

ISSUE : \_\_\_\_\_

To: \_\_\_\_\_

23, July, 2008

**Preliminary**

**SPECIFICATIONS**

**Product Type:** 1/10-type VGA CMOS Camera Module

**Model No. :** **RJ6ABA100**

\*This specification contains 21 pages including the cover, contents and appendix.  
If you have any objections, please contact us before issuing purchasing order.

CUSTOMERS ACCEPTANCE

DATE: \_\_\_\_\_

BY: \_\_\_\_\_

PRESENTED

BY: \_\_\_\_\_

N. FUJITA

Dept. General Manager

REVIEWED

PREPARED

BY: \_\_\_\_\_

BY: \_\_\_\_\_

MODULE DEVELOPMENT DEPT.III  
IMAGING & SENSING LSI DIVISION  
ELECTRONIC COMPONENTS AND DEVICES GROUP  
SHARP CORPORATION

## CAUTIONS FOR USE

- Handle this document carefully for it contains material protected by international copyright law. Any reproduction, full or in part, of this material is prohibited without the express written permission from the company.
- When using the products covered herein, please observe the conditions written herein and the precautions outlined in the following paragraphs. In no event shall the company be liable for any damages resulting from failure to strictly adhere to these conditions and precautions.
  - (1) The products covered herein are designed and manufactured for the following application areas. When using the products covered herein for the equipment listed in Paragraph (2), even for the following application areas, be sure to observe the precautions given in Paragraph (2). Never use the products for the equipment listed in Paragraph (3).
    - Office electronics
    - Instrumentation and measuring equipment
    - Machine tools
    - Audiovisual equipment
    - Home appliances
    - Communication equipment other than for trunk lines
  - (2) Those contemplating using the products covered herein for the following equipment which demands high reliability, should first contact a sales representative of the company and then accept responsibility for incorporating into the design fail-safe operation, redundancy, and other appropriate measures for ensuring reliability and safety of the equipment and the overall system.
    - Mainframe computers
    - Traffic control systems
    - Gas leak detectors and automatic control devices
    - Rescue and security equipment
    - Other safety devices and safety equipment, etc.
  - (3) Do not use the products covered herein for the following equipment which demands extremely high performance in terms of functionality, reliability, or accuracy.
    - Aerospace equipment
    - Communication equipment for trunk lines
    - Control equipment for the nuclear power industry
    - Medical equipment related to life support, etc.
  - (4) Please direct all queries and comments regarding the interpretation of the above three paragraphs to a sales representative of the company.
- Please direct all queries regarding the products covered herein to a sales representative of the company.

## CONTENTS

<b>1. OVERVIEW</b> .....	2
1-1. FEATURE .....	2
1-2. FUNCTION .....	2
1-3. APPLICATION .....	2
<b>2. BLOCK DIAGRAM</b> .....	3
2-1. CAMERA MODULE BLOCK DIAGRAM .....	3
<b>3. PIN ASSIGNMENT</b> .....	4
<b>4. PIXEL ARRANGEMENT</b> .....	5
<b>5. CAMERA SPECIFICATION</b> .....	6
5-1. ABSOLUTE MAXIMUM RATING .....	6
5-2. RECOMMENDED OPERATING CONDITION .....	6
5-3. CMOS IMAGE SENSOR SPECIFICATION .....	7
5-4. LENS SPECIFICATION .....	7
<b>6. ELECTRICAL CHARACTERISTICS</b> .....	8
6-1. DC CHARACTERISTICS .....	8
6-2. CAMERA PERFORMANCE .....	9
<b>7. SIGNAL INTERFACE SPECIFICATION</b> .....	10
7-1. CAMERA CLOCK .....	10
7-2. PLL .....	10
7-3. RSTN .....	11
7-4. STANDBY MODE .....	11
<b>8. AC CHARACTERISTICS</b> .....	12
8-1. DIGITAL PARALLEL OUTPUT TIMING .....	12
8-2. DSP SERIAL CONTROL INTERFACE TIMING .....	13
8-3. SETUP TIME OF PLL .....	14
8-4. POWER SUPPLY SEQUENCE .....	15
<b>9. RECOMMENDED MOUNTING CONDITIONS</b> .....	16
<b>10. CAMERA MODULE DIMENSIONS</b> .....	17
<b>11. CAUTIONS</b> .....	18
11-1. BREAKAGE OF THE PACKAGE .....	18
11-2. STATIC ELECTRICITY .....	18
11-3. DUST, STAIN .....	18
11-4. OTHERS .....	19

## 1. Overview

This product is CMOS camera module. It is composed of the following part.

- Digital signal processor LSI and 1/10 type 350K pixels CMOS color sensor
- Lens

Output video signal is UYVY 8 bit parallel format

### 1-1. Feature

- 1) Progressive scan
- 2) A square : Pixel pitch :  $2.2\mu\text{m(H)} \times 2.2\mu\text{m(V)}$
- 3) RGB primary color mosaic filter.
- 4) VGA format (640×480)
- 5) Variable electronic shutter system
- 6) Built-in up and down-left and right inversion function
- 7) Analog supply voltage 2.8V, digital supply voltage 1.8V, I/F power 1.8V/2.8V
- 8) Horizontal angle of view: 54 deg

