HAMAMATSU

CMOS linear image sensors

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					3.0
S10111-512Q	512					3.5
S10112-128Q	128		0.5			3.0
S10112-256Q	256					3.0
S10112-512Q	512					3.5
S10113-256Q	256	25	0.5			3.0
S10113-512Q	512					3.0
S10113-1024Q	1024					3.5
S10114-256Q	256		2.5			3.0
S10114-512Q	512					3.0
S10114-1024Q	1024					3.5

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	V(CLK)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	
Start pulse voltage	High level	V(ST)	Vdd - 0.25	Vdd	Vdd + 0.25	V
	Low level		0	-	0.4	
Integration time control pulse voltage	High level	V(INT)	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	f(CLK)	10 k	-	250 k	Hz
	S10112/S10113 series		10 k	-	500 k	
Video data rate		VR	-	f(CLK)	-	Hz
Power consumption*2	S10111-128Q	P	-	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	Cv	-	10	-	pF
	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)

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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		λ	200	-	1000	nm
Peak sensitivity wavelength		λp	-	750	-	nm
Dark current	S10111 series	I_D	-	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	Qsat	110	140	-	pC
	S10112 series		22	28	-	
	S10113 series		11	14	-	
	S10114 series		55	70	-	
Saturation exposure*3		Esat		580		m$lx \cdot$ s
Photo response non-uniformity*3 *4 *5		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= ΔX/X × 100 (%)
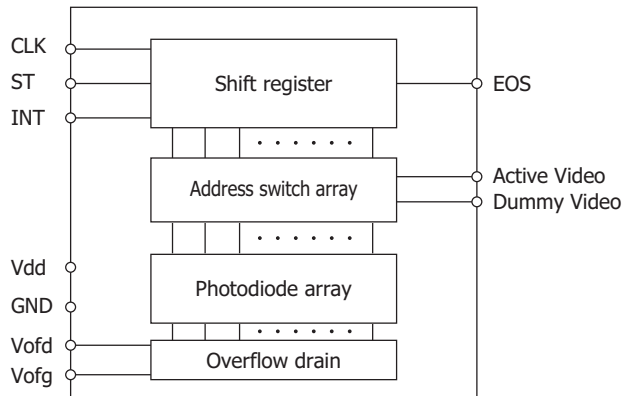   X: the average output of all pixels, ΔX: difference between X and maximum or minimum output.
*5: Except for the first and last pixels
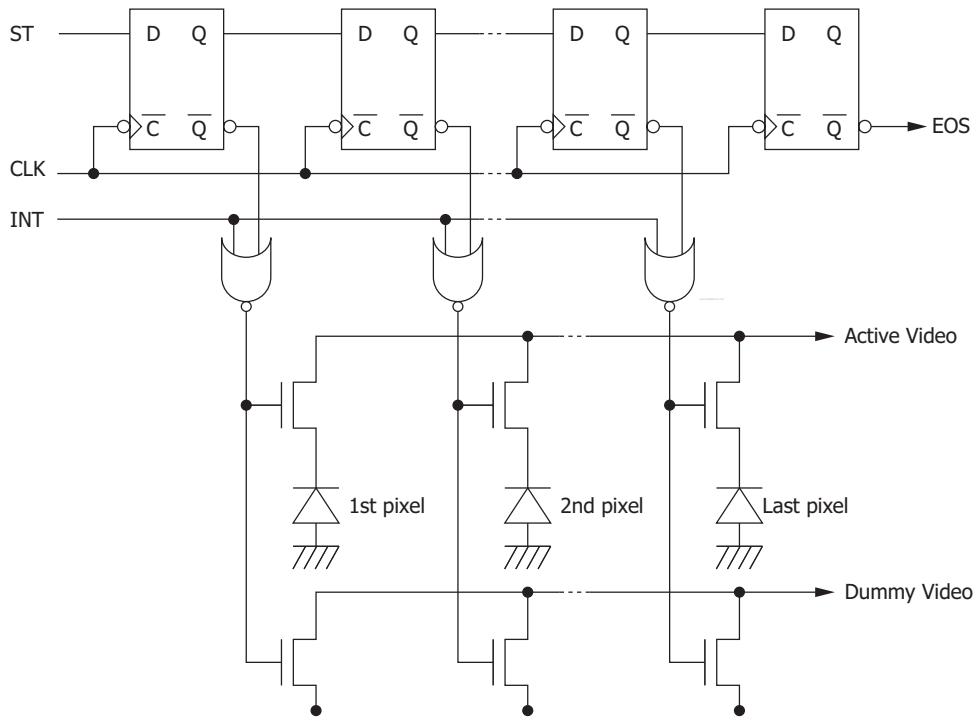
Spectral response (typical example)
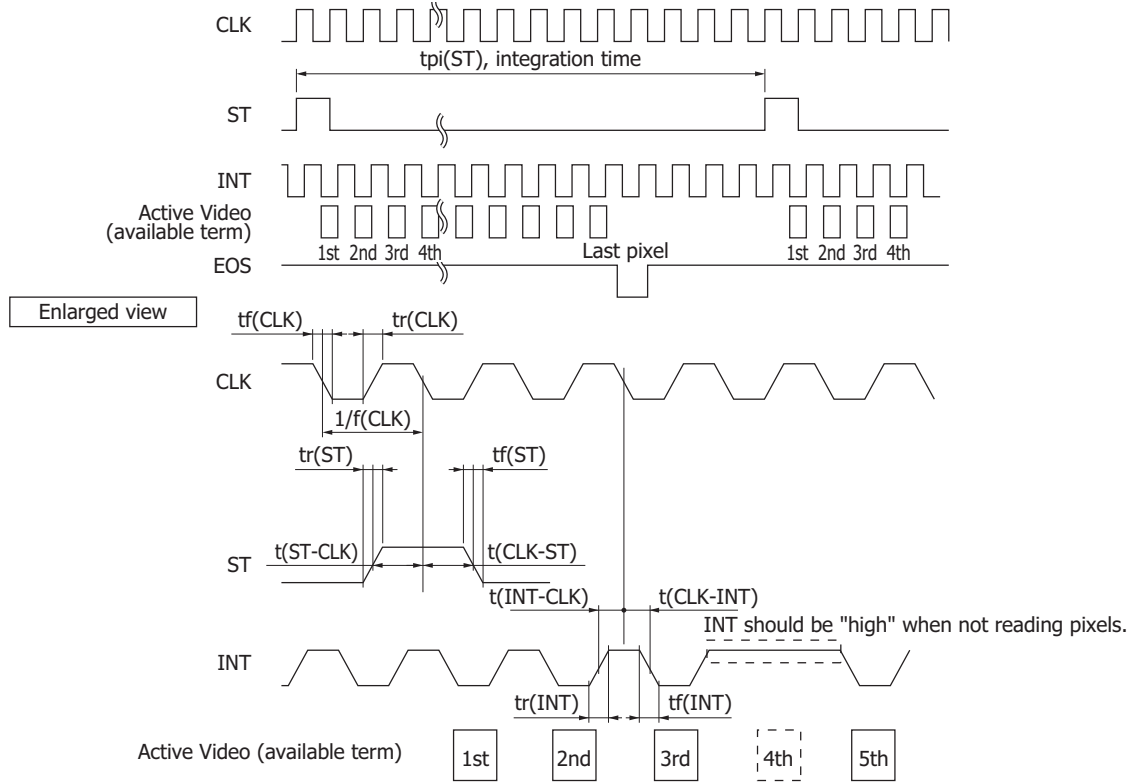

