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NEW

CCD linear image sensor

S16929-01

Front-illuminated type CCD linear image sensor with AR coating featuring high-speed response and high near infrared sensitivity

This is a high-speed line rate (130 kHz max.) front-illuminated type CCD linear image sensor designed for SD-OCT.

Features

- **Window material: Borosilicate glass with AR coating**
- **Pixel size: 10 µm × 180 µm**
- **2048 pixels**
- **High-speed multiport readout [readout speed: 40 MHz max. (× 8 ports)]**
- **High sensitivity in the near infrared region**
- **Image lag: 0.1 % typ.**

Applications

- **SD-OCT (spectral domain-optical coherence tomography)**

Structure

Parameter	Specification	Unit
Image size (H × V)	20.48 × 0.18	mm
Pixel size (H × V)	10 × 180	µm
Number of total pixels	2160	-
Number of effective pixels	2048	-
Fill factor	100	%
Horizontal clock	Two-phase	-
Output circuit	Three-stage MOSFET source follower	-
Package	30-pin ceramic DIP	-
Window material	Borosilicate glass with AR coating*1	

*1: Resin sealing

Absolute maximum ratings (Ta=25 °C, unless otherwise noted)

Parameter	Symbol	Value	Unit
Operating temperature*2*3	Topr	-50 to +70	°C
Storage temperature	Tstg	-50 to +70	°C
Output transistor drain voltage	$V_{OD1,2,3,4}$	-0.5 to +20	V
Reset drain voltage	V_{RD}	-0.5 to +18	V
Transfer gate voltage	V_{TG}	-0.5 to +15	V
Reset gate voltage	V_{RG}	-0.5 to +15	V
Output gate voltage	V_{OG}	-0.5 to +15	V
Horizontal shift register clock voltage	V_{P1H}, V_{P2H}	-0.5 to +15	V

*2: Package temperature
*3: No dew condensation
When there is a temperature difference between a product and the surrounding area in high humidity environments, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

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.
During high-speed operation, the heat generated by the sensor causes its temperature to increase. Take heat dissipation measures as required to prevent exceeding the absolute maximum ratings.

Operating conditions (Ta=25 °C)

Parameter		Symbol	Min.	Typ.	Max.	Unit
Output transistor drain voltage		$V_{OD1, 2, 3, 4}$	13	14	15	V
Reset drain voltage		V_{RD}	13	13.5	14	V
Substrate voltage		Vss	-	0	-	V
Output gate voltage		V_{OG}	4	5	6	V
Transfer gate voltage	High	V_{TGH}	6	7	8	V
	Low	V_{TGL}	-	0	-	
Reset gate voltage	High	V_{RGH}	6	7	8	V
	Low	V_{RGL}	-	0	-	
Horizontal shift register clock voltage	High	V_{P1HH}, V_{P2HH}	4.5	5	5.5	V
	Low	V_{P1HL}, V_{P2HL}	-	0	-	
External load resistance		R_L	2.0	2.2	2.4	kΩ

Electrical characteristics (Ta=25 °C, operating conditions: Typ., unless otherwise noted)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Output signal frequency/port*4	fc	12	20	40	MHz
Line rate	LR	40	68	130	kHz
Horizontal shift register capacitance	C_{P1H}, C_{P2H}	-	120	-	pF
Reset gate capacitance	C_{RG}	-	35	-	pF
Transfer gate capacitance	C_{TG}	-	45	-	pF
Charge transfer efficiency*5	C_{TE}	0.99995	0.99998	-	-
DC output level*4	Vout	8.5	9.5	10.5	V
Output impedance*4	Zo	-	125	190	Ω
Power consumption/port*4 *6	P	-	105	150	mW

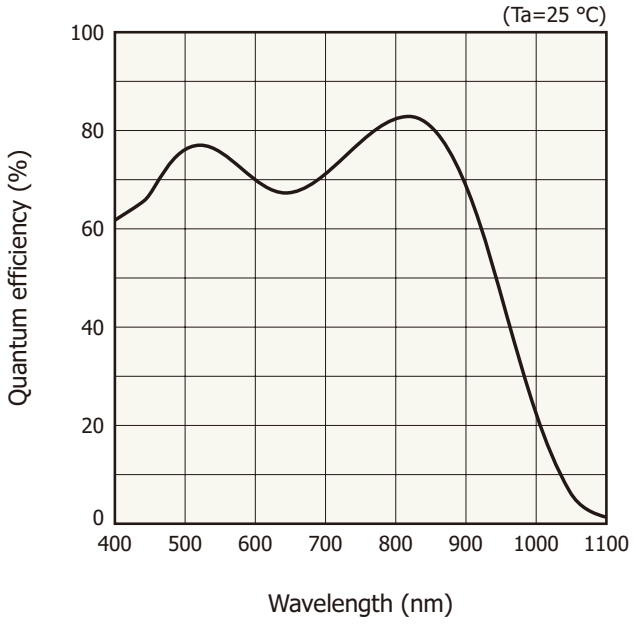
*4: The value depends on the load resistance.
*5: Transfer efficiency per CCD shift register pixel measured at half the saturation output
*6: Power consumption of the on-chip amp plus load resistance

