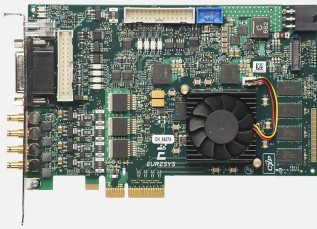




# Coaxlink Quad 3D-LLE

Quad CXP-6 frame grabber with on-board laser line extraction for 3D profiling



## At a Glance

- Laser line extraction with zero host CPU usage
- Single and Dual Laser Line Extraction into a depth map
- Real-time generation of 16-bit 3D height maps
- Choice of algorithms: Maximum, Peak, Center of Gravity (COG)
- Precision: up to 1/256 pixel (with Peak and COG algorithms)
- Performance: 19,000 profiles/s from 1024 x 128 images. 38,000 profiles/s from 1024 x 64 images

## Benefits

### Laser line extraction with zero host CPU usage

The Coaxlink's on-board FPGA measures the position of the laser line during the image acquisition without loading the host CPU.

### Real-time generation of 16-bit 3D height maps

The Coaxlink directly transfers the computed 3D height map to the host PC memory without delay, in real-time.

### Acquire images from the fastest and highest resolution cameras

- Highest data acquisition rate in the industry
- 25 Gbit/s (2,500 MB/s) bandwidth from camera to host PC memory

### Dual laser line extraction

Supported by software and hardware implementations, the dual laser line extraction process reduces the effect of occlusions. Occlusions occur when some parts of the objects are not lit by any laser. Using two lasers with different angles reduces these undefined areas. The object-based calibration included in Easy3DLaserLine allows combining the acquired data into a single calibrated point cloud.

### Long cable support for Coaxlink CXP-6

- 40 meters at CXP-6 speed (6.25 Gbps)
- 100 meters at CXP-3 speed (3 Gbps)

### Use standard coaxial cables

- A single inexpensive cable for data transfer, camera control, trigger and power supply
- Top reliability and flexibility, performs in the harshest environments

### Robust connectors for reliable connections

- Coaxlink CXP-6 uses DIN 1.0/2.3 connectors with push/pull latching system

## **Memento Event Logging Tool**

- Memento is an advanced development and debugging tool available for Coaxlink cards.
- Memento records an accurate log of all the events related to the camera, the frame grabber and its driver as well as the application.
- It provides the developer with a precise timeline of time-stamped events, along with context information and logic analyzer view.
- It provides valuable assistance during application development and debugging, as well as during machine operation.

## **General purpose I/O lines**

- Compatible with a wide range of sensors and motion encoders.
- High-speed differential inputs: Quadrature motion encoder support up to 5 MHz.
- Isolated current-sense inputs: 5V, 12V, 24V signaling voltages accepted, up to 50 kHz, individual galvanic isolation up to 250VDC and 170VAC RMS.
- Isolated contact outputs.
- High-speed 5V-compliant TTL inputs/ LVTTTL outputs.

## **High-performance DMA (Direct Memory Access)**

- Direct transfer into user-allocated memory and hardware boards that expose PCI addresses
- Hardware scatter-gather support
- 64-bit addressing capability

## **Area-scan triggering capabilities**

- A trigger is used to start the acquisition when the part is in position. Hardware triggers come from the Coaxlink's I/O lines. Software triggers come from the application.
- An optional trigger delay is available to postpone the acquisition for a programmable time.
- A trigger decimation function allows to skip some of the triggers.
- Camera exposure control allows the application to control the exposure time of the camera.
- When the acquisition starts, at the appropriate timing, the Coaxlink board generates a signal to control an illumination device connected to one of its output lines.

## **The Coaxlink driver includes the following tools:**

- Genicam Browser: An application giving access to the Genicam features exposed by the GenTL Producer(s) in the system.
- GenTL Console: A command-line tool giving access to the functions and commands exposed by the Euresys GenTL Producer.

