

**OPTOMOTIVE**



## HIGH-SPEED **CAMERAS**

CUTTING-EDGE,  
HIGH-PERFORMANCE  
CAMERAS

/ FPGA TECHNOLOGY  
FOR REAL TIME IMAGE  
PROCESSING

/ STANDARD AND FULLY  
CUSTOMIZED IMAGING  
SOLUTIONS

## CUSTOMIZABLE HIGH-PERFORMANCE, HIGH-SPEED FPGA CAMERAS

We design and produce cutting-edge, high-performance cameras which are based on FPGA technology. The fully programmable FPGAs offer massive computational power which, with image pre-processing inside the camera, substantially reduce bandwidth and offer the most suitable solution for growing sensor speeds and resolutions. We are an established and trusted supplier to OEMs and system integrators.

We specialize in the following camera solutions:

- High-speed Peak detection for laser triangulation;
- High-speed BLOB detection;
- RLE compression and
- Other high-speed machine vision algorithms integrated in cameras.

We provide complete camera solutions with our standard product line, technical expertise and fully customized cameras.

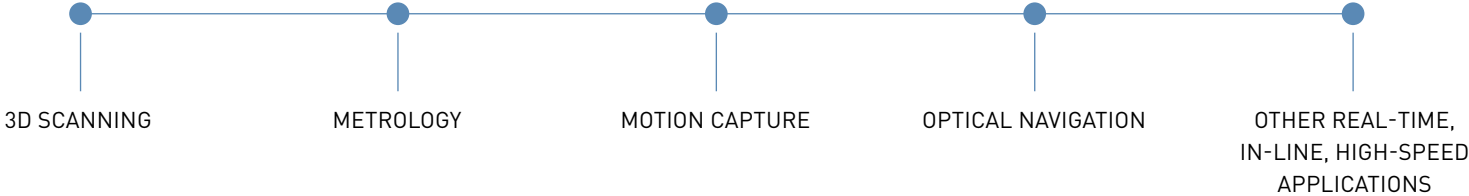
# CUSTOMIZED SOLUTIONS TAILORED TO YOUR NEEDS

Should you require customized camera solutions we can provide you with a machine vision solution which will meet your precise needs and specifications. We offer an entire framework for improving the performance of your existing image processing with high-performance programmable cameras and provide you with a new image processing solution tailored exactly to your business.

Optomotive develops camera solutions for most complex applications system integrators are using today. We are an innovative and reliable long-term supplier of cameras with embedded image pre-processing for one of the fastest and most accurate scanners on the market which is widely used for 3D scanning in the production processes of the world's biggest mobile phone manufacturers.

# COMPANIES AND INDUSTRIES

Optomotive provides solutions for system integrators and OEMs in the following fields:



# CUTTING-EDGE CAMERA SOLUTIONS

Whichever industry you are in you want to achieve high throughput, tight tolerances and 100% automated inspection. Optomotive cameras are designed to perform at high-resolution and at high-framerate to satisfy your growing needs.

We use high-speed industrial CMOS imaging sensors, which can acquire video at rates up to 100.000 frames per second. The image processing unit is a programmable logic device FPGA, coupled with high-speed memory. This reconfigurable image processor enables parallel real-time image processing. Pre-processing includes for example laser line position detection, BLOB centroid calculation, color processing, compression and other algorithms.

For developers and OEM projects we offer EVO cameras which can be freely programmed and are supplied with hardware/software development kits. All of this makes our cameras unique computer vision machines which are also capable of standalone operations.

Our camera solutions range from standard camera assortment to semi-customized cameras and fully customized camera solutions.

## STANDARD CAMERAS

Our standard assortment of modular high-speed intelligent cameras consists of the following camera families:

- Smilodon
- Spinosaurus
- T-REX and
- Velociraptor

They cover a wide array of uses with their flexible architecture. The user has full flexibility to select cameras with housing (regular and IP67) or board-level cameras. The camera sensors can be selected depending on resolution and spectral options to exactly match the user's needs. There are also single-head or multi-head solutions available in our range of options. Thanks to built-in large FPGAs the cameras are innovative components for demanding real-time machine vision in industrial and other applications.

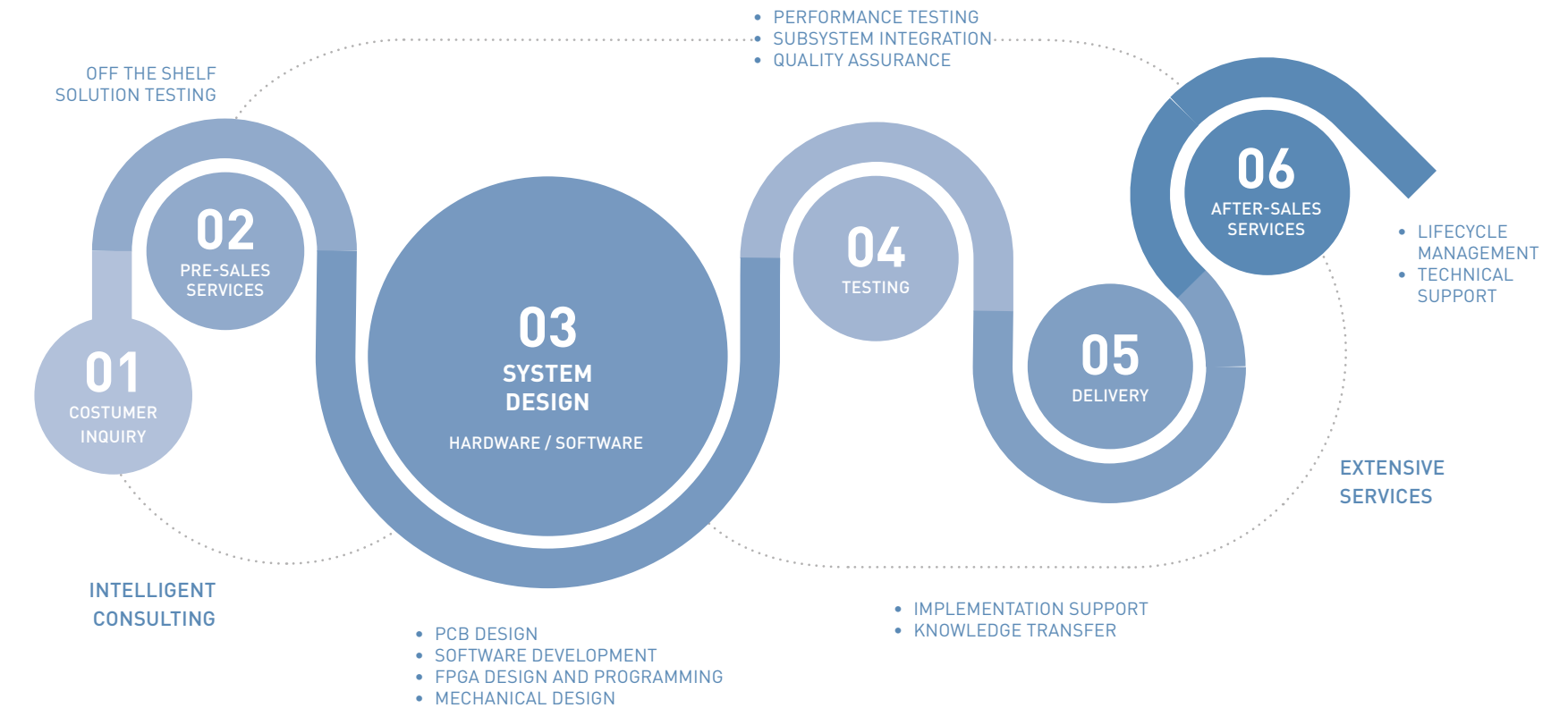
## CUSTOMIZED CAMERAS

Should you require customized camera solutions we can provide you with a machine vision solution which will meet your precise needs and specifications.

We offer an entire framework for improving the performance of your existing image processing with high-performance programmable cameras and can introduce you a new image processing solutions that are tailored exactly to your business needs. When you are developing new applications that require a high-speed response we can provide you extensive support with image processing embedded inside our camera solutions. Our experienced engineering team can support your technical department in the development of camera hardware and software.

We offer several levels of customization:

- Camera integration into your existing product
- Sensor integration into your new product
- PCB and firmware design
- IP core development
- Software and mechanical design
- Production.



