CMOS linear image sensor \$8377/\$8378 series

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

S8377/S8378 series is a family of CMOS linear image sensors designed for image input applications. These linear image sensors operate from single 5 V 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 S8377 series have a height of 0.5 mm and are arrayed in a row at a spacing of 50 µm. The photodiodes of 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 active area

Pixel pitch: 50 μ m (S8377 series) 25 μ m (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
- Single 5 V power supply operation
- 8-pin small package, S8377 and S8378 series are pin compatible.

Applications

- Image input devices
- Optical sensing devices

■ Absolute maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage	Vdd	-0.3 to +10	V
Gain selection terminal voltage	Vg	-0.3 to +10	V
Clock pulse voltage	V (CLK)	-0.3 to +10	V
Start pulse voltage	V (ST)	-0.3 to +10	V
Operating temperature *1	Topr	-20 to +60	°C
Storage temperature	Tstg	-20 to +80	°C

^{*1:} No condensation

■ Shape specifications

Parameter	S8377- 128Q	S8377- 256Q	S8377- 512Q	S8378- 256Q	S8378- 512Q	S8378- 1024Q	Unit
Number of pixels	128	256	512	256	512	1024	-
Package length	15.8	22.2	35.0	15.8	22.2	35.0	mm
Number of pins	8			8			-
Window material	Quartz			Quartz			-



■ Recommended terminal voltage

Parameter		Symbol	Min.	Тур.	Max.	Unit
Supply voltage		Vdd	4.75	5	5.25	V
Gain selection	High gain	\/a	0	-	0.4	V
terminal voltage	Low gain	Vg	Vdd-0.25	Vdd	Vdd+0.25	V
Clark and a make as	High	V (CLIC)	Vdd-0.25	Vdd	Vdd+0.25	V
Clock pulse voltage	Low	V (CLK)	0	-	0.4	V
Ctart mulas valtage	High	V/ (CT)	Vdd-0.25	Vdd	Vdd+0.25	V
Start pulse voltage	Low	V (ST)	0	-	0.4	V

■ Electrical characteristics

Parameter	Symbol	Min.	Тур.	Max.	Unit
Clock pulse frequency *2	f (CLK)	0.1	-	500	kHz
Output impedance	Zo	-	1	-	kΩ
Power consumption	Р	-	25	_	mW

^{*2:} Ta=25 °C, Vdd=5 V, V (CLK)=V (ST)=5 V, Vg=5 V (Low gain)

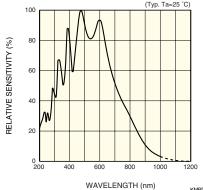
■ Electrical and optical characteristics [Ta=25 °C, Vdd=5 V, V (CLK)=V (ST)=5 V]

Parameter			S8377 series			S8378 series			1.1-26
		Symbol	Min.	Тур.	Max.	Min.	Тур.	Max.	Unit
Spectral response range		λ	200 to 1000		200 to 1000			nm	
Peak sensitivity wavele	ngth	λр	-	500	-	-	500	-	nm
Photo sensitivity	High gain	S	-	22	-	-	22	-	V/lx⋅s
	Low gain	_	-	4.4	-	-	4.4	-	VIIX
Dark current		ΙD	-	0.08	0.24	-	0.04	0.12	pA
Saturation charge		Qsat	-	12.5	-	-	6.3	-	рC
Feedback capacitance *3	High gain	Cf	-	1	-	-	0.5	-	PF
of charge amplifier	Low gain	Cī	=	5	-	-	2.5	-	PF
Dark output voltage *4	High gain	Vd	-	8.0	24	-	8.0	24	MV
	Low gain			1.6	4.8	-	1.6	4.8	IVIV
Saturation output	High gain	Vsat	2.8	3.2	-	2.8	3.2	-	V
voltage	Low gain	vsai	2.1	2.5	-	2.1	2.5	ı	V
Saturation exposure *5	High gain	Foot	-	145	-	-	145	ı	$mlx \cdot s$
Saturation exposure	Low gain	Esat	-	570	-	-	570	ı	111 <i>tx</i> · S
			•	0.1 (-128Q)	-	-	0.2 (-256Q)	-	
	Low gain		ı	0.15 (-256Q)	-	-	0.3 (-512Q)	ı	
Readout noise		Nr	-	0.2 (-512Q)	-	-	0.4 (-1024Q)	-	mV-rms
		INI	-	0.4 (-128Q)	-	-	0.9 (-256Q)	-	IIIV-IIIIS
	High gain		-	0.5 (-256Q)	-	-	1.3 (-512Q)	-	
			-	0.8 (-512Q)	-	-	2.1 (-1024Q)	-	
Photo response non-uniformity *6		PRNU	-	-	±3	-	-	±3	%

^{*3:} Vg=5 V (Low gain), Vg=0 V (High gain)

Where X is the average output of all pixels and ΔX is the difference from the maximum or minimum output and X.

