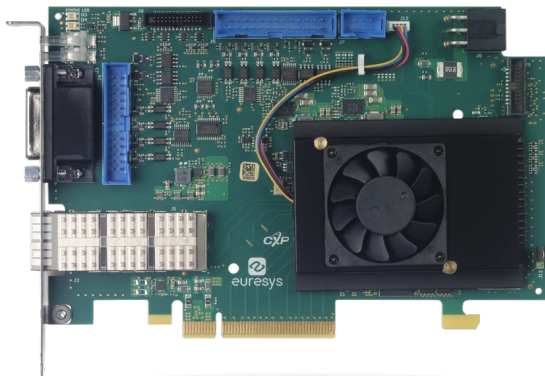


5/15/2024

## Datasheet

# Coaxlink QSFP+

Four-connection CoaXPress-over-Fiber frame grabber



- One QSFP+ port compliant with **40 Gbps optical modules**
- **5,000 MB/s** camera bandwidth
- PCIe 3.0 (Gen 3) x8 bus: **6,700 MB/s** bus bandwidth
- Feature-rich set of **20 digital I/O lines**
- **Extensive camera control functions**
- **Memento Event Logging Tool**
- Compatible with **CustomLogic**: Your own FPGA logic

# Main benefits

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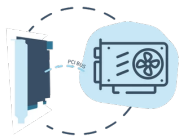
## Acquire images from the fastest and highest resolution cameras

- Highest data acquisition rate in the industry
  - Up to 5,000 MB/s bandwidth from camera to host PC memory
- 



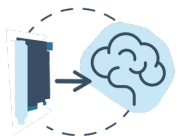
## PCIe 3.0 (Gen 3) x8 bus

- 7,800 MB/s peak bus bandwidth
  - 6,700 MB/s sustained bus bandwidth
- 



## Direct GPU transfer

- Sample programs for AMD DirectGMA and NVIDIA (CUDA) available.
  - Direct GPU transfer eliminates unnecessary system memory copies, lowers CPU overhead, and reduces latency, resulting in significant performance improvements in data transfer times for applications.
  - Direct capture of image data to GPU memory is available using AMD's DirectGMA. Compatible with AMD FirePro W5x00 and above and all AMD FirePro S series products.
- 



## High-performance DMA (Direct Memory Access)

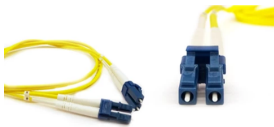
- Direct transfer into user-allocated memory
- Hardware scatter-gather support



## 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 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 or single-mode fiber.



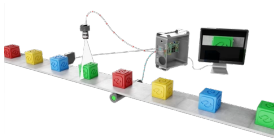
## What is the maximum cable length with single-mode fibers?

With a standard 40GBASE-ER4 QSFP+ LC DOM Optical Transceiver Module and an LC-Duplex single-mode fiber cable, the maximum cable length is 40 kilometers. This solution is suitable, for example, for video transmission applications.



## What is the maximum cable length with multi-mode fibers?

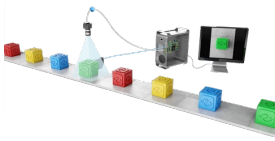
With a standard 40GBASE-SR4 QSFP+ Optical Transceiver Module and an MTP/MPO multi-mode fiber cable, the maximum cable length is 150 meters. This solution is suitable for machine vision applications.



## Line-scan triggering capabilities

Euresys' frame grabbers offer many capabilities to synchronize line-scan or 1D cameras, sensors and lighting controllers. Frame grabbers can control the camera scanning rate based on the signals received from a motion encoder.

They support continuous web scanning (to inspect infinite, continuously moving surfaces without losing a single line) and discrete object scanning (to acquire the image of objects moving in front of the camera).



## Area-scan triggering capabilities

Euresys' frame grabbers offer many capabilities to synchronize area-scan or 2D cameras, sensors and lighting controllers, for stationery or moving objects in the field of view, or moving cameras.



## C2C-Link camera synchronization

Allows to accurately synchronize multiple area-scan or line-scan cameras connected

- to the same card
- to different cards in the same PC
- to different cards in different PCs



## Compatible with eGrabber

- eGrabber Studio: eGrabber's new interactive evaluation and demonstration application
- GenICam Browser: An application giving access to the GenICam features exposed by the GenTL Producer(s)
- GenTL Console: A command-line tool giving access to the functions and commands exposed by the Euresys GenTL Producer

**ARM**   **macOS**



## Windows, Linux and macOS drivers available

Including support for Intel 64-bit platforms as well as ARM 64-bit platforms.

