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NEW

CCD linear image sensor

S15729-01

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

This front-illuminated CCD linear image sensor is designed for SD-OCT.

Features

- **Window material: Borosilicate glass with AR coating**
- **Pixel size: 10 × 180 µm**
- **2048 pixels**
- **High-speed multiport readout [readout speed: 40 MHz max. (× 4 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
Total number of pixels	2104	-
Number of effective pixels	2048	-
Fill factor	100	%
Horizontal clock	Two-phase	-
Output circuit	Three-stage MOSFET source follower	-
Package	24-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	Condition	Value	Unit
Operating temperature	Topr	Package temperature, no dew condensation*2	-50 to +70	°C
Storage temperature	Tstg	No dew condensation*2	-50 to +70	°C
Output transistor drain voltage	V_{OD}1,2,3,4		-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: 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.

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*3	fc	12	20	40	MHz
Line rate	LR	20	36	70	kHz
Horizontal shift register capacitance	C_{P1H}, C_{P2H}	-	90	-	pF
Reset gate capacitance	C_{RG}	-	25	-	pF
Transfer gate capacitance	C_{TG}	-	45	-	pF
Charge transfer efficiency*4	C_{TE}	0.99995	0.99999	-	-
DC output level*3	Vout	8.5	9.5	10.5	V
Output impedance*3	Zo	-	125	190	Ω
Power consumption/port*3 *5	P	-	105	150	mW

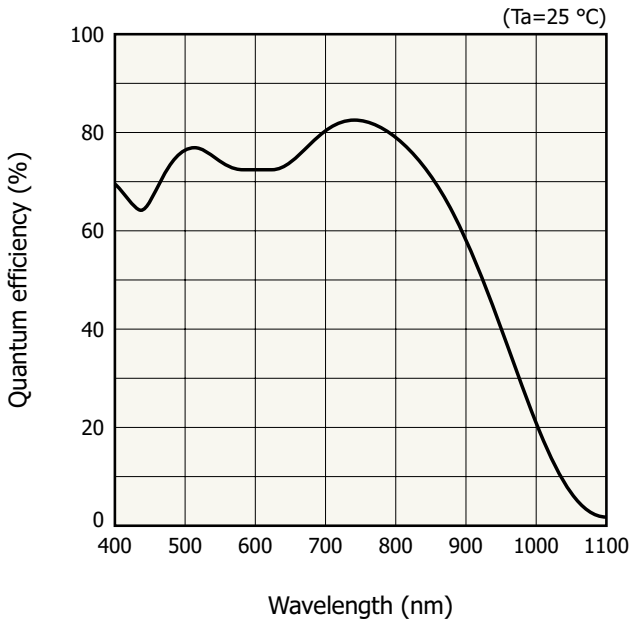
*3: The value depends on the load resistance.
*4: Transfer efficiency per CCD shift register pixel measured at half the saturation output
*5: Power consumption of the on-chip amp plus load resistance

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
Full well capacity*6	Fw	80	100	-	ke^-
Conversion efficiency	CE	8.5	10	11.5	$\mu V/e^-$
Dark current*7 *8	DSmax	-	20	60	$e^-/50\ \mu s$
Readout noise*9	Nread	-	40	60	e^- rms
Dynamic range*10	Drange	1333	2500	-	-
Spectral response range	λ	400 to 1100			nm
Photoresponse nonuniformity*11 *12 *13	PRNU	-	±3	±10	%
Image lag*11 *14	L	-	0.1	1	%

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



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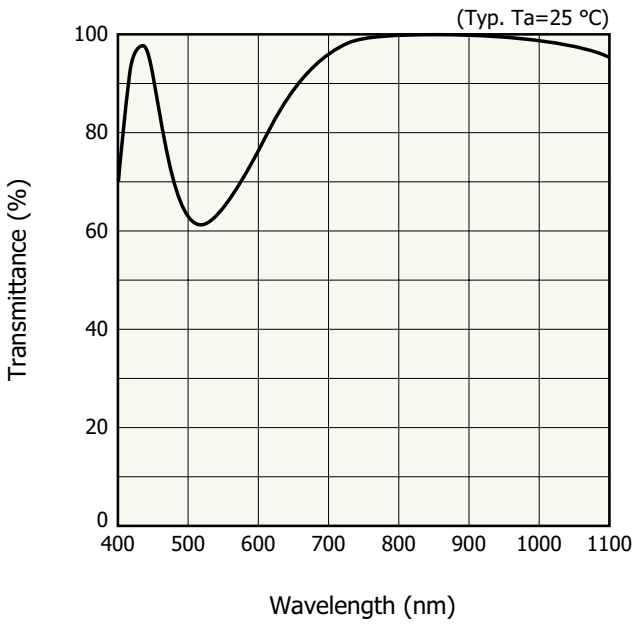
Spectral transmittance of window material



