velociraptor HS

High-speed FPGA-based camera family

for Video recording

Product Brief v1.6

Velociraptor is fast running and fast grabbing!

Save a tree...please don't print this document *unless you really need to.*

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-in the Market gap between standard industrial cameras and high-speed cameras. The Camera has **small and ruggedized waterproof aluminium housing** design (90x52x40 mm) with **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 were picked the best ones market has to offer: turbocharged **CMOSIS imaging sensors** CMV2000 (2048x1088 pixels, 2/3'' size) or CMV4000 (2048x2048 pixels, 1'' size).

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The Sensors include all features the modern Machine Vision Sensor should have: **Global Shutter**, several **High Dynamic Range modes** and **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 reduced frame size the Frame rate can go **up to 5000 frames per second.**

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

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

OptoMotive's concept of joining large FPGAs, high-performance imaging sensors and image processing within the FPGA, is positioning company's cameras Velociraptor, way ahead into the future!

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Key camera features:

- Latest turbocharged industrial CMOSIS sensor, 2.2 or 4.2 MPixel, Colour (Bayer filter), Monochrome and VIS-NIR
- 2x128 MB DDR3 SDRAM internal volatile memory
- User programmable ROI (Region of Interest)
- **Real-time high-speed image processing inside the camera as an option**
- **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**
- Delivered in CNC housing
- Firmware can be upgraded to add new features
- 3 general purpose user-programmable I/Os

Targeted to:

- **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 a bullet in flight
- **Sports:** Golf, Baseball, Basketball, Football
- **Medical imaging:** body movement analyses
- **Troubleshooting analysis** on machine and systems
- **Broadcast: high speed video capture and slow motion reply**

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Specification table

Camera Family		Velociraptor HS					
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) **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**			**28 FPS**		
	Max. frame rate*	**5000 FPS**					
	ADC resolution	**10 bit**					
	Lenses	**Only C/CS mount holder without lens included.**					
	Analogue Gain	1 - 1.6x					
	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					
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					
Processing	FPGA	15 Mgates 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 aluminium, anodized in a special OptoMotive blue colour					
	RoHS	RoHS compliant					
	Fixing holes	4 x M3 OEM / 2 x M6 with housing					

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Electrical	Input voltage	**Power over Ethernet, 42-57V**
	Consumption	10W
	IO	3x bidirectional
	IO isolation	No, but camera has 1.5kV PoE isolation
	Connectors	RJ45, 4 pin LEMO EXG 00 304
Functionalities	**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, 64bit and 32bit compatible
	Protocols	GigE Vision® 1.2 and GenICam™ 2.0 compliant
	Supported vision libraries	MathWorks MATLAB, MVTec HALCON, National Instruments LabVIEW, etc.
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
	GiGE VISION	Compliant with the GigE Vision 1.2 specification which defines the communication interface protocol used by any GigE Vision device. The device description and capabilities are contained in an XML file.

Table 1: Specifications

* Sensor maximum frame rate. GigE Ethernet connection limits a speed of RAW video frame rate streaming to 54 FPS at full resolution. Full speed of 331 FPS at full resolution, can be accomplished with JPEG core only.

Each camera is supplied with:

- Software: SHARKi software for image capturing and recording
- Cable: 2x Ethernet Cable CAT5E
- Power Supply: 100-240V single port PoE injector

