



# SOFTHARD

MR16000x

(C and B)

Camera Core

Specification

November 9, 2009

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## 2 Revision History

Revision	Date	Who	What
0.10	22.03.2009	ML	Initial draft created
0.20	11.05.2009	ML	Mode table updated
0.30	04.08.2009	ML	Weight measure updated
0.30	04.08.2009	ML	Weight measure updated
0.40	09.11.2009	ML	Mode table updated

### 3 Disclaimers

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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

- 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) × 24.0(V)		mm
Unit cell size	7.4(H) × 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 cleanliness (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 cleanliness 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 <sub>typ</sub>	4.5	ē
Acquisition noise (**), max	AN <sub>max</sub>	7.0	ē
Readout noise (***), typical	RN <sub>typ</sub>	10	ē
Readout noise (***), max	RN <sub>max</sub>	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 <sub>nom</sub>	12 ±10%	V
Consumption, typical	P <sub>nom</sub>	2.0	W
Consumption, maximum	P <sub>max</sub>	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 <sub>opt</sub>	+10 ... +25	°C
Ambient temperature operation (*)	T <sub>max</sub>	+5 ... +60	°C
Ambient temperature for storage and transportation	T <sub>storage</sub>	-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	1x1	Color	B/W	4904 x 3280	1.4	14
1	2x2	Color	B/W	2452 x 1640	2.7	14
2	3x3	Color	B/W	1632 x 1092	3.8	14
3	4x4	Color	B/W	1226 x 820	4.9	14
4	1x1 HS	Color	B/W	4904 x 3280	2.5	8
5	2x2 HS	Color	B/W	2452 x 1640	4.9	14
6	3x3 HS	Color	B/W	1632 x 1092	6.5	14
7	4x4 HS	Color	B/W	1226 x 820	6.5	14

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