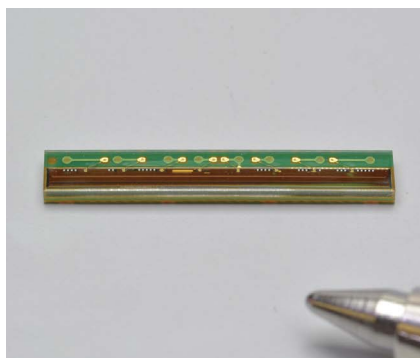# HAMAMATSU
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CMOS linear image sensor

S13434-2496

Pixel size: 5.25 × 63.5 μm, 2496 pixels, compact, thin package

The S13434-2496 is a linear image sensor developed for barcode readers, encoders, and other various types of scanning applications. It is a COB (chip on board) type implemented in a compact (close to chip size) and thin (half the thickness of the previous product, 0.8 mm) package. It operates on a single 3.3 V power supply and features low power consumption and high sensitivity.

Features

- Pixel size: 5.25 × 63.5 μm
- 2496 pixels
- Effective photosensitive area length: 13.104 mm
- Single 3.3 V power supply operation
- Built-in timing generator; requires only a start pulse and clock pulse for operation
- Video data rate: 2 MHz max.
- Small input terminal capacitance: 5 pF
- Compact, thin package: 13.8 × 2.1 × 0.8^t mm

Applications

- Barcode readers
- Encoders
- Various types of image scanning

Structure

Parameter	Specification	Unit
Number of pixels	2496	-
Pixel pitch	5.25	μm
Pixel height	63.5	μm
Photosensitive area length	13.104	mm
Package	Glass epoxy	-
Sealing material	Silicone resin	-

Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	Vdd	Ta=25 °C	-0.3 to +4.2	V
Clock pulse voltage	V(CLK)	Ta=25 °C	-0.3 to +4.2	V
Start pulse voltage	V(ST)	Ta=25 °C	-0.3 to +4.2	V
Vcp terminal voltage	Vcp	Ta=25 °C	-0.3 to +6.5	V
Operating temperature	Topr	No dew condensation[1]	-40 to +85	°C
Storage temperature	Tstg	No dew condensation[1]	-40 to +85	°C
Reflow soldering conditions[2]	Tsol		Peak temperature 260 °C, three 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]: JEDEC level 2a
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	3.15	3.3	3.45	V
Clock pulse voltage	High level	V(CLK)	3	Vdd	Vdd + 0.25	V
	Low level		0	-	0.3	V
Start pulse voltage	High level	V(ST)	3	Vdd	Vdd + 0.25	V
	Low level		0	-	0.3	V

Electrical characteristics [Ta=25 °C, Vdd=3.3 V, V(CLK)=V(ST)=3.3 V]

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency	f(CLK)	50 k	-	2 M	Hz
Data rate	DR	-	f(CLK)	-	Hz
Output impedance	Zo	70	-	260	Ω
Current consumption*3 *4	Ic	7	12	17	mA
Clock pulse input terminal capacitance	C(CLK)	-	5	-	pF
Start pulse input terminal capacitance	C(ST)	-	5	-	pF

*3: f(CLK)=2 MHz
*4: Higher the clock pulse frequency, the greater the current consumption. At f(CLK)=200 kHz, the current consumption is 11 mA typ.

Electrical and optical characteristics [Ta=25 °C, Vdd=3.3 V, V(CLK)=V(ST)=3.3 V, f(CLK)=2 MHz]

Parameter	Symbol	Min.	Typ.	Max.	Unit
Spectral response range	λ		400 to 1000		nm
Peak sensitivity wavelength	λp	-	650	-	nm
Photosensitivity*5	Sw	-	280	-	V/($lx\cdot$s)
Conversion efficiency*6	CE	-	45	-	μV/e⁻
Dark output voltage*7 *8	VD	-	1.5	15	mV
Saturation output voltage*8	Vsat	1.1	1.4	2.1	V
Readout noise	Nread	0.2	0.4	1.0	mV rms
Dynamic range 1*9	DR1	-	3500	-	times
Dynamic range 2*10	DR2	-	933	-	times
Output offset voltage	Voffset	0.3	0.6	0.9	V
Photoresponse nonuniformity*5 *11	PRNU	-	-	±10	%
Image lag*12	Lag	-	-	0.1	%