# FPGA TECHNOLOGY

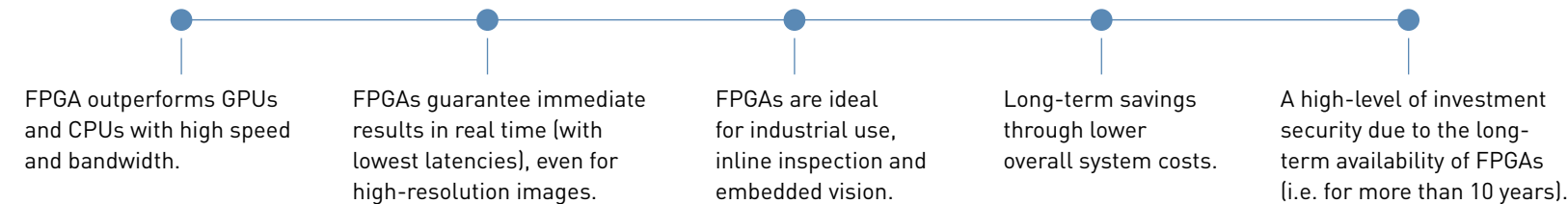
## FPGA (Field-Programmable Gate Array):

an integrated circuit that supports reconfigurable computing and enables hardware updates.

### FPGA enables:

- Programming product features;
- Adapting to new standards and
- Reconfiguring hardware for specific applications (even after hardware installation).

### The Benefits of FPGA



### FPGA Programming Made Easy

- **FPGA code portability guaranteed**
  - The same FPGA code can be used across different FPGA families and vendors and
  - The code has unlimited validity.
- **The FPGA design can be upgraded throughout entire camera's lifetime**
  - After system deployment features can be added during the camera's lifetime through endless firmware upgrade possibilities.
- **No experience with FPGA coding?**
  - We provide the complete solution with FPGA coding: the only thing we need is the original algorithm and
  - We provide training for your engineers.

# SOFTWARE

All our cameras use our own in-house developed GUIs which are shipped with every camera:

## VEVO\_API

For use with all Optomotive EVO cameras, Smilodon, Spinosaurus, T-REX and Velociraptor. MS Windows Dynamic Link Library (DLL)-based Application Programmer Interface (API) used to communicate with Gigabit Ethernet based OptoMotive cameras for usage of cameras in custom applications and in third party applications that allow calling of external DLLs (MATLAB(R), LabVIEW(R), etc.).

Kernel filter driver for reliable transmission

Full source included.

Examples of usage in C, C# included.

## OPTOSTREAM API

For use with GigE Vision compliant cameras.

MS Windows Dynamic Link Library (DLL)-based Application Programmer Interface (API).

## SHARKI

For use with Velociraptor HS camera. MS Windows-based Graphical User Interface (GUI) for video/image acquisition, storing and camera control.

Intuitive and simple to use.

Basic video manipulations included: crop parts of video, replay

Written in C# .NET 4.0 using Windows Presentation Foundation and Silverlight achieving a highly modern professional look.

Furthermore, user application access to OptoMotive cameras is provided through a simple and documented C API by providing a dynamically linked library.

## OPTOMOTIVE TECHNICAL SERVICE

Providing the industry with most innovative Machine Vision systems is the aim of OptoMotive's service.

You can choose from our existing range of various IP cores, hardware and software solutions.

Or you can employ our competent development team to provide you with solutions that most suit your needs.

## OPTOMOTIVE TECHNICAL SUPPORT

By delivering competent technical support, OptoMotive ensures its customers complete and reliable after sales service.

## OPTOMOTIVE DEVELOPMENT

OptoMotive employs highly competent engineers from different technical fields, from physics to mechanical engineering, from computer science to electrical engineering.

With its broad research and development network, which includes different highly professional high-tech companies, institutes and university laboratories, no task is too difficult for OptoMotive.

# CAMERA FAMILIES

/ SMILODON  
SPINOSAURUS  
T-REX  
VELOCIRAPTOR

/ The eye of the master  
will do more work than  
both his hands.

- Benjamin Franklin

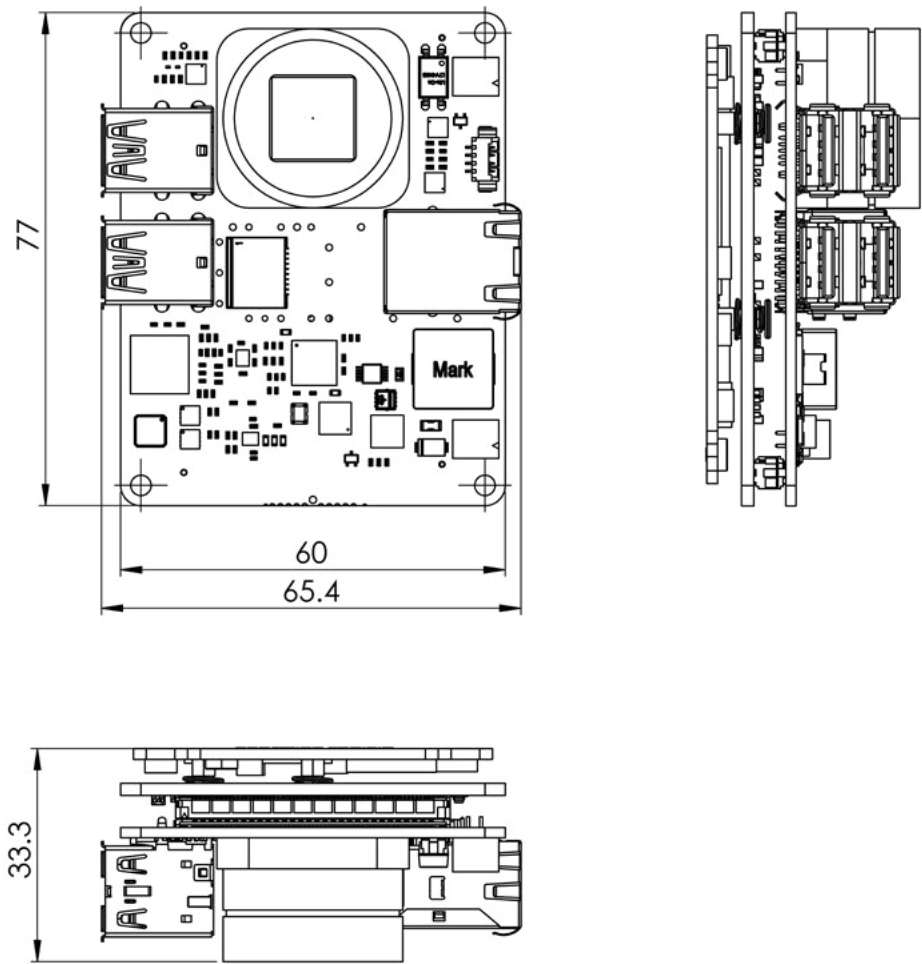
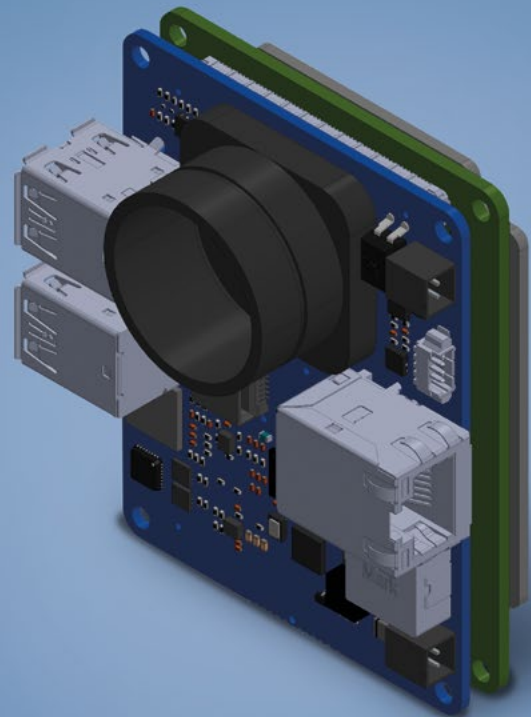


