

CCD linear image sensor



S14290

High-speed line rate

The S14290 is a back-thinned CCD linear image sensor that has achieved a high-speed line rate (30 kHz max.) with multiport readout (10 MHz max. per port). Vertically long pixels required for spectrometers are used. High sensitivity in the near infrared region makes it suitable for raman spectroscopy and OCT.

Features

→ High-speed line rate: 30 kHz max.

Applications

→ OCT (optical coherence tomography)
→ Spectrophotometry

Structure

Parameter	Specification
Image size (H × V)	24.576 × 0.500 mm
Pixel size (H × V)	24 × 500 μm
Number of total pixels (H × V)	1056 × 1
Number of effective pixels (H × V)	1024 × 1
Horizontal clock phase	2 phases
Output circuit	Two-stage MOSFET source follower
Package	54-pin ceramic DIP (refer to dimensional outline)
Window*2	Borosilicate glass*1
Cooling	Non-cooled

*1: Resin sealing

*2: Window-less type (S14290N) and quartz glass window type (S14290Q) are available upon request. For window-less type, temporary window is fixed by tape to protect the CCD chip.

▣ Absolute maximum ratings (Ta=25 °C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	
Operating temperature*3 *4	Topr	-50	-	+50	°C	
Storage temperature	Tstg	-50	-	+70	°C	
Output transistor drain voltage	VOD	-0.5	-	+25	V	
Reset drain voltage	VRD	-0.5	-	+18	V	
Output amplifier return voltage	Vret	-0.5	-	+18	V	
All reset drain voltage	VARD	-0.5	-	+18	V	
Horizontal input source voltage	VISH	-0.5	-	+18	V	
All reset gate voltage	VARG	-10	-	+15	V	
Storage gate voltage	VSTG	-10	-	+15	V	
Horizontal input gate voltage	VIG1H, VIG2H	-10	-	+15	V	
Summing gate voltage	VSG	-10	-	+15	V	
Output gate voltage	VOG	-10	-	+15	V	
Reset gate voltage	VRG	-10	-	+15	V	
Transfer gate voltage	VTG	-10	-	+15	V	
Resistive gate voltage	High	VREGH	-10	-	+15	V
	Low	VREGL				
Horizontal shift register clock voltage	VP1H, VP2H	-10	-	+15	V	
Soldering conditions	Tsol	260 °C, within 5 s, at least 2 mm away from lead roots			-	

*3: Package temperature

*4: The sensor temperature may increase due to heating in high-speed operation. We recommend taking measures to dissipate heat as needed. For more details, refer to the technical information "Resistive gate type CCD linear image sensors with electronic shutter".

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.

▣ Operating conditions (Ta=25 °C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Output transistor drain voltage	VOD	12	15	18	V
Reset drain voltage	VRD	14	15	16	V
Output amplifier return voltage*5	Vret	-	1	2	V
All reset drain voltage	VARD	11	12	13	V
Test point	Horizontal input source	VISH	-	VRD	V
	Horizontal input gate	VIG1H, VIG2H	-9	-8	
All reset gate voltage	VARGL	-6.5	-6	-5.5	V
Storage gate voltage*6	VSTG1	-1	0	0	V
	VSTG2	-1	0	1	V
Summing gate voltage	High	VSGH	5	6	V
	Low	VSGL	-6	-5	
Output gate voltage	VOG	4.5	5	5.5	V
Reset gate voltage	High	VRGH	7	8	V
	Low	VRGL	-6	-5	
Transfer gate voltage	High	VTGH	8	9	V
	Low	VTGL	-8	-7	
Resistive gate high voltage	VREGH	-4	-3	-2	V
Resistive gate low voltage	VREGL	-	VREGH - 2.5	-	V
Horizontal shift register clock voltage	High	VP1HH, VP2HH	5	6	V
	Low	VP1HL, VP2HL	-6	-5	
Substrate voltage	VSS	-	0	-	V
External load resistance	RL	2.0	2.2	2.4	kΩ

*5: Output amplifier return voltage is a positive voltage with respect to Substrate voltage, but the current flows in the direction of flow out of the sensor.

*6: Set VSTG1 lower than VSTG2.