# Other benefits

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## What are the benefits of using CoaXPress-over-Fiber for my application?

- Available as CXP to nGMII (device) or nGMII to CXP (host) Bridge IP Cores
  - Ultra-high data/frame rates
  - Many accessory and cabling options to cover any length requirement
  - Low CPU overhead, low latency, low jitter image acquisition
  - Highest camera count per PC performance
  - Very competitive cost/performance ratio
  - Wide industry acceptance due to J11A standardization
- 

## Flexible line-scan camera operation with the rate converter

- The rate converter is a smart, programmable frequency multiplier/divider.
  - Used with motion encoders and line-scan cameras, it allows the user to choose the aspect ratio of the pixels in the image.
  - It provides a way to calibrate the acquisition chain to easily reach square (1:1 aspect ratio) pixels.
- 

## Line-scan Metadata insertion

When activated, this feature records metadata beside image data. Line metadata are captured every acquired image line. Buffer metadata are only captured when the first image line of a buffer is acquired. The metadata are composed with a configurable set of general purpose event counters, quadrature encoder position counters and/or I/O line status. This feature allows line-scan applications to correlate image data with system events including motion encoder positions.

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## 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 and in 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.

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## 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.

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## CustomLogic: Your own FPGA logic

- [CustomLogic](#) is an FPGA design kit enabling the design and upload of FPGA code to a Coaxlink board
- It is compatible with the [Coaxlink Octo](#), [Coaxlink Quad CXP-12](#) and [Coaxlink QSFP+](#) for which up to 70% of their [AMD Kintex Ultrascale XCKU035](#) FPGA resources are available.
- The design phase uses the [Xilinx Vivado](#) development tools (not provided)
- Using [CustomLogic](#) does not require any additional hardware

# Specifications

## Mechanical

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### Form factor

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PCI Express card

### Format

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Standard profile, half length, 8-lane PCI Express card

### Cooling method

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Air cooling, fan-cooled heatsink

### Mounting

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For insertion in a standard height, 8-lane or higher, PCI Express card slot

### Connectors

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#### 'QSFP+' on card bracket:

Enhanced Quad Small Form-factor Pluggable port  
CoaXPress-over-Fiber Host Interface

#### 'EXTERNAL I/O' on card bracket:

26-pin 3-row high-density D-Sub female socket with UNC4-40 jack socket screws  
I/O lines and I/O power output

#### 'INTERNAL I/O 1' on printed circuit board:

26-pin 2-row 0.1" pitch pin header with shrouding  
I/O lines and I/O power output

#### 'INTERNAL I/O 2' on printed circuit board:

26-pin 2-row 0.1" pitch pin header with shrouding  
I/O lines and I/O power output

#### 'I/O EXTENSION' on printed circuit board:

26-pin 2-row 0.05" pitch pin header with shrouding  
I/O extension cable socket

#### 'C2C-LINK' on printed circuit board:

6-pin 2-row 0.1" pitch pin header with shrouding  
Card-to-card link

#### 'AUXILIARY POWER INPUT' on printed circuit board:

6-pin PEG power socket  
12 V DC power input for I/O power output

## LED indicators

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### 'A', 'B', 'C', 'D' on bracket:

Bi-color red/green LEDs

CoaXPress Host connector indicator

### 'FPGA STATUS LAMP' on PCB:

Bi-color red/green LED

FPGA status indicator

### 'BOARD STATUS LAMP' on PCB:

Bi-color red/green LED

Board status indicator

## Switches

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### 'RECOVERY' on PCB:

3-pin 1-row 0.1" header or 2-way DIP switch

Firmware emergency recovery

## Dimensions

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PCB L x H: 167.65 mm x 111.15 mm [6.6 in x 4.38 in]

## Weight

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Net weight: 178 g [6.3 oz]

Gross weight: 283 g [10 oz]

## Host bus

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### Standard

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PCI Express 3.0

### Link width

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8 lanes

1 lane, 2 lanes or 4 lanes with reduced performance

### Link speed

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8.0 GT/s (PCIe 3.0)

