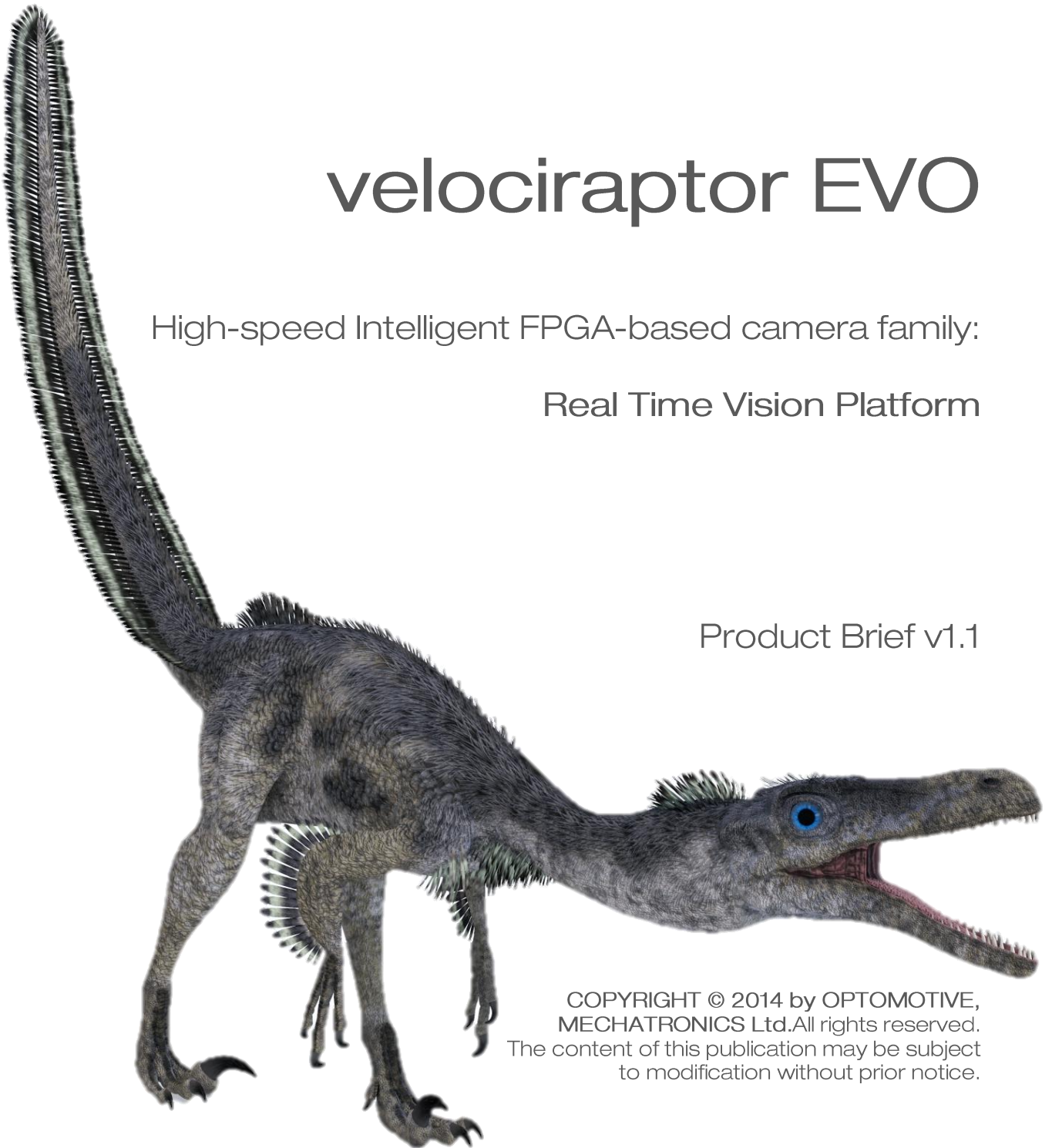# velociraptor EVO

High-speed Intelligent FPGA-based camera family:

