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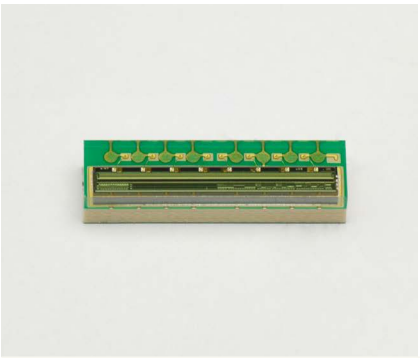
CMOS linear image sensor



S10226-10

Small, resin-sealed CMOS image sensor

The S10226-10 is a resin-sealed CMOS linear image sensor to offer compact size and high cost-performance compared to our previous product (S9226 series).

Features

- **Compact and high cost-performance**
  Surface mount type package: 2.4 × 9.1 × 1.6[t] mm
- **Pixel pitch: 7.8 µm**
  Pixel height: 125 µm
- **1024 pixels**
- **Single 3.3 V power supply operation**
- **High sensitivity, low dark current, low noise**
- **On-chip charge amplifier with excellent input/output characteristics**
- **Built-in timing generator allows operation with only Start and Clock pulse inputs.**
- **Video data rate: 200 kHz max.**
- **Spectral response range: 400 to 1000 nm**

Applications

- **Barcode readers**
- **Displacement meters**
- **Refractometers**
- **Interferometers**
- **Miniature spectrometers**

Structure

Parameter	Specification	Unit
Number of pixels	1024	-
Pixel pitch	7.8	µm
Pixel height	125	µm
Photosensitive area length	7.9872	mm
Package	Glass epoxy	-
Seal material	Silicone resin	-

Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vdd	Ta=25 °C	-0.3 to +6	V
Gain selection terminal voltage	Vg	Ta=25 °C	-0.3 to +6	V
Clock pulse voltage	V(CLK)	Ta=25 °C	-0.3 to +6	V
Start pulse voltage	V(ST)	Ta=25 °C	-0.3 to +6	V
Operating temperature	Topr	No dew condensation*1	-40 to +85	°C
Storage temperature	Tstg	No dew condensation*1	-40 to +85	°C
Soldering temperature*2	Tsol		260 (3 times)	°C

*1: When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.
*2: Reflow soldering, IPC/JEDEC J-STD-020 MSL2a, see P.9
Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

Recommended terminal voltage (Ta=25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		Vdd	3.3	5	5.25	V
Gain selection terminal voltage	High gain	Vg	0	-	0.4	V
	Low gain		Vdd - 0.25	Vdd	Vdd + 0.25	V
Clock pulse voltage	High level	V(CLK)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	V
Start pulse voltage	High level	V(ST)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	V

Electrical characteristics [Ta=25 °C, Vdd=5 V, V(CLK)=V(ST)=5 V]

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency		f(CLK)	100	-	800	kHz
Data rate		DR	-	f(CLK)/4	-	kHz
Current consumption	Vdd=5 V	Ic	-	5	8	mA
	Vdd=3.3 V		-	4.5	7	
Conversion efficiency	High gain	CE	-	3.2	-	μV/e⁻
	Low gain		-	1.6	-	

Electrical and optical characteristics [Ta=25 °C, f(CLK)=800 kHz, Vdd=5 V: V(CLK)=V(ST)=5 V, Vdd=3.3 V: V(CLK)=V(ST)=3.3 V]

Parameter			Symbol	Min.	Typ.	Max.	Unit
Spectral response range			λ		400 to 1000		nm
Peak sensitivity wavelength			λp	-	700	-	nm
Dark output voltage*3	Vdd=5 V	High gain	VD	-	0.3	8	mV
		Low gain		-	0.15	4	
	Vdd=3.3 V	High gain		-	0.2	5	
		Low gain		-	0.1	2.5	
Saturation output voltage*4		Vdd=5 V	Vsat	2.6	3.2	-	V
		Vdd=3.3 V		1.4	2.0	-	
Readout noise		High gain	Nread	-	1.4	2.2	mV rms
		Low gain		-	0.7	1.1	
Output offset voltage			Voffset	0.2	0.35	0.6	V
Photoresponse nonuniformity*5 *6			PRNU	-	-	±8.5	%