(Ta=25 °C)
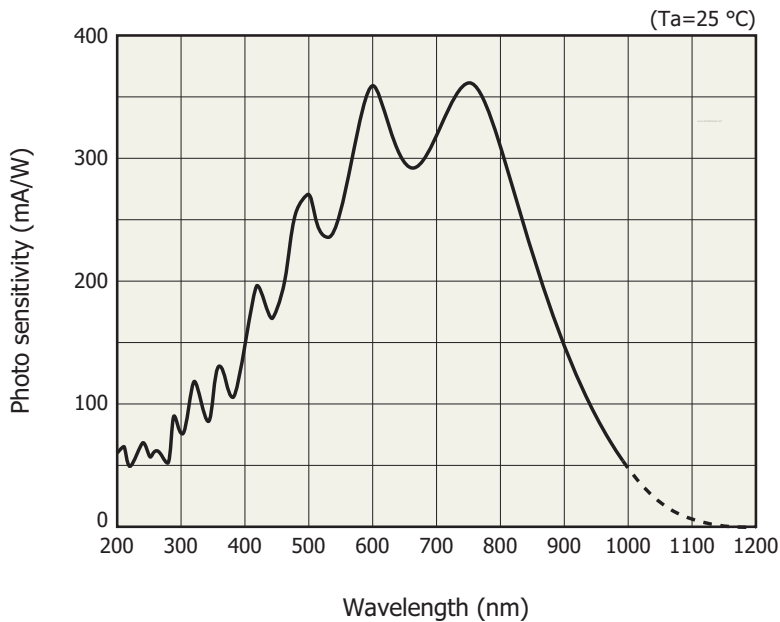
KMPDB0250ED

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.

KMPDC0249ED

| Parameter		Symbol	Min.	Typ.	Max.	Unit
Start pulse (ST) interval	S1011*-128	tpi(ST)	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		tr(INT), tf(INT)	0	20	30	ns
INT pulse - clock pulse timing		t(INT-CLK)	30	-	1 / [2 × f(CLK)]	ns
Clock pulse - INT pulse timing		t(CLK-INT)	30	-	1 / [2 × f(CLK)]	ns
Start pulse rise and fall times		tf(ST), tr(ST)	0	20	30	ns
Clock pulse duty ratio		-	40	50	60	%
Clock pulse rise and fall times		tf(CLK), tr(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

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Current-integration readout circuit example and timing chart

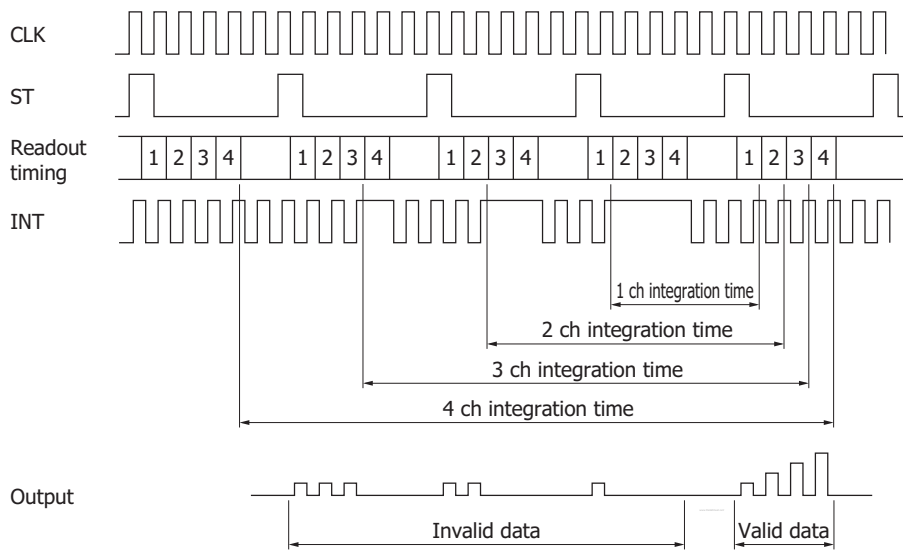■ Readout circuit example
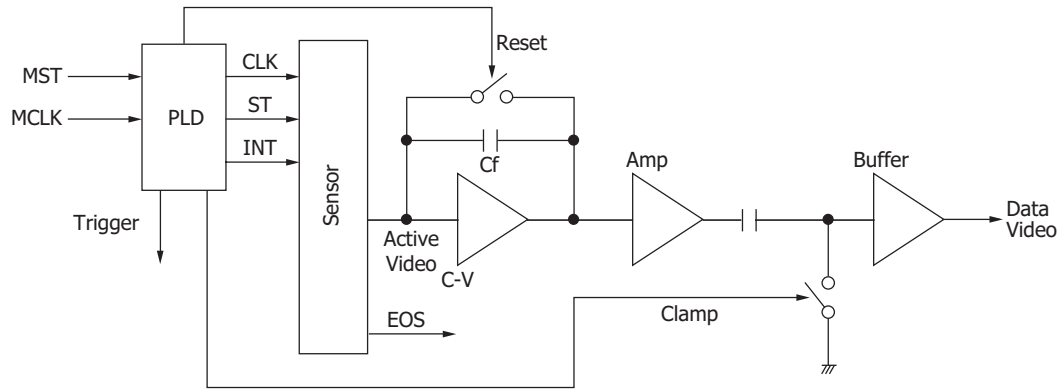
KMPDC0385EB

