

S8377/S8378 series

Built-in timing generator and signal processing circuit; 5 V single supply operation

The S8377/S8378 series is a family of CMOS linear image sensors designed for image input applications. These linear image sensors operate from 5 V single supply with only start and clock pulse inputs, making them easy to use. The signal processing circuit has a charge amplifier with excellent input/output characteristics and allows signal readout at 500 kHz. The photodiodes of the S8377 series have a height of 0.5 mm and are arrayed in a row at a spacing of 50 μm . The photodiodes of the S8378 series also have a height of 0.5 mm but are arrayed at a spacing of 25 μm . The photodiodes are available in 3 different pixel quantities for each series: 128 (S8377-128Q), 256 (S8377-256Q, S8378-256Q), 512 (S8377-512Q, S8378-512Q) and 1024 (S8378-1024Q). Quartz glass is the standard window material.

Features

- **Wide photosensitive area**
Pixel pitch: 50 μm (S8377 series)
25 μm (S8378 series)
Pixel height: 0.5 mm
- **On-chip charge amplifier with excellent input/output characteristics**
- **Built-in timing generator allows operation with only start and clock pulse inputs**
- **Maximum operating clock frequency: 500 kHz**
- **Spectral response range: 200 to 1000 nm**
- **5 V single power supply operation**
- **8-pin small package, S8377 and S8378 series are pin compatible.**

Applications

- **Image input devices**
- **Optical sensing devices**

Structure

Parameter	S8377-128Q	S8377-256Q	S8377-512Q	S8378-256Q	S8378-512Q	S8378-1024Q	Unit
Number of pixels	128	256	512	256	512	1024	-
Pixel pitch	50			25			μm
Pixel height	0.5						mm
Package length	15.8	22.2	35.0	15.8	22.2	35.0	mm
Number of pins	8						-
Package	Ceramic						-
Window material	Quartz						-

Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	V _{dd}	T _a =25 °C	-0.3 to +10	V
Gain selection terminal voltage	V _g	T _a =25 °C	-0.3 to +10	V
Clock pulse voltage	V(CLK)	T _a =25 °C	-0.3 to +10	V
Start pulse voltage	V(ST)	T _a =25 °C	-0.3 to +10	V
Operating temperature*1	T _{opr}		-20 to +60	°C
Storage temperature*1	T _{stg}		-20 to +80	°C

*1: No condensation

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

Parameter		Symbol	Min.	Typ.	Max.	Unit
Supply voltage		Vdd	4.75	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

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency*2		f(CLK)	0.1 k	-	500 k	Hz
Output impedance*3		Zo	-	1	-	kΩ
Power consumption		P	-	15	-	mW

*2: Ta=25 °C, Vdd=5 V, V(CLK)=V(ST)=5 V, Vg=5 V (low gain)

*3: An increased current consumption at the video terminal rises the sensor chip temperature causing an increased dark current. Connect a buffer amplifier for impedance conversion to the video terminal so that the current flowing to the video terminal is minimized.

Use a JFET or CMOS input, high-impedance input op amp as the buffer amplifier.

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

Parameter	Symbol	S8377 series			S8378 series			Unit	
		Min.	Typ.	Max.	Min.	Typ.	Max.		
Spectral response range	λ	200 to 1000			200 to 1000			nm	
Peak sensitivity wavelength	λ_p	-	500	-	-	500	-	nm	
Photosensitivity	High gain	S	-	22	-	-	22	V/lx·s	
	Low gain		-	4.4	-	-	4.4		
Dark current	Id	-	0.01	0.03	-	0.01	0.03	pA	
Saturation charge	Qsat	-	12.5	-	-	6.3	-	pC	
Feedback capacitance*4 of charge amplifier	High gain	Cf	-	1	-	-	0.5	pF	
	Low gain		-	5	-	-	2.5		
Dark output voltage*5	High gain	Vd	-	1.0	3.0	-	2.0	mV	
	Low gain		-	0.2	0.6	-	0.4		1.2
Saturation output voltage	High gain	Vsat	2.8	3.2	-	2.8	3.2	V	
	Low gain		2.1	2.5	-	2.1	2.5		
Saturation exposure*6	High gain	Esat	-	145	-	-	145	m/lx·s	
	Low gain		-	570	-	-	570		
Readout noise	High gain	Nr	-	0.4 (-128Q)	-	-	0.9 (-256Q)	-	mV rms
			-	0.5 (-256Q)	-	-	1.3 (-512Q)	-	
			-	0.8 (-512Q)	-	-	2.1 (-1024Q)	-	
			-	0.1 (-128Q)	-	-	0.2 (-256Q)	-	
			-	0.15 (-256Q)	-	-	0.3 (-512Q)	-	
Photoresponse nonuniformity*7	PRNU	-	-	±3	-	-	±3	%	

