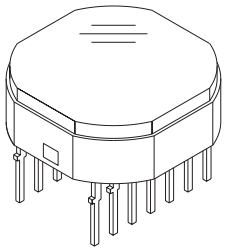
SONY

ICX408ALB

Diagonal 6mm (Type 1/3) CCD Image Sensor for EIA B/W Video Cameras

14 pin DIP (Ceramic)

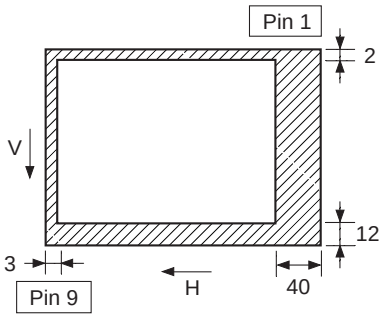


Description

The ICX408ALB is an interline CCD solid-state image sensor suitable for EIA B/W video cameras with a diagonal 6mm (Type 1/3) system. Compared with the current product ICX058ALB, basic characteristics such as sensitivity, smear, dynamic range and S/N are improved drastically.

This chip features a field period readout system and an electronic shutter with variable charge-storage time. Also, this outline is miniaturized by using original package.

This chip is suitable for applications such as surveillance cameras, automative cameras, etc.



Optical black position
(Top View)

Features

- High sensitivity (+5dB compared with the ICX058ALB)
- Low smear (–15dB compared with the ICX058ALB)
- High D range (+4dB compared with the ICX058ALB)
- High S/N
- High resolution and low dark current
- Excellent antiblooming characteristics
- Continuous variable-speed shutter
- No voltage adjustment
  (Reset gate and substrate bias are not adjusted.)
- Horizontal register: 5V drive
- Reset gate pulse: 5V drive

Device Structure

- Interline CCD image sensor
- Optical size: Diagonal 6mm (Type 1/3)
- Number of effective pixels: 768 (H) × 494 (V) approx. 380K pixels
- Total number of pixels: 811 (H) × 508 (V) approx. 410K pixels
- Chip size: 5.59mm (H) × 4.68mm (V)
- Unit cell size: 6.35µm (H) × 7.40µm (V)
- Optical black: Horizontal (H) direction: Front 3 pixels, rear 40 pixels
  Vertical (V) direction: Front 12 pixels, rear 2 pixels
- Number of dummy bits: Horizontal 22
  Vertical 1 (even fields only)
- Substrate material: Silicon

Super **HAD CCD** TM

* Super HAD CCD is a trademark of Sony Corporation. The Super HAD CCD is a version of Sony's high performance CCD HAD (Hole-Accumulation Diode) sensor with sharply improved sensitivity by the incorporation of a new semiconductor technology developed by Sony Corporation.

E01Z03A46

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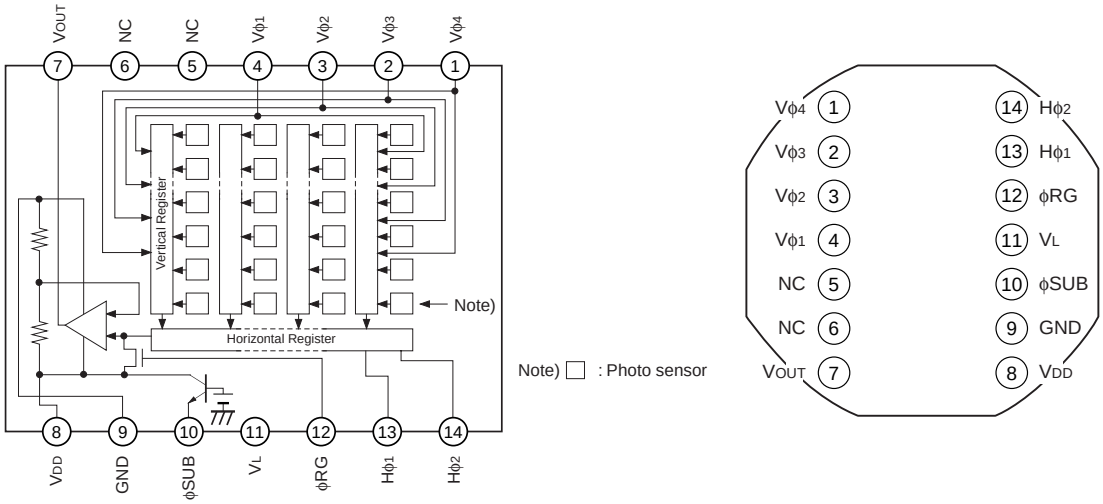
Block Diagram and Pin Configuration

(Top View)



Pin Description

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	Vφ4	Vertical register transfer clock	8	V_{DD}	Supply voltage
2	Vφ3	Vertical register transfer clock	9	GND	GND
3	Vφ2	Vertical register transfer clock	10	φSUB	Substrate clock
4	Vφ1	Vertical register transfer clock	11	V_L	Protective transistor bias
5	NC		12	φRG	Reset gate clock
6	NC		13	Hφ1	Horizontal register transfer clock
7	V_{OUT}	Signal output	14	Hφ2	Horizontal register transfer clock

Absolute Maximum Ratings

Item		Ratings	Unit	Remarks
Against φSUB	V_{DD}, V_{OUT}, RG – φSUB	–40 to +8	V	
	Vφ1, Vφ3 – φSUB	–50 to +15	V	
	Vφ2, Vφ4, V_L – φSUB	–50 to +0.3	V	
	Hφ1, Hφ2, GNG – φSUB	–40 to +0.3	V	
Against GND	V_{DD}, V_{OUT}, RG – GND	–0.3 to +20	V	
	Vφ1, Vφ2, Vφ3, Vφ4 – GND	–10 to +18	V	
	Hφ1, Hφ2 – GND	–10 to +6	V	
Against V_L	Vφ1, Vφ3 – V_L	–0.3 to +28	V	
	Vφ2, Vφ4, Hφ1, Hφ2, GND – V_L	–0.3 to +15	V	
Between input clock pins	Voltage difference between horizontal clock input pins	to +15	V	*1
	Hφ1 – Hφ2	–6 to +6	V	
	Hφ1, Hφ2 – Vφ4	–14 to +14	V	
Storage temperature		–30 to +80	°C	
Operating temperature		–10 to +60	°C	

*1 +24V (Max.) when clock width < 10µs, clock duty factor < 0.1%.

