two or three or four 1-connection devices

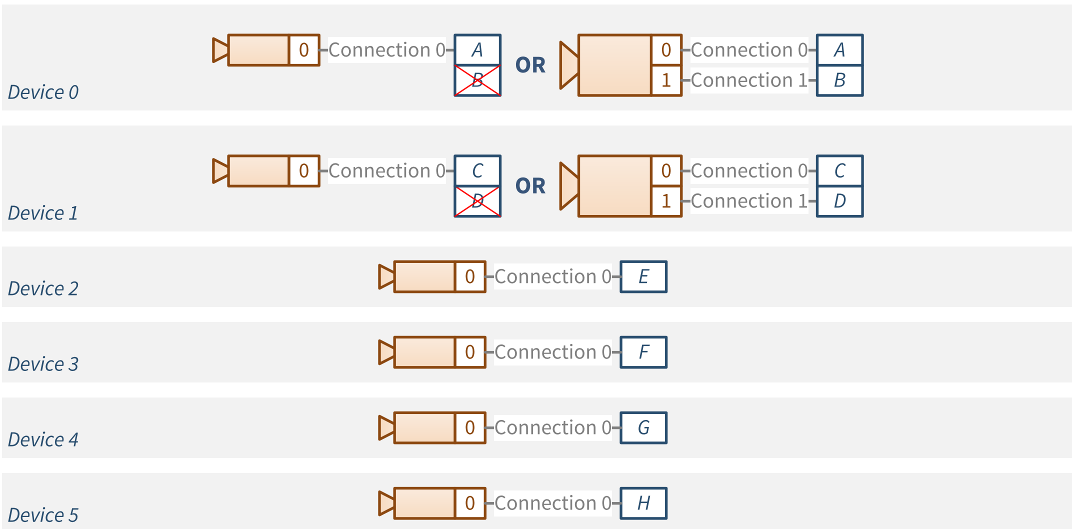


6D221111 host connections map

Applies to the following firmware variants of [2]

Octo (6-camera)

One or two 1- or 2-connection and one or two or three or four 1-connection devices



[1] 3602 Coaxlink Octo.

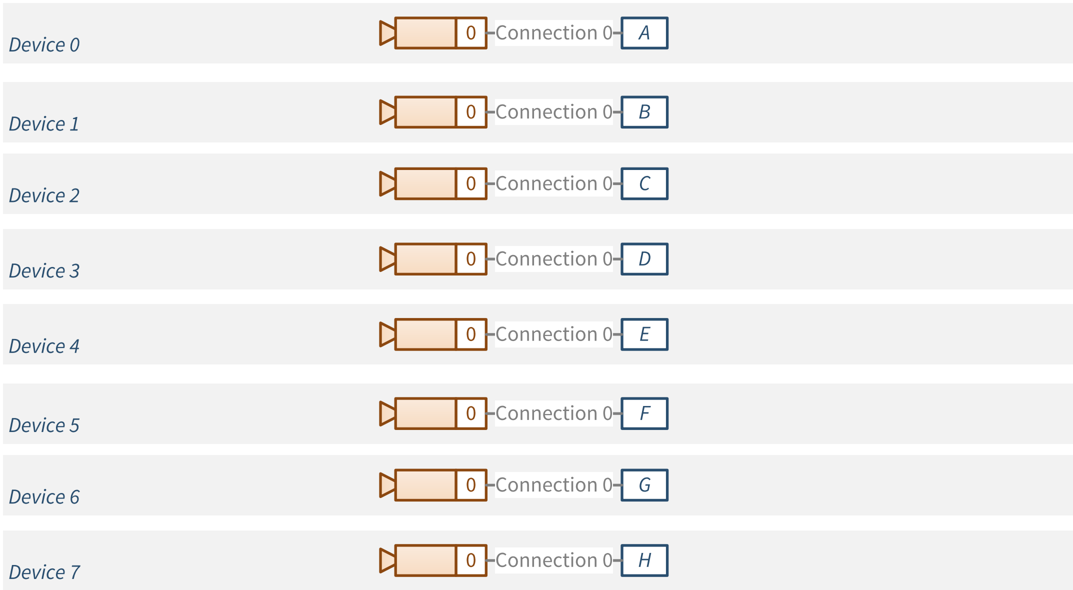
[2] 3602 Coaxlink Octo.

8D11111111 host connections map

Applies to the following firmware variants of [1]

Octo (8-camera)

Up to eight 1-connection devices



[1] 3602 Coaxlink Octo.

2.3. CoaXPress Link Configuration

Automatic Link Configuration

The **eGrabber** driver provides an automatic link discovery and configuration for CoaXPress 1.0 , CoaXPress 1.1 and CoaXPress 2.0 devices.

For each connection of the CoaXPress Host interface, the discovery procedure determines:

- The presence of a CoaXPress Device
- The speed of the down-connection (Device to Host)
- The connection ID

The discovery results are reported through the CxpConnectionState, CxpDownConnectionSpeed and CxpDeviceConnectionID features of the Interface module.

The user is invited to check if the resulting link configuration is appropriate:

- For the application needs in terms of link bandwidth (link speed and number of connections)
- For the card in terms of camera connection schemes supported by the target product/firmware combination

Manual Link Configuration

If necessary, the user can manually configure the CoaXPress link of the Remote Device.

This can be achieved, regardless of the camera brand, by assigning the appropriate value to the CxpLinkConfiguration GenApi feature of the device module.

Assigning the value Preferred enforces the preferred link configuration of the camera:

- The link speed is set to the specified value
- The link width is set to the specified value but, possibly limited to the number of available connections on the Host side

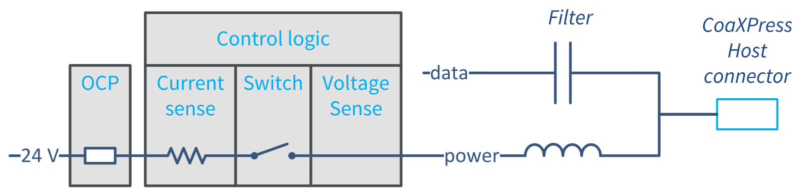
2.4. Power Over CoaXPress

Applies to [1]

Duo104EMB	Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF		

Each connection of the CoaXPress Host connector is capable of delivering power to the camera through the CoaXPress cable.

Power transmitter unit



PoCXP power transmission unit

The Power Transmitting Unit – PTU – is responsible for a safe delivery of power to the Device. It fulfills the requirements of the CoaXPress standard for a CoaXPress Host, namely:

- It is capable of delivering 17 W (or 25W for selected products) of 24 V DC power per connector to the Device
- It implements an over-current protection device – OCP
- It supports the automatic CoaXPress PoCXP detection method

In addition, it provides the application with the capability of:

- Disabling or interrupting the automatic power delivery
- Resetting the OCP when tripped
- Measuring the PoCXP output current and the PoCXP output voltage on each connector
- Controlling the range of the PoCXP sense resistance

See also: "Power Distribution Schemes" on page 461 section in the Hardware Manual

[1] 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 and 3624 Coaxlink Quad CXP-12 DF.

Automatic PoCXP control

On execution of the CxpPoCxpAuto command the PTU controller initiates a *PoCXP device detection procedure*.

> NOTE
> Since version 3.1 of the driver, the automatic PoCXP is enabled at system power-up! The application is not anymore required to enable PoCXP powering by issuing a CxpPoCxpAuto command.

If the PoCXP device detection procedure terminates successfully, the PTU applies power by closing the switch.

If the *PoCXP device detection procedure fails*, the controller doesn't apply power and retries a new PoCXP detection procedure. Possible causes of failure are:

- The external power is not connected (AuxiliaryPowerInput = Unconnected)
- The external power source is off (CxpPoCxpPowerInputStatus = NotOK)
- There are no camera attached
- The attached camera is not PoCXP compliant

Once the power is applied, the controller remains in that state until any of the following situations occurs:

- The application disables the power delivery by executing the PoCxpTurnOff command.
- The external power source is disconnected (CxpPoCxpPowerInputStatus = NotOK)
- The external power source is turned off (CxpPoCxpPowerInputStatus = NotOK)
- The CoaXPress cable is disconnected (The average output current measured over a time interval of 0.3 seconds is less than 8 mA)
- The OCP trips

Manual PoCXP control

On execution of the CxpPoCxpTurnOff command the PTU turns off the switch and disables PoCXP powering. In that state, the PTU is not performing PoCXP detection procedures.

The CxpPoCxpConfigurationStatus feature reports the configuration status of the PTU: Off or AUTO.

The CxpPoCxpStatus feature reports the status of the PTU: Off, On or Tripped.

PoCXP detection mode control

The CxpPoCxpDetectionMode feature of the Interface module selects either the standard or the extended (default) power over CoaXPress detection mode.

When set to Extended, the PoCXP device detection of Coaxlink cards is configured for an extended range of resistance values. This allows cameras that are not fully compliant with the range specification of the PoCXP sense resistor to be detected as valid PoCXP cameras and to be powered. This is the default value after initialization.

When set to Standard the PoCXP device detection of Coaxlink cards is configured for a restricted range of resistance values, namely 4.7 kΩ +/- 10%.

> WARNING
> This setting is not persistent.

Over-current protection

The OCP circuit is built with a PTC device providing two kind of protections:

- The overload protection addresses the cases when the load is excessive.
- The short-circuit protection addresses the cases of accidental short-circuits.

In case of overload, the PTC trips (= opens progressively the circuit) after several seconds or minutes depending on the current level and the ambient temperature. The higher the current, the lower the time to trip. The same applies to the ambient temperature.

In case of short-circuit, the PTC trips immediately. Consequently, the PTU controller enters the tripped state and opens the switch. The tripped PTC device returns to the conducting state after having cooled down. This may take a few seconds. However, the PTU controller remains in the tripped state until the application issues a CxpPoCxpTripReset command. Having left the tripped state, the PTU can initiate a new PoCXP device detection and, if successful, re-establish power.

See also: PoCXP Power Output Specifications in the Hardware Manual

Output current and voltage measurements

The CxpPoCxpCurrent and the CxpPoCxpVoltage features of the Interface module GenApi features report, respectively, the current and the voltage delivered by the PoCXP transmitter unit of the CoaXPress physical Host connection designated by CxpPoCxpHostConnectionSelector.

When CxpHostConnectionSelector is set to All, the CxpPoCxpCurrent Interface module GenApi feature reports the sum of currents delivered via PoCXP and the CxpPoCxpVoltage Interface module GenApi feature reports the average voltage delivered via PoCXP.

> TIP
> The total output power delivered by PoCXP is the product of CxpPoCxpCurrent[All] and CxpPoCxpVoltage[All] values.

2.5. CoaXPress I/O Channel

According to the CoaXPress 1.0 and 1.1 standards, the CoaXPress I/O Channel:

- Is one of the three logical channels of the CoaXPress Link (I/O, Stream, Control)
- Is defined only for the master connection (connection 0) of a CoaXPress Link
- Is used for transmitting of high-priority "triggers" between the Host and the Device
- On CoaXPress 1.0 only, is used for exchanging the state of GPIO registers between the Host and the Device

The Coaxlink card implements only the CoaXPress Host to Device trigger!

> NOTE
> CoaXPress Device to Host trigger and CoaXPress 1.0 GPIO are NOT implemented.

2.6. CoaXPress Host To Device Trigger

The CoaXPress Host To Device Trigger is a functionality of the CoaXPress I/O Channel that allows the Host (frame grabber) to trigger the Device (camera) through the CoaXPress Link.

The CoaXPress Host Interface implements one CoaXPress Host to Device trigger transmitter for *each connected Device*.

Host to Device Trigger Source

The CoaXPress Host to Device Trigger transmitter can be sourced from:

- The Camera Trigger output of the associated Camera and Illumination Controller
- Any input-capable General Purpose I/O

The trigger source is indirectly controlled through the CameraControlMethod GenApi feature.

- When CameraControlMethod is set to RG or RC, the trigger source is the Camera Trigger output of the associated Camera and Illumination Controller.
- When CameraControlMethod is set to EXTERNAL:
  - The trigger source is the line source of a dedicated LIN tool of the I/O Toolbox: LIN1 for Device0, LIN2 for Device1, ... LIN8 for Device7.
  - Any input-capable GPIO line can be used as trigger source by configuring the LineInputToolSource of the dedicated LIN tool.
  - The polarity of the external trigger signal can be controlled with the LineInverter setting of the selected I/O Control block.
  - The time constant of the glitch-removal filter can be adjusted through the LineFilterStrength setting of the selected I/O Control block.
- When CameraControlMethod is set to NC, the Host to Device Trigger transmitter is disabled.

Host to Device Trigger Transmitter - Default Settings

The implementation of the CoaXPress Host to Device Trigger transmitter complies with the requirements of the CoaXPress 1.0 and 1.1 standards for a low-speed CoaXPress Host to Device Trigger when it is configured with the default settings:

- CxpTriggerMessageFormat = Pulse
- CxpTriggerAckTimeout = 20.0
- CxpTriggerMaxResendCount = 3

The transmitter *initiates* a *trigger transaction* on both edges of the trigger source signal:

- It computes a delay value allowing the receiving device to recreate the event with a fixed latency.

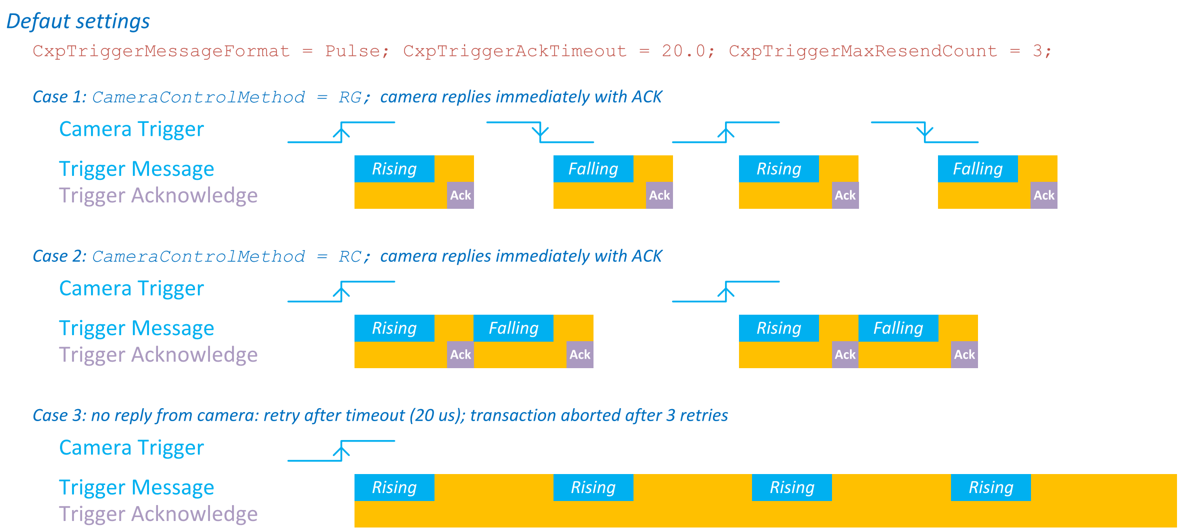
See also: "Camera trigger latency compensation" on page 84

- It inserts a high-priority "trigger packet" on the low-speed host-to-device connection at the next character boundary.

Then, the transmitter waits for the *acknowledgment* from the Device (camera):

- If the acknowledgment is received before the expiration of the timeout, the transaction terminates normally.
- If no acknowledgment is received within the 20 µs timeout, the transmitter performs a *retry*: it resends the trigger packet and initiates a new waiting period for the acknowledgment.
- If no acknowledgment is received after 3 times, the transaction terminates abnormally.

The transmitter doesn't initiate a new transaction while the previous one is not completed.



Trigger message transactions using default settings
Case 1 and case 2: the camera acknowledges each message as expected
Case 3: no acknowledgment from camera. Abort after 3 retries

Events Reporting

The transmitter reports the following events:

- CxpTriggerAck: Received acknowledgment for CoaXPress Host to Device trigger packet.
- CxpTriggerResend: Resent CoaXPress Host to Device trigger packet.

Host to Device Trigger Transmitter - Alternate Settings

The transmitter can be customized:

- To send trigger messages only on the rising edge of the source signal using the *Message Format Control*
- To configure the acknowledge timeout and the number of retries using the *Message Acknowledge Control*

Message Format Control

The Host to Device Trigger transmitter unit provides a "message format" control with the CxpTriggerMessageFormat GenApi feature.

Pulse Message Format (Default)

By default, CxpTriggerMessageFormat is set to Pulse: the transmitter generates a CoaXPress I/O Channel Host to Device Trigger transaction on *both edges* of the input pulse:

- The transaction initiated by the rising edge transmits a *rising edge trigger packet* from the Host to the Device.
- The transaction initiated by the falling edge transmits a *falling edge trigger packet* from the Host to the Device.

> NOTE
> Every trigger pulse requires two distinct CoaXPress I/O Channel transactions!

Rising Edge Message Format

When CxpTriggerMessageFormat is set to RisingEdge, the transmitter generates a CoaXPress I/O Channel Host to Device Trigger transaction on *the rising edge only* of the input pulse.

The transaction always transmits a *rising edge trigger packet* from the Host to the Device.

> NOTE
> Every trigger pulse requires a single CoaXPress I/O Channel transaction.

> NOTE
> This format does not allow the grabber to control the exposure time!

Toggle Message Format

When CxpTriggerMessageFormat is set to Toggle, the transmitter generates a CoaXPress I/O Channel Host to Device Trigger transaction on *the rising edge only* of the input pulse.

The transaction alternatively transmits a *rising edge trigger packet* and a *falling edge trigger packet*.

> NOTE
> Every trigger pulse requires a single CoaXPress I/O Channel transaction.

> NOTE
> This format does not allow the grabber to control the exposure time!

The CxpTriggerLevel feature allows the application to set and/or get the current level of the CoaXPress Host to Device Trigger signal.

Message Acknowledge Control

The Host to Device Trigger transmitter unit provides a user-configurable trigger packet acknowledgment mechanism:

- The time-out value is configurable using the CxpTriggerAckTimeout GenApi feature.
- The number of retries is configurable using the CxpTriggerMaxResendCount GenApi feature.

Enable Acknowledge Checking (Default)

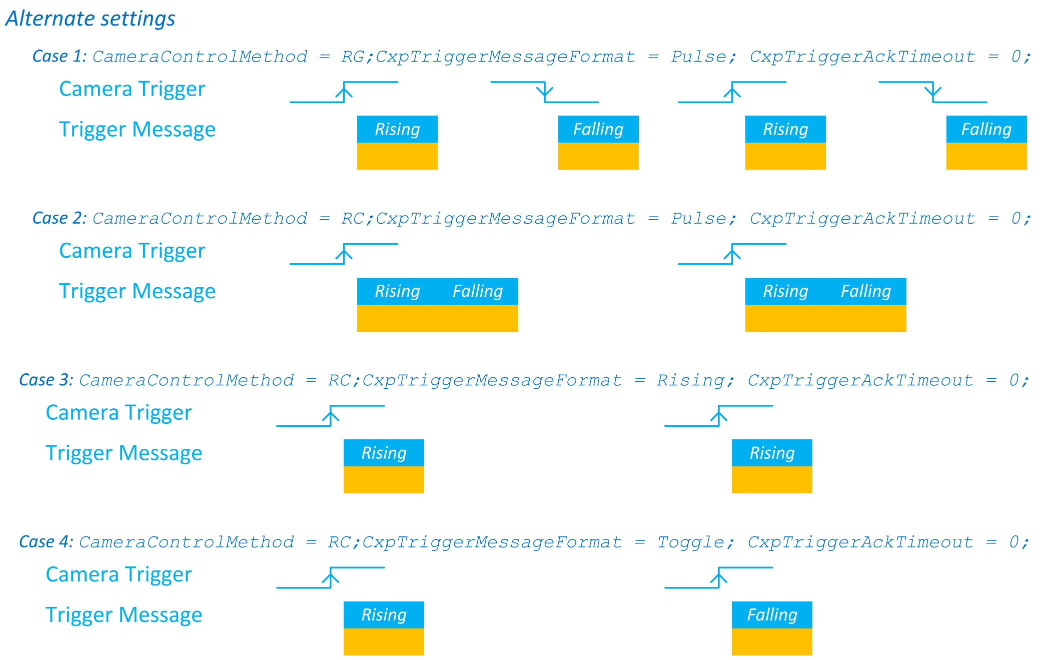
By default, CxpTriggerAckTimeout is set to 20.0 (20 microseconds) and CxpTriggerMaxResendCount is set to 3.

The Coaxlink card expects an I/O Channel Acknowledgment packet in response to every Trigger packet. If the acknowledgment packet is not received within the 20 µs time-out value, the transmitter resends the trigger packet. It performs up to 3 retries.

Setting larger CxpTriggerAckTimeout values allows more time for the Device to acknowledge the trigger packet.

Disable Acknowledge Checking

Setting CxpTriggerAckTimeout to 0 disables the acknowledgement mechanism. The trigger transaction terminates immediately after having sent the trigger packet.



Trigger message transactions using alternate settings to allow higher trigger rates

Alternate settings for fastest trigger rate

The fastest trigger rate of : *595.2 kHz @CXP-10 and CXP-12 link speeds* or *297.6 kHz @CXP-6 and lower link speeds* can be achieved when:

- CameraControlMethod = RC (asynchronous reset camera, camera-controlled exposure),
- CxpTriggerAckTimeout = 0 (acknowledge ckecking disabled),
- CxpTriggerMessageFormat = Rising or CxpTriggerMessageFormat = Toggle.

Camera trigger latency compensation

Trigger accuracy

The Host to Device trigger packets are transmitted over the low-speed up-connection of the CoaXPress Link. The transmission of trigger packets can only start at the boundary of a character. This introduces a jitter corresponding to one character transmission time:

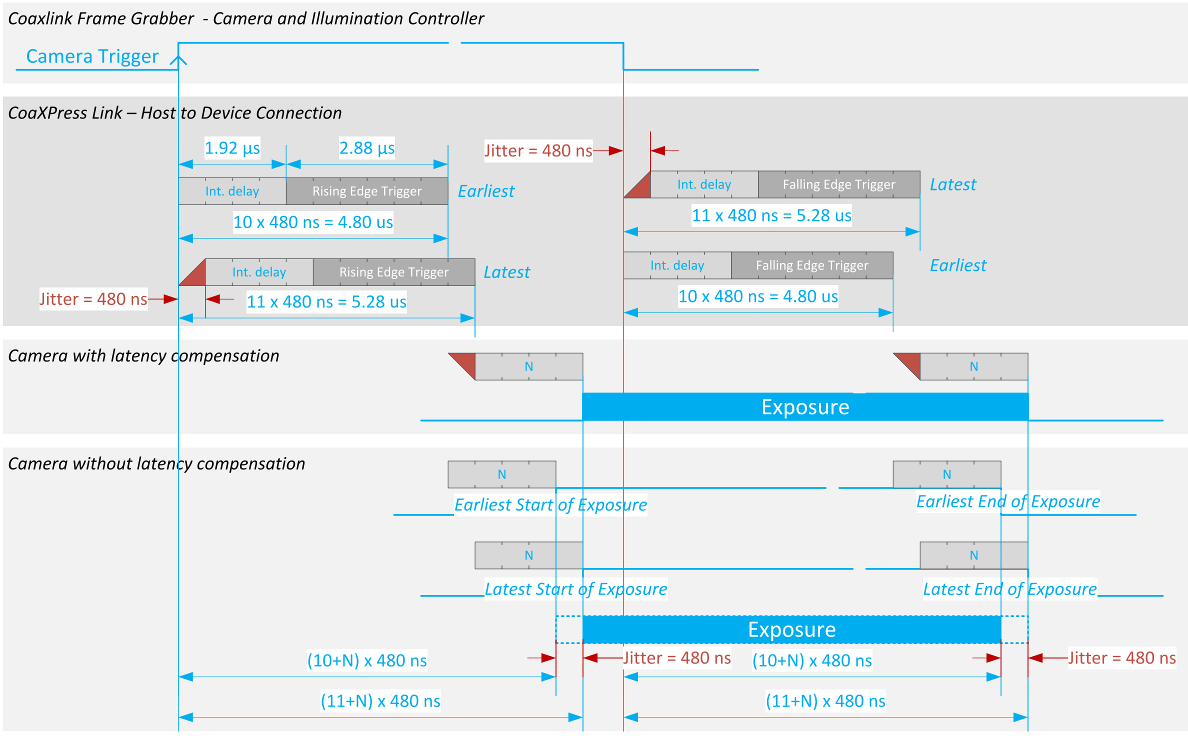
- *240 nanoseconds* @CXP-10 and CXP-12 link speeds or
- *480 nanoseconds* @CXP-6 and lower link speeds.

To minimize trigger jitter, the time between the trigger event and the trigger packet being sent is encoded into the trigger packet as a delay value expressed in units of 1/24th of the bit period:

- *1 nanosecond* @CXP-10 and CXP-12 link speeds or
- *2 nanoseconds* @CXP-6 and lower link speeds.

The receiver (camera) can then use this value to recreate the trigger event with a *fixed latency*. It compensates the transmission jitter by delaying the decoded message by the remaining fraction of one character time.

CoaXPress Camera Trigger transmission timing @CXP-6 and lower link speeds



CIC Camera Trigger to Sensor Exposure timing diagrams @CXP-6 and lower link speeds

The above diagram shows the time delay required to propagate Camera Trigger events from the frame grabber up to the camera through the CoaXPress Link using Host to Device CoaXPress Trigger messages.

The above diagram assumes that:

- CameraControlMethod is set to RG.
- The camera properly acknowledges the trigger messages and effectively initiates a new exposure.

The delay from the rising (or the falling) edge of the Camera Trigger signal (inside the Coaxlink card) up the CoaXPress link is composed of:

- A variable delay of *0-480 ns* corresponding to the time delay until the next character boundary on the low-speed CoaXPress connection.
- A fixed delay of *1.92 µs* corresponding to a 4-character pipeline delay in the Trigger Transmitter implementation.
- A fixed delay of *2.88 µs* corresponding to a 6-character message transmission time.

The delay from the CoaXPress Link to the effective start (or end) of exposure is camera-dependent. In the above drawing, this delay is assumed to be N character times (with N=4).

Jitter-compensated cameras

When the camera implements the CoaXPress jitter compensation, the one-character jitter (480 ns) introduced by the transmitter can be entirely compensated.

The overall latency is *fixed* but it remains camera-dependent: the lowest possible latency is *11 x 480 ns*, i.e. *5.28 µs*.

The residual jitter after compensation can be as low as *4 ns*.

Jitter-Uncompensated cameras

When the camera doesn't implement the CoaXPress jitter compensation, the one-character jitter (*480 ns*) introduced by the transmitter remains.

The overall latency is *variable* and camera-dependent: the lowest possible latency is *(10 ~ 11) x 480 ns*, i.e. *(4.80 ~ 5.28) µs*.

CoaXPress Camera Trigger transmission timing @CXP-10 and CXP-12 link speeds

The delay from the rising (or the falling) edge of the Camera Trigger signal (inside the Coaxlink card) up the CoaXPress link is composed of:

- A variable delay of *0-2400 ns* corresponding to the time delay until the next character boundary on the low-speed CoaXPress connection.
- A fixed delay of *0.96 µs* corresponding to a 4-character pipeline delay in the Trigger Transmitter implementation.
- A fixed delay of *1.44µs* corresponding to a 6-character message transmission time.

The delay from the CoaXPress Link to the effective start (or end) of exposure is camera-dependent. In the above drawing, this delay is assumed to be N character times (with N=4).

Jitter-compensated cameras

When the camera implements the CoaXPress jitter compensation, the one-character jitter (480 ns) introduced by the transmitter can be entirely compensated.

The overall latency is *fixed* but it remains camera-dependent: the lowest possible latency is *11 x 240 ns*, i.e. *2.64 µs*.

The residual jitter after compensation can be as low as *2 ns*.

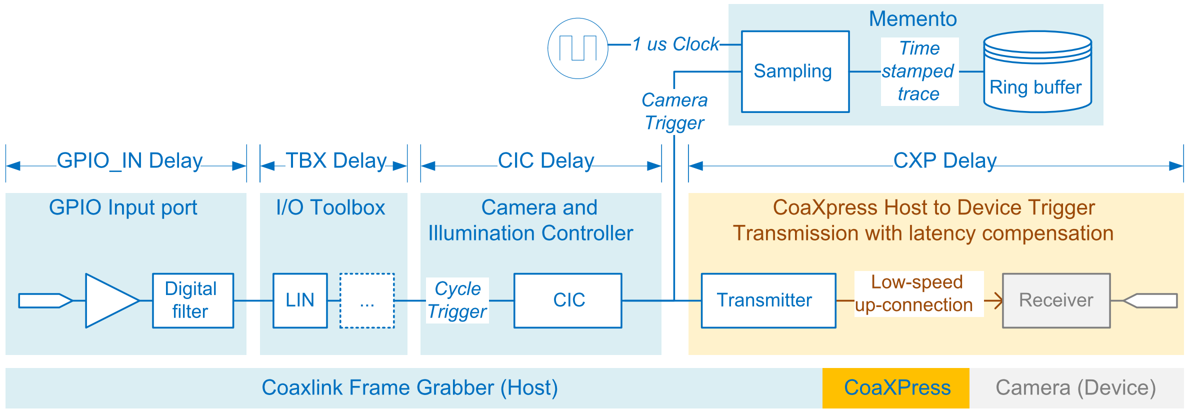
Jitter-Uncompensated cameras

When the camera doesn't implement the CoaXPress jitter compensation, the one-character jitter (*240 ns*) introduced by the transmitter remains.

The overall latency is *variable* and camera-dependent: the lowest possible latency is *(10 ~ 11) x 240 ns*, i.e. *(2.40 ~ 2.64) µs*.

2.7. Trigger Delay Model

This topic describes a timing model of a trigger signal applied to any GPIO input port of a Coaxlink card up to the output of the CoaXPress 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 485	50 ns	50 ns
"Differential Input (Version 2)" on page 487	50 ns	50 ns
"Differential Input/Output" on page 489	50 ns	50 ns
"TTL Input/Output (Version 1)" on page 492	50 ns	50 ns
"TTL Input/Output (Version 2)" on page 495	50 ns	50 ns
"TTL Input/5 V CMOS Output" on page 498	50 ns	50 ns
"Isolated Input (Version 1)" on page 501	2.1 µs	4.5 µs
"Isolated Input (Version 2)" on page 504	0.8 µs	1.35 µs
"Isolated Input (Version 3)" on page 507	0.6 µs	0.6 µs
"Isolated Input (Version 4)" on page 510	6.9 µs	9.8 µs

See also: "Line Filter Control" on page 262 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 268 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 219 and "CIC Timing Diagrams" on page 239

Transmission of the Camera Trigger event- CXP Delay

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

- The CoaXPress Host to Device Trigger transmitter inside the Coaxlink card
- The CoaXPress Host to Device trigger receiver of the camera

The transmitter implements the latency compensation described in the CoaXPress standard.

If the receiver implements also he latency compensation, the transmission delay is constant despite the asynchronism of the trigger messages on the CoaXPress medium.

In that case, the transmission time only depends upon the link speed:

Link speed	Delay
CXP-1 to CXP-6	5.28 µs
CXP-10 to CXP-12	2.64 us

See also: Camera Trigger Latency Compensation for a detailed explanation

NOTE

The delay introduced by the medium is usually not significant!

2.8. CoaXPress LED Lamps

Applies to [1]

Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF	QSFP+		

Each CoaXPress connection is associated with a LED lamp mounted on the bracket (for PCie cards only).

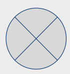
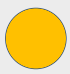
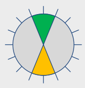
LED lamps mode control

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 CoaXPress 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.

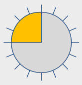
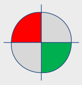
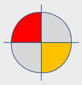
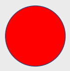
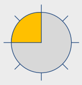
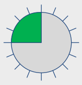
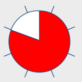
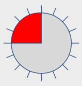
CoaXPress Host Indicator LED lamps states

States description

Symbol	Indication	State
	Off	No power
	Solid orange	System booting
	AlternateFlash_12_5 green / orange[2]	Connection detection in progress; PoCXP active

[1] 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+.

[2] Shown for a minimum of 1 second even if the connection detection is faster

Symbol	Indication	State
	Flash_12_5 orange[1]	Connection detection in progress; PoCXP not in use
	AlternateFlash_0_5 red / green	Device/ Host incompatible; PoCXP active
	AlternateFlash_0_5 red / orange	Device/ Host incompatible; PoCXP not in use
	Solid red	PoCXP over-current
	Solid green	Device / Host connected, but no data being transferred
	Flash_1 orange	Device / Host connected, waiting for event (e.g. trigger, exposure pulse)
	Flash_12_5 green	Device / Host connected, data being transferred
	500 ms red pulse[2]	Error during data transfer (e.g. CRC error, single bit error detected)
	AlternateFlash_0_5 green / orange	Connection test packets being sent
	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)
AlternateFlash_0_5	0.5 Hz	50% (1 second on color 1, 1 second off, 1 second on color 2, 1 second off)

1 Shown for a minimum of 1 second even if the connection detection is faster

2 In case of multiple errors, there shall be at least two green Flash_12_5 pulses before the next error is indicated

2.9. Connection Test

The CoaXPress Host Interface provides connection test facilities to test the quality up- and down-connections of the CoaXPress link according to the procedures defined in section 8.7 of the CoaXPress 1.1 standard.

For each individual CoaXPress connector, it implements

- A test generator
- A test receiver

The test generator transmits a Test Data Packet containing a known test pattern produced by a sequence generator. It increments the packet counter for each test packet transmitted.

The test receiver compares the received test data packet content against its local sequence generator. It increments the error counter for each word that is different in the data packet, and increments the packet counter for each test packet received.

NOTE
The test packet counters show how many test packets have been sent and received, so allowing a judgment to be made on the statistical meaning of the value in the error counter.

NOTE
Both Device to Host and Host to Device connection tests can be run at the same time.

2.10. CoaXPress 2.0 Error Counters

The "CoaXPress 2.0 error counters" keep track of errors that the CoaXPress protocol can detect on each individual CoaXPress connection.

Error counters

Connection lock loss counters

There is one counter per CoaXPress host connector instance that counts the number of lock losses encountered by the CoaXPress receiver.

8b/10b encoding error counters

There is one counter per CoaXPress host connector instance that counts the number of 8b/10b encoding errors encountered by the CoaXPress receiver.

Duplicated characters mismatch counters

There are two counters per CoaXPress host connector instance that counts the number of duplicated characters mismatch encountered by the CoaXPress receiver:

- The first counter counts the occurrences that could be corrected.
- The second counter counts the occurrences that could NOT be corrected.

CRC error counters

There are three counters per CoaXPress host connector instance that counts the number of CRC errors encountered by the CoaXPress receiver:

- The first counter counts the occurrences in data packets.
- The second counter counts the occurrences in control packets.
- The third counter counts the occurrences in event packets.

Error counters management

The application uses the counters by means of Interface module feature of the "CoaXPressErrorCounters Category" on page 771.

Getting the current count value

1. Select a connector instance by setting the CxpHostConnectionSelector
2. Read the corresponding Interface module feature (e.g. CxpLinkLockLossCount)

Resetting a counter

1. Select a connector instance by setting the CxpHostConnectionSelector
2. Write to the corresponding Interface module feature (e.g. CxpLinkLockLossCountReset)

Related Interface module GenApi features

- CoaXPressErrorCounters parameters category
- CxpLinkLockLossCount and CxpLinkLockLossCountReset
- Cxp8b10bErrorCount and Cxp8b10bErrorCountReset
- CxpDuplicatedCharactersUncorrectedErrorCount and CxpDuplicatedCharactersUncorrectedErrorCountReset
- CxpDuplicatedCharactersCorrectedErrorCount and CxpDuplicatedCharactersCorrectedErrorCountReset
- CxpStreamDataPacketCrcErrorCount and CxpStreamDataPacketCrcErrorCountReset
- CxpControlPacketCrcErrorCount and CxpControlPacketCrcErrorCountReset
- CxpEventPacketCrcErrorCount and CxpEventPacketCrcErrorCountReset

2.11. CoaXPress Link Validation Tool

Introduction

Short Description

The *CoaXPress Link Validation Tool* (CXLVT) can be used to validate the operational parameters of a CoaXPress Link.

For a *quick test*, run the CXLVT until reaching a confidence level of 100% that the probability of single bit error (PER) is 10^{-10} or better 10^{-11}. This should just take a *few minutes*.

For an *extensive test*, run the CXLVT until reaching a confidence level of 100% that the PER is 10^{-12} or better 10^{-13}. This will take a *few hours*.

See also: http://en.wikipedia.org/wiki/Bit_error_rate for more information about the theory of bit error rate testing.

Host PC requirements

- The Host PC must be equipped with at least one Coaxlink card.
- The driver must be installed on the Host PC.

Camera requirements

- The camera must be capable to generate a static image pattern.

Installation

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

gentl ber Command

The CXLVT is invoked with the command ber of gentl.exe.

```
$ gentl ber --help
GenTL Explorer

gentl ber [OPTIONS]
  Measure bit error rate confidence level (a.k.a. link validation tool)

Flags:
       --if=ID                Interface ID
       --dev=ID               Device ID
       --ds=ID                DataStream ID
       --buffers=INT          Buffer count (default: 4)
       --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 with stream
       --remotexml=FILE       Use FILE as register description (default:
                              register description is read from remote device)
  -c   --create-only          Create a reference pattern and quit (requires
                              --output)
  -i   --input=FILE           Input reference pattern file (default:
                              automatically create a reference image before
                              measuring the bit error rate confidence level)
  -o   --output=FILE          Output reference pattern file (default: no output
                              file)
       --enable-dump=FILE     Enable dump of defective surfaces to files with
                              the given file path prefix
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 ber --help

```
> help
Ber commands:
  levels              show confidence levels
  levels -N           show confidence levels every N seconds
  results             show intermediate bit error rate results
  results -N          show intermediate bit error rate results every N
                      seconds
  report FILE         write current report to a file
  enable-dump FILE    enable dump of defective surfaces to files with the
                      given file path prefix
  disable-dump        disable dump of defective surfaces
General commands:
  quiet               set verbosity level to quiet
  normal              set verbosity level to normal
  loud                set verbosity level to loud
  help                display this help message
  exit                exit the CLI
>
```

gentl ber commands

Test procedure

To setup the *CoaxPress Link Validation Tool* proceed as follows:

1. With **GenICam Browser (Deprecated)**:
   - Configure the camera as for normal operation and select a fixed test-pattern as video source
   - Configure the frame grabber as for normal operation
2. Open a command shell and execute gentl ber to start a Read-Eval-Print-Loop
3. Get intermediate results using the results command
   - Check if the number of acquired images counter increases regularly
   - Check the confidence levels
4. Run the test until the required confidence levels are reached. This may require several hours.

Operation

The CoaXPress Link Validation Tool (CXLVT) validates the operational parameters of a CoaXPress Link installation (bit rate, cable type, cable length) resulting in reliable, long-term performance.

CXLVT does this by estimating, with a known confidence level, the probability of single bit errors in a CoaXPress Link setup.

We define:

- *PER:* Probability of single bit error in a digital connection like a CoaXPress Link; this is an unknown quantity that we want to estimate
- *BER:* Bit Error Rate, actually measured by the CXLVT

It is generally accepted that a CoaXPress Link will operate reliably, if PER < 10^{-12}. This criterion is similar to the one used in other digital serial image transmission schemes. Of course, a better (lower) PER will provide even more assurance that the operation is reliable.

The CXLVT computes the confidence level (CL), or likelihood, that the PER is less than a set of values (10^{-10}, 10^{-11}, 10^{-12}, 10^{-13}, 10^{-14}), based on the measurement of the BER, during a time sufficiently long to accumulate the necessary evidence.

When started, the CXLVT displays these confidence levels, as evidence accumulates with the passing of time, as illustrated in the screenshots hereafter.

Entering the levels command, during the operation of the CXLVT, displays the confidence levels for the 5 PER values.

```
> levels
------------------------------------------------------------------------------
Confidence level (rounded) that the probability of error is less        Elapsed
than:                                                                       Time
      1.0e-10      1.0e-11      1.0e-12      1.0e-13      1.0e-14      H:MM:SS
------------------------------------------------------------------------------
       99.99%       64.97%        9.95%        1.04%        0.10%      0:08:56
>
```

Confidence levels reported 8 seconds after start

After 8 seconds, we have reached 99.99 % confidence level that the PER is less than 10^{-10}. The PER might very well be much better than that, but at this stage we have insufficient evidence to conclude that this is the case. The CXLVT must be continued.

By entering the results command, during the operation of the CXLVT, additional information can be displayed, after which the CXLVT continues its normal operation, for as long as necessary, to achieve the required confidence level for a predetermined PER.

```
> results
Intermediate results:
---------------------
Duration (hours:minutes:seconds):                                  0:16:37
Duration (seconds):                                                    997
Acquired images:                                                     11975
Bad images:                                                              0
Acquired bits:                                                 1.986509e11
Bit errors:                                                    0.000000e0
Average bit errors per bad image:                                        0
Bit rate (bits per second):                                    1.992486e8
Bit error rate:                                                0.000000e0
Confidence level (rounded) that the probability of error
is less than 1.0e-10:                                              99.99%
             1.0e-11:                                              86.28%
             1.0e-12:                                              18.01%
             1.0e-13:                                               1.96%
             1.0e-14:                                               0.19%

>
```

Intermediate results reported after 16 minutes

From this screenshot, we can already conclude that the confidence level that the PER is less than 10^{-11} has risen from 64.97 % to 86.28 %, after 16 minutes.

The CXLVT should be continued until the confidence level that the PER is less than 10^{-12} (at most – a stronger test would be a PER less than 10^{-13}) has reached a satisfactory level (at least 95 %, and 99 % for a stronger result). This may require quite some time, because these outcomes require a significant amount of evidence.

```
Intermediate results:
---------------------
Duration (hours:minutes:seconds):                                  3:30:12
Duration (seconds):                                                  12612
Acquired images:                                                    149753
Bad images:                                                              0
Acquired bits:                                                 2.484223e12
Bit errors:                                                    0.000000e0
Average bit errors per bad image:                                        0
Bit rate (bits per second):                                    1.969729e8
Bit error rate:                                                0.000000e0
Confidence level (rounded) that the probability of error
is less than 1.0e-10:                                             100.00%
             1.0e-11:                                              99.99%
             1.0e-12:                                              91.66%
             1.0e-13:                                              21.99%
             1.0e-14:                                               2.45%
```

Intermediate results reported after 3.5 hours

From this screenshot, we can conclude that the confidence level that the PER is less than 10^{-12} has risen from 18.01 % to 91.66 %, after 3.5 hours.

To generate a report, execute the report command.

```
> report ber-report
Report ber-report-20171107-093451.log successfully created
>
```

Generate a report command line

2.12. Multi-tap CoaXPress Cameras

Applies to the following firmware variants of [1]

Quad12 Quad12-4 (1-camera)

Value12 (1-camera)

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

QSFP+ (1-camera)

1X_2YE geometry

Multi-tap is controlled through the following GenApi features of the MultiTapControl category of the Coaxlink Data Stream module:

- DeviceTapGeometry: Image scan format. Supported values:
  - 1X_1Y: Single tap. Default value.
  - 1X_2YE: Two zones across vertical direction, pixel extractors at both top and bottom lines.
- Image1StreamID: Stream ID of first tap (ignored when DeviceTapGeometry is Geometry_1X_1Y).
- Image2StreamID: Stream ID of second tap (ignored when DeviceTapGeometry is Geometry_1X_1Y).

See also: "Transmission Methods of 1X_2YE Images (Coaxlink series)" on page 212

[1] 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+.

2.13. CoaXPress-over-Fiber

Applies to [1]
QSFP+

CoaXPress-over-Fiber (CoF) is a light but significant extension of the existing CoaXPress specification to support transport over fiber optics.

CoaXPress (CXP) is the de-facto standard for high-bandwidth computer vision applications. CoaXPress 2.0, the latest version of the specification, specifies the CXP-12 speed, a 12.5 Gbps (Gigabit per second) link over a coaxial copper cable. As link aggregation is common with CoaXPress, bandwidths of 50 Gbps (12.5 x 4) are easily achievable with four CXP-12 links. The CoaXPress specification is hosted by the JIIA (Japan Industrial Imaging Association).

CoaXPress-over-Fiber has been designed as an add-on to the CoaXPress 2.0 specification. It provides a way to run the CoaXPress protocol, as it is, unmodified, over a standard Ethernet connection, including fiber optics. As such, CoaXPress-over-Fiber uses standard electronics, connectors and cables designed for Ethernet, but the protocol is CoaXPress, not Ethernet, not GigE Vision.

What are the pros and cons of using fiber optics?

Pros

- First and foremost, cable length is not an issue anymore as fiber connectivity is basically not limited in length.
- Fiber optics provide more bandwidth, as connectivity at 10 and 25 Gbps per fiber is standard today and widely used in data centers.
- Fiber optics are immune to electrical noise, which will be a significant advantage on the production floor in and some medical applications.
- Fiber optics are lighter and smaller in size than the equivalent copper cabling, making it appropriate for applications where this characteristic is essential, like in aircrafts or vehicles.

Cons

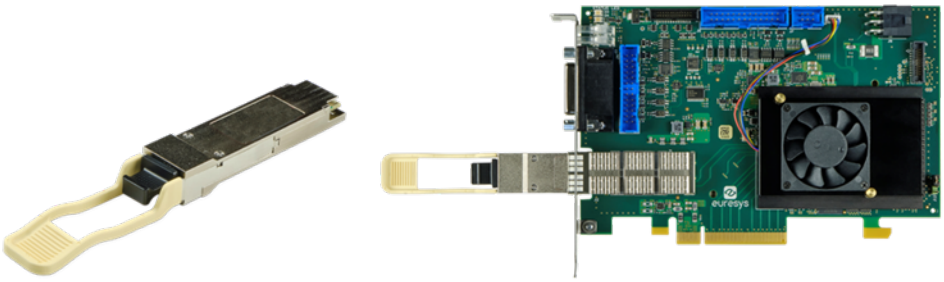
- There is no "power over fiber". As signals in fiber optics are transmitted using light, there is no way to transfer power over fiber optics and devices such as cameras must be powered separately.

[1] 3625 Coaxlink QSFP+.

What are the cable options for CoaXPress-over-Fiber?

One of the most important benefits of CoaXPress-over-Fiber is the wide variety of connectivity options already available from multiple companies.

The initial connectivity options for CoaXPress-over-Fiber and the **3625 Coaxlink QSFP+** at 10 Gbps are SFP+ and QSFP+ (Quad, or four times SFP+) modules. The advantage of using modules compared to fixed interfaces is that ports can be equipped with any suitable type of transceiver as required by the application. A variety of transmitter and receiver types is available, allowing users to select the appropriate transceiver to provide the required optical reach over multi-mode fiber (MMF) or single-mode fiber (SMF).



3625 Coaxlink QSFP+ fitted with an AOC (Active Optical Cable) transceiver

The first option is using a 40GBASE-SR4 QSFP+ Optical Transceiver Module for multi-mode fibers. It uses an MTP/MPO fiber connector with a maximum 150-meter fiber optic cable. This solution is suitable for machine vision applications.

40GBASE-SR4 QSFP+ 850nm 150m MTP/MPO Optical Transceiver Module for MMF
MTP/MPO fiber connector, with maximum 150 m fiber optic cable

The second option is using a 40GBASE-ER4 QSFP+ LC DOM Optical Transceiver Module for single-mode fibers. It uses an LC-Duplex fiber connector with a maximum 40-km fiber optic cable. This solution is suitable, for example, for video transmission applications.

40GBASE-ER4 QSFP+ 1310nm 40km LC DOM Optical Transceiver Module for SMF
LC-Duplex fiber connector, with maximum 40 km fiber optic cable

What are the jitter and latency of CoaXPress-over-Fiber? How do they compare to "traditional" CoaXPress?

CoaXPress-over-Fiber is based on the CoaXPress protocol and it exhibits the same high performance as CoaXPress in terms of jitter and latency. In addition, as CoaXPress-over-Fiber supports higher transmission speed compared to CoaXPress, the jitter and latency will be further improved in these versions.

3. On-board Memory

Coaxlink frame grabbers are fitted with a large on-board memory.

On-board memory size per product

Product	Memory Size [MB]
1629 Coaxlink Duo PCIe/104-EMB	512
1630 Coaxlink Mono	512
1631 Coaxlink Duo	1024
1632 Coaxlink Quad	1024
1633 Coaxlink Quad G3	1024
1633-LH Coaxlink Quad G3 LH	1024
1635 Coaxlink Quad G3 DF	1024
1637 Coaxlink Quad 3D-LLE	1024
3602 Coaxlink Octo	2048
3603 Coaxlink Quad CXP-12	2048
3603-4 Coaxlink Quad CXP-12	4096
3620 Coaxlink Quad CXP-12 JPEG	2048
3620-4 Coaxlink Quad CXP-12 JPEG	4096
3621 Coaxlink Mono CXP-12	512
3621-LH Coaxlink Mono CXP-12 LH	512
3622 Coaxlink Duo CXP-12	1024
3622-LH Coaxlink Duo CXP-12 LH	1024
3623 Coaxlink Quad CXP-12 Value	4096
3624 Coaxlink Quad CXP-12 DF	4096
3625 Coaxlink QSFP+	4096

On-board memory partitions

The memory is partitioned according to the installed firmware variants:

- For all firmware-variants, there is one *Image data* partition for each stream of each device.
- For firmware variants supporting FFC, there is another partition, named *FFC coefficients* for each stream of each device.

See also: "Partition Schemes" on page 107 for a detailed description.

Image data partition

The *Image data* partition is operated as a First-In-First-Out memory to decouple the CoaXPress 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 CoaXPress data acquisition.

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

FFC coefficients partition

The *FFC coefficients* partition is used to store gain and offset coefficients for each pixel of the camera.

See also: "FFC in Coaxlink frame grabbers" on page 152for a detailed description.

3.1. Partition Schemes

One device, one 'Image data' partition

Applies to the following firmware variants of [1]

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

Duo104EMB (Not recommended for new designs) Duo104MIL (1-camera), (1-camera, line-scan)

Mono (Not recommended for new designs) (1-camera)

Duo (Not recommended for new designs) (1-camera), (1-camera, line-scan)

Quad (Not recommended for new designs) (1-camera), (1-camera, line-scan)

QuadG3 QuadG3LH (1-camera, line-scan), (1-slm-camera), (1-sls-camera)

QuadG3DF (1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)

Quad3DLLE (1-camera)

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

Quad12 Quad12-4 (1-camera, line-scan)

Mono12 Mono12LH (1-camera), (1-camera, line-scan)

Duo12 Duo12LH (1-camera), (1-camera, line-scan)

Value12 (1-camera, line-scan)

Quad12DF (1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)

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

	Image data
Device 0	1/1

1D partition scheme

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

One device, two partitions per device: 'CustomLogic' and 'Image data'

Applies to the following firmware variants of [1]

Octo (1-camera, custom-logic)

Quad12 Quad12-4 (1-camera, custom-logic), (1-camera, line-scan, custom-logic)

QSFP+ (1-camera, custom-logic)

	CustomLogic	Image data
Device 0	1/2	1/2

1D_CL partition scheme

One device, two partitions per device: 'FFC coefficients' and 'Image data'

Applies to the following firmware variants of [2]

QuadG3 QuadG3LH (1-camera)

Quad12 Quad12-4 (1-camera)

Value12 (1-camera)

	FFC coefficients	Image data
Device 0	1/2	1/2

1D_FFC partition scheme

[1] 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12 and 3625 Coaxlink QSFP+.

[2] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12 and 3623 Coaxlink Quad CXP-12 Value.

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)

	Image data
Device 0	1/2
Device 1	1/2

2D partition scheme

Two devices, two partitions per device: 'CustomLogic' and 'Image data'

Applies to the following firmware variants of [2]

Octo (2-camera, line-scan, custom-logic)

Quad12 Quad12-4 (2-camera, custom-logic), (2-camera, line-scan, custom-logic), (4-camera, line-scan, custom-logic)

	CustomLogic	Image data
Device 0	1/4	1/4
Device 1	1/4	1/4

2D_CL 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.

[2] 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12 and 3603-4 Coaxlink Quad CXP-12.

Two devices, two partitions per device: 'FFC coefficients' and 'Image data'

Applies to the following firmware variants of [1]

Octo (2-camera)

	FFC coefficients	Image data
Device 0	1/4	1/4
Device 1	1/4	1/4

2D_FFC partition scheme

Three devices, one 'Image data' partition per device

Applies to the following firmware variants of [2]

QuadG3 QuadG3LH (3-camera)

Octo (3-camera)

	Image data
Device 0	1/2
Device 1	1/4
Device 2	1/4

3D partition scheme

[1] 3602 Coaxlink Octo.

[2] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH and 3602 Coaxlink Octo.

Four devices, one 'Image data' partition per device

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (4-camera), (4-camera, line-scan)

Octo (4-camera), (4-camera, line-scan)

Quad12 Quad12-4 (4-camera), (4-camera, line-scan)

Quad12J Quad12J-4 (4-camera)

Value12 (4-camera), (4-camera, line-scan)

	Image data
Device 0	1/4
Device 1	1/4
Device 2	1/4
Device 3	1/4

4D partition scheme

Four devices, two partitions per device: 'CustomLogic' and 'Image data'

Applies to the following firmware variants of [2]

Quad12 Quad12-4 (4-camera, custom-logic)

	CustomLogic	Image data
Device 0	1/8	1/8
Device 1	1/8	1/8
Device 2	1/8	1/8
Device 3	1/8	1/8

4D_CL partition scheme

[1] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 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 and 3623 Coaxlink Quad CXP-12 Value.

[2] 3603 Coaxlink Quad CXP-12 and 3603-4 Coaxlink Quad CXP-12.

Four data streams, one 'Image data' partition per data stream

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (1-camera, 4-data-stream)

	Image data
Stream0	1/4
Stream1	1/4
Stream2	1/4
Stream3	1/4

4S partition scheme

Five devices, one 'Image data' partition per device, 5D22211 scheme

Applies to the following firmware variants of [2]

Octo (5-camera, 5D22211)

	Image data
Device 0	1/4
Device 1	1/4
Device 2	1/4
Device 3	1/8
Device 4	1/8

5D22211 partition scheme

[1] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

[2] 3602 Coaxlink Octo.

Five devices, one 'Image data' partition per device, 5D41111 scheme

Applies to the following firmware variants of [1]

Octo (5-camera)

	Image data
Device 0	1/2
Device 1	1/8
Device 2	1/8
Device 3	1/8
Device 4	1/8

5D4111 partition scheme

[1] 3602 Coaxlink Octo.

Eight devices, one 'Image data' partition per device

Applies to the following firmware variants of [1]

Octo (8-camera)

	Image data
Device 0	1/8
Device 1	1/8
Device 2	1/8
Device 3	1/8
Device 4	1/8
Device 5	1/8
Device 6	1/8
Device 7	1/8

8D partition scheme

[1] 3602 Coaxlink Octo.

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 136 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 116 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 123 for more information and configuration instructions.

5. Area-scan Acquisition

Applies to the following firmware variants of [1]

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

Duo104EMB Duo104MIL (1-camera), (2-camera)

Mono (1-camera)

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

Quad (1-camera), (2-camera)

QuadG3 QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, bayer), (3-camera), (4-camera)

QuadG3DF (1-camera), (1-df-camera)

Quad3DLLE (1-camera)

Octo (1-camera), (1-camera, custom-logic), (2-camera), (3-camera), (4-camera), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)

Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (2-camera), (2-camera, custom-logic), (4-camera), (4-camera, custom-logic)

Quad12J Quad12J-4 (4-camera)

Mono12 Mono12LH (1-camera)

Duo12 Duo12LH (1-camera), (2-camera)

Value12 (1-camera), (2-camera), (4-camera)

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

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

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

5.1. Area-scan Acquisition Principles

Area-scan imaging

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

GenTL buffer filling rules – Area-scan firmware variants

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

- The first acquired line data of a frame is, by default, stored at the beginning of a new buffer. When vertical image flipping is enabled by setting StripeArrangement to Geometry_1X_1YE, the first acquired line data of a frame is stored at the location of the last full line of a new buffer.
- When image transfer to host memory is done, the buffer, possibly partially filled, is made available to the application for processing.
- NEW When the remaining space of a buffer is not sufficient to store a complete frame, the remaining data is handled according to the "Area-scan Acquisition Principles" on page 117.

5.2. High Frame Rate Acquisition

The High Frame Rate –HFR– feature allows area-scan applications to store more than one image per buffer.

Why high frame rate acquisition?

The processing overhead linked to the buffer management prevents the Host PC to sustain image acquisition at high frame rates. The upper limit depends on the Host PC; the 'grey' area is typically in the 1 kHz to 5 kHz range.

Storing several images per buffer significantly reduces the processing overhead and enables area-scan applications to reach very high acquisition frame rates in excess of several hundred thousand images per second!

Configuring the number of images to put in one buffer

The BufferPartCount GenApi feature of the Data Stream module defines the number of images to put in one buffer.

By default, BufferPartCount is 1. The maximum value is 10,000.

Using larger values is recommended for high frame rate applications. The value should be large enough to keep the buffer handling rate below the upper limit sustainable by the Host PC!

The data stream's Height is set to BufferPartCount * the camera's Height

> NOTE
> The value of BufferPartCount is only used when the buffer is announced.
>
> Not available on line-scan firmware variants
>
> The data stream's Height is set to BufferPartCount * the camera's Height

See also: "310-high-frame-rate" sample program

Managing HFR acquisition

The following commands were added to BUFFER_INFO_CUSTOM_CMD_LIST:

BUFFER_INFO_CUSTOM_PART_SIZE

BUFFER_INFO_CUSTOM_NUM_PARTS

BUFFER_INFO_CUSTOM_NUM_DELIVERED_PARTS

BUFFER_INFO_CUSTOM_PART_TIMESTAMPS

Use BUFFER_INFO_CUSTOM_NUM_DELIVERED_PARTS t o get the number of parts available in the buffer

See also: "311-high-frame-rate" sample program

Use BUFFER_INFO_CUSTOM_PART_TIMESTAMPS 64-bit array to get the timestamps of each buffer part

See also: "312-high-frame-rate" sample program

5.3. Sub-link Acquisition

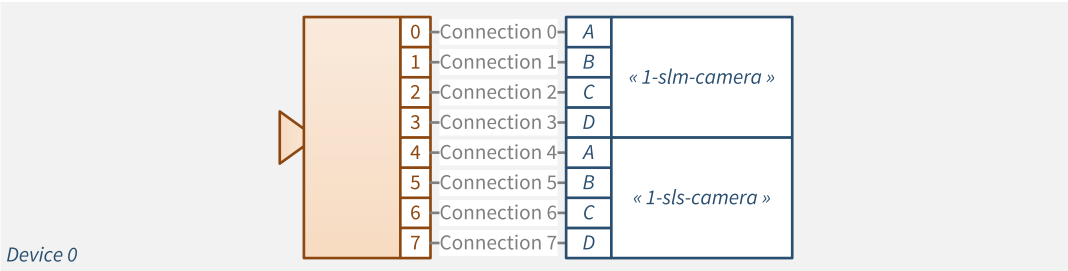
Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (1-slm-camera), (1-sls-camera)

Principles

The *Sub-link Acquisition* feature allows to acquire images from specific 8-connection CoaXPress cameras.

The 8-connection CoaXPress link is divided into 2 sub-links. Each sub-link connects to a Coaxlink card using the 1D8SL4 connection scheme:



8-connection camera using 2 sub-links and 2 Coaxlink cards

The first 4-connection sub-link connects to the "sub-link-master grabber": a Coaxlink card fitted with the *1-slm-camera* firmware variant.

The next 4-connection sub-link connects to the "sub-link-slave grabber": a Coaxlink card fitted with the *1-sls-camera* firmware variant.

Each grabber delivers one-half of the image frame into a GenTL buffer. The application has to reconstruct the whole image frame by merging the contents of the two corresponding buffers. This is shown in the 320-sublink EGrabber sample program.

The master grabber controls the camera and manages the system triggers.

Both grabbers are configured to capture all the image data of their respective sub-link.

[1] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

Camera requirements

This feature applies only to 8-connection area-scan cameras having the following characteristics:

- The image header and the image data of the first line are packed together into a single CoaXPress data packet and delivered to CoaXPress Connection 0.
- For the remaining lines of the frame (or ROI), the image data of a single image line are packed into a single packet and delivered to the next CoaXPress Connection. Connections are rotated using the CoaXPress standard packet distribution ordering rule: (0 to 7, then back 0).
- The image frame (or ROI) height must be a multiple of 8 lines to ensure that the last image line is delivered on the last connection (Connection 7).

5.4. Multi-Stream Acquisition

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (1-camera, 4-data-stream)

4-data-stream concurrent acquisition

The *1-camera, 4-data-stream* firmware variant of **1633 Coaxlink Quad G3** and **1633-LH Coaxlink Quad G3 LH** allows to connect one area-scan CoaXPress camera that delivers up to 4 independent data streams.

The frame grabber sorts the incoming CoaXPress data blocks according to the value of the 2 least significant bits of the CoaXPress StreamID and feeds four independent data paths.

Each data path is capable of handling the full CoaXPress link bandwidth, namely 2.5 Gigabytes/s.

It includes:

1. A 256 MB image data partition,
2. A pixel processor that allows to align 10/12/14-bit data to the LSB or to the MSB of a 16-bit container,
3. A DMA engine that transfers image data directly to the user memory space of the Host PC.

The multistream sample program shows how to create 4 instances of EGrabber and start acquisition on 4 concurrent data streams.

[1] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

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)

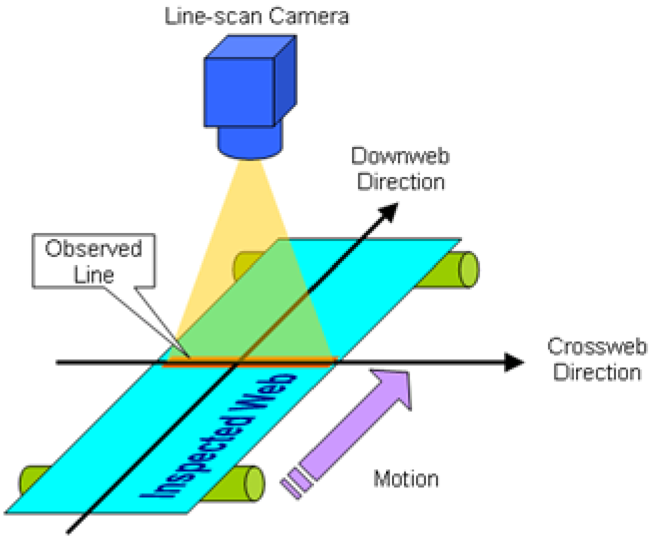
Quad12DF (1-camera, line-scan), (1-df-camera, line-scan)

QSFP+ (1-camera, line-scan)

[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



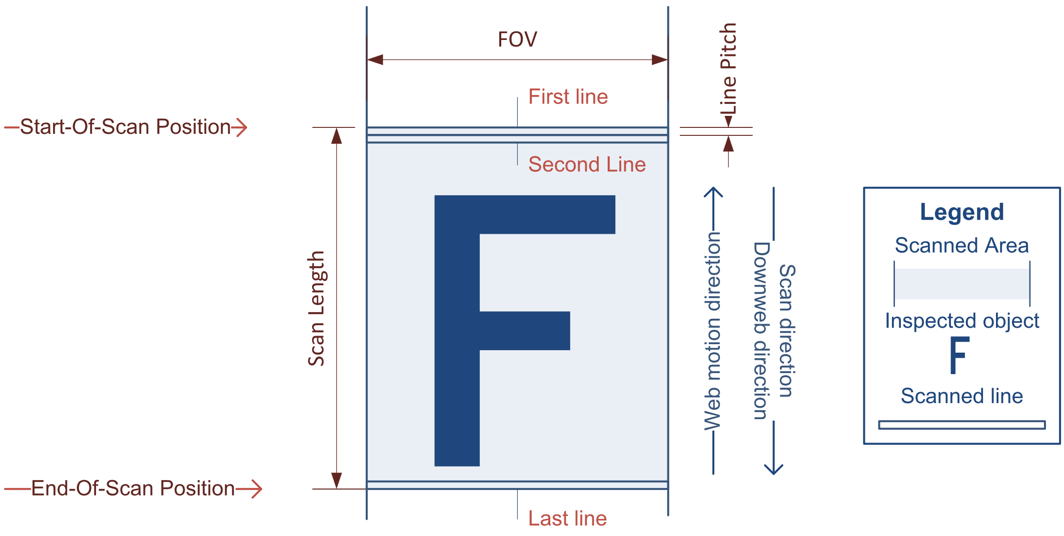
Typical line-scan imaging system

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

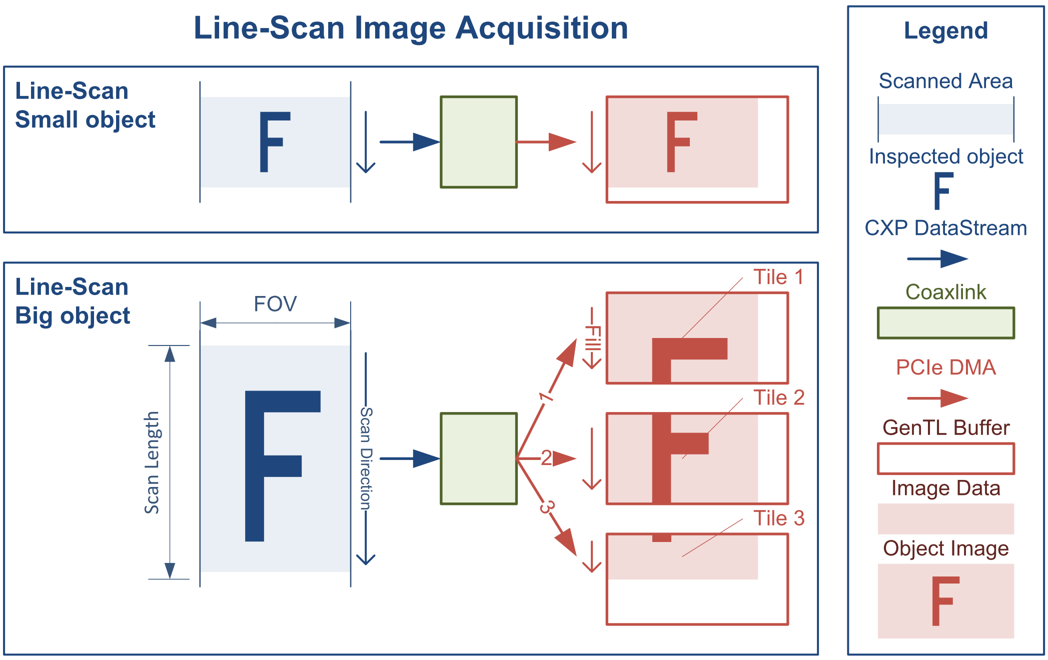


Image capture of small and large objects

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:

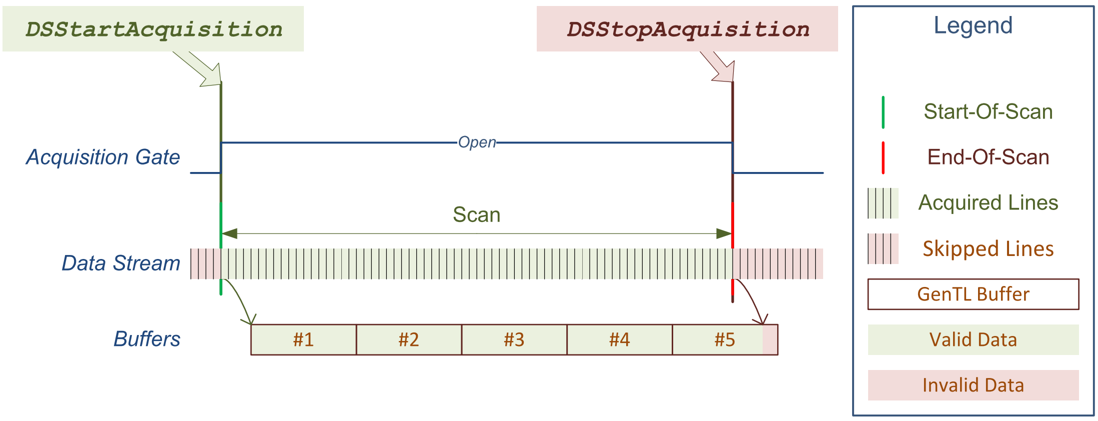
- For small objects, the object image data are delivered into a *single GenTL buffer*.
- For big objects, the object image data are delivered into *multiple GenTL buffers*.

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 (Coaxlink series)

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.

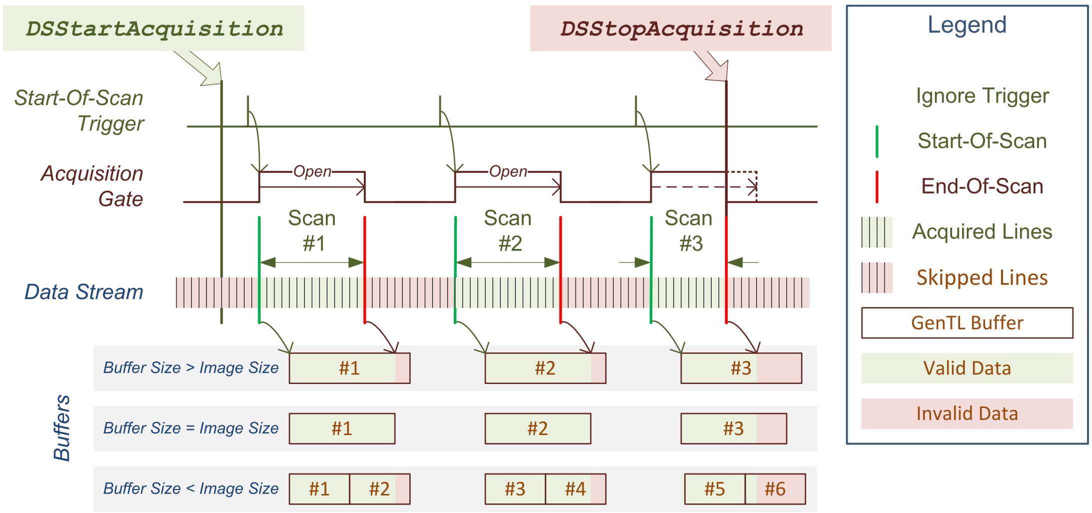
When the DSStartAcquisition function is called, the scanning starts at the next line boundary.

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.

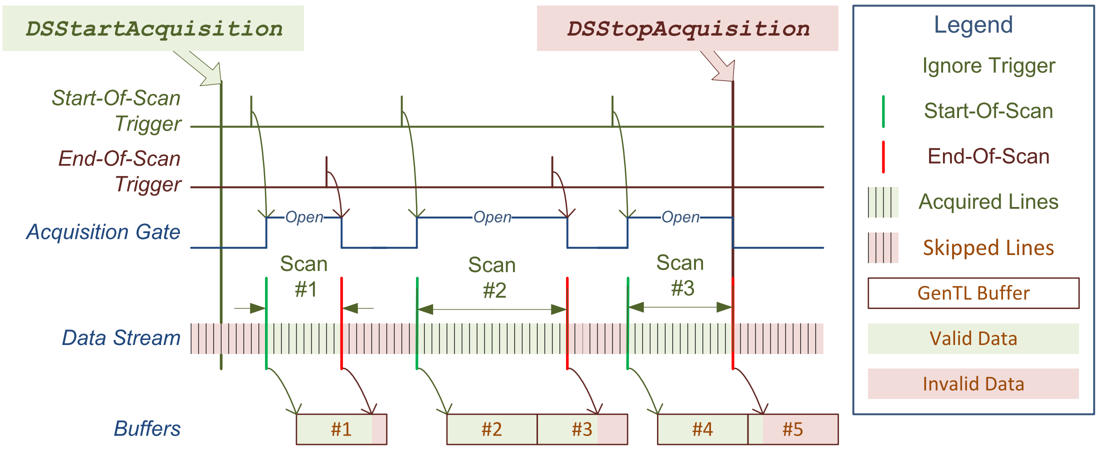
The acquisition controller ignores any Start-of-Scan trigger event while a scanning is in progress.

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.

[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 **Coaxlink frame grabbers***

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

CoaXPress bit stream slicing

This operation extracts individual pixel components data from the CoaXPress image data bit stream according to the bit depth – *input-bit-depth* – specified by the '*PixelF*' property of the CoaXPress Image Header.

All components have the same pixel bit depth. Possible values are 8-/10-/12-/14- and 16-bit.

The slicer delivers, for each image line, all the pixel components necessary to build a number of pixels specified by the '*Xsize*' property of the CoaXPress Image Header.

The slicer discards CoaXPress line-padding data.

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 146 for more information and configuration instructions.

Flat Field Correction — FFC

This operation applies a linear gain and offset transformation to each individual pixel components.

See also: "Flat Field Correction" on page 148 for more information and configuration instructions.

Lookup Table processing — LUT

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

See also: "Lookup Table Processing" on page 162 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 146 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 175 for more information and configuration instructions.

Pixel Binning — BIN

This operation combines a cluster of 2 x 2 or 4 x 4 pixels into a single pixel by summing or averaging their respective pixel values.

See also: "Pixel Binning" on page 188 for more information and configuration instructions.

Pixel component swapping — SWAP

This operation modifies the component order of multi-components pixel data.

See also: "Pixel Components Swapping" on page 196 for more information and configuration instructions.

Endianness conversion

This operation modifies the byte order of 16-bit pixel component data.

See also: "Endianness Conversion" on page 197 for more information.

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, for instance:

- 64-bit for **1630 Coaxlink Mono**, **1631 Coaxlink Duo**, and **1632 Coaxlink Quad**
- 128-bit for **1633 Coaxlink Quad G3**, **1633-LH Coaxlink Quad G3 LH** and **1635 Coaxlink Quad G3 DF**

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.

On-board Memory Bandwidth Limitation

For FFC use cases, the on-board memory bandwidth is not sufficient to sustain the full CoaXPress data rate.

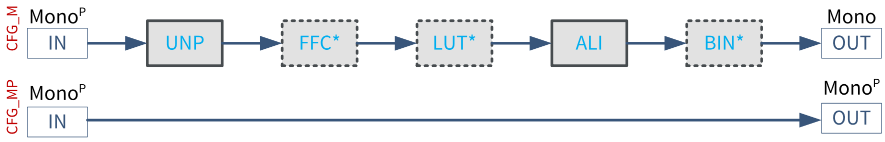
7.2. Configurations

Pixel processing configurations of ***Coaxlink frame grabbers***

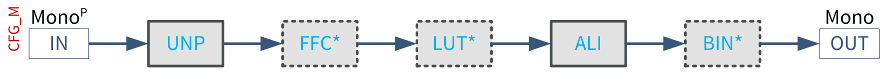
This topic shows the applicable pixel data processing configurations of **Coaxlink frame grabbers**for every class of camera pixel formats. For each class, a drawing shows the relevant pixel data processing configurations:

- "Configurations for monochrome cameras" on page 140
- "Configurations for Bayer CFA cameras" on page 141
- "Configurations for RGB cameras" on page 143
- "Configurations for RGBa cameras" on page 144

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.
- FFC: flat-field correction.
- 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.
- BIN: binning.

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

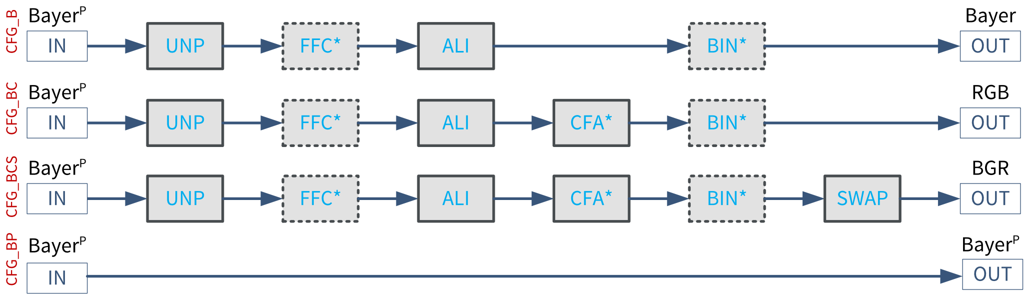
FFC, LUT and BIN are optional processing steps that can be activated or not according to the application needs.

CFG_MP configuration

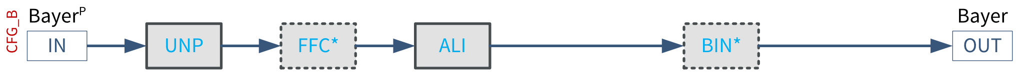
In the "CFG_MP" configuration, pixel unpacking is turned off.

The pixel processing chain is disabled. Pixels are not processed; packed pixels remain unpacked.

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.

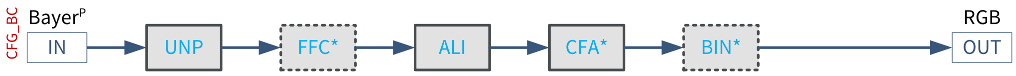
The successive processing steps are:

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

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

FFC and BIN are optional processing steps that can be activated or not according to the application needs.

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.

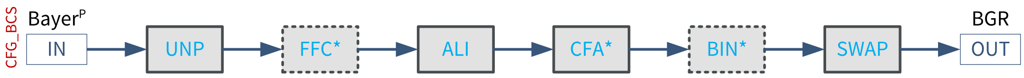
The successive processing steps are:

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

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

FFC and BIN are optional processing steps that can be activated or not according to the application needs.

CFG_BCS configuration



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

The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixels to 16-bit with alignment to lsb.
- FFC: flat-field correction.
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixels.
- CFA: Bayer CFA decoding.
- BIN: binning.
- SWAP: R/B pixel component swapping.

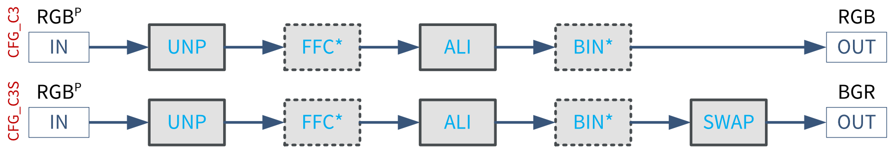
UNP and ALI are *mandatory processing step* that must be active and configured according to the application needs.

FFC and BIN are optional processing steps that can be activated or not according to the application needs.

CFG_BP configuration

In the "CFG_BP" configuration, pixel unpacking is turned off. The pixel processing chain is disabled. Pixels are not processed. Packed pixels remain unpacked.

Configurations for RGB cameras



CFG_C3 configuration

In the "CFG_C3" configuration, the SWAP processing step is disabled. The pixel processing chain transform *packed RGB pixels* into *RGB* pixels.

The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixel components to 16-bit with alignment to lsb.
- FFC: flat-field correction.
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixel components.
- BIN: binning.

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

FFC and BIN are optional processing steps that can be activated or not according to the application needs.

CFG_C3S configuration

In the "CFG_C3S" configuration, the SWAP processing step is enabled. The pixel processing chain transform *packed RGB pixels* into *BGR* pixels.

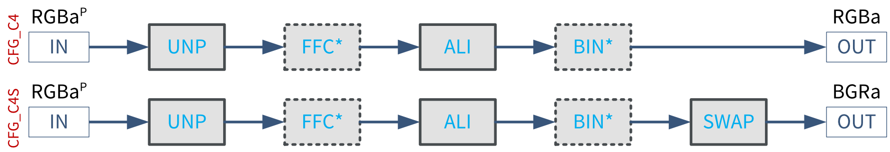
The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixel components to 16-bit with alignment to lsb.
- FFC: flat-field correction.
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixel components.
- BIN: binning.
- SWAP: R/B pixel component swapping.

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

FFC and BIN are optional processing steps that can be activated or not according to the application needs.

Configurations for RGBa cameras



CFG_C4 configuration

In the "CFG_C4" configuration, the SWAP processing step is disabled. The pixel processing chain transform *packed RGBa pixels* into *RGBa* pixels.

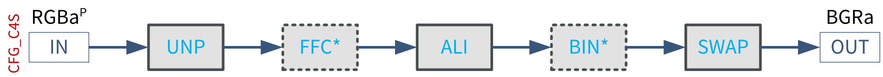
The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixel components to 16-bit with alignment to lsb.
- FFC: flat-field correction.
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixel components.
- BIN: binning.

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

FFC and BIN are optional processing steps that can be activated or not according to the application needs.

CFG_C3S configuration



In the "CFG_C4S" configuration, the SWAP processing step is enabled. The pixel processing chain transform *packed RGBa pixels* into *BGRa* pixels.

The successive processing steps are:

- UNP: unpacking of 10-, 12- and 14-bit pixel components to 16-bit with alignment to lsb.
- FFC: flat-field correction.
- ALI: alignment to lsb (default) or msb of 10-, 12- and 14-bit pixel components.
- BIN: binning.
- SWAP: R/B pixel component swapping.

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

FFC and BIN are optional processing steps that can be activated or not according to the application needs.

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 **Coaxlink frame grabbers**, three options are available:

- Lsb: Unpacking and alignment to lsb (Default setting since release 4.3)
- Msb: Unpacking and alignment to msb
- Off: No unpacking

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.

No unpacking (Coaxlink frame grabbers only)

The packed image data transmitted by the camera through the CoaXPress Link is delivered as is to the output buffer.

NOTE: Keeping packed image data for 10-bit, 12-bit, and 14-bit pixels avoids wasting PCI bandwidth for the transmission of padding zero's.

NOTE: This option is only available for cameras delivering monochrome and Bayer CFA pixels when pixel processing is bypassed!

7.4. Flat Field Correction

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (1-camera), (1-camera, line-scan)

QuadG3DF (1-camera, line-scan), (1-df-camera, line-scan)

Octo (2-camera)

Quad12 Quad12-4 (1-camera)

Value12 (1-camera)

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

[1] 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 and 3624 Coaxlink Quad CXP-12 DF.

What is Flat Field Correction?

The *Flat-field correction* (Wikipedia: FFC) is a method used to correct:

- the differences of light sensitivity between the pixel sensors of a camera
- some artifacts related to the optical system (e.g., non-uniform lighting and vignetting)

The goal is to correct the pixels of the captured (raw) images in such a way that when a uniform background is captured by the system (camera & lens), the resulting output image is uniform.

Formula

This correction is achieved by applying the following operation to each pixel of the raw image:

CorrectedPixel = (RawPixel - Offset) * Gain

where both *Offset* and *Gain* coefficients are specific values for each pixel.

The evaluation of the coefficients *Offset* and *Gain* requires a calibration procedure explained in the next paragraph.

Calibration

The calibration procedure to compute the coefficients is done in two steps:

Dark image acquisition

A dark image is acquired by the system. This is typically achieved by covering the lens with the cap. The captured image represents the dark current of the sensors, and is considered as a fixed bias that we want to eliminate when acquiring images in normal conditions. This correction is called dark-frame subtraction.

$$\text{CorrectedPixel} = \text{RawPixel} - \text{DarkPixel}$$

For each pixel, the *DarkPixel* value corresponds to the *Offset* in the above FFC.

Flat image acquisition

A flat image is acquired by the system. For example by capturing a flat (uniform) background, not too bright to avoid saturation and not too dark.

From dark and flat acquisitions, we have enough data to compute the *Gain* value of the FFC.

For this we define *CorrectedPixel* as the pixel value we consider to be correct for the flat image. Let's set this value as the average pixel value of the flat image (*average(Flat)*), corrected by the average of the dark image (*average(Flat)*). In the FFC terms, this gives:

$$\text{average(Flat)} - \text{average(Dark)} = (\text{FlatPixel} - \text{DarkPixel}) * \text{Gain}$$

This leads to the Gain value

$$\text{Gain} = (\text{average(Flat)} - \text{average(Dark)}) / (\text{FlatPixel} - \text{DarkPixel})$$

The same computation is repeated (*width* * *height*) times, to cover all pixels of both flat and dark images. This results in a specific correction for each pixel of the image.

> NOTE
> Note: this calibration procedure must be redone if any part of the system is changed, including the camera unit, lighting or optics equipment.

Calibration of color pixel formats

For color pixel formats, we have several ways of computing the value of *average(Flat)*. In all cases, the *Gain* computation is repeated (*width* * *height* * *componentsPerPixel*) times to cover all pixel components, which results in specific corrections for each pixel component of the image.

Handling pixel components individually

I.e. in RGB:

- using *average(Flat[Red])* for computing the *Gain* values of *Red* components;
- using *average(Flat[Green])* for computing the *Gain* values of *Green* components;
- using *average(Flat[Blue])* for computing the *Gain* values of *Blue* components.

Handling pixel components together

I.e. in *RGB*, using *average(average(Flat[Red]), average(Flat[Green]), average(Flat[Blue]))* for computing the *Gain* values of *Red*, *Green* and *Blue* components.

This way of computing the average (i.e. over the pixel components) results in FFC coefficients that also correct the balance between components. Therefore, depending on the quality of the uniform background used to acquire the flat image, the FFC can effectively perform a white balance correction.

FFC in Coaxlink frame grabbers

Some cameras have a built-in FFC module while other cameras do not implement this feature. The devices without that functionality can however be corrected by the FFC core of the frame grabber.

The FFC core firmware corrects the pixels directly coming from the camera by applying the FFC using the coefficients (*Offset* and *Gain*) corresponding to their locations in the image. Because the correction happens at a very early stage in the pixel processing chain, the other pixel processing functions such as *RedBlueSwap*, *LUT*, and *Bayer Decoding* are performed on corrected pixels.

Gain and Offset Coefficients Format

The coefficients calculated in the calibration procedure can be loaded into the frame grabber, provided they are encoded as follows:

- *Offset* and *Gain* values for one pixel component are packed together into a 16-bit little-endian value:
  - *Gain* is encoded in Wikipedia:UQ2.8 on bits 9..0
  - *Offset* is a 6-bit unsigned integer on bits 15..10
- Coefficients related to pixel component values are treated separately in the same sequence as the pixel components of the image. For example in *RGB8* format, one pixel is encoded as 3 successive 8-bit values (*Red*, *Green*, *Blue*), therefore we need 3 successive 16-bit packed coefficients to correct one RGB8 pixel.

If the 16-bit packed coefficients are stored (in sequence) in a binary file (let's say *'path/to/coefficients.ffc'*), they can be easily loaded from a Euresys script by calling `require("coaxlink://ffc/load")(grabber, 'path/to/coefficients.ffc');`where *grabber* is the script variable referencing the grabber to configure.

NOTE: such a binary file can be created by the Euresys ffc-wizard sample application.

Specifications

Camera Types

The FFC feature is applicable to monochrome, Bayer CFA and RGB Color area-scan cameras delivering 8-, 10-, 12- 14- or 16-bit data per pixel component.

Maximum Image Size

The maximum size is determined by the size of the memory used to store *FFC coefficients* and the pixel format:

Size	Maximum Image size [Pixels]		
	Monochrome and Bayer CFA	RGB	RGBa
32 KB	16,384	5,461	4,096
512 MB	268,435,456	89,478,485	67,108,864
1024 MB	536,870,912	178,956,970	134,217,728
2048 MB	1,073,741,824	357,913,941	268,435,456

The location and the size of the *FFC coefficients* storage are determined by the product/firmware variant combination:

Product/firmware-variant	Location	Size
1633 Coaxlink Quad G3 (1-camera), (1-camera, line-scan) **1633-LH Coaxlink Quad G3 LH** (1-camera), (1-camera, line-scan)	On-board memory	512 MB
1635 Coaxlink Quad G3 DF (1-camera, line-scan) and (1-df-camera, line-scan)	FPGA memory	32 KB
3602 Coaxlink Octo (2-camera)	On-board memory	512 MB
3603 Coaxlink Quad CXP-12 (1-camera)	On-board memory	1024 MB
3603-4 Coaxlink Quad CXP-12 (1-camera)	On-board memory	2048 MB
3623 Coaxlink Quad CXP-12 Value (1-camera)	On-board memory	2048 MB

NOTE

For most product/firmware-variants, *FFC coefficients* are stored in a dedicated partition of the on-board memory.

However, for the **1635 Coaxlink Quad G3 DF** (1-camera, line-scan) and (1-df-camera, line-scan) firmware variants, the *FFC coefficients* are stored into internal FPGA memory blocks. This allows the FIFO buffer to work at full performance when the FFC is enabled.

Performance

When enabled, the FFC feature adds a significant load to the one-board memory since it fetches an additional 16-bit coefficient data for each processed pixel. When the FFC is enabled, the frame grabber is only able to sustain a fraction of the maximum data rate achievable by the CoaXPress Link. This dimension-less value is named "*Sustainable relative data rate*"

The following table shows the *sustainable relative data rate* for all bit depths and product/firmware variant combinations supporting FFC.

Sustainable Relative Data Rate

Bit depth	Sustainable Relative Data Rate [% of a 4-lane CXP-6 maximum data rate]	
	1633 Coaxlink Quad G3 (1-camera) 1633-LH Coaxlink Quad G3 LH (1-camera)	3602 Coaxlink Octo (2-camera) 3603 Coaxlink Quad CXP-12 (1-camera) 3603-4 Coaxlink Quad CXP-12 (1-camera)
8-bit	70.0 %	123.2 %
10-bit	77.8 %	136.9 %
12-bit	84.0 %	147.8 %
14-bit	89.1 %	156.8 %
16-bit	93.3 %	164.3 %

NOTE
The "Sustainable Relative Data Rate" is global for all cameras attached to a board.For instance, in the **3602 Coaxlink Octo** - 2-camera 8-bit use case, the sustainable data rate of 123.2% can be split unequally to 100% for a camera and 23.2% for the other camera.

NOTE
Coaxlink and Grablink Duo frame grabbers do not acquire any data during blanking intervals. Line- and frame-blanking intervals do not consume memory bandwidth and therefore must be excluded in the calculation of the camera data rate.

TIP
To avoid latencies, FIFO buffer overflow and loss of frames, Euresys recommends to limit the (global) camera data rate accordingly.

Enabling the FFC

In the Data Stream module, set the FfcControl feature value to Enable.

Disabling the FFC

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

FFC Wizard Sample Program

Euresys provides the source code of a sample application, called ffc-wizard, that computes the coefficients and packs them in a binary file targeting the frame grabber.

The purpose of this sample code is threefold:

- guide the user through the calibration procedure;
- provide a technical and practical translation of what's described in this document;
- provide building blocks for developing custom applications.

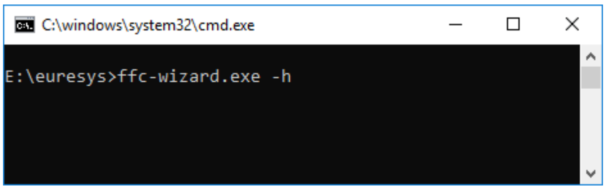
Building

The source code lies in a single source file: src/ffc-wizard.cpp. Building the application should be straightforward;

- for Windows, there is a Microsoft Visual Studio project file ffc-wizard.vcproj;
- for Linux and macOS, a Makefile is provided.

Usage

The wizard is a console application. The help message is displayed when the flag -h (or --help) is given:



getting the help message

