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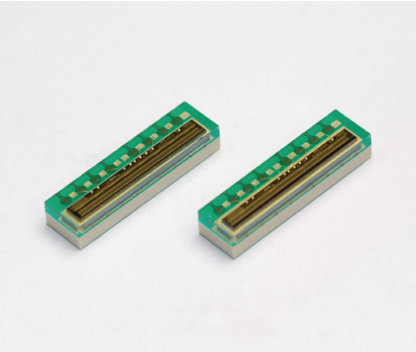
# CMOS linear image sensors

S11106-10 S11107-10



## Compact size and high cost-performance

The S11106-10 and S11107-10 are CMOS linear image sensors of resin sealing type that delivers a video data rate of 10 MHz and low current consumption. The pixel size is 63.5 × 63.5 μm (S11106-10), 127 × 127 μm (S11107-10).

## Features

- **Compact size and high cost-performance**
- **Resin sealing type, surface mount package: 2.4 × 9.1 ×1.6t mm**
- **Pixel size:**
  **S11106-10: 63.5 × 63.5 μm, 128 pixels**
  **S11107-10: 127 × 127 μm, 64 pixels**
- **High-speed data rate: 10 MHz max.**
- **3 V or 5 V single power supply operation**
- **Built-in timing generator allows operation with only Start and Clock pulse inputs**
- **Low current consumption**
- **Allows simultaneous charge integration**

## Applications

- **Position detection**
- **Object measurement**
- **Rotary encoder**
- **Image reading**

## Structure

| Parameter | S11106-10 | S11107-10 | Unit |
|---|---|---|---|
| Number of pixels | 128 | 64 | - |
| Pixel pitch | 63.5 | 127 | μm |
| Pixel height | 63.5 | 127 | μm |
| Photosensitive area length | 8.06 | | mm |
| Package | Glass epoxy | | - |
| Seal material | Silicone resin | | - |

## Absolute maximum ratings

| Parameter | Symbol | Condition | Value | Unit |
|---|---|---|---|---|
| Supply voltage | Vdd | 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*1 | Topr | | -40 to +85 | °C |
| Storage temperature*1 | Tstg | | -40 to +85 | °C |
| Reflow soldering conditions*2 | Tsol | | Peak temperature 260 °C, 3 times (See p.11) | - |

*1: No condensation

*2: JEDEC level 2a

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to the product within the absolute maximum ratings.

## Recommended terminal voltage (Ta=25 °C)

| Parameter | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply voltage | | Vdd | 3.0 | - | 5.25 | V |
| Clock pulse voltage | High level | V(CLK) | 3.0 | Vdd | Vdd + 0.25 | V |
| | Low level | | 0 | - | 0.4 | V |
| Start pulse voltage | High level | V(ST) | 3.0 | Vdd | Vdd + 0.25 | V |
| | Low level | | 0 | - | 0.4 | V |

## Electrical characterisitics (Ta=25 °C)

| Parameter | | Symbol | S11106-10 | | | S11107-10 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Clock pulse frequency | | f(CLK) | 5 k | - | 10 M | 5 k | - | 10 M | Hz |
| Video data rate | | VR | - | f(CLK) | - | - | f(CLK) | - | Hz |
| Output impedance | | Zo | 60 | - | 140 | 60 | - | 140 | Ω |
| Current consumption*3 | Vdd=3 V | I | 4.0 | 6.0 | 8.0 | 2.5 | 4.5 | 6.5 | mA |
| | Vdd=5 V | | 7.0 | 9.0 | 11.0 | 4.5 | 6.5 | 8.5 | |

