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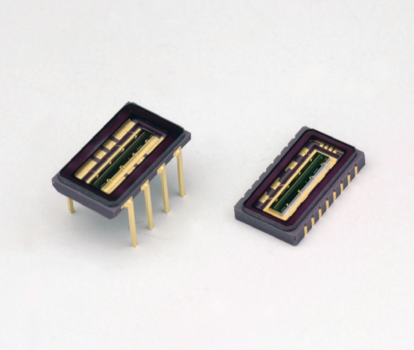


CMOS linear image sensors

S9226 series

Built-in timing generator and signal processing circuit

The S9226 series is a small CMOS linear image sensor designed for image input applications. The signal processing circuit has a charge amplifier with excellent input/output characteristics. Two package styles are provided: a DIP type and a surface mount type.

Features

- **Pixel pitch: 7.8 µm**
  Pixel height: 125 µm
- **1024 pixels**
- **3.3 V single power supply operation available**
- **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**
- **Two package styles are provided:**
  DIP (dual inline package) type: S9226-03
  Surface mount type: S9226-04

Applications

- **Analytical instruments**
- **Position detection**
- **Image reading**

Structure

Parameter	S9226-03	S9226-04	Unit
Number of pixels	1024		-
Pixel pitch	7.8		µm
Pixel height	125		µm
Photosensitive area length	7.9872		mm
Package	Ceramic		-
Window material	Borosilicate glass		-

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	-5 to +60	°C
Storage temperature	Tstg	No dew condensation*1	-10 to +70	°C
Reflow soldering condition*2	Tsol	JEDEC MSL 5	Peak temperature: 240 °C, 2 times (See P.9)	-

*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: S9226-04
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	-	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	-	V
Start pulse voltage	High level	V(ST)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		-	0	-	V

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

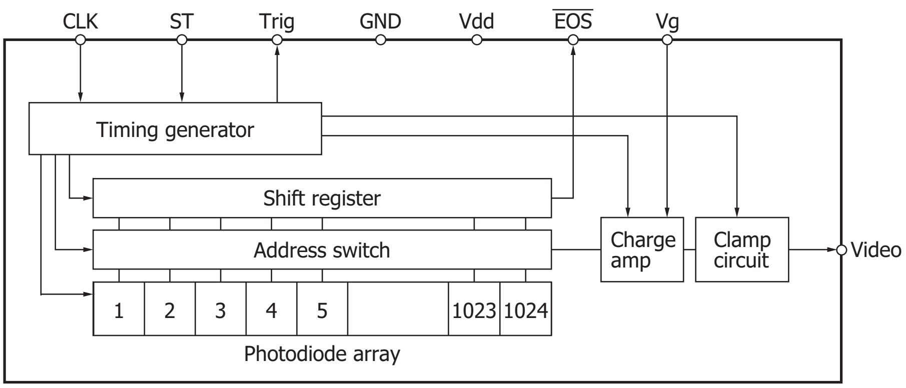
Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency		f(CLK)	10	-	800	kHz
Data rate		DR	-	f(CLK)/4	-	kHz
Current consumption		Ic	4	6	8	mA
Conversion efficiency	High gain	CE	-	3.2	-	µV/e-
	Low gain		-	1.6	-	
Output impedance		Zo	-	185	-	Ω

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

Parameter		Symbol	Min.	Typ.	Max.	Unit
Spectral response range		λ		400 to 1000		nm
Peak sensitivity wavelength		λp	-	650	-	nm
Dark current		ID	-	5	50	fA
Dark output voltage*3	High gain	VD	-	0.8	8	mV
	Low gain		-	0.4	4	
Saturation output voltage*4		Vsat	2.2	3.2	-	V
Readout noise	High gain	Nread	-	1.4	2.2	mV rms
	Low gain		-	0.7	1.1	
Offset output voltage		Voffset	0.2	0.35	0.6	V
Photoresponse nonuniformity*5 *6		PRNU		-	±5	%