*4: Vg=5 V (low gain), Vg=0 V (high gain)

*5: Integration time=100 ms

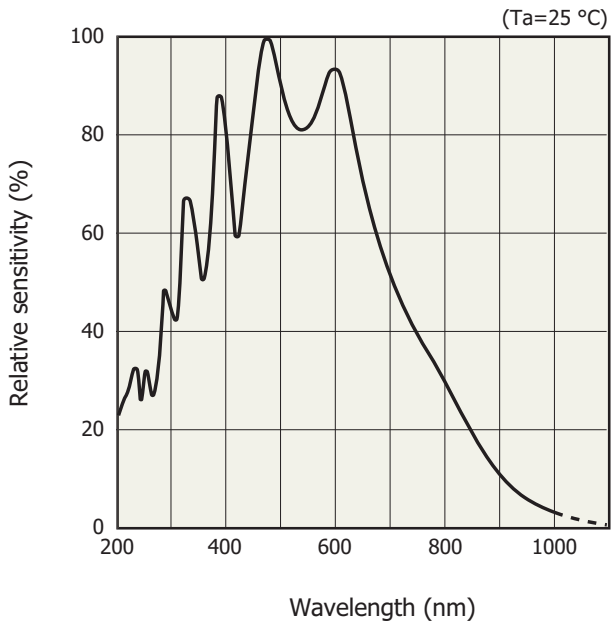
*6: Measured with a tungsten lamp of 2856 K

*7: 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 defined as follows:

$$\text{PRNU} = \frac{\Delta X}{X} \times 100 [\%]$$

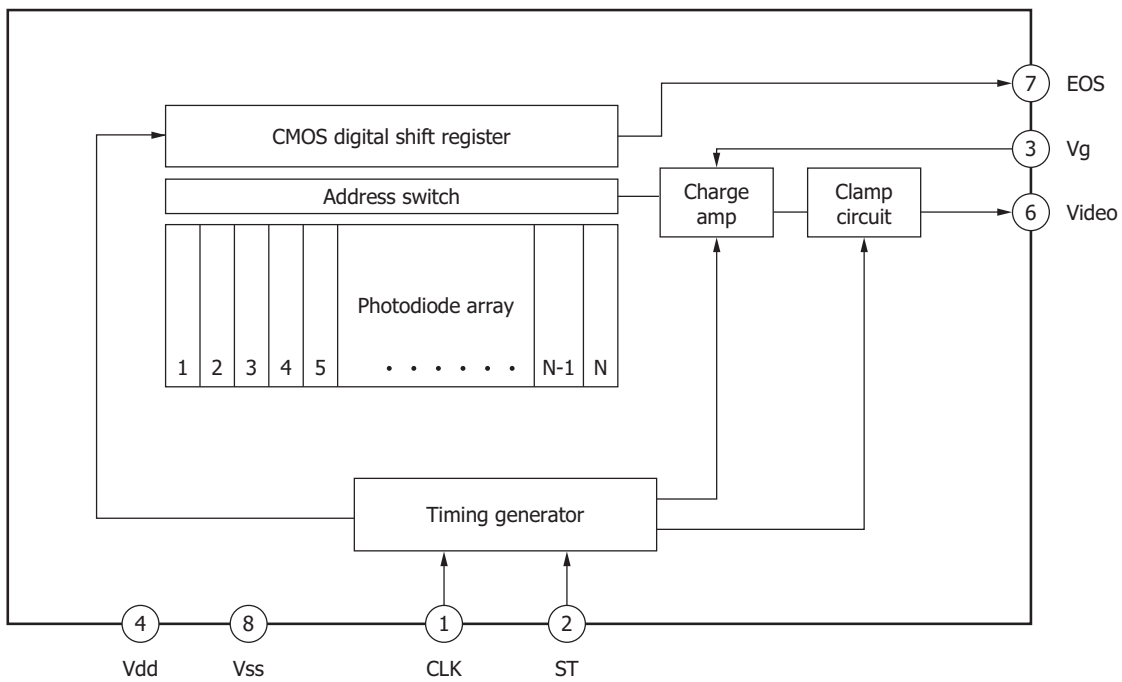
X: average output of all pixels, ΔX : difference between X and maximum or minimum output