Bias Conditions

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	V_{DD}	14.55	15.0	15.45	V	
Protective transistor bias	V_L	*1				
Substrate clock	φSUB	*2				

*1 V_L setting is the V_{VL} voltage of the vertical transfer clock waveform, or the same supply voltage as the V_L power supply for the V driver should be used.

*2 Do not apply a DC bias to the substrate clock pin, because a DC bias is generated within the CCD.

DC Characteristics

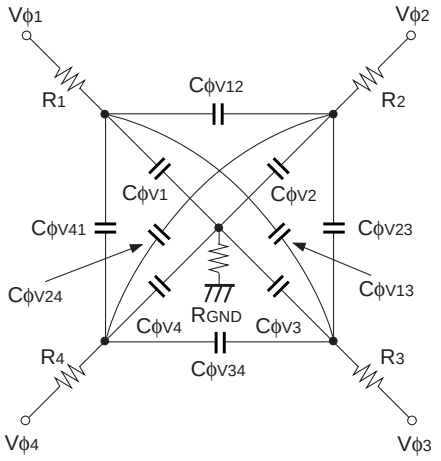
Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply current	I_{DD}		4	6	mA	

Clock Voltage Conditions

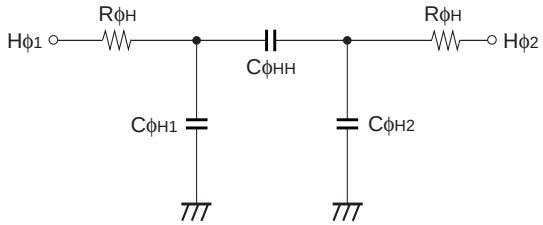
Item	Symbol	Min.	Typ.	Max.	Unit	Waveform diagram	Remarks
Readout clock voltage	V_{VT}	14.55	15.0	15.45	V	1	
Vertical transfer clock voltage	V_{VH1}, V_{VH2}	–0.05	0	0.05	V	2	$V_{VH} = (V_{VH1} + V_{VH2})/2$
	V_{VH3}, V_{VH4}	–0.2	0	0.05	V	2	
	V_{VL1}, V_{VL2}, V_{VL3}, V_{VL4}	–8.0	–7.0	–6.5	V	2	$V_{VL} = (V_{VL3} + V_{VL4})/2$
	$V_{\phi V}$	6.3	7.0	8.05	V	2	$V_{\phi V} = V_{VH}n - V_{VL}n$ (n = 1 to 4)
	$V_{VH3} - V_{VH}$	–0.25		0.1	V	2	
	$V_{VH4} - V_{VH}$	–0.25		0.1	V	2	
	V_{VHH}			0.3	V	2	High-level coupling
	V_{VHL}			0.3	V	2	High-level coupling
	V_{VLH}			0.3	V	2	Low-level coupling
	V_{VLL}			0.3	V	2	Low-level coupling
Horizontal transfer clock voltage	$V_{\phi H}$	4.75	5.0	5.25	V	3	
	V_{HL}	–0.05	0	0.05	V	3	
Reset gate clock voltage	$V_{\phi RG}$	4.5	5.0	5.5	V	4	Input through 0.1µF capacitance
	$V_{RGLH} - V_{RGLL}$			0.4	V	4	Low-level coupling
	$V_{RGL} - V_{RGLm}$		5.0	0.5	V	4	Low-level coupling
	V_{RGH}	V_{DD} +0.3	V_{DD} +0.6	V_{DD} +0.9	V	4	
Substrate clock voltage	$V_{\phi SUB}$	21.0	22.0	23.5	V	5	

Clock Equivalent Circuit Constant

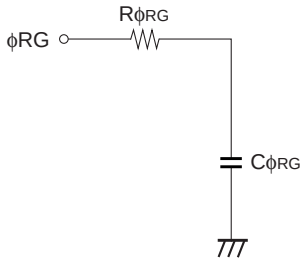
Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Capacitance between vertical transfer clock and GND	$C\phi V1$, $C\phi V3$		1500		pF	
	$C\phi V2$, $C\phi V4$		1000		pF	
Capacitance between vertical transfer clocks	$C\phi V12$, $C\phi V34$		820		pF	
	$C\phi V23$, $C\phi V41$		330		pF	
	$C\phi\varsigma 13$		120		pF	
	$C\phi\varsigma 24$		100		pF	
Capacitance between horizontal transfer clock and GND	$C\phi H1$, $C\phi H2$		75		pF	
Capacitance between horizontal transfer clocks	$C\phi HH$		22		pF	
Capacitance between reset gate clock and GND	$C\phi RG$		5		pF	
Capacitance between substrate clock and GND	$C\phi SUB$		270		pF	
Vertical transfer clock series resistor	$R1$, $R3$		100		Ω	
	$R2$, $R4$		150		Ω	
Vertical transfer clock ground resistor	$RGND$		68		Ω	
Horizontal transfer clock series resistor	$R\phi H$		15		Ω	
Reset gate clock series resistor	$R\phi RG$		50		Ω	



Vertical transfer clock equivalent circuit



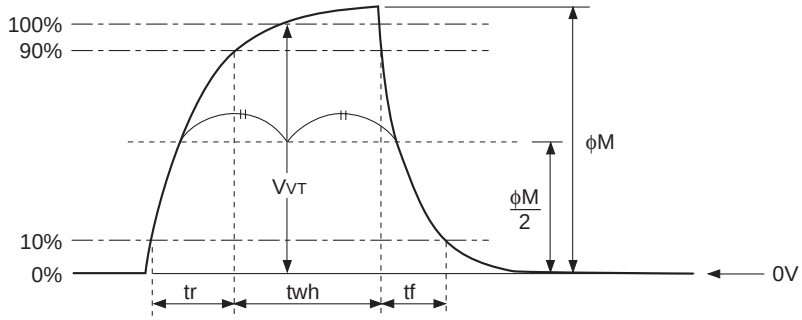
Horizontal transfer clock equivalent circuit