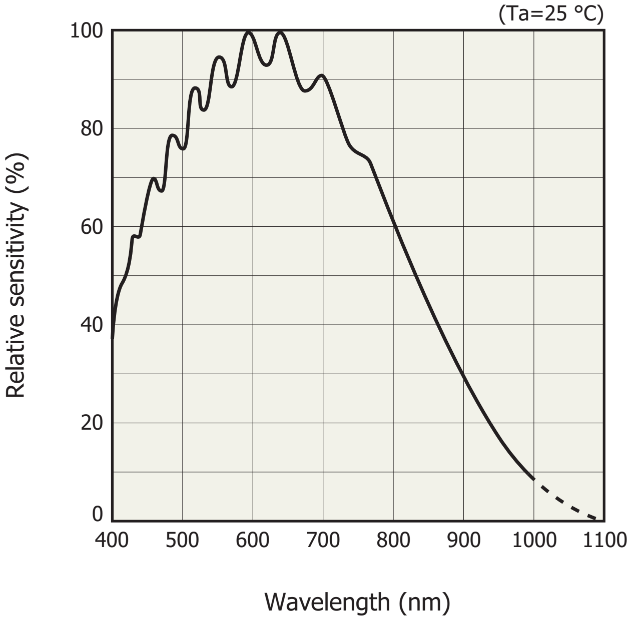
*3: Integration time=10 ms
*4: Voltage difference with respect to Voffset
*5: Photoresponse nonuniformity (PRNU) is the output nonuniformity that occurs when the entire photosensitive area is uniformly illuminated by light which is 50% of the saturation exposure level. PRNU is measured using 1022 pixels excluding the pixels at both ends, and is defined as follows:
PRNU = ΔX/X × 100 (%)
X: average output of all pixels, ΔX: difference between X and maximum or minimum output
*6: Measured with a tungsten lamp of 2856 K

Block diagram



KMPDC0165EC

Spectral response (typical example)



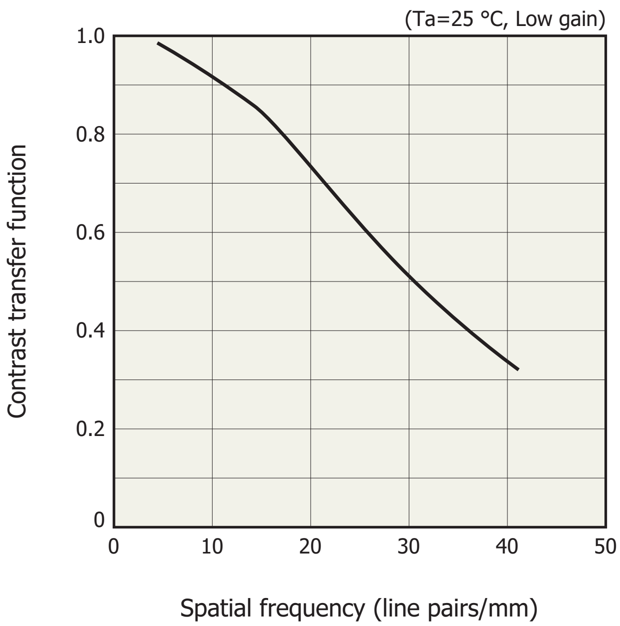
Resolution

CTF: contrast transfer function

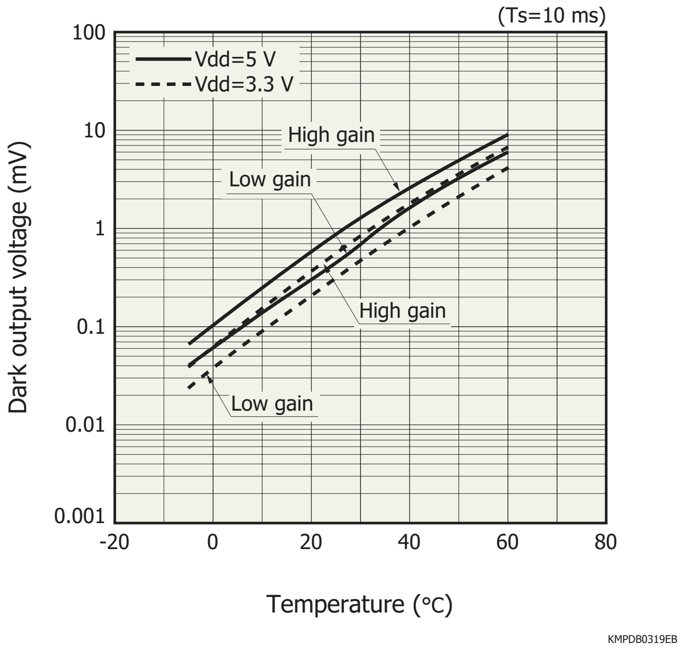
$$CTF = \frac{V_{WO} - V_{BO}}{V_W - V_B}$$

