VISION WITH EMBEDDED VALUE

Embedded Vision Solutions by Basler

- Vision Excellence
- Solution Consultancy
- Broadest Product Portfolio
- Comprehensive Software Solutions
- Development And Production Competencies

BASLER
the power of sight

GO EMBEDDED, GO VISION WITH BASLER AND PROFIT FROM OUR EXPERIENCE, HIGH-QUALITY PRODUCTS, AND SERVICES.

VISION EXCELLENCE

Technology leadership with over 30 years of vision experience

- Most trusted brand in industrial digital cameras
- Best-in-class image processing, well-matched components and driver of innovation.

SOLUTION CONSULTANCY

Expert guidance to your optimal solution

- Expert knowledge in all the relevant elements for an embedded vision system
- Everything from plausibility checks, requirement and feasibility analyses, proof of concept, to final production from one source

BROADEST PRODUCT PORTFOLIO

Get the right product for your embedded vision system

- High-quality products with long-term availability
- Products in different performance classes and technologies to offer best price/performance solutions and full flexibility

COMPREHENSIVE SOFTWARE SOLUTIONS

Everything you need to get your system running

- Everything from drivers to application software optimized for vision applications
- Complete system software packages for highest ease of use
- Application specific building blocks and individual software components

DEVELOPMENT AND PRODUCTION COMPETENCIES

From first idea to mass production

- Full development and customized mass production of your product
- Established high quality standards and extensive in-house product testing
- Service on demand by Basler‘s technical support

EMBEDDED VISION SOLUTIONS BY BASLER

Combining embedded design and vision technology is a rising trend. Embedded vision will replace a variety of PC-based image processing solutions and at the same time enable a number of new applications in which small size, low power consumption and low costs are important. We have set ourselves the goal of significantly reducing the still high integration effort for our customers when using embedded vision.

To do so we support you in every step of the development of your embedded vision application: from consultancy, to development and production. Our broad product portfolio gives you everything you need to set up a system, and our software gets everything running right out of the box.

With embedded vision solutions made by Basler you can rely on high-quality products, easy integration and development, and the leanest solution possible.

Get embedded vision into your application

With 30 years of vision expertise and a dedicated embedded portfolio, Basler will support you in taking your application to the next level.

With embedded vision systems you can profit from

- Reduction of costs
- New applications and markets
- Miniaturization and modularization
- Simplification of existing vision solutions
- Mobility of tools
- Making existing systems sophisticated and smart

Factory automation and logistics

Possible applications: Inspection, logistics, 2D/3D metrology, pick and place machines, microscopy, robotics, Industrial Internet of Things (IIoT), automated assembly, autonomous vehicles and service robots

Industrial applications are the traditional field of Machine Vision and they are an essential part of production and processing. Going embedded will take your industrial application to the next level.

Basler offers: Industrial quality also for embedded products, products for an easy switch from Machine Vision to embedded vision, and easy integration

Medical & life sciences

Possible applications: Ophthalmology, lab automation, digital dermatoscopes, dental scanners, remote surgical systems, 3D body diagnostics, dental scanners, microscopy

The healthcare and life sciences sector is being deeply transformed by a variety of new requirements that call for new approaches in technology design. Embedded vision helps medical device manufacturers achieve the right combination of high performance, low cost, low power, and programmability to meet current trends.

Basler offers: Superior quality, well-tested products, compliant with DIN EN ISO 13485:2016, long-term availability, complete systems, and a stable supply chain

TYPICAL APPLICATIONS

Consumer applications

Possible Applications: Internet of Things (IoT), home automation, guidance and security applications, smart wearables, sports analysis, entertainment and augmented reality

Embedded technology opens up additional markets and enables vision in new applications. By bringing this technology into devices that we encounter every day, Basler aims to make our lives easier, safer and more comfortable.

Basler offers: Excellent price/performance ratio, a broad range of products, and ideal solutions for many applications

Traffic and smart city

Possible applications: Automatic number plate recognition, speed enforcement equipment, parking space monitoring, vehicle monitoring, drone-based land mapping and infrastructure inspection, and other smart city applications

Vision gets more and more important in smart city applications. Embedded vision helps to simplify those applications and makes a lot of applications possible for the first time.

