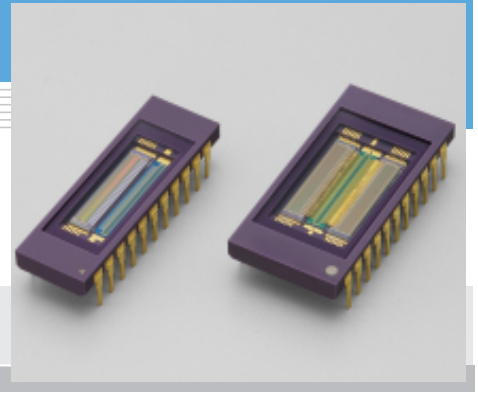


InGaAs linear image sensor G9494-256D/-512D

Near infrared image sensor (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 Transfer 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 ($C_f=0.1 \text{ pF}$, 1 pF)
- Pixel size
G9494-256D: $50 \times 50 \mu\text{m}$
G9494-512D: $25 \times 25 \mu\text{m}$
- CMOS readout circuit incorporated
- Low dark current
- Room temperature operation

Applications

- Foreign object detection monitors
- Near infrared spectroscopy

■ Selection guide

Type No.	Cooling	Number of pixels	Pixel pitch (μm)	Pixel size [μm (H) $\times$ μm (V)]	Spectral response range (μm)	Defective pixel
G9494-256D	Non-cooled	256	50	50×50	0.9 to 1.7 (25 $^{\circ}\text{C}$)	Less than 1 %
G9494-512D		512	25	25×25		

■ Absolute maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage	Vdd	-0.3 to +6	V
Clock pulse voltage	V ϕ	-0.3 to +6	V
Reset pulse voltage	V (RES)	-0.3 to +6	V
Gain selection terminal voltage	VcfSEL	-0.3 to +6	V
Operating temperature *1	Topr	-20 to +70	$^{\circ}\text{C}$
Storage temperature *1	Tstg	-20 to +85	$^{\circ}\text{C}$

*1: No condensation

■ Electrical characteristics (Ta=25 $^{\circ}\text{C}$)

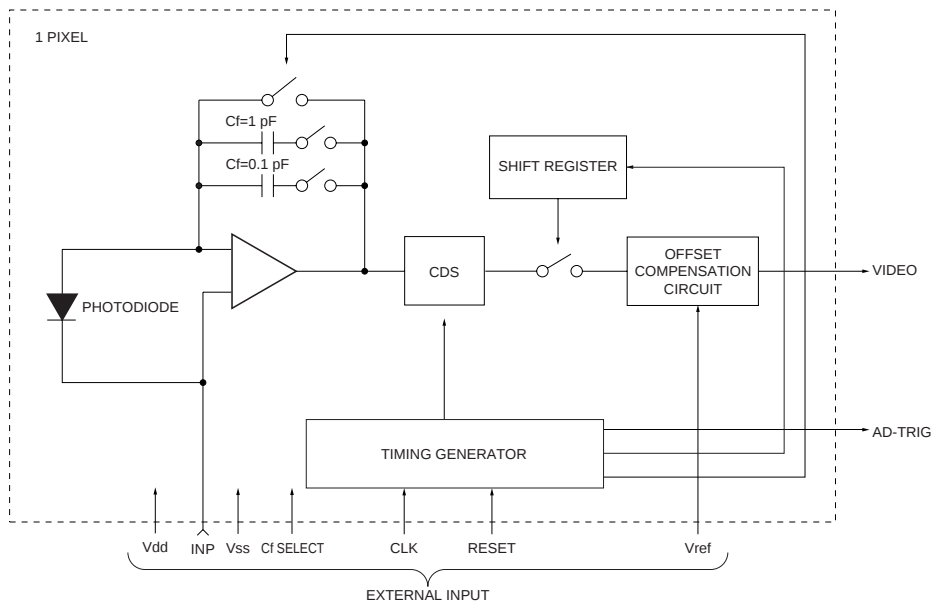
Parameter		Symbol	Min.	Typ.	Max.	Unit
Supply voltage	G9494-256D	V _{dd}	4.5	5.0	5.5	V
	G9494-512D		4.5	5.0	5.5	
Supply voltage		V _{ref}	-	1.26	-	V
Supply current	G9494-256D	I _{Vdd}	-	40	75	mA
	G9494-512D		-	80	150	
Supply current		I _{Vref}	-	-	1	mA
		I _{INP}	-	-	1	
Ground		V _{ss}	-	0	-	V
Element bias		INP	3.3	3.5	3.6	V
Clock frequency		f	0.1	2	4	MHz
Clock pulse voltage	High	V _φ	4.5	5.0	5.5	V
	Low		-	0	0.4	
Clock pulse rise / fall times		tr _φ , tf _φ	0	20	100	ns
Clock pulse width		tpw _φ	100	-	-	ns
Reset pulse voltage	High	V (RES)	4.5	5.0	5.5	V
	Low		-	0	0.4	
Reset pulse rise / fall times		tr (RES), tf (RES)	0	20	100	ns
Reset pulse width *2		tpw (RES)	6/f	-	-	μs
Video output voltage	High	V _H	-	3.5	INP	V
	Low	V _L	-	1.26	-	
Video output impedance		Z _v	-	5	-	kΩ
A/D trigger voltage		V _{trig}	High	V _{dd}	-	V
			Low	-	GND	
A/D trigger drive function		V _{ad}	74HC244 1 ch	-	-	-
Data rate		f _v	-	f	-	Hz