*5: 2856 K, tungsten lamp
*6: Output voltage generated per electron
*7: Integration time=10 ms
*8: Voltage difference relative to Voffset
*9: DR1=Vsat/Nread
*10: DR2=Vsat/VD
    Integration time=10 ms
    The dark output voltage is proportional to the integration time. Shorter the integration time, wider the dynamic range.
*11: Photoresponse nonuniformity is the output nonuniformity when a uniform light with a light exposure that is 50% of saturation output is incident on the entire photosensitive area. It is defined as follows for the 2490 pixels excluding the three pixels at each end of the sensor.
   PRNU=ΔX/X × 100 (%)
    X: average of the output of all pixels, ΔX: difference between the maximum or minimum output and X
*12: The signal component of the previous data that remains after data is read under saturation output conditions. The image lag increases if the output exceeds the saturation output voltage.
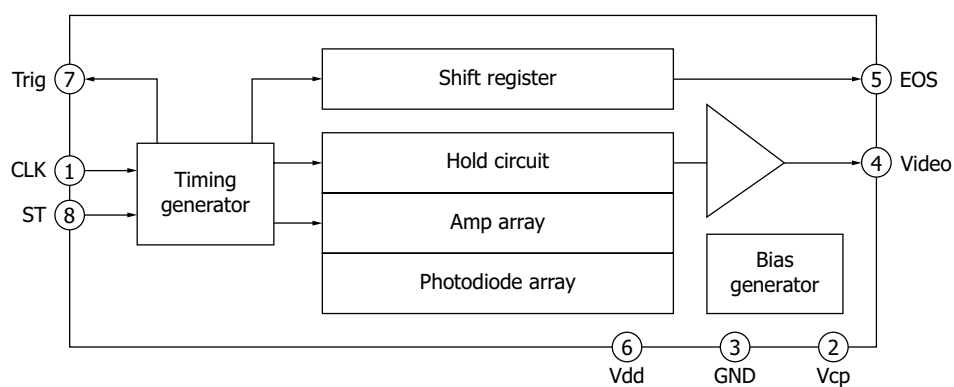
CMOS linear image sensor | S13434-2496

Appearance test standards

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

Spectral response (typical example)

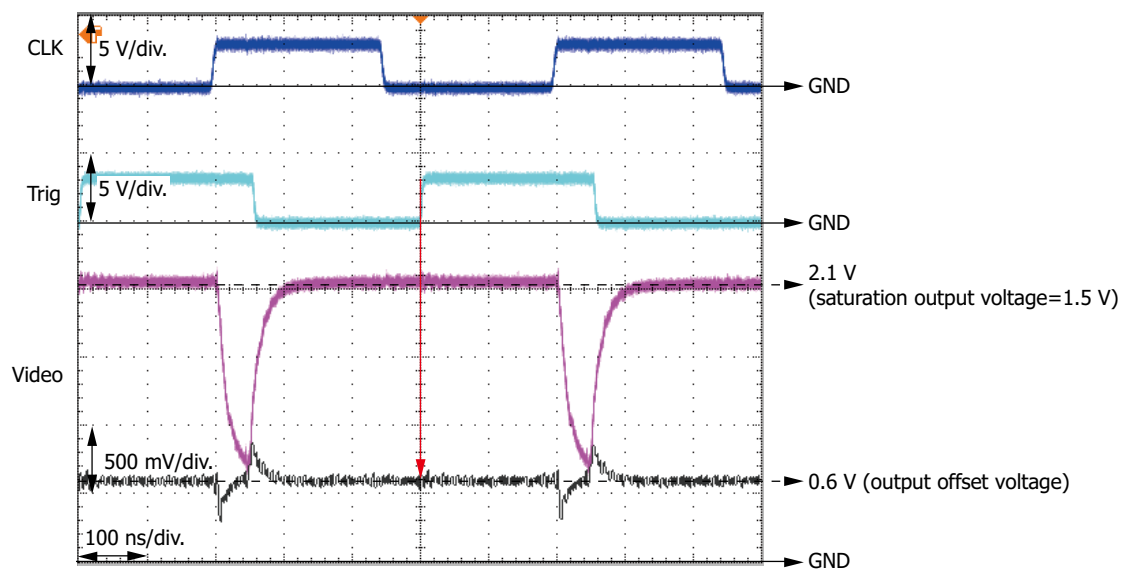(Ta=25 °C)

