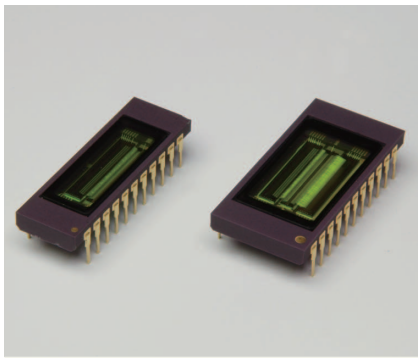


# InGaAs linear image sensors



G9203-256DA G9204-512DA

## Near infrared (0.9 to 1.7 $\mu\text{m}$ ) image sensors

The G9203-256DA and G9204-512DA are InGaAs linear image sensors that deliver high sensitivity and stability in the near infrared region. A charge amplifier array comprised of CMOS transistors, a shift register and a timing generator, etc. are assembled with an InGaAs photodiode array. Low cost is also achieved by using inexpensive ceramic packages. Feedback capacitance for the signal processing circuit formed on the CMOS chip can be selected from 10 pF or 0.5 pF by external voltage.

### Features

- **Pixel pitch**  
G9203-256DA: 50  $\mu\text{m}$   
G9204-512DA: 25  $\mu\text{m}$
- **Low dark current**
- **Room temperature operation**
- **Selectable feedback capacitance (Cf): 10 pF or 0.5 pF**

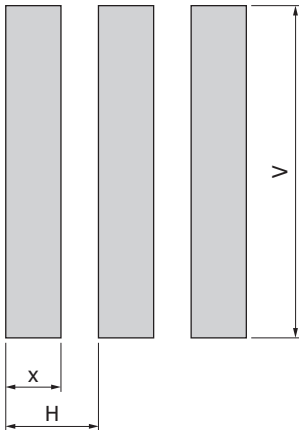
### Applications

- **Near infrared spectroscopy**
- **Foreign matter detection monitors**
- **DWDM monitors**

### Structure

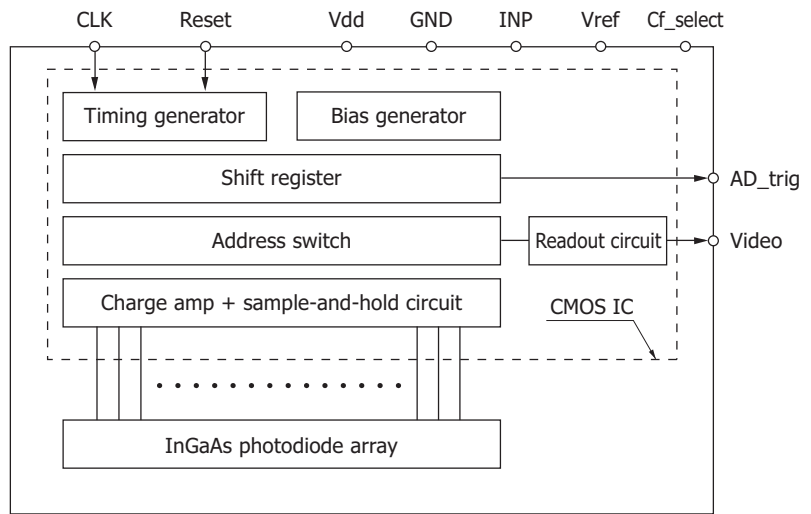
Parameter	G9203-256DA	G9204-512DA	Unit
Cooling	Non-cooled		-
Image size	12.8 × 0.5		mm
Number of total pixels	256	512	pixels
Number of effective pixels	256	512	pixels
Pixel size (H × V)	50 × 500	25 × 500	$\mu\text{m}$
Pixel pitch	50	25	$\mu\text{m}$
Package	22-pin ceramic DIP (See dimensional outlines.)		-
Window material	Borosilicate glass with anti-reflective coating		-