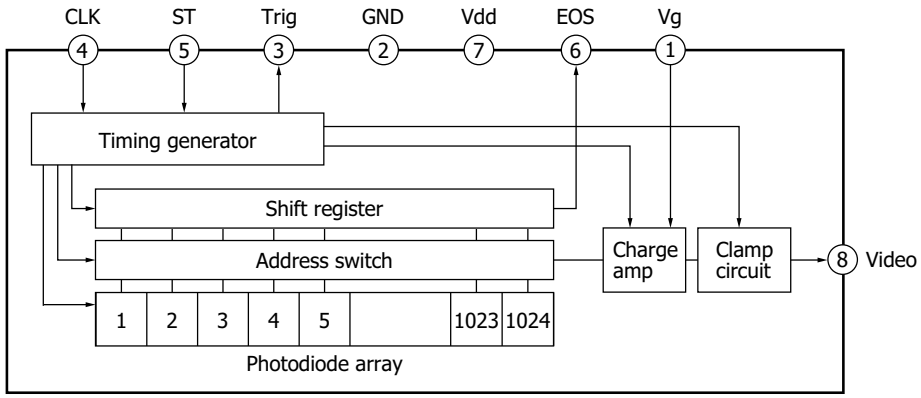
*3: Integration time=10 ms

*4: Voltage difference from Voffset

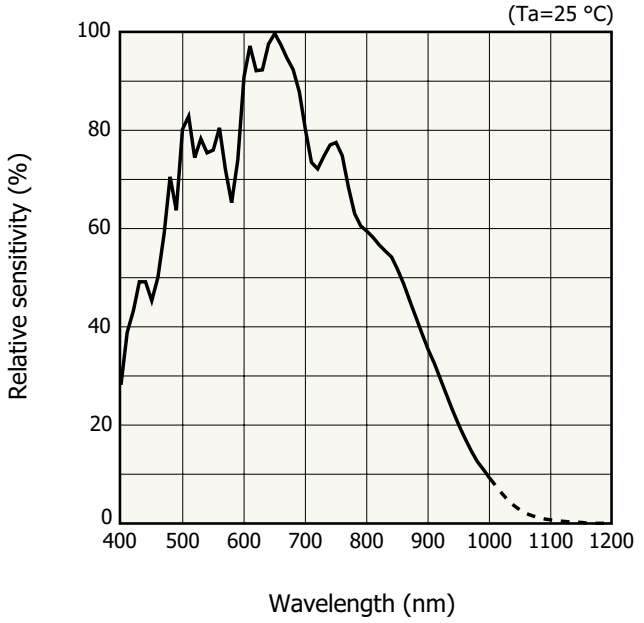
*5: Photoresponse nonuniformity (PRNU) is the output nonuniformity that occurs when the entire photosensitive area is uniformly illuminated by light which is 50% of the saturation exposure level. PRNU is measured using 1022 pixels excluding the pixels at both ends, and is defined as follows:
PRNU= ΔX/X × 100 (%)
X: average output of 1022 pixels excluding the pixels at both ends, ΔX: difference between X and maximum or minimum output