Wavelength (nm)

Relative sensitivity (%)
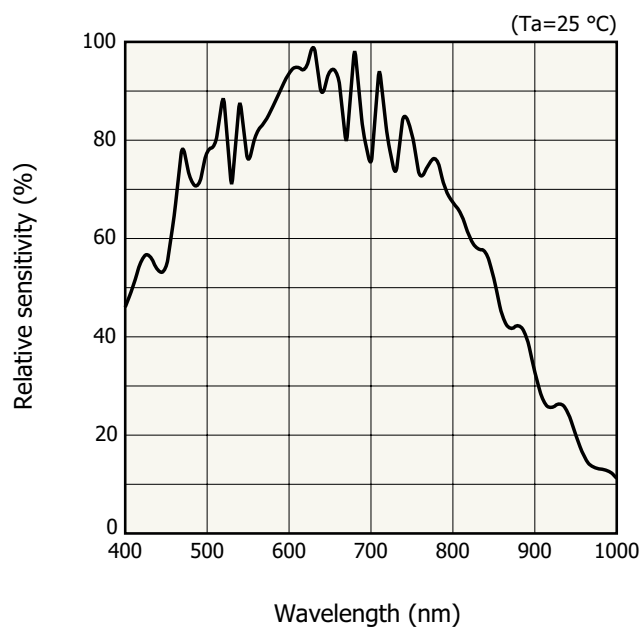
KMPDB0437EA

Block diagram

KMPDC0534EA

3

Output waveforms of a pixel

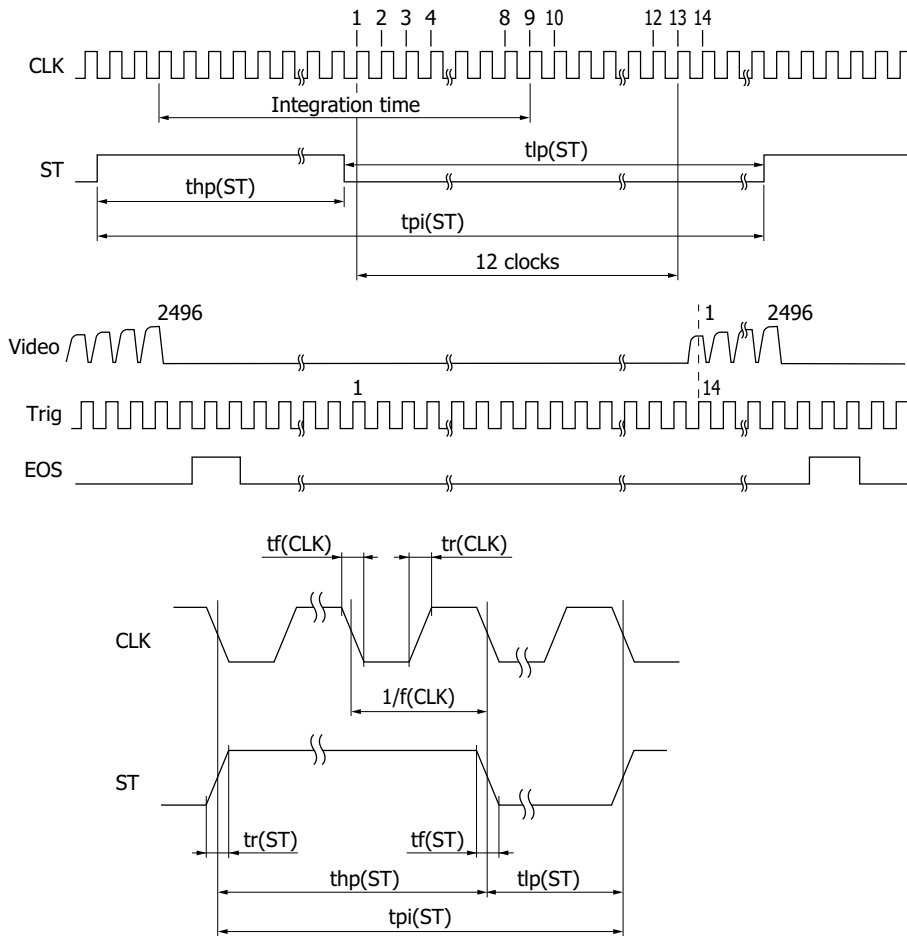The Video is captured at the rising edge of the trigger signal (see the red arrow).