■ Timing chart
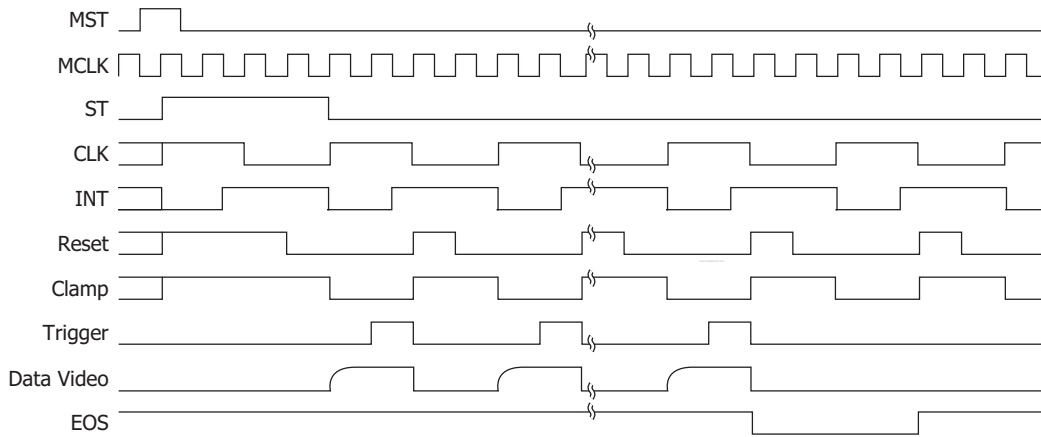
KMPDC0386EA

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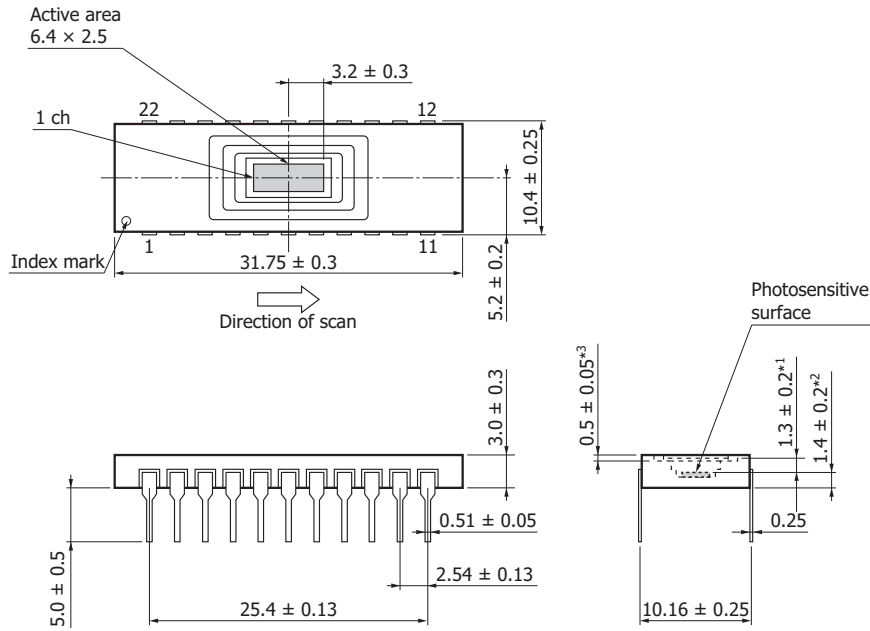
■Timing chart
(Concept view showing the settings to double, triple and quadruple the integration times at channels 2, 3 and 4, respectively, by using the variable integration time function on the basis of the integration time at channel 1.)

