SONY

ICX085AK

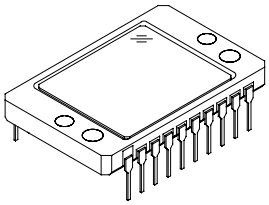
Diagonal 11mm (Type 2/3) Progressive Scan CCD Image Sensor with Square Pixel for Color Cameras

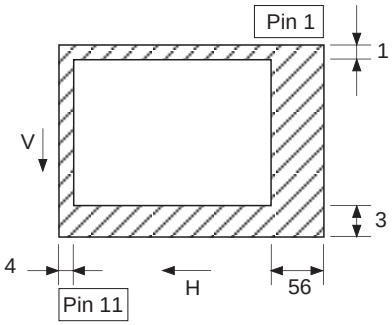
Description

The ICX085AK is a diagonal 11mm (Type 2/3) interline CCD solid-state image sensor with a square pixel array. Progressive scan allows all pixels signals to be output independently within approximately 1/12 second. This chip features an electronic shutter with variable charge-storage time which makes it possible to realize full-frame still image without a mechanical shutter. High resolution and high color reproductivity are achieved through the use of R, G, B primary color mosaic filters. Further, high sensitivity and low dark current are achieved through the adoption of HAD (Hole-Accumulation Diode) sensors.

This chip is suitable for image input applications such as still cameras which require high resolution.

20 pin DIP (Ceramic)





Optical black position
(Top View)

Features

- Progressive scan allows individual readout of the image signals from all pixels.
- High vertical resolution (1024TV-lines) still image without a mechanical shutter.
- Square pixel unit cell
- Aspect ratio 5:4
- Horizontal drive frequency: 20.25MHz
- Reset gate bias is not adjusted.
- Substrate voltage: 5.5 to 12.5V
- R, G, B primary color mosaic filters on chip
- Continuous variable-speed shutter
- High resolution, high color reproductivity, high sensitivity, low dark current
- Low smear
- Excellent antiblooming characteristics
- Horizontal register: 5V drive

Device Structure

- Interline CCD image sensor
- Image size: Diagonal 11mm (Type 2/3)
- Number of effective pixels: 1300 (H) × 1030 (V) approx. 1.3M pixels
- Total number of pixels: 1360 (H) × 1034 (V) approx. 1.4M pixels
- Chip size: 10.0mm (H) × 8.7mm (V)
- Unit cell size: 6.7µm (H) × 6.7µm (V)
- Optical black: Horizontal (H) direction: Front 4 pixels, rear 56 pixels
  Vertical (V) direction: Front 3 pixels, rear 1 pixel
- Number of dummy bits: Horizontal 24
  Vertical 1
- Substrate material: Silicon

Wfine CCD®

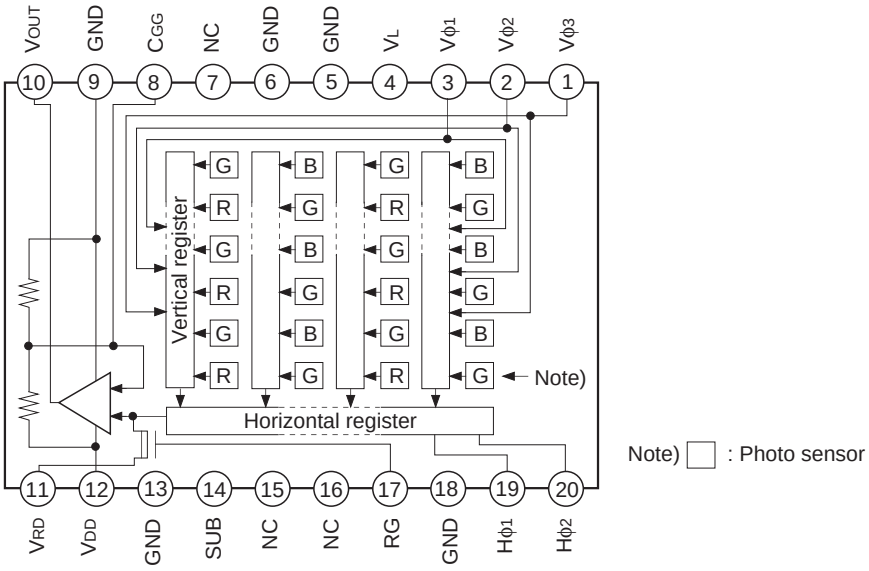
* Wfine CCD is a registered trademark of Sony Corporation.
Represents a CCD adopting progressive scan, primary color filter and square pixel.

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E96414D99

Block Diagram and Pin Configuration

(Top View)



Pin Description

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	Vφ3	Vertical register transfer clock	11	V_{RD}	Reset drain power supply
2	Vφ2	Vertical register transfer clock	12	V_{DD}	Supply voltage
3	Vφ1	Vertical register transfer clock	13	GND	GND
4	V_L	Protective transistor bias	14	SUB	Substrate (overflow drain)
5	GND	GND	15	NC	
6	GND	GND	16	NC	
7	NC		17	RG	Reset gate clock
8	C_{GG}	Output amplifier gate*1	18	GND	GND
9	GND	GND	19	Hφ1	Horizontal register transfer clock
10	V_{OUT}	Signal output	20	Hφ2	Horizontal register transfer clock

*1 DC bias is applied within the CCD, so that this pin should be grounded externally through a capacitance of 1µF or more.

Absolute Maximum Ratings

Item		Ratings	Unit	Remarks
Substrate voltage SUB–GND		–0.3 to +55	V	
Supply voltage	V_{DD}, V_{OUT}, V_{RD}, C_{GG}–GND	–0.3 to +18	V	
	V_{DD}, V_{OUT}, V_{RD}, C_{GG}–SUB	–55 to +9	V	
Vertical clock input voltage	$V\phi_1$, $V\phi_2$, $V\phi_3$–GND	–15 to +16	V	
	$V\phi_1$, $V\phi_2$, $V\phi_3$–SUB	to +10	V	
Voltage difference between vertical clock input pins		to +15	V	*1
Voltage difference between horizontal clock input pins		to +16	V	
$H\phi_1$, $H\phi_2$–$V\phi_3$		–16 to +16	V	
$H\phi_1$, $H\phi_2$–GND		–10 to +15	V	
$H\phi_1$, $H\phi_2$–SUB		–55 to +10	V	
V_L–SUB		–65 to +0.3	V	
$V\phi_2$, $V\phi_3$–V_L		–0.3 to +27.5	V	
RG–GND		–0.3 to +20.5	V	
$V\phi_1$, $H\phi_1$, $H\phi_2$, GND–V_L		–0.3 to +17.5	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	
Substrate voltage adjustment range	V_{SUB}	5.5		12.5	V	*1
Protective transistor bias	V_L	*2				

DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply current	I_{DD}		6	8	mA	

*1 Indications of substrate voltage (V_{SUB}) setting value

The setting value of the substrate voltage is indicated on the back of image sensor by a special code. Adjust the substrate voltage (V_{SUB}) to the indicated voltage.