Details of photosensitive area (unit:  $\mu\text{m}$ )    Block diagram



Type no.	x	H	V
G9203-256DA	30	50	500
G9204-512DA	10	25	500

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Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Operating temperature	$T_{opr}$	Chip temperature, No dew condensation*1	-40 to +70	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	Chip temperature, No dew condensation*1	-40 to +85	$^{\circ}\text{C}$
Soldering conditions	-		260 $^{\circ}\text{C}$ , heating time: within 5 seconds	-
Supply voltage	Vdd, INP, Vref	$T_a=25^{\circ}\text{C}$	-0.3 to +6	V
Clock pulse voltage	Vclk	$T_a=25^{\circ}\text{C}$	-0.3 to +6	V
Reset pulse voltage	V(res)	$T_a=25^{\circ}\text{C}$	-0.3 to +6	V
Gain selection terminal voltage	Vcf sel	$T_a=25^{\circ}\text{C}$	-0.3 to +6	V

\*1: 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.

Recommended terminal voltage

Parameter	Symbol	Min.	Typ.	Max.	Unit	
Supply voltage	Vdd	4.9	5.0	5.1	V	
	Vref	-	1.26	-	V	
Element bias	INP	3.5	4.5	4.6	V	
Ground	GND	-	0	-	V	
Clock pulse voltage	Vclk	High	Vdd - 0.5	Vdd	Vdd + 0.5	V
		Low	-	0	0.4	
Reset pulse voltage	V(res)	High	Vdd - 0.5	Vdd	Vdd + 0.5	V
		Low	0	0	0.4	

### Electrical characteristics (Ta=25 °C)

Parameter	Symbol	G9203-256DA			G9204-512DA			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Current consumption	I(vdd)	-	45	50	-	90	100	mA
	I(Vref)	-	-	1	-	-	1	mA
	I(INP)	-	-	1	-	-	1	mA
Operation frequency	fop	0.1	-	4	0.1	-	4	MHz
Video data rate	DR	0.0125	fop/8	0.5	0.0125	fop/8	0.5	MHz
Output voltage	High	VH	-	4.5	INP	-	4.5	V
	Low	VL	Vref	1.26	-	Vref	1.26	V
Output offset voltage	Vos	-	Vref	-	-	Vref	-	V
Output impedance	Zo	-	2	-	-	2	-	kΩ

### Electrical and optical characteristics (Ta=25 °C, Vdd=5 V, INP=4.5 V, Vref=1.26 V, Vclk=5 V, CE=16 nV/e<sup>-</sup>, fop=250 kHz)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	$\lambda$		-	0.9 to 1.7	-	$\mu\text{m}$
Peak sensitivity wavelength	$\lambda_p$		-	1.55	-	$\mu\text{m}$
Photosensitivity	S	$\lambda=\lambda_p$	0.85	0.95	-	A/W
Conversion efficiency	CE		-	16	-	nV/e <sup>-</sup>
Photoresponse nonuniformity*2	PRNU	Integration time: 10 ms	-	$\pm 2$	$\pm 5$	%
Saturation output voltage	Vsat		-	3	-	V
Saturation charge	Csat		-	187.5	-	Me <sup>-</sup>
Readout noise	Nread	Integration time: 10 ms	-	180	300	$\mu\text{V rms}$
Dynamic range	Drange		-	16666	-	-
Defective pixels*3	-		-	-	0	%