Electrical characteristics [Ta=25 °C, operation conditions: Typ. (P.2)]

Parameter	Symbol	Min.	Typ.	Max.	Unit
Signal output frequency	fc	-	5	10	MHz
Line rate	LR	-	10	30	kHz
Horizontal shift register capacitance	CP1H, CP2H	-	200	-	pF
All reset gate capacitance	CARG	-	300	-	pF
Resistive gate capacitance	CREG	-	1000	-	pF
Summing gate capacitance	CSG	-	30	-	pF
Reset gate capacitance	CRG	-	30	-	pF
Transfer gate capacitance	CTG	-	300	-	pF
Charge transfer efficiency*7	CTE	0.99995	0.99999	-	-
DC output level	Vout	9	10	11	V
Output impedance	Zo	-	300	-	Ω
Output amplifier return current	Iret	-	0.4	-	mA
Power consumption	PAMP*8	-	75	-	mW
	PREG*9	0.6	3.1	6.3	
Resistive gate resistance*10	RREG	0.5	1.5	5	kΩ

*7: Charge transfer efficiency per pixel of CCD shift register, measured at half of the full well capacity

*8: Power consumption of the on-chip amplifier plus load resistance

*9: Power consumption at REG

*10: Resistance value between REGH and REGL

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

Parameter	Symbol	Min.	Typ.	Max.	Unit
Saturation output voltage	Vsat	-	Fw × CE	-	V
Full well capacity	Fw	400	500	-	ke ⁻
Conversion efficiency	CE	4	5	6	μV/e ⁻
Dark current (Non-MPP mode)*11	DS	-	120	600	ke ⁻ /pixel/s
		-	80	400	pA/cm ²
Readout noise*12	Nread	-	100	150	e ⁻ rms
Dynamic range*13	Drange	2600	5000	-	-
Spectral response range	λ	-	320 to 1100*14	-	nm
Photoresponse nonuniformity*15 *16	PRNU	-	±3	±10	%
Image lag*15 *17	L	-	10	20	%

*11: Dark current nearly doubles for every 5 to 7 °C increase in temperature.

*12: Signal output frequency=10 MHz

*13: Dynamic range=Full well capacity/Readout noise

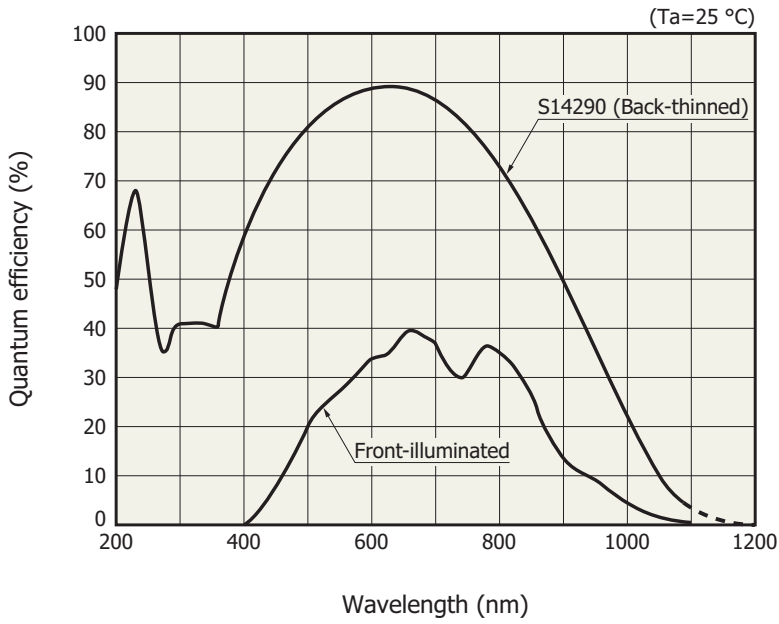
*14: Spectral response range for the S14290N (window-less type) and the S14290Q (quartz window type) are 200 to 1100 nm.

*15: Measured at one-half of the saturation output (full well capacity), using LED light

*16: Photoresponse nonuniformity = $\frac{\text{Fixed pattern noise (peak to peak)}}{\text{Signal}} \times 100$ [%]

*17: The ratio of remaining signal after the image sensor is illuminated with one shot of pulsed light that produces one-half of the saturation output. For more details refer to our technical information on "Resistive gate type CCD linear image sensors with electronic shutter."

