

# Technical documentation

## MC023xG-SY Camera specification

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TD-MC-MC023xG-SY-Camera-specification	
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## Revision History

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Revision	Date	Who	What
<b>WIP1</b>	26.05.2016	OP	Initial draft (OP)
<b>WIP2</b>	28.06.2016	OP	Updates optical path, INOUT specification
<b>WIP3</b>	30.06.2016	JZ	Updated supported sensor readout modes notes
<b>WIP4</b>	29.08.2016	OP	Flexline dimensions added, image quality added

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Trademark	Definition

## Document Scope and Purpose

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The purpose of this document is to specify MC023xG-SY camera parameters and their dependencies.

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## Glossary of Terms, Acronyms and Abbreviations

Term /Abbreviation	Definition
ADC	Analog to Digital Converter
API	Application Programming Interface
AR (coating)	Anti-Reflex
B/W	Black and White
C (mount)	"cine"
CCD	Charge-Coupled Device
DSNU	Dark Signal non-Uniformity
DR	Dynamic Range
FWC	Full Well Capacity
Fps	Frame per second
IR	Infra-Red
JTAG	Joint Test Action Group
LSB	Least Significant Bit
NA	Not Available
PCB	Printed Circuit Board (same as PWB)
PWB	Printed Wiring Board (same as PCB)
RGB	Red Green Blue
SNR	Signal To Noise (ratio)
SW	Software
TBD	To Be Defined
WIP	Work In Progress

## Referenced Documents

- [1] Sony Datasheet IMX174LQJ-C\_E\_TechnicalDatasheet\_REv0.3 (01/06/14)  
 [2] Sony Datasheet IMX174LLJ-C\_E\_data\_sheet\_E14315 (01/06/14)

## Specification

### Model list

Table 1. Model list

Model number	Description
MC023MG-SY	B/W model, TYPE-C USB connection, delivered with C/CS Mount module B
MC023CG-SY	Color model, TYPE-C USB connection, delivered with C/CS Mount module B
MC023MG-SY-UB	B/W model, micro B USB connection, delivered with C/CS Mount module B
MC023CG-SY-UB	Color model, micro B USB connection, delivered with C/CS Mount module B
MC023MG-SY-FL	B/W model, flexline, delivered with C/CS Mount module B
MC023CG-SY-FL	Color model, flexline, delivered with C/CS Mount module B

### Image Sensor

Table 2. Image Sensor

Description	MC023CG-SY(all variations)	MC023MG-SY(all variations)	Units
Sensor Model	IMX174LQJ-C	IMX174LLJ-C	
Sony Datasheet	01/06/14	01/06/14	
Type	CMOS Global shutter, overlap mode		
Pixel resolution (H x V)	1936 x 1216		pixels
Active area size (H x V)	11.344 x 7.12		mm
Optical format	1/1.2		inch
Pixel size (H x V)	5.86 x 5.86		µm
ADC resolution	10, 12		bit
Color filter	RGB Bayer mosaic	None	

### Image Data Characteristics

Table 3. Average camera data characteristics

Description	Average value	Units
FWC	71.5	ke <sup>-</sup>
Dark Temporal noise	7.36	e <sup>-</sup>
Dynamic range	71.7	dB
SNR Max	45	dB
Dark current	TBD	e <sup>-</sup> /s
Dark signal non-uniformity	TBD	LSB <sub>12</sub> /s
PRNU	TBD	RMS
Sensitivity	TBD	LSB <sub>12</sub> / (lux.s)
Linearity	< 0.5	%



**Note:**

Measured on 10 cameras from first production batch in the following conditions:  
 12 bit sensor bit depth  
 Sensor board temperature 50°C  
 Power voltage 5V

## Optical path

Table 4. Optical path specification

Description	MC023CG-SY(all variations)	MC023MG-SY(all variations)	Units
IR Filter Brand	IR650	BK7	
Thickness	1.0±0.1	1.0±0.1	mm
Coating	NA	Antireflex both sides	
Optical path spot deviation from local average		>8	%
Size of the cosmetics defects		>3	lines



**Note:**  
Optical path cleanness is measured under F16 illumination in mid illumination.

## User interface

Table 5. Status LED indicators

Item	Parameter	Default after OpenDevice	Note
Status 1 Indication	yes, red	On	User configurable
Status 2 Indication	yes, green	Exposure Active	User configurable
Status 3 Indication	yes, blue	Frame Active	User configurable
Status 4 Indication	yes, orange	Off	User configurable

**Note:**  
Each LED function can be configured using API to one of the following modes using XI\_PRM\_LED\_SELECTOR, XI\_PRM\_LED\_MODE  
On, Off, Exposure Active, Frame Active, Blink