*6: Measured with a tungsten lamp of 2856 K

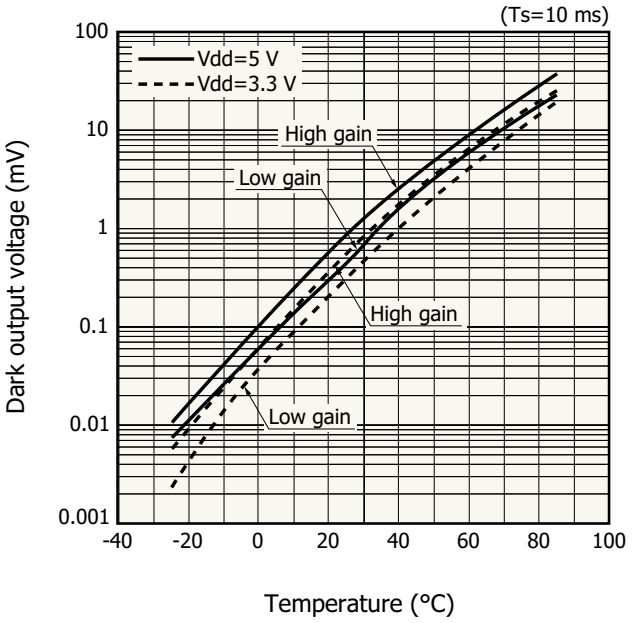
Block diagram



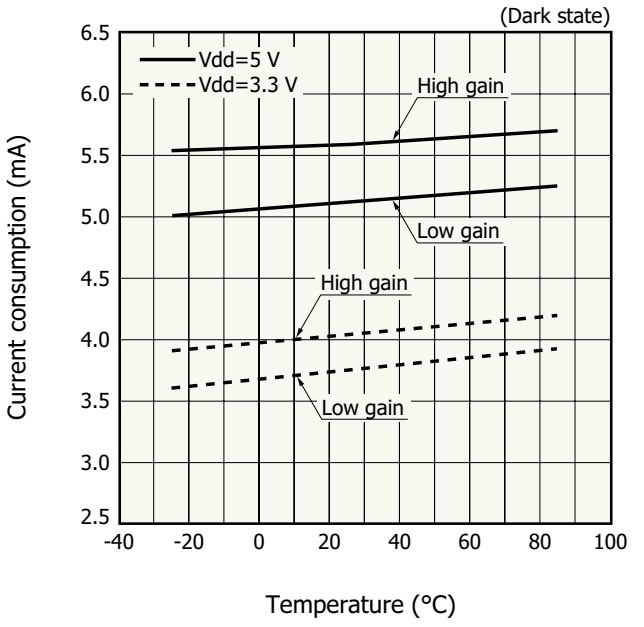
Spectral response (typical example)



Dark output voltage vs. temperature (typical example)



Current consumption vs. temperature (typical example)