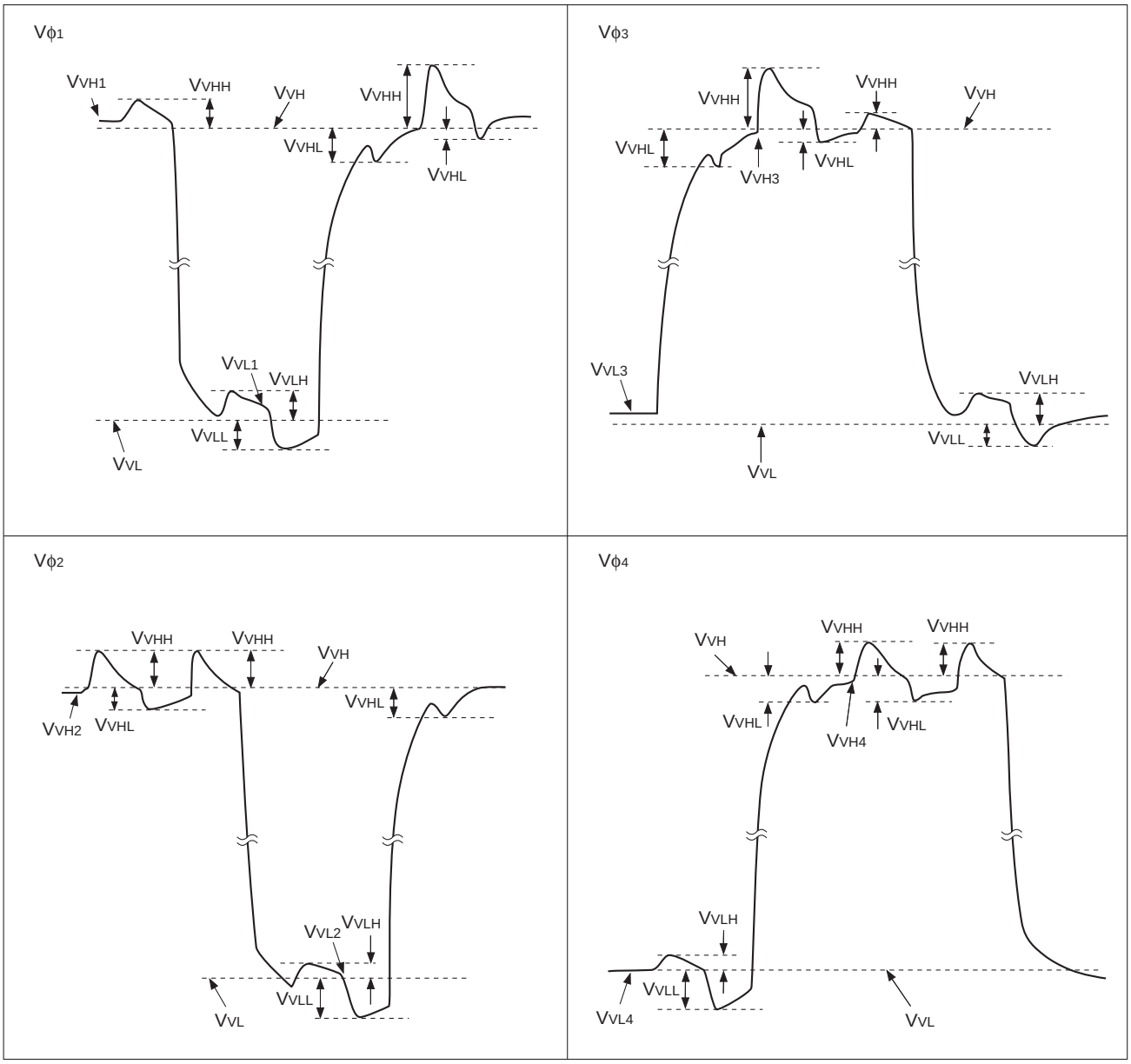
Reset gate clock equivalent circuit

Drive Clock Waveform Conditions

(1) Readout clock waveform



(2) Vertical transfer clock waveform

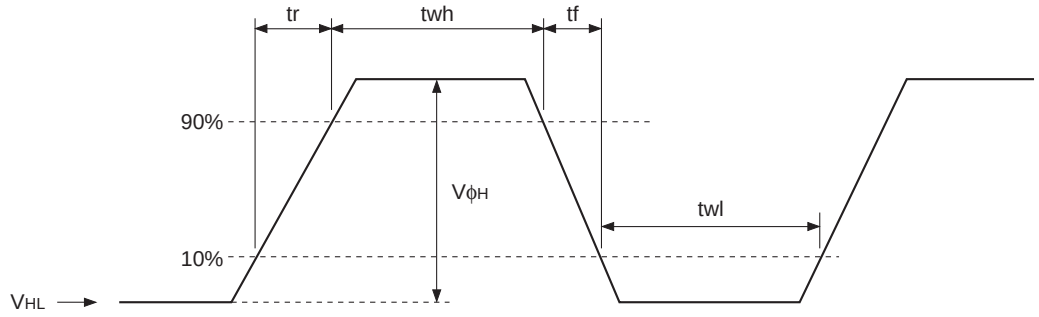


$V_{VH} = (V_{VH1} + V_{VH2})/2$

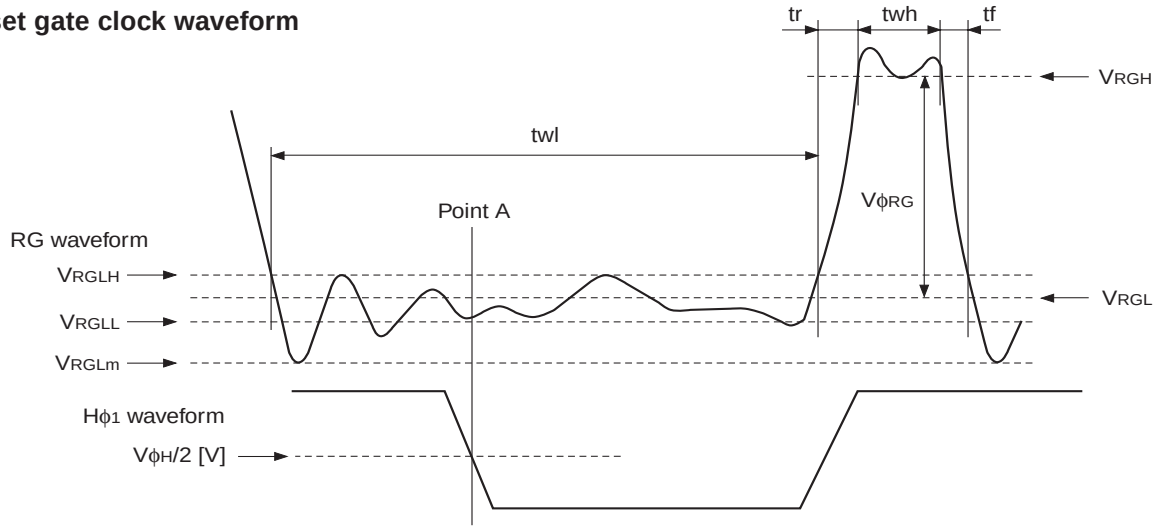
$V_{VL} = (V_{VL3} + V_{VL4})/2$

$V_{\phi V} = V_{VHn} – V_{VLn}$ (n = 1 to 4)

(3) Horizontal transfer clock waveform



(4) Reset gate clock waveform



V_{RGLH} is the maximum value and V_{RGLL} is the minimum value of the coupling waveform during the period from Point A in the above diagram until the rising edge of RG. In addition, V_{RGL} is the average value of V_{RGLH} and V_{RGLL}.

