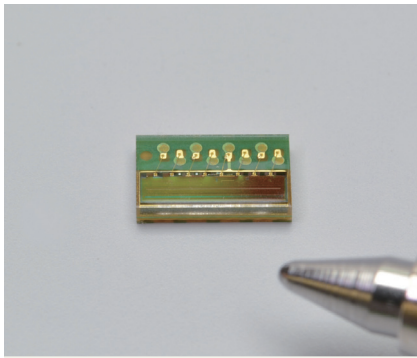


# CMOS linear image sensor



S13131-736

**Pixel size: 5.5 × 63.5 μm, 736 pixels, compact, thin package**

The S13131-736 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: 5.5 × 63.5 μm
- 736 pixels
- Effective photosensitive area length: 4.048 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: 4.7 × 2.8 × 0.8<sup>t</sup> mm

## Applications

- Barcode readers
- Encoders
- Various types of image scanning

## Structure

Parameter	Specification	Unit
Number of pixels	736	-
Pixel pitch	5.5	μm
Pixel height	63.5	μm
Photosensitive area length	4.048	mm
Package	Glass epoxy	-
Sealing material	Silicone resin	-

## Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Supply voltage	V <sub>dd</sub>	T <sub>a</sub> =25 °C	-0.3 to +4.2	V
Clock pulse voltage	V(CLK)	T <sub>a</sub> =25 °C	-0.3 to +4.2	V
Start pulse voltage	V(ST)	T <sub>a</sub> =25 °C	-0.3 to +4.2	V
V <sub>cp</sub> terminal voltage	V <sub>cp</sub>	T <sub>a</sub> =25 °C	-0.3 to +6.5	V
Operating temperature	T <sub>opr</sub>	No dew condensation*1	-40 to +85	°C
Storage temperature	T <sub>stg</sub>	No dew condensation*1	-40 to +85	°C
Reflow soldering conditions*2	T <sub>sol</sub>		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	3	Vdd	Vdd + 0.25	V
	Low level	0	-	0.3	V
Start pulse voltage	High level	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·s)
Conversion efficiency*6	CE	-	45	-	μV/e <sup>-</sup>
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 730 pixels excluding the three pixels at each end of the sensor.

PRNU=ΔX/X × 100 (%)

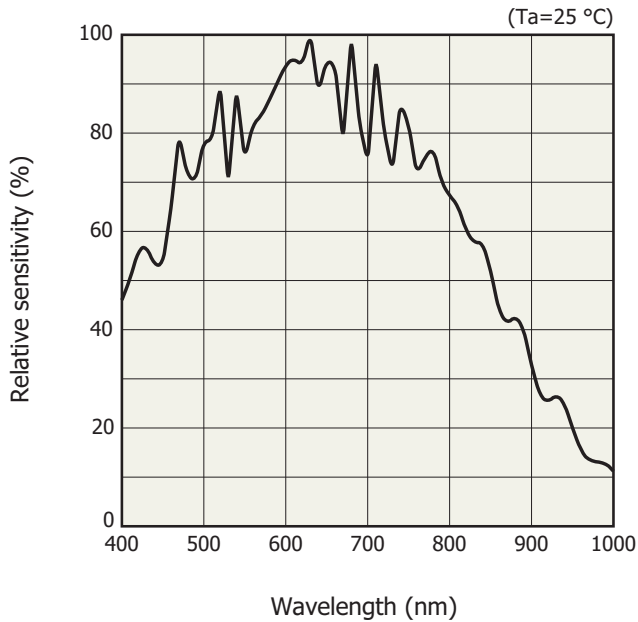
X: average of the output of all pixels, ΔX: difference between the maximum or minimum output and X

\*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.