V_{SUB} code – two characters indication □ □

↑ Integer portion ↑ Decimal portion

Integer portion of code and optimal setting correspond to each other as follows.

Integer portion of code	A	C	d	E	f	G	h	J
Optimal setting	5	6	7	8	9	10	11	12

<Example> "G5"→ V_{SUB} = 10.5V

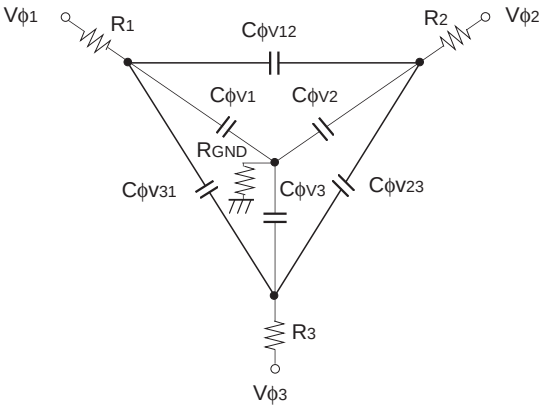
*2 V_L setting is the V_{VL} voltage of the vertical transfer clock waveform, or the same supply voltage as the V_L power supply for the V driver should be used.

Clock Voltage Conditions

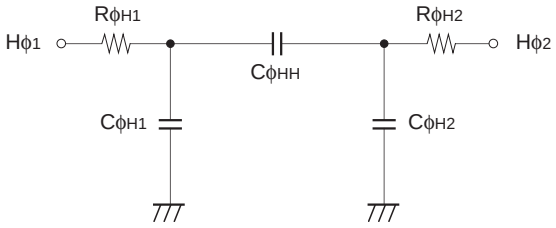
Item	Symbol	Min.	Typ.	Max.	Unit	Waveform diagram	Remarks
Readout clock voltage	V_{VT}	14.55	15.0	15.45	V	1	
Vertical transfer clock voltage	V_{VH02}	–0.05	0	0.05	V	2	$V_{VH} = V_{VH02}$
	V_{VH1},V_{VH2},V_{VH3}	–0.2	0	0.05	V	2	
	V_{VL1},V_{VL2},V_{VL3}	–8.0	–7.5	–7.0	V	2	$V_{VL} = (V_{VL1} + V_{VL3})/2$
	$V\phi_1$, $V\phi_2$, $V\phi_3$	6.8	7.5	8.05	V	2	
	$\lvert V_{VL1}–V_{VL3} \rvert$			0.1	V	2	
	V_{VHH}			0.5	V	2	High-level coupling
	V_{VHL}			0.5	V	2	High-level coupling
	V_{VLH}			0.5	V	2	Low-level coupling
	V_{VLL}			0.5	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 0.01µF capacitance
	$V_{RGLH}–V_{RGLL}$			0.8	V	4	Low-level coupling
	V_{RGH}	V_{DD} +0.4	V_{DD} +0.6	V_{DD} +0.8	V	4	
Substrate clock voltage	$V\phi_{SUB}$	21.5	22.5	23.5	V	5	

Clock Equivalent Circuit Constant

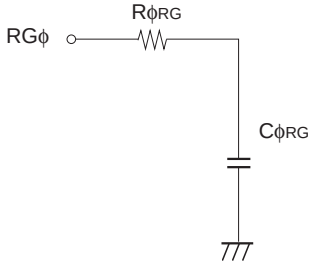
Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Capacitance between vertical transfer clock and GND	$C\phi_{V1}$		5000		pF	
	$C\phi_{V2}$, $C\phi_{V3}$		10000		pF	
Capacitance between vertical transfer clocks	$C\phi_{V12}$		1200		pF	
	$C\phi_{V23}$		100		pF	
	$C\phi_{V31}$		3300		pF	
Capacitance between horizontal transfer clock and GND	$C\phi_{H1}$		82		pF	
	$C\phi_{H2}$		68		pF	
Capacitance between horizontal transfer clocks	$C\phi_{HH}$		22		pF	
Capacitance between reset gate clock and GND	$C\phi_{RG}$		6		pF	
Capacitance between substrate clock and GND	$C\phi_{SUB}$		800		pF	
Vertical transfer clock series resistor	R_1, R_2, R_3		30		Ω	
Vertical transfer clock ground resistor	R_{GND}		30		Ω	
Horizontal transfer clock series resistor	$R\phi_{H1}$, $R\phi_{H2}$		10		Ω	
Reset gate clock series resistor	$R\phi_{RG}$		20		Ω	



Vertical transfer clock equivalent circuit



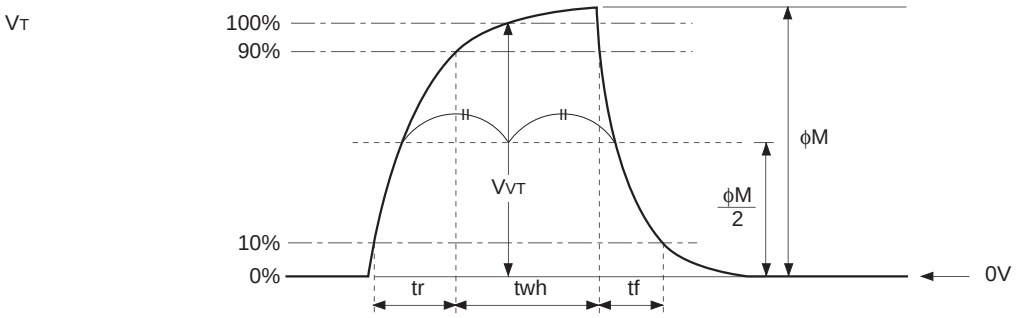
Horizontal transfer clock equivalent circuit