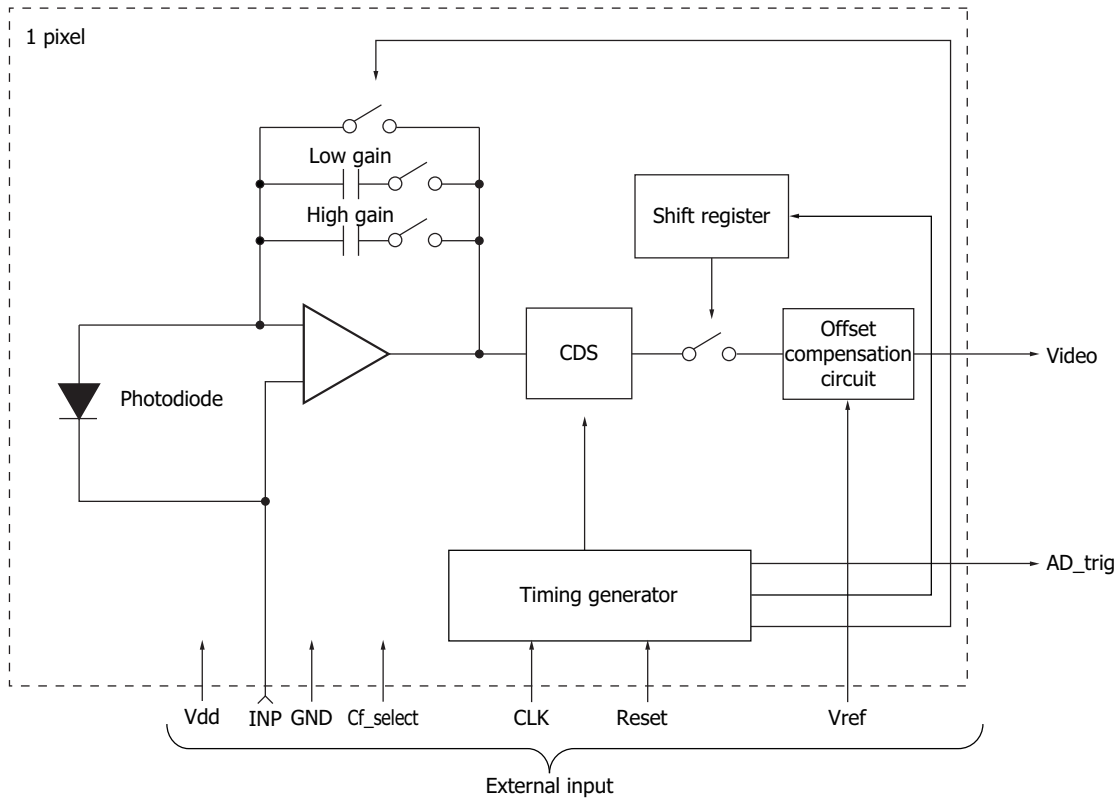
\*2: 50% of saturation, after dark output subtraction, excluding first and last pixels

\*3: Pixels with photoresponse nonuniformity, readout noise or dark current higher than the maximum value

### Dark output characteristics (Ta=25 °C, CE=16 nV/e<sup>-</sup>)

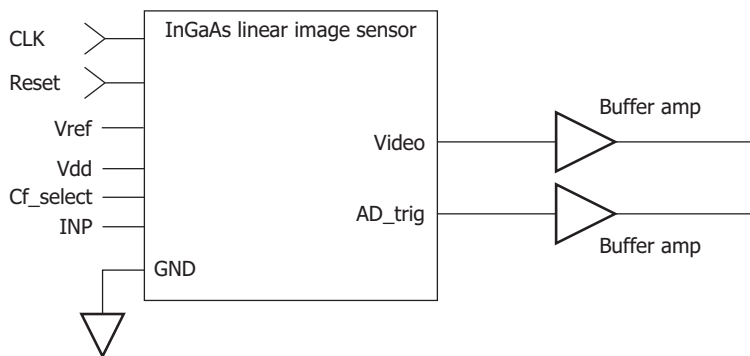
Parameter	Symbol	G9203-256DA			G9204-512DA			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Dark output (dark output nonuniformity)	VD	-2	0.4	2	-0.5	0.1	0.5	V/s
Dark current	ID	-20	4	20	-5	1	5	pA