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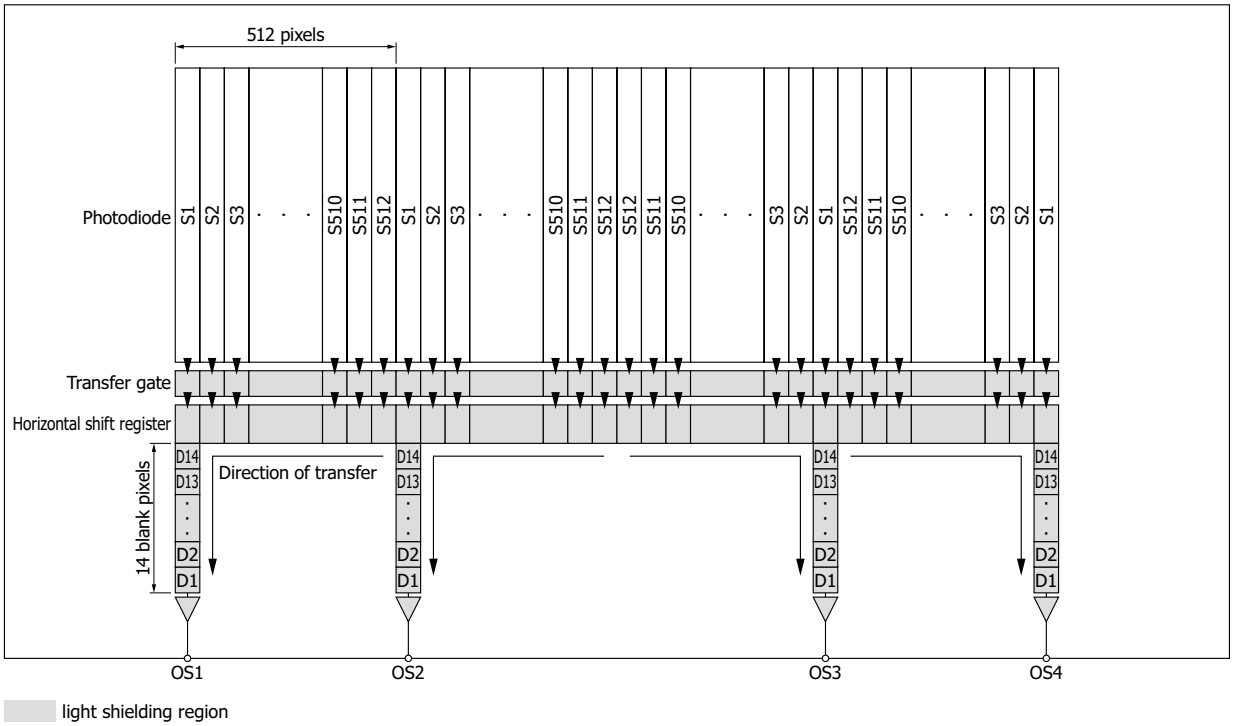
Device structure (schematic of CCD chip as viewed from top of dimensional outline)