f(CLK)=VR=2 MHz

CLK — 5 V/div. — GND

Trig — 5 V/div. — GND

Video — 2.1 V (saturation output voltage=1.5 V)

500 mV/div. — 0.6 V (output offset voltage)

100 ns/div. — GND

f(CLK)=VR=200 kHz

CLK — 5 V/div. — GND

Trig — 5 V/div. — GND

Video — 5 V/div. — 2.1 V (saturation output voltage=1.5 V)

500 mV/div. — 0.6 V (output offset voltage)

1 µs/div. — GND
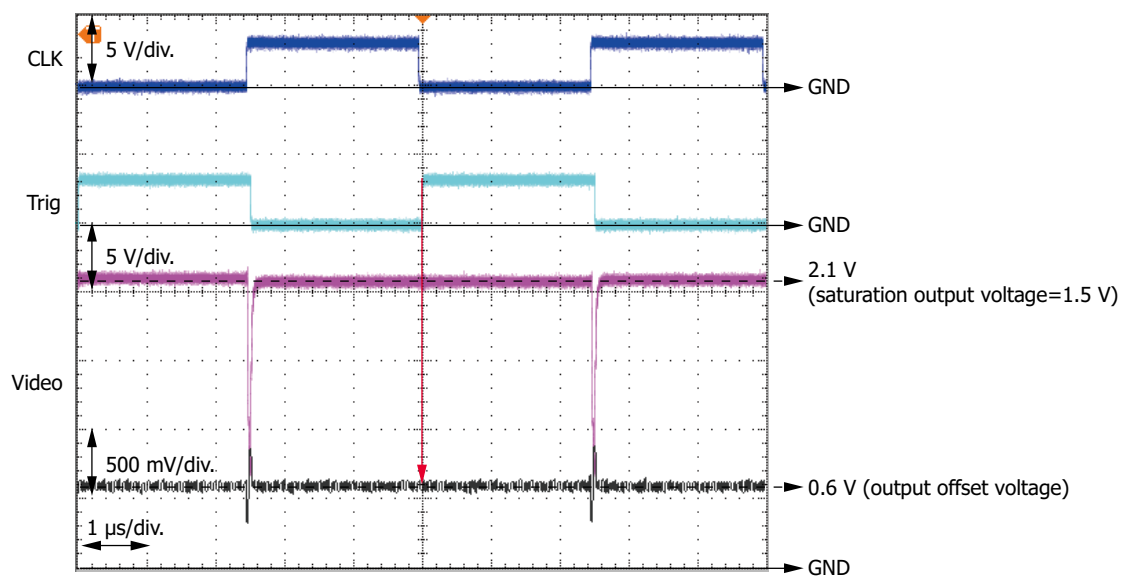
Timing chart

KMPDC0554EA

Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse cycle[13]	$t_{pi}(ST)$	$18/f(CLK)$	-	-	s
High start pulse period[13] [14]	$t_{hp}(ST)$	$2/f(CLK)$	-	-	s
Low start pulse period	$t_{lp}(ST)$	$16/f(CLK)$	-	-	s
Start pulse rise/fall times	$t_r(ST)$, $t_f(ST)$	0	10	30	ns
Clock pulse duty ratio	-	45	50	55	%
Clock pulse rise/fall times	$t_r(CLK)$, $t_f(CLK)$	0	10	30	ns

