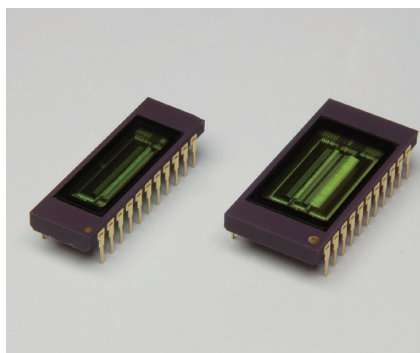


InGaAs linear image sensors



G9494-256D/-512D

Near infrared image sensors (0.9 to 1.7 μm) with high-speed data rate

Hamamatsu provides high-speed, near infrared image sensors designed for detectors used in on-line foreign object inspection equipment. These image sensors use square-shaped pixels that are ideally suited for software processing in pattern recognition systems. The signal processing circuit employs CTIA (Capacitive Trans-Impedance Amplifier) method to perform simultaneous charge integration on all pixels, so there is no time lag among the pixel output signals.

Features

- High-speed data rate: 2 MHz typ.
- Selectable conversion gain
- Pixel size
G9494-256D: 50 $\times$ 50 μm
G9494-512D: 25 $\times$ 25 μm
- CMOS readout circuit incorporated
- Low dark current
- Room temperature operation

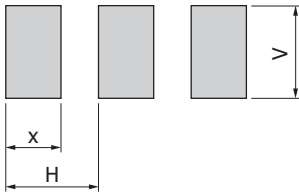
Applications

- Foreign object detection monitors
- Near infrared spectroscopy

Structure

Parameter	G9494-256D	G9494-512D	Unit
Cooling	Non-cooled		-
Image size	12.8 $\times$ 0.050	12.8 $\times$ 0.025	mm
Number of total pixels	256	512	pixels
Number of effective pixels	256	512	pixels
Pixel size (H $\times$ V)	50 $\times$ 50	25 $\times$ 25	μm
Pixel pitch	50	25	μm
Package	22-pin ceramic DIP (See dimensional outlines.)		-
Window material	Borosilicate glass with anti-reflective coating		-

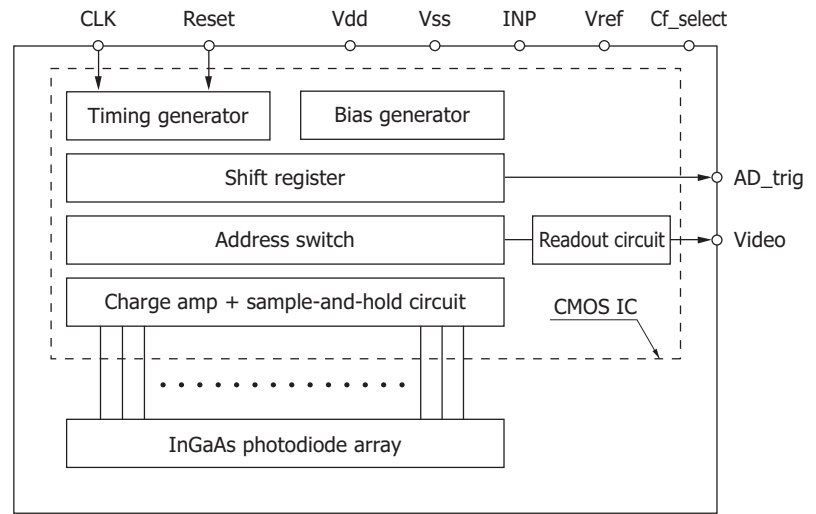
Details of photosensitive area (unit: μm)