V_{WO} : output white level
V_{BO} : output black level
V_W : output white level (when input pattern pulse width is wide)
V_B : output black level (when input pattern pulse width is wide)

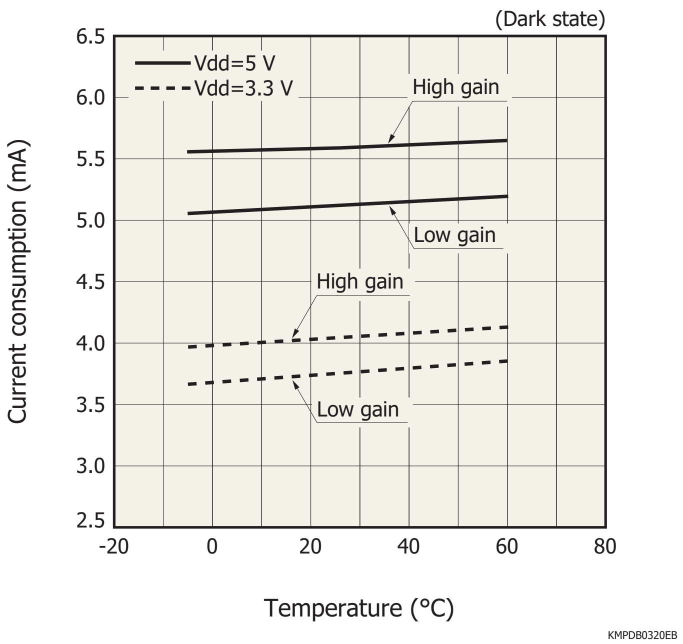
Contrast transfer function vs. spatial frequency (typical example)



Dark output voltage vs. temperature (typical example)



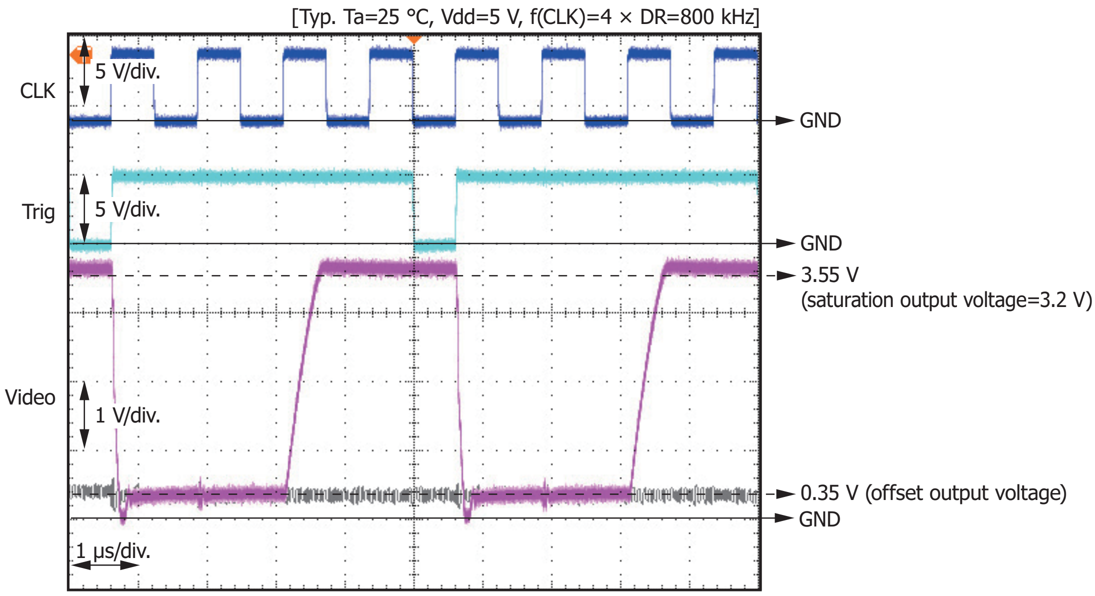
Current consumption vs. temerature (typical example)