5.0 GT/s (PCIe 2.0) with reduced performance

### Maximum payload size

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512 bytes

### DMA

---

32- and 64-bit



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## Peak delivery bandwidth

7,800 MB/s

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## Effective (sustained) delivery bandwidth

6,700 MB/s (Host PC motherboard dependent)

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## Power consumption

Typ. 16.5 W ( 3.0 W @ +3.3V, 12.5 W @ +12V), excluding I/O power output and optical transceiver module

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# Camera / video inputs

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## Camera interface standard

CoaXPress

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## Interface standard(s)

CoaXPress 1.0, 1.1, 1.1.1, 2.0, 2.1, CoaXPress-over-Fiber Bridge Protocol 1.1

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## Maximum link speed

CXP-12

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## Maximum link width

4 connections

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## Connectors

Enhanced Quad Small Form-factor Pluggable (QSFP+) port

Compliant with SFF-8436 (4 x 10 Gbps Pluggable Transceiver) specification

Compliant with CoaXPress-over-Fiber

Available power for the module: 3.5 W (SFF-8436 Power Level 4)

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## Status LEDs

One CoaXPress Host connection status LED per connection

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## Number of cameras

### Area-scan cameras:

One 1- or 2- or 4-connection camera

Four 1-connection cameras

### Line-scan cameras:

One 1- or 2- or 4-connection camera

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## Maximum number of cameras

4

## Line-scan cameras supported

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Yes

## Maximum aggregated camera data transfer rate

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5,000 MB/s

## Supported CXP down-connection speeds

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10 Gbps (CXP-12)

## Supported CXP up-connection speeds

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Low-speed 20.83... Mbps (Device discovery)

Low-speed 41.66... Mbps (CXP-12)

## Number of CXP data streams (per camera)

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1 data stream per camera

## Maximum CXP stream packet size

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16,384 bytes

## Camera types

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Area-scan cameras:

Grayscale and color (YCbCr, YUV, RGB and Bayer CFA)

Single-tap (1X-1Y) progressive-scan

Line-scan cameras and contact imaging sensors:

Grayscale and color RGB

## Camera pixel formats supported

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Mono8, Mono10, Mono12, Mono14, Mono16

BayerXX8, BayerXX10, BayerXX12, BayerXX14, BayerXX16 where XX = GR, RG, GB, or BG

RGB8, RGB10, RGB12, RGB14, RGB16

RGBA8, RGBA10, RGBA12, RGBA14, RGBA16

YCbCr601\_422\_8, YCbCr601\_422\_10

YCbCr709\_422\_8, YCbCr709\_422\_10

YUV422\_8, YUV422\_10

Raw

## Area-scan camera control

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### Trigger

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Precise control of asynchronous reset cameras, with exposure control.

Support of camera exposure/readout overlap.

Support of external hardware trigger, with optional delay and trigger decimation.

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## Strobe

Accurate control of the strobe position for strobed light sources.

Support of early and late strobe pulses.

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## Line-scan camera control

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### Scan/page trigger

Precise control of start-of-scan and end-of-scan triggers.

Support of external hardware trigger, with optional delay.

Support of infinite acquisition, without missing line, for web inspection applications.

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### Line trigger

Support for quadrature motion encoders, with programmable noise filters, selection of acquisition direction and backward motion compensation.

Rate Converter tool for fine control of the pixel aspect ratio: Rate Conversion Ratio in the range 0.001 to 1000 with an accuracy better than 0.1%.

Rate Divider tool

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### Line strobe

Accurate control of the strobe position for strobed light sources.

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## On-board processing

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### On-board memory

4 GB

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### Image data stream processing

Unpacking of 10-/12-/14-bit to 16-bit with selectable justification to LSb or MSb

Optional swap of R and B components

Little endian conversion

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### Input LUT (Lookup Table)

Monochrome 8-bit to 8-bit transformation

Monochrome 10-bit to 8-, 10- or 16-bit transformations

Monochrome 12-bit to 8-, 12- or 16-bit transformations

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### Bayer CFA to RGB decoder

'1-camera' firmware variant:

3x3 linear interpolation method

3x3 median-based interpolation method

## CustomLogic

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Yes (with specific IP license obtainable from AMD/Xilinx)

## CustomLogic firmware variants

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'1-camera, customlogic' firmware variant for one 1- or 2- or 4-connection area-scan camera

## Data stream statistics

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Measurement of:

