

S10111 to S10114 series

**Current-output type sensors with variable integration time function**

The S10111 to S10114 series are self-scanning photodiode arrays designed specifically as detectors for spectroscopy. The scanning circuit operates at low power consumption and is easy to handle. Each photodiode has a large active area with high UV sensitivity.

**Features**

- Variable integration time for each pixel
- Wide active area  
Pixel pitch: 50 μm, 25 μm  
Pixel height: 2.5 mm, 0.5 mm
- High UV sensitivity
- Large saturation output charge

**Applications**

- Spectrophotometry

**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
Integration time control pulse	V(INT)	Ta=25 °C	-0.3 to +6	V
Overflow gate voltage	Vofg	Ta=25 °C	-0.3 to +6	V
Overflow drain voltage	Vofd	Ta=25 °C	-0.3 to +6	V
Operating temperature*1	Topr		-5 to +65	°C
Storage temperature*1	Tstg		-10 to +85	°C

\*1: No condensation

**Shape specifications**

Type no.	Number of pixels	Pixel pitch (μm)	Pixel height (mm)	Package	Window material	Weight (g)
S10111-128Q	128	50	2.5	Ceramic	Quartz (t=0.5 mm)	3.0
S10111-256Q	256					
S10111-512Q	512					
S10112-128Q	128		0.5			3.0
S10112-256Q	256					
S10112-512Q	512					
S10113-256Q	256	25	0.5			3.0
S10113-512Q	512					
S10113-1024Q	1024					
S10114-256Q	256		2.5			3.0
S10114-512Q	512					
S10114-1024Q	1024					

▣ Recommended terminal voltage (Ta=25 °C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	Vdd	4.75	5	5.25	V
Clock pulse voltage	High level	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level	0	-	0.4	
Start pulse voltage	High level	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level	0	-	0.4	
Integration time control pulse voltage	High level	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level	0	-	0.4	
Overflow drain voltage	Vofd	0.5	2	2.5	V
Overflow gate voltage	Vofg	0.17	0.2	0.23	V

▣ Electrical characteristics [Ta=25 °C, Vdd=5 V, Vb=Vofd=2 V, Vofg=0.2 V]

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency	S10111/S10114 series	10 k	-	250 k	Hz
	S10112/S10113 series	10 k	-	500 k	
Video data rate	VR	-	f(CLK)	-	Hz
Power consumption*2	S10111-128Q	-	0.75	-	mW
	S10111-256Q	-	1.75	-	
	S10111-512Q	-	4.25	-	
	S10112-128Q	-	1.5	-	
	S10112-256Q	-	3.5	-	
	S10112-512Q	-	8.25	-	
	S10113-256Q	-	3.25	-	
	S10113-512Q	-	7.25	-	
	S10113-1024Q	-	18.25	-	
	S10114-256Q	-	1.75	-	
	S10114-512Q	-	3.75	-	
	S10114-1024Q	-	8.25	-	
	Video line capacitance (Vb=2 V)	S10111/S10112-128Q	-	10	
S10111/S10112-256Q		-	14	-	
S10111/S10112-512Q		-	22	-	
S10113/S10114-256Q		-	13	-	
S10113/S10114-512Q		-	19	-	
S10113/S10114-1024Q		-	32	-	

\*2: f(CLK)=250 kHz (S10111/S10114 series), 500 kHz (S10112/S10113 series)

**Electrical and optical characteristics [Ta=25 °C, Vdd=5 V, Vb=Vofd=2 V, Vofg=0.2 V, f(CLK)=200 kHz]**

Parameter	Symbol	Min.	Typ.	Max.	Unit
Spectral response range	$\lambda$	200	-	1000	nm
Peak sensitivity wavelength	$\lambda_p$	-	750	-	nm
Dark current	S10111 series	-	0.2	0.6	pA
	S10112 series	-	0.04	0.12	
	S10113 series	-	0.04	0.12	
	S10114 series	-	0.2	0.6	
Saturation output charge	S10111 series	110	140	-	pC
	S10112 series	22	28	-	
	S10113 series	11	14	-	
	S10114 series	55	70	-	
Saturation exposure <sup>*3</sup>	Esat	-	580	-	m/x · s
Photo response non-uniformity <sup>*3 *4 *5</sup>	PRNU	-	-	±3	%