*2: 6 μs or more

■ Specification ($T_a=25\text{ }^{\circ}\text{C}$, $V_{dd}=5\text{ V}$, $INP=3.5\text{ V}$, $V_{ref}=1.26\text{ V}$, $C_f=0.1\text{ pF}$, $f=2\text{ MHz}$, integration time $200\text{ }\mu\text{s}$, per 1 element)

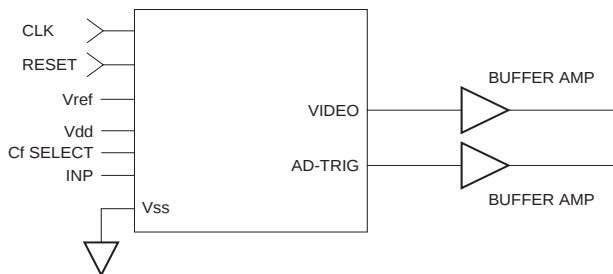
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Peak sensitivity wavelength	λ_p		-	1.55	-	μm
Saturation charge	Q_{sat}	$V_{\phi}=5\text{ V}$	-	0.2	-	pC
Dark current	256 ch	I_D	-	4	20	pA
	512 ch		-	1	5	
RMS noise voltage (readout noise)	N	Standard deviation Number of integration 50	-	900	2000	$\mu\text{V rms}$
Saturation voltage	V_{sat}		-	2	-	V
Photo response non uniformity	PRNU		-	± 5	± 20	%
Detective pixel	-		-	-	1	%

■ Equivalent circuit



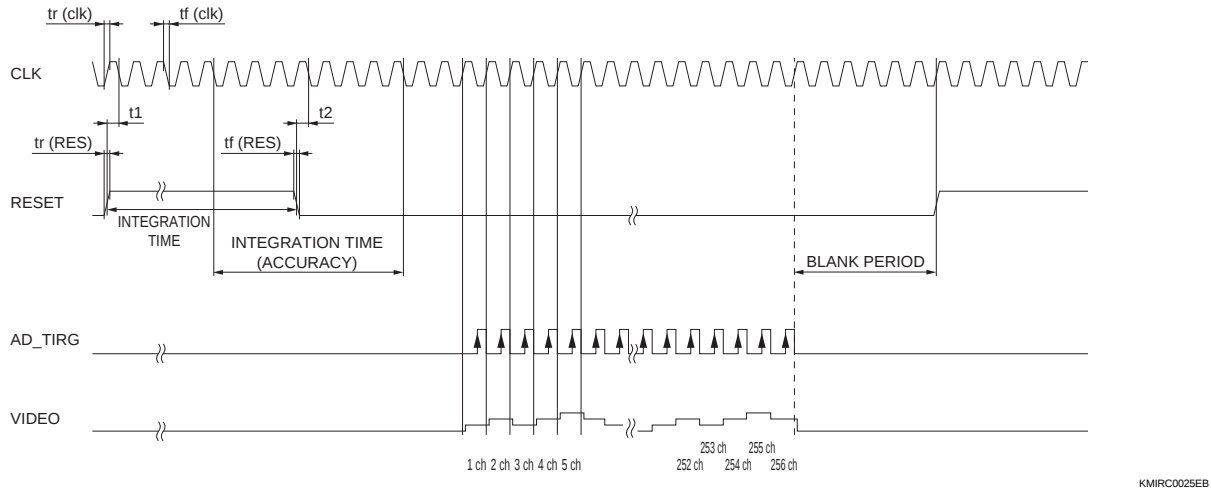
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■ Basic circuit connection