**Equivalent circuit**



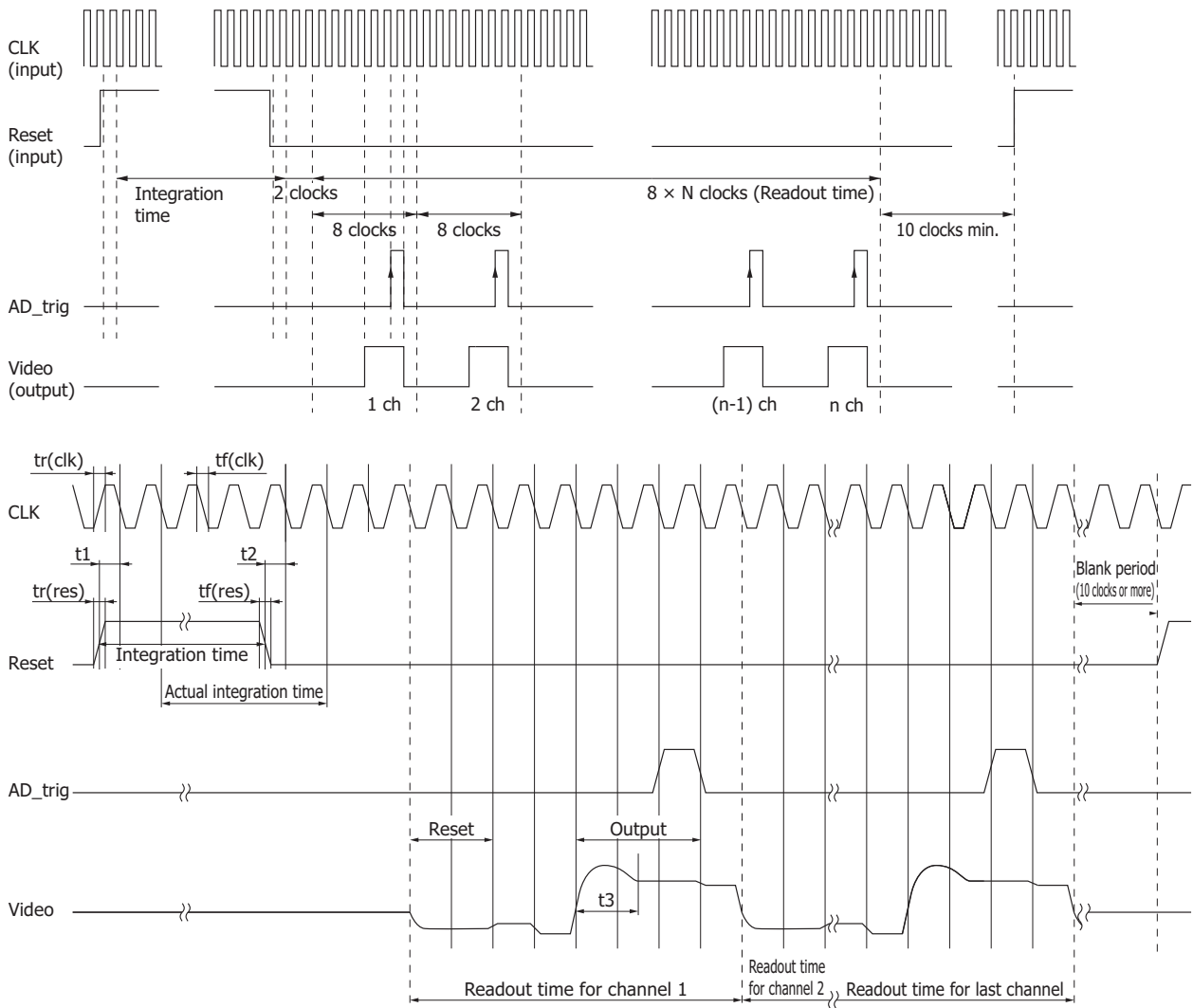
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**Connection example**