## Power

Table 6. Power Specification

Description	Symbol	Value	Units
Power supply, via USB connector or via IO connector	$V_{nom}$	5 (nom), AUX 4.5-5.5	V
Consumption, typical	$P_{nom}$	2.4	W
Consumption standby	$P_{stby}$	2.2	W
Consumption, maximum	$P_{max}$	2.5	W



**Note:**  
All parameters in this table are subject to qualification measurements specified in TBD.

# Mechanical

Table 7. Mechanical properties (Type-C connector)

Parameter	Symbol	Value	Units
Height	H	26.4	mm
Width	W	26.4	mm
Depth	D	33.1 (with C/CS Mount module B) 28.1 (without C/CS Mount module B)	mm
Weight	M	38.3 (with C/CS Mount module B)	g
Lens adapter		CS-Mount (with C/CS Mount module B) C-Mount (without C/CS Mount module B)	
Material and technology		Machined Aluminum alloy, anodized to black color	

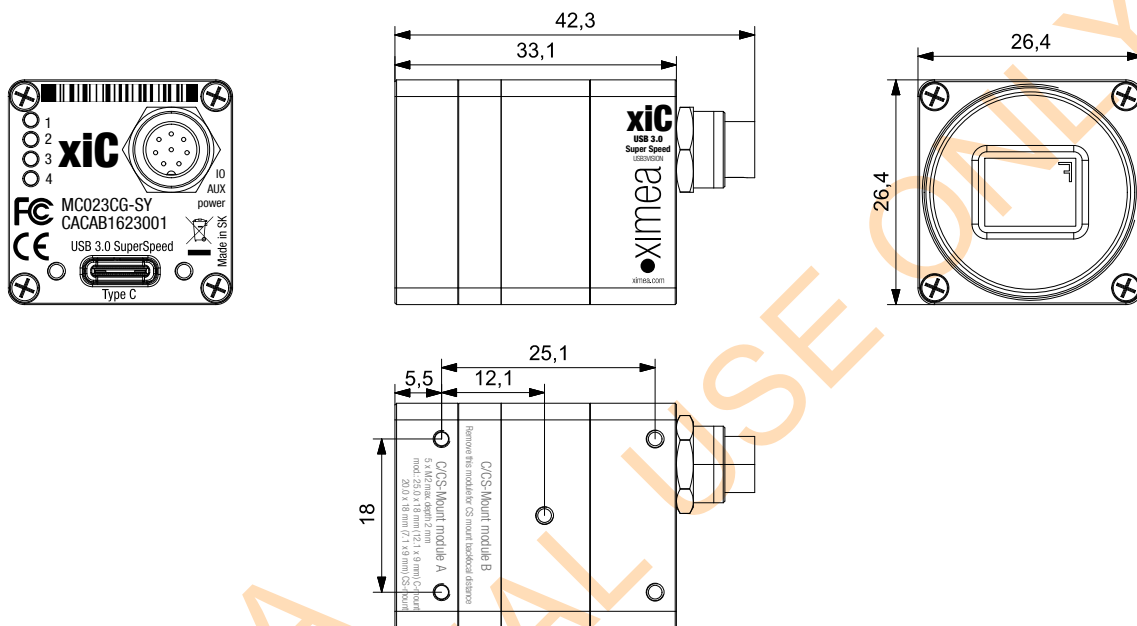


Figure 1. Housing dimensions (with C/CS Mount module B) MC023MG-SY and MC023CG-SY



Table 8. Mechanical properties (micro B connector)

Parameter	Symbol	Value	Units
Height	H	26.4	mm
Width	W	26.4	mm
Depth	D	32.8 (with C/CS Mount module B) 27.8 (without C/CS Mount module B)	mm
Weight	M	37.5 (with C/CS Mount module B)	g
Lens adapter		CS-Mount (with C/CS Mount module B) C-Mount (without C/CS Mount module B)	
Material and technology		Machined Aluminum alloy, anodized to black color	