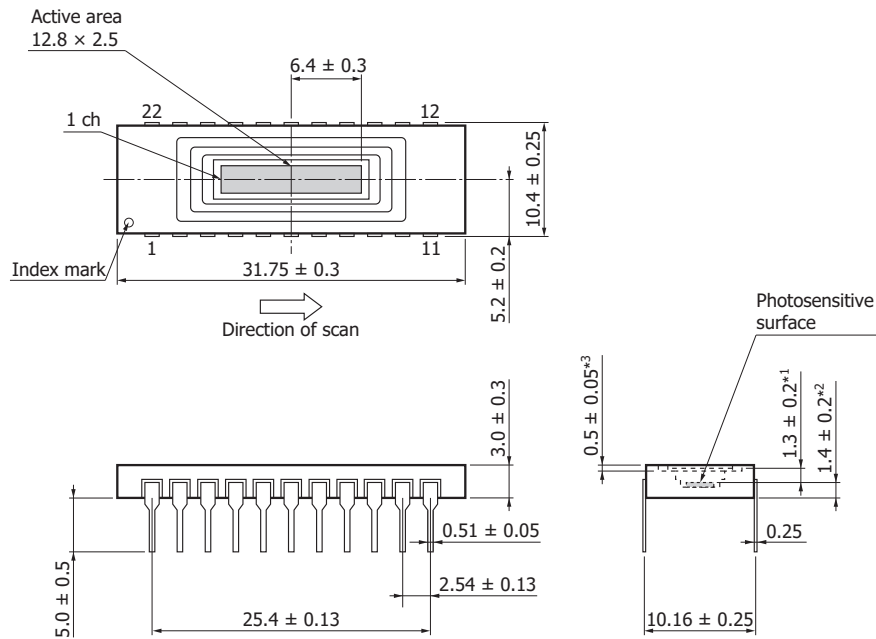KMPDC0233EC

Dimensional outlines (unit: mm)