Spectral response (typical example)



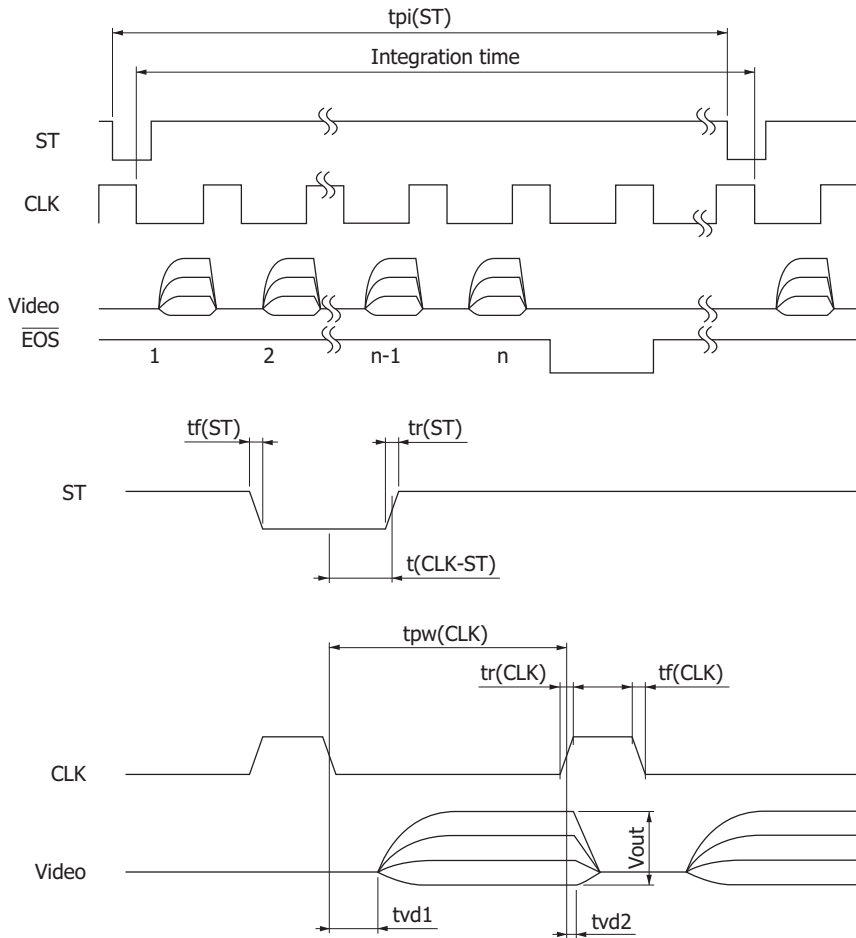
KMPDB0213EC

Block diagram



KMPDC0150EB

Timing chart



KMPDC0149EC

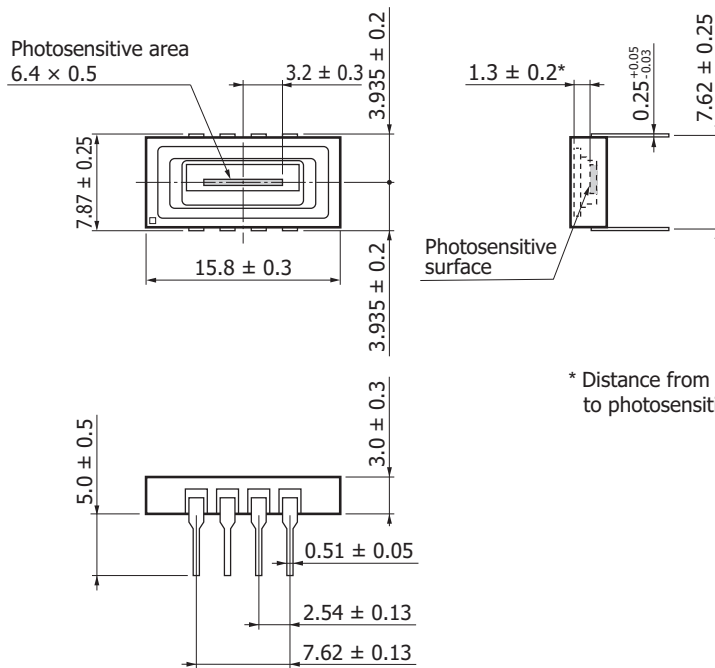
Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse width interval	$t_{pi}(ST)$	$1/f \times$ (number of pixels + 2)	-	-	s
Start pulse rise and fall times	$t_r(ST), t_f(ST)$	0	20	30	ns
Clock pulse width	$t_{pw}(CLK)$	1000 ns	-	5 ms	-
Clock pulse rise and fall times	$t_r(CLK), t_f(CLK)$	0	20	30	ns
Clock pulse-start pulse timing	$t(CLK-ST)$	400 ns	-	5 ms	-
Video delay time 1	t_{vd1}	200	300	400	ns
Video delay time 2	t_{vd2}	50	150	250	ns

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.

Integration time is determined by the interval between the CLK falling edge during the Low period of a start pulse and the CLK falling edge during the Low period of the next start pulse. 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)