*3: f(CLK)=10 MHz, dark state, V(CLK)=V(ST)=Vdd

## Electrical and optical characteristics [Ta=25 °C, Vdd=3 V/5 V, V(CLK)=V(ST)=Vdd, f(CLK)=10 MHz]

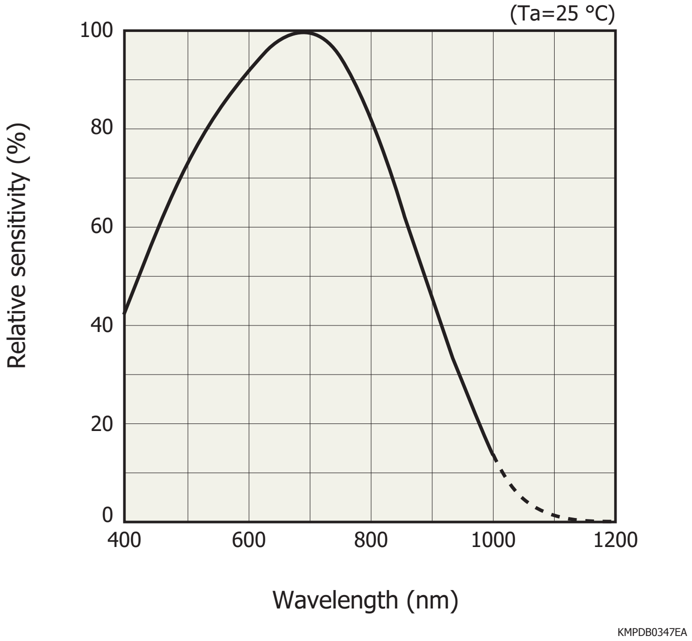
| Parameter | | Symbol | S11106-10 | | | S11107-10 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Spectral response range | | λ | 400 to 1000 | | | 400 to 1000 | | | nm |
| Peak sensitivity wavelength | | λp | - | 700 | | - | 700 | - | nm |
| Photosensitivity*4 | | S | - | 80 | - | - | 75 | - | V/(lx·s) |
| Conversion efficiency*5 | | CE | - | 0.75 | - | - | 0.35 | - | µV/e⁻ |
| Output offset voltage | | Vo | 0.5 | 0.8 | 1.1 | 0.5 | 0.8 | 1.1 | V |
| Dark output voltage*6 | | Vd | - | 0.02 | 0.2 | - | 0.04 | 0.4 | mV |
| Saturation output voltage*7 | Vdd=3 V | Vsat | 1.8 | 2.0 | 2.2 | 1.8 | 2.0 | 2.2 | V |
| | Vdd=5 V | | 3.7 | 4.0 | 4.3 | 3.7 | 4.0 | 4.3 | |
| Readout noise*8 | Vdd=3 V | Nr | - | 1.0 | 1.5 | - | 0.9 | 1.5 | mV rms |
| | Vdd=5 V | | - | 0.7 | 1.2 | - | 0.6 | 1.1 | |
| Dynamic range 1*9 | Vdd=3 V | DR1 | - | 2000 | - | - | 2200 | - | times |
| | Vdd=5 V | | - | 5700 | - | - | 6600 | - | |
| Dynamic range 2*10 | Vdd=3 V | DR2 | - | 100000 | - | - | 50000 | - | times |
| | Vdd=5 V | | - | 200000 | - | - | 100000 | - | |
| Photoresponse nonuniformity*4 *11 | | PRNU | - | ±2 | ±10 | - | ±2 | ±10 | % |

*4: Measured with a 2856 K tungsten lamp
*5: Output voltage generated per one electron
*6: Integration time=10 ms
*7: Voltage difference from Vo
*8: Dark state
*9: DR1 = Vsat/Nr
*10: DR2 = Vsat/Vd
*11: 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 112 pixels (S11106-10) excluding 8 pixels each at both ends or 56 pixels (S11107-10) excluding 4 pixels each at both ends, and is defined as follows:
PRNU = $\Delta X/X \times 100$ [%]
X: the average output of all pixels, ΔX: difference between X and maximum or minimum output