```
> ffc-wizard.exe --help
Flat Field Correction Wizard
fcc-wizard [OPTIONS]

Options:
  --if=INT                  Index of GenTL interface to use
  --dev=INT                 Index of GenTL device to use
  --ds=INT                  Index of GenTL data stream to use
  --average=INT             Number of images to average (default: 10)
  --roi_x=INT               Horizontal offset in pixels of ROI upper-left corner (default: 0)
  --roi_y=INT               Vertical offset in pixels of ROI upper-left corner (default: 0;
ignored for line-scan)
  --roi_width=INT           Width of ROI (default: whole image)
  --roi_height=INT          Height of ROI (default: whole image; ignored for line-scan)
  --balance                 Compute flat image average on all components rather than on each
component
  --linescan                Force line-scan mode i.e. average image lines (automatically
enabled for line-scan cards)
  --dark-setup=SCRIPT       Path to setup script for dark acquisitions
  --flat-setup=SCRIPT       Path to setup script for flat acquisitions
  --timeout=MS              Maximum time in milliseconds to wait for an image (default: 1000)
  --dark-histogram=FILE     Path to histogram html page of average dark image to output and
open
```

```
  --flat-histogram=FILE    Path to histogram html page of average flat image to output and
open
  --output-ffc=FILE        Path to coefficients output file (Coaxlink ffc binary format)
  --load-ffc=FILE          Load coefficients into Coaxlink coefficients partition (default:
computed coefficients)
  --no-interact            Skip user interaction
  -h  --help               Display help message

Note: the ROI options allow defining a rectangular region to consider while computing
averages,
      this is useful to eliminate pixels close to borders in images subject to vignetting.
```

Options details

Flags	Details
--if, --def, --ds	the indexes of the GenTL modules that identify the data stream to use (and/or to configure)
--average	the number of images to acquire for dark and flat acquisitions; only the average of those acquisitions is further used in the calibration procedure
--roi_x, --roi_y, --roi_width, --roi_height	an optional rectangular region to consider when computing the average pixel value of the flat image (*average(Flat)*); this impacts the evaluation of the gain value for each pixel
--balance	enables the white balance; i.e. whether the coefficients of color pixel components are computed to balance the component values or not; obviously, this requires the flat background used to acquire the flat image(s) to be as close as possible to a true gray (for which all RGB components would have identical values)
--dark-setup, --flat-setup	optional configuration scripts to run before dark and flat acquisitions
--dark-histogram, --flat-histogram	optional; path to output file showing the histogram of dark and flat image pixel components; this gives a visual overview of the dark current variations as well as the variations in the flat image
--no-interact	normally the wizard waits for the user to setup the system before starting the dark and flat acquisitions; when this flag is used, the wizard does not wait for the user (nor does it open the created histogram html pages)

Example

Here is an illustrated example that generates FFC coefficients (written to the file coefficients.ffc) using the white balance functionality. The command to run from a console window is the following:

```
C:\windows\system32\cmd.exe

E:\euresys>ffc-wizard.exe --balance --output-ffc=coefficients.ffc
```

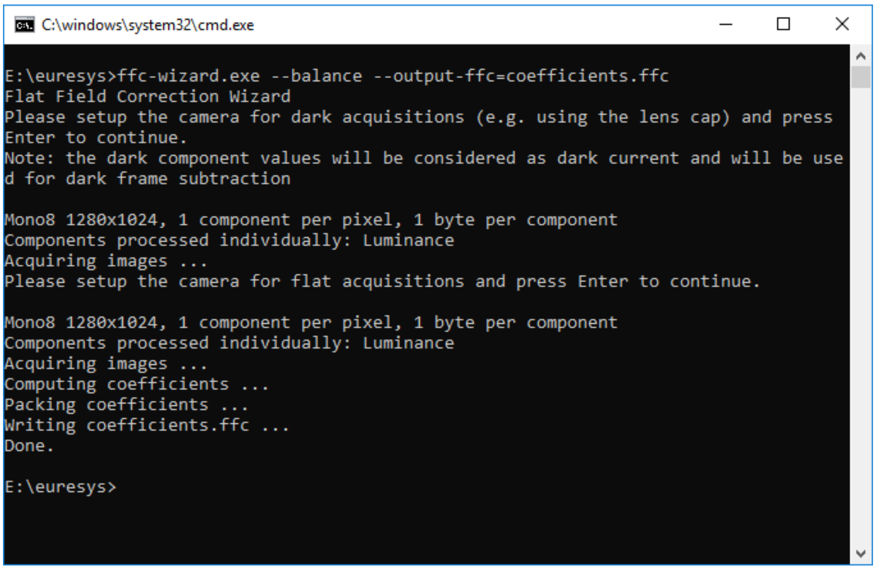
The program starts and tells you what to do:

```
C:\windows\system32\cmd.exe - ffc-wizard.exe --balance --output-ffc=coefficients.ffc

E:\euresys>ffc-wizard.exe --balance --output-ffc=coefficients.ffc
Flat Field Correction Wizard
Please setup the camera for dark acquisitions (e.g. using the lens cap) and press
Enter to continue.
Note: the dark component values will be considered as dark current and will be use
d for dark frame subtraction
```

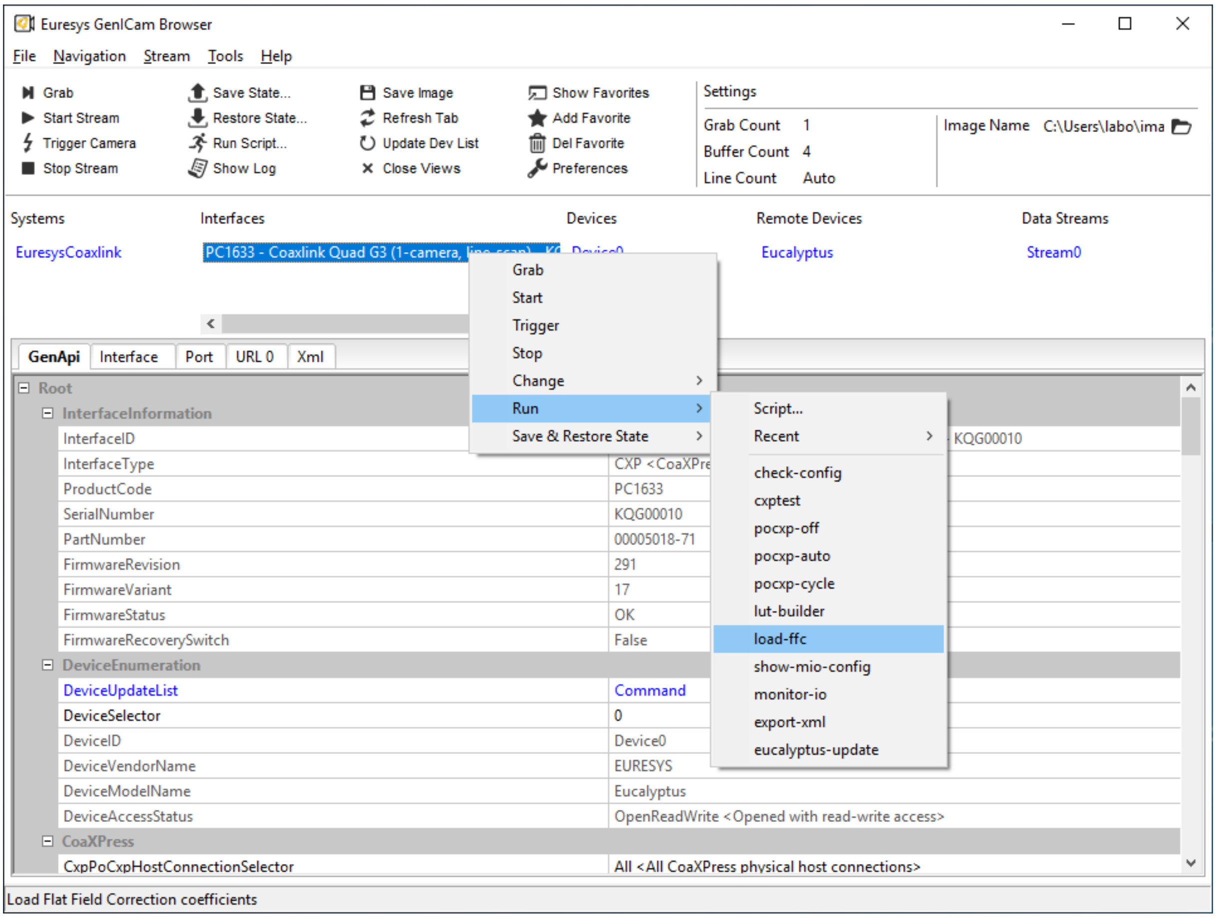
You can prepare your setup for the dark acquisitions and press Enter when you are ready. It will then acquire the series of dark images and display the instructions for the next step

```
C:\windows\system32\cmd.exe - ffc-wizard.exe --balance --output-ffc=coefficients.ffc

E:\euresys>ffc-wizard.exe --balance --output-ffc=coefficients.ffc
Flat Field Correction Wizard
Please setup the camera for dark acquisitions (e.g. using the lens cap) and press
Enter to continue.
Note: the dark component values will be considered as dark current and will be use
d for dark frame subtraction

Mono8 1280x1024, 1 component per pixel, 1 byte per component
Components processed individually: Luminance
Acquiring images ...
Please setup the camera for flat acquisitions and press Enter to continue.
```

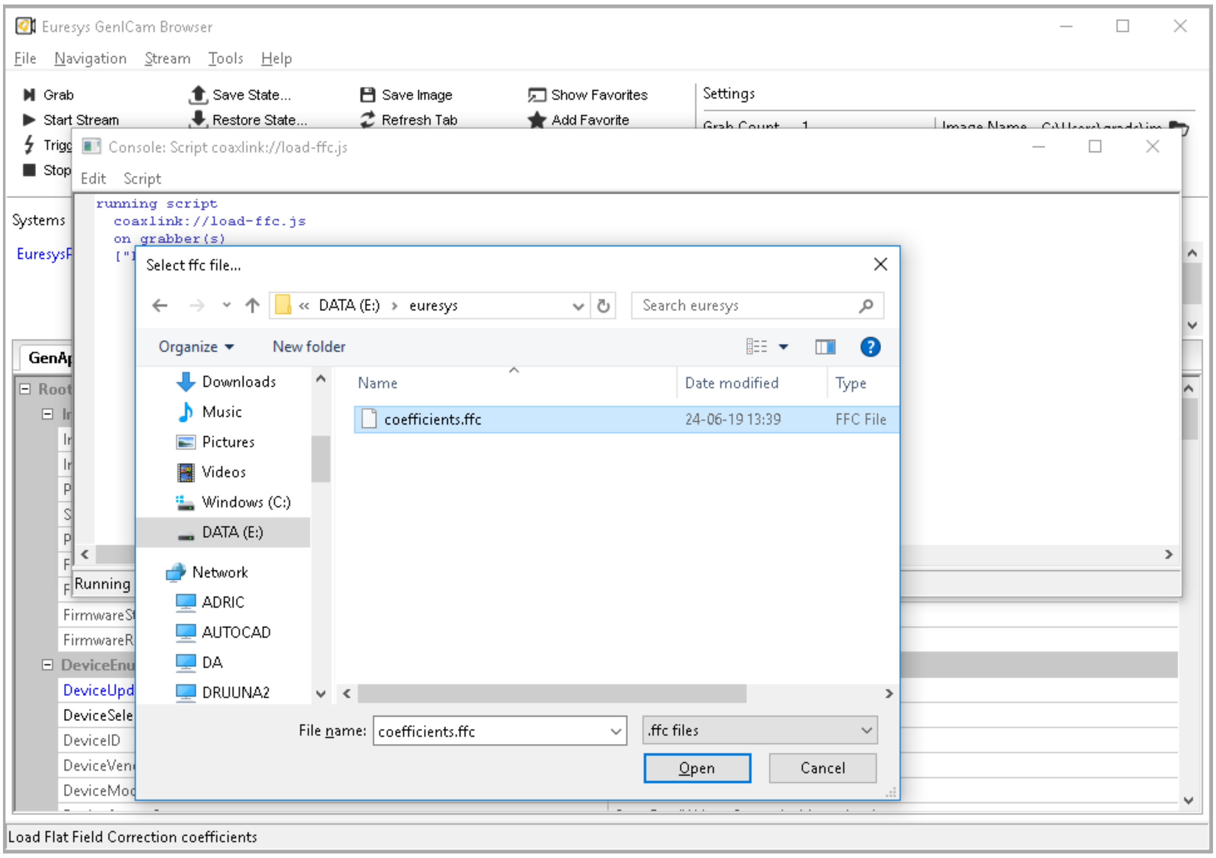
You can prepare your setup for the flat acquisitions and press Enter when you are ready. It will then acquire the series of flat images, compute the corresponding coefficients and write them to the file coefficients.ffc



Later on you can load the coefficients from the **GenICam Browser (Deprecated)** for example, by running the load-ffc script as follows:



Then you can select the previously created file coefficients.ffc



From that moment, the coefficients are loaded into the frame grabber memory and the FFC processing is enabled.

Design

The calibration procedure as well as the packing of the coefficients is controlled by the main function ffcWizard.

ffcWizard tasks

Task	Done by function
acquiring a series of dark images to build an average dark image	acquireImages
acquiring a series of flat images to build an average flat image	acquireImages
computing the gain values for each pixel component	computeGain
using the dark pixel component values as offset values	computeOffset
packing offset and gain values into 16-bit little-endian values	packCoefficients
writing the packed coefficients into a binary file	savePackedCoefficients

Customization

The sample application already supports a few common pixel formats: Mono, RGB, RGBa and Bayer.

Limitation: to limit the complexity of the sample application, we consider (for pixel formats with several components per pixel) that all components have the same size. Supporting pixel formats with different component sizes is still possible by updating the functions addImage and addComponents.

To support a new pixel format (under the condition of the previous limitation), we need to modify two functions:

1. Image::getComponentsPerPixel, to return the number of components per pixel for the new format identified by its PFNC name
2. Image::getComponentFilters, to return a std::vector of ComponentFilter objects describing how the pixel components of the new format (identified by its PFNC name) are positioned in the image

The ComponentFilter objects are used to separate the processing of the different pixel components while evaluating the Gain and Offset values. For example, in RGB format, the FFC coefficients related to the Red components are computed using the Red components from the dark and flat images.

Please see the source code of Image::getComponentFilters for details about pixel component layout configuration.

7.5. Lookup Table Processing

Applies to the following firmware variants of [1]

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

Duo104EMB Duo104MIL (1-camera), (1-camera, line-scan), (2-camera)

Mono (1-camera)

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

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

QuadG3 QuadG3LH (1-camera), (1-camera, line-scan), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, line-scan), (3-camera), (4-camera), (4-camera, line-scan)

QuadG3DF (1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)

Quad3DLLE (1-camera)

Octo (1-camera), (1-camera, custom-logic), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (3-camera), (4-camera), (4-camera, line-scan), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)

Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (1-camera, line-scan), (1-camera, line-scan, custom-logic), (2-camera), (2-camera, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera), (4-camera, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)

Mono12 Mono12LH (1-camera), (1-camera, line-scan)

Duo12 Duo12LH (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan)

Value12 (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (4-camera), (4-camera, line-scan)

Quad12DF (1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)

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

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

Introduction to LUT Processing

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

See also: "Monochrome Lookup Table Processing" on page 164 for a detailed description.

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

See also: "LUT Content Definition" on page 165

See also: "LUT Setup Procedure" on page 172 to setup lookup tables.

Monochrome Lookup Table Processing

Configurations

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

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

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

Lookup Table Data Sets

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

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

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

LUT Content Definition

Methods

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

Response Control

The *Response Control* method defines the transfer function of a lookup table by means of four parameters: "Brightness" on page 166, "Contrast" on page 167, "Visibility" on page 168 and "Negative" on page 169.

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 170 and "Negative" on page 169.

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 171.

Table

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

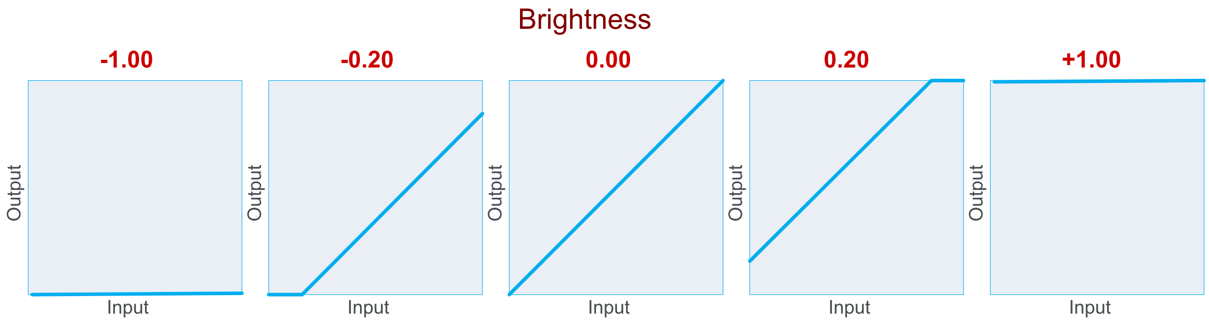
Parameters

Brightness

The Brightness parameter exclusively applies to the "Response Control" on page 165 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 165 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:

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

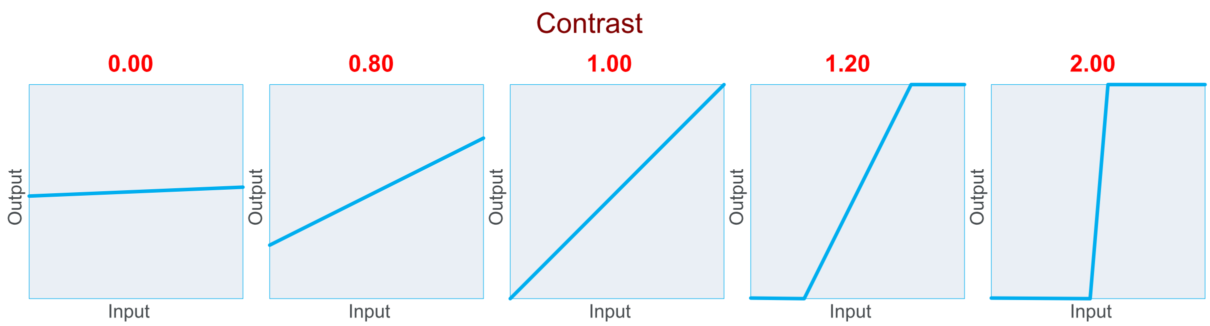
Contrast	Gain	Note
0.00	0.01	Min. Contrast value; smallest gain
1.00	1	Default Contrast value;unity gain
2.00	100	Max. Contrast value; largest gain

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

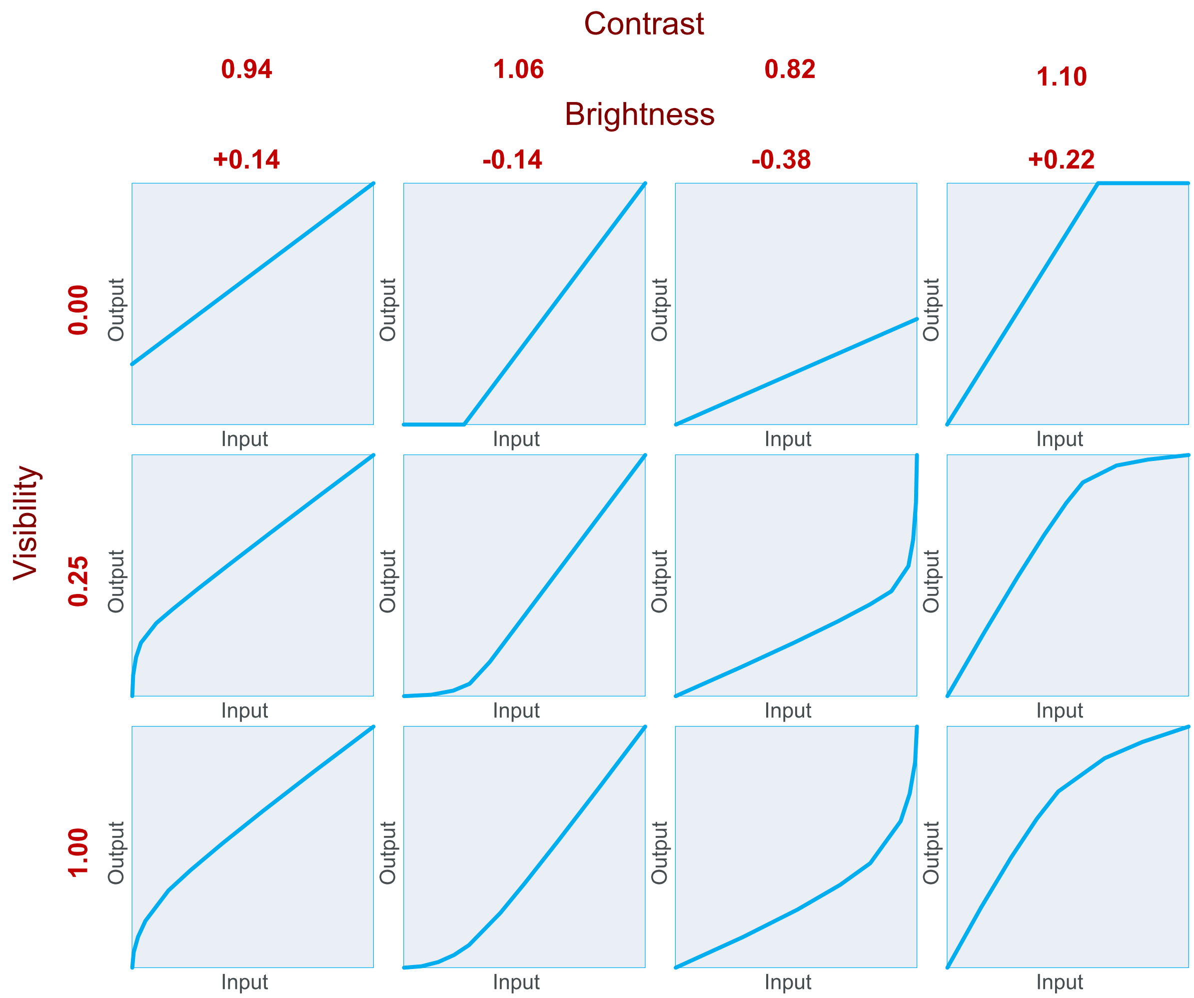
Visibility

The Visibility parameter exclusively applies to the "Response Control" on page 165 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.



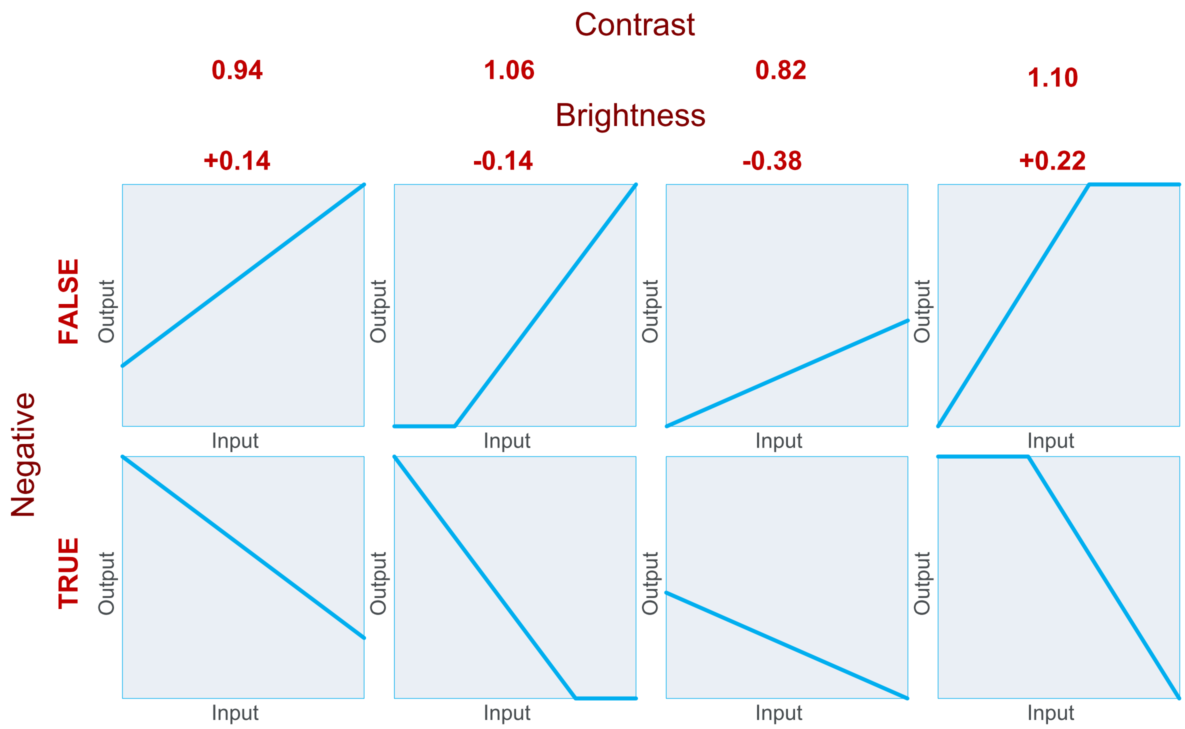
Effect of Visibility for typical values of Contrast and Brightness parameters assuming that Negative = FALSE

Negative

The Negative parameter applies to both the "Response Control" on page 165 and the "Emphasis" on page 165 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 165 lookup table definition method.

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

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

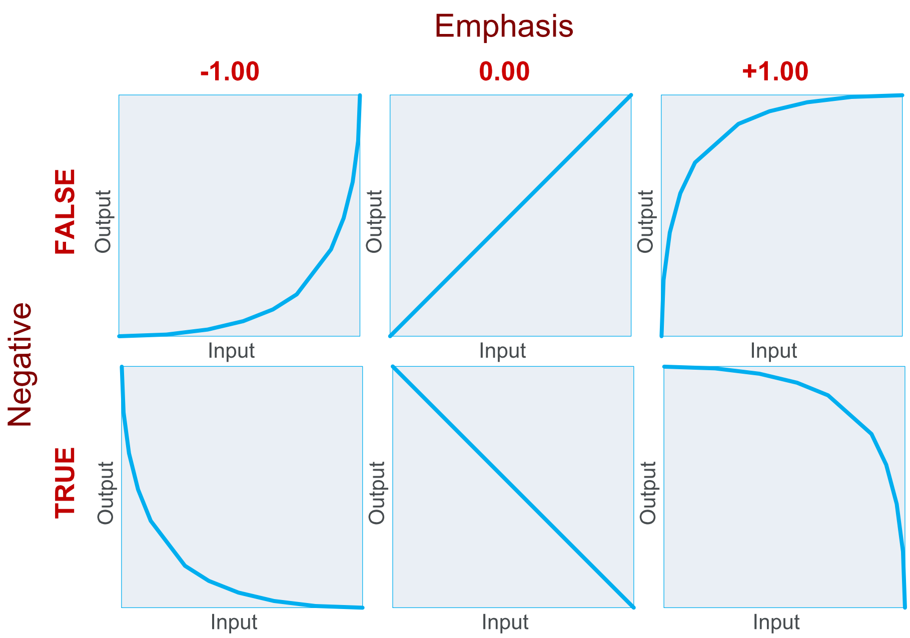
The γ – Gamma – exponent is mathematically linked to Emphasis by:

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

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

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

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



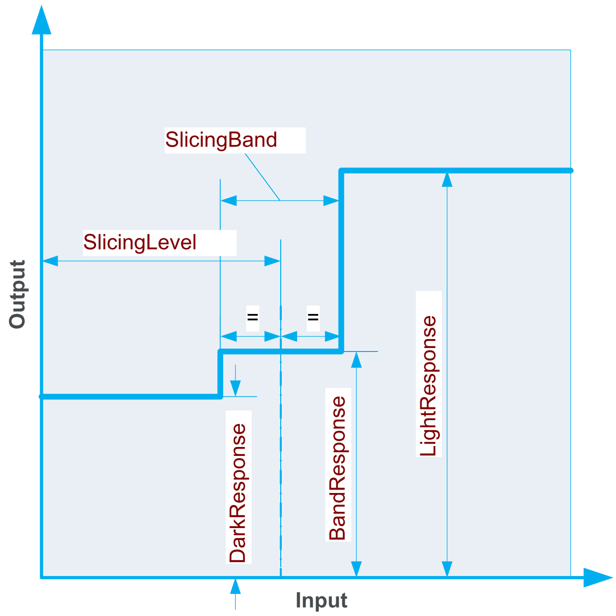
Emphasis effect for typical values of Emphasis and both values of Negative

SlicingLevel, SlicingBand, LightResponse, BandResponse and DarkResponse

SlicingLevel, SlicingBand, LightResponse, BandResponse and DarkResponse parameters exclusively apply to the "Threshold" on page 165 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 164 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 165 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]);
```

7.6. Bayer CFA Decoding

Applies to the following firmware variants of [1]

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

QuadG3 QuadG3LH (1-camera), (2-camera), (2-camera, bayer)

QuadG3DF (1-camera), (1-df-camera)

Octo (1-camera), (2-camera)

Quad12 Quad12-4 (1-camera)

Quad12J Quad12J-4 (4-camera)

Duo12 Duo12LH (1-camera)

Value12 (1-camera)

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

QSFP+ (1-camera)

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

Bayer CFA Decoding Methods

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

CFA decoding method 1

Applies to the following firmware variants of [1]

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

QuadG3 QuadG3LH (1-camera)

QuadG3DF (1-camera), (1-df-camera)

Octo (1-camera), (2-camera)

Quad12 Quad12-4 (1-camera)

Value12 (1-camera)

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

QSFP+ (1-camera)

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

See also: "Advanced and Legacy Methods" on page 184 for an extensive description

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

CFA decoding method 2

Applies to the following firmware variants of [1]

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

QuadG3 QuadG3LH (1-camera)

QuadG3DF (1-camera), (1-df-camera)

Octo (1-camera), (2-camera)

Quad12 Quad12-4 (1-camera)

Quad12J Quad12J-4 (4-camera)

Value12 (1-camera)

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

QSFP+ (1-camera)

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

See also: "Advanced and Legacy Methods" on page 184 for an extensive description

WARNING

Applies to the following firmware variants of [2]

Quad12J Quad12J-4 (4-camera)

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

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

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

CFA decoding method 3

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (2-camera), (2-camera, bayer)

QuadG3DF (1-camera), (1-df-camera)

Octo (1-camera)

Duo12 Duo12LH (1-camera)

The CFA decoding method 3 uses a 5 x 5 kernel and a gradient-based interpolation method to compute the missing color components.

WARNING

Applies to the following firmware variants of [2]

QuadG3 QuadG3LH (2-camera)

The Method 3 decoder is only available for Device0.

CFA decoding method 5

Applies to the following firmware variants of [3]

QuadG3 QuadG3LH (2-camera), (2-camera, bayer)

Octo (2-camera)

The CFA decoding method 5 uses a 2x2 average-based interpolation method to compute the missing color components.

WARNING

Applies to the following firmware variants of [4]

QuadG3 QuadG3LH (2-camera)

The Method 5 decoder is only available for Device0.

[1] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

[2] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

[3] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH and 3602 Coaxlink Octo.

[4] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

Requirements and Performances

Maximum line length

Applies to the following firmware variants of [1]

Quad12J Quad12J-4 (4-camera)

The maximum line length is 5,120 pixels.

Applies to the following firmware variants of [2]

QuadG3 QuadG3LH (2-camera), (2-camera, bayer)

Duo12 Duo12LH (1-camera)

The maximum line length is 8,192 pixels.

Applies to the following firmware variants of [3]

QuadG3 QuadG3LH (1-camera)

QuadG3DF (1-camera), (1-df-camera)

Octo (1-camera)

Quad12 Quad12-4 (1-camera)

Value12 (1-camera)

QSFP+ (1-camera)

The maximum line length is 16,384 pixels.

Applies to the following firmware variants of [4]

Octo (2-camera)

The maximum line length is 32,768 pixels.

[1] 3620 Coaxlink Quad CXP-12 JPEG and 3620-4 Coaxlink Quad CXP-12 JPEG.

[2] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

[3] 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 and 3625 Coaxlink QSFP+.

[4] 3602 Coaxlink Octo.

Peak pixel processing rate

Applies to the following firmware variants of [1]

Quad12J Quad12J-4 (4-camera)

The peak pixel processing rate (per stream) is 500,000,000 pixels/second.

Applies to the following firmware variants of [2]

QuadG3 QuadG3LH (2-camera), (2-camera, bayer)

The peak pixel processing rate (per stream) is 1,000,000,000 pixels/second.

Applies to the following firmware variants of [3]

QuadG3 QuadG3LH (1-camera)

QuadG3DF (1-camera), (1-df-camera)

Octo (2-camera)

Duo12 Duo12LH (1-camera)

The peak pixel processing rate (per stream) is 1,108,000,000 pixels/second.

Applies to the following firmware variants of [4]

Octo (1-camera)

Quad12 Quad12-4 (1-camera)

Value12 (1-camera)

QSFP+ (1-camera)

The peak pixel processing rate (per stream) is 2,216,000,000 pixels/second.

[1] 3620 Coaxlink Quad CXP-12 JPEG and 3620-4 Coaxlink Quad CXP-12 JPEG.

[2] 1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH.

[3] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 3602 Coaxlink Octo, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

[4] 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

PCIe performance

PCI Express Interface	Sustainable PCIe data rate	RGB8	RGB10, RGB12, RGB14, RGB16
"4-lane Rev 3.0 PCIe end-point " on page 458	3,350 MB/s typical	~1,117 Mpixels/s	~558 MPixels/s
"8-lane Rev 3.0 PCIe end-point" on page 459	6,700 MB/s typical	~2,238 Mpixels/s	~1,117 Mpixels/s

NOTE

When configured to deliver RGB8 pixels, the "PCI Express Interfaces" on page 456 is capable to sustain the highest CFA decoder pixel rate!

For 10-, 12-, 14- and 16-bit bit depths, the sustainable data output rate is further limited by the performances of the "PCI Express Interfaces" on page 456 on the Host PC.

Latency

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 Bayer CFA decoder of **Coaxlink frame grabbers***

Prerequisites

1. *Frame grabber*
   Coaxlink frame grabber and firmware-variant with CFA decoder
2. *Camera*
   a. Bayer CFA area-scan
   b. Less than "Max. line length" pixels per line
   c. Having the color registration (GR, RG, GB, or BG) of the first two first transmitted pixels of the first transmitted line and the pixel bit depth (8-bit, 10-bit, 12-bit, 14-bit or 16-bit) correctly specified in the PixelF field of the CoaXPress image header.

> WARNING
> When the fields Xoffs and/or Yoffs are greater than 0, the camera must report an adapted PixelF value corresponding to the transmitted data!

Bayer to RGB Pixel Processing Configurations

When the Bayer CFA decoder is enabled:

- the "Pixel Unpacking and Alignment" on page 146 control is inoperative, the frame grabber unpacks 10-bit, 12-bit or 14-bit pixels to lsb.
- the "Pixel Components Swapping" on page 196 feature allows to swap the Red and Blue components and deliver either BGR or RGB pixels.

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

Enabling the Bayer CFA Decoder

In the Data Stream module, set the BayerMethod feature value to Legacy, Advanced, Method3 or Method5 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

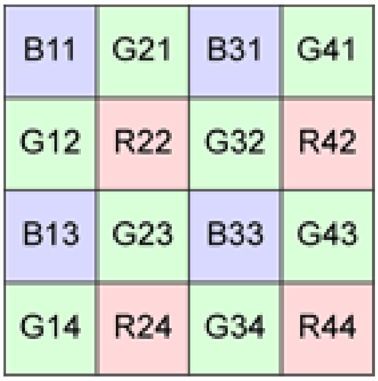
The median() function returns a set of two integer values that are the two median values of a set of four integers. It is computed as follows:

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)]

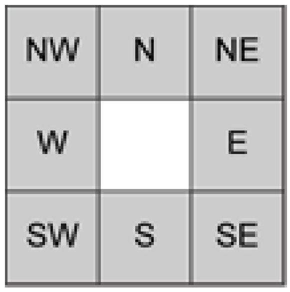
Decoder operation

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

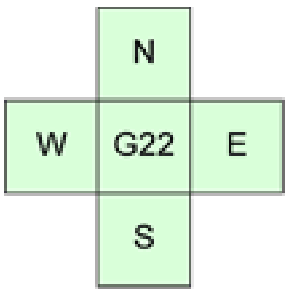
The text hereafter describes how the 4 central pixels located at positions 22, 32, 23 and 33 of a 4 x 4 Bayer CFA array are computed:

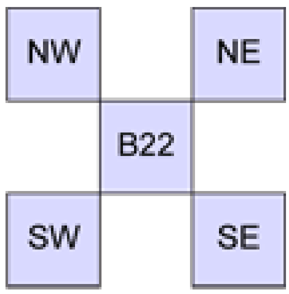


The relative positions of the surrounding pixels are identified by compass markings:



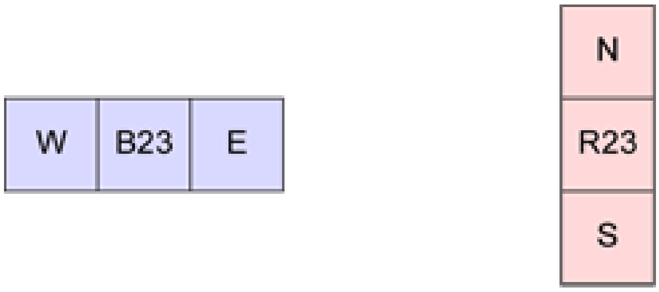
Formulas for position 22





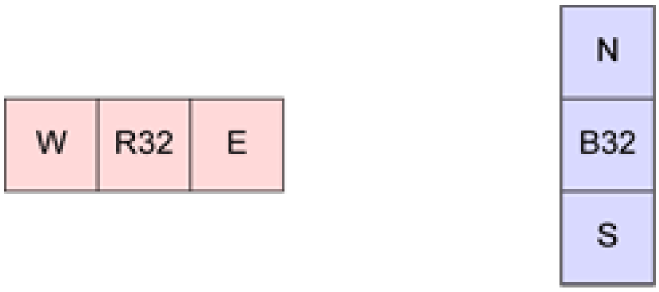
Component	Method	Formula
R22	Legacy, Advanced	R22
G22	Legacy	Mean[Mean(N,S), Mean(W,E)]
	Advanced	Mean[Median(N, S, E, W)]
B22	Legacy	Mean[Mean(NW, SW), Mean(NE, SE)]
	Advanced	Mean[Median(NW, SW, NE, SE)]

Formulas for position 23



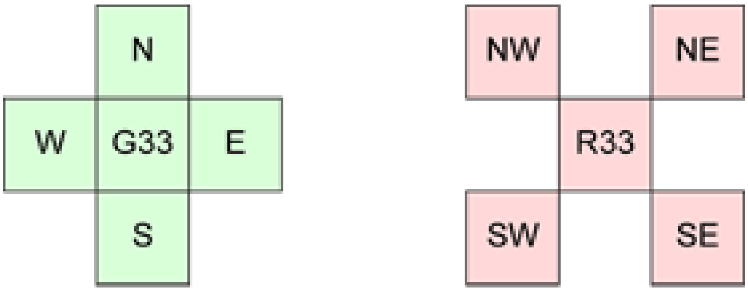
Component	Method	Formula
R23	Legacy, Advanced	Mean(N,S)
G23	Legacy, Advanced	G23
B23	Legacy, Advanced	Mean(W,E)

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

7.7. Pixel Binning

Applies to the following firmware variants of [1]

Quad12 Quad12-4 (1-camera), (1-camera, line-scan)

Value12 (1-camera), (1-camera, line-scan)

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

[1] 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3623 Coaxlink Quad CXP-12 Value and 3624 Coaxlink Quad CXP-12 DF.

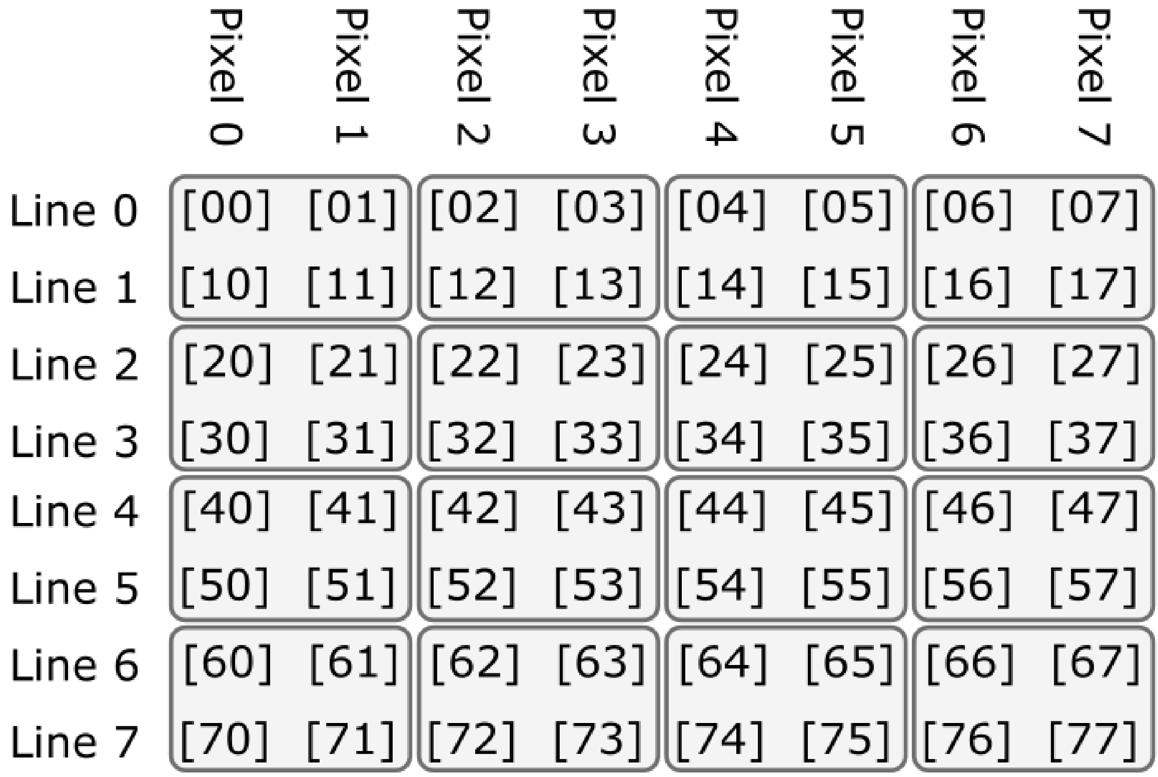
Binning Configurations

The binning processing unit combines a cluster of 2 x 2 or 4 x 4 pixels into a single pixel by summing or averaging their respective pixel values.

Binning windows

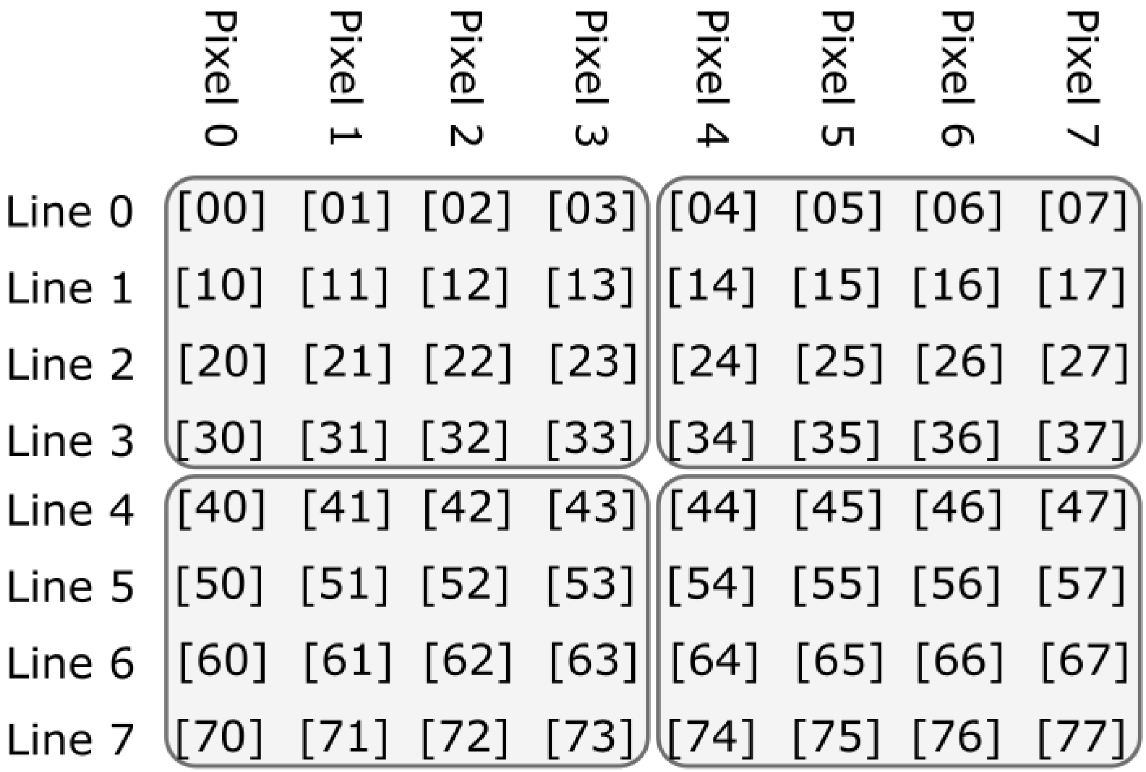
2x2 binning

The pixel binning is performed on a cluster of 4 pixels. It divides both the image width and the image height by 2.



4x4 binning

The pixel binning is performed on a cluster of 16 pixels. It divides both the image width and the image height by 4.



Binning methods

Bypass

The binning processor is bypassed.

Sum

The binning processor sums up the values of the pixels located in the specified *binning window*.

Mean

The binning processor computes the mean value of the pixels located in the specified *binning window*.

> NOTE
> The mean operation divides the summation result by 4 or by 16 depending on the selected *binning window*. The result is rounded down to the nearest unsigned integer.

Enabling /disabling binning

Binning is controlled though the BinningMethod feature of the Data Stream module:

Binning Method	Action on set
Disable	Disable binning. (Default settings)
Sum_2x2	Enable 2x2 binning using 'sum' method
Mean_2x2	Enable 2x2 binning using 'mean' method
Sum_4x4	Enable 4x4 binning using 'sum' method
Mean_4x4	Enable 4x4 binning using 'mean' method

Specifications

Supported camera pixel types

The binning processing unit can be operated with the following camera pixel types:

- 8-/10-/12-/14- and 16-bit single-component pixels (e.g. Monochrome cameras)
- 8-/10-/12-/14- and 16-bit 3-component pixels (e.g. color RGB cameras)
- 8-/10-/12-/14- and 16-bit 4-component pixels (e.g. color RGBa cameras)
- 8-/10-/12-/14- and 16-bit Bayer CFA cameras only when the Bayer CFA decoder is enabled

Supported input bit depth vs. binning configuration

Binning Method	Supported input bit depth
Disable	8-/10-/12-/14- and 16-bit
Mean_2x2	
Mean_4x4	
Sum_4x4	8-/10-/12- and 14-bit
Sum_4x4	8-/10- and 12-bit

Limitations

Image width

Width Increment Step

Depending on the binning configuration, the image width settings of the camera must be a multiple of the specified *Width Increment Step* value.

Bit Depth	Binning Method	Binning Window	Width Increment Step (pixels)
8-bit	Bypass	2x2	4
8-bit	Bypass	4x4	4
8-bit	Mean	2x2	8
8-bit	Mean	4x4	16
8-bit	Sum	2x2	4
8-bit	Sum	4x4	8
10-, 12-, 14- and 16-bit	Bypass	2x2	2
10-, 12-, 14- and 16-bit	Bypass	4x4	2
10-, 12-, 14- and 16-bit	Mean	2x2	4
10-, 12-, 14- and 16-bit	Mean	4x4	8
10-, 12-, 14- and 16-bit	Sum	2x2	4
10-, 12-, 14- and 16-bit	Sum	4x4	8

Maximum image width

The max. image width is limited by the FIFO inside the Binning processor. It depends on the pixel format:

Pixel Format	Max. Image Width (pixels)
Mono8	65,536
Mono10, Mono12, Mono14, Mono16	32,768
RGB8	21,840
RGB10, RGB12, RGB14, RGB16	10,920
RGBa8	16,384
RGBa10, RGBa12, RGBa14, RGBa16	8,192

Image Height

Height increment step (area-scan acquisition)

The image height must be a multiple of 2 when using Binning Window 2x2 and a multiple of 4 when using Binning Window 4x4.

Height increment step (line-scan acquisition)

The ScanLength settings must be a multiple of 2 when using Binning Window 2x2 and a multiple of 4 when using Binning Window 4x4.

Additional limitations

When the Pixel Binning is enabled, the "Pixel Unpacking and Alignment" on page 146 control is inoperative, the frame grabber unpacks 10-bit, 12-bit or 14-bit pixels to lsb.

7.8. 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.

7.9. Endianness Conversion

The image data stream pixel processor delivers 16-bit pixel components using the little-endian convention.

The conversion is not performed when UnpackingMode is set to Off.

Little-endian Convention

The least-significant byte of a multiple byte data is stored at the lowest address location.

For instance, 16-bit data are stored into two consecutive byte locations as follows:

Memory Byte Location	Memory Byte Content
N	Data[7:0]
N+1	Data[15:8]

7.10. Pixel Ordering

The image data stream pixel processor preserves the pixel order of the CoaXPress data stream.

The pixels data of an image frame are stored in successive address locations starting with the first pixel of the first line at the lowest address.

The successive lines of an image frame are concatenated in the image buffer.

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.
- NEW When the remaining space of a buffer is not sufficient to store a complete frame, the remaining data is handled according to the" BufferFilledRule settings" on page 200.

Line-scan firmware variants

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

- The first acquired line data of a scan is, by default, stored at the beginning of a new buffer. When vertical image flipping is enabled by setting StripeArrangement to Geometry_1X_1YE, the first acquired line data of a scan is stored at the location of the last full line of a new buffer.
- A buffer contains an integer number of image lines data.
- NEW When the remaining space of a buffer is not sufficient to store a an image line data, the remaining data is handled according to the" BufferFilledRule settings" on page 200.
- When the last line data of a scan is acquired, the last buffer, possibly partially filled, is made available to the application for processing.

BufferFilledRule settings

Discard remaining data

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

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

Applies to the following firmware variants of [1]

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

Duo104EMB Duo104MIL (1-camera), (2-camera)

Mono (1-camera)

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

Quad (1-camera), (2-camera)

QuadG3 QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, bayer), (3-camera), (4-camera)

QuadG3DF (1-camera), (1-df-camera)

Quad3DLLE (1-camera)

Octo (1-camera), (1-camera, custom-logic), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (3-camera), (4-camera), (4-camera, line-scan), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)

Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (1-camera, line-scan), (1-camera, line-scan, custom-logic), (2-camera), (2-camera, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera), (4-camera, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)

Quad12J Quad12J-4 (4-camera)

Mono12 Mono12LH (1-camera)

Duo12 Duo12LH (1-camera), (2-camera)

Value12 (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (4-camera), (4-camera, line-scan)

Quad12DF (1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)

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

Continue in a next buffer (Default settings for line-scan acquisition)

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

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

NOTE

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

Applies to the following firmware variants of [1]

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

Duo104EMB (Not recommended for new designs) Duo104MIL (1-camera, line-scan)

Duo (Not recommended for new designs) (1-camera, line-scan), (2-camera, line-scan)

Quad (Not recommended for new designs) (1-camera, line-scan)

QuadG3 QuadG3LH (1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)

QuadG3DF (1-camera, line-scan), (1-df-camera, line-scan)

Quad3DLLE (1-camera)

Octo (1-camera, line-scan), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera, line-scan)

Quad12 Quad12-4 (1-camera, line-scan), (1-camera, line-scan, custom-logic), (2-camera, line-scan), (2-camera, line-scan, custom-logic), (4-camera, line-scan), (4-camera, line-scan, custom-logic)

Mono12 Mono12LH (1-camera, line-scan)

Duo12 Duo12LH (1-camera, line-scan), (2-camera, line-scan)

Value12 (1-camera, line-scan), (2-camera, line-scan), (4-camera, line-scan)

Quad12DF (1-camera, line-scan), (1-df-camera, line-scan)

QSFP+ (1-camera, line-scan)

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

8.2. Image Width Increment Step

WARNING
The width of the image delivered by the camera must be a multiple of the *Image Width Increment Step*.

The *Image Width Increment Step* depends on:

- the camera *Pixel Format*
- the *Line Pitch Alignment* - LPA - : the smallest number of bytes that the data stream chain can align

The following table shows the *Image Width Increment Step* vs. the camera *Pixel Format* for all possible LPA values:

Pixel Format	Bytes/pixel	Image Width Increment Step [Pixels]			
		LPA=4	LPA=8	LPA=16	LPA=32
Mono8 or Bayer8	1	4	8	16	32
Mono10-/12-/14-/16 or Bayer10-/12-/14-/16	2	2	4	8	16
RGB8	3	4	8	16	32
RGBA8	4	1	2	4	8
RGB10-/12-/14-/16	6	2	4	8	16
RGBA10-/12-/14-/16	8	1	1	2	4

LPA values

The LPA values depends on the selected product/firmware variant and the usage of the pixel processing:

Values of LPA when the FFC, CFA, JPEG and BIN processing elements are not used

LPA	Applicable product/firmware variants
4	QuadG3 QuadG3LH (1-camera), (1-camera, 4-data-stream), (1-camera, line-scan), (1-slm-camera), (1-sls-camera), (2-camera), (2-camera, bayer), (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) Octo (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (3-camera), (4-camera), (4-camera, line-scan), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera) Quad12 Quad12-4 (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (4-camera), (4-camera, line-scan) Quad12J Quad12J-4 (4-camera) Mono12 Mono12LH (1-camera), (1-camera, line-scan) Duo12 Duo12LH (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan) Value12 (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (4-camera), (4-camera, line-scan) Quad12DF (1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan) QSFP+ (1-camera), (1-camera, line-scan)
8	Duo104EMB (Not recommended for new designs) Duo104MIL (1-camera), (1-camera, line-scan), (2-camera) Mono (Not recommended for new designs) (1-camera) Duo (Not recommended for new designs) (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan) Quad (Not recommended for new designs) (1-camera), (1-camera, line-scan), (2-camera) Quad12 Quad12-4 (4-camera, custom-logic), (4-camera, line-scan, custom-logic)
16	Quad3DLLE (1-camera) Octo (2-camera, line-scan, custom-logic) Quad12 Quad12-4 (2-camera, custom-logic), (2-camera, line-scan, custom-logic)
32	Octo (1-camera, custom-logic) Quad12 Quad12-4 (1-camera, custom-logic), (1-camera, line-scan, custom-logic) QSFP+ (1-camera, custom-logic)

Values of LPA when the FFC corrector is active

Step	Applicable product/firmware variants
16	QuadG3 QuadG3LH (1-camera), (1-camera, line-scan) QuadG3DF (1-camera, line-scan), (1-df-camera, line-scan)
32	Octo (2-camera) Quad12 Quad12-4 (1-camera)

Values of LPA when the CFA decoder is active

LPA	Applicable product/firmware variants
16	QuadG3 QuadG3LH (1-camera) QuadG3DF (1-camera), (1-df-camera) Duo12 Duo12LH (1-camera)
32	Octo (1-camera), (2-camera) Quad12 Quad12-4 (1-camera)

Values of LPA when the JPEG encoder is active

LPA	Applicable product/firmware variants
32	Quad12J Quad12J-4 (4-camera)

Values of LPA for CustomLogic firmware variants

LPA	Applicable product/firmware variants
8	Quad12 Quad12-4 (4-camera, custom-logic)
32	Octo (1-camera, custom-logic) Quad12 Quad12-4 (1-camera, custom-logic), (1-camera, line-scan, custom-logic)

Values of *Image Width Increment Step* when the BIN element is active

See also: "Limitations" on page 194

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.

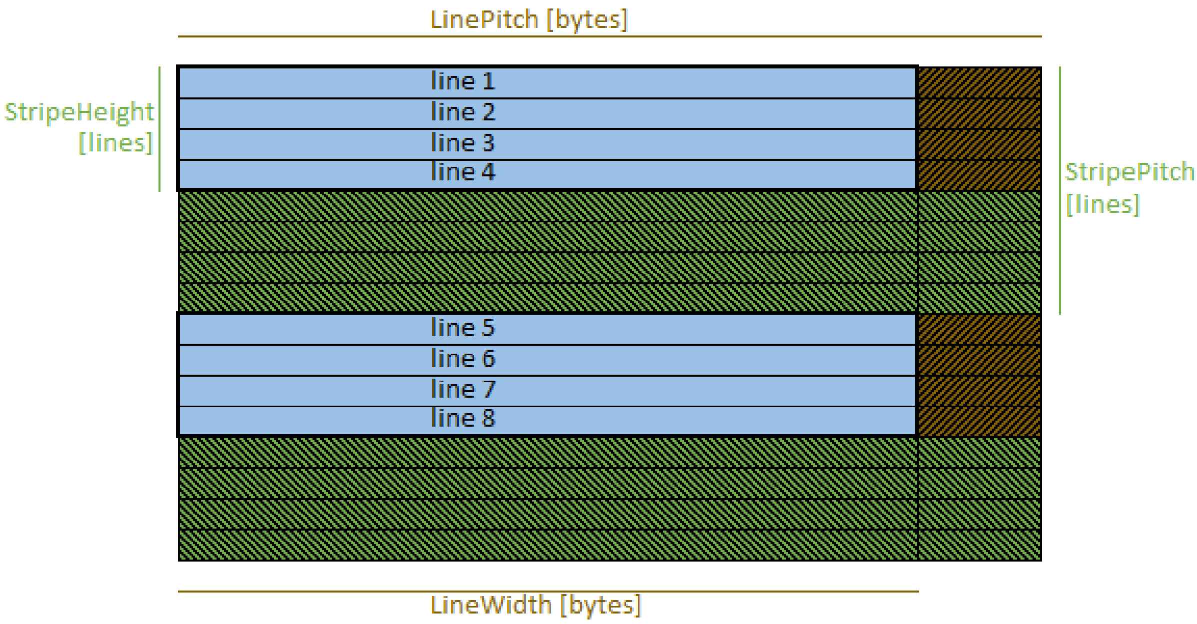


Image buffer padding model

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.

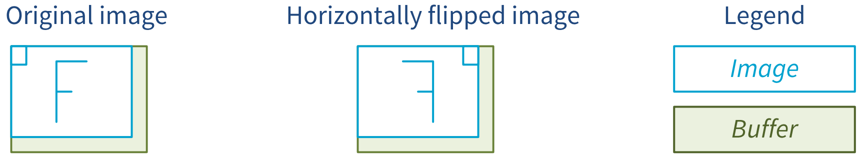
StripePitch can be set to 0 to disable padding after lines.

8.4. Horizontal Image Flipping

Applies to the following firmware variants of [1]

Octo (2-camera, line-scan), (2-camera, line-scan, custom-logic)

Description



Horizontal image flipping

The horizontal image flipping function swaps the order of the pixels one each line of the image:

- The image content is flipped as shown in the above drawing.
- The leftmost pixel or an image line is moved to the rightmost position.
- The rightmost pixel or an image line is moved to the leftmost position.
- Line padding is excluded from the operation.
- For RGB and RGBa, the component order remains unchanged

Data Stream setup

The ReverseX GenApi feature in the "ImageFormatControl Category" on page 1026 of the Coaxlink Data Stream module controls the horizontal image flipping.

- When left to its default value the image horizontal flipping is disabled.
- When set to True, the image horizontal flipping is enabled

Prerequisites

The horizontal image flipping function can be enabled only if following conditions area all satisfied

1. The product firmware variant provides the function.
2. The image width doesn't exceed 48 kilobytes, namely:
   a. 49,152 monochrome or Bayer CFA pixels of 8-bit
   b. 24,576 monochrome or Bayer CFA pixels of 10-/12-/14- or 16-bit
   c. 16,384 RGB pixels of 8-bit
   d. 8,192 RGB pixels of 10-/12-/14- or 16-bit

[1] 3602 Coaxlink Octo.

e. 12,288 RGBa pixels of 8-bit

f. 6,144 RGBa pixels of 10-/12-/14- or 16-bit

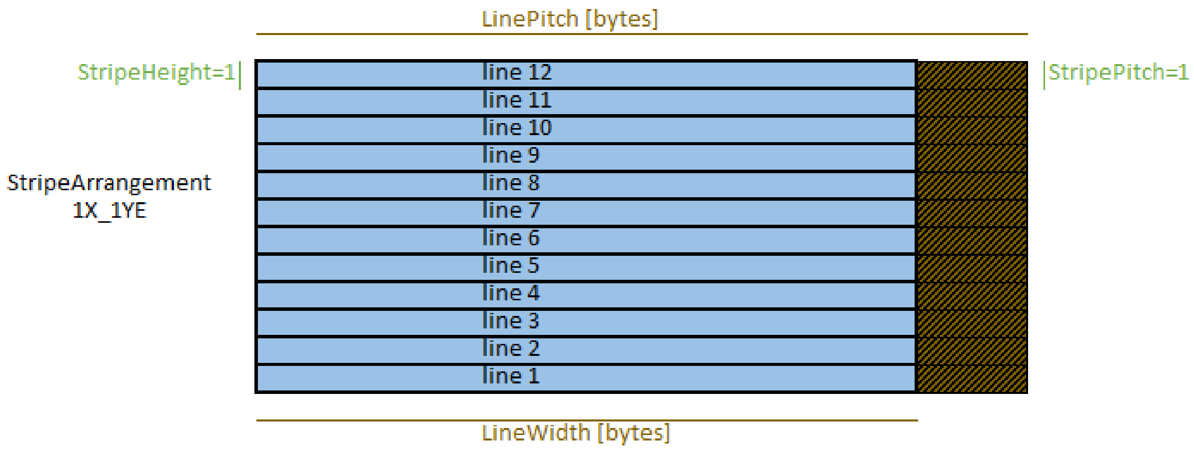
Limitations

When the horizontal image flipping function is enabled:

1. the Pixel Component Unpacking control is inoperative, the Coaxlink card unpacks 10-bit, 12-bit or 14-bit pixels to lsb
2. The Image width increment step is 4 Bytes
3. For Bayer CFA pixel formats , the color pattern changes as following:
   a. BayerGB -> BayerBG
   b. BayerBG -> BayerGB
   c. BayerGR -> BayerRG
   d. BayerRG -> BayerGR

8.5. 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:

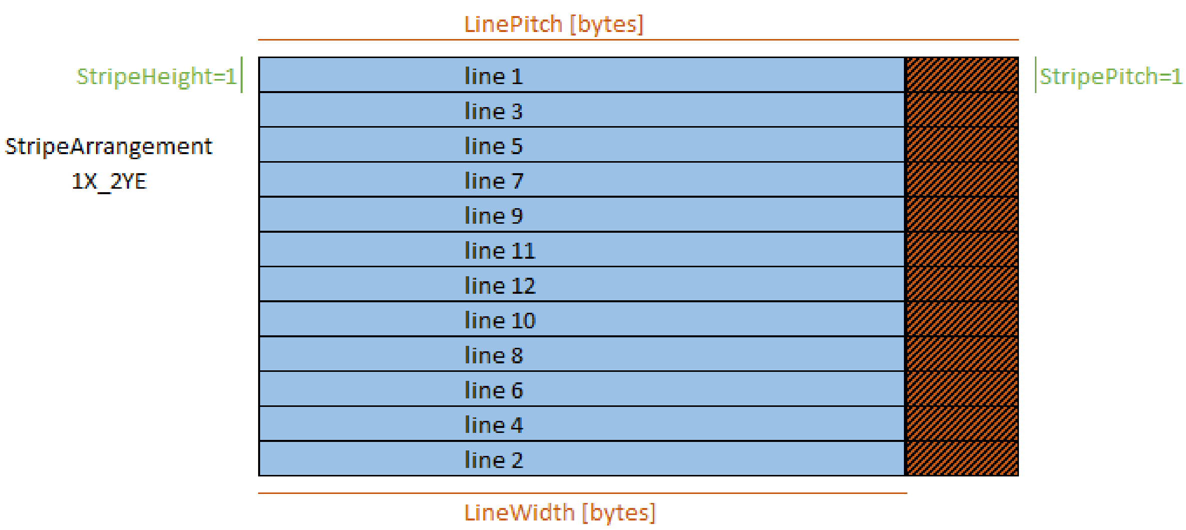
- if the buffer is too small, it is the bottom part of the image (as given by the camera) that will be lost;
- lines will start at BufferBase + n * LinePitch;
- only complete lines are transferred;
- if the buffer size is not a multiple of LinePitch bytes, some bytes at the end of the buffer will be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

8.6. 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.

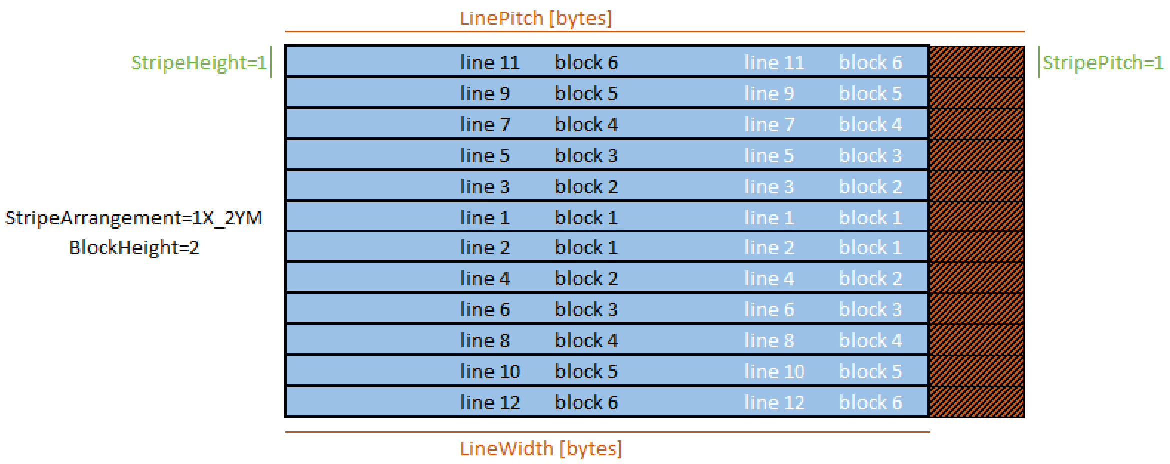
See also: "Transmission Methods of 1X_2YE Images (Coaxlink series)" on page 212

Unscrambling 1X_2YM images

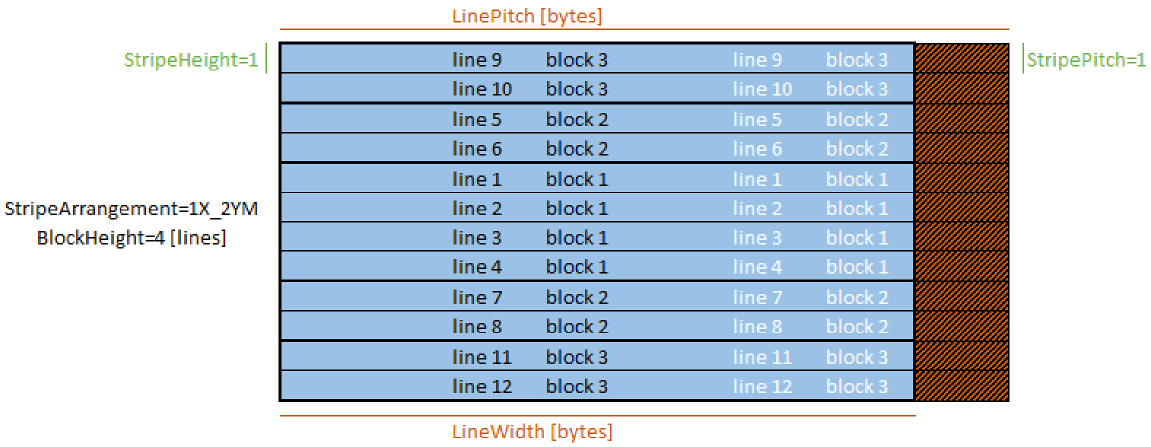
NOTE

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

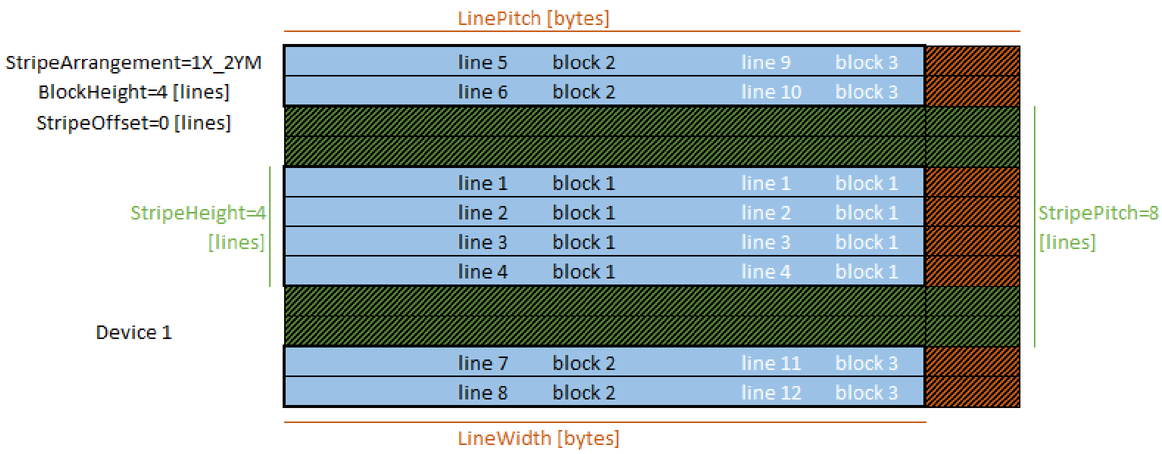
1X_2YM camera delivering lines by blocks of 2

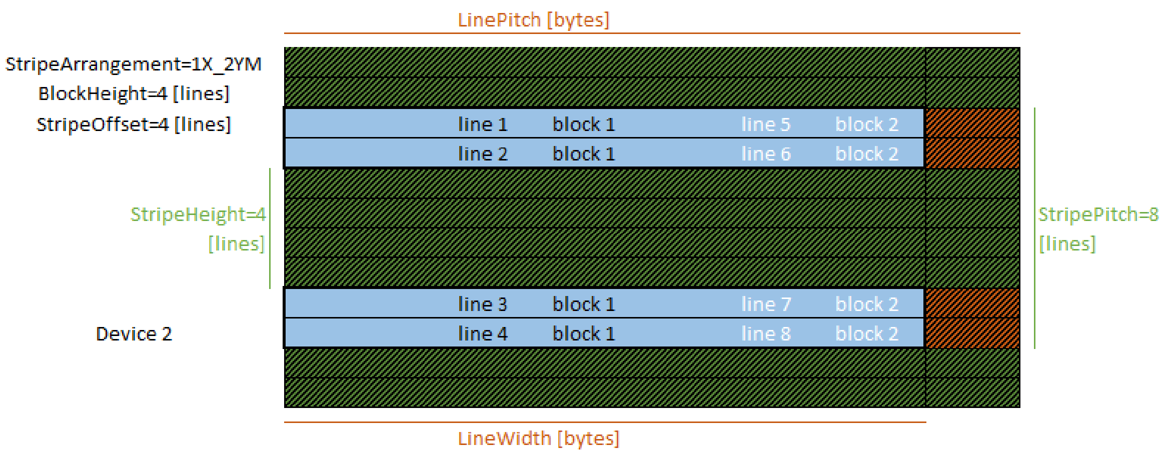


1X_2YM camera delivering lines by blocks of 4



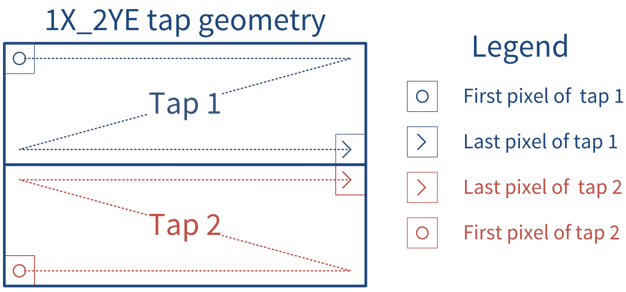
1X_2YM camera delivering lines by blocks of 4 to two hosts





8.7. Transmission Methods of 1X_2YE Images (Coaxlink series)

Geometry of 1X_2YE image sensors



An 1X_2YE image sensor has two taps:

- Tap 1 delivers the pixel data of the upper half of the image. It starts with the leftmost pixel of the top line and ends with the rightmost pixel of the bottom line of the upper half.
- Tap 2 delivers the pixel data of the lower half image lines. It starts with the leftmost pixel of the bottom line and ends with the rightmost pixel of the top line of the lower half.

Two methods are used by CoaXPress cameras to transmit images captured with 1X_2YE image sensors:

- "Method 1 - Transmission using a single CoaXPress data stream" on page 213
- "Method 2 - Transmission using a dedicated CoaXPress data stream for each tap" on page 214.

Method 1 - Transmission using a single CoaXPress data stream

NOTE

- This is NOT the method defined by the CoaXPress standard. However it is the most popular!
- The DMA engine of all area-scan firmware variants of all **Coaxlink frame grabbers** is capable to reorganize the lines and deliver an unscrambled image into the buffer.

The camera transmits the image data through a single CoaXPress data stream composed as follows:

Line 1 > Line H > Line 2 > Line H-1 > ... > Line H/2-1 > Line H/2 + 2 > Line H/2 > Line H/2 + 1

To deliver an unscrambled image into the buffer, configure the data stream as follows:

1. Keep default DeviceTapGeometry settings:

- DeviceTapGeometry=Geometry_1X_1Y

2. Configure the DMA engine (as described in "Unscrambling 1X_2YE images" on page 209):

- StripeArrangement=Geometry_1X_2YE
- LineWidth=<WIDTH>
- LinePitch=<PITCH> (only required when it is not equal to <WIDTH>)

Method 2 - Transmission using a dedicated CoaXPress data stream for each tap

Applies to the following firmware variants of [1]

Quad12 Quad12-4 (1-camera)

Value12 (1-camera)

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

QSFP+ (1-camera)

NOTE

- This is the method defined by the CoaXPress standard.
- Since this method requires more FPGA resources it is only supported by above-listed firmware variants.

The camera transmits the image data through two CoaXPress data streams:

Stream 1: Line 1 > Line 2 > ... > Line H/2 - 1 > Line H/2

Stream 2: Line H > Line H - 1 > ... > Line H/2 + 2 > Line H/2 + 1

To deliver an unscrambled image into the buffer, configure the data stream as follows:

1. Merge the 2 streams (as described in "Multi-tap CoaXPress Cameras" on page 101):

- DeviceTapGeometry=Geometry_1X_2YE
- Image1StreamID=··· (depends on the camera, typically 0)
- Image2StreamID=··· (depends on the camera, typically 1)

2. Configure the DMA engine (as described in "Unscrambling 1X_2YE images" on page 209):

- StripeArrangement=Geometry_1X_2YE
- LineWidth=<WIDTH>
- LinePitch=<PITCH> (only required when it is not equal to <WIDTH>)

NOTE

If an EGrabber object is created from EGRabberDicovery::cameras, and, if a "1X_2YE (Method 2)" camera is detected, eGrabber automatically configures the data streams as described earlier. For instance, this the case when, in **eGrabber Studio**, the user creates a grabber using the Cameras view.

In any other case, the configuration must be performed by the user.

See also: Discovering grabbers and cameras

[1] 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+.

8.8. 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.

8.9. 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 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

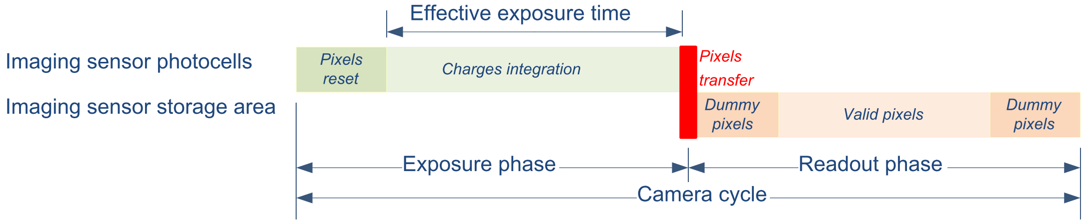
For a better measurement accuracy, use the gentl dtr -n option to execute multiple measurements repeatedly. The DTR program will average the results.

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).

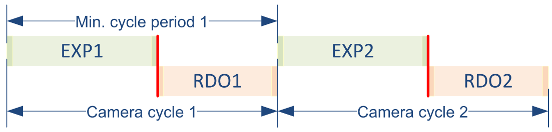
Some sensors provide the capability to select one or more region of interest (ROI) speeding up the readout since less data needs to be transferred.

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.



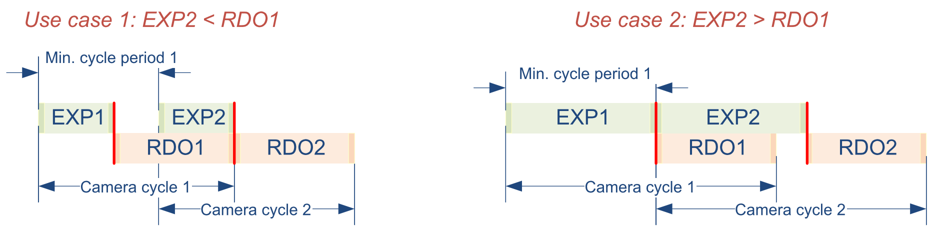
Shortest possible cycle period achievable by cameras NOT allowing the cycle overlapping

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

> 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

$$\textit{Min. cycle period}_n = EXP_n + RDO_n - EXP_{n+1}$$

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:

$$\textit{Min. cycle period}_n = EXP_n$$

> 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 **Coaxlink frame grabbers***

Coaxlink frame grabbers provide four camera control methods named NC, RC, RG and EXTERNAL.

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.

WARNING

The Camera and Illumination Controller (CIC) is not used!

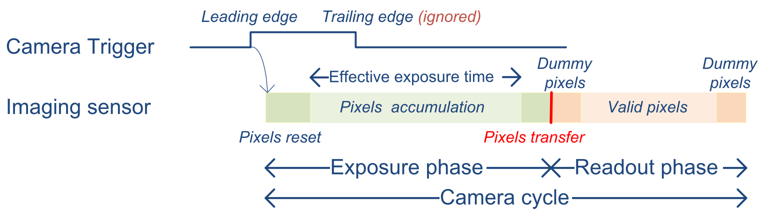
- There is no Camera Trigger signal produced by the CIC. The frame grabber do NOT control the camera cycles.
- There is no Strobe signal produced by the CIC. The frame grabber do NOT control the illumination.

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

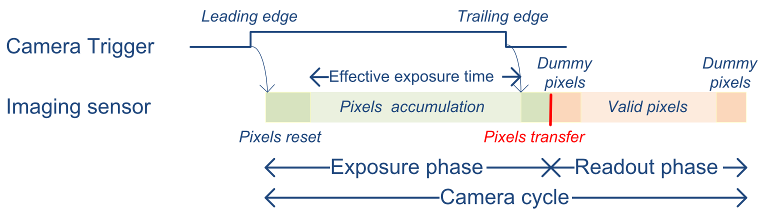
The CIC produces one single Camera Trigger pulse every camera cycle. The Camera Trigger leading edge triggers a new camera cycle and initiates a new exposure period. The Camera Trigger trailing edge is ignored by the camera.

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.

EXTERNAL camera control method

The EXTERNAL camera control method targets 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: "Host to Device Trigger Source" on page 77 to select a GPIO input port as trigger source.

NOTE
There is a CameraTrigger signal that is generated upon external trigger signal. On Coaxlink, the CameraTrigger signal is used to initiate a data packet (unlike Grablink Duo), even though the signal timing is not directly controlled by the CIC.

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!

9.2. Illumination Control Principles

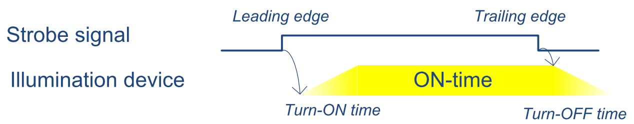
Illumination Devices

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.



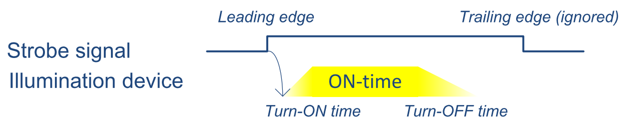
Timing diagram for intermittent illumination devices

The width of the strobe pulse determines the ON time duration of the light source

NOTE: The turn-on time and the turn-off time need to be considered when configuring the illumination controller!

Strobed illumination devices

This illumination device class includes switched light sources where only the turn-on time is controlled by the leading edge of the strobe signal.



Timing diagram for strobed illumination devices

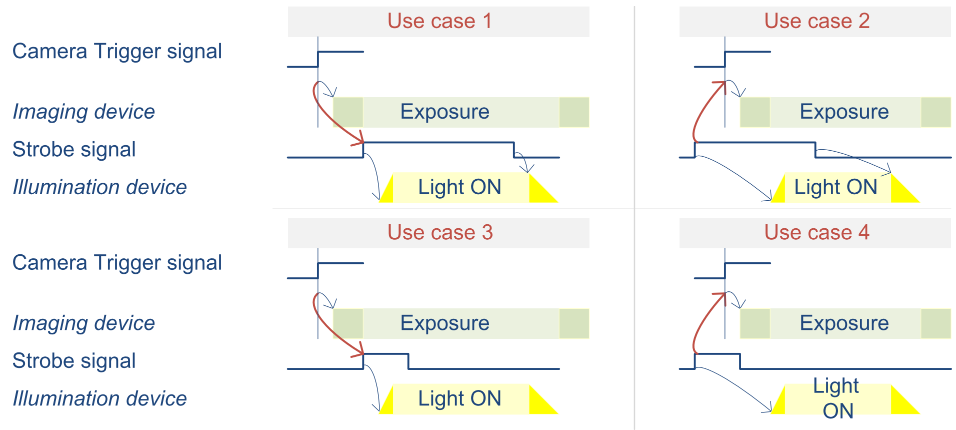
The on-time duration is either uncontrolled or controlled by the illumination device itself.

NOTE: The turn-on time and the ON time duration need to be considered when configuring the illumination controller.

Aligning Camera and Illumination Cycles

Obviously, the ON time of the light source must coincide with the exposure phase of the imaging sensor.

Therefore, the time relationship between the Strobe signal(s) and the Camera Trigger signal must be adequately controlled.



4 typical use cases of Camera Trigger vs. Strobe alignment

Intermittent light sources (Use cases 1 & 2)

The duration of the Strobe pulse must be adequately controlled in order to provide the right amount of light and get a correctly exposed image.

The sensor exposure should be adequately timed in order to terminate the sensor exposure after the light has turned off.

Strobed light sources (Use cases 3 & 4)

The sensor exposure should be adequately timed in order to terminate the sensor exposure after the light has turned off.

Late strobe (Use cases 1 & 3)

The leading edge (beginning) of the Strobe signal is delayed a little to ensure that the light is not turned on too early while the imaging device is resetting its pixels.

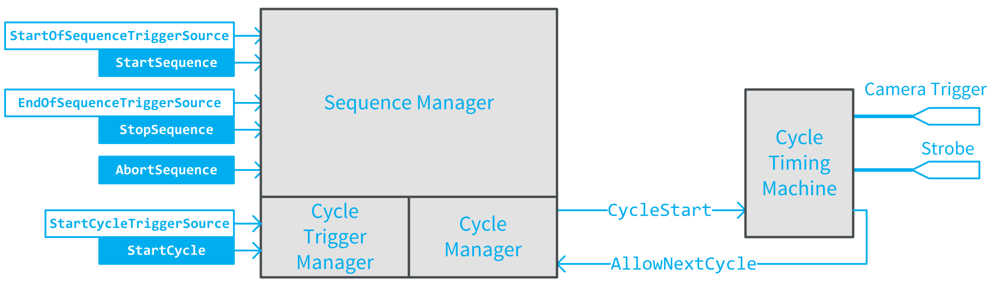
Early strobe (Use cases 2 & 4)

The leading edge of the Camera Trigger signal is delayed a little to ensure that the sensor exposure time is kept as short as possible and closely matches the on time.

9.3. Camera and Illumination Controller

Camera and Illumination Controller Overview

The Camera and Illumination Controller (abbreviated as CIC) controls one camera and its associated illumination.



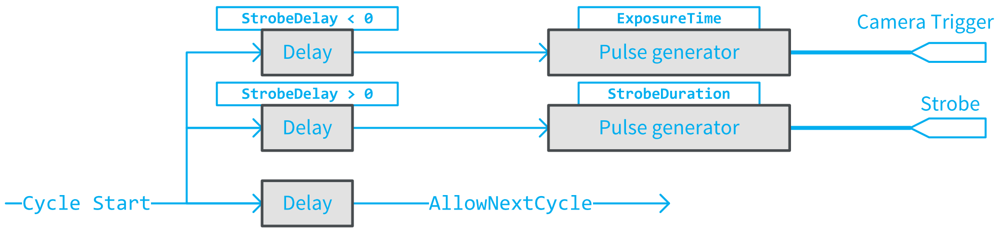
Camera and Illumination Controller block diagram

The CIC is composed of 4 main interconnected blocks:

- The Cycle Timing Machine is responsible for the generation of accurately timed events and signals structuring one camera and illumination controller cycle (CIC Cycle), namely: Camera Trigger and Strobe.
- The Cycle Manager is responsible for the generation of the CycleStart event. It prevents initiating a new cycle while the *start cycle conditions* are not all satisfied and while the cycle timing machine does not allow a new cycle to begin.
- The Cycle Trigger Manager is responsible, in collaboration with the *Cycle Manager* and the *Sequence Manager*, to elaborate the effective CycleStart event that initiates one cycle of the *Cycle Timing Machine*.
- The Sequence Manager manages sequences of CIC cycles according to user-defined start sequence and stop sequence conditions.