KMIRC0012EB

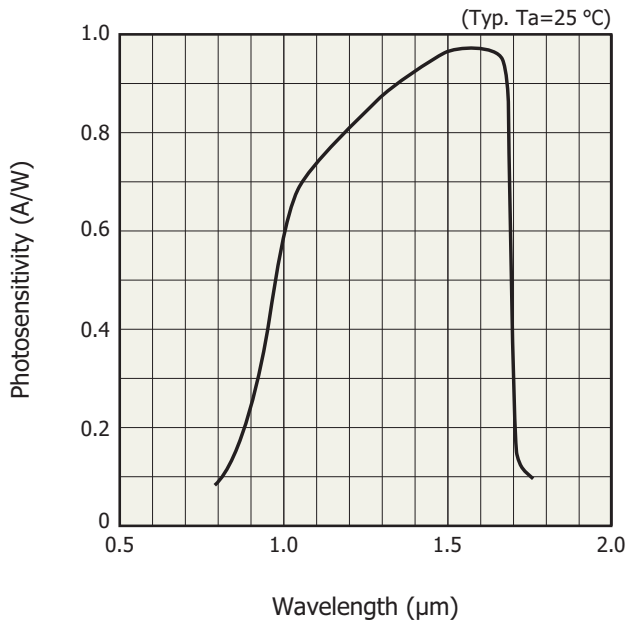
**Timing chart**



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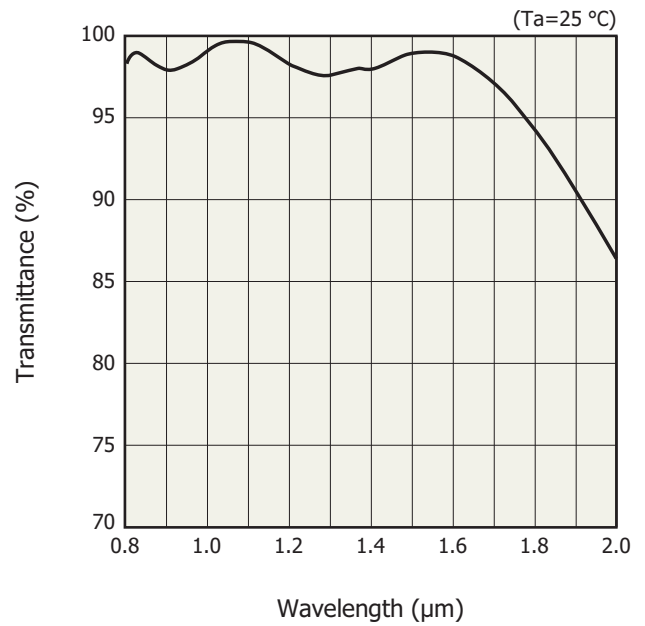
Parameter	Symbol	Min.	Typ.	Max.	Unit
Operation frequency	fop	0.1	-	4	MHz
Clock pulse width	tpw(clk)	100	-	-	ns
Clock pulse rise/fall times	tr(clk), tf(clk)	0	20	100	ns
Reset pulse width	tpw(res)	6000	-	-	ns
Reset pulse rise/fall times	tr(res), tf(res)	0	20	100	ns
Reset (rise) timing	t1	50	-	-	ns
Reset (fall) timing	t2	50	-	-	ns
Output settling time	t3	-	-	600	ns