Number of pixels	x	H	V
256	30	50	50
512	10	25	25

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Block diagram



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Absolute maximum ratings

Parameter	Symbol	Condition	Value	Unit
Operating temperature	T_{opr}	Chip temperature, No dew condensation ^{*1}	-20 to +70	$^{\circ}\text{C}$
Storage temperature	T_{stg}	Chip temperature, No dew condensation ^{*1}	-20 to +85	$^{\circ}\text{C}$
Soldering conditions	-		260 $^{\circ}\text{C}$, less than five seconds	-
Supply voltage	V_{dd} , INP, Vref	$T_a = 25^{\circ}\text{C}$	-0.3 to +6	V
Clock pulse voltage	V_{ϕ}	$T_a = 25^{\circ}\text{C}$	-0.3 to +6	V
Reset pulse voltage	$V(\text{RES})$	$T_a = 25^{\circ}\text{C}$	-0.3 to +6	V
Gain selection terminal voltage	V_{csel}	$T_a = 25^{\circ}\text{C}$	-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	V_{dd}	4.5	5	5.5	V
	Vref	-	1.26	-	V
Element bias	INP	3.3	3.5	3.6	V
Ground	Vss	-	0	-	V
Clock pulse voltage	V_{ϕ}	4.5	5.0	5.5	V
		-	0	0.4	
Reset pulse voltage	$V(\text{RES})$	4.5	5.0	5.5	V
		0	0	0.4	

Electrical characteristics (Ta=25 °C)

Parameter		Symbol	G9494-256D			G9404-512D			Unit
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Current consumption		I(vdd)	-	40	75	-	80	150	mA
		I(Vref)	-	-	1	-	-	1	mA
		I(INP)	-	-	1	-	-	1	mA
Clock frequency		f	0.1	2	4	0.1	2	4	MHz
Video data rate		fv	-	f	-	-	f	-	MHz
Video output voltage	High	VH	-	3.5	INP	-	3.5	INP	V
	Low	VL	-	1.26	-	-	1.26	-	V
Video output impedance		Zv	-	5	-	-	5	-	kΩ
Output offset voltage		Vos	-	Vref	-	-	Vref	-	V
A/D trigger voltage	High	Vtrigh	-	Vdd	-	-	Vdd	-	V
	Low	VtrigL	-	GND	-	-	GND	-	V
A/D trigger drive function		Vad	74HC244 1 ch	-	-	74HC244 1 ch	-	-	-

Electrical and optical characteristics (Ta=25 °C, Vdd=5 V, INP=3.5 V, Vref=1.26 V, Vf=5 V, CE=1600 nV/e⁻, f=2 MHz)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Spectral response range	λ		-	0.9 to 1.7	-	μm
Peak sensitivity wavelength	λp		-	1.55	-	μm
Photosensitivity	S	λ=λp	0.85	0.95	-	A/W
Conversion efficiency	CE		-	1600	-	nV/e ⁻
Photoresponse nonuniformity*2	PRNU	Integration time: 0.2 ms	-	±5	±20	%
Saturation output voltage	Vsat		-	2	-	V
Saturation charge	Qsat		-	1.25	-	Me ⁻
Readout noise	N	Integration time: 0.2 ms	-	900	2000	μV rms
Dynamic range	D		-	2222	-	-
Defective pixels*3	-		-	-	1	%

*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=1600 nV/e⁻)

Parameter	Symbol	G9494-256D			G9494-512D			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
Dark output (dark output nonuniformity)	V _D	-200	40	200	-50	10	50	V/s
Dark current	I _D	-20	4	20	-5	1	5	pA

