Ordering number : ENN6247

LC99104

1/4-Inch Optical Size Frame Transfer Type VGA Compatible B/W Image Sensor

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Overview

The LC99104 is a black-and-white VGA frame transfer CCD solid-state imaging device for 1/4-inch optical systems. It was developed for use in consumer image input products.

Features

- VGA format compatible
- Reads each pixel independently
- Horizontal dual read method (Each horizontal line is read twice: odd line and even line; Therefore, signal processing requires line memory.)
- Variable speed electronic shutter possible (1/8 to 1/4000 s)

Device Structure

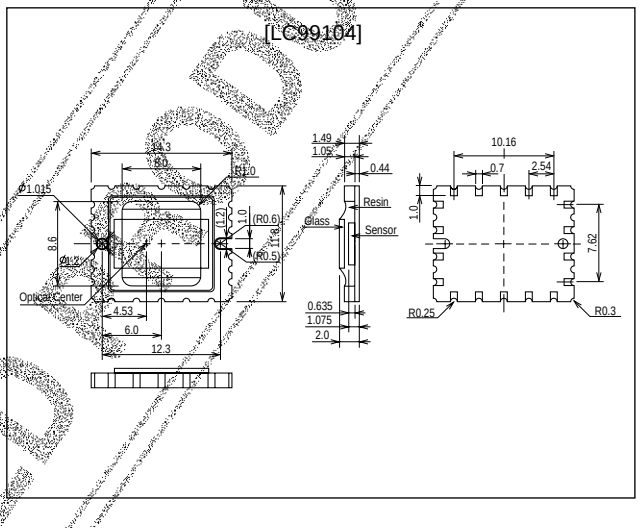
- Effective pixel count [total pixels] :
  654H × 490V [710H × 510V]
- Number of optical black pixels :
  H direction : 44 pixels in front, 12 pixels in back
  V direction : 8 pixels above, 12 pixels below
- Dummy bit : H direction 4 pixels
- Unit cell size : 5.55 µm (H) × 5.55 µm (V)
- Square lattice
- Parallel gate type CCD sensor
- Both imaging block and storage block are composed of 710H × 510V pixels
- 3-phase drive for imaging block and storage block, 2-phase drive for horizontal block
- Built-in high-sensitivity output amplifier

Package Dimensions

unit: mm

3242

[LC99104]