# CAMERA FAMILIES

SMILODON		SPINOSAURUS				T-REX		VELOCIRAPTOR			
Camera	SMILODON 10G EVO	Camera	SPINOSAURUS EVO	SPINOSAURUS LX EVO	Camera	T-REX EVO	Camera	VELOCIRAPTOR EVO	VELOCIRAPTOR HS		
Description	The Smilodon EVO 10G is a global shutter industrial camera based on Xilinx Kria SoM and Gpixel GMAX 5M to 25M high-speed monochrome, colour or near IR imaging sensor - 3D camera with built-in Peak Detection, or with integrated BLOB Detection or RLE Compression. 1G or 10G SFP+ interface.	Description	The Spinosaurus EVO is a highly customizable and user-programmable SoC FPGA based high-speed camera with integrated Sony Pregius Gen3 0.5M to 7.1M high-speed monochrome or colour imaging sensors - 3D camera with built-in Peak Detection or with integrated BLOB Detection or RLE Compression. It has a 10G SFP+ interface.	The Spinosaurus LX EVO is a highly customizable and user-programmable SoC FPGA based high-speed camera with the fastest imaging sensor in our line-up Luxima LUX2810 2.8M monochrome or colour imaging sensor - 3D camera with built-in Peak Detection, or with integrated BLOB Detection or RLE Compression. It has a 10G SFP+ interface.	Description	The T-REX EVO is an entry level user-programmable SoC FPGA based high-speed smart camera with integrated AMS CMV2000/4000 monochrome, colour or near IR 2M to 4M imaging sensors - 3D Camera with built-in Peak Detection, or with integrated BLOB Detection or RLE Compression. It has a 1G PoE interface.	Description	The Velociraptor EVO is an entry level user-programmable FPGA based high-speed smart camera with integrated AMS CMV2000/4000 monochrome, colour or near IR 2M to 4M imaging sensors - 3D Camera with built-in Peak Detection, or with integrated BLOB detection or RLE compression. It has a 1G PoE interface.	The Velociraptor HS is an entry level high-speed camera for long term high frame rate video recording with integrated AMS CMV2000/4000 monochrome or colour 2M to 4M imaging sensors. It has a 1G PoE interface. The camera has on-board JPEG compression. It was developed to fill the gap in the market between standard industrial cameras and high-speed cameras.		
Use	3D Camera BLOB detection RLE compression	Use	3D Camera BLOB detection RLE compression	3D Camera BLOB detection RLE compression	Use	3D Camera BLOB detection RLE compression	Use	3D Camera BLOB detection RLE compression	High-Speed Video Recording		
Resolution	5M-25M	Resolution	0.5M-7.1M	2.8M	Resolution	2M-4M	Resolution	2M-4M	2M-4M		
Spectral Option	monochrome color	Spectral Option	monochrome color	monochrome color	Spectral Option	monochrome color near-IR	Spectral Option	monochrome color near-IR	monochrome color near-IR		
Interface	1G or 10G SFP+	Interface	10G SFP+	10G SFP+	Interface	1G PoE	Interface	1G PoE	1G PoE		
14		18				22		26			
								30			



SMILODON 10G EVO



KEY CAMERA FEATURES

Smilodon 10G EVO				
Resolution	5.0 MP	9 MP	18 MP	25 MP
Active Pixels (HxV)	2600 x 2160	4200 x 2160	4508 x 4096	5120 x 5120
Frame Rate	290 FPS	290 FPS	139 FPS	150 FPS
Sensor Format	1/2"CMOS	2/3"CMOS	1"CMOS	1.1"CMOS
Pixel Size	2.5 µm	2.5 µm	2.5 µm	2.5 µm
Sensor: Gpixel Sensor	GMAX2505	GMAX2509	GMAX2518	GMAX0505
Interface	1 or 10 Gigabit Ethernet SFP+ for fast data transmission			
Program-mable and Reconfigu-rable FPGA	Xilinx Zynq Ultrascale+ Kria K26			

- Turbocharged industrial Gpixel GMAX25xx sensors, Color (Bayer) and
- Possible interfaces: 1 or 10 GigE.

**SMILODON 10G EVO** is a highly customizable and user-programmable FPGA-based high-speed smart camera featuring a high-performance FPGA. It is a camera with a Xilinx Zynq FPGA, high-speed imaging sensor and a 1 or 10 Gigabit Ethernet. It includes high-performance ARM System-on-Chip (SoC) technology, combined with high-speed industrial Gpixel imaging sensors.

Smilodon 10G EVO includes full customizable and user-programmable open-reference design for a high-speed FPGA-based camera and application development system. Its emphasis is on an open hardware/software development model, high-frame rates, real-time image processing on FPGA and modern graphical user interface support on the PC side.

A suite of versatile and high-performance tools for Xilinx Zynq Ultrascale+ SoC FPGA is used to develop algorithms and process data in real-time. Images are acquired by 4 different Gpixel GMAX25xx sensors with up to 48x LVDS interface (46 Gbps), achieving brilliant images at a very high speed. The on-board 4GB DDR4 memory with 19 GB/s of bandwidth enables usage of complex buffered image processing.

The reference design can be easily edited with standard Xilinx Vivado tools. OptoMotive’s custom IP cores seamlessly integrate inside the Xilinx Vivado toolchain. A large portion of the FPGA (PL) is free for the programming and development of new algorithms or the

implementation of additional IP cores. The 1.2 GHz Quad Core ARM Cortex A53 Programmable Subsystem runs a Linux OS with a custom-made EVO control and streaming stack (including Zero-copy TCP/IP stack). The SoC also includes dual 600MHz Cortex R5 processors which are free for user data processing. User applications or custom data post-processing can easily be added to the existing design.

TARGETED FOR:

- Laser triangulation - with a ready-made Peak detector on-board image processing core;
- Motion capture - with a ready-made BLOB detector or Running Length Encoder (RLE) on-board image processing core;
- Industrial process automation - to count, detect, check, verify, read, inspect and test different products, levels, components, etc. at incredible speed and
- Industrial quality control: to inspect defects, cracks or surface blemishes, size, position, dimension and color, foreign objects, quality General R&D.

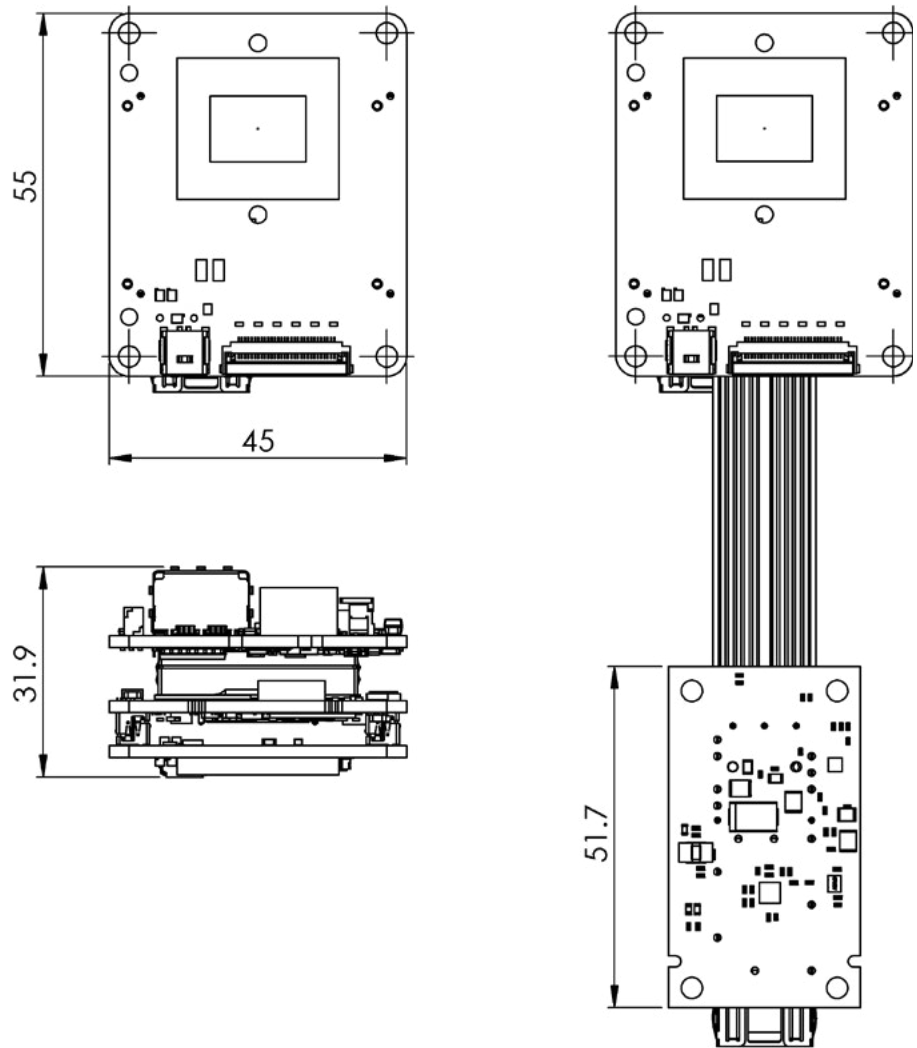


SMILODON 10G EVO

CAMERA FAMILY		SMILODON 10G EVO			
IMAGING SENSOR	Camera Model	5	9	18	25
	Model (Gpixel)	GMAX2505	GMAX2509	GMAX2518	GMAX0505
	Monochrome (M) Bayer Color (C) VIS-NIR (IR)	M or C	M or C	M or C	M or C or IR
	Diagonal mm	8.45 [1/2"]	11.8 [2/3"]	15.2 [1"]	18.1 [1.1"]
	Active pixels H x V	2600 x 2160	4200 x 2160	4508 x 4096	5120 x 5120
	Frame Rate (Full Frame)	290 FPS	290 FPS	139 FPS	150 FPS
	Pixel Size	2.5 µm	2.5 µm	2.5 µm	2.5 µm
	Dynamic Range 10bit/12bit	62/65 dB	62/65 dB	62/67 dB	60/65 dB
	ADC Resolution	10/12 bit			
	Analogue Gain	x1 – x2, step of x0.25 @10bit x1 – x4, step of x0.25 @12bit			
	Region of Interest	YES, with 16 pixel increments			
	Shutter Type	Electronic global shutter			
	Shutter Time	5 us – 90 s			
	Pixel Clock Speed	From 1.5 to 3.8 Gpix/s			
	Exposure	Linear, odd/even row HDR			
FEATURE	Pixel Correction	Dead pixel, LUT, flat-field correction			
	Trigger Modes	Free running, trigger, overlap, pulse width			
	Trigger Features	Delay 0 – 1000 ms, LP Filter 1.5Hz - 100 kHz			
	Shutter Resolution	TBD			