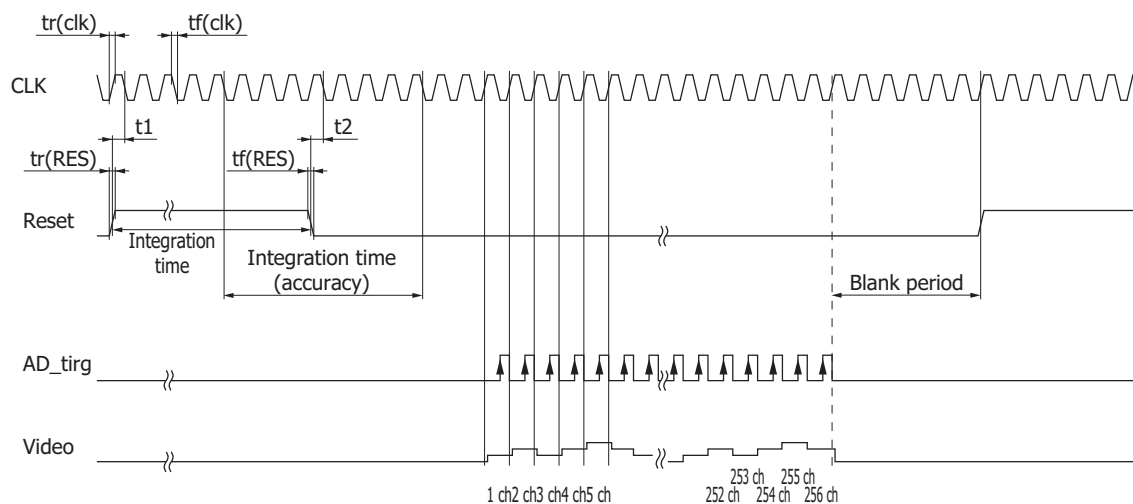
Equivalent circuit



Connection example



Timing chart



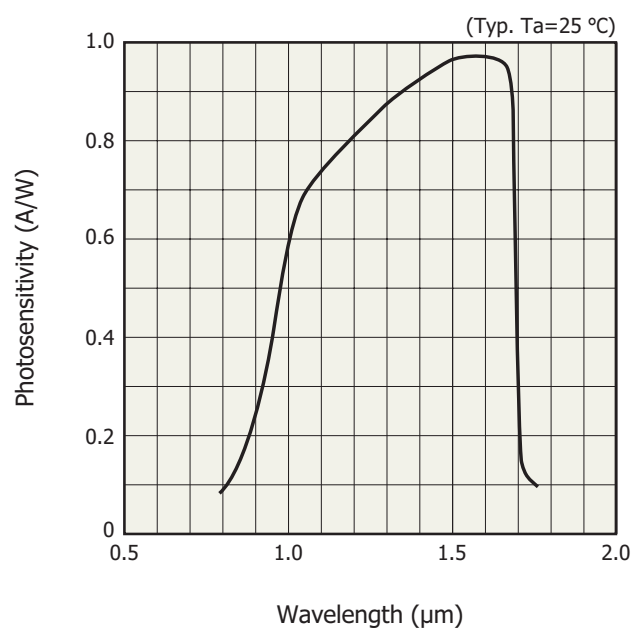
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Note: More than 3 μs is required for a blank period from the last pixel to the rising edge of RESET pulse.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency	-	0.1	2	4	MHz
Clock pulse width	$\text{tpw}(\text{clk})$	100	-	-	ns
Clock pulse rise/fall times	$t_r(\text{clk})$, $t_f(\text{clk})$	0	20	100	ns
Reset pulse width*4	$\text{tpw}(\text{RES})$	6/f	-	-	μs
Reset pulse rise/fall times	$t_r(\text{RES})$, $t_f(\text{RES})$	0	20	100	ns
Clock pulse to start pulse timing	t_1 , t_2	50	-	-	ns
Video delay time	tvd	100	-	-	ns