**Spectral response**



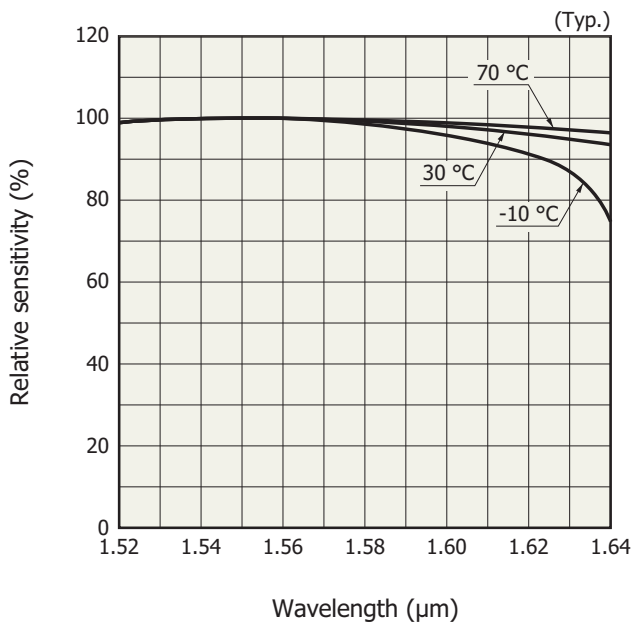
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**Spectral transmittance characteristics of window material (typical example)**



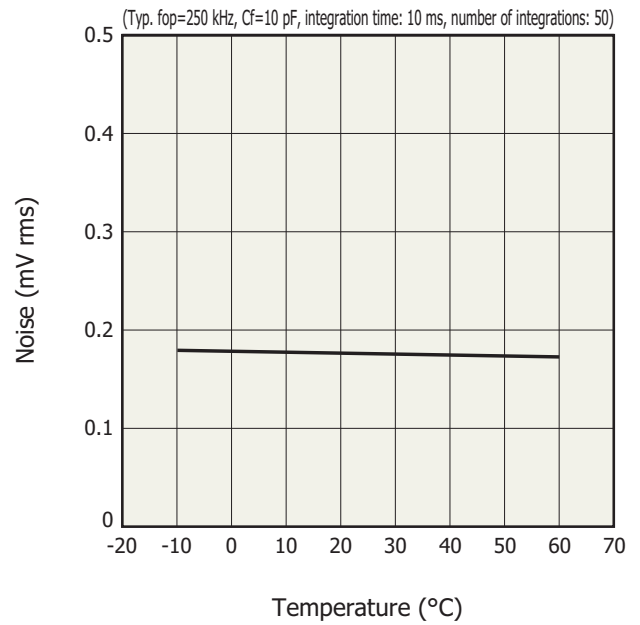
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**Photosensitivity temperature characteristics**



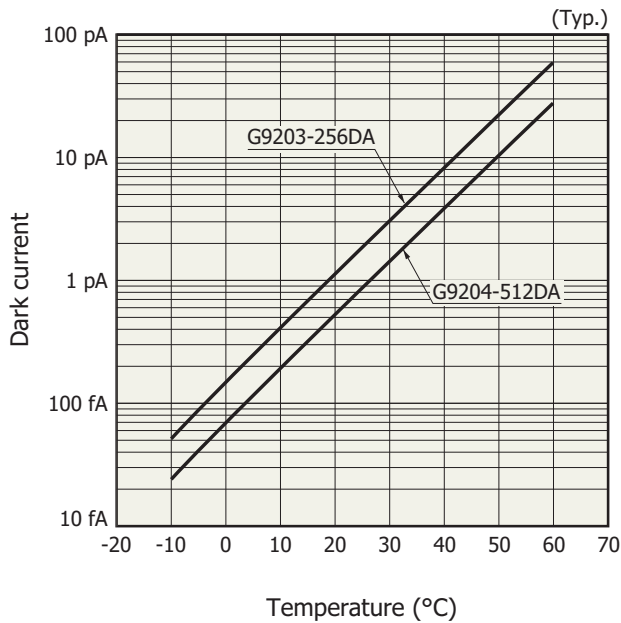
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**Noise vs. temperature**