The camera is controlled with the Camera Trigger signal and the illumination device is controlled with the Strobe signal. Several routing options are available.

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 240 for more explanations and timing diagrams

Cycle-to-cycle timing

The AllowNextCycle event is used by the Cycle Manager to determine when the next Cycle may start.

The position of the AllowNextCycle event is not directly set by the user. Instead, it is evaluated by the driver according to the following user settings:

- The ExposureReadoutOverlap feature of the Camera Model category defines if the camera supports or not the exposure/readout overlapping. If overlapping is allowed, the AllowNextCycle event is issued earlier and faster cycle rates are obtained.
- The ExposureRecoveryTime feature of the Camera Model category defines the minimum time gap required by the camera between two exposures. This feature is relevant when ExposureReadoutOverlap = TRUE and the duration of the exposure phase becomes larger than the duration of the readout phase.
- The CycleMinimumPeriod of the Cycle Control category defines the minimum cycle period. This value may not be smaller than the time required by the camera to perform the image readout!

NOTE
Some cameras have a data store in the image data path. This enables capturing bursts of images at a higher cycle-to-cycle rate than the camera-to-frame grabber data link can sustain. In that case, CycleMinimumPeriod declares the smallest cycle-to-cycle time that the image sensor can achieve!

See also: "Overlapping Cycles - Single timing" on page 242 for more explanations and timing diagrams.

Multiple Cycle Timings

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (1-camera)

Octo (1-camera), (1-camera, custom-logic), (2-camera), (3-camera), (4-camera), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)

Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (2-camera), (2-camera, custom-logic), (4-camera), (4-camera, custom-logic)

Quad12J Quad12J-4 (4-camera)

Value12 (1-camera), (2-camera), (4-camera)

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

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

In the Cycle Timing Category of the Device Module, the CycleTimingSelector parameter acts as a selector for ExposureTime, StrobeDelay and StrobeDuration.

The CIC of above listed firmware variants allows to define up to 16 different timing sets!

By default, CycleTimingSelector = 1.

To activate the *multiple cycle timings* feature, set the CycleTimingCount parameter to any value between 2 and 16 according to the number of cycle timings to be executed.

The CIC uses successively and repeatedly the different timing definitions starting with index 0 up to the value of CycleTimingCount -1.

See also: "Multiple Timings Example" on page 247 for more explanations and timing diagrams.

[1] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 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+.

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.

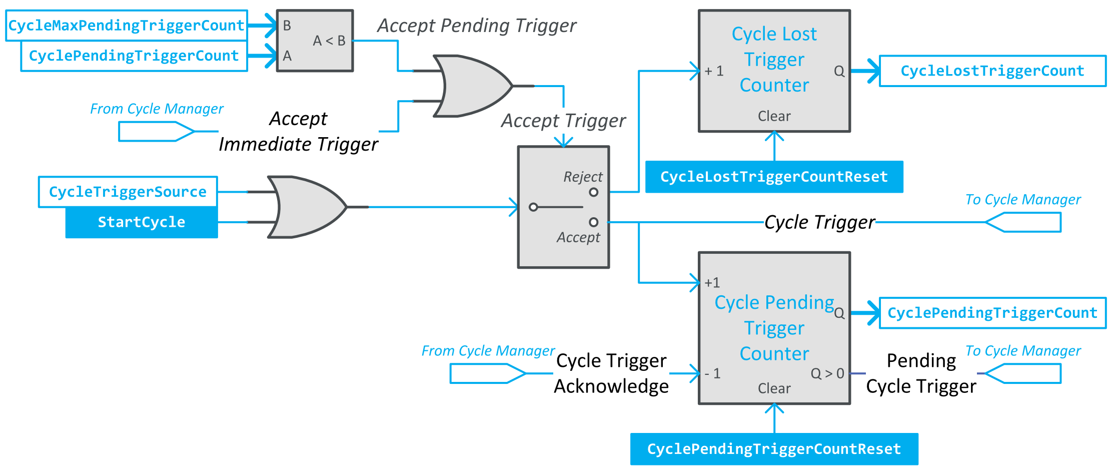
This condition applies only when Cycle TriggerSource ≠ Immediate AND CycleMaxPendingTriggerCount = 0.

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 default SequenceLength value is 1; any value up to 16,777,215 is allowed. The sequence can be stopped anticipatively on execution of the StopSequence command.

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

See also: "CoaXPress Host To Device Trigger" on page 77 for detailed information about the Host to Device Trigger transmitter (Coaxlink series only).

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.

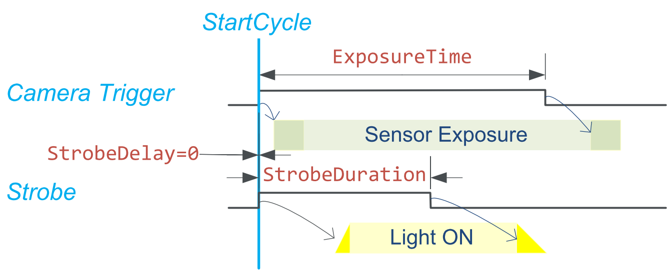
9.4. CIC Timing Diagrams

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.

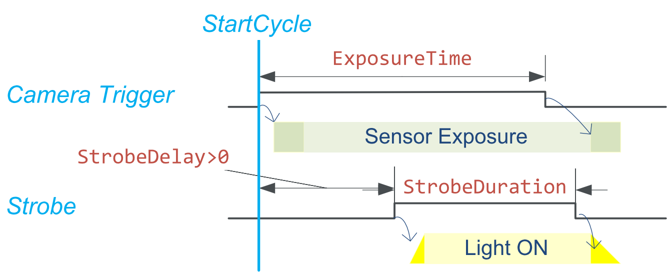
In-phase Strobe



In-phase Strobe signal

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

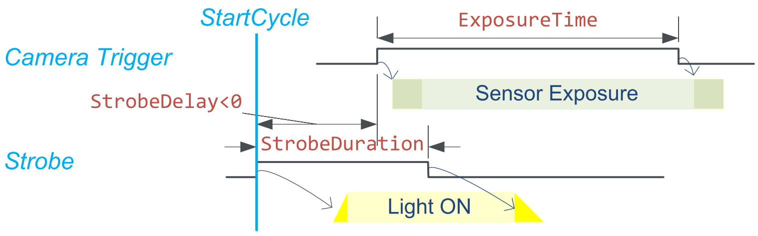
Late Strobe



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.

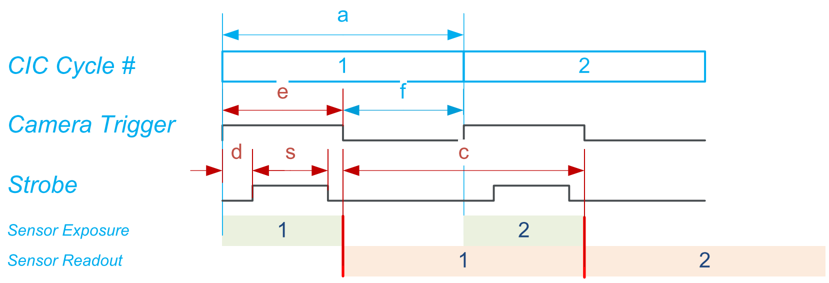
The driver calculates the duration of the CIC Cycle (a value)from the user-defined settings ExposureTime, ExposureRecoveryTime and CycleMinimumPeriod by searching the smallest value satisfying the following conditions:

- *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

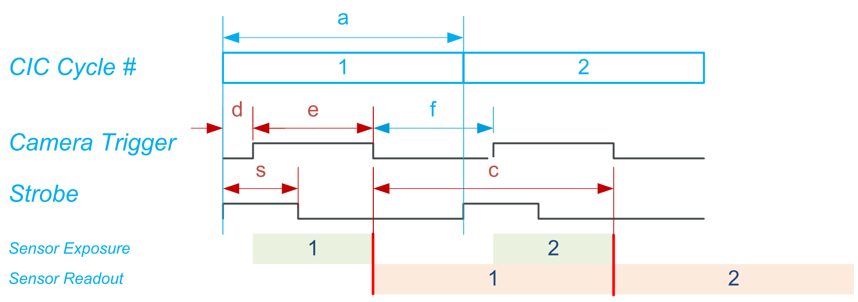
This situation occurs when the exposure time (e value) is significantly smaller than the readout duration (c value). In that situation:

- 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.

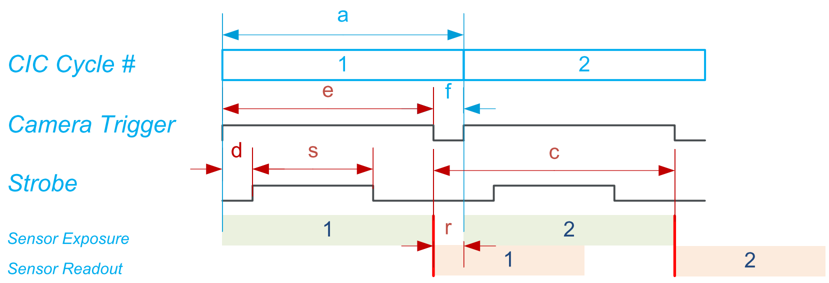
This situation occurs when the exposure time (e value) is significantly smaller than the readout duration (c value). In that situation:

- 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



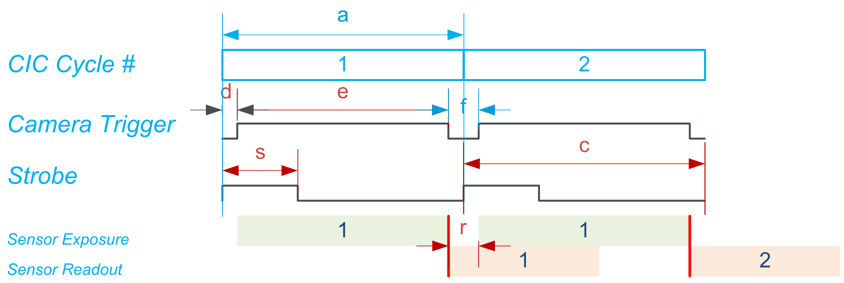
The camera cycle rate is limited by the exposure time settings

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.

Multiple Timings Example

Applies to the following firmware variants of [1]

QuadG3 QuadG3LH (1-camera)

Octo (1-camera), (1-camera, custom-logic), (2-camera), (3-camera), (4-camera), (5-camera), (5-camera, 5D22211), (6-camera), (8-camera)

Quad12 Quad12-4 (1-camera), (1-camera, custom-logic), (2-camera), (2-camera, custom-logic), (4-camera), (4-camera, custom-logic)

Quad12J Quad12J-4 (4-camera)

Value12 (1-camera), (2-camera), (4-camera)

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

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

This topic describes the behavior of the CIC when it is configured to generate one sequence of 4 cycles, each with different timings settings.

Camera model parameters

- CameraControlMethod=RG;
- ExposeReadoutOverlap=TRUE;
- ExposureRecoveryTime set to *r time interval in the drawing*
- CycleMinimumPeriod *set to c time interval in the drawing*

Cycle timing parameters

CycleTimingCount=4

CycleTimingSelector	0	1	2	3
ExposureTime	e1	e2	e3	e4
StrobeDelay	0	0	0	0
StrobeDuration	e1	e2	e3	e4

NOTE

1. In this example, the Strobe signal is identical to the Camera Trigger signal
2. Exposure times (e1, e2, e3, e4) are all different, starting with the smallest and ending with the largest.

[1] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 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+.

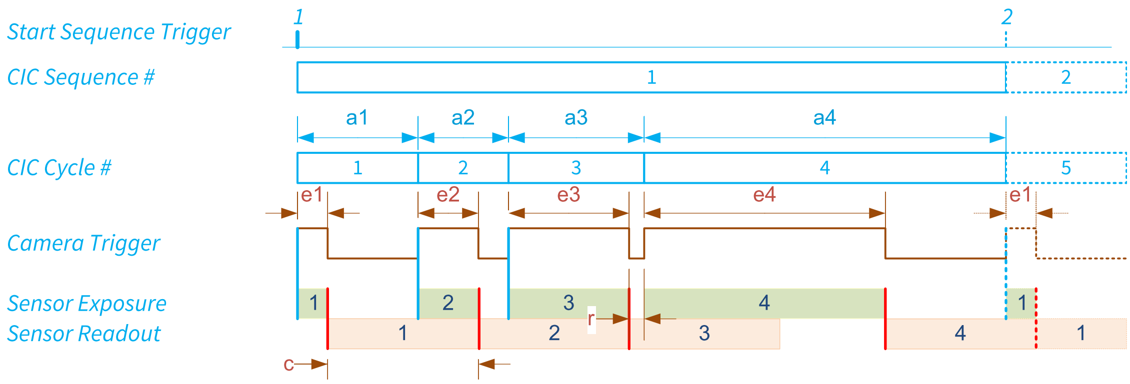
Cycle control parameters

- CycleTriggerSource=Immediate;

Sequence Control parameters

- StartOfSequenceTriggerSource≠Immediate;
- EndOfSequenceTriggerSource=SequenceLength;
- SequenceLength=4;

Description



Optimal sequence of 4 cycles with different timing settings

The sequence starts with the Start Sequence Trigger event *(#1 in the drawing)*and stops automatically after 4 cycles.

The next sequence may only start after the completion of the first sequence.

The four cycles of the sequence are overlapped with the minimum time interval between cycles according to "Camera Cycle Concatenation Rules" on page 222.

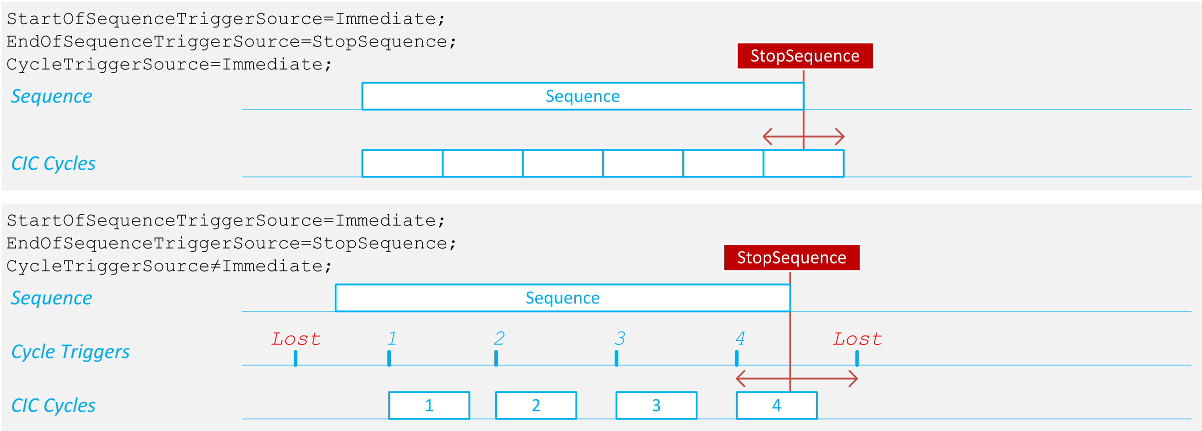
The first three cycles are "Readout Limited"; the fourth cycle is "Exposure Limited".

After having executed 4 cycles, the CIC controller falls back to the first timing definition.

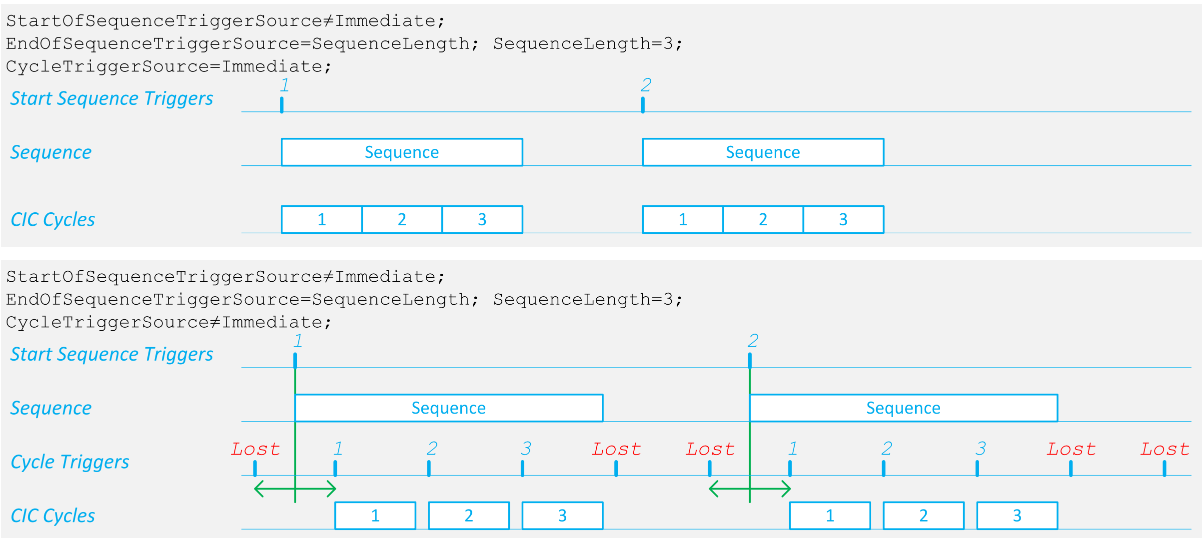
The sequence terminates slightly (*e1 time*) before the end of the fourth readout allowing the next sequence to begin with the optimal timing.

Cycle Sequence Timing Diagrams

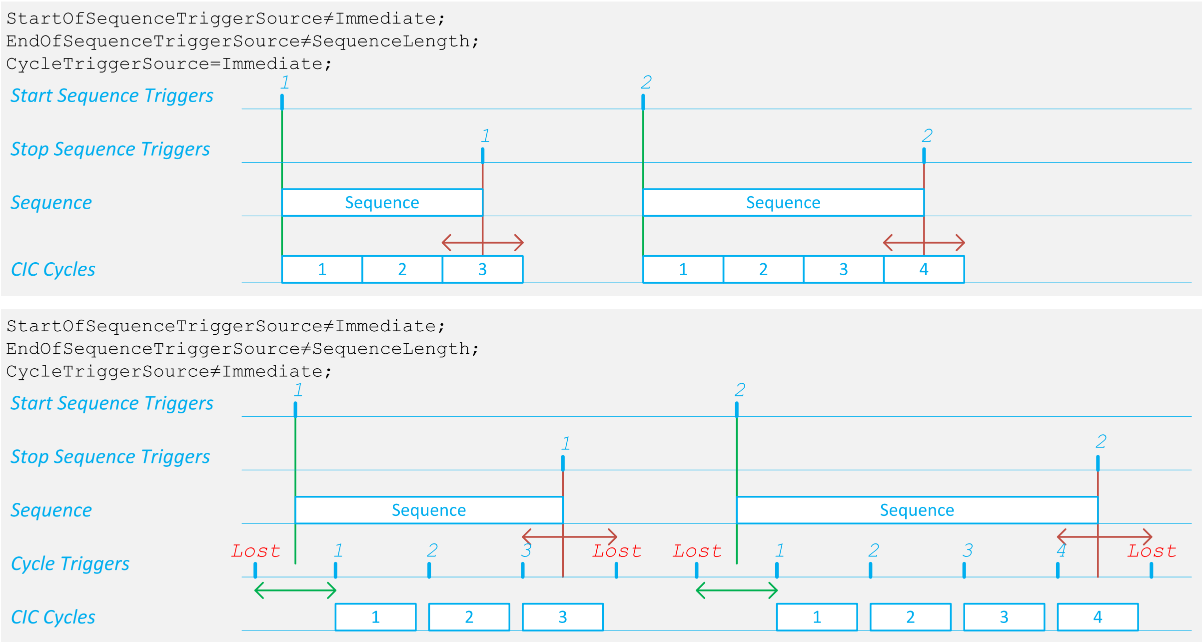
Timing diagrams of sequences of CIC cycles



Cycle sequences with immediate start



Cycle sequences with triggered start and fixed length



Cycle sequences with triggered start and triggered end

10. General Purpose I/O

10.1. I/O Lines Overview

*General Purpose I/O lines overview in **Coaxlink and Grablink Duo frame grabbers***

GPIO lines in GenApi

The LineSelector feature of the **Coaxlink and Grablink Duo frame grabbers** Interface Modules exposes:

- 2 Standard I/O sets of **10** I/O lines named DIN**, IIN**, IOUT** and TTLIO**
- 1 Module I/O set of **40** I/O lines named MIO**

Standard I/O set

Each *Standard I/O Set* is composed of 10 I/O lines:

I/O Line Type	I/O Line Names	Count
Isolated input	IINx1, IINx2, IINx3, IINx4	4
Isolated output	IOUTx1, IOUTx2	2
RS-422 input	DINx1, DINx2	2
TTL I/O	TTLIOx1, TTLIOx2	2
Total		**10**

NOTE: x is the instance number: 1 for the first instance; 2 for the second instance.

Module I/O set

I/O Line Type	I/O Line Names	Count
See note (1)	MIO1 ... MIO40	40

NOTE
(1) The mix of I/O line types is defined by the attached extension.

GPIO lines per product

The number of effectively available GPIO lines is defined by the frame grabber configuration:

- A frame grabber includes 0, 1 or 2 "Standard I/O set" on page 252.
- A selection of frame grabbers with less than 2 "Standard I/O set" on page 252 accepts one extension module with an additional Standard I/O set.
- Frame grabbers with an I/O extension connector may accept one I/O Extension module.

The following table summarizes the capabilities:

Product	Standard I/O sets		Module I/O set
	#1	#2	
1628 Grablink Duo	On-board	On-board	*See note (3)*
1629 Coaxlink Duo PCIe/104-EMB	*See note (1)*	N/A	N/A
1630 Coaxlink Mono	On-board	N/A	N/A
1631 Coaxlink Duo	On-board	On-board	N/A
1632 Coaxlink Quad	On-board	On-board	N/A
1633 Coaxlink Quad G3	On-board	On-board	N/A
1633-LH Coaxlink Quad G3 LH	On-board	On-board	N/A
1635 Coaxlink Quad G3 DF	On-board	N/A	N/A
1637 Coaxlink Quad 3D-LLE	On-board	On-board	N/A
3602 Coaxlink Octo	On-board	*See note (2)*	*See note (3)*
3603 Coaxlink Quad CXP-12	On-board	On-board	*See note (3)*
3603-4 Coaxlink Quad CXP-12	On-board	On-board	*See note (3)*
3620 Coaxlink Quad CXP-12 JPEG	On-board	On-board	*See note (3)*
3620-4 Coaxlink Quad CXP-12 JPEG	On-board	On-board	*See note (3)*
3621 Coaxlink Mono CXP-12	On-board	*See note (2)*	*See note (3)*
3621-LH Coaxlink Mono CXP-12 LH	On-board	*See note (2)*	*See note (3)*
3622 Coaxlink Duo CXP-12	On-board	*See note (2)*	*See note (3)*
3622-LH Coaxlink Duo CXP-12 LH	On-board	*See note (2)*	*See note (3)*
3623 Coaxlink Quad CXP-12 Value	On-board	On-board	*See note (3)*
3624 Coaxlink Quad CXP-12 DF	On-board	*See note (2)*	*See note (3)*
3625 Coaxlink QSFP+	On-board	On-board	*See note (3)*

1. (1) Attach a **3300 HD26F I/O module for Coaxlink Duo PCIe/104** to the Extension Connector to obtain the first "Standard I/O set" on page 252 instance.

See also: "Coaxlink Duo PCIe/104 accessories" on page 566 in the hardware manual for more information.

2. (2) Attach one of the following I/O extension modules to the I/O extension connector:
   - **3614 HD26F I/O Extension Module - Standard I/O Set** to obtain the second "Standard I/O set" on page 252 instance.
   - **3618 HD26F I/O Extension Module - Fast I/O**) to obtain the second "Standard I/O set" on page 252 instance with faster IIN** isolated input lines.

See also: "3618 HD26F I/O Extension Module - Fast I/O" on page 552 in the hardware manual for more information.

3. (3) Attach one of the following I/O extension modules to the I/O extension connector:
   - **3610 HD26F I/O Extension Module - TTL-RS422** to obtain up to a configurable mix of TTL and RS422 I/O lines: the "3610/3612 Module I/O set" on page 254.
   - **3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422** to obtain up to a configurable mix of TTL/CMOS5V and RS422 I/O lines: the "3610/3612 Module I/O set" on page 254.

See also: "3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422" on page 541 in the hardware manual for more information.

WARNING
Only one module can be attached to the I/O extension connector!

GPIO lines electrical style

See also: "I/O Interfaces" on page 484 in the hardware manual for more information about the electrical styles

3610/3612 Module I/O set

Compatible with [1]

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

3610 HD26F I/O Extension Module - TTL-RS422 and **3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422** provide the "3610/3612 Module" I/O set:

I/O Line Type	I/O Line Names	Count
RS-422 input	MIO1, MIO3...MIO19	0 to 10
RS-422 output	MIO1, MIO3...MIO19	0 to 10
TTL input	MIO1, MIO2...MIO20	0 to 20
TTL output (3610) CMOS output (3612)	MIO1, MIO2...MIO20	0 to 20
Total		**10 RS-422 | 0 TTL/CMOS** **...** **0 RS-422 | 20 TTL/CMOS**

[1] 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

10.2. I/O Lines Usage

Input lines

The input-capable I/O lines (DIN, TTLIO, IN, MIO) can be used as:

- General purpose input: An input signal whose state can be read or monitored by the host application.
- Motion encoder input: A pair of input signals delivered by a quadrature motion encoder and used for triggering the acquisition from the camera.
- Trigger input: An input signal used to trigger the acquisition from the camera.

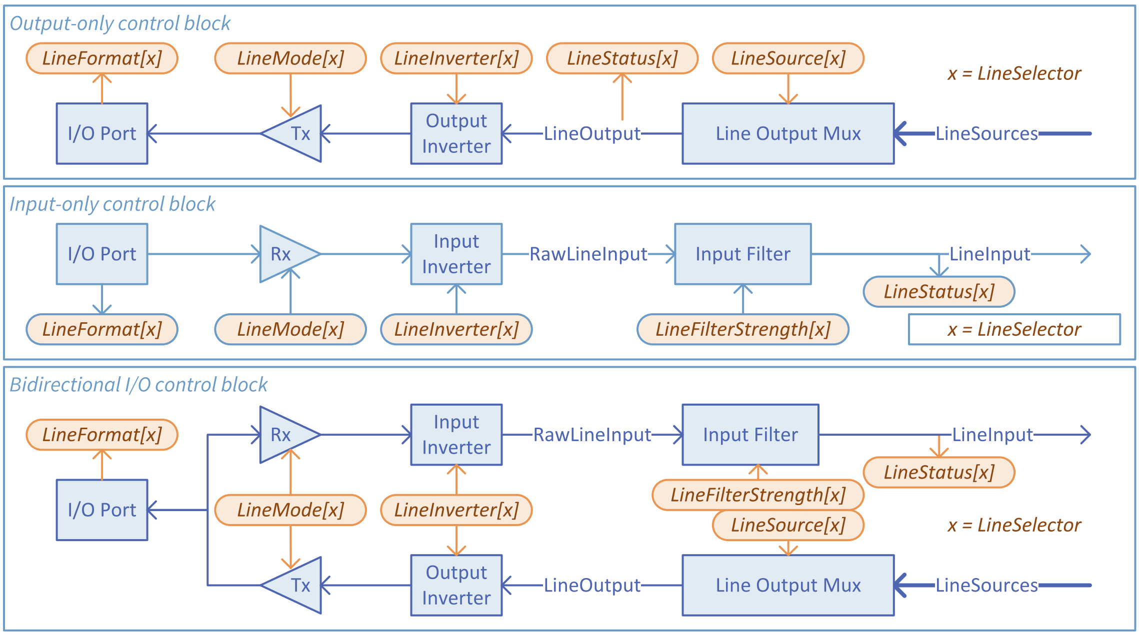
Output lines

The output-capable I/O lines (TTLIO, 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 541 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

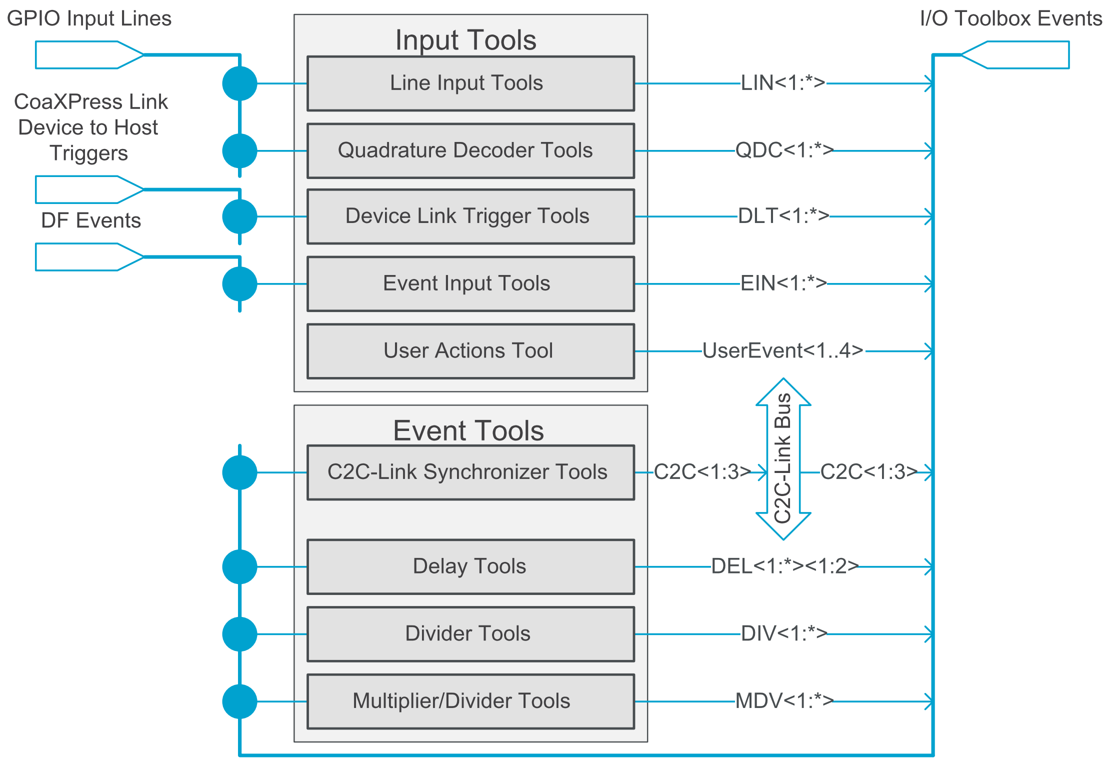
11.1. Introducing the I/O Toolbox

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 278 for use with sensors and detectors attached to a single GPIO input line.
2. The "Quadrature Decoder Tool" on page 279 for use with quadrature motion encoders attached to a pair of GPIO input lines.
3. The "Device Link Trigger Tool" on page 283 for use with triggers issued by CoaXPress 2.0 cameras.
4. The "Event Input Tool" on page 285 for use in line-scan data-forwarding applications.
5. The "User Actions Tool" on page 286for 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 291 delivers one event stream to the C2C-Link Bus driver.
2. The "Delay Tool" on page 293 delays the events of one (or two) stream(s) by a configurable number of clock tick events.
3. The "Divider Tool" on page 295 divides the event rate by an integer factor D.
4. The "Multiplier/Divider Tool" on page 296 converts the event rate by a rational factor M/D.

A fully populated interconnection matrix allows any *Event Tool* to be fed by any I/O Toolbox event stream

I/O Toolbox tools cascading

Tools can be cascaded to form a tool chain:

- A tool chain always begins with an Input Tool.
- A tool may drive 0, 1 or several Event Tools.

11.2. I/O Toolbox Composition Tables

Introduction

Each of the following tables show the composition of the I/O toolbox for all variants of the designated product.

Column Name	Description
Input Tools	I/O Toolbox input tools: - #*LIN*: Number of line input tools - #*QDC*: Number of quadrature decoder tools - #*DLT*: Number of device link trigger tools - #*EIN*: Number of event input tools - #*UAS*: Number of user actions scheduler tools
Event Tools	I/O Toolbox event tools: - #*DEL*: Number of delay tools - #*DIV*: Number of divider tools - #*MDV*: Number of multiplier/divider tools - #*C2C*: Number of C2C-Link synchronization tools

NOTE
An empty cell indicates that the corresponding tool type is not available.

1628 Grablink Duo

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, line-scan	8	2			1	2	2	2	3

1629 Coaxlink Duo PCIe/104-EMB

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2

1630 Coaxlink Mono

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2

1631 Coaxlink Duo

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, line-scan	8	2			1	2	2	2	3

1632 Coaxlink Quad

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2

1633 Coaxlink Quad G3

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, 4-data-stream	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
1-slm-camera	8	1			1	2	1	1	2
1-sls-camera	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, bayer	8	1			1				
2-camera, line-scan	8	2			1	2	2	2	3
3-camera	8	2			1	2	2	2	2
4-camera	8	4			1	4	4	4	2
4-camera, line-scan	8	4			1	4	4	4	3

1633-LH Coaxlink Quad G3 LH

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-camera, 4-data-stream	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
1-slm-camera	8	1			1	2	1	1	2
1-sls-camera	8	1			1	2	1	1	3
2-camera	8	2			1	2	2	2	2
2-camera, bayer	8	1			1				
2-camera, line-scan	8	2			1	2	2	2	3
3-camera	8	2			1	2	2	2	2
4-camera	8	4			1	4	4	4	2
4-camera, line-scan	8	4			1	4	4	4	3

1635 Coaxlink Quad G3 DF

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2
1-df-camera	8	1			1	2	1	1	2
1-camera, line-scan	8	1			1	2	1	1	3
1-df-camera, line-scan	8	1		2	1	2	1	1	3

1637 Coaxlink Quad 3D-LLE

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1			1	2	1	1	2

3602 Coaxlink Octo

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	1	4		1	2	1	1	2
2-camera, line-scan	8	2	4		2	2	1	1	3
2-camera, line-scan, custom-logic	8	2	4		1	2	2	2	3
3-camera	8	1	6		1	2	1	1	2
4-camera	8	1	8		1	2	1	1	2
4-camera, line-scan	8	1	8		1	2	1	1	3
5-camera	8	1	10		1	2	1	1	2
5-camera, 5D22211	8	1	10		1	2	1	1	2
6-camera	8	1	12		1	2	1	1	2
8-camera	8	1	16		1	2	1	1	2

3603 Coaxlink Quad CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
1-camera, line-scan, custom-logic	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, custom-logic	8	1	4		1	2	1	1	2
2-camera, line-scan	8	2	4		1	2	2	2	3
2-camera, line-scan, custom-logic	8	2	4		1	2	2	2	3
4-camera	8	4	8		1	4	4	4	2
4-camera, custom-logic	8	4	8		1	4	4	4	2
4-camera, line-scan	8	4	8		1	4	4	4	3
4-camera, line-scan, custom-logic	8	4	8		1	4	4	4	3

3603-4 Coaxlink Quad CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
1-camera, line-scan, custom-logic	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, custom-logic	8	1	4		1	2	1	1	2
2-camera, line-scan	8	2	4		1	2	2	2	3
2-camera, line-scan, custom-logic	8	2	4		1	2	2	2	3
4-camera	8	4	8		1	4	4	4	2
4-camera, custom-logic	8	4	8		1	4	4	4	2
4-camera, line-scan	8	4	8		1	4	4	4	3
4-camera, line-scan, custom-logic	8	4	8		1	4	4	4	3

3620 Coaxlink Quad CXP-12 JPEG

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
4-camera	8	4	8		1	4	4	4	2

3620-4 Coaxlink Quad CXP-12 JPEG

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
4-camera	8	4	8		1	4	4	4	2

3621 Coaxlink Mono CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3

3621-LH Coaxlink Mono CXP-12 LH

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3

3622 Coaxlink Duo CXP-12

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, line-scan	8	2	4		1	2	2	2	3

3622-LH Coaxlink Duo CXP-12 LH

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, line-scan	8	2	4		1	2	2	2	3

3623 Coaxlink Quad CXP-12 Value

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3
2-camera	8	2	4		1	2	2	2	2
2-camera, line-scan	8	2	4		1	2	2	2	3
4-camera	8	4	8		1	4	4	4	2
4-camera, line-scan	8	4	8		1	4	4	4	3

3624 Coaxlink Quad CXP-12 DF

Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	3
1-df-camera	8	1	2		1	2	1	1	3
1-camera, line-scan	8	1	2		1	2	1	1	3
1-df-camera, line-scan	8	1	2	2	1	2	1	1	3

3625 Coaxlink QSFP+

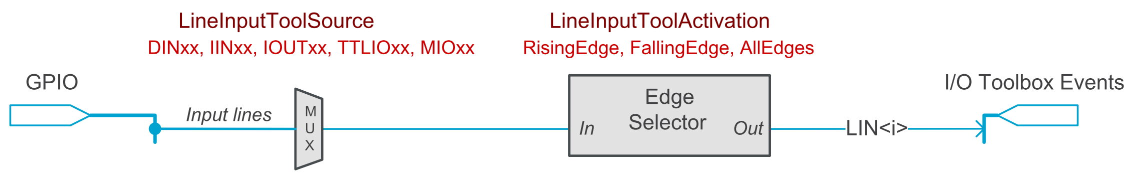
Firmware Variant	Input tools					Event tools			
	#LIN	#QDC	#DLT	#EIN	#UAS	#DEL	#DIV	#MDV	#C2C
1-camera	8	1	2		1	2	1	1	2
1-camera, custom-logic	8	1	2		1	2	1	1	2
1-camera, line-scan	8	1	2		1	2	1	1	3

11.3. Line Input Tool

Applies to all firmware variants of **Coaxlink and Grablink Duo frame grabbers**

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Line Input Tool	LIN	1 GPIO input line	1 event stream: LIN<i>

Diagram



LIN tool functional and wiring diagram

Any input-capable GPIO line can be selected as the input source.

The tool feeds one I/O Toolbox event stream named LIN<i>.

Operation

The Line Input tool detects the rising or the falling edge of the LineInput signal delivered by the I/O Control block selected by LineInputToolSource.

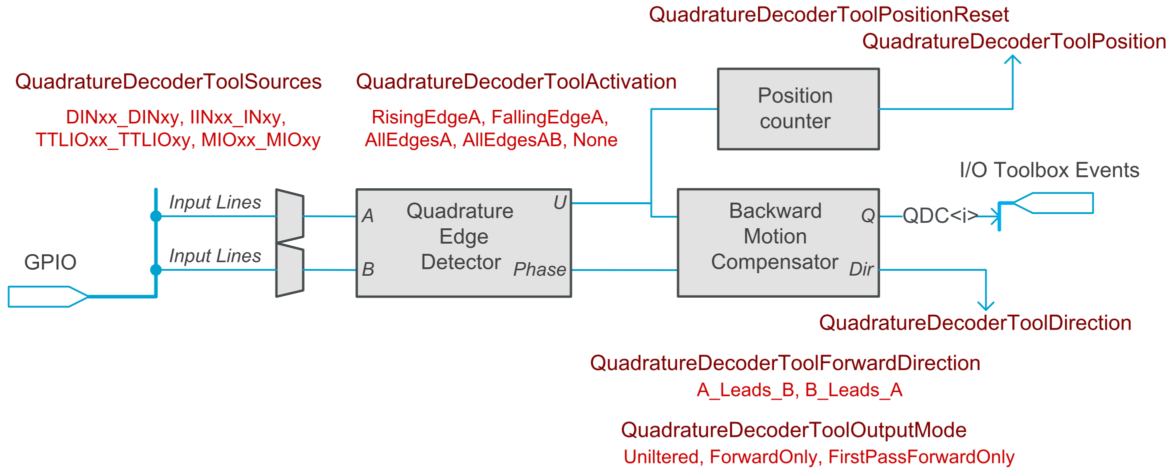
The Line Input tool delivers one event at every rising or falling edge or both according to the LineInputToolActivation settings.

11.4. Quadrature Decoder Tool

Applies to all firmware variants of **Coaxlink and Grablink Duo frame grabbers**

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Quadrature Decoder Tool	QDC	2 paired I/O input lines	1 event stream: QDC<i> 1 status bit: QDC<i>Direction 1 status word: QDC<i>Position

Diagram



QDC tool functional and wiring diagram

The quadrature edge detector is fed by a pair of signals named A and B delivered by a *phase-quadrature motion encoder* device.

The source selectors allows selected pairs of adjacent input-capable GPIO input lines to be selected as A/B input sources.

See also: "QuadratureDecoderToolSources" on page 817

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.

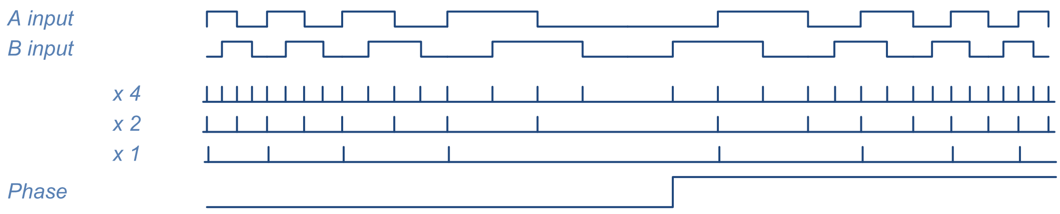
Operation

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

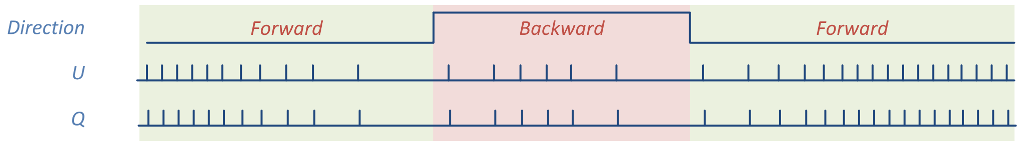
The U stream may be filtered by the backward motion compensator before being delivered to the QDC<i> output.

The phase indication may be inverted according to the QuadratureDecoderToolForwardDirection settings before being delivered to the *Direction* output.

Backward motion compensator

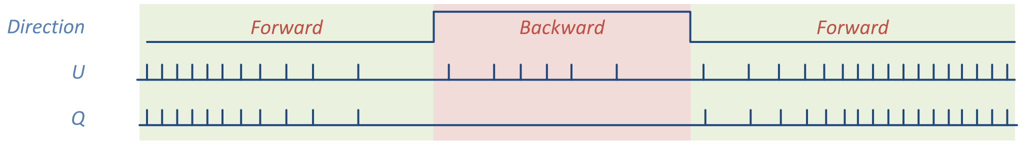
The *backward motion compensator* (BMC) filters the U stream according to the QuadratureDecoderToolOutputMode setting.

When set to Unfiltered, all the events of the U stream are delivered to the QDC<i> output:



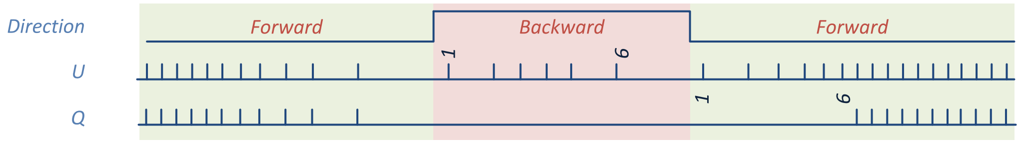
BMC waveforms - Unfiltered

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



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. Device Link Trigger Tool

Applies to the following firmware variants of [1]

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)

Quad12J Quad12J-4 (4-camera)

Mono12 Mono12LH (1-camera), (1-camera, line-scan)

Duo12 Duo12LH (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan)

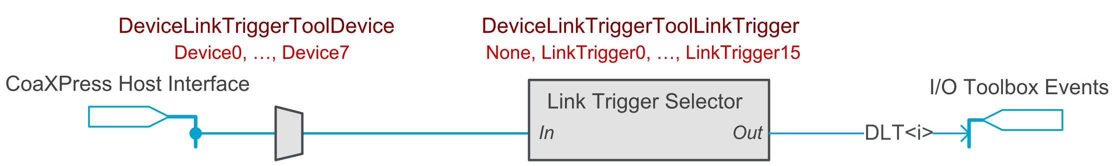
Value12 (1-camera), (1-camera, line-scan), (2-camera), (2-camera, line-scan), (4-camera), (4-camera, line-scan)

Quad12DF (1-camera), (1-df-camera), (1-camera, line-scan), (1-df-camera, line-scan)

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

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Device Link Trigger Tool	DLT	1 Event	1 event stream: DLT<i>

Diagram



DLT tool functional and wiring diagram

Any remote device attached to the CoaXPress Host interface can be selected as the source device for CoaXPress 2.0 Device-to-Host triggers.

Any of the 16 LineTrigger of the selected remote device can be selected as the input source.

The tool feeds one I/O Toolbox event stream named DLT<i>.

[1] 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+.

Operation

The Device Link Trigger tool generates one DLT event when a valid high-speed connection trigger packet message corresponding to the DeviceLinkTriggerToolLinkTrigger is received from a CoaXPress 2.0 remote device designated by DeviceLinkTriggerToolDevice.

11.6. Event Input Tool

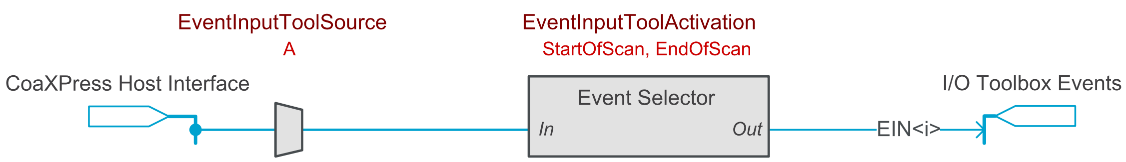
Applies to the following firmware variants of [1]

QuadG3DF (1-df-camera, line-scan)

Quad12DF (1-df-camera, line-scan)

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Event Input Tool	EIN	1 Event	1 event stream: EIN<i>

Diagram



EIN tool functional and wiring diagram

Connector A of the CoaXPress Host Interface is the only source of events that can be selected.

The tool feeds one I/O Toolbox event stream named EIN<i>.

Operation

The Event Input tool decodes the custom CoaXPress GPIO message received on the CoaXPress connector A of a slave **1635 Coaxlink Quad G3 DF**.

The Event Input tool delivers one event on the reception of a "Start-of-scan message" or an "End-of-scan message" according to the EventInputToolActivation settings.

[1] 1635 Coaxlink Quad G3 DF and 3624 Coaxlink Quad CXP-12 DF.

11.7. User Actions Tool

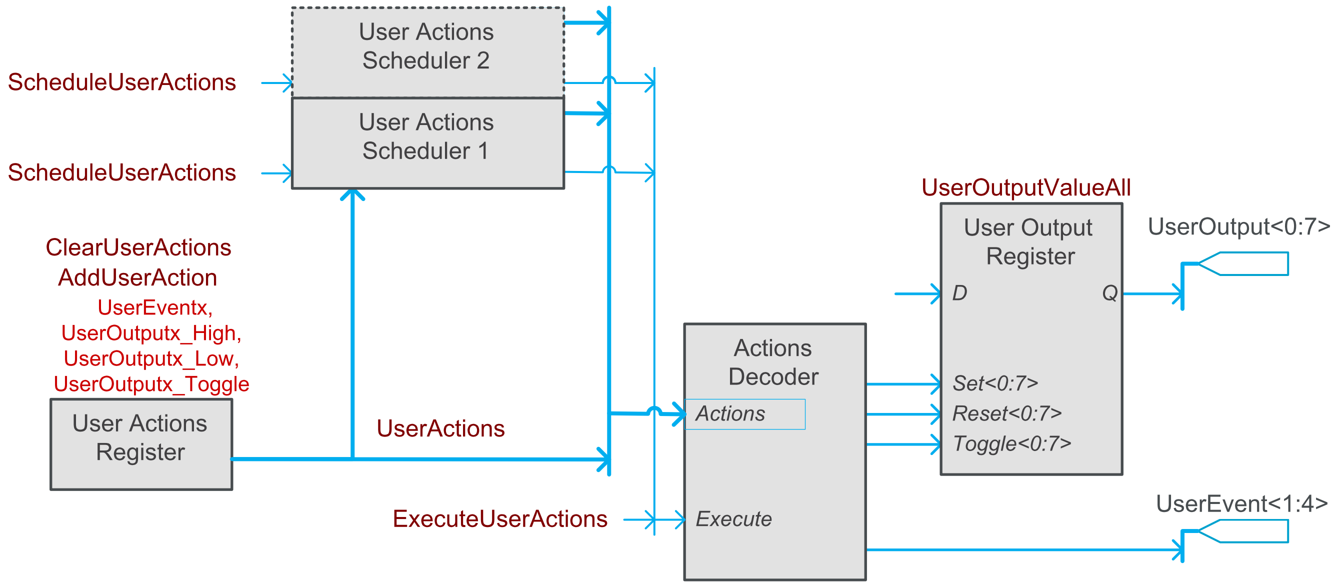
Applies to all firmware variants of **Coaxlink and Grablink Duo frame grabbers**

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.

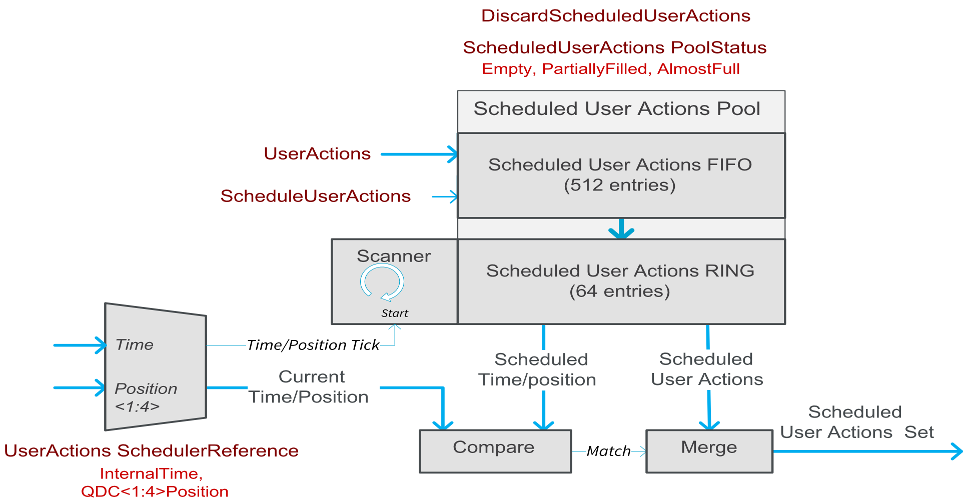
The ClearUserActions feature allows to clear the register.

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.

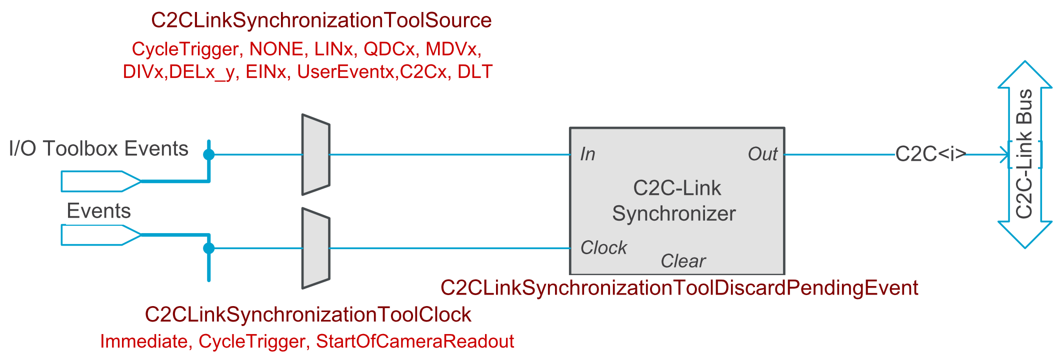
At the end of the scan, the merged elected actions are executed simultaneously. The time delay from the reference tick up to the execution of the elected actions is very small (sub-microsecond) and constant.

11.8. 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.

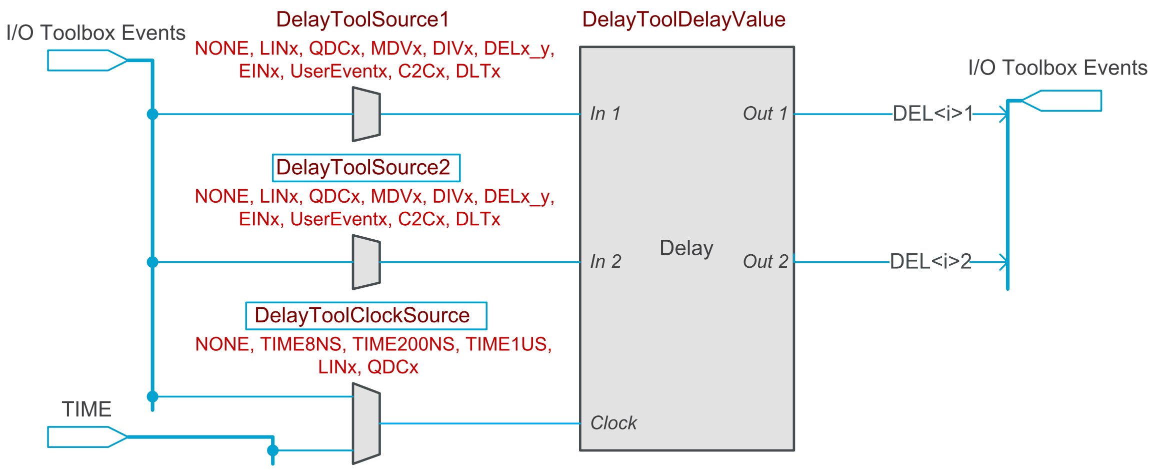
> NOTE
> Area-scan firmware variants provide 2 instances of the C2C tool; line-scan firmware variants provide 3 instances!

11.9. 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.

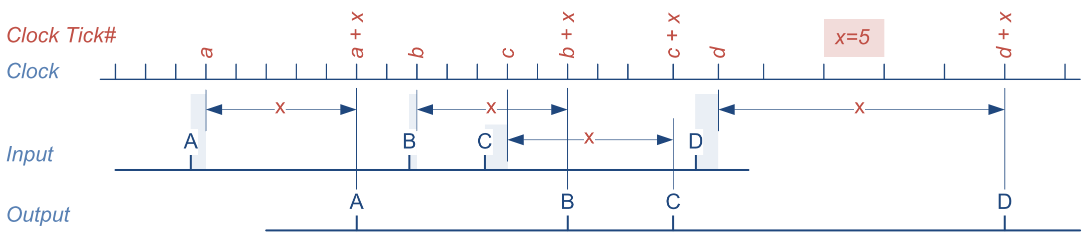
The same clock source applies to both channels. The clock source is defined by DelayToolClockSource. It can be a *time base* , a *Line Tool event stream*, or a *Quadrature Decoder Tool event stream*.

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.



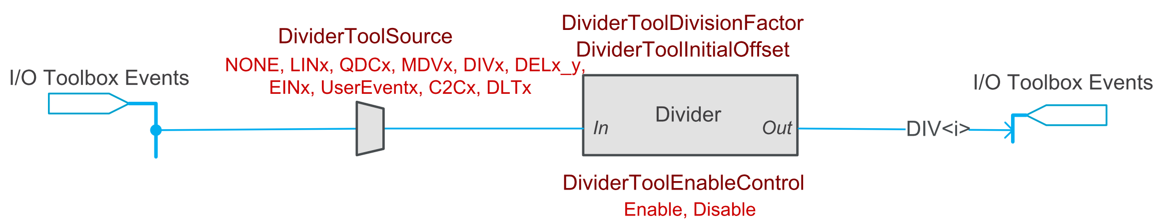
DEL tool waveforms

11.10. Divider Tool

Applies to all firmware variants of **Coaxlink and Grablink Duo frame grabbers**

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Divider Tool	DIV	1 Toolbox event stream	1 event stream: DIV<i>

Diagram

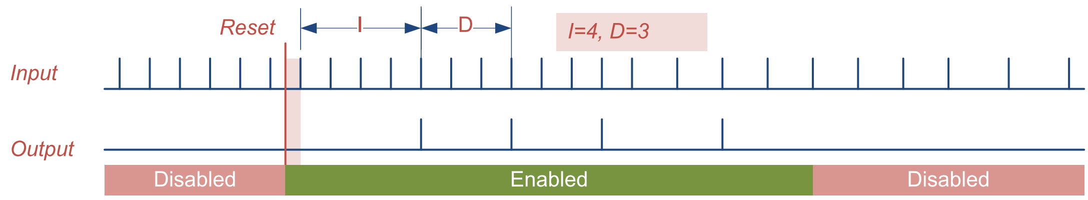


DIV tool functional and wiring diagram

Any I/O Toolbox event stream can be selected as the input source.

The tool feeds one I/O Toolbox event stream named DIV<i>.

Operation



DIV tool waveforms

Once enabled, the Divider tool skips the first – **I** – input events before delivering an event every D input events.

The division factor – **D** – is defined by DividerToolDivisionFactor. The default value is 2 and the value range is 1 ⋯ 65535.

The initial offset – **I** – is defined by DividerToolInitialOffset. The default value is 0 and the value range is 0 ⋯ 65535.

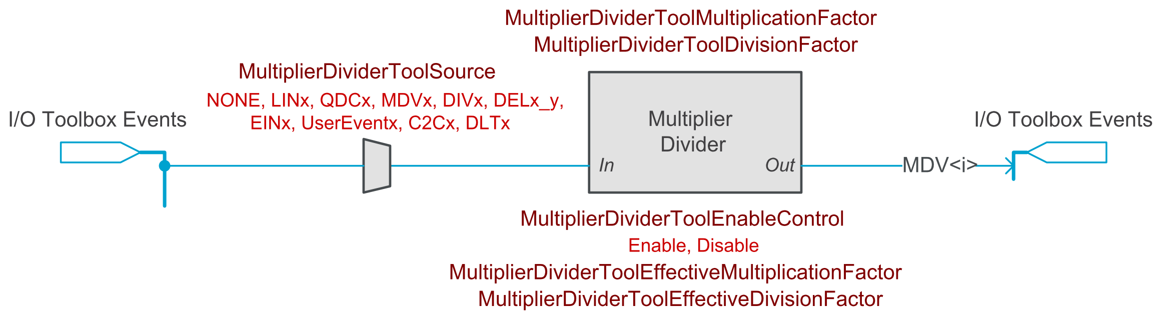
The operation state is defined by DividerToolEnableControl. The default value is Disable.

11.11. Multiplier/Divider Tool

Applies to all firmware variants of **Coaxlink and Grablink Duo frame grabbers**

Tool Name	Short Name	Inputs Count/Type	Outputs Count/Type/Name
Multiplier/Divider Tool	MDV	1 Toolbox event stream	1 Toolbox event stream: MDV<i>

Diagram



MDV tool functional and wiring diagram

Any I/O Toolbox event stream can be selected as the input source.

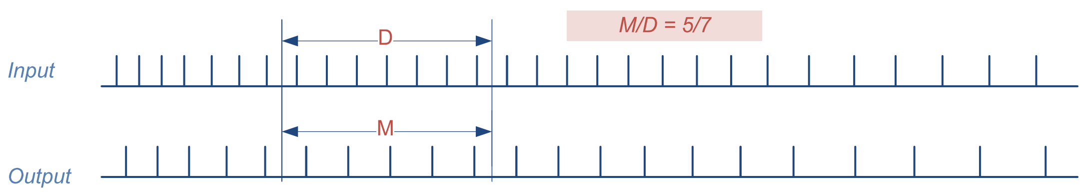
The tool feeds one I/O Toolbox event stream named MDV<i>.

Multiplier/Divider Tool Operation

The Multiplier/Divider tool multiplies and/or divides the input rate by any rate conversion ratio – RCR – value in the range 0.001 to 1000.0.

The Multiplier/Divider tool measures the time interval between every consecutive input events and adapts the output rate accordingly.

The Multiplier/Divider is *frequency accurate*. The output frequency is strictly proportional to the input frequency provided that the input frequency is stable (or varies slowly). In such conditions, the Multiplier/Divider delivers M events for every D input events.



MDV tool waveforms

The Rate Conversion Ratio is configured as the ratio of two float numbers:

- The *M* value is defined by MultiplierDividerToolMultiplicationFactor. The default value is 1.0 and the value range is 0.001 to 1000.0.
- The *D* value is defined by MultiplierDividerToolDivisionFactor. The default value is 1.0 and the value range is 0.001 to 1000.0.

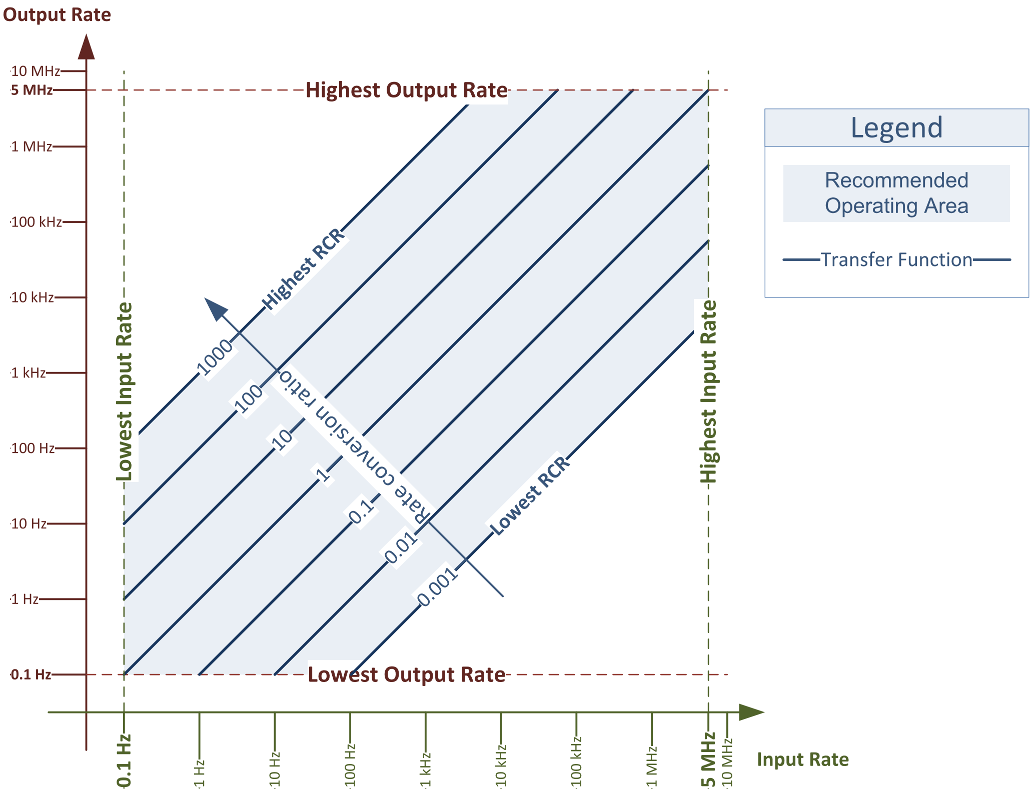
The effective multiplication and division factors are respectively reported by MultiplierDividerToolMultiplicationFactor and MultiplierDividerToolDivisionFactor.

NOTE
The effective values may slightly differ from the specified values. However, the RCR relative error remains negligible (less than 1/1000).

NOTE
Frequency variations of the input event stream are reported to the output event stream with a latency of 1 period of the input event stream. Such a latency induces some phase errors in the output event stream. The accumulated phase error increases when the input frequency increases. It decreases when the input frequency decreases.
The Multiplier/Divider is *not phase accurate*.

Operating Limits

Characteristic	Symbol	Min	Max
Rate Conversion Ratio	RCR	0.001	1000
Input Rate	f_{IN}	0.1 Hz	5 MHz
Output Rate	f_{OUT}	0.1 Hz	5 MHz



MDV tool operating limits diagram

12. Event Signaling And Counting

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

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 Coaxlink 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_CXP_DEVICE	Device	Notification of CoaXPress device events
EVENT_CUSTOM_CXP_INTERFACE	Interface (Device)	Notification of CoaXPress Host Interface 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 and the EVENT_CUSTOM_CXP_INTERFACE event types 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 304 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 316

12.2. Custom Event Sources

EVENT_CUSTOM_CIC

Camera and Illumination Controller custom event sources (Device module)

Coaxlink 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.
_CXP_TRIGGER_ACK	A positive acknowledgment is received in response to a CoaXPress Host to Device Trigger Message.
_CXP_TRIGGER_RESEND	A resent of the CoaXPress Host to Device Trigger Message is executed.
_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_CXP_DEVICE

CoaXPress Host Interface custom event sources (Device Module)

Event Source	Description
_LINK_TRIGGER	LinkTrigger<N> received from CoaXPress device

EVENT_CUSTOM_CXP_INTERFACE

CoaXPress Host Interface custom event sources (Interface module)

Event Source	Description
_CRC_ERROR_CXP_A	A CRC error is detected on the Connection A of the CoaXPress Host Interface
_CRC_ERROR_CXP_B	A CRC error is detected on the Connection B of the CoaXPress Host Interface
_CRC_ERROR_CXP_C	A CRC error is detected on the Connection C of the CoaXPress Host Interface
_CRC_ERROR_CXP_D	A CRC error is detected on the Connection D of the CoaXPress Host Interface
_CRC_ERROR_CXP_E	A CRC error is detected on the Connection E of the CoaXPress Host Interface
_CRC_ERROR_CXP_F	A CRC error is detected on the Connection F of the CoaXPress Host Interface
_CRC_ERROR_CXP_G	A CRC error is

Event Source	Description
	detected on the Connection G of the CoaXPress Host Interface
_CRC_ERROR_CXP_H	A CRC error is detected on the Connection H of the CoaXPress Host Interface
_CONNECTION_DETECTED_CXP_A	Low level connection lock achieved on CXP connector A
_CONNECTION_DETECTED_CXP_B	Low level connection lock achieved on CXP connector B
_CONNECTION_DETECTED_CXP_C	Low level connection lock achieved on CXP connector C
_CONNECTION_DETECTED_CXP_D	Low level connection lock achieved on CXP connector D
_CONNECTION_DETECTED_CXP_E	Low level connection lock achieved on CXP connector E
_CONNECTION_DETECTED_CXP_F	Low level connection lock achieved on CXP connector F
_CONNECTION_DETECTED_CXP_G	Low level connection lock achieved on CXP connector G
_CONNECTION_DETECTED_CXP_H	Low level connection lock achieved on CXP connector H
_CONNECTION_UNDETECTED_CXP_A	Low level connection lock lost on CXP connector A
_CONNECTION_UNDETECTED_CXP_B	Low level

Event Source	Description
	connection lock lost on CXP connector B
_CONNECTION_UNDETECTED_CXP_C	Low level connection lock lost on CXP connector C
_CONNECTION_UNDETECTED_CXP_D	Low level connection lock lost on CXP connector D
_CONNECTION_UNDETECTED_CXP_E	Low level connection lock lost on CXP connector E
_CONNECTION_UNDETECTED_CXP_F	Low level connection lock lost on CXP connector F
_CONNECTION_UNDETECTED_CXP_G	Low level connection lock lost on CXP connector G
_CONNECTION_UNDETECTED_CXP_H	Low level connection lock lost on CXP connector H
_DEVICE_0_READY	CoaXPress link configuration done for Device 0
_DEVICE_1_READY	CoaXPress link configuration done for Device 1
_DEVICE_2_READY	CoaXPress link configuration done for Device 2
_DEVICE_3_READY	CoaXPress link configuration done for Device 3
_DEVICE_4_READY	CoaXPress link configuration done for Device 4
_DEVICE_5_READY	CoaXPress link configuration done for Device 5

Event Source	Description
_DEVICE_6_READY	CoaXPress link configuration done for Device 6
_DEVICE_7_READY	CoaXPress link configuration done for Device 7
_DEVICE_0_LOST	Device 0 disconnected
_DEVICE_1_LOST	Device 1 disconnected
_DEVICE_2_LOST	Device 2 disconnected
_DEVICE_3_LOST	Device 3 disconnected
_DEVICE_4_LOST	Device 4 disconnected
_DEVICE_5_LOST	Device 5 disconnected
_DEVICE_6_LOST	Device 6 disconnected
_DEVICE_7_LOST	Device 7 disconnected
_DEVICE_0_CONFIGURING	CoaXPress link configuration in progress for Device 0
_DEVICE_1_CONFIGURING	CoaXPress link configuration in progress for Device 1
_DEVICE_2_CONFIGURING	CoaXPress link configuration in progress for Device 2
_DEVICE_3_CONFIGURING	CoaXPress link configuration in progress for Device 3
_DEVICE_4_CONFIGURING	CoaXPress link configuration in progress for Device 4
_DEVICE_5_CONFIGURING	CoaXPress link configuration in

Event Source	Description
	progress for Device 5
_DEVICE_6_CONFIGURING	CoaXPress link configuration in progress for Device 6
_DEVICE_7_CONFIGURING	CoaXPress link configuration in progress for Device 7

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)

Coaxlink GenTL Producer

Event Source	Description
_STREAM_PACKET_SIZE_ERROR	Stream packet size error
_STREAM_PACKET_FIFO_OVERFLOW	Stream packet FIFO overflow
_CAMERA_TRIGGER_OVERRUN	New trigger sent to remote device even though readout of previous frame has not started yet
_DID_NOT_RECEIVE_TRIGGER_ACK	Trigger ignored because ACK to previous trigger has not been received yet
_TRIGGER_PACKET_RETRY_ERROR	Trigger packet resend not successful
_INPUT_STREAM_FIFO_HALF_FULL	Input stream FIFO half full
_INPUT_STREAM_FIFO_FULL	Input stream FIFO full
_IMAGE_HEADER_ERROR	Image header error
_MIG_AXI_WRITE_ERROR	MIG AXI write error
_MIG_AXI_READ_ERROR	MIG AXI read error
_PACKET_WITH_UNEXPECTED_TAG	Received a CXP packet with unexpected tag
_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

Event Source	Description
_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
_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
_EIN1	Event Input Tool 1 – Event output
_EIN2	Event Input Tool 2 – Event output
_DLT1	Device Link Trigger Tool 1 – Event output
_DLT2	Device Link Trigger Tool 2 – Event output
_DLT3	Device Link Trigger Tool 3 – Event output
_DLT4	Device Link Trigger Tool 4 – Event output
_DLT5	Device Link Trigger Tool 5 – Event output
_DLT6	Device Link Trigger Tool 6 – Event output
_DLT7	Device Link Trigger Tool 7 – Event output
_DLT8	Device Link Trigger Tool 8 – Event output
_DLT9	Device Link Trigger Tool 9 – Event output
_DLT10	Device Link Trigger Tool 10 – Event output
_DLT11	Device Link Trigger Tool 11 – Event output
_DLT12	Device Link Trigger Tool 12 – Event output
_DLT13	Device Link Trigger Tool 13 – Event output

Event Source	Description
_DLT14	Device Link Trigger Tool 14 – Event output
_DLT15	Device Link Trigger Tool 15 – Event output
_DLT16	Device Link Trigger Tool 16 – Event output

NOTE
Check the "I/O Toolbox Composition Tables" on page 271 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. CoaXPress Data Forwarding

Applies to [1]
QuadG3DF Quad12DF

[1] 1635 Coaxlink Quad G3 DF and 3624 Coaxlink Quad CXP-12 DF.

Data Forwarding Principles

The data forwarding capability allows to forward the image data from a camera to multiple frame grabbers in different Host PCs.

Data forwarding

A *data-forwarding frame grabber* forwards the data received on the CoaXPress Host connector to the CoaXPress Data Forwarding connector.

The image data packets embedded in the serial bit stream on connections A, B, C, D of the CoaXPress Host connector are forwarded to the connections FA, FB, FC, FD of the CoaXPress Data Forwarding connector.

The serial bit streams are re-timed to operate always at the maximum link speed (CXP-6 for **1635 Coaxlink Quad G3 DF** or CXP-12 for **3624 Coaxlink Quad CXP-12 DF**), regardless the link speed of the camera. Therefore, idle characters are, when necessary, removed or added in the bit stream. Addition or removal of idle characters doesn't affect the payload. Image data are preserved, including CRC's. For proper operation of data forwarding, it is mandatory that the camera inserts one IDLE word at least once every 100 words as required by the CoaXPress 1.1 standard § 8.2.5.1.

The image data are retransmitted with a negligible latency: typically, a few periods of the 32-bit character transmission time.

> NOTE
> The Data Forwarding output port doesn't comply with the specification of a CoaXPress Device! It can only feed another *data-forwarding frame grabber.*

Data forwarding chain

A *DF-chain* is composed of 2 or more data-forwarding capable cards of the same type where the CoaXPress Data Forwarding connector of one card is connected to the CoaXPress Host connector of the next card using a set of 1, 2 or 4 coaxial cables named *DF-bridge*.

> NOTE
> There are no specified upper limit to the number of cards in a *DF-chain*.

The camera is attached to the CoaXPress Host connector of the first card of the *DF-chain*, this card is named *DF-master*. The other cards, of the *DF-chain* are named *DF-slaves*. The CoaXPress Data Forwarding connector of the last *DF-slave* card is left unconnected.

> WARNING
> It is not allowed to mix **1635 Coaxlink Quad G3 DF** and **3624 Coaxlink Quad CXP-12 DF** in a "Data forwarding chain" on page 321.

CoaXPress Link discovery and configuration

The *DF-master* card is responsible for the discovery and the configuration of the CoaXPress Link of the camera.

The CoaXPress Host Interface of the *DF-slaves* are automatically configured with the same number of connections as discovered by the DF-Master.

For instance if the camera uses two connections, only two connections are required for every *DF-bridge*.

> WARNING
> To prevent desynchronization in packet tags between the *DF-master* and *DF-slaves* computers, it is mandatory that:
>
> - The *DF-slave* cards are powered on and have their driver loaded during the link configuration performed by the *DF-master* card.
> - You force a new connection configuration (e.g. for **1635 Coaxlink Quad G3 DF**, set ConnectionConfig to CXP6_X1 then back to CXP6_X4 and for **3624 Coaxlink Quad CXP-12 DF**, set ConnectionConfig to CXP12_X1 then back to CXP12_X4) on the *DF-master* computer before starting new acquisitions if one of the *DF-slave* computers has rebooted for whatever reason.

Firmware variants selection

The firmware variant to install on the *DF-master* must be selected according to the camera type:

- For an area-scan camera, install the 1-camera firmware variant.
- For a line-scan camera, install the 1-camera, line-scan firmware variant.

The firmware variant to install on the *DF-slaves* must match the firmware variant installed on the *DF-master*:

- When the 1-camera firmware variant is installed on the *DF-master*, install the 1-df-camera firmware variant on all *DF-slaves*.
- When 1-camera, line-scan firmware variant is installed on the *DF-master*, install the 1-df-camera, line-scan firmware variant on all *DF-slaves*.

Application requirements

Data acquisition control

For correct operation of data forwarding, the application must respect the following rules:

- The data acquisition must be activated on all the *DF-slaves* before being activated on the *DF-master*.
- The data acquisition must be de-activated on the *DF-master* before being de-activated on the *DF-slaves*.

For line-scan applications only, a start-of-scan and end-of-scan synchronization mechanism is implemented to ensure that all the cards of the *DF-chain* can capture the same lines of image data.

See also: "Line-scan Triggers Synchronization" on page 326

Camera Triggering

The *DF-master* card is responsible for the elaboration of the CoaXPress Host-to-Device trigger.

When camera triggering is required, the application must configure the *DF-master* card in the same way as for non-data-forwarding Coaxlink cards.

See also: "CoaXPress Host To Device Trigger" on page 77

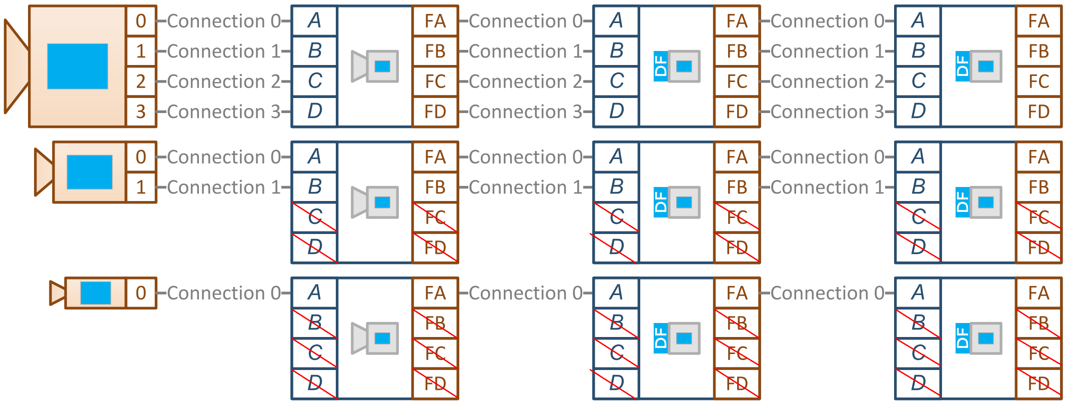
Data Forwarding Connection Schemes

Area-scan Camera Data Forwarding

The following drawing illustrates 3 connection schemes where the image data of an area-scan camera is forwarded to 3 Host PCs: one for a 4-connection camera, one for a 2-connection camera, one for a single-connection camera.

The first card of the "Data forwarding chain" on page 321 must be configured with a 1-camera firmware variant.

The other cards of the "Data forwarding chain" on page 321 must be identical to the first card and be configured with the 1-df-camera firmware variant.



WARNING

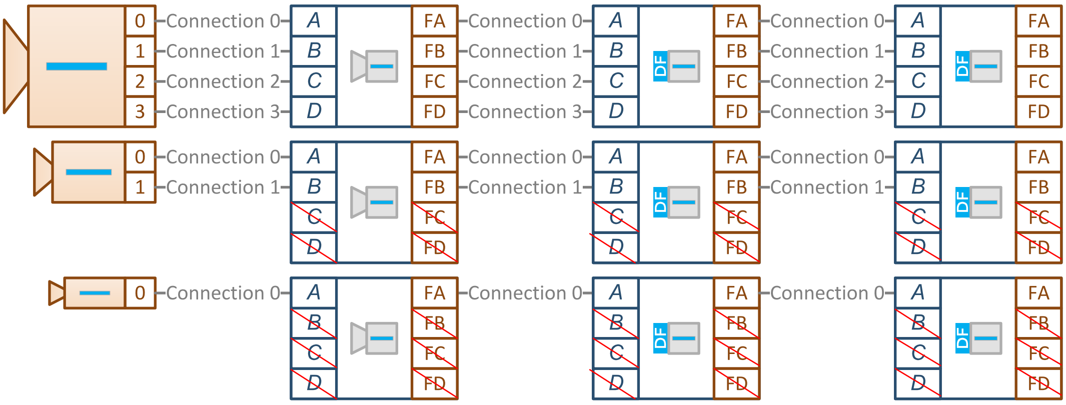
It is not allowed to mix **1635 Coaxlink Quad G3 DF** and **3624 Coaxlink Quad CXP-12 DF** in a "Data forwarding chain" on page 321.

Line-scan Camera Data Forwarding

The following drawing illustrates 3 connection schemes where the image data of a line-scan is forwarded to 3 Host PCs: one for a 4-connection camera, one for a 2-connection camera, one for a single-connection camera.

The first card of the "Data forwarding chain" on page 321 must be configured with a 1-camera, line-scan firmware variant.

The other cards of the "Data forwarding chain" on page 321 must be identical to the first card and configured with the 1-df-camera, line-scan firmware variant.



> **WARNING**
> It is not allowed to mix **1635 Coaxlink Quad G3 DF** and **3624 Coaxlink Quad CXP-12 DF** in a "Data forwarding chain" on page 321.

Line-scan Triggers Synchronization

The start-of-scan and end-of-scan trigger synchronization mechanism ensures that all the cards of the DF-chain capture the same lines of image data.

Data Forwarding - Master Card

In a DF-chain, the DF-master card forwards its start-of-scan and end-of-scan events to the DF-slave cards.

The generation of the start-of-scan and end-of-scan events on the DF-master is achieved in the same way as for non-data-forwarding Coaxlink cards.

See also: "Line-scan Acquisition" on page 123

The DF-master card:

- First, synchronizes the asynchronous scan triggers on the next start-of line image data.
- Then, share the synchronized scan triggers with all the DF-slaves.

The sharing of the scan triggers is achieved by the insertion of high-priority "custom GPIO messages" in the bit stream. These messages are forwarded by all the DF-slaves together with the image data.

Data Forwarding - Slave Card(s)

On reception of such a message, the DF-slave generates a hardware event. Two kind of events are possible:

- Start-of-scan event.
- End-of-scan event

These events are available through the "Event Input Tool" on page 285 of the I/O Toolbox.

For applications requiring synchronized line-scan acquisition, the I/O toolbox EIN tools of the DF-slaves must be used as local start-of-scan and end-of-scan trigger sources.

Configuration Script Example

The following script configures Data Forwarding frame grabbers for synchronized line-scan acquisition:

```
for (var grabber of grabbers) {
  if (grabber.InterfacePort.get("InterfaceID").includes('df-camera')) {
    console.log("Configuring slave card");
    // set the Width/Height/PixelFormat of the (virtual) remote device (on
    // the slave card) equal to the Width/Height/PixelFormat of the (real)
    // camera (connected to the master card)
    grabber.RemotePort.set("Width", 8192);
    grabber.RemotePort.set("Height", 1);
    grabber.RemotePort.set("PixelFormat", "Mono8");
    // configure the event input tool EIN1
    grabber.InterfacePort.set("EventInputToolSource[EIN1]", "A");
    grabber.InterfacePort.set("EventInputToolActivation[EIN1]", "StartOfScan");
    // configure the event input tool EIN2
    grabber.InterfacePort.set("EventInputToolSource[EIN2]", "A");
    grabber.InterfacePort.set("EventInputToolActivation[EIN2]", "EndOfScan");
    // configure start/end of scan triggers
    grabber.StreamPort.set("StartOfScanTriggerSource", "EIN1");
    grabber.StreamPort.set("EndOfScanTriggerSource", "ScanLength");
    grabber.StreamPort.set("ScanLength", 1000);
  } else {
    console.log("Configuring master card");
    grabber.RemotePort.set("TestPattern", "GreyDiagonalRampMoving");
    grabber.RemotePort.set("CxpLinkConfiguration", "CXP6_X4");
    grabber.RemotePort.set("CxpLinkConfigurationPreferredSwitch", "CXP6_X4");
    grabber.RemotePort.set("TriggerSource", "CXPin");
    grabber.RemotePort.set("TriggerMode", "On");
    grabber.DevicePort.set("CameraControlMethod", "RG");
    grabber.DevicePort.set("ExposureReadoutOverlap", "True");
    grabber.DevicePort.set("CxpTriggerAckTimeout", "0");
    grabber.DevicePort.set("StrobeDuration", "0");
    grabber.DevicePort.set("ExposureTime", "20");
    grabber.DevicePort.set("ExposureRecoveryTime", "0");
    grabber.DevicePort.set("CycleMinimumPeriod", "50");
    // configure start/end of scan triggers
    grabber.StreamPort.set("StartOfScanTriggerSource", "Immediate");
    grabber.StreamPort.set("EndOfScanTriggerSource", "ScanLength");
    grabber.StreamPort.set("ScanLength", 1000);
  }
}
```

NOTE

In this example, the start-of-scan trigger is the receipt of the start-of-scan event from the master, but the end-of-scan trigger is generated locally. One alternative would be to use EIN2 as EndOfScanTriggerSource.

13.2. 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:

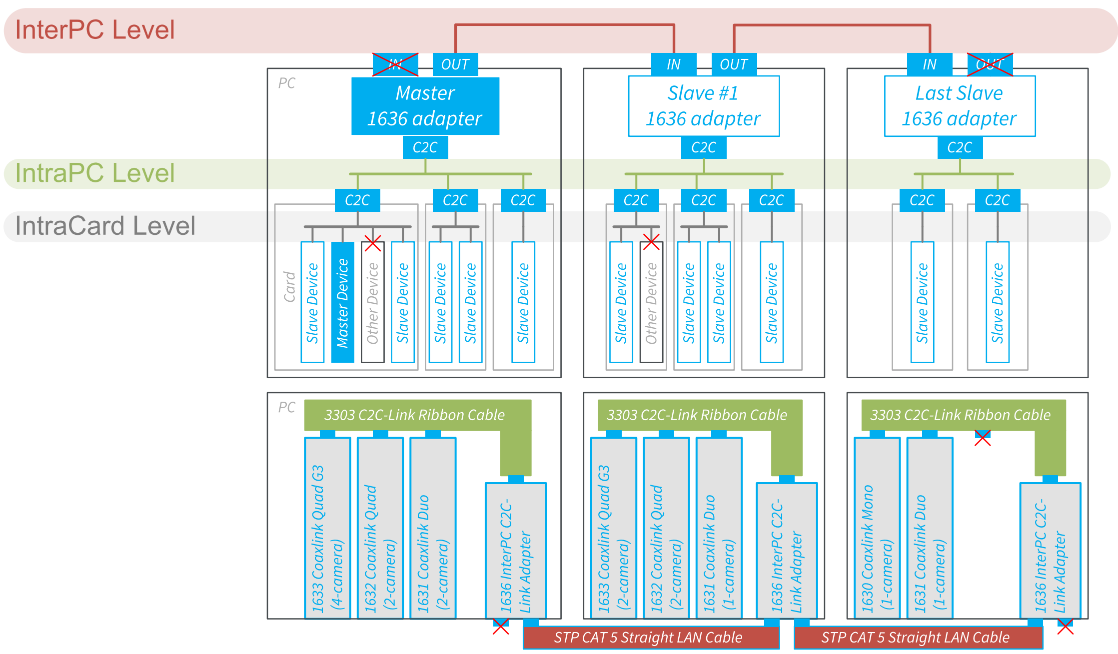
- allows to share up to 2 triggers: a CIC Cycle Trigger (mandatory) and oneI/O Toolbox event (optional).
- allows any C2C-Link device to indicate to the C2C-Link master device that it is not able to accept a trigger.

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:

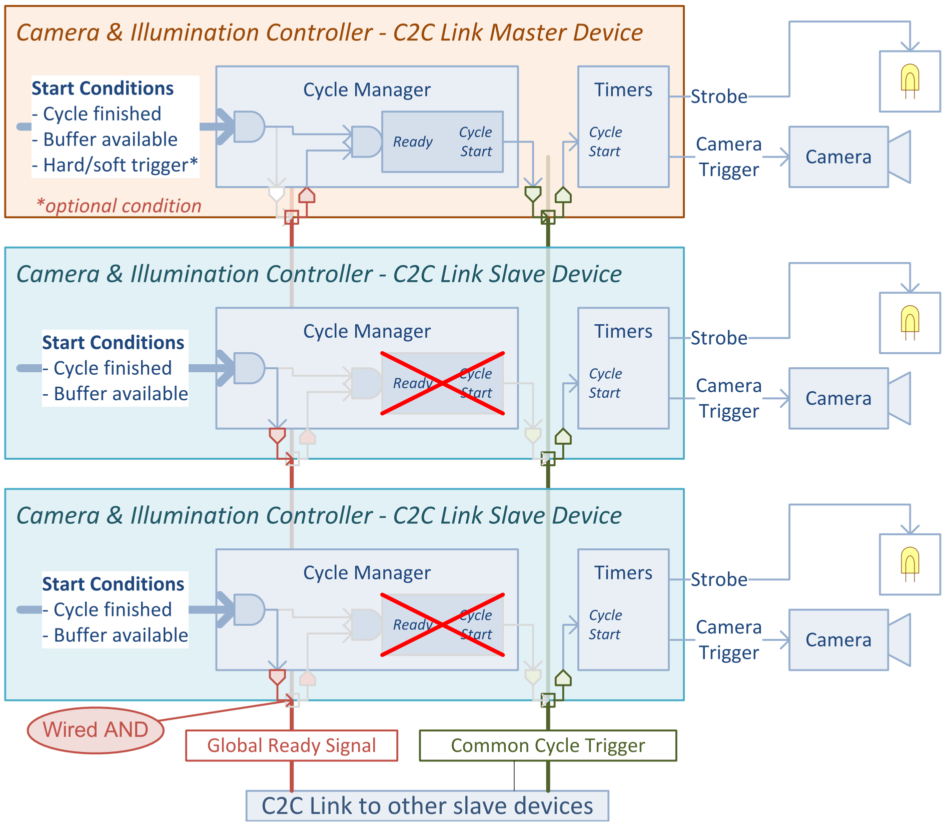
Parameter	Min.	Typ.	Max.	Units
(1) Master IntraPC interconnection	0	5	10	ns
(2) Master **1636 InterPC C2C-Link Adapter** – IntraPC-to-InterPC delay		15		ns
(5) Master to slave1 InterPC LAN cable – 20 m		100		ns
(3) Slave1 **1636 InterPC C2C-Link Adapter** – InterPC-to-IntraPC delay		20		ns
(1) Slave1 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 291 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.