S10111-128Q, S10114-256Q

Active area
6.4 × 2.5

3.2 ± 0.3

1 ch

22   12

10.4 ± 0.25

1

11

Index mark

31.75 ± 0.3

5.2 ± 0.2

Direction of scan

Photosensitive surface

3.0 ± 0.3

0.5 ± 0.05 *3

1.3 ± 0.2 *1

1.4 ± 0.2 *2

0.51 ± 0.05

0.25

2.54 ± 0.13

5.0 ± 0.5

25.4 ± 0.13

10.16 ± 0.25

*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

Active area
12.8 × 2.5

6.4 ± 0.3

1 ch

22   12

10.4 ± 0.25

1

11

Index mark

31.75 ± 0.3

5.2 ± 0.2

Direction of scan

Photosensitive surface

3.0 ± 0.3

0.5 ± 0.05 *3

1.3 ± 0.2 *1

1.4 ± 0.2 *2

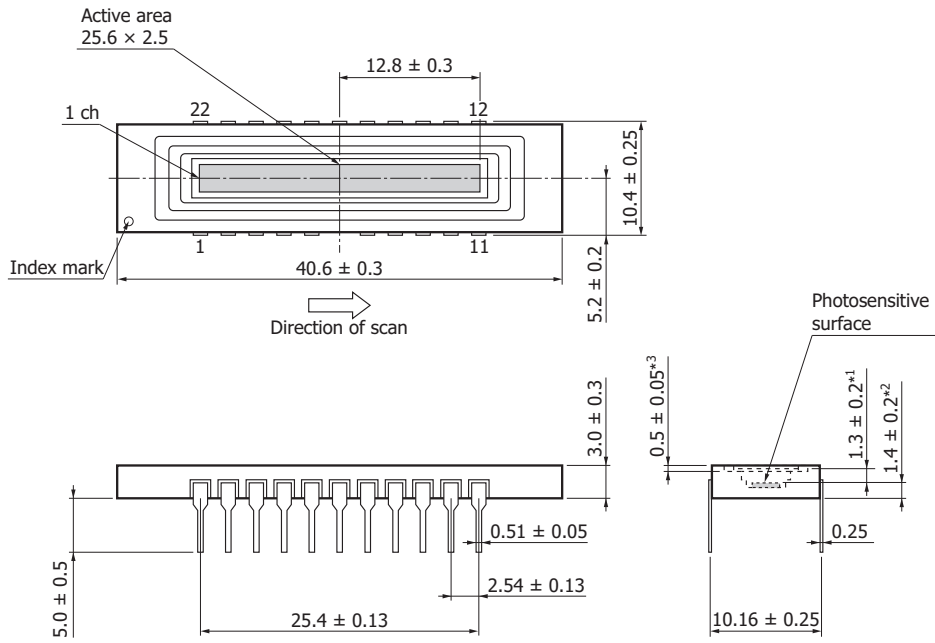0.51 ± 0.05

0.25

2.54 ± 0.13

5.0 ± 0.5

25.4 ± 0.13

10.16 ± 0.25

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

KMPDA0061EE

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S10111-512Q, S10114-1024Q

Active area
25.6 × 2.5

12.8 ± 0.3

1 ch
22   12
10.4 ± 0.25

Index mark
1   11
40.6 ± 0.3
5.2 ± 0.2

Direction of scan

3.0 ± 0.3

0.5 ± 0.05 *3

Photosensitive surface

1.3 ± 0.2 *1
1.4 ± 0.2 *2

0.51 ± 0.05

2.54 ± 0.13

0.25

5.0 ± 0.5

25.4 ± 0.13

10.16 ± 0.25

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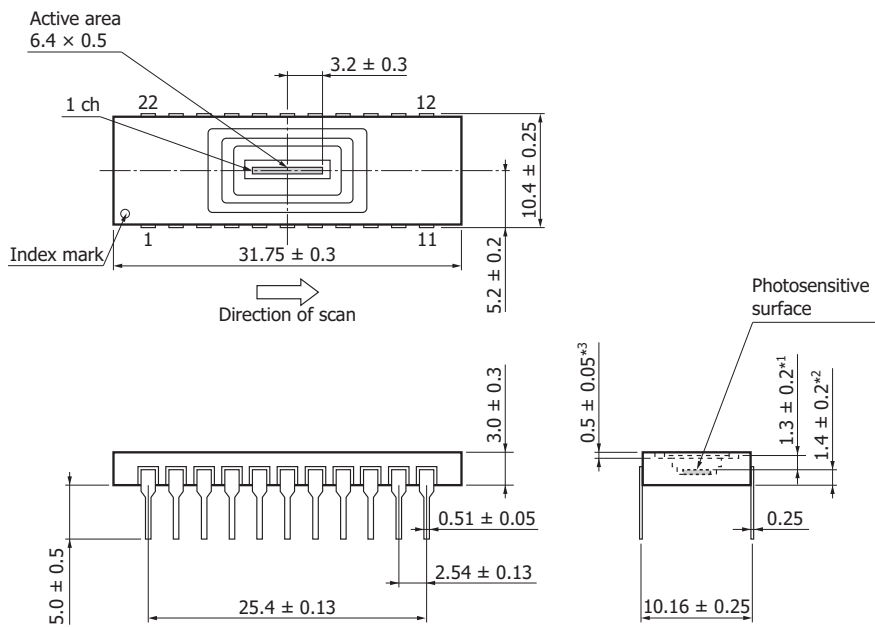*3: Window thickness