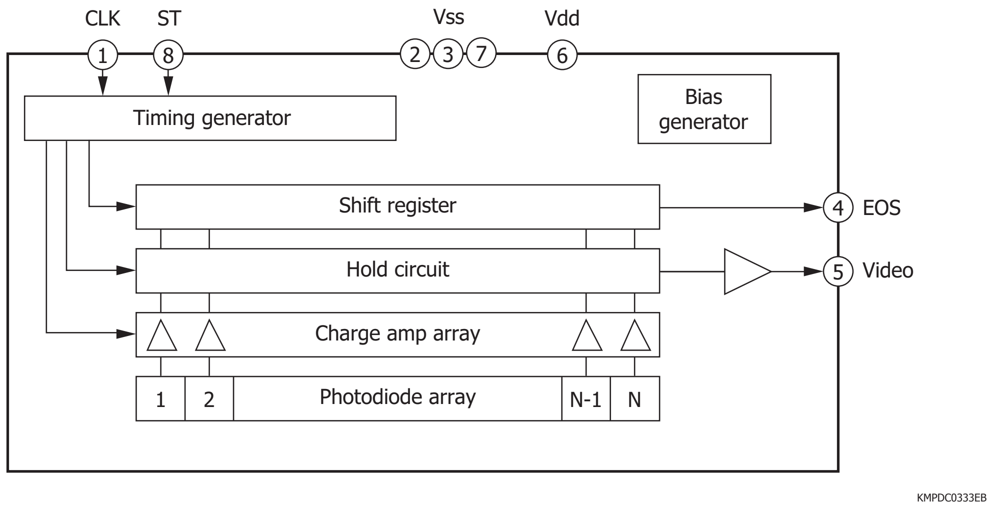
## Appearance inspection standards

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

## Spectral response (typical example)




## Block diagram

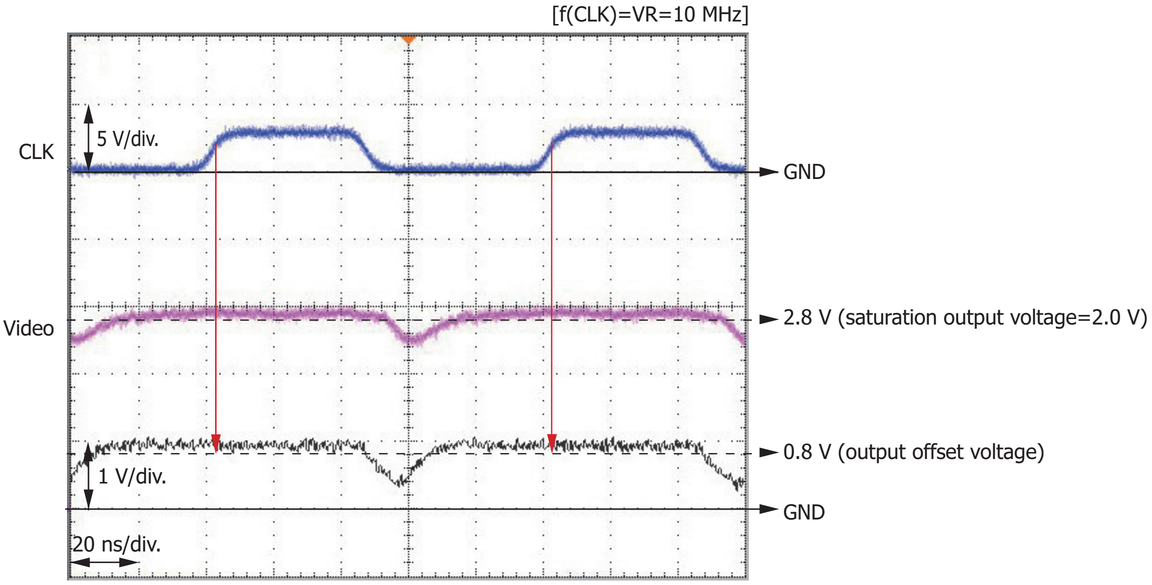


## Output waveform of one pixel

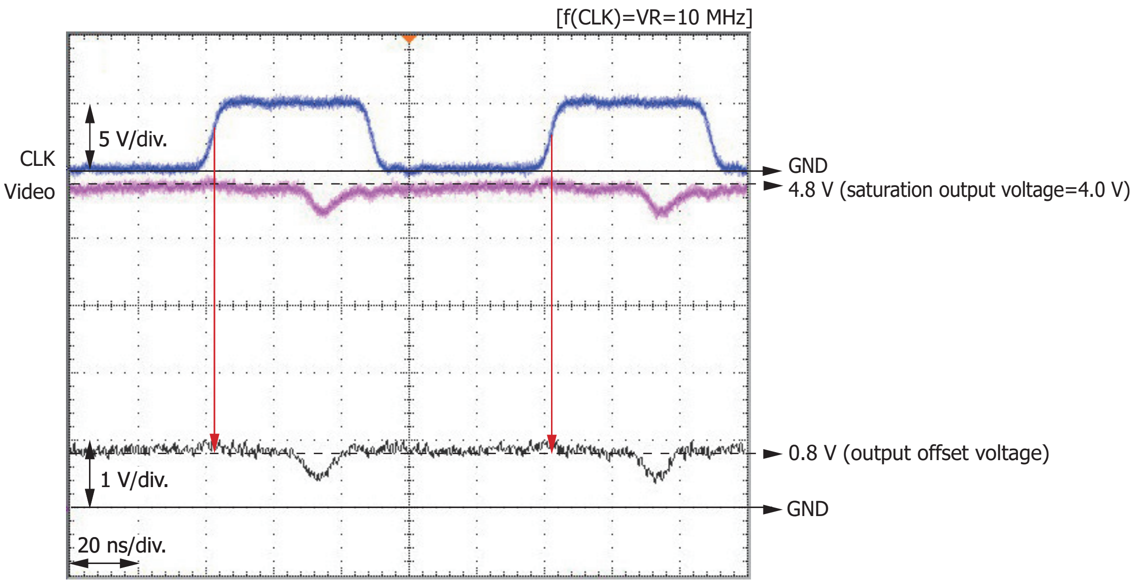
The timing for acquiring the Video signal is synchronized with the rising edge of CLK (See red arrow below).