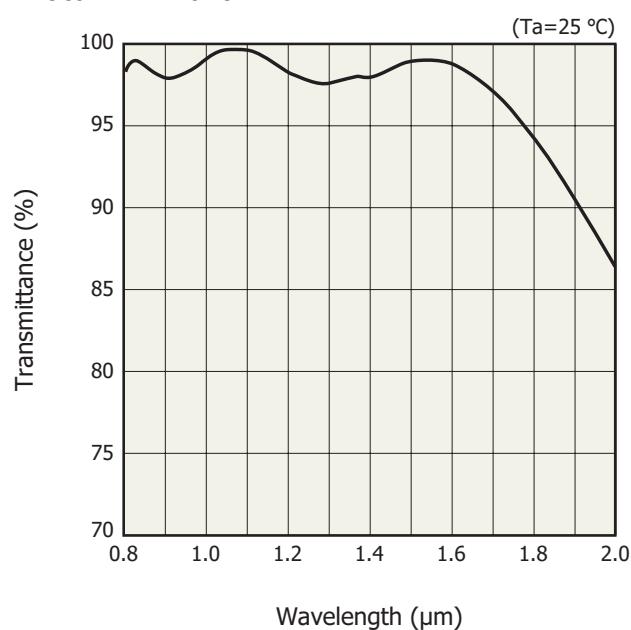
*4: 6 μs or more

Spectral response



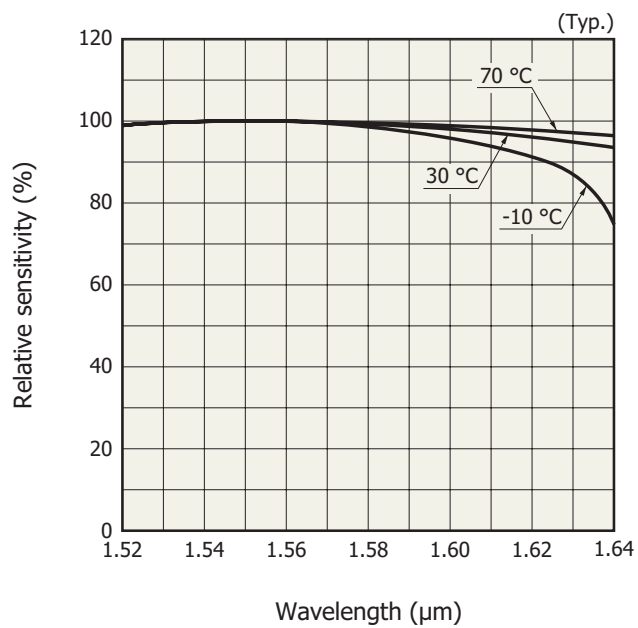
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Spectral transmittance characteristics of window material (typical example)

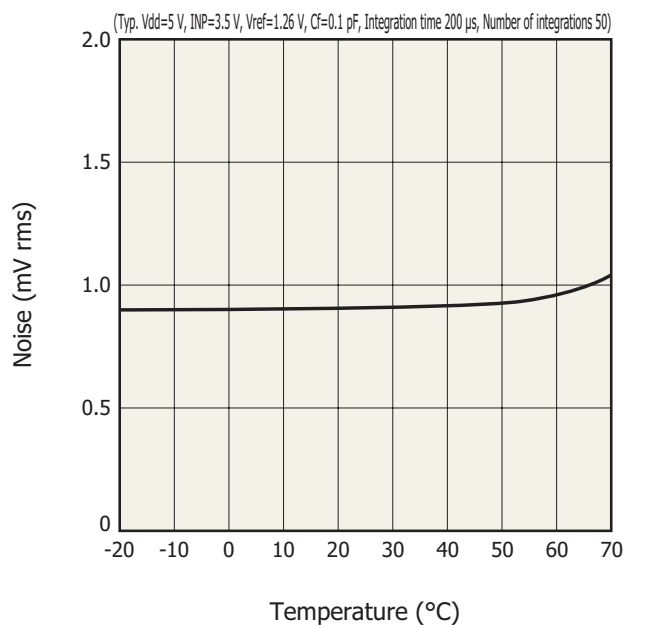


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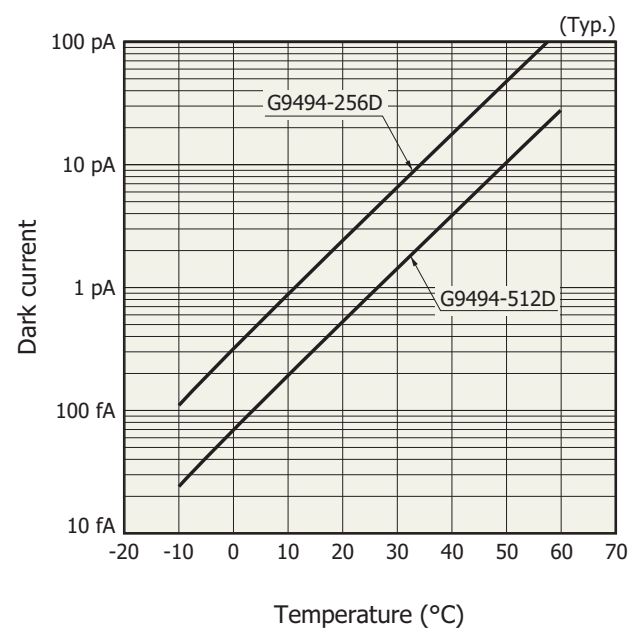
Photosensitivity temperature characteristics