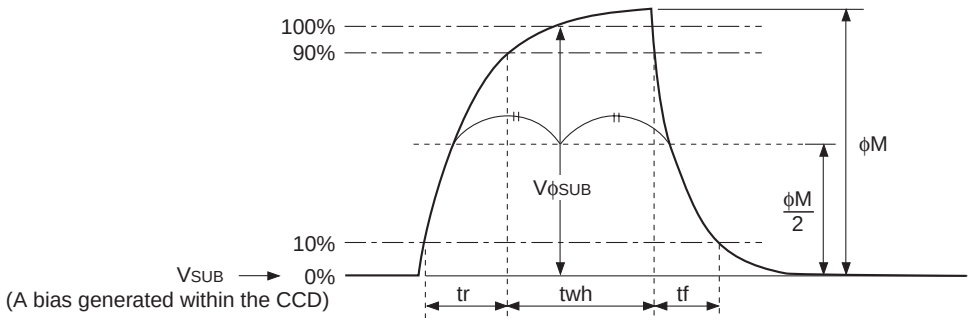
$$V_{RGL} = (V_{RGLH} + V_{RGLL})/2$$

Assuming V_{RGH} is the minimum value during the period twh, then:

$$V\phi_{RG} = V_{RGH} - V_{RGL}$$

Negative overshoot level during the falling edge of RG is V_{RGLm}.

(5) Substrate clock waveform



Clock Switching Characteristics

Item		Symbol	twh			twl			tr			tf			Unit	Remarks
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
Readout clock		V_T	2.3	2.5						0.5			0.5		µs	During readout
Vertical transfer clock		$V\phi_1$, $V\phi_2$, $V\phi_3$, $V\phi_4$										15		250	ns	*1
Horizontal transfer clock	During imaging	$H\phi_1$	26	28.5		26	28.5			6.5	9.5		6.5	9.5	ns	*2
		$H\phi_2$	26	28.5		26	28.5			6.5	9.5		6.5	9.5		
	During parallel-serial conversion	$H\phi_1$		5.38						0.01			0.01		µs	
		$H\phi_2$					5.38			0.01			0.01			
Reset gate clock		ϕRG	11	13			51			3			3		ns	
Substrate clock		ϕSUB	1.5	1.8							0.5			0.5	µs	When draining charge

*1 When vertical transfer clock driver CXD1267AN is used.

*2 tf ≥ tr – 2ns, and the cross-point voltage (V_{CR}) for the $H\phi_1$ rising side of the $H\phi_1$ and $H\phi_2$ waveforms must be at least $V\phi_H/2$ [V].

Item	Symbol	two			Unit	Remarks
		Min.	Typ.	Max.		
Horizontal transfer clock	$H\phi_1$, $H\phi_2$	22	26		ns	*3

*3 The overlap period for twh and twl of horizontal transfer clocks $H\phi_1$ and $H\phi_2$ is two.

Image Sensor Characteristics (Ta = 25°C)

Item	Symbol	Min.	Typ.	Max.	Unit	Measurement method	Remarks
Sensitivity	S	680	850		mV	1	Ta = 60°C
Saturation signal	Vsat	1000			mV	2	
Smear	Sm		–110	–93	dB	3	
Video signal shading	SH			20	%	4	Zone 0 and I
				25	%	4	Zone 0 to II'
Dark signal	Vdt			2	mV	5	Ta = 60°C
Dark signal shading	ΔVdt			1	mV	6	Ta = 60°C
Flicker	F			2	%	7	
Lag	Lag			0.5	%	8	

Zone Definition of Video Signal Shading

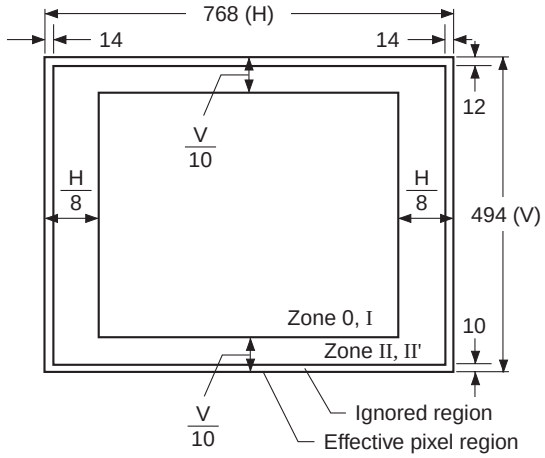


Image Sensor Characteristics Measurement Method

◎ **Measurement conditions**

1) In the following measurements, the device drive conditions are at the typical values of the bias and clock voltage conditions.

2) In the following measurements, spot blemishes are excluded and, unless otherwise specified, the optical black (OB) level is used as the reference for the signal output, and the value measured at the point [*A] in the Drive Circuit is used.

◎ **Definition of standard imaging conditions**

1) Standard imaging condition I:
Use a pattern box (luminance 706cd/m^2, color temperature of 3200K halogen source) as a subject. (Pattern for evaluation is not applicable.) Use a testing standard lens with CM500S (t = 1.0mm) as an IR cut filter and image at F8. The luminous intensity to the sensor receiving surface at this point is defined as the standard sensitivity testing luminous intensity.

2) Standard imaging condition II:
Image a light source (color temperature of 3200K) with a uniformity of brightness within 2% at all angles. Use a testing standard lens with CM500S (t = 1.0mm) as an IR cut filter. The luminous intensity is adjusted to the value indicated in each testing item by the lens diaphragm.

1. Sensitivity
Set to standard imaging condition I. After selecting the electronic shutter mode with a shutter speed of 1/250s, measure the signal output (Vs) at the center of the screen and substitute the value into the following formula.

$$S = Vs \times \frac{250}{60} \quad [mV]$$

2. Saturation signal
Set to standard imaging condition II. After adjusting the luminous intensity to 10 times the intensity with average value of the signal output, 200mV, measure the minimum value of the signal output.