CAMERA FAMILY		SMILODON 10G EVO	
PROCESSING	FPGA	Xilinx Zynq Ultrascale+ Kria K26	
	Free FPGA %	> 50%	
	Volatile Memory	4 GB DDR4 with 19.2 GB/s bandwidth	
	Non-volatile Memory	64 MB QSPI flash, 16 GB eMMC	
MECHANICAL	Lens Mount	C-mount (1" 32G thread)	
	Temp Range	0 - 50°C	
	Mass	TBD	
	Protection	TBD	
	Housing Material	CNC-machined aluminum, anodized	
	RoHS	RoHS compliant	
ELECTRIC	Fixing Holes	4x M3 OEM	
	Input Voltage	DC 9-50V	
	Consumption	up to 30W	
	IO Isolation	1x IN / 1x OUT opto-isolated	
	Connectors	10G SFP+, 1G RJ45, 4x USB, 10 pin Hirose HR10A	
FUNCTIONALITIES	On-board Image Processing	As an option (if an IP Core is integrated)	
	Open Reference Design	Yes	
	Open architecture	Yes	
	Software	Compatible with OptoMotive EVO software (full source included)	
	Operating System	Windows 7, Windows 10, 64bit or 32bit	
	Development Tools	Xilinx Vivado/SDK version 2021 or later Microsoft Visual Studio 2017 or later	

SPINOSAURUS EVO



KEY CAMERA FEATURES

SPINOSAURUS EVO					
Resolution	0.5 MP	2.0 MP	2.8 MP	1.7 MP	7.1 MP
Active Pixels (HxV)	816 x 624	1632 x 1248	1944 x 1427	1608 x 1104	3216 x 2208
Frame Rate	1590 FPS	470 FPS	408 FPS	660 FPS	200 FPS
Sensor Format	1/1.7" CMOS	1/1.7" CMOS	2/3" CMOS	1.1" CMOS	1.1" CMOS
Pixel Size	9 µm	4.5 µm		9 µm	4.5 µm
Sensor: SONY High-Speed Image Sensor	IMX426	IMX422	IMX421	IMX425	IMX420
Interface	10 Gigabit Ethernet SFP+ for fast data transmission				
Program-mable and Reconfigu-rable FPGA	Xilinx Zynq Ultrascale				

**SPINOSAURUS EVO** is a highly customizable and user-programmable FPGA based on high-speed smart cameras, is a high-end FPGA camera with a Xilinx Zynq FPGA and high-speed imaging sensor and a 10 Gigabit Ethernet. It includes high-performance ARM System-on-Chip (SoC) technology combined with a turbocharged industrial SONY imaging sensor.

With high-performance FPGA System-on-Chip (SoC) technology, the Spinosaurus EVO camera family opens new dimensions in computer vision. It is a global shutter industrial camera with high frame rates and an open FPGA architecture. With FPGA processing power the image processing algorithms can run in real-time on the camera. Just add your imagination.

Spinosaurus EVO includes full customizable and user-programmable open reference design for a high-speed, FPGA-based camera and application development system. Its emphasis is on an open hardware/software development model, high-frame rates, real-time image processing on FPGA and modern graphical user interface support on the PC side.

A suite of versatile and high-performance tools for Xilinx Zynq Ultrascale+ SoC FPGA are available to develop algorithms and process data in real-time. Images are acquired by SONY PREGIUS GEN3 sensors with a SLVS-EC v1.2 interface (8x 2.3 Gbps) achieving a brilliant image at very high speed. The on-board 4GB LPDDR4 memory with 9.6 GB/s of bandwidth enables usage

of complex buffered image processing. The reference design can be easily edited with standard Xilinx Vivado tools. OptoMotive ´s custom IP cores seamlessly integrate inside the Xilinx Vivado toolchain. A large portion of FPGA (PL) is free for the programming and development of new algorithms or the implementation of additional IP cores. The 1.2 GHz Dual Core ARM Cortex A53 Programmable Subsystem runs a Linux OS with custom-made EVO control and streaming stack (including Zero-copy TCP/IP stack). The SoC also includes dual 600MHz Cortex R5 processors which are free for user data processing. User applications or custom data post-processing can be easily added to any existing design.

APPLICATIONS:

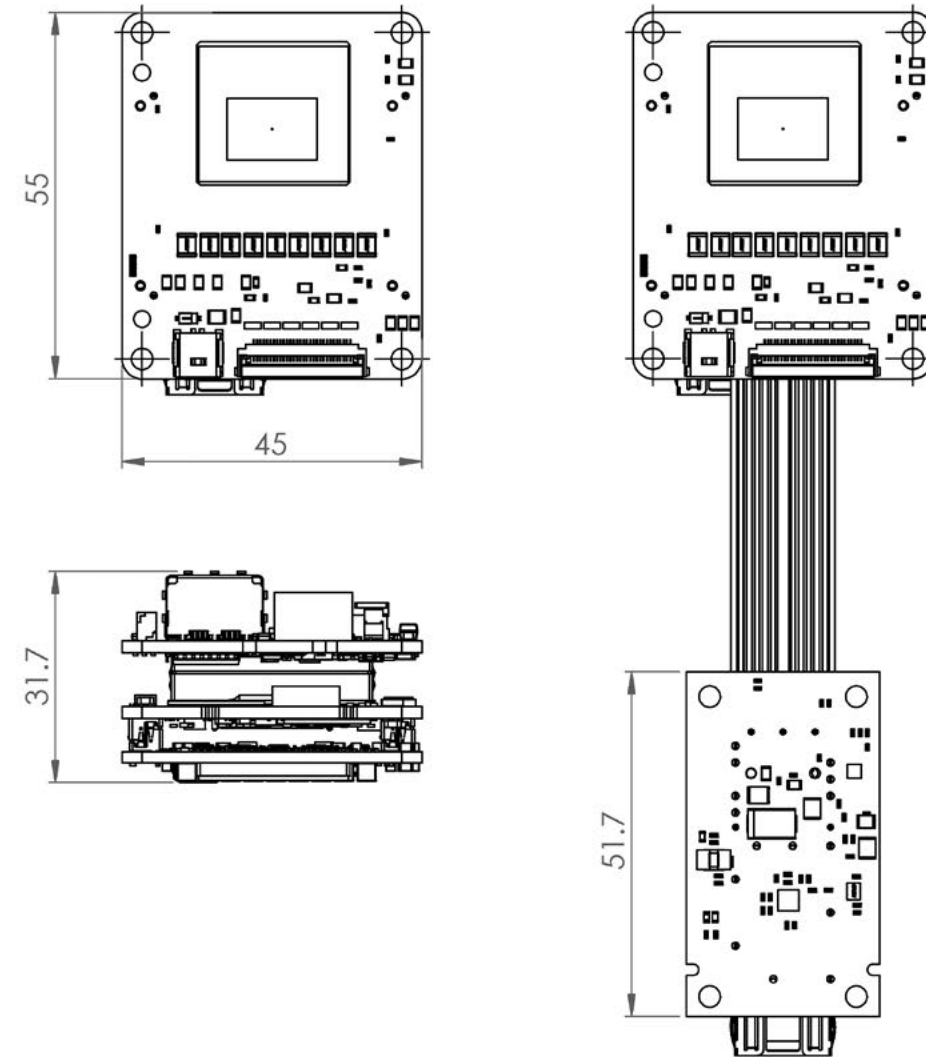
- Laser triangulation - with a ready-made Peak detector on-board image processing core;
- Motion capture - with a ready-made BLOB detector or Running Length Encoder (RLE) on-board image processing core;
- Industrial process automation - to count, detect, check, verify, read, inspect and test different products, levels, components, etc. at incredible speed;
- Industrial quality control - to inspect defects, cracks or surface blemishes, size, position, dimension and color, foreign objects or quality and
- General R&D.