\*3: Measured with a tungsten lamp of 2856 K

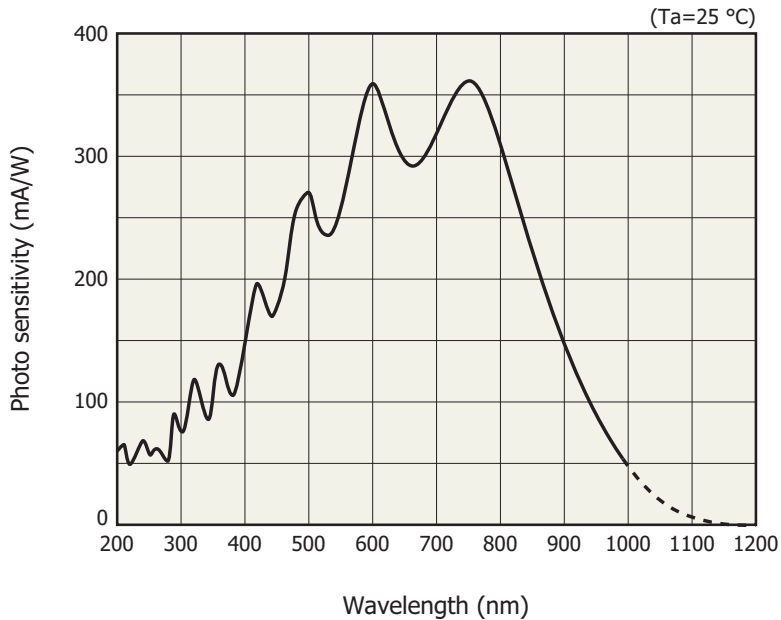
\*4: Photo response non-uniformity is defined under the condition that the device is uniformly illuminated by light which is 50 % of the saturation exposure level as follows:

$$PRNU = \frac{\Delta X}{X} \times 100 (\%)$$

X: the average output of all pixels,  $\Delta X$ : difference between X and maximum or minimum output.

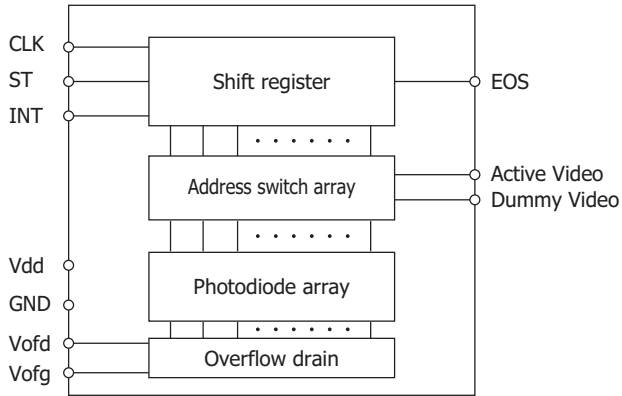
\*5: Except for the first and last pixels