3. Smear
Set to standard imaging condition II. With the lens diaphragm at F5.6 to F8, adjust the luminous intensity to 500 times the intensity with average value of the signal output, 200mV. When the readout clock is stopped and the charge drain is executed by the electronic shutter at the respective H blankings, measure the maximum value (VSm [mV]) of the signal output and substitute the value into the following formula.

$$Sm = 20 \times \log \left(\frac{VSm}{200} \times \frac{1}{500} \times \frac{1}{10} \right) \quad [dB] \quad \text{(1/10V method conversion value)}$$

4. Video signal shading

Set to standard imaging condition II. With the lens diaphragm at F5.6 to F8, adjust the luminous intensity so that the average value of the signal output is 200mV. Then measure the maximum (Vmax [mV]) and minimum (Vmin [mV]) values of the signal output and substitute the values into the following formula.

$SH = (Vmax - Vmin)/200 \times 100$ [%]

5. Dark signal

Measure the average value of the signal output (Vdt [mV]) with the device ambient temperature 60°C and the device in the light-obstructed state, using the horizontal idle transfer level as a reference.

6. Dark signal shading

After measuring 5, measure the maximum (Vdmax [mV]) and minimum (Vdmin [mV]) values of the dark signal output and substitute the values into the following formula.

$\Delta Vdt = Vdmax - Vdmin$ [mV]

7. Flicker

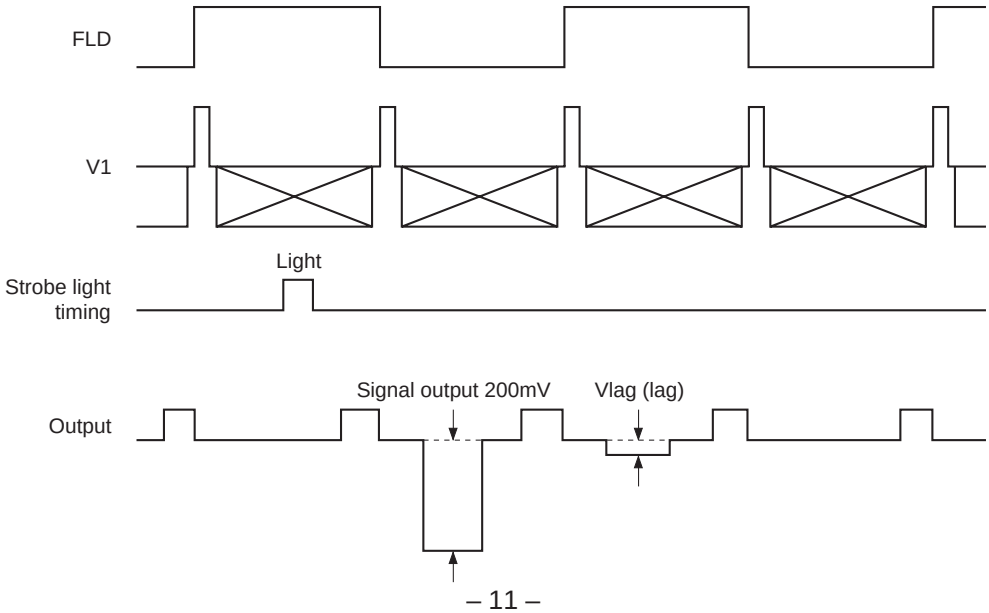
Set to standard imaging condition II. Adjust the luminous intensity so that the average value of the signal output is 200mV, and then measure the difference in the signal level between fields (ΔVf [mV]). Then substitute the value into the following formula.

$F = (\Delta Vf/200) \times 100$ [%]