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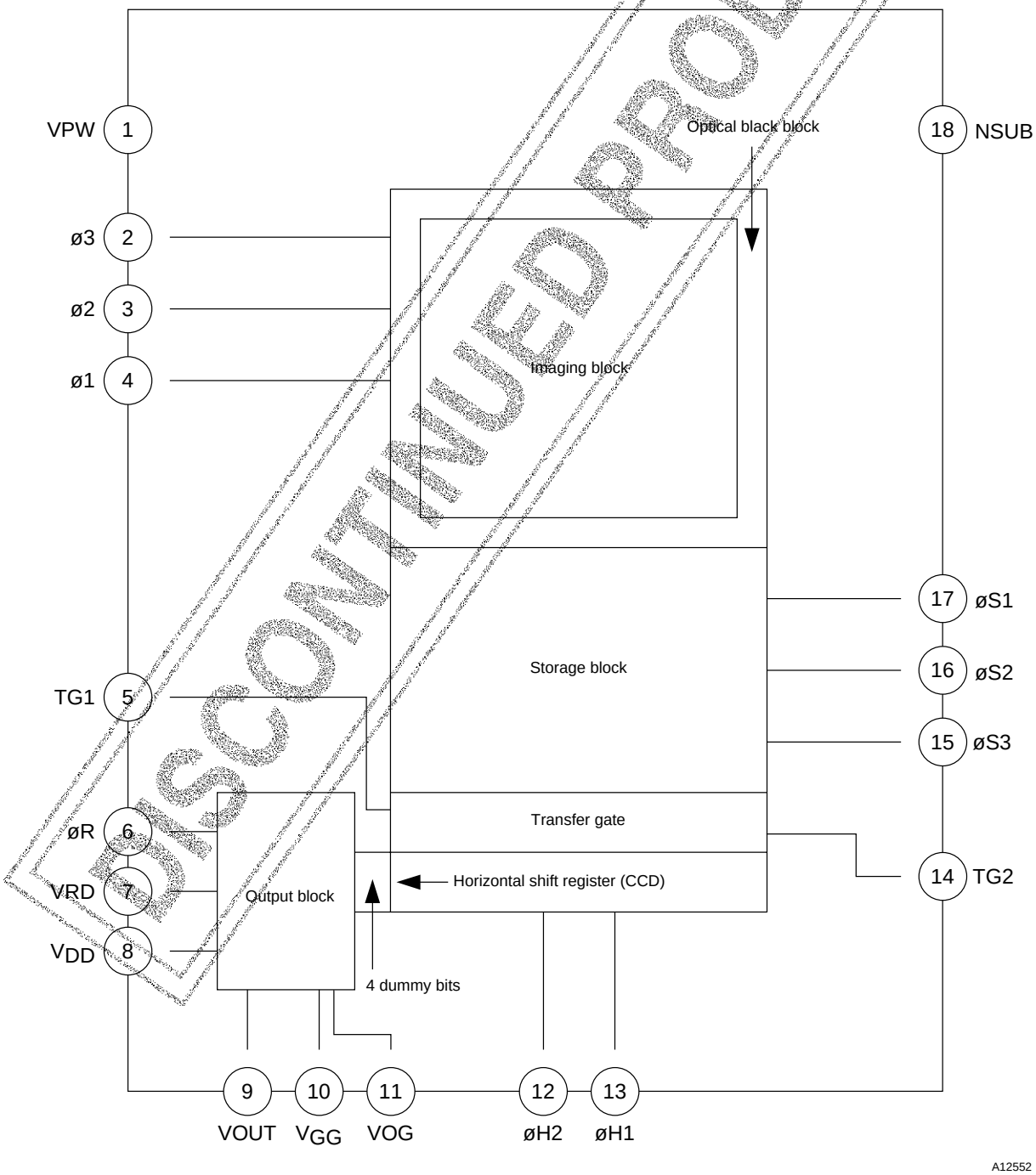
SANYO Electric Co.,Ltd. Semiconductor Company
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{DD}, V_{RD}	V_{PW} = 0 V	– 0.3 to + 18	V
Load gate voltage	V_{GG}	V_{PW} = 0 V	– 0.3 to + 3	V
N-substrate-P-well voltage	NSUB-PW	V_{PW} = 0 V	– 0.3 to + 50	V
N-substrate-imaging block voltage	NSUB	ø1 to ø3, øS1 to øS3, TG1, TG2: V_{PW} = 0 V	– 0.3 to + 55	V
Horizontal clock, reset gate voltage	V_{RD}	Horizontal clock pin, øR: V_{PW} = 0	– 0.3 to + 18	V
Clock voltage		Clock pins other than listed above, V_{PW} = 0 V	–15 to + 18	V
Pin voltage		Pins other than listed above, V_{PW} = 0 V	– 0.3 to + 10	V
Operating temperature	Topr		–10 to +60	°C
Storage temperature	Tstg		–30 to +80	°C