Real Time Vision Platform

Product Brief v1.1

Velociraptor EVOLUTION, Vision REVOLUTION

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Velociraptor EVO, **highly customizable and user-programmable FPGA based high-speed smart cameras,** is 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 is ultimate-performance system-on-chip (SoC) technology, combined with latest turbocharged industrial CMOSIS imaging sensor.
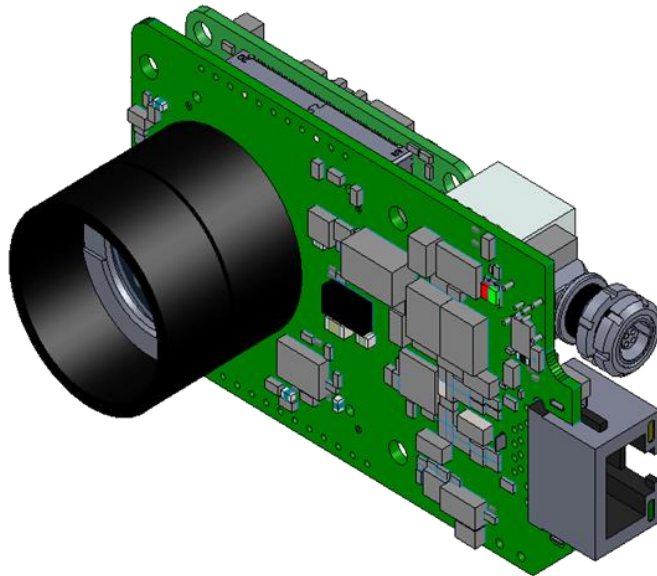
With high performance FPGA system-on-chip (SoC) technology, Velociraptor camera family opens new dimensions in computer vision. It is global shutter industrial camera with incredible frame rates and **open FPGA architecture.** With FPGA processing power the image processing algorithms can run in real time on the camera. Just add your imagination.

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Velociraptor EVO includes full customizable and user-programmable **open reference design** for 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 ultra large FPGA** and modern graphical user interface support.

A suite of intermediate, versatile and **largest Xilinx Spartan-6LX150 FPGA,** is used to develop algorithms and **process data in real-time.** Images are acquired by **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 **331 FPS (CMV2000) and 175 FPS (CMV4000) at full frame**. The on-board 2x128MB DDR3 memory with 2x1.6GB/s of bandwidth enables usage of complex buffered image processing.

The reference design can be easily edited with standard Xilinx EDK/SDK tools. OptoMotive's custom IP cores seamlessly integrate inside the Xilinx EDK toolchain. Only 60% of the camera's FPGA logic is occupied with a powerful System-On-Chip implementation while the only 10% of DSP resources are occupied. The rest **is free for a programming and development of new algorithms, or implementation of additional IP cores.**

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Versatile and affordable, in all possible ways!

Key camera features:

- Latest turbocharged industrial CMOSIS sensor, 2.2 and 4.2M pixel, Colour (Bayer filter), Monochrome and VIS-NIR
- User programmable and reconfigurable FPGA processor Spartan 6LX150
- 2x128 MB DDR3 SDRAM internal volatile memory
- User programmable ROI (Region of Interest)
- Gigabit Ethernet for fast data transmission
- Delivered in CNC housing or OEM version
- Firmware can be upgraded to add new features
- 3 general purpose user-programmable bidirectional I/Os

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Targeted to:

- **Laser triangulation:** with ready-made **PEAK detector** on-board image processing core

- **Motion capture:** with ready-made **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 colour, foreign objects, quality.

- **Solar Cell Panel Inspection:** to inspect wafer, surface defects, glass, etc.

- **General R&D**

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OPTOMOTIVE   velociraptor EVO

Specification table

Camera Family	Velociraptor EVO					
Camera model	2.2M	2.2IR	2.2C	4.2M	4.2IR	4.2C
imaging sensor — Model (CMOSIS)	CMV2000			CMV4000		
	2E5M1 PP	E12M1 PP	2E5C1 PP	2E5M1 PP	E12M1 PP	2E5C1 PP
Colour 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)	333 FPS			178 FPS		
RAW frame rate*	54 FPS			26 FPS		
ADC resolution	10 bit					
Analogue Gain	1 - 1.6x					
Shutter type	Electronic Global Shutter					
Shutter time	210 ns – 90 s					
Exposure	Linear, 3Slope High Dynamic Range					
Dynamic range	60 dB					
Features — Pixel correction	Programmable Look Up Table in FPGA					
Trigger modes	Free running, trigger, overlap, pulse width					
Trigger features	Delay 0 – 1000 ms LP Filter 1.5Hz - 100 kHz					
Shutter resolution	21 ns					
Processing — FPGA	15 Mgates Spartan-6LX					
Free FPGA %	Up to 70%, most of 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 aluminium, anodized in a special OptoMotive blue colour					
RoHS	RoHS compliant					
Fixing holes	4 x M3 OEM / 5 x M6 on housing					
Electrical — Input voltage	Power over Ethernet 42-57V or 5V (OEM)					
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					

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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 VEVO software (full source included)
	Operating system	Windows XP, Windows 7, 64bit or 32bit
	Development tools	Xilinx ISE/EDK version 13.3 or later. Microsoft Visual Studio 2010
Standards	CE	EN55022, class A EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-6
	FCC	Part 15, class A
	RoHS	Compliancy as per European directive 2002/95/EC

NOTE: Gigabit Ethernet connection limits a speed of RAW video frame rate streaming to 55 FPS at full resolution. To harness full sensor speed the on-board image processing is needed.