[13]: If the start pulse period or high start pulse period is increased, the dark output increases.
[14]: The integration time corresponds to high ST period + 6 CLK cycles.
The shift register starts operation on the rising edge of CLK immediately after ST is set to low level.
The integration time can be changed by changing the ratio between ST high and low.
If the first trigger after ST is set to low level is assumed to be the first trigger, the Video is captured on the rising edge of the 14th trigger.

Operation example (when reading out all 2496 pixels)

This example assumes that the clock pulse frequency is maximized (video data rate is also maximized), the time of one scan is minimized, and the integration time is maximized.

Clock pulse frequency=Video data rate=2 MHz

Start pulse cycle=2512/f(CLK)=2512/2 MHz=1256 µs

High start pulse period=Start pulse cycle - minimum low start pulse period

$\qquad$ =2512/f(CLK) - 16/f(CLK)=1248 µs

The integration time corresponds to high start pulse period + 6 clock pulse cycles, which is 1248 + 3=1251 µs.

tlp(ST)=8 µs   thp(ST)=1248 µs

ST

tpi(ST)=1256 µs

KMPDC0558EB
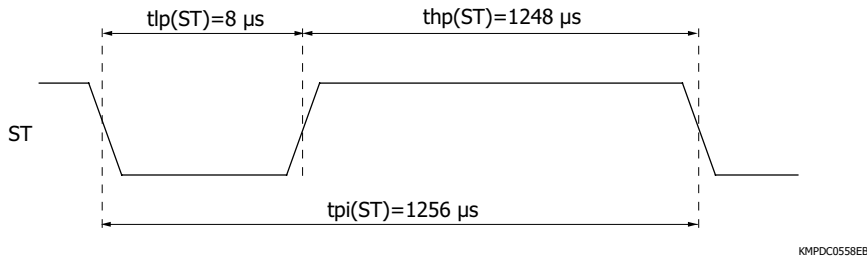
Dimensional outline (unit: mm)

[Top view]

Photosensitive area
13.104 × 0.0635

Index mark

13.8

6.55 ± 0.1

0.52 ± 0.1*1

⑧ ⑦ ⑥ ⑤

① ② ③ ④

1 ch

Scan direction

[Side view]

0.3 ± 0.05*2

0.5 ± 0.1*3

0.3 ± 0.05

Photosensitive surface

2.1

Silicone resin   Glass epoxy

[Bottom view]

12

4

Index mark

⑤ ⑥ ⑦ ⑧

④ ③ ② ①

1.5

Electrode
(8 ×) φ0.4

1 ch
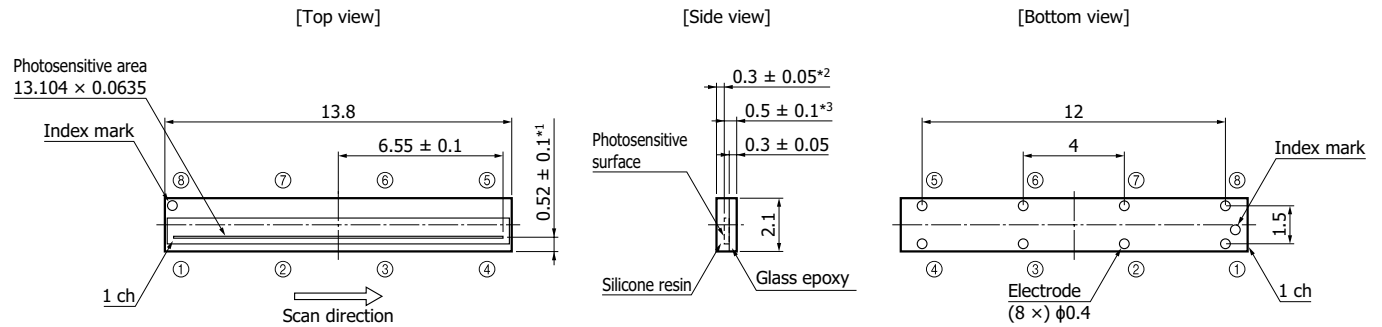
Tolerance unless otherwise noted: ±0.1
*1: Distance from package side to photosensitive area center
*2: Distance from package surface to photosensitive area
*3: Distance from package bottom to photosensitive area