**Appearance test standards**

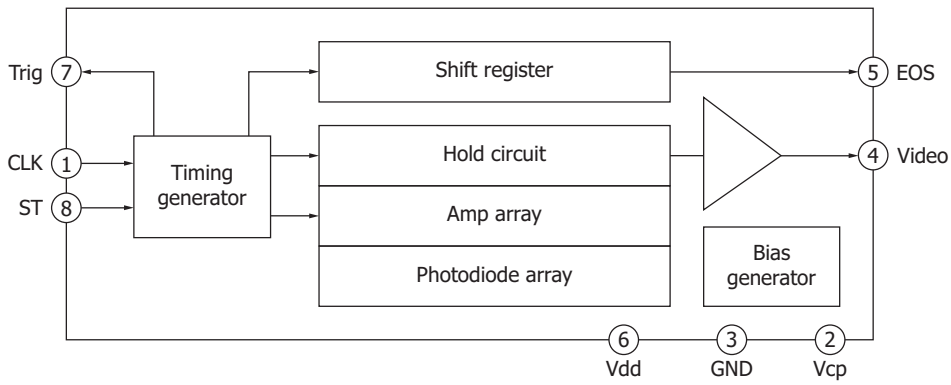
Parameter	Test criterion	Inspection method
Foreign matter on photosensitive area	10 μm max.	Automated camera