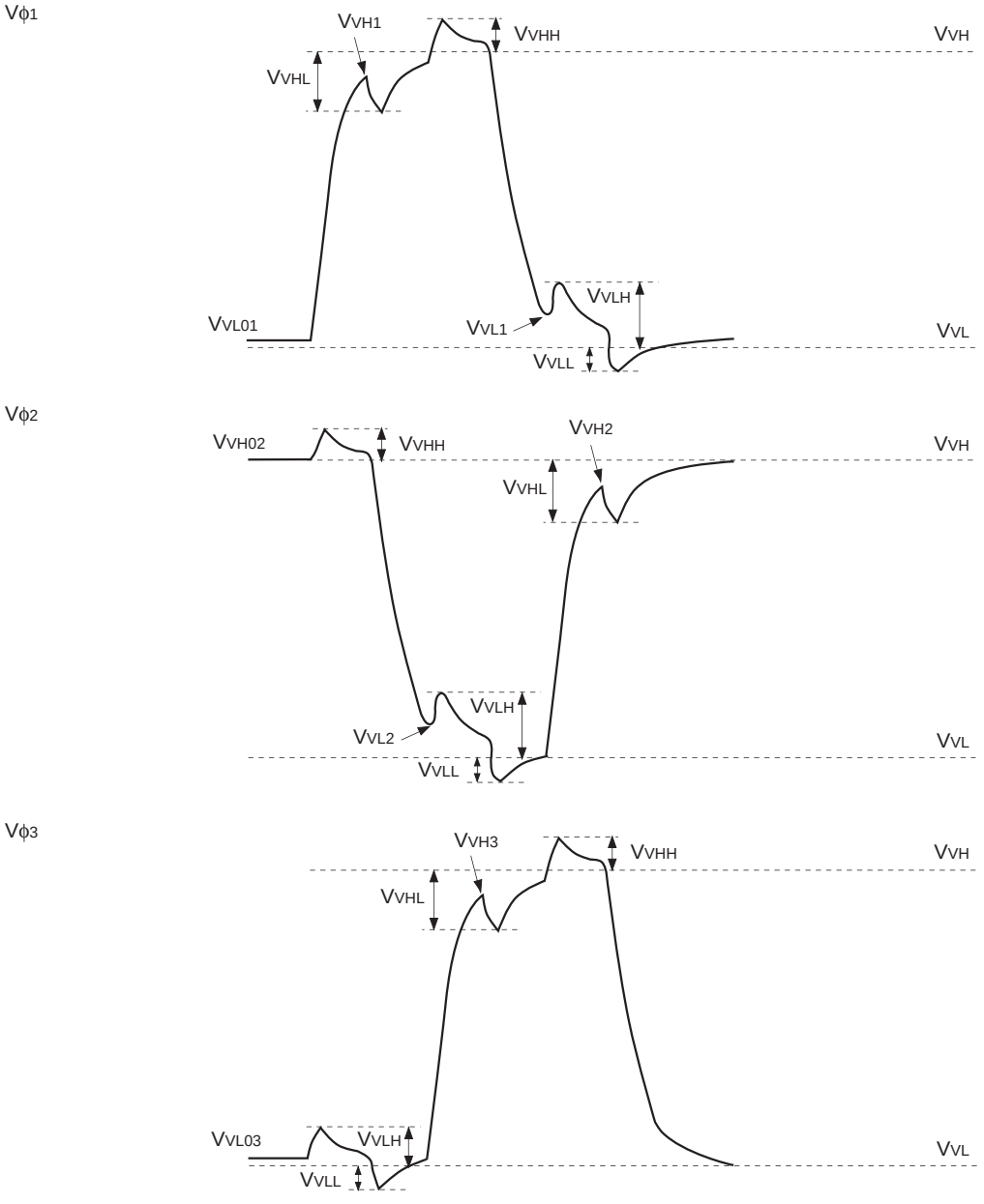
Reset gate clock equivalent circuit

Drive Clock Waveform Conditions

(1) Readout clock waveform



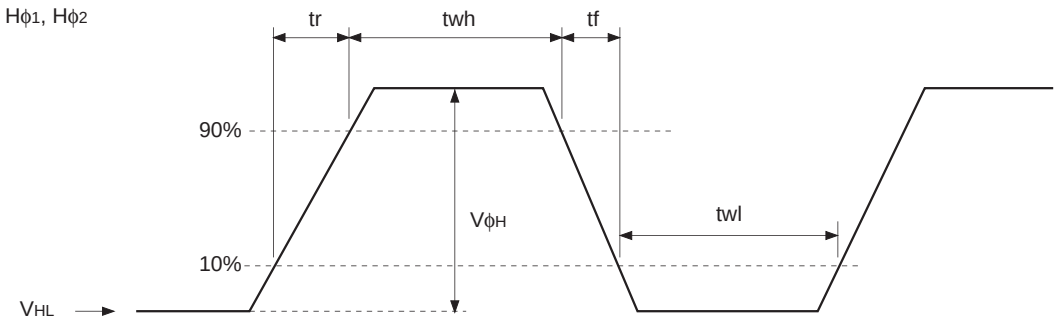
(2) Vertical transfer clock waveform



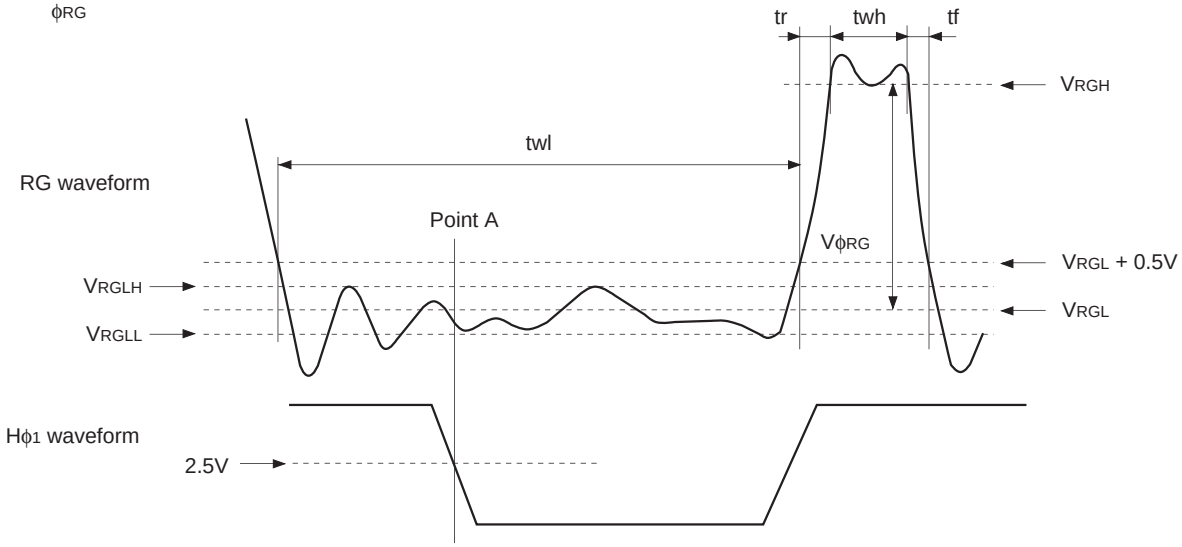
$V_{VH} = V_{VH02}$
$V_{VL} = (V_{VL01} + V_{VL03}) / 2$