SPINOSAURUS EVO

CAMERA FAMILY		SPINOSAURUS EVO				
IMAGING SENSOR	Camera Model	0.5	2.0	2.8	1.7	7.1
	Model (SONY)	IMX426	IMX422	IMX421	IMX425	IMX420
	Monochrome (M) Bayer Color (C)	M or C	M or C	M or C	M or C	M or C
	Diagonal mm	9.25 [1/1.7"]	9.25 [1/1.7"]	10.97 [2/3"]	17.55 [1.1"]	17.55 [1.1"]
	Active Pixels H x V	816 x 624	1632 x 1248	1944 x 1427	1608 x 1104	3216 x 2208
	Frame Rate (Full Frame)	1590 FPS	470 FPS	408 FPS	660 FPS	200 FPS
	Pixel Size	9 µm	4.5 µm		9 µm	4.5 µm
	Dynamic Range	86 dB	80 dB		86 dB	80 dB
	ADC Resolution	8/10/12 bit				
	Analogue Gain	0-48dB at 0.1dB step				
	Region of Interest	YES, with 16 pixel increments				
	Shutter Type	Electronic global shutter				
	Shutter Time	5 µs – 90 s				
	Pixel Clock Speed	1.9 Gpix/s [16 pixels @ 118.8 MHz]				
	FEATURES	Exposure	Linear, dual gain high dynamic range			
Pixel Correction		Dead pixel correction and programmable LUT				
Trigger Modes		Free running, trigger, overlap and pulse width				
Trigger Features		Delay 0 – 1000 ms, LP Filter 1.5Hz - 100 kHz				
Shutter Resolution		1.56 µs				

CAMERA FAMILY		SPINOSAURUS EVO	
PROCESSING	FPGA	Xilinx Zynq Ultrascale+ ZU4CG	
	Free FPGA %	Up to 50%, most of 728 slices of DSP are free.	
	Volatile Memory	2 GB LPDDR4 with 9.6 GB/s bandwidth	
	Non-volatile Memory	64 MB QSPI flash, 8 GB eMMC	
MECHANICAL	Lens Mount	C-mount [1" 32G thread]	
	Temp Range	0 - 50°C	
	Mass	TBD	
	Protection	Up to IP67 with housing	
	Housing Material	CNC-machined aluminum, anodized	
	RoHS	RoHS compliant	
ELECTRICAL	Fixing Holes	4x M3 OEM / 5 x M6 on housing	
	Input Voltage	DC 9-36V or 5V (OEM)	
	Consumption	up to 30W	
	IO	20x 3.3V TTL ZIF	
	IO Isolation	3x IN / 3x OUT opto-isolated	
	Connectors	10G SFP+, 10 pin Hirose HR10A, ZIF or OEM	
FUNCTIONALITIES	On-board Image Processing	As an option (if an IP core is integrated)	
	Open Reference Design	Yes	
	Open Architecture	Yes	
	Software	Compatible with OptoMotive EVO software [full source included]	
	Operating System	Windows 7, Windows 10, 64bit or 32bit	
	Development Tools	Xilinx Vivado/SDK version 2018.2 or later. Microsoft Visual Studio 2017	

# SPINOSAURUS LX EVO



## KEY CAMERA FEATURES

- Resolution: 3.0 MP (2112 x 1432);
- Frame Rate: 934 fps;
- Sensor Format: 1"CMOS;
- Pixel Size: 6.6  $\mu\text{m}$ ;
- Sensor: high-speed industrial Luxima LUX2810 sensor, color (Bayer filter), monochrome;
- Interface: 10 Gigabit Ethernet SFP+ for fast data transmission;
- Programmable and reconfigurable FPGA with Quad ARM processor Zynq Ultrascale+.

**Spinosaurus LX EVO** is a highly customizable and user-programmable FPGA-based high-speed smart cameras, is a high-end FPGA camera with a Xilinx Zynq FPGA and high-speed imaging sensor and a 10 Gigabit Ethernet. It includes high-performance ARM System-on-Chip (SoC) technology combined with turbocharged industrial LUXIMA imaging sensors.

With high-performance FPGA System-on-Chip (SoC) technology, Spinosaurus LX EVO camera opens new dimensions in computer vision. It is a global shutter industrial camera with incredible frame rates and an open FPGA architecture. With its FPGA processing power the image processing algorithms can run in real-time on the camera. Spinosaurus LX EVO includes a fully customizable and user-programmable open-reference design for its high-speed FPGA-based camera and application development system. Its emphasis is on an open hardware/software development model, high-frame rates, real-time image processing on FPGA and modern graphical user interface support on the PC side.

A suite of versatile and high-performance tools for Xilinx Zynq Ultrascale+ SoC FPGA is used to develop algorithms and process data in real-time. Images are acquired by Luxima LUX2810 sensors with 32x LVDS interface (29 Gbps) achieving brilliant images at a very high speed. The on-board 2GB LPDDR4 memory with 19 GB/s of bandwidth enables usage of complex buffered image processing.

The reference design can be easily edited with standard Xilinx Vivado tools. OptoMotive's custom IP cores seamlessly integrate inside the Xilinx Vivado toolchain. A large portion of FPGA (PL) is free for the programming and development of new algorithms, or the implementation of additional IP cores. The 1.2 GHz Quad Core ARM Cortex A53 Programmable Subsystem runs Linux OS with custom made EVO control and streaming stack (including Zero-copy TCP/IP stack). The SoC also includes dual 600MHz Cortex R5 processors which are free for user data processing. User applications or custom data post-processing can easily be added to the existing design.

## APPLICATIONS:

- Laser triangulation- with a ready-made Peak detector on-board image processing core;
- Motion capture - with a ready-made BLOB detector or Running Length Encoder (RLE) on-board image processing core;
- Industrial process automation - to count, detect, check, verify, read, inspect and test different products, levels, components, etc. at an incredible speed;
- Industrial quality control - to inspect defects, cracks or surface blemishes, size, position, dimension and color, foreign objects or quality and
- General R&D.

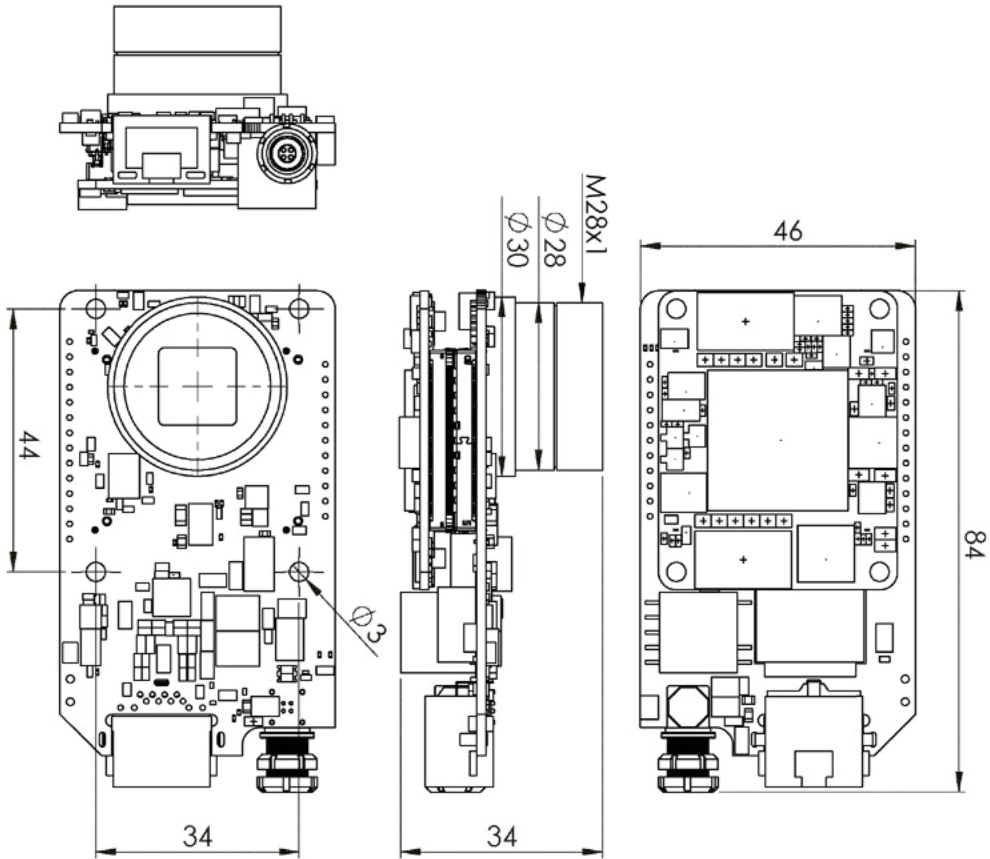
SPINOSAURUS LX EVO

CAMERA FAMILY		SPINOSAURUS LX EVO	
IMAGING SENSOR	Camera model	3.0M	3.0C
	Model (Luxima)	LUX2810M	LUX2810C
	Color Filter	Mono (M)	Bayer (C)
	Diagonal mm	16.84 (1")	
	Active pixels H x V	2112 x 1432	
	Frame Rate (Full Frame)	778 FPS (rev 1), 934 FPS (rev 3)	
	Pixel Size	6.6 µm	
	Dynamic Range	54 dB	
	ADC Resolution	12 bit	
	Analogue Gain	1x-8x at 1x step	
	Region of Interest	YES, with 16 pixel increments	
	Shutter Type	Electronic global shutter	
	Shutter Time	5 µs – 90 s	
	Pixel Clock Speed	2.4 Gpix/s (16 pixels @ 150 MHz for rev 1) 2.88 Gpix/s (16 pixels @ 180 MHz for rev 3)	
	Exposure	Linear, Dual Gain High Dynamic Range	
FEATURES	Pixel Correction	Dead pixel correction and Programmable LUT	
	Trigger Modes	Free running, trigger, overlap, pulse width	
	Trigger Features	Delay 0 – 1000 ms, LP Filter 1.5Hz - 100 kHz	
	Shutter Resolution	1.56 µs	