## **Compliant with Genicam Including support for**

- GenApi
- The Standard Feature Naming Convention (SFNC)
- GenTL

## **Windows, Linux and macOS drivers available**

- Including support for Intel 32-bit and 64-bit platforms as well as ARM 64-bit platforms

## **Developed with the support of the DG06 Technology Development Department**

## **Applications**

### **Machine Vision for the Electronic Manufacturing Industry**

- 3D image acquisition for electronic inspection machines

## Machine Vision for the General Manufacturing Industries

- 3D image acquisition for inspection machines

## Specifications

### Mechanical

Format	Standard profile, half length, 4-lane PCI Express card
Cooling method	Air cooling, fan-cooled heatsink
Mounting	For insertion in a standard height, 4-lane or higher, PCI Express card slot
Connectors	<ul style="list-style-type: none"><li>• 'A', 'B', 'C', 'D' on bracket:<ul style="list-style-type: none"><li>– 4x DIN 1.0/2.3 female connectors</li><li>– CoaXPress host interface</li></ul></li><li>• 'EXTERNAL I/O' on bracket:<ul style="list-style-type: none"><li>– 26-pin 3-row high-density female sub-D connector</li><li>– I/O lines and power output</li></ul></li><li>• 'INTERNAL I/O 1' and 'INTERNAL I/O 2' on PCB:<ul style="list-style-type: none"><li>– 2x 26-pin 2-row 0.1" pitch pin header with shrouding</li><li>– I/O lines and power output</li></ul></li><li>• 'AUXILIARY POWER INPUT' on module:<ul style="list-style-type: none"><li>– 6-pin PEG power socket</li><li>– 12 VDC power input for PoCXP camera(s) and I/O power</li></ul></li><li>• 'C2C-LINK' on module:<ul style="list-style-type: none"><li>– 6-pin 2-row 0.1-in header</li><li>– Card to card link</li></ul></li></ul>
LED indicators	<ul style="list-style-type: none"><li>• 'A', 'B', 'C', 'D' on bracket:<ul style="list-style-type: none"><li>– Bi-color red/green LEDs</li><li>– CoaXPress Host connector indicator</li></ul></li><li>• 'FPGA STATUS LAMP' on PCB:<ul style="list-style-type: none"><li>– Bi-color red/green LED</li><li>– FPGA status indicator</li></ul></li><li>• 'BOARD STATUS LAMP' on PCB:<ul style="list-style-type: none"><li>– Bi-color red/green LED</li><li>– Board status indicator</li></ul></li></ul>
Switches	'RECOVERY' on card PCB: <ul style="list-style-type: none"><li>• 3-pin 1-row 0.1" header</li><li>• Firmware emergency recovery</li></ul>
Dimensions	L 167.65 mm x H 111.15 mm L 6.6 in x H 4.38 in
Weight	180 g, 6.35 oz
<b>Host bus</b>	
Standard	PCI Express 2.0
Link width	<ul style="list-style-type: none"><li>• 4 lanes</li><li>• 1 lane or 2 lanes with reduced performance</li></ul>
Link speed	<ul style="list-style-type: none"><li>• 5.0 GT/s (PCIe 2.0)</li><li>• 2.5 GT/s (PCIe 1.0) with reduced performance</li></ul>

Maximum payload size	512 bytes
DMA	32- and 64-bit
Peak delivery bandwidth	2,000 MB/s
Effective (sustained) delivery bandwidth	1,700 MB/s (Host PC motherboard dependent)
Power consumption	Typ. 16.8 W (3.8 W @ +3.3V, 13 W @ +12V), excluding camera and I/O power output