**Spectral response (typical example)**



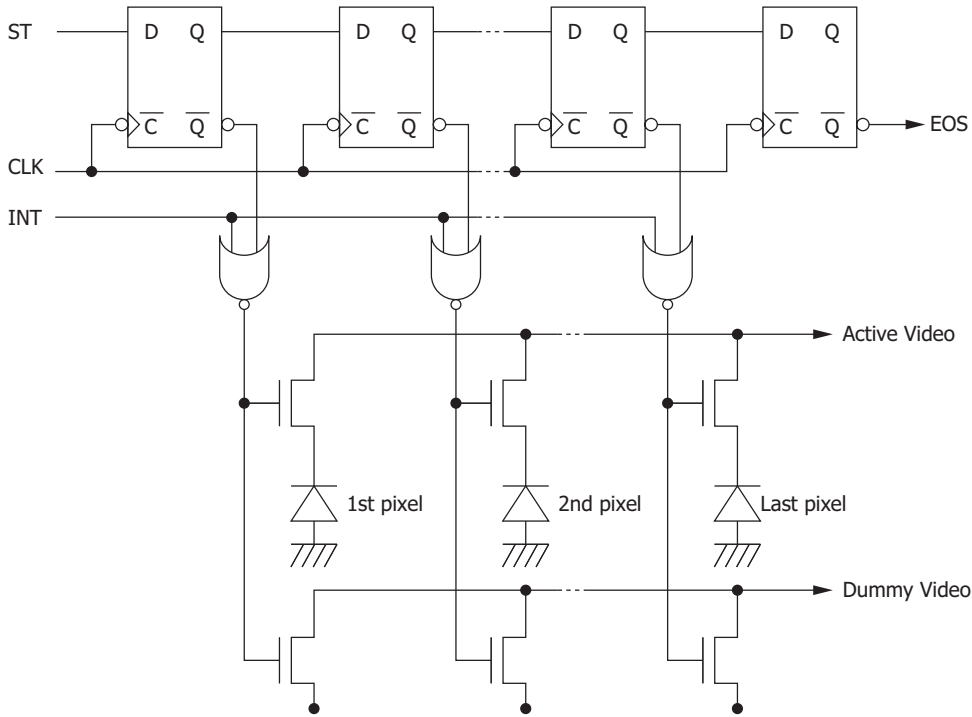
KMPDB0250ED

**Block diagram**



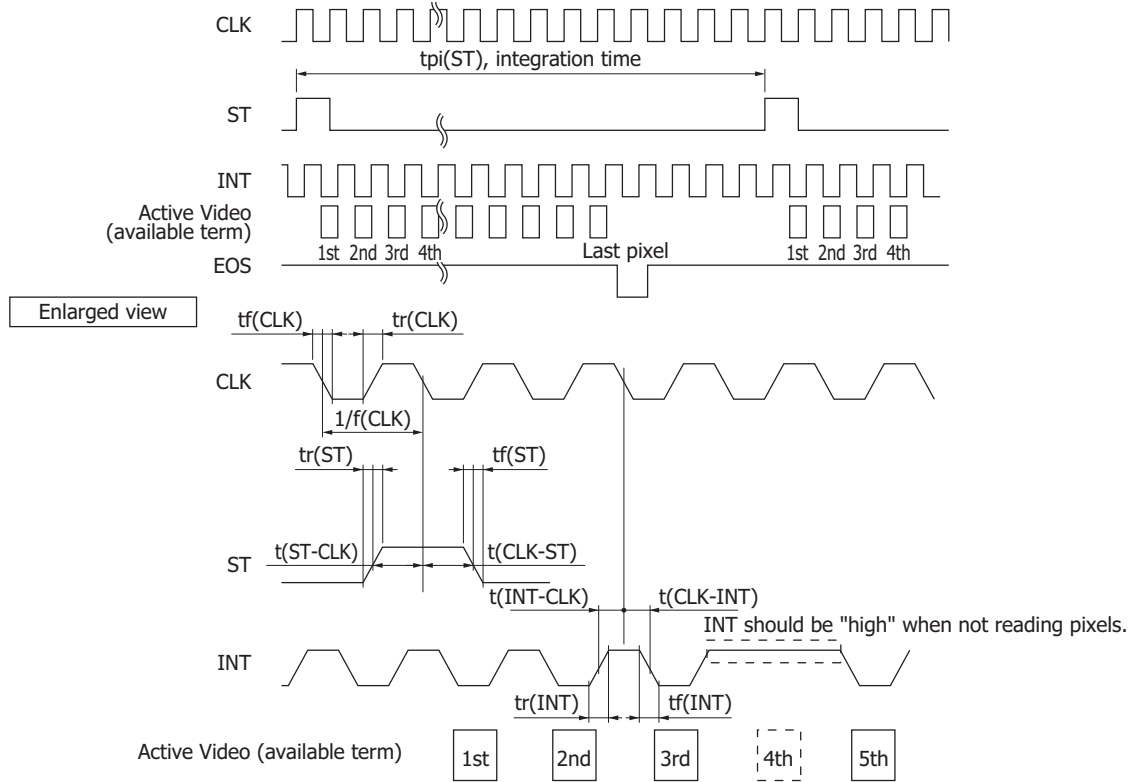
KMPDC0232EC

**Equivalent circuit**



KMPDC0279EB

**Timing chart**



Allow CLK pulse transition from "high" to "low" only one time while ST pulse is "high".  
Integration time is determined by the interval between start pulses.