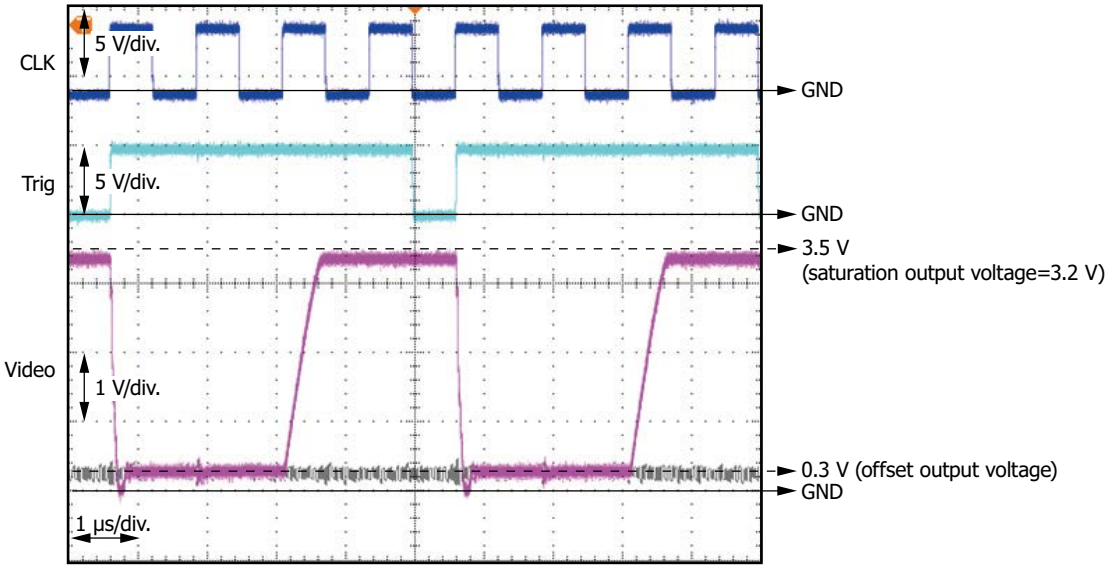


Output waveform of one element

High gain

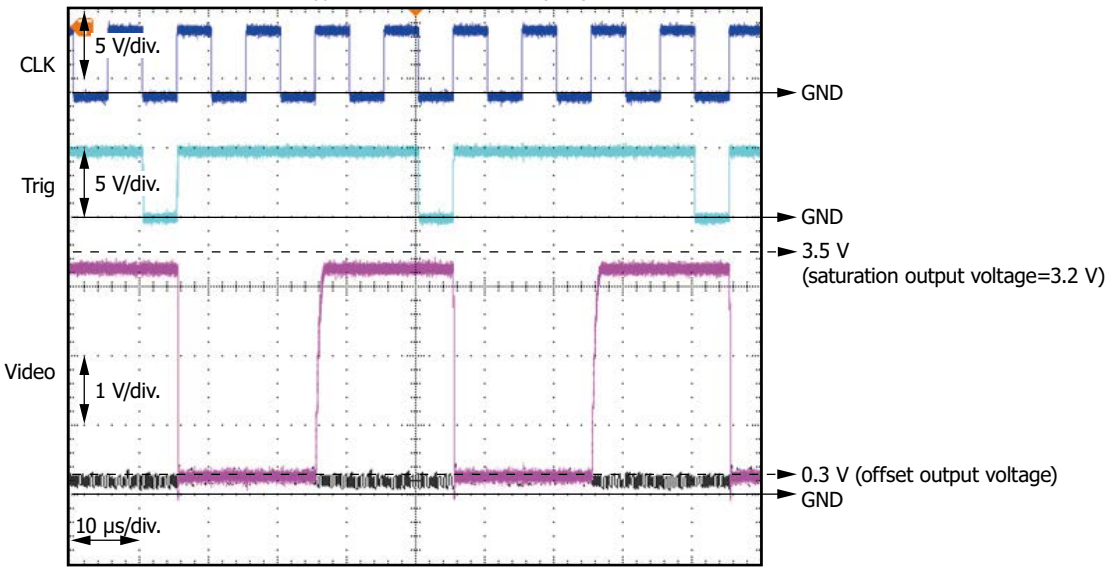
■ f(CLK)=4 × DR=800 kHz

[Typ. Ta=25 °C, Vdd=5 V, f(CLK)=4 × DR=800 kHz]



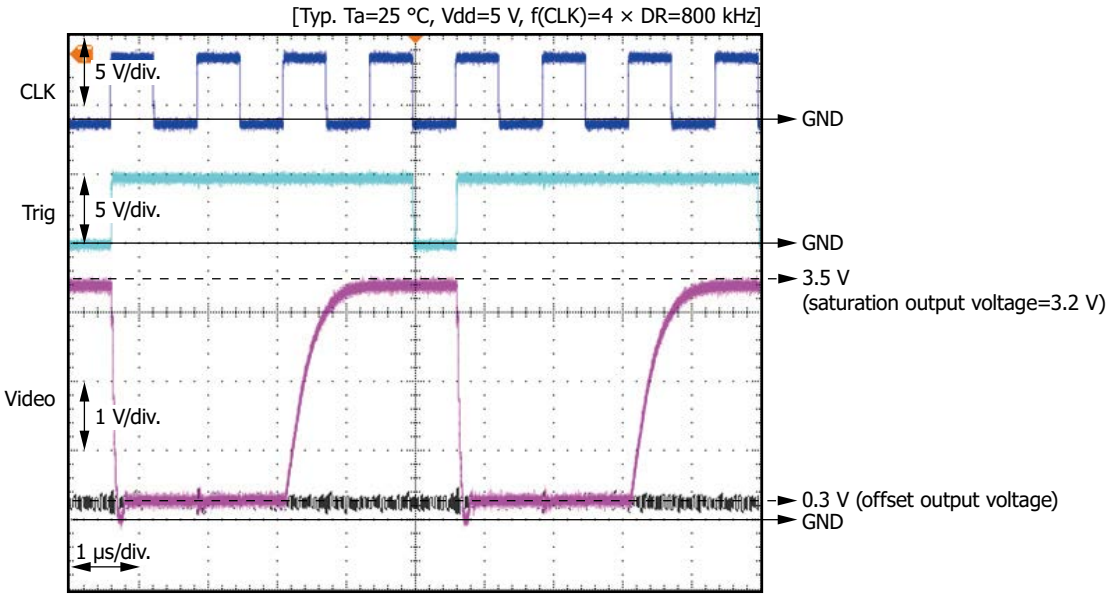
■ f(CLK)=4 × DR=100 kHz

[Typ. Ta=25 °C, Vdd=5 V, f(CLK)=4 × DR=100 kHz]