**Spectral response (typical example)**



KMPDB0437EA

**Block diagram**

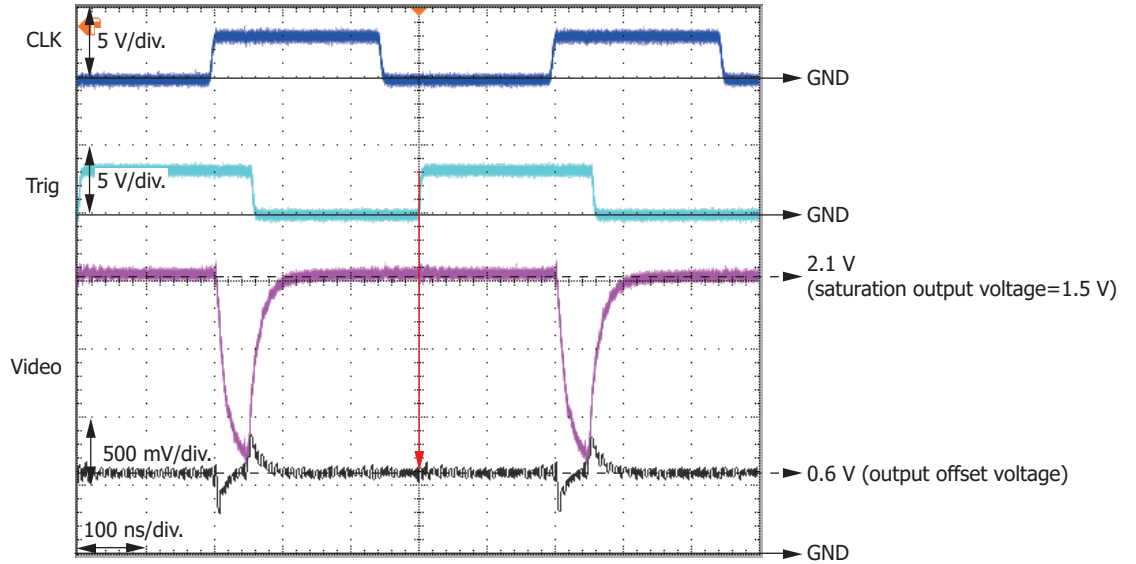


KMPDC0534EA

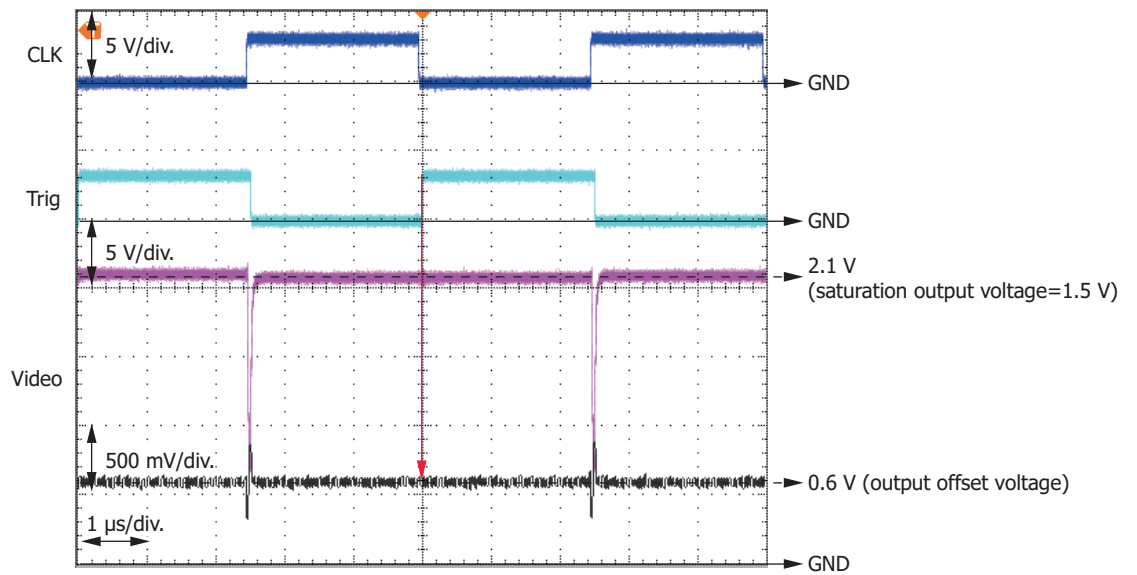
**Output waveforms of a pixel**

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

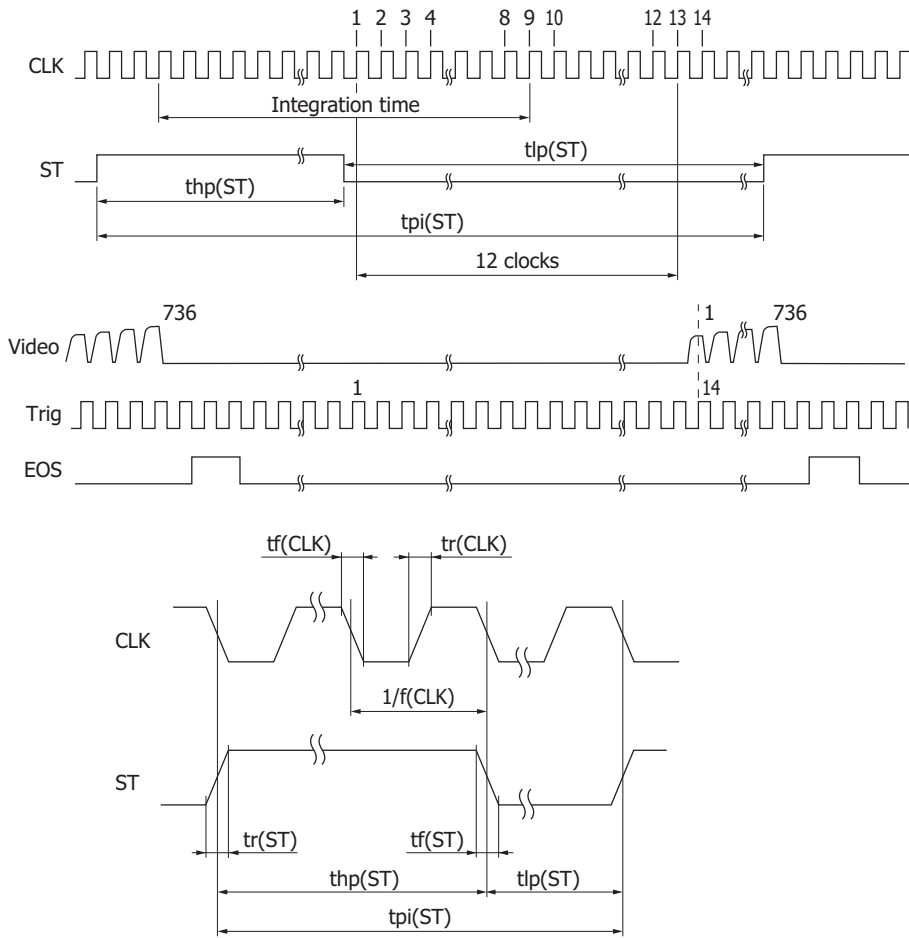
$f(\text{CLK}) = \text{VR} = 2 \text{ MHz}$