Electrical and optical characteristics (Ta=25 °C, operating conditions: Typ., unless otherwise noted)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Saturation output voltage	Vsat	-	FW × CE	-	V
Saturation charge*7	FW	80	100	-	ke^-
Conversion efficiency	CE	8.5	10	11.5	$\mu V/e^-$
Dark current*8 *9	DSmax	-	20	60	$e^-/50\ \mu s$
Readout noise*10	Nread	-	40	60	e^- rms
Dynamic range*11	Drange	1333	2500	-	-
Spectral response range	λ	400 to 1100			nm
Photoresponse nonuniformity*12 *13 *14	PRNU	-	±3	±10	%
Image lag*12 *15	L	-	0.1	1	%

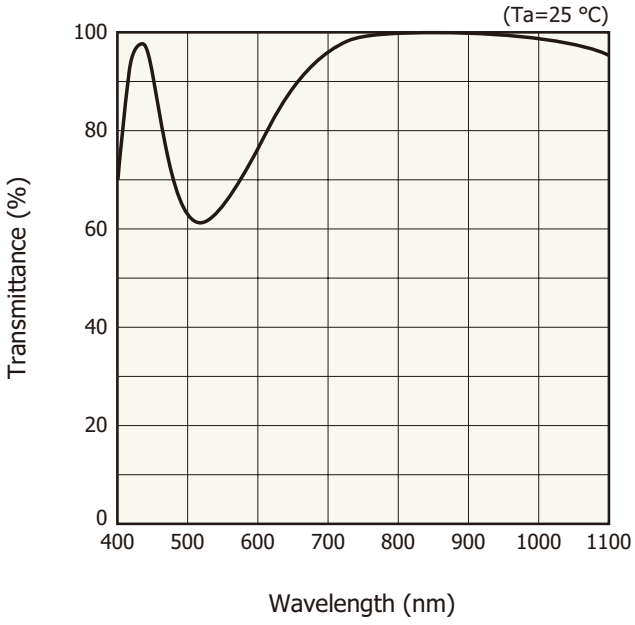
*7: Saturation charge is within linearity ±3 %.
*8: Maximum value among all effective pixels. Dark current nearly doubles for every 5 to 7 °C increase in temperature.
*9: Line rate 20 kHz
*10: Output signal frequency=40 MHz
*11: Dynamic range=Saturation charge/Readout noise
*12: Measured at half the saturation output using an LED light (peak emission wavelength: 880 nm)
*13: Photoresponse nonuniformity = $\frac{\text{Fixed pattern noise (peak to peak)}}{\text{Signal}} \times 100$ [%]
*14: Light incident near the center of the photosensitive area
*15: Percentage of unread signal level when a light pulse is directed so that the output is half the saturation output

Spectral response (without window, typical example)