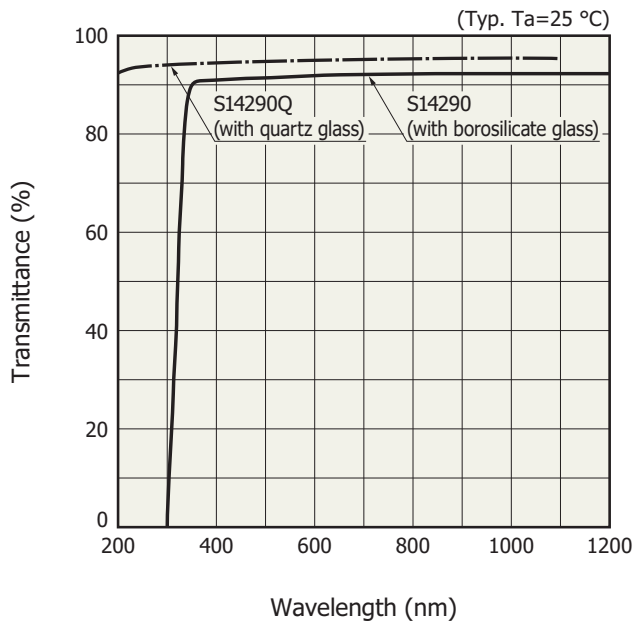
▣ Spectral response (typical example, without window)*18



KMPDB0599EA

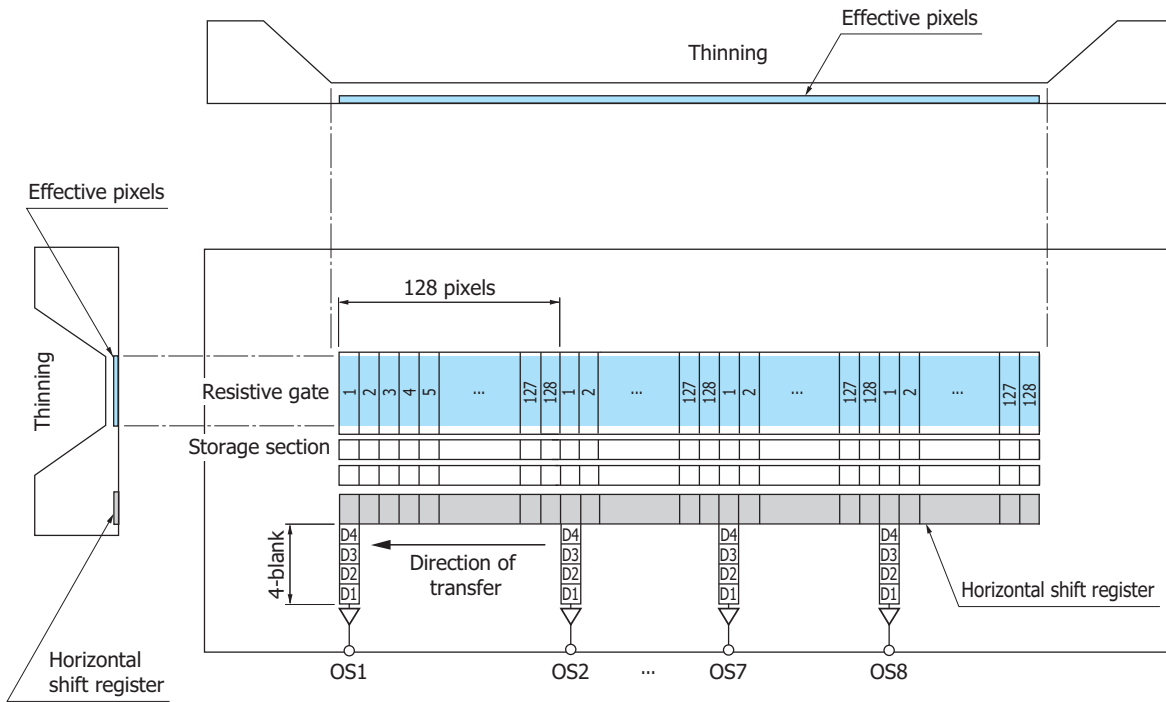
*18: Spectral response is decreased according to the spectral transmittance characteristics of window material.