CAMERA FAMILY		SPINOSAURUS LX EVO	
PROCESSING	FPGA	Xilinx Zynq Ultrascale+ ZU4CG	
	Free FPGA %	Up to 50%, most of the 728 slices of DSP are free.	
	Volatile Memory	2 GB LPDDR4 with 9.6 GB/s bandwidth	
	Non-volatile Memory	64 MB QSPI flash, 8 GB eMMC	
MECHANICAL	Lens Mount	C-mount (1" 32G thread)	
	Temp Range	0 - 50°C	
	Mass	TBD	
	Protection	Up to IP67 with housing	
	Housing Material	CNC-machined aluminum, anodized	
	RoHS	RoHS compliant	
ELECTRICAL	Fixing Holes	4x M3 OEM	
	Input Voltage	DC 9-36V or 5V (OEM)	
	Consumption	up to 30W	
	IO	20x 3.3V TTL ZIF	
	IO Isolation	3x IN / 3x OUT opto-isolated	
	Connectors	10G SFP+, 10 pin Hirose HR10A, ZIF on OEM	
FUNCTIONALITIES	On-board Image Processing	As an option (if an IP Core is integrated)	
	Open Reference Design	Yes	
	Open Architecture	Yes	
	Software	Compatible with OptoMotive EVO software (full source included)	
	Operating System	Windows 7, Windows 10, 64bit or 32bit	
	Development Tools	Xilinx Vivado/SDK version 2018.2 or later. Microsoft Visual Studio 2017	



T-REX EVO



KEY CAMERA FEATURES

T-REX EVO		
Resolution	2.2 MP	4.2 MP
Active Pixels (HxV)	2048 x 1088	2048 x 2048
Frame Rate	331 FPS	176 FPS
Sensor Format	2/3"CMOS	1" CMOS
Pixel Size	5.5 μm	5.5 μm
Sensor: CMOSIS Image Sensor	CMV2000	CMV4000
Interface	1 Gigabit Ethernet SFP+ for fast data transmission	
Programmable and Reconfigurable FPGA	Zynq 7020	

T-REX EVO is a highly customizable and user-programmable FPGA-based high-speed smart camera which features a high-end FPGA camera with a Xilinx Zynq FPGA and a high-speed imaging sensor and a Gigabit Ethernet. It includes ARM System-on-Chip (SoC) technology combined with a turbocharged industrial CMOSIS imaging sensor.

With high-performance FPGA System-on-Chip (SoC) technology, the T-REX EVO camera family opens new dimensions in computer vision. It is a global shutter industrial camera with incredible frame rates and an open FPGA architecture. With FPGA processing power the image processing algorithms can run in real time on the camera: just add your imagination.

T-REX EVO incorporates a fully customizable and user-programmable open-reference design for its high-speed FPGA-based camera and application development system. Its emphasis is on an open hardware/software development model, high-frame rates, real-time image processing on FPGA and modern graphical user-interface support.

A suite of intermediate, versatile Xilinx Zynq 7020 FPGAs is used to develop algorithms and process data in real-time. Images are acquired by a CMOSIS sensor, CMV2000 (2048x1088 pixels, 2/3" size) or CMV4000 (2048x2048 pixels, 1" size). The sensor outputs 760 million pixels per second resulting in 331 FPS (CMV2000) and 176 FPS (CMV4000) at full frame. The on-

board 512MB LPDDR2 memory with 3.2GB/s of bandwidth enables usage of complex buffered image processing.

The reference design can be easily edited with standard Xilinx Vivado tools. OptoMotive 's custom IP cores seamlessly integrate inside the Xilinx Vivado toolchain. A large portion of FPGA (PL) is free for the programming and development of new algorithms or the implementation of additional IP cores. The 700MHz Dual Core ARM Cortex A9 Programmable Subsystem runs Linux OS with a custom-made EVO control and streaming stack. User applications or custom data post-processing can easily be added to the existing design.

TARGETED FOR:

- Laser triangulation - with a ready-made Peak detector with an on-board image processing core;
- Motion capture - with a ready-made BLOB detector or Running Length Encoder (RLE) on-board image processing core;
- Industrial process automation - to count, detect, check, verify, read, inspect and test different products, levels, components, etc. at and incredible speed;
- Industrial quality control - to inspect defects, cracks or surface blemishes, size, position, dimension and color, foreign objects or quality and
- General R&D.

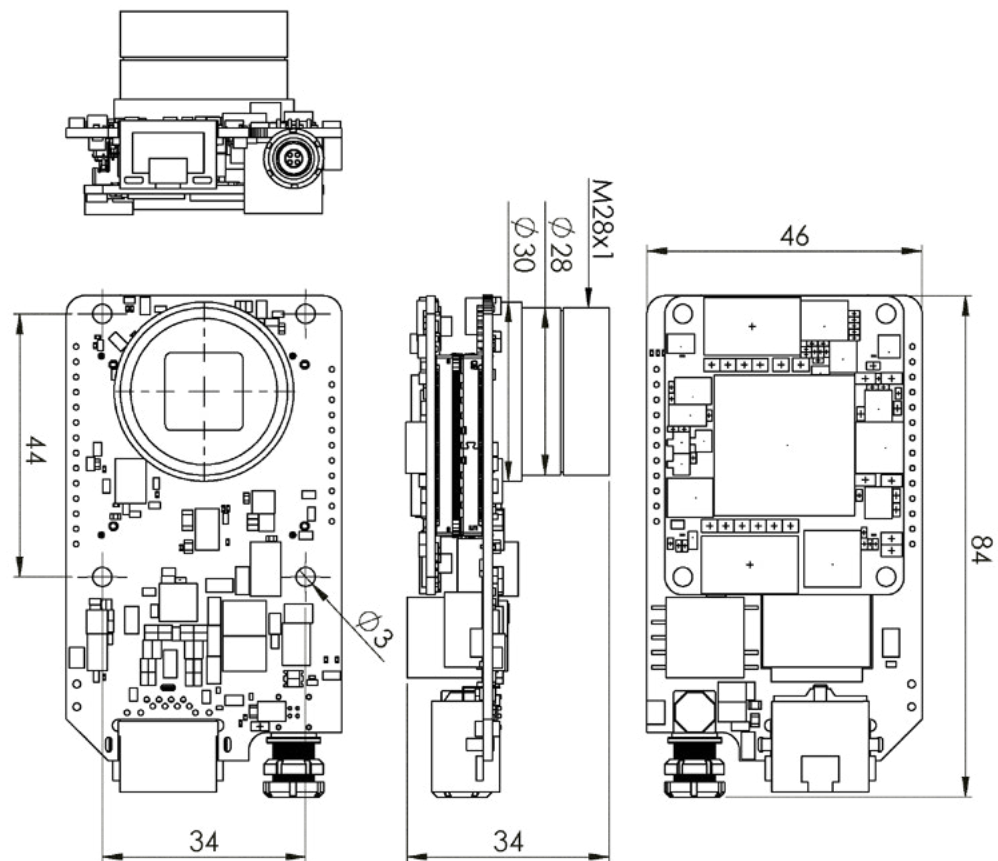


T-REX EVO

CAMERA FAMILY		T-REX EVO					
Camera model	2.2M	2.2IR	2.2C	4.2M	4.2IR	4.2C	
IMAGING SENSOR	Model (CMOSIS)	CMV2000			CMV4000		
		2E5M1PP	E12M1PP	2E5C1PP	2E5M1PP	E12M1PP	2E5C1PP
	Color Filter	None	None	Bayer	None	None	Bayer
	Diagonal	12.7 mm [2/3"]			15.92 mm [1"]		
	Active Pixels	2048 x 1088			2048 x 2048		
	Pixel Size	5.5 µm x 5.5 µm					
	Pixel Data Formats	MONO8 (M and IR), BAYER8 (C only)					
	Region of Interest	YES, with 8 pixel increments					
	Pixel Clock Speed	760 MHz (8 pixels @ 95 MHz)					
	Frame Rate (Full Frame)	331 FPS			176 FPS		
	RAW Frame Rate*	54 FPS			26 FPS		
	ADC Resolution	10 bit					
	Analogue Gain	1 - 3.2x					
	Shutter Type	Electronic global shutter					
	Shutter Time	2.4 us – 90 s					
Exposure	Linear, 3 slope high dynamic range						
Dynamic Range	60 dB						
FEATURES	Pixel Correction	Dead pixel correction and programmable LUT					
	Trigger Modes	Free running, trigger, overlap and pulse width					
	Trigger Features	Delay 0 – 1000 ms LP Filter 1.5Hz - 100 kHz					
	Shutter Resolution	21 ns					