| S11106-10 |
|---|

■ Vdd=3 V

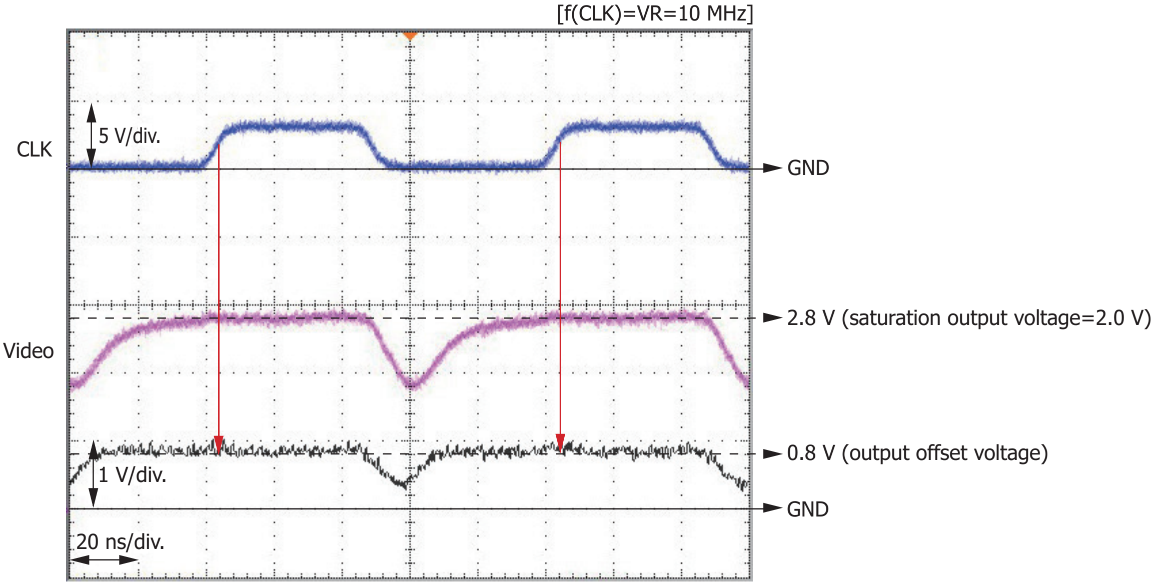



■ Vdd=5 V

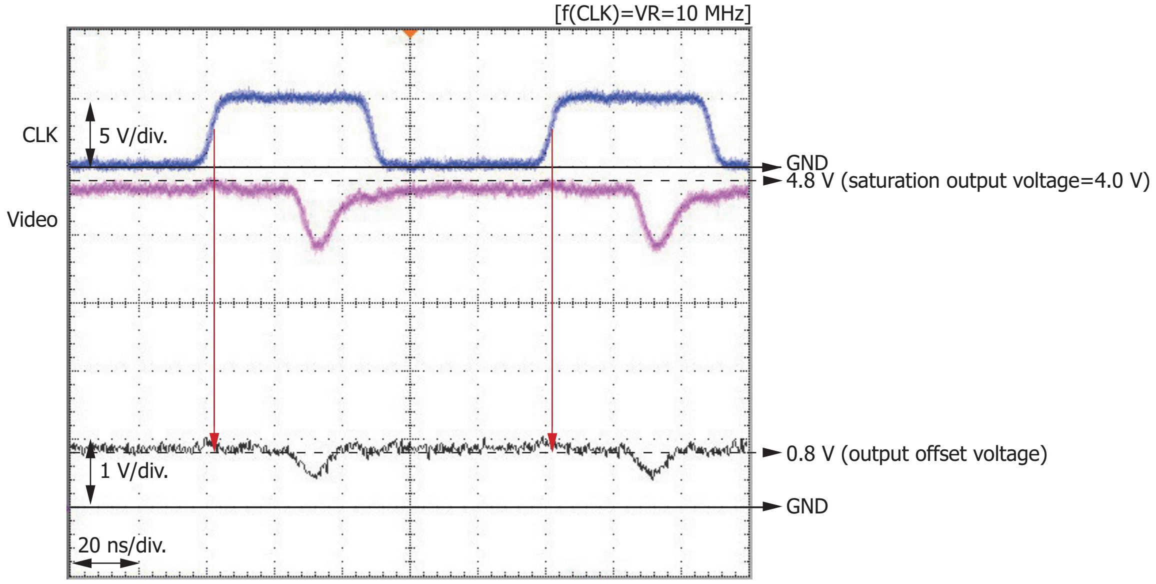


S11107-10

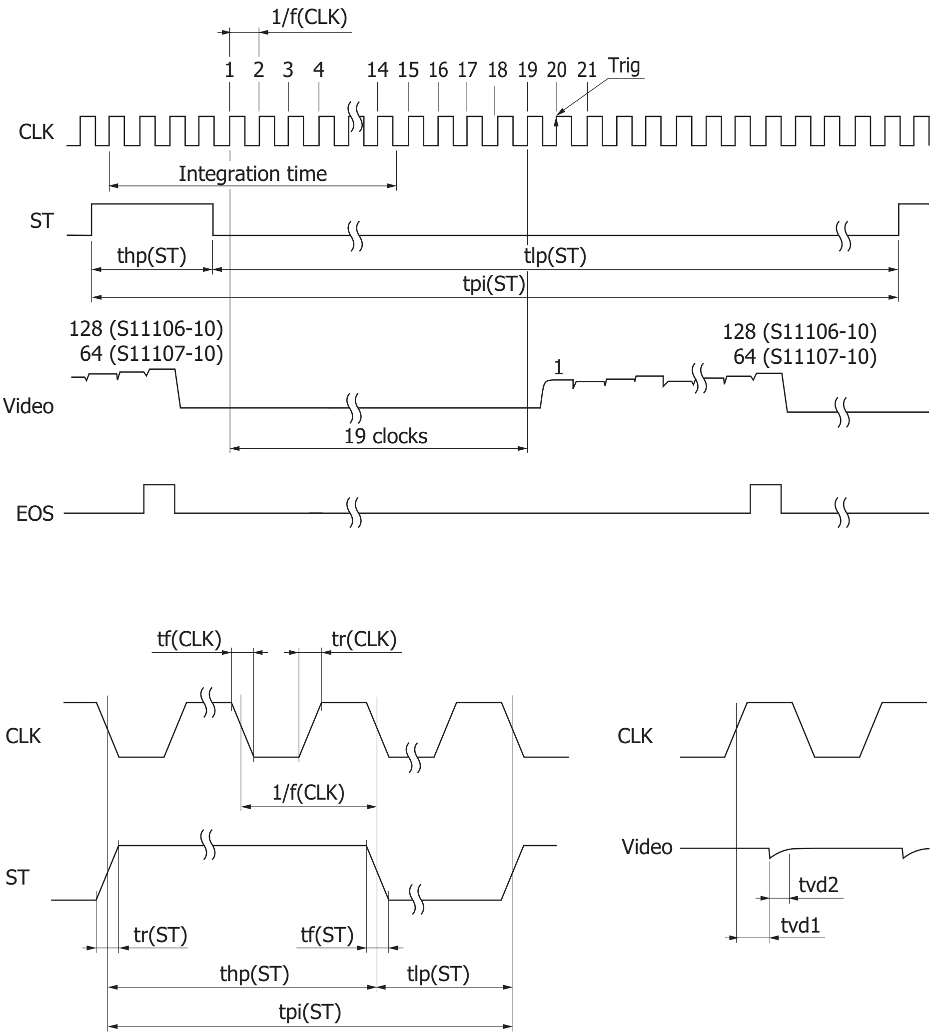
■ Vdd=3 V




■ Vdd=5 V



## Timing chart




KMPDC0515EB

| Parameter | | Symbol | S11106-10 | | | S11107-10 | | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| Start pulse interval | | tpi(ST) | 36/f(CLK) | - | - | 36/f(CLK) | - | - | s |
| Start pulse high period | | thp(ST) | 4/f(CLK) | - | - | 4/f(CLK) | - | - | s |
| Start pulse low period | | tlp(ST) | 32/f(CLK) | - | - | 32/f(CLK) | - | - | s |
| Start pulse rise and fall times | | tr(ST), tf(ST) | 0 | 10 | 15 | 0 | 10 | 15 | ns |
| Clock pulse duty ratio | | - | 45 | 50 | 55 | 45 | 50 | 55 | % |
| Clock pulse rise and fall times | | tr(CLK), tf(CLK) | 0 | 10 | 15 | 0 | 10 | 15 | ns |
| Video delay time 1*12 | Vdd=3 V | tvd1 | - | 60 | - | - | 60 | - | ns |
| | Vdd=5 V | | - | 35 | - | - | 35 | - | |
| Video delay time 2*12 | Vdd=3 V | tvd2 | - | 35 | - | - | 35 | - | ns |
| | Vdd=5 V | | - | 30 | - | - | 30 | - | |

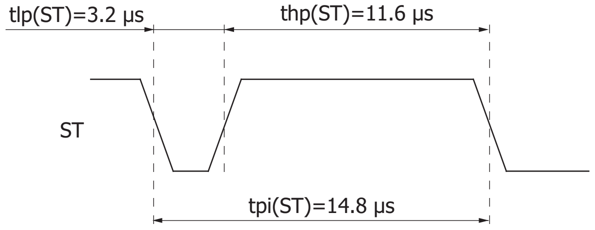
*12: Ta=25 °C, CLK=10 MHz, V(CLK)=V(ST)=Vdd