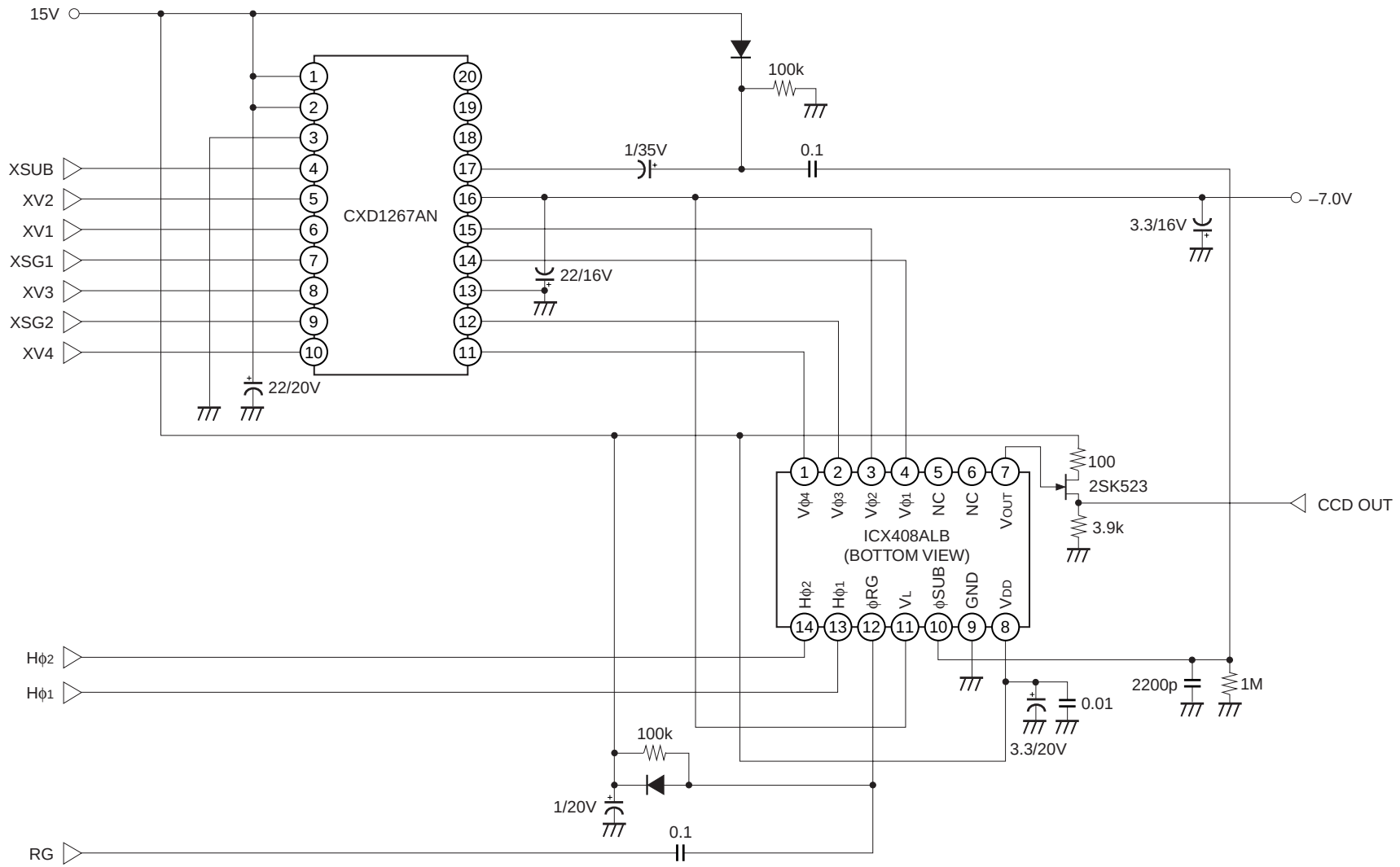
8. Lag

Adjust the signal output value generated by strobe light to 200mV. After setting the strobe light so that it strobes with the following timing, measure the residual signal (Vlag). Substitute the value into the following formula.

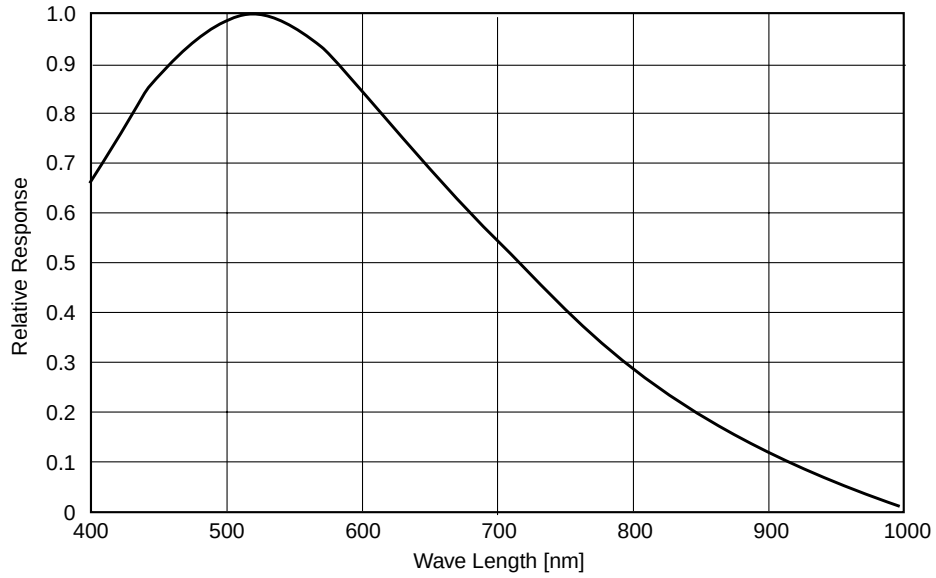
$Lag = (Vlag/200) \times 100$ [%]



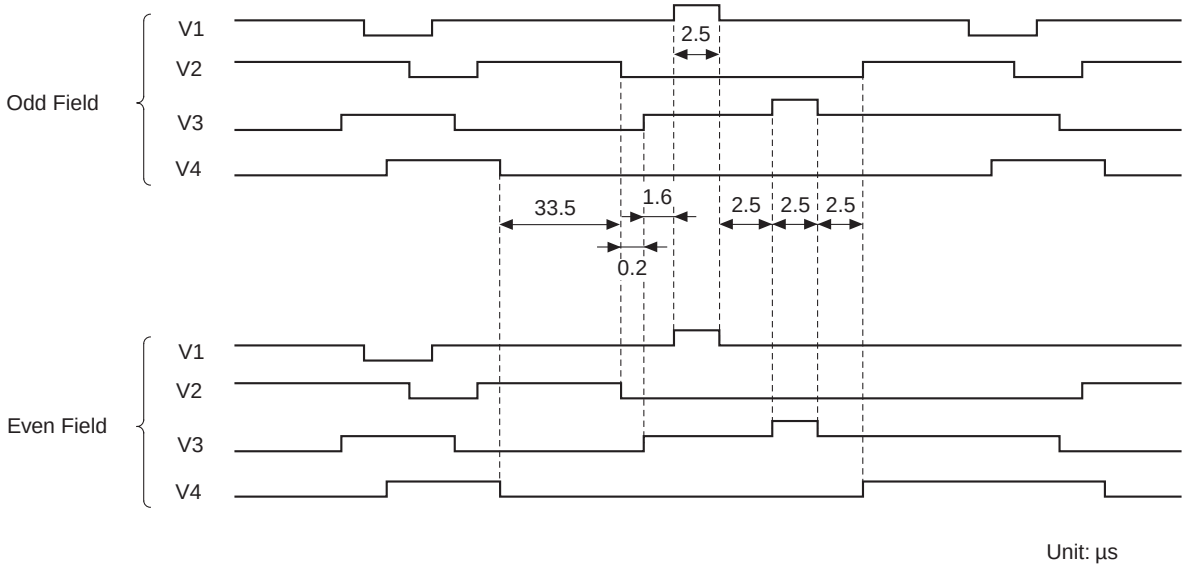
Drive Circuit 1 (substrate bias internal generation mode)



Spectral Sensitivity Characteristics (Excludes lens characteristics and light source characteristics)