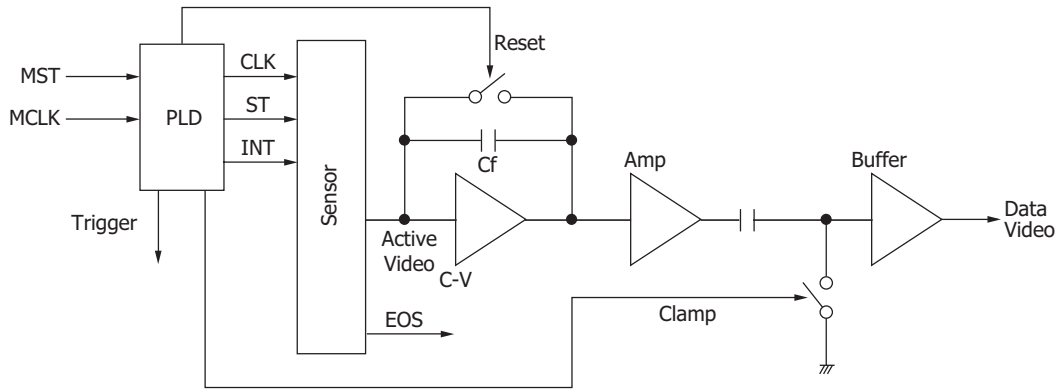
Only the switching noise component is output from the Dummy Video line.  
Do not use the Dummy Video output during integration readout.  
The INT signal is not needed between EOS and the rising edge of the next ST signal.

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Parameter	Symbol	Min.	Typ.	Max.	Unit
Start pulse (ST) interval	S1011*-128	130/f(CLK)	-	-	s
	S1011*-256	258/f(CLK)	-	-	
	S1011*-512	514/f(CLK)	-	-	
	S1011*-1024	1026/f(CLK)	-	-	
INT pulse rise and fall times	$t_r(INT)$ , $t_f(INT)$	0	20	30	ns
INT pulse - clock pulse timing	$t(INT-CLK)$	30	-	$1 / [2 \times f(CLK)]$	ns
Clock pulse - INT pulse timing	$t(CLK-INT)$	30	-	$1 / [2 \times f(CLK)]$	ns
Start pulse rise and fall times	$t_f(ST)$ , $t_r(ST)$	0	20	30	ns
Clock pulse duty ratio	-	40	50	60	%
Clock pulse rise and fall times	$t_f(CLK)$ , $t_r(CLK)$	0	20	30	ns
Clock pulse - start pulse timing	$t(CLK-ST)$	20	-	-	ns
Start pulse - clock pulse timing	$T(ST-CLK)$	20	-	-	ns

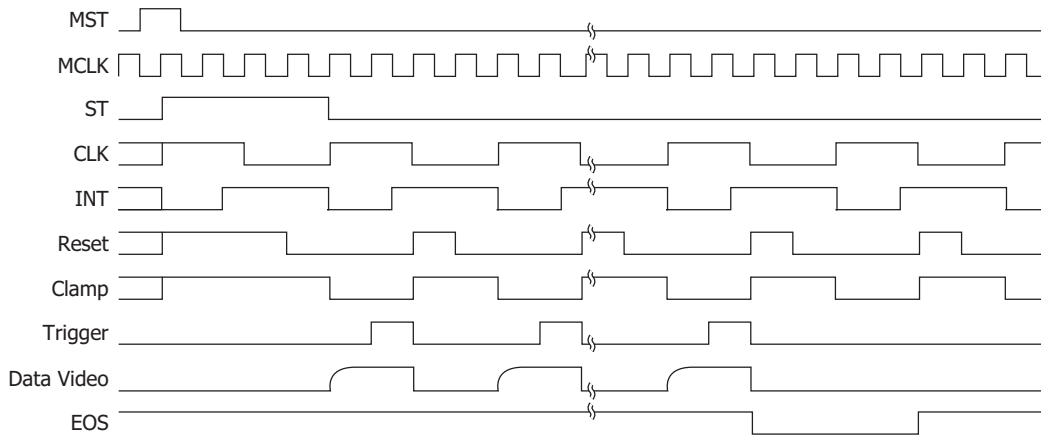
Current-integration readout circuit example and timing chart