$f(\text{CLK}) = \text{VR} = 200 \text{ kHz}$



**Timing chart**



KMPDC0544EA

Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse cycle*13	t <sub>pi</sub> (ST)	18/f(CLK)	-	-	s
High start pulse period*13 *14	t <sub>hp</sub> (ST)	2/f(CLK)	-	-	s
Low start pulse period	t <sub>lp</sub> (ST)	16/f(CLK)	-	-	s
Start pulse rise/fall times	t <sub>r</sub> (ST), t <sub>f</sub> (ST)	0	10	30	ns
Clock pulse duty ratio	-	45	50	55	%
Clock pulse rise/fall times	t <sub>r</sub> (CLK), t <sub>f</sub> (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 736 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.

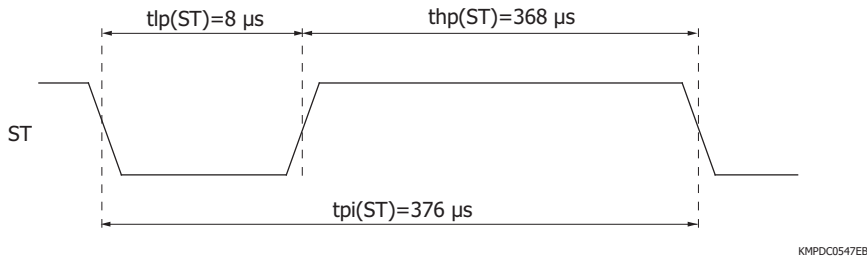
Clock pulse frequency=Video data rate=2 MHz

Start pulse cycle= $752/f(\text{CLK})=752/2 \text{ MHz}=376 \mu\text{s}$

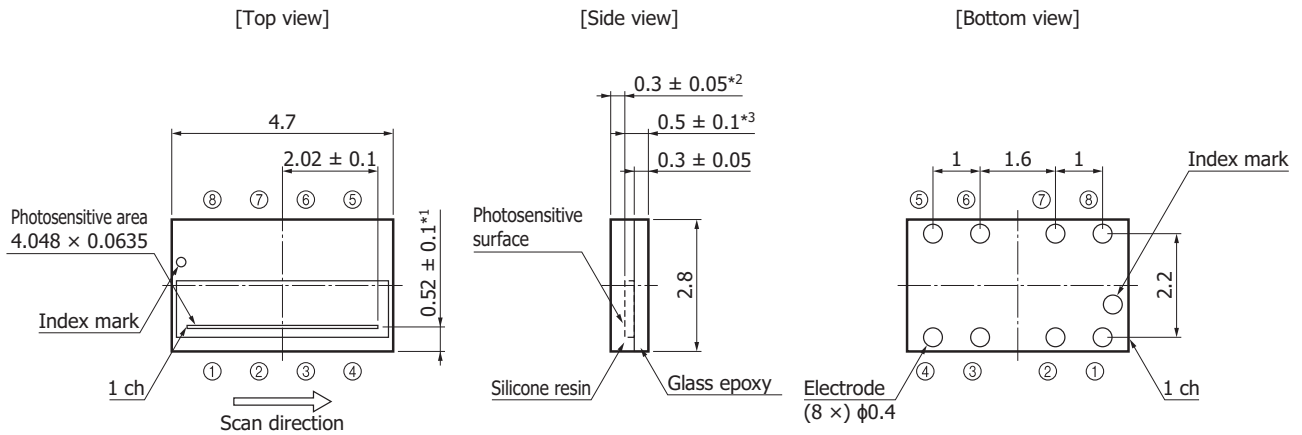
High start pulse period=Start pulse cycle - minimum low start pulse period

$$=752/f(\text{CLK}) - 16/f(\text{CLK})=368 \mu\text{s}$$

The integration time corresponds to high start pulse period + 6 clock pulse cycles, which is  $368 + 3=371 \mu\text{s}$ .