CAMERA FAMILY		T-REX EVO	
PROCESSING	FPGA	Zynq 7020	
	Free FPGA %	Up to 50%, most of the 220 slices of DSP are free.	
	Volatile Memory	512MB LPDDR2	
	Non-volatile Memory	32MB QSPI flash, optional eMMC	
MECHANICAL	Lens Mount	C-mount (1" 32G thread)	
	Temp Range	0 - 50°C	
	Mass	50 g OEM / 290 g with housing	
	Protection	Up to IP67 with housing	
	Housing Material	CNC-machined aluminum, anodized in a special OptoMotive blue color	
	RoHS	RoHS compliant	
ELECTRICAL	Fixing Holes	4x M3 OEM / 5 x M6 on housing	
	Input voltage	Power over Ethernet 42-57V or 5V (OEM)	
	Consumption	up to 11W	
	IO	3x bidirectional 5V TTL	
	IO Isolation	No, but camera has 1.5kV PoE isolation	
	Connectors	RJ45, 4 pin LEMO EXG 00 304	
FUNCTIONALITIES	On-board Image Processing	As an option (if an IP Core is integrated)	
	Open Reference Design	Yes	
	Open Architecture	Yes	
	Software	Compatible with OptoMotive EVO software (full source included)	
	Operating System	Windows 7, Windows 10, 64bit or 32bit	
	Development Tools	Xilinx Vivado/SDK 2017.2 Microsoft Visual Studio 2017	

VELOCIRAPTOR EVO



KEY CAMERA FEATURES

Velociraptor EVO		
Resolution	2.2 MP	4.2 MP
Active Pixels (HxV)	2048 x 1088	2048 x 2048
Frame Rate	331 FPS	176 FPS
Sensor Format	2/3" CMOS	1" CMOS
Pixel Size	5.5 µm	5.5 µm
Sensor: CMOSIS Image Sensor	CMV2000	CMV4000
Interface	1 Gigabit Ethernet SFP+ for fast data transmission	
Programmable and Reconfigurable FPGA	Spartan-6LX150	

**Velociraptor EVO** is a highly customizable and user-programmable FPGA-based high-speed smart camera: the ultimate FPGA camera with a very large Xilinx Spartan-6 FPGA and high-speed imaging sensor. It is based on GigaBee modules which incorporate dual DD3 memory and Gigabit Ethernet. It features the ultimate-performance System-on-Chip (SoC) technology combined with the latest turbocharged industrial CMOSIS imaging sensor.

Velociraptor EVO includes a fully customizable and user-programmable open-reference design for a high-speed FPGA-based camera and application development system. Its emphasis is on an open-hardware/software development model featuring high-frame rates, real-time image processing, ultra-large FPGA and modern graphical user interface support.

A suite of intermediate, versatile and large Xilinx Spartan-6LX150 FPGAs is used to develop algorithms and process data in real-time. Images are acquired by a CMOSIS sensor, CMV2000 (2048x1088 pixels, 2/3" size) or CMV4000 (2048x2048 pixels, 1" size). The Sensor is very fast and outputs up to 768 million pixels per second resulting in 333 FPS (CMV2000) and 178 FPS (CMV4000) at full frame. The on-board 2x128MB DDR3 memory with 2x1.6GB/s of bandwidth enables usage of complex buffered image processing. A unique UDP based Ethernet protocol, developed especially for this camera, is used for communication with a PC. The camera is Ethernet powered (IEEE 802.3at

PoE) with power consumption up to 10W. Velociraptor EVO cameras are suitable for demanding applications where extremely high-speed and high-frame rates are needed in combination with real-time image processing and adaptability to specific products or systems.

The Velociraptor EVO is targeted to Original Equipment Manufacturers (OEMs) who are seeking components that can be adapted to specific products or systems. The Velociraptor EVO camera provides a flexible framework of core capabilities that will serve as a platform for multimodal functionality. The framework is expandable, scalable and flexible to accommodate new algorithms and can be interoperable with existing systems. In two words, it's versatile and affordable, in all possible ways.

TARGETED FOR:

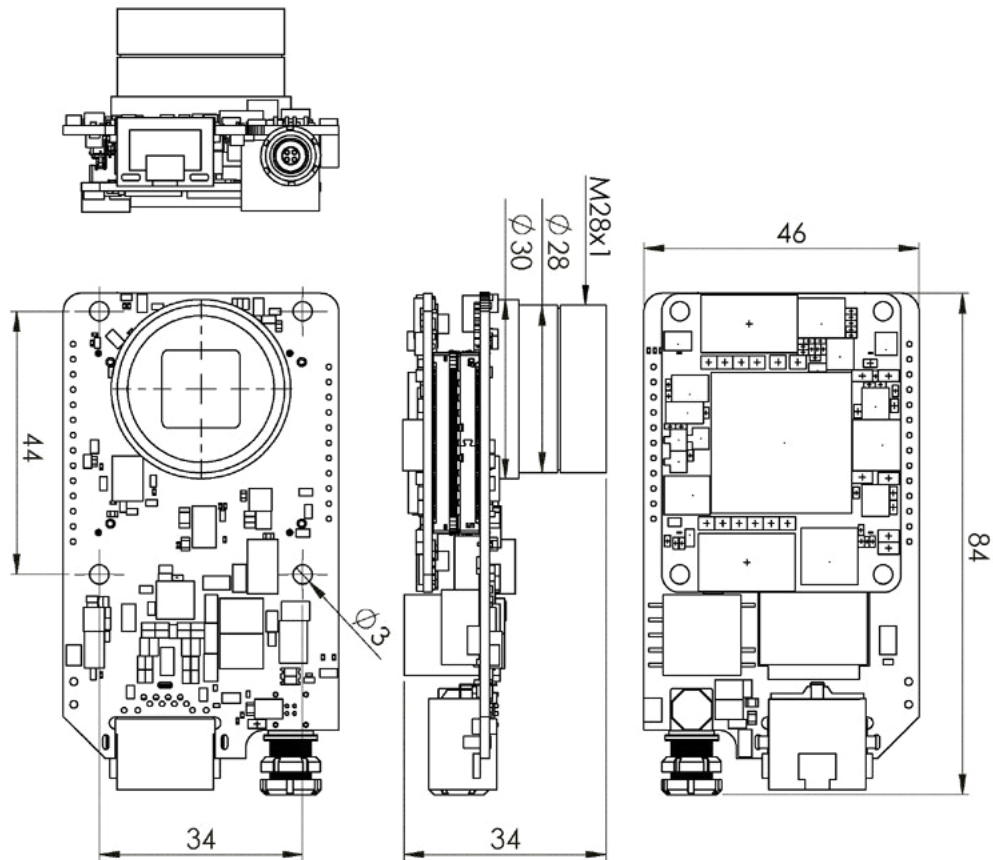
- Industrial process automation - to count, detect, check, verify, read, inspect and test different products, levels, components etc.;
- Industrial quality control - to inspect defects, cracks or surface blemishes, size, position, dimension and color, foreign objects and quality;
- Solar Cell Panel Inspection - to inspect wafer, surface defects, glass, etc. and
- General R&D.

