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Empowering Computer Vision

NEW

Coaxlink Duo CXP-12

Two-connection CoaXPress CXP-12 frame grabber

At a Glance

- Two CoaXPress CXP-12 connections: 2,500 MB/s camera bandwidth
- PCIe 3.0 (Gen 3) x4 bus: 3,300 MB/s bus bandwidth
- Low-profile card. Delivered with standard and low-profile brackets.
- Fan-cooled heatsink
- Feature-rich set of 10 digital I/O lines
- Extensive camera control functions
- Memento Event Logging Tool

Benefits

Low-profile PCIe card
- Delivered with standard and low-profile brackets

PCIe 3.0 (Gen 3) x4 bus
- 3,300 MB/s sustained bus bandwidth

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

Long cable support for Coaxlink CXP-12
- 40 meters at CXP-12 speed (12.5 Gbps)
- 72 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
- Micro-BNC (HD-BNC™) connectors for reliable connection
- Trusted push and turn, bayonet-style positive lock
- Allows for quick and easy connects and disconnects

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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.

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.

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/ LVTTL 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 Genicamfeatures 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

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Applications

Machine Vision for the Electronic Manufacturing Industry
- High speed image acquisition for AOI, 3D SPI, 3D lead/ball inspection machines.
- Very high resolution line-scan image acquisition for Flat Panel Display inspection and solar cell inspection
- Mark inspection

Machine Vision for the General Manufacturing Industries
- High frame rate image acquisition for inspection machines
- Line-scan image acquisition for surface inspection machines
- Line-scan image acquisition for textile inspection
- Image acquisition for robots

Machine Vision for the Printing Industry
- High speed line-scan image acquisition for printing inspection machines

Video Acquisition and Recording
- High-frame-rate video acquisition for motion analysis and recording

Video Monitoring, Surveillance & Security
- Transmission and acquisition of high-definition video over long coaxial cables for traffic surveillance, monitoring and control

Specifications

Mechanical

Format	Low profile, half length, 4-lane PCI Express card
Cooling method	Air cooling, fan-cooled heatsink
Mounting	- For insertion in a 4-lane or higher, PCI Express card slot. - Delivered with standard- and low-profile brackets for insertion in a standard- or a low-profile chassis.
Connectors	'A', 'B' on bracket: - Micro-BNC female connectors - CoaXPress host interface 'EXTERNAL I/O 1' on bracket: 15-pin 3-row high-density female sub-D connector - I/O lines and power output 'INTERNAL I/O 1' on PCB: 26-pin 2-row 0.1" pitch pin header with shrouding - I/O lines and power output 'I/O EXTENSION' on PCB: 26-pin 2-row 0.05" pitch pin header with shrouding - I/O extension lines and power output 'AUXILIARY POWER INPUT' on module: 6-pin PEG power socket 12 VDC power input for PoCXP camera(s) and I/O power 'C2C-LINK' on module: 6-pin 2-row 0.1" header - Card to card link

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LED indicators	• 'A', 'B' 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	'RECOVERY' on card PCB: • 3-pin 1-row 0.1" header • Firmware emergency recovery
Dimensions	L 167.65 mm x H 68,90 mm L 6.6 in x H 2.71 in
Weight	125g, 4.40 oz

Host bus

Standard	PCI Express 3.0
Link width	• 4 lanes • 1 lane or 2 lanes with reduced performance
Link speed	• 8.0 GT/s (PCIe 3.0) • 5.0 GT/s (PCIe 2.0) with reduced performance
Maximum payload size	512 bytes
DMA	32- and 64-bit
Peak delivery bandwidth	3,900 MB/s
Effective (sustained) delivery bandwidth	3,350 MB/s (Host PC motherboard dependent)
Power consumption	Typ. 14.8 W (4.3W @ 3.3V + 10.5 W @12V), excluding camera and I/O power output

Camera / video inputs

Interface standard(s)	CoaXPress 1.0, 1.1, 1.1.1 and 2.0
Connectors	2 micro-BNC 75 Ohms (also known as HD-BNC™) CXP-12
Status LEDs	One CoaXPress Host connection status LED per connector

Number of cameras	• Area-scan cameras:
	  – One 1- or 2-connection camera
	  – One or two 1-connection cameras