Block Diagram



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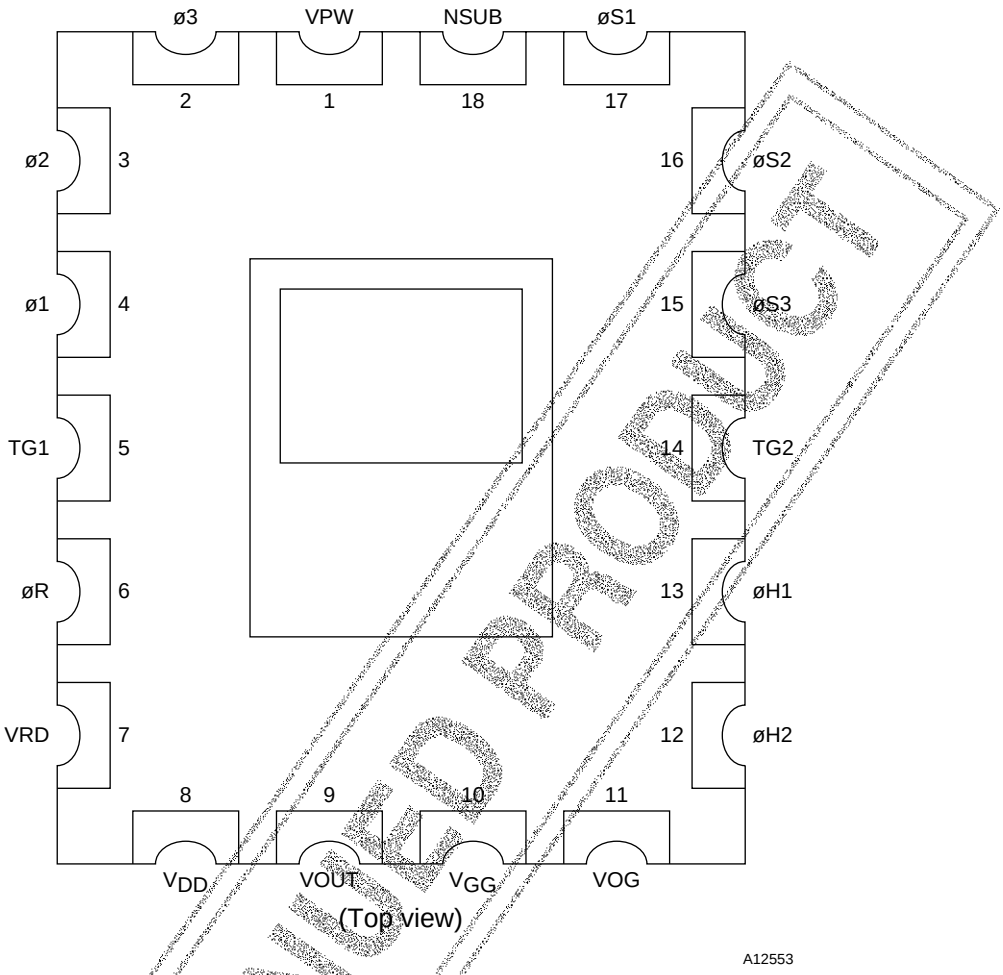
Pin Assignment



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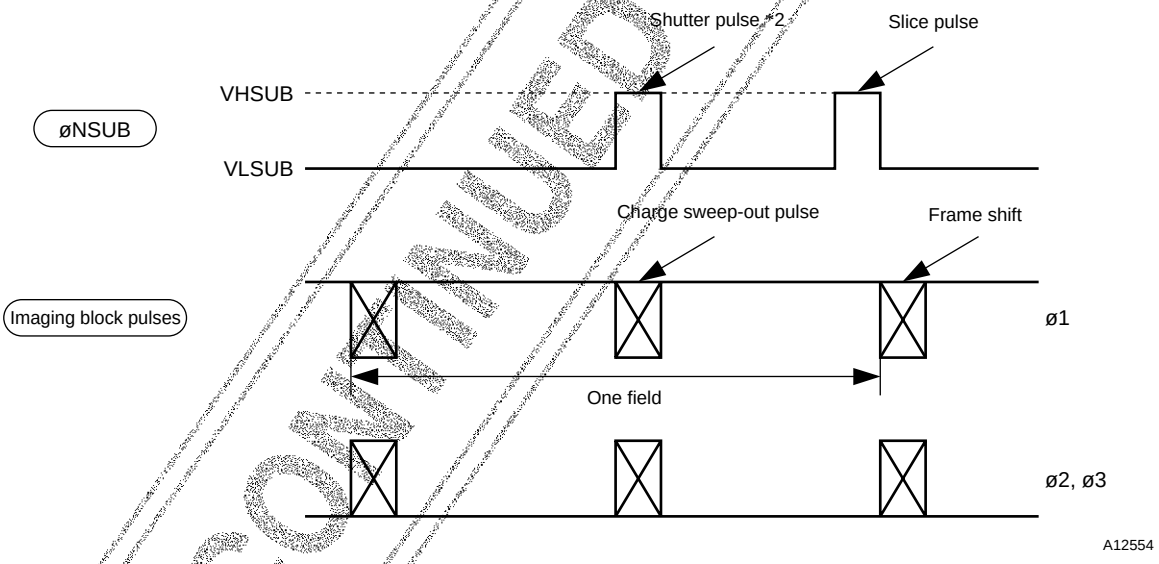
Pin Description