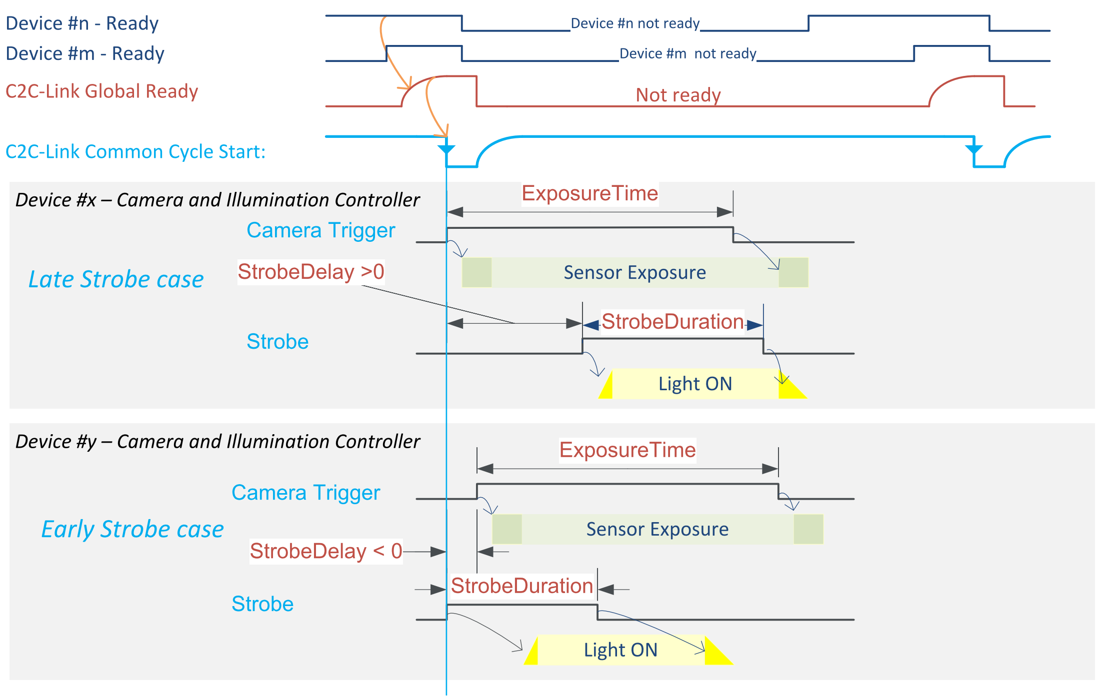
Global Ready signal

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.

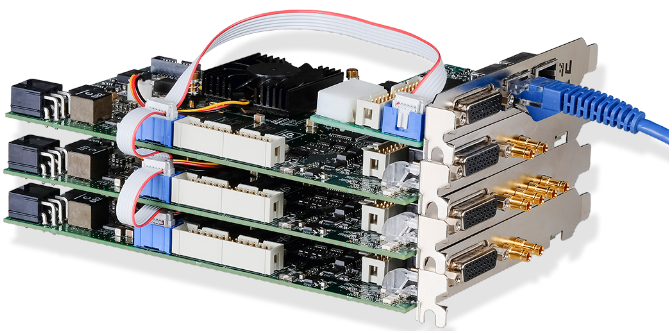
In each participating PC:

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

13.3. 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.

13.4. Laser Line Extraction

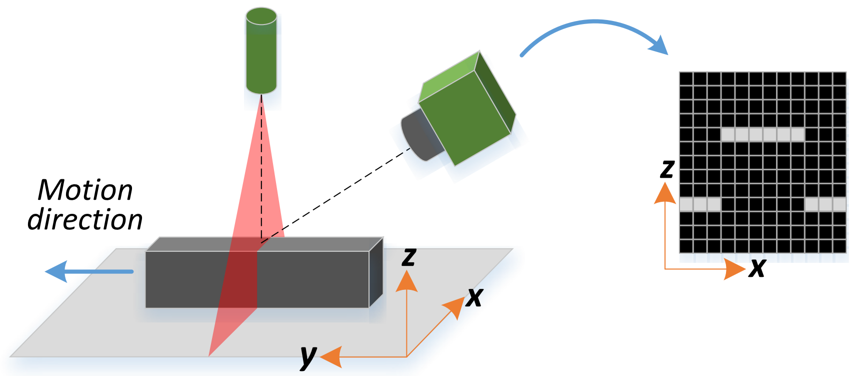
Applies to the following firmware variants of [1]

Quad3DLLE (1-camera)

[1] 1637 Coaxlink Quad 3D-LLE.

Introduction

In a laser-line triangulation system, a laser line (or any other “narrow light stripe” generation method) is projected on a 3D object. A camera, placed in another perspective than the laser, is then used to capture an image of that line, deformed by the shape of the object. The deformations of the line are a direct representation of the shape of the 3D object in the plane of the laser line. By scanning the object, that is making it move under the laser line and taking multiple images, you can reconstruct its 3D shape.



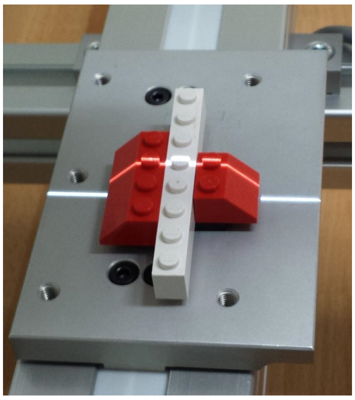
Simplified laser triangulation system

Laser Line Extraction Algorithms

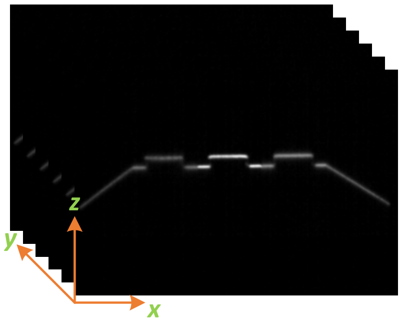
A Laser Line Extraction (LLE) algorithm is required to create a *depth map* based on a sequence of profiles of the object captured by the camera sensor.

The objective of an LLE algorithm is to estimate the position where a laser line horizontally crosses a Region of Interest (ROI). The detection can be done by analyzing each column of a frame individually.

An LLE algorithm typically outputs a data array containing the vertical position of a detected laser line along of a ROI, i.e., each computed ROI produces a single data array.

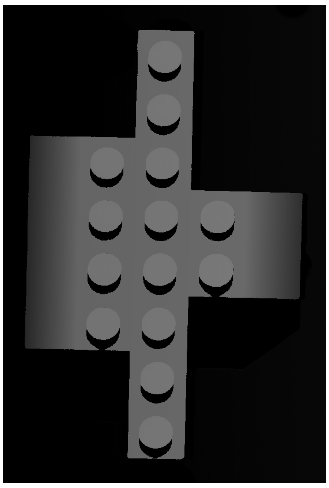


Measured object



Series of profiles

LLE



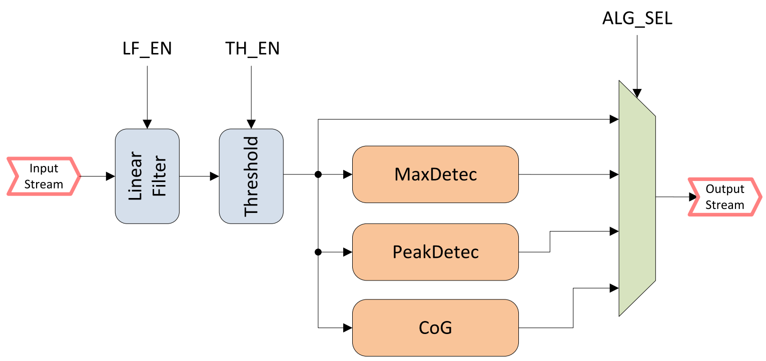
Depth Map

Depth map generation

LLE Processing Core Implementation

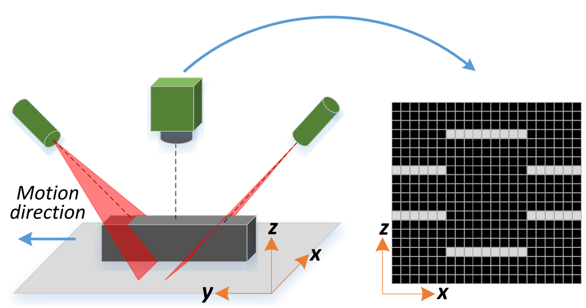
The LLE Processing Core is embedded in the **1637 Coaxlink Quad 3D-LLE** frame grabber. It can compute the *depth map* of a measured object with *zero host CPU usage* and *zero latency*.

It provides 3 algorithms for laser line extraction (*Maximum Detection*, *Peak Detection*, and *Center of Gravity*) as well as a pre-processing stage for filtering and thresholding.



Simplified block diagram of the LLE Processing Core

The LLE Processing Core is also capable to compute simultaneously up to 2 depth maps from a single input ROI. This feature is called *Dual Laser Line Extraction* (*Dual-LLE*). This feature is useful for applications using 2 laser lines projected on the same object.



Simplified dual laser triangulation system

When the Dual-LLE mode is activated, the LLE Processing Core input split the input ROI into two sub-ROIs, called LLE-ROI. Each LLE-ROI is independently processed by the LLE Processing Core resulting in a corresponding depth-map.

LLE Processing Core Characteristics

Absolute Maximum LLE-ROI XSize

- *All algorithms:* 8192 pixels

Max. Effective LLE-ROI YSize [pixels]

MaxDetec 8	MaxDetec 16	PeakDetec 11_5	PeakDetec 8_8	CoG 11_5	CoG 8_8
255	65535	2048	256	2048	256

Output Format [GenICam PFNC v2.1]

MaxDetec 8	MaxDetec 16	PeakDetec 11_5	PeakDetec 8_8	CoG 11_5	CoG 8_8
8-bit (integer)	16-bit (integer)	UQ11.5	UQ8.8	UQ11.5	UQ8.8

Output Pixel Format

MaxDetec 8	MaxDetec 16	PeakDetec 11_5	PeakDetec 8_8	CoG 11_5	CoG 8_8
Coord3D_C8	Coord3D_C16	Coord3D_C16	Coord3D_C16	Coord3D_C16	Coord3D_C16

Output Sub-pixel Resolution [pixel]

MaxDetec 8	MaxDetec 16	PeakDetec 11_5	PeakDetec 8_8	CoG 11_5	CoG 8_8
1	1	1/32	1/256	1/32	1/256

InvalidDataFlag Value

- *MaxDetec 8 algorithm:* 0x00
- *Other algorithms:* 0x0000

> NOTE
> This value identifies a non-valid result.

Valid Output Range

- *MaxDetec 8 algorithm:* 0x01 ~ 0xFF
- *Other algorithms:* 0x0001 ~ 0xFFFF

Supported Input Pixel Format

- *All algorithms:* Mono8

Number of Laser Lines

- *All algorithms:* 1 per LLE-ROI (up to 2 per input ROI)

Maximum Performance

- *All algorithms:* 2.500 megapixels/s
- *All algorithms:* 9,500 profiles/s from a 2048 x 256 or 4096 x 128 image
- *All algorithms:* 19,000 profiles/s from a 2048 x 128 image
- *All algorithms:* 38,000 profiles/s from a 1024 x 128 image
- *All algorithms:* 76,000 profiles/s from a 1024 x 64 image

> NOTE
> The above figures are based on the maximum bandwidth of a 4-connection CXP-6 CoaXPress link and considering that the dual LLE mode is activated.

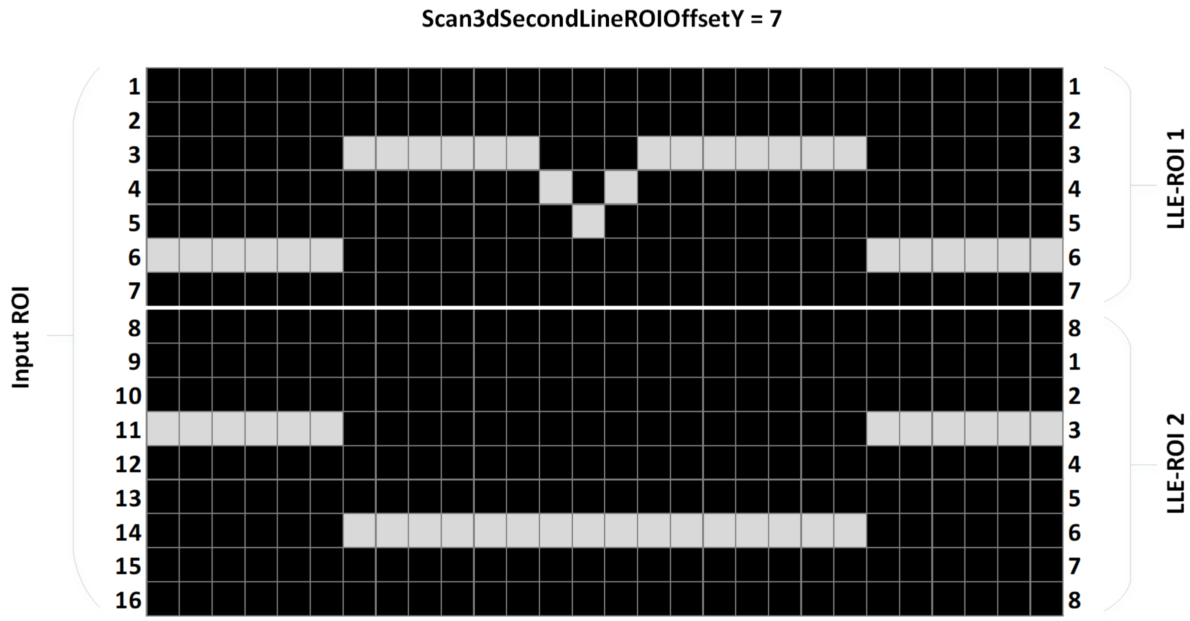
Available Output Types

- *All algorithms:*
  - Depth map
  - Raw camera image

> WARNING
> Not both outputs simultaneously!

Dual Laser-line Extraction

The Dual-LLE mode can be activated by setting the data stream feature Scan3dSecondLineROIOffsetY to a value different from 0. The feature Scan3dSecondLineROIOffsetY corresponds to an offset that defines where the input ROI will be split into two LLE-ROIs.

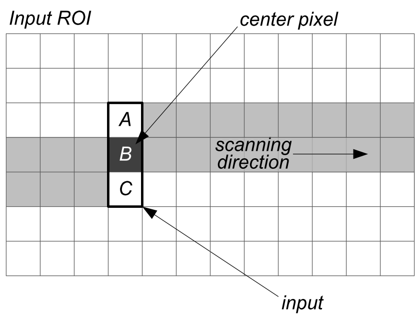


ROI Offset example

Linear Filter

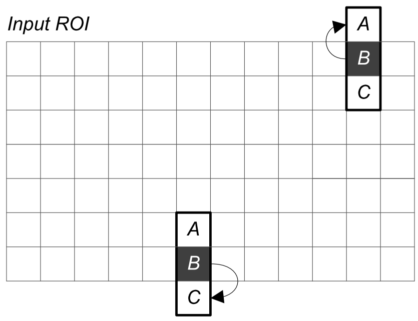
The *Linear Filter* module applies a convolution operator on a 1x3 sliding window directly on the data flow as it comes from the camera. The 3 elements of the convolution kernel (A, B, and C) are configurable accepting any positive integers where the sum of the 3 elements is a value between 1 and 512.

This figure illustrates the positioning of the convolution kernel elements within a given LLE-ROI:



Linear Filter kernel disposition

When an element of the kernel is located outside of the LLE-ROI boundaries (typical sliding window problem), its input pixel value is replaced by the central window pixel.



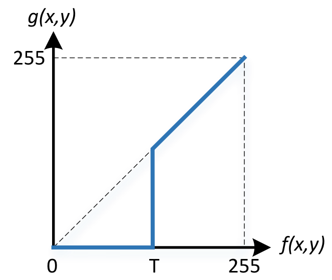
Linear Filter behavior at the LLE-ROI boundaries.

Coring Threshold

The coring is a non-linear operator that performs a simple segmentation technique, classifying pixels into two categories according to the following rule:

$$g(x,y) = \begin{cases} f(x,y), & f(x,y) > T \\ 0, & otherwise \end{cases}$$

T is the coring threshold.



Coring response

Maximum Detection

The Maximum Detection module can be configured to output a depth map in 8-bit or 16-bit data width. The difference between these two modes is the maximum effective LLE-ROI YSize supported by the Maximum Detection module. The 8-bit mode can represent heights of up to 255 Pixels and the 16-bit mode can represent heights of up to 65535 Pixels.

When a maximum intensity is detected in more than one pixel on a given LLE-ROI column, the Maximum Detection algorithm will indicate the one with the highest position.

InvalidDataFlag

An *InvalidDataFlag* is generated when:

- The detected line position is above the maximum LLE-ROI height.

No MAX intensity is detected in an LLE-ROI column.

Peak Detection

The Peak Detection module produces a depth map represented by 16-bit fixed-point words. It can be configured with two precisions:

- *UQ11.5* in which 5-bit (LSB) represent the fraction part and 11-bit (MSB) the integer part. In this mode, the maximum effective LLE-ROI YSize supported by the Peak Detection module is almost 2048 Pixels.
- *UQ8.8* in which 8-bit (LSB) represent the fraction part and 8-bit (MSB) the integer part. In this mode, the maximum effective LLE-ROI YSize supported by the Peak Detection module is almost 256 Pixels.

When more than one peak is detected on a given LLE-ROI column, the Peak Detection module will indicate the position of the one where the corresponding f(x) pixel has the highest intensity. If more than one corresponding f(x) pixel have the same condition (highest intensity), then the one with highest position among them will be indicated.

InvalidDataFlag

An *InvalidDataFlag* is generated when:

- The detected line position is above the max LLE-ROI height supported.
- No line is detected in an LLE-ROI column.

Center of Gravity

The Center of Gravity module produces a depth map represented by 16-bit fixed-point words. It can be configured with two precisions:

- *UQ11.5* in which 5-bit (LSB) represent the fraction part and 11-bit (MSB) the integer part. In this mode, the maximum effective LLE-ROI YSize supported by the Center of Gravity module is almost 2048 Pixels.
- *UQ8.8* in which 8-bit (LSB) represent the fraction part and 8-bit (MSB) the integer part. In this mode, the maximum effective LLE-ROI YSize supported by the Center of Gravity module is almost 256 Pixels.

When more than one peak is detected on a given LLE-ROI column, the Center of Gravity module will indicate the position of the one where the corresponding f(x) pixel has the highest intensity. If more than one corresponding f(x) pixel have the same condition (highest intensity), then the one with highest position among them will be indicated.

InvalidDataFlag

An *InvalidDataFlag* is generated when:

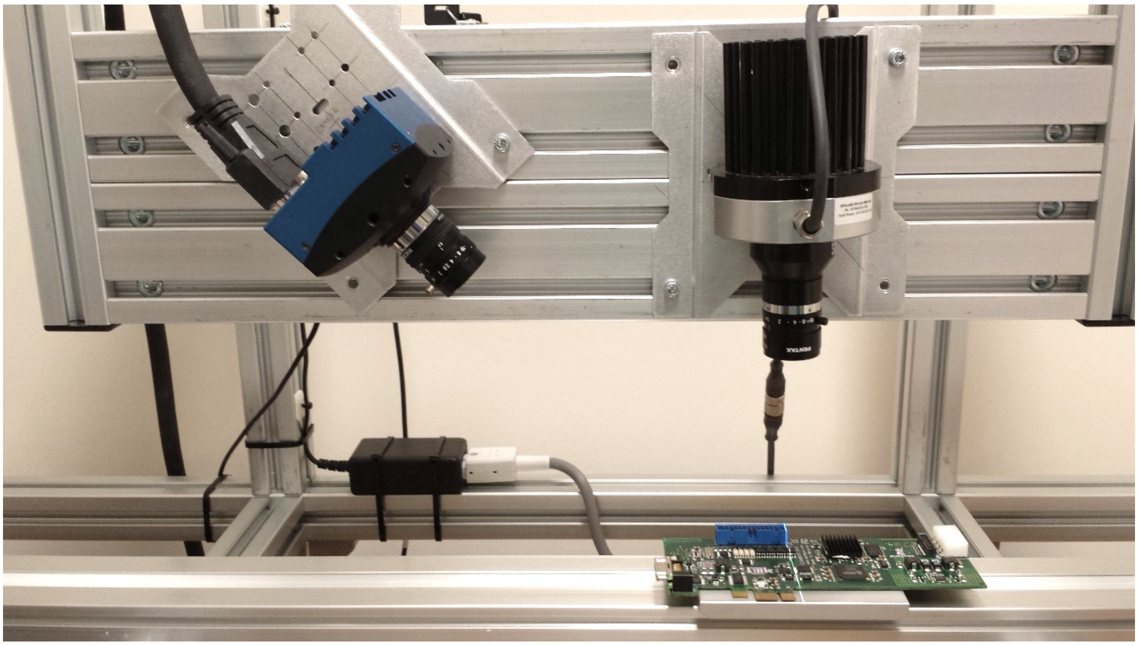
- The detected line position is above the max LLE-ROI height supported.
- An overflow occurs in an internal Sum. This condition can occurs when in a same LLE-ROI column a large number of *successive* pixels present intensities above the threshold level.
- No line is detected in an LLE-ROI column.

Use Case Example

Objective

In this example, the objective is to obtain a reliable measure of a PCB surface. For simplification purposes, the acquisition parameters are set using **GenICam Browser (Deprecated)** and the camera is not controlled (free run). Other parameters like triangulation geometries, lenses, and laser color and power are not covered in this example.

This figure shows the laser line triangulation setup used in this example:

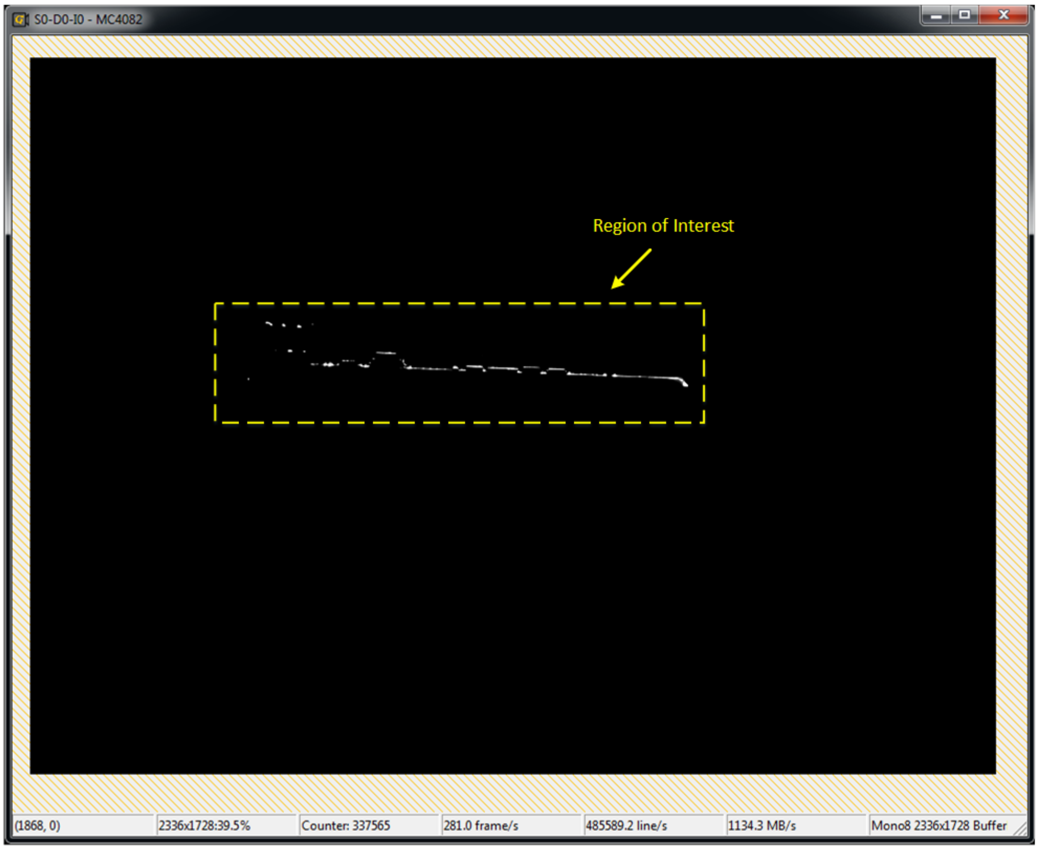


Laser line triangulation setup

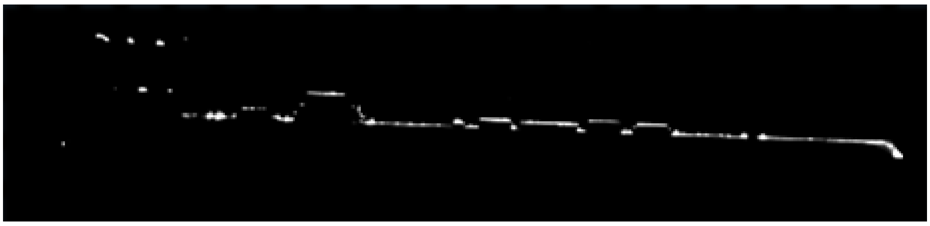
Defining the Input ROI

The defined Input ROI should cover the whole sensor region where the laser line variations occurs. The initial step is to set a full resolution ROI to verify the overall image.

The resulting frame can be seen in the following figure where it is possible to verify the effective region where the laser line variations occur.



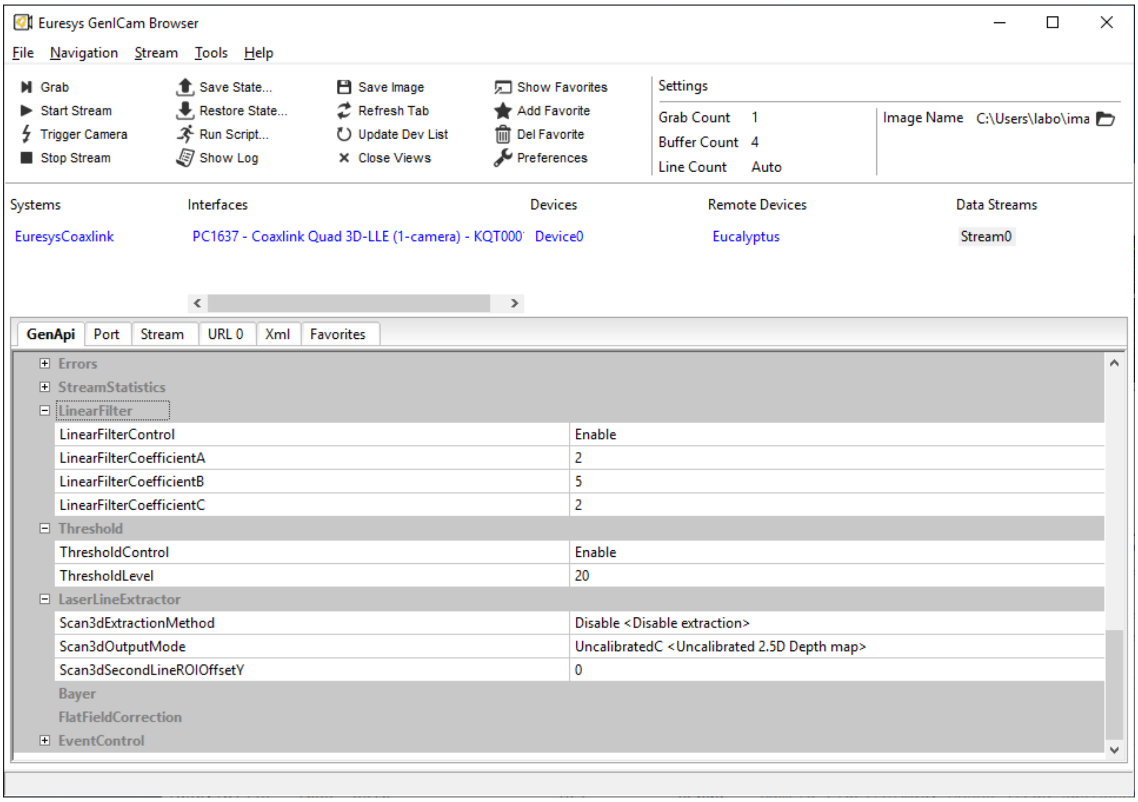
Resulting image (Full resolution ROI)



Input ROI Expanded View

Setting Filtering and Thresholding

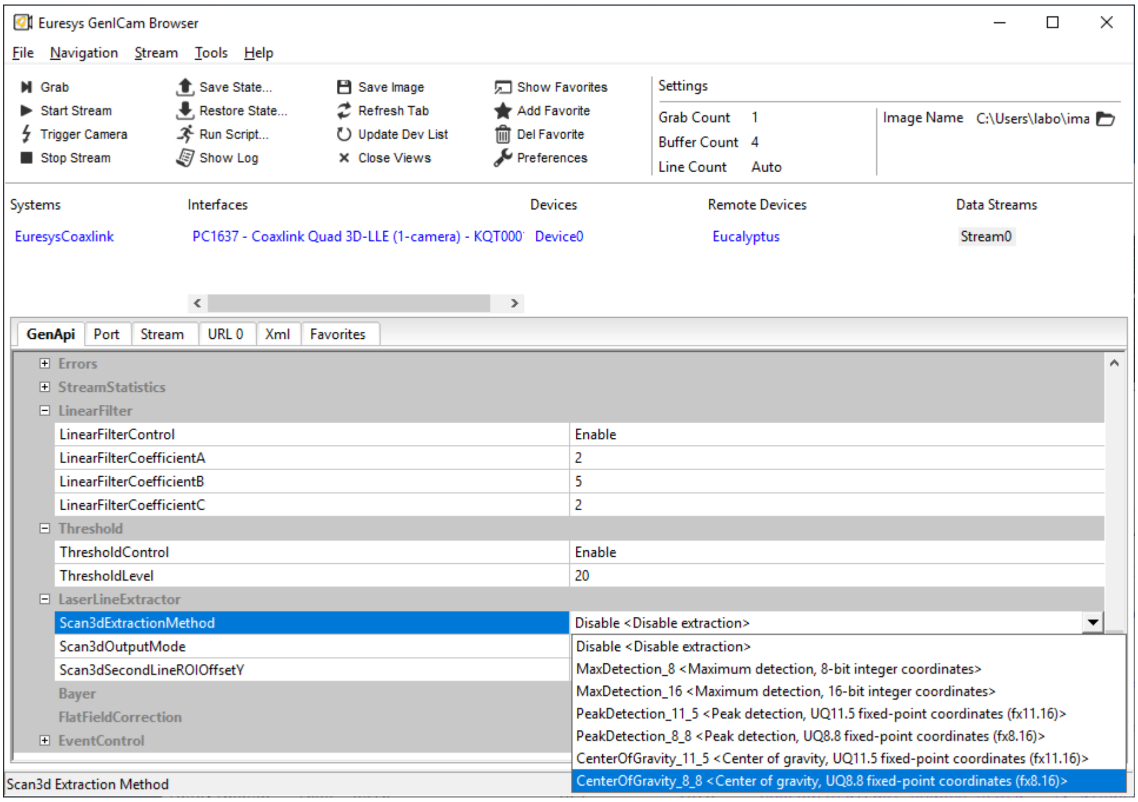
It is possible to activate a pre-processing stage in the LLE process. In the example shown below, the threshold level is set to 20 and the convolution filter kernel is set with A=2, B=5, and C=2. With these parameters, we will have a smoother image where any background noise below the threshold level is replaced by 0.



Filtering and Thresholding parameters

Defining the LLE Algorithm

The GenApi feature Scan3dExtractionMethod gives access to all available LLE Algorithms. The following figure shows how this feature is presented in **GenICam Browser (Deprecated)**.



Laser Line Extraction options

The choice between the available algorithms depends on a number of factors related to the target application. We highlight here the main differences among the available algorithms.

LLE-ROI YSize

The number of effective vertical pixels in a LLE-ROI (YSize) is limited by the maximum integer value that can be represented by the output format of the chosen algorithm as described below:

- MaxDetection_8 (8-bit): 0xFF (255 pixels).
  - The value 0x00 is reserved to indicate an InvalidDataFlag.
- MaxDetection_16 (16-bit): 0xFFFF (65535 pixels).
  - The value 0x0000 is reserved to indicate an InvalidDataFlag.
- PeakDetection_11_5 (UQ11.5): 0xFFFF (almost 2048 pixels).
  - The value 0x0000 is reserved to indicate anInvalidDataFlag.
- PeakDetection_8_8 (UQ8.8): 0xFFFF (almost 256 pixels).
  - The value 0x0000 is reserved to indicate anInvalidDataFlag.
- CenterOfGravity_11_5 (UQ11.5): 0xFFFF (almost 2048 pixels).
  - The value 0x0000 is reserved to indicate an InvalidDataFlag.

- CenterOfGravity_8_8 (UQ8.8): 0xFFFF (almost 256 pixels).
  - The value 0x0000 is reserved to indicate an InvalidDataFlag.

Algorithm Resolution

The position resolution of the available algorithms varies from 1 pixel up to 1/256 pixel as described below:

- MaxDetection_8 (8-bit): 1 pixel.
- MaxDetection_16 (16-bit): 1 pixel.
- PeakDetection_11_5 (UQ11.5): 1/32 pixel.
- PeakDetection_8_8 (UQ8.8): 1/256 pixel.
- CenterOfGravity_11_5 (UQ11.5): 1/32 pixel.
- CenterOfGravity_8_8 (UQ8.8): 1/256 pixel.

Algorithm Specificities

As mentioned previously, the choice of an LLE algorithm strongly depends on the target application. Following, a description of the main features of each LLE algorithm from the application point of view:

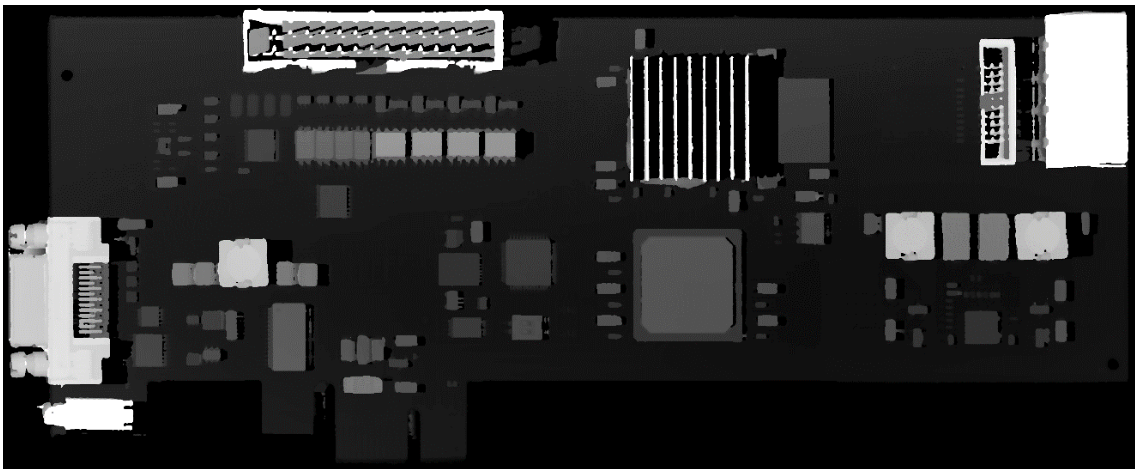
- MaxDetection_8 (8-bit): This version of the MaxDetection module with an 8-bit depth map output generates a very small amount of data which requires less computing performance from the 3D post-processing stage.
- MaxDetection_16 (16-bit): With its 16-bit integer depth map output, the version of the MaxDetection module can support very large LLE-ROI.
- PeakDetection: The two versions of the PeakDetection module offer a trade-off between sub-pixel resolution and maximum effective LLE-ROI size. The PeakDetection was designed to be insensitive to intensity-dependent biases.
- CenterOfGravity: The two versions of the CenterOfGravity module also offer a trade-off between sub-pixel resolution and maximum effective LLE-ROI size. The CenterOfGravity was designed to be robust to noisy inputs and wide lines.

Defining Scan Length and Buffer Size

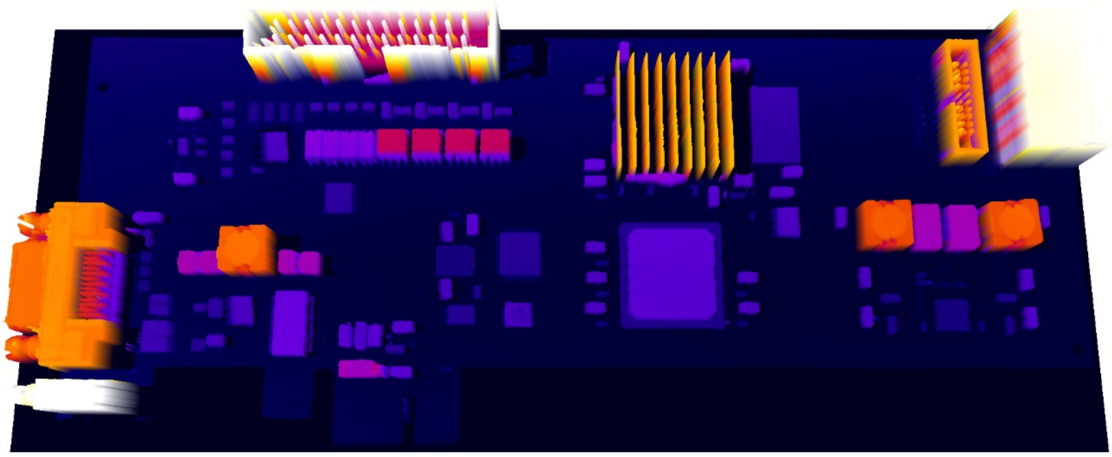
The ScanLength and BufferHeight will depend on the desired number of profiles to acquire from a given object. The size of the object being scanned, the camera frame rate, and the object movement speed are essential parameters to be defined along with the ScanLength.

Scanning Results

The resulting depth map of the measured PCB can be seen in the following figures.



Depth map example



Depth map example: 3D surface plot

Appendix

Fixed-point “Q-format” notation

The UQm.n system is a representation of fixed-point numbers in the Q-format where Q designates a number in the Q-forma notation, U preceding Q indicates an unsigned value, m indicates the number of bits of the integer portion of the number, and n designate the fraction portion the number. For instance, UQ11.5 is an unsigned fixed-point value represented by 16-bit words with 11 integer bits and 5 fractional bits. Other valid notation for UQ11.5 are fx11.16 and 0:11:5.

How to convert “UQ11.5” fixed-point values to floating-point

The UQ11.5 fixed-point values produced by the laser line extractor are 16-bit words representing values with 11 integer bits and 5 fractional bits.

To convert from this format to float, first convert the value to float, then divide by $2^5 = 32$.

```
float toFloat(unsigned short x) {
    float f = x;
    return f / 32;
}
```

How to convert “UQ8.8” fixed-point values to floating-point

The UQ8.8 fixed-point values produced by the laser line extractor are 16-bit words representing values with 8 integer bits and 8 fractional bits.

To convert from this format to float, first convert the value to float, then divide by $2^8 = 256$.

```
float toFloat(unsigned short x) {
    float f = x;
    return f / 256;
}
```

13.5. JPEG Encoding

JPEG encoding on Stream1 only

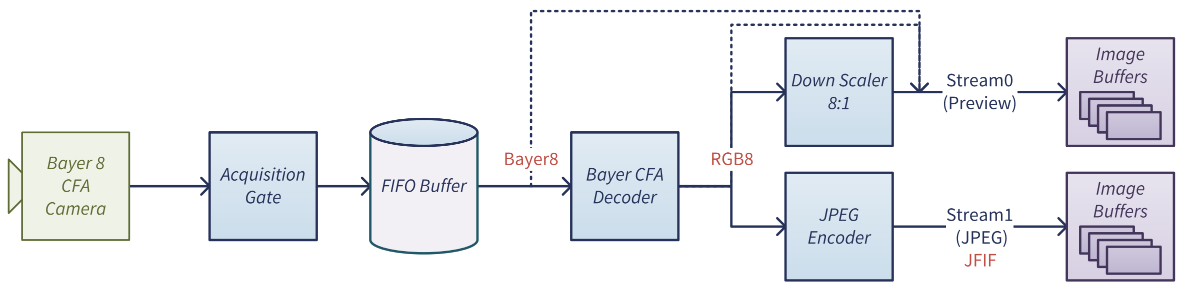
Applies to the following firmware variants of [1]

Quad12J Quad12J-4 (4-camera)

The **3620 Coaxlink Quad CXP-12 JPEG** is a four-connection CoaXPress CXP-12 frame grabber fitted with embedded CFA decoders and JPEG encoders.

The *4-camera* firmware variant implements 4 independent channels composed with:

- A 1-connection CoaXPress CXP-12 Host interface with PoCXP and Camera triggering capabilities,
- An acquisition gate that selects the frames to capture,
- A 512 MB FIFO buffer that provides a large elastic buffer,
- A Bayer CFA decoder that converts the Bayer8 camera data stream into an RGB8 stream using the advanced algorithm,
- A JPEG encoder including an RGB8 to YUV422 converter front-end and a baseline ISO/IEC 10918-1 compliant JPEG encoder,
- A down-scaler that reduces by a factor of 8 the RGB8 image resolution in both directions.



Camera requirements

- 8-bit Bayer CFA area-scan color camera,
- Image resolutions (H x V) : from 128 x 16 up to 5120 x 3840, with both width and height multiples of 8,
- CXP-1 up to CXP-12 CoaXPress interface.

Channel specifications

- Pixel processing rate: up to 250 Megapixels/second
- Output streams: 2 ('Preview' and 'JPEG')
- Encoder control: JPEG quality

[1] 3620 Coaxlink Quad CXP-12 JPEG and 3620-4 Coaxlink Quad CXP-12 JPEG.

Preview stream specifications

- Pixel formats: RGB8 or Bayer8
- Resolution: 'full' or '8:1' (for RGB8 only)

JPEG stream specifications

- JPEG control: Quality from 1 up to 100 (default: 75)
- Pixel format: CustomJFIF
- Resolution: 'full'
- Latency: 20 lines typical

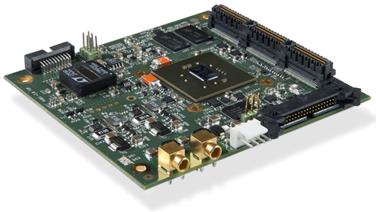
PART III
HARDWARE MANUAL

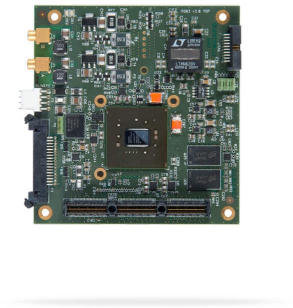
1. Mechanical Specification

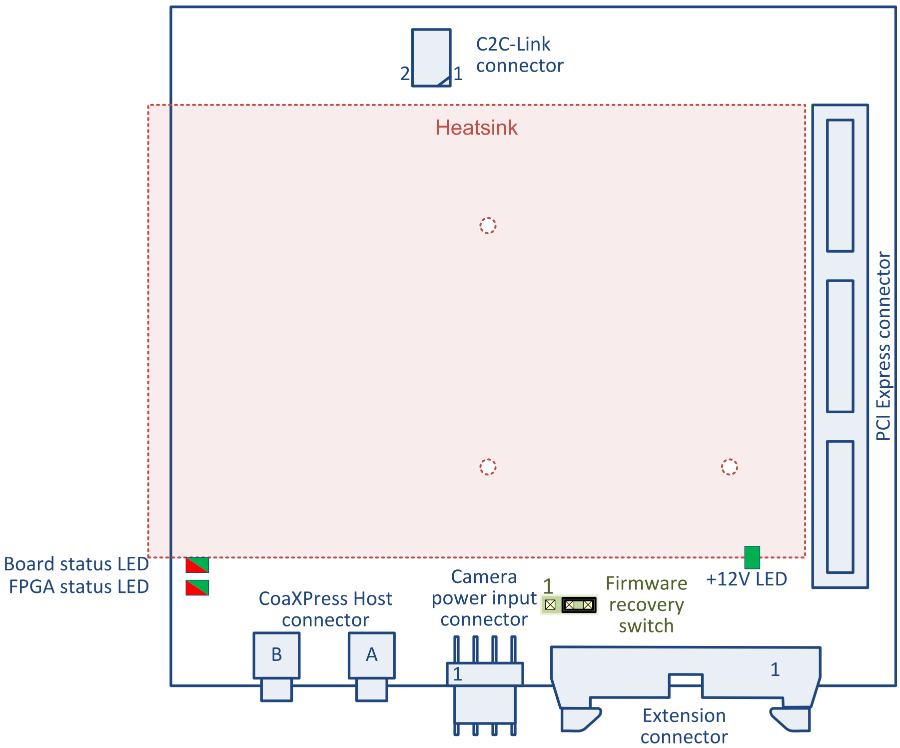
Mechanical specifications of the product(s) including: product pictures, physical dimensions, connectors description and pin assignments, LEDs description, switches description, etc.

1.1. Board and Bracket Layouts

1629 Coaxlink Duo PCIe/104-EMB







Connectors

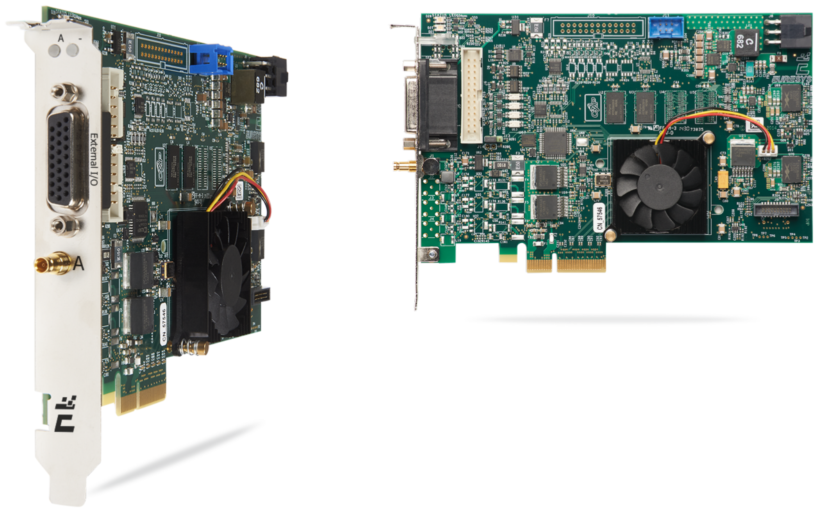
- "C2C-Link Connector" on page 432

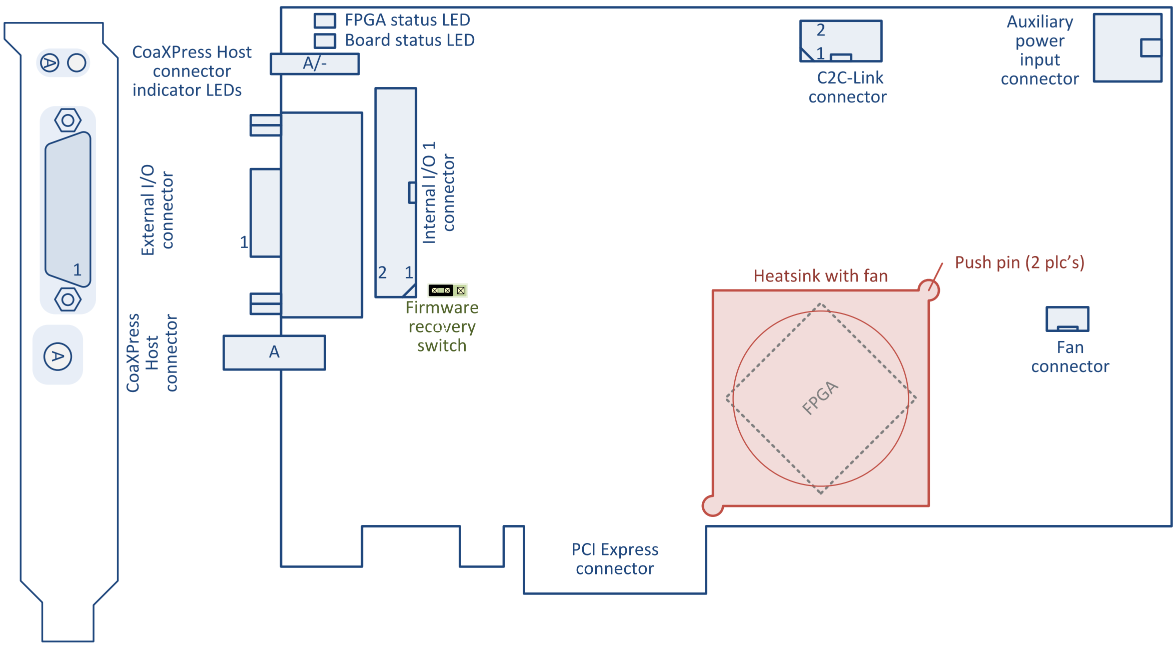
Lamps and switches

- "12 V LED" on page 440
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

- "Camera Power Input Connector" on page 436
- "CoaXPress Host Connector - MCX 2" on page 396

1630 Coaxlink Mono





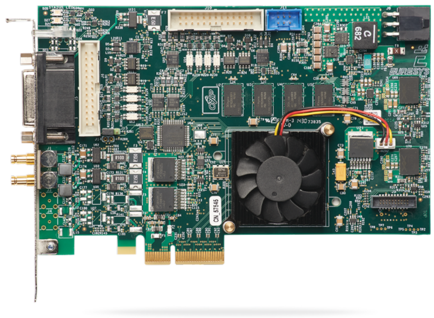
Connectors

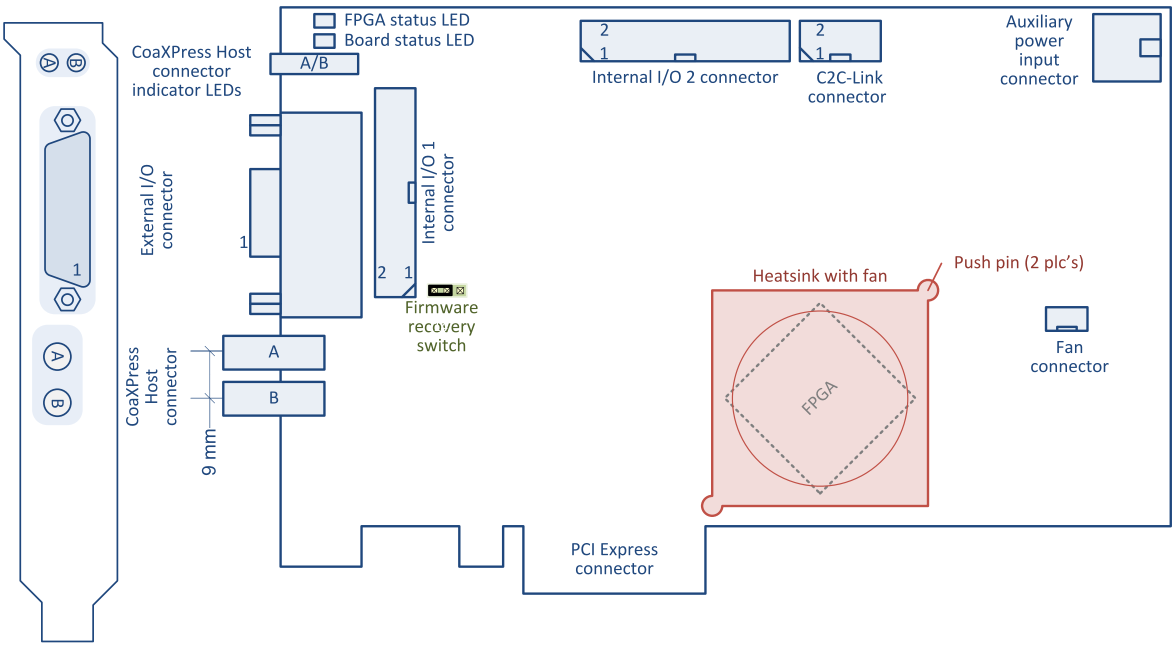
- "Auxiliary Power Input Connector for PoCXP and GPIO" on page 433
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - DIN 1" on page 390
- "External I/O Connector" on page 403
- "Internal I/O 1 Connector" on page 421

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

1631 Coaxlink Duo





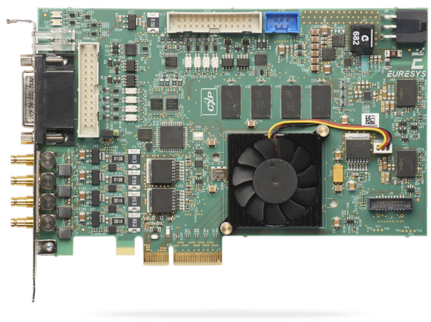
Connectors

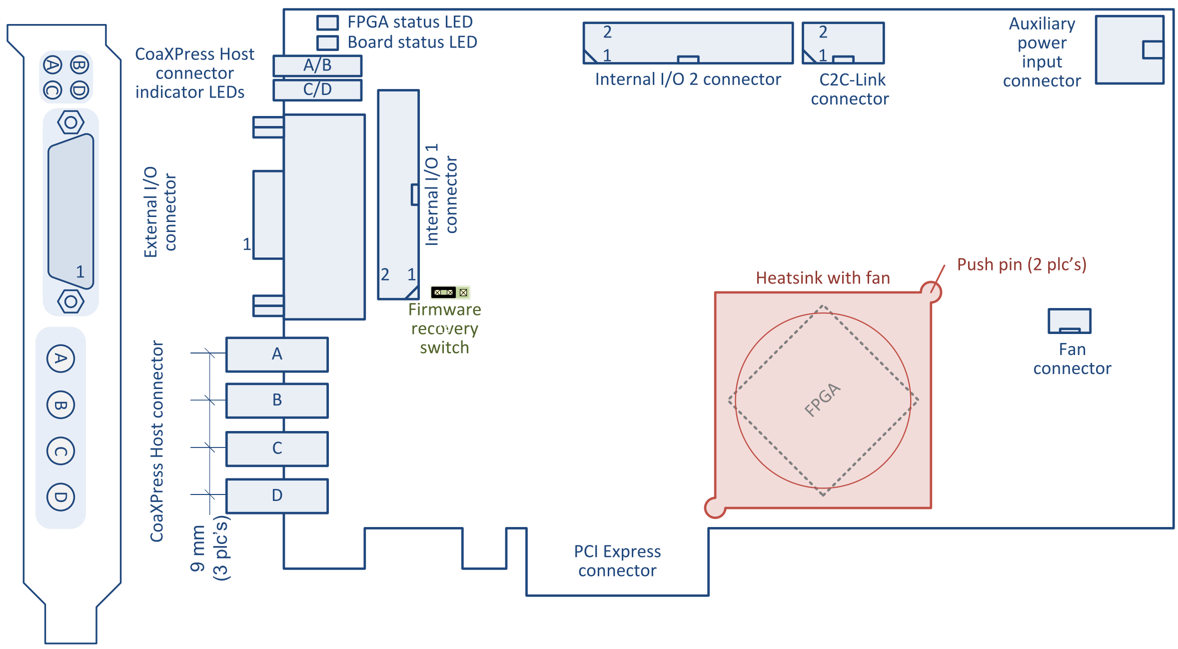
- "Auxiliary Power Input Connector for PoCXP and GPIO" on page 433
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - DIN 2" on page 391
- "External I/O Connector" on page 403
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

1632 Coaxlink Quad





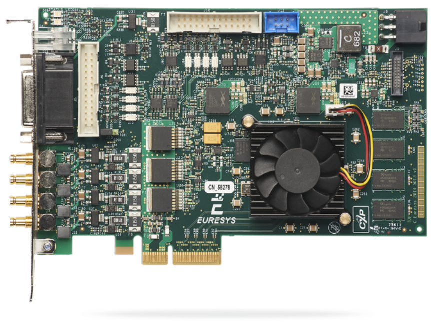
Connectors

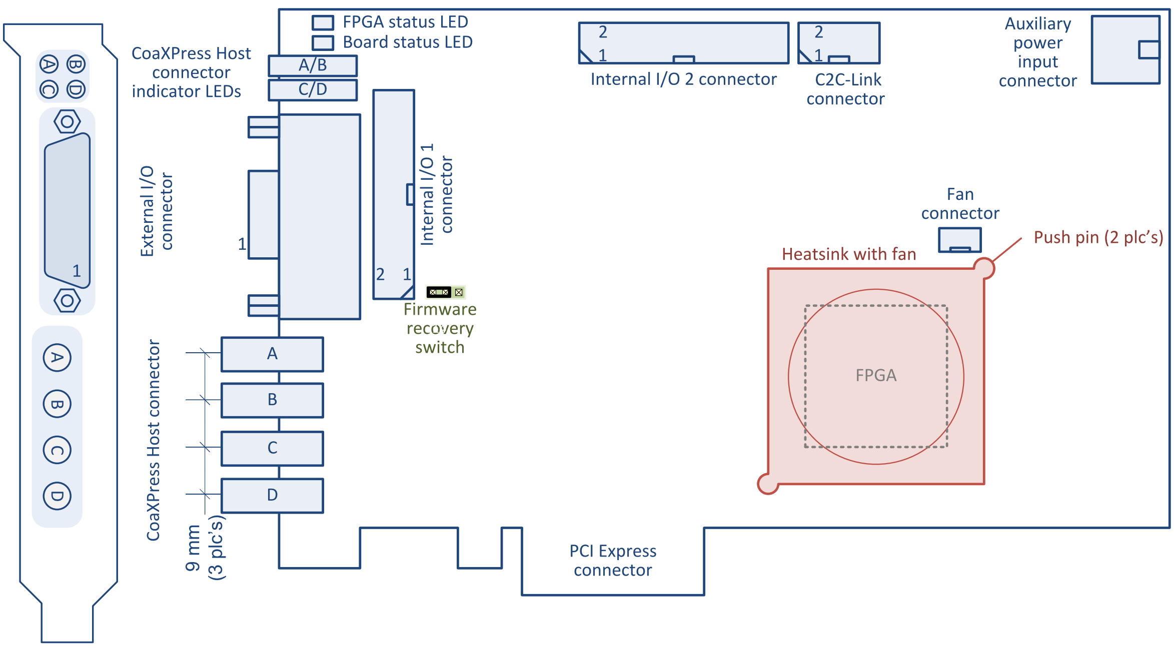
- "Auxiliary Power Input Connector for PoCXP and GPIO" on page 433
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - DIN 4" on page 392
- "External I/O Connector" on page 403
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

1633 Coaxlink Quad G3





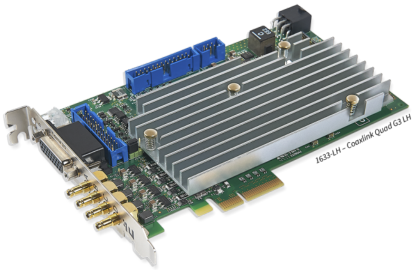
Connectors

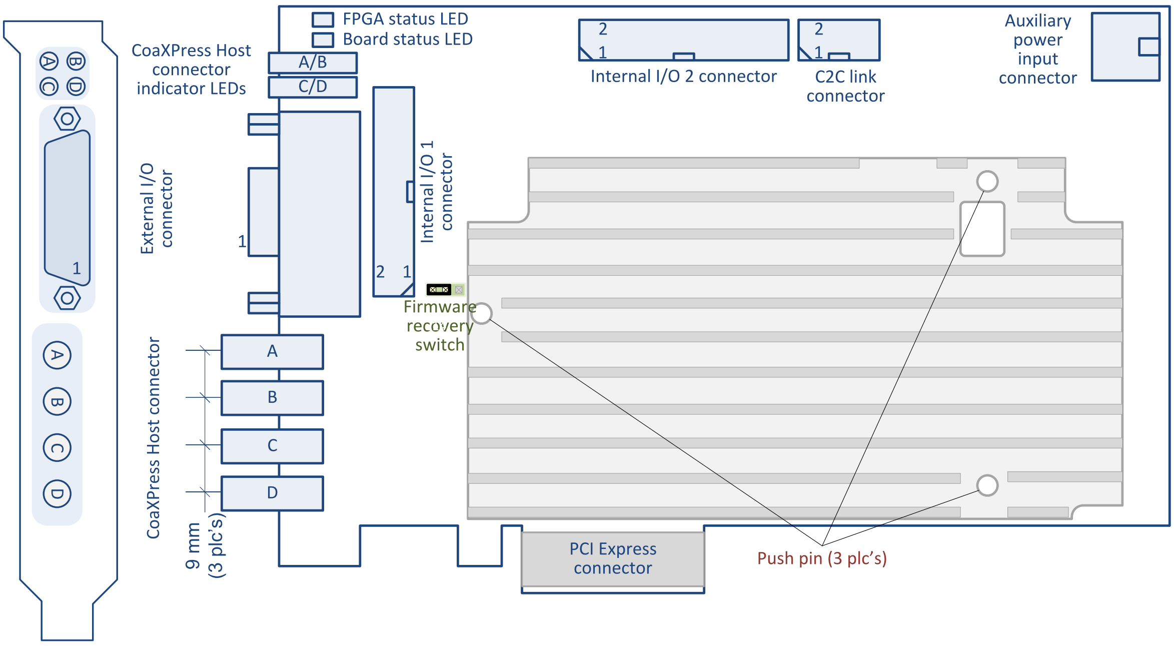
- "Auxiliary Power Input Connector for PoCXP and GPIO" on page 433
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - DIN 4" on page 392
- "External I/O Connector" on page 403
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

1633-LH Coaxlink Quad G3 LH





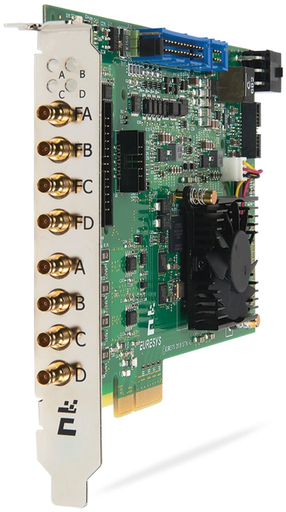
Connectors

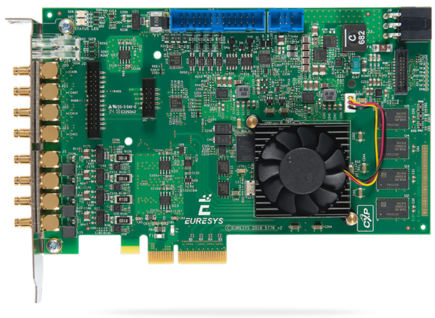
- "Auxiliary Power Input Connector for PoCXP and GPIO" on page 433
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - DIN 4" on page 392
- "External I/O Connector" on page 403
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

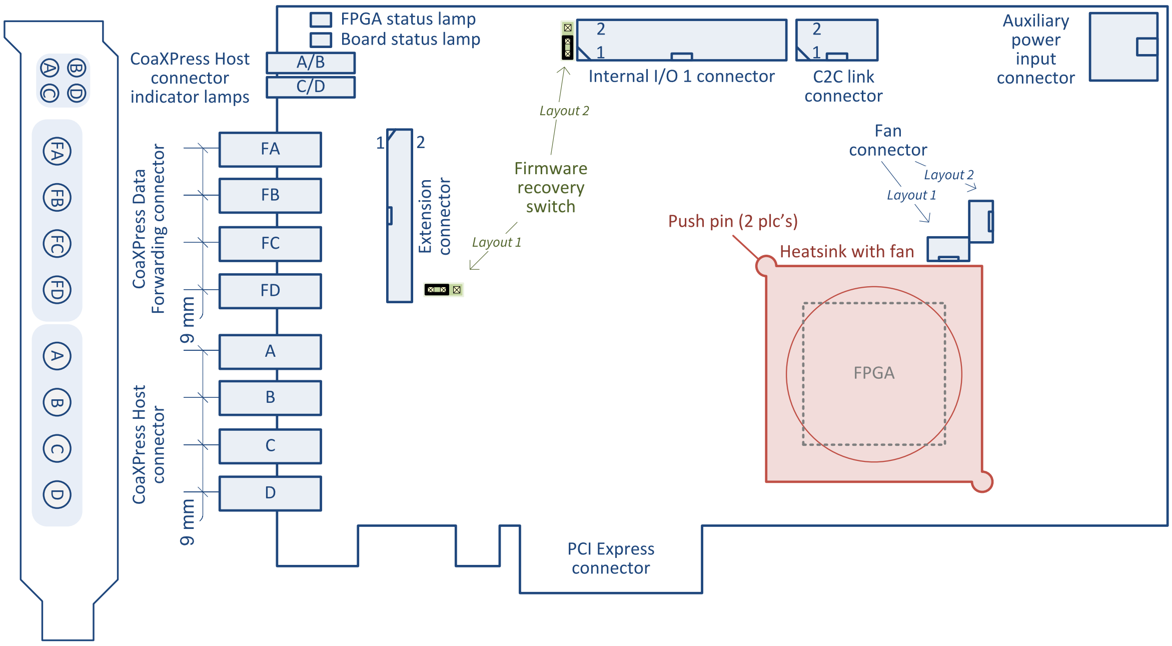
Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

1635 Coaxlink Quad G3 DF







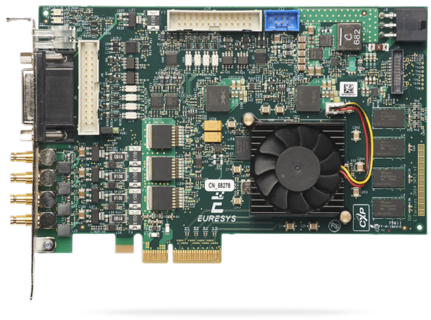
Connectors

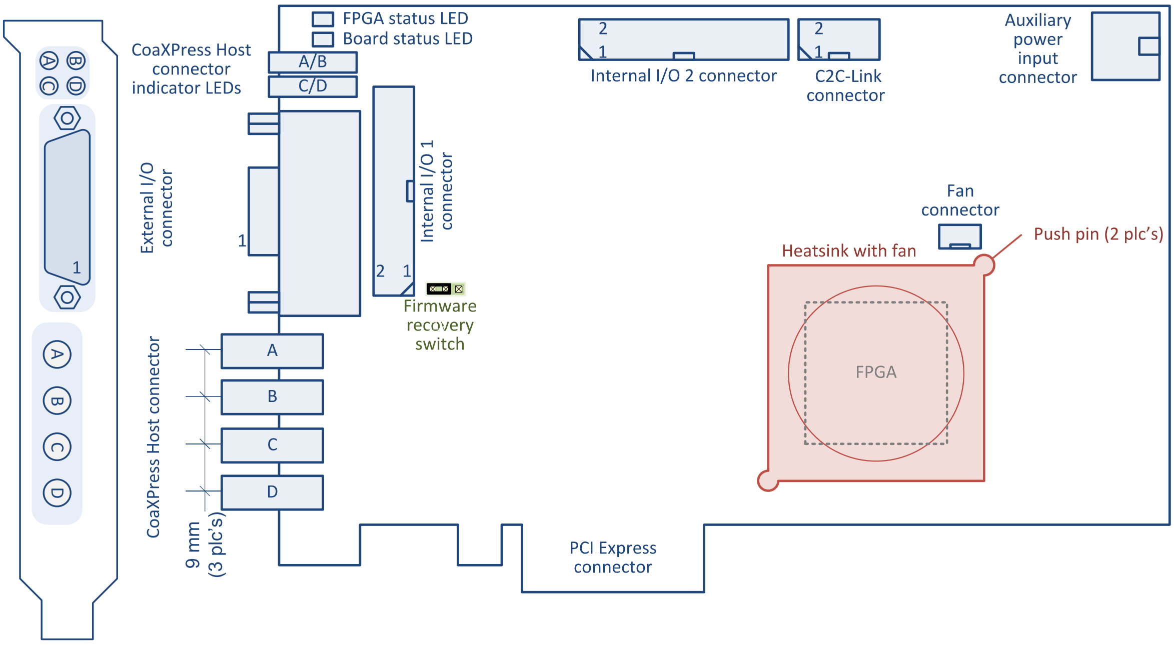
- "Auxiliary Power Input Connector for PoCXP and GPIO" on page 433
- "C2C-Link Connector" on page 432
- "CoaXPress Data Forwarding Connector - DIN 4" on page 393
- "CoaXPress Host Connector - DIN 4" on page 392
- "Internal I/O 1 Connector" on page 421

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

1637 Coaxlink Quad 3D-LLE





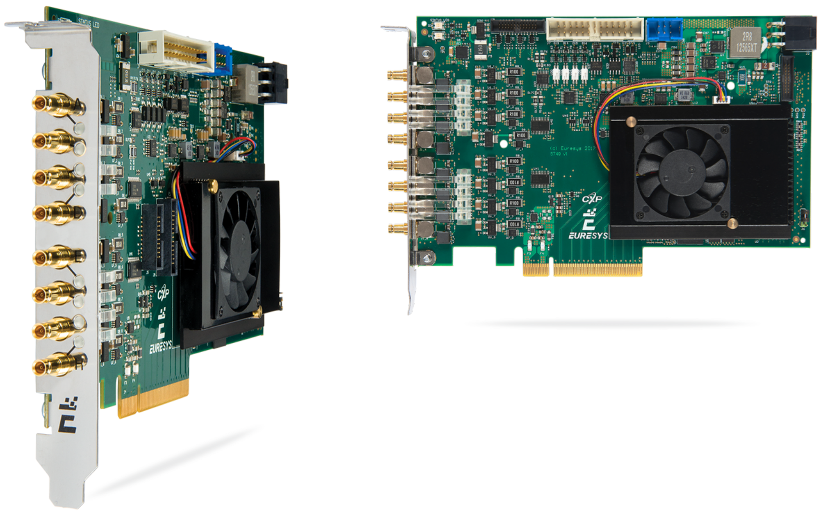
Connectors

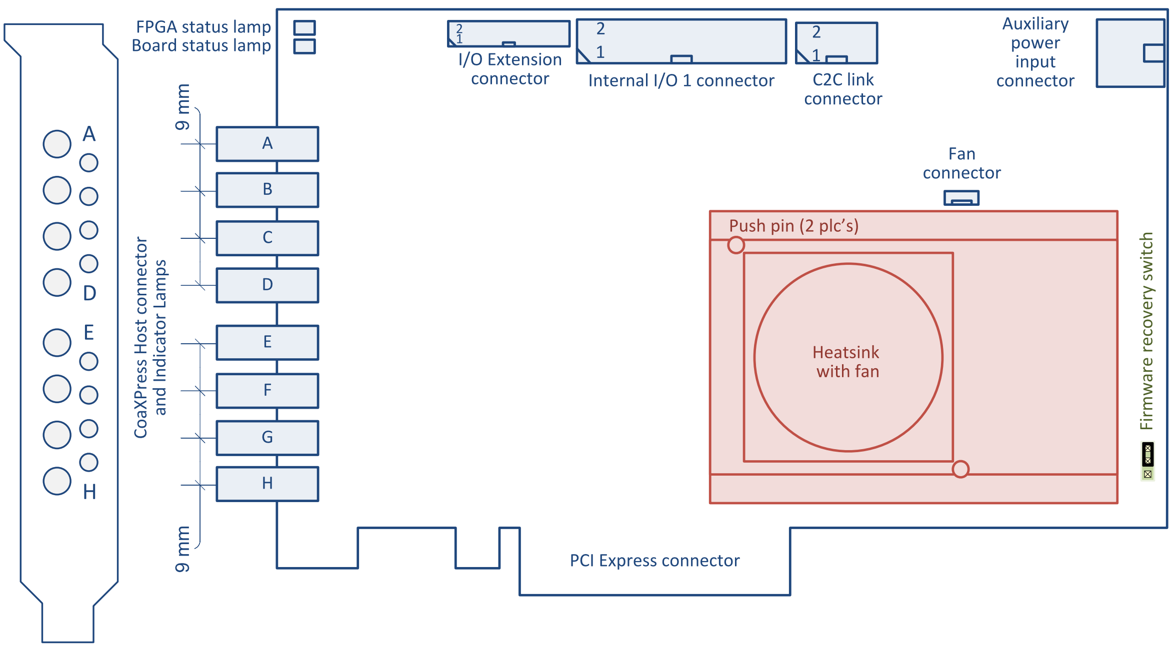
- "Auxiliary Power Input Connector for PoCXP and GPIO" on page 433
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - DIN 4" on page 392
- "External I/O Connector" on page 403
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3602 Coaxlink Octo





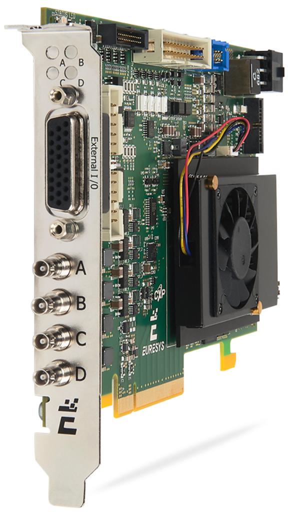
Connectors

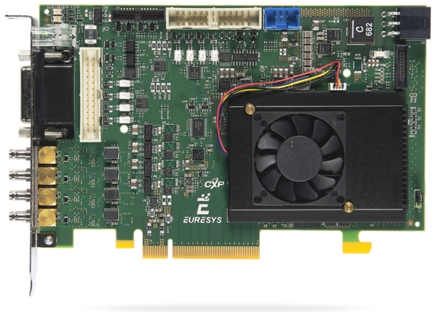
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - DIN 8" on page 395
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421

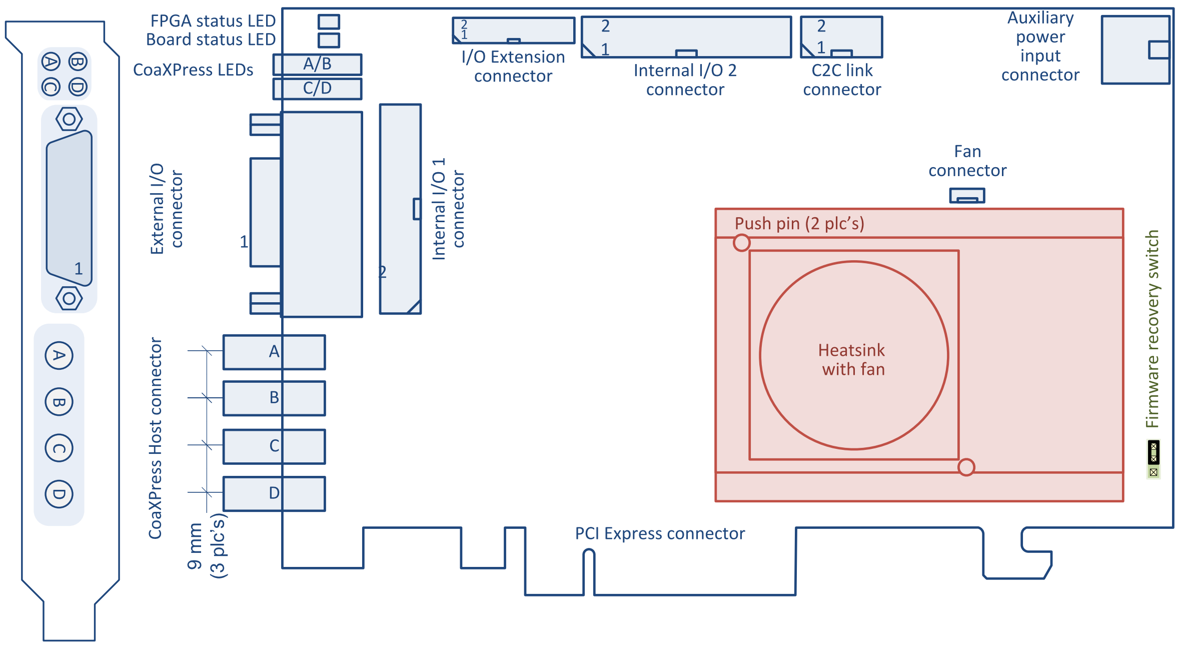
Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3603 Coaxlink Quad CXP-12 and 3603-4 Coaxlink Quad CXP-12







Connectors

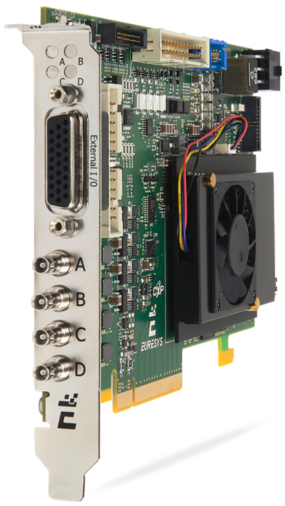
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - Micro-BNC 4" on page 399
- "External I/O Connector" on page 403

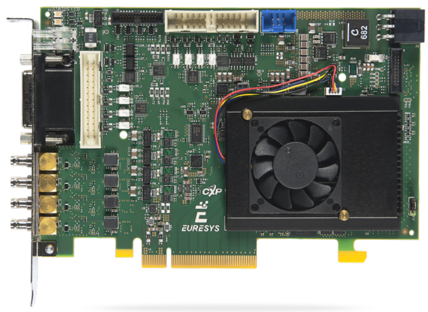
Lamps and switches

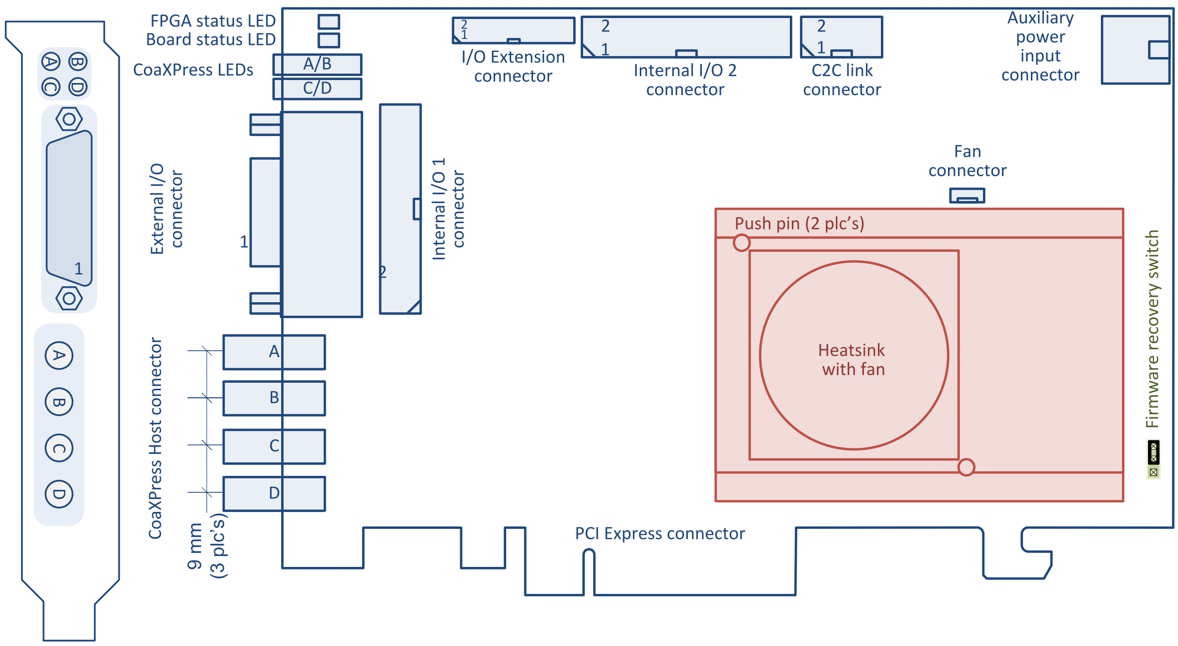
- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

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







Connectors

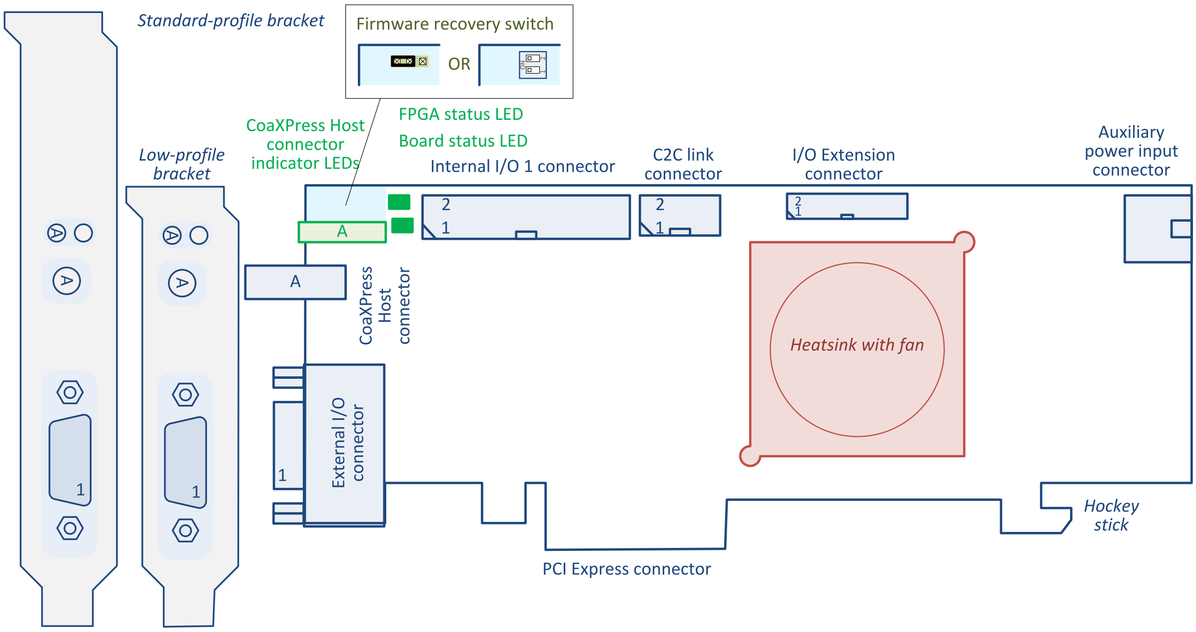
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - Micro-BNC 4" on page 399
- "External I/O Connector" on page 403

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

3621 Coaxlink Mono CXP-12



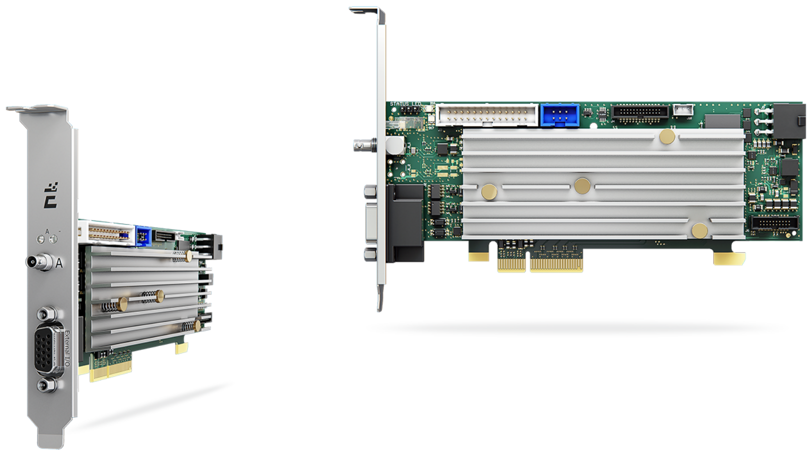
Connectors

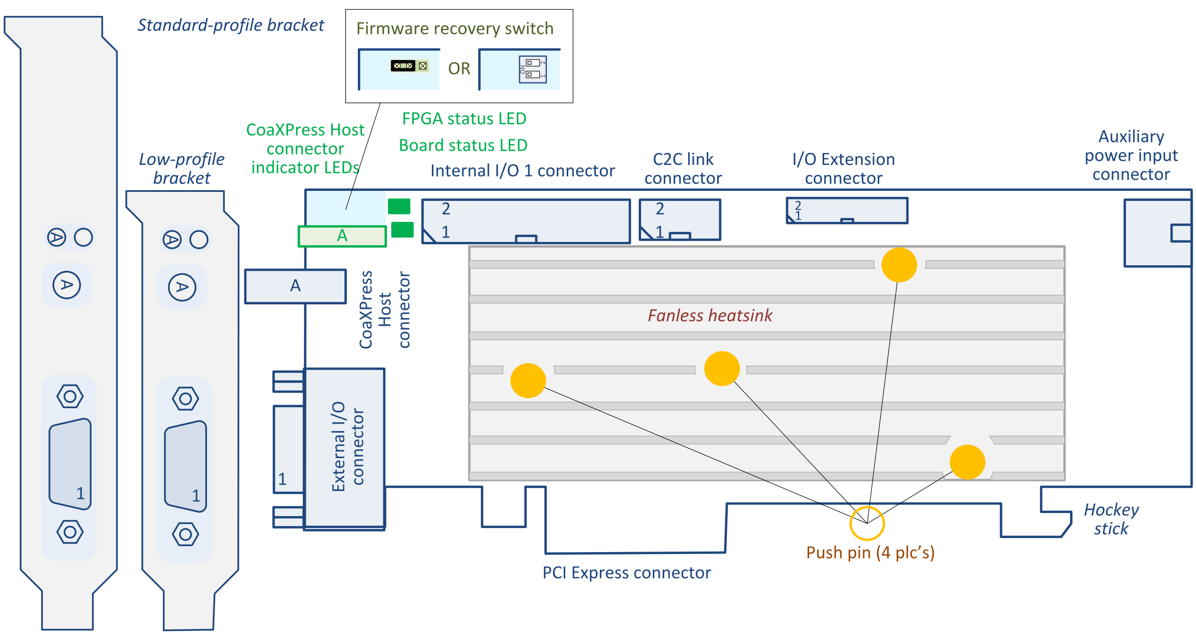
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - Micro-BNC 1" on page 397
- "External I/O Connector - 15-pin" on page 405
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3621-LH Coaxlink Mono CXP-12 LH





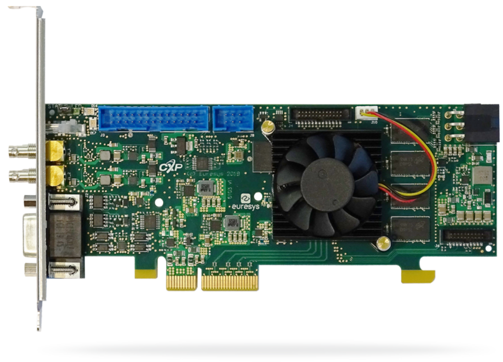
Connectors

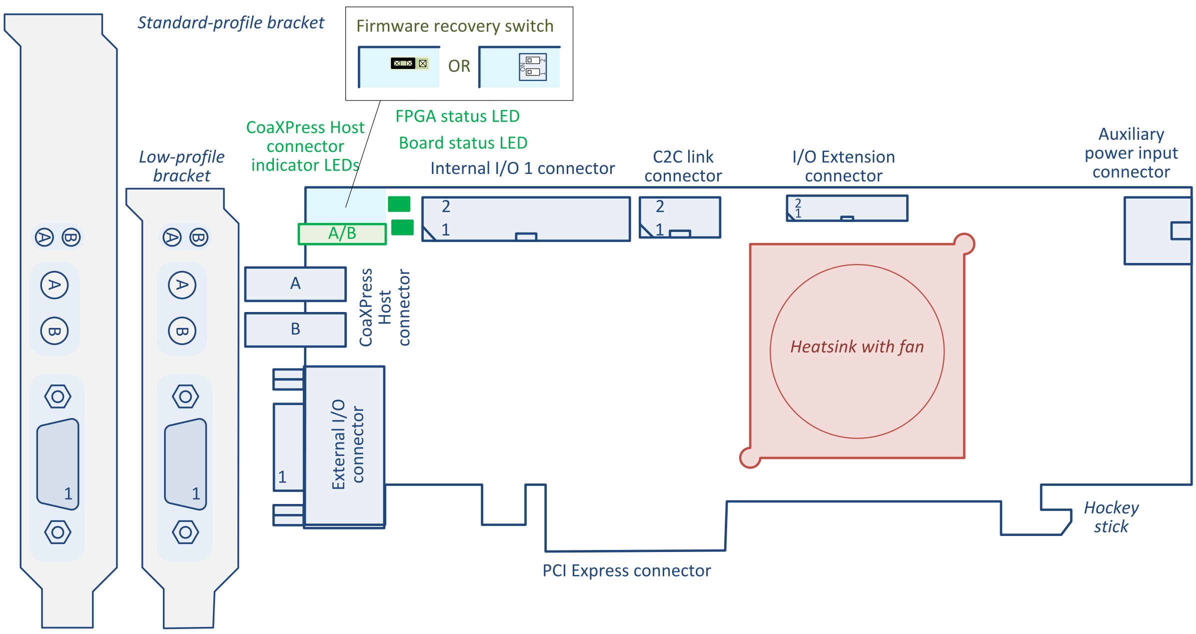
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - Micro-BNC 1" on page 397
- "External I/O Connector - 15-pin" on page 405
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3622 Coaxlink Duo CXP-12