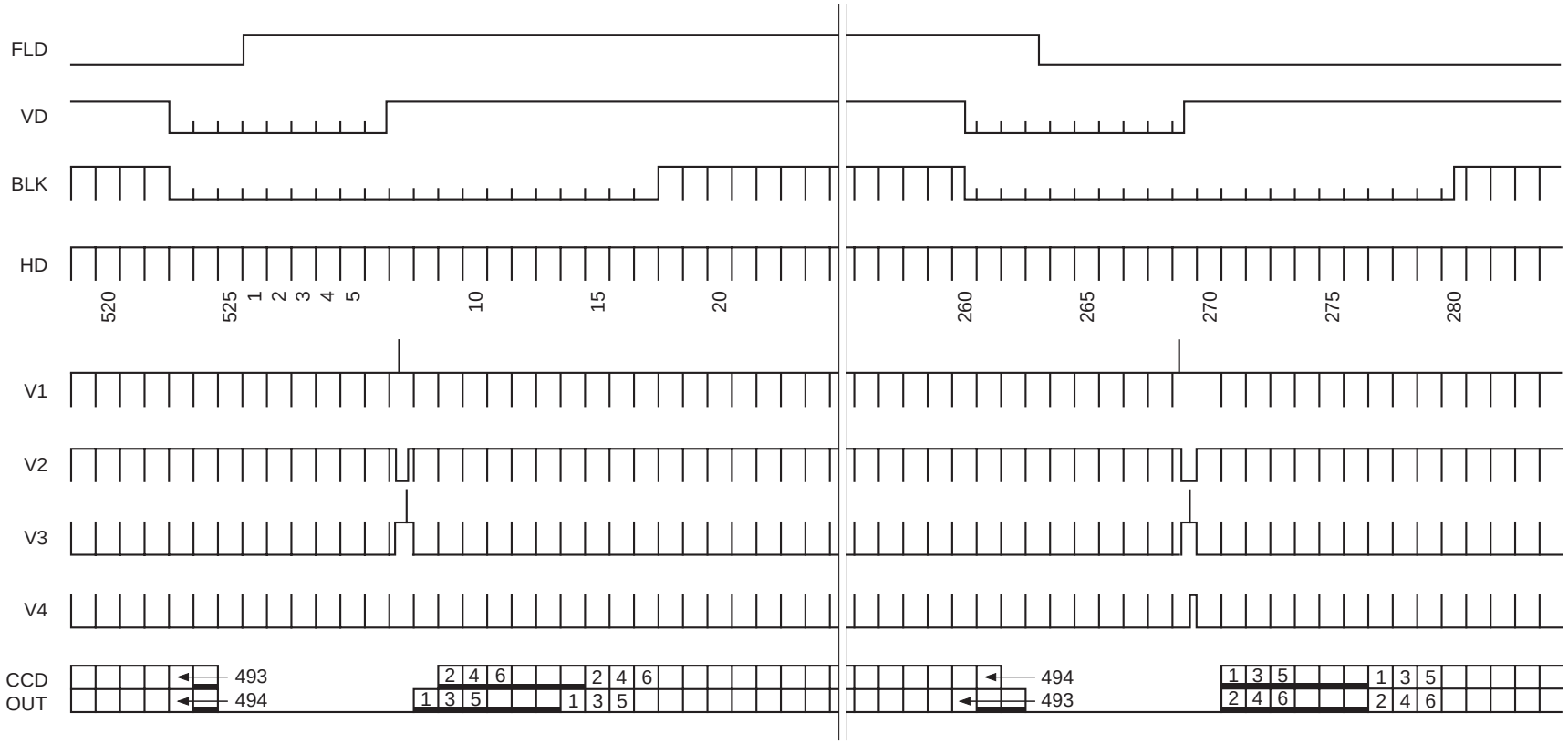


Sensor Readout Clock Timing Chart

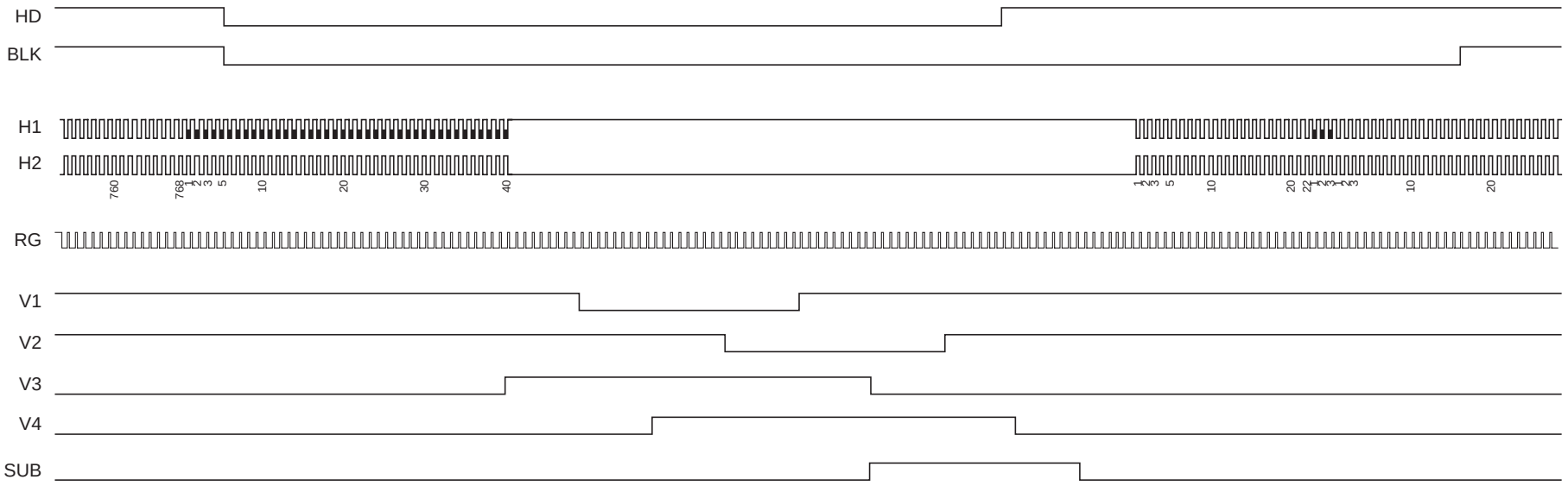


Unit: µs

Drive Timing Chart (Vertical Sync)



Drive Timing Chart (Horizontal Sync)



Notes on Handling

1) Static charge prevention
   CCD image sensors are easily damaged by static discharge. Before handling be sure to take the following protective measures.
   a) Either handle bare handed or use non-chargeable gloves, clothes or material.
      Also use conductive shoes.
   b) When handling directly use an earth band.
   c) Install a conductive mat on the floor or working table to prevent the generation of static electricity.
   d) Ionized air is recommended for discharge when handling CCD image sensor.
   e) For the shipment of mounted substrates, use boxes treated for the prevention of static charges.

2) Soldering
   a) Make sure the package temperature does not exceed 80°C.
   b) Solder dipping in a mounting furnace causes damage to the glass and other defects. Use a 30W soldering iron with a ground wire and solder each pin in less than 2 seconds. For repairs and remount, cool sufficiently.
   c) To dismount an image sensor, do not use a solder suction equipment. When using an electric desoldering tool, use a thermal controller of the zero cross On/Off type and connect it to ground.