Basler offers: Reliable, high-quality products for outdoor and mobile applications

Retail

Possible applications: In-store automation, vending machines/kiosk systems, people counting, tracking & profiling, face recognition (gate control), check-out systems

Applying vision to enhance retail automation processes or consumer convenience is a rising trend. With Basler you can create the right solution for your application.

Basler offers: Excellent price/performance ratio and a broad range of products, possibilities and solutions

LEAN AND EASY-TO-SET-UP EMBEDDED VISION APPLICATIONS – WITH MIPI CSI-2-BASED DART CAMERA MODULES

dart BCON for MIPI camera module

MIPI CSI-2 is the most widely used camera interface in the mobile industry. With the dart BCON for MIPI Basler unites this interface with the standards and features from the Machine Vision world:

- Outstanding performance
- Easy to integrate
- Surprisingly low price
- High quality

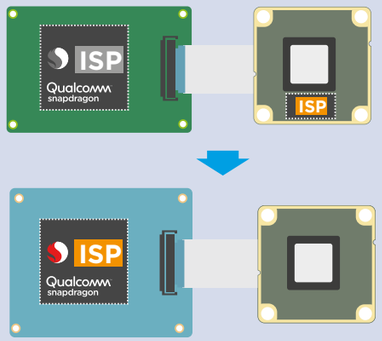
Main benefits of Basler's dart BCON for MIPI

- Tailor-made for MIPI CSI-2 connections
- Best price/performance ratio due to cost-optimized design
- Ready-to-use driver package for Qualcomm Snapdragon SoCs under Linux (Linaro)
- Fast and easy camera integration into the actual user application with only a few lines of code using the pylon SDK
- Easy code migration thanks to GenICam compliance and the unified pylon SDK
- 5 megapixels, 60 fps, ON Semiconductor AR0521 sensor

Utilizing Snapdragon's ISP

The dart camera module with BCON for MIPI interface pursues the path of efficiency in a notably consequent way: for the first time, a professional camera module is making use of the unmatched Image Signal Processors (ISP) of Qualcomm's Snapdragon SoCs under Linux.

All other Basler camera modules come with their own ISP as part of their hardware and firmware. This gives them the flexibility to be operated on any target platform. The dart with BCON for MIPI interface on the other hand utilizes Qualcomm's Snapdragon ISP and thus enables lean embedded systems without compromising image quality.

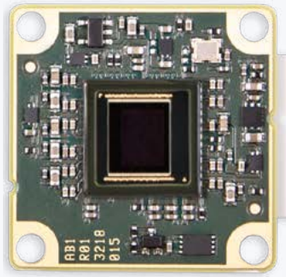


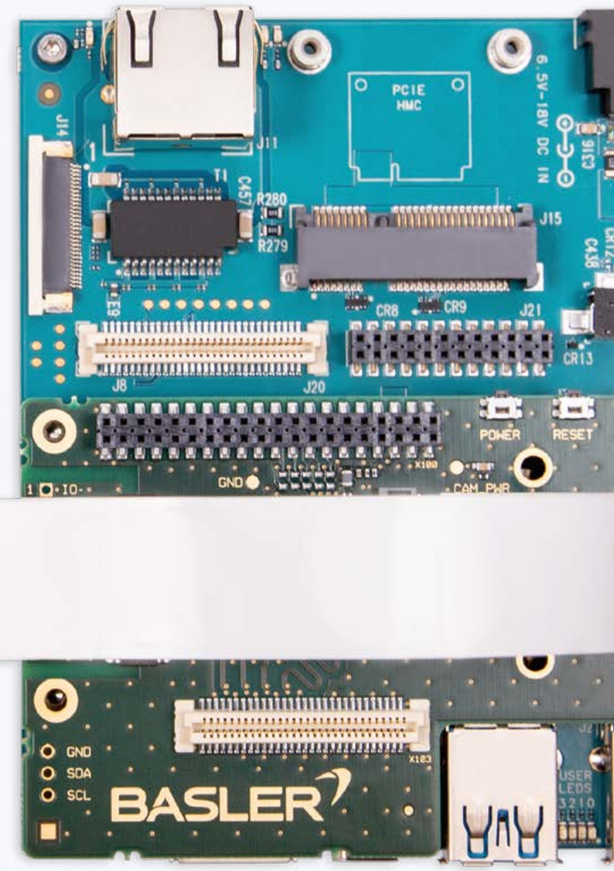
Integrating the dart BCON for MIPI into your system

Integrating the dart BCON for MIPI is straightforward: Basler provides you with everything you need to get your system running.