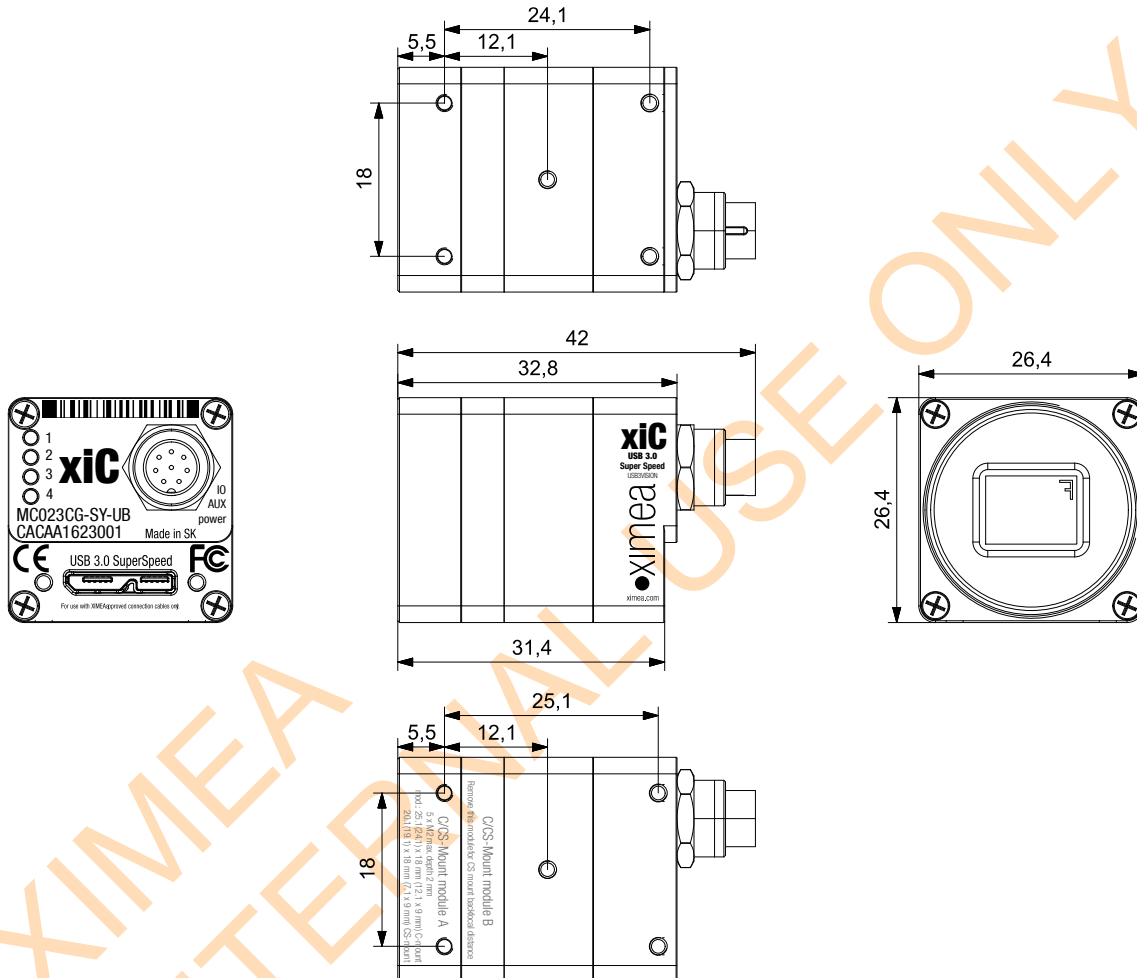


Figure 2. Housing dimensions (with C/CS Mount module B) MC023MG-SY-UB and MC023CG-SY-UB

Table 9. Mechanical properties (flex line)

Parameter	Symbol	Value	Units
Height	H	26.4	mm
Width	W	26.4	mm
Depth	D	28.9 (with C/CS Mount module B) 23.9 (without C/CS Mount module B)	mm
Weight	M	TBD (with C/CS Mount module B)	g
Lens adapter		CS-Mount (with C/CS Mount module B) C-Mount (without C/CS Mount module B)	
Material and technology		Machined Aluminum alloy, anodized to black color	