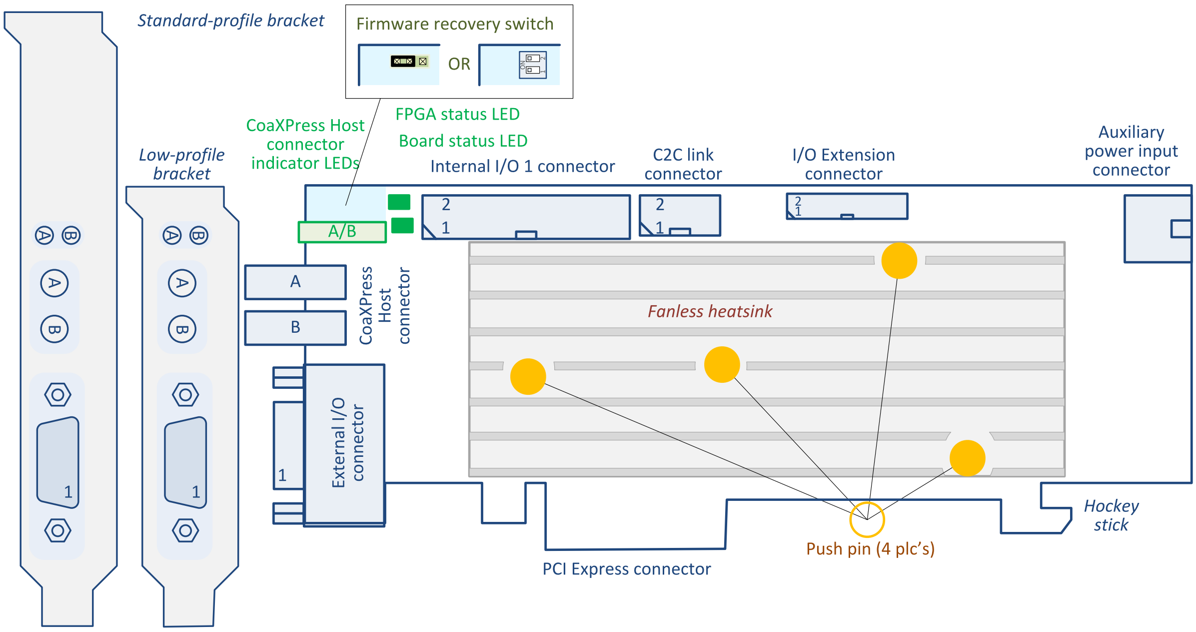
Connectors

- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - Micro-BNC 2" on page 398
- "External I/O Connector - 15-pin" on page 405
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3622-LH Coaxlink Duo CXP-12 LH



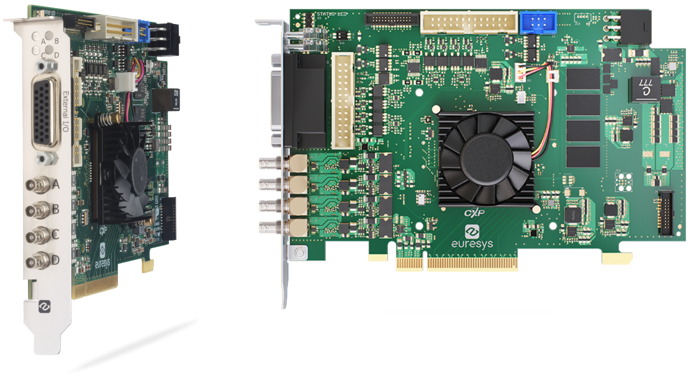
Connectors

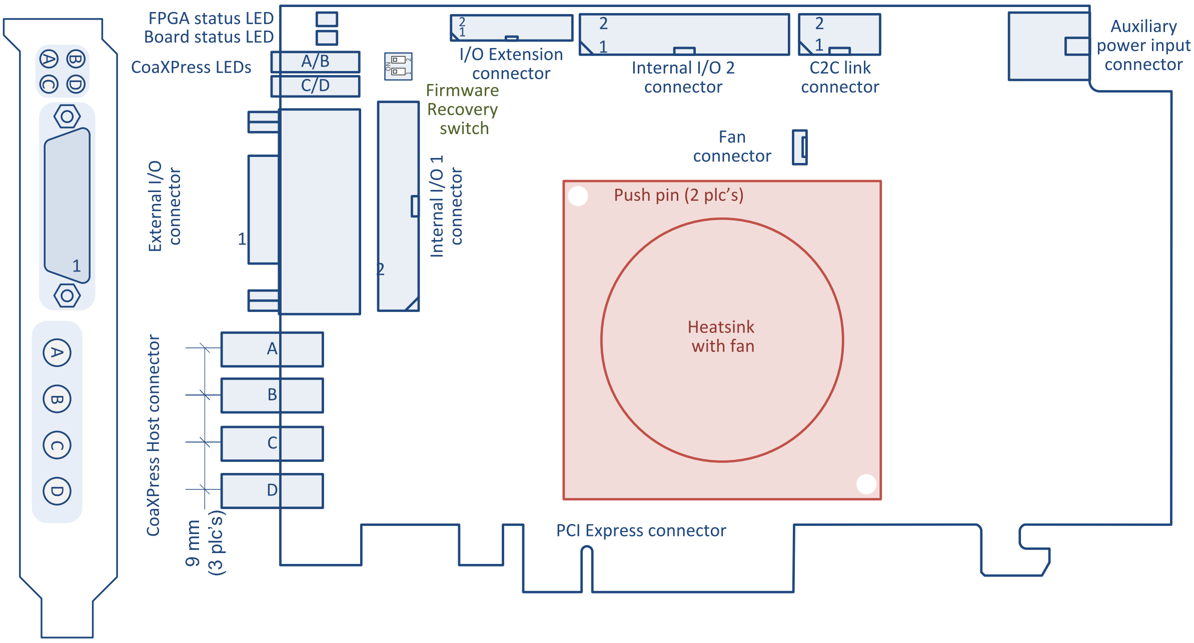
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - Micro-BNC 2" on page 398
- "External I/O Connector - 15-pin" on page 405
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3623 Coaxlink Quad CXP-12 Value





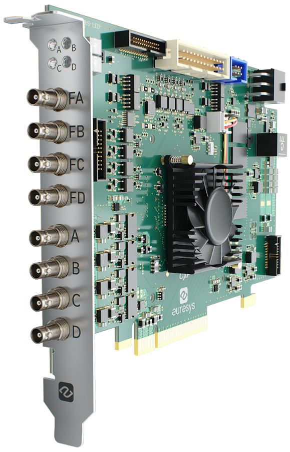
Connectors

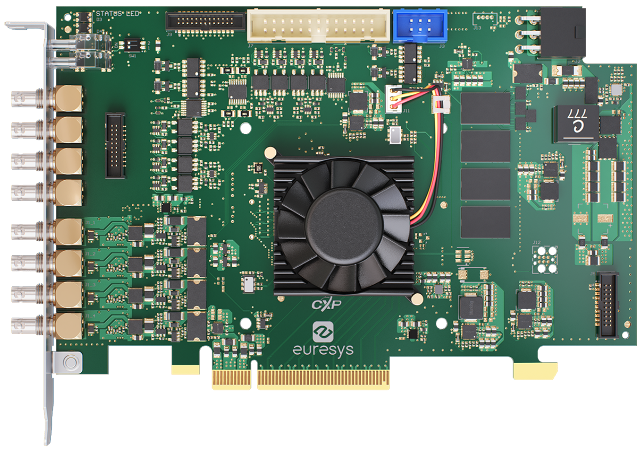
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Host Connector - Micro-BNC 4" on page 399
- "External I/O Connector" on page 403
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421
- "Internal I/O 2 Connector" on page 423

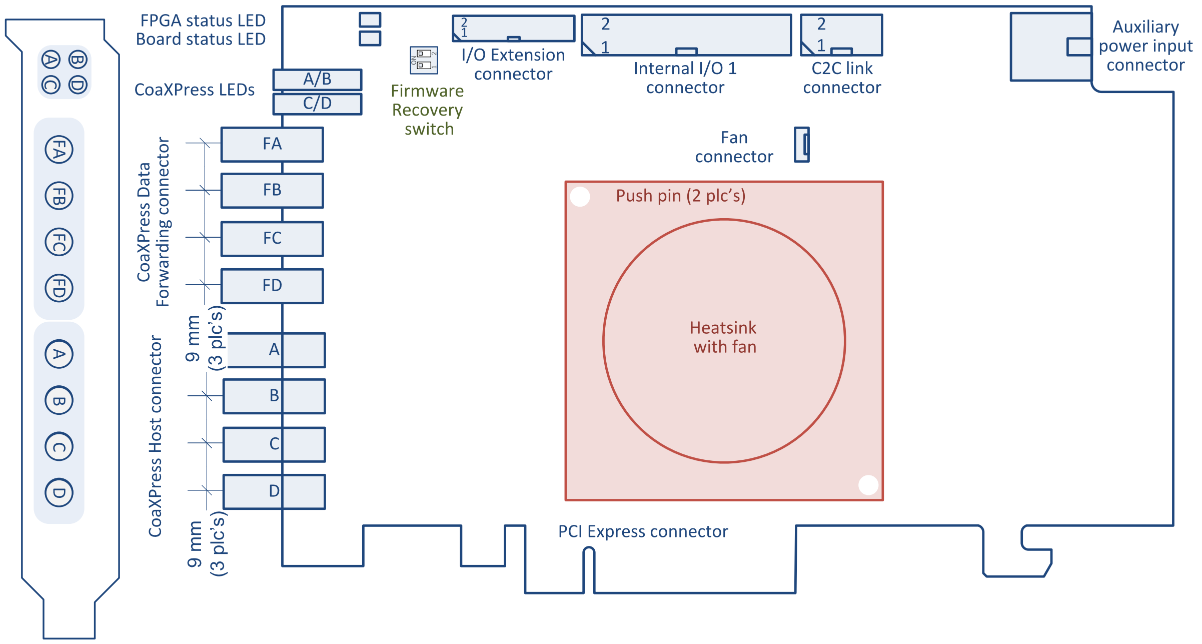
Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3624 Coaxlink Quad CXP-12 DF







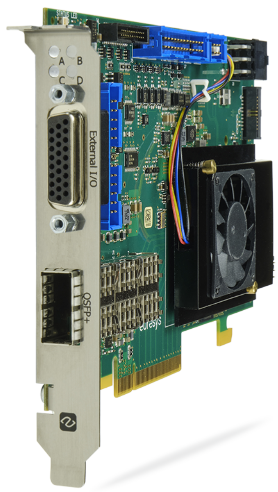
Connectors

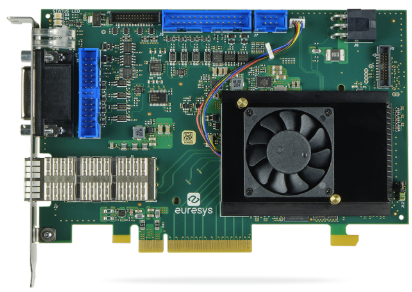
- "Auxiliary Power Input Connector w/o SenseIN" on page 434
- "C2C-Link Connector" on page 432
- "CoaXPress Data Forwarding Connector - Micro-BNC 4" on page 394
- "CoaXPress Host Connector - Micro-BNC 4" on page 399
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421

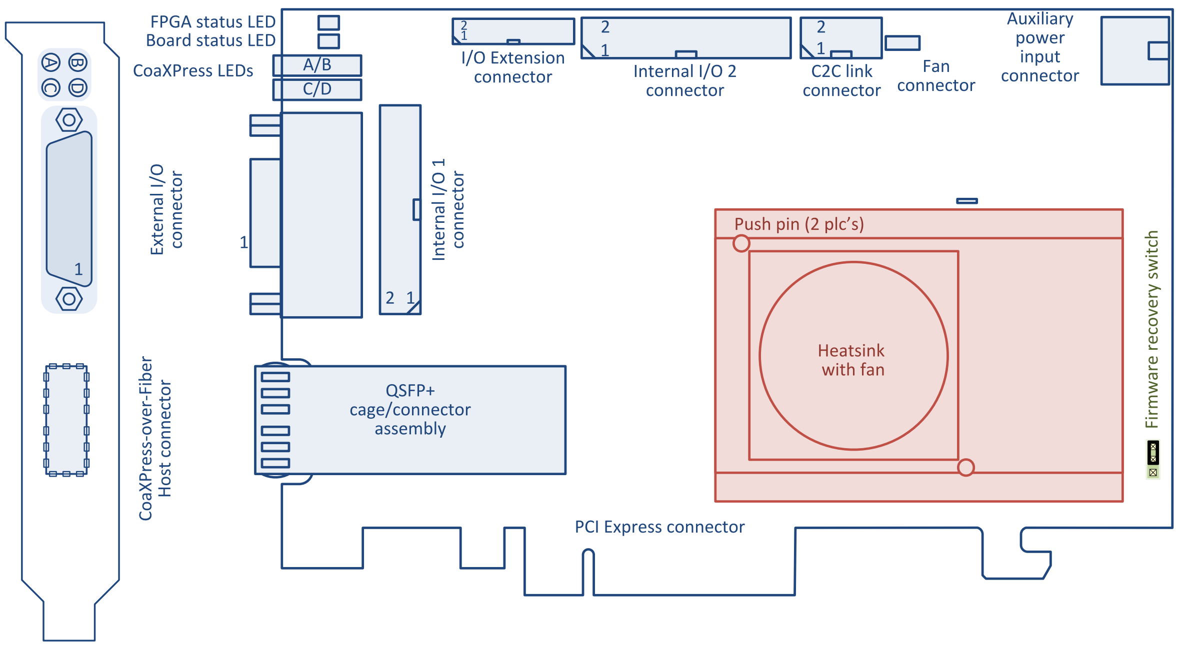
Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

3625 Coaxlink QSFP+







Connectors

- "Auxiliary Power Input Connector for GPIO" on page 435
- "C2C-Link Connector" on page 432
- "CoaXPress-over-Fiber Host Connector - QSFP+" on page 400
- "External I/O Connector" on page 403
- "I/O Extension Connector" on page 430
- "Internal I/O 1 Connector" on page 421

Lamps and switches

- "CoaXPress LED Lamps" on page 438
- "Board Status LED" on page 441
- "FPGA Status LED" on page 442
- "Firmware Recovery Switch" on page 443

- "Internal I/O 2 Connector" on page 423

1.2. Camera Connectors

CoaXPress Host Connector - DIN 1

Applies to [1]

Mono

Not recommended for new designs

Connector description

Property	Value
Name, Label	CoaXPress Host A
Type	DIN 1.0/2.3 75 Ohms coaxial female receptacle
Location	Card bracket
Usage	CoaXPress Host Interface

Pin assignments

Pin	Signal	Usage
Inner	CXP_A	CoaXPress Host Connection A
Outer	GND	Ground

[1] 1630 Coaxlink Mono.

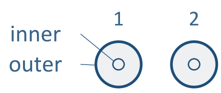
CoaXPress Host Connector - DIN 2

Applies to [1]

Duo Not recommended for new designs

Connector description

Property	Value
Name, Label	CoaXPress Host A B
Type	2 x DIN 1.0/2.3 75 Ohms coaxial receptacles
Location	Card bracket
Usage	CoaXPress Host Interface



Pin assignments

Pin	Signal	Usage
Inner1	CXP_A	CoaXPress Host Connection A
Outer1	GND	Ground
Inner2	CXP_B	CoaXPress Host Connection B
Outer2	GND	Ground

[1] 1631 Coaxlink Duo.

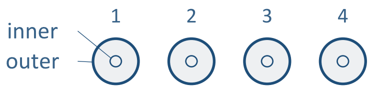
CoaXPress Host Connector - DIN 4

Applies to [1]

Quad QuadG3 QuadG3LH QuadG3DF Quad3DLLE

Connector description

Property	Value
Name, Label	CoaXPress Host A B C D
Type	4 x DIN 1.0/2.3 75 Ohms coaxial receptacles
Location	Card bracket
Usage	CoaXPress Host Interface



Pin assignments

Pin	Signal	Usage
Inner1	CXP_A	CoaXPress Host Connection A
Outer1	GND	Ground
Inner2	CXP_B	CoaXPress Host Connection B
Outer2	GND	Ground
Inner3	CXP_C	CoaXPress Host Connection C
Outer3	GND	Ground
Inner4	CXP_D	CoaXPress Host Connection D
Outer4	GND	Ground

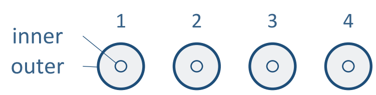
[1] 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF and 1637 Coaxlink Quad 3D-LLE.

CoaXPress Data Forwarding Connector - DIN 4

Applies to [1]
QuadG3DF

Connector description

Property	Value
Name, Label	CoaXPress Data Forwarding FA FB FC FD
Type	4 x DIN 1.0/2.3 75 Ohms coaxial receptacles
Location	Card bracket
Usage	CoaXPress Data Forwarding Interface



Pin assignments

Pin	Signal	Usage
Inner1	CXP_FA	CoaXPress Data Forwarding Connection A
Outer1	GND	Ground
Inner2	CXP_FB	CoaXPress Data Forwarding Connection B
Outer2	GND	Ground
Inner3	CXP_FC	CoaXPress Data Forwarding Connection C
Outer3	GND	Ground
Inner4	CXP_FD	CoaXPress Data Forwarding Connection D
Outer4	GND	Ground

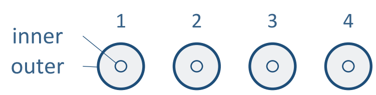
[1] 1635 Coaxlink Quad G3 DF.

CoaXPress Data Forwarding Connector - Micro-BNC 4

Applies to [1]
Quad12DF

Connector description

Property	Value
Name, Label	CoaXPress Data Forwarding FA FB FC FD
Type	4 x Micro-BNC 75 Ohms coaxial receptacles
Location	Card bracket
Usage	CoaXPress Data Forwarding Interface



Pin assignments

Pin	Signal	Usage
Inner1	CXP_FA	CoaXPress Data Forwarding Connection A
Outer1	GND	Ground
Inner2	CXP_FB	CoaXPress Data Forwarding Connection B
Outer2	GND	Ground
Inner3	CXP_FC	CoaXPress Data Forwarding Connection C
Outer3	GND	Ground
Inner4	CXP_FD	CoaXPress Data Forwarding Connection D
Outer4	GND	Ground

[1] 3624 Coaxlink Quad CXP-12 DF.

CoaXPress Host Connector - DIN 8

Applies to [1]
Octo

Connector description

Property	Value
Name, Label	CoaXPress Host A B C D E F G H
Type	8 x DIN 1.0/2.3 75 Ohms coaxial receptacles
Location	Card bracket
Usage	CoaXPress Host Interface

Pin assignments

Pin	Signal	Usage
Inner1	CXP_A	CoaXPress Host Connection A
Outer1	GND	Ground
Inner2	CXP_B	CoaXPress Host Connection B
Outer2	GND	Ground
Inner3	CXP_C	CoaXPress Host Connection C
Outer3	GND	Ground
Inner4	CXP_D	CoaXPress Host Connection D
Outer4	GND	Ground
Inner5	CXP_E	CoaXPress Host Connection E
Outer5	GND	Ground
Inner6	CXP_F	CoaXPress Host Connection F
Outer6	GND	Ground
Inner7	CXP_G	CoaXPress Host Connection G
Outer7	GND	Ground
Inner8	CXP_H	CoaXPress Host Connection H
Outer8	GND	Ground

[1] 3602 Coaxlink Octo.

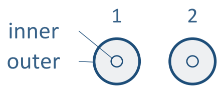
CoaXPress Host Connector - MCX 2

Applies to [1]

Duo104EMB Not recommended for new designs

Connector description

Property	Value
Name, Label	CoaXPress Host A B
Type	2x MCX 75 Ohms coaxial female receptacle
Location	Printed circuit board
Usage	CoaXPress Host Interface



Pin assignments

Pin	Signal	Usage
Inner1	CXP_A	CoaXPress Host Connection A
Outer1	GND	Ground
Inner2	CXP_B	CoaXPress Host Connection B
Outer2	GND	Ground

[1] 1629 Coaxlink Duo PCIe/104-EMB.

CoaXPress Host Connector - Micro-BNC 1

Applies to [1]

Mono12 Mono12LH

Connector description

Property	Value
Name, Label	CoaXPress Host A
Type	Micro-BNC 75 Ohms coaxial receptacle
Location	Card bracket
Usage	CoaXPress Host Interface

Pin assignments

Pin	Signal	Usage
Inner1	CXP_A	CoaXPress Host Connection A
Outer1	GND	Ground

[1] 3621 Coaxlink Mono CXP-12 and 3621-LH Coaxlink Mono CXP-12 LH.

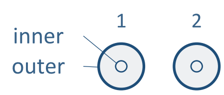
CoaXPress Host Connector - Micro-BNC 2

Applies to [1]

Duo12 Duo12LH

Connector description

Property	Value
Name, Label	CoaXPress Host A B
Type	2 x Micro-BNC 75 Ohms coaxial receptacles
Location	Card bracket
Usage	CoaXPress Host Interface



Pin assignments

Pin	Signal	Usage
Inner1	CXP_A	CoaXPress Host Connection A
Outer1	GND	Ground
Inner2	CXP_B	CoaXPress Host Connection B
Outer2	GND	Ground

[1] 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

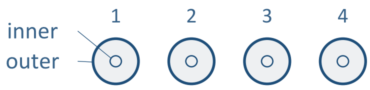
CoaXPress Host Connector - Micro-BNC 4

Applies to [1]

Quad12 Quad12-4 Quad12J Quad12J-4 Value12 Quad12DF

Connector description

Property	Value
Name, Label	CoaXPress Host A B C D
Type	4 x Micro-BNC 75 Ohms coaxial receptacles
Location	Card bracket
Usage	CoaXPress Host Interface



Pin assignments

Pin	Signal	Usage
Inner1	CXP_A	CoaXPress Host Connection A
Outer1	GND	Ground
Inner2	CXP_B	CoaXPress Host Connection B
Outer2	GND	Ground
Inner3	CXP_C	CoaXPress Host Connection C
Outer3	GND	Ground
Inner4	CXP_D	CoaXPress Host Connection D
Outer4	GND	Ground

[1] 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 3624 Coaxlink Quad CXP-12 DF.

CoaXPress-over-Fiber Host Connector - QSFP+

Applies to [1]
QSFP+

Connector description

Property	Value
Name, Label	CoaXPress-over-Fiber Host ABCD
Type	Enhanced Quad Small Form-factor Pluggable port
Location	Card bracket
Usage	CoaXPress-over-Fiber Host Interface

Pin assignments

Pin	Signal	Usage
1	GND	Ground
2	Tx2n	Transmitter B inverted data
3	Tx2p	Transmitter B non-inverted data
4	GND	Ground
5	Tx4n	Transmitter D inverted data
6	Tx4p	Transmitter D non-inverted data
7	GND	Ground
8	ModSel	Module select
9	Reset	Module reset
10	Vcc-Rx	+3.3 V receiver power supply
11	SCL	Two-wire serial interface clock
12	SDA	Two-wire serial interface data
13	GND	Ground
14	Rx3p	Receiver C non-inverted data

[1] 3625 Coaxlink QSFP+.

Pin	Signal	Usage
15	Rx3n	Receiver C inverted data
16	GND	Ground
17	Rx1p	Receiver A non-inverted data
18	Rx1n	Receiver A inverted data
19	GND	Ground
20	GND	Ground
21	Rx2n	Receiver B inverted data
22	Rx2p	Receiver B non-inverted data
23	GND	Ground
24	Rx4n	Receiver D inverted data
25	Rx4p	Receiver D non-inverted data
26	GND	Ground
27	ModPrs	Module present
28	IntRxLOS	Interrupt
29	Vcc-Tx	+3.3 V transmitter power supply
30	Vcc1	+3.3 V power supply
31	LPMode/TxDis	Low power mode
32	GND	Ground
33	Tx3p	Transmitter C non-inverted data
34	Tx3n	Transmitter C inverted data
35	GND	Ground
36	Tx1p	Transmitter A non-inverted data
37	Tx1n	Transmitter A inverted data
38	GND	Ground

1.3. GPIO Connectors

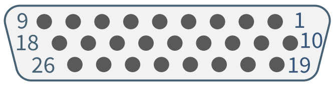
External I/O Connector

Applies to [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	Quad3DLLE
Quad12	Quad12-4	Quad12J	Quad12J-4	Value12	QSFP+	

Connector description

Property	Value
Name, Label	External I/O
Type	26-pin 3-row high-density female sub-D connector with UNC4-40 jack socket screws
Location	Card bracket
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	DIN12+	High-speed differential input #12 – Positive pole
3	IIN11+	Isolated input #11 – Positive pole
4	IIN13-	Isolated input #13 – Negative pole
5	IIN14-	Isolated input #14 – Negative pole
6	IOUT12-	Isolated contact output #12 – Negative pole
7	GND	Ground
8		Not connected
9	GND	Ground

[1] 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

Pin	Signal	Usage
10	GND	Ground
11	DIN12-	High-speed differential input #12 – Negative pole
12	IIN11-	Isolated input #11 – Negative pole
13	IIN12+	Isolated input #12 – Positive pole
14	IIN13+	Isolated input #13 – Positive pole
15	IIN14+	Isolated input #14 – Positive pole
16	IOUT12+	Isolated contact output #12 – Positive pole
17	TTLIO12	TTL input/output #12
18	GND	Ground
19	DIN11-	High-speed differential input #11 – Negative pole
20	DIN11+	High-speed differential input #11 – Positive pole
21	IIN12-	Isolated input #12 – Negative pole
22	IOUT11-	Isolated contact output #11 – Negative pole
23	IOUT11+	Isolated contact output #11 – Positive pole
24	GND	Ground
25	TTLIO11	TTL input/output #11
26	+12V	+12 V Power output

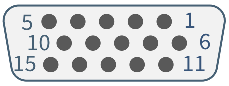
External I/O Connector - 15-pin

Applies to [1]

Mono12 Mono12LH Duo12 Duo12LH

Connector description

Property	Value
Name, Label	External I/O
Type	15-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	DIN12+	High-speed differential input #12 – Positive pole
2	IIN11+	Isolated input #11 – Positive pole
3	IIN12+	Isolated input #12 – Positive pole
4	TTLIO11	TTL input/output #11
5	GND	Ground
6	DIN11+	High-speed differential input #11 – Positive pole
7	DIN12-	High-speed differential input #12 – Negative pole
8	IIN12-	Isolated input #12 – Negative pole
9	IOUT11+	Isolated contact output #11 – Positive pole
10	GND	Ground
11	DIN11-	High-speed differential input #11 – Negative pole
12	IIN11-	Isolated input #11 – Negative pole
13	IOUT11-	Isolated contact output #11 – Negative pole

[1] 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

Pin	Signal	Usage
14	TTLIO12	TTL input/output #12
15	+12V	+12 V Power output

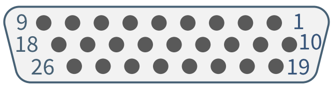
I/O Connector - 3300

Applies to [1]

3300 Not recommended for new designs

Connector description

Property	Value
Name, Label	External I/O 1
Type	26-pin 3-row high-density female sub-D connector with UNC4-40 jack socket screws
Location	Remote I/O module
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] 3300 HD26F I/O module for Coaxlink Duo PCIe/104.

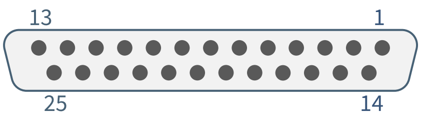
Pin	Signal	Usage
13	IIN12+	Isolated input #12 – Positive pole
14	IIN13+	Isolated input #13 – Positive pole
15	IIN14+	Isolated input #14 – Positive pole
16	IOUT12+	Isolated contact output #12 – Positive pole
17	TTLIO12	TTL input/output #12
18	GND	Ground
19	DIN11-	High-speed differential input #11 – Negative 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

External I/O Connector - 1625

Applies to [1]
1625

Connector description

Property	Value
Name, Label	External I/O
Type	25-pin female sub-D connector with UNC4-40 jack socket screws
Location	Card bracket
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	DIN11+	High-speed differential input #11 – Positive pole
3	DIN11-	High-speed differential input #11 – Negative pole
4	DIN12+	High-speed differential input #12 – Positive pole
5	DIN12-	High-speed differential input #12 – Negative pole
6	IIN11+	Isolated input #11 – Positive pole
7	IIN11-	Isolated input #11 – Negative pole
8	IIN12+	Isolated input #12 – Positive pole
9	IIN12-	Isolated input #12 – Negative pole
10	IIN13+	Isolated input #13 – Positive pole
11	IIN13-	Isolated input #13 – Negative pole
12	IIN14+	Isolated input #14 – Positive pole
13	IIN14-	Isolated input #14 – Negative pole

[1] 1625 DB25F I/O Adapter Cable.

Pin	Signal	Usage
14	IOUT11+	Isolated contact output #11 – Positive pole
15	IOUT11-	Isolated contact output #11 – Negative pole
16	IOUT12+	Isolated contact output #12 – Positive pole
17	IOUT12-	Isolated contact output #12 – Negative pole
18	TTLIO11	TTL input/output #11
19	GND	Ground
20	TTLIO12	TTL input/output #12
21	GND	Ground
22		Not connected
23	GND	Ground
24	+12V	+12 V Power output
25	+12V_RTN	Ground

Standard I/O set #2

Pin	Signal	Usage
1	GND	Ground
2	DIN21+	High-speed differential input #21 – Positive pole
3	DIN21-	High-speed differential input #21 – Negative pole
4	DIN22+	High-speed differential input #22 – Positive pole
5	DIN22-	High-speed differential input #22 – Negative pole
6	IIN21+	Isolated input #21 – Positive pole
7	IIN21-	Isolated input #21 – Negative pole
8	IIN22+	Isolated input #22 – Positive pole
9	IIN22-	Isolated input #22 – Negative pole
10	IIN23+	Isolated input #23 – Positive pole
11	IIN23-	Isolated input #23 – Negative pole
12	IIN24+	Isolated input #24 – Positive pole
13	IIN24-	Isolated input #24 – Negative pole
14	IOUT21+	Isolated contact output #21 – Positive pole
15	IOUT21-	Isolated contact output #21 – Negative pole
16	IOUT22+	Isolated contact output #22 – Positive pole
17	IOUT22-	Isolated contact output #22 – Negative pole
18	TTLIO21	TTL input/output #21

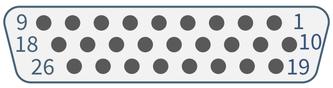
Pin	Signal	Usage
19	GND	Ground
20	TTLIO22	TTL input/output #22
21	GND	Ground
22		Not connected
23	GND	Ground
24	+12V	+12 V Power output
25	+12V_RTN	Ground

External I/O Connector - 3304

Applies to [1]
3304

Connector description

Property	Value
Name, Label	External I/O
Type	26-pin 3-row high-density female sub-D connector with UNC4-40 jack socket screws
Location	Card bracket
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	DIN12+	High-speed differential input #12 – Positive pole
3	IIN11+	Isolated input #11 – Positive pole
4	IIN13-	Isolated input #13 – Negative pole
5	IIN14-	Isolated input #14 – Negative pole
6	IOUT12-	Isolated contact output #12 – Negative pole
7	GND	Ground
8		Not connected
9	GND	Ground
10	GND	Ground
11	DIN12-	High-speed differential input #12 – Negative pole
12	IIN11-	Isolated input #11 – Negative pole

[1] 3304 HD26F I/O Adapter Cable.

Pin	Signal	Usage
13	IIN12+	Isolated input #12 – Positive pole
14	IIN13+	Isolated input #13 – Positive pole
15	IIN14+	Isolated input #14 – Positive pole
16	IOUT12+	Isolated contact output #12 – Positive pole
17	TTLIO12	TTL input/output #12
18	GND	Ground
19	DIN11-	High-speed differential input #11 – Negative pole
20	DIN11+	High-speed differential input #11 – Positive pole
21	IIN12-	Isolated input #12 – Negative pole
22	IOUT11-	Isolated contact output #11 – Negative pole
23	IOUT11+	Isolated contact output #11 – Positive pole
24	GND	Ground
25	TTLIO11	TTL input/output #11
26	+12V	+12 V Power output

Standard I/O set #2

Pin	Signal	Usage
1	GND	Ground
2	DIN22+	High-speed differential input #22 – Positive pole
3	IIN21+	Isolated input #21 – Positive pole
4	IIN23-	Isolated input #23 – Negative pole
5	IIN24-	Isolated input #24 – Negative pole
6	IOUT22-	Isolated contact output #22 – Negative pole
7	GND	Ground
8		Not connected
9	GND	Ground
10	GND	Ground
11	DIN22-	High-speed differential input #22 – Negative pole
12	IIN21-	Isolated input #21 – Negative pole
13	IIN22+	Isolated input #22 – Positive pole
14	IIN23+	Isolated input #23 – Positive pole
15	IIN24+	Isolated input #24 – Positive pole
16	IOUT22+	Isolated contact output #22 – Positive pole

Pin	Signal	Usage
17	TTLIO22	TTL input/output #22
18	GND	Ground
19	DIN21-	High-speed differential input #21 – Negative pole
20	DIN21+	High-speed differential input #21 – Positive pole
21	IIN22-	Isolated input #22 – Negative pole
22	IOUT21-	Isolated contact output #21 – Negative pole
23	IOUT21+	Isolated contact output #21 – Positive pole
24	GND	Ground
25	TTLIO21	TTL input/output #21
26	+12V	+12 V Power output

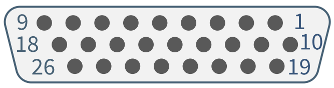
External I/O Connector - 3610/3612

Applies to [1]

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

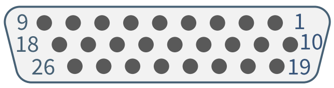
External I/O 1 Connector - 3614/3618

Applies to [1]

3614 3618

Connector description

Property	Value
Name, Label	External I/O 1
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] 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

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

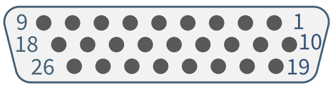
External I/O 2 Connector - 3614/3618

Applies to [1]

3614 3618

Connector description

Property	Value
Name, Label	External I/O 2
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 #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

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

Pin	Signal	Usage
13	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
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

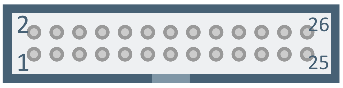
Internal I/O 1 Connector

Applies to [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

Connector description

Property	Value
Name, Label	Internal I/O 1
Type	26-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #1

Pin	Signal	Usage
1	GND	Ground
2	GND	Ground
3	DIN11+	High-speed differential input #11 – Positive pole
4	DIN11-	High-speed differential input #11 – Negative pole
5	DIN12+	High-speed differential input #12 – Positive pole
6	DIN12-	High-speed differential input #12 – Negative pole
7	IIN11+	Isolated input #11 – Positive pole
8	IIN11-	Isolated input #11 – Negative pole
9	IIN12+	Isolated input #12 – Positive pole

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

Pin	Signal	Usage
10	IIN12-	Isolated input #12 – Negative pole
11	IIN13+	Isolated input #13 – Positive pole
12	IIN13-	Isolated input #13 – Negative pole
13	IIN14+	Isolated input #14 – Positive pole
14	IIN14-	Isolated input #14 – Negative pole
15	IOUT11+	Isolated contact output #11 – Positive pole
16	IOUT11-	Isolated contact output #11 – Negative pole
17	IOUT12+	Isolated contact output #12 – Positive pole
18	IOUT12-	Isolated contact output #12 – Negative pole
19	TTLIO11	TTL input/output #11
20	GND	Ground
21	TTLIO12	TTL input/output #12
22	GND	Ground
23		Not connected
24	GND	Ground
25	+12V	+12 V Power output
26	+12V_RTN	Ground

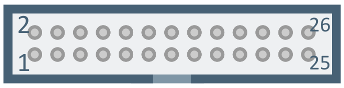
Internal I/O 2 Connector

Applies to [1]

Duo | Duo (Not recommended for new designs) | Quad (Not recommended for new designs) | QuadG3 | QuadG3LH | Quad3DLLE | Quad12 | Quad12-4 | Quad12J | Quad12J-4 | Value12 | QSFP+

Connector description

Property	Value
Name, Label	Internal I/O 2
Type	26-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	General purpose I/O and power output



Pin assignments

Standard I/O set #2

Pin	Signal	Usage
1	GND	Ground
2	GND	Ground
3	DIN21+	High-speed differential input #21 – Positive pole
4	DIN21-	High-speed differential input #21 – Negative pole
5	DIN22+	High-speed differential input #22 – Positive pole
6	DIN22-	High-speed differential input #22 – Negative pole
7	IIN21+	Isolated input #21 – Positive pole
8	IIN21-	Isolated input #21 – Negative pole
9	IIN22+	Isolated input #22 – Positive pole
10	IIN22-	Isolated input #22 – Negative pole
11	IIN23+	Isolated input #23 – Positive pole

[1] 1628 Grablink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

Pin	Signal	Usage
12	IIN23-	Isolated input #23 – Negative pole
13	IIN24+	Isolated input #24 – Positive pole
14	IIN24-	Isolated input #24 – Negative pole
15	IOUT21+	Isolated contact output #21 – Positive pole
16	IOUT21-	Isolated contact output #21 – Negative pole
17	IOUT22+	Isolated contact output #22 – Positive pole
18	IOUT22-	Isolated contact output #22 – Negative pole
19	TTLIO21	TTL input/output #21
20	GND	Ground
21	TTLIO22	TTL input/output #22
22	GND	Ground
23		Not connected
24	GND	Ground
25	+12V	+12 V Power output
26	+12V_RTN	Ground

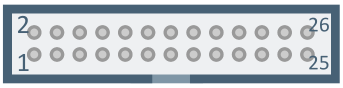
Internal I/O Connector - 3610/3612

Applies to [1]

3610 Not recommended for new designs 3612 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

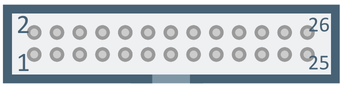
Internal I/O 2 Connector - 3614/3618

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
3	DIN21+	High-speed differential input #21 – Positive pole
4	DIN21-	High-speed differential input #21 – Negative pole
5	DIN22+	High-speed differential input #22 – Positive pole
6	DIN22-	High-speed differential input #22 – Negative pole
7	IIN21+	Isolated input #21 – Positive pole
8	IIN21-	Isolated input #21 – Negative pole
9	IIN22+	Isolated input #22 – Positive pole
10	IIN22-	Isolated input #22 – Negative pole
11	IIN23+	Isolated input #23 – Positive pole
12	IIN23-	Isolated input #23 – Negative pole

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

Pin	Signal	Usage
13	IIN24+	Isolated input #24 – Positive pole
14	IIN24-	Isolated input #24 – Negative pole
15	IOUT21+	Isolated contact output #21 – Positive pole
16	IOUT21-	Isolated contact output #21 – Negative pole
17	IOUT22+	Isolated contact output #22 – Positive pole
18	IOUT22-	Isolated contact output #22 – Negative pole
19	TTLIO21	TTL input/output #21
20	GND	Ground
21	TTLIO22	TTL input/output #22
22	GND	Ground
23		Not connected
24	GND	Ground
25	+12V	+12 V Power output
26	+12V_RTN	Ground

1.4. Other Connectors

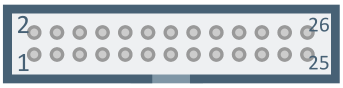
I/O Extension Connector

Applies to [1]

Duo	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	3610 Not recommended for new designs
3612 Not recommended for new designs	3614	3618				

Connector description

Property	Value
Name, Label	I/O Extension
Type	26-pin dual-row 0.050" pitch pin header with shrouding
Location	Printed circuit board
Usage	I/O extension cable socket



Pin assignments

Pin	Signal	Usage
1	IOEXT1WIRE	1-wire serial I/O
2	GND	Ground
3	IOEXT01	I/O Extension #1
4	+3V3	+3.3 V Power
5	IOEXT02	I/O Extension #2
6	GND	Ground
7	IOEXT03	I/O Extension #3
8	+3V3	+3.3 V Power
9	IOEXT04	I/O Extension #4
10	GND	Ground

[1] 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 3610 HD26F I/O Extension Module - TTL-RS422, 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422, 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

Pin	Signal	Usage
11	IOEXT05	I/O Extension #5
12	+3V3	+3.3 V Power
13	IOEXT06	I/O Extension #6
14	GND	Ground
15	IOEXT07	I/O Extension #7
16	+3V3	+3.3 V Power
17	IOEXT08	I/O Extension #8
18	GND	Ground
19	IOEXT09	I/O Extension #9
20	12V	12V Power
21	IOEXT10	I/O Extension #10
22	GND	Ground
23	IOEXT11	I/O Extension #11
24	12V	12V Power
25	IOEXT12	I/O Extension #12
26	GND	Ground

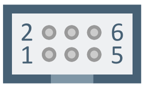
C2C-Link Connector

Applies to [1]

Duo	Duo104EMB Not recommended for new designs	Mono Not recommended for new designs	Duo Not recommended for new designs	Quad Not recommended for new designs	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+
1636						

Connector description

Property	Value
Name, Label	C2C-Link
Type	6-pin dual-row 0.1" pitch pin header with shrouding
Location	Printed circuit board
Usage	Card-to-card link



Pin assignments

Pin	Signal	Usage
1	GND	Ground
2	CSync1	Card-to-card synchronization bus – Signal 1
3	GND	Ground
4	CSync2	Card-to-card synchronization bus – Signal 2
5	GND	Ground
6	CSync3	Card-to-card synchronization bus – Signal 3

[1] 1628 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.

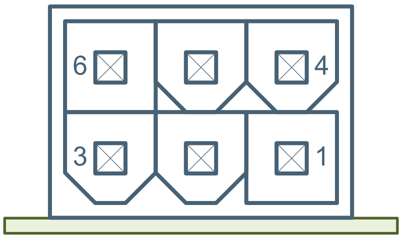
Auxiliary Power Input Connector for PoCXP and GPIO

Applies to [1]

Mono Not recommended for new designs | Duo Not recommended for new designs | Quad Not recommended for new designs | QuadG3 | QuadG3LH | QuadG3DF | Quad3DLLE

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 PoCXP 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] 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF and 1637 Coaxlink Quad 3D-LLE.

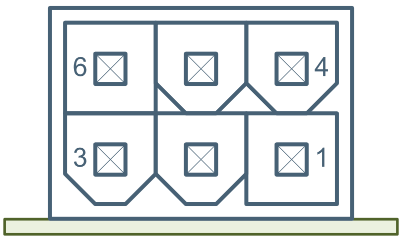
Auxiliary Power Input Connector w/o SenseIN

Applies to [1]

Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF			

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 PoCXP 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	GND	Ground
6	GND	Ground

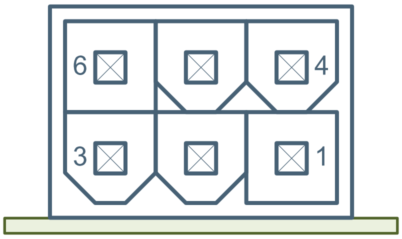
[1] 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value and 3624 Coaxlink Quad CXP-12 DF.

Auxiliary Power Input Connector for GPIO

Applies to [1]
QSFP+

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 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] 3625 Coaxlink QSFP+.

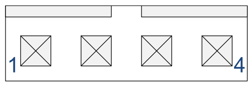
Camera Power Input Connector

Applies to [1]

Duo104EMB Not recommended for new designs

Connector description

Property	Value
Name, Label	Camera Power Input
Type	4-pin 0.1-in Molex KK 7478 male connector
Location	Printed circuit board
Usage	DC power input for PoCXP



Pin assignments

Pin	Signal	Usage
1	GND	Ground
2	+24V0	+24 VDC input
3	+24V0	+24 VDC input
4	GND	Ground

[1] 1629 Coaxlink Duo PCIe/104-EMB.

1.5. LEDs and Switches

CoaXPress LED Lamps

Applies to [1]

Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF	QSFP+		

Each CoaXPress connection is associated with a LED lamp mounted on the bracket (for PCie cards only).

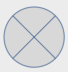
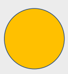
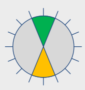
LED lamps mode control

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 CoaXPress 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.

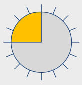
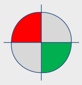
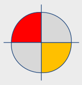
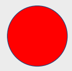
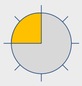
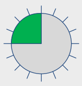
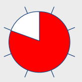
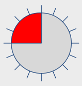
CoaXPress Host Indicator LED lamps states

States description

Symbol	Indication	State
	Off	No power
	Solid orange	System booting
	AlternateFlash_12_5 green / orange[2]	Connection detection in progress; PoCXP active

[1] 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+.

[2] Shown for a minimum of 1 second even if the connection detection is faster

Symbol	Indication	State
	Flash_12_5 orange[1]	Connection detection in progress; PoCXP not in use
	AlternateFlash_0_5 red / green	Device/ Host incompatible; PoCXP active
	AlternateFlash_0_5 red / orange	Device/ Host incompatible; PoCXP not in use
	Solid red	PoCXP over-current
	Solid green	Device / Host connected, but no data being transferred
	Flash_1 orange	Device / Host connected, waiting for event (e.g. trigger, exposure pulse)
	Flash_12_5 green	Device / Host connected, data being transferred
	500 ms red pulse[2]	Error during data transfer (e.g. CRC error, single bit error detected)
	AlternateFlash_0_5 green / orange	Connection test packets being sent
	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)
AlternateFlash_0_5	0.5 Hz	50% (1 second on color 1, 1 second off, 1 second on color 2, 1 second off)

[1] Shown for a minimum of 1 second even if the connection detection is faster

[2] In case of multiple errors, there shall be at least two green Flash_12_5 pulses before the next error is indicated

12 V LED

Applies to [1]

Duo104EMB
Not recommended for new designs

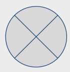
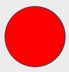
12 V LED states

LED state	Symbol	Meaning
Off		**No 12 V power.** Possible causes are: • There is no power delivered on the +12 V rail of the PCIe/104 connector • The +12 V fuse is blown on the card
Solid green		**12 V power OK.**

[1] 1629 Coaxlink Duo PCIe/104-EMB.

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

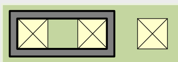
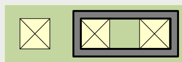
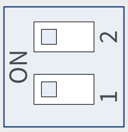
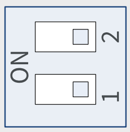
The *firmware recovery switch* has two positions:

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		

1.6. Physical Characteristics

Weight

Product	Gross weight		Net weight	
1629 Coaxlink Duo PCIe/104-EMB	162 g	5.71 oz	62 g	2.19 oz
1630 Coaxlink Mono	260 g	9.17 oz	152 g	5.36 oz
1631 Coaxlink Duo	255 g	9.00 oz	154 g	5.43 oz
1632 Coaxlink Quad	264 g	9.31 oz	163 g	5.75 oz
1633 Coaxlink Quad G3	274 g	9.66 oz	173 g	6.10 oz
1633-LH Coaxlink Quad G3 LH	361 g	12.73 oz	260 g	9.17 oz
1635 Coaxlink Quad G3 DF	269 g	9.49 oz	168 g	5.93 oz
1637 Coaxlink Quad 3D-LLE	275 g	9.70 oz	173 g	6.10 oz
3602 Coaxlink Octo	330 g	11.64 oz	185 g	6.53 oz
3603 Coaxlink Quad CXP-12	297 g	10.48 oz	196 g	6.91 oz
3603-4 Coaxlink Quad CXP-12	297 g	10.48 oz	196 g	6.91 oz
3620 Coaxlink Quad CXP-12 JPEG	297 g	10.48 oz	196 g	6.91 oz
3620-4 Coaxlink Quad CXP-12 JPEG	297 g	10.48 oz	196 g	6.91 oz
3621-LH Coaxlink Mono CXP-12 LH	275 g	9.70 oz	159 g	5.61 oz
3622 Coaxlink Duo CXP-12	232 g	8.18 oz	122 g	4.30 oz
3623 Coaxlink Quad CXP-12 Value	287 g	10.12 oz	187 g	6.60 oz
3624 Coaxlink Quad CXP-12 DF	286 g	10.09 oz	188 g	6.63 oz
3625 Coaxlink QSFP+	283 g	9.98 oz	178 g	6.28 oz
1625 DB25F I/O Adapter Cable	128 g	4.52 oz	40 g	1.41 oz
1636 InterPC C2C-Link Adapter	184 g	6.49 oz	81 g	2.86 oz
3300 HD26F I/O module for Coaxlink Duo PCIe/104	29 g	1.02 oz	29 g	1.02 oz
3301 Thermal drain (Model 1) for Coaxlink Duo PCIe/104	97 g	3.42 oz	97 g	3.42 oz
3302 DIN1.0/2.3 Coaxial cable for Coaxlink Duo PCIe/104	9 g	0.32 oz	9 g	0.32 oz
3303 C2C-Link Ribbon Cable	6 g	0.21 oz	6 g	0.21 oz
3304 HD26F I/O Adapter Cable	143 g	5.04 oz	55 g	1.94 oz
3610 HD26F I/O Extension Module - TTL-RS422	200 g	7.06 oz	100 g	3.53 oz
3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422	200 g	7.06 oz	100 g	3.53 oz
3613 JTAG Adapter Xilinx for Coaxlink	119 g	4.20 oz	19 g	0.67 oz
3614 HD26F I/O Extension Module - Standard I/O Set	200 g	7.06 oz	100 g	3.53 oz
3618 HD26F I/O Extension Module - Fast I/O	200 g	7.06 oz	100 g	3.53 oz

Dimensions

Product	Dimensions	
1629 Coaxlink Duo PCIe/104-EMB	96 x 90 mm	3,775 x 3,555 in
1630 Coaxlink Mono	167,65 x 111,15 mm	6,6 x 4,38 in
1631 Coaxlink Duo	167,65 x 111,15 mm	6,6 x 4,38 in
1632 Coaxlink Quad	167,65 x 111,15 mm	6,6 x 4,38 in
1633 Coaxlink Quad G3	167,65 x 111,15 mm	6,6 x 4,38 in
1633-LH Coaxlink Quad G3 LH	167,65 x 111,15 mm	6,6 x 4,38 in
1635 Coaxlink Quad G3 DF	167,65 x 111,15 mm	6,6 x 4,38 in
1637 Coaxlink Quad 3D-LLE	167,65 x 111,15 mm	6,6 x 4,38 in
3602 Coaxlink Octo	167,65 x 111,15 mm	6,6 x 4,38 in
3603 Coaxlink Quad CXP-12	167,65 x 111,15 mm	6,6 x 4,38 in
3603-4 Coaxlink Quad CXP-12	167,65 x 111,15 mm	6,6 x 4,38 in
3620 Coaxlink Quad CXP-12 JPEG	167,65 x 111,15 mm	6,6 x 4,38 in
3620-4 Coaxlink Quad CXP-12 JPEG	167,65 x 111,15 mm	6,6 x 4,38 in
3621 Coaxlink Mono CXP-12	167,65 x 68,9 mm	6,6 x 2,71 in
3621-LH Coaxlink Mono CXP-12 LH	167,65 x 68,9 mm	6,6 x 2,71 in
3622 Coaxlink Duo CXP-12	167,65 x 68,9 mm	6,6 x 2,71 in
3622-LH Coaxlink Duo CXP-12 LH	167,65 x 68,9 mm	6,6 x 2,71 in
3623 Coaxlink Quad CXP-12 Value	167,65 x 111,15 mm	6,6 x 4,38 in
3624 Coaxlink Quad CXP-12 DF	167,65 x 111,15 mm	6,6 x 4,38 in
3625 Coaxlink QSFP+	167,65 x 111,15 mm	6,6 x 4,38 in
3300 HD26F I/O module for Coaxlink Duo PCIe/104	70 x 40 mm	2,76 x 1,57 in
3301 Thermal drain (Model 1) for Coaxlink Duo PCIe/104	86,8 x 60 mm	3,42 x 2,36 in

Cable length

Product Item	Length
3300 HD26F I/O module for Coaxlink Duo PCIe/104 – Cable	254 mm 10 in
3302 DIN1.0/2.3 Coaxial cable for Coaxlink Duo PCIe/104	200 mm 7.9 in

3D CAD models

3D CAD models are available on request for the following assemblies:

Assembly	File formats
1629 Coaxlink Duo PCIe/104-EMB	DWF, STP
1629 Coaxlink Duo PCIe/104-EMB with **3301 Thermal drain (Model 1) for Coaxlink Duo PCIe/104**	DWF, STP
3300 HD26F I/O module for Coaxlink Duo PCIe/104	DWF, STP

1.7. PCIe/104 Stacking Rules

Applies to [1]

Duo104EMB

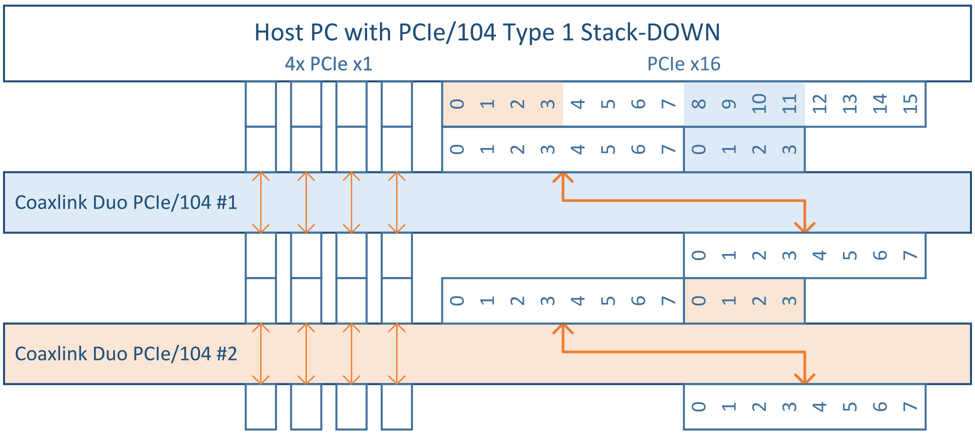
One or two modules can be stacked directly under the Host PC.

The Host PC must be equipped with one *stack-down* connector of the following types:

- Type 2 PCIe/104 with 2 PCI Express x4 links providing four active lanes.
- Type 1 PCIe/104 with 1 PCI Express x16 link configured to operate as 2 x8 links providing at least four active lanes per link.

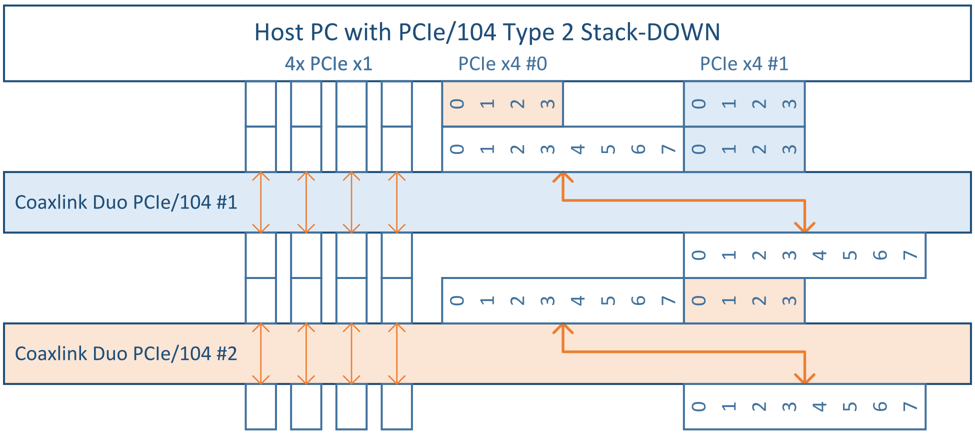
NOTE

According the PCIe/104 specification, a Type 1 PCIe/104 host PC that supports a PCIe x16 link is not required to support two x8, or two x4 links. For such PCs, only one module can be stacked underneath!



PCIe/104 stack with a Type 1 Host PC and 2 modules.

[1] 1629 Coaxlink Duo PCIe/104-EMB.



PCIe/104 stack with a Type 2 Host PC and 2 modules.

Each module:

- Uses only 4 PCI Express lanes.
- Routes to the next module the 4 unused PCI Express x1 links.
- Shifts by 8 positions and routes to the next module the lowest 8 lanes of the PCI Express x16 link.
- Re-drives the clock of the Type 1 PCI Express x16 or the Type 2 PCI Express x4 links.

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 Interfaces

Electrical specification of the camera interfaces

Camera Interfaces per Product

Product	Camera interface standard and type
1630 Coaxlink Mono	"CoaXPress CXP-6 Host Interface" on page 451
1631 Coaxlink Duo	"CoaXPress CXP-6 Host Interface" on page 451
1632 Coaxlink Quad	"CoaXPress CXP-6 Host Interface" on page 451
1633 Coaxlink Quad G3	"CoaXPress CXP-6 Host Interface" on page 451
1633-LH Coaxlink Quad G3 LH	"CoaXPress CXP-6 Host Interface" on page 451
1635 Coaxlink Quad G3 DF	"CoaXPress CXP-6 Host Interface" on page 451
1637 Coaxlink Quad 3D-LLE	"CoaXPress CXP-6 Host Interface" on page 451
1629 Coaxlink Duo PCIe/104-EMB	"CoaXPress CXP-6 Host Interface" on page 451
3602 Coaxlink Octo	"CoaXPress CXP-6 Host Interface" on page 451
3603 Coaxlink Quad CXP-12	"CoaXPress CXP-12 Host Interface" on page 453
3603-4 Coaxlink Quad CXP-12	"CoaXPress CXP-12 Host Interface" on page 453
3620 Coaxlink Quad CXP-12 JPEG	"CoaXPress CXP-12 Host Interface" on page 453
3620-4 Coaxlink Quad CXP-12 JPEG	"CoaXPress CXP-12 Host Interface" on page 453
3621 Coaxlink Mono CXP-12	"CoaXPress CXP-12 Host Interface" on page 453
3621-LH Coaxlink Mono CXP-12 LH	"CoaXPress CXP-12 Host Interface" on page 453
3622 Coaxlink Duo CXP-12	"CoaXPress CXP-12 Host Interface" on page 453
3622-LH Coaxlink Duo CXP-12 LH	"CoaXPress CXP-12 Host Interface" on page 453
3623 Coaxlink Quad CXP-12 Value	"CoaXPress CXP-12 Host Interface" on page 453
3625 Coaxlink QSFP+	"CoaXPress CoF-10 Host Interface" on page 455

CoaXPress CXP-6 Host Interface

Applies to [1]

Duo104EMB Mono Duo Quad QuadG3 QuadG3LH QuadG3DF Quad3DLLE Octo

The *CoaXPress CXP-6 Host Interface* implements for each individual CoaXPress connection:

- a high-speed cable receiver
- a low-speed cable driver
- a power transmitting unit (PTU)
- a connector

See also: "Camera Connectors" on page 389

It fulfills the electrical specification of the CoaXPress 1.1 standard. Namely:

- The cable receiver requirements for the high-speed connection described in Table 2 of the Annex B of the CoaXPress Standard 1.1
- The cable driver requirements for the low-speed connection described in Table 3 of the Annex B of the CoaXPress Standard 1.1

Cable driver and receiver specification

Parameter	Conditions	Min.	Typ.	Max.	Unit
High-speed receiver bit rate		1.25		6.25	GT/s
Low-speed driver bit rate			20.833		MT/s
Max. cable length	BELDEN 1694 @ 1.25 GT/s	130			m
	BELDEN 1694 @ 2.5 GT/s	110			m
	BELDEN 1694 @ 3.125 GT/s	100			m
	BELDEN 1694 @ 5 GT/s	60			m
	BELDEN 1694 @ 6.25 GT/s	40			m

PTU - Power transmitting unit specification

Parameter	Min.	Typ.	Max.	Unit
DC output voltage	22	24	26	V
Available output power	17[2]			W
OCP holding current	790			mA
OCP nominal trip current			5	A
Device detection sense resistance		4.7		kΩ

[1] 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 and 3602 Coaxlink Octo.

[2] Per connection

The Power Transmitting Unit provides 24 V DC power, over-current protection (OCP) and PoCXP device detection as specified by the CoaXPress Standard.

NOTE: The above specification applies over the whole operating temperature range of the card.

See also: Refer to Power Over CoaXPress in the Functional Guide

CoaXPress CXP-12 Host Interface

Applies to [1]

Quad12 | Quad12-4 | Quad12J | Quad12J-4 | Mono12 | Mono12LH | Duo12 | Duo12LH | Value12 | Quad12DF

The *CoaXPress CXP-12 Host Interface* implements for each individual CoaXPress connection:

- a high-speed cable receiver
- a low-speed cable driver
- a power transmitting unit (PTU)
- a connector

See also: "Camera Connectors" on page 389

It fulfills the electrical specification of the CoaXPress 2.0 standard. Namely:

- The cable receiver requirements for the high-speed connection described in Table 2 of the Annex B of the CoaXPress Standard Version 2.0
- The cable driver requirements for the low-speed connection described in Table 3 of the Annex B of the CoaXPress Standard Version 2.0

Cable Driver and Receiver Specification

Parameter	Conditions	Min.	Typ.	Max.	Unit
High-speed receiver bit rate		1.25		12.50	GT/s
Low-speed driver bit rate	1.25 GT/s up to 6.25 GT/s		20.833		MT/s
	10.0 GT/s and 12.5 GT/s		41.666		MT/s
Max. cable length	BELDEN 1694 @ 1.25 GT/s	130			m
	BELDEN 1694 @ 2.5 GT/s	115			m
	BELDEN 1694 @ 3.125 GT/s	100			m
	BELDEN 1694 @ 5 GT/s	80			m
	BELDEN 1694 @ 6.25 GT/s	70			m
	BELDEN 1694 @ 10.0 GT/s	50			m
	BELDEN 1694 @12.5GT/s	40			m

[1] 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 and 3624 Coaxlink Quad CXP-12 DF.

PTU - Power transmitting unit specification

Parameter	Min.	Typ.	Max.	Unit
DC output voltage	22	24	26	V
Available output power[1]	17[2]			W
OCP holding current	790			mA
OCP nominal trip current			5	A
Device detection sense resistance		4.7		kΩ

The Power Transmitting Unit provides 24 V DC power, over-current protection (OCP) and PoCXP device detection as specified by the CoaXPress Standard.

NOTE: The above specification applies over the whole operating temperature range of the card.

See also: Refer to Power Over CoaXPress in the Functional Guide

[1] Per connection

[2] 25 W for **3621-LH Coaxlink Mono CXP-12 LH**

CoaXPress CoF-10 Host Interface

Applies to [1]
QSFP+

The *CoaXPress CoF-10 Host Interface* implements for each individual CoaXPress connection:
- a CoaXPress CXP-12 to 10G Ethernet bridge
- a 10 Gigabit Media Independent Interface

10G Ethernet

Parameter	Conditions	Min.	Typ.	Max.	Unit
Transmitter effective data rate				10	Gbit/s
Receiver effective data rate[2]				10	Gbit/s

NOTE: The effective data rate of CXP-12 and 10G Ethernet are identical!

QSFP+ connector

The QSFP+ connector implements an electrical interface for 4 CoaXPress connections including:
- 4 high-speed transmitter lines
- 4 high-speed receiver lines

It fulfills the electrical requirements of the SNIA SFF-8436 specification for QSFP+ 4X 10 Gb/s Pluggable Transceiver modules

See also: "CoaXPress-over-Fiber Host Connector - QSFP+" on page 400

[1] 3625 Coaxlink QSFP+.

[2] Identical to the effective receiver data rate of CXP-12

2.2. PCI Express Interfaces

Specification of the PCI Express interfaces

PCI Express Interfaces per Product

Product	Type
1628 Grablink Duo	"4-lane Rev 2.0 PCIe end-point" on page 457
1630 Coaxlink Mono	"4-lane Rev 2.0 PCIe end-point" on page 457
1631 Coaxlink Duo	"4-lane Rev 2.0 PCIe end-point" on page 457
1632 Coaxlink Quad	"4-lane Rev 2.0 PCIe end-point" on page 457
1633 Coaxlink Quad G3	"4-lane Rev 3.0 PCIe end-point " on page 458
1633-LH Coaxlink Quad G3 LH	"4-lane Rev 3.0 PCIe end-point " on page 458
1635 Coaxlink Quad G3 DF	"4-lane Rev 3.0 PCIe end-point " on page 458
1637 Coaxlink Quad 3D-LLE	"4-lane Rev 2.0 PCIe end-point" on page 457
1629 Coaxlink Duo PCIe/104-EMB	"4-lane Rev 2.0 PCIe end-point" on page 457
3602 Coaxlink Octo	"8-lane Rev 3.0 PCIe end-point" on page 459
3603 Coaxlink Quad CXP-12 3603-4 Coaxlink Quad CXP-12	"8-lane Rev 3.0 PCIe end-point" on page 459
3620 Coaxlink Quad CXP-12 JPEG 3620-4 Coaxlink Quad CXP-12 JPEG	"8-lane Rev 3.0 PCIe end-point" on page 459
3621 Coaxlink Mono CXP-12	"4-lane Rev 3.0 PCIe end-point " on page 458
3621-LH Coaxlink Mono CXP-12 LH	"4-lane Rev 3.0 PCIe end-point " on page 458
3622 Coaxlink Duo CXP-12	"4-lane Rev 3.0 PCIe end-point " on page 458
3622-LH Coaxlink Duo CXP-12 LH	"4-lane Rev 3.0 PCIe end-point " on page 458
3623 Coaxlink Quad CXP-12 Value	"8-lane Rev 3.0 PCIe end-point" on page 459
3625 Coaxlink QSFP+	"8-lane Rev 3.0 PCIe end-point" on page 459

4-lane Rev 2.0 PCIe end-point

Applies to [1]

Duo | Duo104EMB (Not recommended for new designs) | Mono (Not recommended for new designs) | Duo (Not recommended for new designs) | Quad (Not recommended for new designs) | Quad3DLLE

The PCI Express Interface implements a *PCIe end-point* interface and provides *electrical power* to the on-board circuits.

The 4-lane Rev 2.0 PCIe end-point:

- complies with Revision 2.0 of the PCI Express Card Electromechanical specification,
- supports 1-lane, 2-lane, and 4-lane link width,
- supports PCIe Rev 2.0 link speed (5.0 GT/s with 8b/10b coding),
- supports PCIe Rev 1.0 link speed (2.5 GT/s with 8b/10b coding),
- supports payload size up to 512 bytes,
- offers the optimal performance when it is configured for 4-lane PCIe Rev 2.0 link speed (5 GT/s).

4-lane Rev 2.0 PCIe end-point to PC memory data transfer performance

Parameter	Conditions	Min.	Typ.	Max.	Unit
Sustainable output data rate	4-lane @ 5 GT/s (PCIe Rev 2.0)		1,700		MB/s
	4-lane @ 2.5 GT/s (PCIe Rev 1.0)		800		MB/s
	2-lane @ 5 GT/s (PCIe Rev 2.0)		800		MB/s

[1] 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad and 1637 Coaxlink Quad 3D-LLE.

4-lane Rev 3.0 PCIe end-point

Applies to [1]

QuadG3	QuadG3LH	QuadG3DF	Mono12	Mono12LH	Duo12	Duo12LH

The PCI Express Interface implements a *PCIe end-point* interface and provides *electrical power* to the on-board circuits.

The 4-lane Rev 3.0 PCIe end-point:

- complies with Revision 3.0 of the PCI Express Card Electromechanical specification,
- supports 1-lane, 2-lane, and 4-lane link width,
- supports PCIe Rev 3.0 link speed (8.0 GT/s with 128b/130b coding),
- supports PCIe Rev 2.0 link speed (5.0 GT/s with 8b/10b coding),
- *doesn't support* the 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 3.0 link speed (8 GT/s).

4-lane Rev 3.0 PCIe end-point to PC memory data transfer performance

Parameter	Conditions	Min.	Typ.	Max.	Unit
Sustainable output data rate	4-lane @ 8 GT/s (PCIe Rev 3.0)		3,350		MB/s
	4-lane @ 5 GT/s (PCIe Rev 2.0)		1,700		MB/s
	2-lane @ 8 GT/s (PCIe Rev 3.0)		1,700		MB/s
	2-lane @ 5 GT/s (PCIe Rev 2.0)		800		MB/s
	1-lane @ 8 GT/s (PCIe Rev 3.0)		800		MB/s

[1] 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

8-lane Rev 3.0 PCIe end-point

Applies to [1]

Octo | Quad12 | Quad12-4 | Quad12J | Quad12J-4 | Value12 | Quad12DF | QSFP+

The PCI Express Interface implements a *PCIe end-point* interface and provides *electrical power* to the on-board circuits.

The 8-lane Rev 3.0 PCIe end-point:

- complies with Revision 3.0 of the PCI Express Card Electromechanical specification,
- supports 1-lane, 2-lane, 4-lane and 8-lane link width,
- supports PCIe Rev 3.0 link speed (8.0 GT/s with 128b/130b coding),
- supports PCIe Rev 2.0 link speed (5.0 GT/s with 8b/10b coding)
- supports the 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 8-lane PCIe Rev 3.0 link speed (8 GT/s).

8-lane Rev 3.0 PCIe end-point to PC memory data transfer performance

Parameter	Conditions	Min.	Typ.	Max.	Unit
Sustainable output data rate	8-lane @ 8 GT/s (PCIe Rev 3.0)		6,700		MB/s
	8-lane @ 5 GT/s (PCIe Rev 2.0)		3,400		MB/s
	4-lane @ 8 GT/s (PCIe Rev 3.0)		3,350		MB/s
	4-lane @ 5 GT/s (PCIe Rev 2.0)		1,700		MB/s
	2-lane @ 8 GT/s (PCIe Rev 3.0)		1,700		MB/s
	2-lane @ 5 GT/s (PCIe Rev 2.0)		800		MB/s
	1-lane @ 8 GT/s (PCIe Rev 3.0)		800		MB/s

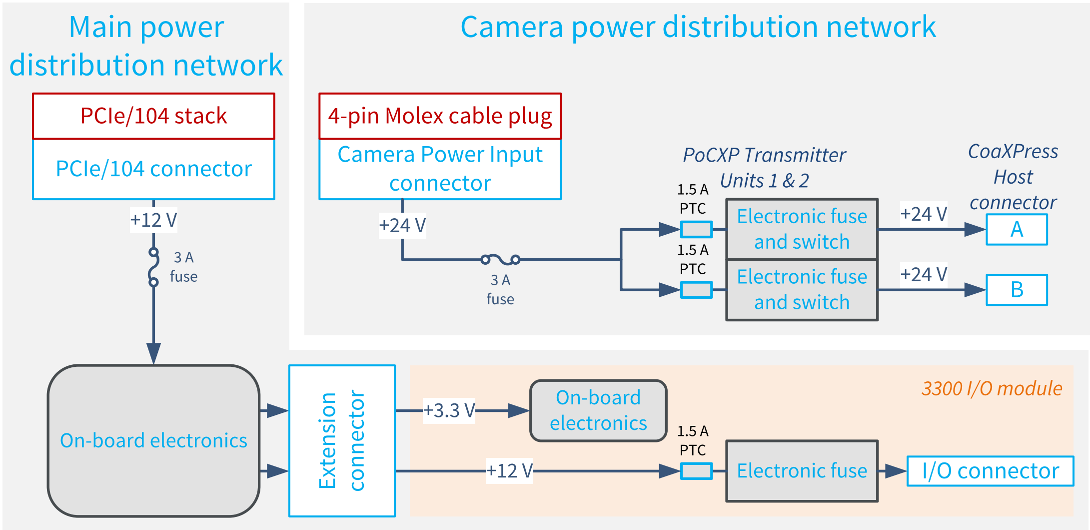
[1] 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

2.3. Power

Power requirements and specifications

Power Distribution Schemes

1629 Coaxlink Duo PCIe/104-EMB



Main power distribution network

The *main power distribution network* delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

It also delivers +3.3 V and +12 V to the **3300 HD26F I/O module for Coaxlink Duo PCIe/104** plugged on the extension connector:

- The +3.3 V is used for powering the on-board electronics: I/O drivers, I/O receivers
- The +12 V is used for delivering power on the I/O connector. A PTC inserted at the input prevents potential fire hazards.

The network is fed by the Host PC through the +12 V power rail of the PCIe/104 connector. A protection fuse prevents potential fire hazards. The *+12 V LED* indicates the presence of +12 V after the protection fuse.

See also: "Main Power Input Requirements" on page 478

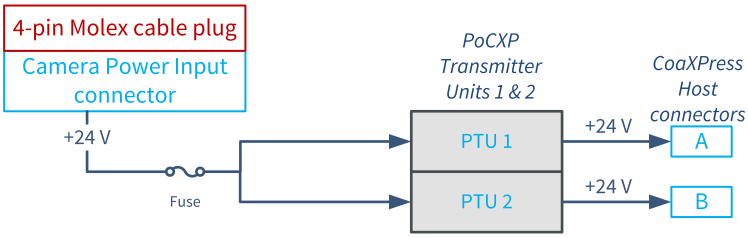
The *board status LED* reflects the global status of all the power converters of the main distribution network.

Camera power distribution network

The *auxiliary power distribution network* delivers power to the CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector.

The network is fed by a 24 VDC external power supply attached to the *camera power input connector* using a power cable terminated by a 4-pin Molex plug connector. A protection fuse inserted at the input side prevents potential fire hazards.

The 24-volt DC power is applied to each camera connection through a PoCXP transmitter unit. Each PoCXP transmitter unit implements an electronic fuse/switch. A PTC inserted at the input of each transmitter unit prevents potential fire hazards.



PoCXP for cards with 24 V DC power source

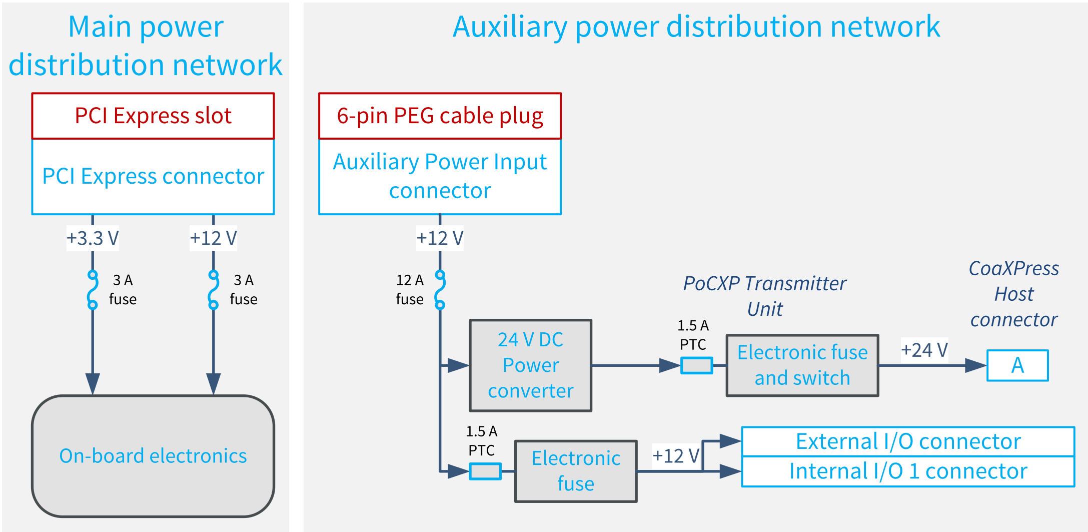
The external 24 V supply is attached to the *auxiliary power input connector* through a 4-pin cable and delivered to each power transmitting unit.

The AuxiliaryPowerInput feature reports the status of the connection made by the power cable between the external power supply and the Coaxlink card auxiliary power input connector.

The CxpPoCxpPowerInputStatus feature reports the status of the 24 V input.