Readout circuit example



KMPDC0385EB

Timing chart



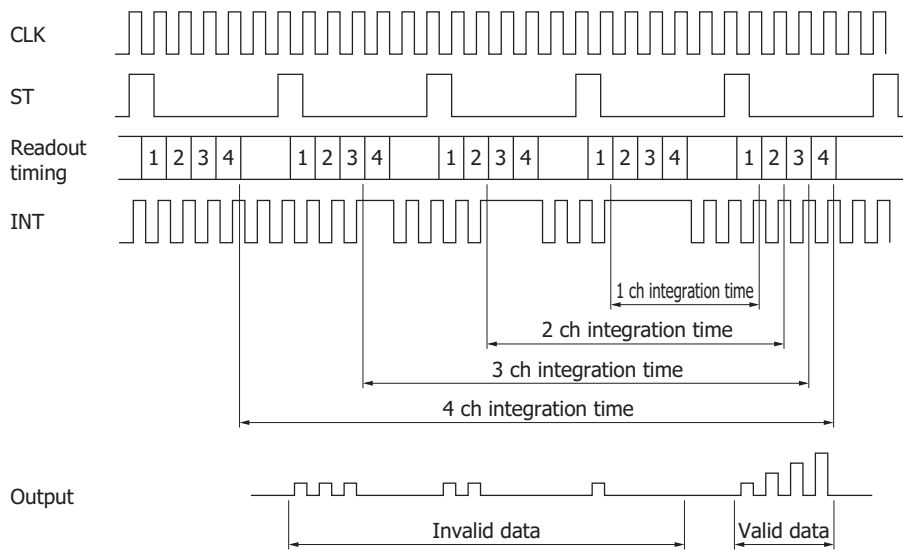
KMPDC0386EA

**Variable integration time function**

By controlling the clock pulse to the INT terminal, the integration time for each pixel can be changed to any length that is an integer multiple of one readout period. When the clock pulse at the INT terminal is set to "high" at the pixel signal readout timing, then no signal is output from that pixel (see below). This allows the signal charge to continuously accumulate in that pixel as long as no signal is output. For example, when the integration time of one readout period is 100 ms and this function is used to output a signal from a pixel once every 3 readout periods, then the integration time of that pixel will be 300 ms. Using this function to lengthen the integration time of certain pixels makes it possible to effectively detect spectral signals of weak wavelength components.

■ Timing chart

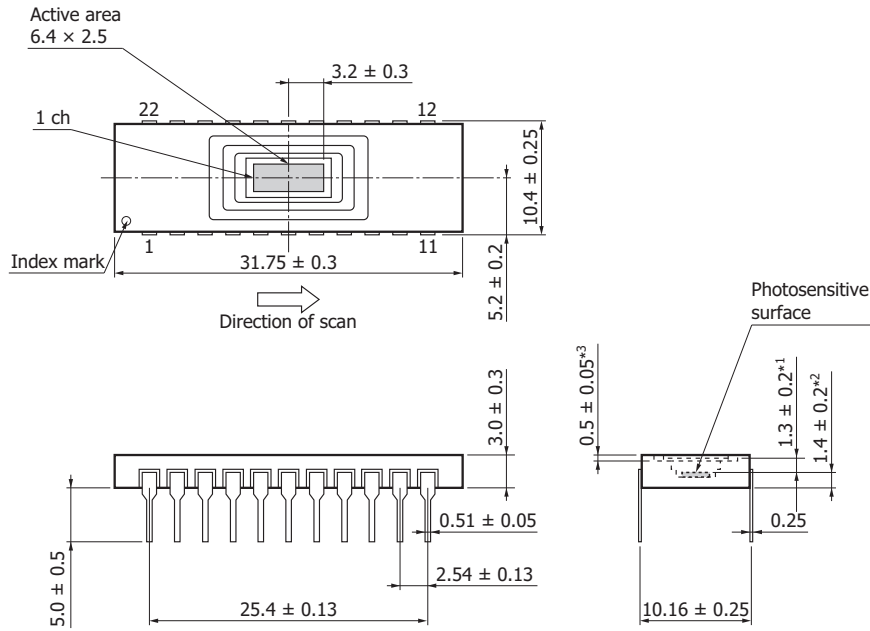
(Concept view showing the settings to double, triple and quadruple the integration times at channels 2, 3 and 4, respectively, by using the variable integration time function on the basis of the integration time at channel 1.)