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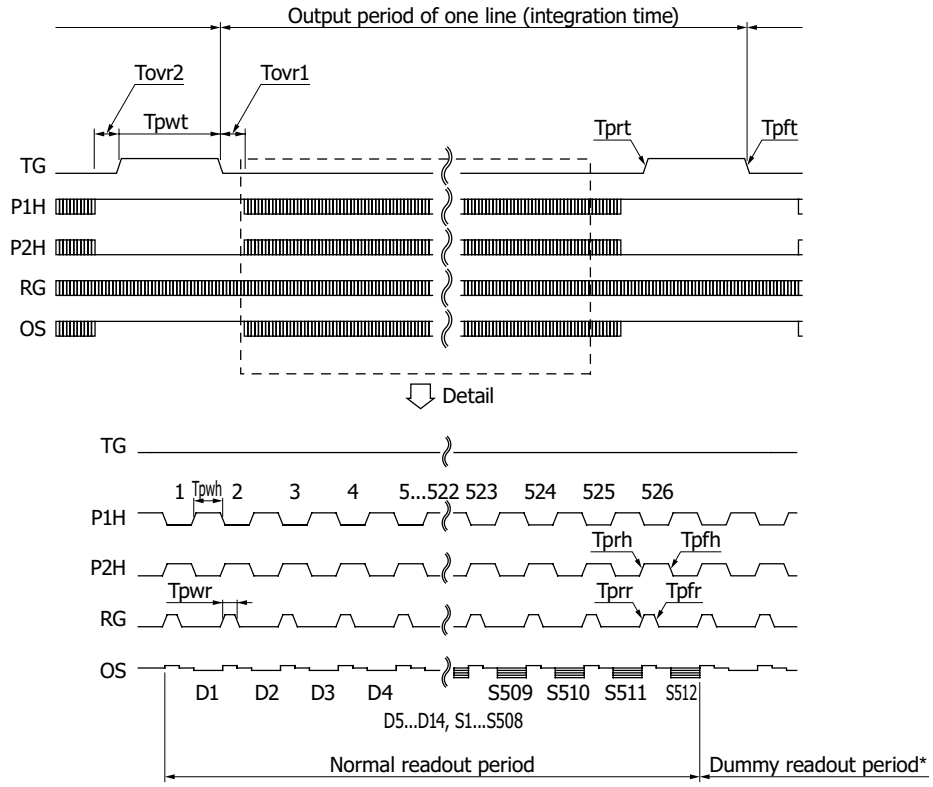
Timing chart



* 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.

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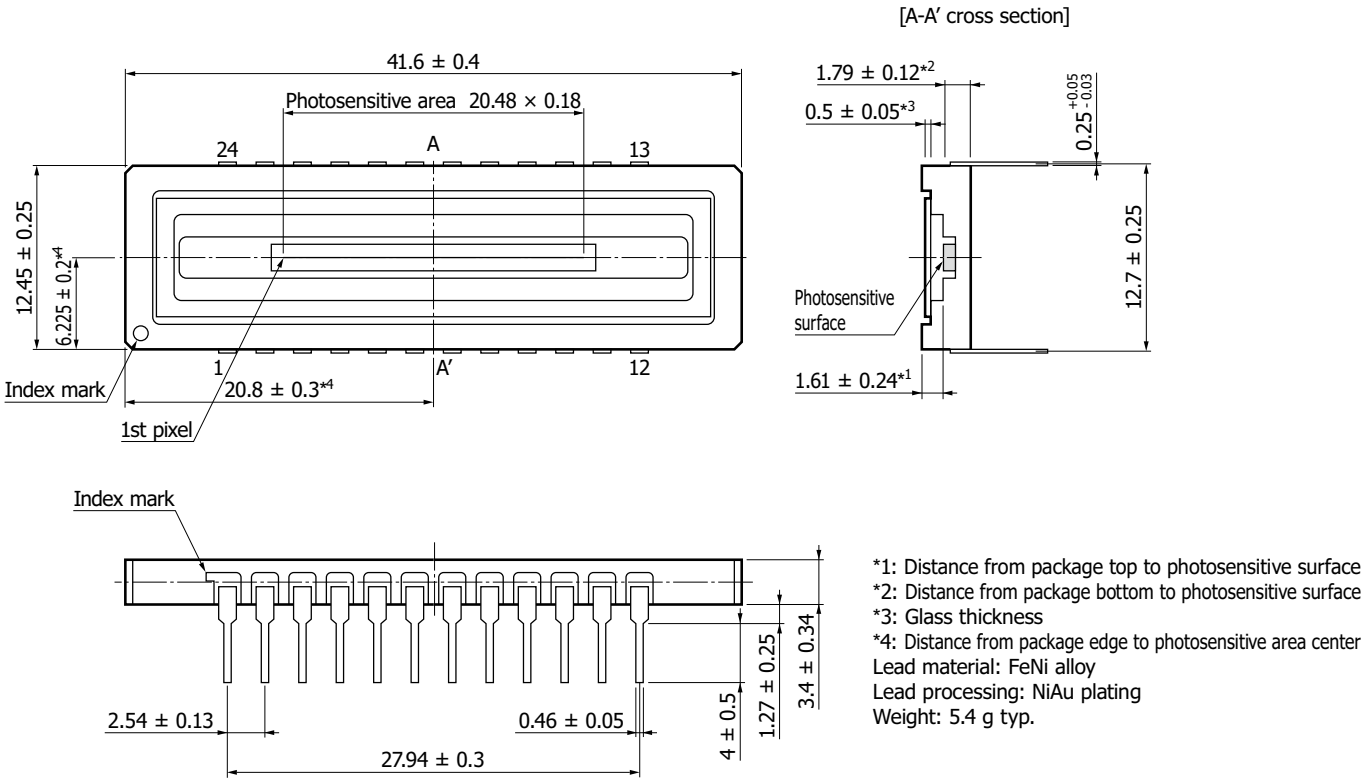
Parameter		Symbol	Min.	Typ.	Max.	Unit
TG	Pulse width	Tpwt	800	1000	-	ns
	Rise and fall times	Tprt, Tpft	20	-	-	ns
P1H, P2H*15	Pulse width	Tpwh	12.5	25	-	ns
	Rise and fall times	Tprh, Tpfh	5	-	-	ns
	Duty ratio	-	40	50	60	%
RG	Pulse width	Tpwr	5	6	-	ns
	Rise and fall times	Tprr, Tpfr	2	-	-	ns
TG-P1H	Overlap time	Tovr1	100	200	-	ns
		Tovr2	100	200	-	ns