Pin No.	Symbol	Pin Description
1	V_{PW}	P well
2	ø3	Imaging block clock
3	ø2	
4	ø1	
5	TG1	Transfer gate
6	øR	Reset gate
7	V_{RD}	Reset drain
8	V_{DD}	Supply voltage
9	V_{OUT}	CCD output
18	NSUB	N substrate
17	øS1	Storage block clock
16	øS2	
15	øS3	
14	TG2	Transfer gate
13	øH1	Horizontal block clock
12	øH2	
11	V_{OG}	CCD output gate
10	V_{GG}	Load gate

Clock Voltage Conditions when the LC89902V CCD driver is used

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Imaging block pulses: ø1, ø2, ø3						
High level	V_{PIF}		4.5	5.0	5.5	V
Low level	V_{LIF}		–11.0	–10.5	–10.0	V
Storage block pulses: øS1, øS2, øS3						
High level	V_{PSL}		4.5	5.0	5.5	V
Low level	V_{LSL}		–11.0	–10.5	–10.0	V
Transfer gate pulses: TG1, TG2						
Pulse amplitude	V_{PTG}		15.0	15.5	16.0	V
Low level	V_{LTG}		–7.0	–6.0	–5.0	V
Horizontal transfer pulses: øH1, øH2						
Pulse amplitude	V_{PH}		4.5	5.0	5.5	V
Low level	V_{LH}		0	0	0.5	V
Reset gate: øR						
Pulse amplitude	V_{PR}		4.5	5.0	5.5	V
Low level	V_{LR}	*1	3.5		7.5	V
Substrate pulse: øNSUB						
High level	V_{HSUB}		39.0	40.0	41.0	V
Low level	V_{LSUB}		20.0	21.0	22.0	V

Note: *1 This must be adjusted so that image deterioration does not occur.



Note: *2 If a shutter operation is performed when there is a signal in the storage block (that is, during signal readout), charge may be lost from the storage block. Therefore, applications must not perform shutter operations with this timing.

Bias Conditions

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
P well	V_{PW}			0		V
Output circuit voltage	V_{DD}	*1	14.5	15.0	15.5	V
Output circuit voltage	V_{GG}	*2	1.2	1.5	1.8	V
Reset drain	V_{RD}		12.5	13.0	13.5	V
OG bias	V_{OG}	*2	3	3.5	4	V

Notes: 1. This level must never rise above the substrate pulse low level, V_{LSUB}.
2. These input pins are high-impedance inputs.

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DC Characteristics

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
DC operating current	I_{DD}		4.5	7.0	11.0	mA

Imaging Characteristics (Storage time: 1/20 s) at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Sensitivity	S	Test procedure 1	200			mV
Image signal uniformity	VF	Test procedure 2			15	%
Saturated signal	Vsat	Test procedure 3	400			mV
Smear	SM	Test procedure 4 *		0.035		%
Dark signal	Vdark	Test procedure 5, Ta = 55°C			14	mV
γ characteristics	γ			1		—

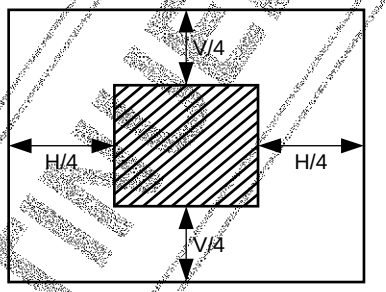
Note: * When the frame shift frequency is 3.0 MHz, and when the storage time is 1/20 s.

Test Procedures

Use the standard drive conditions (see pages 3 and 4), the Sanyo evaluation unit, and the Advantest T8331 tester for the following tests.

1. Sensitivity

   Use the CCD-SY1 (manufactured by Wakasa Optical Institute, Ltd.) as the light source, and illuminate the surface of the device to an intensity of 5 lux. Use the T8331 manufactured by Advantest to measure the CCD output from center of the screen as shown in the figure below to determine the sensitivity.