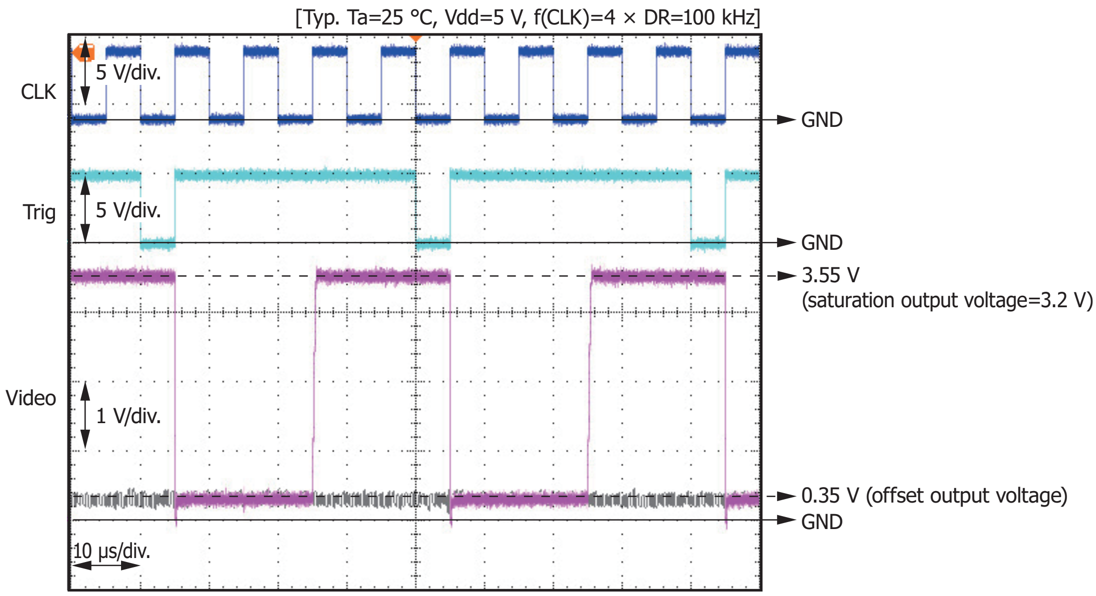
Output waveform of one element

High gain

■ f(CLK)=4 × DR=800 kHz



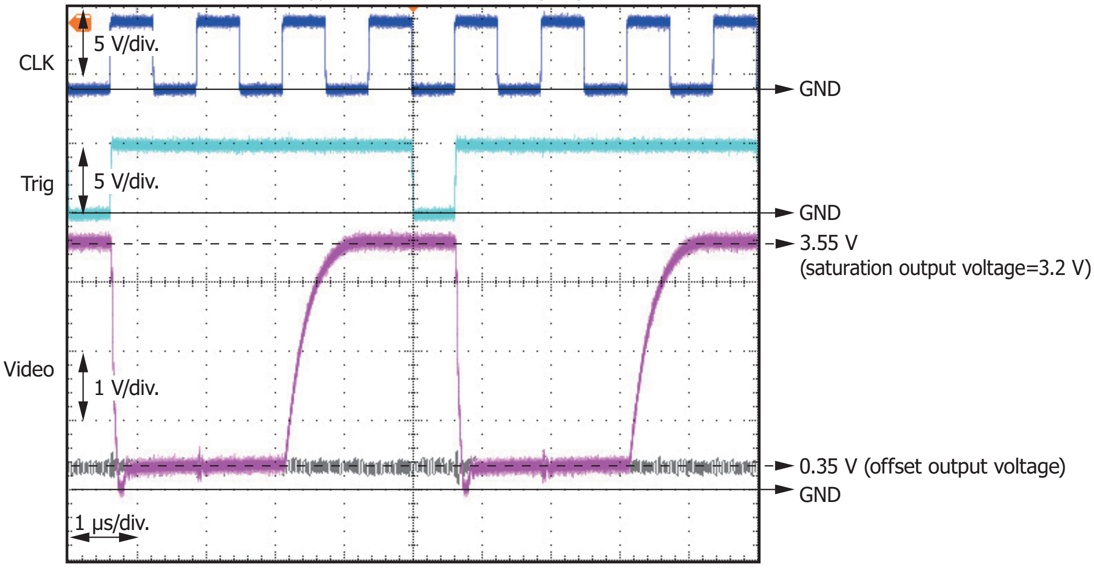
■ f(CLK)=4 × DR=100 kHz



Low gain

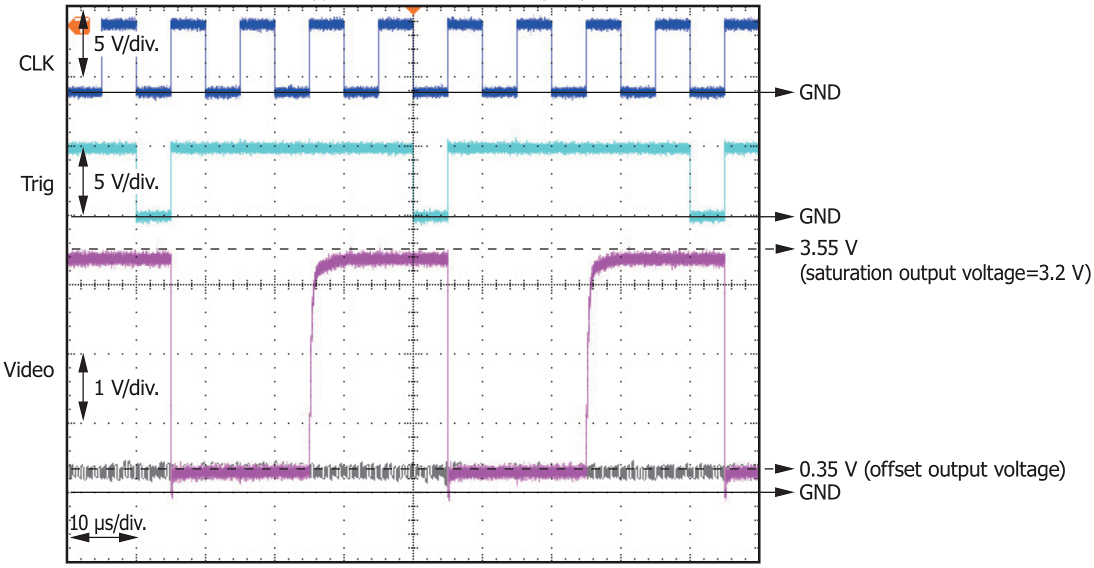
■ f(CLK)=4 × DR=800 kHz

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

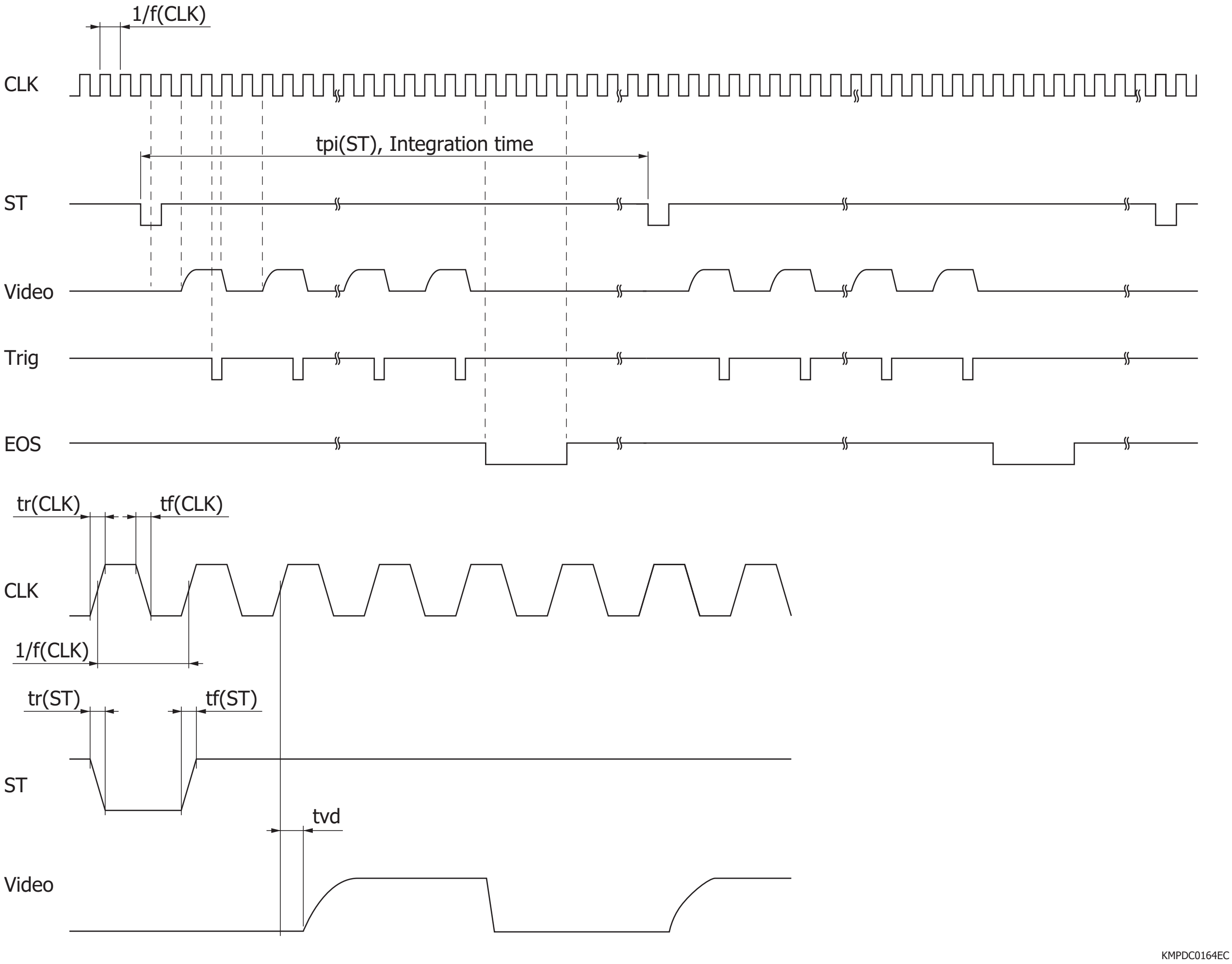


■ f(CLK)=4 × DR=100 kHz