The Driver Package for the supported Snapdragon SoCs under Linux (Linaro) includes the ISP logic, which now implements former camera firmware functionality on the Snapdragon's Spectra™ ISP. The Driver Package also implements the interface to the pylon Camera Software Suite and thus provides the same level of convenience as is offered by USB 3.0.

The development kit includes a complete software and hardware sample setup.





dart BCON for MIPI Development Kit

- Ready to go with already installed BSP, driver package for Linux (Linaro) and the industry-proven pylon Camera Software Suite
- Plug and play operation of dart BCON for MIPI camera modules
- Suitable for demanding applications thanks to high-performance Snapdragon SoC
- Mezzanine board with circuit diagram as example design
- All necessary accessories are included

The Develoment Kit enables easy testing of the camera performance and the overall system: find out directly what the system offers, for fast development without risk.

HIGH-PERFORMANCE FPGA-BASED EMBEDDED VISION SYSTEMS - MADE EASY WITH DART BCON FOR LVDS CAMERA MODULES

dart BCON for LVDS camera module

BCON for LVDS is an LVDS-based interface that allows for direct camera connection to processing boards and thus to on-board-logic devices like FPGAs (Field Programmable Gate Arrays) or comparable components.

BCON for LVDS

Main benefits of Basler's dart BCON for LVDS

- Direct camera-to-processor connection for data access without overhead
- Significantly reduced integration effort: with pylon SDK, camera configuration is possible without further programming (via I^2C bus)
- Straight forward camera integration: image data software protocol is openly and comprehensively documented
- Development kit with reference implementation available
- Flexible flat flex cable and small connector for applications with the highest space constraints
- Stable, reliable data transfer with high bandwidth

Advantages of FPGA-based systems

FPGA based systems are optimal for many special vision applications – like stereovision (3D) or recognition algorithms. FPGAs can be highly optimized for the tasks and efficient systems can be created even for mid-range volume products.

EMBEDDED VISION SOLUTIONS

Integrating a dart BCON for LVDS into your system

Connecting an LVDS-based module can be a complex and time-consuming task. Our dart BCON for LVDS Development Kit smooths the path for you, including sample hardware and software implementations for the Basler dart via BCON for LVDS interface and a compatible processing board based on the Xilinx Zynq®-7010 SoC. This allows you to familiarize yourself not just with the technical opportunities and characteristics of the BCON for LVDS interface, but also provides you with a reference implementation of the image capture algorithm and a clear set of documentation for the interface.

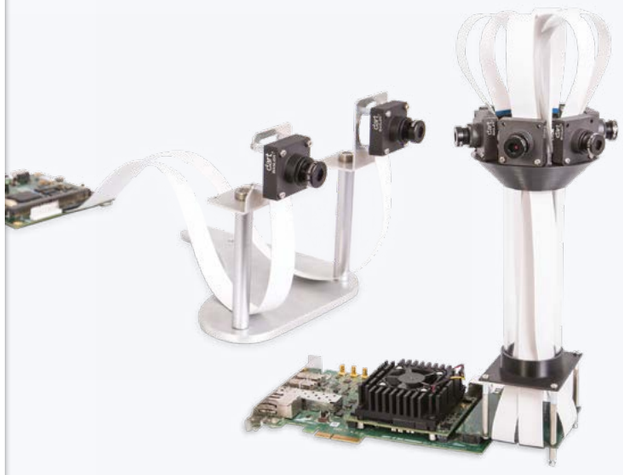
dart BCON for LVDS Development Kit

- Example setup of a BCON for LVDS connection
- Example implementation of the image capture algorithm including well-documented source code
- Supports and shortens the actual product development
- All necessary accessories included
- Proven pylon Camera Software Suite included free of charge
- Extremely compact dart camera with BCON for LVDS interface and a resolution of 5 megapixels

Partner solutions

Development kits for the dart BCON for LVDS camera module are also available from our partners with different hardware setups.