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Dimensional outlines (unit: mm)

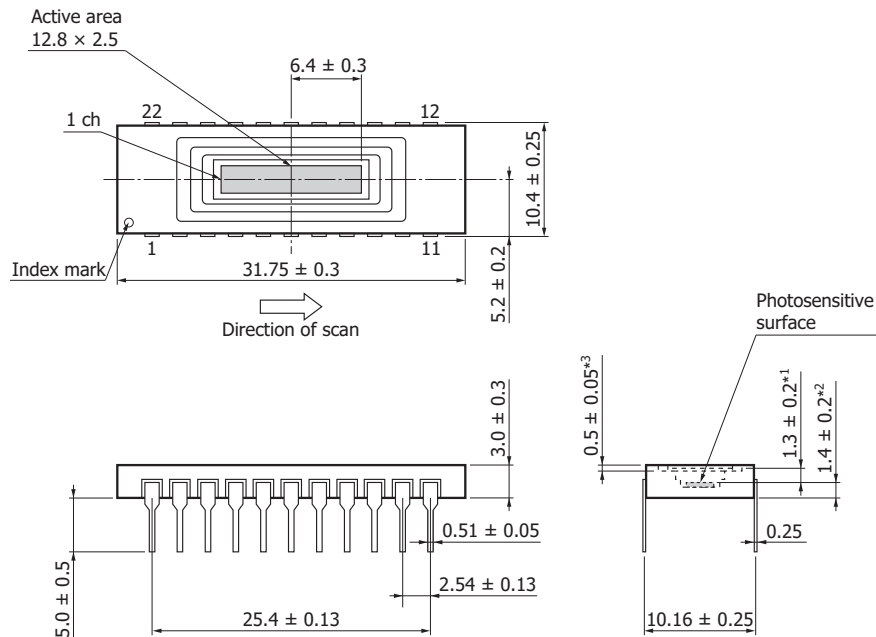
S10111-128Q, S10114-256Q



- \*1: Distance from upper surface of quartz window to chip surface
- \*2: Distance from photosensitive surface to bottom of package
- \*3: Window thickness

KMPDA0060EE

S10111-256Q, S10114-512Q

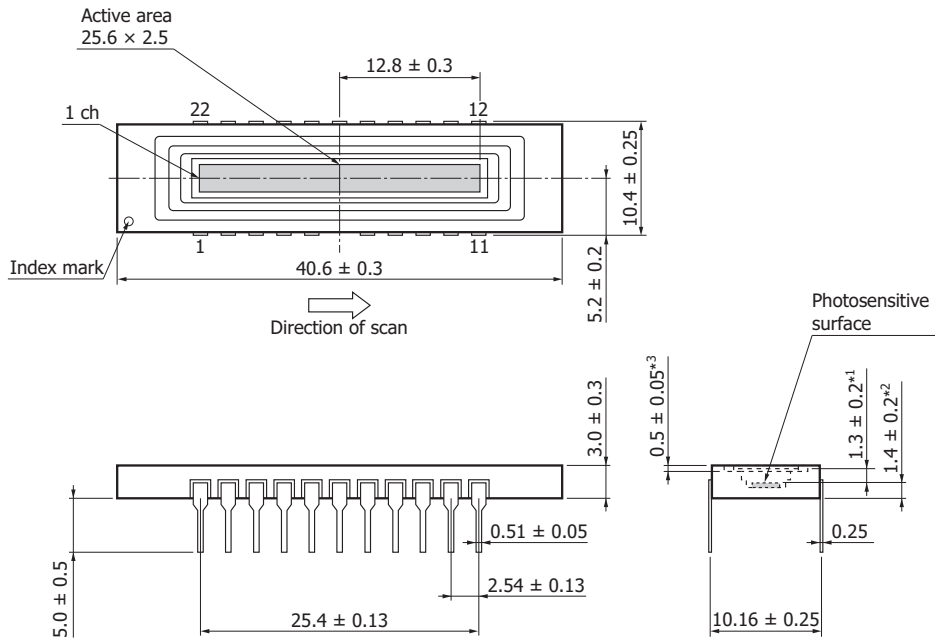


- \*1: Distance from upper surface of quartz window to chip surface
- \*2: Distance from photosensitive surface to bottom of package
- \*3: Window thickness