Each camera is supplied with:

- Software: VEVO software: API, filter driver, examples, GUI for image capturing and recording
  FPGA Reference Design

- Cable: 2x Ethernet Cable CAT5E

- Power Supply: 100-240V single port PoE injector

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Specification: Resolution / FPS

Specifications of resolutions and maximum frame rates are shown in Table 1.

The following equation is used for calculating a theoretical maximum acquisition speed (FPS) refers to a given resolution:

$$FPS = \frac{47500000}{129 \times Y + 2000}$$

where: Y   Number of lines
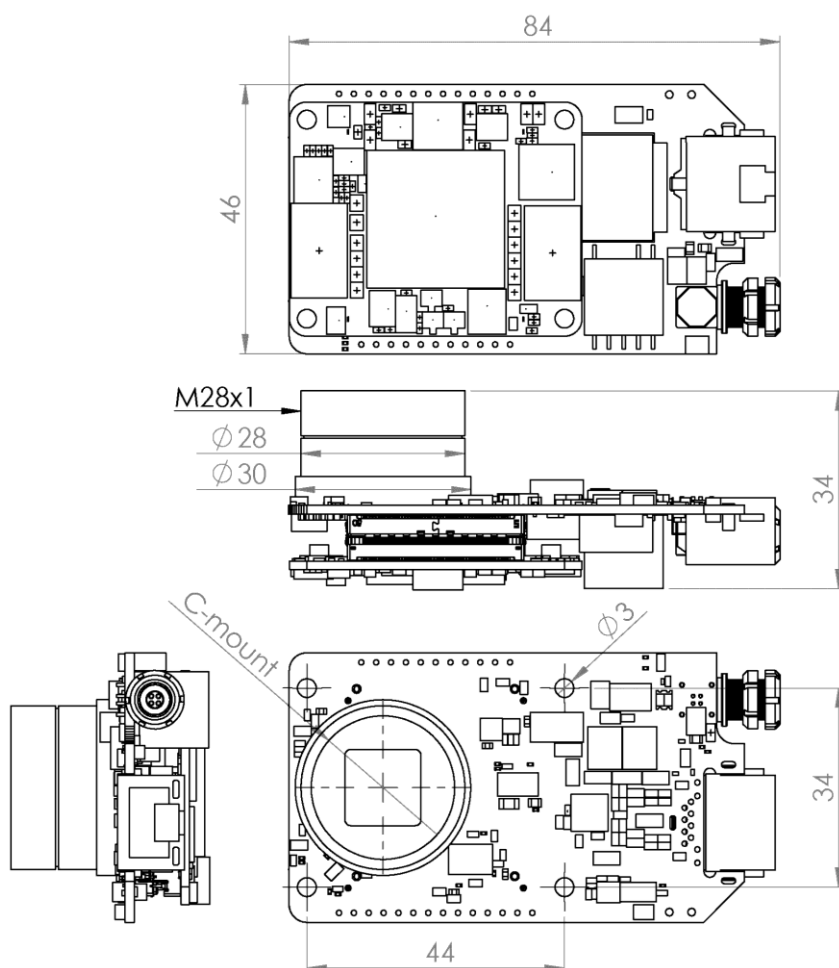
where: FPS   Frames per second

STANDARD RESOLUTIONS

Resolution	Active pixels	MAX. FRAME RATE	MAX. FRAME RATE
Full frame 4.2M	2048 x 2048	N/A	178 FPS
Full frame 2.2M	2048 x 1088	333 FPS	333 FPS
2K	2048 x 1080	336 FPS	336 FPS
HD 1080	1920 x 1080	336 FPS	336 FPS
SXGA	1280 x 1024	354 FPS	354 FPS
HD 720	1280 x 720	500 FPS	500 FPS
XGA	1024 x 768	469 FPS	469 FPS
SVGA	800 x 600	598 FPS	598 FPS
PAL	768 x 576	622 FPS	622 FPS
WVGA	752 x 480	742 FPS	742 FPS
VGA	640 x 480	742 FPS	742 FPS
QVGA	320 x 240	1440 FPS	1440 FPS

The resolutions are scaled to standard sizes for easier comparison; the frame rate depends on the number of lines only.

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Mechanical drawings

Velociraptor EVO, OEM
STEP 3D model available on request

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Velociraptor EVO in housing (fanless and IP67 optional)

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