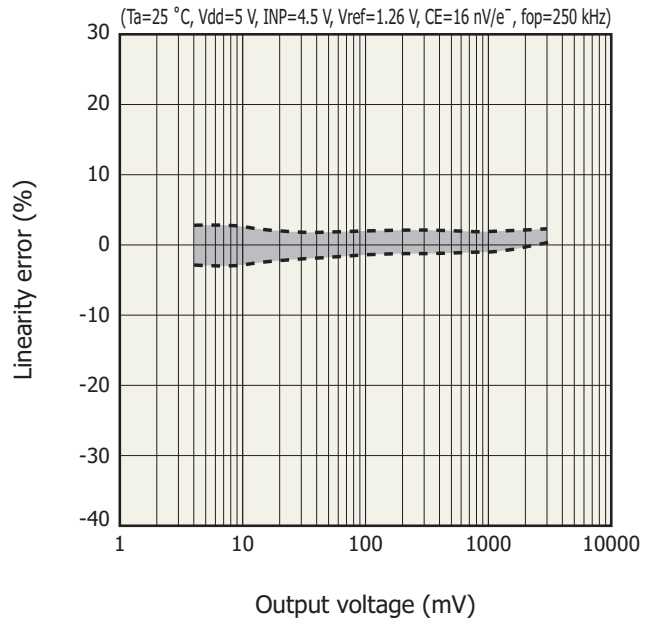
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**Dark current vs. temperature**



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**Linearity error (G9204-512SA)**



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**Pin connections**

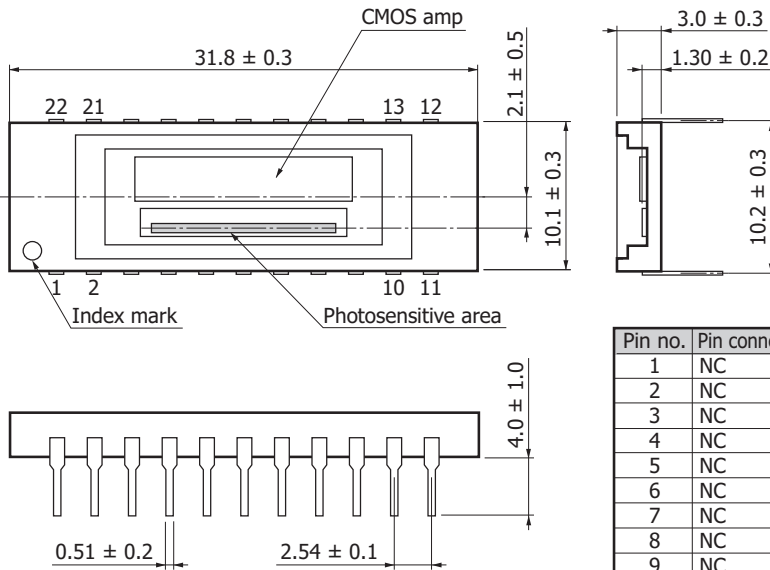
Terminal name	Input/Output	Function
CLK	Input (CMOS logic)	Clock pulse for operating the CMOS shift register
Reset	Input (CMOS logic)	Reset pulse for initializing the feedback capacitance in the charge amplifier formed in the CMOS chip. The width of the reset pulse determines integration time.
Vdd	Input	Supply voltage for operating the signal processing circuit in the CMOS chip
GND	-	Ground for the signal processing circuit in the CMOS chip
INP	Input	Reset voltage for the charge amplifier array in the CMOS chip
Cf_select	Input	Voltage that determines the conversion efficiency in the CMOS chip. Low gain (CE=16 nV/e <sup>-</sup> ) at 0 V, and high gain (CE=320 nV/e <sup>-</sup> ) at 5 V.
Vref	Input	Reset voltage for the offset compensation circuit in the CMOS chip
AD_trig	Output	Digital signal for A/D conversion; positive polarity
Video	Output	Analog video signal; positive polarity

Conversion efficiency	Cf-SELECT
16 nV/e <sup>-</sup> (Cf=10 pF)	High
320 nV/e <sup>-</sup> (Cf=0.5 pF)	Low

Low: 0 V (GND), High: 5 V (Vdd)