KMPDA0062EE

S10112-128Q, S10113-256Q

Active area
6.4 × 0.5

3.2 ± 0.3

1 ch
22   12
10.4 ± 0.25

Index mark
1   11
31.75 ± 0.3
5.2 ± 0.2

Direction of scan

3.0 ± 0.3

0.5 ± 0.05 *3

Photosensitive surface

1.3 ± 0.2 *1
1.4 ± 0.2 *2

0.51 ± 0.05

2.54 ± 0.13

0.25

5.0 ± 0.5

25.4 ± 0.13

10.16 ± 0.25

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

S10112-256Q, S10113-512Q
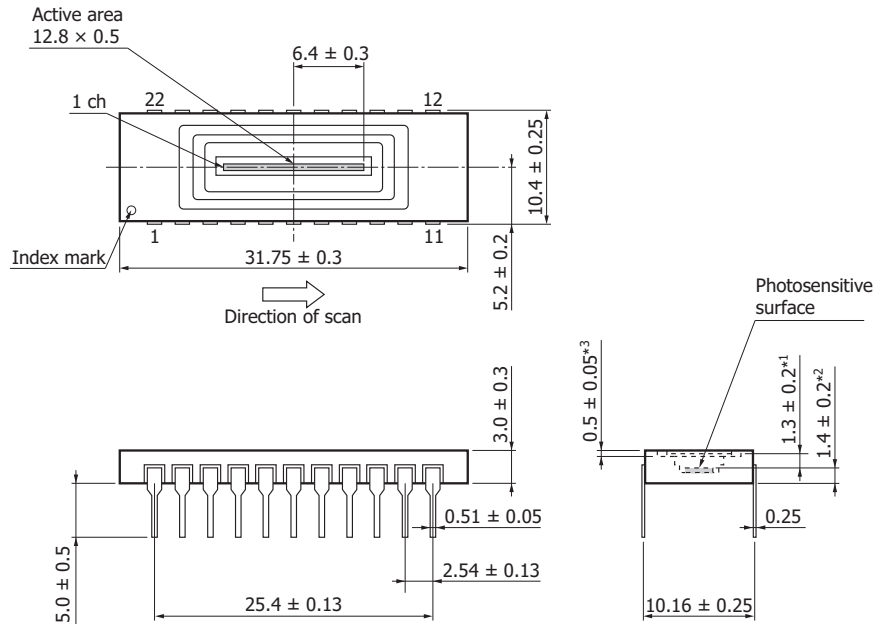
Active area
12.8 × 0.5

