

CA378-AOIS-V2

Camera Module Specification

Model name : CA378-AOIS-V2

Editing History

<i>Editing No.</i>	<i>Editing Date</i>	<i>Summary of Change</i>
Ver.1.0	2024/1/25	Create New

CenturyArks Co., Ltd.

<i>Approval</i>	<i>Responsible person</i>
No:058-000008	Kazumasa Nishiya

Contents

.....	0
General description and application	1
Functions and Features	2
USE RESTRICTION NOTICE	3
Use Restrictions	3
Design for Safety	3
Export Control.....	3
No License Implied	3
Governing Law	4
Other Applicable Terms and Conditions	4
1 Summary of Specifications	5
2 Components	6
3 Temperature Specification	6
4 Block Diagram	6
5 Pin Assignment & Description	7
6 Optical Specifications	8
6.1. Optical Characteristics	8
6.2. Imaging Characteristics	8
7 Communication Specification	9
8 Actuator Specifications	10
8.1. Control Specifications.....	10
8.2. Typical Characteristics	10
9 Image Sensor Specifications.....	11
9.1. Device Structures.....	11
9.2. Image Sensor Characteristics	11
9.3. Control Specifications	11
9.4. Readout Start Position	12
9.5. Transmittance of IR-CF	12
10 OTP ROM & Memory Map Specifications	13
11 EPROM Memory Specifications	13
11.1. Specification of EPROM Memory Area	13
12 Electrical Characteristics	14
12.1. Absolute Maximum Ratings.....	14
12.2. Recommended Operating Conditions	14
12.3. DC Characteristics.....	14
12.4. AC Characteristics.....	15
12.5. Current Consumption	15
13 Start Up Sequence	16
13.1. Power-on Sequence.....	16
13.2. Power-Down Sequence.....	16
14 Notes on Handling and Assembly.....	17
14.1. Notes on Handling	17
14.2. Notes on Assembly.....	19
15 Package Outline	22
15.1. Dimension Outline Drawing.....	22
15.2. Lens Protect Tape.....	22

CA378-AOIS is a lens module using a diagonal 7.857 mm (Type 1/2.3) 12.3M effective pixels CMOS Active pixel type stacked image sensor with a square pixel array. Its camera head size is 13.1mm (W) × 12.3mm (D) and the height is 5.68mm.

As optical control function, VCM driver and actuator are implemented in the module. In addition, this product is designed for use in cellular phone or Tablet PC. When using this for another application, CA (CenturyArks) does not guarantee the quality and reliability of product. Therefore, don't use this for applications other than cellular phone or Tablet PC. Consult your CA sales representative if you have any questions.

Functions and Features

- ◆ Back-illuminated and stacked CMOS image sensor Exmor RSTM
- ◆ Sony CMOS image sensor with large pixel size 1.55 x 1.55um
(1.6~2.4 times larger cell size comparing with recent main stream products for smartphone)
- ◆ Full resolution@60fps(Normal/SME-HDR) 4K2K @60fps(Normal/SME-HDR) 1080p @240fps
- ◆ Embedded “Phase Detection” pixel and self-concealment
- ◆ Optical Image Stabilization driven by synchronized PWM control to achieve
- ◆ Half power consumption for this function
- ◆ Easy to use of OIS control done by embedded FW in the driver
- ◆ No-compromise to optimize the PCB layout to minimize the electrical interference noise on the image.
- ◆ Output video format of RAW12/10/8, COMP8.
- ◆ CSI-2 serial data output (MIPI 2lane/4lane, Max. 2.1Gbps/lane, D-PHY spec. ver. 1.2 compliant)
- ◆ 2-wire serial communication.
- ◆ Small F.No(1.8) lens
- ◆ VCM actuator & driver
- ◆ Two PLLs for independent clock generation for pixel control and data output interface.
- ◆ Dynamic Defect Pixel Correction.
- ◆ Dual sensor synchronization operation.
- ◆ 64K bit of OTP ROM for users.
- ◆ Built-in temperature sensor
- ◆ 10-bit/12-bit A/D conversion on chip

USE RESTRICTION NOTICE

This USE RESTRICTION NOTICE ("Notice") is for customers who are considering or currently using the image sensor products ("Products") set forth in this specifications book. CenturyArks Corporation ("CA") may, at any time, modify this Notice which will be available to you in the latest specifications book for the Products. You should abide by the latest version of this Notice. distributor has its own use restriction notice on the Products, such a use restriction notice will additionally apply between you and the distributor. You should consult a sales representative of the distributor of on such a use restriction notice when you consider using the Products.

Use Restrictions

- The Products are intended for incorporation into such general electronic equipment as office products, communication products, measurement products, and home electronics products in accordance with the terms and conditions set forth in this specifications book and otherwise notified by CA from time to time.
- You should not use the Products for critical applications which may pose a life- or injury-threatening risk or are highly likely to cause significant property damage in the event of failure of the Products. You should consult your sales representative beforehand when you consider using the Products for such critical applications. In addition, you should not use the Products in weapon or military equipment.
- CA disclaims and does not assume any liability and damages arising out of misuse, improper use, modification, use of the Products for the above-mentioned critical applications, weapon and military equipment, or any deviation from the requirements set forth in this specifications book.

Design for Safety

- CA is making continuous efforts to further improve the quality and reliability of the Products; however, failure of a certain percentage of the Products is inevitable. Therefore, you should take sufficient care to ensure the safe design of your products such as component redundancy, anti-conflagration features, and features to prevent mis-operation in order to avoid accidents resulting in injury or death, fire or other social damage as a result of such failure.

Export Control

- If the Products are controlled items under the export control laws or regulations of various countries, approval may be required for the export of the Products under the said laws or regulations. You should be responsible for compliance with the said laws or regulations.

No License Implied

- The technical information shown in this specifications book is for your reference purposes only. The availability of this specifications book shall not be construed as giving any indication that CA and its licensors will license any intellectual property rights in such information by any implication or otherwise. CA will not assume responsibility for any problems in connection with your use of such information or for any infringement of third-party rights due to the same. It is therefore your sole legal and financial responsibility to resolve any such problems and infringement.

Governing Law

- This Notice shall be governed by and construed in accordance with the laws of Japan, without reference to principles of conflict of laws or choice of laws. All controversies and disputes arising out of or relating to this Notice shall be submitted to the exclusive jurisdiction of the Tokyo District Court in Japan as the court of first instance.

Other Applicable Terms and Conditions

- The terms and conditions in the CA additional specifications, which will be made available to you when you order the Products, shall also be applicable to your use of the Products as well as to this specifications book. You should review those terms and conditions when you consider purchasing and/or using the Products.