### 1-2. Function

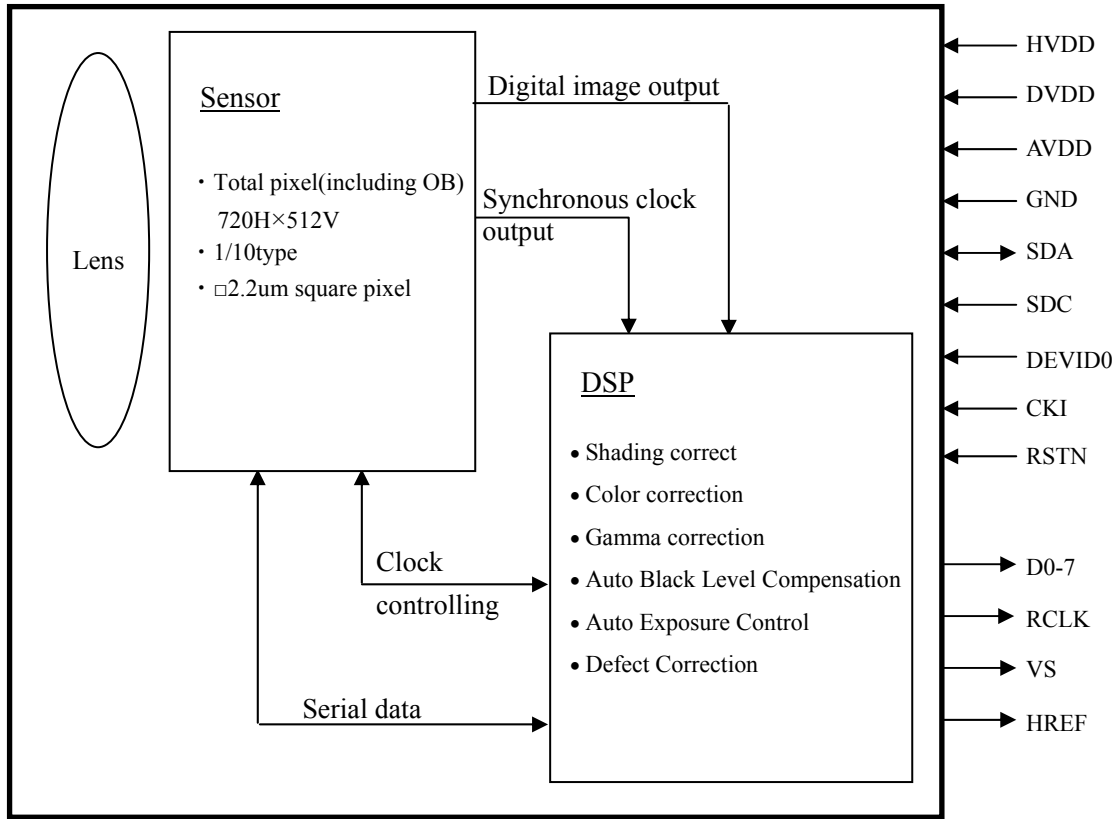
- 1) VGA / QVGA / QQVGA / CIF output format
- 2) UYVY 8bit digital parallel output
- 3) Re-loadable parameters for video signal processing
- 4) Built-in automatic exposure control
- 5) Built-in auto white-balance control
- 6) Built-in defect correction
- 7) Built-in lens shading correction

### 1-3. Application

- 1) Cellular phone / PHS camera.
- 2) PC / PDA camera.
- 3) Game / Toy camera.