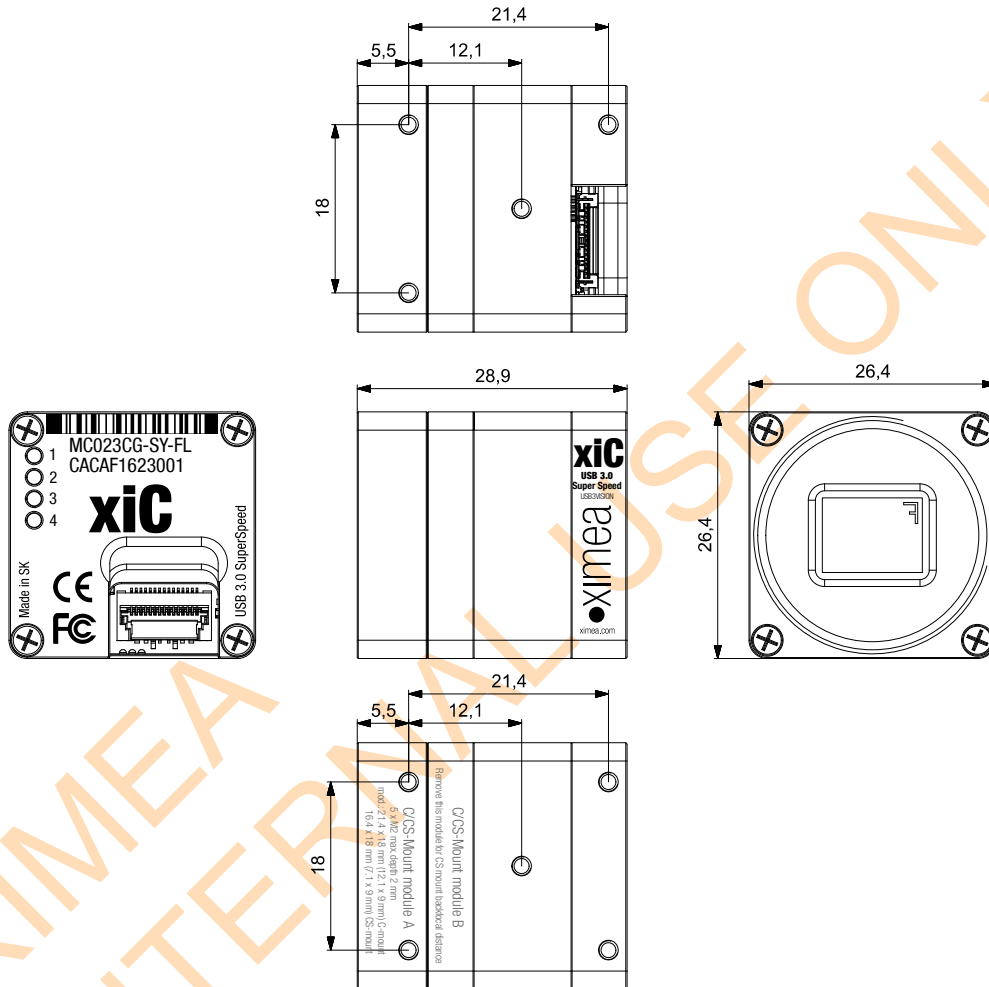


Figure 3. Housing dimensions (with C/CS Mount module B) MC023MG-SY-FL and MC023CG-SY-FL

Table 10. Sensor tolerances specification relative to the camera housing

Description	Symbol	Value	Units
Maximum rotation of image area (relative to the housing seating plane)	$\theta$	$\pm 1$	deg
Maximal sensor center positioning X (relative to the housing mounting holes)	X, Y	$\pm 275$	$\mu\text{m}$
Maximal sensor center positioning Z (relative to the seating plane)	Z	$\pm 250$	$\mu\text{m}$
Maximal sensor tilt $\alpha$ area (relative to the housing seating plane)	$\alpha$	$\pm 0.75$	deg
Maximal sensor tilt $\beta$ area (relative to the housing seating plane)	$\beta$	$\pm 0.75$	deg

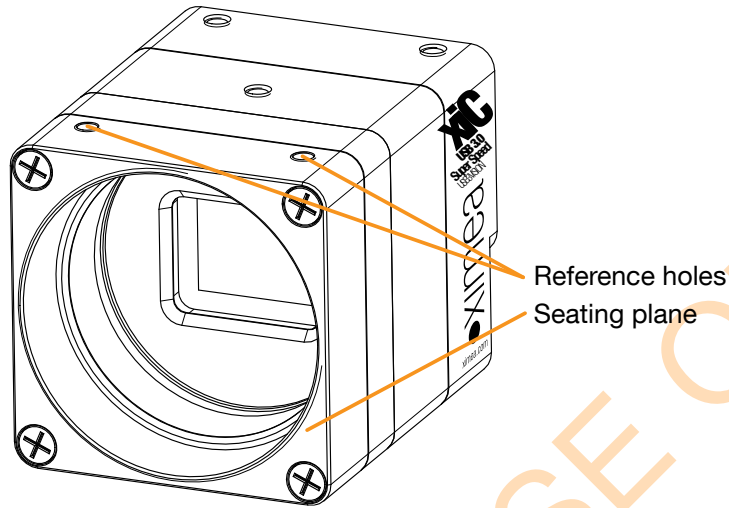


Figure 4. Housing reference points

(TBD – figure of sensor angles relative to housing)

Figure 5. Sensor tolerances illustration relative to the housing

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Table 11. Sensor tolerances specification relative to the board

Description	Symbol	Value	Units
Maximum rotation of image area	$\theta$	$\pm 0.75$	deg
Maximal sensor center positioning X (relative to the board mounting holes)	X, Y	$\pm 175$	$\mu\text{m}$
Maximal sensor center positioning Z (relative to the board seating plane)	Z	$\pm 150$	$\mu\text{m}$
Maximal sensor tilt $\alpha$ area	$\alpha$	$\pm 0.5$	deg
Maximal sensor tilt $\beta$ area	$\beta$	$\pm 0.5$	deg