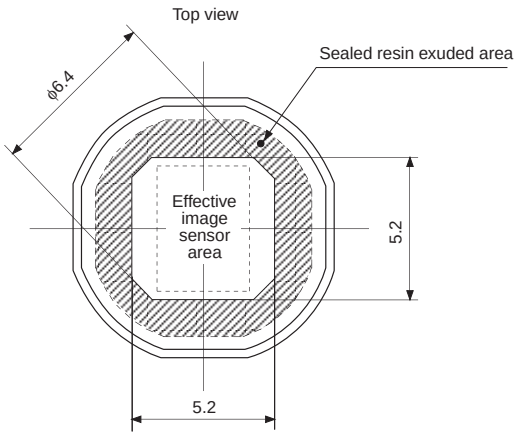
3) Dust and dirt protection
   Image sensors are packed and delivered by taking care of protecting its glass plates from harmful dust and dirt. Clean glass plates with the following operation as required, and use them.
   a) Operate in clean environments (aronud class 1000 is appropriate).
   b) Do not either touch glass plates by hand or have any object come in contact with glass surfaces. Should dirt stick to a glass surface, blow it off with an air blower. (For dirt stuck through static electricity ionized air is recommended.)
   c) Clean with a cotton bud and ethyl alcohol if the grease stained. Be careful not to scratch the glass.
   d) Keep in a case to protect from dust and dirt. To prevent dew condensation, preheat or precool when moving to a room with great temperature differences.
   e) When a protective tape is applied before shipping, just before use remove the tape applied for electrostatic protection. Do not reuse the tape.

4) Do not expose to strong light (sun rays) for long periods. For continuous using under cruel condition exceeding the normal using condition, consult our company.

5) Exposure to high temperature or humidity will affect the characteristics. Accordingly avoid storage or usage in such conditions.

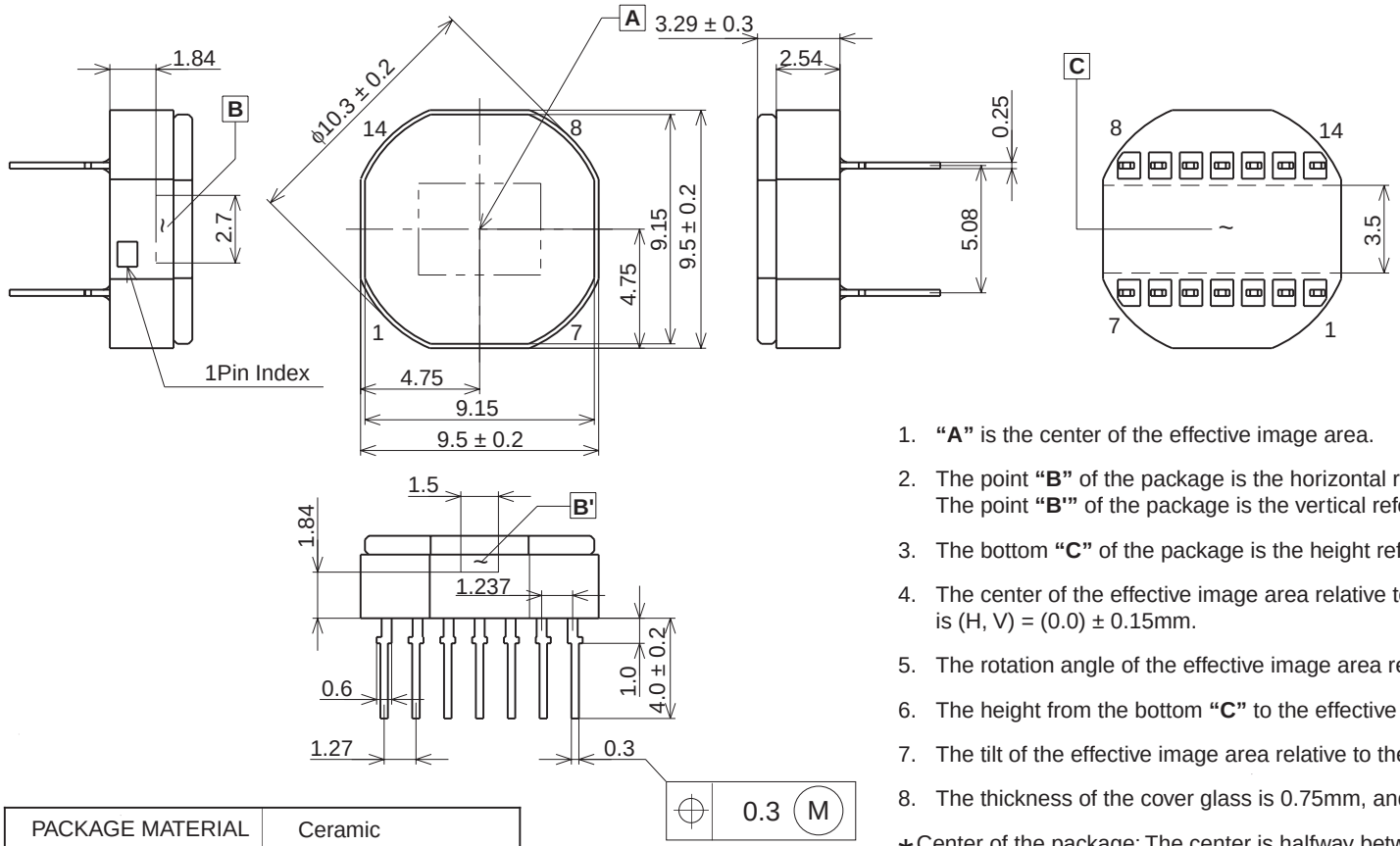
6) CCD image sensors are precise optical equipment that should not be subject to too much mechanical shocka.

7) Eclipse (to get dark around the four corners of the picture) may occur when some object lenses are in the open iris state.



Package Outline Unit: mm

14 Pin DIP (200mil)



PACKAGE MATERIAL	Ceramic
LEAD TREATMENT	GOLD PLATING
LEAD MATERIAL	42 ALLOY
PACKAGE MASS	0.60g
DRAWING NUMBER	AS-C3-02(E)

1. **"A"** is the center of the effective image area.
2. The point **"B"** of the package is the horizontal reference.
   The point **"B'"** of the package is the vertical reference.
3. The bottom **"C"** of the package is the height reference.
4. The center of the effective image area relative to the center of the package (*) is (H, V) = (0.0) ± 0.15mm.
5. The rotation angle of the effective image area relative to H and V is ± 1°.
6. The height from the bottom **"C"** to the effective image area is 1.41 ± 0.15mm.
7. The tilt of the effective image area relative to the bottom **"C"** is less than 60µm.
8. The thickness of the cover glass is 0.75mm, and the refractive index is 1.5.

* Center of the package: The center is halfway between two pairs of opposite sides, as measured from **"B","B'".**