## 2. Block diagram

### 2-1. Camera module block diagram



### 3. Pin assignment

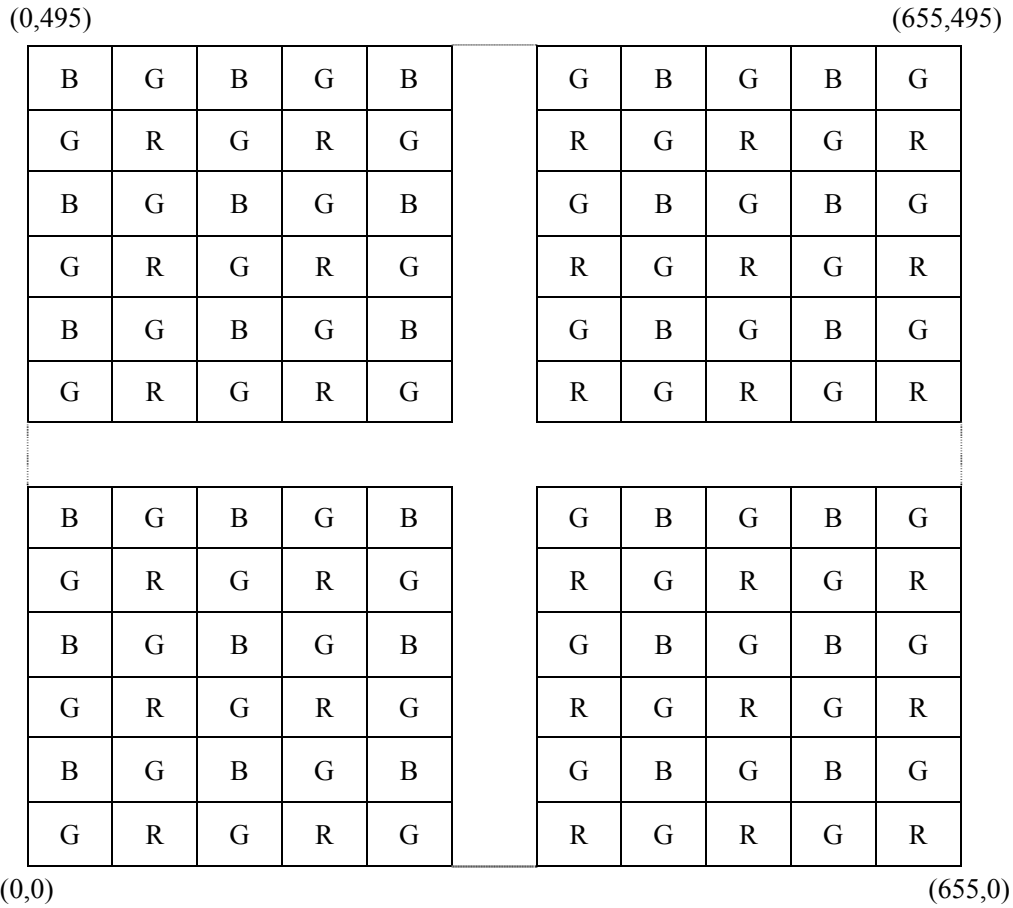
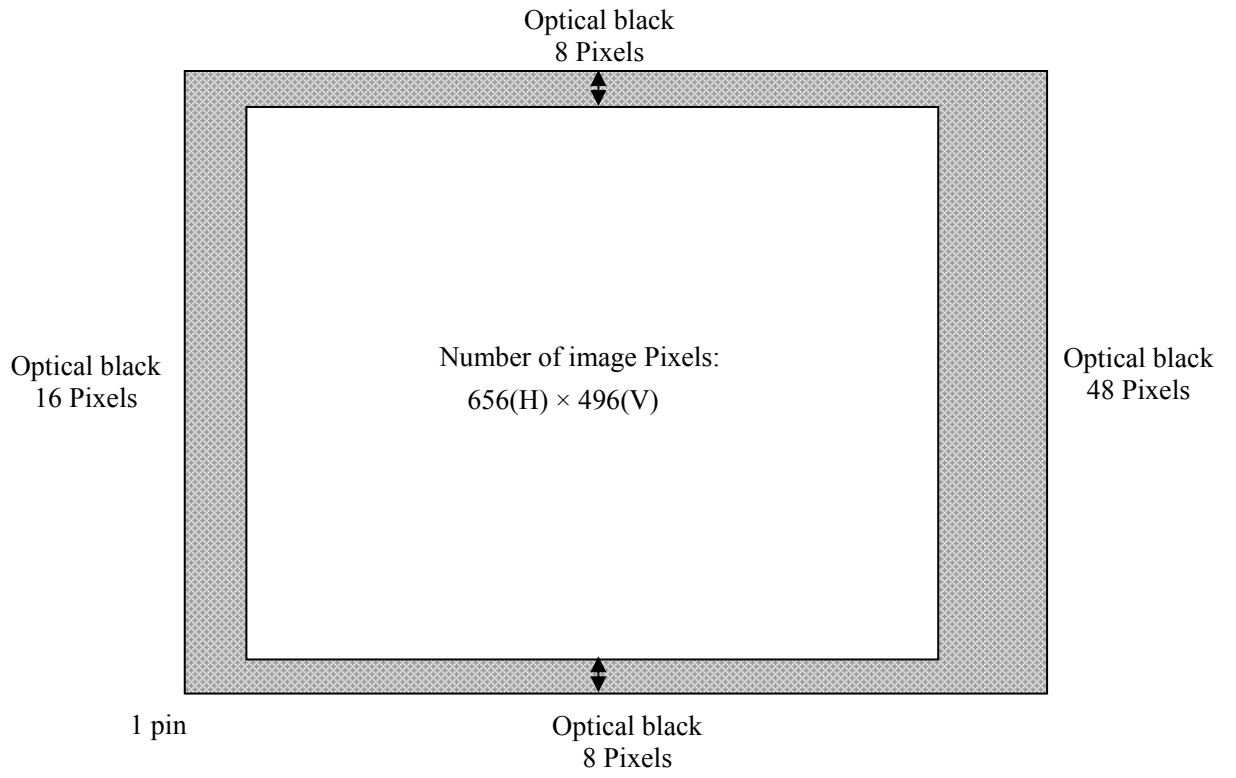
Pin #	Name	I/O	Pin Type
1	D5	O	UYVY Output data 5
2	RSTN	I	Reset input terminal “High”: normal operation “Low” : reset operation
3	AVDD	-	Power supply for analog
4	RCLK	O	Synchronous clock output
5	GND	-	Ground
6	D0	O	UYVY Output data 0
7	D1	O	UYVY Output data 1
8	D2	O	UYVY Output data 2
9	D3	O	UYVY Output data 3
10	D4	O	UYVY Output data 4
11	HVDD	-	Power supply for I/O
12	HREF	O	The horizontal blank pulse output terminal of the digital image output
13	VS	O	The vertical blank pulse output terminal of the digital image output
14	DVDD	-	Power supply for core
15	CKI	I	System clock input
16	DEVID0	I	Device Address
17	SDA	I/O	DSP serial data input/output terminal
18	SDC	I	DSP serial clock input terminal
19	D7	O	UYVY Output data 7
20	D6	O	UYVY Output data 6

SDC and SDA pins need pulled up resistor.

AVDD and DVDD should be decoupled to ground using 1.0uF capacitors.

HVDD should be decoupled to ground using 0.1uF capacitors.

### 4. Pixel Arrangement



## 5. Camera specification

### 5-1. Absolute maximum rating

Items	Symbol	Rated Value	Unit	Note
Power Supply Voltage	HVDD	-0.3 - 4.0	V	
	DVDD	-0.3 - 2.2		
	AVDD	-0.3 - 4.0		
Input voltage	V <sub>i</sub>	-0.3 - HVDD+0.3	V	
Output voltage	V <sub>o</sub>	-0.3 - HVDD+0.3	V	
Storage Temperature	T <sub>STG</sub>	-30 – 70	°C	
Operating Temperature	T <sub>OPR</sub>	-20 – 60	°C	

### 5-2. Recommended operating condition

Items	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	HVDD	2.6	2.8	3.0	V	
		1.7	1.8	1.9	V	
	DVDD	1.7	1.8	1.9	V	
	AVDD	2.6	2.8	3.0	V	
Current Consumption	IHVDD		10	20	mA	(1)
	IDVDD		25	80	mA	
	IAVDD		10	20	mA	
Standby Current	IHVDD <sub>SB1</sub>		1	10	μA	(2)
	IDVDD <sub>SB1</sub>		10	500	μA	
	IAVDD <sub>SB1</sub>		1	100	μA	
Soft Standby Current	IHVDD <sub>SB2</sub>		1	10	μA	(3)
	IDVDD <sub>SB2</sub>		10	500	μA	
	IAVDD <sub>SB2</sub>		1	100	μA	