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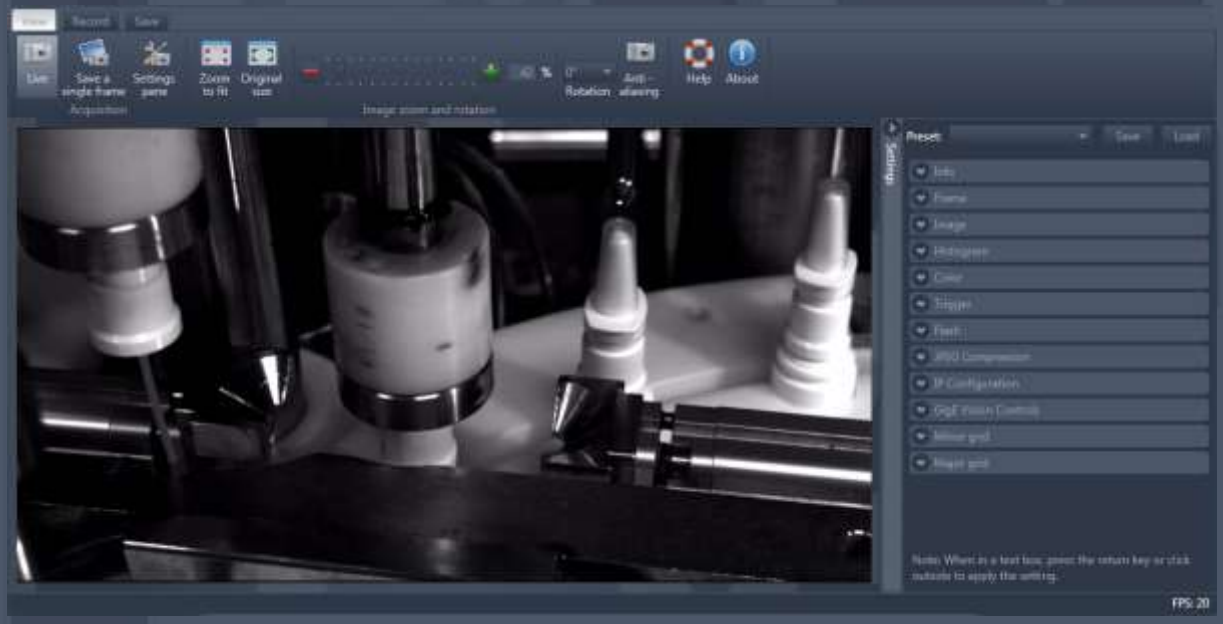

Figure 1: SHARKi video recording software

JPEG compression core

- Real-Time compression reduces bandwidth to GigE transmission
- 760Mpixel/s peak input bandwidth (760MB/s for monochrome and 2,28GB/s for colour version) – runs at maximal sensor speed
- Baseline encoding, JFIF format
- Format: 4:0:0 (monochrome), 4:2:2 (colour)
- Software adjustable quality 0-100
- timestamp insertion into JPEG header
- SHARKi converts JPEG images to MJPEG AVI during video recording

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Specification: Resolution / FPS

Specifications of resolutions and maximum frame rates with JPEG compression Core integrated are shown in Table 2.

Sensor type		CMV2000	CMV4000
Active pixels		2048 x 1088	2048 x 2048
STANDARD RESOLUTIONS			
Resolution	Active pixels	MAX. FRAME RATE	MAX. FRAME RATE
Full frame 4.2M	2048 x 2048	N/A	176 FPS
Full frame 2.2M	2048 x 1088	331 FPS	325 FPS
2K	2048 x 1080	334 FPS	327 FPS
HD 1080	1920 x 1080	334 FPS	327 FPS
SXGA	1280 x 1024	352 FPS	344 FPS
XGA	1024 x 768	466 FPS	453 FPS
HD 720	1280 x 720	495 FPS	481 FPS
SVGA	800 x 600	591 FPS	571 FPS
PAL	768 x 576	615 FPS	593 FPS
WVGA	752 x 480	733 FPS	702 FPS
VGA	640 x 480	733 FPS	702 FPS
QVGA	320 x 240	1405 FPS	1296 FPS

Table 2: Resolution / FPS table

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

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Recording time

Recording time vary on the amount of hard disk available on the PC side and the JPEG compression quality setting. The table below shows approximate recording time by using a 400GB of free hard disk drive capacity and a JPEG compression ratio of 1/10 (approximately 80 JPEG quality setting).

Active pixels X	× Y	Acquisition speed	Max. Recording Time
2048	2048	176 FPS	1 h 35 min
2048	1600	220 FPS	1 h 37 min
2048	1088	331 FPS	1 h 36 min
1920	1080	150 FPS	3 h 50 min
2048	1080	334 FPS	1 h 36 min
1920	1080	334 FPS	1 h 42 min
1024	768	150 FPS	10 h 6 min
1024	768	300 FPS	5 h 3 min
2048	768	466 FPS	1 h 36 min
1024	768	466 FPS	3 h 13 min
1280	720	150 FPS	8 h 37 min
1280	720	300 FPS	4 h 18 min
2048	720	496 FPS	1 h 36 min
1280	720	496 FPS	2 h 34 min
800	600	150 FPS	16 h 34 min
800	600	300 FPS	8 h 17 min
800	600	450 FPS	5 h 31 min
2048	600	590 FPS	1 h 36 min
800	600	590 FPS	4 h 8 min
768	576	150 FPS	17 h 58 min
768	576	300 FPS	8 h 59 min
768	576	600 FPS	4 h 29 min
2048	576	615 FPS	1 h 37 min
768	576	615 FPS	4 h 18 min
640	480	150 FPS	25 h 53 min
640	480	300 FPS	12 h 56 min
640	480	600 FPS	6 h 28 min
2048	480	733 FPS	1 h 37 min
640	480	733 FPS	5 h 11 min
320	240	150 FPS	103 h 33 min
320	240	300 FPS	51 h 46 min
320	240	600 FPS	25 h 53 min
320	240	900 FPS	17 h 15 min
320	240	1200 FPS	12 h 56 min
2048	240	1400 FPS	1 h 39 min
320	240	1400 FPS	10 h 38 min