Preliminary

1 Summary of Specifications

Table 1 List of Specifications

Item		Details	
Image Sensor	Image size	Type 1/2.3 (Diagonal 7.857 mm)	
	Number of total pixels	4072 (H) × 3176 (V)	
		12.93 M pixels	
	Number of effective pixels	4072 (H) × 3064 (V)	
		12.47 M pixels	
	Module effective pixels	4056 (H) × 3040 (V)	
12.33 M pixels			
Number of recommended recording pixels	4040 (H) × 3024 (V)		
	12.21 M pixels		
Lens	Lens construction	5 Lenses	
	Focal length	4.266 mm (35mm equivalent : 23mm)	
	F value	1.8	
	Angle of view (INF position)	Horizontal/Vertical/Diagonal	62.58° / 49.28° / 74.26°
	Focus range	100mm to infinity with auto focus (Resolution is not guaranteed for all focus range.)	
Focus Control	Feedback control VCM linear motor		
OIS	PWM control OIS		
Output	MIPI CSI-2 (4 lane) RAW Data 12/10/8 COMP8 output		
	Frame rate	Capture mode (all images)	Max. 60 frame/sec.
		4K2K movie (16:9)	Max. 60 frame/sec.
		Full HD movie (16:9)	Max. 240 frame/sec.
I/O	Image signal	MIPI CSI2 2/4 lane	
	Control signal	I2C interface for image sensor and AF/OIS driver	
	Number of terminals	34 pins	
Input CLK Frequency	6 MHz - 27 MHz		
Others	Power supply	Image sensor (analog)	2.8 ± 0.1 V
		Image sensor (digital)	1.05 ± 0.1 V
		I/O	1.8 ± 0.1 V
		Actuator	2.8 ± 0.1 V
	Power consumption	650.0 mW(max)	
	EPROM Capacity	64K bits	
	Operating temperature	T operation	-10~+55 °C
	Storage temperature	T storage	-30~+75°C
	Recommended operating temperature	T specification	0~+45 °C
	Operating humidity range	H operation	+80%RH or under, non-condensing
	Package dimensions(All)	13.1mm(W)×21.00mm(D)×5.95mm(H) (AT = 10cm)	
	Package dimensions(Module)	13.1mm(W)×12.5mm(D)×5.95mm(H) (AT = 10cm) (Camera head block/Without tolerance)	
	Package mass	Around 1.5±0.1g	



2 Components

Table 2 Constituent Components

Item	Description
Substrate	Rigid-Plex board
CMOS Image sensor	Type 1/2.3, 12.47M effective pixels, silicon
IRCF	Absorptive + Reflective type + Black Mask
Sensor Base	Base that connect substrate and actuator
Lens unit	Plastic lens x5, with VCM AF/OIS actuator provided
AF/OIS Driver	Gyro& VCM actuator driver IC
Connector	B to B connector

3 Temperature Specification

Table 3 Temperature Specifications

Item	Symbol	Conditions	Specification	Unit
Operating temperature	Topr	Image should be output.	-10~+55°C	°C
Storage temperature	Tstg		-30~+75°C	°C
Recommended operating temperature	Topr		0~+45°C	°C
Operating humidity range	Hopr		+80%RH or under	%RH