(1) AVDD=2.8V, HVDD=DVDD=1.8V, GND=0V

RSTN=1.8V, Ta=60°C

(2) AVDD=2.8V, HVDD=DVDD=1.8V, GND=0V

RSTN=0V, Ta=60°C

(3) AVDD=2.8V, HVDD=DVDD=1.8V, GND=0V

RSTN=1.8V, Ta=60°C

## 5-3. CMOS image sensor specification

Subject	Description
Optical lens	1/10 type
Scanning Method	Progressive Scan, RGB primary mosaic color filter
Number of image Pixels	656(H) × 496(V)
Number of effective Pixels	648(H) × 488(V)
Pixel Pitch	A square : 2.2μm (H) × 2.2μm(V)

## 5-4. Lens specification

Subject	Description	Not e
Lens Configuration	1/10 type 2 pieces of aspherical plastic lens	
Focal Length	1.3 mm	
F number	2.8	
Viewing Angle	(H) 54 deg, (V) 42 deg, (D) 66 deg	
TV Distortion	± 1%(MAX.)	(A)
Focus Range	20 cm to infinity	

(A)

When it takes a rectangle pattern (4:3)

The height of the image center of the monitor screen : Y

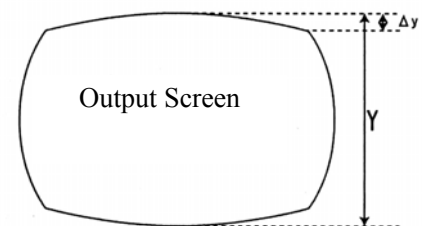
The difference with the height of the penumbra part : Δy

$$(\Delta y / Y) \times 100\%$$

Monitor type

- Cask type : Δy is negative value

- Spool type : Δy is positive value



## 6. Electrical characteristics

### 6-1. DC characteristics

(AVDD= 2.8V, DVDD = 1.8V, Ta = +25°C)

Items	Symbol	Measurement condition	Min.	Typ.	Max.	Unit	Note
Positive trigger voltage	$V_{T+}$	HVDD =2.6 - 3.0V			0.7* HVDD	V	1
		HVDD =1.7 - 1.9V			0.7* HVDD		
Negative trigger voltage	$V_{T-}$	HVDD =2.6 - 3.0V	0.3* HVDD			V	
		HVDD =1.7 - 1.9V	0.3* HVDD				
Hysteresis voltage	$V_{T+} - V_{T-}$	HVDD =2.6 - 3.0V	0.1* HVDD			V	
		HVDD =1.7 - 1.9V	0.1* HVDD				
Low level input voltage	$V_{IL}$	HVDD =2.6 - 3.0V			0.3* HVDD	V	2
		HVDD =1.7 - 1.9V			0.3* HVDD		
High level input voltage	$V_{IH}$	HVDD =2.6 - 3.0V	0.7* HVDD			V	
		HVDD =1.7 - 1.9V	0.7* HVDD				
Low level output voltage1	$V_{OL1}$	HVDD =2.6 - 3.0V $I_{OL} = 3, 5, 7, 9$ mA			0.4	V	3
		HVDD =1.7 - 1.9V $I_{OL} = 1.5, 2.5, 3.5, 4.5$ mA			0.4		
High level output voltage1	$V_{OH1}$	HVDD =2.6 - 3.0V $I_{OH} = -3, -5, -7, -9$ mA	HVDD-0.4			V	
		HVDD =1.7 - 1.9V $I_{OH} = -1.5, -2.5, -3.5, -4.5$ mA	HVDD-0.4				
Low level output voltage2	$V_{OL2}$	HVDD =2.6 - 3.0V $I_{OL} = 6, 10, 14, 18$ mA			0.4	V	4
		HVDD =1.7 - 1.9V $I_{OL} = 3, 5, 7, 9$ mA			0.4		
High level output voltage2	$V_{OH2}$	HVDD =2.6 - 3.0V $I_{OH} = -6, -10, -14, -18$ mA	HVDD-0.4			V	
		HVDD =1.7 - 1.9V $I_{OH} = -3, -5, -7, -9$ mA	HVDD-0.4				
Low level output voltage3	$V_{OL3}$	HVDD =2.6 - 3.0V $I_{OL} = 5$ mA			0.4	V	5
		HVDD =1.7 - 1.9V $I_{OL} = 2.5$ mA			0.4		

(1) Apply to SDC, SDA, DEVID0

(2) Apply to CKI, RSTN

(3) Apply to VS, HREF, D0-D7

(4) Apply to RCLK

(5) Apply to SDA

## 6-2. Camera performance

(DVDD=+1.80V ,AVDD=+2.80V, Ta=+25°C)

Items	Specification				Note
	Min.	Typ.	Max.	Unit	
Horizontal Resolution (Center)	300			TV-line	(A)
Horizontal Resolution (Corner)	200				
Minimum object illumination		30		lx	(B)
Difference of field angle			10	%	(C)

(A) The limit resolution to take picture of TV resolution chart under the condition of the maximum indication image size (640×480) and which can be reproduced on the monitor of the personal computer.(corner: picture height is 70%)