- Dream Chip: Arria 10 SoM Reference Design for dart BCON for LVDS that builds on Intel/Altera's Arria 10 SoC with an integrated Dual-Core ARM Cortex A9 processor
- Critical Link: MitySOM-5CSX Embedded Vision Development Kit featuring an Intel/Altera Cyclone V SoC processor



baslerweb.com/reference-designs

EMBEDDED VISION IN A MINUTE – WITH PLUG AND PLAY USB CAMERA MODULES

The USB 3.0 interface makes camera integration fast and easy. This is not only ideal for testing a camera module but also for quickly building embedded vision systems based on a variety of different single-board computers.

USB 3.0 - Main benefits:

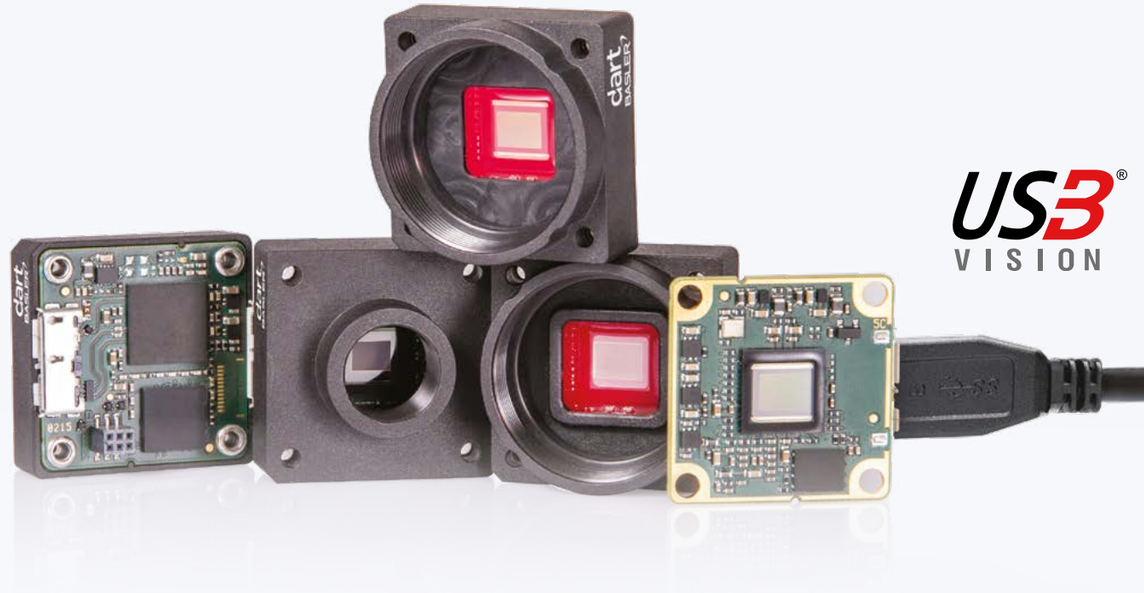
- Easy connection to single-board computers with USB 2.0 or USB 3.0 connector
- Field-proven solutions with Raspberry Pi, NVIDIA Jetson TK1 and many other systems
- Profitable solutions for SoMs with associated base boards
- USB 3 Vision standard compliant and GenICam compatible
- Fast data transfer rates

dart USB Evaluation Kit

The dart USB Evaluation Kit is a plug and play evaluation kit that helps you to find the right camera and accessories for your application. It includes a Basler dart camera with a USB 3.0 interface, a suitable lens, a USB 3.0 cable, and pylon – Basler's industry-proven camera software suite.

Your benefits include:

- Plug and play camera system evaluation
- No additional accessories required
- Industry-proven pylon Camera Software Suite included for free
- Extremely compact, USB3 Vision compliant camera with a resolution of 5 megapixels
- PGI – Basler's unique feature set for powerful in-camera image optimization
- Stable data transfer with a bandwidth of up to 350 MB/s



dart USB

- Camera-internal image pre-processing
- Bare board, S- and CS-mount options
- Global and rolling shutter options
- Same camera functionality for USB and BCON models – easy evaluation of BCON models using USB version

ace

Basler also offers the ultra-flexible ace camera with over 130 models for highest frame rates, resolutions, and sensitivity. For more information visit: *baslerweb.com/ace*