Dimensional outlines (unit: mm)

G9203-256DA

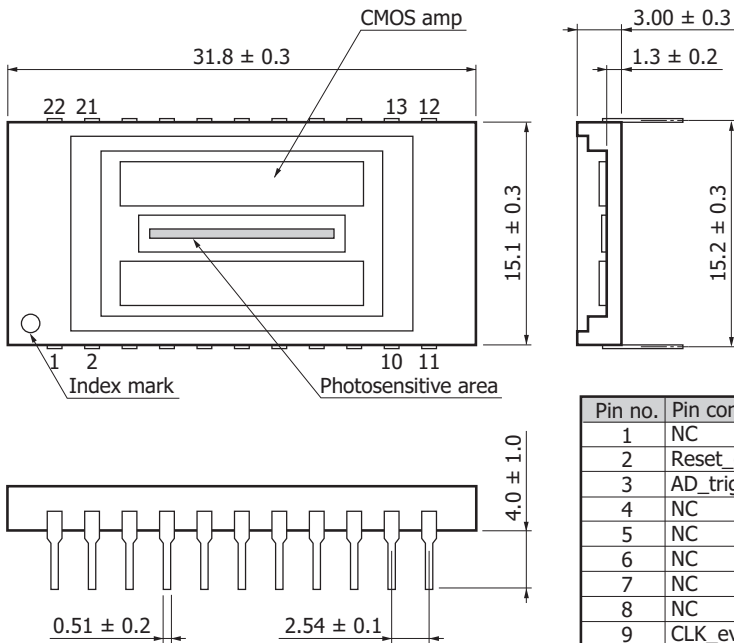


Lead treatment: Ni/Au plating  
 Lead material: FeNi alloy  
 Refractive index of window material: 1.47  
 Window material thickness:  $0.75 \pm 0.05$   
 AR coat: coated (1.55  $\mu$ m peak)  
 Window sealing method: resin bonding  
 Center accuracy of photosensitive area:  $-0.3 \leq X \leq +0.3$   
 $-0.5 \leq Y \leq +0.5$   
 Rotation accuracy of photosensitive area:  $-5^\circ \leq \theta \leq +5^\circ$

Pin no.	Pin connection	Pin no.	Pin connection
1	NC	12	Video
2	NC	13	Vref
3	NC	14	CLK
4	NC	15	NC
5	NC	16	INP
6	NC	17	GND
7	NC	18	Vdd
8	NC	19	NC
9	NC	20	AD_trig
10	NC	21	Reset
11	NC	22	Cf_select

KMIRA0014EC

G9204-512DA



Lead treatment: Ni/Au plating  
 Lead material: FeNi alloy  
 Refractive index of window material: 1.47  
 Window material thickness:  $0.75 \pm 0.05$   
 AR coat: coated (1.55  $\mu$ m peak)  
 Window sealing method: resin bonding  
 Center accuracy of photosensitive area:  $-0.3 \leq X \leq +0.3$   
 $-0.3 \leq Y \leq +0.3$   
 Rotation accuracy of photosensitive area:  $-5^\circ \leq \theta \leq +5^\circ$

Pin no.	Pin connection	Pin no.	Pin connection
1	NC	12	Video_odd
2	Reset_even	13	Vref
3	AD_trig_even	14	CLK_odd
4	NC	15	NC
5	NC	16	INP
6	NC	17	GND
7	NC	18	Vdd
8	NC	19	NC
9	CLK_even	20	AD_trig_odd
10	NC	21	Reset_odd
11	Video_even	22	Cf_select

"\_even" for even no. pixels  
 "\_odd" for odd no. pixels

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### 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.

### Related information

[www.hamamatsu.com/sp/ssd/doc\\_en.html](http://www.hamamatsu.com/sp/ssd/doc_en.html)

#### ■ Precautions

- Disclaimer
- Image sensors

Information described in this material is current as of October 2018.

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