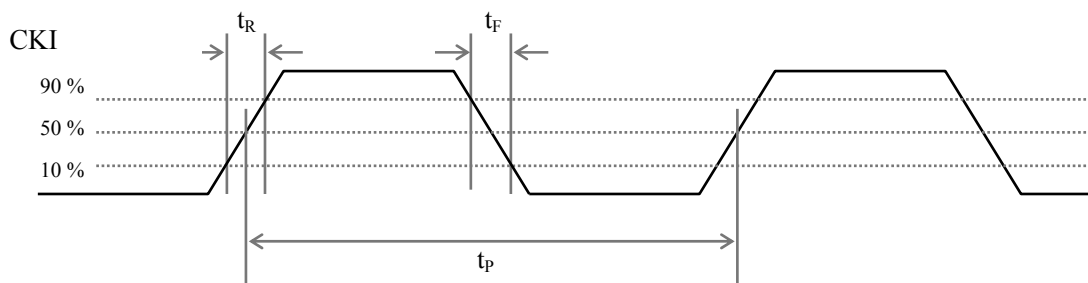
(B) The illuminance to take picture of gray scale chart when a signal level in the center of the screen is a half level under the condition of the maximum indication image size (640×480) and frame ratio is 5 fps,

(C) Difference of field angle: Ratio of difference of horizontal (640 Pixels) / vertical (480 Pixels).

## 7. Signal interface specification

### 7-1. Camera clock

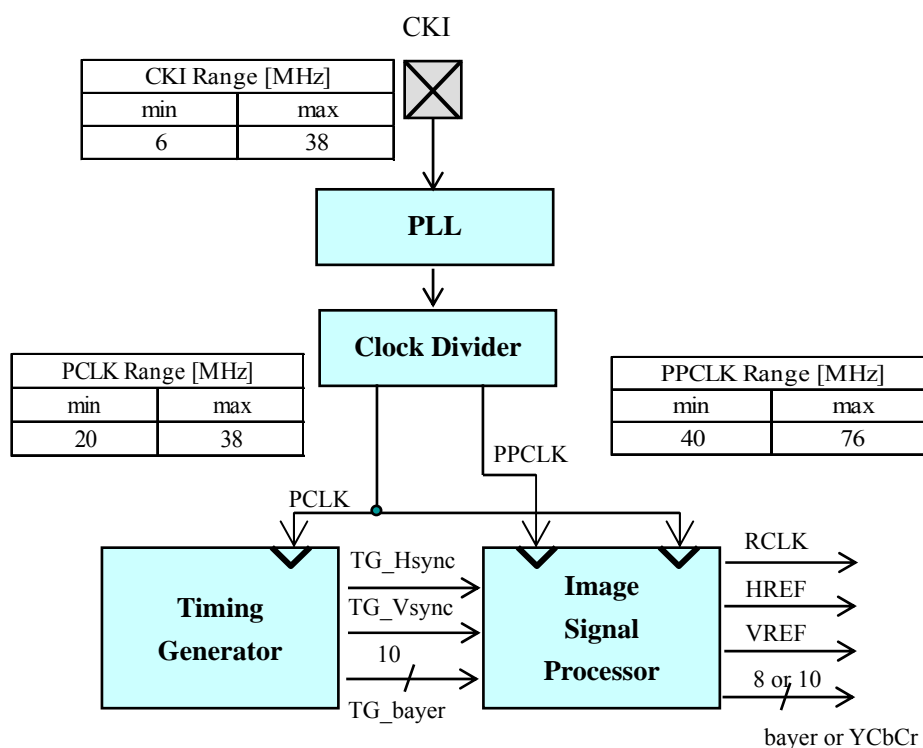
The effective input clock to this module is CKI.



(DVDD = HVDD = +1.8V, AVDD = +2.8V, Ta = +25°C)

Items	Symbol	Min.	Typ.	Max.	Unit	Note
Input clock frequency	fcki	6	-	38	MHz	
Cycle time	t <sub>p</sub>	25	-	166.7	ns	
Input clock Duty	duty	45	50	55	%	
Input clock rise time	t <sub>R</sub>	-	-	4	ns	
Input clock fall time	t <sub>F</sub>	-	-	4	ns	

### 7-2. PLL



(DVDD = HVDD = +1.8V, AVDD = +2.8V, Ta = +25°C)

### 7-3. RSTN

The RSTN signal of this camera module is more necessary than that of the host in initial operation.

RSTN is a reset input signal. (Low active)