Specifications Basler dart

Basler dart	Sensor	Resolution (MP, H × V pixels)	Frame Rate [fps], Mono/ Color	Interface	Pixel Size [µm²]	Sensor Size [mm²]	Optical Size	Shutter Technology
daA1280-54um/uc	AR0134 CMOS	1.3 MP, 1280 × 960	54, m/c	USB 3.0	3.75 × 3.75	4.80 × 3.60	1/3″	Global shutter
daA1280-54lm/lc	AR0134 CMOS	1.3 MP, 1280 × 960	54, m/c	BCON for LVDS	3.75 × 3.75	4.80 × 3.60	1/3″	Global shutter
daA1600-60um/uc	EV76C570 CMOS	2 MP, 1600 × 1200	60, m/c	USB 3.0	4.5 × 4.5	7.20 × 5.40	1/1.8″	Global shutter
daA1600-60lm/lc	EV76C570 CMOS	2 MP, 1600 × 1200	60, m/c	BCON for LVDS	4.5 × 4.5	7.20 × 5.40	1/1.8″	Global shutter
daA1920-15um	MT9P031 CMOS	2 MP, 1920 × 1080	15, m	USB 3.0	2.2 × 2.2	4.22 × 2.38	1/3.7″	Rolling shutter
daA1920-30um/uc	MT9P031 CMOS	2 MP, 1920 × 1080	30, m/c	USB 3.0	2.2 × 2.2	4.22 × 2.38	1/3.7″	Rolling shutter
daA2500-14um/uc	MT9P031 CMOS	5 MP, 2592 × 1944	14, m/c	USB 3.0	2.2 × 2.2	5.70 × 4.28	1/2.5″	Rolling shutter
daA2500-14lm/lc	MT9P031 CMOS	5 MP, 2592 × 1944	14, m/c	BCON for LVDS	2.2 × 2.2	5.70 × 4.28	1/2.5″	Rolling shutter
daA2500-60mc	AR0521 CMOS	5 MP, 2560 × 1920	60, c	BCON for MIPI	2.2 × 2.2	5.70 × 4.30	1/2.5″	Rolling shutter

All dart cameras are available with S-mount or as a bare board variant without a lens mount. USB and BCON for LVDS variants are also available with CS-mount. Current consumption max. 260 mA.

Specifications are subject to change without prior notice.
Latest specifications and availability can be found on our website *baslerweb.com/dart*. Please visit *baslerweb.com/manuals* for the detailed camera User's Manual and *baslerweb.com/thirdparty* for information on third party software.

Overview Basler ace – over 130 models available

Basler ace series with CMOS sensors	Number of models	Benefits	Resolution (H × V pixels)	Frame Rate [fps]	Pixel Size [µm²]	Shutter Technology
ace with PYTHON sensors from ON Semiconductor	20	Highest speed, excellent price/performance ratio	VGA – 5 MP	Up to 750	4.80 × 4.80	Global shutter
ace with CMOSIS sensors	12	High speed, NIR enhancement options, big pixel size	2 MP, 4 MP	Up to 165	5.50 × 5.50	Global shutter
ace with SONY Pregius and STARVIS IMX sensors	34	Outstanding image quality, high speed for demanding applications	2.3 MP – 5 MP	Up to 164	5.86 × 5.86 3.45 × 3.45	Global shutter
ace with MT sensors from ON Semiconductor	14	Highest resolutions	2 MP – 14 MP	Up to 25	2.2 × 2.2 1.67 × 1.67 1.4 × 1.4	Rolling shutter

Specifications are subject to change without prior notice.
Latest specifications and availability can be found on our website *baslerweb.com/ace*. Please visit *baslerweb.com/manuals* for the detailed camera User's Manual and *baslerweb.com/thirdparty* for information on third party software.