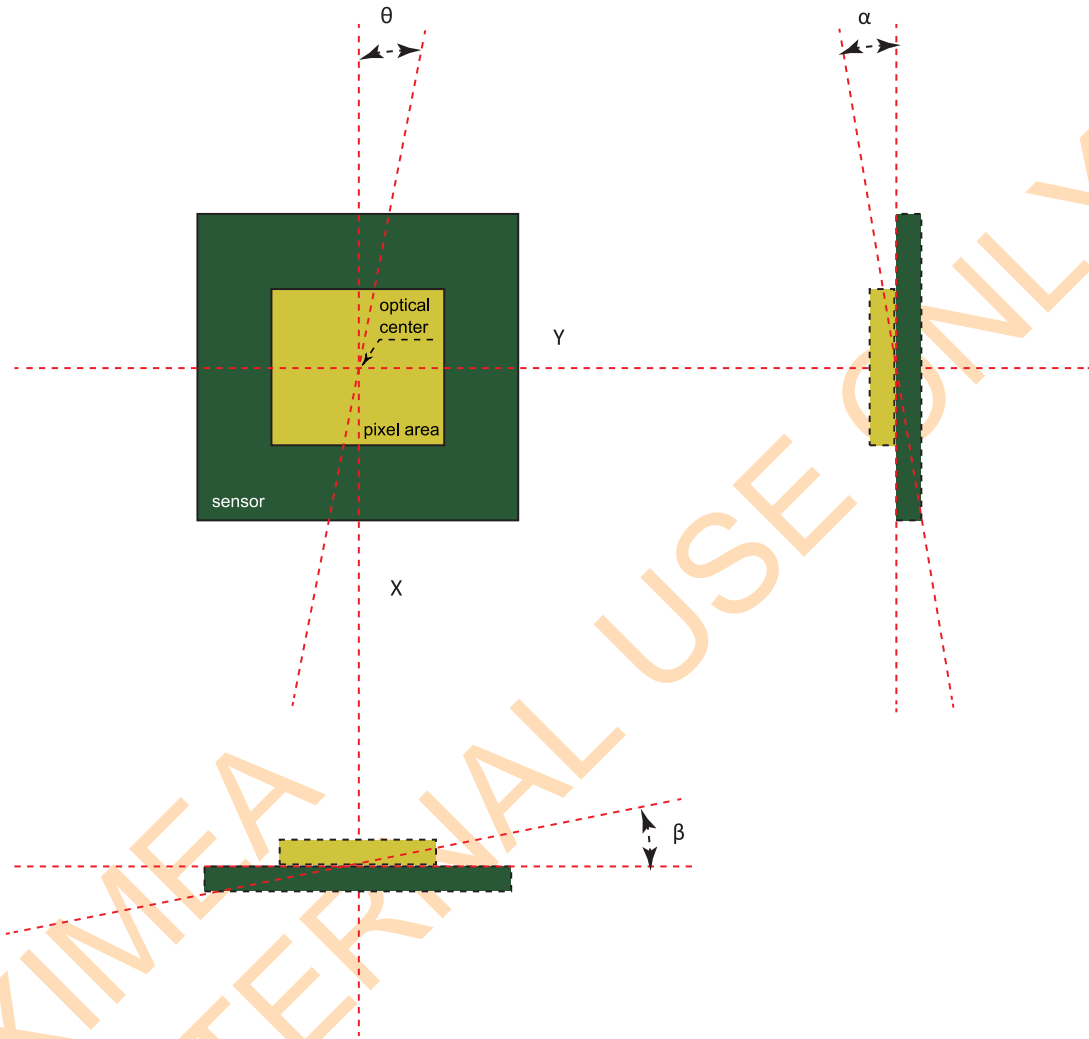


Figure 6. Sensor tolerances illustration relative to the board

## Environment

Table 12. Environment Specification

Description	Symbol	Value	Units
Optimal ambient temperature operation	T <sub>opt</sub>	+10 to +25	°C
Ambient temperature operation	T <sub>max</sub>	+5 to +60	°C
Ambient temperature for storage and transportation	T <sub>storage</sub>	-25 to +70	°C
Sensor Board Operating Temperature	T <sub>sensboard</sub>	0 to +60	°C
Relative Humidity, non-condensing	RH	80	%



**Note:**

All parameters in this table are subject to qualification measurements specified in TBD  
Housing temperature shall not exceed +60°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