Note: Dark output increases if the start pulse period or the start pulse high period is lengthened.
The internal timing generator starts operation at the rising edge of CLK immediately after ST goes low. The rising edge of this CLK is regarded as "1".
The integration time equals the high period of ST plus 14 CLK cycles and minus 100 ns.
When the ST pulse is set to low while the shift register is operating, the operation of the shift register is reset and the next shift register operation will start.
The integration time can be changed by changing the ratio of the high and low periods of ST.

## Operation example

S11106-10

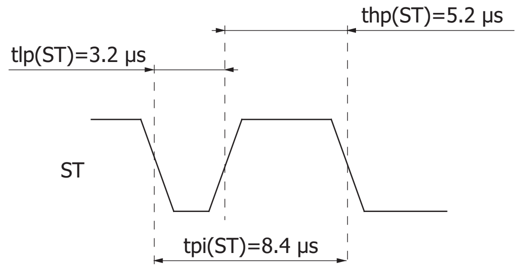
When the clock pulse frequency is maximized (video data rate is also maximized), the time of one scan is minimized, and the integration time is maximized (for outputting signals from all 128 channels)
Clock pulse frequency = Video data rate = 10 MHz
Start pulse cycle = 148/f(CLK) = 148/10 MHz = 14.8 μs
High period of start pulse = Start pulse cycle - Start pulse's low period min.
= 148/f(CLK) - 32/f(CLK) = 148/10 MHz - 32/10 MHz = 11.6 μs
Integration time is equal to the high period of start pulse + 14 cycles of clock pulses - 100 ns, so it will be 11.6 + 1.4 - 0.1 = 12.9 μs.