KMPDB0736EA

Spectral transmittance characteristics of window material



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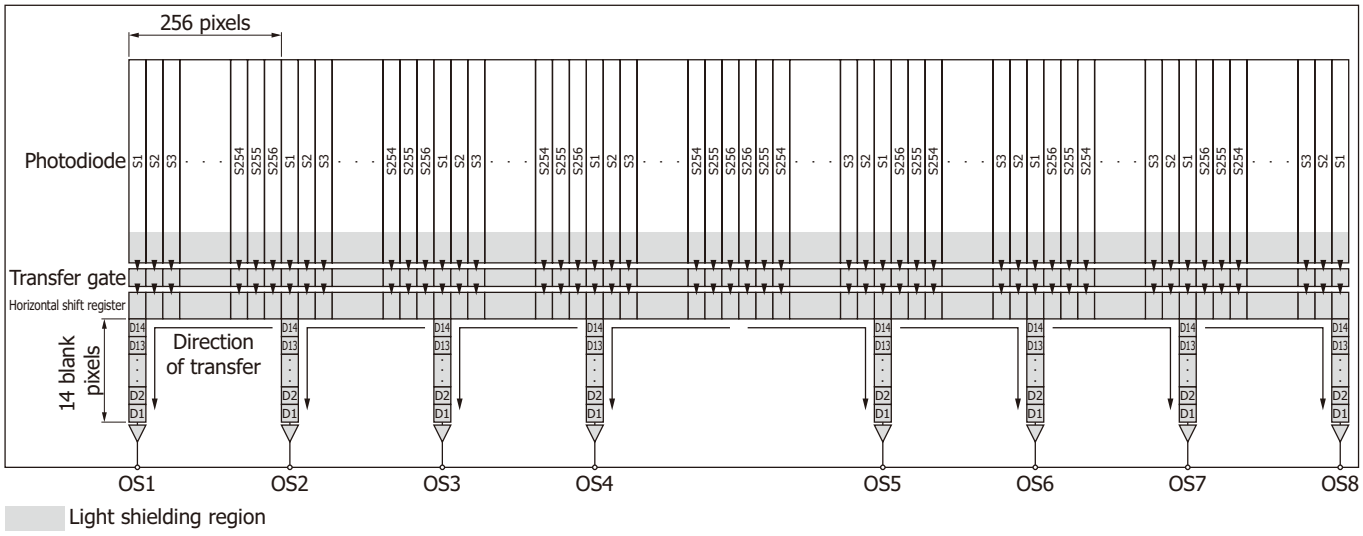
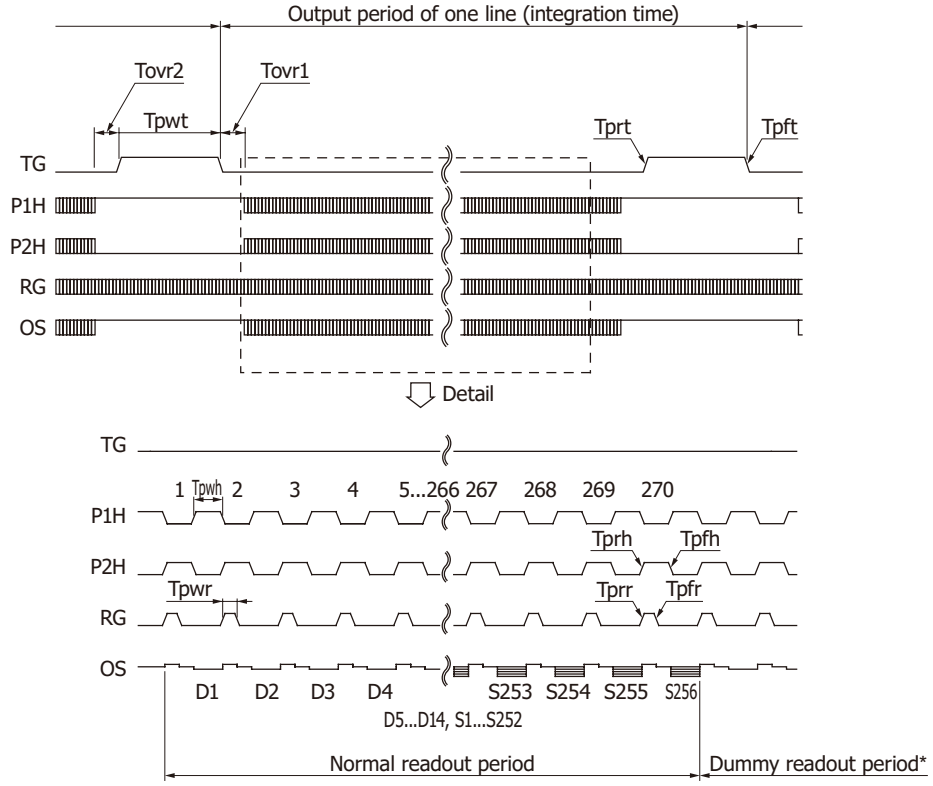
Device structure (schematic of CCD chip as viewed from top of dimensional outline)