## Camera Features

Table 13. Camera - features Specification

Description	xiAPI Parameter	Value/Range	Unit
Exposure time	EXPOSURE_TIME	0.017 - 3600	ms
Region of Interest (ROI)	WIDTH, HEIGHT, OFFSETX, Y	1936 × 1216	
Multiple ROI	REGION_SELECTOR	N/A	
Digitization	SENSOR_DATA_BIT_DEPTH	10, 12	Bit
Output Bit Resolution	OUTPUT_DATA_BIT_DEPTH	8, 10, 12	Bit
Lookup table (LUT)	LUT_EN, LUT_INDEX, LUT_VALUE	12bit input data from sensor -> 12bit output	bit
Frame-rate Control	FRAMERATE	0.5 – maximum	Hz
Fixed Pattern Noise – column correction	COLUMN_FPN_CORRECTION	N/A	
Fixed Pattern Noise – row correction	ROW_FPN_CORRECTION	N/A	
Trigger Source	TRG_SOURCE	Off (free-run), Software or Hardware Line (rising or falling edge)	
Trigger Selector	TRG_SELECTOR	Frame Start, Exposure Start, Exposure Active, Frame Burst Start	
Exposure Burst Count	EXPOSURE_BURST_COUNT	N/A	
Acquisition Frame Burst Count	ACQ_FRAME_BURST_COUNT	1 – 2 <sup>32</sup>	
Image Buffer (Frame Buffer)	-	64	KiB
Analog Gain	GAIN_SELECTOR_ANALOG_ALL, GAIN	0 - 24	dB
Digital Gain	GAIN_SELECTOR_DIGITAL_ALL, GAIN	TBD	dB
Temperature Sensor	SENSOR_BOARD_TEMP	0 - 80	°C
Time Stamp Precision	-	1	us
Firmware Update	-	Possible in field with xiCOP	



More details on xiAPI parameters are available at [XIMEA support pages](#).

## Supported sensor readout modes

Table 14. Supported IMX174 sensor readout modes

Name	Supported on color model	Supported on mono model	Binning Horizontal	Binning Vertical	Decim. Horizontal	Decim. Vertical	Output Resolution	Bit/pix on Transport	Maximum Frame rate [FPS]
Full res. 8 bits <sup>1)</sup>	Yes	Yes	1	1	1	1	1936 × 1216	8 <sup>1)</sup>	165.0
Full res. 10 bits	Yes	Yes	1	1	1	1	1936 × 1216	10pack	129.3
Full res. 12 bits	Yes	Yes	1	1	1	1	1936 × 1216	12pack	108.0



**Note:**

All frame rates were calculated with Sensor Performance Calculator (V2016-05-23) for 16 sensor output channels. Camera frame-rate depends on data transfer properties. Bandwidth Limit should not be limited (it should be set at least to 3088Mbit/sec).

Example: When camera is connected to HUB with other devices – real frame rate can be limited.

1) Sensor bit depth set to 10bit, transport bit depth is set to 8bit.

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## API Software Image Processing Features

Table 15. xiAPI - software image processing features

Filter	Description	xiAPI Parameter	Value	Units
Demosaicing	Bayer color filter array conversion to RGB	IMAGE_DATA_FORMAT	Available	
Demosaicing	White balance correction coefficients range	WB_KR, WB_KG, WB_KB	0.0 to 3.9	(ratio)
Demosaicing	Sharpness filter range	SHARPNESS	-400 to 400	%
Demosaicing	Gamma (Y and C)	GAMMAY, GAMMAC	0.3 to 1.0	
Demosaicing	Color correction matrix (3+1)x3 coefficients ranges	CC_MATRIX_...	-3.9 to 3.9	(ratio)
Sensor Defects Correction	Pixel, column, row sensor defects correction	BPC	Available	
Auto Exp/Gain	Auto exposure, gain setting	AEAG	Available	
Auto Exp/Gain	Auto exposure/gain region (ROI)	AEAG_ROI_...	Available	
Auto White Balance	Auto white balance	AUTO_WB, MANUAL_WB	Available	

**Note:**

More details on xiAPI parameters are available at [XIMEA support pages](#).