KMPDA0061EE



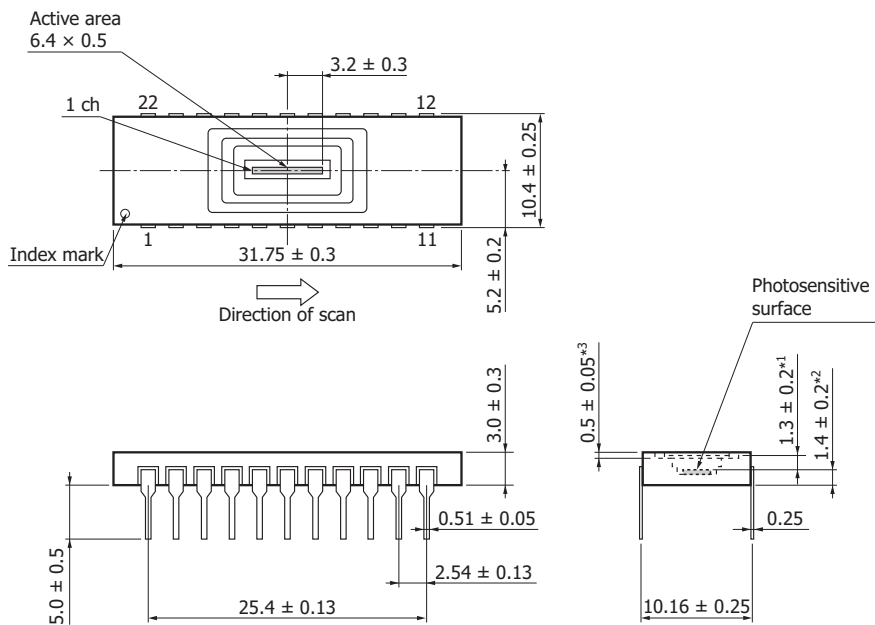
S10111-512Q, S10114-1024Q



- \*1: Distance from upper surface of quartz window to chip surface
- \*2: Distance from photosensitive surface to bottom of package
- \*3: Window thickness

KMPDA0062EE

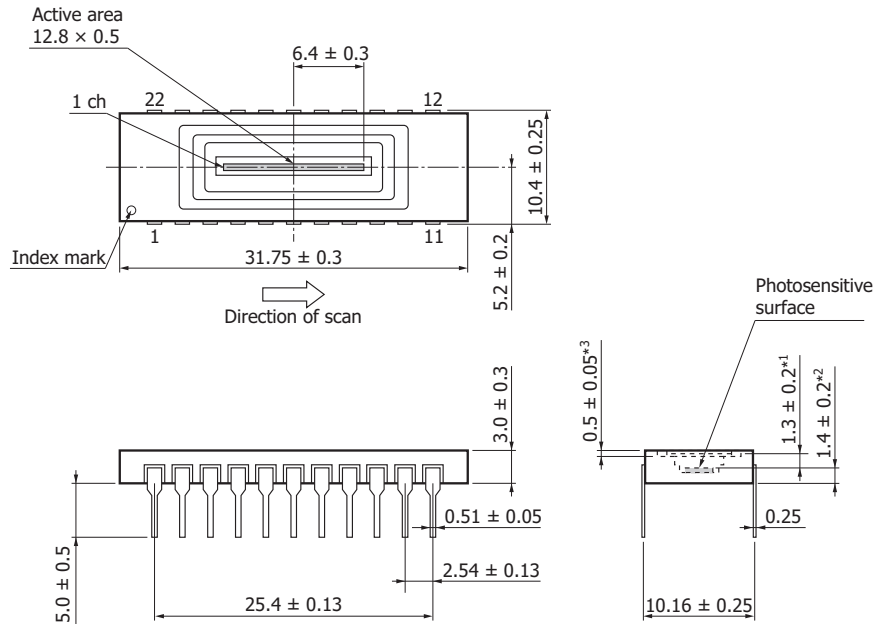
S10112-128Q, S10113-256Q



- \*1: Distance from upper surface of quartz window to chip surface
- \*2: Distance from photosensitive surface to bottom of package
- \*3: Window thickness