■ Spectral response (typical example)



KMPDB0213EA

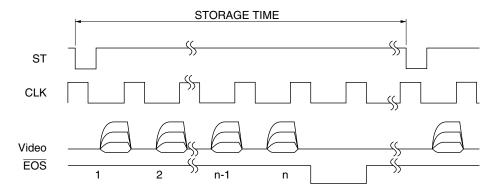
^{*4:} Storage time Ts=100 ms

^{*5:} Measured with a tungsten lamp of 2856 K.

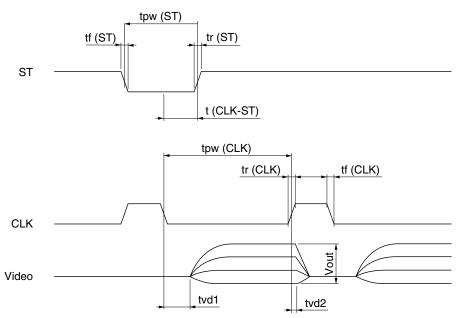
^{*6:} Uniformity is defined under the condition that the device is uniformly illuminated by light which is 50 % of the saturation exposure level as follows:

PRNU= $\Delta X/X \times 100$ (%)

■ Timing chart



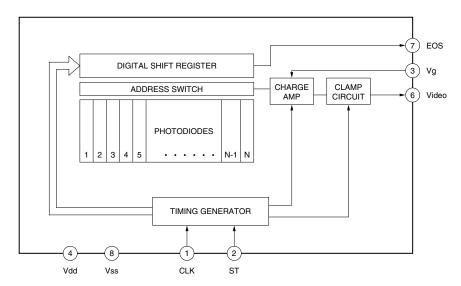
* The storage time is determined by the start pulse intervals. However, since the charge storage of each pixel is carried out between the signal readout of that pixel and the next signal readout of the same pixel, the start time of charge storage differs depending on each pixel. In addition, the next start pulse cannot be input until signal readout from all pixels is completed.



KMPDC0149EA

Parameter	Symbol	Min.	Тур.	Max.	Unit
Start pulse width	tpw (ST)	600	-	ı	ns
Start pulse rise and fall time	tr (ST), tf (ST)	0	20	30	ns
Clock pulse width	tpw (CLK)	1000	-	1	ns
Clock pulse rise and fall time	tr (CLK), tf (CLK)	0	20	30	ns
Clock pulse-start pulse timing	t (CLK-ST)	400	-	-	ns
Video delay time 1	tvd1	-	300	-	ns
Video delay time 2	tvd2	-	150	-	ns

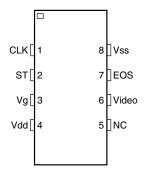
■ Block diagram



KMDDC0150EA

■ Pin connections

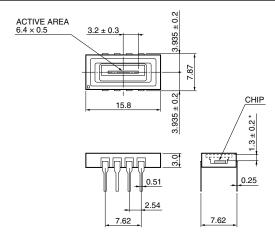
_ 1 111 0011	110000		
Pin No.	Symbol	Name of pin	Function
1	CLK	Clock pulse	Pulse input to operate the shift register. The readout time (data rate) equals the clock pulse frequency.
2	ST	Start pulse	Starts the shift register operation. The start pulse intervals determine the signal storage time.
3	Vg	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	EOS	End of scan	Negative-going signal output obtained at a timing following the last pixel scan.
8	Vss	Ground	



KMPDC0151EA

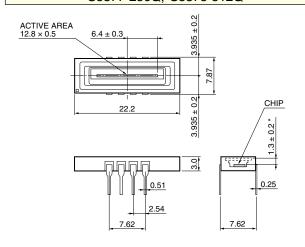
■ Dimensional outlines (unit: mm)

S8377-128Q, S8378-256Q



* Optical distance from the outer surface of the quartz window to the chip surface

S8377-256Q, S8378-512Q

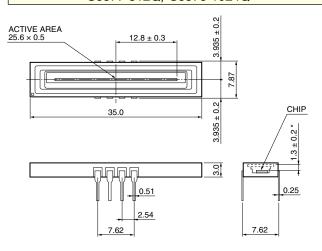


* Optical distance from the outer surface of the quartz window to the chip surface

KMPDA0150EB

KMPDA0151EB

S8377-512Q, S8378-1024Q



* Optical distance from the outer surface of the quartz window to the chip surface

KMPDA0152EB

CMOS linear image sensor S8377/S8378 series

■ 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.

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