$V_{\phi V1} = V_{VH1} - V_{VL01}$
$V_{\phi V2} = V_{VH02} - V_{VL2}$
$V_{\phi V3} = V_{VH3} - V_{VL03}$

(3) Horizontal transfer clock waveform



(4) Reset gate clock waveform



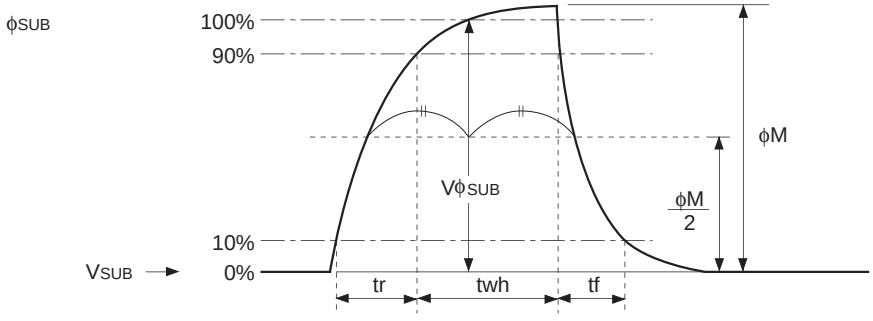
VRGLH is the maximum value and VRGLL is the minimum value of the coupling waveform during the period from Point A in the above diagram until the rising edge of RG. In addition, VRGL is the average value of VRGLH and VRGLL.

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

Assuming VRGH is the minimum value during the interval twh, then:

$$V_{\phi RG} = V_{RGH} - V_{RGL}$$

(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	4.6	5.0						0.5			0.5		µs	During readout
Vertical transfer clock		$V\phi_1$, $V\phi_2$, $V\phi_3$										52.5		110	ns	*1
Horizontal transfer clock	During imaging	$H\phi_1$	15	18		15	19			6	10.6		6	10.6	ns	*2
		$H\phi_2$	16	19		15	18			6	10.6		6	10.6		
	During parallel-serial conversion	$H\phi_1$								0.01			0.01		µs	
		$H\phi_2$								0.01			0.01			
Reset gate clock		ϕ_{RG}	7	8			37.9			2.5			2.5		ns	
Substrate clock		ϕ_{SUB}	1.8	2.1							0.5			0.5	µs	During drain charge

*1 When vertical transfer clock driver CXD1268M × 2 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 2.5V.

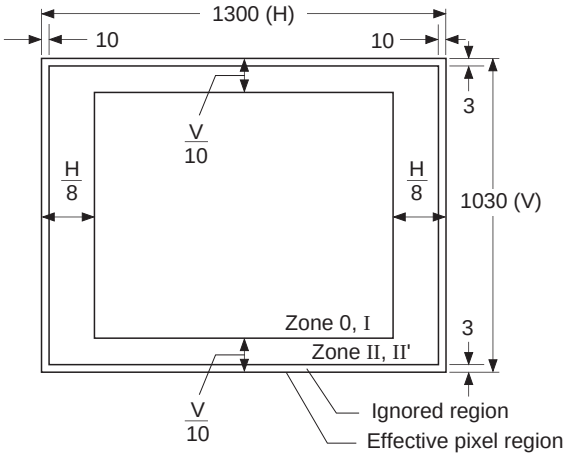
Item	Symbol	two			Unit	Remarks
		Min.	Typ.	Max.		
Horizontal transfer clock	$H\phi_1$, $H\phi_2$	13.0	15.5		ns	*3

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

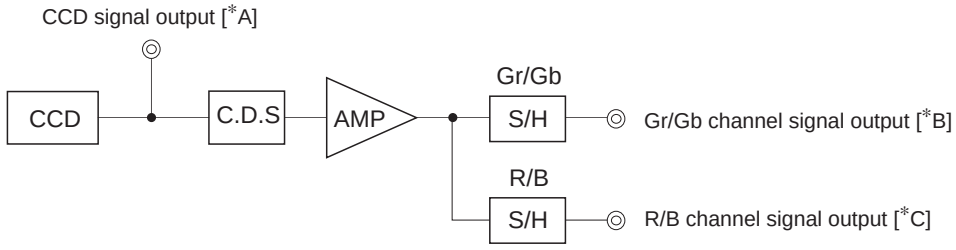
Image Sensor Characteristics (1/12 second accumulation mode, Ta = 25°C)

Item		Symbol	Min.	Typ.	Max.	Unit	Measurement method	Remarks
G sensitivity		Sg	890	1100		mV	1	
Sensitivity comparison	R	Rr	0.4	0.5	0.55		1	
	B	Rb	0.4	0.5	0.55		1	
Saturation signal		Vsat	400			mV	2	Ta = 60°C
Smear		Sm		0.005	0.008	%	3	
Video signal shading		SHg			20	%	4	Zone 0 and I
					25	%	4	Zone 0 to II'
Uniformity between video signal channels		ΔSrg			8	%	5	
		ΔSbg			8	%	5	
Dark signal		Vdt			8	mV	6	Ta = 60°C
Dark signal shading		ΔVdt			4	mV	7	Ta = 60°C
Line crawl G		Lcg			3.8	%	8	
Line crawl R		Lcr			3.8	%	8	
Line crawl B		Lcb			3.8	%	8	
Lag		Lag			0.5	%	9	

Zone Definition of Video Signal Shading



Measurement System



Note) Adjust the amplifier gain so that the gain between [*A] and [*B], and between [*A] and [*C] equals 1.