KMPDA0324EA

Pin connections

Pin no.	Symbol	I/O	Description
1	CLK	I	Clock pulse
2	Vcp	I	Bias voltage for the booster circuit*15
3	GND	-	GND
4	Video	O	Video signal
5	EOS	O	End of scan
6	Vdd	I	Supply voltage
7	Trig	O	Trigger pulse
8	ST	I	Start pulse

*15: Approximately 5.5 V boosted by the booster circuit inside the chip is output to the terminal. To maintain the voltage, insert a capacitor around 1 µF between Vcp and GND.

Recommended land pattern (unit: mm)

KMPDC0555EA
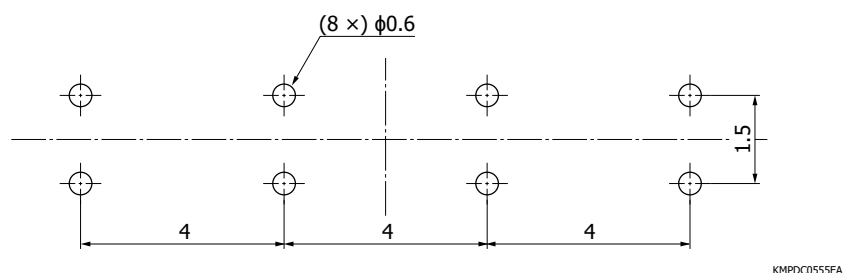
Application circuit example

KMPDC0536EA
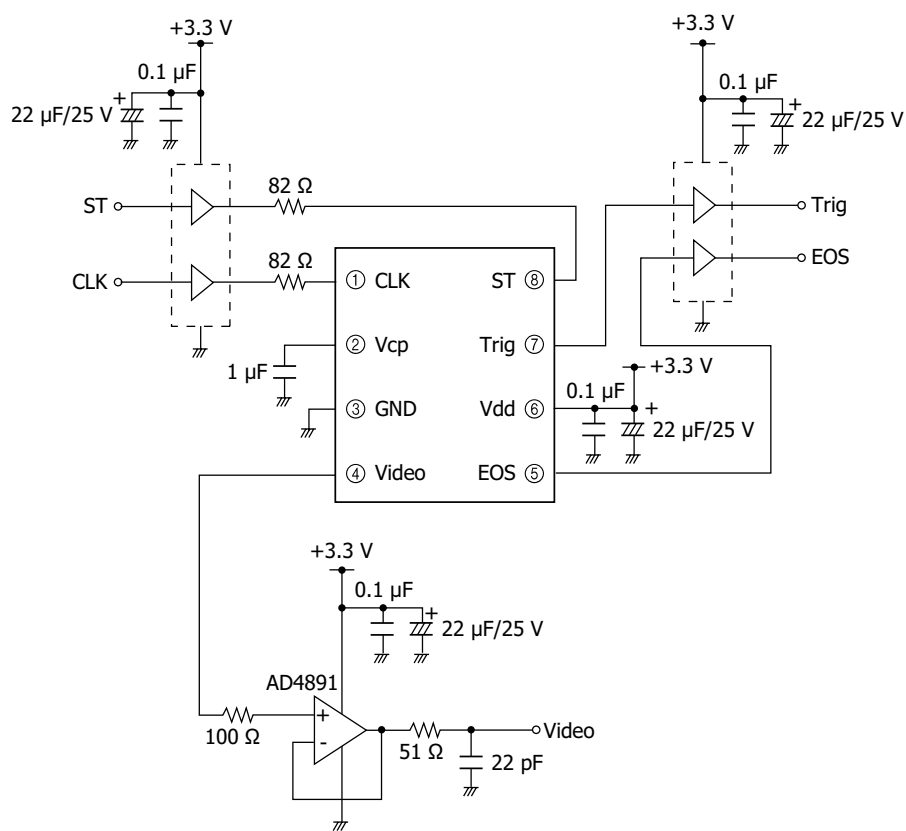
Standard packing specifications