- Frame rate (Area-scan only)
- Line rate
- Data rate

Configurable averaging interval

## Event signaling and counting

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The application software can be notified of the occurrence of various events:

- Standard event: the EVENT\_NEW\_BUFFER event notifies the application of newly filled buffers
- A large set of custom events

Custom events sources:

- I/O Toolbox events
- Camera and Illumination control events
- CoaXPress data stream events
- CoaXPress host interface events

Each custom event is associated with a 32-bit counter that counts the number of occurrences

The last three 32-bit context data words of the event context data can be configured with event-specific context data:

- Event-specific data
- State of all System I/O lines sampled at the event occurrence time
- Value of any event counter

# General Purpose Inputs and Outputs

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## Number of lines

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20 I/O lines:

- 4 differential inputs (DIN)
- 4 singled-ended TTL inputs/outputs (TTLIO)
- 8 isolated inputs (IIN)
- 4 isolated outputs (IOUT)

NOTE: The number of I/O lines can be extended using I/O modules attached to the I/O EXTENSION connector.

## Usage

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Any I/O input lines can be used by any LIN tool of the I/O Toolbox

Selected pairs of I/O input lines can be used by any QDC tool of the I/O toolbox to decode A/B signals of a motion encoder

## Electrical specifications

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DIN: High-speed differential inputs, up to 5 MHz, compatible with ANSI/EIA/TIA-422/485 differential line drivers and complementary TTL drivers

TTLIO: High-speed 5V-compliant TTL inputs or LVTTTL outputs, compatible with totem-pole LVTTTL, TTL, 5V CMOS drivers or LVTTTL, TTL, 3V CMOS receivers

IIN: 200 kHz 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

IOUT: Isolated contact outputs compatible with 30V / 100mA loads

NOTE: IIN and IOUT lines provide a functional isolation grade for the circuit technical protection. It does not provide an isolation that can protect a human being from electrical shock!

## Filter control

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Glitch removal filter available on all System I/O input lines

**Configurable filter delay:**

Custom value

Fixed values for DIN and TTLIO lines: 50 ns, 100 ns, 200 ns, 500 ns, 1  $\mu$ s

Fixed values for IIN lines: 500 ns, 1  $\mu$ s, 2  $\mu$ s, 5  $\mu$ s, 10  $\mu$ s

## Polarity control

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Yes

## Power output

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Non-isolated, +12V, 1A, with electronic fuse protection

## I/O Toolbox tools

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The I/O Toolbox is a configurable interconnection of tools that generates events (usually triggers):

Line Input tool (LIN): edge detector delivering events on rising or falling edges of any selected input line.

**Quadrature Decoder tool (QDC): a composite tool including:**

A quadrature edge detector delivering events on selected transitions of selected pairs of input lines.

An optional backward motion compensator for clean line-scan image acquisition when the motion is unstable.

A 32-bit up/down counter for delivering a position value.

Device Link Trigger tool (DLT): delivers an event on reception of a valid high-speed CoaXPress 2.0 connection trigger packet message from the remote device.

User Actions Scheduler tool (UAS): to delegate the execution of 'User Actions' at a scheduled time or encoder position. Possible user actions include setting low/high/toggle any bit of the User Output Register or generation of any User Events.

Delay tool (DEL): to delay up to 16 events from one or two I/O toolbox event sources, by a programmable time or number of motion encoder ticks (any QDC events).

Divider tool (DIV): to generate an event every nth input events from any I/O toolbox event source.

Multiplier/divider tool (MDV): to generate m events every d input events from any I/O toolbox event source.

The 'Input Tools' (LIN, QDC, DLT and UAS) can be further processed by the 'Event Tools' (DEL, DIV and MDV) to generate any of the following "trigger" events:

- The "cycle trigger" of the Camera and Illumination controller
- The "cycle sequence trigger" of the Camera and Illumination controller
- The "start-of-scan trigger" of the Acquisition Controller (line-scan only)
- The "end-of-scan trigger" of the Acquisition Controller (line-scan only)

## I/O Toolbox composition

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Determined by the selected firmware variant:

'1-camera': 8 LIN, 1 QDC, 2 DLT, 1 UAS, 2 DEL, 1 DIV, 1 MDV, 2 C2C

'1-camera, line-scan': 8 LIN, 1 QDC, 2 DLT, 1 UAS, 2 DEL, 1 DIV, 1 MDV, 3 C2C

'4-camera': 8 LIN, 4 QDC, 8 DLT, 1 UAS, 4 DEL, 4 DIV, 4 MDV, 2 C2C

## C2C-Link

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### Description

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Accurate synchronization of the trigger and the start-of-exposure of multiple grabber-controlled area-scan cameras.