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



Timing chart



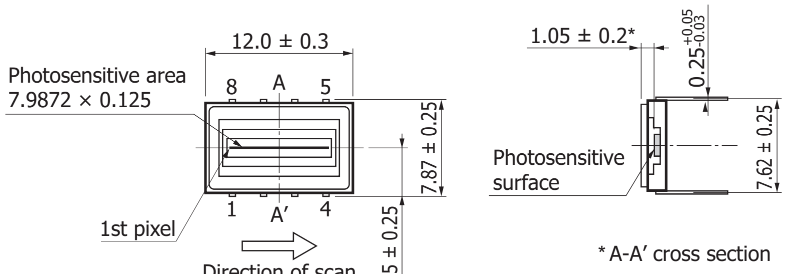
Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse cycle	tpi(ST)	4104/f(CLK)	-	-	s
Start pulse rise and fall times	tr(ST), tf(ST)	0	20	30	ns
Clock pulse duty ratio	-	40	50	60	%
Clock pulse rise and fall times	tr(CLK), tf(CLK)	0	20	30	ns
Video delay time*7	tvd	10	20	30	ns

*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 integration time is determined by the start pulse cycles. However, since the charge integration 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 integration differs depending on each pixel. In addition, the next start pulse cannot be input until signal readout from all pixels is completed.

