



SOFTHARD

MR11002x

(C and B)

Camera Core

Specification

December 28, 2009

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2 Revision History

Revision	Date	Who	What
0.10	10.11.2006	ML	Initial draft created
0.20	01.12.2006	ML	Binning modes added
0.30	04.01.2007	ML	Updated with CCD vs. housing tolerances, quantum efficiency, power consumption, storage and transportation environments, absolute maximum operation conditions
0.40	04.08.2008	ML	Updated: Mode table, environment, Lens mount, added Optical Path
0.50	26.02.2009	ML	Updated: Power consumption
0.60	22.03.2009	ML	Updated: Mode table
0.70	04.08.2009	ML	Updated: Template, weight
0.80	20.11.2009	ML	Updated: Mode table

3 Disclaimers

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4 Privacy Information

This document contains information of a sensitive nature. This information should not be given to persons other than those who are involved in the MR11002 project or who will become involved during the lifecycle.

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 MR11002 camera core parameters and their dependencies.

8 Referenced Documents

- MR11002 Validation and Verification plan revision 0.10 (MR11002VVP)

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	MR11002C	MR11002M	Units
Brand	Kodak KAI-11002CM	Kodak KAI-11002M	
Kodak Datasheet	Revision 1.0 MTD/PS-0938, January 30, 2006		
Type	Interline Progressive CCD image sensor		
Pixel resolution	4008 (H) × 2672 (V)		pixels
Chip size	37.25(H) × 25.70(V)		mm
Unit cell size	9.0(H) × 9.0(V)		µm
Color filter	RGB Bayer mosaic	None	
Quantum efficiency, max	34, 37, 42 (RGB)	50	%
FWC (*), typical	60.000		ē
Dark current (**), typical	40		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 can not be used as a unit qualification parameter.

9.3 Optical path

9.3.1 BH housing

Description	MR11002C	MR11002M	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-0938	MTD/PS-0938	
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 MR11002CTP.

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 MR11002VVP 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 MR11002VVP

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 MR11002VVP

(*) – 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		3.6	Frames/s

All parameters in this table are subject to qualification measurements specified in MR11002VVP

9.8 Supported readout modes

Mode	Binning	Mode MR11002C	Mode MR11002M	Pixels	F/s	Bits /pix
0	1x1	Color	B/W	4032 x 2688	2.1	14
1	2x2	Color	B/W	2016 x 1344	4.1	14
2	3x3	Color	B/W	1344 x 896	5.9	14
3	4x4	Color	B/W	1008 x 672	7.5	14
4	1x1 HS	Color	B/W	4032 x 2688	3.6	12
5	2x2 HS	Color	B/W	2016 x 1344	7.6	8
6	3x3 HS	Color	B/W	1344 x 896	10.5	14
7	4x4 HS	Color	B/W	1008 x 675	12	14

All parameters in this table are subject to qualification measurements specified in MR11002VVP