4 Block Diagram

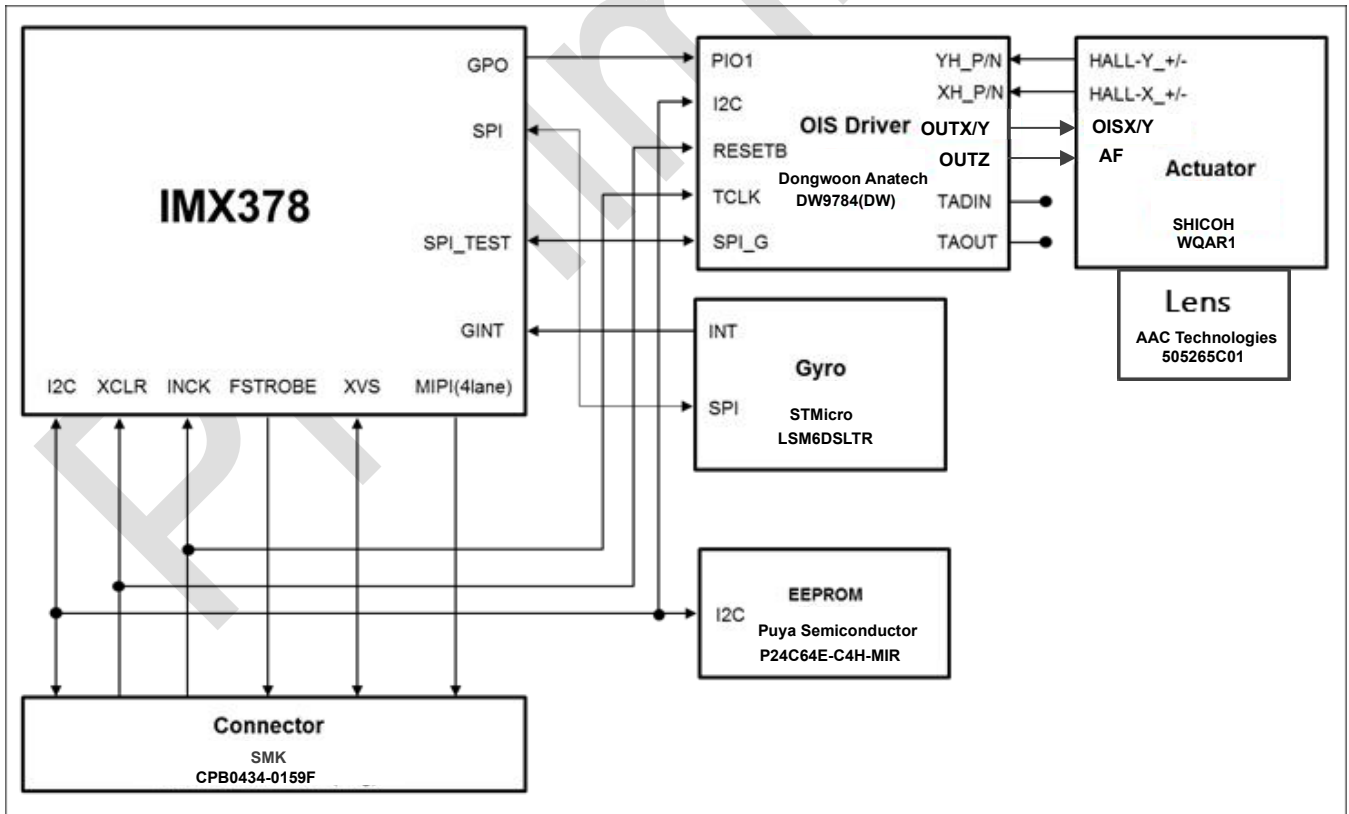


Figure 1 Block Diagram

5 Pin Assignment & Description

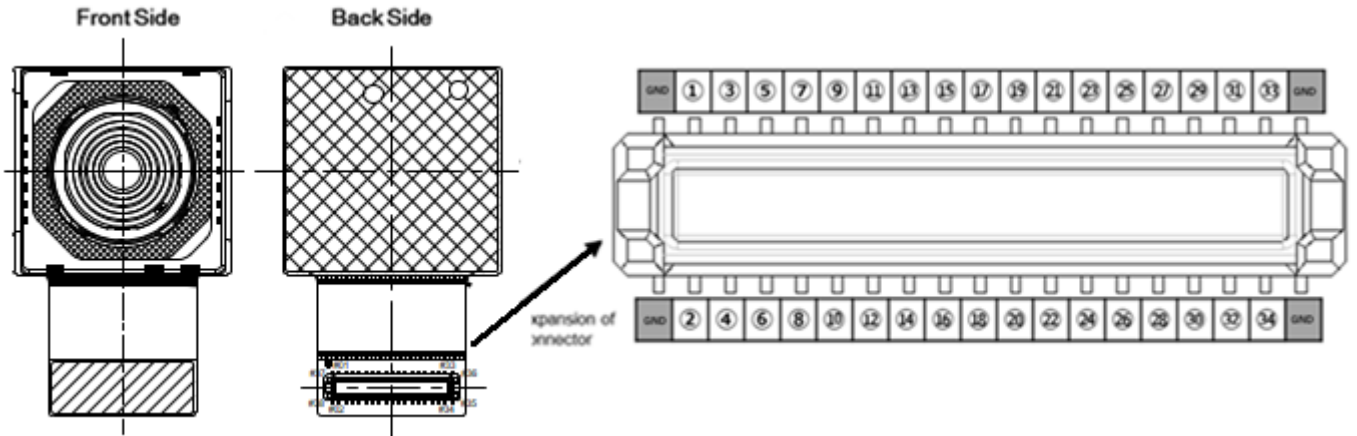


Figure 2 Pin Assignment

Table 4 Pin Descriptions

No	Symbol	I/O	A/D	Spec	Description	Remarks
1	AGND	GND	A	—	Analog GND	
2	AVDD	Power	A	2.8 V	Analog Power supply	
3	SCL	I	D	—	I2C Clock (INPUT)	
4	SDA	I/O	D	—	I2C data (I/O)	
5	FSTROBE	O	D	—	Flash strobe	
6	XVS	I/O	D	—	Sync signal during dual operation	Master : output Slave : input
7	XCLR	I	D	—	Sensor Reset (INPUT)	
8	DGND	GND	D	—	Digital GND	
9	DGND	GND	D	—	Digital GND	
10	DMO3P	O	D	—	MIPI output(DATA+)	
11	DMO1P	O	D	—	MIPI output(DATA+)	
12	DMO3N	O	D	—	MIPI output(DATA-)	
13	DMO1N	O	D	—	MIPI output(DATA-)	
14	DGND	GND	D	—	Digital GND	
15	DGND	GND	D	—	Digital GND	
16	DCKP	O	D	—	MIPI output(CLK+)	
17	DGND	GND	D	—	Digital GND	
18	DCKN	O	D	—	MIPI output(CLK-)	
19	DMO2P	O	D	—	MIPI output(DATA+)	
20	DGND	GND	D	—	Digital GND	
21	DMO2N	O	D	—	MIPI output(DATA-)	
22	DMO4P	O	D	—	MIPI output(DATA+)	
23	DGND	GND	D	—	Digital GND	
24	DMO4N	O	D	—	MIPI output(DATA-)	
25	DGND	GND	D	—	Digital GND	
26	DGND	GND	D	—	Digital GND	
27	DVDD	Power	D	1.05V	Digital Power supply	
28	INCK	I	D	—	Sensor Clock (INPUT)	
29	DVDD	Power	D	1.05V	Digital Power supply	
30	IOVDD	Power	D	1.8 V	Digital I/O Power supply	
31	ACTVDD	Power	A	2.8 V	Actuator Power supply	
32	ACTGND	GND	A	—	Actuator GND	
33	ACTVDD	Power	A	2.8 V	Actuator Power supply	
34	ACTGND	GND	A	—	Actuator GND	

6 Optical Specifications

6.1. Optical Characteristics

- ◆ Lens construction : plastic 5 lenses
- ◆ Focal length : 4.266 mm (23 mm, 35 mm equivalent)
- ◆ F number : 1.8
- ◆ Horizontal angle of view : 62.58°
- ◆ Vertical angle of view : 49.28°
- ◆ Diagonal angle of view : 74.26°
- ◆ Focusing range : Inf. to 100mm

6.2. Imaging Characteristics

(Ta=25°C、Rh=40 to 60%、AVDD=2.8V、IOVDD=1.8V、DVDD=1.05V)

Table 5 Image Performance Ratings

Item		Min	Typ.	Max	Unit	Range	Measurement Method	Note
Resolution (at 400 mm distance)	Center	2490			TV Line	Image Center	(*1)	Determined by boundary sample
	Corner	1800			TV Line	Image height diagonal 70 %		
Focus position	Infinity	Must be focused within movable range of focus lens.				Image Center		
	Macro (100mm)	0.3 mm pitch white and black line chart must be taken as resolved image.				Image Center		Design guarantee value (*2)

*1 : After adjusting the white balance in the center part of the image shot using dedicated chart, undertake the prescribed edge enhancement processing, and specify the resolution using the number of horizontal and vertical lines on the resolution chart.

*2: The design guarantee values are not measured individually.

7 Communication Specification

The 2-wire serial communication characteristics are shown below.

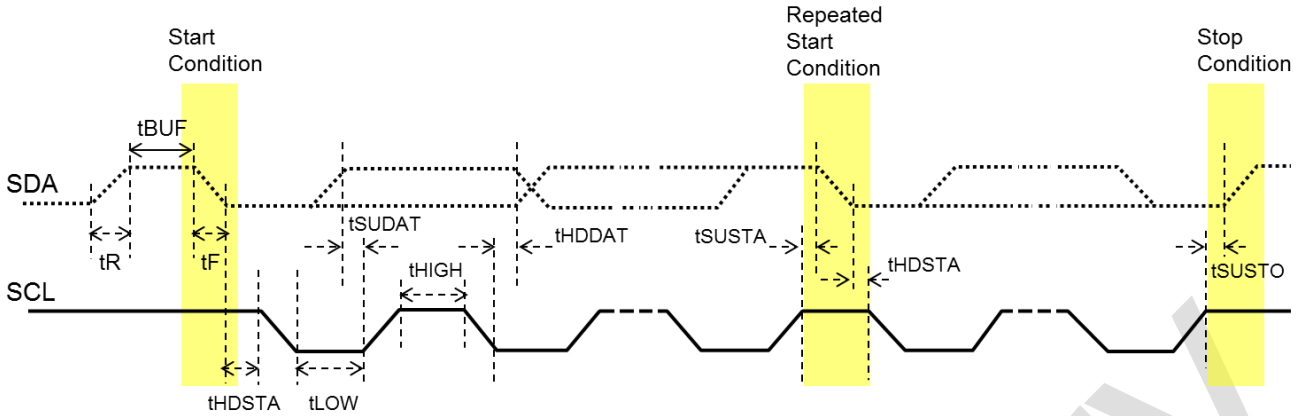


Figure 3 CCI Serial Timing Conditions

Table 6 2 wire serial communication block specification

Parameter	Symbol	Conditions	Min.	Max.	Unit
Low level input voltage	V_{IL}		-0.5	$0.3V_{IF}$	V
High level input voltage	V_{IH}		$0.7V_{IF}$	2.9	V
Low level output voltage	V_{OL1}	$V_{IF} > 2\text{ V}$, Sink 3 mA	0	0.4	V
	V_{OL2}	$V_{IF} < 2\text{ V}$, Sink 3 mA	0	$0.2V_{IF}$	V
Output fall time	t_{of}	Load 10 pF – 400 pF $0.7 V_{IF} \rightarrow 0.3 V_{IF}$		250	ns
Input current	I_i	$0.1 V_{IF} \rightarrow 0.9 V_{IF}$	-10	10	μA
SDA I/O capacitance	$C_{I/O}$			10	pF
SCL Input capacitance	C_I			10	pF

Table 7 2 wire serial communication AC specification

Parameter	Symbol	Min.	Max.	Unit
SCL clock frequency	fSCL	0	400	kHz
Rise time (SDA and SCL)	tR	—	300	ns
Fall time (SDA and SCL)	tF	—	300	ns
Hold time (start condition)	tHDSTA	0.6	—	μs
Setup time (rep.-start condition)	tSUSTA	0.6	—	μs
Setup time (stop condition)	tSUSTO	0.6	—	μs
Data setup time	tSUDAT	100	—	ns
Data hold time	tHDDAT	0	—	μs
Bus free time between Stop and Start condition	tBUF	1.3	—	μs
Low period of the SCL clock	tLOW	1.3	—	μs
High period of the SCL clock	tHIGH	0.6	—	μs

8 Actuator Specifications

8.1. Control Specifications

- ◆ Actuator driver control : CCI
- ◆ Actuator driver slave address : 1110 0100
- ◆ Actuator system : VCM drive
- ◆ Actuator driver output current resolution : 8bit

8.2. Typical Characteristics

Table 8 Actuator Typical Characteristics

	Item	Specification
AF	Sensitivity	$4.00 \pm 1.3 \mu\text{m/mA}$
	Rated Stroke	$\leq -100 \mu\text{m} \quad \geq 280 \mu\text{m}$
	Linearity	$\leq 14 \mu\text{m}$
	Hysteresis	$\leq 10 \mu\text{m}$
OIS	Sensitivity	$2.75 \pm 1.5 \mu\text{m/mA}$
	OIS Rated Stroke	$\pm 110 \mu\text{m}$
	Linearity	$\leq 14 \mu\text{m}$
	Hysteresis	$\leq 18 \mu\text{m}$

Preliminary

9 Image Sensor Specifications

9.1. Device Structures

- ◆ CMOS Image Sensor : IMX378-AAQH5-C (SONY)
- ◆ Image size : Diagonal 7.857mm (Type1/2.3)
- ◆ Total number of pixels : 4072(H) × 3176(V) approx. 12.93M
- ◆ Number of effective pixels : 4072(H) × 3064(V) approx. 12.47M
- ◆ Number of active pixels : 4056(H) × 3040(V) approx. 12.33M
- ◆ Chip size : 7.564mm(H) × 5.476mm(V)
- ◆ Unit cell size : 1.55um(H) × 1.55um(V)
- ◆ Substrate of material : Silicon

Note) For details of the Image Sensor Characteristics, refer to “IMX378 Data Sheets”.