RSTN="H" : Usual operation

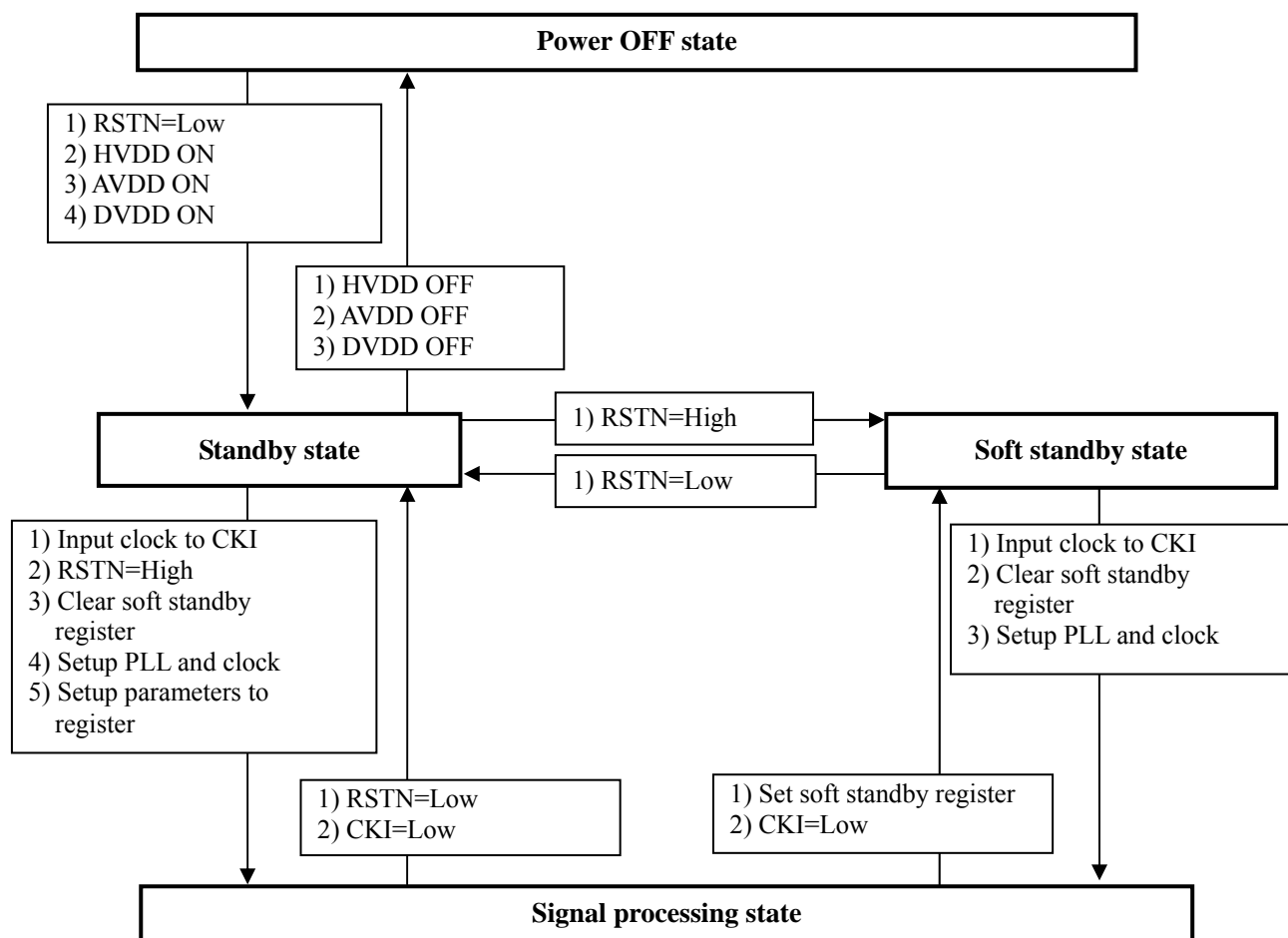
RSTN="L" : Reset state

### 7-4. Standby mode

There are 4 states of operation as a camera system.

Operation states table

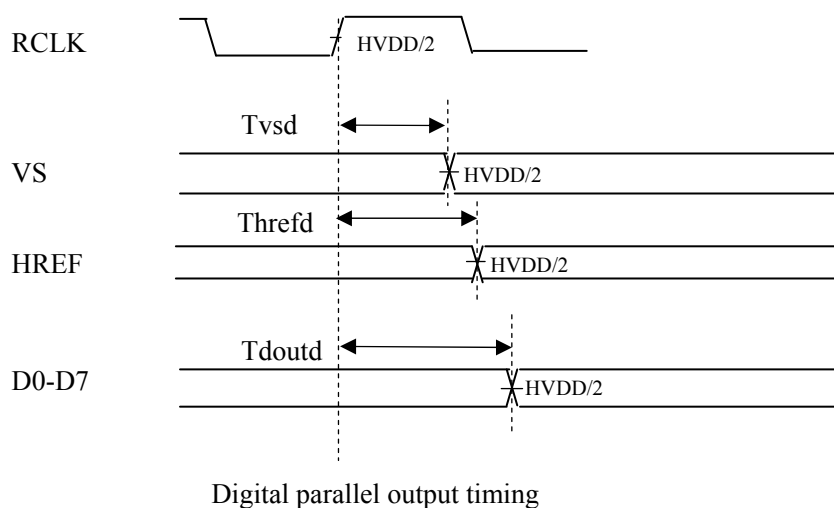
Operation state	Condition
Power OFF state	In this state, all power supplies are OFF.
Standby state	In this state, all power supplies are ON, RSTN = Low. When not using the camera system, power consumption can be reduced by shifting to this state. Since all register setting values are initialized, re-setup of register is required at the time of returning from this state to signal processing state.
Soft standby state	In this state, all power supplies are ON, RSTN = High, and then soft standby register is set to valid. When shifting from signal processing state to this state, all register setting values are kept.
Signal processing state	In this state, all power supplies are ON, RSTN = High, and then soft standby register is cleared. This state is outputting images, under condition of the clock is inputted from CKI terminal, and register setting is performed appropriately.



Operation state transition chart

## 8. AC characteristics

### 8-1. Digital parallel output timing



(DVDD= HVDD= +1.8V, AVDD=+2.8V, Ta=+25°C)

Items	Symbol	Condition		Unit	Note
		Min.	Max.		
VS output delay time	$T_{vsd}$	0	7	ns	1
HREF output delay time	$T_{hrefd}$	0	7	ns	1
D0-D7 output delay time	$T_{doutd}$	0	7	ns	1

(1) Output load capacitance  $CL = 15pF$ .

When HVDD=2.8V

Internal register address Group B 05h bit5-4 = "01" (RCLK=10mA)

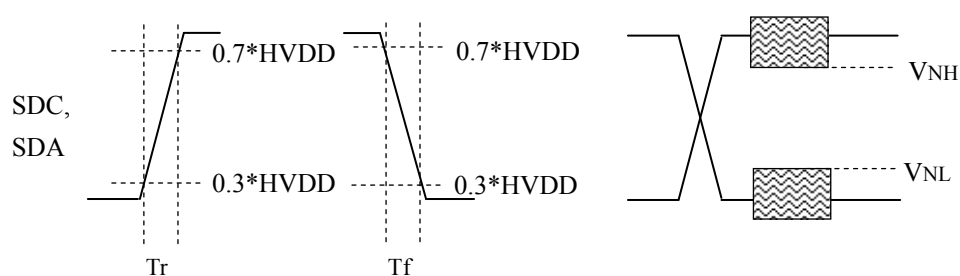
Internal register address Group B 05h bit7-6 = "01" (D0-D7=VS=HREF=5mA)