■ Reel (conforms to JEITA ET-7200)

Dimensions	Hub diameter	Tape width	Material	Electrostatic characteristics
TBD	TBD	TBD	PPE	Conductive

■ Embossed tape (packing example, material: plastic, conductive)

1st pixel

Reel feed direction
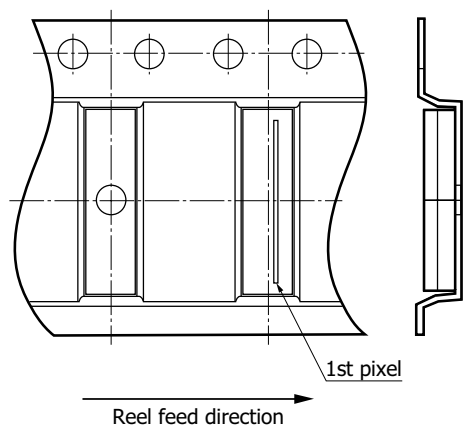
KMPDC0546EA

■ Packing quantity
2000 pcs/reel

■ Packing type
Reel and desiccant in moisture-proof packaging (vacuum-sealed)

Note: The preliminary specifications are subject to change due to improvements or other reasons.

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▶ Recommended temperature profile for reflow soldering (typical example)
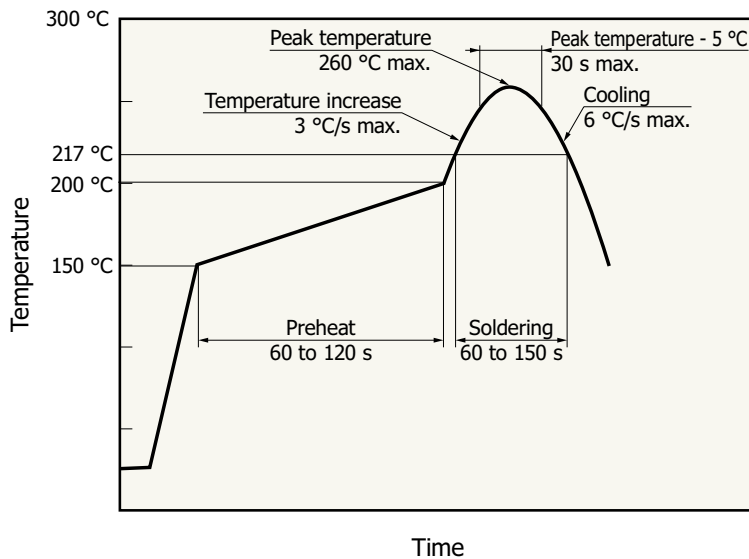
KMPDB0405EB

· 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 is subject to during reflow soldering varies depending on the circuit board and reflow furnace that are used. Before actual reflow soldering, check for any problems by testing out the reflow soldering methods in advance.
· The storage conditions for unopened products are 15 to 35 °C temperature range, 45 to 75% humidity range, and up to 12 month storage.

▶ 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) Package handling
· The photosensitive area of this product is protected by a transparent resin. When compared with a glass window material, the transparent resin exhibits slight unevenness and is prone to scratches. Be careful in handling it, and pay attention to its optical design.
· If dirt or the like adheres to the surface of the photosensitive area, the photoresponse uniformity will be lost. To remove dirt, blow compressed air on to the surface.

(3) Surface protection tape
· To protect the photosensitive area, protective tape is applied to the surface of the product. After assembly, remove this tape before use.

Related information

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

■ Precautions
· Disclaimer
· Precautions / Image sensors
· Precautions / Resin-sealed CMOS linear image sensors
· Precautions / Surface mount type products

■ Catalogs
· Selection guide / CCD/CMOS image sensors
· Technical note / CMOS linear image sensors