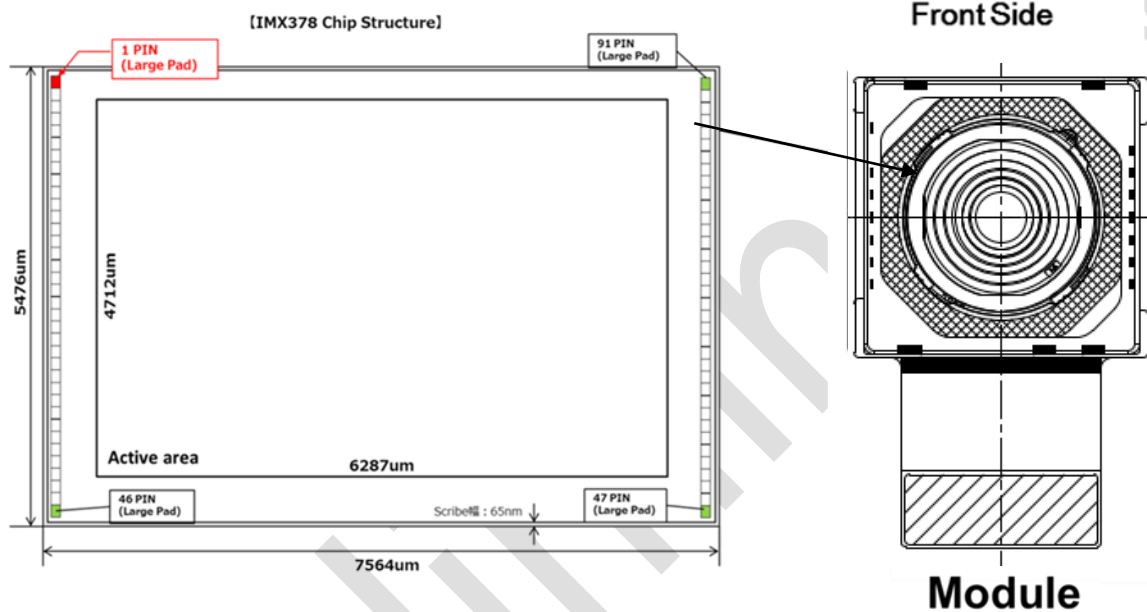


Figure 4 Sensor Structure and Sensor Position in Module

9.2. Image Sensor Characteristics

Note) For details of the Image Sensor Characteristics, refer to “IMX378 Data Sheets”.

9.3. Control Specifications

- ◆ Image sensor control : CCI
- ◆ Image sensor slave address : 0011010b
- ◆ Image sensor registers data width : 8bit

Note) For details of the communication protocol, refer to “IMX378 Application Note”.

9.4. Readout Start Position

Default readout position of Module starts from the lower left when PIN1 is placed at the upper left corner(refer to Figure4). Because the lens will invert the image both vertically and horizontally, the proper image can be archived when PIN1 is placed at the upper left corner.

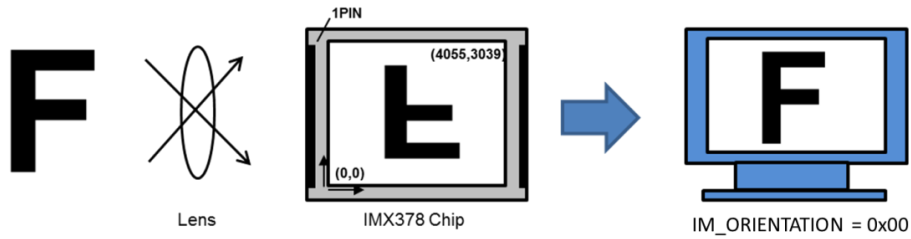


Figure 5 Readout Start Position

Vertical flip and horizontal mirror readout modes can be specified by the register below. And when readout start and end positions are matching the readout size, the same area is displayed when flipping/mirroring the image. When changing the readout direction, the color of first readout pixel (R/Gr/Gb/B) also changes with it.



Figure 6 Readout Image for Each Combination of Flip and Mirror

Note) For details of the communication protocol, refer to “IMX378 Application Note”.

9.5. Transmittance of IR-CF

The transmittance for each wavelength is shown below.

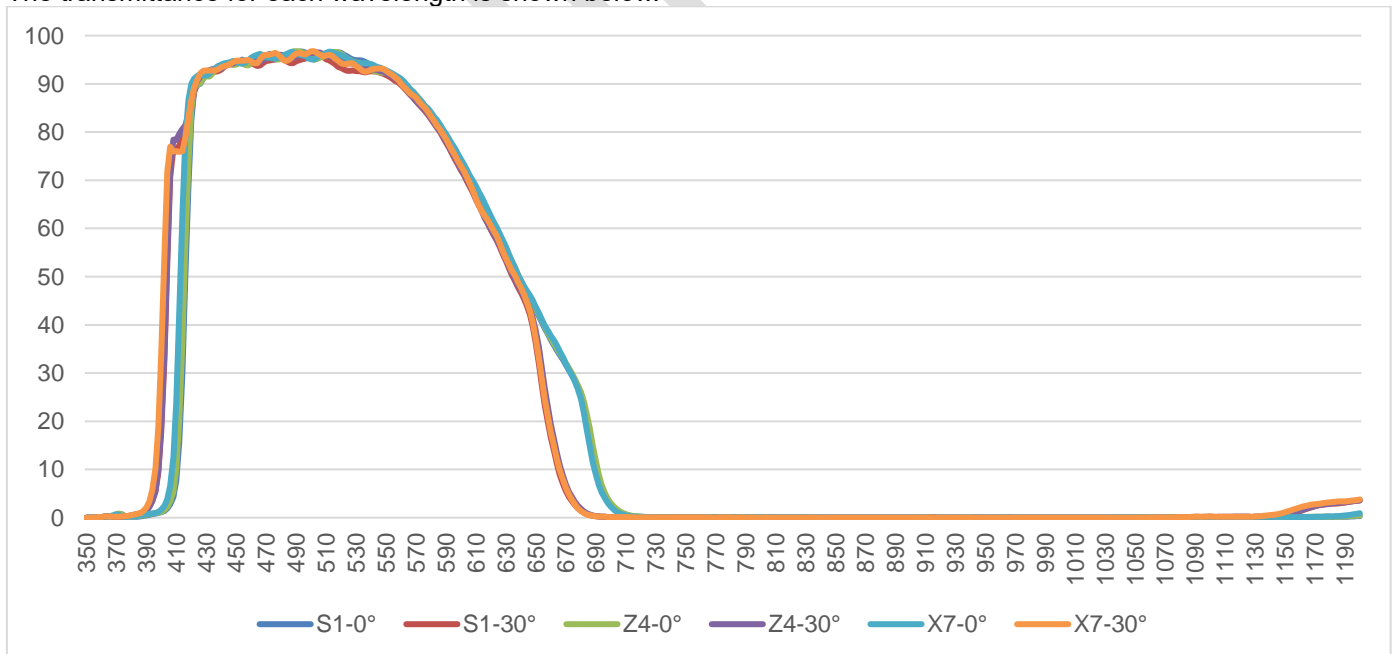


Figure 7 Transmittance of IR-CF

10 OTP ROM & Memory Map Specifications

Note) For details of the OTP ROM & Memory Map, refer to "IMX378 Application Note".