6.4 ± 0.3

1 ch 22 12

10.4 ± 0.25

1 11

Index mark

31.75 ± 0.3

5.2 ± 0.2

Direction of scan

Photosensitive surface

3.0 ± 0.3

0.5 ± 0.05*3

1.3 ± 0.2*1

1.4 ± 0.2*2

0.51 ± 0.05

2.54 ± 0.13

0.25

5.0 ± 0.5

25.4 ± 0.13

10.16 ± 0.25

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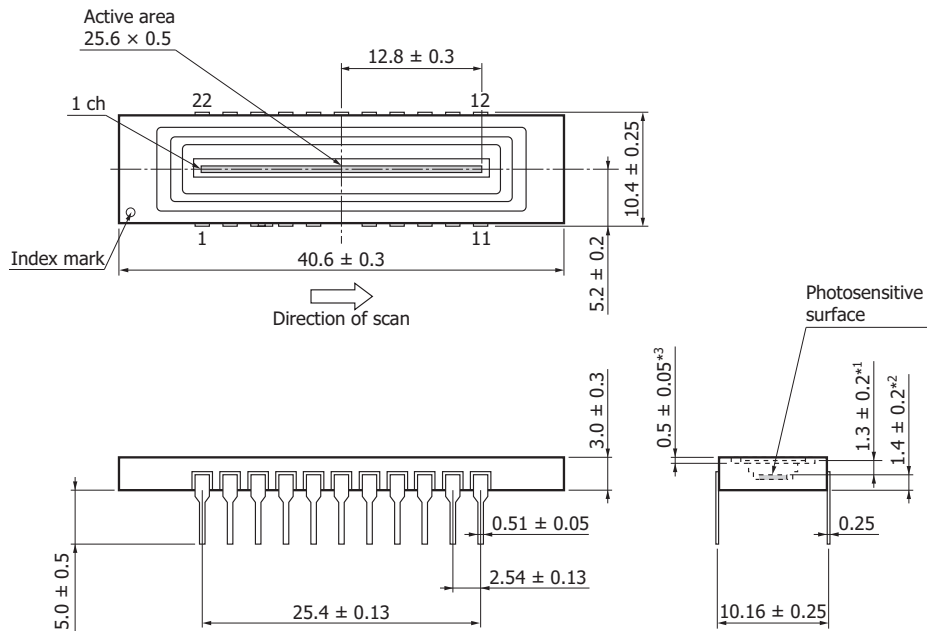   to bottom of package
*3: Window thickness

KMPDA0216EE

S10112-512Q, S10113-1024Q

Active area
25.6 × 0.5

12.8 ± 0.3

1 ch 22 12

10.4 ± 0.25

1 11

Index mark

40.6 ± 0.3

5.2 ± 0.2

Direction of scan

Photosensitive surface

3.0 ± 0.3

0.5 ± 0.05*3

1.3 ± 0.2*1

1.4 ± 0.2*2

0.51 ± 0.05

2.54 ± 0.13

0.25

5.0 ± 0.5

25.4 ± 0.13

10.16 ± 0.25

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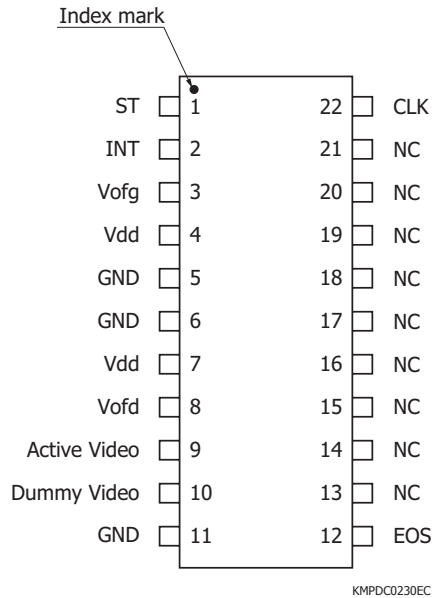   to bottom of package
*3: Window thickness

KMPDA0217EE

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Pin connection

Index mark

ST — 1   22 — CLK
INT — 2   21 — NC
Vofg — 3   20 — NC
Vdd — 4   19 — NC
GND — 5   18 — NC
GND — 6   17 — NC
Vdd — 7   16 — NC
Vofd — 8   15 — NC
Active Video — 9   14 — NC
Dummy Video — 10   13 — NC
GND — 11   12 — EOS

KMPDC0230EC

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		
14	NC		
15	NC		
16	NC		
17	NC	No connection	
18	NC		
19	NC		
20	NC		
21	NC		
22	CLK	Clock pulse	Input

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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Cat. No. KMPD1090E07 Oct. 2010 DN