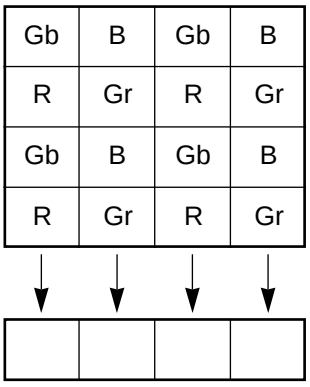
Image Sensor Characteristics Measurement Method

◎ Measurement conditions

1) In the following measurements, the substrate voltage is set to the value indicated on the device, and 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 level (OB) is used as the reference for the signal output, which is taken as the value of the Gr/Gb signal output or the R/B signal output of the measurement system.

◎ Color coding and readout of this image sensor



Color Coding Diagram

The primary color filters of this image sensor are arranged in the layout shown in the figure on the left (Bayer arrangement).
Gr and Gb denote the G signals on the same line as the R signal and the B signal, respectively.

All pixels signals are output successively in a 1/12s period.
The R signal and Gr signal lines and the Gb signal and B signal lines are output successively.

◎ **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 F5.6. 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. G sensitivity, sensitivity comparison
Set to standard imaging condition I. After selecting the electronic shutter mode with a shutter speed of 1/80s, measure the signal outputs (V_{Gr}, V_{Gb}, V_R and V_B) at the center of each Gr, Gb, R and B channel screens, and substitute the values into the following formula.

$V_G = (V_{Gr} + V_{Gb})/2$

$Sg = V_G \times \frac{80}{12}$ [mV]

$Rr = V_R/V_G$

$Rb = V_B/V_G$

2. Saturation signal
Set to standard imaging condition II. After adjusting the luminous intensity to 10 times the intensity with the average value of the Gr signal output, 150mV, measure the minimum values of the Gr, Gb, R and B signal outputs.

3. Smear
Set to standard imaging condition II. With the lens diaphragm at F5.6 to F8, first adjust the average value of the Gr signal output to 150mV. Measure the average values of the Gr signal output, Gb signal output, R signal output and B signal output (Gra, Gba, Ra and Ba), and then adjust the luminous intensity to 500 times the intensity with average value of the Gr signal output, 150mV. After the readout clock is stopped and the charge drain is executed by the electronic shutter at the respective H blankings, measure the maximum value (V_{Sm} [mV]), independent of the Gr, Gb, R and B signal outputs, and substitute the values into the following formula.

$$Sm = V_{Sm} \div \frac{Gra + Gba + Ra + Ba}{4} \times \frac{1}{500} \times \frac{1}{10} \times 100\ [\%]$$ (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 Gr signal output is 150mV. Then measure the maximum (Grmax [mV]) and minimum (Grmin [mV]) values of the Gr signal output and substitute the values into the following formula.

$SHg = (Grmax - Grmin)/150 \times 100$ [%]

5. Uniformity between video signal channels
   After measuring 4, measure the maximum (Rmax [mV]) and minimum (Rmin [mV]) values of the R signal and the maximum (Bmax [mV]) and minimum (Bmin [mV]) values of the B signal, and substitute the values into the following formula.

   $\Delta Srg = (Rmax - Rmin)/150 \times 100$ [%]
   $\Delta Sbg = (Bmax - Bmin)/150 \times 100$ [%]

6. 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.

7. Dark signal shading
   After measuring 6, measure the maximum (Vdmax [mV]) and minimum (Vdmin [mV]) values of the dark signal output and substitute the values into the following formula.

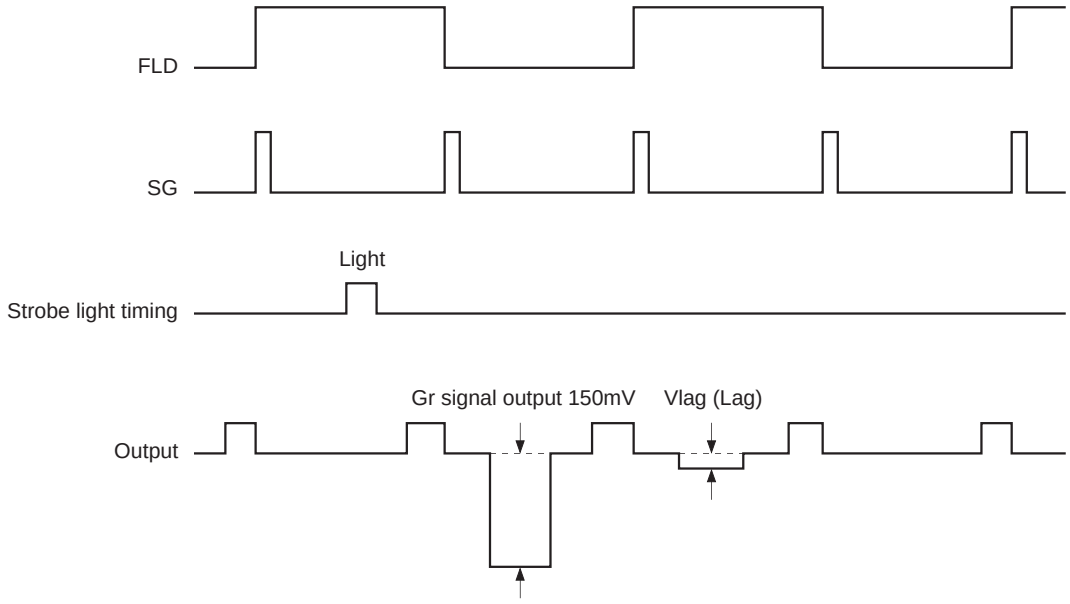
   $\Delta Vdt = Vdmax - Vdmin$ [mV]

8. Line crawl
   Set to standard imaging condition II. Adjust the luminous intensity so that the average value of the Gr signal output is 150mV, and then insert R, G, and B filters and measure the difference between G signal lines (ΔGlr, ΔGlg, ΔGlb [mV]) as well as the average value of the G signal output (Gar, Gag, Gab). Substitute the values into the following formula.