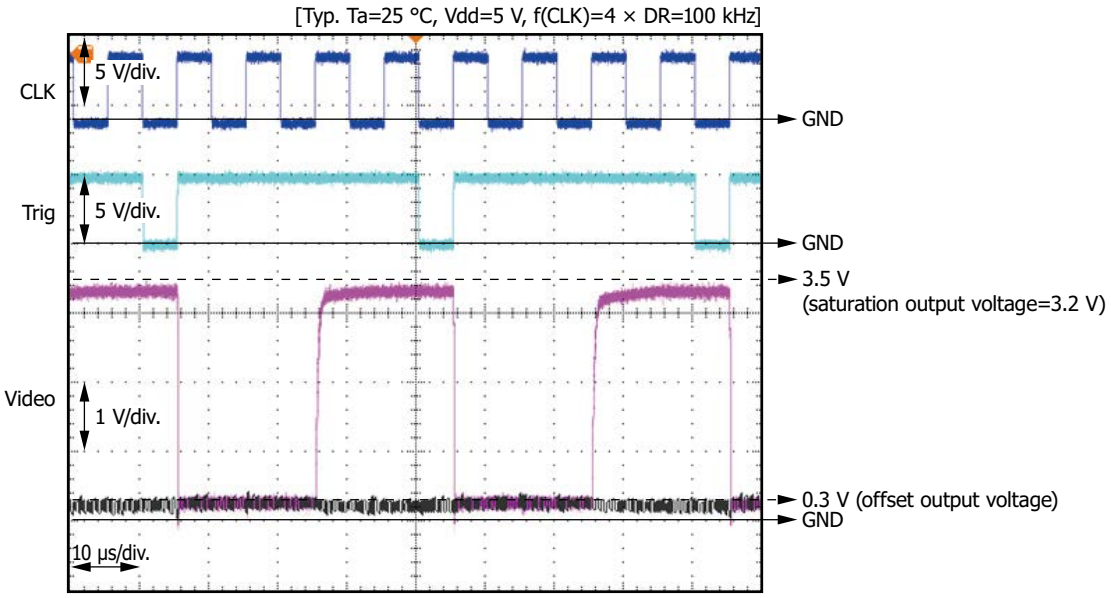


Low gain

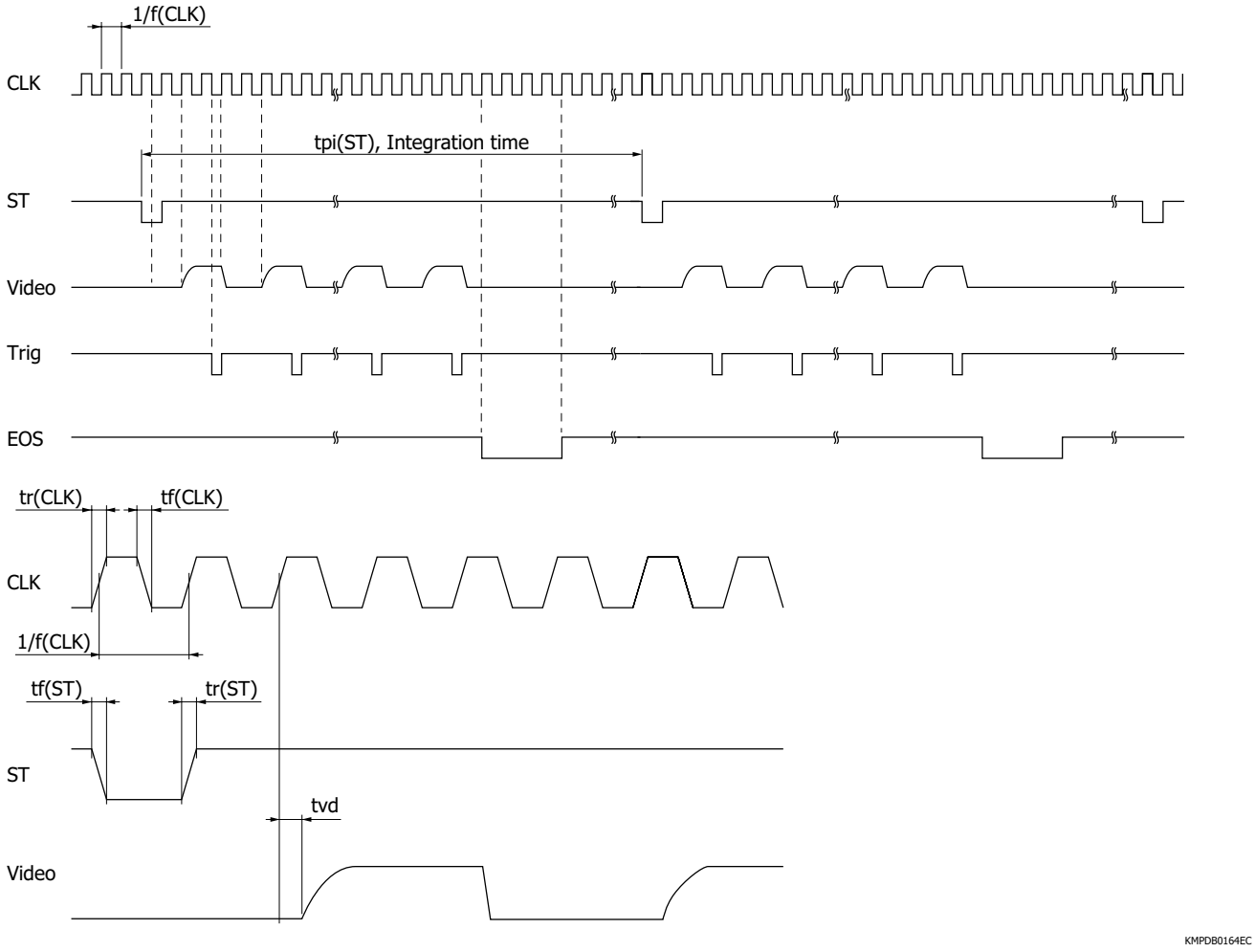
■ f(CLK)=4 × DR=800 kHz



■ f(CLK)=4 × DR=100 kHz



Timing chart

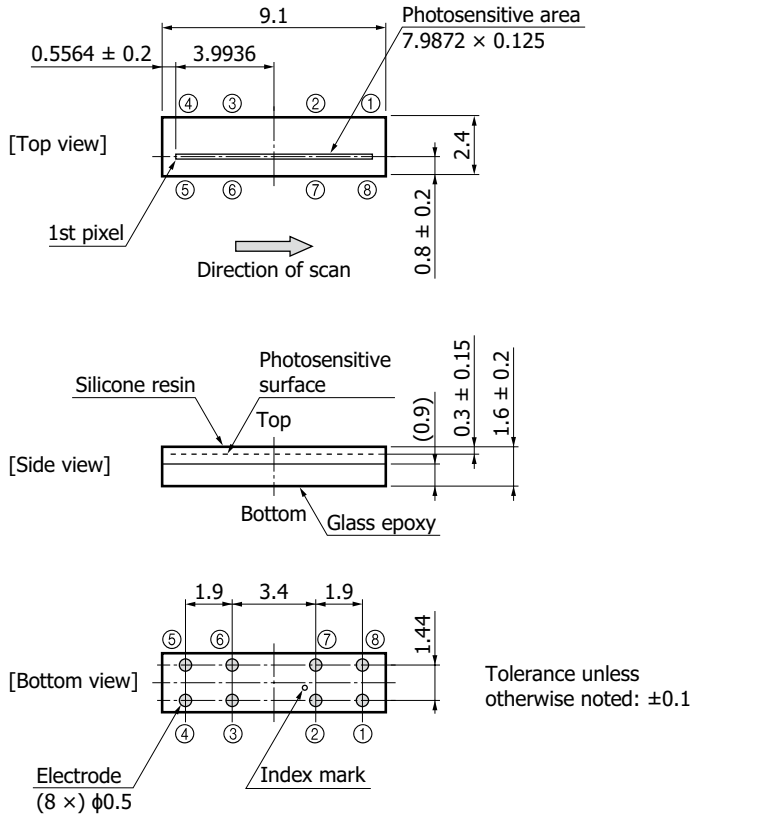


Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse interval	tpi(ST)	4104/f(CLK)	-	-	s
Start pulse rise and fall times	tr(ST), tf(ST)	0	20	30	ns
Clock pulse duty ratio	-	40	50	60	%
Clock pulse rise and fall times	tr(CLK), tf(CLK)	0	20	30	ns
Video delay time*7	tvd	10	20	30	ns

*7: Ta=25 °C, Vdd=5 V, V(CLK)=V(ST)=5 V

Note: The CLK pulse should be set from high to low just once when the ST pulse is low. The internal shift register starts operating at this timing.
The storage time is determined by the start pulse intervals. However, since the charge storage of each pixel is carried out between the signal readout of that pixel and the next signal readout of the same pixel, the start time of charge storage differs depending on each pixel. In addition, the next start pulse cannot be input until signal readout from all pixels is completed.