When HVDD=1.8V

Internal register address Group B 05h bit5-4 = "11" (RCLK=9mA)

Internal register address Group B 05h bit7-6 = "11" (D0-D7=VS=HREF=4.5mA)

## 8-2. DSP serial control interface timing



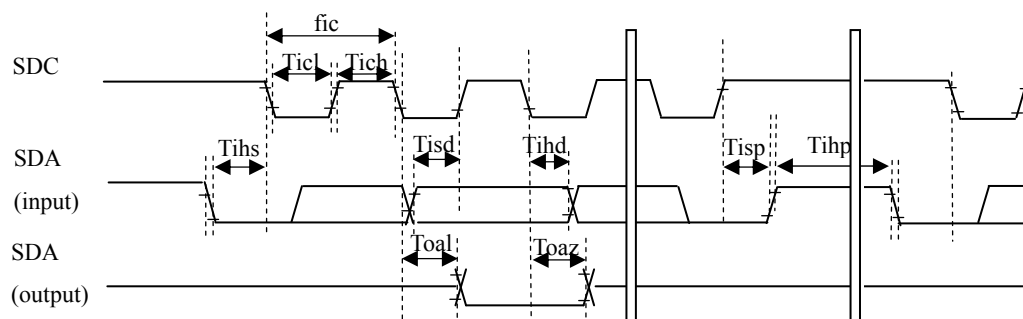
Input rise/fall time, input noise level

(DVDD = HVDD = +1.8V, AVDD = +2.8V, Ta = +25°C)

Items	Symbol	Condition		Unit	Note
		Min.	Max.		
Input rise time	$T_r$		300	ns	
Input fall time	$T_f$		300	ns	
Input noise peak level(High level)	$V_{NH}$	$0.7 \cdot HVDD$		V	1
Input noise peak level(Low level)	$V_{NL}$		$0.3 \cdot HVDD$	V	1

(1) Please input the shape of waves that the noise doesn't superimpose though SDC and the terminal though SDA have given hysteresis characteristics.

## DSP serial bus signal timing



(DVDD = HVDD = +1.8V, AVDD = +2.8V, Ta = +25°C)

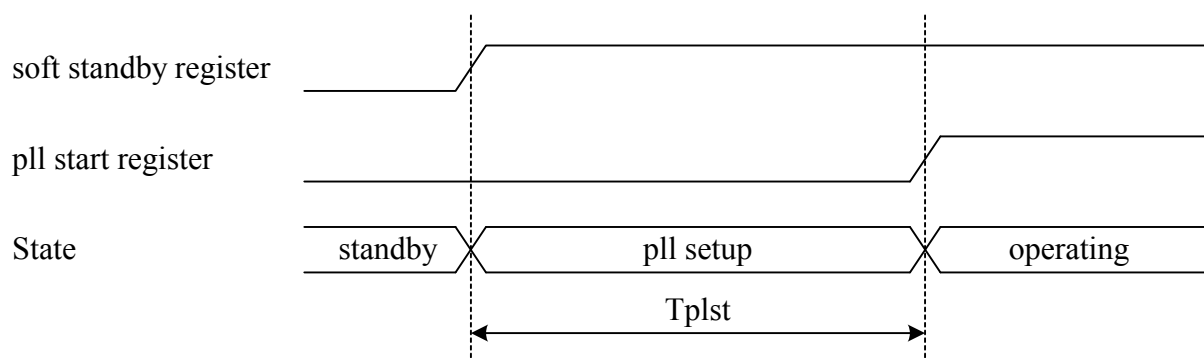
Items	Symbol	Condition		Unit	Note
		Min.	Max.		
Clock frequency	$f_{ic}$		400	kHz	
Clock High period	$T_{ich}$	260		ns	
Clock Low period	$T_{iel}$	260		ns	
Hold time for start condition	$T_{ihs}$	600		ns	
Setup time for input data	$T_{isd}$	300		ns	
Hold time for input data	$T_{ihd}$	0		ns	
Output delay time (Hi-Z → Low output)	$T_{oal}$	2	160	ns	1,2
Output delay time (Low → Hi-Z output)	$T_{oaz}$	2	100	ns	1,3
Setup time of stop conditions	$T_{isp}$	600		ns	
Guard time	$T_{ihp}$	2500		ns	

(1) Output load capacitance  $C_L = 15\text{pF}$ .

(2) Time transit from the state of Hi-Z output to Low output

(3) Time transit from the state of Low output to Hi-Z output

## 8-3. Setup time of PLL

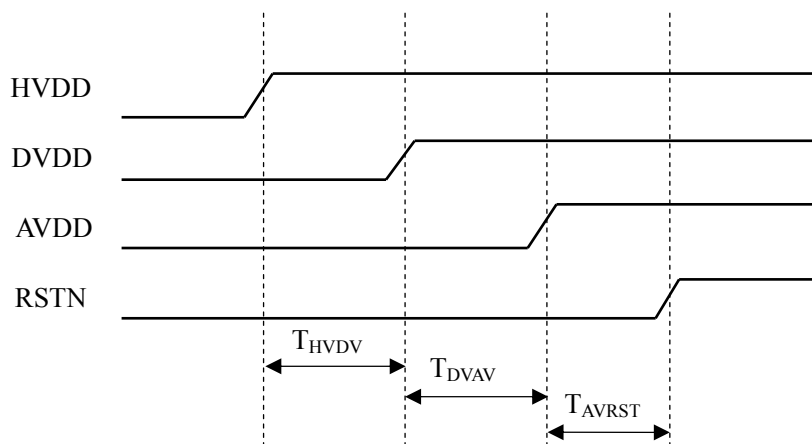


(DVDD = HVDD = +1.8V, AVDD = +2.8V, Ta = +25°C)