See also: Power Over CoaXPress in the Functional Guide

1630 Coaxlink Mono



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

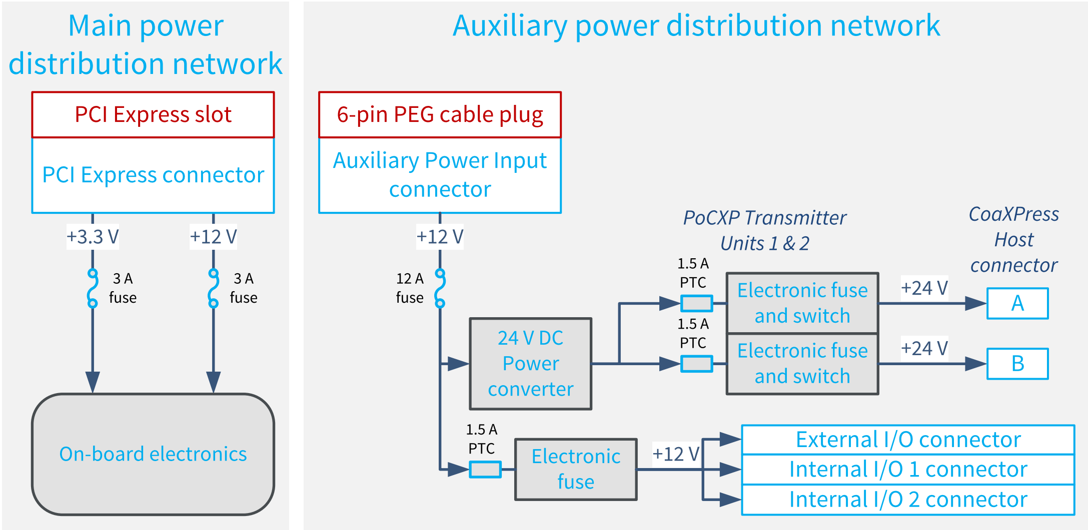
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

1631 Coaxlink Duo



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

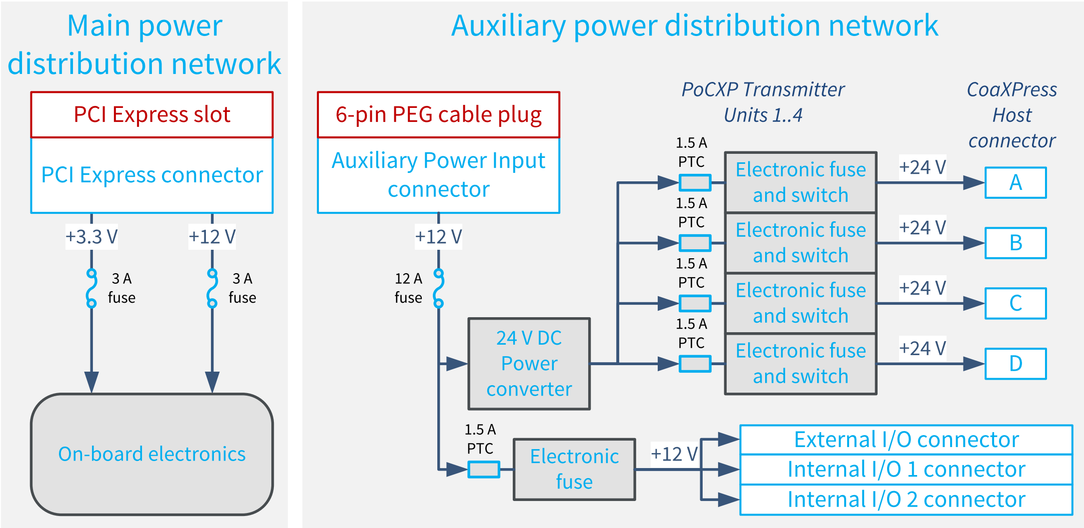
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

1632 Coaxlink Quad



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

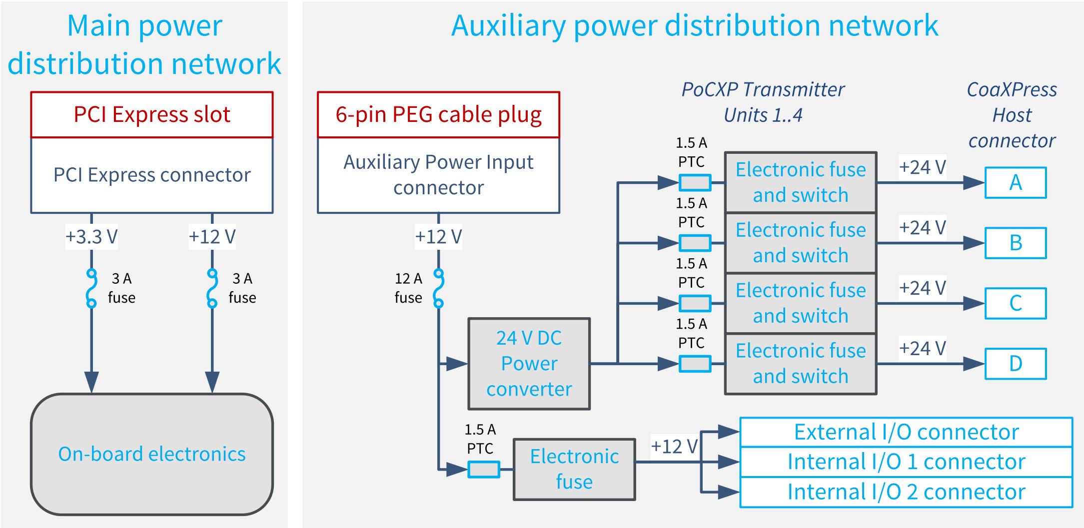
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

1633 Coaxlink Quad G3 and 1633-LH Coaxlink Quad G3 LH



Main power distribution network

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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 478

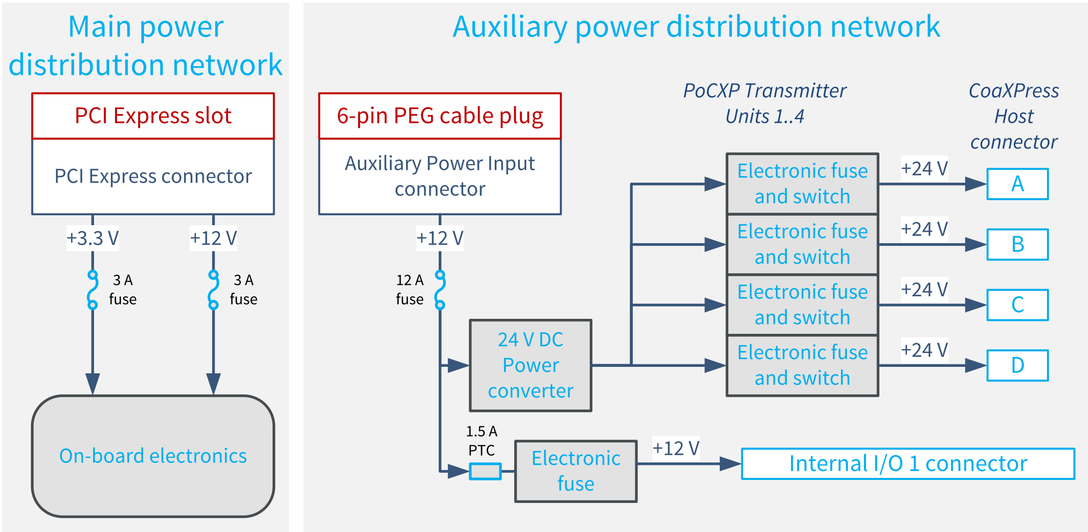
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

1635 Coaxlink Quad G3 DF



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

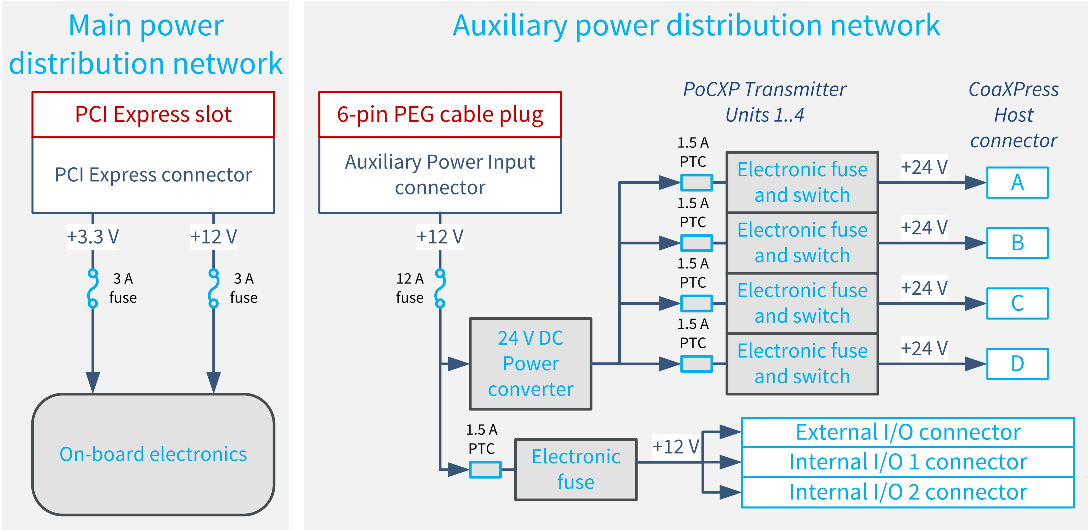
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

1637 Coaxlink Quad 3D-LLE



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

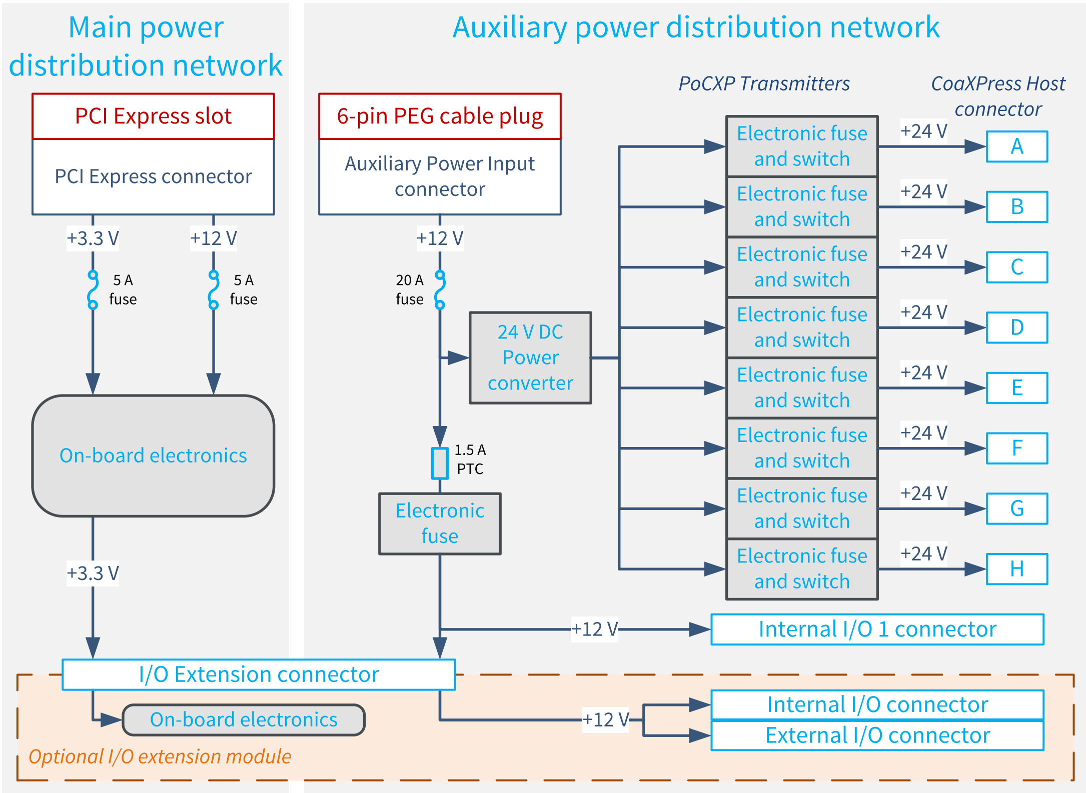
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

3602 Coaxlink Octo



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

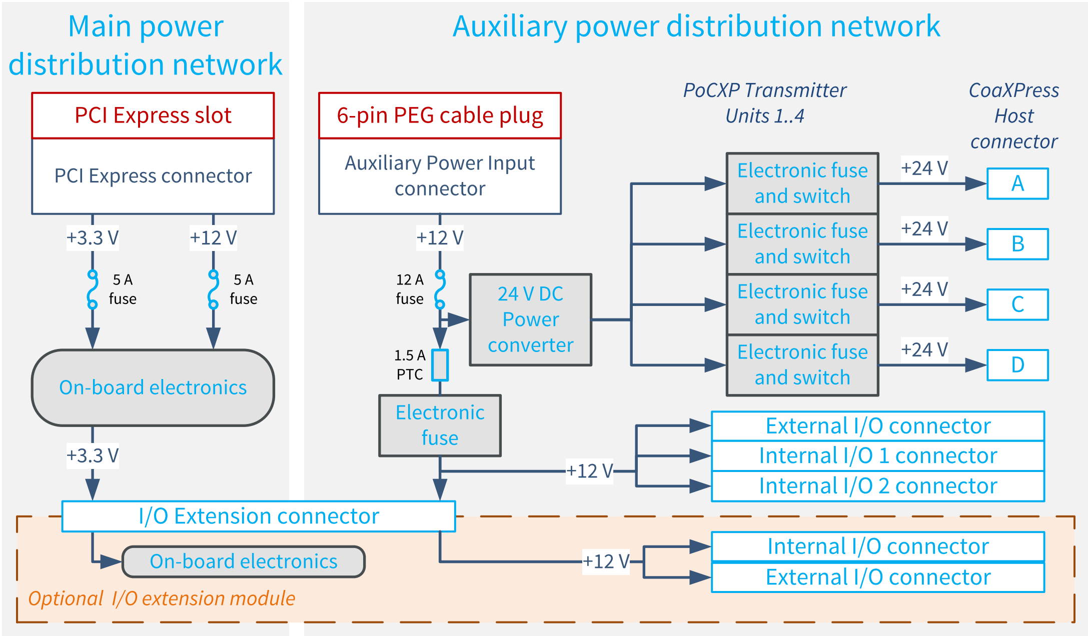
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

3603 Coaxlink Quad CXP-12 and 3603-4 Coaxlink Quad CXP-12



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

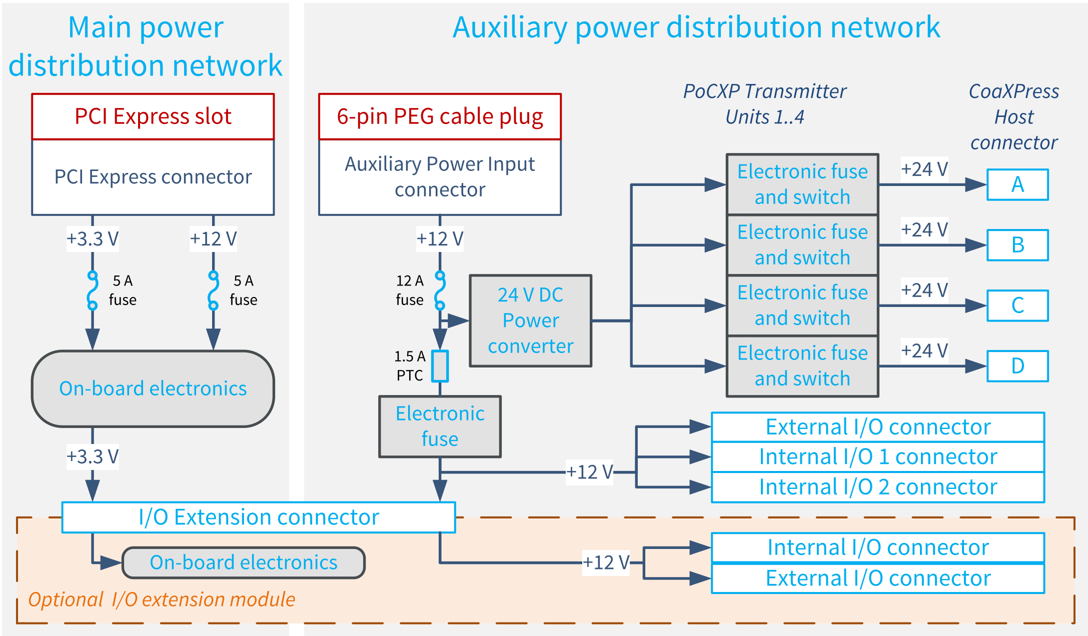
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

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



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

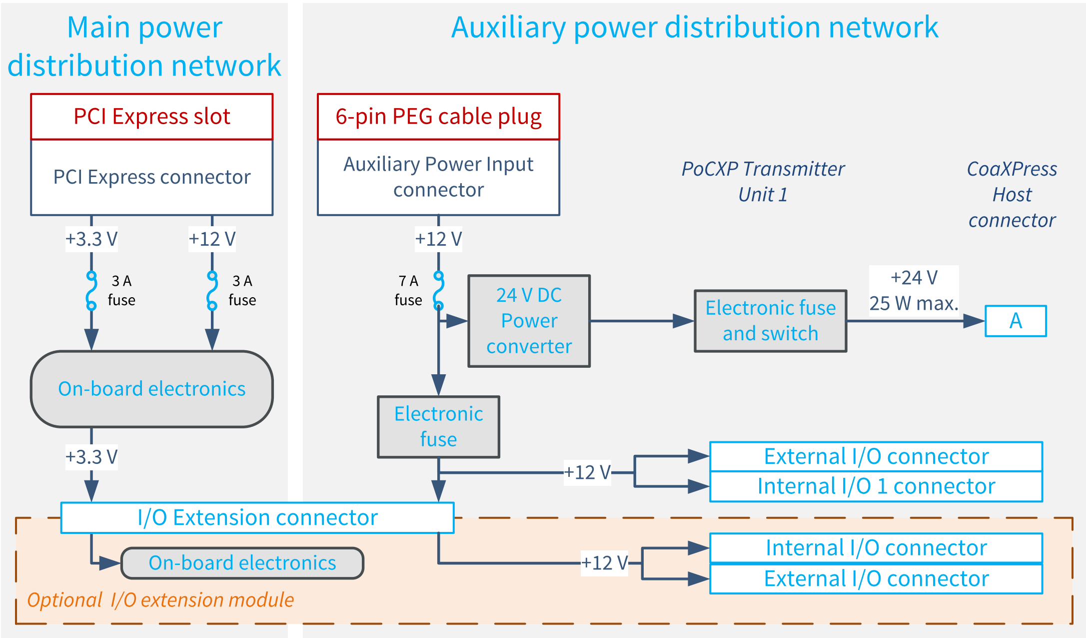
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

3621 Coaxlink Mono CXP-12 and 3621-LH Coaxlink Mono CXP-12 LH



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

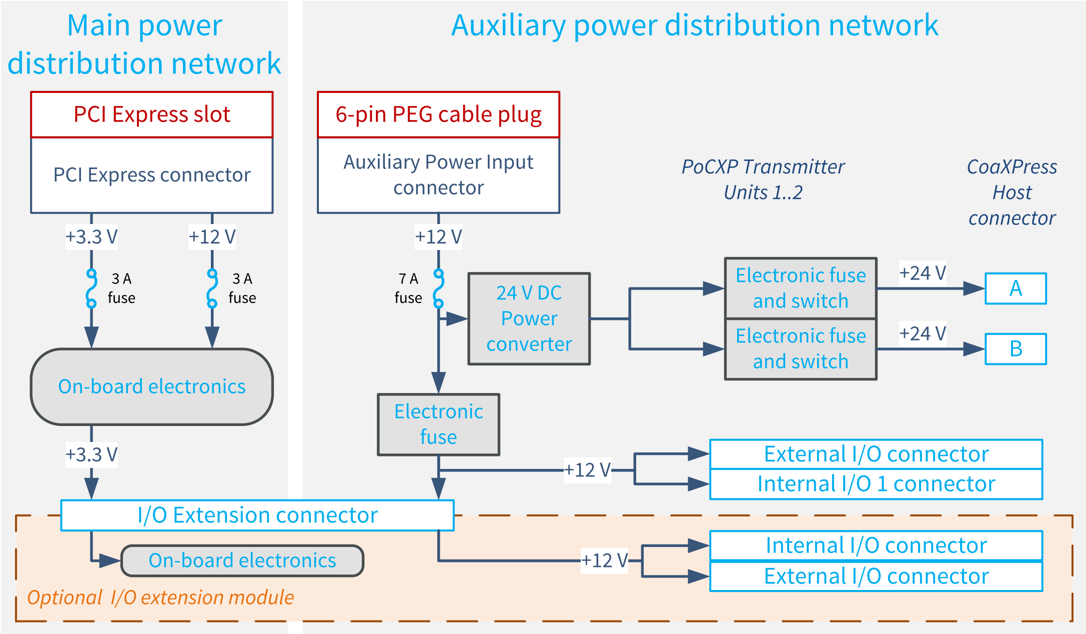
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

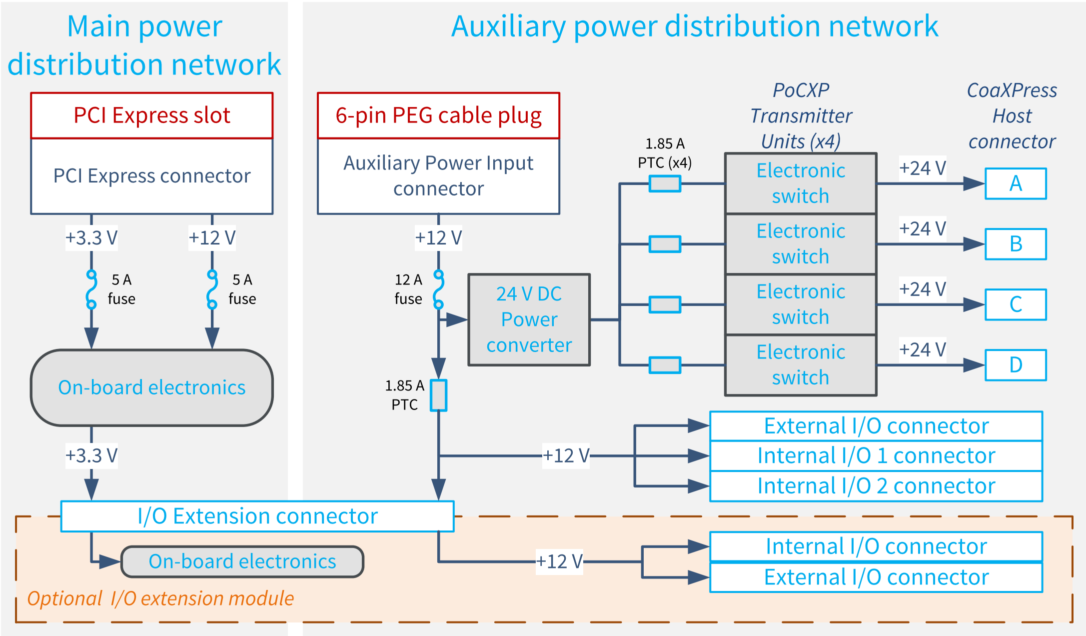
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

3623 Coaxlink Quad CXP-12 Value



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

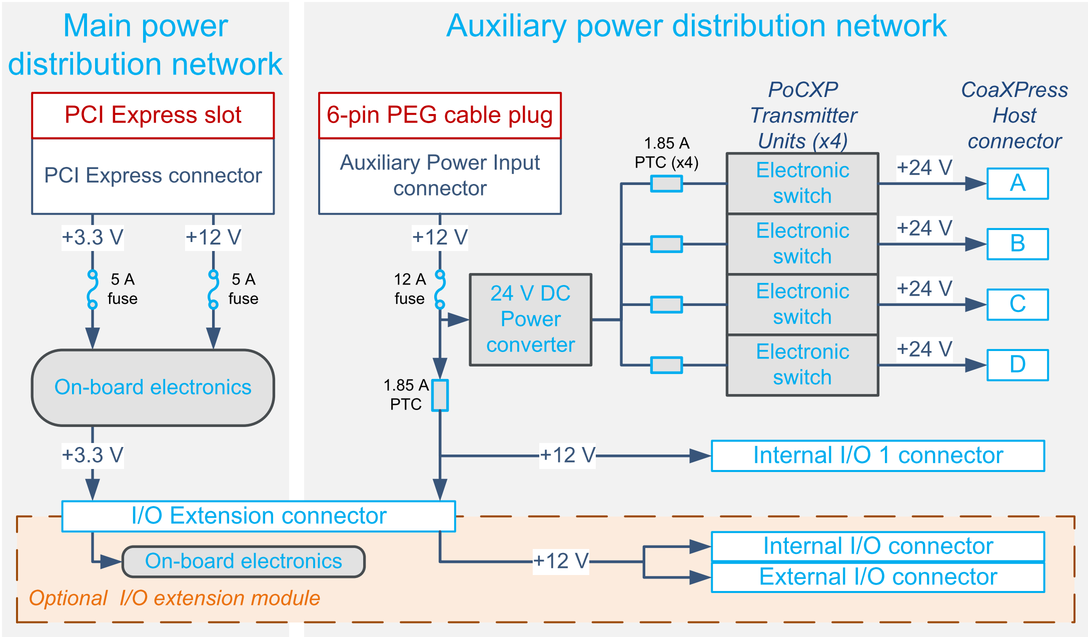
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

3624 Coaxlink Quad CXP-12 DF



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

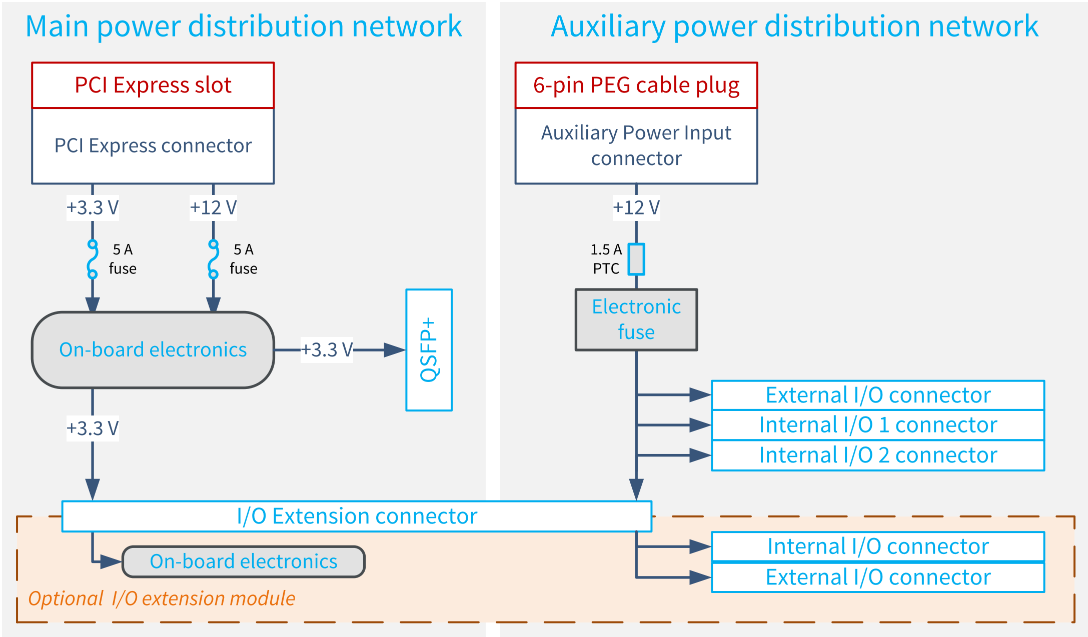
Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external devices including:

- CoaXPress cameras using the PoCXP capability available on all connections of the CoaXPress Host connector
- System devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480 and PoCXP Output with 12V-to-24V converter

3625 Coaxlink QSFP+



Main power distribution network

The main power distribution network delivers power to *all the on-board electronic devices* including FPGA, memory chips, CoaXPress transceivers, I/O drivers and receivers, fan motor.

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 478

Auxiliary power distribution network

The auxiliary power distribution network delivers power to the external system devices using the +12 V power output available on all I/O connectors

See also: "Auxiliary Power Input" on page 480, PoCXP Output with 12V-to-24V converter and

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
1629 Coaxlink Duo PCIe/104-EMB	8.4			W
1630 Coaxlink Mono	7.2	2.1	9.3	W
1631 Coaxlink Duo	8.7	2.7	11.4	W
1632 Coaxlink Quad	9.6	2.5	12.1	W
1633 Coaxlink Quad G3	13	3.8	16.8	W
1633-LH Coaxlink Quad G3 LH	13	3.8	16.8	W
1635 Coaxlink Quad G3 DF	13	3.8	16.8	W
1637 Coaxlink Quad 3D-LLE	13	3.8	16.8	W
3602 Coaxlink Octo	11.8	4.2	16	W
3603 Coaxlink Quad CXP-12	9.8	7.3	17.1	W
3603-4 Coaxlink Quad CXP-12	9.8	7.3	17.1	W
3620 Coaxlink Quad CXP-12 JPEG	11.8	6.3	18.1	W
3620-4 Coaxlink Quad CXP-12 JPEG	11.8	6.3	18.1	W
3621 Coaxlink Mono CXP-12	8.5	3	11.5	W
3621-LH Coaxlink Mono CXP-12 LH	8.5	3	11.5	W
3622 Coaxlink Duo CXP-12	10.5	4.3	14.8	W
3622-LH Coaxlink Duo CXP-12 LH	9.9	4.3	14.2	W
3623 Coaxlink Quad CXP-12 Value	13.4	3.3	16.7	W
3624 Coaxlink Quad CXP-12 DF	14	3.6	17.6	W
3625 Coaxlink QSFP+	12.5	3	15.5	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	I/O power [W]	Camera power [W]	Total power [W]
1630 Coaxlink Mono	PEG	12	19	31
1631 Coaxlink Duo	PEG	12	2 x 19	50
1632 Coaxlink Quad	PEG	12	4 x 19	88
1633 Coaxlink Quad G3	PEG	12	4 x 19	88
1633-LH Coaxlink Quad G3 LH	PEG	12	4 x 19	88
1629 Coaxlink Duo PCIe/104-EMB	MOLEX	N/A	2 x 17	34
1635 Coaxlink Quad G3 DF	PEG	12	4 x 19	88
1637 Coaxlink Quad 3D-LLE	PEG	12	4 x 19	88
3602 Coaxlink Octo	PEG*	12	8 x 19	164
3603 Coaxlink Quad CXP-12	PEG*	12	4 x 19	88
3603-4 Coaxlink Quad CXP-12	PEG*	12	4 x 19	88
3620 Coaxlink Quad CXP-12 JPEG	PEG*	12	4 x 19	88
3620-4 Coaxlink Quad CXP-12 JPEG	PEG*	12	4 x 19	88
3621 Coaxlink Mono CXP-12	PEG*	12	1 x 28	40
3621-LH Coaxlink Mono CXP-12 LH	PEG*	12	1 x 28	40
3622 Coaxlink Duo CXP-12	PEG*	12	2 x 19	50
3622-LH Coaxlink Duo CXP-12 LH	PEG*	12	2 x 19	50
3623 Coaxlink Quad CXP-12 Value	PEG*	12	4 x 19	88
3625 Coaxlink QSFP+	PEG	12	N/A	12

*PEG**: PEG connectors without *SenseIN* input!

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 581

Requirements (MOLEX connector)

The network is fed by a 24 V external power supply attached to the auxiliary power input connector using a power cable terminated by a 4-pin MOLEX plug connector. A protection fuse inserted at the input side prevents potential fire hazards.

Parameter	Min.	Typ.	Max.	Units
Voltage	23	24	25	V

WARNING
On the card side of the power cable, check carefully the voltage on each pin of the 4-pin Molex connector plug before insertion!

See also: "Avoid Mixing Power Supply Cables" on page 581

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. This feature is only available for products having a PEG connector with a *SenseIN* input.

NOTE
The *SenseIN* input of the PEG connector is used for power source cable presence detection. It should be grounded at the power supply level.

I/O Power Output

I/O Power Output (Version 1)

Applies to [1]

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

Description

A non-isolated +12 V power output is available on every I/O connector.

The power originates from an external 12 V power supply plugged into the Auxiliary Power Input connector. It is distributed from a common electronic fuse to all the I/O connectors.

The electronic fuse provides the following protections:

- Limits the inrush current during power on sequence
- Protects the frame grabber and the power source against overload
- Protects the frame grabber and the power source against short-circuits.

The sum of the load currents drawn from all the 12 V outputs of the I/O connectors must be lower or equal to the specified maximum output current.

Specification

Parameter	Conditions	Min.	Typ.	Max.	Units
Aggregated output current	Operating temperature range			1.0	A
Voltage drop across the electronic fuse	Max. output current			0.2	V

NOTE: The above specification applies over the whole operating temperature range of the frame grabber.

[1] 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH and 3625 Coaxlink QSFP+.

I/O Power Output (Version 2)

Applies to [1]

Value12 Quad12DF

A non-isolated +12 V power output is available on every I/O connector.

The power originates from an external 12 V power supply plugged into the Auxiliary Power Input connector. It is distributed from a common resettable fuse to all the I/O connectors.

The resettable fuse provides the following protections:

- Limits the inrush current during power on sequence
- Protects the frame grabber and the power source against overload
- Protects the frame grabber and the power source against short-circuits.
- The resettable fuse is a positive temperature coefficient device 1.85 A PTC.

The sum of the load currents drawn from all the 12 V outputs of the I/O connectors must be lower or equal to the specified maximum output current.

Specification

Parameter	Conditions	Min.	Typ.	Max.	Units
Aggregated output current	Operating temperature range			1.0	A
Voltage drop across the electronic fuse	Max. output current			0.2	V

NOTE: The above specification applies over the whole operating temperature range of the frame grabber.

[1] 3623 Coaxlink Quad CXP-12 Value and 3624 Coaxlink Quad CXP-12 DF.

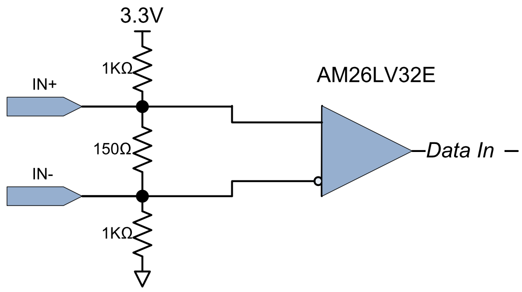
2.4. I/O Interfaces

Electrical specification of the I/O interfaces

Differential Input (Version 1)

Applies to [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Value12
Quad12DF	3300 (Not recommended for new designs)	3614				



Differential Input Simplified Schematic

The receiver complies with the ANSI/TIA/EIA-422B specification.

DC Characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Common mode voltage		-7		+7	V
Differential sensitivity				200	mV
Input impedance			120		Ohm
ESD protection	Human Body Model (HBM)	15			kV
	Contact discharge	8			kV
	Air gap discharge	15			kV

AC characteristics

Parameter	Min.	Typ.	Max.	Units
Pulse width	100			ns
Pulse rate	0		5	MHz
10%-90% rise/fall time			1	µs

[1] 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3300 HD26F I/O module for Coaxlink Duo PCIe/104 and 3614 HD26F I/O Extension Module - Standard I/O Set.

Logical map

The state of the port is reported as follows:

Relative V+/V- voltage	Logical State
V+ > V-	HIGH
V+ < V-	LOW
Unconnected input	HIGH

Compatible drivers

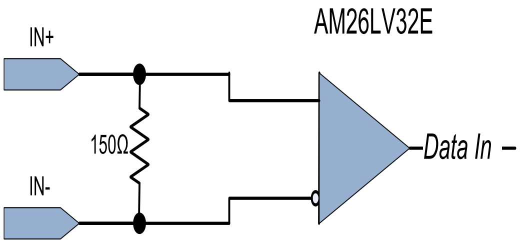
The following drivers are compatible with the high-speed differential input ports:

- RS-422/RS-485 differential line drivers
- Complementary TTL drivers

Differential Input (Version 2)

Applies to [1]

Mono12 | Mono12LH | Duo12 | Duo12LH | QSFP+ | 3618



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			150		Ohm
ESD protection	Human Body Model (HBM)	15			kV
	Contact discharge	8			kV
	Air gap discharge	15			kV

AC characteristics

Parameter	Min.	Typ.	Max.	Units
Pulse width	100			ns
Pulse rate	0		5	MHz
10%-90% rise/fall time			1	µs

[1] 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3625 Coaxlink QSFP+ and 3618 HD26F I/O Extension Module - Fast I/O.

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	Unknown

Compatible drivers

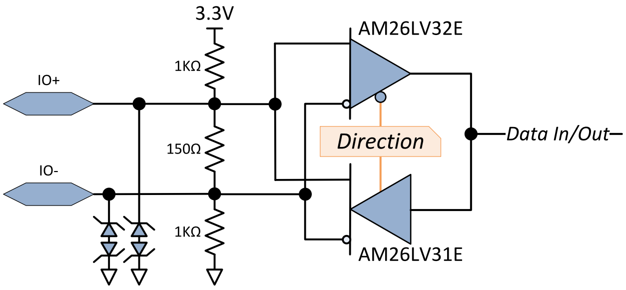
The following drivers are compatible with the high-speed differential input ports:

- 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

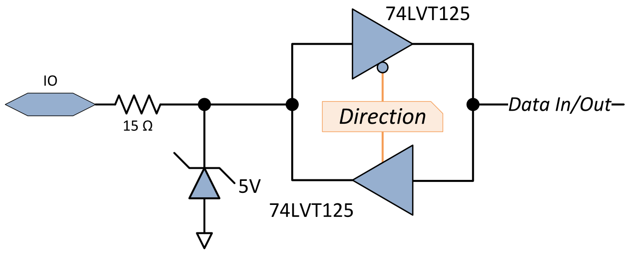
Loads with the following receivers are compatible:

- RS-422 differential line receivers

TTL Input/Output (Version 1)

Applies to [1]

Mono	Duo	Quad	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
3300	3614					



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] 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, 3300 HD26F I/O module for Coaxlink Duo PCIe/104 and 3614 HD26F I/O Extension Module - Standard I/O Set.

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

Parameter	Conditions	Min.	Typ.	Max.	Units
Pulse width		100			ns
Pulse rate		0		5	MHz
10%-90% rise/fall time	(1)		10	20	ns

Condition (1): Short cable (1 m) and a 300 Ohms line termination resistor to GND.

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

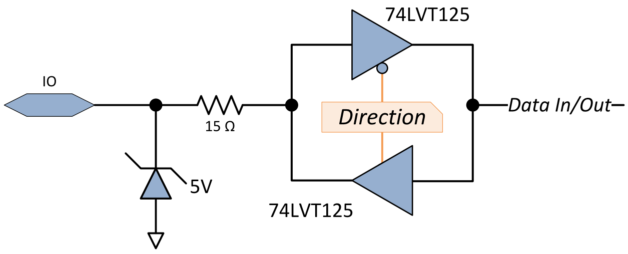
Loads with the following receivers are compatible:

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

TTL Input/Output (Version 2)

Applies to [1]

Duo	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	3610 Not recommended for new designs
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

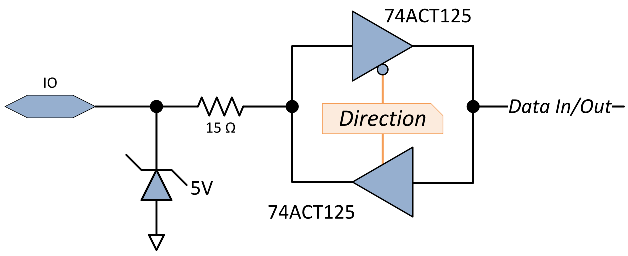
Loads with the following receivers are compatible:

- 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:

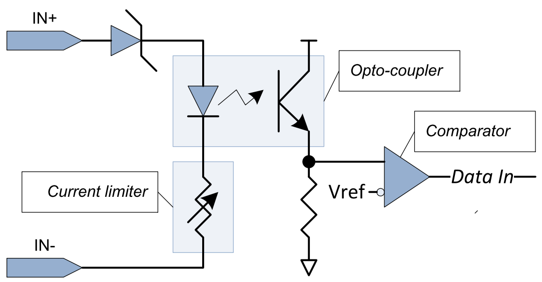
- TTL (5 V TTL)
- CMOS (5 V CMOS)

Isolated Input (Version 1)

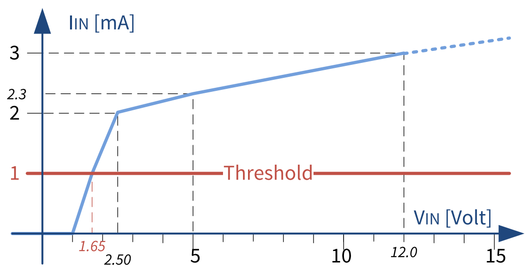
Applies to [1]

Mono (Not recommended for new designs) | Duo (Not recommended for new designs) | Quad (Not recommended for new designs) | QuadG3 | QuadG3LH | QuadG3DF | Quad3DLLE | Octo | Quad12 | Quad12-4 | Quad12J | Quad12J-4 | QSFP+ | 3300 (Not recommended for new designs) | 3614

Isolated current-sense input with wide voltage input range up to 30V, compatible with totem-pole LVTTL, TTL, 5V CMOS drivers, RS-422 differential line 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			1		mA
Differential voltage	@1 mA	1.5	1.65	1.9	V
Input current	@(VIN+ - VIN-) < 1 V			10	µA
	@(VIN+ - VIN-) = 1.65 V		1		mA
	@(VIN+ - VIN-) = 2.5 V		2		mA
	@(VIN+ - VIN-) = 5 V		2.3		mA
	@(VIN+ - VIN-) = 12 V		3		mA
	@(VIN+ - VIN-) = 30 V			5	mA

[1] 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, 3625 Coaxlink QSFP+, 3300 HD26F I/O module for Coaxlink Duo PCIe/104 and 3614 HD26F I/O Extension Module - Standard I/O Set.

AC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Positive pulse width		10			µs
Negative pulse width		10			µs
Pulse rate		0		50	kHz
Turn-ON delay[1]	30°C; 50 kHz; 2 V square wave signal LineFilterStrength = Lowest (LineFilterDelay = 500 ns)		2.1		µs
Turn-OFF delay[2]			4.5		µs

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
$I_{IN} > 1$ mA	HIGH
$I_{IN} < 1$ mA	LOW
Unconnected input port	LOW

Compatible drivers

The following drivers are compatible with this version of the isolated current-sense inputs:

- Totem-pole LVTTL, TTL, 5 V CMOS drivers
- RS-422 Differential line drivers
- Potential free contact, solid-state relay, or opto-isolators
- 12 V and 24 V signaling voltages are also accepted

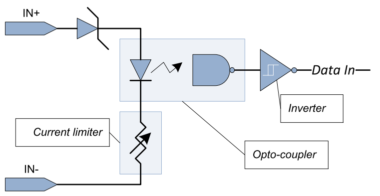
> NOTE
>
> - The +12 V power supply on the I/O connector(s) can be used for powering drivers requiring a power supply.
> - No external resistors are required. However, to obtain the best noise immunity with 12 V and 24 V signaling, it is recommended to insert a series resistor in the circuit. The recommended resistor values are: 4.7k Ohms for 12 V signaling and 10k Ohms for 24 V signaling.

Isolated Input (Version 2)

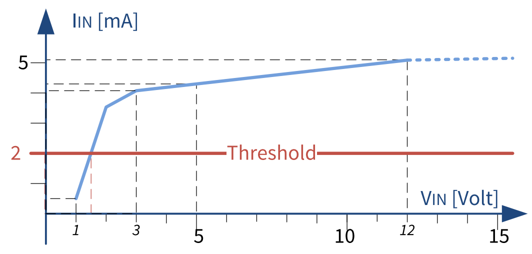
Applies to [1]

Duo Value12 Quad12DF

Isolated current-sense input with wide voltage input range up to 30V, compatible with totem-pole (push-pull) HTL drivers, 5V TTL/RS-422 differential line drivers, 5V CMOS drivers, potential free contacts, solid-state relays and opto-couplers



Simplified schematic



Input Current vs. Input Voltage Characteristics

DC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Differential voltage		-30		+30	V
Input current threshold			2	3	mA
Differential voltage	@3 mA		2.2		V
Input current	@(VIN+ - VIN-) < 1 V		0.5		mA
	@(VIN+ - VIN-) = 3 V		4.1		mA
	@(VIN+ - VIN-) = 5 V		4.4		mA
	@(VIN+ - VIN-) = 12 V		5.1		mA
	@(VIN+ - VIN-) = 30 V		6.8		mA

[1] 1628 Grablink Duo, 3623 Coaxlink Quad CXP-12 Value and 3624 Coaxlink Quad CXP-12 DF.

AC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Positive pulse width		2.5			µs
Negative pulse width		2.5			µs
Pulse rate		0		200	kHz
Turn-ON delay[1]	25 °C; 100 kHZ; 5 V square signal LineFilterStrength = Lowest (LineFilterDelay = 500 ns)		800		ns
Turn-OFF delay[2]			1350		ns

NOTE

1. The "Turn-ON" delay is defined as the time difference between a transition of state at the input that turns ON the opto-coupler and the subsequent transition in the FPGA.
2. The "Turn-OFF" delay is defined as the time difference between a transition of state at the input that turns OFF the opto-coupler and the subsequent transition in the FPGA.

These delays include the delay introduced by the digital line filter controlled by the LineFilterStrength GenApi feature!

Isolation characteristics

Parameter	Value
Isolation grade	Functional
Max. DC voltage	250 V
Max. AC voltage	170 V_{RMS}

NOTE

The functional isolation is only for the circuit technical protection. It does not provide an isolation that can protect a human being from electrical shock!

Logical map

The state of the port is reported as follows:

Input current	Logical State
$I_{IN} \geq 3$ 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

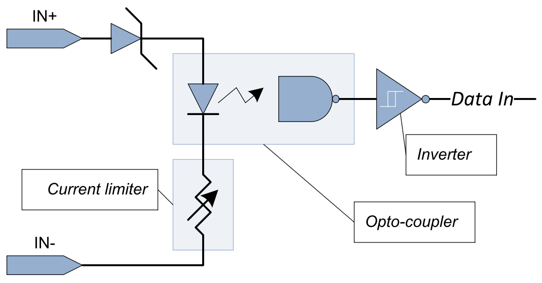
NOTE

- 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.

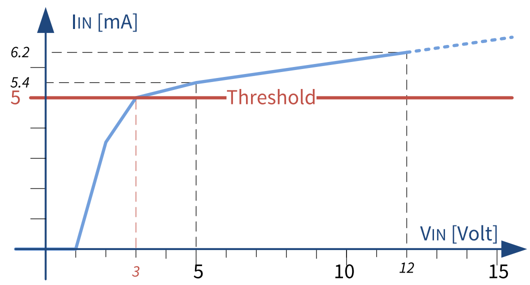
Isolated Input (Version 3)

Applies to [1]
3618

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				5	mA
Differential voltage	@5 mA		3.0		V
Input current	@(VIN+ - VIN-) < 1 V		0.1		mA
	@(VIN+ - VIN-) = 3 V		5.0		mA
	@(VIN+ - VIN-) = 5 V		5.4		mA
	@(VIN+ - VIN-) = 12 V		6.2		mA
	@(VIN+ - VIN-) = 30 V		7.6		mA

AC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Positive pulse width		1.25			µs
Negative pulse width		1.25			µs
Pulse rate		0		400	kHz

[1] 3618 HD26F I/O Extension Module - Fast I/O.

Parameter	Conditions	Min.	Typ.	Max.	Units
Turn-ON delay[1]	55°C; 400 kHz 3.5V square signal; LineFilterStrength = Lowest (LineFilterDelay = 500 ns)		600		ns
Turn-OFF delay[2]			600		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
$I_{IN} \geq 5$ mA	HIGH
$I_{IN} < 0.1$ 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

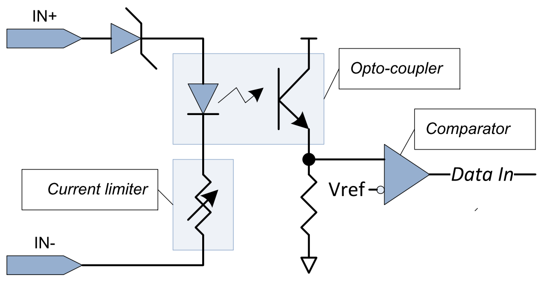
> NOTE
>
> - The +12 V power supply on the I/O connector(s) can be used for powering drivers requiring a power supply.
> - No external resistors are required. However, to obtain the best noise immunity with 12 V and 24 V signaling, it is recommended to insert a series resistor in the circuit. The recommended resistor values are: 4.7k Ohms for 12 V signaling and 10k Ohms for 24 V signaling.

Isolated Input (Version 4)

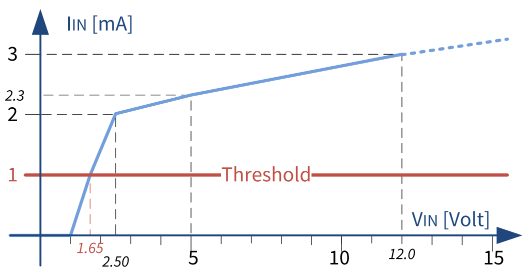
Applies to [1]

Mono12 Mono12LH Duo12 Duo12LH

Isolated current-sense input with wide voltage input range up to 30V, compatible with totem-pole LVTTL, TTL, 5V CMOS drivers, RS-422 differential line 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			1		mA
Differential voltage	@1 mA	1.5	1.65	1.9	V
Input current	@(VIN+ - VIN-) < 1 V			10	µA
	@(VIN+ - VIN-) = 1.65 V		1		mA
	@(VIN+ - VIN-) = 2.5 V		2		mA
	@(VIN+ - VIN-) = 5 V		2.3		mA
	@(VIN+ - VIN-) = 12 V		3		mA
	@(VIN+ - VIN-) = 30 V			5	mA

[1] 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

AC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Positive pulse width		10			µs
Negative pulse width		10			
Pulse rate		0		50	kHz
Turn-ON delay[1]	30°C; 50 kHz; 2 V square wave signal LineFilterStrength = Lowest (LineFilterDelay = 500 ns)		6.9		µs
Turn-OFF delay[2]			9.8		µs

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} > 1 mA	HIGH
I_{IN} < 1 mA	LOW
Unconnected input port	LOW

Compatible drivers

The following drivers are compatible with this version of the isolated current-sense inputs:

- Totem-pole LVTTL, TTL, 5 V CMOS drivers
- RS-422 Differential line drivers
- Potential free contact, solid-state relay, or opto-isolators
- 12 V and 24 V signaling voltages are also accepted

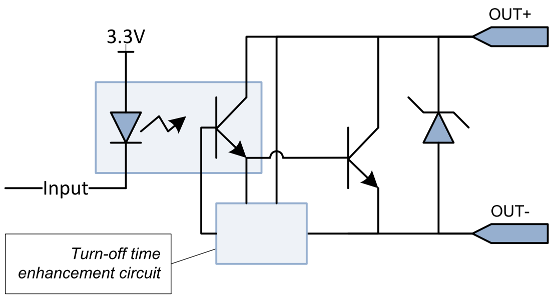
NOTE

- The +12 V power supply on the I/O connector(s) can be used for powering drivers requiring a power supply.
- No external resistors are required. However, to obtain the best noise immunity with 12 V and 24 V signaling, it is recommended to insert a series resistor in the circuit. The recommended resistor values are: 4.7k Ohms for 12 V signaling and 10k Ohms for 24 V signaling.

Isolated Output

Applies to [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	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.

DC characteristics

Parameter	Conditions	Min.	Typ.	Max.	Units
Current				100	mA
Differential voltage	Open state	-30		30	V
	Closed state @ 1 mA			0.4	V
	Closed state @ 100 mA			1.0	V

NOTE

- The output port in the closed state has no current limiter, the user circuit must be designed to avoid excessive currents that could destroy the output port.
- The output port remains in the OFF-state until it is under control of the application.

[1] 1628 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.

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 Not recommended for new designs	Mono Not recommended for new designs	Duo Not recommended for new designs	Quad Not recommended for new designs	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+

Parameter	Conditions	Min	Max	Units
Ambient air temperature		-20 [-4]	70 [158]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

[1] 1628 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

Standard operating conditions (0°C ~ 55°C) — 80°C max FPGA temperature

Applies to [1]

Duo104EMB (Not recommended for new designs) | Mono (Not recommended for new designs) | Duo (Not recommended for new designs) | Quad (Not recommended for new designs) | QuadG3 | QuadG3DF | Quad3DLLE | Value12 | Quad12DF | QSFP+

Parameter	Conditions	Min	Max	Units
FPGA die temperature			80 [176]	°C [°F]
Ambient air temperature		0 [32]	55 [131]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

Standard operating conditions (0°C ~ 55°C) — 95°C max FPGA temperature

Applies to [2]

Octo | Quad12 | Quad12-4 | Quad12J | Quad12J-4 | Mono12 | Duo12

Parameter	Conditions	Min	Max	Units
FPGA die temperature			95 [203]	°C [°F]
Ambient air temperature		0 [32]	55 [131]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

Standard operating conditions (0°C ~ 55°C) — 80°C max FPGA temperature — 250 lfm min. airflow

Applies to [3]

QuadG3LH

Parameter	Conditions	Min	Max	Units
FPGA die temperature			80 [176]	°C [°F]
Ambient air temperature	150 LFM minimum required airflow	0 [32]	55 [131]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

[1] 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

[2] 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 and 3622 Coaxlink Duo CXP-12.

[3] 1633-LH Coaxlink Quad G3 LH.

Standard operating conditions (0°C ~ 55°C) — 95°C max FPGA temperature — 150 lfm min. airflow

Applies to [1]

Mono12LH

Parameter	Conditions	Min	Max	Units
FPGA die temperature			95 [203]	°C [°F]
Ambient air temperature	150 LFM minimum required airflow	0 [32]	55 [131]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

Standard operating conditions (0°C ~ 55°C) — 95°C max FPGA temperature — 250 lfm min. airflow

Applies to [2]

Duo12LH

Parameter	Conditions	Min	Max	Units
FPGA die temperature			95 [203]	°C [°F]
Ambient air temperature	250 LFM minimum required airflow	0 [32]	55 [131]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

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

Applies to [3]

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 3618

Parameter	Conditions	Min	Max	Units
Ambient air temperature		0 [32]	55 [131]	°C [°F]
Ambient air humidity	Non-condensing	10	90	% RH

WARNING
The thermal design of the host PC must ensure that, at any time, the FPGA die temperature never exceeds the recommended limit.

[1] 3621-LH Coaxlink Mono CXP-12 LH.

[2] 3622-LH Coaxlink Duo CXP-12 LH.

[3] 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.

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 (85°C/100°C) temperature detection with automatic acquisition stop

Applies to [1]

Mono12 Mono12LH Duo12 Duo12LH

The above listed frame grabbers implement a dual-threshold excessive FPGA die temperature detection and an automatic acquisition stopping service.

Warning threshold (85 °C) - Notify

When the measured FPGA die temperature reaches *87°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 83°C or increases above 103°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] 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12 and 3622-LH Coaxlink Duo CXP-12 LH.

Error threshold (100 °C) - Notify - Stop acquisition

When the measured FPGA die temperature reaches 103°C, the frame grabber stops image acquisition and 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 97°C.

> TIP
> Stopping the acquisition reduces significantly the heat production of the FPGA. This action is aimed to reduce the die temperature, to prevent the application against unexpected FPGA behavior and to prevent damaging the card.

> 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!

Dual-threshold (85°C/100°C) temperature detection

Applies to [1]

Value12 Quad12DF

The above listed frame grabbers implement a dual-threshold excessive FPGA die temperature detection.

Warning threshold (85 °C) - Notify

When the measured FPGA die temperature reaches *87°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 83°C or increases above 103°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] 3623 Coaxlink Quad CXP-12 Value and 3624 Coaxlink Quad CXP-12 DF.

Error threshold (100 °C) - Notify

When the measured FPGA die temperature reaches 103°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 97°C.

TIP

Stopping the acquisition reduces significantly the heat production of the FPGA. This action is aimed to reduce the die temperature, to prevent the application against unexpected FPGA behavior and to prevent damaging the card.

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 **Coaxlink frame grabbers** are:

1. The electronic devices and power converters of the *main* power distribution network.
2. The losses of the PoCXP 12V-24 V power converter of the *auxiliary* power distribution network. The actual contribution depends on the effectively delivered PoCXP power!

NOTE: The I/O powering contribution is not significant!

Generated heat power estimation and cooling method

The following table shows the estimated heat power generated by **Coaxlink frame grabbers** for two use cases:

1. *Heat power 1:* when the card is not delivering power
1. *Heat power 2:* when the card delivers the maximum I/O and PoCXP power on all camera connectors.

Product	Heat power 1	Heat power 2	Cooling method
1629 Coaxlink Duo PCIe/104-EMB	8.4 W	8.4 W	Conduction
1630 Coaxlink Mono	9.3 W	10.7 W	Air, heatsink with fan
1631 Coaxlink Duo	11.4 W	14.2 W	Air, heatsink with fan
1632 Coaxlink Quad	12.1 W	17.6 W	Air, heatsink with fan
1633 Coaxlink Quad G3	16.8 W	22.3 W	Air, heatsink with fan
1633-LH Coaxlink Quad G3 LH	16.8 W	22.3 W	Air, fanless heatsink
1635 Coaxlink Quad G3 DF	16.8 W	22.3 W	Air, heatsink with fan
1637 Coaxlink Quad 3D-LLE	16.8 W	22.3 W	Air, heatsink with fan
3602 Coaxlink Octo	16 W	27 W	Air, heatsink with fan
3603 Coaxlink Quad CXP-12	17.1 W	22.6 W	Air, heatsink with fan
3603-4 Coaxlink Quad CXP-12	17.1 W	22.6 W	Air, heatsink with fan
3620 Coaxlink Quad CXP-12 JPEG	18.1 W	23.6 W	Air, heatsink with fan
3620-4 Coaxlink Quad CXP-12 JPEG	18.1 W	23.6 W	Air, heatsink with fan
3621 Coaxlink Mono CXP-12	11.5 W	13.5 W	Air, heatsink with fan
3621-LH Coaxlink Mono CXP-12 LH	11.5 W	13.5 W	Air, fanless heatsink
3622 Coaxlink Duo CXP-12	14.8 W	17.6 W	Air, heatsink with fan
3622-LH Coaxlink Duo CXP-12 LH	14.2 W	17 W	Air, fanless heatsink
3623 Coaxlink Quad CXP-12 Value	16.7 W	24.3 W	Air, heatsink with fan

Product	Heat power 1	Heat power 2	Cooling method
3624 Coaxlink Quad CXP-12 DF	17.6 W	25.2 W	Air, heatsink with fan
3625 Coaxlink QSFP+	15.5 W	15.5 W	Air, heatsink with fan

Requirements for air-cooled products with fan

Applies to [1]

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

The heat is dissipated into the ambient air inside the Host PC. The heat exchange is facilitated by a heat sink and a fan mounted on the FPGA (the component having the largest heat source).

The thermal design must ensure sufficient air flow along both sides to keep the FPGA die temperature below the upper limit of the allowed temperature range. The application is responsible for regularly checking the temperature and for taking the appropriate action in case of excessive temperature.

Requirements for fanless air-cooled products

Applies to [2]

QuadG3LH | Mono12LH | Duo12LH

The heat is dissipated into the ambient air inside the Host PC. The heat exchange is facilitated by a large heat sink mounted on the FPGA (the component having the largest heat source).

The thermal design must ensure sufficient the specified minimum 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.

Requirements for conduction-cooled products

Applies to [3]

Duo104EMB

The heat produced by the board is conducted to the chassis enclosure using a heatsink such as the **3301 Thermal drain (Model 1) for Coaxlink Duo PCIe/104**

The thermal design of the PCIe/104 system must ensure an adequate cooling of the enclosure to keep the FPGA die temperature and the ambient air temperature below the upper limits of the allowed temperature range. The application is responsible for regularly checking the temperature and for taking the appropriate action in case of excessive temperature.

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

[2] 1633-LH Coaxlink Quad G3 LH, 3621-LH Coaxlink Mono CXP-12 LH and 3622-LH Coaxlink Duo CXP-12 LH.

[3] 1629 Coaxlink Duo PCIe/104-EMB.

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 A emission | EN55024/35 immunity

Applies to [1]
QuadG3DF Octo

This piece of equipment has been tested and found to comply with:

- Class A 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

This product has been tested in typical class A compliant host systems. It is assumed that this product will also achieve compliance in any class A compliant unit.

To meet EC requirements, shielded cables must be used to connect a peripheral to the card.

EN55032 Class A emission | EN50121-3-2, EN61000-6-2 immunity

Applies to [2]
Duo104EMB

This piece of equipment has been tested and found to comply with:

- EN 50121 electromagnetic compatibility requirements for rolling stock apparatus in railways applications
- 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 compliant host systems. It is assumed that this product will also achieve compliance in any class A compliant unit.

To meet EC requirements, shielded cables must be used to connect a peripheral to the card.

[1] 1635 Coaxlink Quad G3 DF and 3602 Coaxlink Octo.

[2] 1629 Coaxlink Duo PCIe/104-EMB.

EN55022/32 Class B emission | EN55024/35 immunity

Applies to [1]

Mono (Not recommended for new designs) | Duo (Not recommended for new designs) | Quad (Not recommended for new designs) | QuadG3 | QuadG3LH | Quad3DLLE | Quad12 | Quad12-4 | Quad12J | Quad12J-4 | Mono12 | Mono12LH | Duo12 | Duo12LH | 1636 | 3610 (Not recommended for new designs) | 3612 (Not recommended for new designs)

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

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.

EN55022/32 Class B emission | EN55024/35 EN61000-6-2 immunity

Applies to [2]

Duo | Value12 | Quad12DF | QSFP+ | 3614

This piece of equipment has been tested and found to comply with:

- Class B EN 55022 / CISPR 22 or EN 55032 / CISPR 32 electromagnetic emission requirements for information technology equipment
- EN 55024 / CISPR 24 or EN 55035 / CISPR 35 electromagnetic immunity requirements for information technology equipment
- EN 610006-2 Immunity standard for industrial environments

This product has been tested in typical class A and class B compliant host systems. It is assumed that this product will also achieve compliance in any class A or class B compliant unit.

To meet EC requirements, shielded cables must be used to connect a peripheral to the card.

[1] 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, 1636 InterPC C2C-Link Adapter, 3610 HD26F I/O Extension Module - TTL-RS422 and 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422.

[2] 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 A emission

Applies to [1]
Duo104EMB (Not recommended for new designs) QuadG3DF Octo

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference in a residential installation or when the equipment is operated in a commercial environment.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

[1] 1629 Coaxlink Duo PCIe/104-EMB, 1635 Coaxlink Quad G3 DF and 3602 Coaxlink Octo.

Class B emission

Applies to [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	Quad3DLLE
Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH	Duo12
Duo12LH	Value12	Quad12DF	QSFP+	1636	3610 (Not recommended for new designs)	3612 (Not recommended for new designs)
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.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

[1] 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 1636 InterPC C2C-Link Adapter, 3610 HD26F I/O Extension Module - TTL-RS422, 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422 and 3614 HD26F I/O Extension Module - Standard I/O Set.

EMC Compliance statement for Korea

Applies to [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	1636
3610 (Not recommended for new designs)	3612 (Not recommended for new designs)	3614	3618			

Notice for Korea

Registered products under the Clause 3, Article 58-2 of Radio Waves Act:

Product	Registration Number
1630 Coaxlink Mono	MSIP-REM-EUr-PC1631
1631 Coaxlink Duo	MSIP-REM-EUr-PC1631
1632 Coaxlink Quad	MSIP-REM-EUr-PC1632
1633 Coaxlink Quad G3	MSIP-REM-EUr-PC1633
1633-LH Coaxlink Quad G3 LH	MSIP-REM-EUr-PC1633
1635 Coaxlink Quad G3 DF	R-R-EUr-PC1635
1637 Coaxlink Quad 3D-LLE	MSIP-REM-EUr-PC1633
3602 Coaxlink Octo	R-R-EUr-PC3602
3603 Coaxlink Quad CXP-12	R-R-EUr-PC3603
3603-4 Coaxlink Quad CXP-12	R-R-EUr-PC3603
3620 Coaxlink Quad CXP-12 JPEG	R-R-EUr-PC3603
3620-4 Coaxlink Quad CXP-12 JPEG	R-R-EUr-PC3603
3621 Coaxlink Mono CXP-12	R-R-EUr-PC3622
3621-LH Coaxlink Mono CXP-12 LH	R-R-EUr-PC3622
3622 Coaxlink Duo CXP-12	R-R-EUr-PC3622
3622-LH Coaxlink Duo CXP-12 LH	R-R-EUr-PC3622
3623 Coaxlink Quad CXP-12 Value	R-R-EUr-PC3623
3624 Coaxlink Quad CXP-12 DF	R-R-EUr-PC3624
3625 Coaxlink QSFP+	R-R-EUr-PC3625
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

[1] 1628 Grablink Duo, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF, 3625 Coaxlink QSFP+, 1636 InterPC C2C-Link Adapter, 3610 HD26F I/O Extension Module - TTL-RS422, 3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422, 3614 HD26F I/O Extension Module - Standard I/O Set and 3618 HD26F I/O Extension Module - Fast I/O.

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

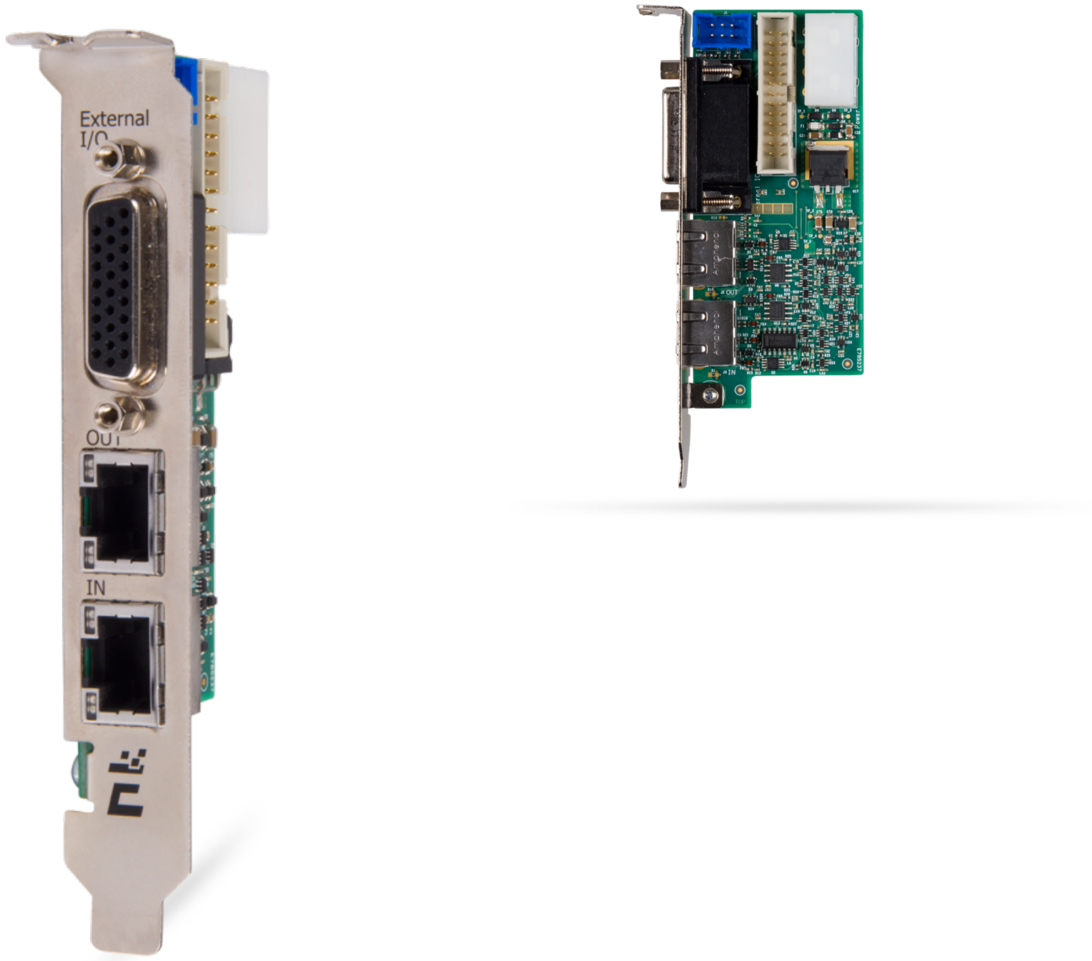
According the European Union 2012/19/EU directive, the product must be disposed of separately from normal household waste. It must be recycled according to the local regulations.

4. Accessories

4.1. 1636 InterPC C2C-Link Adapter

Compatible with [1]

Duo	Mono Not recommended for new designs	Duo Not recommended for new designs	Quad Not recommended for new designs	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

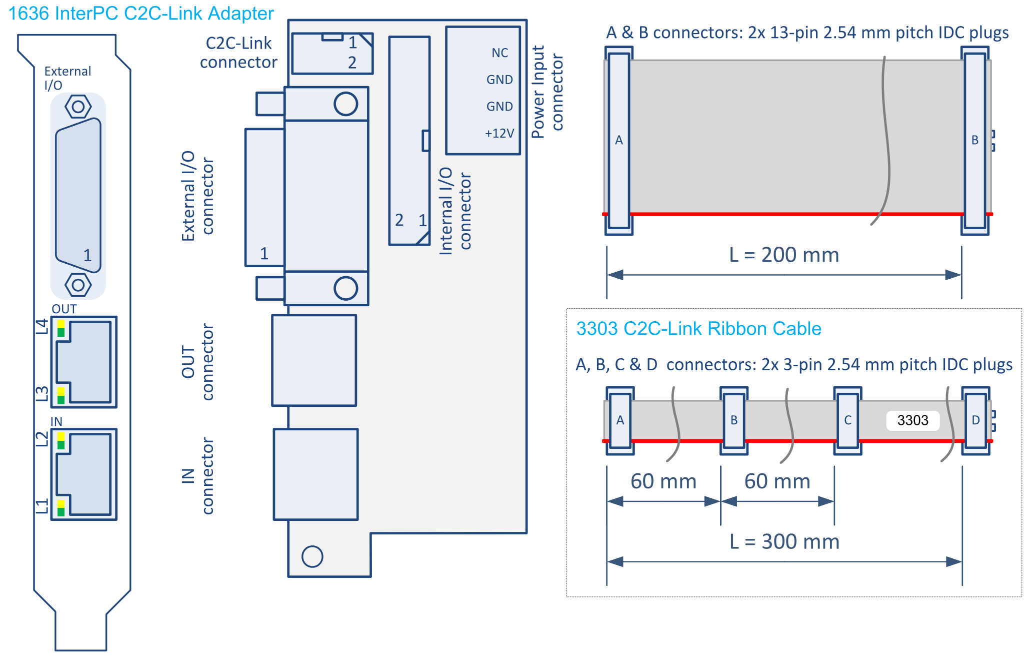


Pictures of 1636 InterPC C2C-Link Adapter

The **1636 InterPC C2C-Link Adapter** is an accessory product for use as an InterPC C2C-Link extender and/or as a HD26F I/O adapter.

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

Layout



1636 InterPC C2C-Link Adapter

The **1636 InterPC C2C-Link Adapter** product accessory is composed of:

- A printed circuit board assembly fitted with a standard-profile PC bracket.
- A 200-mm 26-way ribbon cable.
- A **3303 C2C-Link Ribbon Cable**.

Connectors

The **External I/O connector** is a HD26F – 26-pin 3-row high-density female – Sub-D connector fitted on the bracket with UNC 4-40 screws.

The **IN connector** and the **OUT connector** are RJ-45 8-pin sockets fitted on the bracket.

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

Using 1636 as C2C-Link Extender

Compatible with [1]

Duo	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF
Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12
Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+	

Adapter Powering

WARNING

The **1636 InterPC C2C-Link Adapter** must be powered when it is used as a C2C-Link extender.

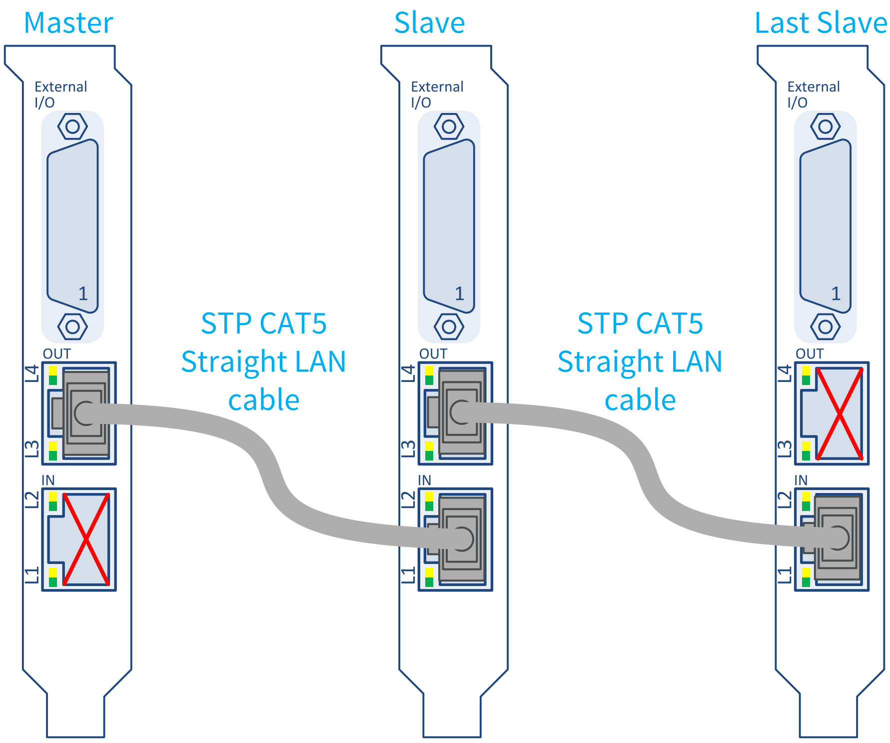
The user has two options to supply power to the adapter:

- From the compatible frame grabber +12 V power output through the 26-way ribbon cable attached to the **Internal I/O** connector.
- From the Host PC power supply through a Disk Drive Power connector cable plugged into the **Power Input connector**.

Parameter	Min.	Typ.	Max.	Units
+12 V DC Input voltage	11.0	12.0	13.0	V
+12 V Input power		1.8		W

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

InterPC Interconnect



External wiring of a C2C-Link across 3 adapters.

The external wiring of the C2C-Link is made with RJ 45 CAT 5 STP straight LAN cables. N-1 cables are required to interconnect N adapters in a daisy-chain scheme.

The daisy-chain begins on the OUT connector of the Master adapter and ends at the IN connector of the Last Slave adapter.

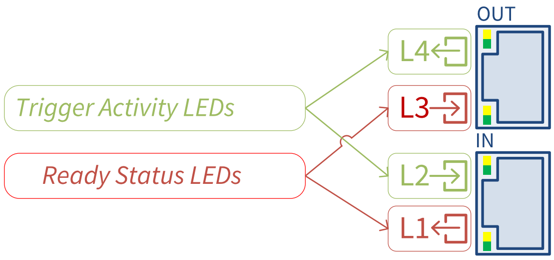
The IN connector of the Master adapter and the OUT connector of the Last Slave adapter are unused.

NOTE
The adapter disables the signal drivers of the IN and OUT connectors to avoid electrical damages when it detects a bad or a missing connection.

The InterPC cable drivers and receivers are not electrically isolated.

WARNING
To avoid damages, the interconnected PCs must have a common ground reference.

LEDs



1636 InterPC C2C-Link Adapter LEDs

Trigger Activity LEDs

The L2 and L4 LEDs indicate the trigger activity on the LAN cable. L2 shows the activity on the received trigger signals; L4 shows the activity on the transmitted trigger signals.

LED State	Indication
Off	The LAN cable is unplugged or the adapter is not powered.
Green	No trigger activity. *No trigger events in the past 10 milliseconds.*
Yellow	Trigger activity. *One or more trigger events in the past 10 milliseconds.*

Ready Status LEDs

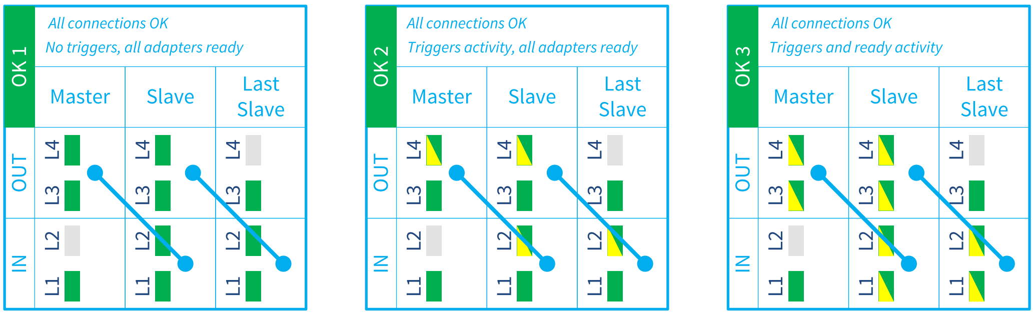
The L1 and L3 LEDs indicate the state of the ready signal on the LAN cable. L1 shows the state of the transmitted ready signal; L3 shows the state of the received ready signal.

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



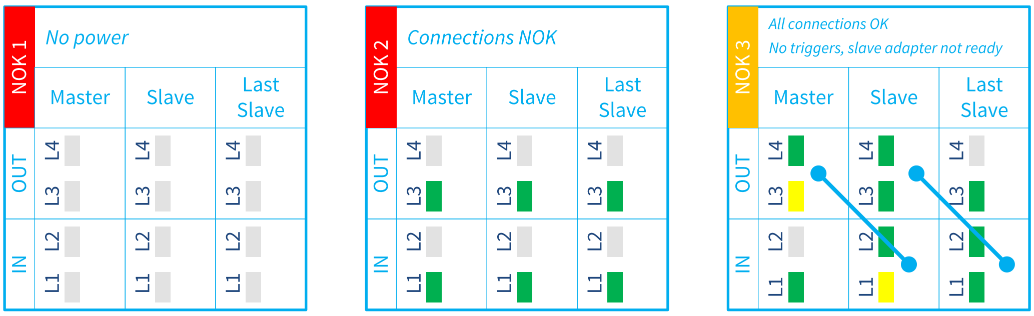
The above drawings show the LEDs states of 3 daisy-chained adapters for 3 normal situations.

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 (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Value12	Quad12DF
QSFP+						

- Plug the A-connector of the supplied 200-mm 26-way ribbon cable to the **Internal I/O** connector of the **1636 InterPC C2C-Link Adapter**
- Plug the B-connector to the **Internal I/O** connector of the target card.

Target cards where the 1636 InterPC C2C-Link Adapter can be used for the standard I/O set #1

Compatible with [2]

QuadG3DF	Octo	Quad12DF

Target cards where the 1636 InterPC C2C-Link Adapter can be used for the standard I/O set #2

Compatible with [3]

Duo	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	Quad3DLLE	Quad12
Quad12-4	Quad12J	Quad12J-4	Value12	QSFP+		

NOTE
No power supply connection is required when using the **1636 InterPC C2C-Link Adapter** as an HD26F I/O adapter only.

[1] 1628 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	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

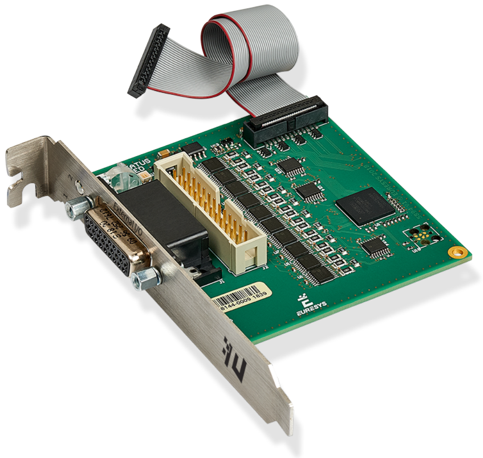
NOTE
The 3610 and the 3612 I/O extension modules are almost identical!
They differ only by the electrical specification of the single-ended outputs: low-voltage 3.3 V TTL for 3610, 5 V CMOS for 3612.

These modules:

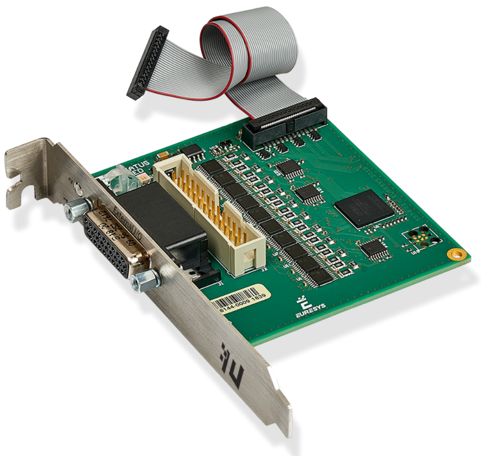
- are powered by the frame grabber through the I/O EXTENSION cable.
- are software configurable There are no jumpers.
- provide a persistent configuration. The last configuration is automatically restored at power-up

WARNING
Hot plugging is not allowed!

[1] 1628 Grablink Duo, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3621 Coaxlink Mono CXP-12, 3621-LH Coaxlink Mono CXP-12 LH, 3622 Coaxlink Duo CXP-12, 3622-LH Coaxlink Duo CXP-12 LH, 3623 Coaxlink Quad CXP-12 Value, 3624 Coaxlink Quad CXP-12 DF and 3625 Coaxlink QSFP+.

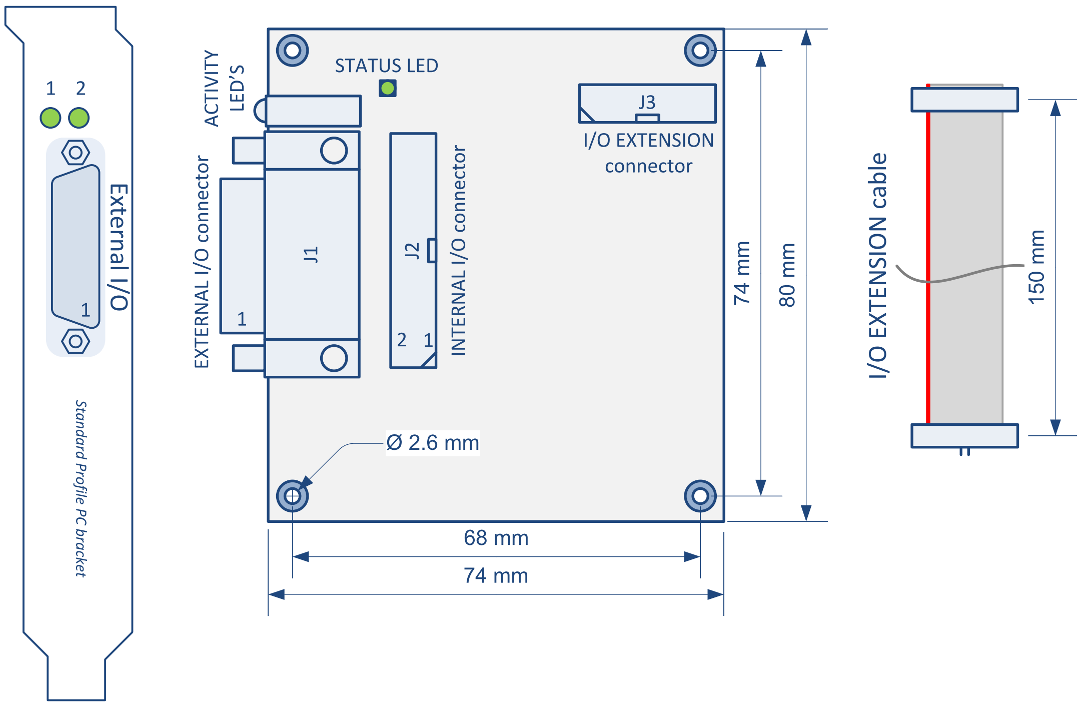


3610 HD26F I/O Extension Module - TTL-RS422



3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422

Module layout



Connectors

- "External I/O Connector - 3610/3612" on page 415
- "I/O Extension Connector" on page 430
- "Internal I/O Connector - 3610/3612" on page 425

- 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 489	
Single-ended I/O	"TTL Input/Output (Version 2)" on page 495	"TTL Input/5 V CMOS Output" on page 498
Power output	"I/O Power Output" on page 482	
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 MIO2	2 x TTL in	2 x TTL out	MIO1	4 x RS-422 in	4 x RS-422 out
	MIO3 MIO4	2 x TTL in	2 x TTL out	MIO3		
	MIO5 MIO6	2 x TTL in	2 x TTL out	MIO5		
	MIO7 MIO8	2 x TTL in	2 x TTL out	MIO7		
Group #2	MIO9 MIO10	2 x TTL in	2 x TTL out	MIO9	4 x RS-422 in	4 x RS-422 out
	MIO11 MIO12	2 x TTL in	2 x TTL out	MIO11		
	MIO13 MIO14	2 x TTL in	2 x TTL out	MIO13		
	MIO15 MIO16	2 x TTL in	2 x TTL out	MIO15		
Group #3	MIO17 MIO18	2 x TTL in	2 x TTL out	MIO17	4 x RS-422 in	4 x RS-422 out
	MIO19 MIO20	2 x TTL in	2 x TTL out	MIO19		

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 545 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

3614 HD26F I/O Extension Module - Standard I/O Set

Compatible with [1]

Octo	Mono12	Mono12LH	Duo12	Duo12LH	Quad12DF

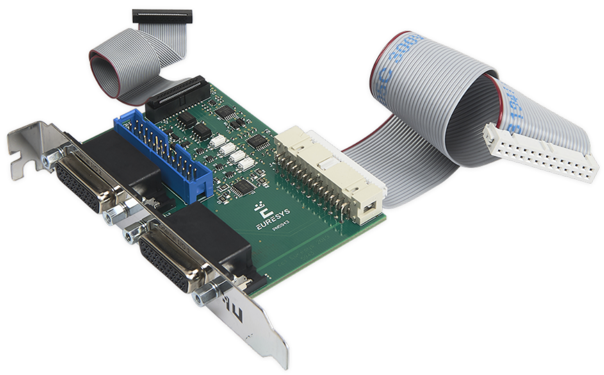
The **3614 HD26F I/O Extension Module - Standard I/O Set** accessory is an *I/O extension module* to be used with above listed frame grabber products.

This module:

- adds a **second standard I/O set** of 10 I/O lines
- provides an HD26F adapter for the **first standard I/O set**.

It allows users of above listed frame grabber products to extend the number of I/O ports and to have all I/O ports on two robust HD26F Sub-D connector.

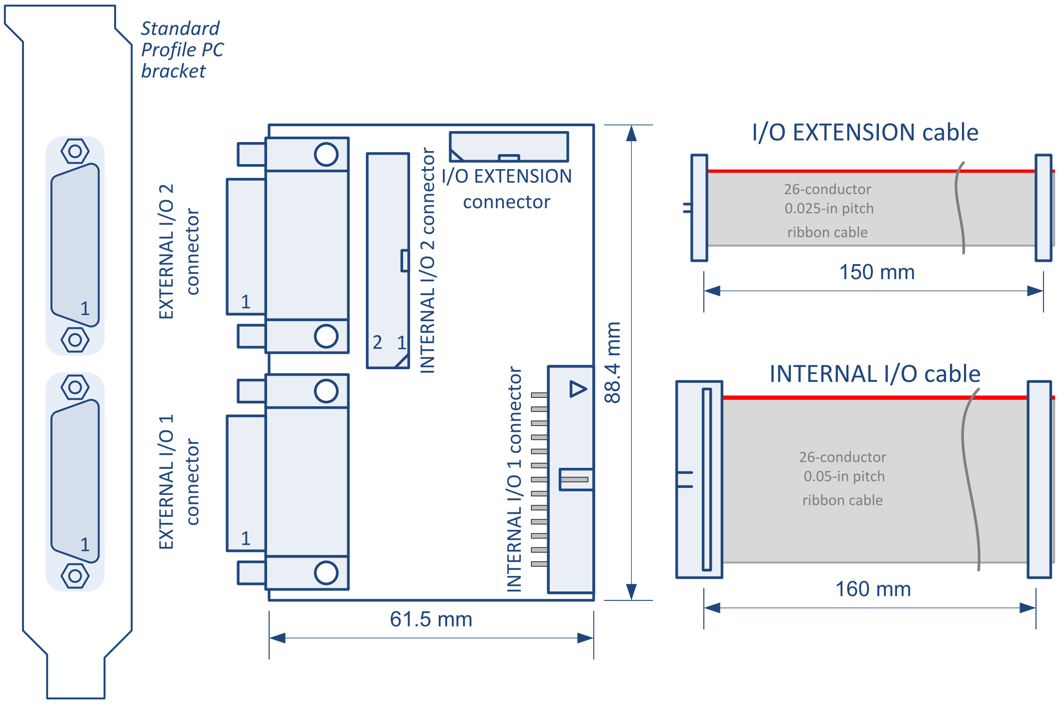
The module is powered by the frame grabber through the I/O EXTENSION cable.



3614 I/O extension module assembly

[1] 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.

Description



3614 I/O extension module layout

This I/O extension module includes:

- a PC bracket fitted with two 26-pin high-density female Sub-D connectors named EXTERNAL I/O 1 and EXTERNAL I/O 2,
- a printed circuit board assembly implementing five connectors and the I/O drivers and receivers of the second I/O set,
- a 26-pin high-density flat cable for direct connection to the I/O EXTENSION connector of the attached frame grabber,
- a 26-pin flat cable for direct connection to the INTERNAL I/O 1 connector of the attached frame grabber.

Connectors

- "External I/O 1 Connector - 3614/3618" on page 417
- "External I/O 2 Connector - 3614/3618" on page 419
- "I/O Extension Connector" on page 430
- "Internal I/O 2 Connector - 3614/3618" on page 427

- EXTERNAL I/O 1 connector
  - Robust 26-pin high-density Sub-D
  - All I/O lines of the standard I/O set *#1*
  - Same pin layout as the *External I/O* connectors of **Coaxlink and Grablink Duo frame grabbers**
- EXTERNAL I/O 2 connector
  - Robust 26-pin high-density Sub-D
  - All I/O lines of the standard I/O set *#2*
  - Similar pin layout as the *External I/O* connectors of **Coaxlink and Grablink Duo frame grabbers**
- INTERNAL I/O 2 connector
  - Two-row 0.1 in pitch straight 26-pin flat cable header
  - All I/O lines of the standard I/O set *#2*
  - Same pin layout as the *Internal I/O* 2 connectors of **Coaxlink and Grablink Duo frame grabbers**
- INTERNAL I/O 1 connector
  - Two-row 0.1 in pitch right-angled 26-pin flat cable header
  - For connection via the INTERNAL I/O cable to the Internal I/O 1 Connector of the attached frame grabber
- I/O EXTENSION connector
  - Two-row 0.5 in pitch 26-pin straight flat cable header
  - For connection via the I/O EXTENSION cable to the to I/O Extension Connector of the attached frame grabber

Electrical specifications

External I/O 2 (I/O set #2)

Item	Electrical Specification
Isolated inputs	"Isolated Input (Version 1)" on page 501
Isolated output	"Isolated Output" on page 513
Differential inputs	"Differential Input (Version 1)" on page 485
TTL I/O	"TTL Input/Output (Version 1)" on page 492
I/O Power output	"I/O Power Output" on page 482

NOTE
The electrical specifications of External I/O 1 (I/O set #1) are defined by the frame grabber!

3618 HD26F I/O Extension Module - Fast I/O

Compatible with [1]

Octo	Mono12	Mono12LH	Duo12	Duo12LH	Quad12DF

The **3618 HD26F I/O Extension Module - Fast I/O** accessory is an *I/O extension module* to be used with above listed frame grabber products.

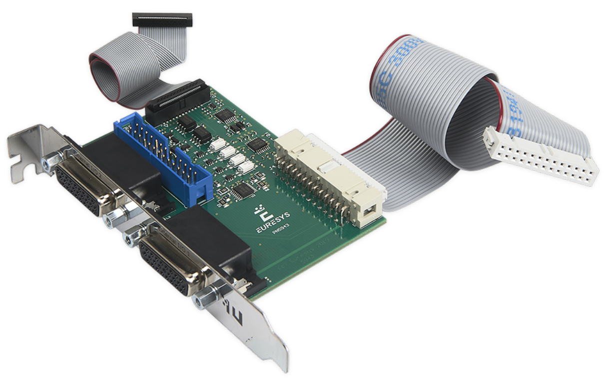
This module:

- adds a **second standard I/O set** of 10 I/O lines
- provides an HD26F adapter for the **first standard I/O set**.

It allows users of above listed frame grabber products to extend the number of I/O ports and to have all I/O ports on two robust HD26F Sub-D connector.

> TIP
> This module offers faster isolated inputs in comparison to the **3614 HD26F I/O Extension Module - Standard I/O Set**.

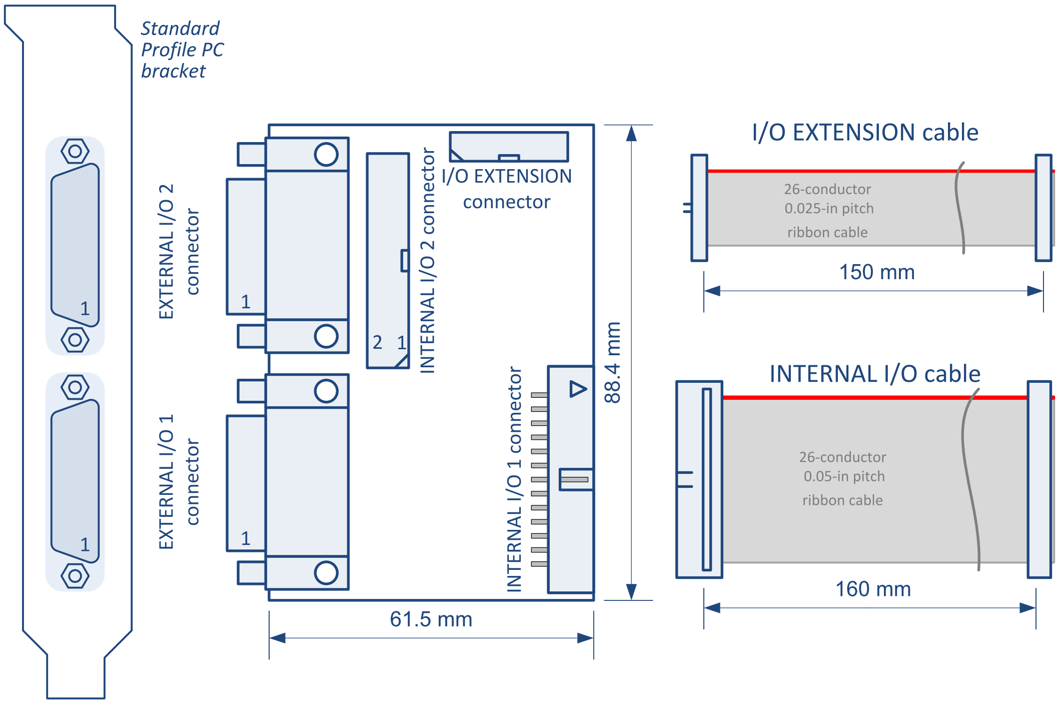
The module is powered by the frame grabber through the I/O EXTENSION cable.



3614 I/O extension module assembly

[1] 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.

Description



3618 I/O extension module layout

This I/O extension module includes:

- a PC bracket fitted with two 26-pin high-density female Sub-D connectors named EXTERNAL I/O 1 and EXTERNAL I/O 2,
- a printed circuit board assembly implementing five connectors and the I/O drivers and receivers of the second I/O set,
- a 26-pin high-density flat cable for direct connection to the I/O EXTENSION connector of the attached frame grabber,
- a 26-pin flat cable for direct connection to the INTERNAL I/O 1 connector of the attached frame grabber.

Connectors

- "External I/O 1 Connector - 3614/3618" on page 417
- "External I/O 2 Connector - 3614/3618" on page 419
- "I/O Extension Connector" on page 430
- "Internal I/O 2 Connector - 3614/3618" on page 427

- EXTERNAL I/O 1 connector
  - Robust 26-pin high-density Sub-D
  - All I/O lines of the standard I/O set *#1*
  - Same pin layout as the *External I/O* connectors of **Coaxlink and Grablink Duo frame grabbers**
- EXTERNAL I/O 2 connector
  - Robust 26-pin high-density Sub-D
  - All I/O lines of the standard I/O set *#2*
  - Similar pin layout as the *External I/O* connectors of **Coaxlink and Grablink Duo frame grabbers**
- INTERNAL I/O 2 connector
  - Two-row 0.1 in pitch straight 26-pin flat cable header
  - All I/O lines of the standard I/O set *#2*
  - Same pin layout as the *Internal I/O* 2 connectors of **Coaxlink and Grablink Duo frame grabbers**
- INTERNAL I/O 1 connector
  - Two-row 0.1 in pitch right-angled 26-pin flat cable header
  - For connection via the INTERNAL I/O cable to the Internal I/O 1 Connector of the attached frame grabber
- I/O EXTENSION connector
  - Two-row 0.5 in pitch 26-pin straight flat cable header
  - For connection via the I/O EXTENSION cable to the to I/O Extension Connector of the attached frame grabber

Electrical specifications

External I/O 2 (I/O set #2)

Item	Electrical Specification
Isolated inputs	"Isolated Input (Version 3)" on page 507
Isolated output	"Isolated Output" on page 513
Differential inputs	"Differential Input (Version 2)" on page 487
TTL I/O	"TTL Input/Output (Version 1)" on page 492
I/O Power output	"I/O Power Output" on page 482

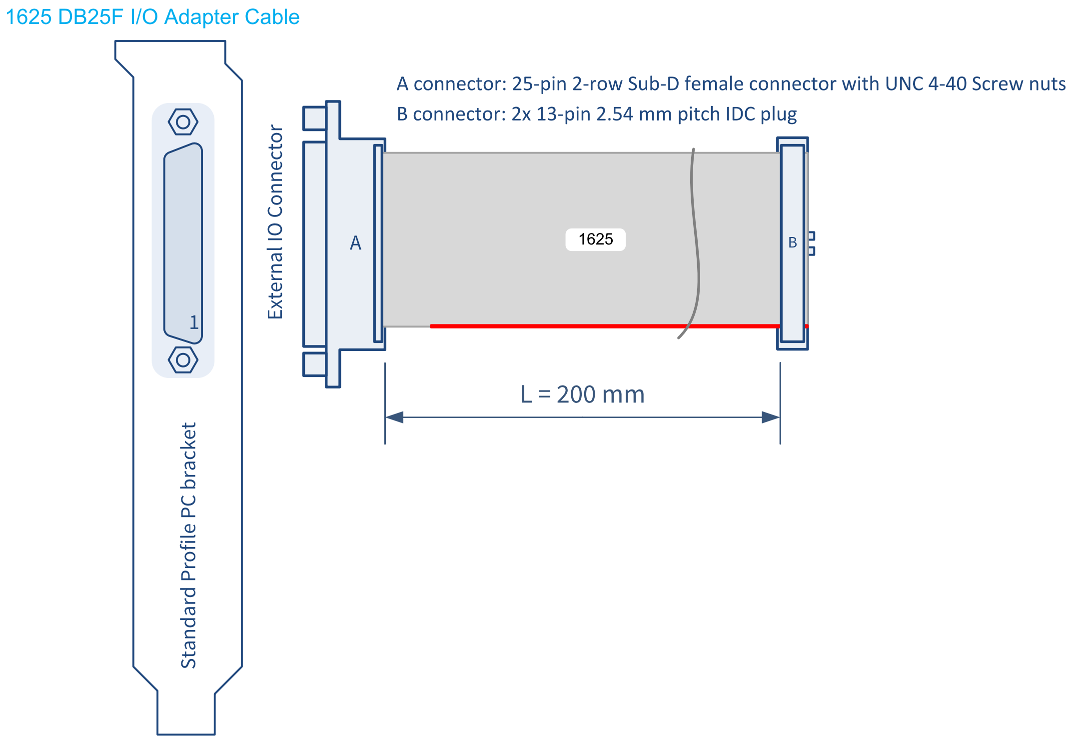
NOTE
The electrical specifications of External I/O 1 (I/O set #1) are defined by the frame grabber!