KMPDA0215EE

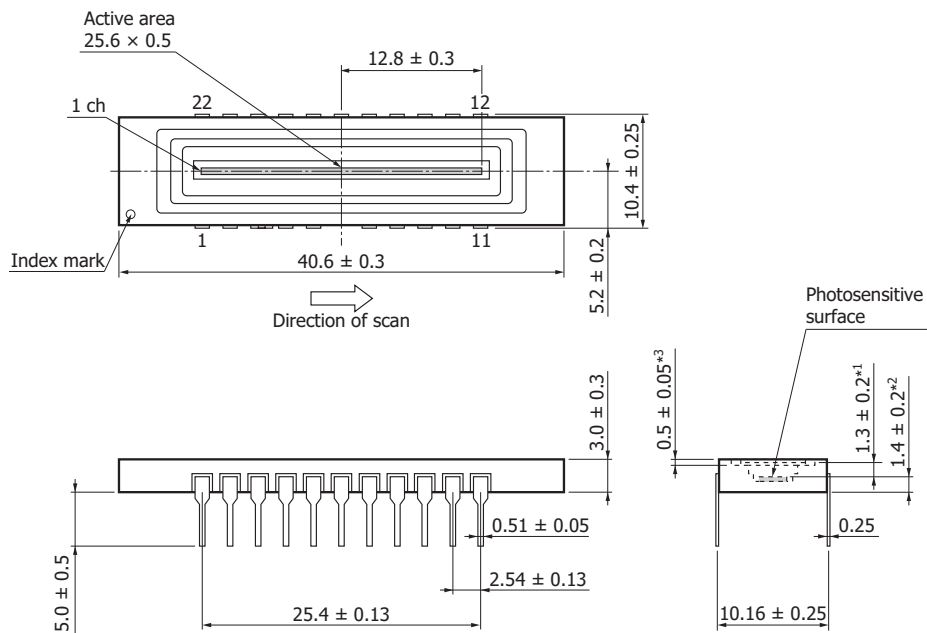
S10112-256Q, S10113-512Q



- \*1: Distance from upper surface of quartz window to chip surface
- \*2: Distance from photosensitive surface to bottom of package
- \*3: Window thickness

KMPDA0216EE

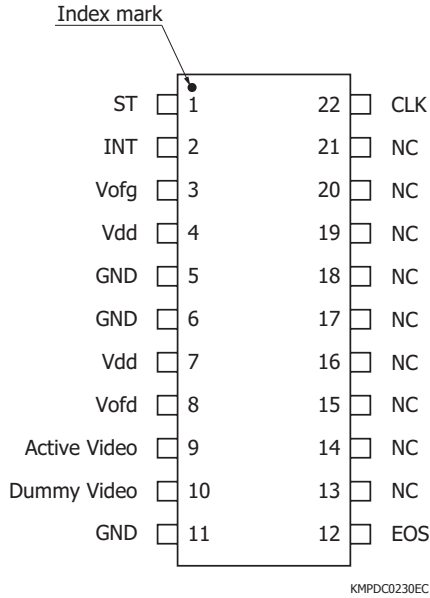
S10112-512Q, S10113-1024Q



- \*1: Distance from upper surface of quartz window to chip surface
- \*2: Distance from photosensitive surface to bottom of package
- \*3: Window thickness

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**Pin connection**



Pin no.	Symbol	Name of pin	I/O
1	ST	Start pulse	Input
2	INT	Integration time control pulse	Input
3	Vofg	Overflow gate voltage	Input
4	Vdd	Supply voltage	Input
5	GND	Ground	Input
6	GND	Ground	Input
7	Vdd	Supply voltage	Input
8	Vofd	Overflow drain voltage	Input
9	Active Video	Video output	Output
10	Dummy Video	Dummy video output	Output
11	GND	Ground	Input
12	EOS	End of scan	Output
13	NC	No connection	
14	NC		
15	NC		
16	NC		
17	NC		
18	NC		
19	NC		
20	NC		
21	NC		
22	CLK		Clock pulse

**Precautions during use**

(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) Incident window

If dust or dirt gets on the light incident window, it will show up as black blemishes on the image. When cleaning, avoid rubbing the window surface with dry cloth or dry cotton swab, since doing so may generate static electricity. Use soft cloth, paper or a cotton swab moistened with alcohol to wipe dust and dirt off the window surface. Then blow compressed air onto the window surface so that no spot or stain remains.

(3) Soldering

To prevent damaging the device during soldering, take precautions to prevent excessive soldering temperatures and times. Soldering should be performed within 5 seconds at a soldering temperature below 260 °C.

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