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2. Image signal uniformity

   Perform this test under the following conditions.

   • Standard drive conditions (See the device specifications.)
   • Use a Halogen lamp with a color temperature of 3200 °K as the light source.
   • Use a C-500 (1 mm thick) IR blocking filter.

   Set the CCD surface illumination to 5 lux and divide the screen into 45 blocks as shown below. Measure the average value for each block and determine the maximum, minimum, and mean values. Determine the ratio of the difference (between the maximum and the minimum values) and the mean value.

$$VF = \frac{\text{Maximum of the block averages} - \text{Minimum of the block averages}}{\text{Mean of the block averages}}$$

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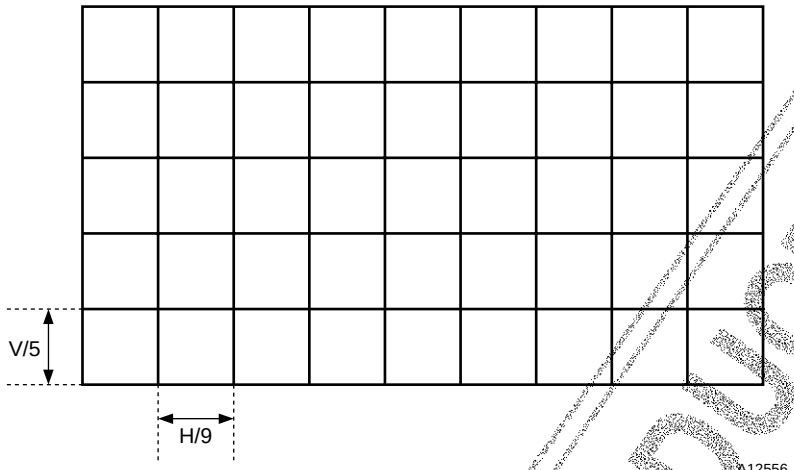
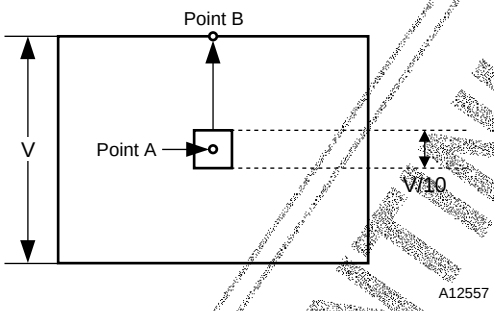


3. Saturated signal

Set up the conditions of test 1 above, but modify the illumination intensity to be 100 lux to saturate the output signal. Measure the output signal at the center of the CCD at this time.

4. Smear

- Place the 1/10-V chart described below in front of the halogen light source and image it.
- Using neutral density filters, adjust the incident illumination such that the CCD output signal at point A becomes 250 mV.
- Remove the neutral density filters and measure the value of the CCD output signal for the first line (i.e. at point B).



$$SM = \frac{VB \cdot TND}{250} \times 100\ [\%]$$

VB : The amount of smear at point B [mV]
TND: The transmittance of the neutral density filters used.

5. Dark signal

Block all light to the surface of the CCD element, and measure the CCD output signal at the center of the screen. For this measurement, do not measure the difference between the signal level and the optical black area level, but rather, read out the difference with respect to the no-signal level at a point where there is no pixel information. (See the figure.)