4.3. Cables

1625 DB25F I/O Adapter Cable

Compatible with [1]

Duo	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	Quad12J-4	Mono12	Mono12LH
Duo12	Duo12LH	Value12	Quad12DF	QSFP+		



1625 DB25F I/O Adapter Cable

The **1625 DB25F I/O Adapter Cable** connects all the pins (but the pin 1) 1of a 26-pin dual-row 0.1" pitch connector to a 25-pin female SubD connector fitted into a standard-profile PC bracket.

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

Usage with Internal IO2 connector

The adapter brings the second set of I/O lines and the +12 V power output to a bracket-mount SubD connector. The pins are assigned as follows:

Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1		GND	Ground
2	2	1	GND	Ground
3	3	14	DIN21+	High-speed differential input #21 – Positive pole
4	4	2	DIN21-	High-speed differential input #21 – Negative pole
5	5	15	DIN22+	High-speed differential input #22 – Positive pole
6	6	3	DIN22-	High-speed differential input #22 – Negative pole
7	7	16	IIN21+	Isolated input #21 – Positive pole
8	8	4	IIN21-	Isolated input #21 – Negative pole
9	9	17	IIN22+	Isolated input #22 – Positive pole
10	10	5	IIN22-	Isolated input #22 – Negative pole
11	11	18	IIN23+	Isolated input #23 – Positive pole
12	12	6	IIN23-	Isolated input #23 – Negative pole
13	13	19	IIN24+	Isolated input #24 – Positive pole
14	14	7	IIN24-	Isolated input #24 – Negative pole
15	15	20	IOUT21+	Isolated contact output #21 – Positive pole
16	16	8	IOUT21-	Isolated contact output #21 – Negative pole
17	17	21	IOUT22+	Isolated contact output #22 – Positive pole
18	18	9	IOUT22-	Isolated contact output #22 – Negative pole
19	19	22	TTLIO21	TTL input/output #21
20	20	10	GND	Ground (TTLIO21 return)
21	21	23	TTLIO22	TTL input/output #22
22	22	11	GND	Ground (TTLIO22 return)
23	23	24	-	Not used
24	24	12	GND	Ground
25	25	25	+12V	+12 V Power output
26	26	13	GND	Ground (+12 V return)

Usage with Internal IO1 connector

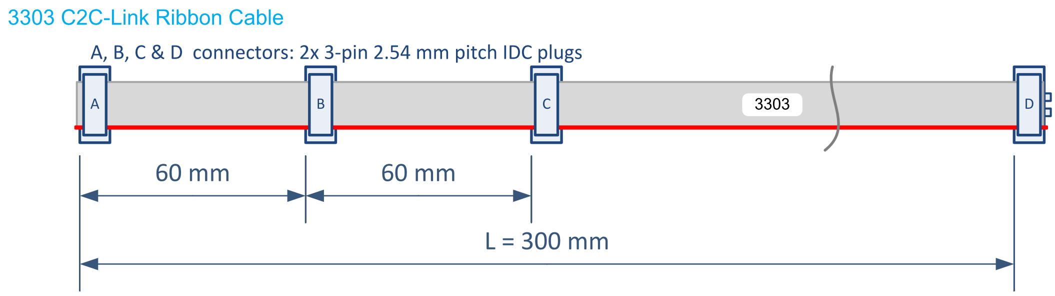
The adapter brings the second set of I/O lines and the +12 V power output to a bracket-mount SubD connector. The pins are assigned as follows:

Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1		GND	Ground
2	2	1	GND	Ground
3	3	14	DIN11+	High-speed differential input #11 – Positive pole
4	4	2	DIN11-	High-speed differential input #11 – Negative pole
5	5	15	DIN12+	High-speed differential input #12 – Positive pole
6	6	3	DIN12-	High-speed differential input #12 – Negative pole
7	7	16	IIN11+	Isolated input #11 – Positive pole
8	8	4	IIN11-	Isolated input #11 – Negative pole
9	9	17	IIN12+	Isolated input #12 – Positive pole
10	10	5	IIN12-	Isolated input #12 – Negative pole
11	11	18	IIN13+	Isolated input #13 – Positive pole
12	12	6	IIN13-	Isolated input #13 – Negative pole
13	13	19	IIN14+	Isolated input #14 – Positive pole
14	14	7	IIN14-	Isolated input #14 – Negative pole
15	15	20	IOUT11+	Isolated contact output #11 – Positive pole
16	16	8	IOUT11-	Isolated contact output #11 – Negative pole
17	17	21	IOUT12+	Isolated contact output #12 – Positive pole
18	18	9	IOUT12-	Isolated contact output #12 – Negative pole
19	19	22	TTLIO11	TTL input/output #11
20	20	10	GND	Ground (TTLIO11 return)
21	21	23	TTLIO12	TTL input/output #12
22	22	11	GND	Ground (TTLIO12 return)
23	23	24	-	Not used
24	24	12	GND	Ground
25	25	25	+12V	+12 V Power output
26	26	13	GND	Ground (+12 V return)

3303 C2C-Link Ribbon Cable

Compatible with [1]

Duo	Duo104EMB (Not recommended for new designs)	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+



3303 C2C-Link Ribbon Cable assembly

The **3303 C2C-Link Ribbon Cable** is a 6-conductor 0.05-in pitch ribbon fitted with 4 6-pin female ribbon cable connectors.

This cable is used for interconnecting the C2C-Link connectors of up to 4 cards located in the same PC.

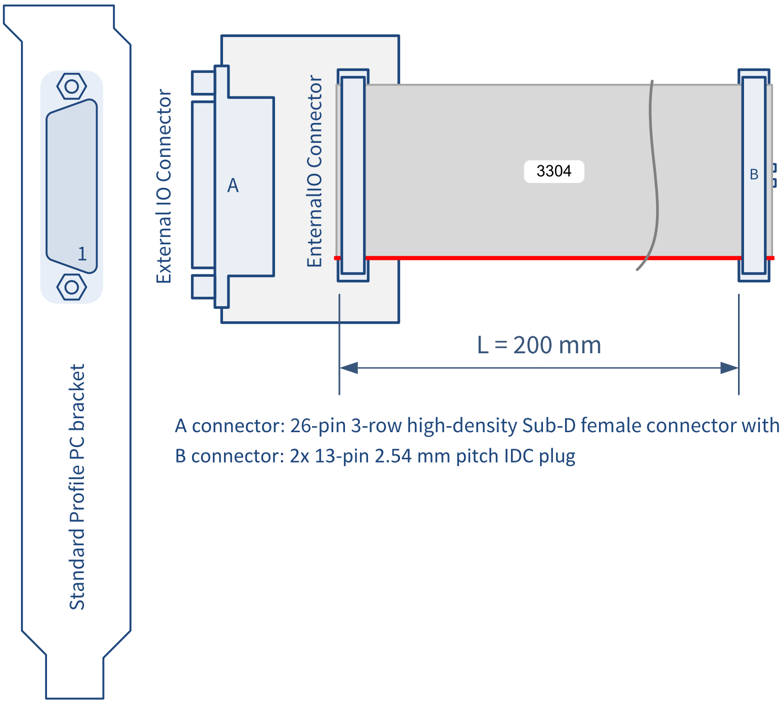
[1] 1628 Grablink Duo, 1629 Coaxlink Duo PCIe/104-EMB, 1630 Coaxlink Mono, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1635 Coaxlink Quad G3 DF, 1637 Coaxlink Quad 3D-LLE, 3602 Coaxlink Octo, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink 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 (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	QuadG3DF	Quad3DLLE
Octo	Quad12	Quad12-4	Quad12J	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 (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH	Quad3DLLE	Quad12
Quad12-4	Quad12J	Quad12J-4	Value12	QSFP+		

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

[2] 1628 Grablink Duo, 1631 Coaxlink Duo, 1632 Coaxlink Quad, 1633 Coaxlink Quad G3, 1633-LH Coaxlink Quad G3 LH, 1637 Coaxlink Quad 3D-LLE, 3603 Coaxlink Quad CXP-12, 3603-4 Coaxlink Quad CXP-12, 3620 Coaxlink Quad CXP-12 JPEG, 3620-4 Coaxlink Quad CXP-12 JPEG, 3623 Coaxlink Quad CXP-12 Value and 3625 Coaxlink QSFP+.

The adapter brings the second set of I/O lines and the +12 V power output to a bracket-mount SubD connector. The pins are assigned as follows:

Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1	1	GND	Ground
2	2	10	GND	Ground
3	3	20	DIN21+	High-speed differential input #21 – Positive pole
4	4	19	DIN21-	High-speed differential input #21 – Negative pole
5	5	2	DIN22+	High-speed differential input #22 – Positive pole
6	6	11	DIN22-	High-speed differential input #22 – Negative pole
7	7	3	IIN21+	Isolated input #21 – Positive pole
8	8	12	IIN21-	Isolated input #21 – Negative pole
9	9	13	IIN22+	Isolated input #22 – Positive pole
10	10	21	IIN22-	Isolated input #22 – Negative pole
11	11	14	IIN23+	Isolated input #23 – Positive pole
12	12	4	IIN23-	Isolated input #23 – Negative pole
13	13	15	IIN24+	Isolated input #24 – Positive pole
14	14	5	IIN24-	Isolated input #24 – Negative pole
15	15	23	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.

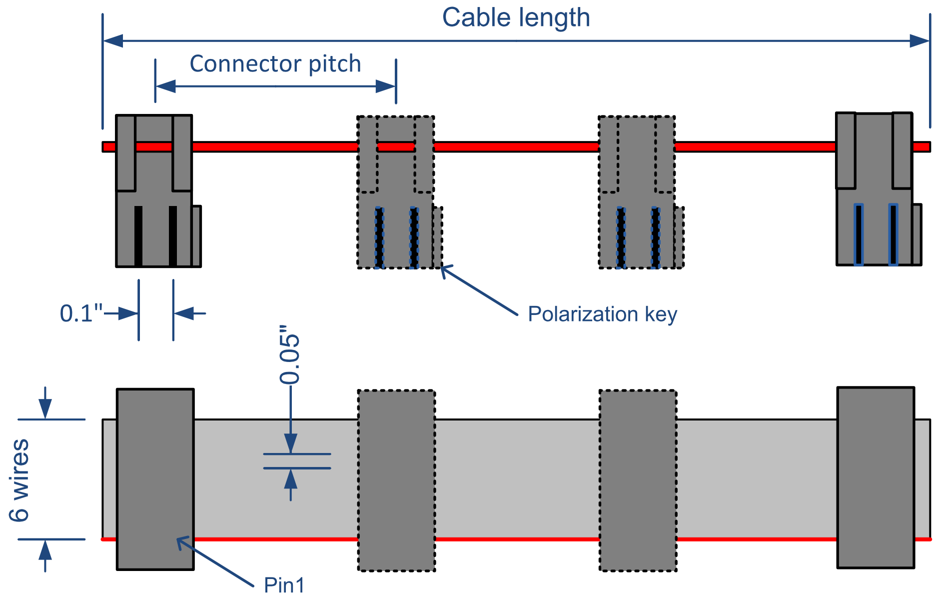
Wire #	IDC Pin #	SubD Pin #	Signal Name	Signal Description
1	1	1	GND	Ground
2	2	10	GND	Ground
3	3	20	DIN11+	High-speed differential input #11 – Positive pole
4	4	19	DIN11-	High-speed differential input #11 – Negative pole
5	5	2	DIN12+	High-speed differential input #12 – Positive pole
6	6	11	DIN12-	High-speed 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 (Not recommended for new designs)	Mono (Not recommended for new designs)	Duo (Not recommended for new designs)	Quad (Not recommended for new designs)	QuadG3	QuadG3LH
QuadG3DF	Quad3DLLE	Octo	Quad12	Quad12-4	Quad12J	Quad12J-4
Mono12	Mono12LH	Duo12	Duo12LH	Value12	Quad12DF	QSFP+

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



Custom C2C-Link Ribbon Cable Assembly

The cable assembly is composed with:

- A piece of a 6-conductor 0.05-in pitch ribbon cable. For instance: *Belden's (9L280XX Series)*.
- Two or more pieces of a 2 x 3-pin female ribbon cable connectors. For instance: *TE connectivity 1-1658528-1*.

The cable assembly has:

- A maximum of 4 connectors allowing up to 4 cards to share the same C2C-Link.
- A maximum length of 60 cm.

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

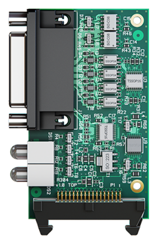
NOTE

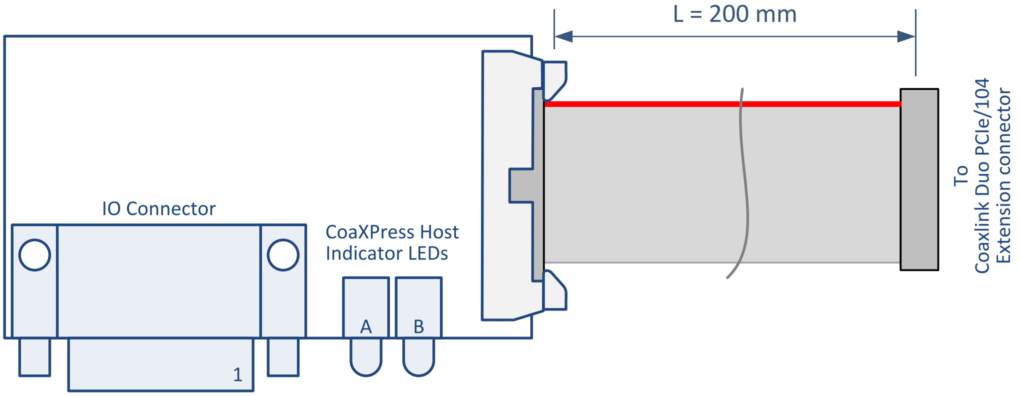
The connector pitch(es) must be determined according to the actual card to card spacing in the Host PC.

4.4. Coaxlink Duo PCIe/104 accessories

3300 HD26F I/O module for Coaxlink Duo PCIe/104

Compatible with [1]
Duo104EMB





Connectors

- "I/O Connector - 3300" on page 407

Lamps and switches

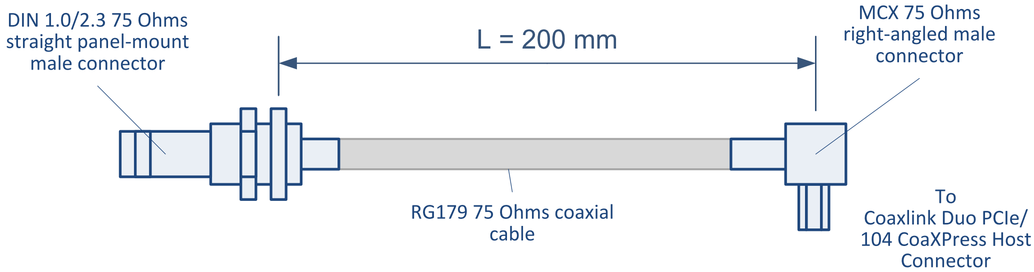
- "CoaXPress LED Lamps" on page 438

3302 DIN1.0/2.3 Coaxial cable for Coaxlink Duo PCIe/104

Compatible with [2]
Duo104EMB

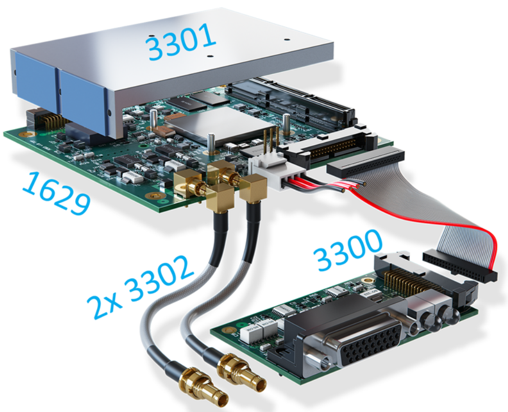
[1] 1629 Coaxlink Duo PCIe/104-EMB.

[2] 1629 Coaxlink Duo PCIe/104-EMB.



Coaxlink Duo PCIe/104 assembly

Compatible with [1]
Duo104EMB

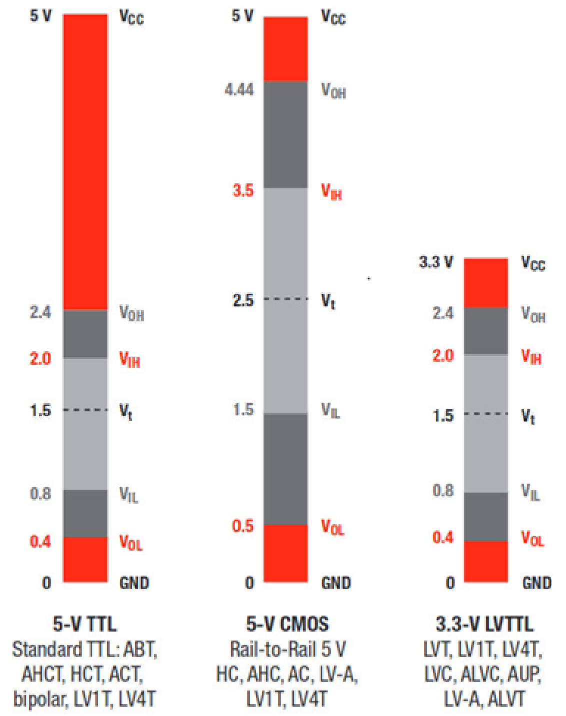


1629 Coaxlink Duo PCIe/104-EMB with 3300 HD26F I/O module for Coaxlink Duo PCIe/104, 3301 Thermal drain (Model 1) for Coaxlink Duo PCIe/104 and 2 3302 DIN1.0/2.3 Coaxial cable for Coaxlink Duo PCIe/104

[1] 1629 Coaxlink Duo PCIe/104-EMB.

5. Appendix

5.1. TTL, 5 V CMOS and LVTTL Levels



Colors

Dark gray
: Noise margin

Light gray
: Transition range, low and high levels are unspecified

Voltage levels

V_{OH}
: Minimum high-state voltage @driver output

V_{IH}
: Minimum high-state voltage @receiver input

V_t
: Threshold level, typically at the middle of the transition range

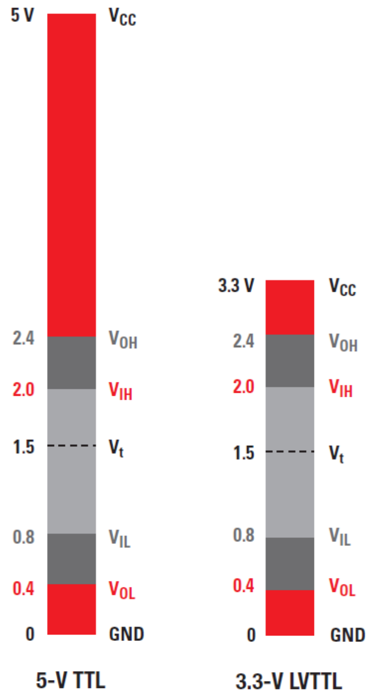
V_{IL}
: Maximum low-state voltage @receiver input

$V_{OL:}$
: Maximum low-state voltage @driver output

5.2. Connecting TTL Devices to Isolated I/O Ports

This application note explains how to connect TTL devices to the isolated inputs and isolated outputs.

TTL And 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.

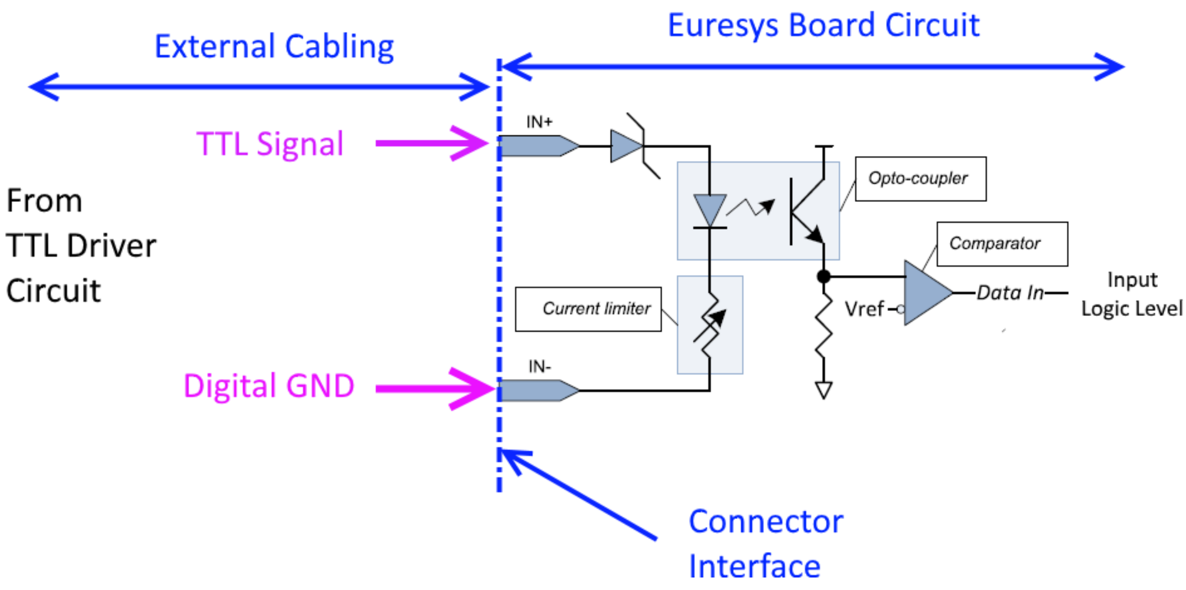
Typically the actual transition V_t between logic level low and high will occur at around 1.5 V but the actual V_t level may change a lot according to specimens or process (P) variations, actual Vcc supply voltage (V), and temperature (T). Only V_{IL} and V_{IH} are guaranteed over P,V,T variations.

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 575 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 578 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.

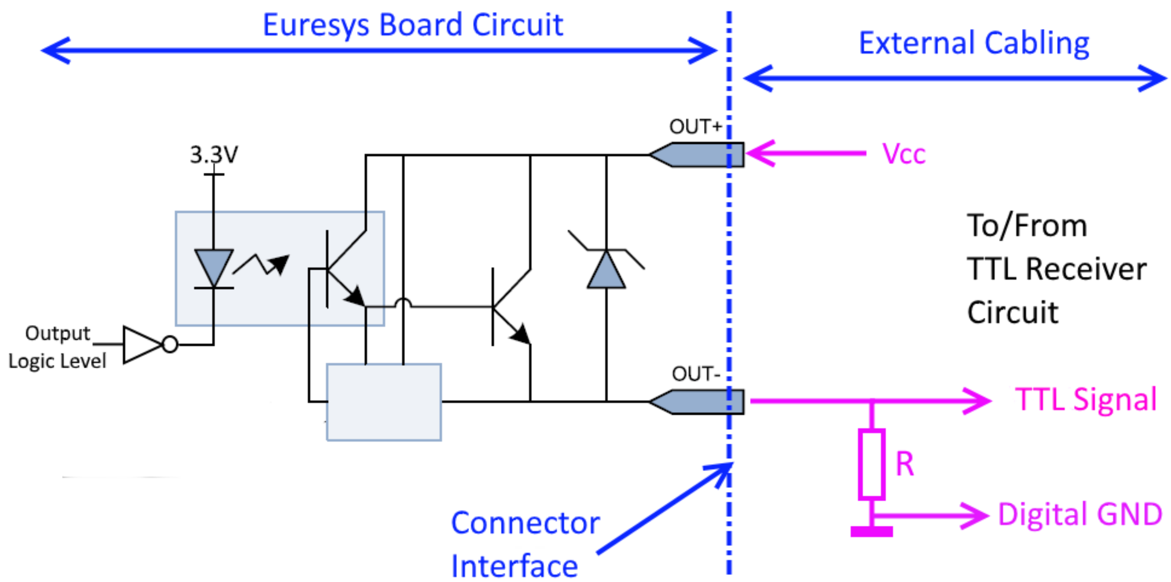
This circuit needs only one pull-down resistor as show in the next figure. A resistor of 180 ohm 1/8 W is suggested as best compromise but the circuit can also work within a large range of resistor values from 50 ohm 1/2 W to 10K ohm 1/16 W (1).

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 576or "Dynamic limitations " on page 577performance 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 402in 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 513 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.

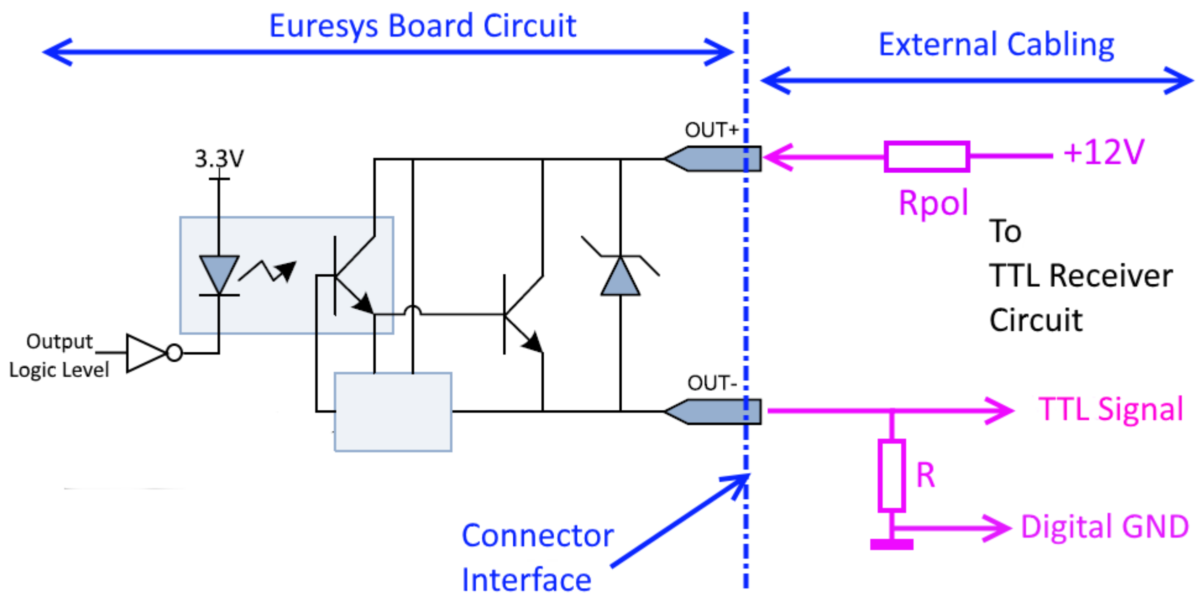
If an existing pull-down resistor is already available at the TTL receiver side it can be used as R resistor to operate the circuit, avoiding the need of adding an extra resistor somewhere in the cabling.

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 402 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 513 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. Coaxlink System Module Register Description

Categorized features list of Systemmodule version 24_04_0

1.1. Root Category

SystemInformation

Feature Info

Module	Category Path	Type	Access
System	Root	Category	RW

Category Members

See also: "SystemInformation Category" on page 587

InterfaceEnumeration

Feature Info

Module	Category Path	Type	Access
System	Root	Category	RW

Category Members

See also: "InterfaceEnumeration Category" on page 596

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

- CXP: This enumeration value indicates CoaXPress 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 599

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. Coaxlink Interface Module Register Description

Categorized features list of Interfacemodule version 24_04_0

2.1. Root Category

InterfaceInformation

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "InterfaceInformation Category" on page 620

DeviceEnumeration

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "DeviceEnumeration Category" on page 630

CoaXPress

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "CoaXPress Category" on page 737

CoaXPressErrorCounters

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "CoaXPressErrorCounters Category" on page 771

CoaXPressAdvanced

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "CoaXPressAdvanced Category" on page 786

DigitalIOControl

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "DigitalIOControl Category" on page 637

IOExtensionModule

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "IOExtensionModule Category" on page 654

UserOutputRegister

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "UserOutputRegister Category" on page 671

IOToolbox

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "IOToolbox Category" on page 684

PCIExpress

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "PCIExpress Category" on page 693

InterfaceControl

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "InterfaceControl Category" on page 708

InterfaceDetails

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "InterfaceDetails Category" on page 725

EventControl

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "EventControl Category" on page 853

OemSafetyKey

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "OemSafetyKey Category" on page 875

CustomLogic

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "CustomLogic Category" on page 881

OnboardMemory

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "OnboardMemory Category" on page 884

QsfpModule

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "QsfpModule Category" on page 887

ForwardErrorCorrection

Feature Info

Module	Category Path	Type	Access
Interface	Root	Category	RW

Category Members

See also: "ForwardErrorCorrection Category" on page 892

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

- CXP: This enumeration value indicates CoaXPress 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 633
- "DeviceVendorName" on page 634
- "DeviceModelName" on page 635
- "DeviceAccessStatus" on page 636

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

Description

Selects one physical GPIO line.

Default value: DIN11.

Selected Features

- "LineFormat" on page 641
- "LineMode" on page 642
- "LineInverter" on page 643
- "LineFilterStrength" on page 644
- "LineFilterDelay" on page 645
- "LineStatus" on page 646
- "LineSource" on page 648
- "LineSourceInitialOffset" on page 652
- "LineSourceDivisionFactor" on page 653

Enumeration Values

- DIN11: Differential input 1 of Internal I/O connector 1.
- DIN12: Differential input 2 of Internal I/O connector 1.
- DIN21: Differential input 1 of Internal I/O connector 2.
- DIN22: Differential input 2 of Internal I/O connector 2.
- IIN11: Isolated input 1 of Internal I/O connector 1.
- IIN12: Isolated input 2 of Internal I/O connector 1.
- IIN13: Isolated input 3 of Internal I/O connector 1.
- IIN14: Isolated input 4 of Internal I/O connector 1.
- IIN21: Isolated input 1 of Internal I/O connector 2.
- IIN22: Isolated input 2 of Internal I/O connector 2.
- IIN23: Isolated input 3 of Internal I/O connector 2.
- IIN24: Isolated input 4 of Internal I/O connector 2.

- IOUT11: Isolated output 1 of Internal I/O connector 1.
- IOUT12: Isolated output 2 of Internal I/O connector 1.
- IOUT21: Isolated output 1 of Internal I/O connector 2.
- IOUT22: Isolated output 2 of Internal I/O connector 2.
- TTLIO11: TTL input/output 1 of Internal I/O connector 1.
- TTLIO12: TTL input/output 2 of Internal I/O connector 1.
- TTLIO21: TTL input/output 1 of Internal I/O connector 2.
- TTLIO22: TTL input/output 2 of Internal I/O connector 2.
- MIO1: Input/output 1 of I/O extension module.
- MIO2: Input/output 2 of I/O extension module.
- MIO3: Input/output 3 of I/O extension module.
- MIO4: Input/output 4 of I/O extension module.
- MIO5: Input/output 5 of I/O extension module.
- MIO6: Input/output 6 of I/O extension module.
- MIO7: Input/output 7 of I/O extension module.
- MIO8: Input/output 8 of I/O extension module.
- MIO9: Input/output 9 of I/O extension module.
- MIO10: Input/output 10 of I/O extension module.
- MIO11: Input/output 11 of I/O extension module.
- MIO12: Input/output 12 of I/O extension module.
- MIO13: Input/output 13 of I/O extension module.
- MIO14: Input/output 14 of I/O extension module.
- MIO15: Input/output 15 of I/O extension module.
- MIO16: Input/output 16 of I/O extension module.
- MIO17: Input/output 17 of I/O extension module.
- MIO18: Input/output 18 of I/O extension module.
- MIO19: Input/output 19 of I/O extension module.
- MIO20: Input/output 20 of I/O extension module.
- MIO21: Input/output 21 of I/O extension module.
- MIO22: Input/output 22 of I/O extension module.
- MIO23: Input/output 23 of I/O extension module.
- MIO24: Input/output 24 of I/O extension module.
- MIO25: Input/output 25 of I/O extension module.
- MIO26: Input/output 26 of I/O extension module.
- MIO27: Input/output 27 of I/O extension module.
- MIO28: Input/output 28 of I/O extension module.

- MIO29: Input/output 29 of I/O extension module.
- MIO30: Input/output 30 of I/O extension module.
- MIO31: Input/output 31 of I/O extension module.
- MIO32: Input/output 32 of I/O extension module.
- MIO33: Input/output 33 of I/O extension module.
- MIO34: Input/output 34 of I/O extension module.
- MIO35: Input/output 35 of I/O extension module.
- MIO36: Input/output 36 of I/O extension module.
- MIO37: Input/output 37 of I/O extension module.
- MIO38: Input/output 38 of I/O extension module.
- MIO39: Input/output 39 of I/O extension module.
- MIO40: Input/output 40 of I/O extension module.

LineFormat

Feature Info

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

Description

Returns the electrical style of the selected physical GPIO line.

Enumeration Values

- ISO: The I/O line is opto-coupled.
- DIFF: The differential I/O line is RS-422 compliant.
- TTL: The singled-ended I/O line is TTL compliant.

LineMode

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

Description

Direction and line driver mode of the selected physical GPIO line.

Default value: Input for the input-capable GPIO lines; Output for the output-only GPIO lines.

Enumeration Values

- Input: Input line.
- Output: Output line.
- DriveLow: Open-collector driver capable of driving low only.
- DriveHigh: Open-emitter driver capable of driving high only.

LineInverter

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Boolean	RW

Description

Signal inversion of the selected input or output line.

When set to False, the line signal is not inverted.

When set to True, the line signal is inverted.

> NOTE
> For bidirectional GPIO lines such as the TTL input/output lines, the settings applies equally to the signal input path and the signal output path!

Default value: False.

LineFilterStrength

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

Description

Strength of the glitch removal filter of the selected physical GPIO line.

> NOTE
> This feature is only available for input-capable GPIO lines.

Default value: Low.

Enumeration Values

- Lowest: Lowest filter strength.
- Low: Low filter strength.
- Medium: Medium filter strength.
- High: High filter strength.
- Highest: Highest filter strength.
- Custom: Custom filter strength.

LineFilterDelay

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Float	RW

Value Info

Maximum value: 1048

Unit: us (microsecond)

Description

Returns the latency delay, expressed in microseconds, introduced by the glitch removal filter of the selected physical GPIO line.

NOTE
This feature is only available for input-capable GPIO lines.

LineStatus

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Boolean	RW

Description

Returns the current status of the selected physical GPIO line.

When False, the logical state of the selected physical GPIO line is low.

When True, The logical state of the selected physical GPIO line is high.

> NOTE
> For input-capable I/O lines, the reported value is the logical state of the LineInput signal: a node in the input path of the I/O control block that is located after the Input Inverter.

> NOTE
> For output-only I/O lines, the reported value is the logical state of the LineOutput signal, a note in the output path of the I/O control block that is located before the Output Inverter.

LineStatusAll

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Integer	RW

Description

Returns the current state of all available GPIO line signals at time of polling in a single bit field.

Bit values:

- 0: The logical state of the corresponding GPIO line is low.
- 1: The logical state of the corresponding GPIO line is high.

Bit assignments:

- Bit 0: DIN11 GPIO line.
- Bit 1: DIN12 GPIO line.
- Bit 2: DIN21 GPIO line.
- Bit 3: DIN22 GPIO line.
- Bit 4: IIN11 GPIO line.
- Bit 5: IIN12 GPIO line.
- Bit 6: IIN13 GPIO line.
- Bit 7: IIN14 GPIO line.
- Bit 8: IIN21 GPIO line.
- Bit 9: IIN22 GPIO line.
- Bit 10: IIN23GPIO line.
- Bit 11: IIN24 GPIO line.
- Bit 12: IOUT11 GPIO line.
- Bit 13: IOUT12 GPIO line.
- Bit 14: IOUT21 GPIO line.
- Bit 15: IOUT22 GPIO line.
- Bit 16: TTLIO11 GPIO line.
- Bit 17: TTLIO12 GPIO line.
- Bit 18: TTLIO21 GPIO line.
- Bit 19: TTLIO22 GPIO line.
- Bit 20 ... Bit 59 : MIO1 ... MIO40 GPIO lines.

LineSource

Feature Info

Module	Category Path	Type	Access
Interface	Root → DigitalIOControl	Enumeration	RW

Description

Select the internal signal sourcing the output of the selected physical GPIO line.

> NOTE
> This feature is only available for output-capable GPIO lines.

Enumeration Values

- UserOutput0: Bit 0 of user output register.
- UserOutput1: Bit 1 of user output register.
- UserOutput2: Bit 2 of user output register.
- UserOutput3: Bit 3 of user output register.
- UserOutput4: Bit 4 of user output register.
- UserOutput5: Bit 5 of user output register.
- UserOutput6: Bit 6 of user output register.
- UserOutput7: Bit 7 of user output register.
- Device0Strobe: Strobe output of device 0.
- Device1Strobe: Strobe output of device 1.
- Device2Strobe: Strobe output of device 2.
- Device3Strobe: Strobe output of device 3.
- Device4Strobe: Strobe output of device 4.
- Device5Strobe: Strobe output of device 5.
- Device6Strobe: Strobe output of device 6.
- Device7Strobe: Strobe output of device 7.
- Device0CameraTrigger: Camera trigger output of device 0.
- Device1CameraTrigger: Camera trigger output of device 1.
- Device2CameraTrigger: Camera trigger output of device 2.
- Device3CameraTrigger: Camera trigger output of device 3.
- Device4CameraTrigger: Camera trigger output of device 4.

- Device5CameraTrigger: Camera trigger output of device 5.
- Device6CameraTrigger: Camera trigger output of device 6.
- Device7CameraTrigger: Camera trigger output of device 7.
- Device0Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 0.
- Device0Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 0.
- Device0Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 0.
- Device0Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 0.
- Device0Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 0.
- Device0Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 0.
- Device0Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 0.
- Device0Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 0.
- Device1Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 1.
- Device1Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 1.
- Device1Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 1.
- Device1Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 1.
- Device1Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 1.
- Device1Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 1.
- Device1Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 1.
- Device1Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 1.
- Device2Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 2.
- Device2Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 2.
- Device2Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 2.
- Device2Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 2.
- Device2Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 2.
- Device2Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 2.
- Device2Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 2.
- Device2Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 2.
- Device3Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 3.
- Device3Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 3.
- Device3Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 3.
- Device3Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 3.
- Device3Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 3.
- Device3Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 3.
- Device3Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 3.
- Device3Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 3.
- Device4Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 4.

- Device4Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 4.
- Device4Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 4.
- Device4Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 4.
- Device4Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 4.
- Device4Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 4.
- Device4Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 4.
- Device4Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 4.
- Device5Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 5.
- Device5Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 5.
- Device5Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 5.
- Device5Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 5.
- Device5Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 5.
- Device5Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 5.
- Device5Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 5.
- Device5Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 5.
- Device6Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 6.
- Device6Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 6.
- Device6Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 6.
- Device6Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 6.
- Device6Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 6.
- Device6Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 6.
- Device6Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 6.
- Device6Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 6.
- Device7Stream0StartOfCameraReadout: Start of camera readout on stream 0 of device 7.
- Device7Stream1StartOfCameraReadout: Start of camera readout on stream 1 of device 7.
- Device7Stream2StartOfCameraReadout: Start of camera readout on stream 2 of device 7.
- Device7Stream3StartOfCameraReadout: Start of camera readout on stream 3 of device 7.
- Device7Stream4StartOfCameraReadout: Start of camera readout on stream 4 of device 7.
- Device7Stream5StartOfCameraReadout: Start of camera readout on stream 5 of device 7.
- Device7Stream6StartOfCameraReadout: Start of camera readout on stream 6 of device 7.
- Device7Stream7StartOfCameraReadout: Start of camera readout on stream 7 of device 7.
- CustomLogicOutput0: Bit 0 of custom logic output register.
- CustomLogicOutput1: Bit 1 of custom logic output register.
- CustomLogicOutput2: Bit 2 of custom logic output register.
- CustomLogicOutput3: Bit 3 of custom logic output register.
- CustomLogicOutput4: Bit 4 of custom logic output register.

- CustomLogicOutput5: Bit 5 of custom logic output register.
- CustomLogicOutput6: Bit 6 of custom logic output register.
- CustomLogicOutput7: Bit 7 of custom logic output register.
- CustomLogicOutput8: Bit 8 of custom logic output register.
- CustomLogicOutput9: Bit 9 of custom logic output register.
- CustomLogicOutput10: Bit 10 of custom logic output register.
- CustomLogicOutput11: Bit 11 of custom logic output register.
- CustomLogicOutput12: Bit 12 of custom logic output register.
- CustomLogicOutput13: Bit 13 of custom logic output register.
- CustomLogicOutput14: Bit 14 of custom logic output register.
- CustomLogicOutput15: Bit 15 of custom logic output register.
- CustomLogicOutput16: Bit 16 of custom logic output register.
- CustomLogicOutput17: Bit 17 of custom logic output register.
- CustomLogicOutput18: Bit 18 of custom logic output register.
- CustomLogicOutput19: Bit 19 of custom logic output register.
- CustomLogicOutput20: Bit 20 of custom logic output register.
- CustomLogicOutput21: Bit 21 of custom logic output register.
- CustomLogicOutput22: Bit 22 of custom logic output register.
- CustomLogicOutput23: Bit 23 of custom logic output register.
- CustomLogicOutput24: Bit 24 of custom logic output register.
- CustomLogicOutput25: Bit 25 of custom logic output register.
- CustomLogicOutput26: Bit 26 of custom logic output register.
- CustomLogicOutput27: Bit 27 of custom logic output register.
- CustomLogicOutput28: Bit 28 of custom logic output register.
- CustomLogicOutput29: Bit 29 of custom logic output register.
- CustomLogicOutput30: Bit 30 of custom logic output register.
- CustomLogicOutput31: Bit 31 of custom logic output register.
- 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

Description

This feature selects the I/O extension module configuration action.

NOTE
Committing a new configuration is only possible when no conflict is detected in the current configuration (i.e. when IOExtensionModuleErrorCount = 0)

Enumeration Values

- Begin: Enter configuration mode.
- Commit: Commit current configuration.
- Abort: Cancel current configuration.

IOExtensionModuleLineSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

Short Description

Selects an extension module I/O line to configure.

Selected Features

- "IOExtensionModuleLineFormat" on page 658
- "IOExtensionModuleLineMode" on page 659
- "IOExtensionModuleLineStatus" on page 660

Enumeration Values

- MIO1: Input/output 1 of I/O extension module.
- MIO2: Input/output 2 of I/O extension module.
- MIO3: Input/output 3 of I/O extension module.
- MIO4: Input/output 4 of I/O extension module.
- MIO5: Input/output 5 of I/O extension module.
- MIO6: Input/output 6 of I/O extension module.
- MIO7: Input/output 7 of I/O extension module.
- MIO8: Input/output 8 of I/O extension module.
- MIO9: Input/output 9 of I/O extension module.
- MIO10: Input/output 10 of I/O extension module.
- MIO11: Input/output 11 of I/O extension module.
- MIO12: Input/output 12 of I/O extension module.
- MIO13: Input/output 13 of I/O extension module.
- MIO14: Input/output 14 of I/O extension module.
- MIO15: Input/output 15 of I/O extension module.
- MIO16: Input/output 16 of I/O extension module.
- MIO17: Input/output 17 of I/O extension module.
- MIO18: Input/output 18 of I/O extension module.
- MIO19: Input/output 19 of I/O extension module.

- MIO20: Input/output 20 of I/O extension module.
- MIO21: Input/output 21 of I/O extension module.
- MIO22: Input/output 22 of I/O extension module.
- MIO23: Input/output 23 of I/O extension module.
- MIO24: Input/output 24 of I/O extension module.
- MIO25: Input/output 25 of I/O extension module.
- MIO26: Input/output 26 of I/O extension module.
- MIO27: Input/output 27 of I/O extension module.
- MIO28: Input/output 28 of I/O extension module.
- MIO29: Input/output 29 of I/O extension module.
- MIO30: Input/output 30 of I/O extension module.
- MIO31: Input/output 31 of I/O extension module.
- MIO32: Input/output 32 of I/O extension module.
- MIO33: Input/output 33 of I/O extension module.
- MIO34: Input/output 34 of I/O extension module.
- MIO35: Input/output 35 of I/O extension module.
- MIO36: Input/output 36 of I/O extension module.
- MIO37: Input/output 37 of I/O extension module.
- MIO38: Input/output 38 of I/O extension module.
- MIO39: Input/output 39 of I/O extension module.
- MIO40: Input/output 40 of I/O extension module.

IOExtensionModuleLineFormat

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

Short Description

Electrical style of the selected I/O line.

Enumeration Values

- DIFF: RS-422 compliant.
- TTL: TTL compliant.

IOExtensionModuleLineMode

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

Short Description

Direction of the selected I/O line.

Enumeration Values

- Input: Input line.
- Output: Output line.

IOExtensionModuleLineStatus

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Boolean	RW

Short Description

Default status of the selected output line at power up (or after leaving the configuration mode).

IOExtensionModuleLineToRepair

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Enumeration	RW

Description

This feature helps the user to solve a I/O module configuration conflict by indicating the first I/O line requiring attention.

> NOTE
> This feature is not available unless configuration conflicts are detected in the current configuration (i.e. when IOExtensionModuleErrorCount > 0)

Enumeration Values

- MIO1: Input/output 1 of I/O extension module.
- MIO2: Input/output 2 of I/O extension module.
- MIO3: Input/output 3 of I/O extension module.
- MIO4: Input/output 4 of I/O extension module.
- MIO5: Input/output 5 of I/O extension module.
- MIO6: Input/output 6 of I/O extension module.
- MIO7: Input/output 7 of I/O extension module.
- MIO8: Input/output 8 of I/O extension module.
- MIO9: Input/output 9 of I/O extension module.
- MIO10: Input/output 10 of I/O extension module.
- MIO11: Input/output 11 of I/O extension module.
- MIO12: Input/output 12 of I/O extension module.
- MIO13: Input/output 13 of I/O extension module.
- MIO14: Input/output 14 of I/O extension module.
- MIO15: Input/output 15 of I/O extension module.
- MIO16: Input/output 16 of I/O extension module.
- MIO17: Input/output 17 of I/O extension module.
- MIO18: Input/output 18 of I/O extension module.
- MIO19: Input/output 19 of I/O extension module.
- MIO20: Input/output 20 of I/O extension module.

- MIO21: Input/output 21 of I/O extension module.
- MIO22: Input/output 22 of I/O extension module.
- MIO23: Input/output 23 of I/O extension module.
- MIO24: Input/output 24 of I/O extension module.
- MIO25: Input/output 25 of I/O extension module.
- MIO26: Input/output 26 of I/O extension module.
- MIO27: Input/output 27 of I/O extension module.
- MIO28: Input/output 28 of I/O extension module.
- MIO29: Input/output 29 of I/O extension module.
- MIO30: Input/output 30 of I/O extension module.
- MIO31: Input/output 31 of I/O extension module.
- MIO32: Input/output 32 of I/O extension module.
- MIO33: Input/output 33 of I/O extension module.
- MIO34: Input/output 34 of I/O extension module.
- MIO35: Input/output 35 of I/O extension module.
- MIO36: Input/output 36 of I/O extension module.
- MIO37: Input/output 37 of I/O extension module.
- MIO38: Input/output 38 of I/O extension module.
- MIO39: Input/output 39 of I/O extension module.
- MIO40: Input/output 40 of I/O extension module.

IOExtensionModuleErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Integer	Imposed: RO

Short Description

Number of I/O line configuration errors.

IOExtensionModuleInformation

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOExtensionModule	Category	RW

Category Members

See also: "IOExtensionModuleInformation Category" on page 665

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

Description

Value of all User Output Register bits as a bit-field in a single data word.

Bit values:

- 0: The value of the corresponding User Output Register bit is low.
- 1: The value of the corresponding User Output Register bit is high.

Bit assignments:

- Bit 0: Value for bit 0 of the user output register.
- Bit 1: Value for bit 1 of the user output register.
- Bit 2: Value for bit 2 of the user output register.
- Bit 3: Value for bit 3 of the user output register.
- Bit 4: Value for bit 4 of the user output register.
- Bit 5: Value for bit 5 of the user output register.
- Bit 6: Value for bit 6 of the user output register.
- Bit 7: Value for bit 7 of the user output register.

UserActions

Feature Info

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Integer	RW

Value Info

Minimum value: 0

Maximum value: 2147483647

Description

Current set of user actions (built with AddUserAction) that can be executed immediately (c.f. ExecuteUserActions) or scheduled for execution at a specific time/position (c.f. ScheduleUserActions).

AddUserAction

Feature Info

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

Description

Add an action to the current set of user actions (UserActions).

Enumeration Values

- UserEvent1: User Event 1.
- UserEvent2: User Event 2.
- UserEvent3: User Event 3.
- UserEvent4: User Event 4.
- UserOutput0_High: Set User Output Register bit 0 high.
- UserOutput0_Low: Set User Output Register bit 0 low.
- UserOutput0_Toggle: Toggle User Output Register bit 0.
- UserOutput1_High: Set User Output Register bit 1 high.
- UserOutput1_Low: Set User Output Register bit 1 low.
- UserOutput1_Toggle: Toggle User Output Register bit 1.
- UserOutput2_High: Set User Output Register bit 2 high.
- UserOutput2_Low: Set User Output Register bit 2 low.
- UserOutput2_Toggle: Toggle User Output Register bit 2.
- UserOutput3_High: Set User Output Register bit 3 high.
- UserOutput3_Low: Set User Output Register bit 3 low.
- UserOutput3_Toggle: Toggle User Output Register bit 3.
- UserOutput4_High: Set User Output Register bit 4 high.
- UserOutput4_Low: Set User Output Register bit 4 low.
- UserOutput4_Toggle: Toggle User Output Register bit 4.
- UserOutput5_High: Set User Output Register bit 5 high.
- UserOutput5_Low: Set User Output Register bit 5 low.
- UserOutput5_Toggle: Toggle User Output Register bit 5.
- UserOutput6_High: Set User Output Register bit 6 high.
- UserOutput6_Low: Set User Output Register bit 6 low.

- UserOutput6_Toggle: Toggle User Output Register bit 6.
- UserOutput7_High: Set User Output Register bit 7 high.
- UserOutput7_Low: Set User Output Register bit 7 low.
- UserOutput7_Toggle: Toggle User Output Register bit 7.

ClearUserActions

Feature Info

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

Description

Clear the current set of user actions (UserActions).

ExecuteUserActions

Feature Info

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

Description

Immediately execute the current set of user actions (UserActions).

InternalTime

Feature Info

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	IntReg	RO

Register Port: InterfacePort

Short Description

Reports the Coaxlink 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 680
- "ScheduledUserActionsPoolStatus" on page 681
- "ScheduleUserActions" on page 682
- "DiscardScheduledUserActions" on page 683

Enumeration Values

- UAS1: User Action Scheduler Tool 1.
- UAS2: User Action Scheduler Tool 2.

UserActionsSchedulerReference

Feature Info

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Enumeration	RW

Description

Defines the reference used by the user action scheduler; can only be changed when ScheduledUserActionsPoolStatus is Empty.

Enumeration Values

- InternalTime: Coaxlink card internal time.
- QDC1Position: Quadrature Decoder Tool 1 Position.
- QDC2Position: Quadrature Decoder Tool 2 Position.
- QDC3Position: Quadrature Decoder Tool 3 Position.
- QDC4Position: Quadrature Decoder Tool 4 Position.

ScheduledUserActionsPoolStatus

Feature Info

Module	Category Path	Type	Access
Interface	Root → UserOutputRegister	Enumeration	RW

Description

Reports the status of the pool of scheduled user actions.

Enumeration Values

- Empty: The pool of scheduled user actions is empty.
- PartiallyFilled: The pool of scheduled user actions is partially filled.
- AlmostFull: The pool of scheduled user actions is almost full.

ScheduleUserActions

Feature Info

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

Value Info

Minimum value: 0

Maximum value: 4294967295

Description

Schedule the current set of user actions (UserActions) for execution at given time/position.

DiscardScheduledUserActions

Feature Info

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

Short Description

Discard all scheduled user actions.

2.8. IOToolbox Category

LineInputTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "LineInputTool Category" on page 800

MultiplierDividerTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "MultiplierDividerTool Category" on page 806

QuadratureDecoderTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "QuadratureDecoderTool Category" on page 815

DividerTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "DividerTool Category" on page 824

DelayTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "DelayTool Category" on page 831

EventInputTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "EventInputTool Category" on page 839

C2CLinkSynchronizationTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "C2CLinkSynchronizationTool Category" on page 843

DeviceLinkTriggerTool

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox	Category	RW

Category Members

See also: "DeviceLinkTriggerTool Category" on page 849

2.9. PCIExpress Category

PCIeMaxPayloadSizeSupported

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntReg	RO

Register Port: InterfacePort

Description

Maximum payload size of PCIe TLPs (Transaction Layer Packets) that this interface can support (cf. PCIe Capability Structure offset 04h (Device Capabilities) bits 2:0).

NOTE
PCIeMaxPayloadSizeSupported is the max packet payload size supported by Coaxlink for data in the direction frame grabber to PC memory.

PCIeMaxPayloadSize

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntReg	RO

Register Port: InterfacePort

Description

Maximum payload size of PCIe TLPs (Transaction Layer Packets) that this interface is allowed to generate (cf. PCIe Capability Structure offset 08h (Device Control) bits 7:5).

NOTE
PCIeMaxPayloadSize is the max packet payload size supported by the PC for data in the direction frame grabber to PC memory.

PCIeMaxReadRequestSize

Feature Info

Module	Category Path	Type	Access
Interface	Root → PCIExpress	IntReg	RO

Register Port: InterfacePort

Description

Maximum size of PCIe read requests that this interface is allowed to generate (cf. PCIe Capability Structure offset 08h (Device Control) bits 14:12).

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 711

Enumeration Values

- Grabber: Grabber Temperature Sensor.

Temperature

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	SwissKnife	RW

Description

Returns the temperature, expressed in °C measured by the selected temperature sensor.

AuxiliaryPowerInput

Feature Info

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

Description

Auxiliary power input cable connection status.

> NOTE
> This status is valid only if a PEG-compliant power supply is attached to the Coaxlink auxiliary power input connector through a PEG-compliant power cable.

Enumeration Values

- Unconnected: There is no PEG-compliant power cable connected to the auxiliary power input.
- Connected: A PEG-compliant power cable is connected to the auxiliary power input.

AuxiliaryPower12VInput

Feature Info

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

Short Description

Return the status of the 12 V Auxiliary Power Input.

Enumeration Values

- NotOK: The 12 V auxiliary power input is NOK.
- OK: The 12 V auxiliary power input is OK.

LampMode

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceControl	Enumeration	RW

Short Description

Selects the lamp mode.

Enumeration Values

- Standard: CoaXPress Standard bracket lamps behavior (default).
- 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.

SpiBankStatus

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntReg	RO

Register Port: InterfacePort

Short Description

Spi Bank Status.

PotBankStatus

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	IntReg	RO

Register Port: InterfacePort

Short Description

Pot Bank Status.

DriverVersion

Feature Info

Module	Category Path	Type	Access
Interface	Root → InterfaceDetails	String	RW

Short Description

Driver Version.

2.12. CoaXPress Category

CxpPoCxpHostConnectionSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Enumeration	RW

Description

Selects one (or a group of) CoaXPress physical Host connection(s) for PoCXP control.

Default value: All.

Selected Features

- "CxpPoCxpAuto" on page 739
- "CxpPoCxpDetectionMode" on page 742
- "CxpPoCxpTurnOff" on page 740
- "CxpPoCxpTripReset" on page 741
- "CxpPoCxpConfigurationStatus" on page 743
- "CxpPoCxpStatus" on page 744
- "CxpPoCxpCurrent" on page 745
- "CxpPoCxpVoltage" on page 746

Enumeration Values

- All: All CoaXPress physical host connections.
- A: CoaXPress physical host connection A.
- B: CoaXPress physical host connection B.
- C: CoaXPress physical host connection C.
- D: CoaXPress physical host connection D.
- E: CoaXPress physical host connection E.
- F: CoaXPress physical host connection F.
- G: CoaXPress physical host connection G.
- H: CoaXPress physical host connection H.

CxpPoCxpAuto

Feature Info

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

Description

Activates automatic control of Power over CoaXPress (PoCXP) on the CoaXPress physical Host connection(s) designated by CxpPoCxpHostConnectionSelector.

CxpPoCxpTurnOff

Feature Info

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

Description

Disables Power over CoaXPress (PoCXP) on the CoaXPress physical Host connection(s) designated by CxpPoCxpHostConnectionSelector.

CxpPoCxpTripReset

Feature Info

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

Description

Resets Power over CoaXPress (PoCXP) after an over-current trip on the CoaXPress physical Host connection(s) designated by CxpPoCxpHostConnectionSelector.

CxpPoCxpDetectionMode

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Enumeration	RW

Short Description

Selects the Power over CoaXPress (PoCXP) detection mode.

Enumeration Values

- Extended: Extended PoCXP detection mode (default).
- Standard: Standard PoCXP detection mode.
- Compound: Compound PoCXP detection mode (read-only).

CxpPoCxpConfigurationStatus

Feature Info

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

Description

Returns the Power over CoaXPress (PoCXP) configuration of the CoaXPress physical Host connection(s) designated by CxpPoCxpHostConnectionSelector.

Enumeration Values

- Off: PoCXP is forced off.
- Auto: Normal automatic PoCXP operation.
- Unknown: PoCXP configuration is unknown.
- Compound: PoCXP configuration is compound.

CxpPoCxpStatus

Feature Info

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

Description

Returns the Power over CoaXPress (PoCXP) status on the CoaXPress physical Host connection(s) designated by CxpPoCxpHostConnectionSelector.

Enumeration Values

- Off: PoCXP is off.
- On: PoCXP is on.
- Tripped: PoCXP has shut down because of an over-current trip.
- Compound: PoCXP status is compound.

CxpPoCxpCurrent

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Float	RW

Value Info

Dimension: Current

Unit: A (Ampere)

Description

Returns the current delivered by the PoCXP transmitter unit of the CoaXPress physical Host connection designated by CxpPoCxpHostConnectionSelector.

Unit: Ampere.

Value range: from 0.0 up to 1.020 by steps of 0.004.

CxpPoCxpVoltage

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Float	RW

Value Info

Dimension: Voltage

Unit: V (Volt)

Description

Returns the output voltage delivered by the PoCXP transmitter unit of the CoaXPress physical Host connection designated by CxpPoCxpHostConnectionSelector.

Unit: Volt.

Value range: from 21.0 up to 29.16 by steps of 0.032.

CxpPoCxpPowerInputStatus

Feature Info

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

Description

Returns the status of the 24 V power converter delivering power to all the PoCXP transmitter units.

Enumeration Values

- NotOK: The 24 V Power Converter is not OK.
- OK: The 24 V Power Converter is OK.

CxpHostConnectionCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	IntReg	RO

Register Port: InterfacePort

Short Description

CoaXPress Host Connection Count.

CxpHostConnectionSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Enumeration	RW

Short Description

Selects the CoaXPress physical connection.

Selected Features

- "CxpConnectionState" on page 751
- "CxpDownConnectionSpeed" on page 752
- "CxpUpConnectionSpeedConfig" on page 795
- "CxpDeviceConnectionID" on page 753
- "CxpHostConnectionTestMode" on page 763
- "CxpHostConnectionTestErrorCount" on page 764
- "CxpHostConnectionTestPacketCountRx" on page 765
- "CxpHostConnectionTestPacketCountTx" on page 766
- "CxpHostConnectionTestInjectError" on page 767
- "CxpLinkLockLossCount" on page 772
- "Cxp8b10bErrorCount" on page 773
- "CxpDuplicatedCharactersCorrectedErrorCount" on page 774
- "CxpDuplicatedCharactersUncorrectedErrorCount" on page 775
- "CxpStreamDataPacketCrcErrorCount" on page 776
- "CxpControlPacketCrcErrorCount" on page 777
- "CxpEventPacketCrcErrorCount" on page 778
- "CxpLinkLockLossCountReset" on page 779
- "Cxp8b10bErrorCountReset" on page 780
- "CxpDuplicatedCharactersCorrectedErrorCountReset" on page 781
- "CxpDuplicatedCharactersUncorrectedErrorCountReset" on page 782
- "CxpStreamDataPacketCrcErrorCountReset" on page 783
- "CxpControlPacketCrcErrorCountReset" on page 784
- "CxpEventPacketCrcErrorCountReset" on page 785

Enumeration Values

- A: CoaXPress physical host connection A.
- B: CoaXPress physical host connection B.
- C: CoaXPress physical host connection C.
- D: CoaXPress physical host connection D.
- E: CoaXPress physical host connection E.
- F: CoaXPress physical host connection F.
- G: CoaXPress physical host connection G.
- H: CoaXPress physical host connection H.

CxpConnectionState

Feature Info

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

Description

Returns the CoaXPress connection state of the CoaXPress physical Host connection designated by CxpHostConnectionSelector.

Enumeration Values

- Undetected: Undetected.
- Detected: Detected.

CxpDownConnectionSpeed

Feature Info

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

Description

Returns the CoaXPress down-connection speed of the CoaXPress physical Host connection designated by CxpHostConnectionSelector.

Enumeration Values

- CXP1: 1.250 Gbps.
- CXP2: 2.500 Gbps.
- CXP3: 3.125 Gbps.
- CXP5: 5.000 Gbps.
- CXP6: 6.250 Gbps.
- CXP10: 10.000 Gbps.
- CXP12: 12.500 Gbps.

CxpDeviceConnectionID

Feature Info

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

Description

Returns the CoaXPress connection topology information of the CoaXPress physical Host connection designated by CxpHostConnectionSelector.

Enumeration Values

- CameraW_Master: Master Connection of Camera W.
- CameraW_Extension1: Extension 1 of Camera W.
- CameraW_Extension2: Extension 2 of Camera W.
- CameraW_Extension3: Extension 3 of Camera W.
- CameraW_Extension4: Extension 4 of Camera W.
- CameraW_Extension5: Extension 5 of Camera W.
- CameraW_Extension6: Extension 6 of Camera W.
- CameraW_Extension7: Extension 7 of Camera W.
- CameraX_Master: Master Connection of Camera X.
- CameraX_Extension1: Extension 1 of Camera X.
- CameraX_Extension2: Extension 2 of Camera X.
- CameraX_Extension3: Extension 3 of Camera X.
- CameraX_Extension4: Extension 4 of Camera X.
- CameraX_Extension5: Extension 5 of Camera X.
- CameraX_Extension6: Extension 6 of Camera X.
- CameraX_Extension7: Extension 7 of Camera X.
- CameraY_Master: Master Connection of Camera Y.
- CameraY_Extension1: Extension 1 of Camera Y.
- CameraY_Extension2: Extension 2 of Camera Y.
- CameraY_Extension3: Extension 3 of Camera Y.
- CameraY_Extension4: Extension 4 of Camera Y.
- CameraY_Extension5: Extension 5 of Camera Y.
- CameraY_Extension6: Extension 6 of Camera Y.

- CameraY_Extension7: Extension 7 of Camera Y.
- CameraZ_Master: Master Connection of Camera Z.
- CameraZ_Extension1: Extension 1 of Camera Z.
- CameraZ_Extension2: Extension 2 of Camera Z.
- CameraZ_Extension3: Extension 3 of Camera Z.
- CameraZ_Extension4: Extension 4 of Camera Z.
- CameraZ_Extension5: Extension 5 of Camera Z.
- CameraZ_Extension6: Extension 6 of Camera Z.
- CameraZ_Extension7: Extension 7 of Camera Z.
- CameraS_Master: Master Connection of Camera S.
- CameraS_Extension1: Extension 1 of Camera S.
- CameraS_Extension2: Extension 2 of Camera S.
- CameraS_Extension3: Extension 3 of Camera S.
- CameraS_Extension4: Extension 4 of Camera S.
- CameraS_Extension5: Extension 5 of Camera S.
- CameraS_Extension6: Extension 6 of Camera S.
- CameraS_Extension7: Extension 7 of Camera S.
- CameraT_Master: Master Connection of Camera T.
- CameraT_Extension1: Extension 1 of Camera T.
- CameraT_Extension2: Extension 2 of Camera T.
- CameraT_Extension3: Extension 3 of Camera T.
- CameraT_Extension4: Extension 4 of Camera T.
- CameraT_Extension5: Extension 5 of Camera T.
- CameraT_Extension6: Extension 6 of Camera T.
- CameraT_Extension7: Extension 7 of Camera T.
- CameraU_Master: Master Connection of Camera U.
- CameraU_Extension1: Extension 1 of Camera U.
- CameraU_Extension2: Extension 2 of Camera U.
- CameraU_Extension3: Extension 3 of Camera U.
- CameraU_Extension4: Extension 4 of Camera U.
- CameraU_Extension5: Extension 5 of Camera U.
- CameraU_Extension6: Extension 6 of Camera U.
- CameraU_Extension7: Extension 7 of Camera U.
- CameraV_Master: Master Connection of Camera V.
- CameraV_Extension1: Extension 1 of Camera V.
- CameraV_Extension2: Extension 2 of Camera V.

- CameraV_Extension3: Extension 3 of Camera V.
- CameraV_Extension4: Extension 4 of Camera V.
- CameraV_Extension5: Extension 5 of Camera V.
- CameraV_Extension6: Extension 6 of Camera V.
- CameraV_Extension7: Extension 7 of Camera V.
- SubLink_Extension1: Sub-Link Extension 1.
- SubLink_Extension2: Sub-Link Extension 2.
- SubLink_Extension3: Sub-Link Extension 3.
- SubLink_Extension4: Sub-Link Extension 4.
- SubLink_Extension5: Sub-Link Extension 5.
- SubLink_Extension6: Sub-Link Extension 6.
- SubLink_Extension7: Sub-Link Extension 7.
- NotReady: Not Ready.

CXP1Supported

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	Imposed: RO

Short Description

CXP1Supported.

CXP2Supported

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	Imposed: RO

Short Description

CXP2Supported.

CXP3Supported

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	Imposed: RO

Short Description

CXP3Supported.

CXP5Supported

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	Imposed: RO

Short Description

CXP5Supported.

CXP6Supported

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	Imposed: RO

Short Description

CXP6Supported.

CXP10Supported

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	Imposed: RO

Short Description

CXP10Supported.

CXP12Supported

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	Imposed: RO

Short Description

CXP12Supported.

CxpHostConnectionTestMode

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Enumeration	RW

Description

Controls the Host to Device connection test mode for the CoaXPress physical Host connection designated by CxpHostConnectionSelector.

Default value: Off.

Enumeration Values

- Off: The test mode is disabled on the selected Host connection.
- Mode1: The test mode is one on the selected Host connection.

CxpHostConnectionTestErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Integer	RW

Value Info

Minimum value: 0

Maximum value: 4294967295

Short Description

Reports the current connection error count for test packets received by the Host on the selected Host connection.

CxpHostConnectionTestPacketCountRx

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Integer	RW

Value Info

Minimum value: 0

Maximum value: 4294967295

Short Description

Reports the current count for test packets received by the Host on the selected Host connection.

CxpHostConnectionTestPacketCountTx

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Integer	RW

Value Info

Minimum value: 0

Maximum value: 4294967295

Short Description

Reports the current count for test packets sent by the Host on the selected Host connection.

CxpHostConnectionTestInjectError

Feature Info

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

Description

Injects a single character error into the Host to Device test packet of the CoaXPress physical Host connection designated by CxpHostConnectionSelector.

CxpRevisionSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Enumeration	RW

Description

Selects the CoaXPress Standard Revision for current support.

Default value: CXP_1_0.

Selected Features

- "CxpRevisionSupport" on page 769

Enumeration Values

- CXP_1_0: CoaXPress Standard Version 1.0.
- CXP_1_1: CoaXPress Standard Version 1.1.
- CXP_1_1_1: CoaXPress Standard Version 1.1.1.
- CXP_2_0: CoaXPress Standard Version 2.0.
- CXP_2_1: CoaXPress Standard Version 2.1.

CxpRevisionSupport

Feature Info

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

Short Description

Reports the current support of the selected CoaXPress Standard Revision.

Enumeration Values

- NotSupported: Not supported.
- PartiallySupported: Partially supported.
- Supported: Supported.

ShowCoaXPressAdvancedFeatures

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPress	Boolean	RW

Short Description

Show CoaXPress advanced features.

2.13. CoaXPressErrorCounters Category

CxpLinkLockLossCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressErrorCounters	Integer	Imposed: RO

Short Description

Reports the count of connection lock losses on the selected Host connection.

Cxp8b10bErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressErrorCounters	Integer	Imposed: RO

Short Description

Reports the count of encoding errors on the selected Host connection.

CxpDuplicatedCharactersCorrectedErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressErrorCounters	Integer	Imposed: RO

Short Description

Reports the count of errors detected in duplicated characters (P0, P1, P2, P3) that could be decoded on the selected Host connection.

CxpDuplicatedCharactersUncorrectedErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressErrorCounters	Integer	Imposed: RO

Short Description

Reports the count of errors detected in duplicated characters (P0, P1, P2, P3) that could not be decoded on the selected Host connection.

CxpStreamDataPacketCrcErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressErrorCounters	Integer	Imposed: RO

Short Description

Reports the count of CRC errors detected in stream data packets on the selected Host connection.

CxpControlPacketCrcErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressErrorCounters	Integer	Imposed: RO

Short Description

Reports the count of CRC errors detected in control packets on the selected Host connection.

CxpEventPacketCrcErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressErrorCounters	Integer	Imposed: RO

Short Description

Reports the count of CRC errors detected in event packets on the selected Host connection.

CxpLinkLockLossCountReset

Feature Info

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

Short Description

CoaXPress Link Lock Loss Count Reset.

Cxp8b10bErrorCountReset

Feature Info

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

Short Description

CoaXPress8b10b Error Count Reset.

CxpDuplicatedCharactersCorrectedErrorCountReset

Feature Info

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

Short Description

CoaXPress Duplicated Characters Corrected Error Count Reset.

CxpDuplicatedCharactersUncorrectedErrorCountReset

Feature Info

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

Short Description

CoaXPress Duplicated Characters Uncorrected Error Count Reset.

CxpStreamDataPacketCrcErrorCountReset

Feature Info

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

Short Description

CoaXPress Stream Data Packet Crc Error Count Reset.

CxpControlPacketCrcErrorCountReset

Feature Info

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

Short Description

CoaXPress Control Packet Crc Error Count Reset.

CxpEventPacketCrcErrorCountReset

Feature Info

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

Short Description

CoaXPress Event Packet Crc Error Count Reset.

2.14. CoaXPressAdvanced Category

CxpRateMask

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Integer	RW

Value Info

Minimum value: 0

Short Description

Mask of CoaXPress rates allowed to be used by the host (CXP1=0x01,CXP2=0x02,CXP3=0x04,CXP5=0x08,CXP6=0x10,CXP10=0x20,CPX12=0x40).

CxpRateMaskCXP1

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Boolean	RW

Short Description

CoaXPress Rate Mask CXP1.

CxpRateMaskCXP2

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Boolean	RW

Short Description

CoaXPress Rate Mask CXP2.

CxpRateMaskCXP3

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Boolean	RW

Short Description

CoaXPress Rate Mask CXP3.

CxpRateMaskCXP5

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Boolean	RW

Short Description

CoaXPress Rate Mask CXP5.

CxpRateMaskCXP6

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Boolean	RW

Short Description

CoaXPress Rate Mask CXP6.

CxpRateMaskCXP10

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Boolean	RW

Short Description

CoaXPress Rate Mask CXP10.

CxpRateMaskCXP12

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Boolean	RW

Short Description

CoaXPress Rate Mask CXP12.

CxpUpConnectionSpeedConfig

Feature Info

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

Short Description

Configure upconnection speed on the selected Host connection.

Enumeration Values

- Auto: 41.667 Mbps when downconnection speed is above CXP6, 20.833 Mbps otherwise.
- Use_20Mbps: 20.833 Mbps.
- Use_40Mbps: 41.667 Mbps.
- Off: Disable upconnection.

CxpDiscoveryTimingSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Enumeration	RW

Short Description

Selects a CoaXPress discovery timing value.

Selected Features

- "CxpDiscoveryTiming" on page 797

Enumeration Values

- DiscoveryPeriod: Period of the discovery link resets on undetected connectors (default: 1100).
- RecoveryTime: Recovery time following an error on a connector before restarting the discovery (default: 500).
- ExtensionSetupMaxTime: Maximum time for extensions to be discovered by the master (default: 6000).
- DiscoveryInitialDelay: Initial delay following a low-level lock before accessing device registers (default: 1000).
- LinkReconfigMaxTime: Maximum time for link re-configuration (default: 1100).
- DeviceLinkReconfigDelay: Delay to allow the device to complete link re-configuration (default: 200).

CxpDiscoveryTiming

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Integer	RW

Value Info

Unit: ms (millisecond)

Short Description

Value of the selected CoaXPress discovery timing (millisecond).

CxpControlParameterSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Enumeration	RW

Short Description

Selects a CoaXPress control parameter.

Selected Features

- "CxpControlParameter" on page 799

Enumeration Values

- TransactionTimeout: Control transaction timeout (millisecond) (default: 300).
- TransactionMaxResendCount: Control transaction maximum resend counter (default: 10).
- ControlPacketSizeMax: Control packet size max (bytes) (default: 128).
- CxpVersion20Supported: Enable version 2.x of the CoaXPress standard (boolean) (default: 1).
- EnableCommunicationWithTag: Enable control command packets with tag (boolean) (default: 1).
- ForceCommunicationWithTag: Force control command packets with tag (boolean) (default: 0).

CxpControlParameter

Feature Info

Module	Category Path	Type	Access
Interface	Root → CoaXPressAdvanced	Integer	RW

Value Info

Minimum value: 0

Maximum value: 2147483647

Short Description

Value of the selected CoaXPress control parameter.

2.15. 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 802
- "LineInputToolActivation" on page 805

Enumeration Values

- LIN1: Line Input Tool 1.
- LIN2: Line Input Tool 2.
- LIN3: Line Input Tool 3.
- LIN4: Line Input Tool 4.
- LIN5: Line Input Tool 5.
- LIN6: Line Input Tool 6.
- LIN7: Line Input Tool 7.
- LIN8: Line Input Tool 8.

LineInputToolSource

Feature Info

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

Description

Physical GPIO line used as input for the selected Line Input Tool.

Default value: DIN11.

Enumeration Values

- DIN11: Differential input 1 of Internal I/O connector 1.
- DIN12: Differential input 2 of Internal I/O connector 1.
- DIN21: Differential input 1 of Internal I/O connector 2.
- DIN22: Differential input 2 of Internal I/O connector 2.
- IIN11: Isolated input 1 of Internal I/O connector 1.
- IIN12: Isolated input 2 of Internal I/O connector 1.
- IIN13: Isolated input 3 of Internal I/O connector 1.
- IIN14: Isolated input 4 of Internal I/O connector 1.
- IIN21: Isolated input 1 of Internal I/O connector 2.
- IIN22: Isolated input 2 of Internal I/O connector 2.
- IIN23: Isolated input 3 of Internal I/O connector 2.
- IIN24: Isolated input 4 of Internal I/O connector 2.
- IOUT11: Isolated output 1 of Internal I/O connector 1.
- IOUT12: Isolated output 2 of Internal I/O connector 1.
- IOUT21: Isolated output 1 of Internal I/O connector 2.
- IOUT22: Isolated output 2 of Internal I/O connector 2.
- TTLIO11: TTL input/output 1 of Internal I/O connector 1.
- TTLIO12: TTL input/output 2 of Internal I/O connector 1.
- TTLIO21: TTL input/output 1 of Internal I/O connector 2.
- TTLIO22: TTL input/output 2 of Internal I/O connector 2.
- MIO1: Input/output 1 of I/O extension module.
- MIO2: Input/output 2 of I/O extension module.
- MIO3: Input/output 3 of I/O extension module.

- MIO4: Input/output 4 of I/O extension module.
- MIO5: Input/output 5 of I/O extension module.
- MIO6: Input/output 6 of I/O extension module.
- MIO7: Input/output 7 of I/O extension module.
- MIO8: Input/output 8 of I/O extension module.
- MIO9: Input/output 9 of I/O extension module.
- MIO10: Input/output 10 of I/O extension module.
- MIO11: Input/output 11 of I/O extension module.
- MIO12: Input/output 12 of I/O extension module.
- MIO13: Input/output 13 of I/O extension module.
- MIO14: Input/output 14 of I/O extension module.
- MIO15: Input/output 15 of I/O extension module.
- MIO16: Input/output 16 of I/O extension module.
- MIO17: Input/output 17 of I/O extension module.
- MIO18: Input/output 18 of I/O extension module.
- MIO19: Input/output 19 of I/O extension module.
- MIO20: Input/output 20 of I/O extension module.
- MIO21: Input/output 21 of I/O extension module.
- MIO22: Input/output 22 of I/O extension module.
- MIO23: Input/output 23 of I/O extension module.
- MIO24: Input/output 24 of I/O extension module.
- MIO25: Input/output 25 of I/O extension module.
- MIO26: Input/output 26 of I/O extension module.
- MIO27: Input/output 27 of I/O extension module.
- MIO28: Input/output 28 of I/O extension module.
- MIO29: Input/output 29 of I/O extension module.
- MIO30: Input/output 30 of I/O extension module.
- MIO31: Input/output 31 of I/O extension module.
- MIO32: Input/output 32 of I/O extension module.
- MIO33: Input/output 33 of I/O extension module.
- MIO34: Input/output 34 of I/O extension module.
- MIO35: Input/output 35 of I/O extension module.
- MIO36: Input/output 36 of I/O extension module.
- MIO37: Input/output 37 of I/O extension module.
- MIO38: Input/output 38 of I/O extension module.
- MIO39: Input/output 39 of I/O extension module.

- MIO40: Input/output 40 of I/O extension module.

LineInputToolActivation

Feature Info

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

Short Description

Edge activating the output of the selected Line Input Tool.

Enumeration Values

- RisingEdge: Activate the output on the rising edge only.
- FallingEdge: Activate the output on the falling edge only.
- AllEdges: Activate the output on all edges.

2.16. 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 808
- "MultiplierDividerToolOutputControl" on page 810
- "MultiplierDividerToolMultiplicationFactor" on page 811
- "MultiplierDividerToolDivisionFactor" on page 812
- "MultiplierDividerToolEffectiveMultiplicationFactor" on page 813
- "MultiplierDividerToolEffectiveDivisionFactor" on page 814

Enumeration Values

- MDV1: Multiplier/Divider Tool 1.
- MDV2: Multiplier/Divider Tool 2.
- MDV3: Multiplier/Divider Tool 3.
- MDV4: Multiplier/Divider Tool 4.

MultiplierDividerToolSource

Feature Info

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

Short Description

I/O Toolbox event stream used as input for the selected Multiplier/Divider Tool.

Enumeration Values

- NONE: No event stream.
- LIN1: When an event occurs on Line Input Tool 1.
- LIN2: When an event occurs on Line Input Tool 2.
- LIN3: When an event occurs on Line Input Tool 3.
- LIN4: When an event occurs on Line Input Tool 4.
- LIN5: When an event occurs on Line Input Tool 5.
- LIN6: When an event occurs on Line Input Tool 6.
- LIN7: When an event occurs on Line Input Tool 7.
- LIN8: When an event occurs on Line Input Tool 8.
- QDC1: When an event occurs on Quadrature Decoder Tool 1.
- QDC2: When an event occurs on Quadrature Decoder Tool 2.
- QDC3: When an event occurs on Quadrature Decoder Tool 3.
- QDC4: When an event occurs on Quadrature Decoder Tool 4.
- MDV1: When an event occurs on Multiplier/Divider Tool 1.
- MDV2: When an event occurs on Multiplier/Divider Tool 2.
- MDV3: When an event occurs on Multiplier/Divider Tool 3.
- MDV4: When an event occurs on Multiplier/Divider Tool 4.
- DIV1: When an event occurs on Divider Tool 1.
- DIV2: When an event occurs on Divider Tool 2.
- DIV3: When an event occurs on Divider Tool 3.
- DIV4: When an event occurs on Divider Tool 4.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1.

- DEL2_2: When an event occurs on Delay Tool 2 Output 2.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2.
- EIN1: When an event occurs on Event Input Tool 1.
- EIN2: When an event occurs on Event Input Tool 2.
- UserEvent1: When an event occurs on User Event 1.
- UserEvent2: When an event occurs on User Event 2.
- UserEvent3: When an event occurs on User Event 3.
- UserEvent4: When an event occurs on User Event 4.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1.
- DLT2: When an event occurs on DeviceLinkTrigger Tool 2.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16.

MultiplierDividerToolOutputControl

Feature Info

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

Short Description

Output control of the selected Multiplier/Divider Tool.

Enumeration Values

- Enable: Output enabled.
- Disable: Output disabled.

MultiplierDividerToolMultiplicationFactor

Feature Info

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

Value Info

Minimum value: 0.001

Maximum value: 1000

Description

Multiplication factor of the selected Multiplier/Divider Tool.

This feature is the **numerator** of the fraction defining the Rate Conversion Ratio (RCR) of the Multiplier/Divider Tool.

RCR = M/D where:

- M = MultiplierDividerToolMultiplicationFactor
- D = MultiplierDividerToolDivisionFactor

The Multiplier/Divider Tools allows defining any RCR values in the range 0.001 to 1000.0.

> NOTE
> The user may define RCR using any of the following methods:
>
> - A ratio of 2 integer numbers by assigning integer values to both the numerator and the denominator.
> - A single non-integer number greater or smaller than 1 assigned to the numerator leaving the denominator to the default value (1.0).
> - A single non-integer number greater or smaller than 1 assigned to the denominator leaving the numerator to the default value (1.0).

Default value: 1.0.

MultiplierDividerToolDivisionFactor

Feature Info

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

Value Info

Minimum value: 0.001

Maximum value: 1000

Description

Division factor of the selected Multiplier/Divider Tool.

This feature is the **denominator** of the fraction defining the Rate Conversion Ratio (RCR) of the Multiplier/Divider Tool.

RCR = M/D where:

- M = MultiplierDividerToolMultiplicationFactor
- D = MultiplierDividerToolDivisionFactor

The Multiplier/Divider Tools allows defining any RCR values in the range 0.001 to 1000.0.

NOTE

The user may define RCR using any of the following methods:

- A ratio of 2 integer numbers by assigning integer values to both the numerator and the denominator.
- A single non-integer number greater or smaller than 1 assigned to the numerator leaving the denominator to the default value (1.0).
- A single non-integer number greater or smaller than 1 assigned to the denominator leaving the numerator to the default value (1.0).

Default value: 1.0.

MultiplierDividerToolEffectiveMultiplicationFactor

Feature Info

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

Description

Effective multiplication factor of the selected Multiplier/Divider Tool.

This feature is the **numerator** of the fraction defining the Effective Rate Conversion Ratio (Effective RCR) of the Multiplier/Divider Tool.

Effective RCR = Effective M/Effective D where:

- Effective M = MultiplierDividerToolEffectiveMultiplicationFactor
- Effective D = MultiplierDividerToolEffectiveDivisionFactor

MultiplierDividerToolEffectiveDivisionFactor

Feature Info

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

Description

Effective division factor of the selected Multiplier/Divider Tool.

This feature is the **denominator** of the fraction defining the Effective Rate Conversion Ratio (Effective RCR) of the Multiplier/Divider Tool.

Effective RCR = Effective M/Effective D where:

- Effective M =MultiplierDividerToolEffectiveMultiplicationFactor
- Effective D = MultiplierDividerToolEffectiveDivisionFactor

2.17. 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 817
- "QuadratureDecoderToolActivation" on page 818
- "QuadratureDecoderToolForwardDirection" on page 819
- "QuadratureDecoderToolOutputMode" on page 820
- "QuadratureDecoderToolPosition" on page 821
- "QuadratureDecoderToolDirection" on page 822
- "QuadratureDecoderToolPositionReset" on page 823

Enumeration Values

- QDC1: Quadrature Decoder Tool 1.
- QDC2: Quadrature Decoder Tool 2.
- QDC3: Quadrature Decoder Tool 3.
- QDC4: Quadrature Decoder Tool 4.

QuadratureDecoderToolSources

Feature Info

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

Description

Selects the pair of physical GPIO lines used as A/B inputs for the selected Quadrature Decoder Tool.

Enumeration Values

- DIN11_DIN12: Differential inputs 1 and 2 of Internal I/O connector 1.
- DIN21_DIN22: Differential inputs 1 and 2 of Internal I/O connector 2.
- IIN11_IIN12: Isolated inputs 1 and 2 of Internal I/O connector 1.
- IIN13_IIN14: Isolated inputs 3 and 4 of Internal I/O connector 1.
- IIN21_IIN22: Isolated inputs 1 and 2 of Internal I/O connector 2.
- IIN23_IIN24: Isolated inputs 3 and 4 of Internal I/O connector 2.
- TTLIO11_TTLIO12: TTL inputs 1 and 2 of Internal I/O connector 1.
- TTLIO21_TTLIO22: TTL inputs 1 and 2 of Internal I/O connector 2.
- MIO1_MIO3: Inputs 1 and 3 of I/O extension module.
- MIO5_MIO7: Inputs 5 and 7 of I/O extension module.
- MIO9_MIO11: Inputs 9 and 11 of I/O extension module.
- MIO13_MIO15: Inputs 13 and 15 of I/O extension module.
- MIO17_MIO19: Inputs 17 and 19 of I/O extension module.
- MIO21_MIO23: Inputs 21 and 23 of I/O extension module.
- MIO25_MIO27: Inputs 25 and 27 of I/O extension module.
- MIO29_MIO31: Inputs 29 and 31 of I/O extension module.
- MIO33_MIO35: Inputs 33 and 35 of I/O extension module.
- MIO37_MIO39: Inputs 37 and 39 of I/O extension module.

QuadratureDecoderToolActivation

Feature Info

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

Description

Edge activating the output of the selected Quadrature Decoder Tool.

> NOTE
> The A output of the quadrature encoder device connects to the first physical GPIO line of the designated pair, e.g. DIN11.

> NOTE
> The B output of the quadrature encoder device connects to the second physical GPIO line of the designated pair, e.g. DIN12.

Enumeration Values

- RisingEdgeA: The event is activated on the rising edge of the A signal.
- FallingEdgeA: The event is activated on the falling edge of the A signal.
- AllEdgesA: The event is activated on both edges of the A signal.
- AllEdgesAB: The event is activated on both edges of all signals.
- None: The event is not activated.

QuadratureDecoderToolForwardDirection

Feature Info

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

Short Description

Selects the A/B phase relationship corresponding to the forward direction.

Enumeration Values

- A_Leads_B: A leads B.
- B_Leads_A: B leads A.

QuadratureDecoderToolOutputMode

Feature Info

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

Short Description

Selects the filtering mode of the backward motion compensator.

Enumeration Values

- Unfiltered: All the quadrature decoder events are delivered.
- ForwardOnly: Only the events corresponding to the forward motion are delivered.
- FirstPassForwardOnly: Only the events corresponding to the first pass in the forward direction are delivered.

QuadratureDecoderToolPosition

Feature Info

Module	Category Path	Type	Access
Interface	Root → IOToolbox → QuadratureDecoderTool	IntReg	RO

Register Port: InterfacePort

Description

Position counter value of the selected Quadrature Decoder Tool.

The position counter is a 32-bit up/down counter that increments by 1 for any event corresponding to the forward direction and decrements by 1 for the backward direction.

Unit: encoder events as defined by QuadratureDecoderToolActivation.

Value range: from -2,147,483,648 up to 2,147,483,647.

QuadratureDecoderToolDirection

Feature Info

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

Short Description

Current direction of the selected Quadrature Decoder Tool.

Enumeration Values

- Forward: Forward.
- Backward: Backward.

QuadratureDecoderToolPositionReset

Feature Info

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

Short Description

Reset Position counter of the selected Quadrature Decoder Tool.

2.18. 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 826
- "DividerToolEnableControl" on page 828
- "DividerToolDivisionFactor" on page 829
- "DividerToolInitialOffset" on page 830

Enumeration Values

- DIV1: Divider Tool 1.
- DIV2: Divider Tool 2.
- DIV3: Divider Tool 3.
- DIV4: Divider Tool 4.

DividerToolSource

Feature Info

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

Short Description

I/O Toolbox event stream used as input for the selected Divider Tool.