Accurate synchronization of the start-of-cycle, start-of-scan and end-of-scan of multiple grabber-controlled line-scan cameras.

### Specification

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**C2C-Link synchronizes cameras connected to:**

- the same card
- to different cards in the same PC (requires an accessory cable such as the "3303 C2C-Link Ribbon Cable" or a custom-made C2C-Link cable)
- to different cards in different PCs (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)

**Maximum distance:**

- 120 cm inside a PC
- 1200 m cumulated adapter to adapter cable length

**Maximum trigger rate:**

- 2.5 MHz for configurations using a single PC, or up to 10 PCs and 100 m total C2C-Link cable length
- 200 kHz for configurations up to 32 PCs and 1200m total C2C-Link cable length

**Trigger propagation delay from master to slave devices:**

- Less than 10 ns for cameras on the same card or on different cards in the same PC
- Less than 265 ns for cameras on different cards in different PCs (3 PCs and 40m total C2C-Link cable length)

## Software

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### Driver name

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eGrabber

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## First release

eGrabber 17.0

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## Current release

eGrabber 25.05

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## Host PC Operating System

Microsoft Windows 11, 10 for x86-64 (64-bit) processor architecture

Linux for x86-64 (64-bit) and AArch64 (64-bit) processor architectures

macOS for x86-64 (64-bit) and AArch64 (64-bit) processor architectures

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## APIs

EGrabber class, with C++ and .NET APIs: .NET assembly designed to be used with development environments

compatible with .NET frameworks version 4.6 or higher

GenICam GenTL producer libraries compatible with C/C++ compilers:

'x86\_64' dynamic library designed to be used with ISO-compliant C/C++ compilers for the development of x86-64 (64-bit) applications

'aarch64' dynamic library designed to be used with ISO-compliant C/C++ compilers for the development of AArch64 (64-bit) applications

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## Memento supported

Yes

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## Environmental conditions

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### Operating ambient air temperature

0 °C to +55 °C / +32 °F to +131 °F

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### Operating ambient air humidity

10% to 90% RH non-condensing

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### Storage ambient air temperature

-20 °C to +70 °C/ -4 °F to +158 °F

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### Storage ambient air humidity

10% to 90% RH non-condensing

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## Certifications

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### EMC standards

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European Council EMC Directive 2014/30/EU

United States FCC rule 47 CFR 15

## EMC - Emission

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EN 55032:2015 / CISPR 32:2012 Class B

FCC 47 Part 15 Class B

## EMC - Immunity

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EN 55035:2017 / CISPR 35:2016

EN 61000-6-2:2005 / IEC 61000-6-2:2016

EN 61000-4-2:2009

EN 61000-4-3:2006

EN 61000-4-4:2004

EN 61000-4-6:2014

## KC Certification

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Korean Radio Waves Act, Article 58-2, Clause 3

## Flammability

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PCB compliant with UL 94 V-0

## RoHS

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European Union Directive 2015/863 (ROHS3)

## REACH

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European Union Regulation 1907/2006

## WEEE

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Must be disposed of separately from normal household waste and must be recycled according to local regulations

# Ordering Information

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## Product status

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Released

## Product code - Description

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PC3625 Coaxlink QSFP+

## Related products

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PC1625 DB25F I/O Adapter Cable

PC1636 InterPC C2C-Link Adapter

PC3303 C2C-Link Ribbon Cable



PC3304 HD26F I/O Adapter Cable

PC3610 HD26F I/O Extension Module - TTL-RS422

PC3612 HD26F I/O Extension Module - TTL-CMOS5V-RS422

PC3613 JTAG Adapter Xilinx for Coaxlink

PC3629 Coaxlink CXP-12 to QSFP+ Converter

## Offices

- Europe, Middle East & Africa

Euresys SA

Contact support : [support.europe@euresys.com](mailto:support.europe@euresys.com)

Sensor to Image GmbH

Contact support : [support.europe@euresys.com](mailto:support.europe@euresys.com)

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Euresys Shenzhen Liaison Office

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TKH Vision Experience Center

Contact support : [support.usa@euresys.com](mailto:support.usa@euresys.com)