**Dimensional outline (unit: mm)**



- Tolerance unless otherwise noted:  $\pm 0.1$   
 \*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

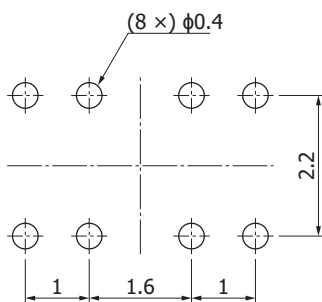
KMPDA0321EA

**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

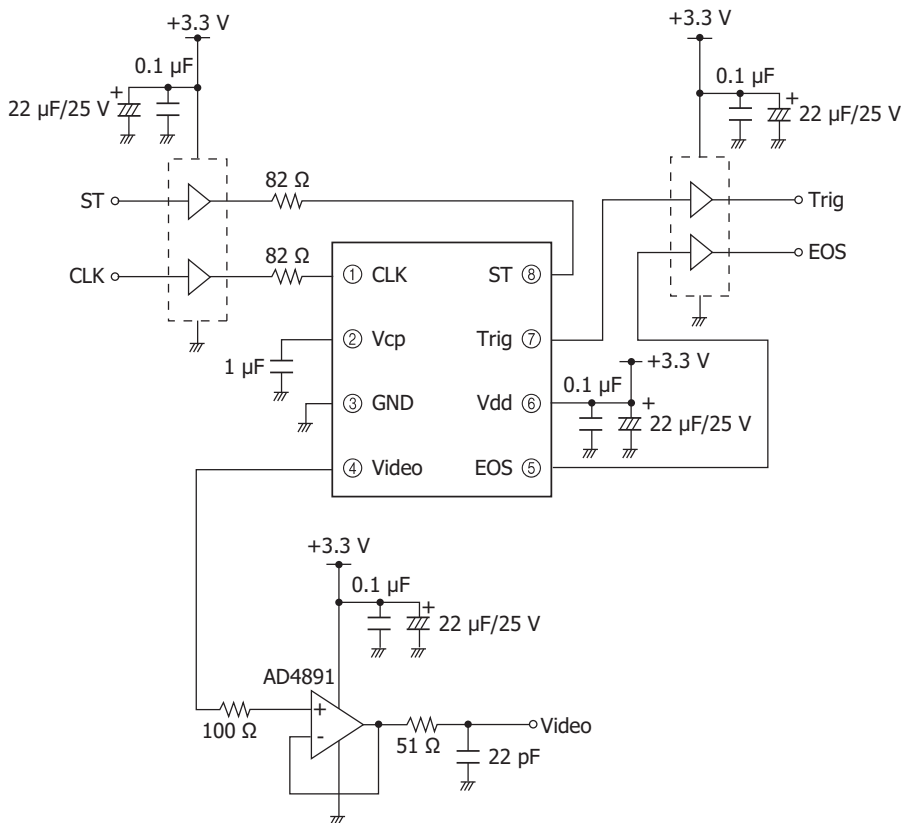
\*15: Approximately 5.5 V boosted by the booster circuit inside the chip is output to the terminal. To maintain the voltage, insert a capacitor around 1  $\mu\text{F}$  between Vcp and GND.