Structure of a Horizontal Period

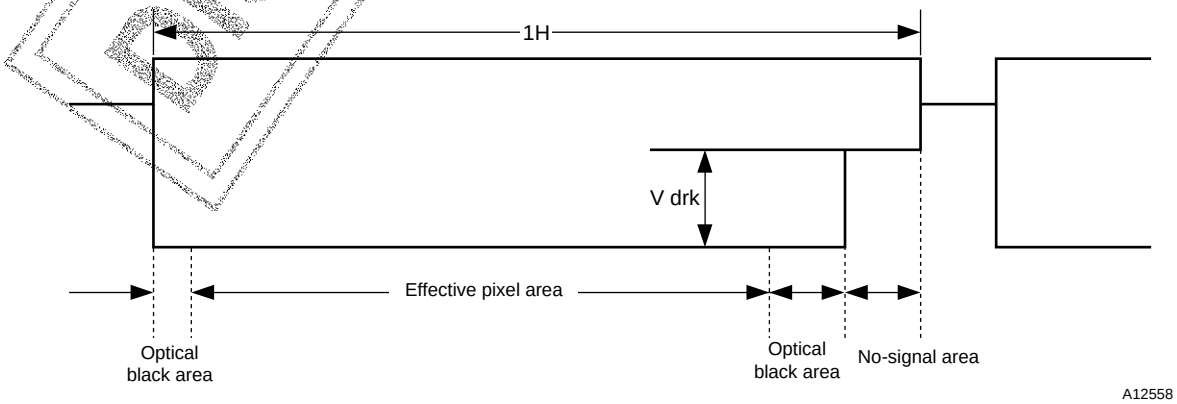


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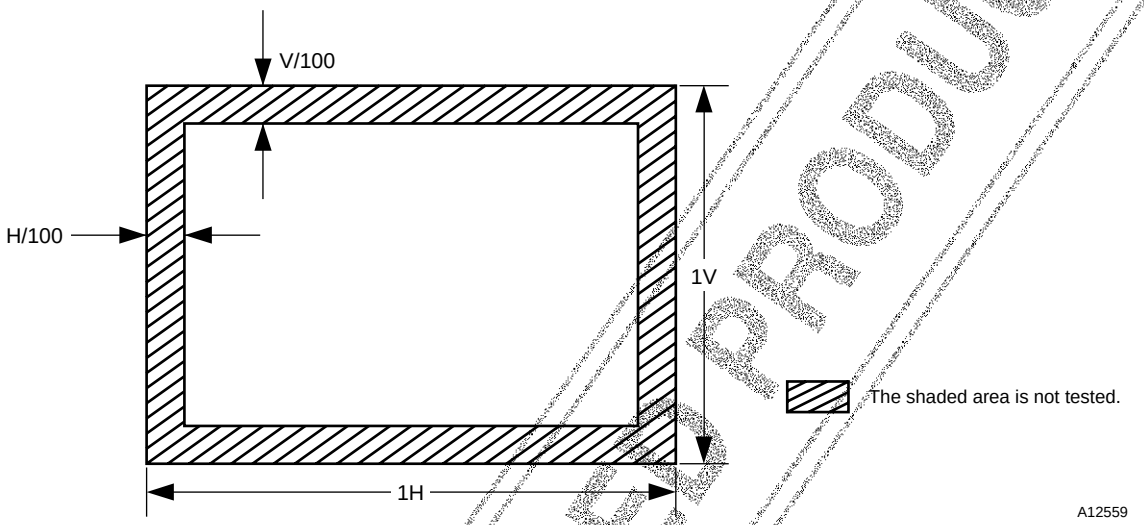
Image Defect Standards (Storage time: 1/20 s)

Test temperature	Test item	Allowable defects	Notes
55°C	White defects	No more than 5 per zone	1
		No white defects that cover 2 or more pixels in the horizontal direction or 2 or more lines in the vertical direction.	
25°C	Black defects	No more than 10 per zone	2
		No black defects that cover 3 or more pixels in the horizontal direction or 3 or more lines in the vertical direction.	

Test Conditions

Defect position are classified on the monitor as shown below.



Notes

- A white defect is a pixel with a level 30 mV or more higher than the CCD output optical black area for a black image. The CCD device is defective if any such level is 60 mV or more above the optical black level.
- A black defect is a pixel with a level that is 10% or more below the level when the CCD is illuminated evenly at an intensity such that the output level is 400 mV.

Notes on Handling and Mounting

1. ESD Prevention

This CCD image sensor is easily damaged by ESD (electrostatic discharge). The following ESD prevention measures must be taken when handling this device.