Dimensional outline (unit: mm)



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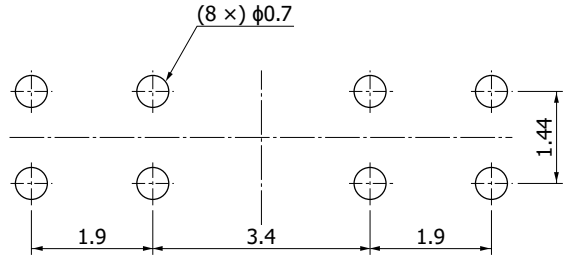
Pin connections

Pin no.	Name	I/O	Description
1	Vg	I	Gain selection; low gain: Vdd or open, high gain: GND
2	GND	-	Ground
3	Trig	O	Trigger: timing signal output for A/D converter
4	CLK	I	Clock pulse (pulse for synchronizing the internally generated pulses that control sensor operation frequency)
5	ST	I	Start pulse (pulse for initializing the internally generated pulses that set the timing to start reading pixel signals)
6	EOS	O	End of scan (shift register end-of-scan signal pulse generated after reading signals from all pixels)
7	Vdd	I	Power supply voltage
8	Video	O	Video signal output*8

*8: Connect a buffer amplifier for impedance conversion to the video output terminal so as to minimize the current flow. As the buffer amplifier, use a high input impedance operational amplifier with JFET or CMOS input.