**Recommended land pattern (unit: mm)**



KMPDC0545EA

**Application circuit example**



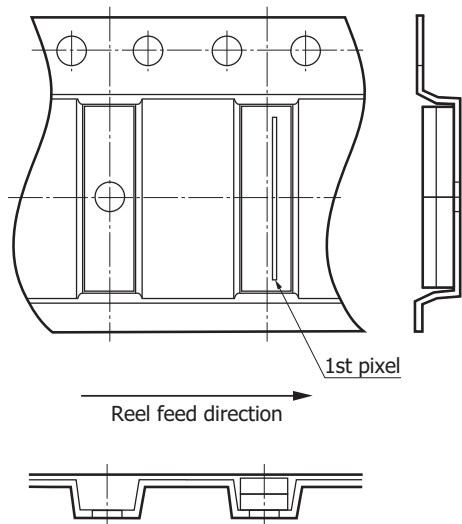
KMPDC0536EA

**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)



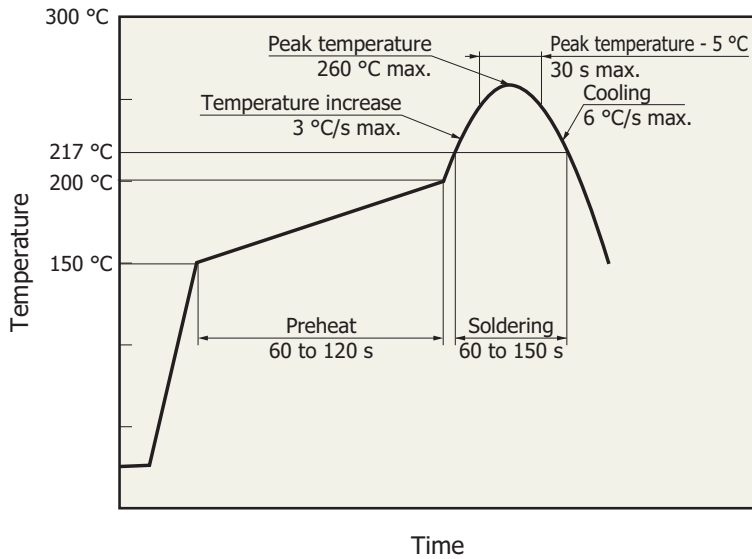
KMPDC0546EA

- 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.



### Recommended temperature profile for reflow soldering (typical example)



KMPD80405EB

- 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 3 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](http://www.hamamatsu.com/sp/ssd/doc_en.html)

### ■ Precautions

- Disclaimer
- Image sensors
- Resin sealed type CMOS linear image sensors
- Surface mount type products

Information described in this material is current as of March 2018.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use. Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.

# HAMAMATSU

[www.hamamatsu.com](http://www.hamamatsu.com)

HAMAMATSU PHOTONICS K.K., Solid State Division

1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81)53-434-3311, Fax: (81)53-434-5184

U.S.A.: Hamamatsu Corporation: 360 Foothill Road, Bridgewater, N.J. 08807, U.S.A., Telephone: (1)908-231-0960, Fax: (1)908-231-1218, E-mail: [usa@hamamatsu.com](mailto:usa@hamamatsu.com)

Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49)8152-375-0, Fax: (49)8152-265-8, E-mail: [info@hamamatsu.de](mailto:info@hamamatsu.de)

France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: (33)1 69 53 71 00, Fax: (33)1 69 53 71 10, E-mail: [infos@hamamatsu.fr](mailto:infos@hamamatsu.fr)

United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44)1707-294888, Fax: (44)1707-325777, E-mail: [info@hamamatsu.co.uk](mailto:info@hamamatsu.co.uk)

North Europe: Hamamatsu Photonics Norden AB: Torshamnsgatan 35 16440 Kista, Sweden, Telephone: (46)8-509 031 00, Fax: (46)8-509 031 01, E-mail: [info@hamamatsu.se](mailto:info@hamamatsu.se)

Italy: Hamamatsu Photonics Italia S.r.l.: Strada della Moia, 1 int. 6, 20020 Arese (Milano), Italy, Telephone: (39)02-93 58 17 33, Fax: (39)02-93 58 17 41, E-mail: [info@hamamatsu.it](mailto:info@hamamatsu.it)

China: Hamamatsu Photonics (China) Co., Ltd.: B1201, Jiaming Center, No.27 Dongsanhuan Bellu, Chaoyang District, 100020 Beijing, P.R.China, Telephone: (86)10-6586-6006, Fax: (86)10-6586-2866, E-mail: [hpc@hamamatsu.com.cn](mailto:hpc@hamamatsu.com.cn)

Taiwan: Hamamatsu Photonics Taiwan Co., Ltd.: 8F-3, No. 158, Section2, Gongdao 5th Road, East District, Hsinchu, 300, Taiwan R.O.C. Telephone: (886)3-659-0080, Fax: (886)3-659-0081, E-mail: [info@hamamatsu.com.tw](mailto:info@hamamatsu.com.tw)