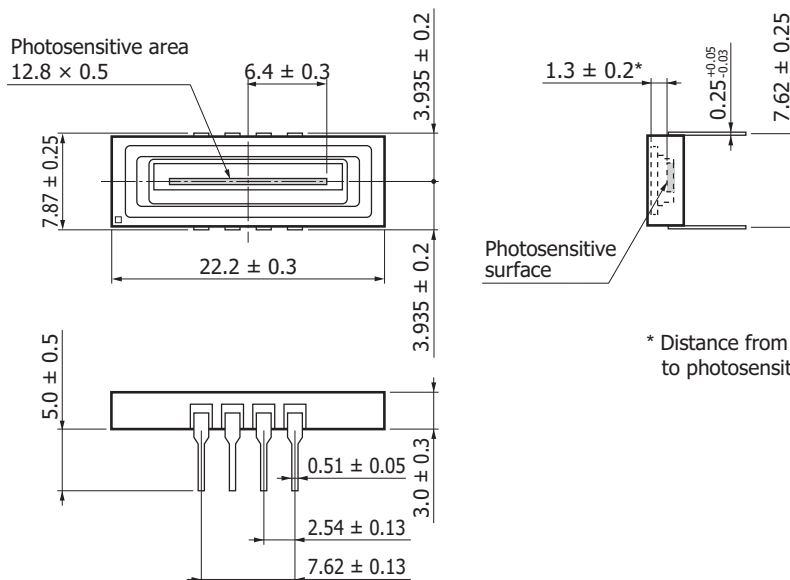
S8377-128Q, S8378-256Q



* Distance from upper surface of window to photosensitive surface

KMPDA0150ED

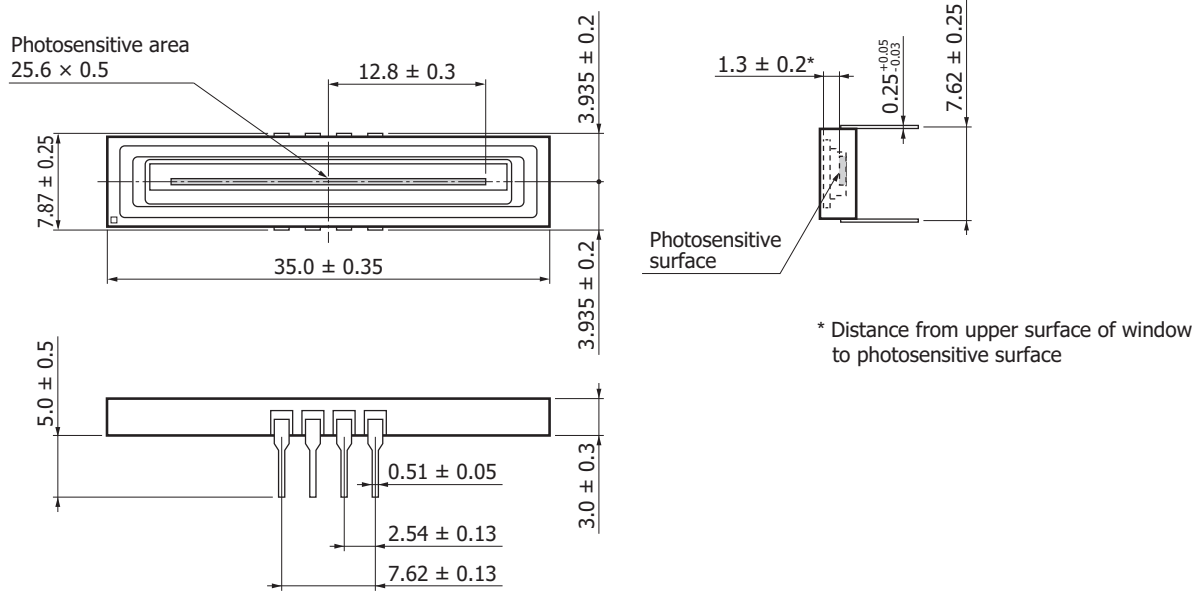
S8377-256Q, S8378-512Q



* Distance from upper surface of window to photosensitive surface

KMPDA0151ED

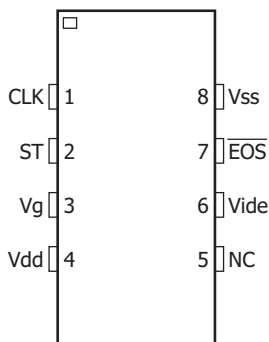
S8377-512Q, S8378-1024Q



KMPDA0152ED

Pin connections

Pin no.	Symbol	Name of pin	Function
1	CLK	Clock pulse	Pulse input to operate the shift register. The readout time (data rate) equals the clock pulse frequency.
2	ST	Start pulse	Starts the shift register operation. Integration time is determined by the interval between the CLK falling edge during the Low period of a start pulse and the CLK falling edge during the Low period of the next start pulse.
3	Vg	Gain selection voltage	Input of 5 V selects "Low gain" and 0 V selects "High gain".
4	Vdd	Supply voltage	5 V typ.
5	NC		Open
6	Video	Video	Signal output. Positive-going output from 1 V
7	$\overline{\text{EOS}}$	End of scan	Negative-going signal output obtained at a timing following the last pixel scan
8	Vss	Ground	



KMPDC0151EA

Handling precautions

(1) Electrostatic countermeasures

Although the CMOS linear image sensor is protected against static electricity, proper electrostatic countermeasures must be provided to prevent device destruction by static electricity. For example, such measures include wearing non-static gloves and clothes, and grounding the work area and tools.

(2) Incident 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) UV exposure

The CMOS linear image sensor is designed to suppress performance deterioration due to UV exposure. Even so, avoid unnecessary UV exposure to the device.

Also, be careful not to allow UV light to strike the cemented portion between the ceramic base and the glass.

(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.

Related information

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

■ Precautions

- Notice
- Image sensors/Precautions

Information described in this material is current as of February, 2014.

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