High-end cameras

ximea

outstanding performance for scientific purposes • minimal size

ximea
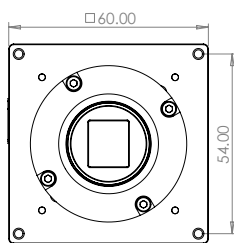xiCool16

xiCe|xiRAY

cooled and uncooled cameras

xiCe, xiRAY - quick facts

xiCe and xiRAY are ultra-compact camera families for scientific and special industrial purposes with outstanding specifications and extra features:

- ultra-low read-out noise, clear 14 bits/pixel images in all modes
- partial readout and several binning modes with enhanced sensitivity and higher frame rates
- TEC Peltier cooled versions and board level versions of cameras are available

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Sensor technology	CCD
Small	Fits into places where no other similar grade of camera can fit
Robust	Full metal housing, no sheet metal covers
Connectivity	Programmable input and output
Compatibility	Support for Windows and Linux, various Image Processing Libraries
Software interfaces	GenICam / GenTL and highly optimized xiAPI SDK
Economical	Excellent value and price, low TCO and fast ROI
Auto adjustments	Auto white balance, auto gain, auto exposure
System integration	Single board design, perfect for OEM integration

MR285 uncooled - standard housing
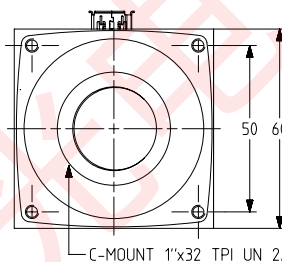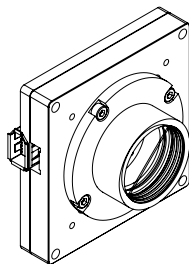
MR4021/MR4022 uncooled - standard housing
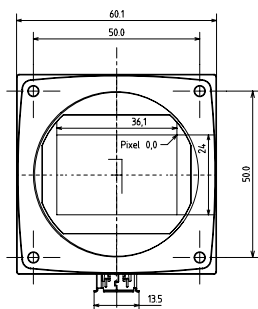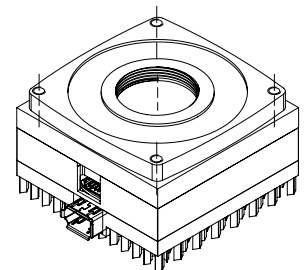
MR11002/MR16000 uncooled - standard housing
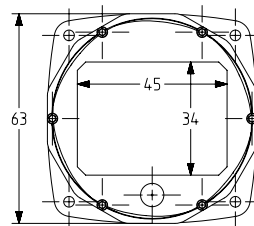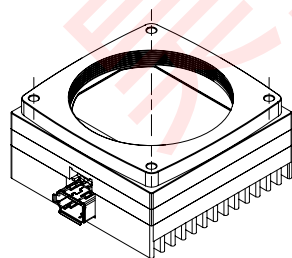
xiCOOL, xiRAY - standard cooled housing
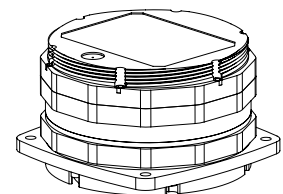
Details X-ray cameras, xiRAY models:

Fiber optics	Magnification	1:1	**Fiber center to center distance**	6 µm
	Field of view	36 x 24 mm	**FO plate thickness**	5 mm
	Radiation hardened	yes	**Extra-Mural Absorption**	Enhanced Statistical
Scintillator	Phosphor composition	P43, Gd_2O_2S:Tb	**Thickness**	~22 µm
	Energy range	Min: 5 KeV, Max 100 KeV		
Cooling system	Type	TEC Peltier cooler	**Dissipation**	Heatsink, optional fan
	Temperature	+12°C	**Power supply / Control**	Internal
Physical	Dimensions	63 x 63 x 63mm	**Operating Temperature**	-5..+50°C
	Power consumption	6W max		

3 Disclaimers

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4 Privacy Information

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5 Trademarks

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6 Glossary of Terms, Acronyms and Abbreviations

ADU   Analog to Digital Units
API   Application Program Interface
CCD   Charge Coupled Device
DDRAM   Dual Data rate Random Access Memory
DLL   Dynamic Link Library
FPGA   Field Programmable Gate Array
FWC   Full Well Capacity
GUI   Graphical User Interface
OHCI   Open Host Controller Interface
PC   Personal Computer
PCB   Printed Circuit Board

7 Document Scope and Purpose

The purpose of this document is to specify MR16000 camera core parameters and their dependencies.

8 Referenced Documents

o MR16000 Validation and Verification plan revision 0.10 (MR16000VVP)

9 Parameter tables

9.1   Mechanical

Description	Symbol	Value	Units
Height	H	30	mm
Width	W	60	mm

Depth	D	60	mm
Weight	M	190	g
Lens thread		M50x0.75 thread, machined Aluminium alloy	
Distance from lens thread edge to the protective filter glass		6.0	mm
Distance from lens thread edge to the protective filter glass		10.0	mm
Alignment of CCD chip sensitive area relative to the housing/lens thread		±0.25	mm

9.2   Sensors

Description	MR16000C	MR16000M	Units
Brand	Kodak KAI-16000CM	Kodak KAI-16000M	
Kodak Datasheet	Revision 2.0 MTD/PS-1027, July 24, 2007		
Type	Interline Progressive CCD image sensor		
Pixel resolution	4872 (H) × 3248 (V)		pixels
Chip size	36.1(H) x 24.0(V)		mm
Unit cell size	7.4(H) x 7.4(V)		μm
Color filter	RGB Bayer mosaic	None	
Quantum efficiency, max	30, 37, 42 (RGB)	45	%
FWC (*), typical	30.000		ē
Dark current (**), typical	20		ē/p/s

All parameters in this table are reprinted from the respective Kodak datasheet
(*) – Saturation signal.
(**) – Dark current, limit specified by CCD chip vendor is 350ē/p/s. A typical value provided here is for informational purposes only. It cannot be used as a unit qualification parameter.