KMPDC0388EB

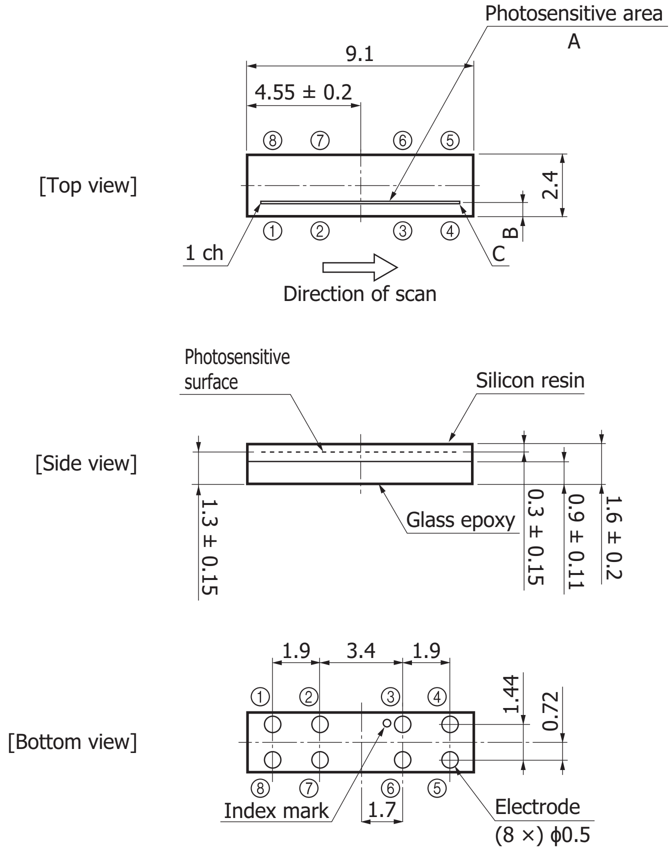
S11107-10

When 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 (for outputting signals from all 64 channels)
Clock pulse frequency = Video data rate = 10 MHz
Start pulse cycle = 84/f(CLK) = 84/10 MHz = 8.4 μs
High period of start pulse = Start pulse cycle - Start pulse's low period min.
= 84/f(CLK) - 32/f(CLK) = 84/10 MHz - 32/10 MHz = 5.2 μs
Integration time is equal to the high period of start pulse + 14 cycles of clock pulses - 100 ns, so it will be 5.2 + 1.4 - 0.1 = 6.5 μs.




KMPDC0389EB

## Dimensional outline (unit: mm)




Tolerance unless otherwise noted: ±0.2

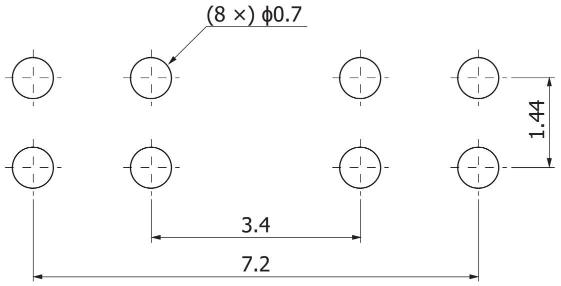
| Type no. | A | B | C |
|---|---|---|---|
| S11106-10 | 8.06 × 0.0635 | 0.4 | 128 ch |
| S11107-10 | 8.06 × 0.127 | 0.5 | 64 ch |

KMPDA0314EB

## Pin connections

| Pin no. | Symbol | Description | Input/Output |
|---|---|---|---|
| 1 | CLK | Clock pulse | Input |
| 2 | Vss | Ground | - |
| 3 | Vss | Ground | - |
| 4 | EOS | End of scan | Output |
| 5 | Video | Video signal | Output |
| 6 | Vdd | Supply voltage | Input |
| 7 | Vss | Ground | - |
| 8 | ST | Start pulse | Input |