Noise vs. temperature



Dark current vs. temperature



Pin connections

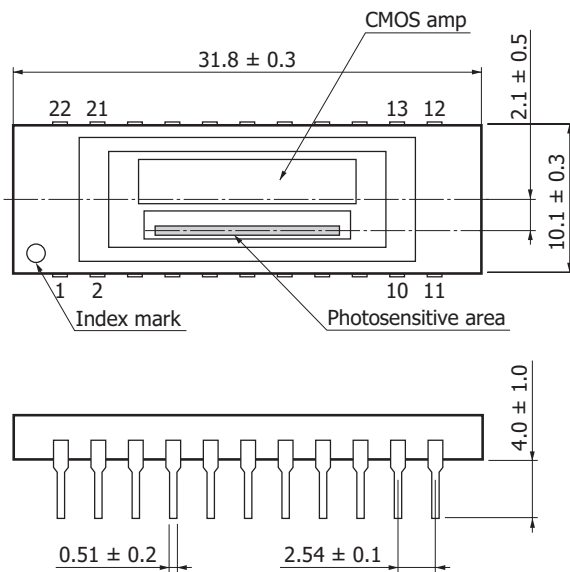
Terminal name	Input/Output	Function
CLK	Input (CMOS logic compatible)	Clock pulse for operating the CMOS shift register
Reset	Input (CMOS logic compatible)	Reset pulse for initializing the feedback capacitance in the charge amplifier formed in the CMOS chip. The width of the reset pulse is integration time.
Vdd	Input	Supply voltage for operating the signal processing circuit in the CMOS chip
Vss	-	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. High gain ($CE=1600 \text{ nV/e}^-$) at 0 V, and low gain ($CE=160 \text{ nV/e}^-$) at 5 V.
Vref	Input	Reset voltage for the offset compensation circuit in the CMOS chip
AD_trig	Output	Digital signal for AD conversion; positive polarity
Video	Output	Analog video signal; positive polarity

Conversion efficiency	Cf-SELECT
1600 nV/e ⁻	Low
160 nV/e ⁻	High

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

Dimensional outlines (unit: mm)

G9494-256D

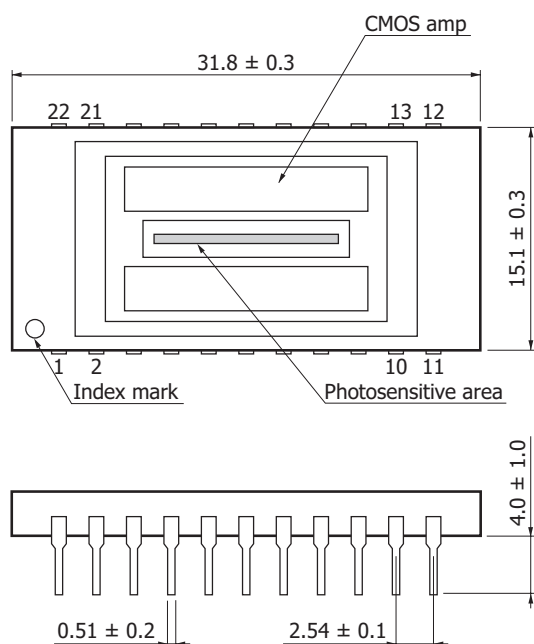


Lead treatment: Ni/Au plating
 Lead material: FeNi alloy
 Refractive index of window material: 1.47
 Window material thickness: 0.75 ± 0.05
 AR coat: coated ($1.55 \mu\text{m}$ peak)
 Window sealing method: resin bonding
 Center accuracy of photosensitive area: $-0.3 \leq X \leq +0.3$
 $-0.5 \leq Y \leq +0.5$
 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	Vss
7	NC	18	Vdd
8	NC	19	NC
9	NC	20	AD_trig
10	NC	21	Reset
11	NC	22	Cf_select

KMIRA0015EC

G9494-512D



Lead treatment: Ni/Au plating
 Lead material: FeNi alloy
 Refractive index of window material: 1.47
 Window material thickness: 0.75 ± 0.05
 AR coat: coated ($1.55 \mu\text{m}$ 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_odd
2	Reset_even	13	Vref
3	AD_trig_even	14	CLK_odd
4	NC	15	NC
5	NC	16	INP
6	NC	17	Vss
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

Precautions

- Disclaimer
- Safety consideration
- Image sensors

Information described in this material is current as of November, 2022.

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