▣ Spectral transmittance characteristics of window material



KMPDB0374EB

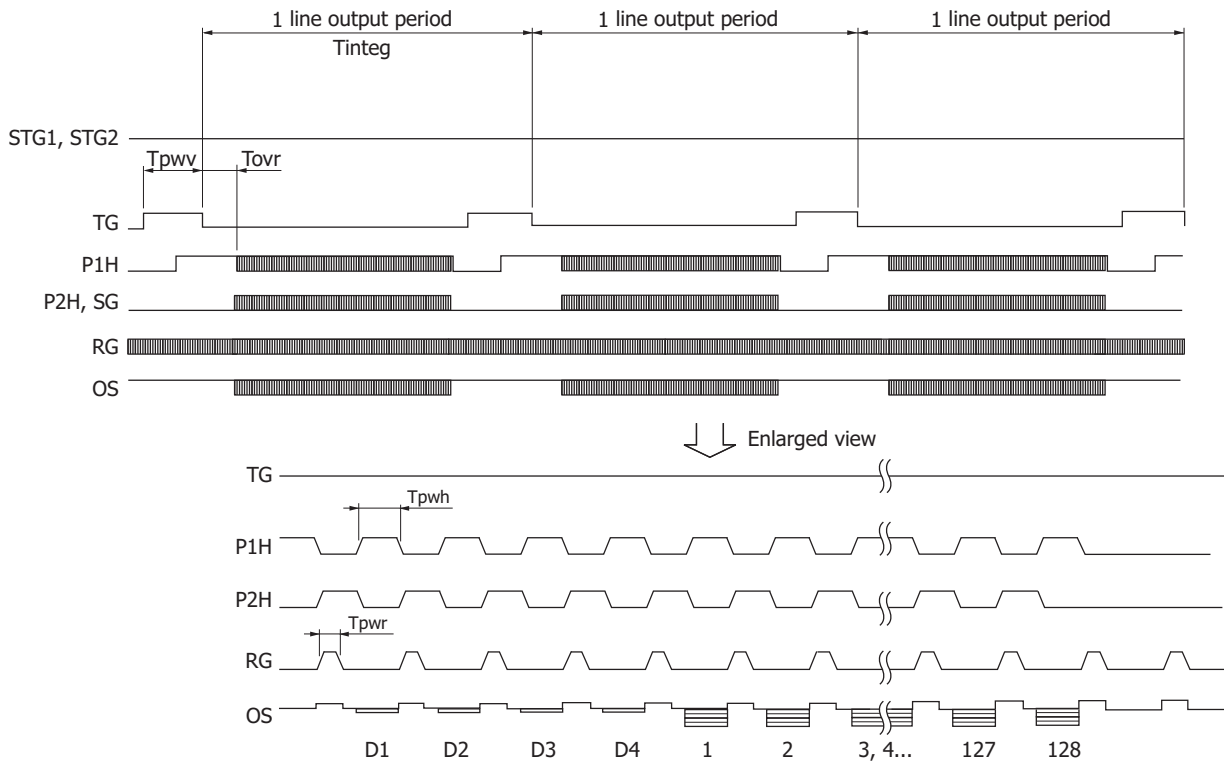
Device structure (conceptual drawing of top view in dimensional outline)



Note: When viewed from the direction of the incident light, the horizontal shift register is covered with a thick silicon layer (dead layer). However, long-wavelength light passes through the silicon dead layer and may possibly be detected by the horizontal shift register. To prevent this, provide light shield on that area as needed.