Enumeration Values

- NONE: No event stream.
- LIN1: When an event occurs on Line Input Tool 1.
- LIN2: When an event occurs on Line Input Tool 2.
- LIN3: When an event occurs on Line Input Tool 3.
- LIN4: When an event occurs on Line Input Tool 4.
- LIN5: When an event occurs on Line Input Tool 5.
- LIN6: When an event occurs on Line Input Tool 6.
- LIN7: When an event occurs on Line Input Tool 7.
- LIN8: When an event occurs on Line Input Tool 8.
- QDC1: When an event occurs on Quadrature Decoder Tool 1.
- QDC2: When an event occurs on Quadrature Decoder Tool 2.
- QDC3: When an event occurs on Quadrature Decoder Tool 3.
- QDC4: When an event occurs on Quadrature Decoder Tool 4.
- MDV1: When an event occurs on Multiplier/Divider Tool 1.
- MDV2: When an event occurs on Multiplier/Divider Tool 2.
- MDV3: When an event occurs on Multiplier/Divider Tool 3.
- MDV4: When an event occurs on Multiplier/Divider Tool 4.
- DIV1: When an event occurs on Divider Tool 1.
- DIV2: When an event occurs on Divider Tool 2.
- DIV3: When an event occurs on Divider Tool 3.
- DIV4: When an event occurs on Divider Tool 4.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1.

- DEL2_2: When an event occurs on Delay Tool 2 Output 2.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2.
- EIN1: When an event occurs on Event Input Tool 1.
- EIN2: When an event occurs on Event Input Tool 2.
- UserEvent1: When an event occurs on User Event 1.
- UserEvent2: When an event occurs on User Event 2.
- UserEvent3: When an event occurs on User Event 3.
- UserEvent4: When an event occurs on User Event 4.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1.
- DLT2: When an event occurs on DeviceLinkTrigger Tool 2.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16.

DividerToolEnableControl

Feature Info

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

Short Description

Output control of the selected Divider Tool.

Enumeration Values

- Enable: Output enabled.
- Disable: Output disabled.

DividerToolDivisionFactor

Feature Info

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

Value Info

Minimum value: 1

Maximum value: 65535

Default value: 2

Description

Division factor of the selected Divider Tool.

This feature is the **denominator** of the fraction defining the Rate Conversion Ratio (RCR) of the Divider Tool.

RCR = 1/D where:

- D = DividerToolDivisionFactor

DividerToolInitialOffset

Feature Info

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

Value Info

Minimum value: 0

Maximum value: 65535

Description

Initial offset of the selected Divider Tool.

This feature defines the number of skipped input events after enabling the Divider tool.

2.19. 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 833
- "DelayToolSource2" on page 835
- "DelayToolClockSource" on page 837
- "DelayToolDelayValue" on page 838

Enumeration Values

- DEL1: Delay Tool 1.
- DEL2: Delay Tool 2.
- DEL3: Delay Tool 3.
- DEL4: Delay Tool 4.

DelayToolSource1

Feature Info

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

Short Description

I/O Toolbox event stream used as input 1 for the selected Delay Tool.

Enumeration Values

- NONE: No event stream.
- LIN1: When an event occurs on Line Input Tool 1.
- LIN2: When an event occurs on Line Input Tool 2.
- LIN3: When an event occurs on Line Input Tool 3.
- LIN4: When an event occurs on Line Input Tool 4.
- LIN5: When an event occurs on Line Input Tool 5.
- LIN6: When an event occurs on Line Input Tool 6.
- LIN7: When an event occurs on Line Input Tool 7.
- LIN8: When an event occurs on Line Input Tool 8.
- QDC1: When an event occurs on Quadrature Decoder Tool 1.
- QDC2: When an event occurs on Quadrature Decoder Tool 2.
- QDC3: When an event occurs on Quadrature Decoder Tool 3.
- QDC4: When an event occurs on Quadrature Decoder Tool 4.
- MDV1: When an event occurs on Multiplier/Divider Tool 1.
- MDV2: When an event occurs on Multiplier/Divider Tool 2.
- MDV3: When an event occurs on Multiplier/Divider Tool 3.
- MDV4: When an event occurs on Multiplier/Divider Tool 4.
- DIV1: When an event occurs on Divider Tool 1.
- DIV2: When an event occurs on Divider Tool 2.
- DIV3: When an event occurs on Divider Tool 3.
- DIV4: When an event occurs on Divider Tool 4.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1.

- DEL2_2: When an event occurs on Delay Tool 2 Output 2.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2.
- EIN1: When an event occurs on Event Input Tool 1.
- EIN2: When an event occurs on Event Input Tool 2.
- UserEvent1: When an event occurs on User Event 1.
- UserEvent2: When an event occurs on User Event 2.
- UserEvent3: When an event occurs on User Event 3.
- UserEvent4: When an event occurs on User Event 4.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1.
- DLT2: When an event occurs on DeviceLinkTrigger Tool 2.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16.

DelayToolSource2

Feature Info

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

Short Description

I/O Toolbox event stream used as input 2 for the selected Delay Tool.

Enumeration Values

- NONE: No event stream.
- LIN1: When an event occurs on Line Input Tool 1.
- LIN2: When an event occurs on Line Input Tool 2.
- LIN3: When an event occurs on Line Input Tool 3.
- LIN4: When an event occurs on Line Input Tool 4.
- LIN5: When an event occurs on Line Input Tool 5.
- LIN6: When an event occurs on Line Input Tool 6.
- LIN7: When an event occurs on Line Input Tool 7.
- LIN8: When an event occurs on Line Input Tool 8.
- QDC1: When an event occurs on Quadrature Decoder Tool 1.
- QDC2: When an event occurs on Quadrature Decoder Tool 2.
- QDC3: When an event occurs on Quadrature Decoder Tool 3.
- QDC4: When an event occurs on Quadrature Decoder Tool 4.
- MDV1: When an event occurs on Multiplier/Divider Tool 1.
- MDV2: When an event occurs on Multiplier/Divider Tool 2.
- MDV3: When an event occurs on Multiplier/Divider Tool 3.
- MDV4: When an event occurs on Multiplier/Divider Tool 4.
- DIV1: When an event occurs on Divider Tool 1.
- DIV2: When an event occurs on Divider Tool 2.
- DIV3: When an event occurs on Divider Tool 3.
- DIV4: When an event occurs on Divider Tool 4.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1.

- DEL2_2: When an event occurs on Delay Tool 2 Output 2.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2.
- EIN1: When an event occurs on Event Input Tool 1.
- EIN2: When an event occurs on Event Input Tool 2.
- UserEvent1: When an event occurs on User Event 1.
- UserEvent2: When an event occurs on User Event 2.
- UserEvent3: When an event occurs on User Event 3.
- UserEvent4: When an event occurs on User Event 4.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1.
- DLT2: When an event occurs on DeviceLinkTrigger Tool 2.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16.

DelayToolClockSource

Feature Info

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

Short Description

I/O Toolbox event stream used as clock.

Enumeration Values

- NONE: No event stream.
- TIME8NS: Clock input 8 nanoseconds time base.
- TIME200NS: Clock input 200 nanoseconds time base.
- TIME1US: Clock input 1 microsecond time base.
- LIN1: When an event occurs on Line Input Tool 1.
- LIN2: When an event occurs on Line Input Tool 2.
- LIN3: When an event occurs on Line Input Tool 3.
- LIN4: When an event occurs on Line Input Tool 4.
- LIN5: When an event occurs on Line Input Tool 5.
- LIN6: When an event occurs on Line Input Tool 6.
- LIN7: When an event occurs on Line Input Tool 7.
- LIN8: When an event occurs on Line Input Tool 8.
- QDC1: When an event occurs on Quadrature Decoder Tool 1.
- QDC2: When an event occurs on Quadrature Decoder Tool 2.
- QDC3: When an event occurs on Quadrature Decoder Tool 3.
- QDC4: When an event occurs on Quadrature Decoder Tool 4.

DelayToolDelayValue

Feature Info

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

Value Info

Maximum value: 16777215

Description

Delay value of the selected Delay Tool.

Minimum value:

- 5 when DelayToolClockSource is TIME8NS
- 1 in other cases

Unit: time or event according to DelayToolClockSource.

2.20. EventInputTool Category

EventInputToolSelector

Feature Info

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

Short Description

Selects an Event Input Tool.

Selected Features

- "EventInputToolSource" on page 841
- "EventInputToolActivation" on page 842

Enumeration Values

- EIN1: Event Input Tool 1.
- EIN2: Event Input Tool 2.

EventInputToolSource

Feature Info

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

Short Description

CoaXPress connector used as input for the selected Event Input Tool.

Enumeration Values

- A: CoaXPress physical host connection A..

EventInputToolActivation

Feature Info

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

Short Description

Signal activating the output of the selected Event Input Tool.

Enumeration Values

- StartOfScan: Receipt of start of scan signal.
- EndOfScan: Receipt of end of scan signal.

2.21. 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 845
- "C2CLinkSynchronizationToolClock" on page 847
- "C2CLinkSynchronizationToolDiscardPendingEvent" on page 848

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.

2.22. DeviceLinkTriggerTool Category

DeviceLinkTriggerToolSelector

Feature Info

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

Short Description

Selects a Device Link Trigger Tool.

Selected Features

- "DeviceLinkTriggerToolDevice" on page 851
- "DeviceLinkTriggerToolLinkTrigger" on page 852

Enumeration Values

- DLT1: Device Link Trigger Tool 1.
- DLT2: Device Link Trigger Tool 2.
- DLT3: Device Link Trigger Tool 3.
- DLT4: Device Link Trigger Tool 4.
- DLT5: Device Link Trigger Tool 5.
- DLT6: Device Link Trigger Tool 6.
- DLT7: Device Link Trigger Tool 7.
- DLT8: Device Link Trigger Tool 8.
- DLT9: Device Link Trigger Tool 9.
- DLT10: Device Link Trigger Tool 10.
- DLT11: Device Link Trigger Tool 11.
- DLT12: Device Link Trigger Tool 12.
- DLT13: Device Link Trigger Tool 13.
- DLT14: Device Link Trigger Tool 14.
- DLT15: Device Link Trigger Tool 15.
- DLT16: Device Link Trigger Tool 16.

DeviceLinkTriggerToolDevice

Feature Info

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

Short Description

Device used as source for the the selected Device Link Trigger Tool.

Enumeration Values

- Device0: Link Trigger from Device 0.
- Device1: Link Trigger from Device 1.
- Device2: Link Trigger from Device 2.
- Device3: Link Trigger from Device 3.
- Device4: Link Trigger from Device 4.
- Device5: Link Trigger from Device 5.
- Device6: Link Trigger from Device 6.
- Device7: Link Trigger from Device 7.

DeviceLinkTriggerToolLinkTrigger

Feature Info

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

Short Description

LinkTriggerN used as source for the selected Device Link Trigger Tool.

Enumeration Values

- None: Link Trigger Disabled.
- LinkTrigger0: Link Trigger 0.
- LinkTrigger1: Link Trigger 1.
- LinkTrigger2: Link Trigger 2.
- LinkTrigger3: Link Trigger 3.
- LinkTrigger4: Link Trigger 4.
- LinkTrigger5: Link Trigger 5.
- LinkTrigger6: Link Trigger 6.
- LinkTrigger7: Link Trigger 7.
- LinkTrigger8: Link Trigger 8.
- LinkTrigger9: Link Trigger 9.
- LinkTrigger10: Link Trigger 10.
- LinkTrigger11: Link Trigger 11.
- LinkTrigger12: Link Trigger 12.
- LinkTrigger13: Link Trigger 13.
- LinkTrigger14: Link Trigger 14.
- LinkTrigger15: Link Trigger 15.

2.23. 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 858
- "EventNotificationContext1" on page 859
- "EventNotificationContext2" on page 863
- "EventNotificationContext3" on page 867
- "EventCount" on page 871
- "EventCountReset" on page 872

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.
- EIN1: Event Input Tool 1.
- EIN2: Event Input Tool 2.
- DLT1: Device Link Trigger Tool 1.
- DLT2: Device Link Trigger Tool 2.
- DLT3: Device Link Trigger Tool 3.
- DLT4: Device Link Trigger Tool 4.
- DLT5: Device Link Trigger Tool 5.
- DLT6: Device Link Trigger Tool 6.
- DLT7: Device Link Trigger Tool 7.
- DLT8: Device Link Trigger Tool 8.
- DLT9: Device Link Trigger Tool 9.
- DLT10: Device Link Trigger Tool 10.
- DLT11: Device Link Trigger Tool 11.

- DLT12: Device Link Trigger Tool 12.
- DLT13: Device Link Trigger Tool 13.
- DLT14: Device Link Trigger Tool 14.
- DLT15: Device Link Trigger Tool 15.
- DLT16: Device Link Trigger Tool 16.
- CrcErrorCxpA: Detected CRC error on CXP connector A.
- CrcErrorCxpB: Detected CRC error on CXP connector B.
- CrcErrorCxpC: Detected CRC error on CXP connector C.
- CrcErrorCxpD: Detected CRC error on CXP connector D.
- CrcErrorCxpE: Detected CRC error on CXP connector E.
- CrcErrorCxpF: Detected CRC error on CXP connector F.
- CrcErrorCxpG: Detected CRC error on CXP connector G.
- CrcErrorCxpH: Detected CRC error on CXP connector H.
- ConnectionDetectedCxpA: Low level connection lock achieved on CXP connector A.
- ConnectionDetectedCxpB: Low level connection lock achieved on CXP connector B.
- ConnectionDetectedCxpC: Low level connection lock achieved on CXP connector C.
- ConnectionDetectedCxpD: Low level connection lock achieved on CXP connector D.
- ConnectionDetectedCxpE: Low level connection lock achieved on CXP connector E.
- ConnectionDetectedCxpF: Low level connection lock achieved on CXP connector F.
- ConnectionDetectedCxpG: Low level connection lock achieved on CXP connector G.
- ConnectionDetectedCxpH: Low level connection lock achieved on CXP connector H.
- ConnectionUndetectedCxpA: Low level connection lock lost on CXP connector A.
- ConnectionUndetectedCxpB: Low level connection lock lost on CXP connector B.
- ConnectionUndetectedCxpC: Low level connection lock lost on CXP connector C.
- ConnectionUndetectedCxpD: Low level connection lock lost on CXP connector D.
- ConnectionUndetectedCxpE: Low level connection lock lost on CXP connector E.
- ConnectionUndetectedCxpF: Low level connection lock lost on CXP connector F.
- ConnectionUndetectedCxpG: Low level connection lock lost on CXP connector G.
- ConnectionUndetectedCxpH: Low level connection lock lost on CXP connector H.
- Device0Ready: CoaXPress link configuration done for Device 0.
- Device1Ready: CoaXPress link configuration done for Device 1.
- Device2Ready: CoaXPress link configuration done for Device 2.
- Device3Ready: CoaXPress link configuration done for Device 3.
- Device4Ready: CoaXPress link configuration done for Device 4.
- Device5Ready: CoaXPress link configuration done for Device 5.
- Device6Ready: CoaXPress link configuration done for Device 6.

- Device7Ready: CoaXPress link configuration done for Device 7.
- Device0Lost: Device 0 disconnected.
- Device1Lost: Device 1 disconnected.
- Device2Lost: Device 2 disconnected.
- Device3Lost: Device 3 disconnected.
- Device4Lost: Device 4 disconnected.
- Device5Lost: Device 5 disconnected.
- Device6Lost: Device 6 disconnected.
- Device7Lost: Device 7 disconnected.
- Device0Configuring: CoaXPress link configuration in progress for Device 0.
- Device1Configuring: CoaXPress link configuration in progress for Device 1.
- Device2Configuring: CoaXPress link configuration in progress for Device 2.
- Device3Configuring: CoaXPress link configuration in progress for Device 3.
- Device4Configuring: CoaXPress link configuration in progress for Device 4.
- Device5Configuring: CoaXPress link configuration in progress for Device 5.
- Device6Configuring: CoaXPress link configuration in progress for Device 6.
- Device7Configuring: CoaXPress link configuration in progress for Device 7.

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.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.
- DLT12EventCount: Number of DLT12 events.

- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH events.
- ConnectionDetectedCxpAEventCount: Number of ConnectionDetectedCxpA events.
- ConnectionDetectedCxpBEventCount: Number of ConnectionDetectedCxpB events.
- ConnectionDetectedCxpCEventCount: Number of ConnectionDetectedCxpC events.
- ConnectionDetectedCxpDEventCount: Number of ConnectionDetectedCxpD events.
- ConnectionDetectedCxpEEventCount: Number of ConnectionDetectedCxpE events.
- ConnectionDetectedCxpFEventCount: Number of ConnectionDetectedCxpF events.
- ConnectionDetectedCxpGEventCount: Number of ConnectionDetectedCxpG events.
- ConnectionDetectedCxpHEventCount: Number of ConnectionDetectedCxpH events.
- ConnectionUndetectedCxpAEventCount: Number of ConnectionUndetectedCxpA events.
- ConnectionUndetectedCxpBEventCount: Number of ConnectionUndetectedCxpB events.
- ConnectionUndetectedCxpCEventCount: Number of ConnectionUndetectedCxpC events.
- ConnectionUndetectedCxpDEventCount: Number of ConnectionUndetectedCxpD events.
- ConnectionUndetectedCxpEEventCount: Number of ConnectionUndetectedCxpE events.
- ConnectionUndetectedCxpFEventCount: Number of ConnectionUndetectedCxpF events.
- ConnectionUndetectedCxpGEventCount: Number of ConnectionUndetectedCxpG events.
- ConnectionUndetectedCxpHEventCount: Number of ConnectionUndetectedCxpH events.
- Device0ReadyEventCount: Number of Device0Ready events.
- Device1ReadyEventCount: Number of Device1Ready events.
- Device2ReadyEventCount: Number of Device2Ready events.
- Device3ReadyEventCount: Number of Device3Ready events.
- Device4ReadyEventCount: Number of Device4Ready events.
- Device5ReadyEventCount: Number of Device5Ready events.
- Device6ReadyEventCount: Number of Device6Ready events.
- Device7ReadyEventCount: Number of Device7Ready events.

- Device0LostEventCount: Number of Device0Lost events.
- Device1LostEventCount: Number of Device1Lost events.
- Device2LostEventCount: Number of Device2Lost events.
- Device3LostEventCount: Number of Device3Lost events.
- Device4LostEventCount: Number of Device4Lost events.
- Device5LostEventCount: Number of Device5Lost events.
- Device6LostEventCount: Number of Device6Lost events.
- Device7LostEventCount: Number of Device7Lost events.
- Device0ConfiguringEventCount: Number of Device0Configuring events.
- Device1ConfiguringEventCount: Number of Device1Configuring events.
- Device2ConfiguringEventCount: Number of Device2Configuring events.
- Device3ConfiguringEventCount: Number of Device3Configuring events.
- Device4ConfiguringEventCount: Number of Device4Configuring events.
- Device5ConfiguringEventCount: Number of Device5Configuring events.
- Device6ConfiguringEventCount: Number of Device6Configuring events.
- Device7ConfiguringEventCount: Number of Device7Configuring 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.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.
- DLT12EventCount: Number of DLT12 events.

- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH events.
- ConnectionDetectedCxpAEventCount: Number of ConnectionDetectedCxpA events.
- ConnectionDetectedCxpBEventCount: Number of ConnectionDetectedCxpB events.
- ConnectionDetectedCxpCEventCount: Number of ConnectionDetectedCxpC events.
- ConnectionDetectedCxpDEventCount: Number of ConnectionDetectedCxpD events.
- ConnectionDetectedCxpEEventCount: Number of ConnectionDetectedCxpE events.
- ConnectionDetectedCxpFEventCount: Number of ConnectionDetectedCxpF events.
- ConnectionDetectedCxpGEventCount: Number of ConnectionDetectedCxpG events.
- ConnectionDetectedCxpHEventCount: Number of ConnectionDetectedCxpH events.
- ConnectionUndetectedCxpAEventCount: Number of ConnectionUndetectedCxpA events.
- ConnectionUndetectedCxpBEventCount: Number of ConnectionUndetectedCxpB events.
- ConnectionUndetectedCxpCEventCount: Number of ConnectionUndetectedCxpC events.
- ConnectionUndetectedCxpDEventCount: Number of ConnectionUndetectedCxpD events.
- ConnectionUndetectedCxpEEventCount: Number of ConnectionUndetectedCxpE events.
- ConnectionUndetectedCxpFEventCount: Number of ConnectionUndetectedCxpF events.
- ConnectionUndetectedCxpGEventCount: Number of ConnectionUndetectedCxpG events.
- ConnectionUndetectedCxpHEventCount: Number of ConnectionUndetectedCxpH events.
- Device0ReadyEventCount: Number of Device0Ready events.
- Device1ReadyEventCount: Number of Device1Ready events.
- Device2ReadyEventCount: Number of Device2Ready events.
- Device3ReadyEventCount: Number of Device3Ready events.
- Device4ReadyEventCount: Number of Device4Ready events.
- Device5ReadyEventCount: Number of Device5Ready events.
- Device6ReadyEventCount: Number of Device6Ready events.
- Device7ReadyEventCount: Number of Device7Ready events.

- Device0LostEventCount: Number of Device0Lost events.
- Device1LostEventCount: Number of Device1Lost events.
- Device2LostEventCount: Number of Device2Lost events.
- Device3LostEventCount: Number of Device3Lost events.
- Device4LostEventCount: Number of Device4Lost events.
- Device5LostEventCount: Number of Device5Lost events.
- Device6LostEventCount: Number of Device6Lost events.
- Device7LostEventCount: Number of Device7Lost events.
- Device0ConfiguringEventCount: Number of Device0Configuring events.
- Device1ConfiguringEventCount: Number of Device1Configuring events.
- Device2ConfiguringEventCount: Number of Device2Configuring events.
- Device3ConfiguringEventCount: Number of Device3Configuring events.
- Device4ConfiguringEventCount: Number of Device4Configuring events.
- Device5ConfiguringEventCount: Number of Device5Configuring events.
- Device6ConfiguringEventCount: Number of Device6Configuring events.
- Device7ConfiguringEventCount: Number of Device7Configuring 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.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.
- DLT12EventCount: Number of DLT12 events.

- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH events.
- ConnectionDetectedCxpAEventCount: Number of ConnectionDetectedCxpA events.
- ConnectionDetectedCxpBEventCount: Number of ConnectionDetectedCxpB events.
- ConnectionDetectedCxpCEventCount: Number of ConnectionDetectedCxpC events.
- ConnectionDetectedCxpDEventCount: Number of ConnectionDetectedCxpD events.
- ConnectionDetectedCxpEEventCount: Number of ConnectionDetectedCxpE events.
- ConnectionDetectedCxpFEventCount: Number of ConnectionDetectedCxpF events.
- ConnectionDetectedCxpGEventCount: Number of ConnectionDetectedCxpG events.
- ConnectionDetectedCxpHEventCount: Number of ConnectionDetectedCxpH events.
- ConnectionUndetectedCxpAEventCount: Number of ConnectionUndetectedCxpA events.
- ConnectionUndetectedCxpBEventCount: Number of ConnectionUndetectedCxpB events.
- ConnectionUndetectedCxpCEventCount: Number of ConnectionUndetectedCxpC events.
- ConnectionUndetectedCxpDEventCount: Number of ConnectionUndetectedCxpD events.
- ConnectionUndetectedCxpEEventCount: Number of ConnectionUndetectedCxpE events.
- ConnectionUndetectedCxpFEventCount: Number of ConnectionUndetectedCxpF events.
- ConnectionUndetectedCxpGEventCount: Number of ConnectionUndetectedCxpG events.
- ConnectionUndetectedCxpHEventCount: Number of ConnectionUndetectedCxpH events.
- Device0ReadyEventCount: Number of Device0Ready events.
- Device1ReadyEventCount: Number of Device1Ready events.
- Device2ReadyEventCount: Number of Device2Ready events.
- Device3ReadyEventCount: Number of Device3Ready events.
- Device4ReadyEventCount: Number of Device4Ready events.
- Device5ReadyEventCount: Number of Device5Ready events.
- Device6ReadyEventCount: Number of Device6Ready events.
- Device7ReadyEventCount: Number of Device7Ready events.

- Device0LostEventCount: Number of Device0Lost events.
- Device1LostEventCount: Number of Device1Lost events.
- Device2LostEventCount: Number of Device2Lost events.
- Device3LostEventCount: Number of Device3Lost events.
- Device4LostEventCount: Number of Device4Lost events.
- Device5LostEventCount: Number of Device5Lost events.
- Device6LostEventCount: Number of Device6Lost events.
- Device7LostEventCount: Number of Device7Lost events.
- Device0ConfiguringEventCount: Number of Device0Configuring events.
- Device1ConfiguringEventCount: Number of Device1Configuring events.
- Device2ConfiguringEventCount: Number of Device2Configuring events.
- Device3ConfiguringEventCount: Number of Device3Configuring events.
- Device4ConfiguringEventCount: Number of Device4Configuring events.
- Device5ConfiguringEventCount: Number of Device5Configuring events.
- Device6ConfiguringEventCount: Number of Device6Configuring events.
- Device7ConfiguringEventCount: Number of Device7Configuring 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.

2.24. OemSafetyKey Category

OemSafetyKeyVerification

Feature Info

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	Enumeration	RW

Description

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

Acts as a selector for CheckOemSafetyKey.

Recommended value: EncryptedKey.

Default value: ProgrammingKeyOrEncryptedKey.

Selected Features

- "CheckOemSafetyKey" on page 877

Enumeration Values

- ProgrammingKey: Only the key written to ProgramOemSafetyKey can be used to verify the OEM safety key.
- EncryptedKey: Only the key read from EncryptedOemSafetyKey can be used to verify the OEM safety key (recommended).
- ProgrammingKeyOrEncryptedKey: Both the key written to ProgramOemSafetyKey and the key read from EncryptedOemSafetyKey can be used to verify the OEM safety key.

CheckOemSafetyKey

Feature Info

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	String	Imposed: WO

Description

Write-only string to use for comparing a key (the key written to ProgramOemSafetyKey or the key read from EncryptedOemSafetyKey) and the programmed OEM safety key.

ProgramOemSafetyKey

Feature Info

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	String	Imposed: WO

Short Description

Write-only string to use for programming the non-volatile OEM safety key.

EncryptedOemSafetyKey

Feature Info

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	String	Imposed: RO

Description

Read-only string that contains the encrypted version of the OEM safety key just programmed with ProgramOemSafetyKey.

MaximumOemKeyLength

Feature Info

Module	Category Path	Type	Access
Interface	Root → OemSafetyKey	Integer	RW

Value Info

Minimum value: 40

Maximum value: 2147483647

Description

The length of ProgramOemSafetyKey and CheckOemSafetyKey is limited by MaximumOemKeyLength.

Default value: 4096.

2.25. CustomLogic Category

CustomLogicControlAddress

Feature Info

Module	Category Path	Type	Access
Interface	Root → CustomLogic	Integer	RW

Value Info

Minimum value: 0

Maximum value: 65535

Short Description

Custom Logic Control Address.

Selected Features

- "CustomLogicControlData" on page 883

CustomLogicControlData

Feature Info

Module	Category Path	Type	Access
Interface	Root → CustomLogic	Integer	RW

Value Info

Minimum value: 0

Maximum value: 4294967295

Short Description

Custom Logic Control Data.

2.26. OnboardMemory Category

OnboardMemoryBase

Feature Info

Module	Category Path	Type	Access
Interface	Root → OnboardMemory	Integer	Imposed: RO

Short Description

Base address of the onboard memory.

OnboardMemorySize

Feature Info

Module	Category Path	Type	Access
Interface	Root → OnboardMemory	IntReg	RO

Register Port: InterfacePort

Short Description

Available size in bytes of the onboard memory.

2.27. QsfpModule Category

QsfpModulePresent

Feature Info

Module	Category Path	Type	Access
Interface	Root → QsfpModule	Boolean	RW

Short Description

Qsfp Module Present.

QsfpModuleFault

Feature Info

Module	Category Path	Type	Access
Interface	Root → QsfpModule	Boolean	RW

Short Description

Qsfp Module Fault.

QsfpModuleRegisterAddress

Feature Info

Module	Category Path	Type	Access
Interface	Root → QsfpModule	Integer	RW

Value Info

Minimum value: 0

Maximum value: 255

Short Description

Qsfp Module Register Address.

Selected Features

- "QsfpModuleRegisterData" on page 891

QsfpModuleRegisterData

Feature Info

Module	Category Path	Type	Access
Interface	Root → QsfpModule	Integer	RW

Value Info

Minimum value: 0

Maximum value: 255

Short Description

Qsfp Module Register Data.

2.28. ForwardErrorCorrection Category

EthernetPHYSelector

Feature Info

Module	Category Path	Type	Access
Interface	Root → ForwardErrorCorrection	Integer	RW

Value Info

Minimum value: 0

Maximum value: 3

Short Description

Selects the Ethernet PHY.

Selected Features

- "FecCorrectedErrorCount" on page 894
- "FecUncorrectedErrorCount" on page 895
- "FecCorrectedErrorCountReset" on page 896
- "FecUncorrectedErrorCountReset" on page 897

FecCorrectedErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → ForwardErrorCorrection	Integer	Imposed: RO

Short Description

Reports the number of errors detected and corrected by the FEC.

FecUncorrectedErrorCount

Feature Info

Module	Category Path	Type	Access
Interface	Root → ForwardErrorCorrection	Integer	Imposed: RO

Short Description

Reports the number of errors detected but not corrected by the FEC.

FecCorrectedErrorCountReset

Feature Info

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

Short Description

Fec Corrected Error Count Reset.

FecUncorrectedErrorCountReset

Feature Info

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

Short Description

Fec Uncorrected Error Count Reset.

3. Coaxlink Device Module Register Description

Categorized features list of Devicemodule version 24_04_0

3.1. Root Category

DeviceInformation

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "DeviceInformation Category" on page 907

StreamEnumeration

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "StreamEnumeration Category" on page 914

CameraAndIlluminationControl

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Description

Set of features related to the Camera and Illumination Controller (CIC).

Category Members

See also: "CameraAndIlluminationControl Category" on page 934

CoaXPress

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "CoaXPress Category" on page 917

RemoteDeviceEventControl

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "RemoteDeviceEventControl Category" on page 929

EventControl

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "EventControl Category" on page 977

Errors

Feature Info

Module	Category Path	Type	Access
Device	Root	Category	RW

Category Members

See also: "Errors Category" on page 997

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

- CXP: This enumeration value indicates CoaXPress 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 916

StreamID

Feature Info

Module	Category Path	Type	Access
Device	Root → StreamEnumeration	String	Imposed: RO

Short Description

Device unique ID for the stream.

3.4. CoaXPress Category

CxpLinkConfiguration

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Enumeration	RW

Description

Set/report the CoaXPress Link configuration.

Enumeration Values

- CXP1_X1: 1 connection @1.250 Gbps.
- CXP2_X1: 1 connection @2.500 Gbps.
- CXP3_X1: 1 connection @3.125 Gbps.
- CXP5_X1: 1 connection @5.000 Gbps.
- CXP6_X1: 1 connection @6.250 Gbps.
- CXP10_X1: 1 connection @10.000 Gbps.
- CXP12_X1: 1 connection @12.500 Gbps.
- CXP1_X2: 2 connections @1.250 Gbps.
- CXP2_X2: 2 connections @2.500 Gbps.
- CXP3_X2: 2 connections @3.125 Gbps.
- CXP5_X2: 2 connections @5.000 Gbps.
- CXP6_X2: 2 connections @6.250 Gbps.
- CXP10_X2: 2 connections @10.000 Gbps.
- CXP12_X2: 2 connections @12.500 Gbps.
- CXP1_X3: 3 connections @1.250 Gbps.
- CXP2_X3: 3 connections @2.500 Gbps.
- CXP3_X3: 3 connections @3.125 Gbps.
- CXP5_X3: 3 connections @5.000 Gbps.
- CXP6_X3: 3 connections @6.250 Gbps.
- CXP10_X3: 3 connections @10.000 Gbps.
- CXP12_X3: 3 connections @12.500 Gbps.
- CXP1_X4: 4 connections @1.250 Gbps.
- CXP2_X4: 4 connections @2.500 Gbps.
- CXP3_X4: 4 connections @3.125 Gbps.

- CXP5_X4: 4 connections @5.000 Gbps.
- CXP6_X4: 4 connections @6.250 Gbps.
- CXP10_X4: 4 connections @10.000 Gbps.
- CXP12_X4: 4 connections @12.500 Gbps.
- CXP1_X8: 8 connections @1.250 Gbps.
- CXP2_X8: 8 connections @2.500 Gbps.
- CXP3_X8: 8 connections @3.125 Gbps.
- CXP5_X8: 8 connections @5.000 Gbps.
- CXP6_X8: 8 connections @6.250 Gbps.
- CXP10_X8: 8 connections @10.000 Gbps.
- CXP12_X8: 8 connections @12.500 Gbps.
- Preferred: Camera Preferred Configuration adapted to the capabilities of the frame grabber.

CxpLinkConfigurationOption

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Enumeration	RW

Short Description

CxpLinkConfigurationOption defines how the ConnectionConfig bootstrap register of the CoaXPress device can be changed by writing to CxpLinkConfiguration. Changing the ConnectionConfig bootstrap register of the CoaXPress device by writing to the CxpLinkConfiguration of the device module is discouraged. It is recommended to use the equivalent feature of the remote device module instead.

Selected Features

- "CxpLinkConfiguration" on page 918

Enumeration Values

- AlwaysWrite: Always write to the ConnectionConfig bootstrap register of the CoaXPress device.
- WriteIfDifferent: Write to the ConnectionConfig bootstrap register of the CoaXPress device only if it is different from the current configuration.
- NeverWrite: Never write to the ConnectionConfig bootstrap register of the CoaXPress device.

CxpHostConnectionBase

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Enumeration	RW

Short Description

Returns the base CoaXPress physical connection of this device.

Enumeration Values

- A: CoaXPress physical host connection A.
- B: CoaXPress physical host connection B.
- C: CoaXPress physical host connection C.
- D: CoaXPress physical host connection D.
- E: CoaXPress physical host connection E.
- F: CoaXPress physical host connection F.
- G: CoaXPress physical host connection G.
- H: CoaXPress physical host connection H.

CxpHostConnectionCount

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	IntReg	RO

Register Port: DevicePort

Short Description

Returns the number of CoaXPress physical connections of this device.

CxpTriggerMessageFormat

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Enumeration	RW

Description

Sets/gets the CoaXPress Host to Device Trigger Message Format.

When set to Pulse, every Camera Trigger requires two transactions on the Host to Device I/O Channel: one **rising edge trigger packet** and one **falling edge trigger packet**. This is the standard behavior.

When set to RisingEdge, every Camera Trigger requires a single transaction on the Host to Device I/O Channel: one **rising edge trigger packet**.

When set to Toggle, every Camera Trigger generates a single message transaction on the Host to Device I/O Channel alternating rising edge or falling edge trigger messages.

Default value: Pulse.

Enumeration Values

- Pulse: Rising edge and falling edge CoaXPress trigger messages.
- RisingEdge: Rising edge CoaXPress trigger message.
- Toggle: Alternating rising edge or falling edge CoaXPress trigger message.

CxpTriggerLevel

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Enumeration	RW

Description

This feature allows to set or get the logical state of the CoaXPress Host to Device Trigger signal.

Setting the logical state is only allowed when CxpTriggerMessageFormat is set to Toggle.

Getting the logical state is allowed for any value of CxpTriggerMessageFormat.

Enumeration Values

- Low: Next trigger message format will be rising edge CoaXPress trigger message.
- High: Next trigger message format will be falling edge CoaXPress trigger message.

CxpTriggerAckTimeout

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Float	RW

Value Info

Minimum value: 0

Maximum value: 2097.15

Description

Acknowledge timeout value of the CoaXPress Host to Device trigger message .

Default value: 20.0 (20 microseconds).

CxpTriggerMaxResendCount

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Integer	RW

Value Info

Minimum value: 0

Maximum value: 7

Description

Sets/gets the maximum resend count of the CoaXPress Host to Device Trigger Message.

Default value: 3.

CxpPacketArbiterReset

Feature Info

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

Description

CoaXPress Data Packet Arbiter Reset.

Reset the CoaXPress Data Packet Arbiter to Connection 0.

> NOTE
> This command is only useful for multi-connection cameras that unduly reset the round-Robin connection sequence order.

CxpPortAlignment

Feature Info

Module	Category Path	Type	Access
Device	Root → CoaXPress	Integer	RW

Value Info

Minimum value: 0

Maximum value: 8

Unit: B (byte)

Short Description

When accessing the GenTL remote port, the driver adapts the GenTL remote port address (and size) to meet the alignment constraint. CxpPortAlignment value can be set to 0 (default) or any value up to 8. When the value is greater than 0, the alignment constraint is set to the specified value; otherwise, the automatic mode is enabled. The automatic mode sets the alignment to 4 bytes for bootstrap registers while no alignment constraints are set for accesses in the manufacturer-specific space; in this case if an application reads 2 bytes at 0x2001, the driver accesses 3 bytes at 0x2000 (or 4 bytes at 0x2000 if the camera refuses the 3-byte read) and only returns the requested bytes, and if an application reads 1 byte at 0x6003, the driver performs the CoaXPress read as instructed by the application. To completely disable adaptation of GenTL remote port address (or size) while accessing the port, CxpPortAlignment must be set to 1.

3.5. RemoteDeviceEventControl Category

RemoteDeviceEventSelector

Feature Info

Module	Category Path	Type	Access
Device	Root → RemoteDeviceEventControl	Enumeration	RW

Short Description

Select a remote device event namespace.

Selected Features

- "RemoteDeviceEventEnable" on page 931
- "RemoteDeviceEventCount" on page 932
- "RemoteDeviceEventCountReset" on page 933

Enumeration Values

- GenICam: GenICam event namespace.
- CoaXPress: CoaXPress specific event namespace.
- DeviceSpecific: Device specific event namespace.

RemoteDeviceEventEnable

Feature Info

Module	Category Path	Type	Access
Device	Root → RemoteDeviceEventControl	Boolean	RW

Short Description

Activate or deactivate the remote device event with the selected namespace.

RemoteDeviceEventCount

Feature Info

Module	Category Path	Type	Access
Device	Root → RemoteDeviceEventControl	IntReg	RO

Register Port: DevicePort

Short Description

Number of occurrences of the selected event namespace (32-bit counter).

RemoteDeviceEventCountReset

Feature Info

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

Short Description

Reset the selected RemoteDeviceEventCount.

3.6. CameraAndIlluminationControl Category

CameraModel

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Description

Set of features describing the behavioral model of a grabber-controlled camera.

NOTE
These features defines the operating limits of the camera and are used to configure the trigger-overrun protection mechanism of the CIC.

NOTE
An incorrectly set behavioral model may prevent reaching the highest achievable camera cycle rate or, reversely, allow the grabber to assert triggers too quickly.

Category Members

See also: "CameraModel Category" on page 941

CycleTiming

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Description

Set of features describing the CIC Cycle timing properties.

Category Members

See also: "CycleTiming Category" on page 949

CycleControl

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Description

Set of features describing the CIC cycle control properties.

Category Members

See also: "CycleControl Category" on page 955

SequenceControl

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Category	RW

Description

Set of features describing the CIC cycle sequence control properties.

Default value: True.

Category Members

See also: "SequenceControl Category" on page 964

DeviceReset

Feature Info

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

Description

Reset the CIC.

CameraAndIlluminationControllerStream

Feature Info

Module	Category Path	Type	Access
Device	Root → CameraAndIlluminationControl	Enumeration	RW

Short Description

Defines which data stream the CIC uses to check whether a new cycle can be started.

Enumeration Values

- Stream0: CIC uses camera readout and frame buffer status from Stream0.
- Stream1: CIC uses camera readout and frame buffer status from Stream1.
- Stream2: CIC uses camera readout and frame buffer status from Stream2.
- Stream3: CIC uses camera readout and frame buffer status from Stream3.

3.7. CameraModel Category

CameraControlMethod

Feature Info

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

Description

Camera control method.

The NC camera control method is to be used with free-run or asynchronous reset cameras not controlled by the frame grabber.

The RCcamera control method is to be used with asynchronous reset cameras having the camera cycle start controlled by the grabber CIC and the exposure time controlled by the camera.

The RG camera control method is to be used with asynchronous reset cameras having the camera cycle start and the exposure duration controlled by the grabber CIC.

The EXTERNAL camera control method is to be used with asynchronous reset cameras having the camera cycle start and the exposure duration controlled by a hardware signal applied by an external controller to any GPIO input port of the grabber.

> NOTE
> The NC and the EXTERNAL camera control methods doesn't use the CIC.

Enumeration Values

- NC: Not Controlled.
- RC: Grabber-controlled cycle start, Camera-controlled exposure time.
- RG: Grabber-controlled cycle start and exposure time.
- EXTERNAL: Externally-controlled cycle start and exposure time.

C2CLinkConfiguration

Feature Info

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

Description

Sets/gets the C2C-Link configuration.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

Default value: Disconnected.

Enumeration Values

- Disconnected: Disconnected from the C2C-Link.
- Master: Connected to the C2C-Link as the C2C-Link Master Device.
- Slave: Connected to the C2C-Link as a C2C-Link Slave Device.

ExposureReadoutOverlap

Feature Info

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

Description

Declares the exposure overlapping capability of the camera.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

When set to true, it indicates that the camera allows overlapping. The exposure phase of a new camera cycle is allowed to begin during the readout phase.

Wen set to false, it indicates that the camera doesn't allow overlapping. The exposure phase of a new camera cycle is not allowed to begin before the completion of the readout phase.

ExposureRecoveryTime

Feature Info

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

Value Info

Minimum value: 0

Maximum value: 1.71799e+07

Dimension: Time

Unit: µs

Increment: 0.008 µs (8 ns)

Description

Minimum time interval between two consecutive exposure phases.

When CameraControlMethod is RG, the CIC ensure that the time interval between two consecutive camera trigger pulses is not lower than the specified value in case of large exposure time (exposure time > readout time).

Directive

Only when CameraControlMethod is RG, set this value to the minimum time interval allowed by the camera.

WARNING
A too small value may cause missed triggers.

WARNING
An excessive value prevents reaching the highest achievable camera cycle rate.

ExposureTimeMin

Feature Info

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

Value Info

Dimension: Time

Unit: µs

Increment: 0.008 µs (8 ns)

Description

Minimum exposure time.

When CameraControlMethod is RG, the CIC ensure that the camera trigger pulse width is not lower than the specified value.

Directive

Only when CameraControlMethod is RG, set this value to the minimum exposure time allowed by the camera.

> WARNING
> A too small value may cause missed triggers.

ExposureTimeMax

Feature Info

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

Value Info

Maximum value: 5.6295e+11

Dimension: Time

Unit: µs

Increment: 0.008 µs (8 ns)

Description

Maximum exposure time.

When CameraControlMethod is RG, the CIC ensure that the camera trigger pulse width is not larger than the specified value.

Directive

Only when CameraControlMethod is RG, set this value to the maximum exposure time allowed by the camera.

WARNING
An excessive value may cause missed triggers.

CycleMinimumPeriod

Feature Info

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

Value Info

Maximum value: 5.6295e+11

Dimension: Time

Unit: µs

Increment: 0.008 µs (8 ns)

Description

Minimum camera cycle period.

When CameraControlMethod is RC or RG, the CIC ensure that the camera cycle period is not smaller than the specified value.

NOTE
was named CycleTargetPeriod in Coaxlink driver versions prior to 9.4

NOTE
was named CyclePeriodTarget in Coaxlink driver versions prior to 4.1

Directive

Only when CameraControlMethod is RC or RG, set this value to the minimum cycle period allowed by the camera.

WARNING
A too small value may cause missed triggers.

3.8. CycleTiming Category

CycleTimingSelector

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 952
- "StrobeDelay" on page 953
- "StrobeDuration" on page 954

CycleTimingCount

Feature Info

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

Value Info

Minimum value: 1

Short Description

A timing represents a set of values in the CycleTiming category.

ExposureTime

Feature Info

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

Value Info

Dimension: Time

Unit: µs

Increment: 0.008 µs (8 ns)

Description

Sets/gets the exposure time.

Applies only when CameraControlMethod is RG.

> NOTE
> Avoid using exposure time settings outside the exposure time range of the camera.

> NOTE
> The upper limit is very high: > 150 hours!

Default value: 1,000.0 (1 millisecond).

StrobeDelay

Feature Info

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

Value Info

Minimum value: -8.58993e+06

Maximum value: 8.58993e+06

Dimension: Time

Unit: µs

Increment: 0.008 µs (8 ns)

Description

Sets/gets the strobe pulse delay.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

Default value: 0.

StrobeDuration

Feature Info

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

Value Info

Minimum value: 0

Maximum value: 5.6295e+11

Dimension: Time

Unit: µs

Increment: 0.008 µs (8 ns)

Description

Sets/gets the strobe pulse duration.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

> NOTE
> The upper limit is very high: > 150 hours!

Default value: 1,000.0 (1 millisecond).

3.9. CycleControl Category

CycleTriggerSource

Feature Info

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

Description

Sets/gets the start-of-camera-cycle trigger conditions and selects a hardware or software trigger source.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

Default value: Immediate.

Enumeration Values

- Immediate: Immediately after the start of the sequence and then repeatedly every CycleMinimumPeriod period.
- StartCycle: On execution of the StartCycle command.
- C2C: Synchronized with the C2C-Link master device. This value is enforced when C2CLinkConfiguration = Slave.
- LIN1: When an event occurs on Line Input Tool 1 or on execution of the StartCycle command.
- LIN2: When an event occurs on Line Input Tool 2 or on execution of the StartCycle command.
- LIN3: When an event occurs on Line Input Tool 3 or on execution of the StartCycle command.
- LIN4: When an event occurs on Line Input Tool 4 or on execution of the StartCycle command.
- LIN5: When an event occurs on Line Input Tool 5 or on execution of the StartCycle command.
- LIN6: When an event occurs on Line Input Tool 6 or on execution of the StartCycle command.
- LIN7: When an event occurs on Line Input Tool 7 or on execution of the StartCycle command.
- LIN8: When an event occurs on Line Input Tool 8 or on execution of the StartCycle command.
- QDC1: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StartCycle command.
- QDC2: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StartCycle command.
- QDC3: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StartCycle command.
- QDC4: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StartCycle command.
- MDV1: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StartCycle command.

- MDV2: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StartCycle command.
- MDV3: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StartCycle command.
- MDV4: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StartCycle command.
- DIV1: When an event occurs on Divider Tool 1 or on execution of the StartCycle command.
- DIV2: When an event occurs on Divider Tool 2 or on execution of the StartCycle command.
- DIV3: When an event occurs on Divider Tool 3 or on execution of the StartCycle command.
- DIV4: When an event occurs on Divider Tool 4 or on execution of the StartCycle command.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1 or on execution of the StartCycle command.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2 or on execution of the StartCycle command.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1 or on execution of the StartCycle command.
- DEL2_2: When an event occurs on Delay Tool 2 Output 2 or on execution of the StartCycle command.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1 or on execution of the StartCycle command.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2 or on execution of the StartCycle command.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1 or on execution of the StartCycle command.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2 or on execution of the StartCycle command.
- EIN1: When an event occurs on Event Input Tool 1 or on execution of the StartCycle command.
- EIN2: When an event occurs on Event Input Tool 2 or on execution of the StartCycle command.
- UserEvent1: When an event occurs on User Event 1 or on execution of the StartCycle command.
- UserEvent2: When an event occurs on User Event 2 or on execution of the StartCycle command.
- UserEvent3: When an event occurs on User Event 3 or on execution of the StartCycle command.
- UserEvent4: When an event occurs on User Event 4 or on execution of the StartCycle command.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StartCycle command.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StartCycle command.

- C2C3: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StartCycle command.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StartCycle command.
- DLT2: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StartCycle command.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StartCycle command.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StartCycle command.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StartCycle command.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StartCycle command.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StartCycle command.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StartCycle command.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StartCycle command.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StartCycle command.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StartCycle command.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StartCycle command.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StartCycle command.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StartCycle command.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StartCycle command.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StartCycle command.

StartCycle

Feature Info

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

Description

Starts a camera cycle.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

> NOTE
> was named CycleSoftwareTrigger in Coaxlink driver versions prior to 4.1.

CycleMaxPendingTriggerCount

Feature Info

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

Value Info

Minimum value: 0

Maximum value: 7

Description

The Camera and Illumination Controller is fitted with a trigger latching mechanism capable of recording triggers that cannot be served immediately and postponing their execution.

This feature determines the capacity of the latch :

- When 0, the trigger latch mechanism is disabled. Any cycle trigger that cannot be served immediately is rejected and increments CycleLostTriggerCount.
- When set to any value ranging from 1 to 7, the trigger latch mechanism is enabled. Providing that CyclePendingTriggerCount is below CycleMaxPendingTriggerCount, any cycle trigger that cannot be served immediately is latched and increments CyclePendingTriggerCount.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

Default value: 0 (Disabled)

CyclePendingTriggerCount

Feature Info

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

Register Port: DevicePort

Description

Returns the count of pending CIC cycle trigger events.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

CycleLostTriggerCount

Feature Info

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

Register Port: DevicePort

Description

Returns the count of lost CIC cycle trigger events.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

Value range: from 0 up to 4,294,967,295.

CycleLostTriggerCountReset

Feature Info

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

Description

Resets the count of lost CIC cycle trigger events.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

3.10. SequenceControl Category

StartOfSequenceTriggerSource

Feature Info

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

Description

Sets/gets the start-of-sequence trigger conditions and selects a hardware or software trigger source.

- When set to Immediate, the sequence starts immediately.
- When set to StartSequence, the sequence starts only on execution of the StartSequence command.
- When set to <any-event-source>, the sequence starts on the next occurrence of an event on the specified event source or on execution of the StartSequence command. Possible event sources include any available LIN*, QDC*, MDV*, DIV*, DEL*, EIN*, User Event* event source.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

Enumeration Values

- Immediate: Immediate.
- StartSequence: StartSequence command.
- LIN1: When an event occurs on Line Input Tool 1 or on execution of the StartSequence command.
- LIN2: When an event occurs on Line Input Tool 2 or on execution of the StartSequence command.
- LIN3: When an event occurs on Line Input Tool 3 or on execution of the StartSequence command.
- LIN4: When an event occurs on Line Input Tool 4 or on execution of the StartSequence command.
- LIN5: When an event occurs on Line Input Tool 5 or on execution of the StartSequence command.
- LIN6: When an event occurs on Line Input Tool 6 or on execution of the StartSequence command.
- LIN7: When an event occurs on Line Input Tool 7 or on execution of the StartSequence command.
- LIN8: When an event occurs on Line Input Tool 8 or on execution of the StartSequence command.
- QDC1: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StartSequence command.

- QDC2: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StartSequence command.
- QDC3: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StartSequence command.
- QDC4: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StartSequence command.
- MDV1: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StartSequence command.
- MDV2: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StartSequence command.
- MDV3: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StartSequence command.
- MDV4: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StartSequence command.
- DIV1: When an event occurs on Divider Tool 1 or on execution of the StartSequence command.
- DIV2: When an event occurs on Divider Tool 2 or on execution of the StartSequence command.
- DIV3: When an event occurs on Divider Tool 3 or on execution of the StartSequence command.
- DIV4: When an event occurs on Divider Tool 4 or on execution of the StartSequence command.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1 or on execution of the StartSequence command.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2 or on execution of the StartSequence command.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1 or on execution of the StartSequence command.
- DEL2_2: When an event occurs on Delay Tool 2 Output 2 or on execution of the StartSequence command.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1 or on execution of the StartSequence command.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2 or on execution of the StartSequence command.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1 or on execution of the StartSequence command.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2 or on execution of the StartSequence command.
- EIN1: When an event occurs on Event Input Tool 1 or on execution of the StartSequence command.
- EIN2: When an event occurs on Event Input Tool 2 or on execution of the StartSequence command.

- UserEvent1: When an event occurs on User Event 1 or on execution of the StartSequence command.
- UserEvent2: When an event occurs on User Event 2 or on execution of the StartSequence command.
- UserEvent3: When an event occurs on User Event 3 or on execution of the StartSequence command.
- UserEvent4: When an event occurs on User Event 4 or on execution of the StartSequence command.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StartSequence command.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StartSequence command.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StartSequence command.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StartSequence command.
- DLT2: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StartSequence command.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StartSequence command.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StartSequence command.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StartSequence command.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StartSequence command.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StartSequence command.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StartSequence command.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StartSequence command.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StartSequence command.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StartSequence command.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StartSequence command.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StartSequence command.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StartSequence command.

- DLT15: When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StartSequence command.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StartSequence command.

EndOfSequenceTriggerSource

Feature Info

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

Description

Sets/gets the end-of-sequence trigger conditions and selects a hardware or software trigger source.

- When set to SequenceLength, the sequence stops automatically after having executed a number of camera cycles specified by SequenceLength. The sequence can be stopped anticipatively on execution of the StopSequence command.
- When set to StopSequence, the sequence stops only on execution of the StopSequence command.
- When set to <any-event-source>, the sequence stops on the next occurrence of an event on the specified event source or on execution of the StopSequence command. Possible event sources include any available LIN*, QDC*, MDV*, DIV*, DEL*, EIN*, User Event* event source.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

Enumeration Values

- SequenceLength: SequenceLength.
- StopSequence: StopSequence command.
- LIN1: When an event occurs on Line Input Tool 1 or on execution of the StopSequence command.
- LIN2: When an event occurs on Line Input Tool 2 or on execution of the StopSequence command.
- LIN3: When an event occurs on Line Input Tool 3 or on execution of the StopSequence command.
- LIN4: When an event occurs on Line Input Tool 4 or on execution of the StopSequence command.
- LIN5: When an event occurs on Line Input Tool 5 or on execution of the StopSequence command.
- LIN6: When an event occurs on Line Input Tool 6 or on execution of the StopSequence command.
- LIN7: When an event occurs on Line Input Tool 7 or on execution of the StopSequence command.
- LIN8: When an event occurs on Line Input Tool 8 or on execution of the StopSequence command.

- QDC1: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StopSequence command.
- QDC2: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StopSequence command.
- QDC3: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StopSequence command.
- QDC4: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StopSequence command.
- MDV1: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StopSequence command.
- MDV2: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StopSequence command.
- MDV3: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StopSequence command.
- MDV4: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StopSequence command.
- DIV1: When an event occurs on Divider Tool 1 or on execution of the StopSequence command.
- DIV2: When an event occurs on Divider Tool 2 or on execution of the StopSequence command.
- DIV3: When an event occurs on Divider Tool 3 or on execution of the StopSequence command.
- DIV4: When an event occurs on Divider Tool 4 or on execution of the StopSequence command.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1 or on execution of the StopSequence command.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2 or on execution of the StopSequence command.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1 or on execution of the StopSequence command.
- DEL2_2: When an event occurs on Delay Tool 2 Output 2 or on execution of the StopSequence command.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1 or on execution of the StopSequence command.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2 or on execution of the StopSequence command.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1 or on execution of the StopSequence command.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2 or on execution of the StopSequence command.
- EIN1: When an event occurs on Event Input Tool 1 or on execution of the StopSequence command.

- EIN2: When an event occurs on Event Input Tool 2 or on execution of the StopSequence command.
- UserEvent1: When an event occurs on User Event 1 or on execution of the StopSequence command.
- UserEvent2: When an event occurs on User Event 2 or on execution of the StopSequence command.
- UserEvent3: When an event occurs on User Event 3 or on execution of the StopSequence command.
- UserEvent4: When an event occurs on User Event 4 or on execution of the StopSequence command.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StopSequence command.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StopSequence command.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StopSequence command.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StopSequence command.
- DLT2: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StopSequence command.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StopSequence command.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StopSequence command.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StopSequence command.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StopSequence command.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StopSequence command.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StopSequence command.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StopSequence command.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StopSequence command.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StopSequence command.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StopSequence command.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StopSequence command.

- DLT14: When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StopSequence command.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StopSequence command.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StopSequence command.

SequenceLength

Feature Info

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

Value Info

Minimum value: 1

Maximum value: 16777215

Short Description

Sequence Length.

StartSequence

Feature Info

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

Description

Starts a CIC sequence.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG) and StartOfSequenceTriggerSource is not set to Immediate.

StopSequence

Feature Info

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

Description

Stops a CIC sequence.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG).

AbortSequence

Feature Info

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

Description

Abort a CIC sequence.

Applies only when the CIC is used (i.e., when CameraControlMethod is RC or RG) and StartOfSequenceTriggerSource is not set to Immediate.

3.11. 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 980
- "EventNotificationContext1" on page 981
- "EventNotificationContext2" on page 985
- "EventNotificationContext3" on page 989
- "EventCount" on page 993
- "EventCountReset" on page 994

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.
- CxpTriggerAck: Received acknowledgement for previous CXP trigger message.
- CxpTriggerResend: Resent CXP trigger message (acknowledgement to previous CXP trigger message not received).
- Trigger: CIC trigger.
- LinkTrigger: LinkTrigger<N> received from CoaXPress device.
- StreamPacketSizeError: Stream packet size error.
- StreamPacketFifoOverflow: Stream packet FIFO overflow.
- CameraTriggerOverrun: New trigger sent to remote device even though readout of previous frame has not started yet.

- DidNotReceiveTriggerAck: Trigger ignored because ACK to previous trigger has not been received yet.
- TriggerPacketRetryError: Trigger packet resend not successful.
- InputStreamFifoHalfFull: Input stream FIFO half full.
- InputStreamFifoFull: Input stream FIFO full.
- ImageHeaderError: Image header error.
- MigAxiWriteError: MIG AXI write error.
- MigAxiReadError: MIG AXI read error.
- PacketWithUnexpectedTag: Received a CXP packet with unexpected tag.
- 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.
- StreamPacketArbiterError: Stream packet arbiter error.

EventNotification

Feature Info

Module	Category Path	Type	Access
Device	Root → EventControl	Boolean	RW

Description

Activate or deactivate the notification to the host application of the occurrence of the selected event.

When true, activate the notification.

When false, deactivate the notification.

Default value: False.

EventNotificationContext1

Feature Info

Module	Category Path	Type	Access
Device	Root → EventControl	Enumeration	RW

Short Description

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_1.

Enumeration Values

- EventSpecific: Event-specific context information.
- LineStatusAll: Low 32-bit part of LineStatusAll.
- LineStatusAllHi: High 32-bit part of LineStatusAll.
- QDC1Position: Position of Quadrature Decoder Tool 1.
- QDC2Position: Position of Quadrature Decoder Tool 2.
- QDC3Position: Position of Quadrature Decoder Tool 3.
- QDC4Position: Position of Quadrature Decoder Tool 4.
- PendingCicTriggerCount: Number of currently pending CIC triggers.
- LIN1EventCount: Number of LIN1 events.
- LIN2EventCount: Number of LIN2 events.
- LIN3EventCount: Number of LIN3 events.
- LIN4EventCount: Number of LIN4 events.
- LIN5EventCount: Number of LIN5 events.
- LIN6EventCount: Number of LIN6 events.
- LIN7EventCount: Number of LIN7 events.
- LIN8EventCount: Number of LIN8 events.
- QDC1EventCount: Number of QDC1 events.
- QDC1DirEventCount: Number of QDC1Dir events.
- QDC2EventCount: Number of QDC2 events.
- QDC2DirEventCount: Number of QDC2Dir events.
- QDC3EventCount: Number of QDC3 events.
- QDC3DirEventCount: Number of QDC3Dir events.
- QDC4EventCount: Number of QDC4 events.
- QDC4DirEventCount: Number of QDC4Dir events.

- DIV1EventCount: Number of DIV1 events.
- DIV2EventCount: Number of DIV2 events.
- DIV3EventCount: Number of DIV3 events.
- DIV4EventCount: Number of DIV4 events.
- MDV1EventCount: Number of MDV1 events.
- MDV2EventCount: Number of MDV2 events.
- MDV3EventCount: Number of MDV3 events.
- MDV4EventCount: Number of MDV4 events.
- DEL11EventCount: Number of DEL11 events.
- DEL12EventCount: Number of DEL12 events.
- DEL21EventCount: Number of DEL21 events.
- DEL22EventCount: Number of DEL22 events.
- DEL31EventCount: Number of DEL31 events.
- DEL32EventCount: Number of DEL32 events.
- DEL41EventCount: Number of DEL41 events.
- DEL42EventCount: Number of DEL42 events.
- UserEvent1EventCount: Number of UserEvent1 events.
- UserEvent2EventCount: Number of UserEvent2 events.
- UserEvent3EventCount: Number of UserEvent3 events.
- UserEvent4EventCount: Number of UserEvent4 events.
- C2C1EventCount: Number of C2C1 events.
- C2C2EventCount: Number of C2C2 events.
- C2C3EventCount: Number of C2C3 events.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.

- DLT12EventCount: Number of DLT12 events.
- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH 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.
- CxpTriggerAckEventCount: Number of CxpTriggerAck events.
- CxpTriggerResendEventCount: Number of CxpTriggerResend events.
- TriggerEventCount: Number of Trigger events.
- LinkTriggerEventCount: Number of LinkTrigger events.
- StreamPacketSizeErrorEventCount: Number of StreamPacketSizeError events.
- StreamPacketFifoOverflowEventCount: Number of StreamPacketFifoOverflow events.
- CameraTriggerOverrunEventCount: Number of CameraTriggerOverrun events.
- DidNotReceiveTriggerAckEventCount: Number of DidNotReceiveTriggerAck events.
- TriggerPacketRetryErrorEventCount: Number of TriggerPacketRetryError events.
- InputStreamFifoHalfFullEventCount: Number of InputStreamFifoHalfFull events.
- InputStreamFifoFullEventCount: Number of InputStreamFifoFull events.
- ImageHeaderErrorEventCount: Number of ImageHeaderError events.
- MigAxiWriteErrorEventCount: Number of MigAxiWriteError events.
- MigAxiReadErrorEventCount: Number of MigAxiReadError events.
- PacketWithUnexpectedTagEventCount: Number of PacketWithUnexpectedTag events.
- FillLevelAboveIlSosRejectedEventCount: Number of FillLevelAboveIlSosRejected events.

- FillLevelAboveAfEarlyEosEventCount: Number of FillLevelAboveAfEarlyEos events.
- ExternalTriggerReqsTooCloseEventCount: Number of ExternalTriggerReqsTooClose events.
- StreamPacketArbiterErrorEventCount: Number of StreamPacketArbiterError 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.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.

- DLT12EventCount: Number of DLT12 events.
- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH 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.
- CxpTriggerAckEventCount: Number of CxpTriggerAck events.
- CxpTriggerResendEventCount: Number of CxpTriggerResend events.
- TriggerEventCount: Number of Trigger events.
- LinkTriggerEventCount: Number of LinkTrigger events.
- StreamPacketSizeErrorEventCount: Number of StreamPacketSizeError events.
- StreamPacketFifoOverflowEventCount: Number of StreamPacketFifoOverflow events.
- CameraTriggerOverrunEventCount: Number of CameraTriggerOverrun events.
- DidNotReceiveTriggerAckEventCount: Number of DidNotReceiveTriggerAck events.
- TriggerPacketRetryErrorEventCount: Number of TriggerPacketRetryError events.
- InputStreamFifoHalfFullEventCount: Number of InputStreamFifoHalfFull events.
- InputStreamFifoFullEventCount: Number of InputStreamFifoFull events.
- ImageHeaderErrorEventCount: Number of ImageHeaderError events.
- MigAxiWriteErrorEventCount: Number of MigAxiWriteError events.
- MigAxiReadErrorEventCount: Number of MigAxiReadError events.
- PacketWithUnexpectedTagEventCount: Number of PacketWithUnexpectedTag events.
- FillLevelAboveIlSosRejectedEventCount: Number of FillLevelAboveIlSosRejected events.

- FillLevelAboveAfEarlyEosEventCount: Number of FillLevelAboveAfEarlyEos events.
- ExternalTriggerReqsTooCloseEventCount: Number of ExternalTriggerReqsTooClose events.
- StreamPacketArbiterErrorEventCount: Number of StreamPacketArbiterError 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.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.

- DLT12EventCount: Number of DLT12 events.
- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH 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.
- CxpTriggerAckEventCount: Number of CxpTriggerAck events.
- CxpTriggerResendEventCount: Number of CxpTriggerResend events.
- TriggerEventCount: Number of Trigger events.
- LinkTriggerEventCount: Number of LinkTrigger events.
- StreamPacketSizeErrorEventCount: Number of StreamPacketSizeError events.
- StreamPacketFifoOverflowEventCount: Number of StreamPacketFifoOverflow events.
- CameraTriggerOverrunEventCount: Number of CameraTriggerOverrun events.
- DidNotReceiveTriggerAckEventCount: Number of DidNotReceiveTriggerAck events.
- TriggerPacketRetryErrorEventCount: Number of TriggerPacketRetryError events.
- InputStreamFifoHalfFullEventCount: Number of InputStreamFifoHalfFull events.
- InputStreamFifoFullEventCount: Number of InputStreamFifoFull events.
- ImageHeaderErrorEventCount: Number of ImageHeaderError events.
- MigAxiWriteErrorEventCount: Number of MigAxiWriteError events.
- MigAxiReadErrorEventCount: Number of MigAxiReadError events.
- PacketWithUnexpectedTagEventCount: Number of PacketWithUnexpectedTag events.
- FillLevelAboveIlSosRejectedEventCount: Number of FillLevelAboveIlSosRejected events.

- FillLevelAboveAfEarlyEosEventCount: Number of FillLevelAboveAfEarlyEos events.
- ExternalTriggerReqsTooCloseEventCount: Number of ExternalTriggerReqsTooClose events.
- StreamPacketArbiterErrorEventCount: Number of StreamPacketArbiterError 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.

3.12. Errors Category

ErrorSelector

Feature Info

Module	Category Path	Type	Access
Device	Root → Errors	Enumeration	RW

Short Description

Error Selector.

Selected Features

- "ErrorCount" on page 1000
- "ErrorCountReset" on page 1001

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.
- StreamPacketSizeError: Stream packet size error.
- StreamPacketFifoOverflow: Stream packet FIFO overflow.
- DidNotReceiveTriggerAck: Trigger ignored because ACK to previous trigger has not been received yet.
- TriggerPacketRetryError: Trigger packet resend not successful.
- InputStreamFifoHalfFull: Input stream FIFO half full.
- InputStreamFifoFull: Input stream FIFO full.
- ImageHeaderError: Image header error.
- PacketWithUnexpectedTag: Received a CXP packet with unexpected tag.
- StreamPacketArbiterError: Stream packet arbiter error.
- StreamPacketCrcError0: Stream packet CRC error on connector A.

- StreamPacketCrcError1: Stream packet CRC error on connector B.
- StreamPacketCrcError2: Stream packet CRC error on connector C.
- StreamPacketCrcError3: Stream packet CRC error on connector D.
- StreamPacketCrcError4: Stream packet CRC error on connector E.
- StreamPacketCrcError5: Stream packet CRC error on connector F.
- StreamPacketCrcError6: Stream packet CRC error on connector G.
- StreamPacketCrcError7: Stream packet CRC error on connector H.

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. Coaxlink Data Stream Module Register Description

Categorized features list of Data Streammodule version 24_04_0

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 1021

ImageFormatControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "ImageFormatControl Category" on page 1026

TransportLayerControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "TransportLayerControl Category" on page 1056

BufferHandlingControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "BufferHandlingControl Category" on page 1058

PixelProcessing

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "PixelProcessing Category" on page 1072

LineScanAcquisitionControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "LineScanAcquisitionControl Category" on page 1078

StreamControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "StreamControl Category" on page 1089

Errors

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "Errors Category" on page 1115

LUTControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "LUTControl Category" on page 1120

LinearFilter

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "LinearFilter Category" on page 1129

Threshold

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "Threshold Category" on page 1134

LaserLineExtractor

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "LaserLineExtractor Category" on page 1137

Bayer

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "Bayer Category" on page 1141

FlatFieldCorrection

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "FlatFieldCorrection Category" on page 1143

MetadataInsertion

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "MetadataInsertion Category" on page 1149

EventControl

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "EventControl Category" on page 1167

StreamStatistics

Feature Info

Module	Category Path	Type	Access
Data Stream	Root	Category	RW

Category Members

See also: "StreamStatistics Category" on page 1183

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

- CXP: This enumeration value indicates CoaXPress 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 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.

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

Description

Unpacking Mode of multi-byte pixel components.

When set to Lsb, each pixel component is unpacked to the least significant bit. Padding '0' bits are put as necessary in the most significant bits to reach the next 8-bit boundary. 16-bit data are delivered using the little-endian convention.

When set to Msb, each pixel component is unpacked to the most significant bit. Padding '0' bits are put as necessary in the least significant bits to reach the next 8-bit boundary. 16-bit data are delivered using the little-endian convention.

When set to Off, the pixel components are not unpacked. The pixel data stream is left unchanged.

Default value: Lsb.

> NOTE
> The default value was Msb for Coaxlink driver versions prior to 4.3.

Enumeration Values

- Lsb: Unpacking to lsb.
- Msb: Unpacking to msb.
- Off: No unpacking.

RedBlueSwap

Feature Info

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

Description

Red-Blue component swapping.

When true, the first (Red) and the last (Blue) color components of an RGB packed pixel are swapped before being delivered.

Wen false, the pixel component order remains unchanged.

Default value: False.

ImageScaling

Feature Info

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

Short Description

Image scaling.

Enumeration Values

- Off: No image scaling.
- Scaling_1_8: 1:8 image down-scaling.

JpegQuality

Feature Info

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

Value Info

Minimum value: 1

Maximum value: 100

Short Description

JPEG quality.

BinningMethod

Feature Info

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

Short Description

Binning method and window.

> WARNING
> This feature can only be activated or de-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

Description

Start-of-scan trigger conditions and trigger source.

Default value: Immediate.

Enumeration Values

- Immediate: Immediate.
- StartScan: StartScan command.
- LIN1: When an event occurs on Line Input Tool 1 or on execution of the StartScan command.
- LIN2: When an event occurs on Line Input Tool 2 or on execution of the StartScan command.
- LIN3: When an event occurs on Line Input Tool 3 or on execution of the StartScan command.
- LIN4: When an event occurs on Line Input Tool 4 or on execution of the StartScan command.
- LIN5: When an event occurs on Line Input Tool 5 or on execution of the StartScan command.
- LIN6: When an event occurs on Line Input Tool 6 or on execution of the StartScan command.
- LIN7: When an event occurs on Line Input Tool 7 or on execution of the StartScan command.
- LIN8: When an event occurs on Line Input Tool 8 or on execution of the StartScan command.
- QDC1: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StartScan command.
- QDC2: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StartScan command.
- QDC3: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StartScan command.
- QDC4: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StartScan command.
- MDV1: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StartScan command.
- MDV2: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StartScan command.
- MDV3: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StartScan command.

- MDV4: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StartScan command.
- DIV1: When an event occurs on Divider Tool 1 or on execution of the StartScan command.
- DIV2: When an event occurs on Divider Tool 2 or on execution of the StartScan command.
- DIV3: When an event occurs on Divider Tool 3 or on execution of the StartScan command.
- DIV4: When an event occurs on Divider Tool 4 or on execution of the StartScan command.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1 or on execution of the StartScan command.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2 or on execution of the StartScan command.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1 or on execution of the StartScan command.
- DEL2_2: When an event occurs on Delay Tool 2 Output 2 or on execution of the StartScan command.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1 or on execution of the StartScan command.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2 or on execution of the StartScan command.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1 or on execution of the StartScan command.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2 or on execution of the StartScan command.
- EIN1: When an event occurs on Event Input Tool 1 or on execution of the StartScan command.
- EIN2: When an event occurs on Event Input Tool 2 or on execution of the StartScan command.
- UserEvent1: When an event occurs on User Event 1 or on execution of the StartScan command.
- UserEvent2: When an event occurs on User Event 2 or on execution of the StartScan command.
- UserEvent3: When an event occurs on User Event 3 or on execution of the StartScan command.
- UserEvent4: When an event occurs on User Event 4 or on execution of the StartScan command.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StartScan command.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StartScan command.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StartScan command.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StartScan command.

- DLT2: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StartScan command.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StartScan command.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StartScan command.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StartScan command.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StartScan command.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StartScan command.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StartScan command.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StartScan command.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StartScan command.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StartScan command.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StartScan command.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StartScan command.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StartScan command.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StartScan command.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StartScan command.

EndOfScanTriggerSource

Feature Info

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

Description

End-of-scan trigger conditions and trigger source.

Default value: ScanLength.

Enumeration Values

- ScanLength: ScanLength.
- StopScan: StopScan command.
- LIN1: When an event occurs on Line Input Tool 1 or on execution of the StopScan command.
- LIN2: When an event occurs on Line Input Tool 2 or on execution of the StopScan command.
- LIN3: When an event occurs on Line Input Tool 3 or on execution of the StopScan command.
- LIN4: When an event occurs on Line Input Tool 4 or on execution of the StopScan command.
- LIN5: When an event occurs on Line Input Tool 5 or on execution of the StopScan command.
- LIN6: When an event occurs on Line Input Tool 6 or on execution of the StopScan command.
- LIN7: When an event occurs on Line Input Tool 7 or on execution of the StopScan command.
- LIN8: When an event occurs on Line Input Tool 8 or on execution of the StopScan command.
- QDC1: When an event occurs on Quadrature Decoder Tool 1 or on execution of the StopScan command.
- QDC2: When an event occurs on Quadrature Decoder Tool 2 or on execution of the StopScan command.
- QDC3: When an event occurs on Quadrature Decoder Tool 3 or on execution of the StopScan command.
- QDC4: When an event occurs on Quadrature Decoder Tool 4 or on execution of the StopScan command.
- MDV1: When an event occurs on Multiplier/Divider Tool 1 or on execution of the StopScan command.
- MDV2: When an event occurs on Multiplier/Divider Tool 2 or on execution of the StopScan command.
- MDV3: When an event occurs on Multiplier/Divider Tool 3 or on execution of the StopScan command.

- MDV4: When an event occurs on Multiplier/Divider Tool 4 or on execution of the StopScan command.
- DIV1: When an event occurs on Divider Tool 1 or on execution of the StopScan command.
- DIV2: When an event occurs on Divider Tool 2 or on execution of the StopScan command.
- DIV3: When an event occurs on Divider Tool 3 or on execution of the StopScan command.
- DIV4: When an event occurs on Divider Tool 4 or on execution of the StopScan command.
- DEL1_1: When an event occurs on Delay Tool 1 Output 1 or on execution of the StopScan command.
- DEL1_2: When an event occurs on Delay Tool 1 Output 2 or on execution of the StopScan command.
- DEL2_1: When an event occurs on Delay Tool 2 Output 1 or on execution of the StopScan command.
- DEL2_2: When an event occurs on Delay Tool 2 Output 2 or on execution of the StopScan command.
- DEL3_1: When an event occurs on Delay Tool 3 Output 1 or on execution of the StopScan command.
- DEL3_2: When an event occurs on Delay Tool 3 Output 2 or on execution of the StopScan command.
- DEL4_1: When an event occurs on Delay Tool 4 Output 1 or on execution of the StopScan command.
- DEL4_2: When an event occurs on Delay Tool 4 Output 2 or on execution of the StopScan command.
- EIN1: When an event occurs on Event Input Tool 1 or on execution of the StopScan command.
- EIN2: When an event occurs on Event Input Tool 2 or on execution of the StopScan command.
- UserEvent1: When an event occurs on User Event 1 or on execution of the StopScan command.
- UserEvent2: When an event occurs on User Event 2 or on execution of the StopScan command.
- UserEvent3: When an event occurs on User Event 3 or on execution of the StopScan command.
- UserEvent4: When an event occurs on User Event 4 or on execution of the StopScan command.
- C2C1: When an event occurs on C2C-Link Synchronization Tool 1 or on execution of the StopScan command.
- C2C2: When an event occurs on C2C-Link Synchronization Tool 2 or on execution of the StopScan command.
- C2C3: When an event occurs on C2C-Link Synchronization Tool 3 or on execution of the StopScan command.
- DLT1: When an event occurs on DeviceLinkTrigger Tool 1 or on execution of the StopScan command.

- DLT2: When an event occurs on DeviceLinkTrigger Tool 2 or on execution of the StopScan command.
- DLT3: When an event occurs on DeviceLinkTrigger Tool 3 or on execution of the StopScan command.
- DLT4: When an event occurs on DeviceLinkTrigger Tool 4 or on execution of the StopScan command.
- DLT5: When an event occurs on DeviceLinkTrigger Tool 5 or on execution of the StopScan command.
- DLT6: When an event occurs on DeviceLinkTrigger Tool 6 or on execution of the StopScan command.
- DLT7: When an event occurs on DeviceLinkTrigger Tool 7 or on execution of the StopScan command.
- DLT8: When an event occurs on DeviceLinkTrigger Tool 8 or on execution of the StopScan command.
- DLT9: When an event occurs on DeviceLinkTrigger Tool 9 or on execution of the StopScan command.
- DLT10: When an event occurs on DeviceLinkTrigger Tool 10 or on execution of the StopScan command.
- DLT11: When an event occurs on DeviceLinkTrigger Tool 11 or on execution of the StopScan command.
- DLT12: When an event occurs on DeviceLinkTrigger Tool 12 or on execution of the StopScan command.
- DLT13: When an event occurs on DeviceLinkTrigger Tool 13 or on execution of the StopScan command.
- DLT14: When an event occurs on DeviceLinkTrigger Tool 14 or on execution of the StopScan command.
- DLT15: When an event occurs on DeviceLinkTrigger Tool 15 or on execution of the StopScan command.
- DLT16: When an event occurs on DeviceLinkTrigger Tool 16 or on execution of the StopScan command.

ScanLength

Feature Info

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

Value Info

Minimum value: 1

Maximum value: 16777215

Unit: lines

Default value: 512

Description

Sets/gets the number of captured lines before stopping the scanning.

NOTE
Applies only when EndOfScanTriggerSource = ScanLength.

BufferHeight

Feature Info

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

Value Info

Unit: lines

Short Description

Height of the image in line-scan mode. This feature is only used in line-scan acquisition scenarios to compute PayloadSize

StartScan

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Command	Imposed: WO

Short Description

Starts a scan.

StopScan

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → LineScanAcquisitionControl	Command	Imposed: WO

Short Description

Stops a scan.

4.8. StreamControl Category

StreamReset

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

See also: "MultiTapControl Category" on page 1107

SyncMarker

Feature Info

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

Category Members

See also: "SyncMarker Category" on page 1111

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 1118
- "ErrorCountReset" on page 1119

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.
- StreamPacketSizeError: Stream packet size error.
- StreamPacketFifoOverflow: Stream packet FIFO overflow.
- DidNotReceiveTriggerAck: Trigger ignored because ACK to previous trigger has not been received yet.
- TriggerPacketRetryError: Trigger packet resend not successful.
- InputStreamFifoHalfFull: Input stream FIFO half full.
- InputStreamFifoFull: Input stream FIFO full.
- ImageHeaderError: Image header error.
- PacketWithUnexpectedTag: Received a CXP packet with unexpected tag.
- StreamPacketArbiterError: Stream packet arbiter error.
- StreamPacketCrcError0: Stream packet CRC error on connector A.

- StreamPacketCrcError1: Stream packet CRC error on connector B.
- StreamPacketCrcError2: Stream packet CRC error on connector C.
- StreamPacketCrcError3: Stream packet CRC error on connector D.
- StreamPacketCrcError4: Stream packet CRC error on connector E.
- StreamPacketCrcError5: Stream packet CRC error on connector F.
- StreamPacketCrcError6: Stream packet CRC error on connector G.
- StreamPacketCrcError7: Stream packet CRC error on connector H.

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.

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 1126

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 1126

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 1157

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 1159
- "GeneralPurposeCounterIncrementSource" on page 1160
- "GeneralPurposeCounterDecrementSource" on page 1163
- "GeneralPurposeCounterLatchAndResetSource" on page 1165

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.

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:

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 1169
- "EventNotificationContext1" on page 1170
- "EventNotificationContext2" on page 1173
- "EventNotificationContext3" on page 1176
- "EventCount" on page 1179
- "EventCountReset" on page 1180

Enumeration Values

- StartOfCameraReadout: Starts acquiring data of a new image frame (area-scan only).
- EndOfCameraReadout: Stops acquiring data of an image frame (area-scan only).
- StartOfScan: Starts acquiring data of a new image scan (line-scan only).
- EndOfScan: Stops acquiring data of an image scan (line-scan only).
- RejectedFrame: Dropped image frame data (area-scan only).
- RejectedScan: Dropped image scan data (line-scan only).
- TriggerToCameraReadoutTimeout: Trigger to camera readout timeout.
- CameraReadoutTimeout: Camera readout timeout.
- BrokenFrame: Broken frame due to frame store overflow (area-scan only).

EventNotification

Feature Info

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

Description

Activate or deactivate the notification to the host application of the occurrence of the selected event.

Default value: True.

EventNotificationContext1

Feature Info

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

Description

Select context information reported in EVENT_DATA_CUSTOM_CONTEXT_1 (context information value is latched when the event occurs).

Default value: EventSpecific.

Enumeration Values

- EventSpecific: Event-specific context information.
- LineStatusAll: Low 32-bit part of LineStatusAll.
- LineStatusAllHi: High 32-bit part of LineStatusAll.
- QDC1Position: Position of Quadrature Decoder Tool 1.
- QDC2Position: Position of Quadrature Decoder Tool 2.
- QDC3Position: Position of Quadrature Decoder Tool 3.
- QDC4Position: Position of Quadrature Decoder Tool 4.
- PendingCicTriggerCount: Number of currently pending CIC triggers.
- LIN1EventCount: Number of LIN1 events.
- LIN2EventCount: Number of LIN2 events.
- LIN3EventCount: Number of LIN3 events.
- LIN4EventCount: Number of LIN4 events.
- LIN5EventCount: Number of LIN5 events.
- LIN6EventCount: Number of LIN6 events.
- LIN7EventCount: Number of LIN7 events.
- LIN8EventCount: Number of LIN8 events.
- QDC1EventCount: Number of QDC1 events.
- QDC1DirEventCount: Number of QDC1Dir events.
- QDC2EventCount: Number of QDC2 events.
- QDC2DirEventCount: Number of QDC2Dir events.
- QDC3EventCount: Number of QDC3 events.
- QDC3DirEventCount: Number of QDC3Dir events.

- QDC4EventCount: Number of QDC4 events.
- QDC4DirEventCount: Number of QDC4Dir events.
- DIV1EventCount: Number of DIV1 events.
- DIV2EventCount: Number of DIV2 events.
- DIV3EventCount: Number of DIV3 events.
- DIV4EventCount: Number of DIV4 events.
- MDV1EventCount: Number of MDV1 events.
- MDV2EventCount: Number of MDV2 events.
- MDV3EventCount: Number of MDV3 events.
- MDV4EventCount: Number of MDV4 events.
- DEL11EventCount: Number of DEL11 events.
- DEL12EventCount: Number of DEL12 events.
- DEL21EventCount: Number of DEL21 events.
- DEL22EventCount: Number of DEL22 events.
- DEL31EventCount: Number of DEL31 events.
- DEL32EventCount: Number of DEL32 events.
- DEL41EventCount: Number of DEL41 events.
- DEL42EventCount: Number of DEL42 events.
- UserEvent1EventCount: Number of UserEvent1 events.
- UserEvent2EventCount: Number of UserEvent2 events.
- UserEvent3EventCount: Number of UserEvent3 events.
- UserEvent4EventCount: Number of UserEvent4 events.
- C2C1EventCount: Number of C2C1 events.
- C2C2EventCount: Number of C2C2 events.
- C2C3EventCount: Number of C2C3 events.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.

- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.
- DLT12EventCount: Number of DLT12 events.
- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH 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.
- CxpTriggerAckEventCount: Number of CxpTriggerAck events.
- CxpTriggerResendEventCount: Number of CxpTriggerResend events.
- TriggerEventCount: Number of Trigger events.
- LinkTriggerEventCount: Number of LinkTrigger 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.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.

- DLT12EventCount: Number of DLT12 events.
- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH 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.
- CxpTriggerAckEventCount: Number of CxpTriggerAck events.
- CxpTriggerResendEventCount: Number of CxpTriggerResend events.
- TriggerEventCount: Number of Trigger events.
- LinkTriggerEventCount: Number of LinkTrigger 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.
- EIN1EventCount: Number of EIN1 events.
- EIN2EventCount: Number of EIN2 events.
- DLT1EventCount: Number of DLT1 events.
- DLT2EventCount: Number of DLT2 events.
- DLT3EventCount: Number of DLT3 events.
- DLT4EventCount: Number of DLT4 events.
- DLT5EventCount: Number of DLT5 events.
- DLT6EventCount: Number of DLT6 events.
- DLT7EventCount: Number of DLT7 events.
- DLT8EventCount: Number of DLT8 events.
- DLT9EventCount: Number of DLT9 events.
- DLT10EventCount: Number of DLT10 events.
- DLT11EventCount: Number of DLT11 events.

- DLT12EventCount: Number of DLT12 events.
- DLT13EventCount: Number of DLT13 events.
- DLT14EventCount: Number of DLT14 events.
- DLT15EventCount: Number of DLT15 events.
- DLT16EventCount: Number of DLT16 events.
- CrcErrorCxpAEventCount: Number of CrcErrorCxpA events.
- CrcErrorCxpBEventCount: Number of CrcErrorCxpB events.
- CrcErrorCxpCEventCount: Number of CrcErrorCxpC events.
- CrcErrorCxpDEventCount: Number of CrcErrorCxpD events.
- CrcErrorCxpEEventCount: Number of CrcErrorCxpE events.
- CrcErrorCxpFEventCount: Number of CrcErrorCxpF events.
- CrcErrorCxpGEventCount: Number of CrcErrorCxpG events.
- CrcErrorCxpHEventCount: Number of CrcErrorCxpH 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.
- CxpTriggerAckEventCount: Number of CxpTriggerAck events.
- CxpTriggerResendEventCount: Number of CxpTriggerResend events.
- TriggerEventCount: Number of Trigger events.
- LinkTriggerEventCount: Number of LinkTrigger events.
- StartOfCameraReadoutEventCount: Number of StartOfCameraReadout events.
- EndOfCameraReadoutEventCount: Number of EndOfCameraReadout events.
- StartOfScanEventCount: Number of StartOfScan events.
- EndOfScanEventCount: Number of EndOfScan events.
- RejectedFrameEventCount: Number of RejectedFrame events.
- RejectedScanEventCount: Number of RejectedScan events.
- TriggerToCameraReadoutTimeoutEventCount: Number of TriggerToCameraReadoutTimeout events.
- CameraReadoutTimeoutEventCount: Number of CameraReadoutTimeout events.
- BrokenFrameEventCount: Number of BrokenFrame events.

EventCount

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → EventControl	IntReg	RO

Register Port: StreamPort

Short Description

Number of occurrences of the selected event (32-bit counter).

EventCountReset

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Command	Imposed: WO

Short Description

Reset the selected EventCount.

EventNotificationAll

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Boolean	Imposed: WO

Short Description

Activate or deactivate the notification of all events.

EventCountResetAll

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → EventControl	Command	Imposed: WO

Short Description

Reset all EventCount.

4.21. StreamStatistics Category

StatisticsSamplingSelector

Feature Info

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

Description

Selects the stream statistics sampling method.

Default value: LastSecond.

Selected Features

- "StatisticsFrameRate" on page 1185
- "StatisticsLineRate" on page 1186
- "StatisticsDataRate" on page 1187

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)

Description

Average frame delivery rate using the selected sampling method.

NOTE
This feature is only available for area-scan firmware variants.

NOTE
The statistics measures the frame rate at the level of the PCI Express interface, NOT at the level of the CoaXPress interface!

StatisticsLineRate

Feature Info

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

Register Port: StreamPort

Value Info

Unit: Lps (Lines per second)

Description

Average line delivery rate using the selected sampling method.

> NOTE
> This feature is only available for line-scan firmware variants.

> NOTE
> The statistics measures the line rate at the level of the PCI Express interface, NOT at the level of the CoaXPress interface!

StatisticsDataRate

Feature Info

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

Register Port: StreamPort

Value Info

Unit: MBps (Megabytes per second)

Short Description

Get the average PCI data delivery rate using the selected sampling method.

StatisticsStartSampling

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	Command	Imposed: WO

Short Description

Start sampling the stream data. Applies only when StatisticsSamplingSelector = Custom.

StatisticsStopSampling

Feature Info

Module	Category Path	Type	Access
Data Stream	Root → StreamStatistics	Command	Imposed: WO

Short Description

Stop sampling the stream data. Applies only when StatisticsSamplingSelector = Custom.