9.3   Optical path

9.3.1 BH housing

Description	MR16000C	MR16000M	Units
Filter Brand	Hoya E-CM500S	BK7	
Filter Thickness	1.0±0.1	1.0±0.1	mm
Filter Tilt	0.0	0.0	°
Specification	HOYA 8405E	TBD	
Coating	NA	NA	
CCD Spot blemishes and stain specification	MTD/PS-1027	MTD/PS-1027	
Filter cleanness (spots, scratches)	±3 (*)	±3 (*)	%
Size of the cosmetics defects free aperture on filter	TBD	TBD	mm
Back focal distance in the air	10.0/+0.0/-0.2	10.0/+0.0/-0.2	mm

(*) – Filter cleanness is measured with the method and set of tools described in MR16000CTP.

9.4   Camera core

Description	Symbol	Value	Units
Digitization		14	Bit
Supported bit resolutions		8, 10, 12 and 14	Bit/pix
Exposure time	EXP	20μs … 500sec	

Variable Gain	VGA	6 … 42	dB
Refresh rate	MRR	4	Fps
Trigger/sync input (r)		Asynchronous CMOS 3.3V	
Trigger/sync output (rr)		CMOS 3.3V	
Dynamic range, Typical	DR	~70	dB
Linearity (*)	Lin	<1	%
Acquisition Gain	G	4 ±0.3	ē/ADU
Lens adapter		M50x0.75	
External interface		IEEE1394A	
Acquisition noise (**), typical	AN_{typ}	4.5	ē
Acquisition noise (**), max	AN_{max}	7.0	ē
Readout noise (***), typical	RN_{typ}	10	ē
Readout noise (***), max	RN_{max}	NA	ē

All parameters in this table are subject to qualification measurements specified in MR16000VVP and Kodak data sheet

(r) – Pull up resistor of 100kΩ

(rr) – Serial resistor of 1kΩ

(*) – Linearity of 1% guaranteed in the range of exposures 1ms to 16s.

(**) – Acquisition noise means noise generated by the camera with ADC input connected to ground via resistor equivalent to CCD output impedance of 130Ω.

(***) – Readout noise means noise generated by the camera with ADC input connected to CCD chip. Typical value provided here is for informational purposes only. It can not be used as a unit qualification parameter.

9.5   Power

Description	Symbol	Value	Units
Power supply, via IEEE1394 system connector	V_{nom}	12 ±10%	V
Consumption, typical	P_{nom}	2.0	W
Consumption, maximum	P_{max}	3.4	W

All parameters in this table are subject to qualification measurements specified in MR16000VVP

9.6   Environment

Description	Symbol	Value	Units
Optimal ambient temperature operation	T_{opt}	+10 … +25	°C
Ambient temperature operation (*)	T_{max}	+5 … +60	°C
Ambient temperature for storage and transportation	$T_{storage}$	-25 … +70	°C
Relative Humidity, non condensing	RH	80	%

All parameters in this table are subject to qualification measurements specified in MR16000VVP

(*) – Housing temperature shall not exceed +65°C, also beyond of the optimal range the following parameters are not guaranteed:

   Dark current, Dynamical Range, Linearity, Acquisition and readout noise, S/N ratio, durability.

9.7   Firmware/Host driver/API features

Description	Symbol	Value	Units
MCU firmware version		4.0.1	
FPGA build		20070831	
API DLL version		2.1.43	
Interpolation methods		9331, SHT_advanced	

White balance coefficients ranges		0.0 … 3.9	x
Sharpness filter		0 … 100	%
Gamma		0.3 … 1.0	
Full color correction matrix (3+1)x3 coefficients ranges		-3.9 … 3.9	x
Partial readout granularity @ (1x binning)		2 (H) x 2 (V)	pixels
Max refresh rate x1 binning			Frames/s

All parameters in this table are subject to qualification measurements specified in MR16000VVP

9.8   Supported readout modes

Mode	Binning	Mode MR16000C	Mode MR16000M	Pixels	F/s	Bits /pix
0	1×1	Color	B/W	4904 × 3280	1.4	14
1	2×2	Color	B/W	2452 × 1640	2.7	14
2	3×3	Color	B/W	1632 × 1092	3.8	14
3	4×4	Color	B/W	1226 × 820	4.9	14
4	1×1 HS	Color	B/W	4904 × 3280	2.5	8
5	2×2 HS	Color	B/W	2452 × 1640	4.9	14
6	3×3 HS	Color	B/W	1632 × 1092	6.5	14
7	4×4 HS	Color	B/W	1226 × 820	6.5	14

All parameters in this table are subject to qualification measurements specified in MR16000VVP