Dimensional outlines (unit: mm)

S9226-03



* Distance from upper surface of window to photosensitive surface

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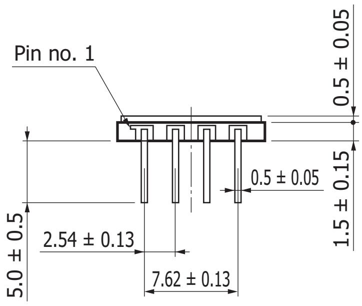
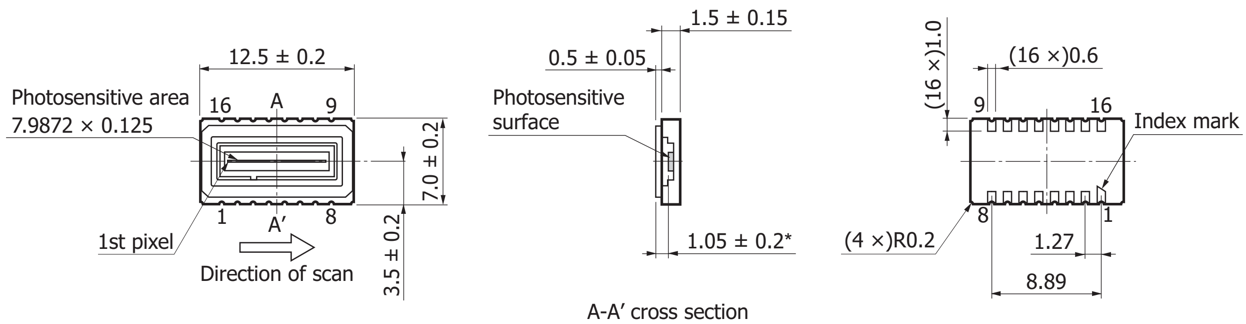


Pin no.	Symbol	Pin name	Input/Output
1	GND	Ground	Input
2	CLK	Clock pulse	Input
3	Trig	Trigger pulse	Output
4	ST	Start pulse	Input
5	Vg	Gain selection voltage	Input
6	Video	Video signal*8	Output
7	EOS	End of scan	Output
8	Vdd	Supply voltage	Input

*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.

Note: Leave the "NC" terminals open and do not connect them to GND.