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

Dimensional outline (unit: mm, tolerance unless otherwise noted: ±0.1)



*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
Lead material: FeNi alloy
Lead processing: NiAu plating
Weight: 5.4 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 to form inside the package, so avoid such environments.

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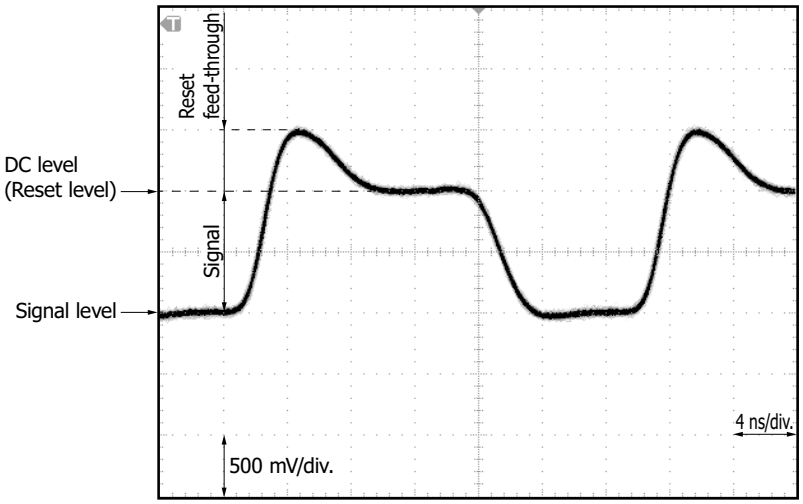
Pin connections

Pin no.	Symbol	Function	Remark (standard operation)
1	SS	Substrate	0 V
2	OS1	Output transistor source 1	RL=2.2 kΩ (OS1-SS)
3	OD1	Output transistor drain 1	+14 V
4	SS	Substrate	0 V
5	OS2	Output transistor source 2	RL=2.2 kΩ (OS2-SS)
6	OD2	Output transistor drain 2	+14 V
7	OD3	Output transistor drain 3	+14 V
8	OS3	Output transistor source 3	RL=2.2 kΩ (OS3-SS)
9	SS	Substrate	0 V
10	OD4	Output transistor drain 4	+14 V
11	OS4	Output transistor source 4	RL=2.2 kΩ (OS4-SS)
12	SS	Substrate	0 V
13	-		
14	-		
15	-		
16	SS	Substrate	0 V
17	RG	Reset gate	+7/0 V
18	P1H	CCD horizontal shift register clock 1	+5/0 V
19	P2H	CCD horizontal shift register clock 2	+5/0 V
20	OG	Output gate	+5 V
21	SS	Substrate	0 V
22	-		
23	TG	Transfer gate	+7/0 V
24	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.
· Connect a ground wire also to the tools such as tweezers and soldering irons to be 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, operating time, and operating 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 1.8 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
· Image sensors

■ Technical information

CCD multichannel detector head C15821 (sold separately)

The C15821 is a multichannel detector head with built-in driver circuit for CCD linear image sensor S15729-01. This product comes with application software (Dcam-CL) that runs on Windows 10 (64-bit). It can be used to operate the C15821 from the PC. It also includes a control library (SSDic.DLL) for software development that users can use to develop their own software.

Features

- **Line rate: 70 kHz**
- **Data output: 10-bit, 12-bit**
- **Interface: CameraLink (Base Configuration)**
- **Single +12 V power supply**
- **External trigger control**
- **Compact: 60 (W) mm × 45.82 (D) mm × 60 (H) mm**

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Cat. No. KMPD1243E01 Jun. 2021 DN