KMPDC0426EA

Timing chart

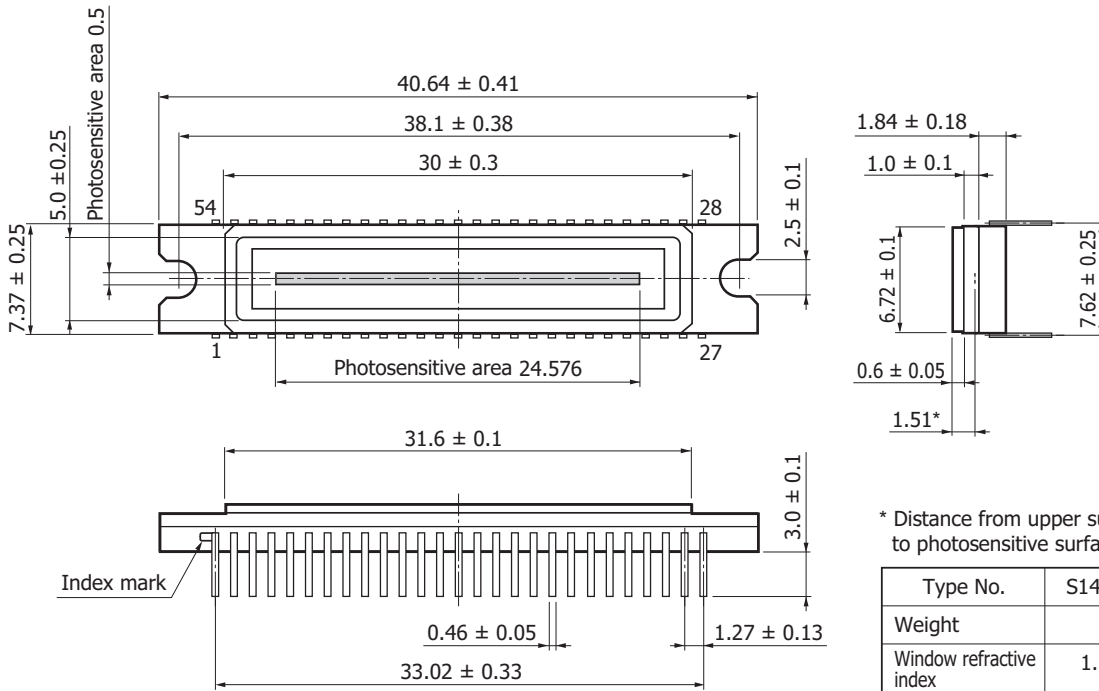


KMPDC0427EB

Parameter		Symbol	Min.	Typ.	Max.	Unit
TG	Pulse width	T_{pwv}	0.6	1.2	-	μs
	Rise and fall times	T_{prv}, T_{pfv}	20	-	-	ns
P1H, P2H*19	Pulse width	T_{pwh}	50	100	-	ns
	Rise and fall times	T_{prh}, T_{pfh}	10	-	-	ns
	Duty ratio	-	40	50	60	%
SG	Pulse width	T_{pws}	50	100	-	ns
	Rise and fall times	T_{prs}, T_{pfs}	10	-	-	ns
	Duty ratio	-	40	50	60	%
RG	Pulse width	T_{pwr}	5	15	-	ns
	Rise and fall times	T_{pr}, T_{pfr}	5	-	-	ns
TG - P1H	Overlap time	T_{ovr}	200	400	-	ns
Integration time		T_{integ}	33	66	-	μs

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

Dimensional outline (unit: mm)



* Distance from upper surface of window to photosensitive surface

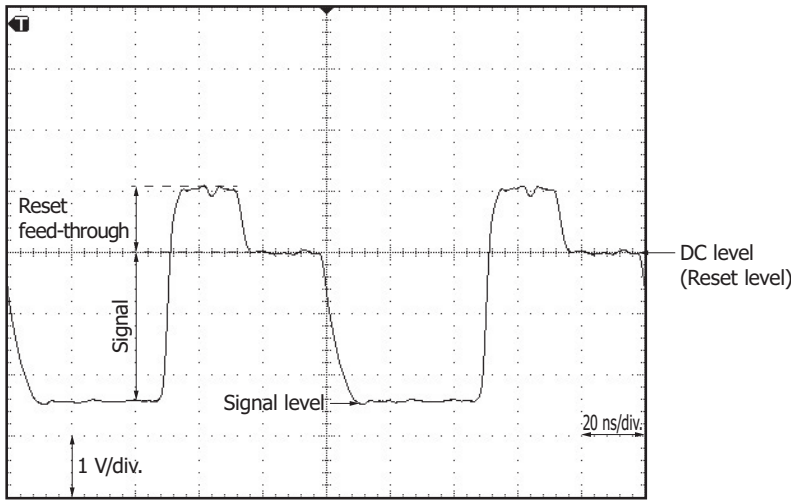
Type No.	S14290	S14290Q
Weight	3.5 g	
Window refractive index	1.52	1.45
AR coat	none	