VELOCIRAPTOR EVO

CAMERA FAMILY		VELOCIRAPTOR EVO				
Camera Model	2.2M	2.2IR	2.2C	4.2M	4.2IR	4.2C
Model (CMOSIS)	CMV2000			CMV4000		
	2E5M1PP	E12M1PP	2E5C1PP	2E5M1PP	E12M1PP	2E5C1PP
Color Filter	None	None	Bayer	None	None	Bayer
Diagonal	12.7 mm (2/3")			15.92 mm (1")		
Active Pixels	2048 x 1088			2048 x 2048		
Pixel Size	5.5 µm x 5.5 µm					
Pixel Data Formats	MONO8 (M and IR), BAYER8 (C only)					
Region of Interest	YES, with 8 pixel increments					
Pixel Clock Speed	760 MHz (8 pixels @ 95 MHz)					
Frame Rate (Full Frame)	331 FPS			176 FPS		
RAW Frame Rate	54 FPS			26 FPS		
ADC Resolution	10 bit					
Analogue Gain	C mount holder without lens included					
Analogue Gain	1-32x					
Digital Gain	Programmable look up table in FPGA					
Shutter Type	Electronic global shutter					
Shutter Resolution	21 ns					
Shutter Time	210 ns – 90 s					
Exposure	Linear, 3 slope high dynamic range					
Scanning System	Progressive					
FEATURES	Trigger Modes	Free running, trigger, overlap, pulse width				
	Trigger Features	Delay 0 – 1000 ms LP Filter 1.5Hz - 100 kHz				
	Dynamic Range	60 dB				

CAMERA FAMILY		VELOCIRAPTOR EVO	
PROCESSING	FPGA	Spartan6LX150	
	Free FPGA %	Up to 70%, most of the 180 slices of DSP are free.	
	Volatile Memory	2x 128 MB DDR3 SDRAM	
	Non-volatile Memory	8MB flash	
MECHANICAL	Lens Mount	C-mount (1" 32G thread)	
	Temp Range	0 - 50°C	
	Mass	50 g OEM / 290 g with housing	
	Protection	Up to IP67 with housing	
	Housing Material	CNC-machined aluminum, anodized in a special OptoMotive blue color	
	RoHS	RoHS compliant	
	Fixing Holes	4 x M3 OEM / 2 x M6 with housing	
ELECTRICAL	Input Voltage	Power over Ethernet, 42-57V	
	Consumption	Up to 10W	
	IO	3x bidirectional	
	IO Isolation	No, but camera has 1.5kV PoE isolation	
	Connectors	RJ45, 4 pin LEMO EXG 00 304	
FUNCTIONALITIES	On-board Image Processing	As an option (if an IP core is integrated)	
	IP Cores	Yes. Can be implemented into the camera additionally. See the List of IP cores available.	
	Open Reference Design	Yes	
	Open Architecture	Yes	
	Software	Compatible with OptoMotive VEVO software (full source code included)	
	Operating System	Windows 7, Windows 10, 64bit or 32bit	
	Development Tools	Xilinx ISE/EDK version 13.3 or later, Microsoft Visual Studio 2010	

VELOCIRAPTOR HS



KEY CAMERA FEATURES

Velociraptor HS		
Resolution	2.2 MP	4.2 MP
Active Pixels (HxV)	2048 x 1088	2048 x 2048
Frame Rate	331 FPS	176 FPS
Sensor Format	2/3" CMOS	1" CMOS
Pixel Size	5.5 µm	5.5 µm
Sensor: CMOSIS Image Sensor	CMV2000	CMV4000
Interface	1 Gigabit Ethernet SFP+ for fast data transmission	
Programmable and Reconfigurable FPGA	Spartan6 LX150	

- JPEG compression core embedded in the camera for achieving high streaming frame rates up to 333 FPS at full resolution as an option;
- GigE Vision® 1.2 and GenICam™ 2.0 compliant;
- Gigabit Ethernet for easy data transmission and
- Delivered in CNC housing.

**VELOCIRAPTOR HS** is the ultimate FPGA camera with a very large Xilinx Spartan-6 FPGA and high-speed imaging sensor. It is developed to fill the gap in the market between standard industrial cameras and high-speed cameras. The Camera has small and ruggedized waterproof aluminum housing design (90x52x40 mm) with an innovative mounting system (ball-joint).

It is Ethernet powered (IEEE 802.3at PoE) with a power consumption up to 10W. Imaging sensors were carefully selected and the ones selected were the best market has to offer: turbocharged CMOSIS imaging sensors CMV2000 (2048x1088 pixels, 2/3" size) or CMV4000 (2048x2048 pixels, 1" size). The sensors include all features a modern machine vision sensor should have: a global shutter, several high dynamic range modes and an overlapping trigger mode. As already mentioned the sensor is very fast and outputs up to 768 million pixels per second resulting in 331 FPS (CMV2000) and 176 FPS (CMV4000). At a reduced frame size the frame rate can go up to 5000 frames per second.

With high-performance FPGA System-on-Chip (SoC) technology, the Velociraptor camera family opens new dimensions in computer vision. It is a global shutter high-speed camera with incredible frame rates and a range of real-time image-processing cores (JPEG compression, color processing, etc.).

A JPEG compression core operating at maximum frame rate is offered with this camera. This core was developed especially for this camera, since there was no JPEG core with sufficient performance available on the market. The compression core enables long recording of high-speed video and direct PC storage.

TARGETED FOR:

- Motion analysis and slow-motion photography - from understanding river erosion to unravelling the mysteries of the flight of fruit flies;
- Ballistics - freeze the motion of an in-flight bullet;
- Sports - golf, baseball, basketball or football;
- Medical imaging - body movement analyses;
- Troubleshooting analysis and
- Broadcast – high-speed video capture and slow-motion replay.

VELOCIRAPTOR HS

CAMERA FAMILY			VELOCIRAPTOR HS			
Camera Model	2.2M	2.2IR	2.2C	4.2M	4.2IR	4.2C
Model (CMOSIS)	CMV2000			CMV4000		
	2E5M1PP	E12M1PP	2E5C1PP	2E5M1PP	E12M1PP	2E5C1PP
Color Filter	None	None	Bayer	None	None	Bayer
Diagonal	12.7 mm [2/3"]			15.92 mm [1"]		
Active Pixels	2048 x 1088			2048 x 2048		
Pixel Size	5.5 µm x 5.5 µm					
Pixel Data Formats	MONO8 (M and IR), BAYER8 (C only) JPEG					
Region of Interest	YES, with 8 pixel increments					
Pixel Clock Speed	760 MHz (8 pixels @ 95 MHz)					
Frame Rate (Full Frame)	331 FPS			176 FPS		
RAW Frame Rate	54 FPS			26 FPS		
Max. Frame Rate*	5000 FPS					
ADC resolution	10 bit					
Lenses	C mount holder without lens included.					
Analogue Gain	1 - 3.2x					
Digital Gain	Programmable look up table in FPGA					
Shutter Type	Electronic global shutter					
Shutter Resolution	21 ns					
Shutter Time	20us – 90 s					
Exposure	Linear, 3Slope high dynamic range					
Scanning System	Progressive					
Trigger Modes	Free running, trigger, overlap and pulse width					
Trigger Features	Delay 0 – 1000 ms LP Filter 1.5Hz - 100 kHz					
Dynamic Range	60 dB					

CAMERA FAMILY		VELOCIRAPTOR HS	
PROCESSING	FPGA	Spartan-6LX	
	Volatile Memory	2x 128 MB DDR3 SDRAM	
	Non-volatile Memory	8MB flash	
MECHANICAL	Lens Mount	C-mount [1" 32G thread]	
	Temp Range	0 - 50°C	
	Mass	50 g OEM / 290 g with housing	
	Protection	Up to IP67 with housing	
	Housing Material	CNC-machined aluminum, anodized in a special OptoMotive blue color	
ELECTRICAL	RoHS	RoHS compliant	
	Fixing Holes	4x M3 OEM / 2 x M6 with housing	
	Input Voltage	Power over Ethernet, 42-57V	
	Consumption	10W	
	IO	3x bidirectional	
FUNCTIONALITIES	IO Isolation	No, but camera has 1.5kV PoE isolation	
	Connectors	RJ45, 4 pin LEMO EXG 00 304	
	Real-time Image Processing	Yes. JPEG compression core implemented as a standard configuration	
	Software	Compatible with OptoMotive SHARKi software and any other GigE vision software	
	Operating System	Windows 7, Windows 10, 64bit or 32bit	
	Protocols	GigE Vision® 1.2 and GenICam™ 2.0 compliant	
	Supported Vision Libraries	MathWorks MATLAB, MVTec HALCON, National Instruments LabVIEW etc.	

# HIGH-SPEED CAMERAS

CUTTING-EDGE,  
HIGH-PERFORMANCE  
CAMERAS

FPGA TECHNOLOGY  
FOR REAL TIME IMAGE  
PROCESSING

STANDARD AND FULLY  
CUSTOMIZED IMAGING  
SOLUTIONS

## OPTOMOTIVE LTD.

KOPRSKA ULICA 98  
SI-1000 LJUBLJANA  
SLOVENIA, EU

T: +386 (0) 1 429 29 14  
E: [info@optomotive.com](mailto:info@optomotive.com)  
W: [www.optomotive.com](http://www.optomotive.com)





OPTOMOTIVE LTD.

KOPRSKA ULICA 98  
SI-1000 LJUBLJANA  
SLOVENIA, EU

T: +386 (0) 1 429 29 14  
E: [info@optomotive.com](mailto:info@optomotive.com)  
W: [www.optomotive.com](http://www.optomotive.com)