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■ Timing chart

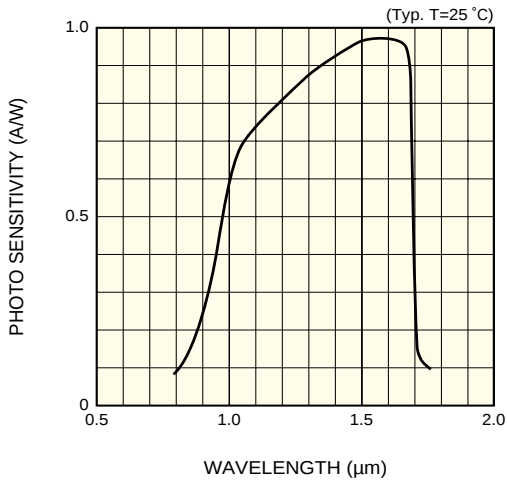


Note) More than 3 μ s is required for a blank period from the last pixel to the rising edge of RESET pulse.

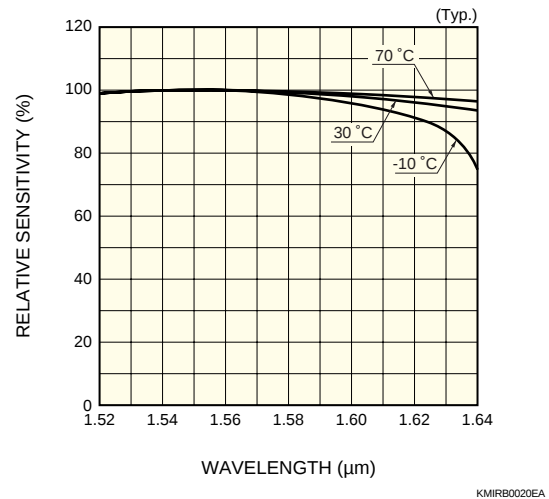
Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock pulse frequency	-	0.1	2	4	MHz
Clock pulse width	tpw (clk)	100	-	-	ns
Clock pulse rise / fall times	tr (clk), tf (clk)	0	20	100	ns
Reset pulse width ^{*3}	tpw (RES)	6/f	-	-	μ s
Reset pulse rise / fall times	tr (RES), tf (RES)	0	20	100	ns
Clock pulse to start pulse timing	t1, t2	50	-	-	ns
Video delay time	tvd	100	-	-	ns