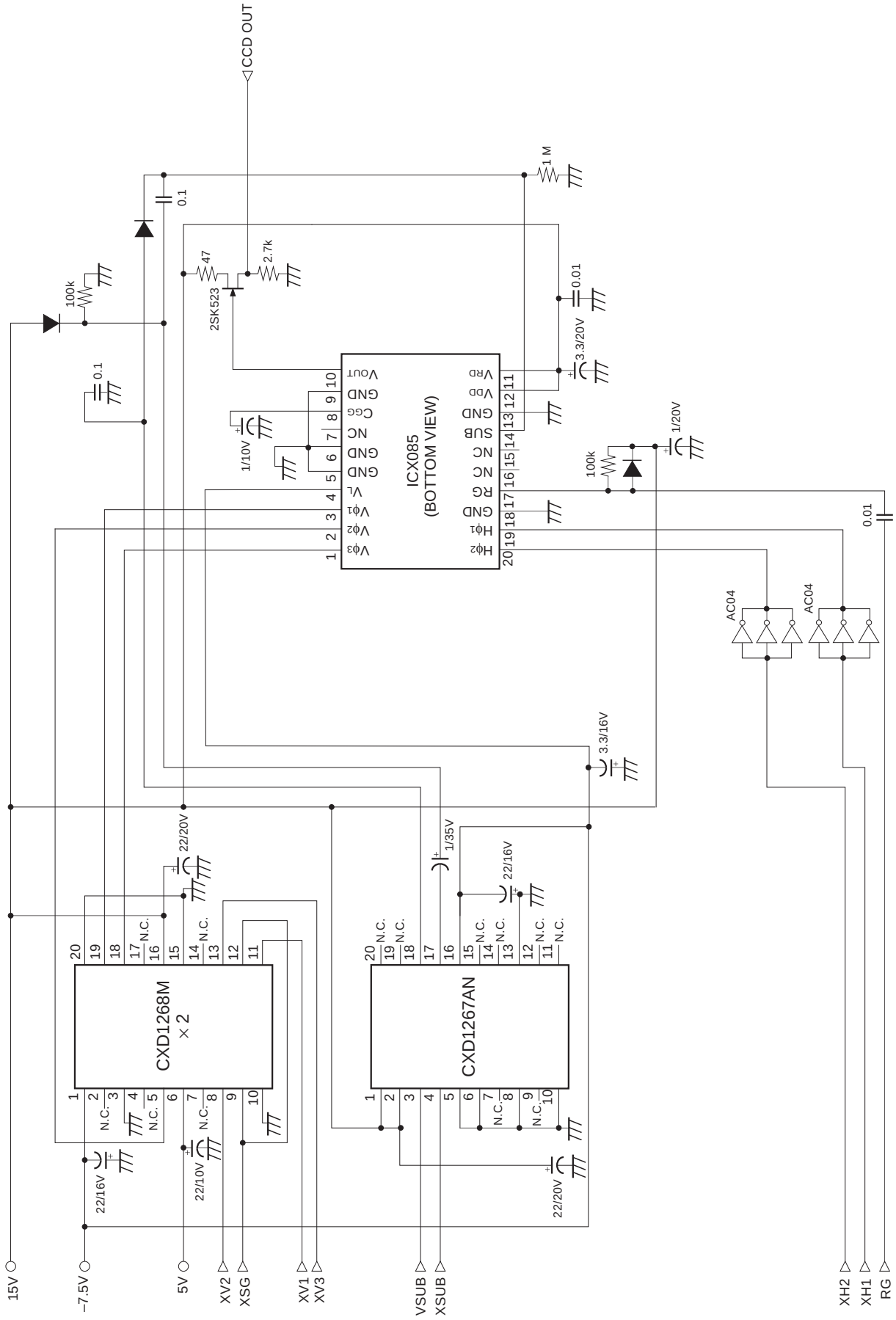
   $$Lci = \frac{\Delta Gli}{Gai} \times 100 \text{ [\%]} \quad (i = r, g, b)$$

9. Lag
   Adjust the Gr signal output value generated by strobe light to 150mV. 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.

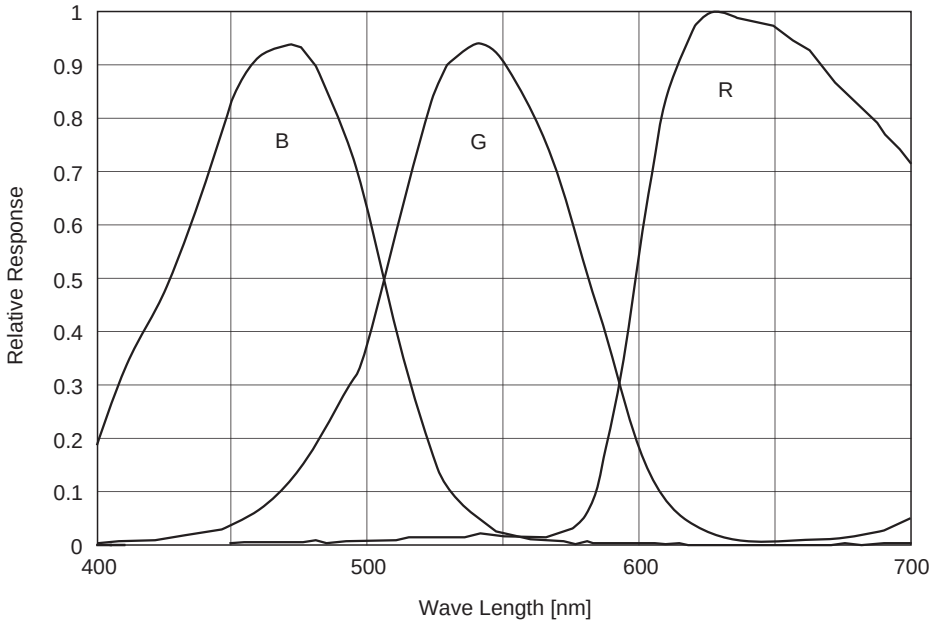
   $Lag = (Vlag/150) \times 100$ [%]