KMPDC1085EA

Timing chart



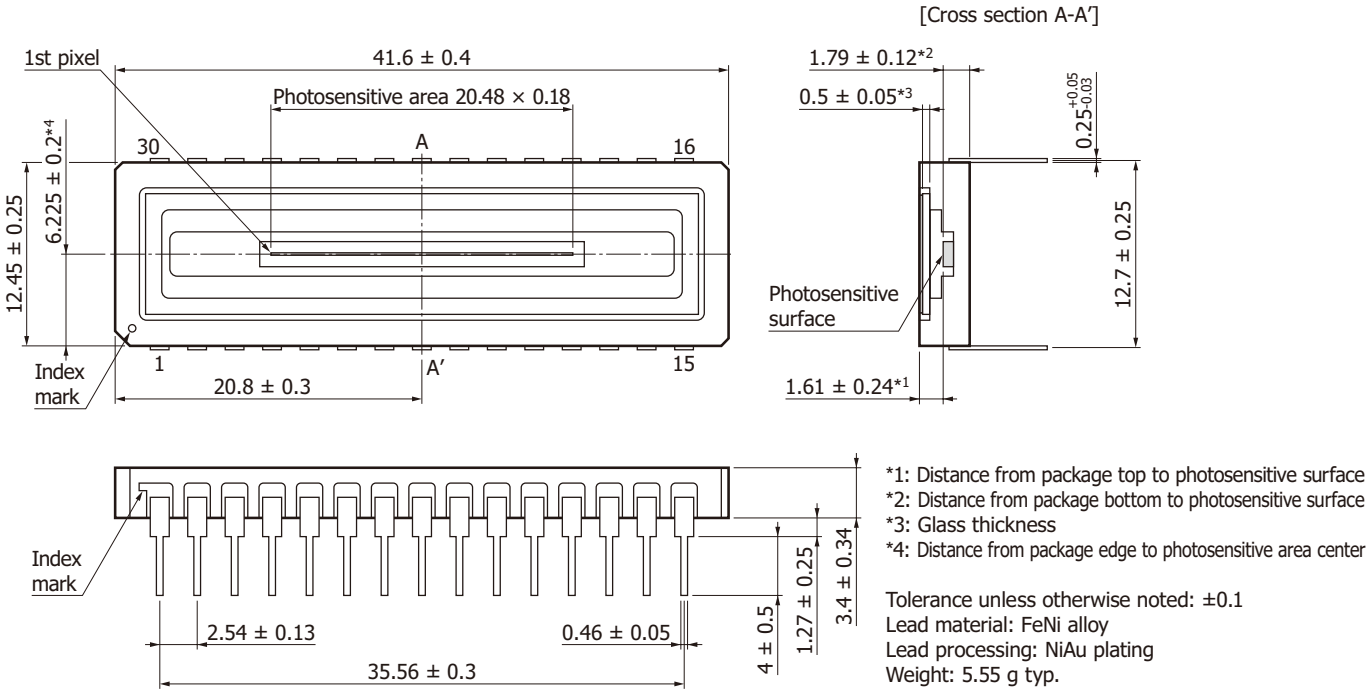
* It is necessary to wipe out the dark current generated in the horizontal shift register when integration time is set longer than normal readout time.
Do dummy readout after the normal readout period until just before the rising edge of transfer gate pulse.

KMPDC1086EA

Parameter		Symbol	Min.	Typ.	Max.	Unit
TG	Pulse width	Tpwt	700	800	-	ns
	Rise and fall times	Tprt, Tpft	20	-	-	ns
P1H, P2H*16	Pulse width	Tpwh	12.5	25	-	ns
	Rise and fall times	Tprh, Tpfh	5	-	-	ns
	Duty ratio	-	40	50	60	%
RG	Pulse width	Tpwr	6	7	-	ns
	Rise and fall times	Tprr, Tpfr	2	-	-	ns
TG-P1H	Overlap time	Tovr1	100	200	-	ns
		Tovr2	100	200	-	ns

*16: Symmetrical clock pulses should be overlapped at 50 % of maximum pulse amplitude.

Dimensional outline (unit: mm)



*1: Distance from package top to photosensitive surface
*2: Distance from package bottom to photosensitive surface
*3: Glass thickness
*4: Distance from package edge to photosensitive area center

Tolerance unless otherwise noted: ±0.1
Lead material: FeNi alloy
Lead processing: NiAu plating
Weight: 5.55 g typ.