### Camera / video inputs

Interface standard(s)	CoaXPress 1.0, 1.1 and 1.1.1
Connectors	Four DIN1.0/2.3 75 Ohms CXP-6
Status LEDs	One CoaXPress Host connection status LED per connector
Number of cameras	One 1- or 2- or 4-connection camera
Maximum aggregated camera data transfer rate	25 Gbit/s (2,500 MB/s)
Supported CXP down-connection speeds	1.25 GT/s (CXP-1), 2.5 GT/s (CXP-2), 3.125 GT/s (CXP-3), 5 GT/s (CXP-5), and 6.25 GT/s (CXP-6)
Number of CXP data streams (per camera)	1 data stream per camera
Maximum CXP stream packet size	16,384 bytes
PoCXP (Power over CoaXPress)	<ul style="list-style-type: none"> <li>• PoCXP Safe Power: <ul style="list-style-type: none"> <li>– 17 W of 24V DC regulated power per CoaXPress connector</li> <li>– PoCXP Device detection and automatic power-on</li> <li>– Overload and short-circuit protections</li> </ul> </li> <li>• On-board 12V to 24V DC/DC converter</li> <li>• A +12V power source must be connected to the AUXILIARY POWER INPUT connector using a 6-pin PEG cable</li> </ul>
Camera types	<ul style="list-style-type: none"> <li>• Gray-scale area-scan cameras</li> </ul>
Camera pixel formats supported	Monochrome 8-bit (Mono8)

### Area-scan camera control

Trigger	<ul style="list-style-type: none"> <li>• Precise control of asynchronous reset cameras, with exposure control.</li> <li>• Support of camera exposure/readout overlap.</li> <li>• Support of external hardware trigger, with optional delay and trigger decimation.</li> </ul>
Strobe	<ul style="list-style-type: none"> <li>• Accurate control of the strobe position for strobed light sources.</li> <li>• Support of early and late strobe pulses.</li> </ul>

### On-board processing

On-board memory	1 GB
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## Image data stream processing

Laser Line Extraction (LLE) processing core to compute the vertical position of one detected laser line along a ROI using one of the following algorithms:

- Maximum Detection algorithm
  - Maximum ROI width: 8192 pixels
  - Maximum ROI height: 65536 pixels
  - Depth map format: 16-bit unsigned integer number
  - Accuracy: 1 pixel
- 8-bit Maximum Detection algorithm
  - Maximum ROI width: 8192 pixels
  - Maximum ROI height: 256 pixels
  - Depth map format: 8-bit unsigned integer number
  - Accuracy: 1 pixel
- Peak Detection algorithm
  - Maximum ROI width: 8192 pixels
  - Maximum ROI height: 2048 pixels
  - Depth map format: UQ11.5 fixed-point unsigned number
  - Accuracy: 1/32 pixel
- High accuracy Peak Detection algorithm
  - Maximum ROI width: 8192 pixels
  - Maximum ROI height: 256 pixels
  - Depth map format: UQ8.8 fixed-point unsigned number
  - Accuracy: 1/256 pixel
- Center Of Gravity algorithm
  - Maximum ROI width: 8192 pixels
  - Maximum ROI height: 2048 pixels
  - Depth map format: UQ11.5 fixed-point unsigned number
  - Accuracy: 1/32 pixel
- High accuracy Center Of Gravity algorithm
  - Maximum ROI width: 8192 pixels
  - Maximum ROI height: 256 pixels
  - Depth map format: UQ8.8 fixed-point unsigned number
  - Accuracy: 1/256 pixel

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## Data stream statistics

- Measurement of:
    - Frame rate (Area-scan only)
    - Line rate
    - Data rate
  - Configurable averaging interval
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## Event signaling and counting

- 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

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## General Purpose Inputs and Outputs