Recommended land pattern (unit: mm)



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Appearance inspection standards

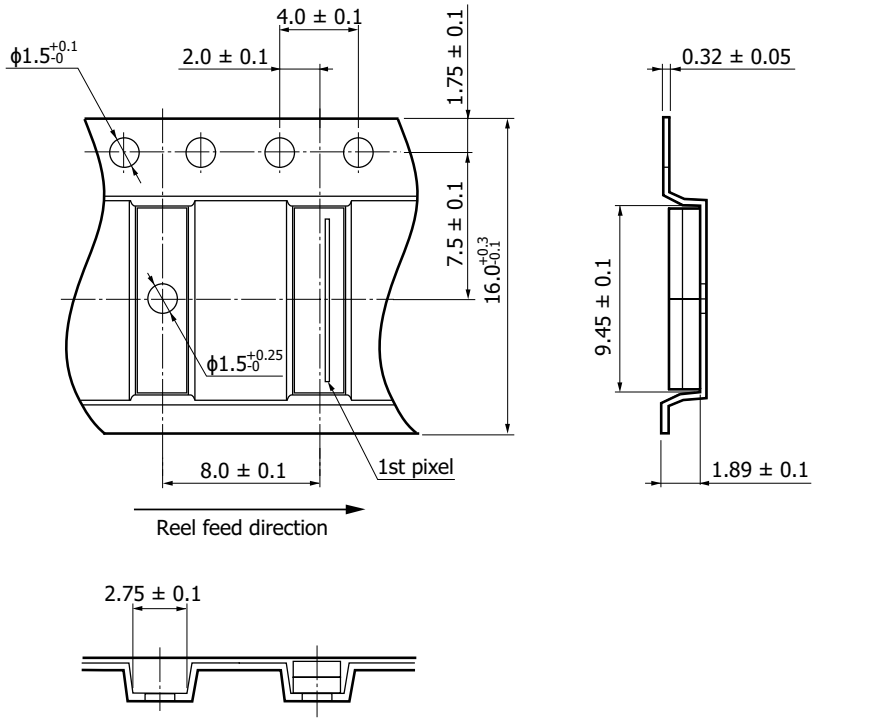
Parameter	Test criterion	Inspection method
Foreign matter on photosensitive area	10 µm max.	Automated camera

Standard packing specifications

■ Reel (conforms to JEITA ET-7200)

Dimensions	Hub diameter	Tape width	Material	Electrostatic characteristic
330 mm	100 mm	16 mm	PPE	Conductive

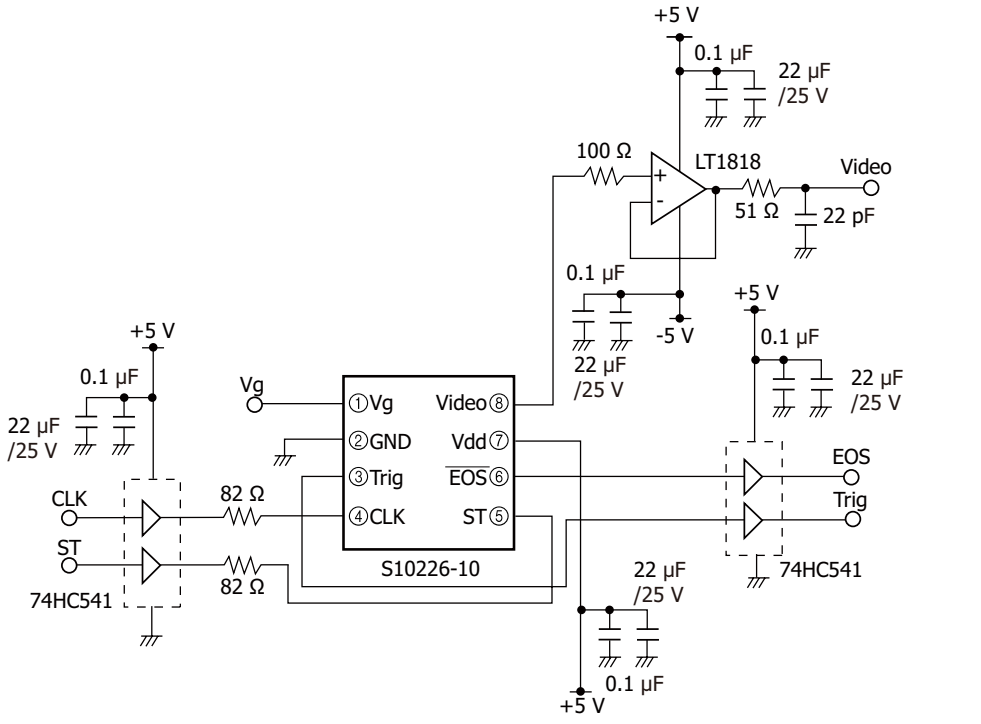
■ Embossed tape (unit: mm, material: polycarbonete resin, conductive)