11 EPROM Memory Specifications

- ◆ EPROM control : CCI
- ◆ EPROM slave address : 1010000b
- ◆ EPROM registers data width : 8 bit

11.1. Specification of EPROM Memory Area

- Memory map contents (CA dedicated area)

Table 9 Memory Map for CA Dedicated Area

Address	Format	Data	Data name	adjustment	Comment
0000	ASC	"C"			
0001	ASC	"A"			
0002	ASC	"3"			
0003	ASC	"7"			
0004	ASC	"8"			
0005	ASC	"."			
0006	ASC	"A"			
0007	ASC	"O"			
0008	ASC	"I"			
0009	ASC	"S"			
000A	ASC	"."			
000B	ASC	" V"			
000C	ASC	" 2"			
000D~0027			reserved		
0028	BCD	YY	Factory test date		
0029	BCD	YY			
002A	BCD	MM			
002B	BCD	DD			

12 Electrical Characteristics

12.1. Absolute Maximum Ratings

Table 10 Absolute Maximum Ratings

Item	Symbol	Specification	Unit	Remarks
Supply voltage (Image sensor analog)	AVDD	-0.3 to +3.3	V	—
Supply voltage (Image sensor digital)	DVDD	-0.3 to +1.8	V	—
Supply voltage (I/O)	IOVDD	-0.3 to +3.3	V	—
Supply voltage (Lens system)	ACTVDD	-0.3 to +3.3	V	XCL, INCK
Input Voltage	VI	-0.3 to +3.3	V	SDA, SCL
Output Voltage	VO	-0.3 to +3.3	V	

(DGND=0V, AGND=0V, ACTGND=0V)

12.2. Recommended Operating Conditions

Table 11 Recommended Operating Conditions

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage (Image sensor analog)	AVDD	2.7	2.8	2.9	V	
Supply voltage (Image sensor digital)	DVDD	0.95	1.05	1.15	V	
Supply voltage (I/O)	IOVDD	1.7	1.8	1.9	V	
Supply voltage (Lens system)	ACTVDD	2.7	2.8	2.9	V	

12.3. DC Characteristics

Table 12 DC Characteristics

Item	Pin	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	AVDD	AVDD	-	2.7	2.8	2.9	V
	IOVDD	IOVDD	-	1.7	1.8	1.9	V
	DVDD	DVDD	-	0.95	1.05	1.15	V
	ACTVDD	ACTVDD	-	1.8	2.8	3.3	V
Input voltage (High Level)	XCLK INCK		-	0.65IOVDD		IOVDD+0.3	V
	SDA SCL		-	0.7IOVDD		2.9	V
Input voltage (Low Level)	XCLK INCK		-	-0.3		0.35IOVDD	V
	SDA SCL		-	-0.3		-0.3IOVDD	V
Output voltage (High Level)	SDA			IOVDD-0.4			
Output voltage (Low Level)	SDA		-			0.4	V

12.4. AC Characteristics

The input specifications when the square wave signal is input directly to the external pin INCK are shown below.

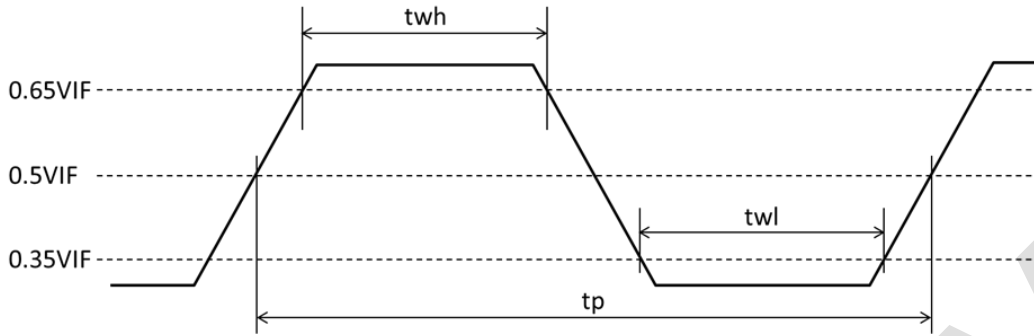


Figure8 Master Clock Square Waveform Input Diagram

Table 13 Master Clock Square Waveform Input Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	comment
INCK clock frequency	f _{sck}	6		27	MHz	
INCK clock period	tp	37.0		166.7	ns	
INCK low level width	twl	0.4tp		0.6tp	ns	
INCK high level width	twh	0.4tp		0.6tp	ns	
INCK jitter	Tjitter			600	ps	

12.5. Current Consumption

Table 14 Current Consumption

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Current Consumption during Operation	AVDD		46.5		mA	Full 60fps
	DVDD		323.7	450	mA	
	IOVDD		33.2		mA	
	ACTVDD	2.3		200	mA	
Current Consumption during Operation	AVDD		46.5		mA	Full 30fps
	DVDD		194.4	290	mA	
	IOVDD		33.2		mA	
	ACTVDD	2.3		200	mA	
Standby Current	AVDD		3.8		mA	
	DVDD		3.5		mA	
	IOVDD		1.6		mA	
	ACTVDD	2.3		200	mA	

13 Start Up Sequence

13.1. Power-on Sequence

A diagram of the power-on sequence is shown in Figure9.

Turn on ACTVDD first. Other power lines can be turned on in any order. In order to avoid potential issues such as pulling down the I C bus during start-up, the power-on sequence described in Figure 7 should be followed.

Note) For details of the Power-on Sequence, refer to “IMX378 Data Sheets”.

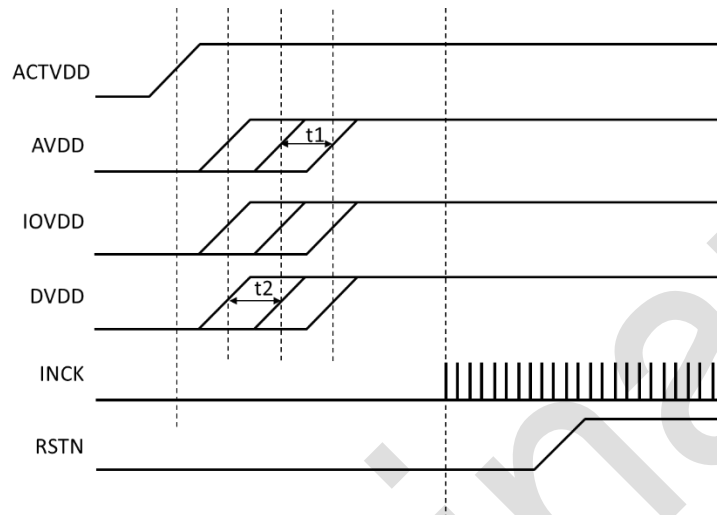


Figure 9 Power-On Sequence
(*t1,t2: AVDD,DVDD,IOVDD may rise in any order.)

13.2. Power-Down Sequence

A diagram of the power-down sequence is shown in Figure10.

The ACTVDD power supply is cut at the very end. Other power lines can be turned off in any order.

Note) For details of the Power-down Sequence, refer to “IMX378 Data Sheets”.