## External data interface

Table 16. External data interface

Item	Parameter	Note
External data interface	USB3.0	Protocol is the same for all variants
External data protocol	USB 3 VISION	Version 1.0.1
Interface connector	MC023xG-SY features Type-C connector MC023xG-SY-UB features micro B UCB 3.0 connector MC023xG-SY-FL features MOLEX 502244-1530	

## Digital Input and Output Interface

### General

Table 17. Digital Input and Output interface (MC023xG-SY and MC023xG-SY-UB only)

Item	Parameter	Note
<b>Digital Input and Output interface type</b>	BINDER 711 series - 09 0481 22 08 Receptacle	Mating connector: BINDER 711 series - 99 0480 100 08 BINDER 712 series - 99 0426 00 08 BINDER 702 series - cable assembly
<b>Pollution degree</b>	Degree 1	No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
<b>Limited power circuit</b>	Yes, <20VDC	Inherently limited power sources, IEC 61131-2, Section 11.3, Table 45
<b>Optical isolation</b>	yes	1 digital input and 1 digital output with isolation potential 50VDC, Overvoltage category II, $V_{peak}=500V$
<b>Material group</b>	all	Material group is not specified
<b>Micro-environment</b>	yes	Voltages are known and controlled
<b>Protective coating on PWB</b>	no	
<b>Shielding connection</b>	yes, to chassis via shell	
<b>Common pole</b>	yes, Input and Output	

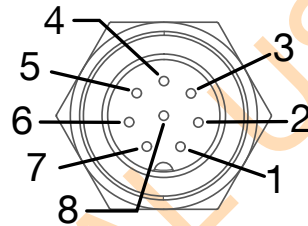


Figure 7. Digital Input and Output interface pinning

Table 18. Digital Input interface

Pin	Name	Direction	Level	Description
1	AUX PWR	-	4.5-5.5V	Power Supply Input
2	INOUT2	In/Out	LVTTTL(3.3, 50µA)	non-isolated Input/Output
3	OUT1	Out	Open collector	Opto-isolated Output 1
4	OUT GND	-	Common GND for OUT	Ground for Opto-Isolated out
5	IN1	In	(<0.8 Low; 4-24 High)	Opto-isolated Input 1
6	IN GND	-		Common ground for Opto-Isolated inputs
7	GND	-		External grounds for power supply and non-isolated I/O
8	INOUT1	In/Out	LVTTTL(3.3, 50µA)	non-isolated Input/Output



## Interface connector (flexline)

### General

Table 19. Digital Input and Output interface (MC023xG-SY-FL only)

Item	Parameter	Note
Digital Input and Output interface type	MOLEX 502244-1530	
Optical isolation	yes	1 digital input and 1 digital output with isolation potential 50VDC, Overvoltage category II, $V_{peak}=500V$
Material group	all	Material group is not specified
Micro-environment	yes	Voltages are known and controlled
Protective coating on PWB	no	
Common pole	yes, Input and Output	


**Note:**

For connection of camera custom flat ribbon cable has to be used.

Table 20. Interface connector MC023xG-SY-FL pinout

Pin	Name	Direction	Level	Description
1	GND	-		Ground for power return and for SuperSpeed signal return
2	SSRX-	In		SuperSpeed receiver differential pair; Accepted SSRX-
3	SSRX+	In		SuperSpeed receiver differential pair; Accepted SSRX+
4	GND	-		Ground for power return and for SuperSpeed signal return
5	SSTX-	Out		SuperSpeed transmitter differential pair; Accepted SSTX-
6	SSTX+	Out		SuperSpeed transmitter differential pair; Accepted SSTX+
7	GND	-		Ground for power return and for SuperSpeed signal return
8	D+	-	-	USB 2.0 differential pair
9	D-	-	-	USB 2.0 differential pair
10	GND	-		Ground for power return and for SuperSpeed signal return
11	VBUS	-	5V	+5V Power input
12	VBUS	-	5V	+5V Power input
13	OUT1	Out	Open collector	Opto-isolated Output 1
14	IN OUT GND	-	Common GND for IN/OUT	Ground for Opto-Isolated out and in
15	IN1	In	(<0.8 Low; 4-24 High)	Opto-isolated Input 1
Ground pins	GND	-		Ground for power return and for SuperSpeed signal return

### FPC cable

. FPC cable is produced by Pragoboard. Length of cable is 100mm. Part number is CBL-MQ-FL-0M1. FPC cable is polarized. Camera side is laser marked "CAM" and break-out-board side is marked "BOB".



Figure 8. FPC cable polarization and marking

## Digital Input and Output characteristics

### Optically isolated Digital Input (IN)

Table 21. Digital Input interface

Item	Parameter	Note
Maximal input voltage	24V DC	
Common pole	No	
Effect of incorrect input terminal connection	Reverse voltage polarity protected	
Effects when withdrawing/inserting input module under power	no damage, no lost data	
Maximal recommended cable length	5m	
Input Level for logical 0	Voltage < 1.5V / Current < 1mA	
Input Level for logical 1	Voltage > 4.0V / Current > 1mA	
Input debounce filter	No	
Input delay - rising edge	1.7±0.2 μs	V <sub>INPUT</sub> =10V, T <sub>AMBIENT</sub> =25°C
Input delay - falling edge*	10.7±0.2μs	V <sub>INPUT</sub> =10V, T <sub>AMBIENT</sub> =25°C
Number of inputs	1	
External trigger mapping	Yes	
Input functions	Trigger, Get current level	Rising or falling edge are supported for trigger



**Note:**

Propagation delay depends on voltage level on input. Propagation jitter is significantly lower.