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), 6.25 GT/s (CXP-6), 10.0 GT/s (CXP-10)*, and 12.5 GT/s (CXP-12)* NOTE: mixing CXP-10 and CXP-12 is not allowed!
Number of CXP data streams (per camera)	1 data stream per camera
Maximum CXP stream packet size	16,384 bytes

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PoCXP (Power over CoaXPress)	• PoCXP Safe Power:
	− 17 W of 24V DC regulated power per CoaXPress connector
	− PoCXP Device detection and automatic power-on
	− Overload and short-circuit protections
	• On-board 12V to 24V DC/DC converter
	• A +12V power source must be connected to the AUXILIARY POWER INPUT connector using a 6-pin PEG cable
Camera types	• Area-scan cameras:
	− Gray-scale and color (RGB and Bayer CFA)
	− Single-tap (1X-1Y) progressive-scan
Camera pixel formats supported	Raw, Monochrome, Bayer, RGB, and RGBA (PFNC names):
	• Raw
	• 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

Area-scan camera control

Trigger	• 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.
Strobe	• Accurate control of the strobe position for strobed light sources.
	• Support of early and late strobe pulses.

On-board processing

On-board memory	1 GB
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
Input LUT (Lookup Table)	Only available for monochrome cameras:
	• 8 to 8 bits
	• 10 to 8, 10 or 16 bits
	• 12 to 8, 12 or 16 bits
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

General Purpose Inputs and Outputs

Number of lines	10 I/O lines:
	• 2 differential inputs (DIN)
	• 2 singled-ended TTL inputs/outputs (TTLIO)
	• 4 isolated inputs (IIN)*
	• 2 isolated outputs (IOUT)*
	NOTE: Only 2 IIN and 1 IOUT lines are available on the EXTERNAL I/O connector.
	NOTE: The number of I/O lines can be extended using I/O modules attached to the I/O EXTENSION connector.
Usage	• 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
	• 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:
	– The "cycle trigger" of the Camera and Illumination controller
	– The "cycle sequence trigger" of the Camera and Illumination controller
Electrical specifications	• DIN: High-speed differential inputs compatible with ANSI/EIA/TIA-422/485 differential line drivers and complementary TTL drivers
	• TTLIO: High-speed 5V-compliant TTL inputs or LVTTL outputs, compatible with totem-pole LVTTL, TTL, 5V CMOS drivers or LVTTL, TTL, 3V CMOS receivers
	• IIN: Isolated current-sense inputs 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
	• IOUT: Isolated contact outputs compatible with 30V / 100mA loads
Filter control	• Glitch removal filter available on all System I/O input lines
	• Configurable filter time constants:
	– for DIN and TTLIO lines: 50 ns, 100 ns, 200 ns, 500 ns, 1 µs
	– for IIN lines: 500 ns, 1 µs, 2 µs, 5 µs, 10 µs
Polarity control	Yes
Power output	Non-isolated, +12V, 1A, with electronic fuse protection

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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.
I/O Toolbox composition	Determined by the selected firmware variant:
	• 1-camera: 8 LIN, 1 QDC, 1 DIV, 1 MDV, 2 DEL, 1 UAS
	• 2-camera: 8 LIN, 2 QDC, 2 DIV, 2 MDV, 2 DEL, 1 UAS

C2C-Link

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.
Specification	• C2C-Link synchronizes cameras connected to:
	− the same Coaxlink 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 Coaxlink card or on different Coaxlink cards in the same PC
	− Less than 265 ns for cameras on different Coaxlink cards in different PCs (3 PCs and 40m total C2C-Link cable length)

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Software

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
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	• European Council EMC Directive 2004/108/EC • United States FCC rule 47 CFR 15
EMC - Emission	• EN 55022:2010 Class B • FCC 47 Part 15 Class B
EMC - Immunity	• EN 55024:2010 Class B • EN 61000-4-3 • EN 61000-4-4 • EN 61000-4-6
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	• 3622 - Coaxlink Duo CXP-12
Optional accessories	• 1625 - DB25F I/O Adapter Cable • 1636 - InterPC C2C-Link Adapter • 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 • 3614 - HD26F I/O Extension Module - Standard I/O Set

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