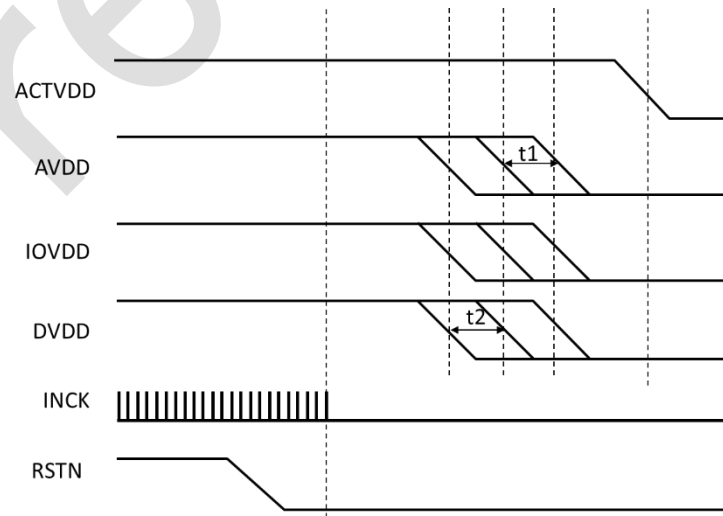


Figure 10 Power-Down Sequence
(*t1,t2: AVDD, DVDD, IOVDD may fall in an arbitrary order.)

14 Notes on Handling and Assembly

14.1. Notes on Handling

This lens module was designed to be assembled into electronic products. When using it, ensure safe design by heeding the following precautions.

1. Prevention of Electrostatic Discharge (ESD)

CMOS image sensors and other ICs can easily be damaged by static discharge. When handling the lens modules, take the following measures to prevent static discharge.

- (1) Either use non-chargeable gloves, clothes or material. Also use conductive shoes.
- (2) Use a wrist strap when handling directly.
- (3) Install grounded conductive mats on the floor and working table to prevent the generation of static electricity.
- (4) Ionized air is recommended for discharge when handling CMOS image sensors.
- (5) For the shipment of mounted boards, use boxes treated for the prevention of static charges.

2. Light resistance of CMOS image sensors

- (1) Do not expose the lens modules to strong light for long periods. With color devices, the colors of the color filters will fade when the devices are left exposed to strong light for long periods. In such cases where high-brightness subjects are to be shot with an exposure amount control system that uses an electronic iris, the image surface brightness will rise to an excessively high level, accelerating the progression of the color fading. Consult with **SSS(Sony Semiconductor Solutions Corporation)** if the lens modules will be used continuously under harsh conditions that exceed the normal conditions for use.
- (2) Do not store or use the lens modules in harsh conditions where the temperature and humidity levels are high, because their characteristics will be adversely affected as a result.

3. Notes on storage and operating environments

Do not store or use the lens modules in harsh environments with high temperatures, high humidity levels, and high concentrations of dust or in environments where condensation may form from moisture or dampness. It is also recommended that the lens modules not be stored for periods exceeding 1 month.

4. Mechanical strength

(1) This lens module is a precision-made optical component and, as such, care must be taken to avoid subjecting it to excessive mechanical impact and other forces.

(2) Precaution concerning the bonding strength of FPCs and circuit boards. (Fig. (A))

The strength of the FPC and circuit board bonding is weak so care must be taken to avoid applying force in the direction in which the FPCs will be peeled off. In particular, applying forces such as those that will twist the FPCs will cause stress to become concentrated locally, possibly causing the FPCs to be peeled off. If it is absolutely necessary to allow force to be applied, handle the lens modules while using the strength shown in the figure below as the upper limit even temporarily.

(This must not be construed to be the strength that is guaranteed in the face of loads that are applied under normal conditions.)

In particular, once adhesive tape has been affixed to the back surfaces, do not then attempt to peel it off.

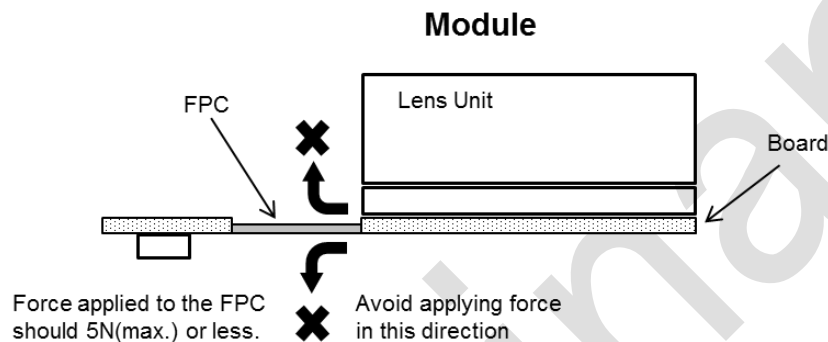


Fig.(A)

5. Remodeling

Do not attempt to remodel or rework the lens module. Absolutely no guarantees will be given in the event that a module has been remodeled or reworked.

6. Safety standards

This lens module is a semi-finished product and, as such, no guarantees are given in regard to its compliance with any safety standards.

Take steps to ensure compliance with the applicable safety standards after it has been incorporated into the completed products. We can't guarantee it to any damage when incorporating in customer's product. Please evaluate sufficiently in customer's product.

7. Protection from dust and dirt

- (1) Do not touch the lens surface with hand and make any objects to contact with it. When there is any dirt or other contaminant on the lens surface, remove it using a soft cloth or a similar object dipped in alcohol while taking care not to scratch or mark the surface.
- (2) Keep in a dedicated case to protect from dust and dirt.
- (3) Install the lens system and do other related tasks in a clean environment. (Class 1000 or below)

14.2. Notes on Assembly

1. How to secure the module in place

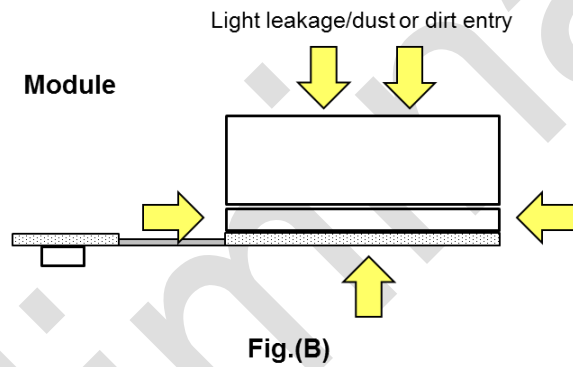
It is recommended that the module be secured in place using cushioning material in order to ensure that impacts will be absorbed.

- (1) For the top part of the module, use cushioning material to secure the parts around the lens top in place. Avoid the lens barrel and lens drive shaft areas.
- (2) For the bottom part, secure the bottom surface of the module using electrically conductive cushioning material.

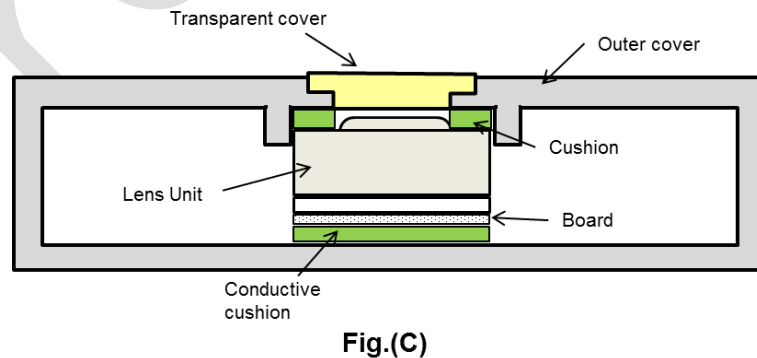
2. Measures to provide protection from dust and light leakage

The structure of this lens module is neither dust-proof nor drip-proof.