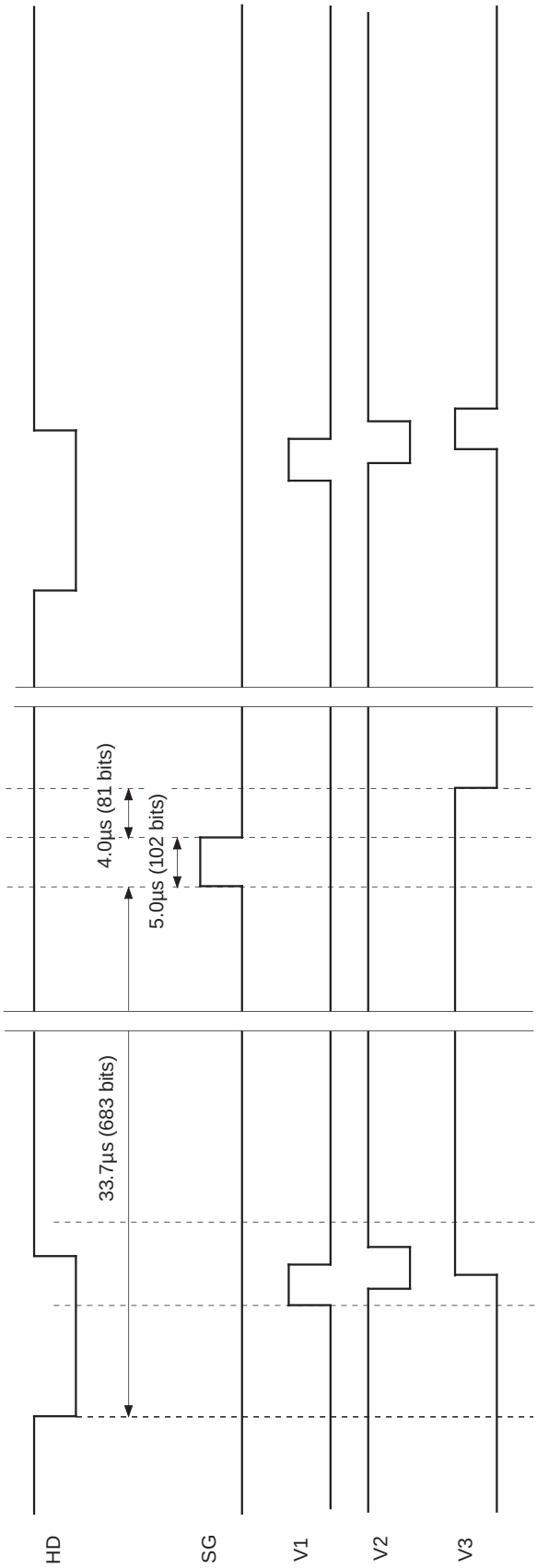
Drive Circuit



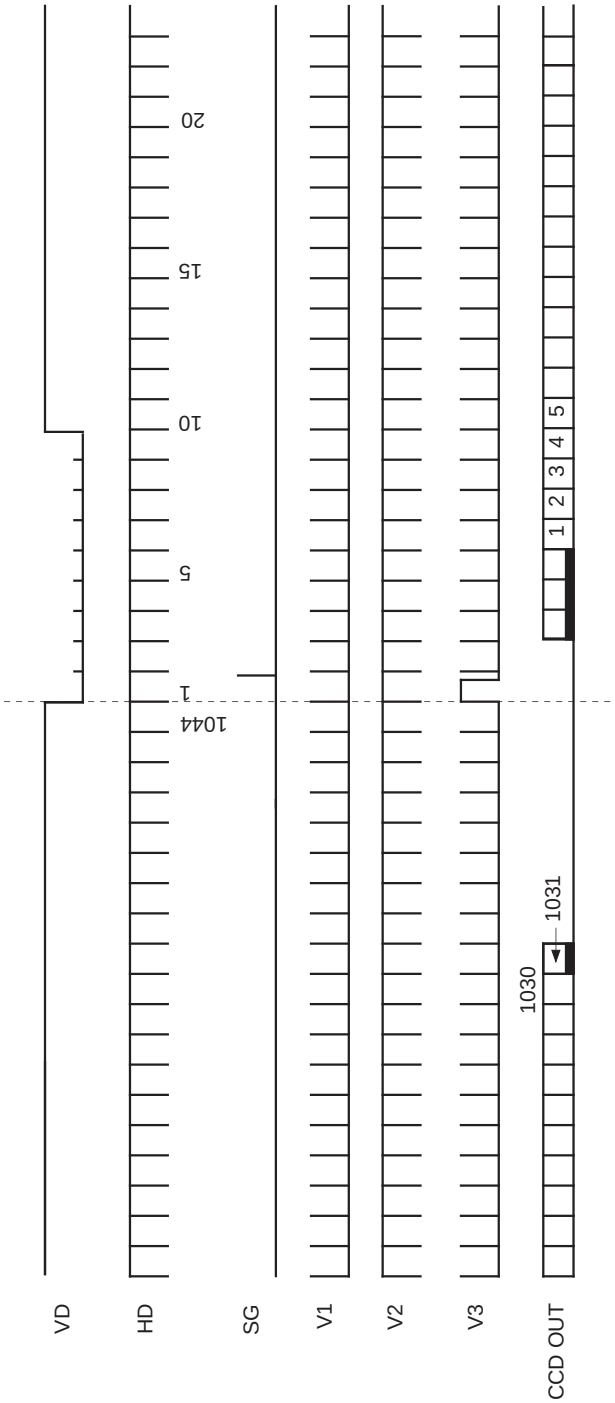
Spectral Sensitivity Characteristics
(Includes lens characteristics, excludes light source characteristics)