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Number of lines	20 I/O lines: <ul style="list-style-type: none"><li>• 4 differential inputs (DIN)</li><li>• 4 singled-ended TTL inputs/outputs (TTLIO)</li><li>• 8 isolated inputs (IIN)</li><li>• 4 isolated outputs (IOUT)</li></ul>
Usage	<ul style="list-style-type: none"><li>• Any I/O input lines can be used by any LIN tool of the I/O Toolbox</li><li>• 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</li><li>• The LIN and QDC tools outputs can be further processed by the other tools (DIV, MDV, DEL) of the I/O toolbox to generate any of the following "trigger" events:<ul style="list-style-type: none"><li>– The "cycle trigger" of the Camera and Illumination controller</li><li>– The "cycle sequence trigger" of the Camera and Illumination controller</li><li>– The "start-of-scan trigger" of the Acquisition Controller (line-scan only)</li><li>– The "end-of-scan trigger" of the Acquisition Controller (line-scan only)</li></ul></li></ul>
Electrical specifications	<ul style="list-style-type: none"><li>• DIN: High-speed differential inputs compatible with ANSI/EIA/TIA-422/485 differential line drivers and complementary TTL drivers</li><li>• 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</li><li>• IIN: Isolated current-sense inputs with wide voltage input range up to 30V, compatible with totem-pole LVTTTL, TTL, 5V CMOS drivers, RS-422 differential line drivers, potential free contacts, solid-state relays and opto-couplers</li><li>• IOUT: Isolated contact outputs compatible with 30V / 100mA loads</li></ul>
Filter control	<ul style="list-style-type: none"><li>• Glitch removal filter available on all System I/O input lines</li><li>• Configurable filter time constants:<ul style="list-style-type: none"><li>– for DIN and TTLIO lines: 50 ns, 100 ns, 200 ns, 500 ns, 1 <math>\mu</math>s</li><li>– for IIN lines: 500 ns, 1 <math>\mu</math>s, 2 <math>\mu</math>s, 5 <math>\mu</math>s, 10 <math>\mu</math>s</li></ul></li></ul>
Polarity control	Yes
Power output	Non-isolated, +12V, 1A, with electronic fuse protection

## I/O Toolbox tools

The I/O Toolbox is a configurable interconnection of tools that generates events (usually triggers) from input lines. The composition of the toolset is product- and firmware-dependent.

- 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.
- 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.
- 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).
- 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.

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I/O Toolbox composition

8 LIN, 1 QDC, 1 DIV, 1 MDV, 2 DEL, 1 UAS

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## C2C-Link

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Description

- 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.

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Specification

- 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:
    - 60 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 Coaxlink 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)
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## Software

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Host PC Operating System

- Microsoft Windows 10, 8.1, 7 for x86 (32-bit) and x86-64 (64-bit) processor architectures
- Linux for x86 (32-bit), x86-64 (64-bit) and aarch64 (64-bit) processor architectures
- macOS for x86-64 (64-bit) processor architecture

Refer to release notes for details

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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 4.0 or higher
- GenICam GenTL producer libraries compatible with C/C++ compilers:
- x86 dynamic library designed to be used with ISO-compliant C/C++ compilers for the development of x86 applications
  - x86\_64 dynamic library designed to be used with ISO-compliant C/C++ compilers for the development of x86\_64 applications
  - aarch64 dynamic library designed to be used with ISO-compliant C/C++ compilers for the development of aarch64 applications

## Environmental conditions

Operating ambient air temperature	0 to +55 °C / +32 to +131 °F
Operating ambient air humidity	10 to 90% RH non-condensing
Storage ambient air temperature	-20 to +70 °C/ -4 to +158 °F
Storage ambient air humidity	10% to 90% RH non-condensing

## Certifications

Electromagnetic - EMC standards	<ul style="list-style-type: none"> <li>• European Council EMC Directive 2004/108/EC</li> <li>• United States FCC rule 47 CFR 15</li> </ul>
EMC - Emission	<ul style="list-style-type: none"> <li>• EN 55022:2010 Class B</li> <li>• FCC 47 Part 15 Class B</li> </ul>
EMC - Immunity	<ul style="list-style-type: none"> <li>• EN 55024:2010 Class B</li> <li>• EN 61000-4-3</li> <li>• EN 61000-4-4</li> <li>• EN 61000-4-6</li> </ul>
KC Certification	Korean Radio Waves Act, Article 58-2, Clause 3
Flammability	PCB compliant with UL 94 V-0
RoHS	European Union Directive 2015/863 (ROHS3)
REACH	European Union Regulation 1907/2006
WEEE	Must be disposed of separately from normal household waste and must be recycled according to local regulations

## Ordering Information

Product code - Description	<ul style="list-style-type: none"> <li>• 1637 - Coaxlink Quad 3D-LLE</li> </ul>
Optional accessories	<ul style="list-style-type: none"> <li>• 1625 - DB25F I/O Adapter Cable</li> <li>• 1636 - InterPC C2C-Link Adapter</li> <li>• 3303 - C2C-Link Ribbon Cable</li> <li>• 3304 - HD26F I/O Adapter Cable</li> </ul>





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