S9226-04



* Distance from upper surface of window to photosensitive surface

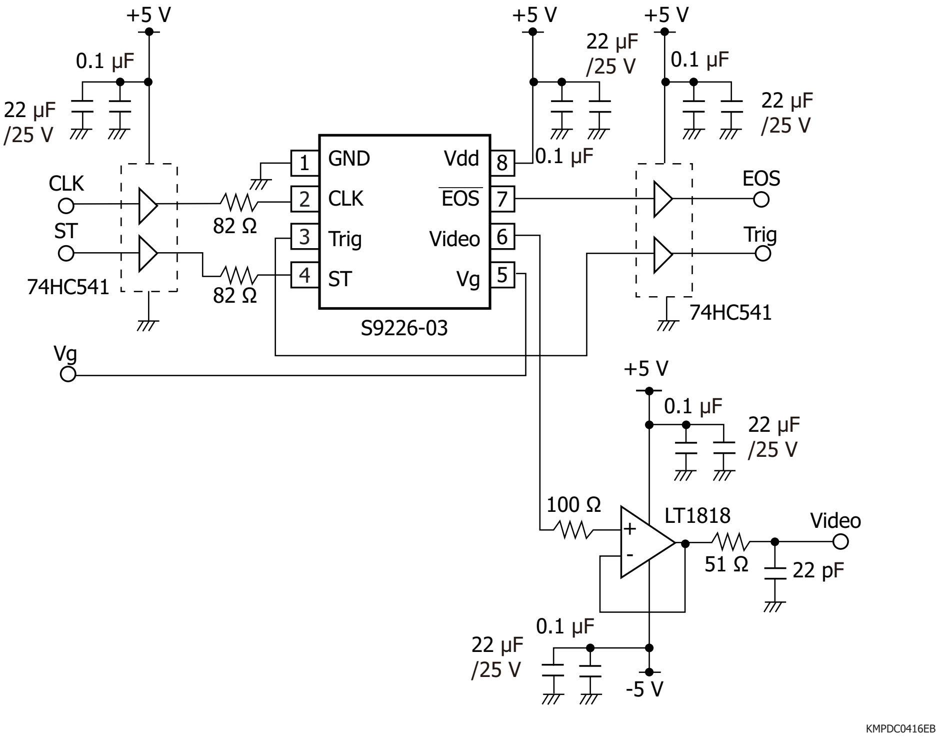
KMPDA0258ED

Pin no.	Symbol	Pin name	Input/Output	Pin no.	Symbol	Pin name	Input/Output
1	NC	No connection		9	NC	No connection	
2	NC	No connection		10	NC	No connection	
3	GND	Ground	Input	11	Vg	Gain selection voltage	Input
4	CLK	Clock pulse	Input	12	Video	Video signal*8	Output
5	Trig	Trigger pulse	Output	13	EOS	End of scan	Output
6	ST	Start pulse	Input	14	Vdd	Supply voltage	Input
7	NC	No connection		15	NC	No connection	
8	NC	No connection		16	NC	No connection	

*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.

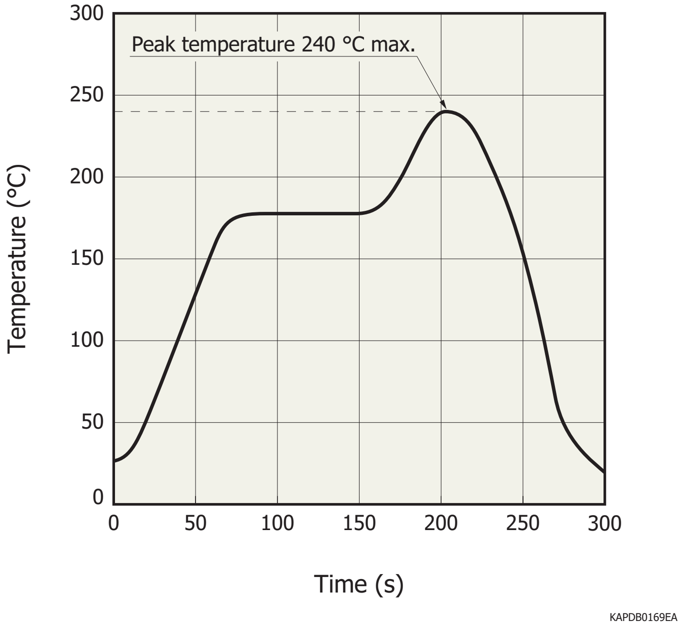
Note: Leave the "NC" terminals open and do not connect them to GND.

Application circuit example (S9226-03)*9



*9: The S9226-04 has a different pin connections, but uses the same circuit.

Recommended reflow soldering conditions (S9226-04)



- This product (S9226-04) 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 24 hours.
- 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 testing out the reflow soldering methods in advance.
- A sudden temperature rise and cooling may be the cause of trouble, so make sure that the temperature change is within 4 °C per second.
- The bonding portion between the ceramic base and the glass may discolor after reflow soldering, but this has no adverse effects on the hermetic sealing of the product.

Precautions

(1) Electrostatic countermeasures
This device has a built-in protection circuit against static electrical charges. However, to prevent destroying the device with electrostatic charges, take countermeasures such as grounding yourself, the workbench and tools to prevent static discharges. Also protect this device from surge voltages which might be caused by peripheral equipment.

(2) Light input window
If the incident window is contaminated or scratched, the output uniformity will deteriorate considerably, so care should be taken in handling the window. Avoid touching it with bare hands.
The window surface should be cleaned before using the device. If dry cloth or dry cotton swab is used to rub the window surface, static electricity may be generated, and therefore this practice should be avoided. Use soft cloth, cotton swab or soft paper moistened with ethyl alcohol to wipe off dirt and foreign matter on the window surface.

(3) Soldering
To prevent damaging the device during soldering, take precautions to prevent excessive soldering temperatures and times. Soldering should be performed within 5 seconds at a soldering temperature below 260 °C.

(4) Operating and storage environments
Always observe the rated temperature range when handling the device. 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/Precautions
· Surface mount type products/Precautions

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