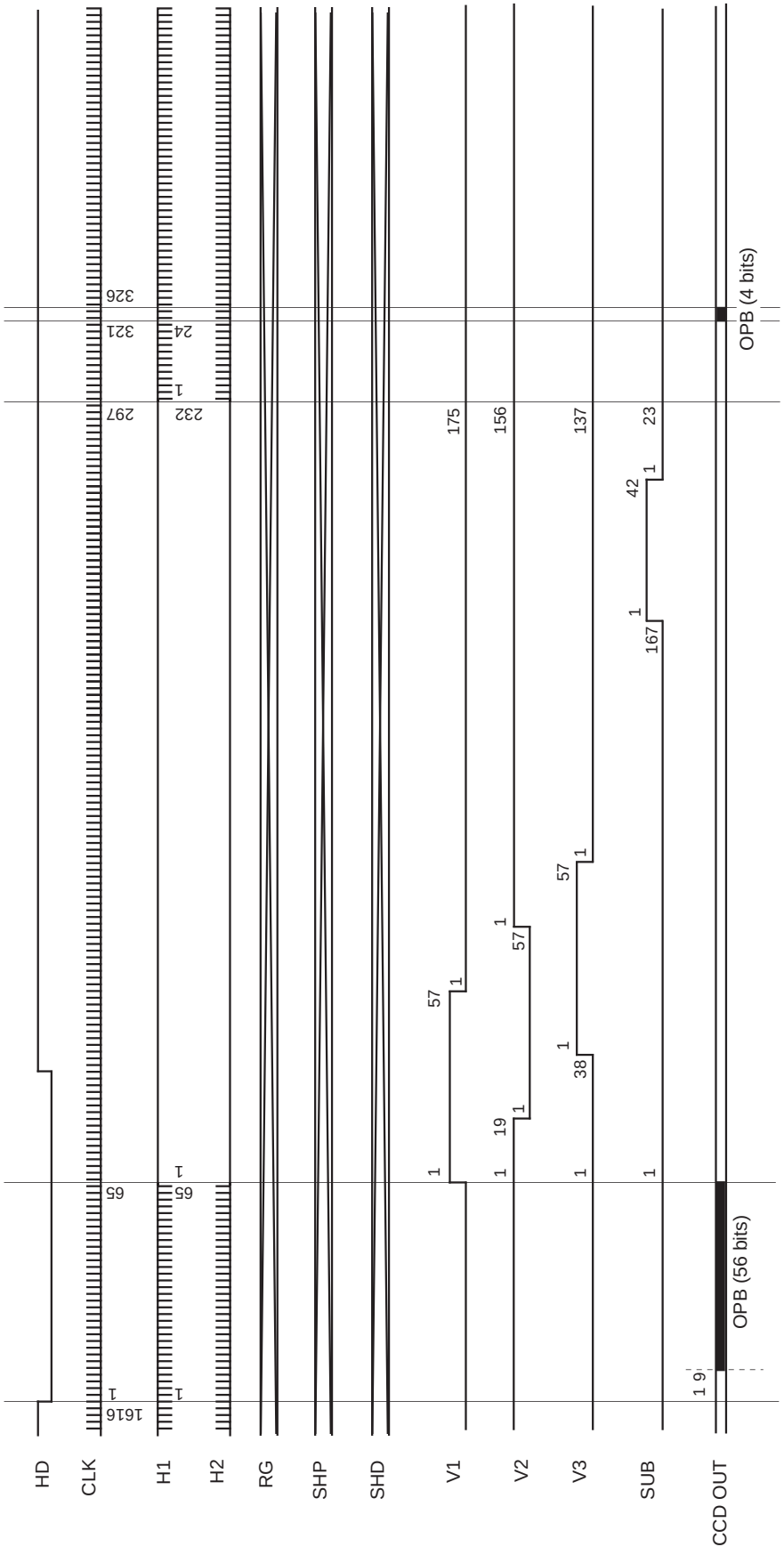
Sensor Readout Clock Timing Chart



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 ground 30W soldering iron 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 (around 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.

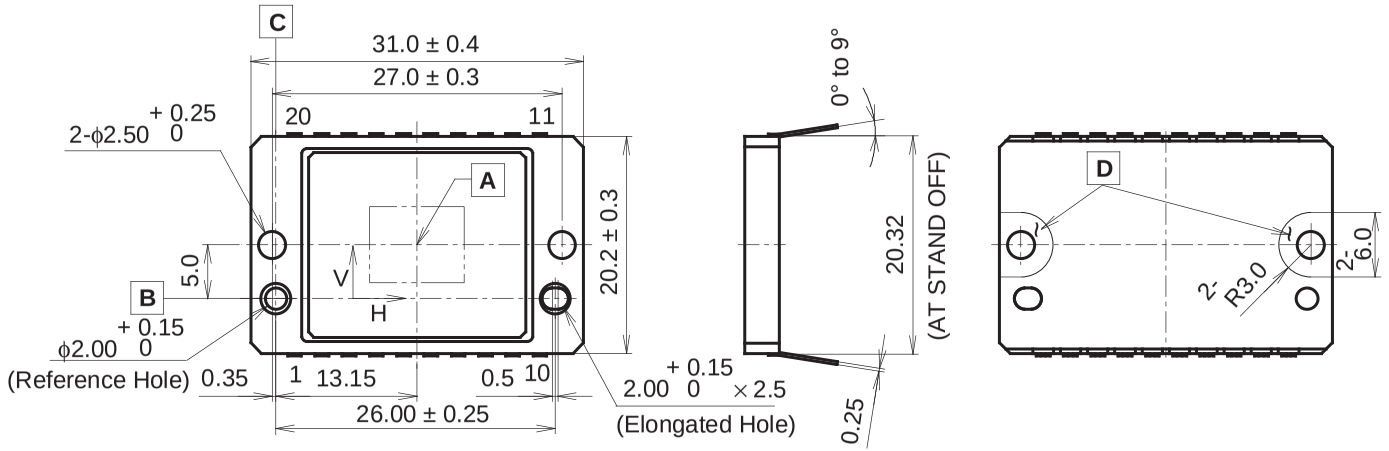
4) Do not expose to strong light (sun rays) for long periods, color filters will be discolored. When high luminance objects are imaged with the exposure level control by electronic-iris, the luminance of the image-plane may become excessive and discolor of the color filter will possibly be accelerated. In such a case, it is advisable that taking-lens with the automatic-iris and closing of the shutter during the power-off mode should be properly arranged. For continuous using under cruel condition exceeding the normal using condition, consult our company.

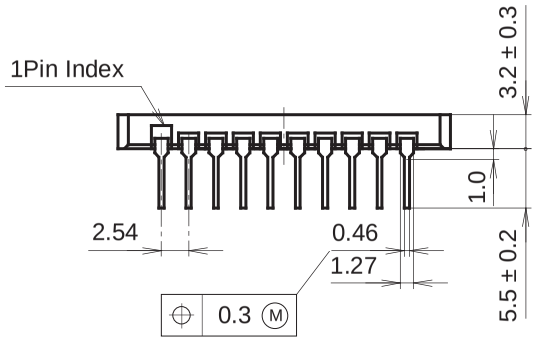
5) Exposure to high temperature or humidity will affect the characteristics. Accordingly avoid storage or usage in such conditions.

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

Package Outline Unit: mm

20pin DIP (800mil)





PACKAGE STRUCTURE

PACKAGE MATERIAL	Ceramic
LEAD TREATMENT	GOLD PLATING
LEAD MATERIAL	42 ALLOY
PACKAGE WEIGHT	5.9g

1. **"A"** is the center of the effective image sensor area.
2. A straight line **"B"** which passes through the centers of the reference hole and the elongated hole is the reference axis of vertical direction.
3. A straight line **"C"** which passes through the center of the reference hole at right angles to vertical reference line **"B"** is the reference axis of horizontal direction.
4. The bottom **"D"** is the height reference. (Two points are specified.)
5. The center of the effective image area, specified relative to the reference hole is (H, V) = (13.15, 5.0) ± 0.15mm.
6. The angle of rotation relative to the reference line **"B"** is less than ± 1°.
7. The height from the bottom **"D"** to the effective image area is 1.46 ± 0.15mm.
8. Planar orientation of the effective image area relative to the bottom **"D"** is less than 60µm.
9. The thickness of the cover glass is 0.75mm and the refractive index is 1.5.