## Recommended land pattern

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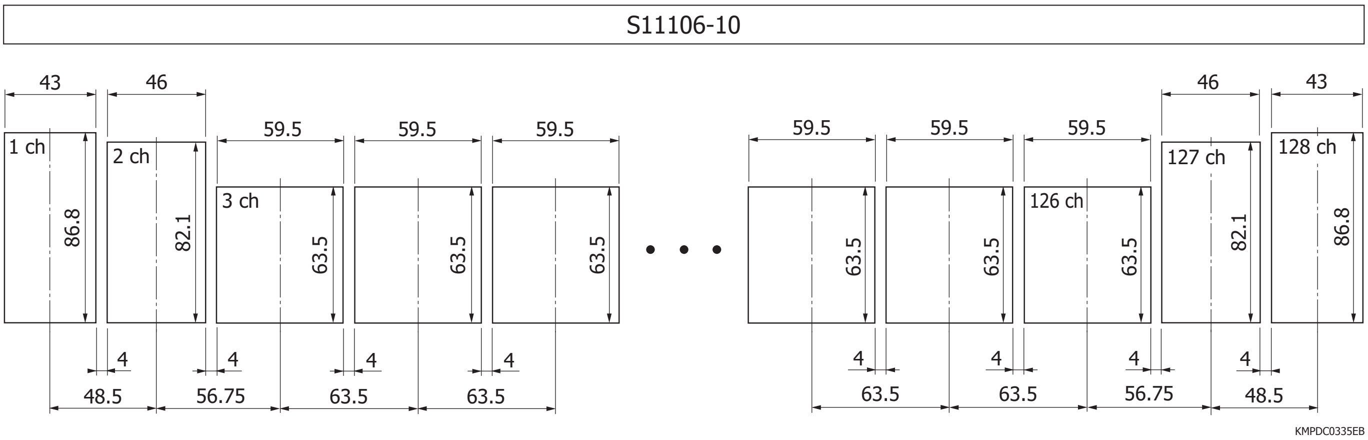
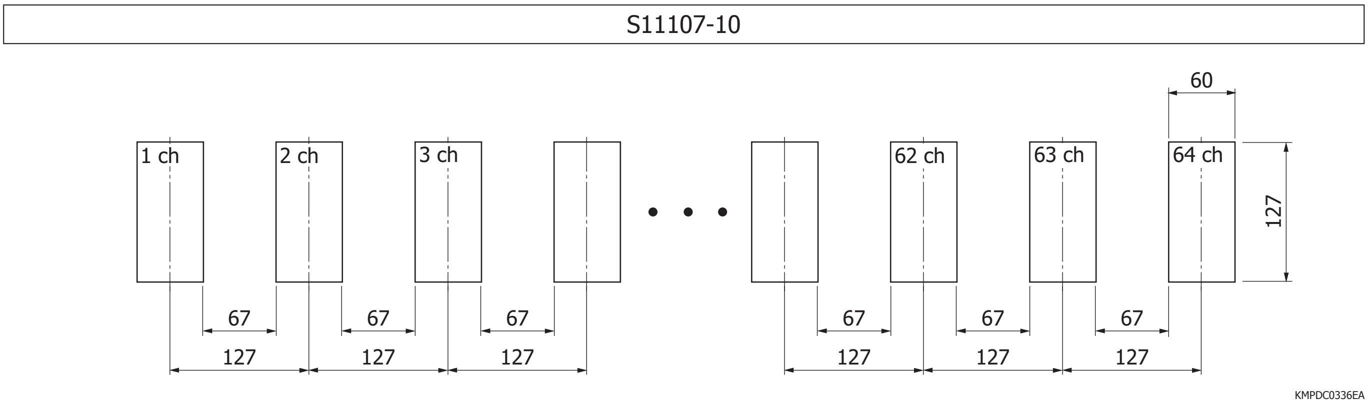
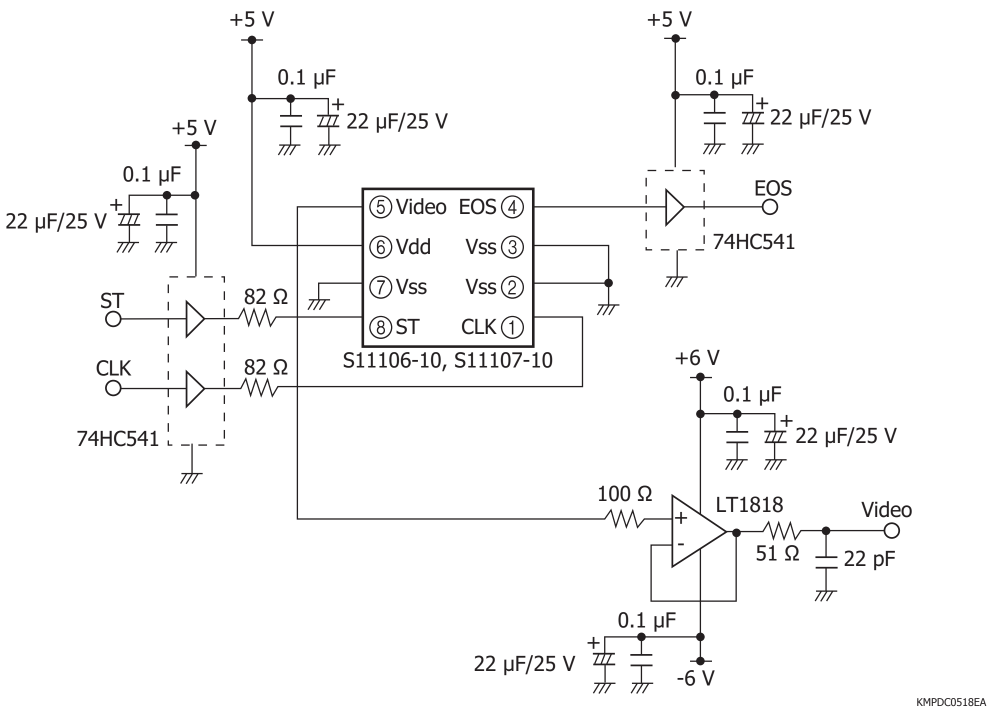
## Details of active area (unit: μm)