- All personnel and all equipment must be grounded when handling this CCD device. For safety, personnel should be grounded through a resistor of about 1 MΩ connected in series. (We recommend using wrist straps.)
- This device should be handled with either bare hands or antistatic gloves. Personnel should wear antistatic clothing. Conductive shoes must be worn.
- Spread conductive mats on floors and benches in the work areas to prevent static charges from accumulating.
- We recommend using ionized air blowers to minimize static charges in areas where CCD sensors are handled.
- Antistatic boxes must be used for transporting substrate mounting materials.
- Packing materials, boxes, and other items made from plastics, such as styrofoam, that easily accumulate static charges must not be placed on tables where CCD sensors are handled or in the vicinity of CCD handling operations.
- Tools, including testers, conveyors, and soldering irons, used in operations on CCD sensors must be grounded. Furthermore, the quality of that grounding must be tested periodically.
- Do not handle this IC in the vicinity of TV monitors or other devices that generate high static charges. If unavoidable, apply antistatic measures, such as covering the TV monitor screen with an antistatic filter.
- Since static charges accumulate more easily at a low relative humidity, the work environment must be maintained at a relative humidity of 50% or higher.

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2. Soldering

- The package temperature must never exceed 80°C.
- In addition to ESD, CCD sensors are easily damaged by thermal stress. When mounting on a printed circuit board, the soldering iron temperature must never exceed 300°C, and the soldering time for each pin should be not exceed 3 seconds.
- Only use soldering irons that include a (grounded) temperature controller that holds the soldering tip at a fixed temperature.
- Be especially careful to avoid heating the device to over 80°C when repairing solder joints by hand and when removing CCD sensors from printed circuit boards.
- Do not allow solder flux to get onto the glass surface.
- Never immerse a CCD sensor in solvent, and never use ultrasonic cleaning.

3. Debris and Contamination

- Only handle CCD sensors in a clean location.
- Do not touch the package surface with bare hands. Do not allow pairs of CCDs to come in contact with each other, and do not allow any other object, including jigs and other CCD packages, to come in contact with the glass surface of the CCD package. If any foreign matter gets onto the glass surface, remove it with an air blower. (We recommend using an ionized air blower if possible.)
- Remove oil or grease contamination from the CCD package glass surface with a cotton swab dipped in ethyl alcohol. Be careful not to damage the glass surface.
- To prevent foreign matter and contamination from occurring, use dedicated cases to hold the CCD sensors, and also equalize temperatures gradually when moving CCD sensors between rooms with radical temperature differences to prevent condensation.
- Do not allow sharp or pointed objects to hit the glass surface or the vicinity of the glass surface on a CCD sensor.

4. Protective sheet

- Use the following ESD prevention measures when removing the protective sheet.
  — Grounded wrist straps must be worn by all personnel.
  — Install ionized air blowers at the stage in the manufacturing process where the tape is removed.
- Do not touch the outer surface of the protective sheet.
- Do not reuse a protective sheet once it has been removed from a device.

5. Storage

- Do not leave CCDs exposed to strong light, such as direct sunlight, for extended periods.
- Since high temperatures and high humidity can degrade device characteristics, avoid storing or using these devices in such environments. The temperature and humidity of locations used to store samples must always be within normal ranges (5 to 30°C and 45 to 75% RH).
- Since CCD sensors are precision optical instruments, be extremely careful not to drop or otherwise apply mechanical shocks to these devices.
- Avoid locations with high dust levels or where corrosive gases could be present.
- Avoid locations subject to rapid temperature changes.
- Do not stack heavy objects on top of containers holding CCD sensors during storage.
- Containers used to hold sample must be made from materials with good antistatic properties.

6. Notes on Mounting

- Use of lenses with optical sizes in excess of 1/4 inch can lead to flare. Consult your Sanyo representative when selecting lenses for use with this product.
- The CCD element used in this device is extremely sensitive to temperature. As the temperature rises, the dark current increases and noise becomes prominent. In particular, the device characteristics degrade rapidly if the operating or storage temperature is exceeded.

  Also, when used under the recommended operating conditions, although the heat generated by the sensor itself is not particularly high, the device may be influenced by heat generated by the surrounding ICs. Use great care in end product thermal design, in particular with respect to the layout of components, the printed circuit board, and the case.

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7. Transport

- Do not throw or drop packages containing CCD sensors.
- Protect CCD sensors from moisture when transporting during rain or snow.
- Minimize mechanical vibration and shock as much as possible when transporting CCD sensors.

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