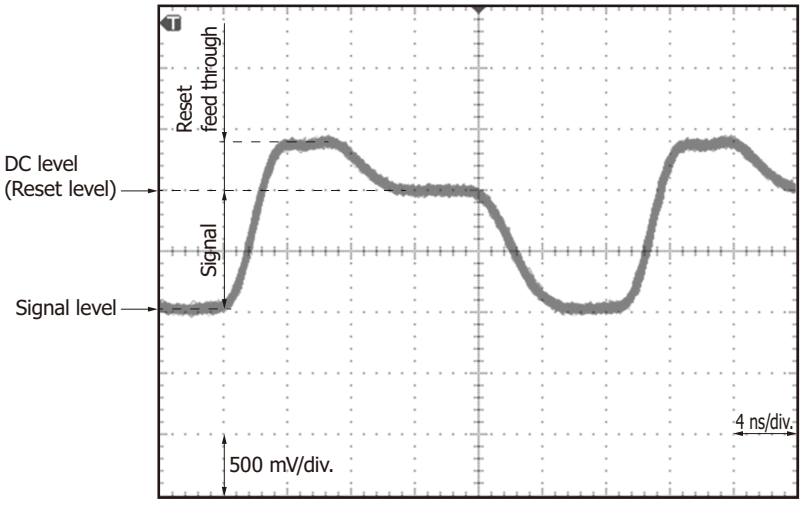
Note: This product is not hermetically sealed, and therefore moisture may penetrate into the package. Storing or using the product in a place with sudden temperature or humidity changes may cause condensation inside the package, so avoid such environments.

KMPDA0652EA

Pin connections

Pin no.	Symbol	Function	Remark (standard operation)
1	OS1	Output transistor source 1	RL=2.2 kΩ (OS1-SS)
2	SS	Substrate	0 V
3	OS2	Output transistor source 2	RL=2.2 kΩ (OS2-SS)
4	SS	Substrate	0 V
5	OS3	Output transistor source 3	RL=2.2 kΩ (OS3-SS)
6	SS	Substrate	0 V
7	OS4	Output transistor source 4	RL=2.2 kΩ (OS4-SS)
8	SS	Substrate	0 V
9	OS5	Output transistor source 5	RL=2.2 kΩ (OS5-SS)
10	SS	Substrate	0 V
11	OS6	Output transistor source 6	RL=2.2 kΩ (OS6-SS)
12	SS	Substrate	0 V
13	OS7	Output transistor source 7	RL=2.2 kΩ (OS7-SS)
14	SS	Substrate	0 V
15	OS8	Output transistor source 8	RL=2.2 kΩ (OS8-SS)
16	-	-	-
17	OD4	Output transistor drain 4	+14 V
18	OD3	Output transistor drain 3	+14 V
19	SS	Substrate	0 V
20	-	-	-
21	RG	Reset gate	+7/0 V
22	P1H	CCD horizontal shift register clock 1	+5/0 V
23	P2H	CCD horizontal shift register clock 2	+5/0 V
24	OG	Output gate	+5 V
25	-	-	-
26	TG	Transfer gate	+7/0 V
27	SS	Substrate	0 V
28	OD2	Output transistor drain 2	+14 V
29	OD1	Output transistor drain 1	+14 V
30	RD	Reset drain	+13.5 V

OS output waveform example (fc=40 MHz, VOD=+14 V, RL=2.2 kΩ)



Precautions

■ Electrostatic measures

· Handle the sensor with bare hands or wearing cotton gloves. In addition, wear anti-static clothing or use a wrist band and with earth ring when handling the sensor, in order to prevent electrostatic damage due to electrical charges from friction.
· Do not place the sensor directly on workbenches or floors that may become charged with static electricity.
· Connect a ground wire to workbenches or floors in order to discharge static electricity.
· Also connect a ground wire to tools such as tweezers and soldering irons used for handling the sensor.

It is not always necessary to provide all the electrostatic countermeasures stated above. Implement these countermeasures according to the extent of deterioration or damage that may occur.

■ When UV light irradiation is applied

When UV light irradiation is applied, the product characteristics may degrade. Such examples include degradation of the product's UV sensitivity and increase in dark current. This phenomenon varies depending on the irradiation level, irradiation intensity, usage time, and ambient environment and also varies depending on the product model. Before employing the product, we recommend that you check the tolerance under the ultraviolet light environment that the product will be used in.

Recommended soldering conditions

Parameter	Specification	Note
Soldering temperature	260 °C max. (once, within 5 seconds)	at least 1.5 mm away from lead roots

Note: When you set soldering conditions, check that problems do not occur in the product by testing out the conditions in advance.

Related information

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

■ Precautions
· Disclaimer
· Precautions / Image sensors

■ Catalog
· Selection guide / CCD/CMOS image sensors
· Technical note / CCD image sensors

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