Specifications

Embedded Vision Kits	daA2500-14uc-EVA	daA2500-14lc-MZ7010	daA2500-60mc-SD820-DB8
Components			
Scope of Delivery	Camera, lens, USB 3.0 cable	Camera, lens, processing board, carrier card, power supply. cables (USB, FFC, Ethernet) and accessories	Camera module, lens, processing board, mezzanine board , power supply, cables (USB, HDMI, FFC, Ethernet) and accessories
Camera Model	**daA2500-14uc**	**daA2500-14lc**	**daA2500-60mc**
Resolution (H × V pixels)	2592 × 1944		2560 × 1920
Sensor	ON Semiconductor MT9P031, 1/2.5″, CMOS, rolling shutter		ON Semiconductor AR0521, 1/2.5″, CMOS, rolling shutter
Pixel Size [µm²]	2.2 × 2.2		
Frame Rate [fps]	14		60
Mono / Color	Color		
Video Output Format	YUV 4:2:2 Packed (YCbCr 422), Bayer (8, 12), RGB 8		YUV 4:2:2 Packed, YUV 4:2:0 semi-planer (YCbCr 422), RGB 8
Interface	USB 3.0	Basler BCON for LVDS	BCON for MIPI
Exposure Control	Via external trigger or programmable via the camera API		Automatic, manual, programmable via the camera API
Housing Size Camera (L × W × H)[mm]	20 × 29 × 29	17.5 × 29 × 29	
Lens Mount	S-mount (M12)		
Digital I/O	2 Fast-GPIO	1 LVDS input, 2 outputs	2 inputs, 2 outputs
Power Requirements	Via USB 3.0 interface	Via Basler BCON interface	Via BCON for MIPI interface
Power Consumption (typical)	~1.3 W	~1.4	~0,6 W
Conformity	CE, FCC, RoHS, USB3 Vision	CE, FCC, RoHS	CE, FCC, RoHS, MIPI CSI-2
Lens Model	**Evetar N118B05518W F1.8 f5.5mm 1/1.8″**		
Focal Length	5.5 mm		
Processing Board Model	**-**	**MicroZed**	**DB8**
SoC	–	Xilinx Zynq-7010	Qualcomm Snapdragon 820E
Size (L × W × H)[mm]	–	101.6 × 57.2 × 25.5	100 x 85 x 15 (96Boards CE – extended B)
Interfaces	–	10/100/1000 Ethernet,USB 2.0, USB-UART	10/100/1000 Ethernet, Wi-Fi, USB 2.0, USB 3.0, HDMI, PCIe 2.0, MIPI CSI-2
Memory	–	1 GB DDR3 SDRAM, 128 MB QSPI Flash	3GB LPDDR4 RAM, 64GB UFS Flash
Software / Driver	**Basler pylon Camera Software Suite**		
Operating System	Windows, Linux, Mac OS X	Linux	
Conformity	USB3 Vision, GenICam	GenICam	

Specifications are subject to change without prior notice.
Latest specifications and availability can be found on our website *baslerweb.com/devkits*. Please visit *baslerweb.com/manuals* for the detailed camera User's Manual and *baslerweb.com/thirdparty* for information on third party software.

PYLON

Basler pylon Camera Software Suite

Basler's pylon Camera Software Suite provides a user-friendly SDK that allows easy access to the camera. With its universal API it allows for simple image grabbing, camera setup and parameterization. This can be done without further camera-specific programming but with straightforward, well-documented commands. pylon works in same manner for all OS, platforms and camera interfaces. And the best part is – it's free of charge!

Basler also offers the pylon SDK for embedded platforms (ARM and x86), laying out everything needed for simple integration of the camera into applications. This includes drivers, sample program code, an API for C and C++ applications as well as user-friendly tools such as the pylon Viewer and comprehensive documentation.

pylon's benefits include

Portability

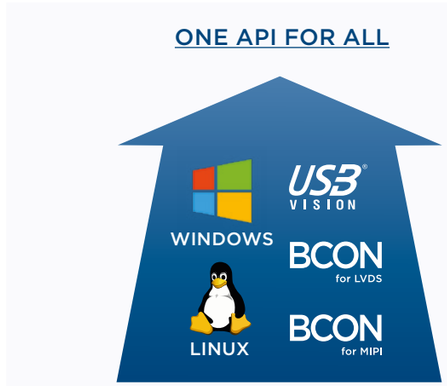
It doesn't matter which operating system (Windows, Mac OS X, Linux (ARM), Linux (x86)) you use to create an application; pylon's cross-platform compatibility ensures that applications port easily from one system to another.

Access to all camera features

pylon is based on GenICam technology. This ensures that pylon can always access all features on any Basler camera, such as gain, brightness, auto-function, region of interest and many more.