■ Packing quantity
2000 pcs/reel

■ Packing type
Reel and desiccant in moisture-proof packing (vaccum-sealed)

Application circuit example



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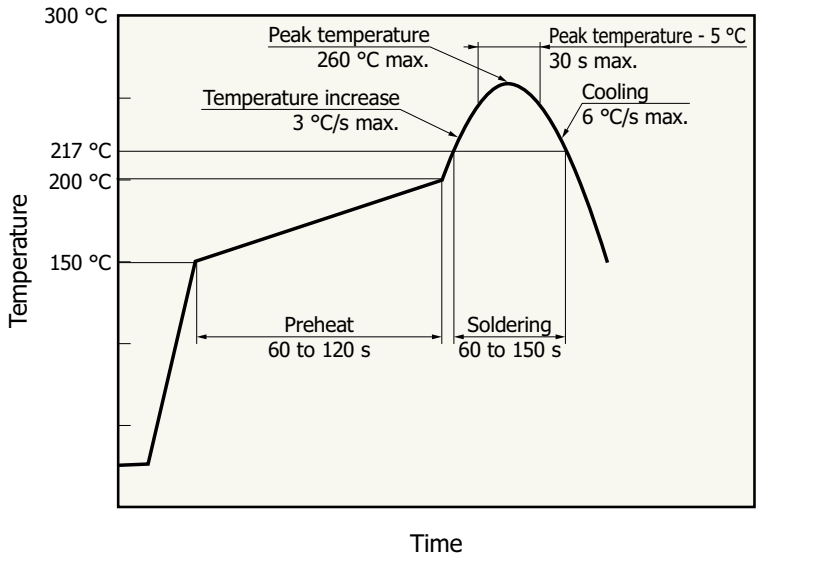
Recommended reflow soldering conditions (typical example)



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- This product supports lead-free soldering. After unpacking, store it in an environment at a temperature of 30 °C or less and a humidity of 60% or less, and perform soldering within 4 weeks.
- The effect that the product receives during reflow soldering varies depending on the circuit board and reflow oven that are used. Before actual reflow soldering, check for any problems by tesitng out the reflow soldering methods in advance.
- For the baking method, see the related information "Resin sealed type CMOS linear image sensor / Precautions."

Precautions

(1) Electrostatic countermeasures

· This device has a built-in protection circuit as a safeguard against static electrical charges. However, to prevent destroying the device with electrostatic charges, take countermeasures such as grounding yourself, the workbench and tools.

· Protect this device from surge voltages which might be caused by peripheral equipment.

(2) Package handling

· The photosensitive area of this device is sealed and protected by transparent resin. When compared to a glass faceplate, the surface of transparent resin may be less uniform and is more likely to be scratched. Be very careful when handling this device and also when designing the optical systems.

· Dust or grime on the light input window might cause nonuniform sensitivity. To remove dust or grime, blow it off with compressed air.

(3) Surface protective tape

· Protective tape is affixed to the surface of this product to protect the photosensitive area. After assembling the product, remove the tape before use.

(4) Operating and storage environments

· Handle the device within the temperature range specified in the absolute maximum ratings. Operating or storing the device at an excessively high temperature and humidity may cause variations in performance characteristics and must be avoided.

(5) UV exposure

· This product is not designed to prevent deterioration of characteristics caused by UV exposure, so do not expose it to UV light.

Related information

www.hamamatsu.com/sp/ssd/doc_en.html

■ Precautions

· Disclaimer

· Image sensors

· Resin-sealed CMOS linear image sensors

■ Technical information

· CMOS linear image sensors

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