- (1) The module is structured in such a way that there is a gap between the lens barrel and CMOS imaging device package, and light leaking through this gap may cause flare and other trouble. Furthermore, dust may gain entry so when mounting the module in the products, take steps to shield the light and prevent the entry of dust. (Fig. (B) below)



- (2) Since it will not be possible to remove any dust or dirt entering the optical viewing part (diaphragm area), it is recommended that a transparent cover such as the one shown in Fig. (C) below be attached to the top part of the module. Cover the transparent cover with an anti-reflection film to eliminate the reflection of extraneous light.



3. Measures to prevent ghosting

When light with outside angle of view enters the lens, ghosts may appear in the screen. For this reason, it is recommended that light-shielding steps be taken so that the entry of light with an incident angle*1 outside the viewing angle will be prevented. When noticeable ghost images are found that cannot be eliminated by lens module countermeasures, separate ghost image will be presented. Ghosts caused by inner reflection may appear in the screen when setting a cover over the upper side of the module. Putting anti-reflection film on both sides of the cover is recommended to decrease the ghosts.

*1 Incident angle: Angle formed with the optical axis

4. FPC precautions

Do not adhere shielding materials or other electrically conductive materials to the FPCs. Shielding will reduce the quality of the CSI2 signals and make it impossible to meet the MIPI Alliance Specification for D-PHY Spec and, in a worst case scenario, errors may occur in the signal reception and transmission.

5. Precautions for CCI connection (Fig. (D))

Note that the communication line not be shared with any other devices.

In case of shared the communication line, The 2-wire serial communication bus is sometimes fixed to Low, while the module's power is off. This condition may occur the state of through current.

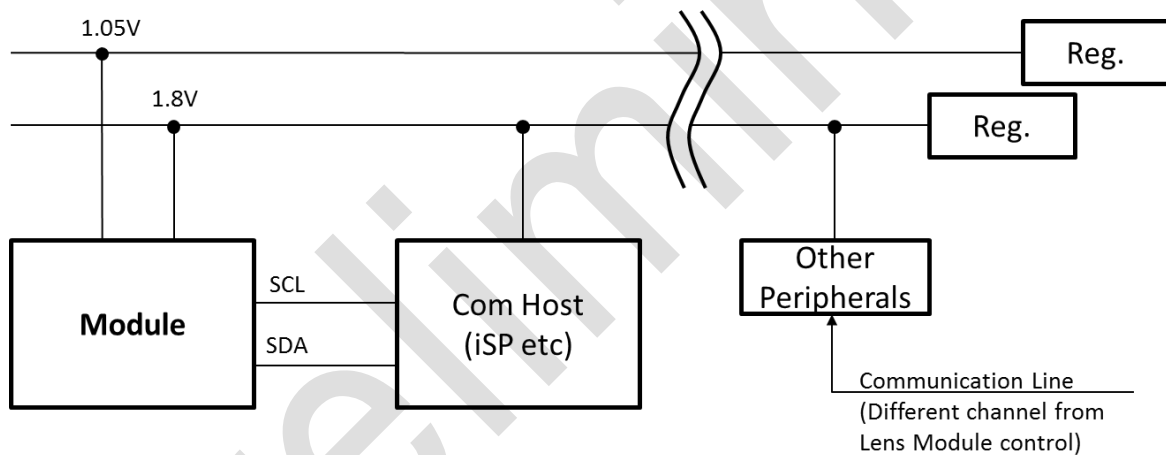


Fig.(D)

6. Precautions for CSI2 signal transfer circuit design

In this product, the pixel signals are output using a CSI2 high-speed serial interface.

At the transfer circuit design stage, refer to the MIPI standard, MIPI Alliance Standard for Camera Serial Interface 2 (CSI-2) Version 1.01.00 and MIPI Alliance Specification for D-PHY Version 1.00.00.

7. Notes on actuator block

This actuator controls AF (auto focus) by magnetic field which the coil generates. Therefore, when there is another magnetic field, AF control may be affected by it.

In addition, equipment utilizing magnetic field may be affected because magnetic field leaks out from the module.

8. Power supply precautions (Fig. (E))

- (1) Reduce the AVDD impedance as much as possible. Otherwise, the image quality will be affected.
- (2) Ensure that the power from the actuator driver ACTVDD power supply and the sensor AVDD power supply is not shared.
 - ⇒ Otherwise, noise may appear on the screen during actuator drive. Separate the actuator power supply and sensor power supply by, for instance, inserting a regulator in each.
- (3) Ensure that the power from the DSP and memory power supply and the sensor power supply are not shared.
 - ⇒ Otherwise, noise may appear on the screen. Separate the two power supplies by, for instance, inserting a regulator in each.
- (3) Ensure that the power from the AVDD, DVDD, IOVDD, ACTVDD and other module power supplies is not shared with the power from the power supplies of other circuits inside the product. Do this by separating them.

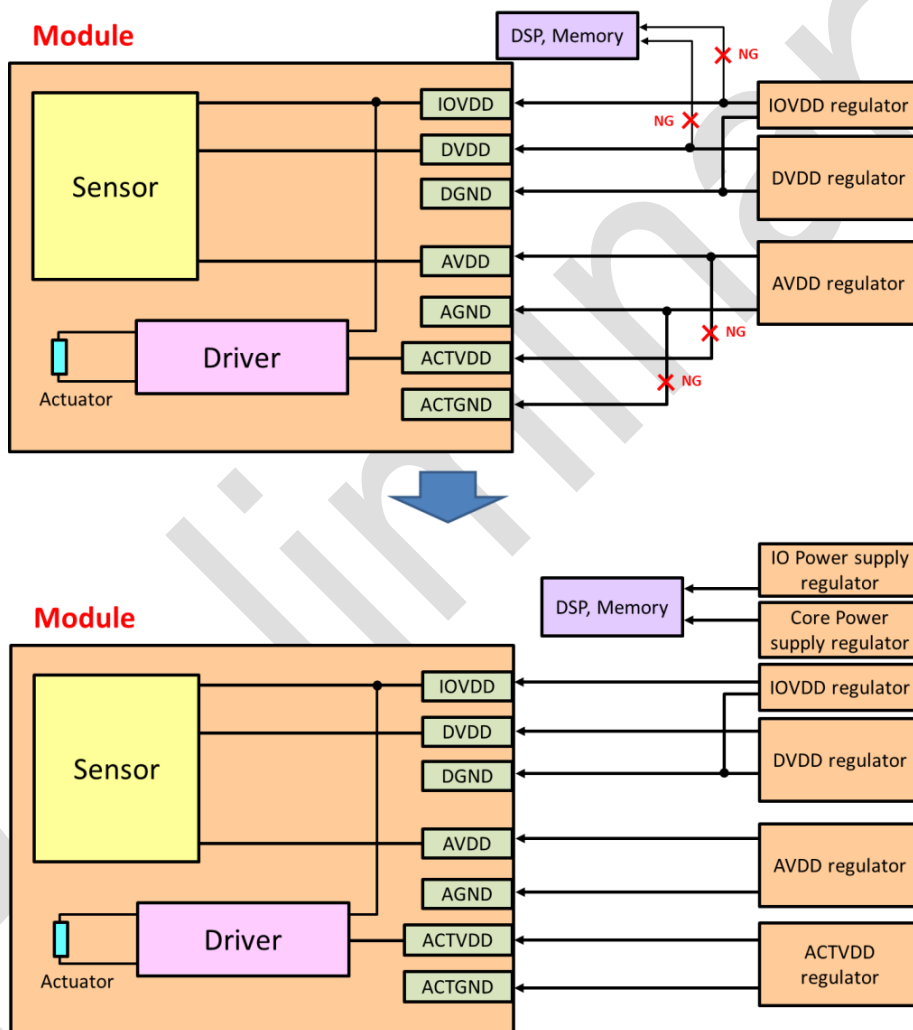


Fig.(E)