*3: 6 μ s or more

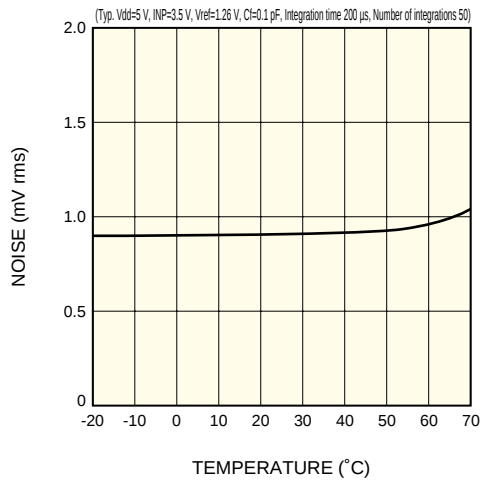
■ Spectral response



■ Photo sensitivity temperature characteristics

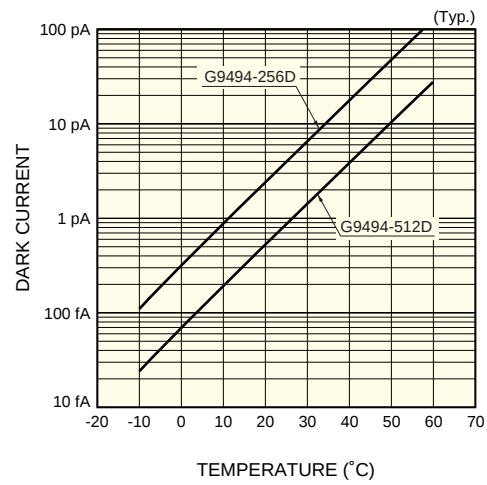


Noise vs. temperature



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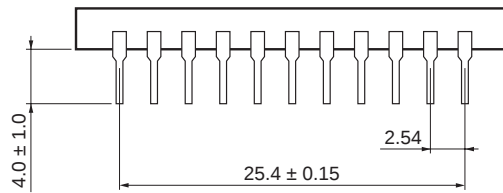
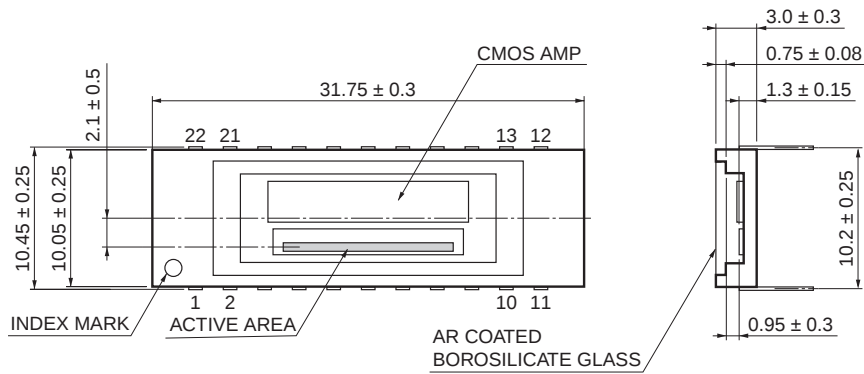
Dark current vs. temperature



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Dimensional outlines (unit: mm)

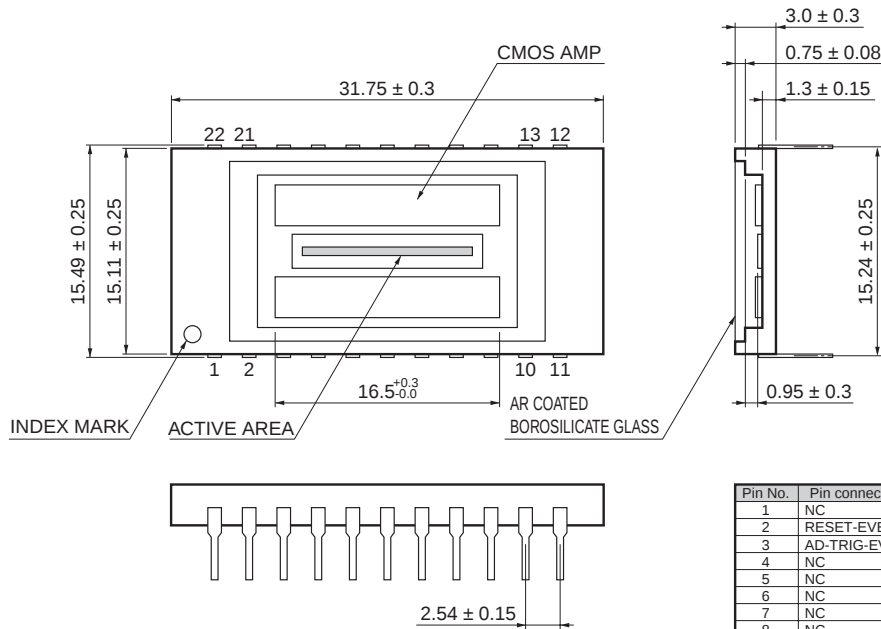
G9494-256D



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	CI-SELECT

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G9494-512D



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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Pin connection

Terminal name	Input/Output	Function and recommended connection
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 on the CMOS chip. The width of the reset pulse determines integration time.
Vdd	Input	Supply voltage for operating the signal processing circuit on the CMOS chip
Vss	-	Ground for the signal processing circuit on the CMOS chip
INP	Input	Reset voltage for the charge amplifier array on the CMOS chip
Cf SELECT	Input	Voltage that determines the feedback capacitance (Cf) on the CMOS chip. Cf=0.1 pF at 0 V, and Cf=1 pF at 5 V
Vref	Input	Reset voltage for the offset compensation circuit at the CMOS chip
AD-TRIG	Output	Digital signal for AD conversion; positive polarity
VIDEO	Output	Analog video signal; positive polarity

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