Items	Symbol	Condition		Unit	Note
		Min.	Max.		
Setup time of PLL	Tplst	30		us	

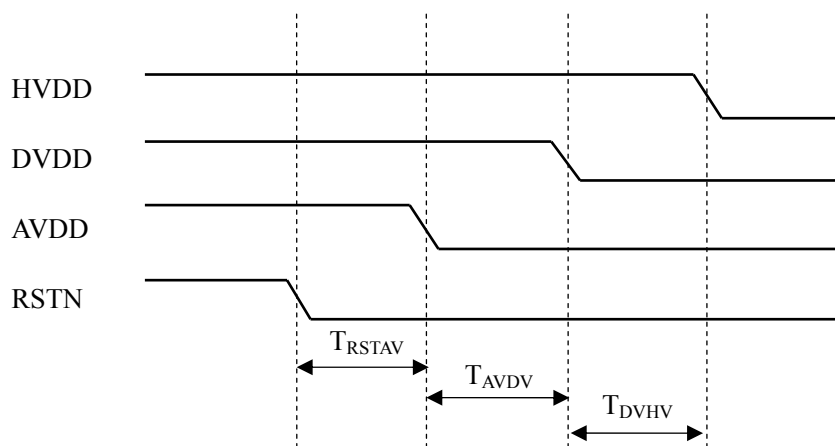
## 8-4. Power supply sequence

## Power On sequence



Items	Symbol	Min.	Typ.	Max.	Unit	Note
HVDD to DVDD Delay Time	$T_{HVDV}$	0	-	-	ns	
DVDD to AVDD Delay Time	$T_{DVAV}$	0	-	-	ns	
AVDD to RSTN Delay Time	$T_{AVRST}$	10	-	-	ns	

## Power Off sequence



Items	Symbol	Min.	Typ.	Max.	Unit	Note
RSTN to AVDD Delay Time	$T_{RSTAV}$	10	-	-	ns	
AVDD to DVDD Delay Time	$T_{AVDV}$	0	-	-	ns	
DVDD to HVDD Delay Time	$T_{DVHV}$	0	-	-	ns	

## **9. Recommended mounting conditions**

- This camera module cannot go through a reflow soldering process.
- Soldering by the hand isn't recommended.
- We cannot guarantee operation of the sensor once the device has been removed, re-soldered, or re-mounted at the user's site.
- This camera module is designed only for socket mounting. The appropriate camera module mounting socket is No. CLE9120-6601F produced by SMK.
- It is suggested to use insert jig which is recommended by manufacturer. If the module is inserted without using jig, please set the pressure given to ceiling plane under 15N.



## 11. Cautions

### 11-1. Breakage of the package

In order to avoid the breakage of the package, please take care of things as follows.

- (1) CMOS image sensors installed in this camera module are the precise, optical parts.

Therefore:

- Please do not drop the element while equipping, handling, and transporting .
  - Please do not strike to the main body of the camera module.
- (2) Lens property will become defective if contusions, damage, breakage in the surface arised, following things are not allowed.
    - Beating lens
    - A big impact that occurs the distortion to lens.
    - The surface of the lens will be damaged by the cloth or cotton when they are turn to dry though it is soft at the beginning
    - (Please note that dry cotton bar may also cause damage on the lens since dust may scratch the sure face of lens with the dry cotton.)

### 11-2. Static electricity

At least the following static electricity measures are necessary for handling.

- (1) Please ground the human body and apparatus to discharge static electricity when you handle the element. Please use the resistance of safety first 1M $\Omega$  level for the earth of the human body
- (2) Please maintain the part without terminal, and do not touch the terminal when you handle it by the finger directly.
- (3) Please do not rub the surface of the lens by the cloth that static electricity is generated easily.
- (4) Please do not wash the surface of the lens with the garbage or tape that static electricity is generated easily.
- (5) Please do not put it in the container which is electro conductive when preserving and moving.

### 11-3. Dust, Stain

When there are dust or stain in the surface of the lens, it becomes an output defective characteristic and causes defect.

Please note that neither garbage nor dirt is put as much as possible.

Please do not touch the surface of the lens by finger.

But when dust or stain adhere to the surface of the lens, the following methods are recommend.

Please wipe dust that adheres to the surface of the lens off slowly and lightly with clean cotton bud that soaks a small amount of isopropyl alcohol.

--- Frequently exchanging, and avoiding use one bud cleaning two or more elements

#### 11-4. Others

- (1) Please do not touch the surface of lens after the peel of the protection sheet.
- (2) Please do not apply strong light to the sensor. The color filter will discolor if strong light is applied for a long time.
- (3) Please do not add a mechanical impact to the sensor because lens is a kind of precise and optical parts.
- (4) Please note that impossible power such as stresses should not be added to the main body of the module when camera module is equipped
- (5) There is a possibility of buying the material (lens and substrate) from two or more makers for securing the production amount. Please get the contact ahead of time and make change under the performance is confirmed.
- (6) To the factory which has the experience to our production in the past, I will develop by my judgment. In that case, after reporting the content of the change beforehand, and obtaining approval, it will be executed.
- (7) There is no problem in the lens performance through the color might attach to the surface of the lens according to the hit condition of the lighting and it be observed.
- (8) In order to avoiding dust/foreign matters invade to lens, sprays or the suck of the wind like convection which air circulates on the heaven side are not allowed.
- (9) Shading  
The glass epoxy substrate is used for the base substrate of this camera module. Please confirm the shading when equipping it in a real machine in your company.
- (10) Maintenance condition  
Please avoid keeping in the condition of high temperature and high humidity that exceeds the range of the specification.  
Please do not execute the Bake processing for the lens performance securing.