15 Package Outline

15.1. Dimension Outline Drawing

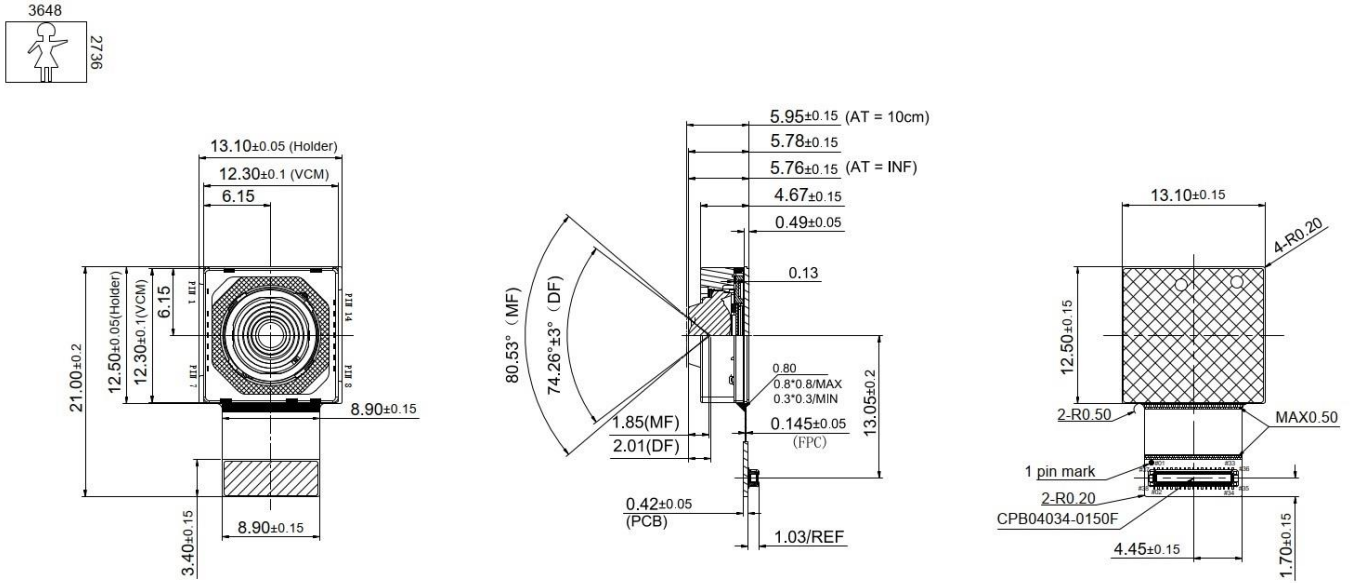


Figure 11 Outline Drawing

15.2. Lens Protect Tape

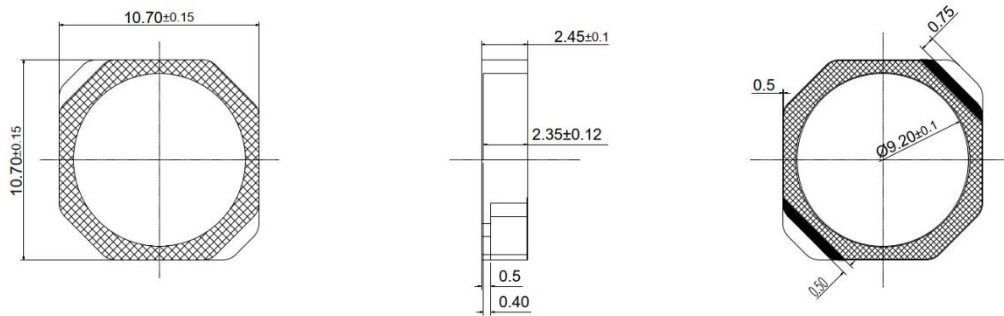


Figure 12 Lens Protect Tape Specification

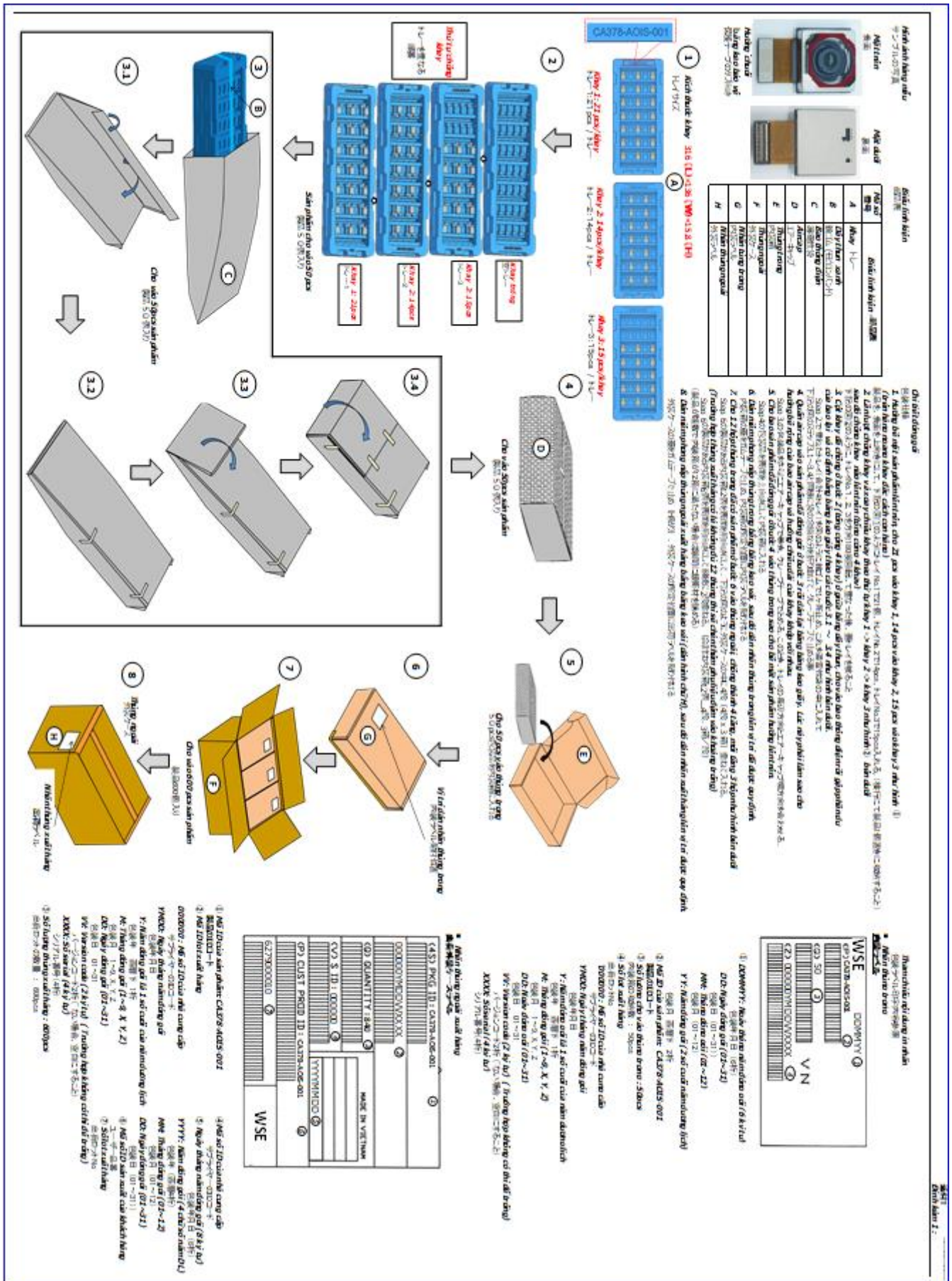


Figure 13 Packing Specification