## Application circuit example

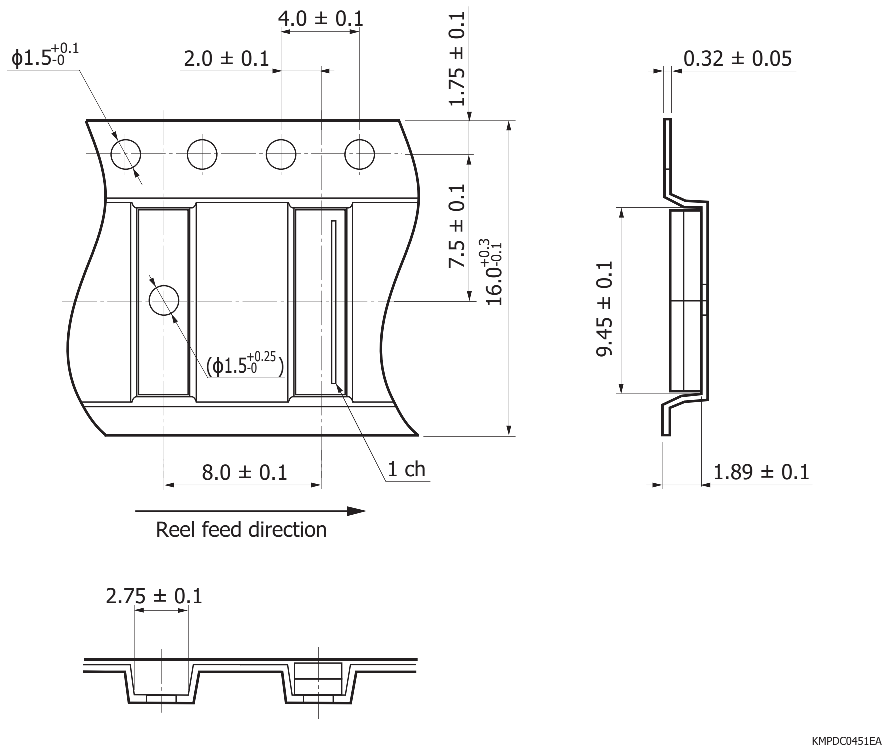


## Standard packing specifications

■ Reel (conforms to JEITA ET-7200)

| Dimensions | Hub diameter | Tape width | Material | Electrostatic characteristics |
|---|---|---|---|---|
| 330 mm | 100 mm | 16 mm | PPE | Conductive |

■ Embossed (unit: mm, material: polystyrene, conductive)




■ Packing quantity

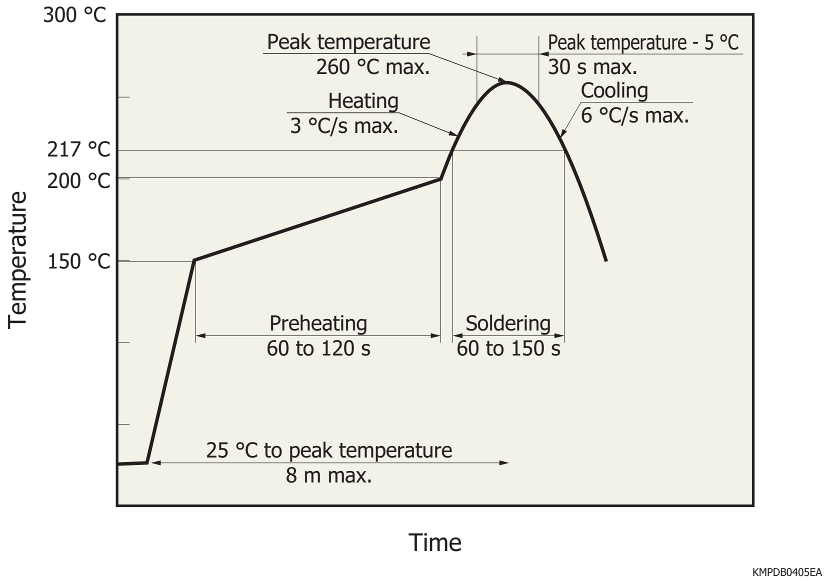
2000 pcs/reel

Packing specifications may vary on orders less than 2000 pieces.

■ Packing type

Reel and desiccant in moisture-proof packing (vaccum-sealed)

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




· 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 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 tesitng out the reflow soldering methods in advance.
· When three or more months have passed or if the packing bag has not been stored in an environment described above, perform baking. For the baking method, see the precautons "Resin sealed type CMOS linear image sensors."

## Precautions

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

(2) Package handling
· The photosensitive area of this device is sealed and protected by transparent resin. When compared to a glass faceplate, the surface of transparent resin may be less uniform and is more likely to be scratched. Be very careful when handling this device and also when designing the optical systems.
· Dust or grime on the light input window might cause nonuniform sensitivity. To remove dust or grime, blow it off with compressed air.

(3) Surface protective tape
· Protective tape is affixed to the surface of this product to protect the photosensitive area. After assembling the product, remove the tape before use.

(4) Operating and storage environments
· Handle the device within the temperature range specified in the absolute maximum ratings. 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

· Notice
· Image sensor
· Resin-sealed CMOS linear image sensors



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