KMPDA0297EB

Pin connections

Pin no.	Symbol	Function	Remark (standard operation)
1	Vret	Output amplifier return	+1 V
2	OG	Output gate	+5 V
3	RD	Reset drain	+15 V
4	Vret	Output amplifier return	+1 V
5	OS1	Output transistor source 1	RL=2.2 kΩ
6	OD1	Output transistor drain 1	+15 V
7	OS2	Output transistor source 2	RL=2.2 kΩ
8	OD2	Output transistor drain 2	+15 V
9	Vret	Output amplifier return	+1 V
10	OS3	Output transistor source 3	RL=2.2 kΩ
11	OD3	Output transistor drain 3	+15 V
12	OS4	Output transistor source 4	RL=2.2 kΩ
13	OD4	Output transistor drain 4	+15 V
14	Vret	Output amplifier return	+1 V
15	OS5	Output transistor source 5	RL=2.2 kΩ
16	OD5	Output transistor drain 5	+15 V
17	OS6	Output transistor source 6	RL=2.2 kΩ
18	OD6	Output transistor drain 6	+15 V
19	Vret	Output amplifier return	+1 V
20	OS7	Output transistor source 7	RL=2.2 kΩ
21	OD7	Output transistor drain 7	+15 V
22	OS8	Output transistor source 8	RL=2.2 kΩ
23	OD8	Output transistor drain 8	+15 V
24	Vret	Output amplifier return	+1 V
25	IGH	Test point (horizontal input gate)	-8 V
26	ISH	Test point (horizontal input source)	Connect to RD
27	Vret	Output amplifier return	+1 V
28	SS	Substrate	GND
29	TG	Transfer gate	
30	STG2	Storage gate 2	0 V
31	REGH	Resistive gate (High)	-3 V
32	STG1	Storage gate 1	0 V
33	SS	Substrate	GND
34	ARD	All reset drain	+12 V
35	ARG	All reset gate	
36	REGL	Resistive gate (Low)	-5.5 V
37	SS	Substrate	GND
38	SG	Summing gate	
39	SS	Substrate	GND
40	P1H	CCD horizontal shift register clock-1	
41	SS	Substrate	GND
42	P2H	CCD horizontal shift register clock-2	
43	SS	Substrate	GND
44	RG	Reset gate	
45	SS	Substrate	GND
46	REGL	Resistive gate (Low)	-5.5 V
47	ARG	All reset gate	
48	ARD	All reset drain	+12 V
49	SS	Substrate	GND
50	STG1	Storage gate 1	0 V
51	REGH	Resistive gate (High)	-3 V
52	STG2	Storage gate 2	0 V
53	TG	Transfer gate	
54	SS	Substrate	GND

OS output waveform example (fc=10 MHz, RL=2.2 kΩ, VOD=+15 V)



Precautions

■ Electrostatic countermeasures

- Handle these sensors with bare hands or wearing cotton gloves. In addition, wear anti-static clothing or use a wrist band with an earth ring, in order to prevent electrostatic damage due to electrical charges from friction.
- Avoid directly placing these sensors on a work-desk or work-bench that may carry an electrostatic charge.
- Provide ground lines or ground connection with the work-floor, work-desk and work-bench to allow static electricity to discharge.
- Ground the tools used to handle these sensors, such as tweezers and soldering irons.

It is not always necessary to provide all the electrostatic measures stated above. Implement these measures according to the amount of damage that occurs.

■ 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. (5 seconds or less)	at least 2 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

- Resistive gate type CCD linear image sensors with electronic shutter

Information described in this material is current as of October 2021.

Product specifications are subject to change without prior notice due to improvements or other reasons. This document has been carefully prepared and the information contained is believed to be accurate. In rare cases, however, there may be inaccuracies such as text errors. Before using these products, always contact us for the delivery specification sheet to check the latest specifications.

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