Table 3: Recording time table

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Mechanical drawings

Velociraptor HS in housing with C-mount lens holder (IP67 optional)

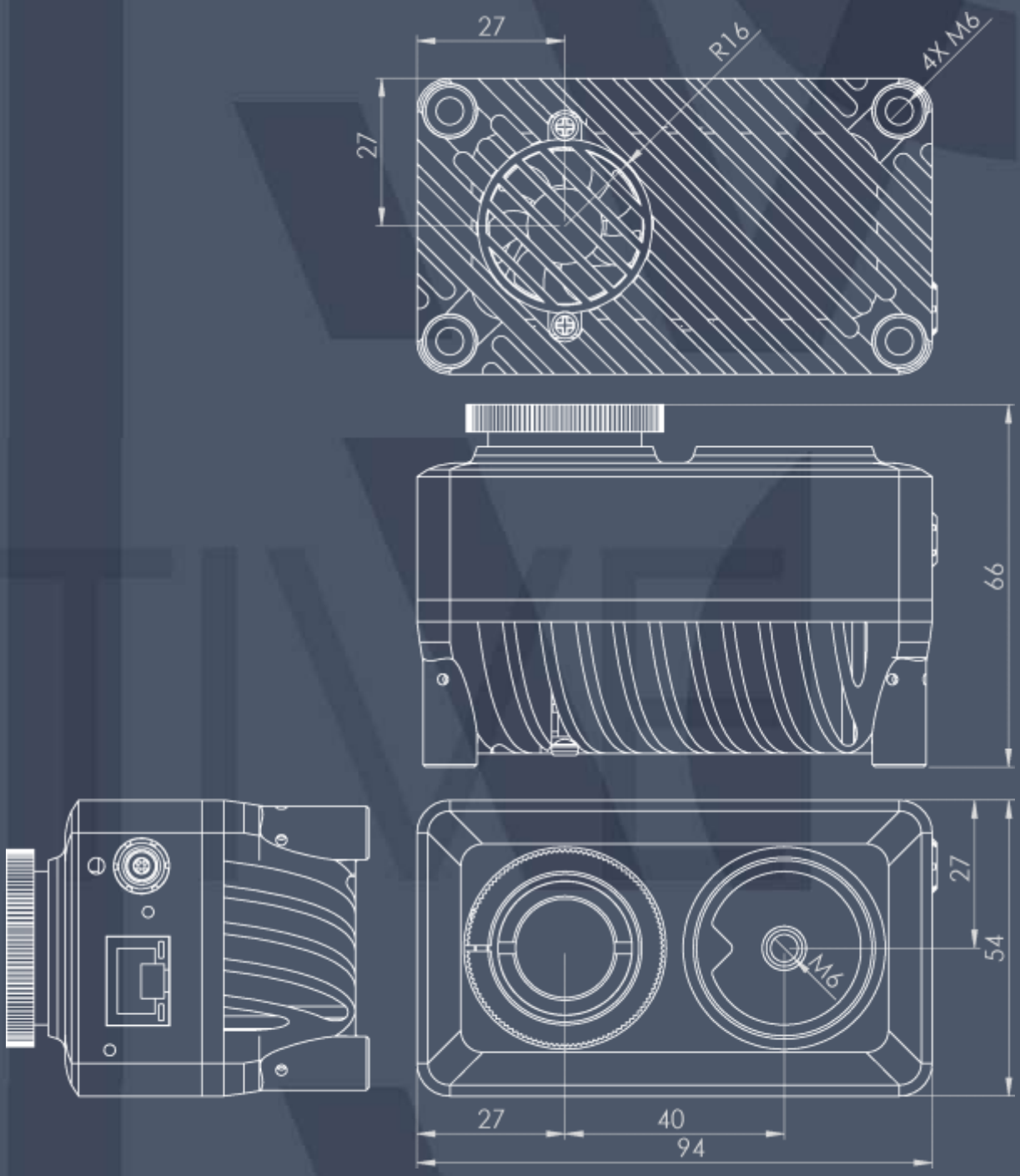

Figure 2: Velociraptor HS in housing with C-mount lens holder

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