### Optically isolated Digital Output (OUT)

Table 22. Digital Output interface

Item	Parameter	Note
Maximal open circuit voltage	24V DC	
Output port type	Open collector NPN	
Common pole	no	
Protection	short-circuit / over-current / Reverse voltage	
Protection circuit	PTC Resettable Fuse	
Maximal sink current	25mA	
Trip current	50mA	Self-restarting when failure mode current disconnected
Inductive loads	no	
Effect of incorrect output terminal connection	Protected against reverse voltage connection	
Maximal output dropout	1V	Sink current 25mA
Number of outputs	1	
Strobe output mapping	yes	

Table 23. Digital Output delay

Output current	OFF->ON	ON->OFF	Note
2mA	0.55µs	41µs	VOUTPUT=5V, T AMBIENT=25°C
5mA	0.60µs	43µs	VOUTPUT=5V, T AMBIENT=25°C
10mA	0.88µs	51µs	VOUTPUT=11V, T AMBIENT=25°C
25mA	1.4µs	51µs	VOUTPUT=13V, T AMBIENT=25°C

### Non isolated digital lines - Digital Input/Output (INOUT)

Table 24. Non isolated digital lines (Input / Output) (MC023xG-SY and MC023xG-SY-UB only)

Item	Parameter	Note
Number of digital lines	2	Each line can be configured by application separately as input or output
Maximal input voltage	24V DC	
Common pole	yes, AUX power GND	
Effect of incorrect input terminal connection	Reverse voltage polarity protected	
Effects when withdrawing/inserting input module under power	no damage, no lost data	
Protection	short-circuit / over-current / Reverse voltage	
Maximal output sink current	30µA	Maximal advised load = 60kOhm
Inductive loads	no	
Output Level logical 0	< 0.4V	Load 100kOhm
Output level logical 1	> 2.5V	Load 100kOhm
Output delay - rising edge	400ns	Load 100kOhm threshold 2V
Output delay - falling edge	450ns	Load 100kOhm threshold 0.5V
Input Impedance- minimum	15kOhm	
Input Level for logical 0	< 0.7V	
Input Level for logical 1	> 2.4V	
Input debounce filter	no	
Input delay - rising edge	750ns	V <sub>INPUT</sub> =5V, T <sub>AMBIENT</sub> =25°C
Input delay - falling edge*	1200ns	V <sub>INPUT</sub> =5V, T <sub>AMBIENT</sub> =25°C
Input functions	Trigger, Get current level	Rising or falling edge are supported for trigger
Output functions	Off, On, Exposure active, Frame active	Signal inversion supported



**Note:**

Because of low input impedance of non-insolated input it is not possible to connect master slave of two cameras directly. Signal conditioning (buffer, opamp ...) is required.

### External power supply input (AUX)

Table 25. External power supply interface

Item	Parameter	Note
Supported voltage range	4.5-5.5V	
Typical input current	0.48 A	@5V while acquisition
Maximum input current	0.5 A	@5V
Protection	over/under voltage protection	



**Note:**

External power supply has to be connected and active prior to connection of USB cable. Otherwise it will cause camera reset. Disconnecting AUX power during operation is not allowed.

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## Conformity

### Regulatory

Table 26. Regulatory conformity

Item	Parameter	Note
<b>Directive 2002/95/EC</b>	yes	restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
<b>Directive 2002/96/EC</b>	yes	waste electrical and electronic equipment (WEEE)
<b>Directive 2004/108/EC</b>	yes	electromagnetic compatibility (EMC)
<b>FCC</b>	yes	FCC Part 15 Class A Digital Device

### Standards

Table 27. Standards

Item	Parameter	Note
<b>EN 60950-1</b>	yes	Information technology equipment - Safety - Part 1: General requirements
<b>EN 55022 (2010)</b>	yes	Information technology equipment. Radio disturbance characteristics. Limits and methods of measurement
<b>EN 61000-6-3 (2007)</b>	yes	Generic standards – Emission standard for residential, commercial and light-industrial environments
<b>EN 61000-6-4 (2007)</b>	yes	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
<b>EN 55024 (2010)</b>	yes	Information technology equipment - Immunity characteristics - Limits and methods of measurement
<b>EN 61000-6-1 (2007)</b>	yes	Generic standards – Immunity for residential, commercial and light-industrial environments
<b>EN 61000-6-2 (2005)</b>	yes	Electromagnetic compatibility (EMC). Generic standards. Immunity for industrial environments

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