Uniform API

No matter which camera interface (GigE, USB 3.0, BCON for MIPI or BCON for LVDS) or for which Basler camera or camera module an application is being created: the pylon programming interface always looks the same. Converting a pylon based application from one interface technology (such as USB 3.0) to another (such as BCON for MIPI) typically requires little, if any, change to the code.



Easy camera evaluation and application development for embedded vision applications

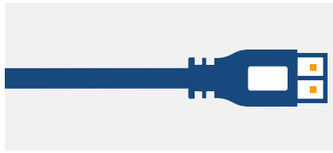
pylon makes it possible to evaluate cameras on a standard Windows PC using a plug and play interface (such as USB 3.0) and to develop an applications prototype. The prototype can then later be ported with little extra effort, using pylon to work on an embedded system (Linux ARM) via a camera interface such as BCON.

INTERFACES

Interfaces – flexible and fitting your needs

Whatever the specifications regarding your application, Basler fulfills them with a broad range of cameras with different sensors, resolutions, and interfaces.

All of them work with the same Basler industry-proven pylon Camera Software Suite which facilitates switching from one interface technology to another (see previous page).



USB

- PLUG AND PLAY
- UNIVERSAL, EASIEST, AND MOST FLEXIBLE INTEGRATION

BCON

FOR CONVINIENT SETUP OF DIRECT SOC CONNECTIONS AND LEANEST ARCHITECTURES

BCON FOR LVDS
FOR FGPA BASED SYSTEMS

BCON FOR MIPI
FOR EMBEDDED SOCS WITH MIPI-CSI2 INTERFACE

USB 3.0 - Main benefits:

- Easy connection to single-board computers with USB 2.0 or USB 3.0 connector
- Field-proven solutions with Raspberry Pi, NVIDIA Jetson TK1 and many other systems
- Stable data transfer with a bandwidth of up to 350 MB/s

BCON for LVDS – Main benefits:

- Direct camera-to-processor connection for data access without overhead.
- Significantly reduced integration effort: with pylon SDK, camera configuration is possible without further programming (via I^2C bus)
- Straightforward camera integration: image data software protocol is openly and comprehensively documented
- Free-to-use FPGA sample grabbing routing in development kit

BCON for MIPI - Main benefits:

- Direct camera-to-processor connection over MIPI CSI-2 for data transfer and camera configuration without any overhead
- Drivers provided, including image preprocessing
- Fast and easy camera integration into the actual user application with only a few lines of code using the pylon SDK

OTHER INFORMATION

About Basler

Basler is a leading manufacturer of high-quality cameras and camera accessories for industry, medicine, traffic and a variety of other markets. The company's product portfolio encompasses area scan and line scan cameras in compact housing dimensions, camera modules in board level variants for embedded solutions, and 3D cameras. The catalog is rounded off by our user-friendly pylon SDK and a broad spectrum of accessories, including several developed specially for Basler and optimally harmonized for our cameras.

Basler has three decades of experience in computer vision. The Basler Group is home to approximately 800 employees at its headquarters in Ahrensburg, Germany, and at other locations in Europe, Asia and North America.

3-Year Warranty

Basler offers a 3-year warranty for their cameras and Basler Lenses 1/2.5". We make this unprecedented promise because we have unparalleled confidence in our products. We continually reinvest in research, development and superior manufacturing capabilities so that our customers can fully rely on the products we manufacture.

Discover Basler

For more information about Basler's offering for your individual embedded vision application please visit:

baslerweb.com/embedded

Or stay in touch through our social media channels:

How Does Basler Ensure Superior Quality and Reliable High Performance?

Our approach to quality assurance is rigorous: we continually audit all facets of our business to ensure powerful performance, increase efficiency and reduce costs for our customers. We are compliant with all major quality standards including ISO 9001, CE, RoHS, and more.

To ensure consistently high product quality, we employ several quality inspection procedures during manufacturing. Every Basler camera is subjected to exhaustive optical and mechanical tests before leaving the factory. Regardless of what technology or camera model you choose you can be assured of consistent performance.

> Basler has always been in on the ground floor of game-changing camera technology and it's in our DNA to move forward. By embracing and shaping embedded vision technology, we bring new value to applications that touch our lives every day.
>
> *Arndt Bake*
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